Submittal Review Response

Project Name:	***Hilo WWTP Rehabilitation and Replacement Project Phase 1***
Submittal No.:	***03055-001.0***
Date:	***8/14/2025***

Client:	County of Hawaiʻi	**Carollo Project No.:**	203975
Contractor:	Nan, Inc.		
Submittal Name:	Adhesive Bonded Reinforcing Bars and All Thread Rods in Concrete		
Reviewed By:	Marissa Kurniawan, Felicia Fan		

SUBMITTAL REVIEW		
Review is for general compliance with contract documents. No responsibility is assumed by Carollo for correctness of quantities, dimensions, and details. No deviation or variation is approved unless specifically addressed in these review comments. Refer to Section 01330 for additional requirements. The Contractor shall assume full responsibility for coordination with all other trades and deviations from contract requirements.		
Approved	☒	No Exceptions
	☐	Make Corrections Noted - See Comments
	☐	Make Corrections Noted - Confirm
Not Approved	☐	Correct and Resubmit
	☐	Rejected - See Remarks
Receipt Acknowledged	☐	Filed for Record
	☐	With Comments - Resubmit

Review Comments:

1. No comments.

☐ High Priority

CONTRACTOR SUBMITTAL TRANSMITTAL FORM REV. A

Owner:	County of Hawaii		
Contractor:	Nan, Inc.	**Project No.:**	WW-4705R
Project Name:	Hilo WWTP Phase 1	**Submittal Number:**	03055 - 001.0
Submittal Title:	ADHESIVE-BONDED REINFORCING BARS AND	☐ For Information Only	
TO:	County		
From:	Nan Inc.		

Specification No. and Subject of Submittal / Equipment Supplier			
Spec: 03055	**Paragraph:** 1.04, 1.06, 1.07, 2.01, 2.02,		
Authored By: Hilti		**Date Submitted:**	06/26/2025

Submittal Certification

Check Either (A) or (B):

☑ (A) We have verified that the equipment or material contained in this submittal meets all the requirements specified in the project manual or shown on the contract drawings with no exceptions.

☐ (B) We have verified that the equipment or material contained in this submittal meets all the requirements specified in the project manual or shown on the contract drawings except for the deviations listed.

Certification Statement: By this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data, and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements.

General Contractor's Reviewer's Signature:

Printed Name and Title: Jyun-Cheng Jhuo, Project Engineer

In the event, Contractor believes the Submittal response does or will cause a change to the requirements of the Contract, Contractor shall immediately give written notice stating that Contractor considers the response to be a Change Order.

Firm: **Signature:** **Date Returned:**

PM/CM Office Use

Date Received GC to PM/CM:

Date Received PM/CM to Reviewer:

Date Received Reviewer to PM/CM:

Date Sent PM/CM to GC:

Nan, Inc

PROJECT: HILO WWTP REHABILITATION AND REPLACEMENT PROJECT - PHASE 1

JOB NO. WW-4705R

THIS SUBMITTAL HAS BEEN CHECKED BY THIS CONTRACTOR. IT IS CERTIFIED CORRECT, COMPLETE, AND IN COMPLIANCE WITH CONTRACT DRAWINGS AND SPECIFICATIONS. ALL AFFECTED CONTRACTORS AND SUPPLIERS ARE AWARE OF, AND WILL INTEGRATE THIS SUBMITTAL (UPON APPROVAL) INTO THEIR OWN WORK.

DATE RECEIVED 6/26/2025
SPECIFICATION SECTION # 03055
SPECIFICATION ADHESIVE-BONDED REINF
PARAGRAPH 1.04, 1.06, 1.07, 2.01, 2.02,
DRAWING n/a
SUBCONTRACTOR n/a
SUPPLIER n/a
MANUFACTURER Hilti

CERTIFIED BY CQCM or Designee :________

SECTION 03055

ADHESIVE-BONDED REINFORCING BARS AND ALL THREAD RODS IN CONCRETE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Bonding reinforcing bars and all thread rods in concrete using adhesives.

1.02 REFERENCES

A. American Concrete Institute (ACI).
   1. 355.4 - Qualification of Post-Installed Adhesive Anchors in Concrete and Commentary.

B. American National Standards Institute (ANSI):
   1. Standard B212.15 - Carbide Tipped Masonry Drills and Blanks for Carbide Tipped Masonry Drills.

C. ASTM international (ASTM):
   1. C881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
   2. E488 - Standard Test Method for Strength of Anchors in Concrete Elements.

D. Concrete Reinforcing Steel Institute (CRSI).

E. ICC Evaluation Service, Inc. (ICC-ES):
   1. AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.

F. Society for Protective Coatings (SSPC):
   1. SP-1 - Solvent Cleaning.

1.03 DEFINITIONS

A. Evaluation Service Report (ESR): Report prepared by ICC-ES, or other testing agency acceptable to Engineer and to the Building Official, that documents testing and review of a product to confirm that it complies with the requirements of designated ICC-ES Acceptance Criteria, and to document its acceptance for use under the Building Code specified in Section 01410 - Regulatory Requirements.

1.04 SUBMITTALS

A. Product data: Technical data for adhesives, including:
   1. Manufacturer's printed installation instructions (MPII).

2. Independent laboratory test results indicating allowable loads in tension and shear for concrete of the types included in this Work, with load modification factors for temperature, spacing, edge distance, and other installation variables.
3. Handling and storage instructions.

B. Quality control submittals:
   1. Special inspection: Detailed step-by-step instructions for the special inspection procedures required by the building code specified in Section 01410 - Regulatory Requirements.
   2. For each adhesive to be used, Evaluation Report confirming that the product complies with the requirements of AC308 for both un-cracked and cracked concrete and for use in Seismic Design Categories A through F.
   3. Installer qualifications:
      a. Submit evidence of successful completion of adhesive manufacturer's installation training program.
      b. Submit evidence of current certification for installation of inclined and overhead anchors under sustained tension loading.

C. Inspection and testing reports:
   1. Inspections: Field quality control: Reports of inspections and tests.
      a. Inspections: Field quality assurance: Reports of special inspections and tests.

1.05 QUALITY ASSURANCE

A. Qualifications:
   1. Installation requirements:
      a. Have available at the site, and install anchors in accordance with, the adhesive manufacturer's printed installation instructions.
   2. Installer qualifications:
      a. Demonstrating successful completion of adhesive manufacturer's on-site training program for installation of adhesive-bonded anchors.
      b. Holding current certification for installation of adhesive-bonded anchors by a qualified organization acceptable to the Engineer and to the Building Official.
         1) Organizations/certification programs deemed to be qualified are:
            a) ACI-CRSI Adhesive Anchor Installer Certification Program.
            b) Adhesive anchor manufacturer's certification program, subject to acceptance by the Engineer and the Building Official.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store and protect products as follows, unless more restrictive requirements are recommended by the manufacturer:
   1. Store adhesives and adhesive components on pallets or shelving in a covered-storage area protected from weather.

2. Control temperature to maintain storage within manufacturer's recommended temperature range.
   a. If products have been stored at temperatures outside manufacturer's recommended range, test by methods acceptable to the Engineer to confirm acceptability before installing in the Work.
3. Dispose of products that have passed their expiration date.

1.07 PROJECT CONDITIONS

A. As specified in Section 01850 - Design Criteria.

B. Seismic Design Category (SDC) for structures: As specified in Section 01850 - Design Criteria.

PART 2 PRODUCTS

2.01 GENERAL

A. Like items of materials: Use end products of one manufacturer in order to achieve structural compatibility and singular responsibility.

B. Adhesives shall have a current Evaluation Report documenting testing and compliance with the requirements or ACI 355.4 and of ICC-ES AC308 for use with un-cracked concrete and with cracked concrete in the Seismic Design Category specified.

C. Bond reinforcing bars and all thread rods in concrete using epoxy adhesive unless other adhesives specified are specifically indicated on the Drawings or approved in writing by the Engineer.

2.02 EPOXY ADHESIVE

A. Materials:
   1. Meeting the physical requirements of ASTM C881, Type IV, Grade 3, Class B or C depending on site conditions.
   2. 2-component, 100 percent solids, insensitive to moisture.
   3. Cure temperature, pot life, and workability: Compatible with intended use and environmental conditions.

B. Packaging:
   1. Disposable, self-contained cartridge system furnished in side-by-side cartridges designed to fit into a manually or pneumatically operated caulking gun, and with resin and hardener components isolated until mixing through manufacturer's static mixing nozzle.
      a. Nozzle designed to dispense components in the proper ratio and to thoroughly blend the components for injection from the nozzle directly into prepared hole.
      b. Provide nozzle extensions as required to allow full-depth insertion and filing from the bottom of the hole.

2. Container markings: Include manufacturer's name, product name, batch number, mix ratio by volume, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.

C. Manufacturers: One of the following or equal:
1. Hilti, Inc., HIT-RE 500-V3.
2. Simpson Strong-Tie Co., Inc., SET-XP.

2.03 ALL THREAD RODS

A. Materials: As specified in Section 05120 - Structural Steel Framing for rods, nuts and washers.

2.04 REINFORCING BARS

A. As specified in Section 03200 - Concrete Reinforcing.

PART 3 EXECUTION

3.01 GENERAL

A. Execution of this work is restricted to installers who have personally completed the adhesive manufacturer's on-site training for the products to be installed, and who are personally certified through a qualified certification program described under Quality Assurance and accepted by the Engineer and the Building Official.
1. Do not install holes or adhesive until training is complete.

B. Perform work in strict compliance with the accepted MPII and the following instructions. Where the accepted MPII and the instructions conflict, the MPII shall prevail.

C. Install reinforcing bars and all thread rods to embedment depth, and at spacing and locations indicated on the Drawings.
1. If embedment depth is not indicated, contact Engineer for requirements.
2. Do not install adhesive-bonded all thread rods or reinforcing bars in upwardly inclined or overhead applications unless accepted in advance by Engineer.

3.02 PREPARATION

A. Do not begin installation of adhesive bonded anchors until:
1. Concrete has achieved an age of at least 21 days after placement.
2. On-site training in installation of adhesive bonded anchors by manufacturer's technical representative is complete. Do not drill holes in concrete or install adhesive and embeds in holes.

B. Review manufacturer's printed installation instructions (MPII) and "conditions of use" stipulated in the Evaluation Report before beginning work.
1. Bring to the attention of the adhesive manufacturer's technical representative any discrepancies between these documents and resolve before proceeding with installation.

C. Install adhesive bonded anchors in full compliance with manufacturer's printed installation instructions using personnel who have successfully completed manufacturer's on-site training for products to be used and who hold certifications specified in this Section.

D. Confirm that adhesive and substrate receiving adhesive are within manufacturer's recommended range for temperature and moisture conditions, and will remain so during the curing time for the product.

3.03 HOLE SIZING AND INSTALLATION

A. Drilling holes:
   1. Determine location of reinforcing bars or other obstructions with a nondestructive indicator device, and mark locations with construction crayon on the surface of the concrete.
   2. Do not damage or cut existing reinforcing bars, electrical conduits, or other items embedded in the existing concrete without prior acceptance by Engineer.

B. Hole drilling equipment:
   1. Electric or pneumatic rotary impact type with medium or light impact.
      a. Installation of anchors in cored holes is not permitted.
      b. Set drill to "rotation only" mode, or to "rotation plus hammer" mode in accordance with the manufacturer's installation instructions and the requirements of the Evaluation Report.
      c. Where edge distances are less than 2 inches and "rotation plus hammer" mode is permitted, use lighter impact equipment to prevent micro-cracking and concrete spalling during the drilling process.
   2. Drill bits: Carbide-tipped in accordance with ANSI B212-15 unless otherwise recommended by the manufacturer or required as a "condition of use" in the Evaluation Report.
      a. Hollow drill bits with flushing air systems are preferred. Air supplied to hollow drill bits shall be free of oil, water, or other contaminants that will reduce bond.

C. Hole diameter: As recommended in the manufacturer's installation instructions and the Evaluation Report.

D. Hole depth: As recommended in the manufacturer's installation instructions to provide minimum effective embedment indicated on the Drawings.

E. Obstructions in drill path:
   1. If an existing reinforcing bar or other obstruction is hit while drilling a hole, unless otherwise accepted by Engineer, stop drilling. Prepare and fill the hole with dry-pack mortar. Relocate the hole to miss the obstruction and drill another hole to the required depth.
      a. Obtain Engineer's acceptance of distance between abandoned and relocated holes before proceeding with the relocation.

b. Allow dry-pack mortar to cure to a strength equal to that of the surrounding concrete before resuming drilling in the area.
c. Epoxy grout may be substituted for dry-pack mortar when accepted by Engineer.
2. Avoid drilling an excessive number of holes in an area of a structural member, which would excessively weaken the member and endanger the stability of the structure.
3. When existing reinforcing steel is encountered during drilling and when specifically accepted by Engineer, enlarge the hole by 1/8 inch, core through the existing reinforcing steel at the larger diameter, and resume drilling at original hole diameter using pneumatic rotary impact drill.
4. Bent bar reinforcing bars: Where edge distances are critical, and interference with existing reinforcing steel is likely, if acceptable to Engineer, drill hole at 10 degree (or less) angle from axis of reinforcing bar or all thread rod being installed.

F. Cleaning holes:
1. Insert air nozzle to bottom of hole and blow out loose dust.
a. Use compressed air that is free of oil, water, or other contaminants that will reduce bond.
b. Provide minimum air pressure of 90 pounds per square inch for not less than 4 seconds.
2. Using a stiff bristle brush with diameter that provides contact around the full perimeter of the hole, vigorously brush hole to dislodge compacted drilling dust.
a. Insert brush to the bottom of the hole and withdraw using a simultaneous twisting motion.
b. Repeat at least 4 times.
3. Repeat the preceding steps as required to remove drilling dust or other material that will reduce bond, and in the number of cycles required by the MPII and the Evaluation Report.
4. Leave prepared holes clean and dry.
5. Protect prepared and cleaned holes from contamination and moisture until adhesive is installed.
6. Re-clean and dry previously prepared holes if, in the opinion of the Engineer, the hole has become contaminated after initial cleaning.

3.04 INSTALLATION OF ADHESIVE AND INSERTS

A. Clean and prepare inserts reinforcing bars and all thread rods:
1. Prepare embedded length of reinforcing bars and all thread rods by cleaning to bare metal. Inserts shall be free of oil, grease, paint, dirt, mill scale, rust, or other coatings that will reduce bond.
2. Solvent clean prepared reinforcing bars and all thread rods over the embedment length in accordance with SSPC SP-1. Provide an oil and grease free surface for bonding of adhesive to steel.

B. Fill holes with adhesive:
1. Starting at the bottom of the hole, fill hole with adhesive inserting the reinforcing bar or all thread rod.
2. Fill hole as nozzle is withdrawn without creating air voids.

3. Unless otherwise indicated on the Drawings, fill hole with sufficient adhesive so that excess adhesive is extruded out of the hole when the reinforcing bar or all thread rod is inserted.
4. Where necessary, seal hole at surface of concrete to prevent loss of adhesive during curing.

C. Installing reinforcing bars and all thread rods.
   1. Unless otherwise indicated on the Drawings, install bars and rods perpendicular to the concrete surface.
   2. Insert reinforcing bars and all thread rods into adhesive in accordance with manufacturer's recommended procedures.
   3. Confirm that insert has reached the designated embedment in the concrete, and that adhesive completely surrounds the embedded portion.
   4. Securely brace bars and all thread rods in place to prevent displacement while the adhesive cures. Bars and rods displaced during curing will be considered damaged and replacement will be required.
   5. Clean excess adhesive from the mouth of the hole.

D. Curing and loading.
   1. Provide and maintain curing conditions recommended by the adhesive manufacturer for the period required to fully cure the adhesive at the temperature of the concrete.
   2. Do not disturb or load bonded embeds until manufacturer's recommended cure time, based on temperature of the concrete, has elapsed.

3.05 POST-INSTALLATION ACTIVITIES

A. Do not bend bars or all-thread rods after bonding to the concrete, unless accepted in advance by the Engineer.

B. Attachments to all thread rods:
   1. After assemblies to be connected are placed, install nuts and washers for threaded rods as indicated on the Drawings.
   2. Draw nuts down tight, using practices specified for "snug tight" installation of bolts in steel to steel connections.

3.06 FIELD QUALITY CONTROL BY CONTRACTOR

A. Provide field quality control over the Work of this Section as specified in Section 01450 - Quality Control.

B. Do not allow work described in this Section to be performed by individuals who do not hold the specified certifications and who have not completed the specified job site training.

C. Manufacturer's services:

1. Before beginning installation, furnish adhesive manufacturer's technical representative to conduct on-site training in proper storage and handling of adhesive, drilling and cleaning of holes, and preparation and installation of reinforcing bars and all thread rods.
   a. Provide notice of scheduled training to Engineer and to Special Inspector(s) not less than 10 working days before training occurs. Engineer and Special Inspector may attend training sessions.
2. Submit record, signed by the manufacturer's technical representative, listing Contractor's personnel who completed the training. Only qualified personnel who have completed manufacturer's on-site training shall perform installations.

D. Field inspections and testing:

1. Hole drilling and preparation.
2. Results: Submit records to Engineer by electronic copies within 24 hours after completion.

3.07 FIELD QUALITY CONTROL BY OWNER

A. Provide field quality assurance over the Work of this Section as specified in Section 01455 - Regulatory Quality Assurance.

B. Special inspections, special tests, and structural observation:

1. Provide as specified in Section 01455 - Regulatory Quality Assurance.
2. Frequency of inspections:
   a. Unless otherwise indicated on the Drawings or in this Section, provide periodic special inspection as required by the Evaluation Report for the product installed.
   b. Provide continuous inspection for the initial installation of each type and size of adhesive bonded reinforcing bar and all thread rod. Subsequent installations of the same anchor may be installed with periodic inspection as defined in subsequent paragraphs.
   c. Provide continuous inspection of all drilling, cleaning and bonding activities for bars and rods installed in horizontal and upwardly inclined positions.
3. Preparation:
   a. Review Drawings and Specifications for the Work to be observed.
   b. Review adhesive manufacturer's MPII and recommended installation procedures.
   c. Review Evaluation Report "Conditions of Use" and "Special Inspection" requirements.
4. Inspection: Periodic:
   a. Initial inspection. Provide an initial inspection for each combination of concrete and reinforcing bar strength or concrete strength and all thread rod material being installed. During initial inspection, observe the following for compliance with the installation requirements.
      1) Concrete: Class (minimum specified compressive strength) and thickness.
      2) Environment: Temperature conditions at work area, and moisture conditions of concrete and drilled hole.

3) Holes: Locations, spacing, and edge distances; verification of drill bit compliance with requirements; cleaning equipment and procedures; cleanliness of hole. Before adhesive is placed, confirm that depth and preparation of holes conforms to the requirements of the Contract Documents, the MPII, and the "conditions of use" listed in the Evaluation Report.
4) Adhesive: Product manufacturer and name; lot number and expiration date; temperature of product at installation; installation procedure. Note initial set times observed during installation.
5) Reinforcing bars and all thread rods: Material diameter and length; steel grade and/or strength; cleaning and preparation; cleanliness at insertion; minimum effective embedment provided.

b. Subsequent inspections: Subsequent installations of the same reinforcing bars or all thread rods may be performed without the presence of the special inspector, provided that:
1) There is no change in personnel performing the installation, the general strength and characteristics of the concrete receiving the inserts, or the reinforcing bars and all thread rods being used.
2) For ongoing installations, the special inspector visits the site at least once for every 4 hours of work during each day of installation to observe the work for compliance with material requirements and installation procedures.

5. Inspection: Continuous.
   a. Make observations as described under "Inspection - Periodic, Initial Inspection" during all drilling, cleaning, and bonding activities for all bars and rods installed.
6. Records of inspections:
   a. Provide a written record of each inspection using forms acceptable to the Building Official.
   b. Complete inspection reports within 24 hours after completion of inspection.

END OF SECTION

SUBMITTED TO:

To

Firm

Project

Date of Submittal

PRODUCT SUBMITTAL:

Submitted Product

Specified Product

Section

Page

Paragraph

Detail/Sheet No.

Description of Application

SUBMITTED BY:

Name

Signature

Company

Address

Phone

Email

FOR ARCHITECT/ENGINEER USE:

Approved ☐

Approved As Noted ☐

Not Approved ☐

If not approved, briefly explain

By

Date

Remarks

CONTENTS

HIT-RE 500 V3 Epoxy anchor

Approvals/Certificates

ICC EVALUATION SERVICE®

ICC-ES Evaluation Report

ESR-3814

Reissued January 2023

Revised March 2023

This report is subject to renewal January 2025.

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

DIVISION: 05 00 00—METALS
Section: 05 05 19—Post-installed Concrete Anchors

REPORT HOLDER:

HILTI, INC.

EVALUATION SUBJECT:

HILTI HIT-RE 500 V3 ADHESIVE ANCHORS AND POST-INSTALLED REINFORCING BAR CONNECTIONS IN CRACKED AND UNCRACKED CONCRETE

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2021, 2018, 2015, and 2012 *International Building Code®* (IBC)
- 2021, 2018, 2015, and 2012 *International Residential Code®* (IRC)

For evaluation for compliance with the *National Building Code of Canada®* (NBCC), see listing report ELC-3814.

For evaluation for compliance with codes adopted by Los Angeles Department of Building and Safety (LADBS), see ESR-3814 LABC and LARC Supplement.

Property evaluated:

Structural

2.0 USES

The Hilti HIT-RE 500 V3 Adhesive Anchoring System and Post-Installed Reinforcing Bar System are used to resist static, wind and earthquake (Seismic Design Categories A through F) tension and shear loads in cracked and uncracked normal-weight and lightweight 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 complies with anchors as described in Section 1901.3 of the 2021, 2018 and 2015 IBC, and Section 1909 of the 2012 IBC and is an alternative to cast-in-place anchors described in Section 1908 of the 2012 IBC. The anchor systems may also be used where an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

The post-installed reinforcing bar system is an alternative to cast-in-place reinforcing bars governed by ACI 318 and IBC Chapter 19.

3.0 DESCRIPTION

3.1 General:

The Hilti HIT-RE 500 V3 Adhesive Anchoring System and Post-Installed Reinforcing Bar System are comprised of the following components:

- Hilti HIT-RE 500 V3 adhesive packaged in foil packs
- Adhesive mixing and dispensing equipment
- Equipment for hole cleaning and adhesive injection

The Hilti HIT-RE 500 V3 Adhesive Anchoring System may be used with continuously threaded rod, Hilti HIS-(R)N internally threaded inserts or deformed steel reinforcing bars as depicted in Figure 4. The Hilti HIT-RE 500 V3 Post-Installed Reinforcing Bar System may only be used with deformed steel reinforcing bars as depicted in Figures 2 and 3. The primary components of the Hilti Adhesive Anchoring and Post-Installed Reinforcing Bar Systems, including the Hilti HIT-RE 500 V3 Adhesive, HIT-RE-M static mixing nozzle and steel anchoring elements, are shown in Figure 7 of this report.

The manufacturer's printed Installation instructions (MPII), as included with each adhesive unit package, are consolidated as Figure 8A and 8B.

3.2 Materials:

3.2.1 Hilti HIT-RE 500 V3 Adhesive: Hilti HIT-RE 500 V3 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 V3 is available in 11.1-ounce (330 ml), 16.9-ounce (500 ml), and 47.3-ounce (1400 ml) foil packs. The manifold attached to each foil pack is stamped with the adhesive expiration date. The shelf life, as indicated by the expiration date, applies to an unopened foil pack stored in a dry, dark environment and in accordance with Figure 8A.

3.2.2 Hole Cleaning Equipment:

3.2.2.1 Standard Equipment: Standard hole cleaning equipment, comprised of steel wire brushes and air nozzles, is described in Figure 8A of this report.

3.2.2.2 Hilti Safe-Set™ System: For the elements described in Sections 3.2.5.1 through 3.2.5.3 and Section 3.2.6, the Hilti TE-CD or TE-YD hollow carbide drill bit with a carbide drilling head conforming to ANSI B212.15 must be used. When used in conjunction with a Hilti vacuum with a minimum value for the maximum volumetric flow rate of

129 CFM (61 ℓ/s), the Hilti TE-CD or TE-YD drill bit will remove the drilling dust, automatically cleaning the hole. Available sizes for Hilti TE-CD or TE-YD drill bit are shown in Figure 8A.

3.2.3 Hole Preparation Equipment:

3.2.3.1 Hilti Safe-Set™ System: TE-YRT Roughening Tool: For the elements described in Sections 3.2.5.1 through 3.2.5.3 and Tables 9, 12, 17, 20, and 29, the Hilti TE-YRT roughening tool with a carbide roughening head is used for hole preparation in conjunction with holes core drilled with a diamond core bit as illustrated in Figure 5.

3.2.4 Dispensers: Hilti HIT-RE 500 V3 must be dispensed with manual, electric, or pneumatic dispensers provided by Hilti.

3.2.5 Anchor Elements:

3.2.5.1 Threaded Steel Rods: Threaded steel rods must be clean, continuously threaded rods (all-thread) in diameters as described in Tables 6 and 14 and Figure 4 of this report. Steel design information for common grades of threaded rods is provided in Table 2. Carbon steel threaded rods must be furnished with a 0.0002-inch-thick (0.005 mm) zinc electroplated coating complying with ASTM B633 SC 1 or must be hot-dipped galvanized complying with ASTM A153, Class C or D. Stainless steel threaded rods must comply with ASTM F593 or ISO 3506 A4. Threaded steel rods must be straight and free of indentations or other defects along their length. The ends may be stamped with identifying marks and the embedded end may be blunt cut or cut on the bias to a chisel point.

3.2.5.2 Steel Reinforcing Bars for use in Post-Installed Anchor Applications: Steel reinforcing bars are deformed bars as described in Table 3 of this report. Tables 6, 14, and 22 and Figure 4 summarize reinforcing bar size ranges. The embedded portions of reinforcing bars must be straight, and free of mill scale, rust, mud, oil, and other coatings (other than zinc) that may impair the bond with the adhesive. Reinforcing bars must not be bent after installation, except as set forth in ACI 318-19 Section 26.6.3.2(b), ACI 318-14 Section 26.6.3.1(b) or ACI 318-11 Section 7.3.2, as applicable, with the additional condition that the bars must be bent cold, and heating of reinforcing bars to facilitate field bending is not permitted.

3.2.5.3 Hilti 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 Hilti HIS-N and HIS-RN inserts are provided in Table 4. The inserts are available in diameters and lengths as shown in Table 26 and Figure 4. Hilti HIS-N inserts are produced from carbon steel and furnished with a 0.0002-inch-thick (0.005 mm) zinc electroplated coating complying with ASTM B633 SC 1. The stainless steel Hilti 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 Hilti 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 Hilti HIS-N and HIS-RN inserts.

3.2.5.4 Ductility: In accordance with ACI 318 (-19 and -14) 2.3 or ACI 318-11 D.1, as applicable, in order for a steel element to be considered ductile, the tested elongation must be at least 14 percent and reduction of area must be at least 30 percent. Steel elements with a tested elongation of less than 14 percent or a reduction of area of less than 30 percent, or both, are considered brittle. Values for various steel materials are provided in Tables 2, 3, 4, and 5 of this report. Where values are nonconforming or unstated, the steel must be considered brittle.

3.2.6 Steel Reinforcing Bars for Use in Post-Installed Reinforcing Bar Connections: Steel reinforcing bars used in post-installed reinforcing bar connections are deformed bars (rebar) as depicted in Figures 2 and 3. Tables 31, 32, 33, and Figure 4 summarize reinforcing bar size ranges. The embedded portions of reinforcing bars must be straight, and free of mill scale, rust, mud, oil, and other coatings that may impair the bond with the adhesive. Reinforcing bars must not be bent after installation, except as set forth in Section 26.6.3.2(b) of ACI 318-19, ACI 318-14 26.6.3.1(b) or ACI 318-11 7.3.2, as applicable, with the additional condition that the bars must be bent cold, and heating of reinforcing bars to facilitate field bending is not permitted.

3.3 Concrete:

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

4.0 DESIGN AND INSTALLATION

4.1 Strength Design of Post-Installed Anchors:

Refer to Table 1 for the design parameters for specific installed elements, and refer to Figure 5 and Section 4.1.4 for a flowchart to determine the applicable design bond strength or pullout strength.

4.1.1 General: The design strength of anchors under the 2021 IBC, as well as the 2021 IRC, must be determined in accordance with ACI 318-19 and this report. The design strength of anchors complying with the 2018 and 2015 IBC, as well as Section R301.1.3 of the 2018 and 2015 IRC must be determined in accordance with ACI 318-14 Chapter 17 and this report.

The design strength of anchors under the 2012 IBC, as well as the 2012 IRC must be determined in accordance with ACI 318-11 and this report.

Design parameters are based on ACI 318-19 for use with the 2021 IBC, ACI 318-14 for use with the 2018 and 2015 IBC, and ACI 318-11 for use with the 2012 IBC unless noted otherwise in Sections 4.1.1 through 4.1.11 of this report.

The strength design of anchors must comply with ACI 318-19 17.5.1.2, ACI 318-14 17.3.1 or ACI 318-11 D.4.1 as applicable, except as required in ACI 318-19 17.10, ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable.

Design parameters are provided in Table 6A through Table 30. Strength reduction factors, ϕ, as given in ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, must be used for load combinations calculated in accordance with Section 1605.1 of the 2021 IBC, Section 1605.2 of the 2018, 2015, and 2012 IBC or ACI 318 (-19 and -14) 5.3 or ACI 318-11 9.2, as applicable. Strength reduction factors, ϕ, as given in ACI 318-11 D.4.4 must be used for load combinations calculated in accordance with ACI 318-11 Appendix C.

4.1.2 Static Steel Strength in Tension: The nominal static steel strength of a single anchor in tension, N_{sa}, in accordance with ACI 318-19 17.6.1.2, ACI 318-14 17.4.1.2 or ACI 318-11 Section D.5.1.2, as applicable, and the associated strength reduction factors, ϕ, in accordance with ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 Section D.4.3, as applicable, are provided in the tables outlined in Table 1 for the anchor element types included in this report.

4.1.3 Static Concrete Breakout Strength in Tension: The nominal concrete breakout strength of a single anchor or group of anchors in tension, N_{cb} or N_{cbg}, must be calculated in accordance with ACI 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, with the following addition:

The basic concrete breakout strength of a single anchor in tension, N_b, must be calculated in accordance with ACI 318-19 17.6.2.2, ACI 318-14 17.4.2.2 or ACI 318-11 D.5.2.2, as applicable using the values of $k_{c,cr}$, and $k_{c,uncr}$, as described in this report. Where analysis indicates no cracking in accordance with ACI 318-19 17.6.2.5, ACI 318-14 17.4.2.6 or ACI 318-11 D.5.2.6, as applicable, N_b must be calculated using $k_{c,uncr}$ and $\Psi_{c,N}$ = 1.0. See Table 1. For anchors in lightweight concrete, see ACI 318-19 17.2.4, ACI 318-14 17.2.6 or ACI 318-11 D.3.6, as applicable. The value of f'_c used for calculation must be limited to 8,000 psi (55 MPa) in accordance with ACI 318-19 17.3.1, ACI 318-14 17.2.7 or ACI 318-11 D.3.7, as applicable. Additional information for the determination of nominal bond strength in tension is given in Section 4.1.4 of this report.

4.1.4 Static Bond Strength in Tension: The nominal static bond strength of a single adhesive anchor or group of adhesive anchors in tension, N_a or N_{ag}, must be calculated in accordance with ACI 318-19 17.6.5, ACI 318-14 17.4.5 or ACI 318-11 D.5.5, as applicable. Bond strength values are a function of the concrete compressive strength, whether the concrete is cracked or uncracked, the concrete temperature range, the drilling method, and the installation conditions (dry or water-saturated, etc.). The resulting characteristic bond strength shall be multiplied by the associated strength reduction factor ϕ_{nn} as follows:

DRILLING METHOD	CONCRETE TYPE	PERMISSIBLE INSTALLATION CONDITIONS	BOND STRENGTH	ASSOCIATED STRENGTH REDUCTION FACTOR
Hammer-drill	Cracked and Uncracked	Dry	$\tau_{k,uncr}$ or $\tau_{k,cr}$	ϕ_d
		Water-saturated	$\tau_{k,uncr}$ or $\tau_{k,cr}$	ϕ_{ws}
		Water-filled hole	$\tau_{k,uncr}$ or $\tau_{k,cr}$	ϕ_{wf}
		Underwater application	$\tau_{k,uncr}$ or $\tau_{k,cr}$	ϕ_{uw}
Core Drilled with Roughening Tool or Hilti TE-CD or TE-YD Hollow Drill Bit	Cracked and Uncracked	Dry	$\tau_{k,uncr}$ or $\tau_{k,cr}$	ϕ_d
		Water-saturated	$\tau_{k,uncr}$ or $\tau_{k,cr}$	ϕ_{ws}
Core Drilled	Uncracked	Dry	$\tau_{k,uncr}$	ϕ_d
		Water-saturated	$\tau_{k,uncr}$	ϕ_{ws}

Figure 5 of this report presents a bond strength design selection flowchart. Strength reduction factors for determination of the bond strength are outlined in Table 1 of this report. Adjustments to the bond strength may also be made for increased concrete compressive strength as noted in the footnotes to the bond strength tables.

4.1.5 Static Steel Strength in Shear: The nominal static strength of a single anchor in shear as governed by the steel, V_{sa}, in accordance with ACI 318-19 17.7.1.2, ACI 318-14 17.5.1.2 or ACI 318-11 D.6.1.2, as applicable, and strength reduction factors, ϕ, in accordance with ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are given in the tables outlined in Table 1 for the anchor element types included in this report.

4.1.6 Static Concrete Breakout Strength in Shear: The nominal static concrete breakout strength of a single anchor or group of anchors in shear, V_{cb} or V_{cbg}, must be calculated in accordance with ACI 318-19 17.7.2, ACI 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable, based on information given in the tables outlined in Table 1. The basic concrete breakout strength of a single anchor in shear, V_b, must be calculated in accordance with ACI 318-19 17.7.2.2, ACI 318-14 17.5.2.2 or ACI 318-11 D.6.2.2, as applicable, using the values of d given in the tables as outlined in Table 1 for the corresponding anchor steel in lieu of d_a (2021, 2018, 2015, and 2012 IBC). In addition, h_{ef} must be substituted for ℓ_e. In no case must ℓ_e exceed $8d$. The value of f'_c must be limited to a maximum of 8,000 psi (55 MPa) in accordance with ACI 318-19 17.3.1, ACI 318-14 17.2.7 or ACI 318-11 D.3.7, as applicable.

4.1.7 Static Concrete Pryout Strength in Shear: The nominal static pryout strength of a single anchor or group of anchors in shear, V_{cp} or V_{cpg}, must be calculated in accordance with ACI 318-19 17.7.3, ACI 318-14 17.5.3 or ACI 318-11 D.6.3, as applicable.

4.1.8 Interaction of Tensile and Shear Forces: For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318-19 17.8, ACI 318-14 17.6 or ACI 318-11 D.7, as applicable.

4.1.9 Minimum Member Thickness, h_{min}, Anchor Spacing, s_{min} and Edge Distance, c_{min}: In lieu of ACI 318-19 17.9.2, ACI 318-14 17.7.1 and 17.7.3 or ACI 318-11 D.8.1 and D.8.3, as applicable, values of s_{min} and c_{min} described in this report must be observed for anchor design and installation. Likewise, in lieu of ACI 318-19 17.9.4, ACI 318-14 17.7.5 or ACI 318-11 D.8.5, as applicable, the minimum member thicknesses, h_{min}, described in this report must be observed for anchor design and installation. For adhesive anchors that will remain untorqued, ACI 318-19 17.9.3, ACI 318-14 17.7.4 or ACI 318-11 D.8.4, as applicable, applies.

For edge distances c_{ai} and anchor spacing s_{ai}, the maximum torque T_{max} shall comply with the following requirements:

REDUCED MAXIMUM INSTALLATION TORQUE $T_{max,red}$ FOR EDGE DISTANCES c_{ai} < (5 x d_a)		
EDGE DISTANCE, c_{ai}	**MINIMUM ANCHOR SPACING, s_{ai}**	**MAXIMUM TORQUE, $T_{max,red}$**
1.75 in. (45 mm) ≤ c_{ai} < 5 x d_a	5 x d_a ≤ s_{ai} < 16 in.	0.3 x T_{max}
	s_{ai} ≥ 16 in. (406 mm)	0.5 x T_{max}

4.1.10 Critical Edge Distance c_{ac}: In lieu of ACI 318-19 17.9.5, ACI 318-14 17.7.6 or ACI 318-11 D.8.6, as applicable, c_{ac} must be determined as follows:

$$c_{ac}=h_{ef}\cdot\left(\frac{\tau_{k,uncr}}{1160}\right)^{0.4}\cdot\left[3.1\text{-}0.7\frac{h}{h_{ef}}\right] \qquad \text{Eq. (4-1)}$$

where $\left[\frac{h}{h_{ef}}\right]$ need not be taken as larger than 2.4: and

$\tau_{k,uncr}$ is the characteristic bond strength in uncracked concrete stated in the tables of this report, whereby $\tau_{k,uncr}$ need not be taken as greater than:

$$\tau_{k,uncr}=\frac{k_{uncr}\sqrt{h_{ef}\cdot f'_c}}{\pi\cdot d_a}$$

4.1.11 Design Strength in Seismic Design Categories C, D, E and F: In structures assigned to Seismic Design Category C, D, E or F under the IBC or IRC, the design must be performed according to ACI 318-19 17.10, ACI 318-14 17.2.3 or ACI 318-11 Section D.3.3, as applicable. Modifications to ACI 318-19 17.10 and ACI 318-14 17.2.3 shall be applied under Section 1905.1.8 of the 2021, 2018 and 2015 IBC. For the 2012 IBC, Section 1905.1.9 shall be omitted.

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 anchor element types included in this report. For tension, the nominal pullout strength $N_{p,cr}$ or bond strength τ_{cr} must be adjusted by $\alpha_{N,seis}$. See Tables 8, 9, 11, 12, 16, 17, 19, 20, 24, 28 and 29.

Modify ACI 318-11 Sections D.3.3.4.2, D.3.3.4.3(d) and D.3.3.5.2 to read as follows:

ACI 318-11 D.3.3.4.2 - Where the tensile component of the strength-level earthquake force applied to anchors exceeds 20 percent of the total factored anchor tensile force associated with the same load combination, anchors and their attachments shall be designed in accordance with ACI 318-11 D.3.3.4.3. The anchor design tensile strength shall be determined in accordance with ACI 318-11 D.3.3.4.4

Exception:

1. Anchors designed to resist wall out-of-plane forces with design strengths equal to or greater than the force determined in accordance with ASCE 7 Equation 12.11-1 or 12.14-10 shall be deemed to satisfy ACI 318-11 D.3.3.4.3(d).

ACI 318-11 D.3.3.4.3(d) – The anchor or group of anchors shall be designed for the maximum tension obtained from design load combinations that include E, with E increased by Ω_0. The anchor design tensile strength shall be calculated from ACI 318-11 D.3.3.4.4.

ACI 318-11 D.3.3.5.2 – Where the shear component of the strength-level earthquake force applied to anchors exceeds 20 percent of the total factored anchor shear force associated with the same load combination, anchors and their attachments shall be designed in accordance with ACI 318-11 D.3.3.5.3. The anchor design shear strength for resisting earthquake forces shall be determined in accordance with ACI 318-11 D.6.

Exceptions:

1. For the calculation of the in-plane shear strength of anchor bolts attaching wood sill plates of bearing or non-bearing walls of light-frame wood structures to foundations or foundation stem walls, the in-plane shear strength in accordance with ACI 318-11 D.6.2 and D.6.3 need not be computed and ACI 318-11 D.3.3.5.3 need not apply provided all of the following are satisfied:

1.1. The allowable in-plane shear strength of the anchor is determined in accordance with AF&PA NDS Table 11E for lateral design values parallel to grain.

1.2. The maximum anchor nominal diameter is $^5/_8$ inch (16 mm).

1.3. Anchor bolts are embedded into concrete a minimum of 7 inches (178 mm).

1.4. Anchor bolts are located a minimum of $1^3/_4$ inches (45 mm) from the edge of the concrete parallel to the length of the wood sill plate.

1.5. Anchor bolts are located a minimum of 15 anchor diameters from the edge of the concrete perpendicular to the length of the wood sill plate.

1.6. The sill plate is 2-inch or 3-inch nominal thickness.

2. For the calculation of the in-plane shear strength of anchor bolts attaching cold-formed steel track of bearing or non-bearing walls of light-frame construction to foundations or foundation stem walls, the in-plane shear strength in accordance with ACI 318-11 D.6.2 and D.6.3, need not be computed and ACI 318-11 D.3.3.5.3 need not apply provided all of the following are satisfied:

2.1. The maximum anchor nominal diameter is $^5/_8$ inch (16 mm).

2.2. Anchors are embedded into concrete a minimum of 7 inches (178 mm).

2.3. Anchors are located a minimum of $1^3/_4$ inches (45 mm) from the edge of the concrete parallel to the length of the track.

2.4. Anchors are located a minimum of 15 anchor diameters from the edge of the concrete perpendicular to the length of the track.

2.5. The track is 33 to 68 mil designation thickness.

Allowable in-plane shear strength of exempt anchors, parallel to the edge of concrete shall be permitted to be determined in accordance with AISI S100 Section E3.3.1.

3. In light-frame construction, bearing or nonbearing walls, shear strength of concrete anchors less than or equal to 1 inch [25 mm] in diameter attaching a sill plate or track to foundation or foundation stem wall need not satisfy ACI 318-11 D.3.3.5.3(a) through (c) when the design strength of the anchors is determined in accordance with ACI 318-11 D.6.2.1(c).

4.2 Strength Design of Post-Installed Reinforcing Bars:

4.2.1 General: The design of straight post-installed deformed reinforcing bars must be determined in accordance with ACI 318 rules for cast-in place reinforcing bar development and splices and this report.

Examples of typical applications for the use of post-installed reinforcing bars are illustrated in Figures 2 and 3 of this report.

4.2.2 Determination of bar development length l_d: Values of l_d must be determined in accordance with the ACI 318 development and splice length requirements for straight cast-in place reinforcing bars.

Exceptions:

1. For uncoated and zinc-coated (galvanized) post-installed reinforcing bars, the factor Ψ_e shall be taken as 1.0. For all other cases, the requirements in ACI 318-19 25.4.2.5, *ACI 318-14 25.4.2.4 or ACI 318-11 12.2.4 (b) shall apply.*

2. When using alternate methods to calculate the development length (e.g., anchor theory), the applicable factors for post-installed anchors generally apply.

4.2.3 Minimum Member Thickness, h_{min}, Minimum Concrete Cover, $c_{c,min}$, Minimum Concrete Edge Distance, $c_{b,min}$, Minimum Spacing, $s_{b,min}$: For post-installed reinforcing bars, there is no limit on the minimum member thickness. In general, all requirements on concrete cover and spacing applicable to straight cast-in bars designed in accordance with ACI 318 shall be maintained.

For post-installed reinforcing bars installed at embedment depths, h_{ef}, larger than 20d (h_{ef} > 20d), the minimum concrete cover shall be as follows:

REBAR SIZE	MINIMUM CONCRETE COVER, $c_{c,min}$
d_b ≤ No. 6 (16 mm)	*$1^3/_{16}$ in. (30mm)*
No. 6 < d_b ≤ No. 10 (16mm < d_b ≤ 32mm)	*$1^9/_{16}$ in. (40mm)*

The following requirements apply for minimum concrete edge and spacing for h_{ef} > 20d:

Required minimum edge distance for post-installed reinforcing bars (measured from the center of the bar):

$c_{b,min} = d_0/2 + c_{c,min}$

Required minimum center-to-center spacing between post-installed bars:

$s_{b,min} = d_0 + c_{c,min}$

Required minimum center-to-center spacing from existing (parallel) reinforcing:

$s_{b,min} = d_b/2$ *(existing reinforcing)* $+ d_0/2 + c_{c,min}$

All other requirements applicable to straight cast-in place bars designed in accordance with ACI 318 shall be maintained.

4.2.4 Design Strength in Seismic Design Categories C, D, E and F: In structures assigned to Seismic Category C, D, E or F under the IBC or IRC, design of straight post-installed reinforcing bars must take into account the provisions of ACI 318 (-19 or -14) Chapter 18 or ACI 318-11 Chapter 21, as applicable.

4.2.5 Design in Fire Resistive Construction: For post-installed reinforcing bars, the relationship of bond stress to temperature under fire conditions for short term loading (including seismic), suitable for use in determining conformance with fire resistance rating requirements is as follows (see Figures 6A and 6B):

$$\tau_{fire(\theta)} = 1{,}137{,}318 \cdot \theta^{-1.47} \qquad \text{(psi)}$$

$$\tau_{fire(\theta)} = 522.93 \cdot \theta^{-1.14} \qquad \textit{(N/mm2)}$$

Where θ is the temperature in the concrete at the post-installed reinforcing bar in ºF (for psi) or ºC (for N/mm^2), as applicable.

For temperatures above θ_{max} of 581 ºF (305 ºC), $\tau_{fire(\theta)}=0$. For load cases including sustained loads, with or without short term loading, multiply $\tau_{fire(\theta)}$ by 0.93.

The bond stress, $\tau_{fire(\theta)}$, shall not exceed 1,090 psi (7.5 N/mm^2).

Determination of the temperature in the concrete at the location of the post-installed reinforcing bar is dependent on the geometry of the concrete members under consideration, and its calculation is the responsibility of the design professional. The design professional shall use the bond strength / temperature curves in Figure 6 along with a determination of the temperature in the concrete appropriate for the member geometry under consideration to calculate the reinforcing bar development length l_d.

4.3 Installation:

Installation parameters are illustrated in Figures 1 and 4. Installation must be in accordance with ACI 318-19 26.7.2, ACI 318-14 17.8.1 and 17.8.2 or ACI 318-11 D.9.1 and D.9.2, as applicable. Anchor and post-installed reinforcing bar locations must comply with this report and the plans and specifications approved by the code official. Installation of the Hilti HIT-RE 500 V3 Adhesive Anchor and Post-Installed Reinforcing Bar Systems must conform to the manufacturer's printed installation instructions (MPII) included in each unit package consolidated as Figures 8A and 8B of this report. The MPII contains additional requirements for combinations of drill hole depth, diameter, drill bit type, hole preparation, and dispensing tools.

The initial cure time, $t_{cure,ini}$, as noted in Figure 8A of this report, is intended for rebar applications only and is the time where rebar and concrete formwork preparation may continue. Between the initial cure time and the full cure time, $t_{cure,final}$, the adhesive has a limited load bearing capacity. Do not apply a torque or load on the rebar during this time

4.4 Special Inspection:

Periodic special inspection must be performed where required in accordance with Section 1705.1.1 and Table 1705.3 of the 2021, 2018, 2015 and 2012 IBC, as applicable, and this report. The special inspector must be on the jobsite initially during anchor or post-installed reinforcing bar installation to verify anchor or post-installed reinforcing bar type and dimensions, concrete type, concrete compressive strength, adhesive identification and expiration date, hole dimensions, hole cleaning procedures, spacing, edge distances, concrete thickness, anchor or post-installed reinforcing bar embedment, tightening torque and adherence to the manufacturer's printed installation instructions.

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

Continuous special inspection of adhesive anchors or post-installed reinforcing bar installed in horizontal or upwardly inclined orientations to resist sustained tension loads shall be performed in accordance with ACI 318-19 26.13.3.2(e) and 26.7.1(j), ACI 318-14 17.8.2.4, 26.7.1(h), and 26.13.3.2(c) or ACI 318-11 D.9.2.4, as applicable.

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

5.0 CONDITIONS OF USE

The Hilti HIT-RE 500 V3 Adhesive Anchor System and Post-Installed Reinforcing Bar System described in this report complies with, or is a suitable alternative to what is specified in, the codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 Hilti HIT-RE 500 V3 Adhesive anchors and post-installed reinforcing bars must be installed in accordance with the manufacturer's printed installation instructions (MPII) as included in the adhesive packaging and consolidated as Figures 8A and 8B of this report.

5.2 The anchors and post-installed reinforcing bars 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 The concrete shall have attained its minimum design strength prior to installation of the Hilti HIT-RE 500 V3 adhesive anchors or post-installed reinforcing bars.

5.5 Anchors and post-installed reinforcing bars must be installed in concrete base materials in holes drilled using carbide-tipped drill bits manufactured with the range of maximum and minimum drill-tip dimensions specified in ANSI B212.15-1994, or diamond core drill bits, as detailed in Figure 8A. Use of the Hilti TE-YRT Roughening Tool in conjunction with diamond core bits must be as detailed in Figure 8B.

5.6 Loads applied to the anchors must be adjusted in accordance with Section 1605.1 of the 2021 IBC or Section 1605.2 of the 2018, 2015 and 2012 IBC for strength design and in accordance with Section 1605.1 of the 2021 IBC or Section 1605.3 of the 2018, 2015, and 2012 IBC for allowable stress design.

5.7 Hilti HIT-RE 500 V3 adhesive anchors and post-installed reinforcing bars are recognized for use to resist short- and long-term loads, including wind and earthquake, subject to the conditions of this report.

5.8 In structures assigned to Seismic Design Category C, D, E or F under the IBC or IRC, anchor strength must be adjusted in accordance with Section 4.1.11 of this report, and post-installed reinforcing bars must comply with section 4.2.4 of this report.

5.9 Hilti HIT-RE 500 V3 adhesive anchors and post-installed reinforcing bars are permitted to be installed in concrete that is cracked or that may be expected to crack during the service life of the anchor, subject to the conditions of this report.

5.10 Anchor strength design values must be established in accordance with Section 4.1 of this report.

5.11 Post-installed reinforcing bar development and splice length is established in accordance with Section 4.2 of this report.

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

5.13 Post-installed reinforcing bar spacing, minimum member thickness, and cover distance must be in accordance with the provisions of ACI 318 for cast-in place bars and section 4.2.3 of this report.

5.14 Prior to anchor installation, calculations and details demonstrating compliance with this report must be submitted to the code official. The calculations and details must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

5.15 Anchors and post-installed reinforcing bars are not permitted to support fire-resistive construction. Where not otherwise prohibited by the code, Hilti HIT-RE 500 V3 adhesive anchors and post-installed reinforcing bars are permitted for installation in fire-resistive construction provided that at least one of the following conditions is fulfilled:

- Anchors and post-installed reinforcing bars are used to resist wind or seismic forces only.
- Anchors and post-installed reinforcing bars that support gravity load–bearing structural elements are within a fire-resistive envelope or a fire-resistive membrane, are protected by approved fire-resistive materials, or have been evaluated for resistance to fire exposure in accordance with recognized standards.
- Anchors and post-installed reinforcing bars are used to support nonstructural elements.
- Post-installed reinforcing bars designed in accordance with Section 4.2.5 of this report.

5.16 Since an ICC-ES acceptance criteria for evaluating data to determine the performance of adhesive anchors and post-installed reinforcing bars 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.

5.17 Use of zinc-plated carbon steel threaded rods or steel reinforcing bars is limited to dry, interior locations.

5.18 Use of hot-dipped galvanized carbon steel and stainless steel rods is permitted for exterior exposure or damp environments.

5.19 Steel anchoring materials in contact with preservative-treated and fire-retardant-treated wood must be of zinc-coated carbon steel or stainless steel. The minimum coating weights for zinc-coated steel must comply with ASTM A153. Periodic special inspection must be provided in accordance with Section 4.4 of this report. Continuous special inspection for anchors and post-installed reinforcing bars installed in horizontal or upwardly inclined orientations to resist sustained tension loads must be provided in accordance with Section 4.4 of this report.

5.20 Installation of anchors and post-installed reinforcing bars in horizontal or upwardly inclined orientations to resist sustained tension loads shall be performed by personnel certified by an applicable certification program in accordance with ACI 318-19 26.7.2(e), ACI 318-14 17.8.2.2 or 17.8.2.3, or ACI 318-11 D.9.2.2 or D.9.2.3, as applicable.

5.21 Hilti HIT-RE 500 V3 adhesive anchors and post-installed reinforcing bars may be used to resist tension and shear forces in floor, wall, and overhead installations only if installation is into concrete with a temperature between 23°F and 104°F (-5°C and 40°C) for threaded rods, rebar, and Hilti HIS-(R)N inserts. Overhead installations for hole diameters larger than $^{7}/_{16}$-inch or 10mm require the use of piston plugs (HIT-SZ, -IP) during injection to the back of the hole. $^{7}/_{16}$-inch or 10mm diameter holes may be injected directly to the back of the hole with the use of extension tubing on the end of the nozzle. The anchor or post-installed reinforcing bars must be supported until fully cured (i.e., with Hilti HIT-OHW wedges, or other suitable means). Where temporary restraint devices are used, their use shall not result in impairement of the anchor shear resistance. Installations in concrete temperatures below 41°F (5°C) require the adhesive to be conditioned to a minimum temperature of 41°F (5°C).

5.22 Anchors and post-installed reinforcing bars shall not be used for applications where the concrete temperature can rise from 40°F or less to 80°F or higher within a 12-hour period. Such applications may include but are not limited to anchorage of building façade systems and other applications subject to direct sun exposure.

5.23 Hilti HIT-RE 500 V3 adhesives are manufactured by Hilti GmbH, Kaufering, Germany, under a quality-control program with inspections by ICC-ES.

5.24 Hilti HIS-N and HIS-RN inserts are manufactured by Hilti (China) Ltd., Guangdong, China, under a quality-control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Post-installed Adhesive Anchors and Reinforcing Bars in Concrete Elements (AC308), dated October 2022, which incorporates requirements in ACI 355.4 (-19 and -11), including but not limited to tests under freeze/thaw conditions (Table 3.2, test series 6), and Table 3.8 for evaluating post-installed reinforcing bars including test series 15 for effects of fire on bond stress.

7.0 IDENTIFICATION

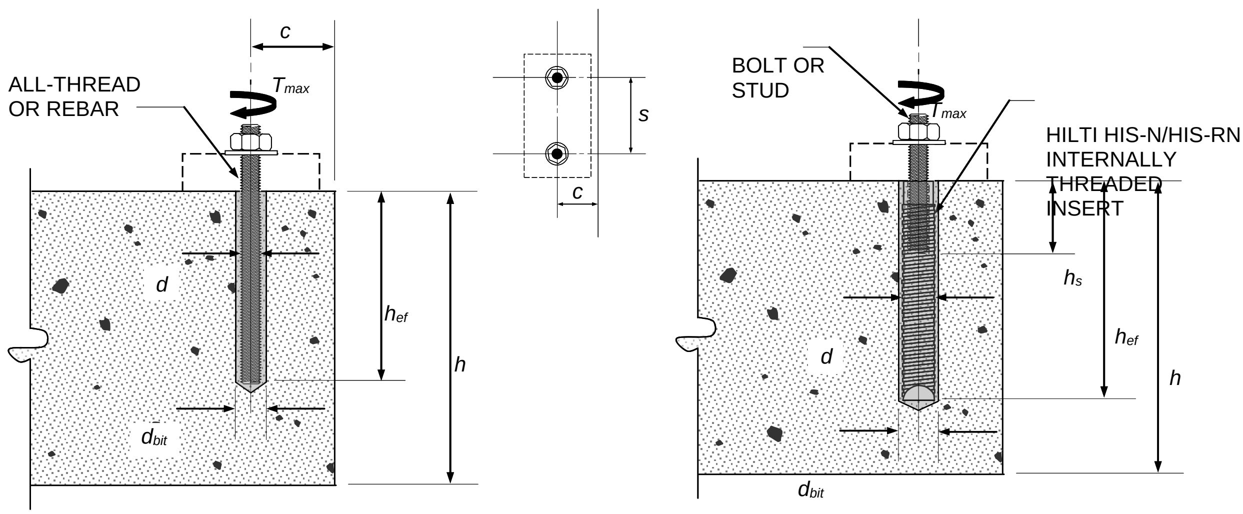
7.1 The ICC-ES mark of conformity, electronic labeling, or the evaluation report number (ICC-ES ESR-3814) along with the name, registered trademark, or registered logo of the report holder must be included in the product label.

7.2 In addition, Hilti HIT-RE 500 V3 adhesive is identified by packaging labeled with the manufacturer's name (Hilti Corp.) and address, product name, lot number, expiration date.

7.3 Hilti HIS-N and HIS-RN inserts are identified by packaging labeled with the manufacturer's name (Hilti Corp.) and address, anchor name and size, and evaluation report number (ESR-3814). Threaded rods, nuts, washers, bolts, cap screws, and deformed reinforcing bars are standard elements and must conform to applicable national or international specifications.

7.4 The report holder's contact information is the following:

HILTI, INC.
7250 DALLAS PARKWAY, SUITE 1000
PLANO, TEXAS 75024
(800) 879-8000
www.hilti.com



THREADED ROD/REINFORCING BAR **HIS-N AND HIS-RN INSERTS**

FIGURE 1—INSTALLATION PARAMETERS FOR POST-INSTALLED ADHESIVE ANCHORS

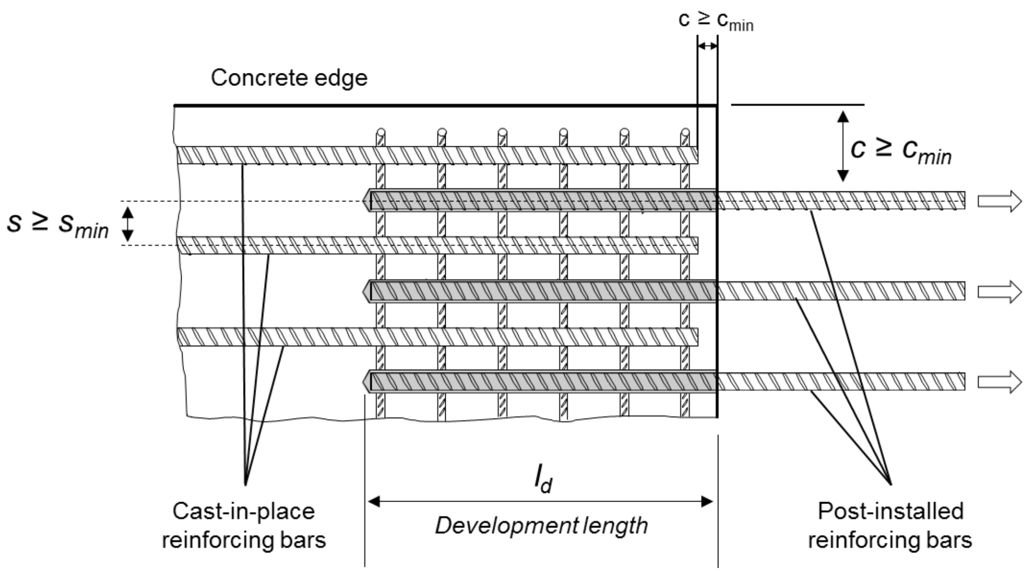


FIGURE 2—INSTALLATION PARAMETERS FOR POST-INSTALLED REINFORCING BARS

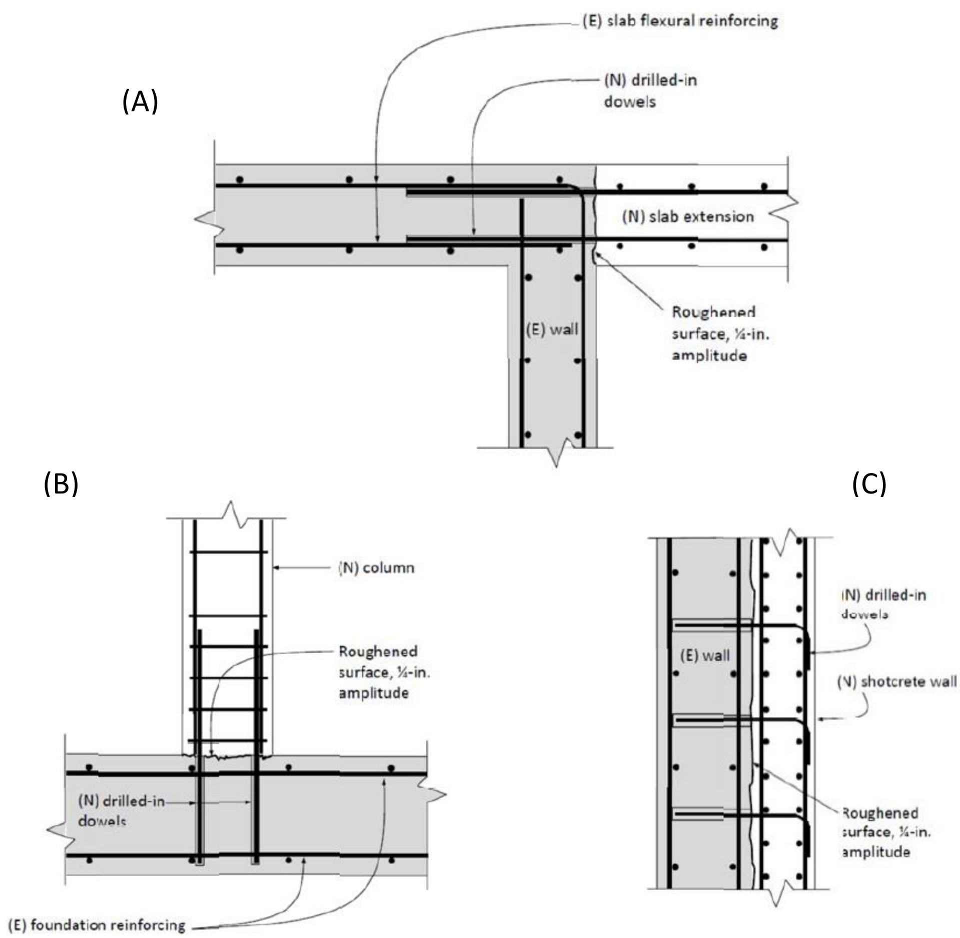
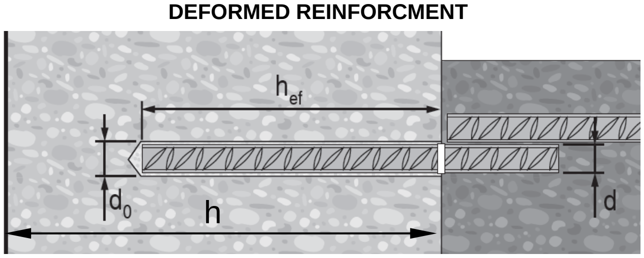


FIGURE 3—(A) TENSION LAP SPLICE WITH EXISTING FLEXURAL REINFORCEMENT; (B) TENSION DEVELOPMENT OF COLUMN DOWELS; (C) DEVELOPMENT OF SHEAR DOWELS FOR NEW ONLAY SHEAR WALL

DEFORMED REINFORCMENT



EU Rebar

Ø d [mm]	Ø d_0 [mm]	h_{ef} [mm]
8	12	60...480
10	14	60...600
12	16	70...720
14	18	75...840
16	20	80...960
18	22	85...1080
20	25	90...1200
22	28	95...1320
24	32	96...1440
25	32	100...1500
26	35	104...1560
28	35	112...1680
30	37	120...1800
32	40	128...1920

US Rebar

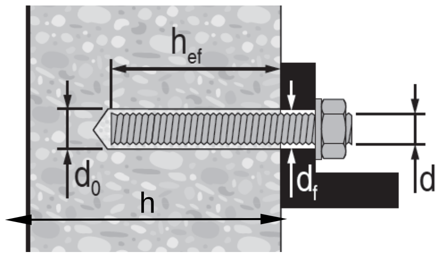
d	Ø d_0 [inch]	h_{ef} [inch]
# 3	½	2⅜...22½
# 4	⅝	2¾...30
# 5	¾	3⅛...37½
# 6	⅞	3½...15
	1	15...45
# 7	1	3½...17½
	1⅛	17½...52½
# 8	1⅛	4...20
	1¼	20...60
# 9	1⅜	4½...67½
# 10	1½	5...75
# 11	1¾	5½...82½

CA Rebar

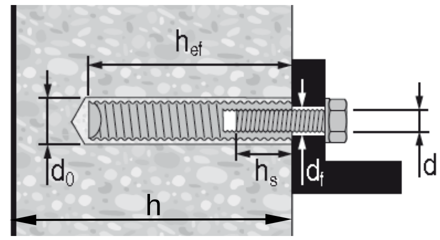
d	Ø d_0 [inch]	h_{ef} [mm]
10 M	9/16	70…678
15 M	¾	80…960
20 M	1	90…1170
25 M	1¼ (32 mm)	101…1512
30 M	1½	120…1794

FIGURE 4—INSTALLATION PARAMETERS

THREADED ROD



HILTI HIS-N AND HIS-RN THREADED INSERTS



HAS / HIT-V

Ø d [inch]	Ø d_0 [inch]	h_{ef} [inch]	Ø d_f [inch]	T_{max} [ft-lb]	T_{max} [Nm]
3/8	7/16	2 3/8 … 7 1/2	7/16	15	20
1/2	9/16	2 3/4 … 10	9/16	30	41
5/8	3/4	3 1/8 … 12 1/2	11/16	60	81
3/4	7/8	3 1/2 … 15	13/16	100	136
7/8	1	3 1/2 … 17 1/2	15/16	125	169
1	1 1/8	4 … 20	1 1/8	150	203
1 1/4	1 3/8	5 … 25	1 3/8	200	271

HIT-V

Ø d [mm]	Ø d_0 [mm]	h_{ef} [mm]	Ø d_f [mm]	T_{max} [Nm]
M8	10	60...160	9	10
M10	12	60...200	12	20
M12	14	70...240	14	40
M16	18	80...320	18	80
M20	22	90...400	22	150
M24	28	100...480	26	200
M27	30	110...540	30	270
M30	35	120...600	33	300

Ø d [inch]	Ø d_0 [inch]	h_{ef} [inch]	Ø d_f [inch]	h_s [inch]	T_{max} [ft-lb]	T_{max} [Nm]
3/8	11/16	4 3/8	7/16	3/8…15/16	15	20
1/2	7/8	5	9/16	1/2…1 3/16	30	41
5/8	1 1/8	6 3/4	11/16	5/8…1 1/2	60	81
3/4	1 1/4	8 1/8	13/16	3/4…1 7/8	100	136

Ø d [mm]	Ø d_0 [mm]	h_{ef} [mm]	Ø d_f [mm]	h_s [mm]	T_{max} [Nm]
M8	14	90	9	8…20	10
M10	18	110	12	10…25	20
M12	22	125	14	12…30	40
M16	28	170	18	16…40	80
M20	32	205	22	20…50	150

FIGURE 4—INSTALLATION PARAMETERS (Continued)

TABLE 1—DESIGN TABLE INDEX

Design Table		Fractional		Metric	
		Table	Page	Table	Page
Standard Threaded Rod	Steel Strength - N_{sa}, V_{sa}	6A	13	14	20
	Concrete Breakout - N_{cb}, N_{cbg}, V_{cb}, V_{cbg}, V_{cp}, V_{cpg}	7	15	15	21
	Bond Strength - N_a, N_{ag}	11-13	18-19	19-21	25-26
Hilti HIS-N and HIS-RN Internally Threaded Insert	Steel Strength - N_{sa}, V_{sa}	26	30	26	30
	Concrete Breakout - N_{cb}, N_{cbg}, V_{cb}, V_{cbg}, V_{cp}, V_{cpg}	27	31	27	31
	Bond Strength - N_a, N_{ag}	28-30	32-33	28-30	32-33

Design Table		Fractional		EU Metric		Canadian	
		Table	Page	Table	Page	Table	Page
Steel Reinforcing Bars	Steel Strength - N_{sa}, V_{sa}	6B	14	14	20	22	27
	Concrete Breakout - N_{cb}, N_{cbg}, V_{cb}, V_{cbg}, V_{cp}, V_{cpg}	7	15	15	21	23	27
	Bond Strength - N_a, N_{ag}	8-10	16-17	16-18	22-24	24-25B	28-29
	Determination of development length for post-installed reinforcing bar connections	31	34	32	34	33	35

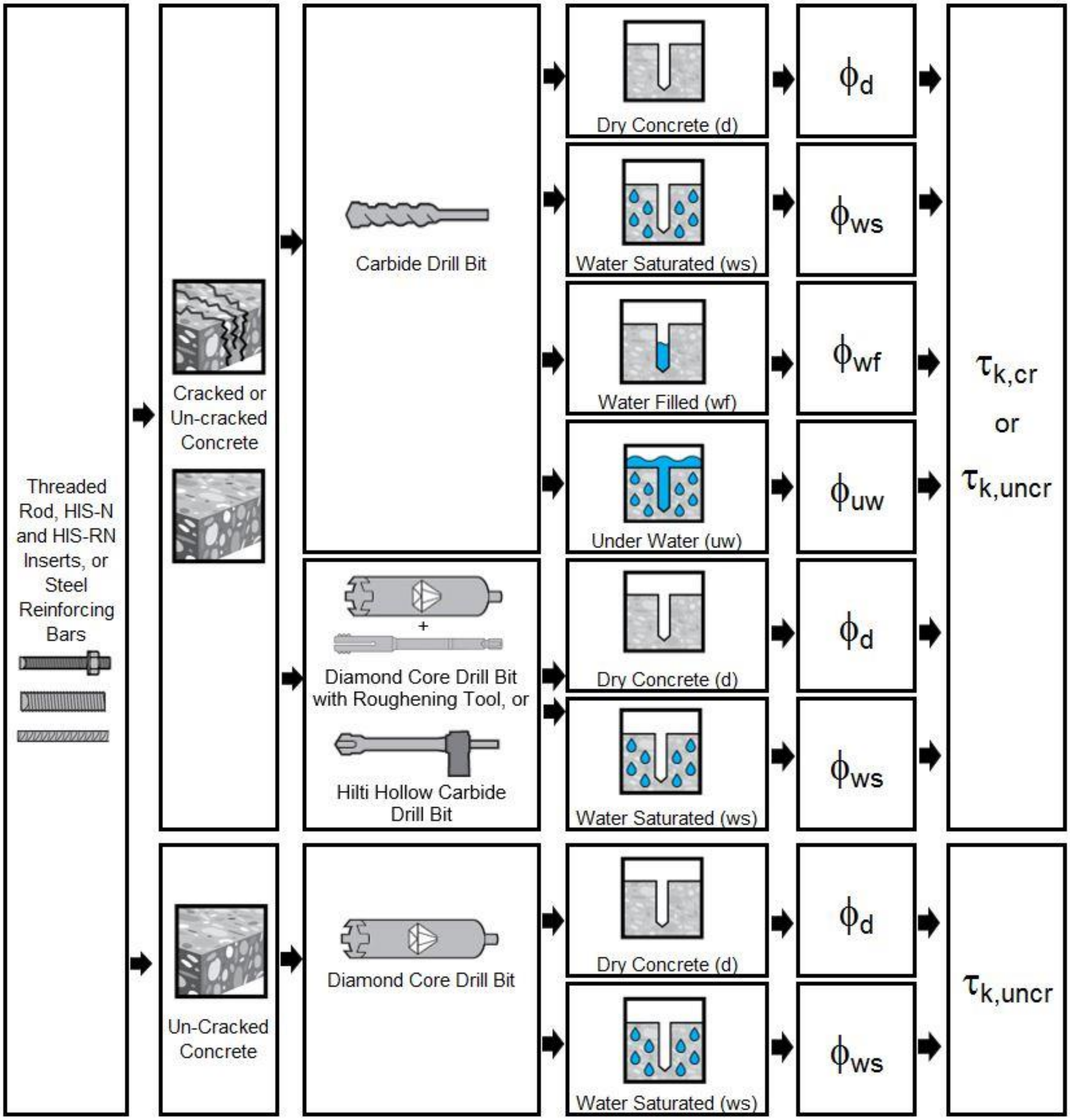


FIGURE 5—FLOWCHART FOR THE ESTABLISHMENT OF DESIGN BOND STRENGTH

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

THREADED ROD SPECIFICATION 			Minimum specified ultimate strength, f_{uta}	Minimum specified yield strength 0.2 percent offset, f_{ya}	f_{uta}/f_{ya}	Elongation, min. percent[7]	Reduction of Area, min. percent	Specification for nuts[8]
CARBON STEEL	ASTM A193[2] Grade B7 ≤ $2\frac{1}{2}$ in. (≤ 64 mm)	psi (MPa)	125,000 (862)	105,000 (724)	1.19	16	50	ASTM A563 Grade DH
	ASTM F568M[3] Class 5.8 M5 ($\frac{1}{4}$ in.) to M24 (1 in.) (equivalent to ISO 898-1)	psi (MPa)	72,500 (500)	58,000 (400)	1.25	10	35	ASTM A563 Grade DH[9] DIN 934 (8-A2K)
	ASTM F1554, Grade 36[7]	psi (MPa)	58,000 (400)	36,000 (248)	1.61	23	40	ASTM A194 or ASTM A563
	ASTM F1554, Grade 55[7]	psi (MPa)	75,000 (517)	55,000 (379)	1.36	21	30	ASTM A194 or ASTM A563
	ASTM F1554, Grade 105[7]	psi (MPa)	125,000 (862)	105,000 (724)	1.19	15	45	ASTM A194 or ASTM A563
	ISO 898-1[4]Class 5.8	MPa (psi)	500 (72,500)	400 (58,000)	1.25	22	-	DIN 934 Grade 6
	ISO 898-1[4] Class 8.8	MPa (psi)	800 (116,000)	640 (92,800)	1.25	12	52	DIN 934 Grade 8
STAINLESS STEEL	ASTM F593[5] CW1 (316) $\frac{1}{4}$-in. to $\frac{5}{8}$-in.	psi (MPa)	100,000 (689)	65,000 (448)	1.54	20	-	ASTM F594
	ASTM F593[5] CW2 (316) $\frac{3}{4}$-in. to $1\frac{1}{2}$-in.	psi (MPa)	85,000 (586)	45,000 (310)	1.89	25	-	ASTM F594
	ASTM A193 Grade 8(M), Class 1[2] - 1 ¼-in.	psi (MPa)	75,000 (517)	30,000 (207)	2.50	30	50	ASTM F594
	ISO 3506-1[6] A4-70 M8 – M24	MPa (psi)	700 (101,500)	450 (65,250)	1.56	40	-	ISO 4032
	ISO 3506-1[6] A4-50 M27 – M30	MPa (psi)	500 (72,500)	210 (30,450)	2.38	40	-	ISO 4032

[1]Hilti HIT-RE 500 V3 adhesive may be used in conjunction with all grades of continuously threaded carbon or stainless steel rod (all-thread) that comply with the code reference standards and that have thread characteristics comparable with ANSI B1.1 UNC Coarse Thread Series or ANSI B1.13M M Profile Metric Thread Series. Values for threaded rod types and associated nuts supplied by Hilti are provided here.
[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]Standard Steel Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
[6]Mechanical properties of corrosion-resistant stainless steel fasteners – Part 1: Bolts, screws and studs
[7]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.
[8]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.
[9]Nuts for fractional rods.

TABLE 3—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 A615[1] Gr. 60	psi (MPa)	80,000 (550)	60,000 (414)
ASTM A615[1] Gr. 40	psi (MPa)	60,000 (414)	40,000 (276)
ASTM A706[2] Gr. 60	psi (MPa)	80,000 (550)	60,000 (414)
DIN 488[3] BSt 500	MPa (psi)	550 (79,750)	500 (72,500)
CAN/CSA-G30.18[4] Gr. 400	MPa (psi)	540 (78,300)	400 (58,000)

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

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

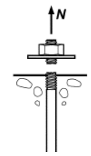
HILTI HIS-N AND HIS-RN INSERTS 		**Minimum specified ultimate strength, f_{uta}**	**Minimum specified yield strength, f_{ya}**
Carbon Steel DIN EN 10277-3 11SMnPb30+c or DIN 1561 9SMnPb28K	psi (MPa)	71,050 (490)	56,550 (390)
Stainless Steel EN 10088-3 X5CrNiMo 17-12-2	psi (MPa)	101,500 (700)	50,750 (350)

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]**
ASTM A193 Grade B7	psi (MPa)	125,000 (862)	105,000 (724)	1.119	16	50	ASTM A563 Grade DH
SAE J429[3] Grade 5	psi (MPa)	120,000 (828)	92,000 (634)	1.30	14	35	SAE J995
ASTM A325[4] $^1/_2$ to 1-in.	psi (MPa)	120,000 (828)	92,000 (634)	1.30	14	35	A563 C, C3, D, DH, DH3 Heavy Hex
ASTM A193[5] Grade B8M (AISI 316) for use with HIS-RN	psi (MPa)	110,000 (759)	95,000 (655)	1.16	15	45	ASTM F594[7] Alloy Group 1, 2 or 3
ASTM A193[5] Grade B8T (AISI 321) for use with HIS-RN	psi (MPa)	125,000 (862)	100,000 (690)	1.25	12	35	ASTM F594[7] Alloy Group 1, 2 or 3

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

Fractional Threaded Rod



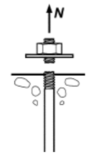
Steel Strength

TABLE 6A—STEEL DESIGN INFORMATION FOR FRACTIONAL THREADED ROD

DESIGN INFORMATION		Symbol	Units	Nominal rod diameter (in.)[1]						
				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	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)	3,370 (15.0)	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	$\alpha_{V,seis}$	-	1.0						
	Strength reduction factor ϕ for tension[2]	ϕ	-	0.65						
	Strength reduction factor ϕ for shear[2]	ϕ	-	0.60						
ASTM A193 B7	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)	5,810 (25.9)	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	$\alpha_{V,seis}$	-	1.0						
	Strength reduction factor ϕ for tension[3]	ϕ	-	0.75						
	Strength reduction factor ϕ for shear[3]	ϕ	-	0.65						
ASTM F1554 Gr. 36	Nominal strength as governed by steel strength	N_{sa}	lb (kN)	- -	8,230 (36.6)	13,110 (58.3)	19,400 (86.3)	26,780 (119.1)	35,130 (156.3)	56,210 (250.0)
		V_{sa}	lb (kN)	- -	4,940 (22.0)	7,865 (35.0)	11,640 (51.8)	16,070 (71.5)	21,080 (93.8)	33,725 (150.0)
	Reduction factor, seismic shear	$\alpha_{V,seis}$	-	0.6						
	Strength reduction factor ϕ for tension [3]	ϕ	-	0.75						
	Strength reduction factor ϕ for shear [3]	ϕ	-	0.65						
ASTM F1554 Gr. 55	Nominal strength as governed by steel strength	N_{sa}	lb (kN)	- -	10,645 (47.4)	16,950 (75.4)	25,090 (111.6)	34,630 (154.0)	45,430 (202.1)	72,685 (323.3)
		V_{sa}	lb (kN)	- -	6,385 (28.4)	10,170 (45.2)	15,055 (67.0)	20,780 (92.4)	27,260 (121.3)	43,610 (194.0)
	Reduction factor, seismic shear	$\alpha_{V,seis}$	-	1.0						
	Strength reduction factor ϕ for tension [3]	ϕ	-	0.75						
	Strength reduction factor ϕ for shear [3]	ϕ	-	0.65						
ASTM F1554 Gr. 105	Nominal strength as governed by steel strength	N_{sa}	lb (kN)	- -	17,740 (78.9)	28,250 (125.7)	41,815 (186.0)	57,715 (256.7)	75,715 (336.8)	121,135 (538.8)
		V_{sa}	lb (kN)	- -	10,645 (47.4)	16,950 (75.4)	25,090 (111.6)	34,630 (154.0)	45,430 (202.1)	72,680 (323.3)
	Reduction factor, seismic shear	$\alpha_{V,seis}$	-	1.0						
	Strength reduction factor ϕ for tension [3]	ϕ	-	0.75						
	Strength reduction factor ϕ for shear [3]	ϕ	-	0.65						
ASTM F593, CW Stainless	Nominal strength as governed by steel strength	N_{sa}	lb (kN)	7,750 (34.5)	14,190 (63.1)	22,600 (100.5)	28,435 (126.5)	39,245 (174.6)	51,485 (229.0)	- -
		V_{sa}	lb (kN)	4,650 (20.7)	8,515 (37.9)	13,560 (60.3)	17,060 (75.9)	23,545 (104.7)	30,890 (137.4)	- -
	Reduction factor, seismic shear	$\alpha_{V,seis}$	-	0.80						-
	Strength reduction factor ϕ for tension [2]	ϕ	-	0.65						-
	Strength reduction factor ϕ for shear [2]	ϕ	-	0.60						-
ASTM A193, Gr. 8(M), Class 1 Stainless	Nominal strength as governed by steel strength	N_{sa}	lb (kN)	-						55,240 (245.7)
		V_{sa}	lb (kN)	-						33,145 (147.4)
	Reduction factor, seismic shear	$\alpha_{V,seis}$	-	-						0.8
	Strength reduction factor ϕ for tension [2]	ϕ	-	-						0.75
	Strength reduction factor ϕ for shear [2]	ϕ	-	-						0.65

For **SI**: 1 inch = 25.4 mm, 1 lbf = 4.448 N. For **pound-inch** units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf

[1]Values provided for common rod material types are based on specified strengths and calculated in accordance with ACI 318-19 Eq. (17.6.1.2) and Eq. (17.7.1.2b), ACI 318-14 Eq. (17.4.1.2) and Eq (17.5.1.2b) or ACI 318-11 Eq. (D-2) and Eq. (D-29), as applicable. Nuts and washers must be appropriate for the rod.
[2]For use with the load combinations of Section 1605.1 of the 2021 IBC or Section 1605.2 of the 2018, 2015, and 2012 IBC, ACI 318 (-19 and -14) 5.3 or ACI 318-11 9.2, as applicable, as set forth in ACI 318-19 17.5.3 or ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4. Values correspond to a brittle steel element.
[3]For use with the load combinations of Section 1605.1 of the 2021 IBC or Section 1605.2 of the 2018, 2015, and 2012 IBC, ACI 318 (-19 and -14) 5.3 or ACI 318-11 9.2, as applicable, as set forth in ACI 318-19 17.5.3 or ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4. Values correspond to a ductile steel element.



Fractional Reinforcing Bars **Steel Strength**

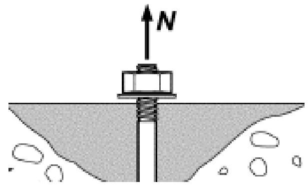
TABLE 6B—STEEL DESIGN INFORMATION FOR FRACTIONAL REINFORCING BARS

DESIGN INFORMATION		Symbol	Units	Nominal Reinforcing bar size (Rebar)[1]							
				#3	#4	#5	#6	#7	#8	#9	#10
Nominal bar diameter		d	in.	3/8	1/2	5/8	3/4	7/8	1	1.128	1.270
			(mm)	(9.5)	(12.7)	(15.9)	(19.1)	(22.2)	(25.4)	(28.7)	(32.3)
Bar effective cross-sectional area		A_{se}	in.^{2}	0.11	0.2	0.31	0.44	0.60	0.79	1.00	1.27
			(mm^2)	(71)	(129)	(199)	(284)	(387)	(510)	(645)	(819)
ASTM A615 Grade 40	Nominal strength as governed by steel strength	N_{sa}	lb	6,600	12,000	18,600	26,400	36,000	47,400	60,000	76,200
			(kN)	(29.4)	(53.4)	(82.7)	(117.4)	(160.1)	(210.9)	(266.9)	(339.0)
		V_{sa}	lb	3,960	7,200	11,160	15,840	21,600	28,440	36,000	45,720
			(kN)	(17.6)	(32.0)	(49.6)	(70.5)	(96.1)	(126.5)	(160.1)	(203.4)
	Reduction for seismic shear	$\alpha_{V,seis}$	-	0.70							
	Strength reduction factor ϕ for tension[2]	ϕ	-	0.65							
	Strength reduction factor ϕ for shear[2]	ϕ	-	0.60							
ASTM A615 Grade 60	Nominal strength as governed by steel strength	N_{sa}	lb	8,800	16,000	24,800	35,200	48,000	63,200	80,000	101,600
			(kN)	(39.1)	(71.2)	(110.3)	(156.6)	(213.5)	(281.1)	(355.9)	(451.9)
		V_{sa}	lb	5,280	9,600	14,880	21,120	28,800	37,920	48,000	60,960
			(kN)	(23.5)	(42.7)	(66.2)	(93.9)	(128.1)	(168.7)	(213.5)	(271.2)
	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							
ASTM A706 Grade 60	Nominal strength as governed by steel strength	N_{sa}	lb	8,800	16,000	24,800	35,200	48,000	63,200	80,000	101,600
			(kN)	(39.1)	(71.2)	(110.3)	(156.6)	(213.5)	(281.1)	(355.9)	(452.0)
		V_{sa}	lb	5,280	9,600	14,880	21,120	28,800	37,920	48,000	60,960
			(kN)	(23.5)	(42.7)	(66.2)	(94.0)	(128.1)	(168.7)	(213.5)	(271.2)
	Reduction for seismic shear	$\alpha_{V,seis}$		0.70							
	Strength reduction factor ϕ for tension[3]	ϕ		0.75							
	Strength reduction factor ϕ for shear[3]	ϕ		0.65							

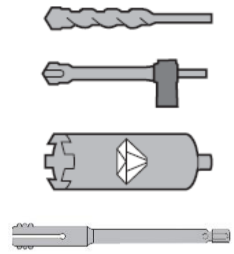
For **SI**: 1 inch = 25.4 mm, 1 lbf = 4.448 N. For **pound-inch** units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf

[1] Values provided for common rebar types are based on specified strengths and calculated in accordance with ACI 318-19 Eq. (17.6.1.2) and Eq. (17.7.1.2b), ACI 318-14 Eq. (17.4.1.2) and Eq (17.5.1.2b) or ACI 318-11 Eq. (D-2) and Eq. (D-29). Nuts and washers must be appropriate for the rod.
[2] For use with the load combinations of Section 1605.1 of the 2021 IBC or Section 1605.2 of the 2018, 2015, and 2012 IBC, ACI 318 (-19 and -14) 5.3 or ACI 318-11 9.2, as set forth in ACI 318-19 17.5.3 or ACI 318-14 17.3.3 or ACI 318-11 D.4.3. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4. Values correspond to a brittle steel element.
[3] For use with the load combinations of Section 1605.1 of the 2021 IBC or Section 1605.2 of the 2018, 2015, and 2012 IBC, ACI 318 (-19 and -14) 5.3 or ACI 318-11 9.2, as set forth in ACI 318-19 17.5.3 or ACI 318-14 17.3.3 or ACI 318-11 D.4.3. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4. Values correspond to a ductile steel element.

Fractional Threaded Rod and Reinforcing Bars



Concrete Breakout Strength



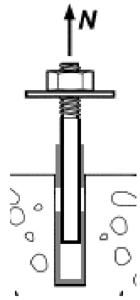
Carbide Bit or Hilti Hollow Carbide Bit Diamond Core Bit + Roughening Tool, or Diamond Core Bit

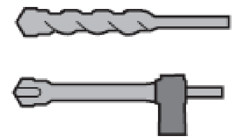
TABLE 7—CONCRETE BREAKOUT DESIGN INFORMATION FOR FRACTIONAL THREADED ROD AND REINFORCING BARS ALL DRILLING METHODS[1]

DESIGN INFORMATION	Symbol	Units	Nominal rod diameter (in.) / Reinforcing bar size											
			$^3/_8$ or #3	$^1/_2$	#4	$^5/_8$	#5	$^3/_4$	#6	$^7/_8$	#7	1 or #8	#9	$1^1/_4$ or #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)											
Minimum Embedment	$h_{ef,min}$	in. (mm)	$2^3/_8$ (60)	$2^3/_4$ (70)	$2^3/_8$ (60)	$3^1/_8$ (79)	3 (76)	$3^1/_2$ (89)	3 (76)	$3^1/_2$ (89)	$3^3/_8$ (85)	4 (102)	$4^1/_2$ (114)	5 (127)
Maximum Embedment	$h_{ef,max}$	in. (mm)	$7^1/_2$ (191)	10 (254)	10 (254)	$12^1/_2$ (318)	$12^1/_2$ (318)	15 (381)	15 (381)	$17^1/_2$ (445)	$17^1/_2$ (445)	20 (508)	$22^1/_2$ (572)	25 (635)
Min. anchor spacing[3]	s_{min}	in. (mm)	$1^7/_8$ (48)	$2^1/_2$ (64)	$2^1/_2$ (64)	$3^1/_8$ (79)	$3^1/_8$ (79)	$3^3/_4$ (95)	$3^3/_4$ (95)	$4^3/_8$ (111)	$4^3/_8$ (111)	5 (127)	$5^5/_8$ (143)	$6^1/_4$ (159)
Min. edge distance[3]	c_{min}	-	5d; or see Section 4.1.9 of this report for design with reduced minimum edge distances											
Minimum concrete thickness	h_{min}	in. (mm)	$h_{ef} + 1^1/_4$ $(h_{ef} + 30)$			$h_{ef} + 2d_0$ [(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[2]	ϕ	-	0.65											
Strength reduction factor for shear, concrete failure modes[2]	ϕ	-	0.70											

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

[1]Additional setting information is described in Figure 8A and 8B, Manufacturers Printed Installation Instructions (MPII).
[2]The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, the appropriate strength reduction factor must be determined in accordance with ACI 318-11 D.4.4.
[3]For installations with $1^3/_4$-inch edge distance, refer to Section 4.1.9 for spacing and maximum torque requirements.
[4]d_0 = hole diameter.





Fractional Reinforcing Bars **Bond Strength** **Carbide Bit or Hilti Hollow Carbide Bit**

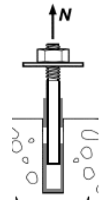
TABLE 8—BOND STRENGTH DESIGN INFORMATION FOR FRACTIONAL REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR HILTI HOLLOW CARBIDE DRILL BIT)[1]

DESIGN INFORMATION			Symbol	Units	Nominal reinforcing bar size							
					#3	#4	#5	#6	#7	#8	#9	#10
Minimum Embedment			$h_{ef,min}$	in. (mm)	2 3/8 (60)	2 3/8 (60)	3 (76)	3 (76)	3 3/8 (85)	4 (102)	4½ (114)	5 (127)
Maximum Embedment			$h_{ef,max}$	in. (mm)	7½ (191)	10 (254)	12½ (318)	15 (381)	17½ (445)	20 (508)	22½ (572)	25 (635)
Dry concrete and Water Saturated Concrete	Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (MPa)	1,350 (9.3)	1,360 (9.4)	1,390 (9.6)	1,410 (9.7)	1,410 (9.7)	1,420 (9.8)	1,390 (9.6)	1,340 (9.3)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	1,770 (12.2)	1,740 (12.0)	1,720 (11.9)	1,690 (11.7)	1,670 (11.5)	1,640 (11.3)	1,620 (11.2)	1,590 (11.0)
	Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (MPa)	930 (6.4)	940 (6.5)	960 (6.6)	970 (6.7)	980 (6.7)	980 (6.8)	960 (6.6)	930 (6.4)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	1,220 (8.4)	1,200 (8.3)	1,190 (8.2)	1,170 (8.1)	1,150 (7.9)	1,130 (7.8)	1,120 (7.7)	1,100 (7.6)
	Anchor Category		-	-	1	1	1	1	1	1	1	1
	Strength Reduction factor		ϕ_d, ϕ_{ws}	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Water-filled hole	Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (MPa)	1,000 (6.9)	1,010 (6.9)	1,040 (7.2)	1,060 (7.3)	1,070 (7.4)	1,090 (7.5)	1,070 (7.4)	1,050 (7.2)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	1,300 (9.0)	1,290 (8.9)	1,290 (8.9)	1,280 (8.8)	1,270 (8.7)	1,260 (8.7)	1,240 (8.6)	1,240 (8.6)
	Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (MPa)	690 (4.7)	700 (4.8)	720 (5.0)	730 (5.0)	740 (5.1)	750 (5.2)	740 (5.1)	720 (5.0)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	900 (6.2)	890 (6.1)	890 (6.1)	880 (6.1)	870 (6.0)	870 (6.0)	860 (5.9)	860 (5.9)
	Anchor Category		-	-	3	3	3	3	3	3	3	3
	Strength Reduction factor		ϕ_{wf}	-	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Submerged concrete	Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (MPa)	860 (5.9)	890 (6.1)	920 (6.3)	940 (6.5)	960 (6.6)	990 (6.9)	970 (6.7)	980 (6.8)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	1,140 (7.9)	1,130 (7.8)	1,140 (7.9)	1,140 (7.9)	1,140 (7.9)	1,150 (7.9)	1,130 (7.8)	1,150 (8.0)
	Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (MPa)	590 (4.1)	610 (4.2)	630 (4.4)	650 (4.5)	660 (4.6)	690 (4.7)	670 (4.6)	680 (4.7)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	790 (5.4)	780 (5.4)	790 (5.4)	790 (5.4)	790 (5.4)	790 (5.5)	790 (5.4)	800 (5.5)
	Anchor Category		-	-	3	3	3	3	3	3	3	3
	Strength Reduction factor		ϕ_{uw}	-	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Reduction for seismic tension			$\alpha_{N,seis}$	-	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9

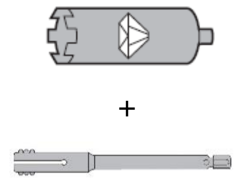
For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2{,}500)^{0.25}$ for uncracked concrete [For SI: $(f'_c / 17.2)^{0.25}$] and $(f'_c / 2{,}500)^{0.15}$ for cracked concrete [For SI: $(f'_c / 17.2)^{0.15}$]. See Section 4.1.4 of this report for bond strength determination.
[2]Temperature range A: Maximum short term temperature = 130°F (55°C), Maximum long term temperature = 110°F (43°C).
Temperature range B: Maximum short term temperature = 176°F (80°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.

Fractional Reinforcing Bars



Bond Strength



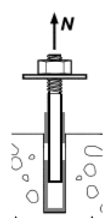
Diamond Core Bit + Roughening Tool

TABLE 9—BOND STRENGTH DESIGN INFORMATION FOR FRACTIONAL REINFORCING BARS IN HOLES CORE DRILLED WITH A DIAMOND CORE BIT AND ROUGHENED WITH A HILTI ROUGHENING TOOL[1]

DESIGN INFORMATION			Symbol	Units	Nominal reinforcing bar size				
					#5	#6	#7	#8	#9
Minimum Embedment			$h_{ef,min}$	in. (mm)	3 (76)	3 (76)	3 3/8 (85)	4 (102)	4½ (115)
Maximum Embedment			$h_{ef,max}$	in. (mm)	12½ (318)	11 ¼ (286)	17½ (445)	20 (508)	22½ (573)
Dry and water saturated concrete	Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (MPa)	970 (6.7)	990 (6.8)	990 (6.8)	995 (6.9)	970 (6.7)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	1,720 (11.9)	1,690 (11.7)	1,670 (11.5)	1,640 (11.3)	1,620 (11.2)
	Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (MPa)	670 (4.6)	680 (4.7)	680 (4.7)	690 (4.8)	670 (4.6)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	1,190 (8.2)	1,170 (8.1)	1,150 (7.9)	1,130 (7.8)	1,120 (7.7)
	Anchor Category		-	-	1	1	1	1	1
	Strength Reduction factor		ϕ_d, ϕ_{ws}	-	0.65	0.65	0.65	0.65	0.65
Reduction for seismic tension			$\alpha_{N,seis}$	-	0.9	0.9	0.9	0.9	0.9

For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi
[1]Bond strength values correspond to concrete compressive strength in the range 2,500 psi ≤ f′c ≤ 8,000 psi).
[2]Temperature range A: Maximum short term temperature = 130°F (55°C), Maximum long term temperature = 110°F (43°C).
Temperature range B: Maximum short term temperature = 176°F (80°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.

Fractional Reinforcing Bars



Bond Strength

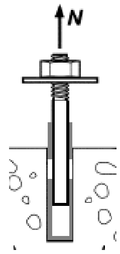
Diamond Core Bit

TABLE 10—BOND STRENGTH DESIGN INFORMATION FOR FRACTIONAL REINFORCING BARS IN HOLES CORE DRILLED WITH A DIAMOND CORE BIT[1]

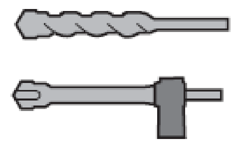
DESIGN INFORMATION			Symbol	Units	Nominal reinforcing bar size							
					#3	#4	#5	#6	#7	#8	#9	#10
Minimum Embedment			$h_{ef,min}$	in. (mm)	2 3/8 (60)	2 3/8 (60)	3 (76)	3 (76)	3 3/8 (85)	4 (102)	4½ (114)	5 (127)
Maximum Embedment			$h_{ef,max}$	in. (mm)	7½ (191)	10 (254)	12½ (318)	15 (381)	17½ (445)	20 (508)	22½ (572)	25 (635)
Dry and water saturated concrete	Temperature range A[2]	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	1,150 (8.0)	1,150 (8.0)	1,150 (8.0)	1,150 (8.0)	1,150 (8.0)	1,150 (8.0)	1,150 (8.0)	1,150 (8.0)
	Temperature range B[2]	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	800 (5.5)	800 (5.5)	800 (5.5)	800 (5.5)	800 (5.5)	800 (5.5)	800 (5.5)	800 (5.5)
	Anchor Category		-	-	2	2	3	3	3	3	3	3
	Strength Reduction factor		ϕ_d, ϕ_{ws}	-	0.55	0.55	0.45	0.45	0.45	0.45	0.45	0.45

For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi
[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2,500)^{0.25}$ for uncracked concrete. [For SI: $(f'_c / 17.2)^{0.25}$]. See Section 4.1.4 of this report for bond strength determination.
[2]Temperature range A: Maximum short term temperature = 130°F (55°C), Maximum long term temperature = 110°F (43°C).
Temperature range B: Maximum short term temperature = 176°F (80°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.

Fractional Threaded Rod



Bond Strength



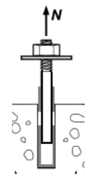
Carbide Bit or Hilti Hollow Carbide Bit

TABLE 11—BOND STRENGTH DESIGN INFORMATION FOR FRACTIONAL THREADED ROD IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR HILTI HOLLOW CARBIDE DRILL BIT)[1]

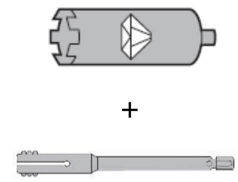
DESIGN INFORMATION			Symbol	Units	Nominal rod diameter (in.)						
					3/8	1/2	5/8	3/4	7/8	1	1 1/4
Minimum Embedment			$h_{ef,min}$	in.	2 3/8	2 3/4	3 1/8	3 1/2	3 1/2	4	5
				(mm)	(60)	(70)	(79)	(89)	(89)	(102)	(127)
Maximum Embedment			$h_{ef,max}$	in.	7½	10	12½	15	17½	20	25
				(mm)	(191)	(254)	(318)	(381)	(445)	(508)	(635)
Dry concrete and Water Saturated Concrete	Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi	1,280	1,270	1,260	1,250	1,240	1,240	1,180
				(MPa)	(8.8)	(8.7)	(8.7)	(8.6)	(8.6)	(8.5)	(8.1)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi	2,380	2,300	2,210	2,130	2,040	1,960	1,790
				(MPa)	(16.4)	(15.8)	(15.3)	(14.7)	(14.1)	(13.5)	(12.4)
	Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi	880	870	870	860	860	850	810
				(MPa)	(6.1)	(6.0)	(6.0)	(5.9)	(5.9)	(5.9)	(5.6)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi	1,640	1,590	1,530	1,470	1,410	1,350	1,240
				(MPa)	(11.3)	(10.9)	(10.5)	(10.1)	(9.7)	(9.3)	(8.5)
	Anchor Category		-	-	1	1	1	1	1	1	1
	Strength Reduction factor		ϕ_d, ϕ_{ws}	ϕ_δ, $\phi_{\omega\sigma}$	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Water-filled hole	Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi	940	940	940	940	940	950	920
				(MPa)	(6.5)	(6.5)	(6.5)	(6.5)	(6.5)	(6.5)	(6.4)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi	1,760	1,700	1,660	1,600	1,550	1,500	1,400
				(MPa)	(12.1)	(11.7)	(11.4)	(11.0)	(10.7)	(10.4)	(9.7)
	Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi	650	650	650	650	650	650	640
				(MPa)	(4.5)	(4.5)	(4.5)	(4.5)	(4.5)	(4.5)	(4.4)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi	1,210	1,170	1,140	1,110	1,070	1,040	970
				(MPa)	(8.4)	(8.1)	(7.9)	(7.6)	(7.4)	(7.1)	(6.7)
	Anchor Category		-	-	3	3	3	3	3	3	3
	Strength Reduction factor		ϕ_{wf}	-	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Submerged concrete	Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi	820	830	830	840	850	860	860
				(MPa)	(5.7)	(5.7)	(5.8)	(5.8)	(5.9)	(5.9)	(5.9)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi	1,530	1,500	1,470	1,430	1,400	1,370	1,300
				(MPa)	(10.6)	(10.3)	(10.1)	(9.9)	(9.6)	(9.4)	(9.0)
	Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi	570	570	580	580	590	590	590
				(MPa)	(3.9)	(3.9)	(4.0)	(4.0)	(4.0)	(4.1)	(4.1)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi	1,060	1,030	1,010	990	960	940	900
				(MPa)	(7.3)	(7.1)	(7.0)	(6.8)	(6.6)	(6.5)	(6.2)
	Anchor Category		-	-	3	3	3	3	3	3	3
	Strength Reduction factor		ϕ_{uw}	-	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Reduction for seismic tension			$\alpha_{N,seis}$	-	0.92	0.93	0.95	1	1	1	1

For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi
[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2,500)^{0.25}$ for uncracked concrete [For SI: $(f'_c / 17.2)^{0.25}$] and $(f'_c / 2,500)^{0.15}$ for cracked concrete [For SI: $(f'_c / 17.2)^{0.15}$]. See Section 4.1.4 of this report for bond strength determination.
[2]Temperature range A: Maximum short term temperature = 130°F (55°C), Maximum long term temperature = 110°F (43°C).
Temperature range B: Maximum short term temperature = 176°F (80°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.

Fractional Threaded Rod



Bond Strength



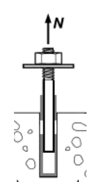
Diamond Core Bit + Roughening Tool

TABLE 12—BOND STRENGTH DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT THREADED RODS IN HOLES CORE DRILLED WITH A DIAMOND CORE BIT AND ROUGHENED WITH A HILTI ROUGHENING TOOL[1]

DESIGN INFORMATION			Symbol	Units	Nominal rod diameter (in.)				
					5/8	¾	7/8	1	1¼
Minimum Embedment			$h_{ef,min}$	in. (mm)	3 1/8 (79)	3 1/2 (89)	3½ (89)	4 (102)	5 (127)
Maximum Embedment			$h_{ef,max}$	in. (mm)	12½ (318)	11¼ (286)	17½ (445)	20 (508)	25 (635)
Dry and water saturated concrete	Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (MPa)	880 (6.1)	875 (6.0)	870 (6.0)	870 (6.0)	825 (5.7)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	2,210 (15.3)	2,130 (14.7)	2,040 (14.1)	1,960 (13.5)	1,790 (12.4)
	Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (MPa)	610 (4.2)	605 (4.2)	605 (4.2)	600 (4.1)	570 (3.9)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	1,530 (10.5)	1,470 (10.1)	1,410 (9.7)	1,350 (9.3)	1,240 (8.5)
	Anchor Category		-	-	1	1	1	1	1
	Strength Reduction factor		ϕ_d, ϕ_{ws}	-	0.65	0.65	0.65	0.65	0.65
Reduction for seismic tension			$\alpha_{N,seis}$	-	0.95	1	1	1	1

For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi
[1]Bond strength values correspond to concrete compressive strength in the range 2,500 psi ≤ f′c ≤ 8,000 psi.
[2]Temperature range A: Maximum short term temperature = 130°F (55°C), Maximum long term temperature = 110°F (43°C).
Temperature range B: Maximum short term temperature = 176°F (80°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.

Fractional Threaded Rod



Bond Strength

Diamond Core Bit

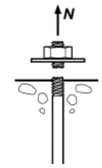
TABLE 13—BOND STRENGTH DESIGN INFORMATION FOR FRACTIONAL THREADED RODS IN HOLES CORE DRILLED WITH A DIAMOND CORE BIT[1]

DESIGN INFORMATION			Symbol	Units	Nominal rod diameter (in.)						
					3/8	½	5/8	¾	7/8	1	1 ¼
Minimum Embedment			$h_{ef,min}$	in. (mm)	2 3/8 (60)	2 3/4 (70)	3 1/8 (79)	3 1/2 (89)	3 1/2 (89)	4 (102)	5 (127)
Maximum Embedment			$h_{ef,max}$	in. (mm)	7½ (191)	10 (254)	12½ (318)	15 (381)	17½ (445)	20 (508)	25 (635)
Dry concrete and Water saturated concrete	Temperature range A[2]	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	1,550 (10.7)	1,550 (10.7)	1,550 (10.7)	1,550 (10.7)	1,550 (10.7)	1,550 (10.7)	1,550 (10.7)
	Temperature range B[2]	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	1,070 (7.4)	1,070 (7.4)	1,070 (7.4)	1,070 (7.4)	1,070 (7.4)	1,070 (7.4)	1,070 (7.4)
	Anchor Category		-	-	2	2	3	3	3	3	3
	Strength Reduction factor		ϕ_d, ϕ_{ws}	-	0.55	0.55	0.45	0.45	0.45	0.45	0.45

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

[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2{,}500)^{0.25}$ for uncracked concrete [For SI: $(f'_c / 17.2)^{0.25}$]. See Section 4.1.4 of this report for bond strength determination.
[2]Temperature range A: Maximum short term temperature = 130°F (55°C), Maximum long term temperature = 110°F (43°C).
Temperature range B: Maximum short term temperature = 176°F (80°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.

Metric Threaded Rod and EU Metric Reinforcing Bars



Steel Strength

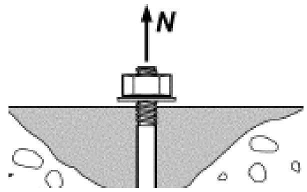
TABLE 14—STEEL DESIGN INFORMATION FOR METRIC THREADED ROD AND EU METRIC REINFORCING BARS

DESIGN INFORMATION		Symbol	Units	Nominal rod diameter (mm)[1]							
				8	10	12	16	20	24	27	30
Rod Outside Diameter		d	mm	8	10	12	16	20	24	27	30
			(in.)	(0.31)	(0.39)	(0.47)	(0.63)	(0.79)	(0.94)	(1.06)	(1.18)
Rod effective cross-sectional area		A_{se}	mm²	36.6	58.0	84.3	157	245	353	459	561
			(in.²)	(0.057)	(0.090)	(0.131)	(0.243)	(0.380)	(0.547)	(0.711)	(0.870)
ISO 898-1 Class 5.8	Nominal strength as governed by steel strength	N_{sa}	kN	18.3	29.0	42.0	78.5	122.5	176.5	229.5	280.5
			(lb)	(4,114)	(6,519)	(9,476)	(17,647)	(27,539)	(39,679)	(51,594)	(63,059)
		V_{sa}	kN	11.0	14.5	25.5	47.0	73.5	106.0	137.5	168.5
			(lb)	(2,648)	(3,260)	(5,685)	(10,588)	(16,523)	(23,807)	(30,956)	(37,835)
	Reduction for seismic shear	$\alpha_{V,seis}$	-	1.00							
	Strength reduction factor for tension[2]	ϕ	-	0.65							
	Strength reduction factor for shear[2]	ϕ	-	0.60							
ISO 898-1 Class 8.8	Nominal strength as governed by steel strength	N_{sa}	kN	29.3	46.5	67.5	125.5	196.0	282.5	367.0	449.0
			(lb)	(6,582)	(10,431)	(15,161)	(28,236)	(44,063)	(63,486)	(82,550)	(100,894)
		V_{sa}	kN	17.6	23.0	40.5	75.5	117.5	169.5	220.5	269.5
			(lb)	(3,949)	(5,216)	(9,097)	(16,942)	(26,438)	(38,092)	(49,530)	(60,537)
	Reduction for seismic shear	$\alpha_{V,seis}$	-	1.00							
	Strength reduction factor for tension[2]	ϕ	-	0.65							
	Strength reduction factor for shear[2]	ϕ	-	0.60							
ISO 3506-1 Class A4 Stainless[3]	Nominal strength as governed by steel strength	N_{sa}	kN	25.6	40.6	59.0	109.9	171.5	247.1	229.5	280.5
			(lb)	(5,760)	(9,127)	(13,266)	(24,706)	(38,555)	(55,550)	(51,594)	(63,059)
		V_{sa}	kN	15.4	20.3	35.4	65.9	102.9	148.3	137.7	168.3
			(lb)	(3,456)	(4,564)	(7,960)	(14,824)	(23,133)	(33,330)	(30,956)	(37,835)
	Reduction for seismic shear	$\alpha_{V,seis}$	-	0.80							
	Strength reduction factor for tension[2]	ϕ	-	0.65							
	Strength reduction factor for shear[2]	ϕ	-	0.60							

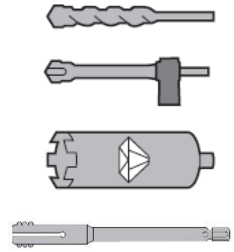
DESIGN INFORMATION		Symbol	Units	Nominal reinforcing bar diameter (mm)								
				10	12	14	16	20	25	28	30	32
Nominal bar diameter		d	mm	10.0	12.0	14.0	16.0	20.0	25.0	28.0	30.0	32.0
			(in.)	(0.394)	(0.472)	(0.551)	(0.630)	(0.787)	(0.984)	(1.102)	(1.224)	(1.260)
Bar effective cross-sectional area		A_{se}	mm²	78.5	113.1	153.9	201.1	314.2	490.9	615.8	706.9	804.2
			(in.²)	(0.122)	(0.175)	(0.239)	(0.312)	(0.487)	(0.761)	(0.954)	(1.096)	(1.247)
DIN 488 BSt 550/500	Nominal strength as governed by steel strength	N_{sa}	kN	43.0	62.0	84.5	110.5	173.0	270.0	338.5	388.8	442.5
			(lb)	(9,711)	(13,984)	(19,034)	(24,860)	(38,844)	(60,694)	(76,135)	(87,406)	(99,441)
		V_{sa}	kN	26.0	37.5	51.0	66.5	103.0	162.0	203.0	233.3	265.5
			(lb)	(5,827)	(8,390)	(11,420)	(14,916)	(23,307)	(36,416)	(45,681)	(52,444)	(59,665)
	Reduction for seismic shear	$\alpha_{V,seis}$	-	0.70								
	Strength reduction factor for tension[2]	ϕ	-	0.65								
	Strength reduction factor for shear[2]	ϕ	-	0.60								

[1] Values provided for common rod and rebar material types are based on specified strengths and calculated in accordance with ACI 318-19 Eq. (17.6.1.2) and Eq. (17.7.1.2b), ACI 318-14 Eq (17.4.1.2) or Eq (17.5.1.2b) or ACI 318-11 Eq. (D-2) and Eq. (D-29), as applicable. Nuts and washers must be appropriate for the rod.
[2] For use with the load combinations of Section 1605.1 of the 2021 IBC or Section 1605.2 of the 2018, 2015, and 2012 IBC, ACI 318 (-19 or -14) 5.3, or ACI 318-11 9.2, as applicable, as set forth in ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4. Values correspond to a brittle steel element.
[3] A4-70 Stainless (M8- M24); A4-502 Stainless (M27- M30)

Metric Threaded Rod and EU Metric Reinforcing Bars



Concrete Breakout Strength



Carbide Bit or Hilti Hollow Carbide Bit Diamond Core Bit + Roughening Tool, or Diamond Core Bit

TABLE 15—CONCRETE BREAKOUT DESIGN INFORMATION FOR METRIC THREADED ROD AND EU METRIC REINFORCING BARS ALL DRILLING METHODS[1]

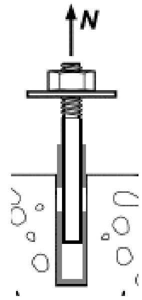
DESIGN INFORMATION	Symbol	Units	Nominal rod diameter (mm)							
			8	10	12	16	20	24	27	30
Minimum Embedment	$h_{ef,min}$	mm	60	60	70	80	90	100	110	120
		(in.)	(2.4)	(2.4)	(2.8)	(3.1)	(3.5)	(3.9)	(4.3)	(4.7)
Maximum Embedment	$h_{ef,max}$	mm	160	200	240	320	400	480	540	600
		(in.)	(6.3)	(7.9)	(9.4)	(12.6)	(15.7)	(18.9)	(21.4)	(23.7)
Min. anchor spacing[3]	s_{min}	mm	40	50	60	80	100	120	135	150
		(in.)	(1.6)	(2.0)	(2.4)	(3.2)	(3.9)	(4.7)	(5.3)	(5.9)
Min. edge distance[3]	c_{min}	-	5d; or see Section 4.1.9 of this report for design with reduced minimum edge distances							
Minimum concrete thickness	h_{min}	mm	h_{ef} + 30		$h_{ef} + 2d_o$[(4)]					
		(in.)	(h_{ef} + 1$^1/_4$)							

DESIGN INFORMATION	Symbol	Units	Nominal reinforcing bar diameter (mm)								
			10	12	14	16	20	25	28	30	32
Minimum Embedment	$h_{ef,min}$	mm	60	70	80	80	90	100	112	120	128
		(in.)	(2.4)	(2.8)	(3.1)	(3.1)	(3.5)	(3.9)	(4.4)	(4.7)	(5.0)
Maximum Embedment	$h_{ef,max}$	mm	200	240	280	320	400	500	560	600	640
		(in.)	(7.9)	(9.4)	(11.0)	(12.6)	(15.7)	(19.7)	(22.0)	(23.7)	(25.2)
Min. anchor spacing[3]	s_{min}	mm	50	60	70	80	100	125	140	150	160
		(in.)	(2.0)	(2.4)	(2.8)	(3.2)	(3.9)	(4.9)	(5.5)	(5.9)	(6.3)
Min. edge distance[3]	c_{min}	-	5d; or see Section 4.1.9 of this report for design with reduced minimum edge distances								
Minimum concrete thickness	h_{min}	mm	h_{ef} + 30	$h_{ef} + 2d_o$[(4)]							
		(in.)	(h_{ef} + 1$^1/_4$)								
Critical edge distance – splitting (for uncracked concrete)	c_{ac}	-	See Section 4.1.10 of this report.								
Effectiveness factor for cracked concrete	$k_{c,cr}$	SI	7.1								
		(in-lb)	(17)								
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	SI	10								
		(in-lb)	(24)								
Strength reduction factor for tension, concrete failure modes[2]	ϕ	-	0.65								
Strength reduction factor for shear, concrete failure modes[2]	ϕ	-	0.70								

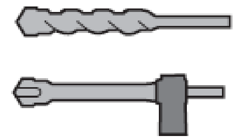
For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

[1]Additional setting information is described in Figure 8A and 8B, Manufacturers Printed Installation Instructions (MPII).
[2] The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, the appropriate strength reduction factor must be determined in accordance with ACI 318-11 D.4.4.
[3]For installations with 1$^3/_4$-inch edge distance, refer to Section 4.1.9 for spacing and maximum torque requirements.
[4] d_0 = hole diameter.

EU Metric Reinforcing Bars



Bond Strength



Carbide Bit or Hilti Hollow Carbide Bit

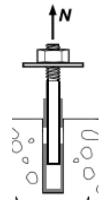
TABLE 16—BOND STRENGTH DESIGN INFORMATION FOR EU METRIC REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR HILTI HOLLOW CARBIDE DRILL BIT)[1]

DESIGN INFORMATION			Symbol	Units	Nominal reinforcing bar diameter (mm)								
					10	12	14	16	20	25	28	30	32
Minimum Embedment			$h_{ef,min}$	mm	60	70	80	80	90	100	112	120	128
				(in.)	(2.4)	(2.8)	(3.1)	(3.1)	(3.5)	(3.9)	(4.4)	(4.7)	(5.0)
Maximum Embedment			$h_{ef,max}$	mm	200	240	280	320	400	500	560	600	640
				(in.)	(7.9)	(9.4)	(11.0)	(12.6)	(15.7)	(19.7)	(22.0)	(23.7)	(25.2)
Dry concrete and Water saturated concrete	Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	9.3	9.4	9.5	9.6	9.7	9.8	9.7	9.5	9.3
				(psi)	(1,350)	(1,360)	(1,380)	(1,390)	(1,410)	(1,420)	(1,400)	(1,370)	(1,350)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	12.2	12.1	12.0	11.8	11.6	11.4	11.2	11.1	11.0
				(psi)	(1,770)	(1,750)	(1,730)	(1,720)	(1,690)	(1,650)	(1,620)	(1,610)	(1,590)
	Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	6.4	6.5	6.5	6.6	6.7	6.8	6.7	6.5	6.4
				(psi)	(930)	(940)	(950)	(960)	(970)	(980)	(970)	(950)	(930)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	8.4	8.3	8.3	8.2	8.0	7.8	7.7	7.7	7.6
				(psi)	(1,220)	(1,210)	(1,200)	(1,190)	(1,160)	(1,140)	(1,120)	(1,110)	(1,100)
	Anchor Category		-		1	1	1	1	1	1	1	1	1
	Strength Reduction factor		ϕ_d, ϕ_{ws}		0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Water-filled hole	Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	6.9	6.9	7.0	7.2	7.4	7.4	7.4	7.4	7.2
				(psi)	(1,000)	(1,010)	(1,020)	(1,040)	(1,070)	(1,080)	(1,080)	(1,070)	(1,050)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	9.0	8.9	8.9	8.9	8.8	8.7	8.6	8.6	8.6
				(psi)	(1,310)	(1,300)	(1,280)	(1,280)	(1,270)	(1,250)	(1,250)	(1,250)	(1,240)
	Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	4.7	4.8	4.8	5.0	5.1	5.1	5.1	5.1	5.0
				(psi)	(690)	(700)	(700)	(720)	(740)	(740)	(740)	(740)	(720)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	6.2	6.2	6.1	6.1	6.1	6.0	5.9	5.9	5.9
				(psi)	(900)	(890)	(890)	(890)	(880)	(870)	(860)	(860)	(860)
	Anchor Category		-	-	3	3	3	3	3	3	3	3	3
	Strength Reduction factor		ϕ_{wf}	-	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Submerged concrete	Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	6.0	6.1	6.2	6.3	6.6	6.8	6.8	6.8	6.8
				(psi)	(880)	(890)	(890)	(920)	(960)	(980)	(980)	(990)	(980)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	7.9	7.8	7.8	7.8	7.9	7.8	7.9	8.0	8.0
				(psi)	(1,140)	(1,140)	(1,130)	(1,140)	(1,140)	(1,140)	(1,140)	(1,150)	(1,160)
	Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	4.2	4.2	4.3	4.4	4.6	4.7	4.7	4.7	4.7
				(psi)	(600)	(610)	(620)	(630)	(660)	(680)	(680)	(680)	(680)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.5	5.5
				(psi)	(790)	(780)	(780)	(790)	(790)	(780)	(790)	(800)	(800)
	Anchor Category		-	-	3	3	3	3	3	3	3	3	3
	Strength Reduction factor		ϕ_{uw}	-	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Reduction for seismic tension			$\alpha_{N,seis}$	-	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9

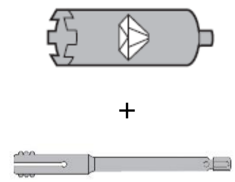
For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2{,}500)^{0.25}$ for uncracked concrete [For SI: $(f'_c / 17.2)^{0.25}$] and $(f'_c / 2{,}500)^{0.15}$ for cracked concrete [For SI: $(f'_c / 17.2)^{0.15}$].. See Section 4.1.4 of this report for bond strength determination.
[2]Temperature range A: Maximum short term temperature = 130°F (55°C), Maximum long term temperature = 110°F (43°C).
Temperature range B: Maximum short term temperature = 176°F (80°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.

EU Metric Reinforcing Bars



Bond Strength



Diamond Core Bit + Roughening Tool

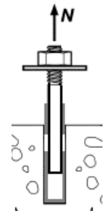
TABLE 17—BOND STRENGTH DESIGN INFORMATION FOR EU METRIC REINFORCING BARS IN HOLES CORE DRILLED WITH A DIAMOND CORE BIT AND ROUGHENED WITH A HILTI ROUGHENING TOOL[1]

DESIGN INFORMATION			Symbol	Units	Nominal reinforcing bar diameter (mm)				
					14	**16**	**20**	**25**	**28**
Minimum Embedment			$h_{ef,min}$	mm	80	80	90	100	112
				(in.)	(3.1)	(3.1)	(3.5)	(3.9)	(4.4)
Maximum Embedment			$h_{ef,max}$	mm	280	320	400	500	560
				(in.)	(11.0)	(12.6)	(15.7)	(19.7)	(22.0)
Dry and water saturated concrete	Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	6.7	6.7	6.8	6.9	6.8
				(psi)	(965)	(970)	(985)	(995)	(980)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	12.0	11.8	11.6	11.4	11.2
				(psi)	(1,730)	(1,720)	(1,690)	(1,650)	(1,620)
	Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	4.6	4.6	4.7	4.8	4.7
				(psi)	(665)	(670)	(680)	(685)	(680)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	8.3	8.2	8.0	7.8	7.7
				(psi)	(1,200)	(1,190)	(1,160)	(1,140)	(1,120)
	Anchor Category		-	-	1	1	1	1	1
	Strength Reduction factor		ϕ_d, ϕ_{ws}	-	0.65	0.65	0.65	0.65	0.65
Reduction for seismic tension			$\alpha_{N,seis}$	-	0.9	0.9	0.9	0.9	0.9

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

[1]Bond strength values correspond to concrete compressive strength in the range 2,500 psi ≤ $f'c$ ≤ 8,000 psi).
[2]Temperature range A: Maximum short term temperature = 130°F (55°C), Maximum long term temperature = 110°F (43°C).
Temperature range B: Maximum short term temperature = 176°F (80°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.

EU Metric Reinforcing Bars



Bond Strength

Diamond Core Bit

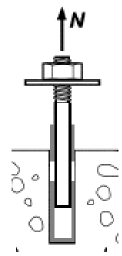
TABLE 18—BOND STRENGTH DESIGN INFORMATION FOR EU METRIC REINFORCING BARS IN HOLES CORE DRILLED WITH A DIAMOND CORE BIT[1]

DESIGN INFORMATION			Symbol	Units	Nominal reinforcing bar diameter (mm)								
					10	12	14	16	20	25	28	30	32
Minimum Embedment			$h_{ef,min}$	mm	60	70	80	80	90	100	112	120	128
				(in.)	(2.4)	(2.8)	(3.1)	(3.1)	(3.5)	(3.9)	(4.4)	(4.7)	(5.0)
Maximum Embedment			$h_{ef,max}$	mm	200	240	280	320	400	500	560	600	640
				(in.)	(7.9)	(9.4)	(11.0)	(12.6)	(15.7)	(19.7)	(22.0)	(23.7)	(25.2)
Dry and Water Saturated concrete	Temperature range A[2]	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
				(psi)	(1,150)	(1,150)	(1,150)	(1,150)	(1,150)	(1,150)	(1,150)	(1,150)	(1,150)
	Temperature range B[2]	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
				(psi)	(800)	(800)	(800)	(800)	(800)	(800)	(800)	(800)	(800)
	Anchor Category		-		2	2	2	3	3	3	3	3	3
	Strength Reduction factor		ϕ_d, ϕ_{ws}		0.55	0.55	0.55	0.45	0.45	0.45	0.45	0.45	0.45

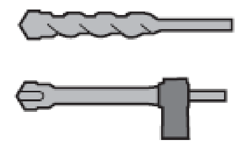
For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2,500)^{0.25}$ for uncracked concrete [For SI: $(f'_c / 17.2)^{0.25}$]. See Section 4.1.4 of this report for bond strength determination.
[2]Temperature range A: Maximum short term temperature = 130°F (55°C), Maximum long term temperature = 110°F (43°C).
Temperature range B: Maximum short term temperature = 176°F (80°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.

Metric Threaded Rod



Bond Strength



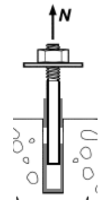
Carbide Bit or Hilti Hollow Carbide Bit

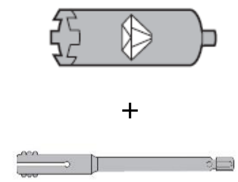
TABLE 19—BOND STRENGTH DESIGN INFORMATION FOR METRIC THREADED RODS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR HILTI HOLLOW CARBIDE DRILL BIT)[1]

DESIGN INFORMATION			Symbol	Units	Nominal rod diameter (mm) 8	10	12	16	20	24	27	30
Minimum Embedment			$h_{ef,min}$	mm	60	60	70	80	90	100	110	120
				(in.)	(2.4)	(2.4)	(2.8)	(3.1)	(3.5)	(3.9)	(4.3)	(4.7)
Maximum Embedment			$h_{ef,max}$	mm	160	200	240	320	400	480	540	600
				(in.)	(6.3)	(7.9)	(9.4)	(12.6)	(15.7)	(18.9)	(21.4)	(23.7)
Dry and Water Saturated Concrete	Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	8.8	8.8	8.8	8.7	8.6	8.5	8.5	8.4
				(psi)	(1,280)	(1,280)	(1,270)	(1,260)	(1,250)	(1,240)	(1,230)	(1,220)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	16.7	16.3	16.0	15.2	14.5	13.8	13.2	12.7
				(psi)	(2,420)	(2,370)	(2,320)	(2,210)	(2,100)	(2,000)	(1,920)	(1,840)
	Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	6.1	6.1	6.0	6.0	5.9	5.9	5.9	5.8
				(psi)	(890)	(880)	(880)	(870)	(860)	(860)	(850)	(840)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	11.5	11.3	11.0	10.5	10.0	9.5	9.1	8.7
				(psi)	(1,670)	(1,630)	(1,600)	(1,520)	(1,450)	(1,380)	(1,320)	(1,270)
	Anchor Category		-	-	1	1	1	1	1	1	1	1
	Strength Reduction factor		ϕ_d, ϕ_{ws}	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Water-filled hole	Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
				(psi)	(940)	(940)	(940)	(940)	(940)	(940)	(950)	(950)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	12.3	12.1	11.8	11.4	11.0	10.5	10.2	9.8
				(psi)	(1,780)	(1,750)	(1,710)	(1,650)	(1,590)	(1,520)	(1,470)	(1,430)
	Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
				(psi)	(650)	(650)	(650)	(650)	(650)	(650)	(650)	(650)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	8.5	8.3	8.2	7.9	7.6	7.2	7.0	6.8
				(psi)	(1,230)	(1,210)	(1,180)	(1,140)	(1,100)	(1,050)	(1,020)	(990)
	Anchor Category		-	-	3	3	3	3	3	3	3	3
	Strength Reduction factor		ϕ_{wf}	-	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Submerged concrete	Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	5.7	5.7	5.7	5.7	5.8	5.9	6.0	6.0
				(psi)	(820)	(820)	(830)	(830)	(840)	(860)	(870)	(870)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	10.7	10.5	10.4	10.1	9.8	9.5	9.3	9.1
				(psi)	(1,550)	(1,530)	(1,500)	(1,460)	(1,420)	(1,380)	(1,350)	(1,320)
	Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	3.9	3.9	3.9	4.0	4.0	4.1	4.1	4.2
				(psi)	(570)	(570)	(570)	(580)	(580)	(590)	(600)	(600)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	7.4	7.3	7.2	7.0	6.8	6.6	6.4	6.3
				(psi)	(1,070)	(1,060)	(1,040)	(1,010)	(980)	(950)	(930)	(910)
	Anchor Category		-	-	3	3	3	3	3	3	3	3
	Strength Reduction factor		ϕ_{uw}	-	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Reduction for seismic tension			$\alpha_{N,seis}$	-	1	0.92	0.93	0.95	1	1	1	1

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

[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2{,}500)^{0.25}$ for uncracked concrete [For SI: $(f'_c / 17.2)^{0.25}$] and $(f'_c / 2{,}500)^{0.15}$ for cracked concrete [For SI: $(f'_c / 17.2)^{0.15}$]. See Section 4.1.4 of this report for bond strength determination.
[2]Temperature range A: Maximum short term temperature = 130°F (55°C), Maximum long term temperature = 110°F (43°C).
Temperature range B: Maximum short term temperature = 176°F (80°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.





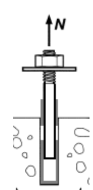
Metric Threaded Rod **Bond Strength** **Diamond Core Bit + Roughening Tool**

TABLE 20—BOND STRENGTH DESIGN INFORMATION FOR METRIC THREADED RODS IN HOLES CORE DRILLED WITH A DIAMOND CORE BIT AND ROUGHENED WITH A HILTI ROUGHENING TOOL[1]

DESIGN INFORMATION			Symbol	Units	Nominal rod diameter (mm)				
					16	20	24	27	30
Minimum Embedment			$h_{ef,min}$	mm (in.)	80 (3.1)	90 (3.5)	100 (3.9)	110 (4.3)	120 (4.7)
Maximum Embedment			$h_{ef,max}$	mm (in.)	320 (12.6)	400 (15.7)	480 (18.9)	540 (21.4)	600 (23.7)
Dry and water saturated concrete	Temp. range A[2]	Characteristic bond trength in cracked concrete	$\tau_{k,cr}$	MPa (psi)	6.1 (880)	6.0 (875)	6.0 (870)	6.0 (860)	5.9 (855)
		Characteristic bond trength in uncracked concrete	$\tau_{k,uncr}$	Mpa (psi)	15.2 (2,210)	14.5 (2,100)	13.8 (2,000)	13.2 (1,920)	12.7 (1,840)
	Temp. range B[2]	Characteristic bond trength in cracked concrete	$\tau_{k,cr}$	MPa (psi)	4.2 (610)	4.2 (605)	4.2 (600)	4.2 (595)	4.1 (590)
		Characteristic bond trength in uncracked concrete	$\tau_{k,uncr}$	MPa (psi)	10.5 (1,520)	10.0 (1,450)	9.5 (1,385)	9.1 (1,320)	8.7 (1,270)
	Anchor Category		-	-	1	1	1	1	1
	Strength Reduction factor		ϕ_d, ϕ_{ws}	-	0.65	0.65	0.65	0.65	0.65
Reduction for seismic tension			$\alpha_{N,seis}$	-	0.95	1	1	1	1

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

[1]Bond strength values correspond to concrete compressive strength in the range 2,500 psi ≤ f′c ≤ 8,000 psi).
[2]Temperature range A: Maximum short term temperature = 130°F (55°C), Maximum long term temperature = 110°F (43°C).
Temperature range B: Maximum short term temperature = 176°F (80°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.



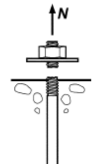
Metric Threaded Rod **Bond Strength** **Diamond Core Bit**

TABLE 21—BOND STRENGTH DESIGN INFORMATION FOR METRIC THREADED RODS IN HOLES CORE DRILLED WITH A DIAMOND CORE BIT[1]

DESIGN INFORMATION			Symbol	Units	Nominal rod diameter (mm)							
					8	10	12	16	20	24	27	30
Minimum Embedment			$h_{ef,min}$	mm (in.)	60 (2.4)	60 (2.4)	70 (2.8)	80 (3.1)	90 (3.5)	100 (3.9)	110 (4.3)	120 (4.7)
Maximum Embedment			$h_{ef,max}$	mm (in.)	160 (6.3)	200 (7.9)	240 (9.4)	320 (12.6)	400 (15.7)	480 (18.9)	540 (21.4)	600 (23.7)
Dry and Water saturated concrete	Temp. range A[2]	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa (psi)	10.7 (1,550)	10.7 (1,550)	10.7 (1,550)	10.7 (1,550)	10.7 (1,550)	10.7 (1,550)	10.7 (1,550)	10.7 (1,550)
	Temp. range B[2]	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa (psi)	7.4 (1,070)	7.4 (1,070)	7.4 (1,070)	7.4 (1,070)	7.4 (1,070)	7.4 (1,070)	7.4 (1,070)	7.4 (1,070)
	Anchor Category		-	-	2	2	2	3	3	3	3	3
	Strength Reduction factor		ϕ_d, ϕ_{ws}	-	0.55	0.55	0.55	0.45	0.45	0.45	0.45	0.45

For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi
[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2{,}500)^{0.25}$ for uncracked concrete [For SI: $(f'_c / 17.2)^{0.25}$]. See Section 4.1.4 of this report for bond strength determination.
[2]Temperature range A: Maximum short term temperature = 130°F (55°C), Maximum long term temperature = 110°F (43°C).
Temperature range B: Maximum short term temperature = 176°F (80°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.

Canadian Reinforcing Bars



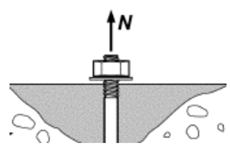
Steel Strength

TABLE 22—STEEL DESIGN INFORMATION FOR CANADIAN METRIC REINFORCING BARS[1]

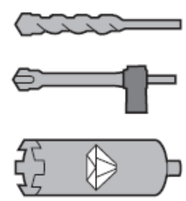
DESIGN INFORMATION		Symbol	Units	Nominal reinforcing bar size				
				10 M	15 M	20 M	25 M	30 M
Nominal bar diameter		d	mm (in.)	11.3 (0.445)	16.0 (0.630)	19.5 (0.768)	25.2 (0.992)	29.9 (1.177)
Bar effective cross-sectional area		A_{se}	mm^2 ($in.^2$)	100.3 (0.155)	201.1 (0.312)	298.6 (0.463)	498.8 (0.773)	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 for tension[2]	ϕ	-	0.65				
	Strength reduction factor for shear[2]	ϕ	-	0.60				

For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi
[1]Values provided for common rod material types based on specified strengths and calculated in accordance with ACI 318-19 Eq. (17.6.1.2) and Eq. (17.7.1.2b), ACI 318-14 Eq (17.4.1.2) or Eq (17.5.1.2b) or ACI 318-11 Eq. (D-2) and Eq. (D-29), as applicable. Other material specifications are admissible.
[2]For use with the load combinations of ACI 318 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable, as set forth in ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable.

Canadian Reinforcing Bars



Concrete Breakout Strength



Carbide Bit or
Hilti Hollow Carbide Bit
or Diamond Core Bit

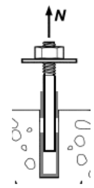
TABLE 23—CONCRETE BREAKOUT DESIGN INFORMATION FOR CANADIAN METRIC REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR HILTI HOLLOW CARBIDE DRILL BIT), OR DIAMOND CORE BIT[1]

DESIGN INFORMATION	Symbol	Units	Nonminal reinforcing 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)				
Minimum Embedment	$h_{ef,min}$	mm (in.)	60 (2.4)	80 (3.1)	90 (3.5)	101 (4.0)	120 (4.7)
Maximum Embedment	$h_{ef,max}$	mm (in.)	226 (8.9)	320 (12.6)	390 (15.4)	504 (19.8)	598 (23.5)
Min. bar spacing[3]	s_{min}	mm (in.)	57 (2.2)	80 (3.1)	98 (3.8)	126 (5.0)	150 (5.9)
Min. edge distance[3]	c_{min}	mm (in.)	5d; or see Section 4.1.9 of this report for design with reduced minimum edge distances				
Minimum concrete thickness	h_{min}	mm (in.)	h_{ef} + 30 (h_{ef} + 1$^1/_4$)	$h_{ef} + 2d_o$[(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[2]	ϕ	-	0.65				
Strength reduction factor for shear, concrete failure modes[2]	ϕ	-	0.70				

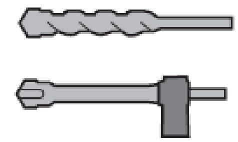
For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

[1]Additional setting information is described in Figure 8A, Manufacturers Printed Installation Instructions (MPII).
[2] The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, the appropriate strength reduction factor must be determined in accordance with ACI 318-11 D.4.4.
[3]For installations with 1$^3/_4$-inch edge distance, refer to Section 4.1.9 for spacing and maximum torque requirements.
[4] d_0 = hole diameter.

Canadian Reinforcing Bars



Bond Strength



Carbide Bit or Hilti Hollow Carbide Bit

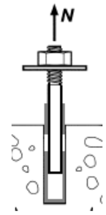
TABLE 24—BOND STRENGTH DESIGN INFORMATION FOR CANADIAN METRIC REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR HILTI HOLLOW CARBIDE DRILL BIT) [1]

DESIGN INFORMATION			Symbol	Units	Nominal reinforcing bar size				
					10M	15M	20M	25M	30M
Minimum Embedment			$h_{ef,min}$	mm	60	80	90	101	120
				(in.)	(2.4)	(3.1)	(3.5)	(4.0)	(4.7)
Maximum Embedment			$h_{ef,max}$	mm	226	320	390	504	598
				(in.)	(8.9)	(12.6)	(15.4)	(19.8)	(23.5)
Dry concrete and Water Saturated Concrete	Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	9.4	9.6	9.7	9.8	9.5
				(psi)	(1,360)	(1,390)	(1,410)	(1,420)	(1,380)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	12.1	11.8	11.7	11.3	11.1
				(psi)	(1,760)	(1,720)	(1,690)	(1,650)	(1,610)
	Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	6.5	6.6	6.7	6.8	6.5
				(psi)	(940)	(960)	(970)	(980)	(950)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	8.4	8.2	8.0	7.8	7.7
				(psi)	(1,210)	(1,190)	(1,170)	(1,140)	(1,110)
	Anchor Category		-	-	1	1	1	1	1
	Strength Reduction factor		ϕ_d, ϕ_{ws}	-	0.65	0.65	0.65	0.65	0.65
Water-filled hole	Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	6.9	7.2	7.3	7.4	7.3
				(psi)	(1,010)	(1,040)	(1,060)	(1,080)	(1,060)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	8.9	8.9	8.8	8.6	8.5
				(psi)	(1,300)	(1,280)	(1,270)	(1,250)	(1,240)
	Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	4.8	5.0	5.0	5.1	5.0
				(psi)	(700)	(720)	(730)	(740)	(730)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	6.2	6.1	6.1	6.0	5.9
				(psi)	(900)	(890)	(880)	(860)	(850)
	Anchor Category		-	-	3	3	3	3	3
	Strength Reduction factor		ϕ_{wf}	-	0.45	0.45	0.45	0.45	0.45
Submerged concrete	Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	6.1	6.3	6.5	6.8	6.6
				(psi)	(880)	(920)	(940)	(980)	(960)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	7.8	7.8	7.8	7.8	7.8
				(psi)	(1,130)	(1,140)	(1,140)	(1,140)	(1,130)
	Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	4.2	4.4	4.5	4.7	4.6
				(psi)	(610)	(630)	(650)	(680)	(660)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	5.4	5.4	5.4	5.4	5.4
				(psi)	(780)	(790)	(780)	(780)	(780)
	Anchor Category		-	-	3	3	3	3	3
	Strength Reduction factor		ϕ_{uw}	-	0.45	0.45	0.45	0.45	0.45
Reduction for seismic tension			$\alpha_{N,seis}$	-	0.9	0.9	0.9	0.9	0.9

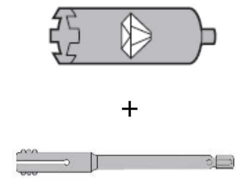
For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2{,}500)^{0.25}$ for uncracked concrete [For SI: $(f'_c / 17.2)^{0.25}$] and $(f'_c / 2{,}500)^{0.15}$ for cracked concrete [For SI: $(f'_c / 17.2)^{0.15}$]. See Section 4.1.4 of this report for bond strength determination.
[2]Temperature range A: Maximum short term temperature = 130°F (55°C), Maximum long term temperature = 110°F (43°C).
Temperature range B: Maximum short term temperature = 176°F (80°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.

Canadian Reinforcing Bars



Bond Strength



Diamond Core Bit + Roughening Tool

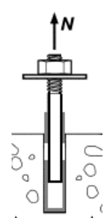
TABLE 25A—BOND STRENGTH DESIGN INFORMATION FOR CANADIAN METRIC REINFORCING BARS IN HOLES CORE DRILLED WITH A DIAMOND CORE BIT AND ROUGHENED WITH A HILTI ROUGHENING TOOL[1]

DESIGN INFORMATION			Symbol	Units	Nominal reinforcing bar size	
					15M	20M
Minimum Embedment			$h_{ef,min}$	mm (in.)	80 (3.1)	90 (3.5)
Maximum Embedment			$h_{ef,max}$	mm (in.)	320 (12.6)	390 (15.4)
Dry and Water Saturated concrete	Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa (psi)	6.7 (970)	6.8 (985)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa (psi)	11.8 (1,720)	11.7 (1,690)
	Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa (psi)	4.6 (670)	4.7 (680)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa (psi)	8.2 (1,190)	8.0 (1,170)
	Anchor Category		-		1	1
	Strength Reduction factor		ϕ_d, ϕ_{ws}		0.65	0.65
Reduction for seismic tension			$\alpha_{N,seis}$	-	0.9	0.9

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

[1]Bond strength values correspond to concrete compressive strength in the range 2,500 psi ≤ f′c ≤ 8,000 psi).
[2]Temperature range A: Maximum short term temperature = 130°F (55°C), Maximum long term temperature = 110°F (43°C).
Temperature range B: Maximum short term temperature = 176°F (80°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.

Canadian Reinforcing Bars



Bond Strength

Diamond Core Bit

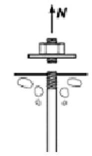
TABLE 25B—BOND STRENGTH DESIGN INFORMATION FOR CANADIAN METRIC REINFORCING BARS IN HOLES CORE DRILLED WITH A DIAMOND CORE BIT[1]

DESIGN INFORMATION			Symbol	Units	Nominal reinforcing bar size				
					10M	15M	20M	25M	30M
Minimum Embedment			$h_{ef,min}$	mm (in.)	60 (2.4)	80 (3.1)	90 (3.5)	101 (4.0)	120 (4.7)
Maximum Embedment			$h_{ef,max}$	mm (in.)	226 (8.9)	320 (12.6)	390 (15.4)	504 (19.8)	598 (23.5)
Dry and Water Saturated concrete	Temperature range A[2]	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa (psi)	8.0 (1,150)	8.0 (1,150)	8.0 (1,150)	8.0 (1,150)	8.0 (1,150)
	Temperature range B[2]	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa (psi)	5.5 (800)	5.5 (800)	5.5 (800)	5.5 (800)	5.5 (800)
	Anchor Category		-	-	2	3	3	3	3
	Strength Reduction factor		ϕ_d, ϕ_{ws}	-	0.55	0.45	0.45	0.45	0.45

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

[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2{,}500)^{0.25}$ for uncracked concrete [For SI: $(f'_c / 17.2)^{0.25}$]. See Section 4.1.4 of this report for bond strength determination.
[2]Temperature range A: Maximum short term temperature = 130°F (55°C), Maximum long term temperature = 110°F (43°C).
Temperature range B: Maximum short term temperature = 176°F (80°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.

Fractional and Metric HIS-N and HIS-RN Internal Threaded Insert



Steel Strength

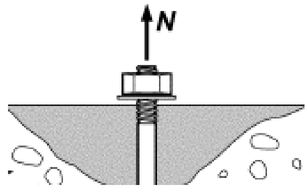
TABLE 26—STEEL DESIGN INFORMATION FOR FRACTIONAL AND METRIC HIS-N AND HIS-RN THREADED INSERTS[1]

DESIGN INFORMATION		Symbol	Units	Nominal Bolt/Cap Screw Diameter (in.) Fractional				Units	Nominal Bolt/Cap Screw Diameter (mm) Metric				
				$^3/_8$	$^1/_2$	$^5/_8$	$^3/_4$		8	10	12	16	20
HIS Insert O.D.		D	in. (mm)	0.65 (16.5)	0.81 (20.5)	1.00 (25.4)	1.09 (27.6)	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	in. (mm)	4.33 (110)	4.92 (125)	6.69 (170)	8.07 (205)	mm (in.)	90 (3.54)	110 (4.33)	125 (4.92)	170 (6.69)	205 (8.07)
Bolt effective cross-sectional area		A_{se}	in.^{2} (mm^2)	0.0775 (50)	0.1419 (92)	0.2260 (146)	0.3345 (216)	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}	in.^{2} (mm^2)	0.178 (115)	0.243 (157)	0.404 (260)	0.410 (265)	mm^2 (in.^{2})	51.5 (0.080)	108 (0.167)	169.1 (0.262)	256.1 (0.397)	237.6 (0.368)
ASTM A193 B7	Nominal steel strength – ASTM A193 B7[3] bolt/cap screw	N_{sa}	lb (kN)	9,690 (43.1)	17,740 (78.9)	28,250 (125.7)	41,815 (186.0)	kN (lb)	- -	- -	- -	- -	- -
		V_{sa}	lb (kN)	5,815 (25.9)	10,645 (47.3)	16,950 (75.4)	25,090 (111.6)	kN (lb)	- -	- -	- -	- -	- -
	Nominal steel strength – HIS-N insert	N_{sa}	lb (kN)	12,645 (56.3)	17,250 (76.7)	28,680 (127.6)	29,145 (129.7)	kN (lb)	- -	- -	- -	- -	- -
ASTM A193 Grade B8M SS	Nominal steel strength – ASTM A193 Grade B8M SS bolt/cap screw	N_{sa}	lb (kN)	8,525 (37.9)	15,610 (69.4)	24,860 (110.6)	36,795 (163.7)	kN (lb)	- -	- -	- -	- -	- -
		V_{sa}	lb (kN)	5,115 (22.8)	9,365 (41.7)	14,915 (66.3)	22,075 (98.2)	kN (lb)	- -	- -	- -	- -	- -
	Nominal steel strength – HIS-RN insert	N_{sa}	lb (kN)	18,065 (80.4)	24,645 (109.6)	40,970 (182.2)	41,635 (185.2)	kN (lb)	- -	- -	- -	- -	- -
ISO 898-1 Class 8.8	Nominal steel strength – ISO 898-1 Class 8.8 bolt/cap screw	N_{sa}	lb (kN)	- -	- -	- -	- -	kN (lb)	29.5 (6,582)	46.5 (10,431)	67.5 (15,161)	125.5 (28,236)	196.0 (44,063)
		V_{sa}	lb (kN)	- -	- -	- -	- -	kN (lb)	17.5 (3,949)	28.0 (6,259)	40.5 (9,097)	75.5 (16,942)	117.5 (26,438)
	Nominal steel strength – HIS-N insert	N_{sa}	lb (kN)	- -	- -	- -	- -	kN (lb)	25.0 (5,669)	53.0 (11,894)	83.0 (18,628)	125.5 (28,210)	116.5 (26,176)
ISO 3506-1 Class A4-70 Stainless	Nominal steel strength – ISO 3506-1 Class A4-70 Stainless bolt/cap screw	N_{sa}	lb (kN)	- -	- -	- -	- -	kN (lb)	25.5 (5,760)	40.5 (9,127)	59.0 (13,266)	110.0 (24,706)	171.5 (38,555)
		V_{sa}	lb (kN)	- -	- -	- -	- -	kN (lb)	15.5 (3,456)	24.5 (5,476)	35.5 (7,960)	66.0 (14,824)	103.0 (23,133)
	Nominal steel strength – HIS-RN insert	N_{sa}	lb (kN)	- -	- -	- -	- -	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		$\alpha_{V,seis}$	-	0.94				-	0.94				
Strength reduction factor for tension[2]		ϕ	-	0.65				-	0.65				
Strength reduction factor for shear[2]		ϕ	-	0.60				-	0.60				

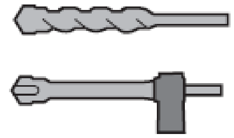
For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

[1]Values provided for common rod material types based on specified strengths and calculated in accordance with ACI 318-19 Eq. (17.6.1.2) and Eq. (17.7.1.2b), ACI 318-14 Eq (17.4.1.2) or Eq (17.5.1.2b) or ACI 318-11 Eq. (D-2) and Eq. (D-29), as applicable. Nuts and washers must be appropriate for the rod.
[2]For use with the load combinations of ACI 318 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable, as set forth in ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. Values correspond to a brittle steel element for the HIS insert.
[3]For the calculation of the design steel strength in tension and shear for the bolt or screw, the ϕ factor for ductile steel failure according to ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, can be used

Fractional and Metric HIS-N and HIS-RN Internal Threaded Insert



Concrete Breakout Strength



Carbide Bit or Hilti Hollow Carbide Bit

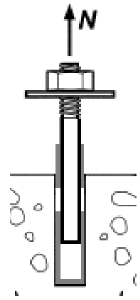
TABLE 27—CONCRETE BREAKOUT DESIGN INFORMATION FOR FRACTIONAL AND METRIC HILTI HIS-N AND HIS-RN INSERTS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR HILTI HOLLOW CARBIDE DRILL BIT)[1]

DESIGN INFORMATION	Symbol	Units	Nominal Bolt/Cap Screw Diameter (in.) Fractional				Units	Nominal Bolt/Cap Screw Diameter (mm) Metric				
			$^3/_8$	$^1/_2$	$^5/_8$	$^3/_4$		8	10	12	16	20
Effectiveness factor for cracked concrete	$k_{c,cr}$	in-lb	17				SI	7.1				
		(SI)	(7.1)				(in-lb)	(17)				
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	in-lb	24				SI	10				
		(SI)	(10)				(in-lb)	(24)				
Effective embedment depth	h_{ef}	in.	$4^3/_8$	5	$6^3/_4$	$8^1/_8$	mm	90	110	125	170	205
		(mm)	(110)	(125)	(170)	(205)	(in.)	(3.5)	(4.3)	(4.9)	(6.7)	(8.1)
Min. anchor spacing[3]	s_{min}	in.	$3^1/_4$	4	5	$5^1/_2$	mm	63	83	102	127	140
		(mm)	(83)	(102)	(127)	(140)	(in.)	(2.5)	(3.25)	(4.0)	(5.0)	(5.5)
Min. edge distance[3]	c_{min}	in.	$3^1/_4$	4	5	$5^1/_2$	mm	63	83	102	127	140
		(mm)	(83)	(102)	(127)	(140)	(in.)	(2.5)	(3.25)	(4.0)	(5.0)	(5.5)
Minimum concrete thickness	h_{min}	in.	5.9	6.7	9.1	10.6	mm	120	150	170	230	270
		(mm)	(150)	(170)	(230)	(270)	(in.)	(4.7)	(5.9)	(6.7)	(9.1)	(10.6)
Critical edge distance – splitting (for uncracked concrete)	c_{ac}	-	See Section 4.1.10 of this report				-	See Section 4.1.10 of this report				
Strength reduction factor for tension, concrete failure modes[2]	ϕ	-	0.65				-	0.65				
Strength reduction factor for shear, concrete failure modes[2]	ϕ	-	0.70				-	0.70				

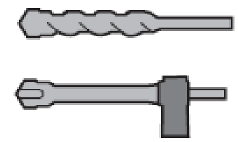
For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

[1]Additional setting information is described in Figure 8A, Manufacturers Printed Installation Instructions (MPII).
[2]The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, the appropriate strength reduction factor must be determined in accordance with ACI 318-11 D.4.4.
[3]For installations with $1^3/_4$-inch edge distance, refer to Section 4.1.9 for spacing and maximum torque requirements.

Fractional and Metric HIS-N and HIS-RN Internal Threaded Insert



Bond Strength



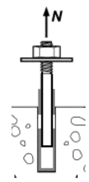
Carbide Bit or Hilti Hollow Carbide Bit

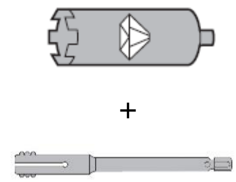
TABLE 28—BOND STRENGTH DESIGN INFORMATION FOR FRACTIONAL AND METRIC HILTI HIS-N AND HIS-RN INSERTS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR HILTI HOLLOW CARBIDE DRILL BIT)[1]

DESIGN INFORMATION			Symbol	Units	Nominal bolt/cap screw diameter (in.)				Units	Nominal bolt/cap screw diameter (mm)				
					$^3/_8$	$^1/_2$	$^5/_8$	$^3/_4$		8	10	12	16	20
Embedment			h_{ef}	in. (mm)	$4^3/_8$ (110)	5 (125)	$6^3/_4$ (170)	$8^1/_8$ (205)	mm (in.)	90 (3.5)	110 (4.3)	125 (4.9)	170 (6.7)	205 (8.1)
Dry concrete and Water saturated concrete	Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (MPa)	1,070 (7.4)	1,070 (7.4)	1,070 (7.4)	1,070 (7.4)	MPa (psi)	7.4 (1,070)	7.4 (1,070)	7.4 (1,070)	7.4 (1,070)	7.4 (1,070)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	1,790 (12.3)	1,790 (12.3)	1,790 (12.3)	1,790 (12.3)	MPa (psi)	12.3 (1,790)	12.3 (1,790)	12.3 (1,790)	12.3 (1,790)	12.3 (1,790)
	Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (MPa)	740 (5.1)	740 (5.1)	740 (5.1)	740 (5.1)	MPa (psi)	5.1 (740)	5.1 (740)	5.1 (740)	5.1 (740)	5.1 (740)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	1,240 (8.5)	1,240 (8.5)	1,240 (8.5)	1,240 (8.5)	MPa (psi)	8.5 (1,240)	8.5 (1,240)	8.5 (1,240)	8.5 (1,240)	8.5 (1,240)
	Anchor Category		-	-	1	1	1	1	-	1	1	1	1	1
	Strength Reduction factor		ϕ_d, ϕ_{ws}	-	0.65	0.65	0.65	0.65	-	0.65	0.65	0.65	0.65	0.65
Water-filled hole	Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (MPa)	800 (5.5)	810 (5.6)	820 (5.7)	820 (5.7)	MPa (psi)	5.5 (790)	5.5 (800)	5.6 (810)	5.7 (820)	5.7 (820)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	1,340 (9.2)	1,350 (9.3)	1,370 (9.5)	1,380 (9.5)	MPa (psi)	9.1 (1,330)	9.2 (1,340)	9.3 (1,350)	9.5 (1,370)	9.5 (1,380)
	Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (MPa)	550 (3.8)	560 (3.8)	570 (3.9)	570 (3.9)	MPa (psi)	3.8 (550)	3.8 (550)	3.8 (560)	3.9 (570)	3.9 (570)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	920 (6.4)	930 (6.4)	950 (6.5)	950 (6.6)	MPa (psi)	6.3 (920)	6.4 (920)	6.4 (930)	6.5 (950)	6.6 (950)
	Anchor Category		-	-	3	3	3	3	-	3	3	3	3	3
	Strength Reduction factor		ϕ_{wf}	-	0.45	0.45	0.45	0.45	-	0.45	0.45	0.45	0.45	0.45
Submerged concrete	Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (MPa)	710 (4.9)	720 (5.0)	750 (5.1)	750 (5.2)	MPa (psi)	4.8 (700)	4.9 (710)	5.0 (720)	5.1 (750)	5.2 (750)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	1,190 (8.2)	1,210 (8.4)	1,250 (8.6)	1,260 (8.7)	MPa (psi)	8.0 (1,160)	8.2 (1,190)	8.4 (1,210)	8.6 (1,250)	8.7 (1,260)
	Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (MPa)	490 (3.4)	500 (3.4)	510 (3.5)	520 (3.6)	MPa (psi)	3.3 (480)	3.4 (490)	3.4 (500)	3.5 (510)	3.6 (520)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	820 (5.6)	840 (5.8)	860 (5.9)	870 (6.0)	MPa (psi)	5.5 (800)	5.6 (820)	5.8 (840)	5.9 (860)	6.0 (870)
	Anchor Category		-	-	3	3	3	3	-	3	3	3	3	3
	Strength Reduction factor		ϕ_{uw}	-	0.45	0.45	0.45	0.45	-	0.45	0.45	0.45	0.45	0.45
Reduction for seismic tension			$\alpha_{N,seis}$	-	1	1	1	1	-	1	1	1	1	1

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

[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2{,}500)^{0.25}$ for uncracked concrete [For SI: $(f'_c / 17.2)^{0.25}$] and $(f'_c / 2{,}500)^{0.15}$ for cracked concrete [For SI: $(f'_c / 17.2)^{0.15}$]. See Section 4.1.4 of this report for bond strength determination.
[2]Temperature range A: Maximum short term temperature = 130°F (55°C), Maximum long term temperature = 110°F (43°C).
Temperature range B: Maximum short term temperature = 176°F (80°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.





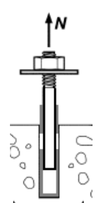
Fractional and Metric HIS-N and HIS-RN Internal Threaded Insert **Bond Strength** **Diamond Core Bit + Roughening Tool**

TABLE 29—BOND STRENGTH DESIGN INFORMATION FOR FRACTIONAL AND METRIC HILTI HIS-N AND HIS-RN INSERTS IN HOLES CORE DRILLED WITH A DIAMOND CORE BIT AND ROUGHENED WITH A HILTI ROUGHENING TOOL[1]

DESIGN INFORMATION			Symbol	Units	Nominal bolt/cap screw diameter (in.)			Units	Nominal bolt/cap screw diameter (mm)		
					$^1/_2$	$^5/_8$	$^3/_4$		12	16	20
Embedment			h_{ef}	in. (mm)	5 (125)	6¾ (170)	$8^1/_8$ (205)	mm (in.)	125 (4.9)	170 (6.7)	205 (8.1)
Dry concrete and Water Saturated Concrete	Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (MPa)	750 (5.2)	750 (5.2)	750 (5.2)	MPa (psi)	5.2 (750)	5.2 (750)	5.2 (750)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	1,790 (12.3)	1,790 (12.3)	1,790 (12.3)	MPa (psi)	12.3 (1,790)	12.3 (1,790)	12.3 (1,790)
	Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (MPa)	515 (3.6)	515 (3.6)	515 (3.6)	MPa (psi)	3.6 (515)	3.6 (515)	3.6 (515)
		Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	1,240 (8.5)	1,240 (8.5)	1,240 (8.5)	MPa (psi)	8.5 (1,240)	8.5 (1,240)	8.5 (1,240)
	Anchor Category		-	-	1	1	1	-	1	1	1
	Strength Reduction factor		ϕ_d, ϕ_{ws}	-	0.65	0.65	0.65	-	0.65	0.65	0.65
Reduction for seismic tension			$\alpha_{N,seis}$	-	1	1	1	-	1	1	1

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

[1]Bond strength values correspond to concrete compressive strength in the range 2,500 psi ≤ f′c ≤ 8,000 psi.
[2]Temperature range A: Maximum short term temperature = 130°F (55°C), Maximum long term temperature = 110°F (43°C).
Temperature range B: Maximum short term temperature = 176°F (80°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.



Fractional and Metric HIS-N and HIS-RN Internal Threaded Insert **Bond Strength** **Diamond Core Bit**

TABLE 30—BOND STRENGTH DESIGN INFORMATION FOR FRACTIONAL AND METRIC HILTI HIS-N AND HIS-RN INSERTS IN HOLES CORE DRILLED WITH A DIAMOND CORE BIT[1]

DESIGN INFORMATION			Symbol	Units	Nominal bolt/cap screw diameter (in.)				Units	Nominal bolt/cap screw diameter (mm)				
					$^3/_8$	$^1/_2$	$^5/_8$	$^3/_4$		8	10	12	16	20
Embedment			h_{ef}	in. (mm)	$4^3/_8$ (110)	5 (125)	$6^3/_4$ (170)	$8^1/_8$ (205)	mm (in.)	90 (3.5)	110 (4.3)	125 (4.9)	170 (6.7)	205 (8.1)
Dry concrete and Water Saturated Concrete	Temperature range A[2]	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	1,200 (8.3)	1,200 (8.3)	1,200 (8.3)	1,200 (8.3)	MPa (psi)	8.3 (1,200)	8.3 (1,200)	8.3 (1,200)	8.3 (1,200)	8.3 (1,200)
	Temperature range B[2]	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	830 (5.7)	830 (5.7)	830 (5.7)	830 (5.7)	MPa (psi)	5.7 (830)	5.7 (830)	5.7 (830)	5.7 (830)	5.7 (830)
	Anchor Category		-	-	3	3	3	3	-	2	3	3	3	3
	Strength Reduction factor		ϕ_d, ϕ_{ws}	-	0.45	0.45	0.45	0.45	-	0.55	0.45	0.45	0.45	0.45

For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi
[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2{,}500)^{0.25}$ for uncracked concrete [For SI: $(f'_c / 17.2)^{0.25}$]. See Section 4.1.4 of this report for bond strength determination.
[2]Temperature range A: Maximum short term temperature = 130°F (55°C), Maximum long term temperature = 110°F (43°C).
Temperature range B: Maximum short term temperature = 176°F (80°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.

TABLE 31—DEVELOPMENT LENGTH FOR U.S. CUSTOMARY UNIT REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT OR HILTI HOLLOW CARBIDE BIT OR CORE DRILLED WITH A DIAMOND CORE BIT OR A DIAMOND CORE BIT AND ROUGHENED WITH A HILTI ROUGHENING TOOL [1,2,5,6]

DESIGN INFORMATION	Symbol	Criteria Section of Reference Standard	Units	Bar Size							
				#3	#4	#5	#6	#7	#8	#9	#10
Nominal reinforcing bar diameter	d_b	ASTM A615/A706	in.	0.375	0.500	0.625	0.750	0.875	1.000	1.128	1.270
			(mm)	(9.5)	(12.7)	(15.9)	(19.1)	(22.2)	(25.4)	(28.7)	(32.3)
Nominal bar area	A_b	ASTM A615/A706	in^2	0.11	0.20	0.31	0.44	0.60	0.79	1.00	1.27
			(mm^2)	(71)	(129)	(199)	(284)	(387)	(510)	(645)	(819)
Development length for f_y = 60 ksi and f'_c = 2,500 psi (normal weight concrete)[3,4]	l_d	ACI 318-19 25.4.2.4 ACI 318-14 25.4.2.3 ACI 318-11 12.2.3	in.	12.0	14.4	18.0	21.6	31.5	36.0	40.6	45.7
			(mm)	(304.8)	(365.8)	(457.2)	(548.6)	(800.1)	(914.4)	(1031.4)	(1161.3)
Development length for f_y = 60 ksi and f'_c = 4,000 psi (normal weight concrete)[3,4]	l_d	ACI 318-19 25.4.2.4 ACI 318-14 25.4.2.3 ACI 318-11 12.2.3	in.	12.0	12.0	14.2	17.1	24.9	28.5	32.1	36.1
			(mm)	(304.8)	(304.8)	(361.4)	(433.7)	(632.5)	(722.9)	(815.4)	(918.1)

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

[1]Development lengths valid for static, wind, and earthquake loads (SDC A and B).
[2]Development lengths in SDC C through F must comply with ACI 318 (-19 or -14) Chapter 18 or ACI 318-11 Chapter 21, as applicable, and section 4.2.4 of this report.
[3] For all-lightweight concrete, increase development length by 33% unless the provisions of ACI 318-19 25.4.2.5 or ACI 318-14 25.4.2.4 are met to permit λ > 0.75. For sand-lightweight concrete, increase development length by 18% unless the provisions of ACI 318-19 25.4.2.5 or ACI 318-14 25.4.2.4 are met to permit λ > 0.85.
[4] $\left(\frac{c_b+K_{tr}}{d_b}\right)$ = 2.5, ψ_t=1.0, ψ_e=1.0, ψ_s=0.8 for $d_b \leq$ #6,1.0 for $d_b >$ #6
[5]Calculations may be performed for other steel grades per ACI 318 (-19 or -14) Chapter 25 or ACI 318-11 Chapter 12.
[6]Minimum development length shall not be less than 12 in (305 mm) per ACI 318 (-19 or -14) Section 25.4.2.1.

TABLE 32—DEVELOPMENT LENGTH FOR EU METRIC REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT OR HILTI HOLLOW CARBIDE BIT OR CORE DRILLED WITH A DIAMOND CORE BIT OR A DIAMOND CORE BIT AND ROUGHENED WITH A HILTI ROUGHENING TOOL[1,2,5,6]

DESIGN INFORMATION	Symbol	Criteria Section of Reference Standard	Units	Bar Size					
				10	12	16	20	25	32
Nominal reinforcing bar diameter	d_b	BS4449: 2005	mm	10	12	16	20	25	32
			(in.)	(0.394)	(0.472)	(0.630)	(0.787)	(0.984)	(1.260)
Nominal bar area	A_b	BS 4449: 2005	mm^2	78.5	113.1	201.1	314.2	490.9	804.2
			(in^2)	(0.12)	(0.18)	(0.31)	(0.49)	(0.76)	(1.25)
Development length for f_y = 72.5 ksi and f'_c = 2,500 psi (normal weight concrete)[3,4]	l_d	ACI 318-19 25.4.2.4[7] ACI 318-14 25.4.2.3 ACI 318-11 12.2.3	mm	348	417	556	871	1087	1392
			(in.)	(13.7)	(16.4)	(21.9)	(34.3)	(42.8)	(54.8)
Development length for f_y = 72.5 ksi and f'_c = 4,000 psi (normal weight concrete)[3,4]	l_d	ACI 318-19 25.4.2.4[7] ACI 318-14 25.4.2.3 ACI 318-11 12.2.3	mm	305	330	439	688	859	1100
			(in.)	(12.0)	(13.0)	(17.3)	(27.1)	(33.8)	(43.3)

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

[1]Development lengths valid for static, wind, and earthquake loads (SDC A and B).
[2]Development lengths in SDC C through F must comply with ACI 318 (-19 or -14) Chapter 18 or ACI 318-11 Chapter 21 and section 4.2.4 of this report.
[3] For all-lightweight concrete, increase development length by 33% unless the provisions of ACI 318-19 25.4.2.5 or ACI 318-14 25.4.2.4 are met to permit λ > 0.75. For sand-lightweight concrete, increase development length by 18% unless the provisions of ACI 318-19 25.4.2.5 or ACI 318-14 25.4.2.4 are met to permit λ > 0.85.
[4] $\left(\frac{c_b+K_{tr}}{d_b}\right)$ = 2.5, ψ_t=1.0, ψ_e=1.0, ψ_s=0.8 for d_b < 20 mm,1.0 for $d_b \geq$ 20 mm
[5]Calculations may be performed for other steel grades per ACI 318 (-19 or -14) Chapter 25 or ACI 318-11 Chapter 12.
[6]Minimum development length shall not be less than 12 in (305 mm) per ACI 318 (-19 or -14) Section 25.4.2.1.
[7] l_d must be increased by 9.5% to account for ψ_g in ACI 318-19 25.4.2.4. ψ_g has been interpolated from Table 25.4.2.5 of ACI 318-19 for f_y = 72.5 ksi.

TABLE 33—DEVELOPMENT LENGTH FOR CANADIAN REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT OR HILTI HOLLOW CARBIDE BIT OR CORE DRILLED WITH A DIAMOND CORE BIT OR A DIAMOND CORE BIT AND ROUGHENED WITH A HILTI ROUGHENING TOOL [1,2,5,6]

DESIGN INFORMATION	Symbol	Criteria Section of Reference Standard	Units	Bar Size				
				10M	15M	20M	25M	30M
Nominal reinforcing bar diameter	d_b	CAN/CSA-G30.18 Gr.400	mm	11.3	16.0	19.5	25.2	29.9
			(in.)	(0.445)	(0.630)	(0.768)	(0.992)	(1.177)
Nominal bar area	A_b	CAN/CSA-G30.18 Gr.400	mm^2	100.3	201.1	298.6	498.8	702.2
			(in^2)	(0.16)	(0.31)	(0.46)	(0.77)	(1.09)
Development length for f_y = 58 ksi and f'_c = 2,500 psi (normal weight concrete)[3,4]	l_d	ACI 318-19 25.4.2.4 ACI 318-14 25.4.2.3 ACI 318-11 12.2.3	mm	315	445	678	876	1,041
			(in.)	(12.4)	(17.5)	(26.7)	(34.5)	(41.0)
Development length for f_y = 58 ksi and f'_c = 4,000 psi (normal weight concrete)[3,4]	l_d	ACI 318-19 25.4.2.4 ACI 318-14 25.4.2.3 ACI 318-11 12.2.3	mm	305	353	536	693	823
			(in.)	(12.0)	(13.9)	(21.1)	(27.3)	(32.4)

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

[1]Development lengths valid for static, wind, and earthquake loads (SDC A and B).
[2]Development lengths in SDC C through F must comply with ACI 318 (-19 or -14) Chapter 18 or ACI 318-11 Chapter 21 and section 4.2.4 of this report.
[3] For all-lightweight concrete, increase development length by 33% unless the provisions of ACI 318-19 25.4.2.5 or ACI 318-14 25.4.2.4 are met to permit λ > 0.75. For sand-lightweight concrete, increase development length by 18% unless the provisions of ACI 318-19 25.4.2.5 or ACI 318-14 25.4.2.4 are met to permit λ > 0.85.
[4] $\left(\frac{c_b+K_{tr}}{d_b}\right)$ = 2.5, ψ_t=1.0, ψ_e=1.0, ψ_s=0.8 for d_b < 20M,1.0 for d_b ≥ 20M
[5]Calculations may be performed for other steel grades per ACI 318 (-19 or -14) Chapter 25 or ACI 318-11 Chapter 12.
[6]Minimum development length shall not be less than 12 in (305 mm) per ACI 318 (-19 or -14) Section 25.4.2.1.

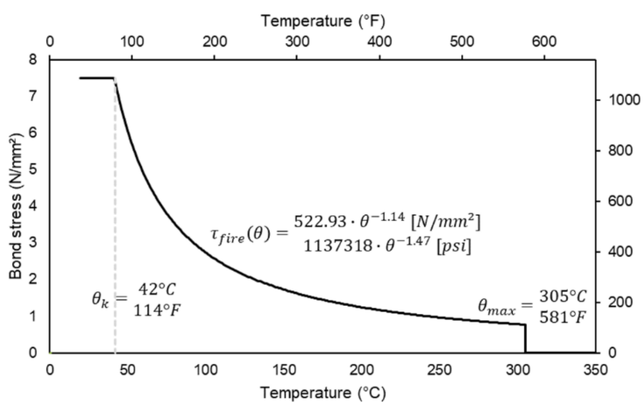


FIGURE 6A

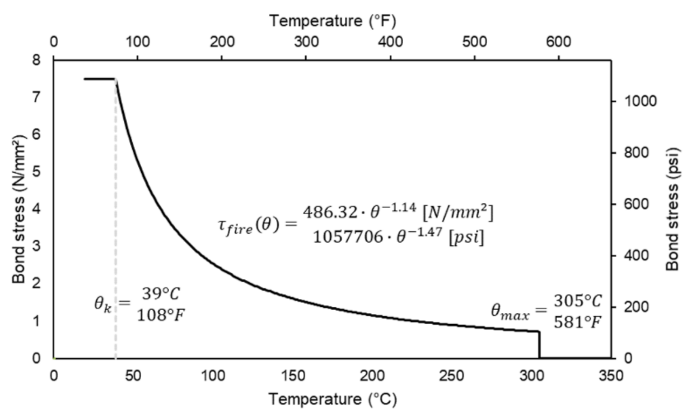


FIGURE 6B

FIGURE 6 – BOND STRESS VS TEMPERATURE OF POST INSTALLED REINFORCING BAR APPLICATIONS SUBJECT TO ELEVATED TEMPERATURE / FIRE.
FIGURE 6A FOR SHORT TERM LOADS INCLUDING SEISMIC; FIGURE 6B FOR SUSTAINED LOADS INCLUDING SEISMIC

HILTI HIT-RE 500 V3 FOIL PACK AND MIXING NOZZLE

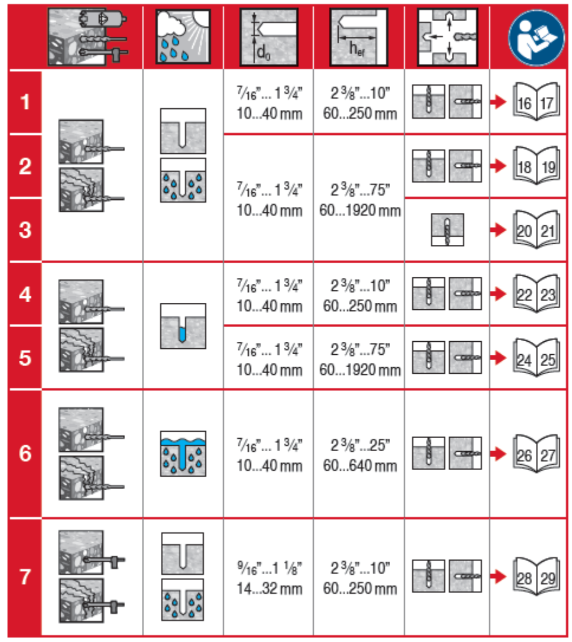
HILTI DISPENSER

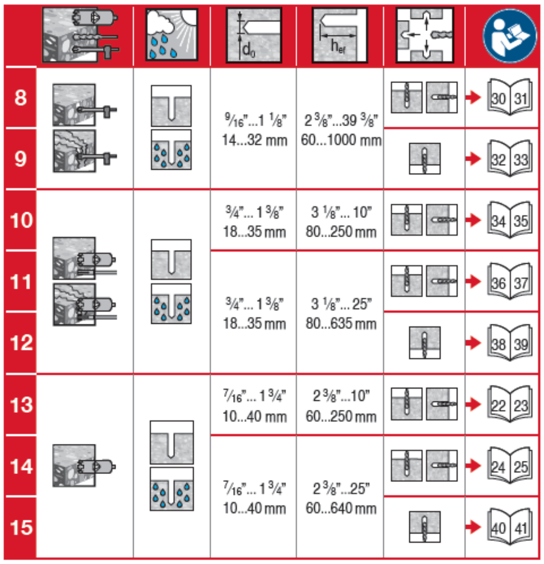
ANCHORING ELEMENTS

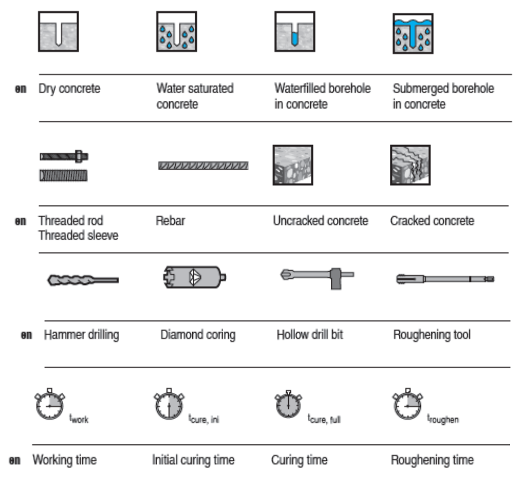
HILTI TE-CD OR TE-YD HOLLOW CARBIDE DRILL BIT

HILTI TE-YRT ROUGHENING TOOL

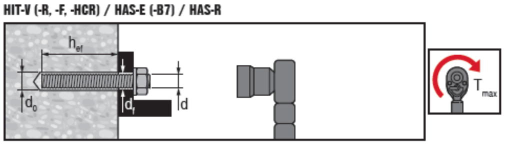
FIGURE 7—HILTI HIT-RE 500 V3 ANCHORING SYSTEM







HIT-V (-R, -F, -HCR) / HAS-E (-B7) / HAS-R



HAS / HIT-V

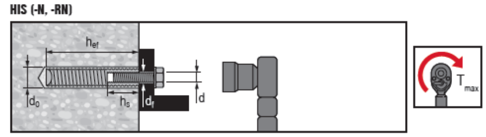
Ø d [inch]	Ø d_0 [inch]	h_{ef} [inch]	Ø d_f [inch]	T_{max} [ft-lb]	T_{max} [Nm]
3/8	7/16	2 3/8 ... 7 1/2	7/16	15	20
1/2	9/16	2 3/4 ... 10	9/16	30	41
5/8	3/4	3 1/8 ... 12 1/2	11/16	60	81
3/4	7/8	3 1/2 ... 15	13/16	100	136
7/8	1	3 1/2 ... 17 1/2	15/16	125	169
1	1 1/8	4 ... 20	1 1/8	150	203
1 1/4	1 3/8	5 ... 25	1 3/8	200	271

HIT-V

Ø d [mm]	Ø d_0 [mm]	h_{ef} [mm]	Ø d_f [mm]	T_{max} [Nm]
M8	10	60...160	9	10
M10	12	60...200	12	20
M12	14	70...240	14	40
M16	18	80...320	18	80
M20	22	90...400	22	150
M24	28	100...480	26	200
M27	30	110...540	30	270
M30	35	120...600	33	300

1 inch = 25,4 mm

HIS (-N, -RN)

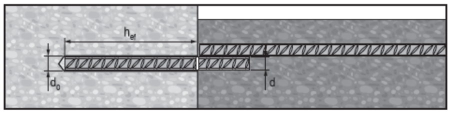


Ø d [inch]	Ø d_0 [inch]	h_{ef} [inch]	Ø d_f [inch]	h_s [inch]	T_{max} [ft-lb]	T_{max} [Nm]
3/8	11/16	4 3/8	7/16	3/8...15/16	15	20
1/2	7/8	5	9/16	1/2...1 3/16	30	41
5/8	1 1/8	6 3/4	11/16	5/8...1 1/2	60	81
3/4	1 1/4	8 1/8	13/16	3/4...1 7/8	100	136

Ø d [mm]	Ø d_0 [mm]	h_{ef} [mm]	Ø d_f [mm]	h_s [mm]	T_{max} [Nm]
M8	14	90	9	8...20	10
M10	18	110	12	10...25	20
M12	22	125	14	12...30	40
M16	28	170	18	16...40	80
M20	32	205	22	20...50	150

FIGURE 8A—MANUFACTURER'S PRINTED INSTALLATION INSTRUCTIONS (MPII)

Rebar



US Rebar

d	Ø d_0 [inch]	h_{ef} [inch]
#3	½	2⅜...22½
#4	⅝	2¾...30
#5	¾	3⅛...37½
#6	⅞	3½...15
	1	15...45
#7	1	3½...17½
	1⅛	17½...52½
#8	1⅛	4...20
	1¼	20...60
#9	1⅜	4½...67½
#10	1½	5...75
#11	1¾	5½...82½

CA Rebar

d	Ø d_0 [inch]	h_{ef} [mm]
10 M	9/16	70...678
15 M	¾	80...960
20 M	1	90...1170
25 M	1¼ (32 mm)	101...1512
30 M	1½	120...1794

1 inch = 25,4 mm

Ø d_0 [inch]	HAS d [inch]	HIS-N d [inch]	Rebar d [inch]	HIT-RB [inch]	HIT-SZ [inch]	HIT-DL [inch]	TE-YRT [inch]
7/16	⅜	–	–	7/16	–	–	
½	–	–	#3	½	½	½	
9/16	½	–	10M	9/16	9/16	9/16	
⅝	–	–	#4	⅝	⅝	9/16	
11/16	–	⅜	–	11/16	11/16	11/16	
¾	⅝	–	15M #5	¾	¾	¾	¾
⅞	¾	½	#6	⅞	⅞	⅞	⅞
1	⅞	–	20M #6 #7	1	1	1	1
1⅛	1	⅝	#7 #8	1⅛	1⅛	1	1⅛
1¼	–	¾	25M #8	1¼	1¼	1	
1⅜	1¼	–	#9	1⅜	1⅜	1⅜	1⅜
1½	–	–	30M #10	1½	1½	1⅜	
1¾	–	–	#11	1¾	1¾	1⅜	

HIT-DL: h_{ef} > 10"   HIT-RB: h_{ef} > 20 x d

	HIT-RE-M Art. No.		HIT-OHW Art. No.
Hilti VC	337111	HDM 330 HDM 500 HDE 500-A18	387550

Ø d_0 [inch]	h_{ef} [inch]	Art. No. 381215	
7/16"...1⅛"	2⅜"... 52½"	✔	≥ 6 bar/90 psi @ 6 m³/h
1¼"...1½"	4"... 75"	–	≥ 140 m³/h / ≥ 82 CFM

[°F]	[°C]	t_{work}	$t_{cure, ini}$	$t_{cure, full}$
23	-5	2 h	48 h	168 h
32	0	2 h	24 h	36 h
40	4	2 h	16 h	24 h
50	10	1.5 h	12 h	16 h
60	16	1 h	8 h	16 h
72	22	25 min	4 h	6.5 h
85	29	15 min	2.5 h	5 h
95	35	12 min	2 h	4.5 h
105	41	10 min	2 h	4 h

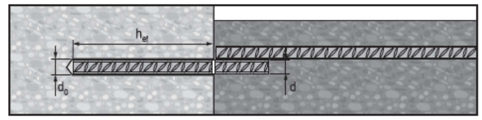
≥ +5 °C / 41 °F

= 2x t_{cure}

h_{ef} [inch]	h_{ef} [mm]	$t_{roughen}$
0 ... 4	0 ... 100	10 sec
4.01 ...8	101 ... 200	20 sec
8.01 ...12	201 ... 300	30 sec
12.01 ... 16	301 ... 400	40 sec
16.01 ... 20	401 ... 500	50 sec

$t_{roughen} = h_{ef}$ [inch] * 2.5 $t_{roughen} = h_{ef}$ [mm] / 10

Rebar



EU Rebar

Ø d [mm]	Ø d_0 [mm]	h_{ef} [mm]
8	12	60...480
10	14	60...600
12	16	70...720
14	18	75...840
16	20	80...960
18	22	85...1080
20	25	90...1200
22	28	95...1320
24	32	96...1440
25	32	100...1500
26	35	104...1560
28	35	112...1680
30	37	120...1800
32	40	128...1920

Ø d_0 [mm]	HIT-V d [mm]	HIS-N d [mm]	Rebar d [mm]	HIT-RB [mm]	HIT-SZ [mm]	HIT-DL	TE-YRT [mm]
10	8	–	–	10	–	–	
12	10	–	8	12	12	12	
14	12	8	10	14	14	14	
16	–	–	12	16	16	16	
18	16	10	14	18	18	18	18
20	–	–	16	20	20	20	20
22	20	12	18	22	22	20	22
25	–	–	20	25	25	25	25
28	24	16	22	28	28	25	28
30	27	–	–	30	30	25	30
32	–	20	24/25	32	32	32	32
35	30	–	26/28	35	35	32	35
37	–	–	30	37	37	32	
40	–	–	32	40	40	32	

HIT-DL: h_{ef} > 250 mm   HIT-RB: h_{ef} > 20 x d

	HIT-RE-M Art. No.		HIT-OHW Art. No.
Hilti VC	337111	HDM 330 / 500 HDE 500-A18	387550

Ø d_0 [mm]	h_{ef} [mm]	Art. No. 381215	
10...32	60...1500	✔	≥ 6 bar/90 psi
35...40	100...1920	–	≥ 140 m³/h

Rebar - h_{ef} ≥ 20d

		h_{ef}		
HDM, HDE, HIT-P 8000D	≤ US #5	12 ½ ... 37 ½ [inch]	23 °F ... 104 °F -5 °C ... 40 °C	41 °F ... 104 °F 5 °C ... 40 °C
	≤ EU 16mm	320 ... 960 [mm]		
	≤ CAN 15M	320 ... 960 [mm]		
HDE, HIT-P 8000D	≤ US #7	17 ½ ...52 ½ [inch]	23 °F ... 104 °F -5 °C ... 40 °C	41 °F ... 104 °F 5 °C ... 40 °C
	≤ EU 20mm	400 ... 1200 [mm]		
	≤ CAN 20M	390 ... 1170 [mm]		
HIT-P 8000D	≤ US #10	25 ... 75 [inch]	23 °F ... 104 °F -5 °C ... 40 °C	41 °F ... 104 °F 5 °C ... 40 °C
	≤ EU 32mm	640 ... 1920 [mm]		
	≤ CAN 30M	598 ... 1794 [mm]		

		h_{ef}		
HDM, HDE, HIT-P 8000D	≤ US #5	12 ½ ... 37 ½ [inch]	23 °F ... 104 °F -5 °C ... 40 °C	41 °F ... 104 °F 5 °C ... 40 °C
	≤ EU 16mm	320 ... 960 [mm]		
	≤ CAN 15M	320 ... 960 [mm]		
HDE, HIT-P 8000D	≤ US #7	17 ½ ... 39 ⅜ [inch]	23 °F ... 104 °F -5 °C ... 40 °C	41 °F ... 104 °F 5 °C ... 40 °C
	≤ EU 20mm	400 ... 1000 [mm]		
	≤ CAN 20M	390 ... 1000 [mm]		

FIGURE 8A—MANUFACTURER'S PRINTED INSTALLATION INSTRUCTIONS (MPII) (Continued)

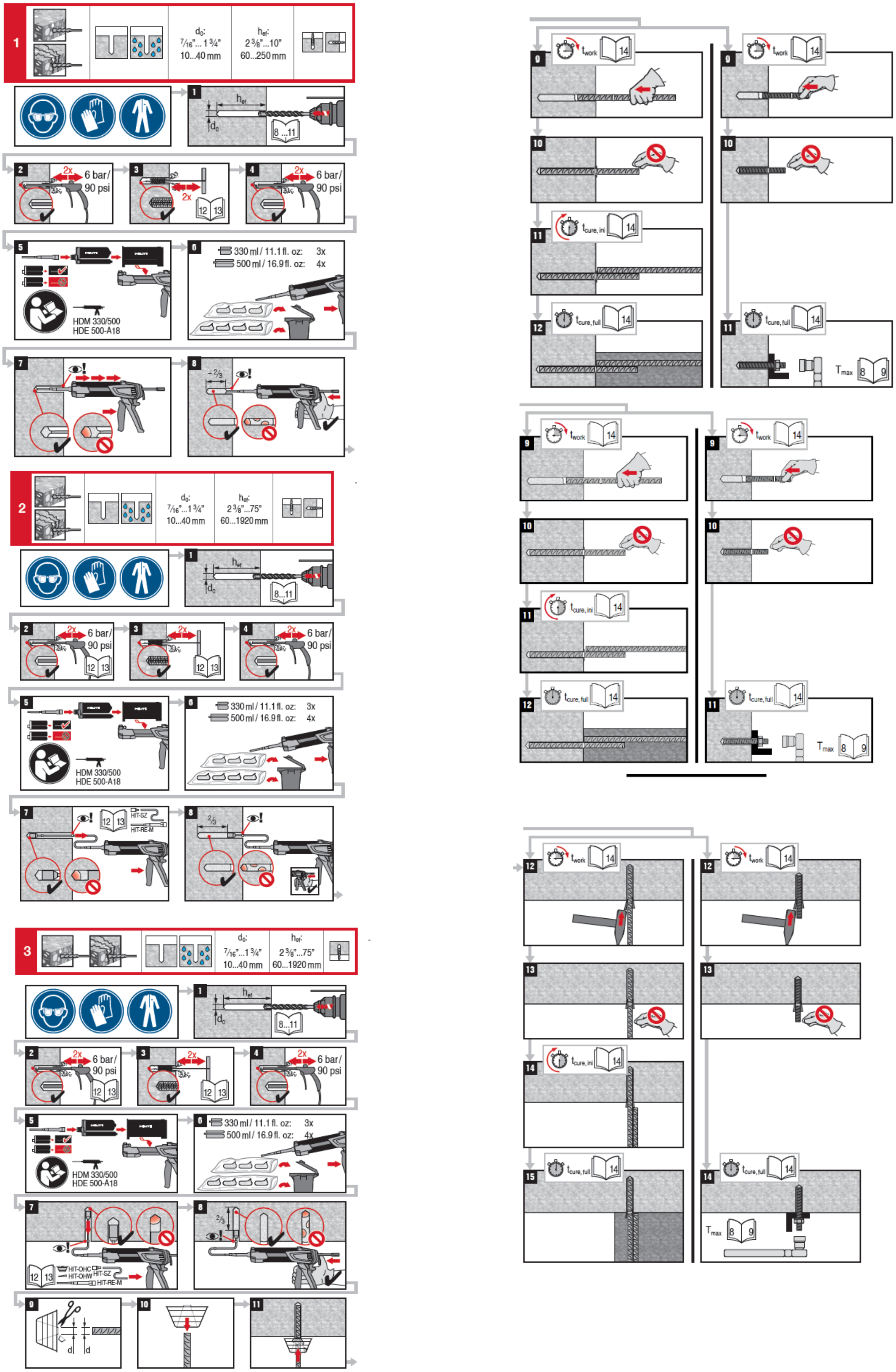


FIGURE 8A—MANUFACTURER'S PRINTED INSTALLATION INSTRUCTIONS (MPII) (Continued)

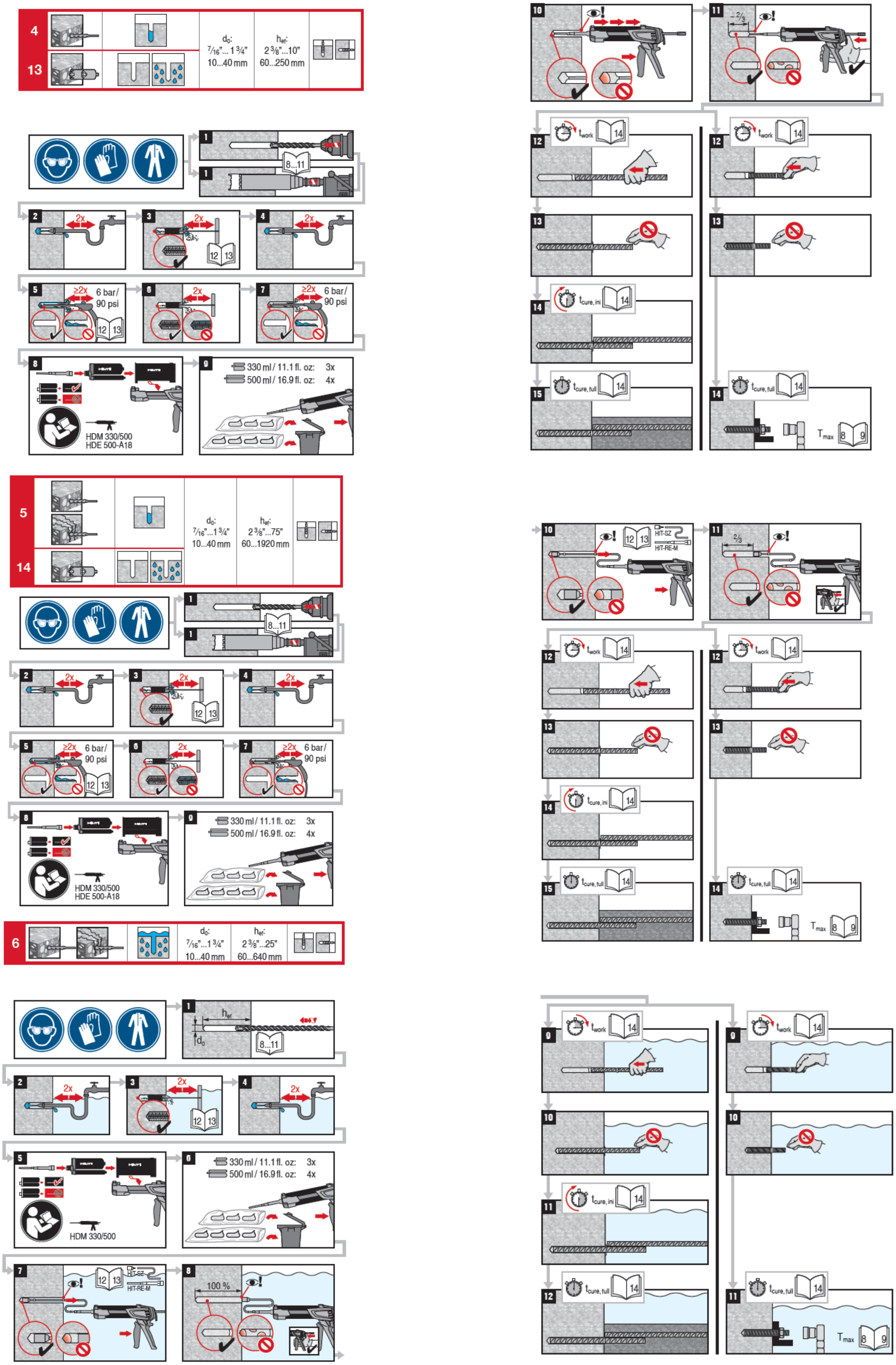


FIGURE 8A—MANUFACTURER'S PRINTED INSTALLATION INSTRUCTIONS (MPII) (Continued)

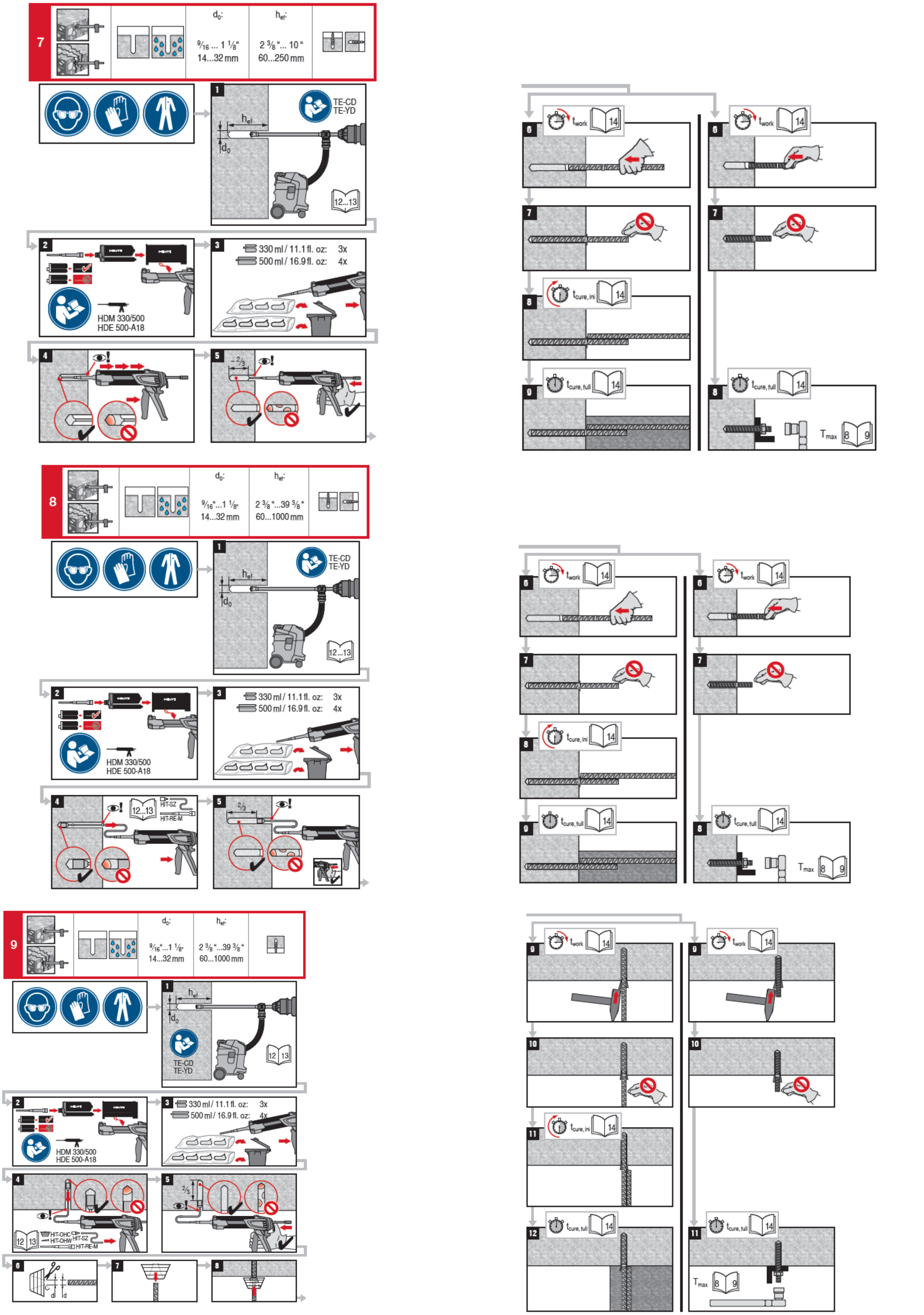


FIGURE 8A—MANUFACTURER'S PRINTED INSTALLATION INSTRUCTIONS (MPII) (Continued)

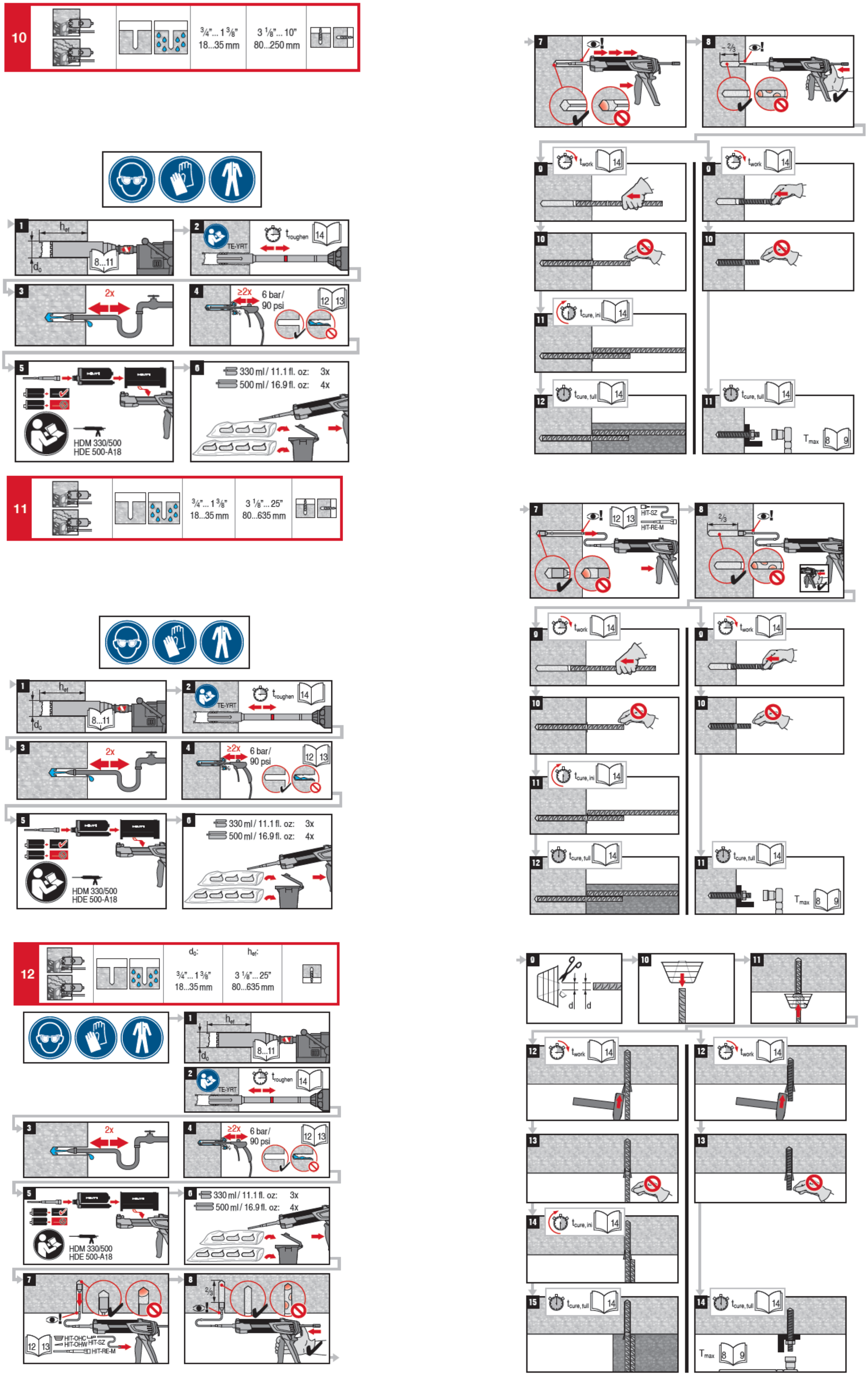
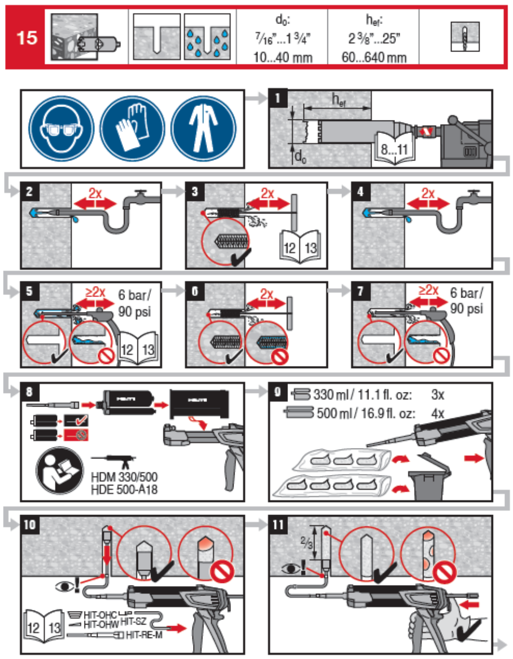
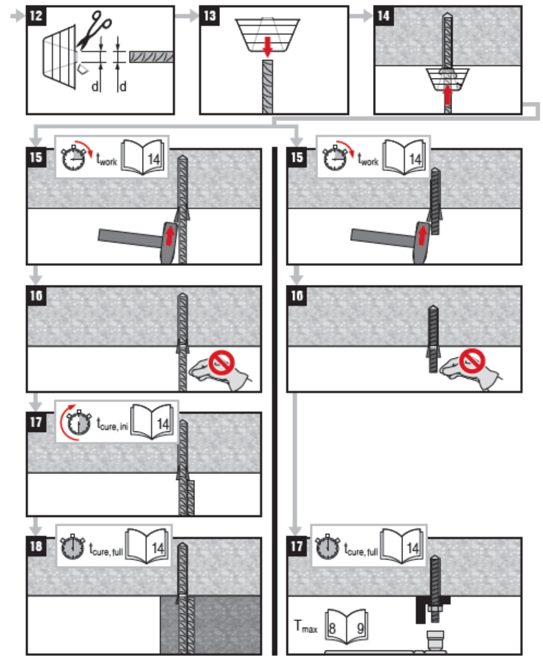


FIGURE 8A—MANUFACTURER'S PRINTED INSTALLATION INSTRUCTIONS (MPII) (Continued)





Adhesive anchoring system for rebar and anchor fastenings in concrete

► Prior to use of product, follow the instructions for use and the legally obligated safety precautions.

► See the Safety Data Sheet for this product.

Hilti HIT-RE 500 V3

Contains epoxy constituents. May produce an allergic reaction.(A)

Contains: reaction product: bisphenol-A/F-(epichlorhydrin) epoxy resin MW ≤ 700 (A), butanedioldiglycidyl ether (A), m-Xylenediamine (B), 2-methyl-1,5-pentanediamine (B)

Danger

H314	Causes severe skin burns and eye damage.(A,B)
H317	May cause an allergic skin reaction.(A,B)
H335	May cause respiratory irritation (B)
H411	Toxic to aquatic life with long lasting effects.(A)
P280	Wear protective gloves/protective clothing/eye protection/face protection.
P260	Do not breathe vapours.
P303+P361+P353	IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
P305+P351+P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P333+P313	If skin irritation or rash occurs: Get medical advice/attention.
P337+P313	If eye irritation persists: Get medical advice/attention.

Recommended protective equipment:
Eye protection: Tightly sealed safety glasses e.g.: #02065449 Safety glasses PP EY-CA NCH clear; #02065591 Goggles PP EY-HA R HC/AF clear;
Protective gloves: EN 374 ; Material of gloves: Nitrile rubber, NBR
Avoid direct contact with the chemical/ the product/ the preparation by organizational measures.
Final selection of appropriate protective equipment is in the responsibility of the user

Disposal considerations

Empty packs:

► Leave the Mixer attached and dispose of via the local Green Dot collecting system
  – or EAK waste material code 15 01 02 plastic packaging.

Full or partially emptied packs:

► dispose of as special waste in accordance with official regulations.
  – EAK waste material code: 20 01 27* paint, inks, adhesives and resins containing dangerous substances.
  – or waste material code: EAK 08 04 09* waste adhesives and sealants containing organic solvents or other dangerous substances.

Content:	330 ml / 11.1 fl.oz	500 ml / 16.9 fl.oz
Weight:	465 g / 16.4 oz	705 g / 24.9 oz

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

en

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.

Product Information

– Always keep this instruction for use together with the product.
– Ensure that the instruction for use is with the product when it is given to other persons.
– **Safety Data Sheet:** Review the DS before use.
– **Check expiration date:** See expiration date imprint on foilpack manifold (month/year). Do not use expired product.
– **Foil pack temperature during usage:** +5 °C to 40 °C / 41 °F to 104 °F.
– **Conditions for transport and storage:** Keep in a cool, dry and dark place between +5 °C to 25 °C / 41 °F to 77 °F.
– For any application not covered by this document / beyond values specified, please contact Hilti.
– **Partly used foil packs must be used up within 4 weeks.** Leave the mixer attached on the foil pack manifold and store under the recommended storage conditions. If reused, attach a new mixer and discard the initial quantity of anchor adhesive.

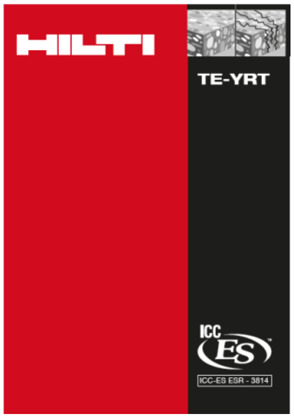
⚠ WARNING

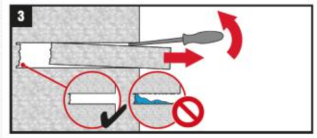
⚠ Improper handling may cause mortar splashes. Eye contact with mortar may cause irreversible eye damage!
– Always wear tightly sealed safety glasses, gloves and protective clothes before handling the mortar!
– Never start dispensing without a mixer properly screwed on.
– When using an extension hose: Discard of initial mortar flow must be done through supplied mixer only (not through the extension hose).
– Attach a new mixer prior to dispensing a new foil pack (snug fit).
– Caution! Never remove the mixer while the foil pack system is under pressure. Press the release button of the dispenser to avoid mortar splashing.
– Use only the type of mixer supplied with the adhesive. Do not modify the mixer in any way.
– Never use damaged foil packs and/or damaged or unclean foil pack holders.

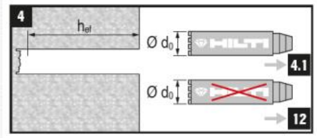
⚠ Poor load values / potential failure of fastening points due to inadequate borehole cleaning. The boreholes must be dry and free of debris, dust, water, ice, oil, grease and other contaminants prior to adhesive injection.
– For blowing out the borehole - blow out with oil free air until return air stream is free of noticeable dust.
– For flushing the borehole - flush with water line pressure until water runs clear.
– Important! Remove all water from the borehole and blow out with oil free compressed air until borehole is completely dried before mortar injection (not applicable to hammer drilled hole in underwater application).

⚠ Ensure that boreholes are filled from the back of the boreholes without forming air voids.
– If necessary, use the accessories / extensions to reach the back of the borehole.
– For overhead applications use the overhead accessories HIT-SZ / IP and take special care when inserting the fastening element. Excess adhesive may be forced out of the borehole. Make sure that no mortar drips onto the installer.
– If a new mixer is installed onto a previously-opened foil pack, the first trigger pulls must be discarded.
– A new mixer must be used for each new foil pack.

FIGURE 8A—MANUFACTURER'S PRINTED INSTALLATION INSTRUCTIONS (MPII) (Continued)

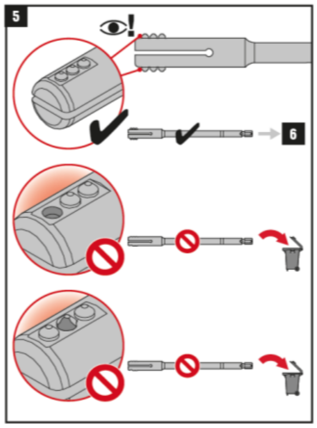






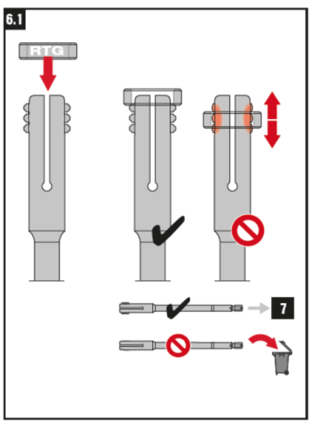
4.1

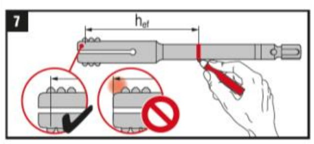
Ø d_0 [mm]	TE-YRT
18	TE-YRT 18/320
20	TE-YRT 20/320
22	TE-YRT 22/400
25	TE-YRT 25/400
28	TE-YRT 28/480
30	TE-YRT 30/540
32	TE-YRT 32/500
35	TE-YRT 35/600
Ø d_0 [inch]	**TE-YRT**
3/4"	TE-YRT 3/4" / 12 1/2"
7/8"	TE-YRT 7/8" / 15"
1"	TE-YRT 1" / 17 1/2"
1 1/8"	TE-YRT 1 1/8" / 20"
1 3/8"	TE-YRT 1 3/8" / 25"

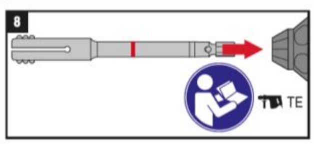


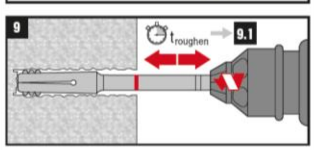
6

TE-YRT	RTG
TE-YRT 18/320	RTG 18
TE-YRT 20/320	RTG 20
TE-YRT 22/400	RTG 22
TE-YRT 25/400	RTG 25
TE-YRT 28/480	RTG 28
TE-YRT 30/540	RTG 30
TE-YRT 32/500	RTG 32
TE-YRT 35/600	RTG 35
TE-YRT	**RTG**
TE-YRT 3/4" / 12 1/2"	RTG 3/4"
TE-YRT 7/8" / 15"	RTG 7/8"
TE-YRT 1" / 17 1/2"	RTG 1"
TE-YRT 1 1/8" / 20"	RTG 1 1/8"
TE-YRT 1 3/8" / 25"	RTG 1 3/8"



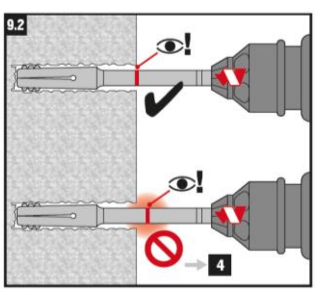


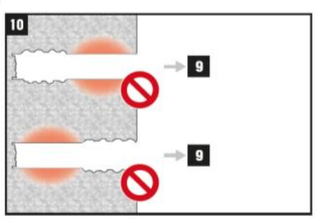


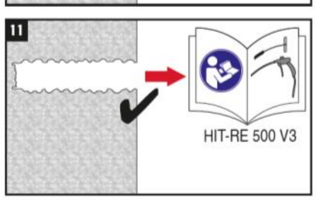


9.1

h_{ef} [mm]	$t_{roughen}$ (= h_{ef} / 10)
0 … 100	10 sec
101 … 200	20 sec
201 … 300	30 sec
301 … 400	40 sec
401 … 500	50 sec
501 … 600	60 sec
h_{ef} [inch]	**$t_{roughen}$ (= $h_{ef} \cdot 2.5$)**
0 … 4	10 sec
4.01 … 8	20 sec
8.01 … 12	30 sec
12.01 … 16	40 sec
16.01 … 20	50 sec
20.01 … 25	60 sec







12

Ø d_0 [mm]	TE-YRT
17,9 … 18,2	TE-YRT 18/320
19,9 … 20,2	TE-YRT 20/320
21,9 … 22,2	TE-YRT 22/400
24,9 … 25,2	TE-YRT 25/400
27,9 … 28,2	TE-YRT 28/480
29,9 … 30,2	TE-YRT 30/540
31,9 … 32,2	TE-YRT 32/500
34,9 … 35,2	TE-YRT 35/600
Ø d_0 [inch]	**TE-YRT**
0.764 … 0.776	TE-YRT 3/4" / 12 1/2"
0.862 … 0.874	TE-YRT 7/8" / 15"
1.008 … 1.020	TE-YRT 1" / 17 1/2"
1.146 … 1.157	TE-YRT 1 1/8" / 20"
1.374 … 1.386	TE-YRT 1 3/8" / 25"

FIGURE 8B—MANUFACTURER'S PRINTED INSTALLATION INSTRUCTIONS (MPII)

ICC EVALUATION SERVICE®

ICC-ES Evaluation Report

ESR-3814 LABC and LARC Supplement

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

DIVISION: 05 00 00—METALS
Section: 05 05 19—Post-Installed Concrete Anchors

REPORT HOLDER:

HILTI, INC.

EVALUATION SUBJECT:

HILTI HIT-RE 500 V3 ADHESIVE ANCHORS AND POST-INSTALLED REINFORCING BAR CONNECTIONS IN CRACKED AND UNCRACKED CONCRETE

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the Hilti HIT RE 500 V3 Adhesive Anchoring System and Post-Installed Reinforcing Bar System for cracked and uncracked concrete, described in ICC-ES evaluation report ESR-3814, has also been evaluated for compliance with the codes noted below as adopted by the Los Angeles Department of Building and Safety (LADBS).

Applicable code editions:

- 2023 *City of Los Angeles Building Code* (LABC)
- 2023 *City of Los Angeles Residential Code* (LARC)

2.0 CONCLUSIONS

The Hilti HIT-RE 500 V3 Adhesive Anchoring System and Post-Installed Reinforcing Bar System for cracked and uncracked concrete, described in Sections 2.0 through 7.0 of the evaluation report ESR-3814, complies with LABC Chapter 19, and the LARC, and is subject to the conditions of use described in this supplement.

3.0 CONDITIONS OF USE

The Hilti HIT RE 500 V3 Adhesive Anchoring System and Post-Installed Reinforcing Bar System described in this evaluation report supplement must comply with all of the following conditions:

- All applicable sections in the evaluation report ESR-3814.
- The design, installation, conditions of use and identification of the Hilti HIT-RE 500 V3 Adhesive Anchoring System and Post-Installed Reinforcing Bar System are in accordance with the 2021 *International Building Code®* (IBC) provisions noted in the evaluation report ESR-3814.
- The design, installation and inspection are in accordance with additional requirements of LABC Chapters 16 and 17, as applicable.
- Under the LARC, an engineered design in accordance with LARC Section R301.1.3 must be submitted.
- The allowable and strength design values listed in the evaluation report and tables are for the connection of the adhesive anchors and post installed reinforcing bars to the concrete. The connection between the adhesive anchors or post installed reinforcing bars and the connected members shall be checked for capacity (which may govern).
- For use in wall anchorage assemblies to flexible diaphragm, anchors shall be designed per the requirements of City of Los Angeles Information Bulletin P/BC 2020-071.

This supplement expires concurrently with the evaluation report, reissued January 2023 and revised March 2023.

ICC EVALUATION SERVICE®

ICC-ES Evaluation Report

ESR-3814 FBC Supplement

Reissued January 2023

Revised May 2024

This report is subject to renewal January 2025.

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

DIVISION: 05 00 00—METALS
Section: 05 05 19—Post-Installed Concrete Anchors

REPORT HOLDER:

HILTI, INC.

EVALUATION SUBJECT:

HILTI HIT-RE 500 V3 ADHESIVE ANCHORS AND POST-INSTALLED REINFORCING BAR CONNECTIONS IN CRACKED AND UNCRACKED CONCRETE

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the Hilti HIT-RE 500 V3 Adhesive Anchors and Post-Installed Reinforcing Bar System in Concrete, described in ICC-ES evaluation report ESR-3814, have also been evaluated for compliance with the codes noted below.

Applicable code editions:

- 2023 *Florida Building Code—Building*
- 2023 *Florida Building Code—Residential*

2.0 CONCLUSIONS

The Hilti HIT-RE 500 V3 Adhesive Anchor System and Post-Installed Reinforcing Bar System, described in Sections 2.0 through 7.0 of ICC-ES evaluation report ESR-3814, comply with the *Florida Building Code—Building* and the *Florida Building Code—Residential*, provided the design requirements are determined in accordance with the *Florida Building Code—Building* or the *Florida Building Code—Residential,* as applicable. The installation requirements noted in ICC-ES evaluation report ESR-3814 for the 2021 *International Building Code®* meet the requirements of the *Florida Building Code—Building* or the *Florida Building Code—Residential,* as applicable.

Use of the Hilti HIT-RE 500 V3 Adhesive Anchor System and Post-Installed Reinforcing Bar System has also been found to be in compliance with the High-Velocity Hurricane Zone provisions of the *Florida Building Code—Building* and the *Florida Building Code—Residential* with the following condition.

a) For anchorage of wood members, the connection subject to uplift must be designed for no less than 700 pounds (3114 N).

For products falling under Florida Rule 61G20-3, verification that the report holder's quality-assurance program is audited by a quality-assurance entity approved by the Florida Building Commission for the type of inspections being conducted is the responsibility of an approved validation entity (or the code official, when the report holder does not possess an approval by the Commission).

This supplement expires concurrently with the evaluation report, reissued January 2023 and revised November 2023.

The following excerpt are pages from the North American Product Technical Guide, Volume 2: Anchor Fastening, Edition 22.

Please refer to the publication in its entirety for complete details on this product including data development, product specifications, general suitability, installation, corrosion and spacing and edge distance guidelines.
US&CA: https://submittals.us.hilti.com/PTGVol2/

To consult directly with a team member regarding our anchor fastening products, contact Hilti's team of technical support specialists between the hours of 7:00am – 6:00pm CST.
US: 877-749-6337 or HNATechnicalServices@hilti.com
CA: 1-800-363-4458, ext. 6 or CATechnicalServices@hilti.com

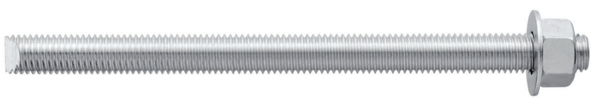
Hilti, Inc.
7250 Dallas Parkway, Suite 1000
Plano, TX 75024

1-800-879-8000
www.hilti.com

3.2.3 HIT-RE 500 V3 EPOXY ADHESIVE ANCHORING SYSTEM

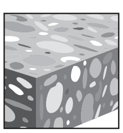
PRODUCT DESCRIPTION

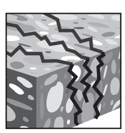
HIT-RE 500 V3 with Threaded Rod, Rebar, and HIS-N/RN Inserts

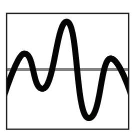
Anchor System	
	Hilti HIT-RE 500 V3 Cartridge
	Hilti HAS Threaded Rods
	Rebar
	Hilti HIS-N

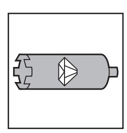
Features and Benefits

- Superior bond performance in both cracked and uncracked concrete
- Seismic qualified in accordance with ICC-ES Acceptance Criteria AC308 and ACI 355.4
- No hole cleaning requirement when installed with SafeSet™ hollow drill bit and Hilti vacuum technology
- ICC-ES approved for cracked concrete and seismic service
- May be installed in diamond cored holes in cracked and uncracked concrete including all seismic zones concrete using the Safe-Set™ system using the TE-YRT Roughening tool
- Use underwater up to 165 ft (50 m)
- Meets requirements of ASTM C881-14, Type I, II, IV, and V, Grade 3, Class A, B, and C.
- Meets requirements of AASHTO specification M235, Type I, II, IV, and V, Grade 3, Class A, B, and C
- Technical data available for larger diameters, oversized holes, deeper embedments. Contact Hilti Technical Services for additional information


Uncracked concrete


Cracked concrete


Seismic design categories A-F


Diamond cored holes for cracked and uncracked concrete

Hollow drill bit Roughening tool

Profis anchor design software

Approvals/Listings	
ICC-ES (International Code Council)	ESR-3814 in concrete per ACI 318 Ch. 17 / ACI 355.2/ ICC-ES AC308 ELC-3814 in concrete per CSA A23.3 / ACI 355.2
NSF/ANSI Std 61	Certification for use in potable water
European Technical Approval	ETA-16/0142, ETA-16/0143, ETA-16/0180
City of Los Angeles	City of Los Angeles 2017 LABC Supplement (within ESR-3814)
Florida Building Code	2017 FBC Supplement (within ESR-1814)
U.S. Green Building Council	LEED® Credit 4.1-Low Emitting Materials
Department of Transportation	Contact Hilti for various states

MATERIAL SPECIFICATIONS

Table 1 — Material properties of fully cured Hilti HIT-RE 500 V3

Bond Strength ASTM C882-13A[1] 2 day cure 14 day cure	 10.8 MPa 11.7 MPa	 1,560 psi 1,690 psi
Compressive Strength ASTM D695-10[1]	82.7 MPa	12,000 psi
Compressive Modulus ASTM D695-10[1]	2,600 MPa	0.38 x 10^6 psi
Tensile Strength 7 day ASTM D638-14	49.3 MPa	7,150 psi
Elongation at break ASTM D638-14	1.1%	1.1%
Heat Deflection Temperature ASTM D648-07	50°C	122°F
Absorption ASTM D570-98	0.18%	0.18%
Linear Coefficient of Shrinkage on Cure ASTM D2566-86	0.008	0.008

1 Minimum values obtained as the result of tests at 35°F, 50°F, 75°F and 110°F.

DESIGN DATA IN CONCRETE FOR ACI 318

ACI 318 Chapter 17 design

The load values contained in this section are Hilti Simplified Design Tables. The load tables in this section were developed using the strength design parameters and variables of ESR-3814 and the equations within ACI 318 Chapter 17. For a detailed explanation of the Hilti Simplified Design Tables, refer to Section 3.1.8. Data tables from ESR-3814 are not contained in this section, but can be found at www.icc-es.org or at www.hilti.com.

HIT-RE 500 V3 adhesive with deformed reinforcing bars (rebar)

Figure 1 — Rebar installed with Hilti HIT-RE 500 V3 adhesive

Cracked or uncracked concrete	Permissible drilling methods	Permissible concrete conditions
Cracked and uncracked concrete	Hammer drilling with carbide-tipped drill bit	Dry concrete Water-saturated concrete Water-filled holes Submerged (underwater)
	Hilti TE-CD or TE-YD hollow drill bit and VC 20/40 vacuum Diamond core drill bit with Hilti TE-YRT roughening tool	Dry concrete Water-saturated concrete
Uncracked concrete	Diamond core drill bit	Dry concrete Water-saturated concrete

Figure 2 — Rebar installed with Hilti HIT-RE 500 V3 adhesive

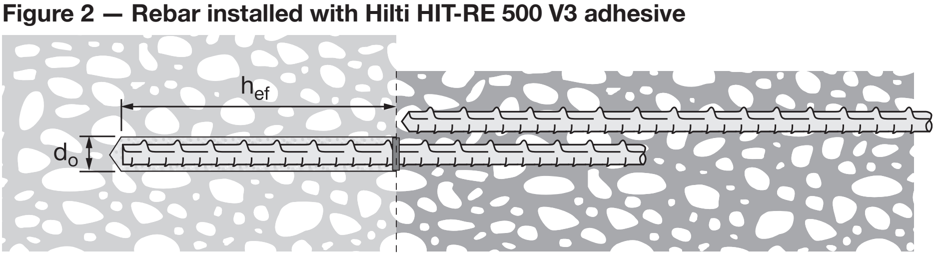


Table 2 — Specifications for rebar installed with Hilti HIT-RE 500 V3 adhesive

Setting information		Symbol	Units	Rebar size							
				#3	#4	#5	#6	#7	#8	#9	#10
Nominal bit diameter		d_o	in.	1/2	5/8	3/4	7/8	1	1-1/8	1-3/8	1-1/2
Effective embedment	minimum	$h_{ef,min}$	in. (mm)	2-3/8 (60)	2-3/8 (60)	3 (76)	3 (76)	3-3/8 (85)	4 (102)	4-1/2 (114)	5 (127)
	maximum	$h_{ef,max}$	in. (mm)	7-1/2 (191)	10 (254)	12-1/2 (318)	15 (381)	17-1/2 (445)	20 (508)	22-1/2 (572)	25 (635)
Minimum concrete member thickness		h_{min}	in. (mm)	h_{ef} + 1-1/4 (h_{ef} + 30)		(h_{ef} + $2d_o$)					
Minimum edge distance[1]		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 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)	5-5/8 (143)	6-1/4 (159)

1 Edge distance of 1-3/4-inch (44mm) is permitted provided the rebar remains un-torqued.

Note: The installation specifications in table 2 above and the data in tables 3 through 23 pertain to the use of Hilti HIT-RE 500 V3 with rebar designed as a post-installed anchor using the provisions of ACI 318 Chapter 17. For the use of Hilti HIT-RE 500 V3 with rebar for typical development calculations according to ACI 318 Chapter 25 (formerly ACI 318-11 Chapter 12), refer to section 3.1.14 for the design method and tables 83 through 87 in section 3.2.4.3.8.

Table 3 — Hilti HIT-RE 500 V3 adhesive design strength with concrete / bond failure for US rebar in uncracked concrete [1,2,3,4,5,6,7,8,9,11]

		Tension — ϕN_n				Shear — ϕV_n			
Rebar size	Effective embedment in. (mm)	f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)	f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)
#3	3-3/8 (86)	4,575 (20.4)	4,790 (21.3)	5,145 (22.9)	5,695 (25.3)	9,855 (43.8)	10,310 (45.9)	11,080 (49.3)	12,265 (54.6)
	4-1/2 (114)	6,100 (27.1)	6,385 (28.4)	6,860 (30.5)	7,590 (33.8)	13,135 (58.4)	13,750 (61.2)	14,775 (65.7)	16,350 (72.7)
	7-1/2 (191)	10,165 (45.2)	10,640 (47.3)	11,435 (50.9)	12,655 (56.3)	21,895 (97.4)	22,915 (101.9)	24,625 (109.5)	27,250 (121.2)
#4	4-1/2 (114)	7,445 (33.1)	8,155 (36.3)	8,990 (40.0)	9,950 (44.3)	16,035 (71.3)	17,570 (78.2)	19,365 (86.1)	21,430 (95.3)
	6 (152)	10,660 (47.4)	11,155 (49.6)	11,990 (53.3)	13,265 (59.0)	22,960 (102.1)	24,030 (106.9)	25,820 (114.9)	28,575 (127.1)
	10 (254)	17,765 (79.0)	18,595 (82.7)	19,980 (88.9)	22,110 (98.3)	38,265 (170.2)	40,050 (178.2)	43,035 (191.4)	47,625 (211.8)
#5[10]	5-5/8 (143)	10,405 (46.3)	11,400 (50.7)	13,165 (58.6)	15,370 (68.4)	22,415 (99.7)	24,550 (109.2)	28,350 (126.1)	33,105 (147.3)
	7-1/2 (191)	16,020 (71.3)	17,230 (76.6)	18,515 (82.4)	20,490 (91.1)	34,505 (153.5)	37,115 (165.1)	39,880 (177.4)	44,135 (196.3)
	12-1/2 (318)	27,440 (122.1)	28,720 (127.8)	30,860 (137.3)	34,155 (151.9)	59,100 (262.9)	61,855 (275.1)	66,470 (295.7)	73,560 (327.2)
#6[10]	6-3/4 (171)	13,680 (60.9)	14,985 (66.7)	17,305 (77.0)	21,190 (94.3)	29,460 (131.0)	32,275 (143.6)	37,265 (165.8)	45,645 (203.0)
	9 (229)	21,060 (93.7)	23,070 (102.6)	26,200 (116.5)	28,995 (129.0)	45,360 (201.8)	49,690 (221.0)	56,430 (251.0)	62,450 (277.8)
	15 (381)	38,825 (172.7)	40,635 (180.8)	43,665 (194.2)	48,325 (215.0)	83,620 (372.0)	87,520 (389.3)	94,045 (418.3)	104,080 (463.0)
#7[10]	7-7/8 (200)	17,235 (76.7)	18,885 (84.0)	21,805 (97.0)	26,705 (118.8)	37,125 (165.1)	40,670 (180.9)	46,960 (208.9)	57,515 (255.8)
	10-1/2 (267)	26,540 (118.1)	29,070 (129.3)	33,570 (149.3)	38,995 (173.5)	57,160 (254.3)	62,615 (278.5)	72,300 (321.6)	83,995 (373.6)
	17-1/2 (445)	52,220 (232.3)	54,655 (243.1)	58,730 (261.2)	64,995 (289.1)	112,470 (500.3)	117,715 (523.6)	126,495 (562.7)	139,990 (622.7)
#8[10]	9 (229)	21,060 (93.7)	23,070 (102.6)	26,640 (118.5)	32,625 (145.1)	45,360 (201.8)	49,690 (221.0)	57,375 (255.2)	70,270 (312.6)
	12 (305)	32,425 (144.2)	35,520 (158.0)	41,015 (182.4)	50,020 (222.5)	69,835 (310.6)	76,500 (340.3)	88,335 (392.9)	107,735 (479.2)
	20 (508)	66,980 (297.9)	70,100 (311.8)	75,330 (335.1)	83,365 (370.8)	144,260 (641.7)	150,990 (671.6)	162,250 (721.7)	179,560 (798.7)
#9[10]	10-1/8 (257)	25,130 (111.8)	27,530 (122.5)	31,785 (141.4)	38,930 (173.2)	54,125 (240.8)	59,290 (263.7)	68,465 (304.5)	83,850 (373.0)
	13-1/2 (343)	38,690 (172.1)	42,380 (188.5)	48,940 (217.7)	59,940 (266.6)	83,330 (370.7)	91,285 (406.1)	105,405 (468.9)	129,095 (574.2)
	22-1/2 (572)	83,245 (370.3)	87,640 (389.8)	94,175 (418.9)	104,225 (463.6)	179,300 (797.6)	188,765 (839.7)	202,840 (902.3)	224,480 (998.5)
#10	11-1/4 (286)	29,430 (130.9)	32,240 (143.4)	37,230 (165.6)	45,595 (202.8)	63,395 (282.0)	69,445 (308.9)	80,185 (356.7)	98,205 (436.8)
	15 (381)	45,315 (201.6)	49,640 (220.8)	57,320 (255.0)	70,200 (312.3)	97,600 (434.1)	106,915 (475.6)	123,455 (549.2)	151,200 (672.6)
	25 (635)	97,500 (433.7)	106,195 (472.4)	114,115 (507.6)	126,290 (561.8)	210,000 (934.1)	228,730 (1017.4)	245,785 (1093.3)	272,005 (1209.9)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8 to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 8-23 as necessary to the above values. Compare to the steel values in table 7. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69.
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.
6 Tabular values are for dry concrete and water-saturated concrete conditions.
For water-filled drilled holes multiply design strength by 0.51.
For submerged (under water) applications multiply design strength by 0.45.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λ_a as follows:
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for holes drilled in concrete with carbide tipped hammer drill bit. For diamond core drilling, except as indicated in note 10, multiply above values by 0.55.
Diamond core drilling is not permitted for the water-filled or under-water (submerged) applications.
10 Diamond core drilling with the Hilti TE-YRT roughening tool is permitted for #5, #6, #7, #8, and #9 rebar in dry and water-saturated concrete. See Table 5
11 Tabular values are for static loads only. Seismic design is not permitted for uncracked concrete.

Table 4 — Hilti HIT-RE 500 V3 adhesive design strength with concrete / bond failure for US rebar in cracked concrete[1,2,3,4,5,6,7,8,9,11]

Rebar size	Effective embedment in. (mm)	Tension — ϕN_n				Shear — ϕV_n			
		f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)	f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)
#3	3-3/8	3,425	3,585	3,745	3,980	7,380	7,725	8,065	8,570
	(86)	(15.2)	(15.9)	(16.7)	(17.7)	(32.8)	(34.4)	(35.9)	(38.1)
	4-1/2	4,650	4,780	4,990	5,305	10,020	10,300	10,750	11,425
	(114)	(20.7)	(21.3)	(22.2)	(23.6)	(44.6)	(45.8)	(47.8)	(50.8)
	7-1/2	7,755	7,970	8,320	8,840	16,700	17,165	17,920	19,045
	(191)	(34.5)	(35.5)	(37.0)	(39.3)	(74.3)	(76.4)	(79.7)	(84.7)
#4	4-1/2	5,275	5,780	6,670	7,125	11,360	12,445	14,370	15,345
	(114)	(23.5)	(25.7)	(29.7)	(31.7)	(50.5)	(55.4)	(63.9)	(68.3)
	6	8,120	8,560	8,940	9,500	17,490	18,440	19,255	20,465
	(152)	(36.1)	(38.1)	(39.8)	(42.3)	(77.8)	(82.0)	(85.7)	(91.0)
	10	13,885	14,270	14,900	15,835	29,910	30,735	32,095	34,105
	(254)	(61.8)	(63.5)	(66.3)	(70.4)	(133.0)	(136.7)	(142.8)	(151.7)
#5[10]	5-5/8	7,370	8,075	9,325	11,380	15,875	17,390	20,080	24,510
	(143)	(32.8)	(35.9)	(41.5)	(50.6)	(70.6)	(77.4)	(89.3)	(109.0)
	7-1/2	11,350	12,430	14,275	15,170	24,440	26,775	30,750	32,680
	(191)	(50.5)	(55.3)	(63.5)	(67.5)	(108.7)	(119.1)	(136.8)	(145.4)
	12-1/2	22,175	22,790	23,795	25,285	47,760	49,085	51,250	54,465
	(318)	(98.6)	(101.4)	(105.8)	(112.5)	(212.4)	(218.3)	(228.0)	(242.3)
#6[10]	6-3/4	9,690	10,615	12,255	15,010	20,870	22,860	26,395	32,330
	(171)	(43.1)	(47.2)	(54.5)	(66.8)	(92.8)	(101.7)	(117.4)	(143.8)
	9	14,920	16,340	18,870	22,160	32,130	35,195	40,640	47,735
	(229)	(66.4)	(72.7)	(83.9)	(98.6)	(142.9)	(156.6)	(180.8)	(212.3)
	15	32,095	33,290	34,760	36,935	69,135	71,700	74,865	79,560
	(381)	(142.8)	(148.1)	(154.6)	(164.3)	(307.5)	(318.9)	(333.0)	(353.9)
#7[10]	7-7/8	12,210	13,375	15,445	18,915	26,300	28,810	33,265	40,740
	(200)	(54.3)	(59.5)	(68.7)	(84.1)	(117.0)	(128.2)	(148.0)	(181.2)
	10-1/2	18,800	20,590	23,780	29,120	40,490	44,355	51,215	62,725
	(267)	(83.6)	(91.6)	(105.8)	(129.5)	(180.1)	(197.3)	(227.8)	(279.0)
	17-1/2	40,445	44,310	47,310	50,275	87,115	95,430	101,895	108,285
	(445)	(179.9)	(197.1)	(210.4)	(223.6)	(387.5)	(424.5)	(453.2)	(481.7)
#8[10]	9	14,920	16,340	18,870	23,110	32,130	35,195	40,640	49,775
	(229)	(66.4)	(72.7)	(83.9)	(102.8)	(142.9)	(156.6)	(180.8)	(221.4)
	12	22,965	25,160	29,050	35,580	49,465	54,190	62,570	76,635
	(305)	(102.2)	(111.9)	(129.2)	(158.3)	(220.0)	(241.0)	(278.3)	(340.9)
	20	49,415	54,135	62,230	66,130	106,435	116,595	134,035	142,440
	(508)	(219.8)	(240.8)	(276.8)	(294.2)	(473.4)	(518.6)	(596.2)	(633.6)
#9[10]	10-1/8	17,800	19,500	22,515	27,575	38,340	42,000	48,495	59,395
	(257)	(79.2)	(86.7)	(100.2)	(122.7)	(170.5)	(186.8)	(215.7)	(264.2)
	13-1/2	27,405	30,020	34,665	42,455	59,025	64,660	74,665	91,445
	(343)	(121.9)	(133.5)	(154.2)	(188.8)	(262.6)	(287.6)	(332.1)	(406.8)
	22-1/2	58,965	64,595	74,585	81,930	127,005	139,125	160,650	176,465
	(572)	(262.3)	(287.3)	(331.8)	(364.4)	(564.9)	(618.9)	(714.6)	(785.0)
#10	11-1/4	20,850	22,840	26,370	32,295	44,905	49,190	56,800	69,565
	(286)	(92.7)	(101.6)	(117.3)	(143.7)	(199.7)	(218.8)	(252.7)	(309.4)
	15	32,095	35,160	40,600	49,725	69,135	75,730	87,445	107,100
	(381)	(142.8)	(156.4)	(180.6)	(221.2)	(307.5)	(336.9)	(389.0)	(476.4)
	25	69,060	75,655	87,360	97,510	148,750	162,945	188,155	210,020
	(635)	(307.2)	(336.5)	(388.6)	(433.7)	(661.7)	(724.8)	(837.0)	(934.2)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8 to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 8-23 as necessary to the above values. Compare to the steel values in table 7. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69.
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.
6 Tabular values are for dry concrete and water-saturated concrete conditions.
For water-filled drilled holes multiply design strength by 0.51.
For submerged (under water) applications multiply design strength by 0.45.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λ_a as follows:
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for holes drilled in concrete with carbide tipped hammer drill bit. Diamond core drilling is not permitted in cracked concrete except as indicated in note 10.
10 Diamond core drilling with the Hilti TE-YRT roughening tool is permitted for #5, #6, #7, #8, and #9 rebar in dry and water-saturated concrete. See Table 6
11 Tabular values are for static loads only. For seismic loads, multiply cracked concrete tabular values in tension and shear by α_{seis} = 0.68. See section 3.1.8 for additional information on seismic applications.

Table 5 — Hilti HIT-RE 500 V3 for Core Drilled Holes with TE-YRT Roughening Tool adhesive design strength with concrete / bond failure for US rebar in uncracked concrete[1,2,3,4,5,6,7,8,9]

Rebar size	Effective embedment in. (mm)	Tension — ϕN_n				Shear — ϕV_n			
		f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)	f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)
#5	5-5/8 (143)	10,405 (46.3)	11,400 (50.7)	12,350 (54.9)	12,350 (54.9)	22,415 (99.7)	24,550 (109.2)	26,595 (118.3)	26,595 (118.3)
	7-1/2 (191)	16,020 (71.3)	16,465 (73.2)	16,465 (73.2)	16,465 (73.2)	34,505 (153.5)	35,460 (157.7)	35,460 (157.7)	35,460 (157.7)
	12-1/2 (318)	27,440 (122.1)	27,440 (122.1)	27,440 (122.1)	27,440 (122.1)	59,100 (262.9)	59,100 (262.9)	59,100 (262.9)	59,100 (262.9)
#6	6-3/4 (171)	13,680 (60.9)	14,985 (66.7)	17,305 (77.0)	17,470 (77.7)	29,460 (131.0)	32,275 (143.6)	37,265 (165.8)	37,630 (167.4)
	9 (229)	21,060 (93.7)	23,070 (102.6)	23,295 (103.6)	23,295 (103.6)	45,360 (201.8)	49,690 (221.0)	50,175 (223.2)	50,175 (223.2)
	11-1/4 (286)	29,120 (129.5)	29,120 (129.5)	29,120 (129.5)	29,120 (129.5)	62,715 (279.0)	62,715 (279.0)	62,715 (279.0)	62,715 (279.0)
#7	7-7/8 (200)	17,235 (76.7)	18,885 (84.0)	21,805 (97.0)	23,500 (104.5)	37,125 (165.1)	40,670 (180.9)	46,960 (208.9)	50,610 (225.1)
	10-1/2 (267)	26,540 (118.1)	29,070 (129.3)	31,330 (139.4)	31,330 (139.4)	57,160 (254.3)	62,615 (278.5)	67,485 (300.2)	67,485 (300.2)
	17-1/2 (445)	52,220 (232.3)	52,220 (232.3)	52,220 (232.3)	52,220 (232.3)	112,470 (500.3)	112,470 (500.3)	112,470 (500.3)	112,470 (500.3)
#8	9 (229)	21,060 (93.7)	23,070 (102.6)	26,640 (118.5)	30,140 (134.1)	45,360 (201.8)	49,690 (221.0)	57,375 (255.2)	64,920 (288.8)
	12 (305)	32,425 (144.2)	35,520 (158.0)	40,185 (178.8)	40,185 (178.8)	69,835 (310.6)	76,500 (340.3)	86,555 (385.0)	86,555 (385.0)
	20 (508)	66,980 (297.9)	66,980 (297.9)	66,980 (297.9)	66,980 (297.9)	144,260 (641.7)	144,260 (641.7)	144,260 (641.7)	144,260 (641.7)
#9	10-1/8 (257)	25,130 (111.8)	27,530 (122.5)	31,785 (141.4)	37,680 (167.6)	54,125 (240.8)	59,290 (263.7)	68,465 (304.5)	81,160 (361.0)
	13-1/2 (343)	38,690 (172.1)	42,380 (188.5)	48,940 (217.7)	50,240 (223.5)	83,330 (370.7)	91,285 (406.1)	105,405 (468.9)	108,215 (481.4)
	22-1/2 (572)	83,245 (370.3)	83,735 (372.5)	83,735 (372.5)	83,735 (372.5)	179,300 (797.6)	180,355 (802.3)	180,355 (802.3)	180,355 (802.3)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8 to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 8 - 23 as necessary to the above values. Compare to the steel values in table 7. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C). For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69. 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.
6 Tabular values are for dry concrete and water-saturated concrete conditions. Water-filled and submerged (under water) applications are not permitted for this hole preparation method.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λ_a as follows: For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for static loads only. Seismic design is not permitted for uncracked concrete.

Table 6 — Hilti HIT-RE 500 V3 for Core Drilled Holes with TE-YRT Roughening Tool adhesive design strength with concrete / bond failure for US rebar in cracked concrete[1,2,3,4,5,6,7,8,9]

Rebar size	Effective embedment in. (mm)	Tension — ϕN_n				Shear — ϕV_n			
		f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)	f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)
#5	5-5/8 (143)	6,965 (31.0)	6,965 (31.0)	6,965 (31.0)	6,965 (31.0)	15,000 (66.7)	15,000 (66.7)	15,000 (66.7)	15,000 (66.7)
	7-1/2 (191)	9,285 (41.3)	9,285 (41.3)	9,285 (41.3)	9,285 (41.3)	20,000 (89.0)	20,000 (89.0)	20,000 (89.0)	20,000 (89.0)
	12-1/2 (318)	15,475 (68.8)	15,475 (68.8)	15,475 (68.8)	15,475 (68.8)	33,330 (148.3)	33,330 (148.3)	33,330 (148.3)	33,330 (148.3)
#6	6-3/4 (171)	9,690 (43.1)	10,235 (45.5)	10,235 (45.5)	10,235 (45.5)	20,870 (92.8)	22,045 (98.1)	22,045 (98.1)	22,045 (98.1)
	9 (229)	13,645 (60.7)	13,645 (60.7)	13,645 (60.7)	13,645 (60.7)	29,390 (130.7)	29,390 (130.7)	29,390 (130.7)	29,390 (130.7)
	11-1/4 (286)	17,055 (75.9)	17,055 (75.9)	17,055 (75.9)	17,055 (75.9)	36,740 (163.4)	36,740 (163.4)	36,740 (163.4)	36,740 (163.4)
#7	7-7/8 (200)	12,210 (54.3)	13,375 (59.5)	13,930 (62.0)	13,930 (62.0)	26,300 (117.0)	28,810 (128.2)	30,005 (133.5)	30,005 (133.5)
	10-1/2 (267)	18,575 (82.6)	18,575 (82.6)	18,575 (82.6)	18,575 (82.6)	40,005 (178.0)	40,005 (178.0)	40,005 (178.0)	40,005 (178.0)
	17-1/2 (445)	30,955 (137.7)	30,955 (137.7)	30,955 (137.7)	30,955 (137.7)	66,675 (296.6)	66,675 (296.6)	66,675 (296.6)	66,675 (296.6)
#8	9 (229)	14,920 (66.4)	16,340 (72.7)	18,285 (81.3)	18,285 (81.3)	32,130 (142.9)	35,195 (156.6)	39,385 (175.2)	39,385 (175.2)
	12 (305)	22,965 (102.2)	24,380 (108.4)	24,380 (108.4)	24,380 (108.4)	49,465 (220.0)	52,515 (233.6)	52,515 (233.6)	52,515 (233.6)
	20 (508)	40,635 (180.8)	40,635 (180.8)	40,635 (180.8)	40,635 (180.8)	87,525 (389.3)	87,525 (389.3)	87,525 (389.3)	87,525 (389.3)
#9	10-1/8 (257)	17,800 (79.2)	19,500 (86.7)	22,515 (100.2)	22,560 (100.4)	38,340 (170.5)	42,000 (186.8)	48,495 (215.7)	48,595 (216.2)
	13-1/2 (343)	27,405 (121.9)	30,020 (133.5)	30,085 (133.8)	30,085 (133.8)	59,025 (262.6)	64,660 (287.6)	64,795 (288.2)	64,795 (288.2)
	22-1/2 (572)	50,140 (223.0)	50,140 (223.0)	50,140 (223.0)	50,140 (223.0)	107,990 (480.4)	107,990 (480.4)	107,990 (480.4)	107,990 (480.4)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8 to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 8 - 23 as necessary to the above values. Compare to the steel values in table 7. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C). For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69. 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.
6 Tabular values are for dry concrete and water-saturated concrete conditions. Water-filled and submerged (under water) applications are not permitted for this hole preparation method.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λ_a as follows: For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for static loads only. Seismic design is not permitted for uncracked concrete. For seismic loads, multiply cracked concrete tabular values in tension and shear by α_{seis} = 0.68. See section 3.1.8 for additional information on seismic applications.

3.2.3

Table 7 — Steel design strength for US rebar[1]

Rebar size	ASTM A 615 Grade 40[2]			ASTM A 615 Grade 60[2]			ASTM A 706 Grade 60[2]		
	Tensile[3] ϕN_{sa} lb (kN)	Shear[4] ϕV_{sa} lb (kN)	Seismic Shear[5] $\phi V_{sa,eq}$ lb (kN)	Tensile[3] ϕN_{sa} lb (kN)	Shear[4] ϕV_{sa} lb (kN)	Seismic Shear[5] $\phi V_{sa,eq}$ lb (kN)	Tensile[3] ϕN_{sa} lb (kN)	Shear[4] ϕV_{sa} lb (kN)	Seismic Shear[5] $\phi V_{sa,eq}$ lb (kN)
#3	4,290 (19.1)	2,375 (10.6)	1,665 (7.4)	5,720 (25.4)	3,170 (14.1)	2,220 (9.9)	6,600 (29.4)	3,430 (15.3)	2,400 (10.7)
#4	7,800 (34.7)	4,320 (19.2)	3,025 (13.5)	10,400 (46.3)	5,760 (25.6)	4,030 (17.9)	12,000 (53.4)	6,240 (27.8)	4,370 (19.4)
#5	12,090 (53.8)	6,695 (29.8)	4,685 (20.8)	16,120 (71.7)	8,930 (39.7)	6,250 (27.8)	18,600 (82.7)	9,670 (43.0)	6,770 (30.1)
#6	17,160 (76.3)	9,505 (42.3)	6,655 (29.6)	22,880 (101.8)	12,670 (56.4)	8,870 (39.5)	26,400 (117.4)	13,730 (61.1)	9,610 (42.7)
#7	23,400 (104.1)	12,960 (57.6)	9,070 (40.3)	31,200 (138.8)	17,280 (76.9)	12,095 (53.8)	36,000 (160.1)	18,720 (83.3)	13,105 (58.3)
#8	30,810 (137.0)	17,065 (75.9)	11,945 (53.1)	41,080 (182.7)	22,750 (101.2)	15,925 (70.8)	47,400 (210.8)	24,650 (109.6)	17,255 (76.8)
#9	39,000 (173.5)	21,600 (96.1)	15,120 (67.3)	52,000 (231.3)	28,800 (128.1)	20,160 (89.7)	60,000 (266.9)	31,200 (138.8)	21,840 (97.1)
#10	49,530 (220.3)	27,430 (122.0)	19,200 (85.4)	66,040 (293.8)	36,575 (162.7)	25,605 (113.9)	76,200 (339.0)	39,625 (176.3)	27,740 (123.4)

1 See Section 3.1.8 to convert design strength value to ASD value.
2 ASTM A706 Grade 60 rebar are considered ductile steel elements. ASTM A 615 Grade 40 and 60 rebar are considered brittle steel elements.
3 Tensile = $\phi A_{se,N} f_{uta}$ as noted in ACI 318 Chapter 17
4 Shear = $\phi\, 0.60\, A_{se,N} f_{uta}$ as noted in ACI 318 Chapter 17
5 Seismic Shear = $\alpha_{V,seis}\, \phi V_{sa}$: Reduction for seismic shear only. See section 3.1.8 for additional information on seismic applications.

Table 8 — Load adjustment factors for #3 rebar in uncracked concrete[1,2,3]

#3 Rebar uncracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ‖ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef}	in.	3-3/8	4-1/2	7-1/2	3-3/8	4-1/2	7-1/2	3-3/8	4-1/2	7-1/2	3-3/8	4-1/2	7-1/2	3-3/8	4-1/2	7-1/2	3-3/8	4-1/2	7-1/2
	(mm)	(86)	(114)	(191)	(86)	(114)	(191)	(86)	(114)	(191)	(86)	(114)	(191)	(86)	(114)	(191)	(86)	(114)	(191)
Spacing (s) / edge eistance (c_a) / concrete thickness (h), - in. (mm) 1-3/4	(44)	n/a	n/a	n/a	0.29	0.22	0.13	n/a	n/a	n/a	0.07	0.06	0.03	0.15	0.11	0.07	n/a	n/a	n/a
1-7/8	(48)	0.59	0.57	0.54	0.30	0.22	0.13	0.53	0.53	0.52	0.08	0.06	0.04	0.17	0.12	0.07	n/a	n/a	n/a
2	(51)	0.59	0.57	0.54	0.31	0.23	0.13	0.53	0.53	0.52	0.09	0.07	0.04	0.18	0.14	0.08	n/a	n/a	n/a
3	(76)	0.64	0.61	0.57	0.38	0.28	0.16	0.55	0.54	0.53	0.17	0.13	0.08	0.34	0.25	0.15	n/a	n/a	n/a
4	(102)	0.69	0.65	0.59	0.45	0.33	0.19	0.57	0.56	0.54	0.26	0.19	0.12	0.45	0.33	0.19	n/a	n/a	n/a
4-5/8	(117)	0.72	0.67	0.60	0.50	0.37	0.22	0.58	0.56	0.55	0.32	0.24	0.14	0.50	0.37	0.22	0.56	n/a	n/a
5	(127)	0.74	0.69	0.61	0.54	0.39	0.23	0.58	0.57	0.55	0.36	0.27	0.16	0.54	0.39	0.23	0.58	n/a	n/a
5-3/4	(146)	0.77	0.71	0.63	0.61	0.45	0.26	0.60	0.58	0.56	0.45	0.33	0.20	0.61	0.45	0.26	0.62	0.57	n/a
6	(152)	0.78	0.72	0.63	0.64	0.47	0.27	0.60	0.58	0.56	0.47	0.36	0.21	0.64	0.47	0.27	0.64	0.58	n/a
7	(178)	0.83	0.76	0.66	0.75	0.54	0.32	0.62	0.60	0.57	0.60	0.45	0.27	0.75	0.54	0.32	0.69	0.63	n/a
8	(203)	0.88	0.80	0.68	0.85	0.62	0.36	0.64	0.61	0.58	0.73	0.55	0.33	0.85	0.62	0.36	0.74	0.67	n/a
8-3/4	(222)	0.91	0.82	0.69	0.93	0.68	0.39	0.65	0.62	0.59	0.84	0.63	0.38	0.93	0.68	0.39	0.77	0.70	0.59
9	(229)	0.92	0.83	0.70	0.96	0.70	0.41	0.65	0.63	0.59	0.87	0.65	0.39	0.96	0.70	0.41	0.78	0.71	0.60
10	(254)	0.97	0.87	0.72	1.00	0.78	0.45	0.67	0.64	0.60	1.00	0.77	0.46	1.00	0.78	0.45	0.82	0.75	0.63
11	(279)	1.00	0.91	0.74		0.85	0.50	0.69	0.65	0.61		0.88	0.53		0.85	0.50	0.86	0.78	0.66
12	(305)		0.94	0.77		0.93	0.54	0.70	0.67	0.62		1.00	0.60		0.93	0.54	0.90	0.82	0.69
14	(356)		1.00	0.81		1.00	0.63	0.74	0.70	0.64			0.76		1.00	0.63	0.97	0.88	0.75
16	(406)			0.86			0.72	0.77	0.72	0.66			0.93			0.72	1.00	0.95	0.80
18	(457)			0.90			0.81	0.80	0.75	0.68			1.00			0.81		1.00	0.85
24	(610)			1.00			1.00	0.91	0.83	0.74						1.00			0.98
30	(762)							1.00	0.92	0.80									1.00
36	(914)								1.00	0.86									
> 48	(1219)									0.98									

Table 9 — Load adjustment factors for #3 rebar in cracked concrete[1,2,3]

#3 Rebar cracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ‖ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef}	in.	3-3/8	4-1/2	7-1/2	3-3/8	4-1/2	7-1/2	3-3/8	4-1/2	7-1/2	3-3/8	4-1/2	7-1/2	3-3/8	4-1/2	7-1/2	3-3/8	4-1/2	7-1/2
	(mm)	(86)	(114)	(191)	(86)	(114)	(191)	(86)	(114)	(191)	(86)	(114)	(191)	(86)	(114)	(191)	(86)	(114)	(191)
Spacing (s) / edge eistance (c_a) / concrete thickness (h), - in. (mm) 1-3/4	(44)	n/a	n/a	n/a	0.53	0.49	0.43	n/a	n/a	n/a	0.07	0.05	0.03	0.14	0.11	0.06	n/a	n/a	n/a
1-7/8	(48)	0.59	0.57	0.54	0.55	0.50	0.44	0.53	0.53	0.52	0.08	0.06	0.03	0.16	0.12	0.07	n/a	n/a	n/a
2	(51)	0.59	0.57	0.54	0.56	0.51	0.44	0.53	0.53	0.52	0.09	0.06	0.04	0.17	0.13	0.08	n/a	n/a	n/a
3	(76)	0.64	0.61	0.57	0.68	0.60	0.49	0.55	0.54	0.53	0.16	0.12	0.07	0.32	0.24	0.14	n/a	n/a	n/a
4	(102)	0.69	0.65	0.59	0.81	0.70	0.55	0.57	0.55	0.54	0.25	0.18	0.11	0.49	0.36	0.22	n/a	n/a	n/a
4-5/8	(117)	0.72	0.67	0.60	0.90	0.76	0.58	0.58	0.56	0.54	0.31	0.23	0.14	0.61	0.45	0.27	0.55	n/a	n/a
5	(127)	0.74	0.69	0.61	0.95	0.80	0.60	0.58	0.57	0.55	0.34	0.25	0.15	0.69	0.51	0.30	0.57	n/a	n/a
5-3/4	(146)	0.77	0.71	0.63	1.00	0.88	0.64	0.59	0.58	0.55	0.42	0.31	0.19	0.85	0.63	0.38	0.61	0.55	n/a
6	(152)	0.78	0.72	0.63		0.91	0.66	0.60	0.58	0.56	0.45	0.33	0.20	0.91	0.67	0.40	0.63	0.57	n/a
7	(178)	0.83	0.76	0.66		1.00	0.72	0.61	0.59	0.57	0.57	0.42	0.25	1.00	0.84	0.50	0.68	0.61	n/a
8	(203)	0.88	0.80	0.68			0.78	0.63	0.61	0.58	0.70	0.51	0.31		1.00	0.62	0.72	0.65	n/a
8-3/4	(222)	0.91	0.82	0.69			0.83	0.64	0.62	0.58	0.80	0.59	0.35			0.70	0.76	0.68	0.58
9	(229)	0.92	0.83	0.70			0.85	0.65	0.62	0.59	0.83	0.61	0.37			0.74	0.77	0.69	0.58
10	(254)	0.97	0.87	0.72			0.91	0.66	0.63	0.60	0.97	0.72	0.43			0.86	0.81	0.73	0.62
11	(279)	1.00	0.91	0.74			0.98	0.68	0.65	0.60	1.00	0.83	0.50			0.98	0.85	0.77	0.65
12	(305)		0.94	0.77			1.00	0.70	0.66	0.61		0.94	0.57			1.00	0.89	0.80	0.68
14	(356)		1.00	0.81				0.73	0.69	0.63		1.00	0.71				0.96	0.86	0.73
16	(406)			0.86				0.76	0.71	0.65			0.87				1.00	0.92	0.78
18	(457)			0.90				0.79	0.74	0.67			1.00					0.98	0.83
24	(610)			1.00				0.89	0.82	0.73			1.00					1.00	0.96
30	(762)							0.99	0.90	0.79			1.00						1.00
36	(914)							1.00	0.98	0.84			1.00						
> 48	(1219)								1.00	0.96			1.00						

1 Linear interpolation not permitted.
2 Shaded area with reduced edge distance is permitted provided the rebar has no installation torque.
3 When combining multiple load adjustment factors (e.g. for a four-anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use PROFIS Engineering or perform anchor calculation using design equations from ACI 318 Chapter 17.
4 Spacing factor reduction in shear applicable when $c < 3{*}h_{ef}$. f_{AV}, is applicable when edge distance, $c < 3{*}h_{ef}$. If $c \geq 3{*}h_{ef}$, then $f_{AV} = f_{AN}$.
5 Concrete thickness reduction factor in shear, f_{HV}, is applicable when edge distance, $c < 3{*}h_{ef}$. If $c \geq 3{*}h_{ef}$, then $f_{HV} = 1.0$.

Table 10 — Load adjustment factors for #4 rebar in uncracked concrete[1,2,3]

#4 Rebar uncracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear ⊥ Toward edge f_{RV}			Edge distance in shear ‖ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef}	in. (mm)	4-1/2 (114)	6 (152)	10 (254)	4-1/2 (114)	6 (152)	10 (254)	4-1/2 (114)	6 (152)	10 (254)	4-1/2 (114)	6 (152)	10 (254)	4-1/2 (114)	6 (152)	10 (254)	4-1/2 (114)	6 (152)	10 (254)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm) 1-3/4	(44)	n/a	n/a	n/a	0.26	0.20	0.11	n/a	n/a	n/a	0.05	0.04	0.02	0.11	0.07	0.04	n/a	n/a	n/a
2-1/2	(64)	0.59	0.57	0.54	0.29	0.22	0.13	0.53	0.53	0.52	0.09	0.06	0.04	0.18	0.13	0.08	n/a	n/a	n/a
3	(76)	0.61	0.58	0.55	0.32	0.24	0.14	0.54	0.53	0.52	0.12	0.08	0.05	0.24	0.17	0.10	n/a	n/a	n/a
4	(102)	0.64	0.61	0.57	0.37	0.28	0.16	0.55	0.54	0.53	0.18	0.13	0.08	0.37	0.26	0.15	n/a	n/a	n/a
5	(127)	0.68	0.64	0.58	0.42	0.32	0.18	0.57	0.55	0.54	0.26	0.18	0.11	0.42	0.32	0.18	n/a	n/a	n/a
5-3/4	(146)	0.70	0.66	0.60	0.47	0.35	0.20	0.58	0.56	0.54	0.32	0.22	0.13	0.47	0.35	0.20	0.56	n/a	n/a
6	(152)	0.71	0.67	0.60	0.48	0.36	0.21	0.58	0.56	0.55	0.34	0.24	0.14	0.48	0.36	0.21	0.57	n/a	n/a
7	(178)	0.75	0.69	0.62	0.55	0.40	0.24	0.59	0.57	0.55	0.42	0.30	0.18	0.55	0.40	0.24	0.61	n/a	n/a
7-1/4	(184)	0.76	0.70	0.62	0.57	0.42	0.24	0.60	0.58	0.55	0.45	0.31	0.19	0.57	0.42	0.24	0.62	0.55	n/a
8	(203)	0.79	0.72	0.63	0.63	0.46	0.27	0.61	0.58	0.56	0.52	0.36	0.22	0.63	0.46	0.27	0.66	0.58	n/a
9	(229)	0.82	0.75	0.65	0.70	0.52	0.30	0.62	0.60	0.57	0.62	0.43	0.26	0.70	0.52	0.30	0.70	0.62	n/a
10	(254)	0.86	0.78	0.67	0.78	0.57	0.34	0.63	0.61	0.58	0.72	0.51	0.30	0.78	0.57	0.34	0.73	0.65	n/a
11-1/4	(286)	0.90	0.81	0.69	0.88	0.65	0.38	0.65	0.62	0.58	0.86	0.60	0.36	0.88	0.65	0.38	0.78	0.69	0.58
12	(305)	0.93	0.83	0.70	0.94	0.69	0.40	0.66	0.63	0.59	0.95	0.67	0.40	0.94	0.69	0.40	0.80	0.71	0.60
14	(356)	1.00	0.89	0.73	1.00	0.80	0.47	0.69	0.65	0.61	1.00	0.84	0.50	1.00	0.80	0.47	0.87	0.77	0.65
16	(406)		0.94	0.77		0.92	0.54	0.72	0.67	0.62		1.00	0.61		0.92	0.54	0.93	0.82	0.69
18	(457)		1.00	0.80		1.00	0.60	0.74	0.69	0.64			0.73		1.00	0.60	0.98	0.87	0.74
20	(508)			0.83			0.67	0.77	0.71	0.65			0.86			0.67	1.00	0.92	0.78
22	(559)			0.87			0.74	0.80	0.73	0.67			0.99			0.74		0.97	0.81
24	(610)			0.90			0.81	0.82	0.75	0.68			1.00			0.81		1.00	0.85
30	(762)			1.00			1.00	0.90	0.82	0.73						1.00			0.95
36	(914)							0.98	0.88	0.77									1.00
> 48	(1219)							1.00	1.00	0.86									

Table 11 — Load adjustment factors for #4 rebar in cracked concrete[1,2,3]

#4 Rebar cracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear ⊥ Toward edge f_{RV}			Edge distance in shear ‖ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef}	in. (mm)	4-1/2 (114)	6 (152)	10 (254)	4-1/2 (114)	6 (152)	10 (254)	4-1/2 (114)	6 (152)	10 (254)	4-1/2 (114)	6 (152)	10 (254)	4-1/2 (114)	6 (152)	10 (254)	4-1/2 (114)	6 (152)	10 (254)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm) 1-3/4	(44)	n/a	n/a	n/a	0.48	0.45	0.41	n/a	n/a	n/a	0.05	0.03	0.02	0.11	0.07	0.04	n/a	n/a	n/a
2-1/2	(64)	0.59	0.57	0.54	0.55	0.50	0.44	0.53	0.53	0.52	0.09	0.06	0.03	0.18	0.12	0.07	n/a	n/a	n/a
3	(76)	0.61	0.58	0.55	0.59	0.53	0.46	0.54	0.53	0.52	0.12	0.08	0.05	0.24	0.16	0.09	n/a	n/a	n/a
4	(102)	0.64	0.61	0.57	0.68	0.60	0.49	0.55	0.54	0.53	0.18	0.12	0.07	0.37	0.24	0.14	n/a	n/a	n/a
5	(127)	0.68	0.64	0.58	0.78	0.67	0.53	0.57	0.55	0.54	0.26	0.17	0.10	0.52	0.34	0.20	n/a	n/a	n/a
5-3/4	(146)	0.70	0.66	0.60	0.86	0.73	0.56	0.58	0.56	0.54	0.32	0.21	0.12	0.64	0.41	0.24	0.56	n/a	n/a
6	(152)	0.71	0.67	0.60	0.89	0.75	0.57	0.58	0.56	0.54	0.34	0.22	0.13	0.68	0.44	0.26	0.57	n/a	n/a
7	(178)	0.75	0.69	0.62	1.00	0.83	0.62	0.59	0.57	0.55	0.43	0.28	0.16	0.86	0.56	0.33	0.62	n/a	n/a
7-1/4	(184)	0.76	0.70	0.62		0.85	0.63	0.60	0.57	0.55	0.45	0.29	0.17	0.90	0.59	0.34	0.63	0.54	n/a
8	(203)	0.79	0.72	0.63		0.91	0.66	0.61	0.58	0.56	0.52	0.34	0.20	1.00	0.68	0.40	0.66	0.57	n/a
9	(229)	0.82	0.75	0.65		1.00	0.70	0.62	0.59	0.56	0.62	0.41	0.24		0.81	0.47	0.70	0.60	n/a
10	(254)	0.86	0.78	0.67			0.75	0.64	0.60	0.57	0.73	0.47	0.28		0.95	0.56	0.74	0.64	n/a
11-1/4	(286)	0.90	0.81	0.69			0.81	0.65	0.61	0.58	0.87	0.57	0.33		1.00	0.66	0.78	0.68	0.56
12	(305)	0.93	0.83	0.70			0.85	0.66	0.62	0.59	0.96	0.62	0.36			0.73	0.81	0.70	0.58
14	(356)	1.00	0.89	0.73			0.95	0.69	0.64	0.60	1.00	0.79	0.46			0.92	0.87	0.75	0.63
16	(406)		0.94	0.77			1.00	0.72	0.66	0.61		0.96	0.56			1.00	0.93	0.81	0.67
18	(457)		1.00	0.80				0.74	0.68	0.63		1.00	0.67				0.99	0.85	0.71
20	(508)			0.83				0.77	0.70	0.64			0.79				1.00	0.90	0.75
22	(559)			0.87				0.80	0.72	0.66			0.91					0.94	0.79
24	(610)			0.90				0.82	0.74	0.67			1.00					0.99	0.83
30	(762)			1.00				0.91	0.80	0.71								1.00	0.92
36	(914)							0.99	0.87	0.76									1.00
> 48	(1219)							1.00	0.99	0.84									

1 Linear interpolation not permitted.
2 Shaded area with reduced edge distance is permitted provided the rebar has no installation torque.
3 When combining multiple load adjustment factors (e.g. for a four-anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use PROFIS Engineering or perform anchor calculation using design equations from ACI 318 Chapter 17.
4 Spacing factor reduction in shear applicable when $c < 3^*h_{ef}$. f_{AV}, is applicable when edge distance, $c < 3^*h_{ef}$. If $c \geq 3^*h_{ef}$, then $f_{AV} = f_{AN}$.
5 Concrete thickness reduction factor in shear, f_{HV}, is applicable when edge distance, $c < 3^*h_{ef}$. If $c \geq 3^*h_{ef}$, then $f_{HV} = 1.0$.

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Table 12 — Load adjustment factors for #5 rebar in uncracked concrete[1,2,3]

#5 Rebar uncracked concrete			Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear ⊥ Toward edge f_{RV}			Edge distance in shear ‖ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef}		in. (mm)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)
Spacing (s) / edge eistance (c_a) / concrete thickness (h), - in. (mm)	1-3/4	(44)	n/a	n/a	n/a	0.24	0.18	0.11	n/a	n/a	n/a	0.04	0.03	0.02	0.08	0.06	0.03	n/a	n/a	n/a
	3-1/8	(79)	0.59	0.57	0.54	0.29	0.22	0.13	0.54	0.53	0.52	0.10	0.07	0.04	0.20	0.13	0.08	n/a	n/a	n/a
	4	(102)	0.61	0.59	0.55	0.33	0.25	0.14	0.55	0.53	0.52	0.15	0.10	0.06	0.29	0.19	0.11	n/a	n/a	n/a
	5	(127)	0.64	0.61	0.57	0.37	0.28	0.16	0.56	0.54	0.53	0.21	0.13	0.08	0.37	0.27	0.16	n/a	n/a	n/a
	6	(152)	0.67	0.63	0.58	0.41	0.31	0.18	0.57	0.55	0.54	0.27	0.18	0.10	0.41	0.31	0.18	n/a	n/a	n/a
	7	(178)	0.70	0.66	0.59	0.46	0.34	0.20	0.58	0.56	0.54	0.34	0.22	0.13	0.46	0.34	0.20	n/a	n/a	n/a
	7-1/8	(181)	0.70	0.66	0.60	0.46	0.34	0.20	0.58	0.56	0.54	0.35	0.23	0.13	0.46	0.34	0.20	0.57	n/a	n/a
	8	(203)	0.73	0.68	0.61	0.51	0.38	0.22	0.59	0.57	0.55	0.41	0.27	0.16	0.51	0.38	0.22	0.61	n/a	n/a
	9	(229)	0.76	0.70	0.62	0.56	0.41	0.24	0.60	0.58	0.55	0.50	0.32	0.19	0.56	0.41	0.24	0.65	0.56	n/a
	10	(254)	0.79	0.72	0.63	0.63	0.46	0.27	0.62	0.59	0.56	0.58	0.38	0.22	0.63	0.46	0.27	0.68	0.59	n/a
	11	(279)	0.82	0.74	0.65	0.69	0.51	0.30	0.63	0.60	0.57	0.67	0.43	0.25	0.69	0.51	0.30	0.71	0.62	n/a
	12	(305)	0.84	0.77	0.66	0.75	0.55	0.32	0.64	0.60	0.57	0.76	0.50	0.29	0.75	0.55	0.32	0.75	0.65	n/a
	14	(356)	0.90	0.81	0.69	0.88	0.64	0.38	0.66	0.62	0.59	0.96	0.62	0.36	0.88	0.64	0.38	0.81	0.70	0.58
	16	(406)	0.96	0.86	0.71	1.00	0.74	0.43	0.69	0.64	0.60	1.00	0.76	0.45	1.00	0.74	0.43	0.86	0.75	0.62
	18	(457)	1.00	0.90	0.74		0.83	0.49	0.71	0.66	0.61		0.91	0.53		0.83	0.49	0.91	0.79	0.66
	20	(508)		0.94	0.77		0.92	0.54	0.73	0.67	0.62		1.00	0.62		0.92	0.54	0.96	0.83	0.70
	22	(559)		0.99	0.79		1.00	0.59	0.75	0.69	0.63			0.72		1.00	0.59	1.00	0.87	0.73
	24	(610)		1.00	0.82			0.65	0.78	0.71	0.65			0.82			0.65		0.91	0.76
	26	(660)			0.85			0.70	0.80	0.73	0.66			0.92			0.70		0.95	0.79
	28	(711)			0.87			0.75	0.82	0.74	0.67			1.00			0.75		0.99	0.82
	30	(762)			0.90			0.81	0.85	0.76	0.68						0.81		1.00	0.85
	36	(914)			0.98			0.97	0.92	0.81	0.72						0.97			0.94
	> 48	(1219)			1.00			1.00	1.00	0.92	0.79						1.00			1.00

Table 13 — Load adjustment factors for #5 rebar in cracked concrete[1,2,3]

#5 Rebar cracked concrete			Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear ⊥ Toward edge f_{RV}			Edge distance in shear ‖ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef}		in. (mm)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)
Spacing (s) / edge eistance (c_a) / concrete thickness (h), - in. (mm)	1-3/4	(44)	n/a	n/a	n/a	0.46	0.43	0.40	n/a	n/a	n/a	0.04	0.03	0.01	0.09	0.06	0.03	n/a	n/a	n/a
	3-1/8	(79)	0.59	0.57	0.54	0.55	0.50	0.44	0.54	0.53	0.52	0.10	0.07	0.03	0.20	0.13	0.07	n/a	n/a	n/a
	4	(102)	0.61	0.59	0.55	0.61	0.55	0.46	0.55	0.53	0.52	0.15	0.10	0.05	0.30	0.19	0.10	n/a	n/a	n/a
	5	(127)	0.64	0.61	0.57	0.69	0.60	0.49	0.56	0.54	0.53	0.21	0.13	0.07	0.41	0.27	0.14	n/a	n/a	n/a
	6	(152)	0.67	0.63	0.58	0.77	0.66	0.53	0.57	0.55	0.53	0.27	0.18	0.09	0.54	0.35	0.18	n/a	n/a	n/a
	7	(178)	0.70	0.66	0.59	0.85	0.72	0.56	0.58	0.56	0.54	0.34	0.22	0.11	0.68	0.44	0.23	n/a	n/a	n/a
	7-1/8	(181)	0.70	0.66	0.60	0.86	0.73	0.56	0.58	0.56	0.54	0.35	0.23	0.12	0.70	0.46	0.23	0.58	n/a	n/a
	8	(203)	0.73	0.68	0.61	0.93	0.78	0.59	0.59	0.57	0.54	0.42	0.27	0.14	0.84	0.54	0.28	0.61	n/a	n/a
	9	(229)	0.76	0.70	0.62	1.00	0.85	0.62	0.60	0.58	0.55	0.50	0.32	0.17	1.00	0.65	0.33	0.65	0.56	n/a
	10	(254)	0.79	0.72	0.63		0.91	0.66	0.62	0.59	0.56	0.58	0.38	0.19		0.76	0.39	0.68	0.59	n/a
	11	(279)	0.82	0.74	0.65		0.98	0.69	0.63	0.60	0.56	0.67	0.44	0.22		0.88	0.45	0.72	0.62	n/a
	12	(305)	0.84	0.77	0.66		1.00	0.73	0.64	0.60	0.57	0.77	0.50	0.26		1.00	0.51	0.75	0.65	n/a
	14	(356)	0.90	0.81	0.69			0.81	0.66	0.62	0.58	0.97	0.63	0.32			0.64	0.81	0.70	0.56
	16	(406)	0.96	0.86	0.71			0.89	0.69	0.64	0.59	1.00	0.77	0.39			0.79	0.86	0.75	0.60
	18	(457)	1.00	0.90	0.74			0.97	0.71	0.66	0.60		0.92	0.47			0.94	0.92	0.79	0.63
	20	(508)		0.94	0.77			1.00	0.73	0.67	0.61		1.00	0.55			1.00	0.97	0.84	0.67
	22	(559)		0.99	0.79				0.76	0.69	0.62			0.63				1.00	0.88	0.70
	24	(610)		1.00	0.82				0.78	0.71	0.63			0.72					0.92	0.73
	26	(660)			0.85				0.80	0.73	0.65			0.81					0.95	0.76
	28	(711)			0.87				0.83	0.74	0.66			0.91					0.99	0.79
	30	(762)			0.90				0.85	0.76	0.67			1.00					1.00	0.82
	36	(914)			0.98				0.92	0.81	0.70									0.90
	> 48	(1219)			1.00				1.00	0.92	0.77									1.00

1 Linear interpolation not permitted.
2 Shaded area with reduced edge distance is permitted provided the rebar has no installation torque.
3 When combining multiple load adjustment factors (e.g. for a four-anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use PROFIS Engineering or perform anchor calculation using design equations from ACI 318 Chapter 17.
4 Spacing factor reduction in shear applicable when $c < 3*h_{ef}$. f_{AV}, is applicable when edge distance, $c < 3*h_{ef}$. If $c \geq 3*h_{ef}$, then $f_{AV} = f_{AN}$.
5 Concrete thickness reduction factor in shear, f_{HV}, is applicable when edge distance, $c < 3*h_{ef}$. If $c \geq 3*h_{ef}$, then $f_{HV} = 1.0$.

3.2.3

Table 14 — Load adjustment factors for #6 rebar in uncracked concrete[1,2,3]

#6 Rebar uncracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ‖ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef}	in. (mm)	6-3/4 (171)	9 (229)	15 (381)	6-3/4 (171)	9 (229)	15 (381)	6-3/4 (171)	9 (229)	15 (381)	6-3/4 (171)	9 (229)	15 (381)	6-3/4 (171)	9 (229)	15 (381)	6-3/4 (171)	9 (229)	15 (381)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																			
1-3/4	(44)	n/a	n/a	n/a	0.24	0.18	0.10	n/a	n/a	n/a	0.03	0.02	0.01	0.07	0.05	0.02	n/a	n/a	n/a
3-3/4	(95)	0.59	0.57	0.54	0.30	0.22	0.13	0.54	0.53	0.52	0.11	0.07	0.04	0.22	0.14	0.08	n/a	n/a	n/a
4	(102)	0.60	0.57	0.54	0.31	0.23	0.13	0.54	0.53	0.52	0.12	0.08	0.04	0.24	0.16	0.08	n/a	n/a	n/a
5	(127)	0.62	0.59	0.56	0.34	0.25	0.15	0.55	0.54	0.53	0.17	0.11	0.06	0.33	0.22	0.12	n/a	n/a	n/a
6	(152)	0.64	0.61	0.57	0.38	0.28	0.16	0.56	0.55	0.53	0.22	0.14	0.08	0.38	0.28	0.16	n/a	n/a	n/a
7	(178)	0.67	0.63	0.58	0.41	0.30	0.18	0.57	0.55	0.54	0.28	0.18	0.10	0.41	0.30	0.18	n/a	n/a	n/a
8	(203)	0.69	0.65	0.59	0.45	0.33	0.19	0.58	0.56	0.54	0.34	0.22	0.12	0.45	0.33	0.19	n/a	n/a	n/a
8-1/2	(216)	0.70	0.66	0.59	0.47	0.34	0.20	0.59	0.56	0.54	0.37	0.24	0.13	0.47	0.34	0.20	0.59	n/a	n/a
9	(229)	0.72	0.67	0.60	0.49	0.36	0.21	0.59	0.57	0.55	0.40	0.26	0.14	0.49	0.36	0.21	0.60	n/a	n/a
10	(254)	0.74	0.69	0.61	0.53	0.39	0.23	0.60	0.58	0.55	0.47	0.31	0.17	0.53	0.39	0.23	0.64	n/a	n/a
10-3/4	(273)	0.76	0.70	0.62	0.57	0.41	0.24	0.61	0.58	0.55	0.53	0.34	0.19	0.57	0.41	0.24	0.66	0.57	n/a
12	(305)	0.79	0.72	0.63	0.64	0.46	0.27	0.62	0.59	0.56	0.62	0.40	0.22	0.64	0.46	0.27	0.70	0.60	n/a
14	(356)	0.84	0.76	0.66	0.74	0.54	0.32	0.64	0.61	0.57	0.78	0.51	0.28	0.74	0.54	0.32	0.75	0.65	n/a
16	(406)	0.89	0.80	0.68	0.85	0.62	0.36	0.66	0.62	0.58	0.96	0.62	0.34	0.85	0.62	0.36	0.80	0.70	n/a
16-3/4	(425)	0.90	0.81	0.69	0.89	0.65	0.38	0.67	0.63	0.58	1.00	0.67	0.36	0.89	0.65	0.38	0.82	0.71	0.58
18	(457)	0.93	0.83	0.70	0.96	0.69	0.41	0.68	0.64	0.59		0.74	0.40	0.96	0.69	0.41	0.85	0.74	0.60
20	(508)	0.98	0.87	0.72	1.00	0.77	0.45	0.70	0.65	0.60		0.87	0.47	1.00	0.77	0.45	0.90	0.78	0.64
22	(559)	1.00	0.91	0.74		0.85	0.50	0.72	0.67	0.61		1.00	0.54		0.85	0.50	0.94	0.82	0.67
24	(610)		0.94	0.77		0.93	0.54	0.74	0.68	0.62			0.62		0.93	0.54	0.99	0.85	0.70
26	(660)		0.98	0.79		1.00	0.59	0.76	0.70	0.63			0.70		1.00	0.59	1.00	0.89	0.72
28	(711)		1.00	0.81			0.63	0.78	0.71	0.64			0.78			0.63		0.92	0.75
30	(762)			0.83			0.68	0.80	0.73	0.65			0.87			0.68		0.95	0.78
36	(914)			0.90			0.81	0.86	0.77	0.68			1.00			0.81		1.00	0.85
> 48	(1219)			1.00			1.00	0.99	0.86	0.74						1.00			0.98

Table 15 — Load adjustment factors for #6 rebar in cracked concrete[1,2,3]

#6 Rebar cracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ‖ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef}	in. (mm)	6-3/4 (171)	9 (229)	15 (381)	6-3/4 (171)	9 (229)	15 (381)	6-3/4 (171)	9 (229)	15 (381)	6-3/4 (171)	9 (229)	15 (381)	6-3/4 (171)	9 (229)	15 (381)	6-3/4 (171)	9 (229)	15 (381)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																			
1-3/4	(44)	n/a	n/a	n/a	0.44	0.42	0.39	n/a	n/a	n/a	0.03	0.02	0.01	0.07	0.05	0.02	n/a	n/a	n/a
3-3/4	(95)	0.59	0.57	0.54	0.55	0.50	0.44	0.54	0.53	0.52	0.11	0.07	0.03	0.22	0.14	0.07	n/a	n/a	n/a
4	(102)	0.60	0.57	0.54	0.57	0.51	0.44	0.54	0.53	0.52	0.12	0.08	0.04	0.24	0.16	0.07	n/a	n/a	n/a
5	(127)	0.62	0.59	0.56	0.63	0.56	0.47	0.55	0.54	0.52	0.17	0.11	0.05	0.34	0.22	0.10	n/a	n/a	n/a
6	(152)	0.64	0.61	0.57	0.69	0.60	0.49	0.56	0.55	0.53	0.22	0.14	0.07	0.44	0.29	0.13	n/a	n/a	n/a
7	(178)	0.67	0.63	0.58	0.76	0.65	0.52	0.57	0.55	0.53	0.28	0.18	0.08	0.56	0.36	0.17	n/a	n/a	n/a
8	(203)	0.69	0.65	0.59	0.82	0.70	0.55	0.58	0.56	0.54	0.34	0.22	0.10	0.68	0.44	0.21	n/a	n/a	n/a
8-1/2	(216)	0.70	0.66	0.59	0.86	0.72	0.56	0.59	0.56	0.54	0.37	0.24	0.11	0.75	0.49	0.23	0.59	n/a	n/a
9	(229)	0.72	0.67	0.60	0.90	0.75	0.57	0.59	0.57	0.54	0.41	0.26	0.12	0.82	0.53	0.25	0.61	n/a	n/a
10	(254)	0.74	0.69	0.61	0.97	0.80	0.60	0.60	0.58	0.55	0.48	0.31	0.14	0.95	0.62	0.29	0.64	n/a	n/a
10-3/4	(273)	0.76	0.70	0.62	1.00	0.84	0.62	0.61	0.58	0.55	0.53	0.35	0.16	1.00	0.69	0.32	0.66	0.57	n/a
12	(305)	0.79	0.72	0.63		0.91	0.66	0.62	0.59	0.55	0.63	0.41	0.19		0.82	0.38	0.70	0.61	n/a
14	(356)	0.84	0.76	0.66		1.00	0.72	0.64	0.61	0.56	0.79	0.51	0.24		1.00	0.48	0.76	0.65	n/a
16	(406)	0.89	0.80	0.68			0.78	0.66	0.62	0.57	0.97	0.63	0.29			0.58	0.81	0.70	n/a
16-3/4	(425)	0.90	0.81	0.69			0.81	0.67	0.63	0.58	1.00	0.67	0.31			0.62	0.83	0.72	0.55
18	(457)	0.93	0.83	0.70			0.85	0.68	0.64	0.58		0.75	0.35			0.70	0.86	0.74	0.57
20	(508)	0.98	0.87	0.72			0.91	0.70	0.65	0.59		0.88	0.41			0.82	0.90	0.78	0.61
22	(559)	1.00	0.91	0.74			0.98	0.72	0.67	0.60		1.00	0.47			0.94	0.95	0.82	0.63
24	(610)		0.94	0.77			1.00	0.74	0.68	0.61			0.54			1.00	0.99	0.86	0.66
26	(660)		0.98	0.79				0.76	0.70	0.62			0.60				1.00	0.89	0.69
28	(711)		1.00	0.81				0.79	0.71	0.63			0.68					0.92	0.72
30	(762)			0.83				0.81	0.73	0.64			0.75					0.96	0.74
36	(914)			0.90				0.87	0.77	0.66			0.98					1.00	0.81
> 48	(1219)			1.00				0.99	0.87	0.72			1.00						0.94

1 Linear interpolation not permitted.

2 Shaded area with reduced edge distance is permitted provided the rebar has no installation torque.

3 When combining multiple load adjustment factors (e.g. for a four-anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use PROFIS Engineering or perform anchor calculation using design equations from ACI 318 Chapter 17.

4 Spacing factor reduction in shear applicable when $c < 3^*h_{ef}$. f_{AV}, is applicable when edge distance, $c < 3^*h_{ef}$. If $c \geq 3^*h_{ef}$, then $f_{AV} = f_{AN}$.

5 Concrete thickness reduction factor in shear, f_{HV}, is applicable when edge distance, $c < 3^*h_{ef}$. If $c \geq 3^*h_{ef}$, then $f_{HV} = 1.0$.

Table 16 — Load adjustment factors for #7 rebar in uncracked concrete[1,2,3]

#7 Rebar uncracked concrete			Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ‖ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef}	in.		7-7/8	10-1/2	17-1/2	7-7/8	10-1/2	17-1/2	7-7/8	10-1/2	17-1/2	7-7/8	10-1/2	17-1/2	7-7/8	10-1/2	17-1/2	7-7/8	10-1/2	17-1/2
	(mm)		(200)	(267)	(445)	(200)	(267)	(445)	(200)	(267)	(445)	(200)	(267)	(445)	(200)	(267)	(445)	(200)	(267)	(445)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)	1-3/4	(44)	n/a	n/a	n/a	0.24	0.17	0.10	n/a	n/a	n/a	0.03	0.02	0.01	0.05	0.04	0.02	n/a	n/a	n/a
	4-3/8	(111)	0.59	0.57	0.54	0.31	0.22	0.13	0.54	0.53	0.52	0.11	0.07	0.04	0.22	0.14	0.07	n/a	n/a	n/a
	5	(127)	0.60	0.58	0.55	0.33	0.23	0.14	0.54	0.53	0.52	0.13	0.09	0.04	0.27	0.17	0.09	n/a	n/a	n/a
	6	(152)	0.62	0.60	0.56	0.36	0.25	0.15	0.55	0.54	0.52	0.17	0.11	0.06	0.35	0.23	0.12	n/a	n/a	n/a
	7	(178)	0.65	0.61	0.57	0.39	0.28	0.16	0.56	0.55	0.53	0.22	0.14	0.07	0.39	0.28	0.15	n/a	n/a	n/a
	8	(203)	0.67	0.63	0.58	0.42	0.30	0.18	0.57	0.55	0.53	0.27	0.17	0.09	0.42	0.30	0.18	n/a	n/a	n/a
	9	(229)	0.69	0.64	0.59	0.45	0.32	0.19	0.58	0.56	0.54	0.32	0.21	0.11	0.45	0.32	0.19	n/a	n/a	n/a
	9-7/8	(251)	0.71	0.66	0.59	0.48	0.34	0.20	0.59	0.56	0.54	0.37	0.24	0.12	0.48	0.34	0.20	0.59	n/a	n/a
	10	(254)	0.71	0.66	0.60	0.49	0.35	0.20	0.59	0.57	0.54	0.38	0.24	0.12	0.49	0.35	0.20	0.59	n/a	n/a
	11	(279)	0.73	0.67	0.60	0.52	0.37	0.22	0.60	0.57	0.55	0.43	0.28	0.14	0.52	0.37	0.22	0.62	n/a	n/a
	12	(305)	0.75	0.69	0.61	0.56	0.40	0.23	0.60	0.58	0.55	0.49	0.32	0.16	0.56	0.40	0.23	0.65	n/a	n/a
	12-1/2	(318)	0.76	0.70	0.62	0.59	0.41	0.24	0.61	0.58	0.55	0.52	0.34	0.17	0.59	0.41	0.24	0.66	0.57	n/a
	14	(356)	0.79	0.72	0.63	0.66	0.46	0.27	0.62	0.59	0.56	0.62	0.40	0.21	0.66	0.46	0.27	0.70	0.60	n/a
	16	(406)	0.83	0.75	0.65	0.75	0.53	0.31	0.64	0.60	0.57	0.76	0.49	0.25	0.75	0.53	0.31	0.75	0.65	n/a
	18	(457)	0.87	0.79	0.67	0.84	0.60	0.35	0.66	0.62	0.57	0.91	0.59	0.30	0.84	0.60	0.35	0.79	0.68	n/a
	19-1/2	(495)	0.91	0.81	0.69	0.92	0.65	0.38	0.67	0.63	0.58	1.00	0.66	0.34	0.92	0.65	0.38	0.82	0.71	0.57
	20	(508)	0.92	0.82	0.69	0.94	0.66	0.39	0.67	0.63	0.58		0.69	0.35	0.94	0.66	0.39	0.83	0.72	0.58
	22	(559)	0.96	0.85	0.71	1.00	0.73	0.43	0.69	0.64	0.59		0.80	0.40	1.00	0.73	0.43	0.87	0.76	0.60
	24	(610)	1.00	0.88	0.73		0.80	0.47	0.71	0.66	0.60		0.91	0.46		0.80	0.47	0.91	0.79	0.63
	26	(660)		0.91	0.75		0.86	0.51	0.73	0.67	0.61		1.00	0.52		0.86	0.51	0.95	0.82	0.66
	28	(711)		0.94	0.77		0.93	0.54	0.74	0.68	0.62			0.58		0.93	0.54	0.99	0.85	0.68
	30	(762)		0.98	0.79		1.00	0.58	0.76	0.70	0.62			0.64		1.00	0.58	1.00	0.88	0.71
	36	(914)		1.00	0.84			0.70	0.81	0.73	0.65			0.85			0.70		0.97	0.77
	> 48	(1219)			0.96			0.93	0.92	0.81	0.70			1.00			0.93		1.00	0.89

Table 17 — Load adjustment factors for #7 rebar in cracked concrete[1,2,3]

#7 Rebar cracked concrete			Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ‖ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef}	in.		7-7/8	10-1/2	17-1/2	7-7/8	10-1/2	17-1/2	7-7/8	10-1/2	17-1/2	7-7/8	10-1/2	17-1/2	7-7/8	10-1/2	17-1/2	7-7/8	10-1/2	17-1/2
	(mm)		(200)	(267)	(445)	(200)	(267)	(445)	(200)	(267)	(445)	(200)	(267)	(445)	(200)	(267)	(445)	(200)	(267)	(445)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)	1-3/4	(44)	n/a	n/a	n/a	0.43	0.41	0.38	n/a	n/a	n/a	0.03	0.02	0.01	0.06	0.04	0.02	n/a	n/a	n/a
	4-3/8	(111)	0.59	0.57	0.54	0.55	0.50	0.44	0.54	0.53	0.52	0.11	0.07	0.03	0.22	0.14	0.07	n/a	n/a	n/a
	5	(127)	0.60	0.58	0.55	0.58	0.52	0.45	0.54	0.53	0.52	0.13	0.09	0.04	0.27	0.17	0.08	n/a	n/a	n/a
	6	(152)	0.62	0.60	0.56	0.64	0.56	0.47	0.55	0.54	0.52	0.18	0.11	0.05	0.35	0.23	0.11	n/a	n/a	n/a
	7	(178)	0.65	0.61	0.57	0.69	0.60	0.49	0.56	0.55	0.53	0.22	0.14	0.07	0.44	0.29	0.13	n/a	n/a	n/a
	8	(203)	0.67	0.63	0.58	0.75	0.64	0.52	0.57	0.55	0.53	0.27	0.18	0.08	0.54	0.35	0.16	n/a	n/a	n/a
	9	(229)	0.69	0.64	0.59	0.81	0.68	0.54	0.58	0.56	0.54	0.32	0.21	0.10	0.65	0.42	0.20	n/a	n/a	n/a
	9-7/8	(251)	0.71	0.66	0.59	0.86	0.72	0.56	0.59	0.56	0.54	0.37	0.24	0.11	0.74	0.48	0.22	0.59	n/a	n/a
	10	(254)	0.71	0.66	0.60	0.87	0.73	0.56	0.59	0.57	0.54	0.38	0.25	0.11	0.76	0.49	0.23	0.59	n/a	n/a
	11	(279)	0.73	0.67	0.60	0.93	0.77	0.59	0.60	0.57	0.54	0.44	0.28	0.13	0.87	0.57	0.26	0.62	n/a	n/a
	12	(305)	0.75	0.69	0.61	1.00	0.82	0.61	0.60	0.58	0.55	0.50	0.32	0.15	1.00	0.65	0.30	0.65	n/a	n/a
	12-1/2	(318)	0.76	0.70	0.62		0.84	0.62	0.61	0.58	0.55	0.53	0.34	0.16		0.69	0.32	0.66	0.57	n/a
	14	(356)	0.79	0.72	0.63		0.91	0.66	0.62	0.59	0.55	0.63	0.41	0.19		0.82	0.38	0.70	0.61	n/a
	16	(406)	0.83	0.75	0.65		1.00	0.71	0.64	0.60	0.56	0.77	0.50	0.23		1.00	0.46	0.75	0.65	n/a
	18	(457)	0.87	0.79	0.67			0.76	0.66	0.62	0.57	0.91	0.59	0.28			0.55	0.79	0.69	n/a
	19-1/2	(495)	0.91	0.81	0.69			0.80	0.67	0.63	0.58	1.00	0.67	0.31			0.62	0.82	0.71	0.55
	20	(508)	0.92	0.82	0.69			0.82	0.67	0.63	0.58		0.70	0.32			0.65	0.84	0.72	0.56
	22	(559)	0.96	0.85	0.71			0.87	0.69	0.64	0.59		0.80	0.37			0.75	0.88	0.76	0.59
	24	(610)	1.00	0.88	0.73			0.93	0.71	0.66	0.59		0.91	0.43			0.85	0.92	0.79	0.61
	26	(660)		0.91	0.75			0.99	0.73	0.67	0.60		1.00	0.48			0.96	0.95	0.82	0.64
	28	(711)		0.94	0.77			1.00	0.74	0.68	0.61			0.54			1.00	0.99	0.86	0.66
	30	(762)		0.98	0.79				0.76	0.70	0.62			0.59				1.00	0.89	0.69
	36	(914)		1.00	0.84				0.81	0.74	0.64			0.78					0.97	0.75
	> 48	(1219)			0.96				0.92	0.81	0.69			1.00					1.00	0.87

1 Linear interpolation not permitted.
2 Shaded area with reduced edge distance is permitted provided the rebar has no installation torque.
3 When combining multiple load adjustment factors (e.g. for a four-anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use PROFIS Engineering or perform anchor calculation using design equations from ACI 318 Chapter 17.
4 Spacing factor reduction in shear applicable when $c < 3*h_{ef}$. f_{AV}, is applicable when edge distance, $c < 3*h_{ef}$. If $c \geq 3*h_{ef}$, then $f_{AV} = f_{AN}$.
5 Concrete thickness reduction factor in shear, f_{HV}, is applicable when edge distance, $c < 3*h_{ef}$. If $c \geq 3*h_{ef}$, then $f_{HV} = 1.0$.

Table 18 — Load adjustment factors for #8 rebar in uncracked concrete[1,2,3]

#8 Rebar uncracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ∥ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef}	in. (mm)	9 (229)	12 (305)	20 (508)	9 (229)	12 (305)	20 (508)	9 (229)	12 (305)	20 (508)	9 (229)	12 (305)	20 (508)	9 (229)	12 (305)	20 (508)	9 (229)	12 (305)	20 (508)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																			
1-3/4	(44)	n/a	n/a	n/a	0.24	0.17	0.10	n/a	n/a	n/a	0.02	0.01	0.01	0.05	0.03	0.01	n/a	n/a	n/a
5	(127)	0.59	0.57	0.54	0.32	0.22	0.13	0.54	0.53	0.52	0.11	0.07	0.03	0.22	0.14	0.07	n/a	n/a	n/a
6	(152)	0.61	0.58	0.55	0.34	0.24	0.14	0.55	0.53	0.52	0.14	0.09	0.04	0.29	0.19	0.09	n/a	n/a	n/a
7	(178)	0.63	0.60	0.56	0.37	0.26	0.15	0.55	0.54	0.52	0.18	0.12	0.06	0.36	0.23	0.11	n/a	n/a	n/a
8	(203)	0.65	0.61	0.57	0.40	0.28	0.16	0.56	0.55	0.53	0.22	0.14	0.07	0.40	0.28	0.14	n/a	n/a	n/a
9	(229)	0.67	0.63	0.58	0.43	0.30	0.17	0.57	0.55	0.53	0.26	0.17	0.08	0.43	0.30	0.17	n/a	n/a	n/a
10	(254)	0.68	0.64	0.58	0.46	0.32	0.19	0.58	0.56	0.54	0.31	0.20	0.10	0.46	0.32	0.19	n/a	n/a	n/a
11	(279)	0.70	0.65	0.59	0.49	0.34	0.20	0.58	0.56	0.54	0.35	0.23	0.11	0.49	0.34	0.20	n/a	n/a	n/a
11-1/4	(286)	0.71	0.66	0.59	0.50	0.34	0.20	0.59	0.56	0.54	0.37	0.24	0.12	0.50	0.34	0.20	0.58	n/a	n/a
12	(305)	0.72	0.67	0.60	0.52	0.36	0.21	0.59	0.57	0.54	0.40	0.26	0.13	0.52	0.36	0.21	0.60	n/a	n/a
13	(330)	0.74	0.68	0.61	0.55	0.38	0.22	0.60	0.57	0.55	0.46	0.30	0.14	0.55	0.38	0.22	0.63	n/a	n/a
14	(356)	0.76	0.69	0.62	0.59	0.41	0.24	0.61	0.58	0.55	0.51	0.33	0.16	0.59	0.41	0.24	0.65	n/a	n/a
14-1/4	(362)	0.76	0.70	0.62	0.60	0.42	0.24	0.61	0.58	0.55	0.52	0.34	0.16	0.60	0.42	0.24	0.66	0.57	n/a
16	(406)	0.79	0.72	0.63	0.67	0.47	0.27	0.62	0.59	0.56	0.62	0.40	0.20	0.67	0.47	0.27	0.70	0.60	n/a
18	(457)	0.83	0.75	0.65	0.76	0.53	0.31	0.64	0.60	0.56	0.74	0.48	0.23	0.76	0.53	0.31	0.74	0.64	n/a
20	(508)	0.87	0.78	0.67	0.84	0.58	0.34	0.65	0.61	0.57	0.87	0.56	0.27	0.84	0.58	0.34	0.78	0.67	n/a
22	(559)	0.90	0.81	0.68	0.93	0.64	0.38	0.67	0.63	0.58	1.00	0.65	0.32	0.93	0.64	0.38	0.82	0.71	n/a
22-1/4	(565)	0.91	0.81	0.69	0.94	0.65	0.38	0.67	0.63	0.58		0.66	0.32	0.94	0.65	0.38	0.82	0.71	0.56
24	(610)	0.94	0.83	0.70	1.00	0.70	0.41	0.68	0.64	0.58		0.74	0.36	1.00	0.70	0.41	0.85	0.74	0.58
26	(660)	0.98	0.86	0.72		0.76	0.45	0.70	0.65	0.59		0.84	0.41		0.76	0.45	0.89	0.77	0.60
28	(711)	1.00	0.89	0.73		0.82	0.48	0.71	0.66	0.60		0.94	0.45		0.82	0.48	0.92	0.80	0.63
30	(762)		0.92	0.75		0.88	0.51	0.73	0.67	0.61		1.00	0.50		0.88	0.51	0.95	0.83	0.65
36	(914)		1.00	0.80		1.00	0.62	0.77	0.70	0.63			0.66		1.00	0.62	1.00	0.91	0.71
> 48	(1219)			0.90			0.82	0.86	0.77	0.67			1.00			0.82		1.00	0.82

Table 19 — Load adjustment factors for #8 rebar in cracked concrete[1,2,3]

#8 Rebar cracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ∥ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef}	in. (mm)	9 (229)	12 (305)	20 (508)	9 (229)	12 (305)	20 (508)	9 (229)	12 (305)	20 (508)	9 (229)	12 (305)	20 (508)	9 (229)	12 (305)	20 (508)	9 (229)	12 (305)	20 (508)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																			
1-3/4	(44)	n/a	n/a	n/a	0.42	0.40	0.38	n/a	n/a	n/a	0.02	0.01	0.01	0.05	0.03	0.01	n/a	n/a	n/a
5	(127)	0.59	0.57	0.54	0.55	0.50	0.44	0.54	0.53	0.52	0.11	0.07	0.03	0.22	0.14	0.07	n/a	n/a	n/a
6	(152)	0.61	0.58	0.55	0.60	0.53	0.46	0.55	0.53	0.52	0.14	0.09	0.04	0.29	0.19	0.09	n/a	n/a	n/a
7	(178)	0.63	0.60	0.56	0.65	0.57	0.47	0.55	0.54	0.52	0.18	0.12	0.05	0.36	0.24	0.11	n/a	n/a	n/a
8	(203)	0.65	0.61	0.57	0.70	0.60	0.49	0.56	0.55	0.53	0.22	0.14	0.07	0.44	0.29	0.13	n/a	n/a	n/a
9	(229)	0.67	0.63	0.58	0.75	0.64	0.51	0.57	0.55	0.53	0.26	0.17	0.08	0.53	0.34	0.16	n/a	n/a	n/a
10	(254)	0.68	0.64	0.58	0.80	0.67	0.53	0.58	0.56	0.53	0.31	0.20	0.09	0.62	0.40	0.19	n/a	n/a	n/a
11	(279)	0.70	0.65	0.59	0.85	0.71	0.55	0.58	0.56	0.54	0.36	0.23	0.11	0.72	0.46	0.22	n/a	n/a	n/a
11-1/4	(286)	0.71	0.66	0.59	0.87	0.72	0.56	0.59	0.56	0.54	0.37	0.24	0.11	0.74	0.48	0.22	0.59	n/a	n/a
12	(305)	0.72	0.67	0.60	0.91	0.75	0.57	0.59	0.57	0.54	0.41	0.26	0.12	0.82	0.53	0.25	0.61	n/a	n/a
13	(330)	0.74	0.68	0.61	0.96	0.79	0.59	0.60	0.57	0.54	0.46	0.30	0.14	0.92	0.60	0.28	0.63	n/a	n/a
14	(356)	0.76	0.69	0.62	1.00	0.83	0.62	0.61	0.58	0.55	0.51	0.33	0.16	1.00	0.67	0.31	0.65	n/a	n/a
14-1/4	(362)	0.76	0.70	0.62		0.84	0.62	0.61	0.58	0.55	0.53	0.34	0.16		0.69	0.32	0.66	0.57	n/a
16	(406)	0.79	0.72	0.63		0.91	0.66	0.62	0.59	0.55	0.63	0.41	0.19		0.82	0.38	0.70	0.61	n/a
18	(457)	0.83	0.75	0.65		1.00	0.70	0.64	0.60	0.56	0.75	0.49	0.23		0.97	0.45	0.74	0.64	n/a
20	(508)	0.87	0.78	0.67			0.75	0.65	0.61	0.57	0.88	0.57	0.26		1.00	0.53	0.78	0.68	n/a
22	(559)	0.90	0.81	0.68			0.80	0.67	0.63	0.58	1.00	0.66	0.31			0.61	0.82	0.71	n/a
22-1/4	(565)	0.91	0.81	0.69			0.80	0.67	0.63	0.58		0.67	0.31			0.62	0.82	0.71	0.55
24	(610)	0.94	0.83	0.70			0.85	0.68	0.64	0.58		0.75	0.35			0.70	0.86	0.74	0.57
26	(660)	0.98	0.86	0.72			0.90	0.70	0.65	0.59		0.84	0.39			0.78	0.89	0.77	0.60
28	(711)	1.00	0.89	0.73			0.95	0.71	0.66	0.60		0.94	0.44			0.88	0.92	0.80	0.62
30	(762)		0.92	0.75			1.00	0.73	0.67	0.60		1.00	0.49			0.97	0.96	0.83	0.64
36	(914)		1.00	0.80				0.77	0.71	0.62			0.64			1.00	1.00	0.91	0.70
> 48	(1219)			0.90				0.87	0.77	0.66			0.98					1.00	0.81

1 Linear interpolation not permitted.
2 Shaded area with reduced edge distance is permitted provided the rebar has no installation torque.
3 When combining multiple load adjustment factors (e.g. for a four-anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use PROFIS Engineering or perform anchor calculation using design equations from ACI 318 Chapter 17.
4 Spacing factor reduction in shear applicable when $c < 3*h_{ef}$. f_{AV}, is applicable when edge distance, $c < 3*h_{ef}$. If $c \geq 3*h_{ef}$, then $f_{AV} = f_{AN}$.
5 Concrete thickness reduction factor in shear, f_{HV}, is applicable when edge distance, $c < 3*h_{ef}$. If $c \geq 3*h_{ef}$, then $f_{HV} = 1.0$.

Table 20 — Load adjustment factors for #9 rebar in uncracked concrete[1,2,3]

#9 Rebar uncracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ‖ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef}	in. (mm)	10-1/8 (257)	13-1/2 (343)	22-1/2 (572)	10-1/8 (257)	13-1/2 (343)	22-1/2 (572)	10-1/8 (257)	13-1/2 (343)	22-1/2 (572)	10-1/8 (257)	13-1/2 (343)	22-1/2 (572)	10-1/8 (257)	13-1/2 (343)	22-1/2 (572)	10-1/8 (257)	13-1/2 (343)	22-1/2 (572)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm): 1-3/4	(44)	n/a	n/a	n/a	0.24	0.17	0.10	n/a	n/a	n/a	0.02	0.01	0.01	0.04	0.02	0.01	n/a	n/a	n/a
5-5/8	(143)	0.59	0.57	0.54	0.33	0.23	0.13	0.54	0.53	0.52	0.11	0.07	0.03	0.22	0.14	0.07	n/a	n/a	n/a
6	(152)	0.60	0.57	0.54	0.33	0.23	0.13	0.54	0.53	0.52	0.12	0.08	0.04	0.24	0.16	0.07	n/a	n/a	n/a
7	(178)	0.61	0.59	0.55	0.36	0.25	0.14	0.55	0.54	0.52	0.15	0.10	0.05	0.30	0.20	0.09	n/a	n/a	n/a
8	(203)	0.63	0.60	0.56	0.38	0.27	0.15	0.55	0.54	0.52	0.18	0.12	0.06	0.37	0.24	0.11	n/a	n/a	n/a
9	(229)	0.65	0.61	0.57	0.41	0.28	0.16	0.56	0.55	0.53	0.22	0.14	0.07	0.41	0.28	0.13	n/a	n/a	n/a
10	(254)	0.66	0.62	0.57	0.44	0.30	0.17	0.57	0.55	0.53	0.26	0.17	0.08	0.44	0.30	0.16	n/a	n/a	n/a
11	(279)	0.68	0.64	0.58	0.46	0.32	0.18	0.57	0.56	0.53	0.30	0.19	0.09	0.46	0.32	0.18	n/a	n/a	n/a
12	(305)	0.70	0.65	0.59	0.49	0.34	0.20	0.58	0.56	0.54	0.34	0.22	0.10	0.49	0.34	0.20	n/a	n/a	n/a
12-7/8	(327)	0.71	0.66	0.60	0.52	0.36	0.21	0.59	0.57	0.54	0.38	0.24	0.11	0.52	0.36	0.21	0.59	n/a	n/a
13	(330)	0.71	0.66	0.60	0.52	0.36	0.21	0.59	0.57	0.54	0.38	0.25	0.12	0.52	0.36	0.21	0.59	n/a	n/a
14	(356)	0.73	0.67	0.60	0.55	0.38	0.22	0.59	0.57	0.54	0.43	0.28	0.13	0.55	0.38	0.22	0.61	n/a	n/a
16	(406)	0.76	0.70	0.62	0.62	0.43	0.25	0.61	0.58	0.55	0.52	0.34	0.16	0.62	0.43	0.25	0.66	n/a	n/a
16-1/4	(413)	0.77	0.70	0.62	0.63	0.43	0.25	0.61	0.58	0.55	0.53	0.35	0.16	0.63	0.43	0.25	0.66	0.57	n/a
18	(457)	0.80	0.72	0.63	0.69	0.48	0.28	0.62	0.59	0.55	0.62	0.40	0.19	0.69	0.48	0.28	0.70	0.60	n/a
20	(508)	0.83	0.75	0.65	0.77	0.54	0.31	0.63	0.60	0.56	0.73	0.47	0.22	0.77	0.54	0.31	0.73	0.64	n/a
22	(559)	0.86	0.77	0.66	0.85	0.59	0.34	0.65	0.61	0.57	0.84	0.55	0.25	0.85	0.59	0.34	0.77	0.67	n/a
24	(610)	0.89	0.80	0.68	0.93	0.64	0.37	0.66	0.62	0.57	0.96	0.62	0.29	0.93	0.64	0.37	0.80	0.70	n/a
25-1/4	(641)	0.91	0.81	0.69	0.97	0.68	0.39	0.67	0.63	0.58	1.00	0.67	0.31	0.97	0.68	0.39	0.83	0.71	0.55
26	(660)	0.93	0.82	0.69	1.00	0.70	0.40	0.68	0.63	0.58		0.70	0.33	1.00	0.70	0.40	0.84	0.73	0.56
28	(711)	0.96	0.85	0.71		0.75	0.43	0.69	0.64	0.59		0.78	0.36		0.75	0.43	0.87	0.75	0.58
30	(762)	0.99	0.87	0.72		0.80	0.46	0.70	0.65	0.59		0.87	0.40		0.80	0.46	0.90	0.78	0.60
36	(914)	1.00	0.94	0.77		0.96	0.55	0.74	0.68	0.61		1.00	0.53		0.96	0.55	0.99	0.85	0.66
> 48	(1219)		1.00	0.86		1.00	0.74	0.82	0.74	0.65			0.82		1.00	0.74	1.00	0.99	0.76

Table 21 — Load adjustment factors for #9 rebar in cracked concrete[1,2,3]

#9 Rebar cracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ‖ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef}	in. (mm)	10-1/8 (257)	13-1/2 (343)	22-1/2 (572)	10-1/8 (257)	13-1/2 (343)	22-1/2 (572)	10-1/8 (257)	13-1/2 (343)	22-1/2 (572)	10-1/8 (257)	13-1/2 (343)	22-1/2 (572)	10-1/8 (257)	13-1/2 (343)	22-1/2 (572)	10-1/8 (257)	13-1/2 (343)	22-1/2 (572)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm): 1-3/4	(44)	n/a	n/a	n/a	0.41	0.39	0.38	n/a	n/a	n/a	0.02	0.01	0.01	0.04	0.02	0.01	n/a	n/a	n/a
5-5/8	(143)	0.59	0.57	0.54	0.56	0.50	0.44	0.54	0.53	0.52	0.11	0.07	0.03	0.22	0.14	0.07	n/a	n/a	n/a
6	(152)	0.60	0.57	0.54	0.57	0.51	0.44	0.54	0.53	0.52	0.12	0.08	0.04	0.24	0.16	0.07	n/a	n/a	n/a
7	(178)	0.61	0.59	0.55	0.61	0.54	0.46	0.55	0.54	0.52	0.15	0.10	0.05	0.30	0.20	0.09	n/a	n/a	n/a
8	(203)	0.63	0.60	0.56	0.65	0.57	0.48	0.55	0.54	0.52	0.19	0.12	0.06	0.37	0.24	0.11	n/a	n/a	n/a
9	(229)	0.65	0.61	0.57	0.70	0.60	0.49	0.56	0.55	0.53	0.22	0.14	0.07	0.44	0.29	0.13	n/a	n/a	n/a
10	(254)	0.66	0.62	0.57	0.74	0.63	0.51	0.57	0.55	0.53	0.26	0.17	0.08	0.52	0.34	0.16	n/a	n/a	n/a
11	(279)	0.68	0.64	0.58	0.79	0.67	0.53	0.57	0.56	0.53	0.30	0.19	0.09	0.60	0.39	0.18	n/a	n/a	n/a
12	(305)	0.70	0.65	0.59	0.84	0.70	0.55	0.58	0.56	0.54	0.34	0.22	0.10	0.68	0.44	0.21	n/a	n/a	n/a
12-7/8	(327)	0.71	0.66	0.60	0.88	0.73	0.56	0.59	0.57	0.54	0.38	0.25	0.11	0.76	0.49	0.23	0.59	n/a	n/a
13	(330)	0.71	0.66	0.60	0.89	0.73	0.56	0.59	0.57	0.54	0.39	0.25	0.12	0.77	0.50	0.23	0.59	n/a	n/a
14	(356)	0.73	0.67	0.60	0.94	0.77	0.58	0.60	0.57	0.54	0.43	0.28	0.13	0.86	0.56	0.26	0.62	n/a	n/a
16	(406)	0.76	0.70	0.62	1.00	0.84	0.62	0.61	0.58	0.55	0.53	0.34	0.16	1.00	0.68	0.32	0.66	n/a	n/a
16-1/4	(413)	0.77	0.70	0.62	1.00	0.85	0.63	0.61	0.58	0.55	0.54	0.35	0.16	1.00	0.70	0.32	0.66	0.58	n/a
18	(457)	0.80	0.72	0.63	1.00	0.91	0.66	0.62	0.59	0.55	0.63	0.41	0.19	1.00	0.82	0.38	0.70	0.61	n/a
20	(508)	0.83	0.75	0.65	1.00	0.99	0.70	0.64	0.60	0.56	0.73	0.48	0.22	1.00	0.95	0.44	0.74	0.64	n/a
22	(559)	0.86	0.77	0.66	1.00	1.00	0.74	0.65	0.61	0.57	0.85	0.55	0.26	1.00	1.00	0.51	0.77	0.67	n/a
24	(610)	0.89	0.80	0.68	1.00	1.00	0.78	0.66	0.62	0.57	0.97	0.63	0.29	1.00	1.00	0.58	0.81	0.70	n/a
25-1/4	(641)	0.91	0.81	0.69	1.00	1.00	0.81	0.67	0.63	0.58	1.00	0.68	0.31	1.00	1.00	0.63	0.83	0.72	0.56
26	(660)	0.93	0.82	0.69	1.00	1.00	0.82	0.68	0.63	0.58	1.00	0.71	0.33	1.00	1.00	0.66	0.84	0.73	0.56
28	(711)	0.96	0.85	0.71	1.00	1.00	0.87	0.69	0.64	0.59	1.00	0.79	0.37	1.00	1.00	0.73	0.87	0.76	0.58
30	(762)	0.99	0.87	0.72	1.00	1.00	0.91	0.70	0.65	0.59	1.00	0.88	0.41	1.00	1.00	0.82	0.90	0.78	0.61
36	(914)	1.00	0.94	0.77	1.00	1.00	1.00	0.74	0.68	0.61	1.00	1.00	0.54	1.00	1.00	1.00	0.99	0.86	0.66
> 48	(1219)	1.00	1.00	0.86	1.00	1.00	1.00	0.83	0.74	0.65	1.00	1.00	0.82	1.00	1.00	1.00	1.00	0.99	0.77

1 Linear interpolation not permitted.
2 Shaded area with reduced edge distance is permitted provided the rebar has no installation torque.
3 When combining multiple load adjustment factors (e.g. for a four-anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use PROFIS Engineering or perform anchor calculation using design equations from ACI 318 Chapter 17.
4 Spacing factor reduction in shear applicable when $c < 3*h_{ef}$. f_{AV}, is applicable when edge distance, $c < 3*h_{ef}$. If $c \geq 3*h_{ef}$, then $f_{AV} = f_{AN}$.
5 Concrete thickness reduction factor in shear, f_{HV}, is applicable when edge distance, $c < 3*h_{ef}$. If $c \geq 3*h_{ef}$, then $f_{HV} = 1.0$.

3.2.3

Table 22 — Load adjustment factors for #10 rebar in uncracked concrete[1,2,3]

#10 Rebar uncracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ‖ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef}	in. (mm)	11-1/4 (286)	15 (381)	25 (635)	11-1/4 (286)	15 (381)	25 (635)	11-1/4 (286)	15 (381)	25 (635)	11-1/4 (286)	15 (381)	25 (635)	11-1/4 (286)	15 (381)	25 (635)	11-1/4 (286)	15 (381)	25 (635)
Spacing (s) / edge eistance (c_a) / concrete thickness (h), - in. (mm)																			
1-3/4	(44)	n/a	n/a	n/a	0.24	0.17	0.09	n/a	n/a	n/a	0.02	0.01	0.00	0.03	0.02	0.01	n/a	n/a	n/a
6-1/4	(159)	0.59	0.57	0.54	0.33	0.23	0.13	0.54	0.53	0.52	0.11	0.07	0.03	0.22	0.14	0.07	n/a	n/a	n/a
7	(178)	0.60	0.58	0.55	0.35	0.24	0.14	0.54	0.53	0.52	0.13	0.08	0.04	0.26	0.17	0.08	n/a	n/a	n/a
8	(203)	0.62	0.59	0.55	0.37	0.26	0.15	0.55	0.54	0.52	0.16	0.10	0.05	0.31	0.20	0.10	n/a	n/a	n/a
9	(229)	0.63	0.60	0.56	0.39	0.27	0.15	0.55	0.54	0.52	0.19	0.12	0.06	0.38	0.24	0.11	n/a	n/a	n/a
10	(254)	0.65	0.61	0.57	0.42	0.29	0.16	0.56	0.55	0.53	0.22	0.14	0.07	0.42	0.29	0.13	n/a	n/a	n/a
11	(279)	0.66	0.62	0.57	0.44	0.31	0.17	0.57	0.55	0.53	0.25	0.16	0.08	0.44	0.31	0.15	n/a	n/a	n/a
12	(305)	0.68	0.63	0.58	0.47	0.32	0.18	0.57	0.55	0.53	0.29	0.19	0.09	0.47	0.32	0.17	n/a	n/a	n/a
13	(330)	0.69	0.64	0.59	0.49	0.34	0.19	0.58	0.56	0.54	0.33	0.21	0.10	0.49	0.34	0.19	n/a	n/a	n/a
14	(356)	0.71	0.66	0.59	0.52	0.36	0.20	0.59	0.56	0.54	0.36	0.24	0.11	0.52	0.36	0.20	n/a	n/a	n/a
14-1/4	(362)	0.71	0.66	0.60	0.52	0.36	0.21	0.59	0.56	0.54	0.37	0.24	0.11	0.52	0.36	0.21	0.59	n/a	n/a
15	(381)	0.72	0.67	0.60	0.54	0.38	0.21	0.59	0.57	0.54	0.40	0.26	0.12	0.54	0.38	0.21	0.60	n/a	n/a
16	(406)	0.74	0.68	0.61	0.57	0.40	0.22	0.60	0.57	0.54	0.45	0.29	0.13	0.57	0.40	0.22	0.62	n/a	n/a
17	(432)	0.75	0.69	0.61	0.60	0.42	0.24	0.60	0.58	0.55	0.49	0.32	0.15	0.60	0.42	0.24	0.64	n/a	n/a
18	(457)	0.77	0.70	0.62	0.64	0.44	0.25	0.61	0.58	0.55	0.53	0.35	0.16	0.64	0.44	0.25	0.66	0.57	n/a
20	(508)	0.80	0.72	0.63	0.71	0.49	0.28	0.62	0.59	0.55	0.62	0.40	0.19	0.71	0.49	0.28	0.70	0.60	n/a
22	(559)	0.83	0.74	0.65	0.78	0.54	0.31	0.63	0.60	0.56	0.72	0.47	0.22	0.78	0.54	0.31	0.73	0.63	n/a
24	(610)	0.86	0.77	0.66	0.85	0.59	0.33	0.65	0.61	0.57	0.82	0.53	0.25	0.85	0.59	0.33	0.76	0.66	n/a
26	(660)	0.89	0.79	0.67	0.92	0.64	0.36	0.66	0.62	0.57	0.92	0.60	0.28	0.92	0.64	0.36	0.79	0.69	n/a
28	(711)	0.91	0.81	0.69	0.99	0.69	0.39	0.67	0.63	0.58	1.00	0.67	0.31	0.99	0.69	0.39	0.82	0.71	0.55
30	(762)	0.94	0.83	0.70	1.00	0.74	0.42	0.68	0.64	0.58		0.74	0.35	1.00	0.74	0.42	0.85	0.74	0.57
36	(914)	1.00	0.90	0.74		0.88	0.50	0.72	0.66	0.60		0.98	0.45		0.88	0.50	0.94	0.81	0.63
> 48	(1219)		1.00	0.82		1.00	0.67	0.79	0.72	0.63		1.00	0.70		1.00	0.67	1.00	0.94	0.72

Table 23 — Load adjustment factors for #10 rebar in cracked concrete[1,2,3]

#10 Rebar cracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ‖ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef}	in. (mm)	11-1/4 (286)	15 (381)	25 (635)	11-1/4 (286)	15 (381)	25 (635)	11-1/4 (286)	15 (381)	25 (635)	11-1/4 (286)	15 (381)	25 (635)	11-1/4 (286)	15 (381)	25 (635)	11-1/4 (286)	15 (381)	25 (635)
Spacing (s) / edge eistance (c_a) / concrete thickness (h), - in. (mm)																			
1-3/4	(44)	n/a	n/a	n/a	0.40	0.39	0.37	n/a	n/a	n/a	0.02	0.01	0.00	0.03	0.02	0.01	n/a	n/a	n/a
6-1/4	(159)	0.59	0.57	0.54	0.56	0.50	0.44	0.54	0.53	0.52	0.11	0.07	0.03	0.22	0.14	0.07	n/a	n/a	n/a
7	(178)	0.60	0.58	0.55	0.58	0.52	0.45	0.54	0.53	0.52	0.13	0.08	0.04	0.26	0.17	0.08	n/a	n/a	n/a
8	(203)	0.62	0.59	0.55	0.62	0.55	0.46	0.55	0.54	0.52	0.16	0.10	0.05	0.32	0.21	0.10	n/a	n/a	n/a
9	(229)	0.63	0.60	0.56	0.66	0.57	0.48	0.55	0.54	0.52	0.19	0.12	0.06	0.38	0.25	0.11	n/a	n/a	n/a
10	(254)	0.65	0.61	0.57	0.70	0.60	0.49	0.56	0.55	0.53	0.22	0.14	0.07	0.44	0.29	0.13	n/a	n/a	n/a
11	(279)	0.66	0.62	0.57	0.74	0.63	0.51	0.57	0.55	0.53	0.26	0.17	0.08	0.51	0.33	0.15	n/a	n/a	n/a
12	(305)	0.68	0.63	0.58	0.78	0.66	0.53	0.57	0.55	0.53	0.29	0.19	0.09	0.58	0.38	0.18	n/a	n/a	n/a
13	(330)	0.69	0.64	0.59	0.82	0.69	0.54	0.58	0.56	0.54	0.33	0.21	0.10	0.66	0.43	0.20	n/a	n/a	n/a
14	(356)	0.71	0.66	0.59	0.87	0.72	0.56	0.59	0.56	0.54	0.37	0.24	0.11	0.73	0.48	0.22	n/a	n/a	n/a
14-1/4	(362)	0.71	0.66	0.60	0.88	0.73	0.56	0.59	0.57	0.54	0.38	0.25	0.11	0.75	0.49	0.23	0.59	n/a	n/a
15	(381)	0.72	0.67	0.60	0.91	0.75	0.57	0.59	0.57	0.54	0.41	0.26	0.12	0.82	0.53	0.25	0.61	n/a	n/a
16	(406)	0.74	0.68	0.61	0.96	0.78	0.59	0.60	0.57	0.54	0.45	0.29	0.14	0.90	0.58	0.27	0.63	n/a	n/a
17	(432)	0.75	0.69	0.61	1.00	0.81	0.61	0.60	0.58	0.55	0.49	0.32	0.15	0.98	0.64	0.30	0.64	n/a	n/a
18	(457)	0.77	0.70	0.62		0.85	0.62	0.61	0.58	0.55	0.54	0.35	0.16	1.00	0.70	0.32	0.66	0.57	n/a
20	(508)	0.80	0.72	0.63		0.91	0.66	0.62	0.59	0.55	0.63	0.41	0.19		0.82	0.38	0.70	0.61	n/a
22	(559)	0.83	0.74	0.65		0.98	0.69	0.63	0.60	0.56	0.72	0.47	0.22		0.94	0.44	0.73	0.63	n/a
24	(610)	0.86	0.77	0.66		1.00	0.73	0.65	0.61	0.57	0.82	0.54	0.25		1.00	0.50	0.77	0.66	n/a
26	(660)	0.89	0.79	0.67			0.77	0.66	0.62	0.57	0.93	0.60	0.28			0.56	0.80	0.69	n/a
28	(711)	0.91	0.81	0.69			0.81	0.67	0.63	0.58	1.00	0.68	0.31			0.63	0.83	0.72	0.55
30	(762)	0.94	0.83	0.70			0.85	0.68	0.64	0.58		0.75	0.35			0.70	0.86	0.74	0.57
36	(914)	1.00	0.90	0.74			0.97	0.72	0.66	0.60		0.98	0.46			0.91	0.94	0.81	0.63
> 48	(1219)		1.00	0.82			1.00	0.79	0.72	0.63		1.00	0.70			1.00	1.00	0.94	0.73

1 Linear interpolation not permitted.

2 Shaded area with reduced edge distance is permitted provided the rebar has no installation torque.

3 When combining multiple load adjustment factors (e.g. for a four-anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use PROFIS Engineering or perform anchor calculation using design equations from ACI 318 Chapter 17.

4 Spacing factor reduction in shear applicable when $c < 3^*h_{ef}$. f_{AV}, is applicable when edge distance, $c < 3^*h_{ef}$. If $c \geq 3^*h_{ef}$, then $f_{AV} = f_{AN}$.

5 Concrete thickness reduction factor in shear, f_{HV}, is applicable when edge distance, $c < 3^*h_{ef}$. If $c \geq 3^*h_{ef}$, then $f_{HV} = 1.0$.

HIT-RE 500 V3 adhesive with HAS threaded rod

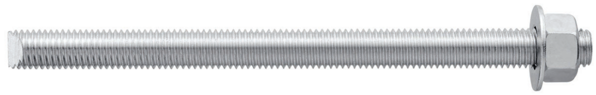


Figure 4 — Hilti HAS threaded rod installation conditions

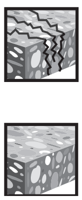
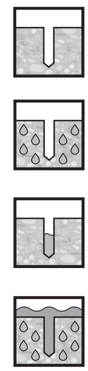
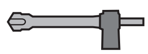
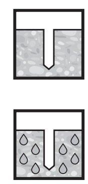
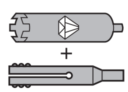
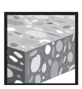
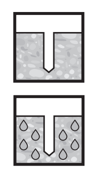
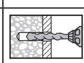
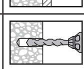
Cracked or uncracked concrete		Permissible drilling methods		Permissible concrete conditions	
	Cracked and uncracked concrete		Hammer drilling with carbide-tipped drill bit		Dry concrete Water-saturated concrete Water-filled holes Submerged (underwater)
			Hilti TE-CD or TE-YD hollow drill bit and VC 20/40 Vacuum		Dry concrete Water-saturated concrete
			Diamond core drill bit with Hilti TE-YRT roughening tool		
	Uncracked concrete		Diamond core drill bit		Dry concrete Water-saturated concrete

Table 24 — Hilti HAS threaded rod installation specifications

Setting information		Symbol	Units	Nominal rod diameter, d						
				3/8	1/2	5/8	3/4	7/8	1	1-1/4
Nominal bit diameter		d_o	in.	7/16	9/16	3/4	7/8	1	1-1/8	1-3/8
Effective embedment	minimum	$h_{ef,min}$	in. (mm)	2-3/8 (60)	2-3/4 (70)	3-1/8 (79)	3-1/2 (89)	3-1/2 (89)	4 (102)	5 (127)
	maximum	$h_{ef,max}$	in. (mm)	7-1/2 (191)	10 (254)	12-1/2 (318)	15 (381)	17-1/2 (445)	20 (508)	25 (635)
Diameter of fixture hole	through-set		in.	1/2	5/8	13/16[1]	15/16[1]	1-1/8[1]	1-1/4[1]	1-1/2[1]
	preset		in.	7/16	9/16	11/16	13/16	15/16	1-1/8	1-3/8
Installation torque		T_{inst}	ft-lb (Nm)	15 (20)	30 (40)	60 (80)	100 (136)	125 (169)	150 (203)	200 (271)
Minimum concrete thickness		h_{min}	in. (mm)	h_{ef}+1-1/4 (h_{ef}+30)		$h_{ef}+2d_o$				
Minimum edge distance[2]		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 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)

1 Install using (2) washers. See Figure 5.
2 Edge distance of 1-3/4-inch (44mm) is permitted provided the installation torque is reduced to 0.30 T_{inst} for 5d < s < 16-in. and to 0.5T_{inst} for s >16-in.

Figure 4 — Hilti HAS threaded rods

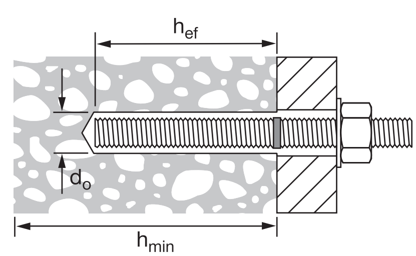


Figure 5 — Installation with (2) washers

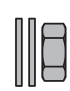


Table 25 — Hilti HIT-RE 500 V3 adhesive design strength with concrete / bond failure for threaded rod in uncracked concrete[1,2,3,4,5,6,7,8,9,11]

Nominal anchor diameter in.	Effective embedment in. (mm)	Tension — ΦN_n				Shear — ΦV_n			
		f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)	f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)
3/8	2-3/8 (60)	2,855 (12.7)	3,125 (13.9)	3,610 (16.1)	4,425 (19.7)	3,075 (13.7)	3,370 (15.0)	3,890 (17.3)	4,765 (21.2)
	3-3/8 (86)	4,835 (21.5)	5,300 (23.6)	6,115 (27.2)	7,490 (33.3)	10,415 (46.3)	11,410 (50.8)	13,175 (58.6)	16,135 (71.8)
	4-1/2 (114)	7,445 (33.1)	8,155 (36.3)	9,225 (41.0)	10,210 (45.4)	16,035 (71.3)	17,570 (78.2)	19,865 (88.4)	21,985 (97.8)
	7-1/2 (191)	13,670 (60.8)	14,305 (63.6)	15,375 (68.4)	17,015 (75.7)	29,440 (131.0)	30,815 (137.1)	33,110 (147.3)	36,645 (163.0)
1/2	2-3/4 (70)	3,555 (15.8)	3,895 (17.3)	4,500 (20.0)	5,510 (24.5)	7,660 (34.1)	8,395 (37.3)	9,690 (43.1)	11,870 (52.8)
	4-1/2 (114)	7,445 (33.1)	8,155 (36.3)	9,420 (41.9)	11,535 (51.3)	16,035 (71.3)	17,570 (78.2)	20,285 (90.2)	24,845 (110.5)
	6 (152)	11,465 (51.0)	12,560 (55.9)	14,500 (64.5)	17,535 (78.0)	24,690 (109.8)	27,045 (120.3)	31,230 (138.9)	37,775 (168.0)
	10 (254)	23,485 (104.5)	24,580 (109.3)	26,410 (117.5)	29,230 (130.0)	50,580 (225.0)	52,940 (235.5)	56,885 (253.0)	62,955 (280.0)
5/8[10]	3-1/8 (79)	4,310 (19.2)	4,720 (21.0)	5,450 (24.2)	6,675 (29.7)	9,280 (41.3)	10,165 (45.2)	11,740 (52.2)	14,380 (64.0)
	5-5/8 (143)	10,405 (46.3)	11,400 (50.7)	13,165 (58.6)	16,120 (71.7)	22,415 (99.7)	24,550 (109.2)	28,350 (126.1)	34,720 (154.4)
	7-1/2 (191)	16,020 (71.3)	17,550 (78.1)	20,265 (90.1)	24,820 (110.4)	34,505 (153.5)	37,800 (168.1)	43,650 (194.2)	53,455 (237.8)
	12-1/2 (318)	34,470 (153.3)	36,900 (164.1)	39,655 (176.4)	43,885 (195.2)	74,245 (330.3)	79,480 (353.5)	85,405 (379.9)	94,520 (420.4)
3/4[10]	3-1/2 (89)	5,105 (22.7)	5,595 (24.9)	6,460 (28.7)	7,910 (35.2)	11,000 (48.9)	12,050 (53.6)	13,915 (61.9)	17,040 (75.8)
	6-3/4 (171)	13,680 (60.9)	14,985 (66.7)	17,305 (77.0)	21,190 (94.3)	29,460 (131.0)	32,275 (143.6)	37,265 (165.8)	45,645 (203.0)
	9 (229)	21,060 (93.7)	23,070 (102.6)	26,640 (118.5)	32,625 (145.1)	45,360 (201.8)	49,690 (221.0)	57,375 (255.2)	70,270 (312.6)
	15 (381)	45,315 (201.6)	49,640 (220.8)	55,035 (244.8)	60,905 (270.9)	97,600 (434.1)	106,915 (475.6)	118,535 (527.3)	131,180 (583.5)
7/8[10]	3-1/2 (89)	5,105 (22.7)	5,595 (24.9)	6,460 (28.7)	7,910 (35.2)	11,000 (48.9)	12,050 (53.6)	13,915 (61.9)	17,040 (75.8)
	7-7/8 (200)	17,235 (76.7)	18,885 (84.0)	21,805 (97.0)	26,705 (118.8)	37,125 (165.1)	40,670 (180.9)	46,960 (208.9)	57,515 (255.8)
	10-1/2 (267)	26,540 (118.1)	29,070 (129.3)	33,570 (149.3)	41,115 (182.9)	57,160 (254.3)	62,615 (278.5)	72,300 (321.6)	88,550 (393.9)
	17-1/2 (445)	57,100 (254.0)	62,550 (278.2)	71,740 (319.1)	79,395 (353.2)	122,990 (547.1)	134,730 (599.3)	154,520 (687.3)	171,005 (760.7)
1[10]	4 (102)	6,240 (27.8)	6,835 (30.4)	7,895 (35.1)	9,665 (43.0)	13,440 (59.8)	14,725 (65.5)	17,000 (75.6)	20,820 (92.6)
	9 (229)	21,060 (93.7)	23,070 (102.6)	26,640 (118.5)	32,625 (145.1)	45,360 (201.8)	49,690 (221.0)	57,375 (255.2)	70,270 (312.6)
	12 (305)	32,425 (144.2)	35,520 (158.0)	41,015 (182.4)	50,230 (223.4)	69,835 (310.6)	76,500 (340.3)	88,335 (392.9)	108,190 (481.3)
	20 (508)	69,765 (310.3)	76,425 (340.0)	88,245 (392.5)	99,635 (443.2)	150,265 (668.4)	164,605 (732.2)	190,070 (845.5)	214,595 (954.6)
1-1/4[10]	5 (127)	8,720 (38.8)	9,555 (42.5)	11,030 (49.1)	13,510 (60.1)	18,785 (83.6)	20,575 (91.5)	23,760 (105.7)	29,100 (129.4)
	11-1/4 (286)	29,430 (130.9)	32,240 (143.4)	37,230 (165.6)	45,595 (202.8)	63,395 (282.0)	69,445 (308.9)	80,185 (356.7)	98,205 (436.8)
	15 (381)	45,315 (201.6)	49,640 (220.8)	57,320 (255.0)	70,200 (312.3)	97,600 (434.1)	106,915 (475.6)	123,455 (549.2)	151,200 (672.6)
	25 (635)	97,500 (433.7)	106,805 (475.1)	123,330 (548.6)	142,175 (632.4)	210,000 (934.1)	230,045 (1023.3)	265,630 (1181.6)	306,220 (1362.1)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8 to convert design strength (factored resistance) value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in Tables 30-41 as necessary to the above values. Compare to the steel values in Table 29. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69.
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.
6 Tabular values are for dry or water saturated concrete conditions.
For water-filled drilled holes multiply design strength by 0.51.
For submerged (under water) applications multiply design strength by 0.45.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength (factored resistance) by λ_a as follows:
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for holes drilled in concrete with carbide tipped hammer drill bit. For diamond core drilling, except as indicated in note 10, multiply above values by 0.55. Diamond core drilling is not permitted for water-filled or underwater (submerged) applications.
10 Diamond core drilling with Hilti TE-YRT roughening tool is permitted for 5/8", 3/4", 7/8", 1", and 1 1/4" diameter anchors for dry and water-saturated concrete conditions. See Table 27.
11 Tabular values are for static loads only. Seismic design is not permitted for uncracked concrete.

Table 26 — Hilti HIT-RE 500 V3 adhesive design strength with concrete / bond failure for threaded rod in cracked concrete[1,2,3,4,5,6,7,8,9,11]

Nominal anchor diameter in.	Effective embedment in. (mm)	Tension — ΦN_n				Shear — ΦV_n			
		f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)	f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)
3/8	2-3/8 (60)	2,020 (9.0)	2,215 (9.9)	2,500 (11.1)	2,655 (11.8)	2,180 (9.7)	2,385 (10.6)	2,690 (12.0)	2,860 (12.7)
	3-3/8 (86)	3,310 (14.7)	3,400 (15.1)	3,550 (15.8)	3,770 (16.8)	7,125 (31.7)	7,325 (32.6)	7,645 (34.0)	8,125 (36.1)
	4-1/2 (114)	4,410 (19.6)	4,535 (20.2)	4,735 (21.1)	5,030 (22.4)	9,500 (42.3)	9,765 (43.4)	10,195 (45.3)	10,835 (48.2)
	7-1/2 (191)	7,350 (32.7)	7,555 (33.6)	7,890 (35.1)	8,385 (37.3)	15,835 (70.4)	16,275 (72.4)	16,990 (75.6)	18,055 (80.3)
1/2	2-3/4 (70)	2,520 (11.2)	2,760 (12.3)	3,185 (14.2)	3,905 (17.4)	5,425 (24.1)	5,945 (26.4)	6,865 (30.5)	8,405 (37.4)
	4-1/2 (114)	5,275 (23.5)	5,780 (25.7)	6,260 (27.8)	6,655 (29.6)	11,360 (50.5)	12,445 (55.4)	13,485 (60.0)	14,330 (63.7)
	6 (152)	7,780 (34.6)	7,995 (35.6)	8,350 (37.1)	8,870 (39.5)	16,755 (74.5)	17,220 (76.6)	17,980 (80.0)	19,110 (85.0)
	10 (254)	12,965 (57.7)	13,325 (59.3)	13,915 (61.9)	14,785 (65.8)	27,930 (124.2)	28,705 (127.7)	29,970 (133.3)	31,850 (141.7)
5/8[10]	3-1/8 (79)	3,050 (13.6)	3,345 (14.9)	3,860 (17.2)	4,730 (21.0)	6,575 (29.2)	7,200 (32.0)	8,315 (37.0)	10,185 (45.3)
	5-5/8 (143)	7,370 (32.8)	8,075 (35.9)	9,325 (41.5)	10,315 (45.9)	15,875 (70.6)	17,390 (77.4)	20,080 (89.3)	22,215 (98.8)
	7-1/2 (191)	11,350 (50.5)	12,395 (55.1)	12,940 (57.6)	13,755 (61.2)	24,440 (108.7)	26,695 (118.7)	27,875 (124.0)	29,620 (131.8)
	12-1/2 (318)	20,100 (89.4)	20,660 (91.9)	21,570 (95.9)	22,920 (102.0)	43,295 (192.6)	44,495 (197.9)	46,460 (206.7)	49,370 (219.6)
3/4[10]	3-1/2 (89)	3,620 (16.1)	3,965 (17.6)	4,575 (20.4)	5,605 (24.9)	7,790 (34.7)	8,535 (38.0)	9,855 (43.8)	12,070 (53.7)
	6-3/4 (171)	9,690 (43.1)	10,615 (47.2)	12,255 (54.5)	14,735 (65.5)	20,870 (92.8)	22,860 (101.7)	26,395 (117.4)	31,740 (141.2)
	9 (229)	14,920 (66.4)	16,340 (72.7)	18,490 (82.2)	19,650 (87.4)	32,130 (142.9)	35,195 (156.6)	39,820 (177.1)	42,320 (188.2)
	15 (381)	28,715 (127.7)	29,510 (131.3)	30,815 (137.1)	32,745 (145.7)	61,850 (275.1)	63,565 (282.7)	66,370 (295.2)	70,530 (313.7)
7/8[10]	3-1/2 (89)	3,620 (16.1)	3,965 (17.6)	4,575 (20.4)	5,605 (24.9)	7,790 (34.7)	8,535 (38.0)	9,855 (43.8)	12,070 (53.7)
	7-7/8 (200)	12,210 (54.3)	13,375 (59.5)	15,445 (68.7)	18,915 (84.1)	26,300 (117.0)	28,810 (128.2)	33,265 (148.0)	40,740 (181.2)
	10-1/2 (267)	18,800 (83.6)	20,590 (91.6)	23,780 (105.8)	26,530 (118.0)	40,490 (180.1)	44,355 (197.3)	51,215 (227.8)	57,140 (254.2)
	17-1/2 (445)	38,775 (172.5)	39,850 (177.3)	41,605 (185.1)	44,215 (196.7)	83,510 (371.5)	85,825 (381.8)	89,610 (398.6)	95,230 (423.6)
1[10]	4 (102)	4,420 (19.7)	4,840 (21.5)	5,590 (24.9)	6,845 (30.4)	9,520 (42.3)	10,430 (46.4)	12,040 (53.6)	14,750 (65.6)
	9 (229)	14,920 (66.4)	16,340 (72.7)	18,870 (83.9)	23,110 (102.8)	32,130 (142.9)	35,195 (156.6)	40,640 (180.8)	49,775 (221.4)
	12 (305)	22,965 (102.2)	25,160 (111.9)	29,050 (129.2)	34,650 (154.1)	49,465 (220.0)	54,190 (241.0)	62,570 (278.3)	74,630 (332.0)
	20 (508)	49,415 (219.8)	52,045 (231.5)	54,340 (241.7)	57,750 (256.9)	106,435 (473.4)	112,100 (498.6)	117,045 (520.6)	124,385 (553.3)
1-1/4[10]	5 (127)	6,175 (27.5)	6,765 (30.1)	7,815 (34.8)	9,570 (42.6)	13,305 (59.2)	14,575 (64.8)	16,830 (74.9)	20,610 (91.7)
	11-1/4 (286)	20,850 (92.7)	22,840 (101.6)	26,370 (117.3)	32,295 (143.7)	44,905 (199.7)	49,190 (218.8)	56,800 (252.7)	69,565 (309.4)
	15 (381)	32,095 (142.8)	35,160 (156.4)	40,600 (180.6)	49,725 (221.2)	69,135 (307.5)	75,730 (336.9)	87,445 (389.0)	107,100 (476.4)
	25 (635)	69,060 (307.2)	75,655 (336.5)	80,800 (359.4)	85,865 (381.9)	148,750 (661.7)	162,945 (724.8)	174,030 (774.1)	184,945 (822.7)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8 to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 30-41 as necessary to the above values. Compare to the steel values in table 29. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69.
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.
6 Tabular values are for dry or water saturated concrete conditions.
For water-filled drilled holes multiply design strength by 0.51.
For submerged (under water) applications multiply design strength by 0.44.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λ_a as follows:
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for holes drilled in concrete with carbide tipped hammer drill bit. Diamond core drilling is not permitted in cracked concrete conditions except as indicated in note 10.
10 Diamond core drilling with Hilti TE-YRT roughening tool is permitted for 5/8" 3/4", 7/8", 1", and 1 1/4" diameter anchors for dry and water-saturated concrete conditions. See Table 28
11 Tabular values are for static loads only. For seismic loads, multiply cracked concrete tabular values in tension and shear by α_{seis} indicated below.
See section 3.1.8 for additional information on seismic applications.
3/8-in. diameter - α_{seis} = 0.69
1/2-in. diameter - α_{seis} = 0.70
5/8-in. diameter - α_{seis} = 0.71
3/4-in. diameter and larger - α_{seis} = 0.75

3.2.3

Table 27 — Hilti HIT-RE 500 V3 for Core Drilled Holes with TE-YRT Roughening Tool adhesive design strength with concrete / bond failure for threaded rod in uncracked concrete[1,2,3,4,5,6,7,8,9]

Nominal anchor diameter in.	Effective embedment in. (mm)	Tension — ΦN_n				Shear — ΦV_n			
		f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)	f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)
5/8	3-1/8 (79)	4,310 (19.2)	4,720 (21.0)	5,450 (24.2)	6,675 (29.7)	9,280 (41.3)	10,165 (45.2)	11,740 (52.2)	14,380 (64.0)
	5-5/8 (143)	10,405 (46.3)	11,400 (50.7)	13,165 (58.6)	15,865 (70.6)	22,415 (99.7)	24,550 (109.2)	28,350 (126.1)	34,170 (152.0)
	7-1/2 (191)	16,020 (71.3)	17,550 (78.1)	20,265 (90.1)	21,155 (94.1)	34,505 (153.5)	37,800 (168.1)	43,650 (194.2)	45,565 (202.7)
	12-1/2 (318)	34,470 (153.3)	35,255 (156.8)	35,255 (156.8)	35,255 (156.8)	74,245 (330.3)	75,940 (337.8)	75,940 (337.8)	75,940 (337.8)
3/4	3-1/2 (89)	5,105 (22.7)	5,595 (24.9)	6,460 (28.7)	7,910 (35.2)	11,000 (48.9)	12,050 (53.6)	13,915 (61.9)	17,040 (75.8)
	6-3/4 (171)	13,680 (60.9)	14,985 (66.7)	17,305 (77.0)	21,190 (94.3)	29,460 (131.0)	32,275 (143.6)	37,265 (165.8)	45,645 (203.0)
	9 (229)	21,060 (93.7)	23,070 (102.6)	26,640 (118.5)	29,360 (130.6)	45,360 (201.8)	49,690 (221.0)	57,375 (255.2)	63,235 (281.3)
	11-1/4 (286)	29,430 (130.9)	32,240 (143.4)	36,700 (163.2)	36,700 (163.2)	63,395 (282.0)	69,445 (308.9)	79,045 (351.6)	79,045 (351.6)
7/8	3-1/2 (89)	5,105 (22.7)	5,595 (24.9)	6,460 (28.7)	7,910 (35.2)	11,000 (48.9)	12,050 (53.6)	13,915 (61.9)	17,040 (75.8)
	7-7/8 (200)	17,235 (76.7)	18,885 (84.0)	21,805 (97.0)	26,705 (118.8)	37,125 (165.1)	40,670 (180.9)	46,960 (208.9)	57,515 (255.8)
	10-1/2 (267)	26,540 (118.1)	29,070 (129.3)	33,570 (149.3)	38,275 (170.3)	57,160 (254.3)	62,615 (278.5)	72,300 (321.6)	82,435 (366.7)
	17-1/2 (445)	57,100 (254.0)	62,550 (278.2)	63,790 (283.8)	63,790 (283.8)	122,990 (547.1)	134,730 (599.3)	137,390 (611.1)	137,390 (611.1)
1	4 (102)	6,240 (27.8)	6,835 (30.4)	7,895 (35.1)	9,665 (43.0)	13,440 (59.8)	14,725 (65.5)	17,000 (75.6)	20,820 (92.6)
	9 (229)	21,060 (93.7)	23,070 (102.6)	26,640 (118.5)	32,625 (145.1)	45,360 (201.8)	49,690 (221.0)	57,375 (255.2)	70,270 (312.6)
	12 (305)	32,425 (144.2)	35,520 (158.0)	41,015 (182.4)	48,030 (213.6)	69,835 (310.6)	76,500 (340.3)	88,335 (392.9)	103,445 (460.1)
	20 (508)	69,765 (310.3)	76,425 (340.0)	80,050 (356.1)	80,050 (356.1)	150,265 (668.4)	164,605 (732.2)	172,410 (766.9)	172,410 (766.9)
1-1/4	5 (127)	8,720 (38.8)	9,555 (42.5)	11,030 (49.1)	13,510 (60.1)	18,785 (83.6)	20,575 (91.5)	23,760 (105.7)	29,100 (129.4)
	11-1/4 (286)	29,430 (130.9)	32,240 (143.4)	37,230 (165.6)	45,595 (202.8)	63,395 (282.0)	69,445 (308.9)	80,185 (356.7)	98,205 (436.8)
	15 (381)	45,315 (201.6)	49,640 (220.8)	57,320 (255.0)	68,535 (304.9)	97,600 (434.1)	106,915 (475.6)	123,455 (549.2)	147,615 (656.6)
	25 (635)	97,500 (433.7)	106,805 (475.1)	114,225 (508.1)	114,225 (508.1)	210,000 (934.1)	230,045 (1023.3)	246,025 (1094.4)	246,025 (1094.4)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8 to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 30-41 as necessary to the above values. Compare to the steel values in table 29. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69.
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.
6 Tabular values are for dry or water saturated concrete conditions. Water-filled and submerged (under water) applications are not permitted for this hole preparation method.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λ_a as follows:
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for static loads only. Seismic design is not permitted for uncracked concrete.

Table 28 — Hilti HIT-RE 500 V3 for Core Drilled Holes with TE-YRT Roughening Tool adhesive design strength with concrete / bond failure for threaded rod in cracked concrete[1,2,3,4,5,6,7,8,9]

Nominal anchor diameter in.	Effective embedment in. (mm)	Tension — ΦN_n				Shear — ΦV_n			
		f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)	f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)
5/8	3-1/8 (79)	3,050 (13.6)	3,345 (14.9)	3,510 (15.6)	3,510 (15.6)	6,575 (29.2)	7,200 (32.0)	7,560 (33.6)	7,560 (33.6)
	5-5/8 (143)	6,320 (28.1)	6,320 (28.1)	6,320 (28.1)	6,320 (28.1)	13,605 (60.5)	13,605 (60.5)	13,605 (60.5)	13,605 (60.5)
	7-1/2 (191)	8,425 (37.5)	8,425 (37.5)	8,425 (37.5)	8,425 (37.5)	18,145 (80.7)	18,145 (80.7)	18,145 (80.7)	18,145 (80.7)
	12-1/2 (318)	14,040 (62.5)	14,040 (62.5)	14,040 (62.5)	14,040 (62.5)	30,240 (134.5)	30,240 (134.5)	30,240 (134.5)	30,240 (134.5)
3/4	3-1/2 (89)	3,620 (16.1)	3,965 (17.6)	4,575 (20.4)	4,690 (20.9)	7,790 (34.7)	8,535 (38.0)	9,855 (43.8)	10,100 (44.9)
	6-3/4 (171)	9,045 (40.2)	9,045 (40.2)	9,045 (40.2)	9,045 (40.2)	19,485 (86.7)	19,485 (86.7)	19,485 (86.7)	19,485 (86.7)
	9 (229)	12,060 (53.6)	12,060 (53.6)	12,060 (53.6)	12,060 (53.6)	25,975 (115.5)	25,975 (115.5)	25,975 (115.5)	25,975 (115.5)
	11-1/4 (286)	15,075 (67.1)	15,075 (67.1)	15,075 (67.1)	15,075 (67.1)	32,470 (144.4)	32,470 (144.4)	32,470 (144.4)	32,470 (144.4)
7/8	3-1/2 (89)	3,620 (16.1)	3,965 (17.6)	4,575 (20.4)	5,440 (24.2)	7,790 (34.7)	8,535 (38.0)	9,855 (43.8)	11,720 (52.1)
	7-7/8 (200)	12,210 (54.3)	12,240 (54.4)	12,240 (54.4)	12,240 (54.4)	26,300 (117.0)	26,365 (117.3)	26,365 (117.3)	26,365 (117.3)
	10-1/2 (267)	16,320 (72.6)	16,320 (72.6)	16,320 (72.6)	16,320 (72.6)	35,155 (156.4)	35,155 (156.4)	35,155 (156.4)	35,155 (156.4)
	17-1/2 (445)	27,205 (121.0)	27,205 (121.0)	27,205 (121.0)	27,205 (121.0)	58,595 (260.6)	58,595 (260.6)	58,595 (260.6)	58,595 (260.6)
1	4 (102)	4,420 (19.7)	4,840 (21.5)	5,590 (24.9)	6,845 (30.4)	9,520 (42.3)	10,430 (46.4)	12,040 (53.6)	14,750 (65.6)
	9 (229)	14,920 (66.4)	15,990 (71.1)	15,990 (71.1)	15,990 (71.1)	32,130 (142.9)	34,440 (153.2)	34,440 (153.2)	34,440 (153.2)
	12 (305)	21,320 (94.8)	21,320 (94.8)	21,320 (94.8)	21,320 (94.8)	45,920 (204.3)	45,920 (204.3)	45,920 (204.3)	45,920 (204.3)
	20 (508)	35,530 (158.0)	35,530 (158.0)	35,530 (158.0)	35,530 (158.0)	76,530 (340.4)	76,530 (340.4)	76,530 (340.4)	76,530 (340.4)
1-1/4	5 (127)	6,175 (27.5)	6,765 (30.1)	7,815 (34.8)	9,570 (42.6)	13,305 (59.2)	14,575 (64.8)	16,830 (74.9)	20,610 (91.7)
	11-1/4 (286)	20,850 (92.7)	22,840 (101.6)	23,690 (105.4)	23,690 (105.4)	44,905 (199.7)	49,190 (218.8)	51,025 (227.0)	51,025 (227.0)
	15 (381)	31,590 (140.5)	31,590 (140.5)	31,590 (140.5)	31,590 (140.5)	68,035 (302.6)	68,035 (302.6)	68,035 (302.6)	68,035 (302.6)
	25 (635)	52,645 (234.2)	52,645 (234.2)	52,645 (234.2)	52,645 (234.2)	113,390 (504.4)	113,390 (504.4)	113,390 (504.4)	113,390 (504.4)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8 to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 30-41 as necessary to the above values. Compare to the steel values in table 29. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69.
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.
6 Tabular values are for dry or water saturated concrete conditions. Water-filled and submerged (under water) applications are not permitted for this hole preparation method.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λ_a as follows:
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for static loads only. Seismic design is not permitted for uncracked concrete. For seismic loads, multiply cracked concrete tabular values in tension and shear by α_{seis}=0.75. See section 3.1.8 for additional information on seismic applications.

3.2.3

Table 29 — Steel design strength for Hilti HAS threaded rods for use with ACI 318 Chapter 17

Nominal anchor diameter in.	HAS-V-36 / HAS-V-36 HDG ASTM F1554 Gr.36[4,6]			HAS-E-55 / HAS-E-55 HDG ASTM F1554 Gr. 55[4,6]			HAS-B-105 / HAS-B-105 HDG ASTM A193 B7 and ASTM F 1554 Gr.105[4,6]			HAS-R stainless steel ASTM F593 (3/8-in to 1-in)[5] ASTM A193 (1-1/8-in to 2-in)[4]		
	Tensile[1] ΦN_{sa} lb (kN)	Shear[2] ΦV_{sa} lb (kN)	Seismic Shear[3] $\Phi V_{sa,eq}$ lb (kN)	Tensile[1] ΦN_{sa} lb (kN)	Shear[2] ΦV_{sa} lb (kN)	Seismic Shear[3] $\Phi V_{sa,eq}$ lb (kN)	Tensile[1] ΦN_{sa} lb (kN)	Shear[2] ΦV_{sa} lb (kN)	Seismic Shear[3] $\Phi V_{sa,eq}$ lb (kN)	Tensile[1] ΦN_{sa} lb (kN)	Shear[2] ΦV_{sa} lb (kN)	Seismic Shear[3] $\Phi V_{sa,eq}$ lb (kN)
3/8	3,370 (15.0)	1,750 (7.8)	1,050 (4.7)	4,360 (19.4)	2,270 (10.1)	2,270 (10.1)	7,270 (32.3)	3,780 (16.8)	3,780 (16.8)	5,040 (22.4)	2,790 (12.4)	2,230 (9.9)
1/2	6,175 (27.5)	3,210 (14.3)	1,925 (8.6)	7,985 (35.5)	4,150 (18.5)	4,150 (18.5)	13,305 (59.2)	6,920 (30.8)	6,920 (30.8)	9,225 (41.0)	5,110 (22.7)	4,090 (18.2)
5/8	9,835 (43.7)	5,110 (22.7)	3,065 (13.6)	12,715 (56.6)	6,610 (29.4)	6,610 (29.4)	21,190 (94.3)	11,020 (49.0)	11,020 (49.0)	14,690 (65.3)	8,135 (36.2)	6,510 (29.0)
3/4	14,550 (64.7)	7,565 (33.7)	4,540 (20.2)	18,820 (83.7)	9,785 (43.5)	9,785 (43.5)	31,360 (139.5)	16,310 (72.6)	16,310 (72.6)	18,485 (82.2)	10,235 (45.5)	8,190 (36.4)
7/8	20,085 (89.3)	10,445 (46.5)	6,265 (27.9)	25,975 (115.5)	13,505 (60.1)	13,505 (60.1)	43,285 (192.5)	22,510 (100.1)	22,510 (100.1)	25,510 (113.5)	14,125 (62.8)	11,300 (50.3)
1	26,350 (117.2)	13,700 (60.9)	8,220 (36.6)	34,075 (151.6)	17,720 (78.8)	17,720 (78.8)	56,785 (252.6)	29,530 (131.4)	29,530 (131.4)	33,465 (148.9)	18,535 (82.4)	14,830 (66.0)
1-1/4	42,160 (187.5)	21,920 (97.5)	13,150 (58.5)	54,515 (242.5)	28,345 (126.1)	28,345 (126.1)	90,855 (404.1)	47,245 (210.2)	47,245 (210.2)	41,430 (184.3)	21,545 (95.8)	17,235 (76.7)

1 Tensile = $\phi A_{se,N} f_{uta}$ as noted in ACI 318 17.4.1.2
2 Shear = $\phi\ 0.60\ A_{se,V} f_{uta}$ as noted in ACI 318 17.5.1.2b.
3 Seismic Shear = $\alpha_{V,seis}\ \phi\ V_{sa}$: Reduction factor for seismic shear only. See ACI 318 for additional information on seismic applications.
4 HAS-V, HAS-E (3/8-in to 1-1/4-in), HAS-B, and HAS-R (Class 1; 1-1/4-in) threaded rods are considered ductile steel elements (including HDG rods).
5 HAS-R (CW1 and CW2; 3/8-in to 1-in) threaded rods are considered brittle steel elements.
6 3/8-inch dia. threaded rods are not included in the ASTM F1554 standard. Hilti 3/8-inch dia. HAS-V, HAS-E, and HAS-E-B (incl. HDG) threaded rods meet the chemical composition and mechanical property requirements of ASTM F1554.

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Table 30 — Load adjustment factors for 3/8-in. diameter threaded rods in uncracked concrete[1,2,3]

3/8-in. threaded rods uncracked concrete	Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[4] f_{AV}				Edge distance in shear ⊥ Toward edge f_{RV}				Edge distance in shear ∥ To and away from edge f_{RV}				Concrete thickness factor in shear[5] f_{HV}			
Embedment h_{ef} in. (mm)	2-3/8 (60)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)	2-3/8 (60)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)	2-3/8 (60)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)	2-3/8 (60)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)	2-3/8 (60)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)	2-3/8 (60)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																								
1-3/4 (44)	n/a	n/a	n/a	n/a	0.35	0.26	0.21	0.12	n/a	n/a	n/a	n/a	0.23	0.07	0.05	0.03	0.35	0.14	0.09	0.05	n/a	n/a	n/a	n/a
1-7/8 (48)	0.58	0.58	0.57	0.54	0.36	0.27	0.22	0.13	0.57	0.53	0.52	0.52	0.25	0.08	0.05	0.03	0.36	0.16	0.10	0.06	n/a	n/a	n/a	n/a
2 (51)	0.58	0.58	0.57	0.54	0.37	0.28	0.23	0.13	0.57	0.53	0.52	0.52	0.28	0.09	0.06	0.03	0.37	0.17	0.11	0.06	n/a	n/a	n/a	n/a
3 (76)	0.62	0.62	0.61	0.57	0.48	0.34	0.27	0.16	0.61	0.55	0.54	0.52	0.51	0.16	0.10	0.06	0.48	0.32	0.21	0.11	n/a	n/a	n/a	n/a
3-5/8 (92)	0.65	0.65	0.63	0.58	0.56	0.38	0.30	0.17	0.63	0.56	0.54	0.53	0.68	0.21	0.14	0.07	0.56	0.38	0.27	0.15	0.72	n/a	n/a	n/a
4 (102)	0.66	0.66	0.65	0.59	0.62	0.41	0.31	0.18	0.64	0.57	0.55	0.53	0.79	0.24	0.16	0.09	0.62	0.41	0.31	0.17	0.75	n/a	n/a	n/a
4-5/8 (117)	0.69	0.69	0.67	0.60	0.71	0.45	0.35	0.20	0.66	0.58	0.56	0.54	0.98	0.30	0.20	0.11	0.71	0.45	0.35	0.20	0.81	0.55	n/a	n/a
5 (127)	0.70	0.70	0.69	0.61	0.77	0.48	0.36	0.21	0.68	0.58	0.56	0.54	1.00	0.34	0.22	0.12	0.77	0.48	0.36	0.21	0.84	0.57	n/a	n/a
5-3/4 (146)	0.73	0.73	0.71	0.63	0.89	0.55	0.40	0.23	0.70	0.59	0.57	0.55		0.42	0.27	0.15	0.89	0.55	0.40	0.23	0.91	0.61	0.53	n/a
6 (152)	0.74	0.74	0.72	0.63	0.92	0.58	0.42	0.24	0.71	0.60	0.57	0.55		0.45	0.29	0.16	0.92	0.58	0.42	0.24	0.92	0.63	0.54	n/a
7 (178)	0.78	0.78	0.76	0.66	1.00	0.67	0.48	0.28	0.75	0.61	0.59	0.56		0.57	0.37	0.20	1.00	0.67	0.48	0.28	1.00	0.68	0.58	n/a
8 (203)	0.82	0.82	0.80	0.68		0.77	0.55	0.32	0.79	0.63	0.60	0.57		0.69	0.45	0.24		0.77	0.55	0.32		0.72	0.63	n/a
8-3/4 (222)	0.86	0.86	0.82	0.69		0.84	0.61	0.35	0.81	0.64	0.61	0.57		0.79	0.51	0.28		0.84	0.61	0.35		0.76	0.65	0.53
9 (229)	0.87	0.87	0.83	0.70		0.86	0.62	0.36	0.82	0.65	0.61	0.57		0.83	0.54	0.29		0.86	0.62	0.36		0.77	0.66	0.54
10 (254)	0.91	0.91	0.87	0.72		0.96	0.69	0.40	0.86	0.66	0.62	0.58		0.97	0.63	0.34		0.96	0.69	0.40		0.81	0.70	0.57
11 (279)	0.95	0.95	0.91	0.74		1.00	0.76	0.44	0.89	0.68	0.63	0.59		1.00	0.72	0.39		1.00	0.76	0.44		0.85	0.73	0.60
12 (305)	0.99	0.99	0.94	0.77			0.83	0.48	0.93	0.70	0.65	0.60			0.83	0.45			0.83	0.48		0.88	0.77	0.63
14 (356)	1.00	1.00	1.00	0.81			0.97	0.56	1.00	0.73	0.67	0.61			1.00	0.57			0.97	0.56		0.96	0.83	0.68
16 (406)				0.86			1.00	0.64		0.76	0.70	0.63				0.69			1.00	0.64		1.00	0.88	0.72
18 (457)				0.90				0.72		0.79	0.72	0.65				0.83				0.72			0.94	0.77
24 (610)				1.00				0.96		0.89	0.79	0.70				1.00				0.96			1.00	0.88
30 (762)								1.00		0.99	0.87	0.74								1.00				0.99
36 (914)										1.00	0.94	0.79												1.00
> 48 (1219)											1.00	0.89												

Table 31 — Load adjustment factors for 3/8-in. diameter threaded rods in cracked concrete[1,2,3]

3/8-in. threaded rods cracked concrete	Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[4] f_{AV}				Edge distance in shear ⊥ Toward edge f_{RV}				Edge distance in shear ∥ To and away from edge f_{RV}				Concrete thickness factor in shear[5] f_{HV}			
Embedment h_{ef} in. (mm)	2-3/8 (60)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)	2-3/8 (60)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)	2-3/8 (60)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)	2-3/8 (60)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)	2-3/8 (60)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)	2-3/8 (60)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																								
1-3/4 (44)	n/a	n/a	n/a	n/a	0.50	0.50	0.49	0.43	n/a	n/a	n/a	n/a	0.23	0.07	0.06	0.03	0.46	0.15	0.11	0.07	n/a	n/a	n/a	n/a
1-7/8 (48)	0.58	0.58	0.57	0.54	0.52	0.52	0.50	0.44	0.57	0.53	0.53	0.52	0.26	0.08	0.06	0.04	0.51	0.16	0.12	0.07	n/a	n/a	n/a	n/a
2 (51)	0.58	0.58	0.57	0.54	0.53	0.53	0.51	0.44	0.57	0.53	0.53	0.52	0.28	0.09	0.07	0.04	0.53	0.18	0.14	0.08	n/a	n/a	n/a	n/a
3 (76)	0.62	0.62	0.61	0.57	0.63	0.63	0.60	0.49	0.61	0.55	0.54	0.53	0.52	0.17	0.12	0.07	0.63	0.33	0.25	0.15	n/a	n/a	n/a	n/a
3-5/8 (92)	0.65	0.65	0.63	0.58	0.70	0.70	0.66	0.53	0.63	0.56	0.55	0.54	0.69	0.22	0.17	0.10	0.70	0.44	0.33	0.20	0.72	n/a	n/a	n/a
4 (102)	0.66	0.66	0.65	0.59	0.74	0.74	0.70	0.55	0.64	0.57	0.56	0.54	0.80	0.26	0.19	0.11	0.74	0.51	0.38	0.23	0.76	n/a	n/a	n/a
4-5/8 (117)	0.69	0.69	0.67	0.60	0.81	0.81	0.76	0.58	0.67	0.58	0.56	0.55	0.99	0.32	0.24	0.14	0.81	0.63	0.48	0.29	0.81	0.56	n/a	n/a
5 (127)	0.70	0.70	0.69	0.61	0.86	0.86	0.80	0.60	0.68	0.58	0.57	0.55	1.00	0.36	0.27	0.16	0.86	0.71	0.54	0.32	0.85	0.58	n/a	n/a
5-3/4 (146)	0.73	0.73	0.71	0.63	0.95	0.95	0.88	0.64	0.71	0.60	0.58	0.56		0.44	0.33	0.20	0.95	0.88	0.66	0.40	0.91	0.62	0.56	n/a
6 (152)	0.74	0.74	0.72	0.63	0.98	0.98	0.91	0.66	0.71	0.60	0.58	0.56		0.47	0.35	0.21	0.98	0.94	0.70	0.42	0.93	0.63	0.58	n/a
7 (178)	0.78	0.78	0.76	0.66	1.00	1.00	1.00	0.72	0.75	0.62	0.60	0.57		0.59	0.44	0.27	1.00	1.00	0.89	0.53	1.00	0.69	0.62	n/a
8 (203)	0.82	0.82	0.80	0.68				0.78	0.79	0.63	0.61	0.58		0.72	0.54	0.32			1.00	0.65		0.73	0.67	n/a
8-3/4 (222)	0.86	0.86	0.82	0.69				0.83	0.81	0.65	0.62	0.59		0.83	0.62	0.37				0.74		0.77	0.70	0.59
9 (229)	0.87	0.87	0.83	0.70				0.85	0.82	0.65	0.62	0.59		0.86	0.65	0.39				0.78		0.78	0.71	0.60
10 (254)	0.91	0.91	0.87	0.72				0.91	0.86	0.67	0.64	0.60		1.00	0.76	0.45				0.91		0.82	0.74	0.63
11 (279)	0.95	0.95	0.91	0.74				0.98	0.89	0.68	0.65	0.61			0.87	0.52				0.98		0.86	0.78	0.66
12 (305)	0.99	0.99	0.94	0.77				1.00	0.93	0.70	0.67	0.62			1.00	0.60				1.00		0.90	0.82	0.69
14 (356)	1.00	1.00	1.00	0.81					1.00	0.73	0.69	0.64				0.75						0.97	0.88	0.74
16 (406)				0.86						0.77	0.72	0.66				0.92						1.00	0.94	0.79
18 (457)				0.90						0.80	0.75	0.68				1.00							1.00	0.84
24 (610)				1.00						0.90	0.83	0.74												0.97
30 (762)										1.00	0.92	0.80												1.00
36 (914)											1.00	0.85												
> 48 (1219)												0.97												

1 Linear interpolation not permitted

2 Shaded area with reduced edge distance is permitted provided the installation torque is reduced to 0.30 T_{max} for 5d ≤ s ≤ 16-in. and to 0.5 T_{max} for s > 16-in.

3 When combining multiple load adjustment factors (e.g. for a four-anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use PROFIS Engineering or perform anchor calculation using design equations from ACI 318 Chapter 17.

4 Spacing factor reduction in shear applicable when c < 3*h_{ef}. f_{AV}, is applicable when edge distance, c < 3*h_{ef}. If c ≥ 3*h_{ef}, then f_{AV} = f_{AN}.

5 Concrete thickness reduction factor in shear, f_{HV}, is applicable when edge distance, c < 3*h_{ef}. If c ≥ 3*h_{ef}, then f_{HV} = 1.0.

3.2.3

Table 32 — Load adjustment factors for 1/2-in. diameter threaded rods in uncracked concrete[1,2,3]

1/2-in. threaded rods uncracked concrete		Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[4] f_{AV}				Edge distance in shear ⊥ Toward edge f_{RV}				Edge distance in shear ‖ To and away from edge f_{RV}				Concrete thickness factor in shear[5] f_{HV}			
Embedment h_{ef}	in. (mm)	2-3/4 (70)	4-1/2 (114)	6 (152)	10 (254)	2-3/4 (70)	4-1/2 (114)	6 (152)	10 (254)	2-3/4 (70)	4-1/2 (114)	6 (152)	10 (254)	2-3/4 (70)	4-1/2 (114)	6 (152)	10 (254)	2-3/4 (70)	4-1/2 (114)	6 (152)	10 (254)	2-3/4 (70)	4-1/2 (114)	6 (152)	10 (254)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																									
1-3/4	(44)	n/a	n/a	n/a	n/a	0.34	0.24	0.19	0.11	n/a	n/a	n/a	n/a	0.10	0.05	0.03	0.02	0.21	0.11	0.07	0.03	n/a	n/a	n/a	n/a
2-1/2	(64)	0.58	0.58	0.57	0.54	0.41	0.28	0.22	0.13	0.55	0.53	0.53	0.52	0.18	0.09	0.06	0.03	0.35	0.18	0.12	0.06	n/a	n/a	n/a	n/a
3	(76)	0.59	0.59	0.58	0.55	0.46	0.30	0.23	0.14	0.56	0.54	0.53	0.52	0.23	0.12	0.08	0.04	0.46	0.24	0.15	0.08	n/a	n/a	n/a	n/a
4	(102)	0.62	0.62	0.61	0.57	0.57	0.35	0.26	0.15	0.58	0.55	0.54	0.53	0.36	0.18	0.12	0.06	0.57	0.35	0.24	0.12	0.58	n/a	n/a	n/a
5	(127)	0.65	0.65	0.64	0.58	0.71	0.40	0.30	0.17	0.60	0.57	0.55	0.53	0.50	0.26	0.17	0.08	0.71	0.40	0.31	0.16	0.65	n/a	n/a	n/a
5-3/4	(146)	0.68	0.68	0.66	0.60	0.78	0.44	0.33	0.19	0.62	0.58	0.56	0.54	0.61	0.32	0.21	0.10	0.81	0.44	0.34	0.20	0.69	0.56	n/a	n/a
6	(152)	0.69	0.69	0.67	0.60	0.80	0.46	0.33	0.20	0.63	0.58	0.56	0.54	0.65	0.34	0.22	0.11	0.85	0.46	0.35	0.21	0.71	0.57	n/a	n/a
7	(178)	0.72	0.72	0.69	0.62	0.90	0.52	0.37	0.22	0.65	0.59	0.57	0.54	0.82	0.42	0.28	0.13	0.99	0.52	0.38	0.27	0.77	0.61	n/a	n/a
7-1/4	(184)	0.72	0.72	0.70	0.62	0.92	0.54	0.38	0.22	0.65	0.60	0.57	0.55	0.87	0.45	0.29	0.14	1.00	0.54	0.39	0.28	0.78	0.62	0.54	n/a
8	(203)	0.75	0.75	0.72	0.63	0.99	0.59	0.41	0.24	0.67	0.61	0.58	0.55	1.00	0.52	0.34	0.16		0.59	0.42	0.30	0.82	0.66	0.57	n/a
9	(229)	0.78	0.78	0.75	0.65	1.00	0.67	0.46	0.27	0.69	0.62	0.59	0.56		0.62	0.40	0.20		0.67	0.46	0.32	0.87	0.70	0.60	n/a
10	(254)	0.81	0.81	0.78	0.67		0.74	0.52	0.30	0.71	0.63	0.60	0.56		0.72	0.47	0.23		0.74	0.52	0.34	0.92	0.73	0.64	n/a
11-1/4	(286)	0.85	0.85	0.81	0.69		0.83	0.58	0.34	0.74	0.65	0.61	0.57		0.86	0.56	0.27		0.83	0.58	0.37	0.97	0.78	0.67	0.53
12	(305)	0.87	0.87	0.83	0.70		0.89	0.62	0.36	0.75	0.66	0.62	0.58		0.95	0.62	0.30		0.89	0.62	0.38	1.00	0.80	0.70	0.55
14	(356)	0.93	0.93	0.89	0.73		1.00	0.72	0.42	0.79	0.69	0.64	0.59		1.00	0.78	0.38		1.00	0.72	0.43		0.87	0.75	0.59
16	(406)	1.00	1.00	0.94	0.77			0.82	0.48	0.83	0.72	0.66	0.60			0.95	0.47			0.82	0.48		0.93	0.80	0.63
18	(457)			1.00	0.80			0.93	0.54	0.88	0.74	0.68	0.61			1.00	0.56			0.93	0.54		0.98	0.85	0.67
20	(508)				0.83			1.00	0.60	0.92	0.77	0.70	0.63				0.65			1.00	0.60		1.00	0.90	0.71
22	(559)				0.87				0.66	0.96	0.80	0.72	0.64				0.75				0.66			0.94	0.74
24	(610)				0.90				0.72	1.00	0.82	0.74	0.65				0.85				0.72			0.98	0.77
30	(762)				1.00				0.90		0.90	0.80	0.69				1.00				0.90			1.00	0.87
36	(914)								1.00		0.98	0.86	0.73								1.00				0.95
> 48	(1219)										1.00	0.98	0.80												1.00

Table 33 — Load adjustment factors for 1/2-in. diameter threaded rods in cracked concrete[1,2,3]

1/2-in. threaded rods cracked concrete		Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[4] f_{AV}				Edge distance in shear ⊥ Toward edge f_{RV}				Edge distance in shear ‖ To and away from edge f_{RV}				Concrete thickness factor in shear[5] f_{HV}			
Embedment h_{ef}	in. (mm)	2-3/4 (70)	4-1/2 (114)	6 (152)	10 (254)	2-3/4 (70)	4-1/2 (114)	6 (152)	10 (254)	2-3/4 (70)	4-1/2 (114)	6 (152)	10 (254)	2-3/4 (70)	4-1/2 (114)	6 (152)	10 (254)	2-3/4 (70)	4-1/2 (114)	6 (152)	10 (254)	2-3/4 (70)	4-1/2 (114)	6 (152)	10 (254)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																									
1-3/4	(44)	n/a	n/a	n/a	n/a	0.47	0.47	0.45	0.41	n/a	n/a	n/a	n/a	0.10	0.05	0.04	0.02	0.21	0.11	0.07	0.04	n/a	n/a	n/a	n/a
2-1/2	(64)	0.58	0.58	0.57	0.54	0.52	0.52	0.50	0.44	0.55	0.53	0.53	0.52	0.18	0.09	0.06	0.04	0.35	0.18	0.12	0.07	n/a	n/a	n/a	n/a
3	(76)	0.59	0.59	0.58	0.55	0.56	0.56	0.53	0.46	0.56	0.54	0.53	0.52	0.23	0.12	0.08	0.05	0.47	0.24	0.16	0.10	n/a	n/a	n/a	n/a
4	(102)	0.62	0.62	0.61	0.57	0.63	0.63	0.60	0.49	0.58	0.55	0.54	0.53	0.36	0.18	0.13	0.08	0.72	0.37	0.25	0.15	0.58	n/a	n/a	n/a
5	(127)	0.65	0.65	0.64	0.58	0.72	0.72	0.67	0.53	0.61	0.57	0.55	0.54	0.50	0.26	0.18	0.11	1.00	0.52	0.35	0.21	0.65	n/a	n/a	n/a
5-3/4	(146)	0.68	0.68	0.66	0.60	0.78	0.78	0.73	0.56	0.62	0.58	0.56	0.54	0.62	0.32	0.22	0.13		0.64	0.43	0.26	0.70	0.56	n/a	n/a
6	(152)	0.69	0.69	0.67	0.60	0.80	0.80	0.75	0.57	0.63	0.58	0.56	0.54	0.66	0.34	0.23	0.14		0.68	0.46	0.28	0.71	0.57	n/a	n/a
7	(178)	0.72	0.72	0.69	0.62	0.90	0.90	0.83	0.62	0.65	0.59	0.57	0.55	0.83	0.43	0.29	0.17		0.86	0.58	0.35	0.77	0.62	n/a	n/a
7-1/4	(184)	0.72	0.72	0.70	0.62	0.92	0.92	0.85	0.63	0.65	0.60	0.58	0.55	0.88	0.45	0.31	0.18		0.90	0.61	0.37	0.78	0.63	0.55	n/a
8	(203)	0.75	0.75	0.72	0.63	0.99	0.99	0.91	0.66	0.67	0.61	0.58	0.56	1.00	0.52	0.35	0.21		1.00	0.71	0.43	0.82	0.66	0.58	n/a
9	(229)	0.78	0.78	0.75	0.65	1.00	1.00	1.00	0.70	0.69	0.62	0.59	0.57		0.62	0.42	0.25			0.85	0.51	0.87	0.70	0.61	n/a
10	(254)	0.81	0.81	0.78	0.67				0.75	0.71	0.64	0.60	0.57		0.73	0.50	0.30			0.99	0.59	0.92	0.74	0.65	n/a
11-1/4	(286)	0.85	0.85	0.81	0.69				0.81	0.74	0.65	0.62	0.58		0.87	0.59	0.35			1.00	0.71	0.97	0.78	0.69	0.58
12	(305)	0.87	0.87	0.83	0.70				0.85	0.75	0.66	0.63	0.59		0.96	0.65	0.39				0.78	1.00	0.81	0.71	0.60
14	(356)	0.93	0.93	0.89	0.73				0.95	0.79	0.69	0.65	0.60		1.00	0.82	0.49				0.95		0.87	0.76	0.64
16	(406)	1.00	1.00	0.94	0.77				1.00	0.84	0.72	0.67	0.62			1.00	0.60				1.00		0.93	0.82	0.69
18	(457)			1.00	0.80					0.88	0.74	0.69	0.63				0.72						0.99	0.87	0.73
20	(508)				0.83					0.92	0.77	0.71	0.65				0.84						1.00	0.91	0.77
22	(559)				0.87					0.96	0.80	0.73	0.66				0.97							0.96	0.81
24	(610)				0.90					1.00	0.82	0.75	0.68				1.00							1.00	0.84
30	(762)				1.00						0.91	0.81	0.72												0.94
36	(914)										0.99	0.88	0.77												1.00
> 48	(1219)										1.00	1.00	0.86												

1 Linear interpolation not permitted.

2 Shaded area with reduced edge distance is permitted provided the installation torque is reduced to 0.30 T_{max} for 5d ≤ s ≤ 16-in. and to 0.5 T_{max} for s > 16-in.

3 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with a thin concrete member) the design can become very conservative. To optimize the design, use PROFIS Engineering or perform anchor calculation using the design equations from ACI 318 Chapter 17.

4 Spacing factor reduction in shear applicable when $c < 3{*}h_{ef}$. f_{AV}, is applicable when edge distance, $c < 3{*}h_{ef}$. If $c \geq 3{*}h_{ef}$, then $f_{AV} = f_{AN}$.

5 Concrete thickness reduction factor in shear, f_{HV}, is applicable when edge distance, $c < 3{*}h_{ef}$. If $c \geq 3{*}h_{ef}$, then $f_{HV} = 1.0$.

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Table 34 — Load adjustment factors for 5/8-in. diameter threaded rods in uncracked concrete[1,2,3]

5/8-in. threaded rods uncracked concrete		Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[4] f_{AV}				Edge distance in shear: ⊥ Toward edge f_{RV}				Edge distance in shear: ‖ To and away from edge f_{RV}				Concrete thickness factor in shear[5] f_{HV}			
Embedment h_{ef}	in.	3-1/8	5-5/8	7-1/2	12-1/2	3-1/8	5-5/8	7-1/2	12-1/2	3-1/8	5-5/8	7-1/2	12-1/2	3-1/8	5-5/8	7-1/2	12-1/2	3-1/8	5-5/8	7-1/2	12-1/2	3-1/8	5-5/8	7-1/2	12-1/2
	(mm)	(79)	(143)	(191)	(318)	(79)	(143)	(191)	(318)	(79)	(143)	(191)	(318)	(79)	(143)	(191)	(318)	(79)	(143)	(191)	(318)	(79)	(143)	(191)	(318)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																									
1-3/4	(44)	n/a	n/a	n/a	n/a	0.35	0.24	0.19	0.11	n/a	n/a	n/a	n/a	0.09	0.04	0.03	0.01	0.19	0.08	0.06	0.03	n/a	n/a	n/a	n/a
3-1/8	(79)	0.58	0.58	0.57	0.54	0.47	0.29	0.22	0.13	0.56	0.54	0.53	0.52	0.22	0.10	0.07	0.03	0.45	0.20	0.13	0.06	n/a	n/a	n/a	n/a
4	(102)	0.60	0.60	0.59	0.55	0.56	0.32	0.24	0.14	0.58	0.55	0.53	0.52	0.32	0.15	0.10	0.04	0.56	0.29	0.19	0.09	n/a	n/a	n/a	n/a
4-5/8	(117)	0.62	0.62	0.60	0.56	0.62	0.35	0.26	0.15	0.59	0.55	0.54	0.52	0.40	0.18	0.12	0.06	0.62	0.35	0.24	0.11	0.60	n/a	n/a	n/a
5	(127)	0.63	0.63	0.61	0.57	0.64	0.36	0.27	0.16	0.60	0.56	0.54	0.53	0.45	0.21	0.13	0.06	0.67	0.36	0.27	0.12	0.63	n/a	n/a	n/a
6	(152)	0.65	0.65	0.63	0.58	0.71	0.41	0.30	0.17	0.62	0.57	0.55	0.53	0.59	0.27	0.18	0.08	0.80	0.41	0.32	0.16	0.69	n/a	n/a	n/a
7	(178)	0.68	0.68	0.66	0.59	0.78	0.45	0.33	0.19	0.64	0.58	0.56	0.54	0.75	0.34	0.22	0.10	0.94	0.45	0.35	0.21	0.74	n/a	n/a	n/a
7-1/8	(181)	0.68	0.68	0.66	0.60	0.79	0.46	0.33	0.19	0.64	0.58	0.56	0.54	0.77	0.35	0.23	0.11	0.95	0.46	0.35	0.21	0.75	0.57	n/a	n/a
8	(203)	0.70	0.70	0.68	0.61	0.85	0.50	0.36	0.21	0.66	0.59	0.57	0.54	0.91	0.41	0.27	0.13	1.00	0.50	0.38	0.25	0.79	0.61	n/a	n/a
9	(229)	0.73	0.73	0.70	0.62	0.93	0.56	0.39	0.22	0.68	0.60	0.58	0.55	1.00	0.50	0.32	0.15		0.56	0.41	0.29	0.84	0.65	0.56	n/a
10	(254)	0.75	0.75	0.72	0.63	1.00	0.62	0.43	0.24	0.70	0.62	0.59	0.55		0.58	0.38	0.18		0.62	0.44	0.30	0.89	0.68	0.59	n/a
11	(279)	0.78	0.78	0.74	0.65		0.68	0.47	0.27	0.72	0.63	0.60	0.56		0.67	0.43	0.20		0.68	0.47	0.32	0.93	0.71	0.62	n/a
12	(305)	0.80	0.80	0.77	0.66		0.74	0.51	0.29	0.74	0.64	0.60	0.56		0.76	0.50	0.23		0.74	0.51	0.34	0.97	0.75	0.65	n/a
14	(356)	0.85	0.85	0.81	0.69		0.86	0.60	0.34	0.77	0.66	0.62	0.57		0.96	0.62	0.29		0.86	0.60	0.37	1.00	0.81	0.70	0.54
16	(406)	0.90	0.90	0.86	0.71		0.99	0.68	0.39	0.81	0.69	0.64	0.58		1.00	0.76	0.35		0.99	0.68	0.41		0.86	0.75	0.58
18	(457)	0.96	0.96	0.90	0.74		1.00	0.77	0.44	0.85	0.71	0.66	0.59			0.91	0.42		1.00	0.77	0.44		0.91	0.79	0.61
20	(508)	1.00	1.00	0.94	0.77			0.86	0.49	0.89	0.73	0.67	0.60			1.00	0.50			0.86	0.49		0.96	0.83	0.65
22	(559)			0.99	0.79			0.94	0.54	0.93	0.75	0.69	0.61				0.57			0.94	0.54		1.00	0.87	0.68
24	(610)			1.00	0.82			1.00	0.59	0.97	0.78	0.71	0.63				0.65			1.00	0.59			0.91	0.71
26	(660)				0.85				0.64	1.00	0.80	0.73	0.64				0.73				0.64			0.95	0.74
28	(711)				0.87				0.68		0.82	0.74	0.65				0.82				0.68			0.99	0.76
30	(762)				0.90				0.73		0.85	0.76	0.66				0.91				0.73			1.00	0.79
36	(914)				0.98				0.88		0.92	0.81	0.69				1.00				0.88				0.87
> 48	(1219)				1.00				1.00		1.00	0.92	0.75								1.00				1.00

Table 35 — Load adjustment factors for 5/8-in. diameter threaded rods in cracked concrete[1,2,3]

5/8-in. threaded rods cracked concrete		Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[4] f_{AV}				Edge distance in shear: ⊥ Toward edge f_{RV}				Edge distance in shear: ‖ To and away from edge f_{RV}				Concrete thickness factor in shear[5] f_{HV}			
Embedment h_{ef}	in.	3-1/8	5-5/8	7-1/2	12-1/2	3-1/8	5-5/8	7-1/2	12-1/2	3-1/8	5-5/8	7-1/2	12-1/2	3-1/8	5-5/8	7-1/2	12-1/2	3-1/8	5-5/8	7-1/2	12-1/2	3-1/8	5-5/8	7-1/2	12-1/2
	(mm)	(79)	(143)	(191)	(318)	(79)	(143)	(191)	(318)	(79)	(143)	(191)	(318)	(79)	(143)	(191)	(318)	(79)	(143)	(191)	(318)	(79)	(143)	(191)	(318)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																									
1-3/4	(44)	n/a	n/a	n/a	n/a	0.44	0.44	0.43	0.40	n/a	n/a	n/a	n/a	0.09	0.04	0.03	0.02	0.19	0.09	0.06	0.03	n/a	n/a	n/a	n/a
3-1/8	(79)	0.58	0.58	0.57	0.54	0.52	0.52	0.50	0.44	0.56	0.54	0.53	0.52	0.22	0.10	0.07	0.04	0.45	0.20	0.13	0.07	n/a	n/a	n/a	n/a
4	(102)	0.60	0.60	0.59	0.55	0.58	0.58	0.55	0.46	0.58	0.55	0.53	0.52	0.33	0.15	0.10	0.05	0.65	0.30	0.19	0.11	n/a	n/a	n/a	n/a
4-5/8	(117)	0.62	0.62	0.60	0.56	0.62	0.62	0.58	0.48	0.59	0.55	0.54	0.53	0.40	0.18	0.12	0.07	0.81	0.37	0.24	0.13	0.60	n/a	n/a	n/a
5	(127)	0.63	0.63	0.61	0.57	0.64	0.64	0.60	0.49	0.60	0.56	0.54	0.53	0.45	0.21	0.13	0.08	0.91	0.41	0.27	0.15	0.63	n/a	n/a	n/a
6	(152)	0.65	0.65	0.63	0.58	0.71	0.71	0.66	0.53	0.62	0.57	0.55	0.54	0.60	0.27	0.18	0.10	1.00	0.54	0.35	0.20	0.69	n/a	n/a	n/a
7	(178)	0.68	0.68	0.66	0.59	0.78	0.78	0.72	0.56	0.64	0.58	0.56	0.54	0.75	0.34	0.22	0.13		0.68	0.44	0.25	0.74	n/a	n/a	n/a
7-1/8	(181)	0.68	0.68	0.66	0.60	0.79	0.79	0.73	0.56	0.64	0.58	0.56	0.54	0.77	0.35	0.23	0.13		0.70	0.46	0.26	0.75	0.58	n/a	n/a
8	(203)	0.70	0.70	0.68	0.61	0.85	0.85	0.78	0.59	0.66	0.59	0.57	0.55	0.92	0.42	0.27	0.15		0.84	0.54	0.31	0.79	0.61	n/a	n/a
9	(229)	0.73	0.73	0.70	0.62	0.93	0.93	0.85	0.62	0.68	0.60	0.58	0.55	1.00	0.50	0.32	0.18		1.00	0.65	0.37	0.84	0.65	0.56	n/a
10	(254)	0.75	0.75	0.72	0.63	1.00	1.00	0.91	0.66	0.70	0.62	0.59	0.56		0.58	0.38	0.21			0.76	0.43	0.89	0.68	0.59	n/a
11	(279)	0.78	0.78	0.74	0.65			0.98	0.69	0.72	0.63	0.60	0.57		0.67	0.44	0.25			0.88	0.49	0.93	0.72	0.62	n/a
12	(305)	0.80	0.80	0.77	0.66			1.00	0.73	0.74	0.64	0.60	0.57		0.77	0.50	0.28			1.00	0.56	0.97	0.75	0.65	n/a
14	(356)	0.85	0.85	0.81	0.69				0.81	0.78	0.66	0.62	0.58		0.97	0.63	0.36				0.71	1.00	0.81	0.70	0.58
16	(406)	0.90	0.90	0.86	0.71				0.89	0.82	0.69	0.64	0.60		1.00	0.77	0.43				0.87		0.86	0.75	0.62
18	(457)	0.96	0.96	0.90	0.74				0.97	0.85	0.71	0.66	0.61			0.92	0.52				0.97		0.92	0.79	0.66
20	(508)	1.00	1.00	0.94	0.77				1.00	0.89	0.73	0.67	0.62			1.00	0.61				1.00		0.97	0.84	0.69
22	(559)			0.99	0.79					0.93	0.76	0.69	0.63				0.70						1.00	0.88	0.72
24	(610)			1.00	0.82					0.97	0.78	0.71	0.64				0.80							0.92	0.76
26	(660)				0.85					1.00	0.80	0.73	0.66				0.90							0.95	0.79
28	(711)				0.87						0.83	0.74	0.67				1.00							0.99	0.82
30	(762)				0.90						0.85	0.76	0.68											1.00	0.85
36	(914)				0.98						0.92	0.81	0.71												0.93
> 48	(1219)				1.00						1.00	0.92	0.79												1.00

1 Linear interpolation not permitted

2 Shaded area with reduced edge distance is permitted provided the installation torque is reduced to 0.30 T_{max} for 5d ≤ s ≤ 16-in. and to 0.5 T_{max} for s > 16-in.

3 When combining multiple load adjustment factors (e.g. for a four-anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use PROFIS Engineering or perform anchor calculation using design equations from ACI 318 Chapter 17.

4 Spacing factor reduction in shear applicable when $c < 3{*}h_{ef}$. f_{AV}, is applicable when edge distance, $c < 3{*}h_{ef}$. If $c \geq 3{*}h_{ef}$, then $f_{AV} = f_{AN}$.

5 Concrete thickness reduction factor in shear, f_{HV}, is applicable when edge distance, $c < 3{*}h_{ef}$. If $c \geq 3{*}h_{ef}$, then $f_{HV} = 1.0$.

Table 36 — Load adjustment factors for 3/4-in. diameter threaded rods in uncracked concrete[1,2,3]

3/4-in. threaded rods uncracked concrete		Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[4] f_{AV}				Edge distance in shear: ⊥ Toward edge f_{RV}				Edge distance in shear: ∥ To and away from edge f_{RV}				Concrete thickness factor in shear[5] f_{HV}			
Embedment h_{ef} in.	(mm)	3-1/2 (89)	6-3/4 (171)	9 (229)	15 (381)	3-1/2 (89)	6-3/4 (171)	9 (229)	15 (381)	3-1/2 (89)	6-3/4 (171)	9 (229)	15 (381)	3-1/2 (89)	6-3/4 (171)	9 (229)	15 (381)	3-1/2 (89)	6-3/4 (171)	9 (229)	15 (381)	3-1/2 (89)	6-3/4 (171)	9 (229)	15 (381)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																									
1-3/4	(44)	n/a	n/a	n/a	n/a	0.35	0.24	0.18	0.10	n/a	n/a	n/a	n/a	0.09	0.03	0.02	0.01	0.17	0.07	0.05	0.02	n/a	n/a	n/a	n/a
3-3/4	(95)	0.58	0.58	0.57	0.54	0.52	0.30	0.23	0.13	0.57	0.54	0.53	0.52	0.27	0.11	0.07	0.03	0.52	0.22	0.14	0.07	n/a	n/a	n/a	n/a
4	(102)	0.59	0.59	0.57	0.54	0.54	0.31	0.23	0.13	0.57	0.54	0.53	0.52	0.29	0.12	0.08	0.04	0.54	0.24	0.16	0.07	n/a	n/a	n/a	n/a
5	(127)	0.61	0.61	0.59	0.56	0.59	0.34	0.25	0.14	0.59	0.55	0.54	0.52	0.41	0.17	0.11	0.05	0.64	0.33	0.22	0.10	n/a	n/a	n/a	n/a
5-1/4	(133)	0.61	0.61	0.60	0.56	0.61	0.35	0.26	0.15	0.60	0.55	0.54	0.52	0.44	0.18	0.12	0.05	0.66	0.35	0.23	0.11	0.62	n/a	n/a	n/a
6	(152)	0.63	0.63	0.61	0.57	0.65	0.38	0.28	0.16	0.61	0.56	0.55	0.53	0.54	0.22	0.14	0.07	0.76	0.38	0.29	0.13	0.66	n/a	n/a	n/a
7	(178)	0.65	0.65	0.63	0.58	0.70	0.41	0.30	0.17	0.63	0.57	0.55	0.53	0.68	0.28	0.18	0.08	0.89	0.41	0.32	0.17	0.72	n/a	n/a	n/a
8	(203)	0.67	0.67	0.65	0.59	0.76	0.45	0.33	0.18	0.65	0.58	0.56	0.54	0.83	0.34	0.22	0.10	1.00	0.45	0.35	0.20	0.77	n/a	n/a	n/a
8-1/2	(216)	0.68	0.68	0.66	0.59	0.79	0.47	0.34	0.19	0.66	0.59	0.56	0.54	0.91	0.37	0.24	0.11		0.47	0.36	0.22	0.79	0.59	n/a	n/a
9	(229)	0.69	0.69	0.67	0.60	0.83	0.49	0.35	0.20	0.67	0.59	0.57	0.54	0.99	0.40	0.26	0.12		0.49	0.37	0.24	0.81	0.60	n/a	n/a
10	(254)	0.71	0.71	0.69	0.61	0.89	0.53	0.38	0.21	0.68	0.60	0.58	0.55	1.00	0.47	0.31	0.14		0.53	0.40	0.28	0.86	0.64	n/a	n/a
10-3/4	(273)	0.73	0.73	0.70	0.62	0.94	0.57	0.40	0.23	0.70	0.61	0.58	0.55		0.53	0.34	0.16		0.57	0.42	0.29	0.89	0.66	0.57	n/a
12	(305)	0.76	0.76	0.72	0.63	1.00	0.64	0.44	0.25	0.72	0.62	0.59	0.55		0.62	0.40	0.19		0.64	0.45	0.31	0.94	0.70	0.60	n/a
14	(356)	0.80	0.80	0.76	0.66		0.74	0.52	0.29	0.76	0.64	0.61	0.56		0.78	0.51	0.24		0.74	0.52	0.33	1.00	0.75	0.65	n/a
16	(406)	0.84	0.84	0.80	0.68		0.85	0.59	0.33	0.79	0.66	0.62	0.57		0.96	0.62	0.29		0.85	0.59	0.36		0.80	0.70	n/a
16-3/4	(425)	0.86	0.86	0.81	0.69		0.89	0.62	0.35	0.81	0.67	0.63	0.58		1.00	0.67	0.31		0.89	0.62	0.37		0.82	0.71	0.55
18	(457)	0.89	0.89	0.83	0.70		0.96	0.66	0.37	0.83	0.68	0.64	0.58			0.74	0.35		0.96	0.66	0.39		0.85	0.74	0.57
20	(508)	0.93	0.93	0.87	0.72		1.00	0.74	0.41	0.87	0.70	0.65	0.59			0.87	0.40		1.00	0.74	0.42		0.90	0.78	0.60
22	(559)	0.97	0.97	0.91	0.74			0.81	0.45	0.91	0.72	0.67	0.60			1.00	0.47			0.81	0.46		0.94	0.82	0.63
24	(610)	1.00	1.00	0.94	0.77			0.89	0.50	0.94	0.74	0.68	0.61				0.53			0.89	0.50		0.99	0.85	0.66
26	(660)			0.98	0.79			0.96	0.54	0.98	0.76	0.70	0.62				0.60			0.96	0.54		1.00	0.89	0.69
28	(711)			1.00	0.81			1.00	0.58	1.00	0.78	0.71	0.63				0.67			1.00	0.58			0.92	0.71
30	(762)				0.83				0.62		0.80	0.73	0.64				0.74				0.62			0.95	0.74
36	(914)				0.90				0.74		0.86	0.77	0.66				0.98				0.74			1.00	0.81
> 48	(1219)				1.00				0.99		0.99	0.86	0.72				1.00				0.99				0.94

Table 37 — Load adjustment factors for 3/4-in. diameter threaded rods in cracked concrete[1,2,3]

3/4-in. threaded rods cracked concrete		Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[4] f_{AV}				Edge distance in shear: ⊥ Toward edge f_{RV}				Edge distance in shear: ∥ To and away from edge f_{RV}				Concrete thickness factor in shear[5] f_{HV}			
Embedment h_{ef} in.	(mm)	3-1/2 (89)	6-3/4 (171)	9 (229)	15 (381)	3-1/2 (89)	6-3/4 (171)	9 (229)	15 (381)	3-1/2 (89)	6-3/4 (171)	9 (229)	15 (381)	3-1/2 (89)	6-3/4 (171)	9 (229)	15 (381)	3-1/2 (89)	6-3/4 (171)	9 (229)	15 (381)	3-1/2 (89)	6-3/4 (171)	9 (229)	15 (381)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																									
1-3/4	(44)	n/a	n/a	n/a	n/a	0.43	0.43	0.42	0.39	n/a	n/a	n/a	n/a	0.09	0.03	0.02	0.01	0.17	0.07	0.05	0.02	n/a	n/a	n/a	n/a
3-3/4	(95)	0.58	0.58	0.57	0.54	0.53	0.53	0.50	0.44	0.57	0.54	0.53	0.52	0.27	0.11	0.07	0.04	0.54	0.22	0.14	0.07	n/a	n/a	n/a	n/a
4	(102)	0.59	0.59	0.57	0.54	0.54	0.54	0.51	0.44	0.57	0.54	0.53	0.52	0.30	0.12	0.08	0.04	0.59	0.24	0.16	0.08	n/a	n/a	n/a	n/a
5	(127)	0.61	0.61	0.59	0.56	0.59	0.59	0.56	0.47	0.59	0.55	0.54	0.52	0.41	0.17	0.11	0.06	0.83	0.34	0.22	0.11	n/a	n/a	n/a	n/a
5-1/4	(133)	0.61	0.61	0.60	0.56	0.61	0.61	0.57	0.47	0.60	0.55	0.54	0.53	0.45	0.18	0.12	0.06	0.89	0.36	0.24	0.12	0.62	n/a	n/a	n/a
6	(152)	0.63	0.63	0.61	0.57	0.65	0.65	0.60	0.49	0.61	0.56	0.55	0.53	0.54	0.22	0.14	0.07	1.00	0.44	0.29	0.15	0.67	n/a	n/a	n/a
7	(178)	0.65	0.65	0.63	0.58	0.70	0.70	0.65	0.52	0.63	0.57	0.55	0.53	0.69	0.28	0.18	0.09		0.56	0.36	0.19	0.72	n/a	n/a	n/a
8	(203)	0.67	0.67	0.65	0.59	0.76	0.76	0.70	0.55	0.65	0.58	0.56	0.54	0.84	0.34	0.22	0.12		0.68	0.44	0.23	0.77	n/a	n/a	n/a
8-1/2	(216)	0.68	0.68	0.66	0.59	0.79	0.79	0.72	0.56	0.66	0.59	0.56	0.54	0.92	0.37	0.24	0.13		0.75	0.49	0.25	0.79	0.59	n/a	n/a
9	(229)	0.69	0.69	0.67	0.60	0.83	0.83	0.75	0.57	0.67	0.59	0.57	0.54	1.00	0.41	0.26	0.14		0.82	0.53	0.28	0.82	0.61	n/a	n/a
10	(254)	0.71	0.71	0.69	0.61	0.89	0.89	0.80	0.60	0.69	0.60	0.58	0.55		0.48	0.31	0.16		0.95	0.62	0.32	0.86	0.64	n/a	n/a
10-3/4	(273)	0.73	0.73	0.70	0.62	0.94	0.94	0.84	0.62	0.70	0.61	0.58	0.55		0.53	0.35	0.18		1.00	0.69	0.36	0.89	0.66	0.57	n/a
12	(305)	0.76	0.76	0.72	0.63	1.00	1.00	0.91	0.66	0.72	0.62	0.59	0.56		0.63	0.41	0.21			0.82	0.42	0.94	0.70	0.61	n/a
14	(356)	0.80	0.80	0.76	0.66			1.00	0.72	0.76	0.64	0.61	0.57		0.79	0.51	0.27			1.00	0.53	1.00	0.76	0.65	n/a
16	(406)	0.84	0.84	0.80	0.68				0.78	0.80	0.66	0.62	0.58		0.97	0.63	0.33				0.65		0.81	0.70	n/a
16-3/4	(425)	0.86	0.86	0.81	0.69				0.81	0.81	0.67	0.63	0.58		1.00	0.67	0.35				0.70		0.83	0.72	0.57
18	(457)	0.89	0.89	0.83	0.70				0.85	0.83	0.68	0.64	0.59			0.75	0.39				0.78		0.86	0.74	0.60
20	(508)	0.93	0.93	0.87	0.72				0.91	0.87	0.70	0.65	0.60			0.88	0.46				0.91		0.90	0.78	0.63
22	(559)	0.97	0.97	0.91	0.74				0.98	0.91	0.72	0.67	0.61			1.00	0.53				0.98		0.95	0.82	0.66
24	(610)	1.00	1.00	0.94	0.77				1.00	0.94	0.74	0.68	0.62				0.60				1.00		0.99	0.86	0.69
26	(660)			0.98	0.79					0.98	0.76	0.70	0.63				0.68						1.00	0.89	0.72
28	(711)			1.00	0.81					1.00	0.79	0.71	0.64				0.75							0.92	0.74
30	(762)				0.83						0.81	0.73	0.65				0.84							0.96	0.77
36	(914)				0.90						0.87	0.77	0.68				1.00							1.00	0.84
> 48	(1219)				1.00						0.99	0.87	0.74												0.97

1 Linear interpolation not permitted.
2 Shaded area with reduced edge distance is permitted provided the installation torque is reduced to 0.30 T_{max} for 5d ≤ s ≤ 16-in. and to 0.5 T_{max} for s > 16-in.
3 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with a thin concrete member) the design can become very conservative. To optimize the design, use PROFIS Engineering or perform anchor calculation using the design equations from ACI 318 Chapter 17.
4 Spacing factor reduction in shear applicable when $c < 3 h_{ef}$. f_{AV}, is applicable when edge distance, $c < 3 h_{ef}$. If $c \geq 3 h_{ef}$, then $f_{AV} = f_{AN}$.
5 Concrete thickness reduction factor in shear, f_{HV}, is applicable when edge distance, $c < 3 h_{ef}$. If $c \geq 3 h_{ef}$, then $f_{HV} = 1.0$.

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Table 38 — Load adjustment factors for 7/8-in. diameter threaded rods in uncracked concrete[1,2,3]

7/8-in. threaded rods uncracked concrete		Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[4] f_{AV}				Edge distance in shear: ⊥ Toward edge f_{RV}				Edge distance in shear: ‖ To and away from edge f_{RV}				Concrete thickness factor in shear[5] f_{HV}			
Embedment	in.	3-1/2	7-7/8	10-1/2	17-1/2	3-1/2	7-7/8	10-1/2	17-1/2	3-1/2	7-7/8	10-1/2	17-1/2	3-1/2	7-7/8	10-1/2	17-1/2	3-1/2	7-7/8	10-1/2	17-1/2	3-1/2	7-7/8	10-1/2	17-1/2
h_{ef}	(mm)	(89)	(200)	(267)	(445)	(89)	(200)	(267)	(445)	(89)	(200)	(267)	(445)	(89)	(200)	(267)	(445)	(89)	(200)	(267)	(445)	(89)	(200)	(267)	(445)
Spacing (s) / Edge Distance (c_a) / Concrete Thickness (h), - in. (mm)																									
1-3/4	(44)	n/a	n/a	n/a	n/a	0.39	0.24	0.18	0.10	n/a	n/a	n/a	n/a	0.09	0.03	0.02	0.01	0.18	0.05	0.04	0.02	n/a	n/a	n/a	n/a
4-3/8	(111)	0.58	0.58	0.57	0.54	0.53	0.31	0.23	0.13	0.58	0.54	0.53	0.52	0.35	0.11	0.07	0.03	0.63	0.22	0.14	0.07	n/a	n/a	n/a	n/a
5	(127)	0.59	0.59	0.58	0.55	0.56	0.33	0.24	0.13	0.59	0.54	0.53	0.52	0.43	0.13	0.09	0.04	0.70	0.27	0.17	0.08	n/a	n/a	n/a	n/a
5-1/2	(140)	0.60	0.60	0.59	0.55	0.58	0.34	0.25	0.14	0.60	0.55	0.54	0.52	0.50	0.15	0.10	0.05	0.76	0.31	0.20	0.09	0.65	n/a	n/a	n/a
6	(152)	0.61	0.61	0.60	0.56	0.61	0.36	0.26	0.15	0.61	0.55	0.54	0.52	0.57	0.17	0.11	0.05	0.83	0.35	0.23	0.11	0.68	n/a	n/a	n/a
7	(178)	0.63	0.63	0.61	0.57	0.65	0.39	0.28	0.16	0.63	0.56	0.55	0.53	0.71	0.22	0.14	0.07	0.97	0.39	0.29	0.13	0.73	n/a	n/a	n/a
8	(203)	0.65	0.65	0.63	0.58	0.71	0.42	0.31	0.17	0.65	0.57	0.55	0.53	0.87	0.27	0.17	0.08	1.00	0.42	0.33	0.16	0.78	n/a	n/a	n/a
9	(229)	0.67	0.67	0.64	0.59	0.76	0.45	0.33	0.18	0.67	0.58	0.56	0.54	1.00	0.32	0.21	0.10		0.45	0.35	0.19	0.83	n/a	n/a	n/a
9-7/8	(251)	0.69	0.69	0.66	0.59	0.80	0.48	0.35	0.19	0.69	0.59	0.56	0.54		0.37	0.24	0.11		0.48	0.37	0.22	0.87	0.59	n/a	n/a
10	(254)	0.69	0.69	0.66	0.60	0.81	0.49	0.35	0.19	0.69	0.59	0.57	0.54		0.38	0.24	0.11		0.49	0.37	0.23	0.87	0.59	n/a	n/a
11	(279)	0.71	0.71	0.67	0.60	0.87	0.52	0.38	0.21	0.71	0.60	0.57	0.54		0.43	0.28	0.13		0.52	0.40	0.26	0.91	0.62	n/a	n/a
12	(305)	0.73	0.73	0.69	0.61	0.92	0.56	0.40	0.22	0.73	0.60	0.58	0.55		0.49	0.32	0.15		0.56	0.42	0.29	0.95	0.65	n/a	n/a
12-1/2	(318)	0.74	0.74	0.70	0.62	0.95	0.59	0.41	0.23	0.74	0.61	0.58	0.55		0.52	0.34	0.16		0.59	0.43	0.29	0.97	0.66	0.57	n/a
14	(356)	0.76	0.76	0.72	0.63	1.00	0.66	0.46	0.25	0.77	0.62	0.59	0.55		0.62	0.40	0.19		0.66	0.47	0.31	1.00	0.70	0.60	n/a
16	(406)	0.80	0.80	0.75	0.65		0.75	0.52	0.29	0.80	0.64	0.60	0.56		0.76	0.49	0.23		0.75	0.52	0.34		0.75	0.65	n/a
18	(457)	0.84	0.84	0.79	0.67		0.84	0.59	0.32	0.84	0.66	0.62	0.57		0.91	0.59	0.27		0.84	0.59	0.36		0.79	0.68	n/a
19-1/2	(495)	0.87	0.87	0.81	0.69		0.92	0.64	0.35	0.87	0.67	0.63	0.58		1.00	0.66	0.31		0.92	0.64	0.38		0.82	0.71	0.55
20	(508)	0.88	0.88	0.82	0.69		0.94	0.65	0.36	0.88	0.67	0.63	0.58			0.69	0.32		0.94	0.65	0.39		0.83	0.72	0.56
22	(559)	0.91	0.91	0.85	0.71		1.00	0.72	0.40	0.92	0.69	0.64	0.59			0.80	0.37		1.00	0.72	0.41		0.87	0.76	0.59
24	(610)	0.95	0.95	0.88	0.73			0.78	0.43	0.96	0.71	0.66	0.59			0.91	0.42			0.78	0.44		0.91	0.79	0.61
26	(660)	0.99	0.99	0.91	0.75			0.85	0.47	0.99	0.73	0.67	0.60			1.00	0.48			0.85	0.47		0.95	0.82	0.64
28	(711)	1.00	1.00	0.94	0.77			0.91	0.50	1.00	0.74	0.68	0.61				0.53			0.91	0.50		0.99	0.85	0.66
30	(762)			0.98	0.79			0.98	0.54		0.76	0.70	0.62				0.59			0.98	0.54		1.00	0.88	0.68
36	(914)			1.00	0.84			1.00	0.65		0.81	0.73	0.64				0.77			1.00	0.65			0.97	0.75
> 48	(1219)				0.96				0.86		0.92	0.81	0.69				1.00				0.86			1.00	0.87

Table 39 — Load adjustment factors for 7/8-in. diameter threaded rods in cracked concrete[1,2,3]

7/8-in. threaded rods cracked concrete		Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[4] f_{AV}				Edge distance in shear: ⊥ Toward edge f_{RV}				Edge distance in shear: ‖ To and away from edge f_{RV}				Concrete thickness factor in shear[5] f_{HV}			
Embedment	in.	3-1/2	7-7/8	10-1/2	17-1/2	3-1/2	7-7/8	10-1/2	17-1/2	3-1/2	7-7/8	10-1/2	17-1/2	3-1/2	7-7/8	10-1/2	17-1/2	3-1/2	7-7/8	10-1/2	17-1/2	3-1/2	7-7/8	10-1/2	17-1/2
h_{ef}	(mm)	(89)	(200)	(267)	(445)	(89)	(200)	(267)	(445)	(89)	(200)	(267)	(445)	(89)	(200)	(267)	(445)	(89)	(200)	(267)	(445)	(89)	(200)	(267)	(445)
Spacing (s) / Edge Distance (c_a) / Concrete Thickness (h), - in. (mm)																									
1-3/4	(44)	n/a	n/a	n/a	n/a	0.42	0.42	0.41	0.38	n/a	n/a	n/a	n/a	0.09	0.03	0.02	0.01	0.18	0.06	0.04	0.02	n/a	n/a	n/a	n/a
4-3/8	(111)	0.58	0.58	0.57	0.54	0.53	0.53	0.50	0.44	0.58	0.54	0.53	0.52	0.36	0.11	0.07	0.03	0.71	0.22	0.14	0.07	n/a	n/a	n/a	n/a
5	(127)	0.59	0.59	0.58	0.55	0.56	0.56	0.52	0.45	0.60	0.54	0.53	0.52	0.43	0.13	0.09	0.04	0.87	0.27	0.17	0.08	n/a	n/a	n/a	n/a
5-1/2	(140)	0.60	0.60	0.59	0.55	0.58	0.58	0.54	0.46	0.61	0.55	0.54	0.52	0.50	0.15	0.10	0.05	1.00	0.31	0.20	0.10	0.65	n/a	n/a	n/a
6	(152)	0.61	0.61	0.60	0.56	0.61	0.61	0.56	0.47	0.61	0.55	0.54	0.52	0.57	0.18	0.11	0.06		0.35	0.23	0.11	0.68	n/a	n/a	n/a
7	(178)	0.63	0.63	0.61	0.57	0.65	0.65	0.60	0.49	0.63	0.56	0.55	0.53	0.72	0.22	0.14	0.07		0.44	0.29	0.14	0.73	n/a	n/a	n/a
8	(203)	0.65	0.65	0.63	0.58	0.71	0.71	0.64	0.52	0.65	0.57	0.55	0.53	0.88	0.27	0.18	0.09		0.54	0.35	0.17	0.78	n/a	n/a	n/a
9	(229)	0.67	0.67	0.64	0.59	0.76	0.76	0.68	0.54	0.67	0.58	0.56	0.54	1.00	0.32	0.21	0.10		0.65	0.42	0.20	0.83	n/a	n/a	n/a
9-7/8	(251)	0.69	0.69	0.66	0.59	0.80	0.80	0.72	0.56	0.69	0.59	0.56	0.54		0.37	0.24	0.12		0.74	0.48	0.23	0.87	0.59	n/a	n/a
10	(254)	0.69	0.69	0.66	0.60	0.81	0.81	0.73	0.56	0.69	0.59	0.57	0.54		0.38	0.25	0.12		0.76	0.49	0.24	0.87	0.59	n/a	n/a
11	(279)	0.71	0.71	0.67	0.60	0.87	0.87	0.77	0.59	0.71	0.60	0.57	0.54		0.44	0.28	0.14		0.87	0.57	0.28	0.92	0.62	n/a	n/a
12	(305)	0.73	0.73	0.69	0.61	0.92	0.92	0.82	0.61	0.73	0.60	0.58	0.55		0.50	0.32	0.16		1.00	0.65	0.31	0.96	0.65	n/a	n/a
12-1/2	(318)	0.74	0.74	0.70	0.62	0.95	0.95	0.84	0.62	0.74	0.61	0.58	0.55		0.53	0.34	0.17			0.69	0.33	0.98	0.66	0.57	n/a
14	(356)	0.76	0.76	0.72	0.63	1.00	1.00	0.91	0.66	0.77	0.62	0.59	0.56		0.63	0.41	0.20			0.82	0.40	1.00	0.70	0.61	n/a
16	(406)	0.80	0.80	0.75	0.65			1.00	0.71	0.81	0.64	0.60	0.56		0.77	0.50	0.24			1.00	0.48		0.75	0.65	n/a
18	(457)	0.84	0.84	0.79	0.67				0.76	0.84	0.66	0.62	0.57		0.91	0.59	0.29				0.58		0.79	0.69	n/a
19-1/2	(495)	0.87	0.87	0.81	0.69				0.80	0.87	0.67	0.63	0.58		1.00	0.67	0.32				0.65		0.82	0.71	0.56
20	(508)	0.88	0.88	0.82	0.69				0.82	0.88	0.67	0.63	0.58			0.70	0.34				0.67		0.84	0.72	0.57
22	(559)	0.91	0.91	0.85	0.71				0.87	0.92	0.69	0.64	0.59			0.80	0.39				0.78		0.88	0.76	0.60
24	(610)	0.95	0.95	0.88	0.73				0.93	0.96	0.71	0.66	0.60			0.91	0.44				0.89		0.92	0.79	0.62
26	(660)	0.99	0.99	0.91	0.75				0.99	1.00	0.73	0.67	0.61			1.00	0.50				0.99		0.95	0.82	0.65
28	(711)	1.00	1.00	0.94	0.77				1.00		0.74	0.68	0.61				0.56				1.00		0.99	0.86	0.67
30	(762)			0.98	0.79						0.76	0.70	0.62				0.62						1.00	0.89	0.70
36	(914)			1.00	0.84						0.81	0.74	0.65				0.81							0.97	0.76
> 48	(1219)				0.96						0.92	0.81	0.69				1.00							1.00	0.88

1 Linear interpolation not permitted.

2 Shaded area with reduced edge distance is permitted provided the installation torque is reduced to 0.30 T_{max} for 5d ≤ s ≤ 16-in. and to 0.5 T_{max} for s > 16-in.

3 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with a thin concrete member) the design can become very conservative. To optimize the design, use PROFIS Engineering or perform anchor calculation using the design equations from ACI 318 Chapter 17.

4 Spacing factor reduction in shear applicable when c < 3*h_{ef}. f_{AV}, is applicable when edge distance, c < 3*h_{ef}. If c ≥ 3*h_{ef}, then f_{AV} = f_{AN}.

5 Concrete thickness reduction factor in shear, f_{HV}, is applicable when edge distance, c < 3*h_{ef}. If c ≥ 3*h_{ef}, then f_{HV} = 1.0.

Table 40 — Load adjustment factors for 1-in. diameter threaded rods in uncracked concrete[1,2,3]

1-in. threaded rods uncracked concrete		Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[4] f_{AV}				Edge distance in shear: ⊥ Toward edge f_{RV}				Edge distance in shear: ‖ To and away from edge f_{RV}				Concrete thickness factor in shear[5] f_{HV}			
Embedment	in.	4	9	12	20	4	9	12	20	4	9	12	20	4	9	12	20	4	9	12	20	4	9	12	20
h_{ef}	(mm)	(102)	(229)	(305)	(508)	(102)	(229)	(305)	(508)	(102)	(229)	(305)	(508)	(102)	(229)	(305)	(508)	(102)	(229)	(305)	(508)	(102)	(229)	(305)	(508)
Spacing (s) / Edge Distance (c_a) / Concrete Thickness (h), - in. (mm)																									
1-3/4	(44)	n/a	n/a	n/a	n/a	0.38	0.24	0.18	0.10	n/a	n/a	n/a	n/a	0.08	0.02	0.01	0.01	0.15	0.05	0.03	0.01	n/a	n/a	n/a	n/a
5	(127)	0.58	0.58	0.57	0.54	0.53	0.32	0.23	0.13	0.59	0.54	0.53	0.52	0.37	0.11	0.07	0.03	0.65	0.22	0.14	0.07	n/a	n/a	n/a	n/a
6	(152)	0.60	0.60	0.58	0.55	0.58	0.34	0.25	0.14	0.60	0.55	0.53	0.52	0.48	0.14	0.09	0.04	0.74	0.29	0.19	0.09	n/a	n/a	n/a	n/a
6-1/4	(159)	0.60	0.60	0.59	0.55	0.59	0.35	0.26	0.14	0.61	0.55	0.54	0.52	0.51	0.15	0.10	0.05	0.77	0.30	0.20	0.09	0.65	n/a	n/a	n/a
7	(178)	0.62	0.62	0.60	0.56	0.62	0.37	0.27	0.15	0.62	0.55	0.54	0.52	0.61	0.18	0.12	0.05	0.87	0.36	0.23	0.11	0.69	n/a	n/a	n/a
8	(203)	0.63	0.63	0.61	0.57	0.66	0.40	0.29	0.16	0.64	0.56	0.55	0.53	0.74	0.22	0.14	0.07	0.99	0.40	0.29	0.13	0.74	n/a	n/a	n/a
9	(229)	0.65	0.65	0.63	0.58	0.71	0.43	0.31	0.17	0.65	0.57	0.55	0.53	0.89	0.26	0.17	0.08	1.00	0.43	0.34	0.16	0.78	n/a	n/a	n/a
10	(254)	0.67	0.67	0.64	0.58	0.75	0.46	0.33	0.18	0.67	0.58	0.56	0.53	1.00	0.31	0.20	0.09		0.46	0.35	0.19	0.83	n/a	n/a	n/a
11	(279)	0.68	0.68	0.65	0.59	0.80	0.49	0.35	0.19	0.69	0.58	0.56	0.54		0.35	0.23	0.11		0.49	0.37	0.21	0.87	n/a	n/a	n/a
11-1/4	(286)	0.69	0.69	0.66	0.59	0.81	0.50	0.35	0.19	0.69	0.59	0.56	0.54		0.37	0.24	0.11		0.50	0.38	0.22	0.88	0.58	n/a	n/a
12	(305)	0.70	0.70	0.67	0.60	0.85	0.52	0.37	0.20	0.70	0.59	0.57	0.54		0.40	0.26	0.12		0.52	0.39	0.24	0.91	0.60	n/a	n/a
13	(330)	0.72	0.72	0.68	0.61	0.90	0.55	0.39	0.21	0.72	0.60	0.57	0.54		0.46	0.30	0.14		0.55	0.42	0.28	0.94	0.63	n/a	n/a
14	(356)	0.73	0.73	0.69	0.62	0.95	0.59	0.41	0.23	0.74	0.61	0.58	0.55		0.51	0.33	0.15		0.59	0.44	0.30	0.98	0.65	n/a	n/a
14-1/4	(362)	0.74	0.74	0.70	0.62	0.97	0.60	0.42	0.23	0.74	0.61	0.58	0.55		0.52	0.34	0.16		0.60	0.44	0.30	0.99	0.66	0.57	n/a
16	(406)	0.77	0.77	0.72	0.63	1.00	0.67	0.47	0.26	0.77	0.62	0.59	0.55		0.62	0.40	0.19		0.67	0.48	0.32	1.00	0.70	0.60	n/a
18	(457)	0.80	0.80	0.75	0.65		0.76	0.53	0.29	0.81	0.64	0.60	0.56		0.74	0.48	0.22		0.76	0.53	0.34		0.74	0.64	n/a
20	(508)	0.84	0.84	0.78	0.67		0.84	0.58	0.32	0.84	0.65	0.61	0.57		0.87	0.56	0.26		0.84	0.58	0.36		0.78	0.67	n/a
22	(559)	0.87	0.87	0.81	0.68		0.93	0.64	0.35	0.88	0.67	0.63	0.58		1.00	0.65	0.30		0.93	0.64	0.38		0.82	0.71	n/a
22-1/4	(565)	0.87	0.87	0.81	0.69		0.94	0.65	0.36	0.88	0.67	0.63	0.58			0.66	0.31		0.94	0.65	0.39		0.82	0.71	0.55
24	(610)	0.90	0.90	0.83	0.70		1.00	0.70	0.38	0.91	0.68	0.64	0.58			0.74	0.35		1.00	0.70	0.41		0.85	0.74	0.57
26	(660)	0.94	0.94	0.86	0.72			0.76	0.42	0.94	0.70	0.65	0.59			0.84	0.39			0.76	0.43		0.89	0.77	0.60
28	(711)	0.97	0.97	0.89	0.73			0.82	0.45	0.98	0.71	0.66	0.60			0.94	0.43			0.82	0.45		0.92	0.80	0.62
30	(762)	1.00	1.00	0.92	0.75			0.88	0.48	1.00	0.73	0.67	0.60			1.00	0.48			0.88	0.48		0.95	0.83	0.64
36	(914)			1.00	0.80			1.00	0.58		0.77	0.70	0.62				0.63			1.00	0.58		1.00	0.91	0.70
> 48	(1219)				0.90				0.77		0.86	0.77	0.66				0.98				0.77			1.00	0.81

Table 41 — Load adjustment factors for 1-in. diameter threaded rods in cracked concrete[1,2,3]

1-in. threaded rods cracked concrete		Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[4] f_{AV}				Edge distance in shear: ⊥ Toward edge f_{RV}				Edge distance in shear: ‖ To and away from edge f_{RV}				Concrete thickness factor in shear[5] f_{HV}			
Embedment	in.	4	9	12	20	4	9	12	20	4	9	12	20	4	9	12	20	4	9	12	20	4	9	12	20
h_{ef}	(mm)	(102)	(229)	(305)	(508)	(102)	(229)	(305)	(508)	(102)	(229)	(305)	(508)	(102)	(229)	(305)	(508)	(102)	(229)	(305)	(508)	(102)	(229)	(305)	(508)
Spacing (s) / Edge Distance (c_a) / Concrete Thickness (h), - in. (mm)																									
1-3/4	(44)	n/a	n/a	n/a	n/a	0.41	0.41	0.40	0.38	n/a	n/a	n/a	n/a	0.08	0.02	0.01	0.01	0.15	0.05	0.03	0.01	n/a	n/a	n/a	n/a
5	(127)	0.58	0.58	0.57	0.54	0.53	0.53	0.50	0.44	0.59	0.54	0.53	0.52	0.37	0.11	0.07	0.03	0.74	0.22	0.14	0.07	n/a	n/a	n/a	n/a
6	(152)	0.60	0.60	0.58	0.55	0.58	0.58	0.53	0.46	0.60	0.55	0.53	0.52	0.49	0.14	0.09	0.04	0.97	0.29	0.19	0.09	n/a	n/a	n/a	n/a
6-1/4	(159)	0.60	0.60	0.59	0.55	0.59	0.59	0.54	0.46	0.61	0.55	0.54	0.52	0.52	0.15	0.10	0.05	1.00	0.31	0.20	0.09	0.66	n/a	n/a	n/a
7	(178)	0.62	0.62	0.60	0.56	0.62	0.62	0.57	0.47	0.62	0.55	0.54	0.52	0.61	0.18	0.12	0.05		0.36	0.24	0.11	0.69	n/a	n/a	n/a
8	(203)	0.63	0.63	0.61	0.57	0.66	0.66	0.60	0.49	0.64	0.56	0.55	0.53	0.75	0.22	0.14	0.07		0.44	0.29	0.13	0.74	n/a	n/a	n/a
9	(229)	0.65	0.65	0.63	0.58	0.71	0.71	0.64	0.51	0.65	0.57	0.55	0.53	0.89	0.26	0.17	0.08		0.53	0.34	0.16	0.79	n/a	n/a	n/a
10	(254)	0.67	0.67	0.64	0.58	0.75	0.75	0.67	0.53	0.67	0.58	0.56	0.53	1.00	0.31	0.20	0.09		0.62	0.40	0.19	0.83	n/a	n/a	n/a
11	(279)	0.68	0.68	0.65	0.59	0.80	0.80	0.71	0.55	0.69	0.58	0.56	0.54		0.36	0.23	0.11		0.72	0.46	0.22	0.87	n/a	n/a	n/a
11-1/4	(286)	0.69	0.69	0.66	0.59	0.81	0.81	0.72	0.56	0.69	0.59	0.56	0.54		0.37	0.24	0.11		0.74	0.48	0.22	0.88	0.59	n/a	n/a
12	(305)	0.70	0.70	0.67	0.60	0.85	0.85	0.75	0.57	0.71	0.59	0.57	0.54		0.41	0.26	0.12		0.82	0.53	0.25	0.91	0.61	n/a	n/a
13	(330)	0.72	0.72	0.68	0.61	0.90	0.90	0.79	0.59	0.72	0.60	0.57	0.54		0.46	0.30	0.14		0.92	0.60	0.28	0.95	0.63	n/a	n/a
14	(356)	0.73	0.73	0.69	0.62	0.95	0.95	0.83	0.62	0.74	0.61	0.58	0.55		0.51	0.33	0.16		1.00	0.67	0.31	0.98	0.65	n/a	n/a
14-1/4	(362)	0.74	0.74	0.70	0.62	0.97	0.97	0.84	0.62	0.74	0.61	0.58	0.55		0.53	0.34	0.16			0.69	0.32	0.99	0.66	0.57	n/a
16	(406)	0.77	0.77	0.72	0.63	1.00	1.00	0.91	0.66	0.77	0.62	0.59	0.55		0.63	0.41	0.19			0.82	0.38	1.00	0.70	0.61	n/a
18	(457)	0.80	0.80	0.75	0.65			1.00	0.70	0.81	0.64	0.60	0.56		0.75	0.49	0.23			0.97	0.45		0.74	0.64	n/a
20	(508)	0.84	0.84	0.78	0.67				0.75	0.84	0.65	0.61	0.57		0.88	0.57	0.26			1.00	0.53		0.78	0.68	n/a
22	(559)	0.87	0.87	0.81	0.68				0.80	0.88	0.67	0.63	0.58		1.00	0.66	0.31				0.61		0.82	0.71	n/a
22-1/4	(565)	0.87	0.87	0.81	0.69				0.80	0.88	0.67	0.63	0.58			0.67	0.31				0.62		0.82	0.71	0.55
24	(610)	0.90	0.90	0.83	0.70				0.85	0.91	0.68	0.64	0.58			0.75	0.35				0.70		0.86	0.74	0.57
26	(660)	0.94	0.94	0.86	0.72				0.90	0.95	0.70	0.65	0.59			0.84	0.39				0.78		0.89	0.77	0.60
28	(711)	0.97	0.97	0.89	0.73				0.95	0.98	0.71	0.66	0.60			0.94	0.44				0.88		0.92	0.80	0.62
30	(762)	1.00	1.00	0.92	0.75				1.00	1.00	0.73	0.67	0.60			1.00	0.49				0.97		0.96	0.83	0.64
36	(914)			1.00	0.80						0.77	0.71	0.62				0.64				1.00		1.00	0.91	0.70
> 48	(1219)				0.90						0.87	0.77	0.66				0.98							1.00	0.81

1 Linear interpolation not permitted.

2 Shaded area with reduced edge distance is permitted provided the installation torque is reduced to 0.30 T_{max} for 5d ≤ s ≤ 16-in. and to 0.5 T_{max} for s > 16-in.

3 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with a thin concrete member) the design can become very conservative. To optimize the design, use PROFIS Engineering or perform anchor calculation using the design equations from ACI 318 Chapter 17.

4 Spacing factor reduction in shear applicable when c < 3*h_{ef}. f_{AV}, is applicable when edge distance, c < 3*h_{ef}. If c ≥ 3*h_{ef}, then f_{AV} = f_{AN}.

5 Concrete thickness reduction factor in shear, f_{HV}, is applicable when edge distance, c < 3*h_{ef}. If c ≥ 3*h_{ef}, then f_{HV} = 1.0.

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Table 42 — Load adjustment factors for 1-1/4-in. diameter threaded rods in uncracked concrete[1,2,3]

1-1/4-in. threaded rods uncracked concrete		Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[4] f_{AV}				Edge distance in shear: ⊥ Toward edge f_{RV}				Edge distance in shear: ‖ To and away from edge f_{RV}				Concrete thickness factor in shear[5] f_{HV}			
Embedment h_{ef}	in. (mm)	5 (127)	11-1/4 (286)	15 (381)	25 (635)	5 (127)	11-1/4 (286)	15 (381)	25 (635)	5 (127)	11-1/4 (286)	15 (381)	25 (635)	5 (127)	11-1/4 (286)	15 (381)	25 (635)	5 (127)	11-1/4 (286)	15 (381)	25 (635)	5 (127)	11-1/4 (286)	15 (381)	25 (635)
Spacing (s) / Edge Distance (c_a) / Concrete Thickness (h), - in. (mm) 1-3/4	(44)	n/a	n/a	n/a	n/a	0.37	0.24	0.17	0.09	n/a	n/a	n/a	n/a	0.05	0.02	0.01	0.00	0.11	0.03	0.02	0.01	n/a	n/a	n/a	n/a
6-1/4	(159)	0.59	0.59	0.57	0.54	0.54	0.33	0.24	0.13	0.59	0.54	0.53	0.52	0.37	0.11	0.07	0.03	0.67	0.22	0.14	0.07	n/a	n/a	n/a	n/a
7	(178)	0.60	0.60	0.58	0.55	0.57	0.35	0.25	0.13	0.60	0.54	0.53	0.52	0.43	0.13	0.08	0.04	0.73	0.26	0.17	0.08	n/a	n/a	n/a	n/a
8	(203)	0.61	0.61	0.59	0.55	0.61	0.37	0.26	0.14	0.61	0.55	0.54	0.52	0.53	0.16	0.10	0.05	0.82	0.31	0.20	0.10	0.66	n/a	n/a	n/a
9	(229)	0.63	0.63	0.60	0.56	0.64	0.39	0.28	0.15	0.62	0.55	0.54	0.52	0.63	0.19	0.12	0.06	0.93	0.38	0.24	0.11	0.70	n/a	n/a	n/a
10	(254)	0.64	0.64	0.61	0.57	0.68	0.41	0.29	0.16	0.64	0.56	0.55	0.53	0.74	0.22	0.14	0.07	1.00	0.41	0.29	0.13	0.74	n/a	n/a	n/a
11	(279)	0.65	0.65	0.62	0.57	0.72	0.44	0.31	0.17	0.65	0.57	0.55	0.53	0.86	0.25	0.16	0.08		0.44	0.33	0.15	0.78	n/a	n/a	n/a
12	(305)	0.67	0.67	0.63	0.58	0.76	0.46	0.33	0.18	0.66	0.57	0.55	0.53	0.98	0.29	0.19	0.09		0.46	0.36	0.17	0.81	n/a	n/a	n/a
13	(330)	0.68	0.68	0.64	0.59	0.80	0.49	0.35	0.19	0.68	0.58	0.56	0.54	1.00	0.33	0.21	0.10		0.49	0.38	0.20	0.84	n/a	n/a	n/a
14	(356)	0.70	0.70	0.66	0.59	0.84	0.52	0.36	0.20	0.69	0.59	0.56	0.54		0.36	0.24	0.11		0.52	0.40	0.22	0.87	0.58	n/a	n/a
14-1/4	(362)	0.70	0.70	0.66	0.60	0.85	0.52	0.37	0.20	0.69	0.59	0.56	0.54		0.37	0.24	0.11		0.52	0.40	0.23	0.88	0.59	n/a	n/a
15	(381)	0.71	0.71	0.67	0.60	0.88	0.54	0.38	0.21	0.70	0.59	0.57	0.54		0.40	0.26	0.12		0.54	0.41	0.24	0.91	0.60	n/a	n/a
16	(406)	0.72	0.72	0.68	0.61	0.92	0.57	0.40	0.22	0.72	0.60	0.57	0.54		0.45	0.29	0.13		0.57	0.43	0.27	0.94	0.62	n/a	n/a
17	(432)	0.74	0.74	0.69	0.61	0.96	0.60	0.42	0.23	0.73	0.60	0.58	0.55		0.49	0.32	0.15		0.60	0.45	0.29	0.96	0.64	n/a	n/a
18	(457)	0.75	0.75	0.70	0.62	1.00	0.63	0.44	0.24	0.75	0.61	0.58	0.55		0.53	0.35	0.16		0.63	0.47	0.31	0.99	0.66	0.57	n/a
20	(508)	0.78	0.78	0.72	0.63		0.70	0.49	0.27	0.77	0.62	0.59	0.55		0.62	0.40	0.19		0.70	0.50	0.33	1.00	0.70	0.60	n/a
22	(559)	0.81	0.81	0.74	0.65		0.77	0.54	0.29	0.80	0.63	0.60	0.56		0.72	0.47	0.22		0.77	0.54	0.35		0.73	0.63	n/a
24	(610)	0.84	0.84	0.77	0.66		0.84	0.59	0.32	0.83	0.65	0.61	0.57		0.82	0.53	0.25		0.84	0.59	0.36		0.76	0.66	n/a
26	(660)	0.87	0.87	0.79	0.67		0.91	0.64	0.34	0.86	0.66	0.62	0.57		0.92	0.60	0.28		0.91	0.64	0.38		0.79	0.69	n/a
28	(711)	0.89	0.89	0.81	0.69		0.98	0.68	0.37	0.88	0.67	0.63	0.58		1.00	0.67	0.31		0.98	0.68	0.40		0.82	0.71	0.55
30	(762)	0.92	0.92	0.83	0.70		1.00	0.73	0.40	0.91	0.68	0.64	0.58			0.74	0.35		1.00	0.73	0.42		0.85	0.74	0.57
36	(914)	1.00	1.00	0.90	0.74			0.88	0.48	0.99	0.72	0.66	0.60			0.98	0.45			0.88	0.48		0.94	0.81	0.63
> 48	(1219)			1.00	0.82			1.00	0.64	1.00	0.79	0.72	0.63			1.00	0.70			1.00	0.64		1.00	0.94	0.72

Table 43 — Load adjustment factors for 1-1/4-in. diameter threaded rods in cracked concrete[1,2,3]

1-1/4-in. threaded rods cracked concrete		Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[4] f_{AV}				Edge distance in shear: ⊥ Toward edge f_{RV}				Edge distance in shear: ‖ To and away from edge f_{RV}				Concrete thickness factor in shear[5] f_{HV}			
Embedment h_{ef}	in. (mm)	5 (127)	11-1/4 (286)	15 (381)	25 (635)	5 (127)	11-1/4 (286)	15 (381)	25 (635)	5 (127)	11-1/4 (286)	15 (381)	25 (635)	5 (127)	11-1/4 (286)	15 (381)	25 (635)	5 (127)	11-1/4 (286)	15 (381)	25 (635)	5 (127)	11-1/4 (286)	15 (381)	25 (635)
Spacing (s) / Edge Distance (c_a) / Concrete Thickness (h), - in. (mm) 1-3/4	(44)	n/a	n/a	n/a	n/a	0.40	0.40	0.39	0.37	n/a	n/a	n/a	n/a	0.05	0.02	0.01	0.00	0.11	0.03	0.02	0.01	n/a	n/a	n/a	n/a
6-1/4	(159)	0.59	0.59	0.57	0.54	0.54	0.54	0.50	0.44	0.59	0.54	0.53	0.52	0.37	0.11	0.07	0.03	0.74	0.22	0.14	0.07	n/a	n/a	n/a	n/a
7	(178)	0.60	0.60	0.58	0.55	0.57	0.57	0.52	0.45	0.60	0.54	0.53	0.52	0.44	0.13	0.08	0.04	0.88	0.26	0.17	0.08	n/a	n/a	n/a	n/a
8	(203)	0.61	0.61	0.59	0.55	0.61	0.61	0.55	0.46	0.61	0.55	0.54	0.52	0.54	0.16	0.10	0.05	1.00	0.32	0.21	0.10	0.66	n/a	n/a	n/a
9	(229)	0.63	0.63	0.60	0.56	0.64	0.64	0.57	0.48	0.62	0.55	0.54	0.52	0.64	0.19	0.12	0.06		0.38	0.25	0.11	0.70	n/a	n/a	n/a
10	(254)	0.64	0.64	0.61	0.57	0.68	0.68	0.60	0.49	0.64	0.56	0.55	0.53	0.75	0.22	0.14	0.07		0.44	0.29	0.13	0.74	n/a	n/a	n/a
11	(279)	0.65	0.65	0.62	0.57	0.72	0.72	0.63	0.51	0.65	0.57	0.55	0.53	0.86	0.26	0.17	0.08		0.51	0.33	0.15	0.78	n/a	n/a	n/a
12	(305)	0.67	0.67	0.63	0.58	0.76	0.76	0.66	0.53	0.66	0.57	0.55	0.53	0.98	0.29	0.19	0.09		0.58	0.38	0.18	0.81	n/a	n/a	n/a
13	(330)	0.68	0.68	0.64	0.59	0.80	0.80	0.69	0.54	0.68	0.58	0.56	0.54	1.00	0.33	0.21	0.10		0.66	0.43	0.20	0.85	n/a	n/a	n/a
14	(356)	0.70	0.70	0.66	0.59	0.84	0.84	0.72	0.56	0.69	0.59	0.56	0.54		0.37	0.24	0.11		0.73	0.48	0.22	0.88	0.58	n/a	n/a
14-1/4	(362)	0.70	0.70	0.66	0.60	0.85	0.85	0.73	0.56	0.70	0.59	0.57	0.54		0.38	0.25	0.11		0.75	0.49	0.23	0.89	0.59	n/a	n/a
15	(381)	0.71	0.71	0.67	0.60	0.88	0.88	0.75	0.57	0.71	0.59	0.57	0.54		0.41	0.26	0.12		0.82	0.53	0.25	0.91	0.61	n/a	n/a
16	(406)	0.72	0.72	0.68	0.61	0.92	0.92	0.78	0.59	0.72	0.60	0.57	0.54		0.45	0.29	0.14		0.90	0.58	0.27	0.94	0.63	n/a	n/a
17	(432)	0.74	0.74	0.69	0.61	0.96	0.96	0.81	0.61	0.73	0.60	0.58	0.55		0.49	0.32	0.15		0.98	0.64	0.30	0.97	0.64	n/a	n/a
18	(457)	0.75	0.75	0.70	0.62	1.00	1.00	0.85	0.62	0.75	0.61	0.58	0.55		0.54	0.35	0.16		1.00	0.70	0.32	0.99	0.66	0.57	n/a
20	(508)	0.78	0.78	0.72	0.63			0.91	0.66	0.77	0.62	0.59	0.55		0.63	0.41	0.19			0.82	0.38	1.00	0.70	0.61	n/a
22	(559)	0.81	0.81	0.74	0.65			0.98	0.69	0.80	0.63	0.60	0.56		0.72	0.47	0.22			0.94	0.44		0.73	0.63	n/a
24	(610)	0.84	0.84	0.77	0.66			1.00	0.73	0.83	0.65	0.61	0.57		0.82	0.54	0.25			1.00	0.50		0.77	0.66	n/a
26	(660)	0.87	0.87	0.79	0.67				0.77	0.86	0.66	0.62	0.57		0.93	0.60	0.28				0.56		0.80	0.69	n/a
28	(711)	0.89	0.89	0.81	0.69				0.81	0.88	0.67	0.63	0.58		1.00	0.68	0.31				0.63		0.83	0.72	0.55
30	(762)	0.92	0.92	0.83	0.70				0.85	0.91	0.68	0.64	0.58			0.75	0.35				0.70		0.86	0.74	0.57
36	(914)	1.00	1.00	0.90	0.74				0.97	0.99	0.72	0.66	0.60			0.98	0.46				0.91		0.94	0.81	0.63
> 48	(1219)			1.00	0.82				1.00	1.00	0.79	0.72	0.63			1.00	0.70				1.00		1.00	0.94	0.73

1 Linear interpolation not permitted.

2 Shaded area with reduced edge distance is permitted provided the installation torque is reduced to $0.30\,T_{max}$ for $5d \le s \le 16$-in. and to $0.5\,T_{max}$ for $s > 16$-in.

3 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with a thin concrete member) the design can become very conservative. To optimize the design, use PROFIS Engineering or perform anchor calculation using the design equations from ACI 318 Chapter 17.

4 Spacing factor reduction in shear applicable when $c < 3{*}h_{ef}$. f_{AV}, is applicable when edge distance, $c < 3{*}h_{ef}$. If $c \ge 3{*}h_{ef}$, then $f_{AV} = f_{AN}$.

5 Concrete thickness reduction factor in shear, f_{HV}, is applicable when edge distance, $c < 3{*}h_{ef}$. If $c \ge 3{*}h_{ef}$, then $f_{HV} = 1.0$.

HIT-RE 500 V3 adhesive with HIS-N and HIS-RN internally threaded insert

3.2.3

Figure 7 — Hilti HIS-N and HIS-RN internally threaded insert installation conditions

Cracked or uncracked concrete	Permissible drilling methods	Permissible concrete conditions
Cracked and uncracked concrete	Hammer drilling with carbide-tipped drill bit	Dry concrete Water-saturated concrete Water-filled holes Submerged (underwater)
	Hilti TE-CD or TE-YD hollow drill bit Diamond core drill bit with Hilti TE-YRT roughening tool	Dry concrete Water-saturated concrete
Uncracked concrete	Diamond core drill bit	Dry concrete Water-saturated concrete

Table 44 — HIS-N and HIS-RN specifications

Setting information		Symbol	Units	Thread size			
				3/8-16 UNC	1/2-13 UNC	5/8-11 UNC	3/4-10 UNC
Outside diameter of insert			in.	0.65	0.81	1.00	1.09
Nominal bit diameter		d_o	in.	11/16	7/8	1-1/8	1-1/4
Effective embedment		h_{ef}	in. (mm)	4-3/8 (110)	5 (125)	6-3/4 (170)	8-1/8 (205)
Thread engagement	minimum	h_s	in.	3/8	1/2	5/8	3/4
	maximum		in.	15/16	1-3/16	1-1/2	1-7/8
Installation torque		T_{inst}	ft-lb (Nm)	15 (20)	30 (40)	60 (81)	100 (136)
Minimum concrete thickness		h_{min}	in. (mm)	5.9 (150)	6.7 (170)	9.1 (230)	10.6 (270)
Minimum edge distance		c_{min}	in (mm)	3-1/4 (83)	4 (102)	5 (127)	5-1/2 (140)
Minimum anchor spacing		s_{min}	in (mm)	3-1/4 (83)	4 (102)	5 (127)	5-1/2 (140)

Figure 8 — Hilti HIS-N and HIS-RN specifications

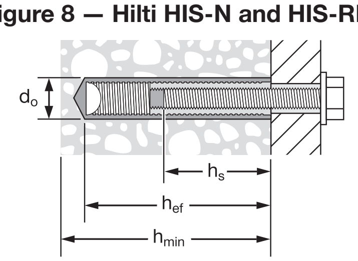

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Table 45 — Hilti HIT-RE 500 V3 adhesive design strength with concrete / bond failure for Hilti HIS-N and HIS-RN internally threaded inserts in uncracked concrete[1,2,3,4,5,6,7,8,9,11]

Thread size	Effective embedment in. (mm)	Tension — ΦN_n				Shear — ΦV_n			
		f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)	f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)
3/8-16 UNC	4-3/8 (111)	7,140 (31.8)	7,820 (34.8)	9,030 (40.2)	11,060 (49.2)	15,375 (68.4)	16,840 (74.9)	19,445 (86.5)	23,815 (105.9)
1/2-13[10] UNC	5 (127)	8,720 (38.8)	9,555 (42.5)	11,030 (49.1)	13,510 (60.1)	18,785 (83.6)	20,575 (91.5)	23,760 (105.7)	29,100 (129.4)
5/8-11[10] UNC	6-3/4 (171)	13,680 (60.9)	14,985 (66.7)	17,305 (77.0)	21,190 (94.3)	29,460 (131.0)	32,275 (143.6)	37,265 (165.8)	45,645 (203.0)
3/4-10[10] UNC	8-1/8 (206)	18,065 (80.4)	19,790 (88.0)	22,850 (101.6)	27,985 (124.5)	38,910 (173.1)	42,620 (189.6)	49,215 (218.9)	60,275 (268.1)

Table 46 — Hilti HIT-RE 500 V3 adhesive design strength with concrete / bond failure for Hilti HIS-N and HIS-RN internally threaded inserts in cracked concrete[1,2,3,4,5,6,7,8,9,11]

Thread size	Effective embedment in. (mm)	Tension — ΦN_n				Shear — ΦV_n			
		f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)	f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)
3/8-16 UNC	4-3/8 (111)	5,055 (22.5)	5,540 (24.6)	6,395 (28.4)	7,085 (31.5)	10,890 (48.4)	11,930 (53.1)	13,775 (61.3)	15,260 (67.9)
1/2-13[10] UNC	5 (127)	6,175 (27.5)	6,765 (30.1)	7,815 (34.8)	9,570 (42.6)	13,305 (59.2)	14,575 (64.8)	16,830 (74.9)	20,610 (91.7)
5/8-11[10] UNC	6-3/4 (171)	9,690 (43.1)	10,615 (47.2)	12,255 (54.5)	15,010 (66.8)	20,870 (92.8)	22,860 (101.7)	26,395 (117.4)	32,330 (143.8)
3/4-10[10] UNC	8-1/8 (206)	12,795 (56.9)	14,015 (62.3)	16,185 (72.0)	19,825 (88.2)	27,560 (122.6)	30,190 (134.3)	34,860 (155.1)	42,695 (189.9)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8 to convert design strength (factored resistance) value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 50 and 51 as necessary to the above values. Compare to the steel values in table 49. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130° F (55° C), max. long term temperature = 110° F (43° C).
For temperature range B: Max. short term temperature = 176° F (80° C), max. long term temperature = 110° F (43° C) multiply above values by 0.69
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.
6 Tabular values are for dry concrete and water saturated concrete conditions.
For water-filled drilled holes multiply design strength by 0.52.
For submerged (under water) applications multiply design strength by 0.46.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λ_a as follows:
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for holes drilled in concrete with carbide tipped hammer drill bit. Diamond core drilling is not permitted in cracked concrete except as indicated in note 10. For diamond core drilling in uncracked concrete, except as indicated in note 10, multiply the above values by 0.57. Diamond core drilling is not permitted for water-filled or under-water (submerged) applications in uncracked concrete.
10 Diamond core drilling is permitted in uncracked and cracked concrete with use of the Hilti TE-YRT roughening tool for 1/2-13 UNC, 5/8-11 UNC, and 3/4-10 UNC anchors in dry and water-saturated concrete. See Tables 47 and 48.
11 Tabular values are for static loads only. Seismic design is not permitted for uncracked concrete. For seismic loads, multiply cracked concrete tabular values in tension and shear by α_{seis} = 0.75. See section 3.1.8 for additional information on seismic applications.

3.2.3

Table 47 — Hilti HIT-RE 500 V3 in Core Drilled Holes roughened with TE-YRT Roughening Tool adhesive design strength with concrete / bond failure for Hilti HIS-N and HIS-RN internally threaded inserts in uncracked concrete[1,2,3,4,5,6,7,8]

Thread size	Effective embedment in. (mm)	Tension — ΦN_n				Shear — ΦV_n			
		f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)	f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)
1/2-13 UNC	5 (127)	8,720 (38.8)	9,555 (42.5)	11,030 (49.1)	13,510 (60.1)	18,785 (83.6)	20,575 (91.5)	23,760 (105.7)	29,100 (129.4)
5/8-11 UNC	6-3/4 (171)	13,680 (60.9)	14,985 (66.7)	17,305 (77.0)	21,190 (94.3)	29,460 (131.0)	32,275 (143.6)	37,265 (165.8)	45,645 (203.0)
3/4-10 UNC	8-1/8 (206)	18,065 (80.4)	19,790 (88.0)	22,850 (101.6)	27,985 (124.5)	38,910 (173.1)	42,620 (189.6)	49,215 (218.9)	60,275 (268.1)

Table 48 — Hilti HIT-RE 500 V3 in Core Drilled Holes roughened with TE-YRT Roughening Tool adhesive design strength with concrete / bond failure for Hilti HIS-N and HIS-RN internally threaded inserts in cracked concrete[1,2,3,4,5,6,7,8,9]

Thread size	Effective embedment in. (mm)	Tension — ΦN_n				Shear — ΦV_n			
		f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)	f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)
1/2-13 UNC	5 (127)	6,175 (27.5)	6,205 (27.6)	6,205 (27.6)	6,205 (27.6)	13,305 (59.2)	13,360 (59.4)	13,360 (59.4)	13,360 (59.4)
5/8-11 UNC	6-3/4 (171)	9,690 (43.1)	10,340 (46.0)	10,340 (46.0)	10,340 (46.0)	20,870 (92.8)	22,265 (99.0)	22,265 (99.0)	22,265 (99.0)
3/4-10 UNC	8-1/8 (206)	12,795 (56.9)	13,565 (60.3)	13,565 (60.3)	13,565 (60.3)	27,560 (122.6)	29,215 (130.0)	29,215 (130.0)	29,215 (130.0)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8 to convert design strength (factored resistance) value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 50 and 51 as necessary to the above values. Compare to the steel values in table 49. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130° F (55° C), max. long term temperature = 110° F (43° C). For temperature range B: Max. short term temperature = 176° F (80° C), max. long term temperature = 110° F (43° C) multiply above values by 0.69 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.
6 Tabular values are for dry concrete and water saturated concrete conditions. Water-filled and submerged (underwater) applications are not permitted for this hole preparation method.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λ_a as follows: For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for static loads only. Seismic design is not permitted for uncracked concrete. For seismic loads, multiply cracked concrete tabular values in tension and shear by α_{seis} = 0.75. See section 3.1.8 for additional information on seismic applications.

Table 49 — Steel design strength for steel bolt / cap screw for Hilti HIS-N and HIS-RN internally threaded inserts[1,2,3]

Thread size	ASTM A 193 B7			ASTM A 193 Grade B8M stainless steel		
	Tensile[4] ϕN_{sa} lb (kN)	Shear[5] ϕV_{sa} lb (kN)	Seismic Shear[6] $\phi V_{sa,eq}$ lb (kN)	Tensile[4] ϕN_{sa} lb (kN)	Shear[5] ϕV_{sa} lb (kN)	Seismic Shear[6] $\phi V_{sa,eq}$ lb (kN)
3/8-16 UNC	6,300 (28.0)	3,490 (15.5)	2,445 (10.9)	5,540 (24.6)	3,070 (13.7)	2,150 (9.6)
1/2-13 UNC	10,525 (46.8)	6,385 (28.4)	4,470 (19.9)	10,145 (45.1)	5,620 (25.0)	3,935 (17.5)
5/8-11 UNC	17,500 (77.8)	10,170 (45.2)	7,120 (31.7)	16,160 (71.9)	8,950 (39.8)	6,265 (27.9)
3/4-10 UNC	17,785 (79.1)	15,055 (67.0)	10,540 (46.9)	23,915 (106.4)	13,245 (58.9)	9,270 (41.2)

1 See Section 3.1.8 to convert design strength value to ASD value.
2 Hilti HIS-N and HIS-RN inserts with steel bolts are considered brittle steel elements.
3 Table values are the lesser of steel failure in the HIS-N insert or inserted steel bolt.
4 Tensile = $\phi A_{se,N} f_{uta}$ as noted in ACI 318 Chapter 17.
5 Shear = ϕ 0.60 $A_{se,V} f_{uta}$ as noted in ACI 318 Chapter 17.
6 Seismic Shear = $\alpha_{V,seis} \phi V_{sa}$: Reduction for seismic shear only. See section 3.1.8 for additional information on seismic applications.

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Table 50 — Load adjustment factors for Hilti HIS-N and HIS-RN internally threaded inserts in uncracked concrete[1,2]

HIS-N and HIS-RN all diameters uncracked concrete		Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[3] f_{AV}				Edge Distance in Shear ⊥ Toward edge f_{RV}				Edge Distance in Shear ∥ To and away from edge f_{RV}				Concrete thickness factor in shear[4] f_{HV}			
Internal diameter	in. (mm)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)
Embedment h_{ef}	in. (mm)	4-3/8 (111)	5 (127)	6-3/4 (171)	8-1/8 (206)	4-3/8 (111)	5 (127)	6-3/4 (171)	8-1/8 (206)	4-3/8 (111)	5 (127)	6-3/4 (171)	8-1/8 (206)	4-3/8 (111)	5 (127)	6-3/4 (171)	8-1/8 (206)	4-3/8 (111)	5 (127)	6-3/4 (171)	8-1/8 (206)	4-3/8 (111)	5 (127)	6-3/4 (171)	8-1/8 (206)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm) 3-1/4	(83)	0.59	n/a	n/a	n/a	0.36	n/a	n/a	n/a	0.55	n/a	n/a	n/a	0.15	n/a	n/a	n/a	0.31	n/a	n/a	n/a	n/a	n/a	n/a	n/a
4	(102)	0.61	0.59	n/a	n/a	0.41	0.40	n/a	n/a	0.56	0.55	n/a	n/a	0.21	0.19	n/a	n/a	0.41	0.38	n/a	n/a	n/a	n/a	n/a	n/a
5	(127)	0.64	0.61	0.59	n/a	0.47	0.45	0.39	n/a	0.57	0.57	0.55	n/a	0.29	0.26	0.17	n/a	0.47	0.45	0.33	n/a	n/a	n/a	n/a	n/a
5-1/2	(140)	0.65	0.62	0.60	0.59	0.50	0.48	0.41	0.37	0.58	0.58	0.56	0.55	0.34	0.30	0.19	0.15	0.50	0.48	0.39	0.29	n/a	n/a	n/a	n/a
6	(152)	0.66	0.63	0.61	0.60	0.53	0.51	0.43	0.39	0.59	0.58	0.56	0.55	0.39	0.35	0.22	0.17	0.53	0.51	0.43	0.33	0.60	n/a	n/a	n/a
7	(178)	0.69	0.65	0.62	0.61	0.61	0.57	0.48	0.42	0.60	0.60	0.57	0.56	0.49	0.43	0.28	0.21	0.61	0.57	0.48	0.42	0.64	0.62	n/a	n/a
8	(203)	0.72	0.67	0.64	0.63	0.70	0.65	0.52	0.45	0.62	0.61	0.58	0.57	0.60	0.53	0.34	0.26	0.70	0.65	0.52	0.45	0.69	0.66	n/a	n/a
9	(229)	0.74	0.70	0.66	0.65	0.78	0.73	0.57	0.49	0.63	0.62	0.59	0.58	0.71	0.63	0.40	0.31	0.78	0.73	0.57	0.49	0.73	0.70	n/a	n/a
10	(254)	0.77	0.72	0.68	0.66	0.87	0.81	0.62	0.53	0.65	0.64	0.60	0.58	0.83	0.74	0.47	0.36	0.87	0.81	0.62	0.53	0.77	0.74	0.64	n/a
11	(279)	0.80	0.74	0.69	0.68	0.96	0.89	0.68	0.56	0.66	0.65	0.61	0.59	0.96	0.86	0.55	0.41	0.96	0.89	0.68	0.56	0.81	0.78	0.67	0.61
12	(305)	0.82	0.76	0.71	0.69	1.00	0.97	0.74	0.60	0.68	0.66	0.62	0.60	1.00	0.98	0.62	0.47	1.00	0.97	0.74	0.60	0.84	0.81	0.70	0.64
14	(356)	0.88	0.80	0.75	0.73		1.00	0.86	0.70	0.71	0.69	0.64	0.62		1.00	0.78	0.59		1.00	0.86	0.70	0.91	0.87	0.75	0.69
16	(406)	0.93	0.85	0.78	0.76			0.98	0.80	0.74	0.72	0.66	0.63			0.96	0.73			0.98	0.80	0.97	0.94	0.80	0.73
18	(457)	0.99	0.89	0.82	0.79			1.00	0.90	0.77	0.75	0.68	0.65			1.00	0.87			1.00	0.90	1.00	0.99	0.85	0.78
24	(610)	1.00	1.00	0.92	0.89				1.00	0.85	0.83	0.74	0.70				1.00				1.00		1.00	0.99	0.90
30	(762)			1.00	0.98					0.94	0.91	0.80	0.75											1.00	1.00
36	(914)				1.00					1.00	0.99	0.86	0.80												
> 48	(1219)											0.99	0.90												

Table 51 — Load adjustment factors for Hilti HIS-N and HIS-RN internally threaded inserts in cracked concrete[1,2]

HIS-N and HIS-RN all diameters cracked concrete		Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[3] f_{AV}				Edge Distance in Shear ⊥ Toward edge f_{RV}				Edge Distance in Shear ∥ To and away from edge f_{RV}				Concrete thickness factor in shear[4] f_{HV}			
Internal diameter	in. (mm)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)
Embedment h_{ef}	in. (mm)	4-3/8 (111)	5 (127)	6-3/4 (171)	8-1/8 (206)	4-3/8 (111)	5 (127)	6-3/4 (171)	8-1/8 (206)	4-3/8 (111)	5 (127)	6-3/4 (171)	8-1/8 (206)	4-3/8 (111)	5 (127)	6-3/4 (171)	8-1/8 (206)	4-3/8 (111)	5 (127)	6-3/4 (171)	8-1/8 (206)	4-3/8 (111)	5 (127)	6-3/4 (171)	8-1/8 (206)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm) 3-1/4	(83)	0.59	n/a	n/a	n/a	0.54	n/a	n/a	n/a	0.55	n/a	n/a	n/a	0.16	n/a	n/a	n/a	0.31	n/a	n/a	n/a	n/a	n/a	n/a	n/a
4	(102)	0.61	0.59	n/a	n/a	0.59	0.54	n/a	n/a	0.56	0.55	n/a	n/a	0.21	0.19	n/a	n/a	0.42	0.38	n/a	n/a	n/a	n/a	n/a	n/a
5	(127)	0.64	0.61	0.59	n/a	0.66	0.60	0.54	n/a	0.57	0.57	0.55	n/a	0.30	0.26	0.17	n/a	0.59	0.53	0.34	n/a	n/a	n/a	n/a	n/a
5-1/2	(140)	0.65	0.62	0.60	0.59	0.70	0.62	0.57	0.55	0.58	0.58	0.56	0.55	0.34	0.31	0.19	0.15	0.69	0.61	0.39	0.29	n/a	n/a	n/a	n/a
6	(152)	0.66	0.63	0.61	0.60	0.74	0.65	0.59	0.57	0.59	0.58	0.56	0.55	0.39	0.35	0.22	0.17	0.74	0.65	0.44	0.34	0.60	n/a	n/a	n/a
7	(178)	0.69	0.65	0.62	0.61	0.81	0.71	0.63	0.61	0.60	0.60	0.57	0.56	0.49	0.44	0.28	0.21	0.81	0.71	0.56	0.42	0.64	0.62	n/a	n/a
8	(203)	0.72	0.67	0.64	0.63	0.89	0.77	0.68	0.65	0.62	0.61	0.58	0.57	0.60	0.54	0.34	0.26	0.89	0.77	0.68	0.52	0.69	0.66	n/a	n/a
9	(229)	0.74	0.70	0.66	0.65	0.98	0.83	0.73	0.69	0.63	0.62	0.59	0.58	0.72	0.64	0.41	0.31	0.98	0.83	0.73	0.62	0.73	0.70	n/a	n/a
10	(254)	0.77	0.72	0.68	0.66	1.00	0.90	0.78	0.73	0.65	0.64	0.60	0.58	0.84	0.75	0.48	0.36	1.00	0.90	0.78	0.72	0.77	0.74	0.64	n/a
11	(279)	0.80	0.74	0.69	0.68		0.96	0.83	0.78	0.66	0.65	0.61	0.59	0.97	0.86	0.55	0.42		0.96	0.83	0.78	0.81	0.78	0.67	0.61
12	(305)	0.82	0.76	0.71	0.69		1.00	0.88	0.83	0.68	0.66	0.62	0.60	1.00	0.98	0.63	0.48		1.00	0.88	0.83	0.84	0.81	0.70	0.64
14	(356)	0.88	0.80	0.75	0.73			0.99	0.92	0.71	0.69	0.64	0.62		1.00	0.79	0.60			0.99	0.92	0.91	0.88	0.76	0.69
16	(406)	0.93	0.85	0.78	0.76			1.00	1.00	0.74	0.72	0.66	0.64			0.97	0.73			1.00	1.00	0.97	0.94	0.81	0.74
18	(457)	0.99	0.89	0.82	0.79					0.77	0.75	0.68	0.65			1.00	0.87					1.00	0.99	0.86	0.78
24	(610)	1.00	1.00	0.92	0.89					0.86	0.83	0.74	0.70				1.00						1.00	0.99	0.90
30	(762)			1.00	0.98					0.95	0.91	0.81	0.75											1.00	1.00
36	(914)				1.00					1.00	0.99	0.87	0.80												
> 48	(1219)										1.00	0.99	0.91												

1 Linear interpolation not permitted.

2 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with a thin concrete member) the design can become very conservative. To optimize the design, use PROFIS Engineering or perform anchor calculation using the design equations from ACI 318 Chapter 17.

3 Spacing factor reduction in shear applicable when $c < 3 {*} h_{ef}$. f_{AV} is applicable when edge distance, $c < 3 {*} h_{ef}$. If $c \geq 3 {*} h_{ef}$, then $f_{AV} = f_{AN}$.

4 Concrete thickness reduction factor in shear, f_{HV}, is applicable when edge distance, $c < 3 {*} h_{ef}$. If $c \geq 3 {*} h_{ef}$, then $f_{HV} = 1.0$.

DESIGN DATA IN CONCRETE PER CSA A23.3

CSA A23.3 Annex D design

Limit State Design of anchors is described in the provisions of CSA A23.3 Annex D for post-installed anchors tested and assessed in accordance with ACI 355.2 for mechanical anchors and ACI 355.4 for adhesive anchors. This section contains the Limit State Design tables with unfactored characteristic loads that are based on the published loads in ICC Evaluation Services ESR-3814 and ELC-3814. These tables are followed by factored resistance tables. The factored resistance tables have characteristic design loads that are prefactored by the applicable reduction factors for a single anchor with no anchor-to-anchor spacing or edge distance adjustments for the convenience of the user of this document. All the figures in the previous ACI 318 Chapter 17 design section are applicable to Limit State Design and the tables will reference these figures.

For a detailed explanation of the tables developed in accordance with CSA A23.3 Annex D, refer to Section 3.1.8. Technical assistance is available by contacting Hilti Canada at (800) 363-4458 or at www.hilti.com.

HIT-RE 500 V3 adhesive with Deformed Reinforcing Bars (Rebar)

Table 52 — Specifications for CA rebar installed with Hilti HIT-RE 500 V3

Setting information		Symbol	Units	Rebar size				
				10M	15M	20M	25M	30M
Nominal bit diameter		d_o	in.	9/16	3/4	1	1-1/4	1-1/2
Effective embedment	minimum	$h_{ef,min}$	mm	60	80	90	100	120
	maximum	$h_{ef,max}$	mm	226	320	390	504	598
Minimum concrete member thickness		h_{min}	mm	h_{ef} + 30	h_{ef} + $2d_o$			

Note: The installation specifications in table 52 above and the data in tables 53 through 67 pertain to the use of Hilti HIT-RE 500 V3 with rebar designed as a post-installed anchor using the provisions of CSA A23.3 Annex D. For the use of Hilti HIT-RE 500 V3 with rebar for typical development calculations according to CSA A23.3 Chapter 12, refer to section 3.1.8 for the design method and tables 88 through 92 in section 3.2.4.

Table 53 — Steel factored resistance for CA rebar[1]

Rebar size	CSA-G30.18 Grade 400[2]		
	Tensile[3] N_{sar} lb (kN)	Shear[4] V_{sar} lb (kN)	Seismic shear[5] $V_{sar,eq}$ lb (kN)
10M	7,245 (32.2)	4,035 (17.9)	2,825 (12.6)
15M	14,525 (64.6)	8,090 (36.0)	5,665 (25.2)
20M	21,570 (95.9)	12,020 (53.5)	8,415 (37.4)
25M	36,025 (160.2)	20,070 (89.3)	14,050 (62.5)
30M	50,715 (225.6)	28,255 (125.7)	19,780 (88.0)

1 See Section 3.1.8 to convert design strength value to ASD value.
2 CSA-G30.18 Grade 400 rebar are considered ductile steel elements.
3 Tensile = $A_{se,N}\ \phi_s\ f_{uta}$ R as noted in CSA A23.3 Annex D
4 Shear = $A_{se,V}\ \phi_s$ 0.60 f_{uta} R as noted in CSA A23.3 Annex D.
5 Seismic Shear = $\alpha_{V,seis}\ V_{sar}$: Reduction factor for seismic shear only.
See section 3.1.8 for additional information on seismic applications.

Table 54 — Hilti HIT-RE 500 V3 adhesive design information with CA rebar in hammer drilled holes in accordance with CSA A23.3 Annex D[1]

Design parameter		Symbol	Units	Rebar size 10M	15M	20M	25M	30M	Ref A23.3-14
Anchor O.D.		d_a	–	11.3	16.0	19.5	25.2	29.9	
Effective minimum embedment[2]		h_{ef}	–	60	80	90	101	120	
Effective maximum embedment[2]		h_{ef}	–	226	320	390	504	598	
Min. concrete thickness[2]		h_{min}	–	h_{ef} + 30	$h_{ef} + 2d_0$				
Critical edge distance		c_{ac}	–	$2h_{ef}$					
Minimum edge distance[3]		c_{min}	–	57	80	98	126	150	
Minimum anchor spacing		s_{min}	–	57	80	98	126	150	
Coeff. for factored conc. breakout resistance, uncracked concrete[4]		$k_{c,uncr}$	–	10					D.6.2.2
Coeff. for factored conc. breakout resistance, cracked concrete[4]		$k_{c,cr}$	–	7					D.6.2.2
Concrete material resistance factor		ϕc	–	0.65					8.4.2
Resistance modification factor for tension and shear, concrete failure modes, Condition B[5]		R_{conc}	–	1.00					D.5.3(c)
Dry concrete and water saturated									
Temp. range A[6]	Characteristic bond stress in cracked concrete[7,8]	τ_{cr}	psi (MPa)	1,360 (9.4)	1,390 (9.6)	1,410 (9.7)	1,420 (9.8)	1,380 (9.5)	D.6.5.2
Temp. range A[6]	Characteristic bond stress in uncracked concrete[7,8]	τ_{uncr}	psi (MPa)	1,760 (12.1)	1,720 (11.9)	1,690 (11.7)	1,650 (11.4)	1,610 (11.1)	D.6.5.2
Temp. range B[6]	Characteristic bond stress in cracked concrete[7,8]	τ_{cr}	psi (MPa)	940 (6.5)	960 (6.6)	970 (6.7)	980 (6.8)	950 (6.6)	D.6.5.2
Temp. range B[6]	Characteristic bond stress in uncracked concrete[7,8]	τ_{uncr}	psi (MPa)	1,210 (8.3)	1,190 (8.2)	1,170 (8.1)	1,140 (7.9)	1,110 (7.7)	D.6.5.2
Anchor category, dry concrete		–	–	1	1	1	1	1	D.5.3(c)
Resistance modification factor		R_{dry}	–	1.00	1.00	1.00	1.00	1.00	
Water-filled hole									
Temp. range A[6]	Characteristic bond stress in cracked concrete[7,8]	τ_{cr}	psi (MPa)	1,010 (7.0)	1,040 (7.2)	1,060 (7.3)	1,080 (7.4)	1,060 (7.3)	D.6.5.2
Temp. range A[6]	Characteristic bond stress in uncracked concrete[7,8]	τ_{uncr}	psi (MPa)	1,300 (9.0)	1,280 (8.8)	1,270 (8.8)	1,250 (8.6)	1,240 (8.6)	D.6.5.2
Temp. range B[6]	Characteristic bond stress in cracked concrete[7,8]	τ_{cr}	psi (MPa)	700 (4.8)	720 (5.0)	730 (5.0)	740 (5.1)	730 (5.0)	D.6.5.2
Temp. range B[6]	Characteristic bond stress in uncracked concrete[7,8]	τ_{uncr}	psi (MPa)	900 (6.2)	890 (6.1)	880 (6.1)	860 (5.9)	850 (5.9)	D.6.5.2
Anchor category, water-filled hole		–	–	3	3	3	3	3	D.5.3(c)
Resistance modification factor		R_{wf}	–	0.75	0.75	0.75	0.75	0.75	
Underwater application									
Temp. range A[6]	Characteristic bond stress in cracked concrete[7,8]	τ_{cr}	psi (MPa)	880 (6.1)	920 (6.3)	940 (6.5)	980 (6.8)	960 (6.6)	D.6.5.2
Temp. range A[6]	Characteristic bond stress in uncracked concrete[7,8]	τ_{uncr}	psi (MPa)	1,130 (7.8)	1,140 (7.9)	1,140 (7.9)	1,140 (7.9)	1,130 (7.8)	D.6.5.2
Temp. range B[6]	Characteristic bond stress in cracked concrete[7,8]	τ_{cr}	psi (MPa)	610 (4.2)	630 (4.3)	650 (4.5)	680 (4.7)	660 (4.6)	D.6.5.2
Temp. range B[6]	Characteristic bond stress in uncracked concrete[7,8]	τ_{uncr}	psi (MPa)	780 (5.4)	790 (5.4)	780 (5.4)	780 (5.4)	780 (5.4)	D.6.5.2
Anchor category, underwater		–	–	3	3	3	3	3	D.5.3(c)
Resistance modification factor		R_{uw}	–	0.75	0.75	0.75	0.75	0.75	
Resistance for seismic tension		$\alpha_{N,seis}$	–	0.90	0.90	0.90	0.90	0.90	

1 Design information in this table is taken from ICC-ES ELC-3814, dated April 2018,, table 23 and 24, and converted for use with CSA A23.3 Annex D.

2 See figure 2 of section 3.2.4.3.1.

3 Minimum edge distance may be reduced to 45mm provided rebar remains untorqued. See ESR-3814 section 4.1.9.

4 For all design cases, $\psi_{c,N}$ = 1.0. The appropriate coefficient for breakout resistance for cracked concrete ($k_{c,cr}$) or uncracked concrete ($k_{c,uncr}$) must be used.

5 For use with the load combinations of CSA A23.3 chapter 8. Condition B applies where supplementary reinforcement in conformance with CSA A23.3 section D.5.3 is not provided, or where pullout or pryout strength governs. For cases where the presence of supplementary reinforcement can be verified, the resistance modification factors associated with Condition A may be used.

6 Temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
Temperature range B: Max. short term temperature = 176°F (80°C), max. 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.

7 Bond stress values corresponding to concrete compressive stress f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond stress may be increased by a factor of $(f'_c/2{,}500)^{0.25}$ [for SI: $(f'_c/17.2)^{0.25}$] for uncracked concrete and $(f'c/2{,}500)^{0.15}$ [for SI: $(f'c/17.2)^{0.15}$] for cracked concrete.

8 For structures assigned to Seismic Design Categories C, D, E, or F, bond stress values must be multiplied by $\alpha_{N,seis}$.

Table 55 — Hilti HIT-RE 500 V3 adhesive design information with CA rebar in diamond core drilled holes in accordance with CSA A23.3 Annex D[1]

Design parameter	Symbol	Units	Rebar size					Ref
			10M	15M	20M	25M	30M	A23.3-14
Anchor O.D.	d_a	–	11.3	16.0	19.5	25.2	29.9	
Effective minimum embedment[2]	h_{ef}	–	60	80	90	101	120	
Effective maximum embedment[2]	h_{ef}	–	226	320	390	504	598	
Min. concrete thickness[2]	h_{min}	–	h_{ef} + 30	$h_{ef} + 2d_0$				
Critical edge distance	c_{ac}	–	$2h_{ef}$					
Minimum edge distance[3]	c_{min}	–	57	80	98	126	150	
Minimum anchor spacing	s_{min}	–	57	80	98	126	150	
Coeff. for factored conc. breakout resistance, uncracked concrete[4]	$k_{c,uncr}$	–	10					D.6.2.2
Coeff. for factored conc. breakout resistance, cracked concrete[4]	$k_{c,cr}$	–	7					D.6.2.2
Concrete material resistance factor	ϕc	–	0.65					8.4.2
Resistance modification factor for tension and shear, concrete failure modes, Condition B[5]	R_{conc}	–	1.00					D.5.3(c)
Dry concrete and water saturated concrete								
Temp. range A[6] Characteristic bond stress in cracked concrete[7]	τ_{uncr}	psi (MPa)	1,150 (7.9)	1,150 (7.9)	1,150 (7.9)	1,150 (7.9)	1,150 (7.9)	D.6.5.2
Temp. range B[6] Characteristic bond stress in uncracked concrete[7]	τ_{uncr}	psi (MPa)	800 (5.5)	800 (5.5)	800 (5.5)	800 (5.5)	800 (5.5)	D.6.5.2
Anchor category, dry concrete	–	–	2	3	3	3	3	D.5.3(c)
Resistance modification factor	R_{dry}	–	0.85	0.75	0.75	0.75	0.75	

1 Design information in this table is taken from ELC-3814, dated April 2018, table 23 and 25B, and converted for use with CSA A23.3 Annex D.
2 See figure 2 of section 3.2.4.3.1.
3 Minimum edge distance may be reduced to 45mm provided rebar remains untorqued. See ESR-3814 section 4.1.9.
4 For all design cases, $\psi_{c,N}$ = 1.0. The appropriate coefficient for breakout resistance for cracked concrete ($k_{c,cr}$) or uncracked concrete ($k_{c,uncr}$) must be used.
5 For use with the load combinations of CSA A23.3 chapter 8. Condition B applies where supplementary reinforcement in conformance with CSA A23.3 section D.5.3 is not provided, or where pullout or pryout strength governs. For cases where the presence of supplementary reinforcement can be verified, the resistance modification factors associated with Condition A may be used.
6 Temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
Temperature range B: Max. short term temperature = 176°F (80°C), max. 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.
7 Bond stress values correspond to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond stress may be increased by a factor of $(f'_c/2{,}500)^{0.25}$ [for SI: $(f'_c/17.2)^{0.25}$] for uncracked concrete.

Table 56 — Hilti HIT-RE 500 V3 adhesive factored resistance with concrete/bond failure for CA rebar in uncracked concrete[1,2,3,4,5,6,7,8,9,11]

Rebar size	Effective embedment in. (mm)	Tension N_r				Shear V_r			
		f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)	f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)
10M	4-1/2 (115)	7,520 (33.4)	7,950 (35.4)	8,320 (37.0)	8,940 (39.8)	15,040 (66.9)	15,900 (70.7)	16,645 (74.0)	17,885 (79.6)
	7-1/16 (180)	11,770 (52.4)	12,445 (55.4)	13,025 (57.9)	13,995 (62.3)	23,540 (104.7)	24,890 (110.7)	26,050 (115.9)	27,990 (124.5)
	8-7/8 (226)	14,775 (65.7)	15,625 (69.5)	16,355 (72.7)	17,575 (78.2)	29,555 (131.5)	31,250 (139.0)	32,705 (145.5)	35,145 (156.3)
15M[10]	5-11/16 (145)	11,410 (50.8)	12,755 (56.7)	13,975 (62.2)	15,600 (69.4)	22,820 (101.5)	25,515 (113.5)	27,950 (124.3)	31,205 (138.8)
	9-13/16 (250)	22,620 (100.6)	23,915 (106.4)	25,030 (111.3)	26,900 (119.7)	45,240 (201.2)	47,835 (212.8)	50,065 (222.7)	53,800 (239.3)
	12-5/8 (320)	28,950 (128.8)	30,615 (136.2)	32,040 (142.5)	34,430 (153.2)	57,905 (257.6)	61,225 (272.3)	64,080 (285.1)	68,860 (306.3)
20M[10]	7-7/8 (200)	18,485 (82.2)	20,665 (91.9)	22,640 (100.7)	25,770 (114.6)	36,965 (164.4)	41,330 (183.8)	45,275 (201.4)	51,540 (229.3)
	14 (355)	38,460 (171.1)	40,670 (180.9)	42,565 (189.3)	45,740 (203.5)	76,925 (342.2)	81,340 (361.8)	85,130 (378.7)	91,480 (406.9)
	15-3/8 (390)	42,255 (188.0)	44,680 (198.7)	46,760 (208.0)	50,250 (223.5)	84,510 (375.9)	89,355 (397.5)	93,525 (416.0)	100,500 (447.0)
25M	9-1/16 (230)	22,795 (101.4)	25,485 (113.4)	27,920 (124.2)	32,235 (143.4)	45,590 (202.8)	50,970 (226.7)	55,835 (248.4)	64,475 (286.8)
	15-15/16 (405)	53,265 (236.9)	58,540 (260.4)	61,270 (272.5)	65,840 (292.9)	106,525 (473.9)	117,080 (520.8)	122,540 (545.1)	131,680 (585.7)
	19-13/16 (504)	68,895 (306.5)	72,850 (324.1)	76,245 (339.2)	81,935 (364.5)	137,795 (612.9)	145,700 (648.1)	152,495 (678.3)	163,865 (728.9)
30M	10-1/4 (260)	27,395 (121.9)	30,630 (136.3)	33,555 (149.3)	38,745 (172.3)	54,795 (243.7)	61,260 (272.5)	67,110 (298.5)	77,490 (344.7)
	17-15/16 (455)	63,425 (282.1)	70,910 (315.4)	77,680 (345.5)	85,635 (380.9)	126,850 (564.3)	141,825 (630.9)	155,360 (691.1)	171,270 (761.8)
	23-9/16 (598)	94,640 (421.0)	100,070 (445.1)	104,740 (465.9)	112,550 (500.6)	189,285 (842.0)	200,145 (890.3)	209,475 (931.8)	225,100 (1001.3)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8 to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 61-70 as necessary to the above values. Compare to the steel values in table 53. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69.
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.
6 Tabular values are for dry concrete and water-saturated concrete conditions.
For water-filled drilled holes multiply design strength by 0.51.
For submerged (under water) applications multiply design strength by 0.45.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λ_a as follows:
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for holes drilled in concrete with carbide tipped hammer drill bit. For diamond core drilling, except as indicated in note 10, multiply above values by 0.48.
Diamond core drilling is not permitted for the water-filled or under-water (submerged) applications.
10 Diamond core drilling with Hilti TE-YRT roughening tool is permitted for 15M and 20M diameter anchors for dry and water-saturated concrete conditions. See Table 59.
11 Tabular values are for static loads only. Seismic design is not permitted for uncracked concrete.

3.2.3

Table 57 — Hilti HIT-RE 500 V3 adhesive factored resistance with concrete/bond failure for CA rebar in cracked concrete[1,2,3,4,5,6,7,8,9]

Rebar size	Effective embedment in. (mm)	Tension N_r				Shear V_r			
		f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)	f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)
10M	4-1/2 (115)	5,640 (25.1)	5,920 (26.3)	6,080 (27.1)	6,350 (28.2)	11,285 (50.2)	11,835 (52.7)	12,165 (54.1)	12,700 (56.5)
	7-1/16 (180)	8,960 (39.8)	9,265 (41.2)	9,520 (42.3)	9,940 (44.2)	17,915 (79.7)	18,525 (82.4)	19,040 (84.7)	19,880 (88.4)
	8-7/8 (226)	11,250 (50.0)	11,630 (51.7)	11,955 (53.2)	12,480 (55.5)	22,495 (100.1)	23,260 (103.5)	23,905 (106.3)	24,960 (111.0)
15M[10]	5-11/16 (145)	7,985 (35.5)	8,930 (39.7)	9,780 (43.5)	11,295 (50.2)	15,975 (71.1)	17,860 (79.4)	19,565 (87.0)	22,590 (100.5)
	9-13/16 (250)	18,005 (80.1)	18,620 (82.8)	19,135 (85.1)	19,980 (88.9)	36,010 (160.2)	37,235 (165.6)	38,270 (170.2)	39,955 (177.7)
	12-5/8 (320)	23,045 (102.5)	23,830 (106.0)	24,495 (108.9)	25,575 (113.8)	46,095 (205.0)	47,665 (212.0)	48,985 (217.9)	51,145 (227.5)
20M[10]	7-7/8 (200)	12,940 (57.6)	14,465 (64.3)	15,845 (70.5)	18,300 (81.4)	25,875 (115.1)	28,930 (128.7)	31,695 (141.0)	36,595 (162.8)
	14 (355)	30,595 (136.1)	32,685 (145.4)	33,590 (149.4)	35,075 (156.0)	61,195 (272.2)	65,370 (290.8)	67,185 (298.8)	70,145 (312.0)
	15-3/8 (390)	34,725 (154.5)	35,910 (159.7)	36,905 (164.2)	38,530 (171.4)	69,450 (308.9)	71,815 (319.5)	73,805 (328.3)	77,060 (342.8)
25M	9-1/16 (230)	15,955 (71.0)	17,840 (79.4)	19,540 (86.9)	22,565 (100.4)	31,915 (142.0)	35,680 (158.7)	39,085 (173.9)	45,130 (200.8)
	15-15/16 (405)	37,285 (165.8)	41,685 (185.4)	45,665 (203.1)	52,075 (231.6)	74,570 (331.7)	83,370 (370.8)	91,325 (406.2)	104,150 (463.3)
	19-13/16 (504)	51,760 (230.2)	57,870 (257.4)	62,070 (276.1)	64,805 (288.3)	103,520 (460.5)	115,735 (514.8)	124,135 (552.2)	129,610 (576.5)
30M	10-1/4 (260)	19,180 (85.3)	21,440 (95.4)	23,490 (104.5)	27,120 (120.6)	38,355 (170.6)	42,885 (190.8)	46,975 (209.0)	54,245 (241.3)
	17-15/16 (455)	44,400 (197.5)	49,640 (220.8)	54,375 (241.9)	62,790 (279.3)	88,795 (395.0)	99,275 (441.6)	108,750 (483.7)	125,575 (558.6)
	23-9/16 (598)	66,895 (297.6)	74,790 (332.7)	81,930 (364.4)	88,665 (394.4)	133,790 (595.1)	149,580 (665.4)	163,860 (728.9)	177,325 (788.8)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8 to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 61-70 as necessary to the above values. Compare to the steel values in table 53. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69.
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.
6 Tabular values are for dry concrete and water-saturated concrete conditions.
For water-filled drilled holes multiply design strength by 0.51.
For submerged (under water) applications multiply design strength by 0.45.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λ_a as follows:
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for holes drilled in concrete with carbide tipped hammer drill bit. Diamond core drilling is not permitted in cracked concrete conditions except as indicated in note 10.
10 Diamond core drilling with Hilti TE-YRT roughening tool is permitted for 15M and 20M diameter anchors for dry and water-saturated concrete conditions. See Table 60.
11 Tabular values are for static loads only. For seismic loads, multiply cracked concrete tabular values by α_{seis} = 0.68. See section 3.1.8 for additional information on seismic applications.

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Table 58 — Hilti HIT-RE 500 V3 adhesive design information with CA rebar in core drilled holes roughened with the TE-YRT Roughening Tool in accordance with CSA A23.3 Annex D[1]

Design parameter		Symbol	Units	Rebar size 15M	Rebar size 20M	Ref A23.3-14
Anchor O.D.		d_a	–	16.0	19.5	
Effective minimum embedment[2]		h_{ef}	–	80	90	
Effective maximum embedment[2]		h_{ef}	–	320	390	
Min. concrete thickness[2]		h_{min}	–	$2h_{ef}$		
Critical edge distance		c_{ac}	–	$h_{ef} + 2d_0$		
Minimum edge distance[3]		c_{min}	–	80	98	
Minimum anchor spacing		s_{min}	–	80	98	
Coeff. for factored conc. breakout resistance, uncracked concrete[4]		$k_{c,uncr}$	–	10		D.6.2.2
Coeff. for factored conc. breakout resistance, cracked concrete[4]		$k_{c,cr}$	–	7		D.6.2.2
Concrete material resistance factor		ϕc	–	0.65		8.4.2
Resistance modification factor for tension and shear, concrete failure modes, Condition B[5]		R_{conc}	–	1.00		D.5.3 (c)
Dry concrete and water saturated concrete						
Temp. range A[6]	Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	970 (6.7)	985 (6.8)	D.6.5.2
Temp. range A[6]	Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	1,720 (11.9)	1,690 (11.7)	D.6.5.2
Temp. range B[6]	Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	670 (4.6)	680 (4.7)	D.6.5.2
Temp. range B[6]	Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	1,190 (8.2)	1,170 (8.1)	D.6.5.2
Anchor category, dry concrete		-	-	1	1	D.5.3(c)
Resistance modification factor		R_{dry}	-	1.00	1.00	
Reduction for Seismic Tension		$\alpha_{N,seis}$	-	0.90	0.90	

1 Design information in this table is taken from ICC-ES ELC-3814, dated April 2018, table 23 and 25A, and converted for use with CSA A23.3 Annex D.
2 See figure 2 of section 3.2.4.3.4.
3 Minimum edge distance may be reduced to 45mm provided rebar remains untorqued. See ESR-3814 section 4.1.9.
4 For all design cases, ψc,N = 1.0. The appropriate coefficient for breakout resistance for cracked concrete (kc,cr) or uncracked concrete (kc,uncr) must be used.
5 For use with the load combinations of CSA A23.3 chapter 8. Condition B applies where supplementary reinforcement in conformance with CSA A23.3 section D.5.3 is not provided, or where pullout or pryout strength governs. For cases where the presence of supplementary reinforcement can be verified, the resistance modification factors associated with Condition A may be used.
6 Temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C). Temperature range B: Max. short term temperature = 176°F (80°C), max. 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.
7 Bond stress values correspond to concrete compressive strength in the range 2,500 psi ≤ f′c ≤ 8,000 psi.
8 For structures assigned to Seismic Design Categories C, D, E, or F, bond stress values must be multiplied by $\alpha_{N,seis}$.

Table 59 — Hilti HIT-RE 500 V3 adhesive factored resistance for core drilled holes roughened with Hilti TE-YRT roughening tool with concrete / bond failure for CA rebar in uncracked concrete[1,2,3,4,5,6,7,8,9]

Rebar size	Effective embedment in. (mm)	Tension - N_r				Shear - V_r			
		f'_c = 20 MPa (2,900psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)	f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)
15M	5-11/16	11,410	12,635	12,635	12,635	22,820	25,265	25,265	25,265
	(145)	(50.8)	(56.2)	(56.2)	(56.2)	(101.5)	(112.4)	(112.4)	(112.4)
	9-13/16	21,780	21,780	21,780	21,780	43,565	43,565	43,565	43,565
	(250)	(96.9)	(96.9)	(96.9)	(96.9)	(193.8)	(193.8)	(193.8)	(193.8)
	12-5/8	27,880	27,880	27,880	27,880	55,760	55,760	55,760	55,760
	(320)	(124.0)	(124.0)	(124.0)	(124.0)	(248.0)	(248.0)	(248.0)	(248.0)
20M	7-7/8	18,485	20,665	20,865	20,865	36,965	41,330	41,735	41,735
	(200)	(82.2)	(91.9)	(92.8)	(92.8)	(164.4)	(183.8)	(185.6)	(185.6)
	14	37,040	37,040	37,040	37,040	74,080	74,080	74,080	74,080
	(355)	(164.8)	(164.8)	(164.8)	(164.8)	(329.5)	(329.5)	(329.5)	(329.5)
	15-3/8	40,690	40,690	40,690	40,690	81,380	81,380	81,380	81,380
	(390)	(181.0)	(181.0)	(181.0)	(181.0)	(362.0)	(362.0)	(362.0)	(362.0)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8 to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 61-70 as necessary to the above values. Compare to the steel values in table 53. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69.
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.
6 Tabular values are for dry concrete or water-saturated concrete conditions. Water-filled and submerged (under water) applications are not permitted for this hole preparation method.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λ_a as follows:
For sand-lightweight, λ_a = 0.51. For all lightweight, λ_a = 0.45.
9 Tabular values are for static loads only. Seismic design is not permitted for uncracked concrete.

Table 60 — Hilti HIT-RE 500 V3 adhesive factored resistance for core drilled holes roughened with Hilti TE-YRT roughening tool with concrete / bond failure for CA rebar in cracked concrete[1,2,3,4,5,6,7,8,9]

Rebar size	Effective embedment in. (mm)	Tension - N_r				Shear - V_r			
		f'_c = 20 MPa (2,900psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)	f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)
15M	5-11/16	7,125	7,125	7,125	7,125	14,250	14,250	14,250	14,250
	(145)	(31.7)	(31.7)	(31.7)	(31.7)	(63.4)	(63.4)	(63.4)	(63.4)
	9-13/16	12,285	12,285	12,285	12,285	24,570	24,570	24,570	24,570
	(250)	(54.6)	(54.6)	(54.6)	(54.6)	(109.3)	(109.3)	(109.3)	(109.3)
	12-5/8	15,725	15,725	15,725	15,725	31,445	31,445	31,445	31,445
	(320)	(69.9)	(69.9)	(69.9)	(69.9)	(139.9)	(139.9)	(139.9)	(139.9)
20M	7-7/8	12,160	12,160	12,160	12,160	24,325	24,325	24,325	24,325
	(200)	(54.1)	(54.1)	(54.1)	(54.1)	(108.2)	(108.2)	(108.2)	(108.2)
	14	21,590	21,590	21,590	21,590	43,175	43,175	43,175	43,175
	(355)	(96.0)	(96.0)	(96.0)	(96.0)	(192.1)	(192.1)	(192.1)	(192.1)
	15-3/8	23,715	23,715	23,715	23,715	47,435	47,435	47,435	47,435
	(390)	(105.5)	(105.5)	(105.5)	(105.5)	(211.0)	(211.0)	(211.0)	(211.0)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8 to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 61-70 as necessary to the above values. Compare to the steel values in table 53. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69.
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.
6 Tabular values are for dry concrete or water-saturated concrete conditions. Water-filled and submerged (under water) applications are not permitted for this hole preparation method.
Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λ_a as follows:
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for static loads only. For seismic loads, multiply cracked concrete tabular values by α_{seis} = 0.675. See section 3.1.8 for additional information on seismic applications.

Table 61 — Load adjustment factors for 10M rebar in uncracked concrete[1,2,3]

10M Rebar uncracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ǁ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef} in.	(mm)	4-1/2 (115)	7-1/16 (180)	8-7/8 (226)	4-1/2 (115)	7-1/16 (180)	8-7/8 (226)	4-1/2 (115)	7-1/16 (180)	8-8/9 (226)	4-1/2 (115)	7-1/16 (180)	8-7/8 (226)	4-1/2 (115)	7-1/16 (180)	8-7/8 (226)	4-1/2 (115)	7-1/16 (180)	8-7/8 (226)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																			
1-3/4	(44)	n/a	n/a	n/a	0.24	0.15	0.12	n/a	n/a	n/a	0.06	0.04	0.03	0.11	0.07	0.06	n/a	n/a	n/a
2-3/16	(55)	0.58	0.55	0.54	0.26	0.16	0.13	0.53	0.52	0.52	0.08	0.05	0.04	0.15	0.10	0.08	n/a	n/a	n/a
3	(76)	0.61	0.57	0.56	0.30	0.19	0.15	0.54	0.53	0.53	0.12	0.08	0.06	0.25	0.16	0.13	n/a	n/a	n/a
4	(102)	0.65	0.59	0.57	0.35	0.22	0.17	0.56	0.54	0.54	0.19	0.12	0.10	0.35	0.22	0.17	n/a	n/a	n/a
5	(127)	0.68	0.62	0.59	0.41	0.25	0.20	0.57	0.55	0.54	0.27	0.17	0.14	0.41	0.25	0.20	n/a	n/a	n/a
5-11/16	(145)	0.71	0.63	0.61	0.45	0.28	0.22	0.58	0.56	0.55	0.33	0.21	0.17	0.45	0.28	0.22	0.56	n/a	n/a
6	(152)	0.72	0.64	0.61	0.47	0.29	0.23	0.58	0.56	0.55	0.35	0.22	0.18	0.47	0.29	0.23	0.58	n/a	n/a
7	(178)	0.76	0.66	0.63	0.54	0.34	0.27	0.60	0.57	0.56	0.44	0.28	0.23	0.54	0.34	0.27	0.62	n/a	n/a
8	(203)	0.79	0.69	0.65	0.62	0.38	0.30	0.61	0.58	0.57	0.54	0.35	0.28	0.62	0.38	0.30	0.67	n/a	n/a
8-1/4	(210)	0.80	0.69	0.65	0.64	0.40	0.31	0.61	0.58	0.57	0.57	0.36	0.29	0.64	0.40	0.31	0.68	0.58	n/a
9	(229)	0.83	0.71	0.67	0.70	0.43	0.34	0.62	0.59	0.58	0.65	0.41	0.33	0.70	0.43	0.34	0.71	0.61	n/a
10-1/16	(256)	0.87	0.74	0.69	0.78	0.48	0.38	0.64	0.60	0.59	0.76	0.49	0.39	0.78	0.48	0.38	0.75	0.64	0.60
11	(279)	0.90	0.76	0.71	0.85	0.53	0.42	0.65	0.61	0.60	0.87	0.56	0.44	0.85	0.53	0.42	0.78	0.67	0.62
12	(305)	0.94	0.78	0.72	0.93	0.58	0.45	0.67	0.62	0.61	0.99	0.63	0.51	0.93	0.58	0.45	0.81	0.70	0.65
14	(356)	1.00	0.83	0.76	1.00	0.67	0.53	0.69	0.64	0.62	1.00	0.80	0.64	1.00	0.67	0.53	0.88	0.76	0.70
16	(406)		0.88	0.80		0.77	0.61	0.72	0.66	0.64		0.98	0.78		0.77	0.61	0.94	0.81	0.75
18	(457)		0.92	0.84		0.87	0.68	0.75	0.68	0.66		1.00	0.93		0.87	0.68	1.00	0.86	0.80
24	(610)		1.00	0.95		1.00	0.91	0.83	0.75	0.71			1.00		1.00	0.91		0.99	0.92
30	(762)			1.00			1.00	0.91	0.81	0.76						1.00		1.00	1.00
36	(914)							1.00	0.87	0.82									
> 48	(1219)								0.99	0.92									

Table 62 — Load adjustment factors for 10M rebar in cracked concrete[1,2,3]

10M Rebar cracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ǁ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef} in.	(mm)	4-1/2 (115)	7-1/16 (180)	8-7/8 (226)	4-1/2 (115)	7-1/16 (180)	8-7/8 (226)	4-1/2 (115)	7-1/16 (180)	8-8/9 (226)	4-1/2 (115)	7-1/16 (180)	8-7/8 (226)	4-1/2 (115)	7-1/16 (180)	8-7/8 (226)	4-1/2 (115)	7-1/16 (180)	8-7/8 (226)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																			
1-3/4	(44)	n/a	n/a	n/a	0.49	0.44	0.42	n/a	n/a	n/a	0.05	0.03	0.03	0.10	0.07	0.05	n/a	n/a	n/a
2-3/16	(55)	0.58	0.55	0.54	0.52	0.46	0.43	0.53	0.52	0.52	0.07	0.04	0.04	0.14	0.09	0.07	n/a	n/a	n/a
3	(76)	0.61	0.57	0.56	0.60	0.50	0.47	0.54	0.53	0.53	0.11	0.07	0.06	0.23	0.15	0.12	n/a	n/a	n/a
4	(102)	0.65	0.59	0.57	0.70	0.56	0.51	0.55	0.54	0.53	0.18	0.11	0.09	0.35	0.23	0.18	n/a	n/a	n/a
5	(127)	0.68	0.62	0.59	0.80	0.62	0.56	0.57	0.55	0.54	0.25	0.16	0.13	0.49	0.32	0.25	n/a	n/a	n/a
5-11/16	(145)	0.71	0.63	0.61	0.88	0.66	0.59	0.57	0.56	0.55	0.30	0.19	0.15	0.60	0.39	0.31	0.55	n/a	n/a
6	(152)	0.72	0.64	0.61	0.91	0.68	0.61	0.58	0.56	0.55	0.32	0.21	0.17	0.65	0.41	0.33	0.56	n/a	n/a
7	(178)	0.76	0.66	0.63	1.00	0.74	0.65	0.59	0.57	0.56	0.41	0.26	0.21	0.82	0.52	0.42	0.61	n/a	n/a
8	(203)	0.79	0.69	0.65		0.81	0.70	0.60	0.58	0.57	0.50	0.32	0.25	1.00	0.64	0.51	0.65	n/a	n/a
8-1/4	(210)	0.80	0.69	0.65		0.83	0.72	0.61	0.58	0.57	0.53	0.34	0.27		0.67	0.53	0.66	0.57	n/a
9	(229)	0.83	0.71	0.67		0.88	0.76	0.62	0.59	0.58	0.60	0.38	0.30		0.76	0.61	0.69	0.59	n/a
10-1/16	(256)	0.87	0.74	0.69		0.96	0.81	0.63	0.60	0.58	0.71	0.45	0.36		0.90	0.72	0.73	0.63	0.58
11	(279)	0.90	0.76	0.71		1.00	0.86	0.64	0.61	0.59	0.81	0.51	0.41		1.00	0.82	0.76	0.65	0.61
12	(305)	0.94	0.78	0.72			0.92	0.66	0.62	0.60	0.92	0.59	0.47			0.92	0.79	0.68	0.63
14	(356)	1.00	0.83	0.76			1.00	0.68	0.64	0.62	1.00	0.74	0.59			1.00	0.86	0.74	0.68
16	(406)		0.88	0.80				0.71	0.66	0.63		0.90	0.72				0.92	0.79	0.73
18	(457)		0.92	0.84				0.74	0.68	0.65		1.00	0.86				0.97	0.84	0.78
24	(610)		1.00	0.95				0.81	0.73	0.70			1.00				1.00	0.97	0.90
30	(762)			1.00				0.89	0.79	0.75								1.00	1.00
36	(914)							0.97	0.85	0.80									
> 48	(1219)							1.00	0.97	0.90									

1 Linear interpolation not permitted.
2 Shaded area with reduced edge distance is permitted provided the rebar has no installation torque.
3 When combining multiple load adjustment factors (e.g. for a four-anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use PROFIS Engineering or perform anchor calculation using design equations from CSA A23.3 Annex D.
4 Spacing factor reduction in shear applicable when $c < 3*h_{ef}$. f_{AV}, is applicable when edge distance, $c < 3*h_{ef}$. If $c \geq 3*h_{ef}$, then $f_{AV} = f_{AN}$.
5 Concrete thickness reduction factor in shear, f_{HV}, is applicable when edge distance, $c < 3*h_{ef}$. If $c \geq 3*h_{ef}$, then $f_{HV} = 1.0$.

Table 63 — Load adjustment factors for 15M rebar in uncracked concrete[1,2,3]

15M Rebar uncracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ‖ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef} in.		5-11/16	9-13/16	12-5/8	5-11/16	9-13/16	12-5/8	5-11/16	9-13/16	12-5/8	5-11/16	9-13/16	12-5/8	5-11/16	9-13/16	12-5/8	5-11/16	9-13/16	12-5/8
(mm)		(145)	(250)	(320)	(145)	(250)	(320)	(145)	(250)	(320)	(145)	(250)	(320)	(145)	(250)	(320)	(145)	(250)	(320)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm) in.	(mm)																		
1-3/4	(44)	n/a	n/a	n/a	0.24	0.14	0.11	n/a	n/a	n/a	0.04	0.02	0.02	0.08	0.04	0.03	n/a	n/a	n/a
3-1/8	(80)	0.59	0.55	0.54	0.29	0.17	0.13	0.54	0.52	0.52	0.10	0.05	0.04	0.20	0.11	0.08	n/a	n/a	n/a
4	(102)	0.61	0.57	0.55	0.33	0.19	0.14	0.55	0.53	0.53	0.14	0.08	0.06	0.29	0.15	0.12	n/a	n/a	n/a
5	(127)	0.64	0.58	0.57	0.37	0.21	0.16	0.56	0.54	0.53	0.20	0.11	0.08	0.37	0.21	0.16	n/a	n/a	n/a
6	(152)	0.67	0.60	0.58	0.41	0.23	0.18	0.57	0.54	0.54	0.27	0.14	0.11	0.41	0.23	0.18	n/a	n/a	n/a
7	(178)	0.70	0.62	0.59	0.46	0.26	0.20	0.58	0.55	0.54	0.33	0.18	0.14	0.46	0.26	0.20	n/a	n/a	n/a
7-1/4	(184)	0.71	0.62	0.60	0.47	0.26	0.20	0.58	0.55	0.55	0.35	0.18	0.14	0.47	0.26	0.20	0.58	n/a	n/a
8	(203)	0.73	0.64	0.61	0.50	0.28	0.22	0.59	0.56	0.55	0.41	0.21	0.17	0.50	0.28	0.22	0.61	n/a	n/a
9	(229)	0.76	0.65	0.62	0.56	0.31	0.24	0.60	0.57	0.56	0.49	0.26	0.20	0.56	0.31	0.24	0.64	n/a	n/a
10	(254)	0.78	0.67	0.63	0.62	0.35	0.27	0.61	0.57	0.56	0.57	0.30	0.23	0.62	0.35	0.27	0.68	n/a	n/a
11-3/8	(289)	0.82	0.69	0.65	0.71	0.40	0.31	0.63	0.58	0.57	0.69	0.36	0.28	0.71	0.40	0.31	0.72	0.58	n/a
12	(305)	0.84	0.70	0.66	0.74	0.42	0.32	0.64	0.59	0.58	0.75	0.39	0.31	0.74	0.42	0.32	0.74	0.60	n/a
14-1/8	(359)	0.90	0.74	0.69	0.88	0.49	0.38	0.66	0.61	0.59	0.96	0.50	0.39	0.88	0.49	0.38	0.81	0.65	0.60
16	(406)	0.96	0.77	0.71	0.99	0.56	0.43	0.68	0.62	0.60	1.00	0.61	0.47	0.99	0.56	0.43	0.86	0.69	0.64
18	(457)	1.00	0.80	0.74	1.00	0.63	0.48	0.71	0.63	0.61		0.72	0.56	1.00	0.63	0.48	0.91	0.73	0.67
20	(508)		0.84	0.76		0.70	0.54	0.73	0.65	0.63		0.85	0.66		0.70	0.54	0.96	0.77	0.71
22	(559)		0.87	0.79		0.77	0.59	0.75	0.66	0.64		0.98	0.76		0.77	0.59	1.00	0.81	0.75
24	(610)		0.91	0.82		0.83	0.65	0.78	0.68	0.65		1.00	0.87		0.83	0.65		0.85	0.78
30	(762)		1.00	0.90		1.00	0.81	0.84	0.72	0.69			1.00		1.00	0.81		0.95	0.87
36	(914)			0.98			0.97	0.91	0.77	0.73						0.97		1.00	0.95
> 48	(1219)			1.00			1.00	1.00	0.86	0.80						1.00			1.00

Table 64 — Load adjustment factors for 15M rebar in cracked concrete[1,2,3]

15M Rebar cracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ‖ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef} in.		5-11/16	9-13/16	12-5/8	5-11/16	9-13/16	12-5/8	5-11/16	9-13/16	12-5/8	5-11/16	9-13/16	12-5/8	5-11/16	9-13/16	12-5/8	5-11/16	9-13/16	12-5/8
(mm)		(145)	(250)	(320)	(145)	(250)	(320)	(145)	(250)	(320)	(145)	(250)	(320)	(145)	(250)	(320)	(145)	(250)	(320)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm) in.	(mm)																		
1-3/4	(44)	n/a	n/a	n/a	0.46	0.41	0.40	n/a	n/a	n/a	0.04	0.02	0.02	0.09	0.04	0.03	n/a	n/a	n/a
3-1/8	(80)	0.59	0.55	0.54	0.55	0.46	0.44	0.54	0.52	0.52	0.10	0.05	0.04	0.21	0.09	0.07	n/a	n/a	n/a
4	(102)	0.61	0.57	0.55	0.61	0.50	0.46	0.55	0.53	0.52	0.15	0.07	0.05	0.29	0.13	0.10	n/a	n/a	n/a
5	(127)	0.64	0.58	0.57	0.68	0.54	0.49	0.56	0.53	0.53	0.21	0.09	0.07	0.41	0.19	0.15	n/a	n/a	n/a
6	(152)	0.67	0.60	0.58	0.76	0.58	0.52	0.57	0.54	0.53	0.27	0.12	0.10	0.54	0.25	0.19	n/a	n/a	n/a
7	(178)	0.70	0.62	0.59	0.84	0.62	0.56	0.58	0.55	0.54	0.34	0.15	0.12	0.68	0.31	0.24	n/a	n/a	n/a
7-1/4	(184)	0.71	0.62	0.60	0.86	0.63	0.56	0.58	0.55	0.54	0.36	0.16	0.13	0.72	0.33	0.25	0.58	n/a	n/a
8	(203)	0.73	0.64	0.61	0.93	0.66	0.59	0.59	0.55	0.55	0.42	0.19	0.15	0.83	0.38	0.30	0.61	n/a	n/a
9	(229)	0.76	0.65	0.62	1.00	0.71	0.62	0.60	0.56	0.55	0.50	0.23	0.18	0.99	0.45	0.35	0.65	n/a	n/a
10	(254)	0.78	0.67	0.63		0.76	0.66	0.62	0.57	0.56	0.58	0.26	0.21	1.00	0.53	0.41	0.68	n/a	n/a
11-3/8	(289)	0.82	0.69	0.65		0.82	0.71	0.63	0.58	0.57	0.71	0.32	0.25		0.64	0.50	0.73	0.56	n/a
12	(305)	0.84	0.70	0.66		0.86	0.73	0.64	0.58	0.57	0.77	0.35	0.27		0.69	0.54	0.75	0.57	n/a
14-1/8	(359)	0.90	0.74	0.69		0.97	0.81	0.66	0.60	0.58	0.98	0.44	0.35		0.89	0.69	0.81	0.62	0.57
16	(406)	0.96	0.77	0.71		1.00	0.88	0.69	0.61	0.59	1.00	0.53	0.42		1.00	0.84	0.86	0.66	0.61
18	(457)	1.00	0.80	0.74			0.96	0.71	0.62	0.60		0.64	0.50			0.96	0.91	0.70	0.65
20	(508)		0.84	0.76			1.00	0.73	0.64	0.62		0.75	0.58			1.00	0.96	0.74	0.68
22	(559)		0.87	0.79				0.76	0.65	0.63		0.86	0.67				1.00	0.78	0.72
24	(610)		0.91	0.82				0.78	0.66	0.64		0.98	0.77					0.81	0.75
30	(762)		1.00	0.90				0.85	0.71	0.67		1.00	1.00					0.91	0.84
36	(914)			0.98				0.92	0.75	0.71								0.99	0.92
> 48	(1219)			1.00				1.00	0.83	0.78								1.00	1.00

1 Linear interpolation not permitted.
2 Shaded area with reduced edge distance is permitted provided the rebar has no installation torque.
3 When combining multiple load adjustment factors (e.g. for a four-anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use PROFIS Engineering or perform anchor calculation using design equations from CSA A23.3 Annex D.
4 Spacing factor reduction in shear applicable when $c < 3*h_{ef}$. f_{AV}, is applicable when edge distance, $c < 3*h_{ef}$. If $c \geq 3*h_{ef}$, then $f_{AV} = f_{AN}$.
5 Concrete thickness reduction factor in shear, f_{HV}, is applicable when edge distance, $c < 3*h_{ef}$. If $c \geq 3*h_{ef}$, then $f_{HV} = 1.0$.

Table 65 — Load adjustment factors for 20M rebar in uncracked concrete[1,2,3]

20M Rebar uncracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ‖ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef} in.	(mm)	7-7/8 (200)	14 (355)	15-3/8 (390)	7-7/8 (200)	14 (355)	15-3/8 (390)	7-7/8 (200)	14 (355)	15-3/8 (390)	7-7/8 (200)	14 (355)	15-3/8 (390)	7-7/8 (200)	14 (355)	15-3/8 (390)	7-7/8 (200)	14 (355)	15-3/8 (390)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																			
1-3/4	(44)	n/a	n/a	n/a	0.21	0.11	0.10	n/a	n/a	n/a	0.03	0.01	0.01	0.06	0.03	0.02	n/a	n/a	n/a
3-7/8	(98)	0.58	0.55	0.54	0.26	0.14	0.13	0.53	0.52	0.52	0.09	0.04	0.04	0.18	0.09	0.08	n/a	n/a	n/a
4	(102)	0.58	0.55	0.54	0.27	0.15	0.13	0.53	0.52	0.52	0.10	0.05	0.04	0.19	0.09	0.09	n/a	n/a	n/a
5	(127)	0.61	0.56	0.55	0.30	0.16	0.15	0.54	0.53	0.53	0.13	0.07	0.06	0.27	0.13	0.12	n/a	n/a	n/a
6	(152)	0.63	0.57	0.57	0.33	0.18	0.16	0.55	0.53	0.53	0.17	0.09	0.08	0.33	0.17	0.16	n/a	n/a	n/a
7	(178)	0.65	0.58	0.58	0.36	0.19	0.18	0.56	0.54	0.54	0.22	0.11	0.10	0.36	0.19	0.18	n/a	n/a	n/a
8	(203)	0.67	0.60	0.59	0.39	0.21	0.19	0.57	0.54	0.54	0.27	0.13	0.12	0.39	0.21	0.19	n/a	n/a	n/a
9	(229)	0.69	0.61	0.60	0.42	0.23	0.21	0.58	0.55	0.55	0.32	0.16	0.15	0.42	0.23	0.21	n/a	n/a	n/a
10	(254)	0.71	0.62	0.61	0.46	0.25	0.23	0.59	0.55	0.55	0.38	0.19	0.17	0.46	0.25	0.23	0.59	n/a	n/a
11	(279)	0.73	0.63	0.62	0.50	0.27	0.25	0.60	0.56	0.56	0.43	0.22	0.20	0.50	0.27	0.25	0.62	n/a	n/a
12	(305)	0.75	0.64	0.63	0.54	0.30	0.27	0.60	0.57	0.56	0.49	0.25	0.22	0.54	0.30	0.27	0.65	n/a	n/a
14	(356)	0.80	0.67	0.65	0.63	0.34	0.31	0.62	0.58	0.57	0.62	0.31	0.28	0.63	0.34	0.31	0.70	n/a	n/a
16	(406)	0.84	0.69	0.67	0.72	0.39	0.36	0.64	0.59	0.58	0.76	0.38	0.34	0.72	0.39	0.36	0.74	0.59	n/a
18	(457)	0.88	0.71	0.70	0.81	0.44	0.40	0.66	0.60	0.59	0.91	0.45	0.41	0.81	0.44	0.40	0.79	0.63	0.61
20	(508)	0.92	0.74	0.72	0.90	0.49	0.45	0.67	0.61	0.60	1.00	0.53	0.48	0.90	0.49	0.45	0.83	0.66	0.64
22	(559)	0.97	0.76	0.74	0.99	0.54	0.49	0.69	0.62	0.61		0.61	0.56	0.99	0.54	0.49	0.87	0.69	0.67
24	(610)	1.00	0.79	0.76	1.00	0.59	0.54	0.71	0.63	0.62		0.70	0.63	1.00	0.59	0.54	0.91	0.72	0.70
26	(660)		0.81	0.78		0.64	0.58	0.73	0.64	0.63		0.79	0.72		0.64	0.58	0.95	0.75	0.73
28	(711)		0.83	0.80		0.69	0.62	0.74	0.65	0.64		0.88	0.80		0.69	0.62	0.99	0.78	0.76
30	(762)		0.86	0.83		0.74	0.67	0.76	0.66	0.65		0.97	0.89		0.74	0.67	1.00	0.81	0.78
36	(914)		0.93	0.89		0.89	0.80	0.81	0.70	0.68		1.00	1.00		0.89	0.80		0.89	0.86
> 48	(1219)		1.00	1.00		1.00	1.00	0.92	0.76	0.75					1.00	1.00		1.00	0.99

Table 66 — Load adjustment factors for 20M rebar in cracked concrete[1,2,3]

20M Rebar cracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ‖ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef} in.	(mm)	7-7/8 (200)	14 (355)	15-3/8 (390)	7-7/8 (200)	14 (355)	15-3/8 (390)	7-7/8 (200)	14 (355)	15-3/8 (390)	7-7/8 (200)	14 (355)	15-3/8 (390)	7-7/8 (200)	14 (355)	15-3/8 (390)	7-7/8 (200)	14 (355)	15-3/8 (390)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																			
1-3/4	(44)	n/a	n/a	n/a	0.43	0.39	0.39	n/a	n/a	n/a	0.03	0.01	0.01	0.06	0.02	0.02	n/a	n/a	n/a
3-7/8	(98)	0.58	0.55	0.54	0.53	0.45	0.44	0.53	0.52	0.52	0.09	0.04	0.04	0.18	0.08	0.07	n/a	n/a	n/a
4	(102)	0.58	0.55	0.54	0.54	0.45	0.44	0.54	0.52	0.52	0.10	0.04	0.04	0.19	0.08	0.07	n/a	n/a	n/a
5	(127)	0.61	0.56	0.55	0.59	0.48	0.47	0.54	0.52	0.52	0.14	0.06	0.05	0.27	0.11	0.10	n/a	n/a	n/a
6	(152)	0.63	0.57	0.57	0.64	0.51	0.49	0.55	0.53	0.53	0.18	0.08	0.07	0.36	0.15	0.14	n/a	n/a	n/a
7	(178)	0.65	0.58	0.58	0.70	0.53	0.52	0.56	0.53	0.53	0.22	0.09	0.09	0.45	0.19	0.17	n/a	n/a	n/a
8	(203)	0.67	0.60	0.59	0.76	0.56	0.54	0.57	0.54	0.54	0.27	0.12	0.10	0.55	0.23	0.21	n/a	n/a	n/a
9	(229)	0.69	0.61	0.60	0.82	0.59	0.57	0.58	0.54	0.54	0.33	0.14	0.12	0.65	0.28	0.25	n/a	n/a	n/a
10	(254)	0.71	0.62	0.61	0.88	0.62	0.60	0.59	0.55	0.55	0.38	0.16	0.15	0.77	0.32	0.29	0.59	n/a	n/a
11	(279)	0.73	0.63	0.62	0.95	0.65	0.62	0.60	0.55	0.55	0.44	0.19	0.17	0.88	0.37	0.34	0.62	n/a	n/a
12	(305)	0.75	0.64	0.63	1.00	0.69	0.65	0.61	0.56	0.56	0.50	0.21	0.19	1.00	0.43	0.38	0.65	n/a	n/a
14	(356)	0.80	0.67	0.65		0.75	0.71	0.62	0.57	0.56	0.64	0.27	0.24		0.54	0.48	0.70	n/a	n/a
16	(406)	0.84	0.69	0.67		0.82	0.77	0.64	0.58	0.57	0.77	0.33	0.30		0.66	0.59	0.75	0.56	n/a
18	(457)	0.88	0.71	0.70		0.89	0.83	0.66	0.59	0.58	0.93	0.39	0.35		0.78	0.71	0.80	0.60	0.58
20	(508)	0.92	0.74	0.72		0.96	0.90	0.68	0.60	0.59	1.00	0.46	0.41		0.92	0.83	0.84	0.63	0.61
22	(559)	0.97	0.76	0.74		1.00	0.96	0.69	0.61	0.60		0.53	0.48		1.00	0.95	0.88	0.66	0.64
24	(610)	1.00	0.79	0.76			1.00	0.71	0.62	0.61		0.60	0.54			1.00	0.92	0.69	0.67
26	(660)		0.81	0.78				0.73	0.63	0.62		0.68	0.61				0.96	0.72	0.69
28	(711)		0.83	0.80				0.75	0.64	0.63		0.76	0.68				0.99	0.74	0.72
30	(762)		0.86	0.83				0.76	0.65	0.64		0.84	0.76				1.00	0.77	0.74
36	(914)		0.93	0.89				0.82	0.68	0.67		1.00	1.00					0.84	0.82
> 48	(1219)		1.00	1.00				0.92	0.74	0.72								0.98	0.94

1 Linear interpolation not permitted.
2 Shaded area with reduced edge distance is permitted provided the rebar has no installation torque.
3 When combining multiple load adjustment factors (e.g. for a four-anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use PROFIS Engineering or perform anchor calculation using design equations from CSA A23.3 Annex D.
4 Spacing factor reduction in shear applicable when $c < 3*h_{ef}$. f_{AV}, is applicable when edge distance, $c < 3*h_{ef}$. If $c \geq 3*h_{ef}$, then $f_{AV} = f_{AN}$.
5 Concrete thickness reduction factor in shear, f_{HV}, is applicable when edge distance, $c < 3*h_{ef}$. If $c \geq 3*h_{ef}$, then $f_{HV} = 1.0$.

Table 67 — Load adjustment factors for 25M rebar in uncracked concrete[1,2,3]

25M Rebar uncracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ∥ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef} in.	(mm)	9-1/16 (230)	15-15/16 (405)	19-13/16 (504)	9-1/16 (230)	15-15/16 (405)	19-13/16 (504)	9-1/16 (230)	15-15/16 (405)	19-13/16 (504)	9-1/16 (230)	15-15/16 (405)	19-13/16 (504)	9-1/16 (230)	15-15/16 (405)	19-13/16 (504)	9-1/16 (230)	15-15/16 (405)	19-13/16 (504)
1-3/4	(44)	n/a	n/a	n/a	0.24	0.12	0.10	n/a	n/a	n/a	0.02	0.01	0.01	0.04	0.02	0.02	n/a	n/a	n/a
5	(127)	0.59	0.55	0.54	0.32	0.16	0.13	0.54	0.52	0.52	0.11	0.05	0.04	0.22	0.09	0.07	n/a	n/a	n/a
6	(152)	0.61	0.56	0.55	0.34	0.18	0.14	0.55	0.53	0.52	0.14	0.06	0.05	0.28	0.12	0.10	n/a	n/a	n/a
7	(178)	0.63	0.57	0.56	0.37	0.19	0.15	0.55	0.53	0.53	0.18	0.08	0.06	0.36	0.15	0.12	n/a	n/a	n/a
8	(203)	0.65	0.58	0.57	0.40	0.21	0.16	0.56	0.53	0.53	0.22	0.09	0.07	0.40	0.19	0.15	n/a	n/a	n/a
9	(229)	0.67	0.59	0.58	0.43	0.22	0.18	0.57	0.54	0.53	0.26	0.11	0.09	0.43	0.22	0.18	n/a	n/a	n/a
10	(254)	0.68	0.60	0.58	0.46	0.24	0.19	0.58	0.54	0.54	0.30	0.13	0.10	0.46	0.24	0.19	n/a	n/a	n/a
11-9/16	(294)	0.71	0.62	0.60	0.51	0.26	0.21	0.59	0.55	0.54	0.38	0.16	0.13	0.51	0.26	0.21	0.59	n/a	n/a
12	(305)	0.72	0.63	0.60	0.52	0.27	0.21	0.59	0.55	0.54	0.40	0.17	0.14	0.52	0.27	0.21	0.60	n/a	n/a
14	(356)	0.76	0.65	0.62	0.59	0.31	0.24	0.61	0.56	0.55	0.50	0.22	0.17	0.59	0.31	0.24	0.65	n/a	n/a
16	(406)	0.79	0.67	0.63	0.68	0.35	0.28	0.62	0.57	0.56	0.62	0.26	0.21	0.68	0.35	0.28	0.69	n/a	n/a
18	(457)	0.83	0.69	0.65	0.76	0.39	0.31	0.64	0.58	0.57	0.74	0.31	0.25	0.76	0.39	0.31	0.74	n/a	n/a
18-7/16	(469)	0.84	0.69	0.66	0.78	0.40	0.32	0.64	0.58	0.57	0.76	0.33	0.26	0.78	0.40	0.32	0.75	0.56	n/a
20	(508)	0.87	0.71	0.67	0.85	0.44	0.35	0.65	0.59	0.57	0.86	0.37	0.30	0.85	0.44	0.35	0.78	0.59	n/a
22-3/8	(568)	0.91	0.73	0.69	0.95	0.49	0.39	0.67	0.60	0.58	1.00	0.44	0.35	0.95	0.49	0.39	0.82	0.62	0.58
24	(610)	0.94	0.75	0.70	1.00	0.52	0.42	0.68	0.60	0.59		0.48	0.39	1.00	0.52	0.42	0.85	0.64	0.60
26	(660)	0.98	0.77	0.72		0.57	0.45	0.70	0.61	0.60		0.55	0.44		0.57	0.45	0.89	0.67	0.62
28	(711)	1.00	0.79	0.74		0.61	0.49	0.71	0.62	0.60		0.61	0.49		0.61	0.49	0.92	0.69	0.64
30	(762)		0.81	0.75		0.66	0.52	0.73	0.63	0.61		0.68	0.54		0.66	0.52	0.95	0.72	0.67
36	(914)		0.88	0.80		0.79	0.63	0.77	0.65	0.63		0.89	0.71		0.79	0.63	1.00	0.79	0.73
> 48	(1219)		1.00	0.90		1.00	0.84	0.86	0.71	0.68		1.00	1.00		1.00	0.84		0.91	0.84

Rows: Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)

Table 68 — Load adjustment factors for 25M rebar in cracked concrete[1,2,3]

25M Rebar cracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ∥ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef} in.	(mm)	9-1/16 (230)	15-15/16 (405)	19-13/16 (504)	9-1/16 (230)	15-15/16 (405)	19-13/16 (504)	9-1/16 (230)	15-15/16 (405)	19-13/16 (504)	9-1/16 (230)	15-15/16 (405)	19-13/16 (504)	9-1/16 (230)	15-15/16 (405)	19-13/16 (504)	9-1/16 (230)	15-15/16 (405)	19-13/16 (504)
1-3/4	(44)	n/a	n/a	n/a	0.42	0.39	0.38	n/a	n/a	n/a	0.02	0.01	0.01	0.05	0.02	0.01	n/a	n/a	n/a
5	(127)	0.59	0.55	0.54	0.55	0.46	0.44	0.54	0.52	0.52	0.11	0.05	0.03	0.22	0.09	0.07	n/a	n/a	n/a
6	(152)	0.61	0.56	0.55	0.60	0.48	0.46	0.55	0.53	0.52	0.14	0.06	0.04	0.29	0.12	0.09	n/a	n/a	n/a
7	(178)	0.63	0.57	0.56	0.65	0.51	0.48	0.55	0.53	0.52	0.18	0.08	0.06	0.36	0.16	0.11	n/a	n/a	n/a
8	(203)	0.65	0.58	0.57	0.70	0.53	0.50	0.56	0.53	0.53	0.22	0.10	0.07	0.44	0.19	0.14	n/a	n/a	n/a
9	(229)	0.67	0.59	0.58	0.75	0.56	0.51	0.57	0.54	0.53	0.27	0.11	0.08	0.53	0.23	0.16	n/a	n/a	n/a
10	(254)	0.68	0.60	0.58	0.80	0.59	0.53	0.58	0.54	0.53	0.31	0.13	0.10	0.62	0.27	0.19	n/a	n/a	n/a
11-9/16	(294)	0.71	0.62	0.60	0.89	0.63	0.57	0.59	0.55	0.54	0.39	0.17	0.12	0.77	0.33	0.24	0.60	n/a	n/a
12	(305)	0.72	0.63	0.60	0.91	0.64	0.58	0.59	0.55	0.54	0.41	0.17	0.13	0.82	0.35	0.25	0.61	n/a	n/a
14	(356)	0.76	0.65	0.62	1.00	0.69	0.62	0.61	0.56	0.55	0.51	0.22	0.16	1.00	0.44	0.32	0.65	n/a	n/a
16	(406)	0.79	0.67	0.63		0.75	0.66	0.62	0.57	0.56	0.63	0.27	0.19		0.54	0.39	0.70	n/a	n/a
18	(457)	0.83	0.69	0.65		0.81	0.71	0.64	0.58	0.56	0.75	0.32	0.23		0.64	0.46	0.74	n/a	n/a
18-7/16	(469)	0.84	0.69	0.66		0.83	0.72	0.64	0.58	0.56	0.78	0.33	0.24		0.67	0.48	0.75	0.57	n/a
20	(508)	0.87	0.71	0.67		0.87	0.75	0.65	0.59	0.57	0.88	0.38	0.27		0.75	0.54	0.78	0.59	n/a
22-3/8	(568)	0.91	0.73	0.69		0.95	0.81	0.67	0.60	0.58	1.00	0.44	0.32		0.89	0.64	0.83	0.62	0.56
24	(610)	0.94	0.75	0.70		1.00	0.85	0.68	0.60	0.58		0.49	0.36		0.99	0.71	0.86	0.65	0.58
26	(660)	0.98	0.77	0.72			0.90	0.70	0.61	0.59		0.56	0.40		1.00	0.80	0.89	0.67	0.60
28	(711)	1.00	0.79	0.74			0.95	0.71	0.62	0.60		0.62	0.45			0.90	0.93	0.70	0.63
30	(762)		0.81	0.75			1.00	0.73	0.63	0.60		0.69	0.50			1.00	0.96	0.72	0.65
36	(914)		0.88	0.80				0.78	0.66	0.63		0.91	0.65				1.00	0.79	0.71
> 48	(1219)		1.00	0.90				0.87	0.71	0.67		1.00	1.00					0.91	0.82

Rows: Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)

1 Linear interpolation not permitted.
2 Shaded area with reduced edge distance is permitted provided the rebar has no installation torque.
3 When combining multiple load adjustment factors (e.g. for a four-anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use PROFIS Engineering or perform anchor calculation using design equations from CSA A23.3 Annex D.
4 Spacing factor reduction in shear applicable when $c < 3 h_{ef}$. f_{AV}, is applicable when edge distance, $c < 3 h_{ef}$. If $c \geq 3 h_{ef}$, then $f_{AV} = f_{AN}$.
5 Concrete thickness reduction factor in shear, f_{HV}, is applicable when edge distance, $c < 3 h_{ef}$. If $c \geq 3 h_{ef}$, then $f_{HV} = 1.0$.

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Table 69 — Load adjustment factors for 30M rebar in uncracked concrete[1,2,3]

Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)

30M Rebar uncracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear ⊥ Toward edge f_{RV}			Edge distance in shear ∥ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef}		10-1/4	17-15/16	23-9/16	10-1/4	17-15/16	23-9/16	10-1/4	17-15/16	23-9/16	10-1/4	17-15/16	23-9/16	10-1/4	17-15/16	23-9/16	10-1/4	17-15/16	23-9/16
in.	(mm)	(260)	(455)	(598)	(260)	(455)	(598)	(260)	(455)	(598)	(260)	(455)	(598)	(260)	(455)	(598)	(260)	(455)	(598)
1-3/4	(44)	n/a	n/a	n/a	0.25	0.13	0.10	n/a	n/a	n/a	0.02	0.01	0.01	0.04	0.02	0.01	n/a	n/a	n/a
5-7/8	(150)	0.59	0.55	0.54	0.34	0.17	0.13	0.54	0.52	0.52	0.12	0.05	0.03	0.23	0.10	0.07	n/a	n/a	n/a
6	(152)	0.59	0.56	0.54	0.34	0.18	0.13	0.54	0.52	0.52	0.12	0.05	0.04	0.24	0.10	0.07	n/a	n/a	n/a
7	(178)	0.61	0.57	0.55	0.37	0.19	0.14	0.55	0.53	0.52	0.15	0.06	0.04	0.30	0.13	0.09	n/a	n/a	n/a
8	(203)	0.63	0.57	0.56	0.39	0.20	0.15	0.55	0.53	0.52	0.18	0.08	0.05	0.36	0.16	0.11	n/a	n/a	n/a
9	(229)	0.64	0.58	0.56	0.42	0.21	0.16	0.56	0.53	0.53	0.22	0.09	0.07	0.42	0.19	0.13	n/a	n/a	n/a
10	(254)	0.66	0.59	0.57	0.45	0.23	0.17	0.57	0.54	0.53	0.25	0.11	0.08	0.45	0.22	0.15	n/a	n/a	n/a
11	(279)	0.67	0.60	0.58	0.47	0.24	0.18	0.57	0.54	0.53	0.29	0.13	0.09	0.47	0.24	0.18	n/a	n/a	n/a
12	(305)	0.69	0.61	0.58	0.50	0.25	0.19	0.58	0.55	0.54	0.33	0.14	0.10	0.50	0.25	0.19	n/a	n/a	n/a
13-1/4	(337)	0.71	0.62	0.59	0.54	0.27	0.21	0.59	0.55	0.54	0.39	0.17	0.12	0.54	0.27	0.21	0.60	n/a	n/a
14	(356)	0.72	0.63	0.60	0.56	0.28	0.21	0.59	0.55	0.54	0.42	0.18	0.13	0.56	0.28	0.21	0.61	n/a	n/a
16	(406)	0.75	0.65	0.61	0.63	0.32	0.24	0.61	0.56	0.55	0.51	0.22	0.15	0.63	0.32	0.24	0.65	n/a	n/a
18	(457)	0.78	0.67	0.63	0.71	0.35	0.27	0.62	0.57	0.55	0.61	0.26	0.18	0.71	0.35	0.27	0.69	n/a	n/a
20	(508)	0.81	0.69	0.64	0.79	0.39	0.30	0.63	0.58	0.56	0.72	0.31	0.22	0.79	0.39	0.30	0.73	n/a	n/a
20-7/8	(531)	0.83	0.69	0.65	0.82	0.41	0.31	0.64	0.58	0.56	0.77	0.33	0.23	0.82	0.41	0.31	0.75	n/a	n/a
22	(559)	0.85	0.70	0.66	0.87	0.43	0.33	0.65	0.58	0.57	0.83	0.36	0.25	0.87	0.43	0.33	0.77	0.58	n/a
24	(610)	0.88	0.72	0.67	0.94	0.47	0.36	0.66	0.59	0.57	0.94	0.41	0.28	0.94	0.47	0.36	0.80	0.61	n/a
26-9/16	(675)	0.92	0.75	0.69	1.00	0.52	0.39	0.68	0.60	0.58	1.00	0.47	0.33	1.00	0.52	0.39	0.84	0.64	0.56
28	(711)	0.94	0.76	0.70		0.55	0.42	0.69	0.61	0.58		0.51	0.36		0.55	0.42	0.86	0.65	0.58
30	(762)	0.97	0.78	0.71		0.59	0.44	0.70	0.61	0.59		0.57	0.40		0.59	0.44	0.89	0.68	0.60
36	(914)	1.00	0.83	0.75		0.71	0.53	0.74	0.64	0.61		0.75	0.52		0.71	0.53	0.98	0.74	0.66
> 48	(1219)		0.95	0.84		0.95	0.71	0.82	0.68	0.64		1.00	0.80		0.95	0.71	1.00	0.86	0.76

Table 70 — Load adjustment factors for 30M rebar in cracked concrete[1,2,3]

Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)

30M Rebar cracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear ⊥ Toward edge f_{RV}			Edge distance in shear ∥ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef}		10-1/4	17-15/16	23-9/16	10-1/4	17-15/16	23-9/16	10-1/4	17-15/16	23-9/16	10-1/4	17-15/16	23-9/16	10-1/4	17-15/16	23-9/16	10-1/4	17-15/16	23-9/16
in.	(mm)	(260)	(455)	(598)	(260)	(455)	(598)	(260)	(455)	(598)	(260)	(455)	(598)	(260)	(455)	(598)	(260)	(455)	(598)
1-3/4	(44)	n/a	n/a	n/a	0.41	0.38	0.38	n/a	n/a	n/a	0.02	0.01	0.01	0.04	0.02	0.01	n/a	n/a	n/a
5-7/8	(150)	0.59	0.55	0.54	0.56	0.47	0.44	0.54	0.52	0.52	0.12	0.05	0.03	0.23	0.10	0.07	n/a	n/a	n/a
6	(152)	0.59	0.56	0.54	0.56	0.47	0.44	0.54	0.52	0.52	0.12	0.05	0.03	0.24	0.10	0.07	n/a	n/a	n/a
7	(178)	0.61	0.57	0.55	0.60	0.49	0.46	0.55	0.53	0.52	0.15	0.07	0.04	0.30	0.13	0.09	n/a	n/a	n/a
8	(203)	0.63	0.57	0.56	0.64	0.51	0.47	0.55	0.53	0.52	0.19	0.08	0.05	0.37	0.16	0.11	n/a	n/a	n/a
9	(229)	0.64	0.58	0.56	0.68	0.53	0.49	0.56	0.53	0.53	0.22	0.10	0.06	0.44	0.19	0.13	n/a	n/a	n/a
10	(254)	0.66	0.59	0.57	0.72	0.56	0.50	0.57	0.54	0.53	0.26	0.11	0.07	0.52	0.22	0.15	n/a	n/a	n/a
11	(279)	0.67	0.60	0.58	0.77	0.58	0.52	0.57	0.54	0.53	0.30	0.13	0.09	0.60	0.26	0.17	n/a	n/a	n/a
12	(305)	0.69	0.61	0.58	0.81	0.60	0.54	0.58	0.55	0.54	0.34	0.15	0.10	0.68	0.29	0.19	n/a	n/a	n/a
13-1/4	(337)	0.71	0.62	0.59	0.87	0.63	0.56	0.59	0.55	0.54	0.40	0.17	0.11	0.79	0.34	0.23	0.60	n/a	n/a
14	(356)	0.72	0.63	0.60	0.91	0.65	0.57	0.59	0.55	0.54	0.43	0.19	0.12	0.86	0.37	0.25	0.62	n/a	n/a
16	(406)	0.75	0.65	0.61	1.00	0.70	0.61	0.61	0.56	0.55	0.52	0.23	0.15	1.00	0.45	0.30	0.66	n/a	n/a
18	(457)	0.78	0.67	0.63		0.75	0.64	0.62	0.57	0.55	0.62	0.27	0.18		0.54	0.36	0.70	n/a	n/a
20	(508)	0.81	0.69	0.64		0.81	0.68	0.64	0.58	0.56	0.73	0.32	0.21		0.63	0.42	0.74	n/a	n/a
20-7/8	(531)	0.83	0.69	0.65		0.83	0.70	0.64	0.58	0.56	0.78	0.34	0.22		0.68	0.45	0.75	n/a	n/a
22	(559)	0.85	0.70	0.66		0.86	0.72	0.65	0.59	0.56	0.84	0.36	0.24		0.73	0.48	0.77	0.58	n/a
24	(610)	0.88	0.72	0.67		0.92	0.76	0.66	0.59	0.57	0.96	0.42	0.28		0.83	0.55	0.81	0.61	n/a
26-9/16	(675)	0.92	0.75	0.69		0.99	0.81	0.68	0.60	0.58	1.00	0.48	0.32		0.97	0.64	0.85	0.64	0.56
28	(711)	0.94	0.76	0.70		1.00	0.84	0.69	0.61	0.58		0.52	0.35		1.00	0.69	0.87	0.66	0.57
30	(762)	0.97	0.78	0.71			0.88	0.70	0.62	0.59		0.58	0.39			0.77	0.90	0.68	0.59
36	(914)	1.00	0.83	0.75			1.00	0.74	0.64	0.61		0.76	0.51			1.00	0.99	0.75	0.65
> 48	(1219)		0.95	0.84				0.82	0.69	0.64		1.00	0.78				1.00	0.86	0.75

1 Linear interpolation not permitted.
2 Shaded area with reduced edge distance is permitted provided the rebar has no installation torque.
3 When combining multiple load adjustment factors (e.g. for a four-anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use PROFIS Engineering or perform anchor calculation using design equations from CSA A23.3 Annex D.
4 Spacing factor reduction in shear applicable when $c < 3*h_{ef}$. f_{AV}, is applicable when edge distance, $c < 3*h_{ef}$. If $c \geq 3*h_{ef}$, then $f_{AV} = f_{AN}$.
5 Concrete thickness reduction factor in shear, f_{HV}, is applicable when edge distance, $c < 3*h_{ef}$. If $c \geq 3*h_{ef}$, then $f_{HV} = 1.0$.

HIT-RE 500 V3 adhesive with HAS Threaded Rod

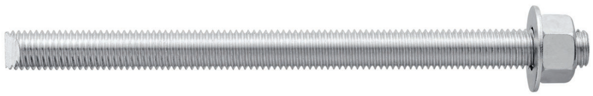


Table 71 — Hilti HIT-RE 500 V3 design information with Hilti HAS threaded rods in hammer drilled holes in accordance with CSA A23.3 Annex D[1,8]

Design parameter	Symbol	Units	3/8	1/2	5/8	3/4	7/8	1	1-1/4	Ref A23.3-14
			Nominal rod diameter (in.)							
Nominal anchor diameter	d_a	mm	9.5	12.7	15.9	19.1	22.2	25.4	31.8	
Effective minimum embedment[2]	$h_{ef,min}$	mm	60	70	79	89	89	102	127	
Effective maximum embedment[2]	$h_{ef,max}$	mm	191	254	318	381	445	508	635	
Min. concrete thickness[2]	h_{min}	mm	h_{ef} + 30	$h_{ef} + 2d_0$						
Critical edge distance	c_{ac}	–	$2h_{ef}$							
Minimum edge distance[3]	c_{min}	mm	48	64	79	95	111	127	159	
Minimum anchor spacing	s_{min}	mm	48	64	79	95	111	127	159	
Coeff. for factored conc. breakout resistance, uncracked concrete[4]	$k_{c,uncr}$	–	10							D.6.2.2
Coeff. for factored conc. breakout resistance, cracked concrete[4]	$k_{c,cr}$	–	7							D.6.2.2
Concrete material resistance factor	ϕ_c	–	0.65							8.4.2
Resistance modification factor for tension and shear, concrete failure modes, Condition B[5]	R_{conc}	–	1.00							D.5.3(c)
Dry and water saturated concrete										
Temp. range A[6]: Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	1,280 (8.8)	1,270 (8.8)	1,260 (8.7)	1,250 (8.6)	1,240 (8.6)	1,240 (8.6)	1,180 (8.1)	D.6.5.2
Temp. range A[6]: Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	2,380 (16.4)	2,300 (15.9)	2,210 (15.2)	2,130 (14.7)	2,040 (14.1)	1,960 (13.5)	1,790 (12.3)	D.6.5.2
Temp. range B[6]: Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	880 (6.1)	870 (6.0)	870 (6.0)	860 (5.9)	860 (5.9)	850 (5.9)	810 (5.6)	D.6.5.2
Temp. range B[6]: Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	1,640 (11.3)	1,590 (11.0)	1,530 (10.6)	1,470 (10.1)	1,410 (9.7)	1,350 (9.3)	1,240 (8.6)	D.6.5.2
Anchor category, dry concrete	–	–	1	1	1	1	1	1	1	
Resistance modification factor	R_{dry}	–	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Water-filled hole										
Temp. range A[6]: Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	940 (6.5)	940 (6.5)	940 (6.5)	940 (6.5)	940 (6.5)	950 (6.6)	920 (6.3)	D.6.5.2
Temp. range A[6]: Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	1,760 (12.1)	1,700 (11.7)	1,660 (11.4)	1,600 (11.0)	1,550 (10.7)	1,500 (10.3)	1,400 (9.7)	D.6.5.2
Temp. range B[6]: Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	650 (4.5)	650 (4.5)	650 (4.5)	650 (4.5)	650 (4.5)	650 (4.5)	640 (4.4)	D.6.5.2
Temp. range B[6]: Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	1,210 (8.3)	1,170 (8.1)	1,140 (7.9)	1,110 (7.7)	1,070 (7.4)	1,040 (7.2)	970 (6.7)	D.6.5.2
Anchor category, water-filled hole	–	–	3	3	3	3	3	3	3	
Resistance modification factor	R_{wf}	–	0.75	0.75	0.75	0.75	0.75	0.75	0.75	
Submerged concrete										
Temp. range A[6]: Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	820 (5.7)	830 (5.7)	830 (5.7)	840 (5.8)	850 (5.9)	860 (5.9)	860 (5.9)	D.6.5.2
Temp. range A[6]: Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	1,530 (10.6)	1,500 (10.3)	1,470 (10.1)	1,430 (9.9)	1,400 (9.7)	1,370 (9.4)	1,300 (9.0)	D.6.5.2
Temp. range B[6]: Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	570 (3.9)	570 (3.9)	580 (4.0)	580 (4.0)	590 (4.1)	590 (4.1)	590 (4.1)	D.6.5.2
Temp. range B[6]: Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	1,060 (7.3)	1,030 (7.1)	1,010 (7.0)	990 (6.8)	960 (6.6)	940 (6.5)	900 (6.2)	D.6.5.2
Anchor category, underwater	–	–	3	3	3	3	3	3	3	
Resistance modification factor	R_{uw}		0.75	0.75	0.75	0.75	0.75	0.75	0.75	
Reduction for seismic tension	$\alpha_{N,seis}$	–	0.92	0.93	0.95	1.00	1.00	1.00	1.00	

1 Design information in this table is taken from ICC-ES ELC-3814, dated April 2018, tables 8 and 9, and converted for use with CSA A23.3 Annex D.
2 See figure 4 of section 3.2.4.3.4.
3 Minimum edge distance may be reduced to 45mm ≤ c_{ai} < 5d provided T_{inst} is reduced. See ESR-3814 section 4.1.9.
4 For all design cases, $\psi_{c,N}$ = 1.0. The appropriate coefficient for breakout resistance for cracked concrete ($k_{c,cr}$) or uncracked concrete ($k_{c,uncr}$) must be used.
5 For use with the load combinations of CSA A23.3 chapter 8. Condition B applies where supplementary reinforcement in conformance with CSA A23.3 section D.5.3 is not provided, or where pullout or pryout strength governs. For cases where the presence of supplementary reinforcement can be verified, the resistance modification factors associated with Condition A may be used.
6 Temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
Temperature range B: Max. short term temperature = 176°F (80°C), max. 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.
7 Bond stress values corresponding to concrete compressive stress f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond stress may be increased by a factor of $(f'_c/2{,}500)^{0.25}$ [for SI: $(f'_c/17.2)^{0.25}$] for uncracked concrete and $(f'c/2{,}500)^{0.15}$ [for SI: $(f'c/17.2)^{0.15}$] for cracked concrete.
8 For structures assigned to Seismic Design Categories C, D, E, or F, bond strength values must be multiplied by $\alpha_{N,seis}$.

Table 72 — Hilti HIT-RE 500 V3 design information with Hilti HAS threaded rods in diamond core drilled holes in accordance with CSA A23.3 Annex D[1]

Design parameter		Symbol	Units	Nominal rod diameter (in.)							Ref
				3/8	1/2	5/8	3/4	7/8	1	1-1/4	A23.3-14
Nominal anchor diameter		d_a	mm	9.5	12.7	15.9	19.1	22.2	25.4	31.8	
Effective minimum embedment[2]		h_{ef}	mm	60	70	79	89	89	102	127	
Effective maximum embedment[2]		h_{ef}	mm	191	254	318	381	445	508	635	
Minimum concrete thickness[2]		h_{min}	mm	h_{ef} + 30		h_{ef} + $2d_o$					
Critical edge distance		c_{ac}	–	$2h_{ef}$							
Minimum edge distance		c_{min} [3]	mm	48	64	79	95	111	127	159	
Minimum anchor spacing		s_{min}	mm	48	64	79	95	111	127	159	
Coeff. for factored concrete breakout resistance, uncracked concrete		$k_{c,uncr}$ [4]	–	10							D.6.2.2
Coeff. for factored concrete breakout resistance, cracked concrete		$k_{c,cr}$ [4]	–	7							D.6.2.2
Concrete material resistance factor		ϕ_s	–	0.65							8.4.2
Resistance modification factor for tension and shear, concrete failure modes, Condition B[5]		R_{conc}	–	1.00							D.5.3(c)
Dry and water saturated concrete											
Temp. range A[6]	Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi	1,550	1,550	1,550	1,550	1,550	1,550	1,550	D.6.5.2
			(MPa)	(10.7)	(10.7)	(10.7)	(10.7)	(10.7)	(10.7)	(10.7)	
Temp. range B[6]	Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi	1,070	1,070	1,070	1,070	1,070	1,070	1,070	D.6.5.2
			psi	(7.4)	(7.4)	(7.4)	(7.4)	(7.4)	(7.4)	(7.4)	
Anchor category, dry concrete		–	–	2	2	3	3	3	3	3	
Resistance modification factor		R_{dry}	–	0.85	0.85	0.75	0.75	0.75	0.75	0.75	

1 Design information in this table is taken from ICC-ES ELC-3814, dated April 2018, tables 8 and 10, and converted for use with CSA A23.3 Annex D.

2 See figure 4 of section 3.2.4.3.4.

3 Minimum edge distance may be reduced to 45mm ≤ c_{ai} < 5d provided T_{inst} is reduced. See ESR-3814 section 4.1.9.

4 For all design cases, $\psi_{c,N}$ = 1.0. The appropriate coefficient for breakout resistance for cracked concrete ($k_{c,cr}$) or uncracked concrete ($k_{c,uncr}$) must be used.

5 For use with the load combinations of CSA A23.3 chapter 8. Condition B applies where supplementary reinforcement in conformance with CSA A23.3 section D.5.3 is not provided, or where pullout or pryout strength governs. For cases where the presence of supplementary reinforcement can be verified, the resistance modification factors associated with Condition A may be used.

6 Temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
Temperature range B: Max. short term temperature = 176°F (80°C), max. 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.

7 Bond stress values corresponding to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond stress may be increased by a factor of $(f'_c/2{,}500)^{0.25}$ [for SI: $(f'_c/17.2)^{0.25}$] for uncracked concrete.

Table 73 — Hilti HIT-RE 500 V3 adhesive factored resistance with concrete/bond failure for threaded rod in uncracked concrete[1,2,3,4,5,6,7,8,9,11]

Nominal anchor diameter in.	Effective embedment in. (mm)	Tension N_r				Shear V_r			
		f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)	f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)
3/8	2-3/8 (60)	3,060 (13.6)	3,425 (15.2)	3,750 (16.7)	4,330 (19.3)	3,060 (13.6)	3,425 (15.2)	3,750 (16.7)	4,330 (19.3)
	3-3/8 (86)	5,185 (23.1)	5,800 (25.8)	6,355 (28.3)	7,335 (32.6)	10,375 (46.1)	11,600 (51.6)	12,705 (56.5)	14,670 (65.3)
	4-1/2 (114)	7,985 (35.5)	8,930 (39.7)	9,430 (41.9)	10,130 (45.1)	15,970 (71.0)	17,855 (79.4)	18,855 (83.9)	20,260 (90.1)
	7-1/2 (191)	14,200 (63.2)	15,010 (66.8)	15,715 (69.9)	16,885 (75.1)	28,395 (126.3)	30,025 (133.6)	31,425 (139.8)	33,770 (150.2)
1/2	2-3/4 (70)	3,815 (17.0)	4,265 (19.0)	4,670 (20.8)	5,395 (24.0)	7,630 (33.9)	8,530 (37.9)	9,345 (41.6)	10,790 (48.0)
	4-1/2 (114)	7,985 (35.5)	8,930 (39.7)	9,780 (43.5)	11,295 (50.2)	15,970 (71.0)	17,855 (79.4)	19,560 (87.0)	22,585 (100.5)
	6 (152)	12,295 (54.7)	13,745 (61.1)	15,060 (67.0)	17,385 (77.3)	24,590 (109.4)	27,490 (122.3)	30,115 (134.0)	34,775 (154.7)
	10 (254)	24,390 (108.5)	25,790 (114.7)	26,995 (120.1)	29,005 (129.0)	48,785 (217.0)	51,585 (229.5)	53,990 (240.2)	58,015 (258.1)
5/8[10]	3-1/8 (79)	4,620 (20.6)	5,165 (23.0)	5,660 (25.2)	6,535 (29.1)	9,245 (41.1)	10,335 (46.0)	11,320 (50.4)	13,070 (58.1)
	5-5/8 (143)	11,160 (49.6)	12,480 (55.5)	13,670 (60.8)	15,785 (70.2)	22,320 (99.3)	24,955 (111.0)	27,335 (121.6)	31,565 (140.4)
	7-1/2 (191)	17,185 (76.4)	19,210 (85.5)	21,045 (93.6)	24,300 (108.1)	34,365 (152.9)	38,420 (170.9)	42,090 (187.2)	48,600 (216.2)
	12-1/2 (318)	36,620 (162.9)	38,725 (172.2)	40,530 (180.3)	43,550 (193.7)	73,245 (325.8)	77,445 (344.5)	81,055 (360.6)	87,100 (387.4)
3/4[10]	3-1/2 (89)	5,480 (24.4)	6,125 (27.2)	6,710 (29.8)	7,745 (34.5)	10,955 (48.7)	12,250 (54.5)	13,420 (59.7)	15,495 (68.9)
	6-3/4 (171)	14,670 (65.3)	16,400 (73.0)	17,970 (79.9)	20,745 (92.3)	29,340 (130.5)	32,805 (145.9)	35,935 (159.8)	41,495 (184.6)
	9 (229)	22,585 (100.5)	25,255 (112.3)	27,665 (123.1)	31,945 (142.1)	45,175 (200.9)	50,505 (224.7)	55,325 (246.1)	63,885 (284.2)
	15 (381)	48,600 (216.2)	53,740 (239.1)	56,250 (250.2)	60,445 (268.9)	97,200 (432.4)	107,485 (478.1)	112,495 (500.4)	120,885 (537.7)
7/8[10]	3-1/2 (89)	5,480 (24.4)	6,125 (27.2)	6,710 (29.8)	7,745 (34.5)	10,955 (48.7)	12,250 (54.5)	13,420 (59.7)	15,495 (68.9)
	7-7/8 (200)	18,485 (82.2)	20,670 (91.9)	22,640 (100.7)	26,145 (116.3)	36,975 (164.5)	41,340 (183.9)	45,285 (201.4)	52,290 (232.6)
	10-1/2 (267)	28,465 (126.6)	31,820 (141.6)	34,860 (155.1)	40,255 (179.1)	56,925 (253.2)	63,645 (283.1)	69,720 (310.1)	80,505 (358.1)
	17-1/2 (445)	61,240 (272.4)	68,470 (304.6)	73,325 (326.2)	78,795 (350.5)	122,485 (544.8)	136,940 (609.1)	146,650 (652.3)	157,585 (701.0)
1[10]	4 (102)	6,690 (29.8)	7,480 (33.3)	8,195 (36.5)	9,465 (42.1)	13,385 (59.5)	14,965 (66.6)	16,395 (72.9)	18,930 (84.2)
	9 (229)	22,585 (100.5)	25,255 (112.3)	27,665 (123.1)	31,945 (142.1)	45,175 (200.9)	50,505 (224.7)	55,325 (246.1)	63,885 (284.2)
	12 (305)	34,775 (154.7)	38,880 (172.9)	42,590 (189.5)	49,180 (218.8)	69,550 (309.4)	77,760 (345.9)	85,180 (378.9)	98,360 (437.5)
	20 (508)	74,825 (332.8)	83,655 (372.1)	91,640 (407.6)	98,875 (439.8)	149,650 (665.7)	167,310 (744.2)	183,280 (815.3)	197,755 (879.7)
1-1/4[10]	5 (127)	9,355 (41.6)	10,455 (46.5)	11,455 (51.0)	13,225 (58.8)	18,705 (83.2)	20,915 (93.0)	22,910 (101.9)	26,455 (117.7)
	11-1/4 (286)	31,565 (140.4)	35,290 (157.0)	38,660 (172.0)	44,640 (198.6)	63,135 (280.8)	70,585 (314.0)	77,320 (343.9)	89,285 (397.1)
	15 (381)	48,600 (216.2)	54,335 (241.7)	59,520 (264.8)	68,730 (305.7)	97,200 (432.4)	108,670 (483.4)	119,045 (529.5)	137,460 (611.4)
	25 (635)	104,570 (465.1)	116,910 (520.0)	128,070 (569.7)	141,095 (627.6)	209,140 (930.3)	233,825 (1040.1)	256,140 (1139.4)	282,190 (1255.2)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8 to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 30 - 41 as necessary to the above values. Compare to the steel values in table 29. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69.
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.
6 Tabular values are for dry concrete or water-saturated concrete conditions.
For water-filled drilled holes multiply design strength by 0.51.
For submerged (under water) applications multiply design strength by 0.44.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λ_a as follows:
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for holes drilled in concrete with carbide tipped hammer drill bit. For diamond core drilling, except as indicated in note 10, multiply above values by 0.55.
Diamond core drilling is not permitted for the water-filled or under-water (submerged) applications.
10 Diamond core drilling with Hilti TE-YRT roughening tool is permitted for 5/8", 3/4", 7/8", 1", and 1-1/4". See Table 76.
11 Tabular values are for static loads only. Seismic design is not permitted for uncracked concrete.

Table 74 — Hilti HIT-RE 500 V3 adhesive factored resistance with concrete/bond failure for threaded rod in cracked concrete[1,2,3,4,5,6,7,8,9,11]

Nominal anchor diameter in.	Effective embedment in. (mm)	Tension N_r				Shear V_r			
		f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)	f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)
3/8	2-3/8 (60)	2,145 (9.5)	2,395 (10.7)	2,530 (11.3)	2,645 (11.8)	2,145 (9.5)	2,395 (10.7)	2,530 (11.3)	2,645 (11.8)
	3-3/8 (86)	3,385 (15.1)	3,500 (15.6)	3,595 (16.0)	3,755 (16.7)	6,770 (30.1)	7,000 (31.1)	7,195 (32.0)	7,510 (33.4)
	4-1/2 (114)	4,515 (20.1)	4,665 (20.8)	4,795 (21.3)	5,005 (22.3)	9,025 (40.1)	9,335 (41.5)	9,590 (42.7)	10,015 (44.5)
	7-1/2 (191)	7,520 (33.5)	7,780 (34.6)	7,995 (35.6)	8,345 (37.1)	15,045 (66.9)	15,555 (69.2)	15,985 (71.1)	16,690 (74.2)
1/2	2-3/4 (70)	2,670 (11.9)	2,985 (13.3)	3,270 (14.5)	3,775 (16.8)	5,340 (23.8)	5,970 (26.6)	6,540 (29.1)	7,555 (33.6)
	4-1/2 (114)	5,590 (24.9)	6,175 (27.5)	6,345 (28.2)	6,625 (29.5)	11,180 (49.7)	12,345 (54.9)	12,690 (56.4)	13,250 (58.9)
	6 (152)	7,960 (35.4)	8,230 (36.6)	8,460 (37.6)	8,830 (39.3)	15,920 (70.8)	16,460 (73.2)	16,920 (75.3)	17,665 (78.6)
	10 (254)	13,265 (59.0)	13,720 (61.0)	14,100 (62.7)	14,720 (65.5)	26,535 (118.0)	27,435 (122.0)	28,200 (125.4)	29,440 (131.0)
5/8[10]	3-1/8 (79)	3,235 (14.4)	3,615 (16.1)	3,960 (17.6)	4,575 (20.4)	6,470 (28.8)	7,235 (32.2)	7,925 (35.2)	9,150 (40.7)
	5-5/8 (143)	7,810 (34.8)	8,735 (38.9)	9,570 (42.6)	10,270 (45.7)	15,625 (69.5)	17,470 (77.7)	19,135 (85.1)	20,540 (91.4)
	7-1/2 (191)	12,030 (53.5)	12,760 (56.8)	13,115 (58.3)	13,690 (60.9)	24,055 (107.0)	25,520 (113.5)	26,230 (116.7)	27,385 (121.8)
	12-1/2 (318)	20,565 (91.5)	21,265 (94.6)	21,855 (97.2)	22,820 (101.5)	41,135 (183.0)	42,535 (189.2)	43,715 (194.4)	45,640 (203.0)
3/4[10]	3-1/2 (89)	3,835 (17.1)	4,285 (19.1)	4,695 (20.9)	5,425 (24.1)	7,670 (34.1)	8,575 (38.1)	9,390 (41.8)	10,845 (48.2)
	6-3/4 (171)	10,270 (45.7)	11,480 (51.1)	12,575 (55.9)	14,525 (64.6)	20,540 (91.4)	22,965 (102.1)	25,155 (111.9)	29,045 (129.2)
	9 (229)	15,810 (70.3)	17,675 (78.6)	18,735 (83.3)	19,560 (87.0)	31,620 (140.7)	35,355 (157.3)	37,470 (166.7)	39,120 (174.0)
	15 (381)	29,380 (130.7)	30,380 (135.1)	31,225 (138.9)	32,600 (145.0)	58,760 (261.4)	60,760 (270.3)	62,445 (277.8)	65,200 (290.0)
7/8[10]	3-1/2 (89)	3,835 (17.1)	4,285 (19.1)	4,695 (20.9)	5,425 (24.1)	7,670 (34.1)	8,575 (38.1)	9,390 (41.8)	10,845 (48.2)
	7-7/8 (200)	12,940 (57.6)	14,470 (64.4)	15,850 (70.5)	18,300 (81.4)	25,880 (115.1)	28,935 (128.7)	31,700 (141.0)	36,605 (162.8)
	10-1/2 (267)	19,925 (88.6)	22,275 (99.1)	24,400 (108.5)	26,410 (117.5)	39,850 (177.3)	44,550 (198.2)	48,805 (217.1)	52,820 (235.0)
	17-1/2 (445)	39,670 (176.5)	41,020 (182.5)	42,160 (187.5)	44,020 (195.8)	79,340 (352.9)	82,040 (364.9)	84,315 (375.1)	88,035 (391.6)
1[10]	4 (102)	4,685 (20.8)	5,240 (23.3)	5,740 (25.5)	6,625 (29.5)	9,370 (41.7)	10,475 (46.6)	11,475 (51.0)	13,250 (58.9)
	9 (229)	15,810 (70.3)	17,675 (78.6)	19,365 (86.1)	22,360 (99.5)	31,620 (140.7)	35,355 (157.3)	38,730 (172.3)	44,720 (198.9)
	12 (305)	24,340 (108.3)	27,215 (121.1)	29,815 (132.6)	34,425 (153.1)	48,685 (216.6)	54,430 (242.1)	59,625 (265.2)	68,850 (306.3)
	20 (508)	51,815 (230.5)	53,580 (238.3)	55,065 (244.9)	57,490 (255.7)	103,630 (461.0)	107,155 (476.7)	110,130 (489.9)	114,985 (511.5)
1-1/4[10]	5 (127)	6,545 (29.1)	7,320 (32.6)	8,020 (35.7)	9,260 (41.2)	13,095 (58.2)	14,640 (65.1)	16,035 (71.3)	18,520 (82.4)
	11-1/4 (286)	22,095 (98.3)	24,705 (109.9)	27,060 (120.4)	31,250 (139.0)	44,195 (196.6)	49,410 (219.8)	54,125 (240.8)	62,500 (278.0)
	15 (381)	34,020 (151.3)	38,035 (169.2)	41,665 (185.3)	48,110 (214.0)	68,040 (302.7)	76,070 (338.4)	83,330 (370.7)	96,220 (428.0)
	25 (635)	73,200 (325.6)	79,665 (354.4)	81,875 (364.2)	85,485 (380.3)	146,395 (651.2)	159,330 (708.7)	163,750 (728.4)	170,970 (760.5)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8 to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 30-41 as necessary to the above values. Compare to the steel values in table 29 to the above values. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176 °F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69.
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.
6 Tabular values are for dry or water saturated concrete conditions.
For water-filled drilled holes multiply design strength by 0.51.
For submerged (under water) applications multiply design strength by 0.44.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λ_a as follows:
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for holes drilled in concrete with carbide tipped hammer drill bit. Diamond core drilling is not permitted in cracked concrete except as indicated in note 10.
10 Diamond core drilling with Hilti TE-YRT roughening tool is permitted for 5/8", 3/4", 7/8", 1", and 1-1/4". See Table 77.
11 Tabular values are for static loads only. For seismic loads, multiply cracked concrete tabular values by α_{seis} indicated below. See section 3.1.8 for additional information on seismic applications.
3/8-in. diameter - α_{seis} = 0.69
1/2-in. diameter - α_{seis} = 0.70
5/8-in. diameter - α_{seis} = 0.71
3/4-in. diameter and larger - α_{seis} = 0.75

Table 75 — Steel factored resistance for Hilti HAS threaded rods for use with CSA A23.3 Annex D

Nominal anchor diameter in.	HAS-V-36 / HAS-V-36 HDG ASTM F1554 Gr.36[4,6]			HAS-E-55 / HAS-E-55 HDG ASTM F1554 Gr. 55[4,6]			HAS-B-105 / HAS-B-105 HDG ASTM A193 B7 and ASTM F 1554 Gr.105[4,6]			HAS-R stainless steel ASTM F593 (3/8-in to 1-in)[5] ASTM A193 (1-1/8-in to 2-in)[4]		
	Tensile[1] ΦN_{sar} lb (kN)	Shear[2] ΦV_{sar} lb (kN)	Seismic Shear[3] $\Phi V_{sar,eq}$ lb (kN)	Tensile[1] ΦN_{sar} lb (kN)	Shear[2] ΦV_{sar} lb (kN)	Seismic Shear[3] $\Phi V_{sar,eq}$ lb (kN)	Tensile[1] ΦN_{sar} lb (kN)	Shear[2] ΦV_{sar} lb (kN)	Seismic Shear[3] $\Phi V_{sar,eq}$ lb (kN)	Tensile[1] ΦN_{sar} lb (kN)	Shear[2] ΦV_{sar} lb (kN)	Seismic Shear[3] $\Phi V_{sar,eq}$ lb (kN)
3/8	3,055 (13.6)	1,720 (7.7)	1,030 (4.6)	3,955 (17.6)	2,225 (9.9)	2,225 (9.9)	6,570 (29.2)	3,695 (16.4)	3,695 (16.4)	4,610 (20.5)	2,570 (11.4)	2,055 (9.1)
1/2	5,595 (24.9)	3,150 (14.0)	1,890 (8.4)	7,240 (32.2)	4,070 (18.1)	4,070 (18.1)	12,035 (53.5)	6,765 (30.1)	6,765 (30.1)	8,445 (37.6)	4,705 (20.9)	3,765 (16.7)
5/8	8,915 (39.7)	5,015 (22.3)	3,010 (13.4)	11,525 (51.3)	6,485 (28.8)	6,485 (28.8)	19,160 (85.2)	10,780 (48.0)	10,780 (48.0)	13,445 (59.8)	7,490 (33.3)	5,990 (26.6)
3/4	13,190 (58.7)	7,420 (33.0)	4,450 (19.8)	17,060 (75.9)	9,600 (42.7)	9,600 (42.7)	28,365 (126.2)	15,955 (71.0)	15,955 (71.0)	16,920 (75.3)	9,425 (41.9)	7,540 (33.5)
7/8	18,210 (81.0)	10,245 (45.6)	6,145 (27.3)	23,550 (104.8)	13,245 (58.9)	13,245 (58.9)	39,150 (174.1)	22,020 (97.9)	22,020 (97.9)	23,350 (103.9)	13,010 (57.9)	10,410 (46.3)
1	23,890 (106.3)	13,440 (59.8)	8,065 (35.9)	30,890 (137.4)	17,380 (77.3)	17,380 (77.3)	51,360 (228.5)	28,890 (128.5)	28,890 (128.5)	30,635 (136.3)	17,065 (75.9)	13,650 (60.7)
1-1/4	38,225 (170.0)	21,500 (95.6)	12,900 (57.4)	49,425 (219.9)	27,800 (123.7)	27,800 (123.7)	82,175 (365.5)	46,220 (205.6)	46,220 (205.6)	37,565 (167.1)	21,130 (94.0)	16,905 (75.2)

1 Tensile = $\phi A_{se,N} f_{uta} R$ as noted in CSA A23.3 Eq. D.2.
2 Shear = ϕ 0.60 $A_{se,V} f_{uta} R$ as noted in CSA A23.3 Eq. D.31.
3 Seismic Shear = $\alpha_{V,seis} V_{sar}$: Reduction factor for seismic shear only. See CSA A23.3 Annex D for additional information on seismic applications. Seismic shear for HIT-RE 500 V3
4 HAS-V, HAS-E (3/8-in to 1-1/4-in), HAS-B, and HAS-R (Class 1; 1-1/4-in) threaded rods are considered ductile steel elements (including HDG rods).
5 HAS-R (CW1 and CW2; 3/8-in to 1-in) threaded rods are considered brittle steel elements.
6 3/8-inch dia. threaded rods are not included in the ASTM F1554 standard. Hilti 3/8-inch dia. HAS-V, HAS-E, and HAS-E-B (incl. HDG) threaded rods meet the chemical composition and mechanical property requirements of ASTM F1554.

Table 75 — Hilti HIT-RE 500-V3 design information with HAS threaded rods in core drilled holes roughened with the TE-YRT Roughening Tool in accordance with CSA A23.3 Annex D[1,8]

Design parameter	Symbol	Units	Nominal rod diameter (in.) 5/8	3/4	7/8	1	1-1/4	Ref A23.3-14
Nominal anchor diameter	d_a	mm	15.9	19.1	22.2	25.4	31.8	
Effective minimum embedment[2]	h_{ef}	mm	79	89	89	102	127	
Effective maximum embedment[2]	h_{ef}	ƒmm	318	286	445	508	635	
Minimum concrete thickness[2]	h_{min}	mm	$h_{ef} + 2d_o$					
Critical edge distance	c_{ac}	–	$2h_{ef}$					
Minimum edge distance[3]	c_{min}	mm	79	95	111	127	159	
Minimum anchor spacing	s_{min}	mm	79	95	111	127	159	
Coeff. for factored concrete breakout resistance, uncracked concrete[4]	$k_{c,uncr}$	–	10					D.6.2.2
Coeff. for factored concrete breakout resistance, cracked concrete[4]	$k_{c,cr}$	–	7					D.6.2.2
Concrete material resistance factor	ϕ_s	–	0.65					8.4.2
Resistance modification factor for tension and shear, concrete failure modes, Condition B[5]	R_{conc}	–	1.00					D.5.3(c)
Dry and water saturated concrete								
Temp. range A[6]: Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	880 (6.1)	875 (6.0)	870 (6.0)	870 (6.0)	825 (5.7)	D.6.5.2
Temp. range A[6]: Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	2,210 (15.2)	2,130 (14.7)	2,040 (14.1)	1,960 (13.5)	1,790 (12.3)	D.6.5.2
Temp. range B[6]: Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	610 (4.2)	605 (4.2)	605 (4.2)	600 (4.1)	570 (3.9)	D.6.5.2
Temp. range B[6]: Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	1,530 (10.6)	1,470 (10.1)	1,410 (9.7)	1,350 (9.3)	1,240 (8.6)	D.6.5.2
Anchor category, dry concrete	-	-	1	1	1	1	1	
Resistance modification factor	R_{dry}	-	1.00	1.00	1.00	1.00	1.00	
Reduction for seismic tension	$\alpha_{N,seis}$	-	0.95	1.00	1.00	1.00	1.00	

1 Design information in this table is taken from ICC-ES ELC-3814, dated April 2018, table 11 and 12, and converted for use with CSA A23.3 Annex D.
2 See figure 8 of section 3.2.4.3.4.
3 Minimum edge distance may be reduced to 45mm ≤ c_{ai} < 5d provided Tinst is reduced. See ESR-3814 section 4.1.9.
4 For all design cases, $\psi_{c,N}$ = 1.0. The appropriate coefficient for breakout resistance for cracked concrete ($k_{c,cr}$) or uncracked concrete ($k_{c,uncr}$) must be used.
5 For use with the load combinations of CSA A23.3 chapter 8. Condition B applies where supplementary reinforcement in conformance with CSA A23.3 section D.5.3 is not provided, or where pullout or pryout strength governs. For cases where the presence of supplementary reinforcement can be verified, the resistance modification factors associated with Condition A may be used.
6 Temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
Temperature range B: Max. short term temperature = 176°F (80°C), max. 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.
7 Bond stress values correspond to concrete compressive strength in the range 2,500 psi ≤ f'_c ≤ 8,000 psi.
8 For structures assigned to Seismic Design Categories C, D, E, or F, bond stress values must be multiplied by $\alpha_{N,seis}$.

Table 76 — Hilti HIT-RE 500 V3 Core Drilled and roughened with TE-YRT Roughening Tool adhesive factored resistance with concrete / bond failure for threaded rod in uncracked concrete[1,2,3,4,5,6,7,8,9]

Nominal anchor diameter in.	Effective embedment in. (mm)	Tension N_r				Shear V_r			
		f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)	f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)
5/8	3-1/8 (79)	4,620 (20.6)	5,165 (23.0)	5,660 (25.2)	6,535 (29.1)	9,245 (41.1)	10,335 (46.0)	11,320 (50.4)	13,070 (58.1)
	5-5/8 (143)	11,160 (49.6)	12,480 (55.5)	13,670 (60.8)	15,785 (70.2)	22,320 (99.3)	24,955 (111.0)	27,335 (121.6)	31,565 (140.4)
	7-1/2 (191)	17,185 (76.4)	19,210 (85.5)	21,045 (93.6)	21,160 (94.1)	34,365 (152.9)	38,420 (170.9)	42,090 (187.2)	42,320 (188.2)
	12-1/2 (318)	35,265 (156.9)	35,265 (156.9)	35,265 (156.9)	35,265 (156.9)	70,535 (313.7)	70,535 (313.7)	70,535 (313.7)	70,535 (313.7)
3/4	3-1/2 (89)	5,480 (24.4)	6,125 (27.2)	6,710 (29.8)	7,745 (34.5)	10,955 (48.7)	12,250 (54.5)	13,420 (59.7)	15,495 (68.9)
	6-3/4 (171)	14,670 (65.3)	16,400 (73.0)	17,970 (79.9)	20,745 (92.3)	29,340 (130.5)	32,805 (145.9)	35,935 (159.8)	41,495 (184.6)
	9 (229)	22,585 (100.5)	25,255 (112.3)	27,665 (123.1)	29,365 (130.6)	45,175 (200.9)	50,505 (224.7)	55,325 (246.1)	58,735 (261.3)
	11-1/4 (286)	31,565 (140.4)	35,290 (157.0)	36,710 (163.3)	36,710 (163.3)	63,135 (280.8)	70,585 (314.0)	73,420 (326.6)	73,420 (326.6)
7/8	3-1/2 (89)	5,480 (24.4)	6,125 (27.2)	6,710 (29.8)	7,745 (34.5)	10,955 (48.7)	12,250 (54.5)	13,420 (59.7)	15,495 (68.9)
	7-7/8 (200)	18,485 (82.2)	20,670 (91.9)	22,640 (100.7)	26,145 (116.3)	36,975 (164.5)	41,340 (183.9)	45,285 (201.4)	52,290 (232.6)
	10-1/2 (267)	28,465 (126.6)	31,820 (141.6)	34,860 (155.1)	38,285 (170.3)	56,925 (253.2)	63,645 (283.1)	69,720 (310.1)	76,565 (340.6)
	17-1/2 (445)	61,240 (272.4)	63,805 (283.8)	63,805 (283.8)	63,805 (283.8)	122,485 (544.8)	127,610 (567.6)	127,610 (567.6)	127,610 (567.6)
1	4 (102)	6,690 (29.8)	7,480 (33.3)	8,195 (36.5)	9,465 (42.1)	13,385 (59.5)	14,965 (66.6)	16,395 (72.9)	18,930 (84.2)
	9 (229)	22,585 (100.5)	25,255 (112.3)	27,665 (123.1)	31,945 (142.1)	45,175 (200.9)	50,505 (224.7)	55,325 (246.1)	63,885 (284.2)
	12 (305)	34,775 (154.7)	38,880 (172.9)	42,590 (189.5)	48,040 (213.7)	69,550 (309.4)	77,760 (345.9)	85,180 (378.9)	96,085 (427.4)
	20 (508)	74,825 (332.8)	80,070 (356.2)	80,070 (356.2)	80,070 (356.2)	149,650 (665.7)	160,140 (712.3)	160,140 (712.3)	160,140 (712.3)
1-1/4	5 (127)	9,355 (41.6)	10,455 (46.5)	11,455 (51.0)	13,225 (58.8)	18,705 (83.2)	20,915 (93.0)	22,910 (101.9)	26,455 (117.7)
	11-1/4 (286)	31,565 (140.4)	35,290 (157.0)	38,660 (172.0)	44,640 (198.6)	63,135 (280.8)	70,585 (314.0)	77,320 (343.9)	89,285 (397.1)
	15 (381)	48,600 (216.2)	54,335 (241.7)	59,520 (264.8)	68,555 (304.9)	97,200 (432.4)	108,670 (483.4)	119,045 (529.5)	137,110 (609.9)
	25 (635)	104,570 (465.1)	114,255 (508.2)	114,255 (508.2)	114,255 (508.2)	209,140 (930.3)	228,515 (1016.5)	228,515 (1016.5)	228,515 (1016.5)

1 See Section 3.1.8 for explanation on development of load values.

2 See Section 3.1.8 to convert design strength value to ASD value.

3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.

4 Apply spacing, edge distance, and concrete thickness factors in tables 30 - 41 as necessary to the above values. Compare to the steel values in table 29. The lesser of the values is to be used for the design.

5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69.
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.

6 Tabular values are for dry concrete or water-saturated concrete conditions. Water-filled and submerged (under water) applications are not permitted for this hole preparation method.

7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.

8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λ_a as follows:
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.

9 Tabular values are for static loads only. Seismic design is not permitted for uncracked concrete.

Table 77 — Hilti HIT-RE 500 V3 Core Drilled and roughened with TE-YRT Roughening Tool adhesive factored resistance with concrete / bond failure for threaded rod in cracked concrete[1,2,3,4,5,6,7,8,9]

Nominal anchor diameter in.	Effective embedment in. (mm)	Tension N_r				Shear V_r			
		f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)	f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)
5/8	3-1/8 (79)	3,235 (14.4)	3,510 (15.6)	3,510 (15.6)	3,510 (15.6)	6,470 (28.8)	7,020 (31.2)	7,020 (31.2)	7,020 (31.2)
	5-5/8 (143)	6,320 (28.1)	6,320 (28.1)	6,320 (28.1)	6,320 (28.1)	12,640 (56.2)	12,640 (56.2)	12,640 (56.2)	12,640 (56.2)
	7-1/2 (191)	8,425 (37.5)	8,425 (37.5)	8,425 (37.5)	8,425 (37.5)	16,850 (75.0)	16,850 (75.0)	16,850 (75.0)	16,850 (75.0)
	12-1/2 (318)	14,045 (62.5)	14,045 (62.5)	14,045 (62.5)	14,045 (62.5)	28,085 (124.9)	28,085 (124.9)	28,085 (124.9)	28,085 (124.9)
3/4	3-1/2 (89)	3,835 (17.1)	4,285 (19.1)	4,690 (20.9)	4,690 (20.9)	7,670 (34.1)	8,575 (38.1)	9,385 (41.7)	9,385 (41.7)
	6-3/4 (171)	9,050 (40.2)	9,050 (40.2)	9,050 (40.2)	9,050 (40.2)	18,095 (80.5)	18,095 (80.5)	18,095 (80.5)	18,095 (80.5)
	9 (229)	12,065 (53.7)	12,065 (53.7)	12,065 (53.7)	12,065 (53.7)	24,130 (107.3)	24,130 (107.3)	24,130 (107.3)	24,130 (107.3)
	11-1/4 (286)	15,080 (67.1)	15,080 (67.1)	15,080 (67.1)	15,080 (67.1)	30,160 (134.2)	30,160 (134.2)	30,160 (134.2)	30,160 (134.2)
7/8	3-1/2 (89)	3,835 (17.1)	4,285 (19.1)	4,695 (20.9)	5,425 (24.1)	7,670 (34.1)	8,575 (38.1)	9,390 (41.8)	10,845 (48.2)
	7-7/8 (200)	12,245 (54.5)	12,245 (54.5)	12,245 (54.5)	12,245 (54.5)	24,490 (108.9)	24,490 (108.9)	24,490 (108.9)	24,490 (108.9)
	10-1/2 (267)	16,325 (72.6)	16,325 (72.6)	16,325 (72.6)	16,325 (72.6)	32,655 (145.2)	32,655 (145.2)	32,655 (145.2)	32,655 (145.2)
	17-1/2 (445)	27,210 (121.0)	27,210 (121.0)	27,210 (121.0)	27,210 (121.0)	54,420 (242.1)	54,420 (242.1)	54,420 (242.1)	54,420 (242.1)
1	4 (102)	4,685 (20.8)	5,240 (23.3)	5,740 (25.5)	6,625 (29.5)	9,370 (41.7)	10,475 (46.6)	11,475 (51.0)	13,250 (58.9)
	9 (229)	15,810 (70.3)	15,995 (71.1)	15,995 (71.1)	15,995 (71.1)	31,620 (140.7)	31,985 (142.3)	31,985 (142.3)	31,985 (142.3)
	12 (305)	21,325 (94.9)	21,325 (94.9)	21,325 (94.9)	21,325 (94.9)	42,650 (189.7)	42,650 (189.7)	42,650 (189.7)	42,650 (189.7)
	20 (508)	35,540 (158.1)	35,540 (158.1)	35,540 (158.1)	35,540 (158.1)	71,080 (316.2)	71,080 (316.2)	71,080 (316.2)	71,080 (316.2)
1-1/4	5 (127)	6,545 (29.1)	7,320 (32.6)	8,020 (35.7)	9,260 (41.2)	13,095 (58.2)	14,640 (65.1)	16,035 (71.3)	18,520 (82.4)
	11-1/4 (286)	22,095 (98.3)	23,695 (105.4)	23,695 (105.4)	23,695 (105.4)	44,195 (196.6)	47,395 (210.8)	47,395 (210.8)	47,395 (210.8)
	15 (381)	31,595 (140.5)	31,595 (140.5)	31,595 (140.5)	31,595 (140.5)	63,190 (281.1)	63,190 (281.1)	63,190 (281.1)	63,190 (281.1)
	25 (635)	52,660 (234.2)	52,660 (234.2)	52,660 (234.2)	52,660 (234.2)	105,320 (468.5)	105,320 (468.5)	105,320 (468.5)	105,320 (468.5)

1 See Section 3.1.8 for explanation on development of load values.

2 See Section 3.1.8 to convert design strength value to ASD value.

3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.

4 Apply spacing, edge distance, and concrete thickness factors in tables 30 - 41 as necessary to the above values. Compare to the steel values in table 29. The lesser of the values is to be used for the design.

5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69. 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.

6 Tabular values are for dry concrete or water-saturated concrete conditions. Water-filled and submerged (under water) applications are not permitted for this hole preparation method.
Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.

8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λa as follows:
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.

9 Tabular values are for static loads only. For seismic loads, multiply cracked concrete tabular values by α_{seis} indicated below. See section 3.1.8 for additional information on seismic applications.
5/8-in. diameter α_{seis}=0.71
3/4-in. diameter and larger - α_{seis} = 0.75

HIT-RE 500 V3 adhesive with HIS-(R)N Inserts

Table 78 — Hilti HIT-RE 500 V3 design information with Hilti HIS-N and HIS-RN internally threaded inserts in hammer drilled holes in accordance with CSA A23.3 Annex D[1,7]

	Design parameter	Symbol	Units	Nominal bolt/cap screw diameter (in.)				Ref
				3/8	1/2	5/8	3/4	A23.3-14
	HIS insert outside diameter	D	mm	16.5	20.5	25.4	27.6	
	Effective embedment[2]	h_{ef}	mm	110	125	170	205	
	Min. concrete thickness[2]	h_{min}	mm	150	170	230	270	
	Critical edge distance	c_{ac}	–	$2h_{ef}$				
	Minimum edge distance	c_{min}	mm	83	102	127	140	
	Minimum anchor spacing	s_{min}	mm	83	102	127	140	
	Coeff. for factored conc. breakout resistance, uncracked concrete[3]	$k_{c,uncr}$	–	10				D.6.2.2
	Coeff. for factored conc. breakout resistance, cracked concrete[3]	$k_{c,cr}$	–	7				D.6.2.2
	Concrete material resistance factor	ϕ_c	–	0.65				8.4.2
	Resistance modification factor for tension and shear, concrete failure modes, Condition B[5]	R_{conc}	–	1.00				D.5.3(c)
	Dry and water saturated concrete							
Temp. range A[5]	Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	1,070 (7.4)	1,070 (7.4)	1,070 (7.4)	1,070 (7.4)	D.6.5.2
Temp. range A[5]	Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	1,790 (12.3)	1,790 (12.3)	1,790 (12.3)	1,790 (12.3)	D.6.5.2
Temp. range B[5]	Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	740 (5.1)	740 (5.1)	740 (5.1)	740 (5.1)	D.6.5.2
Temp. range B[5]	Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	1,240 (8.6)	1,240 (8.6)	1,240 (8.6)	1,240 (8.6)	D.6.5.2
	Anchor category, dry concrete	–	–	1	1	1	1	
	Resistance modification factor	R_{dry}	–	1.00	1.00	1.00	1.00	
	Water-filled hole							
Temp. range A[5]	Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	800 (5.5)	810 (5.6)	820 (5.7)	820 (5.7)	D.6.5.2
Temp. range A[5]	Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	1,340 (9.2)	1,350 (9.3)	1,370 (9.4)	1,380 (9.5)	D.6.5.2
Temp. range B[5]	Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	550 (3.8)	560 (3.9)	570 (3.9)	570 (3.9)	D.6.5.2
Temp. range B[5]	Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	920 (6.3)	930 (6.4)	950 (6.6)	950 (6.6)	D.6.5.2
	Anchor category, water-filled hole	–	–	3	3	3	3	
	Resistance modification factor	R_{wf}	–	0.75	0.75	0.75	0.75	
	Underwater applications							
Temp. range A[5]	Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	710 (4.9)	720 (5.0)	750 (5.2)	750 (5.2)	D.6.5.2
Temp. range A[5]	Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	1,190 (8.2)	1,210 (8.3)	1,250 (8.6)	1,260 (8.7)	D.6.5.2
Temp. range B[5]	Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	490 (3.4)	500 (3.4)	510 (3.5)	520 (3.6)	D.6.5.2
Temp. range B[5]	Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	820 (5.7)	840 (5.8)	860 (5.9)	870 (6.0)	D.6.5.2
	Anchor category, underwater	–	–	3	3	3	3	
	Resistance modification factor	R_{uw}		0.75	0.75	0.75	0.75	
	Reduction for seismic tension	$\alpha_{N,seis}$	–	1.00	1.00	1.00	1.00	

1 Design information in this table is taken from ICC-ES ELC-3814, dated April 2018, tables 16 and 17, and converted for use with CSA A23.3 Annex D.

2 See figure 3 of this section.

3 For all design cases, $\psi_{c,N}$ = 1.0. The appropriate coefficient for breakout resistance for cracked concrete ($k_{c,cr}$) or uncracked concrete ($k_{c,uncr}$) must be used.

4 For use with the load combinations of CSA A23.3 chapter 8. Condition B applies where supplementary reinforcement in conformance with CSA A23.3 section D.5.3 is not provided, or where pullout or pryout strength governs. For cases where the presence of supplementary reinforcement can be verified, the resistance modification factors associated with Condition A may be used.

5 Temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
Temperature range B: Max. short term temperature = 176°F (80°C), max. 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.

6 Bond stress values corresponding to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond stress may be increased by a factor of $(f'_c/2{,}500)^{0.25}$ [for SI: $(f'_c/17.2)^{0.25}$]. for uncracked concrete and $(f'c/2{,}500)^{0.15}$ [for SI: $(f'c/17.2)^{0.15}$] for cracked concrete

7 For structures assigned to Seismic Design Categories C, D, E, or F, bond stress values must be multiplied by $\alpha_{N,seis}$.

3.2.3

Table 79 — Hilti HIT-RE 500 V3 design information with Hilti HIS-N and HIS-RN internally threaded inserts in diamond core drilled holes in accordance with CSA A23.3 Annex D[1]

Design parameter	Symbol	Units	Nominal bolt/cap screw diameter (in.) 3/8	1/2	5/8	3/4	Ref A23.3-14
HIS insert outside diameter	D	mm	16.5	20.5	25.4	27.6	
Effective embedment[2]	h_{ef}	mm	110	125	170	205	
Min. concrete thickness[2]	h_{min}	mm	150	170	230	270	
Critical edge distance	c_{ac}	–	$2h_{ef}$				
Minimum edge distance	c_{min}	mm	83	102	127	140	
Minimum anchor spacing	s_{min}	mm	83	102	127	140	
Coeff. for factored conc. breakout resistance, uncracked concrete[3]	$k_{c,uncr}$	–	10				D.6.2.2
Coeff. for factored conc. breakout resistance, cracked concrete[3]	$k_{c,cr}$	–	7				D.6.2.2
Concrete material resistance factor	ϕ_c	–	0.65				8.4.2
Resistance modification factor for tension and shear, concrete failure modes, Condition B[5]	R_{conc}	–	1.00				D.5.3(c)
Dry concrete							
Temp. range A[5] – Characteristic bond stress in uncracked concrete[6,7]	τ_{cr}	psi	1,200	1,200	1,200	1,200	D.6.5.2
		(MPa)	(8.3)	(8.3)	(8.3)	(8.3)	
Temp. range B[5] – Characteristic bond stress in uncracked concrete[6,7]	τ_{cr}	psi	830	830	830	830	D.6.5.2
		(MPa)	(5.7)	(5.7)	(5.7)	(5.7)	
Anchor category, dry concrete	–	–	3	3	3	3	
Resistance modification factor	R_{dry}	–	0.75	0.75	0.75	0.75	
Water saturated hole							
Temp. range A[5] – Characteristic bond stress in uncracked concrete[6,7]	τ_{cr}	psi	1,200	1,200	1,200	1,200	D.6.5.2
		(MPa)	(8.3)	(8.3)	(8.3)	(8.3)	
Temp. range B[5] – Characteristic bond stress in uncracked concrete[6,7]	τ_{cr}	psi	830	830	830	830	D.6.5.2
		(MPa)	(5.7)	(5.7)	(5.7)	(5.7)	
Anchor category, water-saturated conc.	–	–	3	3	3	3	
Resistance modification factor	R_{wf}	–	0.75	0.75	0.75	0.75	

1 Design information in this table is taken from ICC-ES ELC-3814, dated April 2018, tables 16 and 17, and converted for use with CSA A23.3 Annex D.
2 See figure 8 of section 3.2.4.3.6.
3 For all design cases, $\psi_{c,N}$ = 1.0. The appropriate coefficient for breakout resistance for cracked concrete ($k_{c,cr}$) or uncracked concrete ($k_{c,uncr}$) must be used.
4 For use with the load combinations of CSA A23.3 chapter 8. Condition B applies where supplementary reinforcement in conformance with CSA A23.3 section D.5.3 is not provided, or where pullout or pryout strength governs. For cases where the presence of supplementary reinforcement can be verified, the resistance modification factors associated with Condition A may be used.
5 Temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
Temperature range B: Max. short term temperature = 176°F (80°C), max. 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.
6 Bond stress values corresponding to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond stress may be increased by a factor of $(f'_c/2{,}500)^{0.25}$ [for SI: $(f'_c/17.2)^{0.25}$] for uncracked concrete.

Table 80 — Hilti HIT-RE 500 V3 adhesive factored resistance with concrete / bond failure for Hilti HIS-N and HIS-RN internally threaded inserts in uncracked concrete[1,2,3,4,5,6,7,8,9,11]

Thread size	Effective embedment in. (mm)	Tension N_r				Shear V_r			
		f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)	f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)
3/8-16 UNC	4-3/8 (110)	7,540 (33.5)	8,430 (37.5)	9,235 (41.1)	10,660 (47.4)	15,080 (67.1)	16,860 (75.0)	18,470 (82.1)	21,325 (94.9)
1/2-13 UNC[10]	5 (125)	9,135 (40.6)	10,210 (45.4)	11,185 (49.8)	12,915 (57.5)	18,265 (81.3)	20,420 (90.8)	22,370 (99.5)	25,830 (114.9)
5/8-11 UNC[10]	6-3/4 (170)	14,485 (64.4)	16,195 (72.0)	17,740 (78.9)	20,485 (91.1)	28,970 (128.9)	32,390 (144.1)	35,480 (157.8)	40,970 (182.2)
3/4-10 UNC[10]	8-1/8 (205)	19,180 (85.3)	21,445 (95.4)	23,490 (104.5)	27,125 (120.7)	38,360 (170.6)	42,890 (190.8)	46,985 (209.0)	54,255 (241.3)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8 to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 50 - 51 as necessary to the above values. Compare to the steel values in table 49. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C). For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69.
6 Tabular values are for dry concrete or water-saturated concrete conditions. For water-filled drilled holes multiply design strength by 0.52. For submerged (under water) applications multiply design strength by 0.46.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength (factored resistance) by λ_a as follows: For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for holes drilled in concrete with carbide tipped hammer drill bit. For diamond core drilling, except as indicated in note 10, multiply uncracked concrete tabular values by 0.57. Diamond core drilling is not permitted for the water-filled or under-water (submerged) applications.
10 Diamond core drilling with Hilti TE-YRT roughening tool is permitted for 1/2-13 UNC, 5/8-11 UNC, and 3/4-10 UNC anchors in dry and water-saturated concrete. See Table 83.
11 Tabular values are for static loads only. Seismic design is not permitted for uncracked concrete.

Table 81 — Hilti HIT-RE 500 V3 adhesive factored resistance with concrete / bond failure for Hilti HIS-N and HIS-RN internally threaded inserts in cracked concrete[1,2,3,4,5,6,7,8,9,11]

Thread size	Effective embedment in. (mm)	Tension N_r				Shear V_r			
		f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)	f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)
3/8-16 UNC	4-3/8 (110)	5,280 (23.5)	5,900 (26.2)	6,465 (28.8)	6,985 (31.1)	10,555 (47.0)	11,800 (52.5)	12,925 (57.5)	13,965 (62.1)
1/2-13 UNC[10]	5 (125)	6,395 (28.4)	7,150 (31.8)	7,830 (34.8)	9,040 (40.2)	12,785 (56.9)	14,295 (63.6)	15,660 (69.7)	18,080 (80.4)
5/8-11 UNC[10]	6-3/4 (170)	10,140 (45.1)	11,335 (50.4)	12,420 (55.2)	14,340 (63.8)	20,280 (90.2)	22,675 (100.9)	24,835 (110.5)	28,680 (127.6)
3/4-10 UNC[10]	8-1/8 (205)	13,425 (59.7)	15,010 (66.8)	16,445 (73.1)	18,990 (84.5)	26,855 (119.5)	30,025 (133.5)	32,890 (146.3)	37,975 (168.9)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8 to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 50-51 as necessary to the above values. Compare to the steel values in table 49. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130 (55°C), max. long term temperature = 110°F (43°C). For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69. 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.
6 Tabular values are for dry concrete or water-saturated concrete conditions. For water-filled drilled holes multiply design strength by 0.52. For submerged (under water) applications multiply design strength by 0.46.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength (factored resistance) by λ_a as follows: For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for holes drilled in concrete with carbide tipped hammer drill bit. Diamond core drilling is not permitted in cracked concrete except as indicated in note 10.
10 Diamond core drilling is permitted in cracked concrete with use of the Hilti TE-YRT roughening tool for 1/2-13 UNC, 5/8-11 UNC, and 3/4-10 UNC anchors in dry and water-saturated concrete. See Table 84.
11 Tabular values are for static loads only. For seismic loads, multiply cracked concrete tabular values by α_{seis} = 0.75. See section 3.1.8 for additional information on seismic applications.

Table 82 — Hilti HIT-RE 500 V3 design information with Hilti HIS-N and HIS-RN internally threaded inserts in core drilled holes roughened with the TE-YRT Roughening Tool in accordance with CSA A23.3 Annex D[1]

Design parameter		Symbol	Units	Nominal bolt/cap screw diameter (in.)			Ref
				1/2	5/8	3/4	A23.3-14
HIS insert outside diameter		D	mm	20.5	25.4	27.6	
Effective embedment[2]		h_{ef}	mm	125	170	205	
Min. concrete thickness[2]		h_{min}	mm	170	230	270	
Critical edge distance		c_{ac}	–	$2h_{ef}$			
Minimum edge distance		c_{min}	mm	102	127	140	
Minimum anchor spacing		s_{min}	mm	102	127	140	
Coeff. for factored conc. breakout resistance, uncracked concrete[3]		$k_{c,uncr}$	–	10			D.6.2.2
Coeff. for factored conc. breakout resistance, cracked concrete[3]		$k_{c,cr}$	–	7			D.6.2.2
Concrete material resistance factor		ϕ_c	–	0.65			8.4.2
Resistance modification factor for tension and shear, concrete failure modes, Condition B[5]		R_{conc}	–	1.00			D.5.3(c)
Dry and water saturated concrete							
Temp. range A[5]	Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	750 (5.2)	750 (5.2)	750 (5.2)	D.6.5.2
	Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	1,790 (12.3)	1,790 (12.3)	1,790 (12.3)	D.6.5.2
Temp. range B[5]	Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	515 (3.6)	515 (3.6)	515 (3.6)	D.6.5.2
	Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	1,240 (8.6)	1,240 (8.6)	1,240 (8.6)	D.6.5.2
Anchor category, dry concrete		-	-	1	1	1	
Resistance modification factor		R_{dry}	-	1.00	1.00	1.00	
Reduction for seismic tension		$\alpha_{N,seis}$	-	1.00	1.00	1.00	

1 Design information in this table is taken from ICC-ES ELC-3814, dated April 2018,, table 29, and converted for use with CSA A23.3 Annex D.
2 See figure 8 of section 3.2.4.3.6.
3 For all design cases, $\psi_{c,N}$ = 1.0. The appropriate coefficient for breakout resistance for cracked concrete ($k_{c,cr}$) or uncracked concrete ($k_{c,uncr}$) must be used.
4 For use with the load combinations of CSA A23.3 chapter 8. Condition B applies where supplementary reinforcement in conformance with CSA A23.3 section D.5.3 is not provided, or where pullout or pryout strength governs. For cases where the presence of supplementary reinforcement can be verified, the resistance modification factors associated with Condition A may be used.
5 Temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
Temperature range B: Max. short term temperature = 176°F (80°C), max. 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.
6 Bond stress values correspond to concrete compressive strength in the range 2,500 psi ≤ f'_c ≤ 8,000 psi.
7 For structures assigned to Seismic Design Categories C, D, E, or F, bond stress values must be multiplied by $\alpha_{N,seis}$.

Table 83 — Hilti HIT-RE 500-V3 adhesive core drilled and roughened with TE-YRT Roughening Tool factored resistance with concrete / bond failure for Hilti HIS-N and HIS-RN internally threaded inserts in uncracked concrete[1,2,3,4,5,6,7,8]

Thread size	Effective embedment in. (mm)	Tension N_r				Shear V_r			
		f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)	f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)
1/2-13 UNC	5 (125)	9,135 (40.6)	10,210 (45.4)	11,185 (49.8)	12,915 (57.5)	18,265 (81.3)	20,420 (90.8)	22,370 (99.5)	25,830 (114.9)
5/8-11 UNC	6-3/4 (170)	14,485 (64.4)	16,195 (72.0)	17,740 (78.9)	20,485 (91.1)	28,970 (128.9)	32,390 (144.1)	35,480 (157.8)	40,970 (182.2)
3/4-10 UNC	8-1/8 (205)	19,180 (85.3)	21,445 (95.4)	23,490 (104.5)	27,125 (120.7)	38,360 (170.6)	42,890 (190.8)	46,985 (209.0)	54,255 (241.3)

Table 84 — Hilti HIT-RE 500 V3 adhesive core drilled and roughened with TE-YRT Roughening Tool factored resistance with concrete / bond failure for Hilti HIS-N and HIS-RN internally threaded inserts in cracked concrete[1,2,3,4,5,6,7,8,9]

Thread size	Effective embedment in. (mm)	Tension N_r				Shear V_r			
		f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)	f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)
1/2-13 UNC	5 (125)	6,105 (27.2)	6,105 (27.2)	6,105 (27.2)	6,105 (27.2)	12,215 (54.3)	12,215 (54.3)	12,215 (54.3)	12,215 (54.3)
5/8-11 UNC	6-3/4 (170)	10,140 (45.1)	10,255 (45.6)	10,255 (45.6)	10,255 (45.6)	20,280 (90.2)	20,505 (91.2)	20,505 (91.2)	20,505 (91.2)
3/4-10 UNC	8-1/8 (205)	13,425 (59.7)	13,475 (59.9)	13,475 (59.9)	13,475 (59.9)	26,855 (119.5)	26,955 (119.9)	26,955 (119.9)	26,955 (119.9)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8 to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 50 - 51 as necessary to the above values. Compare to the steel values in table 49. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69.
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.
6 Tabular values are for dry concrete or water-saturated concrete conditions. Water-filled and submerged (under water) applications are not permitted for this hole preparation method.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength (factored resistance) by λ_a as follows:
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for static loads only. For seismic loads, multiply cracked concrete tabular values by α_{seis} = 0.75. See section 3.1.8 for additional information on seismic applications.

Table 85 — Steel factored resistance for steel bolt/cap screw for Hilti HIS-N and HIS-RN internally threaded inserts[1,2,3]

Thread size	ASTM A193 B7			ASTM A193 Grade B8M Stainless Steel		
	Tensile[4] N_{sar} lb (kN)	Shear[5] V_{sar} lb (kN)	Seismic Shear[6] $V_{sar,eq}$ lb (kN)	Tensile[4] N_{sar} lb (kN)	Shear[5] V_{sar} lb (kN)	Seismic Shear[6] $V_{sar,eq}$ lb (kN)
3/8-16 UNC	5,765 (25.6)	3,215 (14.3)	2,250 (10.0)	5,070 (22.6)	2,825 (12.6)	1,975 (8.8)
1/2-13 UNC	9,635 (42.9)	5,880 (26.2)	4,115 (18.3)	9,290 (41.3)	5,175 (23.0)	3,620 (16.1)
5/8-11 UNC	16,020 (71.3)	9,365 (41.7)	6,555 (29.2)	14,790 (65.8)	8,240 (36.7)	5,770 (25.7)
3/4-10 UNC	16,280 (72.4)	13,860 (61.7)	9,700 (43.1)	21,895 (97.4)	12,195 (54.2)	8,535 (38.0)

1 See Section 3.1.8 to convert design strength value to ASD value.
2 Hilti HIS-N and HIS-RN inserts with steel bolts are considered brittle steel elements.
3 Table values are the lesser of steel failure in the HIS-N insert or inserted steel bolt.
4 Tensile = $A_{se,N}$ ϕ_s f_{uta} R as noted in CSA A23.3 Annex D
5 Shear = $A_{se,V}$ ϕ_s 0.60 f_{uta} R as noted in CSA A23.3 Annex D. For 3/8-in diameter insert, shear = $A_{se,V}$ ϕ_s 0.50 f_{uta} R.
6 Seismic Shear = $\alpha_{V,seis}$ V_{sar} : Reduction factor for seismic shear only. See section 3.1.8 for additional information on seismic applications.

POST-INSTALLED REBAR DESIGN IN CONCRETE PER ACI 318

3.2.4.3.8 Development and splicing of post-installed reinforcement

Calculations for post-installed rebar for typical development lengths may be done according to ACI 318 Chapter 25 (formerly ACI 318-11 Chapter 12) and CSA A23.3 Chapter 12 for adhesive anchors tested and approved in accordance with AC 308. This section contains tables for the data provided in ICC Evaluation Services ESR-3814. Refer to section 3.1.14 and the Hilti North America Post-Installed Reinforcing Bar Guide for the design method.

Table 86 — Calculated tension development and Class B Splice lengths for Grade 60 bars in walls, slabs, columns, and footings per ACI 318 Chapter 25 for Hilti HIT-RE 500 V3

				f'_c = 2,500 psi		f'_c = 3,000 psi		f'_c = 4,000 psi		f'_c = 6,000 psi	
Rebar size	$\frac{c_b + K_{tr}}{d_b}$	min. edge dist. in.[1]	min. spacing in.[2]	ℓ_d in.	Class B splice in.	ℓ_d in.	Class B splice in.	ℓ_d in.	Class B splice in.	ℓ_d in.	Class B splice in.
#3	2.5	2-1/4	2	12	14	12	13	12	12	12	12
#4		2-3/4	2-1/2	14	19	13	17	12	15	12	12
#5		3	3-1/4	18	23	16	21	14	18	12	15
#6		3-3/4	3-3/4	22	28	20	26	17	22	14	18
#7		4-1/2	4-1/2	32	41	29	37	25	32	20	26
#8		5	5	36	47	33	43	28	37	23	30
#9		5-1/4	5-3/4	41	53	37	48	32	42	26	34
#10		5-3/4	6-1/2	46	59	42	54	36	47	30	38

1 Edge distances are determined using the minimum cover specified by ESR-3814 with an additional 6% of the development length per suggestions for drilling without an aid per Hilti Post-Installed Reinforcing Bar Guide Section 3.3. Smaller edge distances may be possible, for which development and splice lengths may need to be recalculated. For further information on required cover see ACI 318, Sec. 20.6.1.3.1; see Sec. 2.2 for determination of c_b.
2 Spacing values represent those producing c_b =5 d_b rounded up to the nearest 1/4 in. Smaller spacing values may be possible, for which development and splice lengths may need to be recalculated. For further information on required spacing see ACI 318 Sec. 25.2; see Sec. 2.2 for determination of c_b.
3 ψ_t = 1.0 See ACI 318, Sec. 25.4.2.4.
4 ψ_e = 1.0 for non-epoxy coated bars. See ACI 318, Sec. 25.4.2.4.
5 ψ_s = 0.8 for #6 bars and smaller bars, 1.0 for #7 and larger bars. See ACI 318, Sec. 25.4.2.4.
6 Values are for normal weight concrete. For sand-lightweight concrete, multiply development and splice lengths by 1.18, for all-lightweight concrete multiply development and splice lengths by 1.33. See ACI 318 Sec. 19.2.4.
7 Development and splice length values are for static design. Seismic design development and splice lengths can be found in ACI 318 18.8.5 for special moment frames and ACI 318 18.10.2.3 for special structural walls. For further information about reinforcement in seismic design, see ACI 318 Ch. 18.
8 Refer to the Hilti North America Post-Installed Reinforcing Bar Guide for further explanation, background information, and design examples.

Table 87 — Suggested embedment, edge distance, and spacing (see figure below) to develop 125% of f_y in Grade 60 bars based on ACI 318 Chapter 17 - SDC A and B only[1,2,3,4,5,6,7]

	f'_c = 2,500 psi				f'_c = 3,000 psi				f'_c = 4,000 psi				f'_c = 6,000 psi			
	Effective embed.	Minimum edge dist $c_{a,min}$ in.		Min. spacing	Effective embed.	Minimum edge dist $c_{a,min}$ in.		Min. spacing	Effective embed.	Minimum edge dist $c_{a,min}$ in.		Min. spacing	Effective embed.	Minimum edge dist $c_{a,min}$ in.		Min. spacing
Rebar size	h_{ef} in.	Cond. I	Cond. II	s_{min} in.	h_{ef} in.	Cond. I	Cond. II	s_{min} in.	h_{ef} in.	Cond. I	Cond. II	s_{min} in.	h_{ef} in.	Cond. I	Cond. II	s_{min} in.
#3	7	17	8	15	6	16	7	14	6	16	7	13	5	15	6	11
#4	9	23	11	22	9	23	11	21	8	22	10	19	7	20	9	17
#5	11	29	15	29	11	28	14	28	10	27	13	25	9	25	11	22
#6	13	35	19	37	13	34	18	35	12	32	16	32	11	30	14	28
#7	16	41	23	45	15	40	22	43	14	38	20	39	13	36	17	34
#8	18	48	27	54	17	46	26	51	16	44	24	47	15	42	21	41
#9	21	56	32	63	20	54	30	60	18	50	27	54	17	47	24	48
#10	25	65	37	74	24	63	35	70	22	58	32	64	19	54	28	56

1 For additional information see May-June 2013 issue of the ACI Structural Journal, "Recommended Procedures for Development and Splicing of Post-Installed Bonded Reinforcing Bars in Concrete Structures" by Charney, Pal and Silva.
2 h_{ef} is the calculated bar embedment based on uncracked bond and concrete breakout strengths using equations in section 3.1.14 to develop 125% of nominal bar yield. Bond stresses apply for sustained and non-sustained load conditions. Additional reductions per ACI 318, 17.3.1.2 are not included, however, and as such these embedments are not intended for sustained tension load applications. The particular assumptions used for the application of anchor theory to bar development (e.g., bar yield and bond strength values) are a matter of engineering judgment and will in part depend on the specific circumstances of the design. For embedments corresponding to nominal yield (i.e., no overstrength) multiply the unbolded and bolded tabulated hef values by 0.80 and 0.86, respectively. Reduction factors for non-sustained loading and no bar overstrength may be combined.
3 c_a and s are the minimum edge distance and bar spacing (from bar centerline) associated with the tabulated embedments. Refer to sec. 3.1.14 for applicability of edge distance "Condition I" and "Condition II."
4 Applicable for hammer-drilled holes. For rock-drilled and core-drilled holes, contact Hilti.
5 Values determined with bond stresses, k-factors and strength reduction factors taken from ESR-3814 Tables 12 and 13 assuming dry, uncracked concrete conditions where concrete temperatures will not exceed a maximum short-term temperature of 130°F (55°C) and long-term temperature of 110°F (43°C). Bond stresses are for static (non-seismic) loading conditions.
6 Values are for normal weight concrete. For lightweight concrete contact Hilti.
7 Refer to the Hilti North America Post-Installed Reinforcing Bar Guide for further explanation, background information, and design examples. See Hilti Instructions for Use (IFU) for specific installation requirements.

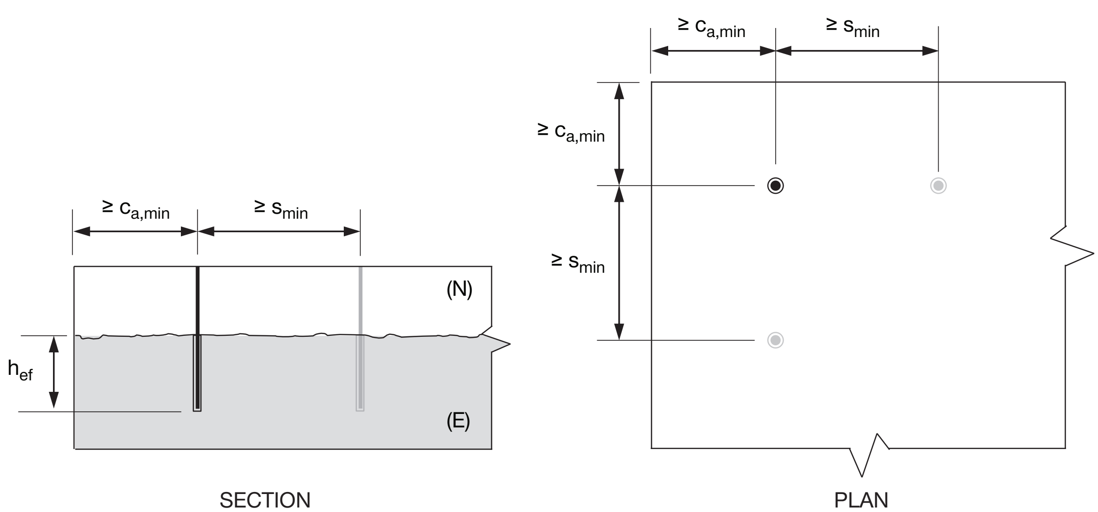


Illustration of Table 87 dimensions

3.2.3

Table 88 — Suggested embedment and edge distance (see figure below) based on ACI 318 Chapter 17 to develop 125% of f_y in Grade 60 wall/column starter bars in a linear array with bar spacing = 24 inches - SDC A and B only[1,2,3,4,5,6]

Rebar size	Linear spacing s in.	f'_c = 2,500 psi			f'_c = 3,000 psi			f'_c = 4,000 psi			f'_c = 6,000 psi		
		Effective embed. h_{ef} in.	Minimum edge dist $c_{a,min}$ in.		Effective embed. h_{ef} in.	Minimum edge dist $c_{a,min}$ in.		Effective embed. h_{ef} in.	Minimum edge dist $c_{a,min}$ in.		Effective embed. h_{ef} in.	Minimum edge dist $c_{a,min}$ in.	
			Cond. I	Cond. II		Cond. I	Cond. II		Cond. I	Cond. II		Cond. I	Cond. II
#3	24	7	17	8	6	16	7	6	16	7	5	15	6
#4		9	23	11	9	23	11	8	22	10	7	20	9
#5		13	34	19	11	30	17	10	27	13	9	25	11
#6		21	57	32	19	51	28	15	43	23	11	32	17
#7		–	–	–	–	–	–	24	66	35	18	52	27

1 h_{ef} is the calculated bar embedment based on uncracked bond and concrete breakout strengths using equations in section 3.1.14.4 to develop 125% of nominal bar yield. Shaded embedment values exceed 20 bar diameters. For non-tabulated rebar sizes, design per development length provisions is recommended. The particular assumptions used for the application of anchor theory to bar development (e.g., bar yield and bond strength values) are a matter of engineering judgment and will in part depend on the specific circumstances of the design. For embedments corresponding to nominal yield (i.e., no overstrength) multiply the tabulated hef values by 0.86.

2 c_a is the minimum edge distance (from bar centerline) associated with the tabulated embedments and s = 24 in. Refer to sec. 3.1.14.3 for applicability of edge distance “Condition I” and “Condition II.”

3 Applicable for hammer-drilled holes. For rock-drilled and core-drilled holes, contact Hilti.

4 Values determined with bond stresses, k-factors and strength reduction factors taken from ESR-3814 Tables 12 and 13 assuming dry concrete conditions where concrete temperatures will not exceed a maximum short-term temperature of 130°F (55°C) and long-term temperature of 110°F (43°C). Bond stresses are for static (non-seismic) loading conditions.

5 Values are for normal weight concrete. For lightweight concrete contact Hilti.

6 Refer to the Hilti North America Post-Installed Reinforcing Bar Guide for detailed explanation, background information, and design examples. See Hilti Instructions for Use (IFU) for specific installation requirements.

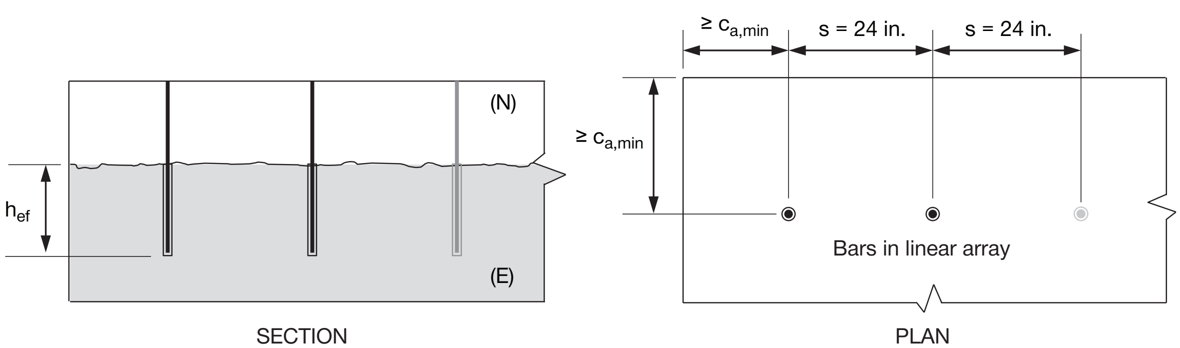


Illustration of Table 88 dimensions

Table 89 — Suggested embedment and edge distance (see figure below) based on ACI 318 Chapter 17 to develop 125% of fy in Grade 60 wall/column starter bars in a linear array with bar spacing = 18 inches - SDC A and B only[1,2,3,4,5,6]

Rebar size	Linear spacing s in.	f'_c = 2,500 psi			f'_c = 3,000 psi			f'_c = 4,000 psi			f'_c = 6,000 psi		
		Effective embed. h_{ef} in.	Minimum edge dist $c_{a,min}$ in.		Effective embed. h_{ef} in.	Minimum edge dist $c_{a,min}$ in.		Effective embed. h_{ef} in.	Minimum edge dist $c_{a,min}$ in.		Effective embed. h_{ef} in.	Minimum edge dist $c_{a,min}$ in.	
			Cond. I	Cond. II		Cond. I	Cond. II		Cond. I	Cond. II		Cond. I	Cond. II
#3	18	7	17	8	6	16	7	6	16	7	5	15	6
#4		10	26	14	9	23	13	8	22	10	7	20	9
#5		-	-	-	-	-	-	13	36	19	10	28	14

1 h_{ef} is the calculated bar embedment based on uncracked bond and concrete breakout strengths using equations in section 3.1.14.4 to develop 125% of nominal bar yield. Shaded embedment values exceed 20 bar diameters. For non-tabulated rebar sizes, design per development length provisions is recommended. The particular assumptions used for the application of anchor theory to bar development (e.g., bar yield and bond strength values) are a matter of engineering judgment and will in part depend on the specific circumstances of the design. For embedments corresponding to nominal yield (i.e., no overstrength) multiply the tabulated hef values by 0.86.
2 c_a is the minimum edge distance (from bar centerline) associated with the tabulated embedments and s = 18 in. Refer to sec. 3.1.14.3 for applicability of edge distance “Condition I” and “Condition II.”
3 Applicable for hammer-drilled holes. For rock-drilled and core-drilled holes, contact Hilti.
4 Values determined with bond stresses, k-factors and strength reduction factors taken from ESR-3814 Tables 12 and 13 assuming dry concrete conditions where concrete temperatures will not exceed a maximum short-term temperature of 130°F (55°C) and long-term temperature of 110°F (43°C). Bond stresses are for static (non-seismic) loading conditions.
5 Values are for normal weight concrete. For lightweight concrete contact Hilti.
6 Refer to the Hilti North America Post-Installed Reinforcing Bar Guide for detailed explanation, background information, and design examples. See Hilti Instructions for Use (IFU) for specific installation requirements.

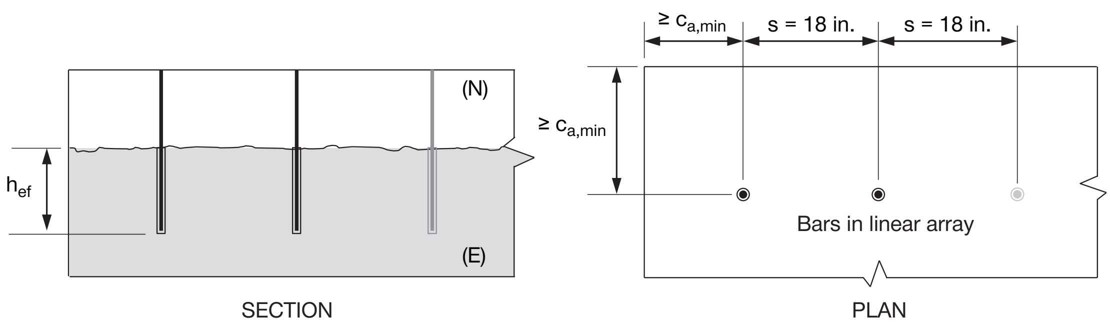


Illustration of Table 89 dimensions

Table 90 — Suggested embedment and edge distance (see figure below) based on ACI 318 Chapter 17 to develop 125% of f_y in Grade 60 wall/column starter bars in a linear array with bar spacing = 12 inches - SDC A and B only[1,2,3,4,5,6]

Rebar size	Linear spacing s in.	f'_c = 2,500 psi			f'_c = 3,000 psi			f'_c = 4,000 psi			f'_c = 6,000 psi		
		Effective embed. h_{ef} in.	Minimum edge dist $c_{a,min}$ in. Cond. I	Minimum edge dist $c_{a,min}$ in. Cond. II	Effective embed. h_{ef} in.	Minimum edge dist $c_{a,min}$ in. Cond. I	Minimum edge dist $c_{a,min}$ in. Cond. II	Effective embed. h_{ef} in.	Minimum edge dist $c_{a,min}$ in. Cond. I	Minimum edge dist $c_{a,min}$ in. Cond. II	Effective embed. h_{ef} in.	Minimum edge dist $c_{a,min}$ in. Cond. I	Minimum edge dist $c_{a,min}$ in. Cond. II
#3	12	7	17	10	6	16	9	6	16	7	5	15	6
#4		–	–	–	–	–	–	11	31	16	8	24	12

1 h_{ef} is the calculated bar embedment based on uncracked bond and concrete breakout strengths using equations in section 3.1.14.4 to develop 125% of nominal bar yield. Shaded embedment values exceed 20 bar diameters. For non-tabulated rebar sizes, design per development length provisions is recommended. The particular assumptions used for the application of anchor theory to bar development (e.g., bar yield and bond strength values) are a matter of engineering judgment and will in part depend on the specific circumstances of the design. For embedments corresponding to nominal yield (i.e., no overstrength) multiply the tabulated hef values by 0.86.
2 c_a is the minimum edge distance (from bar centerline) associated with the tabulated embedments and s = 12 in. Refer to sec. 3.1.14.3 for applicability of edge distance "Condition I" and "Condition II."
3 Applicable for hammer-drilled holes. For rock-drilled and core-drilled holes, contact Hilti.
4 Values determined with bond stresses, k-factors and strength reduction factors taken from ESR-3814 Tables 12 and 13 assuming dry concrete conditions where concrete temperatures will not exceed a maximum short-term temperature of 130°F (55°C) and long-term temperature of 110°F (43°C). Bond stresses are for static (non-seismic) loading conditions.
5 Values are for normal weight concrete. For lightweight concrete contact Hilti.
6 Refer to the Hilti North America Post-Installed Reinforcing Bar Guide for detailed explanation, background information, and design examples. See Hilti Instructions for Use (IFU) for specific installation requirements.

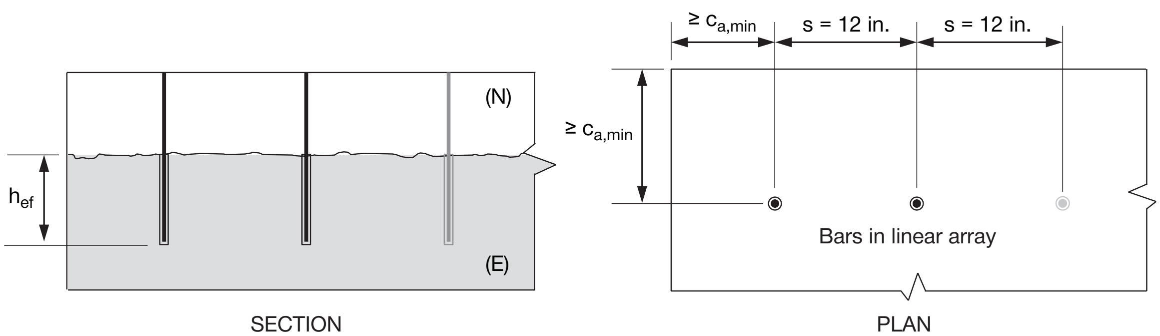


Illustration of Table 90 dimensions

Table 91 — Calculated tension development and Class B Splice lengths for Canadian 400 MPa bars in walls, slabs, columns, and footings per CSA 23.3-14 for Hilti HIT-RE 500 V3 - non-seismic design only[3,4,5,6,7,8]

Rebar size	$d_{cs} + K_{tr}$	min. edge dist. mm[1]	min. spacing mm[2]	f'_c = 20 MPa		f'_c = 25 MPa		f'_c = 30 MPa		f'_c = 40 MPa	
				ℓ_d mm	Class B splice mm	ℓ_d mm	Class B splice mm	ℓ_d mm	Class B splice mm	ℓ_d mm	Class B splice mm
10M	2.5 d_b	60	50	300	380	300	340	300	310	300	300
15M		70	75	410	540	370	480	340	440	300	380
20M		80	100	510	660	450	490	410	540	360	460
25M		120	125	820	1,060	730	950	670	870	580	750
30M		130	150	960	1,250	860	1,120	790	1,020	680	890

1 Edge distances are determined using the minimum cover specified by ESR-3184 with an additional 6% of the development length per suggestions for drilling without an aid per Hilti Post-Installed Reinforcing Bar Guide Section 3.3. Smaller edge distances may be possible, for which development and splice lengths may need to be recalculated. For further information on required cover see CSA A23.1-14 Table 17; see Sec. 3.2 for determination of d_{cs}.
2 Spacing values represent those producing $d_{cs} = 5d_b$. Smaller spacing values may be possible, for which development and splice lengths may need to be recalculated. For further information on required spacing see CSA A23.1 Sec. 6.6.5.2; see Sec. 3.2 for determination of d_{cs}.
3 k_1 and k_2 as defined by CSA A23.3 12.2.4 (a) and (b), are taken as 1.0 for post-installed reinforcing bars. For additional information see May-June 2013 issue of the ACI Structural Journal, "Recommended Procedures for Development and Splicing of Post-Installed Bonded Reinforcing Bars in Concrete Structures" by Charney, Pal and Silva.
4 k_4 = 0.8 for 20M bars and smaller bars, 1.0 for 25M and larger bars. See CSA A23.3 12.2.4 (d).
5 K_{tr} is assumed to equal zero.
6 Values are for normal weight concrete. For lightweight concrete, multiply development and splice lengths by 1.3.
7 Development and splice length values are for static design. For tension development and splice lengths of bars in joints, see CSA A23.3 21.3.3.5. For further information about reinforcement in seismic design, see CSA A23.3 Ch. 21.
8 Refer to the Hilti North America Post-Installed Reinforcing Bar Guide for further explanation, background information, and design examples.

Table 92 — Suggested embedment, edge distance, and spacing (see figure below) to develop 125% of f_y in Canadian 400 MPa bars based on CSA 23.3-14 Annex D - non-seismic design only[1,2,3,4,5,6,7]

Rebar size	f'_c = 20 MPa				f'_c = 25 MPa				f'_c = 30 MPa				f'_c = 40 MPa			
	Effective embed. h_{ef} mm	Minimum edge dist $c_{a,min}$ in.		Min. spacing s_{min} mm	Effective embed. h_{ef} mm	Minimum edge dist $c_{a,min}$ in.		Min. spacing s_{min} mm	Effective embed. h_{ef} mm	Minimum edge dist $c_{a,min}$ in.		Min. spacing s_{min} mm	Effective embed. h_{ef} mm	Minimum edge dist $c_{a,min}$ in.		Min. spacing s_{min} mm
		Cond. I	Cond. II			Cond. I	Cond. II			Cond. I	Cond. II			Cond. I	Cond. II	
10M	180	480	220	440	170	470	200	400	160	450	190	380	150	430	180	350
15M	260	690	350	690	240	670	320	640	230	650	300	600	220	620	280	550
20M	310	850	450	900	300	820	420	840	280	800	400	790	270	760	360	720
25M	420	1,140	630	1,260	400	1,080	590	1,170	380	1,050	560	1,110	350	1,000	500	1,000
30M	530	1,420	790	1,580	490	1,340	740	1,470	460	1,280	690	1,380	420	1,200	630	1,260

1 For additional information see May-June 2013 issue of the ACI Structural Journal, "Recommended Procedures for Development and Splicing of Post-Installed Bonded Reinforcing Bars in Concrete Structures" by Charney, Pal and Silva.

2 h_{ef} is the calculated bar embedment based on uncracked bond and concrete breakout strengths using equations in section 3.1.14.3 to develop 125% of nominal bar yield. Bond stresses apply for sustained and non-sustained load conditions. Additional reductions per ACI 318, 17.3.1.2 are not included, however, and as such these embedments are not intended for sustained tension load applications. The particular assumptions used for the application of anchor theory to bar development (e.g., bar yield and bond strength values) are a matter of engineering judgment and will in part depend on the specific circumstances of the design. For embedments corresponding to nominal yield (i.e., no overstrength) multiply the unbolded and bolded tabulated hef values by 0.80 and 0.86, respectively. Reduction factors for non-sustained loading and no bar overstrength may be combined.

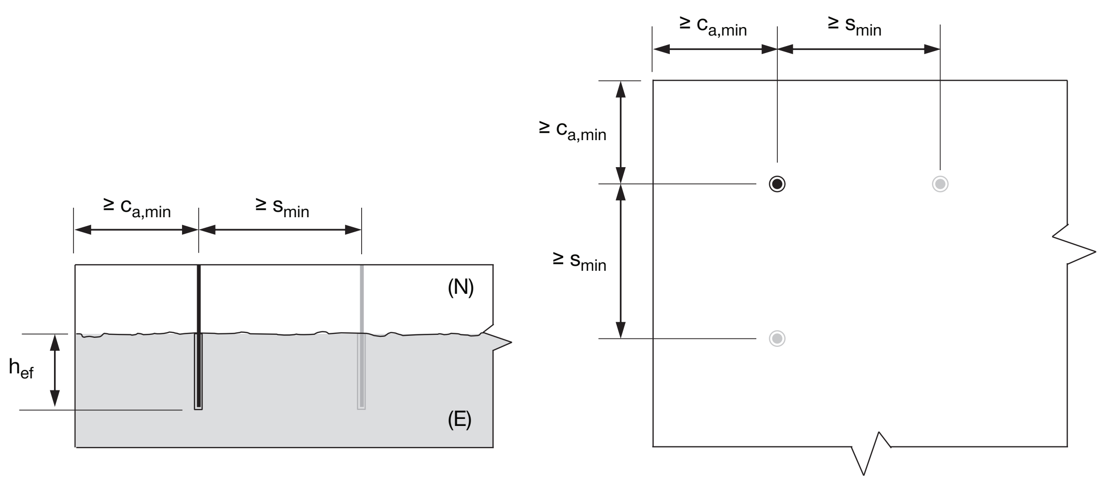
3 c_a and s are the minimum edge distance and bar spacing (from bar centerline) associated with the tabulated embedments. Refer to sec. 3.1.14.3 for applicability of edge distance "Condition I" and "Condition II."

4 Applicable for hammer-drilled holes. For rock-drilled and core-drilled holes, contact Hilti.

5 Values determined with bond stresses, k-factors and strength reduction factors taken from ESR-3814 Tables 12 and 13 assuming dry, uncracked concrete conditions where concrete temperatures will not exceed a maximum short-term temperature of 130°F (55°C) and long-term temperature of 110°F (43°C). Bond stresses are for static (non-seismic) loading conditions.

6 Values are for normal weight concrete. For lightweight concrete contact Hilti.

7 Refer to the Hilti North America Post-Installed Reinforcing Bar Guide for further explanation, background information, and design examples. See Hilti Instructions for Use (IFU) for specific installation requirements.



SECTION PLAN

Illustration of Table 91 dimensions

Table 93 — Suggested embedment and edge distance (see figure below) based on CSA 23.3 Annex D to develop 125% of f_y in Canadian 400 MPa wall/column starter bars in a linear array with bar spacing = 600 mm - non-seismic only[1,2,3,4,5]

Rebar size	Linear spacing s mm	f'_c = 20 MPa			f'_c = 25 MPa			f'_c = 30 MPa			f'_c = 40 MPa		
		Effective embed. h_{ef} mm	Minimum edge dist $c_{a,min}$ mm		Effective embed. h_{ef} mm	Minimum edge dist $c_{a,min}$ mm		Effective embed. h_{ef} mm	Minimum edge dist $c_{a,min}$ mm		Effective embed. h_{ef} mm	Minimum edge dist $c_{a,min}$ mm	
			Cond. I	Cond. II		Cond. I	Cond. II		Cond. I	Cond. II		Cond. I	Cond. II
10M	600	180	480	220	170	470	200	160	450	190	150	430	180
15M		280	760	420	240	670	350	230	650	300	220	620	280
20M		–	–	–	430	1,220	650	380	1,080	570	310	890	460

1 h_{ef} is the calculated bar embedment based on uncracked bond and concrete breakout strengths using equations in section 3.1.14.4 to develop 125% of nominal bar yield. Shaded embedment values exceed 20 bar diameters. For non-tabulated rebar sizes, design per development length provisions is recommended. The particular assumptions used for the application of anchor theory to bar development (e.g., bar yield and bond strength values) are a matter of engineering judgment and will in part depend on the specific circumstances of the design. For embedments corresponding to nominal yield (i.e., no overstrength) multiply the tabulated hef values by 0.86.
2 c_a is the minimum edge distance (from bar centerline) associated with the tabulated embedments and s = 600 mm. Refer to sec. 3.1.14.3 for applicability of edge distance "Condition I" and "Condition II."
3 Values determined with bond stresses, k-factors and strength reduction factors taken from ESR-3814, Tables 12 and 13 assuming dry, uncracked concrete conditions where concrete temperatures will not exceed a maximum short-term temperature of 130°F (55°C) and long-term temperature of 110°F (43°C). Bond stresses are for static (non-seismic) loading conditions.
4 Values are for normal weight concrete. For lightweight concrete contact Hilti.
5 Refer to the Hilti North America Post-Installed Reinforcing Bar Guide for further explanation, background information, and design examples. See Hilti Instructions for Use (IFU) for specific installation requirements.

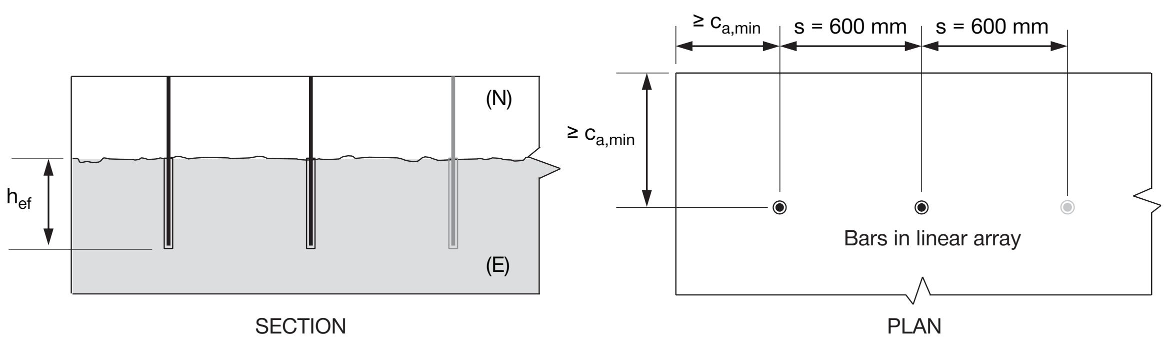


Illustration of Table 93 dimensions

3.2.3

Table 94 — Suggested embedment and edge distance (see figure below) based on CSA 23.3 Annex D to develop 125% of f_y in Canadian 400 MPa wall/column starter bars in a linear array with bar spacing = 450 mm - non-seismic only[1,2,3,4,5]

Rebar size	Linear spacing s mm	f'_c = 20 MPa			f'_c = 25 MPa			f'_c = 30 MPa			f'_c = 40 MPa		
		Effective embed. h_{ef} mm	Minimum edge dist $c_{a,min}$ mm		Effective embed. h_{ef} mm	Minimum edge dist $c_{a,min}$ mm		Effective embed. h_{ef} mm	Minimum edge dist $c_{a,min}$ mm		Effective embed. h_{ef} mm	Minimum edge dist $c_{a,min}$ mm	
			Cond. I	Cond. II		Cond. I	Cond. II		Cond. I	Cond. II		Cond. I	Cond. II
10M	450	180	480	220	170	470	200	160	450	190	150	430	180
15M		400	1,090	590	340	950	510	300	840	440	240	690	360

1 h_{ef} is the calculated bar embedment based on uncracked bond and concrete breakout strengths using equations in section 3.1.14.4 to develop 125% of nominal bar yield. Shaded embedment values exceed 20 bar diameters. For non-tabulated rebar sizes, design per development length provisions is recommended. The particular assumptions used for the application of anchor theory to bar development (e.g., bar yield and bond strength values) are a matter of engineering judgment and will in part depend on the specific circumstances of the design. For embedments corresponding to nominal yield (i.e., no overstrength) multiply the tabulated hef values by 0.86.

2 c_a is the minimum edge distance (from bar centerline) associated with the tabulated embedments and s = 450 mm. Refer to sec. 3.1.14.3 for applicability of edge distance “Condition I” and “Condition II.”

3 Values determined with bond stresses, k-factors and strength reduction factors taken from ESR-3814, Tables 12 and 13 assuming dry, uncracked concrete conditions where concrete temperatures will not exceed a maximum short-term temperature of 130°F (55°C) and long-term temperature of 110°F (43°C). Bond stresses are for static (non-seismic) loading conditions.

4 Values are for normal weight concrete. For lightweight concrete contact Hilti.

5 Refer to the Hilti North America Post-Installed Reinforcing Bar Guide for further explanation, background information, and design examples. See Hilti Instructions for Use (IFU) for specific installation requirements.

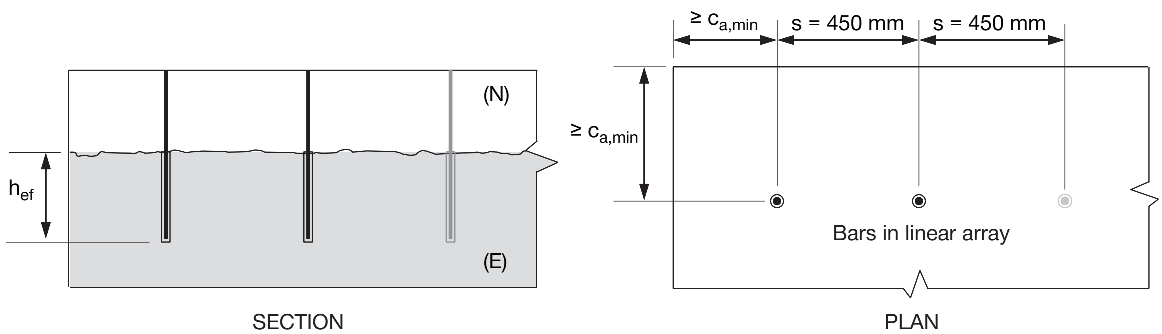


Illustration of Table 94 dimensions

Table 95 — Suggested embedment and edge distance (see figure below) based on CSA 23.3 Annex D to develop 125% of f_y in Canadian 400 MPa wall/column starter bars in a linear array with bar spacing = 300 mm - non-seismic only[1,2,3,4,5]

Rebar size	Linear spacing s mm	f'_c = 20 MPa			f'_c = 25 MPa			f'_c = 30 MPa			f'_c = 40 MPa		
		Effective embed. h_{ef} mm	Minimum edge dist $c_{a,min}$ mm		Effective embed. h_{ef} mm	Minimum edge dist $c_{a,min}$ mm		Effective embed. h_{ef} mm	Minimum edge dist $c_{a,min}$ mm		Effective embed. h_{ef} mm	Minimum edge dist $c_{a,min}$ mm	
			Cond. I	Cond. II		Cond. I	Cond. II		Cond. I	Cond. II		Cond. I	Cond. II
10M	300	240	650	350	200	560	300	180	500	260	160	450	210

1 h_{ef} is the calculated bar embedment based on uncracked bond and concrete breakout strengths using equations in section 3.1.14.4 to develop 125% of nominal bar yield. Shaded embedment values exceed 20 bar diameters. For non-tabulated rebar sizes, design per development length provisions is recommended. The particular assumptions used for the application of anchor theory to bar development (e.g., bar yield and bond strength values) are a matter of engineering judgment and will in part depend on the specific circumstances of the design. For embedments corresponding to nominal yield (i.e., no overstrength) multiply the tabulated hef values by 0.86.
2 c_a is the minimum edge distance (from bar centerline) associated with the tabulated embedments and s = 300 mm. Refer to sec. 3.1.14.3 for applicability of edge distance "Condition I" and "Condition II."
3 Values determined with bond stresses, k-factors and strength reduction factors taken from ESR-3814, Tables 12 and 13 assuming dry, uncracked concrete conditions where concrete temperatures will not exceed a maximum short-term temperature of 130°F (55°C) and long-term temperature of 110°F (43°C). Bond stresses are for static (non-seismic) loading conditions.
4 Values are for normal weight concrete. For lightweight concrete contact Hilti.
5 Refer to the Hilti North America Post-Installed Reinforcing Bar Guide for further explanation, background information, and design examples. See Hilti Instructions for Use (IFU) for specific installation requirements.

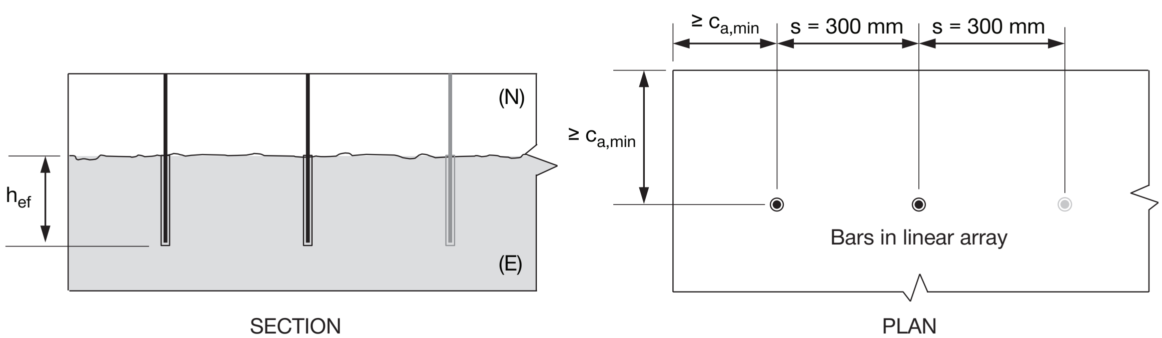


Illustration of Table 95 dimensions

3.2.3

INSTALLATION INSTRUCTIONS

Installation Instructions For Use (IFU) are included with each product package. They can also be viewed or downloaded online at www.hilti.com. Because of the possibility of changes, always verify that downloaded IFU are current when used. Proper installation is critical to achieve full performance. Training is available on request. Contact Hilti Technical Services for applications and conditions not addressed in the IFU.

MATERIAL SPECIFICATIONS

Figure 9 — Hilti HIT-RE 500 V3 adhesive cure and working time (approx.)

[°F]	[°C]	t_{work}	$t_{cure, ini}$	$t_{cure, full}$
23	-5	2 h	48 h	168 h
32	0	2 h	24 h	36 h
40	4	2 h	16 h	24 h
50	10	1.5 h	12 h	16 h
60	16	1 h	8 h	16 h
72	22	25 min	4 h	6.5 h
85	29	15 min	2.5 h	5 h
95	35	12 min	2 h	4.5 h
105	41	10 min	2 h	4 h

≥ +5 °C / 41 °F

= 2x t_{cure}

Table 96 — Resistance of cured Hilti HIT-RE 500 V3 to chemicals

Chemicals tested	Content (%)	Resistance
toluene	47.5	
iso-octane	30.4	
heptane	17.1	+
methanol	3	
butanol	2	
toluene	60	
xylene	30	+
methylnaphthalene	10	
diesel	100	+
petrol	100	+
methanol	100	–
dichloromethane	100	–
mono-chlorobenzene	100	●
ethylacetat	50	+
methylisobutylketone	50	
salicylic acid-methylester	50	+
mcetophenon	50	
acetic acid	50	–
propionic acid	50	
sulfuric acid	100	–
nitric acid	100	–
hyrdocholoric acid	36	–
potassium hydroxide	100	–
sodium hydroxide 20%	100	–
triethanolamine	50	–
butylamine	50	
benzyl alcohol	100	
ethanol	100	
ethyl acetate	100	–
methyl ethly ketone (MEK)	100	
trichlorethylene	100	
lutensit TC KLC 50	3	
marlophen NP 9,5	2	+
water	95	
tetrahydrofurane	100	–
demineralized water	100	+
salt water	saturated	+
salt spray testing	–	+
SO_2	–	+
environment/weather	–	+
oil for formwork (forming oil)	100	+
concrete plasticizer	–	+
concrete drilling mud	–	+
concrete potash solution	–	+
saturated suspension of bore-hole cuttings	–	+

Key: – non-resistant
\+ resistant
● limited resistance

Samples of the HIT-HY 200 A/R V3 adhesive were immersed in the various chemical compounds for up to one year. At the end of the test period, the samples were analyzed. Any samples showing no visible damage and having less than a 25% reduction in bending (flexural) strength were classified as "Resistant." Samples that had slight damage, such as small cracks, chips, etc. or reduction in bending strength of 25% or more were classified as "Limited Resistance" (i.e. exposed for 48 hours or less until chemical is cleaned up). Samples that were heavily damaged or destroyed were classified as "Non-Resistant."

Note: In actual use, the majority of the adhesive is encased in the base material, leaving very little surface area exposed.

HILTI

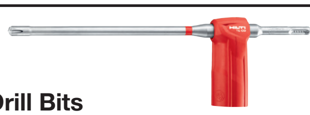
ORDERING INFORMATION

HIT-RE 500 V3

Description	Package contents	Qty
HIT-RE 500 V3 (11.1 fl oz/330 ml)	Includes (1) foil pack with (1) mixer and 3/8 filler tube per pack	1
HIT-RE 500 V3 Master Carton (11.1 fl oz/330 ml)	Includes (1) master carton containing (25) foil packs with (1) mixer and 3/8 filler tube per pack	25
HIT-RE 500 V3 Combo (11.1 fl oz/330 ml)	Includes (1) master carton containing (25) foil packs with (1) mixer and 3/8 filler tube per pack and (1) HDM 500 Manual Dispenser	25
HIT-RE 500 V3 Master Carton (16.9 fl oz/500 ml)	Includes (1) master carton containing (20) foil packs with (1) mixer and 3/8 filler tube per pack	20
HIT-RE 500 V3 Combo (16.9 fl oz/500 ml)	Includes (2) master cartons containing (20) foil packs each with (1) mixer and 3/8 filler tube per pack and (1) HDM 500 Manual Dispenser	40
HIT-RE 500 V3 (47.3 fl oz/1400 ml)	Includes (4) foil packs with (1) mixer and 3/8 filler tube per pack	4
HIT-RE 500 V3 Pallet (47.3 fl oz/1400 ml)	Includes (64) foil packs with (1) mixer and 3/8 filler tube per pack and (1) P800 Pneumatic Dispenser	64
HIT-RE 500 V3 TE-CD Starter Package	Includes foil packs, dispensers, vacuum, hammer drill and various drill bit sizes. Contact Hilti for exact package contents.	40
HIT-RE 500 V3 TE-YD Starter Package	Includes foil packs, dispensers, vacuum, hammer drill and various drill bit sizes. Contact Hilti for exact package contents.	40
HIT-RE-M Static Mixer For use with HIT-RE 500 V3 cartridges		1

TE-YRT Roughening Tool

Order description	Description	Length
TE-YRT 7/8" x 15"	Roughening tool for use with 3/4" diameter threaded rod in core drilled holes	15"
TE-YRT 1-1/8" x 20	Roughening tool for use with 1" diameter threaded rod in core drilled holes	20"
TE-YRT 1-3/8" x 25"	Roughening tool for use with 1-1/4" diameter threaded rod in core drilled holes	25"
RTG 7/8"	Roughening tool gauge for TE-YRT 7/8"	
RTG 1-1/8"	Roughening tool gauge for TE-YRT 1-1/8"	
RTG 1-3/8"	Roughening tool gauge for TE-YRT 1-3/8"	



TE-CD Hollow Drill Bits

Order description	Working length
Hollow Drill Bit TE-CD 1/2" x 13"	8"
Hollow Drill Bit TE-CD 9/16" x 14"	9-1/2"
Hollow Drill Bit TE-CD 5/8" x 14"	9-1/2"
Hollow Drill Bit TE-CD 3/4" x 14"	9-1/2"

TE-YD Hollow Drill Bits

Order description	Working length
Hollow drill bit TE-YD 5/8" x 24"	15-3/4"
Hollow drill bit TE-YD 3/4" x 24"	15-3/4"
Hollow drill bit TE-YD 7/8" x 24"	15-3/4"
Hollow drill bit TE-YD 1" x 24"	15-3/4"
Hollow drill bit TE-YD 1-1/8" x 24"	15-3/4"
Hollow drill bit TE-YD 5/8" x 35"	26"
Hollow drill bit TE-YD 3/4" x 35"	26"
Hollow drill bit TE-YD 7/8" x 35"	26"
Hollow drill bit TE-YD 1" x 35"	26"
Hollow drill bit TE-YD 1-1/8" x 47"	39"