

ICC-ES Evaluation Report

ESR-3608

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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:

SIKA SERVICES AG

ADDITIONAL LISTEES:

SIKA CORPORATION USA

EVALUATION SUBJECT:

SIKA ANCHORFIX®-3001 ADHESIVE ANCHORS FOR CRACKED AND UNCRACKED CONCRETE

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2015, 2012, 2009, 2006 and 2003 International Building Code[®] (IBC)
- 2015, 2012, 2009, 2006 and 2003 *International Residential Code*[®] (IRC)

Property evaluated:

Structural

2.0 USES

The Sika AnchorFix[®]-3001 Adhesive Anchors are used to resist static, wind or earthquake (Seismic Design Categories A through F) tension and shear loads in cracked and uncracked, normal-weight concrete having a specified compressive strength, f'_{c} , of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).

The anchors comply with anchors as described in Section 1901.3 of the 2015 IBC, Section 1909 of the 2012 IBC and are an alternative to cast-in-place anchors described in Section 1908 of the 2012 IBC, and Sections 1911 and 1912 of the 2009 and 2006 IBC, and Sections 1912 and 1913 of the 2003 IBC. The anchors may also be used where an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

3.0 DESCRIPTION

3.1 General:

The Sika AnchorFix[®]-3001 Anchor System is comprised of the following:

• Sika AnchorFix[®]-3001 adhesive packaged in cartridges

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- Adhesive mixing and dispensing equipment
- Equipment for cleaning holes and injecting adhesive

The Sika AnchorFix[®]-3001 adhesive is used with continuously threaded steel rods or deformed steel reinforcing bars. Installation information, guidelines and parameters are shown in Tables 1, 15, 16, and 17 of this report.

The manufacturer's printed installation instructions (MPII), included with each adhesive cartridge unit, are shown in Figure 3 of this report.

3.2 Materials:

3.2.1 Sika AnchorFix®-3001 Adhesive: The Sika AnchorFix®-3001 adhesive is a two-component (resin and hardener) epoxy-based adhesive, supplied in dual chamber cartridges separating the chemical components. The components are combined in a 1:1 ratio by volume when dispensed through the system static mixing nozzle. The Sika AnchorFix®-3001 is available in 250-milliliter (8.5 fl. oz.), 400-milliliter (13.5 fl. oz.), 600-milliliter (20.3 fl. oz.) and 1500-milliliter (50.7 fl. oz.) cartridges. The shelf life of the Sika AnchorFix®-3001 is two years, when stored in the manufacturer's unopened containers at temperatures between 50°F (10°C) and 77°F (25°C).

3.2.2 Dispensing Equipment: The Sika AnchorFix[®]-3001 adhesive must be dispensed using pneumatic or manual actuated dispensing tools as listed in Table 17 of this report.

3.2.3 Hole Preparation Equipment: The holes must be cleaned with hole-cleaning brushes and air nozzles. The brush must be the appropriate size brush shown in Tables 15 and 16 of this report, and the air nozzle must be equipped with an extension capable of reaching the bottom of the drilled hole and having an inside bore diameter of not less than $^{1}/_{4}$ inch (6 mm). The holes must be prepared in accordance with the installation instructions shown in Figure 3 of this report.

3.2.4 Steel Anchor Elements:

3.2.4.1 Threaded Steel Rod: Threaded anchor rods must be clean, continuously threaded rods (all-thread) in diameters and types as shown in Tables 2 and 4 of this report. Steel design information for the common grades of threaded rod is provided in Tables 2 and 4. Carbon steel threaded rods may be furnished with a zinc electroplated coating or may be hot-dipped galvanized, or may be uncoated. Threaded steel rods must be straight and free of indentations or other defects along their length.

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3.2.4.2 Steel Reinforcing Bars: Steel reinforcing bars must be deformed bars (rebar). Tables 3 and 4 summarize reinforcing bar size ranges, specifications, and grades. The embedded portions of reinforcing bars must be straight, and free of mill scale, rust and other coatings or substances that may impair the bond with the adhesive. Reinforcing bars must not be bent after installation except as set forth in 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.

3.2.4.3 Ductility: In accordance with ACI 318-14 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 the reduction of area must be at least 30 percent. Steel elements with a tested elongation of less than 14 percent or a reduction of area less than 30 percent, or both, are considered brittle. Values for various steel materials are provided in Tables 2 through 4 of this report. Where values are nonconforming or unstated, the steel must be considered brittle.

3.3 Concrete: Normal-weight concrete must comply with Sections 1903 and 1905 of the IBC, 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:

4.1.1 General: The design strength of anchors complying with the 2015 IBC, as well as the 2015 IRC must be determined in accordance with ACI 318-14 and this report. The design strength of anchors complying with the 2012, 2009, 2006 and 2003 IBC, as well as the 2012, 2009, 2006 and 2003 IRC, must be determined in accordance with ACI 318-11 and this report.

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

A design example in accordance with the 2012 IBC is given in Figure 4 of this report.

Design parameters are provided in Tables 2 through 14 of this report. Strength reduction factors, ϕ , as described in 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 1605.2 of the IBC or ACI 318-14 5.3 or ACI 318-11 9.2, as applicable. Strength reduction factors, ϕ , described in ACI 318-11 Section D.4.4 must be used for load combinations calculated in accordance with Appendix C of ACI 318-11.

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 318-14 17.4.1.2 or ACI 318-11 D.5.1.2, as applicable, and the associated strength reduction factor, ϕ , in accordance with ACI 318-14 17.3.3 or ACI 314-11 D.4.3, as applicable, are provided in Tables 2, 3, and 4 for the anchor element types included in this report.

4.1.3 Static Concrete Breakout Strength in Tension: The nominal static concrete breakout strength of a single anchor or group of anchors in tension, N_{cb} or N_{cbg} , must be calculated in accordance with ACI 318-14 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 318-14 17.4.2.2 or ACI 318-11 D.5.2.2, as applicable,

using the selected values of $k_{c,cr}$ and $k_{c,uncr}$ as provided in the tables of this report. Where analysis indicates no cracking in accordance with 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 $\Psi_{c,N} = 1.0$. For anchors in lightweight concrete see 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 318-14 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 318-14 17.4.5 or ACI 318-11 D.5.5, as applicable. Bond strength values are a function of the concrete condition, whether the concrete is cracked or uncracked, the concrete temperature range, and the installation conditions (dry or water-saturated concrete, water-filled holes). The resulting characteristic bond strength shall be multiplied by the associated strength reduction factor ϕ_{nn} as follows corresponding to the level of special inspection provided:

CONCRETE STATE	DRILLING METHOD	PERMISSIBLE INSTALLATION CONDITIONS	BOND STRENGTH	ASSOCIATED STRENGTH REDUCTION FACTOR
		Dry concrete	τ _{k,cr}	$\phi_{\sf d}$
Cracked	Hammer- drill	Water- saturated concrete	T _{k,cr}	Øws
	.	Water-filled hole (flooded)	T _{k,cr}	Øwf
		Dry concrete	τ _{k,uncr}	$\phi_{\sf d}$
Uncracked	Hammer- drill	Hammer-		Øws
		Water-filled hole (flooded)	τ _{k,uncr}	Øwf

Figure 1 of this report presents a bond strength design selection flowchart. Strength reduction factors for determination of the bond strength are given in Tables 7 through 14 of this report.

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 318-14 17.5.1.2 or ACI 318-11 D.6.1.2, as applicable, and strength reduction factors, ϕ , in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are given in Tables 2 through 4 of this report for the anchor element types included in this report.

4.1.6 Static Concrete Breakout Strength in Shear: The nominal concrete breakout strength of a single anchor or group of anchors in shear, V_{cb} or V_{cbg} , must be calculated in accordance with ACI 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable based on information given in Tables 5 and 6 of this report. The basic concrete breakout strength of a single anchor in shear, V_b , must be calculated in accordance with ACI 318-14 17.5.2.2 or ACI 318-11 D.6.2.2, as applicable, using the values of *d* given in Tables 2 through 4 for the corresponding anchor steel in lieu of d_a (2015, 2012 and 2009 IBC) and d_o (IBC 2006). In addition, h_{ef} must be substituted for ℓ_e . In no case shall ℓ_e exceed 8*d*. The value of f_c must be limited to a maximum of 8,000 psi (55 MPa), in accordance with ACI 318-14 17.2.7 or ACI 318-11 Section 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} , shall be calculated in accordance with 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 forces, the interaction of the tension and shear loads must be calculated in accordance with 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 Minimum Edge Distance c_{min} : In lieu of 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. The minimum member thickness, h_{min} , described in this report must be observed for anchor design and installation. For adhesive anchors that will remain untorqued, ACI 318-14 17.7.4 or ACI 318-11 D.8.4, as applicable, applies.

4.1.10 Critical Edge Distance c_{ac} and $\psi_{cp,Na}$: The modification factor $\psi_{cp,Na}$, must be determined in accordance with ACI 318-14 17.4.5.5 or ACI 318-11 D.5.5.5, as applicable, except as noted below:

For all cases where $c_{Na'}/c_{ac}$ <1.0, $\psi_{cp,Na}$ determined from ACI 318-14 Eq. 17.4.5.5b or ACI 318-11 Eq. D-27, as applicable, need not be taken less than $c_{Na'}/c_{ac}$. For all other cases, $\psi_{cp,Na}$ shall be taken as 1.0.

The critical edge distance, c_{ac} must be calculated according to Eq. 17.4.5.5c for ACI 318-14 or Eq. D-27a for ACI 318-11, in lieu of ACI 318-14 17.7.6 or ACI 318-11 D.8.6, as applicable.

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

(Eq. 17.4.5.5c for ACI 318-14 or Eq. D-27a for ACI 318-11)

where

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

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

$$\tau_{k,uncr} = \frac{k_{uncr} \sqrt{h_{ef} f_c'}}{\pi \cdot d_a}$$
 Eq. (4-1)

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, anchors must be designed in accordance with ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, except as described below.

The nominal steel shear strength, V_{sa} , must be adjusted by $\alpha_{V,seis}$ as given in Tables 2 through 4 of this report for the corresponding anchor steel.

As an exception to ACI 318-11 D.3.3.4.2: 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).

Under ACI 318-11 D.3.3.4.3(d), in lieu of requiring the anchor design tensile strength to satisfy the tensile strength requirements of ACI 318-11 D.4.1.1, the anchor design tensile strength shall be calculated from ACI 318-11 D.3.3.4.4.

1. For the calculation of the in-plane shear strength of anchor bolts attaching wood sill plates of bearing or nonbearing 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 $\frac{5}{8}$ 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 $\frac{5}{8}$ 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 Installation:

Installation parameters are provided in Tables 1, 15, 16, 17, and Figure 3. Installation must be in accordance with ACI 318-14 17.8.1 and 17.8.2 or ACI 318-11 D.9.1 and D.9.2, as applicable. Anchor locations must comply with this report and the plans and specifications approved by the building official. Installation of the Sika AnchorFix[®]-3001 adhesive anchor system must conform to the manufacturer's printed installation instructions (MPII) included in each package unit and as described in Figure 3. The nozzles, brushes, dispensing tools and resin

stoppers shown in Figure 2 and listed in Tables 15, 16, and 17 supplied by the manufacturer, must be used along with the adhesive cartridges. Installation of anchors may be vertically down (floor), horizontal (walls) and vertically overhead. Use of nozzle extension tubes and resin stoppers must be in accordance with Tables 15 and 16.

4.3 Special Inspection:

4.3.1 General: Installations may be made under continuous special inspection or periodic special inspection, as determined by the registered design professional. Tables 7 through 14 of this report provide strength reduction factors, ϕ , corresponding to the type of inspection provided.

Continuous special inspection of adhesive anchors installed in horizontal or upwardly inclined orientations to resist sustained tension loads shall be performed in accordance with ACI 318-14 17.8.2.4 or ACI 318-11 D.9.2.4, as applicable.

Under the IBC, additional requirements as set forth inSection 1705.1.1 and Table 1705.3 of the 2015 or 2012 IBC and Sections 1705, 1706 or 1707 of the 2009, 2006 and 2003 IBC must be observed, where applicable.

4.3.2 Continuous Special Inspection: Installations made under continuous special inspection with an on-site proof loading program must be performed in accordance with Section 1705.1.1 and Table 1705.3 of the 2015 and 2012 IBC, Section 1704.15 and Table 1704.4 of the 2009 IBC, or Section 1704.13 of the 2006 or 2003 IBC, whereby continuous special inspection is defined in Section 1702.1 of the IBC, and this report. The special inspector must be on the jobsite continuously during anchor installation to verify anchor type, adhesive expiration date, anchor dimensions, concrete type, concrete compressive strength, hole dimensions, hole cleaning procedures, anchor spacing, edge distances, concrete thickness, anchor embedment, tightening torque, and adherence to the manufacturer's printed installation instructions.

The proof loading program must be established by the registered design professional. As a minimum, the following requirements must be addressed in the proof loading program:

- 1. Frequency of proof loading based on anchor type, diameter, and embedment.
- 2. Proof loads by anchor type, diameter, embedment, and location.
- 3. Acceptable displacements at proof load.
- 4. Remedial action in the event of a failure to achieve proof load, or excessive displacement.

Unless otherwise directed by the registered design professional, proof loads must be applied as confined tension tests. Proof load levels must not exceed the lesser of 67 percent of the load corresponding to the nominal bond strength as calculated from the characteristic bond stress for uncracked concrete modified for edge effects and concrete properties, or 80 percent of the minimum specified anchor element yield strength ($A_{se,N}$ f_{ya}). The proof load shall be maintained at the required load level for a minimum of 10 seconds.

4.3.3 Periodic Special Inspection: Periodic special inspection must be performed where required in accordance with Section 1705.1.1 and Table 1705.4 of the 2015 and 2012 IBC, Section 1704.15 and Table 1704.4 of the 2009 IBC or Section 1704.13 of the 2006 or 2003 IBC and this report. The special inspector must be on the jobsite initially during anchor installation to verify the anchor type,

anchor dimensions, concrete type, concrete compressive strength, adhesive identification and expiration date, hole dimensions, hole cleaning procedures, anchor spacing, edge distances, concrete thickness, anchor embedment, tightening torque and adherence to the manufacturer's published installation instructions. The special inspector must verify the initial installations of each type and size of adhesive anchor by construction personnel on site. Subsequent installations of the same anchor type and size by the same construction personnel are permitted to be performed in the absence of the special inspector. Any change in the anchor product being installed or the personnel performing the installation requires an initial inspection. For ongoing installations over an extended period, the special inspector must make regular inspections to confirm correct handling and installation of the product.

5.0 CONDITIONS OF USE

The Sika AnchorFix[®]-3001 Adhesive Anchor 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 Sika AnchorFix[®]-3001 adhesive anchors must be installed in accordance with the manufacturer's printed installation instructions (MPII) and as shown in Figure 3 of this report.
- **5.2** The anchors must be installed in cracked or uncracked normal-weight concrete having a specified compressive strength, $f'_c = 2,500$ psi to 8,500 psi (17.2 MPa to 58.6 MPa).
- **5.3** The values of f'_c used for calculation purposes must not exceed 8,000 psi (55.1 MPa).
- **5.4** Anchors must be installed in concrete base materials in holes predrilled in accordance with the instructions provided in Figure 3 of this report, with carbide-tipped drill bits complying with ANSI B212.15-1994.
- **5.5** Loads applied to the anchors must be adjusted in accordance with Section 1605.2 of the IBC for strength design, and Section 1605.3 of the IBC for allowable stress design.
- **5.6** Sika AnchorFix[®]-3001 adhesive anchors are recognized for use to resist short- and long-term loads, including wind and earthquake, subject to the conditions of this report.
- 5.7 In structures assigned to Seismic Design Category C, D, E or F under the IBC or IRC, anchor strength must be adjusted in accordance with Section 4.1.11 of this report.
- 5.8 Sika AnchorFix[®]-3001 adhesive anchors are permitted to be installed in concrete that is cracked or that may be expected to crack during the service life of the anchor, subject to the conditions of this report.
- **5.9** Strength design values must be established in accordance with Section 4.1 of this report.
- **5.10** Allowable stress design values must be established in accordance with Section 4.2 of this report.
- **5.11** Minimum anchor spacing and edge distance, as well as minimum member thickness, must comply with the values described in this report.
- 5.12 Prior to installation, calculations and details demonstrating compliance with this report must be submitted to the 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.

- **5.13** Anchors are not permitted to support fire-resistive construction. Where not otherwise prohibited by the code, Sika AnchorFix®-3001 adhesive anchors are permitted for installation in fire-resistive construction provided at least one of the following conditions is fulfilled:
 - Anchors are used to resist wind or seismic forces only.
 - Anchors that support gravity load-bearing structural elements are within a fire-resistive envelope or a fire-resistive membrane, are protected by approved fire-resistive materials, or have been evaluated for resistance to fire exposure in accordance with recognized standards.
 - Anchors are used to support nonstructural elements.
- **5.14** Since an ICC-ES acceptance criteria for evaluating data to determine the performance of adhesive anchors subjected to fatigue or shock loading is unavailable at this time, the use of these anchors under such conditions is beyond the scope of this report.
- **5.15** Use of zinc-plated carbon steel threaded rods or steel reinforcing bars is limited to dry, interior locations.
- **5.16** Use of hot-dipped galvanized carbon steel and stainless steel rods is permitted for exterior exposure or damp environments.
- **5.17** Steel anchoring materials in contact with preservativetreated wood and fire-retardant-treated wood must be zinc-coated carbon steel or stainless steel. The minimum coating weights for zinc-coated steel must comply with ASTM A153.
- **5.18** Special inspection must be provided in accordance with Section 4.4 in this report. Continuous special inspection for anchors installed in horizontal or upwardly inclined orientations to resist sustained tension loads must be provided in accordance with Section 4.4 of this report.
- **5.19** Installation of anchors 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 318-14 17.8.2.2 or 17.8.2.3; ACI 318-11 D.9.2.2 or D.9.2.3, as applicable.
- 5.20 AnchorFix[®]-3001 adhesive anchors 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 40°F and 104°F (4°C and 40°C) for threaded rods and rebar. Overhead installations for hole diameters larger than ⁵/₈-inch or 16mm require the use of resin stoppers during injection to the back of the hole. ¹/₂-inch,

 $^{9/_{16}-inch}$, $^{5/_{8}-inch}$, 12 mm, 14 mm, and 16 mm 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 must be supported until fully cured (i.e., with wedges, or other suitable means). Where temporary restraint devices are used, their use shall not result in impairment of the anchor shear resistance.

- **5.21** Anchors shall not be used for installations 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 facade systems and other applications subject to direct sun exposure.
- **5.22** Sika AnchorFix[®]-3001 adhesive is manufactured and packaged into cartridges 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 in Concrete (AC308), dated June 2019, which incorporates requirements in ACI 355.4-11.

7.0 IDENTIFICATION

- 7.1 Sika AnchorFix[®]-3001 adhesive is identified in the field by labels on the cartridge and packaging, bearing the company name (Sika Services AG), product name (Sika AnchorFix[®]-3001), the batch number, the expiration date, and the evaluation report number (ESR-3608).
- **7.2** Threaded rods, nuts, and washers are standard elements, and must conform to applicable national or international specifications.
- **7.3** The report holder's contact information is the following:

SIKA SERVICES AG TUEFFENWIES 16 ZURICH CH-8048 SWITZERLAND +41 (0) 58 436 40 40 <u>www.sika.com</u>

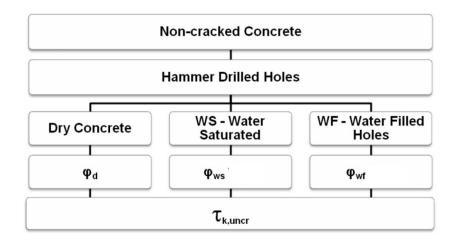
7.4 The Additional Listee's contact information is the following:

SIKA CORPORATION USA 201 POLITO AVENUE LYNDHURST, NEW JERSEY 07071 (800) 933-SIKA www.sika.com

Characte	eristic	Symbol	Units			Nominal Anc	hor Elemer	t Diameter		
$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$		¹ / ₂	⁵ /8	³ / ₄	⁷ / ₈	1	1 ¹ / ₄			
Threaded Rod	Drill Size	d _{hole}	inch	¹ / ₂	⁹ / ₁₆	³ / ₄	⁷ /8	1	1 ¹ / ₈	1 ³ / ₈
Fractional Da har	Size	d _o	inch	#3	#4	#5	#6	#7	#8	#10
Fractional Re-bar	Drill Size	d _{hole}	$\begin{array}{c c c c c c c c c c c c c c c c c c c $			1 ³ / ₈				
Metric Threaded	Size	d _o	mm	M10	M12	M16	M20	-	M24	M30
Rod	Drill Size	d _{hole}	mm	12	14	18	22	$7_{/_8}$ 1 1 $1^{1}_{/_8}$ #7 #8 1 $1^{1}_{/_8}$ - M24 - 26 - T25 - 32 125 150 4 4 17^{1/_2} 20 as report 2 2	35	
Matria Da han	Size	d _o	mm	T10	T12	T16	T20	-	1 ¹ / ₈ #8 1 ¹ / ₈ M24 26 T25 32 150 4 20	T32
Metric Re-dar	Drill Size	d _{hole}	mm	14	16	20	25	-	32	40
Maximum Tighte	ening Torque	T _{inst}	ft·lb	15	30	60	100	125	1 ¹ / ₈ #8 1 ¹ / ₈ M24 26 T25 32 150 4 20	200
Enchedment D	Drill Size dh Maximum Tightening Torque Ti h _{ef} h _{ef}		inch	2 ³ / ₈	2 ³ / ₄	3 ¹ / ₈	3 ³ / ₄	4	4	5
	epth Range	h _{ef,max}	inch	7 ¹ / ₂	10	12 ¹ / ₂	15	17 ¹ / ₂	20	25
Minimum Concre	ete Thickness	h _{min}	inch				1.5 · h _{ef}			
Critical Edge										
Minimum Edg	inch	1 ¹ / ₂	1 ¹ / ₂	1 ³ / ₄	1 ⁷ / ₈	2	2	2 ¹ / ₂		
Minimum Anch	nor Spacing	S _{min}	inch	1 ¹ / ₂	1 ¹ / ₂	1 ³ / ₄	1 ⁷ / ₈	2	2	2 ¹ / ₂

TABLE 1—SIKA ANCHORFIX[®]-3001 ANCHOR SYSTEM INSTALLATION INFORMATION

For SI: 1 inch = 25.4 mm, 1 ft·lb = 1.356 N m



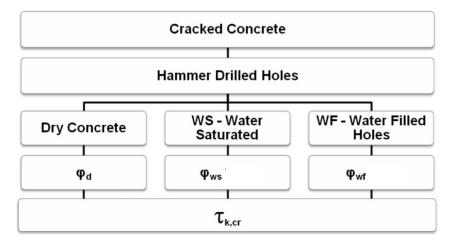


TABLE 2—STEEL DESIGN INFORMATION FOR FRACTIONAL CARBON STEEL AND STAINLESS STEEL THREADED ROD^{1,2}

Nominal Size Stress Area ¹ Strength Reduction Factor for Tension Steel Failure ² Strength Reduction Factor for Shear Steel Failure ² Reduction for Seismic Tension Reduction for Seismic Shear Tension Resistance of Carbon Steel ASTM F1554 Grade 36 Tension Resistance of Carbon Steel ASTM A193 B7	d _o A _{se} φ φ α _{N,seis} α _{V,seis}	inch in. ² - -	³ / ₈ 0.0775	¹ / ₂ 0.1419		³ / ₄ 0.334).75	⁷ / ₈ 0.462	1 0.606	1 ¹ / ₄ 0.969
Strength Reduction Factor for Tension Steel Failure ² Strength Reduction Factor for Shear Steel Failure ² Reduction for Seismic Tension Reduction for Seismic Shear Tension Resistance of Carbon Steel ASTM F1554 Grade 36 Tension Resistance of Carbon Steel	φ φ α _{N,seis} α _{V,seis}	-	0.0775	0.1419	(0.462	0.606	0.969
Steel Failure ² Strength Reduction Factor for Shear Steel Failure ² Reduction for Seismic Tension Reduction for Seismic Shear Tension Resistance of Carbon Steel ASTM F1554 Grade 36 Tension Resistance of Carbon Steel	ϕ $\alpha_{N,seis}$ $\alpha_{V,seis}$	-).75	•		
Failure ² Reduction for Seismic Tension Reduction for Seismic Shear Tension Resistance of Carbon Steel ASTM F1554 Grade 36 Tension Resistance of Carbon Steel	$\alpha_{N,seis}$ $\alpha_{V,seis}$				ſ				
Reduction for Seismic Shear Tension Resistance of Carbon Steel ASTM F1554 Grade 36 Tension Resistance of Carbon Steel	α _{V,seis}).65			
Tension Resistance of Carbon Steel ASTM F1554 Grade 36 Tension Resistance of Carbon Steel		_				1.00			
ASTM F1554 Grade 36 Tension Resistance of Carbon Steel	N _{sa}	_	0.58	0.57	0.57	0.57	0.42	0.42	0.42
		lb (kN)	4,495 (20.0)	8,230 (36.6)	13,110 (58.3)	19,370 (86.2)	26,795 (119.2)	35,150 (156.4)	56,200 (250.0)
ASTIVI A 195 D7	N _{sa}	lb (kN)	9,690 (43.1)	17,740 (78.9)	28,250 (125.7)	41,750 (185.7)	57,750 (256.9)	75,750 (337.0)	121,125 (538.8)
Shear Resistance of Carbon Steel ASTM F1554 Grade 36	V _{sa}	lb (kN)	2,250 (10.0)	4,940 (22.0)	7,865 (35.0)	11,625 (51.7)	16,080 (71.5)	21,090 (93.8)	33,720 (150.0)
Shear Resistance of Carbon Steel ASTM A193 B7	V _{sa}	lb (kN)	4,845 (21.6)	10,645 (47.4)	16,950 (75.4)	25,050 (111.4)	34,650 (154.1)	45,450 (202.2)	72,675 (323.3)
Strength Reduction Factor for Tension Steel Failure ²	φ	-			().65			
Strength Reduction Factor for Shear Steel Failure ²	φ	-			().60			
Reduction for Seismic Tension	α _{N,seis}	-				1.00			
Reduction for Seismic Shear	$lpha_{V,seis}$	-	0.51	0.50	0.49	049	0.43	0.43	0.43
Tension Resistance of Stainless Steel ASTM F593 CW1	N _{sa}	lb (kN)	7,365 (32.8)	13,480 (60.0)	21,470 (95.5)				
Tension Resistance of Stainless Steel ASTM F593 CW2	N _{sa}	lb (kN)				25,385 (112.9)	35,110 (156.2)	46,055 (204.9)	73,645 (327.6)
Tension Resistance of Stainless Steel ASTM F593 SH1	N _{sa}	lb (kN)	8,915 (39.7)	16,320 (72.6)	25,990 (115.6)				
Tension Resistance of Stainless Steel ASTM F593 SH2	N _{sa}	lb (kN)				35,070 (156.0)	48,510 (215.8)	63,630 (283.0)	
Tension Resistance of Stainless Steel ASTM F593 SH3	N _{sa}	lb (kN)							92,055 (409.5)
Shear Resistance of Stainless Steel ASTM F593 CW1	V _{sa}	lb (kN)	3,680 (16.4)	6,740 (30.0)	10,735 (47.8)				
Shear Resistance of Stainless Steel	V _{sa}	lb				12,690 (56,4)	17,555	23,030	36,820 (163.8)
Shear Resistance of Stainless Steel	V _{sa}	lb	4,455	9,790	15,595 (69.4)				
Shear Resistance of Stainless Steel	V _{sa}	lb				17,535			
Shear Resistance of Stainless Steel	V _{sa}	lb							46,030 (204.8)
	Shear Resistance of Carbon Steel ASTM A193 B7 Strength Reduction Factor for Tension Steel Failure ² Reduction for Seismic Tension Reduction for Seismic Tension Reduction for Seismic Shear Tension Resistance of Stainless Steel ASTM F593 CW1 Tension Resistance of Stainless Steel ASTM F593 CW2 Tension Resistance of Stainless Steel ASTM F593 SH1 Tension Resistance of Stainless Steel ASTM F593 SH2 Tension Resistance of Stainless Steel ASTM F593 SH2 Tension Resistance of Stainless Steel ASTM F593 SH3 Shear Resistance of Stainless Steel ASTM F593 CW1 Shear Resistance of Stainless Steel ASTM F593 CW2 Shear Resistance of Stainless Steel ASTM F593 CW2 Shear Resistance of Stainless Steel ASTM F593 CW2 Shear Resistance of Stainless Steel ASTM F593 SH1 Shear Resistance of Stainless Steel ASTM F593 SH1 Shear Resistance of Stainless Steel ASTM F593 SH1	Shear Resistance of Carbon Steel ASTM A193 B7 V_{sa} Strength Reduction Factor for Tension Steel Failure2 ϕ Strength Reduction Factor for Shear Steel Failure2 ϕ Reduction for Seismic Tension $\alpha_{M,seis}$ Reduction for Seismic Shear $\alpha_{V,seis}$ Tension Resistance of Stainless Steel ASTM F593 CW1 N_{sa} Tension Resistance of Stainless Steel ASTM F593 CW2 N_{sa} Tension Resistance of Stainless Steel ASTM F593 SH1 N_{sa} Tension Resistance of Stainless Steel ASTM F593 SH2 N_{sa} Tension Resistance of Stainless Steel ASTM F593 SH2 N_{sa} Shear Resistance of Stainless Steel ASTM F593 CW1 V_{sa} Shear Resistance of Stainless Steel ASTM F593 CW2 V_{sa} Shear Resistance of Stainless Steel ASTM F593 SH1 V_{sa} Shear Resistance of Stainless Steel ASTM F593 SH1 V_{sa} Shear Resistance of Stainless Steel ASTM F593 SH2 V_{sa}	Shear Resistance of Carbon Steel ASTM A193 B7 V_{sa} Ib (kN)Strength Reduction Factor for Tension Steel Failure2 ϕ -Reduction Factor for Shear Steel Failure2 ϕ -Reduction for Seismic Tension $\alpha_{V,seis}$ -Reduction for Seismic Tension $\alpha_{V,seis}$ -Reduction for Seismic Shear $\alpha_{V,seis}$ -Tension Resistance of Stainless Steel ASTM F593 CW1 N_{sa} Ib (kN)Tension Resistance of Stainless Steel ASTM F593 CW2 N_{sa} Ib (kN)Tension Resistance of Stainless Steel ASTM F593 SH1 N_{sa} Ib (kN)Tension Resistance of Stainless Steel ASTM F593 SH2 N_{sa} Ib (kN)Tension Resistance of Stainless Steel ASTM F593 SH2 N_{sa} Ib (kN)Shear Resistance of Stainless Steel ASTM F593 CW2 N_{sa} Ib (kN)Shear Resistance of Stainless Steel ASTM F593 CW2 V_{sa} Ib (kN)Shear Resistance of Stainless Steel ASTM F593 CW2 V_{sa} Ib (kN)Shear Resistance of Stainless Steel ASTM F593 CW2 V_{sa} Ib (kN)Shear Resistance of Stainless Steel ASTM F593 SH1 V_{sa} Ib (kN)Shear Resistance of Stainless Steel ASTM F593 SH2 V_{sa} Ib (kN) <td>Shear Resistance of Carbon Steel ASTM A193 B7$V_{sa}$$Ib$ $(kN)$$4,845$ (kN)Strength Reduction Factor for Tension Steel Failure2ϕStrength Reduction Factor for Shear Steel Failure2ϕReduction for Seismic Tension Failure2$\alpha_{V,seis}$-0.51Reduction for Seismic Shear$\alpha_{V,seis}$-0.51Tension Resistance of Stainless Steel ASTM F593 CW1N_{sa}Ib (kN)7,365 (kN)Tension Resistance of Stainless Steel ASTM F593 SH1N_{sa}Ib (kN)Tension Resistance of Stainless Steel ASTM F593 SH2N_{sa}Ib (kN)Tension Resistance of Stainless Steel ASTM F593 SH2N_{sa}Ib (kN)Tension Resistance of Stainless Steel ASTM F593 SH3N_{sa}Ib (kN)Shear Resistance of Stainless Steel ASTM F593 CW2N_{sa}Ib (kN)Shear Resistance of Stainless Steel ASTM F593 CW2V_{sa}Ib (kN)Shear Resistance of Stainless Steel ASTM F593 CW2V_{sa}Ib (kN)Shear Resistance of Stainless Steel ASTM F593 SH1V_{sa}Ib (kN)Shear Resistance of Stainless Steel ASTM F593 SH1V_{sa}Ib (kN)Shear Resistance of Stainless Steel ASTM F593 SH2V_{sa}Ib (kN)Shear Resistance of Stainless Steel ASTM F593 SH2V_{sa}Ib (kN)<tr <td=""><tr< td=""><td>$\begin{array}{c c c c c c c c c c c c c c c c c c c$</td><td>Shear Resistance of Carbon Steel ASTM A193 B7 V_{sat} Ib (kN) 4,845 (21.6) 10,645 (47.4) 16,950 (75.4) Strength Reduction Factor for Tension Steel Failure² ϕ - - (75.4) Strength Reduction Factor for Shear Steel Failure² ϕ - - (75.4) Reduction for Seismic Tension Astron For Seismic Shear $\alpha_{V,seis}$ - 0.51 0.50 0.49 Tension Resistance of Stainless Steel ASTM F593 CW1 N_{sat} Ib 7,365 13,480 21,470 (kN) (32.8) (60.0) (95.5) (95.5) (15.6) 0.19 (15.6) Tension Resistance of Stainless Steel ASTM F593 CW2 N_{sat} Ib Tension Resistance of Stainless Steel ASTM F593 SH2 N_{sat} Ib ASTM F593 SH2 N_{sat} Ib ASTM F593 SH3 N_{sat} Ib ASTM F593 CW1 N_{sat} Ib </td><td>$\begin{array}{c c c c c c c c c c c c c c c c c c c$</td><td>$\begin{array}{c c c c c c c c c c c c c c c c c c c$</td><td>$\begin{array}{c c c c c c c c c c c c c c c c c c c$</td></tr<></tr></td>	Shear Resistance of Carbon Steel ASTM A193 B7 V_{sa} Ib (kN) $4,845$ (kN) Strength Reduction Factor for Tension Steel Failure2 ϕ Strength Reduction Factor for Shear Steel Failure2 ϕ Reduction for Seismic Tension Failure2 $\alpha_{V,seis}$ -0.51Reduction for Seismic Shear $\alpha_{V,seis}$ -0.51Tension Resistance of Stainless Steel ASTM F593 CW1 N_{sa} Ib (kN)7,365 (kN)Tension Resistance of Stainless Steel ASTM F593 SH1 N_{sa} Ib (kN)Tension Resistance of Stainless Steel ASTM F593 SH2 N_{sa} Ib (kN)Tension Resistance of Stainless Steel ASTM F593 SH2 N_{sa} Ib (kN)Tension Resistance of Stainless Steel ASTM F593 SH3 N_{sa} Ib (kN)Shear Resistance of Stainless Steel ASTM F593 CW2 N_{sa} Ib (kN)Shear Resistance of Stainless Steel ASTM F593 CW2 V_{sa} Ib (kN)Shear Resistance of Stainless Steel ASTM F593 CW2 V_{sa} Ib (kN)Shear Resistance of Stainless Steel ASTM F593 SH1 V_{sa} Ib (kN)Shear Resistance of Stainless Steel ASTM F593 SH1 V_{sa} Ib (kN)Shear Resistance of Stainless Steel ASTM F593 SH2 V_{sa} Ib (kN)Shear Resistance of Stainless Steel ASTM F593 SH2 V_{sa} Ib (kN) <tr <td=""><tr< td=""><td>$\begin{array}{c c c c c c c c c c c c c c c c c c c$</td><td>Shear Resistance of Carbon Steel ASTM A193 B7 V_{sat} Ib (kN) 4,845 (21.6) 10,645 (47.4) 16,950 (75.4) Strength Reduction Factor for Tension Steel Failure² ϕ - - (75.4) Strength Reduction Factor for Shear Steel Failure² ϕ - - (75.4) Reduction for Seismic Tension Astron For Seismic Shear $\alpha_{V,seis}$ - 0.51 0.50 0.49 Tension Resistance of Stainless Steel ASTM F593 CW1 N_{sat} Ib 7,365 13,480 21,470 (kN) (32.8) (60.0) (95.5) (95.5) (15.6) 0.19 (15.6) Tension Resistance of Stainless Steel ASTM F593 CW2 N_{sat} Ib Tension Resistance of Stainless Steel ASTM F593 SH2 N_{sat} Ib ASTM F593 SH2 N_{sat} Ib ASTM F593 SH3 N_{sat} Ib ASTM F593 CW1 N_{sat} Ib </td><td>$\begin{array}{c c c c c c c c c c c c c c c c c c c$</td><td>$\begin{array}{c c c c c c c c c c c c c c c c c c c$</td><td>$\begin{array}{c c c c c c c c c c c c c c c c c c c$</td></tr<></tr>	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Shear Resistance of Carbon Steel ASTM A193 B7 V_{sat} Ib (kN) 4,845 (21.6) 10,645 (47.4) 16,950 (75.4) Strength Reduction Factor for Tension Steel Failure ² ϕ - - (75.4) Strength Reduction Factor for Shear Steel Failure ² ϕ - - (75.4) Reduction for Seismic Tension Astron For Seismic Shear $\alpha_{V,seis}$ - 0.51 0.50 0.49 Tension Resistance of Stainless Steel ASTM F593 CW1 N_{sat} Ib 7,365 13,480 21,470 (kN) (32.8) (60.0) (95.5) (95.5) (15.6) 0.19 (15.6) Tension Resistance of Stainless Steel ASTM F593 CW2 N_{sat} Ib Tension Resistance of Stainless Steel ASTM F593 SH2 N_{sat} Ib ASTM F593 SH2 N_{sat} Ib ASTM F593 SH3 N_{sat} Ib ASTM F593 CW1 N_{sat} Ib	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{c c c c c c c c c c c c c c c c c c c $
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Shear Resistance of Carbon Steel ASTM A193 B7 V_{sat} Ib (kN) 4,845 (21.6) 10,645 (47.4) 16,950 (75.4) Strength Reduction Factor for Tension Steel Failure ² ϕ - - (75.4) Strength Reduction Factor for Shear Steel Failure ² ϕ - - (75.4) Reduction for Seismic Tension Astron For Seismic Shear $\alpha_{V,seis}$ - 0.51 0.50 0.49 Tension Resistance of Stainless Steel ASTM F593 CW1 N_{sat} Ib 7,365 13,480 21,470 (kN) (32.8) (60.0) (95.5) (95.5) (15.6) 0.19 (15.6) Tension Resistance of Stainless Steel ASTM F593 CW2 N_{sat} Ib Tension Resistance of Stainless Steel ASTM F593 SH2 N_{sat} Ib ASTM F593 SH2 N_{sat} Ib ASTM F593 SH3 N_{sat} Ib ASTM F593 CW1 N_{sat} Ib	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{c c c c c c c c c c c c c c c c c c c $					

¹Values provided for steel threaded rod are based on minimum specified strengths and calculated in accordance with 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.

²The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2 are used in accordance with 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.

						Nominal	Reinforcin	g Bar size,	do	
	Characteristic	Symbol	Units	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 10
	Nominal bar diameter	do	inch	0.375	0.500	0.625	0.750	0.875	1.000	1.250
	Stress Area	A _{se}	in.2	0.11	0.20	0.31	0.44	0.60	0.79	1.27
	Strength Reduction Factor for Tension Steel Failure	φ	-				0.65			
	Strength Reduction Factor for Shear Steel Failure	φ	-				0.60			
bar	Reduction for Seismic Tension	$\alpha_{N,seis}$	-				1.00			
Reinforcing	Reduction for Seismic Shear	$lpha_{V,seis}$	-	0.70	0.70	0.82	0.82	0.42	0.42	0.42
einfo	Tension Resistance of Carbon Steel	N _{sa}	lb	6,600	12,000	18,600	26,400	36,000	47,400	76,200
Ŕ	ASTM A615 Grade 40	IV _{Sa}	(kN)	(29.4)	(53.4)	(82.7)	(117.4)	(160.1)	(210.8)	(339.0)
	Tension Resistance of Carbon Steel	N	lb	9,900	18,000	27,900	39,600	54,000	71,100	114,300
	ASTM A615 Grade 60	N _{sa}	(kN)	(44.0)	(80.1)	(124.1)	(176.1)	(240.2)	(316.3)	(508.4)
	Shear Resistance of Carbon Steel		lb	3,960	7,200	11,160	15,840	21,600	28,440	45,720
	ASTM A615 Grade 40	V _{sa}	(kN)	(17.6)	(32.0)	(49.6)	(70.5)	(96.1)	(126.5)	(203.4)
	Shear Resistance of Carbon Steel	V	lb	5,940	10,800	16,740	23,760	32,400	42,660	68,580
	ASTM A615 Grade 60	V _{sa}	(kN)	(26.4)	(48.0)	(74.5)	(105.7)	(144.1)	(189.8)	(305.1)

TABLE 3-STEEL DESIGN INFORMATION FOR FRACTIONAL STEEL REINFORCING BAR^{1,2}

For **SI:** 1 inch = 25.4 mm, 1 in.² = 645.16 mm², 1 lb = 0.004448 kN

¹Values provided for steel threaded rod are based on minimum specified strengths and calculated in accordance with 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. ²The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2 are used in accordance with 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.

TABLE 4—STEEL DESIGN INFORMATION FOR METRIC THREADED ROD AND REINFORCING BAR^{1,2}

	Characteristic	Symbol	Units		N	ominal Ro	d Diameter	, d o	
	Nominal Size	do	mm	M10	M12	M16	M20	M24	M30
	Stress Area	A _{se}	mm ²	58	84	157	245	353	561
	Strength Reduction Factor for Tension Steel Failure	φ	-			0	.65		
	Strength Reduction Factor for Shear Steel Failure	φ	-			0	.60		
	Reduction for Seismic Tension	$\alpha_{N,seis}$	-			. 1	.00		
	Reduction for Seismic Shear	$\alpha_{V,seis}$	-	0.58	0.57	0.57	0.42	0.42	0.42
Rod	Tension Resistance of Carbon Steel ISO 898-1 Class 5.8	N _{sa}	kN Ib	29.0 (6,519)	42.2 (9,476)	78.5 (17,648)	122.5 (27,539)	176.5 (39,679)	280.5 (63,059)
aded	Tension Resistance of Carbon Steel ISO 898-1 Class 8.8	N _{sa}	kN Ib	46.4 (10,431)	67.4 (15,161)	125.6 (28,236)	196.0 (44,063)	282.4 (63,486)	448.8 (100,894)
Metric Threaded Rod	Tension Resistance of Carbon Steel ISO 898-1 Class 12.9	N _{sa}	kN Ib	50.0 (11,240)	72.7 (16,336)	135.3 (30,424)	211.2 (47,477)	304.3 (68,406)	483.6 (108,714)
Netri	Tension Resistance of Stainless Steel ISO 3506-1 A4-70	N _{sa}	kN Ib	40.6 (9,127)	59.0 (13,266)	109.9 (24,707)	171.5 (38,555)	247.1 (55,550)	392.7 (88,282)
-	Tension Resistance of Stainless Steel ISO 3506-1 A4-80	N _{sa}	kN Ib	46.4 (10,431)	67.4 (15,161)	125.6 (28,236)	196.0 (44,063)	282.4 (63,486)	448.8 (100,894)
	Shear Resistance of Carbon Steel ISO 898-1 Class 5.8	V _{sa}	kN Ib	17.4 (3,912)	25.3 (5,685)	47.1 (10,589)	73.5 (16,523)	105.9 (23,807)	168.3 (37,835)
	Shear Resistance of Carbon Steel ISO 898-1 Class 8.8	V _{sa}	kN Ib	27.8 (6,259)	40.5 (9,097)	75.4 (16,942)	117.6 (26,438)	169.4 (38,092)	269.3 (60,537)
	Shear Resistance of Carbon Steel ISO 898-1 Class 12.9	V _{sa}	kN Ib	30.0 (6,744)	43.6 (9,802)	81.2 (18,255)	126.7 (28,486)	182.6 (41,044)	290.1 (65,228)
	Shear Resistance of Stainless Steel ISO 3506-1 A4-70	V _{sa}	kN Ib	24.4 (5,476)	35.4 (7,960)	65.9 (14,824)	102.9 (23,133)	148.3 (33,330)	235.6 (52,969)
	Shear Resistance of Stainless Steel ISO 3506-1 A4-80	V _{sa}	kN Ib	27.8 (6,259)	40.5 (9,097)	75.4 (16,942)	117.6 (26,438)	169.4 (38,092)	269.3 (60,537)
	Nominal Size	do	mm	T10	T12	T16	T20	T25	T32
	Stress Area	A _{se}	mm ²	78.5	113	201	314	491	804
g bar	Strength Reduction Factor for Tension Steel Failure	φ	-			0	.65		
Metric Reinforcing bar	Strength Reduction Factor for Shear Steel Failure	φ	-			0	.60		
Rein	Reduction for Seismic Tension	$\alpha_{N,seis}$	-			1	.00		
etric	Reduction for Seismic Shear	$\alpha_{V,seis}$	-	0.70	0.70	0.82	0.42	0.42	0.42
Š	Tension Resistance of DIN 488 BSt 500	N _{sa}	kN Ib	43.2 (9,706)	62.2 (13,972)	110.6 (24,853)	172.7 (38,825)	270.1 (60,710)	442.2 (99,411)
	Shear Resistance of DIN 488 BSt 500	V _{sa}	kN Ib	25.9 (5,824)	37.3 (8,383)	66.3 (14,912)	103.6 (23,295)	162.0 (36,426)	265.3 (59,646)

For **SI:** 1 inch = 25.4 mm, 1 in.² = 645.16 mm², 1 lb = 0.004448 kN

¹Values provided for steel threaded rod are based on minimum specified strengths and calculated in accordance with 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.

²The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with 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.

TABLE 5—FRACTIONAL THREADED ROD AND REINFORCING BAR CONCRETE BREAKOUT STRENGTH DESIGN INFORMATION

	Characteristic	Symbol	Units		Ν	Iominal And	hor Eleme	nt Diamete	r	
US	Size	do	inch	³ / ₈	¹ / ₂	⁵ / ₈	³ / ₄	⁷ /8	1	1 ¹ / ₄
Threaded Rod	Drill Size	d _{hole}	inch	¹ / ₂	⁹ / ₁₆	³ / ₄	⁷ / ₈	1	1 ¹ / ₈	1 ³ / ₈
	Size	d _o	inch	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 10
US Re-bar	Drill Size	d _{hole}	inch	⁹ / ₁₆	⁵ /8	³ / ₄	⁷ /8	1	1 ¹ / ₈	1 ³ / ₈
Europh a	desent Denth Denne	h _{ef,min}	inch	2 ³ / ₈	2 ³ / ₄	3 ¹ / ₈	3 ³ / ₄	4	4	5
Empe	edment Depth Range	h _{ef,max}	inch	7 ¹ / ₂	10	12 ¹ / ₂	15	17 ¹ / ₂	20	25
Minin	num Anchor Spacing	S _{min}	inch	1 ¹ / ₂	1 ¹ / ₂	1 ³ / ₄	1 ⁷ / ₈	2	2	2 ¹ / ₂
Minir	num Edge Distance	C _{min}	inch	1 ¹ / ₂	1 ¹ / ₂	1 ³ / ₄	1 ⁷ / ₈	2	2	2 ¹ / ₂
Minimu	m Concrete Thickness	h _{min}	inch				1.5 · h _{ef}			
Crit	ical Edge Distance	C _{ac}	-			See Section	n 4.1.10 of	this report		
Effectiven	ess Factor for Uncracked	k					24			
Co	oncrete, Breakout	k _{c,uncr}	(SI)				(10)			
Effectiveness	Factor for Cracked Concrete,	k _{c.cr}					17			
	Breakout		(SI)				(7.1)			
	k _{c,uncr} / k _{c,cr}						1.41			
	duction Factor for Tension, ailure Modes, Condition B ¹	φ					0.65			
	eduction Factor for Shear, ailure Modes, Condition B ¹	φ					0.70			

For **SI:** 1 inch = 25.4 mm, 1 in.² = 645.16 mm², 1 lb = 0.004448 kN

¹Condition B applies where supplemental reinforcement is not provided as set forth in ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with 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.

TABLE 6-METRIC THREADED ROD AND REINFORCING BAR CONCRETE BREAKOUT STRENGTH DESIGN INFORMATION

	Characteristic	Symbol	Units		Nomi	nal Anchor El	ement Dian	neter	
SI Threaded	Size	do	mm	M10	M12	M16	M20	M24	M30
Rod	Drill Size	d _{hole}	mm	12	14	18	22	26	35
	Size	d _o	mm	T10	T12	T16	T20	T25	T32
SI Re-bar	Drill Size	d _{hole}	mm	14	16	20	25	32	40
Each	a day and Danith Day and	h _{ef,min}	inch	2 ³ / ₈	2 ³ / ₄	3 ¹ / ₈	3 ³ / ₄	4	5
Emp	edment Depth Range	h _{ef,max}	inch	7 ¹ / ₂	10	12 ¹ / ₂	15	20	25
Mini	mum Anchor Spacing	S _{min}	inch	1 ¹ / ₂	1 ¹ / ₂	1 ³ / ₄	1 ⁷ / ₈	2	2 ¹ / ₂
Min	imum Edge Distance	C _{min}	inch	1 ¹ / ₂	1 ¹ / ₂	1 ³ / ₄	1 ⁷ / ₈	2	2 ¹ / ₂
Minim	um Concrete Thickness	h _{min}	inch			1.5 ·	h _{ef}		
Cr	itical Edge Distance		-		See	Section 4.1.1	0 of this rep	port	
Effectiveness	Factor for Uncracked Concrete,	<i>k_{uncr}</i>							
	Breakout	Nuncr	(SI)			(10)		
Effectiveness	Factor for Cracked Concrete,	k _{cr}				17			
	Breakout	-	(SI)			(7.1)		
	k _{uncr} / k _{cr}					1.4	1		
	eduction Factor for Tension, Failure Modes, Condition B	ϕ				0.6	5		
	ction Factor for Shear, Concrete re Modes, Condition B	ϕ				0.7	0		

For **SI:** 1 inch = 25.4 mm, 1 in.² = 645.16 mm², 1 lb = 0.004448 kN

¹Condition B applies where supplemental reinforcement is not provided as set forth in ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.2 or ACI 318-11 D.2, as applicable, are used in accordance with 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.

TABLE 7—FRACTIONAL THREADED ROD BOND STRENGTH DESIGN INFORMATION FOR ANCHORS INSTALLED WITH PERIODIC SPECIAL INSPECTION^{1,7}

	Deal	an Information	Sumbal	Unite					od Diame	eter	
	Desig	gn Information	Symbol	Units	³ /8"	¹ / ₂ "	⁵ /8"	³ / ₄ "	⁷ /8"	1"	1 ¹ / ₄ "
	Minimum Effe	ective Installation Depth	h _{ef,min}	in.	$2^{3}/_{8}$	$2^{3}/_{4}$	3 ¹ / ₈	3 ¹ / ₂	4	4	5
				mm	60	70	79	89	102	102	127
	Maximum Effe	ective Installation Depth	h _{ef,max}	in.	$7^{1}/_{2}$	10 254	$12^{1}/_{2}$	15 381	17 ¹ / ₂	20 508	25 635
				mm	191	254	318	725	445	508	635
	Temperature	Characteristic Bond Strength in Non-cracked Concrete	T _{k,uncr}	psi							
	Category A ^{2,5}			N/mm ²				5.0		. = 4	
		Characteristic Bond Strength in	τ _{k.cr}	psi	620	585	550	520	485	450	385
		Cracked Concrete	• K, C/	N/mm ²	4.3	4.0	3.8	3.6	3.3	3.1	2.7
a		Characteristic Bond Strength in	-	psi				1,350			
rete	Temperature	Non-cracked Concrete	$\tau_{k,uncr}$	N/mm ²				9.3			
Concrete	Category B, Range	Characteristic Bond Strength in		psi	1150	1090	1025	965	900	840	715
		Cracked Concrete	$\tau_{k,cr}$	N/mm ²	7.9	7.5	7.0	6.7	6.2	5.8	4.9
Dry		Characteristic Bond Strength in		psi				1,030			
	Temperature	Non-cracked Concrete	$\tau_{k,uncr}$	N/mm ²				7.1			
	Category B, Range 2 ^{4,5}	Characteristic Bond Strength in		psi	875	830	780	735	685	640	545
	2	Cracked Concrete	T _{k,cr}	N/mm ²	6.1	5.7	5.4	5.1	4.7	4.4	3.8
	Anchor Category, dr	y concrete	-	-	1	1	1	1	1	1	1
	Strength Reduction		ϕ_{d}	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
		Characteristic Bond Strength in		psi	N/.	A			725		
	Temperature	Non-cracked Concrete	$\tau_{k,uncr}$	N/mm ²	N/	A			5.0		
	Category A ^{2,5}	Characteristic Bond Strength in		psi	520	490	550	520	485	450	385
e		Cracked Concrete	$\tau_{k,cr}$	N/mm ²	3.6	3.4	3.8	3.6	3.3	3.1	2.7
cre				psi		1,135		0.0	1,350	••••	
Concrete	Temperature	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	N/mm ²							
p	Category B, Range 1 ^{3,5}						100-		9.3		
Saturated	1 ^{3,5}	Characteristic Bond Strength in	T _{k,cr}	psi	965	915	1025	965	900	840	715
atu		Cracked Concrete		N/mm ²	6.7	6.3	7.0	6.7	6.2	5.8	4.9
er S	Tamananatuma	Characteristic Bond Strength in	_	psi	86	5			1,030		
Water	Temperature	Non-cracked Concrete	$\tau_{k,uncr}$	N/mm ²	6.	0			7.1		
5	Category B, Range 2 ^{4,5}	Characteristic Bond Strength in		psi	735	695	780	735	685	640	545
		Cracked Concrete	$\tau_{k,cr}$	N/mm ²	5.1	4.8	5.4	5.1	4.7	4.4	3.8
	Anchor Category, wa	ater saturated concrete	-	-	3	3	3	3	3	3	3
	Strength Reduction	Factor	Øws	-	0.45	0.45	0.45	0.45	0.45	0.45	0.45
	_	Characteristic Bond Strength in	-	psi	N/.	A		725		N//	4
	Temperature Category A ^{2,5}	Non-cracked Concrete	$\tau_{k,uncr}$	N/mm ²	N/.	A		5.0		N//	4
	Category A	Characteristic Bond Strength in		psi	540	510	550	520	485	170	145
		Cracked Concrete	$\tau_{k,cr}$	N/mm ²	3.7	3.5	3.8	3.6	3.3	1.2	1.0
e		Characteristic Bond Strength in		psi	1,1			1,350		N//	Δ
운	Temperature	Non-cracked Concrete	T _{k,uncr}	N/mm ²	8.			9.3		N//	
Water-filled Hole	Category B, Range						1025		000		
r-fil	1 ^{3,5}	Characteristic Bond Strength in	τ _{k,cr}	psi	1000	945	1025	965	900	320	270
ate		Cracked Concrete	.,	N/mm ²	6.9	6.5	7.0	6.7	6.2	2.2	1.9
≥	Temperature	Characteristic Bond Strength in	T _{k,uncr}	psi	89			1,030		N//	
	Category B, Range	Non-cracked Concrete		N/mm ²	6.2		700	7.1	0.0-	N//	
	24,5	Characteristic Bond Strength in Cracked Concrete	τ _{k,cr}	psi N/mm²	765	720 5.0	780 5.4	735	685	245 1.7	205
	Anchor Category, wa		.,	N/mm ⁻	5.3 3	5.0 3	5.4 3	5.1 3	4.7 3	1.7	1.4 3
	Strength Reduction		ϕ_{wf}	-	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Eor		$1 \text{ in.}^2 = 645.16 \text{ mm}^2$, 1 lb = 0.0044									

¹Bond strength values correspond to concrete compressive strength f_c = 2,500 psi. Bond strength values must not be increased for increased concrete compressive strength.

²Temperature Category A: Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 176°F (80°C)

³Temperature Category B, Range 1 = Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 130°F (55°C)

⁴Temperature Category B, Range 2 = Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 162°F (72°C)

⁵Short-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.

⁶The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2 are used in accordance with 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. ⁷For sustained loads, bond strengths must be multiplied by 0.73.

TABLE 8—FRACTIONAL THREADED ROD BOND STRENGTH DESIGN INFORMATION FOR ANCHORS INSTALLED WITH CONTINUOUS SPECIAL INSPECTION^{1,7}

		Desi		0	11		Nom	ninal Thr	eaded R	od Diame	eter	
Minimum Effective Instalation Depth har.cos mm 60 70 79 89 102 103 <		Desi	gn Information	Symbol	Units					⁷ /8"		1 ¹ / ₄ "
$ \begin{array}{ c $		Minimum Effe	ective Installation Depth	h _{ef min}								-
Maximum Enclove instantion pair of the standard begin in Cracked Concrete nm 191 254 318 331 445 508 635 Importance Category A ¹⁵ Characteristic Bond Strength in Cracked Concrete r.um 191 254 318 331 445 508 635 Temperature Category A ¹⁵ Characteristic Bond Strength in Cracked Concrete r.um 191 254 318 331 445 508 635 Temperature Category B, Rang Category B, Range Category A ¹⁵ Characteristic Bond Strength in Cracked Concrete r.um r.um psi 1150 1090 1025 965 640 543 450 384 445 588 560 640 543 1150 1090 1025 965 900 840 715 7.0 6.7 6.2 5.8 4.9 98 Nmm ² 7.1 1.1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1												
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$		Maximum Eff	ective Installation Depth	h _{ef,max}								
Temperature Category A ^{2,5} Non-viacked Concrete nume Nume 5.0 Temperature Category B, Rang 1 ^{3,5} Characteristic Bond Strength in Cracked Concrete nume pil 620 585 550 485 450 385 Temperature Category B, Rang 2 ^{4,5} Characteristic Bond Strength in Cracked Concrete nume nume pil 1,350						191	254	318		445	508	635
Category A ^{2,5} Characteristic Bond Strength in Cracked Concrete psi N/mm ² count psi Psi psi psi Psi psi Psi		Tomporaturo		Tkuper	•							
PSI Characteristic Bond Strength in Cracked Concrete PSI 620 580 520 485 450 385 3.8 3.8 3.8 3.8 3.1 2.7 Temperature Category B, Rang 1 ³⁵ Characteristic Bond Strength in Cracked Concrete hurm Paure Pair 1.35 1.05 1.030 1025 966 900 840 715 Temperature Category B, Rang 1 ³⁵ Characteristic Bond Strength in Cracked Concrete n.urm Pair 1150 1000 1025 966 900 840 715 Anchor Category M, Concrete Characteristic Bond Strength in Cracked Concrete n.urm Nmm ² 5.7 5.4 5.1 4.7 4.4 3.8 Temperature Category A ¹⁵ Characteristic Bond Strength in Cracked Concrete n.urm Nmm ² 5.0 5.0			Non-cracked Concrete	-K,unor	N/mm ²			-				-
Temperature Category B, Range 1 ^{3,5} , S Characteristic Bond Strength in Cracked Concrete n.u. pis 1.150 1090 1025 965 900 640 715 Temperature Category B, Range 2 ^{4,5} Characteristic Bond Strength in Non-cracked Concrete n.u. n.u. pis 1150 1090 1025 965 900 640 715 Temperature Category B, Range 2 ^{4,5} Characteristic Bond Strength in Non-cracked Concrete n.u. pis 1.030 1.030 1.030 1.030 1.030 5.0 5.6 640 5445 3.8 3.3 3.1 2.7 1.030 1.1 <		eategery	Characteristic Bond Strength in			620	585	550	520	485	450	385
Bit Temperature (algor) 1 ^{1,1,1} On-cracked Concrete Numn ² Pictor Numn ² 9.3 Time (algor) 1025 965 900 840 715 Temperature Category B, Range 2 ^{2,1} Temperature Category B, Range 2 ^{2,1} Characteristic Bond Strength in Non-cracked Concrete numn ² Pisi			Cracked Concrete	$\tau_{k,cr}$	N/mm ²	4.3	4.0	3.8	3.6	3.3	3.1	2.7
Bit Category R, Range 1 ^{13,5} Non-cracked Concrete num psi 1150 1090 1025 965 900 840 715 Temperature Category B, Range 2 ^{2,4} Characteristic Bond Strength in Cracked Concrete num			Characteristic Bond Strength in		psi				1,350			
Construction	ete			$\tau_{k,uncr}$					93			
Construction	ncr	Category B, Range	Characteristic David Strength in			1150	1090	1025		900	840	715
Column Characteristic Bond Strength in Non-cracked Concrete Psi. Psi. 1.030 Anchor Category, B. Range 2 ^{1,5} Characteristic Bond Strength in Cracked Concrete Psi. 875 830 780 735 685 640 545 Anchor Category, Arv Characteristic Bond Strength in Cracked Concrete Psi. 875 830 780 735 685 640 545 Anchor Category, Arv Granacteristic Bond Strength in Cracked Concrete Psi. 875 830 780 735 685 0.65 0.55 0.55 0.55 0.55 0.5	ပိ	1.,	Characteristic Bond Strength In	$\tau_{k,cr}$								-
Temperature Category B, Range 2 ¹⁵ Characteristic Bond Strength in Cracked Concrete PL/VIC PL/VIC PL/VIC <td>Jr V</td> <td></td> <td></td> <td></td> <td></td> <td>7.9</td> <td>7.5</td> <td>7.0</td> <td>-</td> <td>0.2</td> <td>5.0</td> <td>4.9</td>	Jr V					7.9	7.5	7.0	-	0.2	5.0	4.9
Category B, Rang 2 ¹⁵ Individual control Nmm		Temperature	0	Tkuper					,			
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$		Category B. Range		-R,unor	N/mm ²				7.1			
$ \begin{tabular}{ c c c c c c c c c c c c c c c c c c c$		2 ^{4,5}		$ au_{1}$		875				685		
				ικ,cr	N/mm ²							
Product Characteristic Bond Strength in Non-cracked Concrete psi 725 Nmm ² 5.0 50 450 385 Temperature Category A ^{2,5} Characteristic Bond Strength in Cracked Concrete $\overline{r_{k,cr}}$ psi 620 585 550 520 485 450 385 Temperature Category B, Range 2 ^{4,5} Characteristic Bond Strength in Non-cracked Concrete $\overline{r_{k,cr}}$ psi 4.0 3.8 3.6 3.3 3.1 2.7 Temperature Category B, Range 2 ^{4,5} Characteristic Bond Strength in On-cracked Concrete $\overline{r_{k,cr}}$ psi 1150 1090 1025 965 900 840 715 Non-cracked Concrete $\overline{r_{k,cr}}$ psi 1150 1090 1025 965 900 840 715 Achor Category, B, Range 2 ^{4,5} Characteristic Bond Strength in Cracked Concrete $\overline{r_{k,cr}}$ psi 1.030 7.1 5.5 5.5 5.5 5.5 5.5 5.5 5.5 5.5 5.5 5.5 5.5 5.5 5.5 5.5<												-
Temperature Category A ²⁵ Non-cracked Concrete \$		Strength Reduction	Factor	ϕ_{d}		0.65	0.65	0.65		0.65	0.65	0.65
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$		Tanananatura	Characteristic Bond Strength in	Thursday	•				725			
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$		Category $A^{2,5}$	Non-cracked Concrete	¢K,UNCI	N/mm ²				5.0			
new proper of the category B, Range 1*5 Cracked Concrete T _{k,unc} Psi 4.3 4.0 3.8 3.6 3.3 3.1 2.7 Temperature Category B, Range 1*5 Characteristic Bond Strength in Cracked Concrete T _{k,unc} Psi 1150 1090 1025 965 900 840 715 Cracked Concrete T _{k,unc} Psi 1150 1090 1025 965 900 840 715 Temperature Category B, Range 2*5 Characteristic Bond Strength in Cracked Concrete T _{kunc} Psi 7.9 7.5 7.0 6.7 6.2 5.8 4.9 Temperature Category M, Range 2*5 Characteristic Bond Strength in Cracked Concrete T _{kunc} Psi 7.1 7.1 4.4 3.8 Anchor Category, water saturated concrete T _{kunc} Psi 875 830 780 735 685 640 545 Strength Reduction Factor Que Que - - 3 3 3.6 3.3 1.4 1.2 Tempe		Ouldgoly A	Characteristic Bond Strength in		psi	620	585	550	520	485	450	385
Temperature Category B, Range 2 ^{4,5} Characteristic Bond Strength in Characteristic Bond Strength in Cracked Concrete T _{k,uner} psi 875 830 780 735 685 640 545 Anchor Category, water saturated concrete - - 3 3 2<	ste			$\tau_{k,cr}$	N/mm ²	4.3	4.0	3.8	3.6	3.3	3.1	2.7
Temperature Category B, Range 2 ^{4,5} Characteristic Bond Strength in Characteristic Bond Strength in Cracked Concrete T _{k,uner} psi 875 830 780 735 685 640 545 Anchor Category, water saturated concrete - - 3 3 2<	JCre		Characteristic Bond Strength in		psi				1,350			
Temperature Category B, Range 2 ^{4,5} Characteristic Bond Strength in Characteristic Bond Strength in Cracked Concrete T _{k,uner} psi 875 830 780 735 685 640 545 Anchor Category, water saturated concrete - - 3 3 2<	Co			$\tau_{k,uncr}$	•		4.5 4.0					
Temperature Category B, Range 2 ^{4,5} Characteristic Bond Strength in Characteristic Bond Strength in Cracked Concrete T _{k,uner} psi 875 830 780 735 685 640 545 Anchor Category, water saturated concrete - - 3 3 2<	eq	Category B, Range				1150				000	940	715
Temperature Category B, Range 2 ^{4,5} Characteristic Bond Strength in Characteristic Bond Strength in Cracked Concrete T _{k,uner} psi 875 830 780 735 685 640 545 Anchor Category, water saturated concrete - - 3 3 2<	Irat	10,0		T _{k,cr}								-
Temperature Category B, Range 2 ^{4,5} Characteristic Bond Strength in Characteristic Bond Strength in Cracked Concrete T _{k,uner} psi 875 830 780 735 685 640 545 Anchor Category, water saturated concrete - - 3 3 2<	atu					7.9	7.5	7.0	-	0.2	0.0	4.9
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	er 0	Tomporatura	Characteristic Bond Strength in	-					1,030			
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Vate		Non-cracked Concrete	ℓk,uncr	N/mm ²				7.1			
$ \begin{array}{ c c c c c c c c } \hline \mbox{Cracked Concrete} & $r_{k,crr}$ & N/mm^2 & 6.1 & 5.7 & 5.4 & 5.1 & 4.7 & 4.4 & 3.8 \\ \hline \mbox{Anchor Category, water saturated concrete} & $-$ & $-$ & 3 & 3 & 2 & $1/A$ & 1 & 2 & 0 & 0 & $1/A$ & 1 & 2 & 0 & 2 & 0 & $1/A$ & 1 & 2 & 0 & $1/A$ & 1 & 2 & 0 & $1/A$ & 1 & 2 & 0 & 1 & 1 & 1 & 2 & 0 & $1/A$ & 1 & 1 & 1 & 2 & 1	>	2 ^{4,5}	Characteristic Bond Strength in		psi	875	830	780	735	685	640	545
$ \frac{\text{Anchor Category, water saturated concrete}}{\text{Strength Reduction Factor}} = 3 3 3 2 2 2 2 2 2 2 2 2 2 3 3 3 2 2 2 2 2 2 2 3 3 3 2 2 2 2 2 2 2 2 3 3 3 3 2 2 2 2 2 2 2 3 3 3 3 2 2 2 2 2 2 2 2 3 3 3 3 2 2 2 2 2 2 2 2 2 2 3 3 3 3 2 2 2 2 2 3 3 3 2 2 2 2 3 3 3 2 2 2 2 2 3 3 3 2 2 2 2 2 3 3 3 2 2 2 2 2 3 3 3 2 0 0 0 0$				$\tau_{k,cr}$								
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$		Anchor Category, w	ater saturated concrete	-	-		3	2	2	2	2	2
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$		Strength Reduction	Factor	Øws	-	0.45	0.45	0.55	0.55	0.55	0.55	0.55
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $			Characteristic Bond Strength in		psi			725			N/.	Ą
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$			Non-cracked Concrete	$\tau_{k,uncr}$	N/mm ²			5.0			N/	Ą
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$		Category A ^{2,0}	Characteristic Bond Strength in		psi	540	510	550	520	485	200	175
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $				$\tau_{k,cr}$		3.7	3.5		3.6	3.3	1.4	1.2
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	e											
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	P	Temperature		T _{k,uncr}				· ·				
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	pe								-			
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	-fille	1 ^{3,5}		τ_{i}								
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Iter		Cracked Concrete	►K,Cr	N/mm ²	6.9	6.5		6.7	6.2		
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Na	Tomperatura	Characteristic Bond Strength in					1,030			N/	4
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$			Non-cracked Concrete	T _{k,uncr}	N/mm ²			7.1			N/.	Ą
Image: Clarked Concrete Image: Clarked Conconconcrete Image: Clarked Conc		2 ^{4,5}	Characteristic Bond Strength in	τ								
Strength Reduction Factor φ _{wf} - 0.45 0.45 0.55 0.55 0.45 0.45				ι _{k,cr}	N/mm ²							
					-							
					-	0.45	0.45	0.55	0.55	0.55	0.45	0.45

¹Bond strength values correspond to concrete compressive strength f_c = 2,500 psi. Bond strength values must not be increased for increased concrete compressive strength.

²Temperature Category A: Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 176°F (80°C)

³Temperature Category B, Range 1 = Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 130°F (55°C)

⁴Temperature Category B, Range 2 = Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 162°F (72°C)

⁵Short-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.

⁶The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2 are used in accordance with 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. ⁷ For sustained loads, bond strengths must be multiplied by 0.73.

TABLE 9—FRACTIONAL REINFORCING BAR BOND STRENGTH DESIGN INFORMATION FOR ANCHORS INSTALLED WITH PERIODIC SPECIAL INSPECTION^{1,7}

			_				Reinfo	orcing Ba	ar Size		
	Desig	gn Information	Symbol	Units	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 10
	Nom	ninal Diameter	da	in.	³ / ₈ "	¹ / ₂ "	⁵ / ₈ "	³ / ₄ "	⁷ / ₈ "	1"	1 ¹ / ₄ "
	Minimum Effe	ective Installation Depth	h _{ef,min}	in.	2 ³ / ₈	2 ³ / ₄	3 ¹ / ₈	3 ¹ / ₂	4	4	5
			rier, min	mm	60	70	79	89	102	102	127
	Maximum Effe	ective Installation Depth	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
		Characteristic Dand Strength in		psi	131	234	510	725	440	500	000
	Temperature	Characteristic Bond Strength in Non-cracked Concrete	T _{k,uncr}	N/mm ²				5.0			
	Category A ^{2,5}			psi	620	585	550	520	485	450	385
		Characteristic Bond Strength in Cracked Concrete	T _{k,cr}	N/mm ²	4.3	4.0	3.8	3.6	3.3	3.1	2.7
				psi		1.0	0.0	1,350	0.0	0.1	_
ete	Temperature	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	N/mm ²							
Dry Concrete	Category B, Range				1150	1000	1025	9.3 965	000	040	715
õ	1 ^{3,5}	Characteristic Bond Strength in Cracked Concrete	T _{k,cr}	psi N/mm ²	7.9	1090 7.5	7.0	905 6.7	900 6.2	840 5.8	4.9
D					1.9	7.5	7.0		0.2	5.0	4.9
_	Temperature	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi				1,030			
	Category B, Range			N/mm ²				7.1			
	2 ^{4,5}	Characteristic Bond Strength in Cracked Concrete	T _{k,cr}	psi N/mm ²	875 6.1	830 5.7	780 5.4	735 5.1	685 4.7	640 4.4	545 3.8
	Anchor Category, dr			-	0.1	5.7 1	5.4 1	5.1 1	4.7	4.4	3.0 1
	Strength Reduction		фа	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
	0	Characteristic Bond Strength in	/-	psi	N/	A			725		
	Temperature	Non-cracked Concrete	$\tau_{k,uncr}$	N/mm ²	N/	A			5.0		
	Category A ^{2,5}	Characteristic Bond Strength in		psi	520	490	550	520	485	450	385
e		Cracked Concrete	T _{k,cr}	N/mm ²	3.6	3.4	3.8	3.6	3.3	3.1	2.7
Water Saturated Concrete		Characteristic Bond Strength in		psi	1,1	35			1,350		
Co	Temperature	Non-cracked Concrete	$\tau_{k,uncr}$	N/mm ²	7.				9.3		
eq	Category B, Range 1 ^{3,5}	Characteristic Dand Strength in		psi	965	915	1025	965	900	840	715
urat	1	Characteristic Bond Strength in Cracked Concrete	T _{k,cr}	N/mm ²	6.7	6.3	7.0	6.7	6.2	5.8	4.9
Sat				psi	86		1.0	0.1	1,030	0.0	1.0
ter	Temperature	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	•		-			,		
Wa	Category B Range			N/mm ²	6.				7.1		
	2 ^{4,5}	Characteristic Bond Strength in	T _{k,cr}	psi	735	695	780	735	685	640	545
	Anchor Category w	Cracked Concrete ater saturated concrete	_	N/mm ²	5.1 3	4.8 3	5.4 3	5.1 3	4.7 3	4.4 3	3.8 3
	Strength Reduction		φ _{ws}	-	0.45	0.45	0.45	0.45	0.45	0.45	0.45
	0	Characteristic Bond Strength in	7 110	psi	N/	A		725			I/A
	Temperature	Non-cracked Concrete	T _{k,uncr}	N/mm ²	N/	A		5.0		N	I/A
	Category A ^{2,5}	Characteristic Bond Strength in		psi	540	510	550	520	485	170	145
		Cracked Concrete	τ _{k,cr}	N/mm ²	3.7	3.5	3.8	3.6	3.3	1.2	1.0
<u>e</u>		Characteristic Bond Strength in		psi	1,1			1,350			I/A
운	Temperature	Non-cracked Concrete	$\tau_{k,uncr}$	N/mm ²	8.			9.3			I/A
Water-filled Hole	Category B, Range 1 ^{3,5}			psi	0. 1000	945	1025	9.3 965	900	320	270
er-fi	1-,-	Characteristic Bond Strength in Cracked Concrete	T _{k,cr}	N/mm ²	6.9	6.5	7.0	6.7	6.2	2.2	1.9
Vaté		Characteristic Bond Strength in		psi	89			1,030	0.2		I/A
>	Temperature	Non-cracked Concrete	T _{k,uncr}	N/mm ²	6.			7.1			I/A
	Category B, Range 2 ^{4,5}	Characteristic Bond Strength in		psi	765	720	780	735	685	245	205
	2	Cracked Concrete	T _{k,cr}	N/mm ²	5.3	5.0	5.4	5.1	4.7	1.7	1.4
	Anchor Category, wa Strength Reduction	ater-filled hole	-	-	3 0.45	3 0.45	3 0.45	3 0.45	3 0.45	3 0.45	3 0.45

¹Bond strength values correspond to concrete compressive strength f_c = 2,500 psi. Bond strength values must not be increased for increased concrete compressive strength.

²Temperature Category A: Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 176°F (80°C)

³Temperature Category B, Range 1 = Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 130°F (55°C)

⁴Temperature Category B, Range 2 = Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 162°F (72°C)

⁵Short-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.

⁶The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with 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. ⁷ For sustained loads, bond strengths must be multiplied by 0.73.

TABLE 10—FRACTIONAL REINFORCING BAR BOND STRENGTH DESIGN INFORMATION FOR ANCHORS INSTALLED WITH CONTINUOUS SPECIAL INSPECTION 1,7

	Dasi	gn Information	Symbol	Units			Reinfo	orcing Ba			
	Desi	gnimonnation	Symbol	Units	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 10
	Non	ninal Diameter	da	in.	³ / ₈ "	¹ / ₂ "	⁵ /8"	³ / ₄ "	⁷ / ₈ "	1"	1 ¹ / ₄ "
	Minimum Effe	ective Installation Depth	h _{ef,min}	in.	2 ³ / ₈	2 ³ / ₄	3 ¹ / ₈	3 ¹ / ₂	4	4	5
			riei,min	mm	60	70	79	89	102	102	127
	Maximum Eff	ective Installation Depth	h _{ef,max}	in.	7 ¹ / ₂	10	$12^{1}/_{2}$	15	17 ¹ / ₂	20	25
				mm	191	254	318	381	445	508	635
	Temperature	Characteristic Bond Strength in Non-cracked Concrete	T _{k,uncr}	psi				725			
	Category A ^{2,5}			N/mm ²	000	505	550	5.0	405	450	005
		Characteristic Bond Strength in Cracked Concrete	T _{k,cr}	psi N/mm ²	620 4.3	585 4.0	550 3.8	520 3.6	485 3.3	450 3.1	385 2.7
~		Characteristic Bond Strength in		psi				1,350			
Concrete	Temperature	Non-cracked Concrete	$ au_{k,uncr}$	N/mm ²				9.3			
onc	Category B, Range 1 ^{3,5}	Characteristic Bond Strength in		psi	1150	1090	1025	965	900	840	715
y C		Cracked Concrete	T _{k,cr}	N/mm ²	7.9	7.5	7.0	6.7	6.2	5.8	4.9
Dry		Characteristic Bond Strength in		psi		•	•	1,030	•		
	Temperature	Non-cracked Concrete	$\tau_{k,uncr}$	N/mm ²				7.1			
	Category B, Range 2 ^{4,5}	Characteristic Bond Strength in		psi	875	830	780	735	685	640	545
	2	Cracked Concrete	T _{k,cr}	N/mm ²	6.1	5.7	5.4	5.1	4.7	4.4	3.8
	Anchor Category, dr	ry concrete	-	-	1	1	1	1	1	1	1
	Strength Reduction		ϕ_{d}	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
		Characteristic Bond Strength in		psi				725			
	Temperature	Non-cracked Concrete	$\tau_{k,uncr}$	N/mm ²				5.0			
	Category A ^{2,5}	Characteristic Bond Strength in		psi	620	585	550	520	485	450	385
ete		Cracked Concrete	$\tau_{k,cr}$	N/mm ²	4.3	4.0	3.8	3.6	3.3	3.1	2.7
ncre		Characteristic Bond Strength in		psi				1,350			
Сo	Temperature	Non-cracked Concrete	$\tau_{k,uncr}$	N/mm ²				9.3			
Ited	Category B, Range 1 ^{3,5}	Characteristic Bond Strength in		psi	1150	1090	1025	965	900	840	715
ture	•	Cracked Concrete	T _{k,cr}	N/mm ²	7.9	7.5	7.0	6.7	6.2	5.8	4.9
r Sa		Characteristic Bond Strength in		psi			•	1,030			
Water Saturated Concrete	Temperature Category B, Range	Non-cracked Concrete	$\tau_{k,uncr}$	N/mm ²				7.1			
-	2 ^{4,5}	Characteristic Bond Strength in	τ _{k.cr}	psi	875	830	780	735	685	640	545
		Cracked Concrete	<i>₽K,CI</i>	N/mm ²	6.1	5.7	5.4	5.1	4.7	4.4	3.8
		ater saturated concrete	-	-	3	3	2	2	2	2	2
	Strength Reduction		Øws	-	0.45	0.45	0.55	0.55	0.55	0.55	0.55
	Temperature	Characteristic Bond Strength in	T _{k,uncr}	psi			725				I/A
	Category A ^{2,5}	Non-cracked Concrete	.,	N/mm ²		1	5.0	1	1		I/A
		Characteristic Bond Strength in	$\tau_{k,cr}$	psi	540	510	550	520	485	200	175
		Cracked Concrete	•ĸ,c/	N/mm ²	3.7	3.5	3.8	3.6	3.3	1.4	1.2
Water-filled Hole	Tomporatura	Characteristic Bond Strength in	$ au_{t_1,\ldots,t_n}$	psi			1,350			N	I/A
⊢ Þ	Temperature Category B, Range	Non-cracked Concrete	$ au_{k,uncr}$	N/mm ²			9.3			N	I/A
fille	1 ^{3,5}	Characteristic Bond Strength in	_	psi	1000	945	1025	965	900	380	320
ter-		Cracked Concrete	T _{k,cr}	N/mm ²	6.9	6.5	7.0	6.7	6.2	2.6	2.2
Wa	Tantati	Characteristic Bond Strength in		psi			1,030			N	I/A
	Temperature Category B, Range	Non-cracked Concrete	T _{k,uncr}	N/mm ²			7.1			N	I/A
		Characteristic Bond Strength in	-	psi	765	720	780	735	685	290	245
		Cracked Concrete	T _{k,cr}	N/mm ²	5.3	5.0	5.4	5.1	4.7	2.0	1.7
	Anchor Category, w		-	-	3	3	2	2	2	3	3
	Strength Reduction	Factor	ϕ_{wf}	-	0.45	0.45	0.55	0.55	0.55	0.45	0.45

For **SI:** 1 inch = 25.4 mm, 1 in.² = 645.16 mm², 1 lb = 0.004448 kN

¹Bond strength values correspond to concrete compressive strength f_c = 2,500 psi. Bond strength values must not be increased for increased concrete compressive strength.

²Temperature Category A: Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 176°F (80°C)

³Temperature Category B, Range 1 = Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 130°F (55°C) ⁴Temperature Category B, Range 2 = Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 162°F (72°C)

⁵Short-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.

⁶The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2 are used in accordance with 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.

⁷For sustained loads, bond strengths must be multiplied by 0.73.

TABLE 11-METRIC THREADED ROD BOND STRENGTH DESIGN INFORMATION FOR ANCHORS INSTALLED WITH PERIODIC SPECIAL INSPECTION 1,7

						Nomin	al Thread	ed Rod Di	ameter	
	Desi	gn Information	Symbol	Units	M10	M12	M16	M20	M24	M30
	Minimum Eff	ective Installation Depth	h _{ef,min}	in.	2.4	2.8	3.1	3.5	3.8	4.7
			r er,min	mm	60	70	80	90	96	120
	Maximum Fff	ective Installation Depth	h _{ef,max}	in.	7.9	9.4	12.6	15.7	18.9	23.6
			· ·ei,iiidx	mm	200	240	320	400	480	600
		Characteristic Bond Strength in		psi			72	25		
	Temperature Category A ^{2,5}	Non-cracked Concrete	T _{k,uncr}	N/mm ²			5	.0		
	Calegory A	Characteristic Bond Strength in		psi	615	590	550	510	465	400
		Cracked Concrete	$\tau_{k,cr}$	N/mm ²	4.2	4.1	3.8	3.5	3.2	2.8
		Characteristic Bond Strength in		psi			1,3	50		
Dry Concrete	Temperature	Non-cracked Concrete	T _{k,uncr}	N/mm ²			9			
ncr	Category B, Range	Ob and attacked in David Observation		psi	1140	1100	1025	945	865	750
ပိ	1°,°	Characteristic Bond Strength in Cracked Concrete	τ _{k,cr}	N/mm ²	7.9	7.6	7.0	945 6.5	6.0	5.2
Jry		Clacked Coliciele			7.9	7.0	-		0.0	J.Z
	Temperature	Characteristic Bond Strength in	T _{k,uncr}	psi			1,0			
		Non-cracked Concrete	vr,uno	N/mm ²			7.	.1		
	Category B, Range 2 ^{4,5}	Characteristic Bond Strength in		psi	870	840	780	720	660	570
		Cracked Concrete	T _{k,cr}	N/mm ²	6.0	5.8	5.4	5.0	4.6	3.9
	Anchor Category, dr		-	-	1	1	1	1	1	1
	Strength Reduction	Factor	$\phi_{\sf d}$	-	0.65	0.65	0.65	0.65	0.65	0.65
	T	Characteristic Bond Strength in	7	psi	N	/A		7:	25	
	Temperature Category A ^{2,5}	Non-cracked Concrete	Tk,uncr	N/mm ²	N	/A		5	.0	
	Calegory A	Characteristic Bond Strength in		psi	520	490	550	510	465	400
ete		Cracked Concrete	$\tau_{k,cr}$	N/mm ²		3.8	3.5	3.2	2.8	
JCré		Characteristic Bond Strength in		psi	1,1	1,135		1,3	350	
Saturated Concrete	Temperature	Non-cracked Concrete	$\tau_{k,uncr}$	N/mm ²				9	.3	
ed	Category B, Range	Ob and attacked in David Observation		psi	960	925	1025	945	865	750
ırat	1-,-	Characteristic Bond Strength in Cracked Concrete		N/mm ²	6.6	6.4	7.0	6.5	6.0	5.2
àatı						-	7.0			5.2
er (Temperature	Characteristic Bond Strength in	7	psi	86	55		1,0	030	
Water \$		Non-cracked Concrete	Tk,uncr	N/mm ²	6	.0		7	.1	
>	Category B, Range 2 ^{4,5}	Characteristic Bond Strength in		psi	730	705	780	720	660	570
		Cracked Concrete	$\tau_{k,cr}$	N/mm ²	5.0	4.9	5.4	5.0	4.6	3.9
	Anchor Category, w	ater saturated concrete	-	-	3	3	3	3	3	3
	Strength Reduction	Factor	ϕ_{ws}	-	0.45	0.45	0.45	0.45	0.45	0.45
		Characteristic Bond Strength in		psi	N	/A	72	<u>2</u> 5	N/	A
	Temperature	Non-cracked Concrete	Tk,uncr	N/mm ²	N	/A	5	.0	N/	A
	Category A ^{2,5}	Characteristic Bond Strength in		psi	535	515	550	510	N/A	N/A
		Cracked Concrete	$\tau_{k,cr}$	N/mm ²	3.7	3.6	3.8	3.5	N/A	N/A
e				psi		75	1,3		N/	
Ы	Temperature	Characteristic Bond Strength in Non-cracked Concrete	T _{k,uncr}							
Water-filled Hole	Category B, Range			N/mm ²	-	.1	-	.3	N/	
-fill	1 ^{3,5}	Characteristic Bond Strength in	T _{k,cr}	psi	995	960	1025	945	330	285
ater		Cracked Concrete	• K, CI	N/mm ²	6.9	6.6	7.0	6.5	2.3	2.0
Ŵ	Temperature	Characteristic Bond Strength in	π	psi	89		1,0		N/	
	Category B, Range	Non-cracked Concrete	T _{k,uncr}	N/mm ²	-	.2	7.	.1	N/	A
	2 ^{4,5}	Characteristic Bond Strength in	T:	psi	760	730	780	720	250	215
		Cracked Concrete	$\tau_{k,cr}$	N/mm ²	5.2	5.0	5.4	5.0	1.7	1.5
	Anchor Category, w		-	-	3	3	3	3	3	3
	Strength Reduction	Factor	ϕ_{wf}	-	0.45	0.45	0.45	0.45	0.45	0.45

For **SI:** 1 inch = 25.4 mm, 1 in.² = 645.16 mm², 1 lb = 0.004448 kN

¹Bond strength values correspond to concrete compressive strength f_c = 2,500 psi. Bond strength values must not be increased for increased concrete compressive strength.

²Temperature Category A: Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 176°F (80°C)

³Temperature Category B, Range 1 = Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 130°F (55°C)

⁴Temperature Category B, Range 2 = Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 162°F (72°C)

⁵Short-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.

⁶The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with 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. ⁷ For sustained loads, bond strengths must be multiplied by 0.73.

TABLE 12-METRIC THREADED ROD BOND STRENGTH DESIGN INFORMATION FOR ANCHORS INSTALLED WITH CONTINUOUS SPECIAL INSPECTION 1,7

Design Information		Symbol	Units		r	al Threade				
				M10	M12	M16	M20	M24	M30	
Minimum Effective Installation Depth		h _{ef,min}	in. mm	2.4 60	2.8 70	3.1 80	3.5 90	3.8 96	4.7 120	
				in.	7.9	9.4	12.6	15.7	18.9	23.6
	Maximum Ef	fective Installation Depth	h _{ef,max}	mm	200	240	320	400	480	600
		Oberneterietie Devel Othersette in		psi	200	240	72		400	000
	Temperature	Characteristic Bond Strength in Non-cracked Concrete	T _{k,uncr}		-					
	Category A ^{2,5}			N/mm ²	o / =		5.			
		Characteristic Bond Strength in	$\tau_{k,cr}$	psi	615	590	550	510	465	400
		Cracked Concrete	•ĸ,c/	N/mm ²	4.2	4.1	3.8	3.5	3.2	2.8
0		Characteristic Bond Strength in		psi			1,3	50		
rete	Temperature	Non-cracked Concrete	T _{k,uncr}	N/mm ²			9.	3		
Dry Concrete	Category B, Range 1 ^{3,5}	Characteristic Bond Strength in		psi	1140	1100	1025	945	865	750
ŏ	•	Cracked Concrete	$\tau_{k,cr}$	N/mm ²	7.9	7.6	7.0	6.5	6.0	5.2
Dry		Oberneterietie Dered Otreresth in		psi	-	-	1,0	30		-
	Temperature	Characteristic Bond Strength in Non-cracked Concrete	T _{k,uncr}				,			
	Category B, Range			N/mm ²			7.	n		
	2 ^{4,5}	Characteristic Bond Strength in	T _{k,cr}	psi	870	840	780	720	660	570
	Anchor Category, dr	Cracked Concrete	· · ·	N/mm ²	6.0 1	5.8 1	5.4 1	5.0 1	4.6 1	3.9 1
	Strength Reduction		 φ _d	-	0.65	0.65	0.65	0.65	0.65	0.65
	Strength Reduction		Ψd		0.05	0.05			0.05	0.05
	Temperature	Characteristic Bond Strength in Non-cracked Concrete	T _{k,uncr}	psi	725					
	Category A ^{2,5}	Non-cracked Concrete	.,	N/mm ²		1	5.	-		
		Characteristic Bond Strength in	τ	psi	615	590	550	510	465	400
ete		Cracked Concrete	$\tau_{k,cr}$	N/mm ²	4.2	4.1	3.8	3.5	3.2	2.8
ncr		Characteristic Bond Strength in Non-cracked Concrete	τ _{k,uncr}	psi			1,3	50		
Water Saturated Concrete	Temperature Category B, Range 1 ^{3,5}			N/mm ²			9.	3		
ed		Characteristic Bond Strength in Cracked Concrete	-	psi	1140	1100	1025	945	865	750
urat			T _{k,cr}	N/mm ²	7.9	7.6	7.0	6.5	6.0	5.2
Satı		Characteristic Bond Strength in			1.5	7.0	-		0.0	5.2
er S	Temperature		<i>T</i> 1	psi	1,030					
Vat	Category B. Range		T _{k,uncr}	N/mm ²	7.1					
>	Category B, Range 2 ^{4,5}	Characteristic Bond Strength in		psi	870	840	780	720	660	570
		Cracked Concrete	$\tau_{k,cr}$	N/mm ²	6.0	5.8	5.4	5.0	4.6	3.9
		ater saturated concrete	-	-	3	3	2	2	2	2
	Strength Reduction	Factor	Øws	-	0.45	0.45	0.55	0.55	0.55	0.55
		Characteristic Bond Strength in		psi		72	25		N/	A
	Temperature	Non-cracked Concrete	T _{k,uncr}	N/mm ²		5.	0		N/	A
	Category A ^{2,5}	Characteristic Bond Strength in		psi	615	590	550	510	210	N/A
		Cracked Concrete	$ au_{k,cr}$	N/mm ²	4.2	4.1	3.8	3.5	1.5	N/A
e						1,3			N/	
РЧ	Temperature	Characteristic Bond Strength in Non-cracked Concrete	T _{k,uncr}	psi						
ed I				N/mm ²		9.	-	1	N/	
Water-filled Hole	Category B, Range 1 ^{3,5}	Characteristic Bond Strength in	au	psi	1140	1100	1025	945	390	335
ater		Cracked Concrete	$ au_{k,cr}$	N/mm ²	7.9	7.6	7.0	6.5	2.7	2.3
Wê	Temperature	Characteristic Bond Strength in	_	psi		1,0	30		N/	A
	Category B Range	Non-cracked Concrete	$\tau_{k,uncr}$	N/mm ²		7.	1		N/	A
	Category B, Range 2 ^{4,5}	Characteristic Bond Strength in	T.	psi	870	840	780	720	295	255
		Cracked Concrete	$ au_{k,cr}$	N/mm ²	6.0	5.8	5.4	5.0	2.0	1.8
	Anchor Category, w		-	-	3	3	2	2	3	3
	Strength Reduction	Factor , 1 in. ² = 645.16 mm ² , 1 lb = 0.0044	ϕ_{wf}	-	0.45	0.45	0.55	0.55	0.45	0.45

For **SI:** 1 inch = 25.4 mm, 1 in.² = 645.16 mm², 1 lb = 0.004448 kN

¹Bond strength values correspond to concrete compressive strength f_c = 2,500 psi. Bond strength values must not be increased for increased concrete compressive strength.

²Temperature Category A: Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 176°F (80°C)

³Temperature Category B, Range 1 = Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 130°F (55°C)

⁴Temperature Category B, Range 2 = Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 162°F (72°C)

⁵Short-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.

⁶The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with 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. ⁷For sustained loads, bond strengths must be multiplied by 0.73.

TABLE 13—METRIC REBAR BOND STRENGTH DESIGN INFORMATION FOR ANCHORS INSTALLED WITH PERIODIC SPECIAL INSPECTION 1,7

	Decian Information		Symbol	Unito		Nomina	I Reinford	ing Bar D	iameter	
	Design Information			Units	M10	M12	M16	M20	M25	M32
Minimum Effective Installation Depth		h _{ef,min}	in.	2.4	2.8	3.1	3.5	3.9	5.0	
		r er, min	mm	60	70	80	90	100	128	
	Maximum Ef	fective Installation Depth	h _{ef,max}	in.	7.9	9.4	12.6	15.7	19.7	25.2
				mm	200	240	320	400	500	640
	Temperature	Characteristic Bond Strength in	$\tau_{k,uncr}$	psi			72	25		
	Category A ^{2,5}	Non-cracked Concrete	-K, unci	N/mm ²		-	-	.0	-	
	category	Characteristic Bond Strength in	_	psi	615	590	550	510	455	380
		Cracked Concrete	T _{k,cr}	N/mm ²	4.2	4.1	3.8	3.5	3.1	2.6
0		Characteristic Bond Strength in		psi			1,3	350		
Concrete	Temperature	Non-cracked Concrete	$\tau_{k,uncr}$	N/mm ²			9	.3		
ouc	Category B, Range 1 ^{3,5}	Characteristic Bond Strength in		psi	1140	1100	1025	945	845	710
Ŭ	•	Cracked Concrete	$\tau_{k,cr}$	N/mm ²	7.9	7.6	7.0	6.5	5.8	4.9
Dry		Characteristic Bond Strength in		psi		1	1 ()30	1	1
	Temperature	Non-cracked Concrete	$\tau_{k,uncr}$	N/mm ²			7			
	Category B, Range 2 ^{4,5}	Characteristic Dand Strength in			870	840	780	720	645	540
	2	Characteristic Bond Strength in Cracked Concrete	T _{k,cr}	psi N/mm ²	6.0	5.8	5.4	5.0	4.5	340
	Anchor Category, dr		_	-	1	1	1	1	+.0 1	1
	Strength Reduction		$\phi_{\sf d}$	-	0.65	0.65	0.65	0.65	0.65	0.65
	Ŭ	Characteristic Bond Strength in	70	psi	N	/A	•	72	25	
	Temperature	Non-cracked Concrete	$\tau_{k,uncr}$	N/mm ²	N	/A		5	.0	
	Category A ^{2,5}	Characteristic Bond Strength in Cracked Concrete		psi	520	490	550	510	455	380
e			T _{k,cr}	N/mm ²	3.6	3.4	3.8	3.5	3.1	2.6
Saturated Concrete						-	0.0		-	2.0
ũ	Temperature	Characteristic Bond Strength in Non-cracked Concrete	T _{k,uncr}	psi	1,135 7.8				350	
p	Category B Range			N/mm ²				-	.3	
ate	1 ^{3,5}	· · · · · · · · · · · · · · · · · · ·	The art	psi	960	925	1025	945	845	710
atur		Cracked Concrete	$\tau_{k,cr}$	N/mm ²	6.6	6.4	7.0	6.5	5.8	4.9
ŝ		Characteristic Bond Strength in		psi	865		1,030			
Water 8	Temperature Category B, Range	Temperature Non-cracked Concrete	$\tau_{k,uncr}$	N/mm ²	6.0 7.1					
\$	2 ^{4,5}	2 ^{4,5} Characteristic Bond Strength in		psi	730	705	780	720	645	540
		Cracked Concrete		N/mm ²	5.0	4.9	5.4	5.0	4.5	3.7
	Anchor Category, w	ater saturated concrete	-	-	3	3	3	3	3	3
	Strength Reduction	Factor	ϕ_{ws}	-	0.45	0.45	0.45	0.45	0.45	0.45
		Characteristic Bond Strength in		psi	N	/A	72	25	N/.	A
	Temperature	Non-cracked Concrete	$\tau_{k,uncr}$	N/mm ²	N	/A	5.	0	N/	Ą
	Category A ^{2,5}	Characteristic Bond Strength in		psi	535	515	550	510	N/A	N/A
		Cracked Concrete	T _{k,cr}	N/mm ²	3.7	3.6	3.8	3.5	N/A	N/A
e		Characteristic Bond Strength in		psi	1 1	75	1,3	50	N/	Δ
Я	Temperature	Non-cracked Concrete	T _{k, uncr}	N/mm ²	.,.		9.		N/.	
Water-filled Hole	Category B. Range									
r-fil	1 ^{3,5}	Characteristic Bond Strength in	$\tau_{k,cr}$	psi	995	960	1025	945	330	285
ate		Cracked Concrete		N/mm ²	6.9	6.6	7.0	6.5	2.3	2.0
≥	Temperature	Characteristic Bond Strength in	$\tau_{k,uncr}$	psi		95	1,0		N/.	
	Category B, Range	Non-cracked Concrete		N/mm ²		.2	7.		N/.	
	2 ^{4,5}	Characteristic Bond Strength in Cracked Concrete	τ _{k,cr}	psi N/mm ²	760 5.2	730	780 5.4	720 5.0	245 1.7	205
	Anchor Category, wa			-	5.2 3	5.0 3	5.4 3	5.0 3	3	1.4 3
	Strength Reduction		φ _{wf}	-	0.45	0.45	0.45	0.45	0.45	0.45
-		$1 \text{ in.}^2 = 645.16 \text{ mm}^2$. 1 lb = 0.0044		1						

For **SI:** 1 inch = 25.4 mm, 1 in.² = 645.16 mm², 1 lb = 0.004448 kN

¹Bond strength values correspond to concrete compressive strength $f_c = 2,500$ psi. Bond strength values must not be increased for increased concrete compressive strength.

²Temperature Category A: Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 176°F (80°C)

³Temperature Category B, Range 1 = Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 130°F (55°C) ⁴Temperature Category B, Range 2 = Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 162°F (72°C)

⁵Short-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.

⁶The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with 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.

⁷For sustained loads, bond strengths must be multiplied by 0.73.

TABLE 14-METRIC REBAR BOND STRENGTH DESIGN INFORMATION FOR ANCHORS INSTALLED WITH CONTINUOUS SPECIAL INSPECTION 1,7 7

Desire le famo di an		Symbol		Nominal Reinforcing Bar Diameter						
Design Information			Units	M10	M12	M16	M20	M25	M32	
Minimum Effective Installation Depth			h _{ef,min}	in.	2.4	2.8	3.1	3.5	3.9	5.0
			l let,min	mm	60	70	80	90	100	128
	Maximum Ef	fective Installation Depth	h _{ef,max}	in.	7.9	9.4	12.6	15.7	19.7	25.2
			···ei,max	mm	200	240	320	400	500	640
	_	Characteristic Bond Strength in	-	psi			72	25		
	Temperature Category A ^{2,5}	Non-cracked Concrete	$\tau_{k,uncr}$	N/mm ²			5.	0		
	Calegory A	Characteristic Bond Strength in		psi	615	590	550	510	455	380
		Cracked Concrete	$\tau_{k,cr}$	N/mm ²	4.2	4.1	3.8	3.5	3.1	2.6
		Characteristic Dand Strength in		psi			1,3	50	1	
ete	Temperature	Characteristic Bond Strength in Non-cracked Concrete	T _{k, uncr}	N/mm ²						
Concrete	Category B, Range				1110	1100	9.	-	0.15	740
Cor	1 ^{3,5}	Characteristic Bond Strength in	$\tau_{k,cr}$	psi	1140	1100	1025	945	845	710
Dry (Cracked Concrete	-1,01	N/mm ²	7.9	7.6	7.0	6.5	5.8	4.9
	Tamananatuma	Characteristic Bond Strength in		psi			1,0	30		
	Temperature Category B, Range	Non-cracked Concrete	$\tau_{k,uncr}$	N/mm ²			7.	1		
	2 ^{4,5}	Characteristic Bond Strength in		psi	870	840	780	720	645	540
		Cracked Concrete	T _{k,cr}	N/mm ²	6.0	5.8	5.4	5.0	4.5	3.7
	Anchor Category, dr		-	-	1	1	1	1	1	1
	Strength Reduction	Factor	ϕ_{d}	-	0.65	0.65	0.65	0.65	0.65	0.65
		Characteristic Bond Strength in		psi	725					
	Temperature Category A ^{2,5}	Non-cracked Concrete	Tk,uncr	N/mm ²	5.0					
		Characteristic Bond Strength in Cracked Concrete		psi	615	590	550	510	455	380
te			$\tau_{k,cr}$	N/mm ²	4.2	4.1	3.8	3.5	3.1	2.6
Concrete		Characteristic Dand Strength in		psi			1,3			
Son	Temperature	Characteristic Bond Strength in Non-cracked Concrete	T _{k,uncr}		,					
	Category B, Range			N/mm ²	9.3					
Saturated		Characteristic Bond Strength in	T _{k,cr}	psi	1140	1100	1025	945	845	710
atur		Cracked Concrete	PR,07	N/mm ²	7.9	7.6	7.0	6.5	5.8	4.9
r Si				psi	1,030					
Water 8	Temperature		T _{k,uncr}	N/mm ²	7.1					
\geq	Category B, Range 2 ^{4,5}	Characteristic Dand Strength in			870	840	780	720	645	540
	2	Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi N/mm ²	6.0	5.8	5.4	5.0	4.5	3.7
	Anchor Category w	ater saturated concrete	_	-	3	3	2	2	2	2
	Strength Reduction		Øws	-	0.45	0.45	0.55	0.55	0.55	0.55
	0	Characteristic Bond Strength in	7 11 3	psi		72			N/	
	Temperature	Non-cracked Concrete	T _{k,uncr}	N/mm ²		5.			N/.	
	Category A ^{2,5}				615	590	550	510	205	- N/A
		Characteristic Bond Strength in	$\tau_{k,cr}$	psi						
		Cracked Concrete		N/mm ²	4.2	4.1	3.8	3.5	1.4	N/A
Water-filled Hole	Tamagast	Characteristic Bond Strength in	$ au_{1}$	psi		1,3	50		N/.	4
ЧP	Temperature Category B, Range	Non-cracked Concrete	$\tau_{k,uncr}$	N/mm ²		9.3 N/A				4
fille	1 ^{3,5}	Characteristic Bond Strength in		psi	1140	1100	1025	945	330	320
er-		Cracked Concrete	T _{k,cr}	N/mm ²	7.9	7.6	7.0	6.5	2.6	2.2
Nat		Characteristic Bond Strength in		psi		1,0	30	1	N/	۹.
^	Temperature	Non-cracked Concrete	$\tau_{k,uncr}$	N/mm ²		7.			N/	
	Category B, Range 2 ^{4,5}	Characteristic Bond Strength in		psi	870	840	780	720	290	245
	2	Cracked Concrete	$\tau_{k,cr}$	N/mm ²	6.0	5.8	5.4	5.0	2.0	1.7
	Anchor Category, wa		-	-	3	3	2	2	3	3
	Strength Reduction	Factor	ϕ_{wf}	-	0.45	0.45	0.55	0.55	0.45	0.45
For	SI 1 inch = 25.4 mm	, 1 in. ² = 645.16 mm ² , 1 lb = 0.0044	48 kN							

For **SI:** 1 inch = 25.4 mm, 1 in.² = 645.16 mm², 1 lb = 0.004448 kN

¹Bond strength values correspond to concrete compressive strength f_c = 2,500 psi. Bond strength values must not be increased for increased concrete compressive strength.

²Temperature Category A: Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 176°F (80°C)

³Temperature Category B, Range 1 = Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 130°F (55°C)

⁴Temperature Category B, Range 2 = Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 162°F (72°C)

⁵Short-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.

⁶The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with 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. ⁷ For sustained loads, bond strengths must be multiplied by 0.73.



FIGURE 2—SIKA ANCHORFIX[®] ADHESIVE ANCHORING SYSTEM

TABLE 15—INSTALL PARAMETERS (FR	ACTIONAL SIZES)
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Threaded Rod Installations									
Anchor Size	Drilled Hole Size	Cleaning Brush Size	Nozzl SAF-Q	e Type SAF-Q2	Extension Tube Required?	Resin Stopper Required?	Notes		
	A		N. M.	₹					
³ / ₈ "	¹ / ₂ "	SAF-14MM	~		Y1 > 3.5" h _{ef}	N			
¹ / ₂ "	⁹ / ₁₆ "	SAF-16MM	~		Y1 > 3.5" h _{ef}	N			
⁵ /8"	³ / ₄ "	SAF-22MM	~	~	Y2 > 10" h _{ef}	SAF RS18>10"h _{ef}	SAF-Q2 nozzle required at h _{ef} > 8"		
³ / ₄ "	⁷ / ₈ "	SAF-24MM		/	Y2 > 10" h _{ef}	SAF RS18>10"h _{ef}			
⁷ / ₈ "	1"	SAF-27MM		<	Y2 > 10" h _{ef}	SAF RS22>10"h _{ef}			
1"	1 ¹ / ₈ "	SAF31MM		~	Y2 > 10" h _{ef}	SAF RS22>10"h _{ef}			
1 ¹ / ₄ "	1 ³ / ₈ "	SAF-38MM		V	Y2 > 10" h _{ef}	SAF RS30>10"h _{ef}			
			Reinf	orcing Bar Iı	nstallations				
Anchor Size	Drilled Hole Size	Cleaning Brush Size	Nozzle SAF-Q	e Type SAF-Q2	Extension Tube Required?	Resin Stopper Required?	Notes		
				, Sector					
#3	⁹ / ₁₆ "	SAF-16MM	~		Y1 > 3.5" h _{ef}	N			
#4	⁵ /8"	SAF-18MM	V	~	Y1 > 3.5" h _{ef}	N	SAF-Q2 nozzle required at h _{ef} > 3.5"		
#5	³ / ₄ "	SAF-22MM	~	~	Y2 > 10" h _{ef}	SAF RS18>10"h _{ef}	SAF-Q2 nozzle required at h _{ef} > 8"		
#6	⁷ / ₈ "	SAF-27MM		~	Y2 > 10" h _{ef}	SAF RS18>10"h _{ef}			
#7	1"	SAF-31MM		V	Y2 > 10" h _{ef}	SAF RS22>10"h _{ef}			
#8	1 ¹ / ₈ "	SAF-35MM		V	Y2 > 10" h _{ef}	SAF RS22>10"h _{ef}			
#10	1 ³ / ₈ "	SAF-43MM		V	Y2 > 10" h _{ef}	SAF RS30>10"h _{ef}			

<u>Key:</u> Y1 Y2

Requires ${}^{3}/{}_{8}$ " diameter extension tube fitted to SAF-Q nozzle Requires ${}^{9}/{}_{16}$ " diameter extension tube fitted toSAF-Q2 nozzle Use 18 mm diameter resin stopper Use 22 mm diameter resin stopper Use 30 mm diameter resin stopper Not required

SAF RS18 SAF RS22 SAF RS30 N

TABLE 16—INSTALI	PARAMETERS	(METRIC SIZES)
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Threaded Rod Installations										
Anchor Size	Drilled Hole Size	Cleaning Brush Size	Nozzle SAF-Q	e Type SAF-Q2	Extension Tube Required?	Resin Stopper Required?	Notes			
	Ŕ		(internet)	2 - Secondar Mir Mir						
M10	12	SAF-14MM	~		Y1 >90 mm h _{ef}	N				
M12	14	SAF-16MM	~		Y1 > 90 mm h _{ef}	Ν				
M16	18	SAF-22MM	~	>	Y2 > 250 mm h _{ef}	SAF RS18>250 mm h _{ef}	SAF-Q2 nozzle required at h _{ef} > 200 mm			
M20	22	SAF-24MM		~	Y2 > 250 mm h _{ef}	SAF RS18>250 mm h _{ef}				
M24	26	SAF-31MM		~	Y2 > 250 mm h _{ef}	SAF RS22>250 mm h _{ef}				
M30	35	SAF-38MM		~	Y2 > 250 mm h _{ef}	SAF RS30>250 mm h _{ef}				
Anchor	Drilled Hole	Cleaning Druch		-	Installations Extension Tube	Desin Stanner				
Size	Size	Cleaning Brush Size	SAF-Q	e Type SAF-Q2	Required?	Resin Stopper Required?	Notes			
	Ŕ			ک سے ایک میں میں م						
T10	14	SAF-16MM			Y1 > 90 mm h _{ef}	N				
T12	16	SAF-18MM	~	>	Y1 > 90 mm h _{ef}	N	SAF-Q2 nozzle required at h _{ef} > 90 mm			
T16	20	SAF-22MM	~	>	Y2 > 250 mm h _{ef}	SAF RS18>250 mm h _{ef}	SAF-Q2 nozzle required at h _{ef} > 200 mm			
T20	25	SAF-27MM		~	Y2 > 250 mm h _{ef}	SAF RS22>250 mm h _{ef}				
T25	32	SAF-35MM		~	Y2 > 250 mm h _{ef}	SAF RS22>250 mm h _{ef}				
T32	40	SAF-43MM		V	Y2 > 250 mm h _{ef}	SAF RS30>250 mm h _{ef}				

<u>Key:</u> Y1 Y2

Requires 10 mm diameter extension tube fitted to SAF- Q nozzle Requires14 mm diameter extension tube fitted to SAF- Q2 nozzle

Use 18 mm diameter resin stopper

Use 22 mm diameter resin stopper Use 30 mm diameter resin stopper

SAF RS18 SAF RS22 SAF RS30

N Not required

	LE AND DISPENSING TOOL Allowable Nozzle Types		
Cartridge Reference	Allowable Applicator Tools	SAF-Q	SAF-Q2
Sika AnchorFix [®] -3001 250 mL	Cox 300 mL Manual (26:1 mechanical advantage)	~	
Sika AnchorFix [®] -3001 400 mL	Cox 400 mL Manual (26:1 mechanical advantage)	•	•
Sika AnchorFix [®] -3001 600 mL	Newborn 600 mL Manual (26:1 mechanical advantage)	· ·	•
Sika AnchorFix [®] -3001 1500 mL	Newborn 1500 mL Pneumatic	~	•

 TABLE 17—ALLOWABLE COMBINATIONS OF CARTRIDGE, MIXER NOZZLE AND DISPENSING TOOL

TABLE 18—GEL AND CURE TIMES¹

Substrate Temperature (°C)	Substrate Temperature (°F)	Gel Time	Cure Time
4 to 9	40 to 49		24 hours
10 to 15	50 to 59	20 mins	12 hours
15 to 22	59 to 72	15 mins	8 hours
22 to 25	72 to 77	11 mins	7 hours
25 to 30	77 to 86	8 mins	6 hours
30 to 35	86 to 95	6 mins	5 hours
35 to 40	95 to 104	4 mins	4 hours
40	104	3 mins	3 hours

 $^1\text{Cartridge}$ must be conditioned to a minimum 10°C / 50°F

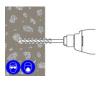
SIKA ANCHORFIX[®]-3001: MPII

Before commencing installation ensure the installer is equipped with appropriate personal protection equipment, SDS Hammer Drill, Air Lance, Hole Cleaning Brush, good quality dispensing tool – either manual or power operated, adhesive cartridge with mixing nozzle, and extension tube with resin stopper as required in Tables 15 and 16. Refer to Figure 2, Table 1, Table 15, Table 16, and Table 17 for parts specification or guidance for individual items or dimensions.

Important: check the expiration date on the cartridge (do not use expired material) and that the cartridge has been stored in its original packaging, the correct way up, in cool conditions (50°F to 77°F) out of direct sunlight.

Solid Substrate Installation Method

 Using the SDS Hammer Drill in rotary hammer mode for drilling, with a carbide tipped drill bit conforming to ANSI B212.15-1994 of the appropriate size, drill the hole to the specified hole diameter and depth.



 Select the correct Air Lance, insert to the bottom of the hole and depress the trigger for 2 seconds. The compressed air must be clean – free from water and oil – and at a minimum pressure of 90 psi (6 bar).

Perform the blowing operation twice.

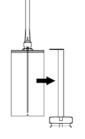
3. Select the correct size Hole Cleaning Brush. Ensure that the brush is in good condition and the correct diameter. Insert the brush to the bottom of the hole, using a brush



extension if needed to reach the bottom of the hole and withdraw with a twisting motion. *There should be positive interaction between the steel bristles of the brush and the sides of the drilled hole.*

Perform the brushing operation twice.

- 4. Repeat 2 (blowing operation) twice.
- 5. Repeat 3 (brushing operation) twice.
- 6. Repeat 2 (blowing operation) twice.
- Select the appropriate static mixer nozzle, checking that the mixing elements are present and correct (do not modify the mixer). Attach mixer nozzle to the cartridge. Check the Dispensing Tool is in good working order. Place the cartridge into the dispensing tool.



Note: The SAF-Q2 nozzle is in two sections. One section contains the mixing elements and the other section is an extension piece. Connect the extension piece to the mixing section by pushing the two sections firmly together until a positive engagement is felt.

Note: AnchorFix[®]-3001 may only be installed between concrete temperatures of 40°F to 104°F for horizontal to downward installation direction, and 50° to 104°F for horizontal to overhead direction. The product must be conditioned to a minimum of 50°F. For gel and cure time data, refer to Table 18. Extrude some resin to waste until an even-colored mixture is extruded, The cartridge is now ready for use.

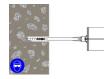


 As specified in Figure 2, Table 15, and Table 16, attach an extension tube with resin stopper (if required) to the end of the mixing nozzle with a push fit.



(The extension tubes may be pushed into the resin stoppers and are held in place with a coarse internal thread).

 Insert the mixing nozzle to the bottom of the hole. Extrude the resin and slowly withdraw the nozzle from the hole.
 Ensure no air voids are created as the nozzle is withdrawn. Inject resin until



the hole is approximately ½ to ¾ full and remove the nozzle from the hole.

11. Select the steel anchor element ensuring it is free from oil or other contaminants, and mark with the required embedment depth. Insert the steel element into the hole using a back and forth twisting



motion to ensure complete cover, until it reaches the bottom of the hole. Adhesive must completely fill the annular gap between the steel element and the concrete. Excess resin will be expelled from the hole evenly around the steel element and there shall be no gaps between the anchor element and the wall of the drilled hole.

- 12. Clean any excess resin from around the mouth of the hole.
- Do not disturb the anchor until at least the minimum cure time has elapsed. Refer to the Table 18 Gel and Cure Times to determine the appropriate cure time.
- 14. Position the fixture and tighten the anchor to the appropriate installation torque.
 - Do not over-torque the anchor as this could adversely affect its performance.





Overhead Substrate Installation

- Using the SDS Hammer Drill in rotary hammer mode for drilling, with a carbide tipped drill bit conforming to ANSI B212.15-1994 of the appropriate size, drill the hole to the specified hole diameter and depth.
- Select the correct Air Lance, insert to the bottom of the hole and depress the trigger for 2 seconds. The compressed air must be clean – free from water and oil – and at a minimum pressure of 90 psi (6 bar).

×2

Perform the blowing operation twice.

3. Select the correct size Hole Cleaning Brush. Ensure that the brush is in good condition and the correct diameter. Insert the brush to the bottom of the hole, using a brush extension if needed to reach the bottom of the hole, and withdraw with a twisting motion. There should be positive interaction between the steel

bristles of the brush and the sides of the drilled hole.

Perform the brushing operation twice.

- 4. Repeat 2 (blowing operation) twice.
- 5. Repeat 3 (brushing operation) twice.
- 6. Repeat 2 (blowing operation) twice.
- Select the appropriate static mixer nozzle checking that the mixing elements are present and correct (do not modify the mixer). Attach mixer nozzle to the cartridge. Check the Dispensing Tool is in good working order. Place the cartridge into the dispensing tool.



Note: The SAF-Q2 nozzle is in two sections. One section contains the mixing elements and the other section is an extension piece. Connect the extension piece to the mixing section by pushing the two sections firmly together until a positive engagement is felt.

Note: AnchorFix[®]-3001 may only be installed between concrete Temperatures of 50°F and 104°F for overhead and upwardly inclined installations. The product must be Conditioned to a minimum of 50°F.

For gel and cure time data, refer to Table 18.

 Extrude some resin to waste until an even-colored mixture is extruded, The cartridge is now ready for use.



- As specified in Figure 2, Table 15, and Table 16, attach an extension tube with resin stopper (if required) to the end of the mixing nozzle with a push fit. (The extension tubes may be pushed into the resin stoppers and are held in place with a coarse internal thread).
- 10. Insert the mixing nozzle, extension tube, or resin stopper (see Tables 15 and 16) to the back of the hole. Extrude the resin and slowly withdraw the nozzle from the hole. Ensure no air voids are created as the nozzle is withdrawn. Inject resin until the hole is approximately ½ to ¾ full and remove the nozzle from the hole.
- 11. Select the steel anchor element ensuring it is free from oil or other contaminants, and mark with the required embedment depth. Insert the steel element into the hole using a back and forth twisting motion to ensure complete cover, until it reaches the bottom of the hole.





Adhesive must completely fill the annular gap between the steel element and the concrete. Excess resin will be expelled from the hole evenly around the steel element and there shall be no gaps between the anchor element and the wall of the drilled hole.

- 12. Clean any excess resin from around the mouth of the hole.
- Do not disturb the anchor until at least the minimum cure time has elapsed. Refer to the Working and Load Timetable to determine the appropriate cure time.
- 14. Position the fixture and tighten the anchor to the appropriate installation torque.

Do not over-torque the anchor as this could adversely affect its performance.



FIGURE 3—INSTALLATION DETAILS (Continued)

TABLE 19—EXAMPLE OF ALOWABLE STRESS DESIGN (ASD) TENSION VALUES FOR ILLUSTRATIVE PURPOSES

Example Allowable Stress Design (ASD) Calculation for Illustrative Purposes								
Anchor Diameter (in.)	Embedment Depth Max / Min (in.)	Characteristic Bond Strength $\tau_{k,unor}$ (psi)	Allowable Tension Load (lb) 2500 psi - 8000 psi Concrete	Controlling Failure Mode				
³ /8"	2.375	1,350	1,929	Breakout Strength				
78	7.500	1,350	4,910	Steel Strength				
¹ / ₂ "	2.750	1,350	2,403	Breakout Strength				
12	10.000	1,350	8,990	Steel Strength				
⁵ /8"	3.125	1,350	2,911	Breakout Strength				
78	12.500	1,350	14,316	Steel Strength				
³ / ₄ "	3.500	1,350	3,451	Breakout Strength				
74	15.000	1,350	21,157	Steel Strength				
7	4.000	1,350	4,216	Breakout Strength				
⁷ / ₈ "	17.500	1,350	29,265	Steel Strength				
1"	4.000	1,350	4,216	Breakout Strength				
I	20.000	1,350	38,387	Steel Strength				
1 ¹ / ₄ "	4.000	1,350	4,216	Breakout Strength				
1 /4	25.000	1,350	61,381	Steel Strength				

Design Assumptions:

1. Single anchor in static tension only, Grade B7 threaded rod.

2. Vertical downwards installation.

3. Inspection regimen = Periodic.

4. Installation temperature 70F to 110F

5. Long term temperature 110F

6. Short term temperature 130F

7. Dry condition (carbide drilled hoe).

8. Embedment $(h_{ef}) = min / max$ for each diameter.

9. Concrete determined to remain uncracked for life of anchor.

10. Load combinations from ACI 318-11 Section 9.2 (no seismic loading).

11. 30% dead load and 70% live load. Controlling load combination 1.2D + 1.6L

12. Calculation of weighted average for $\alpha = 1.2(0.3) + 1.6(0.7) = 1.48$

13. f'_c = 2500 psi (normal weight concrete)

14. $C_{ac1} = C_{ac2} \ge C_{ac}$

15. h≥h_{min}

Illustrative Procedure to Calculate Allowable Stress Design Tension Value SIKA ANCHORFIX®-3001 Anchor ¹/₂" Diameter, using an embedment of 2.75", with the design assumptions given in Table 19 (for use with the 2012 IBC, based on ACI 318-11 Appendix D)

	PROCEDURE	-		CALCULATION
Step 1:	Calculate steel strength of a single anchor in tension per ACI 318-11 D.5.1.2 (Table 2 of this report).		φN _{sa}	= φN _{sa} =0.65 x 17740 =11531 lb
Step 2:	Calculate breakout strength of a single anchor in tension per ACI 318-11 D.5.2 (Table 5 of this report).		Nb	= $k_{c,uncr} \lambda_a \sqrt{(f_c)} h_{ef}^{1.5}$ =(24) x(1.0) x (2500) ^{0.5} x (2.75) ^{1.5} =5472 lb
			φΝ _{cb}	= $\phi (A_{NC} / A_{NC0}) \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b$ =0.65 x 1.0 x 1.0 x 1.0 x 1.0 x 5472 =3557 Ib
Step 3:	Calculate bond strength of a single anchor in tension per ACI 318-11 D.5.5 (Table 8 of this report).		N _{ba}	= λ _a τ _{k,uncr} π d h _{ef} =1.0 x 1350 x 3.141 x 0.5 x 2.75 =5830 lb
			φNa	= φ (A _{Na} / A _{Na0})ψ _{ed,Na} ψ _{cp,Na} N _{ba} =0.65 x 1.0 x 1.0 x 1.0 x 5830 =3789 Ib
Step 4:	Determine controlling resistance strength in tension per ACI 318-11 D 4.1.1 and D 4.1.2.		3557	<i>lb = controlling resistance (breakout)</i>
Step 5:	Calculate Allowable Stress Design conversion factor for loading condition per ACI 318-11 Section 9.2.		α	= 1.2DL + 1.6LL = 1.2*0.3 + 1.6*0.7 = 1.48
Step 6:	Calculate Allowable Stress Design value per Section 4.2 of this report.		T _{allowable,} ASD	= 3557 / 1.48 = 2403 lb

FIGURE 4—SAMPLE CALCULATIONS



ICC-ES Evaluation Report

ESR-3608 FBC Supplement

Reissued August 2019 This report is subject to renewal August 2020.

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

REPORT HOLDER:

SIKA SERVICES AG

EVALUATION SUBJECT:

SIKA ANCHORFIX® -3001 ADHESIVE ANCHORS FOR CRACKED AND UNCRACKED CONCRETE

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that Sika AnchorFix® -3001 Adhesive Anchors for Cracked and Uncracked Concrete, recognized in ICC-ES master evaluation report ESR-3608, have also been evaluated for compliance with the codes noted below.

Applicable code editions:

- 2014 Florida Building Code—Building
- 2014 Florida Building Code—Residential

2.0 CONCLUSIONS

The Sika AnchorFix®-3001 Adhesive Anchors for Cracked and Uncracked Concrete, described in Sections 2.0 through 7.0 of the master evaluation report ESR-3608, comply with the *Florida Building Code—Building* and the *Florida Building Code—Residential*, provided the design and installation are in accordance with the 2012 *International Building Code*[®] (IBC) provisions noted in the master report and the following provisions apply:

- Design wind loads must be based on Section 1609 of the *Florida Building Code—Building* or Section 301.2.1.1 of the *Florida Building Code—Residential*, as applicable.
- Load combinations must be in accordance with Section 1605.2 or Section 1605.3 of the Florida Building Code—Building.

Use of the Sika AnchorFix[®]-3001 Adhesive Anchors for Cracked and Uncracked Concrete for compliance with the High-Velocity Hurricane Zone provisions of the *Florida Building Code—Building* has not been evaluated and is outside the scope of this supplemental report.

For products falling under Florida Rule 9N-3, verification that the report holder's quality assurance program is audited by a quality assurance entity approved by the Florida Building Commission for the type of inspections being conducted is the responsibility of an approved validation entity (or the code official, when the report holder does not possess an approval by the Commission).

This supplement expires concurrently with the master report, reissued August 2019.

