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ICC-ES Evaluation Report
ESR-4778

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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

EVALUATION SUBJECT:

SIKA ANCHORFIX®-3030 ADHESIVE ANCHORS AND POST INSTALLED REINFORCING BAR CONNECTIONS FOR CRACKED AND UNCRACKED CONCRETE

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2018, 2015, 2012, 2009, and 2006 *International Building Code®* (IBC)
- 2018, 2015, 2012, 2009, and 2006 *International Residential Code®* (IRC)

For evaluation for compliance with codes adopted by the Los Angeles Department of Building and Safety (LADBS), see ESR-4778 LABC and LARC Supplement.

Property evaluated:

Structural

2.0 USES

The Sika AnchorFix®-3030 Adhesive Anchors are used as anchorage and the Post-Installed Reinforcing Bar Connections are used as reinforcing bar connections (for development length and splice length) 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 2018 and 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. The anchors may also be used where an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

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

3.0 DESCRIPTION

3.1 General:

The Sika AnchorFix®-3030 Anchor System is comprised of the following:

- Sika AnchorFix®-3030 adhesive packaged in cartridges
- Adhesive mixing and dispensing equipment
- Equipment for cleaning holes and injecting adhesive

The Sika AnchorFix®-3030 adhesive is used with continuously threaded steel rods or deformed steel reinforcing bars. Installation information, guidelines and parameters are shown in Tables 1, 17, 18, and 19 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®-3030 Adhesive: Sika AnchorFix®-3030 adhesive is a two-component (resin and hardener) epoxy-based adhesive, supplied in dual chamber cartridges separating the chemical components, which are combined in a 3:1 ratio by volume when dispensed through the system static mixing nozzle. The Sika AnchorFix®-3030 is available in 385 ml (13 fl. oz.), and 585 ml (19.8 fl. oz.) cartridges. The shelf life of Sika AnchorFix®-3030 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: Sika AnchorFix®-3030 adhesive must be dispensed using pneumatic or manual actuated dispensing tools listed in Table 19 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 17 and 18 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 described 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 hot-dipped galvanized, or may be uncoated. Threaded steel rods must be straight and free of indentations or other defects along their length.

3.2.4.2 Steel Reinforcing Bars for Post-Installed Anchors: 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.

3.2.5 Steel Reinforcing Bars for Post-Installed Reinforcing Bar Connections: Steel reinforcing bars used in post-installed reinforcing bar connections are deformed reinforcing bars (rebar). Tables 15 and 16 in this report provide additional details for reinforcing bar connections. The embedded portions of reinforcing bars must be straight, and free of mill scale, rust, mud, oil, and other coatings that may impair the bond with adhesive. Reinforcing bars must not be bent after installation, except as set forth in ACI 318-14 Section 26.6.3.1 (b) or ACI 318-11 Section 7.3.2, as applicable, with the additional condition that the bars must be bent cold, and heating of reinforcing bars to facilitate field bending is not permitted.

3.3 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 of Post-Installed Anchors:

4.1.1 General: The design strength of anchors complying with the 2018 and 2015 IBC, as well as the 2018 and 2015 IRC must be determined in accordance with ACI 318-14 and this report. The design strength of anchors complying with the 2012, 2009, and 2006 IBC, as well as the 2012, 2009, and 2006 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
Cracked	Hammer-drill	Dry concrete	$\tau_{k,cr}$	ϕ_d
		Water-saturated concrete	$\tau_{k,cr}$	ϕ_{ws}
		Water-filled hole (flooded)	$\tau_{k,cr}$	ϕ_{wf}
Uncracked	Hammer-drill	Dry concrete	$\tau_{k,uncr}$	ϕ_d
		Water-saturated concrete	$\tau_{k,uncr}$	ϕ_{ws}
		Water-filled hole (flooded)	$\tau_{k,uncr}$	ϕ_{wf}

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 (2018, 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 8d. 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 Section 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

$\left[\frac{h}{h_{ef}}\right]$ 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:

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

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 Section 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 Section 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.

The following exceptions apply to ACI 318-11 D.3.3.5.2:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

4.2 Strength Design of Post-Installed Reinforcing Bars:

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

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

Exceptions:

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

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

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

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

REBAR SIZE	MINIMUM CONCRETE COVER, $c_{c,min}$
$d_b \leq$ No. 6	$1^1/_8$ in.
No. 6 < $d_b \leq$ No. 10	2.3 in.

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

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

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

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

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

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

$$s_{b,min} = {d_o}/{2}\,(existing\ reinforcing) + {d_o}/{2} + c_{c,min}$$

4.2.4 Design Strength in Seismic Design Categories C, D, E and F: In structures assigned to Seismic Category C, D, E or F under the IBC or IRC, design of straight post-installed reinforcing bars must take into account the provisions of ACI 318-14 Chapter 18 or ACI 318-11 Chapter 21, as applicable. The value of f'_c to be used in ACI 318-14 25.4.2.2, 25.4.2.3, and 25.4.9.2, or ACI 318-11 Section 12.2.2, 12.2.3, and 12.3.2, as applicable, calculations shall not exceed 2,500 psi for post-installed reinforcing bar applications in SDCs C, D, E and F.

4.3 Allowable Stress Design (ASD):

4.3.1 General: For anchors designed using load combinations calculated in accordance with IBC Section 1605.3 (Allowable Stress Design), allowable loads must be established using the following relationships:

$$T_{allowable,ASD} = \phi N_n/\alpha \qquad \text{Eq. (4-2)}$$

$$V_{allowable,ASD} = \phi V_n/\alpha \qquad \text{Eq. (4-3)}$$

where

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

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

ϕN_n = The lowest design strength of an anchor or anchor group in tension as determined in accordance with ACI 318-14 Chapter 17 and 2018 and 2015 IBC Section 1905.1.8; ACI 318-11 Appendix D as amended in this report; ACI 318-08 Appendix D and 2009 IBC Sections 1908.1.9 and 1908.1.10; or ACI 318-05 Appendix D and 2006 IBC Section 1908.1.16, as applicable. For the 2012 IBC, Section 1905.1.9 shall be omitted.

ϕV_n = The lowest design strength of an anchor or anchor group in shear as determined in accordance with ACI 318-14 Chapter 17 and 2018 and 2015 IBC Section 1905.1.8; ACI 318-11 Appendix D as amended in this report; ACI 318-08 Appendix D and 2009 IBC Sections 1908.1.9 and 1908.1.10; or ACI 318-05 Appendix D and 2006 IBC Section 1908.1.16, as applicable. For the 2012 IBC, Section 1905.1.9 shall be omitted.

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

Table 21 provides an illustration of calculated Allowable Stress Design (ASD) values for each anchor diameter at minimum and maximum embedment depths.

The requirements for member thickness, edge distance and spacing, as described in Table 1 of this report, must apply. An example of allowable stress design values for illustrative purposes is shown in Figure 4 of this report.

4.3.2 Interaction of Tensile and Shear Forces: In lieu of ACI 318-14 17.6.1, 17.6.2 and 17.6.3 or ACI 318-11 D.7.1, D.7.2 and D.7.3, as applicable, interaction of tension and shear loads must be calculated as follows:

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

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

For all other cases:

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

4.4 Installation:

Installation parameters are provided in Tables 1, 17, 18, 19, 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 and post-installed reinforcing bar locations must comply with this report and the plans and specifications approved by the building official. Installation of Sika AnchorFix®-3030 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 17, 18, and 19 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 17 and 18.

4.5 Special Inspection:

4.5.1 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 in Section 1705.1.1 and Table 1705.3 of the 2018, 2015 or 2012 IBC and Sections 1705, 1706 or 1707 of the 2009, and 2006 IBC must be observed, where applicable.

4.5.2 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 2018, 2015 and 2012 IBC, Section 1704.15 and Table 1704.4 of the 2009 IBC, or Section 1704.13 of the 2006 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 ($A_{se,N} \cdot f_{ya}$). The proof load must be maintained at the required load level for a minimum of 10 seconds.

4.5.3 Periodic Special Inspection: Periodic special inspection must be performed where required in accordance with Section 1705.1.1 and Table 1705.4 of the 2018, 2015 and 2012 IBC, Section 1704.15 and Table 1704.4 of the 2009 IBC or Section 1704.13 of the 2006 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

Sika Services AG Sika AnchorFix®-3030 Adhesive Anchors and Post-Installed Reinforcing Bar Connections 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®-3030 adhesive anchors and post-installed reinforcing bars 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 and post-installed reinforcing bars 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) for anchors and post-installed reinforcing bars, except f'_c shall not exceed 2,500 psi for post-installed reinforcing bar applications in SDCs C, D, E and F.

5.4 The concrete shall have attained its minimum design strength prior to installation of the adhesive anchors.

5.5 Anchors and post-installed reinforcing bars 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.

5.6 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.

5.7 Sika AnchorFix®-3030 adhesive anchors and post-installed reinforcing bars are recognized for use to resist short- and long-term loads, including wind and earthquake, subject to the conditions of this report.

5.8 In structures assigned to Seismic Design Category C, D, E or F under the IBC or IRC, anchor strength must be adjusted in accordance with Section 4.1.11 of this report.

5.9 Sika AnchorFix®-3030 adhesive anchors and post-installed reinforcing bars are permitted to be installed in concrete that is cracked or that may be expected to crack during the service life of the anchor, subject to the conditions of this report.

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

5.11 Allowable stress design values must be established in accordance with Section 4.3 of this report.

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

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

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

5.15 Anchors and post-installed reinforcing bars are not permitted to support fire-resistive construction. Where not otherwise prohibited by the code, Sika AnchorFix®-3030 adhesive anchors and post-installed reinforcing bars are permitted for installation in fire-resistive construction provided at least one of the following conditions is fulfilled:

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

5.16 Since an ICC-ES acceptance criteria for evaluating data to determine the performance of adhesive anchors and post-installed reinforcing bars subjected to fatigue or shock loading is unavailable at this time, the use of these anchors under such conditions is beyond the scope of this report.

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

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

5.19 Steel anchoring materials in contact with preservative-treated 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.

5.20 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.

5.21 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; or ACI 318-11 D.9.2.2 or D.9.2.3, as applicable.

5.22 Sika AnchorFix®-3030 adhesive anchors and post-installed reinforcing bars may be used to resist tension and shear forces in floor, wall, and overhead installations only if installation is into concrete with a temperature between 50°F and 104°F (10°C and 40°C) for threaded rods and rebar. Overhead installations for hole diameters larger than $^5/_8$-inch or 16 mm require the use of resin stoppers during injection to the back of the hole. ½-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.

5.23 Anchors and post-installed reinforcing bars 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

5.24 Sika AnchorFix®-3030 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®-3030 adhesive is identified in the field by labels on the cartridge and packaging, bearing the company name (Sika Services AG), product name (Sika AnchorFix®-3030), the batch number, the expiration date, and the evaluation report number (ESR-4778).

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
www.sika.com

TABLE 1—Sika AnchorFix®-3030 ANCHOR SYSTEM INSTALLATION INFORMATION

CHARACTERISTIC		SYMBOL	UNITS	NOMINAL ANCHOR ELEMENT DIAMETER							
Fractional Threaded Rod	Size	d_a	inch	$^{3}/_{8}$	$^{1}/_{2}$	$^{5}/_{8}$	$^{3}/_{4}$	$^{7}/_{8}$	1	-	$1^{1}/_{4}$
	Drill Size	d_{hole}	inch	$^{1}/_{2}$	$^{9}/_{16}$	$^{3}/_{4}$	$^{7}/_{8}$	1	$1^{1}/_{8}$	-	$1^{3}/_{8}$
Fractional Rebar	Size	d_a	inch	#3	#4	#5	#6	#7	#8	-	#10
	Drill Size	d_{hole}	inch	$^{9}/_{16}$	$^{5}/_{8}$	$^{3}/_{4}$	$^{7}/_{8}$	1	$1^{1}/_{8}$	-	$1^{3}/_{8}$
Metric Threaded Rod	Size	d_a	mm	M10	M12	M16	M20	-	M24	M27	M30
	Drill Size	d_{hole}	mm	12	14	18	22	-	26	30	35
Metric Rebar	Size	d_a	mm	M10	M12	M16	M20	-	M25	M28	M32
	Drill Size	d_{hole}	mm	14	16	20	25	-	32	35	40
Maximum Tightening Torque		T_{inst}	ft·lb	15	30	60	100	125	150	175	200
Embedment Depth Range		$h_{ef,min}$	inch	$2^{3}/_{8}$	$2^{3}/_{4}$	$3^{1}/_{8}$	$3^{1}/_{2}$	$3^{1}/_{2}$	4	$4^{1}/_{2}$	5
		$h_{ef,max}$	inch	$7^{1}/_{2}$	10	$12^{1}/_{2}$	15	$17^{1}/_{2}$	20	$21^{1}/_{4}$	25
Minimum Concrete Thickness		h_{min}	inch	$1.5 \cdot h_{ef}$							
Critical Edge Distance		c_{ac}	inch	See Section 4.1.10 of this report							
Minimum Edge Distance		c_{min}	inch	$1^{1}/_{2}$	$1^{1}/_{2}$	$1^{3}/_{4}$	$1^{7}/_{8}$	2	2	$2^{1}/_{4}$	$2^{1}/_{2}$
Minimum Anchor Spacing		s_{min}	inch	$1^{1}/_{2}$	$1^{1}/_{2}$	$1^{3}/_{4}$	$1^{7}/_{8}$	2	2	$2^{1}/_{4}$	$2^{1}/_{2}$

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

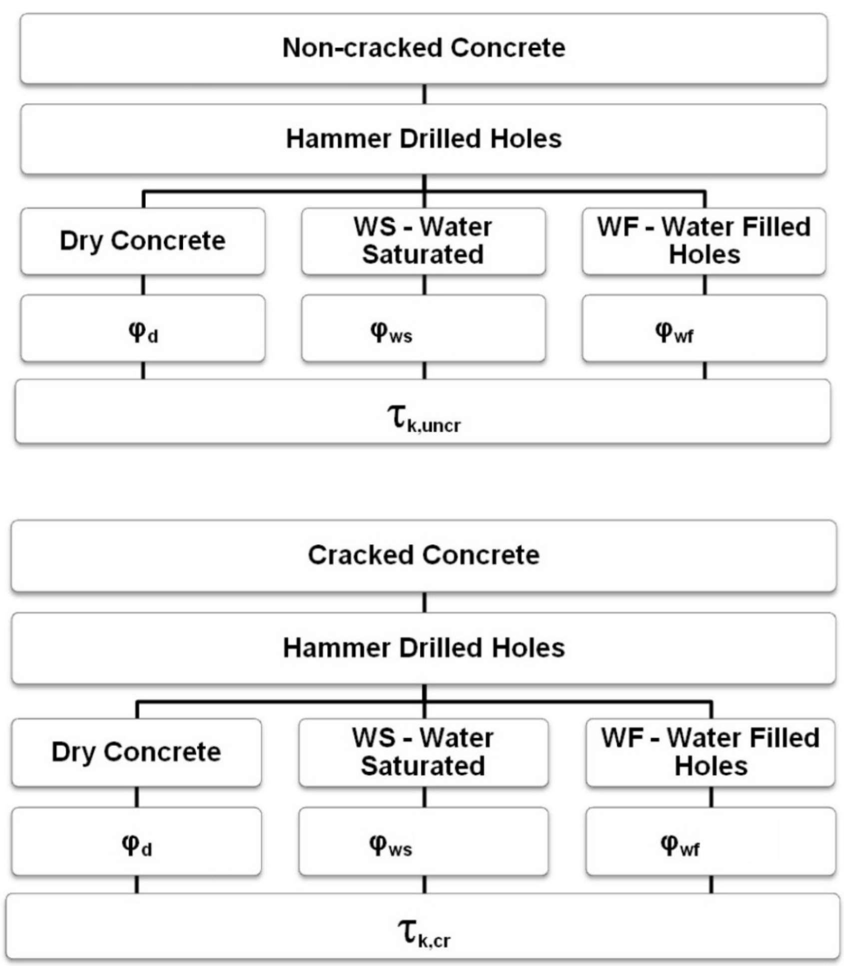


FIGURE 1—FLOWCHART FOR THE ESTABLISHMENT OF DESIGN BOND STRENGTH

TABLE 2—STEEL DESIGN INFORMATION FOR FRACTIONAL CARBON STEEL AND STAINLESS STEEL THREADED ROD[1,2]

	CHARACTERISTIC	SYMBOL	UNITS	NOMINAL ROD DIAMETER, d_o						
	Nominal Size	d_a	inch	$^3/_8$	$^1/_2$	$^5/_8$	$^3/_4$	$^7/_8$	1	$1^1/_4$
	Stress Area[1]	A_{se}	in.^{2}	0.0775	0.1419	0.226	0.334	0.462	0.606	0.969
Carbon Steel Threaded Rod	Strength Reduction Factor for Tension Steel Failure[2]	ϕ	-	0.75						
	Strength Reduction Factor for Shear Steel Failure[2]	ϕ	-	0.65						
	Reduction for Seismic Shear	$\alpha_{V,seis}$	-	0.75	0.65	0.65	0.65	0.40	0.40	0.40
	Tension Resistance of Carbon Steel ASTM F1554 Grade 36	N_{sa}	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)
	Tension Resistance of Carbon Steel ASTM A193 B7	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)
Stainless Steel Threaded Rod	Strength Reduction Factor for Tension Steel Failure[2]	ϕ	-	0.65						
	Strength Reduction Factor for Shear Steel Failure[2]	ϕ	-	0.60						
	Reduction for Seismic Shear	$\alpha_{V,seis}$	-	0.65	0.65	0.65	075	0.60	0.60	0.60
	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 ASTM F593 CW2	V_{sa}	lb (kN)	-- --	-- --	-- --	12,690 (56.4)	17,555 (78.1)	23,030 (102.4)	36,820 (163.8)
	Shear Resistance of Stainless Steel ASTM F593 SH1	V_{sa}	lb (kN)	4,455 (19.8)	9,790 (43.5)	15,595 (69.4)	-- --	-- --	-- --	-- --
	Shear Resistance of Stainless Steel ASTM F593 SH2	V_{sa}	lb (kN)	-- --	-- --	-- --	17,535 (78.0)	24,255 (107.9)	31,815 (141.5)	-- --
	Shear Resistance of Stainless Steel ASTM F593 SH3	V_{sa}	lb (kN)	-- --	-- --	-- --	-- --	-- --	-- --	46,030 (204.8)

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

[1]Values 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.

[2]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 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 3—STEEL DESIGN INFORMATION FOR FRACTIONAL STEEL REINFORCING BAR[1,2]

	CHARACTERISTIC	SYMBOL	UNITS	NOMINAL REINFORCING BAR SIZE, d_o						
				No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 10
Reinforcing bar	Nominal bar diameter	d_a	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						
	Reduction for Seismic Shear	$\alpha_{V,seis}$	-	0.75	0.75	0.75	0..80	0.50	0.50	0.50
	Tension Resistance of Carbon Steel ASTM A615 Grade 40	N_{sa}	lb (kN)	6,600 (29.4)	12,000 (53.4)	18,600 (82.7)	26,400 (117.4)	36,000 (160.1)	47,400 (210.8)	76,200 (339.0)
	Tension Resistance of Carbon Steel ASTM A615 Grade 60	N_{sa}	lb (kN)	9,900 (44.0)	18,000 (80.1)	27,900 (124.1)	39,600 (176.1)	54,000 (240.2)	71,100 (316.3)	114,300 (508.4)
	Shear Resistance of Carbon Steel ASTM A615 Grade 40	V_{sa}	lb (kN)	3,960 (17.6)	7,200 (32.0)	11,160 (49.6)	15,840 (70.5)	21,600 (96.1)	28,440 (126.5)	45,720 (203.4)
	Shear Resistance of Carbon Steel ASTM A615 Grade 60	V_{sa}	lb (kN)	5,940 (26.4)	10,800 (48.0)	16,740 (74.5)	23,760 (105.7)	32,400 (144.1)	42,660 (189.8)	68,580 (305.1)

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

[1]Values 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.

[2]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 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	NOMINAL ROD DIAMETER, d_o						
Metric Threaded Rod	Nominal Size	d_a	mm	M10	M12	M16	M20	M24	M27	M30
	Stress Area	A_{se}	mm²	58	84	157	245	353	459	561
	Strength Reduction Factor for Tension Steel Failure	ϕ	-	0.65						
	Strength Reduction Factor for Shear Steel Failure	ϕ	-	0.60						
	Reduction for Seismic Shear	$\alpha_{V,seis}$	-	0.75	0.65	0.65	0.65	0.40	0.40	0.40
	Tension Resistance of Carbon Steel ISO 898-1 Class 5.8	N_{sa}	kN lb	29.0 (6,519)	42.2 (9,476)	78.5 (17,648)	122.5 (27,539)	176.5 (39,679)	229.5 (51,394)	280.5 (63,059)
	Tension Resistance of Carbon Steel ISO 898-1 Class 8.8	N_{sa}	kN lb	46.4 (10,431)	67.4 (15,161)	125.6 (28,236)	196.0 (44,063)	282.4 (63,486)	367.2 (82,550)	448.8 (100,894)
	Tension Resistance of Carbon Steel ISO 898-1 Class 12.9	N_{sa}	kN lb	50.0 (11,240)	72.7 (16,336)	135.3 (30,424)	211.2 (47,477)	304.3 (68,406)	395.7 (88,951)	483.6 (108,714)
	Tension Resistance of Stainless Steel ISO 3506-1 A4-70	N_{sa}	kN lb	40.6 (9,127)	59.0 (13,266)	109.9 (24,707)	171.5 (38,555)	247.1 (55,550)	321.3 (72,231)	392.7 (88,282)
	Tension Resistance of Stainless Steel ISO 3506-1 A4-80	N_{sa}	kN lb	46.4 (10,431)	67.4 (15,161)	125.6 (28,236)	196.0 (44,063)	282.4 (63,486)	367.2 (82,550)	448.8 (100,894)
	Shear Resistance of Carbon Steel ISO 898-1 Class 5.8	V_{sa}	kN lb	17.4 (3,912)	25.3 (5,685)	47.1 (10,589)	73.5 (16,523)	105.9 (23,807)	137.7 (30,956)	168.3 (37,835)
	Shear Resistance of Carbon Steel ISO 898-1 Class 8.8	V_{sa}	kN lb	27.8 (6,259)	40.5 (9,097)	75.4 (16,942)	117.6 (26,438)	169.4 (38,092)	220.3 (49,530)	269.3 (60,537)
	Shear Resistance of Carbon Steel ISO 898-1 Class 12.9	V_{sa}	kN lb	30.0 (6,744)	43.6 (9,802)	81.2 (18,255)	126.7 (28,486)	182.6 (41,044)	237.4 (53,374)	290.1 (65,228)
	Shear Resistance of Stainless Steel ISO 3506-1 A4-70	V_{sa}	kN lb	24.4 (5,476)	35.4 (7,960)	65.9 (14,824)	102.9 (23,133)	148.3 (33,330)	192.8 (43,339)	235.6 (52,969)
	Shear Resistance of Stainless Steel ISO 3506-1 A4-80	V_{sa}	kN lb	27.8 (6,259)	40.5 (9,097)	75.4 (16,942)	117.6 (26,438)	169.4 (38,092)	220.3 (49,530)	269.3 (60,537)

Metric Reinforcing Bar	Nominal Size	d_o	mm	M10	M12	M16	M20	M25	M28	M32
	Stress Area	A_{se}	mm²	78.5	113	201	314	491	616	804
	Strength Reduction Factor for Tension Steel Failure	ϕ	-	0.65						
	Strength Reduction Factor for Shear Steel Failure	ϕ	-	0.60						
	Reduction for Seismic Shear	$\alpha_{V,seis}$	-	0.75	0.75	0.75	0.80	0.50	0.50	0.50
	Tension Resistance of DIN 488 BSt 500	N_{sa}	kN lb	43.2 (9,706)	62.2 (13,972)	110.6 (24,853)	172.7 (38,825)	270.1 (60,710)	338.8 (76,165)	442.2 (99,411)
	Shear Resistance of DIN 488 BSt 500	V_{sa}	kN lb	25.9 (5,824)	37.3 (8,383)	66.3 (14,912)	103.6 (23,295)	162.0 (36,426)	203.3 (45,696)	265.3 (59,646)

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

[1]Values 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.

[2]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. 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	NOMINAL ANCHOR ELEMENT DIAMETER						
US Threaded Rod	Size	d_a	Inch	$^3/_8$	$^1/_2$	$^5/_8$	$^3/_4$	$^7/_8$	1	$1^1/_4$
	Drill Size	d_{hole}	Inch	$^1/_2$	$^9/_{16}$	$^3/_4$	$^7/_8$	1	$1^1/_8$	$1^3/_8$
US Rebar	Size	d_a	Inch	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 10
	Drill Size	d_{hole}	Inch	$^9/_{16}$	$^5/_8$	$^3/_4$	$^7/_8$	1	$1^1/_8$	$1^3/_8$
Embedment Depth Range		$h_{ef,min}$	Inch	$2^3/_8$	$2^3/_4$	$3^1/_8$	$3^1/_2$	$3^1/_2$	4	5
		$h_{ef,max}$	Inch	$7^1/_2$	10	$12^1/_2$	15	$17^1/_2$	20	25
Minimum Anchor Spacing		s_{min}	Inch	$1^1/_2$	$1^1/_2$	$1^3/_4$	$1^7/_8$	2	2	$2^1/_2$
Minimum Edge Distance		c_{min}	Inch	$1^1/_2$	$1^1/_2$	$1^3/_4$	$1^7/_8$	2	2	$2^1/_2$
Minimum Concrete Thickness		h_{min}	Inch	$1.5 \cdot h_{ef}$						
Critical Edge Distance		c_{ac}	-	See Section 4.1.10 of this report						
Effectiveness Factor for Uncracked Concrete, Breakout		$k_{c,uncr}$	-- (SI)	24 (10)						
Effectiveness Factor for Cracked Concrete, Breakout		$k_{c,cr}$	-- (SI)	17 (7.1)						
$k_{c,uncr} / k_{c,cr}$		--	--	1.41						
Strength Reduction Factor for Tension, Concrete Failure Modes, Condition B[1]		ϕ	--	0.65						
Strength Reduction Factor for Shear, Concrete Failure Modes, Condition B[1]		ϕ	--	0.70						

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

[1]Condition 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	NOMINAL ANCHOR ELEMENT DIAMETER						
SI Threaded Rod	Size	d_a	mm	M10	M12	M16	M20	M24	M27	M30
	Drill Size	d_{hole}	mm	12	14	18	22	26	30	35
SI Rebar	Size	d_a	mm	M10	M12	M16	M20	M25	M28	M32
	Drill Size	d_{hole}	mm	14	16	20	25	32	35	40
Embedment Depth Range		$h_{ef,min}$	inch	$2^3/_8$	$2^3/_4$	$3^1/_8$	$3^1/_2$	4	$4^1/_2$	5
		$h_{ef,max}$	inch	$7^1/_2$	10	$12^1/_2$	15	20	$21^1/_4$	25
Minimum Anchor Spacing		s_{min}	inch	$1^1/_2$	$1^1/_2$	$1^3/_4$	$1^7/_8$	2	$2^1/_2$	$2^1/_2$
Minimum Edge Distance		c_{min}	inch	$1^1/_2$	$1^1/_2$	$1^3/_4$	$1^7/_8$	2	$2^1/_2$	$2^1/_2$
Minimum Concrete Thickness		h_{min}	inch	$1.5 \cdot h_{ef}$						
Critical Edge Distance		--	--	See Section 4.1.10 of this report						
Effectiveness Factor for Uncracked Concrete, Breakout		k_{uncr}	-- (SI)	24 (10)						
Effectiveness Factor for Cracked Concrete, Breakout		k_{cr}	-- (SI)	17 (7.1)						
k_{uncr} / k_{cr}		--	--	1.41						
Strength Reduction Factor for Tension, Concrete Failure Modes, Condition B		ϕ	--	0.65						
Strength Reduction Factor for Shear, Concrete Failure Modes, Condition B		ϕ	--	0.70						

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

[1]Condition B applies where supplemental reinforcement is not provided as set forth in ACI 318-14 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 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.4.5.

TABLE 7—FRACTIONAL THREADED ROD BOND STRENGTH DESIGN INFORMATION FOR ANCHORS INSTALLED WITH PERIODIC SPECIAL INSPECTION[1,6,7]

DESIGN INFORMATION			SYMBOL	UNITS	NOMINAL THREADED ROD DIAMETER						
					$^3/_8$"	$^1/_2$"	$^5/_8$"	$^3/_4$"	$^7/_8$"	1"	$1^1/_4$"
Minimum Effective Installation Depth			$h_{ef,min}$	in.	$2^3/_8$	$2^3/_4$	$3^1/_8$	$3^1/_2$	$3^1/_2$	4	5
				mm	60	70	79	89	89	102	127
Maximum Effective 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
Reduction Factor for Seismic Tension			$\alpha_{N,seis}$	-	0.79	0.99	0.91	0.81	0.81	0.88	0.79
Dry Concrete	Temperature Category A[2,6]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1880	1775	1670	1565	1460	1355	1145
				N/mm²	13.0	12.2	11.5	10.8	10.1	9.3	7.9
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	760	965	1145	1075	965	955	700
				N/mm²	5.2	6.7	7.9	7.4	6.7	6.6	4.8
	Temperature Category B, Range 1 & 2[3,4,6]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	2290	2165	2035	1910	1780	1655	1395
				N/mm²	15.8	14.9	14.0	13.2	12.3	11.4	9.6
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	925	1180	1400	1310	1175	1165	855
				N/mm²	6.4	8.1	9.7	9.0	8.1	8.0	5.9
	Anchor Category, dry concrete		–	-	1	1	1	1	1	1	1
	Strength Reduction Factor		ϕ_d	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Water Saturated Concrete	Temperature Category A[2,6]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1880	1775	1670	1565	1460	1355	1145
				N/mm²	13.0	12.2	11.5	10.8	10.1	9.3	7.9
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	760	965	1145	1075	965	955	700
				N/mm²	5.2	6.7	7.9	7.4	6.7	6.6	4.8
	Temperature Category B, Range 1 & 2[3,4,6]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	2290	2165	2035	1910	1780	1655	1395
				N/mm²	15.8	14.9	14.0	13.2	12.3	11.4	9.6
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	925	1180	1400	1310	1175	1165	855
				N/mm²	6.4	8.1	9.7	9.0	8.1	8.0	5.9
	Anchor Category, water saturated concrete, 4d ≤ h_{ef} ≤*12d*		–	-	1	1	3	3	3	1	1
	Strength Reduction Factor, 4d ≤ h_{ef} ≤*12d*		ϕ_{ws}	-	0.65	0.65	0.45	0.45	0.45	0.65	0.65
	Anchor Category, water saturated concrete, 12d < h_{ef} ≤*20d*		–	-	N/A	N/A	3	3	3	1	1
	Strength Reduction Factor, 12d < h_{ef} ≤*20d* [8]		ϕ_{ws}	-	N/A	N/A	0.45	0.45	0.45	0.65	0.65
Water-filled Hole	Temperature Category A[2,6]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	750	710	920	860	805	1355	1145
				N/mm²	5.2	4.9	6.3	5.9	5.5	9.3	7.9
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	305	385	630	590	530	955	700
				N/mm²	2.1	2.7	4.3	4.1	3.7	6.6	4.8
	Temperature Category B, Range 1 & 2[3,4,6]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	915	865	1,120	1,050	980	1655	1395
				N/mm²	6.3	6.0	7.7	7.2	6.7	11.4	9.6
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	370	470	770	721	645	1165	855
				N/mm²	2.6	3.3	5.3	5.0	4.5	8.0	5.9
	Anchor Category, water-filled hole		–	-	3	3	3	3	3	3	3
	Strength Reduction Factor		ϕ_{wf}	-	0.45	0.45	0.45	0.45	0.45	0.45	0.45

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

[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi. Bond strength values must not be increased for increased concrete compressive strength.
[2]Temperature Category A: Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 176°F (80°C)
[3]Temperature Category B, Range 1 = Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 130°F (55°C)
[4]Temperature Category B, Range 2 = Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 145°F (63°C)
[5]Short-term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long-term concrete temperatures are roughly constant over significant periods of time.
[6]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 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]Bond strengths shown are for sustained loading. In cases where anchors are subject to short term loads only, bond strengths may be multiplied by 1.13.
[8] $^3/_8$- and ½-inch diameter bond strengths limited to embedment depths 4*d* ≤ h_{ef} ≤*12d.*

TABLE 8—FRACTIONAL THREADED ROD BOND STRENGTH DESIGN INFORMATION FOR ANCHORS INSTALLED WITH CONTINUOUS SPECIAL INSPECTION[1,6,7]

DESIGN INFORMATION			SYMBOL	UNITS	NOMINAL THREADED ROD DIAMETER						
					$^{3}/_{8}$"	$^{1}/_{2}$"	$^{5}/_{8}$"	$^{3}/_{4}$"	$^{7}/_{8}$"	1"	$1^{1}/_{4}$"
Minimum Effective Installation Depth			$h_{ef,min}$	in.	$2^{3}/_{8}$	$2^{3}/_{4}$	$3^{1}/_{8}$	$3^{1}/_{2}$	$3^{1}/_{2}$	4	5
				mm	60	70	79	89	89	102	127
Maximum Effective 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
Reduction Factor for Seismic Tension			$\alpha_{N,seis}$	-	0.79	0.99	0.91	0.81	0.81	0.88	0.79
:./Dry Concrete	Temperature Category A[2,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1880	1775	1670	1565	1460	1355	1145
				N/mm²	13.0	12.2	11.5	10.8	10.1	9.3	7.9
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	760	965	1145	1075	965	955	700
				N/mm²	5.2	6.7	7.9	7.4	6.7	6.6	4.8
	Temperature Category B, Range 1 & 2[3,4,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	2290	2165	2035	1910	1780	1655	1395
				N/mm²	15.8	14.9	14.0	13.2	12.3	11.4	9.6
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	925	1180	1400	1310	1175	1165	855
				N/mm²	6.4	8.1	9.7	9.0	8.1	8.0	5.9
	Anchor Category, dry concrete		–	-	1	1	1	1	1	1	1
	Strength Reduction Factor		ϕ_d	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Water Saturated Concrete	Temperature Category A[2,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1880	1775	1670	1565	1460	1355	1145
				N/mm²	13.0	12.2	11.5	10.8	10.1	9.3	7.9
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	760	965	1145	1075	965	955	700
				N/mm²	5.2	6.7	7.9	7.4	6.7	6.6	4.8
	Temperature Category B, Range 1 & 2[3,4,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	2290	2165	2035	1910	1780	1655	1395
				N/mm²	15.8	14.9	14.0	13.2	12.3	11.4	9.6
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	925	1180	1400	1310	1175	1165	855
				N/mm²	6.4	8.1	9.7	9.0	8.1	8.0	5.9
	Anchor Category, water saturated concrete, 4d ≤ h_{ef} ≤*12d*		–	-	1	1	2	2	2	1	1
	Strength Reduction Factor, 4d ≤ h_{ef} ≤*12d*		ϕ_{ws}	-	0.65	0.65	0.55	0.55	0.55	0.65	0.65
	Anchor Category, water saturated concrete, 12d < h_{ef} ≤*20d*		–	-	N/A	N/A	2	2	2	1	1
	Strength Reduction Factor, 12d < h_{ef} ≤*20d* [8]		ϕ_{ws}	-	N/A	N/A	0.55	0.55	0.55	0.65	0.65
Water-filled Hole	Temperature Category A[2,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	885	835	1085	1015	950	1355	1145
				N/mm²	6.1	5.8	7.5	7.0	6.5	9.3	7.9
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	355	455	745	700	625	955	700
				N/mm²	2.5	3.1	5.1	4.8	4.3	6.6	4.8
	Temperature Category B, Range 1 & 2[3,4,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1075	1020	1325	1240	1155	1655	1395
				N/mm²	7.4	7.0	9.1	8.6	8.0	11.4	9.6
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	435	555	910	850	765	1165	855
				N/mm²	3.0	3.8	6.3	5.9	5.3	8.0	5.9
	Anchor Category, water-filled hole		–	-	3	3	3	3	3	2	2
	Strength Reduction Factor		ϕ_{wf}	-	0.45	0.45	0.45	0.45	0.45	0.55	0.55

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

[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi. Bond strength values must not be increased for increased concrete compressive strength.

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

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

[4]Temperature Category B, Range 2 = Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 145°F (63°C)

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

[6]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 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]Bond strengths shown are for sustained loading. In cases where anchors are subject to short term loads only, bond strengths may be multiplied by 1.13.

[8] $^{3}/_{8}$- and ½-inch diameter bond strengths limited to embedment depths 4*d* ≤ h_{ef} ≤*12d.*

TABLE 9—FRACTIONAL REINFORCING BAR BOND STRENGTH DESIGN INFORMATION FOR ANCHORS INSTALLED WITH PERIODIC SPECIAL INSPECTION [1,6,7]

DESIGN INFORMATION			SYMBOL	UNITS	REINFORCING BAR SIZE						
					No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 10
Nominal Diameter			d_a	in.	$^3/_8$"	$^1/_2$"	$^5/_8$"	$^3/_4$"	$^7/_8$"	1"	$1^1/_4$"
Minimum Effective Installation Depth			$h_{ef,min}$	in.	$2^3/_8$	$2^3/_4$	$3^1/_8$	$3^1/_2$	$3^1/_2$	4	5
				mm	60	70	79	89	89	102	127
Maximum Effective 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
Reduction Factor for Seismic Tension			$\alpha_{N,seis}$	-	0.90	0.90	0.90	0.94	0.94	0.94	0.94
Dry Concrete	Temperature Category A[2,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1300	1270	1225	1190	1150	1120	1085
				N/mm^2	9.0	8.8	8.4	8.2	7.9	7.7	7.5
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	925	895	1035	880	845	475	450
				N/mm^2	6.4	6.2	7.1	6.1	5.8	3.3	3.1
	Temperature Category B, Range 1 & 2[3,4,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1585	1550	1495	1450	1405	1365	1325
				N/mm^2	10.9	10.7	10.3	10.0	9.7	9.4	9.1
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	1125	1090	1265	1075	1030	580	550
				N/mm^2	7.8	7.5	8.7	7.4	7.1	4.0	3.8
	Anchor Category, dry concrete		–	-	1	1	1	1	1	1	1
	Strength Reduction Factor		ϕ_d	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Water Saturated Concrete	Temperature Category A[2,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1300	1270	1225	1190	1150	1120	1085
				N/mm^2	9.0	8.8	8.4	8.2	7.9	7.7	7.5
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	925	895	1035	880	845	475	450
				N/mm^2	6.4	6.2	7.1	6.1	5.8	3.3	3.1
	Temperature Category B, Range 1 & 2[3,4,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1585	1550	1495	1450	1405	1365	1325
				N/mm^2	10.9	10.7	10.3	10.0	9.7	9.4	9.1
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	1125	1090	1265	1075	1030	580	550
				N/mm^2	7.8	7.5	8.7	7.4	7.1	4.0	3.8
	Anchor Category, water saturated concrete, 4d ≤ h_{ef} ≤12d		–	-	1	1	3	3	3	1	1
	Strength Reduction Factor, 4d ≤ h_{ef} ≤12d		ϕ_{ws}	-	0.65	0.65	0.45	0.45	0.45	0.65	0.65
	Anchor Category, water saturated concrete, 12d < h_{ef} ≤20d		–	-	N/A	N/A	3	3	3	1	1
	Strength Reduction Factor, 12d < h_{ef} ≤20d		ϕ_{ws}	-	N/A	N/A	0.45	0.45	0.45	0.65	0.65
Water-filled Hole	Temperature Category A[2,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	520	510	675	655	635	1120	1085
				N/mm^2	3.6	3.5	4.6	4.5	4.4	7.7	7.5
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	370	360	570	485	465	475	450
				N/mm^2	2.6	2.5	3.9	3.3	3.2	3.3	3.1
	Temperature Category B, Range 1 & 2[3,4,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	635	620	820	800	775	1365	1325
				N/mm^2	4.4	4.3	5.7	5.5	5.3	9.4	9.1
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	450	435	695	590	565	580	550
				N/mm^2	3.1	3.0	4.8	4.1	3.9	4.0	3.8
	Anchor Category, water-filled hole		–	-	3	3	3	3	3	3	3
	Strength Reduction Factor		ϕ_{wf}	-	0.45	0.45	0.45	0.45	0.45	0.45	0.45

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

[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi. Bond strength values must not be increased for increased concrete compressive strength.

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

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

[4]Temperature Category B, Range 2 = Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 145°F (63°C)

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

[6]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 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]Bond strengths shown are for sustained loading. In cases where anchors are subject to short term loads only, bond strengths may be multiplied by 1.13.

[8]No. 3 and No.4 diameter bond strengths limited to embedment depths 4*d* ≤ h_{ef} ≤12*d.*

TABLE 10—FRACTIONAL REINFORCING BAR BOND STRENGTH DESIGN INFORMATION FOR ANCHORS INSTALLED WITH CONTINUOUS SPECIAL INSPECTION [1,6,7]

DESIGN INFORMATION			SYMBOL	UNITS	REINFORCING BAR SIZE						
					No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 10
Nominal Diameter			d_a	in.	$^{3}/_{8}$"	$^{1}/_{2}$"	$^{5}/_{8}$"	$^{3}/_{4}$"	$^{7}/_{8}$"	1"	$1^{1}/_{4}$"
Minimum Effective Installation Depth			$h_{ef,min}$	in.	$2^{3}/_{8}$	$2^{3}/_{4}$	$3^{1}/_{8}$	$3^{1}/_{2}$	$3^{1}/_{2}$	4	5
				mm	60	70	79	89	89	102	127
Maximum Effective 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
Reduction Factor for Seismic Tension			$\alpha_{N,seis}$	-	0.90	0.90	0.90	0.94	0.94	0.94	0.94
Dry Concrete	Temperature Category A[2,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1300	1270	1225	1190	1150	1120	1085
				N/mm²	9.0	8.8	8.4	8.2	7.9	7.7	7.5
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	925	895	1035	880	845	475	450
				N/mm²	6.4	6.2	7.1	6.1	5.8	3.3	3.1
	Temperature Category B, Range 1 & 2[3,4,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1585	1550	1495	1450	1405	1365	1325
				N/mm²	10.9	10.7	10.3	10.0	9.7	9.4	9.1
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	1125	1090	1265	1075	1030	580	550
				N/mm²	7.8	7.5	8.7	7.4	7.1	4.0	3.8
	Anchor Category, dry concrete		–	-	1	1	1	1	1	1	1
	Strength Reduction Factor		ϕ_d	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Water Saturated Concrete	Temperature Category A[2,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1300	1270	1225	1190	1150	1120	1085
				N/mm²	9.0	8.8	8.4	8.2	7.9	7.7	7.5
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	925	895	1035	880	845	475	450
				N/mm²	6.4	6.2	7.1	6.1	5.8	3.3	3.1
	Temperature Category B, Range 1 & 2[3,4,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1585	1550	1495	1450	1405	1365	1325
				N/mm²	10.9	10.7	10.3	10.0	9.7	9.4	9.1
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	1125	1090	1265	1075	1030	580	550
				N/mm²	7.8	7.5	8.7	7.4	7.1	4.0	3.8
	Anchor Category, water saturated concrete, $4d \le h_{ef} \le 12d$		–	-	1	1	2	2	2	1	1
	Strength Reduction Factor, $4d \le h_{ef} \le 12d$		ϕ_{ws}	-	0.65	0.65	0.55	0.55	0.55	0.65	0.65
	Anchor Category, water saturated concrete, $12d < h_{ef} \le 20d$		–	-	N/A	N/A	2	2	2	1	1
	Strength Reduction Factor, $12d < h_{ef} \le 20d$ [8]		ϕ_{ws}	-	N/A	N/A	0.55	0.55	0.55	0.65	0.65
Water-filled Hole	Temperature Category A[2,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	610	595	795	775	750	1120	1085
				N/mm²	4.2	4.1	5.5	5.3	5.2	7.7	7.5
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	435	420	675	570	550	475	450
				N/mm²	3.0	2.9	4.6	3.9	3.8	3.3	3.1
	Temperature Category B, Range 1 & 2[3,4,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	745	730	970	945	915	1365	1325
				N/mm²	5.1	5.0	6.7	6.5	6.3	9.4	9.1
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	530	510	820	700	670	580	550
				N/mm²	3.6	3.5	5.7	4.8	4.6	4.0	3.8
	Anchor Category, water-filled hole		–	-	3	3	3	3	3	2	2
	Strength Reduction Factor		ϕ_{wf}	-	0.45	0.45	0.45	0.45	0.45	0.55	0.55

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

[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi. Bond strength values must not be increased for increased concrete compressive strength.
[2]Temperature Category A: Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 176°F (80°C)
[3]Temperature Category B, Range 1 = Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 130°F (55°C)
[4]Temperature Category B, Range 2 = Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 145°F (63°C)
[5]Short-term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long-term concrete temperatures are roughly constant over significant periods of time.
[6]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 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]Bond strengths shown are for sustained loading. In cases where anchors are subject to short term loads only, bond strengths may be multiplied by 1.13.
[8]No. 3 and No.4 diameter bond strengths limited to embedment depths $4d \le h_{ef} \le 12d$.

TABLE 11—METRIC THREADED ROD BOND STRENGTH DESIGN INFORMATION FOR ANCHORS INSTALLED WITH PERIODIC SPECIAL INSPECTION [1,6,7]

DESIGN INFORMATION			SYMBOL	UNITS	NOMINAL THREADED ROD DIAMETER						
					M10	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Minimum Effective Installation Depth			$h_{ef,min}$	in.	2.4	2.8	3.1	3.5	3.8	4.3	4.7
				mm	60	70	80	90	96	108	120
Maximum Effective Installation Depth			$h_{ef,max}$	in.	7.9	9.4	12.6	15.7	18.9	21.3	23.6
				mm	200	240	320	400	480	540	600
Reduction Factor for Seismic Tension			$\alpha_{N,seis}$	-	0.79	0.99	0.91	0.81	0.88	0.90	0.79
Dry Concrete	Temperature Category A[2,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1615	1585	1535	1485	1435	1395	1360
				N/mm^2	11.1	10.9	10.6	10.2	9.9	9.6	9.4
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	475	625	750	710	645	660	545
				N/mm^2	3.3	4.3	5.2	4.9	4.4	4.6	3.8
	Temperature Category B, Range 1 & 2[3,4,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1965	1935	1875	1810	1750	1705	1655
				N/mm^2	13.5	13.3	12.9	12.5	12.1	11.8	11.4
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	580	765	915	865	785	805	665
				N/mm^2	4.0	5.3	6.3	6.0	5.4	5.6	4.6
	Anchor Category, dry concrete		–	-	1	1	1	1	1	1	1
	Strength Reduction Factor		ϕ_d	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Water Saturated Concrete	Temperature Category A[2,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1615	1585	1535	1485	1435	1395	1360
				N/mm^2	11.1	10.9	10.6	10.2	9.9	9.6	9.4
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	475	625	750	710	645	660	545
				N/mm^2	3.3	4.3	5.2	4.9	4.4	4.6	3.8
	Temperature Category B, Range 1 & 2[3,4,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1965	1935	1875	1810	1750	1705	1655
				N/mm^2	13.5	13.3	12.9	12.5	12.1	11.8	11.4
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	580	765	915	865	785	805	665
				N/mm^2	4.0	5.3	6.3	6.0	5.4	5.6	4.6
	Anchor Category, water saturated concrete, 4d ≤ h_{ef} ≤12d		–	-	1	1	3	3	3	1	1
	Strength Reduction Factor, 4d ≤ h_{ef} ≤12d		ϕ_{ws}	-	0.65	0.65	0.45	0.45	0.45	0.65	0.65
	Anchor Category, water saturated concrete, 12d < h_{ef} ≤20d		–	-	N/A	N/A	3	3	3	1	1
	Strength Reduction Factor, 12d < h_{ef} ≤20d [8]		ϕ_{ws}	-	N/A	N/A	0.45	0.45	0.45	0.65	0.65
Water-filled Hole	Temperature Category A[2,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	645	635	845	815	790	1395	1360
				N/mm^2	4.5	4.4	5.8	5.6	5.4	9.6	9.4
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	190	250	415	390	355	660	545
				N/mm^2	1.3	1.7	2.8	2.7	2.4	4.6	3.8
	Temperature Category B, Range 1 & 2[3,4,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	785	775	1030	995	965	1705	1655
				N/mm^2	5.4	5.3	7.1	6.9	6.6	11.8	11.4
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	230	305	505	475	430	805	665
				N/mm^2	1.6	2.1	3.5	3.3	3.0	5.6	4.6
	Anchor Category, water-filled hole		–	-	3	3	3	3	3	3	3
	Strength Reduction Factor		ϕ_{wf}	-	0.45	0.45	0.45	0.45	0.45	0.45	0.45

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

[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi. Bond strength values must not be increased for increased concrete compressive strength.

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

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

[4]Temperature Category B, Range 2 = Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 145°F (63°C)

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

[6]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 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]Bond strengths shown are for sustained loading. In cases where anchors are subject to short term loads only, bond strengths may be multiplied by 1.13.

[8]M10 and M12 diameter bond strengths limited to embedment depths 4*d* ≤ h_{ef} ≤12*d*.

TABLE 12—METRIC THREADED ROD BOND STRENGTH DESIGN INFORMATION FOR ANCHORS INSTALLED WITH CONTINUOUS SPECIAL INSPECTION[1,6,7]

DESIGN INFORMATION			SYMBOL	UNITS	NOMINAL THREADED ROD DIAMETER						
					M10	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Minimum Effective Installation Depth			$h_{ef,min}$	in.	2.4	2.8	3.1	3.5	3.8	4.3	4.7
Minimum Effective Installation Depth			$h_{ef,min}$	mm	60	70	80	90	96	108	120
Maximum Effective Installation Depth			$h_{ef,max}$	in.	7.9	9.4	12.6	15.7	18.9	21.3	23.6
Maximum Effective Installation Depth			$h_{ef,max}$	mm	200	240	320	400	480	540	600
Reduction Factor for Seismic Tension			$\alpha_{N,seis}$	-	0.79	0.99	0.91	0.81	0.88	0.90	0.79
Dry Concrete	Temperature Category A[2,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1615	1585	1535	1485	1435	1395	1360
Dry Concrete	Temperature Category A[2,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	N/mm²	11.1	10.9	10.6	10.2	9.9	9.6	9.4
Dry Concrete	Temperature Category A[2,5]	Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	475	625	750	710	645	660	545
Dry Concrete	Temperature Category A[2,5]	Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	N/mm²	3.3	4.3	5.2	4.9	4.4	4.6	3.8
Dry Concrete	Temperature Category B, Range 1 & 2[3,4,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1965	1935	1875	1810	1750	1705	1655
Dry Concrete	Temperature Category B, Range 1 & 2[3,4,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	N/mm²	13.5	13.3	12.9	12.5	12.1	11.8	11.4
Dry Concrete	Temperature Category B, Range 1 & 2[3,4,5]	Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	580	765	915	865	785	805	665
Dry Concrete	Temperature Category B, Range 1 & 2[3,4,5]	Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	N/mm²	4.0	5.3	6.3	6.0	5.4	5.6	4.6
Dry Concrete	Anchor Category, dry concrete		–	-	1	1	1	1	1	1	1
Dry Concrete	Strength Reduction Factor		ϕ_d	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Water Saturated Concrete	Temperature Category A[2,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1615	1585	1535	1485	1435	1395	1360
Water Saturated Concrete	Temperature Category A[2,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	N/mm²	11.1	10.9	10.6	10.2	9.9	9.6	9.4
Water Saturated Concrete	Temperature Category A[2,5]	Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	475	625	750	710	645	660	545
Water Saturated Concrete	Temperature Category A[2,5]	Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	N/mm²	3.3	4.3	5.2	4.9	4.4	4.6	3.8
Water Saturated Concrete	Temperature Category B, Range 1 & 2[3,4,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1965	1935	1875	1810	1750	1705	1655
Water Saturated Concrete	Temperature Category B, Range 1 & 2[3,4,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	N/mm²	13.5	13.3	12.9	12.5	12.1	11.8	11.4
Water Saturated Concrete	Temperature Category B, Range 1 & 2[3,4,5]	Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	580	765	915	865	785	805	665
Water Saturated Concrete	Temperature Category B, Range 1 & 2[3,4,5]	Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	N/mm²	4.0	5.3	6.3	6.0	5.4	5.6	4.6
Water Saturated Concrete	Anchor Category, water saturated concrete, $4d \leq h_{ef} \leq 12d$		–	-	1	1	2	2	2	1	1
Water Saturated Concrete	Strength Reduction Factor, $4d \leq h_{ef} \leq 12d$		ϕ_{ws}	-	0.65	0.65	0.55	0.55	0.55	0.65	0.65
Water Saturated Concrete	Anchor Category, water saturated concrete, $12d < h_{ef} \leq 20d$		–	-	N/A	N/A	2	2	2	1	1
Water Saturated Concrete	Strength Reduction Factor, $12d < h_{ef} \leq 20d$ [8]		ϕ_{ws}	-	N/A	N/A	0.55	0.55	0.55	0.65	0.65
Water-filled Hole	Temperature Category A[2,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	760	745	1000	965	935	1395	1360
Water-filled Hole	Temperature Category A[2,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	N/mm²	5.2	5.1	6.9	6.7	6.4	9.6	9.4
Water-filled Hole	Temperature Category A[2,5]	Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	225	295	490	460	420	660	545
Water-filled Hole	Temperature Category A[2,5]	Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	N/mm²	1.5	2.0	3.4	3.2	2.9	4.6	3.8
Water-filled Hole	Temperature Category B, Range 1 & 2[3,4,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	925	910	1220	1175	1140	1705	1655
Water-filled Hole	Temperature Category B, Range 1 & 2[3,4,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	N/mm²	6.4	6.3	8.4	8.1	7.8	11.8	11.4
Water-filled Hole	Temperature Category B, Range 1 & 2[3,4,5]	Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	275	360	595	560	510	805	665
Water-filled Hole	Temperature Category B, Range 1 & 2[3,4,5]	Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	N/mm²	1.9	2.5	4.1	3.9	3.5	5.6	4.6
Water-filled Hole	Anchor Category, water-filled hole		–	-	3	3	3	3	3	2	2
Water-filled Hole	Strength Reduction Factor		ϕ_{wf}	-	0.45	0.45	0.45	0.45	0.45	0.55	0.55

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

[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi. Bond strength values must not be increased for increased concrete compressive strength.
[2]Temperature Category A: Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 176°F (80°C)
[3]Temperature Category B, Range 1 = Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 130°F (55°C)
[4]Temperature Category B, Range 2 = Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 145°F (63°C)
[5]Short-term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long-term concrete temperatures are roughly constant over significant periods of time.
[6]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 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]Bond strengths shown are for sustained loading. In cases where anchors are subject to short term loads only, bond strengths may be multiplied by 1.13.
[8]M10 and M12 diameter bond strengths limited to embedment depths $4d \leq h_{ef} \leq 12d$.

TABLE 13—METRIC REINFORCING BAR BOND STRENGTH DESIGN INFORMATION FOR ANCHORS INSTALLED WITH PERIODIC SPECIAL INSPECTION [1,6,7]

DESIGN INFORMATION			SYMBOL	UNITS	REINFORCING BAR SIZE						
					M10	**M12**	**M16**	**M20**	**M25**	**M28**	**M32**
Nominal Diameter			d_a	mm	10	12	16	20	25	28	32
Minimum Effective Installation Depth			$h_{ef,min}$	in.	2.4	2.8	3.1	3.5	3.9	4.4	5.0
				mm	60	70	80	90	100	112	128
Maximum Effective Installation Depth			$h_{ef,max}$	in.	7.9	9.4	12.6	15.7	19.7	20	25.2
				mm	200	240	320	400	500	560	640
Reduction Factor for Seismic Tension			$\alpha_{N,seis}$	-	0.82	0.91	0.91	0.88	0.92	0.81	0.82
Dry Concrete	Temperature Category A[2,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1300	1270	1225	1190	1150	1120	1085
				N/mm^2	9.0	8.8	8.4	8.2	7.9	7.7	7.5
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	925	895	1035	880	845	475	450
				N/mm^2	6.4	6.2	7.1	6.1	5.8	3.3	3.1
	Temperature Category B, Range 1 & 2[3,4,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1585	1550	1495	1450	1405	1365	1325
				N/mm^2	10.9	10.7	10.3	10.0	9.7	9.4	9.1
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	1125	1090	1265	1075	1030	580	550
				N/mm^2	7.8	7.5	8.7	7.4	7.1	4.0	3.8
	Anchor Category, dry concrete		–	-	1	1	1	1	1	1	1
	Strength Reduction Factor		ϕ_d	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Water Saturated Concrete	Temperature Category A[2,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1300	1270	1225	1190	1150	1120	1085
				N/mm^2	9.0	8.8	8.4	8.2	7.9	7.7	7.5
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	925	895	1035	880	845	475	450
				N/mm^2	6.4	6.2	7.1	6.1	5.8	3.3	3.1
	Temperature Category B, Range 1 & 2[3,4,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1585	1550	1495	1450	1405	1365	1325
				N/mm^2	10.9	10.7	10.3	10.0	9.7	9.4	9.1
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	1125	1090	1265	1075	1030	580	550
				N/mm^2	7.8	7.5	8.7	7.4	7.1	4.0	3.8
	Anchor Category, water saturated concrete, $4d \le h_{ef} \le 12d$		–	-	1	1	3	3	3	1	1
	Strength Reduction Factor, $4d \le h_{ef} \le 12d$		ϕ_{ws}	-	0.65	0.65	0.45	0.45	0.45	0.65	0.65
	Anchor Category, water saturated concrete, $12d < h_{ef} \le 20d$		–	-	N/A	N/A	3	3	3	1	1
	Strength Reduction Factor, $12d < h_{ef} \le 20d$ [8]		ϕ_{ws}	-	N/A	N/A	0.45	0.45	0.45	0.65	0.65
Water-filled Hole	Temperature Category A[2,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	520	510	675	655	635	1120	1085
				N/mm^2	3.6	3.5	4.6	4.5	4.4	7.7	7.5
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	370	360	570	485	465	475	450
				N/mm^2	2.6	2.5	3.9	3.3	3.2	3.3	3.1
	Temperature Category B, Range 1 & 2[3,4,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	635	620	820	800	775	1365	1325
				N/mm^2	4.4	4.3	5.7	5.5	5.3	9.4	9.1
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	450	435	695	590	565	580	550
				N/mm^2	3.1	3.0	4.8	4.1	3.9	4.0	3.8
	Anchor Category, water-filled hole		–	-	3	3	3	3	3	3	3
	Strength Reduction Factor		ϕ_{wf}	-	0.45	0.45	0.45	0.45	0.45	0.45	0.45

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

[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi. Bond strength values must not be increased for increased concrete compressive strength.
[2]Temperature Category A: Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 176°F (80°C)
[3]Temperature Category B, Range 1 = Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 130°F (55°C)
[4]Temperature Category B, Range 2 = Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 145°F (63°C)
[5]Short-term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long-term concrete temperatures are roughly constant over significant periods of time.
[6]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 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]Bond strengths shown are for sustained loading. In cases where anchors are subject to short term loads only, bond strengths may be multiplied by 1.13.
[8]M10 and M12 diameter bond strengths limited to embedment depths $4d \le h_{ef} \le 12d$.

TABLE 14—METRIC REINFORCING BAR BOND STRENGTH DESIGN INFORMATION FOR ANCHORS INSTALLED WITH CONTINUOUS SPECIAL INSPECTION [1,6,7]

DESIGN INFORMATION			SYMBOL	UNITS	REINFORCING BAR SIZE						
					M10	M12	M16	M20	M25	M28	M32
Nominal Diameter			d_a	mm	10	12	16	20	25	28	32
Minimum Effective Installation Depth			$h_{ef,min}$	in.	2.4	2.8	3.1	3.5	3.9	4.4	5.0
				mm	60	70	80	90	100	112	128
Maximum Effective Installation Depth			$h_{ef,max}$	in.	7.9	9.4	12.6	15.7	19.7	20	25.2
				mm	200	240	320	400	500	560	640
Reduction Factor for Seismic Tension			$\alpha_{N,seis}$	-	0.82	0.91	0.91	0.88	0.92	0.81	0.82
Dry Concrete	Temperature Category A[2,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1300	1270	1225	1190	1150	1120	1085
				N/mm²	9.0	8.8	8.4	8.2	7.9	7.7	7.5
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	925	895	1035	880	845	475	450
				N/mm²	6.4	6.2	7.1	6.1	5.8	3.3	3.1
	Temperature Category B, Range 1 & 2[3,4,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1585	1550	1495	1450	1405	1365	1325
				N/mm²	10.9	10.7	10.3	10.0	9.7	9.4	9.1
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	1125	1090	1265	1075	1030	580	550
				N/mm²	7.8	7.5	8.7	7.4	7.1	4.0	3.8
	Anchor Category, dry concrete		–	-	1	1	1	1	1	1	1
	Strength Reduction Factor		ϕ_d	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Water Saturated Concrete	Temperature Category A[2,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1300	1270	1225	1190	1150	1120	1085
				N/mm²	9.0	8.8	8.4	8.2	7.9	7.7	7.5
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	925	895	1035	880	845	475	450
				N/mm²	6.4	6.2	7.1	6.1	5.8	3.3	3.1
	Temperature Category B, Range 1 & 2[3,4,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1585	1550	1495	1450	1405	1365	1325
				N/mm²	10.9	10.7	10.3	10.0	9.7	9.4	9.1
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	1125	1090	1265	1075	1030	580	550
				N/mm²	7.8	7.5	8.7	7.4	7.1	4.0	3.8
	Anchor Category, water saturated concrete, $4d \le h_{ef} \le 12d$		–	-	1	1	2	2	2	1	1
	Strength Reduction Factor, $4d \le h_{ef} \le 12d$		ϕ_{ws}	-	0.65	0.65	0.55	0.55	0.55	0.65	0.65
	Anchor Category, water saturated concrete, $12d < h_{ef} \le 20d$		–	-	N/A	N/A	2	2	2	1	1
	Strength Reduction Factor, $12d < h_{ef} \le 20d$ [8]		ϕ_{ws}	-	N/A	N/A	0.55	0.55	0.55	0.65	0.65
Water-filled Hole	Temperature Category A[2,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	610	595	795	775	750	1120	1085
				N/mm²	4.2	4.1	5.5	5.3	5.2	7.7	7.5
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	435	420	675	570	550	475	450
				N/mm²	3.0	2.9	4.6	3.9	3.8	3.3	3.1
	Temperature Category B, Range 1 & 2[3,4,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	745	730	970	945	915	1365	1325
				N/mm²	5.1	5.0	6.7	6.5	6.3	9.4	9.1
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	530	510	820	700	670	580	550
				N/mm²	3.6	3.5	5.7	4.8	4.6	4.0	3.8
	Anchor Category, water-filled hole		–	-	3	3	3	3	3	2	2
	Strength Reduction Factor		ϕ_{wf}	-	0.45	0.45	0.45	0.45	0.45	0.55	0.55

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

[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi. Bond strength values must not be increased for increased concrete compressive strength.
[2]Temperature Category A: Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 176°F (80°C)
[3]Temperature Category B, Range 1 = Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 130°F (55°C)
[4]Temperature Category B, Range 2 = Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 145°F (63°C)
[5]Short-term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long-term concrete temperatures are roughly constant over significant periods of time.
[6]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 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]Bond strengths shown are for sustained loading. In cases where anchors are subject to short term loads only, bond strengths may be multiplied by 1.13.
[8]M10 and M12 diameter bond strengths limited to embedment depths $4d \le h_{ef} \le 12d$.

TABLE 15—DEVELOPMENT LENGTH FOR GRADE 60 FRACTIONAL REINFORCING BARS INSTALLED WITH SIKA ANCHORFIX®-3030 IN NORMAL WEIGHT CONCRETE[1, 2, 4,5]

DESIGN INFORMATION	SYMBOL	UNITS	Bar size							
			#3	#4	#5	#6	#7	#8	#9	#10
Nominal reinforcing bar diameter	d_b	in. (mm)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)	0.875 (22.2)	1.000 (25.4)	1.125 (28.6)	1.250 (31.8)
Nominal bar area	A_b	in^2 (mm^2)	0.11 (71.3)	0.20 (126.7)	0.31 (197.9)	0.44 (285.0)	0.60 (387.9)	0.79 (506.7)	1.00 (644.7)	1.27 (817.3)
Development length for f_y = 60 ksi and f'_c = 2,500 psi[3]	l_d	in. (mm)	12.0 (304.8)	14.4 (365.8)	18.0 (457.2)	21.6 (548.6)	31.5 (800.1)	36.0 (914.4)	40.5 (1028.7)	45.0 (1143)
Development length for f_y = 60 ksi and f'_c = 4,000 psi [3]	l_d	in. (mm)	12.0 (304.8)	12.0 (304.8)	14.2 (361.4)	17.1 (433.7)	24.9 (632.5)	28.5 (722.9)	32.0 (812.8)	35.6 (904.2)

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

[1]Development lengths valid for static, wind, and earthquake loads (SDC A and B).
[2] Development lengths in SDC C through F must comply with ACI 318-14 Chapter 18 or ACI 318-11 Chapter 21 and Section 4.2.4 of this report. The value of f'_c used to calculate development lengths shall not exceed 2,500 psi for post-installed reinforcing bar applications in SDCs C, D, E, and F.
[3] For sand-lightweight concrete, increase development length by 33%, unless the provisions of ACI 318-14 25.4.2.4 or ACI 318-11 12.2.4 (d) are met to permit λ > 0.75.
[4] $\left(\frac{c_b + K_{tr}}{d_b}\right) = 2.5$, ψ_t = 1.0, ψ_e = 1.0, ψ_s = 0.8 for d_b ≤ #6, 1.0 for d_b > #6.
[5]Calculations may be performed for other steel grades and concrete compressive strengths per ACI 318-14 Chapter 25 or ACI 318-11 Chapter 12, as applicable.

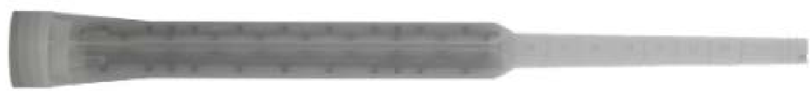
TABLE 16—DEVELOPMENT LENGTH FOR 500 MPA (72.5 KSI) METRIC REINFORCING BARS INSTALLED WITH SIKA ANCHORFIX®-3030 IN NORMAL WEIGHT CONCRETE[1, 2, 4,5]

DESIGN INFORMATION	SYMBOL	UNITS	Bar size						
			10	12	16	20	25	28	32
Nominal reinforcing bar diameter	d_b	mm (in.)	10 (0.394)	12 (0.472)	16 (0.630)	20 (0.787)	25 (0.984)	28 (1.102)	32 (1.260)
Nominal bar area	A_b	mm^2 (in^2)	78.5 (0.12)	113 (0.18)	201 (0.31)	314 (0.49)	491 (0.76)	616 (0.95)	804 (1.25)
Development length for f_y = 72.5 ksi and f'_c = 2,500 psi (normal weight concrete) [3]	l_d	mm (in.)	348 (13.7)	417 (16.4)	556 (21.9)	871 (34.3)	1087 (42.8)	1218 (47.9)	1392 (54.8)
Development length for f_y = 72.5 ksi and f'_c = 4,000 psi (normal weight concrete) [3]	l_d	mm (in.)	305 (12.0)	330 (13.0)	439 (17.3)	688 (27.1)	859 (33.8)	963 (37.9)	1100 (43.3)

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

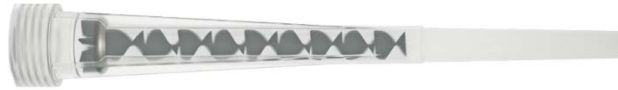
[1]Development lengths valid for static, wind, and earthquake loads (SDC A and B).
[2] Development lengths in SDC C through F must comply with ACI 318-14 Chapter 18 or ACI 318-11 Chapter 21 and section 4.2.4 of this report. The value of f'_c used to calculate development lengths shall not exceed 2,500 psi for post-installed reinforcing bar applications in SDCs C, D, E, and F.
[3] For sand-lightweight concrete, increase development length by 33%, unless the provisions of ACI 318-14 25.4.2.4 or ACI 318-11 12.2.4 (d) are met to permit λ > 0.75.
[4] $\left(\frac{c_b + K_{tr}}{d_b}\right) = 2.5$, ψ_t = 1.0, ψ_e = 1.0, ψ_s = 0.8 for d_b < 20mm, 1.0 for d_b ≥ 20mm.
[5]Calculations may be performed for other steel grades and concrete compressive strengths per ACI 318-14 Chapter 25 or ACI 318-11 Chapter 12, as applicable

Left to right: Sika AnchorFix®-3030 385ml, Sika AnchorFix®-3030 585ml



SAF-Q mixing Nozzle

SAF-Q2-Flow mixing Nozzle

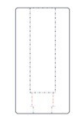
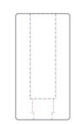


SAF EZ-Flow mixing Nozzle

Left to right 3/8" (9mm) dia. Y1 extension tube, 9/16" (14mm) dia. Y2 extension tube, resin stoppers

FIGURE 2—SIKA ANCHORFIX®-3030 ADHESIVE ANCHORING SYSTEM

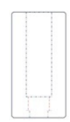
TABLE 17—INSTALL PARAMETERS (FRACTIONAL SIZES)

THREADED ROD INSTALLATIONS (FRACTIONAL)								
Anchor Size	**Drilled Hole Size**	**Cleaning Brush Size**	**Nozzle Type**			**Extension Tube Required?**	**Resin Stopper Required?**	**Notes**
			SAF-Q	**SAF-Q2**	**SAF EZ-Flow**			
								
$^{3}/_{8}$"	$^{1}/_{2}$"	S14H/F	✔		✔	Y1 > 3.5" h_{ef}	N	
$^{1}/_{2}$"	$^{9}/_{16}$"	S16H/F	✔		✔	Y1 > 3.5" h_{ef}	N	
$^{5}/_{8}$"	$^{3}/_{4}$"	S22H/F	✔	✔	✔	Y2 > 10" h_{ef}	RS18>10"h_{ef}	SAF-QH nozzle required at h_{ef} > 8"
$^{3}/_{4}$"	$^{7}/_{8}$"	S24H/F		✔		Y2 > 10" h_{ef}	RS18>10"h_{ef}	
$^{7}/_{8}$"	1"	S27H/F		✔		Y2 > 10" h_{ef}	RS22>10"h_{ef}	
1"	1$^{1}/_{8}$"	S31H/F		✔		Y2 > 10" h_{ef}	RS22>10"h_{ef}	
1$^{1}/_{4}$"	1$^{3}/_{8}$"	S38H/F		✔		Y2 > 10" h_{ef}	RS30>10"h_{ef}	
REINFORCING BAR INSTALLATIONS								
Anchor Size	**Drilled Hole Size**	**Cleaning Brush Size**	**Nozzle Type**			**Extension Tube Required?**	**Resin Stopper Required?**	**Notes**
			SAF-Q	**SAF-Q2**	**SAF EZ-Flow**			
								
#3	$^{9}/_{16}$"	S16H/F	✔		✔	Y1 > 3.5" h_{ef}	N	
#4	$^{5}/_{8}$"	S18H/F	✔	✔	✔	Y1 > 3.5" h_{ef}	N	SAF-Q2 nozzle required at h_{ef} > 3.5"
#5	$^{3}/_{4}$"	S22H/F	✔	✔	✔	Y2 > 10" h_{ef}	RS18>10"h_{ef}	SAF-Q2 nozzle required at h_{ef} > 8"
#6	$^{7}/_{8}$"	S27H/F		✔		Y2 > 10" h_{ef}	RS18>10"h_{ef}	
#7	1"	S31H/F		✔		Y2 > 10" h_{ef}	RS22>10"h_{ef}	
#8	1$^{1}/_{8}$"	S35H/F		✔		Y2 > 10" h_{ef}	RS22>10"h_{ef}	
#10	1$^{3}/_{8}$"	S43H/F		✔		Y2 > 10" h_{ef}	RS30>10"h_{ef}	

Key:

Y1	Requires $^{3}/_{8}$"-diameter extension tube fitted to SAF-Q nozzle
Y2	Requires $^{9}/_{16}$"-diameter extension tube fitted to SAF-Q2 nozzle
RS18	Use 18 mm-diameter resin stopper
RS22	Use 22 mm-diameter resin stopper
RS30	Use 30 mm-diameter resin stopper
N	Not required
H	Brush with handle
F	Brush with ferrule

TABLE 18—INSTALL PARAMETERS (METRIC SIZES)

THREADED ROD INSTALLATIONS (METRIC)								
Anchor Size	**Drilled Hole Size**	**Cleaning Brush Size**	**Nozzle Type**			**Extension Tube Required?**	**Resin Stopper Required?**	**Notes**
			SAF-Q	**SAF-Q2**	**SAF EZ-Flow**			
								
M8	10	S11H/F	✔		✔	Y1 >90 mm h_{ef}	N	
M10	12	S14H/F	✔		✔	Y1 >90 mm h_{ef}	N	
M12	14	S16H/F	✔		✔	Y1 > 90 mm h_{ef}	N	
M16	18	S20H/F	✔	✔	✔	Y2 > 250 mm h_{ef}	RS18> 250 mm h_{ef}	SAF-Q2 nozzle required at h_{ef} > 200 mm
M20	22	S24H/F		✔		Y2 > 250 mm h_{ef}	RS18> 250 mm h_{ef}	
M24	26	S31H/F		✔		Y2 > 250 mm h_{ef}	RS22> 250 mm h_{ef}	
M27	30	S35H/F		✔		Y2 > 250 mm h_{ef}	RS22> 250 mm h_{ef}	
M30	35	S38H/F		✔		Y2 > 250 mm h_{ef}	RS30> 250 mm h_{ef}	
REINFORCING BAR INSTALLATIONS (METRIC)								
Anchor Size	**Drilled Hole Size**	**Cleaning Brush Size**	**Nozzle Type**			**Extension Tube Required?**	**Resin Stopper Required?**	**Notes**
			SAF-Q	**SAF-Q2**	**SAF EZ-Flow**			
								
M10	14	S14H/F	✔		✔	Y1 > 90 mm h_{ef}	N	
M12	16	S18H/F	✔	✔	✔	Y1 > 90 mm h_{ef}	N	SAF-Q2 nozzle required at h_{ef} > 90 mm
M16	20	S22H/F	✔	✔	✔	Y2 > 250 mm h_{ef}	RS18> 250 mm h_{ef}	SAF-Q2 nozzle required at h_{ef} > 200 mm
M20	25	S27H/F		✔		Y2 > 250 mm h_{ef}	RS22> 250 mm h_{ef}	
M25	32	S35H/F		✔		Y2 > 250 mm h_{ef}	RS22> 250 mmh_{ef}	
M28	35	S38H/F		✔		Y2 > 250 mm h_{ef}	RS30> 250 mm h_{ef}	
M32	40	S43H/F		✔		Y2 > 250 mm h_{ef}	RS30> 250 mm h_{ef}	

<u>Key:</u>

Y1	Requires 10 mm-diameter extension tube fitted to SAF-Q nozzle
Y2	Requires14 mm-diameter extension tube fitted to SAF-Q2 nozzle
RS18	Use 18 mm-diameter resin stopper
RS22	Use 22 mm-diameter resin stopper
RS30	Use 30 mm-diameter resin stopper
N	Not required
H	Brush with handle
F	Brush with ferrule

TABLE 19—ALLOWABLE COMBINATIONS OF CARTRIDGE, MIXER NOZZLE AND DISPENSING TOOL

CARTRIDGE REFERENCE	ALLOWABLE APPLICATOR TOOLS	ALLOWABLE NOZZLE TYPES		
		SAF-Q	SAF-Q2	SAF EZ-Flow
Sika AnchorFix®-3030 385ml	 Sika Manual 3:1 385ml spec 26:1	✔		✔
Sika AnchorFix®-3030 585ml	 Sika Manual 3:1 585ml spec 26:1  Manual, 585ml 3:1 Model: 585-XSP 26:1 Thrust Ratio Newborn  Pneumatic TS444KX (3:1) Cox  Model 7000-585-31 cordless dispenser 20v Meritool	✔	✔	✔

TABLE 20—GEL AND CURE TIMES

SUBSTRATE TEMPERATURE (°C)	SUBSTRATE TEMPERATURE (°F)	GEL TIME	CURE TIME
10 to 15	50 to 59	40 mins	24 hours
15 to 20	59 to 68	25 mins	12 hours
20 to 25	68 to 77	18 mins	8 hours
25 to 30	77 to 86	12 mins	6 hours
30 to 35	86 to 95	8 mins	4 hours
35 to 40	95 to 104	6 mins	2 hours

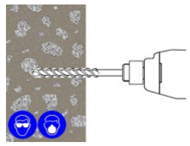
Sika AnchorFix®-3030: MPII

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 17 and 18. Refer to Figure 2, Table 1, Table 17, Table 18, and Table 19 for parts specification or guidance for individual items or dimensions.

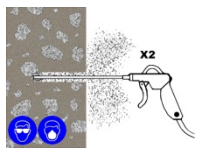
Important: check the expiration date on the cartridge **(do not use expired material**) and that the cartridge has been stored in its original packaging, the correct way up, in cool conditions (50°F to 77°F) out of direct sunlight.

Solid Substrate Installation Method

1. 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.

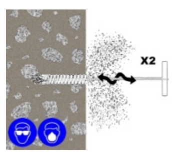


2. Select the correct Air Lance, insert to the bottom of the hole and depress the trigger for 2 seconds. The compressed air must be clean – free from water and oil – and at a minimum pressure of 90 psi (6 bar).



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*.



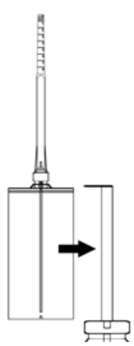
Perform the brushing operation twice.

4. Repeat 2 (blowing operation) twice.

5. Repeat 3 (brushing operation) twice.

6. Repeat 2 (blowing operation) twice.

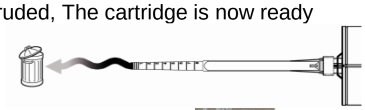
7. Select the appropriate static mixer nozzle, checking that the mixing elements are present and correct **(do not modify the mixer)**. Attach mixer nozzle to the cartridge. Check the Dispensing Tool is in good working order. Place the cartridge into the dispensing tool.



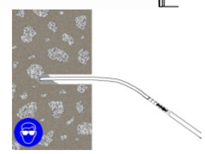
Note: The SAF-Q2 nozzle is in two sections. One section contains the mixing elements and the other section is an extension piece. Connect the extension piece to the mixing section by pushing the two sections firmly together until a positive engagement is felt.

Note: Sika AnchorFix®-3030 may only be installed between concrete temperatures of 50°F to 104°F. The product must be conditioned to a minimum of 50°F. For gel and cure time data, refer to Table 20.

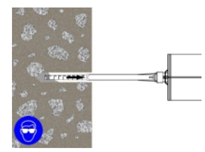
8. Extrude some resin to waste until an even-colored mixture is extruded, The cartridge is now ready for use.



9. As specified in Figure 2, Table 17, and Table 18, 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).



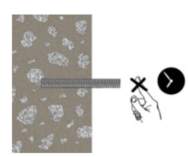
10. Insert the mixing nozzle to the bottom of the hole. Extrude the resin and slowly withdraw the nozzle from the hole. **Ensure no air voids are created** as the nozzle is withdrawn. Inject resin until the hole is approximately $^3/_4$ full and remove the nozzle from the hole.



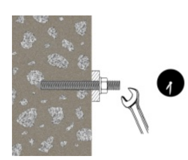
11. Select the steel anchor element ensuring it is free from oil or other contaminants, and mark with the required embedment depth. Insert the steel element into the hole using a back and forth twisting motion to ensure complete cover, until it reaches the bottom of the hole. Adhesive must completely 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.

13. Do not disturb the anchor until at least the minimum cure time has elapsed. Refer to the Table 20 Gel and Cure Times to determine the appropriate cure time.



14. Position the fixture and tighten the anchor to the appropriate installation torque.

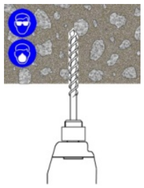


Do not over-torque the anchor as this could adversely affect its performance.

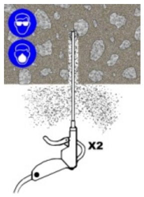
FIGURE 3—INSTALLATION DETAILS

Overhead Substrate Installation

1. 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.

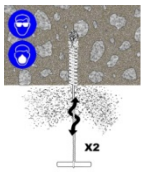


2. Select the correct Air Lance, insert to the bottom of the hole and depress the trigger for 2 seconds. The compressed air must be clean – free from water and oil – and at a minimum pressure of 90 psi (6 bar).



   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*.



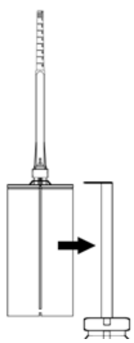
   Perform the brushing operation twice.

4. Repeat 2 (blowing operation) twice.

5. Repeat 3 (brushing operation) twice.

6. Repeat 2 (blowing operation) twice.

7. 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: Sika AnchorFix®-3030 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 20.

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

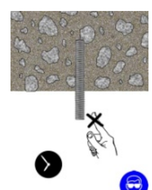
9. As specified in Figure 2, Table 17, and Table 18, attach an extension tube with resin stopper (if required) to the end of the mixing nozzle with a push fit. (The extension tubes may be pushed into the resin stoppers and are held in place with a coarse internal thread).

10. Insert the mixing nozzle, extension tube, or resin stopper (see Tables 17 and 18) to the end 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 $^{3}/_{4}$ full and remove the nozzle from the hole.

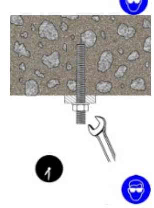
11. Select the steel anchor element ensuring it is free from oil or other contaminants, and mark with the required embedment depth. Insert the steel element into the hole using a back and forth twisting motion to ensure complete cover, until it reaches the bottom of the hole. Adhesive must completely 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.

13. Do not disturb the anchor until at least the minimum cure time has elapsed. Refer to 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.

FIGURE 3—INSTALLATION DETAILS (Continued)

TABLE 21—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 $\tau_{k,uncr}$ (psi)**	**Allowable Tension Load (lb) 2500 psi - 8000 psi Concrete**	**Controlling Failure Mode**
3/8"	2.375	2,290	1,929	Breakout Strength
	7.500	2,290	4,910	Steel Strength
1/2"	2.750	2,165	2,403	Breakout Strength
	10.000	2,165	8,990	Steel Strength
5/8"	3.125	2,035	2,911	Breakout Strength
	12.500	2,035	14,316	Steel Strength
3/4"	3.500	1,910	3,451	Breakout Strength
	15.000	1,910	21,157	Steel Strength
7/8"	4.000	1,780	4,216	Breakout Strength
	17.500	1,780	29,265	Steel Strength
1"	4.000	1,655	4,216	Breakout Strength
	20.000	1,655	38,387	Steel Strength
1 1/4"	4.000	1,395	4,216	Breakout Strength
	25.000	1,395	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 318-14 Section 5.3 (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. $c_{ac1} = c_{ac2} \geq c_{ac}$
15. $h \geq h_{min}$

ILLUSTRATIVE PROCEDURE TO CALCULATE ALLOWABLE STRESS DESIGN TENSION VALUE

Sika AnchorFix®-3030 Anchor $^1/_2$" Diameter, using an embedment of 2.75", with the design assumptions given in Table 21 (for use with the 2018 IBC, based on ACI 318-14)

Procedure		-	**Calculation**	
Step 1:	Calculate steel strength of a single anchor in tension per ACI 318-14 17.4.1.2 (Table 2 of this report).		ϕN_{sa}	$= \phi N_{sa}$ $=0.65 \times 17740$ $\mathbf{=11531\ lb}$
Step 2:	Calculate breakout strength of a single anchor in tension per ACI 318-14 17.4.2 (Table 5 of this report).		N_b	$= k_{c,uncr}\,\lambda_a \sqrt{(f'_c)}\, h_{ef}^{1.5}$ $=(24) \times (1.0) \times (2500)^{0.5} \times (2.75)^{1.5}$ $=5472\ lb$
			ϕN_{cb}	$= \phi\,(A_{NC} / A_{NC0})\psi_{ed,N}\,\psi_{c,N}\,\psi_{cp,N}\,N_b$ $=0.65 \times 1.0 \times 1.0 \times 1.0 \times 1.0 \times 5472$ $\mathbf{=3557\ lb}$
Step 3:	Calculate bond strength of a single anchor in tension per ACI 318-14 17.4.5 (Table 7 of this report).		N_{ba}	$= \lambda_a\,\tau_{k,uncr}\,\pi\, d\, h_{ef}$ $=1.0 \times 2165 \times 3.141 \times 0.5 \times 2.75$ $=9350\ lb$
			ϕN_a	$= \phi\,(A_{Na} / A_{Na0})\psi_{ed,Na}\,\psi_{cp,Na}\,N_{ba}$ $=0.65 \times 1.0 \times 1.0 \times 1.0 \times 9350$ $\mathbf{=6078\ lb}$
Step 4:	Determine controlling resistance strength in tension per ACI 318-14 17.3.1.1 and 17.3.1.2.		***3557***	*lb = controlling resistance* *(breakout)*
Step 5:	Calculate Allowable Stress Design conversion factor for loading condition per ACI 318-14 Section 5.3.		α	$= 1.2DL + 1.6LL$ $= 1.2*0.3 + 1.6*0.7$ $\mathbf{= 1.48}$
Step 6:	Calculate Allowable Stress Design value per Section 4.3 of this report.		$T_{allowable,ASD}$	$= 3557 / 1.48$ $\mathbf{= 2403\ lb}$

FIGURE 4—SAMPLE CALCULATIONS

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

EVALUATION SUBJECT:

SIKA ANCHORFIX®-3030 ADHESIVE ANCHORS AND POST INSTALLED REINFORCING BAR CONNECTIONS 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®-3030 Adhesive Anchors and the Post-Installed Reinforcing Bar Connections in cracked and uncracked concrete, described in ICC-ES evaluation report ESR-4778, have also been evaluated for compliance with the codes noted below as adopted by the Los Angeles Department of Building and Safety (LADBS).

Applicable code editions:

- 2020 *City of Los Angeles Building Code* (LABC)
- 2020 *City of Los Angeles Residential Code* (LARC)

2.0 CONCLUSIONS

The Sika AnchorFix®-3030 Adhesive Anchors and the Post-Installed Reinforcing Bar Connections in cracked and uncracked concrete, described in Sections 2.0 through 7.0 of the evaluation report ESR-4778, comply with the LABC Chapter 19, and the LARC, and are subject to the conditions of use described in this supplement.

3.0 CONDITIONS OF USE

The Sika AnchorFix®-3030 Adhesive Anchors and the Post-Installed Reinforcing Bar Connections in cracked and uncracked concrete described in this evaluation report must comply with all of the following conditions:

- All applicable sections in the evaluation report ESR-4778.
- The design, installation, conditions of use and labeling of the anchors are in accordance with the 2018 *International Building Code®* (2018 IBC) provisions noted in the evaluation report ESR-4778.
- The design, installation and inspection are in accordance with additional requirements of LABC Chapters 16 and 17, as applicable.
- Under the LARC, an engineered design in accordance with LARC Section R301.1.3 must be submitted.
- The allowable and strength design values listed in the evaluation report and tables are for the connection of the anchors or reinforcing bars to the concrete. The connection between the anchors or the reinforcing bars and the connected members shall be checked for capacity (which may govern).
- For use in wall anchorage assemblies to flexible diaphragm applications, anchors shall be designed per the requirements of City of Los Angeles Information Bulletin P/BC 2017-071.

This supplement expires concurrently with the evaluation report, reissued February 2023.

ICC-ES Evaluation Report

ESR-4778 FBC Supplement

Reissued February 2023

This report is subject to renewal February 2024.

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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

EVALUATION SUBJECT:

SIKA ANCHORFIX®-3030 ADHESIVE ANCHORS AND POST INSTALLED REINFORCING BAR CONNECTIONS FOR CRACKED AND UNCRACKED CONCRETE

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the Sika AnchorFix®-3030 Adhesive Anchors are used as anchorage and the Post-Installed Reinforcing Bar Connections, described in ICC-ES evaluation report ESR-4778, has also been evaluated for compliance with the codes noted below.

Applicable code editions:

- 2020 and 2017 *Florida Building Code—Building*
- 2020 and 2017 *Florida Building Code—Residential*

2.0 CONCLUSIONS

The Sika AnchorFix®-3030 Adhesive Anchors and the Post-Installed Reinforcing Bar Connections, described in Sections 2.0 through 7.0 of the evaluation report ESR-4778, comply with the *Florida Building Code—Building* and the *Florida Building Code—Residential*, provided the design requirements are determined in accordance with the *Florida Building Code—Building* or the *Florida Building Code—Residential,* as applicable. The installation requirements noted in ICC-ES evaluation report ESR-4778 for the 2018 and 2015 *International Building Code®* meet the requirements of the *Florida Building Code—Building* or the *Florida Building Code—Residential*, as applicable.

Use of the Sika AnchorFix®-3030 Adhesive Anchors and the Post-Installed Reinforcing Bar Connections has also been found to be in compliance with the High-Velocity Hurricane Zone provisions of the *Florida Building Code—Building* and *Florida Building Code—Residential* with the following condition:

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

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

This supplement expires concurrently with the evaluation report, reissued February 2023.