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# ICC-ES Evaluation Report ESR-3298

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:**

#### DEWALT

#### **EVALUATION SUBJECT:**

PURE110+<sup>®</sup> EPOXY ADHESIVE ANCHOR SYSTEM AND POST-INSTALLED REINFORCING BAR CONNECTIONS IN CRACKED AND UNCRACKED CONCRETE (DEWALT)

#### **1.0 EVALUATION SCOPE**

Compliance with the following codes:

- 2021, 2018, 2015, 2012, and 2009 International Building Code<sup>®</sup> (IBC)
- 2021, 2018, 2015, 2012, and 2009 International Residential Code<sup>®</sup> (IRC)
- 2013 Abu Dhabi International Building Code (ADIBC)<sup>†</sup>

 $^{\dagger}\text{The ADIBC}$  is based on the 2009 IBC. 2009 IBC code sections referenced in this report are the same sections in the ADIBC.

For evaluation for compliance with codes adopted by Los Angeles Department of Building and Safety (LADBS), see ESR-3298 LABC and LARC Supplement.

For evaluation for compliance with the *National Building Code of Canada*<sup>®</sup> (NBCC), see listing report <u>ELC-3298</u>.

#### Property evaluated:

Structural

#### 2.0 USES

The Pure110+ Epoxy Adhesive Anchor System and Post-Installed Reinforcing Bar Connections are used as anchorage in cracked and uncracked normal-weight concrete or lightweight concrete with a specified compressive strength,  $f_c$ , of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa) [minimum of 24 MPa is required under ADIBC Appendix L, Section 5.1.1] to resist static, wind or earthquake (IBC Seismic Design Categories A through F) tension and shear loads.



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The anchor system complies with anchors as described in Section 1901.3 of the 2021, 2018 and 2015 IBC, Section 1909 of the 2012 IBC and is an alternative to cast-in-place and post-installed anchors described in Section 1908 of the 2012 IBC, and Sections 1911 and 1912 of the 2009 IBC. The anchor systems may also be used where an engineered design is submitted in accordance with Section R301.1.3 of the IRC. The post-installed reinforcing bar 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 Pure110+ Epoxy Adhesive System is comprised of a two-component epoxy adhesive filled in cartridges, static mixing nozzles, dispensing tools, hole cleaning equipment and adhesive injection accessories. The Pure110+ epoxy adhesive system may be used with continuously threaded steel rods or deformed steel reinforcing bars to form the Pure110+ Epoxy Adhesive Anchor System (see Table 1A and Figure 1 of this report) or with deformed steel reinforcing bars to form the Pure110+ Epoxy Adhesive Post-Installed Reinforcing Bar Connections (see Table 1B, Figure 1 and Figure 3 of this report). Product name for the report holder is presented in the following table.

COMPANY NAME	PRODUCT NAME						
DEWALT	Pure110+ <sup>®</sup>						
DEWALI	Pure110-PRO (outside the Americas)						

The adhesive and steel anchor elements (continuously threaded steel rods or deformed steel reinforcing bars) are installed in pre-drilled holes into concrete. The primary components of the Pure110+ Epoxy Adhesive Anchor System and Post-Installed Reinforcing Bar Connections, including the epoxy adhesive cartridge, static mixing nozzle, the nozzle extension tube, dispensing tool and typical steel anchor elements, are shown in Figure 2 of this report. Manufacturer's printed installation instructions (MPII) and parameters, included with each adhesive unit package, are shown in Figure 4A and 4B.

#### 3.2 Materials:

**3.2.1 Pure110+ Epoxy Adhesive:** Pure110+ epoxy adhesive is an injectable two-component epoxy. The two components are separated by means of a labelled dual-cylinder cartridge. The two components combine and react when dispensed through a static mixing nozzle, supplied by DEWALT, which is attached to the cartridge.

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The Pure110+ epoxy adhesive is available in 9-ounce (265 mL), 9.5-ounce (280 mL), 13.5-ounce (400 mL), 20.5-ounce (610 mL) and 50.5-ounce (1500 mL) cartridges. Each cartridge label is marked with the adhesive expiration date. The shelf life, as indicated by the expiration date, applies to an unopened cartridge when stored in accordance with the manufacturer's printed installation instructions (MPII) as illustrated in Figure 4A and 4B of this report.

**3.2.2 Hole Cleaning Equipment:** Standard hole cleaning equipment and dust extraction system equipment (i.e. suction, vacuum) are available from the report holder.

**3.2.2.1 Standard Hole Cleaning:** Standard hole cleaning equipment used after drilling is comprised of steel wire brushes supplied by DEWALT and a compressed air nozzle (applicable for both post-installed adhesive anchor system and post-installed reinforcing bar connections). Standard hole cleaning equipment is shown in Figure 4A and 4B.

**3.2.2.2 DustX+™ Extraction System:** The DustX+™ extraction system automatically cleans the holes during drilling using hollow drill bits with a carbide head meeting the requirements of ANSI B212.15 and a DEWALT DWV012 / DWV902M vacuum equipped with an automatic filter cleaning system or equivalent as approved by DEWALT (applicable for post-installed adhesive anchors and post-installed reinforcing bar connections). After drilling with the DustX+™ system, no further hole cleaning is required. See Figure A for illustration of the DustX+™ extraction system.

**3.2.3 Dispensers** Pure110+ epoxy adhesive must be dispensed with manual dispensers, pneumatic dispensers, or electric powered dispensers supplied by DEWALT.

#### 3.2.4 Steel Anchor Elements:

3.2.4.1 Threaded Steel Rods: Threaded steel rods must be clean and continuously threaded (all-thread) in diameters as described in Tables 4 and 8 of this report. The embedded portions of threaded rods must be clean, straight, and free of mill scale, rust and other coatings (other than zinc) that may impair the bond with the adhesive. Threaded rods, matching nuts and washers must comply with the requirements including specifications, grades, and mechanical properties prescribed in Table 2 of this report. Carbon steel threaded rods may be furnished with a 0.0002-inch-thick (0.005 mm) zinc electroplated coating complying with ASTM B633, SC1; or a minimum 0.0021-inch-thick (0.053 mm) mechanically deposited zinc coating complying with ASTM B695, Class 55; or a hot dip galvanized zinc coating complying with ASTM A153, Class C or D. Steel grades and material types (carbon, stainless) of the washers and nuts must be matched to the threaded rods. Threaded steel rods must be straight and free of indentations or other defects along their length. The embedded end may be either flat cut or cut on the bias to a chisel point.

**3.2.4.2 Steel Reinforcing Bars:** Steel reinforcing bars must be deformed reinforcing bars (rebars) as described in Table 3 of this report. Tables 1A, 5, 6, 7, 9, 10 and 11 summarize reinforcing bar size ranges. The embedded portions of reinforcing bars must be clean, straight, and free of mill scale, rust and other coatings (other than zinc) that may impair the bond with the adhesive. Reinforcing bars must not be bent after installation, except as set forth in ACI 318-19 Section 26.6.3.2 (b), ACI 318-14 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 the reinforcing bars to facilitate field bending is not permitted.

**3.2.4.3 Ductility:** In accordance with ACI 318 (-19 and -14) Section 2.3 or ACI 318-11 Appendix D.1, as applicable, in order for a steel anchor 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 and 3 of this report. Where values are nonconforming or unstated, the steel element must be considered brittle.

**3.2.5** Steel Reinforcing Bars for Use in Post-Installed Reinforcing Bar Connections: Steel reinforcing bars used in post-installed reinforcing bar connections must be deformed bars (rebar) as depicted in Figure 3. Tables 1B and 13 summarize reinforcing bar size ranges. The embedded portions of reinforcing bars must be straight, and free of mill scale, rust, mud, oil, and other coatings (other than zinc) that may impair the bond with the adhesive. Reinforcing bars must not be bent after installation, except as set forth in ACI 318-19 Section 26.6.3.2 (b), ACI 318-14 26.6.3.1 (b) or ACI 318-11 7.3.2, as applicable, with the additional condition that the bars must be bent cold, and heating of reinforcing bars to facilitate field bending is not permitted.

#### 3.3 Concrete:

Normalweight concrete and lightweight concrete must comply with Sections 1903 and 1905 of the IBC, as applicable. The specified compressive strength of the concrete must be from 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa) [minimum of 24 MPa is required under ADIBC Appendix L, Section 5.1.1].

#### 4.0 DESIGN AND INSTALLATION

# 4.1 Strength Design of Pure110+ Epoxy Adhesive Post-installed Adhesive Anchor System:

**4.1.1 General:** The design strength of anchors under the 2021 IBC, as well as the 2021 IRC must be determined in accordance with ACI 318-19 and this report. The design strength of anchor system under 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 anchor system under the 2012 and 2009 IBC, as well the 2012 and 2009 IRC, must be determined in accordance with ACI 318-11 and this report.

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

Design parameters are provided in Table 4 through Table 11. Strength reduction factors,  $\phi$ , as given in ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, must be used for load combinations calculated in accordance with Section 1605.1 of the 2021 IBC, Section 1605.2 of the 2018, 2015, 2012, and 2009 IBC, ACI 318 (-19 and -14) 5.3, or ACI 318-11 9.2, as applicable. Strength reduction factors,  $\phi$ , as described in ACI 318-11 D.4.4 must be used for load combinations calculated in accordance with ACI 318-11 Appendix C.

**4.1.2 Static Steel Strength in Tension:** The nominal static steel strength of a single anchor in tension,  $N_{sa}$ , in accordance with ACI 318-19 17.6.1.2, ACI 318-14 17.4.1.2 or ACI 318-11 D.5.1.2, as applicable, and the associated strength reduction factors,  $\phi$ , in accordance with ACI 318-19

17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are provided in Tables 4, 5, 8 and 9 of this report for the corresponding steel anchor element. See Table 1A for index of design tables.

**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 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, with the following addition:

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

4.1.4 Static Bond Strength in Tension: The nominal static bond strength of a single adhesive anchor or group of adhesive anchors in tension, Na or Nag, must be calculated in accordance with ACI 318-19 17.6.5, ACI 318-14 17.4.5 or ACI 318-11 D.5.5, as applicable. Bond strength values ( $\tau_{k,cr}$ ,  $\tau_{k,uncr}$ ) are a function of the concrete service temperature, concrete state (cracked, uncracked), drilling method (hammer-drill, i.e. rotary impact drill or rock drill with a carbide bit), concrete compressive strength  $(f'_c)$  and installation conditions (dry concrete, water-saturated concrete, water-filled holes, underwater). Special inspection level is qualified as periodic for all anchors except as noted in Section 4.4 of this report. The selection of continuous special inspection level, with an onsite proof loading program, is not necessary and does not provide a benefit of a lower anchor category or an increase in the associated strength reduction factors for design. The following table summarizes the requirements.

CONCRETE STATE	DRILLING METHOD	BOND STRENGTH	CONCRETE STRENGTH	PERMISSIBLE INSTALLATION CONDITIONS	ASSOCIATED STRENGTH REDUCTION FACTOR
acked	Hammer- drill with carbide	Dry concrete	$\phi_{ m d}$		
Cracked and Uncracked	drill bit or DEWALT hollow bit	drill bit or DEWALT <i>T<sub>k,cr</sub></i>	f'c	Water-saturated concrete	Øws
ked ar	Hammer- drill with		Water-filled hole (flooded)	Øwf	
Crac	carbide drill bit			Underwater (submerged)	Фиw

The bond strength values in this report, correspond to concrete compressive strength  $f'_c$  equal to 2,500 psi (17.2 MPa). For concrete compressive strength,  $f'_c$ , between 2,500 psi and 8,000 psi (17.2 MPa and 55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of  $(f'_c / 2,500)^{0.23}$  [For **SI**:  $(f'_c / 17.2)^{0.23}$ ]. Where applicable, the modified bond strength values must be used

in lieu of  $\tau_{k,cr}$  and  $\tau_{k,uncr}$  in ACI 318-19 Equations (17.6.5.1.2b) and (17.6.5.2.1), ACI 318-14 Equations (17.4.5.1d) and (17.4.5.2) or ACI 318-11 Equations (D-21) and (D-22), as applicable. The resulting nominal bond strength must be multiplied by the associated strength reduction factor  $\phi_{nn}$ .

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 and 11 of this report (see Table 1A for an index of design tables). Adjustments to the bond strength may also be taken for increased concrete compressive strength as noted in the footnotes to the corresponding tables. For anchors in lightweight concrete see ACI 318-19 17.2.4, ACI 318-14 17.2.6 or ACI 318-11 D.3.6, as applicable.

**4.1.5** Static Steel Strength in Shear: The nominal static steel strength of a single anchor in shear as governed by the steel,  $V_{sa}$ , in accordance with ACI 318-19 17.7.1.2, ACI 318-14 17.5.1.2 or ACI 318-11 D.6.1.2, as applicable, and strength reduction factors,  $\phi$ , in accordance with ACI 318-19 17.5.3, ACI 318-14 17.2.3 or ACI 318-11 D.4.3, as applicable, are given in Tables 4, 5, 8 and 9 of this report for the anchor element types included herein.

4.1.6 Static Concrete Breakout Strength in Shear: The nominal concrete breakout strength of a single anchor or group of anchors in shear, Vcb or Vcbg, must be calculated in accordance with ACI 318-19 17.7.2, ACI 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable, based on information given in Table 6 and 10 of this report. The basic concrete breakout strength in shear of a single anchor in cracked concrete,  $V_b$ , must be calculated in accordance with ACI 318-19 17.7.2.2, ACI 318-14 17.5.2.2 or ACI 318-11 D.6.2.2, as applicable, using the value of d given in Tables 4, 5, 8 and 9 of this report in lieu of  $d_a$ . In addition,  $h_{ef}$  must be substituted for  $\ell_e$ . In no case shall  $\ell_e$  exceed 8d. For anchors in lightweight concrete see ACI 318-19 17.2.4, ACI 318-14 17.2.6 or ACI 318-11 D.3.6, as applicable. The value of  $f_c$  must be limited to a maximum of 8,000 psi (55.2 MPa), in accordance with ACI 318-19 17.3.1, ACI 318-14 17.2.7 or ACI 318-11 D.3.7, as applicable.

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

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

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

For anchors that will be torqued during installation, the maximum torque,  $T_{max}$ , must be reduced for edge distances of less than five anchor diameters (5*d*).  $T_{max}$  is subject to the edge distance,  $c_{min}$ , and anchor spacing,  $s_{min}$ , and must comply with the following requirements:

MAXIMUM TOP		CT TO EDGE DIS	STANCE
NOMINAL ANCHOR SIZE,	MIN. EDGE DISTANCE, Cmin	MIN. ANCHOR SPACING, Smin	MAXIMUM TORQUE, <i>T<sub>max</sub></i>
All sizes	5d	5d	T <sub>max</sub>
<sup>3</sup> / <sub>8</sub> in. to 1 in. (9.5 mm to 25.4 mm) 1 <sup>1</sup> / <sub>4</sub> in. (31.8 mm)	1.75 in. (45 mm) 2.75 in. (70 mm)	5d	0.45 · T <sub>max</sub>
10 mm to 27 mm (0.39 in. to 1.06 in.) 28 mm to 32 mm (1.1 in. to 1.26 in.)	45 mm (1.75 in.) 70 mm (2.75 in.)	5d	0.45 · T <sub>max</sub>

For values of  $T_{max}$ , see Table 12 and Figure 4A.

**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 318-19 17.6.5.5, 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 318-19 Eq. 17.6.5.5.1b, 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. 17.6.5.5.1c for ACI 318-19, Eq. 17.4.5.5c for ACI 318-14 or Eq. D-27a for ACI 318-11, in lieu of ACI 318-19 17.9.5, ACI 318-14 17.7.6 or ACI 318-11 D.8.6, as applicable.

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

(Eq. 17.6.5.5.1c for ACI 318-19, Eq. 17.4.5.5c for ACI 318-14 or Eq. D-27a for ACI 318-11)

where

 $\left|\frac{h}{h}\right|$  need not be taken as larger than 2.4; and where

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

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

**4.1.11 Design Strength in Seismic Design Categories C, D, E and F:** In structures assigned to Seismic Design Category (SDC) C, D, E or F under the IBC or IRC, anchor system must be designed in accordance with ACI 318-19 17.10, ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, except as described below.

The nominal steel shear strength,  $V_{sa}$ , must be adjusted by  $\alpha_{V,seis}$  as given in Tables 4 and 5 for the corresponding anchor steel. The nominal bond strength  $\tau_{kcr}$  need not be adjusted by  $\alpha_{N,seis}$  since  $\alpha_{N,seis} = 1.0$ .

As an exception to ACI 318-11 D.3.3.4.2: Anchor system 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 nominal anchor 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 Pure110+ Epoxy Adhesive Post-Installed Reinforcing Bar Connections:

**4.2.1 General:** The design of straight post-installed deformed reinforcing bars must be determined in accordance with ACI 318 rules for cast-in place reinforcing bar development and splices and this report. Examples of typical applications for the use of post-installed reinforcing bars are illustrated in Figure 3 of this report.

**4.2.2 Determination of bar development length**  $I_d$ : Values of  $I_d$  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  $\Psi_e$  shall be taken as 1.0. For all other cases, the requirements in ACI 318-19 25.4.2.5, ACI 318-14 25.4.2.4 or ACI 318-11 12.2.4 (b) shall apply.

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

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

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

REBAR SIZE	MINIMUM CONCRETE COVER, cc,min						
<i>d</i> <sup><i>b</i></sup> ≤ No. 6 (16 mm)	1 <sup>1</sup> / <sub>8</sub> in. (29 mm)						
No. 6 < <i>d</i> <sub>b</sub> ≤ No. 11	1 <sup>9</sup> / <sub>16</sub> in.						
$(16 \text{ mm} < d_b \leq 36 \text{ mm})$	(40 mm)						

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

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

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

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

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

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

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

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

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

#### 4.3 Allowable Stress Design (ASD):

**4.3.1 General:** For anchor system designed using load combinations in accordance with Section 1605.1 of the 2021 IBC, or 2018, 2015, 2012, and 2009 IBC Section 1605.3 (Allowable Stress Design), allowable loads must be established using Eq. (4-2) and Eq. (4-3):

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

and

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

#### where

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

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

- φNn = Lowest design strength of an anchor or anchor group in tension as determined in accordance with ACI 318 (-19 and -14) Chapter 17 or ACI 318 (-11, -08) Appendix D, as applicable, and 2021, 2018 and 2015 IBC Section 1905.1.8, 2012 IBC Errata Section 1905.1.9, or 2009 IBC Section 1908.1.9, as applicable, and Section 4.1 of this report, as applicable (lbf or kN).
- $\phi V_n$  = Lowest design strength of an anchor or anchor group in shear as determined in accordance with ACI 318 (-19 and -14 Chapter 17 or ACI 318 (-11, -08) Appendix D, as applicable, and 2021, 2018 and 2015 IBC Section 1905.1.8, 2012 IBC Errata Section 1905.1.9, or 2009 IBC Section 1908.1.9, as applicable, and Section 4.1 of this report, as applicable (lbf or kN).
- $\alpha$  = Conversion factor calculated as a weighted average of the load factors for the controlling load combination. In addition,  $\alpha$  must include all applicable factors to account for non-ductile failure modes and required over-strength.

The requirements described in this report for member thickness, edge distance and spacing, must apply.

**4.3.2 Interaction of Tensile and Shear Forces:** Interaction must be calculated in accordance with ACI 318-19 17.8, ACI 318-14 17.6 or ACI 318 (-11, -08) D.7, as applicable, as follows:

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

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

For all other cases:

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

#### 4.4 Installation:

Installation parameters are illustrated in Table 12 of this report for post-installed adhesive anchor system and Table 14 for post-installed reinforcing bar connections. Installation must be in accordance with ACI 318-19 26.7.2, ACI 318-14 17.8.1 and 17.8.2 or ACI 318-11 D.9.1 and D.9.2, as applicable. Anchor and post-installed reinforcing bar locations must comply with this report and the plans and specifications approved by the code official. Installation of the Pure110+ Epoxy Adhesive Anchor System and Postinstalled Reinforcing Bar Connections must be in accordance with the Manufacturer's printed installation instructions (MPII) included in each unit package as reproduced in Figure 4A and 4B of this report.

The adhesive anchor system may be used for upwardly inclined orientation applications (e.g. overhead). Upwardly inclined and horizontal orientation applications are to be installed using piston plugs for the 5/8-inch through  $1^{1}/4$ -inch (M16 through M30) diameter threaded steel rods and No. 5 through No. 10 (14 mm through 32 mm) steel reinforcing bars, installed in the specified hole diameter, and attached to the mixing nozzle and extension tube supplied by DEWALT as described in Figure 4A and 4B in this report. Upwardly inclined and horizontal orientation installation for

the  ${}^{3}/{}_{8}$ -inch and  ${}^{1}/{}_{2}$ -inch (M10 and M12) diameter threaded steel rods, and No. 3 and No. 4 (10 mm and 12 mm) steel reinforcing bars may be injected directly to the end of the hole using extension tubing attached to the mixing nozzle with a hole depth  $h_{0} \le 10$ " (250 mm).

Installation of anchors in horizontal or upwardly inclined (overhead) orientations shall be fully restrained from movement throughout the specified curing period through the use of temporary wedges, external supports, or other methods. Where temporary restraint devices are used, their use shall not result in impairment of the anchor shear resistance.

#### 4.5 Special Inspection:

Periodic special inspection must be performed where required in accordance with Section 1705.1.1 and Table 1705.3 of the 2021, 2018, 2015 and 2012 IBC, Section 1704.15 and Table 1704.4 of the 2009 IBC and this report. The special inspector must be on the jobsite initially during adhesive anchor or post-installed reinforcing bar connection installation to verify anchor or post-installed reinforcing bar type and dimensions, concrete type, concrete compressive strength, adhesive identification and expiration date, hole dimensions, hole cleaning procedures, anchor spacing, edge distances, concrete thickness, adhesive anchor or post-installed reinforcing bar connection embedment, tightening torque and adherence to the manufacturer's printed installation instructions (MPII). The special inspector must verify the initial installations of each type and size of adhesive anchor or post-installed reinforcing bar connection by construction personnel on the 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.

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

Under the IBC, additional requirements as set forth in Section 1705 of the 2018, 2015 or 2012 IBC and Sections 1705, 1706 or 1707 of the 2009 IBC must be observed, where applicable.

#### 4.6 Compliance with NSF/ANSI Standard 61:

The Pure110+ Epoxy Adhesive Anchor System and Post-installed Reinforcing Bar Connections comply with the requirements of NSF/ANSI Standard 61, as referenced in Section 605 of the 2021, 2018, 2015, 2012 and 2009 *International Plumbing Code*<sup>®</sup> (IPC), and is certified for use in water distribution systems and may have a maximum exposed surface area to volume ratio of 216 square inches per 1000 gallons (3785 L) for water treatment applications.

#### 5.0 CONDITIONS OF USE:

The Pure110+ Epoxy Adhesive Anchor System and Post-installed Reinforcing Bar Connections described in this report comply 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** Pure110+ epoxy Adhesive Anchors System and Post-installed Reinforcing Bar Connections must be

installed in accordance with the Manufacturer's printed installation instructions (MPII) as attached to each cartridge and reproduced in Figure 4A and 4B of this report.

- **5.2** The Adhesive Anchor System and Post-installed Reinforcing Bar Connections described in this report must be installed in cracked or uncracked normalweight concrete or lightweight 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 (55.2 MPa). Steel anchor elements must be installed in concrete base materials in holes predrilled in accordance with the instructions provided in Figure 4A and 4B of this report.
- **5.4** The concrete shall have attained its minimum design strength prior to installation of the Adhesive Anchor System and Post-installed Reinforcing Bar Connections.
- **5.5** Loads applied to the Adhesive Anchor System and Post-installed Reinforcing Bar Connections must be adjusted in accordance with Section 1605.2 of the IBC for strength design and in accordance with Section 1605.3 of the IBC for allowable stress design.
- **5.6** Pure110+ epoxy Adhesive Anchors System and Post-installed Reinforcing Bar Connections are recognized for use to resist short and long-term loads, including wind and earthquake, subject to the conditions of this report.
- **5.7** In structures assigned to Seismic Design Categories C, D, E, and F under the IBC or IRC, anchor strength must be adjusted in accordance with Section 4.1.11 of this report, and post-installed reinforcing bars must comply with Section 4.2.4 of this report.
- **5.8** Pure110+ epoxy Adhesive Anchors System and Post-installed Reinforcing Bar Connections are permitted to be installed in concrete that is cracked or that may be expected to crack during the service life of the anchors or post-installed reinforcing bar, subject to the conditions of this report.
- **5.9** Adhesive anchor strength design values must be established in accordance with Section 4.1 of this report.
- **5.10** Post-installed reinforcing bar connection development and splice length is established in accordance with Section 4.2 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 connection 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 Pure110+ epoxy Adhesive Anchors System and Post-installed Reinforcing Bar Connections are not

permitted to support fire-resistive construction. Where not otherwise prohibited by the code, Pure110+ epoxy adhesive anchors and post-installed reinforcing bar connections are permitted for installation in fireresistive construction provided that at least one of the following conditions is fulfilled:

- Pure110+ epoxy Adhesive Anchors System and Post-installed Reinforcing Bar Connections are used to resist wind or seismic forces only.
- Pure110+ epoxy Adhesive Anchors System and Post-installed Reinforcing Bar Connections 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.
- Pure110+ epoxy Adhesive Anchors System and Post-installed Reinforcing Bar Connections are used to support non-structural elements.
- **5.16** Since an ICC-ES acceptance criteria for evaluating data to determine the performance of adhesive anchor system and post-installed reinforcing bar connections 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 for adhesive anchors is limited to dry, interior locations.
- **5.18** Use of hot-dipped galvanized carbon steel and stainless steel threaded rods for adhesive anchors 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 of zinc-coated carbon steel or stainless steel. The minimum coating weights for zinc-coated steel must comply with ASTM A153.
- **5.20** Periodic special inspection must be provided in accordance with Section 4.5 of this report. Continuous special inspection of adhesive anchor system and post-installed reinforcing bar connections installed in horizontal or upwardly inclined orientations to resist sustained tension loads must be provided in accordance with Section 4.5 of this report.
- 5.21 Pure110+ epoxy Adhesive Anchors System and Postinstalled Reinforcing Bar Connections may be used to resist tension and shear forces in floor, wall and overhead installations into concrete with a temperature between 41°F and 104°F (5°C and 40°C). For overhead and upwardly inclined applications, cartridge temperature must be between 50°F and 90°F (10°C and 32°C) Overhead and upward inclined installations require the use of piston plugs and extension tubing during injection and the adhesive anchor or post-

installed reinforcing bar connection system must be supported until fully cured (e.g. wedges or other suitable means). See the MPII in Figure 4A and 4B of this report for detailed installation requirements, including required installation equipment, procedures, and temperatures.

- **5.22** Installation of adhesive anchor system and postinstalled reinforcing bar connections in horizontal or upwardly inclined orientations to resist sustained tension loads must be performed by personnel certified by an applicable certification program in accordance with ACI 318-19 26.7.1(I) and 26.7.2(e), ACI 318-14 17.8.2.2 or 17.8.2.3 or ACI 318-11 D.9.2.2 or D.9.2.3, as applicable.
- **5.23** The Pure110+ epoxy adhesive is manufactured under an approved 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 (editorially revised February 2021), which incorporates requirements in ACI 355.4-19 and ACI 355.4-11 for use in cracked and uncracked concrete; including, but not limited to, tests under freeze/thaw conditions, tests under sustained load, tests for installation including installation direction, tests at elevated temperatures, tests for resistance to alkalinity, tests for resistance to sulfur, tests for seismic tension and shear, and tests for post-installed reinforcing bar connections.

#### 7.0 IDENTIFICATION

- 7.1 The ICC-ES mark of conformity, electronic labeling, or the evaluation report (ICC-ES ESR-3298) along with the name, registered trademark, or registered logo of the report holder [and/or listee] must be included in the product label.[Electronic labeling is the ICC-ES web address (<u>www.icc-es.org</u>); specific URL related to the report; or the ICC-ES machine-readable code placed on the aforementioned items.]
- 7.2 In addition, the Pure110+ epoxy adhesive described in Section 3.1 of this report is identified by packaging labeled with the lot number; expiration date; company name (DEWALT); and the evaluation report number (ESR-3298). Threaded rods, nuts, washers and deformed reinforcing bars are standard steel anchor elements and must conform to applicable national or international specifications as set forth in Tables 2 and 3 of this report.
- 7.3 The report holder's contact information is the following:

DEWALT 701 EAST JOPPA ROAD TOWSON, MARYLAND 21286 (800) 524-3244 www.DEWALT.com anchors@DEWALT.com

#### TABLE 1A—DESIGN USE AND REPORT TABLE INDEX FOR POST-INSTALLED ADHESIVE ANCHORS

POST-INSTALLED ADHESIVE ANCHORS – COMMON THREADED RODS AND REINFORCING BARS (Tables 4 through 11 and Figure 1)

									- g			
	DESI	GN STREN	GTH1		READED ROD RACTIONAL)	REINFOR	ORMED RCING BAR TIONAL)	THREADED ROD (METRIC)		DEFORMED NFORCING BAR (METRIC)		
Steel	N <sub>sa</sub> , V	/ <sub>sa</sub>			Table 4	Ta	able 5	Table 8		Table 9		
Concrete	N <sub>cb</sub> , N	Icbg, Vcb, Vct	g, Vcb, Vcbg, Vcp, Vcpg		Table 6	Ta	able 6	Table 10		Table 10		
Bond <sup>2</sup>	Na, Na	ag			Table 7   Table 7   Table 11		Table 11					
Concre Type		Concrete State	Threaded Ro Diameter (in		Reinford Bar Size (	0	Drilling Method <sup>3</sup>	Minimum and Maxir Embedment	num	Seismic Design Categories <sup>4</sup>		
Normal-we	eight	Cracked	<sup>3</sup> / <sub>8</sub> , <sup>1</sup> / <sub>2</sub> , <sup>5</sup> / <sub>8</sub> , <sup>3</sup> / <sub>4</sub> , <sup>7</sup> / <sub>8</sub> ,	1, 1 <sup>1</sup> / <sub>4</sub>	3, 4, 5, 6, 7,	8, 9, 10	Hammer-drill	See Table 7		A through F		
and lightw	eight Uncracked		eight Uncracked 3/8, 1/2, 5/8, 3/4, 7/8, 1, 11/4 3, 4, 5		<sup>3</sup> / <sub>8</sub> , <sup>1</sup> / <sub>2</sub> , <sup>5</sup> / <sub>8</sub> , <sup>3</sup> / <sub>4</sub> , <sup>7</sup> / <sub>8</sub> , 1, 1 <sup>1</sup> / <sub>4</sub>		3, 4, 5, 6, 7,	3, 4, 5, 6, 7, 8, 9, 10 Hammer-dr		See Table 7		A and B
Concre Type		Concrete State	Threaded Ro Diameter (m		Reinford Bar Size	0	Drilling Method <sup>3</sup>	Minimum and Maxir Embedment	num	Seismic Design Categories <sup>4</sup>		
Normal-we	eight	Cracked	10, 12, 16, 20, 24,	27, 30	10, 12, 14, 16, 20	, 25, 28, 32	Hammer-drill	See Table 11		A through F		
and lightw	eight l	Uncracked	10, 12, 16, 20, 24,	27, 30	10, 12, 14, 16, 20	, 25, 28, 32	Hammer-drill	See Table 11		A and B		

For SI: 1 inch = 25.4 mm. For pound-inch units: 1 mm = 0.03937 inch.

<sup>1</sup>Reference ACI 318-19 17.5.1, ACI 318-14 17.3.1.1 or 318-11 D.4.1.1, as applicable for post-installed adhesive anchors. The controlling strength is decisive from all appropriate failure modes (i.e. steel, concrete, bond) and design assumptions.

<sup>2</sup>See Section 4.1.4 of this report for bond strength determination of post-installed adhesive anchors.

<sup>3</sup>Hammer-drill, i.e. rotary impact drills or rock drills with a carbide drill bit (including hollow drill bits).

<sup>4</sup>See Section 4.1.11 for requirements for seismic design of post-installed adhesive anchors, where applicable.

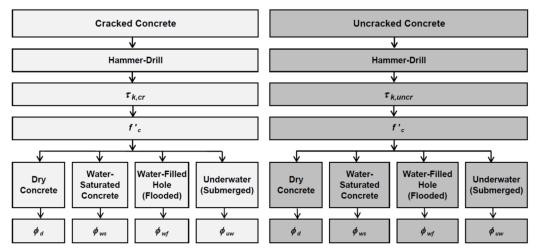


FIGURE 1—FLOWCHART FOR THE ESTABLISHMENT OF DESIGN BOND STRENGTH FOR POST-INSTALLED ADHESIVE ANCHORS

#### TABLE 1B—DESIGN USE AND REPORT TABLE INDEX FOR POST-INSTALLED REINFORCING BAR CONNECTIONS<sup>1</sup>

POST-INSTALLED REINFORCING BARS See Table 13 and Figure 3										
Concrete Type	Reinforcing Bar Size	Drilling Method <sup>2</sup>	Seismic Design Categories <sup>3</sup>							
	#3, #4, #5, #6, #7, #8, #9, #10, #11	Hammer-drill or core-drill	A through F							
Normal-weight and lightweight	Ø10, Ø12, Ø14, Ø16, Ø20, Ø25, Ø28, Ø32, Ø34, Ø36	Hammer-drill or core-drill	A through F							
and ignewoight	10M, 15M, 20M, 25M, 30M, 35M	Hammer-drill or core-drill	A through F							

For **SI:** 1 inch = 25.4 mm. For **pound-inch** units: 1 mm = 0.03937 inch.

<sup>1</sup>Determination of development length for post-installed reinforcing bar connections in accordance with this report.

<sup>2</sup>Hammer-drill, i.e. rotary impact drills or rock drills with a carbide drill bit (including hollow drill bits); core-drill, i.e. core drill with a diamond core drill bit.

<sup>3</sup>See Section 4.2.4 for requirements for seismic design of post-installed reinforcing bar connections, where applicable.





The DEWALT drilling systems shown above collect and remove dust with a HEPA dust extractor during the hole drilling operation in dry base materials using hammer-drills (see step 1 of the manufacturer's published installation instructions - MPII).

#### FIGURE A-EXAMPLES DEWALT DUST REMOVAL DRILLING SYSTEMS WITH HEPA DUST EXTRACTORS FOR ILLUSTRATION

THREAD	ED ROD SPECIFICATION	UNITS	MIN. SPECIFIED ULTIMATE STRENGTH, futa	MIN. SPECIFIED YIELD STRENGTH 0.2 PERCENT OFFSET, fya	f <sub>uta</sub> — f <sub>ya</sub>	ELONGATION MINIMUM PERCENT <sup>11</sup>	REDUCTION OF AREA MIN. PERCENT	NUT SPECIFICATION <sup>12</sup>
	ASTM A36 <sup>2</sup> and F1554 <sup>3</sup> Grade 36	psi (MPa)	58,000 (400)	36,000 (248)	1.61	23	40 (50 for A36)	ASTM A194 /
	ASTM F1554 <sup>3</sup> Grade 55	psi (MPa)	75,000 (517)	55,000 (380)	1.36	23	40	A563 Grade A
	ASTM F1554 <sup>3</sup> Grade 105	psi (MPa)	125,000 (862)	105,000 (724)	1.19	15	45	ASTM A194 /
	ASTM A193⁴ Grade B7	psi (MPa)	125,000 (860)	105,000 (720)	1.19	16	50	A563 Grade DH
Carbon Steel	ASTM A449 <sup>5</sup> psi         120,000           (³/₀ to 1 inch dia.)         (MPa)         (828)           ASTM A449 <sup>5</sup> psi         105,000		-,	92,000 (635)	1.30	14	35	ASTM A194 /
	ASTM A449 <sup>5</sup> (1 <sup>1</sup> / <sub>4</sub> inch dia.)	ASTM A449 <sup>5</sup> psi 105,0		81,000 (560)	1 30		35	A563 Grade DH
	ASTM F568M <sup>6</sup> Class 5.8 (equivalent to ISO 898-1)	psi (MPa)	72,500 (500)	58,000 (400)	1.25	10	35	ASTM A563 Grade DH DIN 934 (8-A2K) <sup>13</sup>
	ISO 898-1 <sup>7</sup> Class 5.8	MPa (psi)	500 (72,500)	400 (58,000)	1.25	22	_14	DIN 934 Grade 6
	ISO 898-1 <sup>7</sup> Class 8.8	MPa (psi)	800 (116,000)	640 (92,800)	1.25	12	52	DIN 934 Grade 8
	ASTM F593 <sup>8</sup> CW1 ( <sup>3</sup> / <sub>8</sub> to <sup>5</sup> / <sub>8</sub> inch dia.)	psi (MPa)	100,000 (690)	65,000 (450)	1.54	20	_14	ASTM F594
	ASTM F593 <sup>8</sup> CW2 ( <sup>3</sup> / <sub>4</sub> to 1 <sup>1</sup> / <sub>4</sub> inch dia.)	psi (MPa)	85,000 (590)	45,000 (310)	1.89	25	_14	Alloy Group 1, 2 or 3
Stainless	ASTM A193/A193M <sup>9</sup> Grade B8/B8M, Class 1	psi (MPa)	75,000 (515)	30,000 (205)	2.50	30	50	
Steel	ASTM A193/A193M <sup>9</sup> Grade B8/B8M2, Class 2B	psi (MPa)	95,000 (655)	75,000 (515)	1.27	25	40	ASTM A194/A194M
	ISO 3506-1 <sup>10</sup> A4-70 and HCR-70 (M8 – M24)	MPa (psi)	700 (101,500)	450 (65,250)	1.56	40	_14	ISO 4032
	ISO 3506-1 <sup>10</sup> A4-50 and HCR-50 (M27 – M30)	MPa (psi)	500 (72,500)	210 (30,450)	2.38	40	_14	130 4032

#### TABLE 2-SPECIFICATIONS AND PROPERTIES OF COMMON THREADED CARBON AND STAINLESS STEEL ROD MATERIALS<sup>1</sup>

For SI: 1 inch = 25.4 mm, 1 psi = 0.006897 MPa. For pound-inch units: 1 mm = 0.03937 inch, 1 MPa = 145.0 psi.

See Table 2 Notes on the Following Page

#### Table 2 Notes (Continued)

<sup>1</sup>Pure110+ epoxy adhesive may be used in conjunction with all grades of continuously threaded carbon or stainless steels (all-thread) that comply with this table and that have thread characteristics comparable with ANSI B1.1 UNC Coarse Thread Series or ANSI B1.13M M Profile Metric Thread Series. Tabulated values correspond to anchor diameters included in this report. See Section 3.2.4.3 of this report for ductility of steel anchor elements.

<sup>2</sup>Standard Specification for Carbon Structural Steel.

<sup>3</sup>Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

<sup>4</sup>Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications. <sup>5</sup>Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use.

<sup>6</sup>Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners.

<sup>7</sup>Mechanical properties of fasteners made of carbon steel and alloy steel – Part 1: Bolts, screws and studs

<sup>8</sup>Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

<sup>9</sup>Standard Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
<sup>10</sup> Mechanical properties of fasteners made of corrosion-resistant stainless steel fasteners – Part 1: Bolts, screws and studs

<sup>11</sup>Based on 2-inch (50 mm) gauge length except ASTM A193, which are based on a gauge length of 4*d* and ISO 898, which is based on 5*d*; *d* = nominal diameter.
<sup>12</sup>Nuts of other grades and style having specified proof load stress greater than the specified grade and style are also suitable. Nuts must have specified proof load stresses equal to or greater than the minimum tensile strength of the specified threaded rod. Material types of the nuts and washers must be matched to the threaded rods.

<sup>13</sup>Nuts for metric rods.

<sup>14</sup>Minimum percent reduction of area not reported in the referenced standard.

#### TABLE 3—SPECIFICATIONS AND PROPERTIES OF COMMON STEEL REINFORCING BARS<sup>1</sup>

REINFORCING SPECIFICATION	UNITS	MINIMUM SPECIFIED ULTIMATE STRENGTH, futa	MINIMUM SPECIFIED YIELD STRENGTH, fya
ASTM A615 <sup>2</sup> , A767 <sup>4</sup> , Grade 75	psi	100,000	75,000
	(MPa)	(690)	(520)
ASTM A615 <sup>2</sup> , A767 <sup>4</sup> , Grade 60	psi	90,000	60,000
	(MPa)	(620)	(420)
ASTM A706 <sup>3</sup> , A767 <sup>4</sup> , Grade 60	psi	80,000	60,000
	(MPa)	(550)	(420)
ASTM A615 <sup>2</sup> , A767 <sup>4</sup> , Grade 40	psi	60,000	40,000
	(MPa)	(420)	(280)
DIN 488⁵ BSt 500	MPa	550	500
	(psi)	(80,000)	(72,500)
CAN/CSA G30.18 <sup>6</sup> , Grade 400	MPa	540	400
	(psi)	(78,300)	(58,000)

For SI: 1 psi = 0.006897 MPa. For pound-inch units: 1 MPa = 145.0 psi.

<sup>1</sup>Adhesive must be used with specified deformed reinforcing bars. Tabulated values correspond to bar sizes included in this report.

<sup>2</sup>Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement. Grade 40 and Grade 60 bars furnished to specification are considered ductile elements. In accordance with ACI 318-19 17.10.5.3(a)(vi), ACI 318-14 17.2.3.4.3(a)(vi) or ACI 318-11 D.3.3.4.3(a)6, as applicable, deformed reinforcing bars meeting this specification used as ductile steel elements to resist earthquake effects shall be limited to reinforcing bars satisfying the requirements of ACI 318 (-19 or -14) 20.2.2.4 and 20.2.2.5 or ACI 318-11 21.1.5.2(a) and (b), as applicable. Grade 75 bars furnished to specification are considered brittle elements unless evidence is otherwise shown to the satisfaction of the registered design professional and code official in accordance with Section 3.2.4.3 of this report.

<sup>3</sup>Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement. Bars furnished to specification are considered ductile elements. <sup>4</sup>Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement. Bars furnished to specification are considered brittle elements unless

evidence is otherwise shown to the satisfaction of the registered design professional and code official in accordance with Section 3.2.4.3 of this report. <sup>5</sup>*Reinforcing steel; reinforcing steel bars; dimensions and masses.* Bars furnished to this specification are considered brittle elements unless evidence is otherwise shown to the satisfaction of the registered design professional and code official in accordance with Section 3.2.4.3 of this report.

<sup>6</sup>Billet bars for Concrete Reinforcement.

#### TABLE 4—STEEL DESIGN INFORMATION FOR FRACTIONAL THREADED ROD

	DESIGN INFORMATION	evupo:	UNITO	NOMINAL ROD DIAMETER <sup>1</sup> (inch)							
	DESIGN INFORMATION	SYMBOL	UNITS	<sup>3</sup> /8	<sup>1</sup> / <sub>2</sub>	<sup>5</sup> /8	<sup>3</sup> /4	7/8	1	<b>1</b> <sup>1</sup> / <sub>4</sub>	
Threaded rod	nominal outside diameter	d	inch	0.375	0.500	0.625	0.750	0.875	1.000	1.250	
Theaded Tod		ŭ	(mm)	(9.5)	(12.7)	(15.9)	(19.1)	(22.2)	(25.4)	(31.8)	
Threaded rod	effective cross-sectional area	Ase	inch <sup>2</sup>	0.0775	0.1419	0.2260	0.3345	0.4617	0.6057	0.969	
		-	(mm²) Ibf	(50) 4.495	(92) 8,230	(146) 13,110	(216)	(298) 26,780	(391) 35,130	(625) 56,21	
	Nominal strength as governed by steel	Nsa	(kN)	(20.0)	(36.6)	(58.3)	(86.3)	(119.1)	(156.3)	(250.0	
ASTM A36	strength (for a single anchor)		lbf	2,695	4,940	7,860	11,640	16,070	21,080	33,72	
and ASTM	5 ( 5 )	Vsa	(kN)	(12.0)	(22.0)	(35.0)	(51.8)	(71.4)	(93.8)	(150.0	
F1554	Reduction factor for seismic shear	α <sub>V,seis</sub>	-				0.80		• • •		
Grade 36	Strength reduction factor for tension <sup>2</sup>	φ	-				0.75				
	Strength reduction factor for shear <sup>2</sup>	φ	-				0.65				
		,	lbf	5,810	10,640	16,950	25,085	34,625	45,425	72,68	
	Nominal strength as governed by steel	N <sub>sa</sub>	(kN)	(25.9)	(47.3)	(75.4)	(111.6)	(154.0)	(202.0)	(323.3	
ASTM	strength (for a single anchor)	Vsa	lbf	3,485	6,385	10,170	15,050	20,775	27,255	43,61	
F1554		v sa	(kN)	(15.5)	(28.4)	(45.2)	(67.0)	(92.4)	(121.2)	(194.0	
Grade 55	Reduction factor for seismic shear	α <sub>V</sub> ,seis	-				0.80				
	Strength reduction factor for tension <sup>2</sup>	$\phi$	-				0.75				
	Strength reduction factor for shear <sup>2</sup>	φ	-		1	1	0.65	1	1		
		Nsa	lbf	9,685	17,735	28,250	41,810	57,710	75,710	121,13	
ASTM A193 Grade B7	Nominal strength as governed by steel		(kN)	(43.1)	(78.9)	(125.7)	(186.0)	(256.7)	(336.8)	(538.8	
and	strength (for a single anchor)	Vsa	lbf (kN)	5,815 (25.9)	10,640 (7.3)	16,950 (75.4)	25,085 (111.6)	34,625 (154.0)	45,425 (202.1)	72,68 (323.3	
ASTM	Reduction factor for seismic shear	α <sub>V,seis</sub>	(KIN)	(23.9)	(7.3)	(73.4)	0.80	(134.0)	(202.1)	(525.0	
F1554	Strength reduction factor for tension <sup>2</sup>	φ	-				0.75				
Grade 105	Strength reduction factor for shear <sup>2</sup>	,					0.65				
		φ	lbf	0.200	17 025	27,120	40,140	55,905	72.685	101,75	
		Nsa	(kN)	9,300 (41.4)	17,025 (75.7)	(120.6)	40,140 (178.5)	55,905	(323.3)	(452.6	
	Nominal strength as governed by steel	,	(((())))	()	(10.1)	(120.0)	(110.0)	(248.7)	(020.0)	(102.0	
	strength (for a single anchor)	V	lbf	5,580	10,215	16,270	24,085	33,540	43,610	61,05	
		Vsa	(kN)	(24.8)	(45.4)	(72.4)	(107.1)	(149.2)	(194.0)	(271.6	
	Reduction factor for seismic shear	α <sub>V,seis</sub> - 0.80									
	Strength reduction factor for tension <sup>2</sup>	$\phi$	-	0.75							
	Strength reduction factor for shear <sup>2</sup>	$\phi$	-				0.65				
		N <sub>sa</sub>	lbf	5,620	10,290	16,385	24,250	33,475	43,915	5	
	Nominal strength as governed by steel	1458	(kN)	(25.0)	(45.8)	(72.9)	(107.9)	(148.9)	(195.4)		
ISO 898-1	strength (for a single anchor)	Vsa	lbf	3,370	6,175	9,830	14,550	20,085	26,350	5	
Class 5.8	De duction factor fan e ciencia altera		(kN)	(15.0)	(27.5)	(43.7)	(64.7)	(89.3)	(117.2)	5	
	Reduction factor for seismic shear	α <sub>V,seis</sub>	-	0.00							
	Strength reduction factor for tension <sup>3</sup>	φ	-				0.65				
	Strength reduction factor for shear <sup>3</sup>	$\phi$	-	7 750	44.400	00.000	0.60	00.045	54 405	00.07	
	Neminal strangth as governed by steel	Nsa	lbf (kN)	7,750 (34.5)	14,190 (63.1)	22,600 (100.5)	28,430 (126.5)	39,245 (174.6)	51,485 (229.0)	82,37 (366.4	
ASTM F593	Nominal strength as governed by steel strength (for a single anchor)		lbf	4,650	8,515	13,560	17.060	23,545	30.890	49,42	
CW Stainless		Vsa	(kN)	(20.7)	(37.9)	(60.3)	(75.9)	(104.7)	(137.4)	(219.8	
(Types 304	Reduction factor for seismic shear	α <sub>V,seis</sub>	-	0.7		()	( /	0.80	( - )		
and 316)	Strength reduction factor for tension <sup>3</sup>	φ	-				0.65				
	Strength reduction factor for shear <sup>3</sup>	φ	-				0.60				
	Cherigan reduction habitor for cheat		lbf	4,420	8,090	12,880	19,065	26,315	34,525	55,24	
ASTM A193 Grade	Nominal strength as governed by steel	N <sub>sa</sub>	(kN)	(19.7)	(36.0)	(57.3)	(84.8)	(117.1)	(153.6)	(245.7	
B8/B8M,	strength (for a single anchor) <sup>4</sup>	V	lbf	2,650	4,855	7,730	11,440	15,790	20715	33,14	
Class 1		Vsa	(kN)	(11.8)	(21.6)	(34.4)	(50.9)	(70.2)	(92.1)	(147.4	
Stainless	Reduction factor for seismic shear	α <sub>V,seis</sub>	-	0.7	0			0.80			
(Types 304	Strength reduction factor for tension <sup>2</sup>	$\phi$	-				0.75				
and 316)	Strength reduction factor for shear <sup>2</sup>	$\phi$	-				0.65				
ASTM A193		Nsa	lbf	7,365	13,480	21,470	31,775	43,860	57,545	92,06	
Grade	Nominal strength as governed by steel	i vsa	(kN)	(32.8)	(60.0)	(95.5)	(141.3)	(195.1)	(256.0)	(409.5	
B8/B8M2,	strength (for a single anchor)	Vsa	lbf	4,420	8,085	12,880	19,065	26,315	34,525	55,24	
Class 2B			(kN)	(19.7)	(36.0)	(57.3)	(84.8)	(117.1)	(153.6)	(245.7	
Stainless	Reduction factor for seismic shear	α <sub>V,seis</sub>	-	0.7	U		0 ==	0.80			
(Types 304 and 316)	Strength reduction factor for tension <sup>2</sup>	$\phi$	-	<u> </u>			0.75				
	Strength reduction factor for shear <sup>2</sup>	$\phi$	-	1			0.65				

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

<sup>1</sup>Values provided for steel element material types are based on minimum specified strengths and calculated in accordance with ACI 318-19 Eq. 17.6.1.2 and Eq. 17.7.1.2(b), ACI 318-14 Eq. 17.4.1.2 and Eq. 17.5.1.2(b) or ACI 318-11 Eq. D-2 and Eq. D-29, as applicable, except where noted. Nuts and washers must be appropriate for the rod. See Table 2 for nut specifications.

<sup>2</sup>The tabulated value of  $\phi$  applies when the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable are used in accordance with ACI 318-19 17.5.3, 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  $\phi$  must be determined in accordance with ACI 318-11 D.4.4. Values correspond to ductile steel elements.

<sup>3</sup>The tabulated value of  $\phi$  applies when the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable are used in accordance with ACI 318-19 17.5.3, 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  $\phi$  must be determined in accordance with ACI 318-11 D.4.4. Values correspond to brittle steel elements.

<sup>4</sup>In accordance with ACI 318-19 Eq. 17.6.1.2 and Eq. 17.7.1.2, ACI 318-14 17.4.1.2 and 17.5.1.2 or ACI 318-11 D.5.1.2 and D.6.1.2, as applicable, the calculated values for nominal tension and shear strength for ASTM A193 Grade B8/B8M Class 1 stainless steel threaded rods are based on limiting the specified tensile strength of the anchor steel to 1.9*f*<sub>y</sub> or 57,000 psi (393 MPa).

<sup>5</sup>The referenced standard includes rod diameters up to and including 1-inch (24 mm).

		0)(117.0)		NOMINAL REINFORCING BAR SIZE (REBAR) <sup>1</sup>									
	DESIGN INFORMATION	SYMBOL	UNITS	#3	#4	#5	#6	#7	#8	#9	#10		
Rebar n	ominal outside diameter	d	inch (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 (28.7)	1.250 (32.3)		
Rebar e	ffective cross-sectional area	Ase	inch <sup>2</sup> (mm <sup>2</sup> )	0.110 (71.0)	0.200 (129.0)	0.310 (200.0)	0.440 (283.9)	0.600 (387.1)	0.790 (509.7)	(444.8) (564.3 60,000 76,20 (266.9) (338.9 90,000 114,30			
	Nominal strength as governed by steel	Nsa	lbf (kN)	11,000 (48.9)	20,000 (89.0)	31,000 (137.9)	44,000 (195.7)	60,000 (266.9)	79,000 (351.4)	,	127,000 (564.9)		
ASTM A615	strength (for a single anchor)	Vsa	lbf (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 (338.9)		
Grade 75	Reduction factor for seismic shear	α <sub>V,seis</sub>	-	0.7	0			0.8	80				
15	Strength reduction factor for tension <sup>3</sup>	$\phi$	-				0.65						
	Strength reduction factor for shear <sup>3</sup>	φ	-				0.60		0.600         0.790         1.001         1.27           387.1)         (509.7)         (645.2)         (819.           00000         79,000         100,000         127,0           266.9)         (351.4)         (444.8)         (564.           160.00         47,400         60,000         76,20           160.1)         (210.8)         (266.9)         (338.           0.80				
	Nominal strength as governed by steel	N <sub>sa</sub>	lbf (kN)	9,900 (44.0)	18,000 (80.1)	27,900 (124.1)	39,600 (176.1)	54,000 (240.2)			114,300 (508.4)		
ASTM stre A615	trength (for a single anchor)	Vsa	lbf (kN)	5,940 (26.4)	10,800 (48.0)	16,740 (74.5)	23,760 (105.7)	32,400 (144.1)	,	,	68,580 (305.0)		
Grade 60	Reduction factor for seismic shear	𝔅V,seis	-	0.7	0			0.8	0.80				
00	Strength reduction factor for tension <sup>3</sup>	$\phi$	-	0.65									
	Strength reduction factor for shear <sup>3</sup>	$\phi$	-				0.60						
	Nominal strength as governed by steel	Nsa	lbf (kN)	8,800 (39.1)	16,000 (71.2)	24,800 (110.3)	35,200 (156.6)	48,000 (213.5)	,	,	101,600 (452.0)		
ASTM A706	strength (for a single anchor)	Vsa	lbf (kN)	5,280 (23.5)	9,600 (42.7)	14,880 (66.2)	21,120 (94.0)	28,800 (128.1)	- ,	- ,	60,960 (271.2)		
Grade 60	Reduction factor for seismic shear	αv,seis	-	0.7	0			0.8	(213.5) (281.1) (355.9) (452 28,800 37,920 48,000 60,9 (128.1) (168.7) (213.5) (271				
00	Strength reduction factor for tension <sup>2</sup>	$\phi$	-				0.75						
	Strength reduction factor for shear <sup>2</sup>	$\phi$	-				0.65						
	Nominal strength as governed by steel	N <sub>sa</sub>	Lbf (kN)	6,600 (29.4)	12,000 (53.4)	18,600 (82.7)	26,400 (117.4)	In acc	cordance v	vith ASTM	A615		
ASTM A615	strength (for a single anchor)	Vsa	Lbf (kN)	3,960 (17.6)	7,200 (32.0)	11,160 (49.6)	15,840 (70.5)	Grade	In accordance with ASTM A615 Grade 40 bars are furnished only sizes No. 3 through No. 6				
Grade 40	Reduction factor for seismic shear	𝔅V,seis	-	0.7	0	0.8	80						
70	Strength reduction factor for tension <sup>3</sup>	$\phi$	-				0.65						
	Strength reduction factor for shear <sup>3</sup>	$\phi$	-				0.60						

#### TABLE 5—STEEL DESIGN INFORMATION FOR FRACTIONAL REINFORCING BARS

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

<sup>1</sup>Values provided for reinforcing bar material types based on minimum specified strengths and calculated in accordance with ACI 318-19 Eq. 17.6.1.2 and Eq. 17.7.1.2(b), 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.

<sup>2</sup>The tabulated value of  $\phi$  applies when the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-19 17.5.3, 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  $\phi$  must be determined in accordance with ACI 318-11 D.4.4. Values correspond to ductile steel elements. In accordance with ACI 318-11 D.3.3.4.3 (a) 6, as applicable, deformed reinforcing bars meeting this specification used as ductile steel elements to resist earthquake effects shall be limited to reinforcing bars satisfying the requirements of ACI 318 (-19 or -14) 20.2.2.4 and 20.2.2.5 or ACI 318-11 21.1.5.2 (a) and (b) as applicable.

<sup>3</sup>The tabulated value of  $\phi$  applies when the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-19 17.5.3, 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  $\phi$  must be determined in accordance with ACI 318-11 D.4.4. Values correspond to brittle steel elements.

#### TABLE 6—CONCRETE BREAKOUT DESIGN INFORMATION FOR FRACTIONAL THREADED ROD AND REINFORCING BARS<sup>1</sup>

			NOMINAL ROD DIAMETER (inch) / REINFORCING BAR SIZE									
DESIGN INFORMATION	SYMBOL	UNITS	<sup>3</sup> / <sub>8</sub> or #3	<sup>1</sup> / <sub>2</sub> or #4	<sup>5</sup> / <sub>8</sub> or #5	<sup>3</sup> /4 or #6	<sup>7</sup> / <sub>8</sub> or #7	1 or #8	#9	1¹/₄ or #10		
Effectiveness factor for cracked concrete	k <sub>c,cr</sub>	- (SI)	17 (7.1)									
Effectiveness factor for uncracked concrete	K <sub>c,uncr</sub>	- (SI)				2. (10	-					
Minimum embedment	h <sub>ef,min</sub>	inch (mm)	2 <sup>3</sup> / <sub>8</sub> (60)	2 <sup>3</sup> / <sub>4</sub> (70)	3 <sup>1</sup> / <sub>8</sub> (79)	3 <sup>1</sup> / <sub>2</sub> (89)	3 <sup>1</sup> / <sub>2</sub> (89)	4 (102)	4 <sup>1</sup> / <sub>2</sub> (114)	5 (127)		
Maximum embedment	h <sub>ef,max</sub>	inch (mm)	7 <sup>1</sup> / <sub>2</sub> (191)	10 (254)	12 <sup>1</sup> / <sub>2</sub> (318)	15 (381)	17 <sup>1</sup> / <sub>2</sub> (445)	20 (508)	22 <sup>1</sup> / <sub>2</sub> (572)	25 (635)		
Minimum anchor spacing	Smin	inch (mm)	1 <sup>7</sup> / <sub>8</sub> (48)	2 <sup>1</sup> / <sub>2</sub> (64)	3 <sup>1</sup> / <sub>8</sub> (79)	3 <sup>3</sup> / <sub>4</sub> (95)	4 <sup>3</sup> / <sub>8</sub> (111)	5 (127)	5 <sup>5</sup> / <sub>8</sub> (143)	6 <sup>1</sup> / <sub>4</sub> (159)		
Minimum edge distance	Cmin	inch (mm)	5d where d is nominal outside diameter of the anchor; or see Section 4.1.9 of this report for design with reduced minimum edge distances down to the following values $1^{3/4}$ $2^{3/4}$									
Minimum member thickness	h <sub>min</sub>	inch (mm)	h <sub>ef</sub> + (h <sub>ef</sub> +		for i	h <sub>ef</sub> + 20 nstallation p	d₀ where d₀ arameters s			eport		
Critical edge distance—splitting (for uncracked concrete only)	Cac	nch (mm)		-	See	Section 4.1.	.10 of this re	eport				
Strength reduction factor for tension, concrete failure modes, Condition B, (supplemental reinforcement not present) <sup>2</sup> [concrete breakout]	φ	-	0.65									
Strength reduction factor for shear, concrete failure modes, Condition B, (supplemental reinforcement not present) <sup>2</sup> [concrete breakout and pryout]	φ	-				0.7	70					

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

<sup>1</sup>Additional setting information is described in Table 12 and in the installation instructions, Figure 4A of this report.

<sup>2</sup>Condition A requires supplemental reinforcement, while Condition B applies where supplemental reinforcement is not provided or where pryout governs, as set forth in ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. The tabulated value of  $\phi$  applies when the load combinations of Section 1605.2 of the IBC or ACI 318 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 D.4.4.

#### TABLE 7—BOND STRENGTH DESIGN INFORMATION FOR FRACTIONAL THREADED RODS AND REINFORCING BARS<sup>1</sup>

DEALO		0/400	NOMINAL ROD DIAMETER (inch)								
DESIG	N INFORMATION	SYMBOL	UNITS	<sup>3</sup> /8	1/ <sub>2</sub>	5/ <sub>8</sub>	<sup>3</sup> / <sub>4</sub>	7/8	1	1	<sup>1</sup> / <sub>4</sub>
Minimum embedm	ent	h.c.i	inch	2 <sup>3</sup> /8	2 <sup>3</sup> /4	3 <sup>1</sup> /8	3 <sup>1</sup> / <sub>2</sub>	3 <sup>1</sup> / <sub>2</sub>	4		5
	GIIL	h <sub>ef,min</sub>	(mm)	(60)	(70)	(79)	(89)	(89)	(102)		27)
Maximum embedn	nent	h <sub>ef,max</sub>	inch	7 <sup>1</sup> / <sub>2</sub>	10	12 <sup>1</sup> / <sub>2</sub>	15	17 <sup>1</sup> / <sub>2</sub>	20		25
		Ter,max	(mm)	(191)	(254)	(318)	(381)	(445)	(508)		35)
110°F (43°C)	Characteristic bond strength		psi	1,206	1,206	1,206	1,206	1,206	1,206		206
Maximum long- term service	in cracked concrete <sup>6,9</sup>	_	(N/mm <sup>2</sup> )	(8.3)	(8.3)	(8.3)	(8.3)	(8.3)	(8.3)	8)	.3)
temperature;	Characteristic bond strength in cracked concrete,	T <sub>k,cr</sub>	psi	1,206	1,206	1,206	1,206	1,206	1,206	1,2	206
140°F (60°C)	short-term loading only <sup>9</sup>		(N/mm <sup>2</sup> )	(8.3)	(8.3)	(8.3)	(8.3)	(8.3)	(8.3)	(8	.3)
maximum short-	Characteristic bond strength		psi	1,829	1,738	1,671	1,617	1,567	1,538	1,4	479
term service	in uncracked concrete6,8		(N/mm <sup>2</sup> )	(12.6)	(12.0)	(11.5)	(11.1)	(10.8)	(10.6)	(10	0.2)
temperature <sup>3,5</sup>	Characteristic bond strength	$\tau_{k,uncr}$	psi	1,829	1,738	1,671	1,617	1,567	1,538	14	479
with Threaded Rods	in uncracked concrete,		(N/mm <sup>2</sup> )	(12.6)	(12.0)	(11.5)	(11.1)	(10.8)	(10.6)		0.2)
	short-term loading only <sup>8</sup>		· ,	. ,	. ,	. ,	. ,	. ,	, ,		
110°F (43°C)	Characteristic bond strength in cracked concrete <sup>6,9</sup>		psi (N/mm²)	882 (6.1)	882 (6.1)	882 (6.1)	882 (6.1)	882 (6.1)	882 (6.1)		82 5.1)
Maximum long- term service	Characteristic bond strength	$\tau_{k,cr}$	(11/11111)	. /						Ì	,
temperature;	in cracked concrete,	₽K,Cr	psi	882	882	882	882	882	882		82
176°F (80°C)	short-term loading only9		(N/mm <sup>2</sup> )	(6.1)	(6.1)	(6.1)	(6.1)	(6.1)	(6.1)	(6	5.1)
maximum short-	Characteristic bond strength		psi	1,334	1,262	1,218	1,175	1,146	1,117	1,0	073
term service	in uncracked concrete6,8		(N/mm <sup>2</sup> )	(9.2)	(8.7)	(8.4)	(8.1)	(7.9)	(7.7)	(7	.4)
temperature <sup>4,5</sup>	Characteristic bond strength	$\tau_{k,uncr}$	psi	1,334	1,262	1,218	1,175	1,146	1,117	1 (	073
with Threaded Rods	in uncracked concrete, short-term loading onlv <sup>8</sup>		(N/mm <sup>2</sup> )	(9.2)	(8.7)	(8.4)	(8.1)	(7.9)	(7.7)		.4)
Threaded Roas	short-term loading only					NOMINI	L REINFOR		SIZE	1	
DESIGN INFORM	ATION	SYMBOL	UNITS	#3	#4	#5	#6	#7	#8	#9	#10
			inch	2 <sup>3</sup> /8	2 <sup>3</sup> / <sub>4</sub>	3 <sup>1</sup> /8	3 <sup>1</sup> / <sub>2</sub>	3 <sup>1</sup> /2	4	4 <sup>1</sup> / <sub>2</sub>	5
Minimum embedn	nent	h <sub>ef,min</sub>	(mm)	(60)	(70)	(79)	(89)	(89)	(102)	(114)	(127)
Maxima una anabad	mant	h.	inch	7 <sup>1</sup> / <sub>2</sub>	10	12 <sup>1</sup> / <sub>2</sub>	15	17 <sup>1</sup> / <sub>2</sub>	20	22 <sup>1</sup> / <sub>2</sub>	25
Maximum embed		h <sub>ef,max</sub>	(mm)	(191)	(254)	(318)	(381)	(445)	(508)	(572)	(635)
110°F (43°C)	Characteristic bond strength		psi	1,206	1,170	1,122	1,122	1,122	1,122	1,122	1,122
Maximum long-	in cracked concrete <sup>6,9</sup>		(N/mm <sup>2</sup> )	(8.3)	(8.1)	(7.7)	(7.7)	(7.7)	(7.7)	(7.7)	(7.7)
term service temperature;	Characteristic bond strength in cracked concrete,	T <sub>k,cr</sub>	psi	1,206	1,170	1,122	1,122	1,122	1,122	1,122	1,122
140°F (60°C)	short-term loading only <sup>9</sup>		(N/mm <sup>2</sup> )	(8.3)	(8.1)	(7.7)	(7.7)	(7.7)	(7.7)	(7.7)	(7.7)
maximum short-	Characteristic bond strength		psi	1,829	1,738	1,671	1,617	1,567	1,538	1,507	1,479
term service	in uncracked concrete <sup>6,8</sup>		(N/mm <sup>2</sup> )	(12.6)	(12.0)	(11.5)	(11.1)	(10.8)	(10.6)	(10.4)	(10.2)
temperature <sup>3,5</sup>	Characteristic bond strength	$\tau_{k,uncr}$	psi	1,829	1,738	1,671	1,617	1,567	1,538	1,507	1,479
with	in uncracked concrete,		psi (N/mm²)	(12.6)	(12.0)	(11.5)	(11.1)	(10.8)	(10.6)	(10.4)	(10.2)
Rebars	short-term loading only8		· ,	. ,		. ,	. ,	. ,	, ,	. ,	· ,
110°F (43°C)	Characteristic bond strength in cracked concrete <sup>6,9</sup>		psi (N/mm²)	882 (6.1)	848 (5.8)	814 (5.6)	814 (5.6)	814 (5.6)	814 (5.6)	814 (5.6)	814 (5.6)
Maximum long- term service	Characteristic bond strength	T <sub>k,cr</sub>	(11/11/11)		(5.6)	(5.0)	(5.0)	(5.0)	(3.0)	(5.0)	(5.0)
temperature;	in cracked concrete,	CK,Cr	psi	882	848	814	814	814	814	814	814
176°F (80°C)	short-term loading only9		(N/mm <sup>2</sup> )	(6.1)	(5.8)	(5.6)	(5.6)	(5.6)	(5.6)	(5.6)	(5.6)
maximum short-	Characteristic bond strength		psi	1,334	1,262	1,218	1,175	1,146	1,117	1,102	1,073
term service	in uncracked concrete6,8		(N/mm <sup>2</sup> )	(9.2)	(8.7)	(8.4)	(8.1)	(7.9)	(7.7)	(7.6)	(7.4)
temperature <sup>4,5</sup> with	Characteristic bond strength	$\tau_{k,uncr}$	psi	1,334	1,262	1,218	1,175	1,146	1,117	1,102	1,073
Rebars	in uncracked concrete, short-term loading only <sup>8</sup>		(N/mm <sup>2</sup> )	(9.2)	(8.7)	(8.4)	(8.1)	(7.9)	(7.7)	(7.6)	(7.4)
		Anchor C	ategory.		<u>I</u>	<u> </u>	1	<u> </u>	<u> </u>	<u>I</u>	<u> </u>
	Dry concrete						0.65				
Permissible		φ Anobor C									
installation	Water-saturated concrete, Water-filled hole (flooded)	Anchor C					2				
	vvalei-iiileu iiole (iiooued)	φws,	Øwf,	0.55							
conditions <sup>7</sup>		A	Sets as			0			~		
	Underwater (submerged)	Anchor C				2			3		
		Anchor C φι α <sub>N,</sub> .	w			2 55	1.0		3 0.45	5	

For SI: 1 inch = 25.4 mm, 1 psi = 0.006894 MPa. For pound-inch units: 1 mm = 0.03937 inch, 1 MPa = 145.0 psi.

<sup>1</sup>Bond strength values correspond to a normal-weight concrete compressive strength  $f_c = 2,500$  psi (17.2 MPa). For concrete compressive strength,  $f'_c$  between 2,500 psi and 8,000 psi (17.2 MPa and 55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of  $(f'_c / 2,500)^{0.23}$  [For **SI**:  $(f'_c / 17.2)^{0.23}$ ]. See Section 4.1.4 of this report for bond strength determination.

<sup>2</sup>The modification factor for bond strength of adhesive anchors in lightweight concrete shall be taken as given in ACI 318-19 17.2.4, ACI 318-14 17.2.6 or ACI 318-11 D.3.6, as applicable, where applicable.

<sup>3</sup>The maximum short-term service temperature may be increased to 162°F (72°C) provided characteristic bond strengths are reduced by 3 percent. Long-term and short-term temperatures meet the requirements of Section 8.5 of ACI 355.4 and Table 8.1, Temperature Category B.

<sup>4</sup>Long-term and short-term temperatures meet the requirements of Section 8.5 of ACI 355.4 and Table 8.1, Temperature Category A.

<sup>5</sup>Short-term base material service temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling. Long-term base material service temperatures are roughly constant over significant periods of time.

<sup>6</sup>Characteristic bond strengths are for sustained loads including dead and live loads.

<sup>7</sup>Permissible installation conditions include dry concrete, water-saturated concrete, water-filled holes and underwater. Water-filled holes include applications in dry or water-saturated concrete where the drilled holes contain standing water during anchor installation. For installation instructions see Figure 4A of this report. <sup>8</sup>Bond strength values for uncracked concrete are applicable for structures assigned to Seismic Design Categories A and B only.

<sup>9</sup>For structures assigned to Seismic Design Categories C, D, E or F, the tabulated bond strength values for cracked concrete do not require an additional reduction factor applied for seismic tension (α<sub>N,seis</sub> = 1.0), where seismic design is applicable. See Section 4.1.11 of this report for requirements for seismic design.

		0.00			N	MINAL RC	D DIAMET	ER <sup>1</sup> (mm)		
	DESIGN INFORMATION	SYMBOL	UNITS	10	12	16	20	24	27	30
Throadod rod po	ominal outside diameter	d	mm	10	12	16	20	24	27	30
Threaded Tod Ho		u	(inch)	(0.39)	(0.47)	(0.63)	(0.79)	(0.94)	(1.06)	(1.18)
Threaded rod eff	fective cross-sectional area	Ase	mm²	58.0	84.3	157	245	353	459	561
			(inch <sup>2</sup> )	(0.090)	(0.131)	(0.243)	(0.380)	(0.547)	(0.711)	(0.870)
	Nominal strength as governed by steel	Nsa	kN (lbf)	29.0 (6,520)	42.0 (9,475)	78.5 (17,645)	122.5 (27,540)	176.5 (39,680)	229.5 (51,595)	280.5 (63,060)
	strength (for a single anchor)		kN	17.4	25.5	47.0	73.5	106.0	137.5	168.5
ISO 898-1		Vsa	(lbf)	(3,910)	(5,685)	(10,590)	(16,525)	(23,805)		(37,835)
Class 5.8	Reduction factor for seismic shear	α <sub>V,seis</sub>	-		•	•	0.80		•	
	Strength reduction factor for tension <sup>3</sup>	$\phi$	-				0.65			
	Strength reduction factor for shear <sup>3</sup>	$\phi$	-				0.60			
		Nsa	kN	46.5	67.5	125.5	196.0	282.5	367.0	449.0
	Nominal strength as governed by steel	Tvsa	(lbf)	(10,430)	(15,160)	(28,235)	(44,065)	(63,485)	(82,550)	(100,895
ISO 898-1	strength (for a single anchor)	Vsa	kN	27.9	40.5	75.5	117.5	169.5	220.5	269.5
Class 8.8		-	(lbf)	(6,270)	(9,095)	(16,940)	(26,440)	(38,090)	(49,530)	(60,535)
01000 010	Reduction factor for seismic shear	αv,seis	-				0.80			
	Strength reduction factor for tension <sup>3</sup>	φ	-				0.65			
	Strength reduction factor for shear <sup>3</sup>	φ	-				0.60			
		Nsa	kN (lbf)	40.6 (9,125)	59.0	109.9 (24,705)	171.5 (38,555)	247.1	229.5	280.5 (63,060)
ISO 3506-1	Nominal strength as governed by steel strength (for a single anchor)		(lbf) kN	24.4	(13,265) 35.4	(24,703)	102.9	(55,550) 148.3	(51,595) 137.7	168.3
Stainless	chonger (for a onigic anonor)	Vsa	(lbf)	(5,475)	(7,960)	(14,825)	(23,135)	(33,330)	(30,955)	(37,835)
Grades A4	Reduction factor for seismic shear	α <sub>V,seis</sub>	-	(-, -,	( ))	( ))	0.80	(	(	(- //
and HCR	Strength reduction factor for tension <sup>3</sup>	φ	-				0.65			
	Strength reduction factor for shear <sup>3</sup>	φ	-				0.60			
		,	kN	22.8	33.1	61.7	96.3	138.7	180.4	220.5
ASTM A193M	Nominal strength as governed by steel	N <sub>sa</sub>	(lbf)	(5,125)	(7,450)	(13,870)	(21,645)	(21,645)	(40,455)	(49,465
Grade B8/B8M,	strength (for a single anchor) <sup>4</sup>	Vsa	kN	13.7	19.9	37.0	57.8	83.2	108.2	132.3
Class 1 Stainless		-	(lbf)	(3,075)	(4,470)	(8,325)	(12,990)	(18,715)	(24,335)	(29,740)
(Types 304	Reduction factor for seismic shear	α <sub>V,seis</sub>	-				0.80			
and 316)	Strength reduction factor for tension <sup>2</sup>	$\phi$	-				0.75			
	Strength reduction factor for shear <sup>2</sup>	$\phi$	-		1	i	0.65		1	i
		Nsa	kN (lbf)	38.0	55.2	102.8	160.5	231.2	300.6	367.5
ASTM A193M Grade B8/B8M2.	Nominal strength as governed by steel strength (for a single anchor)		(lbf)	(8,540)	(12,415)	(23,120) 61.7	(36,080) 96.3	(51,980) 138.7	(67,590) 180.4	(82,610)
Class 2B		Vsa	kN (lbf)	22.8 (5,125)	33.1 (7,450)	(13,870)	96.3 (21,645)	(21,645)	(40,455)	(49,465)
Stainless	Reduction factor for seismic shear	α <sub>V,seis</sub>	-	(0,120)	(1,100)	(10,010)	0.80	(_1,010)	(10,100)	(10,100)
(Types 304	Strength reduction factor for tension <sup>2</sup>	φ	-				0.75			
and 316)	Strength reduction factor for shear <sup>2</sup>	φ					0.65			
	units: $1 \text{ mm} = 0.03937 \text{ inches} 1 \text{ N} = 0.224$	I	4				0.00			

#### **TABLE 8—STEEL DESIGN INFORMATION FOR METRIC THREADED RODS**

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

<sup>1</sup>Values provided for steel element material types are based on minimum specified strengths and calculated in accordance with ACI 318-19 Eq. 17.6.1.2 and Eq. 17.7.1.2(b), ACI 318-11 Eq. (D-2) and Eq. (D-29) except where noted. Nuts and washers must be appropriate for the rod. See Table 2 for nut specifications.

<sup>2</sup>The tabulated value of *p* applies when the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-19 17.5.3, 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  $\phi$  must be determined in accordance with ACI 318-11 D.4.4. Values correspond to ductile steel elements.

<sup>3</sup>The tabulated value of  $\phi$  applies when the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable are used in accordance with ACI 318-19 17.5.3, 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  $\phi$  must be determined in accordance with ACI 318-11 D.4.4. Values correspond to brittle steel elements. <sup>4</sup>In accordance with ACI 318-19 Eq. 17.6.1.2 and Eq. 17.7.1.2, ACI 318 D.5.1.2 and D.6.1.2 the calculated values for nominal tension and shear strength for ASTM

A193 Grade B8/B8M Class 1 stainless steel threaded rods are based on limiting the specified tensile strength of the anchor steel to 1.9 fy or 393 MPa (57,000 psi).

		SYMBOL	UNITS			NOMINAL	REINFOR	CING BAR	SIZE (Ø)		
	DESIGN INFORMATION	SYMBOL	UNITS	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Rebar r	nominal outside diameter	d	mm (inch)	10.0 (0.394)	12.0 (0.472)	14.0 (0.551)	16.0 (0.630)	20.0 (0.787)	25.0 (0.984)	28.0 (1.102)	32.0 (1.260)
Rebar e	effective cross-sectional area	Ase	mm² (inch²)	78.5 (0.122)	113.1 (0.175)	153.9 (0.239)	201.1 (0.312)	314.2 (0.487)	490.9 (0.761)	615.8 (0.954)	804.2 (1.247)
	Nominal strength as governed by	Nsa	kN (lbf)	43.0 (9,710)	62.0 (13,985)	84.5 (19,035)	110.5 (24,860)	173.0 (38,845)	270.0 (60,695)	338.5 (76,135)	442.5 (99,440)
DIN 488	steel strength (for a single anchor)	V <sub>sa</sub>	kN (lbf)	26.0 (5,825)	37.5 (8,390)	51.0 (11,420)	66.5 (14,915)	103.0 (23,305)	162.0 (36,415)	203.0 (45,680)	265.5 (59,665)
488 BSt 500	Reduction factor for seismic shear	α <sub>V,seis</sub>	-	0.7	0			0.8	80		
500	Strength reduction factor for tension <sup>2</sup>	$\phi$	-				0.6	5			
	Strength reduction factor for shear <sup>2</sup>	φ	-				0.6	0			

#### TABLE 9-STEEL DESIGN INFORMATION FOR METRIC REINFORCING BARS<sup>1</sup>

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

<sup>1</sup>Values provided for reinforcing bar material types based on minimum specified strengths and calculated in accordance with ACI 318-19 Eq. 17.6.1.2 and Eq. 17.7.1.2(b), 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.

<sup>2</sup>The tabulated value of  $\phi$  applies when the load combinations of Section 1605.2 of the IBC or ACI 318 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-19 17.5.3, 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  $\phi$  must be determined in accordance with ACI 318-11 D.4.4. Values correspond to brittle steel elements.

#### TABLE 10—CONCRETE BREAKOUT DESIGN INFORMATION FOR METRIC THREADED ROD AND REINFORCING BARS<sup>1</sup>

					NOM	/INAL R	OD DIAI	METER /	REINFO	RCING	BAR SIZ	ZE		
DESIGN INFORMATION	SYMBOL	UNITS	M10 or Ø10	M12	Ø12	Ø14	M16 or	M20 or	M24	Ø25	M27	Ø28	M30	Ø32
			210				Ø16	Ø20						
Effectiveness factor for cracked concrete	k <sub>c,cr</sub>	SI -						17 (7.1						
Effectiveness factor for uncracked concrete	k <sub>c,uncr</sub>	SI -						24 (10.						
Minimum embedment	h <sub>ef,min</sub>	mm (inch)	60 (2.4)	70 (2.8)	70 (2.8)	70 (2.8)	80 (3.2)	90 (3.6)	96 (3.8)	100 (3.9)	108 (4.3)	112 (4.4)	120 (4.7)	128 (5.0)
Maximum embedment	h <sub>ef,max</sub>	mm (inch)	200 (7.8)	240 (14.8)	240 (14.8)	280 (11.0)	320 (12.6)	400 (15.8)	480 (18.8)	500 (19.6)	540 (21.4)	560 (22.0)	600 (23.6)	640 (25.2)
Minimum anchor spacing	Smin	mm (inch)	50 (2.0)	60 (2.4)	60 (2.4)	70 (3.7)	80 (3.2)	100 (4.0)	120 (4.8)	125 (4.9)	135 (5.3)	140 (5.5)	150 (5.9)	160 (6.3)
Minimum edge distance	C <sub>min</sub>	mm (inch)		or see S	5d ection 4.		s report down te		n with re			edge dis	tances 0	
						(1.7	5)					(2.	75)	
Minimum member thickness	h <sub>min</sub>	mm (inch)	h <sub>ef</sub> + (h <sub>ef</sub> +			f				, is hole see Tab			rt	
Critical edge distance—splitting (for uncracked concrete only)	Cac	mm (inch)				:	See Sec	tion 4.1.	10 of this	report				
Strength reduction factor for tension, concrete failure modes, Condition B, (supplemental reinforcement not present) <sup>2</sup> [concrete breakout]	φ	-						0.6	5					
Strength reduction factor for shear, concrete failure modes, Condition B, (supplemental reinforcement not present) <sup>2</sup> [concrete breakout and pryout]	φ	-						0.7	0					

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

<sup>1</sup>Additional setting information is described in Table 12 and the installation instructions, Figure 4A of this report.

<sup>2</sup>Condition A requires supplemental reinforcement, while Condition B applies where supplemental reinforcement is not provided or where pryout governs, as set forth in ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. The tabulated value of  $\phi$  applies when the load combinations of Section 1605.2 of the IBC ACI 318 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-19 17.5.3, 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  $\phi$  must be determined in accordance with ACI 318-11 D.4.5.

#### TABLE 11—BOND STRENGTH DESIGN INFORMATION FOR METRIC THREADED RODS AND REINFORCING BARS<sup>1</sup>

$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$			0.00					NOMINAL		IETER		
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	DESIG	N INFORMATION	SYMBOL	UNITS	M10	M12	М	16	M20	M24	M27	M30
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Minimum embedr	nent	h <sub>ef,min</sub>			-	-	-				120 (4.7)
Maximum Inorgatures temporatures in cracked concrete.         (ps)         (1205) <td>Maximum embed</td> <td>ment</td> <td>h<sub>ef,max</sub></td> <td></td> <td></td> <td>-</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>600 (23.6)</td>	Maximum embed	ment	h <sub>ef,max</sub>			-						600 (23.6)
temperature; in cracked concrete, short-tem loading only <sup>2</sup> Nmm <sup>2</sup> (ps)         8.3 (1205)         8.3 (1523)         8.3 (1177)         8.3 (1226)         8.4 (1228)         8.4 (1228)         8.4 (1175)         8.7 (1177)         7.7 (1177)         7.7 (1177)         7.7 (1177)         7.7 (1177)         7.7 (1177)         7.7 (1177)         7.7 (1177)         7.7 (1177) <td></td> <td></td> <td></td> <td>-</td> <td></td> <td></td> <td>-</td> <td>-</td> <td></td> <td></td> <td></td> <td>8.3 (1205)</td>				-			-	-				8.3 (1205)
	temperature;	in cracked concrete,	Tk,cr	-								8.3 (1205)
	term service temperature <sup>3,5</sup>	in uncracked concrete <sup>6,8</sup> Characteristic bond strength	Tk,uncr	(psi)	(1813)	(1755)	(16	68)	(1610)	(1552)	(1523)	10.3 (1494) 10.3
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$		short-term loading only8		(psi)	(1813)	(1755)	(16	68)	(1610)	(1552)	(1523)	(1494)
temperature; maximum short-term loading only <sup>0</sup> Inc.       N/mm <sup>2</sup> (psi)       6.1 (psi)       6.1 (882)       6.1 (115)       6.1 (1111)       6.1 (1117)       6.1 (1120)       6.1 (1117)       6.1 (1120)	Maximum long-	in cracked concrete <sup>6,9</sup>	-	(psi)		-	-		-	-	-	6.1 (882)
term service temperature <sup>4,8</sup> in uncracked concrete <sup>8,8</sup> $\mathcal{D}_{kunc}$ $(psi)$ (1320)         (1276)         (1218)         (1175)         (1131)         (1117)         (11	temperature;	in cracked concrete,	U <sub>k,cr</sub>									6.1 (882)
with Threaded Rod         Unmarked concrete, short-term loading only <sup>a</sup> $IR, order(psi)         N/mm2(1320)         9.1(1320)         8.8(1276)         8.4(1218)         8.4(1218)         8.1(1175)         7.8(1131)         7.7(1131)         7.7(1117)         7.7(1117)           DESIGN INFORMATION         SYMBOL         UNTS         IREINFORCING BAR SIZE IREINFORCING BAR SIZE IREINFORCING BAR SIZE           Minimum embedment         het,min         mm(inch)         60         70         70         80         90         100         112         IREINFORCING BAR SIZE           Maximum embedment         het,min         mm(inch)         60         70         70         80         90         100         112         IREINFORCING BAR SIZE           Maximum embedment         het,max         mm(inch)         2240         280         32.2         (3.6)         (3.9)         (4.4)         (I.4)           110°F (43°C)term servicetemperature3.         Characteristic bond strengthin cracked concrete6.9 V_{Kcr} N/mm^2         8.3         8.1         7.7         7.7         7.7         7.7         7.7         7.7         7.7         7.7         7.7         7.7         7.7         7.7         7.7         7.7        $	term service	in uncracked concrete6,8		-								7.5 (1088)
DESIGN INFORMATION         SYMBOL         UNITS $             \frac{0}{010}         $ $             \frac{0}{012}         $ $             \frac{0}{010}         $ $             \frac{0}{012}         $ $             \frac{0}{010}         $ $             \frac{0}{012}         $ $             \frac{0}{012}         $ $             \frac{0}{010}         $ $             \frac{0}{012}         $ $             \frac{0}{010}         $ $             0 100 \ (1220)         $	with	in uncracked concrete,	Tk,uncr									7.5 (1088)
Minimum embedment $h_{et,min}$ mm (inch) $(2.0)$ $0.12$ $0.14$ $0.16$ $0.20$ $0.225$ $0.28$ $0.025$ $0.228$ $0.025$ $0.228$ $0.025$ $0.025$ $0.025$ $0.025$ $0.025$ $0.025$ $0.025$ $0.025$ $0.025$ $0.025$ $0.025$ $0.025$ $0.025$ $0.025$ $0.056$ $0.056$ $0.056$ $0.056$ $0.0560$	DESIGN INFORM	ATION	SYMBOL	UNITS		-					- -	
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$												Ø32
Maximum embedment $h_{et,max}$ (inch)       (7.8)       (14.8)       (11.0)       (12.6)       (15.8)       (19.6)       (22.0)       (7.8)         110°F (43°C)       Characteristic bond strength in cracked concrete <sup>6,9</sup> Characteristic bond strength in cracked concrete, short-term loading only <sup>9</sup> N/mm <sup>2</sup> 8.3       8.1       7.7 <td>Minimum embed</td> <td>ment</td> <td>h<sub>ef,min</sub></td> <td>(inch)</td> <td>(2.4)</td> <td>(2.8)</td> <td>(2.8)</td> <td>(3.2)</td> <td>(3.6)</td> <td>(3.9)</td> <td>(4.4)</td> <td>128 (5.0)</td>	Minimum embed	ment	h <sub>ef,min</sub>	(inch)	(2.4)	(2.8)	(2.8)	(3.2)	(3.6)	(3.9)	(4.4)	128 (5.0)
Maximum long- term service temperature;       in cracked concrete <sup>6,9</sup> $T_{k,cr}$ (psi)       (1205)       (1171)       (1120)       (1	Maximum embe	dment	h <sub>ef,max</sub>	(inch)	(7.8)	(14.8)	(11.0)	(12.6)	(15.8)	(19.6)	(22.0)	640 (25.2)
temperature; 140°F (60°C)       in cracked concrete, short-term loading only <sup>9</sup> N/mm <sup>2</sup> (psi)       8.3 (psi)       8.1 (1205)       7.7 (1120)	Maximum long-	in cracked concrete <sup>6,9</sup>				-						7.7 (1120)
term service temperatures <sup>3,5</sup> with Rebars       in uncracked concrete <sup>6,8</sup> $T_{k,uncr}$ (psi)       (1813)       (1755)       (1711)       (1668)       (1610)       (1537)       (1508)       (1718)         10°F (43°C) Maximum long- term service temperature;       Characteristic bond strength in cracked concrete <sup>6,9</sup> $T_{k,uncr}$ $V_{mm^2}$ 12.5       12.1       11.8       11.5       11.1       10.6       10.4       (1508)       (1         110°F (43°C) Maximum long- term service temperature;       Characteristic bond strength in cracked concrete <sup>6,9</sup> $V_{k,crr}$ $V_{mm^2}$ 6.1       5.9       5.6	temperature;	in cracked concrete,	Tk,cr		(1205)	(1171)	(1120)	(1120)	(1120)	(1120)	(1120)	7.7 (1120)
with Rebars       Orlationate ball of strength in uncracked concrete, short-term loading only <sup>8</sup> $V/mm^2$ (psi)       12.5 (1813)       11.1 (1755)       11.1 (1711)       10.6 (1668)       10.4 (1537)       0.4 (1508)       0.4 (1508)         110°F (43°C) Maximum long- term service temperature;       Characteristic bond strength in cracked concrete <sup>6,9</sup> N/mm <sup>2</sup> (psi)       6.1 (882)       5.9 (882)       5.6 (848)       5.6 (814)       6.8 (814)       8.8 (814)       8.6 (1131)       7.8 (1132)       7.6 (1102)       7.	term service	in uncracked concrete6,8										10.2 (1479)
Maximum long-term service temperature;       in cracked concrete <sup>6,9</sup> $\tau_{k,cr}$ (psi)       (882)       (848)       (814	with	in uncracked concrete,	Tk,uncr	(psi)			-	(1668)			-	10.2 (1479)
temperature;       in cracked concrete, short-term loading only <sup>9</sup> N/mm <sup>2</sup> 6.1       5.9       5.6       5	Maximum long-	in cracked concrete6,9										5.6 (814)
$\begin{array}{c} \mbox{maximum short-term service} \\ \mbox{temperature}^{4,5} \\ \mbox{with} \\ \mbox{Rebars} \end{array} \begin{array}{c} \mbox{Characteristic bond strength} \\ \mbox{in uncracked concrete}, \\ \mbox{short-term loading only}^8 \end{array} \end{array} \begin{array}{c} \mbox{N/mm}^2 & 9.1 \\ \mbox{T}_{k,uncr} \end{array} \begin{array}{c} \mbox{8.8} & 8.6 \\ \mbox{(1276)} & \mbox{(1247)} & \mbox{(1218)} & \mbox{(1175)} & \mbox{(1131)} & \mbox{(1102)} & \mbox{(1102)} \end{array} \end{array} \begin{array}{c} \mbox{(1102)} \\ \mbox{(1102)} & \mbox{(1102)} & \mbox{(1102)} \end{array} \end{array}$	temperature;	in cracked concrete,	T <sub>k,cr</sub>									5.6 (814)
with RebarsCharacteristic bold strength in uncracked concrete, short-term loading only8 $l_{k,uncr}$ (psi) $9.1$ (1320) $8.8$ (1276) $8.6$ (1247) $8.4$ (1218) $8.1$ (1175) $7.8$ (1131) $7.6$ (1102) $(1102)$ $(1102)$ Dry concrete	maximum short- term service											7.4 (1073)
Dry concrete	with	in uncracked concrete,	Tk,uncr									7.4 (1073)
Dry concrete			Anchor C	ategorv		<u> </u>	L	<u>l</u>	1	<u></u>	<u> </u>	-
Pormissible realized and realiz	Permissible	,	φ	d					0.65			
Permissible     Water-saturated concrete, installation conditions <sup>7</sup> Mater-filled hole (flooded)     Anchor Category     2	installation											
Underwater (submerged)Anchor Category23 $\phi_{UW}$ 0.550.45		Underwater (submerged)										
Reduction factor for seismic tension $\alpha_{N,seis}$ 1.0	Reduction factor f	or seismic tension							1.0			

For **pound-inch** units: 1 mm = 0.03937 inch, 1 MPa = 145.0 psi. For **SI:** 1 inch = 25.4 mm, 1 psi = 0.006894 MPa.

<sup>1</sup>Bond strength values correspond to normal-weight concrete compressive strength  $f_c = 2,500$  psi (17.2 MPa). For concrete compressive strength,  $f_c$  between 2,500 psi and 8,000 psi (17.2 MPa and 55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of  $(f_c/2,500)^{0.23}$  [For **SI:**  $(f_c/17.2)^{0.23}$ ]. See Section 4.1.8 of this report for bond strength determination.

<sup>2</sup>The modification factor for bond strength of adhesive anchors in lightweight concrete shall be taken as given in ACI 318-19 17.2.4, ACI 318-14 17.2.6 or ACI 318-11 D.3.6, as applicable.

<sup>3</sup>The maximum short-term service temperature may be increased to 162°F (72°C) provided characteristic bond strengths are reduced by 3 percent. Long-term and short-term temperatures meet the requirements of Section 8.5 of ACI 355.4 and Table 8.1, Temperature Category B.

<sup>4</sup>Long-term and short-term temperatures meet the requirements of Section 8.5 of ACI 355.4 and Table 8.1, Temperature Category A.

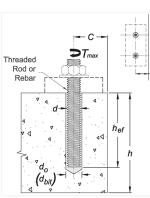
<sup>5</sup>Short-term elevated concrete temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling. Long-term concrete temperatures are roughly constant over significant periods of time.

<sup>6</sup>Characteristic bond strengths are for sustained loads including dead and live loads.

<sup>7</sup>Permissible installation conditions include dry concrete, water-saturated concrete, water-filled holes and underwater. Water-filled holes include applications in dry or water-saturated concrete where the drilled holes contain standing water during anchor installation. For installation instructions see Figure 4A of this report. <sup>8</sup>Bond strength values for uncracked concrete are applicable for structures assigned to Seismic Design Categories A and B only.

<sup>9</sup>For structures assigned to Seismic Design Categories C, D, E or F, the tabulated bond strength values for cracked concrete do not require an additional reduction factor applied for seismic tension (*QN,seis* = 1.0), where seismic design is applicable. See Section 4.1.11 of this report for requirements for seismic design.

#### TABLE 12—INSTALLATION PARAMETERS FOR THREADED RODS AND REINFORCING BARS FOR POST-INSTALLED ADHESIVE ANCHORS<sup>7</sup>



PARAMETER Threaded rod

outside diameter Rebar nominal

outside diameter Carbide drill bit

nominal size6 Minimum

embedment Maximum

embedment Minimum member

thickness Minimum anchor

spacing Minimum edge

distance Max. torque<sup>1</sup>

Max. torque<sup>1,3</sup>

Minimum edge

Max. torque,

(low strength rod)

distance, reduced4

T<sub>max</sub>

Cmin.red

Tmax,red

N-m

mm

(inch)

N-m

		DAD			0.000			FRA	сті	ONAL		MINAL RO		[ER (inch)	/ REINF	ORCI	NG BA	R SIZE
		PAR	AMET	ER	SYMB		NIIS	<sup>3</sup> /8 or	#3	<sup>1</sup> / <sub>2</sub>	#4	<sup>5</sup> / <sub>8</sub> or #5	<sup>3</sup> / <sub>4</sub> or #6	<sup>7</sup> / <sub>8</sub> or #7	1 or #8	#9	<b>1</b> <sup>1</sup> / <sub>4</sub>	#10
		hreade outside		er	d		nch nm)	0.37 (9.5	-	0.50 (12.		0.625 (15.9)	0.750 (19.1)	0.875 (22.2)	1.000 (25.4)	-	1.250 (31.8)	-
1		Rebar n outside			d		nch nm)	0.37 (9.5		0.50 (12.		0.625 (15.9)	0.750 (19.1)	0.875 (22.2)	1.000 (25.4)	1.125 (28.7)	-	1.250 (31.8)
-		Carbide Iominal		t	d <sub>bit</sub> (d	do) ii	nch	<sup>7</sup> / <sub>16</sub>		<sup>9</sup> / <sub>16</sub>	<sup>5</sup> /8 <sup>1</sup>	<sup>11</sup> / <sub>16</sub> or <sup>3</sup> / <sub>4</sub> 5	<sup>7</sup> /8	1	1 <sup>1</sup> /8	1 <sup>3</sup> /8	1 <sup>3</sup> /8	1 <sup>1</sup> / <sub>2</sub>
	N	/linimur mbedn			h <sub>ef,m</sub>		nch nm)	2 <sup>3</sup> / <sub>8</sub> (60)	)	2 <sup>3</sup> /. (70	))	3 <sup>1</sup> / <sub>8</sub> (79)	3 <sup>1</sup> / <sub>2</sub> (89)	3 <sup>1</sup> / <sub>2</sub> (89)	4 (102)	4 <sup>1</sup> / <sub>2</sub> (114)	5 (127)	5 (127)
		/laximu mbedn			h <sub>ef,m</sub>		nch nm)	7 <sup>1</sup> / <sub>2</sub> (191	)	10 (254		12 <sup>1</sup> / <sub>2</sub> (318)	15 (381)	17 <sup>1</sup> / <sub>2</sub> (445)	20 (508)	22 <sup>1</sup> / <sub>2</sub> (572)	25 (635)	25 (635)
		/linimur hicknes		lber	h <sub>mii</sub>		nch nm)			· 1¹/₄ ⊦ 30)				h <sub>ef</sub> +	2d <sub>o</sub>			
h <sub>ef</sub>		/linimur pacing	n anch	or	S <sub>mir</sub>	-	nch nm)	1 <sup>7</sup> / <sub>8</sub> (48)		2 <sup>1</sup> /; (64		3 <sup>1</sup> / <sub>8</sub> (79)	3 <sup>3</sup> / <sub>4</sub> (95)	4 <sup>3</sup> / <sub>8</sub> (111)	5 (127)	5 <sup>5</sup> / <sub>8</sub> (143)	6 <sup>1</sup> / <sub>4</sub> (159)	6 <sup>1</sup> / <sub>4</sub> (159)
h		/linimur listance		•	Cmir		nch mm)	1 <sup>7</sup> / <sub>8</sub> (48)		2 <sup>1</sup> /; (64		3 <sup>1</sup> / <sub>8</sub> (79)	3 <sup>3</sup> / <sub>4</sub> (95)	4 <sup>3</sup> / <sub>8</sub> (111)	5 (127)	5 <sup>5</sup> / <sub>8</sub> (143)	6 <sup>1</sup> / <sub>4</sub> (159)	6 <sup>1</sup> / <sub>4</sub> (159)
۹.		/lax. tor			T <sub>ma</sub>	x ft	-lbs	15		30	)	60	105	125	165	200	280	280
		/lax. tor low stre		ods)	T <sub>ma</sub>	<sub>x</sub> ft	-lbs	5		20	)	40	60	100	165	-	280	-
		/linimur listance			Cmin,r		nch nm)	1 <sup>3</sup> / <sub>4</sub> (45)		1 <sup>3</sup> /. (45		1 <sup>3</sup> / <sub>4</sub> (45)	1 <sup>3</sup> / <sub>4</sub> (45)	1 <sup>3</sup> / <sub>4</sub> (45)	1 <sup>3</sup> / <sub>4</sub> (45)	2 <sup>3</sup> / <sub>4</sub> (70)	2 <sup>3</sup> / <sub>4</sub> (70)	2 <sup>3</sup> / <sub>4</sub> (70)
		/lax. tor educed			T <sub>max,</sub>	<sub>red</sub> ft	-lbs	7 [5]	3	14	Ļ	27	47	56	74	90	126	126
SYMBOL	UNITS					MET	RIC	NOMIN	IAL	ROD	DIAN	METER / R	EINFORC	ING BAR	SIZE			
STMBOL		M10			Ø12	Ø14	4	M16 Ø	16	M20		-	Ø25	M27	Ø28	B	M30	Ø32
d	mm (inch)		10 .39)	1 (0.4		-		16 (0.63)	)		20 .79)	24 (0.94)	-	27 (1.06)	-	(*	30 1.18)	-
d	mm (inch)		0.0 394)		2.0 472)	14.0 (0.55		16.0 (0.630	))		0.0 787)	-	25.0 (0.984)	-	28.0 (1.10		-	32.0 (1.260)
d <sub>bit</sub> (d <sub>o</sub> )	mm	12	14	14	16	18		18 2	20	24	25	5 28	32	32	35		35	38
h <sub>ef,min</sub>	$H_{o}$ mm 12 14 mm 60 (inch) (2.4)			7 (2.	-	70 (2.8		80 (3.2)			90 8.6)	96 (3.8)	100 (3.9)	108 (4.3)	112 (4.4		120 (4.7)	128 (5.0)
h <sub>ef,max</sub>	<sup>n</sup> (inch) (2.4) mm 200			24 (14	40 4.8)	280 (11.0		320 (12.6)	)		00 5.8)	480 (18.8)	500 (19.6)	540 (21.4)	560 (22.0		600 23.6)	640 (25.2)
h <sub>min</sub>	$\begin{array}{c c} & \text{(inch)} & (7.8) \\ & \text{mm} & h_{ef} + 30 \\ \hline n & (\text{inch}) & (h_{ef} + 1^{1}/_{4}) \end{array}$											hef	+ 2d <sub>o</sub>					
S <sub>min</sub>	$\begin{array}{c c} (incn) & (7.8) \\ \hline mm & h_{ef} + 30 \\ (inch) & (h_{ef} + 1^{1/2}) \\ \hline mm & 50 \end{array}$			6 (2.	0 .4)	70 (3.7	)	80 (3.2)			00 .0)	120 (4.8)	125 (4.9)	135 (5.3)	140 (5.5		150 (5.9)	160 (6.3)
Cmin	mm (inch)		50 2.0)	6 (2.	0 .4)	70 (3.7	)	80 (3.2)			00 .0)	120 (4.8)	125 (4.9)	135 (5.3)	140 (5.5		150 (5.9)	160 (6.3)
T <sub>max</sub>	N-m		20	4	0	60		80			20	160	160	180	180		200	300
		1 -							Ē									

reduced<sup>1</sup> For pound-inch units: 1 mm = 0.03937 inch, 1 N-m = 0.7375 ft-lbf. For SI: 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m.

20

45

 $(1^{3}/_{4})$ 

18

\_

45

 $(1^{3}/_{4})$ 

27

<sup>1</sup>Torque may not be applied to the anchors until the full cure time of the adhesive has been achieved.

7

45

 $(1^{3}/_{4})$ 

9 [7]<sup>3</sup>

<sup>2</sup>These torque values apply to ASTM A36 / F1554 Grade 36 carbon steel threaded rods; ASTM F1554 Grade 55 carbon steel threaded rods; and ASTM A193 Grade B8/B8M (Class 1) stainless steel threaded rods.

40

45

 $(1^{3}/_{4})$ 

36

100

45

 $(1^{3}/_{4})$ 

54

160

45

 $(1^{3}/_{4})$ 

72

-

45

 $(1^{3}/_{4})$ 

72

180

45

 $(1^{3}/_{4})$ 

81

-

70

(23/4)

81

200

70

 $(2^{3}/_{4})$ 

90

\_

70

(23/4)

135

<sup>3</sup>These torque values apply to ASTM A193 Grade B8/B8M (Class 1) stainless steel threaded rod only.

<sup>4</sup>See Section 4.1.9 of this report for requirements of anchors installed at reduced edge distances.

<sup>5</sup>Either drill bit size listed is acceptable for threaded rod <sup>5</sup>/<sub>8</sub>-inch diameter and rebar size No. 5.

<sup>6</sup>For any case, it must be possible for the steel anchor element to be inserted into the cleaned drill hole without resistance.

<sup>7</sup>The DEWALT DustX+ extraction system can be used to automatically clean holes drilled in concrete with a hammer-drill. See Figure A for an illustration of the DustX+ extraction system. The DustX+ extraction system is qualified for use in dry concrete and water saturated concrete, however, drilling in dry concrete is recommended by DEWALT when using hollow drill bits.



# Pure110+ Instruction Card

Pure 110+ is a high strength, 100% solids epoxy adhesive which is formulated for use in anchoring and rebar connection applications by trained professionals. Refer to installation instructions and SDS for additional detailed information. DESCRIPTION:

# RECAUTION:

Safety glasses and dust masks should be used when drilling holes into concrete store and masonry. Wear gloves and safety glasses when handling and dispensing adhesive. Do not sand the adhesive and create silica dust which could be inhaled. Avoid skin and eye contact. Use a NIOSH-approved chemical could be inhaled. odor begins to cause discomfort. mask to avoid respiratory discontrof if working indoors or in a confined area, or i sensitive to adhesive odors. Wash hands or other affected body parts with soap and water if skin contact occurs. Flush eyes with plenty of water and seek mmediate medical attention if eye contact occurs. Move to fresh air if adhesive

a dust hazard; therefore, this classification is not relevant. However, if reacted (fully cured) product is further processed (e.g. sanded, drilled) be sure to wear proper respiratory and eye protection to avoid health risk. term and chronic exposure (via inhalation) to silica dust; e.g. mining, quarry, stone crushing, refractory brick and pottery workers. This product does not pose This product contains crystalline silica and as supplied does not pose a dust nazard. IARC classifies crystalline silica (quatz sand) as a Group I carcinogen nased upon evidence among workers in industries where there has been long-MPORTANT! Before using, read and review Safety Data Sheet (SDS).

# HANDLING AND STORAGE:

Store in a cool, dry, well ventilated area at temperatures between 41°F (5°C) and 86°F (30°C). Do not freeze. Store and keep away from flame, heat and light. Keep partially used containers closed when not in use. Protect from damage.

Note expiration date on product label before use. Do not use expired product. Partially used catridges may be stored with hardened adhesive in the attached mixing nozzle. It the catridge is reused, attach a new mixing nozzle and discard initial quantity of anchor adhesive as described in installation instructions.

NALT anchors@DEWALT.com East Joppa Road www.DEWALT.com rson, MD 21286 U.S.A. P: (800) 524-3244 [J]							
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DEWALT 701 East J Towson, N	DEWALT 701 East Joppa Road Towson, MD 21286 U.S.A	S.A.		anchor www.D P: (800	anchors@DEWALT.com www.DEWALT.com P: (800) 524-3244 [J]
[I.] Pure'	110+ epox	[I.] Pure110+ epoxy system selection table	selection t	table	
	Dispensers	s	Cart	Cartridges	Mixing nozzles
Tool	Size	Cat.#	Type	Size	Cat.#
Manual	Heavy Duty	08437-PWR	Quik-shot	9 fl.oz. or	
Cordless	Caulk Gun	DCE560D1	(coaxial)	9.5 fl.oz.	PFC18408000
Manual	13.5 fl.oz.	DFC1610275	Dual tube	13.5 fl.oz	0 0000-1 111
Manual		08409-PWR			
Pneumatic	20.5 fl.oz.	08413-PWR	Dual tube	20.5 fl.oz.	08609-PWR
Cordless		DCE591D1			
Pneumatic 50.5 fl.oz	50.5 fl.oz.	08438-PWR	Dual tube	50.5 fl.oz.	08609-PWR
	(working	[]] ] Gol (working) times and curing times for adhesive	d curina ti	mae for	adhasiva
Tempera	Temperature of base material	e material	Gel (working) time	ıg) time	Full curing time
41°F		5°C	120 minutes	utes	48 hours
50°F		10°C	90 minutes	Ites	24 hours
68°F		20°C	25 minutes	ıtes	8 hours
86°F		30°C	20 minutes	Ites	6 hours
95°F		35°C	15 minutes	ites	6 hours
104°F	-"	40°C	12 minutes	Ites	4 hours
110°E	-	13°C	10 minutes	100	4 hours

II.] Gel (wor Temperature d	II.] Gel (working) times an Temperature of base material	II.] Gel (working) times and curing times for adhesive Temperature of base material   Gel (working) time   Full curing	adhesive
41°F	5°C	120 minutes	48 hours
50°F	10°C	90 minutes	24 hours
68°F	20°C	25 minutes	8 hours
86°F	30°C	20 minutes	6 hours
95°F	35°C	15 minutes	6 hours
104°F	40°C	12 minutes	4 hours
110°F	43°C	10 minutes	4 hours
haar internalativ	on for intermediate	near internolation for intermediate have material temperatures is nossible	inas is nossikla

<sup>1</sup>Torque may not be applied to the anchors until the full cure time of the adhesive has been achieved. <sup>2</sup>These forque values apply to ASTM A 36 /F ISS4 Grade 36 carbon steel threaded rots, ASTM F 1554 Grade 55 carbon steel threaded rods; and ASTM A 193 Grade B8/B8M (Class 1) stainless steel threaded rods or equivalent. Travue may not be applied to the anchors until the full cure time of the adhesive has been achieved. <sup>3</sup>These torque values apply to ASTM A 193 Grade B8/B8M (Class 1) stainless steel threaded rod only.

cmin,red = Minimum edge distance (mm), reduced Tmax,red = Maximum torque (N-m), reduced edge1 Tmax = Maximum torque (N-m), Grade B8/B8M SS<sup>1,3</sup>

9[7]<sup>3</sup>

21 45

<u>- 2888</u>

822 .

886885

8888488

<u>663368</u>2

72 45 15 15 15 15

<u>9888888</u>

828858

25

<u>8</u>

33 0

70

Tmax = Maximum torque (N-m)<sup>1</sup>

	50 60 70 80 100	nm) her + 1 <sup>1</sup> / <sub>4</sub> her + 2do, where do is hole diameter	0) 200 240 280 320 400 480 500 540	60 70 70 80 90 96 100	e (mm) 12 14 14 16 18 18 20 24 25 28 32 32 32	10 12 14 16 20 - 25	0 12 - 16 20 24 - 27	Anchor property / Setting information M10 Ø10 M12 Ø12 Ø14 M16 Ø16 M20 Ø20 M24 Ø25 M27 Ø28	$Im_{32/Rd} = Maximum (u-u), reduced edge I [2] I = \frac{2}{2} I = \frac{2}{2} I = \frac{1}{2} I = \frac{1}{2}$		Compared = Minimum edge distance reduced (index) / summer use $13/L$ $1$	$T_{mx}$ = Maximum forque (ft-lb.) for A36/Grade 36 and Grade 55 5 20 40 60 100 165 - rations shell most and Grade BRBM (13es 1) statisfies mode 5 5 20 40 60 100 165 -	T <sub>max</sub> = Maximum torque (ftlb.) <sup>1</sup> 15         33         60         105         125         165	cmn = Minimum edge distance (inches) 1 <sup>7</sup> /8 2 <sup>1</sup> /2 3 <sup>1</sup> /8 3 <sup>3</sup> /4 4 <sup>3</sup> /8 5 5 <sup>5</sup> /8	1 <sup>7</sup> / <sub>8</sub> 2 <sup>1</sup> / <sub>2</sub> 3 <sup>1</sup> / <sub>8</sub> 3 <sup>3</sup> / <sub>4</sub>	nes) her + 11/4	her max         = Maximum embedment (inches)         4 <sup>1</sup> / <sub>2</sub> 10         12 <sup>1</sup> / <sub>2</sub> 15         17 <sup>1</sup> / <sub>2</sub> 20         22 <sup>1</sup> / <sub>2</sub>	$2^{3}/_{8}$ $2^{3}/_{4}$ $3^{1}/_{8}$ $3^{1}/_{2}$ $3^{1}/_{2}$	9/16 5/8 11/16 OF 3/4 7/8 1	0.375 0.500 0.625	0.500 0.625 0.750 0.875 1.000	Anchor property / Setting information 3/8" or #3 1/2" #4 5/8" or #5 3/4" refer 7/8" or #7 1 or refer to the set of the se	IV.] Installation parameters - Specifications for installation of threaded rods and relinforcing bars is for Anchors Noninelinforcing bars is a consistent of the second	<sup>7</sup> All overhead (i.e upwardly inclined) installations require the use of piston plugs where one is tabulated together with the anchor size (see table). NA = Not applicable. All horizontal installations require the use of piston plugs where one is tabulated together with the anchor size and where the embedment depth is greater than 8 inches A plastic extension tube (Cat# 08281 or 08297) or equivalent approved by DEWALT must be used with piston plugs. The use of niston plugs is also recommended for underwater installations where one is tabulated together with the anchor size	A plastic extension tube (Cat# 06281 or 6297) or flexible extension hose (Cat.# PFC1640600) or equivalent approved by DEWALT must be used if the bottom or back of the anchor hole is not reached with the mixing nozzle only.	Brush adaptors for power tool connections are available for drill chuck (Cat # 08296) and SDS (Cat # 08283).	A brush extension (Cat. #09222) must be used with a steel wire brush for holes drilled deeper than the listed brush length.	Protes are aniled with hammer-dmil (i.e. rodary impact dnils or rock dnils with a cancie dnill bit, including the use of hollow dnill bits). For any case it must be crossible for the a norhor to be incended in the cleaned dnill hole without resistance	If the DEWALT DustX+ extraction system is used to automatically clean the holes during drilling, standard hole cleaning (brushing and blowing following drilling) is not required	10 11/2 11/2 117/8 08291 11/2 08309 Std. piston plug - 32 38 38	1 <sup>3</sup> / <sub>8</sub> 11 <sup>7</sup> / <sub>8</sub> 08290 1 <sup>3</sup> / <sub>8</sub> 08305 30 28 35 35 300	8 1 <sup>1</sup> / <sub>6</sub> 1 <sup>1</sup> / <sub>6</sub> 11 <sup>7</sup> / <sub>8</sub> 08289 1 <sup>1</sup> / <sub>8</sub> 08303 27 25 32 32 300	7 1 1 1 1 <sup>7</sup> / <sub>2</sub> 08288 1 08301 Compressed air nozzle 24 - 28 28 300	7/8 77/8 08287 7/8 08300 20 20 25 25 300	5/8 5 11/10 11/10 17/8 USZ80 11/10 02/59 505 adaptor 1 16 17 20 200 DECENTION 3/4 3/4 7/1/8 0978 11/10 092/59 505 adaptor 1 16 18 18 2/00 DECENTION 10 14 18 18 2/00 DECENTION	5/8 0°/4 USZ/S N/A N/A UNII CNUCK adaptor - 12 10 10 200	- 9/16 9/16 6 <sup>3</sup> / <sub>4</sub> 08285 N/A N/A harmonic 12 10 14 14 170	N/A N/A Drush extension 10 - 12 12 170	mm) (Ø) (inch) (mm) (mm) (Cat #)	Rebar Drill bit Brush Brush Wire Plug Piston Rod Rebar Drill bit Brush Brush Wire	Fractional anchor sizes Metric anchor sizes	[III.] Hole cleaning tools and accessories for Adhesive Anchors <sup>1234567</sup>	
+			_		-		+	7	ŀ	+	+	- 55	$\vdash$		5 5 <sup>5</sup> /8	s hole diameter		_		_	┥	「悲」 悲	sive Anchor	). N/A = Not ap is greater than	ed if the bottom				following drillin	DFC1670600	DFC1670550	DFC1670500	DFC1670450	DFC1670400	DFC1670300		DFC1670150	DFC1670100	brush (Cat. #)	Wire	sizes		
+	150 160		600 640	120 128	35	- 32	+	M30 Ø32	071 071	+	731, 731,	280 -	280 280	61/4 61/4	6 <sup>1</sup> / <sub>4</sub> 6 <sup>1</sup> / <sub>4</sub>		25 25	5 5	1 <sup>3</sup> /8 1 <sup>1</sup> /2	+	-	11/4" #10	)rs	pplicable. n 8 inches.	m or back of the				ng) is not required.	8	ւն	32	8	23	20 08259	NA	NA	NA	(mm) (Cat. #)	Plug Piston			

FIGURE 4A—PURE110+® EPOXY ADHESIVE ANCHOR SYSTEM MANUFACTURER'S PUBLISHED INSTALLATION INSTRUCTIONS (MPII)

# **Pure110+ Instruction Card (continued)**

		HO	LE CLEANI TER IN STAI				CLEANING WET HOLE	s	HAMME	RDRILLING	
		Brush 2x Repeat Rinsing	Rinse		Repeat Blowing 2x	Brush 2x	Blow 2x	x	2		CT HAMMER D
	This section is intentionally lett blank.	Should resist insertion into the drilled hole, if not the brush is too small and must be replaced with the proper brush dameter (i.e. new wire brush). 2uw-ii. Repeat Step 2uw-i again by rinse/flushing the hole clean with air/water. When finished the hole should be clean and free of dust, debris, of or other foreign material. → Next go to Step 3.	Zuw-i. Determine wire brush dameter isee Tabe III) for the crilled hole and attach the brush with adaptor to a rotary drill tool. Brush the hole with the selected wire brush a minimum of two times (2x). A brush extension (supplied by DEWALT) must be used for holes drilled deeper than the listed brush length. The wire brush diameter must be checked periodically during use; The brush	2uw-i. Starting from the bottom or back of the drilled anchor hole, rinse/flush the hole clean with air/water (air/water line pressure) until clear water comes out.	2c. Repeat Step 2a again by blowing the hole clean a minimum of two times (2x). When finished the hole should be clean and free of dust, debris, oil or other foreign material. → Next go to Step 3.	A brush extension (supplied by DEWALT) must be used for holes drilled deeper than the listed brush length. The wire brush diameter must be checked periodically during use; the brush should resist insertion into the drilled hole, if not the brush is too small and must be replaced with the proper brush diameter (i.e. new wire brush).	20 Determine wire brush diameter (see Table III) for the shilled hole and attach the brush with adaptor to a rotary drill tool or battlery screw gun. Brush the hole with the selected wire brush a minimum of the times (2x)	27 Starting from the bottom or back of the drilled anchor hole, blow the hole clean a minimum of two times ( <b>2</b> C). Use a compressed air nozzle (min. 90 psi) for all sizes of anchor rod and reinforcing bar (retar).	Drilling in dry concrete is recommended when using hollow drill bts (vacuum must be on). → Go to Step 3 for holes drilled with DustX+ <sup>m</sup> extraction system (no further hole cleaning is required). Otherwater (Submerged) installation condition go to Step > In the case of an underwater (submerged) installation condition go to Step 2uv-i for separate specific hole cleaning instructions.	drill bit to the size and embedment required by the selected size! Fardware element (see Table 11). Tolerances of carbide drill bits including hollow drill bits must meet ANSI Standard 8212 15. <b>Precaution:</b> Wear suitable eye and skip protection. Avoid inhalation of dusts during drilling and/or removal (see dust extraction equipment by DEVALT to minimize dust emissions). <b>Notes:</b> In case of starting water in the drilled hole (flooced hole condition), all the water has to be removed from the hole (e.g. vacuum, compressed air, etc.) prior to cleaning.	SELECT HAMMER DRILLING AS SUITABLE FOR APPLICATION
CUR	ING & FIXTURE	, *, j.o., *, j.o., *,	IN ST/			en can can c		1	PREPARING	//	_ _
CUR	ING & FIXTURE				with pistan plug:		the the	he s	PREPARING		

FIGURE 4A—PURE110+<sup>®</sup> EPOXY ADHESIVE ANCHOR SYSTEM MANUFACTURER'S PUBLISHED INSTALLATION INSTRUCTIONS (MPII) (Continued) Installation instructions for Adhesive Anchors in solid base material – For any application not covered by this document please contact DEWALT

#### TABLE 13—DEVELOPMENT LENGTHS FOR COMMON REINFORCING BAR CONNECTIONS PROVIDED FOR ILLUSTRATION<sup>1,2,3,7,8</sup>

			FRACTIC	NAL RE	INFOR	CING BA	RS							
DESIGN INFORMATION	SYMBOL	REFERENCE	UNITS		-	_	NC	MINAL I	REBAR S	IZE (US	5)			
DESIGN INFORMATION	STNIBOL	STANDARD	UNITS	#3	#4	#		#6	#7	#8	#9		10	#11
Nominal rebar diameter	db	ASTM A615/A706, Grade 60	in. (mm)	0.375 (9.5)	0.500 (12.7			).750 19.1)	0.875 (22.2)	1.000 (25.4)	1.12 (28.6		270 2.3)	1.410 (35.8)
Nominal rebar area	Ab	$(f_y = 60 \text{ ksi})$	in <sup>2</sup> (mm <sup>2</sup> )	0.11 (71)	0.20	0.3		0.44 285)	0.60 (388)	0.79 (507)	1.00 (645		.27 17)	1.56 (1006)
Development length in f'c = 2,500 psi concrete <sup>4,5</sup>			in. (mm)	12.0 (305)	14.4 (366)	18 (45	-	21.6 549)	31.5 (800)	36.0 (914)	40.6 (103		5.7 161)	50.8 (1290)
Development length in f'c = 3,000 psi concrete <sup>4,5</sup>		ACI 318-19 25.4.2.4,	in. (mm)	12.0 (305)	13.1 (334)	16 (41		19.7 501)	28.8 (730)	32.9 (835)	37.1 (942		1.7 060)	46.3 (1177)
Development length in f'c = 4,000 psi concrete <sup>4,5</sup>	ld	ACI 318-14 25.4.2.3 or ACI 318-11 12.2.3	in. (mm)	12.0 (305)	12.0 (305)	14 (36		17.1 434)	24.9 (633)	28.5 (723)	32.1 (815		6.2 20)	40.1 (1019)
Development length in f'c = 6,000 psi concrete <sup>4,5</sup>		as applicable	in. (mm)	12.0 (305)	12.0 (305)	12 (30		13.9 354)	20.3 (516)	23.2 (590)	26.2 (666		9.5 50)	32.8 (832)
Development length in f'c = 8,000 psi concrete <sup>4,5</sup>			in. (mm)	12.0 (305)	12.0 (305)	12 (30		12.1 307)	17.6 (443)	20.1 (511)	22.7 (577		5.6 49)	28.4 (721)
		•	METR	IC REIN		G BARS	;		-					
DESIGN INFORMATION	SYMBOL	REFERENCE	UNITS				N	OMINAL	REBAR S	SIZE (EL	J)			
DESIGN INFORMATION	STMBOL	STANDARD		Ø10	Ø12	Ø14	Ø16	Ø20	Ø24	Ø25	Ø28	Ø32	Ø34	Ø36
Nominal rebar diameter	db	DIN 488, BSt 500 (BS 4449: 2005)	mm (in)	10 (0.394)	12 (0.472)	14.0 (0.551)	16 (0.630	20 ) (0.787	24 ) (0.945)	25 (0.984)	28 (1.102)	32 (1.260)	34 (1.339	36 ) (1.417
Nominal rebar area	Ab	$(f_y = 72.5 \text{ ksi})$	mm² (in²)	78.5 (0.12)	113 (0.18)	154 (0.23)	201 (0.31	314 ) (0.49)	452 (0.70)	491 (0.76)	616 (0.96)	804 (1.25)	908 (1.41)	1018 (1.58
Development length in f' <sub>c</sub> = <b>2,500 psi</b> concrete <sup>4,6</sup>			mm (in)	348 (13.7)	417 (16.4)	487 (19.2)	556 (21.9	870 (34.2)	1044 (41.1)	1087 (42.8)	1217 (47.9)	1392 (54.8)	1479 (58.2)	1566 (61.6
Development length in f' <sub>c</sub> = <b>3,000 psi</b> concrete <sup>4,6</sup>		ACI 318-19 25.4.2.4,	mm (in)	318 (12.5)	381 (15.0)	445 (17.5)	508 (20.0	794 (31.3)	953 (37.5)	992 (39.1)	1112 (43.8)	1271 (50.0)	1351 (53.2)	1429 (56.3)
Development length in f'c= <b>4,000 psi</b> concrete <sup>4,6</sup>	ld	ACI 318-14 25.4.2.3 or ACI 318-11 12.2.3	mm (in)	305 (12.0)	330 (13.0)	385 (15.2)	439 (17.3	688 (27.1)	825 (32.5)	859 (33.8)	963 (37.9)	1100 (43.3)	1170 (46.0)	1238 (48.7)
Development length in f'c = 6,000 psi concrete <sup>4,6</sup>		as applicable	mm (in)	305 (12.0)	305 (12.0)	314 (12.4)	359 (14.2	562 (22.1)	674 (26.4)	702 (27.6)	786 (30.9)	899 (35.4)	955 (37.6)	1011 (39.8
Development length in f' <sub>c</sub> = 8,000 psi concrete <sup>4,6</sup>			mm (in)	305 (12.0)	305 (12.0)	305 (12.0)	311 (12.3	486	584 (23.0)	608 (23.9)	681 (26.8)	778 (30.6)	827 (32.6)	875 (34.5)
· · ·		REFERENCE		, ,	, ,	. ,	NC	MINAL			N	, ,	, ,	, ,
DESIGN INFORMATION	SYMBOL	STANDARD	UNITS	10M		15M		20M	25	· · ·	, 30	M	3	5M
Nominal rebar diameter	db	CAN/CSA G30.18, Grade 400	mm (in)	11.3 (0.44		16.0 (0.630)	(	19.5 0.768)	25 (0.9		29 (1.1			5.7 406)
Nominal rebar area	Ab	$(f_y = 58 \text{ ksi})$	mm <sup>2</sup> (in <sup>2</sup> )	100 (0.16		200 (0.31)		300 (0.46)	50 (0.7	-	70 (1.0			000 .56)
Development length in f'c = <b>2,500 psi</b> concrete <sup>4,6</sup>			mm (in)	315 (12.4		445 (17.5)		678 (26.7)	87 (34	-	10 (41			242 8.9)
Development length in f'c = <b>3,000 psi</b> concrete <sup>4,6</sup>		ACI 318-19 25.4.2.4,	mm (in)	305 (12.0		407 (16.0)		620 (24.4)	80 (31		95 (37			135 4.7)
Development length in $f'_c = 4,000$ psi concrete <sup>4,6</sup>	ld	ACI 318-14 25.4.2.3 or ACI 318-11 12.2.3	mm (in)	305 (12.0		353 (13.9)		536 (21.1)	69 (27	-	82 (32			83 8.7)
Development length in $f_c = 6,000 \text{ psi}$ concrete <sup>4,6</sup>	]	as applicable	mm (in)	305 (12.0		305 (12.0)		438 (17.3)	56 (22		67 (26		-	02 1.6)
Development length in f'c = 8,000 psi concrete <sup>4,6</sup>	1		mm (in)	305 (12.0		305 (12.0)		379 (14.9)	49		58 (22			i95 7.4)

For SI: 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa; for pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi. <sup>1</sup>Calculated development lengths in accordance with Section 4.2.2 of this report and ACI 318-19 25.4.2.4, ACI 318-14 25.4.2.3 or ACI 318-11 12.2.3, as

applicable, for reinforcing bars are valid for static, wind, and earthquake loads.

<sup>2</sup>Calculated development lengths in SDC C through F must comply with ACI 318 (-19 or -14) Chapter 18 or ACI 318-11 Chapter 21, as applicable, and Section 4.2.4 of this report. Post-installed reinforcing bars may be installed into holes drilled with a hammer-drill (i.e. rotary impact drills or rock drills with a carbide drill bit, including hollow drill bits) or a core-drill (i.e. core drill with a diamond core drill bit).

<sup>3</sup>For Class B splices, minimum length of lap for tension lap splices is 1.3*I*<sub>d</sub> in accordance with ACI 318 (-19 or -14) 25.5.2 and ACI 318-11 12.15.1, as applicable. <sup>4</sup>For lightweight concrete, λ = 0.75; therefore multiply development lengths by 1.33 (increase development length by 33 percent), unless the provisions of ACI 318-19 25.4.2.5, ACI 318-14 25.4.2.4 or ACI 318-11 12.2.4 (d), as applicable, are met to permit alternate values of  $\lambda$  (e.g for sand-lightweight concrete,  $\lambda$  = 0.85; therefore multiply development lengths by 1.18). Refer to ACI 318 (-19 or -14) 19.2.4 or ACI 318-11 8.6.1, as applicable.

 $5\left(\frac{c_b+K_{tr}}{d_s}\right) = 2.5, \psi_i=1.0, \psi_s=0.8 \text{ for } d_b \le \#6, 1.0 \text{ for } d_b > \#6. \text{ Refer to ACI 318-19 } 25.4.2.5, \text{ ACI 318-14 } 25.4.2.4 \text{ or ACI 318-11 } 12.2.4, \text{ as applicable.}$ 

 $\left(\frac{c_b + K_{tr}}{d_b}\right) = 2.5, \psi_t = 1.0, \psi_s = 0.8 \text{ for } d_b \le \#0, 1.0 \text{ for } d_b > \#0. \text{ Refer to ACI 318-19} 25.4.2.5, ACI 318-14 25.4.2.4 or ACI 318-11 12.2.4, as applicable.$   $\left(\frac{c_b + K_{tr}}{d_b}\right) = 2.5, \psi_t = 1.0, \psi_s = 0.8 \text{ for } d_b \le 19 \text{ mm}, 1.0 \text{ for } d_b > 19 \text{ mm}. \text{ Refer to ACI 318-19} 25.4.2.5, ACI 318-14 25.4.2.4 or ACI 318-11 12.2.4, as applicable.$ 

<sup>7</sup>Minimum *f* 'c of 24 MPa is required under ADIBC Appendix L, Section 5.1.1.

<sup>8</sup>Calculations may be performed for other steel grades and concrete compressive strengths per ACI 318 (-19 or -14) Chapter 25 or ACI 318-11 Chapter 12, as applicable.

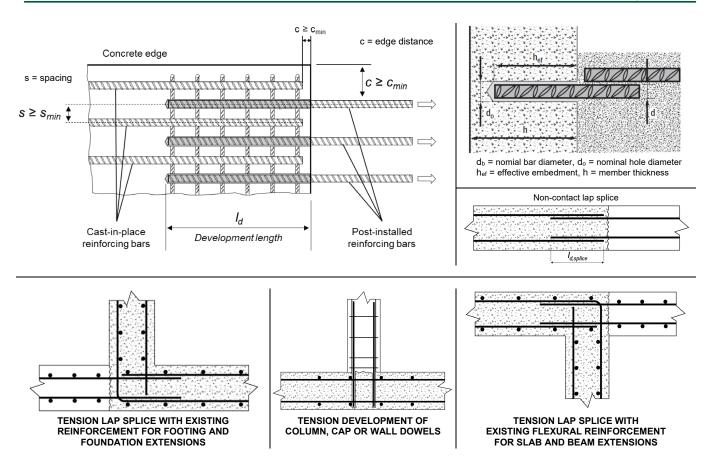


FIGURE 3—INSTALLATION DETAIL FOR POST-INSTALLED REINFORCING BAR CONNECTIONS (Top Pictures), EXAMPLES OF DEVELOPMENT LENGTH APPLICATION DETAILS FOR POST-INSTALLED REINFORCING BAR CONNECTIONS **PROVIDED FOR ILLUSTRATION (Bottom Pictures)** 

				FRACT	IONAL REIN		ARS				
PARAMETER	SYMBO	UNIT				NOMINA	AL REBAR SI	ZE (US)			
PARAMETER	L	S	#3	#4	#5	#6	#7	#8	#9	#10	#11
Nominal hole diameter <sup>1,3</sup>	do	in.	7/ <sub>16</sub>	<sup>5</sup> /8	<sup>3</sup> / <sub>4</sub>	7/ <sub>8</sub>	1	1 <sup>1</sup> /8	1 <sup>3</sup> /8	1 <sup>1</sup> / <sub>2</sub>	1 <sup>3</sup> /4
Effective embedment <sup>2,3</sup>	h <sub>ef</sub>	in.	Up to $7^{1}/_{2}$	Up to 10	Up to $12^{1/2}$	Up to 15	Up to 17 <sup>1</sup> / <sub>2</sub>	Up to 20	Up to $22^{1/2}$	Up to 25	Up to $27^{1/2}$
Nominal hole diameter <sup>1,3</sup>	do	in.	<sup>1</sup> / <sub>2</sub>	<sup>5</sup> /8	3/4	1	1 <sup>1</sup> /8	1 <sup>1</sup> / <sub>4</sub>	1 <sup>3</sup> /8	1 <sup>1</sup> / <sub>2</sub>	1 <sup>3</sup> /4
Effective embedment <sup>2,3</sup>	h <sub>ef</sub>	in.	Up to $22^{1/2}$	Up to 30	Up to 371/2	Up to 45	Up to $52^{1}/_{2}$	Up to 60	Up to $67^{1}/_{2}$	Up to 75	Up to $82^{1/2}$

					METRIC	REINFOF	CING BARS	3					
PARAMETER	SYMBOL						NOMINA	L REBAR	SIZE (EU)				
PARAIVIETER	STWBUL		Ø10	Ø12	Ø14	Ø16	Ø20	Ø24	Ø25	Ø28	Ø32	Ø34	Ø36
Nominal hole diameter <sup>1</sup>	do	mm	14	16	18	20	25	32	32	35	40	42	45
Effective embedment <sup>2</sup>	h <sub>ef</sub>	mm	Up to 600	Up to 720	Up to 840	Up to 120	00 Up to 1440	Up to 1500	Up to 1500	Up to 1680	Up to 1920	Up to 2040	Up to 2160
PARAMETER	SYMBO						NOMINA	L REBAR	SIZE (CA)				
PARAMETER			1	0M	15N	1	20M		25M		30M		35M
Nominal hole diameter <sup>1</sup>	l da	in	9	/16	3/4		1		1 <sup>1</sup> /4		1 <sup>1</sup> /2		1 <sup>3</sup> /4

mm For SI: 1 inch ≡ 25.4 mm,; for pound-inch units: 1 mm = 0.03937 inches.

 $h_{\rm ef}$ 

Effective embedment<sup>2</sup>

<sup>1</sup>For any case, it must be possible for the reinforcing bar (rebar) to be inserted into the cleaned drill hole without resistance.

Up to 678

<sup>2</sup>Consideration should be given regarding the commercial availability of carbide drill bits (including hollow bits) and diamond core drill bits, as applicable, with lengths necessary to achieve the effective embedments for post-installed reinforcing bar connections.

Up to 1170

Up to 1512

Up to 1794

Up to 2100

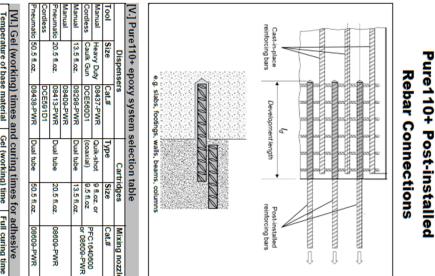
<sup>3</sup>For fractional reinforcing bars where the effective embedment is listed for two nominal hole diameters, either nominal hole diameter may be used.

Up to 960

<sup>4</sup>The DEWALT DustX+ extraction system can be used to automatically clean holes drilled in concrete with a hammer-drill. See Figure A for an illustration of the DustX+ extraction system. The DustX+ extraction system is qualified for use in dry concrete and water saturated concrete, however, drilling in dry concrete is recommended by DEWALT when using hollow drill bits.



Linear



J Pure	9110+ epo	J Pure110+ epoxy system selection table	selection	able	
	Dispensers	S	Cart	Cartridges	Mixing nozzles
의	Size	Cat.#	Type	Size	Cat.#
nual	Heavy Duty	08437-PWR	Quik-shot	9 fl.oz. or	
dless	Caulk Gun	DCE560D1	(coaxial)	9.5 fl.oz	PEC1640600
nual	13.5 fl.oz.	08298-PWR	Dual tube	13.5 fl.oz.	
nual		08409-PWR			
eumatic	eumatic 20.5 fl.oz.	08413-PWR	Dual tube	20.5 fl.oz.	08609-PWR
dless		DCE591D1			
eumatic	eumatic 50.5 fl.oz.	08438-PWR	Dual tube	50.5 fl.oz.	08609-PWR
VI.] Ge	el (working	VI.] Gel (working) times and curing times for adhesive	d curing ti	mes for	adhesive
empera	emperature of base material		Gel (working) time		Full curing time

MANUFACTURER'S PUBLISHED INSTALLATION INSTRUCTIONS (MPII)

Gel (wo	rking) times a	Gel (working) times and curing times for adhesive	r adhesive
iperature o	perature of base material	Gel (working) time	Full curing time
41°F	5°C	120 minutes	48 hours
50°F	10°C	90 minutes	24 hours
68°F	20°C	25 minutes	8 hours
86°F	30°C	20 minutes	6 hours
95°F	35°C	15 minutes	6 hours
04°F	40°C	12 minutes	4 hours
10°F	43°C	10 minutes	4 hours
interpolatio	on for intermediate	interpolation for intermediate base material temperatures is possible.	ures is possible.

<sup>7</sup> All ove All horiz A flexib	<sup>6</sup> A flexit or back	<sup>5</sup> Brush a	<sup>4</sup> A brust	<sup>3</sup> For any	"Holes diamon	<sup>1</sup> If the D		11	10	9	٥	•	•	7	•	0	5	4	U	ى ە	(No.)	size	Rebar		
nhead (i.e ontal inst e extensi	le extens of the an	adaptors	n extensio	/ case, it	"Holes are drilled wit diamond core drill bit)	EWALTI		13/4	2/11	1 <sup>3</sup> /8	11/4	11/8	1 <sup>1</sup> /8	1	1	8/2	3/4	5/8	1/2	7/16	(inch)	size	Drill bit Brush Brush	Frac	
allations on tube	ion tube chor hol	for powe	on (Cata	must be	d with h II bit).	DustX+		13/4	11/2	1 <sup>3</sup> /8	11/4	11/16	11/16	1	-	7/8	3/4	5/8	1/2	7/16	(inch)	size	Brush	tional	
lly incline 3 require (Cat.# 0)	e is not r	er tool co	<b># 08282)</b>	possible	ammer-d	extraction		117/8	8/ <sub>2</sub> L1	117/8	117/8	117/8	117/8	117/8	117/8	77/8	77/8	63/4	6 <sup>3</sup> /4	63/4	(inches)	length brush size	Brush	Fractional reinforcing bar sizes	7
d) instal the use 3297) or	18297) o eached	nnection	must be	for the	hilling (i.	n system		08299	08291	08290	08276	08289	08289	08288	08288	08287	08278	08275	08285	08284 N/A	(Cat.#) (inch	brush	Wire Plug	cing ba	II.] Ho
of pist flexib	r flexit with th	is are	used	reinfo	e. Tot	n is us			11/2		11/4	11/8		1	-	7/8	3/4	5/8	N/A	NA	(inch	size	Plu	Ir siz	le cle
s require the us on plugs when le extension ho	<sup>6</sup> A flexible extension tube (Cat # 08297) or flexible extension hose (C or back of the anchor hole is not reached with the mixing nozzle only.	available for d	with a steel wi	rcing bar to be	ary impact dril	ed to automati		1 <sup>3</sup> / <sub>4</sub> PFC1691580	1 <sup>1</sup> / <sub>2</sub> PFC1691570	1 <sup>3</sup> /8 PFC1691560	11/4 PFC1691555	11/8 PFC1691550	11/8 PFC1691550	PFC1691540	PFC1691540	PFC1691530	PFC1691520	N/A	N/A	NA	) (Cat.#)		Piston	es	aning tool:
<sup>7</sup> All overhead (i.e upwardly inclined) installations require the use of piston plugs during where one is tabulated together with the anchor size (see table). NA = Not applicable All horizontal installations require the use of piston plugs where one is tabulated together with the anchor size and where the embedment depth is greater than 8 inches. All horizontal installations tube (Cat.# 06297) or flexible extension hose (Cat.# PFC1640600) or equivalent approved by DEWALT must be used with piston plugs.	<sup>4</sup> A flexible extension tube (Cat.# 08297) or flexible extension hose (Cat.# PFC1640600) or equivalent approved by DEWALT must be used with the mixing nozzle if the bottom or back of the anchor hole is not reached with the mixing nozzle only.	Brush adaptors for power tool connections are available for drill chuck (Cat.# 08296) and SDS (Cat.# 08283)	A brush extension (Cat.# 08282) must be used with a steel wire brush for holes drilled deeper than the listed brush length	For any case, it must be possible for the reinforcing bar to be inserted into the cleaned hole without resistance	Holes are drilled with hammer-drilling (i.e. rotary impact drills or rock drills with a carbide drill bit, including the use of hollow drill bits) or core-drilling (i.e. core drill with diamond core drill bit).	If the DEWALT DustX+ extraction system is used to automatically clean the holes during dniling, standard hole cleaning (brushing and blowing following dniling) is not required.	DustX+ <sup>TM</sup> system						Compressed air nozzle	and the second s	-	Rehar connection		SDS adaptor	Unii chuck adaptor		Brush extension	WIE DIUSI	Wine kench		[VII.] Hole cleaning tools and accessories for Post-installed Rebar Connections <sup>12,345,67</sup>
er wit	ore	nd St	deep	hole	arbide	ng dri	8	1	8	32	•	28	25	24	8	16	1	14	12	10	3	size	Rebar		or P
h the uival	quiva		er tha	witho	dnil	lling,	•	<u>5</u>		•	0		25	1	20	I.	15	1	•	10	(Ø) (M)	Ze	ä		ost.
is tabu anchor ent app	lent app	at.# 08	an the li	ut resis	bit, inc	standar	\$	1	42	<del>4</del> 0	•	<del>3</del> 5	32	32	ß	8	i.	18	16	14 9	(mm) (inch) (mm) (inch)	size	Drill bit		-insta
lated t size a roved	provec	283).	sted b	tance	luding	d hole	•	13/4	1	•	11/2	1	11/4	1	-	•	3/4	1	•	9/16	nch) (	e	¥		led I
and w	1 by D		han		g the	clea	\$	1	42	40	•	Ճ	32	32	ß	20	1	18	<b>1</b> 6	14	(mm)	size	Brush	_	Reba
her with	EWAL		length.		use of	ning (b	•	13/4	i.	•	11/2	•	11/4	•	-	•	3/4	i.	•	9/16	(inch)	I	Ish	Metric	Ir Co
the an e embe f must t	T must				hollow	rushing	300	300	300	300	300	300	300	300	ö	300	200	200	200	170	(mm)	length	Brush	reinfo	nnecti
chor size (set idment depth be used with p	be used with				drill bits) or	and blowing	DFC1870810	•	DFC1670605	DFC1670600		DFC1670550	DFC1670500 08290	DFC1670500	DFC1670400	DFC1670300	•	DFC1670250	DFC1670200	DFC1670150 08285	(Cat.#)	brush	Wire	Metric reinforcing bar sizes	ons <sup>1,2, 3,4,5,</sup>
table). is great biston pl	the mixi				core-dri	followin	•	08299	•	•	08291	•	08290	•	08288	•	08278		•	08285		ſ		sizes	67
N/A = er than lugs.	ing noz				iling (i.	g drillir	<del>5</del>	•	42	4	•	8	32	32	25	20	1	18	16	NA	(mm)	<u>s</u>	₽		
Not ap	zle if t				e. con	ng) is n	•	13/4	i.	•	11/2	•	11/4	i.	-	•	3/4	i.	i.	A	(mm) (inch)	size	Plua		
nes.	he bottom				e drill with a	ot required.	PFC1691580	PFC1691580	PFC1691575	PFC1691570	PFC1691570	PFC1691560	PFC1691555	PFC1691555	PFC1891540	PFC1691520	PFC1691520	N/A	N/A	NA	(Cat.#)	plug	Piston		

1.00	001 7 01 00	$\left  \right $		4	ALV.	00101014		2	DO OF 1				000000	ľ		ş	INCOLOUR IN	COLLAR CI	ŗ
2100	Into	+	10 1794	-	512	In to 1	1	70	In to 1170		In to gen		I In to 678	3	4	1	Effective embedment <sup>2</sup>	ective er	T t
13/4	13	-	11/2		-	11/4			-		3/4		8/18	-	5.	ц ф	Nominal hole diameter	ninal hol	Nor
ŝM	35M	_	30M	_	-	25M			20M		15M		10M			STIM		PAKAMETER	
					СА)	SIZE (	NOMINAL REBAR SIZE (CA	IAL RE	NOMIN					;					
Jp to 2160	2040 U	Up to	Jp to 1920	Up to 1440 Up to 1500 Up to 1500 Up to 1680 Up to 1920 Up to 2040 Up to 2160	500 Up	Jp to 15	1500 L	Up to .	1440	0 Up to	Up to 600 Up to 720 Up to 840 Up to 1200	720 Up to (	to 600 Up to	mm Up		2 J.S.	Effective embedment <sup>2</sup>	ective en	₽
45	2	42	40	35		32	~	32	25		20	6 18	14 16	mm		r1 do	Nominal hole diameter	ninal hol	Nor
Ø36	<sup>34</sup>	Ø34	Ø32	Ø28		Ø25	4	Ø24	Ø20	0	4 Ø16	12 Ø14	Ø10 Ø12		SYMBOL UNITS	SYM	IETER	PARAMETER	
					Ë	SIZE (	BAR	RS IAL RE	<mark>NG BARS</mark> Nominal Rebar Size (EU)	ORCI	METRIC REINFORCING BARS	ME		-	_				
op to 62./2	l e	c/ of do	╟	21. Ja m dn	no m dn	pp.	up to 52.12	op ro	0 40	Up to 40	up to ar 12	oc or do	up to 22.12		Uat				ļ
17/4	:	2112	+	8/~1	174	-	18				44	+			+				
431.	ł		-					4	1	Ę	a).	╟	┢	_	-				
Up to 271/2	B	Up to 25	-	Up to 221/2	Up to 20	5	Up to 171/2		15	Up to 15	Up to 121/2	3	1/2	_	_		Effective embedment <sup>2,3</sup>	ective en	
13/4	+	11/2		13/8	11/8	<u> </u>	*		0 0	8/7	3/4	5/8	7/18	<b>.</b>	¢.		Nominal hole diameter <sup>1,3</sup>	ninal hol	Non
			_	5	(SD)	SIZE	NOMINAL REBAR SIZE (US)	NAL R	NON	•	=	•	<b>H</b> 5		SYMBOL UNITS	SYN	METER	PARAMETER	
								BARS	CING	NFOR	FRACTIONAL REINFORCING BARS	FRAC							
ns	ection	Conn	Rebar	nstalled	Post-i	s for	g bar	orcin	reinf	on of	[VIII.] Installation parameters - Specifications for installation of reinforcing bars for Post-installed Rebar Connections	ations fo	- Specific	neters	ı paran	Illatior	III.] Insta	Z	
pplicable.	= Not ap	). N/A =	(see table	chor size (	the an	her with	d toget	bulate	ne is ta	here o	or back of the anchor hole is not reached with the mixing nozzle only. All overhead (i.e upwardly inclined) installations require the use of piston plugs during where one is tabulated together with the anchor size (see table). N/A = Not applicable	e of piston p	or back of the anchor hole is not reached with the mixing nozzle only 7All overhead (i.e upwardly inclined) installations require the use of pi	with the	eached v d) install	<u>; is not r</u> y incline	nchor hole e upwardly	k of the a erhead (i	r bac
the bottom	yzzle if t	ixing no	vith the mi	be used w	.T must	DEWAL	ed by [	approv	valent	or equi	'Drush adaptors for power tool connections are available for onli chuck (cat.# 052%) and SUS (cat.# 052%). 'A flexible extension tube (Cat.# 06297) or flexible extension hose (Cat.# PFC1640600) or equivalent approved by DEWALT must be used with the mixing nozzle if the bottom	bse (Cat.# P	extension ho	flexible	8297) or	(Cat.# 0	s for power	ible exter	Aflex
					ľ	length.	brush	e listed	than th	leeper	A brush extension (Cat.# 08282) must be used with a steel wire brush for holes dnilled deeper than the listed brush length	e brush for	th a steel wir	used w	must be	08282)	sion (Cat.#	sh extens	bru
							e.	sistan	thout re	tole wi	For any case, it must be possible for the reinforcing bar to be inserted into the cleaned hole without resistance.	nserted into	ng bar to be i	einforcir	for the n	possible	t must be p	ny case,	ora
standard note creating (wrushing and blowing rollowing drilling) is not required to the including the use of hollow drill bits) or core-drilling (i.e. core drill with	(i.e. cor	trilling (	or core-d	drill bits)	f hollow	use of	ing the	includi	i <u>g, stan</u> Irill bit,	nbide c	In the Devixer Dusky+ extraction system is used to automatically clean the noise during onlining, standard nois cleaning (orusning and blowing onlining). Tholes are drilled with hammer-drilling (i.e. rotary impact drills or rock drills with a carbide drill bit, including the use of hollow drill bits) or core-drilling (i.e. data of core-drilling).	s or rock dr	impact drills	s. rotary	nilling (i.e	mmer-d	ed with ha	Holes are drilled with Holes are drilled with	loles
PFC169158		45	610 -	DFC1670610	300	•	45		- 45	8	DustX+ *** system	DustX+							
PFC1691580	13/4	<del>ت</del> ن ۱	08299		300	13/4	•	13/4	ଞ '	۱ س			PFC1691580	1 <sup>3</sup> /4 P	08299	117/8	13/4	13/4	≓
PFC169157	•	42	605 -	DFC1670605	00	•	42	•	- 42	¥			PFC1691570	11/2 P	08291	117/8	11/2	11/2	6
PFC169157	•	40	- 008	DFC1670600	00E	•	40	1	- 40	32		)	PFC1691560	1 <sup>3</sup> /8 P	08290	117/8	1 <sup>3</sup> /8	1 <sup>3</sup> /8	9
PFC169157(	11/2	-	08291		300	11/2	1	11/2	3 '	ı س			PFC1691555	11/4 P	08276	117/8	11/4	11/4	•
PFC169156	•	35	- 550	DFC1870550	00E	•	35	•	- 35	28			PFC1691550	11/8 P	08289	117/8	11/16	11/8	•
PFC1691555	11/4	30	500 08290	DFC1670500	00	11/4	32	11/4	5 32	25 25	Compressed air nozzle	Compresse	PFC1691550	11/8 P	08289	117/8	1 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> /8	-
PFC1691558	•	32	- 500	DFC1670500	300	•	32		- 32	24		To	PFC1691540	- <u>1</u>	08288	117/8	-	-	4
PFC169154(	-	38 25	400 08288	DFC1670400	00	-	25	-	25	20 20	premium piston plug	premium	PFC1691540	-1 P	08288	117/8	1	-	0
PFC1691520	•	8	300	DFC1670300	300	·	8	•	' 8	<del>1</del> 6		Reharing	PFC1691530	7/8 P	08287	77/8	7/8	7/8	<b>°</b>
PFC169152	3/4	8	08278		200	3/4	•	3/4	5	- 15	1110		PFC1691520	3/4 P	08278	77 <sub>8</sub>	3/4	3/4	5
N/A	•	18	250 -	DFC1670250	200	•	18	•	- 18	14	SDS adaptor	SDS a	N/A	8/5	08275	6 <sup>3</sup> /4	5/8	<u>5/8</u>	4
NIA	•	16	200	DFC1670200	200	٠	16	•	- 16	12	Drill chuck adaptor	Drill chuy	NIA	NA	08285	6 <sup>3</sup> /4	1/2	112	6
					:	2		5	:	1					0020.		1		J

For SI: 1 inch ≡ 25.4 mm,; for pound-inch units: 1 mm = 0.03937 inches

"For any case, it must be possible for the reinforcing bar (rebar) to be inserted into the cleaned drill hole without resistance. "Consideration should be given regarding the commercial availability of carbide drill bits (including hollow bits) and diamond core drill bits, as lengths necessary to achieve the effective epipedingoing for post-installed reinforcing bar connections "For fractional reinforcing bars where the effective embedment is listed for two nominal hole diameters, either nominal hole diameter may be used." applicable, with

# Pure110+ Post-installed Rebar Connections (cont.)

ase material with rotary hammer drill (i.e. percussion drill) and a carbide mibediment required by the selected reinforcing bar (see Table VI), for the drilled hole (flooded hole condition), all the water has e hole (e.g. vacuum, compressed air, etc.) prior to clean a minimum of <i>two</i> to core (min. 90 ps) for all sizes of reinforcing bar (rebar).	rrial.			E CLEANING RILLED HOLES	CORE DRILLING		HOLE CLEAN DRY OR WET H		HAMMER DRILLING
es (2x).	earbide (10). (14).	Repeat Blowing 2x Repeat Blowing 2x	Blow 2x	Rinse Rinse Brush 2x Repeat Rinsing		Repeat Blowing 2x	2X Brush 2x	Blow 2x	
CURING & POUR INSTALLATION PREPARING	with piston plug:	<ul> <li>Ze. Repeat Step Zb again by brushing the hole with a wire brush a minimum of two times (Zx).</li> <li>Zf. Repeat Step Zd again by blowing the hole clean a minimum of two times (Zx).</li> <li>When finished the hole should be clean and free of dust, debris, oil or other foreign material.</li> <li>→ Next no to sten 3.</li> </ul>	2d. Starting from the bottom or back of the drilled hole, blow the hole clean a minimum of two times (2x). Use a compressed air nozzle (min. 90 psi) for all sizes of reinforcing bar (rebar). When finished the hole should be clean and free of water, debris, oil or other foreign material.	<ul> <li>22. Starting from the bottom or back of the drilled hole, rinse/flush the hole clean with ali/water (ari/water line pressure) until clear water comes out.</li> <li>22b. Determine wire brush diameter (see Table VII) for the drilled hole and attach the brush with adaptor to a rotary drill tool. Brush the hole with the selected wire brush a minimum of <i>two</i> times (2x).</li> <li>A bush extension (supplied by DEWALT) must be used for holes drilled deeper than the listed brush length. The wire brush diameter must be checked periodically during use; The brush with the proper brush diameter (i.e. new wire brush).</li> <li>22. Repeat Step 2a again by rinse/flushing the hole clean with air/water.</li> </ul>	1. Drill a hole into the base material with core drill to the size and embedment required by the selected steel hardware element. Precaution: Wear suitable eye and skin protection. Avoid inhalation of dusts during drilling and/or removal.	2. Repeat Step 2a again by blowing the hole clean a minimum of two times (2x). When finished the hole should be clean and free of dust, debris, oil or other foreign material. → Next go to Step 3.	2.5. Determine wire brush diameter (see Table VII) for the drilled hole and attach the brush with adaptor to a rotary drill tool or battery screw gun. Brush the hole with the selected wire brush a minimum of two times (2x). A brush extension (supplied by DEWALT) must be used for holes drilled deeper than the isted brush length. The wire brush diameter must be checked periodically during use; The brush should resist insertion into the drilled hole, if not the hush is too small and must be replaced with the respect hush brush brush of the thrush of the hush brush is too small.	2a. Starting from the bottom or back of the drilled hole, blow the hole clean a minimum of two times (2x). Use a compressed air nozzle (min. 90 psi) for all sizes of reinforcing bar (rebar).	III Drill a hole into the base material with ordary hammer drill (i.e. perussion drill) and a carbide drill bit to the size and embedment required by the selected reinforcing bar (see Table VII). Tolerances of carbide drill bits including hollow drill bits must meet ANSI Standard B212.15. Precaution: Wear suitable eye and skin protection. Avoid inhalation of dusts during drilling and/or removal (see <i>dust extraction equipment by DEWALT to minimize dust emissions</i> ). Notes: In case of standing water in the drilled hole (flooded hole condition, all the water has to be removed from the hole (e.g. vacuum, compressed air, etc.) prior to cleaning. Drilling in dry concrete is recommended when using hollow drill bits (vacuum must be on). → Go to Step 3 for holes drilled with DustX+ <sup>™</sup> extraction system (no further hole cleaning is required). Otherwise go to Step 2a for hole cleaning instructions.
		CURING	& POUR				the second	and and	

for overhead applications cartridge adhesive temperature must (10°C - 32°C) when in use. For best adhesive dispensing gested minimum cartridge adhesive temperature is 68°F (20°C) terration should be given to the reduced gel (working) time of the imperatures. For the permitted range of the base material ≦ od (where necessary) through the use of temporary wedges, r other methods. Minor adjustments to the position of the rebar einforcing bar is installed to the specified embedment depth. pletely fil the annular gap at the concrete surface. Following bar, remove excess adhesive. the rebar must be restrained from movement throughout the turally extruded from the drilled hole by the adhesive pressure. sstall anchors overhead without proper training, and installation y DEWALT; contact DEWALT prior to use. must be used with and attached to mixing nozzle and extension e. upwardly inclined) installations and horizontal installations with ted in Table III. Insert piston plug to the back of the drilled hole ed in the method above. During injection of the adhesive the f the anchor hole. A plastic extension tube must be used with the sottom or back of the anchor hole is not reached with the mixing yle VII). Slowly withdraw the mixing nozzle as the hole fills to published gel (working) and cure times prior to injection of the he cleaned anchor hole (see Table VI). properly mixed to achieve published properties. Prior to into the drilled hole, separately dispense at least three full strok the mixing nozzle until the adhesive is a consistent red color. ie ≤ xxpiration date on cartridge label. Do not use expired product. Sheet (SDS) before use. Review published gel (working) and cure esive temperature must be between 50°F - 110°F (10°C - 43°C) le approximately two-thirds full with mixed adhesive starting from rebar into the drilled hole, the position of the embedment depth the anchor. Verify rebar is straight and free of surface damage. new mixing nozzle with new cartridges of adhesive and also seeding the published get (working) time of the adhesive. king nozzle to the cartridge. Do not modify the mixer in any way ixing element is inside the nozzle. Load the cartridge into the nnection to cure to the specified full curing time prior to applying nchor hole while turning slightly to ensure positive distribution of ne cleaned anchor hole Inection kets or voids. the rebar connection, new concrete can be poured (placed) to torque or load the anchor until it is fully cured ring the gel (working) embedment depth is reached. Observe the gel (working) time. should be free of dirt, grease, oil or other foreign material. Push FOR RECOMMENDED INSTALLATION time only đ Tes s g FIGURE 4B-

-PURE110+® EPOXY ADHESIVE POST-INSTALLED REINFORCING BAR CONNECTIONS MANUFACTURER'S PUBLISHED INSTALLATION INSTRUCTIONS (MPII) (Continued)



### **ICC-ES Evaluation Report**

# ESR-3298 LABC and LARC Supplement

Reissued July 2023

This report is subject to renewal July 2024.

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A Subsidiary of the International Code Council®

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:

DEWALT

**EVALUATION SUBJECT:** 

# PURE110+® EPOXY ADHESIVE ANCHOR SYSTEM AND POST-INSTALLED REINFORCING BAR CONNECTIONS IN CRACKED AND UNCRACKED CONCRETE

#### 1.0 REPORT PURPOSE AND SCOPE

#### Purpose:

The purpose of this evaluation report supplement is to indicate that the Pure110+ Epoxy Adhesive Anchor System and Post-Installed Reinforcing Bar Connections in cracked and uncracked concrete, described in ICC-ES evaluation report <u>ESR-3298</u>, have also been evaluated for compliance with the codes noted below as adopted by 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 Pure110+ Epoxy Adhesive Anchor System and Post-Installed Reinforcing Bar Connections in cracked and uncracked concrete, described in Sections 2.0 through 7.0 of the evaluation report <u>ESR-3298</u>, comply with LABC Chapter 19, and the LARC, and are subjected to the conditions of use described in this supplement.

#### 3.0 CONDITIONS OF USE

The Pure110+ Epoxy Adhesive Anchor System and Post-Installed Reinforcing Bar Connections described in this evaluation report supplement must comply with all of the following conditions:

- All applicable sections in the evaluation report ESR-3298.
- The design, installation, conditions of use and labeling of the Pure110+ Epoxy Adhesive Anchor System and Post-Installed Reinforcing Bar Connections are in accordance with the 2018 International Building Code<sup>®</sup> (IBC) provisions noted in the evaluation report <u>ESR-3298</u>.
- 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 steel anchors and post-installed reinforcing bars to the concrete. The connection between the steel anchors or post-installed reinforcing bars and the connected members shall be checked for capacity (which may govern).
- For use in wall anchorage assemblies to flexible diaphragm applications, anchors shall be designed per the requirements of City of Los Angeles information Bulletin P/BC 2020-071.

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

ICC-ES Evaluation Reports are not to be construed as representing aesthetics or any other attributes not specifically addressed, nor are they to be construed as an endorsement of the subject of the report or a recommendation for its use. There is no warranty by ICC Evaluation Service, LLC, express or implied, as to any finding or other matter in this report, or as to any product covered by the report.





# **ICC-ES Evaluation Report**

# **ESR-3298 FBC Supplement**

Reissued July 2023

This report is subject to renewal July 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:

DEWALT

**EVALUATION SUBJECT:** 

# PURE110+® EPOXY ADHESIVE ANCHOR SYSTEM AND POST-INSTALLED REINFORCING BAR CONNECTIONS IN CRACKED AND UNCRACKED CONCRETE (DEWALT)

#### 1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the Pure110+ Epoxy Adhesive Anchor System and Post-Installed Reinforcing Bar Connections in Cracked and Uncracked Concrete, described in ICC-ES evaluation report ESR-3298, has also been evaluated for compliance with the codes noted below.

#### Applicable code editions:

- 2020 Florida Building Code—Building
- 2020 Florida Building Code—Residential

#### 2.0 CONCLUSIONS

The Pure110+ Epoxy Adhesive Anchor System and Post-Installed Reinforcing Bar Connections in Cracked and Uncracked Concrete, described in Sections 2.0 through 7.0 of the evaluation report ESR-3298, comply with the *Florida Building Code*—*Building Code*—*Building Code*—*Residential*, provided the design requirements are determined in accordance with the *Florida Building Code*—*Building Code*—*Building Code*—*Building Code*—*Building Code*—*Residential*, as applicable. The installation requirements noted in ICC-ES evaluation report ESR-3298 for the 2018 *International Building Code*<sup>®</sup> meet the requirements of the *Florida Building Code*—*Residential*, as applicable.

Use of the Pure110+ epoxy adhesive anchors and 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 the *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 July 2023.

