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USP STRUCTURAL CONNECTORS CIA-GEL 7000-C

CSI Sections:
03 15 19 Cast-in Concrete Anchors
05 05 19 Post-Installed Concrete Anchors

1.0 RECOGNITION

USP CIA-Gel 7000-C Adhesive Anchor System recognized in this report has been evaluated for use as resisting static, wind and earthquake tension and shear loads in cracked and uncracked normal-weight concrete. The structural performance properties of the CIA-Gel 7000-C complies with the intent of the provisions of the following codes and regulations:

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

2.0 LIMITATIONS

Use of the USP CIA-Gel 7000-C Adhesive Anchor System recognized in this report is subject to the following limitations:

2.1 CIA-Gel 7000-C Adhesive Anchor System shall be installed in accordance with the manufacturer's published installation instructions (MPII) and as shown in Figures 3 and 4 of this report.

2.2 Anchor elements shall be installed in cracked and uncracked normal-weight or lightweight concrete having a specified compressive strength, f'_c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).

2.3 Values of f'_c used for calculation purposes shall not exceed 8,000 psi (55.1 MPa).

2.4 Anchor elements shall be installed in concrete base materials as set forth in Section 3.4 and Figures 3 and 4 of this report in holes predrilled with a rotary-hammer drilling method using carbide-tipped drill bits complying with the dimensional tolerances of ANSI B212.15-1994 or ISO 5468 for metric sizes.

2.5 CIA-Gel 7000-C adhesive anchors are recognized for use to resist short-term and long-term loads, and wind and earthquake loads, subject to the conditions of this report.

2.6 In structures assigned to Seismic Design Category C, D, E or F under the IBC or IRC, anchor strength shall comply with the requirements in Section 3.2.9 of this report.

2.7 CIA-Gel 7000-C adhesive anchors are permitted to be installed in concrete that is cracked or that may be expected to crack during the service life of the anchor, subject to the conditions of this report.

2.8 Strength design values shall be established in accordance with Section 3.2 of this report. Loads applied to the anchors shall be adjusted in accordance with Section 1605.2 of the IBC for strength design.

2.9 Allowable design values shall be established in accordance with Section 3.3 of this report. Loads applied to the anchors shall be adjusted in accordance with Section 1605.3 of the IBC.

2.10 Minimum anchor spacing and edge distance, critical edge distance, critical spacing, and minimum member thickness shall comply with the values described in this report.

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

2.12 Fire-resistive construction: Anchors are not permitted to support fire-resistive construction. Where not otherwise prohibited in the applicable code, CIA-Gel 7000-C adhesive anchors are permitted for installation in fire-resistive construction provided at least one of the following conditions is fulfilled:

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

2.13 Since a criteria for evaluating data to determine the performance of adhesive anchors subjected to fatigue or shock loading is unavailable at this time, the use of these anchors under such conditions is beyond the scope of this report.

2.14 Use of uncoated or zinc-plated carbon steel threaded rods or steel reinforcing bars is limited to dry, interior locations. Exterior anchor locations and water saturated conditions require the use of hot-dipped galvanized carbon steel or stainless steel anchors or threaded rods. The coating weights for zinc-coated steel shall be in accordance with ASTM A153 Class C or D.

2.15 Steel anchoring materials in contact with preservative-treated and fire-retardant-treated wood shall be zinc-coated steel or stainless steel. Coating weights for zinc-coated steel shall be in accordance with ASTM A153 Class C or D.

2.16 Stainless steel anchors are required for exterior exposure or damp environments.

2.17 Special inspection shall be provided in accordance with Section 3.5 of this report. Continuous special inspection for horizontally inclined or upwardly inclined installations that are designed to resist sustained tension loads shall be provided in accordance with Section 3.5 of this report.

2.18 CIA-Gel 7000-C Adhesive Anchor System may be used for floor (downwardly inclined), wall (horizontally inclined), and overhead (upwardly inclined) applications. Wall and overhead applications are limited to use with 1-1/4 inch (30 mm) diameter threaded rod and No. 10 (T32) reinforcing bar, or smaller.

2.19 Anchors installed in a horizontally inclined or upwardly inclined orientation to resist sustained tension loads shall be performed by personnel certified by an applicable certification program in accordance with ACI 318-14 17.8.2.2 or 17.8.2.3; or ACI 318-11 D.9.2.2 or D.9.2.3.

2.20 CIA-Gel 7000-C adhesive compound is manufactured and packaged into cartridges with quality control inspections by IAPMO Uniform ES.

3.0 PRODUCT USE

3.1 General: USP CIA-Gel 7000-C Adhesive Anchor System is used to resist static, wind and earthquake (Seismic Design Categories A through F under the IBC) tension and shear loads in cracked and uncracked, normal-weight concrete having a specified compressive strength, f'_c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa). Cracked concrete shall be assumed except for anchors located a region of the concrete member where analysis indicates no cracking (uncracked) at service loads in accordance with ACI 318-14 Sections 17.4.2.6 and 17.5.2.7 (ACI 318-11 D 5.2.6 and D.6.2.7). The analysis for the determination of crack formation shall include the effects of restrained shrinkage, as applicable in accordance with 24.4.2 of ACI 318-14 (7.12.1.2 of ACI 318-11). Cracked concrete also shall be assumed for anchors in structures assigned to Seismic Design Category C, D, E, or F. The adhesive anchor is an alternative to anchors described in Section 1901.3 of the 2015 IBC, Sections 1908 and 1909 of the 2012 IBC, Sections 1911 and 1912 of the 2009 and 2006 IBC, and Sections 1912 and 1913 of the 2003 IBC. The system may also be used where an engineering design is submitted in accordance with Section R301.1.3 of the 2015, 2012, 2009, 2006 and 2003 IRC.

3.2 Strength Design (LRFD): Anchor design strengths, ϕN_n and ϕV_n, under the 2015 IBC and Section R301.1.3 of the 2015 IRC shall be determined in accordance with ACI 318-14 as amended in IBC Section 1905 and this report. The design strength of anchors under the 2012, 2009 and 2006 IBC and Section R301.1.3 of the 2012, 2009 and 2006 IRC shall be determined in accordance with ACI 318-11 Appendix D and this report. Design parameters are provided in Tables 5 through 14 of this report and are based on the 2015 and 2012 IBC unless noted otherwise in this report. Anchor designs shall satisfy the requirements of ACI 318-14 17.3.1.1 and 17.3.1.2; or ACI 318-11 Sections D.4.1.1 and D.4.1.2. Anchor group effects shall be considered in accordance with ACI 318-14 17.2.1.1; or ACI-11 Section D.3.1.1. Strength reduction factors, ϕ, described in ACI 318-14 17.3.3 or ACI 318-11 Section D.4.3, and noted in Tables 5 through 14 of this report, shall be used for load combinations calculated in accordance with Section 1605.2.1 of the IBC, ACI 318-14 5.3, and ACI 318-11 Section 9.2. Post-installed Anchor Categories used to determine the strength reduction factors, ϕ, in ACI 318-14 17.3.3 or D.4.3 or D.4.4 of ACI 318-11 are given for each diameter in Tables 7, 8, and 9 of this report. Strength reduction factors, ϕ, described in ACI 318-11 Section D.4.4 shall be used for load combinations calculated in accordance with Appendix C of ACI 318-11. This section provides amendments to ACI 318-14 Chapter 17 and ACI 318-11 Appendix D as required for the strength design of adhesive anchors. In conformance with ACI 318, all equations are expressed in inch-pounds units.

3.2.1 Static Steel Strength in Tension: Nominal steel strength of a single anchor in tension, N_{sa}, shall be calculated in accordance with ACI 318-14 17.4.1.2; or ACI 318-11 Section D.5.1.2, and strength reduction factors, depending on whether the steel is considered brittle or ductile, in accordance with ACI 318-14 17.3.3; or ACI 318-11 Section D.4.3 are given in Tables 5 and 6 of this report for for computing design strengths of corresponding anchor steel elements.

3.2.2 Static Concrete Breakout Strength in Tension: Nominal concrete breakout strength a single anchor or group of anchors in tension, N_{cb} and N_{cbg}, shall be calculated in accordance with ACI 318-14 17.4.2; or ACI 318-11 Section D.5.2 with the following addition:

Basic concrete breakout strength of a single anchor in tension, N_b, shall be calculated in accordance with ACI 318-14 17.4.2.2; or ACI 318-11 D.5.2.2 where the values of h_{ef} complies with Tables 7 through 14 of this report. The value of k_c to be used in ACI 318-14 Eq. (17.4.2.2a) and ACI 318-

11 Eq. (D-6) shall be as follows:

$k_{c,cr}$ = 17 where analysis indicates cracking at service load levels in the vicinity of the anchor (cracked concrete)
$k_{c,uncr}$ = 24 where analysis indicates no cracking ($f_t < f_r$) at service load levels in the vicinity of the anchor (uncracked concrete)

To design for uncracked concrete, anchors shall be located in a region of the concrete member where analysis indicates no cracking at service load levels. Corresponding strength reduction factors, ϕ, are given in Table 5 of this report for Condition B, as defined in ACI 318-14 17.3.3 or ACI 318-11 D.4.3. For anchors installed in lightweight concrete, the corresponding modification factors, λ and λ_a, shall be applied to the breakout strengths in accordance with ACI 318-14 17.2.6; or ACI 318-11 D.3.6. Value of f'_c shall be limited to a maximum of 8,000 psi (55 MPa) in accordance with 318-14 17.2.7; or ACI 318-11 Section D.3.7.

3.2.3 Static Bond Strength in Tension: The nominal static bond strength of a single adhesive anchor, N_{ba}, or group of adhesive anchors in tension shall be calculated in accordance with ACI 318-14 17.4.5 or ACI 318-11 D.5.5. For anchors designed to resist sustained tension loads, bond strength shall be calculated in accordance with Section 3.2.3.1 of this report. Embedment depths shall comply with ACI 318-14 17.3.2.3 or ACI 318-11 D.4.2.3 and Tables 7 to 14 of this report. Bond strength values are a function of concrete conditions (i.e., cracked or uncracked), concrete temperature, installation conditions (i.e. dry, water saturated, or water-filled), drilling method (i.e., hammer drill), and special inspection level (i.e., continuous or periodic). The USP Structural Connectors CIA-Gel 7000-C system has been tested at elevated temperatures in cracked and uncracked concrete using a hammer drill in dry, water-saturated, and water-filled concrete holes. To design for uncracked concrete, anchors shall be located in a region of the concrete member where analysis indicates no cracking at service load levels. Elevated concrete temperatures arise from a number of factors, including sun exposure, proximity to operating machinery, or containment of liquids or gasses at elevated temperature. Therefore bond strengths, anchor categories and strength reduction factors, ϕ, for each anchor diameter for installation in normal weight concrete are listed in Tables 7 through 14 of this report for each permitted concrete condition, concrete temperature, installation condition, and special inspection level. Bond strength values shall be modified with the factor ϕ_{ws} for cases wherein the holes are drilled in water-saturated concrete or ϕ_{wf} for cases where anchors are installed in water-filled holes in concrete as shown in Figure 1 of this report. Characteristic bond strength, τ_k, shown in Figure 1 refers to $\tau_{k,cr}$ or $\tau_{k,uncr}$, and where applicable, the modified bond strengths shall be used in lieu of $\tau_{k,cr}$ or $\tau_{k,uncr}$. For anchors installed in lightweight concrete, the corresponding modification factors, λ and λ_a, shall be applied to ACI 318-14 Eq. (17.4.5.2) in accordance with ACI 318-14 17.2.6 or ACI 318-11 Eq. (D-22) in accordance with ACI 318-11 D.3.6.

3.2.3.1 Sustained Loads: In addition to requirements in Section 3.2.3 of this report for the design of a single anchor in tension to resist sustained loads, ACI 318-14 17.2.5 and 17.3.1.2; or ACI 318-11 D.4.1.2 shall apply, using $\tau_{k,sust,uncr}$ from Table 8 or 9 of this report in lieu of τ_{cr}.

3.2.3.2 Splitting Control: Replace Section D.5.5.5 of ACI 318-11 Appendix D or Section 17.4.5.5 of ACI 318-14 as follows:

D.5.5.5 (17.4.5.5 for ACI 318-14) – The modification factor for adhesive anchors designed for uncracked concrete in accordance with D.5.5.2 (17.4.5.2 for ACI 318-14) without supplementary reinforcement to control splitting, $\psi_{cp,Na}$, shall be computed as:

If $c_{a,min} \geq c_{ac}$ then $\psi_{cp,Na} = 1.0$ (D-26 for ACI 318-11, or 17.4.5.5.a for ACI 318-14))

If $c_{a,min} < c_{ac}$ then $\psi_{cp,Na\ a,min} = c_{a,min} / c_{ac}$ (D-27 for ACI 318-11, or 17.4.5.5.b for ACI 318-14)

where

c_{ac} shall be determined in accordance with Eq. (D-27a for ACI 318-11, or 17.4.5.5.c for ACI 318-14) for anchor diameters up to 1-1/4 inches and for characteristic bond strengths in uncracked concrete less than or equal to 3000 psi.

$c_{ac} = h_{ef}(\tau_{k,uncr}/1160)^{0.4} \times [3.1 - 0.7(h/h_{ef})]$ (inches) *(D-27a for ACI 318-11, or 17.4.5.5.c for ACI 318-14)*

where

(h/h_{ef}) need not be taken as larger than 2.4; and $\tau_{k,uncr}$ = characteristic bond strength stated in Tables 7 to 14 of this Evaluation Report, whereby $\tau_{k,uncr}$ need not be taken as larger than:

$\tau_{k,uncr} = k_{uncr}((h_{ef} \times f'_c)^{0.5}/(\pi \times d))$

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

3.2.4 Static Steel Strength in Shear: The nominal steel strength of a single anchor in shear, V_{sa}, in accordance with ACI 318-14 17.5.1.2; or ACI 318-11 Section D.6.1.2, is given in Tables 5 and 6 of this report. The strength reduction factor, ϕ, corresponding to the steel element selected and whether the steel is considered brittle or ductile, and complying with ACI 318-14 17.5.1.2 and 17.3.3; or ACI 318-11 D.6.1.2, and D.4.3, respectively, is also given in Tables 5 and 6 of this report, for use with load combinations of ACI 318-14 5.3 or ACI 318-11 Section 9.2. Where grout pads are present, the nominal strengths shall be reduced in accordance with ACI 318-14 17.5.1.3 or ACI 318-11

D.6.1.3.

3.2.5 Static Concrete Breakout Strength in Shear: The nominal concrete breakout strength of a single anchor or group of anchors in shear, V_{cb} or V_{cbg}, shall be calculated in accordance with ACI 318-14 17.5.2; or ACI 318-11 D.6.2 with modifications as described in this section. The basic concrete breakout strength in shear, V_b, shall be calculated in accordance with ACI 318-14 17.5.2.2; or ACI 318-11 Section 6.2.2 using the applicable values of h_{ef} and d_o as described in Table 4 of this report in lieu of l_e and d_a. In no case shall l_e exceed $8d_o$. For anchors in lightweight concrete, the modification factors λ and λ_a shall be applied in accordance with ACI 318-14 17.2.6; or ACI 318-11 D.3.6. The value of f'_c shall be limited to 8,000 psi (55 MPa), in accordance with ACI 318-14 17.2.7; or ACI 318-11 Section D.3.7. Corresponding strength reduction factors, ϕ, are given in Table 7 for Condition B, as defined in ACI 318-14 17.3.3; or ACI 318-11 D.4.3.

3.2.6 Static Concrete Pryout Strength in Shear: The nominal static pryout strength of a single anchor or group of anchors in shear, V_{cp} or V_{cpg}, shall be calculated in accordance with ACI 318-14 17.5.3; or ACI 318-11 D.6.3.1.

3.2.7 Interaction of Tensile and Shear Forces: For loadings that include combined tension and shear as noted in ACI 318-14 17.3.1.3 or ACI 318-11 D.4.1.3, the design shall be performed in accordance with ACI 318-11 Section D.7.

3.2.8 Minimum Member Thickness, Minimum Anchor Spacing and Minimum Edge Distance: In lieu of using ACI 318-14 17.7.1 and 17.7.3; or ACI 318-11 Section D.8.1 and D.8.3, values of c_{min} and s_{min} provided in Table 4 of this report shall be used. In lieu of using ACI 318-14 17.7.5 or ACI 318 Section D.8.5, minimum member thickness, h_{min}, shall be in accordance with Table 4 of this report. In determining minimum edge distances, c_{min}, the following section shall be added to ACI 318-14 Chapter 17 (ACI 318-11, Appendix D):

17.7.8 (D.8.8) – For adhesive anchors that will remain untorqued, the minimum edge distance shall be based on minimum cover requirements for reinforcement in 20.6.1 (Section 7.7). For adhesive anchors that will be torqued, the minimum edge distance and spacing shall be taken from Table 4 of this report.

3.2.9 Design Strength in Seismic Design Categories C, D, E and F: In structures assigned to Seismic Design Category C, D, E or F under the IBC or IRC, the design shall be performed according to ACI 318-14 17.2.3 as modified by 2015 IBC Section 1905.1.8; or ACI 318-11 D.3.3 as modified by Section 4.1.11.2 of this report, which replaces 2012 IBC Section 1905.1.9. Nominal steel shear strength, V_{sa}, shall be adjusted by $\alpha_{V,seis}$ as given in Tables 5 and 6 or this report for the corresponding anchor steel. Nominal bond strength, $\pi_{k,cr}$, shall be adjusted by $\alpha_{N,seis}$ as given in Tables 5 and 6 of this report for the corresponding anchor steel.

3.2.9.1 2012, 2009, and 2006 IBC: Replace Section 1905.1.9 of the 2012 IBC with the following:

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

1905.1.9 ACI 318 Section D.3.3: Delete ACI 318 Sections D.3.3.4.2, D3.3.4.3 (d), and D.3.3.5.2 and replace with the following:

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

Exception:

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

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

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

Exceptions:

1. For the calculation of the in-plane shear strength of anchor bolts attaching wood sill plates of bearing or non-bearing walls of light-frame wood structures to foundations or foundation stem walls, the in-plane shear strength in accordance with D.6.2 and D.6.3 need not be computed and D3.3.5.3 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 D.6.2 and D.6.3 need not be computed and D3.3.5.3 need not apply provided all of the following are satisfied:

2.1. The maximum anchor nominal diameter is 5/8 inch (16 mm).

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

2.3. Anchors are located a minimum of 1 3/4 inches (45 mm) from the edge of the concrete parallel to the length of the track.

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

2.5. The track is 33 to 68 mil designation thickness. Allowable in-plane shear strength of exempt anchors, parallel to the edge of concrete shall be permitted to be determined in accordance with AISI S100 Section E3.3.1.

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

3.3 Allowable Stress Design (ASD)

3.3.1 General: For anchors designed using load combinations calculated in accordance with Section 1605.3 of the IBC, allowable loads shall be established using Eq. (3-1) or Eq. (3-2):

$T_{allowable,\ ASD} = \phi N_n/\alpha$ Eq. (3-1)

$V_{allowable,\ ASD} = \phi V_n/\alpha$ Eq. (3-2)

Where:

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

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

ϕN_n = lowest design strength of an anchor or anchor group in tension as determined in accordance with ACI 318-14 Chapter 17 or ACI 318-11 Appendix D as amended in Section 4.1 of this report and as applicable, 2009 IBC Sections 1908.1.9 and 1908.1.10 or 2006 IBC Section 1908.1.16.

ϕV_n = lowest design strength of an anchor or anchor group in shear as determined in accordance with ACI 318-14 Chapter 17 or ACI 318-11 Appendix D as amended in Section 4.1 of this report and as applicable, 2009 IBC Sections 1908.1.9 and 1908.1.10 or 2006 IBC Section 1908.1.16.

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

Requirements for member thickness, edge distance and spacing, as described in Sections 4.1.9 and 4.1.10 this report, shall also apply.

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

If $T_{applied} \leq 0.2\ T_{allowable,ASD}$, then the full allowable strength in shear, $V_{allowable,ASD}$, shall be permitted.

If $V_{applied} \leq 0.2\ V_{allowable,ASD}$, then the full allowable strength in shear, $T_{allowable,ASD}$, shall be permitted.

For all other cases:
$T_{applied}/T_{allowable,ASD} + V_{applied}/V_{allowable,ASD} \leq 1.2$

3.4 Installation: Installation shall be in accordance with the codes referenced in Section 1.0 of this report, this report and the manufacturer's printed installation instructions (MPII). Where conflicts occur, the more restrictive shall govern. Installation parameters are provided in Table 4 and Figures 3 and 4 of this report. Anchor locations shall comply with this report and the plans and specifications approved by the building official. Installation of the USP Structural Connectors CIA-Gel 7000-C Adhesive Anchor System shall conform to the manufacturer's published installation instructions (MPII) included in each package unit and as described in Figures 3 and 4 of this report. Nozzles, brushes, dispensing tools and adhesive retaining caps shown in Figure 2 and listed in Tables 15, 16 and 17 of this report as supplied by the manufacturer, shall be used along with the adhesive compound cartridges. Installation of anchor elements may be downwardly inclined (floor), horizontally inclined (walls) and upwardly inclined (ceilings). Installation may occur into dry concrete, water-saturated concrete or flooded holes in normal-weight or lightweight concrete. Use of anchors in submerged concrete is beyond the scope of this report.

3.5 Special Inspection

3.5.1 General: All adhesive anchor systems shall be installed with special inspection. Continuous special inspection is required for all cases where adhesive anchors are installed in horizontally or upwardly inclined orientations that are designed to resist sustained tension loads in accordance with ACI 318-14 26.13.3; or ACI 318-11 D.9.2.4.

Other installations shall be made under continuous or periodic special inspection in accordance with the requirements in Tables 7 through 14 of this report or as determined by the registered design professional and approved by the building official.

Installations made under special inspection shall be performed in accordance with Sections 1705.1 and 1705.3 of the 2015 and 2012 IBC, Sections 1704.4 and 1704.15 of the 2009 IBC, or Sections 1704.4 and 1704.13 of the 2006 and 2003 IBC, with continuous and periodic special inspection as defined in IBC Section 1702.1 and this report. In addition, under the 2015 IBC or IRC, ACI 318-14 26.13.3 shall apply.

3.5.2 Continuous Special Inspection: Continuous special inspection is required shall be provided in accordance with 2015 and 2012 IBC Section 202, 2009 IBC Sections 1704.4 and 1704.15 or 2006 IBC Sections 1704.4 and 1704.13; ACI 318-14 26.13.3.2 under the 2015 IBC and IRC; and this report for all cases where anchors installed horizontally or upwardly inclined and are designed to resist sustained tension loads. The special inspector shall verify anchor element type, material, diameter, length, spacing, location, embedment and edge distances, adhesive system identification in accordance with Section 5.0 of this report, adhesive expiration date, concrete type, compressive strength and thickness; hole drilling method, dimensions and cleaning procedures, cleaning brush identification, cleaning air pressure, installation torque and adhesive installation in accordance with manufacturer's printed installation instructions (MPII). The special inspector shall observe all aspects of the anchor installation except holes shall be permitted to be drilled in the absence of the special inspector provided the special inspector examines the drill bits used for the drilling and verifies the hole sizes.

3.5.3 Periodic Special Inspection: Periodic special inspection shall be provided in accordance with 2015 and 2012 IBC Sections 202, 2009 IBC Sections 1704.4 and 1704.15 or 2006 IBC Section 1704.13; ACI 318-14 26.13.3.3 under the 2015 IBC and IRC; and this report. The special inspector shall be on the jobsite initially during anchor installation to verify those items shown for continuous special inspection in Section 3.5.2 of this report. Special inspector shall verify the initial installations of each type and size of adhesive anchor by construction personnel on site. Subsequent installations of the same anchor type and size by the same construction personnel are permitted to be performed in the absence of the special inspector. Any change in the anchor product being installed or with the personnel performing the installation shall require an initial inspection. For ongoing installations over an extended period of time, the special inspector shall make regular inspections to confirm correct handling and installation of the product.

3.5.4 Proof loading program: Where required, a program for on-site proof loading, that is, proof loading program, to be conducted as part of the special inspection shall be established by the engineer or design professional of record and shall conform to the following minimum requirements:

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

Unless otherwise directed by the engineer or design professional of record, proof loads shall be applied as confined tension tests in accordance with ASTM E488 or ACI 355.4. Proof loads shall not exceed the lesser of 67 percent of the load corresponding to the nominal bond strength as calculated from the characteristic bond stress for uncracked concrete modified for edge effects and concrete properties or 80 percent of the minimum specified anchor element yield strength ($A_{se,N} \cdot f_{ya}$). Maintain the proof load at the required load level for a minimum of 10 seconds.

4.0 PRODUCT DESCRIPTION

4.1 General: The USP CIA-Gel 7000-C Adhesive Anchoring System is inserted into a pre-drilled hole in hardened normal-weight or lightweight concrete and transfers loads to the concrete by bond between the anchor and the adhesive, and bond between the adhesive and the concrete.

4.2 Product Information: USP CIA-Gel 7000-C Adhesive Anchor System is comprised of the following components:

- CIA-Gel 7000-C adhesive compound packaged in cartridges.
- Adhesive mixing and dispensing equipment.
- Equipment for cleaning holes and injecting adhesive.

Continuously threaded steel rods or deformed steel reinforcing bars shall be provided by the installer or a third party according to standard specifications and are not proprietary.

Installation may occur into dry concrete, water-saturated concrete or flooded holes in concrete. Manufacturer's printed installation instructions (MPII) and parameters are included with each adhesive unit package as shown in Figures 3 and 4 of this report.

4.3 Material Information

4.3.1 CIA-Gel 7000-C Adhesive Compound: CIA-Gel 7000-C is a two-component (resin and hardener) epoxy-based adhesive, supplied in dual, side-by-side cartridges separating the chemical components, which are combined in a 1:1 ratio by volume when dispensed through the system static mixing nozzle. CIA-Gel 7000-C is available in 250 ml (10 fl. oz.), 400 ml (14 fl. oz.), 600 ml (22 fl. oz.) and 1500 ml (52 fl. oz.) cartridges. Shelf life of CIA-Gel 7000-C is two years when stored in the manufacturer's unopened containers at temperatures between 50°F (10 °C) and 77°F (25 °C). Gel and cure times based on product and material temperatures are shown in Table 1 of this report.

4.3.2 Dispensing Equipment: CIA-Gel 7000-C shall be dispensed using pneumatic or manual actuated dispensing tools listed in Table 17 of this report.

4.3.3 Hole Preparation Equipment: Holes shall be cleaned with hole-cleaning brushes and air nozzles. Brushes shall be the appropriate size brush from the list shown in Tables 15 and 16 of this report. Air nozzles shall be equipped with an extension capable of reaching the bottom of the drilled-hole and having an inside bore diameter of not less than 1/4 inch (6.4 mm). Holes shall be prepared in accordance with the MPII shown in Figures 3 and 4 of this report.

4.3.4 Anchor Elements

4.3.4.1 Threaded Steel Rod: Threaded anchor rods shall be clean, continuously threaded rods (all-thread) in diameters and types as described in Tables 2, 4, 5 and 6 of this report. Carbon steel threaded rods may be furnished with a zinc electroplated coating, hot-dipped galvanized coating, or may be uncoated. Threaded steel rods shall be clean, straight and free of indentations or other defects along their length. The embedded portions of the threaded rods shall be free of mill scale, rust, mud, oil, and other coatings that may impair the bond with the adhesive. The tensile strength of the threaded anchor rods shall not exceed 145,000 psi (1,000 MPa).

4.3.4.2 Steel Reinforcing Bars: Steel reinforcing bars are deformed bars (rebar). Tables 3, 4, 5 and 6 of this report summarize reinforcing bar size ranges, specifications, and grades. Embedded portions of reinforcing bars shall be straight, and free of mill scale, rust and other coatings or substances that may impair the bond with the adhesive. Reinforcing bars shall not be bent after installation except as set forth in Section 26.6.3.1 (b) of ACI 318-14 or Section 7.3.2 of ACI 318-11, with the additional condition that the bars shall be bent cold, and heating of reinforcing bars to facilitate field bending is not permitted.

4.3.5 Ductility: In accordance with ACI 318-14 Section 2.3 (ACI 318-11 Appendix D.1), the steel element shall be considered ductile if the tested elongation is not less than 14 percent and the reduction of area is not less than 30 percent. Steel elements that do not satisfy both of these requirements shall be deemed brittle. Except as modified by 17.2.3.4.3 (a) (vi) of ACI 318-14 or D.3.3.4.3 (a) 6 of ACI 318-11 for earthquake effects, deformed reinforcing bars meeting the requirements of ASTM A615 shall be considered as ductile steel elements.

4.4 Concrete: Normal-weight and lightweight concrete shall comply with Sections 1901 and 1903 of the 2015 and 2012 IBC or Sections 1903 and 1905 of the 2009, 2006, and 2003 IBC, and have a minimum compressive strength at the time of anchor installation of 2,500 psi (17.2 MPa), but not less than that required by the applicable code, including IBC Section 1904 and ACI 318-14 Section 19.3.2 or ACI 318-11 Section 4.3, or the structural design, nor more than 8,500 psi (58.6 MPa).

5.0 IDENTIFICATION

5.1 CIA-Gel 7000-C adhesive compound is identified by permanent labels on the cartridge or packaging, bearing the company name (USP Structural Connectors, Mitek® USA, Inc.), product name (CIA-Gel 7000-C), batch number, expiration date, either IAPMO ES Mark of Conformity as shown below and this evaluation report number (ER-473).

5.2 Threaded rods, nuts, washers and deformed reinforcing bars are standard elements, and shall conform to applicable national or international specifications as shown in Tables 2 and 3 of this report where applicable.

IAPMO ES or UES

IAPMO ER-473

6.0 SUBSTANTIATING DATA

6.1 Data and test reports submitted are from laboratories in compliance with ISO/IEC 17025 and in accordance with the ICC-ES Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete (AC308), Approved January 2016.

6.2 Test reports are from laboratories in compliance with ISO/IEC 17025.

7.0 STATEMENT OF RECOGNITION

This evaluation report describes the results of research carried out by IAPMO Uniform Evaluation Service on USP STRUCTURAL CONNECTORS CIA-GEL 7000-C to assess conformance to the codes shown in Section 1.0 of this report and serves as documentation of the product certification.

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Uniform Evaluation Service

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GP Russ Chaney
CEO, The IAPMO Group

For additional information about this evaluation report please visit www.uniform-es.org or email us at info@uniform-es.org

TABLE 1 – PRODUCT TEMPERATURE INFORMATION

Product Temperature	Gel Time	Base Material Temperature	Cure Time
50°F to 59°F	20 minutes	40°F to 49°F	24 hours
		50°F to 59°F	12 hours
59°F to 72°F	15 minutes	59°F to 72°F	8 hours
72°F to 77°F	11 minutes	72°F to 77°F	7 hours
77°F to 86°F	8 minutes	77°F to 86°F	6 hours
86°F to 95°F	6 minutes	86°F to 95°F	5 hours
95°F to 104°F	4 minutes	95°F to 104°F	4 hours
104°F	3 minutes	104°F	3 hours

TABLE 2 – SPECIFICATIONS AND PHYSICAL PROPERTIES OF COMMON FRACTIONAL THREADED CARBON AND STAINLESS STEEL ROD MATERIALS

THREADED ROD SPECIFICATION		UNITS	MINIMUM SPECIFIED ULTIMATE STRENGTH $f_{u,ta}$	MIN. SPECIFIED YIELD STRENGTH f_{ya}	$\frac{f_{uta}}{f_{ya}}$	MINIMUM PERCENT ELONG.	MINIMUM PERCENT REDUCTION OF AREA	SPECIFICATION FOR NUTS
Carbon Steel	ASTM F 1554 Grade 36 (A 307 Gr.C)[1]	psi (MPa)	58,000 (400)	36,000 (250)	1.61	23	40	ASTM A563 Grade A
	ASTM A 193 Grade B7[1]	psi (MPa)	125,000 (860)	105,000 (725)	1.19	16	50	ASTM A194
	ISO 898-1 Class 5.8[1]	psi (MPa)	72,500 (500)	58,000 (400)	1.25	22	35	DIN 934 (Grade 6)
	ISO 898-1 Class 8.8[2]	psi (MPa)	116,000 (800)	92,800 (640)	1.25	12	52	DIN 934 (Grade 8)
Stainless Steel	ASTM F 593 CW1 (¼ -⅝)[2]	psi (MPa)	100,000 (690)	65,000 (450)	1.54	20	-	F 594
	ASTM F 593 CW2 (¾-1¼)[2]	psi (MPa)	85,000 (585)	45,000 (310)	1.89	25	-	F 594
	ASTM F 593 SH1[2]	psi (MPa)	115,000 (800)	90,000 (620)	1.28	12	-	-
	ASTM F 593 SH2[2]	psi (MPa)	105,000 (725)	70,000 (480)	1.50	15	-	-
	ASTM F 593 SH3[2]	psi (MPa)	95,000 (655)	55,000 (380)	1.73	20	-	-
	ISO 3506-1 A4-70[2]	psi (MPa)	101,500 (700)	65,250 (450)	1.56	40	-	ISO 4032
	ISO 3506-1 A4-80[2]	psi (MPa)	116,000 (800)	87,000 (600)	1.33	30	-	-

[1] Rods are considered ductile steel elements in accordance with Sections 4.2, 4.2.1, and 4.3.5 of this report.

[2] Rods are considered brittle steel elements in accordance with Sections 4.2, 4.2.1, and 4.3.5 of this report.

TABLE 3 – SPECIFICATIONS AND PHYSICAL PROPERTIES OF COMMON STEEL DEFORMED REINFORCING BARS

REINFORCING SPECIFICATION	UNITS	MINIMUM SPECIFIED ULTIMATE STRENGTH, f_{uta}	MINIMUM SPECIFIED YIELD STRENGTH, f_{ya}
ASTM A 615 Grade 40	psi (MPa)	60,000 (415)	40,000 (275)
ASTM A 615 Grade 60	psi (MPa)	90,000 (620)	60,000 (415)
DIN 488 BSt 500	psi (MPa)	79,750 (550)	72,500 (500)
CAN/CSA-G30.18 Gr. 400	psi (MPa)	78,300 (540)	58,000 (400)

TABLE 4 – CIA-Gel 7000-C ANCHOR SYSTEM INSTALLATION INFORMATION

Characteristic		Symbol	Units	Nominal Element Diameter						
US Threaded Rod	Size	d_0	inch	3/8	1/2	5/8	3/4	7/8	1	1-1/4
	Drill Size	d_{hole}	inch	1/2	9/16	3/4	7/8	1	1-1/8	1-3/8
US Re-bar	Size	d_0	inch	3	4	5	6	7	8	10
	Drill Size	d_{hole}	inch	9/16	5/8	3/4	7/8	1	1-1/8	1-3/8
SI Threaded Rod	Size	d_0	mm	M10	M12	M16	M20	-	M24	M30
	Drill Size	d_{hole}	mm	12	14	18	22	-	26	35
SI Re-bar	Size	d_0	mm	T10	T12	T16	T20	-	T25	T32
	Drill Size	d_{hole}	mm	14	16	20	25	-	32	40
Maximum Tightening Torque		T_{inst}	ft-lb	15	30	60	100	125	150	200
Embedment Range		$h_{ef,min}$	inch	2-3/8	2-3/4	3-1/8	3-3/4	4	4	5
		$h_{ef,max}$	inch	7-1/2	10	12-1/2	15	17-1/2	20	25
Minimum Concrete Thickness		h_{min}	inch	1.5 h_{ef}						
Minimum Edge Distance		c_{min}	inch	1- 1/2	1-1/2	1-3/4	1-7/8	2	2	2-1/2
Minimum Anchor Spacing		s_{min}	inch	1-1/2	1-1/2	1-3/4	1-7/8	2	2	2-1/2

FIGURE 1 – FLOW CHART FOR THE ESTABLISHMENT OF DESIGN BOND STRENGTH

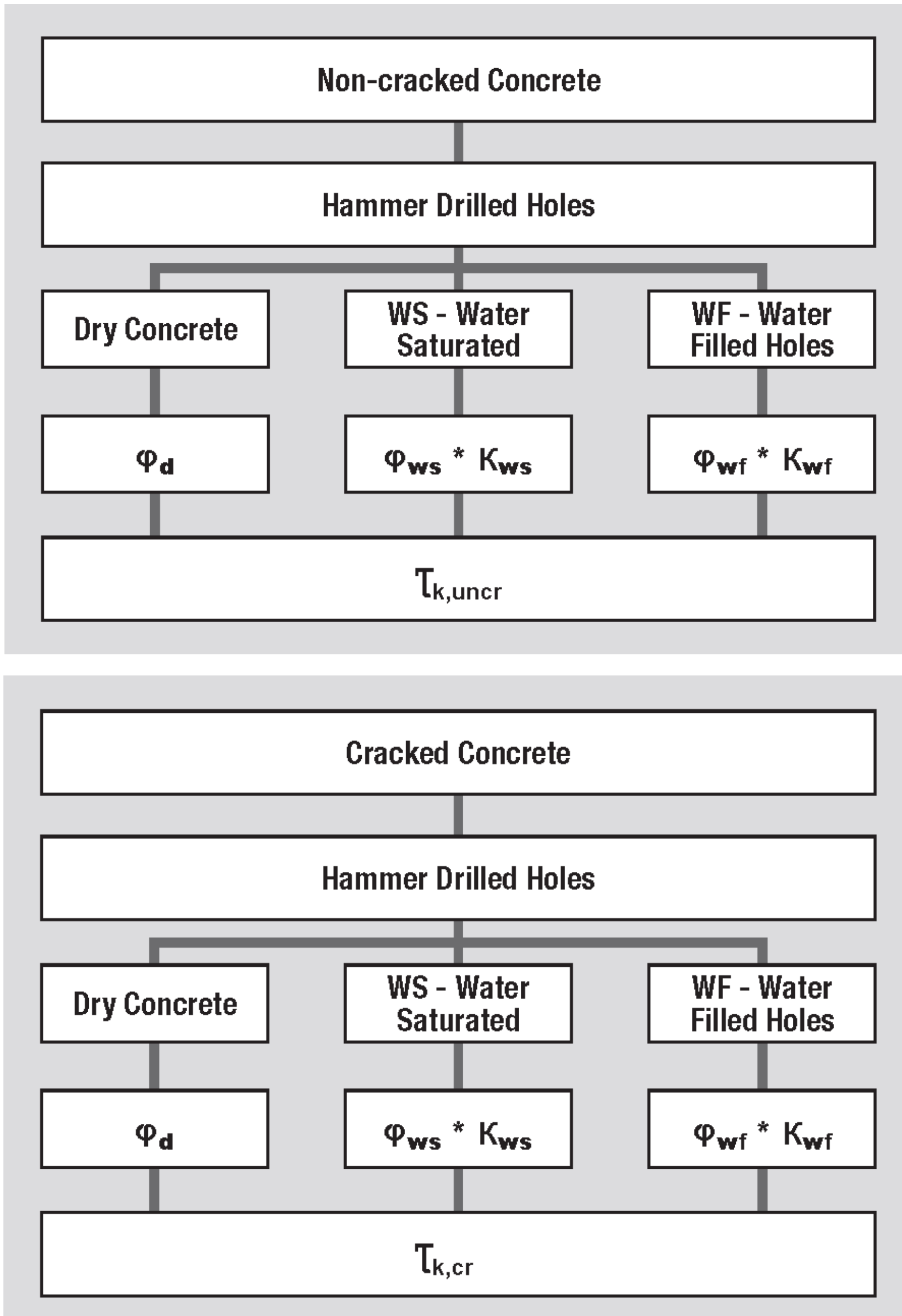


TABLE 5 – STEEL DESIGN INFORMATION FOR US CUSTOMARY STEEL THREADED ROD AND REINFORCING STEEL BAR[1]

	Characteristic	Symbol	Units	Nominal Rod Diameter, d_o						
US Threaded Rod	Nominal Size	d_o	inch	3/8	1/2	5/8	3/4	7/8	1	1 1/4
	Stress Area[2]	A_{se}	in.[2]	0.0775	0.1419	0.226	0.334	0.462	0.606	0.969
	Strength Reduction Factor for Tension Steel Failure[3]	φ	-	0.75						
	Strength Reduction for Shear Steel Failure[3]	φ	-	0.65						
	Reduction for Seismic Tension	$\alpha_{N,seis}$	-	1.00						
	Reduction for Seismic Shear	$\alpha_{V,seis}$	-	1.00						
	Tension Resistance of Carbon Steel ASTM F 1554 Grade 36 (A 307 Gr. C)	N_{sa}	lb (kN)	4495 (20.0)	8230 (36.6)	13110 (58.3)	19370 (86.2)	26795 (119.2)	35150 (156.4)	56200 (250.0)
	Tension Resistance of Carbon Steel ASTM A 193 B7	N_{sa}	lb (kN)	9690 (43.1)	17740 (78.9)	28250 (125.7)	41750 (185.7)	57750 (256.9)	75750 (337.0)	121125 (538.8)
	Tension Resistance of Stainless Steel ASTM F 593 CW1	N_{sa}	lb (kN)	7750 (34.5)	14190 (63.1)	22600 (100.5)	-	-	-	-
	Tension Resistance of Stainless Steel ASTM F CW2	N_{sa}	lb (kN)	-	-	-	28390 (126.3)	39270 (174.7)	51510 (229.1)	82365 (366.4)
	Tension Resistance of Stainless Steel ASTM F 593 SH1	N_{sa}	lb (kN)	8915 (39.7)	16320 (72.6)	25990 (115.6)	-	-	-	-
	Tension Resistance of Stainless Steel ASTM F 593 SH2	N_{sa}	lb (kN)	-	-	-	35070 (156.0)	48510 (215.8)	63630 (283.0)	-
	Tension Resistance of Stainless Steel ASTM F 593 SH3	N_{sa}	lb (kN)	-	-	-	-	-	-	92055 (409.5)
	Shear Resistance of Carbon Steel ASTM F 1554 Grade 36 (A 307 Gr. C)	V_{sa}	lb (kN)	2250 (10.0)	4940 (22.0)	7865 (35.0)	11625 (51.7)	16080 (71.5)	21090 (93.8)	33720 (150.0)
	Shear Resistance of Carbon Steel ASTM A 193 B7	V_{sa}	lb (kN)	4845 (21.6)	10645 (47.4)	16950 (75.4)	25050 (111.4)	34650 (154.1)	45450 (202.2)	72675 (323.3)
	Shear Resistance of stainless Steel ASTM F 593 CW1	V_{sa}	lb (kN)	3875 (17.2)	7095 (31.6)	11300 (50.3)	-	-	-	-
	Shear Resistance of Stainless Steel ASTM F 593 CW2	V_{sa}	lb (kN)	-	-	-	14195 (63.1)	19635 (87.3)	25755 (114.6)	41185 (183.2)
	Shear Resistance of Stainless Steel ASTM F 593 SH1	V_{sa}	lb (kN)	4455 (19.8)	9790 (43.5)	15595 (69.4)	-	-	-	-
	Shear Resistance of Stainless Steel ASTM F 593 SH2	V_{sa}	lb (kN)	-	-	-	17535 (78.0)	24255 (107.9)	31815 (141.5)	-
	Shear Resistance of Stainless Steel ASTM F 593 SH3	V_{sa}	lb (kN)	-	-	-	-	-	-	46030 (204.8)
US Rebar	Nominal Size	d_o	inch	#3	#4	#5	#6	#7	#8	#10
	Stress Area[2]	A_{se}	in.[2]	0.11	0.20	0.31	0.44	0.60	0.79	1.27
	Strength Reduction Factor for Tension Steel Failure[3]	φ	-	0.75						
	Strength Reduction Factor for Shear Failure[3]	φ	-	0.65						
	Reduction Factor for Seismic Tension	$\alpha_{N,seis}$	-	1.00						
	Reduction Factor for Seismic Shear	$\alpha_{V,seis}$	-	1.00						
	Tension Resistance of carbon Steel ASTM A 615 Grade 40	N_{sa}	lb (kN)	6600 (29.4)	12000 (53.4)	18600 (82.7)	26400 (117.4)	36000 (160.1)	47400 (210.8)	76200 (339.0)
	Tension Resistance of Carbon Steel ASTM A 615 Grade 60	N_{sa}	lb (kN)	9900 (44.0)	18000 (80.1)	27900 (124.1)	39600 (176.1)	54000 (240.2)	71100 (316.3)	114300 (508.4)
	Shear Resistance of Carbon Steel ASTM A 615 Grade 40	V_{sa}	lb (kN)	3960 (17.6)	7200 (32.0)	11160 (49.6)	15840 (70.5)	21600 (96.1)	28440 (126.5)	45720 (203.4)
	Shear Resistance of Carbon Steel ASTM A 615 Grade 60	V_{sa}	lb (kN)	5940 (26.4)	10800 (48.0)	16740 (74.5)	23760 (105.7)	32400 (144.1)	42660 (189.8)	68580 (305.1)

[1] Values provided for common rod material types are based on specified strength and calculated in accordance with ACI 318-14 Eq. (17.4.1.2) and Eq. (17.5.1.2b) or ACI 318-11 Eq. (D-2) and Eq. (D-29). Nuts and washers shall be appropriate for the rod as set forth in Table 2 of this report.
[2] Stress Area is minimum stress area applicable for either tension or shear.
[3] Tabulated value of $\varnothing$ complies with ACI 318-14 17.3.3 or ACI 318-11 D.4.3 and applies when the load combinations of Section 1605.1 of the IBC or either ACI 318-14 5.3 or ACI 318-11 9.2 are used. When the load combinations in ACI 318-11 Appendix C are used, the appropriate value of $\varnothing$ shall be determined in accordance with ACI 318-11 D.4.4.

TABLE 6 – STEEL DESIGN INFORMATION FOR INTERNATIONAL STEEL THREADED ROD AND REINFORCING STEEL BAR[1]

	Characteristic	Symbol	Units	Nominal Rod Diameter, d_o					
SI Threaded Rod	Nominal Size	d_o	mm	M10	M12	M16	M20	M24	M30
	Stress Area[2]	A_{se}	mm²	58	84	157	245	353	561
	Strength Reduction Factor for Tension Steel Failure[3]	φ	-	0.75					
	Strength Reduction Factor for Shear Steel Failure[3]	φ	-	0.65					
	Reduction for Seismic Tension	$\alpha_{N,seis}$	-	1.00					
	Reduction for Seismic Shear	$\alpha_{V,seis}$	-	1.00					
	Tension Resistance of carbon Steel ISO 898 Class 5.8	N_{sa}	kN (lb)	29.0 (6519)	42.2 (9476)	78.5 (17648)	122.5 (27539)	176.5 (39679)	280.5 (63059)
	Tension Resistance of carbon Steel ISO 898 Class 8.8	N_{sa}	kN (lb)	46.4 (10431)	67.4 (15161)	125.6 (28236)	196.0 (44063)	282.4 (63486)	448.8 (100894)
	Tension Resistance of Stainless Steel ISO 3506-1 A4-70	N_{sa}	kN (lb)	40.6 (9127)	59.0 (13266)	109.9 (24707)	171.5 (38555)	247.1 (55550)	392.7 (88282)
	Tension Resistance of Stainless Steel ISO 3506-1 A4-80	N_{sa}	kN (lb)	46.6 (10431)	67.4 (15161)	125.6 (28236)	196.0 (44063)	282.4 (63486)	448.8 (100894)
	Shear Resistance of carbon Steel ISO 898 Class 5.8	V_{sa}	kN (lb)	17.4 (3912)	25.3 (5685)	47.1 (10589)	73.5 (16523)	105.9 (23807)	168.3 (37835)
	Shear Resistance of carbon Steel ISO 898 Class 8.8	V_{sa}	kN (lb)	27.8 (6259)	40.5 (9097)	75.4 (16942)	117.6 (26438)	169.4 (38092)	269.3 (60537)
	Shear Resistance of Stainless Steel ISO 3506-1 A4-70	V_{sa}	kN (lb)	24.4 (5476)	35.4 (7960)	65.9 (14824)	102.9 (32133)	148.3 (33330)	235.6 (52969)
	Shear Resistance of Stainless Steel ISO 3506-1 A4-80	V_{sa}	kN (lb)	27.8 (6259)	40.5 (9097)	75.4 (16942)	117.6 (26438)	169.4 (38092)	269.3 (60537)
SI Re-bar	Nominal Size	d_o	mm	T10	T12	T16	T20	T25	T32
	Stress Area[2]	A_{se}	mm²	78.5	113	201	314	491	804
	Strength Reduction Factor for Tension Steel Failure[3]	φ	-	0.75					
	Strength Reduction Factor for Shear Steel Failure[3]	φ	-	0.65					
	Reduction for Seismic Tension	$\alpha_{N,seis}$	-	1.00					
	Reduction for Seismic Shear	$\alpha_{V,seis}$	-	1.00					
	Tension Resistance of Carbon Steel DIN 488 B St 500	N_{sa}	kN (lb)	43.2 (9706)	62.2 (13972)	110.6 (24853)	172.7 (38825)	270.1 (60710)	442.2 (99411)
	Tension Resistance of carbon Steel CAN/CSA-G30.18 Gr. 400	N_{sa}	kN (lb)	42.4 (9530)	61.0 (13718)	108.5 (24401)	169.6 (38119)	265.1 (59606)	434.2 (97603)
	Shear Resistance of Carbon Steel DIN 488 B St 500	V_{sa}	kN (lb)	25.9 (5824)	37.3 (8383)	66.3 (14912)	103.6 (23295)	162.0 (36426)	265.3 (59646)
	Shear Resistance of carbon Steel CAN/CSA-G30.18 Gr. 400	V_{sa}	kN (lb)	25.4 (5718)	36.6 (8231)	65.1 (14640)	101.7 (22871)	159.1 (35764)	260.5 (58562)

[1] [1] Values provided for common rod material types are based on specified strength and calculated in accordance with ACI 318-14 Eq. (17.4.1.2) and Eq. (17.5.1.2b) or ACI 318-11 Eq. (D-2) and Eq. (D-29). Nuts and washers shall be appropriate for the rod as set forth in Table 2 of this report.

[2] Stress Area is minimum stress area applicable for either tension or shear.

[3] Tabulated value of ø complies with ACI 318-14 17.3.3 or ACI 318-11 D.4.3 and applies when the load combinations of Section 1605.1 of the IBC or ACI 318-14 5.3 or ACI 318-11 9.2 are used. When the load combinations in ACI 318 Appendix C are used, the appropriate value of ø shall be determined in accordance with ACI 318-11 D.4.4.

TABLE 7 – US CUSTOMARY THREADED ROD BOND STRENGTH DESIGN INFORMATION WITH PERIODIC SPECIAL INSPECTION[1]

Design Information			Symbol	Units	Nominal Threaded Rod Diameter						
					3/8"	1/2"	5/8"	3/4"	7/8"	1"	1-1/4"
Minimum Effective Installation Depth			$h_{ef,min}$	in.	2 3/8	2 3/4	3 1/8	3 1/2	4	4	5
				mm	60	70	79	89	102	102	127
Maximum Effective Installation Depth			$h_{ef,max}$	in.	7 1/2	10	12 1/2	15	17 1/2	20	25
				mm	191	254	318	381	445	508	635
Adjustment for Sustained Tension Loading[6]			k_{sust}	-	0.71						
Dry Concrete	Temperature Category A[2,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	703					718	
				N/mm²	4.8					4.9	
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	608	573	534	504	470	446	381
				N/mm²	4.2	3.9	3.6	3.4	3.2	3.1	2.6
	Temperature Category B, Range 1[3,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1,310					1,337	
				N/mm²	9.0					9.2	
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	1,127	1,068	994	936	873	832	708
				N/mm²	7.7	7.3	6.8	6.4	6.0	5.7	4.8
	Anchor Category, dry concrete		-	-	1	1	1	1	1	1	1
	Strength Reduction Factor[5,7]		ϕ_d	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Water Saturated Concrete	Temperature Category A[2,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	N/A	N/A	703			718	
				N/mm²	N/A	N/A	4.8			4.9	
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	515	485	545	504	470	446	381
				N/mm²	3.5	3.3	3.7	3.4	3.2	3.0	2.6
	Temperature Category B, Range 1[3,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1,101		1,310			1,337	
				N/mm²	7.5					9.2	
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	946	897	994	936	873	832	708
				N/mm²	6.5	6.1	6.8	6.4	6.0	5.7	4.8
	Anchor Category, water saturated concrete		-	-	3	3	3	3	3	3	3
	Strength Reduction Factor[5,7]		ϕ_{ws}	-	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Water-filled Hole	Temperature Category A[2,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	N/A	N/A	718			N/A	N/A
				N/mm²	N/A	N/A	4.9			N/A	N/A
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	535	500	539	504	475	N/A	N/A
				N/mm²	3.6	3.4	3.7	3.4	3.2	N/A	N/A
	Temperature Category B, Range 1[3,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1,163		1,337	1,323		N/A	N/A
				N/mm²	8.0			9.1		N/A	N/A
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	990	917	1,005	955	864	317	267
				N/mm²	6.8	6.3	6.9	6.5	5.9	2.1	1.8
	Anchor Category, water-filled hole		-	-	3	3	3	3	3	3	3
	Strength Reduction Factor[5,7]		ϕ_{wf}	-	0.45	0.45	0.45	0.45	0.45	0.45	0.45

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

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

[3] Temperature Category B, Range 1: Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 130°F (54°C).

[4] Short-term elevated concrete temperatures are those that occur over brief intervals, e.g., transient or part of a regular cycle of heating and cooling, such as day-night temperature rise and fall. Long-term elevated concrete temperatures are roughly constant over significant periods of time.

[5] The tabulated value of ϕ applies when load combinations of Section 1605.2 of the IBC or either ACI 318-14 5.3 or ACI 318-11 Section 9.2, are used in accordance with ACI 318-14 17.3.3 or ACI 318 D.4.3. If the load combinations of ACI 318 Appendix C are used, the appropriate value of ϕ shall be determined in accordance with ACI 318-11 D.4.4.

[6] Additional reduction factor shall be applied if tension loads are sustained. $\tau_{k,sust,uncr} = \tau_{k,uncr} \cdot k_{sust}$ or $\tau_{k,sust,cr} = \tau_{k,cr} \cdot k_{sust}$

[7] The ϕ values correspond to Condition B as described in ACI 318-14 17.3.3 or Section D.4.3 of ACI 318-11 for post-installed anchors designed using the load combinations of IBC Section 1605.2. If the load combinations in ACI 318 Appendix C are used, the corresponding value of ϕ shall be determined.

TABLE 8 – US CUSTOMARY REBAR BOND STRENGTH DESIGN INFORMATION WITH PERIODIC SPECIAL INSPECTION[1]

Design Information			Symbol	Units	Nominal Rebar Diameter						
					#3	#4	#5	#6	#7	#8	#10
Minimum Effective Installation Depth			$h_{ef,min}$	in.	2 3/8	2 3/4	3 1/8	3 1/2	4	4	5
				mm	60	70	79	89	102	102	127
Maximum Effective Installation Depth			$h_{ef,max}$	in.	7 1/2	10	12 1/2	15	17 1/2	20	25
				mm	191	254	318	381	445	508	635
Adjustment for Sustained Tension Loading[6]			k_{sust}	-	0.71						
Dry Concrete	Temperature Category A[2,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	703				711		
				N/mm²	4.8				4.9		
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	595	562	534	504	470	441	377
				N/mm²	4.1	3.8	3.6	3.4	3.2	3.0	2.5
	Temperature Category B, Range 1[3,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1,310				1,323		
				N/mm²	9.0				9.1		
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	1,104	1,057	994	936	873	815	701
				N/mm²	7.6	7.2	6.8	6.4	6.0	5.6	4.8
	Anchor Category, dry concrete		-	-	1	1	1	1	1	1	1
	Strength Reduction Factor[5,7]		$ø_d$	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Water Saturated Concrete	Temperature Category A[2,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	N/A	N/A	703			711	703
				N/mm²	N/A	N/A	4.8			4.9	4.8
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	515	485	534	504	470	441	373
				N/mm²	3.5	3.3	3.6	3.4	3.2	3.0	2.5
	Temperature Category B, Range 1[3,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1,101		1,310			1,323	
				N/mm²	7.5		9.0			9.1	
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	926	878	994	936	882	823	701
				N/mm²	6.3	6.0	6.8	6.4	6.0	5.6	4.8
	Anchor Category, water saturated concrete		-	-	3	3	3	3	3	3	3
	Strength Reduction Factor[5,7]		$ø_{ws}$	-	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Water-filled Hole	Temperature Category A[2,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	N/A	N/A	703			N/A	N/A
				N/mm²	N/A	N/A	4.8			N/A	N/A
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	529	495	534	504	470	N/A	N/A
				N/mm²	3.6	3.4	3.6	3.4	3.2	N/A	N/A
	Temperature Category B, Range 1[3,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1,128		1,310			N/A	N/A
				N/mm²	7.7		9.0			N/A	N/A
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	960	907	984	936	873	310	262
				N/mm²	6.6	6.2	6.7	6.4	6.0	2.1	1.8
	Anchor Category, water-filled hole		-	-	3	3	3	3	3	3	3
	Strength Reduction Factor[65,7]		$ø_{wf}$	-	0.45	0.45	0.45	0.45	0.45	0.45	0.45

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

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

[3] Temperature Category B, Range 1: Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 130°F (54°C).

[4] Short-term elevated concrete temperatures are those that occur over brief intervals, e.g., transient or part of a regular cycle of heating and cooling, such as day-night temperature rise and fall. Long-term elevated concrete temperatures are roughly constant over significant periods of time.

[5] The tabulated value of ϕ applies when load combinations of Section 1605.2 of the IBC or either ACI 318-14 5.3 or ACI 318-11 Section 9.2, are used in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ shall be determined in accordance with ACI 318 D.4.4.

[6] Additional reduction factor shall be applied if tension loads are sustained. $\tau_{k,sust,uncr} = \tau_{k,uncr} \cdot k_{sust}$ or $\tau_{k,sust,cr} = \tau_{k,cr} \cdot k_{sust}$

[7] The $ø$ values correspond to Condition B as described in ACI 318-14 17.3.3 or Section D.4.3 of ACI 318-11 for post-installed anchors designed using the load combinations of IBC Section 1605.2. If the load combinations in ACI 318-11 Appendix C are used, the corresponding value of ϕ shall be determined.

TABLE 9 – METRIC THREADED ROD BOND STRENGTH DESIGN INFORMATION WITH PERIODIC SPECIAL INSPECTION[1]

Design Information			Symbol	Units	Nominal SI Threaded Rod Diameter					
					M10	M12	M16	M20	M24	M30
Minimum Effective Installation Depth			$h_{ef,min}$	in.	2 1/3	2 3/4	3 1/7	3 1/2	3 7/9	4 5/7
				mm	60	70	80	90	96	120
Maximum Effective Installation Depth			$h_{ef,max}$	in.	7 7/8	9 4/9	12 3/5	15 3/4	18 8/9	23 5/8
				mm	200	240	320	400	480	600
Adjustment for Sustained Tension Loading[7]			k_{sust}	-	0.71					
Dry Concrete	Temperature Category A[2,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	703		696			703
				N/mm^2	4.8		4.7			4.8
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	603	578	539	495	451	388
				N/mm^2	4.1	3.9	3.7	3.4	3.1	2.6
	Temperature Category B, Range 1[3,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1,296			1,283		1,296
				N/mm^2	8.9			8.8		8.9
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	1,106	1,067	994	907	830	720
				N/mm^2	7.6	7.3	6.8	6.2	5.7	4.9
	Anchor Category, dry concrete		-	-	1	1	1	1	1	1
	Strength Reduction Factor[5,7]		ϕ_d	-	0.65	0.65	0.65	0.65	0.65	0.65
Water Saturated Concrete	Temperature Category A[2,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	N/A	N/A	696			
				N/mm^2	N/A	N/A	4.7			
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	515	495	528	490	446	388
				N/mm^2	3.6	3.4	3.6	3.3	3.0	2.6
	Temperature Category B, Range 1[3,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1,090		1,283			
				N/mm^2	7.5		8.8			
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	931	888	984	907	822	713
				N/mm^2	6.4	6.1	6.7	6.2	5.6	4.9
	Anchor Category, water saturated concrete		-	-	3	3	3	3	3	3
	Strength Reduction Factor[5,7]		ϕ_{ws}	-	0.45	0.45	0.45	0.45	0.45	0.45
Water-filled Hole	Temperature Category A[2,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	N/A	N/A	689		N/A	N/A
				N/mm^2	N/A	N/A	4.7		N/A	N/A
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	514	494	528	485	N/A	N/A
				N/mm^2	3.5	3.4	3.6	3.3	N/A	N/A
	Temperature Category B, Range 1[3,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1,116		1,283		N/A	N/A
				N/mm^2	7.6		8.8		N/A	N/A
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	955	922	984	907	330	285
				N/mm^2	6.5	6.3	6.7	6.2	2.3	2.0
	Anchor Category, water-filled hole		-	-	3	3	3	3	3	3
	Strength Reduction Factor[5,7]		ϕ_{wf}	-	0.45	0.45	0.45	0.45	0.45	0.45

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

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

[3] Temperature Category B, Range 1: Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 130°F (54°C).

[4] Short-term elevated concrete temperatures are those that occur over brief intervals, e.g., transient or part of a regular cycle of heating and cooling, such as day-night temperature rise and fall. Long-term elevated concrete temperatures are roughly constant over significant periods of time.

[5] The tabulated value of ϕ applies when load combinations of Section 1605.2 of the IBC or either ACI 318-14 5.3 or ACI 318-11 Section 9.2, are used in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ shall be determined in accordance with ACI 318-11 D.4.4.

[6] Additional reduction factor shall be applied if tension loads are sustained. $\tau_{k,sust,uncr} = \tau_{k,uncr} \cdot k_{sust}$ or $\tau_{k,sust,cr} = \tau_{k,cr} \cdot k_{sust}$

[7] The ϕ values correspond to Condition B as described in Section ACI 318-14 17.3.3 or D.4.3 of ACI 318-11 for post-installed anchors designed using the load combinations of IBC Section 1605.2. If the load combinations in ACI 318-11 Appendix C are used, the corresponding value of ϕ shall be determined.

TABLE 10 – METRIC REBAR BOND STRENGTH DESIGN INFORMATIONWITH PERIODIC SPECIAL INSPECTION[1]

Design Information			Symbol	Units	Nominal Rebar Diameter					
					Ø10mm	Ø12mm	Ø16mm	Ø20mm	Ø25mm	Ø32mm
Minimum Effective Installation Depth			$h_{ef,min}$	in.	2 3/8	2 3/4	3 1/8	3 1/2	4	5
				mm	60	70	79	89	102	127
Maximum Effective Installation Depth			$h_{ef,max}$	in.	7 1/2	10	12 1/2	15	20	25
				mm	191	254	318	381	508	635
Adjustment for Sustained Tension Loading[6]			k_{sust}	-	0.71					
Dry Concrete	Temperature Category A[2,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	703			696		
				N/mm[2]	4.8			4.7		
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	597	572	528	490	446	385
				N/mm[2]	4.1	3.9	3.6	3.3	3.0	2.6
	Temperature Category B, Range 1[3,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1,310		1,296			
				N/mm[2]	9.0		8.9			
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	1,117	1,078	1,005	917	820	715
				N/mm[2]	7.7	7.4	6.9	6.3	5.6	4.9
	Anchor Category, dry concrete		-	-	1	1	1	1	1	1
	Strength Reduction Factor[5,7]		$ø_d$	-	0.65	0.65	0.65	0.65	0.65	0.65
Water Saturated Concrete	Temperature Category A[2,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	N/A	N/A	696			
				N/mm[2]	N/A	N/A	4.7			
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	515	485	528	490	437	385
				N/mm[2]	3.5	3.3	3.6	3.3	3.0	2.7
	Temperature Category B, Range 1[3,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1,124		1,296			1,283
				N/mm[2]	7.7		8.9			8.8
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	965	916	1,005	917	820	715
				N/mm[2]	6.7	6.3	6.9	6.3	5.6	4.9
	Anchor Category, water saturated concrete		-	-	3	3	3	3	3	3
	Strength Reduction Factor[5,7]		$ø_{ws}$	-	0.45	0.45	0.45	0.45	0.45	0.45
Water-filled Hole	Temperature Category A[2,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	N/A	N/A	696		N/A	N/A
				N/mm[2]	N/A	N/A	4.7		N/A	N/A
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	519	500	528	490	N/A	N/A
				N/mm[2]	3.5	3.4	3.6	3.3	N/A	N/A
	Temperature Category B, Range 1[3,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1,140		1,296		N/A	N/A
				N/mm[2]	7.8		8.9		N/A	N/A
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	1,000	945	994	917	320	270
				N/mm[2]	6.9	6.5	6.8	6.3	2.2	1.9
	Anchor Category, water-filled hole		-	-	3	3	3	3	3	3
	Strength Reduction Factor[5,7]		$ø_{wf}$	-	0.45	0.45	0.45	0.45	0.45	0.45

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

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

[3] Temperature Category B, Range 1: Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 130°F (54°C).

[4] Short-term elevated concrete temperatures are those that occur over brief intervals, e.g., transient or part of a regular cycle of heating and cooling, such as day-night temperature rise and fall. Long-term elevated concrete temperatures are roughly constant over significant periods of time.

[5] The tabulated value of ϕ applies when load combinations of Section 1605.2 of the IBC or either ACI 318-14 5.3 or ACI 318-11 Section 9.2, are used in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ shall be determined in accordance with ACI 318-11 D.4.4.

[6] Additional reduction factor shall be applied if tension loads are sustained. $\tau_{k,sust,uncr} = \tau_{k,uncr} \cdot k_{sust}$ or $\tau_{k,sust,cr} = \tau_{k,cr} \cdot k_{sust}$

[7] The $ø$ values correspond to Condition B as described in ACI 318-14 17.3.3 or Section D.4.3 of ACI 318-11 for post-installed anchors designed using the load combinations of IBC Section 1605.2. If the load combinations in ACI 318-11 Appendix C are used, the corresponding value of ϕ shall be determined.

TABLE 11 – US CUSTOMARY THREADED ROD BOND STRENGTH DESIGN INFORMATION WITH CONTINOUS SPECIAL INSPECTION[1]

Design Information			Symbol	Units	Nominal Threaded Rod Diameter						
					3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/4"
Minimum Effective Installation Depth			$h_{ef,min}$	in.	2 3/8	2 3/4	3 1/8	3 1/2	4	4	5
				mm	60	70	79	89	102	102	127
Maximum Effective Installation Depth			$h_{ef,max}$	in.	7 1/2	10	12 1/2	15	17 1/2	20	25
				mm	191	254	318	381	445	508	635
Adjustment for Sustained Tension Loading[7]			k_{sust}	-	0.71						
Dry Concrete	Temperature Category A[2,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	711			718			725
				N/mm^2	4.9			4.9			5.0
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	620	573	534	504	470	450	385
				N/mm^2	4.3	3.9	3.6	3.4	3.2	3.1	2.7
	Temperature Category B, Range 1[3,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1,323			1,337			1,350
				N/mm^2	9.1			9.2			9.3
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	1,150	1,068	994	936	873	840	715
				N/mm^2	7.9	7.3	6.8	6.4	6.0	5.8	4.9
	Anchor Category, dry concrete		-	-	1	1	1	1	1	1	1
	Strength Reduction Factor[5,7]		ϕ_d	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Water Saturated Concrete	Temperature Category A[2,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	718		711		703	718	
				N/mm^2	4.9		4.9		4.8	4.9	
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	614	585	545	515	485	446	381
				N/mm^2	4.2	4.0	3.7	3.5	3.3	3.0	2.6
	Temperature Category B, Range 1[3,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1,350	1,337		1,310			1,337
				N/mm^2	9.3	9.2		9.0			9.2
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	1,150	1,079	1,015	946	882	832	715
				N/mm^2	7.9	7.4	6.9	6.5	6.0	5.7	4.9
	Anchor Category, water saturated concrete		-	-	3	3	2	2	2	2	2
	Strength Reduction Factor[5,7]		ϕ_{ws}	-	0.45	0.45	0.55	0.55	0.55	0.55	0.55
Water-filled Hole	Temperature Category A[2,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	718			725		N/A	N/A
				N/mm^2	4.9			5.0		N/A	N/A
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	540	505	545	510	475	N/A	N/A
				N/mm^2	3.7	3.4	3.7	3.5	3.2	N/A	N/A
	Temperature Category B, Range 1[3,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1,350		1,337			N/A	N/A
				N/mm^2	9.3		9.2			N/A	N/A
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	1,150	926	1,005	955	873	376	320
				N/mm^2	7.9	6.3	6.9	6.5	6.7	2.5	2.2
	Anchor Category, water-filled hole		-	-	3	3	2	2	2	3	3
	Strength Reduction Factor[5,7]		ϕ_{wf}	-	0.45	0.45	0.55	0.55	0.55	0.45	0.45

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

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

[3] Temperature Category B, Range 1: Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 130°F (54°C).

[4] Short-term elevated concrete temperatures are those that occur over brief intervals, e.g., transient or part of a regular cycle of heating and cooling, such as day-night temperature rise and fall. Long-term elevated concrete temperatures are roughly constant over significant periods of time.

[5] The tabulated value of ϕ applies when load combinations of Section 1605.2 of the IBC or either ACI 318-14 5.3 or ACI 318-11 Section 9.2, are used in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ shall be determined in accordance with ACI 318-11 D.4.4.

[6] Additional reduction factor shall be applied if tension loads are sustained. $\tau_{k,sust,uncr} = \tau_{k,uncr} \cdot k_{sust}$ or $\tau_{k,sust,cr} = \tau_{k,cr} \cdot k_{sust}$

[7] The ϕ values correspond to Condition B as described in ACI 318-14 17.3.3 or Section D.4.3 of ACI 318-11 for post-installed anchors designed using the load combinations of IBC Section 1605.2. If the load combinations in ACI 318-11 Appendix C are used, the corresponding value of ϕ shall be determined.

TABLE 12 – US CUSTOMARY REBAR BOND STRENGTH DESIGN INFORMATION WITH CONTINUOUS SPECIAL INSPECTION[1]

Design Information			Symbol	Units	Nominal Rebar Diameter						
					#3	#4	#5	#6	#7	#8	#10
Minimum Effective Installation Depth			$h_{ef,min}$	in.	2 3/8	2 3/4	3 1/8	3 1/2	4	4	5
				mm	60	70	79	89	102	102	127
Maximum Effective Installation Depth			$h_{ef,max}$	in.	7 1/2	10	12 1/2	15	17 1/2	20	25
				mm	191	254	318	381	445	508	635
Adjustment for Sustained Tension Loading[7]			k_{sust}	-	0.71						
Dry Concrete	Temperature Category A[2,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	711		703			718	
				N/mm[2]	4.9		4.8			4.9	
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	601	567	534	504	470	441	377
				N/mm[2]	4.1	3.9	3.6	3.4	3.2	3.0	2.5
	Temperature Category B, Range 1[3,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1,310				1,323		
				N/mm[2]	9.0				9.1		
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	1,116	1,057	994	936	873	823	701
				N/mm[2]	7.6	7.2	6.8	6.4	6.0	5.6	4.8
	Anchor Category, dry concrete		-	-	1	1	1	1	1	1	1
	Strength Reduction Factor[5,7]		ϕ_d	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Water Saturated Concrete	Temperature Category A[2,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	703		711				
				N/mm[2]	4.8		4.9				
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	620	585	534	504	470	441	377
				N/mm[2]	4.3	4.0	3.6	3.4	3.2	3.0	2.5
	Temperature Category B, Range 1[3,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1,337		1,310				1,323
				N/mm[2]	9.2		9.0				9.1
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	1,116	1,046	994	946	882	823	701
				N/mm[2]	7.6	7.2	6.8	6.5	6.0	5.6	4.8
	Anchor Category, water saturated concrete		-	-	3	3	2	2	2	2	2
	Strength Reduction Factor[5,7]		ϕ_{ws}	-	0.45	0.45	0.55	0.55	0.55	0.55	0.55
Water-filled Hole	Temperature Category A[2,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	711			703		N/A	N/A
				N/mm[2]	4.9			4.8		N/A	N/A
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	535	505	534	504	470	N/A	N/A
				N/mm[2]	3.6	3.4	3.6	3.4	3.2	N/A	N/A
	Temperature Category B, Range 1[3,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1,296	1,310	1,323			N/A	N/A
				N/mm[2]	8.9	9.0	9.1			N/A	N/A
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	1,150	1,090	994	936	873	369	310
				N/mm[2]	7.9	7.5	6.8	6.4	6.0	2.5	2.1
	Anchor Category, water-filled hole		-	-	3	3	2	2	2	3	3
	Strength Reduction Factor[5,7]		ϕ_{wf}	-	0.45	0.45	0.55	0.55	0.55	0.45	0.45

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

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

[3] Temperature Category B, Range 1: Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 130°F (54°C).

[4] Short-term elevated concrete temperatures are those that occur over brief intervals, e.g., transient or part of a regular cycle of heating and cooling, such as day-night temperature rise and fall. Long-term elevated concrete temperatures are roughly constant over significant periods of time.

[5] The tabulated value of ϕ applies when load combinations of Section 1605.2 of the IBC or either ACI 318-14 5.3 or ACI 318-11 Section 9.2, are used in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ shall be determined in accordance with ACI 318-11 D.4.4.

[6] Additional reduction factor shall be applied if tension loads are sustained. $\tau_{k,sust,uncr} = \tau_{k,uncr} \cdot k_{sust}$ or $\tau_{k,sust,cr} = \tau_{k,cr} \cdot k_{sust}$

[7] The ϕ values correspond to Condition B as described in ACI 318-14 17.3.3 or Section D.4.3 of ACI 318-11 for post-installed anchors designed using the load combinations of IBC Section 1605.2. If the load combinations in ACI 318-11 Appendix C are used, the corresponding value of ϕ shall be determined.

TABLE 13 – METRIC THREADED ROD BOND STRENGTH DESIGN INFORMATION WITH CONTINUOUS SPECIAL INSPECTION[1]

Design Information			Symbol	Units	Nominal SI Threaded Rod Diameter					
					M10	M12	M16	M20	M24	M30
Minimum Effective Installation Depth			$h_{ef,min}$	in.	2 1/3	2 3/4	3 1/7	3 1/2	3 7/9	4 5/7
				mm	60	70	80	90	96	120
Maximum Effective Installation Depth			$h_{ef,max}$	in.	7 7/8	9 4/9	12 3/5	15 3/4	18 8/9	23 5/8
				mm	200	240	320	400	480	600
Adjustment for Sustained Tension Loading[7]			k_{sust}	-	0.71					
Dry Concrete	Temperature Category A[2,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	711		703		711	
				N/mm[2]	4.9		4.8		4.9	
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	603	578	539	500	451	392
				N/mm[2]	4.1	3.9	3.7	3.4	3.1	2.7
	Temperature Category B, Range 1[3,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1,296					
				N/mm[2]	8.9					
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	1,106	1,067	994	907	830	728
				N/mm[2]	7.6	7.3	6.8	6.2	5.7	5.0
	Anchor Category, dry concrete		-	-	1	1	1	1	1	1
	Strength Reduction Factor[5,7]		ϕ_d	-	0.65	0.65	0.65	0.65	0.65	0.65
Water Saturated Concrete	Temperature Category A[2,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	689		696			703
				N/mm[2]	4.7		4.7			4.8
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	609	584	528	490	451	388
				N/mm[2]	4.1	4.0	3.6	3.3	3.1	2.6
	Temperature Category B, Range 1[3,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1,296		1,283	1,296		
				N/mm[2]	8.9		8.8	8.9		
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	1,094	1,056	984	907	830	720
				N/mm[2]	7.5	7.2	6.7	6.2	5.7	4.9
	Anchor Category, water saturated concrete		-	-	3	3	2	2	2	2
	Strength Reduction Factor[5,7]		ϕ_{ws}	-	0.45	0.45	0.55	0.55	0.55	0.55
Water-filled Hole	Temperature Category A[2,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	696				N/A	N/A
				N/mm[2]	4.7				N/A	N/A
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	535	515	528	490	N/A	N/A
				N/mm[2]	3.7	3.6	3.6	3.3	N/A	N/A
	Temperature Category B, Range 1[3,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1,283		1,296	1,310	N/A	N/A
				N/mm[2]	8.8		8.9	9.0	N/A	N/A
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	1,083	1,056	984	907	390	335
				N/mm[2]	7.4	7.2	6.7	6.2	2.7	2.3
	Anchor Category, water-filled hole		-	-	3	3	2	2	3	3
	Strength Reduction Factor[5,7]		ϕ_{wf}	-	0.45	0.45	0.55	0.55	0.45	0.45

[1] Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi. Bond strength values shall not be increased for concrete compressive strength.
[2] Temperature Category A: Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 176°F (80°C).
[3] Temperature Category B, Range 1: Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 130°F (54°C).
[4] Short-term elevated concrete temperatures are those that occur over brief intervals, e.g., transient or part of a regular cycle of heating and cooling, such as day-night temperature rise and fall. Long-term elevated concrete temperatures are roughly constant over significant periods of time.
[5] The tabulated value of ϕ applies when load combinations of Section 1605.2 of the IBC or either ACI 318-14 5.3 or ACI 318-11 Section 9.2, are used in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ shall be determined in accordance with ACI 318-11 D.4.4.
[6] Additional reduction factor shall be applied if tension loads are sustained. $\tau_{k,sust,uncr} = \tau_{k,uncr} \cdot k_{sust}$ or $\tau_{k,sust,cr} = \tau_{k,cr} \cdot k_{sust}$
[7] The ϕ values correspond to Condition B as described in ACI 318-14 17.3.3 or Section D.4.3 of ACI 318-11 for post-installed anchors designed using the load combinations of IBC Section 1605.2. If the load combinations in ACI 318-11 Appendix C are used, the corresponding value of ϕ shall be determined.

TABLE 14 – METRIC REBAR BOND STRENGTH DESIGN INFORMATION WITH CONTINUOUS SPECIAL INSPECTION[1]

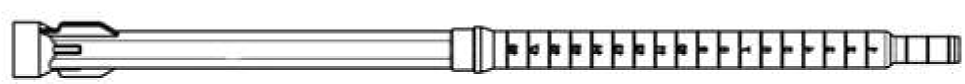
Design Information			Symbol	Units	Nominal Rebar Diameter					
					Ø10mm	Ø12mm	Ø16mm	Ø20mm	Ø25mm	Ø32mm
Minimum Effective Installation Depth			$h_{ef,min}$	in.	2 1/3	2 3/4	3 1/7	3 1/2	4	5
				mm	60	70	80	90	100	128
Maximum Effective Installation Depth			$h_{ef,max}$	in.	7 7/8	9 4/9	12 3/5	15 3/4	19 2/3	25 1/5
				mm	200	240	320	400	500	640
Adjustment for Sustained Tension Loading[6]			k_{sust}	-	0.71					
Dry Concrete	Temperature Category A[2,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	703		711			
				N/mm[2]	4.8		4.9			
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	615	572	534	495	441	380
				N/mm[2]	4.2	3.9	3.6	3.4	3.0	2.6
	Temperature Category B, Range 1[3,5]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1,310					
				N/mm[2]	9.0					
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	1,117	1,078	1,015	936	837	710
				N/mm[2]	7.7	7.4	6.9	6.4	5.7	4.9
	Anchor Category, dry concrete		-	-	1	1	1	1	1	1
	Strength Reduction Factor[5,7]		ϕ_d	-	0.65	0.65	0.65	0.65	0.65	0.65
Water Saturated Concrete	Temperature Category A[2,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	689		703			
				N/mm[2]	4.7		4.8			
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	615	590	545	505	450	380
				N/mm[2]	4.2	4.1	3.7	3.4	3.1	2.6
	Temperature Category B, Range 1[3,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1,337			1,296		
				N/mm[2]	9.2			8.9		
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	1,140	1,089	1,015	926	828	710
				N/mm[2]	7.9	7.5	6.9	6.3	5.7	4.9
	Anchor Category, water saturated concrete		-	-	3	3	2	2	2	2
	Strength Reduction Factor[5,7]		ϕ_{ws}	-	0.45	0.45	0.55	0.55	0.55	0.55
Water-filled Hole	Temperature Category A[2,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	689	696		703	N/A	N/A
				N/mm[2]	4.7	4.7		4.8	N/A	N/A
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	535	515	534	495	N/A	N/A
				N/mm[2]	3.7	3.6	3.6	3.4	N/A	N/A
	Temperature Category B, Range 1[3,4]	Characteristic Bond Strength in Non-cracked Concrete	$\tau_{k,uncr}$	psi	1,350	1,337			N/A	N/A
				N/mm[2]	9.3	9.2			N/A	N/A
		Characteristic Bond Strength in Cracked Concrete	$\tau_{k,cr}$	psi	1,129	1,089	1,005	926	380	320
				N/mm[2]	7.7	7.5	6.9	6.3	2.6	2.2
	Anchor Category, water-filled hole		-	-	3	3	2	2	3	3
	Strength Reduction Factor[5,7]		ϕ_{wf}	-	0.45	0.45	0.55	0.55	0.45	0.45

[1] Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi. Bond strength values shall not be increased for concrete compressive strength.
[2] Temperature Category A: Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 176°F (80°C).
[3] Temperature Category B, Range 1: Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 130°F (54°C).
[4] Short-term elevated concrete temperatures are those that occur over brief intervals, e.g., transient or part of a regular cycle of heating and cooling, such as day-night temperature rise and fall. Long-term elevated concrete temperatures are roughly constant over significant periods of time.
[5] The tabulated value of ϕ applies when load combinations of Section 1605.2 of the IBC or either ACI 318-14 5.3 or ACI 318-11 Section 9.2, are used in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ shall be determined in accordance with ACI 318-11 D.4.4.
[6] Additional reduction factor shall be applied if tension loads are sustained. $\tau_{k,sust,uncr} = \tau_{k,uncr} \cdot k_{sust}$ or $\tau_{k,sust,cr} = \tau_{k,cr} \cdot k_{sust}$
[7] The ϕ values correspond to Condition B as described in ACI 318-14 17.3.3 or Section D.4.3 of ACI 318-11 for post-installed anchors designed using the load combinations of IBC Section 1605.2. If the load combinations in ACI 318-11 Appendix C are used, the corresponding value of ϕ shall be determined.

FIGURE 2 – USP CIA-Gel 7000-C ADHESIVE ANCHORING SYSTEM

Left to right: GEL7C-10, GEL7C-14, GEL7C-22, GEL7C-52

Mixer Nozzle “7C-SMN”



Mixer Nozzle “7C-XLMN”

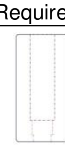
Left to right: 3/8” (9mm) Ø extension tube “FXT38”, 9/16” (14mm) Ø extension tube FXT916”, resin stoppers

TABLE 15 – INSTALLATION PARAMETERS (US CUSTOMARY SIZES)

Threaded Rod Installations

Anchor Size	Drilled Hole Size	Cleaning Brush Size	Nozzle Type 7C-SMN	Nozzle Type 7C-XLMN	Extension Tube Required?	Resin Stopper Required?	Notes
							
3/8”	1/2”	7CHCB-12	✓		FXT-38 > 3.5” h_{ef}	N	
1/2"	9/16”	7CHCB-916	✓		FXT-38 > 3.5” h_{ef}	N	
5/8”	3/4"	7CHCB-34	✓	✓	FXT-916 > 10” h_{ef}	ERS-34>10”h_{ef}	7C-XLMN required at h_{ef} > 8”
3/4"	7/8”	7CHCB-78		✓	FXT-916 > 10” h_{ef}	ERS-34>10”h_{ef}	
7/8”	1”	7CHCB-1		✓	FXT-916 > 10” h_{ef}	ERS-1>10”h_{ef}	
1”	1-1/8”	7CHCB-118		✓	FXT-916 > 10” h_{ef}	ERS-1>10”h_{ef}	
1-1/4"	1-3/8”	7CHCB-138		✓	FXT-916 > 10” h_{ef}	ERS-138>10”h_{ef}	

Reinforcing Bar Installations

Anchor Size	Drilled Hole Size	Cleaning Brush Size	Nozzle Type 7C-SMN	Nozzle Type 7C-XLMN	Extension Tube Required?	Resin Stopper Required?	Notes
							
#3	9/16”	7CHCB-916	✓		FXT-38 > 3.5” h_{ef}	N	
#4	5/8”	7CHCB-58	✓	✓	FXT-38 > 3.5” h_{ef}	N	7C-XLMN nozzle required at h_{ef} > 3.5”
#5	3/4"	7CHCB-34	✓	✓	FXT-916 > 10” h_{ef}	ERS-34 >10”h_{ef}	7C-XLMN nozzle required at h_{ef} > 8”
#6	7/8”	7CHCB-1		✓	FXT-916 > 10” h_{ef}	ERS-34 >10”h_{ef}	
#7	1”	7CHCB-118		✓	FXT-916 > 10” h_{ef}	ERS-1 >10”h_{ef}	
#8	1-1/8”	7CHCB-112		✓	FXT-916 > 10” h_{ef}	ERS-1 >10”h_{ef}	
#10	1-3/8”	7CHCB-158		✓	FXT-916 > 10” h_{ef}	ERS-138 >10”h_{ef}	

Key:
FXT-38 Requires 3/8 inch diameter extension tube fitted to 7C-SMN nozzle
FXT-916 Requires 9/16 inch diameter extension tube fitted to 7C-XLMN nozzle
ERS-34 Use 18mm diameter resin stopper
ERS-1 Use 22mm diameter resin stopper
ERS-138 Use 30mm diameter resin stopper
N Not required

TABLE 16 – INSTALLATION PARAMETERS (SI SIZES)

Threaded Rod Installations							
Anchor Size	Drilled Hole Size	Cleaning Brush Size	Nozzle Type		Extension Tube Required?	Resin Stopper Required?	Notes
			7C-SMN	7C-XLMN			
							
M10	1/2"	7CHCB-12	✓		FXT-38 >90mm h_{ef}	N	
M12	9/16"	7CHCB-916	✓		FXT-38 > 90mm h_{ef}	N	
M16	3/4"	7CHCB-34	✓	✓	FXT-916 > 250mm h_{ef}	ERS-34 > 250mm h_{ef}	7C-XLMN nozzle required at h_{ef} > 200mm
M20	7/8"	7CHCB-78		✓	FXT-916 > 250mm h_{ef}	ERS-34 > 250mm h_{ef}	
M24	1-1/8"	7CHCB-118		✓	FXT-916 > 250mm h_{ef}	ERS-1 > 250mm h_{ef}	
M30	1-3/8"	7CHCB138		✓	FXT-916 > 250mm h_{ef}	ERS-138 > 250mm h_{ef}	

Reinforcing Bar Installations							
Anchor Size	Drilled Hole Size	Cleaning Brush Size	Nozzle Type		Extension Tube Required?	Resin Stopper Required?	Notes
			7C-SMN	7C-XLMN			
							
T10	9/16"	7CHCB-916	✓		FXT38 >90mm h_{ef}	N	
T12	5/8"	7CHCB-58	✓	✓	FXT38 >90mm h_{ef}	N	7C-XLMN nozzle required at h_{ef} > 90mm
T16	3/4"	7CHCB-34	✓	✓	FXT916 > 250mm h_{ef}	ERS-34 > 250mm h_{ef}	7C-XLMN nozzle required at h_{ef} > 200mm
T20	7/8"	7CHCB-1		✓	FXT916 > 250mm h_{ef}	ERS-1 > 250mm h_{ef}	
T25	1-1/8"	7CHCB-112		✓	FXT916 > 250mm h_{ef}	ERS-1 > 250mm h_{ef}	
T32	1-3/8"	7CHCB-158		✓	FXT916 > 250mm h_{ef}	ERS-138 > 250mm h_{ef}	

Key:
FXT-38 Requires 10mm diameter extension tube fitted to 7C-SMN nozzle
FXT-916 Requires 14 mm diameter extension tube fitted to 7C-XLMN nozzle
ERS-34 Use 18 mm diameter resin stopper
ERS-1 Use 22 mm diameter resin stopper
ERS-138 Use 30 mm diameter resin stopper
N Not required

TABLE 17 – ALLOWABLE COMBINATIONS OF CARTRIDGE, MIXER NOZZLE AND DISPENSING TOOLS

Cartridge Reference	Allowable Applicator Tools	Allowable Nozzle Types 7C-SMN	7C-XLMN
GEL7C-10	 USP HDT-10 or Cox 300ml Manual (26:1 mechanical advantage)	✓	
GEL7C-14	 USP HDT-14 or Cox 400ml Manual (26:1 mechanical advantage)	✓	✓
GEL7C-22	 USP HDT-22 or Newborn 600ml Manual (26:1 mechanical advantage)	✓	✓
	 USP PDT-22 or Newborn 600ml Pneumatic		
GEL7C-52	 USP PDT-51 or Newborn 1500ml Pneumatic	✓	✓

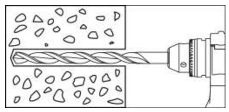
FIGURE 3 – INSTALLATION DETAILS

CIA-Gel 7000-C: MPII

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

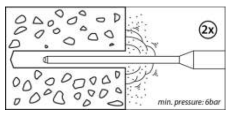
Important: check the expiration date on the cartridge **(do not use expired material)** and that the cartridge has been stored in its original packaging, the correct way up, in cool conditions (50°F to 77°F) out of direct sunlight.

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

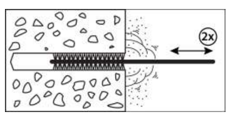


2. Select the correct Air Lance, insert to the bottom of the hole and depress the trigger for 2 seconds. The compressed air must be clean – free from water and oil – and at a minimum pressure of 90 psi (6 bar).

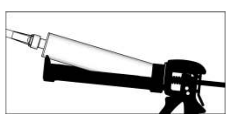
   Perform the blowing operation twice.



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



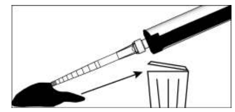
4. Repeat 2 (blowing operation) twice.
5. Repeat 3 (brushing operation) twice.
6. Repeat 2 (blowing operation) twice.
7. Select the appropriate static mixer nozzle, checking that the mixing elements are present and correct (**do not modify the mixer**). Attach mixer nozzle to the cartridge. Check the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



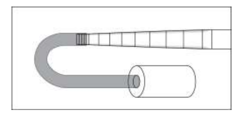
Note: The 7C-XLMN nozzle is in two sections. One section contains the mixing elements and the other section is an extension piece. Connect the extension piece to the mixing section by pushing the two sections firmly together until a positive engagement is felt.

Note: CIA-Gel 7000-C may only be installed between concrete temperatures of 40°F to 104°F for horizontal to downward installation direction, and 50°F to 104°F for horizontal to overhead direction. The product must be conditioned to a minimum of 50°F. For gel and cure time data, refer to Table 18.

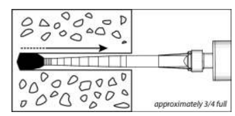
8. Extrude some resin to waste until an even-colored mixture is extruded, the cartridge is now ready for use.



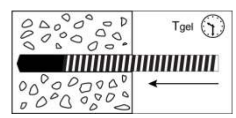
9. Attach an extension tube with resin stopper (if required) to the end of the mixing nozzle with a push fit. (The extension tubes may be pushed into the resin stoppers and are held in place with a coarse internal thread).



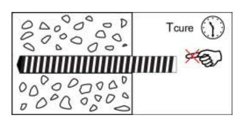
10. Insert the mixing nozzle to the bottom of the hole. Extrude the resin and slowly withdraw the nozzle from the hole. **Ensure no air voids are created as the nozzle is withdrawn**. Inject resin until the hole is approximately 3/4 full and remove the nozzle from the hole.



11. Select the steel anchor element ensuring it is free from oil or other contaminants, and mark with the required embedment depth. Insert the steel element into the hole using a back and forth twisting motion to ensure complete cover, until it reaches the bottom of the hole. Excess resin will be expelled from the hole evenly around the steel element and there shall be no gaps between the anchor element and the wall of the drilled hole.



12. Clean any excess resin from around the mouth of the hole.
13. Do not disturb the anchor until at least the minimum cure time has elapsed.



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

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

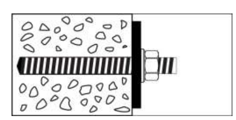
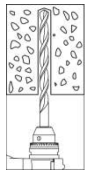


FIGURE 4 – INSTALLATION DETAILS CONTINUED

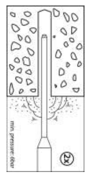
Overhead Substrate Installation

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

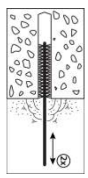


2. Select the correct Air Lance, insert to the bottom of the hole and depress the trigger for 2 seconds. The compressed air must be clean – free from water and oil – and at a minimum pressure of 90 psi (6 bar).

   Perform the blowing operation twice.



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



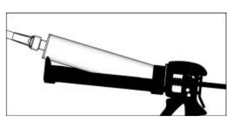
4. Repeat 2 (blowing operation) twice.

5. Repeat 3 (brushing operation) twice.

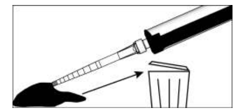
6. Repeat 2 (blowing operation) twice.

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

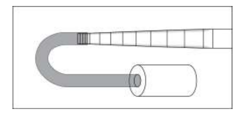
   Note: The 7C-XLMN nozzle is in two sections. One section contains the mixing elements and the other section is an extension piece. Connect the extension piece to the mixing section by pushing the two sections firmly together until a positive engagement is felt.



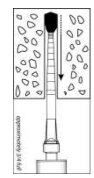
8. Extrude some resin to waste until an even-colored mixture is extruded, the cartridge is now ready for use.



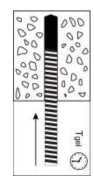
9. Attach an extension tube with resin stopper (if required) to the end of the mixing nozzle with a push fit. (The extension tubes may be pushed into the resin stoppers and are held in place with a coarse internal thread).



10. Insert the mixing nozzle to the bottom of the hole. Extrude the resin and slowly withdraw the nozzle from the hole. **Ensure no air voids are created as the nozzle is withdrawn**. Inject resin until the hole is approximately 3/4 full and remove the nozzle from the hole.

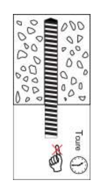


11. Select the steel anchor element ensuring it is free from oil or other contaminants, and mark with the required embedment depth. Insert the steel element into the hole using a back and forth twisting motion to ensure complete cover, until it reaches the bottom of the hole. Excess resin will be expelled from the hole evenly around the steel element and there shall be no gaps between the anchor element and the wall of the drilled hole.



12. Clean any excess resin from around the mouth of the hole.

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



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

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

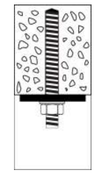

TABLE 18 – EXAMPLE ALOWABLE STRESS DESIGN TENSION VALUES

Example Allowable Stress Design (ASD) Calculation for Illustrative Purposes				
Anchor Diameter (in.)	Embedment Depth Max / Min (in.)	Characteristic Bond Strength $\tau_{k,uncr}$ (psi)	Allowable Tension Load (lb) 2,500 psi – 8,000 psi Concrete	Controlling Failure Mode
3/8”	2.375	1,350	1,929	Breakout Strength
	7.500	1,350	4,910	Steel Strength
1/2"	2.750	1,350	2,403	Breakout Strength
	10.000	1,350	8,990	Steel Strength
5/8”	3.125	1,350	2,911	Breakout Strength
	12.500	1,350	14,316	Steel Strength
3/4"	3.500	1,350	3,451	Breakout Strength
	15.000	1,350	21,157	Steel Strength
7/8”	4.000	1,350	4,216	Breakout Strength
	17.500	1,350	29,265	Steel Strength
1”	4.000	1,350	4,216	Breakout Strength
	20.000	1,350	38,387	Steel Strength
1-1/4"	4.000	1,350	4,216	Breakout Strength
	25.000	1,350	61,381	Steel Strength

Design Assumptions

1. Single anchor in static tension only, Grade B7 threaded rod
2. Downwardly inclined orientation installation direction
3. Inspection regime = Periodic
4. Installation temperature 70°F to 110°F
5. Long term temperature 110°F
6. Short term temperature 110°F
7. Dry condition (carbide drilled hole)
8. Embedment (h_{ef}) = min / max for each diameter
9. Concrete determined to remain uncracked for life of anchor
10. Load combinations from ACI 318 Section 9.2 (no seismic loading)
11. 30% dead load and 70% live load. Controlling combination 1.2D + 1.6L
12. Calculation of weighted average for α = 1.2(0.3) + 1.6(0.7) = 1.48
13. f'_c = 2,500 psi (normal weight concrete)
14. $c_{ac1} = c_{ac2} \geq c_{ac}$
15. $h \geq h_{min}$

Illustrative Procedure to Calculate Allowable Stress Design Tension Value			
EX1 Anchor 1/2" Diameter, using an embedment of 2.75", with the given design assumptions			
	Procedure	Calculation	
Step 1:	Calculate steel strength of a single anchor in tension per ACI 318 D.5.1.2 Table 5 of this report.	φN_{sa}	$= \varphi N_{sa}$ = 0.75 x 17740 = 13,305 lbs.
Step 2:	Calculate breakout strength of a single anchor in tension per ACI 318 D 5.2 Section 4.1.3 of this report.	N_b φN_{cb}	$= k_{c,uncr}\sqrt{(f'_c)}h_{ef}^{1.5}$ $= 24 \times (2500)^{0.5} \times 2.75^{1.5}$ = 5,472 lbs, $= (A_{NC} / A_{NC0})\psi_{ed,N}\psi_{c,N}\psi_{cp,N}N_b$ = 0.65 x 1 x 1 x 1 x1 x 5,472 = 3,557 lbs.
Step 3:	Calculate bond strength of a single anchor in tension per Equations D-16a, D-16f and Table 7 of this report.	N_{ao} φN_{ao}	$= \tau_{k,uncr}\pi d h_{ef}$ = 1,350 x 3.141 x 0.5 x 2.75 = 5,832 lbs. $= (A_{Na} / A_{Na}0)\psi_{ed,Na}\psi_{c,Na}N_{ao}$ = 0.65 x 7,468 = 3,790 lbs.
Step 4:	Determine Controlling resistance strength in tension per ACI318 D 4.1.1 and D 4.1.2.	3,557 lbs.	= controlling resistance (breakout)
Step 5:	Calculate Allowable Stress Design conversion factor for loading condition per ACI 318 Section 9.2	α	= 1.2DL + 1.6LL = 1.2 x 0.3 + 1.6 x 0.7 = 1.48
Step 6:	Calculate Allowable Stress Design value per Section 4.2 of this report.	$T_{allowable,ASD}$	= 3557 / 1.48 = 2,403 lbs