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ICC-ES Evaluation Report

ESR-5026

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

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

REPORT HOLDER:

SIMPSON STRONG-TIE COMPANY INC.

EVALUATION SUBJECT:

SIMPSON STRONG-TIE® AT-3G™ ADHESIVE ANCHORS AND POST-INSTALLED REINFORCING BAR CONNECTIONS IN CRACKED AND UNCRACKED CONCRETE

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2021, 2018, 2015, 2012 and 2009 *International Building Code*® (IBC)
- 2021, 2018, 2015, 2012 and 2009 *International Residential Code*® (IRC)

For evaluation for compliance with codes adopted by Los Angeles Department of Building and Safety (LADBS), see ESR-5026 LABC and LARC Supplement.

Property evaluated:

Structural

2.0 USES

The Simpson Strong-Tie® AT-3G™Adhesive Anchor System is used as anchorage and the Post-Installed Reinforcing Bar Connections is used as reinforcing bar connection (for development length and splice length) in cracked and uncracked normalweight concrete with a specified compressive strength, f'_c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa) to resist static, wind or earthquake (IBC Seismic Design Categories A through F) tension and shear loads.

The anchor system complies with anchors as described in Section 1901.3 of the 2021, 2018 and 2015 IBC, Section 1909 of the 2012 IBC and is an alternative to cast-in-place and post-installed anchors described in Section 1908 of the 2012 IBC, and Sections 1911 and 1912 of the 2009 IBC. The anchor system may also be used where an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

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

3.0 DESCRIPTION

3.1 General:

The Simpson Strong-Tie® AT-3G™ Adhesive Anchor System and Post-Installed Reinforcing Bar Connections is comprised of Simpson Strong-Tie AT-3G two-component adhesive filled in cartridges, static mixing nozzles, dispensing tools, hole cleaning equipment and adhesive injection accessories, and steel anchor elements, which are continuously threaded steel rods or deformed steel reinforcing bars.

The primary components of the Simpson Strong-Tie® AT-3G™ Adhesive Anchor System and Post-Installed Reinforcing Bar Connections, include the Simpson Strong-Tie AT-3G adhesive cartridge, static mixing nozzle and steel anchor elements. The manufacturer's printed installation instructions (MPII), included with each adhesive unit package, are shown in Figure 4 of this report.

3.2 Materials:

3.2.1 Simpson Strong-Tie AT-3G Adhesive: Simpson Strong-Tie AT-3G adhesive is an injectable two-component vinylester-urethane hybrid adhesive. The two components are kept separate by means of a labelled dual-cylinder cartridge. The two components combine and react when dispensed through a static mixing nozzle, supplied by Simpson Strong-Tie, which is attached to the cartridge. Simpson Strong-Tie AT-3G is available in: coaxial cartridges: 9.5-ounce (280 mL) and side-by-side cartridges: 28-ounce (825 mL).

Each cartridge label is marked with the adhesive expiration date. The shelf life, as indicated by the expiration date, applies to an unopened cartridge stored in a dry, dark, and cool environment.

3.2.2 Hole Cleaning Equipment:

3.2.2.1 Standard Equipment: Hole cleaning equipment is comprised of steel wire brushes supplied by Simpson

Strong-Tie, and air blowers which are shown in Figure 4 of this report.

3.2.3 Dispensers: Simpson Strong-Tie AT-3G adhesive must be dispensed with manual dispensers, pneumatic dispensers, or electric powered dispensers supplied by Simpson Strong-Tie.

3.2.4 Steel Anchor Elements:

3.2.4.1 Threaded Steel Rods for use in Post-Installed Anchor Applications: Threaded steel rods must be clean and continuously threaded (all-thread) in diameters described in Table 3 and Figure 4 of this report. Specifications for grades of threaded rod, including the mechanical properties, and corresponding nuts and washers, are included in Table 1 of this report. Carbon steel threaded rods must be furnished with a minimum 0.0002-inch-thick (0.005 mm) zinc electroplated coating complying with ASTM B633, SC1 or a minimum 0.0021-inch-thick (0.053 mm) mechanically deposited zinc coating complying with ASTM B695, Class 55. The stainless steel threaded rods must comply with Table 1 of this report. Steel grades and types of material (carbon, stainless) for the washers and nuts must match the threaded rods. Threaded steel rods must be clean, straight and free of indentations or other defects along their length. The embedded end may be flat cut or cut on the bias to a chisel point.

3.2.4.2 Steel Reinforcing Bars for use in Post-Installed Anchor Applications: Steel reinforcing bars must be deformed reinforcing bars as described in Table 2 of this report. Table 6 and Figure 4 summarize reinforcing bar size ranges. The embedded portions of reinforcing bars must be clean, straight, and free of mill scale, rust, mud, oil and other coatings (other than zinc) that may impair the bond with the adhesive. Reinforcing bars must not be bent after installation except as set forth in ACI 318-19 Section 26.6.3.2 (b), ACI 318-14 Section 26.6.3.1 (b) or ACI 318-11 Section 7.3.2, as applicable, with the additional condition that the bars must be bent cold, and heating of reinforcing bars to facilitate field bending is not permitted.

3.2.4.3 Steel Reinforcing Bars for Use in Post-Installed Reinforcing Bar Connections: Steel reinforcing bars used in post-installed reinforcing bar connections must be deformed reinforcing bars (rebars) as depicted in Figures 2 and 3. Table 9, and Figure 4 summarize reinforcing bar size ranges. The embedded portions of reinforcing bars must be clean, straight, and free of mill scale, rust, mud, oil and other coatings that may impair the bond with the adhesive. Reinforcing bars must not be bent after installation, except as set forth in Section 26.6.3.2(b) of ACI 318-19, Section 26.6.3.1(b) of ACI 318-14 or Section 7.3.2 of ACI 318-11, as applicable, with the additional condition that the bars must be bent cold, and heating of reinforcing bars to facilitate field bending is not permitted.

3.2.4.4 Ductility: In accordance with ACI 318-19 Section 2.3, ACI 318-14 Section 2.3 or ACI 318-11 Appendix D Section D.1, as applicable, in order for a steel anchor element to be considered ductile, the tested elongation must be at least 14 percent and reduction of area must be at least 30 percent. Steel elements with a tested elongation less than 14 percent or a reduction of area less than 30 percent, or both, are considered brittle. Specifications and physical properties of various steel materials are provided for threaded rods in Table 1 and for reinforcing bars in Table 2 of this report. Where values are nonconforming or unstated, the steel must be considered brittle.

3.3 Concrete:

Normalweight concrete must comply with Sections 1903 and 1905 of the IBC. The specified compressive strength of the concrete must be from 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).

4.0 DESIGN AND INSTALLATION

4.1 Strength Design of Post-Installed Anchors:

4.1.1 General: The design strength of anchors under the 2021 IBC and 2021 IRC must comply with ACI 318-19 Section 17.5.1.2 and this report, except as required in ACI 318-19 Section 17.10. The design strength of anchors under the 2018 and 2015 IBC, as well as the 2018 and 2015 IRC, must be determined in accordance with ACI 318-14 and this report. The design strength of anchors under the 2012 and 2009 IBC, as well as the 2012 and 2009 IRC, must be determined in accordance with ACI 318-11 and this report.

Under the 2021 IBC and IRC, strength reduction factors, ϕ, as given in ACI 318-19 Section 17.5.3, must be used for load combinations calculated in accordance with 2021 IBC Section 1605.1 and ACI 318-19 Section 5.3.

Under the 2018 and 2015 IBC and IRC, the strength design of anchors must comply with ACI 318-14 17.3.1 or 318-11 D.4.1, as applicable, except as required in ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable.

Design parameters are provided in Tables 3 through Table 8 of this report.

Under the 2018 and 2015 IBC and IRC, strength reduction factors, ϕ, as given in ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, must be used for load combinations calculated in accordance with Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable.

Under the 2012 and 2009 IBC and IRC, strength reduction factors, ϕ, as given in ACI 318-11 D.4.4 must be used for load combinations calculated in accordance with ACI 318-11 Appendix C.

4.1.2 Static Steel Strength in Tension: The nominal static steel strength of a single anchor in tension, N_{sa}, in accordance with ACI 318-19 17.6.1.2, ACI 318-14 17.4.1.2 or ACI 318-11 D.5.1.2, as applicable, and the associated strength reduction factors, ϕ, in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are provided in Tables 3 and 6 of this report for the corresponding anchor steel.

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

The basic concrete breakout strength of a single anchor in tension, N_b, must be calculated in accordance with ACI 318-19 17.6.2.2, ACI 318-14 17.4.2.2 or ACI 318-11 D.5.2.2, as applicable, using the values of $k_{c,cr}$ and $k_{c,uncr}$ as provided in Tables 4 and 7 of this report. Where analysis indicates no cracking in accordance with ACI 318-19 17.6.2.5, ACI 318-14 17.4.2.6 or ACI 318-11 D.5.2.6, as applicable, N_b must be calculated using $k_{c,uncr}$ and $\Psi_{c,N}$ = 1.0. For anchors in lightweight concrete see ACI 318-19 17.2.4, ACI 318-14 17.2.6 or ACI 318-11 D.3.6, as applicable. The value of f'_c used for calculation must be limited to 8,000 psi (55 MPa) in accordance with ACI 318-19 17.3.1, ACI 318-14 17.2.7 or ACI 318-11 D.3.7, as applicable. Additional information for the determination of nominal bond strength in tension is given in Section 4.1.4 of this report.

4.1.4 Static Bond Strength in Tension: The nominal static bond strength of a single adhesive anchor or group of adhesive anchors in tension, N_a or N_{ag}, must be calculated

in accordance with ACI 318-19 17.6.5, ACI 318-14 17.4.5 or ACI 318-11 D.5.5, as applicable.

Bond strength values ($\tau_{k,cr}$, $\tau_{k,uncr}$) are a function of concrete compressive strength, concrete state (cracked, uncracked) and installation conditions (dry concrete, water-saturated concrete, water-filled holes). Special inspection level is qualified as periodic for all anchors except as shown in Section 4.4 of this report (the selection of continuous special inspection level does not provide an increase in anchor category or associated strength reduction factor for design). The following table summarizes the requirements:

CONCRETE STATE	BOND STRENGTH	CONCRETE COMPRESSIVE STRENGTH	PERMISSIBLE INSTALLATION CONDITIONS	ASSOCIATED STRENGTH REDUCTION FACTOR
cracked	$\tau_{k,cr}$	f'_c	Dry concrete	ϕ_d
			Water-saturated concrete	ϕ_{ws}
			Water-filled holes	ϕ_{wf}
uncracked	$\tau_{k,uncr}$		Dry concrete	ϕ_d
			Water-saturated concrete	ϕ_{ws}
			Water- filled holes	ϕ_w

Strength reduction factors for determination of the bond strength are given in Tables 5 and 8 of this report. Adjustments to the bond strength may also be made for increased concrete compressive strength as noted in the footnotes to the corresponding tables and this section.

The bond strength values in Tables 5 and 8 of this report correspond to concrete compressive strength f'_c equal to 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi and 8,000 psi (17.2 MPa and 55 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2{,}500)^{0.10}$ [For **SI:** $(f'_c / 17.2)^{0.10}$]. Where applicable, the modified bond strength values must be used in lieu of $\tau_{k,cr}$ and $\tau_{k,uncr}$ in ACI 318-19 Equations (17.6.5.1.2b) and (17.6.5.2.1), ACI 318-14 Equations (17.4.5.1d) and (17.4.5.2) or ACI 318-11 Equations (D-21) and (D-22), as applicable.

The resulting nominal bond strength must be multiplied by the associated strength reduction factor ϕ_d, ϕ_{ws} or ϕ_{wf}, as applicable.

4.1.5 Static Steel Strength in Shear: The nominal static steel strength of a single anchor in shear as governed by the steel, V_{sa}, in accordance with ACI 318-19 17.7.1.2, ACI 318-14 17.5.1.2 or ACI 318-11 D.6.1.2, as applicable, and the strength reduction factor, ϕ, in accordance with ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are given in Tables 3 and 6 of this report for the corresponding anchor steel.

4.1.6 Static Concrete Breakout Strength in Shear: The nominal static concrete breakout strength of a single anchor or group of anchors in shear, V_{cb} or V_{cbg}, must be calculated in accordance with ACI 318-19 17.7.2, ACI 318-14 17.5.2 or 318-11 D.6.2, as applicable, based on information given in Tables 4 and 7 in this report.

The basic concrete breakout strength of a single anchor in shear, V_b, must be calculated in accordance with ACI 318-19 17.7.2.2, ACI 318-14 17.5.2.2 or ACI 318-11 D.6.2.2, as applicable, using the values of d given in Tables 4 and 7 of this report for the corresponding anchor steel in lieu of d_a. In addition, h_{ef} must be substituted for ℓ_e. In no case shall ℓ_e exceed $8d$. The value of f'_c shall be limited to a maximum of 8,000 psi (55 MPa) in accordance with ACI 318-19 17.3.1, ACI 318-14 17.2.7 or ACI 318-11 D.3.7, as applicable.

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

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

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

For anchors that will be torqued during installation, the maximum torque, T_{max}, must be reduced for edge distances less than the values given in Tables 4 and 7 as applicable. T_{max} is subject to the edge distance, c_{min}, and anchor spacing, s_{min}, and shall comply with the following requirements:

INSTALLATION TORQUE SUBJECT TO EDGE DISTANCE			
NOMINAL ANCHOR SIZE, d	MINIMUM EDGE DISTANCE, c_{min}	MINIMUM ANCHOR SPACING, s_{min}	MAXIMUM TORQUE, T_{max}
$^5/_8$ in. to 1 in. #5 to #8	1.75 in.	$5d$	$0.45 \cdot T_{max}$
$1^1/_4$ in. #9	2.75 in.		

For values of T_{max}, see Figure 4 of this report.

4.1.10 Critical Edge Distance c_{ac} and $\psi_{cp,Na}$: The modification factor $\psi_{cp,Na}$, must be determined in accordance with ACI 318-19 17.6.5.5, ACI 318-14 17.4.5.5 or ACI 318-11 D.5.5.5, as applicable, except as noted below:

For all cases where $c_{Na}/c_{ac}<1.0$, $\psi_{cp,Na}$ determined from ACI 318-19 Eq. 17-6.5.5.1b, ACI 318-14 Eq. 17.4.5.5b or ACI 318-11 Eq. D-27, as applicable, need not be taken less than c_{Na}/c_{ac}. For all other cases, $\psi_{cp,Na}$ shall be taken as 1.0.

The critical edge distance, c_{ac} must be calculated according to Eq. 17.6.5.5.1c for ACI 318-19, Eq. 17.4.5.5c for ACI 318-14 or Eq. D-27a for ACI 318-11, in lieu of ACI 318-19 17.9.5, ACI 318-14 17.7.6 or ACI 318-11 D.8.6, as applicable.

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

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

where

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

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

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

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

The nominal steel shear strength, V_{sa}, must be adjusted by $\alpha_{V,seis}$ as given in Tables 3 and 6 for the corresponding anchor steel. The nominal bond strength $\tau_{k,cr}$ must be adjusted by $\alpha_{N,seis}$ as given in Table 5 for threaded rods, and Table 8 for reinforcing bars.

As an exception to ACI 318-11 Section D.3.3.4.2: Anchors designed to resist wall out-of-plane forces with design strengths equal to or greater than the force determined in accordance with ASCE 7 Equation 12.11-1 or 12.14-10 shall be deemed to satisfy ACI 318-11 Section D.3.3.4.3(d).

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

4.2 Strength Design of Post-Installed Reinforcing Bars:

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

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

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

Exceptions:

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

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

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

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

REBAR SIZE	MINIMUM CONCRETE COVER, $c_{c,min}$
$d_b \leq$ No. 6	$1^3/_{16}$ in.
No. 6 < $d_b \leq$ No.9	$1^9/_{16}$ in.

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

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

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

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

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

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

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

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

4.3 Installation:

Installation parameters are illustrated in Figure 1 of this report. Installation must be in accordance with ACI 318-19 26.7.2, ACI 318-14 17.8.1 and 17.8.2 or ACI 318-11 D.9.1 and D.9.2. Anchor and post-installed reinforcing bar locations must comply with this report and the plans and specifications approved by the code official. Installation of the Simpson Strong-Tie AT-3G Adhesive Anchor and Post-Installed Reinforcing Bar Connections must conform to the manufacturer's printed installation instructions included in each unit package and provided in Figure 4 of this report.

The adhesive anchor system may be used for upwardly inclined orientation applications (e.g., overhead). Upwardly inclined and horizontal orientation applications are to be installed using piston plugs for the $^1/_2$-inch- through $1^1/_4$-inch-diameter threaded steel rods and No. 4 through No. 9 steel reinforcing bars, installed in the specified hole diameter, and attached to the mixing nozzle and extension tube supplied by Simpson Strong-Tie as described in Figure 4 in this report. Upwardly inclined and horizontal orientation installation for the $^3/_8$-inch diameter threaded steel rods, and No. 3 steel reinforcing bars may be injected directly to the end of the hole using a mixing nozzle with a bore hole depth $d_0 \leq 10$" (250 mm).

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

4.4 Special Inspection:

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

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

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

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

4.5 Compliance with NSF/ANSI Standard 61:

The Simpson Strong-Tie AT-3G Adhesive Anchor System complies with the requirements of NSF/ANSI Standard 61, as referenced in Section 605 of the 2021, 2018, 2015, 2012, and 2009 *International Plumbing Code*® (IPC) and is certified for use as an anchoring adhesive for installing threaded rods less than or equal to 1.3 inches (33 mm) in diameter in concrete for water treatment applications.

5.0 CONDITIONS OF USE

The Simpson Strong-Tie AT-3G Adhesive Anchor System and Post-Installed Reinforcing Bar Connections described in this report comply with or are a suitable alternative to what is specified in, the codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 Simpson Strong-Tie AT-3G adhesive anchors and post-installed reinforcing bars must be installed in accordance with the manufacturer's printed installation instructions included with each cartridge and provided in Figure 4 of this report.

5.2 The anchors and post-installed reinforcing bars described in this report must be installed in cracked and uncracked normalweight concrete having a specified compressive strength f'_c = 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).

5.3 The concrete shall have attained its minimum specified compressive strength, $f'_{c,}$ prior to installation of the anchors and post installed reinforcing bars.

5.4 The values of f'_c used for calculation purposes must not exceed 8,000 psi (55 MPa).

5.5 Anchors and post-installed reinforcing bars must be installed in concrete base materials in holes predrilled in accordance with the instructions provided in Figure 4 of this report.

5.6 Loads applied to the anchors and post-installed reinforcing bars must be adjusted in accordance with Section 1605.1 of the 2021 IBC or Section 1605.2 of the 2018, 2015, and 2012 IBC for strength design.

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

5.8 Simpson Strong-Tie AT-3G adhesive anchors and post-installed reinforcing bars are permitted to be installed in concrete that is cracked or that may be expected to crack during the service life of the anchors and post-installed reinforcing bars, subject to the conditions of this report.

5.9 Strength design values of the post-installed anchors are established in accordance with Section 4.1 of this report.

5.10 Post-installed reinforcing bar development and splice lengths are established in accordance with Section 4.2 of this report.

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

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

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

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

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

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

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

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

5.18 Steel anchoring elements in contact with preservative-treated and fire-retardant-treated wood shall be of zinc-coated steel or stainless steel. The minimum coating weights for zinc-coated steel shall be in accordance with ASTM A153.

5.19 Periodic special inspection must be provided in accordance with Section 4.4 in this report. Continuous special inspection for anchors and post-installed reinforcing bars installed in horizontal or upwardly inclined orientations to resist sustained tension loads must be provided in accordance with Section 4.4 of this report.

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

5.21 Simpson Strong-Tie AT-3G adhesive anchors and post-installed reinforcing bars may be used to resist tension and shear forces in floor, wall for overhead installations into concrete with a temperature between 23°F and 104°F (-5°C and 40°C) for threaded rods and rebar.

5.22 Anchors and post-installed reinforcing bars shall not be used for installations where the concrete temperature can vary from 40°F (5°C) or less to 80°F (27°C) or higher within a 12-hour period. Such applications may include but are not limited to anchorage of building facade systems and other applications subject to direct sun exposure.

5.23 Simpson Strong-Tie AT-3G adhesive is manufactured under a quality-control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete (AC308), dated June 2019, editorially revised February 2021, which incorporates requirements in ACI 355.4-11 for use in cracked and uncracked concrete; including, but not limited to, tests under freeze/thaw conditions, tests under sustained load, tests for installation including installation direction and condition, tests at elevated temperatures, tests for resistance of alkalinity, tests for resistance to sulphur and tests for seismic tension and shear.

7.0 IDENTIFICATION

7.1 Simpson Strong-Tie AT-3G adhesive is identified by packaging labelled with the company's name (Simpson Strong-Tie) and address, anchor name, the lot number, the expiration date, and the evaluation report number (ESR-5026). Threaded rods, nuts, washers, and deformed reinforcing bars must be standard steel anchor elements and must conform to applicable national or international specifications as set forth in Tables 1 and 2 of this report.

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

SIMPSON STRONG-TIE COMPANY INC.
5956 WEST LAS POSITAS BOULEVARD
PLEASANTON, CALIFORNIA 94588
(800) 999-5099
www.strongtie.com

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

	THREADED ROD SPECIFICATION		MINIMUM SPECIFIED ULTIMATE STRENGTH, f_{uta}	MINIMUM SPECIFIED YIELD STRENGTH 0.2 PERCENT OFFSET, f_{ya}	f_{uta}/f_{ya}	ELONGATION, MIN. PERCENT[8]	REDUCTION OF AREA, MIN. PERCENT	SPECIFICATION FOR NUTS[9]
CARBON STEEL	ASTM A193[2] Grade B7	psi (MPa)	125,000 (860)	105,000 (720)	1.19	16	50	ASTM A194 / A563 Grade DH
	ASTM A36[3] / F1554[4], Grade 36	psi (MPa)	58,000 (400)	36,000 (250)	1.61	23	40	ASTM A194 / A563 Grade A
	ASTM F1554[4] Grade 55	psi (MPa)	75,000 (515)	55,000 (380)	1.36	23	40	
	ASTM F1554[4] Grade 105	psi (MPa)	125,000 (860)	105,000 (725)	1.19	15	45	ASTM A194 / A563 Grade DH
	ASTM A449[5] (3/8" to1" dia.)	psi (MPa)	120,000 (830)	92,000 (635)	1.30	14	35	
	ASTM A449[5] (1-1/4" dia.)	psi (MPa)	105,000 (720)	81,000 (560)	1.30	14	35	
STAINLESS STEEL	ASTM F593[6] CW1 3/8 to 5/8 in.	psi (MPa)	100,000 (690)	65,000 (450)	1.54	20	-	ASTM F594 Alloy Group 1, 2 or 3
	ASTM F593[6] CW2 3/4 to 1 1/4 in.	psi (MPa)	85,000 (590)	45,000 (310)	1.89	25	-	
	ASTM A193/A193M[7] Grade B8/B8M2, Class 2B	psi (MPa)	95,000 (655)	75,000 (515)	1.27	25	40	ASTM A194/A194M

[1]Adhesive must be used with continuously threaded carbon or stainless steel rod (all-thread) having thread characteristics complying with ANSI B1.1 UNC Coarse Thread Series.
[2]Standard Specification for Alloy-Steel and Stainless steel Bolting Materials for High temperature of High Pressure service and Other Special Purpose Applications.
[3]Standard Specification for Carbon Structural steel.
[4]Standard Specification for Anchor Bolts, Steel 36, 55 and 105-ksi Yield Strength.
[5]Standard Specification for Hex Cap Screws, Bolts and Studs, Heat Treated, 120/105/50 ksi Minimum Tensile Strength, General Use.
[6]Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
[7]Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
[8]Based on 2-in. (50 mm) gauge length except for ASTM A193, which is based on a gauge length of 4d.
[9]Nuts and washers of other grades and style having specified proof load stress greater than the specified grade and style are also suitable. Nuts must have specified proof load stresses equal to or greater than the minimum tensile strength of the specified threaded rod.

TABLE 2—SPECIFICATIONS AND PHYSICAL PROPERTIES OF COMMON STEEL REINFORCING BARS

REINFORCING SPECIFICATION	UNITS	MINIMUM SPECIFIED ULTIMATE STRENGTH, f_{uta}	MINIMUM SPECIFIED YIELD STRENGTH, f_{ya}
ASTM A615[1], A767[3], A996[4] Grade 60	psi (MPa)	90,000 (620)	60,000 (414)
ASTM A706[2], A767[3] Grade 60	psi (MPa)	80,000 (550)	60,000 (414)
ASTM A615[1], Grade 40	psi (MPa)	60,000 (415)	40,000 (275)

[1]Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
[2]Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
[3]Standard specification for Zinc-Coated (Galvanized) steel Bars for Concrete Reinforcement.
[4]Standard specification for Rail-Steel and Axle-steel Deformed bars for Concrete Reinforcement.

TABLE 3—STEEL DESIGN INFORMATION FOR UNIT THREADED ROD[1]

DESIGN INFORMATION		Symbol	Units	Nominal Rod Diameter (inch)						
				3/8	1/2	5/8	3/4	7/8	1	1 1/4
Threaded rod O.D.		d	in. (mm)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)	0.875 (22.2)	1.000 (25.4)	1.250 (31.8)
Threaded rod effective cross-sectional area		A_{se}	in.² (mm²)	0.0775 (50)	0.1419 (92)	0.2260 (146)	0.3345 (216)	0.4617 (298)	0.6057 (391)	0.9691 (625)
ASTM A36/F1554, Grade 36	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lb (kN)	4,495 (20.0)	8,230 (36.6)	13,110 (58.3)	19,400 (86.3)	26,780 (119.1)	35,130 (156.3)	56,210 (250.0)
		V_{sa}	lb (kN)	2,695 (12.0)	4,940 (22.0)	7,860 (35.0)	11,640 (51.8)	16,070 (71.4)	21,080 (93.8)	33,725 (150.0)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.60						
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						
ASTM F1554 Grade 55	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lb (kN)	5,815 (25.9)	10,645 (47.6)	16,950 (75.5)	25,090 (111.7)	34,630 (154.1)	45,430 (202.1)	72,685 (323.1)
		V_{sa}	lb (kN)	3,490 (15.5)	6,385 (28.6)	10,170 (45.3)	15,055 (67)	20,780 (92.5)	27,260 (121.3)	43,610 (193.9)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.60						
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						
ASTM A193 Grade B7 ASTM F1554 Grade 105	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lb (kN)	9,685 (43.1)	17,735 (78.9)	28,250 (125.7)	41,810 (186.0)	57,710 (256.7)	75,710 (336.8)	121,135 (538.8)
		V_{sa}	lb (kN)	5,810 (25.9)	10,640 (47.3)	16,950 (75.4)	25,085 (111.6)	34,625 (154.0)	45,425 (202.1)	72,680 (323.3)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.60						
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						
ASTM A449	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lb (kN)	9,300 (41.4)	17,030 (76.2)	27,120 (120.9)	40,140 (178.8)	55,405 (246.7)	72,685 (323.7)	101,755 (450.0)
		V_{sa}	lb (kN)	5,580 (24.8)	10,220 (45.7)	16,270 (72.5)	24,085 (107.3)	33,240 (148)	43,610 (194.2)	61,055 (270.0)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.60						
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						
ASTM F593 CW Stainless	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lb (kN)	7,750 (34.5)	14,190 (63.1)	22,600 (100.5)	28,430 (126.5)	39,245 (174.6)	51,485 (229.0)	82,370 (366.4)
		V_{sa}	lb (kN)	4,650 (20.7)	8,515 (37.9)	13,560 (60.3)	17,060 (75.9)	23,545 (104.7)	30,890 (137.4)	49,425 (219.8)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.60						
	Strength reduction factor for tension[2]	ϕ	-	0.65						
	Strength reduction factor for shear[2]	ϕ	-	0.60						
ASTM A193/A193M Grade B8/B8M2, Class 2B	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lb (kN)	7,365 (32.8)	13,480 (60.3)	21,470 (95.6)	31,780 (141.5)	43,860 (195.2)	57,540 (256.1)	92,065 (409.4)
		V_{sa}	lb (kN)	4,420 (19.7)	8,090 (36.2)	12,880 (57.4)	19,070 (84.9)	26,320 (117.1)	34,525 (153.7)	55,240 (245.6)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.60						
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						

[1]Values provided for common rod material types based on specified strengths and calculated in accordance with ACI 318-19 Eq. 17.6.1.2 and 17.7.1.2b, ACI 318-14 Eq. 17.4.1.2 and Eq. 17.5.1.2 b or ACI 318-11 Eq. (D-2) and Eq. (D-29), as applicable. Nuts and washers must comply with requirements for the rod.

[2]The tabulated value of ϕ applies when the load combinations of Section 1605.1 of the 2021 IBC, Section 1605.2 of the 2018, 2015 and 2012 IBC, ACI 318-19 5.3, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, as set forth in ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are used. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.

TABLE 4—CONCRETE BREAKOUT DESIGN INFORMATION FOR THREADED ROD

DESIGN INFORMATION	Symbol	Units	Nominal Rod Diameter (inch)						
			3/8	1/2	5/8	3/4	7/8	1	1 1/4
Effectiveness factor for cracked concrete	$k_{c,cr}$	in-lb (SI)	17 (7)						
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	in-lb (SI)	24 (10)						
Min. anchor spacing	s_{min}	in. (mm)	1 7/8 (48)	2 1/2 (64)	3 (76)	3 3/4 (95)	4 1/4 (108)	4 3/4 (121)	5 7/8 (149)
Min. edge distance	c_{min}	in. (mm)	1 5/8 (41)	1 3/4 (44)	2 (51)	2 3/8 (60)	2 1/2 (64)	2 3/4 (70)	3 1/4 (82)
					For smaller edge distances see Section 4.1.9 of this report.				
Min. member thickness	h_{min}	in. (mm)	h_{ef} + 1 1/4 (h_{ef} + 30)		h_{ef} + 2d_0 [2]				
Critical edge distance - splitting (for uncracked concrete)[1]	c_{ac}	-	See Section 4.1.10 of this report.						
Strength reduction factor for tension, concrete failure modes, Condition B[1]	ϕ	-	0.65						
Strength reduction factor for shear, concrete failure modes, Condition B[1]	ϕ	-	0.70						

[1]Condition A requires supplemental reinforcement, while Condition B applies where supplemental reinforcement is not provided or where pullout or pryout governs, as set forth in ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. The tabulated value of ϕ applies when the load combinations of Section 1605.1 of the 2021 IBC, Section 1605.2 of the 2018, 2015 and 2012 IBC , ACI 318-19 5.3, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, as set forth in ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.
[2] d_0 = hole diameter.

TABLE 5—BOND STRENGTH DESIGN INFORMATION FOR THREADED ROD [1]

DESIGN INFORMATION		Symbol	Units	Nominal Rod Diameter (inch)						
				3/8	1/2	5/8	3/4	7/8	1	1 1/4
Minimum embedment		$h_{ef,min}$	in. (mm)	2 3/8 (60)	2 3/4 (70)	3 1/8 (79)	3 1/2 (89)	3 1/2 (89)	4 (102)	5 (127)
Maximum embedment		$h_{ef,max}$	in. (mm)	7 1/2 (191)	10 (254)	12 1/2 (318)	15 (381)	17 1/2 (445)	20 (508)	25 (635)
Temperature range A[2,3]:	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (N/mm²)	2,600 (17.9)	2,415 (16.6)	2,260 (15.6)	2,140 (14.8)	2,055 (14.2)	2,000 (13.8)	1,990 (13.7)
	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (N/mm²)	1,040 (7.2)	1,040 (7.2)	1,110 (7.7)	1,220 (8.4)	1,210 (8.4)	1,205 (8.3)	1,145 (7.9)
Temperature range B[2,3]:	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (N/mm²)	2,265 (15.6)	2,100 (14.5)	1,970 (13.6)	1,865 (12.8)	1,785 (12.3)	1,740 (12.0)	1,730 (11.9)
	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (N/mm²)	905 (6.2)	905 (6.2)	965 (6.7)	1,060 (7.3)	1,055 (7.3)	1,050 (7.2)	995 (6.9)
Temperature range C[2,3]:	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (N/mm²)	1,630 (11.2)	1,515 (10.4)	1,420 (9.8)	1,345 (9.3)	1,290 (8.9)	1,255 (8.6)	1,250 (8.6)
	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (N/mm²)	650 (4.5)	655 (4.5)	695 (4.8)	765 (5.3)	760 (5.2)	755 (5.2)	720 (5.0)
Dry Concrete	Anchor category	–	-	1	1	1	1	1	1	1
	Strength reduction factor	ϕ_d	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Water-saturated concrete	Anchor category	–	-	2	2	2	2	2	2	2
	Strength reduction factor	ϕ_{ws}	-	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Water-filled holes	Anchor category	–	-	3	3	3	3	3	3	3
	Strength reduction factor	ϕ_{wf}	-	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Reduction factor for seismic tension		$\alpha_{N,seis}$	-	0.95						

[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi. For concrete compressive strength, f'_c between 2,500 psi and 8,000 psi, the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2500)^{0.10}$. See Section 4.1.4 of this report.
[2]Temperature range A: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 122°F (50°C); Temperature range B: Maximum short term temperature = 248°F (120°C), maximum long term temperature = 161°F (72°C); Temperature range C: Maximum short term temperature = 320°F (160°C), maximum long term temperature = 212°F (100°C).
Short term elevated concrete temperatures are those that occur over brief intervals, e.g. as result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
[3]Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only such as wind, bond strengths may be increased by 23 percent for temperature range C.

TABLE 6—STEEL DESIGN INFORMATION FOR REINFORCING BARS [1]

DESIGN INFORMATION		Symbol	Units	Nominal Bar Size						
				No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9
Reinforcing bar O.D.		d	in. (mm)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)	0.875 (22.2)	1.000 (25.4)	1.125 (28.6)
Reinforcing bar effective cross-sectional area		A_{se}	in.² (mm²)	0.110 (71)	0.200 (129)	0.310 (200)	0.440 (284)	0.600 (387)	0.790 (510)	1.000 (645)
ASTM A615, A767, A996 Grade 60	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lb (kN)	9,900 (44.0)	18,000 (80.1)	27,900 (124.1)	39,600 (176.0)	54,000 (240.0)	71,100 (316.0)	90,000 (400.0)
		V_{sa}	lb (kN)	5,940 (26.4)	10,800 (48.0)	16,740 (74.5)	23,760 (105.7)	32,400 (144.1)	42,660 (189.8)	54,000 (240.2)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.65						
	Strength reduction factor for tension[2]	ϕ	-	0.65						
	Strength reduction factor for shear[2]	ϕ	-	0.60						
ASTM A706 Grade 60	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lb	8,800	16,000	24,800	35,200	48,000	63,200	80,000
			(kN)	(39.1)	(71.2)	(110.3)	(156.6)	(213.5)	(281.1)	(355.9)
		V_{sa}	lb	5,280	9,600	14,880	21,120	28,800	37,920	48,000
			(kN)	(23.5)	(42.7)	(66.2)	(93.9)	(128.1)	(168.7)	(213.5)
	Reduction for seismic shear	$\alpha_{V,seis}$	----	0.65						
	Strength reduction factor ϕ for tension[2]	ϕ	----	0.75						
	Strength reduction factor ϕ for shear[2]	ϕ	----	0.65						
ASTM A615 Grade 40	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lb (kN)	6,600 (29.4)	12,000 (53.4)	18,600 (82.7)	26,400 (117.4)	In accordance with ASTM A615, Grade 40 bars are furnished only in sizes No. 3 through No. 6		
		V_{sa}	lb (kN)	3,960 (17.6)	7,200 (32.0)	11,160 (49.6)	15,840 (70.5)			
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.65						
	Strength reduction factor for tension[2]	ϕ	-	0.65						
	Strength reduction factor for shear[2]	ϕ	-	0.60						

[1]Values provided for common bar material types based on specified strengths and calculated in accordance with ACI 318-19 Eq. 17.6.1.2 and Eq. 17.7.1.2b, ACI 318-14 Eq. 17.4.1.2 and Eq. 17.5.1.2 b or ACI 318-11 Eq. (D-2) and Eq. (D-29), as applicable.

[2]The tabulated value of ϕ applies when the load combinations of Section 1605.1 of the 2021 IBC, Section 1605.2 of the 2018, 2015 and 2012 IBC, ACI 318-19 5.3, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, as set forth in ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are used. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.

TABLE 7—CONCRETE BREAKOUT DESIGN INFORMATION FOR REINFORCING BARS

DESIGN INFORMATION	Symbol	Units	Nominal Bar Size						
			No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9
Effectiveness factor for cracked concrete	$k_{c,cr}$	in-lb (SI)	17 (7)						
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	in.-lb. (SI)	24 (10)						
Min. anchor spacing	s_{min}	in. (mm)	$1^7/_8$ (48)	$2^1/_2$ (64)	3 (76)	$3^3/_4$ (95)	$4^1/_4$ (108)	$4^3/_4$ (121)	$5^1/_4$ (133)
Min. edge spacing	c_{min}	in. (mm)	$1^5/_8$ (41)	$1^3/_4$ (44)	2 (51)	$2^3/_8$ (60)	$2^1/_2$ (64)	$2^3/_4$ (70)	3 (76)
					For smaller edge distances see Section 4.1.9 of this report.				
Min. member thickness	h_{min}	in. (mm)	$h_{ef} + 1^1/_4$ (h_{ef} + 30)		$h_{ef} + 2d_0$[2]				
Critical edge spacing – splitting (for uncracked concrete)	c_{ac}	-	See Section 4.1.10 of this report.						
Strength reduction factor for tension, concrete failure modes, Condition B[1]	ϕ	-	0.65						
Strength reduction factor for shear, concrete failure modes, Condition B[1]	ϕ	-	0.70						

[1]Condition A requires supplemental reinforcement, while Condition B applies where supplemental reinforcement is not provided or where pullout or pryout governs, as set forth in ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. The tabulated value of ϕ applies when the load combinations of Section 1605.1 of the 2021 IBC, Section 1605.2 of the 2018, 2015 and 2012 IBC, ACI 318-19 5.3, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, as set forth in ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.
[2]d_0 = hole diameter.

TABLE 8—BOND STRENGTH DESIGN INFORMATION FOR REINFORCING BARS[1]

DESIGN INFORMATION		Symbol	Units	Nominal Bar Size						
				No.3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9
Minimum embedment		$h_{ef,min}$	in. (mm)	$2^3/_8$ (60)	$2^3/_4$ (70)	$3^1/_8$ (79)	$3^1/_2$ (89)	$3^1/_2$ (89)	4 (102)	$4^1/_2$ (114)
Maximum embedment		$h_{ef,max}$	in. (mm)	$7^1/_2$ (191)	10 (254)	$12^1/_2$ (318)	15 (381)	$17^1/_2$ (445)	20 (508)	$22^1/_2$ (572)
Temperature range A[2,3]:	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (N/mm²)	2,200 (15.2)	2,100 (14.5)	2,030 (14.0)	1,970 (13.6)	1,920 (13.2)	1,880 (13.0)	1,845 (12.7)
	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (N/mm²)	1,090 (7.5)	1,055 (7.3)	1,130 (7.8)	1,170 (8.1)	1,175 (8.1)	1,155 (8.0)	1,140 (7.9)
Temperature range B[2,3]:	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (N/mm²)	1,915 (13.2)	1,830 (12.6)	1,765 (12.2)	1,715 (11.8)	1,670 (11.5)	1,635 (11.3)	1,615 (11.1)
	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (N/mm²)	945 (6.5)	915 (6.3)	980 (6.8)	1,015 (7.0)	1,020 (7.0)	1,005 (6.9)	995 (6.8)
Temperature range C[2,3]:	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (N/mm²)	1,380 (9.5)	1,315 (9.1)	1,270 (8.8)	1,235 (8.5)	1,205 (8.3)	1,180 (8.1)	1,155 (8.0)
	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (N/mm²)	680 (4.7)	660 (4.6)	705 (4.9)	735 (5.1)	735 (5.1)	725 (5.0)	715 (4.9)
Dry Concrete	Anchor category	–	-	1	1	1	1	1	1	1
	Strength reduction factor	ϕ_d	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Water-saturated concrete	Anchor category	–	-	2	2	2	2	2	2	2
	Strength reduction factor	ϕ_{ws}	-	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Water-filled holes	Anchor category	–	-	3	3	3	3	3	3	3
	Strength reduction factor	ϕ_{wf}	-	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Reduction factor for seismic tension		$\alpha_{N,seis}$	-	0.95	0.95	1.00	1.00	1.00	1.00	1.00

[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi. For concrete compressive strength f'_c between 2,500 psi and 8,000 psi, tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2{,}500)^{0.10}$. See Section 4.1.4 of this report.
[2]Temperature range A: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 122°F (50°C); Temperature range B: Maximum short term temperature = 248°F (120°C), maximum long term temperature = 161°F (72°C); Temperature range C: Maximum short term temperature = 320°F (160°C), maximum long term temperature = 212°F (100°C). Short term elevated concrete temperatures are those that occur over brief intervals, e.g. as result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
[3]Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short term loads only, such as wind and seismic, bond strengths may be increased by 23 percent for temperature range C.

TABLE 9—DEVELOPMENT LENGTH FOR REINFORCING BARS[1, 2, 4]

DESIGN INFORMATION	Symbol	Criteria Section of Reference Standard	Units	Bar size						
				#3	#4	#5	#6	#7	#8	#9
Nominal reinforcing bar diameter	d_b	ASTM A615/A706	in. (mm)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)	0.875 (22.2)	1.000 (25.4)	1.125 (28.6)
Nominal bar area	A_b	ASTM A615/A706	in^2 (mm^2)	0.11 (71.3)	0.20 (126.7)	0.31 (197.9)	0.44 (285.0)	0.60 (387.9)	0.79 (506.7)	1.00 (644.7)
Development length for f_y = 60 ksi and f'_c = 2,500 psi (normalweight concrete)[3]	l_d	ACI 318-19 25.4.2.4 or ACI 318-14 25.4.2.3 or ACI 318-11 12.2.3	in. (mm)	12.0 (304.8)	14.4 (365.8)	18.0 (457.2)	21.6 (548.6)	31.5 (800.1)	36.0 (914.4)	40.5 (1028.7)
Development length for f_y = 60 ksi and f'_c = 4,000 psi (normalweight concrete)[3]	l_d	ACI 318-19 25.4.2.4 or ACI 318-14 25.4.2.3 or ACI 318-11 12.2.3	in. (mm)	12.0 (304.8)	12.0 (304.8)	14.2 (361.4)	17.1 (433.7)	24.9 (632.5)	28.5 (722.9)	32.0 (812.8)

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

[1] Development lengths valid for static, wind, and earthquake loads (SDC A and B).
[2] Development lengths in SDC C through F must comply with ACI 318-19 Chapter 18, ACI 318-14 Chapter 18 or ACI 318-11 Chapter 21 and Section 4.2.4 of this report.
[3] f_y and f'_c used in this table are for example purposes only. For sand-lightweight concrete, increase development length by 33%, unless the provisions of ACI 318-19 25.4.2.5, ACI 318-14 25.4.2.4 or ACI 318-11 12.2.4 (d) are met to permit $\lambda > 0.75$.
[4] $\left(\frac{c_b + K_{tr}}{d_b}\right) = 2.5$, ψ_t = 1.0, ψ_e = 1.0, ψ_s = 0.8 for $d_b \le$ #6, 1.0 for $d_b >$ #6.

TABLE 10—INSTALLATION DETAILS FOR THREADED RODS

Anchor Diameter (in)	Drill Bit Diameter[1,2] (in)	Maximum Tightening Torque T_{inst} (ft.-lb.)	Wire Brush Part Number	T-Handle Part Number[3]	Handle Extension Part Number[4]	Nozzle Part Number	Dispensing Tool Part Number	Adhesive Retaining Cap Part Number[5]	Adhesive Tubing Part Number[5]	Adhesive Piston Plug Part Number[5]
3/8	7/16	15[7]	ETB43S	ETBS-TH	ETBS-EXT	AMN19Q	CDT10S, ATD813S, ADT30S, ADTA30CKT, ADTA30P	ARC37A-RP25	PPFT25	Not Available[6]
1/2	9/16	30	ETB56S					ARC50A-RP25		PP56-RP10
5/8	11/16	44	ETB68S					ARC62A-RP25		PP68-RP10
3/4	7/8	66	ETB87S					ARC75-RP25		PP87-RP10
7/8	1	96	ETB100S					ARC87-RP25		PP100-RP10
1	1 1/8	147	ETB112S					ARC100-RP25		PP112-RP10
1 1/4	1 3/8	221	ETB137S					ARC125-RP25		PP137-RP10

For **SI:** 1 inch = 25.4mm.

[1]Rotary Hammer must be used to drill all holes.
[2]Drill bits must meet the requirements of ANSI B212.15.
[3]Wire brush must be assembled to T-Handle for proper usage.
[4]Extension is used with T-Handle for holes exceeding 12 inches deep.
[5]Adhesive Retaining Caps, Adhesive Piston Plugs and Tubing are to be used for horizontal and overhead anchor installations.
[6]For 3/8 in. horizontal and overhead installations, inject adhesive directly to the back of the hole using the Adhesive Tubing only.
[7]For ASTM A36/F1554 Grade 36 threaded rod anchors, Maximum Tightening Torque T_{inst} = 11 ft-lb.

TABLE 11—INSTALLATION DETAILS FOR REINFORCING BAR ANCHORS

Rebar Size #	Drill Bit Diameter[1,2] (in)	Maximum Tightening Torque T_{inst} (ft.-lb.)	Wire Brush Part Number	T-Handle Part Number[3]	Handle Extension Part Number[4]	Nozzle Part Number	Dispensing Tool Part Number	Adhesive Retaining Cap Part Number[5]	Adhesive Tubing Part Number[5]	Adhesive Piston Plug Part Number[5]
3	1/2	15	ETB50S	ETBS-TH	ETBS-EXT	AMN19Q	CDT10S, ATD813S, ADT30S, ADTA30CKT, ADTA30P	ARC37-RP25	PPFT25	Not Available[6]
4	5/8	30	ETB62S					ARC50-RP25		PP62-RP10
5	3/4	44	ETB75S					ARC62-RP25		PP75-RP10
6	7/8	66	ETB87S					ARC75-RP25		PP87-RP10
7	1	96	ETB100S					ARC87-RP25		PP100-RP10
8	1 1/8	147	ETB112S					ARC100-RP25		PP112-RP10
9	1 3/8	185	ETB137S					ARC125-RP25		PP137-RP10

For **SI:** 1 inch = 25.4mm.

[1]Rotary Hammer must be used to drill all holes.
[2]Drill bits must meet the requirements of ANSI B212.15.
[3]Wire brush must be assembled to T-Handle for proper usage.
[4]Extension is used with T-Handle for holes exceeding 12 inches deep.
[5]Adhesive Retaining Caps, Adhesive Piston Plugs and Tubing are to be used for horizontal and overhead anchor installations.
[6]For #3 horizontal and overhead installations, inject adhesive directly to the back of the hole using the Adhesive Tubing only.

TABLE 12—CURE SCHEDULE

Concrete Temperature		Gel Time	Cure Time
(°F)	(°C)	(minutes)	
23 to 31	-5 to -1	50	5 hr.
32 to 40	0 to 4	25	3.5 hr.
41 to 49	5 to 9	15	2 hr.
50 to 58	10 to 14	10	1 hr.
59 to 67	15 to 19	6	40 min.
68 to 85	20 to 29	3	30 min
86 to 104	30 to 40	2	30 min.
Cartridge temperature must be between 41°F (5°C) and 104 °F (40°C)			

For **SI:** 1°F = (c x 9/5) + 32

TABLE 13—EMBEDMENT DETAILS FOR POST-INSTALLED REINFORCING BAR CONNECTIONS

Rebar Size #	Min. Emb. Depth $h_{ef,min}$ (in.)	Max. Emb. Depth $h_{ef,max}$ (in.)
3	2 3/8	22 1/2
4	2 3/4	30
5	3 1/8	37 1/2
6	3 1/2	45
7	3 1/2	52 1/2
8	4	60
9	4 1/2	67 1/2

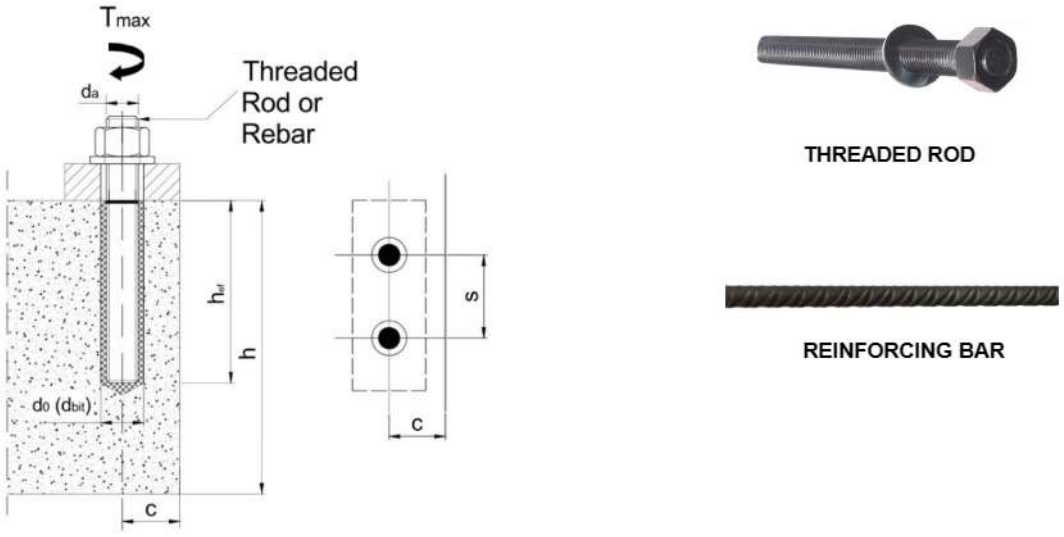


FIGURE 1—INSTALLATION PARAMETERS FOR THREADED RODS AND REINFORCING BARS

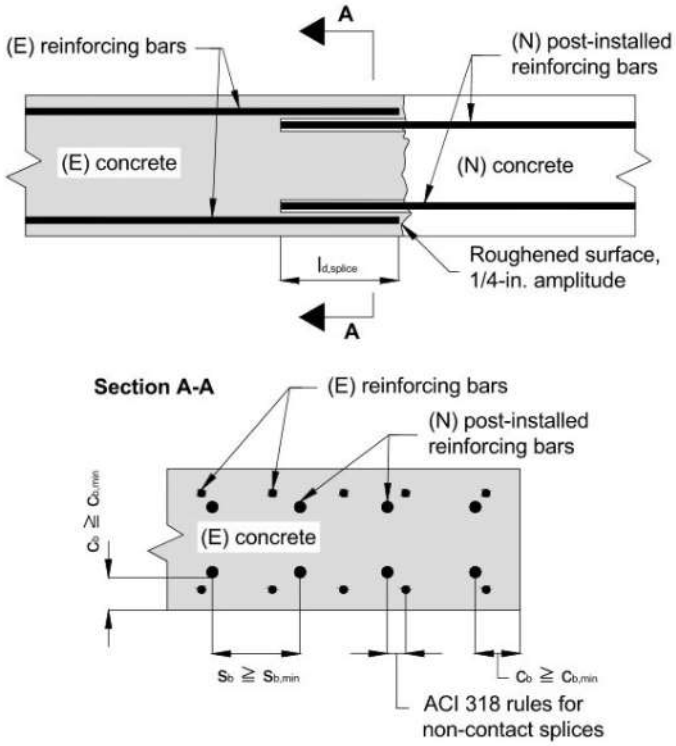


FIGURE 2—INSTALLATION PARAMETERS FOR POST-INSTALLED REINFORCING BARS

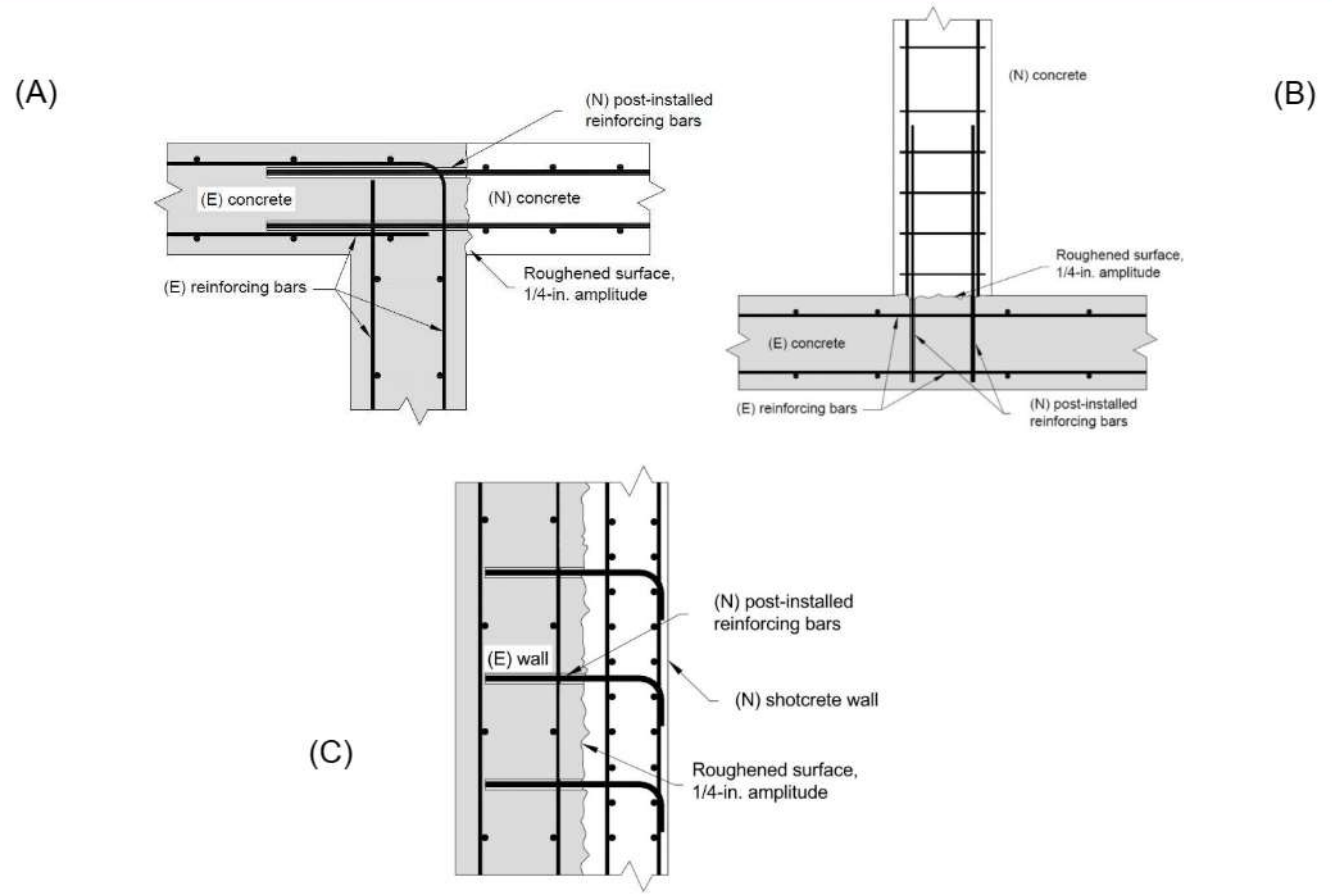
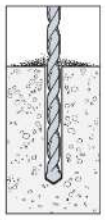


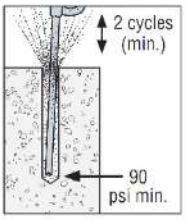
FIGURE 3—APPLICATION EXAMPLES FOR POST-INSTALLED REINFORCING BARS: (A) TENSION LAP SPLICE WITH EXISTING FLEXURAL REINFORCEMENT; (B) TENSION DEVELOPMENT OF COLUMN DOWELS; (C) DEVELOPMENT OF SHEAR DOWELS FOR NEWLY THICKENED SHEAR WALL

1 Hole Preparation

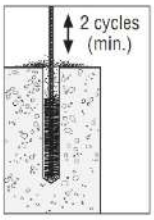
Horizontal, Vertical and Overhead Applications



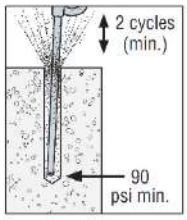
1. Drill.
Drill hole to specified diameter and depth.



2. Blow.
Remove dust from hole with oil-free compressed air for a minimum of two (2) cycles. Compressed air nozzle must reach the bottom of the hole.



3. Brush.
Clean with a steel wire brush for a minimum of two (2) cycles. Brush MUST reach the bottom of the hole. Brush should provide resistance to insertion. If no resistance is felt, the brush is worn and must be replaced.



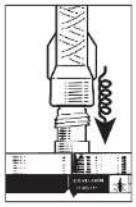
4. Blow.
Remove dust from hole with oil-free compressed air for a minimum of two (2) cycles. Compressed air nozzle must reach the bottom of the hole.

Note: Refer to Tables A and B for proper drill bit size and brush part number.

2 Cartridge Preparation

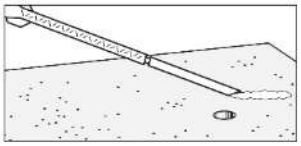
1. Check.
Check expiration date on product label. **Do not use expired product.** Product is usable until end of printed expiration month.

2. Open.
Open cartridge per package instructions.



3. Attach.
Attach proper Simpson Strong-Tie® nozzle and extension to cartridge. Do not modify nozzle.

4. Insert.
Insert cartridge into dispensing tool.



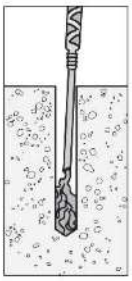
5. Dispense.
Dispense adhesive, at least 3 strokes, to the side until properly mixed (uniform color).

Note: Review MSDS prior to use. Refer to Tables A and B for proper nozzle and dispensing tool part numbers. Refer to Table C for permitted concrete temperature range and adhesive gel times.

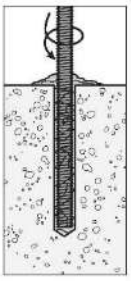
3A Filling the Hole — Vertical Anchorage

Prepare the hole per "Hole Preparation."

DRY AND DAMP HOLES:

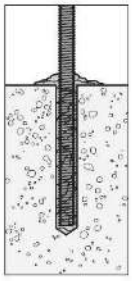


1. Fill.
Fill hole ⅔ full, starting from bottom of hole to prevent air pockets. Withdraw nozzle as hole fills up.



2. Insert.
Insert clean, oil-free anchor, (marked with the required embedment depth), turning slowly until the anchor contacts the bottom of the hole.

Threaded rod or rebar



3. Do not disturb.
Do not disturb load or torque anchor until fully cured.

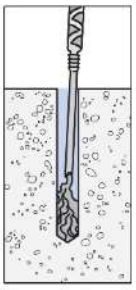
Note: Refer to Table C for proper gel times and cure times, and to Tables D and E for maximum tightening torque. Nozzle extensions (PPFT25) may be needed for deep holes.

FIGURE 4—INSTALLATION INSTRUCTIONS

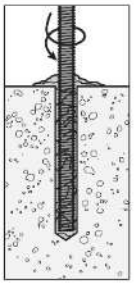
3A Filling the Hole — Vertical Anchorage

Prepare the hole per "Hole Preparation."

WATER-FILLED HOLES:

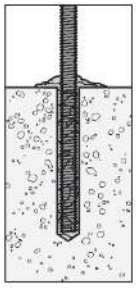


1. Fill.
Fill holes completely full, starting from bottom of hole to prevent water pockets. Withdraw nozzle as hole fills up.



2. Insert.
Insert clean, oil-free anchor, (marked with the required embedment depth), turning slowly until the anchor contacts the bottom of the hole.

Threaded rod or rebar



3. Do not disturb.
Do not disturb load or torque anchor until fully cured.

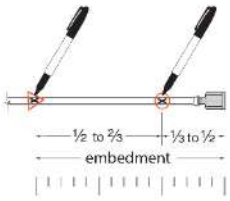
Note: Refer to Table C for proper gel times and cure times, and to Tables D and E for maximum tightening torque. Nozzle extensions (PPFT25) may be needed for deep holes.

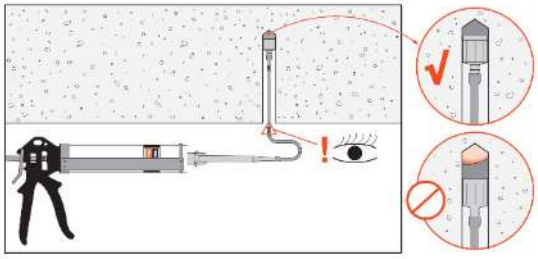
3B Filling the Hole — Horizontal and Overhead Anchorage with Piston Plug System.

Prepare the hole per "Hole Preparation."

Step 1:

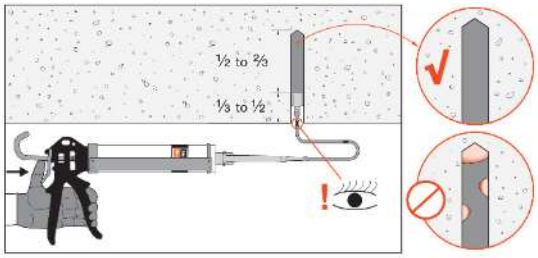
- Attach the piston plug to one end of the flexible tubing (PPFT25). (Refer to Tables A and B.)
- Cut tubing to the length needed for the application, mark tubing as noted below, and attach other end of tubing to the mixing nozzle.
- If using a pneumatic dispensing tool, regulate air pressure to 80–100 psi.





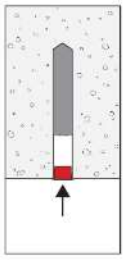
Step 2:

- Insert the piston plug to the back of the drilled hole and dispense adhesive.



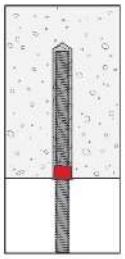
Step 3:

- Fill the hole ⅔ full.
- **Note:** As adhesive is dispensed into the drilled hole, the piston plug will slowly displace out of the hole due to back pressure, preventing air gaps.



Step 4:

- Install the appropriate Simpson Strong-Tie® adhesive retaining cap. (Refer to Tables A and B.)



Step 5:

- Place either threaded rod or rebar through the adhesive retaining cap and into adhesive-filled hole.
- Turn rod/rebar (marked with the required embedment depth) slowly until the insert bottoms out.
- Do not disturb load or torque anchor until fully cured. For overhead installations, the anchor must be secured from movement during the cure time. (e.g., wedges or other restraint methods).

Note: Refer to Table C for proper gel times and cure times, and to Tables D and E for maximum tightening torque.

FIGURE 4—INSTALLATION INSTRUCTIONS (Continued)

Table A — Installation Details for Threaded Rod Anchors

Anchor Diameter (in.)	Drill Bit Diameter[1,2] (in.)	Wire Brush Part Number	T-Handle Part Number[3]	Handle Extension Part Number[4]	Nozzle Part Number	Dispensing Tool Part Number	Adhesive Retaining Cap Part Number[5]	Adhesive Tubing Part Number[5]	Adhesive Piston Plug Part Number[5]
3/8	7/16	ETB43S	ETBS-TH	ETBS-EXT	AMN19Q	CDT10S, ATD813S, ADT30S, ADTA30CKT, ADTA30P	ARC37A-RP25	PPFT25	Not Available[6]
1/2	9/16	ETB56S					ARC50A-RP25		PP56-RP10
5/8	11/16	ETB68S					ARC62A-RP25		PP68-RP10
3/4	7/8	ETB87S					ARC75-RP25		PP87-RP10
7/8	1	ETB100S					ARC87-RP25		PP100-RP10
1	1 1/8	ETB112S					ARC100-RP25		PP112-RP10
1 1/4	1 3/8	ETB137S					ARC125-RP25		PP137-RP10

1. A rotary hammer must be used to drill all holes.
2. Drill bits must meet the requirements of ANSI B212.15.
3. Wire brush must be assembled with T-handle for proper usage.
4. Extension is used with T-handle for holes exceeding 12" deep.
5. Adhesive retaining caps, adhesive piston plugs, and tubing are to be used for horizontal and overhead anchor installations.
6. For 3/8" horizontal and overhead installations, inject adhesive directly to the back of the hole using the adhesive tubing only.

Table B — Installation Details for Reinforcing Bar Anchors

Anchor Size	Drill Bit Diameter[1,2] (in.)	Wire Brush Part Number	T-Handle Part Number[3]	Handle Extension Part Number[4]	Nozzle Part Number	Dispensing Tool Part Number	Adhesive Retaining Cap Part Number[5]	Adhesive Tubing Part Number[5]	Adhesive Piston Plug Part Number[5]
#3	1/2	ETB50S	ETBS-TH	ETBS-EXT	AMN19Q	CDT10S, ATD813S, ADT30S, ADTA30CKT, ADTA30P	ARC37-RP25	PPFT25	Not Available[6]
#4	5/8	ETB62S					ARC50-RP25		PP62-RP10
#5	3/4	ETB75S					ARC62-RP25		PP75-RP10
#6	7/8	ETB87S					ARC75-RP25		PP87-RP10
#7	1	ETB100S					ARC87-RP25		PP100-RP10
#8	1 1/8	ETB112S					ARC100-RP25		PP112-RP10
#9	1 3/8	ETB137S					ARC125-RP25		PP137-RP10

1. A rotary hammer must be used to drill all holes.
2. Drill bits must meet the requirements of ANSI B212.15.
3. Wire brush must be assembled with T-handle for proper usage.
4. Extension is used with T-handle for holes exceeding 12" deep.
5. Adhesive retaining caps, adhesive piston plugs, and tubing are to be used for horizontal and overhead anchor installations.
6. For #3 horizontal and overhead installations, inject adhesive directly to the back of the hole using the adhesive tubing only.

Table C — Cure Schedule

Concrete Temperature		Gel Time (min.)	Cure Time
(F°)	(C°)		
23 to 31	-5 to -1	50	5 hr.
32 to 40	0 to 4	25	3.5 hr.
41 to 49	5 to 9	15	2 hr.
50 to 58	10 to 14	10	1 hr.
59 to 67	15 to 19	6	40 min.
68 to 85	20 to 29	3	30 min.
86 to 104	30 to 40	2	30 min.
Cartridge temperature must be between 41°F (5°C) and 104°F (40°C)			

FIGURE 4—INSTALLATION INSTRUCTIONS (Continued)

Table D — Anchor Tightening Torque, Embedment Depth and Placement Details for Threaded Rod Anchors

Anchor Diameter (in.)	Maximum Tightening Torque T_{inst} (ft.-lb.)	Min. Emb. Depth $h_{ef,min}$ (in.)	Max. Emb. Depth $h_{ef,max}$ (in.)	Min. Anchor Spacing s_{min} (in.)	Min. Edge Distance @ T_{inst} c_{min} (in.)	Min. Edge Distance @ 45% T_{inst}[1] c_{min} (in.)	Min. Concrete Thickness h_{min} (in.)
3/8	15[2]	2 3/8	7 1/2	1 7/8	1 5/8	—	h_{ef} +1 1/4
1/2	30	2 3/4	10	2 1/2	1 3/4		
5/8	44	3 1/8	12 1/2	3	2	1 3/4	h_{ef} + 2d_o
3/4	66	3 1/2	15	3 5/8	2 3/8		
7/8	96	3 1/2	17 1/2	4 1/4	2 1/2		
1	147	4	20	4 3/4	2 3/4		
1 1/4	221	5	25	5 7/8	3 1/4	2 3/4	

1. $s_{min} = 5d_o$
2. For ASTM A36/F1554 Grade 36 threaded rod, Maximum Tightening Torque T_{inst} = 11 ft.-lb.

Table E — Anchor Tightening Torque, Embedment Depth and Placement Details for Reinforcing Bar Anchors

Rebar Size #	Maximum Tightening Torque T_{inst} (ft.-lb.)	Min. Emb. Depth $h_{ef,min}$ (in.)	Max. Emb. Depth $h_{ef,max}$ (in.)	Min. Anchor Spacing s_{min} (in.)	Min. Edge Distance @ T_{inst} c_{min} (in.)	Min. Edge Distance @ 45% T_{inst}[1] c_{min} (in.)	Min. Concrete Thickness h_{min} (in.)
3	15	2 3/8	7 1/2	1 7/8	1 5/8	—	h_{ef} +1 1/4
4	30	2 3/4	10	2 1/2	1 3/4		
5	44	3 1/8	12 1/2	3	2	1 3/4	h_{ef} + 2d_o
6	66	3 1/2	15	3 5/8	2 3/8		
7	96	3 1/2	17 1/2	4 1/4	2 1/2		
8	147	4	20	4 3/4	2 3/4		
9	185	4 1/2	22 1/2	5 1/4	3	2 3/4	

1. $s_{min} = 5d_o$

Table F — Embedment Depth Details for Post-Installed Reinforcing Bar Connections

Rebar Size #	Min. Emb. Depth $h_{ef,min}$ (in.)	Max. Emb. Depth $h_{ef,max}$ (in.)
3	2 3/8	22 1/2
4	2 3/4	30
5	3 1/8	37 1/2
6	3 1/2	45
7	3 1/2	52 1/2
8	4	60
9	4 1/2	67 1/2

FIGURE 4—INSTALLATION INSTRUCTIONS (Continued)

ICC-ES Evaluation Report

ESR-5026 LABC and LARC Supplement

Issued January 2023
Revised April 2023
This report is subject to renewal January 2024.

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

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

REPORT HOLDER:

SIMPSON STRONG-TIE COMPANY INC.

EVALUATION SUBJECT:

SIMPSON STRONG-TIE® AT-3G™ ADHESIVE ANCHORS AND POST-INSTALLED REINFORCING BAR CONNECTIONS IN CRACKED AND UNCRACKED CONCRETE

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the Simpson Strong-Tie AT-3G Adhesive Anchors and Post-Installed Reinforcing Bar Connections in cracked and uncracked concrete, described in ICC-ES evaluation report ESR-5026, have also been evaluated for compliance with the codes noted below as adopted by Los Angeles Department of Building and Safety (LADBS).

Applicable code editions:

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

2.0 CONCLUSIONS

The Simpson Strong-Tie AT-3G Adhesive Anchors and Post-Installed Reinforcing Bar Connections in cracked and uncracked concrete, described in Sections 2.0 through 7.0 of the evaluation report ESR-5026, comply with LABC Chapter 19, and LARC, and are subject to the conditions of use described in this report.

3.0 CONDITIONS OF USE

The Simpson Strong-Tie AT-3G Adhesive Anchors and Post-Installed Reinforcing Bar Connections described in this evaluation report must comply with all of the following conditions:

- All applicable sections in the evaluation report ESR-5026.
- The design, installation, conditions of use and labeling of the anchors are in accordance with the 2021 *International Building Code®* (IBC) provisions noted in the evaluation report ESR-5026.
- The design, installation and inspection are in accordance with additional requirements of LABC Chapters 16 and 17, as applicable.
- Under the LARC, an engineered design in accordance with LARC Section R301.1.3 must be submitted.
- The allowable and strength design values listed in the evaluation report and tables are for the connection of the anchors to the concrete. The connection between the anchors and the connected members shall be checked for capacity (which may govern).
- For use in wall anchorage assemblies to flexible diaphragm applications, anchors shall be designed per the requirements of City of Los Angeles Information Bulletin P/BC 2020-071.

This supplement expires concurrently with the evaluation report, issued January 2023.

ICC-ES Evaluation Report

ESR-5026 FBC Supplement

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REPORT HOLDER:

SIMPSON STRONG-TIE COMPANY INC.

EVALUATION SUBJECT:

SIMPSON STRONG-TIE® AT-3G™ ADHESIVE ANCHORS AND POST-INSTALLED REINFORCING BAR CONNECTIONS IN CRACKED AND UNCRACKED CONCRETE

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the Simpson Strong-Tie AT-3G adhesive anchors, described in ICC-ES evaluation report ESR-5026, have also been evaluated for compliance with the codes noted below.

Applicable code editions:

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

2.0 CONCLUSIONS

The Simpson Strong-Tie AT-3G adhesive anchors, described in Sections 2.0 through 7.0 of the ICC-ES evaluation report ESR-5026, comply with the *Florida Building Code—Building* and the *Florida Building Code—Residential*. The design requirements are in accordance with the *Florida Building Code—Building* and the *Florida Building Code—Residential,* as applicable. The installation requirements noted in ICC-ES evaluation report ESR-5026 for the 2018 *International Building Code®* meet the requirements of the *Florida Building Code—Building* and the *Florida Building Code—Residential*, as applicable.

Use of the Simpson Strong-Tie AT-3G adhesive anchors with stainless steel threaded rod materials and reinforcing bars has also been found to be in compliance with the High-Velocity Hurricane Zone provisions of the *Florida Building Code—Building* and the *Florida Building Code—Residential,* with the following condition:

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

Use of the Simpson Strong-Tie AT-3G adhesive anchors with carbon steel standard steel threaded rod materials for compliance with the High-velocity Hurricane Zone provisions of the *Florida Building Code—Building* and the *Florida Building Code—Residential* has not been evaluated and is outside the scope of the supplemental report, with the following condition:

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

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

This supplement expires concurrently with the evaluation report, issued January 2023.