ICC-ES Evaluation Report

ESR-4632

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This report also contains:

- FBC Supplement

- LABC Supplement

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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: ALLFASTENERS USA LLC**	**EVALUATION SUBJECT: VF200PRO ADHESIVE ANCHOR SYSTEM IN CRACKED AND UNCRACKED CONCRETE**	

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2018, 2015, 2012, 2009 and 2006 *International Building Code®* (IBC)
- 2018, 2015, 2012, 2009 and 2006 *International Residential Code®* (IRC)
- 2013 *Abu Dhabi International Building Code* (ADIBC)†

†The ADIBC is based on the 2009 IBC. 2009 IBC code sections referenced in this report are the same sections in the ADIBC.

For evaluation for compliance with codes adopted by the *Los Angeles Department of Building and Safety* (LADBS), see ESR-4632 LABC and LARC Supplement.

Property evaluated:

Structural

2.0 USES

Adhesive anchors installed using the VF200PRO adhesive are post-installed adhesive anchors used to resist static, wind or earthquake (IBC Seismic Design Categories A through F) tension and shear loads in cracked and uncracked normal-weight concrete with $^1/_2$-, $^5/_8$-, $^3/_4$-, $^7/_8$-, 1-, and $1^1/_4$-inch-diameter (12.7, 15.9, 19.1, 22.2, 25.4 and 31.8 mm) threaded steel rods and No. 4 through No. 10 steel reinforcing bars in hammer-drilled holes. The anchors are used to resist static, wind or earthquake (IBC Seismic Design Categories A and B only) tension and shear loads in uncracked normal-weight concrete only with $^3/_8$-inch-diameter (9.5 mm) threaded steel rods and No. 3 steel reinforcing bars in hammer-drilled holes. Use is limited to normal-weight concrete with a specified compressive strength, f'_c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa) [minimum of 24 MPa is required under ADIBC Appendix L, Section 5.1.1].

The anchor system complies with anchors as described in Section 1901.3 of the 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 and 2006 IBC. The anchor systems may also be used where an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

3.0 DESCRIPTION

3.1 General:

The VF200PRO Adhesive Anchor System is comprised of VF200PRO two-component adhesive filled in cartridges, static mixing nozzles and manual or powered dispensing tools, hole cleaning equipment and adhesive injection accessories.

VF200PRO adhesive may be used with continuously threaded steel rods or deformed steel reinforcing bars. The primary components of the VF200PRO Adhesive Anchor System, including the VF200PRO adhesive cartridge, static mixing nozzle, the nozzle extension tube and steel anchor elements, are shown in Tables 2 and 3, and Figure 1 of this report.

Installation information and parameters are shown in Figure 2 and Tables 10, 11, 12, 13, and 14 of this report.

The manufacturer's printed installation instructions (MPII), as included in the products Technical Data Sheet (TDS) is described in Figure 3 of this report. The MPII is included on each adhesive unit package.

3.2 Materials:

3.2.1 VF200PRO Adhesive: VF200PRO adhesive is an injectable two-component vinylester 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 Allfasteners USA LLC., which is attached to (or included with) the cartridge. VF200PRO is available in 9.5-ounce (280 mL) and 28-ounce (825 mL) cartridges. Each cartridge label is marked with the adhesive expiration date. The shelf life, as indicated by the expiration date, applies to an unopened cartridge stored in a dry, dark, and cool environment, in accordance with the MPII, as illustrated in Figure 3 of this report.

3.2.2 Hole Cleaning Equipment: Hole cleaning equipment is comprised of steel wire brushes supplied by Allfasteners USA LLC., and air nozzles which are depicted in Figure 3 of this report.

3.2.3 Dispensers: VF200PRO adhesive must be dispensed with manual dispensers, pneumatic dispensers, or electric powered dispensers supplied by Allfasteners USA LLC.

3.2.4 Steel Anchor Elements:

3.2.4.1 Threaded Steel Rods: Threaded steel rods must be clean and continuously threaded (all-thread) in diameters described in Tables 4 and 10. Specifications for grades of threaded rod, including the mechanical properties, and corresponding nuts and washers, are included in Table 2 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 SC 1 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 ASTM F593. 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: Steel reinforcing bars are deformed reinforcing bars as described in Table 3 of this report. Tables 7 and 11 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 318-14 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 Ductility: In accordance with ACI 318-14 2.3 or ACI 318-11 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. Values for various steel materials are provided in Table 2 of this report. Where values are nonconforming or unstated, the steel must be considered brittle.

3.3 Concrete:

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

4.0 DESIGN AND INSTALLATION

4.1 Strength Design:

4.1.1 General: 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, 2009, 2006 IBC, as well as the 2012, 2009 and 2006 IRC, must be determined in accordance with ACI 318-11 and this report.

The strength design of anchors must comply with ACI 318-14 17.3.1 or 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 4 through Table 9 of this report. 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.

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 318-14 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 Table 4 and Table 7 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 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, with the following addition:

The basic concrete breakout strength of a single anchor in tension, N_b, must be calculated in accordance with ACI 318-14 17.4.2.2 or ACI 318-11 D.5.2.2, as applicable, using the values of $k_{c,cr}$ and $k_{c,uncr}$ as provided in Table 5 and Table 8 of this report. Where analysis indicates no cracking in accordance with ACI 318-14 17.4.2.6 or ACI 318-11 D.5.2.6, as applicable, N_b must be calculated using $k_{c,uncr}$ and $\Psi_{c,N}$ = 1.0. For anchors in lightweight concrete see ACI 318-14 17.2.6 or ACI 318-11 D.3.6, as applicable. The value of f'_c used for calculation must be limited to 8,000 psi (55 MPa) in accordance with ACI 318-14 17.2.7 or ACI 318-11 D.3.7, as applicable. Additional information for the determination of nominal bond strength in tension is given in Section 4.1.4 of this report.

4.1.4 Static Bond Strength in Tension: The nominal static bond strength of a single adhesive anchor or group of adhesive anchors in tension, N_a or N_{ag}, must be calculated in accordance with ACI 318-14 17.4.5 or ACI 318-11 D.5.5, as applicable.

Bond strength values ($\tau_{k,cr}$, $\tau_{k,uncr}$) are a function of concrete compressive strength, concrete state (cracked, uncracked), and installation conditions (dry concrete, water-saturated concrete, water-filled holes). 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 hole (flooded)	ϕ_{wf}
Uncracked	$\tau_{k,uncr}$	f'_c	Dry concrete	ϕ_d
			Water saturated concrete	ϕ_{ws}
			Water-filled hole (flooded)	ϕ_{wf}

Strength reduction factors for determination of the bond strength are given in Tables 6 and 9 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 Table 6 and Table 9 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 $(f'_c / 2{,}500)^{0.13}$ [For **SI:** $(f'_c / 17.2)^{0.13}$] [minimum of 24 MPa is required under ADIBC Appendix L, Section 5.1.1]. Where applicable, the modified bond strength values must be used in lieu of $\tau_{k,cr}$ and $\tau_{k,uncr}$ in 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 318-14 17.5.1.2 or ACI 318-11 D.6.1.2, as applicable, and the strength reduction factor, ϕ, in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are given in Table 4 and Table 7 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 318-14 17.5.2 or 318-11 D.6.2, as applicable, based on information given in Table 5 and Table 8 in this report.

The basic concrete breakout strength of a single anchor in shear, V_b, must be calculated in accordance with ACI 318-14 17.5.2.2 or ACI 318-11 D.6.2.2, as applicable using the values of d given in Tables 5 and 8 for the corresponding anchor steel in lieu of d_a (2018, 2015, 2012 and 2009 IBC) and d_o (2006 IBC). 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 318-14 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 318-14 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 318-14 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 318-14 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 318-14 17.7.4 or ACI 318-11 D.8.4, as applicable.

For anchors that will be torqued during installation, the maximum torque, T_{max}, must be reduced for edge distances less than five anchor diameters (5d). 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}**
all sizes	5*d*	5*d*	$1.0 \cdot T_{max}$
$^3/_8$ in. to 1 in.	1.75 in. (44.5 mm)	5*d*	$0.45 \cdot T_{max}$
$1^1/_4$ in.	2.75 in. (70 mm)		

For values of T_{max}, see Table 10 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 318-14 17.4.5.5 or ACI 318-11 D.5.5.5, as applicable, except as noted below:

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

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

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

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

where

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

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

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

4.1.11 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 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable.

The nominal steel shear strength, V_{sa}, must be adjusted by $\alpha_{V,seis}$ as given in Tables 4 and 7 for the corresponding anchor steel. The nominal bond strength $\tau_{\kappa,cr}$ must be adjusted by $\alpha_{N,seis}$ as given in Tables 6 and 9 for threaded rods. An adjustment to the nominal bond strength $\tau_{\kappa,cr}$ is not required for reinforcing bars ($\alpha_{N,seis}$ = 1.0.).

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 Section ACI 318-11 D.3.3.4.3(d).

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

4.2 Installation:

Installation parameters are illustrated in Figure 3 of this report. Installation must be in accordance with ACI 318-14 17.8.1 and 17.8.2 or ACI 318-11 D.9.1 and D.9.2. Anchor locations must comply with this report and the plans and specifications approved by the code official. Installation of the VF200PRO Adhesive Anchor System must conform to the manufacturer's printed installation instructions included in each unit package as described in Figure 3 of this report.

The adhesive anchor system may be used for upwardly inclined orientation applications (e.g. overhead). Upwardly inclined and horizontal orientation applications are to be installed using piston plugs for the $^5/_8$-inch through $1^1/_4$-inch diameter threaded steel rods and No. 5 through No. 10 steel reinforcing bars, installed in the specified hole diameter, and attached to the mixing nozzle and extension tube supplied by Allfasteners USA LLC. as described in Figure 3 in this report. Upwardly inclined and horizontal orientation installation for the $^3/_8$-inch and $^1/_2$-inch diameter threaded steel rods, and No. 3 and No. 4 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 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.

4.3 Special Inspection:

Periodic special inspection must be performed where required in accordance with Section 1705.1.1 and Table 1705.3 of the 2018, 2015 and 2012 IBC, 1704.4 and 1704.15 of the 2009 IBC or Section 1704.13 of the 2006 IBC and this report. The special inspector must be on the jobsite initially during anchor installation to verify the anchor type, adhesive expiration date, anchor dimensions, concrete type, concrete compressive strength, hole dimensions, hole cleaning procedures, anchor spacing, edge distances, concrete thickness, anchor embedment, tightening torque, and adherence to the manufacturer's printed installation instructions.

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

Continuous special inspection of adhesive anchors installed in horizontal or upwardly inclined orientations to resist sustained tension loads must be performed in accordance with ACI 318-14 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.

4.4 Compliance with NSF/ANSI Standard 61:

The VF200PRO Adhesive Anchor System complies with the requirements of NSF/ANSI Standard 61, as referenced in Section 605 of the 2018, 2015, 2012, 2009 and 2006 *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 VF200PRO Adhesive Anchor System described in this report complies with, or is a suitable alternative to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 VF200PRO adhesive anchors must be installed in accordance with the manufacturer's printed installation instructions included with each cartridge and provided in Figure 3 of this report.

5.2 Anchors [$^1/_2$-, $^5/_8$-, $^3/_4$-, $^7/_8$-, 1-, and $1^1/_4$ diameter (12.7, 15.9, 19.1, 22.2, 25.4 and 31.8 mm) threaded steel rods and No. 4 through No. 10 steel reinforcing bars] described in this report must be installed in cracked and uncracked normal-weight concrete having a specified compressive strength f'_c = 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa) [minimum of 24 MPa is required under ADIBC Appendix L, Section 5.1.1]. Anchors [$^3/_8$-inch-diameter (9.5 mm)] threaded steel rods and No. 3 steel reinforcing bars in hammer-drilled holes must be installed in uncracked normal-weight concrete having a specified compressive strength f'_c = 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa) [minimum of 24 MPa is required under ADIBC Appendix L, Section 5.1.1].

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

5.4 Anchors must be installed in concrete base materials in holes predrilled in accordance with the instructions provided in Figure 3 of this report.

5.5 Loads applied to the anchors must be adjusted in accordance with Section 1605.2 of the IBC for strength design.

5.6 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.

5.7 VF200PRO 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. For exceptions, see Section 5.2 of this report.

5.8 Strength design values are established in accordance with Section 4.1 of this report.

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

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

5.11 Anchors are not permitted to support fire-resistive construction. Where not otherwise prohibited by the code, VF200PRO adhesive anchors are permitted for installation in fire-resistive construction provided that at least one of the following conditions is fulfilled:

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

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

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

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

5.15 Steel anchoring materials 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.

5.16 Periodic special inspection must be provided in accordance with Section 4.3 in this report. Continuous special inspection for anchors installed in horizontal or upwardly inclined orientations to resist sustained tension loads must be provided in accordance with Section 4.3 of this report.

5.17 Installation of anchors 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 318-14 17.8.2.2 or 17.8.2.3 or ACI 318-11 D.9.2.2 or D.9.2.3, as applicable.

5.18 Anchors 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 façade systems and other applications subject to direct sun exposure.

5.19 VF200PRO anchoring system 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 October 2017 (Editorially revised March 2018), which incorporates requirements in ACI 355.4-11.

7.0 IDENTIFICATION

7.1 VF200PRO adhesive is identified by packaging labeled with the company's name (Allfasteners USA LLC.) and address, product name, lot number, expiration date, and the evaluation report number (ESR-4632). Threaded rods, nuts, washers, and deformed reinforcing bars are standard steel anchor elements and must conform to applicable national or international specifications as set forth in Tables 2 and 3 of this report.

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

ALLFASTENERS USA LLC.
959 LAKE ROAD
MEDINA OHIO 44256
(201) 783-8836
www.allfasteners.com
sales@allfasteners.com

TABLE 1—DESIGN TABLE INDEX

DESIGN STRENGTH[1]		THREADED ROD	REINFORCING BAR (REBAR)
Steel	N_{sa}, V_{sa}	Table 4	Table 7
Concrete	N_{pn}, N_{sb}, N_{sbg}, N_{cb}, N_{cbg}, V_{cb}, V_{cbg}, V_{cp}, V_{cpg}	Table 5	Table 8
Bond[2]	N_a, N_{ag}	Table 6	Table 9

[1]Ref. ACI 318-14 17.3.1.1 or 318-11 D.4.1.1, as applicable.
[2]See Section 4.1 of this evaluation report.

TABLE 2—SPECIFICATIONS AND PHYSICAL PROPERTIES OF 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[5]	REDUCTION OF AREA, MIN. PERCENT	SPECIFICATION FOR NUTS[6]	SPECIFICATION FOR WASHERS[6]
CARBON STEEL	ASTM A193[2] Grade B7 all sizes	psi (MPa)	125,000 (862)	105,000 (724)	1.19	16	50	ASTM A563 Grade D	ASTM F436
	ASTM A36[3] / F1554, Grade 36 all sizes	psi (MPa)	58,000 (400)	36,000 (250)	1.61	23	50	ASTM A563 Grade A	ASTM B18.22.1 Type A Plain
STAINLESS STEEL (304/316)	ASTM F593[4] CW1 $^3/_8$ to $^5/_8$ in.	psi (MPa)	100,000 (690)	65,000 (450)	1.54	40	- [7]	ASTM F594 Alloy Group 1, 2 or 3	ASTM B18.22.1 Type A Plain
	ASTM F593[4] CW2 $^3/_4$ to $1^1/_4$ in.	psi (MPa)	85,000 (590)	45,000 (310)	1.89	40	- [7]		

[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 Stainless Steel Bolts, Hex Cap Screws, and Studs.
[5]Based on 2-in. (50 mm) gauge length except for ASTM A193, which is based on a gauge length of 4d.
[6]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.
[7]Minimum percent reduction of area not reported in the referenced ASTM standard.

TABLE 3—SPECIFICATIONS AND PHYSICAL PROPERTIES OF STEEL REINFORCING BARS

REINFORCING BAR SPECIFICATION 	UNITS	MINIMUM SPECIFIED ULTIMATE STRENGTH, f_{uta}	MINIMUM SPECIFIED YEILD STRENGTH, f_{ya}
ASTM A615[1], A767[3], A996[4] Grade 60	psi (MPa)	90,000 (620)	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 4—STEEL DESIGN INFORMATION FOR THREADED ROD[1]

DESIGN INFORMATION		Symbol	Units	Threaded Rod Diameter (inch)						
				3/8	1/2	5/8	3/4	7/8	1	1 1/4
Nominal Anchor Diameter		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 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 Grade 36 ASTM F1554 Grade 36	Nominal Strength as Governed by Steel Strength	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	$\alpha_{V,seis}$	-	Not Applicable	0.85				0.80	
	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	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)	4,845 (21.5)	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	$\alpha_{V,seis}$	-	Not Applicable	0.85				0.80	
	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	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	$\alpha_{V,seis}$	-	Not Applicable	0.85				0.80	
	Strength Reduction Factor for Tension[2]	ϕ	-	0.65						
	Strength Reduction Factor for Shear[2]	ϕ	-	0.60						

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 006894 MPa.
For **pound-inch** units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

[1]Values provided for common rod material types based on specified strengths and calculated in accordance with 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 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, as set forth in 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 5—CONCRETE BREAKOUT DESIGN INFORMATION THREADED ROD IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT[1]

DESIGN INFORMATION	Symbol	Units	Threaded Rod Diameter (inch)						
			3/8	1/2	5/8	3/4	7/8	1	1 1/4
Minimum Embedment Depth	$h_{ef,min}$	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 Depth	$h_{ef,max}$	in. (mm)	4 1/2 (114)	6 (152)	7 1/2 (191)	9 (229)	10 1/2 (267)	12 (305)	15 (381)
Effectiveness Factor for Cracked Concrete	$k_{c,cr}$	- (SI)	Not Applicable	17 (7.1)					
Effectiveness Factor for Uncracked Concrete	$k_{c,uncr}$	- (SI)	24 (10)						
Minimum Spacing Distance	s_{min}	in. (mm)	$s_{min} = c_{min}$						
Minimum Edge Distance	c_{min}	in. (mm)	1 7/8 (48)	2 1/2 (64)	3 1/8 (79)	3 3/4 (95)	4 3/8 (111)	5 (127)	6 1/4 (159)
Minimum Concrete Thickness	h_{min}	in. (mm)	h_{ef} + 1 1/4, [≥ 3.94] (h_{ef} + 30, [≥ 100])		h_{ef} + 2d_0 where d_0 is the hole diameter				
Critical Edge Distance (Uncracked Concrete Only)	c_{ac}	-	See Section 4.1.10 of this report.						
Strength Reduction Factor for Tension, Concrete Failure Modes, Condition B[2]	ϕ	-	0.65						
Strength Reduction Factor for Shear, Concrete Failure Modes, Condition B[2]	ϕ	-	0.70						

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 006894 MPa.
For **pound-inch** units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

[1]Additional setting information is described in Figure 3, installation instructions.
[2]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 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, as set forth in ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.

TABLE 6—BOND STRENGTH DESIGN INFORMATION FOR THREADED ROD IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT[1,2,3,4]

DESIGN INFORMATION				Symbol	Units	Threaded Rod Diameter (inch)						
						3/8	1/2	5/8	3/4	7/8	1	1 1/4
Minimum Embedment Depth				$h_{ef,min}$	in. (mm)	2 3/8 (60.3)	2 3/4 (69.9)	3 1/8 (79.4)	3 1/2 (88.9)	3 1/2 (88.9)	4 (101.6)	5 (127.0)
Maximum Embedment Depth				$h_{ef,max}$	in. (mm)	4 1/2 (114)	6 (152)	7 1/2 (191)	9 (229)	10 1/2 (267)	12 (305)	15 (381)
Dry and Water Saturated Concrete	Maximum Long Term Temperature **122 °F** (50 °C) Maximum Short Term Temperature **176 °F** (80 °C)	Cracked Concrete	Characteristic Bond Strength with Sustained Load	$\tau_{k,cr}$	psi (N/mm²)	----	498 (3.4)	519 (3.6)	519 (3.6)	519 (3.6)	519 (3.6)	525 (3.6)
			Characteristic Bond Strength without Sustained Load		psi (N/mm²)	----	712 (4.9)	742 (5.1)	742 (5.1)	742 (5.1)	742 (5.1)	751 (5.2)
		Uncracked Concrete	Characteristic Bond Strength with Sustained Load	$\tau_{k,uncr}$	psi (N/mm²)	823 (5.7)	823 (5.7)	823 (5.7)	823 (5.7)	823 (5.7)	743 (5.1)	588 (4.1)
			Characteristic Bond Strength without Sustained Load		psi (N/mm²)	1,177 (8.1)	1,177 (8.1)	1,177 (8.1)	1,177 (8.1)	1,177 (8.1)	1,062 (7.3)	841 (5.8)
	Maximum Long Term Temperature **161 °F** (72 °C) Maximum Short Term Temperature **248 °F** (120 °C)	Cracked Concrete	Characteristic Bond Strength with Sustained Load	$\tau_{k,cr}$	psi (N/mm²)	----	245 (1.7)	255 (1.8)	255 (1.8)	255 (1.8)	255 (1.8)	255 (1.8)
			Characteristic Bond Strength without Sustained Load		psi (N/mm²)	----	544 (3.8)	566 (3.9)	566 (3.9)	566 (3.9)	566 (3.9)	566 (3.9)
		Uncracked Concrete	Characteristic Bond Strength with Sustained Load	$\tau_{k,uncr}$	psi (N/mm²)	405 (2.8)	405 (2.8)	405 (2.8)	405 (2.8)	405 (2.8)	366 (2.5)	----
			Characteristic Bond Strength without Sustained Load		psi (N/mm²)	899 (6.2)	899 (6.2)	899 (6.2)	899 (6.2)	899 (6.2)	813 (5.6)	----
	Strength Reduction Factor for Dry Holes in Concrete			ϕ_d	-	0.65						
	Strength Reduction Factor for Water Saturated Holes in Concrete			ϕ_{ws}	-	0.55						
Water-Filled Holes in Concrete	Maximum Long Term Temperature **122 °F** (50 °C) Maximum Short Term Temperature **176 °F** (80 °C)	Cracked Concrete	Characteristic Bond Strength with Sustained Load	$\tau_{k,cr}$	psi (N/mm²)	----	388 (2.7)	405 (2.8)	405 (2.8)	363 (2.5)	358 (2.5)	352 (2.4)
			Characteristic Bond Strength without Sustained Load		psi (N/mm²)	----	555 (3.8)	579 (4.0)	579 (4.0)	520 (3.6)	512 (3.5)	503 (3.5)
		Uncracked Concrete	Characteristic Bond Strength with Sustained Load	$\tau_{k,uncr}$	psi (N/mm²)	642 (4.4)	642 (4.4)	642 (4.4)	642 (4.4)	576 (4.0)	----	----
			Characteristic Bond Strength without Sustained Load		psi (N/mm²)	918 (6.3)	918 (6.3)	918 (6.3)	918 (6.3)	824 (5.7)	----	----
	Maximum Long Term Temperature **161 °F** (72 °C) Maximum Short Term Temperature **248 °F** (120 °C)	Cracked Concrete	Characteristic Bond Strength with Sustained Load	$\tau_{k,cr}$	psi (N/mm²)	----	191 (1.3)	199 (1.4)	199 (1.4)	179 (1.3)	176 (1.2)	171 (1.2)
			Characteristic Bond Strength without Sustained Load		psi (N/mm²)	----	424 (2.9)	442 (3.0)	442 (3.0)	396 (2.7)	391 (2.7)	379 (2.6)
		Uncracked Concrete	Characteristic Bond Strength with Sustained Load	$\tau_{k,uncr}$	psi (N/mm²)	316 (2.2)	316 (2.2)	316 (2.2)	316 (2.2)	----	----	----
			Characteristic Bond Strength without Sustained Load		psi (N/mm²)	701 (4.8)	701 (4.8)	701 (4.8)	701 (4.8)	----	----	----
	Strength Reduction Factor for Water-Filled Holes in Concrete			ϕ_{wf}	-	0.45						
Reduction Factor for Seismic Tension[5]				$\alpha_{N,seis}$	-	0.95						

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 006894 MPa.
For **pound-inch** units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

[1]Characteristic bond strength values correspond to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For uncracked concrete compressive strength, f'_c between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa) [minimum of 24 MPa is required under ADIBC Appendix L, Section 5.1.1], the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2500)^{0.13}$ (for SI: $(f'_c / 17.2)^{0.13}$). See Section 4.1.4 of this report.
[2]Lightweight concrete may be used by applying a reduction factor as given in ACI 318-14 17.2.6 or ACI 318-11 Appendix D section D.3.6 as applicable.
[3]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.
[4]Characteristic bond strengths are for sustained loads (when noted) including dead and live loads.
[5]For structures assigned to Seismic Design Category C, D, E, or F, the bond strength values must be multiplied by $\alpha_{N,seis}$.

TABLE 7—STEEL DESIGN INFORMATION FOR REINFORCING BAR[1]

DESIGN INFORMATION		Symbol	Units	Rebar Size							
				No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10
Nominal Bar Diameter		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)	1.250 (31.8)
Reinforcing Bar 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)	1.270 (819)
ASTM A615 Grade 40[3]	Nominal Strength as Governed by Steel Strength	N_{sa}	lb (kN)	6,600 (29.4)	12,000 (53.4)	18,600 (82.7)	26,400 (117.4)	Grade 40 bars are only available in sizes No. 3 through No. 6 per ASTM A615			
		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	$\alpha_{V,seis}$	-	-	0.70						
	Strength Reduction Factor for Tension[2]	ϕ	-	0.65							
	Strength Reduction Factor for Shear[2]	ϕ	-	0.60							
ASTM A615 Grade 60	Nominal Strength as Governed by Steel Strength	N_{sa}	lb (kN)	9,900 (44.0)	18,000 (80.1)	27,900 (124.1)	39,600 (176.1)	54,000 (240.2)	71,100 (316.3)	90,000 (400.3)	114,300 (508.4)
		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)	68,580 (305.0)
	Reduction Factor for Seismic Shear	$\alpha_{V,seis}$	--	-	0.70						
	Strength Reduction Factor for Tension[2]	ϕ	-	0.65							
	Strength Reduction Factor for Shear[2]	ϕ	-	0.60							

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 006894 MPa.
For **pound-inch** units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.
[1]Values provided for common bar material types based on specified strengths and calculated in accordance with 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 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, as set forth in 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 8—CONCRETE BREAKOUT DESIGN INFORMATION FOR REINFORCING BAR IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT[1]

DESIGN INFORMATION	Symbol	Units	Rebar Size							
			No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No.10
Minimum Embedment Depth	$h_{ef,min}$	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)	5 (127)
Maximum Embedment Depth	$h_{ef,max}$	in. (mm)	$4^1/_2$ (114)	6 (152)	$7^1/_2$ (191)	9 (229)	$10^1/_2$ (267)	12 (305)	$13^1/_2$ (343)	15 (381)
Effectiveness Factor for Cracked Concrete	$k_{c,cr}$	in-lb (SI)	Not Applicable	17 (7.1)						
Effectiveness Factor for Uncracked Concrete	$k_{c,uncr}$	in.-lb. (SI)	24 (10)							
Minimum Spacing Distance	s_{min}	in. (mm)	$s_{min} = c_{min}$							
Minimum Edge Distance	c_{min}	in. (mm)	$1^7/_8$ (48)	$2^1/_2$ (64)	$3^1/_8$ (79)	$3^3/_4$ (95)	$4^3/_8$ (111)	5 (127)	$5^5/_8$ (143)	$6^1/_4$ (159)
Minimum Concrete Thickness	h_{min}	in. (mm)	$h_{ef} + 1^1/_4$, [$\geq$ 3.94] (h_{ef} + 30, [$\geq$ 100])	$h_{ef} + 2d_0$ where d_0 is the hole diameter						
Critical Edge Distance (Uncracked Concrete Only)[2]	c_{ac}	-	See Section 4.1.10 of this report.							
Strength Reduction Factor for Tension, Concrete Failure Modes, Condition B[2]	ϕ	-	0.65							
Strength Reduction Factor for Shear, Concrete Failure Modes, Condition B[2]	ϕ	-	0.70							

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]Additional setting information is described in Figure 3, installation instructions.
[2]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 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, as set forth in 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. 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 318-14 17.3.3 or ACI 318-11 D.4.3. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11.9.2 are used. 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 9—BOND STRENGTH DESIGN INFORMATION FOR REINFORCING BAR IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT[1,2,3,4]

DESIGN INFORMATION				Symbol	Units	Nominal Bar Size							
						No.3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No.10
Minimum Embedment Depth				$h_{ef,min}$	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)	5 (127)
Maximum Embedment Depth				$h_{ef,max}$	in. (mm)	$4^1/_2$ (114)	6 (152)	$7^1/_2$ (191)	9 (229)	$10^1/_2$ (267)	12 (305)	$13^1/_2$ (343)	15 (381)
Dry and Water Saturated Concrete	Maximum Long Term Temperature **122 °F** (50 °C) Maximum Short Term Temperature **176 °F** (80 °C)	Cracked Concrete	Characteristic Bond Strength with Sustained Load	$\tau_{k,cr}$	psi (N/mm²)	----	331 (2.3)	345 (2.4)	345 (2.4)	345 (2.4)	345 (2.4)	349 (2.4)	349 (2.4)
			Characteristic Bond Strength without Sustained Load		psi (N/mm²)	----	473 (3.3)	493 (3.4)	493 (3.4)	493 (3.4)	493 (3.4)	499 (3.4)	499 (3.4)
		Uncracked Concrete	Characteristic Bond Strength with Sustained Load	$\tau_{k,uncr}$	psi (N/mm²)	823 (5.7)	823 (5.7)	823 (5.7)	823 (5.7)	823 (5.7)	743 (5.1)	668 (4.6)	588 (4.1)
			Characteristic Bond Strength without Sustained Load		psi (N/mm²)	1,177 (8.1)	1,177 (8.1)	1,177 (8.1)	1,177 (8.1)	1,177 (8.1)	1,062 (7.3)	955 (6.6)	841 (5.8)
	Maximum Long Term Temperature **161 °F** (72 °C) Maximum Short Term Temperature **248 °F** (120 °C)	Cracked Concrete	Characteristic Bond Strength with Sustained Load	$\tau_{k,cr}$	psi (N/mm²)	----	163 (1.1)	170 (1.2)	170 (1.2)	170 (1.2)	170 (1.2)	172 (1.2)	172 (1.2)
			Characteristic Bond Strength without Sustained Load		psi (N/mm²)	----	362 (2.5)	377 (2.6)	377 (2.6)	377 (2.6)	377 (2.6)	382 (2.6)	382 (2.6)
		Uncracked Concrete	Characteristic Bond Strength with Sustained Load	$\tau_{k,uncr}$	psi (N/mm²)	405 (2.8)	405 (2.8)	405 (2.8)	405 (2.8)	405 (2.8)	366 (2.5)	329 (2.3)	----
			Characteristic Bond Strength without Sustained Load		psi (N/mm²)	899 (6.2)	899 (6.2)	899 (6.2)	899 (6.2)	899 (6.2)	813 (5.6)	730 (5.0)	----
	Strength Reduction Factor for Dry Holes in Concrete			ϕ_d	-	0.65							
	Strength Reduction Factor for Water Saturated Holes in Concrete			ϕ_{ws}	-	0.55							
Water-Filled Holes in Concrete	Maximum Long Term Temperature **122 °F** (50 °C) Maximum Short Term Temperature **176 °F** (80 °C)	Cracked Concrete	Characteristic Bond Strength with Sustained Load	$\tau_{k,cr}$	psi (N/mm²)	----	258 (1.8)	269 (1.9)	269 (1.9)	242 (1.7)	238 (1.7)	237 (1.6)	234 (1.6)
			Characteristic Bond Strength without Sustained Load		psi (N/mm²)	----	369 (2.5)	385 (2.7)	385 (2.7)	346 (2.4)	340 (2.3)	339 (2.3)	335 (2.3)
		Uncracked Concrete	Characteristic Bond Strength with Sustained Load	$\tau_{k,uncr}$	psi (N/mm²)	642 (4.4)	642 (4.4)	642 (4.4)	642 (4.4)	576 (4.0)	----	----	----
			Characteristic Bond Strength without Sustained Load		psi (N/mm²)	918 (6.3)	918 (6.3)	918 (6.3)	918 (6.3)	824 (5.7)	----	----	----
	Maximum Long Term Temperature **161 °F** (72 °C) Maximum Short Term Temperature **248 °F** (120 °C)	Cracked Concrete	Characteristic Bond Strength with Sustained Load	$\tau_{k,cr}$	psi (N/mm²)	----	127 (0.9)	133 (0.9)	133 (0.9)	119 (0.8)	117 (0.8)	117 (0.8)	115 (0.8)
			Characteristic Bond Strength without Sustained Load		psi (N/mm²)	----	282 (1.9)	295 (2.0)	295 (2.0)	264 (1.8)	260 (1.8)	260 (1.8)	255 (1.8)
		Uncracked Concrete	Characteristic Bond Strength with Sustained Load	$\tau_{k,uncr}$	psi (N/mm²)	316 (2.2)	316 (2.2)	316 (2.2)	316 (2.2)	----	----	----	----
			Characteristic Bond Strength without Sustained Load		psi (N/mm²)	702 (4.8)	702 (4.8)	702 (4.8)	702 (4.8)	----	----	----	----
	Strength Reduction Factor for Water-Filled Holes in Concrete			ϕ_{wf}	-	0.45							
Reduction Factor for Seismic Tension[5]				$\alpha_{N,seis}$	-	1.00							

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]Characteristic bond strength values correspond to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For uncracked concrete compressive strength, f'_c between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa) [minimum of 24 MPa is required under ADIBC Appendix L, Section 5.1.1], the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2500)^{0.13}$ (for SI: $(f'_c / 17.2)^{0.13}$). See Section 4.1.4 of this report.
[2]Lightweight concrete may be used by applying a reduction factor as given in ACI 318-14 17.2.6 or ACI 318-11 Appendix D section D.3.6 as applicable.
[3]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.
[4]Characteristic bond strengths are for sustained loads (when noted) including dead and live loads.
[5]For structures assigned to Seismic Design Category C, D, E, or F, the bond strength values must be multiplied by $\alpha_{N,seis}$.

FIGURE 1—VF200PRO ADHESIVE ANCHORING SYSTEM AND TYPICAL ANCHOR ELEMENTS

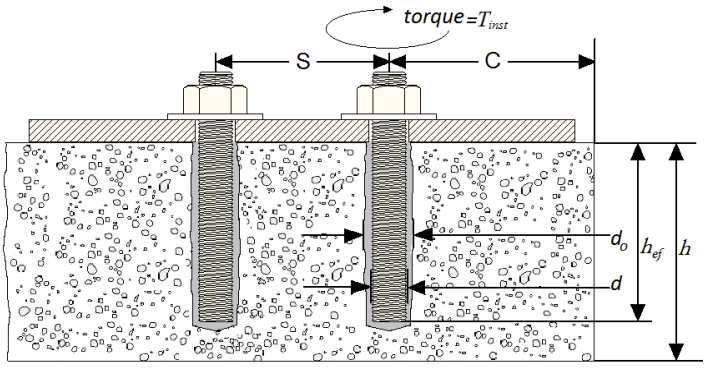


FIGURE 2—TYPICAL INSTALLATION DETAIL FOR THREADED RODS AND REINFORCING BARS

TABLE 10—VF200PRO THREADED ROD INSTALLATION PARAMETERS

Threaded Rod Diameter in.	Drill Bit Diameter in.	Embedment Depth - Min in. (mm)	Embedment Depth - Min in. (mm)	Minimum Concrete Thickness in.	Minimum Concrete Thickness mm	Minimum Spacing = Minimum Edge in. (mm)	Maximum Installation Torque ft-lbs. (N-m)	
							A36/A307 Carbon Steel	A193 B7 Carbon Steel or F593 SS
d	d_o	$h_{ef,min}$	$h_{ef,max}$	h_{min}		s_{min}=c_{min}	$T_{inst,max}$	$T_{inst,max}$
3/8	7/16	2 3/8 (60)	4 1/2 (114)	h_{ef} + 1.25	h_{ef} + 30	1 7/8 (48)	10 (14)	16 (22)
1/2	9/16	2 3/4 (70)	6 (152)			2 1/2 (64)	25 (34)	33 (45)
5/8	3/4	3 1/8 (79)	7 1/2 (191)	h_{ef} + 2d_o		3 1/8 (79)	50 (68)	60 (81)
3/4	7/8	3 1/2 (89)	9 (229)			3 3/4 (95)	90 (122)	105 (142)
7/8	1	3 1/2 (89)	10 1/2 (267)			4 3/8 (111)	125 (170)	
1	1 1/8	4 (102)	12 (305)			5 (127)	165 (224)	
1 1/4	1 3/8	5 (127)	15 (381)			6 1/4 (159)	280 (380)	

TABLE 11—VF200PRO REINFORCING BAR INSTALLATION PARAMETERS

Threaded Rod Diameter in.	Drill Bit Diameter in.	Embedment Depth - Min in. (mm)	Embedment Depth - Min in. (mm)	Minimum Concrete Thickness in.	Minimum Concrete Thickness mm	Minimum Spacing = Minimum Edge in. (mm)
d	d_o	$h_{ef,min}$	$h_{ef,max}$	h_{min}		s_{min}=c_{min}
#3	7/16	2 3/8 (60)	4 1/2 (114)	h_{ef} + 1.25	h_{ef} + 30	1 7/8 (48)
#4	5/8	2 3/4 (70)	6 (152)			2 1/2 (64)
#5	3/4	3 1/8 (79)	7 1/2 (191)	h_{ef} + 2d_o		3 1/8 (79)
#6	7/8	3 1/2 (89)	9 (229)			3 3/4 (95)
#7	1	3 1/2 (89)	10 1/2 (267)			4 3/8 (111)
#8	1 1/8	4 (102)	12 (305)			5 (127)
#9	1 3/8	4 1/2 (114)	13 1/2 (343)			5 5/8 (143)
#10	1 1/2	5 (127)	15 (381)			6 1/4 (159)

TABLE 12—VF200PRO ADHESIVE, DISPENSING TOOLS, AND ACCESSORIES

Package Size	9.5 oz. (280 ml) Cartridge	28 oz. (825 ml) Cartridge
Part #	1VF200PRO	1VF200PRO-28
Mixing Nozzle	1SN10	1SN28
Manual Dispensing Tool	13CAG300	N/A
Pneumatic Dispensing Tool	N/A	N/A
SDS Brush Adaptor	11ESDS-38	
Brush Extension	11EHAN-38	
Nozzle Extension Tubing	1E25-6	
Retention Wedge	WEDGE	

TABLE 13—VF200PRO BRUSHES

Threaded Rod Diameter in.	Rebar Size	Drill Bit Diameter in.	Brush Part #
3/8	#3	7/16	11B012
1/2	----	9/16	11B012
----	#4	5/8	11SB058
5/8	#5	3/4	11SB034
3/4	#6	7/8	11SB078
7/8	#7	1	11SB100
1	#8	1 1/8	11SB118
1 1/4	#9	1 3/8	11SB138
----	#10	1 1/2	11SB112

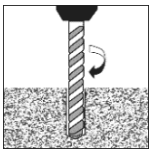
TABLE 14—VF200PRO CURE SCHEDULE[1,2,3]

Concrete Temperature °F (°C)	Working Time	Full Cure Time
14 (-10)	90 min	24 hr
23 (-5)	90 min	14 hr
32 (0)	45 min	7 hr
41 (5)	25 min	2 hr
50 (10)	15 min	90 min
70 (21)	6 min	45 min
86 (30)	4 min	25 min
95 (35)	2 min	20 min
104 (40)	1.5 min	15 min

1. For Installations between 14 °F and 23 °F (-10 °C and -5 °C) the cartridge temperature must be conditioned to between 70 °F and 75 °F (21 °C and 24 °C)
2. Store adhesive in dry cool location free from sun and rain.
3. Storage temperature is 41 °F to 77 °F (5 °C to 25 °C).

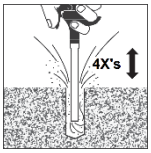
VF200PRO ADHESIVE ANCHOR INSTALLATION INSTRUCTIONS

DRILLING AND CLEANING

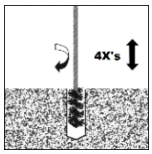


1 Using a rotary hammer drill, and a bit which conforms to ANSI B212.15 and is the appropriate size (see Tables 10 and 11) for the anchor diameter to be installed, drill the hole to the specified embedment depth. **CAUTION:** Always wear appropriate personal protection equipment (PPE) for eyes, ears & skin and avoid inhalation of dust during the drilling and cleaning process. Refer to the Safety Data Sheet (SDS) for details prior to proceeding.

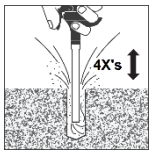
BLOW (4X) - BRUSH (4X) - BLOW (4X)



2 **BLOW - NOTE:** Remove any standing water from hole prior to beginning the cleaning process. Using oil free compressed air with a minimum pressure of 90 psi (6 bar), insert the air wand to the bottom of the drilled hole and blow out the debris with an up/down motion for a minimum of 4 seconds/cycles (4X). For drilled holes < 7/8" in diameter, a hand pump (supplied by Allfasteners USA LLC.) may be used instead of compressed air.



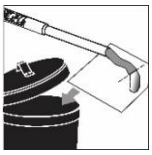
3 Select the correct wire brush size for the drilled hole diameter (see Table 13), making sure that the brush is long enough to reach the bottom of the drilled hole. Reaching the bottom of the hole (use brush extension if required), brush with an up/down and twisting motion for 4 cycles (4X).
CAUTION: The brush should be clean and contact the walls of the hole. If it does not, the brush is either too worn or small and should be replaced with a new brush of the correct diameter.



4 Blow the hole out once more to remove brush debris using oil free compressed air with a minimum pressure of 90 psi (6 bar). Insert the air wand to the bottom of the drilled hole and blow out the debris with an up/down motion for a minimum of 4 seconds/cycles (4X). Visually inspect the hole to confirm it is clean.
NOTE: If installation will be delayed for any reason, cover cleaned holes to prevent contamination

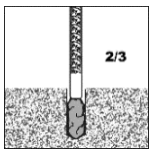
CARTRIDGE PREPARATION

5 **CAUTION:** Check the expiration date on the cartridge to ensure it is not expired. **Do not use expired product!** Remove the protective cap from the cartridge and insert the cartridge into the recommended dispensing tool (see Table 12). Screw on the proper Allfasteners USA LLC. mixing nozzle to the cartridge (see Table 12). Do not modify mixing nozzle and confirm that internal mixing element is in place prior to dispensing adhesive. Never use without the mixing nozzle! Take note of the air and base material temperatures, review the working/full cure time chart (see Table 14) and condition the cartridge accordingly prior to starting the injection process.

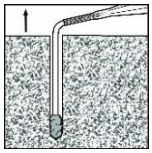


6 Dispense three full strokes of material from the mixing nozzle onto a disposable surface until the product is a uniform gray color with no streaks, as adhesive must be properly mixed in order to perform as published. Dispose of the initial amount of adhesive according to federal, state and local regulations prior to injection into the drill hole.
CAUTION: When changing cartridges, never re-use nozzles. For a new cartridge (or if working time has been exceeded), ensure that cartridge opening is clean, install a new nozzle and repeat steps 5 & 6 accordingly. After finishing work, leave the mixing nozzle attached to the cartridge.

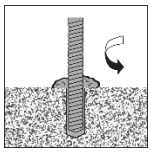
INSTALLATION AND CURING (Vertical Down, Horizontal & Overhead)



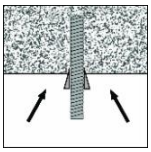
7A **NOTE: The engineering drawings must be followed. For any applications not covered by this document, or for any installation questions, please contact Allfasteners USA LLC.** Insert the mixing nozzle, using an extension tube, if necessary, to the bottom of the hole and fill from the bottom to the top approximately 2/3 full, being careful not to withdraw the nozzle too quickly as this may trap air in the adhesive. **NOTE:** Building Code Requirements for Structural Concrete (ACI 318-11, -14) requires the Installer to be certified where adhesive anchors are to be installed in horizontal or overhead installations for sustained loads.



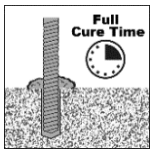
7B Piston plugs must be used with the extension tube attached to the supplied nozzle for horizontal and overhead installations with anchor sizes 5/8" to 1 1/4" diameter and rebar sizes of #5 to #10. Select the proper injection plug for the drill hole diameter as given in Table 13.



8A Prior to inserting the threaded rod or rebar into the hole, make sure it is straight, clean and free of oil and dirt and that the necessary embedment depth is marked on the anchor element. Insert the anchor element into the hole while turning 1-2 rotations prior to the anchor reaching the bottom of the hole. Excess adhesive should be visible on all sides of the fully installed anchor. **CAUTION:** Use extra care with deep embedment or high temperature installations to ensure that the working time has not elapsed prior to the anchor being fully installed.



8B For overhead installations, horizontal and inclined (between horizontal and overhead), wedges should be used to support the anchor while the adhesive is curing. Take appropriate steps to protect the exposed threads of the anchor element from uncured adhesive until after the full cure time has elapsed.



9 Do not disturb, torque or apply any load to the installed anchor until the specified full cure time has passed. The amount of time needed to reach full cure is base material temperature dependent - refer to Table 14 for appropriate full cure time. Use caution not to exceed the maximum specified torque once the anchor has fully cured.

FIGURE 3—INSTALLATION INSTRUCTIONS

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:

ALLFASTENERS USA LLC

EVALUATION SUBJECT:

VF200PRO ADHESIVE ANCHOR SYSTEM IN CRACKED AND UNCRACKED CONCRETE

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that VF200PRO adhesive anchor system in cracked and uncracked concrete, described in ICC-ES evaluation report ESR-4632, has also been evaluated for compliance with the codes noted below as adopted by the Los Angeles Department of Building and Safety (LADBS).

Applicable code editions:

- 2017 *City of Los Angeles Building Code* (LABC)
- 2017 *City of Los Angeles Residential Code* (LARC)

2.0 CONCLUSIONS

The VF200PRO adhesive anchor system in cracked and uncracked concrete, described in Sections 2.0 through 7.0 of the evaluation report ESR-4632, complies with the LABC Chapter 19, and the LARC, and is subject to the conditions of use described in this supplement.

3.0 CONDITIONS OF USE

The VF200PRO adhesive anchor system in cracked and uncracked concrete described in this evaluation report must comply with all of the following conditions:

- All applicable sections in the evaluation report ESR-4632
- The design, installation, conditions of use and identification of the anchor system are in accordance with the 2015 *International Building Code®* (2015 IBC) provisions noted in the evaluation report ESR-4632.
- 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 strength design values listed in the evaluation report and tables are for the connection of the anchor system to the concrete. The connection between the anchor system and the connected members shall be checked for capacity (which may govern).

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

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:

ALLFASTENERS USA LLC

EVALUATION SUBJECT:

VF200PRO ADHESIVE ANCHOR SYSTEM IN CRACKED AND UNCRACKED CONCRETE

1.0 REPORT PURPOSE AND EVALUATION SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the VF200PRO Adhesive Anchor System in Cracked and Uncracked Concrete, described in ICC-ES evaluation report ESR-4632, has also been evaluated for compliance with the codes noted below.

Compliance with the following codes:

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

2.0 PURPOSE OF THIS SUPPLEMENT

The VF200PRO Adhesive Anchor System in Cracked and Uncracked Concrete, described in Sections 2.0 through 7.0 of the evaluation report ESR-4632, complies with the *Florida Building Code—Building* and the *Florida Building Code—Residential*, provided the design and installation are in accordance with the 2015 *International Building Code®* (IBC) provisions noted in the evaluation report.

Use of the VF200PRO Adhesive Anchor System in Cracked and Uncracked Concrete 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 this report.

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

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