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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:

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EVALUATION SUBJECT:

ITW RED HEAD EPCON G5 ADHESIVE ANCHORING SYSTEM FOR CRACKED AND UNCRACKED CONCRETE

1.0 EVALUATION SCOPE

Compliance with the following codes:

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

Property evaluated:

Structural

2.0 USES

The Red Head Epcon G5 Adhesive Anchoring System is a post-installed adhesive anchorage system used to resist static, wind or earthquake (Seismic Design Categories A through F) tension and shear loads when installed in cracked and uncracked normal-weight concrete having a specified compressive strength, f'_c, of 2500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).

The anchoring system is an alternative to cast-in-place anchors described in Sections 1911 and 1912 of the 2009 and 2006 IBC and Sections 1912 and 1913 of the 2003 IBC. The anchoring system 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 Red Head Epcon G5 Adhesive Anchoring System is a two-component, extended working time, structural epoxy adhesive, used with stud-type threaded rods and reinforcing bars installed in normal-weight concrete. The primary components of the Red Head Epcon G5 Adhesive Anchoring System are shown in Figure 1a of this report.

The manufacturer's printed installation instructions (MPII) are included with the adhesive package and are shown in Figure 2 of this report. The adhesive system must be used with the threaded rods and reinforcing bars described in Sections 3.2.4.1 and 3.2.4.2 of this report.

3.2 Materials:

3.2.1 Adhesive: The Red Head Epcon G5 adhesive consists of two components, an epoxy resin and an amine-based hardener, packaged in 22-fluid-ounce (0.6 L) dual component cartridges. The adhesive components are mixed to a 1:1 ratio, by volume, using the nozzle supplied by Red Head. The original, unopened cartridges have an 18-month shelf life, as indicated by the "best used by" date stamped on the cartridge, when stored in a cool, dry, ventilated area at temperatures between 40°F and 90°F (5°C and 32°C) in accordance with the MPII.

3.2.2 Hole Cleaning Equipment: Hole cleaning equipment consists of wire brushes and air nozzles, as described in Figure 1a and Figure 2 of this report.

3.2.3 Dispensing Tools: Red Head Epcon G5 adhesive must be dispensed with manual or pneumatic dispensing tools provided by Red Head as described in Figure 1a.

3.2.4 Anchor Elements:

3.2.4.1 Threaded Steel Rods: The threaded steel rods must be clean, continuously threaded rods (all-thread) ranging from $^3/_8$ inch through $1^1/_4$ inches (9.5 mm through 31.75 mm) in diameter. Carbon steel threaded rods must comply with minimum ASTM A36 [minimum F_u = 58,000 psi (400 MPa)] or ASTM A193, Grade B7 [minimum F_u = 125,000 psi (860 MPa)]. Stainless steel threaded rods must comply with ASTM F593 (Alloy Type 300) [minimum F_u = 75,000 psi (517 MPa)]. Table 1 notes steel properties for the threaded rods. Carbon steel threaded rods must be furnished with a 0.0002-inch-thick (5 µm) zinc electroplated coating complying with ASTM B633 SC1 or must be hot-dipped galvanized complying with ASTM A153, Class C or D.

Threaded steel rods must be straight and free from indentations or other defects along their length.

3.2.4.2 Steel Reinforcing Bars: Steel reinforcing bars are deformed reinforcing bars (rebar) as described in Table 2 of this report. The embedded portions of reinforcing bars must be straight, and free of mill scale, rust, mud, oil, and other coatings that impair the bond with the adhesive.

Reinforcing bars must not be bent after installation except as set forth in Section 7.3.2 of ACI 318, 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 D.1, in order for a steel 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 of less than 14 percent or a reduction of area of less than 30 percent, or both, are considered brittle. 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).

4.0 DESIGN AND INSTALLATION

4.1 Strength Design:

4.1.1 General: The design strength of anchors under the 2009, 2006 and 2003 IBC, as well as the 2009, 2006 and 2003 IRC, must be determined in accordance with ACI 318-11 (ACI 318) and this report.

A design example according to the 2009 IBC based on ACI 318-11 is given in Figure 1b of this report.

Design parameters are based on the ACI 318-11 for use with the 2009, 2006 and 2003 IBC unless noted otherwise in Section 4.1.1 through 4.1.11 of this report.

The strength design of anchors must comply with ACI 318 D.4.1, except as required in ACI 318 D.3.3.

Design parameters are provided in Tables 1, 2, 3, 4, and 5. Strength reduction factors, ϕ, as described in ACI 318-11 D.4.3, must be used for load combinations calculated in accordance with Section 1605.2 of the 2009 or 2006 IBC or Section 9.2 of ACI 318. Strength reduction factors, ϕ, as described in ACI 318 Section D.4.4, must be used for load combinations calculated in accordance with ACI 318 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 D.5.1.2, and the associated strength reduction factors, ϕ, in accordance with ACI 318 D.4.3, are provided in Tables 1 and 2 of this report for the anchor element types included in this report.

4.1.3 Static Concrete Breakout Strength in Tension: The nominal static concrete breakout strength of a single anchor or group of anchors in tension, N_{cb} or N_{cbg}, must be calculated in accordance with ACI 318 D.5.2 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 D.5.2.2 using the values of $k_{c,cr}$, and $k_{c,uncr}$ as described in Table 3 of this report. Where analysis indicates no cracking in accordance with ACI 318 D.5.2.6, N_b must be calculated using $k_{c,uncr}$ and $\Psi_{c,N}$ = 1.0. For anchors in lightweight concrete see ACI 318-11 D.3.6. The value of f'_c used for calculation must be limited to 8,000 psi (55 MPa) in accordance with ACI 318 D.3.7. 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 318-11 D.5.5. Bond strength values are a function whether the concrete is cracked or uncracked, the concrete temperature range, the installation conditions (dry, water-saturated, water-filled holes, or submerged concrete), and the level of inspection provided. The resulting characteristic bond strength shall be multiplied by the associated strength reduction factor ϕ_{nn} as follows:

CONCRETE TYPE	PERMISSIBLE INSTALLATION CONDITIONS	BOND STRENGTH	ASSOCIATED STRENGTH REDUCTION FACTOR
Uncracked	Dry	τ_{uncr}	ϕ_d
	Water-saturated	τ_{uncr}	ϕ_{ws}
	Water-filled holes	τ_{uncr}	ϕ_{wf}
	Submerged	τ_{uncr}	ϕ_{sub}
Cracked	Dry	τ_{cr}	ϕ_d
	Water-saturated	τ_{cr}	ϕ_{ws}
	Water-filled holes	τ_{uncr}	ϕ_{wf}
	Submerged	τ_{uncr}	ϕ_{sub}

Strength reduction factors for determination of the bond strength are given in Tables 4 and 5 of this report.

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 D.6.1.2 and strength reduction factor, ϕ, in accordance with ACI 318 D.4.3, are given in Tables 1 and 2 of this report for the for the anchor element types included in this report.

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 D.6.2 based on information given in Table 3 of this report. The basic concrete breakout strength of a single anchor in shear, V_b, must be calculated in accordance with ACI 318 D.6.2.2 using the values of d given in this report in lieu of d_a (2009 IBC) and d_o (2006 IBC). In addition, h_{ef} shall be substituted for ℓ_e. In no case shall ℓ_e exceed 8d. The value of f'_c must be limited to a maximum value of 8,000 psi (55 MPa) in accordance with ACI 318 D.3.7.

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}, must be calculated in accordance with ACI 318 D.6.3.

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 D.7.

4.1.9 Minimum Member Thickness, h_{min}, Minimum Anchor Spacing, s_{min}, and Minimum Edge Distance, c_{min}: In lieu of ACI 318 D.8.1 and D.8.3, values of s_{min} and c_{min}, as given in Table 3 of this report, must be observed for anchor design and installation. In lieu of ACI 318 D.8.5, minimum member thicknesses h_{min} as given in Table 3 of this report must be observed for anchor design and

installation. For adhesive anchors that will remain untorqued, ACI 318 D.8.4 applies.

4.1.10 Critical Edge Distance c_{ac}: In lieu of ACI 318 D.8.6, c_{ac} must be determined as follows:

$$c_{ac}=h_{ef}\cdot\left(\frac{\tau_{uncr}}{1160}\right)^{0.4}\cdot\left[3.1-0.7\frac{h}{h_{ef}}\right] \quad \text{(D-43)}$$

where

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

τ_{uncr} = characteristic bond strength stated in the table of this report where by τ_{uncr} need not be taken as larger than:

$$\tau_{uncr}=\frac{k_{uncr}\sqrt{h_{ef}f_c'}}{\pi\cdot d_a}$$

4.1.11 Design Strength in Seismic Design Categories C, D, E and F: In structures assigned to Seismic Design Category C, D, E or F under the IBC or IRC, the design must be performed according to ACI 318 Section D.3.3. The nominal steel shear strength, V_{sa}, must be adjusted by $\alpha_{V,seis}$ as given in Tables 1 and 2 for the anchor element types included in this report. The nominal bond strength τ_{cr} must be adjusted by $\alpha_{N,seis}$, as given in Tables 4 and 5.

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

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

Exception:

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

D.3.3.4.3(d) – The anchor or group of anchors shall be designed for the maximum tension obtained from design load combinations that include E, with E increased by Ω0. The anchor design tensile strength shall be calculated from D.3.3.4.4.

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

Exceptions:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

4.2 Allowable Stress Design:

4.2.1 General: For anchors designed using load combinations in accordance with IBC Section 1605.3 (Allowable Stress Design), allowable loads shall be established using Eq. (4-2) or Eq. (4-3):

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

and

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

where:

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

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

ϕN_n = Lowest design strength of an anchor or anchor group in tension as determined in accordance with ACI 318 Appendix D with amendments in this report and 2009 IBC Sections 1908.1.9 and 1908.1.10 or 2006 IBC Section 1908.1.16, as applicable.

ϕV_n = Lowest design strength of an anchor or anchor group in shear as determined in accordance with ACI 318 Appendix D with amendments in this report and 2009 IBC Sections 1908.1.9 and 1908.1.10 or 2006 IBC Section 1908.1.16, as applicable.

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

Limits on edge distance, anchor spacing and member thickness described in this report must apply.

Example calculations for derivation of $T_{allowable,ASD}$ are provided in Table 6.

4.2.2 Interaction of tensile and shear forces: In lieu of ACI 318 D.7.1, D.7.2 and D.7.3, interaction must be calculated as follows:

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

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

For all other cases:

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

4.3 Installation:

Installation parameters are illustrated in Figure 2 of this report. Installation must be in accordance with ACI 318-11 D.9.1 and D.9.2. The anchors must be installed in accordance with the Red Head printed installation instructions, the plans and specifications approved by the code official, and the requirements of this report. The nozzles, brushes, and dispensing tools supplied by Red Head must be used along with the adhesive cartridges. See Figure 2 for brush specifications.

The adhesive anchoring system may be used for floor (vertically down) and wall (horizontal) applications. Horizontal applications are limited to use with the $^3/_8$-inch-(9.5 mm) through $^3/_4$-inch-diameter (19.1 mm) threaded rods and reinforcing bars.

4.4 Special Inspection:

4.4.1 General: Installations may be made under continuous special inspection or periodic special inspection, as determined by the registered design professional. Tables 4 and 5 of this report provides strength reduction factors, ϕ, corresponding to the type of inspection provided.

Continuous special inspection of adhesive anchors installed in horizontal or upwardly inclined orientations to resist sustained tension loads shall be performed in accordance with ACI 318 D.9.2.4.

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

4.4.2 Continuous Special Inspection: Installations made under continuous special inspection with an on-site proof loading program must be performed in accordance with Sections 1704.4 and 1704.15 of the 2009 IBC, Sections 1704.4 and 1704.13 of the 2006 and 2003 IBC, whereby periodic special inspection is defined in Section 1702.1 of the IBC and this report. The special inspector must be on the jobsite continuously during anchor installation to verify anchor type, adhesive expiration date, anchor dimensions, concrete type, concrete compressive strength, hole dimensions, hole cleaning procedures, anchor spacing, edge distances, concrete thickness, anchor embedment, tightening torque, and adherence to the manufacturer's printed installation instructions.

The proof loading program must be established by the registered design professional. As a minimum, the following requirements must be addressed in the proof loading program:

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

Unless otherwise directed by the registered design professional, proof loads must be applied as confined tension tests. Proof load levels must not exceed the lesser of 50 percent of expected peak load based on adhesive bond strength, or 80 percent of the anchor yield strength. The proof load shall be maintained at the required load level for a minimum of 10 seconds.

4.4.3 Periodic Special Inspection: Periodic special inspection must be performed where required in accordance with Sections 1704.4 and 1704.15 of the 2009 IBC, Sections 1704.4 and 1704.13 of the 2006, and 2003 IBC, whereby periodic special inspection is defined in Section 1702.1 of the IBC, and this report. The special inspector must be on the jobsite initially during anchor installation to verify anchor type, adhesive expiration date, anchor dimensions, concrete type, concrete compressive strength, hole dimensions, hole cleaning procedures, anchor spacing, edge distances, concrete thickness, anchor embedment, tightening torque, and adherence to the manufacturer's printed installation instructions. The special inspector must verify the initial installations of each type and size of adhesive anchor by construction personnel on the site. Subsequent installations of the same anchor type and size by the same construction personnel are permitted to be performed in the absence of the special inspector. Any change in the anchor product being installed or the personnel performing the installation requires an initial inspection. For ongoing installations over an extended period, the special inspector must make regular inspections to confirm correct handling and installation of the product.

5.0 CONDITIONS OF USE

The Red Head Epcon G5 Adhesive Anchoring System described in this report is a suitable alternative to what is specified in the codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 The Red Head Epcon G5 Adhesive must be installed in accordance with the manufacturer's printed installation instructions, as included with the adhesive packaging and described in Figure 2 of this report.

5.2 The anchors must be installed in cracked or uncracked normal-weight concrete having a specified compressive strength of f_c'= 2500 psi to 8500 psi (17.2 MPa to 58.6 Mpa).

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

5.4 Anchors must be installed in concrete base materials in holes predrilled in accordance with the instructions provided in Figure 2 of this report, using a carbide-tipped masonry drill bit manufactured within the range of the maximum and minimum drill-tip dimensions of ANSI B212.15-1994.

5.5 Loads applied to the anchors must be adjusted in accordance with Section 1605.2 of the IBC for strength design and in accordance with Section 1605.3 of the IBC for allowable stress design.

5.6 Red Head Epcon G5 adhesive anchors are recognized for use in resisting short- and long-term loads, including wind and earthquake loads, subject to the conditions of this report.

5.7 In structures assigned to Seismic Design Category C, D, E or F under the IBC or IRC, anchor strength must be adjusted in accordance with 2009 IBC Section 1908.1.9 or 2006 IBC Section 1908.1.16

5.8 Red Head Epcon G5 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.

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

5.10 Allowable stress design values must be 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 given in this report.

5.12 Prior to anchor installation, calculations and details demonstrating compliance with this report shall 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.

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

- Anchors are used to resist wind or seismic forces only.
- Anchors that support gravity load-bearing structural elements are 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 nonstructural elements.

5.14 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.

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

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

5.17 Steel anchoring materials in contact with preservative-treated and fire-retardant-treated wood must be of zinc-coated carbon steel or stainless steel. The minimum coating weights for zinc-coated steel must comply with ASTM A153.

5.18 Special inspection must be provided in accordance with Section 4.3 of this report. Continuous special inspection for anchors installed in horizontal orientations to resist sustained tension loads must be provided in accordance with Section 4.3 of this report.

5.19 Installation of anchors in orientations to resist sustained tension loads shall be performed by personnel certified by an applicable certification program in accordance with ACI 318 D.9.2.2 or D.9.2.3.

5.20 Epcon G5 Adhesive Anchors may be used to resist tension and shear forces in floor installations only if installation is within base material temperature of 70 degrees F and 110 degrees F. Wall installations are limited to $^3/_8$-inch- thru $^3/_4$-inch diameter threaded rods and reinforcing bars if installation is within base material temperature of 70 degrees F. Overhead (vertically upward) and upwardly inclined installations are beyond the scope of this report.

5.21 Epcon G5 Adhesive is manufactured by Red Head in Elk Grove Village, Illinois, 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 Elements (AC308), dated February 2013.

7.0 IDENTIFICATION

The Red Head Epcon G5 adhesive is identified by labels on the adhesive cartridges bearing the adhesive manufacturer's name (ITW Commercial Construction North America) and address (Glendale Heights, Illinois), the product name (Red Head Epcon G5), best-used-by expiration date, and the evaluation report number (ESR-1137).

TABLE 1—STEEL DESIGN INFORMATION FOR FRACTIONAL THREADED ROD

CHARACTERISTIC		SYMBOL	UNITS	NOMINAL ROD DIAMETER, *d* (inch)						
				3/8	1/2	5/8	3/4	7/8	1	1 1/4
Threaded rod effective cross-sectional area		A_{se}	inch²	0.078	0.142	0.226	0.335	0.462	0.606	0.969
Carbon Steel A36	Nominal steel strength in tension	N_{sa}	lb	4,500	8,230	13,110	19,400	26,780	35,130	56,210
	Nominal steel strength in shear	V_{sa}	lb	2,250	4,940	7,870	11,640	16,070	21,080	33,730
	Strength reduction factor for tension, steel failure mode[1]	ϕ	-	0.75	0.75	0.75	0.75	0.75	0.75	0.75
	Strength reduction factor for shear, steel failure mode[1]	ϕ	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70	0.70	0.70	0.70	0.70	0.70	0.70
Carbon Steel A193 B7	Nominal steel strength in tension	N_{sa}	lb	9,690	17,740	28,250	41,810	57,710	75,710	121,140
	Nominal steel strength in shear	V_{sa}	lb	4,845	10,640	16,950	25,090	34,630	45,430	72,680
	Strength reduction factor for tension, steel failure mode[1]	ϕ	-	0.75	0.75	0.75	0.75	0.75	0.75	0.75
	Strength reduction factor for shear, steel failure mode[1]	ϕ	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70	0.70	0.70	0.70	0.70	0.70	0.70
Stainless Steel F593	Nominal steel strength in tension	N_{sa}	lb	5,810	10,640	16,950	25,090	34,630	45,430	72,680
	Nominal steel strength in shear	V_{sa}	lb	2,905	6,390	10,170	15,050	20,780	27,260	43,610
	Strength reduction factor for tension, steel failure mode[1]	ϕ	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
	Strength reduction factor for shear, steel failure mode[1]	ϕ	-	0.60	0.60	0.60	0.60	0.60	0.60	0.60
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70	0.70	0.70	0.70	0.70	0.70	0.70

For **SI:** 1 inch = 25.4mm, 1 lbf = 4.45N

[1] The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC or ACI 318 Section 9.2 are used as set forth in ACI 318-11 D.4.3. If the load combinations of ACI 318 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318 D.4.4.

TABLE 2—STEEL DESIGN INFORMATION FOR FRACTIONAL REINFORCING BAR

CHARACTERISTIC		SYMBOL	UNITS	NOMINAL REINFORCING BAR (REBAR) SIZE						
				No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 10
Nominal bar diameter		d	in.	$^3/_8$	$^1/_2$	$^5/_8$	$^3/_4$	$^7/_8$	1	$1^1/_4$
Reinforcing bar effective cross-sectional area		A_{se}	in²	0.11	0.2	0.31	0.44	0.6	0.79	1.27
ASTM 615 Grade 60	Nominal steel strength in tension	N_{sa}	lb	9,900	18,000	27,900	39,600	54,000	71,100	114,300
	Nominal steel strength in shear	V_{sa}	lb	5,940	10,800	16,740	23,760	32,400	42,660	68,580
	Strength reduction factor for tension, steel failure mode[1]	ϕ	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
	Strength reduction factor for shear, steel failure mode[1]	ϕ	-	0.60	0.60	0.60	0.60	0.60	0.60	0.60
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.91	0.91	0.91	0.90	0.90	0.71	0.71

For **SI:** 1 inch = 25.4mm, 1 lbf = 4.45N, 1ft-lbf = 1.356 N-M, 1 psi = 0.006895 MPa.

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

TABLE 3—CONCRETE BREAKOUT DESIGN INFORMATION FOR FRACTIONAL THREADED ROD AND REINFORCING BAR

CHARACTERISTIC	SYMBOL	UNITS	NOMINAL ROD DIAMETER AND REINFORCING BAR SIZE, *d* (inch)						
			$^3/_8$	$^1/_2$	$^5/_8$	$^3/_4$	$^7/_8$	1	$1^1/_4$
			No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 10
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	-	24	24	24	24	24	24	24
Effectiveness factor for cracked concrete	$k_{c,cr}$	-	17	17	17	17	17	17	17
Minimum concrete thickness[2]	h_{min}	in.	$h_{ef} + 1^1/_4$		$h_{ef} + 2d_o$				
Anchor embedment depth - minimum	$h_{ef,min}$	in.	$2^3/_8$	$2^3/_4$	$3^1/_8$	$3^1/_2$	$3^1/_2$	4	5
Anchor embedment depth - maximum	$h_{ef,max}$	in.	$3^3/_8$	$4^1/_2$	$5^5/_8$	$6^3/_4$	$7^7/_8$	9	$11^1/_4$
Minimum spacing	s_{min}	in.	$^{15}/_{16}$	1	$2^1/_2$	6	$3^1/_2$	4	5
Minimum edge distance	c_{min}	in.	$^{15}/_{16}$	1	$2^1/_2$	6	$3^1/_2$	4	5
Critical edge distance	c_{ac}	in.	See Section 4.1.10 of this report						
Strength reduction factor for tension, concrete failure mode[1]	ϕ	Cond. B	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Strength reduction factor for shear, concrete failure mode[1]	ϕ	Cond. B	0.70	0.70	0.70	0.70	0.70	0.70	0.70

For **SI:** 1 inch = 25.4mm, 1 lbf = 4.45N

[1] The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC or ACI 318 Section 9.2 are used and the requirements of ACI 318-11 D.4.3 for Condition B are met. If the load combinations of ACI 318 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4 for Condition B.

[2] d_o represents the nominal drill hole diameter.

TABLE 4—RED HEAD EPCON G5 ADHESIVE ANCHOR BOND STRENGTH DESIGN INFORMATION FOR FRACTIONAL THREADED ROD[1]

CHARACTERISTIC		SYMBOL	UNITS	NOMINAL ROD DIAMETER (inch)						
				$^3/_8$	$^1/_2$	$^5/_8$	$^3/_4$	$^7/_8$	1	$1^1/_4$
Anchor embedment depth – minimum		$h_{ef,min}$	in.	$2^3/_8$	$2^3/_4$	$3^1/_8$	$3^1/_2$	$3^1/_2$	4	5
Anchor embedment depth – maximum		$h_{ef,max}$	in.	$3^3/_8$	$4^1/_2$	$5^5/_8$	$6^3/_4$	$7^7/_8$	9	$11^1/_4$
Temperature Range A[2,4,5]	Characteristic Bond Strength for Uncracked Concrete	$\tau_{k,uncr}$	psi	1,620	1,620	1,620	1,620	1,620	1,620	1,620
	Characteristic Bond Strength for Cracked Concrete[6]	$\tau_{k,cr}$	psi	665	785	785	785	785	785	785
Temperature Range B[3,4,5]	Characteristic Bond Strength for Uncracked Concrete	$\tau_{k,uncr}$	psi	1,245	1,245	1,245	1,245	1,245	1,245	1,245
	Characteristic Bond Strength for Cracked Concrete[6]	$\tau_{k,cr}$	psi	510	605	605	605	605	605	605
Continuous Inspection	Strength Reduction Factor – Dry Concrete	$\phi_{dry,\ ci}$	-	0.65	0.65	0.65	0.65	0.55	0.55	0.55
	Strength Reduction Factor – Water Saturated Concrete	$\phi_{\ s,\ ci}$	-	0.65	0.65	0.65	0.65	0.55	0.55	0.55
	Strength Reduction Factor – Water-Filled Holes	$\phi_{wf,\ ci}$	-	0.65	0.65	0.65	0.65	0.55	0.55	0.55
	Strength Reduction Factor – Submerged Concrete	$\phi_{sub,\ ci}$	-	0.65	0.65	0.65	0.65	0.55	0.55	0.55
Periodic Inspection	Strength Reduction Factor – Dry Concrete	$\phi_{dry,\ ci}$	-	0.55	0.55	0.55	0.55	0.45	0.45	0.45
	Strength Reduction Factor – Water Saturated Concrete	$\phi_{\ s,\ ci}$	-	0.55	0.55	0.55	0.55	0.45	0.45	0.45
	Strength Reduction Factor – Water-Filled Holes	$\phi_{wf,\ ci}$	-	0.55	0.55	0.55	0.55	0.45	0.45	0.45
	Strength Reduction Factor – Submerged Concrete	$\phi_{sub,\ ci}$	-	0.55	0.55	0.55	0.55	0.45	0.45	0.45
Reduction factor for seismic tension		$\phi_{N,seis}$	-	0.80						

For **SI:** 1 inch = 25.4mm, 1 lbf = 4.45N, 1ft-lbf = 1.356 N-M, 1 psi = 0.006895 MPa.

[1] Bond strength values correspond to concrete compressive strength range 2,500 psi to 8,500 psi.
[2] Temperature range A: Maximum short term temperature of 110 degrees F and maximum long term temperature of 70 degrees F.
[3] Temperature range B: Maximum short term temperature of 110 degrees F and maximum long term temperature of 110 degrees F.
[4] Short term elevated concrete temperatures are those that occur over brief interval, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
[5] For load combinations consisting of only short-term loads, such as wind or seismic loads, bond strengths may be increased by 5% for Temperature Range A and by 36% for Temperature Range B.
[6] For structures assigned to IBC or IRC Seismic Design Category C, D, E, or F, bond strength values must be multiplied by $\alpha_{N,seis}$.

TABLE 5—RED HEAD EPCON G5 ADHESIVE ANCHOR BOND STRENGTH DESIGN INFORMATION FOR FRACTIONAL REINFORCING BAR[1]

CHARACTERISTIC		SYMBOL	UNITS	NOMINAL REINFORCING BAR (REBAR) SIZE						
				No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 10
Anchor embedment depth – minimum		$h_{ef,min}$	in.	$2^3/_8$	$2^3/_4$	$3^1/_8$	$3^1/_2$	$3^1/_2$	4	5
Anchor embedment depth – maximum		$h_{ef,max}$	in.	$3^3/_8$	$4^1/_2$	$5^5/_8$	$6^3/_4$	$7^7/_8$	9	$11^1/_4$
Temperature Range A[2,4,5]	Characteristic Bond Strength for Uncracked Concrete	$\tau_{k,uncr}$	psi	1,620	1,620	1,620	1,620	1,620	1,620	1,620
	Characteristic Bond Strength for Cracked Concrete[6]	$\tau_{k,cr}$	psi	665	785	785	785	785	785	785
Temperature Range B[3,4,5]	Characteristic Bond Strength for Uncracked Concrete	$\tau_{k,uncr}$	psi	1,245	1,245	1,245	1,245	1,245	1,245	1,245
	Characteristic Bond Strength for Cracked Concrete[6]	$\tau_{k,cr}$	psi	510	605	605	605	605	605	605
Continuous Inspection	Strength Reduction Factor – Dry Concrete	$\phi_{dry,\ ci}$	-	0.65	0.65	0.65	0.65	0.55	0.55	0.55
	Strength Reduction Factor – Water Saturated Concrete	$\phi_{\ s,\ ci}$	-	0.65	0.65	0.65	0.65	0.55	0.55	0.55
	Strength Reduction Factor – Water-Filled Holes	$\phi_{wf,\ ci}$	-	0.65	0.65	0.65	0.65	0.55	0.55	0.55
	Strength Reduction Factor – Submerged Concrete	$\phi_{sub,\ ci}$	-	0.65	0.65	0.65	0.65	0.55	0.55	0.55
Periodic Inspection	Strength Reduction Factor – Dry Concrete	$\phi_{dry,\ ci}$	-	0.55	0.55	0.55	0.55	0.45	0.45	0.45
	Strength Reduction Factor – Water Saturated Concrete	$\phi_{\ s,\ ci}$	-	0.55	0.55	0.55	0.55	0.45	0.45	0.45
	Strength Reduction Factor – Water-Filled Holes	$\phi_{wf,\ ci}$	-	0.55	0.55	0.55	0.55	0.45	0.45	0.45
	Strength Reduction Factor – Submerged Concrete	$\phi_{sub,\ ci}$	-	0.55	0.55	0.55	0.55	0.45	0.45	0.45
Reduction factor for seismic tension		$\phi_{N,seis}$	-	0.80						

For **SI:** 1 inch = 25.4mm, 1 lbf = 4.45N, 1ft-lbf = 1.356 N-M, 1 psi = 0.006895 MPa.

[1] Bond strength values correspond to concrete compressive strength range 2,500 psi to 8,500 psi.
[2] Temperature range A: Maximum short term temperature of 110 degrees F and maximum long term temperature of 70 degrees F.
[3] Temperature range B: Maximum short term temperature of 110 degrees F and maximum long term temperature of 110 degrees F.
[4] Short term elevated concrete temperatures are those that occur over brief interval, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
[5] For load combinations consisting of only short-term loads, such as wind or seismic loads, bond strengths may be increased by 5% for Temperature Range A and by 36% for Temperature Range B.
[6] For structures assigned to IBC or IRC Seismic Design Category C, D, E, or F, bond strength values must be multiplied by $\alpha_{N,seis}$.

FIGURE 1a—RED HEAD EPCON G5 ADHESIVE CARTRIDGE, DISPENSING TOOLS, MIXING NOZZLE, AND HOLE CLEANING BRUSH

TABLE 6—EXAMPLE RED HEAD EPCON G5 ADHESIVE ALLOWABLE STRESS DESIGN VALUES (ASD) FOR ILLUSTRATIVE PURPOSES

Anchor Diameter (d)	Min/Max Embedment Depth, h_{ef} (in)	Char. Bond Strength $\tau_{k,uncr}$ (psi)	Allowable Tension Load (lb) 2500psi- 8000psi	Controlling Failure Mode
$^3/_8$	$2^3/_8$	1,620	1,684	Bond
	$3^3/_8$	1,620	2,280	Steel
$^1/_2$	$2^3/_4$	1,620	2,403	Concrete
	$4^1/_2$	1,620	4,171	Steel
$^5/_8$	$3^1/_8$	1,620	2,911	Concrete
	$5^5/_8$	1,620	6,643	Steel
$^3/_4$	$3^1/_2$	1,620	3,451	Concrete
	$6^3/_4$	1,620	9,242	Concrete
$^7/_8$	$3^1/_2$	1,620	3,451	Concrete
	$7^7/_8$	1,620	10,663	Bond
1	4	1,620	4,216	Concrete
	9	1,620	13,927	Bond
$1^1/_4$	5	1,620	5,892	Concrete
	$11^1/_4$	1,620	19,887	Concrete

For **SI:** 1 inch = 25.4mm, 1 lbf = 4.45N, 1ft-lbf = 1.356 N-M, 1 psi = 0.006895 MPa.

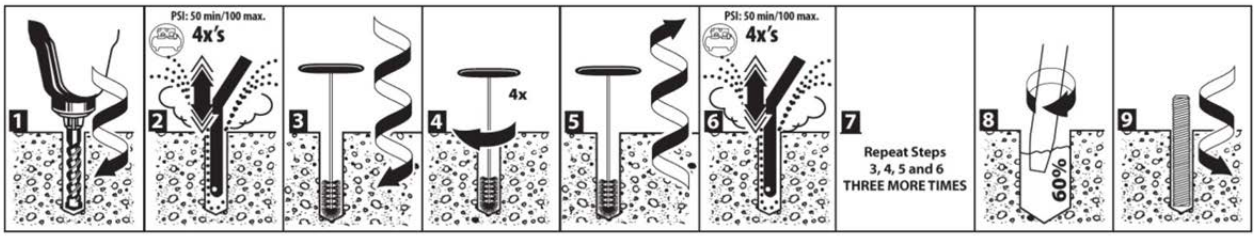
This table was developed based on the following conditions:
[1]Single anchor with static tension only, A36 threaded rod
[2]Vertical downward installation direction
[3]Inspection regimen = Periodic
[4]Installation temperature = 70˚F to 110˚F
[5]Long term temperature = 70˚F
[6]Short term temperature = 110˚F
[7]Dry hole condition (carbide drilled hole)
[8]Embedment = hef (min/max for each diameter)
[9]Concrete determined to remain uncracked for the life of the anchorage
[10]Load combinations from ACI 318 Section 9.2 (no seismic loading)
[11]30% dead load and 70% live load, controlling load combination 1.2D + 1.6L
[12]Calculation of weighted average for α = 0.3*1.2 + 0.7*1.6 = 1.48
[13]f'_c = 2,500 psi (normal weight concrete)
[14]$c_{a1} = c_{a2} \geq c_{ac}$
[15]$h \geq h_{min}$

Illustrative Procedure to Verify Applied Tension Load does not exceed Allowable Stress Design Tension Value:
Red Head Epcon G5 Adhesive Anchor $^{1}/_{2}$-inch diameter, with an embedment of $4^{1}/_{2}$ inches, assuming the conditions given in Table 6 (for use with the 2009 IBC, based on ACI 318-11 Appendix D). Applied Tension load, N_{ua} = 4,000 lbs.

	PROCEDURE	***CALCULATION***
Step 1	Calculate steel strength of a single anchor in tension per ACI 318 D.5.1.2 and Table 1 of this report.	ϕN_{sa} = 0.75*8,230 = 6,173 lbs steel strength
Step 2	Calculate concrete breakout strength of a single anchor in tension per ACI 318 D.5.2 and Table 3 of this report.	$N_b = k_{c,uncr} * \lambda_a \sqrt{f'_c}\ h_{ef}^{1.5}$ = 24*1.0* $\sqrt{2{,}500}$*$4.5^{1.5}$ N_b = 11,455 lbs $\phi N_{cb} = \phi A_{NC}/A_{NC0}\ \psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_b$ ϕN_{cb} = 0.65*1.0*1.0*1.0*1.0*11,455 ϕN_{cb} = 7,446 lbs concrete breakout strength
Step 3	Calculate bond strength of a single anchor in tension per ACI 318 D.5.5 and Table 4 of this report.	$N_{ba} = \lambda_a\ \tau_{k,uncr}\ \pi d h_{ef}$ N_{ba} = 1.0*1,620*3.14*0.5*4.5 N_{ba} = 11,445 lbs $\phi N_a = \phi A_{Na}/A_{Na0}\ \psi_{ed,Na}\ \psi_{cp,Na}\ N_{ba}$ ϕN_a = 0.55*1.0*1.0*1.0*11,445 ϕN_a = 6,295 lbs bond strength
Step 4	Determine compliance with required anchor strength per ACI 318 D.4.1.	ϕN_{sa} = 6,173 lbs > N_{ua} = 4,000 lbs ϕN_{cb} = 7,446 lbs > N_{ua} = 4,000 lbs ϕN_{ao} = 6,295 lbs > N_{ua} = 4,000 lbs
Step 5	Calculate allowable stress design conversion factor for loading condition per ACI 318 Section 9.2.	$\alpha = 1.2D + 1.6L = 1.2(0.3) + 1.6(0.7) = 1.48$
Step 6	Calculate allowable stress design value per Section 4.2 of this report.	$T_{allowable,ASD} = \phi N_n / \alpha$ = 6,173 lbs/1.48 $T_{allowable,ASD}$ = 4,171 lbs allowable stress design

FIGURE 1b—EXAMPLE DESIGN CALCULATION

EPCON G5 ADHESIVE ANCHOR INSTALLATION INSTRUCTIONS



STEP 1

•Use a rotary hammer drill or pneumatic air drilling machine with a drill bit complying to ANSI B212.15.1994 tolerance standards.

• Use a drill bit equal to the threaded rod/rebar diameter plus $^{1}/_{16}$" (for $^{3}/_{8}$" & ½" diameter anchors) and $^{1}/_{8}$" (for $^{5}/_{8}$" diameter & larger anchors). Drill hole to the required embedment depth. See attached table for the minimum/maximum embedment depths.

• The G5 Adhesive Anchors are for use with wall and floor installations only. Wall installations may be used with $^{3}/_{8}$" thru maximum ¾" diameter threaded rod/rebar.

• Per construction specification, adhere to minimum spacing, minimum edge distance, and minimum member thickness.

STEP 2

• Oscillate a clean air nozzle in and out of the dry, damp, water-filled or submerged hole four times, for a total of four seconds, starting at the bottom of the hole with contaminant-free compressed air, exhausting hole until visually clean (i.e. no drill dust, debris, etc.).

• If required, use an extension on the end of the air nozzle to reach the bottom of the hole.

STEP 3

• Select an appropriately sized Red Head brush from part nos. SB038, SB012, SB058, SB034, SBO78, SB010, SB125, or match brush color coding to anchor diameter. Brush must be checked for wear before use. See attached table for brush specifications, including minimum diameter.

• Insert brush into the hole with a clockwise motion. For every ½" forward advancement, complete one full turn until bottom of hole is reached. For faster and more suitable cleaning, attach the brush to a drill.

• If required, use a wire brush extension (part nos. ESDS-38 or EHAN-38) to reach the bottom of the hole

STEP 4

• Twist/spin the brush four full turns at bottom of hole.

STEP 5

• Using a clockwise motion, for every full turn of the brush, pull the brush ½" out of the hole.

• Air-clean the dust off the brush to prevent clogging of brush.

STEP 6

• Oscillate a clean air nozzle in and out of the dry, damp, water-filled or submerged hole four times, for a total of four seconds, starting at the bottom of the hole with contaminant-free compressed air, exhausting hole until visually clean (i.e. no drill dust, debris, etc.).

• If required, use an extension on the end of the air nozzle to reach the bottom of the hole

STEP 7

• Repeat steps 3, 4, 5, and 6 (brushing and blowing) three more times before proceeding to Step 8.

STEP 8

• Check the "best used by" date on cartridge and that the cartridge has been stored in temperatures between 40 F and 90°F. Review Material Safety Data Sheet (MSDS) before use.

• Assemble Red Head supplied cartridge (part no. G5-22) and nozzle (part no. E55).

• Place assembly into a hand injection tool (part no. E102) or pneumatic tool (part no. E202).

• Dispense mixed adhesive outside of hole until uniform color is achieved.

• During floor installations, concrete and adhesive must be between 70°F to 110°F or artificially maintained.

• During wall installations, concrete and adhesive must be 70°F or artificially maintained.

• Insert the nozzle to the bottom of the hole and inject the adhesive at an angle leaving the nozzle tip always slightly below the fill level. In a slow circular direction, work the adhesive into the sides of the hole, filling slowly to ensure proper adhesive distribution, until the hole is approximately 60% filled.

STEP 9

• Immediately insert and oil, rust and scale free threaded rod/rebar to the required embedment depth. Use a counterclockwise motion to ensure proper adhesive distribution.

• After installing the anchor, the gap between the threaded rod/rebar and the concrete must be completely filled with adhesive. The adhesive must fill voids, crevices and uniformly coat the threaded rod/rebar and concrete.

• For holes that contain water, keep injecting the adhesive below the water in order to displace the water upward.

• After installation, do not disturb the anchor until the full cure time has elapsed.

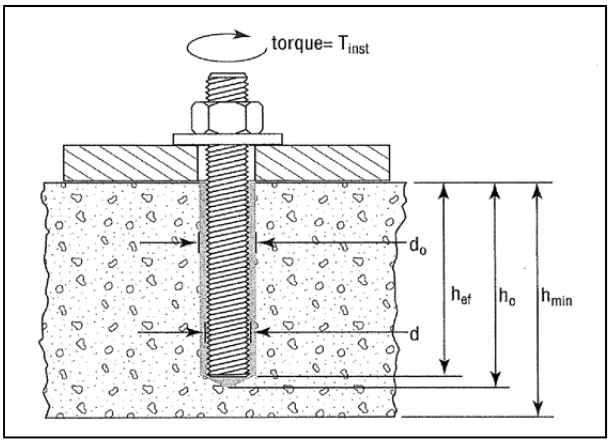
• Adhesive must be fully cured before applying any load or torque

FIGURE 2—INSTALLATION INFORMATION AND PARAMETERS
SPECIFICATIONS FOR INSTALLATION OF RED HEAD EPCON G5 ADHESIVE ANCHORS IN CONCRETE

CHARACTERISTIC	SYMBOL	UNITS	NOMINAL ROD DIAMETER (inch) AND REINFORCING BAR SIZE						
			$^3/_8$	$^1/_2$	$^5/_8$	$^3/_4$	$^7/_8$	1	$1^1/_4$
			No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 10
Nominal carbide bit diameter	d_o	in.	$^7/_{16}$	$^9/_{16}$	$^3/_4$	$^7/_8$	1	$1^1/_8$	$1^3/_8$
Anchor embedment depth - minimum	$h_{ef,\,min}$	in.	$2^3/_8$	$2^3/_4$	$3^1/_8$	$3^1/_2$	$3^1/_2$	4	5
Anchor embedment depth - maximum	$h_{ef,\,max}$	in.	$3^3/_8$	$4^1/_2$	$5^5/_8$	$6^3/_4$	$7^7/_8$	9	$11^1/_4$
Minimum spacing	s_{min}	in.	$^{15}/_{16}$	1	$2^1/_2$	6	$3^1/_2$	4	5
Minimum edge distance	c_{min}	in.	$^{15}/_{16}$	1	$2^1/_2$	6	$3^1/_2$	4	5
Minimum concrete thickness	h_{min}	in.	$h_{ef} + 1^1/_4$		$h_{ef} + 2d_o$				
Maximum tightening torque for pretension clamping	T_{inst}	ft lb	9	16	47	90	145	170	370

For **SI:** 1 inch = 25.4mm, 1 lbf = 4.45N, 1ft-lbf = 1.356N-m, 1psi = 0.006895MPa.

ANCHOR INSTALLATION



BRUSH SPECIFICATIONS

Brush color	Part No.	Anchor diameter (in) (d)	Rebar size (d)	Drill bit diameter (in) (d_o)	Minimum brush diameter (in) (d_{brush})
Grey	SB038	$^3/_8$	No. 3	$^7/_{16}$	0.563
Brown	SB012	$^1/_2$	No. 4	$^9/_{16}$	0.675
Green	SB058	$^5/_8$	No. 5	$^3/_4$	0.900
Yellow	SB034	$^3/_4$	No. 6	$^7/_8$	1.125
Red	SB078	$^7/_8$	No. 7	1	1.350
Purple	SB010	1	No. 8	$1^1/_8$	1.463
Blue	SB125	$1^1/_4$	No. 10	$1^3/_8$	1.575

GEL TIMES AND CURE TIMES FOR RED HEAD EPCON G5 ADHESIVE

Concrete Temp. (°F)[1,2]	Gel Time (minutes)[3]	Cure Time (hours)[4]
70	15	24
90	9	24
110	9	24

For **SI:** t° (°F-32) X .555 = °C.

[1] Adhesive must be installed in base material temperatures of 70°F to 110°F or artificially maintained.
[2] Cartridge temperature should not differ significantly from the temperature of the base material.
[3] Gel time is the maximum time from the end of mixing to when the insertion of the anchor into the adhesive shall be completed.
[4] Cure time is the minimum time from the end of gel time to when the anchor maybe torqued or loaded. Anchors are to be undisturbed during the cure time.

FIGURE 2—INSTALLATION INFORMATION AND PARAMETERS (Continued)

ICC-ES Evaluation Report

ESR-1137 Supplement*

Reissued February 2013

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EVALUATION SUBJECT:

ITW RED HEAD EPCON G5 ADHESIVE ANCHORING SYSTEM FOR CRACKED AND UNCRACKED CONCRETE

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that Red Head Epcon G5 Adhesive Anchoring System for Cracked and Uncracked Concrete, recognized in ICC-ES master evaluation report ESR-1137, has also been evaluated for compliance with the codes noted below.

Compliance with the following codes:

- 2010 *Florida Building Code—Building*
- 2010 *Florida Building Code—Residential*

2.0 PURPOSE OF THIS SUPPLEMENT

This supplement is issued to indicate that the Red Head Epcon G5 Adhesive Anchoring System for Cracked and Uncracked Concrete described in Sections 2.0 through 7.0 of the master report, ESR-1137, complies with the 2010 *Florida Building Code—Building* and the 2010 *Florida Building Code—Residential*, when designed and installed in accordance with the *International Building Code®* (IBC) provisions noted in the master evaluation report under the following conditions:

- Design wind loads must be based on Section 1609 of the 2010 *Florida Building Code—Building* or Section 301.2.1.1 of the 2010 *Florida Building Code—Residential*, as applicable.
- Load combinations must be in accordance with Section 1605.2 or Section 1605.3 of the 2010 *Florida Building Code—Building*, as applicable.
- The modifications to ACI 318 as shown in the 2009 IBC Sections 1908.1.9 and 1908.1.10, as noted in 2009 IBC Section 1912.1, do not apply to the 2010 *Florida Building Code*.

Use of the Red Head Epcon G5 Adhesive Anchoring System for Cracked and Uncracked Concrete described in the master evaluation report, for compliance with the High-Velocity Hurricane Zone provisions of the 2010 *Florida Building Code—Building* and the 2010 *Florida Building Code—Residential* has not been evaluated, and is outside the scope of this supplement.

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 master report reissued February 2013, revised May 2014.

***Revised May 2014**