HILTI TECHNICAL BULLETIN

Date: **August 8, 2024**

Subject: **Early Age Concrete Technical Data for Hilti HIT-RE 500 V3 and Hilti HIT-HY 200 V3 Adhesive Anchor Systems**

ACI 318-19 Section 17.2.2 and CSA A23.3-19 Clause D.1.2 require post-installed adhesive anchors to be installed in concrete having a minimum age of 21 days at the time of installation. Hilti adhesive anchor systems adhere to this requirement and have been qualified in concrete that has cured 21 days or more. This document summarizes and evaluates additional test results performed with Hilti HIT-RE 500 V3 and Hilti HIT-HY 200 V3 adhesive anchor systems in concrete members prior to the 21-day ACI and CSA requirements, also known as "early age concrete" or "green concrete." To summarize, a reduction may be required for a post-installed adhesive anchor that is installed and loaded between 3 days and 21 days concrete cure time. For post-installed adhesive anchors that are installed but not loaded until the concrete has achieved the minimum 21-day concrete cure time, no reduction is required. See installation conditions, design parameters, and Table 1 below for more information.

Early age concrete tests with the HIT-RE 500 V3 or HIT-HY 200 V3 adhesive and the design information presented in Table 1 below is intended for early age concrete in the following conditions:

- Installations with threaded rods or deformed reinforcing bar (rebar) elements for post-installed anchoring-to-concrete applications
- Dry or water-saturated concrete that has achieved or exceeded a minimum concrete compressive strength of 1,500 psi (10.3 MPa) and a minimum concrete cure time of 72 hours (i.e., concrete age of 3 days)
    - Early age concrete with a concrete compressive strength less than 1,500 psi (10.3 MPa) or with a concrete cure time less than 72 hours is outside the scope of this document
- Base material temperature at time of installation must be between 50°F (10°C) to 104°F (41°C)
- Uncracked or cracked concrete
- Holes drilled with hammer drill and standard carbide drill bit
- Compressed air cleaning according to the applicable Instructions for Use (IFU)

Bond reduction factor from Table 1, $\alpha_{(t)}$, is intended to be used in conjunction with a full anchor design per ACI 318 Chapter 17 or CSA A23.3 Annex D and referencing either ICC-ES ESR-3814 or ELC-3814 for HIT-RE 500 V3 or ESR-4868 or ELC-4868 for HIT-HY 200 V3 considering the following:

- For bond failure, $\alpha_{(t)}$ must be multiplied to the appropriate published characteristic bond strength value, $\tau_{k,uncr}$ or $\tau_{k,cr}$, and normalized to the actual concrete compressive strength (f'_c) at time of anchor installation - See Eq. 1 and Eq. 2 below
- The product specific $\tau_{k,uncr}$, $\tau_{k,cr}$, and the normalization factor, n_{uncr} or n_{cr}, can be found in ESR-3814, ELC-3814, ESR-4868, or ELC-4868 as applicable
- Concrete compressive strength at the time of installation must be used for concrete related failure modes
- Early age concrete design is outside the scope of the ACI and CSA provisions and ESR and ELC documents - the design should be approved by the Engineer of Record (EOR)

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$$\tau_{k,uncr,(t)} = \alpha_{(t)}\tau_{k,uncr}\left(\frac{f'_c}{2{,}500\ psi}\right)^{n_{uncr}} \quad or \quad \tau_{k,uncr,(t)} = \alpha_{(t)}\tau_{k,uncr}\left(\frac{f'_c}{17.2\ MPa}\right)^{n_{uncr}} \qquad \text{(Eq. 1)}$$

$$\tau_{k,cr,(t)} = \alpha_{(t)}\tau_{k,cr}\left(\frac{f'_c}{2{,}500\ psi}\right)^{n_{cr}} \quad or \quad \tau_{k,cr,(t)} = \alpha_{(t)}\tau_{k,cr}\left(\frac{f'_c}{17.2\ MPa}\right)^{n_{cr}} \qquad \text{(Eq. 2)}$$

Table 1 – Bond reduction factor, $\alpha_{(t)}$, for HIT-RE 500 V3 and HIT-HY 200 V3 for early aged conc. [1]

Adhesive Anchor System	Age of Concrete at Installation (days) [2]	Bond Reduction Factor $\alpha_{(t)}$	
		Adhesive Anchor Loaded After Adhesive Curing Time [3]	Adhesive Anchor Loaded After 21 Day Concrete Cure [4]
HIT-HY 200-A V3 HIT-HY 200-R V3	3	0.70	1.00
	7	0.85	
	14	0.95	
	21	1.00	
HIT-RE 500 V3	3	0.90	1.00
	7	1.00	
	14	1.00	
	21	1.00	

[1] The bond reduction factors are based on tension tests performed on threaded rods in accordance with ICC-ES AC308 / ACI 355.4 at room temperature in dry and water-saturated normalweight concrete with a minimum concrete compressive strength of 1,500 psi (10.3 MPa).
[2] The age of concrete at installation is defined as the length of time that the concrete has cured and the moment the uncured adhesive anchor system is inserted into the borehole.
[3] Before loading can occur, the adhesive anchor must achieve the published curing time as provided in the Instructions for Use (IFU). After the adhesive curing time is achieved, the corresponding bond reduction factor, $\alpha_{(t)}$, must be applied per Eq. 1 or Eq. 2 as applicable.
[4] If the adhesive curing time is achieved and loading does not occur until the concrete has achieved a minimum 21-day concrete cure, no reduction is necessary.

Please feel free to contact our Engineering Technical Services department for more information or any questions.

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