

WHITE PAPER: EARLY AGE CONCRETE AND ITS EFFECTS ON THE BOND STRENGTH OF ADHESIVES TECHNOLOGY CORPORATION'S ANCHORING PRODUCTS

By: Joseph Hanley (Director of Engineering)

Introduction

Current building code requirements limit the age of concrete to be a minimum 21 days old for installing post-installed anchors in concrete. This is stated in ACI 318-14 Section 17.1.2 and ACI 318-11 Section D.2.2, which is referenced in the 2018, 2015 and the 2012 International Building Code (IBC). Conditions may occur onsite which require anchoring into concrete which is less than 21 days old, or green concrete. For this reason Adhesives Technology Corp. has performed extensive testing on key anchoring adhesives to determine any necessary reduction factors over time in various ages of the concrete substrate. Installing in concrete that has cured for less than 7 days is not recommended.

Scope of Testing & Analysis

Testing was performed to determine the adhesive anchor performance in early age concrete. Concrete was poured and allowed to reach a 7 day cure with a minimum concrete compressive strength of 2,500 psi. The anchor installations followed the Manufactures Printed Installation Instructions (MPII) / Instruction Card for each individual product. The adhesive was installed and tested according to the parameters listed in the table below and the results of the testing were evaluated and compared to anchors installed in 21 day old concrete.

The applicable bond strength reduction factors, α_{concrete} , for early age concrete can be seen below for each installation and curing condition.

EARLY AGE CONCRETE REDUCTIONS

Product	Age of Concrete at Time of Install	Cure Time of Adhesive	Age of Concrete at Time of Loading	Reduction Factor (α_{concrete})
ULTRABOND HS-1CC	7 days	8 hrs	7 days	1.00
		7 days	14 days	
		14 days	21 days	
	14 days	8 hrs	14 days	
		7 days	21 days	
		8 hrs	21 days	
ULTRABOND HYB-2CC	7 days	1 hr	7 days	0.70
		7 days	14 days	
		14 days	21 days	
	14 days	1 hr	14 days	0.80
		7 days	21 days	0.90
		1 hr	21 days	1.00
ULTRABOND EPX-3CC	7 days	6 hrs	7 days	0.90
		7 days	14 days	
		14 days	21 days	
	14 days	6 hrs	14 days	0.95
		7 days	21 days	1.00
		6 hrs	21 days	

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EARLY AGE CONCRETE REDUCTIONS

Product	Age of Concrete at Time of Install	Cure Time of Adhesive	Age of Concrete at Time of Loading	Reduction Factor ($\alpha_{concrete}$)
ULTRABOND ACRYL-8CC	7 days	1 hr	7 days	0.70
		7 days	14 days	0.80
		14 days	21 days	0.90
	14 days	1 hr	14 days	1.00
		7 days	21 days	
	21 days	1 hr	21 days	
ULTRABOND 1	7 days	24 hrs	8 days	0.80
		7 days	14 days	
		14 days	21 days	
	14 days	24 hrs	15 days	0.90
		7 days	21 days	
	21 days	24 hrs	22 days	1.00
ULTRABOND 1300	7 days	24 hr	8 days	0.90
		7 days	14 days	
		14 days	21 days	
	14 days	24 hr	15 days	0.95
		7 days	21 days	
	21 days	24 hr	22 days	1.00

1. Anchors shall be installed in normal weight, uncracked concrete with a compressive strength that complies with minimum allowable concrete strength of 2,500 psi, according to ACI 318-14 or ACI 318-11.
2. Concrete compressive strength at time of installation must be used in design equations.
3. Design of anchors in early age ('green') concrete is beyond the scope of ACI 318 and must be approved by the Engineer of Record, AHJ or the applicable code official.
4. Anchor installation must comply with each products individual MPII and minimum cure times. Technical Data Sheets may be found at www.ATCEPOXY.com.
5. Early age concrete installation has not been tested for long term sustained loads and is beyond the scope of this testing.

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