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Early Age Concrete and its Effect on Adhesive Anchor Bond Strength in Concrete

ACI 318-19, Chapter 17 and ACI 318-14, Chapter 17 (and by reference to the 2021 IBC, and the 2018 IBC and 2015 IBC, respectively) requires that adhesive anchors be installed in concrete with minimum age of 21 days at the time of installation. DEWALT currently publishes bond strengths that are based on concrete which has achieved its 28-day compressive strength and has cured for a minimum of 21 days. Concrete that is less than 21 days old is considered early age (aka 'green') and may influence the performance of adhesive anchors. Occasionally, waiting a minimum of 21 days to install adhesive anchors is not feasible, often due to scheduling and jobsite logistics.

As a result, DEWALT has conducted progressive laboratory testing with several adhesives anchor systems at various concrete ages and adhesive cure time intervals. The table below shows the concrete age at the time of anchor installation crossed with the adhesive cure time after anchor installation. If installations in early age concrete are considered, the corresponding reduction factor derived from testing for the given conditions is provided and must be applied to the bond strength when calculating the design bond strength capacity for the given anchor, as applicable.

Adhesive Anchor System	Concrete Age at Time of Anchor Installation	Adhesive Cure Time after Anchor Installation	Approximate Concrete Age at Time of Testing	Bond Strength Reduction Factor
DEWALT Pure110+ standard cure epoxy	7 days	Published Minimum	7 days	1.0
		7 days	14 days	
		14 days	21 days	
	14 days	Published Minimum	14 days	1.0
		7 days	21 days	
	21 days	Published Minimum	21 days	1.0
DEWALT AC200+ fast cure acrylic	7 days	Published Minimum	7 days	0.7
		7 days	14 days	0.8
		14 days	21 days	1.0
	14 days	Published Minimum	14 days	0.8
		7 days	21 days	1.0
	21 days	Published Minimum	21 days	
DEWALT Pure50+ standard cure epoxy	7 days	Published Minimum	7 days	1.0
		7 days	14 days	
		14 days	21 days	
	14 days	Published Minimum	14 days	1.0
		7 days	21 days	
	21 days	Published Minimum	21 days	1.0
DEWALT AC100+ Gold fast cure acrylic	7 days	Published Minimum	7 days	1.0
		7 days	14 days	
		14 days	21 days	
	14 days	Published Minimum	14 days	1.0
		7 days	21 days	
	21 days	Published Minimum	21 days	1.0
DEWALT Pure220+ standard cure epoxy	7 days	Published Minimum	7 days	0.9
		7 days	14 days	1.0
		14 days	21 days	
	14 days	Published Minimum	14 days	1.0
		7 days	21 days	
	21 days	Published Minimum	21 days	1.0

1. Installing adhesive anchors in concrete having a minimum age of less than 21 days at the time of anchor installation is not in compliance with ACI 318 and must be approved by the engineer of record and AHJ, as applicable. Actual concrete compressive strength at the time of anchor installation must be used for design.
2. Results shown are based on tension tests conducted in accordance with ACI 355.4/ASTM E488 in dry uncracked normal weight concrete at room temperature. The average minimum 7-day concrete compressive strength was approximately 2300 psi.
3. Holes were drilled with a hammer drill and standard carbide drill bit and cleaned following published instructions. Hollow drill bits (DEWALT DustX+ System) may be considered, as applicable.
4. Published minimum cure times vary based on the adhesive anchor system and the temperature of the base material. Anchors were not loaded until time of testing.
5. See published literature for the specific adhesive anchor system for minimum cure times and additional design information which is available at www.DEWALT.com.
6. The reduction factor for early age concrete is supplemental to all other relevant design considerations for the specific application, as applicable.

In addition to what is presented previously in this bulletin, DEWALT has also conducted supplemental installations and testing in 3-day old concrete with the following adhesive anchor system.

Adhesive Anchor System	Concrete Age at Time of Anchor Installation	Adhesive Cure Time after Anchor Installation	Approximate Concrete Age at Time of Testing	Bond Strength Reduction Factor
DEWALT Pure220+ standard cure epoxy	3 days	Published Minimum	3 days	0.9
		4 days	7 days	1.0
		11 days	14 days	
		18 days	21 days	

1. Installing adhesive anchors in concrete having a minimum age of less than 21 days at the time of anchor installation is not in compliance with ACI 318 and must be approved by the engineer of record and AHJ, as applicable. Actual concrete compressive strength at the time of anchor installation must be used for design.
2. Results shown are based on tension tests conducted in accordance with ACI 355.4/ASTM E488 in dry uncracked normal weight concrete at room temperature. The minimum 3-day concrete compressive strength was approximately 1650 psi.
3. Holes were drilled with a hammer drill and standard carbide drill bit and cleaned following published instructions. Hollow drill bits (DEWALT DustX+ System) may be considered, as applicable.
4. Published minimum cure times vary based on the adhesive anchor system and the temperature of the base material. Anchors were not loaded until time of testing.
5. See published literature for the specific adhesive anchor system for minimum cure times and additional design information which is available at www.DEWALT.com.
6. The reduction factor for early age concrete is supplemental to all other relevant design considerations for the specific application, as applicable.

The adhesive anchor systems will achieve published design strengths for relevant loading conditions when the product is properly installed into holes drilled in concrete. The adhesive anchors must be installed in accordance with all other published installation instructions specific to the application and conditions of the connection.