

BULLETIN #3: TEST CODES FOR CURING OF TEST CYLINDERS FOR ACCEPTANCE STRENGTH TESTING

Routinely, test specimens are made at the job site that will later be compression tested to determine compliance with the strength specification. When these specimens will be used for this purpose it is imperative that they be properly fabricated and cured in accordance with requirements set forth in the Virginia Uniform Statewide Building Code (USBC). This bulletin addresses test specimens utilized for evaluation and acceptance of the concrete, but not specimens intended for other purposes. Information pertaining to the difference between “laboratory-cured” and “field-cured test specimens” can be found in VRMCA Technical Bulletin #2.

The prescribed conditions related to the preparation and curing of test specimens used for acceptance purposes are addressed in the Virginia Uniform Statewide Building Code in the following pertinent documents:

- IBC – *International Building Code*
- ACI 318 – *Building Code Requirements for Structural Concrete*
- ASTM C 31 – *Standard Practice for Making and Curing Concrete Test Specimens in the Field*

Both the IBC and ACI 318 prescribe ASTM C 31 as the required method to prepare and cure test specimens in the field. Although ASTM C 31 is a “Standard Practice,” it becomes a mandatory specification requirement of the USBC by direct reference in the adopted model code and reference standard. As a result, the procedures and requirements stipulated in ASTM C 31 are mandatory (not optional). It is the responsibility of those performing tests under this standard to fully comply with these requirements in accordance with the Virginia USBC.

The issue of initial curing of the test specimens is often misunderstood or overlooked. However, the importance of proper initial curing cannot be overemphasized. Numerous studies have shown that non-standard or improper initial curing of the test cylinders can result in an artificial reduction in the indicated strength of the concrete test cylinders. This reduction can range from 5 to 30 percent or more [ref 4]. In accordance with the requirements of ASTM C31, the test specimens must be placed in their initial curing environment IMMEDIATELY following molding and finishing of the specimens. The temperature in this initial curing environment must remain in the range of 60° to 80° F for the duration of the initial curing period, which is permitted to extend for up to 48 hours. The initial curing environment must prevent moisture loss from the specimens and be free of excessive vibration. In addition, the supporting surface that the test specimens will be placed on must be level within ¼ inch per foot. It should also be noted that ASTM C31 requires that the test for slump, air content, and temperature must be conducted on the same sample of concrete from which the test specimens are made.

Although not specifically addressed in the Code, ACI 301 requires the contractor to “provide and maintain” “adequate facilities for safe storage and proper curing of concrete test specimens on the project site.” This is often accomplished by using an insulated box with provisions for heating the enclosure in cold weather and cooling it in hot weather. Another convenient method for initial curing is to partially submerge the test cylinders in a water bath. Any suitable watertight container can be used, but experience has shown that a conventional ice chest works well. The water can be heated with a submersible heating element or cooled with ice as needed to maintain the cor-

rect temperature. Also, the water acts as a buffer to prevent temperature swings when the lid is opened.

Following the initial curing period, the test cylinders must be properly protected from impact, excessive vibration, temperature extremes, and moisture loss while being transported to the laboratory. Upon arrival at the laboratory the specimens must be removed from their molds and placed in a moist curing environment at a temperature of 73°+/- 3° F until the time of compression testing.

Finally, the technician performing the field tests must be properly qualified. The International Building Code and ACI 318 require that a “qualified technician” conduct all tests. The credentials of a “qualified technician” are further defined in ASTM C31 where it is stipulated that the field technician must be certified as an ACI Field Testing Technician-Grade I, or equivalent. Therefore, it is mandatory that the technician conducting the field tests be currently certified under the requirements of the ACI Certified Field Testing Technician-Grade I, or the equivalent.

Field testing, in accordance with ASTM C 31, is not completed until the test specimens are placed in the proper initial curing environment. Therefore, under the requirements of the USBC, the field-testing technician is charged with the responsibility to assure that the test specimens are placed in an appropriate curing environment immediately following fabrication of the test specimens. Otherwise the execution of the testing is not in compliance with the USBC and the results of the test specimens cannot be used for the purpose of acceptance of the concrete.

The Technical Committee of the Virginia Ready-Mixed Concrete Association has supplied this information as a service to the concrete construction industry.

References:

- International Building Code 2003, International Code Council, Inc. Falls Church, VA, 2003.
- ACI 318-02 Building Code Requirements for Structural Concrete, American Concrete Institute, Farmington Hills, MI, 2002.
- ASTM C 31-98, Standard Practice for Making and Curing Test Specimens in the Field, ASTM International, West Conshohocken, PA, 1989.
- Bloem, Delmar. Effect of Curing Condition on Compressive Strength of Concrete Test Specimens, National Ready Mixed Concrete Association, 900 Spring St. Silver Spring, MD, 1969.