Testing & Acceptance of Jobsite Concrete | Position Paper

Reference: Concrete Construction in Kansas & Missouri
Subject: Testing and Acceptance of Ready Mixed Concrete

Concrete is the second most consumed material in the world and critical to our built environment. Its durability, strength, sustainability, and proven performance is the basis for millions of cubic yards placed in buildings, pavements, infrastructure, and more, year after year.

Concrete mixes are typically designed and produced using guides, specifications, and standards from the American Concrete Institute (ACI) and ASTM International (ASTM). These same documents are often included, either directly or by reference, in the specifications of concrete construction projects in our area. This paper highlights the critical requirements of these standards that apply specifically to the proper testing of concrete specimens made in the field and used to determine acceptance.

We suggest everyone obtain copies of the current version of these standards for reference:

- **ACI 301 Specification for Structural Concrete**
- **ASTM C31 Standard Practice for Making and Curing Concrete Test Specimens in the Field**
- **ASTM C39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens**
- **ACI 318 Building Code Requirements for Structural Concrete & Commentary**
- **ACI 311.6 Specification for Testing Ready-Mixed Concrete**

Significant Requirements:

- ACI 301 requires that individuals performing the testing of fresh concrete in the field hold a current certification of ACI Concrete Field Testing Technician Grade 1 or acceptable equivalent. Additionally, owner's testing agencies that perform the required tests of concrete materials must meet the requirements of ASTM C1077. It is not unreasonable to verify these credentials prior to the beginning of a project. ACI provides an app that can be used to easily verify the status of ACI certified individuals. More information can be found at concrete.org/verify.
- ACI 301 defines a strength test as "the average of the compressive strengths of at least two 6 x 12 in. cylinders or at least three 4 x 8 in. cylinders made from the same sample of concrete, taken in accordance with ASTM C172 at the point of delivery, handled and standard cured in accordance with ASTM C31, and tested in accordance with ASTM C39…" While commonly used as an indication of strength at early ages, reported compressive strength values based on the testing of a single specimen at a given age should not be used for acceptance.
- ASTM C31 provides requirements for making, curing, protecting, and transporting concrete test specimens under field conditions. For each sample of concrete from which specimens are made for strength acceptance, ASTM C31 requires the testing of slump or slump flow, air content, and temperature in accordance with the applicable ASTM Test Method. These tests are mandatory and shall be performed regardless of whether the results are used to verify compliance with a specified value. While it is not a requirement, ASTM C31 notes that measurement of the density (unit weight) of concrete by ASTM C138 can provide useful information and is sometimes specified.
- When specimens are used to determine acceptance for specified strength, the procedures in ASTM C31 for standard curing are required. For a period up to 48 hours after molding and finishing, the specimens must be stored in a moisture-controlled environment with an initial curing temperature

in the range of 60 to 80°F (68 to 78°F for concrete mixtures with a design strength of 6000 psi or greater). This requirement must be strictly followed throughout the year, both to comply with the standard and to ensure that the results are accurate. Numerous studies have shown that if initial curing is not provided in accordance with ASTM C31, there can be a significant reduction in the measured compressive strength of the concrete. Following the initial curing period, the specimens are transported to the testing laboratory for final curing. Requirements for protection during transport and final curing are also included in ASTM C31 and must be followed.

- As specified in ACI 301, it is the contractor's responsibility to provide a secure location and sources of electrical power onsite for initial curing of the concrete strength test specimens to meet the requirements of ASTM C31. Proper storage and curing of the test specimens should be discussed and agreed upon with the testing agency in a pre-construction conference. More information and examples of a pre-construction checklists can be found here and here.
- When determining the compressive strength of test specimens, ASTM C39 requires that each specimen must be loaded continuously and without shock, at the required loading rate, until it is certain that the ultimate capacity has been attained and the specimen displays a well-defined fracture pattern. If loading is terminated when the first sign of load decrease is noticed, the measured compressive strength may not be representative of the concrete being tested.
- According to ACI 301, if material furnished fails to conform to the Contract Documents, the testing agency will report this deficiency to the Architect/Engineer, Owner, Contractor and Concrete Supplier. While it is imperative that the concrete supplier be notified immediately if there is a low-test result, it is equally important that they receive all test reports that pertain to their product. ACI 301 requires this reporting to be done within 7 days after tests are performed, but this frequently gets overlooked.

To ensure the success of every concrete construction project, we encourage all parties to make sure your facilities, employees, and procedures meet all ASTM and ACI contractual requirements. We urge all stakeholders to be aware of these requirements and verify that they are adhered to.

This position paper was developed for professionals in the construction industry to use as a reference and foster a better partnering environment. Since improper testing practices often result in unnecessary delays and costly over-design, we ask that these deviations be brought to our attention, so that our technical committee representative can notify the engineer and testing agency involved.

This position paper has the support of these concrete associations:

- Concrete Promotional Group, concretepromotion.com
- Kansas Chapter of the American Concrete Institute, acikansas.org
- Missouri Chapter of the American Concrete Institute, acimissouri.org
- Concrete Council of St. Louis, concretecouncil.com
- Concrete Promotion Council of the Ozarks, cpcoz.com
- MO/KS Chapter, American Concrete Pavement Association, moksacpa.com

Special thanks to the Indiana Ready Mixed Concrete Association for providing a similar paper to model ours after. Thank you to the National Ready Mixed Concrete Association and the Colorado Ready Mixed Concrete Associations for some direction & advice.

5-2021