



AMERICAN SOCIETY OF
CONCRETE CONTRACTORS

TECHNICAL CHECKLIST CONCRETE CORE TESTING

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Ensure that Drilled Cores are Obtained and Tested Properly

Background

If any strength test of laboratory-cured cylinders falls below the specified compressive strength by more than 500 psi (or by more than 0.10 times the specified strength for specified strengths greater than 5000 psi), ACI 318-08, “Building Code Requirements for Structural Concrete,” requires that steps shall be taken to assure that load-carrying capacity of the structure is not jeopardized.

The ACI 318-08 Commentary gives guidance on the procedure to be followed when strength tests have failed to meet the specified acceptance criteria. The Commentary states that the building official should apply judgment as to the significance of low test results and whether they indicate need for concern. When further investigation is deemed necessary, the Commentary suggests that such investigation may include nondestructive tests, or in extreme cases, strength tests of cores taken from the structure. It further states that nondestructive tests of the concrete in place, such as by probe penetration, impact hammer, ultrasonic pulse velocity or pull out may be useful in determining whether or not a portion of the structure actually contains low-strength concrete. A caution is added that such nondestructive tests are of value primarily for comparisons within the same job rather than as quantitative measures of strength. Finally, the Commentary states that lower strength may be tolerated under many circumstances, but this also becomes a matter of judgment on the part of the building official and design engineer.

References: *ACI 318-08, Sections 5.6.5.1 and R5.6.5*
ACI 301-05, Section 1.6.5.3.a

ACI 318-08 then states that if the likelihood of low-strength concrete *is confirmed and calculations indicate that load-carrying capacity is significantly reduced*, core tests may be required. If any strength test of laboratory-cured cylinders falls below the specified compressive strength by more than 500 psi (or by more than 0.10 times the specified strength for specified strengths greater than 5000 psi), the engineer may require tests of cores drilled from the area in question. Three cores are required for each strength test that falls below the specified strength, and the cores must be taken in accordance with ASTM C 42, “Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.”

References: *ACI 318-08, Section 5.6.5.2*
ACI 301-05, Sections 1.6.5.3.a and 1.6.5.3.b

Strength level of concrete in the area represented by core tests is considered adequate when the average compressive strength of the three cores is equal to at least 85% of the specified compressive strength and no single core strength is less than 75% of the specified compressive strength.

References: *ACI 318-08, Section 5.6.5.4*
ACI 301-05, Section 1.6.7.3.

Importance of following ASTM Procedures

Low core strengths can result if the cores are not drilled, stored, and tested in accordance with the requirements of ASTM C 42. Drilling and storage are important for concrete of any strength, and following standard testing methods is especially important for high-strength concretes. When drilling holes to provide access for penetrations in a finished structure, the only goal is to provide an opening of the correct size and alignment. But when drilling is done to produce cores for strength testing, the goal is to provide a core that best represents the in-place concrete.

The following checklist allows contractors and concrete producers to ensure that core strengths best represent the condition of the in-place concrete. Each item in the checklist is based on ASTM C 42-04, “Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete”

Sampling

- A. Take core samples after concrete is strong enough to permit sample removal without disturbing the bond between the mortar and coarse aggregate. Cut surfaces should not display erosion of the mortar and the exposed coarse aggregate particles should be firmly embedded in the mortar. Don't use samples that have been damaged during removal.
- B. Locate reinforcement and drill cores so they don't contain any embedded reinforcement.
- C. Drill cores perpendicular to surface and not near formed joints or obvious edges of a concrete placement (unit of deposit).
- D. Take cores near the middle of a concrete placement (unit of deposit) when possible. In columns or walls, for instance, samples should be taken near mid-height—not at the top or bottom.
- E. Adequately anchor coring machine to minimize damage due to drilling.

Core Specimens

- A. The diameter of the core specimens must be at least 3.70 in. The preferred length of the capped or ground specimen is between 1.9 to 2.1 times the diameter. However, ASTM C 42 provides correction factors for tests on cores with length-to-diameter ratios between 1 and 2.
- B. After the cores have been drilled, wipe drilling water off the surface and allow the remaining surface moisture to evaporate.
- C. When surfaces appear dry, but not later than 1 hr after drilling, place cores in separate plastic bags or nonabsorbent containers and seal the bags to prevent moisture loss.

- D. Transport cores to the testing laboratory as soon as possible.
- E. Keep cores in the sealed plastic bags or nonabsorbent containers at all times except during end preparation. Leave in laboratory air for no more than 2 hr to permit capping before testing.
- F. If water is used during the sawing or grinding of core ends, complete these operations as soon as possible, but no later than 2 days after drilling of cores. After completing end preparation, wipe off surface moisture, allow the surfaces to dry, and place the cores in sealed plastic bags or nonabsorbent containers.
- G. Allow the cores to remain in the sealed plastic bags or nonabsorbent containers for at least 5 days after last being wetted and before testing.
- H. Saw the ends, when necessary, in accordance with requirements in ASTM C 39.
- I. Cap the ends, when necessary, in accordance with requirements in ASTM C 617.

Core Measurement

- A. Before testing, measure the length of the capped or ground specimen to the nearest 0.1 in. and use it to compute the length-to-diameter ratio.
- B. Determine the average core diameter by averaging two measurements taken at right angles to each other at the mid-height of the specimen. Measure core diameters to the nearest 0.01 in. when the difference in core diameters doesn't exceed 2% of their average; otherwise measure to the nearest 0.1 in. Do not test cores if the difference between the largest and smallest diameter exceeds 5% of the average diameter.

Core Testing

- A. Test specimens at 7 days after coring.
- B. Test cores in accordance with the requirements in ASTM C 39.

Core Report

- A. Report core test results in accordance with requirements in ASTM C 42.
 - 1. Length of core to nearest ¼ in.
 - 2. Length of test specimen before and after capping or end grinding to the nearest 0.1 in., and average diameter of core to the nearest 0.01 in.
 - 3. Compressive strength to the nearest 10 psi when the diameter is measured to the nearest 0.01 in. and to the nearest 50 psi when the diameter is measured to the nearest 0.1 in., after correction for length-diameter when required
 - 4. Direction of application of load on the specimen with respect to the horizontal plane of the concrete as placed
 - 5. The moisture conditioning history
 - i. The date and time core was obtained and first placed in sealed bag or nonabsorbent container
 - ii. If water was used during end preparation, the date and time end preparation was completed and core placed in sealed bag or nonabsorbent container

- 6. The date and time when tested
- 7. Nominal maximum size of concrete aggregate
- 8. If determined, the density
- 9. If applicable, description of defects in cores that could not be tested
- 10. If any deviation from this test method was required, describe deviation and explain why it was necessary.

Distribute this Checklist at the preconstruction conference so all parties—owner, design professional, general contractor or construction manager, testing laboratory representative, concrete producer, and concrete contractor—are aware of the need for closely following these ASTM procedures. The degree to which core-test results will reliably estimate strength of the in-place concrete is strongly influenced by the care taken in sampling, conditioning, storing, preparing, and testing the cores.

References:

ACI 301-05, “Specifications for Structural Concrete,” American Concrete Institute, Farmington Hills, MI

ACI 318-08, “Building Code Requirements for Structural Concrete,” American Concrete Institute, Farmington Hills, MI

ASTM C 39-05, “Standard Test Method for Cylindrical Concrete Specimens,” ASTM, West Conshohocken, PA

ASTM C 42-04, “Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete,” ASTM, West Conshohocken, PA

ASTM C 617-98, “Standard Practice for Capping Cylindrical Concrete Specimens,” ASTM, West Conshohocken, PA

Note:

The most recent revisions of ACI documents can be purchased by calling 248-848-3800 or visiting www.concrete.org.

The most recent revisions of ASTM documents can be purchased by calling 610-832-9500 or visiting www.astm.org.

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