

Concrete in Practice

What, why & how?



CIP 34 - Making Cylinders In the Field

WHAT are Concrete Test Cylinders?

Most commonly, the compressive strength of concrete is measured to ensure that concrete delivered to a project meets the requirements of the specification and for quality control. For testing the compressive strength of concrete, cylindrical test specimens of size 4 × 8-in. (100 × 200-mm) or 6 × 12-in. (150 × 300-mm) are cast and stored in the field until the concrete hardens in accordance with the requirements of ASTM C 31, *Standard Practice for Making and Curing Concrete Test Specimens in the Field*.

Technicians making cylinders in the field should be certified by the ACI Field Testing Certification Grade I, or an equivalent program. When making cylinders for acceptance of concrete, the field technician must test other properties of the fresh concrete to include temperature, slump, density (unit weight) and air content. This information should be included on the strength test report for a particular pour or pour location. A strength test result is always the average of at least two specimens tested at the same age. A set of 2 to 6 cylinders may be made from the same sample of concrete at a minimum for every 150 cubic yards (115 m³) of concrete placed.

WHY Make Concrete Test Cylinders?

According to ASTM C31, strength results of *standard-cured* cylinders are used for:

- Acceptance testing for specified strength,
- Verifying mixture proportions for strength,
- Quality control

It is important that the specimens are made and cured following standard procedures. Any deviation from standard procedures will result in a lower measured strength and cause undue concern, cost, and delay to the project.

Field-cured cylinders are used for:

- Determining when structure can be put into service,
- Comparing with results of standard-cured specimens or in-place tests,
- Evaluating the adequacy of curing and protecting concrete in the structure, and
- Scheduling removal of forms or shoring

Because of the different purposes for strength test results, procedures for standard-curing differ from field-curing and the two should not be confused. Refer to ASTM C31 for details.



Making and Curing Cylinders in the Field

HOW to Make Concrete Test Cylinders?

Equipment needed at the job site:

- Molds for casting specimens,
- Standard tamping rod or vibrator,
- Standard rubber or rawhide mallet,
- Shovel, scoop, handheld float or trowel,
- Wheelbarrow or other sample container,
- Water tank or curing box capable of maintaining curing environment during initial curing period,
- Safety equipment to handle fresh concrete.

Sampling concrete:

It is critical that the sample of concrete obtained from the delivery vehicle is representative of the of the load. Sampling should be conducted in accordance with ASTM C172. Concrete should be sampled from the middle of the load. The first or last 10% of the discharge will not be representative and should not be used for the sample. From a truck mixer, the entire discharge stream should be diverted into a wheelbarrow. At least two portions are

necessary to obtain a composite sample. The time between the first and final portion of the composite sample must not exceed 15 minutes. Minimum sample size required is 1 cu. ft. (28 L).

Prior to Casting Cylinders:

Cover the sample to protect it from evaporation, sunlight, and contamination. Move the sample to the location where the fresh concrete tests will be conducted and where the cylinders will be stored for the initial curing period. Remix the concrete in the wheelbarrow. Begin slump, density (unit weight), and air content tests within 5 minutes and start molding cylinders within 15 minutes after the sample was obtained.

Casting Test Cylinders:

- Cylinder identification labels should be placed on the outside of the mold and not on the lids or tops
- Place the cylinder molds on a level surface
- Consolidation—Use vibration for concrete slump less than 1-in. (25-mm); rodding or vibration is permitted when slump 1-in. (25-mm) or higher,
- Layers—For samples that are vibrated, fill mold in two equal layers; for rodded samples, place concrete in 3 equal layers for 6 × 12-in. cylinders and in 2 equal layers for 4 × 8-in. cylinders
- Distribute concrete inside the mold with the scoop. Rod each layer 25 times evenly distributed. For vibration, insert it long enough until large air bubbles are released. Two insertions of the vibrator are required for 6 × 12-in. and one insertion for 4 × 8-in. cylinders. Avoid over vibration. Consolidate bottom layer throughout its depth; for upper layers penetrate 1-in. (25-mm) into underlying layer.
- Tap sides of the mold 10-15 times with the mallet to close any insertion holes formed during consolidation.
- Strike off the top with a wood float or trowel to produce a flat and even surface level with the edge of mold. Cover with a plastic lid or a plastic bag.

Storing and transporting test cylinders:

- Move cylinder molds with fresh concrete very carefully by supporting the bottom
- Place the cylinders on a flat surface and in a controlled environment. Maintain temperature during initial curing in the range of 60-80°F (16-27°C). When concrete specified strength is greater than 6000 psi (40 MPa), the maintain temperature in the range of 68-78°F (20-26°C). Immersing cylinders, completely covered in water is an acceptable and preferred procedure that

ensures more reliable strength results. Temperature in storage containers should be controlled using heating and cooling devices as necessary. The maximum and minimum temperature should be recorded and reported.

- Protect cylinders from direct sunlight or radiant heat and from freezing temperatures in winter.
- Cylinders must be transported back to the laboratory within 48 hours of casting. Cylinders should not be moved until at least 8 hours after final set.

When transporting cylinders, they should be protected to prevent damage, maintain temperature and prevent loss of moisture. Transportation duration from the jobsite to the laboratory should not exceed 4 hours.

Responsibilities and Reports

ACI 301 states that it is the contractor's responsibility to provide space and source of electrical power on the project site for initial curing of concrete test specimens. In some locations it is customary for the contractor to provide equipment and storage for initial curing of test cylinders. If not provided, it is incumbent on the testing agency to have such equipment available. The strength test report should include information required by ASTM C39—storage and curing of specimens before testing; location in the work represented by each strength test, date and time of sampling and batch ticket number. Distribution of test reports to all stakeholders, including concrete producers, should be done within 7 days according to ACI 301. Distribution of all strength test reports is also required by ACI 318.

CAUTION

Fresh concrete can cause severe chemical burns to skin and eyes. Keep fresh concrete off your skin. When working with concrete use rubber work-boots, gloves, protective eyeglasses and clothing. Do not let concrete or other cement-based products soak into clothing or rub against your skin. Wash your skin promptly after contact with fresh concrete with clean water. If fresh concrete gets into your eyes, flush immediately and repeatedly with water. Consult a doctor immediately. Keep children away from all freshly mixed plastic concrete.

References

1. ASTM Standards C31, C39, C172—Annual Book of ASTM Standards, Volume 04.02, ASTM, West Conshohocken, PA, www.astm.org
2. *How Producers can Correct Improper Test-Cylinder Curing*, Ward R. Malisch, The Concrete Producer, Nov 1997, pp. 782 – 805, www.theconcreteproducer.com
3. NRMCA/ASCC Checklist for Concrete Pre-Construction Conference, NRMCA, Silver Spring, MD, www.nrmca.org
4. ACI 301 and ACI 318, American Concrete Institute, Farmington Hills, MI, www.concrete.org

Follow These Procedures to Make and Cure Standard-Cured Strength Test Specimens

1. Obtain a representative concrete sample
2. Place the concrete in layers in the molds and consolidate using standard equipment and procedures
3. Finish the surface smooth and cover the cylinder with a cap or plastic bag
4. For initial curing, store cylinders in the required temperature range. Protect from direct sunlight or extreme weather.
5. Transport the cylinders to the laboratory, properly protected, within 48 hours after they are made.

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