



Concrete in Colorado

Making Concrete Cylinders in the Field

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Concrete Test Cylinders

Compressive strength is the most critical performance standard applied to concrete on a construction project. It is very important for the tests to accurately represent the concrete delivered and placed on the project.

Concrete test cylinders are used to measure the compressive strength of concrete delivered to a project and to ensure the concrete meets the specifications of the job. Cylindrical test specimens of size 4 x 8 inches or 6 x 12 inches are cast, stored and cured in the field in accordance with ASTM C31, "**Standard Practices For Making and Curing Test Specimens In The Field**".

ASTM C31 requires that a certified ACI Field Testing Grade I technician or equivalent shall make test specimens in the field. When making cylinders, the technician must test the fresh concrete for temperature, unit weight, air content and slump. These test results accompany the compressive strength report made for each location. As required by ACI 301 and 318, the compressive strength result shall be the average of at least two specimens, from the same sample, tested at 28 days. An adequate sample size shall be taken to perform the required tests and cast compressive strength specimens.

Compressive strength reports shall be made available to the general contractor, architect, engineer and ready mixed concrete supplier.

Use of Concrete Test Cylinders

ASTM C31 states the results of **standard-cured** cylinders are used for:

- Acceptance testing for specified strength.
- Checking adequacy of mixture proportions for strength.
- Quality control.

ASTM C31 states the results of **field-cured** cylinders are used for:

- Determination of whether a structure is capable of being put into service.
- Comparison with test results of standard cured specimens or with test results from various in-place test methods.
- Adequacy of curing and protection of concrete in the structure.
- Form or shoring removal time requirements.

Making and Curing Cylinders

Necessary equipment:

- Watertight molds. Plastic molds are typically used.
- Tamping rod with at least one end rounded to a hemispherical tip. The rod shall be 5/8-inch in diameter for a 6 x 12 inch cylinder or 3/8 inch diameter for 4 x 8 inch cylinders. A vibrator may also be used.
- A wheelbarrow or other sample container.
- Rubber mallet.
- Safety equipment for handling plastic concrete.
- Shovel, scoop and float or trowel.
- Curing box or water tank capable of maintaining the required curing environment per ASTM C31.

Sampling Concrete

The sample of concrete used must be representative of the concrete being placed. All sampling must be in accordance with ASTM C172, **Standard Practice for Sampling Freshly Mixed Concrete** as follows:

- Samples should be taken from the middle of the load, as the beginning or the end of the load will not provide a representative sample.
- The concrete must be sampled by diverting the mixer truck chute so the entire flow is collected.
- At a minimum, two portions are necessary to obtain a composite sample. The elapsed time from the first and last portion must not exceed 15 minutes.
- The required minimum sample size is at least 1 cu. ft.

Prior to Making Cylinders:

- Protect the sample from evaporation, moisture and jobsite contaminants by covering.
- Move the sample to where the tests are to be conducted which should be close to where the cylinders will be cast and stored for the initial curing period.
- Remix the concrete in the container prior to testing.
- Begin the slump, unit weight and air content tests within 5 minutes and mold cylinders within 15 minutes from when the sample was obtained.



Casting Cylinders

- Select the proper size mold based on the maximum nominal size coarse aggregate.
- Place the molds on a flat, level, rigid surface, free of vibration and other disturbances, at a place as near as practicable to the location where they are initially cured.
- Label the outside of the mold with the pertinent identification information. Do not label the lids or tops. Lids often get lost or misplaced.
- Use the appropriate consolidation method:
 - For concrete with a slump of less than 1 inch, a vibrator should be used.
 - For concrete with a slump greater than or equal to 1 inch, either rodding or vibrating may be used.
- Place the concrete in the molds using the appropriate number of layers. For 6 x 12 inch cylinders, use 3 equal layers. For 4 x 8 inch cylinders, use 2 equal layers.
 - When concrete will be vibrated, place the concrete in 2 equal layers regardless of the size of the mold.
- Utilizing the scoop, place the concrete in the mold.
- Consolidate each layer by rodding 25 times evenly distributed around the mold.
- If using a vibrator, insert it long enough that the surface of the concrete is smooth. Two insertions of the vibrator are required for a 6 x 12 inch cylinder and one insertion for a 4 x 8 inch cylinder. Care must be taken to not over vibrate the sample.
- Tap the side of the mold 10 to 15 times after each layer has been rodded or vibrated to close any insertion holes from the rod or vibrator. Slow removal of the vibrator will help close the insertion hole in very low slump concrete.
- Strike off the top with a float or trowel to insure a flat and level surface and cover with the lid, making sure the lid doesn't come in contact with the concrete.

References:

ACI 301-10, "Specifications for Structural Concrete." American Concrete Institute (2010) www.concrete.org

ACI 318-08, "Building Code Requirements for Structural Concrete and Commentary." American Concrete Institute (2008) www.concrete.org

ASTM C31, "Annual Book of ASTM Standards, Volume 04.02, ASTM, West Conshohocken, PA, www.astm.org

CIP 34, "Concrete In Practice Series", NRMCA, Silver Spring, MD, www.nrmca.org

Storing and Transporting Cylinders

- Carefully move cylinder mold by supporting the bottom.
- Cylinders must be placed on a flat, level surface and in a controlled environment. The temperature must be maintained at 60 to 80 degrees unless the specification calls for greater than 6000 psi. If greater than 6000 psi, then the cylinders must be maintained at a temperature of 68 to 78 degrees.
- Specimens must not suffer any moisture loss. Submerging cylinders completely in water is the preferred method to ensure reliable test information. Temperature in storage, regardless of the storage environment must be maintained using heating and cooling methods as necessary. A min/max thermometer shall be used and results reported. **Cylinders must be protected from direct sunlight, excessive heat, freezing temperatures and moisture loss.**
- Cylinders should not be moved or transported for at least 8 hours after final set or approximately 16 hours after casting. Cylinders must be transported back to the laboratory within 48 hours unless otherwise stated in the specifications.
- During transportation, protect the specimens from jarring. Cylindrical specimens should be transported in an upright position. Protect the specimens from freezing during cold weather and moisture loss during warm weather with suitable insulation material. Transportation time must not exceed 4 hours.

DISCLAIMER

Contact with wet (unhardened) concrete, mortar, cement, or cement mixtures can cause SKIN IRRITATION, SEVERE CHEMICAL BURNS (THIRD-DEGREE), or SERIOUS EYE DAMAGE. Frequent exposure may be associated with irritant and/or allergic contact dermatitis. Wear waterproof gloves, a long-sleeved shirt, full-length trousers, and proper eye protection when working with these materials. If you have to stand in wet concrete, use waterproof boots that are high enough to keep concrete from flowing into them. Wash wet concrete, mortar, cement, or cement mixtures from your skin immediately. Flush eyes with clean water immediately after contact. Indirect contact through clothing can be as serious as direct contact, so promptly rinse out wet concrete, mortar, cement, or cement mixtures from clothing. Seek immediate medical attention if you have persistent or severe discomfort.



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