Tech Data

A publication of the Oregon Concrete & Aggregate Producers Association's Concrete Technology Committee TD 2

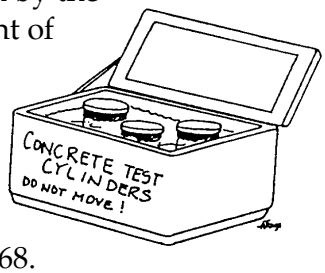
CURING OF CONCRETE TEST SPECIMENS

Compressive strength tests are a common basis for determining the acceptability of concrete. Strength specimens that are made to check the quality of concrete require standard initial curing conditions.

American Society for Testing Materials (ASTM), Specification C31, requires undisturbed initial curing for 24 $\pm$ 8 hours. During this initial curing, test specimens must be stored under conditions that maintain the temperature immediately adjacent to the specimens in the range of 60° - 80° F and prevent the loss of moisture from the specimens.

In order to meet these conditions, it may be necessary to have the specimens. . . "stored in tightly constructed wooden boxes, damp sand pits, temporary buildings at construction sites, under wet burlap in favorable weather or in heavyweight closed plastic bags, or use other suitable methods, provided the foregoing requirements limiting specimen temperature and moisture loss are met. The temperature may be controlled by ventilation, or thermostatically controlled cooling devices, or by heating devices such as stoves, light bulbs or thermostatically controlled heating elements. Temperature record of the specimens may be established by means of maximum/minimum Thermometers." (Reference: ASTM C31 9.1.2)

In addition to the suggested methods in ASTM C31, the OCAPA Concrete Technology Committee endorses a method developed and practiced by the Oregon State Department of Transportation (ODOT). ODOT recommends the use of a 68 quart insulated plastic cooler similar in construction to the Coleman Polylite 68. Cylinders should be carefully placed in the cooler and the cooler filled with water within 1 inch of the top of the cylinders.



To provide adequate heat sink or storage capacity to keep the cylinders within specification limits for the required duration of time, use the guidelines outlined in Table 1. The use of water for curing with a temperature of less than 60° F does not meet specifications.

A maximum/minimum thermometer should be placed in the water to document the actual range of temperatures to which the cylinders are exposed. Record high and low temperatures on the test reports for future reference.

To keep the bottom of the freshly molded cylinder flat, place a thin rigid plate in the bottom of the cooler. This will keep the plastic molds and cooler from deforming under the weight of the concrete. Allow enough clearance to close the cooler lid without touching the cylinders.

Table #1

65 - 75°F INITIAL CONCRETE TEMPERATURE								
Outside Temperature	40	50	60	70	80	90	100	110
Initial Water Temperature	60	60	60	60	60	60	60	60
No. of Cylinders	5	5	4	4	4	4	3	3
75 - 85°F INITIAL CONCRETE TEMPERATURE								
Outside Temperature	40	50	60	70	80	90	100	110
Initial Water Temperature	60	60	60	60	60	60	60	60
No. of Cylinders	4	4	4	4	3	3	3	3

Table #1 outlines the requirements the Quality Control Technician must consider in storing specimens.

The location chosen for the curing box is important. The specimens should be undisturbed and free from vibration. A location should be selected that will not interfere with the construction of the project, out of direct sunlight, free from vibration and protected from damage from vehicles or equipment. Select a secure location where specimens will not be vandalized. Mark coolers with indelible ink or spray paint to discourage theft.

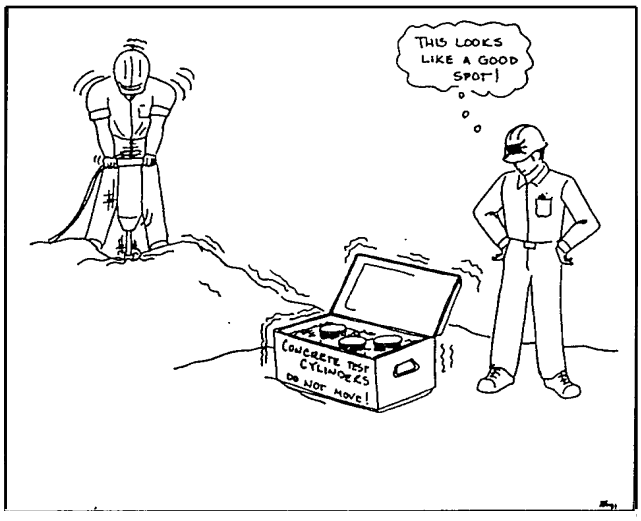
The ODOT initial curing method is for compressive strength cylinder storage. The same initial curing specification requirements apply to other type specimens such as flexural beams. Whatever method is chosen, it is important to plan ahead, have the required material to prevent moisture loss and provide temperature control. A maximum/minimum thermometer should be placed with the specimens to document specification compliance.

The results of strength tests are affected by the initial curing environment. Research indicates that large penalties in strength may result from departures from standard curing requirements. In a study conducted by Delmar L. Bloem, Effects of Curing Conditions on Compressive Strength of Concrete Test Specimens, Bloem reports these concluding remarks:

"*The investigation demonstrated forcefully the need for compliance with standard requirements for curing when strength tests are used as a basis for acceptance of concrete.*

Air storage, even for relatively short periods and regardless of temperature, caused significant reductions in measured strength. The longer the delay before specimens were put into standard moist room storage, the greater the strength reduction."

If initial curing specifications are not followed as specified, the tests will not be a measure of the potential quality of the concrete. Conditions, such as weather and treatment of specimens, will adversely affect the measured strength.



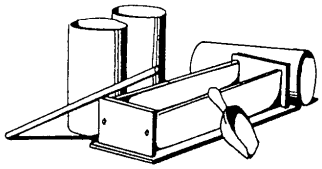
The specimens should be un-disturbed and free from vibration!

When specimens are required on a project for determining form removal time or when a structure may be put into service, a different specification applies. ASTM C31 defines the following procedure for cylinders (sometimes called job cured or field cured):

9.2.1 *Cylinders - Store cylinders in or on the structure as near to the point of deposit of the concrete represented as possible. Protect all surfaces of the cylinders from the elements in as near as possible the same way as the formed work. Provide the cylinders with the same temperature and moisture environment as the structural work. Test the specimens in the moisture condition resulting from the specified curing treatment. To meet these conditions, specimens made for the purpose of determining when a structure may be put in service shall be removed from the molds at the time of removal of form work.*

ASTM C31 specifies the following procedure for field-cured beams:

9.2.2 Beams - As nearly as practicable, cure beams in the same manner as the concrete in the structure. At the end of 48 ± 4 hours after molding, take the molded specimens to the storage location and remove from the molds. Store specimens representing pavements of slabs on grade by placing them on the ground as molded, with their top surfaces up. Bank the sides and ends of the specimens with earth or sand that shall be kept damp, leaving the top surfaces exposed to the specified curing treatment. Store specimens representing structure concrete as near the point in the structure they represent as possible, and afford them in the same temperature protection and moisture environment as the structure. At the end of the curing period, leave the specimens in place exposed to weather in the same manner as the structure. Remove all beam specimens from field storage and store in limewater at 73.4 ± 5° F (23 ± 2.8° C) for 24 ± 4 hours immediately before time of testing to ensure uniform moisture condition from specimen to specimen. Observe the precautions given in 9.1.3.2 to guard against drying between time of removal from curing to testing.



TRANSPORTING TEST SPECIMENS TO THE LABORATORY

After the initial curing period, the specimens shall be transported to the laboratory. It is advisable that the time between the removal of specimens from the initial curing environment and the placement of them in the lab curing environment be as short as possible.

During transportation, the specimens must be protected with suitable cushioning material to prevent damage from jarring. The specimens should also be prevented from damage by freezing temperatures or moisture loss. It is advisable that the specimens be protected from high temperatures as well. Moisture specimens in plastic or surrounding them with wet sand or wet sawdust. At the laboratory, the molds shall be removed and the specimens shall be placed in the required standard curing at 73.4 ± 30 F. The Quality Control Technician should be familiar with all portions of ASTM C31.

Tech Tips

- Protect strength specimens for the initial curing period
  - 24 ± 8 hours
  - specimen environment: temperature 60-80° F
  - use maximum/minimum thermometer and record values
  - no moisture loss
  - keep bases flat and level
  - don't disturb the specimens
- A 68 quart insulated cooler with water can provide curing requirements if used properly
- Know the difference between standard lab cured specimens and field-cured or job-cured specimens
- Transport specimens carefully
- Provide specified curing conditions in the lab
- Keep transportation time to a minimum

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