

MAKING AND CURING CONCRETE STRENGTH (COMPRESSIVE) TEST SPECIMENS IN THE FIELD

1. SCOPE: This method is a modification of ASTM C-31 covering procedures for making and curing compression test specimens in the field.
2. APPARATUS:
 - 2.1. Molds for Test Specimens:
 - 2.1.1. Reusable vertical metal molds shall be provided with a machined metal base plate. The inside dimensions of the cylinder mold shall be 4 inches in diameter by 8 inches in height (4x8's) or 6 inches in diameter by 12 inches in height (6x12's). The assembled mold shall not allow water to leak from the specimen and a suitable sealant shall be used if necessary to prevent leakage through the joints.
 - 2.1.2. Plastic, and sheet metal molds may be used provided they comply with the requirements of ASTM C-470. Molds that are damaged or out of round by more than 1/8 inch shall not be used. **Certifications are required to be submitted by the manufacturer for each shipment stating the molds are made in accordance with ASTM C-470.**
 - 2.2. Tamping Rod: The tamping rod for 6x12's shall be a round straight steel rod, 5/8 inch in diameter, 20 ± 4" long with at least one end rounded to a hemispherical tip. The tamping rod for 4x8's shall be a round straight steel rod, 3/8 inch in diameter, 12 ± 4" long with at least one end rounded to a hemispherical tip.
 - 2.3. Small Tools: Tools such as blunted shovels, scoops, pails, trowels, wood floats, straight edge, etc. shall be provided.
 - 2.4. Sampling and Mixing Container: A suitable pan, wheelbarrow, or flat, clean, non-absorbent mixing board of sufficient capacity to allow easy mixing by shovel or trowel of the entire sample shall be provided.
 - 2.5. Mold Coverings: Domed plastic lids.
 - 2.6. Vibrators: The vibrator frequency shall be at least 7000 vibrations per minute [150 Hz] while the vibrator is operating in the concrete. The diameter of a round vibrator shall be no more than one-fourth the diameter of the cylinder mold. Other shaped vibrators shall have a perimeter equivalent to the circumference of an appropriate round vibrator. The combined length of the vibrator shaft and vibrating element shall exceed the depth of the section being

vibrated by at least 3 inches. The vibrator frequency shall be checked periodically.

3. SAMPLING CONCRETE:

- 3.1. Samples of concrete for test specimens shall be taken in accordance with Kentucky Method 64-301, Sampling Fresh Concrete. The sample shall be remixed the minimum amount necessary to insure uniformity.
- 3.2. Molding of specimens for strength tests shall be started within 15 minutes after the composite sample is taken.
- 3.3. Perform an air content, slump, and temperature test from the same sample of concrete from which cylinders are cast. Record the results on the ~~KMIMS~~-SiteManager Sample Identification Form. Determine the air content, temperature and slump in accordance with the applicable Kentucky Methods.

4. PROCEDURE FOR MOLDING AND CURING SPECIMENS:

- 4.1. Place of Molding: Mold specimens promptly on a flat, rigid, horizontal surface, free from vibration and other disturbances and as near as practical to the place where they are to be stored during the first 24 hours.
- 4.2. Placing the Concrete: Place the concrete in the molds using a scoop, blunted trowel or shovel. Select each scoop from the mixing container in such a way as to insure that it is representative of the sample. It may be necessary to remix the sample in the container to prevent segregation during molding of the specimens. Discharge the concrete into the molds in such a way as to insure a symmetrical distribution of the concrete to minimize segregation within the mold. Further distribute the concrete by the use of the tamping rod prior to the start of consolidation.

Note: Cylinders for all classes of concrete are molded in sets of two for 6 inch diameter by 12 inch height cylinders (6x12's) and in sets of three for 4 inch diameter by 8 inch height cylinders (4x8's).

- 4.3. Method of Consolidation For 4x8's using Tamping Rod (Slump > 1 inch):
 - 4.3.1. Place the concrete in the mold in 2 layers of approximately equal volume. Rod each layer 25 strokes with the tamping rod, distributed evenly over the cross section of the mold, then tap the sides of the mold 10-15 times to close the voids before adding the next layer.
 - 4.3.2. Rod the bottom layer throughout its depth, however, do not strike the bottom of the molds so hard that dents or cracks are formed. Dents will cause a rough surface on the hardened specimen.
 - 4.3.3. Penetrate the rod about 1 inch into the underlying layer during rodding of the upper

layer.

- 4.3.4. Take special care in molding specimens of low slump concrete to insure that no voids remain in the completed specimen and that the mold is not damaged during the molding process.
 - 4.3.5. Strike off the surface of the concrete without undue manipulation with a straight edge, wood float, or trowel and immediately cover the specimen with a domed plastic lid.
- 4.4. Method of Consolidation For 6x12's using Tamping Rod (Slump > 1 inch):
- 4.4.1. Place the concrete in the mold in 3 layers of approximately equal volume. Rod each layer 25 strokes with the tamping rod, distributed evenly over the cross section of the mold, then tap the sides of the mold 10-15 times to close the voids before adding the next layer.
 - 4.4.2. Rod the bottom layer throughout its depth, however, do not strike the bottom of molds so hard that dents or cracks are formed. Dents will cause a rough surface on the hardened specimen.
 - 4.4.3. Penetrate the rod about 1 inch into the underlaying layer during rodding of the upper layers.
 - 4.4.4. Take special care in molding specimens of low slump concrete to insure that no voids remain in the completed specimen and that the mold is not damaged during the molding process.
 - 4.4.5. Strike off the surface of the concrete without undue manipulation with the straight edge, wood float, or trowel and immediately cover the specimen with a domed plastic lid.
- 4.5 Method of Consolidation For 4 x 8's and 6 x 12's using Vibrator:
- 4.5.1 Concrete with a slump \geq 1 inch consolidation may be done either by rodding or by vibration. Concrete with a slump < 1 inch shall be consolidated by vibration only.
 - 4.5.2 Place the concrete in the mold and fill to one-half depth of specimen.
 - 4.5.3 Start the vibrator and then insert vibrator throughout the depth. [(4 x 8's – 1 insertion) (6 x 12's – 2 insertions)] Do not over vibrate. Usually sufficient vibration has been applied as soon as the surface of the concrete has become relatively smooth and large air bubbles cease to break through the top surface. Continue vibration only long enough to achieve proper consolidation. Generally, no more than 5 seconds of vibration should be required fore each insertion to adequately consolidate concrete with a slump greater than 3 inches. Longer times may be required for

lower slump concrete, but the vibration time should rarely have to exceed 10 seconds per insertion. Slowly withdraw the vibrator so that no large air pockets are left in the specimen.

- 4.5.4 Place the final lift in the mold, avoid overfilling by more than ¼ inch. Repeat vibration.

4.6. Curing Test Specimens:

- 4.6.1 Covering After Finishing: Cover the specimens immediately after finishing with a domed plastic lid to prevent evaporation of water from the concrete.

- 4.6.2. Initial Curing 6x12's and 4x8's:

- 4.6.2.1. Specimens made to check the adequacy of the mix design: During the first 24 ± 4 hours, store all test specimens under conditions that maintain the temperature immediately adjacent to the specimens in the range of 60°F to 90°F, and prevent loss of moisture from the specimens. Storage temperatures may be regulated by the means outlined in ASTM C31.

- 4.6.2.2. Specimens made from Class 'M', JPCP 24/48/72, Latex Modified Concrete, Low Slump Overlay Concrete or specimens made to determine falsework/form removal time or when a structure or pavement may be put into service: During the first 24 ± 4 hours, store the test specimens under conditions that represents the curing of the structure or pavement as much as possible and prevent loss of moisture from the specimens by using domed plastic lids. The specimens shall receive, insofar as practical, the same protection from the elements as is given to the concrete that they represent. This can usually be accomplished by placing the specimens under the curing blankets, wet burlap, or whatever is being used to cure the concrete. When the specimens cannot be placed under the curing blanket or wet burlap, the specimens may be stored in ~~unheated~~-curing boxes ~~made of wood or styrofoam~~. maintained at the same temperature as the in place product. Temperature measuring devices are required to document temperatures at both locations.

- 4.6.3. Final Curing:

- 4.6.3.1. Specimens Made to Check the Adequacy of the Mix Design. - Regular Concrete and Low Slump Overlay Concrete: Remove the specimens from the mold at the end of 24 ± 4 hours and store in a moist condition at 60°F. to 80°F with free water maintained on all surfaces of the cylinder until time of shipment for testing. Do not expose specimens to dripping or running water. If storage in water is

utilized, a saturated lime solution shall be used. (Approximately 7 grams of hydrated lime per gallon of storage water is sufficient to obtain a saturated solution). **Bi-weekly tank temperature documentation is required for each tank. This documentation should include the date, time, temperature, and technician.**

- 4.6.3.2. Latex Modified Concrete: Remove the specimens from the molds at the end of 24 ± 4 hours and then air cure at a temperature of 55°F to 85°F, until time of shipment for testing. Latex modified concrete cylinders shall be tested in the air-cured condition.
- 4.6.3.3. Specimens made from Class 'M', JPCP 24/48/72 or specimens made for determining falsework/form removal time or when a structure or pavement may be put into service: Leave the specimens covered in the molds and store in or on the structure. The specimens shall receive, insofar as practical, the same protection from the elements as is given the portions of the structure which they represent until time of shipment for testing. This may be accomplished by placing the specimens under the same curing blankets or wet burlap used for curing the concrete. Specimens that represent pavement may be placed at the edge of the pavement under the curing blanket or wet burlap with soil or aggregate placed around the specimens. When the specimens cannot be placed under the curing blanket or wet burlap, the specimens may be stored in unheated curing boxes made of wood or styrofoam. Specimens shall not be directly exposed to the elements anytime during the time the structure is being cured. When curing of the concrete is discontinued and the specimens are not yet tested, the specimens shall be uncovered and removed from the molds for the remaining amount of time until sent to the Lab for testing.

5. PROCEDURE FOR IDENTIFYING SPECIMENS:

- 5.1. Mark the specimens to positively identify them and the concrete they represent. Use a method that will not alter the top surface of the concrete. Do not mark the removable caps. Upon removal of the molds, mark the test specimens to retain their identities.
- 5.2. The identification procedure shall be as follows:
 - 5.2.1. Non QC/QA Projects: Structure # - Date – Letter representing the sequence of units*.

* The sequence of units is based on the testing frequency for that class of concrete. For example: if 150 cubic yards of class AA concrete are poured contiguously on a

single day, the cylinders representing the first 50 cubic yards would be designated by the letter "A", the cylinders representing the second 50 cubic yards would be designated by the letter "B", etc. If a set of cylinders are made for early breaks, the unit identification should be replaced with an "X".

- 5.3. Independent Assurance (Progress Record Sample) specimens shall be identified the same as job control specimens except the letter R shall be added after the letter designating the number of daily units.

6. SHIPPING SPECIMENS FOR TESTS:

- 6.1. Ship all specimens, insofar as practical, in suitable containers or in damp sand or sawdust so as to prevent either damage, freezing, or loss of moisture.
- 6.2. If testing is to be performed by the Central Laboratory, cylinders made to check the adequacy of the mix design should be shipped at the age of 21 days. (This does not apply to mixes that require strength before 28 days.)

APPROVED

DIRECTOR
DIVISION OF MATERIALS

DATE

03/07/08

APPROVED

Director

Division of Materials

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