T 23

METHOD OF MAKING AND CURING CONCRETE TEST SPECIMENS IN THE FIELD

FOP FOR AASHTO T 23

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Typical Strength Specimens

Significance

02 Concrete is specified primarily on the basis of strength. Standard specimens are made and subsequently tested to determine the acceptability of concrete. Concrete strength test specimens are made in accordance with a standard procedure to produce results that are reliable and tests that can be reproduced by someone else with the same concrete, following the same procedures.

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04 Specimens are molded according to standard procedures and then cured under proper temperature and moisture conditions. Deviation from the standard procedures can cause significant differences in strength results. For example, specimens improperly cured between 90º and 100°F will develop strength at a different rate than specimens cured at the specified temperature range of 60º to 80°F required by this method. Ultimate strength is also affected.

This FOP pertains to specimens cast for the purpose of acceptance. Agencies sometimes specify curing practices other than those presented here. (To determine adequacy of protection or when a structure may be placed in service for example.)

Scope

This procedure covers the method for making, initially curing, and transporting concrete test specimens in the field in accordance with AASHTO T 23.

Apparatus, Cylinders

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Apparatus and Test Specimens

- Concrete cylinder molds: Conforming to AASHTO M 205 with a length equal to twice the diameter. Standard specimens shall be 6 in. by 12 in. cylinders. Mold diameter must be at least three times maximum aggregate size unless wet sieving is conducted according to FOP for WAQTC TM 2. Agency specifications may allow cylinder molds of 4 in. by 8 in. size when the nominal maximum aggregate size does not exceed 1 in..
- Beam molds: Rectangular in shape with ends and sides at right angles to each other. Must be sufficiently rigid to resist warpage. Surfaces must be smooth. Molds shall produce length no more than 1/16” shorter than that required (greater length is allowed). Maximum variation from nominal cross section shall not exceed 1/8 in. Ratio of width to depth may not exceed 1.5; the smaller dimension must be at least 3 times maximum aggregate size. Unless otherwise noted in specifications, beam molds for casting specimens in the field shall result in specimens having width and depth of not less than 6 inches. Specimens shall be cast and hardened with the long axes horizontal.
- Standard tamping rod: 5/8 in. diameter and approximately 24 in. long, having a hemispherical tip for preparing 6 in. x 12 in. cylinders.
- Small tamping rod: 3/8 in. diameter and approximately 12 in. long, having a hemispherical tip for preparing 4 in. x 8 in. cylinders
- Vibrator: At least 7000 vibrations per minute, diameter no more than one fourth the diameter or width of the mold and at least 3 in. longer than the section being vibrated for use with low slump concrete.
- Scoop
- Trowel or Float
- Mallet: With a rubber or rawhide head having a mass of 1.25 ±0.5 lb.
- Rigid base plates and cover plates: metal, glass, or plywood.
- Initial Curing Facilities: Temperature controlled curing box or enclosure capable of maintaining the required range of 60º to 80°F during the entire initial curing period (for

Procedure – Making Specimens – General

07 1. Obtain the sample according with the FOP for WAQTC TM 2.

   Wet Sieving per the FOP for WAQTC TM 2 is required when concrete contains aggregate with a nominal maximum size greater than 2 in. for specimen's with a 6 in. diameter, or greater than 1 in. for specimen's with a 4 in. diameter.

2. Remix the sample after transporting to testing location.

3. Begin making specimens within 15 minutes of obtaining the sample.

08 4. Set molds upright on a level rigid base in a location free from vibration and relatively close to where they will be stored.

5. Fill molds in the required number of layers. In placing the final layer, try to add an amount of concrete that will exactly fill the mold after consolidation. Add or remove concrete prior to completion of consolidation to avoid a deficiency or excess of concrete.

09 6. There are two methods of consolidating the concrete – rodding and internal vibration. If the slump is greater than 1 in., consolidation may be by rodding or vibration. When the slump is 1 in. or less, consolidation must be accomplished by internal vibration. Agency specifications may dictate when rodding or vibration will be used.

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Procedure – Making Cylinders – Rodding

1. For the standard 6 in. by 12 in. specimen, fill each mold in three approximately equal layers, moving the scoop or trowel around the perimeter of the mold to evenly distribute the concrete. For the 4 in. by 8 in. specimen, fill the mold in two layers. When filling the final layer, slightly overfill the mold.

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2. Consolidate each layer with 25 strokes of the appropriate tamping rod, using the rounded end. Distribute strokes evenly over the cross section of the concrete. Rod the first layer throughout its depth without forcibly hitting the bottom. For subsequent layers, rod the layer throughout its depth penetrating approximately 1 in. into the underlying layer.

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3. After rodding each layer, tap the sides of each mold 10 to 15 times with the mallet (reusable steel molds) or lightly with the open hand (single-use light-gauge molds).
4. Strike off the surface of the molds with tamping rod, or straightedge and begin initial curing.

Consolidation of concrete in cylinder by rodding

Note 1: Floating or troweling is permitted instead of striking off with rod or straightedge

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Procedure – Making Cylinders – Internal Vibration

1. Fill the mold in two layers.

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2. Insert the vibrator at the required number of different points for each layer (two points for 6 in. diameter cylinders; one point for 4 in. diameter cylinders). When vibrating the bottom layer, do not let the vibrator touch the bottom or sides of the mold. When vibrating the top layer, the vibrator shall penetrate into the underlying layer approximately 1 in.

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3. Remove the vibrator slowly, so that no air pockets are left in the material.

Note 2: Continue vibration only long enough to achieve proper consolidation of the concrete. Over vibration may cause segregation and loss of appreciable quantities of intentionally entrained air.

4. Strike off the surface of the molds with tamping rod, or straightedge and begin initial curing.

Vibrating cylinder specimens

Procedure – Making Flexural Beams – Rodding

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Making a flexural beam, rodding

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1. Fill the mold in two approximately equal layers with the second layer slightly overfilling the mold.
2. Consolidate each layer with the tamping rod once for every 2 in^2 using the rounded end. Rod each layer throughout its depth taking care to not forcibly strike the bottom of the mold when compacting the first layer. Rod the second layer throughout its depth, penetrating approximately 1” into the lower layer.

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3. After rodding each layer, strike the mold 10 to 15 times with the mallet and spade along the sides and end using a trowel.
4. Strike off to a flat surface using a trowel and begin initial curing.

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Making Beams
Internal Vibration

Procedure – Making Flexural Beams – Vibration

1. Fill the mold to overflowing in one layer.

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2. Consolidate the concrete by inserting the vibrator vertically along the centerline at intervals not exceeding 6 in. Take care to not over vibrate, and withdraw the vibrator slowly to avoid large voids. Do not contact the bottom or sides of the mold with the vibrator.

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3. After vibrating, strike the mold 10 to 15 times with the mallet.
4. Strike off to a flat surface using a trowel and begin initial curing.

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Procedure – Initial Curing

- When moving cylinder specimens made with single use molds, support the bottom of the mold with trowel, hand or other device.

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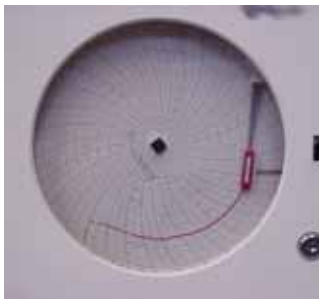
- For initial curing of cylinders, the curing place must be firm, within ¼ in. of a level surface, and free from vibrations or other disturbances.



Recording Thermometer

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- Maintain initial curing temperature of 60º to 80°F or 68º to 78°F for concrete with strength of 6000 psi or more.
- Prevent loss of moisture.

Specimen identification

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Initial cure in a temperature controlled chest-type curing box

1. Finish the cylinder using the tamping rod, straightedge, float or trowel. The finished surface shall be flat with no projections or depressions greater than 6.3 mm (1/8 in.).
2. Place the lid on the mold to prevent moisture loss.
3. Mark the necessary identification data on the cylinder mold and lid.
4. Place the mold in the curing box. When lifting light-gauge molds be careful to avoid distortion (support the bottom, avoid squeezing the sides).
5. Remember, caps keep cylinders round and prevent moisture loss.

Thermostatically Controlled Cure Box

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28 **Procedure – Transporting Specimens**

After 24 to 48 hours of initial curing, the specimens will be transported to the laboratory for storing under standard conditions. Specimen identity will be noted along with the date / time the specimen was made and the maximum and minimum temperatures registered during the initial cure.

- While in transport, specimens shall be protected from jarring, extreme changes in temperature, freezing, or moisture loss.
- Cylinders shall be secured so that the axis is vertical.
- Transportation time shall not exceed 4 hours

29 **Final Curing**

- For all specimens (cylinders or beams) final curing must be started within 30 minutes of mold removal. Temperature shall be maintained at 23° ±2° C (73º ±3° F) Free moisture must be present on the surfaces of the specimens during the entire curing period. Curing may be accomplished in a moist room or water tank conforming to M 201.
- For cylinders, during the final 3 hours prior to testing the temperature requirement may be waived, but free moisture must be maintained on specimen surfaces at all times until tested.
- Final curing of beams must include immersing in lime-saturated water for at least 20 hours prior to testing.

Report

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- Report on standard agency forms.
- Placement information for identification of project, element(s) represented, etc.
- Date molded & Time molded.
- Test ages.
- Slump, Air Content & density.
- Temperature (concrete, initial cure max. & min., and ambient).
- Method of initial curing.
- Other information as required by agency such as concrete supplier, truck number, invoice number, water added, etc.

Tips!

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- Start within 15 minutes of obtaining sample.
- Use hand, for tapping single-use, light-gauge molds.
- Consolidation technique depends on the slump. Rodding and/or vibration may be appropriate for different slumps.
- Protect specimens from damage during transport and keep cylinders vertical.

REVIEW QUESTIONS

1. AASHTO T 23 gives standardized procedures for _____, _____, and _____ of test specimens.

2. Describe two methods for initially curing test specimens.

3. When consolidating a flexural strength test specimen by rodding, rod one stroke for each _____ of top surface area.

4. Describe the process for making flexural beam specimens using internal vibration. What precautions must be taken?

5. During transportation, what must be done to protect test specimens?