



# MAKING AND CURING CONCRETE COMPRESSION AND FLEXURAL TEST SPECIMENS IN THE FIELD

## 1. SCOPE

- 1.1 This method covers procedures for making and curing compression and flexure test specimens of concrete sampled from project sites.

## 2. REFERENCED DOCUMENTS

### 2.1 AASHTO Standards

- T23, Making and Curing Concrete Test Specimens in the Field
- T119, Slump of Hydraulic Cement Concrete
- T121, Mass per Cubic Meter (Cubic Foot), Yield, and Air Content (Gravimetric) of Concrete
- T152, Air Content of Freshly Mixed Concrete by the Pressure Method
- T199, Air Content of Freshly Mixed Concrete by the Chace Indicator

### 2.2 DOH Standards

- 10, Sampling Fresh Portland Cement Concrete

## 3. APPARATUS

- 3.1 *Cylinder Molds* – Reusable cylinder molds shall conform to the requirements of AASHTO T23. Single use molds shall conform to AASHTO T23 for forming 6” x 12” (15 cm x 30.5 cm) and 4” x 8” (10 cm x 20 cm) specimens.
- 3.2 *Beam Molds* – Beam molds shall conform to the requirements of AASHTO T23
- 3.3 *Tamping Rod* – The rod shall be a round, straight steel rod, 5/8” (16 mm) in diameters and 24” (610 mm) long with at least the tamping end rounded to a hemispherical tip of the same diameter.
- 3.4 *Small Tools* – Various tools such as shovels, pails, trowels, wood float, straightedge, scoops, rulers, and other items as required.
- 3.5 *Slump Apparatus* – The apparatus for measurement of slump shall conform to the requirements of AASHTO T119.
- 3.6 *Sampling and Mixing Receptacle* – The receptacle shall be a suitable heavy gauge metal pan, wheelbarrow, or flat, clean, non-absorbent mixing board to allow easy mixing of the entire sample by trowel or shovel.

3.7 *Air Content Apparatus* – The apparatus for measurement of air content shall conform to the requirements of AASHTO T152, Test for Air Content of Freshly Mixed Concrete by the Pressure Method. The apparatus required by AASHTO T199, Air Content of Freshly Mixed Concrete by the Chace Indicator, may be used for rapid tests when required, however, the pressure meter should be considered standard in cases of dispute.

### **3. TEST SPECIMEN REQUIREMENTS**

3.1 Test specimens must be of consistent size and shape.

3.2 Compression test specimens shall be cylindrical, with a length equal to twice the diameter.

3.2.1 Standard cylindrical specimens shall be 6" (15 cm) in diameter by 12" (30.5 cm) length if the coarse aggregate does not exceed 2" (50 mm) nominal size.

3.2.2 Smaller test specimens shall have a ratio of specimen diameter to maximum size aggregate ratio no less than 3 to 1.

3.2.3 The diameter of the specimen shall not be less than 3" (76.2 mm) (for mixtures containing aggregate for which more than 5% of which is retained on a No. 4 (4.76 mm) sieve.

3.2.4 For concrete containing aggregate larger than 2" (50 mm), the cylindrical specimens shall have a diameter at least 3 times the maximum nominal size of aggregate.

3.3 Standard length of flexural specimens shall be 21" (53 cm), however other lengths may be permitted.

3.3.1 Flexural Test Specimens shall have a cross section that is no less than 6" x 6" (15 cm x 15 cm) for coarse aggregate 2" (50 mm) and under in nominal size.

3.3.2 For larger coarse aggregate, the minimum cross-sectional dimension shall be no less than 3 times the maximum nominal size of the coarse aggregate.

### **4. SAMPLING CONCRETE**

4.1 Samples of concrete for test specimens shall be taken in accordance with DOH 10, Sampling Fresh Portland cement concrete.

### **5. PROCEDURE FOR TESTING SLUMP AND AIR CONTENT**

5.1 Slump – The slump of each sample of concrete from which specimens are to be made shall be determined immediately after sampling in accordance with the provisions of AASHTO T119. Concrete used in the slump test shall be discarded.

- 5.2 Air Content – Air content, when required, shall be determined in accordance with the requirements of AASHTO T199M. Concrete used for determination of air content shall be discarded. AASHTO T199M may be used as a rapid check. Air content may also be determined in accordance with the requirements of AASHTO T121, Weight per Cubic Foot, Yield, and Air Content (Gravimetric) of Concrete.

## **6. MOLDING SPECIMENS**

- 6.1 Location of Molding – Specimens shall be made promptly after sampling of the concrete. Molds should be made on a level, rigid, horizontal surface, free from vibration and other disturbances, at a place as near as practicable to the location where they are to be stored during the first 24 hours. If it is not practical to mold the specimens where they are to be stored, move them to the place of storage immediately after being struck off. Take care not to jar, strike, tilt, or scar the surface of the specimens when moving them.
- 6.2 Placing the Concrete – Place the concrete in the molds using a scoop, blunted trowel, or shovel. Select concrete from the mixing pan to ensure that it is representative of the batch. It may be necessary to remix the concrete in the mixing pan to prevent segregation during molding of the specimens. Move the scoop or trowel around the top edge of the mold as the concrete is discharged in order to ensure a symmetrical distribution of the concrete and to minimize segregation of coarse aggregate within the mold. Further distribute the concrete by use of a tamping rod prior to consolidation. The operator shall attempt to add an amount of concrete for the final layer that will exactly fill the mold after compaction. Do not add non-representative concrete to an under-filled mold.
- 6.2.1 For standard cylinders (6" x 12" (15 cm x 30.5 cm)), 3 layers of approximately equal volume should be used to fill the mold.
- 6.2.2 For standard beams (6" x 6" x 21" (15 cm x 15 cm x 53 cm)), 2 layers of approximately equal volume should be used to fill the mold.
- 6.2.3 For all other specimen sizes, consult AASHTO T23, Table 1 for the appropriate number of layers to be used during specimen molding.
- 6.3 Consolidation -- Preparation of satisfactory specimens requires different methods of consolidation. The methods of consolidation are rodding, internal vibration, and external vibration. The method selected should be based on the slump, unless the method is stated in the specifications under which the work is being performed.
- 6.3.1 Slump greater than 3" (76mm) – Rod the concrete
- 6.3.2 Slump between 1" and 3" (25mm to 75mm) – Rod or vibrate the concrete.
- 6.3.3 Slump less than 1" (25mm) – Vibrate the concrete.

6.4 Rodding – Place the concrete in the mold following proper procedures. For cylinders, rod each layer with the rounded end of the rod using the number of strokes specified (for 6” diameter molds, rod each layer 25 times). The number of roddings per layer required for beams is one for each 2 in<sup>2</sup> (1290mm<sup>2</sup>) top surface area of the specimen. Rod the bottom layer throughout its depth. Distribute the strokes uniformly over the cross section of the mold. For each upper layer allow the rod to penetrate about ½” (13mm) into the underlying layer when the depth of the layer is less than 4” (102mm), and about 1” (25mm) when the depth is 4” (102mm) or more. If voids are left by the tamping rod, tap the sides of the mold lightly to close the voids. After each layer is rodded, spade the concrete along the sides and the ends of beam molds with a trowel or other suitable tool.

6.5 Finishing – After consolidation, strike off the surface of the concrete and float or trowel it as required. Perform all finishing with the minimum manipulation necessary to produce a flat, even surface that is level with the rim of the mold, and that has no depressions or projections larger than 1/8 in. (3.2mm).

6.5.1 Cylinders – After consolidation, finish the top surfaces by striking them off with the tamping rod where the consistency of the concrete permits, or with a wood float or trowel.

6.5.2 Beams – Beams shall be finished with a wood or magnesium float.

## **7. CURING**

7.1 Covering After Finishing – To prevent evaporation of water from the unhardened concrete, the specimens shall be covered immediately after finishing, preferably with a non-absorptive, non-reactive plate or a sheet or bag of tough, durable, impervious plastic. Wet burlap may be used for covering, but care must be exercised to keep the burlap wet until the specimens are removed from the molds. Placing a sheet of plastic over the burlap will aid in keeping the specimen wet.

7.2 Initial Curing – During the first 24 to 48 hours after molding, all test specimens shall be stored under conditions representative of the concrete in the structure or pavement. Following the period of initial cure, the specimens may be transported to the laboratory for subsequent curing and testing. Laboratory curing shall consist of a minimum of 95% humidity and a temperature of  $73.4 \pm 3$  °F ( $23 \pm 0.94$ ° C).

## **8. SHIPPING SPECIMENS TO THE LABORATORY**

8.1 Specimens shipped from the field to the laboratory shall be carefully loaded, transported, and unloaded to minimize effects of handling.

8.2 Upon receipt by the laboratory, they shall be placed immediately in the required curing facility.

## **9. STANDARD TESTING**

9.1 Unless required by the Specifications or special conditions on a project, there are standard tests that are performed on Portland cement concrete specimens.

9.1.1 4 cylinders (two 7-day, two 28-day breaks)

9.1.2 1 air test (if air entrained concrete)

9.1.3 1 slump test

9.2 Additional Air and slump tests for project assurance purposes will be taken as required. Flexural specimens are made only in special cases, as directed.