Method of Test for

# MAKING, FIELD CURING AND TRANSPORTING CONCRETE TEST SPECIMENS

DOTD Designation: TR 226M/226-13

## I. Scope

A. This procedure is to be used in making, protecting, curing, and transporting portland cement concrete compression and flexure test specimens.

B. Reference Documents:
   1. DOTD S 301, Sampling Fresh Concrete.
   2. AASHTO M 205, Molds for Forming Concrete Test Cylinders Vertically.
   3. AASHTO T 23, Making and Curing Concrete Test Specimens in the Field.

## II. Apparatus

A. **Cylinder molds** - right circular cylinders having a nominal inside diameter of 150 mm (6 in.) and a length of 300 mm (12 in.) or right cylinder molds having a nominal inside diameter of 100 mm (4 in.) and a length of 200 mm (8 in.) for casting concrete compression test specimens vertically
   1. **Single use molds** - approved plastic molds, to be used only once, with a rigid lipped opening, light gray or light in color in order that permanent black ink markings on containers can be easily read. All molds shall conform to AASHTO M 205.
   2. **Reusable molds** - approved metal molds, intended for use more than once, with a metal base plate. The assembled mold shall be such that the base plate is at right angles to the longitudinal axis of the cylinder and shall conform to AASHTO M 205.

B. **Beam molds** - rectangular metal molds having a nominal inside cross-section equal to 150 mm by 150 mm (6 by 6 in.). The length shall be at least 500 mm (20 in.). Beam molds shall conform to AASHTO T 23.

C. **Tamping rod** - a round, smooth straight steel rod, approximately 15 mm (5/8 in.) in diameter and 600 mm (24 in.) in length, having each end rounded to a hemispherical tip of the same diameter as the rod. The tamping rod for the 4 in. cylinders shall be approximately 3/8 in. in diameter and 10 in. in length, having each end rounded to a hemispherical tip of the same diameter of the rod.

D. **Small tools** - pail, trowel, scoop, timer or watch, water, brush or cloth.

E. **Straightedge** - Approximately 35 mm (1 3/8 in.) wide by 5 mm (3/16 in.) thick by 300 mm (12 in.) long with a 6 mm (1/4 in.) bevel on one side.

F. **Work base** - stable platform or foundation rigid enough to accommodate a minimum of 3 molds, (i.e., concrete, plywood, etc.).

G. **Curing supplies** - approved polyethylene bags and rubber bands or an approved plastic cap, and burlap.

H. **Transport box** - a wooden box for transporting the cylinders in a vertical position (Figures 1-A and 1-B).

I. **Mallet** - with a rubber head having a mass of 0.50 ± 0.25 kg (1.25 ± 0.50 lb).

J. **Dial thermometer** - having a range of -20 to 100°C (0 to 200°F), graduated in 1° C (2°F) increments.

K. **Form release agent** - mineral oil or an approved form release agent for use with metal molds.

L. **Sealant** - any waterproofing sealant for use with metal molds.

M. **Pen** - waterproof black ink marker.

N. **Worksheet** - Structural Concrete Tests, DOTD Form No. 03-22-0740 (Figure 2).

## III. Sample

Obtain sample in accordance with DOTD S 301.

## IV. Procedure for Molding Specimens

A. Compression Test Specimens
   1. a. Single use molds - Before concrete is placed into the mold, identify each specimen by writing on the side of the cylinder mold with the black ink marker the sample number, lot number, project number, and date of pour.
      b. Reusable metal molds - Assemble mold to base plate and lightly coat the inner surface with the form release agent. The assembled mold shall be watertight. Use a

sealant where necessary to prevent leakage through the joints.

2. Place the mold(s) on a level, rigid, horizontal surface, free from vibration and other disturbances at the location where they are to be stored during the first 20 hours. If the ground is not level, place the molds on a level, stable work base. For specimens that are to be used for putting structures into service, form removal, or acceptance of precast concrete, the location of molding shall be as near as possible to the portion of the structure or structural member represented by the specimens.
3. Using a scoop or trowel, place the concrete into the 6 in. diameter cylinder mold in an even layer that will yield approximately 1/3 the volume of the mold. For a 4 in. diameter cylinder mold, fill the mold with an even layer that will yield approximately ½ the volume of the cylinder. When placing the concrete into the mold move the scoop or trowel around the perimeter of the mold opening to ensure an even distribution of the concrete and to minimize segregation.
4. Level the layer of concrete in the mold using a circular motion of the tamping rod.
5. Rod the layer a total of 25 times with the tamping rod, distributing the strokes uniformly over the cross section of the mold. Rod the layer throughout its depth without damage to the bottom of the mold.
6. Tap the sides of the mold to eliminate voids left by rodding. Tapping is to be done around the circumference of the mold at the mid-point of each layer.
   a. For single use molds, use the mallet to lightly tap the sides of the mold around the circumference 10 to 15 times using the mallet or the palm of the hand.
   b. For reusable molds, tap the sides 10 to 15 times using the mallet.

***Note 1:*** *Do not use the tamping rod or any other object other than the mallet to tap the sides of the mold.*

7. For 6 in. diameter cylinders, repeat steps 3 through 6 for two more layers with the following exception. For 4 in. diameter cylinders, repeat steps 3-6 for one more layer with the following exception.
   a. Each layer shall be rodded a total of 25 times, penetrating each underlying layer approximately 10 mm (1/2 in.)
   b. When placing the final layer, slightly overfill the mold nogreater than 10 mm (1/2 in.).
8. After consolidation, strike off the surface of the concrete and finish with the straightedge. Perform all finishing with the minimum manipulation necessary to produce a flat even surface that is level with the rim or edge of the mold and that has no depression or projections larger than 3.0 mm (1/8 in.).

***Note 2:*** *Molding of test specimens shall be completed within 15 minutes from the time the sample was taken.*

9. To prevent loss of moisture, cover the specimens immediately after completion of molding by placing a polyethylene bag or plastic cap over the exposed surface of each specimen. Do not allow the polyethylene bag to come in contact with the plastic concrete. Use a rubber band to secure the bag on the mold.
10. Identification of specimens:
    a. Record all sample identification information on worksheet, including the time specimens were made.
    b. Single use molds were identified before the concrete was placed in them.
    c. For reusable molds, after initial set and before removal from the mold, remove the polyethylene bag or plastic cap and mark the top of the cylinder using the black ink marker with the sample number, lot number, project number, and date of pour. Recover the specimen with the bag or cap.
11. Allow the specimen to cure in accordance with Section V.

B. Flexure Test Specimens

1. Assemble the metal mold and lightly coat the inner surface with the form release agent. The assembled mold shall be watertight. Use the sealant where necessary to prevent leakage through the joints.

2. Place the assembled mold on a level, rigid, horizontal surface (work base), as near as possible to the portion of the structure represented by the specimens.
3. Using a scoop or trowel, place the concrete in the beam mold evenly in one layer approximately 75 mm (3 in.) in depth.
4. Rod the layer with the tamping rod once for each 1300 $mm^2$ (2 $in.^2$) of top surface area of the specimen or (60 strokes for a 150 mm by 150 mm by 500 mm [6 in. by 6 in. by 20 in.] mold). Distribute the strokes uniformly over the cross section of the mold. Rod the layer throughout its depth without damage to the bottom of the mold.
5. Using the mallet, lightly tap the sides of the mold 10 to 15 times to eliminate voids left by rodding.
6. Slightly round the concrete along the sides and ends of the mold with the trowel.
7. Repeat steps 3 through 6 for one more layer with the following exception,
   a. When placing the second layer of concrete, slightly overfill the mold no greater than 10 mm (1/2 in.).
   b. When molding, penetrate the underlying layer approximately 10 mm (1/2 in.) with the tamping rod.
8. After the second layer has been rodded and the sides of the mold tapped, use a side to side motion of the straightedge to strike off the top surface of the concrete even with the top of the mold. Then use the straightedge to produce an even surface with no depressions or projections greater than 3 mm (1/8 in.).

***Note 3:*** *Molding of test specimens shall be completed within 15 minutes from the time the sample was taken.*

9. To prevent loss of moisture cover the beams immediately after completion of molding with a polyethylene bag. Do not allow the polyethylene bag to come in direct contact with the plastic concrete.
10. Record all sample identification information on the worksheet including the time that specimens were made.
11. After the concrete is sufficiently set, remove the polyethylene bag(s) and identify each specimen by marking the following information on the top surface of the beam with a black ink marker.
    a. Sample number
    b. Lot number
    c. Project number
    d. Date of pour

    Resecure the bags on the molds.
12. Allow the specimen to cure in accordance with Section V.

## V. Procedure for Field Curing

A. Cast-in-Place Concrete
   1. Specimens for Acceptance Compression Tests
      a. Do not disturb or move the molded specimens for the first 20 hours of curing.
      b. Allow the specimens to cure in the molds as near as possible to the portion of the structure they represent for a period up to 48 ±4 hours in a temperature range of 60 -80 °F. For mixtures with a specified strength of 6000 psi or greater, the curing temperature shall be between 68 and 78 °F.
         1. In hot weather shield the specimens from direct sunlight.
         2. In cold weather, maintain proper curing temperature range.
      c. To ensure controlled curing environment, specimens may be placed in tightly constructed wooden boxes, damp sand pits, temporary buildings, or other suitable locations.

d. Specimens may be stored in one of the above mentioned manners for 48 ± 4 hours, at which time they must be transported, in the molds,to the lab in accordance with Part VI.

e. Remove molds, store, and cure transported specimens with free water maintained on their surface at all times at a temperature of 73.5 ± 3.5 °F (23.0 ± 2.0 °C) using water storage tanks or moist rooms until the specified age of testing.

2. Putting Structures into Service or Form Removal

a. Do not move or disturb the molded specimens during the first 20 hours of curing.

b. Allow specimens to cure in the molds as near as possible to the portion of the structure which they represent. Provide the specimens with the same temperature and moisture environment as the represented portion of the structure.

c. On the same day as testing is to take place, transport the specimens in the mold to the laboratory in accordance with Part VI.

B. Precast Concrete - Form Acceptance and Removal

1. Allow the specimens to cure while in the molds as near as possible to the portion of the structural member which they represent.

2. Give the specimens the same protection from the elements and provide the same temperature and moisture environment as the represented structural member.

3. For form removal purposes, take specimens directly from the curing environment, remove the molds and test. When molds are removed, transfer information from the molds to the specimens with a waterproof black ink marker.

4. For acceptance purposes, when the forms are removed from the structural members, remove the molds from the specimens, transfer the information on the molds to the specimens with a waterproof black ink marker and allow the concrete specimens to cure in the same environment as the structural member prior to testing.

5. Precast and prestressed concrete compressive strength and surface resistivity samples may be thermocouple controlled cured to match the temperature of the cast elements.

## VI.Transporting Test Specimens

A. Cast-in-Place Concrete

1. Transport test specimens while still in the mold.

2. Transport the specimens while still covered with polyethylene bags or plastic caps.

3. Do not damage specimens during handling or transporting.

4. Specimens shall not be transported until at least 8 hours after final set.

5. Place compression test specimens in a transport box.

6. Protect flexure test specimens with suitable cushioning material

B. Precast Concrete

Do not damage specimens during handling or transporting.

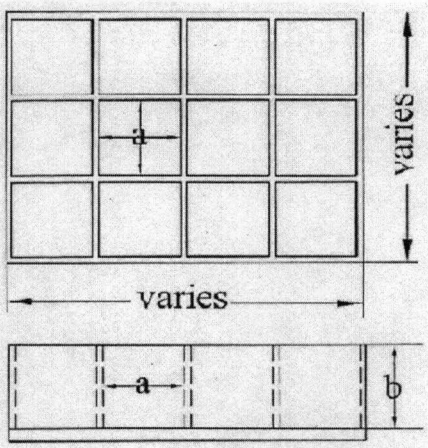
## VII.Report

A worksheet (Figure 2) shall be completed for each lot, pour or specimen. Enter on the worksheet all information required to identify the specimen and the structure it represents.

***Note 5:*** *There is no test report generated with this procedure. For cast-in-place concrete, transporting of cylinders to the testing facility is from 20 hours to 2 days. Precast concrete varies with the curing method and the plant's operations.*

## VIII. Normal Test Reporting Time

Maximum time for making cylinders - 15 minutes.
Minimum time for field curing cylinders - 20 hours.
Maximum time for field curing cylinders – 48 ± 4 hours or 8 hours after final set, whichever is longer.




6x12 a = 6 ¼ ", b = 7-9"

4x8 a = 4 ¼ ", b = 5-6"

Figure 1-A
Dimensions of a Typical Concrete
Cylinder Transport Box

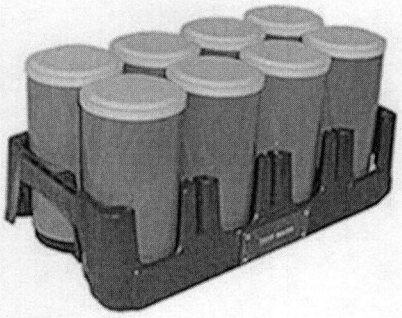


Figure 1-B
Photograph of a Typical
Concrete Cylinder Transport Box

The bottom of each compartment may be cushioned with 12.7 mm (1/2) in) closed cell polyethylene or similar material.

MATT MENU SELECTION - 17

DOTD 03-22-0740
Metric / English
Rev. 7/98

Louisiana Department of Transportation and Development

## STRUCTURAL CONCRETE TESTS

(DOTD TR 226M/226 & 230M/230)

**Metric / English** [ ] (M or E) *Located on MATT Menu*

**Project No.** 450-130-010215 **Material Code** 4215 **Lot No.** 014

**Date Sampled** 07-29-94 **Submitted By** 0722 **Quantity** 4010.10

**Purpose Code** 3 **Plant Code** C7213 **Spec Code**

1. Qual. Cont. 4. Check 7. Design
2. Verification 5. Resample 8. Indep. Assur.
3. Acceptance 6. Source Appr. 9. Pre. Source Test

**Mix Design No.** 0011 Date Rec'd.(lab)

**Admixture:** Y = Yes, N = No **Air** Y **WR-NS** N **WR-SR** N

Remarks 1 USED IN SPAIN

**Item No.** 8015

Cylinders Made By DOTD INSPECTOR Acceptance Tests By DOTD INSPECTOR

Batch Number 02

Date Tested

**Acceptance Tests**

Slump (TR 207), mm (in) 3.175 Air Content (TR 202), % 4.5

| Sample No. | Laboratory No. | Cond. | Break | Age Days | Diam. mm (in) | Area mm² (in²) | Max. Load kN(lb) | Strength MPa (PSI) |
|---|---|---|---|---|---|---|---|---|
| 14-3A | | | | | | | | |
| 14-3B | | | | | | | | |
| 14-3C | | | | | | | | |

Time Made: 10:00AM Critical Strength: Low High Batch Avg.

Batch Number 18

Date Tested

**Acceptance Tests**

Slump (TR 207), mm (in) 3.510 Air Content (TR 202), % 4.10

| Sample No. | Laboratory No. | Cond. | Break | Age Days | Diam. mm (in) | Area mm² (in²) | Max. Load kN(lb) | Strength MPa (PSI) |
|---|---|---|---|---|---|---|---|---|
| 14-4A | | | | | | | | |
| 14-4B | | | | | | | | |
| 14-4C | | | | | | | | |

Time Made: 2:15 PM Critical Strength: Low High Batch Avg.

Break Codes:
1 = Satisfactory 2 = Unsatisfactory

Cond. Codes:
1 = Good
2 = Improperly Made
3 = Damaged
4 = Frozen

Average Strength for Lot

Tested By:

Checked By:

% Pay

Remarks 2

**Approved By**

Structural Concrete Worksheet
Figure 2