

OFFICE OF STATE AID ROAD CONSTRUCTION			S.O.P. NO. SA II-3-13
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Subject: S.O.P. MAKING AND CURING CONCRETE TEST SPECIMENS IN THE FIELD			Distribution A, B, C, D, E
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PURPOSE: To establish standard procedures for molding, curing, and handling cylindrical and prismatic test specimens in the field using job concrete.

1. APPARATUS

- 1.1. Molds, General: Molds for specimens or fastenings thereto in contact with the concrete shall be made of steel, cast iron, or other nonabsorbent material, nonreactive with concrete containing portland cement or other hydraulic cements. Molds shall hold their dimensions and shape under conditions of severe use. Molds shall be watertight during use as judged by their ability to hold water poured into them with no visible signs of leakage. Jointed molds shall be sealed with a suitable sealant such as heavy grease, modeling clay, or microcrystalline wax where necessary to prevent leakage through the joints. Positive means shall be provided to hold the base plates firmly to molds. Metal reusable molds shall be lightly coated with mineral oil or a suitable nonreactive form release material before use.
 - 1.1.1. Cylinder Molds: Cylinder molds shall have a nominal inside diameter of 6 inches and a nominal inside height of 12 inches, and shall conform to the requirements of AASHTO M 205, Molds for Forming Concrete Test Cylinders Vertically. The use of cylinder molds of a size other than indicated above will require approval by the State Aid Engineer. However, only one size mold should be used for all specimens taken on a project.
- 1.2. Tamping Rod: The tamping rod shall be a 5/8 inch diameter, smooth, straight steel rod 24 inches long with at least the tamping end rounded to a hemispherical tip of the same diameter as the rod.
- 1.3. Small Tools: Tools and items which may be required are shovels, pails, trowels, wood float, metal float, blunted trowels, straightedge, feeler gauge, scoops, and rules.
- 1.4. Sampling and Mixing Receptacle: The receptacle shall be a suitable heavy gauge metal pan or wheelbarrow of sufficient capacity to allow easy remixing a composite sample of approximately 0.03 m³ in size with a shovel or trowel.
- 1.5. Slump Apparatus: The apparatus for measurement of slump shall conform to the requirements of AASHTO T 119.
- 1.6. Air Content Apparatus: The apparatus for measuring air content shall conform to the requirements of AASHTO T 152 or T 196.

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2. SAMPLING FRESH CONCRETE

2.1. General:

- 2.1.1. The procedures used in sampling shall include the use of every precaution that will assure obtaining samples that are truly representative of the nature and condition of the concrete being placed in the structure at the time of sampling. Sampling shall not take place until after the addition of all components, including admixtures and/or water added at the pour site for slump adjustments, and until after final mixing.
 - 2.1.2. Sampling fresh concrete prior to its arrival at the pour site for determination of conformance to specification requirements will not be permitted when the time of haul exceeds fifteen (15) minutes.
 - 2.1.3. The elapsed time between obtaining the first and final portions of the composite samples shall be as short as possible, but in no instance shall it exceed fifteen (15) minutes.
 - 2.1.4. Protect the sample from the sun, wind, and other sources of rapid evaporation, and contamination.
 - 2.1.5. At completion of sampling, the composite sample shall be remixed with a shovel for the minimum amount of time necessary to insure uniformity.
 - 2.1.6. Start tests for slump or air content, or both, within five (5) minutes after the sampling is completed. Complete these tests as expeditiously as possible. The portion of the sample used in the air content test shall not be reused. The portion of the sample used in the slump test may be reused, if necessary, for molding test specimens provided it is remixed with the composite sample.
 - 2.1.7. Start molding specimens for strength tests within fifteen (15) minutes after fabricating the composite sample. Keep the elapsed time between obtaining and using the sample as short as possible.
- 2.2. Sample Size: A composite sample of approximately 1 cu. ft. in size will be needed for performing all the tests and for molding the strength specimens.
 - 2.3. Sampling from Stationary Mixers: Sample the concrete at two (2) or more regularly spaced intervals during discharge of the middle portion of the batch and composite into one sample. Do not obtain samples from the very first or last portions of the batch. Perform sampling by passing a receptacle completely through the discharge stream, or by completely diverting the discharge into a sample

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container. If the discharge of the concrete is too rapid to divert the complete discharge stream, discharge the concrete into a container or transportation unit sufficiently large to accommodate the entire batch and then accomplish the sampling in the same manner as given above. Take care not to restrict the flow of concrete from the mixer, container, or transportation unit so as to cause segregation. These requirements apply to both tilting and nontilting mixers.

- 2.4. Sampling from Revolving Drum Truck Mixers or Agitators: Sample the concrete at two or more regularly spaced intervals during discharge of the middle portion of the batch. Do not obtain samples from the very first or last portions of the batch discharge. Sample by repeatedly passing a receptacle through the entire discharge stream or by completely diverting the discharge into a sample container. Regulate the rate of discharge of the batch by the rate of revolution of the drum and not by the size of the gate opening.

3. SLUMP AND AIR CONTENT

- 3.1. Slump: Measure the slump of each batch of concrete from which specimens are made in accordance with AASHTO T 119, Slump of Portland Cement Concrete.
- 3.2. Air Content: On air-entrained concrete, determine the air content on each batch of concrete from which the specimens are made in accordance with AASHTO T 152, Air Content of Freshly Mixed Concrete by the Pressure Method, or AASHTO T 196, Air Content of Freshly Mixed Concrete by the Volumetric Method.

4. TEST SPECIMENS

- 4.1. Compressive Strength Specimens: Compressive strength specimens shall be cylinders with a nominal diameter of 6 inches and a nominal height of 12 inches, of concrete cast and hardened in an upright position using molds meeting the tolerances required in Subsection 1.1. In addition, specimens shall not be used if any individual diameter of a specimen differs from any other diameter of the same specimen by more than 2 percent.

5. MOLDING SPECIMENS

- 5.1. Placing of Molds: Mold specimens promptly on a level, rigid surface, free from vibration and other disturbances, at a place as near as practicable to the location where they are to be stored. Immediately after being struck off, the specimens shall be moved to the storage place where they will remain undisturbed for the initial curing period. If specimens made in single-use molds are moved, lift and support the specimens from the bottom of the molds. Care shall be taken to insure that the specimens are kept level and vertical at all times.

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5.2 Molding Cylinders:

- 5.2.1. Remix the composite sample with a shovel or trowel during the molding of specimens to prevent segregation.
- 5.2.2. Using a scoop or blunted trowel, place the concrete in the molds in three (3) equal layers by volume. Select each scoopful or trowelful of concrete from the sample to insure that it is representative of the batch. Move the scoop or trowel around the perimeter of the mold opening when adding concrete to insure an even distribution of the concrete and to minimize segregation. Further distribute the concrete by use of the tamping rod prior to start of consolidation. The final layer should slightly over fill the mold prior to start of consolidation so that the concrete will exactly fill the mold after consolidation and finishing.
- 5.2.3. Using the rounded end of the tamping rod, consolidate each layer separately by applying twenty-five (25) uniformly distributed strokes over the cross-section of the mold. The bottom layer shall be rodded throughout its depth taking care not to damage the bottom of the mold. For each upper layer, allow the rod to penetrate about 1 inch into the underlying layer. After each layer is rodded, tap the outsides of the mold lightly 10 to 15 times with a mallet. NOTE: Concrete with a slump less than 1 inch shall be consolidated in the molds by the vibration method in accordance with AASHTO T 23.
- 5.2.4. Immediately after consolidation of the top layer, finish the top surfaces by striking them off with the tamping rod, wood float or trowel. 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. Hardened specimens containing concave or convex ends, or with depressions or projections exceeding 1/8 inch, shall not be permitted.

6. MARKING SPECIMENS FOR IDENTIFICATION

- 6.1. Concrete Cylinders: The project number, cylinder number and date cast shall be neatly marked with a permanent marker on disposable containers.

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7. CURING SPECIMENS

- 7.1. Covering after Finishing: Immediately after finishing, precautions shall be taken to prevent evaporation and loss of water from the specimens. Cardboard molds may expand and damage specimens at an early age if the outside of the mold absorbs water; therefore, protect the outside surfaces of cardboard molds from contact with wet burlap or other sources of water. Cover the specimens with a nonabsorbent, nonreactive plate or a sheet of tough, durable, impervious plastic to help retard evaporation. Burlap must not be in contact with the surface of the concrete.
- 7.2. Curing Concrete Cylinders Representing Cast-In-Place Concrete for Checking the Adequacy of Mixture Design Proportions or as the Basis for Acceptance of Concrete Strength.
- 7.2.1. Initial Curing: During the initial 24 ± 8 hours after molding, the temperature immediately adjacent to the specimens shall be maintained in the range of 60 to 80°F, and the loss of moisture from the specimens shall be prevented. Storage temperatures may be regulated by means of evaporation of water from burlap maintained in a wet condition or by using heating devices such as stoves, electric light bulbs, or thermostatically-controlled heating elements. Temperature record of the specimens may be established by means of maximum-minimum thermometers. Store specimens in tightly constructed, firmly braced wooden boxes, temporary or permanent buildings at construction sites, under wet burlap in favorable weather, in heavyweight, sealed plastic bags, or other suitable methods provided the foregoing requirements limiting specimen temperature and moisture loss are met. The specimens shall not be moved prior to completion of initial curing.
- 7.2.2. Standard Curing: At the end of the first 24 ± 8 hours of curing, the cylinders shall be stored in a moist condition with free water maintained on their surfaces at all times at a temperature within the range of 70 to 76°F until tested. Specimens shall not be exposed to dripping or running water. The required moist storage can be obtained by use of wet sand or sawdust pit, moist cabinet or moisture room, or by immersion in saturated lime water.
- 7.2.3. Removal of Molds: The molds shall not be removed prior to completion of initial curing. Specimens to be transported from the field after the initial curing and prior to an age of 48 hours shall not be demolded prior to completion of transportation. Metal molds and cardboard molds shall be removed at the time of placement in standard curing.
- 7.3. Curing Concrete Cylinders Representing Cast-In-Place Concrete for Determining Time of Form Removal or Backfilling: Store specimens with 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 the structure is protected. Molds may be removed after 48 ± 4 hours, but curing with the structure shall continue until time for removal for testing. Drying of the surfaces

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shall be prevented between removal from curing and time of testing.

- 7.4. Curing Concrete Cylinders Representing Precast or Precast-Prestressed Concrete: Store specimen with the structural member 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 the structural member is protected. Do not place specimen in direct contact with steam lines or outlets. Specimens may be demolded after 24 ± 8 hours; however; curing along with the structural member will continue until tested for the purposes of detensioning, form removal, required strength for handling, and required ultimate strength. Any specimens remaining to be tested for determining conformance to ultimate strength at the time the structural members are moved from the casting bed to storage shall continue to be moist-cured with the structural members in storage or cured in accordance with Subsection 7.2.2 above.

8. PROTECTION OF SPECIMENS DURING TRANSPORTATION

- 8.1. During transportation, the specimens must be protected with suitable cushioning material to prevent damage from jarring, freezing temperature, or moisture loss. Moisture loss may be prevented by wrapping the specimens in plastic or surrounding them with wet burlap, wet sand or wet sawdust.
- 8.2. After transporting, the required curing shall be recontinued until time of testing.
- 8.3. Specimens for checking the adequacy of mixture design properties or for determining conformance to 28-day strength requirements shall be transported to the MDOT Central Laboratory or MDOT District Laboratory no earlier than one week prior to time of testing nor later than two days prior to testing time. This will insure adequate storage space in the moisture room and provide sufficient time for at least twenty-four (24) hours moisture-curing prior to testing. All other specimens will normally be transported and tested at the County/LSBP Engineer lab or approved laboratory.

9. REPORTING

- 9.1. For each specimen molding, record the project number, contractor, class concrete, location of concrete represented (station, unit number or description in a structure, etc.), specimen number, date and time molded, and purpose of specimen (i.e., form removal, 28-day strength, etc.).
- 9.2. Specimen submitted to the MDOT Central Laboratory shall be accompanied with Form TMD-320 or TMD-321, as applicable, completed with the above information.