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METHOD OF TEST FOR COMPRESSIVE STRENGTH OF MOLDED CONCRETE CYLINDERS

CAUTION: Prior to handling test materials, performing equipment setups, and/or conducting this method, Caltrans testers are required to read "**SAFETY AND HEALTH**" in Section H and I of this method. It is the responsibility of whoever uses this method to consult and use appropriate safety and health practices and determine the applicability of regulatory limitations before any testing is performed. Users of this method do so at their own risk.

A. SCOPE

This method covers the procedure for compression tests of molded concrete cylinders. It is a modification of ASTM Designation C-39 and AASHTO T-22.

B. APPARATUS

1. Testing Machine:

a. The testing machine may be of any type of sufficient capacity, which will provide the rate of loading prescribed in Section D-2. It shall conform to the requirements of Sections 15, 16, and 17 of the Methods of Verification of Testing Machines (ASTM Designation E-4).

b. The testing machine shall be equipped with two steel bearings with hardened faces, one of which is a spherically seated block that will bear on the upper surface of the specimen, and the other a plain rigid block on which the specimen will rest. The bearing faces shall not depart from the plane by more than 0.025mm. New blocks shall be manufactured within one-half of this tolerance.

c. The center of the sphere shall coincide with the center of the bearing face. If the radius of the sphere is smaller than the radius of the bearing face, the portion of the bearing face extending beyond the sphere shall have a thickness not less than the difference in radii. The diameter of the bearing face shall be at least as great as the diameter of the sphere. The bearing faces shall be at least as large and preferably slightly larger than the surface of the specimen to which the load is applied.

d. Concentric circles shall be inscribed in both the upper and lower bearing blocks at 12.5 mm ($^1/_2$-inch) intervals to facilitate proper centering. The movable portion of the bearing blocks shall be held closely in the spherical seat, but the design shall be such that the bearing face can be rotated freely and tilted through small angles in any direction.

1. Capping Equipment:

a. *Capping Plates*—Sulfur mortar caps shall be formed against similar metal except that the recessed area that receives molten sulfur shall not be deeper than 12½ mm (½ in.). In all cases, plates shall be at least 25 mm (1 in.) greater in diameter than the test specimen and the working surfaces shall not depart from a plane by more than 0.05 mm (0.002 in.) in 152 mm (6 in.). Metal plates that have been in use shall

be free of gouges, grooves, and indentations greater than 0.25 mm (0.010 in.) in depth or greater than 32 mm^2 (0.05 in^2).

b. *Alignment Devices*—Suitable alignment devices, such as guide bars or bull's eye levels, shall be used in conjunction with capping plates to ensure that no single cap will depart from perpendicularity to the axis of cylindrical specimen by more than 0.5˚ (approximately equivalent to 3.2 mm in 305 mm (1/8 in. to 12 in.)). The same requirement is applicable to the relationship between the axis of the alignment device and the surface of a capping plate when guide bars are used. In addition, the location of each bar with respect to its plate must be such that no cap will be off-centered on a test specimen by more than 2 mm (1/16 in.).

c. *Melting Pots for Sulfur Mortars*—Pots used for melting sulfur mortars shall be equipped with automatic temperature controls and shall be made of metal or lined with a material that is non-reactive with molten sulfur.

C. TEST SPECIMEN

1. Preparation:

a. Strip field fabricated test specimens from the cylinder cans as soon as possible after receipt in the laboratory. After stripping, store in a moist curing room or immerse in saturated-lime water until the specified date for testing.

b. Maintain the curing room at a relative humidity of 95 percent or above and at a temperature of 23±1.7˚C(73.4± 3.0˚F).

c. Prepare sulfur mortar for use by heating to about 129 to 143˚C (265 to 295˚F) as periodically determined by an all-metal thermometer inserted near the center of the mass. Recharge the pot with fresh material at frequent enough intervals to ensure that the oldest material in the pot has not been used more than five times. Fresh sulfur mortar must be dry at the time it is placed in the pot as dampness may cause foaming. Keep water away from molten sulfur mortar for the same reason. The capping plate or device should be warmed before use to slow the rate of hardening and permit the production of thin caps. Oil the capping plate lightly and stir the molten sulfur immediately prior to pouring each cap. The ends of moist cured specimens shall be dry enough at the time of capping to preclude the formation of steam or foam pockets under or in the cap larger than 6 mm (¼ in.) in diameter. Replace caps with steam pockets or voids larger than 6 mm (¼ in.). To ensure that the cap is bonded to the surface of the specimen, the end of the specimen shall not be oiled prior to the application of the cap. When using a vertical device, pour the mortar onto the surface of the capping plate, lift the cylinder above the plate and contact he cylinder sides with the guides, slide the cylinder down the guides onto the capping plate while keeping constant contact with the alignment guides. The cylinder end should continue to rest on the capping plate with cylinder sides in positive contact with the alignment guides until the mortar has hardened. Use sufficient material to cover the cylinder end after the sulfur mortar solidifies.

d. Make compression tests of moist cured specimens as soon as practicable after removal from the curing room. Keep test specimens moist by use of wet burlap or blanket covering during the period between their removal from the moist room and testing. Always test specimens in a moist condition.

D. MEASUREMENT

a. Determine the diameter of the test specimens to the nearest 0.25-mm (0.01 in) by averaging two diameters measured at right angles to each other at about mid-height of the specimen.

b. Use this average diameter for calculating the cross-sectional area. (Alternate methods of determining cross-sectional area may be used if proven satisfactory.)

E. PROCEDURE

1. Placing the Specimen:

a. Place the plain (lower) bearing block, with its hardened face up, on the table or platen

of the testing machine directly under the spherically seated (upper) bearing block.

b. Wipe clean the bearing faces of the upper and lower bearing blocks and of the test specimen. Place the test specimen on the lower bearing block.

c. Carefully align the axis of the specimen with the center of thrust of the spherically seated block.

d. As the spherically seated block is brought to bear on the specimen, rotate its movable portion gently by hand so that uniform seating is obtained.

2. Rate of Loading:

a. Apply the load continuously and without shock. Apply the load at a constant rate within the range of 0.14 to 0.34 MPa/second. During the application of the first half of the estimated maximum load, a higher rate of loading may be permitted.

b. Do not make any adjustment in the controls of the testing machine while the specimen is yielding rapidly immediately before failure.

c. Increase the load until the specimen yields or fails and record the maximum load carried by the specimen during the test.

d. Note the type of failure and the appearance of the concrete if other than the usual cone type fracture.

F. CALCULATION

1. Calculate the compressive strength of the specimen by dividing the maximum load carried by the specimen during the test by the average cross-sectional area determined as described Section C, and express the result to the nearest 69 kPa (10 psi).
2. If the specimen length to diameter ratio is less than 1.8, correct the result obtained in F.1 by multiplying by the appropriate correction factor shown in the following table:

L/D:	1.75	1.50	1.25	1.00
Factor:	0.98	0.96	0.93	0.87

G. REPORT

The report shall include the following information:

1. Test specimen identification.

2. Compressive strength calculated to nearest 69 kPa (10 psi).

3. Age of specimen at time of test.

4. Note, if break is considered abnormal, ie. type of fracture, if other than cone.

H. HAZARDS

1. Use sulfur melting pots in a hood to exhaust the fumes to outdoors. Heating over n open flame is dangerous because the flash point of sulfur is approximately 227˚C (440˚F) and the mixture can ignite due to overheating. Should the mixture start to burn, covering will snuff out the flame. The pot should be recharged with fresh material after the flame has been extinguished.
2. Enclose each specimen with a canvas sleeve or cage just prior to applying the load. This protects the operator from being hit by broken pieces from the specimen, should it shatter.

I. SAFETY AND HEALTH

Prior to handling, testing or disposing of any waste materials, Caltrans testers are required to read: Part A (Section 5.0), Part B (Sections: 5.0, 6.0 and 10.0) and Part C (Section 1.0) of Caltrans' Laboratory Safety Manual.

Users of this method do so at their own risk.

REFERENCES:
ASTM Designations E-4 and C-39
AASHTO Designation T-22

End of Text (3 Pages) on California Test 521