Designation: C 512 – 87 (Reapproved 1994)

Standard Test Method for Creep of Concrete in Compression[1]

This standard is issued under the fixed designation C 512; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the determination of the creep of molded concrete cylinders subjected to sustained longitudinal compressive load. This test method is limited to concrete in which the maximum aggregate size does not exceed 2 in. (50 mm).

1.2 The values stated in inch-pound units are to be regarded as the standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

C 39 Test Method for Compressive Strength of Cylindrical Concrete Specimens[2]

C 192 Practice for Making and Curing Concrete Test Specimens in the Laboratory[2]

C 470 Specification for Molds for Forming Concrete Test Cylinders Vertically[2]

C 617 Practice for Capping Cylindrical Concrete Specimens[2]

C 670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials[2]

3. Significance and Use

3.1 This test method measures the load-induced time-dependent compressive strain at selected ages for concrete under an arbitrary set of controlled environmental conditions.

3.2 This test method can be used to compare creep potentials of different concretes. A procedure is available, using the developed equation (or graphical plot), for calculating stress from strain data within massive non-reinforced concrete structures. For most specific design applications, the test conditions set forth herein must be modified to more closely simulate the anticipated curing, thermal, exposure, and loading age conditions for the prototype structure. Current theories and effects of material and environmental parameters are presented in ACI SP-9, Symposium on Creep of Concrete.[3]

3.3 In the absence of a satisfactory hypothesis governing creep phenomena, a number of assumptions have been developed that have been generally substantiated by test and experience.

3.3.1 Creep is proportional to stress from 0 to 40 % of concrete compressive strength.

3.3.2 Creep has been conclusively shown to be directly proportional to paste content throughout the range of paste contents normally used in concrete. Thus the creep characteristics of concrete mixtures containing aggregate of maximum size greater than 2 in. (50 mm) may be determined from the creep characteristics of the minus 2-in. (minus 50-mm) fraction obtained by wet-sieving. Multiply the value of the characteristic by the ratio of the cement paste content (proportion by volume) in the full concrete mixture to the paste content of the sieved sample.

3.4 The use of the logarithmic expression (Section 8) does not imply that the creep strain-time relationship is necessarily an exact logarithmic function; however, for the period of one year, the expression approximates normal creep behavior with sufficient accuracy to make possible the calculation of parameters that are useful for the purpose of comparing concretes.

3.5 There are no data that would support the extrapolation of the results of this test to tension or torsion.

4. Apparatus

4.1 *Molds*—Molds shall be cylindrical conforming to the provisions of Practice C 192C 192, or to the provisions of Specification C 470C 470. If required, provisions shall be made for attaching gage studs and inserts, and for affixing integral bearing plates to the ends of the specimen as it is cast.

4.1.1 Horizontal molds shall conform to the requirements of the section on horizontal molds for creep test cylinders of Practice C 192C 192. A horizontal mold that has proven satisfactory is shown in Fig. 1.

4.2 *Loading Frame*, capable of applying and maintaining the required load on the specimen, despite any change in the dimension of the specimen. In its simplest form the loading

[1] This test method is under the jurisdiction of ASTM Committee C-9 on Concrete and Concrete Aggregates a nd is the direct responsibility of Subcommittee C09.70 on Elastic and Inelastic.

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[2] *Annual Book of ASTM Standards*, Vol 04.02.

[3] Available from the American Concrete Institute, P. O. Box 19150, Detroit, MI 48219.

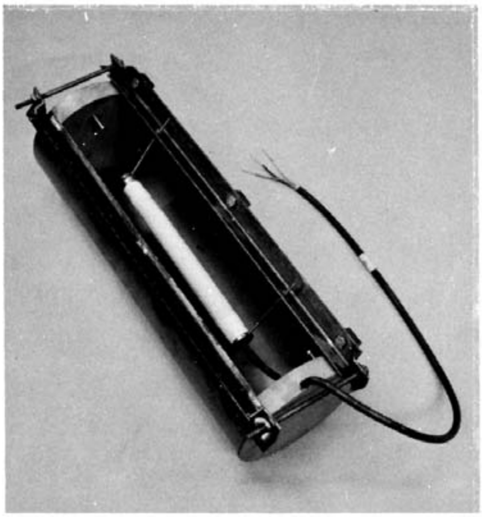

FIG. 1 Horizontal Mold for Creep Specimens

frame consists of header plates bearing on the ends of the loaded specimens, a load-maintaining element that may be either a spring or a hydraulic capsule or ram, and threaded rods to take the reaction of the loaded system. Bearing surfaces of the header plates shall not depart from a plane by more than 0.001 in. (0.025 mm). In any loading frame, several specimens may be stacked for simultaneous loading. The length between header plates shall not exceed 70 in. (1780 mm). When a hydraulic load-maintaining element is used, several frames may be loaded simultaneously through a central hydraulic pressure-regulating unit consisting of an accumulator, a regulator, indicating gages, and a source of high pressure, such as a cylinder of nitrogen or a high-pressure pump. Springs such as railroad car springs may be used to maintain the load in frames similar to those described above; the initial compression shall be applied by means of a portable jack or testing machine. When springs are used, care should be taken to provide a spherical head or ball joint, and end plates rigid enough to ensure uniform loading of the cylinders. Fig. 2 shows an acceptable spring-loaded frame. Means shall be provided for measuring the load to the nearest 2 % of total applied load.

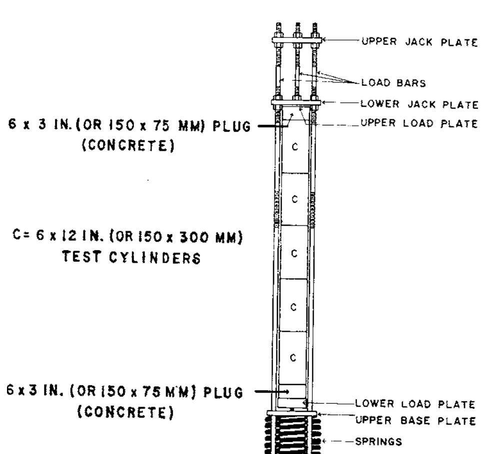

FIG. 2 Spring-Loaded Creep Frame

This may be a permanently installed hydraulic pressure gage or a hydraulic jack and a load cell inserted in the frame when the load is applied or adjusted.

4.3 *Strain-Measuring Device*—Suitable apparatus shall be provided for the measurement of longitudinal strain in the specimen to the nearest 10 millionths. The apparatus may be embedded, attached, or portable. If a portable apparatus is used, gage points shall be attached to the specimen in a positive manner. Attached gages relying on friction contact are not permissible. If an embedded device is used, it shall be situated so that its strain movement occurs along the longitudinal axis of the cylinder. If external devices are used, strains shall be measured on not less than two gage lines spaced uniformly around the periphery of the specimen. The gages may be instrumented so that the average strain on all gage lines can be read directly. The effective gage length shall be at least three times the maximum size of aggregate in the concrete. The strain-measuring device shall be capable of measuring strains for at least 1 year without change in calibration.

NOTE 1—Systems in which the varying strains are compared with a constant-length standard bar are considered most reliable, but unbonded electrical strain gages are satisfactory.

5. Test Specimens

5.1 *Specimen Size*—The diameter of each specimen shall be 6 ± 1⁄16 in. (or 150 ± 1.6 mm), and the length shall be at least 11½ in. (292 mm). When the ends of the specimen are in contact with steel bearing plates, the specimen length shall be at least equal to the gage length of the strain-measuring apparatus plus the diameter of the specimen. When the ends of the specimen are in contact with other concrete specimens similar to the test specimen, the specimen length shall be at least equal to the gage length of the strain-measuring apparatus plus 1½ in. (38 mm). Between the test specimen and the steel bearing plate at each end of a stack, a supplementary noninstrumented cylinder whose diameter is equal to that of the test cylinders and whose length is at least half its diameter shall be installed.

5.2 *Fabricating Specimens*—The maximum size of aggregate shall not exceed 2 in. (50-mm) (Section 3). Vertically cast cylinders shall be fabricated in accordance with the provisions of Practice C 192C 192. The ends of each cylinder shall meet the planeness requirements described in the scope of Practice C 617C 617 (Note 2). Horizontally cast specimens shall be consolidated by the method appropriate to the consistency of the concrete as indicated in the methods of consolidation section of Practice C 192C 192. Care must be taken to ensure that the rod or vibrator does not strike the strain meter. When vibration is used, the concrete shall be placed in one layer and the vibrating element shall not exceed 1¼ in. (32 mm) in diameter. When rodding is used, the concrete shall be placed in two approximately equal layers and each layer shall be rodded 25 times evenly along each side of the strain meter. After consolidation the concrete shall be struck off with trowel or float, then trowelled the minimum amount to form the concrete in the opening concentrically with the rest of the specimen. A template curved in the radius of the specimen may be used as a strikeoff to shape and finish the concrete more precisely in the