Designation: C 1388 – 97

Standard Test Method for Compressive Strength of Laboratory Constructed Masonry Prisms[1]

This standard is issued under the fixed designation C 1388; 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.

This standard has been approved for use by agencies of the Department of Defense. Consult the DoD Index of Specifications and Standards for the specific year of issue which has been adopted by the Department of Defense.

1. Scope

1.1 This test method covers compression tests of masonry prisms for determining comparative data on the compressive strength of masonry built in the laboratory with either different masonry units or mortar types, or both.

NOTE 1—This test method is not intended for use in establishing the compressive strength of a particular set of materials by a preconstruction evaluation or to evaluate quality of materials and workmanship during construction. Nor is this test method intended for use in determining the compressive strength of masonry built at the job site with the same material and workmanship to be used, or being used, in a particular structure (see Test Method C 1314).

1.2 Test specimens are short compression prisms: the influence of slenderness ratio is taken into account either by proportions of the fabricated specimens or by the application of a correction factor.

1.3 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.4 *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 67 Test Method of Sampling and Testing Brick and Structural Clay Tile[3]

C 140 Test Methods of Sampling and Testing Concrete Masonry Units[3]

C 143 Test Method for Slump of Hydraulic Cement Concrete[2]

C 144 Specification for Aggregate for Masonry Mortar[3]

C 270 Specification for Mortar for Unit Masonry[3]

C 476 Specification for Grout for Masonry[3]

C 780 Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry[3]

C 1019 Test Method of Sampling and Testing Grout[3]

C 1314 Test Method for Constructing and Testing Masonry Prisms Used to Determine Compliance with Specified Compressive Strength of Masonry[3]

E 4 Practices for Force Verification of Testing Machines[4]

E 6 Terminology Relating to Methods of Mechanical Testing[4]

E 105 Practice for Probability Sampling of Materials[5]

E 111 Test Method for Young's Modulus, Tangent Modulus, and Chord Modulus[4]

E 575 Practice for Reporting Data from Structural Tests of Building Constructions, Elements, Connections, and Assemblies[6]

E 631 Terminology of Building Constructions[6]

3. Terminology

3.1 *Definitions*—For definitions and terminology used in these test methods, refer to Terminology E 6 and E 631.

4. Apparatus

4.1 The testing machine shall conform to the requirements given in Practices E 4.

4.2 The upper bearing shall be a spherically seated, hardened metal block firmly attached at the center of the upper head of the machine. The center of the sphere shall lie at the center of the surface held in its spherical seat, but shall be free to turn in any direction, and its perimeter shall have at least 6-mm (¼-in.) clearance from the head to allow for specimens whose bearing surfaces are not exactly parallel. The diameter of the bearing surface shall be at least 125 mm (5 in.). A hardened metal bearing block shall be used beneath the specimen to minimize wear of the lower platen of the machine. The bearing block surfaces intended for contact with the specimen should have a hardness not less than 60 HRC (620 HB). These surfaces shall not depart from plane surfaces by more than 0.003 mm (0.0001 in.) in any 150-mm (6-in.) dimension. When the bearing area of the spherical bearing block is not sufficient to cover the area of the specimen, a steel plate with surfaces machined to true planes within ±0.003 mm (0.0001 in.), and with a thickness equal

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

[3] *Annual Book of ASTM Standards*, Vol 04.05.

[4] *Annual Book of ASTM Standards*, Vol 03.01.

[5] *Annual Book of ASTM Standards*, Vol 14.02.

[6] *Annual Book of ASTM Standards*, Vol 04.07.

to at least one half of the distance from the edge of the spherical bearing to the most distant corner shall be placed between the spherical bearing block and the capped specimen.

5. Test Specimen

5.1 *Sampling and Testing of Masonry Units:*

5.1.1 Select representative masonry units and test for percent void area for hollow clay masonry and average net area for hollow concrete masonry and compressive stength in accordance with the following applicable ASTM methods:

Masonry Units	ASTM Designation
Building and face brick	C 67
Sandlime brick	C 140
Concrete brick	C 140
Concrete block	C 140
Structural clay tile	C 67

5.1.2 Select random samples of masonry unit test specimens in accordance with Practice E 105.

5.2 *Sampling and Testing of Mortar*—Use one of the types of mortar as specified in Specification C 270 unless otherwise required. Sample and test in accordance with Test Method C 780. Determine and report the physical properties by the standards indicated:

5.2.1 *Consistency*—Test Method C 780, Annex A1.

5.2.2 *Air Content*—Test Method C780, Annex A5.

5.2.3 *Compressive Strength*—Test Method C 780, Annex A6.

5.2.4 *Sieve Analysis*—Specification C 144.

5.3 *Sampling and Testing of Grout*—Use one of the types of grout as specified in Specification C 476 unless otherwise required. Sample and test in accordance with Test Method C 1019. Determine and report the physical properties by the test methods indicated:

5.3.1 *Slump*—Test Method C 143.

5.3.2 *Compressive Strength*—Test Method C 1019.

5.3.3 *Fine Grout*—Mold a minimum of three 50-mm (2-in.) cubes from a sample of the fine grout and test in the same manner as prescribed in 5.2, except moist cure cubes 48 h before releasing from molds.

5.3.4 *Coarse Grout*—Mold a minimum of three 75 by 150-mm (3 by 6-in.) cylinders from a sample of the coarse grout and moist cure for 48 h before releasing from molds. Cap and test them in compression in accordance with applicable provisions of Test Method C 39.

5.4 *Masonry Prisms*—Build and test a minimum of three prism specimens for each combination of variables. Each test prism shall be a single-wythe specimen laid in stack bond, with a height-to-thickness ratio of not less than two nor more than five. The mortar joints shall be 10 mm (⅜ in.) in thickness. Spread a full bed of mortar on each solid masonry unit and allow no furrowing of the mortar bed. Fully bed the face shells of hollow masonry units with mortar. Strike mortar joints flush with the face of the masonry without tooling. The length of the prism shall be greater than its thickness.

5.5 *Handling and Curing Conditions*—Generally, cure all prisms for 28 days. However, lesser periods of time may be used provided the relation between that period and the 28-day strength of the masonry is established by a suitable statistical method (Practice E 105) (Note 2). Cure the prisms together with the corresponding mortar and grout specimens in laboratory air maintained at a temperature of 24 ± 8°C (75 ± 15°F), with a relative humidity between 30 and 70 %, and free of drafts. These environmental conditions will not require, generally, special air-conditioning equipment. Make a continuous graphical record of temperatures and humidity to detect unusual dryness or excessive moisture together with unusual fluctuations of temperature.

NOTE 2—A preferred method of determining the relation between the strengths of 28-day prisms and those cured for shorter periods of time is to build three additional prisms to be tested after curing the shorter time.

6. Procedure

6.1 *Capping Test Specimens*—Cap the ends of the prisms in the same manner as set forth for capping the units in either Test Method C 67 or Test Methods C 140.

6.2 *Specimen Measurements*—Determine the length and thickness of the prism to the nearest 0.3 mm (0.01 in.) by averaging three measurements taken at the center and quarter points of the height of the specimen. Measure the height of the specimen including caps to the nearest 3 mm (0.1 in.).

6.3 *Placing the Specimen*—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. Wipe clean the bearing faces of the upper and lower bearing blocks and of the test specimen and place the test specimen on the lower bearing block. Carefully align both centroid axes of the specimen with the center of thrust of the spherically seated block. 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.

6.4 *Rate of Loading*—Apply the load, up to one half of the expected maximum load, at any convenient rate, after which adjust the controls of the machine so that the remaining load is applied at a uniform rate in not less than 1 nor more than 2 min.

6.5 *Determination of Young's Modulus*—When stipulated, determine Young's modulus in accordance with Test Method E 111. Follow the designated method to the greatest extent possible.

6.6 *Observations*—During the course of the test, note the loading at which the first cracking sounds are heard. Note whether a stethoscope or other instrument is used for hearing. If observed, note the load corresponding to the appearance of the first crack either in the unit itself or spalling of the mortar joint, or both. Upon increasing the load to a maximum sustained by the prism, describe the mode of failure as fully as possible. In the cases of walls with two or more wythes, apply suitable sensitive gages transversely across the collar joint at the midheight of the specimen to detect the formation of cracks in the plane of the collar joint. (Bonded wire gages have been found to be suitable for these measurements.)

NOTE 3—The measurements of transverse strains across collar joints in double- or multi-wythe walls are essential to determine whether a plane of weakness exists along a continuous vertical joint such as a collar joint that may develop significant tensile strains indicating potential premature cracking.

7. Report

7.1 Prepare the report in conformance with Practice E 575 and include the following:

7.1.1 The compressive strength and other specified physical properties of masonry units, including the name and address of the manufacturer and his unit designation number or name.

7.1.2 The compressive strength and other specified physical properties of the mortar and grout, a sand-sieve analysis, and other specified physical properties of the constituent materials, including the name and address of the manufacturer of each constituent material, and his material designation number or name.

7.1.3 Brief description of specimen fabrication including method of bonding, joint thickness, and prism dimensions.

7.1.4 Age of prism at time of test.

7.1.5 Maximum load for each prism in pounds-force (or newtons).

7.1.6 Cross-sectional area of each specimen in square millimetres (or square inches). The gross area shall be used for solid masonry prisms and the net area for prisms built with hollow units not solidly grouted.

7.1.7 Compressive strength of each prism calculated to the nearest 70 kPa (10 psi).

7.1.8 Average compressive strength, standard deviation, and coefficient of variation of the sample.

7.1.9 When required, the stress-strain curve for each prism, determined in accordance with applicable provisions of Test Method E 111, shall be plotted. The secant modulus of elasticity shall be reported for suitable values of stress and strain. In the case of double-wythe walls, the compressive stress versus the transverse strain measured across the collar joint shall also be plotted.

7.1.10 A full description of the mode of failure. Whenever useful clarification will result, use photographs, and

7.1.11 Unusual defects in either specimens or caps shall be noted, including causes, when known, of unusual test results.

8. Precision and Bias

8.1 No statement is made either on the precision or on the bias of these test methods due to the variety of material and combinations of materials involved. Sufficient test data for all materials and combinations of materials are not presently available to permit the development of precision and bias statements.

9. Keywords

9.1 compressive strength; masonry; prisms