Designation: D 1634 – 00

Standard Test Method for Compressive Strength of Soil-Cement Using Portions of Beams Broken in Flexure (Modified Cube Method) [1]

This standard is issued under the fixed designation D 1634; 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 compressive strength of soil-cement, using for test specimens portions of beams broken in flexure in accordance with Test Method D 1635.

1.2 *Units*—The values stated in SI units are to be regarded as standard. The values given in parentheses are mathematical conversions to inch-pound units, which are provided for information only and are not considered standard.

1.2.1 The converted inch-pound units use the gravitational system of units. In this system, the pound (lbf) represents a unit of force (weight), while the unit for mass is slugs. The converted slug unit is not given, unless dynamic (F = ma) calculations are involved.

1.3 *This standard does not purport to address all of the safety problems, 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:*

D 653 Terminology Relating to Soil, Rock, and Contained Fluids [2]

D 1632 Practice for Making and Curing Soil-Cement Compression and Flexure Test Specimens in the Laboratory [2]

D 1633 Test Method for Compressive Strength of Molded Soil-Cement Cylinders [2]

D 1635 Test Method for Flexural Strength of Soil-Cement Using Simple Beam with Third-Point Loading [2]

D 3740 Practice for the Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction [2]

E 4 Standard Practices for Force Verification of Testing Machines [3]

3. Terminology

3.1 *Definitions:*

3.1.1 For common definitions of terms in this standard, refer to Terminology D 653.

4. Significance and Use

4.1 This test method is intended for use in the laboratory and as a research tool for determining relative compressive strength values for various soil-cement mixtures. It is not intended as an alternative for Test Method D 1633 and the test values obtained by these two test methods are not interchangeable and not necessarily comparable. A comparison of strengths obtained by Test Methods D 1633 and D 1634 is given in Footnote 4.[4]

NOTE 1—The quality of the result produced by this standard is dependent on the competence of the personnel performing it, and the suitability of the equipment and facilities used. Agencies that meet the criteria of Practice D 3740 are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with Practice D 3740 does not in itself assure reliable results. Reliable results depend on many factors; Practice D 3740 provides a means of evaluating some of those factors.

5. Apparatus

5.1 *Compression Testing Machine*—The testing machine may be of any type having sufficient capacity and control to provide the rate of loading prescribed in 7.2. It shall conform to the requirements of Section 15 of Practices E 4. The testing machine shall be equipped with a spherically seated head block having a bearing surface of at least 75 % of the width of the specimen but not greatly in excess of the width of the specimen. The movable portion of this block 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.

5.2 *Bearing Plates*—Square, hardened steel bearing plates 19 mm (¾ in.) thick with side dimensions of 76.2 ± 0.13 mm (3 ± 0.005 in.) (for standard beam). The bearing faces when new shall not depart from a plane by more than 0.013 mm (0.0005 in.) at any point, and they shall be maintained within a permissible variation of 0.025 mm (0.001 in.).

[1] This test method is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.15 on Stabilization by Admixtures.

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[2] *Annual Book of ASTM Standards*, Vol 04.08.

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

[4] Felt, E. J., Abrams, M. S., *Strength and Elastic Properties of Compacted Soil-Cement Mixtures, ASTM STP 206*, ASTM, 1957.

***A Summary of Changes section appears at the end of this standard.**

NOTE 2—It is desirable that the bearing faces of plates used for compression testing of soil-cement have a Rockwell hardness of not less than HRC 60.

6. Test Specimens

6.1 The standard size beams from which broken portions are selected for the compression test shall be 76 by 76 by 290 mm (3 by 3 by 11¼ in.), but a similar test method may be used for testing specimens from other beam sizes. The beam-end specimens shall have a length at least 25 mm (1 in.) greater than their depth and shall be free from cracks, chipped surfaces, or other obvious defects. Test the specimens on their sides with respect to their molded position.

6.2 During the interval between testing of specimens as beams and testing the broken portions as cubes, keep the specimens at a constant water content by suitable protection.

6.3 Determine the width (original height) of the standard specimen at the point where the test will be made to the nearest 0.25 mm (0.01 in.) if it is less than 76.2 mm (3.00 in.); otherwise take it equal to 76.2 mm (3 in.). Take the length equal to 76.2 mm (3 in.). Calculate the cross-sectional area.

6.4 Check the smoothness of the faces with a straightedge. If necessary, cap the faces to meet the requirements of the section on Capping Specimens of Practice D 1632. The caps shall cover the full width of the specimen and shall be of such length as to permit adjustment of the bearing plates for the test so that the upper bearing plate may be placed directly over the lower bearing plate.

7. Procedure

7.1 Place the specimen on its side between the hardened steel bearing plates directly under the spherically seated head of the testing machine, making certain that the vertical axis of the specimen is aligned with the center of thrust of the head. Use a device such as a guide template to ensure that the upper bearing plate is directly over the lower bearing plate. As the spherically seated head is brought to bear on the top bearing plate, rotate its movable portion gently by hand so that uniform seating is obtained.

7.2 Apply the load continuously and without shock. A screw power testing machine, with the moving head operating at approximately 0.02 mm/s (0.05 in./min) when the machine is running idle, may be used. With hydraulic machines, adjust the loading to a constant rate within the limits of 140 ± 70 kPa/s (20 ± 10 psi), depending upon the strength of the specimen. Record the total load at failure of the specimen to the nearest 45 N (10 lbf).

8. Calculation

8.1 Calculate the unit compressive strength of the specimen by dividing the maximum load by the cross-sectional area determined as described in 6.3.

9. Report

9.1 Report the following information:

9.1.1 Specimen identification number,

9.1.2 Width and length of test area, mm (in.),

9.1.3 Cross-sectional area, mm^2($in.^2$),

9.1.4 Maximum load, to the nearest 40 N (10 lbf),

9.1.5 Compressive strength, calculated to the nearest 35 kPa (5 psi),

9.1.6 Age of specimen, and

9.1.7 Details of curing and conditioning periods, and water content at time of test.

10. Precision and Bias

10.1 *Precision*—The precision of this test method has not been established by an interlaboratory test program. However, based on test data that are available, the following may serve as a guide to the variability of compressive strength by the modified cube method.

10.1.1 Tests were performed in a single laboratory on a silt loam soil with 92 % passing the No. 200 sieve. Liquid limit and plasticity index of soil were 26 and 7, respectively. The series of tests consisted of 24 specimens, 12 at 6 % cement and 12 at 14 % cement. The specimens were cured in a moist room at 23°C (73° F) for 28 days. Results [4] of tests on the 76 by 76 mm (3 by 3-in.) modified cubes are given in Table 1.

10.2 *Bias*—There is no accepted reference value for this test method, therefore, bias cannot be determined.

11. Keywords

11.1 soil-cement; soil stabilization; unconfined compressive strength

TABLE 1 Precision

	Average compressive strength, psi	Standard deviation, psi	Coefficient of variation,%
Specimens with 6 % cement	473	35	7.4
Specimens with 14 % cement	887	47	5.3

SUMMARY OF CHANGES

In accordance with Committee D18 policy, this section identifies the location of changes to this standard since the last edition (95) that may impact the use of the standard.

(1) Section 1 — Inserted as 1.2 statement on units and renumbered section 1.2 to 1.3.
(2) Section 2.1 — Inserted references to D 653 and D 3740.
(3) Section 2.1 — Updated title of E 4 reference.
(4) New section 3 — Inserted new section 3 – Terminology with reference to D 653 for terms. Renumbered subsequent sections as needed.
(5) Renumbered section 4 — Inserted as Note 1 standard reference to D 3740 and renumbered remaining notes as needed.
(6) Renumbered sections 5.2, 6.1, 6.3, 7.2, 9.1.2, 9.1.3, 9.1.4, 9.1.5 and 10.1.1 — placed SI units first and places inch-pound units in parentheses.
(7) Added Summary of Changes section.
(8) Corrected headquarters address for ASTM