Designation: D 5202 – 91 (Reapproved 1997)

Standard Test Method for Determining Triaxial Compression Creep Strength of Chemical Grouted Soils[1]

This standard is issued under the fixed designation D 5202; 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 long term strength and deformation of a cylindrical specimen of either a (undisturbed) field sample or laboratory-fabricated chemical grouted soil when it is sheared undrained in compression under a constant sustained load.

NOTE 1—The voids of chemical grouted soils are most often substantially filled with grout. Thus, pore pressures are unlikely to develop. This test method is not applicable to partially grouted soils in which substantial pore pressures may develop. If pore pressures must be measured, reference is made to Test Method D 4767 for equipment and procedures.

1.2 This test method provides data useful in determining strength and deformation properties of chemical grouted soils subjected to sustained loads. Mohr strength envelopes may also be determined.

1.3 The determination of strength envelopes and the development of relationships to aid in interpreting and evaluating test results are left to the engineer or office requesting the test.

1.4 The values stated in either SI or inch-pound units shall be regarded separately as standard. The values in each system may not be exact equivalents, therefore, each system must be used independently of the other, without combining values in any way.

1.5 *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:*

D 422 Method for Particle-Size Analysis of Soils[2]

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

D 854 Test Method for Specific Gravity of Soils[2]

D 2850 Test Method for Unconsolidated, Undrained Strength of Cohesive Soils in Triaxial Compression[2]

D 4219 Test Method for Unconfined Compressive Strength Index Test of Chemical-Grouted Soils[2]

D 4320 Test Method for Laboratory Preparation of Chemically Grouted Soil Specimens for Obtaining Design Strength Parameters[2]

D 4767 Test Method for Consolidated Undrained Triaxial Compression Test on Cohesive Soils[2]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard*:

3.1.1 *failure*—in creep studies, the stress condition at excessive (15 to 20 %) strain, or at continuing strain leading to fracture.

4. Significance and Use

4.1 Data from these tests may be used for structural design purposes. Adequate safety factors, based on engineering judgment must be determined by the user.

NOTE 2—Sampling procedures for in-situ specimens have a major influence on test results. Specimens carefully trimmed in the laboratory from large block samples taken in the field have the least chance of fracturing prior to testing. Sample preparation methods of laboratory-fabricated specimens also have a major influence on test results. Specimens should be fabricated in accordance with Test Method D 4320.

5. Apparatus

5.1 The requirements for equipment needed to perform satisfactory tests are given in the following sections:

5.2 *Axial Loading Device*—The axial compression device may be a dead weight system, a pneumatic or hydraulic load cell, or any other device capable of applying and maintaining desired constant loads to the accuracy prescribed for the load measuring device.

5.3 *Axial Load-Measuring Device*—The axial load-measuring device may be a load ring, electronic load cell, hydraulic load cell, or any other load-measuring device capable of the accuracy prescribed in this subsection and may be part of the axial loading device. The axial load-measuring device shall be capable of measuring the axial load to an accuracy of within ± 1 % of the axial load at failure. If the load-measuring device is located inside the triaxial chamber it shall be insensitive to horizontal forces and to the magnitude of the chamber pressure.

[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 With Admixtures.

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

5.4 *Triaxial Compression Chamber*—The triaxial chamber shall consist of a headplate and a baseplate separated by a cylinder. The size of the cylinder should be enough to yield a minimum annular clearance of ½ in. (12 mm) with the untested specimen. The cylinder may be constructed of any material capable of withstanding the applied pressures. It is desirable to use a transparent material or have a cylinder provided with viewing ports so the behavior of the specimen may be observed. The headplate shall have a vent valve such that air can be forced out of the chamber as it is filled. The baseplate shall have an inlet through which the pressure liquid is supplied to the chamber, and appropriate connections for the specimen base.

5.5 *Axial Load Piston*—The piston passing through the top of the chamber and its seal must be designed so the variation in the axial load due to friction does not exceed 0.1 % of the axial load at failure and so there is negligible lateral bending of the piston during loading. Alternatively, the apparatus may be calibrated, and a correction for friction may be made.

NOTE 3—The use of two linear ball bushings to guide the piston is recommended to minimize friction and maintain alignment.

NOTE 4—A minimum piston diameter of ⅙the specimen diameter has been used successfully in many laboratories to minimize lateral bending.

5.6 *Pressure Control Devices*—The chamber pressure control devices shall be capable of applying and controlling pressures to within ± 0.25 psi (2 kPa) for pressures less than 28 psi (200 kPa) and to within ± 1 % for pressures greater than 28 psi (200 kPa). The device may consist of self compensating mercury pots, pneumatic pressure regulators, or any other device capable of applying and controlling pressures to the required tolerances.

5.7 *Pressure-Measurement Devices*—The chamber pressure measuring devices shall be capable of measuring pressures to the tolerances given in 5.6. They may consist of Bourdon gages, pressures manometers, electronic pressure transducers, or any other device capable of measuring to the stated tolerances.

5.8 *Deformation Indicator*—The vertical deformation of the specimen is usually determined from the travel of the piston acting on top of the specimen. The piston travel shall be measured with an accuracy of at least ± 0.2 % of the initial specimen height. The deformation indicator shall have a travel range of at least 20 % of the initial height of the specimen and may be a dial indicator, linear variable differential transformer (LVDT), extensometer, or other measuring device meeting the requirements for accuracy and range.

5.9 *Specimen Cap and Base*—The specimen cap and base shall be constructed of a rigid, noncorrosive, impermeable material, and shall have a circular plane surface of contact with the specimen and a circular cross section. The weight of the specimen cap shall be less than 0.5 % of the applied axial load at failure or less than 0.1 lb (50 g). The diameter of the cap and base shall be equal to the initial diameter of the specimen. The specimen base shall be connected to the triaxial compression chamber to prevent lateral motion or tilting, and the specimen cap shall be designed to receive the piston such that eccentricity of the piston-to-cap contact relative to the vertical axis of the specimen does not exceed 0.05 in. (0.13 cm). The end of the piston and specimen cap contact area shall be designed so that tilting of the specimen cap during the test is minimal. The cylindrical surface of the specimen base and cap that contacts the membrane to form a seal shall be smooth and free of scratches.

5.10 *Rubber Membrane*—The rubber membrane used to encase the specimen shall provide reliable protection against leakage. To check a membrane for leakage, the membrane shall be placed around a cylindrical form, sealed at both ends with rubber O-rings, subjected to a small air pressure on the inside, and immersed in water. If air bubbles appear from any point on the membrane, it shall be rejected. To offer minimum restraint to the specimen, the unstretched membranes diameter shall be between 90 and 95 % of that specimen. The membrane thickness shall not exceed 1 % of the diameter of the specimen. The membrane shall be sealed to the specimen cap and base with rubber O-rings with an unstressed inside diameter between 75 and 85 % of the diameter of the cap and base, or by other means that will provide a positive seal. An equation for correcting deviator stress (principal stress difference) for the effect of the stiffness of the membrane is given in 10.3.

5.11 *Specimen-Size Measurement Devices*—Devices used to determine the height and diameter of the specimen shall measure the respective dimensions to within ± 0.1 % of the total dimension and be constructed such that their use will not disturb the specimen.

NOTE 5—Circumferential measuring tapes are recommended over calipers for measuring the diameter.

5.12 *Recorders*—Specimen behavior may be recorded manually or by electronic digital or analog recorders. If electronic recorders are used, it shall be necessary to calibrate the measuring devices through the recorder using known input standards.

5.13 *Weighing Device*—The specimen weighing device shall determine the mass of the specimen to an accuracy of within ± 0.05 % of the total mass of the specimen.

5.14 *Testing Environment*—Perform the test in an environment where temperature fluctuations are less than ± 7.2°F (± 4°C) and there is no direct contact with sunlight.

5.15 *Miscellaneous Apparatus*—Specimen trimming and carving tools including a wire saw, steel straightedge, miter box and vertical trimming lath, may be needed for field samples. Apparatus for preparing laboratory specimens is detailed in Test Method D 4320. Membranes and O-ring expander, water content cans, and data sheets shall be provided as required.

6. Test Specimen Preparation

6.1 Fabricate specimens as described in Test Method D 4320, or carefully trim from samples taken in the field.

6.2 *Specimen Size*—Specimens shall be cylindrical and have a minimum diameter of 1.3 in. (3.3 cm). The height-to-diameter ratio shall be between 2.5 and 3.0. The largest particle size shall be smaller than ⅙ the specimen diameter. If, after completion of a test, it is found based on visual observation that oversize particles are present, indicate this information in the report of test data (see Section 11).

NOTE 6—If oversize particles are found in the specimen after testing, a