STANDARD METHOD OF TEST FOR MULTISTAGE TRIAXIAL STRENGTH OF UNDRAINED ROCK CORE SPECIMENS WITHOUT PORE PRESSURE MEASUREMENTS

1. Scope

1.1 This method covers the determination of the strength of cylindrical rock specimens in an undrained state under multistage triaxial loading. The test provides data useful in delineating the strength of joints, seams, bedding planes, etc. This method makes no provision for pore pressure measurements. Thus, the strength values determined are in forms of total stress, i.e. not corrected for pore pressures.

2. Apparatus

2.1 The apparatus is identical with that used in RTH 202, "Triaxial Compressive Strength of Undrained Rock Core Specimens Without Pore Pressure Measurements."

3. Test Specimens

3.1 In the case of intact specimens that develop a well-defined shear failure plane, it is possible to continue testing beyond the first failure; that is, the confining pressure can be raised to a higher level and another peak stress recorded. This may be done immediately following the completion of a conventional triaxial test as conducted according to RTH 202.

3.2 Multistage testing can also be used with cores that are intact initially. The key factor in making these studies is the use of specimens with the failure plane preestablished to cause failure along an inherent weakness, such as seams, open joints, bedding planes, faults, schistosity bands, or laminations. These planes of weakness, when tested, should be oriented at 45 to 65 deg (0.79 to 1.14 radians) from the horizontal, which will normally produce a failure in the preoriented zone. When including these specific geologic features in an NX size core, the specimens can be drilled from 6-in. (15-cm) or larger cores by suitable orientation in the drilling apparatus. Care must be taken when coring these specimens to prevent breakage. However, if the core is

broken along a weakness plane, it may still be tested as an open joint. Broken cores can be taped together with plastic tape, only sufficiently to maintain the matching contact between the broken parts. The test specimens are then prepared in the manner described in Section 3 of RTH 202.

4. Procedure

4.1 The test procedure described in Section 4 of RTH 202 shall be used for the first stage of test. Subsequent stages should be achieved in like manner by applying progressively higher levels of lateral fluid pressure. This may be done as many times as desired, provided the total strain does not cause excessive misalignment of the steel platens and an eccentric loading. This procedure is referred to as multistage testing. Fig. 1 illustrates this loading sequence.

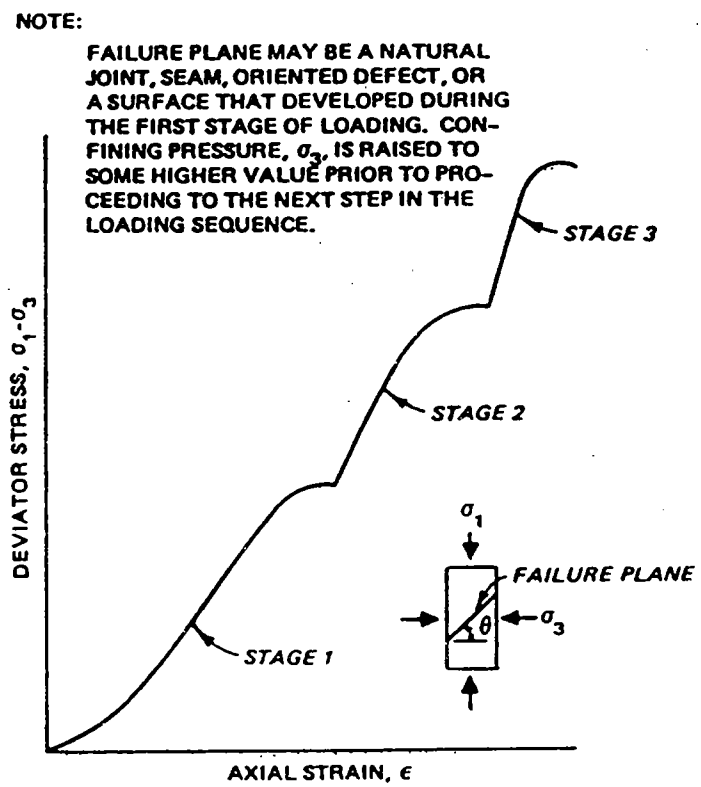

Fig. 1. Stress-strain curve for multistage triaxial test.

5. Calculations

5.1 The shear strength on the joint can be determined graphically by constructing a Mohr circle as shown in Fig. 2. Proof of this construction may be found in most soil mechanics texts.[1] For a multistage test on a given specimen, several Mohr's circles can be drawn and the same angle used to plot the stresses on the failure plane. A strength envelope for this condition, Fig. 3, which is the average of the results determined for each Mohr's circle, is considered to be the joint friction angle.

5.2 There are variations of this plotting technique that may also be employed. The multistage test described above produces a joint friction angle from a single specimen. For a strength envelope derived from tests of several intact specimens, plotting failure plane stresses would yield a higher limiting strength criterion than that of open joints. To report this type of data properly, all orientation data must be carefully and fully stated to ensure proper interpretation of results.

5.3 Various orientations of seams may also be tested to determine that which is most critical. Direct tension and unconfined compression tests may be included to completely define the strength envelope as shown in Fig. 4.

6. Report

6.1 In addition to the plots discussed in Section 5, the report should include the following:

6.1.1 Lithologic description of the rock, including the type of joint, seam, etc., tested.

6.1.2 Source of sample including depth and orientation, dates of sampling and testing, and storage environment.

6.1.3 Specimen diameter and height.

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[1] Taylor, D., "Fundamentals of Soil Mechanics," John Wiley and Sons, Inc., p 317, or Spangler, M., "Soil Engineering," International Textbook Co., p 277.

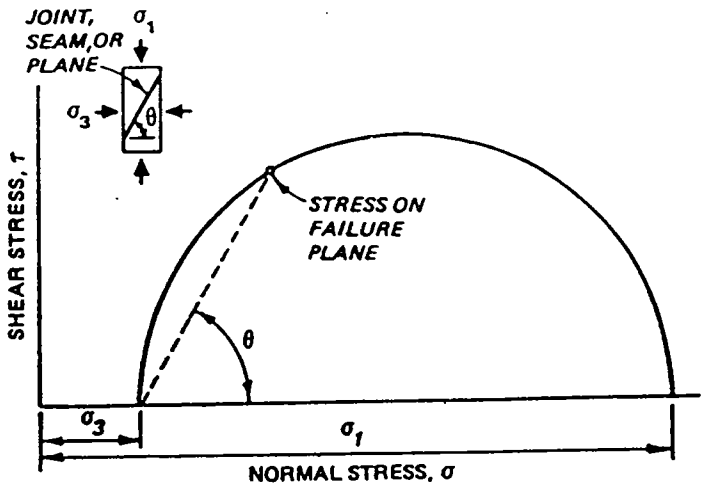

Fig. 2. Mohr circle showing method of construction for locating stresses in failure plane.

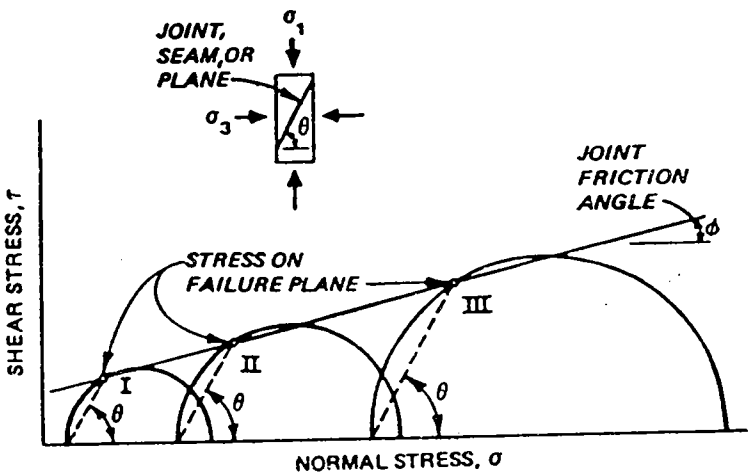

Fig. 3. Mohr diagram for locating stresses on failure plane in a multistage test.

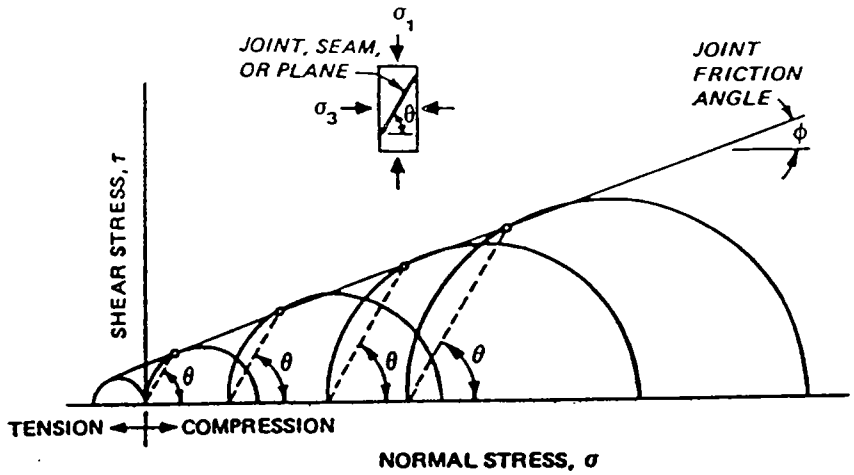

Fig. 4. Mohr diagram for locating stresses on failure plane, including direct tension and unconfined compression test data.

6.1.4 Moisture content and degree of saturation at time of test.

6.1.5 Other physical data, such as specific gravity, absorption, porosity, and permeability, citing the method of determination for each.