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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Test Method for In Situ Determination of Direct Shear Strength of Rock Discontinuities¹

This standard is issued under the fixed designation D 4554; 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 measurement of peak and residual direct shear strength of in situ rock discontinuities as a function of stress normal to the sheared plane. This sheared plane is usually a significant discontinuity which may or may not be filled with gouge or soil-like material.

1.2 The measured shear properties are affected by scale factors. The severity of the effect of these factors must be assessed and applied to the specific problems on an individual basis.

1.3 The values stated in SI units are to be regarded as the standard.

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. Terminology

2.1 *Definitions of Terms Specific to This Standard:*

2.1.1 *discontinuities*—this includes joints, schistosity, faults, bedding planes, cleavage, and zones of weakness, along with any filling material.

2.1.2 *peak shear strength*—the maximum shear stress in the complete curve of stress versus displacement obtained for a specified constant normal stress.

2.1.3 *residual shear strength*—the shear stress at which nominally no further rise or fall in shear strength is observed with increasing shear displacement and constant normal stress (Fig. 1). A true residual strength may only be reached after considerably greater shear displacement than can be achieved in testing. The test value should be regarded as approximate and should be assessed in relation to the complete shear stress - displacement curve.

2.1.4 *shear strength parameter, c* (see Fig. 2)—the projected intercept on the shear stress axis of the plot of shear stress versus normal stress (see Note).

2.1.5 *shear strength parameter, ϕ* (see Fig. 2)—the angle of

the tangent to the failure curve at a normal stress that is relevant to design.

2.1.5.1 *Discussion*—Different values of c and ϕ relate to different stages of a test (for example, c' , c_r' , ϕ_a , and ϕ_b , of Fig. 2).

3. Summary of Test Method

3.1 This test method is performed on rectangular-shaped blocks of rock that are isolated on all surfaces, except for the shear plane surface.

3.2 The blocks are not to be disturbed during preparation operations. The base of the block coincides with the plane to be sheared.

3.3 A normal load is applied perpendicular to the shear plane and then a side load is applied to induce shear along the plane and discontinuity (see Fig. 3).

4. Significance and Use

4.1 Because of scale effects, there is no simple method of predicting the in situ shear strength of a rock discontinuity from the results of laboratory tests on small specimens; in situ tests on large specimens are the most reliable means.

4.2 Results can be employed in stability analysis of rock engineering problems, for example, in studies of slopes, underground openings, and dam foundations. In applying the test results, the pore water pressure conditions and the possibility of progressive failure must be assessed for the design case, as they may differ from the test conditions.

4.3 Tests on intact rock (free from planes of weakness) are usually accomplished using laboratory triaxial testing. Intact rock can, however, be tested in situ in direct shear if the rock is weak and if the specimen block encapsulation is sufficiently strong.

5. Apparatus

5.1 *Equipment for Cutting and Encapsulating the Test Block*—This includes rock saws, drills, hammer and chisels, formwork of appropriate dimensions and rigidity, expanded polystyrene sheeting or weak filler, and materials for reinforced concrete encapsulation.

5.2 *Equipment for Applying the Normal Load* (see Fig. 3)—This includes flat jacks, hydraulic rams, or dead load of sufficient capacity to apply the required normal loads.

¹ This test method is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.12 on Rock Mechanics.

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