



Standard Test Method for Determining the In Situ Modulus of Deformation of Rock Mass Using the Rigid Plate Loading Method¹

This standard is issued under the fixed designation D 4394; 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 preparation, equipment, test procedure, and data reduction for determining in situ modulus of deformation of a rock mass using the rigid plate loading method.

1.2 This test method is designed to be conducted in an adit or small underground chamber; however, with suitable modifications it could be conducted at the surface.

1.3 This test method is usually conducted parallel or perpendicular to the anticipated axis of thrust, as dictated by the design load.

1.4 Time dependent tests can be performed but are to be reported in another standard.

1.5 The values stated in inch-pound units are to be regarded as the standard.

1.6 The references appended to this standard contain further information on this test method.

1.7 *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.* For specific precaution statements, see Section 8.

2. Referenced Documents

2.1 ASTM Standards:

D 4395 Test Method for Determining the In Situ Modulus of Deformation of Rock Mass Using the Flexible Plate Loading Method²

D 4403 Practice for Extensometers Used in Rock²

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *deflection*—movement of the rigid plate, mortar pad, or rock in response to and in the same direction as the applied load.

3.1.2 *load*—total force acting on the rock face.

3.1.3 *peak-to-peak modulus of deformation*—the slope of the stress - strain curve line connecting the peaks of the curves

obtained from successive pressure cycles (see Fig. 1).

3.1.4 *recovery modulus of deformation*—the tangent modulus of the unloading stress - strain curve. This modulus is usually higher than the other moduli and is used in calculations where unloading conditions exist. The difference between the tangent and recovery moduli indicates that material's capacity of hysteresis or energy dissipation capabilities (see Fig. 2).

3.1.5 *rigid plate*—plate with deflection of less than 0.0001 in. (0.0025 mm) from center to edge of plate, when maximum load is applied.

3.1.6 *secant modulus of deformation*—the slope of the stress-strain curve between zero stress and any specified stress. This modulus should be used for complete load steps from zero to the desired load (see Fig. 2).

3.1.7 *tangent modulus of deformation*—the slope of the stress - strain curve obtained over the segment of the loading curve judged by the investigator as the most representative of elastic response. It neglects the end effects of the curve and is better suited to small stress changes. The ratio between the secant modulus and the tangent modulus can be used as a means of measuring the stress damage of the material (see Fig. 2).

4. Summary of Test Method

4.1 Areas on two opposing parallel faces of a test adit are flattened and smoothed.

4.2 A mortar pad and rigid metal plate are installed against each face and a hydraulic loading system is placed between the rigid plates.

4.3 If deflection is to be measured within the rock mass, extensometer instruments should be installed in the rock in accordance with Practice D 4403.

4.4 The two faces are loaded and unloaded incrementally and the deformations of the rock mass at the surfaces and, if desired, within the rock, are measured after each increment. The modulus of deformation is then calculated.

5. Significance and Use

5.1 Results of this type of test method are used to predict displacements in rock mass caused by loads from a structure or from underground construction. It is one of several tests that should be performed. The resulting in situ modulus is commonly less than the elastic modulus determined in the laboratory.

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.

Current edition approved Nov. 12, 1984. Published January 1985.

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