



Designation: D8295 – 19

Standard Test Method for Determination of Shear Wave Velocity and Initial Shear Modulus in Soil Specimens using Bender Elements¹

This standard is issued under the fixed designation D8295; 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 laboratory use of piezo-ceramic bender elements to determine the shear wave velocity in soil specimens. A shear wave is generated at one boundary of a soil specimen and then received at an opposite boundary. The shear wave travel time is measured, which over a known travel distance yields the shear wave velocity. From this shear wave velocity and the density of the soil specimen the initial shear modulus (G_{max}) can be determined, which is the result of primary interest from bender element tests.

1.2 This shear wave velocity determination involves very small strains and is non-destructive to a test specimen. As such, bender element shear wave velocity determinations can be made at any time and any number of times during a laboratory test.

1.3 This test method describes the use of bender elements in a triaxial type test (for example, Test Methods D3999, D4767, D5311, or D7181), but a similar procedure may be used for other laboratory applications, like in Direct Simple Shear (Test Method D6528) or oedometer tests (for example, Test Methods D2435 and D4186). Shear wave velocity can also be determined in unconfined soil specimens held together by matrix suction.

1.4 Shear wave velocity can be determined in different directions in a triaxial test, for example vertically and horizontally. Shear waves generated to determine shear wave velocity can also be polarized in different directions, for example a horizontally propagating shear wave with either vertical or horizontal polarization. This test method describes the use of bender elements mounted in the top platen and base pedestal of a triaxial test specimen to measure shear wave velocity in the vertical direction. With additional bender elements mounted on opposite sides of a triaxial specimen, a similar procedure may be used to determine horizontal shear wave velocity.

1.5 A variety of different interpretation methods to evaluate the shear wave travel time in a soil specimen have been

proposed and used. This test method only describes two of these, Start to Start and Peak to Peak using a single sine wave signal sent to the transmitter bender element. Other interpretation methods producing similar results may also be used.

1.6 Bender element measurements may not work very well in some situations, like in extremely stiff soils where the generated shear wave amplitude may be exceedingly small.

1.7 This test method does not cover the determination of compressional wave velocity in soil specimens. This measurement requires a different type of piezo-ceramic element configuration, and such determinations are generally not useful in saturated soft soil specimens as the earliest identifiable compressional wave arrival at the receiver end of a saturated specimen will likely have been transmitted through the (relatively incompressible) specimen pore water rather than the (compressible) soil skeleton.

1.8 *Units*—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.9 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice D6026, unless superseded by this test method.

1.9.1 The procedures used to specify how data are collected/recorded and calculated in the standard are regarded as the industry standard. In addition, they are representative of the significant digits that generally should be retained. The procedures used do not consider material variation, purpose for obtaining the data, special purpose studies, or any considerations for the user's objectives; and it is common practice to increase or reduce significant digits of reported data to be commensurate with these considerations. It is beyond the scope of these test methods to consider significant digits used in analysis methods for engineering data.

1.10 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.11 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the*

¹ This test method is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.09 on Cyclic and Dynamic Properties of Soils.

Current edition approved Nov. 1, 2019. Published December 2019. DOI: 10.1520/D8295-19