Standard Method of Test for

Rapid Axial Compressive Load Testing of Deep Foundation Units

AASHTO Designation: TP 104-13 (2015)[1]

AASHTO

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1. SCOPE

1.1. This method covers the procedure for testing a vertical or inclined pile to determine the displacement response of the pile to an axial compressive load pulse of a preselected target peak force.

1.2. This test method is applicable to all deep foundation units that function in a manner similar to piles, regardless of their method of installation.

1.3. *Two alternative procedures are provided*:

1.3.1. Procedure A uses a combustion gas pressure apparatus to produce the required axial compression force pulse.

1.3.2. Procedure B uses a cushioned drop mass apparatus to produce the required axial compression force pulse.

1.4. All observed and calculated values shall conform to the guidelines for significant digits and rounding established in ASTM D6026.

1.5. The method used to specify how data are collected, calculated, or recorded in this standard is not directly related to the accuracy to which the data can be applied in the design or other uses.

1.6. AASHTO takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

1.7. The values stated in SI units shall be regarded as the standard. The inch-pound equivalents of the SI units may be approximate.

1.7.1. The gravitational system of inch-pound units is used when dealing with inch-pound units. In this system, the pound (lbf) represents a unit of force (weight), while the unit for mass is slugs. The rationalized slug unit is not given unless dynamic ($F = ma$) calculations are involved.

1.8. *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety concerns 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 its use.* For specific hazards and precautions, refer to Section 6.

2. REFERENCED DOCUMENTS

2.1. *AASHTO Standard*:

- R 13, Conducting Geotechnical Subsurface Investigations

2.2. *ASTM Standards*:

- D653, Standard Terminology Relating to Soil, Rock, and Contained Fluids
- D1143/D1143M, Standard Test Methods for Deep Foundations Under Static Axial Compressive Load
- D3689, Standard Test Methods for Deep Foundations Under Static Axial Tensile Load
- D3740, Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
- D5882, Standard Test Method for Low Strain Impact Integrity Testing of Deep Foundations
- D6026, Standard Practice for Using Significant Digits in Geotechnical Data
- D6760, Standard Test Method for Integrity Testing of Concrete Deep Foundations by Ultrasonic Crosshole Testing

3. TERMINOLOGY

3.1. Except as defined in Section 3.2, the terminology used in this test method conforms to ASTM D653.

3.2. *Descriptions of Terms Specific to This Standard*:

3.2.1. *force pulse*—for the purposes of this standard, a "force pulse" shall result in a force-time event similar to Figure 1. The applied force shall exceed the preload for a duration time of at least twelve times the test pile length (L) divided by the strain wave speed (c), or $12L/c$. The applied force shall also exceed 50 percent of the actual peak force for a minimum duration time of four times L/c. The force pulse shall increase smoothly and continuously to the peak force and then decrease smoothly and continuously. Typical force pulse durations range from 90 to 250 ms.

Note 1—A force pulse duration of less than $12L/c$ may be acceptable to the engineer when using supplemental transducers.

3.2.2. *preload*—the load applied to the pile head due to the static weight of the test apparatus prior to the test and may be negligible depending on the design of the test apparatus.

3.2.3. *strain wave speed (or wave speed)*—the speed with which a strain wave propagates through a pile. It is a property of the pile composition and is represented herein by c. For one-dimensional wave propagation, c is equal to the square root of elastic modulus divided by mass density: $c = (E/\rho)^{1}/_{2}$. Typical values of c are 4000 m/s for concrete piles and 5100 m/s for steel piles.

3.2.4. *target peak force*—a predetermined target value for the desired amplitude of the force pulse as defined by the project requirements. This value should typically exceed the sum of the required ultimate axial static capacity plus the dynamic resistance of the pile by an amount determined by the engineer based on factors including, but not limited to, pile type, soil type, structural strength of the pile, type of structural load, physical restrictions, or other project requirements.