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Standard Test Methods for Determining Consistency and Density of Roller-Compacted Concrete Using a Vibrating Table[1]

This standard is issued under the fixed designation C 1170; 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.

ε[1] NOTE—Section reference in paragraph 9.2.9 was editorially updated in December 1998.

1. Scope

1.1 These test methods are used to determine the consistency of concrete by the Vebe[2] consistometer apparatus and the density of the consolidated concrete specimen. These test methods are applicable to freshly mixed concrete, prepared in both the laboratory and the field, having a nominal maximum size aggregate of 50 mm (2 in.) or less. If the nominal maximum size of aggregate is larger than 50 mm (2 in.), the methods are applicable only when performed on the fraction passing the 50-mm (2-in.) sieve with the larger aggregate being removed in accordance with Practice C 172.

1.2 These test methods, intended for use in testing roller-compacted concrete, may be applicable to testing other types of concrete such as cement-treated aggregate and mixtures similar to soil-cement.

1.3 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information purposes only.

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. Referenced Documents

2.1 *ASTM Standards:*

C 29/C 29M Test Method for Unit Weight and Voids in Aggregate[3]

C 172 Practice for Sampling Freshly Mixed Concrete[3]

E 1 Specification for ASTM Thermometers[4]

E 11 Specification for Wire Cloth and Sieves for Testing Purposes[5]

2.2 *ACI Reports and Standards:*

207.5R-88 Report on Roller-Compacted Concrete[6]

211.3-75 (R 1988) Standard Practice for Selecting Proportions for No-Slump Concrete[6]

2.3 *Bureau of Reclamation Test Procedure:*

USBR 4905-86 Consistency and Density of No-Slump Concrete by Vibrating Table[7]

2.4 *British Standard:*

BS 1881: Part 104: 1983 Method for Determination of Vebe Time[8]

3. Summary of Test Method

3.1 The Vebe vibrating table is used to measure the consistency of stiff to extremely dry concrete mixtures (Note 1). Consistency is measured as the time required for a given mass of concrete to be consolidated by vibrating in a cylindrically shaped mold. Density of the compacted specimen is measured by determining the mass of the consolidated specimen and dividing by its volume, which is determined using water-displacement methods.

NOTE 1—Further description of concrete of this consistency is given in ACI 207.5R-88 and ACI 211.3-75 (R 1988).

3.2 Two procedures are provided:

3.2.1 *Test Method A* [using a 50-lb (22.7-kg) surcharge mass placed on top of the test specimen]—Test Method A shall be used for testing concrete of very stiff to extremely dry consistency in accordance with ACI 211.3-75 (R 1988).

[1] These test methods are under the jurisdiction of ASTM Committee C-9 on Concrete and Concrete Aggregatesand are the direct responsibility of Subcommittee C09.45on Roller-Compacted Concrete.

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[2] The Vebe vibrating table, including cylindrical mold and guide sleeves, is manufactured by SoilTest, 86 Albrecht Drive, P.O. Box 8004, Lake Bluff, IL 60044-9902.

[3] *Annual Book of ASTM Standards,* Vol 04.02.

[4] *Annual Book of ASTM Standards,* Vol 14.03.

[5] *Annual Book of ASTM Standards,* Vol 14.02.

[6] *ACI Manual of Concrete Practice, Part 1, Materials and General Properties of Concrete,* American Concrete Institute, P.O. Box 19150, Detroit, MI 48219, 1988.

[7] "Guidelines for Designing and Constructing Roller-Compacted Concrete Dams," *ACER Technical Memorandum No. 8,* Bureau of Reclamation, Denver, CO, Appendix A, 1987.

[8] *Testing Concrete,* British Standards Institute, 2 Park Street, London, England W1A 2BS.

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3.2.2 *Test Method B* (no surcharge)—Test Method B shall be used for concrete of stiff to very stiff consistency or when the Vebe time by Test Method A is less than 5 s.

4. Significance and Use

4.1 These test methods are intended to be used for determining the consistency and density of stiff to extremely dry concrete mixtures common when using roller-compacted concrete construction.

4.1.1 Because of the stiff to extremely dry consistency of some roller-compacted concrete mixtures, the standard Vebe test method[7] of rodding the specimen in a slump cone is substituted by Test Methods A and B. For Test Method A, the surcharge mass is increased from 6 lb (2.72 kg) to 50 lb (22.7 kg); and for Test Method B, the surcharge mass is eliminated.

4.2 Test Method A uses a 50-lb (22.7-kg) surcharge and is used for concrete consolidated by roller-compaction methods. The consistency and density of concrete suitable for consolidation by vibrating rollers can be determined using Test Method A.

4.3 Test Method B does not use a surcharge and can be used to determine the consistency and density of some concrete mixtures consolidated by conventional vibration techniques and some concrete mixtures consolidated by vibrating rollers.

5. Apparatus

5.1 *Vebe Vibrating Table*—A vibrating table with a ¾-in. (19-mm) thick steel deck with dimensions of approximately 15 in. (381 mm) in length, 10¼ in. (260 mm) in width, and 12 in. (305 mm) in height. The vibrating table shall be constructed in such a manner as to prevent flexing of the table during operation. The table deck shall be activated by an electromechanical vibrator. The total mass of the vibrator and table shall be approximately 210 lb (95 kg). The table shall be level and clamped to a concrete floor or base slab that has sufficient mass to prevent displacement of the apparatus during performance of the test (Note 2).

NOTE 2—The recommended vibrating table for these test methods is the Vebe vibrating table.[2] Testing to date has been performed using this apparatus. An alternative vibrating table may be substituted for the Vebe apparatus (Fig. 1) provided it meets the specifications for the sinusoidal vibration given in 7.1 and is in accordance with the alternative testing requirements of Sections 9 and 11.

5.2 *Cylindrical Mold*—The cylindrical mold shall be made of steel or other hard metal resistant to cement paste corrosion and shall have an inside diameter of 9 ½ ± 1/16 in. (241 ± 2 mm), a height of 7¾ ± 1/16 in. (197 ± 2 mm), and a wall thickness of ¼ ± 1/16 in. (6 ± 2 mm). The volume of the mold shall be determined to the nearest 0.001 ft^3 (0.028 L) in accordance with Test Method C 29/C 29M. The mold shall be equipped with permanently affixed slotted metal brackets so it can be rigidly clamped to the vibrating table. The top rim of the mold shall be smooth, plane, and parallel to the bottom of the mold and shall be capable of providing an air and watertight seal when the glass or plastic plate is placed on the top rim.

5.3 *Swivel Arm and Guide Sleeve*—A metal guide sleeve with a clamp assembly or other suitable holding device mounted on a swivel arm. The swivel arm and guide sleeve must be capable of holding the metal shaft with the attached

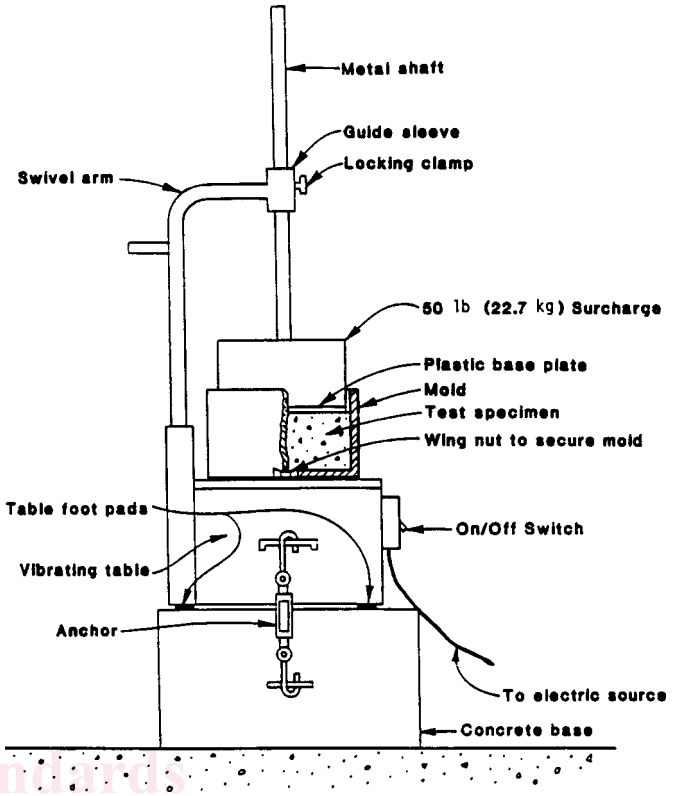

FIG. 1 Vibrating Table—Consistency Test (Test Method A)

50-lb (22.7-kg) cylindrical mass in a position perpendicular to the vibrating surface and allowing the shaft to slide freely when the clamp is released. The inside diameter of the guide sleeve shall be 1/8 by 1/16 in. (3.2 ± 1.6 mm) larger than the diameter of the metal shaft of the surcharge. The swivel arm must be capable of maintaining the guide sleeve in a locked position directly over the center of the vibrating surface. The swivel arm shall be capable of being rotated away from the center of the table (Note 3).

NOTE 3—The Vebe vibrating table comes equipped with the swivel arm and guide sleeve.

5.4 *Surcharge*—A cylindrical steel mass with a circular plastic plate attached to its base and a metal shaft at least 18 in. (457 mm) in length and ⅝ ± 1/16 in. (16 ± 2 mm) in diameter attached perpendicularly to the plate and embedded in the center of the mass. The shaft shall slide through the guide sleeve without binding. The plastic plate shall be approximately ½ in. (13 mm) in thickness and shall have a diameter of 9 ± 1/8 in. (229 ± 3 mm). The surcharge assembly shall have a mass of 50 ± 1 lb (22.7 ± 0.5 kg) including the mass of the plastic plate and the metal shaft.

5.5 *Balance or Scale*—Balance or scale of sufficient capacity to determine the total mass of the sample and the mold. The balance or scale shall be readable to the nearest 0.05 % of the concrete specimen mass.

5.6 *Flat Plate*—A plain, flat piece of plate glass or clear plastic, at least ½ in. (13 mm) thick and at least 1 in. (25 mm) larger than the diameter of the cylindrical mold.

5.7 *Sieve*—A 50-mm (2-in.) sieve conforming to Specification E 11.

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