Designation: C1176/C1176M – 13

Standard Practice for Making Roller-Compacted Concrete in Cylinder Molds Using a Vibrating Table[1]

This standard is issued under the fixed designation C1176/C1176M; 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 practice covers procedures for making cylindrical test specimens from concrete when the standard procedures of rodding and internal vibration, as described in Practice C31/C31M, are not practicable. This practice is applicable to freshly mixed concrete, prepared in the laboratory and the field, having a nominal maximum size aggregate of 50 mm [2 in.] or less. If the nominal maximum size aggregate is larger than 50 mm [2 in.], the practice is applicable only when performed on the fraction passing the 50-mm [2-in.] sieve with the larger aggregate being removed in accordance with Practice C172. This practice, 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.

1.2 Two methods are provided for making concrete cylinders using a vibrating table:

1.2.1 Method A is a procedure for making test specimens in steel reusable molds attached to a vibrating table.

1.2.2 Method B is a procedure for making test specimens in single-use plastic molds that have been inserted into a metal sleeve attached to a vibrating table.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with 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. Referenced Documents

2.1 *ASTM Standards:*[2]

C31/C31M Practice for Making and Curing Concrete Test Specimens in the Field

C39/C39M Test Method for Compressive Strength of Cylindrical Concrete Specimens

C172 Practice for Sampling Freshly Mixed Concrete

C192/C192M Practice for Making and Curing Concrete Test Specimens in the Laboratory

C470/C470M Specification for Molds for Forming Concrete Test Cylinders Vertically

C496/C496M Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens

C1170/C1170M Test Method for Determining Consistency and Density of Roller-Compacted Concrete Using a Vibrating Table

E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves

3. Summary of Practice

3.1 This practice describes methods for making cylindrical concrete test specimens using a vibrating table. Test specimens are made in cylindrical molds that are attached to the vibrating table under a 9-kg [20-lb] surcharge to facilitate consolidation.

4. Significance and Use

4.1 This practice is intended to be used for stiff to extremely dry concrete mixtures commonly used in roller-compacted concrete construction. This practice is used instead of rodding or internal vibration, which cannot properly consolidate concrete of this consistency (Note 1).

NOTE 1—Further description of this concrete consistency is given in ACI 207.5 Roller-Compacted Mass Concrete[3] and 211.3 Guide for Selecting Proportions for No-Slump Concrete[3]. The consistency of roller-compacted concrete may be determined in accordance with Test Method C1170/C1170M.

[1] This practice is under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.45 on Roller-Compacted Concrete.

Current edition approved Dec. 15, 2013. Published February 2014. Originally approved in 1991. Last previous edition approved in 2008 as C1176 – 08. DOI: 10.1520/C1176_C1176M-13.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] *ACI Manual of Concrete Practice, Part 1*, Materials and General Properties of Concrete, 2005, American Concrete Institute (ACI), P.O. Box 9094, Farmington Hills, MI 48333.

***A Summary of Changes section appears at the end of this standard**

5. Apparatus

5.1 *Molds:*

5.1.1 *Type A Mold*—A cylindrical mold conforming to the requirements of Specification C470/C470M for 150-mm [6-in.] diameter by 300-mm [12-in.] high reusable molds. Molds shall be made of steel or other hard metal not readily attacked by the cement paste. Aluminum molds shall not be used. Molds shall be equipped with permanently affixed metal slotted brackets on the baseplate so the molds can be rigidly clamped to a vibrating table. The top rim of the mold shall be smooth, plane, and parallel to the bottom of the mold. The bottom of the mold shall provide a watertight seal.

5.1.2 *Type B Mold*—A single-use plastic, cylindrical mold 150 mm [6 in.] in diameter and 300 mm [12 in.] in height. The mold specifications shall conform to Specification C470/C470M for single-use plastic molds.

5.1.2.1 *Mold Sleeve*—A Type B cylindrical mold shall be inserted into a rigid cylindrical sleeve with a bottom baseplate that is clamped to the vibrating table. The mold sleeve shall be made of steel or other hard metal that does not react with concrete containing portland or other hydraulic cement. The sleeve shall hold firmly the plastic mold without deforming it so that it is vertical and shall be slotted vertically with adjustable clamps for tightening around the mold. The sleeve shall be hinged so that it can be opened to remove the mold (Fig. 1) and shall also have permanently affixed slotted metal brackets so the sleeve may be rigidly clamped to the vibrating table. The mold sleeve shall have a minimum wall thickness of 3 mm [⅛ in.], and a minimum baseplate thickness of 6 mm [¼ in.]. The inside diameter of the mold sleeve shall be 3 ± 1.5 mm [⅛ ± 1/16 in.] larger than the outside diameter of the Type B mold and have a height 6 to 13 mm [¼ to ½ in.] less than the height of the Type B mold.

5.2 *Vebe Table*—A vibrating table with a 20-mm [¾-in.] thick steel deck with dimensions of approximately 380 mm [15 in.] in length, 250 mm [10 in.] in width, and 300 mm [12 in.] 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 90 kg [200 lb]. 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 specimen preparation (Note 2).

NOTE 2—The recommended vibrating table for these procedures is the Vebe table. Testing to date has been performed using this apparatus. An alternative vibrating table may be substituted for the Vebe apparatus provided it meets the specifications for the sinusoidal vibration given in 7.1.

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 a metal shaft attached to a 9-kg [20-lb] cylindrical mass in a position perpendicular to the vibrating surface and allowing the shaft to slide freely when the clamp is released. The swivel arm must be capable of maintaining the guide sleeve in a locked position directly over the center of the specimens to be vibrated. The swivel arm shall also 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 metal shaft at least 460 mm [18 in.] in length and 16 ± 2 mm [⅝ ± 1/16 in.] in diameter attached perpendicularly to and embedded in the center of the mass. The shaft shall slide through the guide sleeve without binding. The surcharge shall have a diameter of 145 ± 3 mm [5¾ ± ⅛ in.]. The surcharge assembly shall have a mass of 9.0 ± 0.25 kg [20 ± 0.5 lb] including the mass of the metal shaft (Fig. 1). If the surcharge is to be hand held, the length of the shaft may be reduced to about 300 mm [12 in.] and fabricated with a "T" or "D" handle for gripping the surcharge shaft to avoid slipping.

5.5 *Sieve*—A 50-mm [2-in.] sieve conforming to Specification E11.

5.6 *Small Tools*—Trowels, square-ended shovel and hand scoops, steel trowel, wooden float, wrench, tamping rod, and flashlight as required.

6. Sampling

6.1 Samples of fresh concrete shall be obtained in accordance with Practice C172.

6.2 Concrete samples shall have a nominal maximum size aggregate of 50 mm [2 in.] or less. If the concrete has aggregate larger than 50 mm [2 in.], samples shall be obtained by wet sieving over a 50-mm [2-in.] sieve in accordance with Practice C172.

6.3 Concrete test specimens shall be made within 45 min after the completion of mixing concrete unless otherwise stipulated.

7. Calibration and Standardization

7.1 The vibrating table shall produce a sinusoidal vibratory motion with a frequency of at least 60 ± 2 Hz [3600 ± 100 vibrations per min] and a double amplitude of vibration of 0.43 ± 0.008 mm [0.0170 ± 0.0030 in.] when a 27.0 ± 1.0-kg [60.0 ± 2.5-lb] surcharge is rigidly bolted to the center of the table.

7.1.1 Determine the frequency and double amplitude[4] of the vibrating table under simulated test conditions prior to initial use and annually thereafter. A vibrating reed tachometer should be used to check the frequency of vibration.

7.2 Recalibrate the vibrating table after any event (including repairs) that might affect its operation, or whenever test results are questionable.

8. Technical Precautions

8.1 When obtaining samples, ensure that the samples are representative of the material being sampled.

[4] Kaufman, L.P., Strickland, E.A., and Benavidez, A.A. "Suggested Method for the Calibration of Vibrating Tables for Maximum Index Density Testing," *Geotechnical Testing Journal*, GTJODJ, Vol 2, No. 3, September 1979, pp. 152–157.

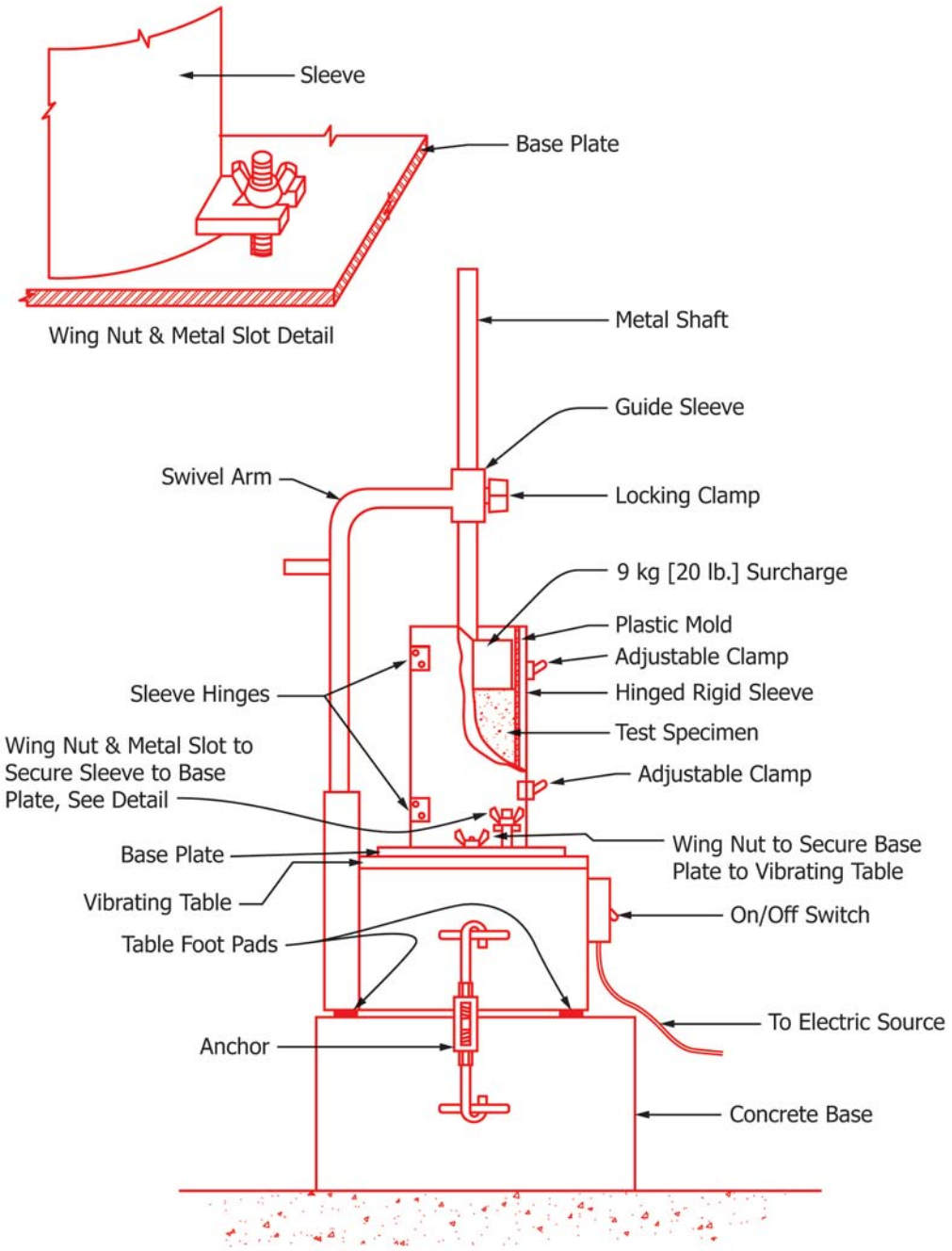

FIG. 1 Vibrating Table—Cylinder Preparation (Type B Mold)

8.2 Concrete with stiff to extremely dry consistency is highly susceptible to segregation during handling. To minimize segregation, use care in obtaining samples and during transporting, remixing, and testing of the concrete.

8.3 After at least every three months of continued use, inspect and clean the underside of the vibrating table top of any hardened concrete or cement paste which may interfere with free movement of the table top.

9. Procedure

9.1 *Method A—Type A Molds:*

9.1.1 Coat Type A molds with a suitable lubricant or bond breaker prior to casting the test specimens to facilitate removal from the mold.

9.1.2 Place the mold on the vibrating table, and center the surcharge so that the edges of the plastic plate do not touch the walls of the mold. Lower the surcharge into the mold to check for proper clearance. Attach the mold to the vibrating table, and firmly tighten the wing nuts. Move the surcharge away from the mold.

9.1.3 Place enough concrete in the mold so that the mold will be filled to one-third of its volume after consolidation

(approximately 4.5 kg [9.5 lb]). A tamping rod may be used to distribute the loose concrete as it is added. During filling, use square-ended shovels and scoops to obtain representative samples, and handle the concrete in such a manner that larger sized coarse aggregate particles do not separate from the mortar.

9.1.4 Move the surcharge over the center of the mold, release the guide sleeve clamp, and place the surcharge gently on the loose concrete. The surcharge shall be able to vertically slide free without binding on the guide sleeve.

9.1.5 If the surcharge cannot be centered in the mold without binding on the inside wall of the mold, place the surcharge directly onto the specimen in the mold without use of the guide sleeve, and hold the surcharge shaft perpendicular to the top of the table. Hold the surcharge shaft manually while vibrating the specimen. Do not apply any additional hand pressure to the surcharge when manually holding the surcharge.

9.1.6 Start the vibrator table, and allow the concrete to consolidate under the surcharge. Using a flashlight, observe the concrete in the annular space between the edge of the surcharge and the inside wall of the mold. As the concrete consolidates, mortar will fill in the annular space between the outer edge of the surcharge and the inside mold wall. Observe the mortar until it forms a ring around the total perimeter of the surcharge. When the mortar ring forms completely around the surcharge, stop the vibrator. If the wing nuts loosen while casting the specimen, retighten the wing nuts, then continue vibrating to ensure complete consolidation of the specimen.

9.1.7 If a rock pocket prevents the mortar ring from forming at one small location, even though it has formed in all other locations, the vibrator can be stopped and another layer of concrete added. If a significant portion of the mortar ring does not form, this indicates the concrete may have insufficient mortar due to either improper sampling, segregation, or improper mixture proportioning. In these instances, the concrete specimen should be visually inspected after stripping from the mold, and a decision then made whether to accept or reject the specimen.

9.1.8 Repeat the procedure in 9.1.3 through 9.1.7 for the second lift of concrete, filling the mold to approximately two-thirds of its volume. For the third lift, overfill the mold by mounding the concrete above the top of the mold. Again, place the surcharge on the loose concrete and consolidate. If the surcharge consolidates concrete below the top level of the mold, turn off the vibrating table. Place additional concrete in the mold so that, when consolidated, the concrete will be about 3 mm [⅛ in.] above the top of the mold. Continue vibrating, and slide the surcharge back and forth across the top of the mold until the compacted concrete is level with the top of the mold. This replaces strikeoff with a float since stiff concrete cannot be easily floated. Do not allow the surcharge to remain in one position when the concrete is being finished because this can cause aggregates to be forced down and mortar to be forced out of the mold resulting in a nonrepresentative test specimen. After the surface has been screeded with the surcharge, vibrate the specimen for 4 ± 1 s without the surcharge to fill in minor surface tears unless damage to the specimen by large-amplitude oscillations of the vibrator is anticipated.

9.1.8.1 When making test specimens using an alternative vibrating table, it may not be possible to vibrate the specimen without a surcharge. This is due to the disturbance of the compacted specimen when large-amplitude, low-frequency oscillations occur after the vibrator has been turned off. If this occurs, keep the surcharge in place until the vibrating table has completely stopped.

9.1.9 Remove the mold with the consolidated specimen from the vibrating table, and finish the top surface of the specimen with a steel trowel or wooden float. Avoid dislodging aggregate particles from the surface when using a wooden float.

9.2 *Method B—Type B Molds:*

Make concrete test specimens in Type B molds in accordance with 9.1. Prior to making test specimens, insert a Type B mold into the metal sleeve ensuring a close fit but not deforming the plastic mold. A sleeve assembly made from an existing steel cylindrical mold is shown in Fig. 1. Rigidly clamp the entire assembly to the vibrating table, and make the test specimen in accordance with procedures in 9.1.2 through 9.1.9.

10. Curing

10.1 Unless otherwise specified, all specimens shall be cured in accordance with the sections on curing in Practice C192/C192M or Practice C31/C31M, whichever is applicable. Specimens tested for compressive strength and splitting tensile strength shall be in accordance with Test Method C39/C39M and Test Method C496/C496M, respectively.

11. Keywords

11.1 concrete; cylinder preparation; roller-compacted concrete

SUMMARY OF CHANGES

Committee C09 has identified the location of selected changes to this practice since the last issue, C1176 – 08, that may impact the use of this practice. (Approved December 15, 2013.)

(1) Revised 5.1.2.1 to clarify description of metal sleeve.
(2) Revised 5.2 and 7.1 to coincide with description of Vebe table presented in ASTM C1170/C1170M.
(3) Revised Fig. 1 to show a more detailed insert view of securing the metal sleeve to the base plate.