Designation: C1245/C1245M – 12

Standard Test Method for Determining Relative Bond Strength Between Hardened Roller Compacted Concrete Lifts (Point Load Test)[1]

This standard is issued under the fixed designation C1245/C1245M; 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 is intended for testing roller-compacted concrete specimens and covers determination of the relative bond between layers of roller-compacted concrete or other hardened concrete in multiple-lift forms of construction. It is applicable to all types of layered roller-compacted concrete where the total depth is sufficient to meet the minimum specimen length and diameter requirements of this test method. This test method is not intended to provide tensile strength results of the material tested.

1.2 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.

1.3 The text of this standard references notes and footnotes, which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of this 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]

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

C42/C42M Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

C125 Terminology Relating to Concrete and Concrete Aggregates

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

C670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials

C1176/C1176M Practice for Making Roller-Compacted Concrete in Cylinder Molds Using a Vibrating Table

C1435/C1435M Practice for Molding Roller-Compacted Concrete in Cylinder Molds Using a Vibrating Hammer

D1557 Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3))

3. Terminology

3.1 Refer to Terminology C125 for definitions of terms used in this test method.

4. Significance and Use

4.1 This test method is used to measure the relative bond strength of roller-compacted concrete to other roller-compacted concrete by using a point load test at the joint (see Note 1). Relative bond strength is determined using drilled cores or cast cylindrical specimens in which the bond surface is essentially normal to the longitudinal axis at approximately the mid-length of the specimen. A splitting tensile stress normal to the bond surface is produced by applying a point load at the joint.

4.2 The test results in a value that can be compared to that obtained by testing other specimens which are made from the same materials and by the same process. Results can be used for the purpose of comparing the relative bond strength of various joint conditions, joint treatments, or bonding materials applied to the joint.

4.3 The test results are not to be taken as a true bond strength. Values of cohesion or tensile strength shall be determined by methods other than this test method.

4.4 This test method may be used either for laboratory investigation by casting individual composite cylinders or by coring prototype structures or assemblies (Test Method C42/C42M).

NOTE 1—This test may be used for testing the relative bond of other

[1] This test method 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.

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[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.

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

hardened hydraulic cement-based materials other than RCC.

5. Apparatus

5.1 *Testing Machine*—The testing machine shall conform to the requirements of Test Method C39/C39M.

5.2 *Testing Apparatus*—The testing apparatus shall be constructed of steel and allow the testing of both 100 and 150-mm [4 and 6-in.] diameter specimens. The test schematic is given in Fig. 1. The testing apparatus shall permit the positioning of a specimen such that the joint of the bonded surfaces is oriented as closely as possible parallel to the direction of loading. Figs. 2-5 provide the information necessary to construct the apparatus for 100 and 150-mm [4 and 6-in.] diameter specimens. Anvil rods (Fig. 2 and Fig. 3) shall have a hardness of not less than 55 HRC (Rockwell hardness number of 55 on the C scale) and shall be plane on the bearing surfaces to within ±0.025 mm [0.001 in.]. The alignment post shall ensure that the anvil rods are kept parallel to each other in the vertical plane. The system is easily adaptable to most testing machines.

6. Test Specimens

6.1 Test specimens shall be cast cylinders or cores. Cylinders shall be cast in accordance with Practice C1176/C1176M, Practice C1435/C1435M, or Test Method D1557 and be 100 or 150 mm [4 or 6 in.] in diameter. Cores shall be obtained in accordance with Practice C42/C42M and be 100 or 150 mm [4 or 6 in] in diameter. Cut specimen to ensure that the plane best describing the bond surface is oriented at 90 ± 15° to the long axes of the specimens.

6.2 Cure molded test specimens in accordance with Practice C192/C192M (laboratory specimens). Drilled cores shall be moisture conditioned in accordance with Test Method C42/C42M.

NOTE 2—Test results are not affected significantly by specimen surfaces

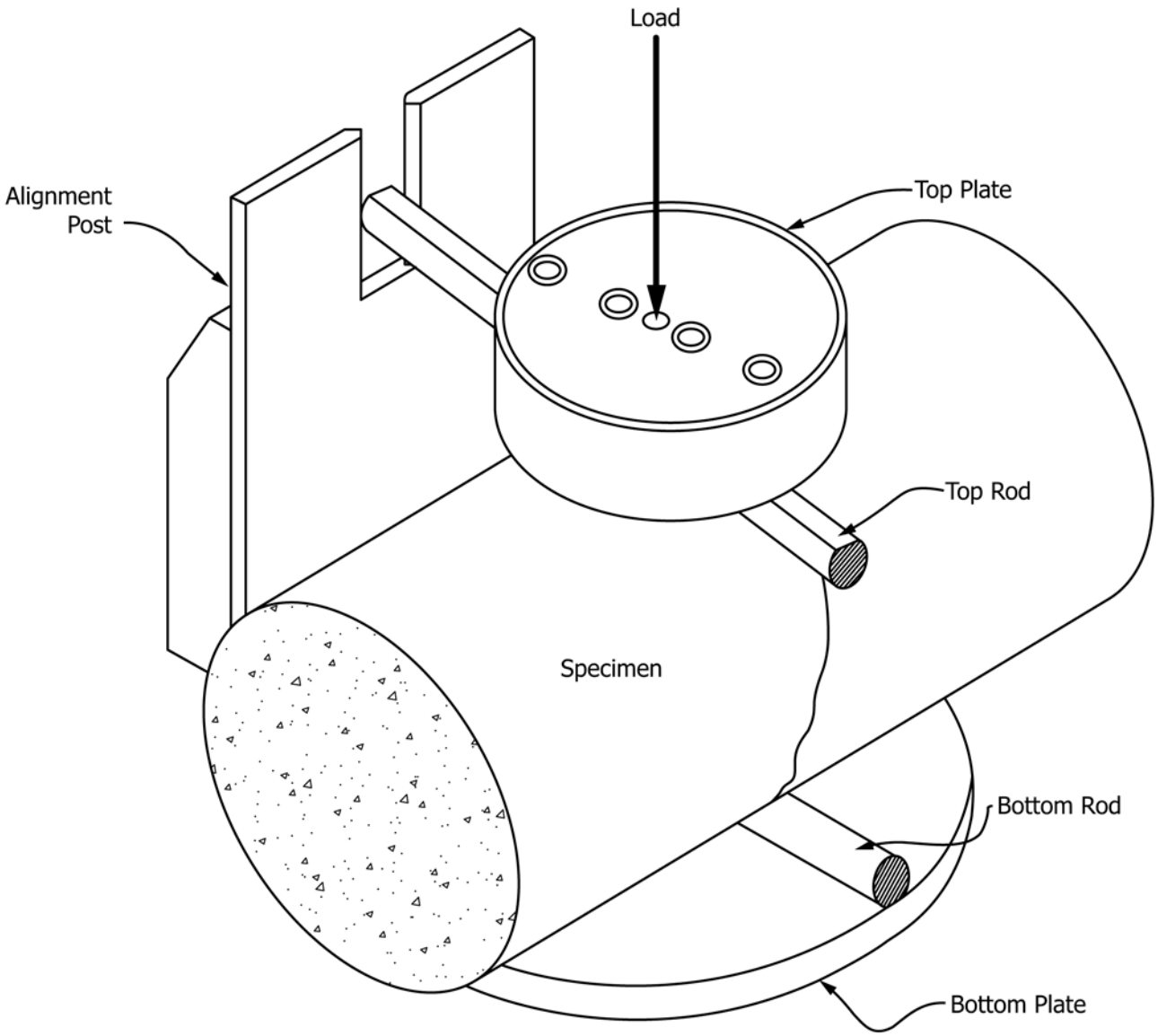
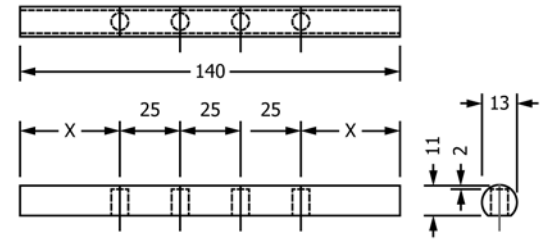
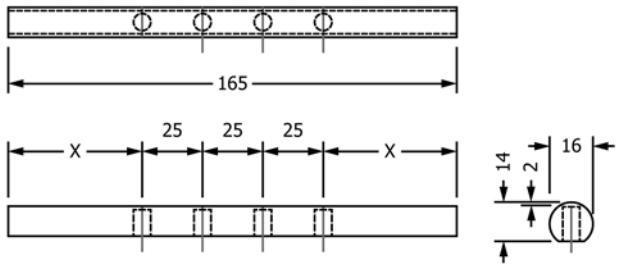


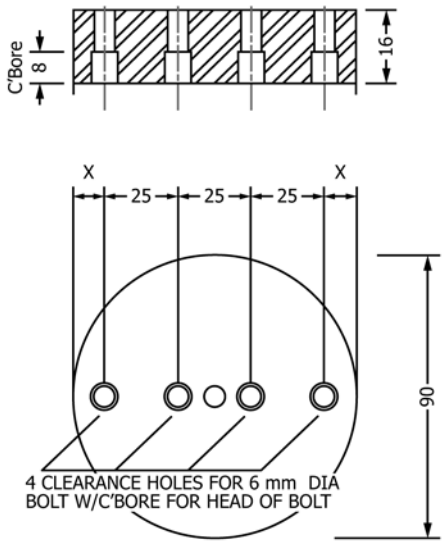
FIG. 1 Schematic of Loading Method



Rod for 100 mm Diameter Specimens



Rod for 150 mm Diameter Specimens



NOTE 1—Dimensions are shown in mm, refer to Table 1 for values in inches.

NOTE 2—x = $\frac{(L-75)}{2}$, where L is the length of the anvil rod or diameter of the top plate.

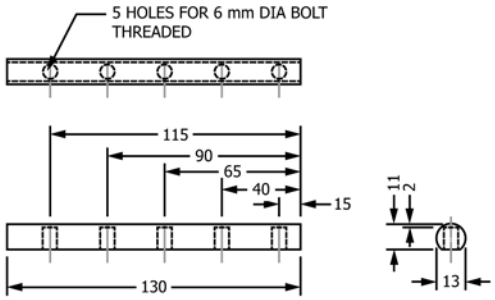
FIG. 2 Top Plate and Anvil Rod

obtained with normal coring operations. The ends of cores need not be trimmed.

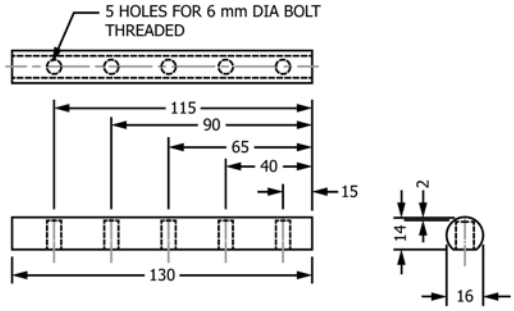
NOTE 3—Where the bond surface undulates grossly, that is, the surface has a local texture exceeding 15 mm [0.5 in.] in amplitude, 150-mm [6-in.] diameter cores are preferable. No information is available on the relative results of 150-mm [6-in.] versus 100-mm [4-in.] diameter specimens.

7. Procedure

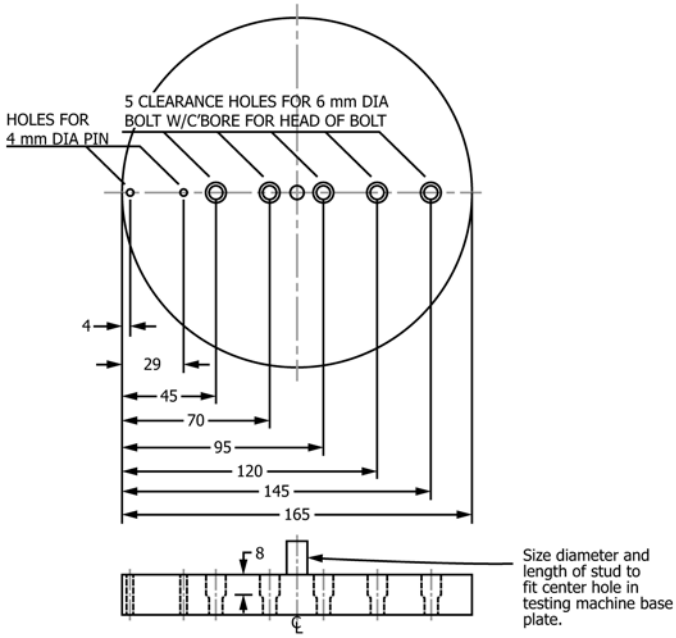
7.1 *Measurements*—Determine the diameter of the test specimens by averaging three diameters measured on the bond surface. Visually identify the bond surface by color, texture, or



ROD for 100 mm Diameter Specimens



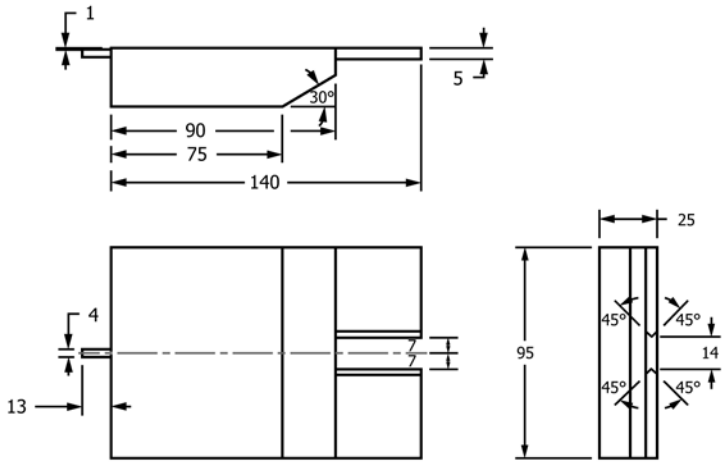
Rod for 150 mm Diameter Specimens

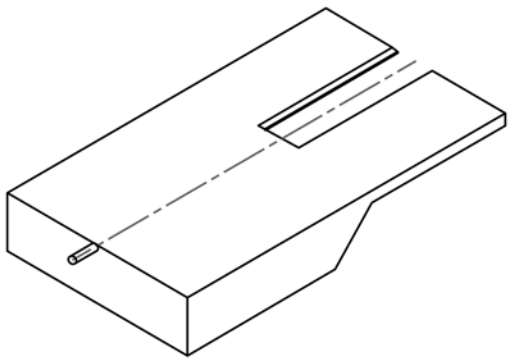


NOTE 1—Dimensions are shown in mm, refer to Table 1 for values in inches.

FIG. 3 Base Plate and Anvil Rod

material contrasts. Measure diameters to the nearest 2.5 mm [0.1 in.]. Determine the length of each section of the bonded specimens to the nearest 2.5 mm [0.1 in.], and use these lengths to determine the section length-to-diameter ratios. Specimens must have a minimum length-to-diameter ratio of 1.2 if the bond plane is at mid-length (within ±5 mm [0.25 in.]) of the specimen. If the bond plane is not at mid-length of the specimen, the section on each side of the bond plane shall be





NOTE 1—Dimensions are shown in mm, refer to Table 1 for values in inches.

FIG. 4 Alignment Post for 100 mm [4 in] Diameter Specimens

of a length at least 0.6 the diameter. Where the bond surface is irregular or undulating, mark on the specimen a line representing a plane extending through and along the approximate average bearing of the bond surface, and measure the length from this line.

7.2 *Positioning*—Assemble and position the apparatus in the testing machine. Place the specimen on the bottom plate with the joint in contact with the anvil rods (see Fig. 1). The longer anvil rods (Fig. 2 and Fig. 3) and the longer alignment post (Fig. 5) are used to test 150-mm [6-in.] diameter specimens. The shorter anvil rods (Fig. 2 and Fig. 3) and the shorter alignment post (Fig. 4) are used to test 100-mm [4-in.] diameter specimens.

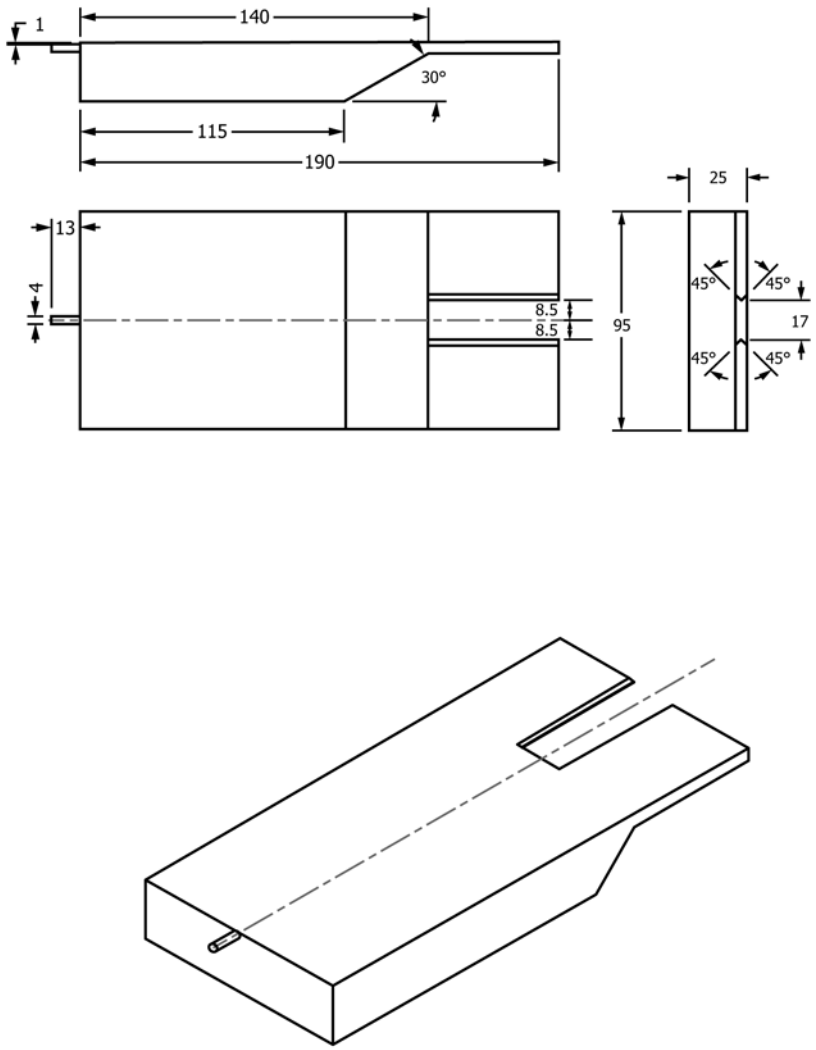
7.2.1 Zero the load-indicating mechanism. Position the specimen so that the bond surface is parallel to the upper and lower anvil rods (see Fig. 1). This is best accomplished by positioning the specimen by hand while gently bringing the top anvil into contact with the specimen. Alternatively, the specimen may be supported with modeling clay or pieces of polystyrene. Where the bond surface is irregular or undulating, align the anvil rods along the approximate average bearing of the bond surface. Bring the anvil rods in contact with the bond surface at the contact point on the circumference of the specimen.

7.3 *Loading*—Do not preload the specimen. Apply the load at a uniform rate within the range of 1 to 1.4 MPa/min [150 to 200 psi/min] until the specimen fails. Record the maximum load applied.

8. Calculation

8.1 Calculate the relative bond strength as follows:

$$f_{tb} = \frac{P}{D^2}$$



NOTE 1—Dimensions are shown in mm, refer to Table 1 for values in inches.

FIG. 5 Alignment Post for 150 mm [6 in] Diameter Specimens

where:

f_{tb} = relative bond strength, MPa [psi],
P = maximum applied load, N [lbf], and
D = average specimen diameter at bond surface, mm [in.].

9. Report

9.1 Report the following information:

9.1.1 Date of testing.

9.1.2 Specimen identification and if cored, the location of the core.

9.1.3 Details of the materials comprising the specimens, such as the following:

9.1.3.1 Mixture proportions of the concretes and mortars;

9.1.3.2 Details of fabrication including the practice or test method used to cast or mold cylinders;

9.1.3.3 Details of bonding techniques;

9.1.3.4 Age, when tested;

9.1.3.5 Specimen size including diameter and length of each layer material and whether a cast cylinder or drilled core was used; and

9.1.3.6 Any other information necessary to describe the production or features of the specimens.

9.1.4 Record of curing and moisture condition of the specimens at the time of test.

9.1.5 Any special treatment or prior testing performed on the specimens.

9.1.6 Relative bond strength to the nearest 0.1 MPa [10 psi].

9.1.7 Mode of failure:

9.1.7.1 Whether bond failure or aggregate failure, or both, were observed in the plane of failure;

9.1.7.2 Should the fracture occur along the original bond surface, the nature of the surface such as texture (smooth or rough), appearance (glossy or dull, undulating or flat), and detailed descriptions of discoloration, foreign objects or materials, loose or dusty material in voids, and the suspected presence and condition, or absence, of any bonding improvement agent;

9.1.7.3 Alternatively, should the plane of fracture occur partially or totally within the concrete layers adjacent to the bond surface, the percentage of the total area subjected to this

type of failure versus the percentage area where failure occurred at the bond surface; and

9.1.7.4 Any unexpected features.

10. Precision and Bias

10.1 *Precision*—Precision of this test method was calculated from results published in Saucier,[3] which compared bond strength of bonded and unbonded concrete for five mixtures of varying proportions. These data only represent within laboratory data for a single laboratory. A report of this analysis is on file at ASTM International Headquarters, as Research Report RR:C09-1025.[4]

10.1.1 The single-laboratory single-batch standard deviation for relative bond strength of unbonded concrete cores has been found to be 0.16 MPa [23 psi].[5] Therefore, results of tests on two cores taken from the same batch of concrete are not expected to differ more than 0.44 MPa [64 psi].[5]

10.1.2 The single-laboratory single-batch standard deviation for relative bond strength of cores obtained from a layered specimen has been found to be 0.26 MPa [38 psi].[5] Therefore, results of tests on two cores taken from the same batch of concrete are not expected to differ more than 0.73 MPa [106 psi].[5]

10.2 *Bias*—This test method has no bias because there is no standard material on which to estimate this property.

11. Keywords

11.1 bond strength; bonding agents; concrete bonding; roller-compacted concretes

TABLE 1 Inch-Pound Equivalents for Figs. 2-5

mm	in.
1	0.039
2	0.079
4	0.157
6	0.236
8	0.315
11	0.433
13	0.512
14	0.551
15	0.591
16	0.630
17	0.669
25	0.984
29	1.142
40	1.575
45	1.772
65	2.559
70	2.756
75	2.953
90	3.543
95	3.740
100	3.937
115	4.528
120	4.724
130	5.118
140	5.512
145	5.709
150	5.906
165	6.496

[3] Saucier, K. L. "No-Slump Roller Compacted Concrete (RCC) for Use in Mass Concrete Construction," Technical Report SL-84-17, U.S. Army Research and Development Center, 3909 Halls Ferry Rd., Vicksburg, MS 39180, 1984.

[4] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:C09-1025. Contact ASTM Customer Service at service@astm.org.

[5] These numbers represent, respectively, the (ls) and (d2s) limits as described in Practice C670.

SUMMARY OF CHANGES

Committee C09 has identified the location of selected changes to this test method since the last issue, C1245/C1245M – 11, that may impact the use of this test method. (Approved April 1, 2012.)

(1) The word "relative" was added to the title and to several locations throughout the standard to emphasize that the test results are in "relative bond strength" as opposed to true bond strength.

(2) "Other hardened cementitious mixtures" was deleted from the title and from the Significance and Use section to clarify that the purpose of the test is for testing relative bond between layers of RCC. Statements were added to the Significance and Use section to emphasize that the values of true bond strength are not obtained by this test method and that values of tensile strength and cohesion shall be obtained by methods other than this test method.

(3) A note was added to the Significance and Use section stating the test may be used for testing the relative bond of hardened hydraulic cement-based materials other than RCC.

Committee C09 has identified the location of selected changes to this test method since the last issue, C1245/C1245M – 06, that may impact the use of this test method. (Approved April 1, 2011.)

(1) Reordered all units so that SI units appear first.

(2) Replaced old Figures 2–9 with new Figs. 2-5.

(3) Replaced old Table 1 with new Table 1 showing rationalized units with SI units listed first.