Designation: C1747/C1747M – 13

Standard Test Method for Determining Potential Resistance to Degradation of Pervious Concrete by Impact and Abrasion[1]

This standard is issued under the fixed designation C1747/C1747M; 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 determining the potential resistance to degradation of pervious concrete by measuring the mass loss of specimens subjected to combined action of impact and abrasion in a rotating steel drum.

1.2 *Units*—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 nonconformance with the standard.

1.3 The text of this test method references notes and footnotes that provide explanatory information. These notes and footnotes (excluding those in tables) shall not be considered as requirements of this test method.

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.*(**Warning**—Fresh hydraulic cementitious mixtures are caustic and may cause chemical burns to skin and tissue upon prolonged use.[2])

2. Referenced Documents

2.1 *ASTM Standards:*[3]

C125 Terminology Relating to Concrete and Concrete Aggregates

C131 Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

C136 Test Method for Sieve Analysis of Fine and Coarse Aggregates

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

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

C1688/C1688M Test Method for Density and Void Content of Freshly Mixed Pervious Concrete

D6926 Practice for Preparation of Bituminous Specimens Using Marshall Apparatus

E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this test method, refer to Terminology C125.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *design density, n*—the mass of a unit volume of pervious concrete based on the theoretical mixture proportions and void content and where the unit volume includes the volume of the solids and the voids.

3.2.2 *raveling, n*—the wearing away of a pavement surface due to dislodgement of aggregate particles.

4. Summary of Test Method

4.1 This test method consists of casting cylindrical specimens of pervious concrete at the design density, then subjecting the cured specimens to a combination of actions including impact, abrasion or attrition, and grinding in a rotating steel drum. The potential resistance to degradation by impact and abrasion is expressed as the percentage mass loss after 500 revolutions of the steel drum. Higher potential resistance to degradation by impact and abrasion is associated with lower mass loss.

5. Significance and Use

5.1 This test method provides a procedure for evaluating the potential resistance to degradation by impact and abrasion of

[1] This test method is under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.49 on Pervious Concrete.

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[2] See Section on Safety Precautions, Manual of Aggregate and Concrete Testing, *Annual Book of ASTM Standards*, Vol. 04.02.

[3] 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**

pervious concrete mixtures. A common failure mode of pervious concrete pavements is raveling. This test allows the comparison of the relative potential resistance to raveling of pervious concrete mixtures of varying proportions and raw materials. In addition, in the field, raveling is caused by improper paste consistency, workability loss, inadequate compaction, and improper curing—this test method does not address any of these causes. There is no known correlation between this test method and the field performance of pervious concrete.

5.1.1 This information may be used to compare proposed mixture proportions, yet to be placed, but is not intended to be used for mixture qualification or jobsite acceptance testing.

5.1.2 This test method is applicable to pervious concrete mixtures containing coarse aggregate with a nominal maximum size of 25 mm [1 in.] or smaller.

5.1.3 This test method is only applicable to cylindrical specimens cast as described herein. The precision and bias have not been evaluated for drilled cores.

6. Apparatus

6.1 *Balance*—A balance or scale accurate to 1 g [0.002 lb] at any point and capable of weighing up to 2.5 kg [5 lb].

6.2 *Marshall Hammer*—A device used to compact the pervious concrete specimen that shall conform to the requirements for a manual compaction hammer in Practice D6926.

6.3 *Cylinder Molds*—Molds for casting concrete test specimens shall be plastic and conform to the requirements of Specification C470/C470M. Cylinder molds shall be 100 mm [4 in.] in diameter and 200 mm [8 in.] tall.

6.4 *Measuring Device*—A ruler, metal roll-up measuring tape, or similar rigid or semi-rigid length-measuring instrument marked in increments of 1 mm [1⁄16 in.] or smaller. The instrument length shall be at least 300 mm [12 in.].

6.5 *Los Angeles Machine*—A Los Angeles machine, conforming to Section 6 of Test Method C131.

6.6 *Sieves*—The sieve cloth and standard sieve frames shall conform to the requirements of Specification E11. Nonstandard sieve frames shall conform to the requirements of Specification E11 as applicable.

6.7 *Hand Tools*—Scoop or spoon of a size large enough so each amount of pervious concrete obtained from the sampling receptacle is representative and small enough so that the concrete is not spilled during placement in the cylinder mold.

7. Sample

7.1 For concrete delivered in a transportation unit, obtain the sample of freshly-mixed pervious concrete in accordance with Practice C172 (See Note 1).

7.1.1 Start molding the specimens within 5 min after obtaining the final portion of the composite sample.

NOTE 1—This option is applicable when trial batches are conducted in a ready mixed concrete truck.

7.2 For laboratory testing, obtain the sample of freshly mixed pervious concrete in accordance with Practice C192/C192M.

7.2.1 Start molding the specimens within 5 min after obtaining the sample.

7.3 *Density*—Determine and record the density of the fresh pervious concrete in accordance with Test Method C1688/C1688M.

8. Test Sample Preparation

8.1 *Place of Molding*—Mold specimens promptly on a level, rigid surface, free of vibration and other disturbances, at a place as near as practicable to the location where they are to be stored.

8.2 *Specimen Preparation*—Calculate to the nearest 1 g [0.001 lb] the mass of pervious concrete required to fill the mold to a height of 100 mm [4 in.] at the design density (See Note 2). Place the balance on a flat, level surface free from vibration. Place the cylinder mold on the balance and tare the mass of the empty mold. Place fresh concrete in the mold in as few scoops as practicable. Adjust concrete mass to within ± 5g [± 0.01 lb] of the calculated fresh mass using a scoop or spoon. Move the cylinders to the place of molding. Drop the mold from a height of 25 ± 12 mm [1 ± 0.5 in.] ten times onto the level, rigid surface. Use the Marshall hammer to consolidate the first specimen to a specified height of 100 ± 2 mm [4 ± 1⁄16 in.]. For a stiff mixture, drop the hammer mass from the full height for each blow while holding the axis of the compaction hammer as nearly perpendicular as possible to the base of the cylinder mold. For a highly workable mixture, use one-half to one-third of the full drop height as is applicable. Use the measuring device to determine the height of the compacted specimen after each blow. Provide additional hammer blows as needed to achieve the specified height. If a specimen is over-compacted, discard the concrete and mold a new specimen. If full blows are used, record the number of Marshall hammer blows necessary to compact the first specimen to the specified height and use that number of blows for the remaining specimens in the set. If less than full blows are used, each specimen must be checked with the measuring device to ensure the specified height is attained. Upon completion of molding, place tight fitting caps or bags on the open end of the cylinder molds to prevent moisture loss during curing. Three specimens shall be prepared to provide a single test result. Specimens shall be allowed to set in an upright position.

NOTE 2—The volume of a 100 by 100 mm [4 by 4 in.] specimen is 0.0007854 m^3 [0.001077 yd^3] so, by multiplying the sum of the batch weights for a cubic meter [yard] of the theoretical mixture proportions by this number, the operator can calculate the mass of fresh concrete required for each specimen.

8.3 *Storage*—If specimens cannot be molded at the place where they will receive initial curing, immediately after compaction move the specimens to an initial curing place for storage. The supporting surface on which specimens are stored shall be level to within 20 mm per m [¼ in. per ft].

8.4 *Initial Curing*—Immediately after molding, the specimens shall be stored for a period up to 48 h in a temperature range from 16 and 27 °C [60 and 80 °F] and in an environment preventing moisture loss from the specimens. Shield all specimens from direct sunlight and, if used, radiant heating devices. The storage temperature shall be controlled by use of heating

and cooling devices, as necessary. Record the air temperature adjacent to the specimens using a maximum-minimum thermometer. Specimens shall not be transported until at least 24 h after casting.

8.5 *Final Curing*—Upon completing of initial curing, cure specimens at a temperature of 23 ± 2 °C [73.5 ± 3.5 °F] for 7.00 ± 0.25 days measured from the time of molding. Final curing shall be completed without removing the cylinder molds, bags, or caps.

8.6 *Identification*—Mark the specimens to positively identify them and the concrete they represent. Do not mark the removable caps or bags.

9. Procedure

9.1 Upon completion of curing, remove the molds, wipe the specimens dry of any free moisture, and place the three specimens used to provide a single test result on the balance. Record the mass of the three specimens as the original mass.

9.2 Within 30 min after removing the molds, place the three specimens in the Los Angeles machine so that no edges are chipped in the process. Do not charge the machine with steel spheres. Rotate the machine at 30 to 33 r/min for 500 revolutions.

9.3 After 500 revolutions, discharge the material from the machine and hand sieve the material on a 25-mm (1-in.) sieve. Rotate the particles, if necessary, in order to determine whether they will pass through the sieve opening; however, do not force particles to pass. Record the final mass as that material retained on the 25-mm (1-in.) sieve.

10. Calculation

10.1 Calculate the mass loss as the difference between the original mass of the three specimens and the final mass retained on the sieve.

10.2 Divide the mass loss by the original mass of the three specimens and multiply by 100.

10.3 Record the mass loss as a percentage of the original mass to the nearest 1 %.

11. Report

11.1 Report the following information:

11.1.1 Identification of the mixture,

11.1.2 Number of blows necessary for compaction,

11.1.3 Maximum and minimum temperature for initial curing,

11.1.4 Original mass and final mass of the three specimens,

11.1.5 Mass loss of the specimens expressed to the nearest 1 % by mass, and

11.1.6 The density and void content of the mixture, as proportioned and as measured by Test Method C1688/C1688M.

12. Precision and Bias

12.1 The precision of this test method is based on an inter-laboratory study, RR:C09-1041,[4] conducted in 2010.

NOTE 3—Repeatability testing was performed by seven laboratories using pervious concrete mixtures proportioned using local materials. Each laboratory prepared three batches (designed at void contents of 18, 20, and 22 % respectively) and performed three replicate tests per batch (a test includes three individual specimens). Five of the laboratories had 2 different technicians performing the test. The percent mass loss ranged between 19 % and 95 %.

12.1.1 The single-operator standard deviation of a single test result (a test includes three individual specimens) has been found to be 1.4 %.

12.1.2 The single-laboratory, multi-operator standard deviation of a single test result (a test includes three individual specimens) has been found to be 1.3 %.

12.2 At the time of the study, there was no accepted reference material suitable for determining the bias for this test method, therefore no statement on bias is being made.

13. Keywords

13.1 abrasion; durability; impact; Marshall hammer; pervious concrete; raveling

[4] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:C09-1041.

SUMMARY OF CHANGES

Committee C09 has identified the location of selected changes to these test methods since the last issue, C1747/C1747M – 11, that may impact the use of these test methods. (Approved Nov. 1, 2013)

(*1*) Revised section 10.2.