

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION  
DIVISION OF HIGHWAYS  
MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

---

STANDARD METHOD OF MICROSCOPIC  
DETERMINATION OF AIR-VOID CONTENT

---

**1. PURPOSE**

- 1.1 To obtain quantitative information concerning air voids, matrix, fine aggregate, and coarse aggregate in hardened concrete.
- 

**2. SCOPE**

- 2.1 By using the linear traverse method of point counts, the relative composition of hardened concrete cylinders or cores on a percentage basis can be determined.
- 

**3. EQUIPMENT**

- 3.1 A large stone saw.
- 3.2 A lapidary grinding apparatus.
- 3.3 A linear traveler apparatus.
- 3.4 A reflecting illumination system.
- 3.5 A binocular microscope with a crosshair type reticle. (Magnification preferably in the 10x, 30x, and 60x range).
- 3.6 Miscellaneous: Silicon carbide grinding material, grit numbers 120, 240, 400 and 600, a set of 4 mechanical specimen counters, or a wet polishing device with similar grit values ranging from 120 to 600, a 12 in (305 mm) ruler, and a permanent marker.
- 

**4. PROCEDURE FOR PREPARATION OF CONCRETE SPECIMENS**

- 4.1 The concrete specimens shall be cut on the large stone saw so as to bisect the cylinder along its longitudinal dimension. Care shall be taken in avoiding, if possible, the steel reinforcing bars encountered in bridge deck cores.
- 4.2 Select the better half of the specimen and make a cut perpendicular to its long axis, 4 in (100 mm) below the top surface of bridge deck core specimens. If the specimen is a concrete cylinder a 4 in (100 mm) section from the middle of the cylinder is cut and used for point counting. These operations are done so that the linear traveler specimen holder can accommodate the specimen.
- 4.3 All portions of the specimen are retained for possible later inspection.

- 4.4 That portion of the specimen prepared in Section 4.2 is now polished, first using silicon carbide grit number 120, in order to obtain a uniform surface, and subsequent polishing by silicon carbide grit numbers 240, 400 and 600 to obtain a smooth, highly polished surface.

---

**5. OPERATIONAL PROCEDURES USING THE LINEAR TRAVELER**

- 5.1 The polished specimen is placed on the specimen holder of the linear traveler.
- 5.2 After the specimen is centered on the specimen holder, the specimen shall be leveled, so as to minimize refocusing.
- 5.3 A right vertical margin and a left vertical margin shall be drawn on the polished surface of the specimen. The placement of each margin is dependent upon the horizontal limits of the linear traveler and the irregularity of the boundaries of the specimen. If an irregularity exists, the corresponding margin is placed along the inner edge of the irregularity.
- 5.4 A light source shall be directed onto the specimen surface for illumination of the visual field.
- 5.5 The binocular microscope assembly shall be positioned so that the technician can observe the entire distance between margins as the linear traveler moves horizontally.
- 5.6 Horizontal movement of the linear traveler is accomplished according to the manufacturer's specifications or recommendations. Automated travelers will transition after the previous point is recorded.
- 5.7 Vertical movement of a manual linear traveler is accomplished according to the manufacturer's recommendation. For automated travelers, the vertical movement will be executed once the horizontal traveler is returned to the home position.
- 5.8 By using the controls of the linear traveler, position the specimen while viewing through the microscope at 10x, 30x or 60x magnification, so that the vertical cross hair is in line with one of the vertical margins and the horizontal cross hair is approximately 1/8<sup>th</sup> in (3.2 mm) below the specimen, or 1/8<sup>th</sup> in (3.2 mm) below the deepest penetration of an irregular edge.
- 5.9 Readjust the light source so as to obtain an adequate field illumination.
- 5.10 Adjust the horizontal linear traveler so that the technician views that portion of the specimen between the margins as the linear traveler moves horizontally.
- 5.11 Focus the microscope on the specimen surface (periodic refocusing may be necessary).
- 5.12 Push the horizontal motion control switch so that the linear traveler moves one unit and stops.

- 5.13 At the intersection of the cross hairs, decide whether the material is an air void, matrix, fine aggregate (-4.75 mm) or coarse aggregate (+4.75 mm) and record the decision on a mechanical specimen counter properly designated.
- 5.14 Repeat procedures set forth in Sections 5.12 and 5.13 for the entire width of the specimen between the margins.
- 5.15 When the vertical cross hair reaches a margin after traversing the specimen, reverse the horizontal direction on a manual traveler according to the manufacturer's specifications. For an automatic traveler, follow the manufacturer prompts to return the horizontal traveler to the beginning of the traverse, and follow the manufacturer prompt to allow the vertical traveler to transition to the next row for testing.
- 5.16 Repeat procedures set forth in Sections 5.14 and 5.15 until the total number of point counts indicated on the mechanical specimen counter equals 600.

---

**6. COMPOSITION PERCENTAGES**

- 6.1 Each category such as air void content, matrix, fine aggregate (-4.75 mm), and coarse aggregate (+4.75 mm), is expressed as a percentage of total number of point counts.

**Michael Mance** Digitally signed by Michael Mance  
Date: 2024.09.05 07:24:38 -04'00'

---

Michael A. Mance, P.E.  
Interim Director  
Materials Control, Soils and Testing Division

MP 700.03.50 Steward – Aggregate and Soils Section  
MM:Rj