Test Method for Porosity Measurements of Portland Cement Pervious Concrete

by Felipe Montes, Srinivas Valavala, and Liv M. Haselbach

1. SCOPE

1.1 This method covers the determination of the porosity of hardened pervious concrete pavement cores.

2. DEFINITIONS

2.1 Pervious Concrete Pavement: a rigid concrete pavement with large interconnected voids that allow rapid water flow through the pavement.

3. APPARATUS

3.1 Balance, capable of measuring to the nearest 0.1 g, suitably equipped with a wire basket or other container so as to be capable of measuring the weight of specimens suspended in water.

3.2 Water bath, filled with tap water maintained at 23 ± 2ºC, for immersing the specimen and wire basket directly beneath the balance.

3.3 Oven, capable of maintaining a temperature of 40 ± 3ºC.

3.4 Rubber mallet, minimum mass of 400 g.

4. TEST SPECIMENS

4.1 Each specimen shall be a drilled concrete core with a minimum diameter of 100 mm and a maximum diameter of 150 mm. Cores shall be drilled through the entire thickness of the pervious concrete pavement.

4.2 Trim the minimum amount necessary from the bottom of the core to create a flat surface perpendicular to the length of the core.

4.3 Rinse the core thoroughly after trimming to remove all residue from the cutting operation. Allow the specimen to drain and remove any excess surface water with a clean towel.

5. PROCEDURE

5.1 Measure the height and diameter of each specimen at three representative locations to the nearest 0.1 mm, and record it.

5.2 Calculate the average height (H_{avg}) and average diameter (D_{avg}) of each specimen as the average of the **four measurements** in Step 5.1.

5.3 Calculate the total volume of the specimen (V_T) using the average height (H_{avg}) and diameter (D_{avg}).

5.4 Determine the mass of each sample core to the nearest 0.1 g, and record it as “Initial Mass.”

5.5 Dry the core initially for 24 h ± 1 hour, and record this mass (W_D), to the nearest 0.1 g. Return the specimen to the oven for one hour and record the mass again. Constant mass is achieved when the difference in mass is less than 0.5%. Continue drying until constant mass is achieved.

5.6 In a bulk density tank-scale measuring system filled with tap water, submerge the specimens completely, and let them sit upright for 30 minutes underwater.

5.7 After 30 min, keeping the specimen underwater, tap the side of the specimen 10 times with a rubber mallet. Rotate the specimen slightly after each tap so that they are equally spaced around the circumference of the core. Note: The purpose of tapping the specimen is to promote the escape of the trapped air bubbles inside the pervious concrete. Avoid tapping near the edges so as to prevent breakage and loss of material from the specimen. If this occurs, ensure that all particles are included in the subsequent mass measurements. Invert the specimen 180°.

5.8 Measure the mass of the specimen to the nearest 0.1 g by keeping the specimen underwater, and record it as the "Submerged Mass" (W_S). (The submerged mass has to be measured underwater. For this purpose, a wire mesh basket can be used to support the specimen underwater. It is important to be sure the tare of the scale includes the mass of the container under water. If that is not the case, the mass of the container underwater should be subtracted from the submerged mass of the specimen (W_S)).

5.9 Record the temperature of the water used for the submerged measurements and determine the density of the water (ρ_w) from an appropriate table.

5.10 Calculate the porosity of the sample using the equation in section 6.3.

5.11 Record the specifications of the instruments used.

6. CALCULATIONS

6.1 Calculate the average height (H_{avg}) and the average diameter (D_{avg}) of each specimen as the average of the **four measurements** recorded in Step 5.2.

6.2 Calculate the total volume of the specimen (V_T) as follows:

$$V_T = (D_{avg})^2 \times \pi \times \left(\frac{H_{avg}}{4}\right)$$

6.3 Calculate the porosity (P) as follows:

$$P = [1 - ((W_D - W_S) / p_w)/V_T] \times 100$$

where: P = porosity, %

W_D = oven dry weight, g

W_S = submerged weight, g

ρ_w = density of water, g/cm^3

V_T = total volume, cm^3

7. REPORT

Report the following information:

7.1 Porosity

Sample Data Sheet

Sample ID #:_____

Height of Sample:	_____ cm	Diameter of Sample:	_____ cm
	_____ cm		_____ cm
	_____ cm		_____ cm
	_____ cm		_____ cm
$H_{avg:}$	_____ cm	$D_{avg:}$	_____ cm

Calculate total Volume of Sample: $V_T = (D_{avg})^2 \times \pi \times \left(\frac{H_{avg}}{4}\right)$

$V_T =$ _____ cm^3

Calculate Initial Mass: Initial Mass = _____ g

Calculate Dry Mass: $W_D =$ _____ g

Calculate Submerged Mass: $W_S =$ _____ g

Water Temperature: Temp = _____ °C; $\rho_w =$ _____ g/cm^3

Calculate Porosity: $P = [1 - ((W_D - W_S) / p_w)/V_T] \times 100$

P = _____ %