



1.1. Water Permeability Test (TS EN 12390-8)

Experimental demonstration:

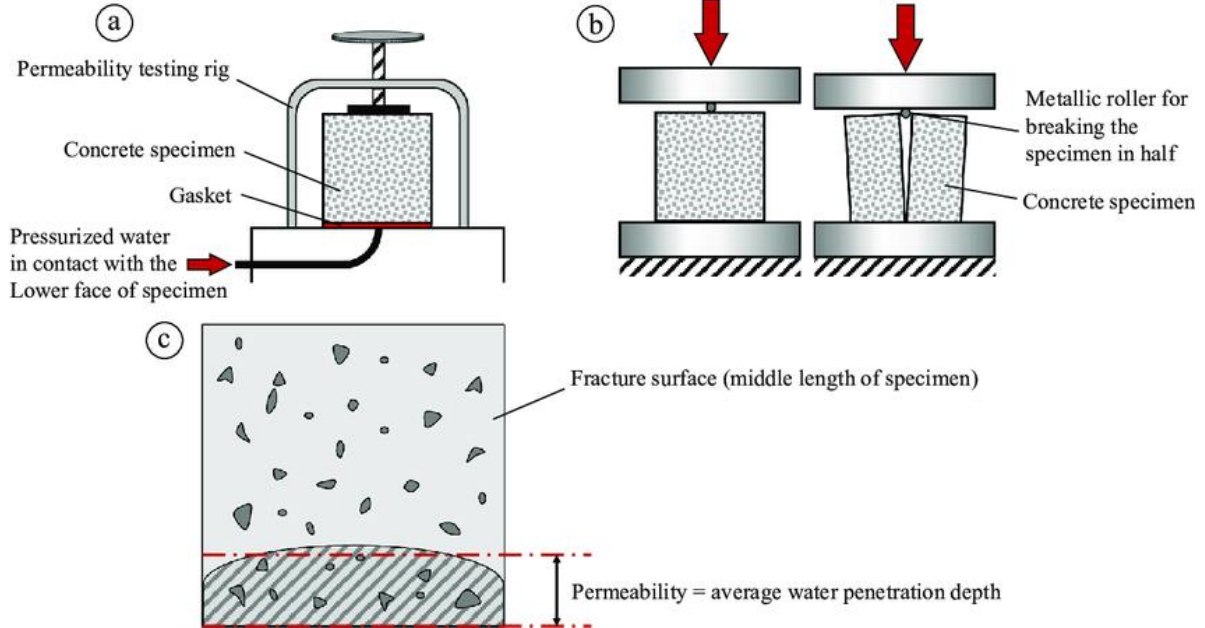


Fig. 1. Schematic demonstration of water permeability test.

The depth of water penetration under pressure test, which was carried out complying with TS EN 12390-8 standard, was performed using $100\Phi \times 200$ (h) mm cylindrical mortar samples from each mixture.

The samples were placed in the instrument and subjected to a water pressure of 500 ± 50 kPa for 72 ± 2 h. At the end of this period, the samples were removed from the instrument and divided into two parts in the direction of water pressure applied. The appearing maximum water depth on the internal surface was then measured.

1.2. Sorptivity Test

Experimental demonstration:

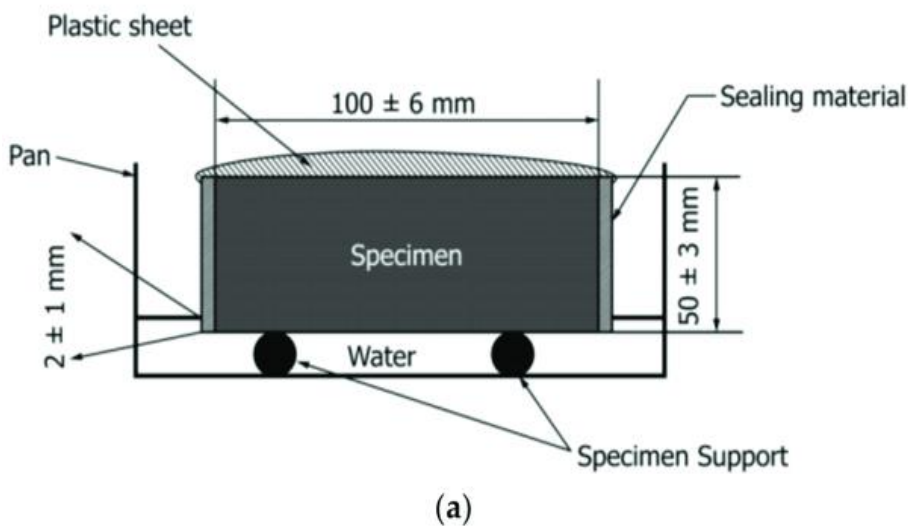


Fig. 2. Schematic demonstration of capillary sorptivity test.

The capillary water absorption test was carried out on sliced cylindrical samples having dimensions of 100 mm diameter and 50 mm thickness which were initially dried to obtain the constant weight in the oven at $105 \pm 5^\circ \text{C}$ for 24 h and then they were kept in ambient temperature to cool down. The side surfaces of samples were coated with paraffin about 5 mm to prevent the water penetration from side surfaces. After the mass recording they were placed into the container filled with enough water to get on the bottom surface of samples. The samples were removed and weighed at different time intervals (1, 4, 9, 16, 25, 36, 49, and 64 min + 24th hour) to obtain the mass gained. The sorptivity values were then calculated by account of slope of regression curve obtained from the relationship between the quantity of water absorbed by a unit surface area and the square root of elapsed time.

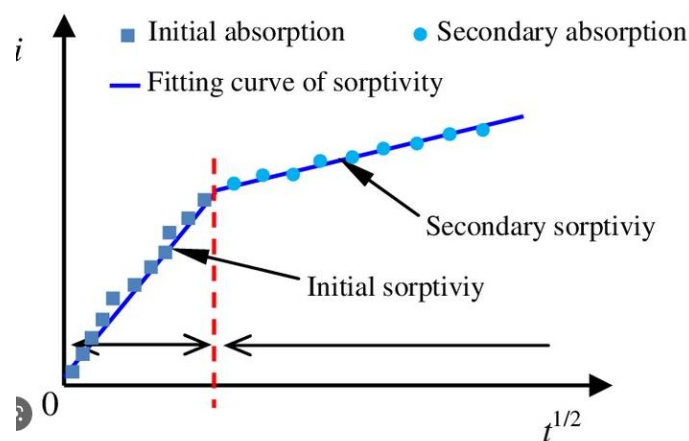


Fig. 3: An example sorptivity plot.

1.3. Water Absorption Test (ASTM C648)

Experimental demonstration:

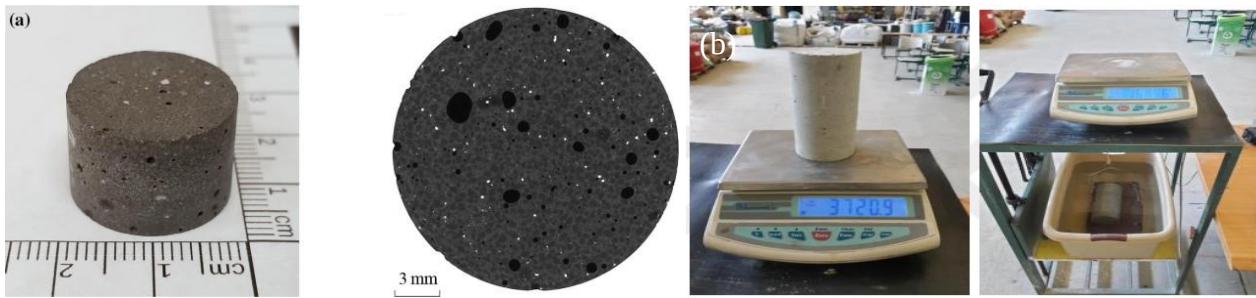


Fig. 4. Schematic demonstration of water absorption test in accordance with (a) ASTM, and (b) EN standards.

The absorption properties of the mortar mixes were determined after 28 days of curing in accordance with ASTM C 642 on two replicate disc specimens with a diameter of 100 mm and height of 50 mm by slicing the cylindrical specimens using a diamond saw. The specimens were initially dried in an oven at a temperature of 110 ± 5 °C to determine the oven-dry mass (A) and then immersed in water for 48 h and the saturated surface dry mass after immersion (B) was determined. The specimens were then kept in boiling water for 5 h and cooled down to room temperature. After removing the surface moisture, the soaked, boiled, and surface-dried mass (C) was determined. Finally the apparent mass of specimens in water after immersion and boiling (D) was determined. Water absorption and volume of permeable pores were calculated by using the following equations.

Equations: Water absorption (ASTM C648) (%): $\frac{B-A}{A} * 100$

Volume of Permeable Pores (ASTM C648) (%): $\frac{C-A}{C-D} * 100$

1.4. Open Porosity

Experimental demonstration:



Fig. 5: The water filling process under vacuum.

The samples were dried in an oven at 110 ± 5 °C until a constant mass was reached (W_0). Then, to determine open porosity [ρ_o (g/cm³)], the samples were kept in an evacuation vessel and the pressure was gradually decreased to 2 ± 0.7 kPa by using a vacuum pump. The vacuum was maintained for 2 h to expel all air from the open pores of the samples. After that, distilled water was gradually added into the vessel to immerse all samples completely under a constant pressure of 2 ± 0.7 kPa. When the sample immersion was completed, the vessel pressure was reduced to atmospheric pressure and the samples were left in water overnight. The next day, the samples were weighed under water to determine their mass in water [W_{sw} (g)]. Then, to determine the mass of the samples saturated with water [W_{sa} (g)], the samples were wiped with a damped cloth and weighed immediately.

$$\rho_o = (W_{sa} - W_0) / (W_{sa} - W_{sw})$$

1.5. Archimedes Test

Experimental demonstration



Fig. 5: The slices derived from mortar samples.

The test was performed on mortar samples to determine the capillary pore volume and gel pore volume. The mortar samples were cut into about 10 mm size after 28 days of curing age and then immersed in acetone to stop the hydration reactions. The samples were immersed in water for 24 h to determine the saturated surface dry mass and then dried at 40 °C for 48 h. The mass difference was calculated to quantify the capillary water. Subsequently, samples were further heated at 105 °C for 24 h to remove the remaining physical water and the mass loss from 40 to 105 °C was quantified as the sum of gel and interlayer water.

SSD mass = A

Mass after 40 °C = B

Mass after 105 °C = C

$$\text{Capillary pore volume: } \frac{A - B}{A} \quad \text{Gel pore volume: } \frac{B - C}{A}$$

1.6. Compressive strength

Experimental demonstration



Fig. 6: The compressive strength test.

The compressive strength of the specimens was determined at 3, 7, and 28 days on two replicate samples with dimensions of $50 \times 50 \times 50 \text{ mm}^3$ for each batch of mixtures, and the average strength values were recorded.