



# **Use of Recycled Crumb Expanded Polystyrene (EPS) Foam with Silica Fume in Light-weight Concrete**

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## ABSTRACT

The following investigation was conducted to determine the mechanical and thermal properties of expanded polystyrene (EPS) foam lightweight concrete (LWC) with different percentages of silica fume (SF). EPS foams have a cellular microstructure with closed cell membranes made of expandable polystyrene (EPS) and its density is typically less than  $0.1 \text{ kg/m}^3$ . Recently applications of EPS lightweight concrete include cladding panels, curtain walls, composite flooring systems, load-bearing concrete blocks, sub-base material for pavements, and floating marine structures, as well as impact-resistant structural protection layers, because of the good energy-absorbing characteristics of LWC. The experimental program incorporated two phases. The first phase was developed by partially replacing normal weight aggregate with recycled EPS foam beads, while the used replacement ratios (0%, 5%, 10%, 15%, 20%, 25%, 30% and 35%) were measured by volume replacement. The second phase deal with the partially replacing by weight of cement type (I) with different percentages of SF in EPS foamed concrete, which ranges

from 0% - 10% using 2% intervals. Twenty three concrete designation mixtures were constructed. Different tests were conducted in accordance with standards set forth by the American Society for Testing and Materials (ASTM) and Egyptian Code Practice (ECP) 203 part: 3, in order to determine the fresh and mechanical properties of the material. These tests included the standard test methods for Fresh Concrete density, Slump, Compacting Factor, Hardened Concrete Density, Absorption, Compressive Strength of Cube Concrete Specimens, Splitting Tensile Strength of Cylindrical Concrete Specimens, Flexural Strength of Beams Concrete Specimens, Ultrasonic Pulse Velocity and Elasticity Modulus of Concrete; also the Stress Strain Curve and Thermal Conductivity were determined for different EPS foamed concrete.

The obtained results showed that, the hardened concrete density was decreased to about  $1800 \text{ kg/m}^3$ . EPS foam improves the consistency and workability of LWC. However, the EPS foam decreases the mechanical properties like compressive, splitting tensile, flexural strength and modulus of elasticity for the concrete. Also,

the replaced EPS foam increase the internal porosity and absorption of the concrete. On the other side, SF is enhancing the EPS foamed concrete strength. The compressive and tensile strengths increased in EPS foam concrete to the ratio 10% of SF. SF content doesn't improve the flexural strength in EPS foamed concrete. EPS foamed concrete modulus of elasticity increases with the SF up to 30% of EPS foam content. Thermal conductivity of EPS foam was decreased to 0.3% for 0.0% EPS foam concrete.