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Field Emission Scanning Microscope Image Analysis for Porosity Characterization of Autoclaved Aerated Concrete

Authors : Venuka Kuruwita Arachchige Don, Mohamed Shaheen, Chris Goodier

Abstract : Aerated autoclaved concrete (AAC) is known for its lightweight, easy handling, high thermal insulation, and extremely porous structure. Investigation of pore behavior in AAC is crucial for characterizing the material, standardizing design and production techniques, enhancing the mechanical, durability, and thermal performance, studying the effectiveness of protective measures, and analyzing the effects of weather conditions. The significant details of pores are complicated to observe with acknowledged accuracy. The High-resolution Field Emission Scanning Electron Microscope (FESEM) image analysis is a promising technique for investigating the pore behavior and density of AAC, which is adopted in this study. Mercury intrusion porosimeter and gas pycnometer were employed to characterize porosity distribution and density parameters. The analysis considered three different densities of AAC blocks and three layers in the altitude direction within each block. A set of understandings was presented to extract and analyze the details of pore shape, pore size, pore connectivity, and pore percentages from FESEM images of AAC. Average pore behavior outcomes per unit area were presented. Comparison of porosity distribution and density parameters revealed significant variations. FESEM imaging offered unparalleled insights into porosity behavior, surpassing the capabilities of other techniques. The analysis conducted from a multi-staged approach provides porosity percentage occupied by various pore categories, total porosity, variation of pore distribution compared to AAC densities and layers, number of two-dimensional and three-dimensional pores, variation of apparent and matrix densities concerning pore behaviors, variation of pore behavior with respect to aluminum content, and relationship among shape, diameter, connectivity, and percentage in each pore classification.

Keywords : autoclaved aerated concrete, density, imaging technique, microstructure, porosity behavior
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