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Numerical Simulation of Flexural Strength of Steel Fiber Reinforced High Volume Fly Ash Concrete by Finite Element Analysis

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Abstract : It is well-known that fly ash can be used in high volume as a partial replacement of cement to get beneficial effects on concrete. High volume fly ash (HVFA) concrete is currently emerging as a popular option to strengthen by fiber. Although studies have supported the use of fibers with fly ash, a unified model along with the incorporation into finite element software package to estimate the maximum flexural loads need to be developed. In this study, nonlinear finite element analysis of steel fiber reinforced high strength HVFA concrete beam under static loadings was conducted to investigate their failure modes in terms of ultimate load. First of all, the experimental investigation of mechanical properties of high strength HVFA concrete was done and validates with developed numerical model with the appropriate modeling of element size and mesh by ANSYS 16.2. To model the fiber within the concrete, three-dimensional random fiber distribution was simulated by spherical coordinate system. Three types of high strength HVFA concrete beams were analyzed reinforced with 0.5, 1 and 1.5% volume fractions of steel fibers with specific mechanical and physical properties. The result reveals that the use of nonlinear finite element analysis technique and three-dimensional random fiber orientation exhibited fairly good agreement with the experimental results of flexural strength, load deflection and crack propagation mechanism. By utilizing this improved model, it is possible to determine the flexural behavior of different types and proportions of steel fiber reinforced HVFA concrete beam under static load. So, this paper has the originality to predict the flexural properties of steel fiber reinforced high strength HVFA concrete by numerical simulations.

Keywords : finite element analysis, high volume fly ash, steel fibers, spherical coordinate system
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