Abstract

Effect of Silica Fume and Steel Fibers on Material and Structural Characteristics of High Strength Concrete

Arunachalam Sumathi

Kaliyaperumal Saravana Raja Mohan, Ph.D.

High strength Steel-fiber reinforced concrete is being used as a structural material which is of immense importance in today’s scenario. There is always a concern on the interaction between various mineral and chemical admixtures with fiber reinforced concrete. In the present research work, it was aimed to find the effect of silica fume as a partial substitute to cement and to study its effect on mechanical properties of steel fiber reinforced concrete. Silica fume was used in six different replacement level of cement ranging from 5 to 30% with increment of 5% by weight. Parametric study was carried out by changing different parameters such steel fiber content, age of concrete and dosage of super plasticizer to study their influence on mechanical properties of high strength concrete. The age of concrete considered in the study was 3, 7, 28, 90 and 180. The dosage of super plasticizer was chosen as 5 ml, 10 ml and 15 ml by weight of cement. Type of steel fiber used was hooked end and was taken as volume fraction of concrete. A high strength concrete with a characteristic compressive strength of 60 MPa was chosen for the purpose of assessing mechanical properties. Mix with higher percentages silica fume exhibited lower workability and less bleeding. To study the structural behavior of concrete elements under static and repeated loading, a total of 20 beams of size 150 mm x 250 mm x 3000 mm were cast with an optimum silica fume percentage of 10%. However
the beams were cast with different percentages of steel fiber to arrive an optimum value based on load deflection characteristics. It was also assessed from the results that, addition of steel fibers enhanced the ductility, energy absorption capacity, stiffness degradation. In order to predict the number of cycles to failure, failure deflection, cyclic ductility and cumulative energy absorption capacity the specimens were tested under repeated cyclic loading. Mix with 10% silica fume and 1% steel fiber yielded better values in terms of strength criteria and modulus of elasticity irrespective of the age of concrete. From the experimental results, show that fiber reinforced concrete beams with 1% fiber volume fraction exhibit an increased load carrying capacity and composite action until failure when compared to the control beam under static and repeated loading.