ABSTRACT

The need to design structures to survive shock loads is increasingly felt these days, not only for functional requirements, but also to resist accidental loads. The shock loads can be due to either blast or impact. Unfortunately, concrete’s low tensile strength and brittle characteristics make it prone to crack or fail due to the above loads. The inclusion of fibers provides an energy absorbing capacity that can maintain the structural integrity of concrete during fracture. Fibers are expected to improve the properties of concrete both in unhardened and hardened states. In the fresh concrete, fibers increase resistance to plastic shrinkage. In the hardened state, fibers improve the strength and toughness of concrete depending on fiber type, shape, size and quantity. This increased interest has led to the development of various types of fibers to be used in cementitious composites.

A drop weight impact test facility capable of dropping 50 kg mass of projectile from heights of upto 5 metre was developed. The energy absorption capacity and behaviour of fiber reinforced concrete slabs of size 1000 mm x 1000 mmx 25 mm were evaluated under impact loading. The fibers used were Polypropylene, Glass and Steel. The slab was subjected to impact by 11.64 kg mass of hemi-spherical nose shaped projectile dropped from various heights. A series of experiments were performed to study the influence of slab properties under various volume fractions of different fibers on the impact response of fiber reinforced concrete slabs.
Steel fiber reinforced concrete slabs performed better in terms of crack resistance, degree of damage and energy absorption than the other fibers under static as well as impact loading. The addition of steel fibers in the slabs results in improved cracking behaviour and prevents scabbing on the distal face and shear plug formation on failure. Increasing the fiber content led to an increase in the impact load and a reduction in the maximum displacement experienced by the slab. The provision of main steel reinforcement led to a reduction in the maximum displacement and an increase in the peak impact load. It was observed that the failure is generally localised in the form of a frustum shaped fracture zone. Higher projectile velocities increase the local deformations on the slabs at the point of impact. Increasing the mass of the projectile resulted in higher loads, higher displacement and more damage in the slabs.

In the present study a cementitious composite material system known as ferrocement was also investigated. The impact response of ferrocement slabs was carried out by varying the volume fractions of different fibers. Addition of fibers led to an increase in energy absorption capacity and number of cracks of smaller crack widths. Slabs containing fibers sustained less damage at the point of impact and the failure was more localised compared to slabs without fibers. Results obtained in experimental methods are compared with analytical method using ANSYS software.