ABSTRACT

The concept of using fibres to reinforce a brittle material is not new. According to American Concrete Institute (ACI) manual of concrete practice, the use of two or more types of fibres in a concrete mix is considered promising. An appropriate combination of fibres produces a better composite concrete than individual fibres for special applications. The various fibres used in concrete are Steel, Glass, Carbon, Polypropylene and Polyolefin. The combination of steel and polyolefin appears to be the currently developing choice, as revealed by a review of recent literature.

In the present research, experimental studies were carried out to investigate the ductile behaviour of Hybrid Fibre Reinforced Concrete (HFRC) elements of grade M25 using Steel and Polyolefin fibres. The effect of hybrid fibres in Beams, Slabs and Frames with and without infills was studied experimentally.

The percentages of fibres used are 0.75, 1.5 and 2.0 by volume of concrete using Steel (70%) and Polyolefin (30%) fibre combination. The mechanical properties like compressive strength, split tensile strength, flexural strength and modulus of elasticity of the HFRC matrix with the above combinations were found and compared with those of control mix
without fibres. It was found that the compressive strength increases with the increase in fibre content. An increase in split tensile strength and flexural strength with the increase in fibre content was also observed.

The beam specimens with hybrid fibres were tested under third point loading. The load-deflection behaviour, stiffness, energy absorption and ductility factor were found. The results are compared with those of control beam. The 2.0 percent HFRC beam exhibited enhanced ductility behaviour than the control beam and other HFRC beams.

The one-way slab specimens with hybrid fibres were tested under third point loading. The general behaviour, crack pattern, load-deflection behaviour, energy absorption, ductility factor, energy ductility and energy absorption characteristics of HFRC slabs is found and the results are compared with those of control slab. It was observed that the HFRC slab with 2% hybrid fibres showed an increase in ductility

Frame specimens with and without infills were subjected to lateral cyclic loading. The hybrid fibres are employed at the joints of both infilled frames and bare frames. The behaviour of frames, load carrying capacity, load-deflection behaviour, ductility factor, energy ductility, energy dissipation capacity and stiffness degradation were obtained for HFRC frames and the results were compared with control frames. An
increase in energy absorption capacity for 2.0% HFRC frame with and without infills was observed.

In order to validate the experimental results, finite element analysis was carried out using ANSYS 14.5 software for HFRC beams, HFRC slabs, HFRC Bare frames and HFRC infilled frames. The comparison of experimental results with ANSYS results are presented in this thesis. A good correlation between experimental results and ANSYS results is obtained.

The experimental results showed that adding 2.0 percent hybrid fibres using Steel (70%)-Polyolefin (30%) fibre combination enhance the ductile behaviour of concrete thus improving seismic resistance of the building components.