A Study of Shear Behaviour of Steel And Polypropylene Fibre Reinforced Concrete Beams

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Abstract- *This thesis presents a series of tests for characterizing the structural behavior of fiber reinforced concrete beams subjected to shear loading. The experimental program involves two types of fibers, steel fiber and a polypropylene fiber. As a reference, plain concrete and conventionally reinforced concrete specimens have also been casted and tested in the laboratory as per ASTM standards. The ultimate shear carrying capacities of the beams are calculated. The study confirms that the shear crack resistance of the material is greatly enhanced by the fibers. Fibers reduced the crack width to approximately a fifth of that in beams with stirrups. The use of steel fibers raises the ductility and fracture energy of concrete. Addition of steel fibers to concrete improves its post cracking behavior in tension. The shear resistance increased with increasing aspect ratio of fibers and volume fraction of fibers.*

Keywords- Beam Strengthening, Fiber Reinforced, Polypropylene Fibers, Shear Behaviour of Beams

I. INTRODUCTION

Beam is a structural element that primarily resists the load applied laterally to the Beam axis. Beams are the vertical or sloping bearing elements of the structural system that connect Columns and Support Slabs.

To determine the shear behavior of steel and polypropylene fibers reinforced concrete beams and to compare the results with ordinary reinforced concrete with stirrups. In this paper we will discuss about the following,

- Both steel and polymeric fibers have been used to reinforce concrete and consequently increase its toughness and crack resistance
- Fiber reinforced concrete can be used in some structural applications with a reduced amount or even without any conventional reinforcement
- One application of the fibers is to increase the load carrying capacity of concrete subjected to shear
- The addition of fibers to concrete effectively improves the shear strength of concrete, as the fiber transfer tensile stresses across crack surfaces.

II. STUDY OF LITERATURE

Lakshmipathy_(1987) [1] has done an experiment on steel fibre reinforced concrete beams conducted an experimental analytical investigation on two span continuous beams with steel fibres. The important characteristics such as cracking behaviour, ductility and energy absorption were ascertained from experimental investigation and compared with analytical results. The fibrous concrete beams served to be superior to conventional concrete .

Rao, Sasidhar.C.H, _(1987) [2] on topic structural repair of shear deficient reinforced concrete beams conducted an experimental investigation on deformation characteristics and strength of reinforced concrete beams made with steel fibres in pure bending. A number of beams each with 1.85m span were cast and tested under static flexural loading. The increase in depth of neutral axis and hence flexural stiffness of fibre reinforced concrete beams at all stages of loading reflected the ability of fibres in arresting the crack growth. The inclusion of steel fibres in the concrete significantly increased the post cracking stiffness at all the stages upto failure.

Dwarakanath (1997) [3] made study on behavior of fibre reinforced concrete beams examined the flexural behaviour of fibre reinforced concrete beams. In this study, fibres were put in two types of locations such as over the entire depth and over half the depth of the beam on the tension side. They tested 20 numbers of 1.8m long reinforced concrete beams with steel fibers, under flexural static loading. Midspan deflections and curvatures at salient points such as cracking, and ultimate points were compared. It is found that half the depth mode of inclusion of fibres for under reinforced concrete beams and full depth mode of inclusion of fibres for over reinforced concrete beams.

Piti Sukontasukkul_(2004) [4] studied conducted an experimental investigation on toughness of steel and polypropylene fibre reinforced concrete beams under bending (2004). The behaviour of Steel Fibre Reinforced Concrete indicated single peak response over the conventional reinforced concrete beams whereas Polypropylene Fibre Reinforced concrete should double peak response. The deformations under two methods were compared.

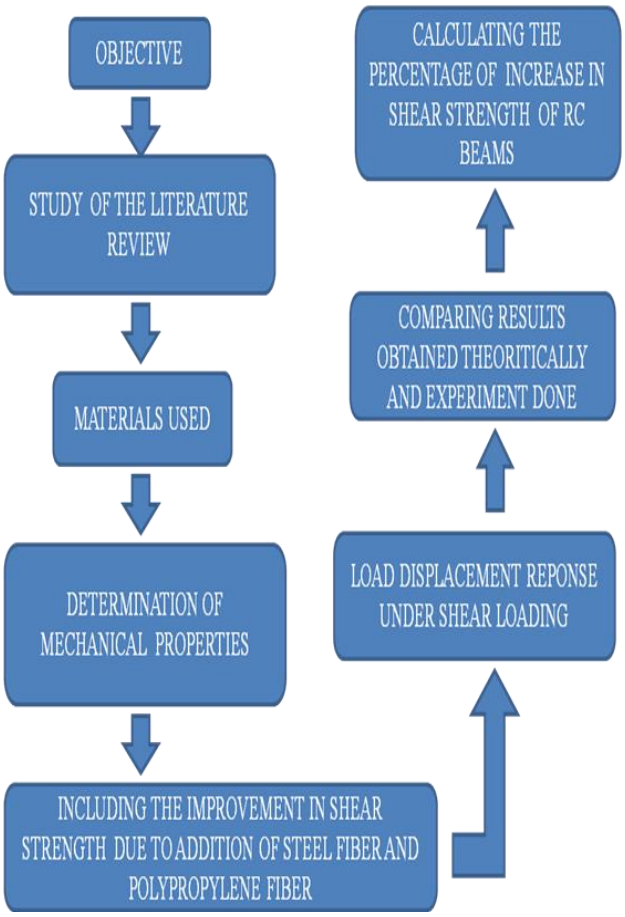
Padmarajaiah_(2004) [5] on flexural strength of steel fibre reinforced high strength concrete in prestressed beam specimens. It is found that the toughness and Ductility of prestressed high strength concrete beams have increased with the increase in fibre content. The maximum increase in ductility was 18%, 45% and 68% and percentage increase in energy absorption 25%, 78% and 88% for prestressed beams with full depth of steel fibre content of 0.5%, 1.0% and 1.5% volume fractions.

Suji.D_(2006) [6] made experimental study on behaviors of polypropylene fibre concrete. Graded fibrillated polypropylene fibres were used in this study. A 1.8 m long rectangular reinforced concrete beam was cast with and without fibre at different volume fractions of 0.1%, 0.2% and 0.3%. Moment carrying capacity of beams were arrived and compared with theoretical equations. Also it was concluded that the crack pattern remained the same for all beams, but the crack width and length were reduced for fibre reinforced concrete beams.

Kumar_(1997) [7] on the topic compressive strength of steel fibre reinforced concrete made a study on statistical prediction of compressive strength of steel fibre reinforced concrete and they reported that the compressive strength of SFRC increased steeply with the increase of fibre content upto 1% (by volume) and beyond 1% of volume addition, the rate of increase in strength reduced drastically. He suggest to use the Steel fibres on Corrected volume.

Rami H. Haddad_ (2001) [8] on topic synthetic fibres incorporated in reinforced concrete found an intresting way of predicting the role of synthetic fibres such as polypropylene and nylon fibres in delaying steel corrosion cracks and improving the bond with concrete. Different lengths of polypropylene and nylon fibres with various volumes were mixed with concrete. Pullout tests and corrosion study were conducted and they were concluded that both the fibres contributed more in delaying the corrosion and improving the bond strength. Moreover it was pointed out that polypropylene fibres played more significant role than nylon fibre in the improvement of bond.

III. METHODOLOGY



IV. CONCLUSION

It has been observed that the incorporation of fibers to the mix increases the material toughness both in tension and compression, as represented by the toughness indexes of the ASTM standards. The toughness increases results in higher shear strength of the concrete and better deformability, i.e. the deflection at maximum load is significantly higher for FRC beams than plain concrete specimens.

- The compressive strength increase only marginally due to fiber incorporation in concrete.
- First crack occurs earlier in PFRC when compared to SFRC.
- In SFRC beams, the maximum load increased by approximately 20% of the RCC beam with minimum stirrups.
- The length and width of the crack is reduced due to the incorporation of fibers in the concrete.

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