Investigation on Properties of Steel Fibre Reinforced Concrete

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***Abstract*— The use of Steel Fibre Reinforced composites in infrastructure applications is becoming more popular with the introduction of new high performance materials. Steel Fibre Reinforced composites are introduced to enhance the overall performance of structures, such as composite bridge decks, beams, bearing walls, etc. This review from the past experiences presents the results of experimental and analytical studies done on composite material made of Fibre reinforced concrete overlaid on Conventional Reinforcement with Concrete. Results show that the composite structures possess good compressive strength, tensile strength, flexural strength, cracking strength and ultimate capacity.**

Keywords—Cocrete, steel fibre,workability, compressive strength

I. INTRODUCTION

This FRC is extensively used material in structures. Due to its possessions, fibre enhances stiffness of concrete and Fibre reinforced concrete is used on huge scale for lots of purposes. Concrete is diverse material which is commonly used for building purpose. In the last, a few years the use of steel fiber-reinforced concrete has considerably increased in engineering pavements, roads, parking areas and airfield runways as an successful option and additives to usual methods. Because intense concentrated loads from industrial equipment and shelves may origin intensive cracking and deformation of pavements, fiber reinforcement may assist from this performance. The key motive behind incorporate fibers into a cement concrete is to increase the toughness and tensile strength and improve the cracking deformation qualities of the resulting combination. For Fibre reinforced concrete to be a significant construction matter, it must be competent to be reasonably with present reinforcing coordination.

II. LITERREVIEW

Lakshmipathy and Santhakumar (1987) conducted an experimental analytical investigation on two span continuous beams with steel fibres. The important characteristics such as cracking, ductility and energy absorption ascertained from experimental investigation and compared with analytical results. The fibrous concrete beams served to be superior on conventional concrete.

Rao et al. (1987) 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, post cracking stiffness at all stages up to failure.

Lim et al. (1987) carried out some experimental and analytical study on bending behaviour of steel fibre reinforced concrete beams. A simplified Moment–Curvature (M–Ø) relationship for beam with rectangular shape was proposed. The proposed model was verified with experimental results that carried out 2.2 m span reinforced concrete beams. The enhancement in ductility and energy absorption under static loading was reported through the study.

Ganesan and Murthy (1990) ascertained the stress – strain behavior of short, confined, reinforced concrete column with and without steel fibres. The volume fraction of 1.5% and aspect ratio- 70 of steel fibres was used. The strain at peak loads was increased to certain extent in this study.

Thomas et al. (1992) presented a computer algorithm to analyze the load – deflection and moment – curvature behavior of steel fibre reinforced concrete beams. A total of 11 SFRC simple beams were cast and tested under two point loading. The experimental results were compared with computerized program results.

III. METHODOLOGY

The Designing the Proposed Grade of concrete M20 as per IS-10262 :2009 and casting the Cube and beams of Steel Fiber Reinforced Concrete (Addition of 0.3% fibres by weight of Concrete) and normal Reinforced Concrete and after testing the compressive strength & Tensile strength at 7 days and 28 (days with the help of usual curing) plot the graph for the Steel Fiber Reinforced Concrete results and normal Reinforced Concrete and evaluate the conventional RCC & Modified Steel Fiber Reinforced Concrete results.

- Preparation of Mix Design of concrete as per code IS 10262 (2009).
- Casting of Cubes and beams with SFRC and normal RCC.
- Find the compressive strength of concrete with compression test carried on cubes.

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- Check out Tensile Strength of beams with Universal testing machine.
- Check out Compressive Strength of beams with Universal testing machine.
- Compare the results with plotting

S.No.	Particulars	Principles
1	Shape	Corrugated
2	Thickness	0.7 mm
3	Length	30 mm
4	Density	78500 N/mt^3
5	Appearance	Bright and clean wire

Physical property of selected Steel fibers in percentage

Fiber Length in mm	25-35	38-45	50
Fiber Diameter	0.5	0.6	1.00
Tensile Strength	>650Mpa	850MPa	>850 MPa

IV. CASTING DETAILS

The cubes were prepared by using Compressive strength testing mould and use compressive strength testing machine for testing. Some specifications for casting of cubes are as follows,

- Cube size taken - 150mm*150mm*150mm
- Mix proportion for concrete 1 **:** 1.526 **:** 3.020
- Water: cement ratio (by mass) - 0.45

The beams were prepared for find tensile and flexure strength with testing mould and use universal testing machine for testing. Some specifications for casting of beams are as follows,

- Beam size taken - 150mm*150mm*700mm
- Mix proportion for concrete 1 : 1.5 : 3
- Water: cement ratio (by mass) - 0.45

Addition of Steel Fibres - 0.3% of Fibres by total weight of concrete

Figure– Casting of cube moulds with concrete

Figure– Cube moulds placed on vibrating table for compaction

Figure – Curing of RCC cubes and SFRC cubes in tank

Figure - Testing of specimen for compressive strength of cubes

Figure – Preparation of main reinforcement used in beams

V. RESULTS

The reinforcement supplied by way of fibres can work at each a micro and macro level. The potential of the fibre to control micro cracking growth relies upon in particular at the range of fibres, deformability and bond to the matrix. A better wide variety of fibres within the matrix leads to a higher chance of a micro-crack being intercepted through a fibre.

This research includes results of two different types of cubes,

1. Cubes without Steel fibres.
2. Cubes with steel fibres.

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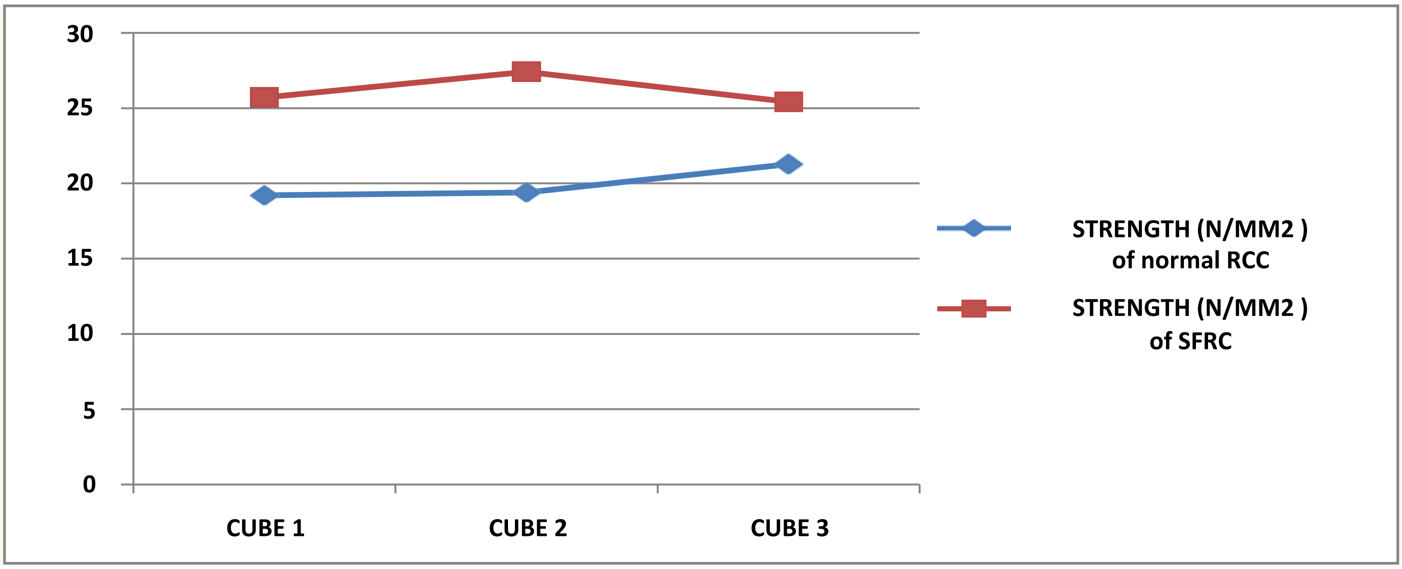

Figure - Comparative graph for 28 days strength of cubes in compression

This research includes results of two different types of beams,

1. Beams without Steel fibres.
2. Beams with steel fibres.

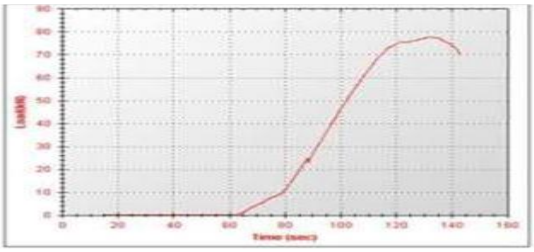

Figure -Graph of Load vs Time (Beam Compression test report normal Concrete)

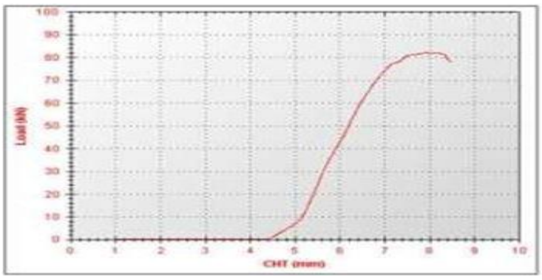

Figure - Load vs CHT graph (Beam Compression test report of SFRC Concrete)

VI. CONCLUSIONS

Based on the results and observations of the investigational presented in this research, the subsequent conclusions could be drawn

1. The major parameters of concrete structures like compressive & Tensile strength can be improved.
2. However, innovative structures in different parts of the world have clearly indicated the unique, unmatched properties of this material and therefore the vast potential waiting to be explored.
3. The load carrying capacity is observed to be improved when added small amount like 0.3% by weight of concrete.
4. Overall it is advantageous to use 0.3% of Steel fibers which gives adequate results in all conducted tests for concrete Grade M20 without making lumps / bunches of fibres.
5. Decrease in bleeding is observed by addition of steel Fibres in the SFRC.
6. Reduction in bleeding improves the surface integrity of concrete, improves its homogeneity and reduces the probability of cracks.
7. The percentage increase of compressive strength of cubes of M20 grade of Steel fibre concrete mixes compared with Conventional concrete compressive strength is observed 25 to 30 %.
8. The percentage increase of tensile strength of beams of M20 grade of Steel fibre concrete mixes compared with Conventional concrete compressive strength is observed 18 to 20 %.
9. The percentage increase of compressive strength of beams of M20 grade of Steel fibre concrete mixes compared with Conventional concrete compressive strength is observed 3 to 5 %.
10. The Initial cost of Steel fiber reinforced Concrete is also little much due to less percentage of mixing the fibres but the overall performance and vide application of use counter the cost-effective aspect

VII. FUTURE STUDY

For further study following parameters will be carried out

- Different percentage further minimize of addition of steel fibres.
- Different grades of concrete.
- Different compaction techniques.
- Different curing techniques.
- Durability aspects.
- Different types / shapes of fibres.

- With replacements of main steel components.
- For different aspects and influence on other properties. And can compare the results with reinforced cement concrete specimens.

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