EXPERIMENTAL INVESTIGATION ON STEEL FIBER REINFORCED CONCRETE

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ABSTRACT
The steel fiber is added at various proportions from 0% to 1% of the concrete. Trial mix of varied proportion showed above which compared to conventional concrete mix and get the optimum mix of steel fiber in concrete and to investigate the compressive strength, split tensile strength, flexural strength of concrete. Trial mix of concrete with addition of steel fiber at 0.75% achieved more strength, compared to other combinations hence utilization of steel fiber which enhanced the strength in the concrete.

Keywords–*Steel fibre,Compressive Strength,split tensile strength, flexural strength.*

I. INTRODUCTION

Fiber reinforced concrete is the type of concrete to use for the construction of large structures. This is durable and efficient material. By achieving the high strength that may be used at the construction prefabricated structures. The concrete are always week in tension and always strong in compression but the steel strong in tension. While adding steel as a fiber material and that may be increase the tensile strength of concrete. The Endeavour looked as a better idea to prevent shrinkage cracking and control of early thermal contraction right after placing the fresh concrete in the formwork. Concrete is characterized by brittle failure, the nearly complete loss of loading capacity, once failure is initiated. This characteristic, which limits the application of the material, can be overcome by the inclusion of layers of steel meshes. The main objective of this project to addition of fiber at in the concrete to improve the post crack arresting property, river sand is also used replacing M sand.The various parameters considered in this study are as follows -:

- Effect of using river sand instead ofM sand.
- Effect of using various mix proportion of steel fibre withM20 grade of concrete with steel fibre.

II. MATERIALS

2.1 Cement

Ordinary Portland Cement (OPC) of 53 grade is used for the construction purpose.It is superior crystallized structure and optimum particle size distribution so it can make that high strength and durability of concrete. As per by the IS: 12269-1987 the compressive strength must be 54.3 kg/m^3 is achieved. The specific gravity of the coarse aggregate is 3.17

2.2 Fine aggregate

It is a substitute of river sand for concrete construction.The river sand is also used replacing M sand. It is produced from hard granite stone by crushing. The specific gravity test is one type of fine aggregate test. The specific gravity for using M sand is 2.70.

2.3 Coarse aggregate

The crushed stone aggregates are available in 10 mm, 20mm, and 40mm. In this project the 20mm coarse aggregate is used. The specific gravity of the coarse aggregate is 2.71.

2.4 Steel fiber

In this project the hooked type steel fiber is used. The length of the fiber in 300 mm. These types of fibers are cheaper and easy to use. It can arrest the crack formation after the post curing. They are hooked at the both ends which can fill the air voids. The diameter of the steel fiber is 0.5 mm and they are available in different size, different length and different diameter.

II. EXPERIMENTAL WORK

3.1 Preparation of concrete

Concrete was prepared by calculating the exact amount of cement, Fine aggregate, Coarse aggregate and water by considering the appropriate mix design and water-cement ratio. At first the cement, fine aggregate and coarse aggregate were mixed dry and thenadded to steel fibre. Water is gradually added to the dry mix and is mixed by using shovel.

Table 1- Mix proportion of concrete

Cement (kg/ m³)	Fine Aggregate (kg/ m³)	Coarse Aggregate (kg/ m³)	Water (lit/ m³)	Water/cement ratio
425.77	709.722	1114.18	191.6	0.45

Table 2 -Mix proportion of steel fibre

% of Steel Fibre	Weight of Steel Fibre (Kg/ m³)
0%	0.00
0.25%	0.285
0.5%	0.570
0.75%	0.850
1%	1.132

3.3 Casting of specimen& Curing of specimen:

A total number 15 no of cubes 150 mm x 150 mm x 150 mm, 15 cylinders of diameter 150mm and 300mm height, 15 no ofprism of size 500 x 100 x100mm were casting by standard steel moulds. These specimens were removed from moulds after 24 hours and cured for each 7 days &28 days in water tank.

Fig. 1 –concrete preparation

IV. RESULT AND DISCUSSIONS

4.1 Concrete testing

- Compressive strength
- Splitting tensile strength
- Flexural strength

We make the specimens of cube, cylinder & beam by using steel fibers to test the strength of structure by adding steel fibers.

Fig.2 –Compressive test

Fig.3 –Splitting tensile test

Fig .4 - Flexural test

Table 3–Strength of Concrete for 7 days

Sl. No.	Proportion of steel fiber	Compressive Strength (N/mm²)	Splitting Tensile Strength (N/mm²)	Flexural strength (N/mm²)
1	0	12.5	2.37	3.01
2	0.25	13.4	2.56	3.67
3	0.5	14.9	2.61	3.82
4	0.75	16.4	2.75	4.01
5	1	15.7	2.63	3.70

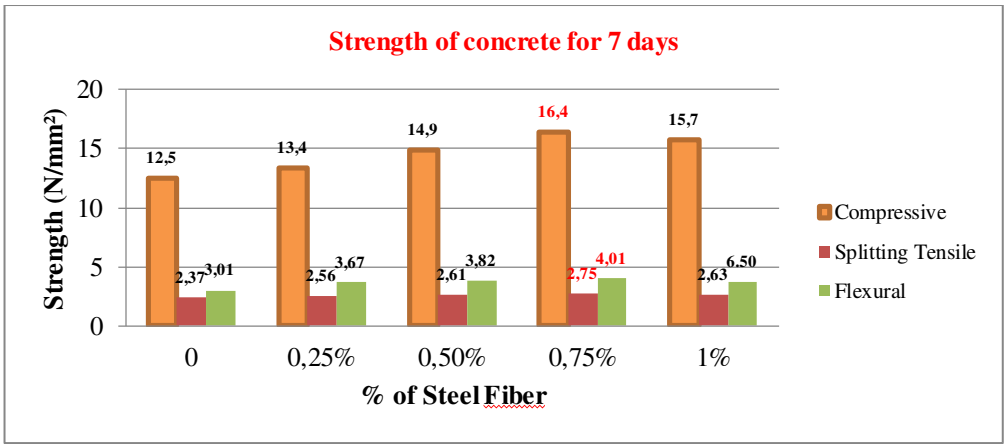

Fig.5–Graphical representation of compression, tensile strength & flexural strength for 7 days

Table 4 –Strength of Concrete for 28 days

Sl. No.	Proportion of steel fiber	Compressive Strength (N/mm²)	Splitting Tensile Strength (N/mm²)	Flexural strength (N/mm²)
1	0	27.74	2.48	4.3
2	0.25	28.43	2.80	4.75
3	0.5	33.25	2.99	5.49
4	0.75	37.41	3.37	5.67
5	1	35.74	3.03	5.04

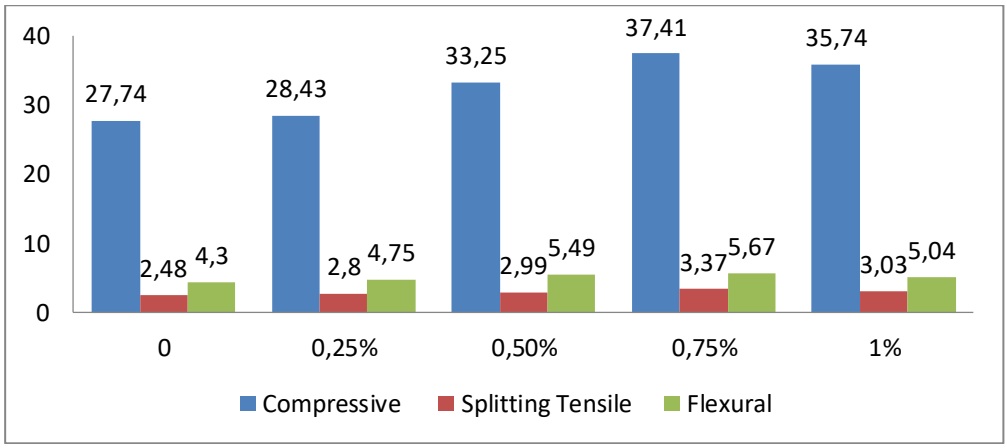

Fig. 6 – Graphical representation of compression, tensile strength & flexural strength for 28 days

The chart shows the comparison of the concrete with steel fiber (0.75 %) having higher strength values of compressive, splitting tensile and flexural strength to the nominal concrete as shown in fig.7.

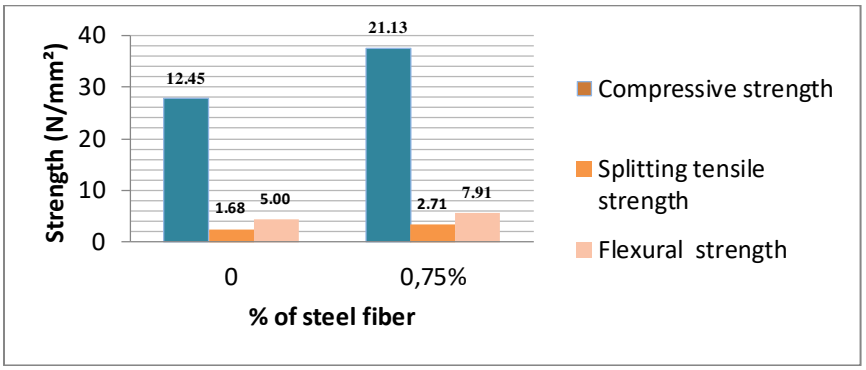

Fig.7–Comparison of the Concrete with steel fiber (0.75 %) with nominalConcrete

V. CONCLUSION

Based on the results of Compressive strength, split tensile strength, Flexural strength of the fiber reinforced concrete is achieved.

- The concretehas achieved higher strength in 0.75% steel fibre from the results of compressive strength, split tensile strength and flexural strength tests.
- Addition of 1% of steel fiber which enhances the lower strength compared to the addition of 0.75 % of steel fiber due to the wrapping of concrete mix.

REFERENCES

- Abdul Ghaffar, AmitS.Chavan, Dr.R.S.Tatwawadi, “Steel Fibre Reinforced Concrete”,International Journal of Engineering Trends and Technology (IJETT).
- Grzybowski, M. (1989). Determination of Crack Arresting Properties of Fiber Reinforced Cementitious Composites. Chapter 12, Royal Institute of Technology, Stockholm, Sweden.
- Hartman, T. (1999). Steel Fiber Reinforced Concrete. Master Thesis., Department of Structural Engineering. Royal Institute of Technology, Stockholm, Sweden.
- Halvorsen, G.T., Kesler,C.E., Robinson,A.R., Stout, J.A. (1976). Durability and Physical Properties of Steel Fiber Reinforced Concrete. Report n° DOT-TST 76T-31, US, Department of Transportation, Federal railway administration, Washington DC.
- Naaman, A. E. 1985. Fiber reinforcement for concrete. Concrete International, 7, 21-25.
- A.Nikhilgadg, “Mix Design of Fiber Reinforced Concrete (FRC) Using Slag & Steel Fiber” International Journal of Modern Engineering Research (IJMER) Vol. 3, Issue. 6, Nov - Dec. 2013 pp-3863-3871.
- G.A. Pikus, “Steel Fiber Concrete Mixture Workability” Procedia Engineering 150 (2016) 2119 – 2123.
- ParveenKaur, “Different types of Fibres used in FRC” Volume 8, No. 4, May 2017.
- PrakashMondal, “Steel fiber reinforced concrete and its use in building” international journal of research in engineering and technology eissn: 2319-1163 | PISSN: 2321-7308.
- S.Ragavendra, I.PraveenReddy, Dr.Archanaa Dongre, “Fibre Reinforced Concrete” ResearchGate Publication 321937230.
- Surendra P. Shah , James I. Daniel, DarmawanLudirdja, “Toughness of Glass Fiber reinforced concrete panels subjected to accelerated aging”, PCI Journal, September-October 1987, (pp 83-88).
- Wiliamson, G.R. (1974). The Effect of Steel Fibers on Compressive Strength of Concrete, Fiber Reinforced Concrete.SP-44.ACI,pp 195-207, Detroit. Michigan, USA.
- Williamson, G. & Morse, D. 1977. Corrosion Behaviour of Steel Fibrous Concrete. Construction Engineering Research Lab (Army) Champaign Ill.