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An Experimental Approach for the Study on Mechanical Properties of M30 Grade Concrete when the Steel Fibers are Induced

T. Naidu[1], K. Murali[2], M. Anata rao[3], D. Vamsi Krishna[4], K. Baskhar Rao[5], S. Durga Prasad[6]
[1]Asst. Professor NSRIT (A) (Guide), [2, 3, 4, 5, 6]B.Tech, Department of Civil Engineering, JNTU-GV

Abstract: ***Fibre Reinforced Concrete (FRC) material is a developed concrete that has been proposed to improve the tensile behaviour of the concrete using fibres in the concrete mix. Steel Fibre Reinforced Concrete (SFRC) is popular FRC material that is being studied to improve the structural behaviour of members under different load conditions.***
This study aims to investigate and examine the structural behaviour of steel fibre reinforced concrete material at different volume fraction of the fibers. Experimental work is conducted for this research to obtain results on the behaviour of SFRC. The experimental work consists of testing concrete under tension and compression.
A result data obtained has been analyzed and compared with a control specimen (0% fiber).a relationship between aspect ratio Vs compressive strength, aspect ratio Vs spilt tensile strength represented graphically. Result data clearly shows percentage increase in 28 days compressive strength and spilt tensile strength for M30 Grade of concrete.
Keywords: Steel Fibres, M30 Grade Concrete, SFRC, Strength Comparison, etc.

I. INTRODUCTION

Plain concrete slabs are known to have low strength and low strain capacity, however these structural properties could be improved by addition of fibres, allowing the thickness of the layer to be reduced. There are different fibres that are used in the concrete namely glass fibre, steel fibre, synthetic fibres and natural fibres. The improvement in the material behaviour of the fibre reinforced concrete depends on dosage and characteristics of the used fibres. The main important effect of fibres as reinforcement is to influence and control the tensile cracking of concrete. Yet, the fibre reinforced concrete is known to have considerable impact on the slab cost owing to reduced thickness needs, prolonged useful life and reduction in maintenance costs. Amongst the fibres mentioned, steel fibres are the most researched and more practical. Steel fibre reinforced concrete is a type of concrete that contains randomly oriented discrete steel fibres. The main aim of addition of steel fibres to concrete is to control crack widening and crack propagation after the concrete matrix has cracked. By control of the cracking the mechanical properties of the composite material as a result will be improved significantly.

II. OBJECTIVE OF THE STUDY

1) Review previous research on FRC material and structural behaviour of structural members.
2) Review previous experimental research on the impact behaviour of slabs and use of fibers.
3) Review the numerical studies conducted by previous researchers to analyse the impact behaviour of slabs.
4) To evaluate the effect of end hooked steel fibers on concrete mechanical behaviour consisting compressive strength, split tensile strength, flexural strength, and ductility.
5) To examine the effect of fiber volume fraction on SFRC material performance.
6) To make a comparison for the performance of concrete with and without steel fibre reinforcement on the material levels both graphically and qualitatively.

III. STEEL-FIBERS

B Steel fiber is a metal reinforcement. Steel fiber for reinforcing concrete is defined as short, discrete lengths of steel fibers with an aspect ratio (ratio of length to diameter) from about 20 to 100, with different cross-sections, and that are sufficiently small to be randomly dispersed in an unhardened concrete mixture using the usual mixing procedures. In this experimental approach, **Flat Crimped Steel Fibers** are used. The length of these fiber is 50 mm and diameter of 0.75 mm, whose aspect ratio is 65. These steel fibers exhibits a tensile strength of greater than 900 Mpa, which is conformed to ASTM A 820 & EN 14889 – 1 global standards.

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IV. MIX PROPORTIONS

Cement	=	489 Kg / cum
Water	=	220 lit / cum
Fine Aggregate	=	698 Kg / cum
COARSE Aggregate	=	972 Kg / cum
w / c ratio	=	0.45

V. RESULTS

A. *Effect of Steel Fibers on Compressive Strength*

Table : 1

7 days strength results	Strength in N/mm^2	Increase in strength (%)
Normal concrete	19.11	-
5% steel fibers	19.55	2.30
10% steel fibers	19.77	3.45
15% steel fibers	19.77	3.45

Table : 2

14 days strength results	Strength in N/mm^2	Increase in strength (%)
Normal concrete	22.44	-
5% steel fibers	22.89	2.00
10% steel fibers	24.00	6.95
15% steel fibers	24.67	9.93

Table : 3

21 days strength results	Strength in N/mm^2	Increase in strength (%)
Normal concrete	28.44	-
5% steel fibers	30.00	5.48
10% steel fibers	30.89	8.61
15% steel fibers	31.55	10.93

Table : 4

28 days strength results	Strength in N/mm^2	Increase in strength (%)
Normal concrete	33.11	-
5% steel fibers	34.89	5.37
10% steel fibers	36.44	10.05
15% steel fibers	36.89	11.41

B. *Effect of Steel Fibers on Compressive strength*

Table : 5

7 days strength results	Strength in N/mm^2	Increase in strength (%)
Normal concrete	2.41	-
5% steel fibers	2.97	23.23
10% steel fibers	3.18	31.95
15% steel fibers	3.39	40.66

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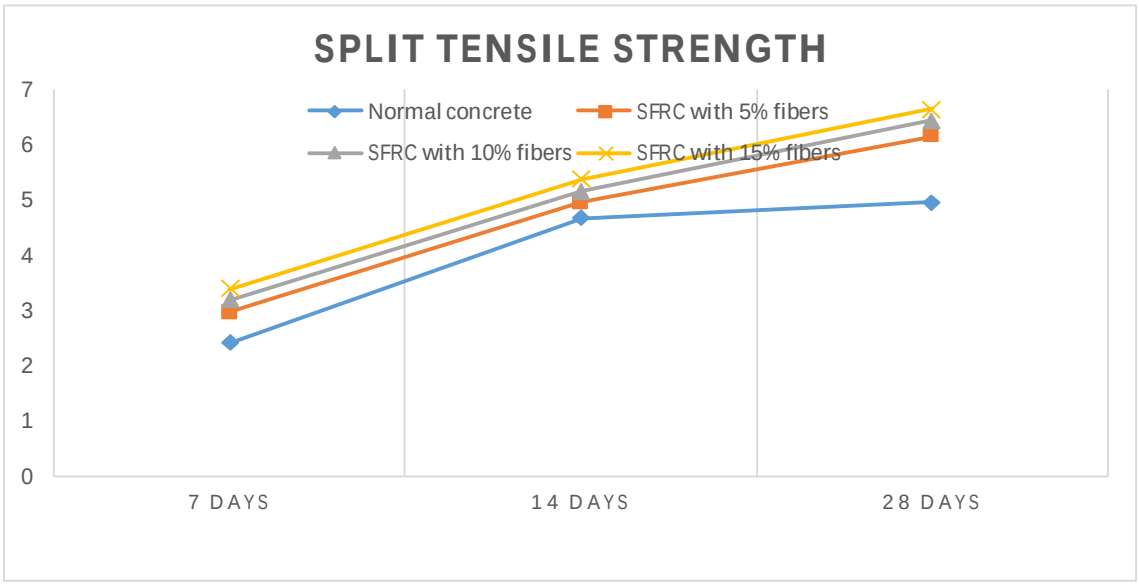
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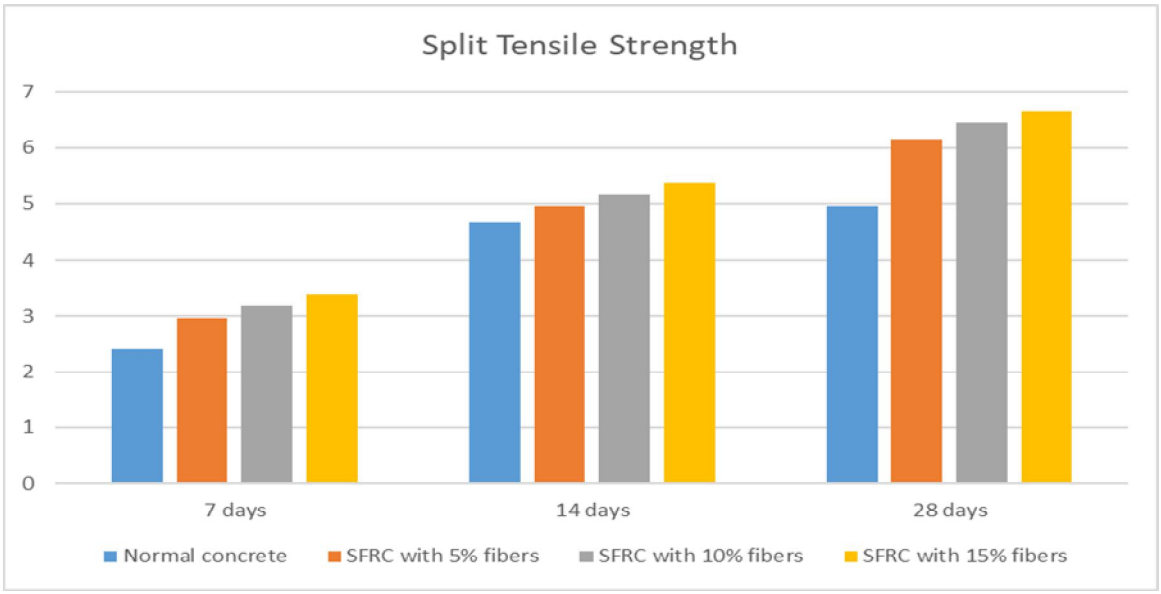
14 days strength results	Strength in N/mm^2	Increase in strength (%)
Normal concrete	4.67	-
5% steel fibers	4.95	5.99
10% steel fibers	5.16	10.49
15% steel fibers	5.38	15.20

Table : 7

28 days strength results	Strength in N/mm^2	Increase in strength (%)
Normal concrete	4.95	-
5% steel fibers	6.15	24.24
10% steel fibers	6.44	30.10
15% steel fibers	6.65	34.34

Graph shows the strength variation of M30 grade of concrete





VI. CONCLUSIONS

From above discussion it's far finish that, all mechanical properties viz. compressive strength and splitting strength are advanced via addition of fibers no matter what kind fiber is used and w/c ratio.

1) All strength likes compressive strength and splitting strength are advanced with increasing w/c ratio. The share growth of compressive strength various when different percentages of steel fibers mixed.

2) When 5% steel fibers are mixed and compared with 7, 14, 21 & 28 days compressive strength with normal concrete is discovered to be 2.3%, 2%, 5.48%, 5.37% respectively. When 10% steel fibers are mixed and compared with 7, 14, 21 & 28 days compressive strength with normal concrete is discovered to be 3.45%, 6.95%, 8.61% & 10.05% respectively. In the same way when 15% of steel fibers added to the concrete, the strength varies for 7, 14, 21 & 28 days are 3.45%, 9.93%, 10.93% & 11.41%.

3) The share increase of split tensile strength of concrete increases with respect to the percentage of fibers added to concrete. When 5% fibers added to the mix 7, 14 & 28 days strength is discovered to be 23.23%, 5.99% & 24.24%. When 10% fibers added to the mix 7, 14 & 28 days strength is discovered to be 31.95%, 10.49% & 30.10%. When 15% fibers added to the mix 7, 14 & 28 days strength is discovered to be 40.66%, 15.20% & 34.34%.

4) In general, the giant development in various strengths is located with the inclusion of steel fibers in the apparent concrete. But, maximum benefit in strength of concrete is found to rely upon the quantity of fiber content. The superior fiber content material to impart maximum gain in numerous strengths varies with sort of the strengths. The width of cracks is found to be much less in SFRC than that in conventional concrete.

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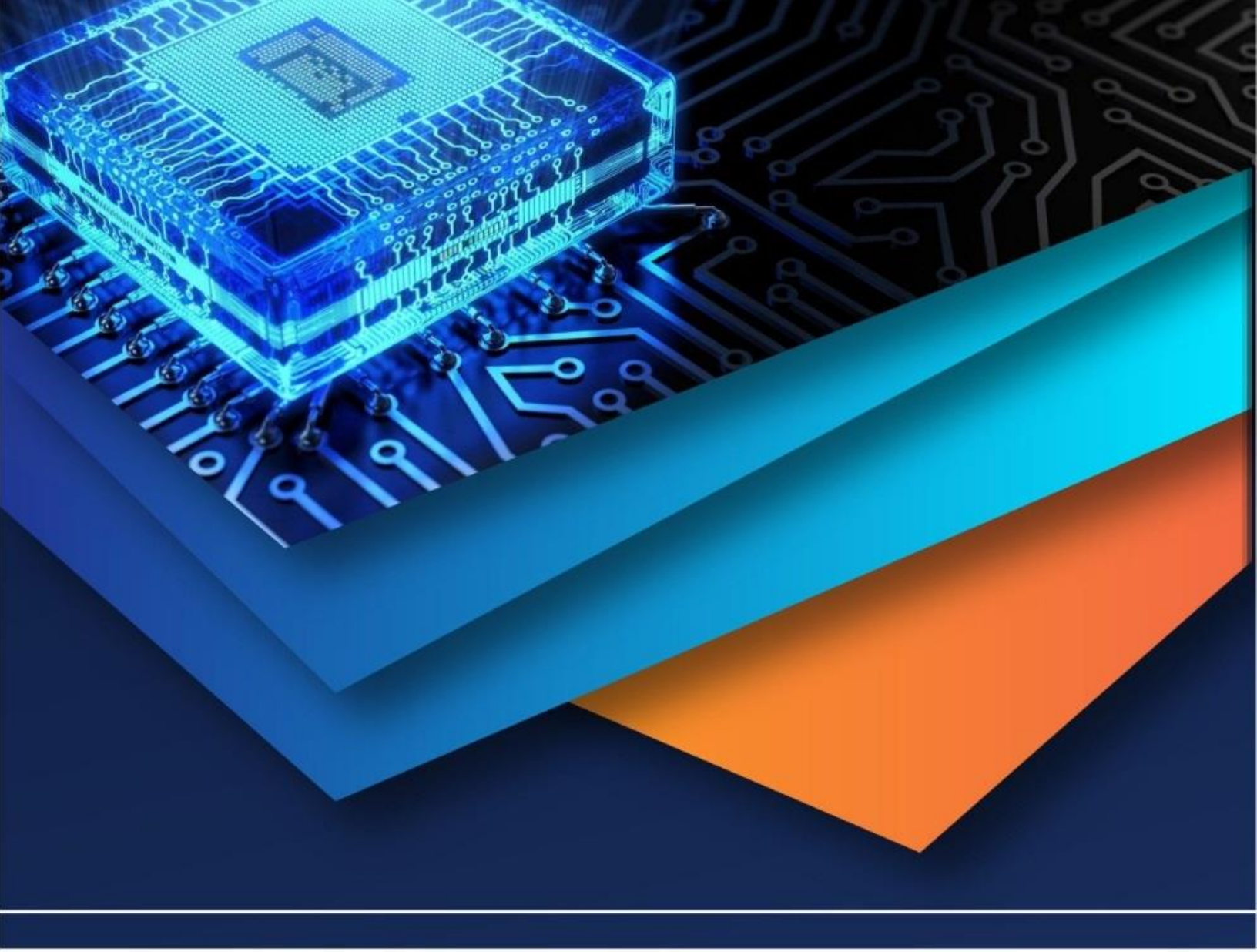
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