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Experimental Study on Compressive Strength and Split Tensile Strength of Steel Fiber Reinforced Concrete for M-25 Grade

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Abstract: ***In this modern age, civil engineering constructions have their own structural and durability requirements, every structure has its own intended purpose and hence to meet this purpose, modification in traditional cement concrete has become mandatory. It has been found that different type of fibers added in specific percentage to concrete improves the mechanical properties, durability and serviceability of the structure. It is now established that one of the important properties of Steel Fiber Reinforced Concrete (SFRC) is its superior resistance to cracking and crack propagation. In this paper effect of steel fibers on the compressive strength and split tensile strength for M 25 grade concrete having mix proportion 1:2.52:1.19 with water cement ratio 0.38 have been studied by varying the percentage of hook tain fibers in concrete. Fiber content were varied by 0.50%, 1% and 1.5% by volume of cement.. Steel fibers of 50, 55 and 60 aspect ratio were used. 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. split tensile strength, Result data clearly shows percentage increase in 28 days Compressive strength and split tensile strength for M-25 Grade of Concrete. . The optimum fiber content for the compressive strength and flexural strength is 1.5% and the ideal aspect ratio is 60.***
Keywords : Steel fiber increases Compressive, split tensile Strength of Concrete.

I. INTRODUCTION

Fiber_reinforced_concrete is a composite material comprised of Portland cement, aggregate, and fibers. Normal unreinforced concrete is brittle with a low tensile strength and strain capacity. The function of the irregular fibers distributed randomly is to fill the cracks in the composite. Fibers are generally utilized in concrete to manage the plastic shrink cracking and drying shrink cracking. They also lessen the permeability of concrete and therefore reduce the flow of water. Some types of fibers create greater impact, abrasion and shatter resistance in the concrete. Usually fibers do not raise the flexural concrete strength. The quantity of fibers required for a concrete mix is normally determined as a percentage of the total volume of the composite materials. The fibers are bonded to the material, and allow the fiber reinforced concrete to withstand considerable stresses during the post-cracking stage. The actual effort of the fibers is to increase the concrete toughness.

During recent years, steel fiber reinforced concrete has gradually advanced from a new, rather unproven material to one which has now attained acknowledgment in numerous engineering applications. Lately it has become more frequent to substitute steel reinforcement with steel fiber reinforced concrete. The applications of steel fiber reinforced concrete have been varied and widespread, due to which it is difficult to categorize. The most common applications are tunnel linings, slabs, and airport pavements.Many types of steel fibers are used for concrete reinforcement. Round fibers are the most common type and their diameter ranges from 0.25 to 0.75 mm. Rectangular steel fibers are usually 0.25 mm thick, although 0.3 to 0.5 mm wires have been used in India. Deformed fibers in the form of a bundle are also used. The main advantage of deformed fibers is their ability to distribute uniformly within the matrix.

II. EXPERIMENTAL PROGRAMME

A. Material Used

The material used for this experimental work are cement, sand, water, steel fibers . *Cement:* Ordinary Portland cement of 43 grade was used in this experimentation conforming to I.S. – 8112-1989.

1) *Sand:* Locally available sand zone II with specific gravity 2.68, water absorption 1.1% and fineness modulus 2.10, conforming to I.S. – 383-1970.

2) *Coarse Aggregate:* Crushed granite stones of 10 mm size having specific gravity of 2.74, fineness modulus of 5.9, conforming to IS 383-1970
3) *Water:* Potable water was used for the experimentation.
1) *Fibers:*
a) *Steel Fibers:* In this experimentation Hook tain Steel fibres were used. The different aspect ratios adopted were 50, 55, and 60.

B. Experimental Methodology

1) *Compressive Strength Test:* For compressive strength test, cube specimens of dimensions 150 x 150 x 150 mm were cast for M25 grade of concrete. The moulds were filled with 0%, 0.5% 1.0% and 1.5% fibres. Vibration was given to the moulds using table vibrator. The top surface of the specimen was levelled and finished. After 24 hours the specimens were demoulded and were transferred to curing tank where in they were allowed to cure for 28 days. After 28 days curing, these cubes were tested on digital compression testing machine as per I.S. 516-1959. The failure load was noted. In each category three cubes were tested and their average value is reported. The compressive strength was calculated as follows. Compressive strength (MPa) = Failure load / cross sectional area.
2) *Split Tensile Strength Test.:* For Split tensile strength test, cylinder specimens of dimension 150 mm diameter and 300 mm length were cast. The specimens were demoulded after 24 hours of casting and were transferred to curing tank where in they were allowed to cure for 28 days. These specimens were tested under compression testing machine. In each category three cylinders were tested and their average value is reported. Split Tensile strength was calculated as follows as split tensile strength: Split Tensile strength (MPa) = 2P / π DL, Where, P = failure load, D = diameter of cylinder, L = length of cylinder.

III. EXPERIMENTAL RESULTS

Following graphs give compressive strength and Split Tensile strength result for M-25 grade of concrete with 0%, 0.5%, 1.0% and 1.5% steel fibres for aspect ratio 50, 55 and 60

Table 1 – Compressive Strength of SFRC with 0% fibres M25 grade

Compressive strength (MPa)	Average Compressive strength (MPa)
33.12 27.85 29.18	30.05

Table 2 – Compressive Strength Of Sfrc With 0.5%, 1.0% And 1.5% Fibres

Different aspect ratios of fibres	For SFRC with 0.5% fibres		For SFRC with 1.0% fibres		For SFRC with 1.5% fibres	
	Comp. strength (MPa)					
		Avg.		Avg.		Avg.
50	36.56 34.44 35.33	35.44	37.67 38.00 36.89	37.52	39.89 40.11 41.07	40.36
55	37.89 31.56 31.42	33.62	37.85 36.08 35.15	36.36	37.01 37.09 40.10	38.07
60	38.12 34.42 36.20	36.25	39.61 37.25 39.50	38.79	43.52 41.12 42.18	42.37

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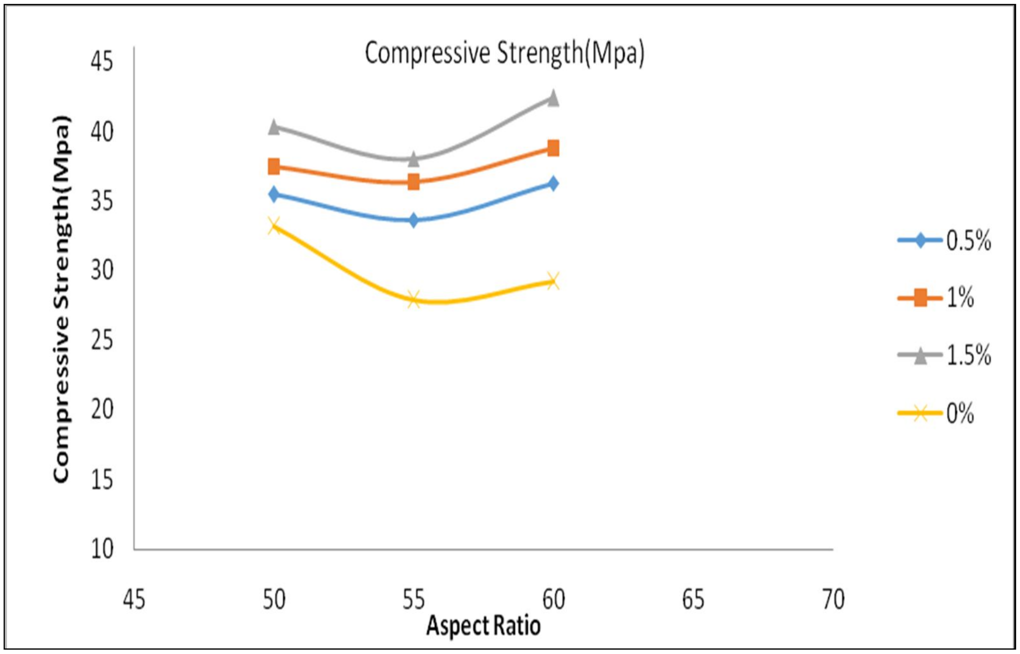


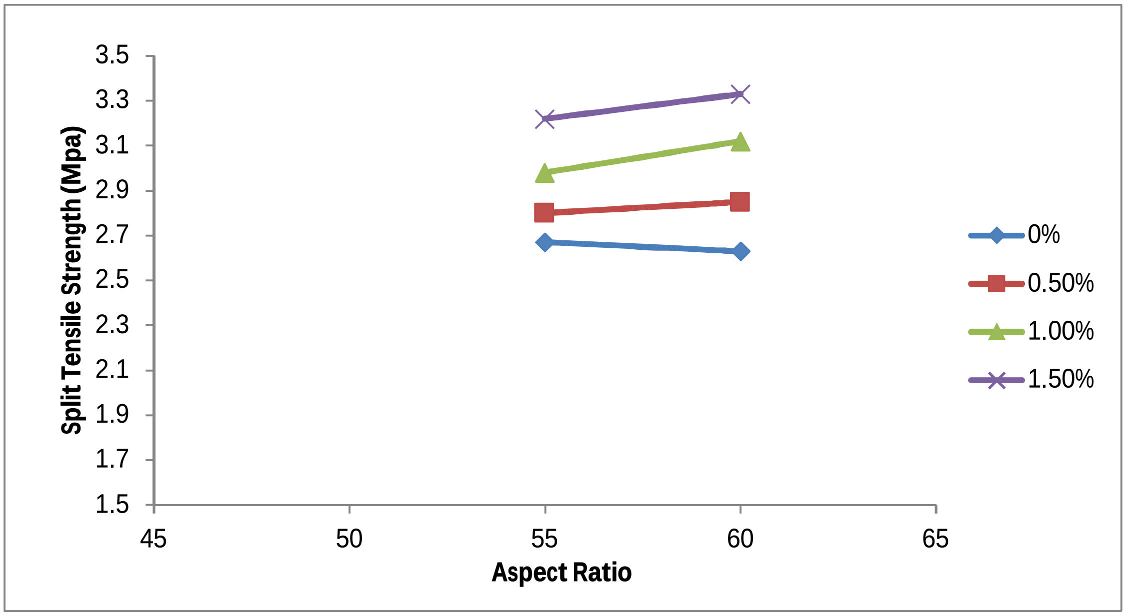
Compressive strength VS Aspect Ratio graph

Table 3–Split Tensile Strength of SFRC with 0% fibres M25 grade

Split Tensile strength (MPa)	Average Split Tensile strength (MPa)
2.61 2.67 2.63	2.64

Table 4 – Split Tensile Strength of SFRC with 0.5%, 1.0% and 1.5% fibres M25 grade

Different aspect ratios of fibres	For SFRC with 0.5% fibres		For SFRC with 1.0% fibres		For SFRC with 1.5% fibres	
	Split Tensile strength (MPa)					
		Avg.		Avg.		Avg.
50	2.74 2.70 2.76	2.73	2.90 2.95 2.92	2.92	3.15 3.18 3.17	3.17
55	2.75 2.79 2.85	2.80	2.9 3.00 2.97	2.98	3.22 3.25 3.20	3.22
60	2.86 2.82 2.88	2.85	3.12 3.10 3.15	3.12	3.36 3.30 3.34	3.33



Split Tensile strength VS Aspect Ratio graph

IV. CONCLUSIONS

The following conclusions could be drawn from the above investigation.

A. It is observed that compressive strength and split tensile strength are on higher side for 1.5% fibres as compared to that produced from 0%, 0.5%, 1.0% fibers.
B. All the strength properties are observed to be on higher side for aspect ratio of 60 as compared to those for aspect ratio 50 and 55
C. It is observed that compressive strength increases from 20 to 40% with addition of steel fibers.
D. It is observed that split tensile strength increases from 18 to 26% with addition of steel fibers.

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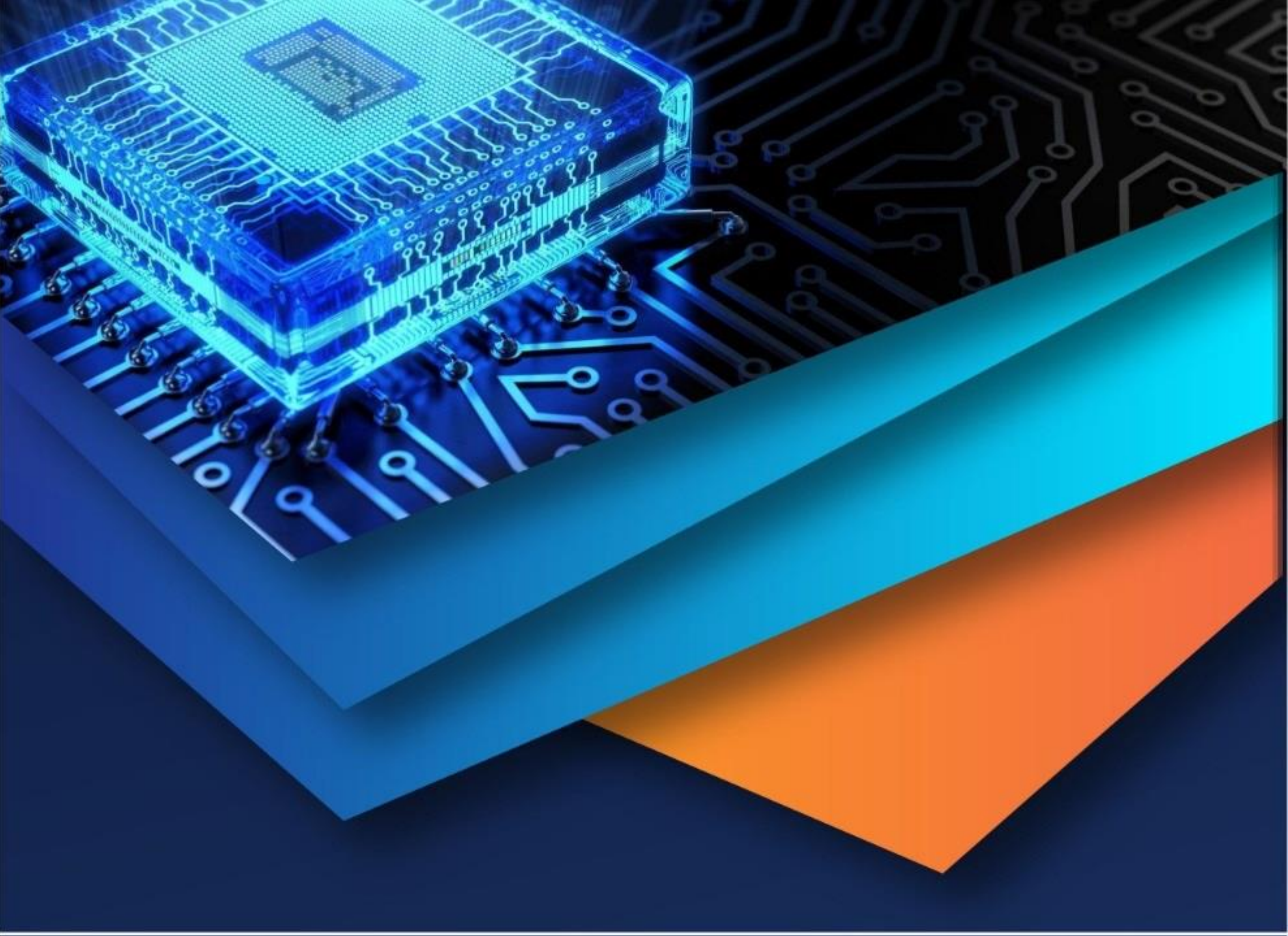

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