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

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***Abstract:** Critical investigation for M-25 grade of concrete having mix proportion 1:2.52:1.19 with water cement ratio 0.38 to study the compressive strength, flexural strength of steel fibre reinforced concrete (SFRC) containing fibers of 0%, 0.5%, 1.0% and 1.5% volume fraction of hook tain 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 and aspect ratio vs. flexural strength has been represented graphically. Result data clearly shows percentage increase in 28 days Compressive strength and Flexural 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, Flexural Strength of Concrete.*

I. INTRODUCTION

Steel fiber reinforced concrete is a composite material having fibers as the additional ingredients, dispersed uniformly at random in small percentages, i.e. between 0.5% and 1.5% by volume in plain concrete. Steel fibers are added to concrete to improve the structural properties, particularly tensile and flexural strength. The extent of improvement in the mechanical properties achieved with SFRC over those of plain concrete depends on several factors, such as shape, size, volume, percentage and distribution of fibers. Plain, straight and round fibers were found to develop very weak bond and hence low flexural strength. For a given shape of fibers, flexural strength of SFRC was found to increase with aspect ratio (ratio of length to equivalent diameter).Even though higher ratios of fibers gave increased flexural strength, workability of green SFRC was found to be adversely affected with increasing aspect ratios. Hence aspect ratio is generally limited to an optimum value to achieve good workability and strength. Grey suggested that aspect ratio of less than 60 are best from the point of handling and mixing of fibers, but an aspect ratio of about 100 is desirable from strength point of view. Schwarz however suggested aspect ratio between 50 and 70 is more practicable value for ready mix concree.

In most of the field applications tried out to date, the size of the fibers varies between 0.25 mm and 1.00mm in diameter and from 12mm to 60mm in length, and the fiber content ranged from 0.5 to 1.5 percent by volume. Mixing of steel fibers considerably improves the structural properties of concrete, particularly tensile and flexural strength. Ductility and post cracking strength, resistance to fatigue, spalling and wear and tear of SFRC are higher than in the case of conventional reinforced concrete.

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.

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.

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

Water: Potable water was used for the experimentation.

1) *Fibers:* Steel Fibers: - In this experiment Hook tain Steel fibres were used. The different aspect ratios adopt 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 , 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.

C. Flexural Strength Test

For flexural strength test beam specimens of dimension 100x100x500 mm 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 flexural strength specimens were tested under two point loading as per I.S. 516-1959, over an effective span of 400 mm on Flexural testing machine. Load and corresponding deflections were noted up to failure. In each category three beams were tested and their average value is reported. The flexural strength was calculated as follows.

Flexural strength (MPa) = (P x L) / (b x d2),

Where, P = Failure load, L = Centre to centre distance between the support = 400 mm, b = width of specimen=100 mm, d = depth of specimen= 100 mm.

III. EXPERIMENTAL RESULTS

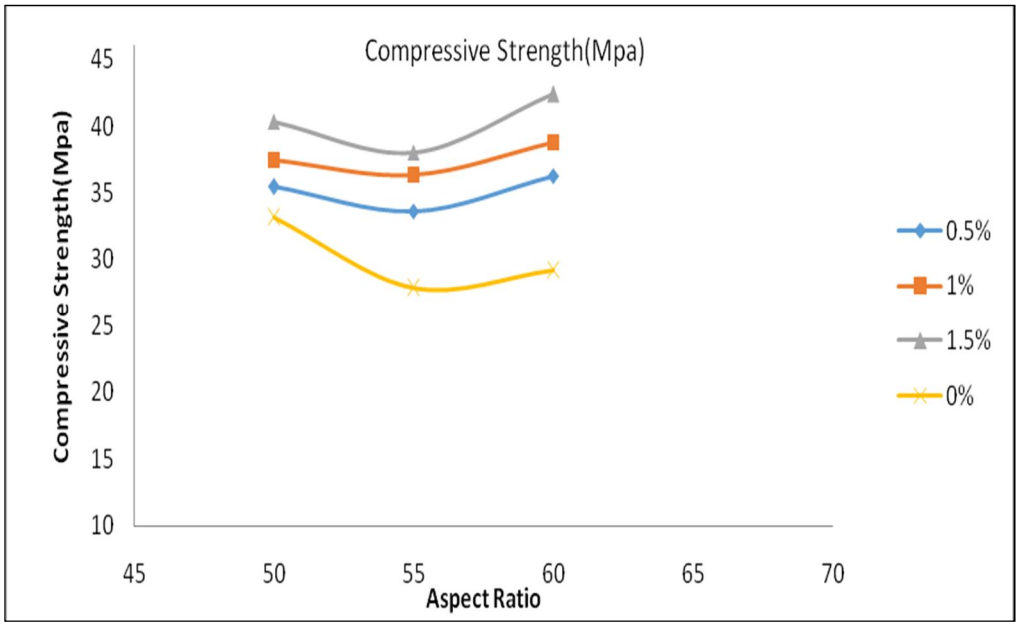
Following graphs give compressive strength and flexural strength result for M-25 grade of concrete with 0%, 0.5%, 1.0% and 1.5% steel fibres for aspect ratio 50, 55 and 60 .

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



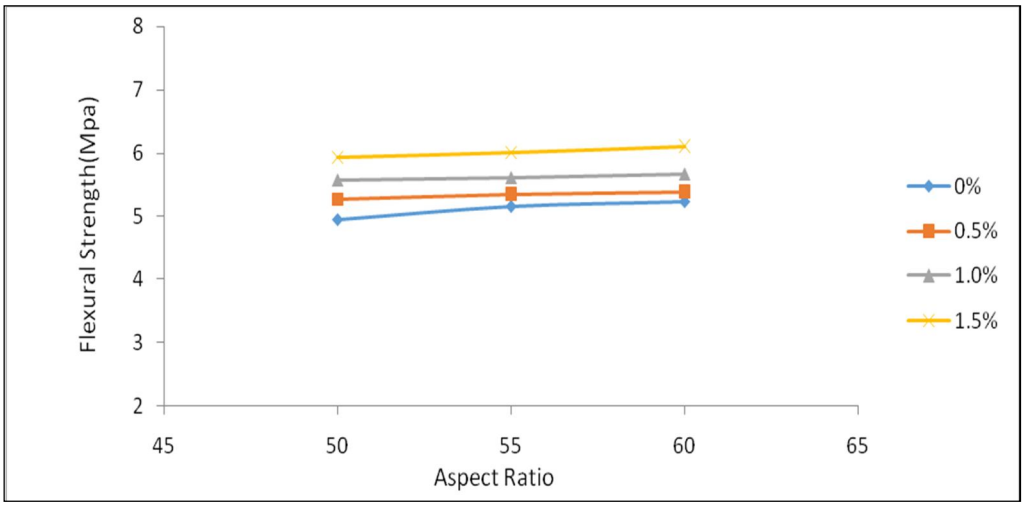
Compressive strength VS Aspect Ratio graph

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

Flexural strength (MPa)	Average Flexural strength (MPa)
4.95 5.16 5.24	5.17

Table 4 – Flexural 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	
	Comp. strength (MPa)					
		Avg.		Avg.		Avg.
50	5.52 5.64 5.58	5.58	5.24 5.32 5.28	5.28	5.91 5.95 5.98	5.94
55	5.57 5.61 5.68	5.62	5.27 5.31 5.44	5.34	6.00 5.99 6.05	6.01
60	5.72 5.62 5.67	5.67	5.49 5.34 5.30	5.38	6.10 6.04 6.16	6.10



Flexural 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 flexural strength are on higher side for 1.5% fibres as compared to that produced from 0%, 0.5% , 1.0% fibres.

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 fibres.

D. It is observed that flexural strength increases from 9 to 18% with addition of steel fibres.

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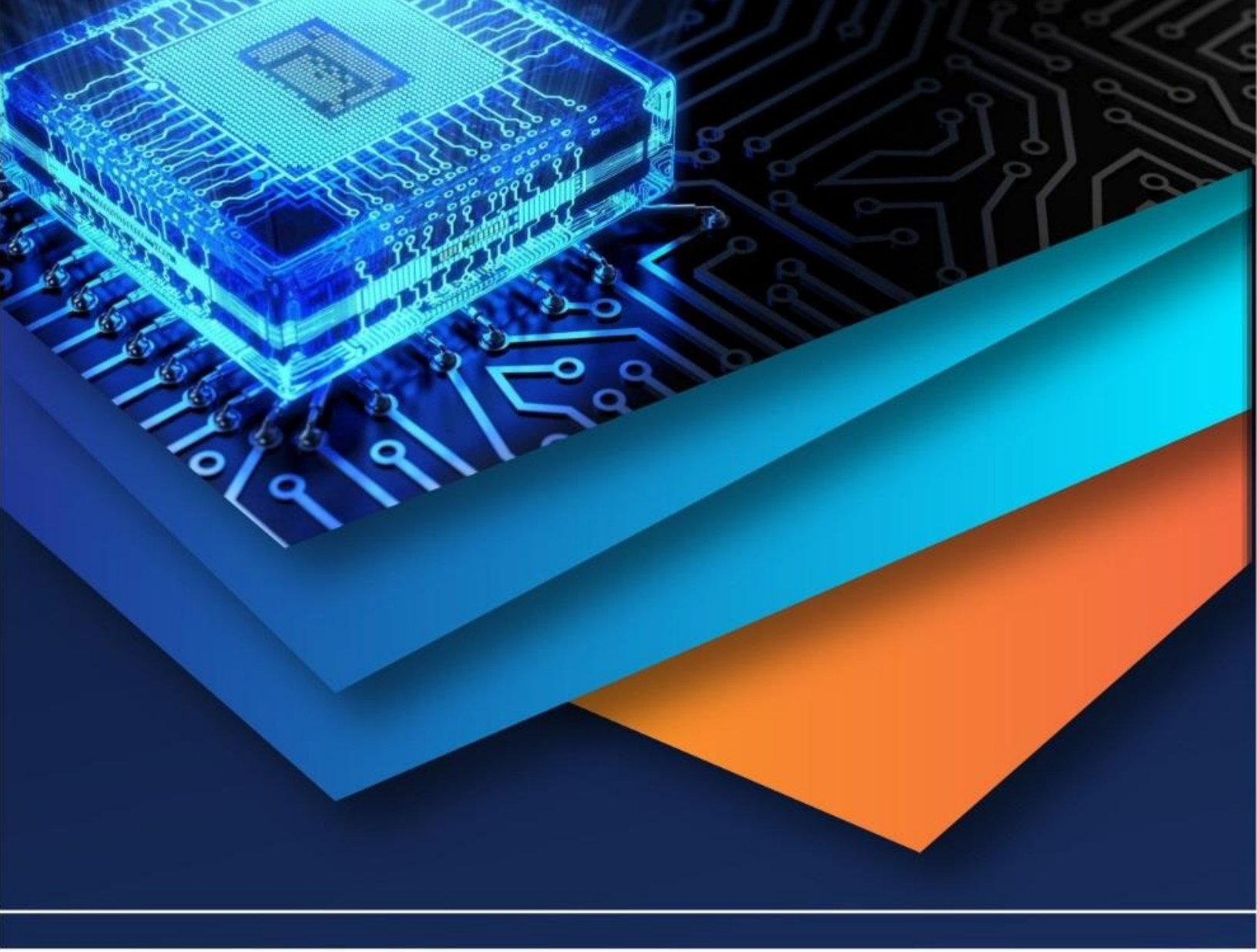

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