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Investigational Study of Steel Fibre Reinforced Cement Concrete (SFRC) with Superplasticizer

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Abstract: ***Fibre Reinforced cement concrete is broadly utilized now a days. Different types of fibres added are being used to improve the quality of concrete. In this work investigation is carried out to determine the effect of Super Plasticizers in Steel fibre reinforced cement concrete through a series of tests. Compressive quality of the control cubes and the compressive quality of steel fibre reinforced cement concrete containing superplasticizer is compared. The compressive strength of concrete containing Super Plasticizers and various percentages (0.5%, 0.75%, &1%) of steel fibre is determined after 7, 14 and 28 Days of curing stages. It is found that compressive strength of steel fibre reinforced cement concrete increases with the addition of superplasticizer and increase in percentage of steel fibre.***
Keywords: Steel Fibre, Superplasticizer, compressive strength, Initial and final setting time.

I. INTRODUCTION

Tensile strength of Plain cement concrete is very low; this leads to constrained pliability and tiny protection from splitting. In the solid concrete member inward micro cracks are naturally present due to its very poor tensile strength. These micro cracks, inevitably prompting to break the solid. Each kind of fibre has its specific properties and confinements. Different types of fibres being utilized in cement concrete are steel filaments, carbon, polypropylene, glass, nylons, asbestos sand coir fibre etc. They can be roundabout or level. The ratio of its length to its diameter is called as aspect ratio. Steel fibres are used in various types of civil structures.

II. MATERIALS USED

In this investigational work following materials are used cement, Coarse aggregate, Superplasticizer, water, fine aggregate, Steel fibre.

1) Steel Fibre: Brand Name: Perfect Solution, Pune

Table1. Properties of steel fibre (https://www.perfectsteelfiber.com)

S. No.	Physical Properties	Results
1.	Fibre type	Hook End
2.	Specific gravity	2.55
3.	Aspect Ratio	58
4.	Length	35 mm
5.	Diameter	0.60 mm

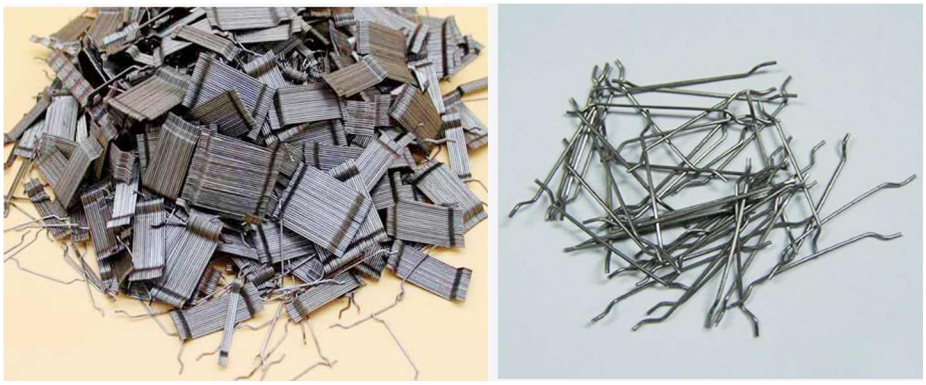

Fig. 1. Steel Fibre

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2) *Water:* Potable water is by and large viewed as acceptable for blending concrete. Locally accessible drinking water is utilized for mixing.
3) *Cement:* OPC 43 grade cement as per IS 8112 was used. Brand Name: Ultra Tech

Table2. Properties of OPC

S. No.	Physical properties	Results
1	OPC Specific gravity	3.14
2	Fineness of OPC	5.26 %
3	Standard Consistency	33 %
3	OPC Initial Setting Time	55 Minutes
4	OPC Final Setting Time	210 Minutes

4) *Coarse Aggregate:* Nominal maximum size of aggregate was 20mm. It was collected from local material suppliers. Specific gravity of coarse aggregate was 2.85. Fineness Modulus of coarse aggregate was 6.91
5) *Fine Aggregate***:** Locally available River sand collected from local material supplier and passing through 4.75mm sieve was used. Its specific gravity was 2.67. The fine aggregate grading zone was II as per IS 383-1970.Fineness modulus of fine aggregate was 2.87
6) *Super Plasticizers:* Conplast Sp 430: Brand Name: Fosroc Chemicals, India, pvt. ltd.

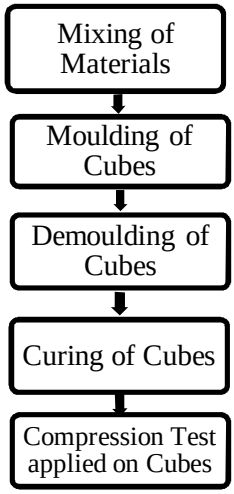
Table3. Properties of super plasticizer (https://www.fosroc.com)

S. No.	Physical Properties	Results
1..	Superplasticizer type	Conplast, SP 430
2.	Content of Chloride	Nil
3.	Specific gravity	1.225 at 30^0C
4.	Air entrainment	1 % Approx extra air is entrained

III. METHODOLOGY

First of All, weigh all the Materials i.e. Cement, Sand, Coarse aggregate, steel fibre, water, superplasticizer. All the materials were mixed by Mechanical Mixer. Control concrete and steel fibre reinforced cement concrete (with and without superplasticizer) samples (dimensions 150 mm x 150 mm x 150 mm) were prepared.

A. Following Steps Are Follows In This Research



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B. Compressive Strength Test

Concrete samples of size 150mm *150mm *150 mm were tested for compressive strength. The table vibrator was utilized to compact the concrete in the moulds. The top surface of the concrete was smoothed. After 24 hours, the solid shapes were demoulded and were moved to curing water tank for different ages curing i.e 7 days, 14 days, and 28 days. After 7 days, 14 days, 28 days samples were tested on compression testing machine according to I.S. 516-1959. The failure load was noted. Compressive strength (MPa) = $\frac{\text{Crushing load}}{\text{cross}-\text{ sectional area}}$

Fig.2. compressive strength test on CTM Machine

IV. RESULTS

A. Compressive Strength Test

It is done via CTM machine. Solid cubes compressive strength were gotten at 7 days, 14 days, and 28 days. It is performed in our college Lab. The consequences of the tests are demonstrated as follows:

Table 4. Compressive strength of plain concrete with 0 % fibres

Days	Sample Designation	Compressive strength (MPa)	Average strength (MPa)
7 days	PS1	34.43	32.75
	PS2	33.33	
	PS3	30.50	
14 days	PS1	38.50	38.05
	PS2	40.22	
	PS3	35.44	
28 days	PS1	41.32	40.04
	PS2	38.57	
	PS3	40.24	

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Table 5. Compressive strength of plain concrete with Superplasticizer and 0% fibre

Days	Sample Designation	Compressive strength (MPa)	Average strength (MPa)
7 days	SS1	38.11	36.64
	SS2	35.42	
	SS3	36.41	
14 days	SS1	37.33	38.73
	SS2	40.19	
	SS3	38.67	
28 days	SS1	41.14	41.55
	SS2	40.31	
	SS3	43.22	

Table 6. Compressive strength of concrete with different fibre percentages

Compressive strength (MPa)									
Days	0.5 % Steel Hook End Fibre			0.75% Steel Hook End fibre			1 % Steel Hook End fibre		
	Sample Designation		Average strength (MPa)	Sample Designation		Average strength (MPa)	Sample Designation		Average strength (MPa)
7 days	SF11	51.15	48.54	SF21	50.51	50.49	SF31	51.53	51.35
	SF12	48.14		SF22	48.50		SF32	49.12	
	SF13	46.33		SF23	52.47		SF33	53.42	
14 days	SF11	48.24	49.50	SF21	52.22	51.9	SF31	54.91	53.17
	SF12	51.15		SF22	50.12		SF32	50.89	
	SF13	49.11		SF23	53.36		SF33	53.73	
28 days	SF11	52.15	52.20	SF21	54.23	53.99	SF31	55.78	56.26
	SF12	54.12		SF22	52.33		SF32	57.45	
	SF13	50.33		SF23	55.41		SF33	55.56	

Table 7. Compressive strength of concrete with Superplastisizer and different fibre percentages

Compressive strength (MPa)									
Days	Superplasticizer and 0.5 % Steel Hook End Fibre			Superplasticizer and 0.75% Steel Hook End fibre			Superplasticizer and 1% Steel Hook End fibre		
	Sample Designation		Average strength (MPa)	Sample Designation		Average strength (MPa)	Sample Designation		Average strength (MPa)
7 days	SSF11	50.33	52.63	SSF21	54.71	52.71	SSF31	57.51	57.15
	SSF12	55.12		SSF22	50.89		SSF32	55.83	
	SSF13	52.46		SSF23	52.55		SSF33	58.12	
14 days	SSF11	58.22	56.40	SSF21	58.84	57.28	SSF31	59.27	60.32
	SSF12	56.55		SSF22	55.29		SSF32	60.44	
	SSF13	54.44		SSF23	57.73		SSF33	61.27	
28 days	SSF11	61.42	61.82	SSF21	63.38	64.89	SSF31	68.74	67.90
	SSF12	63.78		SSF22	66.52		SSF32	64.99	
	SSF13	60.27		SSF23	64.78		SSF33	69.97	

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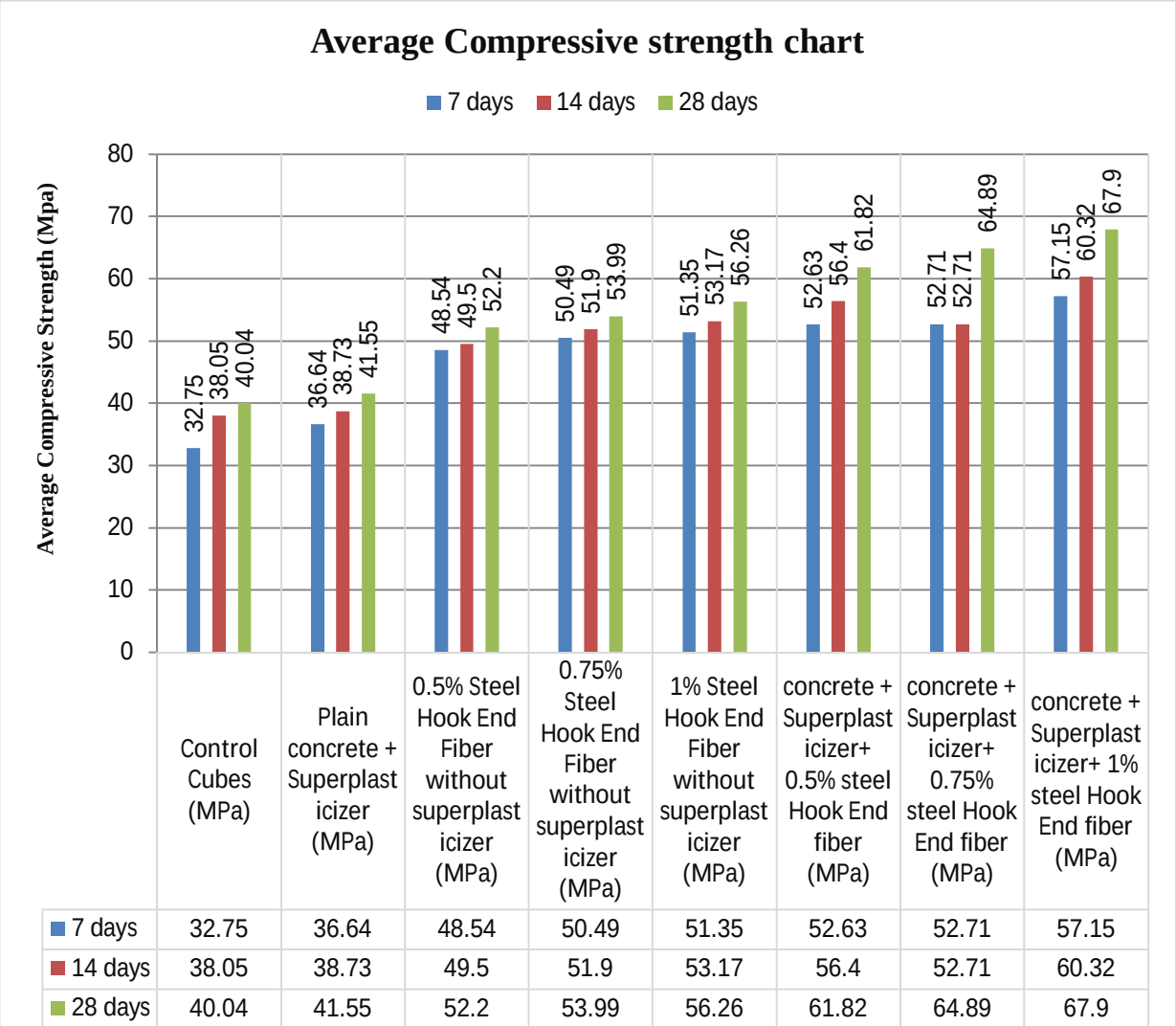
Table 8. Average compressive strength variation of various samples at 28 days

Average Compressive strength (Mpa)								
Days	Average strength of plain concrete with 0 % fibres (Mpa)	Average Compressive strength of plain concrete with Superplasticizer and 0% fibre (Mpa)	Average compressive strength of concrete with different fibre percentages (Mpa)			Average compressive strength of concrete with Superplastisizer and different fibre percentages (Mpa)		
			0.5 % Steel Hook End Fibre	0.75% Steel Hook End fibre	1 % Steel Hook End fibre	Superplasticizer and 0.5 % Steel Hook End Fibre	Superplasticizer and 0.75% Steel Hook End fibre	Superplasticizer and 1% Steel Hook End fibre
28 days	40.04	41.55	52.20	53.99	56.26	61.82	64.89	67.90



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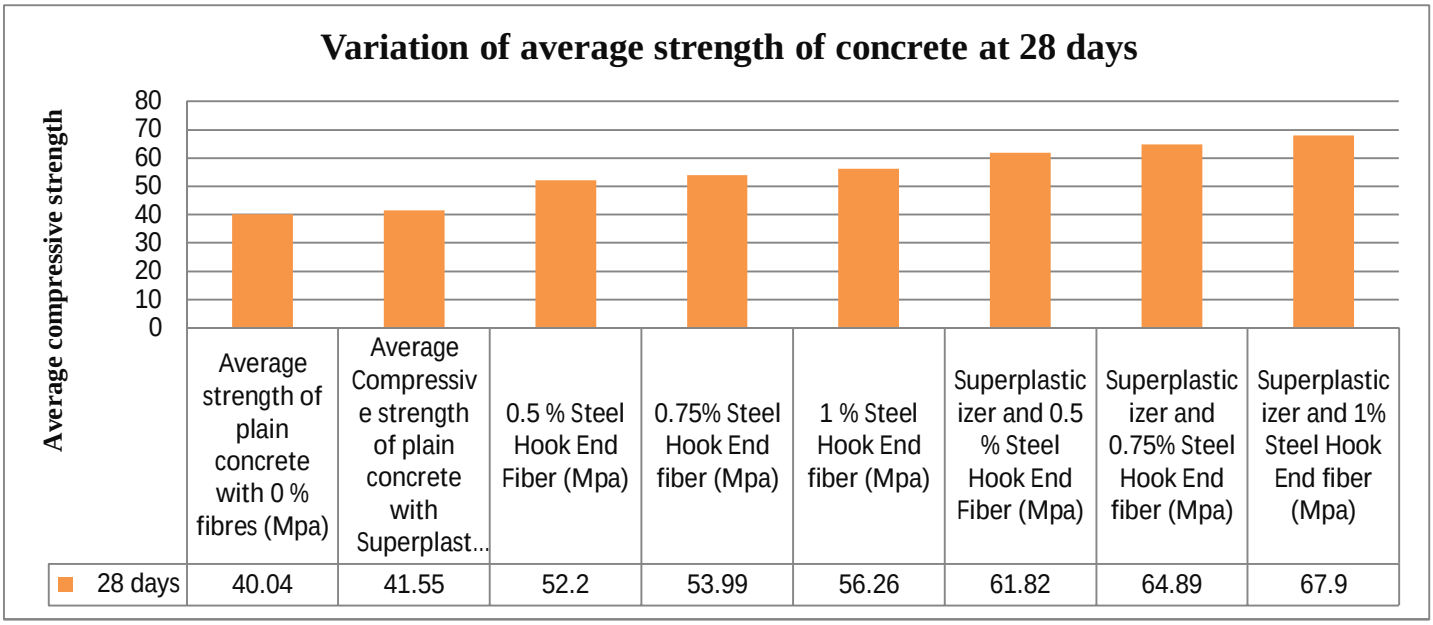

V. CONCLUSION

The following conclusions could be drawn from the present investigations.

A. It is observed that compressive strength of concrete is on higher side for 1 % steel fibre as compared to that produced from 0 %, 0.5 %. 0.75 % steel fibre.

B. The addition of steel fiber and superplasticizer increases the compressive strength to a great extent.

C. The concrete containing 1 % steel fibre along with superplasticizer is having average compressive strength 68 % higher than the concrete without super plasticizer

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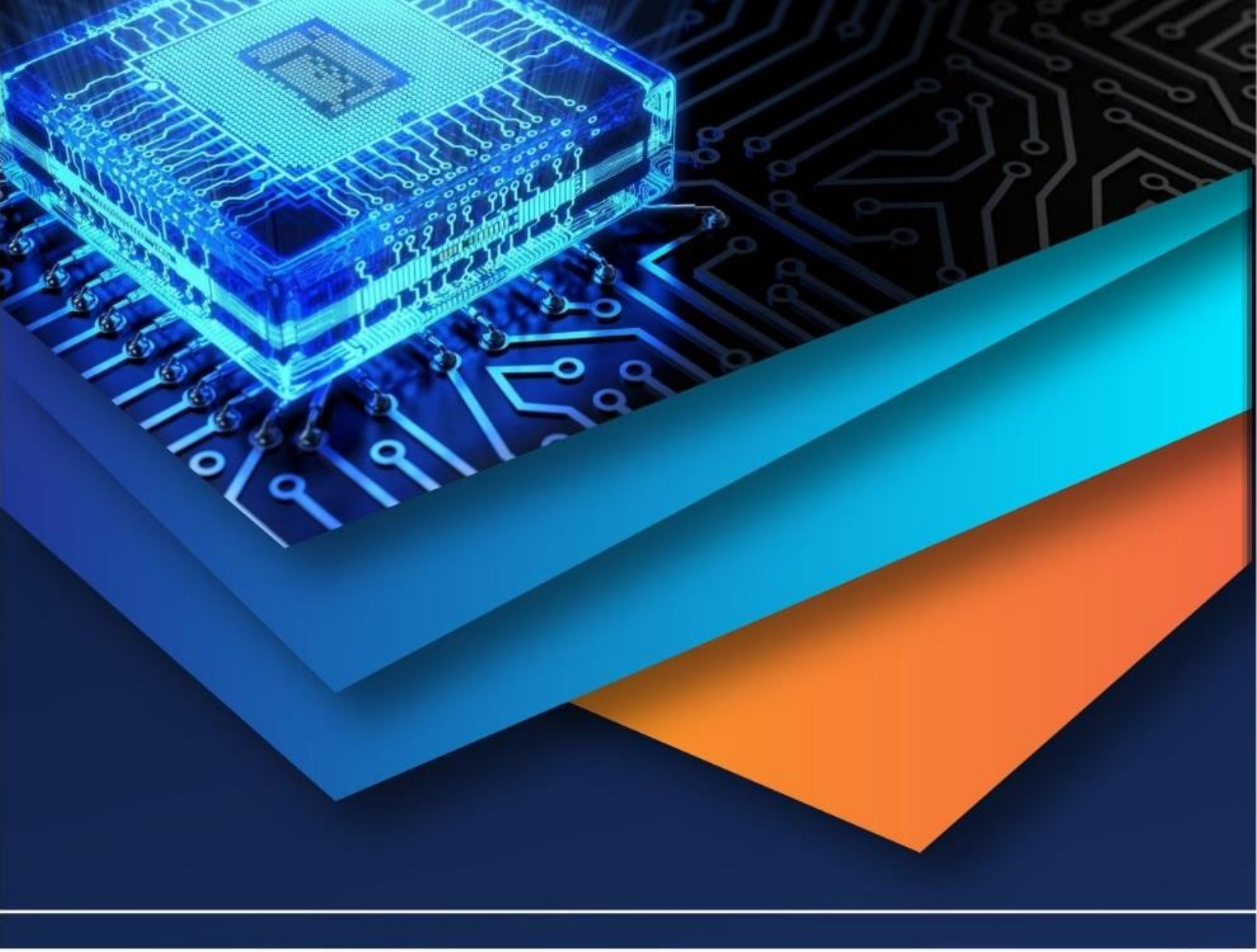

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