PERFORMANCE OF CONCRETE BY USING STEEL FIBRE An Experimental Study

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Abstract - *The purpose of this research is based on the investigation of the use of steel fibres in structural concrete to enhance the mechanical properties of concrete. The objective of the study was to determine and compare the differences in properties of concrete containing without fibres and concrete with fibres. This investigation was carried out using several tests, compressive test and flexural test. A total of eleven mix batches of concrete containing 0% to 5% with an interval of 1% by wt. of cement. 'Hooked' steel fibres were tested to determine the enhancement of mechanical properties of concrete. The workability of concrete significantly reduced as the fibre dosage rate increases.*

***Key Words*: Steel Fibre , Compressive test, Hooked Steel Fibre, Flexural test, Spliting tensile strength.**

1. INTRODUCTION

Concrete is mostly wide construction material in the world due to its ability it can be mould and shape. However concrete has some deficiencies as listed below, Low tensile strength, Low post cracking capacity, Brittleness and low ductility, Limited fatigue life, not capable of accommodating large deformations, Low impact strength. These properties can be improved by the use of steel fiber reinforced concrete. The fibers are dispersed and distributed randomly in the concrete during mixing, and thus improve concrete properties in all directions. The fiber helps to arresting the internal widening cracks and fly ash helps as an admixture for improving the properties of concrete. The introduction of the paper should explain the nature of the problem, previous work, purpose, and the contribution of the paper. The contents of each section may be provided to understand easily about the paper.

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2. LITERATURE SURVEY

Ganeshan N et al, (2007)[1] „steel fibre reinforced high performance concrete for seismic resistant structure" Civil Engineering and construction.

They had investigate a series of compression tests were conducted on 150mm x 150mm x 150mm cubes, 150mm x 300mm cylinders to find compressive strength, static and dynamic modulus of elasticity with and without steel fibers of volume fractions 0%, 0.5%, 1%, 1.5% of 0.5mm dia of aspect ratio 60 on PPC concrete. The weight density of concrete increasing with increasing of steel fibre content. Compressive strength and modulus of elasticity increased with addition of steel fibers. The compressive strength increased with the increase in silica fume with normal concrete. As a result the incorporation of steel fibers, silica fume and cement as produced a strong composite with superior crack resistance, improved ductility and strength behaviour prior to loading.

Bhikshma V, Ravande Kishor and Nitturkar (2005) [2]," Mechanical properties of fibre reinforced high strength concrete „Recent advances in concrete and construction tech.

They had studied the effect of fibers on workability, compressive strength, split tensile strength, modulus of rupture of concrete and also studied the effect of fibers on impact and toughness of concrete. They investigated an experimental study were steel fibers added at the volume of 0.5%, 1%, 1.5%, 2%.. They draw the following conclusions: Due to high content of fibre, large surface area of fibers, fibers are sure to absorb more cement paste and increase of viscosity of mixture makes slump loss. The compressive strength increased from 6% to 17% with the increase of volume fraction of fibers. The split tensile strength increased from 18% to 47% with the increase of volume fraction of fibers. Flexural strength increased from 22% to 63% with the increase of volume fraction of fibers. Modulus of elasticity increased from 8% to 25% with the increase of volume fraction of fibers. Toughness increased by 19.27% with the increase of volume fraction of fibers when compared to plain concrete.

3. EXPERIMENTAL INVESTIGATION

Materials: Ordinary Portland Cement (OPC) of 43 grade J.K. Cement was used throughout the course of investigation. Specific gravity of this cement is 3.15.

Table -3.1: Properties of Cement

Sl. No	Property	Result
1.	Normal Consistency	32%
2.	Initial Setting time	30 mins
3.	Specific Gravity	3.15
4.	Fineness of cement	95%

Fine Aggregate

Natural sand used Specific gravity was 2.50, sieve analysis = III zone Natural sand as per IS: 383-1987 was used. Locally available River sand having bulk density 1860 kg/m^3 was used The properties of fine aggregate are shown in Tab 3.2

Table 3.2: Properties of fine aggregate

S. No	Property	Result
1.	Specific Gravity	2.50
2.	Fineness modulus	2.28
3.	Grading zone	III

Coarse Aggeragate

Natural coarse aggregates were obtained from Gunawata (Rajasthan). Specific gravity of these aggregates were 2.8. Crushed aggregate confirming to IS: 383-1987 was used. Aggregates of size 20mm and 12.5 mm of specific gravity 2.74 and fineness modulus 7.20 were used

Super Plasticizer

There are different type of chemical admixture which are being used in construction and they may be retarding admixture, accelerating admixture, water reducing admixture, air-entraining admixture, Super plasticizing admixture and retarding super plasticizing admixture but because of higher grade of concrete water reducing super plasticizer (workability aid) has been used here in this thesis work i.e. naphtha based as per IS 9103:1999.The super plasticizer which is used for the experimental performance is KavassuPlast SP-431/ Shaliplast SP-431.

It was advised by the manufacturer to shakeit well before use.

Brand of Admixure: Shalimar and Kavassu Brand
Product Description: ShaliplastSP-431/KavassuPlast SP-431
Product Form : Black Brown liquid

KavassuPlast SP-431/Shaliplast SP-431 is a chloride free super-plasticizer & water reducing agent for concrete. It has high workability to flow for concrete mixes so that the voids can be filled by the concrete slurry even with very less amount of compaction. The properties of super plasticizer are shown in Table 3.3.

Table - 3.3: Properties of super plasticizer

Specific Gravity	1.20 – 1.5
Chloride content	NIL
Air entrainment	approximately 1% additional air is entrained

*As per manufacturers manual

4. Mix Proportioning

Concrete mix design in this experiment was designed as per the guidelines specified in ACI234R – 96 .All the samples were prepared using design mix. M35 grade of concrete was used for the present investigation. Mix design was done based on I.S 10262-1982. The Table 4.1 shows mix proportion of concrete (Kg)

Table 4.1: Mix Proportioning

Sl. No	Material	Quantity(kg) (Kg/m^3)
1.	Cement (OPC)	405
2.	Fine Aggregate	660
3.	Coarse Aggregate	1122
4.	Water	162

Table - 4.2 Mix Proportions for (M35) Grade for steel fiber

S. No.	% Steel Fibre	W/C Ratio	**Mix Proportion (Kg/M3)**				
			Cement	Sand	Agg(20mm)	Agg(10mm)	Water
1	0	0.40	405	660	429	393	162
2	1.0	0.40	400.95	660	429	393	162
3	2.0	0.40	396.9	660	429	393	162
4	3.0	0.40	392.85	660	429	393	162
5	4.0	0.40	388.8	660	429	393	162
6	5.0	0.40	284.75	660	429	393	162
Super plastisizer is used in Mixed design is 1.26% of cement.							

Table - 4.3: Cube of Size (150x150x150) for % SFRC

S.No.	% Steel Fibre	W/C Ratio	Mix Proportion (Kg)					
			Steel Fibre	Cement	Sand	Agg(20 mm)	Agg(10 mm)	Water
1	0	0.40	0	1.367	2.228	2.734	1.326	0.5468
2	1	0.40	0.01367	1.3533	2.228	2.734	1.326	0.5468
3	2	0.40	0.02734	1.3396	2.228	2.734	1.326	0.5468
4	3	0.40	0.0410	1.3259	2.228	2.734	1.326	0.5468
5	4	0.40	0.05468	1.3123	2.228	2.734	1.326	0.5468
6	5	0.40	0.06835	1.2986	2.228	2.734	1.326	0.5468
Super plastisizer is used in Mixed design is 1.26% of cement = 0.0169 kg								

5. Experimental methodology

Compressive strength test:

For compressive strength test, cube specimens of dimensions 150 x 150 x 150 mm were cast for M35 grade of concrete. Superplasticized (1.26% by weight of cement) was added to this. The moulds were filled with 0%, 1% 2%, 3%, 4% and 5% steel 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.

Table - 5.1: Compression Strength of Cube on M35 for 7 and 28 days.

% of Steel fiber	7 days (N/mm^2)	28 days (N/mm^2)
0	29	39.33
1	32.34	39.67
2	34.34	40.65
3	35	41.4
4	32.35	39.97
5	30	39

Figure - 5.1: Specimens used for strength

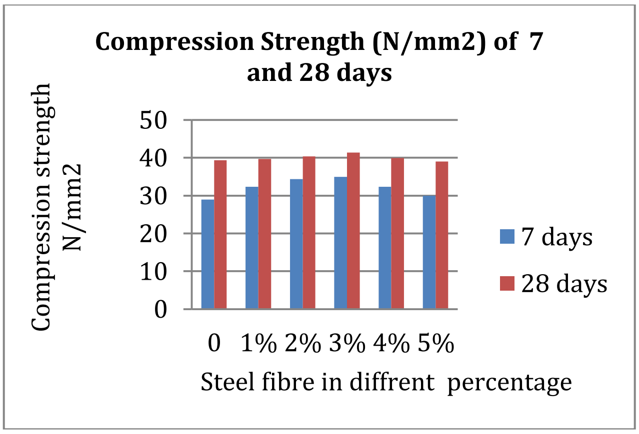

Figure 5.2 Compression strength for 7 and 28 days**.**

Flexural strength test:

For flexural strength test beam specimens of dimension 150x150x700 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 700 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 = 700 mm, b = width of specimen=150 mm, d = depth of specimen= 150 mm

Table - 5.2 Flexural Strength Of M35 Grade Of Concrete

% of Steel fiber	7 days (N/mm²)	28 days (N/mm²)
0	5.11	6.03
1	5.30	6.01
2	5.68	6.09
3	5.74	6.20
4	5.82	7.01
5	5.38	6.90

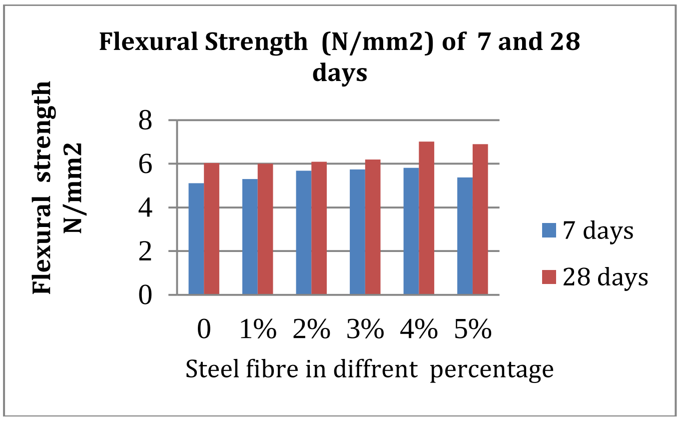

Figure - 5.3 Flexural Strength Of M35 Grade Of Concrete

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

Table - 5.3 Splite Tensile Strength Of M35 Grade Of Concrete

% of Steel fiber	7 days (N/mm²)	28 days (N/mm²)
0	3.21	4.41
1	3.53	4.77
2	4.06	5.07
3	3.21	4.87

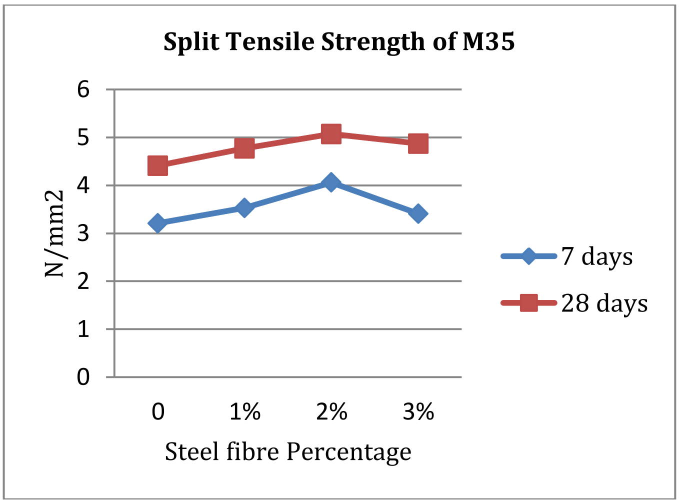

Figure - 5.4 Split Tensile Strength of M35

6. CONCLUSION

The mixing of the Hooked steel fibres in the cubes ands column of two different percentage is improving the compressive strength of the cubes. Steel fibre reinforced concrete column arrest the initiation of the failure of the column and takes more load. The cube and column containing proportion of steel fibre, 3% and 2% carries more loads. The Flexural strength of beam at 4% carries more load.

1. Density of concrete is more as the percentage of steel fiber increases.

2. Slump will lose at the higher percentage of steel fiber & lesser fly ash content.

3. Workability of concrete is improves when fly as percentage increases.

4.The Super-plasticizer is necessary for higher grade to get required slump & workable mix.

5. The wet and dry density (7 and 28 Days) goes on decreasing as the percentage fibre volume fraction increases.

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BIOGRAPHIES

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