ISSN XXXX XXXX © 2017 IJESC

Research Article Volume 7 Issue No.5

Experimental Investigation and Properties of High Strength Composite Concrete with Steel Fibre

Premkumar[1], Pandeeswari[2]
PG Scholar[1], Assistant Professor[2]
Department of Structural Engineering
Sethu Institute of Technology, Tamilnadu, India

Abstract:
This project helps to study the High Strength Fibre Reinforced Concrete exposed to varying depth and mix ratio. The fibre used in this study is steel fibres. The properties of concrete like compressive strength, split tensile strength and flexural strength are required to study experimentally two layer of high performance R.C beam can be arranged as mid height and one-third height of its position. Upper layer normal concrete and bottom layer steel fibre concrete.The objective of the study was to determine and compare the differences in properties of concrete containing without fibres and concrete with fibre's. This investigation was carried out using several tests, compressive test and flexural test. A total of eleven mix batches of concrete containing added steel fibre of 0.75% to 1.25% with an interval of 0.25% by wt. of cement. 'Hooked' steel fibres were tested to determine the enhancement of mechanical properties of concrete.

Keywords: Steel fibres increases Compressive, Flexural and Split Tensile Strength of Concrete

I. INTRODUCTION

Concrete is most widely used construction material in the world due to its ability to get cast in any form and shape. It also replaces old construction materials such as brick and stone masonry. The strength and durability of concrete can be changed by making appropriate changes in its ingredients like cementitious material, aggregate and water and by adding some special ingredients. Hence concrete is very well suitable for a wide range of applications. Concrete is a composite construction material composed primarily of cement, sand, coarse aggregate and water. Concrete is characterised as a brittle material with low tensile strength and strain capacity. Concrete is strong in compression, as the aggregate efficiently carries the compression load. However, it is weak in tension as the cement holding the aggregate in place can crack, allowing the structure to fail. This type of problems can be overcome by the addition of metallic and non-metallic fibres. Such fibres improve the mechanical properties of concrete. Recently, the construction industry has shown more interest in the use of High Strength Concrete (HSC). This is due to the improvements in structural performance, such as high strength and durability, while comparing the HSC with normal strength concrete (NSC), the size of the members can be reduced in HSC and it will increase the working place. HSC is widely used in various applications such as high rise buildings, bridges, off-shore structures and infrastructure projects. One of the major use of HSC in buildings is for structural framing consisting of beams and columns, which are the primary load-bearing components. The main advantage of FRC is to arrest the major and minor crack decrease the ductility of concrete. Fibre has become a practical alternative construction material. It can be used internally to improve the flexural strength. Fibres are usually used in concrete to control cracking due to both plastic shrinkage and drying shrinkage. They also reduce the permeability of concrete and thus reduce seepage. Some types of fibres produce greater impact, abrasion resistance in concrete.

II. EXPERIMENTAL PROGRAMME

The material used for this experimental work are cement, sand, water, steel fibres, and superplasticizer.

Cement: Ordinary Portland cement of 43 grade was used in this experimentation conforming to I.S. – 12269- 1987. Specific gravity of cement 3.13

Sand: Locally available sand zone II with specific gravity 2.63,fineness modulus 2.75, conforming to I.S. – 383-1970.

Coarse aggregate: Crushed granite stones of 20 mm size having specific gravity of 2.75, fineness modulus of 6.62, conforming to IS 383-1970

Super plasticizer: To impart additional workability a superplasticizer (sp400) 0.6 % to 0.8% by weight of cement was used.

Steel fibre: In this experimentation Hook stain Steel fibres were used. 0.4 x 20 mm (L) - Aspect ratio: 50 (tolerance: 15)

III. MIX DESIGN

1.1 Mix Design of Concrete

IS method of mix designed was used for mix design of M50 grade of concrete. The quantities of ingredient materials and mix proportions as per design are as under.

Table.1.1. Quantity of Materials per Cubic Meter of Concrete

Material	Proportion by weight	Weight in Kg/m^3
Cement	1	442
F.A.	1.48	657
CA	2.45	1087
Water	0.35	186

IV. EXPERIMENTAL METHODOLOGY

COMPRESSION TEST:

For compressive strength test, cube specimens of dimensions 150 x 150 x 150 mm were cast for M50 grade of concrete. Super plasticized (0.6% to 0.8% by weight of cement) was added to this. The moulds were filled with 0%, 0.75% 1% and 1.25% fibres added as mid height and one-third height of its position. Vibration was given to the moulds using 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.

Figure. 1. "Testing of compressive strength test specimen"

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

Figure. 2. "Testing of Split tensile strength test specimen"

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 center distance between the support = 400 mm, b = width of specimen=100 mm, d = depth of specimen= 100 mm.

Figure.3. "Flexural strength test"

Testing of beams

7 beams are casted and tested, after the curing period was completed,. All the beams were tested in the loading frame Capacity of 1000kn. The beams were simply supported. A typical loading Arrangement is shown in Figure 4. The load was applied by 500kN hydraulic Jack through steel section and steel plates with two point loads. The deflection Of the beam were measured using dial gauges, before the application of the load, Initial reading were recorded, then the load was gradually applied with constant Increment of 2KN and the corresponding deflection was recorded for every Increment of the load, the beam surface was checked for any visible cracks, the Load at which first crack is observed is noted as cracking load (Pcr) and the corresponding deflections was also noted. Then with increment of the load the Occurrence of different cracks and corresponding loads were noted, also the Zone in which the crack occurred are noted. The loads were also recorded with the progress of the crack from lower side towards upper side with their nature. The load (Pu) along with corresponding deflection.

Figure. 4 "Testing of beam"

V. EXPERIMENTAL RESULTS

Following graphs give compressive strength, flexural strength and Split Tensile strength result for M-50 grade of concrete with 0%, 0.75%, 1% and 1.25% steel fibres for aspect ratio 50 the varying compressive strength

Table.2. Compressive Strength of SFRC with 0%,0.75%,1% and1.25% fibres M50 grade

% OF STEEL FIBRE	7days	28days
0%	22.5	47.5
0.75%	25.82	51.72
1%	26.4	53.18
1.25%	29.8	52.66

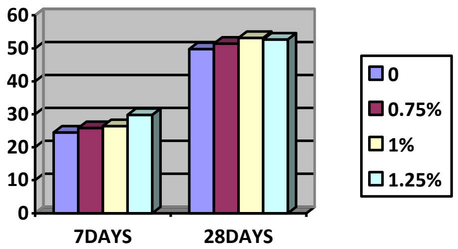

Figure. 5 Compressive strength of steel fibre concrete at a distance of d/2 from the bottom
(d=total depth of specimen)

Table.3. Compressive Strength of SFRC with 0%,0. 75%, 1% and1.25% fibres M50 grade

% OF STEEL FIBRE	7DAYS	28DAYS
0%	22.5	47.5
0.75%	23.17	48.55
1%	25.87	50.44
1.25%	26.81	50.14

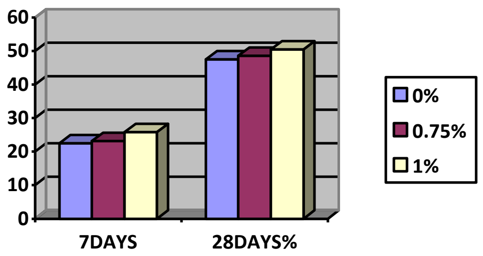

Figure. 5 Compressive strength of steel fibre concrete at a distance of d/3 from the bottom
(d=total depth of specimen)

Table.4. SPLIT TENSILE STRENGTH OF SFRC WITH 0%,0.75%,1%,1.25% FIBRES M50 GRADE

% OF STEEL FIBRE	7DAYS	28DAYS
0%	2.9	4.25
0.75%	3.03	4.43
1%	3.2	4.57
1.25%	3.61	5.12

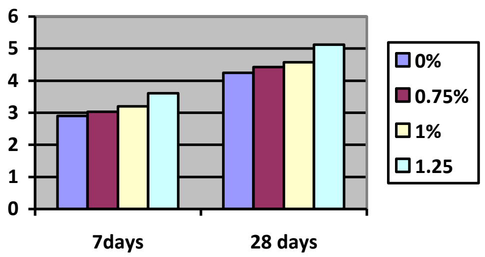

Figure.6. Split tensile strength of steel fibre concrete at a distance of d/3 from the bottom

Table .5. SPLIT TENSILE STRENGTH OF SFRC WITH 0%,0.75%,1%,1.25% FIBRES M50 GRADE

% OF STEEL FIBRE	7DAYS	28DAYS
0%	2.9	4.25
0.75%	3.4	4.73
1%	3.51	5.13
1.25%	3.84	5.32

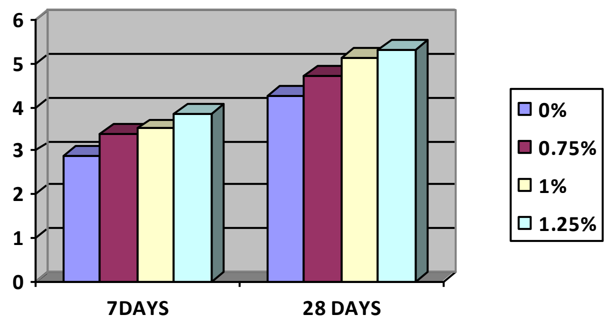

Figure.7.Split tensile strength of steel fibre concrete at a distance of d/2 from the bottom

Table.6. Flexural Strength Of Sfrc With 0%, 0.75%, 1%, 1.25% Fibres M50 Grade(28 Days)

% OF STEEL FIBRE	D/3 DEPTH	D/2 DEPTH
0%	4.5	4.5
0.75%	4.43	4.73
1%	4.57	5.23
1.25%	5.12	5.32

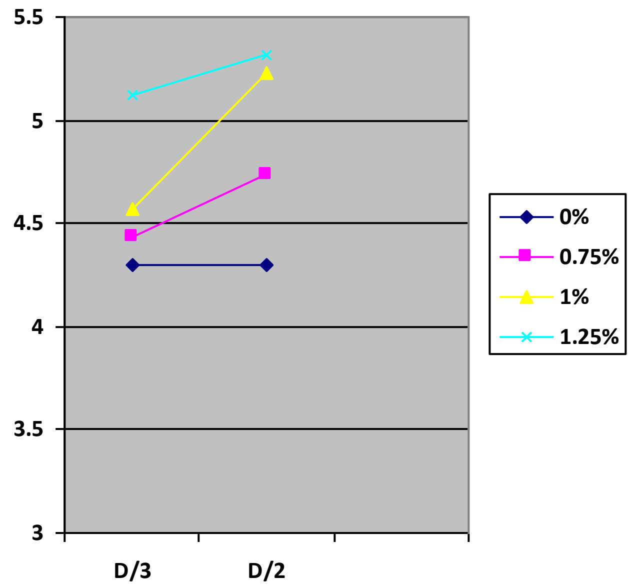

Figure.8. Flexural strength of SFRC with 0%, 0.75%, 1%, 1.25% fibres M50 grade

VI. BEAM RESULT AND COMPARISON:

LOAD AND DEFLECTION OF SFRC WITH 0%,0.75%,1%,1.25% FIBRES M50 GRADE(28 days)

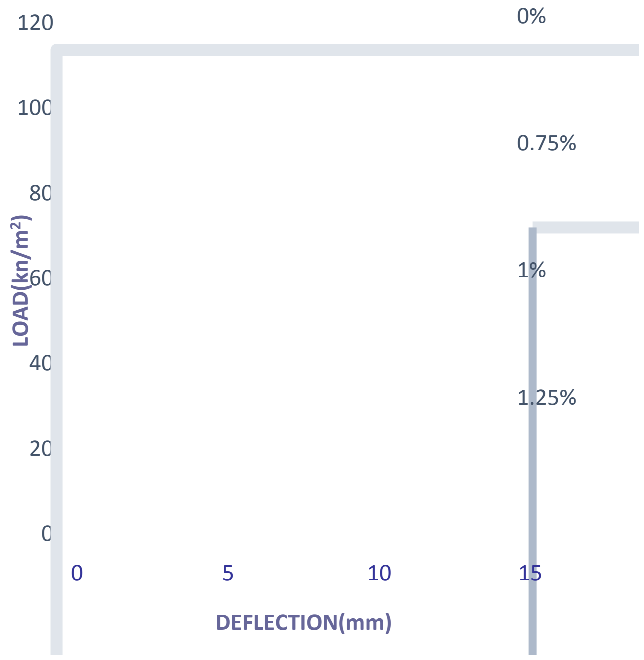

Figure.9. Load v/s deflection for RC beam and SFRC beam at a distance of d/2 from the bottom

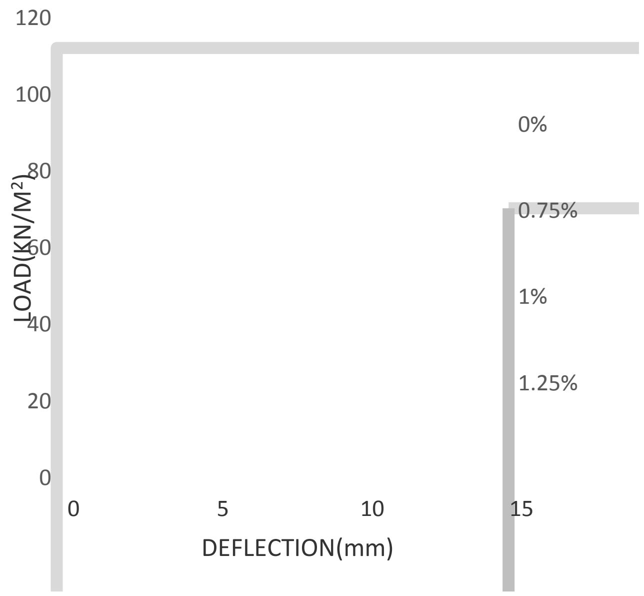

Figure.10. Load v/s deflection for RC beam and SFRC beam at a distance of d/3 from the bottom

VII. CONCLUSION

1. It is observed that compressive strength split tensile strength and flexural strength are on higher side for 1.25% fibres as compared to that produced from 0%,0.75% and1% fibres

2. Once there is an increase in steel fibre content compressive strength in increase. In study was increase 7.2% increase compressive strength with increase steel fibre content 0% to 1%.slighily decrease in compressive strength steel fibre content 1.25%

3. Split tensile strength tests suggests that there is an increase in split tensile strength which is around 21% with increase of steel fibre content 1.25%

4. It is observed that flexural strength increase from 4.7 to 15.5% with addition of steel fibre

5. The load v/s deflection behavior observed to be non linear upto till the failure of the beams

6. It is observed that as the % of fibre increased from 0% 0.75%, 1%and1.25% the load will be increased and the deflection of the beam is decreased

VIII. REFERENCES

[1]. Two-layer concrete bridge beams as composite elements by Iakov Iskhakov and Yuri Ribakov

[2]. A design method for two-layer beams consisting of normal and fibreed high strength concrete by Iskhakov, Y.

[3]. Effect of steel fibres on mechanical properties of high-strength concrete by K. Holschemacher a, T. Mueller a, Y. Ribakov.

[4]. A Effect of change in micro steel fibre content on properties of High strength Steel fibre reinforced Lightweight Self-compacting Concrete by Shahid Iqbala,b,*, Ahsan Alia,b, Klaus Holschemachera, Thomas

[5]. Steel Fibre Reinforced Concrete by Abdul Ghaffar Amit S. Chavhan, Dr.R.S.Tatwawadi.

[6]. IS: 383-1970. "Specification for coarse and fine aggregate from natural sources for concrete"

[7]. IS: 2386-1963, part I to VII "methods to test for aggregates for concrete"

[8]. IS: 516-1959(reaffirmed 1999) "method of tests for strength of concrete"

[9]. IS: 5816-1999 "splitting tensile strength of concrete-method of tests"

[10]. IS 10262-2009 "recommended guidelines for concrete mix design"