STUDY ON PROPERTIES OF CONCRETE BY INFLUINCING STEEL AND GLASS FIBER

Krupal H.Akhiyani.[1], Mr. B.S.BAGAT[2], Mr. H. M. Rabadiya[3]
[1]P.G. Student, Civil (Structure), H.J.D.Institute of Technical Education and Research - Kera (Kutch), Gujarat, India
[2]Assistant Prof., Civil Department, H.J.D.Institute of Technical Education and Research – Kera (Kutch), Gujarat, India
[3]Assistant Prof., Civil Department, H.J.D.Institute of Technical Education and Research – Kera (Kutch), Gujarat, India

Abstract: ***Concrete is most widely used construction material in the world. Fibre reinforced concrete (FRC) is a concrete in which small and discontinuous fibres are dispersed uniformly. The fibres used in FRC may be of different materials like steel, G.I., carbon, glass, aramid, asbestos, polypropylene, jute etc. The addition of these fibres into concrete mass can dramatically increase the compressive strength, tensile strength, flexural strength and impact strength of concrete. Steel 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 bleeding of water. Some types of fibres produced greater impact, abrasion and shatter resistance in concrete. Glass fibre reinforced concrete has advantage of being light weight, high compressive strength and flexural strength. To improve the long term durability an Alkali resistance glass fibre reinforced concrete is also invented.***

Key words: glass fibre, steel fibre, fibre reinforced concrete.

1. INTRODUCTION

Cement concrete is characterized by brittle failure, the nearly complete loss of loading capacity, once failure is initiated. This characteristic, which limits the application of the material, can be overcome by the inclusion of a small amount of short randomly distributed fibers (steel, glass, synthetic and natural) and can be practiced among others that remedy weaknesses of concrete, such as low growth resistance, high shrinkage cracking, low durability, etc. The strength and durability of concrete can be changed by making appropriate changes in its ingredients like cementations material, aggregate and water and by adding some special ingredients. Hence concrete is very well suited for a wide range of applications. However concrete has some deficiencies as low tensile strength, low post cracking capacity, brittleness and low ductility, limited fatigue life, not capable of accommodating large deformations, low impact strength.

Fiber reinforced concrete (FRC) is concrete containing fibrous material which increases its structural integrity. So we can define fiber reinforced concrete as a composite material of cement concrete or mortar and discontinuous discrete and uniformly dispersed fiber. Fiber is discrete material having some characteristic properties.

2. EXPERIMENTAL METHODOLOGY

In this experimental study cement, sand, coarse aggregate, water, steel fiber and glass fiber were used.

Cement: Ordinary Portland cement 53 grade was used in this experiment conforming to I.S.-8112-1989.

Sand: Locally available sand zone II with specific gravity 3.14, water absorption 1%, conforming to I.S.-383-1970.

Water: portable water was used for experimentation.

Steel Fiber: in this experimentation Hook end steel fiber were used.

Glass fiber: In this experimentation, alkali resistance glass fibers were used.

Table 1 Properties of Fiber

Fiber designation	Length (mm)	Description	Dosages of fibre	Aspect ratio(L/D)
Steel	50	Hooked end	0.3, 0.6, 0.9, 1.2	50
Glass	12	Alkali resistance	0.05, 0.1, 0.15, 0.2	--------

Concrete for M30 grade were prepared as per I.S.10262:2009 with w/c 0.45. Mix proportion for M30 grade concrete for tested material as follows:

Table 2 Concrete mix proportion

Material	Quantity
Cement	380 kg/m^3
Sand	720 kg/m^3
Coarse aggregate	1175 kg/m^3

A) Compressive strength test:

For compressive strength test, cube specimens of dimension 150*150*150mm were casted for M30 grade of concrete. The moulds were filled steel and glass fiber concrete. Vibration was given to the moulds using table vibrator. The top surface of specimens was leveled and finished. After 24 hours the specimens were demolded and were transferred to curing tank were they were allowed to cure for 7, 28 and 56 days curing, these cubes were tested on compression testing machine as per 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.

B) Tensile strength test:

For tensile strength test, cylinder specimens of 150mm diameter and 300mm length were casted. The specimen were demoulded after 24 hours of casting and allowed to 7, 28 and 56 days to cure in curing tank. 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:

Spilt Tensile strength (MPa) = $2P / \pi DL$

Where, P = Failure Load (KN)

D = Diameter of Specimen (150 mm)

L = Length of Specimen (300 mm)

C) Flexural strength test:

The flexural tensile strength test was performed on 100*100*500 mm prismatic specimens by using the beam method according to IS 516:1959 at which load is applied at one third points of the specimen. Two prismatic specimens were produced for each series. The tests were carried out by using a closed loop deflection-controlled loading frame of 250 KN capacity and loading rate was 0.5 mm/min. The deflections at the mid-span of

bottom surface and the supports of beams were simultaneously recorded during the test. The net mid-span deflection of the beam was obtained by taking the difference between mid-span deflection and the average of the support deflections. Load–deflection curves for each specimen were also obtained graphically

Flexural strength was calculated as follow:

Flexural strength (MPa) = PL/BD2

Where, P = applied load, L = length of beam, B = width of beam, D = depth of beam.

3. EXPERIMENTAL RESULTS

I) steel fiber concrete:

1) Compressive strength test:

Results of compressive strength for M-30 grade of concrete on cube with 0.3, 0.6, 0.9 and 1.2% of steel fiber are shown in table and graph below:

Table 3 Comparison of compressive strength using cube specimen

Days	Average Compressive strength				
	0%	0.3%	0.6%	0.9%	1.2%
7	24.44	25.38	25.49	25.99	25.84
28	38.00	39.41	39.75	40.21	39.97
56	42.51	43.10	43.63	44.00	43.87

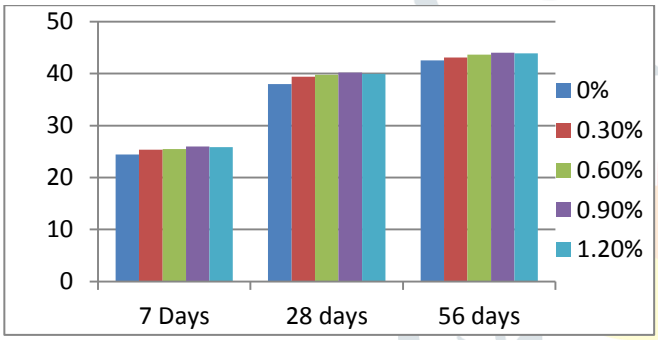

Chart 1 compressive strength of nominal concrete and steel fiber concrete

2) Split tensile strength test

Result of split tensile strength for M30 grade of concrete on cylinder specimen of nominal concrete and steel fiber concrete are shown in table and graph below:

Table 4 Comparison of split tensile strength using cylinder specimen

Days	Average split tensile strength				
	0.0%	0.3%	0.6%	0.9%	1.2%
7	2.54	2.58	2.60	2.62	2.61
28	3.76	3.80	3.82	3.94	3.86
56	4.14	4.44	4.50	4.87	4.69

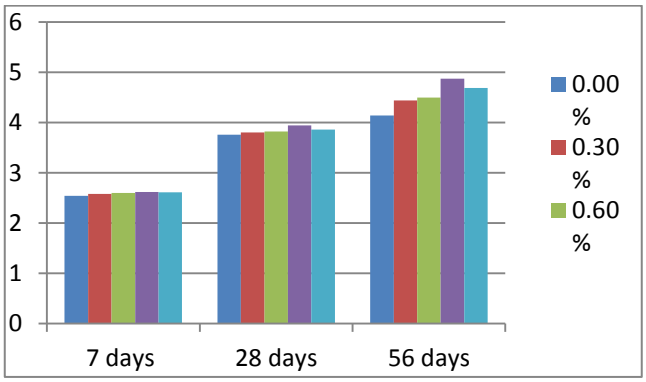

Chart 2 Split tensile strength of nominal concrete and steel fiber concrete

3) Flexural strength test

Result of flexural strength for M30 grade of concrete on beam specimen of nominal concrete and steel fiber concrete are shown in table and graph below:

Table 5 Comparison of flexural strength using beam specimen

Days	Average flexural strength				
	0.0%	0.3%	0.6%	0.9%	1.2%
7	2.56	2.87	2.94	3.30	3.11
28	4.1	4.5	4.8	5.3	5.0
56	4.84	5.1	5.31	5.67	5.34

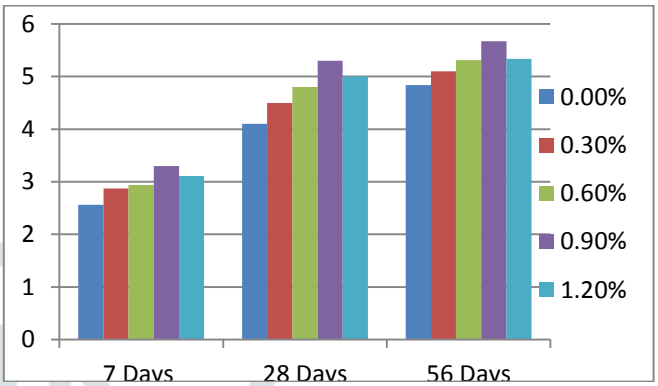

Chart 3 Flexural strength of nominal concrete and steel fiber concrete

From the above results we have got the optimum percentage at which we are getting higher results of compressive strength, split tensile strength, flexural strength is S3 mix of steel fiber concrete. Now on this consideration we are making the steel fiber percentage as constant and taking the variations of glass fiber in concrete mix.

II) Steel & glass fiber concrete

1) Compression strength test

Result of compressive strength for M30 grade of concrete on cube specimen of steel (0.9) and glass fiber (0.05%, 0.1%, 0.15%, 0.2%) concrete are shown in table and graph below:

Table 6 Comparison of compressive strength using cube specimen

Days	Average Compressive strength				
	N	SG1	SG2	SG3	SG4
7	24.44	25.61	25.78	26.24	26.12
28	38.00	41.10	41.34	41.95	41.77
56	42.51	44.45	44.71	45.24	45.01

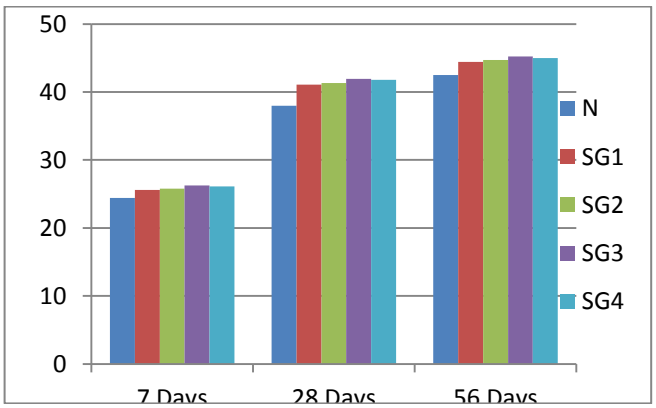

Chart 4 compressive strength of nominal concrete to steel and glass fiber concrete

2) Split tensile strength test

Result of split tensile strength for M30 grade of concrete on cylinder specimen of steel and glass fiber concrete are shown in table and graph below:

Table 7 Comparison of split tensile strength using cylinder specimen

Days	Average split tensile strength				
	N	SG1	SG2	SG3	SG4
7	2.54	2.64	2.66	2.86	2.81
28	3.76	4.01	4.11	4.34	4.28
56	4.14	5.0	5.12	5.31	5.26

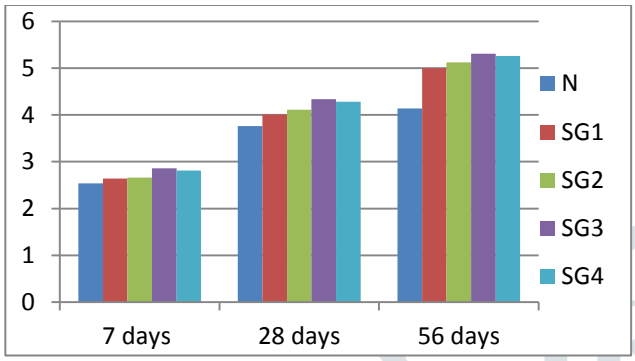

Chart 5 Split tensile strength of nominal concrete to steel and glass fiber concrete

3) Flexural strength test

Result of flexural strength for M30 grade of concrete on beam specimen of steel and glass fiber concrete are shown in table and graph below:

Table 8 Comparison of flexural strength using beam specimen

Days	Average flexural strength				
	N	SG1	SG2	SG3	SG4
7	2.56	3.36	3.41	3.54	3.52
28	4.1	5.39	5.47	5.61	5.58
56	4.84	5.79	5.86	5.97	5.91

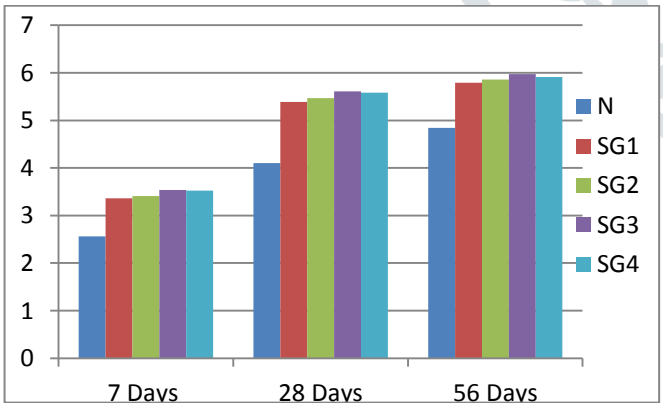

Chart 6 Flexural strength of steel and glass fiber concrete

From the above table and chart the value of compression strength, flexural strength, split tensile strength of steel (0.9%) and glass (1.5%) fiber concrete is more than the other dosage.

4. CONCLUSION

The major conclusions derived from this research study are given below:

- The experimental data obtained showed that steel fiber 0.9% optimum vale we get at which compressive strength, flexural strength, split tensile strength is increase and get high among all other dosages.
- With the constant steel fiber (0.9%) where added and variation made with glass fiber volume (0.05, 0.1, 0.15 and 0.2) we get strength increased compared to only steel fiber concrete.
- With a fiber volume of steel fiber (0.9%) and glass fiber (0.15%) we get compressive strength increased up to 10%.
- Flexural strength is increased up to 35% of nominal concrete with steel and glass fiber.
- Split tensile strength is increased up to 15% of steel and glass fiber concrete.
- Combination of steel fiber and glass fiber concrete get good result compared to use of only steel or glass fiber.

The present study also demonstrates that steel and glass fiber are efficient in increasing the compressive strength, split tensile strength and flexural strength.

ACKNOWLEDGEMENT

The author would like to acknowledge the help of Harish Rabadiya (asst. professor, civil department, HJD-ITER).

REFERENCES

[1] Dimas Alan Strauss Rambo, FlAvio de Andrade Silva, Romildo Dias Toledo Filho, 2014, "EFFECT OF STEEL FIBER HYBRIDIZATION ON THE FRACTURE BEHAVIOUR OF SELF CONSOLIDATING CONCRETE", Cement & Concrete Composites, P. 1-10

[2] ErayBaran, TolgaAkis, SedaYesilmen, 2012, "PULL-OUT BEHAVIOUR OF PRESTRESSING STRANDS IN STEEL FIBER REINFORCED CONCRETE ", Construction and Building Materials, Vol.28, P.362–371

[3] H.L. Ma, C. Cui, X. Li, S.L. Hu, 2013, "STUDY ON MECHANICAL PROPERTIES OF STEEL FIBER RENFORCED AUTOCLAVED LIGHT WEIGHT SHELL AGGREGATE CONCRETE" Materials and Design, Vol.52, P.565–571

[4] J.A.O. Barros, and J.A. Figueiras, 1992 "FLEXURAL BEHAVIOUR OF SFRC: TESTING AND MODELING" , Journal of Materials in Civil Engineering, Volume 11, Issue 4, Pp. 273-366

[5] AvinashGornale, S. Ibrahim Quadri and Syed Hussaini, 2012, "STRENGTH ASPECT OF GLASS FIBER REINFORCED CONCRETE AND ITS PROPERTIES", International journal of Scientific and Engineering research, vol 3, issue 7.

[6] ShrikantHarle, Prof. Ram Meghe, Dec 2013, "GLASS FIBER REINFORCED CONCRETE AND ITS PROPERTIES ", International Journal Of Engineering And Computer Science, Vol 2, Issue 12.

[7] S. C. Patodi, C. V. Kulkarni, 2012, "PERFORMANCE EVALUATION OF HYBRIED FIBRE REINFORCED CONCRETE MATRIX" International Journal of Engineering Research and Applications, Vol. 2, Issue5, pp.1856-1863

[8] Kavita S Kene, Vikrant S Vairagade and SatishSathawane, December 2012, "EXPERIMENTAL STUDY ON BEHAVIOUR OF STEEL AND GLASS FIBER REINFORCED CONCRETE COMPOSITES", International Journal of Industrial Engineering and Management Science, Vol. 2, No. 4, P.125-130