The Flexural and Tensile Behaviour of Fibre Reinforced Concrete

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Abstract - Concrete is most widely used in construction field in all over the world then concrete weak in tension and strong in compression then given the maximum strength of concrete then add to the Fibre Reinforced Concrete (FRC) Fibres are generally used to resistance of cracking and strengthening of the concrete fibre is the small and discontinuous fibres are dispersed in uniformly. The fibres are may be available of different material like Steel, carbon, glass, aramid, asbestos, polypropylene, etc. these addition to the fibres the increasing compressive strength, split tensile strength, flexural strength then we have studied the two types of steel fibres crimped steel fibre and Hook end steel fibres and also used to the experiment the glass fibre then these two fibres add in the various percentage for M20 grade of concrete.

Keywords: Hook end steel fibre, Glass Fibre, Workability, compressive strength, split tensile strength, flexural strength & Stress vs Strain FRC

1 INTRODUCTION

Concrete is most widely used in the entire world. The concrete taken the compression load and fail to the Tension then using the reinforcement of the concrete then give the maximum strength. The used of Steel fibre to achieve and improve the strength of concrete by using various percentage of steel fibre for M20 grade of Concrete 0.50%, 0.75%,1% of steel fibres containing by volume of concrete. The hook end steel fibre of the length of 45mm with aspect ratio 50. And second fibres are used in the concrete to glass fibre to the compression zone and steel fibre are used to the tension zone these two zones are used to the two different fibres the glass fibres are varying with the 0.25%, 0.30%, 0.35%, 0.50% of glass fibre containing by the volume of cement. The necessity for the addition of fibres in structural material to increase the strength of the concrete and mortar and also reduce the crack and mainly depends on parameters like strength of the fibre, bond at fibre matrix interface Ductility OF fibres, volume of fibre reinforcement and shape and aspect ratio. The compressive strength of dual fibre concrete is found to be maximum at 1.0% total fibre content of steel at 28 days compared to plain concrete. There is substantial increase in the compressive strength for mixed fibre combination and glass fibre are used to the concrete to 0.3 to 0.7% are used to give maximum strength as compared to conventional concrete.

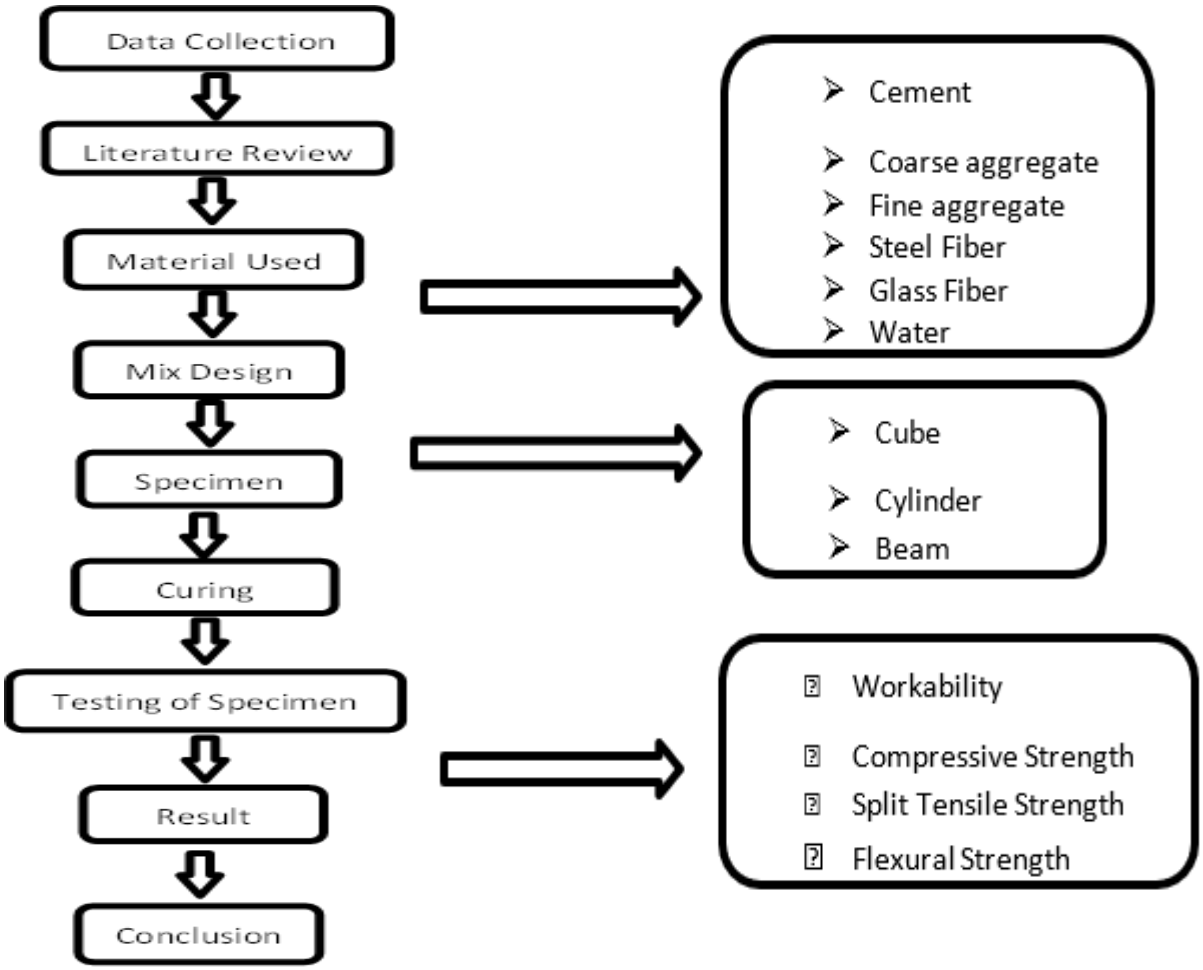
These various properties and test are carried out are followed,

a) To Study Properties of Glass fibre and Steel fibre.
b) To determine workability of FRC
c) To Study of adding Glass fibre and Steel fibre on performance of concrete (compression Strength, Split tensile Strength & Flexural Strength.)
d) To study behaviour of stress strain curve for composite FRC.

2.METHODOLOGY

The aim of this research is to use the Steel Fibers as Fibre reinforcement to concrete. Our objective is to add the Steel fibers to the concrete and to study the compressive strength properties of concrete (M20 Grade) for fiber content of 0.5%, 1%, 1.5 % and 2% at 28 days. The main properties of Steel Fiber Reinforced concrete.

The study aims to investigate the strength related properties of concrete of M20 grade and by varying the volume fraction of glass fiber from 0,0.25,0.30,0.50 and 0.35% with an increment of 0.025%. Then the specimens were cured for 7 days, 14 days and 28 days. The various tests such as compression test, split tensile test, and flexural tests were carried out on the specimens.



2.1 Casting of Specimen & Experimental Methodology

The material is weighted accurately using a digital weighing instrument. For plain concrete, fine aggregate, coarse aggregate, water, cement were added to the mixer machine and mixed to the 5 minutes then to add glass fibre to various percentage inside the mixer, and same like that steel fibre mix inside the machine after through mixing of the ingredients of concrete so that homogeneous mix is formed and preparing the specimen for Compression, Tensile and flexural strength.

Table-1

Sr.no	Specimen Mould	Size
1	Cube	150x150x150mm
2	Cylinder	150mm(D), 300mm(H)
3	Beam	500x100x100mm

In this experimental methodology the study of M20 grade of concrete and the use the two fibres glass and steel the different percentage and take the Compression, Tensile and flexural strength.

2.2 Testing of Specimen

2.2.1 Compression Strength

Concrete cubes, 150mm x 150mm x 150mm are casted for testing of specimen. Every specimen consisting 15 cubes the mould filled with concrete prepared with different percentage variation of glass and steel fibre as S0-G0, S0.50-G0.25, S0.75-G0.3, S0.50-G0.50, S1-G0.35. compaction was done by tamping rod top surface levelled and finished after 7, 14 and 28 days of curing and these cubes are tested.

Compressive Strength = Failure load / cross sectional area

2.2.2 Split Tensile Strength

Concrete cylinder, 150mm Diameter and 300mm Height are casted for testing of specimen. The specimens were demoulded after 24 hours of casting and were transferred to curing tank wherein they were allowed to cure for 7, 14 and 28 days. These specimens were tested under compression testing machine. Tensile strength was calculated as follows as split tensile strength,

$$\text{Tensile strength (MPa)} = 2P / \pi DL$$

Where, P = failure load,

D = diameter of cylinder, L = length of cylinder

2.2.3 Flexural strength

For flexural strength test beam specimens of dimension 100x100x500 mm are casted. The specimens are detached from the moulds after 24 hours of casting and are placed in curing tank for 7 and 14 days of curing. The flexural strength specimens are tested under three point loading as per I.S. 516-1959, over a load effective span of 400 mm on flexural strength testing machine. Load and corresponding deflections are noted up to the failure of specimen. For each percentage of fibre content, three beams

$$\text{Flexural Strength} = (P \times L)/(b \times d^2)$$

Where, P = failure load, L = C/C distance between the support

b= Width of specimen, d = depth of specimen

3 RESULT

The Following Tables (2, 3, 4,5,6) gives Workability, Compressive, split tensile and Flexural Strength & Stress vs Strain graph results for M20 grade of concrete with S0-G0, S0.50-G0.25, S0.75-G0.3, S0.50-G0.50, S1-G0.35 glass and steel fibres and these results are graphically represented in figure 1, 2 and 3

3.1 Workability

Table-2 Workability (Slump test)

Sr.No	Glass Fiber %	Steel Fiber %	Shape Value (mm)
1	0	0	110
2	0.25	0.50	98
3	0.30	0.75	93
4	0.35	0.50	89
5	0.50	1	93

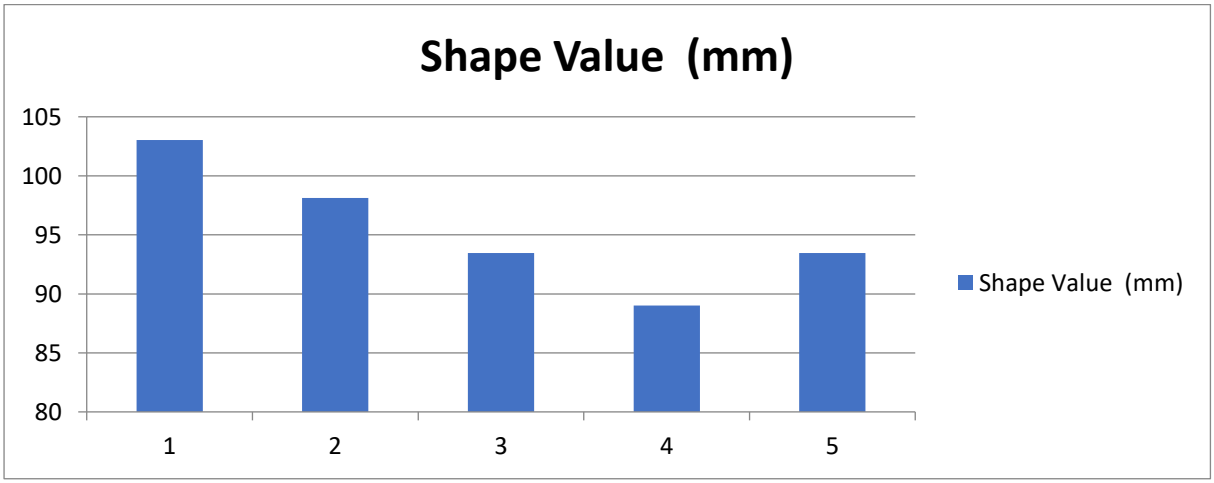


Fig.1 Workability test

There is gradual decrease in the slump values with an increase in GF dose, which indicates that addition of GF &SF content is associated with an increase in water demand. Thus, some water reducing admixtures used to get required workability of concrete without compromising on strength.

3.2 Compressive Strength

Table-3 Compressive strength Test

Sr.No	Steel Fibre %	Glass Fibre %	7days (mpa)	14 days (mpa)	28 days (mpa)
1	0	0	13.8	18	24.2
2	0.50	0.25	14.2	17.5	2.1
3	0.75	0.30	15.6	18.9	23.26
4	0.50	0.50	16.9	20.4	27.8
5	1	0.35	12.9	15.2	22.3

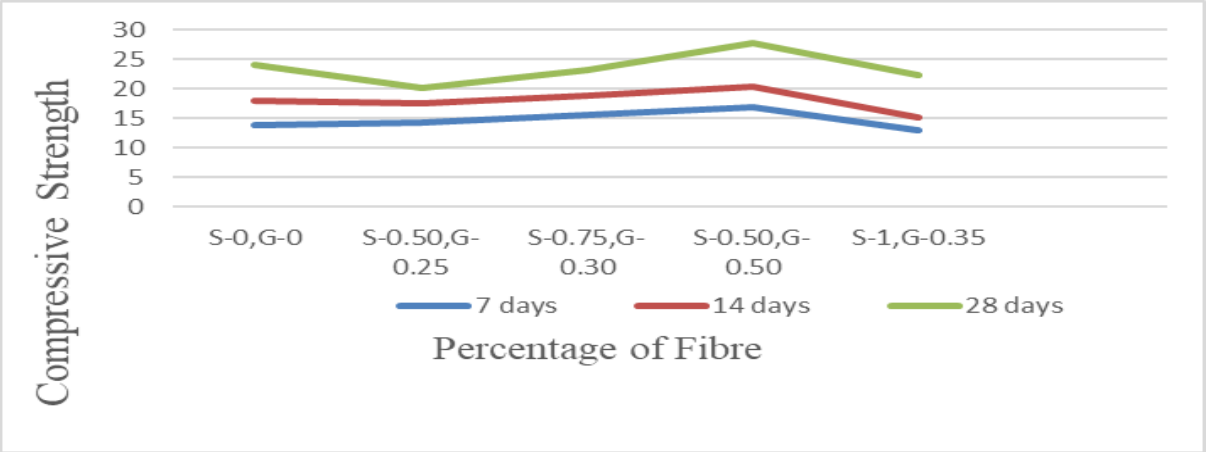


Fig 2 Compressive Strength test

The highest Compressive Strength of Sample S0.50-G0.50 was observed that 14.60% at 28 days compared with the conventional concrete mix S0-G0 and also increasing the both percentage of fibre to give the maximum strength and after that exceed the percentage of steel fibre above 1% also glass fibre above 0.70% the concrete is fails and segregation of concrete.

3.3 Split Tensile Strength

Table 4-Split Tensile Strength

Sr.No	Steel Fibre %	Glass Fibre %	7days (mpa)	14 days (mpa)	28 days (mpa)
1	0	0	1.56	2.05	2.45
2	0.50	0.25	1.42	1.65	1.73
3	0.75	0.30	1.73	1.95	2.01
4	0.50	0.50	1.98	2.08	2.60
5	1	0.35	1.5	1.78	1.90

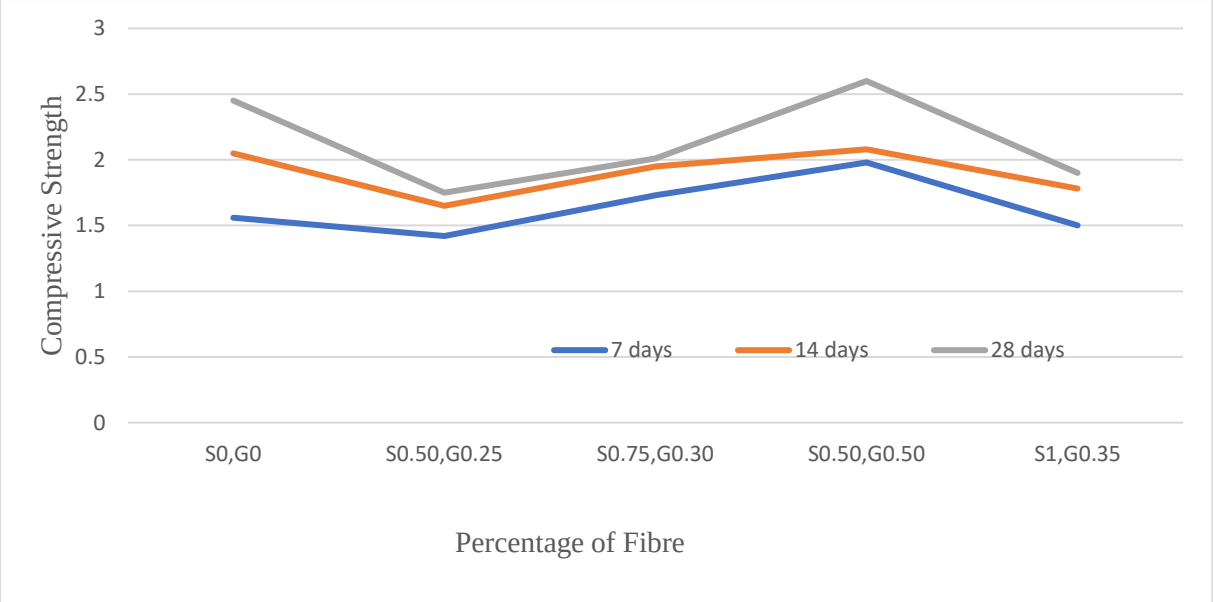


Fig-3 Split Tensile Strength

The highest Split Tensile Strength of Sample S0.50-G0.50 was observed that 11.08% at 28 days compared with the conventional concrete mix S0-G0 and also increasing both percentage of fibre to give the maximum strength and after that exceed the percentage of steel fibre above 1% also glass fibre above 0.70% the concrete is fails and segregation of concrete.

3.4 Flexural Strength

Table 5-Flexural strength

Sr.No	Steel Fibre %	Glass Fibre %	7days (mpa)	14 days (mpa)	28 days (mpa)
1	0	0	2.8	3.30	3.95
2	0.50	0.25	2.70	3.20	3.86
3	0.75	0.30	2.95	3.35	4.15
4	0.50	0.50	3.49	3.55	4.70
5	1	0.35	2.50	2.70	3.15

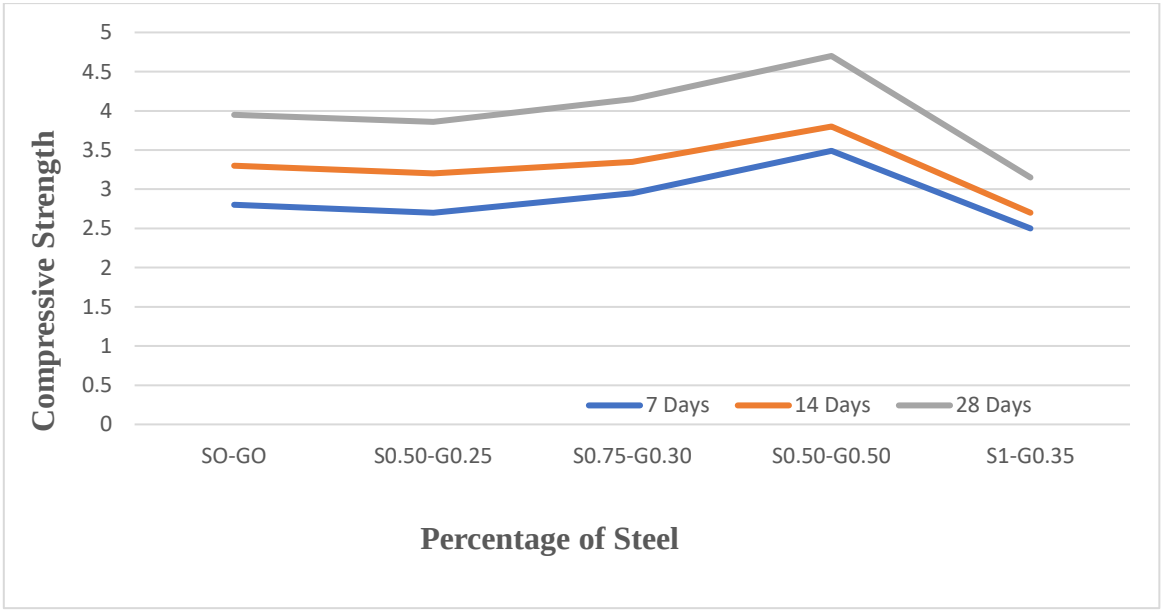


Fig-4 Flexural Strength

The highest Flexural Strength of Sample S0.50-G0.50 was observed that 10.08% at 28 days compared with the conventional concrete mix S0-G0 and also increasing both percentage of fibre to give the maximum strength and after that exceed the percentage of steel fibre above 1% also glass fibre above 0.70% the concrete is fails and segregation of concrete.

3.5 Stress vs Strain graph

Table-6 Stress vs Strain

Stress	S0.50-G0.25	S0.75-G0.30	S0.50-G0.50	S1-G0.35
0	0	0	0	0
5	2.26E-03	2.06E-03	1.87E-03	2.06E-03
10	2.48E-03	2.26E-03	2.06E-03	2.26E-03
15	2.73E-03	2.48E-03	2.26E-03	2.48E-03
20	3.00E-03	2.73E-03	2.48E-03	2.73E-03
25	2.85E-03	3.00E-03	2.73E-03	3.00E-03
30	2.71E-03	2.73E-03	3.00E-03	2.85E-03
35	2.57E-03	2.48E-03	2.73E-03	2.71E-03
40	2.44E-03	2.26E-03	2.48E-03	2.57E-03

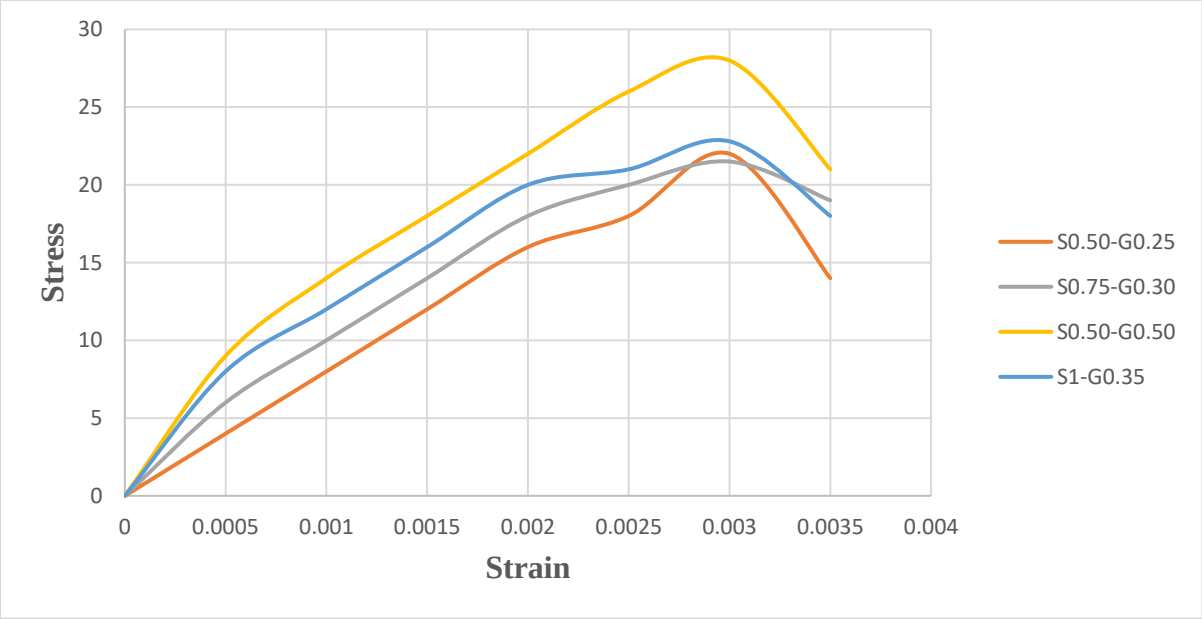


Fig-5 Stress vs Strain graph

There in stress vs strain composite FRC are S0.50-G0.50 is taken maximum stress at 0.003 strain then load decrease only elongates it.

CONCLUSION

From the test results obtained during the experiment work it is clear that the strength of fiber reinforced concrete significantly higher than the normal concrete. The crack formation is also very small in fiber specimen compared to non-fiber specimen.

The highest Compressive Strength of Sample S0.50-G0.50 was observed that 14.60% at 28 days compared with the conventional concrete mix S0-G0

The increasing percentage of compressive strength of samples S0.50-G0.25, S0.75-G0.30, S0.50-G0.50 and S1-G0.35 are 9.95%,10.75%,14.60% and 9.5% respectively at 28 days compared with the conventional concrete mix.

The increasing percentage of Tensile strength of samples S0.50-G0.25, S0.75-G0.30, S0.50-G0.50 and S1-G0.35 are 9.10%,11.08%,12.69% and 9.61% respectively at 28 days compared with the conventional concrete mix.

The increasing percentage of Flexural strength of samples S0.50-G0.25, S0.75-G0.30, S0.50-G0.50 and S1-G0.35 are 9.64%,10.08%,12.40% and 8.92% respectively at 28 days compared with the conventional concrete mix

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