Characteristics Study on Effect of Glass Fiber in Concrete with Replacement of Cement by Fly Ash

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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 Fiber Reinforced Concrete (FRC) Fibers are generally used to resistance of cracking and strengthening of the concrete fiberis the small and discontinuous fibers are dispersed in uniformly. The fibers may be available of different material like Glass, Steel, carbon aramid, asbestos, polypropylene, etc. these addition to the fibers the increasing compressive strength, split tensile strength, flexural strength then we have studied the glassfiber with Fly Ash added in the various percentage for M20 grade of concrete.

Keywords: Glass Fiber, Fly Ash, Workability, compressive strength, split tensile strength, flexural strength & Stress vs Strain FRC

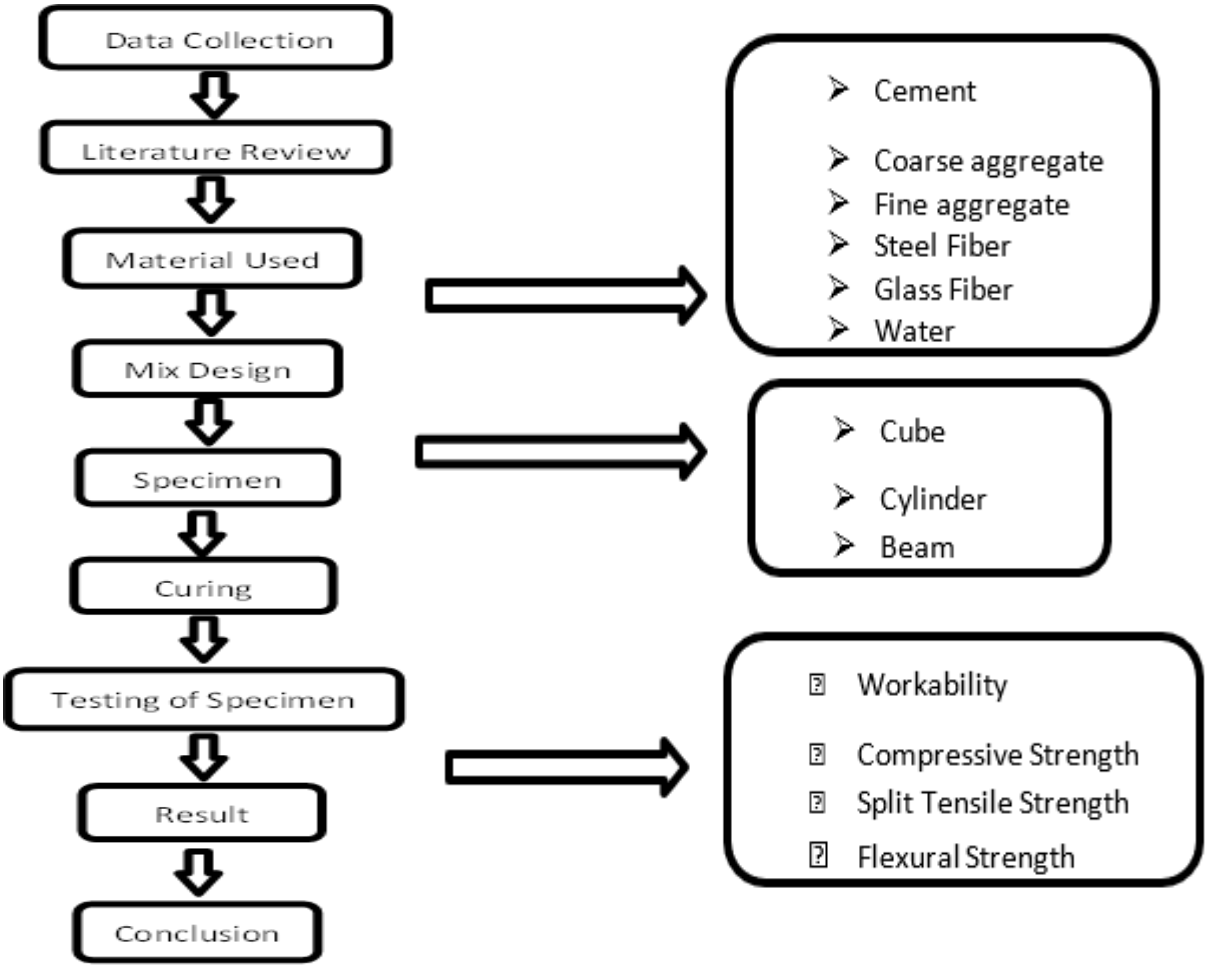
1.INTRODUCTION

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 fiber to achieve and improve the strength of concrete by using various percentage of Glass fiber for M20 grade of Concrete having mix proportion of 1:1.5:3 with 0.50 water cement ratio to study the Compressive strength, Split tensile strength, Flexural strength of Glass fiber reinforced concrete (GFRC). Based on the laboratory experiment on fiber reinforced concrete (FRC), cube, cylinders and beam specimens have been designed with Glass fiber reinforced concrete (GFRC). For concrete mixes 43 grade of ordinary Portland cement and class F type fly ash is used Water/ cement ratio 0.5%. Concrete cubes are casted with varying percentage of Glass fiber by 0.5%, 1%, 1.5%, 2% by weight of cement of 12mm cut length were used with admixture. And fly ash replacement 25% fly ash is used. The necessity for the addition of fibers 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 fiber, bond at fiber matrix interface Ductility Of fibers, volume of fiber reinforcement andshape and aspect ratio. The compressive strength of Glass fiber concrete is found to be maximum at 1.5% fiber content of at 28 days compared to plain concrete.

These various properties and test are carried out as followed,
To Study Properties of Glass fiber
To determine workability of FRC
To Study of adding Glass fiber, performance of concrete (compressionStrength, Split tensile Strength & Flexural Strength.)
To study behavior of stress strain curve for composite FRC

2. METHODOLOGY

The main aim of this present work is to study the effects of glass fiber in concrete with replacement of fly Asha byproduct for partial replacement of cement and glass fiber reinforcement is added by weight of cement in present investigation. Our objective is to add the Glass 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 study aims to investigate the strength related properties of concrete of M20 grade. 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 was added to the mixer machine and mixed to the 5 minutes then to add glass fibre to various percentage inside the mixer machine after through mixing of the ingredients of concrete so that homogeneous mixis formed and specimens are prepared 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

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 of 15 cubes the mould filled with concrete prepared with different percentage variation of glass fiber as GF 0.5%, 1%, 1.5%, 2%. compaction was done by tamping rod top surface levelled and finished after 7, 14 and 28 days of curing and the 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,

Tensile strength (MPa) = $2P / \pi DL$Where, P = failure load,

D = diameter of cylinder, L = length of cylinder

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-pointloading 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 eachpercentage of fiber content, three beams

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

Where, P = failure load, L = C/C distance between the supportb= 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 GF 0.5%, 1%, 1.5%, 2%. glass fibers and these results are graphically represented in figure 1, 2 and 3.

3.1 Workability

Table 2

Sr.No	Glass Fiber %	`Shape Value (mm)
1	0	98
2	0.5	96
3	1	95
4	1.5	80
5	2	88

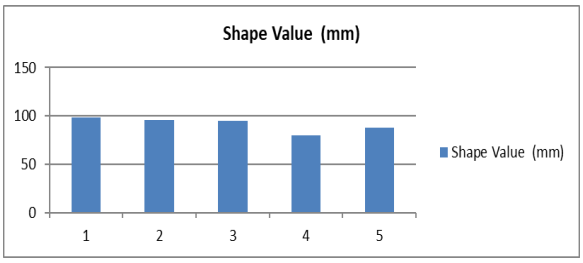


Fig 1 Workability – Slump test

There is gradual decrease in the slump values with an increase in GF and Fly Ash dose, which indicates that addition of GF 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 2

Glass Fiber %	7 days	14 days	28 days
0%	13.78	19.08	21.20
0.5%	15.32	21.22	23.57
1%	16.09	22.28	24.75
1.5%	16.89	23.39	26.66
2%	14.36	19.88	22.09

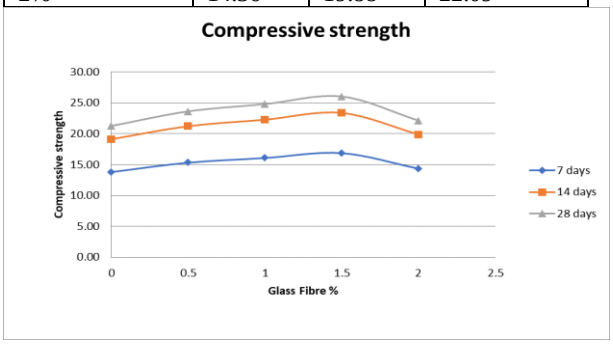


Fig 2 Compressive strength Test

Above Results show that there is a marginal increase in Compressive strength in replacement of glass Fibers and 25% of fly ash ate the 1.5% of at the age of 7, 14, 28days and gets slightly decreased at the 2%.

3.3 Split tensile strength

Table 3

Glass Fiber %	7 days	14 days	28 days
0	1.16	1.60	1.78
0.5	1.26	1.74	1.94
1	1.37	1.90	2.11
1.5	1.49	2.06	2.29
2	1.28	1.77	1.97

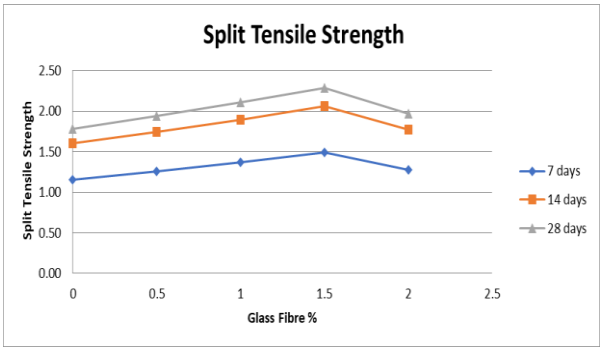


Fig 3 Split Tensile Strength

Above Results show that there is a marginal increase in Split Tensile Strength in replacement of glass Fibers and 25% of fly ash ate the 1.5% of at the age of 7, 14, 28days and gets slightly decreased at the 2%.

3.4 Flexural Strength

Table 4

Glass Fiber %	7 days	14 days	28 days
0	2.54	3.51	3.90
0.5	2.70	3.74	4.15
1	2.87	3.98	4.42
1.5	3.06	4.23	4.70
2	2.51	3.47	3.85

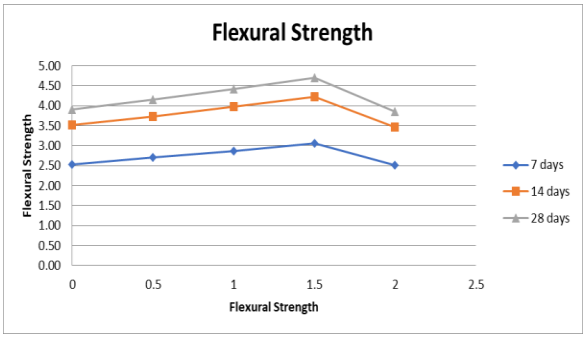


Fig 4 Flexural Strength

Above Results show that there is a marginal increase in Flexural Strength in replacement of glass Fibers and 25% of fly ash ate the 1.5% of at the age of 7, 14, 28days and gets slightly decreased at the 2%.

3.5 STRESS vs STRAIN

For normal weight concrete, the maximum stress is realized at compressive strain ranges from 0.002 to 0.003

Table 5

STRESS vs STRAIN					
STRESS	0% Glass Fiber	0.5% Glass Fiber	1% Glass Fiber	1.5% Glass Fiber	2% Glass Fiber
50	0	0	0	0	0
100	1.87E-03	1.55E-03	1.41E-03	1.17E-03	1.70E-03
150	2.06E-03	1.70E-03	1.55E-03	1.28E-03	1.87E-03
200	2.26E-03	1.87E-03	1.70E-03	1.41E-03	2.06E-03
250	2.48E-03	2.06E-03	1.87E-03	1.55E-03	2.26E-03
300	2.73E-03	2.26E-03	2.06E-03	1.70E-03	2.48E-03
350	3.00E-03	2.48E-03	2.26E-03	1.87E-03	2.73E-03
400	2.85E-03	2.73E-03	2.48E-03	2.06E-03	3.00E-03
450	2.71E-03	3.00E-03	2.73E-03	2.26E-03	2.82E-03
500	2.57E-03	2.73E-03	3.00E-03	2.48E-03	2.65E-03
550	2.44E-03	2.48E-03	2.73E-03	2.73E-03	2.49E-03
600	2.32E-03	2.26E-03	2.48E-03	3.00E-03	2.34E-03
650	2.21E-03	2.06E-03	2.26E-03	2.94E-03	2.20E-03
700	2.10E-03	1.87E-03	2.06E-03	2.88E-03	2.07E-03

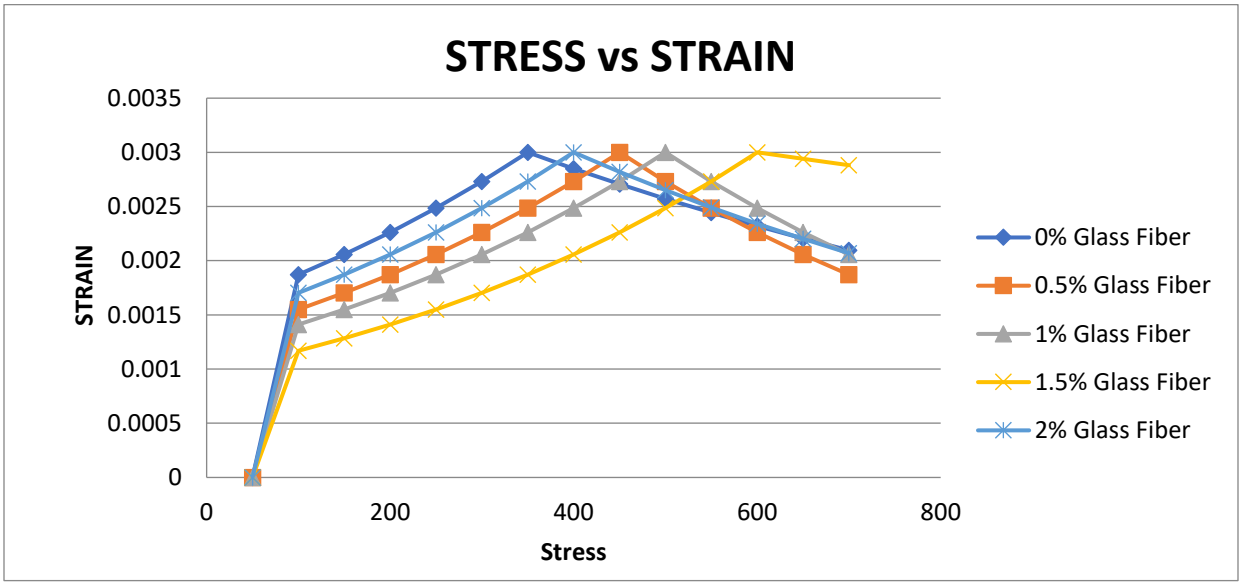


Fig 5 Stress Vs Strain

Above Results show that there is a concrete failure for 0% is at load of 350Kn, for 0.5% is at load of 450Kn.for 1% is at load of 500Kn, for 1.5% is at load of 600Kn and for 2% is at load of 400Kn.

4 CONCLUSION

Inclusion of glass fiber reduces the slump values. This is due to the resistance of fibers for the free flow of concrete.

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 GF1.5% was observed that 25% at 28 days compared with the conventional concrete mix GF0

The increasing percentage of compressive strength of samples GF 0.5, GF 1, GF 1.5, GF 2is11.17%,16.74%, 25% and 4.19% respectively at 28 days compared with the conventional concrete mix.

The highest Tensile Strength of Sample GF 1.5 was observed that 28.65% at 28 days compared with the conventional concrete mix GF0.

The increasing percentage of Tensile strength of samples GF 0.5, GF 1, GF 1.5, GF 2 is 8.9%, 18.53%,28.65% and 10.67% respectively at 28 days compared with the conventional concrete mix.

The highest Flexural strength of Sample GF 1.5 was observed that 20.5% at 28 days compared with the conventional concrete mix GF 0.

The increasing percentage of Flexural strength of samples GF 0.5, GF 1, GF 1.5, GF 2 is6.4%,13.33%, 20.5% and -1.2% respectively at 28 days compared with the conventional concrete mix

REFERENCE

[1] Tarun R. Naik and Bruce W. Ramme, High Strength Concrete Containing Large Quantities of Fly Ash, ACI Materials Journal, March-April (1989) 111-116.

[2] Bureau Of Indian Standards: IS-516: 1959 “Methods of Test for Strength of Concrete”, New Delhi 2003.

[3] Sivakumar. A, Manu Santhanam, “Mechanical Properties of High Strength Concrete Reinforced with Metallic and Non-Metallic Fibers”, Cement & Concrete Composites, 29 (2007) 603–608.

[4] Dr. Mrs. S. A. Bhalchandra1, Mrs. A. Y. Bhosle,” Properties of Glass Fiber Reinforced Geopolymer Concrete” International Journal of Modern Engineering Research (IJMER) Vol. 3, Issue. 4, Jul - Aug. 2013 Pp-2007-2010.

[5] Srinivasa R, Pannirselvam N, Seshadri T.S, And Sravana P., (2010), “Strength Properties of Glass Fiber Concrete” ARPN Journal of Engineering and Applied Sciences, VOL. 5, Issue 4.

[6] Okan Karahan, Cengiz Duran Atis(2010) “The Durability Properties of Polypropylene Fiber Reinforced Fly Ash Concrete”, Materials And Design.

[7] GomaleAvinash, Quadri S Ibrahim, Quadri S Mehmood, Syed Md Akram Ali, Hussaini Shed Shamsuddin (2012). Strength Aspect of Glass Fiber Reinforced Concrete. International Journal of Scientific Engineering Research. ISSN 2229-5518.

[8] Performance Of Steel Fiber Reinforced Concrete,Milind V. Mohod, P.R.M.I.T.&R., Badnera. International Journal of Engineering And Science Vol. 1, Issue 12 (December 2012), Pp 01-04.

[9] Verma Upendra, Kumar A.D (2013). Glass Fiber Reinforced Concerte. A Upendra Verma Et Al. International Journal Of Engineering Research And Applications. ISSN: 2248-9622 VOL. 3.

[10] Selin C. Ravikumr, Thandavamoorthy T.S (2013). Application Of FRP For Strengthening and Reinforcing of Civil Engineering Structures. ISSN(P). International Journal of Civil, Structural, Environmental and Infrastructure Engineering Research and Development (IJCSEIERD) ISSN(P): 2249- 6866; ISSN(E): 2249-7978.

[11] Kartikey T, Jatale A, Khandelwal S, (2013), “Effects on Compressive Strength When Cement Is Partially Replaced by Fly-Ash” IOSR Journal of Mechanical And Civil Engineering (IOSR-JMCE) Volume 5, Issue 4, Jan-Feb 2013.