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Glass Fibre Reinforced Concrete

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ABSTRACT
Glass Fibre Reinforced Concrete is recent introduction in the field of concrete technology. The present day world is witnessing the construction of very challenging and difficult Civil Engineering Structures. Concrete being the most important and widely used material is called upon to possess very high strength and sufficient workability properties. Concrete the most widely used consrtuction material has several desirable properties like high compressive strength, stiffness, durability under usual environmental factors. At the same time concrete is brittle and weak in tension. Efforts are being made in the field of concrete technology to develop high performance concretes by using fibres and other admixtures in concrete upto certain proportions. To improve the concrete properties, the system was named alkali resistance glass fibre reinforced concrete in the present view the alkali resistance glass fibre has been used. In the present experimental investigation the alkali resistance Glass Fibres has been used to study the effect on compressive, split tensile and flexural strength on M20, M40 and M60 grades of concrete

Keywords – Alkali resistance glass fibres, admixtures, concrete, glass fibres, strength properties.

I. INTRODUCTION

Concrete is the most widely used man made construction in the world. Concrete is the most widely used construction material has several desirable properties like high compressive strength, stiffness and durability under usual environmental factors. At the same time concrete is brittle and weak in tension. Plain concrete has two deficiencies, low tensile strength and a low strain at fracture. These shortcomings are generally overcome by reinforcing concrete. Normally reinforcement consists of continuous deformed steel bars or pre-stressing tendons. The advantage of reinforcing and pre-stressing technology utilizing steel reinforcement as high tensile steel wires have helped in overcoming the incapacity of concrete in tension but the ductility magnitude of compressive strength. Glass fibre reinforced concrete is one of the most versatile building materials available to architects and engineers. Composed principally of cement, sand and special alkali resistant (AR) glass fibres, GRC is a thin, high strength concrete with many applications in construction.

II. MATERIALS

2.1. Cement

Ordinary Portland Cement of 53 grades available in local market is used in the investigation. The cement used has been tested for various proportions as per IS :4031-1998 and found to be conforming to various specifications of IS :12269-1987. The specific gravity was 3.15.

2.2. Coarse aggregate

The crushed aggregates used were maximum size of aggregate 20mm and minimum size of aggregate 12mm. The specific gravity 2.74.

2.3. Fine aggregate

River bed sand was used as fine aggregate.The specific gravity was 2.63 and fineness modulus was 2.86 respectively.

2.4. Glass fibre

The glass fibres used are of Cem-fil-anti-crack with modulus of elasticity 72Gpa, filament diameter – 14 microns, specific gravity 2.68, length 12 mm and having the aspect ratio of 857.1.The number of fibres per 1 kg is 212 million fibres.

III. METHODS

3.1. Workability The workability tests were performed using standard sizes of Slump Moulds as per IS: 1199 - 1999 and Compaction Factor apparatus which was developed in UK and is described in IS: 1199 - 1999.

3.2. Compressive Strength The Steel mould of size 150 x 150 x 150 mm is well tighten and oiled thoroughly. They were allowed for curing in a curing tank for 28 days and they were tested in 200-tonnes electro hydraulic closed loop machine. The test procedures were used as per IS: 516-1979.

3.3. Flexural Strength The Steel mould of size 500 x 100 x 100 mm is well tighten and oiled thoroughly. They were allowed for curing in a curing tank for 28 days and they were tested in universal testing

machine. The test procedures were used as per IS 516-1979.

3.4. Split Tensile Strength The specimens shall be cylinder with 150 mm in diameter and 300 mm long and is well tighten and oiled thoroughly. They were allowed for curing in a curing tank for 28 days and they were tested in universal testing machine. The test procedure were used as per IS 5816-1999.

IV. RESULTS AND DISCUSSIONS

Effect of glass fibre on workability of glass fibre concrete

The workability of concrete of M20, M30, M40 and M60 grades of concretes were estimated in terms of compaction factor for addition of 0.03% of glass fibre. It was observed that the addition of glass fibres, the compaction factor of 0.93 to 0.97 was maintained for almost all grades of concrete.

Effect of glass fibre on bleeding of glass fibre concrete

On the basis of the experimental study it was concluded that addition of glass fibre in concrete gives a reduction in bleeding. A reduction in bleeding improves the surface integrity of concrete, improves its homogeneity and reduces the probability of cracks occurring where there is some restraint to settlement.

V. FIGURES AND TABLE

Compressive strength of ordinary concrete and Glass fibre reinforced concrete mixes

From the data tabulated in the Table-2 and represented in Fig 1, it is observed that the Compressive Strength of M-20, M-30, M-40 and M-60 grade of concrete without and with Glass Fibres. The values are observed for 28 days.

 # EXPERIMENTAL SETUP




Table 1. Quantities of materials required for mix per 1 cum of ordinary concrete and glass fibres

Grade of concrete	Cement (kg)	Fine aggregate (kg)	Course aggregate (kg)	Water (lts)	W/C ratio	Glass fibres
M20	338.18	722.45	1132.24	186	0.55	0.03 % by concrete volume
M30	350	686	1137	175	0.5	
M40	410	604	1170	163	0.4	
M60	500	592	1146	160	0.32	

Table 2. Compressive Strength for different grades of concrete

Grade of Concrete	Compressive Strength (N/mm^2) for 28 days	
	Without Glass Fibre	With Glass Fibre
M20	34.12	40.46
M30	40.30	46.04
M40	49.25	56.26
M60	66.92	74.55

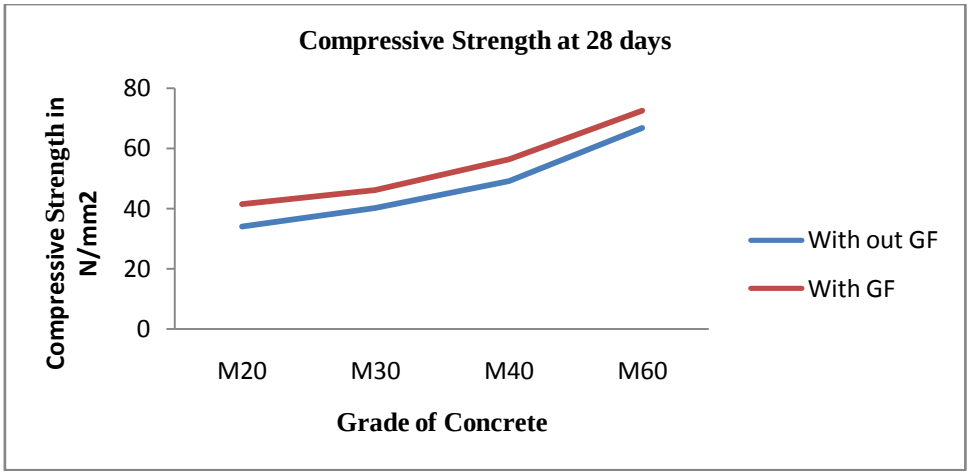

Fig.1. Variation of compressive strength of ordinary concrete and Glass fibre reinforced concrete @ 28 days.

Split tensile strength of ordinary concrete and Glass fibre reinforced concrete mixes

From the data tabulated in the Table-3 and represented in Fig 2, it is observed that the Split Tensile Strength of M-20, M-30, M-40 and M-60 grade of concrete without and with Glass Fibres. The values are observed for 28 days.

Table 3. Split Tensile Strength for different grades of concrete

Grade of Concrete	Split Tensile Strength (N/mm^2) for 28 days	
	With out Glass Fibre	With Glass Fibre
M20	3.62	4.30
M30	4.36	5.12
M40	4.79	5.65
M60	5.72	6.86

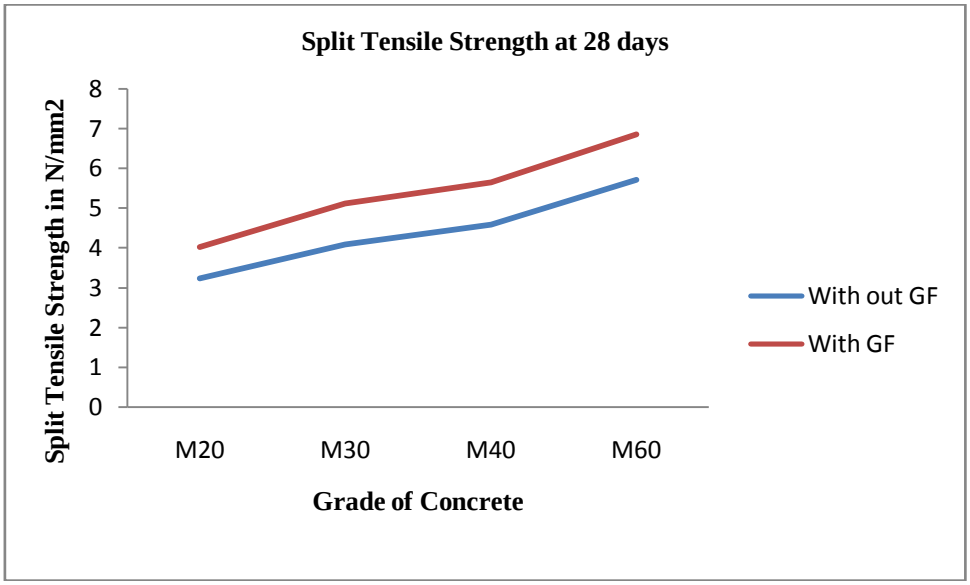

Fig.2. Variation of split tensile strength of ordinary concrete and Glass fibre reinforced concrete @ 28 days

Flexural strength of ordinary concrete and Glass fibre reinforced concrete mixes

From the data tabulated in the Table-4 and represented in Fig 3, it is observed that the Flexural Strength of M-20, M-30, M-40 and M-60 grade of concrete without and with Glass Fibres. The values are observed for 28 days.

Table 4. Flexural Strength for different grades of concrete

Grade of Concrete	Flexural Strength (N/mm^2) for 28 days	
	With out Glass Fibre	With Glass Fibre
M20	3.56	4.08
M30	4.12	4.85
M40	4.86	5.72
M60	6.37	7.12

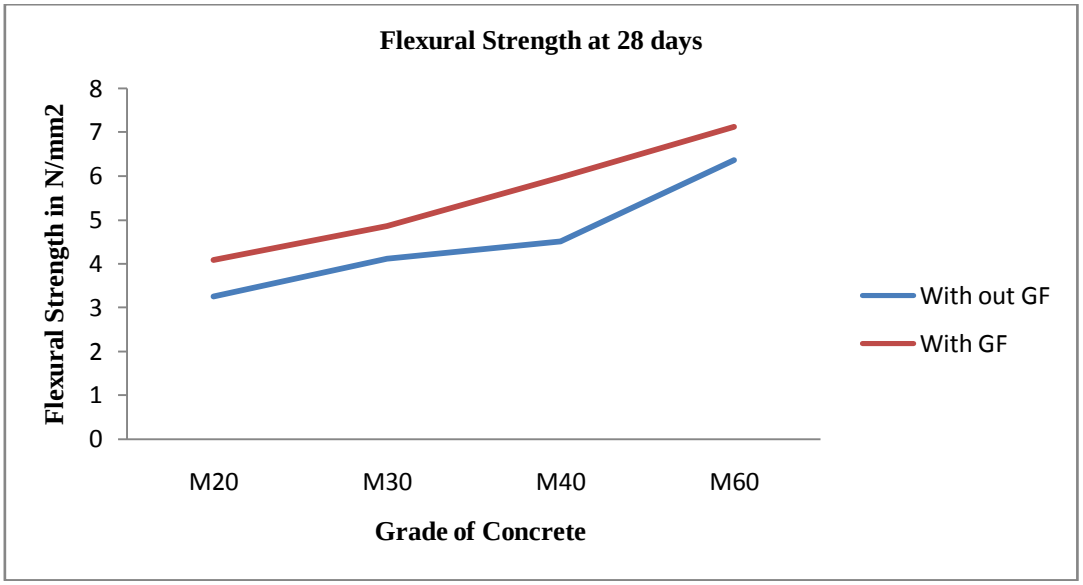

Fig.3. Variation of flexural strength of ordinary concrete and Glass fibre reinforced concrete @ 28 days.

Variation of compressive strength, split tensile strength and flexural strength of the glass fibre concrete mixes compared with ordinary concrete mixes.

Table-5 gives the increase in compressive, split tensile and flexural strength of various grades of glass fibre concrete mixes were compared with ordinary concrete mixes of M20, M30, M40 and M50. The variation in strength of glass fibre concretes is observed to be 10 to 20% when compared with ordinary concrete.

Table-5. Percentage increase of compressive, flexural and split tensile strength of glass fibre concrete in comparison with ordinary concrete mixes.

Grade of Concrete	Number of Days	Compressive Strength (N/mm^2)	Split Tensile Strength (N/mm^2)	Flexural Strength (N/mm^2)
M20	28	18.58	18.71	14.60
M30	28	14.24	17.43	17.71
M40	28	14.23	17.95	17.69
M60	28	11.40	19.93	11.77

VI. CONCLUSIONS

- The percentage increase of compressive strength of various grades of glass fibre concrete mixes compared with 28 days compressive strength is observed from 10to 20%.
- The percentage increase of flexural and split tensile strength of various grades of glass fibre concrete mixes compared with 28 days is observed from 10 to 20%.
- A reduction in bleeding improves the surface integrity of concrete, improves its

homogeneity and reduces the probability of cracks .

- It has been also observed that there is gradual increase in early strength for Compression and Flexural strength of Glass Fibre Reinforced Concrete as compared to Plain Concrete, and there is sudden increase in ultimate strength for Split tensile strength of Glass Fibre Reinforced Concrete as compared to Plain Concrete.

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