

Experimental Investigation on Glass Fibre Reinforced Concrete

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Abstract: Concrete possesses a very low tensile strength, limited ductility and little resistance to cracking by adding glass fibres into concrete can dramatically increases tensile strength and also compressive strength. Glass fibre reinforced concrete will shows considerable improvement in durability when compared to conventional concrete. We can also use plasticizer as “GELENIUM SKY 8234” to reduce water content and increases workability. The main aim of this study is to compare the test results between conventional concrete and glass fibre reinforced concrete. In this study concrete mix design is done for M30 grade concrete. The strength results were compared by addition glass fibres in concrete mixture of different proportions 0%, 0.5% and 1% by weight of cement, the cubes are prepared for different sizes of 150mm X 150mm X 150mm for compression and 100mm X 100mm X 100mm for tension. The curing will be done for 7, 28 days. Finally the strength performance of glass fibred reinforced concrete is compared with normal concrete.

Key words: Compressive Strength, concrete, Fiber Reinforced Concrete, Glass Fibers, Tensile Strength etc....

I. INTRODUCTION

Portland cement is a very commonly used construction material. Concrete made with this cement has certain characteristics. It is relatively strong in compression but weak in tension and tends to be brittle. Because of the load and environmental changes, a micro crack appears in cement products. Therefore cement based materials have low tensile strength and cause brittle failure.

The development of these micro cracks causes elastic deformation of concrete. Plain concrete is a brittle material and having the values of modulus of rupture and strain capacity is low. The fibres of short length and small diameters can be used in concrete to convert its brittle nature to a ductile one. The addition of fibres in the plain concrete will control the cracking due shrinkage and also reduce the bleeding of water. The addition of glass fibres in plain concrete shows higher compressive, tensile and flexural strength than plain concrete.

Glass Fiber Reinforced Concrete (GFRC) or (GRC) is a type of fiber reinforced concrete. Glass fiber concretes are mainly used in exterior building panels and as architectural precast concrete. This material is very good in making shapes on the front of any building and it is less dense than steel.

Earlier research work in the usage of fibres to improve the strength of reinforced Concrete, resistance to fire, reduce the bleeding and arrest the cracks. Some justified in the past studies are

Dr.P.Srinivasa Rao et.al.,⁽¹⁾ study on Durability Studies on Glass Fibre Reinforced Concrete showed that while adding the glass fibre which resistance the acid attack on concrete increases by adding AR-glass fibers in concrete, less permeability of chlorides into concrete when compared with ordinary concrete and glass Fibres Bridge across the cracks causing interconnecting voids to be minimum.

Chandramouli et.al.,⁽²⁾ showed that addition of glass fibre in concrete gives a reduction in bleeding and It was found that the percentage increase of compressive strength from 20 to 25%, split tensile strength and flexural strength from 15 to 20% at 28 days

P. Sangeetha et.al.,⁽³⁾ showed that Increase in the percentage of Glass Fiber by weight of concrete (0.1%,0.2% & 0.3%) increase the Compressive and Impact strength. Different Combinations of admixtures such as (S+AEA+A), (S+AEA+R) & (S+AEA+W) increase the Compressive and Impact Strength Considerably in which (S+AEA+R) combination showed good result both in Compression test and Impact test

Deshmukh S.H. et.al.,⁽⁴⁾ showed that addition of glass fibres into the concrete mixture marginally improves

the compressive strength, splitting tensile strength and flexural strength at 28 days. The 0.1% addition of glass fibers into the concrete shows better result in mechanical properties and durability.

II. EXPERIMENTAL INVESTIGATIONS

2.1 Materials

Cement

The ingredients of cement primarily consist of calcareous materials in the form of limestone, chalks and marl and argillaceous materials. The ordinary Portland cement of Penna 53 Grade is used. The specific gravity of cement is 3.15.

Aggregate

Fine aggregate is a material such as sand, crushed stones or crushed gravel passing through 4.75 mm size. Locally available sand is used as fine aggregate in the concrete mix. The specific gravity of fine aggregate is found to be 2.63. Material which retained on 4.75 mm size is classified as coarse aggregate. For most works, 20 mm aggregate is suitable. The locally available 20 mm size of aggregate is used. The specific gravity of coarse aggregate is found to be 2.72.

Glass Fibers

The glass fibers used in concrete suppressed the localization of micro cracks in to macro cracks hence tensile strength increase. It improves durability of concrete by increasing the strength of concrete. The Glass Fibers are of Cem-FIL Anti - Crack HD with modulus of elasticity 72 GPa, Filament diameter 14 microns. Its Specific Gravity is 2.68, length 12 mm and having the aspect ratio of 857.1. The number of fibers per 1 kg is 212 million.

2.2 Mix Proportions

In this study, control mix was designed as per IS 10262:1982 to achieve a target compressive strength of 30 MPa. The glass fibres of 0 %, 0.5% and 1 % by the Weight of cement were used.

In the present experimental investigation cubes of 150mm x 150mm x 150mm for compressive strength and 100mm x 100mm x 100mm for tensile strength of M-30 grade concrete were casted with varying percentage of addition of 0%, 0.5% and 1% of glass fibre. After casting, test specimens were demolded after 24 hours and were kept in the curing tanks until the time of test.

2.3 Preparation and Details of Test Specimens

Cement Kg	Fine aggregate	Coarse aggregate	Water (lit)
380	722	1207	160

	(kg)	(kg)	
380	722	1207	160

III. RESULTS AND DISCUSSION

3.1 Workability of Concrete Mixes

Table 1 Workability test values

% of Fibre	Slump Value mm	Compaction Factor
0 %	80	0.91
0.5 %	15	0.88
1 %	0	0.84

Table 1 shows that the workability test results conducted according to IS 1199 w/c ratio were kept constant 0.42 for all the concrete mixes. GELENUM SKY 8234 plasticizer (1%) was used to maintain the required slump. It was found the addition of glass fibre decrease the workability compare to normal mix

3.2 Compressive Strength

Table 2 Compressive Test Result

Type of concrete	Days	Weight	Density KN/m ³	Load at failure KN	Compressive Strength N/mm ²
0 %	7 Days	8.36	24.30	956.67	42.52
	28 Days	8.34	24.24	1220	54.21
	56 Days	8.35	24.27	1268.67	56.38
0.5%	7 Days	8.34	24.24	1036.67	46.07
	28 Days	8.23	23.92	1256.67	55.85
	56 Days	8.24	23.95	1272.67	56.56
1%	7 Days	8.21	23.85	813.33	36.15
	28 Days	8.22	23.89	1150	51.11
	56 Days	8.26	24.00	1170	51.99

The results of the compressive strength tests conducted on concrete specimens of different mixes cured at different ages are presented. The compressive strength test was conducted at curing ages of 7, 28 and 56 days. The compressive strength test results of all the mixes at different

curing ages are shown in Table 2.

Table 2 shows that addition of GF 0.5% by weight of OPC shows increase in compressive strength of the concrete mixes Compared with control mix of concrete. Compared to control mix of concrete, concrete containing 0.5% GF the compressive strength of concrete mix was found to increase by 3.02 % at 28 days of curing. Also it can be observed that 28 days compressive strength is decrease by 5.72 % with addition of 1% of glass fiber compared to normal M-30 concrete⁽⁴⁾.

3.3 Tensile Strength Test Results

Table 3 Tensile Test Result

Type of concrete	Days	Weight	Density ³ KN/m ³	Load at failure KN	Compressive Strength ² N/mm ²
0 %	7 Days	2.450	24.03	50.67	2.62
	28 Days	2.471	24.24	60	3.11
	56 Days	2.447	24.00	86.67	4.49
0.5%	7 Days	2.430	23.84	56.67	2.93
	28 Days	2.434	23.87	78.33	4.06
	56 Days	2.399	22.94	79	4.10
1%	7 Days	2.420	23.74	61.67	3.19
	28 Days	2.433	23.86	71.33	3.70
	56 Days	2.437	23.91	72.67	3.77

The results of the tensile strength tests conducted on concrete specimens of different mixes cured at different ages are presented and discussed in this section. The tensile strength test was conducted at curing ages of 7, 28 and 56 days. The tensile strength test results of all the mixes at different curing ages are shown in Table 3.

Table 3 shows that addition of GF 0.5% by weight of OPC shows increase in tensile strength of the concrete mixes compared with control mix of concrete. It can be observed that 28 days tensile strength is increased by 30.54% with addition of 0.5% of glass fiber compared to normal M-30 concrete. Also it can be observed that 28 days tensile strength is Increased by 18.97 % with addition of 1% of glass fiber compared to normal M-30 concrete⁽⁴⁾.

IV. CONCLUSIONS

- ❖ It has been observed that the Density of concrete decreases with the addition of Glass Fibres.
- ❖ Workability of concrete decreases with the addition of Glass Fibres
- ❖ It has been observed that the Compressive strength of concrete increase by 3.02 % by the addition of 0.5 % of Glass Fibres at 28 days compare to normal concrete and decreases by 5.72 % by

addition of 1% of glass fibre

It has been observed that the Tensile strength of concrete increase by 30.54 % by the addition of 0.5 % of Glass Fibres at 28 days compare to normal concrete and increase by 18.97 % by addition of 1 % of glass fibre

Finally we conclude that addition of 0.5 % of glass fibre is gives the better results compare to the normal and 1 % of glass fibre concrete

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