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Effect of Glass Fiber on The Strength of Rc Beam

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Abstract

Concrete is most widely used construction material in the world.Glass Fibre reinforced concrete (FRC) is a concrete in which small and discontinuous fibers are dispersed uniformly. The addition of Glass fibres can dramatically increase/decrease the compressive strength, tensile strength and flexural strength of concrete. In this paper effect of glass fibres on the strength of RC concrete for M25 grade have been studied by varying the percentages of glass fibres in concrete. 0%, 1.5% and 2% volume fraction of glass fibres of weight of cement were used with admixtures.

Keywords: Fibre Reinforced Concrete, Flexural Strength, Glass Fibre, fly ash,admixture.

I.INTRODUCTION

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. So we can define Glass fibre reinforced concrete as a composite material of cement concrete or mortar and discontinuous discrete and uniformly dispersed fibre. The addition of these fibers into concrete mass can dramatically increase/slidly decrease the compressive strength, tensile strength, flexural strength and impact strength of concrete.

II. LITERATURE REVIEW

Following points emerged from a literature review:

1. The tests conducted on GFRC in laboratory have shown good resistance for fire, since the major use of GFRCs is for architectural building panels. In these buildings, fire resistance becomes an important factor in design.
2. When cement, mortar or concrete is splashed or otherwise brought into contact with window glass, etching occurs. This is because the alkali in cement attacks some of the silicates that are used in glass manufacture. The stock used in making glass fibers has better alkali resistance than window glass because zirconium is used as one of the constituents.
3. Tests on telecommunication towers by using GRC with carbon fibre and/or stainless steel bars have shown that GRC can be used as structural material, with reduced weight and has good durability properties. According to the results of the tests performed in small specimens the average

values of the main material properties are: compression strength: 41 MPa, tension strength: 3.7 MPa; initial Young modulus: 16.5 GPa.

4. The mixes with 1.5% volume of fibers gave optimum composite properties in terms of compressive strength with 25.39% strength improvement. The highest increase in split tensile strength was observed in mixes with 1.5% of volumes of fibers and found to be 5.76% higher strength than reference concrete. Similarly, the highest flexural strength was observed in mixes with 1.5% of volume of fibre and found to be 72.5% more than reference concrete.

III. OBJECTIVE OF THE STUDY

In the study, the following objectives are envisaged:

- Study the mix design aspects of the GRC.
- Understand the various applications involving GRC.

IV. MATERIALS USED

4.1 Cement

OPC has been used throughout the experimental program confining to IS: 12269 manufactured by Ultratech Cement.

4.2 Fine Aggregate (Sand)

River sand was used as fine aggregate. The specific gravity and fineness modulus was 2.6 and 2.93 respectively confining IS: 383-1970 has been used.

4.3 Coarse Aggregate

Crushed angular granite metal from a local source was used as coarse aggregate and found to be conforming to various specifications of IS: 383-1970.

4.4 Water

Water is an important of aggregate as it actively participates in the chemical reaction with cement. The potable tap water has been used for casting.

4.5 Reinforcement

The longitudinal reinforcements used were high-yield strength deformed bars of 8 mm diameter at top and 8 mm diameter bar at bottom. The stirrups were made from mild steel bars with 6 mm diameter. at 150 mm spacing between center to center. The steel were used in this investigation were Fe 415.

4.6 Fly Ash

Fly ash is a by-product of coal-fired electric generating plants.

4.7 Glass Fiber

The glass fibers used are of Chimney Enterprises with modulus of elasticity 72 GPa, Filament diameter 14 microns, specific gravity 2.68, length 12 mm and having the aspect ratio of 857.1. The number of fibers per kg is 212 million fibers.

4.8 Polycarboxylate Ether Superplasticizer

Features / Uses:

- Excellent dispersion resulting in High workability
- Increases early & ultimate strengths
- Increases Flexural strength & E-modulus
- **Specification**:

- ASTM C 494

4.9 Form Work

Fresh concrete, being plastic requires some kind of form work to mould it to the required shape and also to hold it till it sets.

V. CONCRETE MIX PROPORTION

Table1:Mix Proportion for One Cubic meter Conventional M25 Grade Concrete

Water	Cement	FA	CA
191.5	491.28	556.26	1111.57
0.39	1	1.13	2.26

Add 20%fly ash of cement

Table 2: Proportion Of Glass Fibre And Fly Ash

Sr. No	%Glass Fiber	%Fly Ash	No Of Cubes & Beams
1	0	20	1
			2
			3
2	1.5	20	4
			5
			6
3	2.0	20	7
			8
			9

Table.3:Schedule of Casting For Mix Proportion

Sr. No.	% of	No of	W/C	Compression	Size of cubes	% of Fly	Plasticizer
01	00	1	0.39	34.66	150x150x150	20%	0.41
		2	0.39	37.33	150x150x150		0.41
		3	0.39	34.44	150x150x150		0.41
02	1.5	4	0.39	27.55	150x150x150	20 %	0.41
		5	0.39	23.55	150x150x150		0.41
		6	0.39	25.55	150x150x150		0.41
03	2.0	7	0.39	27.77	150x150x150	20 %	0.41
		8	0.39	25.66	150x150x150		0.41
		9	0.39	25.77	150x150x150		0.41

VI. METHODOLOGY

The tests have been performed to determine the mechanical properties such as compressive strength and flexural strength of concrete mix with Glass fibre content.

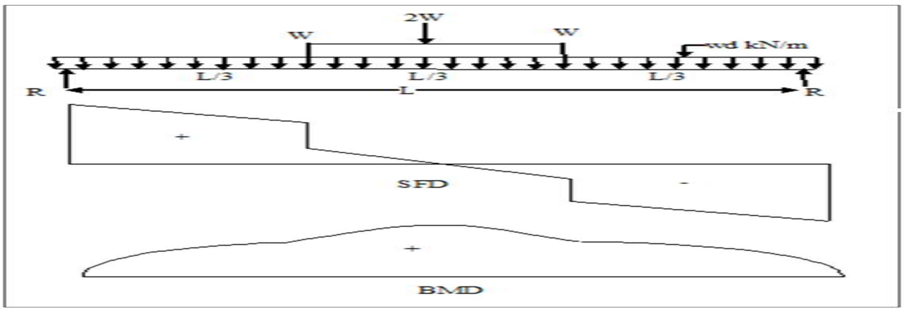
Flexural Strength Test

Standard beam of size 150 x 230 x 2000 mm were supported symmetrically over a span of 2000 mm and subjected two points loading. In flexure test, the beam specimen was placed in the machine in such a manner that the load was applied to the upper most surface as cast in the mould. All beams were tested under two point loading in Universal Testing Machine of 100 tone capacity. The load was applied at a rate of 180Kg/min for 15cm x23cm x 200cm specimens. The load was increased until the specimen failed and the failure load was recorded.

Center point load was applied through two point loading system as shown in fig. The load was applied up to failure. The flexural strength was determined by the formula,

Modulus of rupture, _ft = Pl/bd2

Where,
b = measured width in mm of the specimen,
d = measured depth in mm of the specimen at the point of failure,
l = length in mm of the span on which the specimen was supported, and
P = maximum load in KN applied to the specimen



VII. EXPERIMENTAL RESULTS

7.1 Compressive Strength Test (Cubes)

Table.4: Breaking Load and Compressive Strength Result

Sr. No	%Glass Fiber	No Of Cubes	Breaking Load (KN)	28 Compressive Strength (N/mm2)	Average Compressive Strength (N/mm2)
1	0	1	780	34.66	35.47
		2	840	37.33	
		3	775	34.44	
2	1.5	4	620	27.55	25.70
		5	540	24.00	

		6	575	25.55	
3	2.0	7	550	24.44	25.66
		8	600	26.66	
			580	25.77	

Flexural Strength Test

Table.5:Flexural Strength Result (Beams)

Sr. No	%Glass Fiber	No Of Beams	Flexural Strength (N/mm2)	Average Flexural Strength (N/mm2)
			28 Days	
1	0	1	17.89	17.53
		2	16.76	
		3	17.95	
2	1.5	4	19.30	19.45
		5	19.47	
		6	19.60	
3	2.0	7	15.01	15.00
		8	14.61	
		9	15.37	

VIII. CONCLUSION

The percentage increase of flexural strength for 1.5% Glass Fiber concrete beam is about 11% to that of the conventional concrete beam and for 2% proportion of GFRC beam there has been decrease in flexural strength by 16% to that of Conventional concrete beam. Hence the flexural strength increases up to a certain limit and decreases thereafter.

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