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AN EXPERIMENTAL STUDY ON GLASS FIBRE REINFORCED CONCRETE

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Abstract - *The Plain Concrete have brittle nature and low tensile strength. So placing of reinforcement bars to plain concrete to attain the tensile strength. Since Fibre Reinforced Concrete is most widely used construction materials. Fibre is easily available material. Due to the Glass Fibre Reinforced Concrete the Glass Fibre easily surrounded to the cementitious medium. The study work is focused on strength and durability characteristics of GFRC. As per IS 10262-2009 designed by M40 grade of Concrete and con plast as a super plasticizer and water cement ratio 0.40. The performance of Cement Concrete with varying percentage of Glass Fibre adding like 0.33%, 0.66%, 1%, 1.33%, 1.66%, 2%. The strength and durability properties of Glass Fibre Reinforced Concrete compared to Control Concrete.*

***Key Words*: Cem-FIL AR Glass Fibre,OPC-53 grade, Compressive Strength, Flexural Strength, Split Tensile Strength, Acid attack TEST.**

1.INTRODUCTION

Concrete is one of the mostly used constructions Material. Fibre Reinforced concrete new construction material which is defined as composite material of Cement mortar. Concrete without fibre they may cause cracks in surface. Due to adding of Glass Fibre into cement mortar eliminates the cracks and shrinkage in the surface. The mechanical property of Glass Fibre is fibre orientation, fibre length. There are more types of Glass Fibres are available. **A-glass** - Alkali glass made with soda lime silicate. **C-glass** – Corrosive resistant glass made with calcium borosilicate. **AR-glass** – Alkali Resistant glass made with zirconium silicates. Used in Portland cement substrates. This is called AR Glass Fibre.

2.MATERIALS USED

2.1 Cement

OPC 53 grade of Cement was used and is conforming to IS 12269:2013. The physical properties are given as under,

- Specific Gravity 3.16
- Normal Consistency 26%
- Fineness 8%

2.2 Coarse Aggregate

Crushed angular aggregate of maximum 20mm. The physical properties are given as under,

- Specific Gravity 2.6
- Crushing Value 12.42%
- Abrasion Value 14.5%
- Impact Value 11.2%

2.3 Fine Aggregate

Locally available river sand used. The physical properties are given as under,

- Specific Gravity 2.4
- Water Absorption 0.8%
- Bulking of sand 11.9%

2.4 Water

Fresh portable drinking water should be used for curing and casting of specimen. Water is important ingredient for strength and durability characteristics of concrete.

2.5 Admixture

ConPlast was used as a super plasticizer at the rate 1% by weight of Cement. This was in liquid form.

2.6 Glass Fibre

The Glass Fibre is of Cem-FIL with filament diameter 14 microns, length 12mm, aspect ratio of 857.1, tensile strength 2500Mpa, elongation breaks 3.6%, modulus of elasticity 70Gpa, density 2780 kg/m3, white colour, and chopped strand fibre type and of type alkali resistant are used in this experimental study.

Fig – 1 : Glass Fibre

3. MIX PROPORTION

As per IS 10262-2009 designed by M40 grade of Concrete and Con Plast as a Super plasticizer and water cement ratio 0.40.

Materials	Quantity (kg/m³)	Proportions
Cement	410	1
Fine Aggregate	604	1.5
Coarse aggregate	1170	2.9
Water	164	0.4
Super plasticizer	4.1	0.01

Table -1 : Mix Proportion

4. EXPERIMENTAL METHODOLOGY AND ANALYSIS OF RESULTS

4.1 Compressive Strength Test

The compression test carried out on specimens like cube. The cube specimen is of the size 15×15×15cm. If the largest nominal size of the aggregate does not exceed 20mm, 10cm cubes may also be used as an alternative. The specimens were tested for compressive strength as per IS 516-1959 using a calibrated compression testing machine of 2000KN capacity. After placing the specimen the compression load is applied due to compression the specimen fails this failure is noted.

The compressive strength of the specimen was calculated by using the formula

$$f_c = \frac{P}{A} \text{ N/mm}^2$$

Where,

P = Load at which the specimen fails in Newton (N)

A = Area over which the load is applied in mm²

f_c = Compressive Stress in N/mm²

Types of Concrete \ Age	7days N/mm²	28days N/mm²	60days N/mm²
Control Concrete	35.55	45.33	58.22
0.33% GF	37.33	46.22	59.11
0.66% GF	40.88	48	61.33
1% GF	44.88	48.88	61.78
1.33% GF	43.55	48.44	61.55
1.66% GF	41.77	45.55	60.89
2% GF	39.11	44.88	59.55

Table -2 : Compressive Strength test results

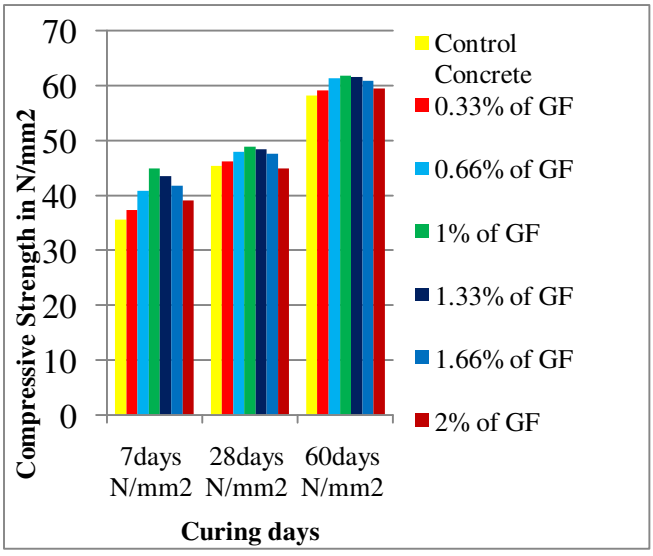

Chart -1 : Analysis of Compressive Strength

4.2 Flexural Strength Test

Flexural strength is the one of the measure of the tensile strength of concrete.

It is measured by loading un-reinforced beam or prism of size of 100×100×500mm.

The prism is casted and after 24 hours it was de-moulded and kept in a curing tank for 7, 28, 60 days and then it was taken out and dried in atmosphere for few hours after that the specimens were tested for its flexural strength as per IS: 516-1959 using a calibrated flexural machine. The bed of testing machine should be supported, and these rollers should be mounded that the distance from centre is 50mm for 100mm specimen.

The flexural strength of the specimen was calculated by using the formula

$$f_b = \frac{Pl}{bd^2} \text{ N/mm}^2$$

Where,

P = Load at which specimen fails in N

l = Effective span in mm

b = Breadth of the specimen in mm

d = Depth of the specimen in mm

Age / Types of Concrete	7days N/mm²	28days N/mm²	60days N/mm²
Control Concrete	5.39	6.37	6.86
0.33% GF	5.6	6.6	7.6
0.66% GF	5.6	6.8	7.8
1% GF	5.8	6.86	8.0
1.33% GF	4.9	5.8	6.37
1.66% GF	4.6	5.39	5.8
2% GF	4.4	4.9	5.39

Table – 3 : Flexural Strength test results

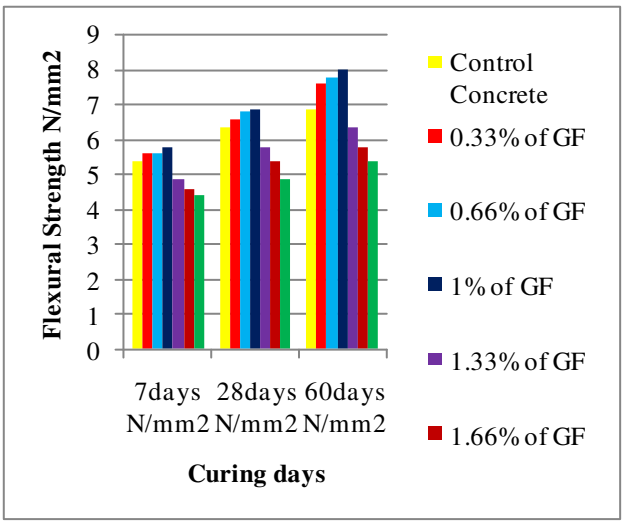

Chart -2 : Analysis of Flexural Strength

4.3 Split Tensile Strength Test

Split tensile strength of concrete is usually found by testing concrete cylinder of size 100mm × 200mm. The specimens were tested for its strength as per IS: 516-1959 using a calibrated compression testing machine of 2000KN capacity.

The tensile strength of the specimen was calculated by using the formula

$$f_t = \frac{2p}{\pi dl} \text{ N/mm}^2$$

Where,

P = Maximum load in N applied to the specimen

d = Measured length in cm of the specimen

l = Measured diameter in cm of the specimen

f_t = Tensile strength N/mm²

Age / Types of Concrete	7days N/mm²	28days N/mm²	60days N/mm²
Control Concrete	4.77	6.36	7.96
0.33% GF	4.84	6.68	8.28
0.66% GF	4.93	7.32	9.23
1% GF	5.09	7.96	9.55
1.33% GF	4.71	6.05	7.32
1.66% GF	3.5	5.25	5.73
2% GF	2.86	4.77	5.09

Table – 4 : Split Tensile Strength test results

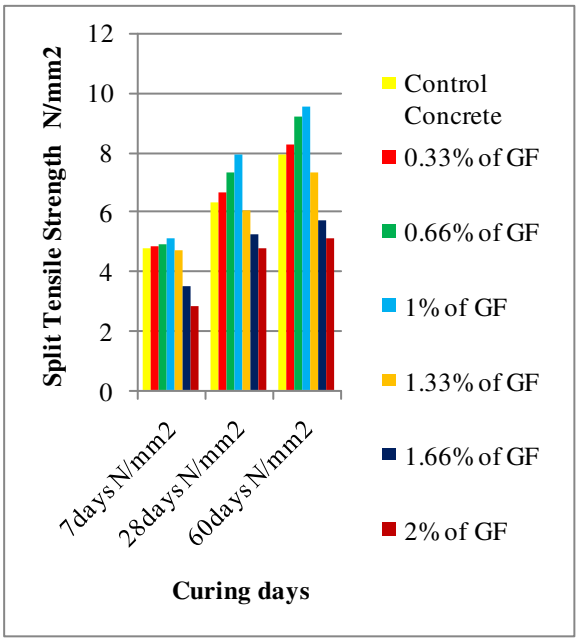

Chart -3 : Analysis of Split Tensile Strength

4.4 Acid Test

In order to access the weight loss concrete is exposed to chemical media. For acid test, hydrochloric acid (HCL) solution was prepared by mixing 5%of Conc.Hcl with one litre of distilled water as per ASTM G20-8 or make an acidic solution with 1N (Normality) as per laboratory standards.

After normal curing (60days) cubes were taken out and weight of cube was noted. Then a weighted cube was immersed in the prepared hydrochloric acid for 7 and 28 days. After curing the cubes were taken out from acid and weight of cubes was noted. From this weight loss of cubes is calculated.

Weight loss = Weight of cube after Normal Curing – Weight of cube after Taken from Acidic Solution

S.No	Type of Concrete	Percentage loss in weight (kg)	
		28days	60days
1	Control Concrete	0.34	0.41
2	GF 0.33%	0.39	0.43
3	GF 0.66%	0.42	0.47
4	GF 1.0%	0.47	0.5
5	GF 1.33%	0.5	0.54
6	GF 1.66%	0.55	0.62
7	GF 2.0%	0.6	0.64

Table – 5 : Percentage loss in weight due to Acid Attack

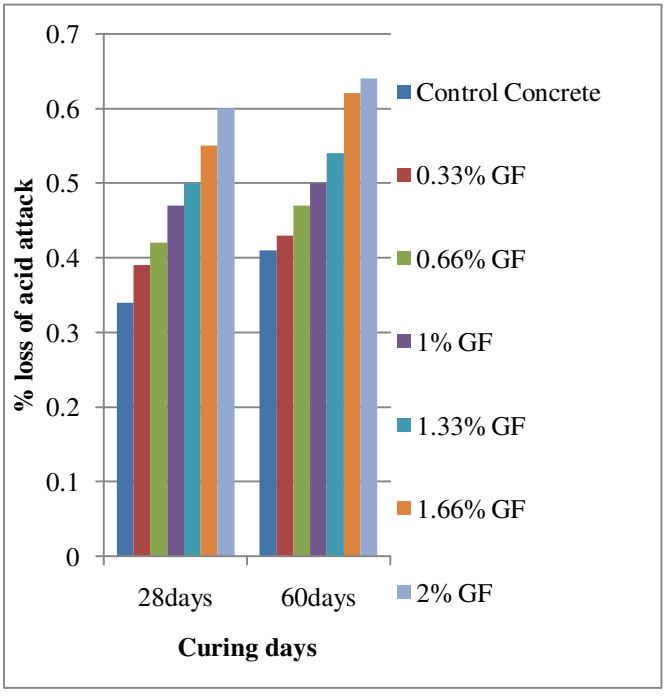

Chart -4 : Analysis of % loss of Acid Attack

5. CONCLUSIONS

Based on experimental investigation addition of Glass Fibre in plain concrete increases the strength and durability characteristics.

Initially addition of Glass Fibre in the plain concrete the strength characterstics like compressive, flexural and split tensile strength is gradually increased.Finally certain percent addition of Glass Fibre attain that gradually decrease in strength.

Maximum compressive, flexural and split tensile strength is attaining in 1.0% addition of Glass Fibre. So adding Glass Fibre upto 1.0% only not exceeds the limit.

The durability characteristics gradually increased based on the addition of Glass Fibre.

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