

Experimental Study on Glass Fibre Reinforced Concrete with Replacement of Fine Aggregate by M.Sand

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ABSTRACT: Glass fibre has gained popularity in concrete reinforcing applications due to its excellent mechanical properties, physical properties and chemical properties. In developing countries where concrete is widely used, the high and steadily increasing cost of concrete has made construction is very expensive. This paper is experimented to reduce the cost construction and increase strength & durability. The environment has led to studies on various materials which could be used as partial replacement for fine aggregate. In this paper, fine aggregate is replaced with manufacture sand and glass fibre used to improve both compression and tensile strength of concrete (0%, 0.66%, 1%, 1.33%).

KEYWORDS: Glass fibre, Compressive strength test, Tensile strength test.

I. INTRODUCTION

Glass fibre is made from molten glass and chemical binder sprayed on fibres as they are created. The wasted glass pieces are recycled to a greater extent and they are processed and manufactured to glass fibres. The density of this glass fiber is same as that of concrete, which allows a quick and even dispersion. It enhances the overall durability of concrete. It doesn't affect the workability of the concrete. The performance of glass fibre depends on parameters such as fibre volume and aspect ratio. The material contains no air, much dense and is a poor thermal insulator. Glass fibres are high strength fabrics and also corrosion and heat resistant fabric.

Glass fibres is formed when thin strands of silica or other formulation glass are melted and thrust out into fibres with small diameters suitable for required concrete. The major compositions of glass fibre are silica, calcium oxide and colemanite. As a result, the fibres can be manufactured with conventional processes and equipment, and less energy, which offers an economic advantage. Moreover, the fibres have no toxic reaction with air or water, and the fiberization process is said to be more environmentally friendly. In terms of mechanical and physical properties, glass fibre has gathered attention due to its high elastic modulus, high strength, corrosion resistance, high temperature resistance, and light-weight. In general, research into using glass fibre as a concrete reinforcing material has grown in popularity because of its potential to replace other fibres.

II. CONSTITUENT MATERIALS AND ITS PROPERTIES

- 1. Fine aggregate:** The particles of granular materials are so fine that they pass through a 4.75mm sieve. It is essential material in concrete consist of manufactured sand. The purpose of fine aggregate is to fill the voids, on coarse aggregate and to act as workability agent. It was screened to remove deleterious materials and tested as per procedure given in IS: 2386-1963. Specific gravity of fine aggregate is 2.67, Grading zone - Zone II, Water absorption-0.5%, Bulk density-1.86 g/cc, Moisture content-nil.
- 2. Coarse aggregate:** Aggregate, which retained in 4.75 mm sieve, is known to be coarse aggregate. Locally available coarse aggregate having the maximum size of 10mm were used in this experiment. Testing of coarse aggregate was done as per IS: 383-1970. Specific gravity of coarse aggregate is 2.77, water absorption-0.3%, Impact value-20%, crushing value-18%.
- 3. Ordinary Portland cement:** cement in concrete acts as a binding material that addition of water. It plays an important role construction sector. In this study the Ordinary Portland Cement (OPC) of 53 grade conforming to IS: 12269-2013 is used. Various tests were performed on cement they are: Consistency 32%, Specific gravity-3.12, Initial and Final setting time 40 minutes & 360 Minutes.

4. **Glass fibre:**

The glass fibres used are of Cem-FIL Anti-Crack. The density of this glass fibre is same as that of concrete, which allows a quick and even dispersion. It enhances the overall durability of concrete. It doesn't affect the workability of the concrete.

a) **Physical Properties:** Color- It is available in white color. Diameter-14 Micron. Length-12mm. Specific gravity-2.68. Elastic Modulus- 72Gpa. Tensile strength- 1700Mpa.

b) **Chemical Properties:** Glass fibre are more stable in strong alkalis. Bleaching agent does not cause harm to glass fibre and does not change on organic solvents. Possess resistance to UV- Light & biologic and fungal contamination. Sunlight does not change the glass fibre properties

5. **Water:** Potable tap water available in the laboratory with PH value 6 to 8 and conforming to the requirement of IS: 456-2000 is used for mixing concrete and curing the specimens.

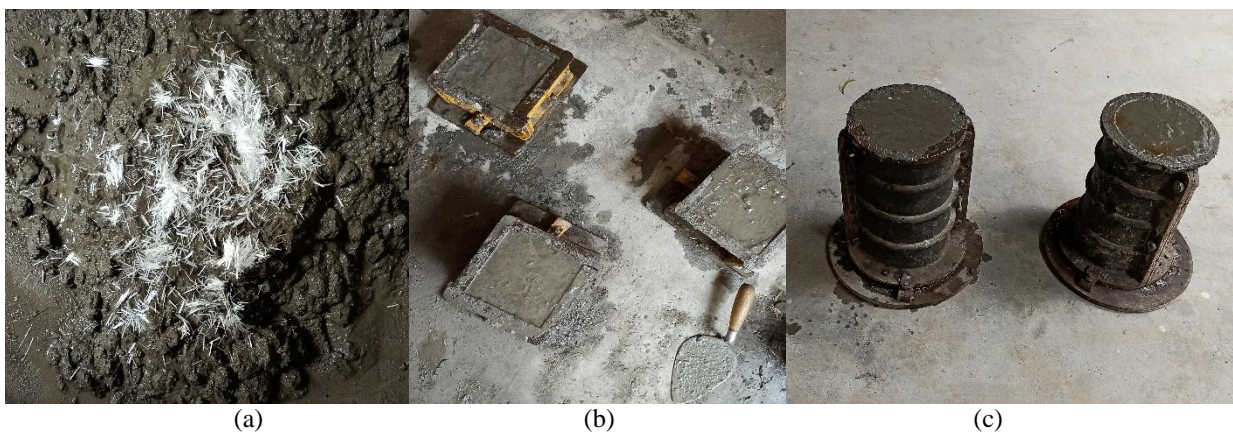


Fig 1. Glass fibre

III. EXPERIMENTAL INVESTIGATION

The experimental investigation is done to know its mechanical property, which is induced by its microstructure of Glass fibre reinforced concrete. The following tests were conducted on the Glass fibre reinforced concrete specimens are

1. **Compression test (conforming to IS 516):** This test was performed on 150 mm x 150 mm x 150 mm sized Glass fibre concrete cubes casted for M30 grade to determine the compressive strength of the mix. The compression test on cube specimens was performed in the compression testing machine.
2. **Split tensile test (conforming to IS 5816-1999):** To determine the tensile strength of Glass fibre reinforced concrete mix for M30 grade, split tensile test was done on the cylindrical test specimens of 150mm x 300mm using the compression testing machine. This method consists of applying a diametric compressive force along the length of a cylindrical specimen.



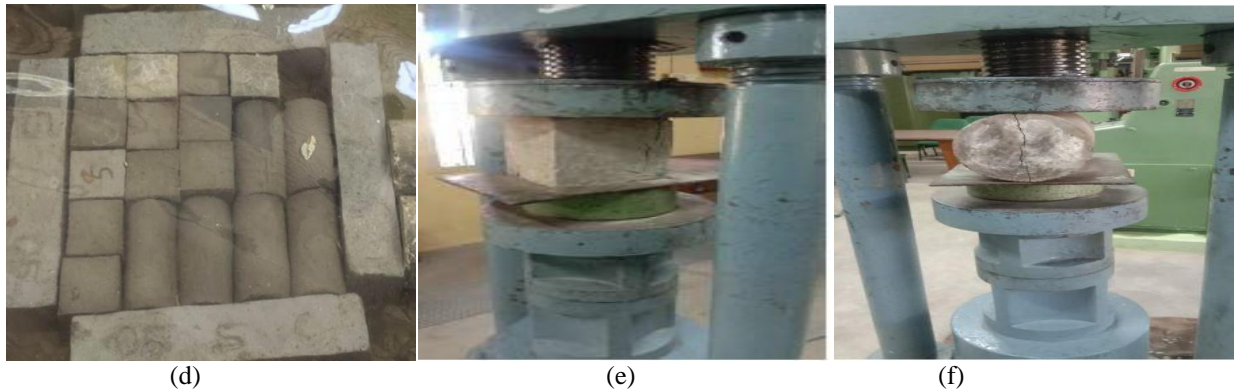


Fig 2. Testing of mechanical properties and casting of specimens (a) Batching (b)GFRC Cube specimen (c)GFRC cylindrical specimens (d) Curing of cubes and cylinders (e) Compression strength test (f) Split tensile strength test

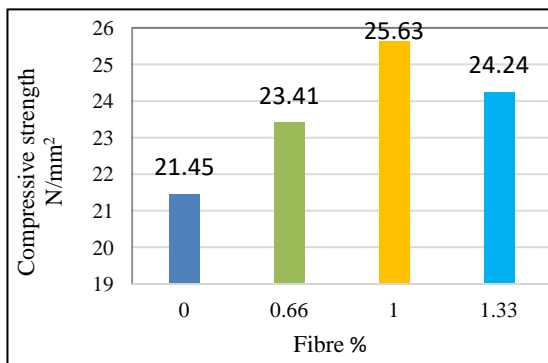
IV. EXPERIMENTAL RESULTS

COMPRESSIVE TEST

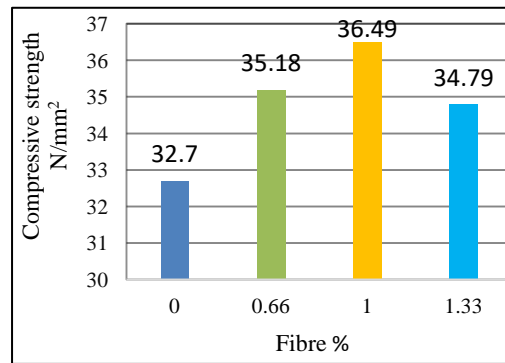
A test result is the average of at least three standard cured strength specimens made from the same concrete sample and tested at the same age. In most cases strength requirements for concrete are at an age of 28 days of curing. The concrete cubes, after 28 days were tested for their compressive strength in the following manner. After cleaning of bearing surface of compression testing machine, the axis of the specimen was carefully aligned with the center of thrust of the plate. No packing was used between faces of the test specimen and of testing machine. The load was applied without shock and increased continuously at a rate approximately 140 Kg/cm²/min until the resistance of the specimen to the increasing load broke down and no greater load could be sustained. The compressive stress calculated in N/mm² from the maximum load sustained by the cube before failure.

Table 1 Compressive strength test of GFRC

S.No	Grade	Glass fibre %	Compressive strength N/mm ²	
			7 days	28 days
1	M30	0	21.45	32.7
2	M30	0.66	23.41	35.18
3	M30	1	25.63	36.49
4	M30	1.33	24.24	34.79



(a)



(b)

Fig 3. Graph of Compressive strength test of GFRC (a) 7 days compressive strength (b) 28 days compressive strength

SPLIT TENSILE TEST:

This method consists of applying a diametric compressive force along the length of a cylindrical specimen. This loading induces tensile stresses on the plane containing the applied load. Tensile failure occurs rather than compressive failure. Plywood strips are used so that the load is applied uniformly along the length of the cylinder. The maximum load is divided by appropriate geometrical factors to obtain the splitting tensile strength. A diametric compressive load is applied along the length of the cylinder until it fails. The cylinder will typically fail due to horizontal tension and not vertical compression.

Table 2 Split tensile strength test of GFRC

S.No	Grade	Glass fiber %	Tensile strength N/mm ²	
			7 days	28 days
1	M30	0	2.69	3.95
2	M30	0.66	2.73	4.14
3	M30	1	2.80	4.40
4	M30	1.33	2.75	4.19

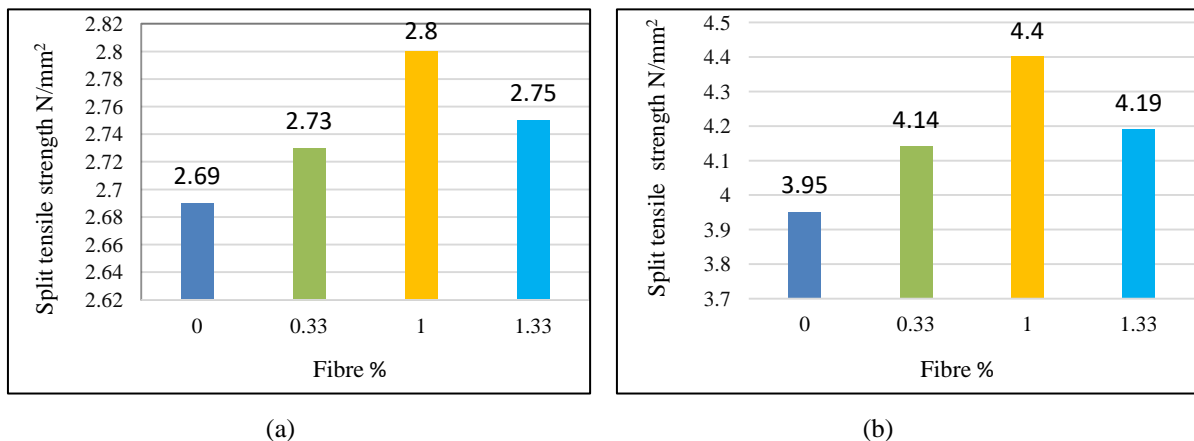


Fig4. Graph of Split tensile strength test of GFRC (a) 7 days Split tensile strength (b) 28 days Split tensile strength

V. CONCLUSION

Based in experimental investigation carried out in this work the following conclusion can be drawn:

1. Optimum value for glass fibre arrived at 1%.
2. The percentage increase of compressive strength of glass fibre concrete mix compared with 28 days compressive strength of plain concrete is observed as 10.38% at 1% of fibre content.
3. The percentage increase of split tensile strength of glass fibre concrete mix compared with 28 days compressive strength of plain concrete is observed as 10.22% at 1% of fibre content.
4. It has been found that strength decreases as glass fibre percentage is increased to 1.33%, it is due to interlocking of glass fibres and the workability of concrete also decreases.
5. It was found from the failure pattern of the specimens, that the formation of cracks is more in the case of concrete without fibers than the glass fibre reinforced concrete.
6. It shows that the presence of fibre in the concrete acts as the crack arrestors.

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