

# Performance Evaluation of Glass Fibre Reinforced Concrete

Prof. Anu Retnakar, Aswin.S, Shamju Kaja Hussain.S, Shilpa.T.S, Varun.V, Sandeep Kumar. M.D

Dept. of Civil Engineering, Ahalia School of Engineering and Technology, Kerala, India

**Abstract** - Researchers all over the world are attempting to develop high performance concretes by using fibres and other admixtures in concrete up to certain proportions. Glass Fibre Reinforced concrete (GFRC) is a recent introduction in the field of concrete technology. GFRC is concrete that uses glass fibres for reinforcement instead of steel. The present study has been taken up for evaluating the different percentage concentration of glass fibre. Emphasis has been given to the workability, compressive strength and flexural strength properties of glass fibre concrete beams. The different dosages of glass fibre are (0%, 0.2%, 0.4% and 0.6%)

**Key Words:** Glass fibre, Concrete, compressive strength, flexural strength, durability, deformation

## 1. INTRODUCTION

The application of cement concrete is limited due to the characteristics of brittle failure. This can be overcome by the inclusion of a small amount of short and randomly distributed fibres. Such concrete can be practiced where there is a weakness of concrete such as less durability, high shrinkage cracking, etc. Concrete has some deficiencies such as low tensile strength, brittleness, highly porous, susceptible to chemical and environmental attack.

The above deficiencies of plain concrete are overcome in the new materials which have unique characteristics, which make them highly susceptible to any environment. Fibre reinforced concrete is one of them and relatively a new composite material in which concrete is reinforced with short discrete (length up to 35 mm), uniformly distributed fibres so that it will improve many engineering properties such as flexural strength, shear strength and resistance to fatigue, impact and eliminate temperature and shrinkage cracks. Fibres of lengths up to 35 mm are used in spray applications and 25 mm length pre-mix applications. Various types of glass fibres used in construction industries are glass, steel, natural fibres, polypropylene, asbestos, carbon, basalt, etc.

Glass fibre has high tensile strength (2-4 GPa) and elastic modulus (70-80 GPa), brittle stress-strain

characteristics (2.5-4.8 % elongation at break) and low creep at room temperature. Glass fibres are usually round and straight with diameters of 0.005 to 0.015 mm. They can be bundled with bundle diameter of 1.3 mm.

### 1.1 Advantages

- GFRC is prepared of minerals and will not easily burn. When exposed to a flame, the concrete functions as a thermal regulator. It protects the materials fixed with it from the flame heat.
- These materials are comparatively lighter when compared to the conventional materials. Their installation is therefore fast, and normally simple. Concrete may be produced in thin sections.
- GFRC may be cast to almost any shape of columns, wall panels, domes, mouldings, and fireplace surrounds.
- High strength can be obtained by using GFRC, being tough and resistant to cracking. It has a high strength-to-weight ratio.
- GFRC products are durable and light. The transportation costs are reduced significantly being of less weight.
- Since GFRC is internally reinforced, other types of reinforcement are not necessary that may be complicated for complicated moulds.
- Suitable consolidation of mix is achieved for GFRC that is sprayed, without any vibrations. Use of rollers or vibrators, to attain consolidation, is simple for GFRC that is poured.

## 2. MATERIALS USED

The key materials used in this study were cement, sand, glass fibre and water. The cement used is Portland pozzolana cement (PPC) of 43 grade. Alkaline resistant 12mm glass fibre is used. The potable water from well is used for mixing and curing the concrete.

### 2.1 CEMENT

Portland cement is the most common type of cement, used as a basic ingredient of concrete, mortar. It is a fine powder produced by heating materials in a kiln to form clinker, grinding the clinker, and adding small amounts of other materials. PPC cement is manufactured by using

pozzolanic materials as one of the main ingredient. The percentage of pozzolanic material used in the preparation should be between 10 to 30. PPC cement of 43 grade is been used in our study.

Specific Gravity	2.94
Normal consistency	38
Initial setting time	3.5
Fineness of cement	6

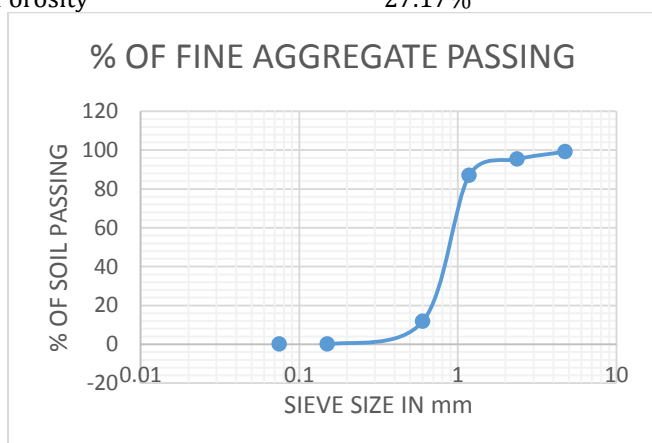


**Fig -1:** PPC cement

### 2.2 FINE AGGREGATE

Fine aggregate are basically sands from the land or the marine environment. Fine aggregates generally consist of natural sand or crushed stone with most particles passing through a 9.5mm sieve and retaining on 75 micron IS sieve.

Specific gravity	2.6
Bulk density	1.53
Void ratio	0.37
Porosity	27.17%



**Chart -1:** Sieve analysis



**Fig -2:** River sand

### 2.3 COARSE AGGREGATE

Coarse aggregates are particles greater than 4.75mm, but generally range between 9.5mm to 37.5mm in diameter.



**Fig -3:** Coarse aggregate

### 2.4 GLASS FIBRE

Glass fibre is a material consisting of numerous extremely fine fibres of glass. Glass fibre-reinforced concrete consists of high-strength, lightweight, durable, alkali-resistant glass fibre embedded in a concrete matrix. Glass fibre of 12mm length is been used.



**Fig -4:** 12mm Glass fibre

### 3. MIX PROPOTION

**Table -1:** Mix Proportion

Materials	Quantity (kg/m <sup>3</sup> )	Proportions
Cement	372	1
Fine Aggregate	555.33	1.49
Coarse aggregate	1270.85	3.4
Water	186	0.5

### 3. TEST METHODS

#### 3.1 Workability Test

Workability tests were performed using Slump moulds as it is the quick measure of workability of concrete mixes. The slump test was done in accordance with the IS 1199-1959.

#### 3.2 Compressive Strength Test

The wooden mould of size 100 x 100 x 100 mm is well tightened and oiled thoroughly. They were allowed for curing in a curing tank 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 Test

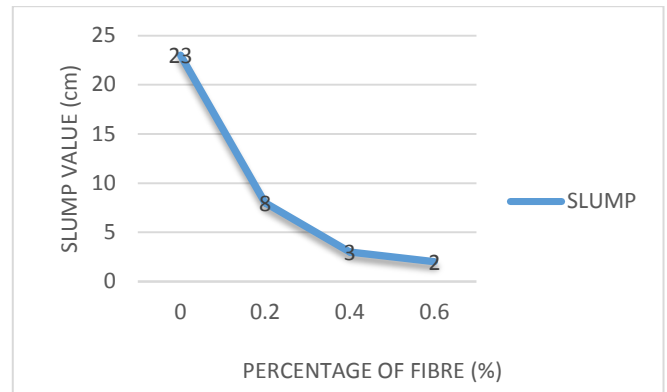
The wooden mould of size 500 x 100 x 100 mm is well tighten and oiled thoroughly. They were allowed for curing in a curing tank and they were tested in universal testing machine. The test procedures were used as per IS 516-1979.

## 4. RESULTS

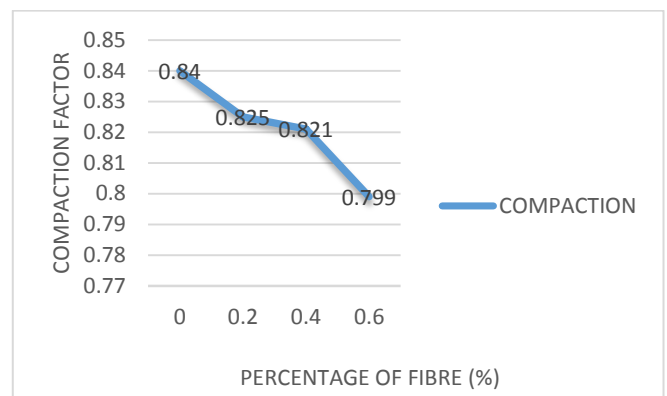
#### 4.1 Workability Test

**Table -2:** Workability

Percentage of fibre (%)	Slump value (cm)	Compaction factor
0	23	0.84
0.2	8	0.825
0.4	3	0.821
0.6	2	0.799



**Chart -2:** Slump Test



**Chart -3:** Compaction Factor Test

#### 4.2 Compression Test

**Table -3:** Compression Test

Percentage of fibre (%)	7 Days (N/mm <sup>2</sup> )	28 Days (N/mm <sup>2</sup> )
0	12	16
0.2	13	19
0.4	18	25
0.6	15	20

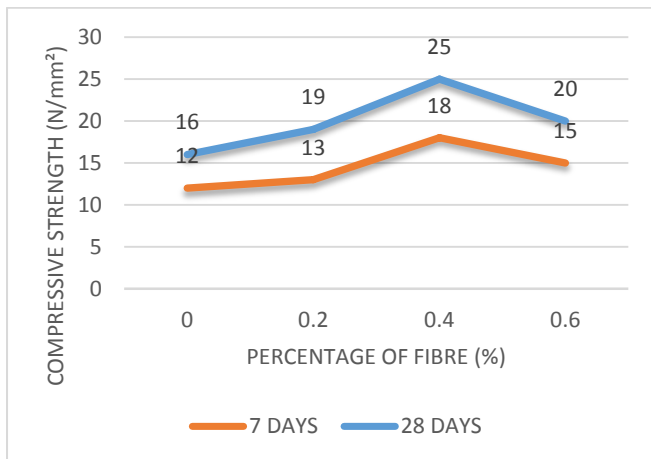


Chart -4: Compression Test

### 4.3 Flexural Test

Table -4: Flexural Test

Percentage of fibre (%)	7 Days (N/mm <sup>2</sup> )	28 Days (N/mm <sup>2</sup> )
0	2.42	3.19
0.2	2.47	3.22
0.4	2.97	3.58
0.6	2.65	3.30

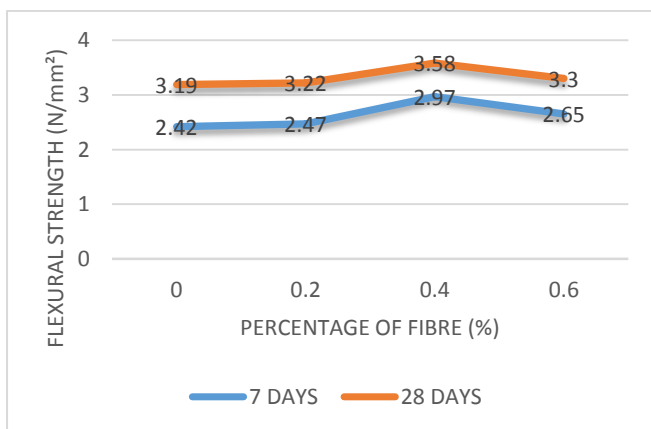


Chart -5: Flexural Test

### 5. CONCLUSIONS

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

Maximum compressive and flexural is attaining in 0.4% addition of Glass Fibre.

Further addition of fibre showed a gradual decrease in strength aspects.

It has been observed that the workability of concrete decreases with the addition of Glass Fibres. But this difficulty can be overcome by using plasticizers or super-plasticizers.

### 6. REFERENCE

- [1] Hemalatha.S and Dr. Leema Rose.A –An Experimental Study On Glass Fibre Reinforced Concrete-International Research Journal of Engineering and Technology, Vol.3, Issue 04, April 2014
- [2] Md.Abid Alam, Imran Ahmad, Fazlur Rehman – Experimental Study on Properties of Glass Fibre Reinforced Concrete- International Journal of Engineering Trends and Technology, Vol.24, Number 6, June 2015
- [3] Saxena.A.K and Seema Singh- Effect of Strength in Grade Concrete with Partial Replacement of Glass Fibre- International Journal for Scientific Research and Development, Vol.3, Issue 09, 2015
- [4] Praveen Kumar Goud.E and Praveen .K.S- Optimization of Percentages of Steel and Glass Fibre Reinforced Concrete-International Journal of Research in Engineering and Technology, Vol.4, Issue, April 2015.
- [5] Adetiloye.A and Ephraim.M.E- Structural Engineering Properties of Fibre Reinforced Concrete Based on Recycled Glass Fibre Polymer-International Journal of Engineering Researches and Application, Vol.5, Issue 04 (part 1) April 2015
- [6] Klaus Holschemacher and Philipp Lober - Structural Glass Fibre Reinforced Concrete for Slabs on Ground-World Journal of Engineering and Technology, 2014, 2, pp 48-54
- [7] Kumar A.D and Upendre Varma.A - Glass Fibre Reinforced Concrete-International Journal Of Engineering Research and Application, Vol.3, Issue 5, Sept-Oct 2013
- [8] Adeel Ahmed and Liaqat Qureshi .A -An investigation of Strength Properties of Glass Fibre Reinforced Concrete-International Journal of Engineering Research and Technology, Vol.2, Issue 4, April 2013.

- [9] **Bharti Tekwani and Komal Chawla** - Studies of Glass Fibre Reinforced Concrete-International Journal of Structural and Civil Engineering Research,Vol.2, No.3, August 2013.
- [10] **SelinRavikumar .C and Thandavamoorthy T.S.** - Glass Fibre Concrete: Investigation on Strength and Fire Resistant Properties-Journal of Mechanical and Civil Engineering, Vol.9, Issue 3, Sept-Oct 2013
- [11] **Avinash Gornale, S.Ibrahim Quadri, S.Mehmood Quadri, Syed Md Akram Ali, Syed Shamsuddin Hussaini**- Strength Aspects of Glass Fibre Reinforced Concrete-International Journal of Scientific and Engineering Research, Vol.3, Issue 7, July 2012
- [12] **P.Sangeetha**- Study on the Compression and Impact Strength of GFRC with combination of Admixtures- Journal of Engineering Research and Studies, Vol.2,Issue 2, Apr-June 2011
- [13] **Prof.S. S. Pimplikar and Eng. Pshtiwan N. Shakor** - Glass Fibre Reinforced Concrete Use in Construction-International Journal of Technology and Engineering System, Vol.2, Jan-Mar 2011
- [14] **B.L.P.Swami, A.K.Asthana and U.Masood**- Studies on Glass Fibre Reinforced Concrete Composites-Strength and Behaviour- Challenges, Opportunities and Solutions in Structural Engineering and Construction-2010
- [15] **Chandramouli.K, Srinivasa Rao.P, Pannirselvam.N, Seshadri Sekhar.T and Sravana.P**- Strength Properties of Glass Fibre Concrete-APRN Journal of Engineering and Applied Sciences, Vol 5, No. 4, April 2010