Experimental Studies on Mechanical Properties of Glass Fibre Reinforced Concrete

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Abstract

Concrete place a vital role in construction field. As we know it is strong in compression but brittle and weak in tension. In order to overcome this problem we generally use steel, but now day's different fibres available in market. Glass fibre reinforced concrete(GRC) is a material made of a cementatious matrix composed of cement , sand , water and admixtures in which short length glass fibres are dispersed . Concrete has several desirable properties like high compressive strength, stiffness and durability. But by the use of alkali resistance glass fibre the above properties increases upto certain Proportions. In the present experimental investigation the glass fibre has been used to study compressive strength and tensile strength on M25 grade concrete. In this study we choose four percentages of glass fibre as 0%, 0.02%, 0.06%, 1% by concrete weight.

Keywords: Tensile strength, Compressive strength, Alkali resistance glass fibre, Portland pozzolana cement

I. INTRODUCTION

Plane concrete possess very low tensile strength, limited ductility and little resistance to cracking. Internal micro cracks are inherently present in the concrete and its poor tensile strength is due to such micro cracks , eventually leading to brittle fracture . In the past to improve the tensile properties of concrete some fibres such as steel applied in concrete mixture. Addition of small closely spaced and uniformly dispersed fibres to concrete would act as crack arrester and would substationally improves its static and dynamic properties. Glass fibres used in this project are of length 20 mm length and 14 microns dia.

Depending on the type and severity of external loads, a composite laminate may exhibit gradual deterioration in properties but usually does not fail in a catastrophic manner. Mechanisms of damage development and growth in metal and composite structure are also quite different. Other important characteristics of many fibre-reinforced composites are their non-corroding behaviour, high damping capacity and low coefficients of thermal expansion.

Glass-fibre-reinforced concrete architectural panels have the general appearance of pre-cast concrete panels, but differ in several significant ways. For example, the GFRC panels, on average, weigh substantially less than pre-cast concrete panels due to their reduced thickness. Their low weight decreases loads superimposed on the building's structural components making construction of the building frame more economical.

II. LITERATURE REVIEW

[1] Kavita Kene, et al conducted experimental study on behaviour of steel and glass Fiber Reinforced Concrete Composites. The study conducted on Fiber Reinforced concrete with steel fibers of 0% and 0.5% volume fraction and alkali resistant glass fibers containing 0% and 25% by weight of cement of 12 mm cut length, compared the result.

[2] Yogesh Murthy, et al studied the performance of Glass Fiber Reinforced Concrete. The study revealed that the use of glass fiber in concrete not only improves the properties of concrete and a small cost cutting but also provide easy outlet to dispose the glass as environmental waste from the industry. From the study it could be revealed that the flexural strength of the beam with 1.5% glass fiber shows almost 30% increase in the strength. The reduction in slump observed with the increase in glass fiber content.

[3] R.Gowri and M.AngelineMary, this study, the present trend in concrete technology is towards increasing the strength and durability of concrete to meet the demands of the modern construction world at lower cost. These factors can be achieved in concrete by adding natural or synthetic fiber. The strength parameters of concrete such as compressive strength and tensile strength were studied by varying the percentage of fiber from 0.025% to 0.075% of the weight of concrete.

[4] S. S. Pimplikar conducted an experiment as the Glass-fiber reinforced concrete (GRC) is a material made of a cementatious matrix composed of cement, sand, water and admixtures, in which short length glass fibers are dispersed.

III. MATERIALS

A. Coarse aggregates

The coarse aggregates used are passing from 20mm and retained on 12.5mm sieve collected from crushed stones. Its specific gravity is 2.74.
Bulk Density-1544kg/m^3

B. Fine aggregates

Fine aggregates collected from river bed which is passing through 2.36mm Is sieve is used. It's specific gravity is 2.68.
Bulk Density -1580kg/m^3
Bulking of Sand-27%

C. Cement

Portland pozzolana cement of 53grade is used. Its specific gravity is 3.16 and it is tested for various proportions as per IS: 456-2000.
Normal Consistency-30%
Initial Setting Time-30 min

D. Glass fibre

Alkali resistance glass fibre of 14 micron dia and length 20 mm is used.
Its specific gravity is 2.68.

E. Water

Potable water is used for mixing. Water cement ratio is 0.5.

IV. METHODOLOGY

A. Workability

Slump cone test is used for finding workability.

B. Tensile strength

Cylinder used for finding tensile strength of concrete is 150mm in dia and 300mm height. Universal testing machine is for finding the tensile strength. These cylinders tested for 7, 14 and 28 days.

C. Compressive strength

15*15*15 cm moulds are used for finding compressive strength. They are tested under universal testing machine.

V. RESULTS AND DISCUSSIONS

Table- 1
Quantities of materials required for mix per 1 cum of ordinary concrete and glass fibres.

Grade of concrete	*Cement in (kg)*	*Coarse aggregate(kg)*	*Fine aggregate(kg)*	*Water (kg)*	*w/c ratio*	*% of glass fibre*
M25	*394.32*	*1151.78*	*705.93*	*197.16*	*0.5*	*0%* *0.02%* *0.06%* *1.00%*

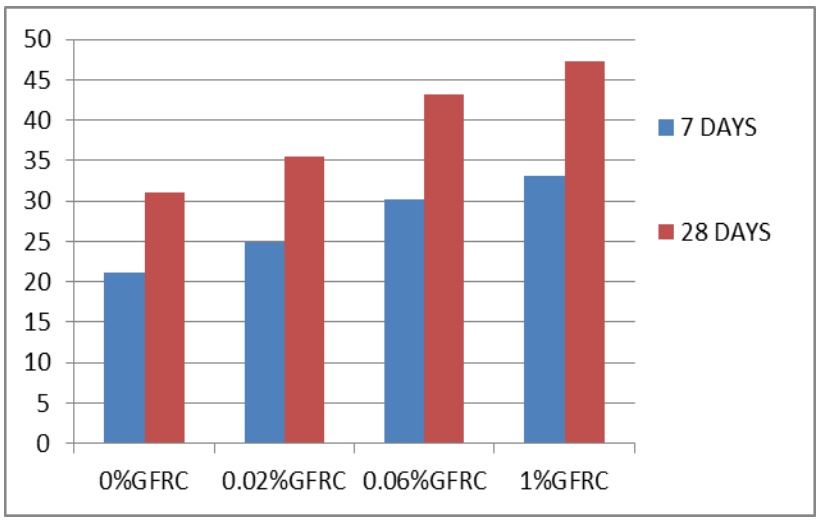
Table – 2
Tensile strength of concrete for different percentages of glass fibre

Grade of concrete	*Curing days*	*Tensile strength (N/mm²) for 7 and 28 days*	
		Without glass fibre	*With glass fibre*
M_{25}	*7 days*	*3.22*	*3.96*
	28 days	*3.90*	*4.52*

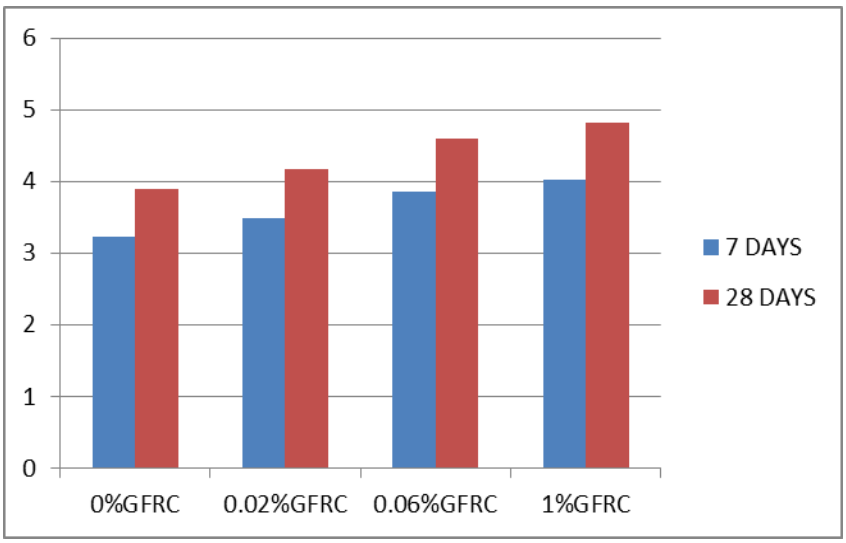
Table- 3
Compressive strength of concrete for different percentages of glass fibre

Grade of concrete	*Curing days*	*Compressive strength (N/mm²) for 7 and 28 days*	
		Without glass fibre	*With glass fibre*
M_{25}	*7 days*	*21.19*	*32.01*
	28 days	*31.07*	*41.8*

A. Comparison of Compressive Strength of Normal Concrete to GFRC



B. Comparison of Tensile Strength of Normal Concrete to GFRC for 7 and 28 days



VI. CONCLUSION

- By this experimental investigation we come to know by the addition of alkali resistance glass fibre to concrete it increases both compressive and tensile strength.
- The addition of glass fibre shows a continuous increase of compressive strength from 32.01% to 41.8% for M25 grade concrete for 28 days.
- In the same manner with addition of glass fibre the tensile strength increases from 3.96% to 4.52% at 28 days for M25 grade concrete.

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