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Experimental investigation on glass fibre reinforced concrete

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***Abstract*:Glass- fibre reinforced concrete(GFRC) is a recent introduction in the field of concrete technology. It has been widely used in the construction industry for non-structural elements, like facade panels, piping and channels. GFRC is a material made of a cementations matrix composed of cement, sand, water in which short length glass fibers are added. The strength characteristics viz., compressive strength, split tensile strength, flexural strength are found for Glass Fibre when adding in different percentage viz.,0%,0.05%,0.1%,0.15%,0.2% respectively by volume of concrete. Then finding out the optimum percentage of fibre.**

***Key Words:*Compressive Strength, Flexural strength, Glass fibre reinforced concrete (GFRC), Split tensile Strength, Strength characteristics.**

I. INTRODUCTION

Concrete is the most widely used constructionmaterial has several desirable properties likehigh compressive strength, stiffness anddurability under usual environmental factors.At the same time concrete is brittle and weakin tension. The strength, durability and other characteristics of concrete depend upon the properties of its ingredients, on the proportions of mix, the method of compaction and other controls during placing, compaction and curing. Fiber reinforced concrete (FRC) is concrete containing fibrous material which increases its structural integrity. Fiber Reinforced Concrete can be defined as a composite material consisting of mixtures of cement, mortar or concrete and discontinuous, discrete, uniformly dispersed suitable fibers. Recent attempts made it possible to incorporate relatively large volumes of steel, glass and synthetic fibres in concrete. The fibres like glass fibres shows great performance in compressive test, split tensile test and flexural test.

In this paper, an investigation has been made to find out the strength properties of glass fibre reinforced concrete in comparison with conventional concrete.

II. MATERIALS USED

Cement

Ordinary Portland cement of 53 grades available in local market is used in the investigation. The cement used has been tested for various proportions. Cement should be clean, dry and free from impurities. The Specific gravity is 3.1.

Fine Aggregate

Locally available zone II river sand used as fine aggregate. The specific gravity was determined and was found as 2.49.

Coarse Aggregate

Crushed angular shape aggregate from a local source was used as coarse aggregate. The specific gravity was 2.71.The coarse aggregate used in this project work are 20mm grade of size.

Fibre

Glass fiber is a material consisting of numerous extremely fine fibersof glass. Glass fiber include mats and fabrics for thermal insulation, electrical insulation, sound insulation, high-strength fabrics or heat- and corrosion-resistant fabrics.

Figure 1: Glass fibre

Table 1: Physical properties of glass fibre

Properties	Values
Diameter(μm)	14
Cut Length(mm)	45
Aspect Ratio	321

III. MIX PROPORTION

Mix design

The proportions for normal mix of M25 Normal Mix are 1:1:2 with water cement ratio 0.45.As per IS 10262-2009 designed by M25 grade of concrete.

Table 2: Mix proportion of material

Materials	Quantity	Ratio
Cement(kg/m^3)	438	1
FA (kg/m^3)	538	1.22
CA (kg/m^3)	1064	2.42
Water(lits)	197	0.45

Mixing of Concrete, Casting and Curing of test Specimens

Hand mixing was done during the entire process of casting of specimens. Initially the dry mix constituents of the mixnamely cement, fine aggregate and coarse aggregate was mixed for two minutes in the mixer and then the water wereadded and mixing continued for another 2 minutes. The totalmixing time was kept at 4 minutes until a homogeneous mixture was obtained. Compaction was achieved by means of Tamping rod.

Figure 2: Mixing of concrete

Test Specimens

Test specimens consisting of 150×150×150 mm cubes, 150×300 mm cylinders and 500×100×100 mm prisms were cast as shown in the Figure-3.

Figure 3: Testing specimens

IV. EXPERIMENTAL INVESTIGATION AND ANALYSIS OF RESULTS

Fresh Concrete

The fresh concrete properties slump test is conducted. The slump value of concrete was 74mm.

Hardened concrete

The hardened concrete specimen properties are checked by compressive strength, split tensile strength and flexural strength.

Compressive Strength Test

Compressive test of concrete is carried out on specimens like cube by compression testing machine.

$f_c = (P/A)\ N/mm^2$

Where,

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

A = Area over which the load is applied in mm

f_c = Compressive Stress in N/mm^2

Table 3: Compressive Strength Test Results

Grade of concrete	**% of glass fibre**	**7days (N/mm^2)**	**28 days (N/mm^2)**
M25	0	15.52	31.24
	0.05	17.7	32.46
	0.1	19.56	34.08
	0.15	18.26	33.58
	0.2	20.6	33.86

Figure 4: Testing of cube

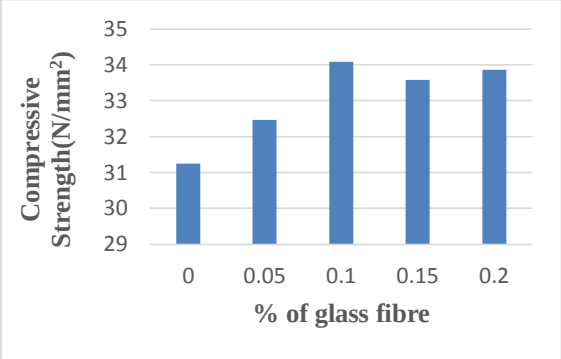

Chart-1 Analysis of Compressive Strength at 28 days

Split Tensile Strength Test

Split tensile Strength test of concrete is carried out on specimens like cylinders by compression testing machine. The Split tensile strength of the specimen was calculated by using the formula

$f_t = (2P/\prod dl)\ N/mm^2$

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/mm^2

Table 4: Split Tensile Test Results

Grade of concrete	% of glass fibre	7days (N/mm^2)	28 days (N/mm^2)
M25	0	1.88	2.495
	0.05	1.9	2.826
	0.1	2.12	3.22
	0.15	2.18	2.788
	0.2	1.9	2.673

Figure 5: Testing of cylinder

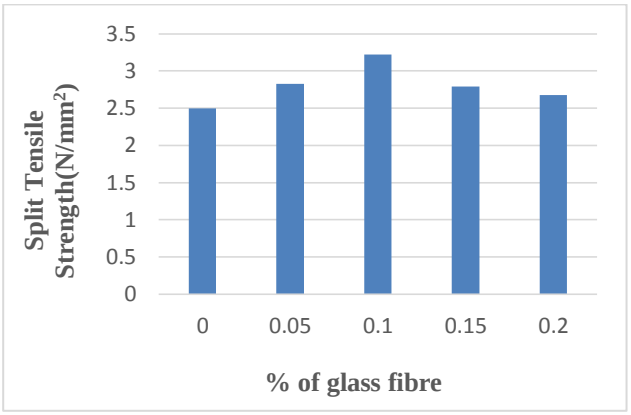

Chart-2 Analysis of Split Tensile Strength at 28 days

Flexural Strength Test

Flexural strength is the one of the measure of the tensile strength of concrete. The flexural strength of the specimen was calculated by using the formula

$f_b = (Pl/bd^2)\ N/mm^2\ N/mm^2$

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

Table 5: Flexural Strength Test Results

Grade of concrete	% of glass fibre	7days (N/mm^2)	28 days (N/mm^2)
M25	0	4.02	4.315
	0.05	4.15	4.692
	0.1	4.236	4.782
	0.15	4.265	4.66
	0.2	4.316	4.42

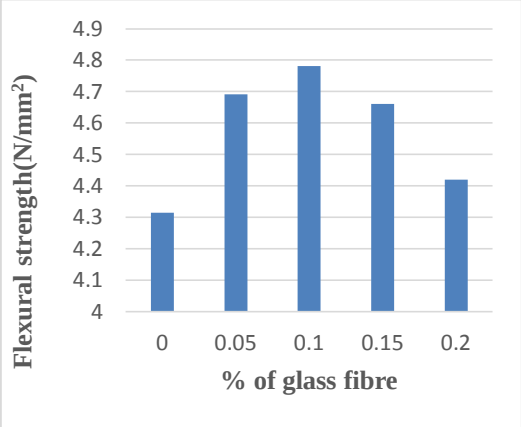

Chart-3 Analysis of Flexural Strength at 28 days

Figure 6: Testing of prism

V. CONCLUSION

Based on experimental investigation addition of Glass Fibre in plain concrete increases the strength and durabilitycharacteristics. The slump value for the glass fibre reinforced concrete is less when compared to conventional concrete without fibre. Initially addition of Glass Fibre in the plain concrete thestrengthcharacteristics like compressive, flexural and split tensile strength is gradually increased. Finally certain percent addition of Glass Fibre attain that gradually decreasein strength.

The optimum percentage of fibre is found as 0.1 %. The Compressive strength for 0.1% of fibre is increased up to 9.09% when compared to conventional concrete.

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