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AN EXPERIMENTAL STUDY ON THE CONCRETE PROPERTIES M30 DUE TO ADDITION OF GLASS FIBRES

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Abstract: ***Many researches has been currently going to modify and improved the concrete properties by the addition of different types of materials. This paper represents the Optimum use of the fibres with the concrete mixture and will also help in achieving the desired results. This paper shows the investigation on M30 grade due to addition of glass fibres . In this paper we used the glass fibres of diameter 0.0125 mm with aspect ratio 857.1 at various percentages as 0%,0.4%.0.8%,1.2%.1.6 by the volume of concrete on M30 grade of mix proportion (1:1.60: 2.96) with water cement ratio 0.45. GFRC based specimens has been tested for the compressive strength, flexural strength and split tensile strength.***

Keywords: ***Glass Fibres, Compressive Strength, Flexural Strength and Split Tensile Strength.***

I. INTRODUCTION

The poor and unsatisfactory performance of conventional concrete under aggressive environmental conditions has necessitated the researchers and engineers to look for new concrete composites. The innovative use of concrete must contemplate explorations of areas , in use of new shapes, materials and technique of construction. Concrete is such a versatile material that such attempts of contemplation are quite possible. In modern age one cannot think of construction work without concrete. Plain concrete has two major deficiencies; a low tensile strength and allow strain at fracture. The tensile strength of concrete is very low because plain concrete normally contains numerous micro cracks. Hence Fibres are generally utilized in concrete to manage the plastic shrink cracking and drying shrink cracking In FRC, thousands of small fibres are dispersed and distributed randomly in the concrete during mixing, and thus improve concrete properties in all directions. That‟s why the addition of fibre with concrete improved the concrete properties such as workability, brittleness, strength, corrosion resistance and ultimately increased life of the structure. The introduction of small, closely spaced, randomly oriented fibers transfers an inherently brittle material with low tensile strength and impact resistance into a strong composite with superior crack resistance, improved ductility and distinctive post cracking behaviour prior to failure. A major advantage of using fibre reinforced concrete besides reducing permeability and increasing fatigue strength is that fibres addition improves the toughness or residual load carrying ability after the first crack .This concrete is known as glass fibre reinforced concrete (GFRC)

II. LITERATURE REVIEW

As we know the properties of concrete gets improved due to the incorporation of glass fibre. Large no. of papers have being published which tells about the compressive strength, flexural strength and split tensile strength of concrete according to their opinion. G. Jyothi Kumari, [1] studied behavior of concrete beams reinforced with glass fiber reinforced polymer flats and observed that beams with silica coated Glass fiber reinforced polymer (GFRP) flats shear reinforcement have shown failure at higher loads. Further they observed that GFRP flats as shear reinforcement exhibit fairly good ductility. The strength of the composites, flats or bars depends upon the fiber orientation and fiber to matrix ratio while higher the fiber content higher the higher the tensile strength. S.Harle [2]Glass fibres have large tensile strength and elastic modulus but have brittle stressstrain characteristics and low creep at room temperature. Glass fibres are usually are usually round and straight with diameters from 0.005 mm to 0.015 mm . Chandramouli [3] The compressive, split tensile and flexural strength on M20, M30, M40 and M50 grades of concrete made of alkali resistant glass fiber . Yogesh Murthy [4]studied the performance of Glass Fiber Reinforced Concrete. The study revealed that the use of glass fiber in concrete so 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 .Michael kemp and David Blowes [5]Glass fiber reinforced polymer (GFRP) has a very important role to play as reinforcement in concrete structures which is exposed to harsh environment conditions where traditional steel reinforcement could corrode . Kavita Kene, et al [6] conducted experimental study on behavior 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.. Jones [7] attempted to use finely ground E-glass fiber and investigated the performance of glass fiber reinforced concrete subjected to accelerated tests
Dr.P.Srinivasa Rao et.al [8] discussed about the effect of glass fibres on durability properties of glass fibre reinforced concrete

III. MATERIALS USED

CEMENT: Ordinary Portland cement of 43 grade has been used in this experimental work. OPC 43 grade of ULTRATECH cement has been used after investigate the

strength of cement at 28 days as per IS 4031-1988. The various properties of the cement are described in Table 1.

FINE AGGREGATES: Locally available river sand passed through 4.75mm IS sieve has been used in the preparation of GFRC. It confirms to IS 383-1970 which comes under Zone I. The physical Properties of sand like Fineness Modulus, Specific Gravity and water absorption are 3.49, 2.67 and 2.31% respectively.

COARSE AGGREGATES: The Coarse aggregate are obtained from a local quarry has been used. The coarse aggregate with a maximum size 20mm having a specific gravity 2.89. In this experimental work coarse aggregate of 20mm are used The physical Properties of coarse aggregates like Fineness Modulus, Specific Gravity are 7.13, 2.89 respectively.

GLASS FIBRE: The glass fibres are of Cem-FIL Anti-Crack HD with Modulus of Elasticity 72 GPA, Filament diameter 14 microns, Specific Gravity 2.68, length 12mm and having the aspect ratio of 857. For 1 kilo gram, the number of fibres are 212 million.

WATER: - Water used for mixing and curing was clean and free from injurious amounts of oils, acids, alkalis, salts and sugar, organic substances that may be deleterious to concrete. As per IS 456- 2000 Potable water is generally considered satisfactory for mixing and curing of concrete. Accordingly, potable tap water was used for the preparation of all concrete specimens.

Table 1: Properties of cement

Sr No.	Characteristics	Experimental value	Specified value as per IS:8112-1989
1	Consistency of cement (%)	33%	—
2	Specific gravity	2.98	3.15
3	Initial setting time (minutes)	35	>30 As Per IS 4031-1968
4	Final setting time (minutes)	282	<600 As per IS4031-1968
5	Compressive strength (N/mm^2)		
	(i) 3 days	27.56	>23
	(ii) 7 days	40.57	>33
	(iii) 28days	48.96	>43
6	Soundness (mm)	1.00	10
7	Fineness of Cement	5%	10% As Per IS 269-1976.

IV. EXPERIMENTAL PROGRAMME

In this section, GFRC based specimens has been tested for the compressive strength, flexural strength and split tensile strength.

COMPRESSIVE STRENGTH TEST: To examine the compressive strength of GFRC, cube of 150mmX150mmX150mm has been used in this experimental work 30-40 cubes has been casted to determine the compressive strength. firstly cement and sand are mixed uniformly in dry condition . Secondly coarse aggregates are added in this mixture . Now glass fibres also added according to mix proportion to get the resultant mixture of M30 grade. Required dosage of water was added in the course of mixing. Through mixing was done until concrete appeared to be homogeneous and of desired consistency. Now cube moulds were filled with concrete in three layers and after each layer, concrete was compacted with temping rod . The mould"s surface level should be plane with trowel . The cube moulds were demoulded after 24 hours then they were placed in water tank containing portable water and were left for curing. After that the specimen are tested at 7 days and 28 days at compression testing machine (CTM) as per IS 516-1959

Fig. 1 Cube Under Compression Testing Machine (CTM)

SPLIT TENSILE STRENGTH TEST:-
To examine the tensile strength of GFRC, cylinder of size 150mmX300mm has been used in this experimental work . 30-40 cylinders has been casted. The cylinder moulds were demoulded after 24 hours and transferred to curing tank for 28 days.After that cylinders were tested horizontally under compression testing machine (CTM).

Fig. 2 Cylinder Under CTM

FLEXURAL STRENGTH TEST:- To examine the flexural strength of GFRC, cylinder of size 150mmX150mmX70mm has been used in this experimental work. 30-40 beams has been casted to determine the tensile strength. The beams specimens of different proportions were demoulded after 24 hours and transferred to the curing tank for 28 days . After

that, beams were placed to the two point loading machine on which we apply the load manually. Note down the load value at which cracks starts developing on the beam.

Fig. 3 Test Set Up for Beam

V. TEST RESULTS

COMPRESSIVE STRENGTH Compressive strength of concrete mixtures was measured at the ages of 7 and 28 days and shown in Table 2.There was an increase in compressive strength of cube concrete specimens produced with glass fibres.

TABLE 2: Compressive Strength Results

S.No	% Glass Fibre	7 days (Mpa)	28 days (Mpa)
1	MX(0)	24.51	38.66
2	MX(0.4)	24.73	39.10
3	MX(0.8)	25.03	39.19
4	MX(1.2)	25.70	39.47
5	MX(1.6)	25.77	40.66

From the above results, we observe that compressive strength of concrete increases due to incorporation of glass fibres. From the plot we can say that compressive strength of concrete increases upto 5 % with 1.6% glass fibres.

FLEXURAL STRENGTH: Table 3 shows the values of flexural strength of GFRC beams at different mix proportions. Plot 5 shows the variations of flexural strength at 7 and 28 days.

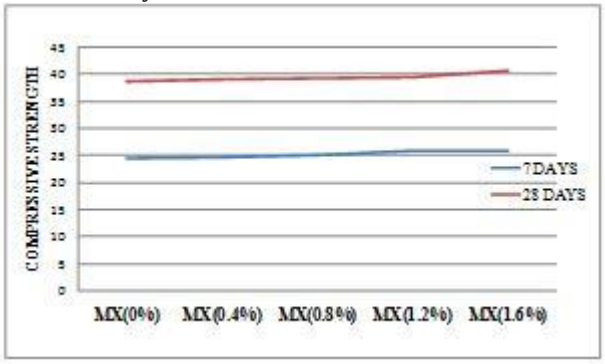

Fig. 4 Variation of Compressive Strength at Different Ages

TABLE 3: Flexural Strength Results

S.No	% Glass Fibre	7 days (Mpa)	28 days (Mpa)
1	MX(0)	2.24	3.75
2	MX(0.4)	2.49	4.15
3	MX(0.8)	2.85	4.77
4	MX(1.2)	3.11	5.21
5	MX(1.6)	3.44	5.74

The results obtained from the experiment showed that flexural strength of the GFRC increased upto 53 % as compared with plain concrete.

SPLIT TENSILE STRENGTH: Split tensile strength of concrete mixtures was measured at the ages of 7 and 28 days as shown in Table 4. The results shows that in general, there is an increase in splitting tensile strength of cylinder concrete specimens with the addition of fibres to the concrete at 28 days age.

TABLE 4: Split Tensile Strength Results

S.No	% Glass Fibre	7 days (Mpa)	28 days (Mpa)
1	MX(0)	1.37	2.35
2	MX(0.4)	1.69	2.83
3	MX(0.8)	1.96	3.21
4	MX(1.2)	1.97	3.10
5	MX(1.6)	1.99	2.97

From the above results, we observe that Split Tensile Strength of concrete increases due to incorporation of glass fibres. From the plot we can say that Split Tensile strength of concrete increases upto 36% with 0.8 % glass fibres as compared to plain concrete.

VI. CONCLUSION

The following conclusions could be drawn from the present investigation.

- The Experimental work shows that properties of concrete M30 gets improved due to incorporation of glass fibres
- The Experimental work shows that workability of GFRC gets reduced as we increased the fibre amount.

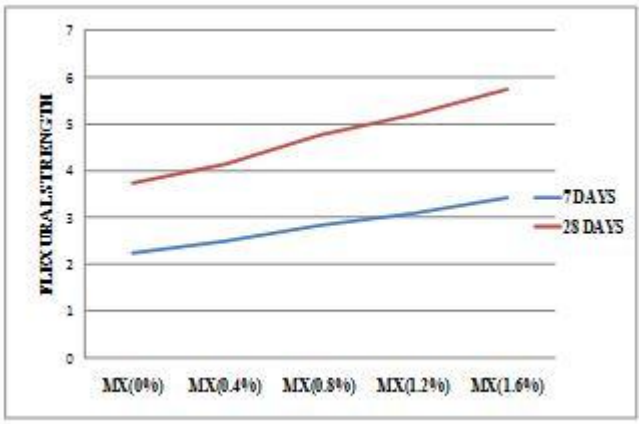

Fig. 5 Variation of Flexural Strength at Different Ages

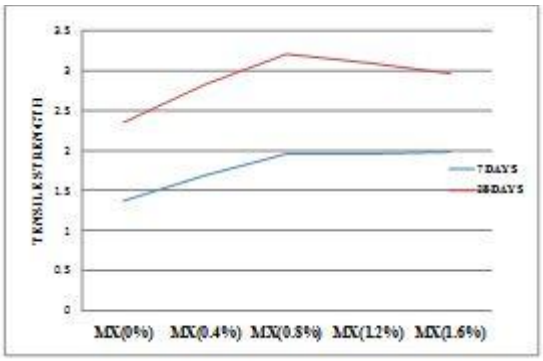

Fig. 6 Variation of Split Tensile Strength at Different Ages

- It can be concluded that the compressive strength of GFRC gets increased up to 5 % with 1.6% glass fibres as compared to plain concrete
- It is observed that the addition of glass fibres into reinforced concrete improves the Compressive strength at 28 days
- It is observed that the Flexural strength of glass fibre reinforced concrete gets increased up to 53 % as compared to plain concrete
- It can be concluded that Flexural strength of the GFRC gets increased continuously and it increases till the last case of 1.6 % fibre amount
- It is also observed that the Split Tensile strength of glass fibre reinforced concrete gets increased increases up to 36 % with 0.8% glass fibres as compared to plain concrete
- The loss of compressive strength in ordinary concrete mixes are more than glass fibre concrete mixes
- Glass fiber reinforced concrete is very effective in resisting flexural tensile stresses as compared to compressive stresses.
- By addition of Glass fibre in concrete reduces the cracks causing interconnecting voids to be minimum.
- From the experimental investigation, it has been found that the flexural strength of GFRC increases very much as compared to compressive strength
- Glass fibre concrete mixes are observed to give higher strengths on thermal effect than ordinary concrete mixes.

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