Glass Fibre Reinforce Concrete

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Abstract— All of us know that the traditional concrete possess very low tensile strength, limited ductility and little resistance to cracking. So in this paper we focuses towards the experimental research of the mechanical properties of glass fiber reinforced concrete (GRFC) with conventional concrete. Fibers while delivered in certain percentage in the concrete improve the property as crack resistance, ductility, as flexural strength and durability. So for improving the durability of the structure we are use glass fiber. Glass-fibre reinforced concrete (GRFC) is a fabric product of a cementatious matrix composed of cement, sand, water and admixtures, where in brief duration of glass fibers are dispersed. It has been widely used within the creation enterprise for non-structural factors, like façade panels, piping and channels. GRFC gives many advantages, inclusive of being lightweight, heat resistance, appropriate look and strength. For this experimental work we are used glass fibers on the volume fractions of 0.5%, 1% and 1.5%. After the casting of cubes, beams and cylinder with the above mentioned quantity fractions we can carry out specific test which include compressive strength, tensile strength and flexural strength respectively. After the completion of this work we compare the results of glass fiber strengthened concrete with that of the traditional concrete. From camparing those two we are able to see that how the addition of the fibers will have an effect on the mechanical properties of conventional concrete and we check that the addition of fibers improves the strength of concrete or not.

Keywords: GFRC, concrete, cement, tensile strength, Durability

I. INTRODUCTION

In construction field concrete is one of the most used creation material. Concrete has various desired properties like high stiffness, high compressive strength and high durability under usual environmental elements. As all of us know that concrete is brittle in nature and also we know that.,it is weak in tension. Concrete has two insufficiencies, low strain at fracture and low tensile strength. To overcome from this problem we use reinforcement in concrete. Normally reinforced concrete consists of pre stress tendons and continuous distorted steel bars. The benefit of reinforcing and pre-stressing technology using metal reinforcement as excessive tensile metal wires have helped in overcoming the incapacity of concrete in concern but the ductility importance of compressive strength.

A. Fiber Reinforced Concrete (FRC)

To demonstrate and maintain academic integrity, some institutions require proctor supervision of online exams. However, proctoring can be very expensive. Costs to students can include fees at testing centers, costs to purchase the Remote Proctor, time to nd an approved proctor, and e ort required to coordinate a time for the exam. Costs to the institution include salaries of staff to administer a proctoring process, approval of proctors, maintaining testing centers, and potential loss of enrollments and revenue since not all institutions require proctors for online exams. FRC is a concrete which have fibrous material in concrete that increases the structure integrity. It also includes the short discrete fibers that are randomly oriented and uniformly distributed. FRC is a concrete made primarily of discrete reinforcing fibers, aggregates and hydraulic cements. It is a comparatively new material in construction field. It is a composite fabric consisting of a matrix containing a random distribution of small fibers, both natural and synthetic, having an excessive tensile strength. The cracking power of concrete is multiplied as we add the uniformly dispersed fibers and the fibers performing as crack arresters. All of us know that concrete is always weak in tension so we use the fibers to raise the tensile strength of concrete. It is also found that if we will provide the fibers in small size, uniformly distributed and closely spaced then it will help in decreasing the occurrence of the cracks and will develop its static and dynamic properties.

Fig. 1: Glass Fiber Reinforced Concrete (GFRC)

B. Necessity of Fiber Reinforced Concrete (FRC)

Fiber reinforced concrete (FRC) reduces the bleeding of water in concrete and thus also reduces the piousness of concrete. Ductility of the concrete improves by adding fibers and the primary function of the fibers is to fill the cracks that develops in concrete. There is large development in the post-cracking conduct of concrete which contains fibers because of each drying shrinkage and plastic shrinkage. Fibers imparts the extra resistance towards impact load. Some forms of fibers produce shatter resistance and extra abrasion in concrete. All of us know about the benefits of the concrete and it is also known to us that concrete fails in tension. So now we will concentrate on the various properties of the glass fibers for this research work and see how it will affect the concrete. In my research I will use glass fiber as a reinforcing material (GFRC). Glass fiber concretes are especially used in outward constructing façade panels and as architectural

precast concrete. Glass fiber is superb in making shapes at the front of any constructing and it's far much less dense than metallic like steel.

II. LITERATURE SURVEY

A. Eng. Pshtiwan N. Shakor, et al, [1]

The motive of this research is to indicate the changes in flexural and compressive strength by using varying sizes of cubes. This is to be conducted for concrete without glass fiber and with glass fiber to indicate the differences. In this paper we located that alkali resistance glass fiber can control shrinkage cracks effortlessly. It indicates this property particularly in facing cause or rendering. Most important thing in GRFC is water cement ratio maximum upto 0.35, which helps to control the bonding and shrinkage by glass fiber. GRFC may be used as substitute material of natural stone, in particular in those international locations where stone is much less or unavailable. Glass fiber allows concrete to increase compressive strength till specified limit. A restrict exists to a particular percent from glass fiber combined with concrete due to the fact growing it impacts at the bond of materials as is visible in the result. For 1.5% of cementitous weight shows excellent outcomes are acquired as compared to other outcomes. Particular percentage from glass fiber blended with concrete because increasing it impacts on the bond of materials as is seen inside the end result. More air entraining is increased in the concrete when we use 20mm of coarse aggregates. To solve the problem of reduced flexural strength only 10mm of coarse aggregates should be used.

B. Yasir Khan, et al, [2]

This paper defined the Experimental Investigation on Durability and strength properties of glass fibers and steel reinforced concrete composite. we discovered that for this M35 grade of concrete with constant water cement ratio of 0.45 is designed mixed, cylinders and cubes are casted. The durability and strength properties are carried out for various mix designs and compared with normal concrete. split tensile strength and compressive strength for cubes are obtained for 7 and 28 days. The diverse mix designation set for FRC is tested for 7 and 28 days and in evaluation with everyday conventional concrete. we located that the Compressive strength of fiber strengthened concrete composite with various mix designs observed better as compared to normal concrete for 7 and 28 days of curing. The Split Tensile strength of fiber strengthened concrete composite with diverse mix designation confirmed better strength as compared to normal concrete. The most advantageous dose of (2% & 2.5%) steel and Glass Fiber confirmed better results consequences in comparison to other dosages of fibers. Slump will lose at the higher percentage of Steel and Glass Fiber. Density of concrete increases as percent of fiber dosages of Steel and Glass. The water absorption capacity of mix designation (2.5 & 3%) & (2 &2.5%) fiber composite showed least value as equated to other mix designation. The Percentage of porosity (2% & 2.5%) FRC composite showed least value among numerous mix Designations.

C. Shrikant Harle, et al, [3]

The main objective of this research is when glass fiber is added into the concrete evaluate the changes in properties of concrete. In this we evaluated that the durability and strength of concrete can be modified through making appropriate changes in its components like aggregates, cementious materials and water by using adding a few unique ingredients. In this paper we found that the alkali glass fiber (AR- glass fiber) shows better results as comparison to other glass fibers.Split tensile strength, compressive strength and flexural strength is more in AR-glass fibers as compare to other glass fibers. When we add 0% glass fibers in the concrete it is located that flexural strength and split tensile strength increases from 15 to 20%. It is also located that 20 to 25% increase in compressive strength found when we compare compressive strength of glass fiber with 28 days.

D. Rama Mohan Rao. P, et al, [4]

The main purpose of this study is when we add fly ash based concrete check the effects of glass fibers. In this study we add glass fibers in various extent proportions and study the flexural strength, split tensile strength, compressive strength of concrete when we replace 25 to 40% of cement by fly ash. As per the Indian Standards the standard sizes of the molds of cylinders, cubes and beams were cast for each mix. After this as per the Indian standards they are tested for 7, 28 and 56 days for compressive, flexural and split tensile strength. Their is slightly improvement in concrete for 28 days compressive strength when we add fly ash. So in this study we get that as the fly ash percentage increases performance of concrete decreases. As we compared fiber mix with control mix there is an increase in compressive strength 8.5% to 12% for all fiber mixes. Better strength values on par with control mix are obtained when the volume fraction of glass fiber 0.3% is mixed.

III. MATERIAL USED

In this research work we are going to use different materials and there name are as follow:

1) *Ordinary Portland Cement (OPC):* in this research I am using OPC of 43 grade.
2) *Fine aggregates:* The fine aggregates are those that can easily pass through the IS Sieve 4.75 mm and should have finesse modulus 2.50-3.50 and silt contents should be restricted upto 4%.
3) *Coarse aggregates:* The course aggregates are those aggregates which are retained on IS Sieve 4.75mm. It has to be hard, solid, thick, tough and clean. It must be free from vein, disciple coatings and harmful measure of broke down pieces, antacids, vegetable issues and different injurious substances. It has to be generally cubical fit as a fiddle. Flaky pieces have to be maintained a strategic distance from.
4) *Fibers:* There are one fiber that we will be going too use in the research work of Glass fiber.
5) *Glass fiber:* It is a material which includes extremely fine particles of glass. Glass fiber is very light in weight and it is also resists the corrosion. It is made up of natural fibers, so is not harmful for human health as its products are natural pure. It has various properties like resistance

to pressure, high bending, pulling and high temperature resistance, resistance against chemical and biological influences. Glass fiber has excellent heat, sound and electronics insulation capacity. Glass fiber concretes are especially used in outdoor constructing façade panels and as architectural precast concrete. This glass fiber is superb in making shapes at the front of any constructing and it's far much less dense than metallic like steel.

6) *Glass fiber reinforced concrete (GFRC):* Glass fiber reinforced concrete (GFRC) is essentially a cement grout with countless parts of entrenched glass fibers. Fibers are the principal load carrying members.
   1) Glass fibers provide high tensile strength from 1020 to4080N/mm2.
   2) Glass fibers are generally of 25mm length are used.
   3) Glass fibers improve the ductility, impact strength, flexural strength and it also provides the resistance to thermal shock.
   4) Glass fibers are generally used in roofs and ducts, sewer lining, swimming pools and formworks etc.

So we are going to use above materials for the research work. All of us know that cement is a binding agent so we are using OPC of 43grade.Similarly, we are using angular coarse aggregate of 20mm with the specific gravity of 2.65 and water absorption of 0.5%.Fine aggregates can be named as very fine particles such as the sand that we are using in the research work with the specific gravity of 2.68 and water absorption of 1%.

A. Types of Glass Fibers

1) A-Glass: This kind of glass is very near to normal glass. Due to its composition, this type of glass is very near to window glass.
2) C-glass: This sort of glass suggests better resistance against chemical effect.
3) E-glass: This type of glass gives the very good insulation to electricity with the combined characteristics of c-glass.
4) AE-glass: This kind of glass shows very good resistance towards the alkali resistance glass.

IV. TESTS OF HARDENED CONCRETE

A. Testing Methods:

Experimental Investigation of fresh mix properties of concrete was conducted based on IS: 516-1959. Compressive Strength of each specimen was determined using IS 516-1959.Length change was measured according to IS 516-1959. Compressive strength were measured 7,14, 28 days of testing.

B. Compressive Test On Cubes As Per Is 516-1959: (SIZE: 150X150X150)

The specimens for are cast with different % of GFRC and aggregate with gradual increase of 2% of GFRC replacing cement by weight. Shows that the strength of GFRC concrete initially does not match with the strength of control specimen at 7 day but it nearly matches at 28 days. Further on replacing cement with GFRC it has to improve the strength than the control specimen .The Graph shows that on replacing the cement by 1%it gives maximum strength.

V. OBSERVATION OF COMPRESSIVE STRENGTH

Compressive strength (N/mm2)	7 Days	21 Days	28 Days
	11	16	20
	13	18	24
Average comp. strength(N/mm2)	12	17	22

Table 1: Compressive strength for 0%

Compressive strength (N/mm2)	7 Days	21 Days	28 Days
	22	28	33
	26	30	29
Average comp. strength(N/mm2)	24	29	31

Table 2: Compressive strength for 0.5%

Compressive strength (N/mm2)	7 Days	21 Days	28 Days
	28	29	33
	22	33	39
Average comp. strength(N/mm2)	25	31	36

Table 3: Compressive strength for 1%

Compressive strength (N/mm2)	7 Days	21 Days	28 Days
	16	24	26
	16	26	26
Average comp. strength(N/mm2)	16	25	26

Table4: Compressive strength for 1.5%

Compressive strength (N/mm2)	7 Days	21 Days	28 Days
	14	20	24
	12	20	26
Average comp. strength(N/mm2)	13	20	25

Table 5: Compressive strength for 2%

Grade of concrete	Replacement in %	Compressive Strength in (N/mm2)	Compressive Strength in (N/mm2)	Compressive Strength in (N/mm2)
		7 Days	21 Days	28 Days
	0%	12	17	22
	0.5%	24	29	31
M 20	1%	25	31	36
	1.5%	16	25	26
	2%	13	20	25

Table 6: Comparison of compressive strength

Fig. 2: Compressive strength test

VI. FUTURE SCOPE

1) Further Research work would be required to give a better understanding of the GFRC concrete mechanical behavior. The effect of GFRC to the bonding of reinforcement has to be investigated as an individual's phenomenon.
2) The research studies confirmed good properties of GFRC as an alternative material and can definitely be considered an encouragement in initiating new research on the possibilities of the applications of the GFRC in construction.
3) Further research will be based on the utilization of the previously heated GFRC in concrete mixtures, in which better performance should be expected in the temperature range between 600-800*.
4) The original scope of this research was to investigate the properties of concrete. The fresh and hardened properties of concrete were tested.
5) In addition to this research several tests were also included such as compressive strength of concrete with. For this research the percentage of the volume of natural cement normally used in concrete was replaced by GFRC. This replacement was done in 0%, 0.5%, 1%, 1.5%, 2% increments until cement were replaced by the GFRC. Thus replacing the cement in concrete
6) Applications with GFRC would lead to considerable environmental benefits and would be economical.

VII. RESULTS OF COMPARISON OF COMPRESSIVE STRENGTH

Grade of concrete	Replacement in %	Compressive Strength in (N/mm2)	Compressive Strength in (N/mm2)	Compressive Strength in (N/mm2)
		7 Days	21 Days	28 Days
	0%	12	17	22
	0.5%	24	29	31
M 20	1%	25	31	36
	1.5%	16	25	26
	2%	13	20	25

Table 1: Comparison of Compressive Strength

A. *Compressive Strength for 7Days*

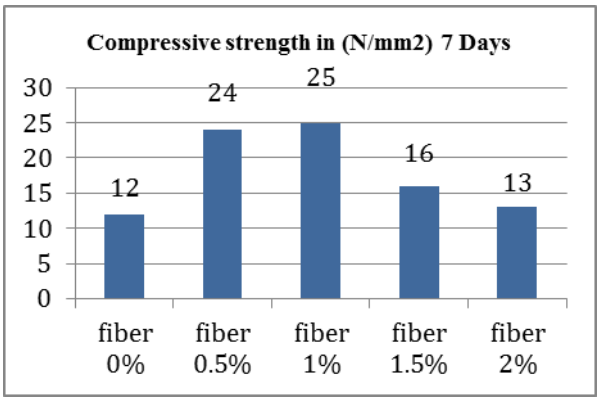

Fig. 3: Compressive Strength for 7Days

B. *Compressive Strength for 14 Days*

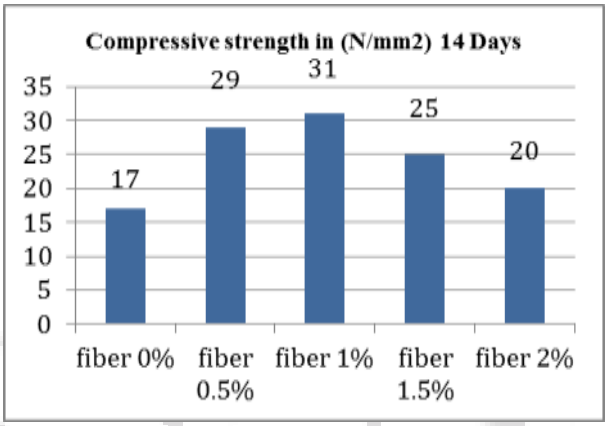

Fig. 4: Compressive Strength for 14 Days

C. *Compressive Strength for 28Days*

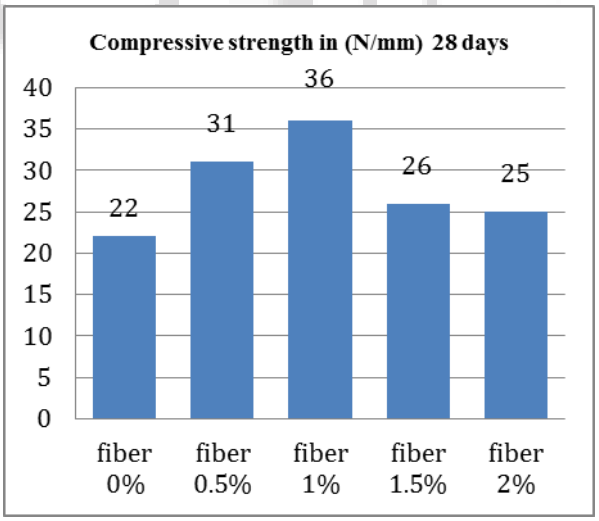

Fig. 5: Compressive Strength for 28Days

VIII. CONCLUSION

Based on the experimental study on concrete mixes, the following conclusions could be made:

1) Glass fibers significantly improve the compressive irrespective of affecting the workability of concrete mixes.

2) The slump value is not much affected by the addition of fibers irrespective of grade of concrete mixes. For M 20 grade the slump value varies between 60 to 70mm.
3) Replacing of cement with 0.5%, 1%, 1.5% and 2% percentages of glass fiber reinforce concrete increase the compressive strength as compare to plain concrete.
4) The tests conducted on GFRC in laboratory have shown good resistance for fire, since the major use of GFRCs is for architectural building panels. In these buildings, fire resistance becomes an important factor in design.

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