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Investigation on Properties of Glass Fiber Reinforced Concrete

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ABSTRCT

The use of Glass fibre Reinforced concrete in infrastructure applications is becoming more popular. Glass Fibre Reinforced concrete are introduced to enhance the overall performance of structures, such as composite bridge decks, beams, bearing walls, etc.It is a well known fact that plain concrete is brittle and exhibits less compressive and tensile strength and it also exhibits cracking. In this paper study was done using different diameters of glass fibres to determine effect on the compressive strength of concrete for 7 days and 28 days by varying diameter of glass fibes . The different diameters of glass fibres taken for study were 6 mm and 12 mm . The percentages of fibres used in concrete were 1% ,2 %, 3 % and 4 % . The 7 days and 28 days compressive strength suggest that there was an increase of 0.035% and 0.042% in strength respectively for 7 and 28 days with the increase in diameter of glass fibres .

Keywords : Compressive Strength Test , Glass Fibres

1. INTRODUCTION

Fiber Reinforced Concrete can be characterized as a composite material comprising of combinations of concrete, mortar or concrete and irregular, discrete, consistently scattered reasonable filaments. Fiber supported concrete are of various kinds and properties with many benefits. Persistent lattices, woven textures, and long wires or poles are not viewed as discrete fibers.Fiber is a little piece of building up material having specific qualities properties. They can be roundabout or level. The fiber is many times depicted by a helpful boundary called "perspective proportion". The viewpoint proportion of the fiber is the proportion of its length to its breadth. The ordinary viewpoint proportion goes from 30 to 150.Fiber-supported concrete (FRC) is concrete containing sinewy material which expands its underlying honesty.

Filaments are typically utilized in cement to control plastic shrinkage breaking and drying shrinkage breaking. They additionallybring down the porousness of cement and hence decrease the draining of water. A few sorts of filaments produce more noteworthy effect, scraped spot and break obstruction in concrete. For the most part, filaments don't expand the flexural strength of cement, so it can not supplant second opposing or primary steel support. A few strands decrease the strength of concrete.If the modulus of flexibility of the fiber is higher than the framework (cement or mortar cover), they help to convey the heap by expanding the elasticity of the material. An expansion in the viewpoint proportion of the fiber as a rule portions the flexural strength and durability of the lattice. Notwithstanding, filaments that are excessively lengthy tend to "ball" in the blend and makeusefulness issues.[5].

2. GLASS FIBRE

Glass fiber supported is material that is making a huge commitment to the financial matters , innovation and style of the development business overall for more than 40 years .gfec is one of the most flexible structure materials that anyone could hopeto find to planners and designers. Contrasted with customary substantial it has complex properties in light of its unique structure.Different boundaries, for example, water concrete proportion porosity,composite thickness ,entomb filler content,fibre content ,direction and length,type of fix impact properties and conduct of gfrc as well as exactness of creation technique. Gfrc can be created as slim as 6mm so their weight is significantly less than conventional pre projected substantial items .advancing of three dimensional printing innovation with glass fiber supported ink can fabricate an entire structure and complex engineeringstructures with high dependability as well as the utilization of premix, splash up,hybrid techniques for gfrc.self cleaning harmlessto the ecosystem boards for modern development have been adding to the gfrc both regarding cost and fame .the utilization of glass strands in the elite execution substantial class, being a class with very high mechanical performane ,durabilty ,usefulness, and feel has picked up speed lately .the plan and assembling of gfrc items is covered by global norms ,which have been created in Europe ,America ,Asia ,Australia .gfrc is produced in north of 101 nations .[1].

Figure 1 : Glass fibres used in concrete

3. MATERIALS AND METHODOLOGY

This chapter emphasizes on the detailed study of various materials used in this research. All the properties essential for understanding the physical and mechanical behavior of the materials into consideration are reflected in this chapter. Characteristics of different materials required for working out the design mix are tested for in the laboratory and analyzed. Different properties like Cement , sand , aggregates and binders are discussed. Also, glass fibers are studied thoroughly before incorporating it in concrete.The methodology involved in carrying out the trials is presented in this chapter in a brief but comprehensive manner. The main object of this study is to determine the effect on strenght on concrete due to change in diameterof Glass fiber.And also to see the effects on concrete due to varying percentages of Glass fiber, And differentiate the same.After understanding the behavior of each material in combination with each other, trials are casted for testing. The process involved in defining the proportions of materials and dosages of additives will be subsequently discussed.

3.1 Cement

Cement is used as the main binder and also for packing of voids to achieve high-density requirements. Ordinary Portland cement(OPC) of 43 grade confirming to IS 8112: 2013 was used for the mix.with specific gravity of 3.14 , Density (DLBD), Kg/m3
-1328, Fineness, mm2/gm. (102). - 2450. [4].

3.2 Water

Water is a crucial component of concrete and is required for the hydration of cementitious material.. A high water-cement ratioprovides the required flow to the mix but in doing so reduces the strength and density of the mix. On the other hand, if the watercontent is reduced, the workability is lost and the density of concrete also increases.for this experiment water cement ratio usedwas 0.5.

3.3 Aggregates

Both fine and coarse aggregates used in the concrete mix was of mix combination ,i.e both 10mm and 20 mm were used,with specific gravity of 2.84 and water absorption was 0.8% ,3.98 and moisture content of 1.01% ,5.02

3.4 Sand

During this experiment M sand was used with specific gravity of 2.78 and water absorption was 4.5% ,33.80 and moisture contentof 4.17% ,31.32

3.5 Glass fiber

Alkali-resistant (AR) glass fibers with 6mm, 12mm length ,and have the ability of dispersing homoge-nously in fresh composite when introduced in the mixer. Other nominal properties of AR-glass fibers are a Young modulus of 70 GPa and a density of 2580 kg/m3.

4. METHODOLOGY

Compressive strength is a vital incentive for plan of designs..For this experiment nominal mix ratio of M25 adopted as grade ofconcrete with mix ratio 1:1:2, mixture of cement sand, aggregate and water In which one part is cement, one part is sand and two parts are sand. Water cement ratio used is 0.5. The detailed characteristic studies of concrete is carried out by partial additionof fibers in concrete composition with different percentages (1%, 2%, 3%, 4%) of Cement quantity. Starting with Glass Fibres

,6mm glass fibers were used ,and similarly 3 cubes were casted for each percentage of fibers , followed by 12mm glass fiber respectively, for which same percentages were used.mixing was done using baby mixer,Following the mixing and casting process, cubes were demoulded after 24 hours. Compressive strength assessment is carried out after 7 daysand 28 days. A universal compression testing machine is used to determine the strength. The test cubes are tested for compressive strength.[3].

Figure 2:Testing cube for compressive strength

4.1 Methodology Process

For this experiment, M25 grade concrete mix IS prepared with water cement ratio 0.5. 24 sets of mix are prepared with the 6mmGlass fibers of varying percentages and tested for 7 and 28 days as follows.[2].

1. Cement + fine aggregate + course aggregate + water
2. [Cement+Glass fiber(1%)] + fine aggregate + course aggregate + water
3. [Cement+Glass fiber(2%)] + fine aggregate + course aggregate + water
4. [Cement+Glass fiber(3%)] + fine aggregate + course aggregate + water
5. [Cement+Glass fiber(4%)] + fine aggregate + course aggregate + water

The concrete mix is prepared as shown in table and casted in 150mm concrete moulds to test compressive test. After 24 hours these moulds were De-moulded and set for curing in a water tank. The compressive strenght were taken in 7days and 28 days to check the results.

Table 1: Details of Mix used (6mm and 12mm)

Mix	Cement (kg)	Percentage of Glass fiber (%)	Glass fiber (kg)	Fine aggregates (kg)	Coarse aggregates (kg)	Water cement ratio	Water (ltr)
Mix1	7	1%	0.07	7	14	0.5	3.5
Mix2	7	2%	0.14	7	14	0.5	3.5
Mix3	7	3%	.210	7	14	0.5	3.5
Mix4	7	4%	.280	7	14	0.5	3.5

For 12mm glass fiber, M25 grade concrete mix IS prepared with water cement ratio 0.5. 24 sets of mix are prepared with the 12mm Glass fibers of varying percentages with similar mix design as that of 6mm glass fibre.

1. Cement + fine aggregate + course aggregate + water
2. [Cement+Glass fiber(1%)] + fine aggregate + course aggregate + water
3. [Cement+Glass fiber(2%)] + fine aggregate + course aggregate + water
4. [Cement+Glass fiber(3%)] + fine aggregate + course aggregate + water
5. [Cement+Glass fiber(4%)] + fine aggregate + course aggregate + water

5. TRIALS AND RESULTS

This chapter deals with the various trials conducted with varying proportions. Different trials produced different strengths. The preliminary mix design adopted and subsequent changes to it to arrive at the final mix will be discussed subsequently. The mix finalized after checking for its compressive strength . Its variations in strength and mass are briefly deliberated.

Table 2 : Compressive strength test results. (6mm),(7 Days)

Mix	Percentage of Glass Fiber	Size of Glass Fiber	Average Compressivestrength (7 days)
M25	1%	6mm	21
M25	2%	6mm	20.5
M25	3%	6mm	20.2
M25	4%	6mm	20.04

Table 3 : Compressive strength test results, (6mm),(28 Days)

Mix	Percentage of Glass Fiber	Size of Glass Fiber	Average Compressive strength (28 days)
M25	1%	6mm	32
M25	2%	6mm	29.1
M25	3%	6mm	27.9
M25	4%	6mm	26.01

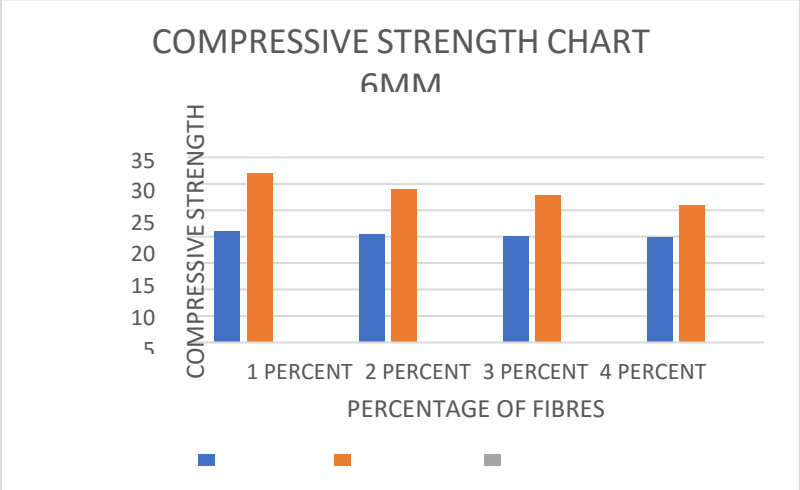

Chart 1 : Comparison of compressive strength(6mm)

From the results above we can find out that there is significant increase in the strength of concrete when we add 6mm glass fibreswith different percentages .

Table 4 : Compressive strength test results. (12mm),(7 Days)

Mix	Percentage of Glass Fiber	Size of Glass Fiber	Average Compressive strength (7 days)
M25	1%	12mm	22
M25	2%	12mm	21.09
M25	3%	12mm	20.9
M25	4%	12mm	20.7

Table 5 : Compressive strength test results, (12mm),(28 Days)

Mix	Percentage of Glass Fiber	Size of Glass Fiber	Average Compressive strength (28 days)
M25	1%	12mm	33.3
M25	2%	12mm	29.8
M25	3%	12mm	28.9
M25	4%	12mm	27.9

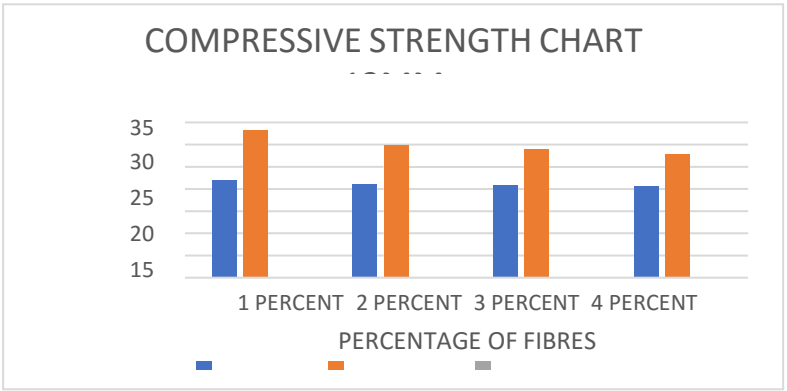

Chart 2 : Comparison of compressive strength (12mm)

From the results above we can find out that there is significant increase in the strength of concrete when we add 12mm glassfibers with different percentages.

6. CONCLUSION

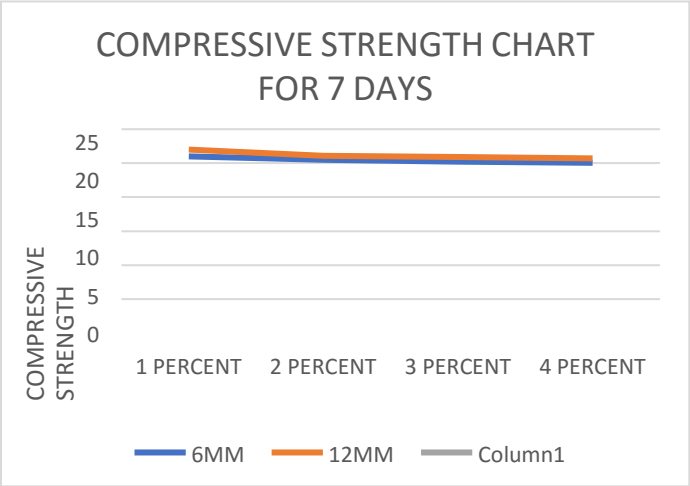

Chart 3 : Variation of compressive strength

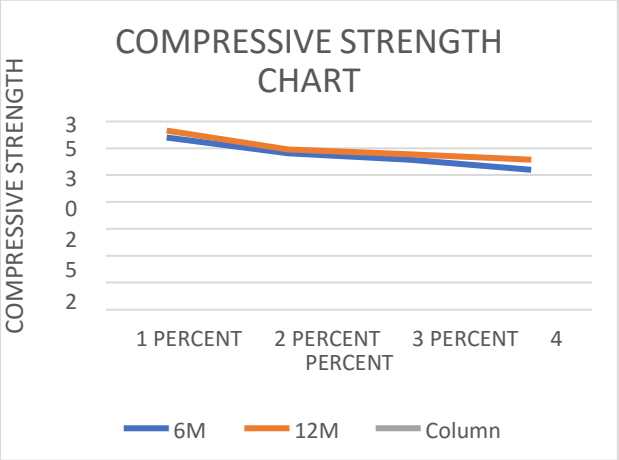

Chart 4: Variation of compressive strength

1. The average compressive strength after 7 days and 28 days decreased as the percentage of the glass fibres in the concreteincreased for 6 mm diameter glass fibres .
2. There was a reduction in the average compressive strength for 7 days and 28 days as the percentage of the glass fibresincreased for 12 mm diameter of glass fibres.
3. With the increase in the diameter of the fibres the average compressive strength of the concrete increased .

7. REFERENCES

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