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GLASS FIBER REINFORCED CONCRETE AS A NEW CONSTRUCTION MATERIAL

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Abstract: - The usefulness of glass fiber reinforced concrete (GFRC) in various civil engineering applications is indisputable. Fiber-reinforced concrete has so far been successfully used in slabs on grade, architectural panels, precast products, offshore structures, structures in seismic regions, thin and thick repairs, crash barriers, footings, hydraulic structures and many other applications. Glass Fiber Reinforced Concrete (GFRC) is gaining attention as an effective way to improve the performance of concrete. Fibers are currently being specified in tunneling, bridge decks, pavements, loading docks, thin unbounded overlays, concrete pads, and concretes slabs. These applications of fiber reinforced concrete are becoming increasingly popular and are exhibiting excellent performance. Glass Fiber-reinforced concrete (GFRC) is concrete containing fibrous material which increases its structural integrity. It contains short discrete fibers that are uniformly distributed and randomly oriented. Fibers include steel fibers, glass fibers, synthetic fibers and natural fibers. This study presents an understanding of the strength of fiber-reinforced concrete. Mechanical properties and durability of fiber reinforced concrete.

Index Terms - Glass fiber, Compressive strength, Reinforcement, Concrete, and Workability

I. INTRODUCTION

Concrete is the most widely used construction material has several desirable properties like high compressive strength, stiffness and durability under usual environmental at the same time concrete is brittle and weak in tension. Plain concrete has two deficiencies, low tensile strength and a low strain at fracture. These shortcomings are generally overcome by reinforcing concrete. Generally, overcome by reinforcing concrete.

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.

Concrete is a composite material composed mainly of water, aggregate, and cement. Often, additives and reinforcements (such as rebar) are included in the mixture to achieve the desired physical properties of the finished material. When these ingredients are mixed together, they form a fluid mass that is easily molded into shape. Over time, the cement forms a hard matrix which binds the rest of the ingredients together into a durable stone-like material with many uses. Concrete is the most widely used material in the world after water.

II. GLASS FIBER REINFORCED CONCRETE (GFRC)

Glass fiber reinforced concrete (GFRC) is a material that is making a significant contribution to the economics, technology and aesthetics of the construction industry worldwide for over 40 years. GFRC is one of the most versatile building materials available to architects and engineers. Compared to traditional concrete, it has complex properties because of its special structure. Different parameters such as water–cement ratio, porosity, composite density, inter filler content, fiber content, orientation and length, type of cure influence properties and behavior of GFRC. The use of glass fiber in the High-Performance Concrete (HPC) class, being a class with extremely high mechanical performance, durability, workability and aesthetics, has gained momentum in recent years. The design and manufacture of GFRC products is covered by international standards, over 1000 years.

Glass-fiber reinforced concrete (GRC) is a material made of a cementations matrix composed of cement, sand, water and admixtures, in which short length glass fibers are dispersed It has been widely used in the construction industry for non-structural elements, like façade panels, piping and channels. GRC offers many advantages, such as being lightweight, fire resistance, good appearance and strength. In this study trial tests for concrete with glass fiber and without glass fiber are conducted to indicate the differences in compressive strength and flexural strength by using cubes of varying sizes.

Of five years. The time series monthly data is collected on stock prices for sample firmsand relative macroeconomic variables for the period of 5 years. The data collection period is ranging from January 2010 to Dec 2014. Monthly prices of KSE -100 Index is taken from yahoo finance.

III. ADVANTAGES OF GFRC

- As compared to the traditional mix GFRC is 75% lighter in volume.
- It provides high level of strength to weight ratio because of its tensile nature**.**
- It does not crack easily and can be easily molded.
- Currently, GFRC is highly used in walls and ceilings and is also used for external restoration work.
- GFRC is easy to apply and no requirement of heavy-duty machinery while application.

IV. OBJECTIVES AND SCOPE

1. To study the mix design aspects of the GFRC
2. To identify the load carrying capacity of the concrete
3. To reduce the moisture absorption of the concrete.
4. To study the properties of glass fiber reinforced concrete.
5. To compare GFRC with conventional concrete.
6. To use the concrete in structural component like beam, slab, column etc.
7. To improve mix cohesion, improving pumping ability without affecting water cement ratio and strength of concrete.

V.METHODOLOGY

I.MATERIALS TO BE USED :

1.1 COARSE AGGREGATE

The coarse 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. Coarse aggregates are an integral part of many construction applications, sometimes used on their own, such as a granular base placed under a slab or pavement, or as a component in a mixture, such as asphalt or concrete mixtures. Coarse aggregates are generally categorized as rock larger than a standard No. 4 sieve (3/16 inches) and less than 2 inches.

1.2 FINE AGGREGATE

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 up to 4%.

Sand is an important engineering material. In concrete works, sand is used as a fine aggregate. Sand is a form of silica (quartz) and may be of argillaceous, siliceous or calcareous according to its composition. Natural sands are formed from weathering of rocks (mainly quartzite) and are of various size or grades depending on the intensity of weathering. The sand grains may be of sharp, angular or rounded.

1.3 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. Glass fiber is formed when thin strands of silica-based or other formulation glass are extruded into many fibers with small diameters suitable for textile processing. The technique of heating and drawing glass into fine fibers has been known for millennia; however, the use of these fibers for textile applications is more recent. Until this time, all glass fiber had been manufactured as staple (that is, clusters of short lengths of fiber).

II.LABORATORY INVESTIGATIONS

2.1 WORKABILITY

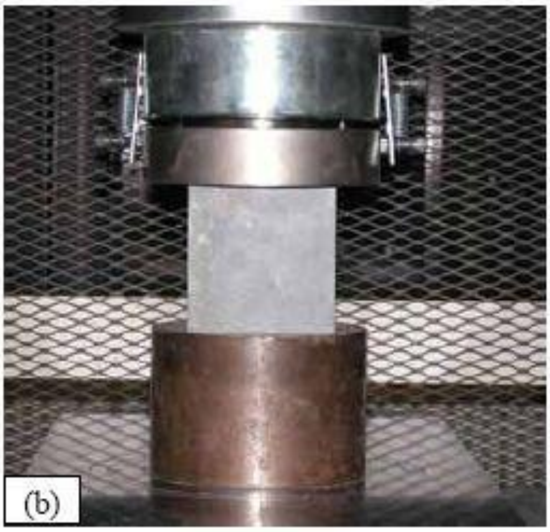
2.1.1 SLUMP CONE TEST

The slump cone test of concrete is one of the methods to calculate the workability or fluidity of concrete. Slump test is the indirect measurement of stiffness of freshly made concrete. This test is carried out by slump cone having 300mm height and base 200mm diameter top cone 100mm.This cone is filled by fresh concrete by three layers, each layer is tamped by tamping rod for 25 times which is having diameter of 16mm.After completion of placing the concrete the cone is lifted vertically and slump of concrete is measured. Generally concrete slump value is used to find the workability, which indicates water-cement ratio, but there are various factors including properties of materials, mixing methods, dosage, admixtures etc. also affect the concrete slump value.

2.1.2 COMPRESSIVE STRENGTH TEST

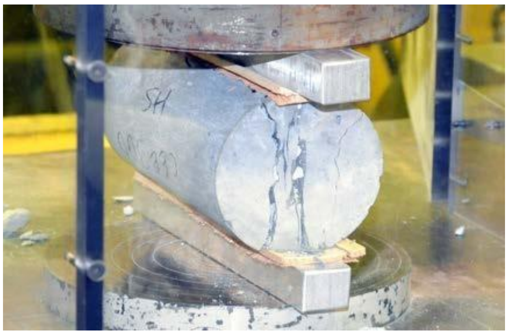
All of us know that the concrete is already good in the compressive strength so we check that when we add glass fibers to the mix and after the formation of the cube we will compare that whether the adding of the fibers will increase the compressive strength or decrease it. So in this test after casting of the cube we will put it in the compressive strength testing machine for seeing whether after the addition of the glass fibers is there any increase in the strength of the concrete or decrease in the strength of the concrete.

Compression Strength Test is done to check whether concreting is done properly or not. We will perform the test on 100mm*100mm of cube mold. The concrete is poured in the mold and then will be tempered properly such that there should be no formation of air voids. We will make M25 grade cubes and then will be tested by Universal Testing Machine (UTM) after 7, 14, 28 days curing at the rate of 140 kg/cm2 per minute till there is failure seen in the specimen.



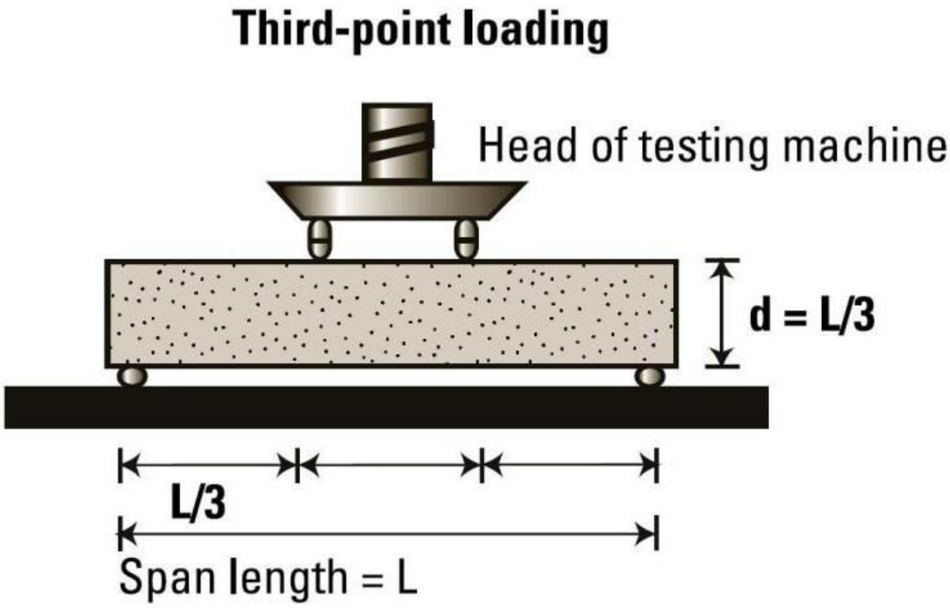
2.1.2 SPLIT TENSILE TEST

As all of us understand that concrete is good in compressive strength but lacks in tensile strength. The tensile strength of the concrete is one of the primary elements that we should taken into consideration even as making a concrete. So split tensile strength is executed at the concrete cylinder to know the tensile strength of concrete.



2.1.3 FLEXURAL STRENGTH TEST

This Test will be done to recognize the bending strength of the concrete. After this we take a look that how much load a beam can convey without breaking.
Beam Mould: Size of the beam is 100mm*100mm*500mm. This test will be conducted with the help of third- point loading. In this test the beam should be rested on the two roller on each side such that if we are using 500mm length beam then on both side of the beam 10mm on beam should be left outside of the rollers and third roller should be applied at the centre of the beam at the rate of 180kg/min.



III. MIX PROPORTION-

IS METHOD

Cement	394kg/m^3
Water	197
fine aggregates	688.43kg/m^3
coarse aggregates	1110.68kg/m^3
chemical admixture	Nil
water cement ratio	0.5

VI. RESULTS

TABLE-1. Quantities Of Materials Required Per 1 Cum Of Ordinary Concrete And Glass Fibre Concrete Mixes

Grade Of Concrete	Cement (Kg)	Fine Aggregate (Kg)	Coarse Aggregates (Kg)	Water (ltr)	W/C ratio	Glass Fibres
M 25	338.18	722.41	1132.42	186	0.55	0.025 % by volume of concrete
M 30	413.33	661.90	1131.33	187	0.45	

TABLE -2. Values of Compaction Factor for Different Concrete Mix

CONCRETE MIX	COMPACTION FACTOR	
	WITHOUT GF	WITH GF
M25	0.960	0.970
M30	0.930	0.915

TABLE-3. COMPRESSIVE, FLEXURAL AND SPLIT TENSILE STRENGTH FOR DIFFERENT GRADES OF CONCRETE MIXES

Grade Of Concrete	**Days Of Curing**	**Compressive Strength (N/mm^2)**		**Flexural Strength (N/mm^2)**		**Split tensile Strength (N/mm^2)**	
		WITHOUT GF	**WITH GF**	**WITHOUT GF**	**WITH GF**	**WITHOUT GF**	**WITH GF**
M25	28	30.07	38.89	14.33	18.75	3.16	4.10
		30.07	38.89	14.33	18.75	3.16	4.10
M30`	28	40.30	49.04	15.58	20.08	4.10	5.18

VII. CONCLUSION

1. The efficient utilization of fibrous concrete involves improved static and dynamic properties like tensile strength, energy absorbing characteristics, Impact strength and fatigue strength.

2. The glass fiber improves the toughness, flexural strength, ductility as well as compressive strength of concrete.

3. GFRC is one of the most versatile building materials available to architects and engineers. It has contributed significantly to the economics, technology and aesthetics of the construction industry. In line with this importance, a comprehensive review that was investigated widespread methods of production of GFRC and compatibility of developing technology was hereby aimed in understanding on the mechanical and physical properties of GFRC.

4. It has been also observed that there is gradual increase in early strength for Compression and Flexural strength of Glass Fiber Reinforced Concrete as compared to Plain Concrete, and there is sudden increase in ultimate strength for Split tensile strength of Glass Fiber Reinforced Concrete as compared to Plain Concrete.

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