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Study on the Effect of Glass Fibre Reinforced Concrete and Concrete Tiles Reinforced Concrete

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Abstract: The objective of this research is to explore the compressive strength, split-tensile strength and flexural strength properties of concrete reinforced with short discrete fibers. The study will be carried out on M-20 grade concrete and the size of glass fibers will be used 30mm and variation of fibre will be 0% to 0.3% of the total weight of concrete. also the effect of glass fiber on cement and concrete tiles will be studied whose fibre content will be varied from 0% to 0.7% of the total weight of concrete.
Keywords: GFRC, Concrete tiles, Cement Matrix, MORTH.

I. INTRODUCTION

Glass fiber reinforced concrete (GFRC) is a composite product of cement reinforced with fiberglass of various lengths and sizes. Used glass fiber is not alkaline as glass fiber is at risk of exposure to alkali which lowers the strength of the GFRC. Glass wires are widely used in exterior assemblies, veneer plates and various other components where their reinforcing effect is required during construction. The GFRC is strong in the new environment with low density and therefore less efficient, so water-based compounds are used. In addition GFRC structures are based on various parameters as a means of production. It can be done in various ways like spraying, spraying, extraction techniques etc. The type of cement is also found to have a significant impact on the GFRC. Fiber length, sand type / filling, cement measurement methods and duration of healing also affect GFRC features.

One of the most important building materials is concrete and its use has been increasing worldwide. The reasons are that it is cheap and its components are easily accessible, and it can be used in many public infrastructure projects. However, concrete has certain disadvantages such as brittleness and resistance to cracking and spreading. Concrete is naturally toxic and has very low strength and as a result the fibers are used in one way or another to increase its strength and reduce fracture behavior. Over time many attempts have been made to improve concrete structures both in the new and durable form. The basics remain the same but superplasticizers, admixtures, micro fillers are also used to obtain the desired properties such as performance, increase or decrease setup time and high compression strength.

Fibers used in structural concrete are classified according to their properties such as steel fibers, Alkali resistant Glass (AR) fibers, synthetic fibers, Carbon, pitch and polyacrylonitrile (PAN) fibers.

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Apps

The main area for FRC applications is as follows

1) Runway, Airport Parking and Road
2) Tunnel construction and slope stability
3) Explosive-resistant structures
4) Small Shell, Walls, Pipes, and Pits
5) Dams and Hydraulic structure
6) Various applications include machine tool and frames, lighting poles, water and oil tanks and concrete repairs.

II. LITERATURE REVIEW

J.G. Ferreria and F.A. Branco (2005) In this paper, the results of a research project were presented in which glass fibers were used in the construction of structural elements, telecommunications towers 30 meters high. The light and strong strength of GRC was associated with carbon and stainless steel reinforcement, resulting in high-strength composites. Concludes, The use of GRC reinforced with carbon fibers or stainless steel bars can be used as building materials, with reduced weight and good strength structures.

The GRC application in telecommunication towers is effective and provides adequate power and disability standards for the facilities. Numerical models developed to determine the strength, disability and flexibility of towers show good correlation with experimental behavior and may be used to design this type of tower.

A.J. Majumdar (1974) In this paper an attempt was made to study the use of glass in concrete, concrete was tested for a period of three years under different environmental conditions and to measure the mechanical properties of these compounds by age. The test results were interpreted according to the micromechanics of the failure of these compounds and an experimental role study was performed to control the behavior of the compound at various stages of its life. It concluded that the interface properties in GRC change over time, in part due to chemical attacks on fiber that weaken the reinforcement but also due to changes in the physical properties of the fiber bundle and porosity and the change in volume in the matrix as it states. and it is hard.

When using alkali-resistant glass fiber, the bending strength indicates an initial increase over the course of months and a slight decrease in strength. The magnitude of the reduction was based on the conditions used in the storage of the material and there are indications that this process was not present when the pfa was added to the mixture. Energy effects were interpreted in terms of quality on the basis of the changes that took place in the junction between the thread and the matrix. These changes were brought about by the interaction of glass fiber with the cement matrix and the continuous flow of the cement itself. These elements, along with many of the matrix fragments, control the mechanical properties of composite materials such as reinforced glass fiber.

M-M. Levitt (1997) examined that when cement, mud or concrete is sprayed or in contact with window glass, embedding occurs. This is because alkali in cement attacks some of the silicates used to make glass. The stock used to make glass fibers has better alkali resistance than window glass because zirconia is used as one of the listed materials.

M.W. Fordyce et. al (1983) examined that the significant difference between GRC dehydrated and non-dewatered density variation has two effects. First, although the fiber content by weight is the same, the high density of the drained board provides a fraction of the higher fiber volume that provides higher strength. Secondly water-repellent board has better strength and reduced porosity which provides better fiber / matrix bond strength.

Perumelsamy N. Balaguru et. al (1992) noted that tests conducted in the GFRC laboratory have shown good resistance to fire, as the main use of GFRCs is on building panels. In these structures, fire resistance becomes an important factor in construction.

Drs. P. Perumal et. al (2006) examined that mixtures with a volume of 1.5% fiber provided a composite composite structure in terms of compressive strength with a power enhancement of 25.39%. The highest increase in the strength of the split strength was observed in the mix with 1.5% of the fiber volume and was found to be more than 5.76% stronger than the reference concrete. Similarly, the highest tensile strength was observed in mixing with 1.5% of fiber volume and was found to be 72.5% above reference concrete.

R .N. Swamy's (1978) study includes not only tests of fiber content and matrix strength, but also details such as fiber distribution, shape, and binding efficiency. Possible production or product defects can also be detected. It also shows that the MOR and LOP in the suspension condition test have a higher effect than the wet round (1- 5) MN / m2 difference.

Surendra P. Shah et. al (1987) has observed that the use of alkali resistant glass fiber as well as E glass fiber in combination and latex fiber when exposed to rapid aging flexibility is reduced. AFTER 52 weeks the rapid aging was just one facet of immortality. The strength level was very low by 1 / 60th.

Benturet. al (1997), has noted that the use of a low percentage of synthetic fibers is most effective in the use of a floor slab. Low fiber content is defined as less than 0.3 percent by volume of concrete mix. The paper is the result of an experimental study of the effect of low percentage of nylon and polypropylene fibers on decay, the duration of the distorted slump cone, air content, compressive and flexible behavior and the impact of concrete resistance. Three percent of the fibers, i.e., 0.15%, 0.22%, and 0.30% by volume of concrete mixture with a single fiber (25 mm) length were used. It is noted that the addition of cables reduces the performance of the concrete and has no significant effect on the compression strength of the concrete. A moderate increase in the flexibility of the order of 10 to 22% with nylon fibers and 8 to 15.5% with polypropylene fibers is observed. Nylon and polypropylene wires also alter the ductility of concrete. Both strands increase the force of impact significantly. The increase in impact strength is 206 kN to 373 kN with nylon fibers.

III. MATERIAL USED

A. Basic Materials

1) *Cement:* The use of cement for experimental studies was Ultra tech cement 43 grade OPC as specified in Indian Standard Code IS: 8112-1989. The gravitational force of cement was 3.10.

Table: Physical Properties of Cement

Sr. No.	Characteristics	Experimental value	Specified value as per IS:8112- 1989
1	Consistency of cement (%)	33%	---
2	Specific gravity	3.10	3.15
3	Initial setting time (minutes)	63	>30 As Per IS 4031-1968
4	Final setting time (minutes)	495	<600 As per IS 4031-1968
5	Compressive strength (N/mm^2) 3days 7days 28days	20.45 23.87 33.50	>23 >33 >43
6	Soundness (mm)	1.00	10
7	Fineness of Cement	5.5%	10% As Per IS 269-1976

2) *Coarse Aggregates:* The coarse aggregate used were a mixture of two locally available crushed stone of 20 mm and 10 mm size in 70:30 proportion. Coarse aggregate of maximum size 20mm and minimum 10 mm is used throughout the concrete. The specific gravity of coarse aggregate is 3.09.
3) *Fine Aggregates:* Fine aggregate is used in this experimental study for concrete is river sand conforming to zone- II. The specific gravity of fine aggregates 2.65.
4) *Fiber:* Fiber is a natural or synthetic fiber or used as part of composite materials, or, when assembled on paper, used to make products such as paper, papyrus, or feel. Concrete has a natural body and is not weak with flexibility and direct friction so to improve this structure fibers are added to the concrete. The strands may be short separated or loosely shaped or they may be of the same type as the fibers of the fabric or the fibers of the woven mesh. Different types of concrete added to concrete some have a high stretch modulus some have a low stretch module each phase can improve certain concrete features. In our case shorter glass fibers were used and as the glass fibers are more susceptible to alkali we used alkali-resistant glass fibers. A filament is a material that is made into a long cord with a normal diameter of 10 tm. The main functions of fiber are to carry the load and provide durability, strength, thermal stability, and other structural properties in the FRC. Glass cords are fibers commonly used as part of marine and mechanical fields to form compounds of the middle class. Their unique trademark is their high quality. The glass is basically made of silicon (SiO2) with a tetrahedral structure (SiO4). Some aluminum oxides and other metal particles are then applied in different proportions to make it easier to operate or modify a few structures (e.g., S-glass fibers show higher elasticity than E-glass).
5) *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.

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IV. METHODOLOGY

In this thesis the work is done in 2 stages in first stage the glass fiber and second stage concrete tiles is taken into consideration.

A. Stage-I

In this stage the effect of glass fibre on flexural strength, split-tensile strength and compressive strength was studied for different fibre content on M- 20 grade concrete.

Batch Mix	Cement (%)	Sand (%)	Aggregate (%)	Glass Fibre (%)
1	100	100	100	0
2	100	100	100	0.1
3	100	100	100	0.2
4	100	100	100	0.3

B. Stage-II

In this Stage cement concrete tiles was taken into consideration and wet transverse strength, compressive strength and water absorption test was carried out.

Batch Mix	Cement (%)	Sand (%)	Aggregate (%)	Cement Concrete Tiles (%)
1	100	100	100	0
2	100	100	100	0.1
3	100	100	100	0.2
4	100	100	100	0.3
5	100	100	100	0.4
6	100	100	100	0.5
7	100	100	100	0.6
8	100	100	100	0.7

The experimental work consists of casting cubes, cylinders and prisms to study the effect of glass fibres on the compressive, flexural and split tensile strength of concrete. The effect was studied by varying the fibre content from 0% to 0.3%, no water reducing admixture was used for the experimental programme. To check the effect on concrete for fibre content variation 6 specimens each of cube, prisms and cylinders were casted. Test were conducted on the specimen after 7days and 28 days.
Further in order to get a practical use of glass fibres in concrete, concrete tiles were casted. The size of the tiles being 400mm*400mm*20mm.The maximum size of aggregates used for 8mm in case of tiles and the testing for tiles were done as per IS 1237:2012.Thefibre content varied from 0% to 0.7% and the main study of interest was compressive strength, wet transverse strength and water absorption.

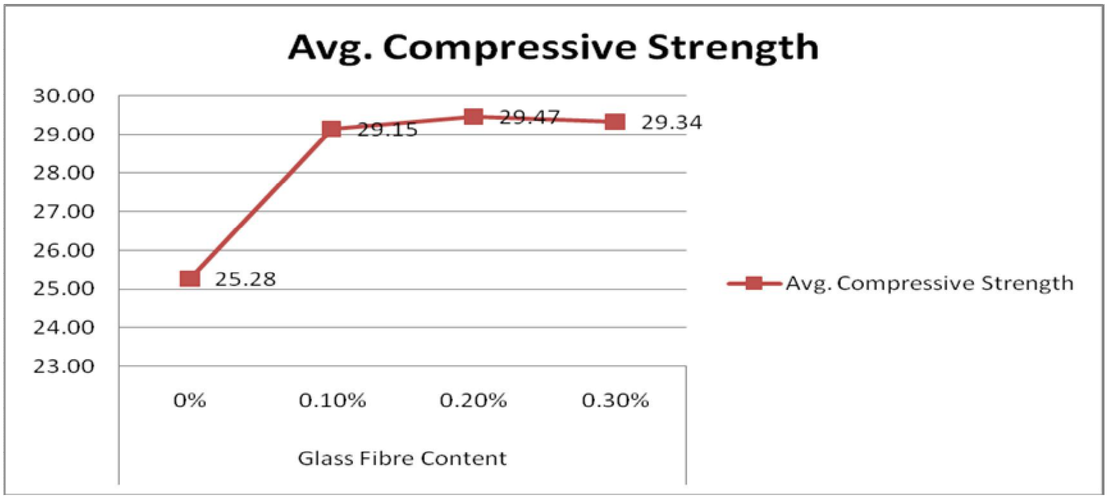
C. Moulds

To determine the compression strength of the fly ash and rice husk concrete, cubes of 150mm×150mm×150mm size were used. For flexural strength test, beams of 150mm×150mm×700mm size were used**.**

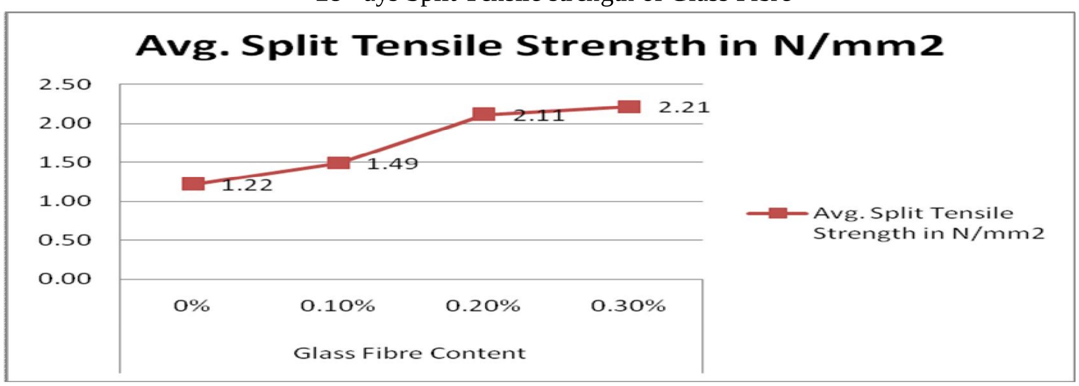
V. RESULTS

The research was undertaken to investigate the compressive strength and flexural strength of concrete with different levels of replacement of fibre content and cement concrete tiles.

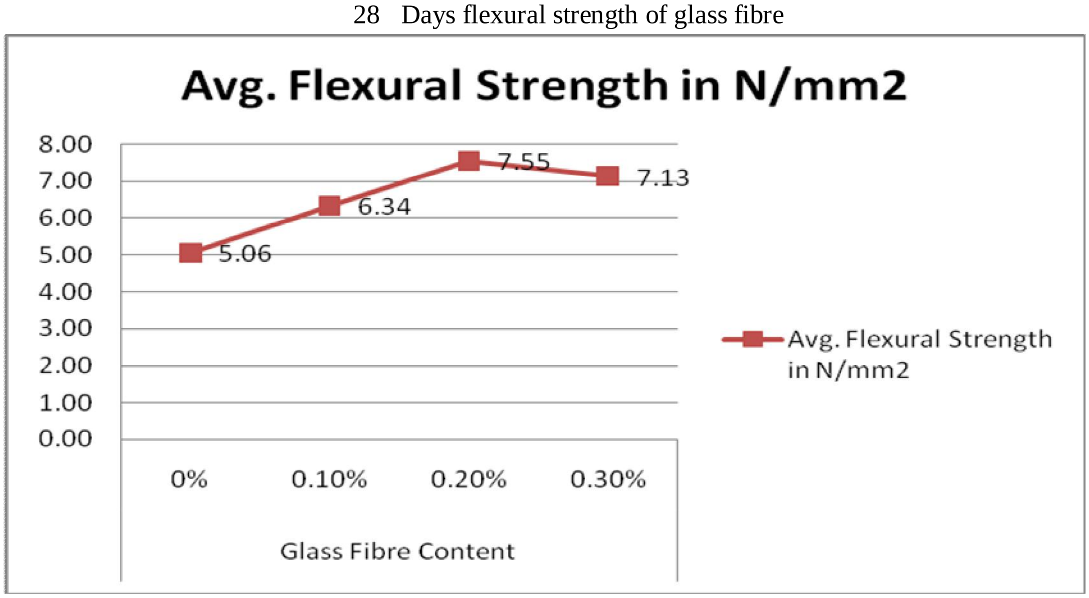
28 days compressive strength of Glass Fibre



28 ays Split Tensile strength of Glass Fibre



28 Days flexural strength of glass fibre



VI. CONCLUSIONS

1) The compressive strength of concrete without admixture is not affected by the presence of short discrete glass fibers with fibre content in the range 0.1 to 0.3 % of fiber content by weight of concrete.
2) The split tensile strength of concrete increases with the addition of glass fibers.
3) The flexural strength of concrete increases with increase in fiber content and as such the tension carrying capacity of concrete may increase in flexure
4) The wet transverse strength of tiles increases and the increase has been found with addition of fibers
5) The water absorption of the concrete also decreases with increase in fiber content.
6) The compressive strength of concrete with admixture was not affected upto 0.4 % fiber content but decreased with the presence of higher amount of fibers.

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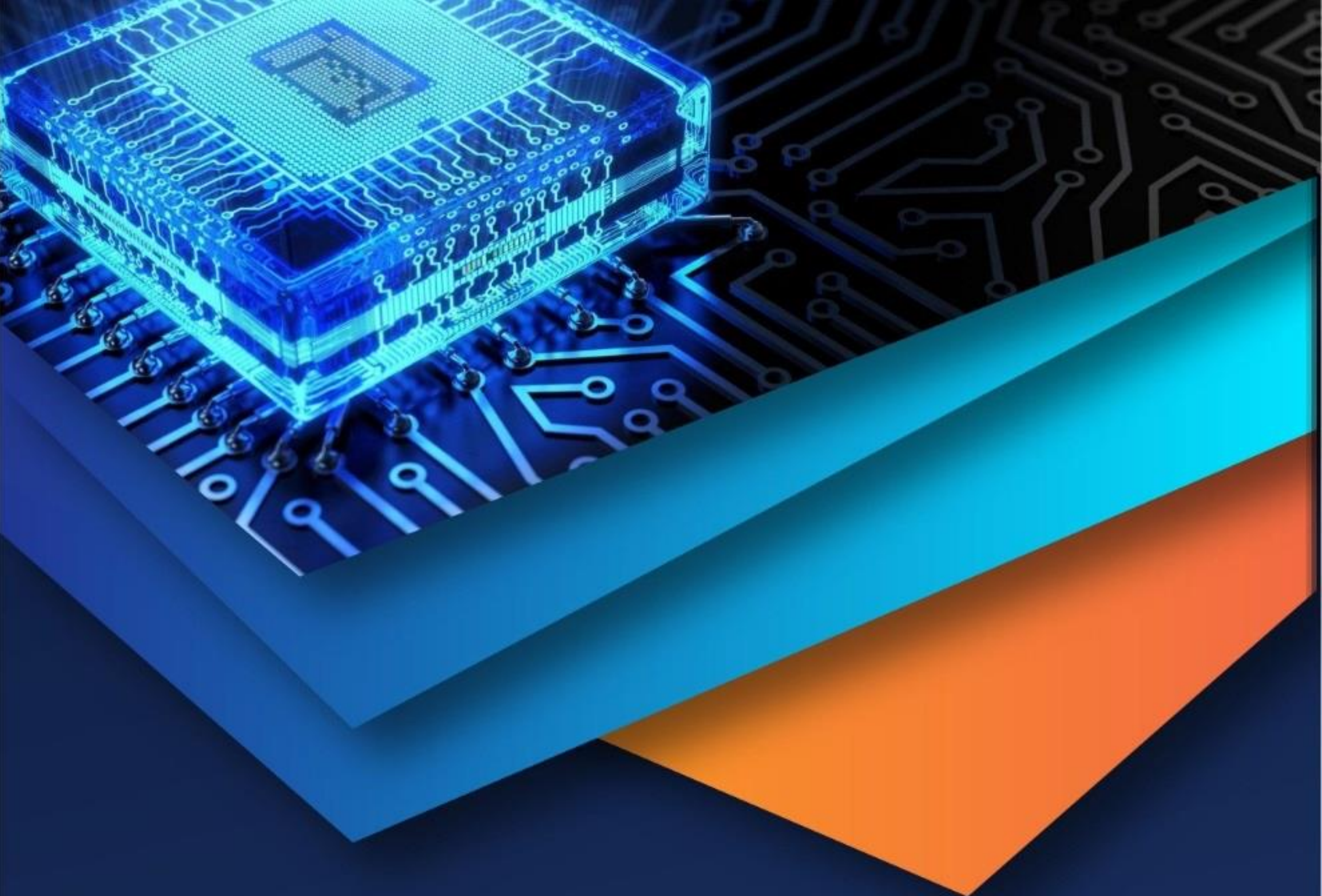

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