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EXPERIMENTAL ANALYSIS AND STUDY THE EFFECT OF WASTE GLASS WOOL FIBER IN PROPERTY OF CONCRETE

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ABSTRACT:- *Concrete is widely used construction material in the world. Nowadays the world is witnessing the construction of more and more challenging and difficult Engineering structures. So, the concrete need to possess very high strength and enough workability. In the case of Glass Fiber reinforced Concrete, strength of the concrete is increased, but at higher cost. Hence, research has to be done to provide an alternative use of Glass Wool Fiber. In the present study, Glass Wool Fiber is added to the concrete to increase the strength as compared to the conventional concrete at lower cost. To increase the compressive strength and tensile strength in concrete we use natural or synthetic fibers. Glass wool is obtained as a by-product from manufacturing of glass in industries. This is considered as a waste and mainly burnt by incineration. Glass wool is mainly used for insulation purpose in refrigerators. Glass wool possess the properties of synthetic fibers thus by adding glass wool to conventional concrete glass wool reinforced concrete is obtained. By this method we can reuse the waste as well as increase the properties of conventional concrete. In this project we have produced glass wool FRC by adding wool of 0.5%, 1%, 1.5%, 2%, 2.5% and 3% to the weight of cement. The grade of concrete used for investigation is M25.*

Keywords: Glass Wool Fiber waste, Compressive strength, Flexural strength, Concrete.

1. INTRODUCTION

Glass fiber has used over many years in many construction elements, mostly non constructional ones, like facade panels, piping for sanitation, decorative non recoverable form work. Concrete is one of the best durable building materials. It provides high fire resistance compared with wooden construction and gains strength over time. Structures made of concrete can have a long life. Concrete is used more than any other manmade material in the world Concrete, has relatively high compressive strength, but much lower tensile strength. Concrete has a too low coefficient of thermal expansion and shrinks when it matures. All concrete structures has fine crack to some extent, due to shrinkage and tension. Glass Wool Fiber concrete (GWFC) consists basically of a matrix composed of cement, sand, water, and admixtures, in which Glass Wool Fibers are dispersed. The effect of the fibers in this composite leads to an increase in the compression and tension strength of the material. Glass Wool Fiber, however, was invented in 1938 by Russell Games Slater of Owens-Corning as a material to be used as insulation. It is marketed under the trade name Fiberglass, which has become a generalized trademark. It is a material made from very fine fibers of glass. Fiberglass is a lightweight, highly strong, and robust material. Although its strength and weight properties are also enough favorable when compared to metals, and it can be easily formed by using molding processes. Glass is the mature, and most well known, performance fiber.

In the study, the following objectives are envisaged:

i) Study the mix design aspects of the GWFRC.
ii) Understand the various applications involving GWFRC
iii) Compare GWFRC with alternatives such as stone, aluminum, wood, glass, steel, marble and granite.
iv) Perform laboratory tests that are related to compressive, tensile and flexure by use of Glass wool fiber in the concrete pour.

Fig – 1 Glass Wool Fiber

2. LITERATURE REVIEW

Keeping in mind the end goal to contextualize the current work, related works from literature are examined and gives an extensive survey of the work done by different researchers in the field of using used Glass Wool Fiber as an additive in concrete.

1. **Rajendiran. M** and his team investigated that, to increase the compressive strength and tensile strength in concrete we use natural or synthetic fibers. Glass wool is obtained as a by-product from manufacturing of glass in industries. This is considered as a waste and mainly burnt by incineration. Glass wool is mainly used for insulation purpose in refrigerators. Glass wool possess the properties of synthetic fibers thus by adding glass wool to conventional concrete glass wool reinforced concrete is obtained. By this method we can reuse the waste as well as increase the properties of conventional concrete. In this project we have produced glass wool FRC by adding wool of 4%, 5%, and 6% to the weight of cement. The grade of concrete used for investigation is M20.
2. **R. Gowri** and team investigated that, the present trend in concrete technology is towards increasing the strength and durability of concrete to meet the demands of the modern construction world at lower cost. These factors can be achieve in concrete by adding natural or synthetic fiber. In the case of Glass Fiber reinforced Concrete, strength of the concrete is increased, but at higher cost. Hence, research has to be done to provide an alternative use of fiber glass. In the present study, Glass wool fiber is added to the concrete to increase the strength as compared to the conventional concrete at lower cost. The strength parameters of concrete such as compressive strength and tensile strength were deliberated by change the percentage of fiber from 0.025% to 0.075% of the weight of concrete.
3. **Jyothi Kumari**, et al 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.

4. **Dr. P. Srinivasa Rao**, et al conducted durability studies on glass fiber reinforced concrete. The alkali resistant glass fibers were used to find out workability, resistance of concrete due to acids, sulphate and rapid chloride permeability test of M30, M40 and M50 grade of glass fiber reinforced concrete and ordinary concrete. The durability of concrete was increased by adding alkali resistant glass fibers in the concrete. The experimental study showed that addition of glass fibers in concrete gives a reduction in bleeding. The addition of glass fibers had shown improvement in the resistance of concrete to the attack of acids.
5. **S. H. Alsayed**, et al studied the performance of glass fiber reinforced plastic bars as reinforcing material for concrete structures. The study revealed that the flexural capacity of concrete beams reinforced by GFRP bars can be accurately estimated using Review on the Performance of Glass Fiber Reinforced Concrete 283 the ultimate design theory. The study also revealed that as GFRP bars have low modulus of elasticity, deflection criteria may control the design of intermediate and long beams reinforced with FDRP bars.
6. **Yogesh Murthy**, et al studied the performance of Glass Fiber Reinforced Concrete. The study revealed that the use of glass fiber in concrete not only improves the properties of concrete and a small cost cutting but also provide easy outlet to dispose the glass as environmental waste from the industry. From the study it could be revealed 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.
7. **Avinash Gornale**, et al studied the strength aspect of glass fiber reinforced concrete. The study had revealed that the increase in compressive strength, flexural strength, split tensile strength for M20, M30 and M40 grade of concrete at 3, 7 and 28 days were observed to be 20% to 30%, 25% to 30% and 25% to 30% respectively after the addition of glass fibers as compared to the plain concrete.

3. Material Used and Property

The composition of the glass wool reinforced concrete consists of two components. The concrete matrix component consisting of cements, aggregate, water and fiber constituent consisting of glass wool fibers added to the concrete mix in different proportion.

A. Cement

Ordinary Portland cement of 53 grades available in local market is used in the investigation. The cement used has been tested for various proportions as per IS: 4031-1988 and found to be conforming to various specifications of IS: 12269-1987. The specific gravity was 3.21, initial setting time is 140 minute and final setting time is 490 minute. The fineness of cement is 1%.

B. Coarse Aggregate

Crushed stone metal with a maximum size of 20mm and minimum size of 12mm from a local, specific gravity is 2.84 and water absorption 0.4004%.

C. Fine Aggregate

Fine aggregate can be natural or crushed stone dust. Locally available river sand passing through 4.75 mm IS sieve and it conforms to zone II (As per IS 383 – 1970). In this project we have used manufactured sand (M sand). The specific gravity and fineness was found to be 2.568, water absorption is 0.67% and bulking of fine aggregate is 30.19%.

D. Glass wool

Natural sand and reprocess glass are mixed and heated to 1,450 °C, to produce glass. The fiberglass is normally produced by a method alike to making cotton candy, by forcing it through a fine mesh by centripetal force, cooling on contact with t air. Cohesive and mechanical strength are obtained by the presence of a binder that "cements" the fibers together. A drop of binder is placed at each fiber crossing. The fiber mat is then heated to around 200 °C to polymerize the resin and is calendared to give it strength and stability. Finally, the wool mat is cut and packed in rolls or panels, palletized, and stored for use.

Mix composition

Quantity of material for M25 Concrete

INGRADIENT	CEMENT	FINE AGGREGATE	COARSE AGGREGATE	WATER
QUANTITY Kg/m^3	394.32	733.7	1118.96	197.160
RATIO	1.00	1.86	2.83	0.5

The experimental investigation was carried out to study the properties of M25 grade concrete. The mix was designed as per IS 10262-1984. To study the effect of glass wool fibers on the strength of concrete the % of Glass Wool fibers is varied from 0.5% to 3% by total weight of cement.

Property of material

Physical properties	result
Cement sp. Gravity	3.21
Cement initial setting time	140 minute
Cement final setting time	490 minute
Cement compressive strength N/mm^2 at 28 days	53.6
Normal consistency of cement	33%
Aggregate impact value (coarse)	23.636%
Sp. gravity of fine aggregate	2.568
Sp. gravity of coarse aggregate	2.84
Water absorption of fine aggregate	0.67%
Water absorption of coarse aggregate	0.4004%
Bulking of sand	30.19%

4. Methodology

The Glass wool fiber reinforced concrete is prepared and investigates by traditional method of preparing conventional concrete.

Manufacture of glass wool reinforced concrete

In the current study the glass wool reinforced concrete is manufactured in traditional method. The materials were batched by weight and mixed using mechanical mixer. Water was added gradually so that concrete attains its plasticity. The concrete is again mixed with trowels before placing in moulds and compact by mechanical vibrator.

Test specimen

In the present study a total of 36 specimens were casted of which, 12 cube of size 150mm x 150mm x150mm for compression test, 12 cylinders of size 150mm X 300mm for split tensile test for flexure strength were prepared for conventional and different percentages of glass wool fibers. The specimens without fibers are considered as control specimens & with fiber are considered as glass wool fiber reinforced concrete. All the specimens were cured and tested for 3, 7 & 28 days.

Fig – 2 Specimens of GWFRC

Compressive strength test

In the pre the compressive strength of concrete is one of the most important and useful properties of concrete. In most structural applications concrete is used primarily to resist compressive stress. The compression test was conducted on cube specimens cured for 7, 14 & 28 days. The test cubes were removed from the moist storage 24 hours before testing. The top and bottom bearing plates of the compression testing machine were wiped and cleaned before the placement of the specimen. After ensuring the connection between, the cube specimen was placed on the lower bearing plate keeping the center alignment by the screwed guides on the bearing plate.

Split tensile strength

The splitting tests are well known indirect tests used for determining the tensile strength of concrete sometimes referred to as split tensile strength of concrete. The test specimens shall consist of concrete cylinder of 150mm diameter and 300mm long. It consists of applying a compressive line load along a concrete cylinder placed with its axis horizontal between the compressive platens using compression testing machine. This test is conducted on specimens cured for 7, 14 and 28 days.

5. RESULT AND DISCUSSION

Workability

In the present study the workability tests were performed using standard sizes of Slump moulds as per IS: 1199 -1999 to find out the workability of the glass wool fiber reinforced concrete. It was noticed that mix was stiff with slum ranging from 20cm to no slump, for fiber glass wool percentages of 0.5% to 3% by weight, the workability is determined by slump value. Higher

percentages of Glass Wool fiber give no slump. At 3% fiber content balling has occurred and mix was not in a workable condition with a W/C ratio of 0.5.

Table- 1 Effect of glass wool on compressive strength

Mix	Compressive strength in N/mm2 when W/C ratio is 0.5			Workability of mix
M 25	7 Days mean	14 Days mean	28 Days mean	W/C ratio 0.5 (mm)
GWFRC 0.0%	28.55	29.27	31.48	32
GWFRC 0.5%	26.2	27.86	28.51	19
GWFRC 1%	27.8	29.98	34.8	15
GWFRC 1.5%	27.3	28.63	31.08	12
GWFRC 2%	25.8	27.66	28.47	8
GWFRC 2.5%	21.8	22.6	23.91	5
GWFRC 3%	19.3	20.8	24.80	0

Table- 2 Effect of glass wool on split tensile strength

Mix	Compressive strength in N/mm2 when W/C ratio is 0.5			Workability of mix
M 25	7 Days mean	14 Days mean	28 Days mean	W/C ratio 0.5 (mm)
GWFRC 0.0%	1.62	1.94	2.88	32
GWFRC 0.5%	1.88	2.26	3.26	19
GWFRC 1%	2.18	2.56	3.78	15
GWFRC 1.5%	1.92	2.68	3.54	12
GWFRC 2%	1.78	2.38	3.08	8
GWFRC 2.5%	1.76	2.48	2.84	5
GWFRC 3%	1.84	2.38	2.54	0

6. Conclusions

Based on the current experimental investigation conducted and the examination of test results, the following conclusions are drawn,

1. Higher percentages of Glass wool fibers greater than 1% affect the workability of concrete and strength, and may need the use of super plasticizers (workability agents) to maintain the workability.
2. It was observed that, the percentage increase in the strength of glass wool fiber reinforced concrete increases with the age of concrete. The maximum value of GWFRC is in 1%. It was observed that compressive strength of GWFRC was increased 10.54% that of conventional concrete at 1% of fiber content.

3. It was observed that flexure strength of GWFRC was increased 31.25% that of conventional concrete at 1% of fiber content.
4. It was observed that compressive strength of GWFRC had achieved the target strength of M25 concrete thus compressive strength parameter is satisfied.

7. REFERENCES

1. Indian standard Recommended guidelines for Concrete Mix Design, IS 10262: 1982, 5th Reprint 1998, Bureau of Indian Standards, New Delhi.
2. M S Shetty (1987, Concrete Technology Theory and Practices, Chand & Company, New Delhi.
3. IS: 10262-1982, Indian Standards – Concrete Mix Proportioning. IS 456:2000, Plain and Reinforced concrete -code of practice (Fourth Revision).
4. Murthy.I.Y, Sharda.A, Jain.G (2012) "Performance of Glass Fiber Reinforced Concrete" International Journal of Engineering and Innovative Technology, Volume-1, Issue-6, June 2012.
5. BIS 10269:1987,"Specification for 53 Grade Ordinary Portland Cement", Bureau of Indian Standard, New Delhi.
6. BIS 9103:1999, "Admixtures for Concrete", First Revision, Bureau of Indian Standard, New Delhi.
7. BIS 10262:1999' "Recommended Guidelines for Concrete Mix Design.