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Experimental Study of glass fibre reinforced concrete

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A B S T R A C T

Glass Fiber Reinforced Concrete (GFRC) is a material with a cementitious matrix made up of small aggregates, fine aggregate, steel reinforcement, cement, water, and additives in which glass fibers are dispersed. The advantages of GFRC include its strength, beauty, light weight, and durability. Glass Fiber Reinforced Concrete or (GFRC) is a composite material that uses fiberglass instead of steel bars for support. Rebar removal is not only poor, but also affects rebar erosion, corrosion, and future repair costs, rebar prices, approvals, etc. eliminates it. In this study, several areas were explored to identify and clarify the use of GFRC to compare its properties with other fibers

Keywords: Fiber Reinforcement, Glass Fiber, GFRC, Composite, Lightweight Concrete

1. Introduction of glass fiber

The following provides information on what GFRC is, how it functions, its properties, and how it is made, including blend strategies, casting methods, and finishing techniques. Glass-fiber reinforced concrete (GFRC) is a fabric made of a cementitious framework made of smaller measured coarse totals, fine totals, rebars, cement, water, and admixtures, in which glass strands are dispersed. GFRC shows numerous ideal characteristics such as being lightweight, tough, stylishly satisfying with satisfactory strength.
Glass fiber strengthened composite materials comprised of tall quality glass fiber implanted in a cementitious framework. In common strands are the foremost load-carrying individuals, whereas the encompassing framework keeps them within the craved areas and introduction, acting as a stack exchange medium between them, and secures them from natural damage."
GFRC is a type of concrete that uses alkali-resistant (AR) glass filaments along with fine sand, cement, polymer (typically an acrylic polymer), water, and other admixtures.

1.1. Properties of GFRC.

Tall ductile quality (1700N/mm2. Affect resistance. Water safe. Moo warm development. Less crawl with increment with time. Light weight. Resistance to breaks in concrete. Resistance to erosion. Progress homogeneity of new concrete. Progress solidness of structure.

1.2. Factors Effecting Properties of GFRC

- The amount of fiber.
- Fiber orientation.
- Workability.
- Compaction of concrete, Mixing.
- Size of coarse aggregate, W/C ratio.

1.3. How the Fiber Work

GFRC utilizes dissolvable base secure glass fibers as the rule tensile-load carrying portion. The polymer and concrete organize serve to tie the fibers together and trade loads from one fiber to another through shear stresses through the organize. Fiber back may be a common methodology to amplify the mechanical properties.
of materials. As indicated a few time as of late, fiberglass is perhaps the preeminent common and broadly recognized shape of fiber fortress. In organize to stand up to bendable loads (and in this way dodge the GFRC piece from breaking or part), there must be a satisfactory entirety of fiber show. Besides, the presentation of the fiber chooses how effective that fiber stands up to the stack. At final, the fiber must be strong and strong adequate to supply the crucial flexible quality. Glass strands have long been the fiber of choice due to their physical properties and their for the most part moo brought.

1.4 Application of GFRC

1. Decorative board board or cladding: Due to the light weight of the GFRC board, the fine workmanship gives adequate steadiness. Shipping costs are moreover diminished. GFRC boards too have great resistance to fire and extraordinary climate, in this way making them the leading material for outdoor utilize. In addition, GFRC could be a flexible fabric that gives simple plan, advertising a assortment of colors, surfaces, designs and finishes.
2. Jet and mash generation are the foremost broadly utilized generation methods.
3. Noise issues: GFRC is utilized as a commotion obstruction. The most reason for usually that the hypothetical esteem shows that a GFRC.
4. 3rd board with 10mm thickness and 20kg/m2 surface quality can accomplish clamor diminishment of up to 30dB.
5. The fabricating handle is the same as for the coating.
6. Reinforcement of columns with GFRC layers: Support of existing compression individuals to extend ductility. In expansion, quality can be expanded by covering the lines with glass fiber strengthened polymer windings. Splashing is the favored strategy of murdering. Subsequently, GFRC gives a comparative fabric that addresses numerous of the natural concerns related with concrete and its destitute quality in antagonistic conditions. All sorts of generation are utilized agreeing to the necessities of the site.
7. Exact Copies of Notable Buildings: GFRC's flexibility in colour, surface, design and surface wrap up makes it perfect for the remodel and rebuilding of memorable buildings and more seasoned buildings utilizing the same design.
8. Indoor utilize: GFRC is more recolor safe than rock and more scratch safe than marble. Kitchen countertops, commercial and mechanical countertops, etc. The premix strategy is best for these purposes.

1.5 Advantages and Disadvantages

Bending, tensile and impact strengths are higher than normal concrete due to the presence of glass fibers.

- No require for covering, lean it out. The softness of the strands minimizes the stack on the existing structure.
- Expanded resistance, such as GFRC, is more safe to chloride infiltration than steel.
- Does not rust or corrode.

Good acoustic products.

- Moo porousness for security against water or discuss contamination. It is recyclable and ecologically friendly.
- Since splashing is wiped out a well-completed development location, there's no hole and no deformity. A few impediments of GRC are:
- It is more costly than typical concrete.
- Glass fiber strengthened concrete may lose a few of its introductory quality within the long run and this should be taken under consideration amid design.
- Right now there are as it were many providers within the Indian showcase and less data on GFRC field application

2. Review of literature

Prof. M. B. Kumthekar (2013) studied "Reinforcement of RCC Cubes and Cylinders Using Different Glass Fibers". A great deal of research is now bei ng done around the world in the repair and reinforcement of reinforced concrete using fiber-polymer-wrapped laminates and panels.
The application of fiber-
reinforced polymers is an excellent way to repair and strengthen the structure that weakens the body during its work. The GFRC Restoration System pr ovides a commercially viable alternative to restoration methods and materials. Experimental data were obtained for loads, deflections, and failure mode s for each cube and cylinder. The detailed process and application of GFRC layers and their effects on the ultimate load capacity and failure of beams ar e studied.

Assoc.P. Srinivasan Rao (2012) reviewed "Performance Study of Glassfibre Reinforced Concrete". He conducted research on glass fiber reinforced con crete. M30, M40, M50 grade glass fiber concrete and ordinary concrete with good performance, acid resistance, sulfate and chloride penetration, alkali-resistant glass fiber. By adding alkali-resistant glass fibers to the concrete, the durability of the concrete is increased.
Clinical studies have shown that adding glass fiber to concrete can reduce bleeding. The addition of glass fiber has been shown to increase the resistanc e of concrete to acid attack.
Assoc. G. Jyothi Kumari (2013) "Behavior of Concrete Beams Reinforced with Glass Fiber Reinforced Polymer Slabs".
He studied the performance of concrete reinforced with glass fiber reinforced polymer plates. They also found that GFRC plates as shear reinforcement exhibited good ductility. Strength of composite, flat or rod depends on fiber orientation and fiber-to-
matrix ratio, higher fiber content, higher tensile strength.

1.7 Aims and objectives

Aim :- To analyses the glass fibre reinforced concrete.
Objectives :- • To perform Experimental Analysis on GFRC Material.

- To use different materials - cement, sand, aggregate, GF, plasticizers for experimental investigation.
- To obtain Compression test, Flexural test, workability test of GFRC material for various combinations.
- To check the strength deviations.

3. Methodology

2.1 Material –

Portland Puzolan Cement:- There are different grades of cement on the market. We are using the locally available 43 grade Portland pozzolan cement u sed for this project that has a specification of 3.15. It should be noted that we use low alkali cement or alkali resistant glass fibers to reduce the alkali co ntent in concrete.
Coarse aggregate: - Coarse aggregate in 20 mm and 10 mm sizes.
Fine Aggregate: - Sand is used as fine aggregate for gravity 2.86
Alkali Resistant Glass Fibers: - We use 12mm and 14 (micron) µm long Alkali Resistant Glass Fibers. We use 0.9kg/cum fiberglass in stone.
Additives: - use plastic 1.
3% by weight cement mix to shorten the setting time and impart plastic to the concrete.
Water: - Use local bottled water.

2.2 grade of concrete
We are using M25 grade of concrete for the whole project Design mix. GFR Concrete comparing with plane concrete mix**.**

4. Design mix

We are performing M25 design mix from RMC plant. Design mix content are mentioned below

Table 3.1 DESIGN MIX OF M25 (GLASS FIBRE MIX)

Ingredient	***Ssd kg/m3***	***Batch for trial mix(0.04m3)***
cement	***290***	***11.60***
Fly ash	***110***	***4.400***
Water	***160***	***7.542***
10mm	***391***	***15.426***
20mm	***649***	***25.602***
C sand	***885***	***34.830***
admixture	***1.3%***	
density	***2485***	
w/c ratio	***0.4***	

***We have added 0.9kg/cum GFRC manually. For trial 0.036kg/cum.**

4. Testing's

4.1 workability

The workability of concrete is characterized as the ease and homogeneity of crisply blended concrete or mortar to be blended, set, compacted and wrapped up.

Concrete Slump Test: - Concrete droop test measures the consistency of new concrete some time recently it sets. It is done to check the execution of the modern concrete and hence the ease of streaming of the concrete. It can too be utilized as an marker of erroneous combinations. This test is well known since of the straightforwardness of the gear and the straightforwardness of the procedure.

The droop test is utilized to guarantee the homogeneity of concrete beneath diverse loads beneath certain conditions. 34 A partitioned test called the stream test or droop test is utilized for rocks that contain as well much water to be measured employing a droop test, as the cone will not hold its shape when uncovered.

Figure 4.1 workability of concrete

4.2 Flexural Strength of GFRC

The bending test indirectly evaluates the tensile strength of concrete. Evaluates the resistance of a weak concrete structure or slab to bending failure. The results of the flexural test of concrete are presented as the fracture standard expressed in MPa or psi. Bending tests on concrete can be performed using a three-point load test or a centre load test.

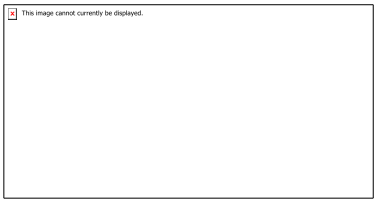

figure 4.2 Flexural Test on Concrete

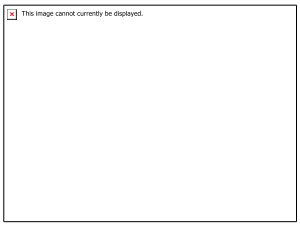

Figure 4.3 Centre Point Load Test

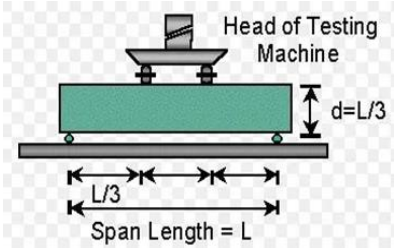

Figure 4.4 Three-Point Load Test

4.3. compressive strength test

Compressive Strength Test - To test the cube, use two types of specimens, 15cm X 15cm X 15cm or 10cm X 10cm x 10cm cube, depending on the size of the aggregate. Usually a mold measuring 15cm x 15cm x 15cm is used.

Figure 4.4 Compression Testing Machine

4.4 results of tests

Workability: - Slump test was performed in accordance with IS 1199: 2018. Sampling was done initially after completion of first trial in which quantity of Glass fiber was 0.5%.

Table 4.1 M25 with glass fiber concrete

SR. NO.	M25 GLASS FIBER	SLUMP (mm)
1	0.5%	200
2	1%	190
3	2%	170
4	3%	165

Compressive strength: - After successful trial, we are cast cubes having 150mm x 150mm x 150mm size of cube moulds. Cubes are cured in curing tank for 7days and 28 days for performing compressive strength.

Table 4.2 Compressive test on glass fibre concrete

SR. NO.	M25 GLASS FIBER CUBE	COMPRESSIVE STRENGTH (N/mm^2) (7 DAYS)	COMPRESSIVE STRENGTH (N/mm^2) (28 DAYS)
1	CUBE ID-1	18.85	31.25
2	CUBE ID-2	20.05	30.42
3	CUBE ID-3	21.25	30.92

Flexural Strength of Concrete: - The flexural test indirectly evaluates the tensile strength of concrete. Evaluates the ability of unreinforced concrete beams and slabs to resist bending fracture. We do three load points for flexural testing of free concrete and GFRC concrete.

Table 4.3 Flexural test on glass fiber concrete

SR. NO	M25 GLASS FIBER CUBE	FLEXURAL STRENGTH (N/mm^2) (7 DAYS	FLEXURAL STRENGTH (N/mm^2) (28 DAYS)
1	CUBE ID-1	2.60	3.50
2	CUBE ID-2	2.40	3.42
3	CUBE ID-3	2.30	3.35

5. Conclusion

Fibers bridge cracks to prevent deformation.

The addition of fibers increases the ductility and load-bearing capacity of concrete after cracking.

Like most composite materials, GFRC properties depend on the quality of the material and the accuracy of the manufacturing process.
Fiberglass can be added to cementitious materials to increase their breaking strength.

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