

Fibre Reinforced Concrete Using Glass Wool

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ABSTRACT: To increase the compressive strength and tensile strength in concrete we use natural or synthetic fibres . 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 fibres 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% , 6% to the weight of cement. The grade of concrete used for investigation is M20

KEYWORDS: *Glass wool , Waste from refrigerators , synthetic fibres.*

I. INTRODUCTION

Construction is a process that consists of the building or assembly of infrastructure. The common construction used widely is cement concrete. Cement is the second largest material which is produced in world. Fibre reinforced concrete(FRC) is one of the special concrete which is used widely in constructing flexural members . It is a type of concrete to which various fibres of very small diameter and length are added to conventional concrete to increase tensile strength , resilience , flexibility. Fibres are of two types synthetic and non synthetic. In this project glass wool is used as a fibre to produce Fibre Reinforced Concrete under site conditions. We have produced glass wool FRC by adding wool of 4% , 5% , 6% to the weight of cement. The grade of concrete used for investigation is M20

II. NEED FOR STUDY

A beam – column joint becomes structurally less efficient when subjected to large lateral loads , such as a strong wind , earth quake or explosion. Since a greater potential is required in the beam – column joint and also to meet construction difficulties without changing the properties , the fibres have been included for strength , stiffness and ductility.

III. MATERIALS USED

The compositions of the glass wool reinforced concrete consists of two components. The concrete matrix component consisting of cement, aggregate & water and fibre component consisting of glass wool fibres added to the concrete matrix.

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 3.15 and the fineness was 3200 cm² /gm.

B. Coarse Aggregate

Crushed stone metal with a maximum size of 20mm and minimum size of 12mm from a local source conforming to IS: 383-1970 was used. The specific gravity was found to be 2.7.

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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 2.6 and 2.63.

D. Glass wool

Glass Wool is manufactured by the fusion of a mixture of natural sand and recycled glass at 1450 °C, the glass that is produced is converted into fibres. In the present study the amount of fibre to be added in a concrete mix is measured as a percentage of the total weight of the concrete.



Fig 1

The fibres with the modulus of elasticity of 55 GPa, specific gravity 2.68 aspect ratio of 125 is used. Fig 1 is a photocopy of glass wool used to produce FRC

IV. MIX COMPOSITION

The experimental investigation was carried out to study the properties of M20 grade concrete. The mix was designed as per IS 10262-1984. To study the effect of glass wool fibres on the strength of concrete the % of fibres is varied from 4% , 5% and 6% by total weight of concrete. The Table I shows the quantity of materials obtained based on the design mix.



Fig 2

Fig 2 shows the materials batched for concrete

TABLE I

S.no	Materials	Quantities per cubic meter of concrete (kg)
1.	Cement	383
2.	Fine aggregate	727
3.	Coarse aggregate	1103
4.	Glass wool for 4%	15.32
5.	Glass wool for 5%	19.15
6.	Glass wool for 6%	22.98
7.	Water cement ratio	0.5

V. METHODOLOGY

The Glass wool fibre reinforced concrete is prepared and investigate by traditional method of preparing conventional concrete.

A. Workability

In the present study the workability tests were performed using standard sizes of Slump moulds as per IS: 1199 -1999 to determine the workability of the glass wool fibre reinforced concrete. It was noticed that mix was stiff with slum ranging from 5cm to no slump.

B. Consistency

In the present study the consistency tests were performed using Vee bee consist meter to determine the consistency of concrete. The consistency of the glass wool fibre reinforced concrete was found in a rage from 6 sec to 7 sec.

C. Manufacture of glass wool reinforced concrete



Fig 3

In the present study the glass wool reinforced concrete is manufactured in traditional method .The materials were batched by weight and mixed using mechanical mixers . Water was added gradually so that concrete attains its plasticity. The concrete is again mixed with trowels before placing in moulds. Fig 3 shows glass wool reinforced concrete being mixed using mechanical mixer.

D. 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 and 12 prisms of size 100mm X 100mm X 500mm for flexure strength were prepared for conventional and different percentages of glass wool fibres.



Fig 4

The specimens without fibres are considered as control specimens & with fibre are considered as glass wool fibre reinforced concrete. All the specimens were cured and tested for 7, 14 & 28 days. The Fig.4 shows the some of the specimens casted.

E. 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.



Fig 5

The load was applied until the concrete specimens failed and the ultimate load was noted. Fig 5 shows compressive strength test done on concrete cube.

F. 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.



Fig 6

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. Fig 6 shows split tensile test done on concrete cylindrical specimen.

G. Flexure strength

The determination of flexure strength is essential to estimate the load at which the concrete member may crack . As it is difficult to determine the tensile strength of concrete by conducting a direct tension test , it is computed by flexure testing.



Fig 7

Flexure strength test is conducted after a period of 7 days , 14 days , 28 days from the day of casting. Fig 7 shows flexure strength test done on concrete prism specimen.

VI. RESULT AND DISCUSSION

A. Effect of glass wool on workability

For fibre glass wool percentages of 4% , 5% , 6% by weight, the workability is determined by slump value. Higher percentages of fibre showed no slump. At 5% fiber content balling has occurred and mix was not in a workable condition with a W/C ratio of 0.5.

B. Effect of glass wool on compressive strength

For fibre glass wool percentages of 4% , 5% , 6% by weight, the compressive strength is determined by compression test and table II shows result obtained from compression strength test .

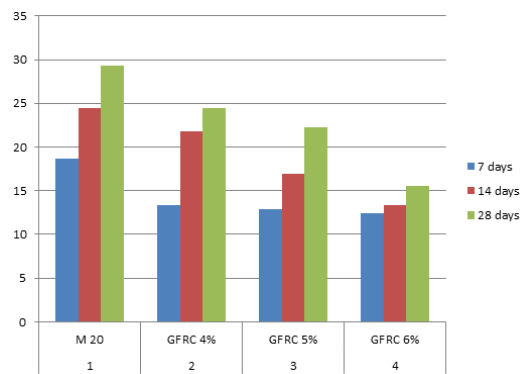
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TABLE III

Mix	Compressive strength in N/mm ²		
	7 Days	14 Days	28 Days
M 20	18.66	24.44	29.33
GFR C 4%	13.33	21.77	24.44
GFR C5%	12.88	16.88	22.22
GFR C6%	12.44	13.33	15.55

Even though compressive strength of glass wool fibre reinforced concrete was not increased, the target strength of conventional concrete was achieved. It was observed that, the formation of cracks is more in the specimens without glass wool fibres, whereas it is minimum in the specimens with fibre. It shows that the presence of fibres in the concrete act as the crack arrestors.



Graph 1

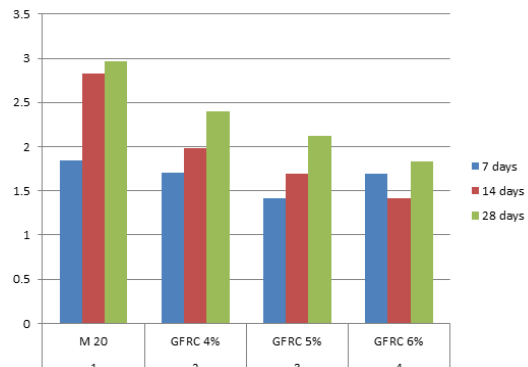
Graph 1 shows the bar chart representation of compressive strength vs % of glass wool fibre

C. Effect of glass wool on split tensile strength

For fibre glass wool percentages of 4% , 5% , 6% by weight, the split tensile strength is determined by split tensile test and table III shows result obtained from split tensile strength test .

TABLE IIIII

Mix	Split tensile strength in N/mm ²		
	7 Days	14 Days	28 Days
M 20	1.84	2.83	2.97
GFR C 4%	1.7	1.98	2.4
GFR C5%	1.41	1.69	2.12
GFR C6%	1.69	1.41	1.83



Graph 2

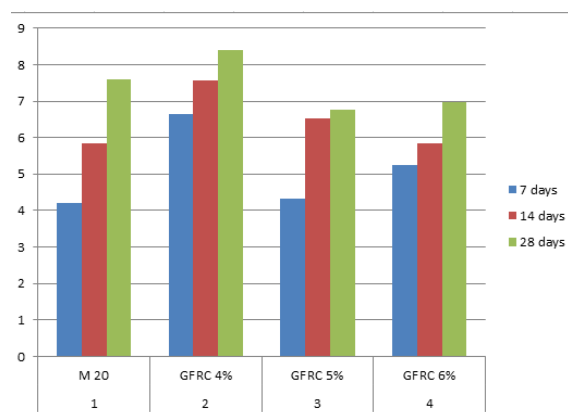
Graph 2 shows the bar chart representation of split tensile strength vs % of glass wool fibre

D. Effect of glass wool on flexure strength

For fibre glass wool percentages of 4% , 5% , 6% by weight , the flexure strength is determined by flexure strength test and table IV shows result obtained from flexure strength test .

TABLE IV

Mix	Flexure strength in N/mm ²		
	7 Days	14 Days	28 Days
M 20	4.2	5.85	7.6
GFR C 4%	6.63	7.56	8.4
GFR C5%	4.32	6.53	6.75
GFR C6%	5.25	5.85	6.97



Graph 3

Graph 3 shows the bar chart representation of flexure strength vs % of glass wool fibre.

VII. CONCLUSION

Based on the present experimental investigation conducted and the analysis of test results, the following conclusions are drawn.

- Higher percentages of Glass wool fibers greater than 4% affect the workability of concrete, and may require the use of super plasticizers (workability agents) to maintain the workability.
- It was observed that, the percentage increase in the strength of glass wool fiber reinforced concrete increases with the age of concrete.
- It was observed that flexure strength of glass wool FRC was increased 10.52% that of conventional concrete at 4% of fibre content
- It was observed that compressive strength of glass wool FRC had achieved the target strength of M20 concrete thus compressive strength parameter is satisfied

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