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# Experimental Analysis of Glass Fibre Reinforced Concrete Composite

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***Abstract*— All nations are concentrating on supportable innovation that can be spared and embraced for the utilization of cement betterly. Concrete is most generally utilized building material and it has low tensile strength, low shear strength and brittle characteristics. Keeping in mind the end goal to enhance these properties a generally new development material created through broad, innovative work called Fibre Reinforced Concrete (FRC). An endeavor has been done to examine the effect of adding of glass fibre in normal Portland cement concrete at their ideal extent. To determine the properties of the concrete, compressive strength test was done at a different test age like 7, 14 and 28 days. M 30 grade concrete was designed as per IS 10262-2009. The additions of fibre were varying from 0.33%, 0.66%, 1.0%, 1.33%, 1.66% and 2.0% by volume of concrete for GFRC the maximum compressive strength of GFRC is obtained at 0.33% and 0.66% addition of fibre respectively. Test outcomes display that the compressive strength of GFRC marginally improved.**

***Keywords*— Glass fibre reinforcement, fibre reinforced concrete, Compressive strength***

## I. INTRODUCTION

Cement is one of the world's most for the most part used building material and it is described as a private blend of binding material, fine aggregate, coarse aggregate and water. Concrete has a few attractive mechanical properties like stiffness, durability and high compressive quality, however in the meantime, cement is feeble in tension and has brittle characteristics. This shortcoming of the Concrete makes it to split under little loads. These splits continuously engender to the compression end of the member and increments in size and magnitude as the time slips by lastly makes the concrete to come up short.

To increase the tensile strength of concrete many endeavors have been made, one of the effective and most regularly utilized ways is giving steel reinforcement. Steel bars, however, strengthen concrete against local tension only. Cracks in strengthening concrete develop unreservedly until experiencing the bar. Therefore, the requirement for multidirectional and firmly divided steel support emerges there, that can't be for all intents and purposes conceivable. Fiber support is one of the ways, which gives the answer for this sort of issue.

## II. OBJECTIVES AND SCOPE OF STUDY

The aim of this experimental program is to develop high strength Fibre Reinforced Concrete containing AR Glass Fibre on strength parameter of concrete. The detailed objectives of this study are as follows:

a. Conduct the experimental investigation to study the effect of volume fraction on mechanical properties.

b. To determine the optimum percent of AR Glass Fibre to determine the maximum compressive strength.

c. To acquire a relative review on the quality of concrete with addition of AR Glass Fiber at their ideal extents.

Several scopes should be concerned for the determination of properties of concrete at hardened state with additions of fibres through the following tests to analyse the effect of fibres reinforcement on the compressive strength of the concrete.

## III. EXPERIMENTAL METHODOLOGY

To attain the objects of this research an experimental program was conducted to study the properties of FRC in the hardened state. The blend configuration was done for M 30 Grade of concrete as per the rules given by IS 10262:2009. The adding of glass fiber was finished by volume of concrete with fluctuating percent like 0%, 0.33%, 0.66%, 1.0%, 1.33%, 1.66% and 2.0%. Utilizing these fibers the concrete mixes, the test examples were cast, cured and tested. To decide the properties of solidified state properties like compressive strength test was resolved at various test age with the end goal that at 7 days, 14 days and 28 days. The aftereffects of the controlled concrete, GFRC, were contrasted with evaluating the beneficial effects of fiber fortified on concrete.

## IV. EXPERIMENTAL INVESTIGATION

In this experimental program, the aim is to compare the basic properties of control concrete such as compressive strength and at 7 days, 14 days, and 28 days with the properties of concrete made using Glass fibre at every percent of fibre content. For this, the experimental program is divided into seven groups as described below.

The 1st group is the control concrete with 0% of glass fibre, 2nd group consists of 0.33% of glass fibre by volume of concrete, 3rd group consists of 0.66% of glass fibre by volume of concrete, 4th group consists of 1.00% of glass fibre by volume of concrete, 5th group consists of 1.33% of glass fibre by volume of concrete, 6th group consists of 1.66% of glass fibre by volume of concrete, And the 7th group consists of 2.00% of glass fibre by volume of concrete.

The mix design was carried out for M-30 Grade of concrete conferring to the guidelines provided by IS: 10262-2009 “Code of Concrete Mix proportioning” and IS: 456-2000 “Code of practice for Plain and Reinforced Concrete’’.

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Table-1 Mix Proportions for M 30 grade Concrete

| Sl. No. | Materials | Quantity ($kg/m^3$) | Proportions |
|---|---|---|---|
| 1 | Cement | 398.7013 | 1 |
| 2 | Water | 179.4156 | 0.45 |
| 3 | Fine Aggregate | 670.029 | 1.6805 |
| 4 | Coarse Aggregate | 1175.2471 | 2.9476 |
| 5 | Super-plasticizer | 3.987 | 0.01 |

Table-2. As per Indian Standard code the size of cubes and beams used during this experiments are given

| Sl. No. | Type of Strength Test | Relevant IS Code | Specimen Details |
|---|---|---|---|
| 1 | Compressive Strength | IS 516-1959 | 150×150×150 mm Cube |
| 2 | Flexural Strength | IS 516-1959 | 700×150×150 mm Beam |

## V. COMPRESSIVE STRENGTH TEST

The Compressive quality of a concrete is a measure of its capacity to oppose static load, which tends to crush it. The compressive quality gives a decent and a clear sign that how the quality of the FRC is influenced by the increase of fiber substance in the test examples. The cubic specimens were taken out from curing tank at the age of 7, 14 and 28 days. The surface water was wiped off with dry cloth also the bearing surface of the machine should be cleaned and there should not be any loose sand or other materials. Before placing the test specimens on the bearing surface of machine each cubic specimens were weighed on electronic balance to know its weight. The cubic specimen were put in between plates of compression testing machine in such a way, that the load should be applied on the opposite sides of the cube as cast and not to the top and base to get parallel forces. The heap was connected with no stuns and expanded progressively at the rate of 140 kg/cm2/min until the resistance of the examples to the expanding load separates and further no heap maintained. The greatest load managed by the specimen was recorded. Three cubes from each batch were tried to decide the normal compressive strength. The deliberate compressive strength were ascertained by dividing the extreme load applied to the specimen by the cross-sectional area as given under.

$$f_c = \frac{P}{A}$$

fc = Compressive strength of concrete (MPa)
P = Maximum load applied to the specimen (N)
A = Cross sectional area of the cubic specimen (mm2)

## VI. COMPRESSIVE STRENGTH TEST RESULTS

The property like Compressive Strength at the hardened state of GFRC at the age of 7, 14 and 28 days evaluated by using automatic compressive strength testing machine by applying the load at the side faces of cube as they were cast in the mould. Three cubes for each percent at different test age have tested to determine the average compressive strength for GRFC.

### *A. Compressive strength test results at age of 7 days*

Table-3 Compressive Strength Test Results of GFRC at Age of 7 days

| Sl. No. | (%) Adding of Glass Fibre by Volume of Concrete | Average Compressive Strength at 7 days (MPa) |
|---|---|---|
| 1 | 0.00 | 27.78 |
| 2 | 0.33 | 28.72 |
| 3 | 0.66 | 30.96 |
| 4 | 1.00 | 29.63 |
| 5 | 1.33 | 27.12 |
| 6 | 1.66 | 25.85 |
| 7 | 2.00 | 22.95 |

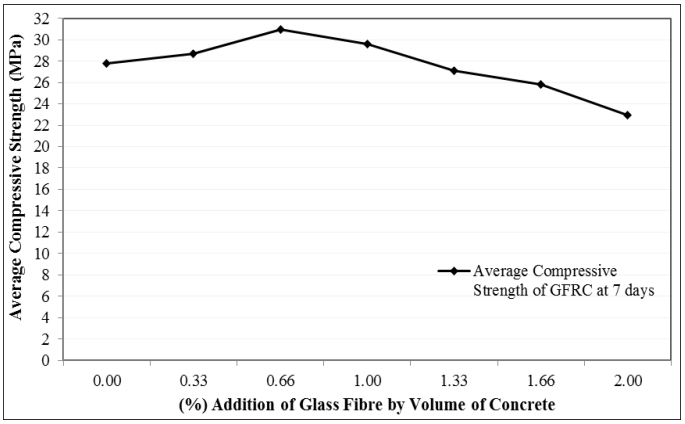


Figure-1. Variation of Compressive Strength for GFRC at Age of 7 days

Table-3, shows the results of compressive strength of GFRC at the age of 7 days. The above given graph shown in Figure- is plotted from the compression strength test results obtained during testing of GFRC at 7 days. It has found that compressive strength of GFRC at 7 days have increased by 3.38%, 11.45% and 6.66% with addition of 0.33%, 0.66% and 1.00% of Glass fibre respectively by volume of concrete as compared to normal M-30 grade concrete. Further addition of glass fibre like 1.33%, 1.66% and 2.00%, reduced the compressive strength of GFRC by 2.38%, 6.95%, and 17.39% respectively.

### *B. Compressive Strength Test Results at Age of 14 days*

Similarly the Compressive Strength at hardened state of GFRC, at the age of 14 days have also evaluated by using automatic compressive strength testing machine by applying the load at the side faces of cube as they were cast in the mould. The test results and variations of compressive strength of GFRC are shown in following tables and figures.

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Table-4. Compressive Strength Test Results of GFRC at Age of 14 days

| Sl. No. | (%) Addition of Glass Fibre by Volume of Concrete | Average Compressive Strength at 14 days (MPa) |
|---|---|---|
| 1 | 0.00 | 31.07 |
| 2 | 0.33 | 31.86 |
| 3 | 0.66 | 33.58 |
| 4 | 1.00 | 32.89 |
| 5 | 1.33 | 29.56 |
| 6 | 1.66 | 27.55 |
| 7 | 2.00 | 23.85 |

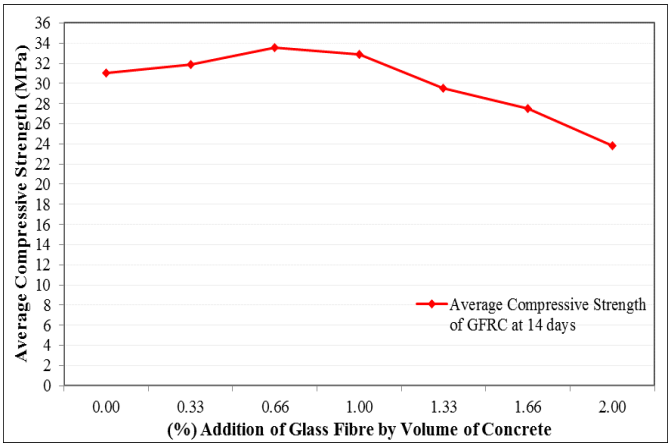


Figure-2. Variation of Compressive Strength for GFRC at Age of 14 days

Table shows the results of compressive strength of GFRC at the age of 14 days. The above given graph shown in Figure-4.9 represents the variation of compressive strength test results obtained during testing of GFRC at 14 days. From the results and analysis it has found that compressive strength of GFRC at 14 days have increased by 2.55%, 8.08% and 5.86% with addition of 0.33%, 0.66% and 1.00% of Glass fibre respectively by volume of concrete as compared to normal M-30 grade concrete. Further addition of glass fibre like 1.33%, 1.66% and 2.00%, decreased the compressive strength of GFRC by 4.86%, 11.33%, and 23.24% respectively.

C. *Compressive Strength Test Results at Age of 28 days*

Similarly the Compressive Strength at hardened state of GFRC, at the age of 28 days have also evaluated by using automatic compressive strength testing machine by applying the load at the side faces of cube as they were cast in the mould. The test results and variations of compressive strength of GFRC are shown in following tables and figures.

Table-5. Compressive Strength Test Results of GFRC at Age of 28 days

| Sl. No. | (%) Addition of Glass Fibre by Volume of Concrete | Average Compressive Strength at 28 days (MPa) |
|---|---|---|
| 1 | 0.00 | 38.46 |
| 2 | 0.33 | 39.63 |
| 3 | 0.66 | 41.26 |
| 4 | 1.00 | 39.85 |
| 5 | 1.33 | 37.04 |
| 6 | 1.66 | 34.89 |
| 7 | 2.00 | 31.78 |

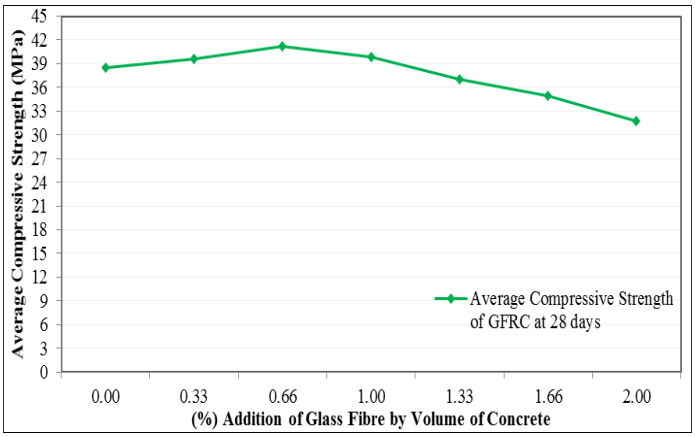


Figure-3. Variation of Compressive Strength for GFRC at Age of 28 days

The below given graph shown in Figure-4.17, Figure-4.18 and Figure-4 represents the variation of compressive strength test results obtained after testing at 7 days, 14 days and 28 days of GFRC, AFRC and HyFRC respectively. Very important facts have seen that in 7 days there is 65 to 73% increase in strength with respect to 28 days strength. This uniformity of increase in strength between 7 and 28 days was found in all type of concrete, prepared during an experiment.

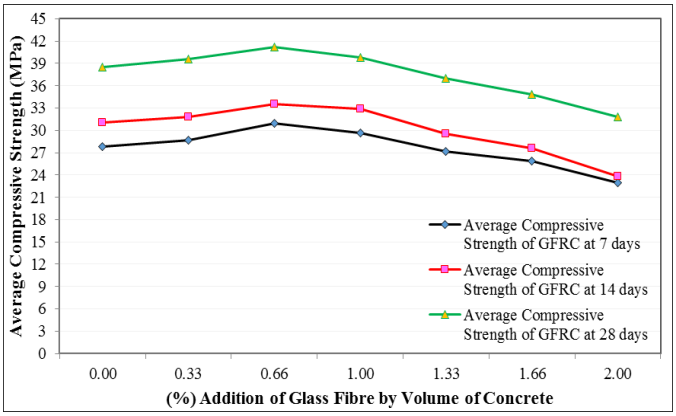


Figure-4. Variation of Compressive Strength of GFRC at Different Test Age

From the results of compressive strength of GFRC at 7, 14 and 28 days of testing it has observed that from 0.33% to 0.66% addition of glass fibre, increased the compressive strength at any age, however beyond 0.66% up to 2.0% addition, decreased the compressive strength of GFRC. The maximum compressive strength is obtained at 0.66% addition of glass fibre as 41.26 MPa at 28 days.

## VII. CONCLUSIONS

In view of the present trial contemplates directed and the investigation of test outcomes the accompanying conclusions are drawn:

Compressive strength of GFRC at first increments with the addition of fiber. Further addition of fiber past a specific percent, diminishes the compressive strength.

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If there should arise an occurrence of GFRC the 0.66% addition of glass fiber, by volume can be taken as the ideal percent for compressive strength, which can be utilized for giving greatest conceivable compressive quality at any age for Glass Fiber Reinforced Concrete.

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