



USAGE OF GLASS FIBER REBAR AS A RETROFITTING MATERIAL IN CONCRETE STRUCTURES

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Abstract Retrofitting Glass fiber rebar is a high Value-added development in construction. The super foundation suppliers, for example, Government and government subsidized, Now have recognized the way that Glass fiber rebar is a practical development material that has the maximum capacity to increase the life of public structures where erosion can have an immense monetary and natural effect. With the ascent of erosion because of a worldwide temperature alteration, the structures get weakening dissimilar to surrenders, may not surface toward the start of the administration life of a structure, however are somewhat time-reliant therefore harm of structure happens. Retrofitting is any change made to a current structure to lessen or reduce the chance of harm to that structure from flooding, disintegration, high breezes, quakes. Fiber glass support material has picked up significant popularity. In future, these serious composite materials would show their qualities and properties all the more evidently.

In the current investigation compressive strength and flexural strength of M25 grade is resolved at first the retrofitting is made for a similar beams with the Glass fiber rebar the compressive strength is estimated again and the examination made with M30 grade retrofitted bar part.

Key words: Retrofitting, Glass fiber rebar, compressive strength, flexural strength

I. INTRODUCTION

Now a day's many existing buildings are not meeting the seismic strength requirements due to material adequacy and material degradation over time or alternative is carried out during the service of the building, due to these reasons the strength of the building decreases. The safety of the building is important concern especially because the loss of most lives during the collapse of building, before attempting any repair procedure, it is important to choose proper planned approach to investigate the condition of the building. Retrofitting is one of the advanced method for increasing the strength of the concrete members it is the process of strengthening the structure with standard code provisions. With the help of retrofitting strength of the concrete increases. The retrofitting method is applied for the building if the cost of the repair and strengthening of building is less than 50% of construction cost.

FRP rebar is picking up business esteem mostly in light of the fact that it is impervious to destructive specialists and doesn't allow cement to rust or debilitate. GFRP or glass fiber strengthened polymer rebar is a variation of FRP. Progressed composite materials like FRP was embraced by US and Canada for underlying applications in the last part of the 1990s. Touchy solid structures like seawalls, dams, and force plants must be strengthened with consumption safe rebar. Fiberglass fortification material, in this manner, is viewed as the ideal item for delicate solid frameworks. The composite material was first created during the 1960s. Fiberglass fortified polymer (FRP) was financially perceived during the 1980s when it was utilized in rapid trains venture by Japan.

FRP rebar is gaining commercial value mainly because it is resistant to corrosive agents and does not let concrete rust or weaken. GFRP or glass fiber reinforced polymer rebar is a variant of FRP. Advanced composite materials like FRP was adopted by US and Canada for structural applications in the late 1990s. Sensitive concrete structures like seawalls, dams, and power plants have to be reinforced with corrosion-resistant rebar. Fiberglass reinforcement material, therefore, is considered to be the ideal product for sensitive concrete infrastructures. The composite material was first produced in the 1960s.

II. MATERIALS USED

2.1 Cement

Cement is one of the most important material which is having more binding properties in concrete making process. For the current study an OPC cement of 53 grade is used which is shown in the below figure 1.



Figure 1: OPC 53 Grade cement

2.2 Fine aggregates

The fine sand which is passing through 4.75mm IS sieve are used for the present project which are helps to reduce the voids in concrete mix the fine aggregates are shown in below figure 2.



Figure 2: Fine aggregates (Sand)

2.3 Coarse aggregates

The coarse aggregates which is retained on 4.75mm IS sieve are used for the present project which are shown in below figure 3. The materials properties are determined as per IS: 383-1970 code.



Figure 3: Coarse aggregates

2.4 Steel Bars

Steel is alloy of iron and carbon, and sometimes other elements because of its high tensile strength and low cost, it is major component used in building construction. For this study 12mm Fe450 grade HYSD bars are used as the reinforcement of beams the bars are shown in below figure 4.

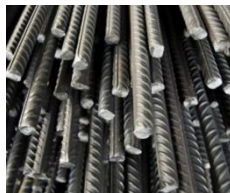


Figure 4: 12mm HYSD steel bars

2.5 Glass fiber reinforced polymer rebars

Glass fiber strengthened (GFRP) rebar can supplant steel rebars in solid structures. The glass fiber strengthened rebars are created with pultrusion in a nonstop cycle. Strands utilized are top notch glass, gum from polyester or vinyl ester with a normal fiber substance of 75%. Glass fiber rebar of 12mm width is appeared in figure 5.



Figure 5: Glass fiber rebar of 12mm diameter

III. METHODOLOGY

3.1 Testing the existing structure strength

The existing beam member was selected initially in order to determine the compressive strength and flexural strength of existing member. The beam member consisting of 4 bars of 12mm and stirrups of 8nos in 700mm length. The existing beam is related to M25 grade concrete mix. the results are shown in the below table 1

Table 1: compressive strength and flexural strength of existing beam member

| S.No | Concrete Grade | Compressive strength of beam in MPa | Flexural strength of beam in MPa | Compressive strength by rebar hammer test |
|------|----------------|-------------------------------------|----------------------------------|---|
| 1 | 25 | 28 | 3.45 | 27 |

From the above table it was observed that compressive strength of concrete is 28MPa and flexural strength of concrete is 3.45MPa the values of strength are less as we compare with characteristic strength of concrete. The improvement of strength of concrete is needed for the existing members.

3.2 Retrofitting of existing beam

For the retrofitting process Glass fiber reinforced (GFR) rebars are used as the reinforcement which is same as the steel bars reinforcement. The grade of concrete for existing beam is used as M25 and M30 grade.

3.3 Compressive strength of concrete

The compressive strength of concrete beam is measured at 14 days and 28 days curing for M25 and M30 grade concrete by using steel bars and glass fiber reinforced bars the comparison of strength values are done for normal beam and retrofitted beam.

3.4 Flexural strength of concrete

The flexural strength of concrete beam is measured at 14 days and 28 days curing for M25 and M30 grade concrete by using steel bars and glass fiber reinforced bars this test has same procedure like compressive strength testing

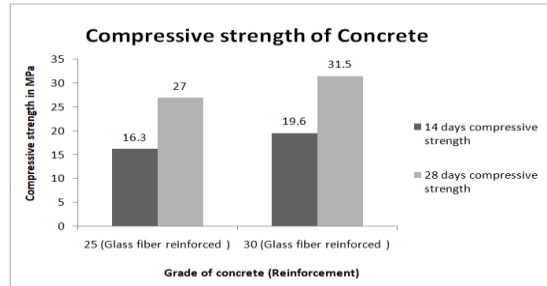
3.5 Rebound hammer test

Rebound hammer test is used to determine the compressive strength of concrete as per IS: 13311 (Part 2). For the present project compressive strength is determined for normal beam and retrofitted beams in M25 and M30 grade concrete mix.

IV. RESULTS AND ANALYSIS

4.1 Compressive strength

Compressive strength of beam is measured for M25 and M30 grade concrete by using reinforcement bars as steel and glass fibers the comparison is shown in below graph.

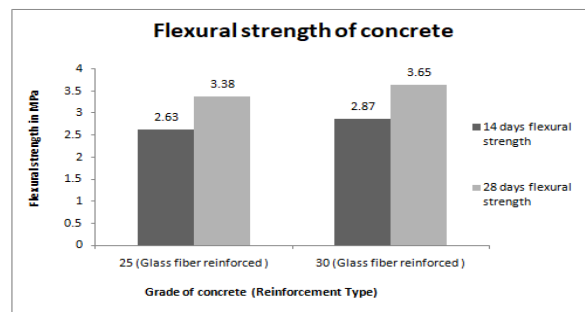


Graph 1: Comparison of Compressive strength of concrete

From the above graph it was observed that the value of compressive strength is almost same for M25 grade Steel and Glass fiber reinforced retrofitting case. It is also observed that by using M30 grade mix for retrofitting the value of compressive strength increases. For M25 grade concrete the compressive strength increased by 7.4% by using glass fiber re bars. In case of M30 grade concrete mix the strength increased by 5%.

4.2 Flexural strength

Flexural strength of the concrete is measured for 14 days and 28 days curing days for M25 and M30 grade concrete mix the results are shown in below graph

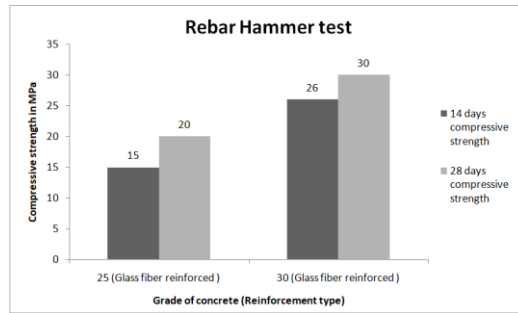


Graph 2: Comparison of flexural strength of concrete

From the above graph it was observed that the value of flexural is same for M25 grade by using steel bars and steel fiber reinforcement bars by increasing the grade to M30 grade. For M25 grade concrete the flexural strength increased by 3.84% by using glass fiber re bars. In case of M30 grade concrete mix the flexural strength increased by 2.53%.

4.3 Rebound hammer test

The compressive strength of concrete is measured with rebar hammer at 14 days and 28 days curing. The comparison of rebound hammer value graph is shown in below graph



Graph 3: Comparison of Rebar hammer test

The above graph shows the compressive strength of concrete for 14 days and 28 days curing by using rebar hammer test it has equal values in M25 grade mix, the strength will be increases in case of M30 grade concrete mix. For M25 grade concrete the compressive strength increased by 25% by using glass fiber re bars in rebound hammer test . In case of M30 grade concrete mix the compressive strength increased by 0%.

V. CONCLUSIONS

1. GFRP strengthening bar has higher rigidity and higher erosion obstruction than steel rebar also, moderate flexural strength, these properties make GFRP is acceptable option of steel in establishments application.
2. Retrofitting is the process of increase in the strength of concrete by using extra reinforcement for existing building structural element.
3. The constituents of GFRP incorporate great erosion safe vinyl ester tar that expands the life expectancy of a solid structure.
4. GFRP rebar is non-conductive to power and warmth settling on it an ideal decision for offices like force age plants and logical establishments. The compressive strength and flexure strength is obtained almost same values for M25 grade concrete with steel bars and glass fiber reinforced bars.
5. The strength values of glass fiber reinforced bars increases in case of M30 grade concrete by using glass fiber reinforced bars mix than M25 grade concrete mix.
6. The compressive strength of concrete which is measured by using rebar hammer is also has same values almost which are determined for concrete beams.

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