

Study of Conventional Material of Construction in Automobile

Nikhil Avhad¹, Sumeet Avhad², Onkar Belose³, Vighnesh Berde⁴

^{1,3,4}Department of Civil Engineering, Mumbai University, Maharashtra-48

²Department of Information Technology, ABC University, USA

Abstract — The evolution of the composite material has replaced most of the conventional material of construction in automobile, aviation industry etc. Fiber reinforced composites have been widely used in hundreds of applications where there was a need for high strength materials. There are thousands of customs formulations which offer GFRP a wide variety of tensile strengths and flexural strengths. When compared with traditional materials such as metals, the combination of high strength and lower weight has made GFRP an extremely popular choice for improving a product's design and performance.

Keywords— GFRP, Fiber, Reinforced, Flexural, Tensile.

I. INTRODUCTION

1.1 General

The traditional strengthened concrete members such as beams are composed of concrete included Portland cement and steel rebar reinforcement. The function of concrete in these beams is the resistance to compressive loads. The tensile and shear loads will be resisted by steel rebar embedded in the concrete. Such structure is efficient where the concrete inseparable resistance to compressive loads, while the steel enhances tensile and partially shear strengths. However, the problem of corrosion associated with the steel re- bars reduced its live time and the solutions such as the coating of the steel rebar are costly. Recent technologies have resulted in alternative reinforcing materials such as GFRP materials commercially available in the form of bars or sheets that can be bonded in concrete members to fulfill several desired properties. The most important is that the corrosion resistance feature of the polymer and the elongated strain to failure that give enough time to alert before failure takes place.

1.2 History of GFRP Rebar

A few years back, Saudi Aramco collaborated with King Fahd University of Petroleum and Minerals, and King Saud University, on separate projects to evaluate the performance and durability of FRP rebar and FRP sheets under the typical local environmental conditions specifically considering exposure to alkaline solutions (i.e., seawater and subkha) acidic solutions thermal variation, the outdoors, and fire. The results of these studies confirmed the excellent potential for the use of these materials on new construction and for the strengthening or repair of existing structures.

1.3 Importance and Need for Study

It is obvious that only limited studies have been carried out on GFRP reinforced beams with different grades of concrete and tension reinforcement.

Therefore, it is worth having a deep understanding through laboratory works on flexural behavior of beams internally reinforced with GFRP bar was understood by conducting experiments on beams with different tension reinforcement ratios and grades of concrete.

1.4 Contribution of the paper

As per the study conducted the following advantages of the GFRP bars over the steel bars have been found out which are as follows

- As compared with the traditional reinforcement material, GFRP rebar is ¼ the weight of steel with 2x the tensile strength of steel.

- GFRP rebar is non-conductive to electricity and heat making it an ideal choice for facilities like power generation plants and scientific installations.
- It is invulnerable to chloride ions and other chemical elements.

II. AIMS AND OBJECTIVE

Glass fiber reinforced polymer (GFRP) was used as an alternative material to the steel rebar. It is light-weight, non-corrosion, superior tensile strength, and high mechanical performance. Installation of the GFRP rebar is similar to steel rebar, but with less handling, transporting and storage problems. In this work, the unsaturated polyester resin and E-glass fibers are used to synthesis GFRP rebar of 1.25 cm diameter to simulate the dimensions of steel rebar. Their surfaces are modified by the inclusion of coarse sand to avoid slipping in stress conditions. Then, the characterizations of reinforced concrete with GFRP rebar's are applied and compared with that of steel rebars.

III. MATERIAL USE

- 53-grade cement: The cement used in the experimentation was Ordinary Portland Cement 53 grade, satisfying the requirements of IS: 12269-1987 specifications.
- Fine Aggregates: Locally available sands was collected from the river bed and used as fine aggregate. The sand used was with fineness modulus 2.96 and conformed to grading zone-III as per IS: 383-1970 specification.
- Coarse Aggregates: The crushed stone aggregate was collected from the local quarry. The coarse aggregates used in the experimentation were 10mm and down size aggregate and tested as per IS: 383-1970 and 2386-1963 (I, II and III) specifications. The aggregates used were having fineness modulus 1.9.
- Water: Ordinary potable water free from organic content, turbidity and salts was used.
- Mix proportion: Mix design was done according to IS: 10262-2007 specification. Mix design for M20 grade concrete is used.

IV. METHODOLOGY

4.1 Preparation of Moulds

Wooden mould for compressive strength and flexural strength are used. Cubic shapes of moulds are used to prepare specimens for compressive strength and prismatic specimens of 100 *100 * 400 mm for flexural strength. Concrete casting was performed in different layers, each layer of 50 mm. Each layer was compacted by using Tamping Rods until no air bubbles emerged in the concrete, and the surface of concrete was levelled off fully to the upper of the moulds by using steel trowel. GFRP and steel bars evenly distributed with specific distance in the mould.

4.2 Mixing Method

The used mixing proportion was (1:1.5:3)(C:S:A). The dry materials (cement and sand) are thoroughly mixed in a pan and then the gravel are combined and mixed with the entire batch by shovel until the gravel is uniformly distributed throughout the batch. Then the water is poured and blended with the dry materials for specific duration until the concrete is homogenous in appearance and has the desired consistency. The mixing process is paused and then returned for a few minutes and the open end or top of the pan is covered to prevent evaporation during the rest period. This step is repeated for two cycles to insure the homogeneity of mixture. The total mixing time is about 15 min.

4.3 Placing of Bars

The bars are being placed in standard specified proportion. The GFRP Bars are uniformly spaced in casing. The volume of GFRP bars is 5% of the total volume of the mould.

4.4 Flexural Test

The test samples were 150 * 150 * 700 mm prisms and tested via three points loading. The results are being concluded after 28 days of immersion in water.

4.5 Tension test

The test on tension capacity of the GFRP bars will be performed on CTM. The tensile strength is measured for GFRP rebar and for steel rebars using specimen of 25 ± 5 cm length, 1.25 cm diameter.

4.6 Bending

The Bending strength is measured for GFRP and steel rebar using specimen of 25 ± 5 cm length, 1.25 cm diameter. This measurement is performed to determine an approximate values of the bending (strength and strain) of GFRP reinforcing bar and it's compared with steel reinforcing bar.

V. CONCLUSION

GFRP could be efficient in prestressed concrete Construction because of its low modulus and high strength property. The use of high strength concrete had increased the load of the first crack significantly The result showed that the theoretical flexural capacity was 30% lower than the experimental value. The bond between the concrete and the smooth surface of GFRP bar was improved by winding helically the bar with continuous fiber and coated with sand using thermosetting resin

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