Experimental Investigation on Glass Fibre Reinforcement Polymer Rebars

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Abstract- *In this research we are studying about Glass fiber reinforced polymer (GFRP) Bar and its importance. In recent constructions, Corrosion of steel is one of the main deteriorating mechanisms that significantly degrades traditionally reinforced concrete elements due to environmental impacts, leading to a reduced service-life of infrastructure components. To overcome this we use GFRP bar because It is cheaper than steel. The considerably new FRP rebar technology is based onpultruded composite products, which are made from longitudinally bundled fibers along the bar axis embedded in a resin matrix. The fibers are the main load carrying component and the resin binds the fibers together, and therefore, transfers the load between individual fibers while protecting them from chemical and physical attacks. Now a days , the most widely used fiber type for FRP rods in the United States is glass based for the production of Glass Fiber Reinforced Polymer (GFRP) rebars. E and E-CR(Electrical/Chemical Resistant) glass fibers are the most commonly used ones because they possess high tensile strength, offer high chemical resistance, and feature low production cost. Further we are going to investigate the behaviour of steel and GFRP bars in concrete with regards to bonding and flexure. We are going to compare normal steel bar with GFRP bar by using various standard test.*

Keywords- Glass fiber reinforced polymer (GFRP) Bar, resin matrix, bundled fibers, E and E-CR (Electrical/Chemical Resistant) glass fibers, high tensile strength.

I. INTRODUCTION

Glass fiber reinforced polymer (GFRP) was used as an alternative material to the steel rebar. The number of reinforced concrete structures in recent years specifying GFRP rebars has increased exponentially, and so has the number of GFRP rebar manufacturers. Additionally, manufacturers have developed different GFRP rebar types, where the surface enhancement to create the bond with concrete varies. The unit weight of GFRP rebar varies from about one-sixth to one-fourth that of steel, which reduces transportation costs and makes the rebars easier to handle at the job site, yielding additional benefits. The tensile behaviour of GFRP rebars is characterized by a linear elastic stress-strain relationship up to failure. Compared to steel rebars, GFRP rebars offer higher tensile strength but lower ultimate tensile strain and lower tensile modulus of elasticity. Unlike steel, the tensile strength of a GFRP rebar varies with its diameter, while the longitudinal modulus does not change appreciably. GFRPrebars are made of continuous glass fibers embedded in a polymeric resin matrix. The fibers have the function of carrying the load; the resin binds and transfers the load to the fibers while protecting the fibers.

II. LITERATURE REVIEWS

Aleesha Alexander, Nimesh Mohan M, (2015)an experimental investigation was carried out to study the effect of glass fiber reinforced polymer strips and sheets toretrofitting the flexural beams. Six different wrapping styles were adopted. In these number of layers of FRP were kept as variables. A total of 26 beams were cast and were tested under monotonic loading. Based on experimental results following conditions are arrived at.

Flexural load carrying capacity of retrofitted beam increases with FRP wrap than control beams.

The FRP wrapped specimens showed improvement in the ultimate load. As the number of layers of FRP was increased the ultimate load carried by the specimens also increased. In the case strip wrapped specimens 60-degree angle double wrap is better and also in the case of sheet wrapped specimen full sheet wrapped specimen is better.

Ultimate and first crack load of 60 degree angle double wrapped specimen is more compared to the other stripwraps and double layer full sheet wrap specimen shows improvement in the first crack and ultimate load compared to other sheet wrap.

Wrapping of beams with FRP was found to be an effective method for repair and retrofitting of beams.

Flexural retrofitting also increases the shear strength of concrete.

David T. Johnson, Shamim A. Sheikh,(2016) Results from an experimental program consisting of 10 large beams are presented herein that investigated the performance of the most current generation of bent glass fiber-reinforced polymer (GFRP)stirrups. In the experiments, strains greater than 1% were measured in the transverse reinforcement, which significantly exceeded the code-prescribed design values. No substantial difference in the shear strength was noted between beams reinforced with eithers and-coated or milled-surface stirrups. Predictions of ultimate strength using CSA S806-12, CSA S6-06, and ACI 440.1R-06 were all found to be safe if the prescribed strain limits for FRP transverse reinforcement were used. Finally, it was shown that performance of the reinforcement at load levels close to service condition with respect to shear cracking was of critical importance, as evidenced by the observations that measured shear cracks were wider in some cases than flexure cracks.

R. Anuradha, Keerthi Kumar, Karthik K., (2017), we have selected Glass Fiber Reinforced Polymer(GFRP) as a retrofitting material for strengthening purpose by External bonding the RC Beam. In this study initially three beams will be preloaded and then retrofitted with Glass Fiber Reinforced Polymer(GFRP). On the other hand, initially other three beams will be strengthened with the same material. All the six beams will be tested under loading and flexural strength of each beam will be studied.

By strengthening the beam at soffit, initial flexural cracks appear at a higher load. The ultimate load carrying capacity of the repaired beam is 10% less than the control beam.

The strengthened beam's ultimate load carrying capacity is 6% more than the control beams and 16% more than the repaired beams.

Compared to Control Beams, the Relative Stiffness Index of the Control Strengthen Beams and the Strengthened Beams was 21.74% and 38.90% respectively.

Avinash G Hiremath, Nagraj Biradar, Sharangouda, (2018) present work focused on study of effect of steel tubes in GFRP(S -GFRP) in terms of strength to weight ratio under bending and tension loading compared to without reinforcement of steel tube in GFRP (GFRP).In this work steel tubes of different diameter were longitudinally reinforced in GFRP. Specimens of S & GFRP and GFRP were prepared using hand layup process and specimens subjected to bending and tensile loading using UTM. From experimental data, mechanical properties like ultimate compressive ultimate strength, stiffness, strength to weight ratio and specific strength were determined. The experimental results show that, aGFRP specimen with longitudinal reinforcement of hypodermic steel tubes (S-GFRP) achieved high strength to weight ratio , high specific stiffness and other improved mechanical properties compared to that of plane fibre reinforced plastic (GFRP).

R. Murugan, G. Kumaran, (2019) presents the flexural behaviour of rectangular concrete beams reinforced with surface treated Glass Fibre Reinforced Polymer (GFRP), Grooved bars and Sand sprinkled reinforcing bars. Beams cast with standard mix of M30 grade concrete, with a reinforcement ratio of 0.73%, and compared with that of conventional steel reinforced beams. Totally five rectangular beams of size 125 mm x 250 mm x 3200 mm were cast. The flexural study was carried under static two-point loading. The experimental prediction was focused on observation of ultimate load capacity, cracks propagation and crack widths and failure modes of beams. The results indicate that both type of GFRP reinforcements is at par with the conventional steel reinforcements.

The ultimate load carrying capacity of GFRP reinforced beams increases when increase in percentage of reinforcement when compared with steel reinforced beam.

The ultimate deflection observed in sand coated GFRP reinforced beams show increase in deflection, when increase in percentage of reinforcement. But at the same time, it is reversed in grooved GFRP reinforced beams compared with steel reinforced beams.

The performance of sand coated GFRP reinforcements is low when compared to grooved GFRP beams with respect to ultimate load carrying capacity and ultimate deflections.

The number of cracks at ultimate load level is higher in sand coated GFRP beams when compared with grooved GFRP and steel reinforced beams.

The grooved GFRP reinforced beams are found superior when compared to sand coated GFRP and conventional steel reinforced beams.

Shital A Patage, Hirnawale Bharat, Makasare Shivon, Katale Prashant, Ghute Damini, (2022) understand the effects of glass fibre on concrete. Glass fibres are available readily in market at cheaper cost. Glass fibre was used as an admixture to test its effects on concrete. Glass fibre reinforced concrete can be used to increase the strength of concrete thereby improving the life of structure. In this study various percentage of glass fibres were added in concrete and the results were compared with Plain Cement Concrete to understand the Effects of glass fibre on concrete. Concrete beams were casted and allowed to cure for 28 days. The result showed that addition of 1% of glass fire increased the flexural strength of concrete, there were minimal or no changes noted in workability of concrete. On further addition of 2% of glass fibre, although the strength of concrete increased significantly but the workability of concrete decreased. It became very difficult to handle thee concrete and carry out tamping process.

It was found that addition of 1% of glass fibres can increase the flexural strength of beam as compared to plain cement concrete. We further added 2% glass fibres and to our surprise the flexural strength increased insignificantly however the workability of concrete was so affected that even addition of glass admixture did not help us in workability.

III. OBJECTIVES

- To study importance of GFRP Bar and its various properties and as compared to steel bar. It is light inweight cheaper easy to handle.
- We can parabling importance of these bars after study.
- The life of GFRP Bar is too much more than steel bar there for it increase the life of structure.

IV. MATERIALS

1. Glass fibre reinforced polymer (GFRP) bar are used for testing.
2. M20 grade concrete are use in this project work.

V. METHODOLOGY

1. Review the existing literature and Indian design code provisions.
2. To study the properties of Glass Fibre Reinforced Polymers (GFRP) Rebar and steel rebar.
3. Various test conducted on Glass Fibre Reinforced Polymers (GFRP) Rebar for the project work.
4. Comparing the result of Glass Fibre Reinforced Polymers (GFRP) Rebar with normal steel bar.
5. Observation of results and discussion.

VI. CONCLUSIONS

Fibre reinforced polymer bars can be the future of reinforcement with the view that steel is susceptible to corrode. Glass fibre reinforced polymer bars is considered to be one of the better replacements of steel. With growing demand and the better technologies, its use in construction of structures can be enhanced by applying better result experiences. The beneficial effect FRP reinforced concrete beams is limited due to various drawbacks. The ductility provided by Glass fibre reinforced polymer (GFRP) Bars were sufficient to prove its use in reinforced structures.

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