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# Developed the Flexure Shear Strength of Rc Beam with Using Fiber Polymer Composite

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***Abstract -- The purpose of this study was to develop the strength in flexure shear of reinforced concrete beam with the help of fiber polymer composites. We use the glass fiber and other polymer matrix as a reinforcement material. The suitability of polymer reinforcement as hard binding material for concrete has been assessed by comparing its ultimate bearing capacity of reinforced concrete beam. We prepare the two set of beam, in set I, we construct three beam, in this 1st beam is normal control beam , and the other two beam are made with fiber reinforcement . As same in set II, three beam are construct, 1st beam is normal and other are made with fiber reinforcement polymer in different way. And compare the result of each beam with each other. The effect of number of GFRP layers and its orientation on ultimate load carrying capacity. The test result indicates that fiber reinforcement polymer can be used effectively used to improve strength of beam.***

***Keywords– fiber, concrete, reinforcement, coarse aggregate, polymer matrix.***

## I. INTRODUCTION

In order to avoid he problems created by the corrosion of steel reinforcement in concrete structure, research has demonstrated that one could replace steel reinforcement by fiber reinforcement polymer (FRP) reinforcement. The corrosion of the steel reinforcement in reinforcement concrete (RC) structures affects the strength of both the steel and concrete. The strength of a corroding steel reinforcing bar is reduced because of a reduction in cross sectional area of a steel bar. While the steel reinforcing bars are corroding, the concrete integrity is impaired, because of cracking of the concrete cover caused by the expansion of the corrosion products.

Only a few year ago, the construction market started to use FRP for structural reinforcement, generally with combination with other construction materials such as wood, steel and concrete. FRPs exhibit several improved properties, such as high strength – weight ratio, high stiffness – weight ratio, flexibility in design non-corrosiveness, high fatigue strength and ease of application. The use of FRP sheets or plates bonded to concrete beams has been studied by the several researchers. Strengthening with adhesive bonded fiber reinforced polymer has been established as an effective method applicable to many type of concrete structures such as columns, beams, slabs and walls. Because the FRP materials are non-corrosive, non-magnetic, and resistance to various types of chemicals, they are increasingly being used for external reinforcement of existing concrete structures. Due to the flexible nature and ease of handling and application, combined with the high tensile strength – weight ratio and stiffness, the flexible glass fiber sheets are found to be highly effective for improve the strength of R.C beams. FRP can be used very efficiently in strengthening the concrete beams which weak in flexure, shear and torsion. FRP materials offer the engineer an outstanding combination of physical and mechanical properties, such as high tensile strength, light weight, high stiffness, high fatigue strength and excellent durability. FRP is a composite material generally consisting of high strength carbon, agamid or glass fibers in a polymeric matrix (e.g. thermosetting resin) where the fibers are the main load carrying element.

## II. LITERATURE REVIEW

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Some investigations in Europe - Recent work on the use of FRP materials as a replacement for steel in plate bonding applications was pioneered at the EMPA in Switzerland. Four point loading tests were initially performed on RC beams 2000mm (Meier, 1987; Kaiser, 1989) or 7000mm (Ladneret al., 1990) in length. Strengthening was achieved through the use of pultruded carbon fiber/epoxy laminates up to 1.0mm thick bonded with the same epoxy adhesives used in earlier steel plating work (Ladner and Weder, 1981). For the 2000mm length beams, the ultimate load was almost doubled over the unplated control beam, although these beams were designed with a low proportion of internal steel, and hence the strength of the unplated beam was low. In the case of the 7000mm length beam, strengthened with a 1.0mm CFRP laminate, the increase in the ultimate load was about 22% (Ladner and Holtgreve, 1989). However, for both beam lengths the ultimate deflection was considerably reduced, although it was claimed that there was still sufficient rotation to predict impending failure

The following modes were observed either individually or in combination in the tests carried out at the EMPA :- sudden, explosive, tensile failure of the CFRP laminates, compressive failure in the concrete, slow, continuous peeling of the laminate during loading resulting from an uneven concrete bond surface, sudden peeling of the laminate during loading due to relative vertical displacement across a shear crack in the concrete horizontal shearing of the concrete in the tensile zone ,interlaminar shear within the CFRP sheet.

## III. MATERIALS AND METHODS

Cement: The specific gravity is at least 3.10. Portland slag cement (PSC) – 43 grade (Kornak Cement) was used for the investigation.

Concrete: Proportioning of the ingredients of concrete is referred to as designing the mixture, and for most structural work the concrete is designed to give compressive strengths of 15 to 35 MPa. The water cement ratio 0.5 is used.

Fine aggregate: The fine aggregate was passing through 4.75 mm sieve and had a specific gravity of 2.68. The grading zone of fine aggregate was zone III as per Indian Standard specifications

Coarse aggregate: The maximum size of coarse aggregate was 20 mm and specific gravity of 2.78

Reinforcement: The longitudinal reinforcements used were high-yield strength deformed bars of 14 mm diameter. The stirrups were made from mild steel bars with 6 mm diameter.

Fiber reinforcement polymer: FRP is the composition of fiber and matrix.


Fiber: there are various fiber like glass fiber, carbon fiber and aramid fiber.

Matrix: Physical and chemical characteristics of the matrix such as melting or curing temperature, viscosity, and reactivity with fibers influence the choice of fabrication process. Thermoset resins are the most commonly used matrices for production of FRP materials. Matrix material like as epoxy resin, unsaturated polyester resin and adhesives.

## IV. EXPERIMENTAL STUDY

The experimental study consists of casting of two sets of reinforced concrete (RC) beams. In SET I three beams weak in flexure were casted, out of which one is controlled beam and other two beams were strengthened using continuous glass fiber reinforced polymer (GFRP) sheets in flexure. In SET II three beams weak in shear were casted, out of which one is the controlled beam and other two beams were strengthened by using continuous glass fiber reinforced polymer (GFRP) sheets in shear. The strengthening of the beams is done with varying configuration and layers of GFRP sheets. Experimental data on load, deflection and failure modes of each of the beams were obtained. The change in load carrying capacity and failure mode of the beams are investigated as the amount and configuration of GFRP sheets are altered.

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## V. RESULTS AND DISCUSSION

The experimental results of SET I beams (weak in flexure) and SET II beams (weak in shear). Their behavior throughout the static test to failure is described using recorded data on deflection behavior and the ultimate load carrying capacity. The crack patterns and the mode of failure of each beam are also described in this chapter. Two sets of beams were tested for their ultimate strengths. In SET I three beams (F1, F2 and F3) weak in flexure are tested. In SET II three beams (S1, S2 and S3) weak in shear are tested. The beams F1and S1 were taken as the control beams. It was observed that the beams F1 and S1 had less load carrying capacity when compared to that of the externally strengthened beams using GFRP sheets. In SET I beams F2 is strengthened only at the soffit of the beam and F3 is strengthened up to the neutral axis of the beam along with the soffit of the beam. SET II beams S2 is strengthened only at the sides of the beam in the shear zone and S3 is strengthened by U-wrapping of the GFRP sheets in the shear zone of the beam. Deflection behavior and the ultimate load carrying capacity of the beams were noted. The ultimate load carrying capacity of all the beams along with the nature of failure. As shown in fig 1.

## VI. CONCLUSIONS

From the test results and calculated strength values, the following conclusions are drawn:

SET I Beams (F1, F2 and F3):- Initial flexural cracks appear at a higher load by strengthening the beam at soffit. The ultimate load carrying capacity of the strengthen beam F2 is 33 % more than the controlled beam F1. Load at initial cracks is further increased by strengthening the beam at the soffit as well as on the two sides of the beam up to the neutral axis from the soffit. The ultimate load carrying capacity of the strengthen beam F3 is 43 % more than the controlled beam F1 and 7 % more than the strengthen beam F2.

SET II Beams (S1, S2 and S3):- The ultimate load carrying capacity of the strengthen beam S2 is 31 % more than the controlled beam S1. When the beam is strengthen by U-wrapping in the shear zone, the ultimate load carrying capacity is increased by 48 % compared to the control beam S1 and by 13% compared the beam S2 strengthen by bonding the GFRP sheets on the vertical sides alone in the shear zone of the beam.

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| Sr. No. | Type of Beam | Beam designation | Load at initial crack (KN) | Ultimate load (kN) | Nature of failure |
|---|---|---|---|---|---|
| 1 | Beams weak in flexure (SET I) | F1 | 33 | 80 | Flexural failure |
| | | F2 | 35 | 107 | GFRP rupture + Flexure-shear failure |
| | | F3 | Not visible | 115 | GFRP rupture + Flexure-shear failure |
| 2 | Beams weak in shear (SET II) | S1 | 38 | 83 | Shear failure |
| | | S2 | 40 | 112 | Flexural failure + Crushing of concrete |
| | | S3 | 41 | 126 | Flexural failure + Crushing of concrete |

Fig 1.Ultimate load for SET I and SET II beams

| SET I Beams | $M_r$ from analytical study | $M_r$ from experimental study |
|---|---|---|
| F1 | 18.22 KN-m | 28.36KN-m |
| F2 | 26.48 KN-m | 39.12 KN-m |