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Flexural Behavior of GFRP Bars

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ABSTRACT

Reinforced Cement Concrete (RCC) structures are usually reinforced with steel bars which are subjected to corrosion at critical temperatures and atmospheric conditions. Also the cost of steel reinforcement plays a significant role in any RCC construction. The rising prices of steel and their unavailability throughout the year have brought the contractors and engineers into a great trouble. The RCC structures can also be reinforced with other materials such as fibers specifically Glass Fiber Reinforced Polymer and Carbon Reinforced Fiber Polymer (GFRP). This deals with the study of RCC beams when reinforced with the Glass Fiber Reinforced Polymer (GFRP) as a replacement of steel reinforcement and studying the behavior of beam under flexure.

Keywords: *Fiber Reinforced Polymer bars, GFRP Bars*

I. INTRODUCTION

Construction industries now a day's facing many problems such as the decrease in the durability of the concrete structure due to corrosion of steel reinforcement. The corrosion problem of steel bar is one of the most important factors that limit the service life of the structure. Furthermore, the process of repair and retrofit of existing structures is very expensive. One of the solutions for this problem is by replacing steel as a reinforcement bar with other strong and durable material. The suitable alternative material that can be used to replace steel bars is Fiber Reinforced Polymer.

A. Problem statement

In the construction industry the steel has some limitations like chloride attack , marine chlorides , corrosion of steel, low resistance to high temperature, high electromagnetic areas , due to all these factors the durability of the steel gets reduced.

So as to avoid these hazardous effects on structures due to limitations of steel we decided to use the Glass Fiber Reinforced Polymer (GFRP) bars as a replacement of steel bars.

B. Objectives

- To study the flexural strength of beam by using GFRP bars.
- To study the maximum deflection.
- To observe the behavior of cracks.

II. LITERATURE REVIEW

A. David Tse Chuen Johnson –" Investigation of Glass Fiber Reinforced Polymer Reinforcing Bars as Internal Reinforcement for Concrete Structures" – T-Space library- July 2014

A study of the existing data shows that two areas of GFRP bar research among others are in need of investigation, the first being behavior of GFRP bars at cold temperatures and the second being the behaviour of large diameter GFRP rods. GFRP internal reinforcing bars are being increasingly considered as a potential corrosion free alternative to regular and stainless steel reinforcing bar. In spite of the availability of code provision governing design and certification of the GFRP bars, their use within concrete structures is currently limited to vary specific applications unless some behavior aspects are further investigated. In particular, crack control ultimate member deformability and the behavior of the bent GFRP bars are areas in need of such further investigation.

B. Venu R. Patil Department of Civil Engineering, Visvesvaraya Technological University- "Experimental Study of Behavior of RCC Beam by Replacing Steel Bars with Glass Fiber Reinforced Polymer and Carbon Reinforced Fiber Polymer (GFRP)"- International Journal of Innovative Research in Advanced Engineering (IJIRAE) Volume 1 Issue 5 (2014)

The behavior of beams reinforced with GFRP bars has been shown to be predictable by section analysis techniques normally used in design. The behavior of the beams is reliable and repeatable. The deformability of beams at failure is similar to that of steel reinforced beams. Different approaches for design are discussed and illustrated with examples. The choice of design approach depends largely on the design constraints. GFRP Reinforcing bars are gradually finding wider acceptance as replacement for conventional steel reinforcement as it offers number of advantages.

III. EXPERIMENTAL ANALYSIS

A. Design of Beam

After achieving the proportion for M30 grade concrete through mix design, beams were casted. To determine the average strength of beam using various reinforcement we had casted 3 beams. For the design of beams we considered the room of size 3 x 3 x 3.5 m, single storey for load calculations. Beams were designed for 230 x 450 mm cross-section, but experimentation the size was scaled to half i.e 115 x 225 x 600 mm

B. Casting of beam

1. RCC beams with steel reinforcement – in these beams, we had used steel bars as main steel as well as anchor bars.
2. RCC beams by replacing steel bar with GFRP – in these beams, we had replaced steel with GFRP bars as a main steel. The anchor bar was of normal steel.
3. RCC beams with combination of steel bar and GFRP – In these beams we had placed steel bars as well as GFRP bars as main steel, where normal steel bars were used as an anchor bars.

C. Testing of beam

After the completion of curing period the each beam was tested on Universal Testing Machine (UTM) for Ultimate Compressive Strength, Ultimate Tensile Strength and Maximum Deflection.

Fig. 1 Beam Before Testing

Fig. 2 Beam After Testing

IV. RESULTS

With reference to the testing of beams following results were observed:

Table 1 RCC beams with steel reinforcement

Parameter	Beam 1	Beam 2	Beam 3
Ult. Comp. Load (KN)	55.60	36.42	38.56
Ult. Comp. Strength (N/mm2)	0.463	0.303	0.353
Max. Deflection (mm)	6.10	5.30	7.40

Table 2 RCC beams by replacing steel bar with GFRP

Parameter	Beam 1	Beam 2	Beam 3
Ult. Comp. Load (KN)	82.50	40.10	54.700
Ult. Comp. Strength (N/mm2)	3.188	1.55	2.11
Max. Deflection (mm)	8.10	15.00	9.70

Table 3 RCC beams of combination (Steel & GFRP)

Parameter	Beam 1	Beam 2	Beam 3
Ult. Comp. Load (KN)	101.90	71.80	74.20
Ult. Comp. Strength (N/mm2)	3.93	2.77	2.86
Max. Deflection (mm)	7.7	4.10	8.4

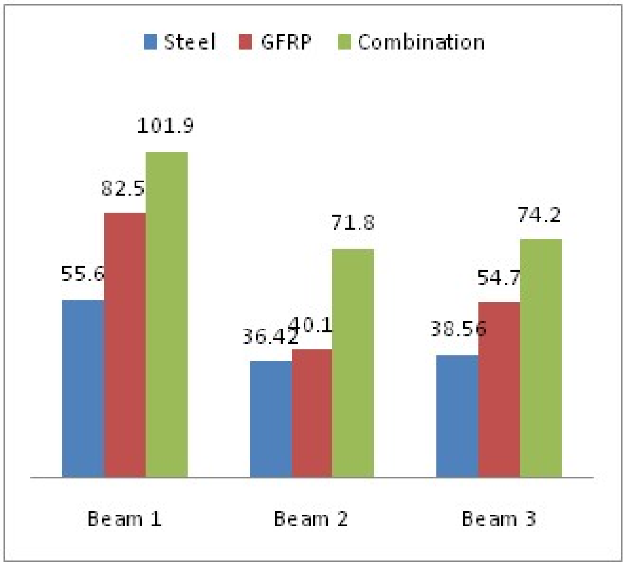

Fig 2: Comparison of Compressive Load.

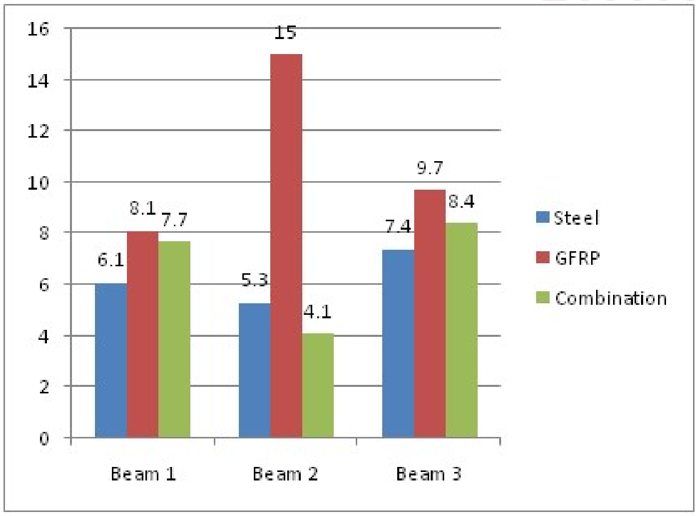

Fig. 3 Comparison of Deflection

Conclusion

- *The compressive load carrying capacity of the GFRP bars and combination (steel & GFRP) is better than the steel bars.*
- The deflection of the GFRP bars and combination (steel & GFRP) is better than the steel bars.
- The combination of steel and GFRP bars will provide economical behavior with respect to strength.

REFERENCES

1. Robert Mathieu and Benmokrane Brahim – "Fiber reinforced polymers (FRP) to be used as an internal reinforcement" -Journal of composites for constructions ,Volume 14 ,issue 4 August 2010, Pages. 353-360
2. Ferreira, J P J G; Branco, F A B. "The use of glass fiber-reinforced concrete as a structural material". Experimental Techniques. Blackwell Publishers Ltd. Via High Beam Research. Retrieved 6 May 2012, volume 31, issue 3, pages 64-7.
3. David Tse Chuen Johnson, "Investigation of glass fiber reinforced polymer reinforcing bars as internal reinforcement for concrete structures" T-Space Library, July 2014.
4. Maher A. Adam -Analytical and experimental flexural behavior of concrete beams reinforced with glass fiber reinforced polymers bars-Department of Civil Engineering, Faculty of Engineering, Benha University, 108 Shoubra St., Shoubra, Cairo, Egypt-1 June 2015
5. Venu R. Patil Department of Civil Engineering, Visvesvaraya Technological University- "Experimental Study of Behavior of RCC Beam by Replacing Steel Bars with Glass Fiber Reinforced Polymer and Carbon Reinforced Fiber Polymer (GFRP)"- International Journal of Innovative Research in Advanced Engineering (IJIRAE) Volume 1 Issue 5 (2014)