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STUDY ON INFLUENCE OF SAND COATED GFRP BARS IN CONCRETE STRUCTURE

S.Aswin kumar[1], V.Antony Francis[2]

Department of Civil Engineering, Agni College of Engineering of Technology, Chennai.

Abstract : The replacement of conventional steel reinforcement with FRP bars has investigated to overcome the corrosion problem in bridge decks, parking garages, water chemical plants. In addition to and wastewater treatment facilities, marine structures their excellent non-corrosive characteristics, FRP reinforcements have high strength-to weigh ratio, good fatigue properties and electromagnetic resistance. Fiber reinforced plastics (FRPS) are innovative material in Structural Engineering, and more research is needed to investigate their performance. Composite materials have a wide range of physical and mechanical properties; in fact, they can be designed choosing the type and quantity of fibers and matrix and commercial products can be realized with different characteristics. In addition FRP rebars with different outer surface treatments vary the performances, in terms of bar-concrete bond, that influence many behavioral aspects such as crack opening, deflections, and anchorage length. Therefore the material properties can be completely different from the traditional reinforcing steel.
The present project work aims to study the effect of sand coated FRP bars in reinforced concrete beam and to assess the feasibility of utilizing the sand-coated GFRP bars for producing a structural clement by investigating the flexural behavior, load carrying, load-deflection response, flexural rigidity, And also compare the performance of sand-coated GFRP bars in reinforced concrete beam to that of identical conventionally reinforced concrete beam.

Keywords :*GFRP Bars, Composite material*

I. INTRODUCTION

The deterioration of reinforced concrete structures become a serious problem in the last decade. This situation is mainly due to corrosion of steel reinforcing bars embedded in concrete. In North America, this phenomenon has been accelerated in bridge and parking garages by the increasing use of deicing salts. Along the Arabian Peninsula and Persian Gulf, deterioration in all types of structures is aggravated by excessive concentration of chlorides in construction materials, high humidity, and marine atmosphere. The added cost of repairing deteriorated structures with replacement cost, commonly more than twice the original cost of construction, led to the adoption of stricter specifications in some building codes and more stringent limits of chloride ions in construction materials. It also stimulated the recent major research efforts in design and construction techniques to improve the durability of reinforced concrete. The use of Fiber Reinforced Plastic (FRP) reinforcing bars as shown in figure 1.1, to replace steel reinforcing bars has emerged as one of the many techniques to enhance the corrosion resistance of reinforced concrete structures. In particular, FRP reinforcing bars offer great potential for use in

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reinforced concrete construction under conditions in which conventional steel reinforced concrete has yielded unacceptable service. Black steel is inexpensive and plentiful. It is a great reinforcement to use if you are not responsible for the long-term maintenance of a concrete structure. As you can see from this photo (light green bars are GFRP) black steel essentially has no corrosion resistance, frequently it comes to the job site without rusting as shown in figure 1.1. Often excessively rusted rebar is sold to the end user. Rust has been called concrete Cancer, it degrades frequently and ugly rust stains often appear on surfaces of structures reinforced with it. Structures built with black steel generally need some rehabilitation in as little as 5 to 10 years and frequently need major rehabilitation within 20 years.

II. MATERIAL

Cement:

Cement sample was subjected to initial and final setting time test as per IS: 4031 (part 5)-1988 and Specific gravity test as per IS: 1727-1967 standards.

- Test on setting time
- Test on consistency

Fine & Coarse Aggregate:

For fine aggregate M-Sand (Manufactured Sand) are shown in Fig.3.9 were used. It satisfying Indian Standards IS 383-1970 was used. The grading of fine aggregate is designated as Zone II. The specific gravity, bulk density and fineness modulus was found to be 2.73, 1.75 kg/m3 and 4.66, respectively. M-Sand available from Chennai is used. 4CFT (273kg) M-Sand are used for three beams.

Sand coated GFRP Bars:

Glass fibers (reinforcement materials) are unsaturated polyster resin with 1% MKEP matrix material via manual process. GFRP rebars have diameter 12 mm which is equivalent to 0.5 inch; it is most common in foundation application. GFRP surfaces are modified by the bond strength of rebars with concrete.

Casting:

To compare the performance of sand- coated GFRP bars in concrete structures to that of identical conventionally reinforced structures, the conventional concrete beams and GFRP reinforced beams are casted and it is cured for 28 days.


Fig. 1: Beams after concreting

III. EXPERIMENTAL SETUP AND LOADING

In this analysis two beam of size of 228.6mm x 228.6mm x 2000mm is casted with M30 grade of concrete and allows to cure for 28 days. Here the beams are kept horizontally in a simply supported

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conditions (Fig. 8.1). Load was applied at the perfected center point of the beam. Load was distributed using 15mm iron rod at the point of L/3 uniformly over the beams as pressure. LVDTs were kept at the bottom of the beams at the point of L/3 distances to record the deflection of the beams. Force was given using the hydraulic pump manually and continued till the major deflection occurs (Fig.8.5.1). Crack pattern were measured (fig. 8.5.3) Applying load was recorded in Load Cell.

Fig. 2: Flexural load setup

Fig. 3: Crack pattern of beam

Table 1: Flexural Loading Test Results

Specimens	LOAD (kN)	DEFLECTION (mm)
B1	40.5	13
B2	23.2	16.4

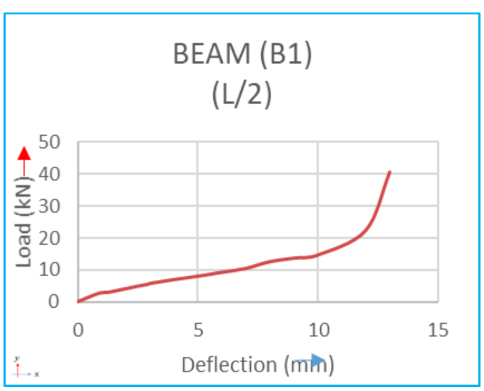

Fig. 4: Load vs Deflection (B1)

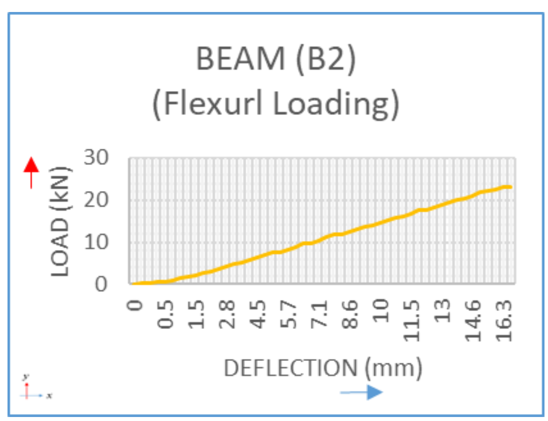

Fig. 5: Load vs Deflection (B2)

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IV. ANALYSED IN ABAQUS SOFTWARE

FLEXURAL LOADING ANALYSIS OF BEAMS:

In this analysis, beams were kept horizontal and force of uniform pressure is applied on top surface of the beams. Hinged and Roller supports was given side faces of the beams.

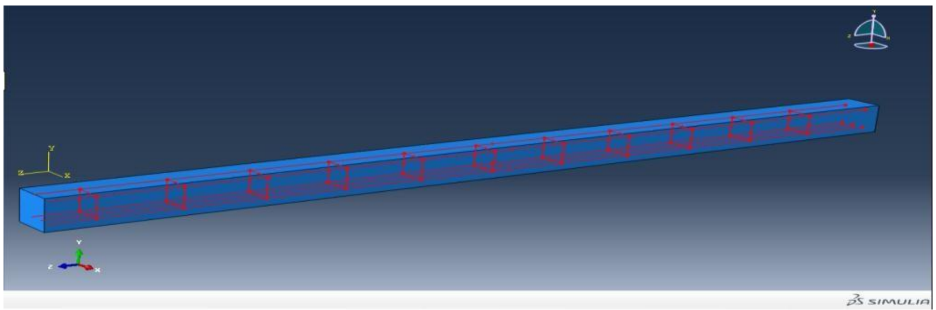

Fig-6: ABAQUS model of RC Beam

Table-9.1: Material Properties of RC beam

Elements	Poisson's ratio	Young's modulus
Concrete	0.2	28000 N/mm²
TMT bar	0.3	200000 N/mm2
Sand Coated GFRP bar	0.32	65000 N/mm2

Table-9.2: Elastic (Type: Lamina) Properties of FRP flat strip

	E1	E2	Nu12	G12	G13	G23
1	17000	900	0.34	4800	4800	4500

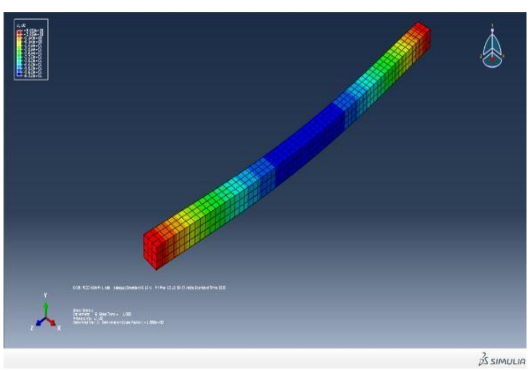

Fig.7 : Deflection of Beam (B1)

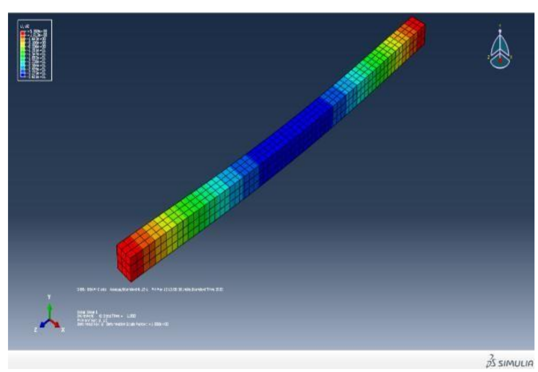

Fig.8: Deflection of Beam (B2)

Table-9.3: Flexural Loading Results

STEP	Load	Deflection
1	40.5	7.03792
2	23.2	14.6838

VI. CONCLUSION

COMPARISON OF EXPERIMENTAL AND ANALYTICAL RESULTS
The structural behavior of the RC beams was observed by measuring the deflection by flexural loading. The performance of beams is described through flexural loading, load carrying capacity, load-deformation response, influencing of longitudinal reinforcement, and crack patterns.

Table-10.1: Comparison of experimental and analytical results for flexural loading

Specimens	**Experimental results**		**Analytical results**		**Error percentage**
	Load (kN)	Deflection (mm)	Load (kN)	Deflection (mm)	(%)
B1	40.5	13	40.5	7.03792	5.96208
B2	23.2	16.4	23.2	14.6838	1.6838

- A good co-relation was found between the analytical and experimental results.
- Comparison of experimental and analytical deflection results error percentage are also calculated and tabulated.
- Crack patterns are studied and measured

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