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Experimental and Comparative Study on Flexural Strength of Reinforced Concrete Beam using Glass Fibre Reinforced Polymer Rebar with Slag Cement

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Abstract: *When deals with salty offshore projects, Extreme condition the corrosion of steel is the major problem. So in order to rectify this problem the GFRP rebar is used as reinforcement in concrete. The main aim of the project is to study the strength differences between steel reinforcement and GFRP rebar reinforcement. The sand coating is provided for GFRP rebar to increase the bonding strength. Because of high durability of the GFRP rebar the maintenance and repair cost is very low, and it's also improving the life span .So the GFRP is economical compare to normal conventional Steel. Slag Cement is used for increase the durability. The specimen beam will cast with convention reinforcement beams and GFRP reinforced beams. After the curing the beam will be tested for flexure strength with the curing period of 7, 14, 28 days. The beam is designed as per is 456-2000*

Key Words: GFRP Rebar, GFRP Reinforced Concrete

1. Introduction

Reinforced concrete is one of the regular building material used in the world. Structures such as buildings, bridges, and highways use reinforced concrete as its main construction materials. Many structures are subjected to aggressive environments and exposed to salts, combination of moisture, temperature and chlorides reduce the alkalinity of the concrete which results in the corrosion of rebar steel. To address corrosion problems, industries across the world are moving towards composite materials for the construction and manufacturing process. Among the different, advanced materials being used, FRP or Fibre Glass fibre-based reinforcement GFRP is used. Fibre reinforced Polymer is the best material because it gives all round efficiency in the manufacturing process and strength, durability in the finished product. FRP materials emerged as an alternative material for producing rebar for concrete structures. FRP rebar offer advantages over steel rebar, in that FRP bars are non-corrosive and some FRP bars are non-conductive. The GFRP bar is produced in Pultrusion process.

Fig 1 Glass Fibre Reinforced Polymer and Steel

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1. ANALYSIS OF MATERIALS

TABLE 1 Test Results of Cement

S.NO	DESCRIPTION	RESULT
1	Type	Slag Cement
2	Specific gravity	3.15
3	Initial Setting Time	155 minutes
4	Final Setting Time	355 minutes

TABLE 2 Test Results of fine aggregate

SI.NO	DESCRIPTION	RESULTS
1	Type	M sand
2	Water absorption	5%
3	Fines modulus	2.78
4	Specific gravity	3.8

TABLE 3 Test Results of coarse aggregate

SI.NO	DESCRIPTION	RESULTS
1	Type	Crushed angular
2	Water Absorption	6.15%
3	Fines Modulus	1.98
4	Specific Gravity	2.63
5	Impact Test	7.2%
6	Crushing Strength	19.6%

2. Casting of specimens

Beams are casted with Steel reinforcement and with GFRP bar reinforcement. The cubes and cylinders are also casted for compressive and split tensile tests. The specimens are cured 28days

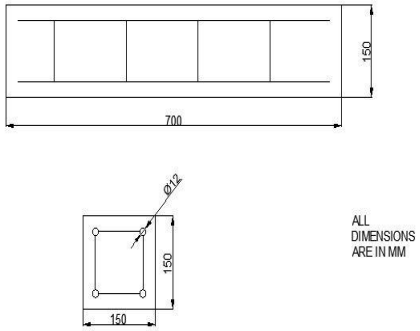

Fig 2 RCC detailing

Fig 3 Steel Reinforcement

4. TESTING

1 Compression test

Table 4 Compressive strength on cube.

Cube	Age in days	Load (KN)	Strength N/mm²
OPC cement		55.93	24.86
Slag cement	7	50.22	22.32
OPC cement		84.63	37.64
Slag cement	14	73.62	32.72
OPC cement		82.67	36.74
Slag cement	28	79.26	35.32

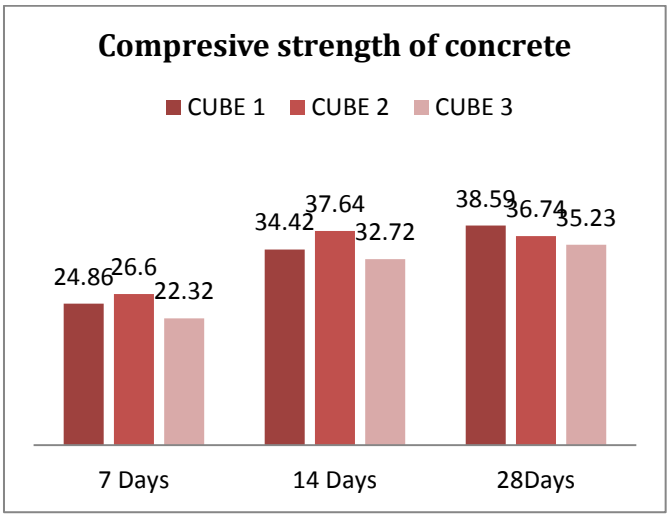

Chart 1 Compressive strength

8.2 Split tensile test

Splitting tensile strength of given concrete =4.61 N/mm^2.

8.3 Flexural Strength Test

Beam mould of size 15cm x 15cm x 70 cm

Fig 3 Marking for Flexural Strength Test

Fig 4 Flexural Strength Test

Table 5 Flexural strength

Beam	Age in days	Load (KN)	Strength N/mm²
Steel	7	47.5	7.9
GFRP		37.5	6
Steel	14	62.3	11.2
GFRP		43.9	7.45
Steel	28	119.3	21.1
GFRP		88.95	15.63

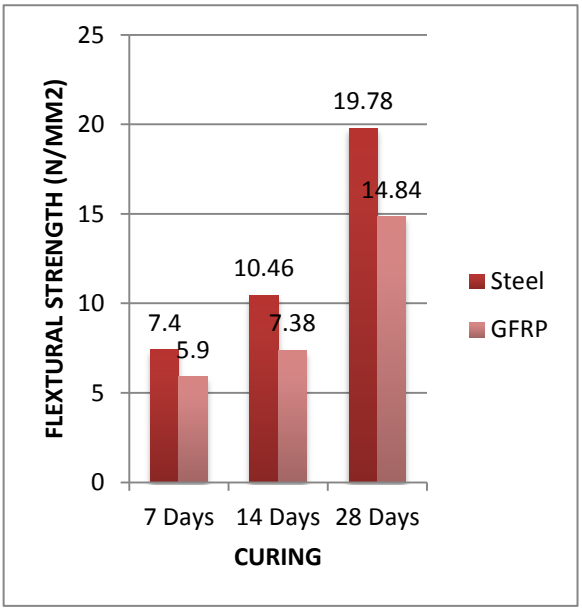

Chart 2 Flexural strength tests

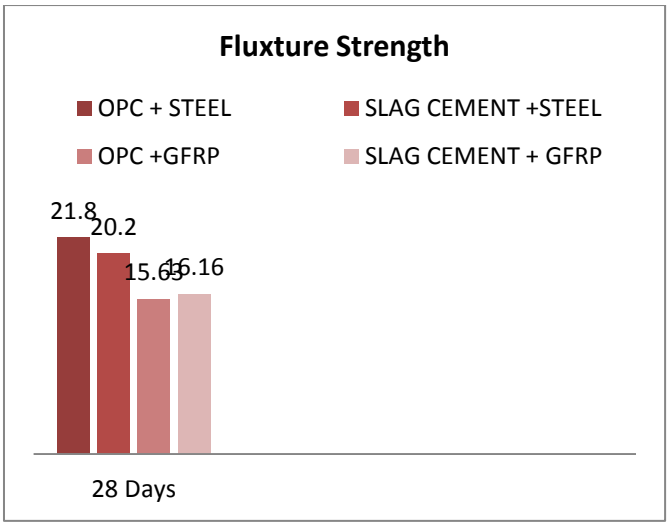

Chart 3 Flexural strength tests with respect to cement

CONCLUSIONS

- GFRP reinforcing bar has higher tensile strength and higher corrosion resistance than steel rebar in addition, moderate flexural strength, these properties make GFRP is good alternative of steel in foundations application
- Tensile strength of bare GFRP bar is high, because they are anisotropic composite materials, GFRP rebar achieved yield tensile strength about 13% higher than that the steel rebar, while yield strain of GFRP is higher than steel about 58%. So it can be used for partial replacement.
- Bend strength of bare GFRP bar is good. The cost of GFRP bar is very low. where yield strength of GFRP rebar achieved 72% of steel rebar strength while yield strain of GFRP is higher than steel about 20%.
- Compressive strength of unreinforced concrete is 35.67 KN this value is acceptable according to Indian Standard specification

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