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EXPERIMENTAL INVESTIGATION ON FLEXURAL BEHAVIOUR OF RCC BEAM WITH GFRP SHEETS AS A WRAPPING MATERIAL

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ABSTRACT

GFRP have been widely used to strengthen reinforced concrete. Because they have high strength to weight ratio, require relatively limited time to cure, and have mechanical properties to meet the desired structural performance. The parameters consider for the study are ultimate load carrying capacity, load deflection failure modes and flexural stiffness of the strengthened beams. FRP laminates have gained popularity as external reinforcement for the strengthening or rehabilitation of reinforced concrete structures. GFRP strengthening exhibits high strength, light in weight, decrease time of construction. Fibre reinforced polymer (FRP) externally bonding with epoxy resin is recently widely used in construction industry to increase the ultimate strength of structures. It is concluded that as deflection goes on increasing that is ultimate load directly varies with deflection. All strengthened beam gives sufficient warning compared to normal beam failure. In the present economic climate, rehabilitation of damaged concrete structures to meet the more stringent limits on serviceability and ultimate strength of the current codes, and strengthening of existing concrete structures to carry higher permissible loads, seem to be a more attractive alternative to demolishing and rebuilding. The study on flexure includes various parameters like percentage of increase in strength of the member due to the externally bonded Fiber reinforced polymer, examining the crack patterns, reasons of de bonding of the fibre from the structure, scaling, convenience of using the fibres, cost effectiveness etc.

KEYWORDS: GFRP Wrapping, Epoxy Resin, FRP Wrapping, Crack Patterns

Fiber-reinforced polymer (FRP) application is very effective way to repair and strengthen structures that have become structurally weak over their life span. FRP repair systems provide an economically viable alternative to traditional repair system and materials.

Reinforced concrete beams usually involves strengthening existing members to carry higher ultimate loads or to satisfy certain serviceability requirements. Infrastructure decay caused by premature deterioration of buildings and structures has lead to the investigation of several processes for repairing or strengthening purposes. This increases the beam strength and its stiffness (load required to cause unit deflection), however decreases the deflection capacity and ductility.

Glass Fiber Reinforced Polymer

Glass fiber also known as fiber glass is made from extremely fine fibers of glass. It is a light weight, extremely strong and a robust material. Glass fibers, the most popular of the synthetics, are chemically inert, hydrophobic, and lightweight. They are produced as continuous cylindrical monofilaments that can be chopped to specified lengths or cut as films and tapes and formed into fine fibrils of rectangular cross section Used at a rate of at least 0.1 percent by volume of concrete.

Glass fibers reduce plastic shrinkage cracking and subsidence cracking over steel reinforcement. Here we are using 0.25, 0.5, and 0.75% addition to the mix of concrete.

Glass Fiber Sheet

Fiber sheet used in this experimental investigation was Glass, bi-directional woven roving mat. It was not susceptible to atmospheric agents. It was also chemically resistive and anti corrosive.

Figure 1: Glass Fiber Sheet

Ingredients of Concrete

Concrete is a construction material composed of Portland cement and water combined with sand, gravel, crushed stone or other inert materials such as expanded slag or vermiculite. The cement and water from a paste which hardens by chemical reaction into a strong, stone-like mass. The inert materials are called aggregate, and for

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economy no more cement paste is used than in necessary to coat all the aggregate surfaces and fill all the voids. The concrete paste is plastic and easily moulded into any form or trowel to produce a smooth surface. Hardening begins immediately, but precautions are taken, usually by covering, to avoid rapid loss of moisture since the presence of water is necessary to continue the chemical reaction and increase the strength. Too much water, however, produces a concrete that is more porous and weaker.

Specimen Details

The beam specimens were 1600mm in length 150mm wide and 150mm deep in cross section and simply supported over an effective span of 1500mm. The clear cover of the beam was 20mm. The geometry of the beam specimen is shown in figure.

Figure 2: Geometry of beam

High yield strength deformed steel bars of diameter 8mm and 10mm were used as longitudinal reinforcement in the specimens. The reinforcement details are given in the table for both compression and tension steel. Two legged vertical stirrups of 8mm diameter at a spacing of 100mm centre to centre provided at entire length .Total numbers of six specimens were casted to study the effect of GFRP Wrapped on the flexural behavior of reinforced cement concrete beams. To Study the effect of RCC Beams. To Study the effect of the following two profiles of strengthening such as fully wrapped at entire length.

Analytical Test Results of Beam by Using ETABS

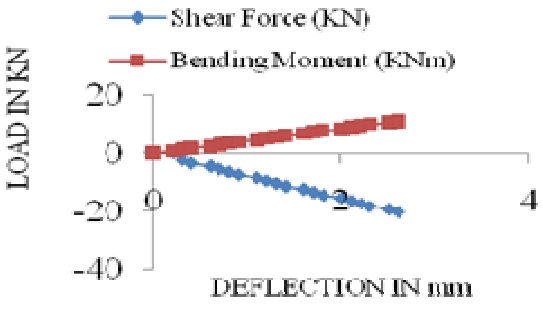

Figure 3: Load Vs deflection in shear force and bending moment

Table 1: Load deflection response for wrapped beam

Load (KN)	Shear force V (KN)	Bending moment (KNm)	Deflection mm
0	0	0	0
1	0.1429	0.7151	0.2
2	-2.4574	1.2651	0.3
3	-3.4574	1.8151	0.4
4	-4.4574	2.3651	0.6
5	-5.4574	2.9151	0.7
6	-6.4574	3.4651	0.8
7	-7.4574	4.0151	0.9
8	-8.4574	4.5651	1.1
9	-9.4574	5.1151	1.2
10	-10.4574	5.6151	1.3
11	-11.4574	6.2151	1.4
12	-12.4574	6.7151	1.6
13	-13.4574	7.3151	1.7
14	-14.4574	7.8651	1.8
15	-15.4574	8.4151	2.0
16	-16.4574	8.9651	2.1
17	-17.4574	9.5151	2.2
18	-18.4574	10.0651	2.3
19	-19.4574	10.6151	2.5
20	-20.4574	11.1651	2.6

Table 2: Load Maximum deflection

Load KN	Maximum Deflection mm
4	0.6
8	1.1
12	1.6
15	2.0

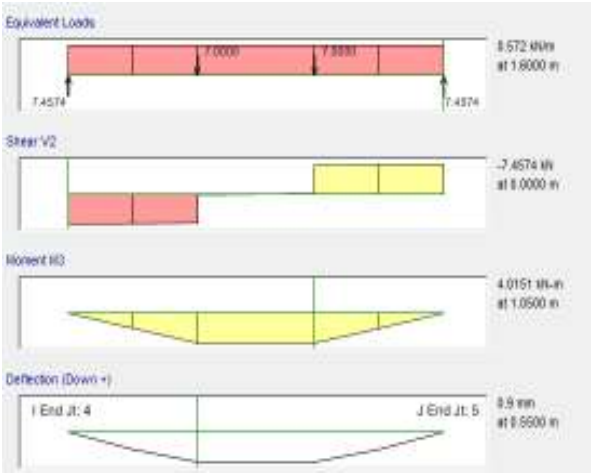

Figure 4: Load deflection variation beam

CONCLUSION

In this study, the behaviour of material properties and analysis of beam have been evaluated. From the graph of load deflection response, when the load increases the deflection value also increases.

The compressive strength of cubes and split tensile strength of cylindrical specimen for conventional concrete of M20 grade have been arrived.

GFRP is a cost effective construction material that has the full potential to extend the life of structures. From the summary of literature, they have used FRP sheets, plates and bars. In this project GFRP sheets have been wrapped to prevent corrosion and provide strength to structures.

In further study, the flexural behaviour of beams wrapped with GFRP sheets using super cover technique will be investigated.

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