AN EXPERIMENTAL INVESTIGATION ON STRENGTHENING OF BEAM IN FLEXURAL AND SHEAR ZONES USING GLASS FIBER WITH EPOXY COATING

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Abstract

Many of the existing reinforced concrete structures are in need for repair and rehabilitation, because of deterioration due to various factors like corrosion, lack of detailing failure of bonding. It leads to cracking loss of strength etc., This project reports on an experimental investigation carried out to investigate shear and flexural strengthening of RC beam with Glass Fibre Reinforced Polymer. Here two beams of size 1500mm x 150mm x 250mm were cast and tested. One beam without GFRP and another beam is bonded with epoxy GFRP wrapped in different layup patterns in shear and flexural zones. With one and two layers of epoxy bonded GFRP sheets using epoxy resin was subjected to flexural test. Initial crack load, ultimate failure load and types of failure are observed and noted. Experimental results indicates the significant increase in beam strength is gained due to of GFRP wrapped beam on compared with unwrapped beams.

1.INTRODUCTION

There are considerable number of concrete structures in India that do not meet current design standards because of inadequate design and construction. The inadequate design standards, deterioration due to corrosion to steel caused by exposure to an aggressive environment and accident events such as earthquakes, corrosion, lack of detailing, failure of bonding between beam – beam joints, increase in service loads. Reinforcement concrete structures often have to face modification and improvements of their performance during service life.

Concrete structure deteriorate with time, a process that becomes much faster in aggressive environmental conditions. The methods to repairs them can be classified under structural repair and non structural repair. Structural repairs is carried out by repair renovation and retrofitting of the entire system as a whole for structural strengthening to carry additional loads or for retrofitting. The flexural behavior of RCC beams were retrofitted with 1.2mm epoxy bonded GFRP sheets using epoxy resins. In total of four beams were tested and respective reading were recorded. Cracking and deflection of GFRP reinforced concrete beams analyzed experimentally. It was concluded, the wrapping of GFRP sheet increases the ultimate load carrying capacity of RCC beams.

Fibre reinforced polymer material began being used in civil engineering applications. The external strengthening of reinforced concrete members was an ideal use for performed FRP strips, which are lighter and easier to install then steel strip. FRP strips do not rust. Glass fibers are considering cheaper than carbon and aramid fibers, because glass fibers composites have become popular in many applications that industry. The module of fibers are 70- 85Gpa with elongation 2-5 percentage depending on quality. Epoxy coating are durable coating purpose from strong adhesives to durable paint and coating for beam and metals. Its created through generation of chemical using an epoxy resin and polyamine hardener.

Epoxy coating are durable coating purpose from strong adhesives to durable paint and coating for beam and metals. Its created through generation of chemical using an epoxies resin and polyamine hardener. Epoxy has wide ranges of applications, including fibre reinforced plastic materials and general purpose adhesives. The matrix should transfer force between the fibre and protest them from the surrounding. Polymeric matrices are of two types, Thermo sets and Thermo plastics of Which thermos sets are most widely used. Epoxy resins are generally used and it imparts good mechanical properties.

1.1 OBJECTIVE

- To evaluate the effectiveness of the external GFRP wrapping technique in retrofitting of built RC Beams.
- To study the ultimate load carrying capacity for the flexural strength of the specimens retrofitting by FRP wrapping technique.
- To evaluate the efficiency of the FRP fabrics in terms of utilization of the strength and deformation capacity of the FRP materials.
- Comparison of the results obtained from the control RC beams and retrofitting RC beams with different percentages of wrapped GFRP.

1.2 SCOPE OF OUR PROJECT

- Different fibre reinforced composites can be used in place of GFRP to study the flexural behaviour of the beam specimens.
- Larger dimensions of beam can be investigated for flexure.
- Similar studies on GFRP strengthening in shear can be done.
- Strengthening of RC concrete beams by retrofitting using GFRP by shear and flexural wrapping and comparing results with control beam.

1.3 METHOLOGY

- Literature Collection And Study
- Material Collection And Study
- Test On Material Study & Properties
- Mix proportion of Beam
- Casting Of Specimens
- Curing Of Specimens
- Testing Of specimens
- Result And Discussions
- Conclusion

2. MATERIAL PROPERTIES

*2.*1 MATERIAL USED

a) Cement (Opc 53)
b) Fine Aggregate
c) Coarse Aggregate
d) Glass Fiber Reinforced Polymer (GFRP)
e) Epoxy Resin
f) Water

2.1.1 Cement

OPC53 Grade conforming IS12269:1987, Minimum cement content: 320 kg/m^3 (IS456:2000)

SL.NO	PROPERTIES	TEST RESULTS
1.	Standard consistency test	33%
2.	Initial setting time	30 minutes
3.	Final setting time	540 minutes
4.	Specific gravity	3.11

2.1.2 Fine Aggregate

S.No	Description test	Result
1	Fineness modulus	3.00
2	Specific gravity	2.56
3	Size	Passing through 4.75mm sieve
4	Water absorption ratio	1%
5	Sand zone	III

2.1.3Corse Aggregate

S.No	Description	Test results
1.	Nominal size used	20mm
2.	Specific gravity	2.70
3.	Water absorption	0.5%

3 MIX PROPORTION

3.1 concrete mix proportion

The mixes were designated in accordance with IS 10262-2009 mix design method. Based on the results, the mix proportions M30 was designed. Concrete mix with w/c ratio of 0.40% was prepared. The details of mix proportions for 1m^3 of concrete are given in Table below

Mix proportions for M30 Grade of Concrete (Kg/m^3)

Grade	Cement	FA	CA	Water
Mix 30	479	632	1134	192
	1	1.3	2.36	0.40

4.CASTING OF SPECIMENS

a) Beam (1500mm x 150mm x 250mm)

5.TESTING OF SPECIMENS

a) Flexural strength test

6.RESULTS

6.1FLEXURAL STRENGTH ANALYSIS

Flexural strength test was conducted after 28 days the RC beams were fabricated and loading frame was used for this test. Prepared one beam of conventional and another is GFRP wrapped beam and gradually applied load the values are noted and also graph is drawn**.**

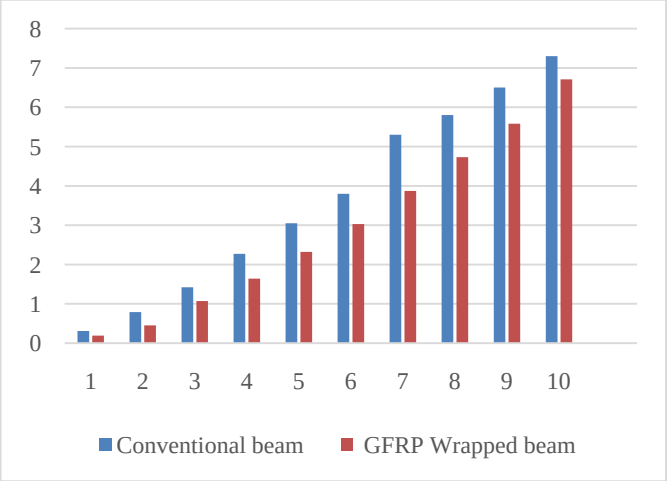
6.1.1 FLEXURAL STRENGTH OF RC BEAM (mid span) DEFLECTION OF RC BEAM

S.No	LOAD (KN)	DEFLECTION (mm)
1	1	0.31
2	2	0.79
3	3	1.42
4	4	2.27
5	5	3.05
6	6	3.80
7	7	5.30
8	8	5.80
9	9	6.50
10	10	7.30

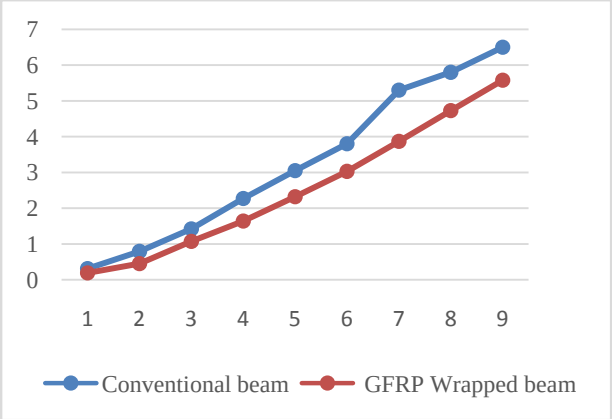
6.1.2 FLEXURAL STRENGTH OF GFRP WRAPPED BEAM (mid span)DEFLECTION OF GFRP WRAPPED BEAM

S. No	LOAD(KN)	DEFLECTION (mm)
1	1	0.19
2	2	0.45
3	3	1.07
4	4	1.64
5	5	2.32
6	6	3.03
7	7	3.87
8	8	4.73
9	9	5.58
10	10	6.71

6.1.3 FLEXURAL COMPARISION OF RC BEAM AND GFRP WRAPPED BEAM (mid span)



6.1.4 GRAPH SHOWING OF UNWRAPPED BEAM AND GFRP WRAPPED BEAM (mid span)



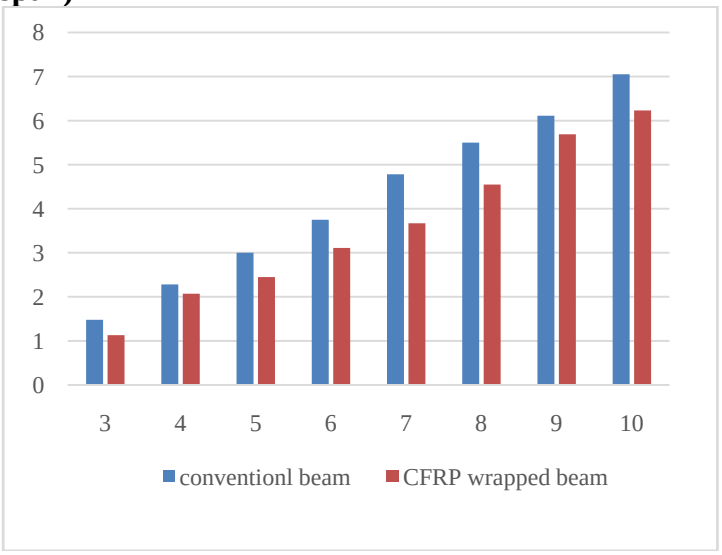
6.1.5 FLEXURAL STRENGTH OF RC BEAM (L/3 span) DEFLECTION OF RC BEAM

S. No	LOAD (KN)	DEFLECTION (mm)
1	1	0.37
2	2	0.84
3	3	1.48
4	4	2.28
5	5	3.00
6	6	3.75
7	7	4.78
8	8	5.50
9	9	6.11
10	10	7.05

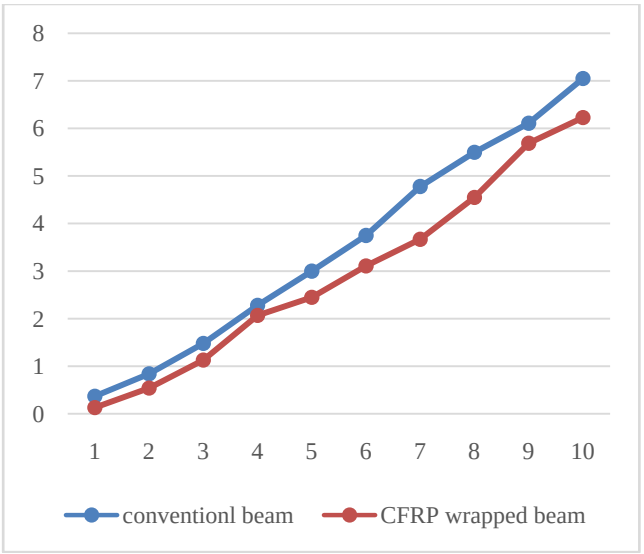
6.1.6FLEXUREAL STRENGTH OF GFRP WRAPPED BEAM (L/3 span) DEFLECTION OF GFRP WRAPPED BEAM

S.No	LOAD (KN)	DEFLECTION(mm)
1	1	0.13
2	2	0.54
3	3	1.13
4	4	2.07
5	5	2.45
6	6	3.11
7	7	3.67
8	8	4.55
9	9	5.69
10	10	6.23

6.1.7FLEXURAL COMPARISION OF RC BEAM AND GFRP WRAPPED BEAM (L/3 span)



6.1.8GRAPH SHOWING OF UNWRAPPED BEAM AND GFRP WRAPPED BEAM (L/3 span)



7. CONCLUSION

Behaviour of reinforced concrete beams with epoxy bonded glass fibre in shear and flexural zones is similar that of conventional reinforced concrete beam. When compared to the conventional beam the strength was increased in GFRP beam. It has been observed that the addition of glass fibres in reinforced concrete beam does not require any extra labour or time. GFRP beam increased in ductility and ultimate flexural strength in beams depends on the percentage of glass fibre. The most important contribution of glass fibre wrapped beam is not only to increase the strength but to increase the flexural toughness of the material. Conventional beam fails suddenly once the deflection corresponding to the ultimate flexural strength is exceeded, on the other hand, Glass fibre wrapped beam specimen continue to sustain considerable loads even at deflection of the plain concrete.

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