Strengthening of RC Beam Weak in Shear using CFRP Technique

Harpalsinh S. Gohil[1] Meet S. Patel[2] Dhaval M. Prajapati[3] Prof. Rajat Mishra[4]
[1,2,3]BE Student [4]Head of Department
[1,2,3,4]Department of Civil Engineering
[1,2,3,4]S.P.B. Patel Engineering College, Mehsana, Gujarat, India

Abstract— A simple problem has been formulated as a part of this study and reinforced concrete (RC) beam specimens, purposefully designed to be weak in shear are casted. M-25 concrete, Fe – 415 main steel and Fe – 250 stirrups are used for the experimentation. There are many external strengthening mechanisms are adopted to strengthen the beam weak in shear. Strengthening using CFRP wrap are carried out as a part of this study. The present work is an attempt in which measurement of various parameters like load at first crack, and load at failure, deflection at first crack and deflection at failure has been carried out. Also, an attempt has been made to compare different parameters and determine which mechanism is the best for maximum load carrying capacity.

Key words: RC Beam, CFRP Technique

I. INTRODUCTION

Since past few years there has been a significant rise in the strengthening of structural members due to reasons like exhaustion of land, increase in population, change in functionality of structure etc. It has been a common practice of a lay contractor to add more steel in tension in a beam assuming it will add more strength. But this leads to over reinforced structural member which will fail catastrophically in shear only. The research consists of two parts. They are 1). Regular beams with CFRP shear strengthening 2). Shear damaged beams with CFRP shear strengthening.

II. PROBLEMS IDENTIFICATION

It is well known now that a significant part of the infrastructure is in urgent need of strengthening and rehabilitation. Mostly older buildings are obsolete. The cost of replacing structures is very high and there is no proper method for it. High-tech solutions must be investigated so innovative use of new technologies and materials can be employed to rebuild the infrastructure. Concrete members have been repaired by post tensioning or jacketing with new concrete in conjunction with a surface adhesive. Since the mid 196O's, epoxy-bonded steel plates have been used in Europe and South Africa to retrofit flexural members. However, steel plates have a durability problem unique to this application, because corrosion may occur along the adhesive interface. This type of corrosion adversely affects the bond at the steel plate concrete interface and is difficult to monitor during routine inspections.

III. DESIGN OF BEAM WEAK IN SHEAR

The following set parameters are selected.

- Dimensions: 700mm X 150mm X 150mm
- Fe 415: 8mm Main Steel & 6mm Anchor Bars.
- Fe 250: 6mm MS Stirrups

Steel Detailing

- 5 – 8mm bars at bottom spaced at 17 – 18 approx. (Main bars)
- 2 – 10mm bars at Top (Anchor Bars)



Design. After that beam is over reinforced section and the below part of the natural axis is tensile section so it will not break but it deflects and the beam will fail in only in shear. Beams are designed for flexure again they are checked in shear.



IV. STRENGTHENING BEAM WITH CFRP SHEET

In this method the CFRP fabric wrapped in the shear span after application of epoxy mortar. After allowing the curing time of 24 hours, the testing of the strengthened beam is performed.

V. DESIGN OF BEAM WEAK IN SHEAR

A beam can be weak in shear only if the section is over – reinforced section. As per IS 456:2000 following three conditions should be satisfied in order to make any section as ORS.

- $Mu>Mlim$
- $Pt>Plim$
- $Xu>Xlim$

VI. DIFFERENT PARAMETER ARE MEASURED

- Tests on cement
- Tests on course aggregates
- Tests on fine aggregates

All rights reserved by *www.ijsrd.com*

– Concrete mix design

Sr.no.	Name of Test	Result
1	Standard Consistency	37.5%
2	Initial Setting Time	28 minutes
3	Final Setting Time	47 minutes
4	Compressive Strength of Cement (with 1:3 cement mortar)	54.7 N/mm2

Table 1: Test on Cement

Sr.no.	Name of Test	Result
1	Specific Gravity	2.87
2	Water Absorption	0.96%
3	Free moisture content	0.38%

Table 2: Test on Course Aggregate



Sr.no.	Name of Test	Result
1	Specific Gravity	2.604
2	Water Absorption	0.8%
3	Free Moisture Content	0.4%

Table 3: Test on Fine Aggregate



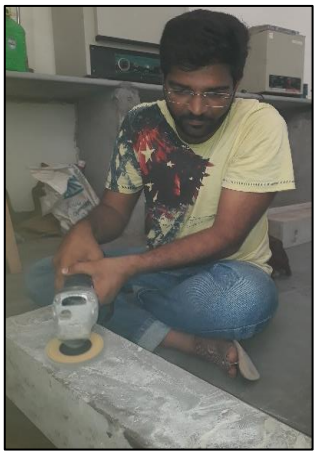
Table 4: Concrete M25 Mix Design

Cement	FA(Sand)	CA(20mm)	CA(10mm)	Water
340.2kg	962.0kg	692 kg	446 kg	167.7 kg

The utmost care was taken to cure the samples. The samples were allowed to cure for 28 days by covering the samples with jute bags.

VII. Testing on Beam

Before the wrapping of the CFRP sheet beam edges should be must smooth using grinding machine.



All beams non-strengthened as well as strengthened tested in this work were tested under two point loading system as shown in figure.



VIII. Testing on Non-Strengthened Beam

Type	Load at 1st crack (KN)	Deflection (mm)
Control A1	37.86	8.90
Control A2	32.59	8.52
Control A3	39.33	8.77

Table 5

Type	Ultimate Load (KN)	Deflection (mm)
Control A1	67.87	11.36
Control A2	62.29	12.20
Control A3	71.13	11.56

Table 6

Type	Load at 1st crack (KN)	Deflection (mm)
Wrapped B1	123.90	5.62
Wrapped B2	124.11	5.21
Wrapped B3	124.36	6.11

Table 7

Type	Ultimate Load (KN)	Deflection (mm)
Wrapped B1	184.68	7.70
Wrapped B2	182.29	7.31
Wrapped B3	183.66	8.19

Table 8

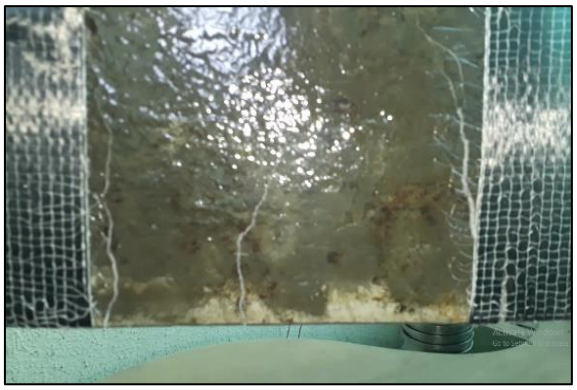
IX. Conclusion

The mechanism adopted in this study shall be recommended since all the beams failed in flexure only instead of shear.

All rights reserved by *www.ijsrd.com*

The maximum increase the load carrying capacity of the strengthened beam is 2.74 % as compare to the non-strengthened.

The deflection of the beam with strengthened of CFRP sheet it's reduce to about 1.5 % at the ultimate loading.



As per the design the beam strengthened in shear and it's fail in flexure which shown in above figure.

REFERENCES

[1] Mital.P, Aadil M. (May 2017). Shear strengthening of RC beam using ferro-cement and micro-concrete. IJCIET. 08 (05), 881-894.
[2] gugulothu rambabu. (March 2016). Strengthening of Reinforced Concrete Beams Using Glass Fiber Reinforced Polymer. IJRD. 2 (3), 8-16.
[3] Nibin.M, Prof.A.Kumar. (Jan 2017). Strengthening of Reinforced Concrete Beams Using Glass Fiber Reinforced Polymer Composites. International Journal of Engineering Science and Computing. 7 (1), 4258-4261.
[4] Sarita R. Khot, H.S.Jadhav. (June 2015). Reinforced Concrete Beam Externally Bonded With GFRP Plates. International Research Journal of Engineering and Technology. 2 (3), 1777-1784.
[5] Mohamed Asick Umar .H, Manikandan .T. (April 2016). Flexural Retrofitting of RC beam Using Hybrid Laminates. International Journal of Science and Research. 5 (4), 2329-2333.
[6] T.H.Patel, Dr.K.B.Parikh. (Sept 2016). Strengthening of Reinforced Concrete Beams with Glass Fiber Reinforced Polymer Sheet with Different Configurations in Shear and Flexure. 7th International Conference on Recent Innovations in Science, Engineering and Management. 2 (3), 152-163.
[7] Nadeem A. Siddiqui. (May 2009). Experimental investigation of RC beams strengthened with externally bonded FRP composites. Latin American Journal of Solids and Structures. 6 (3), 343-362.
[8] K.V. venkatesha, K.balaji Rao, S.V. Dinesh, B.H. bharatkuma, M.B. anoop, balasubraminian, S.R., Nagesh R. Iyer. (2012). Experimental Investigation of Reinforced Concrete Beams with and Without CFRP Wrapping. Slovak journal of civil engineering. 20 (3), 15-26.

All rights reserved by *www.ijsrd.com*