

# To Increase Strength of Beam using Carbon Fiber Reinforced Polymer Sheet

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**Abstract**— As infrastructure is developing now a days, infrastructure development is raising at pace. Many reinforced building are constructed annually around globe. There are many situation in which structure would require strengthening, stiffness, ductility and durability. Column and beam may be strengthened in flexure through CFRP bonded to their tension side using as epoxy as adhesive. Due to many uses of CFRP over other conventional techniques used for structural repairs, therefore use of CFRP is increased. This paper makes comparative studies of plain concrete cement beam and CFRP bonded on various side. An Experimental Study is carried out to study the change in the structural behavior of RCC beams wrapped with carbon fiber of different thickness orientation and length to enhance the flexural and shear capacity of the beams along the existence practice of doing repair work.

**Key words:** Beam, CFRP Sheet, Strength

## I. INTRODUCTION

A CFRP means carbon fiber reinforced polymer or carbon fiber reinforced thermoplastic this fibers are strong and light they also have high strength to weight ratio and also are rigid so they can be use in different fields also. CFRPs are composite material, this composite material have two parts reinforcement and matrix. The reinforcement provide strength while matrix is resin such as epoxy for binding. Now a days CFRP is thoroughly studied in structural engineering, main advantage of CFRP is it is cost effective it is also a strengthening material when mixed with concrete, masonry, steel, timber structure. It is also used in retrofitting industries in wide scale and it dominates the retrofitting industries it considerably increase the load carrying capacity. CFRP is a wrapping fabric. Recently a study is being going on replacing steel bar with CFRP bar because of its resistance against corrosion and light weight which substantially reduces dead load on Structure.

## II. OBJECTIVE

In this paper Research is going to be compare Between plain concrete beam and Concrete Beam with a CFRP wrapped beam, it will be done in three cases, firstly CFRP will be wrapped only on Tension side of the beam, secondly CFRP will be wrapped on two side of the beam i.e. on two parallel side and thirdly it will be wrapped on all three side of Beam. The scope of wrapping the CFRP is to check the strength between plain concrete beam and the CFRP wrapped beams.

## III. LITERATURE REVIEW

1) Zhichao Zhang, Cheng-Tzu Thomas Hsu, Jon Moren (2004) “In this paper the researcher provided deep beam with longitudinal reinforcement and than the sheet of

carbon fiber reinforced polymer is applied and strength increases

- 2) Antonio Nanni, PhD, PE (2000) “In this research paper he used carbon fiber in reinforced and in prestressed structure for retrofitting instead of using steel plates. In this paper after USING CFRP the strength increased. He placed carbon fiber only where it was used i.e for retrofitting structure”
- 3) Prof. B. E. Gite, Miss. Suvidha R. Margaj “In this paper basically Prof. B. E. Gite, Miss. Suvidha R. Margaj told us how CFRP is the important material and what the different quality it possess are. Various properties of CFRP are explained in this paper.”
- 4) Prof ChakrapanTuakta (2005) “In this paper prof. CHAKRAPAN TUAKTA showed us how CFRP is used in bridge repairing, there are 3 cases where he used CFRP.”
- 5) G.P.A.G. van Zijl and P. A. de Vries (2005) “In this paper the researcher used CFRP in masonry wall to control cracks and by using CFRP the cracks are controlled in Masonry wall.”

## IV. METHODOLOGY

The plain concrete beam along with Beams with CFRP wrapped on single side, two parallel side and on three side are tested on flexural testing machine the result of all the beams are compared . Now a days Carbon fiber is mostly used for retrofitting and repairing. But if it resists a significant load than it can also be used for under reinforced and pre stressed structure. Therefore I am going to check the load carrying Capacity of the CFRP wrapped beams. The concrete used was of the grade M25. Total of 12 beams were casted for 7 days and 28 days respectively, the proportion of coarse, fine, cement requirement is as follows.

M25 grade proportion is equal to 1:1:2.

Material	For 1 beam of size 1000*1000*1000mm	For 24 beams of size 500*100*100 mm
Cement	11.58bags	1.33 bags
Fine Aggregate or Crush sand	10.64 kg	1.27 kg
Coarse Aggregate	20.48 kg	2.45 kg
CFRP	36*10 <sup>6</sup> mm <sup>2</sup>	1800*10 <sup>6</sup> mm <sup>2</sup>

Table 1: Quantities of Material required for beam of size 500\*100\*100mm

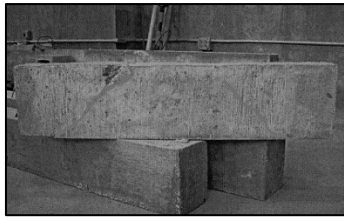


Fig. 1: Plain Concrete Beams of dimension 500\*100\*100mm.



Fig. 2: Failure of Beam with CFRP on tension side of dimension 500\*100\*10mm.



Fig. 3: Failure of Beam with CFRP on two parallel side of dimension 500\*100\*100mm.

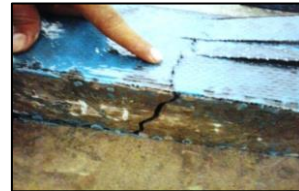


Fig. 4: Failure of Beam with CFRP on all three side of dimension 500\*100\*100mm.

Sr. No For 7 and 28 Days	Plain Concrete Beam (KN)	Beam Wrapped on Tension Side (KN)	Beam Wrapped on Two Parallel Side (KN)	Beam Wrapped on All Three Side (KN)
1	18	21	19	30
2	17	23	18.5	24
3	18	21	19	27
Average of 7 Days	17.66	21.66	18.83	27
4	27.5	36	33	43
5	27	32	28.5	44
6	26	34	27	42
Average of 28 Days	26.83	34	29.5	43

Table 2: Load carrying capacity of various beams

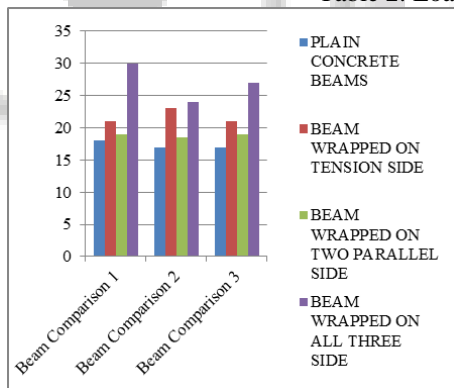


Fig. 5: Results of beam cured for 7 Days

X-axis = Loads in KN

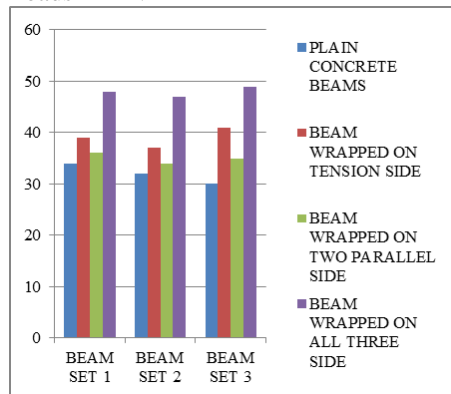


Fig. 5: Results of beam cured for 28 Days

X-axis = Loads in KN

## V. RESULT

By checking the results of the present studies the beam wrapped on three side had greater strength than beam wrapped on tension and two parallel side. However beam wrapped on tension side considerably gave a good amount on increase of strength. From the economic and cost effective point beam wrapped on tension side can be treated more effective.

Sr. No	Beam description	Increase in Strength of beam in %
1	Plain Concrete Beam.	--
2	CFRP wrapped on Tension side of beam	23.57
3	CFRP wrapped on two parallel side of beam	09.47
4	CFRP wrapped on three side of beam.	46

Table 3: Increase in strength of CFRP Beam compared to Plain Concrete Beam.

## VI. CONCLUSION

From the present study the flexural strength was compared between the plain concrete beam and CFRP wrapped beams. The centre loading flexural testing Machine was used. The CFRP wrapped on all three side of beam gave more strength than CFRP wrapped on Tension side and two parallel side. But CFRP wrapped on Tension side gave considerably Good

strength, so from economical point the CFRP wrapped on tension side can be treated more effective .By Flexural Increase in Strength the section become more effective.

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#### REFERENCES

- [1] Zhang, Z. and Hsu, C. T. T. (2002). "Shear strengthening of RC beams using carbon fiber reinforced polymer strips." Proc., 15th EngineeringMechanics Conf., ASCE, Reston, Va
- [2] Antonio Nanni, PhD, PE (2000) "Shear friction, deep beams, corbels, discontinuity regions, and joints." Reinforced concrete mechanics and design, 679–730.
- [3] Prof. B. E. Gite, Miss. Suvidha R. Margaj" "Shear strengthening of RC beams using fiber reinforced polymer laminates." PhD dissertation, New Jersey Institute of Technology, Newark, N.J.
- [4] De Lorenzis, L. (2000), "Strengthening of RC Structures with Near-Surface Mounted FRP Rods", MSc Thesis, Department of Civil Engineering, The University of Missouri – Rolla, Rolla, MO, 175 pp.
- [5] De Jong, P. (1992). "Lessons from damage events in the building industry." Cement, 2, 26–28.

