International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 5.22 (SJIF-2017), e-ISSN: 2455-2585
Volume 4, Issue 11, November-2018

Study on Flexural Strengthening of Corroded R.C Beam with Basalt Fiber Sheet

Prakash Bharvad[1], Abbas Jamani[2].

[1]*Dept. of Structural Engineering, L.J Institute of engineering and technology,*
[2] *Dept. of Structural Engineering, L.J Institute of engineering and technology,*

Abstract*— The presents examination manages the conduct of bars having fluctuating levels of corrosion, for example, 5%, 10% and 15% mass losses of re-bar and the impact of Basalt fiber sheet wrapping on Beam its flexural behaviour. Aggregate of 78 beams examples will be casted which will include of 6 control examples. The control example will be of non-corroded in gathering of 3 each for review of M-20 and M-25. 36 beams will be casted with M-20. From 39beams gathering of 3 beams for 5%, 10% and 15% corrosion and its wrapping by 4 wrap pattern of basalt fiber sheet. Like 39 beams for M25 will be casted. Furthermore, result is contrasted and the compared with normal sample beam. Basalt fiber retrofitting with U-wrapping Pattern enhanced a definitive load conveying limit and flexural Strength of corroded beams altogether high than another wrapping design.

Keywords*— Strengthening of beam, Corrosion of re-bar, Wrapping Pattern, Flexural strength, Basalt fiber sheet.

I. INTRODUCTION

There are Several present structures all around the globe, that don't fulfil the desired needs as it was expected for. These failures area unit due factors like failure of bonding between beam-column rebar corrosion, and to aspects explosive loading like earthquake, impact, etc.

As a human body matured with time similarly way structure or any buildings are also matured. With the passes of time structure strength of structure is reduced slowly. In adding to that building has to face considerable annoyance from atmosphere. Due to that structural integrity lowers down with period. The degradation of structure such as Building, industrial shade, Bridge and water structure are essentially due to destructive atmosphere, chemical atmosphere, poor maintenance and corrosion of steel etc. This despoiled structure cannot take load for which it is calculated.

In such conditions there there are two potential solutions: Strengthening and Dismantle of Structure. Full structural Dismantle might need disadvantages like high prices for material and labour, a stronger environmental impact and once potential, it's usually higher to repair or upgrade the structure by Strengthening.

FRP strengthening works are prepared usually with the help of Carbon fabric and glass fabric. Those are high strength FRP Fabrics. High strength fabrics are surrounded with suitable resin and attached to surface. FRP are present in market in various forms Like bars, Grids, plate and fabric. Out of them fabric and sheets are more commonly used for strengthen the present building because of better flexibility associated to other forms.

II. MATERIAL PROPERTIES.

A. Cement

OPC of 53 Grade factory-made by Abuja cement was utilised in concrete mixes conforming to IS-8112. With specific gravity of cement is 3.15.

B. Sand

Natural river sand is used as fine aggregate. conforming to IS: 2386 (Part III)-1963, the water absorption of the sand is 1.70% and bulk specific gravity is 2.65, in oven dry condition

C. Aggregate

as coarse aggregate wrinkled stones of max size 20 mm are used. As per conforming to IS: 2386 (Part III)-1963 [6], the water absorption of the aggregate is 0.80% and bulk specific gravity is 2.85, in oven dry condition

D. Water

to prepare the concrete mix Portable water was used.

E. Basalt fiber

Basalt fiber may be a material made up of very fine fibres of volcanic rock, volcanic rock fiber is essentially fiber variety of volcanic rock rocks. So, volcanic rock fibres sustain the majority properties that volcanic rock rocks possess. volcanic rock rocks are volcanic dense rocks. it's not Associate in Nursing organic product, therefore it'll not degrade with time. The volcanic rock fiber is somewhat additional economical as a result of no the other additives gift in it. it's sensible lastingness, and conjointly has sensible resistance to chemical attack, impact load and hearth with less toxic hazes

TABLE I
PROPERTY OF BASALT FIBER

Property	Results
Appearance	Black Grey
diameter of Fiber (µm)	13-20
Fiber Thickness (mm)	0.14
Density of Fiber, (g/cm²)	2.8
tensile strength of Fiber, (MPa)	3050
Woven Pattern	Uni-directional

F. Epoxy Resin

An organic compound synthetic resin is used as binding agents with high tensile strength the higher consistency epoxy resin will be used for surface coating or filling larger cracks or holes. Hardener and epoxy glue are employed for connection of the basalt fibre sheet.

III. MIX PROPORTIONS.

A standard mix M20, the W/C ratio were 0.50 and M25, the W/C ratio were 0.45 grade was designed as IS 10262-2009. The mix proportions are given in table-2

TABLE II
PROPORTIONS OF MIX DESIGN SCC

Material	M-25	M-20
Cement	354 kg/ m^3	311 kg/ m^3
Fine aggregate	731 kg/ m^3	869 kg/ m^3
Coarse aggregate	1193 kg/ m^3	1186 kg/ m^3
Water	160 Liter	155 Liter

IV. EXPERIMENTAL WORK.

A. Reinforcement Detail

4 no-10mm Día (2- top, and 2- Bottom) As a main steel and 8mm Dai @ 100 mm c/c As a Shear steel

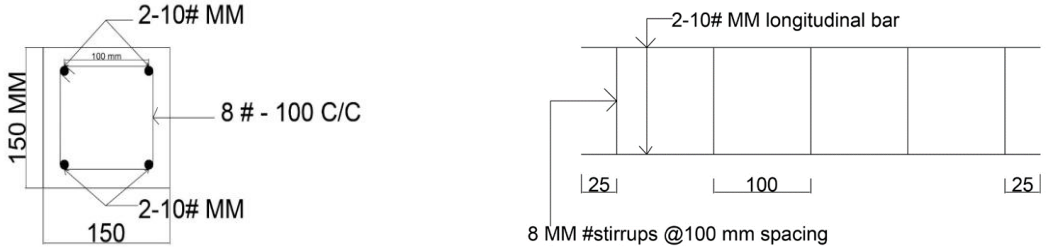

Fig. 1 Detail of Re-bar

B. Corrosion of Reinforcement

The corrosion is persuading in to the Re-bar was completed by using the Hydrochloric acid The Re-bar were put in to the container which is filled with hydrochloric acid and were time measured for persuading closely the corrosion that was essential thickness wise. Vermeer callipers is used to find out Thickness of Re-bar. Previously later

TABLE III
CORROSION DETAILS

Corrosion rate	Día of Re-bar previously corrosion	Día of Re-bar later corrosion	Measured time	Weight loss (%)
5	10mm	9.5mm	304 min	4.97
10	10mm	9mm	614 min	9.86
15	10mm	8.5 mm	917 min	14.93

C. Casting of Beams

Aluminium shuttering is utilised for forming the beam. Appropriate greased is done on Aluminium shuttering for without difficulty removing the shuttering without damage the beam. Beams were reinforced as demonstrated in figure-2.

Fig. 2 Re-bar and Beam Casting

D. Test setup of beam.

Beams are tested under UTM with capacity of 2000kN, arrangement is shown in Fig. 3.

Fig. 3 Beam Testing under (UTM).

As shown in Overhead figure the test arrangement of beams. It contains of hydraulic jack through weight is applied on beams, the beam is put over the steel rollers to support the beam.

TABLE IV
INITIAL CRACK AND ULTIMATE LOAD.

Sr No	Beam Notification	Loads at Initial Crack (kN)	Ultimate load (kN)
1	CB -20	48.34	63.4
2	5CB -20	44.96	59.20
3	10CB – 20	41.38	56.22
4	15CB - 20	38.67	53.48
5	CB -25	64.10	86.97
6	5CB -25	59.38	80.70
7	10CB - 25	57.48	76.48
8	15CB - 25	52.87	72.82

E. Retrofitting of Beams

Hand lay-up methodology is employed for Strengthening of beams. The surface of the beam once rough with steel Wire brush then cleansed with water to get rid of all dirt's for the right bonding with fibre sheets.

A layer of epoxy and Harder 2:1) is applied at an acceptable thickness of regarding one millimetre with help of brush. The basalt fiber sheets were measured and move the required form and dimensions.

The basalt Fiber sheet were placed on surface of beam and lightly pressed onto the coated synthetic resin.

Fig. 5 Surface Preparation and Appling Basalt fiber on Beam.

V. RESULTS.

TABLE V
STRENGTH INCREASES OF RETROFITTED BEAM FOR M-20

Sr No	Wrapping pattern	Avg. Strength in (N/mm^2)		
		5%	10%	15%
1	Full -U	66.63	65.82	66.75
2	Strip	55.46	49.35	49.26
3	Bottom	41.72	40.88	39.19

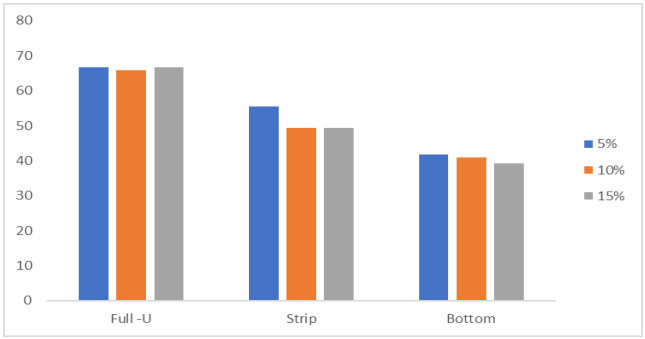

Fig. 5 Strength Increases of Retrofitted beam for M-20

TABLE VI
STRENGTH INCREASES OF RETROFITTED BEAM FOR M-25

Sr No	Wrap- pattern	Avg. Strength (N/mm^2)		
		5%	10%	15%
1	Full -U	66.42	66.33	66.46
2	Strip	50.54	49.27	50.89
3	Bottom	40.90	41.20	40.50

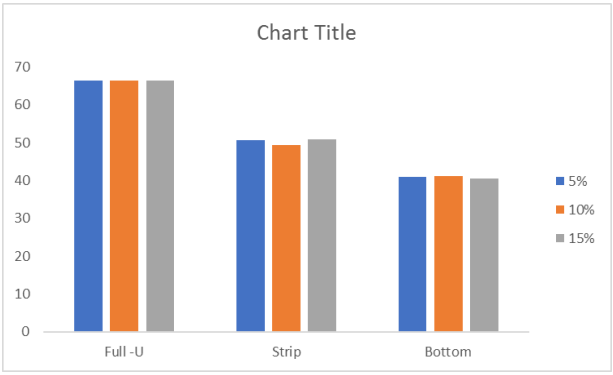

Fig. 6 Strength Increases of Retrofitted beam for M-25

TABLE VII
FLEXURAL STRENGTH OF RETROFITTED BEAM FOR M-20

Sr No	Wrap- pattern	Avg. Flexural Strength (N/mm^2)		
		5%	10%	15%
1	Full -U	13.64	12.89	12.66
2	Strip	12.32	11.61	11.04
3	Bottom	11.60	10.95	10.29

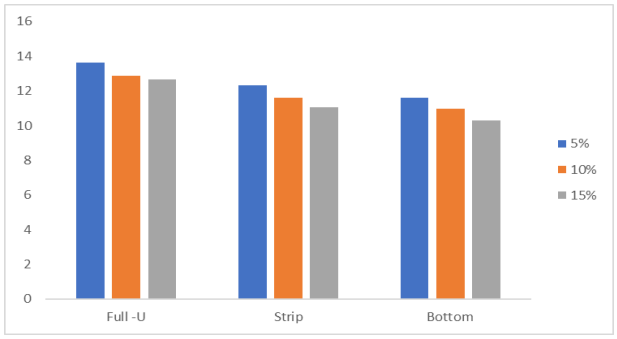

Fig. 7 Flexural Strength of Retrofitted beam for M-20

TABLE VIII
FLEXURAL STRENGTH OF RETROFITTED BEAM FOR M-25

Sr No	Wrap-pattern	Avg. Flexural Strength (N/mm^2)		
		5%	10%	15%
1	Full -U	18.56	17.59	16.76
2	Strip	16.80	15.78	15.19
3	Bottom	15.72	14.93	14.15

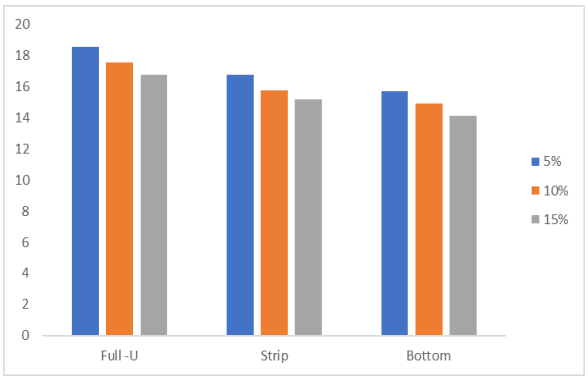

Fig. 8 Flexural Strength of Retrofitted beam for M-25

VI. CONCLUSION.

The outcomes demonstrate with increments of corrosion rate of re-bar reduce the load carrying capacity of beam specimens.

The outcomes demonstrate that the corroded beam specimens have low ultimate load carrying capacity with respect to normal beam specimens.

With the assistance of outside wrapping of basalt fiber on beams flexural strength of retrofitted beams are increments.

Retrofitting of beam specimens with basalt fiber sheet in U- Wrapping pattern enhance a flexural Strength and ultimate load carrying capacity of corroded beam specimens are high than another wrapping pattern. For both grade of concrete (M-20 and M-25) and different rate of corroded beams (5%, 10%, and 15%).

The results indicate that Basalt fiber sheet can be used as a suitable retrofitting material for Corroded Beam specimens.

REFERENCES

[1] Anandakumar, R., et al. "Durability Study on Basalt Fibre Reinforced Polymer (BFRP) Composites Wrapped Specimens for Retrofitting of RCC piles."International Journal of Engineering Research and Technology. Vol. 3. No. 11 (November-2014). ESRSA Publications, 2014.

[2] Gang Wu; Yi-Hua Zeng "Experimental Study on the Flexural Behavior of RC Beams Strengthened with Steel-Wire Continuous Basalt Fiber Composite Plates" American Society of Civil Engineers- 2013.

[3] Balamuralikrishnan R., and Jeyasehar C. A. (2009), "Flexural behaviour of RC beams strengthened with Carbon Fiber Reinforced Polymer (CFRP) fabrics", The Open Civil Engineering Journal, 3, 102-109.

[4] Ceroni F. (2010), "Experimental performances of RC beams strengthened with FRP materials", Construction and Building materials, 24, 1547-1559.

[5] Maariappan, R. Singaravadivelan. "Studies on Behaviour of RCC Beam-Column Joint Retrofitted with Basalt Fiber Reinforced Polymer Sheet." Global Journal of Research In Engineering 13.5 (2013).

[6] Yinh, Seyha, et al. "Flexural Behavior of Reinforced-Concrete (RC) Beams Strengthened with Hemp Fiber-Reinforced Polymer (FRP) Composites."Materials Science Forum. Vol. 860. Trans Tech Publications, 2016.

[7] IS 456-2000 – "Code of Practice is an Indian Standard code of practice for general structural use of plain and reinforced concrete", Bureau of Indian Standards.

[8] IS 10262:2009, "Guidelines for concrete mix design proportioning", Bureau of Indian Standards .

[9] IS: 383-1970, "Specification for Coarse and Fine Aggregates from natural sources for Concrete", Bureau of Indian Standards.