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Experimental study on Retrofitting of RC beam using Basalt Fibers

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Abstract- *In this research the flexural of basalt fiber fabric sheet strengthened reinforced concrete (RC) beams of M25 grade of concrete. The experimental program was including strengthening and testing. Simply supported rectangular beam of size 150*250*1000 strengthened with sheets. Total fifteen specimens were tested. Which are three beam specimens was tested as control beams and remaining for founded various damage degrees. The results indicate that the load carrying capacity of beams will significantly increased as the number of the basalt fiber fabric layer will be increased. In order to study the flexural behaviour of the beam, the specimen was only subjected to two point loading mechanism only. The beams was wrapped with basalt fiber sheets in single u-type layering, double u-type layering, double bottom layering, double layering along the different strength of the beam. The results have been analyzed and useful conclusions have been drawn.*

Keywords – *RCC Beam, Basalt fiber, single U-type layering, double U-type layering, double bottom layering, double layering*

1. INTRODUCTION

A structure is designed for specific period and depending on the nature of the structure, its design life varies. For a rc structure, design life over of the structure. For domestic structure life is twenty five year and public building fifty year. [1] Deterioration in concrete structure is a major challenge faced by the infrastructure and bridge industries worldwide. The deterioration can be mainly due to environmental effects, which includes corrosion of steel, gradual loss of strength with ageing, repeated high intensity loading, variation in temperature, freeze-thaw cycles.[2] As complete replacement or reconstruction of the structure of the structure will be cost effective, strengthening or retrofitting is an effective way to strengthen the rc structure.[2]

Basalt fiber- Basalt fiber is a material made from extremely fine fibers of basalt, which is composed of the minerals plagioclase, pyroxene, and olivine. It is similar to carbon fiber and fibreglass, having better physic mechanical properties than fibreglass, but being significantly cheaper than carbon fiber.

Table.1 Properties of basalt fiber

Tensile strength (Mpa)	2100
Thickness(mm)	0.32
Area weight(g/m^2)	300±20
Woven pattern	Unidirectional
Cost of fiber(per meter)Rs.	750

1.1. OBJECTIVE

- To find the performance of RC beam strengthening with concrete
- To find the performance of concrete specimen under uniaxial tension test and four point loading test
- RC beam strengthening with fiber
- To investigate new shape of wrapping of fiber on beam.

2. METHODOLOGY AND RESULTS

Table.1: Specification of beam for flexural test

Sr. No.	Types of beam	Number of beam	Size of beam 150*250*1000
1	Control beam	3	CMB
2	U-type wrapping	3	CU
3	Double U-type wrapping	3	CCU
4	Double layer bottom wrapping	3	CD
5	Double wrapping	3	CBD

Table.2: Arrangement of reinforcement

Specimen	No of specimen	Size of beam	Top bar	Bottom bar	Stirrups
Weak in flexural	15	150*250*1000	2no.- 12mm	2no.-12mm	8mm @ c/c 190mm

2.1. EXPERIMENTAL SETUP FOR BEAM TESTING:

Experimental setup is kept for the Beam in flexure In this experiment double point are applied at centre. Span of the beam are kept 1000 mm c/c. 50 mm of hang kept on both side of the beam. Deflections are measured only at centre. Double point load setup used for applying load is of 100 tones capacity.

Figure 2: experimental set up

2.2. Casting, curing and basalt fiber fabric layering of Beam:

First mould is lubricating properly by engine oil. First steel cage are kept into mould. After that mix material are casted into mould. Casted materials are properly compacted first by hand and then they are compacted by small needle vibrator. After properly compaction surfaces are levelled and batch name and date are carved on green concrete. After 24 hours beams are unmolded. For each batch two numbers of cubes are casted and compacted properly.

Figure. 2: curing and layering

2.3. RESULTS AND DISCUSSION

2.3.1. CONTROL BEAM

Size of beam mm	Notation	Ultimate load (kn)	Flexural strength (n/mm^2)
150*250*1000	Cmb1	137.8	18.23
	Cmb2	138	18.26
	Cmb3	138	18.26

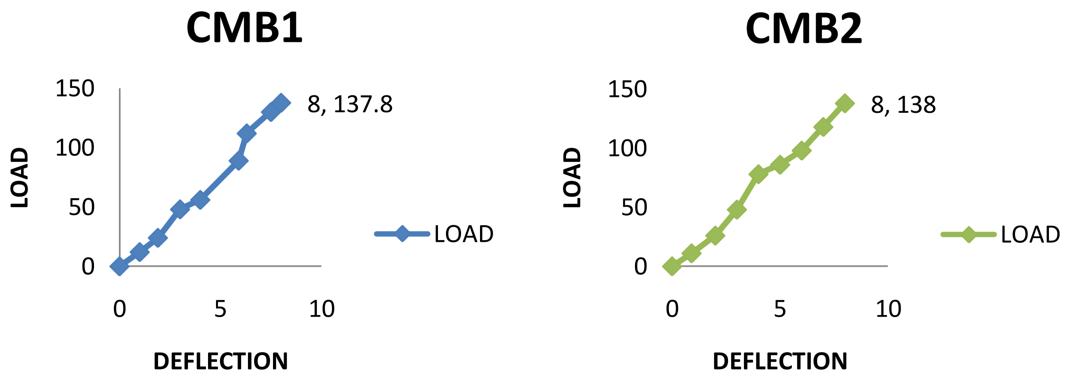


Figure.3: load VS deflection graph

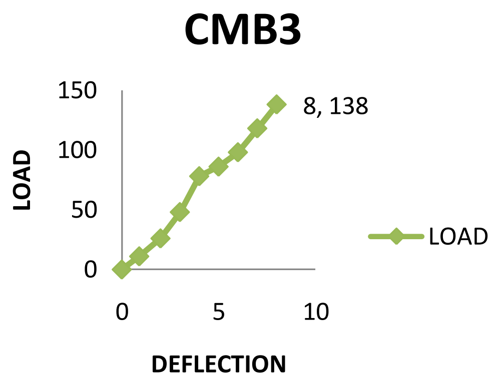


Figure.4 : load VS deflection graph

2.3.2. U – type layering

Size of beam (mm)	Notation	Ultimate load (kn)	Flexural strength (n/mm^2)
150*250*1000	Cu1	141	18.65
	Cu2	141	18.65
	Cu3	142	18.79

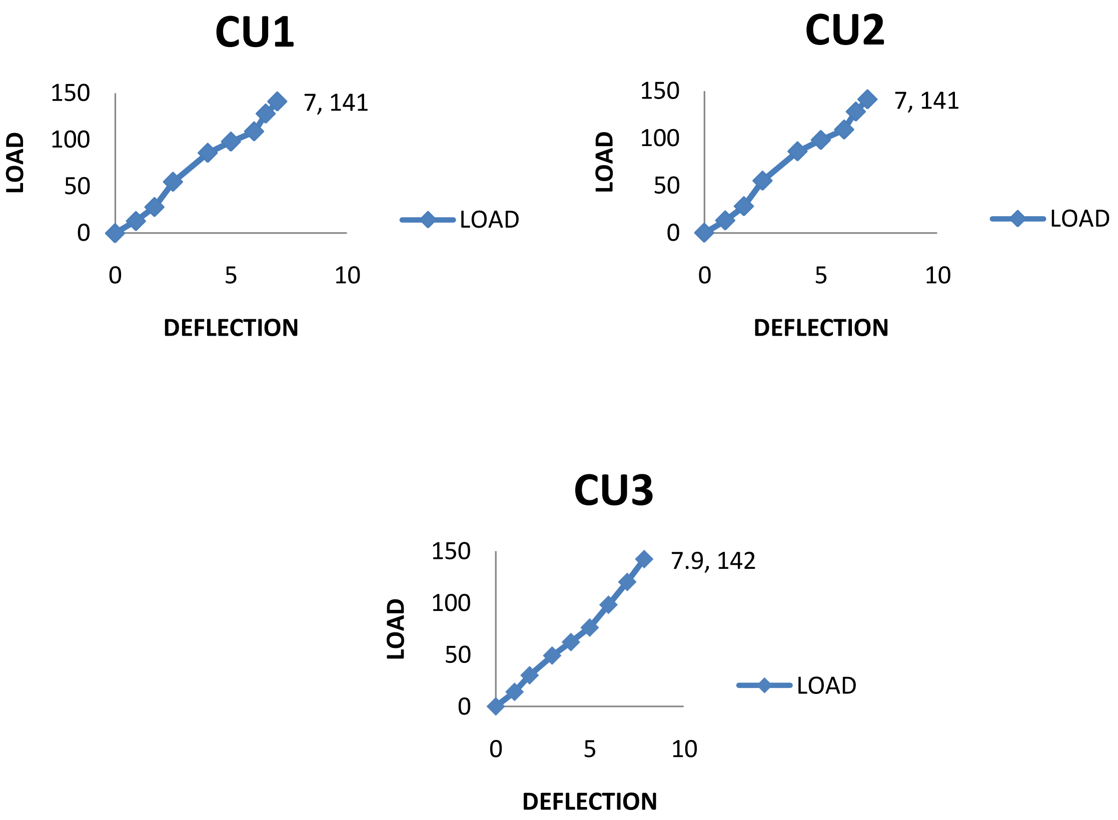
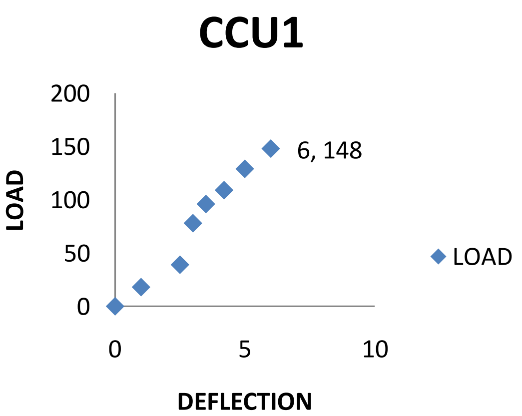
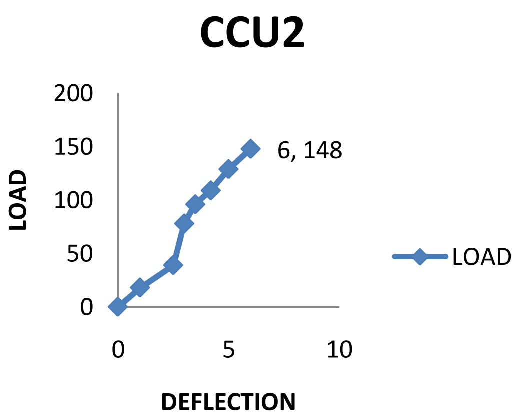


Figure.5: load VS deflection graph

2.3.3. DOUBLE U-TYPE LAYERING

SIZE OF BEAM(mm)	NOTATION	ULTIMATE LOAD (KN)	FLEXURAL STRENGTH(N/mm^2)
150*250*1000	CCU1	148	19.58
	CCU2	148.19	19.60
	CCU3	149.5	20





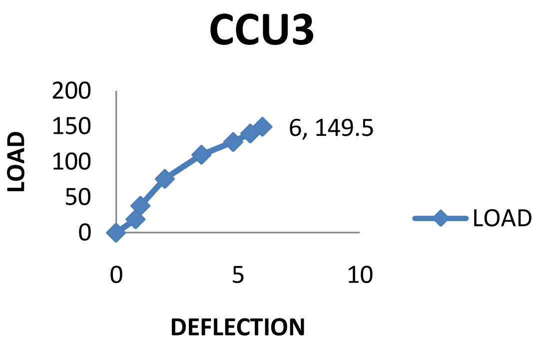


Figure.6: load VS deflection graph

2.3.4. DOUBLE LAYERING

SIZE OF BEAM(mm)	NOTATION	ULTIMATE LOAD (KN)	FLEXURAL STRENGTH (N/mm^2)
150*250*1000	CD1	147	19.45
	CD2	148	19.56
	CD3	148.54	19.65

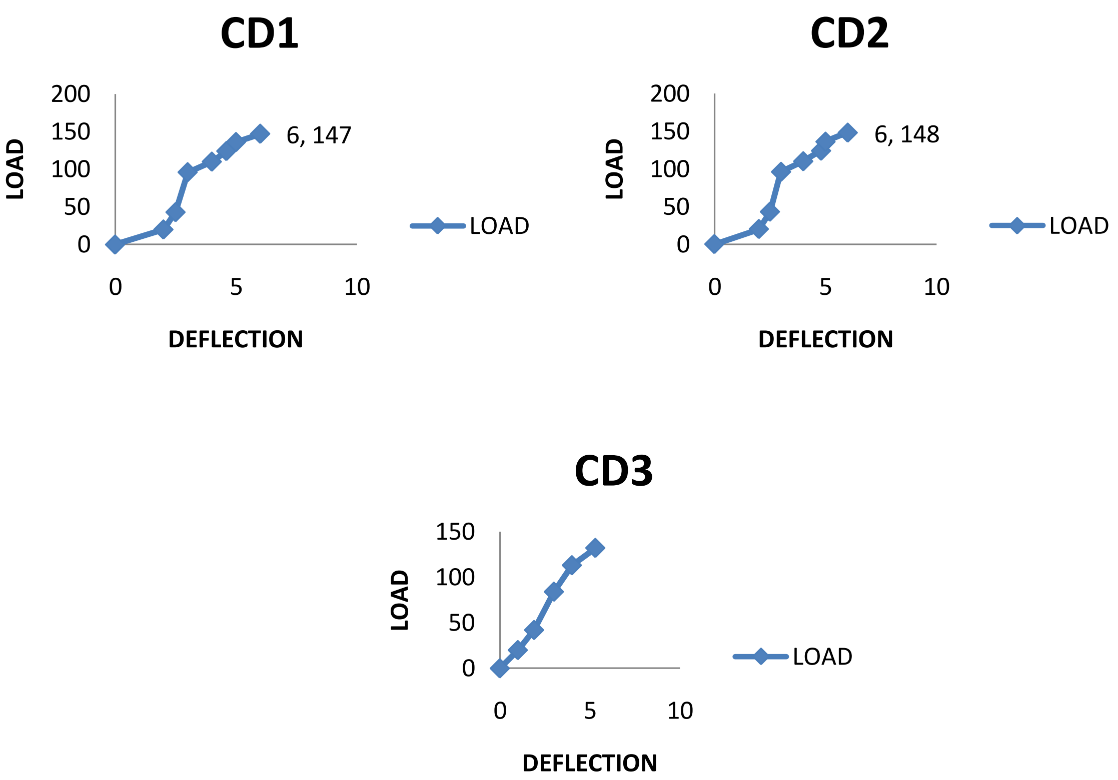
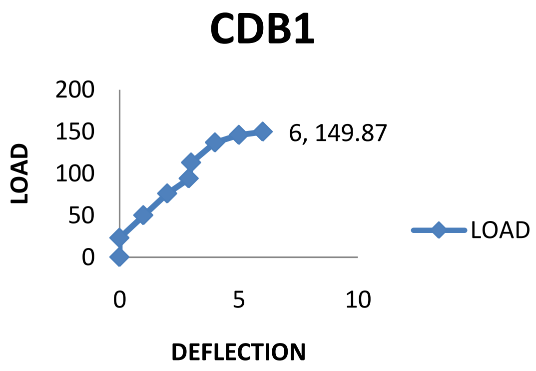
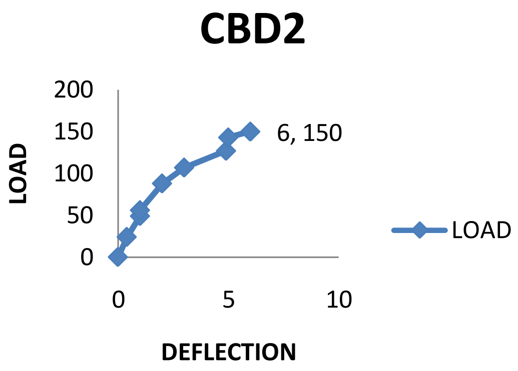


Figure.7 : load VS deflection graph

2.3.5. DOUBLE BOTTOME LAYERING

SIZE OF BEAM(mm)	NOTATION	ULTIMATE LOAD (KN)	FLEXURAL STRENGTH (N/mm^2)
150*250*1000	CDB1	149.87	19.83
	CDB2	150	19.90
	CDB3	150	19.90





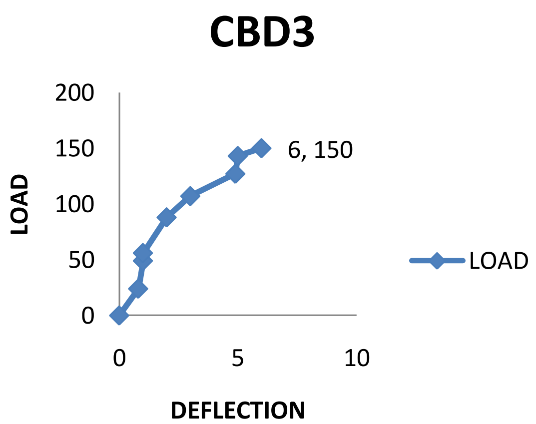
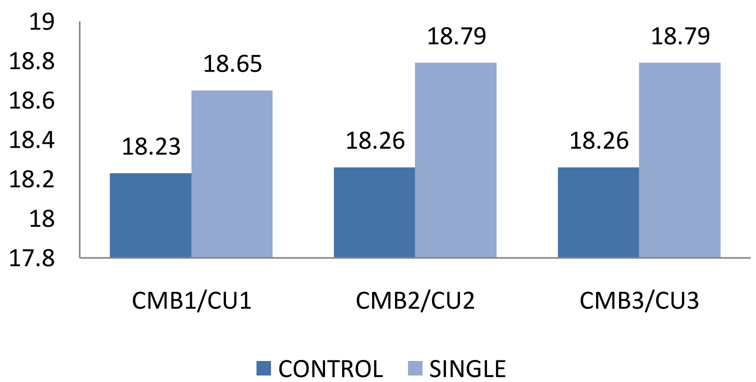


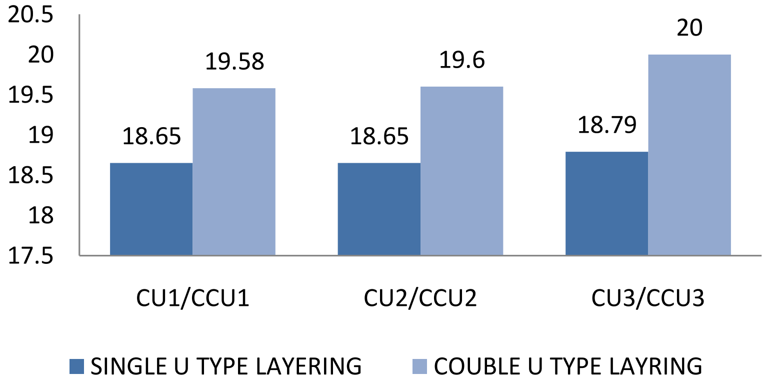
Figure.8: load VS deflection graph

2.4. CONTROL BEAM AND SINGLE U TYPE LAYERING



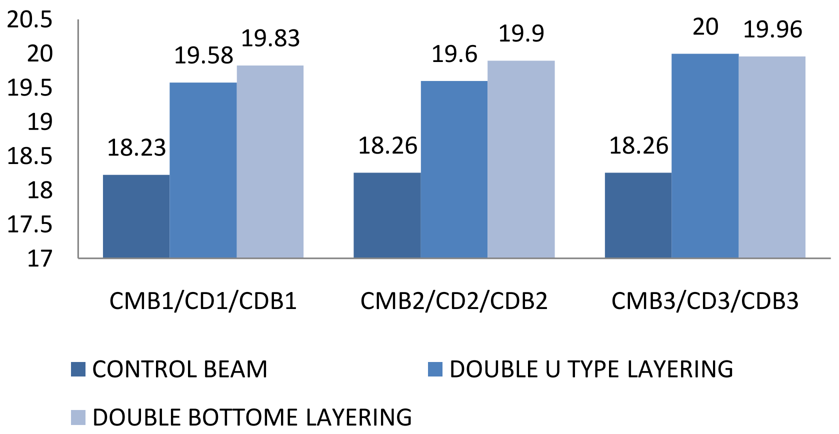
- 8% flexural strength increases by single U-type layering

2.5. SINGLE U TYPE LAYERING AND DOUBLE U TYPE LAYERING



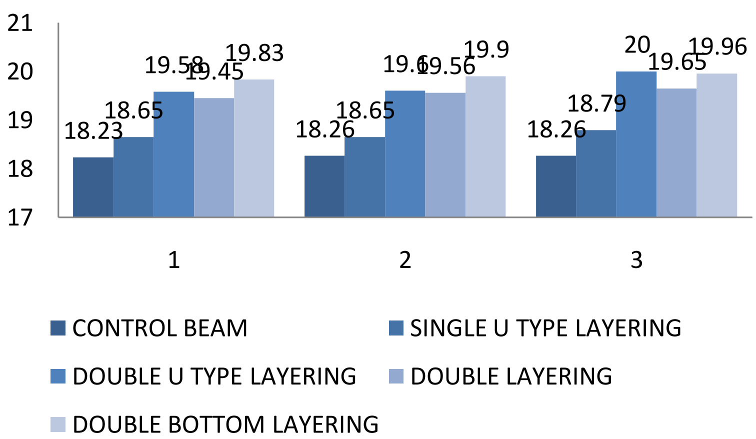
- ➢ 10% Flexural Strength Increasing By Double U-type Layering

2.6. CONTROL BEAM, DOUBLE U-TYPE LAYERING AND DOUBLE BOTTOM LAYERING



- ➢ 11% flexural strength increasing by double bottom layering

2.7. CONTROL BEAM, SINGLE U TYPE LAYRING, DOUBLE U TYPE LAYERING, DOUBLE LAYERING AND DOUBLE BOTTOM LAYERING



- compare to the double layering the double U-type layering and double bottom layering the flexural strength is nearly about same so as compare to double layering using the double U-type layering and double bottom layering is also preferable for layering

3. RESULTS AND DISCUSION

- With the help of external wrapping on bottom it is decently flexural load carrying capacity increases.
- External single U-type layering for beam will increases flexural strength by 8% compare to control beam.
- External single U-type layering and the double u type layering for beam will increases flexural strength 10% compare to single U-type layering.
- Comparison single U-type layering and double U-type layering, 11% flexural strength increased with double bottom layering.
- As compare to double layering the same strength is come in double layering at bottom and double U-type layering.
- compare to the double layering the double U-type layering and double bottom layering the flexural strength is nearly about same as compare to double layering using the double U-type layering and double bottom layering is also preferable for layering

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