Strengthening of RC Beams Using Natural Jute Fiber Wrapping

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Abstract - Natural fibers have lower durability and lower strength than glass fibers. However, recently developed fiber treatments have improved these properties considerably. We have enough natural resources and we must keep on researching on these natural resources. Here an experimental analysis is carried out in order to evaluate the performance of jute fiber fabric designated as NJFRP (Natural jute fiber reinforced polymer) by retrofitting on reinforced concrete beams. Totally seven beams were casted, one is control beam and other beams are retrofitted with NJFRP(2no.full wrapping, 2no.partial wrapping, 2no.bottom wrapping).The results of all the beams retrofitted are compared with control beam and results shows, they have carried more ultimate load compared to that of control beam specimen.

Keywords - RC Beams, Jute Fibre, Polymer.

I. INTRODUCTION

Concrete is one of the most versatile construction materials. The same is now being used in all types of Civil Engineering structures. Its flexibility in giving desired shape, economy and other features made it as one of the preferred building materials. Result is that, now most of the Civil Engineering structures are made of concrete. During the initial stage, it was thought that concrete will be maintenance free structure. Later on, this myth has proved wrong. Due to majority of Civil Engineering structures being RCC and on account of its requirement of maintenance, quantum of such rehabilitation/strengthening work has also increased tremendously.

II. OBJECTIVE OF THE STUDY

The main objective of the research work includes the following:

1. To evaluate the effectiveness of the external natural fiber wrapping technique inretrofitting of as built RC concrete beam.

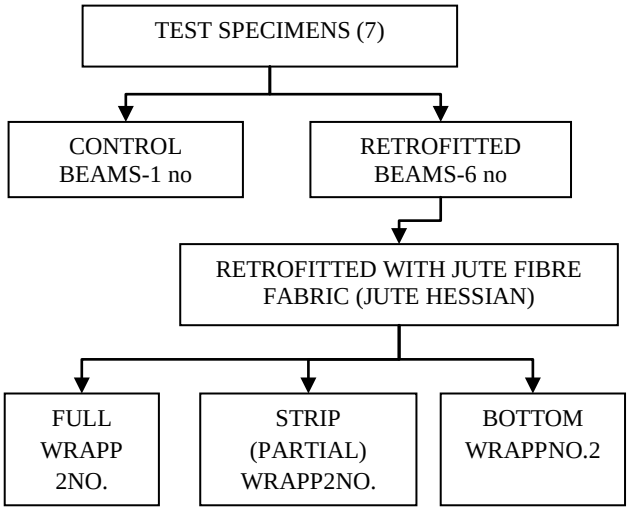
2. To study the ultimate load carrying capacity of the specimens retrofitted bynatural fiber composites wrapping technique.

3. To replace effectively cheaper and locally available natural fibers to artificialfibers in retrofitting.

4. To compare the load carrying capacity of beams retrofitted with natural fiber withcontrolled RC beam.

5. To suggest the recommendations for practicing engineer

PLANNING OF PROGRAMME



Schematic representation of the experimental program

III. CASTING OF SPECIMENS

1) The beams were designed by limit state method considering the section to be under reinforced according to IS: 456-2000. A prototype beam of (300x450x4000) mm size was designed.

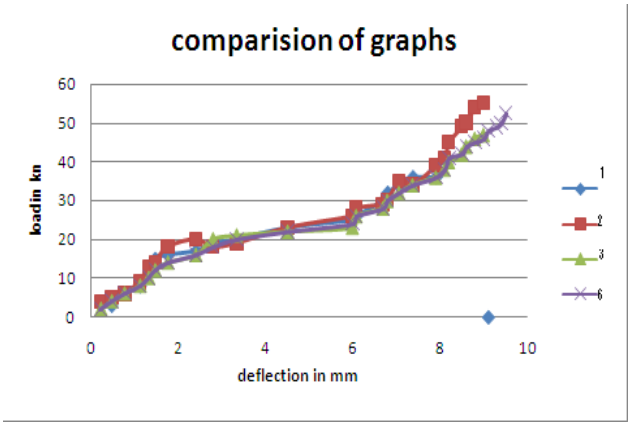
2) Reinforcement details – 2#10 mm diameter bars at tension zone and -2#8mmDiameter at top 8mm stirrups @100mmc/then by model analysis the prototype beam was scaled down using a scale factor 3.

3) The scaled down or model beam was of (100x150x1300) mm size, Moulds of 100x200x1400 mm size were prepared by using steel panels.

4) Concrete of M20 grade was designed as per IS10262 - 2009, the mix Proportion is cement Fine aggregate: Coarse aggregate: 1:2.51:2.43 ratios (is Presented in appendix A) and the concrete First of the entire beam moud was oiled. So that the beams can be easily Demoulded from the mound after 24 hours.

5) As per design, concrete mix was poured in layers and compacted using Mechanical vibrate, the compaction is done until the mould is completely filled and there are no air voids.

6) Along with this, totally 6 number of concrete cubes were also cast and they were tested for 7 and 28 days.

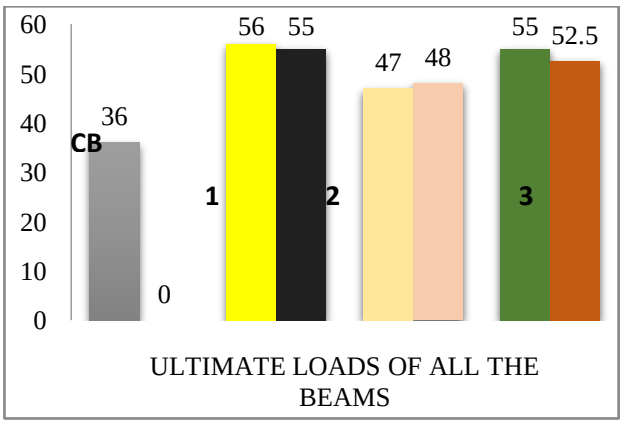


COMPARISON OF FAILURE LOAD

Type	First crack load (kN)	Ultimate load (kN)	Average ultimate load(kN)	Mode of Failure
CB	24	36	36	flexure
NJFRP1	38	54	54.5	shear
NJFRP2	38	55		
NJFRP3	38	47	47.5	flexure
NJFRP4	40	48		
NJFRP5	36	54	53.25	flexure
NJFRP6	40	52.5		

COMPARISON OF FAILURE LOAD

Specimen type	Gauge length of specimen (mm)	Final elongation of the specimen (mm)	Percentage Of elongation (%)	Ultimate Load (N)	Ultimate tensile strength	Average tensile strength	Young's modulus
NJFRP Specimen-1	240	13.2	5.5	2854.6	4.65	4.55	79.11
NJFRP Specimen-2	240	12.9	5.375	2810.3	4.45		



CB-CONTROL BEAM

NJFRP-1(FULL WRAP), NJFRP-2(FULL WRAP), NJFRP-3(PARTIAL WRAP or STRIP WRAP) , NJFRP-4(PARTIAL WRAP or STRIP WRAP) , NJFRP-5 BOTTOM WRAP, NJFRP-6(BOTTOM WRAP)

IV. CONCLUSIONS

From the experimental test results of seven beams and load v/s deflection curves are drawn.

1. Retrofitted by NJFRP composite beams have carried more ultimate load compared to that of Control beam specimen.

2 The load v/s deflection curves reveals that the stiffness of retrofitted beams with NJFRP composite is increased by 7% compared to that of control beams.

3 The flexural strengthening provided was high, which made the beams strong and stiff, because of which full wrapped beams could not fail by flexure so the failed by shear

4. Retrofitted by NJFRP (FULL WRAP) composite beams have carried more ultimate load by about 33.96% compared to that of control beam specimens.

5. Retrofitted by NJFRP (PARTIAL WRAP) composite beams have carried more ultimate load by about 24.3 % compared to that of control beam specimens.

7. Retrofitted by NJFRP (BOTTOM WRAP) composite beams have carried more ultimate load by about 32.4% compared to that of control beam specimens.

REFERENCES

[1] Tara sen and H.N. Jagannatha Reddy (2011),"Finite element simulation of
[2] Retrofitting of RCC beam using coir fibre composites (natural fibre)", International journal of Innovation, Management and Technology, Vol.2, No.2, April 2011.
[3] Tara sen and H.N. Jagannatha Reddy (2011),"Application of Sisal, Bamboo, Coir and Jute Natural Composites in Structural Upgradation", International journal of Innovation, Management and Technology, Vol.2, No.3, June 2011.
[4] Tara sen and H.N. Jagannatha Reddy (2011), "Application of sisal, bamboo, coir and jute natural composites in structural upgradation", International journal of
[5] Innovation, Management and Technology, Vol.2, No.3, June 2011.
[6] Amit Rai1 and C.N. Jha2 (2010),"Natural fibre composites and its potential as building material".
[7] Majid Ali (2010), " Coconut fibre – A Versatile material and application in engineering", Second international conference on sustainable construction materials and technologies, June28-June 30,2010.
[8] Majid Ali1 and Nawawi Chouw2 (2009),"Coir fibre and rope reinforced concrete beam under dynamic loading". The university
[9] A.S Singha and Vijay Kumar Thakur(2008), "Mechanical properties of natural fibre reinforced polymer composites", Bull. Mater. Sci, Vol. 31, No. 5, October 2008, pp. 791–799, Indian Academy of Sciences.
[10] Llewellyn van Wyk(2007), "The application of natural fibre composites in construction: A research case study', Sixth International Conference on Composite Science and Technology, ICCST/6, 22-24 January 2007, Durban, South Africa.
[11] The Effect of Curative Concentration on Thermal and Mechanical Properties of Flexible Epoxy Coated Jute Fabric Reinforced Polyamide 6 Composites Smith Thitithanasarn1*, Kazushi Yamada1, Umaru S. Ishiaku , Hiroyuki Hamada
[12] raw material base of jute industry in india patna university, patna (india) dr. lal keshwar prasad singh. effects of process parameters on tensile strength of jute fiber reinforced thermoplastic composites h.m.m.a. rashed, m. a. islam and f. b. rizvi