International Journal of Current Advanced Research
ISSN: O: 2319-6475, ISSN: P: 2319-6505, Impact Factor: SJIF: 5.995
Available Online at www.journalijcar.org
Volume 7; Issue 1(I); January 2018; Page No. 9351-9355
DOI: http://dx.doi.org/10.24327/ijcar.2018.9355.1543

Research Article

EXPERIMENTAL STUDY ON BAMBOO REINFORCED RUBBER CONCRETE

Jeevan Reddy U and V. Amarnath Reddy

St. Martin's Engineering College, Dhulapally, Hyderabad - 500014

A R T I C L E I N F O

Article History:

Received 11th October, 2017
Received in revised form 10th November, 2017
Accepted 26th December, 2017
Published online 28th January, 2018

Key words:

Bamboo rods, reinforcement, Dial gauge

A B S T R A C T

To take care of the tensile strength steel is commonly used reinforcing material. But because of cost and availability, replacement of steel with some other suitable materials as reinforcement is now a major concern. Though bamboo has been used, which is fast growing and ecologically friendly material for structural applications is being considered as quite appropriate. It is a natural, cheap and also readily available material and also good in tension. This paper presents to study the effect of replacement of steel reinforcement by bamboo reinforcement and replacing 10%, 20%, 30%, 40%, 50% volume of sand by crumb rubber as fine aggregate replacement.

A bending test was performed on conventional concrete and Bamboo reinforced members. This work investigated the the experimental analysis of two simply- supported bamboo-reinforced lightweight concrete beams with an overall length of 500mm and a cross-section of 100 mm by 100 mm width and height, respectively, subjected to two point loads up to collapse are presented. Beams were casted using design mix (M20, M30) as per IS code.The load-deformation curves were drawn, on beams.From these experimental works, the possibility of effective using of 'Bamboo' is discussed.

INTRODUCTION

Problems encountered with the commonly used construction material like steel are rise in cost; degradation of the nonrenewable material, the pollution of the environment due to industrial process etc. are common in the globe. Concrete is the most consumed construction material in the entire world. Concrete is found to have excellent compressive strength but poor in tensile strength. To take care of the tensile strength steel is commonly used reinforcing material. In recent years, steel prices have soared. For developing countries, steel is difficult to obtain because of expensive prices, and for the construction industry, usage of steel is currently limited heavily. Therefore, bamboo has low manufacturing costs compared with steel; bamboo isBamboo is natural, cheap, widely available material. It is strong both in tension and compression. The tensile strength of bamboo is relatively high. Also, it exhibits good flexibility and toughness characteristics.

The strength of bamboo does increase with its age, but the maximum strength occurs at 3-4 years and then begins to decrease in strength. Bamboo is giant grass, not a tree. Bamboo culms are a cylindrical shell divided by solid transversal diaphragms at nodes and have some intriguing properties such as high strength in the direction parallel to the fibers, which run longitudinally along the length of the Culm, and low strength in a direction perpendicular to the fibers. The density of fibers in cross-section of a bamboo shell varies with thickness as well as height. Fiber distribution is more uniform at the base than at the top or the middle. This is because bamboo is subjected to maximum bending stress due to wind at the top portion of the Culm. The strength of bamboo is greater than most of the timber products. The mechanical properties vary with height and age of the bamboo Culm. Research findings indicate that the strength of bamboo increases with age. The function of the nodes is to prevent buckling and they play a role of axial crack arresters One major problem with bamboo is that it is a living organism which is subject to fungi and insect attacks. Bamboo is more prone to insect attack than other trees and grasses because of its high content of nutrients.

Corresponding author:* **Jeevan Reddy U
St. Martin's Engineering College, Dhulapally, Hyderabad – 500014

Its durability varies with the type of species, age, conservation condition, treatment and curing. There is a strong relation between insect attacks and the levels of starch plus humidity content of bamboo Culm. In order to reduce the starch content, bamboo receives a variety of treatments including curing on the spot, immersion, heating or smoke Bamboo can be dried in air, green house, and oven or by fire.Concrete has low tensile strength it is usually reinforced with materials that are strong in tension (often steel). But the cost of steel is high, and it cannot have found everywhere. To overcome this problem civil engineers and scientist were searched for the low-cost material to reinforce the concrete. At last they found bamboo which is used for replacements of reinforcing bar in concrete for low cost constructions. Research had been in progress for long time to find alternatives to the waste tire disposal. Among these alternatives is the recycling of waste-tire rubber. Recycled waste tire rubber is a promising material in the construction industry due to its light weight, elasticity, energy absorption, sound and heat insulating properties.

Details of Specimen of Beams

The 14 beams were tested to investigate their bending performances.In this experimental investigation, beam specimens were cast with conventional concrete and bamboo reinforcement. Similarly, another beams were cast with concrete where fine aggregate is partially replaced with crumb rubber and bamboo reinforcement. The cross sections of the beams were 100 ×100mm, and the lengths of them were 500mm.a beam simply supported subjected to a two-point load at the third span.Design mix ratios adopted were M20and M30 as per IS10262:2009. Bamboo reinforcement adopted were 6 x 4mm.

The details of specimens cast for the beams with conventional concrete similarly beams with concrete and crumb rubber

Size of beam mold (100mm x 100mm x 500mm) and the mould for cube (150 mm x150mm x150 mm).

- Cast bamboo reinforced beams of grade M20, and M30 without replacing crumb rubber and cubes of grade M20, and M30 without replacing crumb rubber.
- Cast beams and cubes of grade M20 with bamboo reinforcement and replacing 10%, 20%, 30%, 40% and 50% volume of sand by crumb rubber.

Details of specimen of cubes

In this experimental investigation, cube specimens were cast with conventional concrete. Similarly, another cube were cast with concrete where fine aggregate is partially replaced with crumb rubber. Design mix ratios adopted were M20, M30 as per IS10262:2009. Mould sizes for the cubes were 150 x 150 x 150mm.

Casting and Curing

The concrete contents such as cement, sand, crumb rubber and coarse aggregate of size 10mm and water were weighed accurately and mixed and Concrete is poured in moulds of size 100 mm width, 100 mm depth and 500 mm length and Cube mould of size 150mm x 150mm x 150mm.Compaction was done after placing one layer of concrete to avoidPresence of voids.bamboo reinforcement was placed at the center of the mould. Covering layer of concrete is placed and compacted and finished finely. After casting, the concrete samples are kept in wet place and de-moulded at 24 hours age. They were submerged in open water tank for curing up to 28 days as required for test.

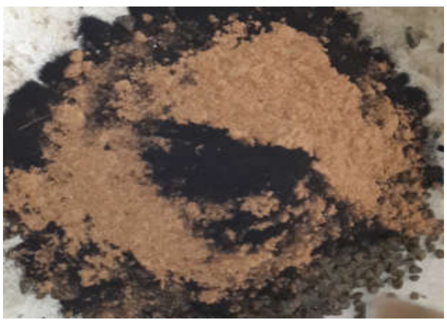

Fig.1 Mixing

Fig.2 Beammould with bamboo Reinforcement

Fig.3 cube mould after concreting

Testing of specimens

After 28 days of curing of curing the specimens were taken out and tested. Before testing, the specimens were cleaned, dried and white washed and grids were drawn for the further analysis and study of crack formation on the surface of beams under deflection.

Experimental setup and procedure for beams

All the beams were tested using Wood Testing Machine. . The beams were simply supported and tested under two symmetrical points load monotonically. The deflection of the beam was measured at regular interval of loading.From the experimental test the load deflection graph, were recorded. The deflections were taken using deflectometer kept at thebottom of the beam at centre. The loads were applied manually, and corresponding deflections were measured for everyone divisions (33 kg) in the dial gauge. A dial gauge of least count 0.002mm was used measuring deflection at mid-span of the beam. The load corresponding to the first crack formation on the beam surface and the ultimate load taken by the slab were noted. The beams were tested up to the maximum failure.

Fig.4 Experimental setup of beam

Fig.5 Deflectometer set up

Experimental setup and procedure for cubes

To check the compressive strength of the M20 and M30 grade concrete the compression test on the cement concrete cubes was conducted. The cubes were of dimension 150*150*150 mm. After casting of the concrete cubes, they were demoulded after 24 hours and were placed for curing for 28 days. Compression test was conducted to check the compressive strength of the cement concrete cubes of grade M20 and M30. Three cubes were tested at the age of 28 days.

Fig.6 Experimental setup of cubes

V.Test Results and Discussions

Studies on Beams

Curves of the Load-Deflection of Beams

The direct results obtained from the bending tests are the load versus midspan deflection curves.Figure 7and 8 shows the load deflection behavior of various beams cast with bamboo reinforced concrete with different percentage of replacement of sand with crumb rubber.

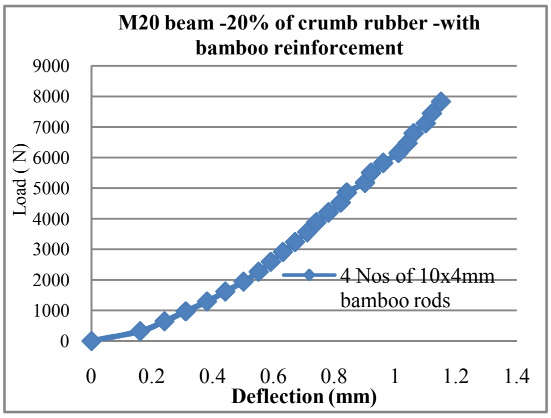

Fig.7 M20 concrete beams with bamboo reinforcement and with crump rubber

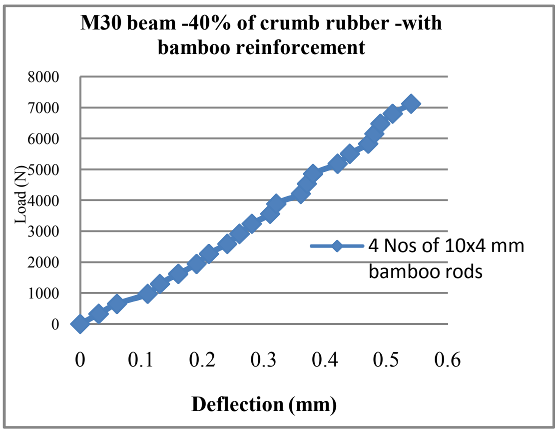

Fig.8 M30 concrete beams with bamboo reinforcement with crumbrubber

The following figures show the first crack load and ultimate crack load for bamboo reinforced concrete beams with different percentage of replacement for M20, and M30 grade concrete.

Table 1 First crack load for m20, m30 bamboo reinforced concrete beams with different percentage of replacement by crumb rubber

grade of concrete	first crack load (kn)					
	0%	10%	20%	30%	40%	50%
M20	9.48	8.62	7.83	7.12	6.48	3.24
M30	11.88	9.12	8.42	7.77	7.12	6.15

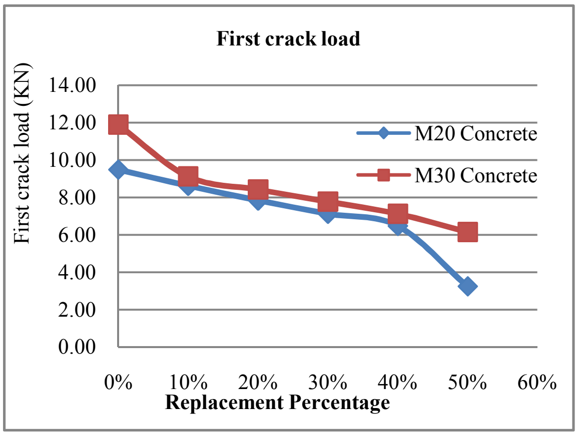

Fig.9 First crack load for M20, M30 bamboo reinforced concrete beams with crumb rubber

Table 2 Ultimate load for m20, m30 bamboo reinforced concrete beams with different percentage of replacement rubber by crumb

Grade of Concrete	Ultimate Load (KN)					
	0%	10%	20%	30%	40%	50%
M20	25.07	22.79	20.72	17.16	13.27	6.64
M30	31.42	24.12	22.26	18.87	14.48	12.50

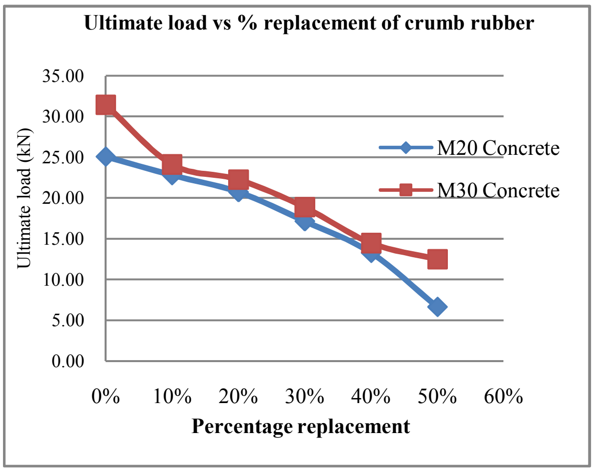

Fig.10 Ultimate load for M20, M30 bamboo reinforced concrete beams with crumb rubber

From figure 9, figure 10 it was found that the first crack load and the ultimate load were found to decrease with the increase in percentage of crumb rubber. The maximum decrease was found to be a maximum of 65% and 73% for the first crack load and the ultimate load respectively for 50%replacement of fine aggregate with crumb rubber. From the experiment results, it is recommended that a replacement of crumb rubber to the extent of 20% can be made which will not affect the strength to a greater extent. Apart from this as suggested earlier a modified mix design can be attempted incorporating the crumb rubber for getting the desired objective strength.

Cubes

Table 3 shows the test results of various cubes cast with different percentage of replacement of sand with crumb rubber of m20, and m30 grade.

Grade of Concrete	Cube Compressive Strength					
	0%	10%	20%	30%	40%	50%
M20	27.46	24.96	22.70	20.63	18.76	18.13
M30	37.11	28.49	26.29	24.27	22.25	16.89

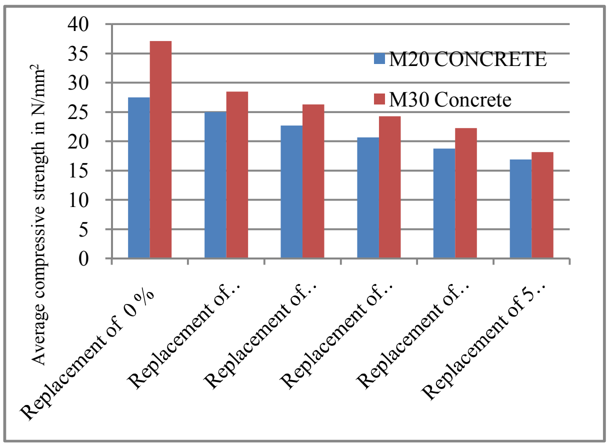

Fig.11 Cubes with percentage of replacement vs. crumb rubber

Cubes were cast as companion specimens for the beams made with bamboo reinforcement and with or without crumb rubber. Curves were drawn between compressive strength and replacement percentage of crumb rubber. From the graph it was found when crumb rubber was added to concrete compressive strength was found to decrease. Up to a replacement of 10% the compressive strength of the specimen was found to be closer to the objective strength. When the crumb rubber was added in more percentage the compressive strength was found to be decrease to the extent of 54% in the case of M30 concrete. Hence suitable modifications may be incorporated in the mix design based on the properties of the material for getting the objective strength utilizing the crumb rubber as partial replacement of fine aggregate.

CONCLUSION

1. When crumb rubber was added as partial replacement to fine aggregates in concrete, the compressive strength was found to be lower as specified by literature. The maximum decrease was found to be 54% for 50% replacement.
2. The first crack load and the ultimate load on beams for the flexural strength was also found to decrease to a maximum of 73% for 50% replacement of crumb rubber as partial replacement of fine aggregate
3. Uptoan addition of 10% replacement of crumb rubber the objective compressive strength was found not to be affected.

References

1. Nirav B. Siddhpuraa*, Deep B. Shaha, Jai V. Kapadiaa, Chetan S. Agrawala and Jigar K. Sevaliaa "Experimental Study on Flexural Element using Bamboo as Reinforcement" *International Journal of Current Engineering and Technology* ISSN 2277-4106, June2013, Vol.3, No.2(June2013) 476-483
2. Jigar K. Sevalia*, Nirav B. Siddhpura**, Chetan S. Agrawal**, Deep B. Shah**, Jai V. Kapadia*" Study on Bamboo as Reinforcement in Cement Concrete" *International Journal of Engineering Research and Applications* (IJERA) Vol. 3, Issue 2, March -April 2013,1181-1190
3. Dinesh Bhonde1, P. B. Nagarnaik2, D. K. Parbat, U. P. Waghe" Experimental Investigation of Bamboo Reinforced Concrete Slab" *American Journal of Engineering Research(*AJER)-2014Volume-03, Issue-01,128-131
4. K. Ghavami "Ultimate Load Behaviour of Bamboo-Reinforced Lightweight Concrete Beams" Cement & Concrete Composites 17 (1995) (Received 23 September 1994; accepted 10 May 1995) 281-288
5. Adom-Asamoah Mark, Afrifa Owusu Russell" A comparative study of Bamboo reinforced concrete beams using different stirrup materials for rural construction" *International Journal of Civil and Structural Engineering* Volume 2, No 1, 2011,407-423
6. Atul Agarwal*and Damodar Maity† "Experimental Investigation onBehaviorof Bamboo Reinforced Concrete Members "16th International Conference on Composite Structures ICCS 16 A. J. M. Ferreira (Editor) © FEUP, Porto, 2011
7. I.K. Khan "Performance of Bamboo Reinforced Concrete Beam" *International Journal of Science*,

Environment ISSN2278-3687 (O) and Technology, Vol. 3, No 3, 2014, 836 – 840

8. Akinwonmi, Ademola Samuel 2, Seckley, Emmanuel "Mechanical Strength of Concrete with Crumb and Shredded Tyre As Aggregate Replacement "*International Journal of Engineering Research and Applications (IJERA)* ISSN: 2248-962, Vol. 3, Issue 2, March -April 2013, pp.1098-11012
9. Chandra. Sabnani, Madhuwanti, Latkar and Utpal. Sharma" Can Bamboo Replace Steel as Reinforcement in Concrete, for the Key Structural Elements in a Low Cost House, designed for The Urban Poor" *International journal of chemical, Environmental and medical Sciences* volume1, Issue 2 (2013) 257-262

How to cite this article:

Jeevan Reddy U and V. Amarnath Reddy (2018) 'Experimental Study on Bamboo Reinforced Rubber Concrete', *International Journal of Current Advanced Research,* 07(1), pp. 9351-9355. DOI: http://dx.doi.org/10.24327/ijcar.2018.9355.1543

****