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COMPARITIVE STUDY ON REPLACEMENT OF STEEL REINFORCEMENT WITH BAMBOO REINFORCEMENT

NIKHIL. N
Assistant Professor, Department of Civil Engineering, AJ Institute of Engineering & Technology, Mangaluru, Karnataka.

ABSTRACT
Steel is one of the conventional material which is used for reinforcement in concrete. But depending upon cost and availability, hence it is required to replace the steel with some other suitable materials as reinforcement is now a major concern. Bamboo is one of the alternate material used as a replacement of steel in the construction of minor structures, especially in the countries like India which is a developing country, But the use of bamboo reinforcement in concrete until today is very limited because of various uncertainties. Since bamboo is a material which is natural obtained, it is a cheap material and also readily available material in nature, if properties of bamboo is studied than it can be a substitute material for steel in reinforcing of concrete. To determine this, the tensile strength test is carried out on bamboo strips, with bamboo having one node at midspan, two nodes at either ends and without node are performed. Bamboo strips of length 30cm with same cross sections are used in this test. Also flexural strength test of bamboo reinforced beam is done to characterize the performance of bamboo as reinforcement. Doubly bamboo reinforced beams of 750 mm length having 150 mm width and depth is tested and is compared with plain concrete beam and steel reinforced beam.

KEYWORDS: Bamboo, Steel, Reinforcement, Flexure, Concrete.

1. INTRODUCTION

India is a country with rich resources of bamboo, In the world India is the second largest country with rich bamboo resource. Bamboo grows naturally in thousands of hectares of forest land, also grown in private plantations and in homesteads. There are 130 types of different species in India, which spreads across the states. The commercially significant species are given below.

1. Bambusa balcooa
2. Bambusa bambos
3. Bambusa nutans
4. Bambusa pallida
5. Bambusa polymorpha
6. Bambusa tulda
7. Bambusa vulgaris
8. Dendrocalamus brandisii
9. Dendrocalamus giganteus
10. Dendrocalamus hamiltonii

Fig 1 Collected bamboo specimen

2. DEFINITION OF THE PROBLEM

In the present energy crisis created by indiscriminate industrial growth in the present decade has created a energy crisis. as a result of this concerns is increasing about energy resource management, to utilize the available material from environment. There is an increase in the research to identify, manufacture and use a material which is non-polluting in nature and which require less energy. All researchers and industrial peoples have diverted their attention towards the materials such as fibres of vegetables including bamboo, waste from soil, industry, waste of mining and agriculture wastes for engineering applications. In a global effort to find new cements using all types of wastes, to find an alternate material for the health hazardous asbestos cement, hence all types of wastes that are developed is used for the production of composites, reinforced with fibres.

In the present industrialization era, the materials are selected mainly based on the type of facility available and used for the manufacturing process and secondly price. The materials like ordinary Portland cement (OPC) and steel which are industrialized materials that finds its applications in all construction sectors and in other sectors, which leads a road in the world. During second half of the 20th century,

The main focus of this is to present a concise summary of the information about the range of material choices, which are locally available for manufacturing or casting of concrete structural elements, with bamboo reinforcement.

2.1 BAMBOO REINFORCED CONCRETE FLEXURAL ELEMENTS- Selected bamboo was made into strips of 20 mm x 8mm for tension reinforcement & 10 mm x 8 mm for compression reinforcement. The bamboo strips were seasoned for a period of 15 days in water and dried for the next 10 days. Renewal of water was done in regular interval to prevent deterioration of Bamboo. Then bamboo was made into strips & strips were varnished.

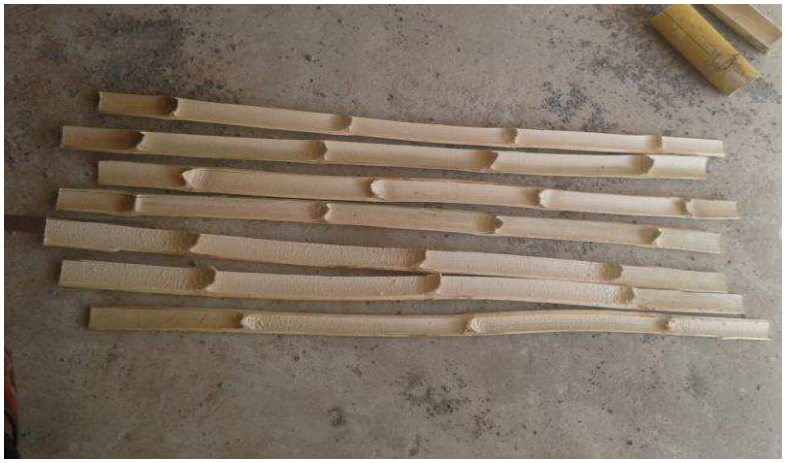

Fig 2 Bamboo Strips

2.1.1. BAMBOO REINFORCED CONCRETE BEAMS-Simply supported bamboo reinforced concrete beams, fabricated normally, prepared with fine aggregates (river sand) and coarse aggregates of 20 mm maximum size, which have been tested. A beam with steel reinforcement was prepared, which served as reference.

The strips bamboo beams were of 30mm wide rectangle shaped sections. The smooth surface of the bamboo strips was cleaned and was made slightly rough before applying a coated of a thin layer of the impermeable product. Than bamboo strips were wrapped with 1.5 mm wire at 10 mm distance and one more coat was applied with the same impermeable product.

Likewise reinforcement cages were made for concrete beams with steel reinforcement with 2% at bottom and 1% reinforcement on top. Stirrups were provided in the form of hoops with 6 mm strips at a spacing of 200 mm.

The concrete beam with bamboo reinforcement is compared with concrete beam made with steel reinforcement, in which 12 mm bars used as tension steel, 8 mm bars used as compression steel & 8 mm bars used as stirrups.

Fig 2.1 Preparation of bamboo reinforcement cage

3. TESTS ON BAMBOO STRIPS- Tensile test was conducted on bamboo strips with node and without node after seasoning & following values were obtained.

Table 3.1. Bamboo Specimen 1, Node at midspan

Area of cross section =202 mm^2

Sl No	Load (kN)	Elongation (mm)	Strain	Stress ($N/Mm^{2)}$
1	0.0	0.00	0.00	0.00
2	20	0.50	0.0010	99.009
3	22	1.00	0.0020	108.9109
4	24	1.50	0.0030	118.812
5	26	2.50	0.0050	128.7129
6	28	3.50	0.0069	138.6139
7	30	4.50	0.0089	148.5149
8	32	5.50	0.0109	158.4158
9	33.50	8.50	0.0168	164.8515

Breaking load =28.5kN

Table 3.2. Bamboo Specimen 2, Node At Two Ends

Area of Cross Section =190 mm^2

Sl No	Load (kN)	Elongation (mm)	Strain	Stress ($N/Mm^{2)}$
1	0	0.00	0.00	0.00
2	16	1.00	0.0020	84.2105
3	18	1.50	0.0030	94.7368
4	20	2.00	0.0040	105.2631
5	22	3.00	0.0059	115.7894
6	24	4.00	0.0079	126.3157
7	26	5.00	0.0099	136.8421
8	28	6.00	0.0119	147.3684
9	29.5	8.00	0.0158	154.2105

Breaking load = 26.5KN

Table 3.3. Bamboo Specimen 3, Without Nodes

Area of Cross Section = 186mm^2

Sl No	Load (kN)	Elongation (mm)	Strain	Stress (N/Mm^2)
1	0.0	0.00	0.00	0.00
2	16	1.00	0.0020	86.0215
3	18	2.00	0.0040	96.7742
4	20	3.00	0.0059	107.5269
5	22	4.00	0.0079	118.2796
6	24	5.00	0.0099	129.0323
7	26	8.00	0.0158	139.7849

Breaking load = 22.5KN

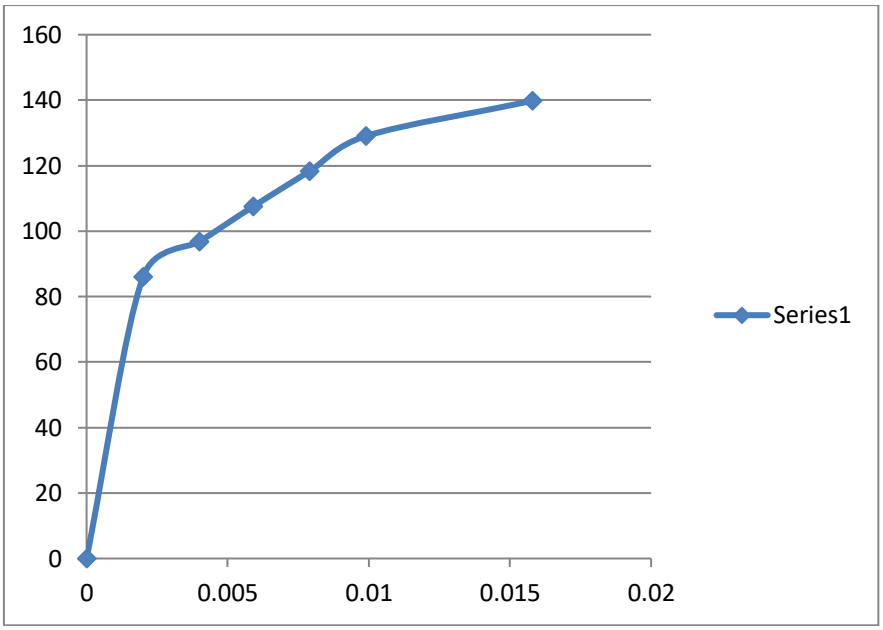

Fig 3.1 Stress Strain Relationship after Seasoning

4. STEEL REINFORCEMENT CAGE

Likewise reinforcement cages were made for concrete beams with steel reinforcement with 2% at bottom and 1% reinforcement on top.

Tension reinforcement was provided by two 12 mm HYSD bars and compression was provided using two 10 mm HYSD bars. Stirrups were provided in the form of hoops of 6 mm diameter mild steel bars It was at 20mm spacing..

4.1. FINAL MIX RATIOS - Cement: sand: coarse aggregate = 1:1.08: 2.72 was used for both steel reinforcement and bamboo reinforcement.

5. RESULTS

4 numbers of bamboo reinforcement cages were casted with a concrete of M30 grade. After casting, the samples of concrete beams reinforced with bamboo and steel were kept in wet place and samples were demoulded after 24 hours. They were immersed in open water tank up to 7 & 28 days for curing, as required for the test following results were obtained.

Fig 5.1 Beam loaded for flexural strength

Table 5.1- Flexural Test Result For 7 Days on Bamboo Reinforced Member

Deformation(mm)	Load (kN)	
	Specimen 1	Specimen 2
0.1	1.0	1.0
0.2	1.0	1.5
0.3	2.5	1.5
0.4	2.5	2.5
0.5	3.5	3.0
0.6	4.0	3.5
0.7	6.0	4.0
0.8	6.5	6.5
0.9	8.0	8.5
1.0	9.0	9.5
1.1	9.0	10
1.2	9.5	10.5
1.3	10.5	10.5
1.4	12.0	11.5
1.5	12.5	12.0
1.6	12.5	12.0
1.8	12.5	--

Breaking load specimen 1 = 9.0 KN
Breaking load specimen 2 = 9.5 KN

Table 5.2- Flexural Test Result For 28 Days Bamboo Reinforced Member

Deformation(mm)	Load (kN)	
	Specimen 1	Specimen 2
0.2	1.5	1.0
0.4	3.0	3.5
0.6	4.0	4.5
0.8	6.5	6.5
1.0	7.5	8.0
1.2	8.0	9.0
1.4	10.5	11.0
1.6	13.0	14.5
1.8	17.0	17.0
2.0	19.5	20.0
2.2	20.5	-

Breaking load specimen 1 = 18.0 KN
Breaking load specimen 2 = 17.0 KN

Table 5.3- Flexural Test Result For 7 Days Reinforced Cement Concrete

Deformation(mm)	Load(kN)
0.50	4.00
1.00	7.50
1.50	9.50
2.00	13.0
2.50	17.0
3.00	21.0
3.50	24.5
4.00	29.0

Breaking load = 25.5 KN

Table 5.4- Flexural Test Result For 28 Days Reinforced Cement Concrete

Deformation(mm)	Load(kN)
0.50	4.50
1.00	9.50
1.50	13.0
2.00	18.0
2.50	20.0
3.00	26.0
3.50	31.0
4.00	34.5
4.50	39.0
5.00	43.5
5.50	48.5

Breaking load = 43.0 KN

6. CONCLUSION

It was found that the bamboo reinforced beam achieved a tensile strength for 7 days was found to be 9.25 kN (avg), and for 28 days it was found to be 18.5 kN which shows this reinforcement can be used in some minor construction. From this comparative study we can conclude there is no effect of nodes on the tensile strength of the bamboo. Hence bamboo reinforcement can be used in place of plain cement concrete for better durability of the section. bamboo reinforcement can be used in the construction of rural areas which will facilitates better strength.

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