



USE OF BAMBOO AS SHEAR REINFORCEMENT FOR BEAMS

**Prof. Chetan G. Joshi¹, Ms. Aarti P. Mali², Ms. Siddheshwari S. Langote³,
Ms. Pooja M. Ghode⁴, Ms. Aarti S. Patil⁵**

¹Asst. Professor, ^{2,3,4,5}B.E. Student, Department of Civil Engineering ,

Guru Gobind Singh College of Engineering and Research Centre, Nashik , Maharashtra (India)

ABSTRACT

This paper represents the feasibility in use of bamboo as a potential reinforcement in concrete structural members. A higher cost reduction ratio could help in creating affordable housing markets in most growing cities in India. As bamboo being a light weight material it is easy to transport and also economical in cost, fast growing natural ecofriendly material very effective to be used as a structural member. The utilization of bamboo reinforcement as a substitute to steel reinforcement is gaining immense importance today, mainly on economic as well as ecological ground. On doing the detail study regarding the availability of bamboo present in India from Maharashtra state, the bamboo named as 'chauli' with all the physical properties required, was found to be in Ratnagiri from Konkan district. The same type bamboo was available for the comparison at Nashik local market. It generally gives idea of cost wise comparison of steel reinforcement with bamboo reinforcement by taking into consideration shear reinforcement. To study this comparison designs which have been conducted with the help of control specimen on beam of size 1000mm x 300mm x 470mm are on the basis of bending and shear test. The intention of this study is to evaluate a design using bamboo as one of the chief structural material, for a safe and durable house, affordable by the urban poor.

Keywords: *bamboo, bamboo reinforced concrete, brc beam, bamboo shear reinforcement, flexural and shear test.*

I. INTRODUCTION

Bamboo has shown great potential for production of composite materials and components which are cost-effective and can be successfully utilized for structural and non-structural applications in construction. Moreover, bamboo can be grown in large quantity with low cost and which will be economical. Bamboo is a versatile material with its high strength, workability and durability.

We have mainly focused on the comparison of steel reinforcement and shear reinforcement by taking into consideration the bamboo as structural material for stirrups. Main objective of shear reinforcement by using as a structural member was to get a good as well as effective shear strength and flexural strength of bamboo and beam.



Total no. of beams casted for the comparison of bamboo and steel as shear reinforcement were 6. Two beams were of steel as main and shear reinforcement, next two were of main reinforcement of steel and shear reinforcement of bamboo and the remaining were of both main and shear reinforcement of bamboo. 28 days of curing after casting of beam has given the results of flexural and shear strength by conducting the test on electronic universal testing machine of 100 tone capacity.

Detail specification of bamboo:

1	Name of bamboo	Chauli
2	Cross section area	78.6mm ²
3	Length	1000mm
4	Outer diameter	25mm
5	Inner diameter	15mm
6	Gauge length	50mm
7	Weight	441kg

II. METHODOLOGY

In order to study the performance evaluation of bamboo as a reinforcement in reinforced cement concrete specimen following tests are executed. Following are the physical and mechanical properties of hollow bamboo:

1. Mechanical properties:

- Static bending strength
- Tensile strength
- Shear strength

2. Physical properties:

- Moisture content
- Basic mass per volume or density
- Shrinkage

1. Mechanical properties

1.1 Static bending strength

The method referred was from the Indian Standard code is 6874(2008):

The specimen tested consist of length 1000mm with diameter of 10 mm size, gauge length 50mm. The test was conducted on electronic universal testing machine with the help of two point load bending test. The results obtained after calculation the bending strength is 255.73 N/mm².

1.2 Tensile Strength

The specimen placed during the test were such that the general direction of the fibres was parallel to longitudinal axis of the test specimen. The load shall be applied continuously and movable head of the testing machine shall travel at constant rate of 0.01m/s. The maximum load recorded was 210 N/mm².



Fig.No. 1 Static bending strength



Fig. No.2 Tensile strength specimen

1.3 Shear Test

Shear test on the bamboo specimen along the fibres was conducted. A suitable attachment was designed to apply the load for shearing, with the help of square steel blocks to cut diagonally in such way that to opposite triangles interact and two other triangles separate. The specimen shall be loaded at the upper end over the other two independent triangular blocks. This result in four shear planes with maximum load at which specimen fails and number of shear areas shall be recorded with the shear strength as 144.4 N/mm^2 .

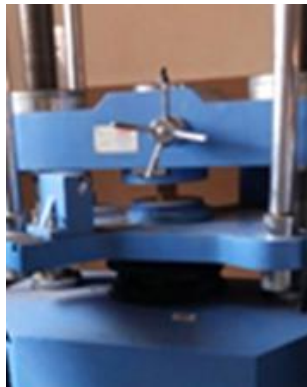


Fig. No.3 Shear Test



Fig. No.4 triangular blocks for shear test

2. Physical properties

The following results of physical test of bamboo were obtained by the procedure given in the referred IS 6874 : 2008.

The sample piece of bamboo 25mm in length was kept for 24 hours at 104°C and then dried in hot air oven, the results obtained were as follows.

2.1 Moisture content - 11.11%

2.2 Basic mass per volume or density - 85.16 kg/m^3

2.3 Shrinkage test -

Shrinkage along diameter = 7.48%

Shrinkage along wall thickness = 3.22%

Shrinkage along length = 2.91%

3. Design of beam

The total design of beam for the steel structure was prepared with the help of indian standard code for rcc is 456-2000 and same procedure was applied for the bamboo using control specimen method .the beam was designed for singly reinforced section.

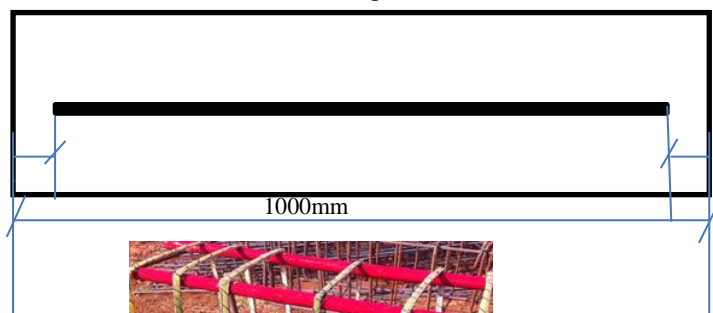
Grade of concrete used- m25

Grade of steel- fe 500n/mm²

The size of beam - 1000mm x 300mm x 470mm

No. Of main reinforcement - 2 ϕ 16mm @100mmc/c at end, 1 ϕ 10mm@150mmc/c at middle.

Shear reinforcement - 6 no of stirrups of 150mmc/c at end and 300mmc/c at middle.



binding wire

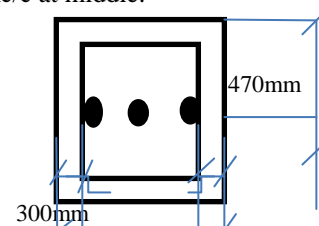


Fig. No. 5 Main and Shear reinforcement

Fig. No. 6 Bamboo Stirrups of Bamboo

4. Bonding of bamboo with concrete :- Asian oil paint and bauxite powder was used for the bonding strength of a bamboo with concrete. Asian oil paint was applied on bamboo with terpentine and bauxite powder was spread on it for the proper grip. For maintaining the grip of bamboo and cement bauxite powder is used in between them.



Fig. No. 7 bonding of bamboo for grip

III. CONCLUSION

- From the study of literature review available extensive research through the use of bamboo as a reinforcement in concrete is being understood.it is established that it can replace the steel for the modest housing for the urban poor who live close to bamboo regions .
- It is a good idea for low cost economical structures,as it is a naturally available material it can be used as ecofriendly.it is cost effective for the poor peoples who cannot afford the high cost houses.
- The results obtained can conclude that replacement of steel with bamboo stirrups as a shear reinforcement as well as by comparsion of steel and bamboo stirrups can give shear and flexural strength of bamboo more than half times the strength of steel .



- From the results it can be cleared that the bamboo reinforcement technique is absolutely cheaper than steel reinforcement technique especially for single storey structure.

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