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# Eco Friendly and Sustainable Materials for Construction using Bamboo

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**ABSTRACT:** One of the major issues faced by humans is Global warming and CO<sub>2</sub> emission. WEF building operation and construction account for about 40% of global energy related CO<sub>2</sub> emissions and it is predicted up to 70% by 2050. Adopting sustainable construction practices, where the materials used and the method utilized create a healthy environment. One such sustainable material that can be used in construction industry is bamboo. Properties of bamboo are flexibility, high tensile strength, compressive strength, weight ratio. In This study bamboo culms are treated and are used as reinforcement in specimens such as beam and slabs and the strength are accessed. Keywords: Global warming, sustainable construction, bamboo culms, strength to weight ratio

## I.INTRODUCTION

This project is about alternative, ecofriendly construction material to reducing carbon footprint and use of bamboo as alternative reinforcement it was given recent consideration for use as reinforcement in soil-cement pavement slabs in which the slabs behave inelastically even under light loads. With the advancement of science and technology and the tight supply of timber, new methods are needed for the processing of bamboo to make it more durable and more usable in terms of building materials . As strong as steel, bamboo gives more strength to RCC beams and it is eco-friendly too. Bamboo is characterized as a bio degradable, renewable and energy efficiency natural resource, it is environmentally sustainable building material, it has been used as construction material in certain areas for centuries. So, bamboo can be used as alternative construction material .

Bamboo grows 60cm or more in a day and can grow up to 30m or even more, the rate of growth of bamboo depends upon the local climatic condition and soil type, it is considered to be matured after three years of its plantation and it is always advisable to choose matured bamboo for construction purpose, important factors to be considered is that bamboo shows its efficiency in climate which has at least a little amount of humidity. The bonding between bamboo and concrete is majorly influenced by friction between concrete and bamboo surface, adhesion of coating substance attached to exterior bamboo surface and mechanical interlock, these treatment procedures are aimed at increasing bamboo concrete bond strength. The process yields a bamboo composite material which is densely compressed, Preliminary physical and mechanical tests have been carried out to evaluate the suitability of bamboo-composite materials for concrete reinforcement, The key factor for implementation is the bonding of reinforcement bars to concrete, Adequate bonding between bamboo-composite reinforcements and the concrete matrix ensures a stable load transfer between the two materials.

## II.OBJECTIVES

- Bamboo reinforced beams are casted and tested for tensile strength and compared with plain cement concrete.
- Bamboo reinforced slabs are tested for uniformly distributed load. 2.3.2 Specific objective
- To obtain sustainable concrete as low water absorbing and water tight member.
- To conduct studies on the use of recycled domestic wastewater for mixing and curing of concrete block.
- To conduct studies on the use of recycled plastic waste partially replacing coarse aggregate in manufacturing of concrete.
- To reduce the amount of sewage sludge reaching landfills by using it for manufacturing of concrete.
- To creating an eco-friendly low-cost concrete block and prefabricated component incorporating different waste materials.

### III.MATERIALS

**Cement** The raw materials for cement production are limestone (calcium), sand or clay (silicon), bauxite (aluminum) and iron ore, and may include shells, chalk, marl, shale, clay, blast furnace slag, slate. Chemical analysis of cement raw materials provides insight into the chemical properties of cement.

**Physical Properties of Cement:** Different blends of cement used in construction are characterized by their physical properties. Some key parameters control the quality of cement.

**Fineness of cement:** The size of the particles of the cement is its fineness. The required

- The tests of strength are performed on cement mortar mix, not on cement paste.
- Cement gains strength over time, so the specific time of performing the test should be mentioned.
- **Compressive Strength:** It is the most common strength test. A test specimen (50mm) is taken and subjected to a compressive load until failure. The loading sequence must be within 20 seconds and 80 seconds.
- **Tensile strength:** This test used to be common during the early years of cement production, now it does not offer any useful information about the properties of cement.

#### Bamboo

Bamboo is the fastest growing plant in the world having growth up to 60 cm or more in a day. Bamboo has social, economic and cultural significance and is used extensively for building materials along with thousands of uses. It is highly versatile raw material for different works. The bamboo is light weight, flexible, tough, high tensile, cheap material than the other building materials like steel. Bamboo can be used in various building works. Bamboo structures are flexible, earthquake resistant, light weight and cheap. Bamboo can be used as reinforcement in various structural members. Bamboo is a green material for sustainable development and has various advantages. Use of bamboo may be promoted for green buildings and sustainable development There are various species of bamboo found all over the world. *Dendrocalamus Strictus* is the predominant specie found in India. Male Green reinforcement as an ecofriendly construction material in reducing carbon footprint *Bamboo* or *Dendrocalamus Strictus* occupies total 53 percent of total bamboo area in India. Various mechanical properties of bamboo are required for its use as a structural material. Various physical and mechanical tests are conducted by the author on the specie. This paper investigates the various properties of *Dendrocalamus Strictus* which will be useful for the engineers in design of structural components .



To enhance its natural durability and to protect it from insects, it is necessary to treat bamboo before use

The sap from the bamboo culm is removed before treatment.

The bamboo sap is soaked in water for 14 days initially.

They are allowed to sun dry for atleast 7 days naturally.

Then lime treatment is carried out for ar

Smoke treatment is carried out immediately after the initial set of treatments.

Bamboo culms are cut into splints of required length and is used as green reinforcement roofing slabs/panels.

Then the culms are treated in the lime for around 2-3 weeks in order to make it less appealing to pests.

After this process the saps can be sliced into partable pieces of required dimension,

In order to proceed with the smoke treatment in a confined chamber for around 2days.

Completion of all these process leads into product development stage.  
Where the required binding materials can be used to cast the panels.  
Next chicken mesh is used to hold the sliced bamboo intact  
Then locally procured mud(red soil) is used as binding agent.  
The panel size would likely to come out in between 500X250X25 mm.  
Which can to tested for different design strength as required.



Lime treatment process around 2-3weeks in order to make less appealing to pests



This is a mould size by 500\*250\*80mm.



Bamboo panels tied with steel wire for bamboo strips and rapping with chicken mesh .

**IV.MIX DESIGN**

MIX RATIO = 1:2 (CEMENT: SAND)

- Density Of Cement = 1440 Kg/m<sup>3</sup>
- Density of M-sand = 1850 Kg/m<sup>3</sup>
- Volume of Slab = (1.0\*0.5\*0.05) = 0.03 m<sup>3</sup>
- Additional 20% = (20/100\*0.03) = 0.006m<sup>3</sup> • Total volume = 0.036 → QUANTITY OF MATERIALS
- Weight of cement = (1/3\*0.036\*1440) = 17.28Kg
- Weight of M-sand = (2/3\*0.036\*1440) = 44.4 Kg
- Quantity of water = (0.45\*17.28) = 7.776L

**Compressive strength**

The mould of size 50\*250\*80mm were cast to find the compressive strength of mud panels  
 The compressive strength is the primary test to identify the strength of panel .The test is done in 7 to 14 days

**V.RESULTS AND DISCUSSION**

In this chapter results of different basic tests that are carried out on cement, alum sludge, secondary treated wastewater are discussed with respect to main tests being conducted on the rectangular sample

**BASIC TESTS CONDUCTED ON INDIVIDUAL MATERIALS AND RESULT**

Table 1 Test results conducted sand as fine aggregates:

SLNO.	TEST CONDUCTED	TEST RESULT
1	Specific Gravity	2.67
2	Fineness modulus	2.77

Table 2 Test results conducted on cement.

SL NO	PROPERTIES	TEST RESULTS
1	Standard consistency	31%
2	Initial setting time	90 minutes
3	Final setting time	560 minutes
4	Fineness modulus	98.5%
5	Specific Gravity	3.14



Figure 1 Strain gauge used for record the deflection



Figure 2 Strain gauge used for record the deflection

### VISCOPE FOR FUTURE WORK

After the completion of our project work, the future works that can be carried out using this concept are further improvement in reduction of carbon emission due to use of steel Green reinforcement as an ecofriendly construction material in reducing carbon footprint. Dept of Civil Engg. DSATM 2021-22 Page 30 Different clear cover dimensions are suggested to be used. The cover used is based on protecting steel from corrosion. Since bamboo does not corrode in concrete the could potentially be les.

An extensive study to evaluate the behavior of different types of bamboo is recommended as the bamboo type behavior is different at different regions of the world. Long term studies investigating the durability of bamboo reinforced concrete should be conducted More tensile tests is suggested to investigate the relationship between the tensile strength of bamboo and its performance as reinforcement in concrete. Pressure treatment of bamboo is suggested before conducting bending tests to provide a greater bamboo strength.

### VII.CONCLUSION

In this work an attempt was made to enhance the mechanical properties of plain cement concrete by using bamboo strips as reinforcement and discuss about the various engineering properties of bamboo reinforced concrete slab as mentioned in the earlier chapters.

This suggest that the bamboo reinforced slab can be used has load bearing members. More experiments have to be conducted to fully understand the behaviors of bamboo mortar composite slab.

These bamboo reinforced slabs has good workability, strength and durability as compared to normal concrete and can be used for future works.

### REFERENCES

1. Pratish Kumar Singh, Aashish Jodhani, Abhay Pratap Singh, Bamboo as Construction Material and Bamboo Reinforcement, Bhopal, (2016), (Vol. 4), (Issue 1)
2. Suresh Barmavath, Kiran M V, Flexural strength of concrete by replacing bamboo in rcc beam (Volume 8), (Issue 6), (2017), INDIA
3. Abhijeet Deya, Dr. (Mrs) Nayanmoni Chetia, Experimental study of Bamboo Reinforced Concrete beams having various frictional properties, INDIA, (2016)
4. Pankaj R. Mali a, Debarati Datta b, Experimental Evaluation of Bamboo Reinforced Concrete Beams, (2019)
5. Atul Agarwal a, Bharadwaj Nanda b, Damodar Mait, Experimental investigation on chemically treated bamboo reinforced concrete beams and columns (2014)
6. Purushottam Kumar, Phalguni Gautam, Simardeep Kaur, Bamboo as reinforcement in structural concrete, (2021)
7. k. Ghavami Ultimate Load Behaviour of Bamboo-Reinforced Lightweight Concrete Beam (1995)



8. Alireza Javadian a, Mateusz Wielopolski Bond-behaviour study of newly developed bamboo-composite reinforcement in concrete(2016)
9. Pankaj R. Mali, D. Datta Experimental evaluation of bamboo reinforced concrete slab panels (2018 )
10. A Green Building Material (January 2021), Ar. Suresh Sharma, M. Arch. Lovely Professional University, Punjab (ISSN-2349-5162)
11. Bamboo in Roofing Material (February 2016), Jorg Stamm. Vol 6.2.8 DOI:10.1080/13467581.2019.1595629
12. Bamboo reinforced mud panels using locally available materials (January 2021), Dr. T. K. Jyothi Government college of engineering Ramanagara Karnataka India ,research gate DOI:10.1007/978-981-19-2836-9\_3



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