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Bamboo as a Material for Various Structure

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ABSTRACT

This report deals with fabrication, analysis, and testing of a Space truss roof using bamboo, also some properties of bamboo. The diminishing wood resources and restrictions imposed on felling in natural forests, particularly in the tropics, have focused world attention on the need to identify a substitute building material that should be renewable, environmentally friendly and widely available. In view of its rapid growth, a ready adaptability to most climatic conditions and properties, bamboo emerges as a very suitable alternative.

In this work Analysis, Fabrication and Testing of 2 panel Space Truss roof has been performed on bamboo elements with various joints. Various techniques of joining bamboo were used in the making of the truss namely 'Bevel Cut Bolted Joint', 'Fish Mouth Bolted Joint'. Compression, Tension, Flexural tests were performed on the truss.

Bamboo, as a fast-growing renewable with a simple production process, is expected to be a suitable alternative for more traditional materials like concrete, steel, and timber.

Keywords: *Bamboo, Material, Fabrication.*

1. INTRODUCTION

Prototype means giving the experience of the final product to the customers before the actual product is developed. It is simply scaled down model of the actual product. A prototype is an early sample, model, or release of a product built to test a concept or process or to act as a thing to be replicated or learned from. It is a term used in a variety of contexts, including semantics, design, electronics, and software programming. A prototype is generally used to evaluate a new design to enhance precision by system analysts and users. Prototyping serves to provide specifications for a real, working system rather than a theoretical one. Because of prototype our time and cost are saved. The bamboos are evergreen perennial flowering plants in the subfamily Bambusoideae of the grass family Poaceae. In bamboo, the internodal regions of the stem are usually hollow. In its natural form, bamboo as a construction material is traditionally associated with the cultures of South Asia, East Asia, and the South Pacific, to some extent in Central and South America. China and India, bamboo was used to hold up simple suspension bridges, either by making cables of split bamboo or twisting whole culms of sufficiently pliable bamboo together.



Fig1 Bamboo



Fig2 Bamboo construction

TRUSS

A truss is a structure consisting of members/elements that takes only tension or compression and no bending is induced what so ever. The members are connected with a gusset joint that is either riveted, bolted or welded in such a way that has only axial forces are induced in the structure. The reason behind axial forces is the reason that the external loads are applied in such a way that their effects are in the form of forces applying only on joints.

A truss can be of two types as far as the workspace is considered:

Planar truss: in this members lie in a two-dimensional plane.

Space truss: In this members, truss lie in three dimensions.

A truss is composed of three basic parts, one is a top chord, the beam at the top which is usually in compression, a bottom chord, beam at the bottom which is usually in tension, webs are interior beams. There are a variety of trusses available depending on the requirement including span length and loading condition.

Basically, two types of trusses exists a) Bridge Truss

b) Roof Truss



Fig. 3 Bridge Truss



Fig. 4 Metal Truss

2. ADVANTAGES

- Bamboo is easy to cut, handle, repair, reposition and maintain.
- Bamboo is non-polluting and does not have crusts or parts that can be considered waste.
- Its circular form and hollow sections make bamboo a light building material, which is easy to handle, transport and store.
- Bamboo can be utilized for permanent and for temporary constructions.
- Bamboo has fantastic characteristic a bamboo construction offers superior earthquake-resistance.
- The composition of the fibers in the walls of the bamboo allows it to be cut length-wise or cross cut in pieces of any length, using simple manual tools like the machete.
- The natural surface of the bamboo is smooth, clean, with an attractive color which does not require painting, scraping or polishing.

3. DISADVANTAGES

- They require preservation.
- Bamboo shrinks much greater than any other type of timber especially when it loses water.
- Bamboo should be sufficiently treated against insect or fungus attack before being utilized for building purposes.
- Despite prevalence of various techniques of jointing, structural reliability of bamboo is questionable
- Resistance to porosity is less.
- Flammable
- Vulnerable to termite.
- Prone to cracking while construction.

4. TEST PREPARATION, RESULTS AND DISCUSSIONS

TEST BED PREPARATION

- Firstly, we prepare the flat base for truss.
- Place the Space Truss Roof on to Wooden base in between two crossheads.
- In this machine the upper one is fixed while the lower one is movable by hydraulics.
- One sliding switch for controlling rate of flow of fluid (to increase or decrease the load on the specimen manually).
- After placing the Space Truss Roof in the setup, keeping zero adjustments.
- Either manually or automatically load applied on the specimen with lower jaw moved in an upward direction.
- After some time load will reach the maximum resistive load of the specimen.
- Then record the maximum load.
- And specimen will gradually move to breaking of some part and record the load.
- Set the lower jaw to its initial stage.
- Remove the specimen and switch off the machine.



Fig. 5 Test bed setup



Fig. 6 Enhanced Digital Indicator

5. RESULT

The load at which the structure fails:

The structure fails at 11.8 KN load.

Peak Stress is 34.70 Mpa.

6. CONCLUSION

The planning of bamboo structure was started with considering their dimensions, various joints, and their strength.

Then pre-analysis of Bamboo Roof is done by the joint method. Then various test performs on a member of a structure, which is Compression test, tensile test, and tensile test on bamboo.

Then, testing on the structure is done using the THREE POINT BENDING TEST. Failure is occurring in joints, which is subjected to tension because this bridge or bamboo does not fail in compression. To avoid such failure of joints, joint need to be replaced by the superior material.

Hence, after performing all the following activities we came to know that for sustaining high weight, the joints must be strong enough followed by tensile strength and compressive strength.

We learned what the procedure to design and make roof prototype is.

Since time immemorial, bamboo has played an important role in the development of mankind. It is used for a wide range of day-to-day purposes, both as a woody material and as food. It has been the backbone of much of the world's rural life and will remain so as the population increases. The properties as top-grade building material and increased availability of bamboo in our country make it possible to use, bamboo in the field of construction extensively. Its high valued utilization not only promotes the economic development but also saves forest resources to protect our ecological environment as a wood substitute. As an economic building material, bamboo's rate of productivity and cycle of annual harvest outstrips any other naturally growing resource, if today you plant three or four structural bamboo plants, then in four or five years later you will have mature clumps, and in eight years you will have enough mature material to build a comfortable, low-cost house.

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