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Effectiveness of Bamboo as a Substituted material in Concrete

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ABSTRACT: In most countries, the building industry is the largest producer of energy and materials. Despite the fact that bamboo has been used as a construction material, especially in developing countries, its use as a reinforcement material has been restricted due to a variety of uncertainties. Bamboo can be used to replace traditional reinforcement in construction because it is a renewable, inexpensive, and readily available material, it can be used to replace traditional concrete reinforcement. Bamboo reinforcement as a substitute for steel reinforcement is gaining a lot of traction these days, owing to its cost-effectiveness and environmental benefits. Bamboo's industrialization was intended to address the issue of using bamboo in an industrial sense, and has been seen as a key strategy for local economic growth in many developing countries with abundant bamboo resources.

While industrialised bamboo is processed and fabricated into a variety of standard industrial items, it is primarily used as a low-cost alternative to hardwood because bamboo grows much faster than timber and is a renewable resource after 5-6 years. However, as a result of this process, industrialised bamboo loses its structural advantages as well as its relation to its traditional bamboo culture. The physical and mechanical properties of the selected bamboo species are measured in a material testing laboratory, including compressive strength, tensile strength, flexure test, bond strength, water absorption, density, and so on. The aim of these experiments on bamboo strips is to validate and justify the findings, which show that bamboo can be used as a reinforcement element. Different bamboos have different properties, according to the report, and are available in India. According to the findings, both solid and hollow bamboo can be used for both furniture and building projects. For data collection, the researcher used observations, interviews, and experiments. The use of bamboo as a complementary resource material for furniture and its advantages and disadvantages for construction field is analyzed.

Keywords: bamboo, tensile strength, eco-friendly, culms, construction, economy, flexure test

I. INTRODUCTION

1.1 Background:

Researchers have looked at the use of bamboo in cement concrete extensively. Bamboo has been used as a building material in some areas for decades, but after the Clemson research, it gained a lot of attention. At the US Army Engineer Waterways Experiment Station, a feasibility study was performed to see whether bamboo could be used as a reinforcement material in precast concrete elements. In many over populated region, bamboo meets the suitability of economical housing. Extensively used for bicycle, windmill etc.

The bamboo culms or stems have been used in a wide range of products, from everyday household items to industrial applications. Food containers, handicrafts, toys, furniture, flooring, pulp and paper, vessels, charcoal, music instruments, and firearms are all examples of bamboo items. Bamboo is often used for bridges, scaffolding, and homes, although it is often used as a temporary solution.

With advances in science and technology, as well as a scarcity of timber, new methods for processing bamboo are needed to make it more durable and useful as a building material. Bamboo has a number of distinct advantages, including the ability to grow quickly while producing a high yield at a low price. New materials for structural systems are actively sought by scientists and engineers. Bamboo has become a good alternative for this.

1.2 Bamboo Properties:

Bamboo culms are a cylindrical shell separated at nodes by strong transversal diaphragms, and they have some interesting

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properties including high strength parallel to the fibres that run longitudinally along the length of the culms and low strength perpendicular to the fibres. The density of fibres in a bamboo shell cross-section varies with thickness and height. The distribution of fibres is more uniform at the bottom than it is at the top or in the centre. This is due to the fact that at the top of the culms, bamboo is exposed to the most bending stress from the wind (Ghavami 2004). The mechanical properties of bamboo culms differ depending on their height and age. According to research, bamboo's strength increases with age. Bamboo is susceptible to fungi and insect attacks, which is one of its main drawbacks. As a result, treatment is needed to improve the stability and durability of bamboo.

1.3 Bamboo as a reinforcement material:

Bamboo grows to full size in a matter of months and achieves its maximum mechanical strength in a matter of years. Because of its abundance in tropical and subtropical areas, it is a cost-effective material. It is a good construction material because of its advantages such as lightweight design, better stability, durability, discretely dispersed nodes, and power. The energy required to produce 1m3 unit stress in practise for materials widely used in civil construction, such as steel or concrete, has been compared to the energy required to produce 1 m^3 unit stress in practise for bamboo. It was discovered that steel needs 50 times the amount of energy as bamboo. Bamboo has an extremely high tensile strength of up to 370N/mm^2. As a result, bamboo can be used as a tensile loading alternative to steel. This is due to the fact that bamboo has a six-fold greater tensile strength-to-specific-weight ratio than steel (Amanda et al. 1997). Bamboo has long been one of the most commonly used building materials as a support for concrete, due to its high compressive strength and low weight. They are a sustainable and highly flexible resource that can be used for a variety of purposes. Among the many applications of bamboo, housing is one of the most important, particularly in light of global housing shortages.

1.4 Objectives:

The aim of this study is to see whether bamboo can be used to strengthen concrete beams in situations where the mechanical properties and behaviour of steel reinforced concrete has been extensively studied and recorded. Bamboo reinforced concrete isn't well-documented. As a result, the aim of this research is to contribute to the collection of mechanical properties and behaviour of bamboo reinforced beams.

The main goal of this study is to use bamboo reinforced cement to reduce the structure's expense. Use of bamboo reinforced cement will be the most effective step towards low cost housing schemes. This research will help in providing the concrete structure houses in low cost housing plan for the rural areas.

II. LITERATURE REVIEW:

This section give insight view of previous literatures for the released involved in understanding the behavior of bamboo for the use of industrialized production as well as construction.

Ghavami (1995-2004) analyzed the engineering application of bamboo especially use of bamboo in concrete. Some characteristics such as strength to weight, eco-friendly is positive for use but some flaws like water-absorption, low-bond strength are also there. Need of simple design codes are required and prior treatment is also needed to enhance the strength of bamboo.

A report produced by the United States Naval Engineering Laboratory (1966, 2000) provides a number of guidelines to develop various structures using bamboo. How workability is allowed to use bamboo in concrete, 3-4% of cross-sectional area reinforced with bamboo in concrete gives optimum results. Masani (1977) presented a comprehensive study detailing the correct use of bamboo in building. Amada (1997) looked at bamboo's mechanical properties.

The various uses of bamboo around the world were investigated in a study published in the INBAR (2001).

III. METHODOLOGIES:

3.1 Methodology flow chart

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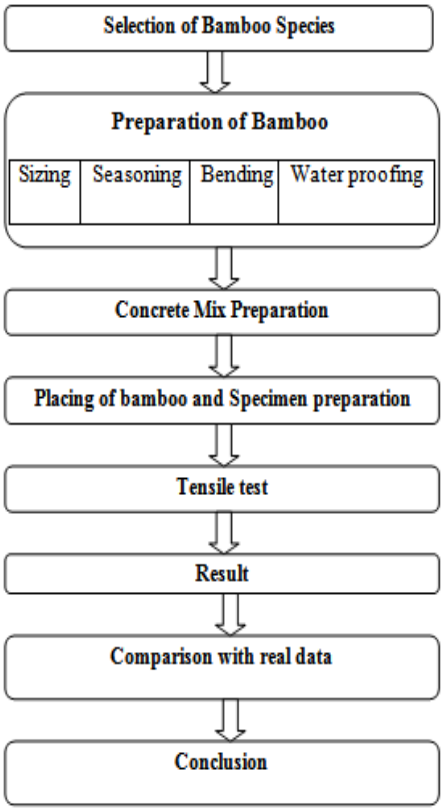

- The specimen used for tensile test has diameter of 19 mm.
- The size of beam used for analysis of reinforcement is 300mm x60 mm up to depth of reinforcement distributed load 30 KN/ m and M25 mix used
- For cost estimation slab of 3m x 7m with depth of 150 mm supported by the wall of 300 mm is used

IV. RESULTS

4.1 Tensile test report

Culm diameter	Tensile strength (MPa)
19 mm	121.173

4.2 Load comparison between steel and bamboo reinforced structure

	Steel reinforced	**Bamboo reinforced**
Analysis	20.11 KN/m	12.85 KN/m
Design	6 bars of 25 mm diameter	10 bars of 25 mm diameter

4.3 Cost analysis

	Steel reinforced	**Bamboo reinforced**
Cost(Rs)	**16800**	**7640.00**

V. CONCLUSIONS:

The research looked at the strength of bamboo and how it can be used in the building industry. The inquiry led to the following conclusions:

1. The tensile strength varies from 150-250 n/mm2
2. Bamboo nodes have no effect on actions.
3. Breaking pattern were in conclusion
4. Based on experiment it can be assume that for at least one or two storey housing bamboo can replace steel reinforcement where area is not so big
5. Predicament is required for better stability

India is a populated country and a developing one also. So residence provision for every Indian is very herculean task steel is very costly. And bamboo can be the alternate to replace it is economical as well as eco friendly so we can look upon a well treated bamboo culms as a replacement of steel for low cost schemes

VI. FUTURE SCOPE

1. Design the structure with bamboo with various species
2. Combination of material can be used to see how it affects strength and durability
3. Workability need to be assets
4. How we can increase bond strength

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