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A Comparative Study of Bamboo Reinforced Vs Steel Reinforced Concrete Structure

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Abstract: ***The building industry is the leading consumer of energy and materials in the majority of nations. Concrete is strong in compression but weak in tensile strength. To obtain tensile strength, steel is added as reinforcement in concrete. Bamboo has a high compressive and tensile strength. As a result, the use of bamboo as a structural building material is gaining popularity, Bamboo is one of the oldest building materials on the planet. Bamboo is been used for bridges, scaffolding, dwellings, and other temporary structures from early times. This review paper is a theoretical demonstration of the extensive use of bamboo as reinforcement in construction and its detailed use in substitution for steel. The goal is to find ways to make the use of bamboo reinforced concrete beams simple, efficient, and cost-effective.***

Keywords: ***Bamboo Reinforcement, Bamboo Reinforced Concrete, Tensile Behaviour, Cost Reduction.***

I. INTRODUCTION

As we all know, India is a developing country with a growing population which is driving up the housing demand. The construction industry is one of the most energy-intensive industries on the planet. Concrete, steel, wood, glass, plastic, and a variety of other materials are used in construction. Steel-reinforced concrete is usually used to construct housing structures. Several studies have begun in recent years to investigate the use of low-cost and low-energy substitutes for construction. Among the various possibilities for such substitutes.

Bamboo's rapid growth and maturity rate, sustainability, aesthetics, acceptability, its strength properties and low cost makes it worth investigating as an alternative to steel. For thousands of years, bamboo has been used in the construction of bridges and homes. As described in [5] due to a unique rhizome dependent system of growth, bamboo is known to have over 1200 different species worldwide which makes it a common and easily available resource it is also known to have been widely used in building construction in different parts of the world. Some species of bamboo can grow as tall as 35 inches within a 24-hour period. Bamboo has a higher compressive strength than wood, brick, and concrete, as well as tensile strength relatively similar to steel.

According to [4] Bamboo has strong mechanics and adaptability, and it is simple to process, making it suitable for a wide range of architectural and industrial applications. Bamboo has a compressive strength 10% higher than wood but a comparative tensile strength.

Though steel has a tensile strength 2.5-3.0 times that of bamboo and a specific gravity 6-8 times that of bamboo, the tensile strength of bamboo is 3- 4 times that of steel when measured per unit weight (bamboo vs steel). The study compares the tensile strength of bamboo to steel as a structural engineering material.

A. Problem Statement

1) *Economy:* In recent years, steel prices have soared. For developing countries, steel is difficult to obtain because of expensive prices, and for the construction industry, usage of steel is currently limited heavily. The production of steel has high consumption of fossil fuels, so, the steel discharge in the construction of structures has been presented, showing the possibility of drastic reduction by research institutes. Meanwhile, for developing countries, it is important to make the development of buildings construction; low cost, no requirement of sophisticated technologies and reliable construction methods.
2) *Efficiency:* To clarify the differences of structural properties from steel reinforced concrete and bamboo reinforced concrete. mainly intended to check the possibility of employing bamboo as reinforcing material for concrete s substitute to steel bars. Bamboo is being used as scaffolding, floorings, rafters, posts, poles and member of trusses in building construction.

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B. Objectives

1) To investigate the behavior of bamboo as reinforcement.
2) To study the evaluation of feasibility of the use of Bamboo as reinforcement in concrete members. The bamboo is to be used as concrete reinforcement it is necessary to understand how bamboo behaves in tension.
3) To study the strength of bamboo reinforced concrete beam with load.
4) To reduce the cost of construction material by using another material that can be found locally.
5) To compare the efficiency of bamboo reinforced concrete against conventional concrete and steel reinforced concrete.

II. LITERATURE REVIEW

Alvin Harrison, Akash Agrawal, Ashhad Imam (et.al); In this research steel is replaced by using bamboo and its mechanical properties were studied. Experiments were performed to check the compressive, tensile and flexural strength the results show the satisfactory anticipation and possibilities of using bamboo reinforcement as a replacement of steel reinforcement in concrete structures may be feasible in terms of low cost green construction.it also shows the significant enhancement in compressive strength and flexural strength of bamboo reinforced concrete as compared to plane cement concrete. The split tensile strength was slightly same in bamboo reinforced concrete and plane concrete, the reason for slightly same result due to failure is taking place in concrete others wise the tensile strength of the bamboo is also high.[6]

Mahzuz H. M. A, Ahmed Mushtaq, Ashrafuzzaman M, Karim Rejaul and Ahmed Raju (et.al); The shear strength of bamboo reinforcement in concrete reveals that concrete members reinforced with sections of bamboo culms, which had been separated along their horizontal axes, developed considerably higher load capacities than unreinforced concrete beams of similar sections. The ductility of tension bamboo reinforcement is low and collapse of beams is distinguished by splitting of concrete from the tension reinforcement and brittle failure. The shear capacity is enhanced by increased amount tension reinforcement and addition of web reinforcement.[7]

Mark, A.A. and Russell (et.al); A study of the shear strength of bamboo reinforcement concrete reveals that concrete members strengthened with sections of bamboo culms, that had been split on their horizontal axes, developed significantly higher load capacities than unreinforced concrete beams of comparable sections. The plasticity of tension bamboo reinforcement is low and failure of beams is characterized by rending of concrete from the stress reinforcement and brittle failure. The shear capability is increased by increased quantity tension reinforcement and addition of net reinforcement. It is therefore recommended that bamboo reinforced concrete beams are reinforced with steel stirrups to improve on its load carrying behavior.[8]

Mritunjay Kumar Singh, Shiv Pratap Singh, Kaisar Jamal, Piyush Verma (et.al); In this study the focus was on the very special type of engineering reinforcing material like bamboo. Their property is well known to us by through upcoming decades and thus it is not yet properly utilized. In some extent bamboo contain some advantageous property like CO2 absorption as well as reduction in environmental pollution The property of bamboo is the reason for which it was selected as the material for reinforcing beams. It is a sure inevitability that the structural member that has been reinforced with bamboo will lose its strength up to a significant limit, so this project report has focused on providing a method by which steel and bamboo can be used as individual or together so that the strength of the member and thus the structure is not compromised with sighting a reduction in self weight and making the structure economical. [9]

III. METHODOLOGY

Bamboo reinforced concrete building follows same project, mix proportions and construction techniques as used for steel reinforced. Bamboo reinforcement is used in place of the original steel reinforcement. Specifically, as a strength bearing material. It is used to construct historical structures. This innovation was inspired by a study conducted at Clemson University's Agricultural College. Bamboo is a natural biodegradable and renewable material. It is energy efficient because it is natural and environmentally sustainable. For centuries, these properties have compelled their use in the construction field. When compared to other materials, including steel, bamboo has an appreciable tensile strength property, which is the main requirement of a reinforcing material. This property is due to the structure of bamboo from its origin. This hollow structure has high resistance against wind forces when it is in natural habitat Working on bamboo's weak points and developing bamboo as a structural steel replacement would be a fantastic alternative.

A. Material Preparation

Based on the previous studies [2], the following criteria have been measured in this research for the selection of bamboo for use as a reinforcement in the concrete structures:

1) The bamboo showing a brown colour with at least three years old is selected.
2) The accessible biggest diameter of the culm is being selected.
3) The whole culm of green bamboo is not being used.
4) Avoid cutting the bamboo in spring or early summer because the bamboo is weaker due to increase in fibre and moisture content.

In this research, three years old bamboos plants of pronounced colour were selected. Samples (1 m each) were collected from the bottom of the plant having four or five nodes. The strength distribution is more uniform at the bottom of bamboo than at the top or at the middle of it since it is subjected to maximum bending stress due to wind at the top portion of the culms [1].

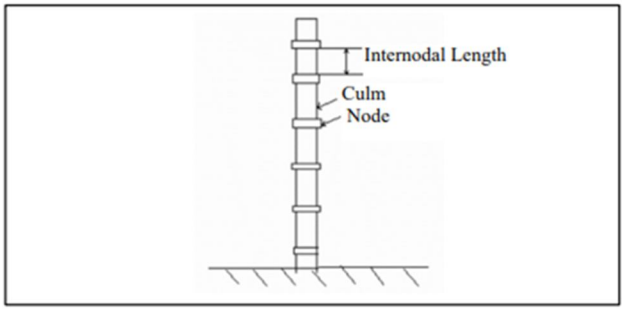


Fig -1: whole bamboo culm

By referring to the previous study [3], the characteristic of bamboos showed high water absorption and low bonding strength between bamboo's surface and concrete when used as a reinforcement in concrete. In order to prevent this problem, 'Tack coat' has been used to minimize the swelling of bamboo and to increase the bonding strength. The coated has been applied one day before the bamboos being used as a reinforcement in the beam sample.

Steel bar High yield steel deformed (HYSD) were used in this study in order to identify the performance of standard reinforcement used in concrete and to make a comparison with the bamboo reinforcement.

Concrete The concrete to be used in the beams was made using Ordinary Portland Cement, sand as the fine aggregate and stone chips as coarse aggregate with a maximum size of 20 mm. The concrete mix proportion (cement: fine aggregate: coarse aggregate) was 1:2:4 with 0.5 water cement ratio used in this study.

IV. RESULT

According to study Compression strength of round bamboo ranges from 47.9 to 69.9 Mpa and they are weak in shear [10]. Plain concrete and untreated bamboo columns showed brittle behavior in which, tiny cracks occurred at the surface of the column at about 80% of maximum axial force [11, 12]. Use of bamboo as reinforcement may lead to economy as compared to structures reinforced with steel; thereby overall cost of construction can be reduced (10- 20%) [13]. Strength-Cost ratio of bamboo is more than nine times higher than that of steel [14].

V. CONCLUSIONS

The concept of sustainability in building construction has evolved over time as well. The issue of limited resources, particularly energy and how to reduce the impact on the natural environment received the most attention. Now, the attention is on more technical issues such as materials, building components, construction technologies, and energy-efficient design. bamboo as a potential material can be used as reinforcement. The load carrying capacity and flexural strength of the BRC beams are found much better with respect to plain cement concrete beam. Compression carrying capacity depends greatly on properties of concrete and bonding between reinforcements and concrete. BRC can resist more compression than PCC.

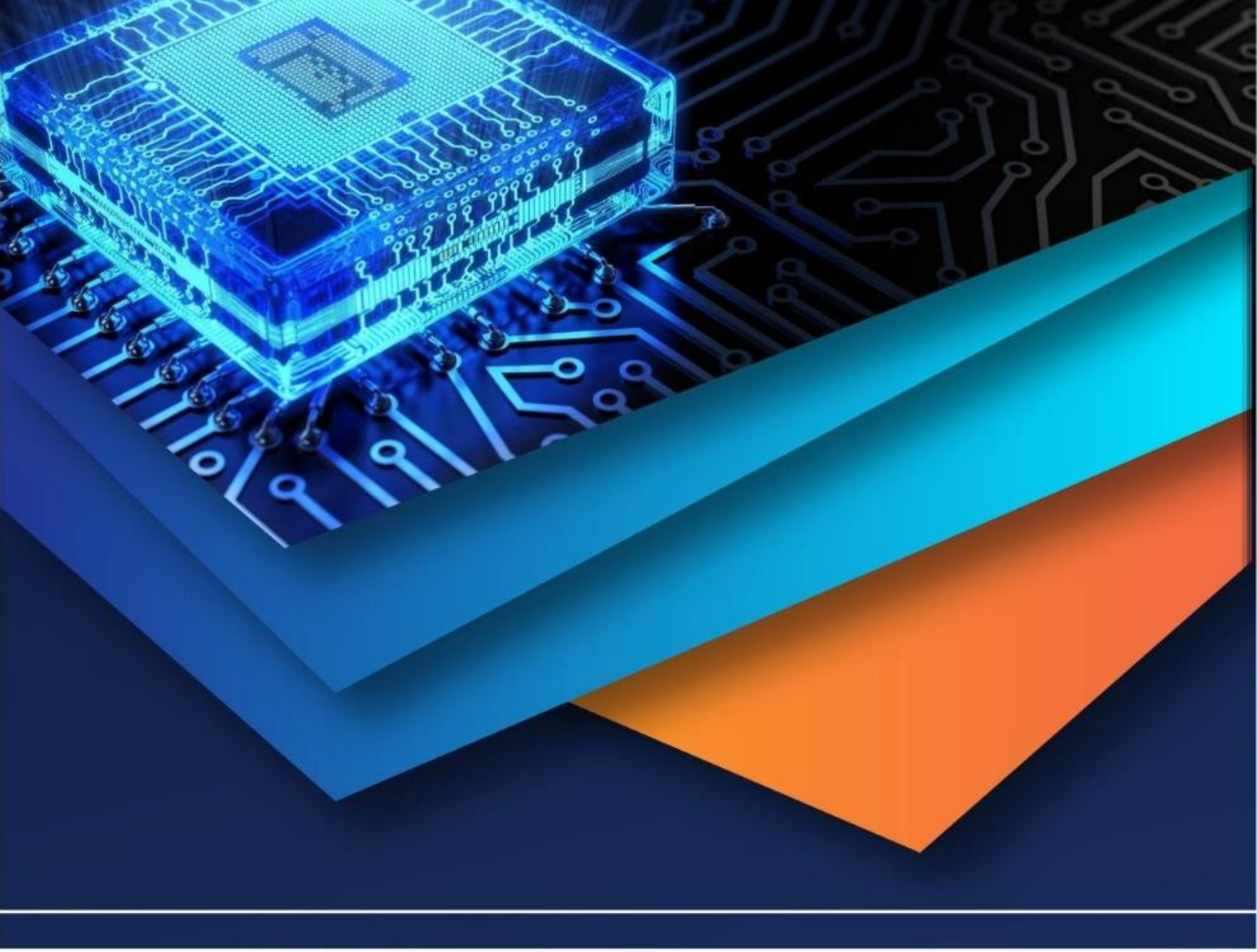
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