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Comparative Analysis of Bamboo Reinforcement with Steel Reinforcement in RC Building

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Abstract- ***The iron and steel industry is one of the largest energy-consuming and carbon-emitting sectors worldwide, contributing significantly to global CO_2 emissions. In response to growing environmental concerns, the construction industry is exploring sustainable alternatives to steel reinforcement. Bamboo, a fast-growing and renewable non-timber forest material, offers high strength, low weight, and excellent ecological benefits, including substantial carbon and nitrogen absorption during growth. Traditionally used in rural construction, bamboo has recently gained attention as a potential reinforcement material in concrete due to its favorable mechanical properties and suitability for light structural loads, especially in seismic regions. This study examines the feasibility of bamboo reinforcement by conducting tensile tests and developing slab and beam models using ANSYS software for comparative analysis with steel. The findings contribute to understanding bamboo's structural performance and highlight its potential as an eco-friendly, cost-effective reinforcement material in reinforced concrete applications.***

Keywords: Proportionate Random Village Sampling Rural Patna Demographic Diversity

I. INTRODUCTION

We're looking into how bamboo can be used in construction. First, we read a lot about its strength and how it can be built with. Then, we plan some tests to check its strength using a well bamboo performs and if it could be a good substitute for steel in building projects.

1.1 Project Plan

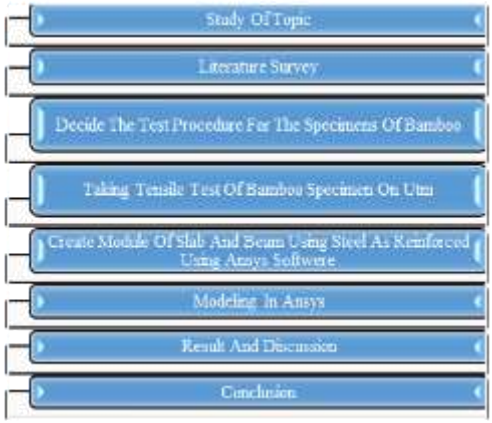

Fig 1: The components of user interface software

practical applications tailored to the field's specific requirements. This ease of adoption makes Python a valuable tool for enhancing the educational experience in Civil Engineering.

Scope:
Bamboo is cheaper and easier to use in construction. This project aims to figure out the right modular ratio for bamboo reinforcement, which can help in designing low-rise buildings. Since steel is a finite resource, it will eventually run out. So, we need alternatives like bamboo to lessen the demand for steel. This project could lead to using bamboo more widely in building different types of structures to cut down on weight and costs. We tested a bunch of bamboo and bamboo twigs to see how strong they are. We'll talk about how they broke and their strength later on. We did tension tests with different ways to hold them. How you grip the samples is really important in these tests. Bamboo is softer than the materials we use for gripping in the testing machine.

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During the tests, we noticed that some samples broke early at the gripping ends. This may have happened because of pressure from the sides. Plus, the surface of bamboo is slippery, so some samples slipped while we tested them. To fix the gripping issue, we wrapped 2mm GI wire tightly around both ends of the bamboo samples. This helped keep everything in place during the tests.

II. RESEARCH METHODOLOGY

Project Aim: Comparative Analysis of Bamboo Reinforcement with Steel Reinforcement in Rc Building

Project Objectives:

2.1 Tensile test

To obtain the tensile strength of bamboo the bamboo specimen should be properly selected following points should be considered while selection of bamboo culms for use as reinforcement in concrete structure.

2.1.1. Selection of bamboo

- Use of bamboo showing a pronounced brown colour. This will ensure that the plant is at least three years old.
- Select the longest large diameter culms available.
- Do not use whole culms of green, unseasoned bamboo
- Avoid bamboo cut in spring or early summer. These culms are generally weaker due to increased fibre moisture content.

2.2 Testing

We tested a bunch of bamboo and bamboo twigs to see how strong they are. We'll talk about how they broke and their strength later on. We did tension tests with different ways to hold them. How you grip the samples is really important in these tests. Bamboo is softer than the materials we use for gripping in the testing machine.

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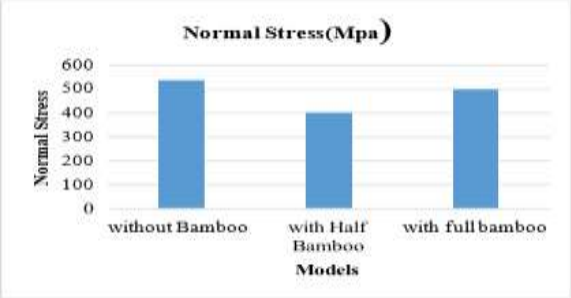
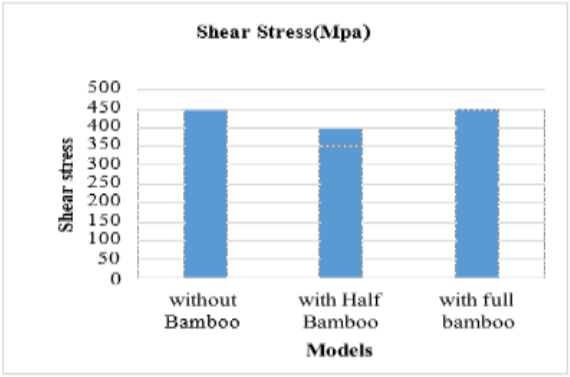


Graph 1: Normal Stress(Mpa)

The graph shows the normal stress in megapascals (MPa) for three different conditions: without bamboo, with half bamboo, and with full bamboo. The data reveals a varying trend in normal stress with the amount of bamboo. Specifically, without bamboo, the normal stress is 538.53 MPa, with half bamboo, it decreases to 407.8 MPa, and with full bamboo, it increases again to 501.63 MPa. This suggests that while half bamboo reduces the normal stress, full bamboo increases it compared to half bamboo but still remains slightly lower than the condition without bamboo. This indicates that the relationship between bamboo content and normal stress is non-linear and may depend on other factors such as the distribution and interaction of bamboo within the material.

III. SHEAR STRESS(MPA)

Fig 2: Shear Stress (Mpa



Graph 2: Shear Stress (Mpa)

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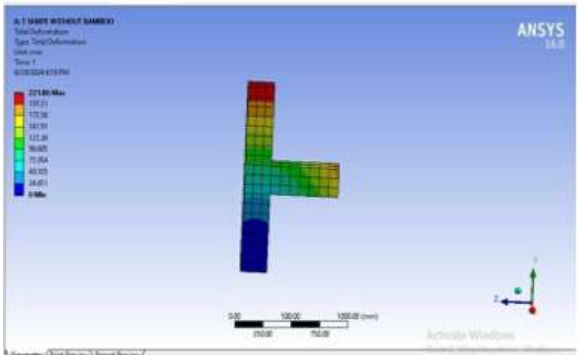
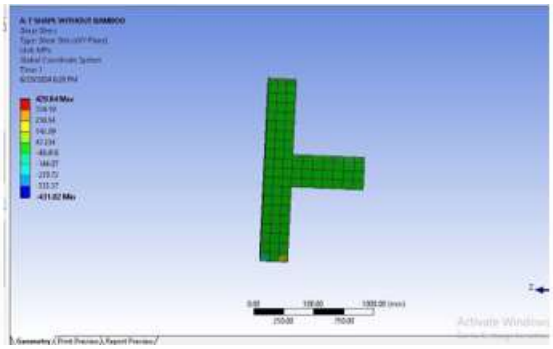
The graph presents the shear stress in megapascals (MPa) for three different conditions: without bamboo, with half bamboo, and with full bamboo. The data shows a varying trend in shear stress with the amount of bamboo. Specifically, without bamboo, the shear stress is 429.84 MPa, with half bamboo, it decreases to 371.19 MPa, and with full bamboo, it increases to 451.27 MPa. This suggests that incorporating half bamboo reduces the shear stress, while using full bamboo increases it beyond the initial value without bamboo. This indicates a non-linear relationship between bamboo content and shear stress, suggesting that the effect of bamboo on shear stress depends on its quantity and possibly its distribution within the material.

IV. RESULT AND DISCUSSION

4.1 Introduction



This chapter presents the detailed results and discussion from a comparative analysis of bamboo and steel reinforcement in RC buildings. Key parameters such as total deformation, elastic strain,



and stress under different bamboo reinforcement scenarios are analyzed. The findings highlight the structural performance differences between bamboo and steel, emphasizing their implications for flexibility, resilience, and load-bearing capacity in construction application.

V. CONCLUSION

To wrap it up, looking at bamboo versus steel in reinforced concrete buildings shows some clear pros and cons. Bamboo can bend more and handle stress better than steel. This means it might make buildings more flexible and able to carry heavier loads. But the extra bending and stress also mean we need to plan carefully to make it work well. In this study, we compare a traditional concrete beam to one with bamboo strips. We checked different cases to find good designs for using bamboo since there are no specific rules for it yet. We did tests to figure out important material traits like how much stress and strain the bamboo can take. After the tests, we used ANSYS software to analyze the data and came to these conclusions:

- Bamboo is lighter than steel, which cuts down the overall weight of the structure.
- The bending is within safe limits.
- Since bamboo grows naturally, using it helps lower carbon emissions.

Adding bamboo increases things like bending, strain, and stress compared to using steel. In fact, using all bamboo gives the highest values for these factors, which means more flexibility and strength. But there's a twist—using half bamboo can sometimes lead to lower stress levels than using all bamboo, though it's still usually stronger than using only steel. The way shear stress changes with how much bamboo is used is a bit tricky too, showing different results based on how it's mixed in.

Overall, bamboo looks promising for building needs, especially for its bending ability and how it handles stress. But we need to be smart about how much we use and where we place it to get the best results in concrete buildings.

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