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An Experimental Investigation on RC Concrete Beam by Replacing Steel Reinforcement

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Abstract – Recently, with respect to increasing problem of global warming, the manufacturers prefer natural materials. Bamboo is low cost, naturally fast growing and easily available so expected to contribute in earthquake-resistant construction the developing countries. RC concrete is commonly used everywhere but it become expensive when steel is use as reinforcement. The intention of research is to use bamboo as a key structural material, for a safe and durable house, which can be affordable by poor people.

The concrete is widely used construction material in the world. It has very good compressive strength but it is weak in tension. To fulfill this tensile strength of concrete we are using concrete and steel in all structural members. RCC Structure becomes more expensive due to steel bars use in the structural members. So it is present requirement to find out some alternate for steel reinforcement bars. Bamboo can replace reinforcement bars in low cost housing.

Keywords- Bamboo, Eco-friendly, Reinforcement, RCC Beam, Economical

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1. INTRODUCTION

In near days, steel cost have increased rapidly. For developing countries, it is difficult to manufacture steel because of expensive process. The production of steel requires high consumption of fossil fuels. Also, for developing countries, it is necessary to make the development of infrastructure. The increasing cost and shortage of reinforcing steel in many parts of the world had generated interest in the possible use of other possible locally available materials for the reinforcement of concrete.

The reason of using local material for construction is to give assurance that to obtain cheaper solution to construction problems especially in the rural areas. In the developing countries like India, more than 75% percent of the population lives in rural area. Bamboo is a natural material which is low cost and easily available. India is the second after China in terms of bamboo production. There are 136 various species of bamboos available in India. The production of bamboo in India is about 4.6 million tons annually and it is strong in both tension and compression. The tensile strength of bamboo can attain 370 MPa which is relatively high.

From ancient time Bamboo is one of the widely used construction materials due to its less cost, high strength, availability, feasibility to work with, low weight, earthquake resistance, etc. If bamboo reinforced concrete beam is reinforced with steel stirrups, it improves its load carrying capacity. It is also used in designer homes as flooring, walling and paneling material. Its strength increases with its age and attains the maximum strength at 3-4 years and then starts to decrease in strength. Bamboo is a bio degradable, renewable and energy efficient natural material. Bamboo is also an eco friendly plant because during the grow thing process bamboo gives oxygen and also it absorbs a lot of nitrogen and carbon dioxide from the air. In addition, bamboo can be grown in abundant at a lower cost which makes it more economical.

The strength properties of bamboo increase from inner to outer layer of the Culm. Bamboo is a versatile material because of its high strength-to-weight ratio, easy workability and availability. This process could make housing affordable so bamboo can be used as alternative material in construction.

GOALS AND OBJECTIVES:

1. To study the alternative for RC concrete beam by replacing steel reinforcement.

2. To study comparison between conventional RC concrete and RC concrete with Bamboo.

2. LITERATURE STUDY

[2.1]– SURESH BARMAVATH; KIRAN M V; CH NARENDRA NAIK; G SAI KUMAR; E HARI NAIK; V AMULYA AND V DIVYA; [JUNE 2017]: Bamboo is a big grass used as construction material from ancient times. Bamboo is eco-friendly and naturally available material. During the grow thing process bamboo gives oxygen & during manufacturing process steel release CO2 which is polluting environment. The concrete has high compressive strength. i.e., steel is used to reinforcement the concrete. Bamboo is the locally available materials as a replacement for conventional steel reinforcement specifically, it is the most suitable material that may be used as reinforcement bar in concrete. Bamboo sticks were seasoned for about 2 to 3 weeks and they were used as reinforcement. Concrete mix design for M40 grade concrete has been found as per design requirement of IS 10262:2009. Ordinary Portland cement used and bamboo reinforcement concrete beam were casted. The beams were single, double reinforcement concrete beam and to be full replacement with bars of bamboo can curing periods 7days, 21days, 28days to compared purpose and tested on UTM. Bamboo is grass type and it's used in construction material .During the wet bamboo is low strength and dry bamboo compressive strength is high.

[2.2] JAMES KARIUKI; RICHARD A. SHUAIBU; TIMOTHY NYOMBOI; AND SIPHILA MUMENYA; [NOV. 2014]: The need to discover new and sustainable building materials has necessitated research in different parts of the world. This study presents a comparative performance of bamboo laminated beams with cypress beams of the same dimensions. Six laminated bamboo beams and three cypress beams were tested in this study. The dimensions of each specimen were 45mm x 95mm x 600mm and tested under two point loading. Experimental results revealed that bamboo laminated beams resisted higher load than cypress beams and had a higher flexural strength of 39kN/mm2 against that of cypress beam of 34kN/mm2. The cypress beams failed with major cracks in flexure and bamboo laminated beams failed in tension on the lower part of the beams and shear along the grains. In addition, it was observed that bamboo laminated beams took longer duration than cypress beam to fail completely. Hence the study found that bamboo laminated beams have better load carrying capacity than cypress beams.

[2.3] ADOM-ASAMAOH MARK; AFRIFA OWUSU RUSSELL; [2011]: This study tries to explore the ways of using the bamboo reinforced concrete beams in simple, efficient and cost-effective style for rural construction with Ghana as a case study. In this comparative study of bamboo reinforced concrete beams and shear links made of different materials is done. The web materials considered were bamboo, rattan cane and steel. Sixteen (16) beams were tested to failure under four point bend tests. The highest and lowest failure loads were recorded for the cases of steel stirrups and no stirrups respectively. The experimental failure loads averaged 5.05 and 1.72 times the observed first crack and theoretical failure loads respectively. A beam performance index (BPI) in terms of energy absorbed per unit cost of beam, indicated the use of steel stirrups as the most economical. It is found that rattan stirrups are more expensive than steel stirrups therefore recommended that steel stirrups be used to enhance the performance of bamboo reinforced concrete beams.

[2.4] M.M. RAHMAN, M.H.RASHID, M.A. HOSSIAN, M.T. HASAN, M.K. HASAN; (AUG. 2011): As bamboo is a naturally available , low cost and also easily available, it can be a substitute of steel in reinforcing of concrete. In this paper, aptness of bamboo as reinforcement in concrete will be evaluated. To assess this, tensile strength test of bamboo having three and five nodes are performed. Sticks of varying cross sections of 1 m bamboo are used in this test. Also flexural strength test of bamboo reinforced beam is done to characterize the performance of bamboo as reinforcement. Singly and double bamboo reinforced beams of 750 mm length having 150 mm width and depth are compared with plain concrete beam to carry out in this test.

3. METHODOLOGY

1. Introduction

The advantage of bamboo reinforcement can be shown by replacement of steel in RC concrete beam. Further estimation of reinforcement is done.

- In this project, we have chosen bamboo reinforcement technique instead of traditionally used steel reinforcement.
- It is good alternative for low cost economic structure.
- Its cost is three times lower than steel reinforcement technique.
- Even in future it has great scope in constructing multi-storey structure using bamboo reinforcement.

The performance evaluation of Bamboo as reinforcement in RC Concrete Specimen following tests is executed.

Step 1:- Laboratory setup, procurement of materials concrete and bamboo test preparation.

Step 2:- Mould preparation, mix design of M40 of concrete and Reinforced Cement Concrete design.

Step 3:- Finding the flexural strength results.

2. Bamboo Experimental Preparation

> As Bamboo is isometric material because its grains are aligned parallel in the axial direction. So the mechanical properties of Bamboo depend on the direction of the force.

> Generally, compared to wet bamboo dry bamboo has higher mechanical properties. Generally bamboo naturally has high moisture content. This moisture content can be brought down by using various treatment methods.

> Generally, larger bamboo can withstand larger forces However; smaller bamboo has stronger mechanical properties (such as ultimate compressive strength) for its size.

> Thick walls of Bamboo Culm have better mechanical properties.

> As the distance to the node decreases, the mechanical properties improve.

> The height of the bamboo affects its properties. Generally, the part of the bamboo nearer the bottom has stronger properties.

> The species of bamboo also matters; some are not useful as a building material.

4. CONCLUSION:

From the above project data we concluded the following points,

- Bamboo is low cost alternative to steel in structural elements.
- It can be use in the area where single storey buildings are preferred.
- Also it is beneficial in Earthquake zones.
- It is eco-friendly and fast growing natural giant grass which is easily available anywhere.

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