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Bamboo-Enhanced Concrete

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Abstract: ***This study presents the assessment of the viability of the use of Bamboo as a reinforcement substance. Here Bamboo was used as a strengthened substance. Nowadays concrete is used as the fundamental substance for a building project. Concrete is good in compression but fragile in tensile strength. So, steel is used as reinforcement in the concrete to achieve tensile potency. Problems experienced with the use of steel are high in cost, erosion, etc. The primary challenge hindering the utilization of bamboo as reinforcement is the insufficient knowledge regarding its impact on the strength and durability of concrete.***

Keywords: Bamboo, Concrete, Reinforced, Material.

I. INTRODUCTION

The use of bamboo as reinforcement in Portland cement concrete has been studied extensively and at the primary stage by Clement Agricultural College. Bamboo has been used as a building substance globally by human civilization for a very long period but after the Clement study, its use as reinforcement has gained little attention.

The investigation of the use of bamboo as a complementary substance with steel in RCC construction has been shown in this study with the economy, safety, convenience, and durability of the application of the particular idea. Since the use of bamboo in ancient times for housing purposes, it has been diminishing in our world in the form of a building substance despite its rich properties, strength, and financial advantages.

There are several methods presented and deduced by universities and the U.S. Navy that have proven the validity of the use of bamboo in structural members such as columns and girders. Hence in this report, the methods are presented by the members of this group for better strength and more applicable methods with the least compromise in strength. Methods that have been put forth in this report are not guaranteed to have the best outcomes or with any assurance of the maximum strength of a structure, the designs being presented are those which have been tested on software simulation for safe working load and failure analysis.

This could be very helpful and have a very good breakthrough in the field of concrete designing with prominent financial benefits over steel (being used with it) and its benefits related to the reduction of carbon emission in the atmosphere if methods like these are applied extensively and studies for the development of a code about concrete design with bamboo strengthenings can be brought forward for a better future of financial and eco-friendly RCC construction.

Bamboo is a giant grass having a place with the group of the bamboo family. It is evaluated that around 1100-1500 species of bamboo persist and there are moreover around 600 varied plant types of bamboo on the celestial body. In this study fully grown Bamboo has been used as a strengthened substance. The upkeep expense of a steel structure is high. Because of the activity of rust in steel, costly paints are required to re-establish occasionally. So resistance against serious conditions increases. Steel has little resistance against flame when contrasted with cement. Just about from 600-700C, the portion of steel quality decreased. Steel can't be molded in any heading you need.

It must be utilized as a part of structures in which segments initially exist. On the off chance that steel loses its pliability property, then the odds of weak breaks increment. On the off chance that there are expansive varieties in elasticity then this leads steel to more strain. The expense of development substances including steel is expanding consistently throughout the years and houses are getting to be excessively expensive for basic man. Subsequently keeping in mind, the end goal to give a safe house to the urban poor of the general public it is significant to either exchange development substances with routine development procedures or to embrace ordinary substances with substitute development methods to decrease the expense of structure.

In the present exploration work, the principal choice i.e. Alternate construction substances with traditional construction technique had been utilized to use bamboo sticks of various states of cross-section area as a substitute for steel bars in structural members. These days, structure construction itself means it would of concrete reinforced with steel or RCC structure. Concrete can readily sustain compressive loads but it has low tensile strength. Steel has a relatively high tensile strength (792N/mm2) and high toleration of tensile strain, steel forms a good bond with concrete, irrespective of pH, moisture, and similar factors.

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It has thermal compatibility, not causing unacceptable stresses in response to changes in temperatures. It also has durability in the concrete environment, irrespective of corrosion or sustained stress.

II. METHODOLOGY

A. *Bamboo Treatment*

1) Bamboo Curing

After cutting the bamboo plant, it should be allowed to dry and season for three to four weeks before using.

2) Coal Tar application:

The bamboo sticks were first coated with coal tar to make bamboo waterproof and to improve the bond between bamboo and concrete.

B. *Tension Test on Bamboo Stick*

At the time of tension tests, early failure was observed at the gripping end. In some cases, bamboo strips experienced slip at the time of the tension test. To solve this gripping problem GI wires (2mm diameter) were wrung spirally at both ends of the specimen.

C. *Casting of Beam*

Preparation of Mould: The beam mold of inner dimensions (710mmx150mmx150mm) is used for casting the concrete beam. They are formed from heavy gauge steel plates to maintain dimensional shape and can be easily disassembled for cleaning.

Hand Mixing of Concrete: Hand mixing should be done on a smooth, clean, and water-tight platform of suitable size in the following manner:

1) The required volume of cement and sand is spread evenly.
2) The sand and cement are then mixed with a spade, turning the mixture over and over again.
3) The sand cement mixture is then spread out and a measured volume of coarse aggregate is spread on its top.
4) The whole mass should be mixed at least three times.
5) A hollow is made in the middle of the mixed pile.
6) Three-quarters of the total volume of water required should be added while the substances are turned in towards the center with spades. The remaining water is added and mixed thoroughly.
7) The mixing platform should be washed at the end of the day.

a) *Placing of Reinforcement:* 3 number of bars are placed in the beam mold at a distance of 40mm and 4 number of stirrups are placed at a distance of 180mm C/C. Reinforcement is placed with a cover of 20mm

b) *Types of Replacements in Reinforcement:*

- Normal Reinforcement.
- Partially Replaced Reinforcement.
- Replaced Reinforcement.

c) *Casting of Beam:* Prepare the test specimen by filling the concrete into the mold in 3 layers of approximately equal thickness. Tamp each layer 35 times using the tamping bar. Tamping should be distributed uniformly. After rodding each layer, use a trowel and Strike off to a flat surface and get a proper finishing. After 24 to 48 hours demolding is done. The specimens will be transported to the water tank for curing. Specimen identity will be noted along with the date and time the specimen was made. Then the beam is kept for curing for 28 days.

D. *Test on Beam*

Flexural Test: To check the flexural strength of the Concrete Beam with dimensions 150*150*710 mm. The Bamboo strips of the length 670 mm are used as reinforcement as singly Reinforced Concrete beams having 3 bars at the bottom with 20mm clear covers.

E. *Flexural Test*

To check the flexural strength of Normal Reinforced Concrete Beam, Partially Replaced Reinforced Concrete Beam, and Replaced Reinforced Concrete Beam, these specimens are cast with dimensions 150*150*710 mm. The Bamboo strips of the length 670 mm are used as reinforcement.

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III. SCENARIO OF BAMBOO

This review paper contains information related to Bamboo as an alternative and this information is collected from different sources such as research papers, journals, magazines, and websites. In this review paper, we tried to collect much information related to bamboo strengthening from already published articles.

IV. SUBSTANCE USED

A. Cement

The binding substances used in concrete are Ordinary Portland cement. This cement is of 53 grades conforming to IS 456-2000 and has having desired properties. The properties of cement were determined by adopting standard procedure. The properties are given in the following table. The normal consistency, initial and final setting time, specific gravity, and fineness are the main basic properties that were determined.

Physical properties of cement and their value PHYSICAL, Normal consistency 32%, Initial setting time(min) 54, Final setting time(min) 340, Specific gravity 3.15, Fineness 7%.

B. Fine Aggregate

The fine aggregate used is M-sand. A research facility test was conducted on fine aggregates to determine the different physical properties as per IS 2386 (part-3) 1963(Reaffirmed 2002). The test results are tabulated in Table 2. The fineness is obtained using the sieve analysis and the result is such that the fine aggregate is confirming to IS 383 – 1970. the properties of fine aggregate regarding to specific gravity is 2.65and fineness modulus is 5.41 and water absorption is 1.7%.

C. Coarse aggregate

The coarse aggregate for the work is crushed stone. Angular shape aggregate of size is 20mm and below. The aggregate that passes through a 75mm sieve and retains on 4.75mm is known as coarse aggregate. The grading of coarse aggregates should be as per the specifications of IS 383-1970. The fineness is calculated from sieve analysis and the result is such that confirming to IS specifications.

D. Water

Water is an significant ingredient of concrete. It gives strength to cement and workability to the concrete. Potable water is used for casting and curing.

E. Bamboo

Through research, it has been found that some species of bamboo have ultimate tensile Strength same as that of mild steel at yield point. Experimentally, it has been found that the ultimate tensile strength of bamboo is comparable to that of mild steel & it varies from 140 N/mm2 to 280 N/mm2. Bamboo is a versatile substance because of its high strength-to-weight ratio, easy workability & availability. Bamboo needs to be chemically treated due to its low natural durability. It can be used as bamboo trusses, bamboo roofs, skeletons, bamboo walling/ceiling, bamboo doors & windows, bamboo flooring, scaffoldings, etc. It has been found that bamboo acts very well in buckling but due to low stresses then compared to steel and due to it not being straight, it may not be very good further it has been established that in the seismic zone, the failure of bamboo is very less as the maximum absorption of the energy is at the joints.

V. CONCLUSION

1) It is three times cheaper than the steel reinforcement technique. It is clear from the results that this bamboo strengthening technique is cheaper than the steel reinforcement technique, especially for single-story structures.
2) It has been observed experimentally that the load taken by bamboo-reinforced beams is 39% less than that of steel-reinforced beams.
3) In this project we have opted for an advanced bamboo strengthening technique instead of traditional steel reinforcement. This is a good idea for a low-cost financial structure.
4) It has been observed that the bamboo reinforced beam failed gradually, Bamboo sticks can work as the reinforcement due to its tensile strength.
5) Bamboo Stick has more flexural strength than plain concrete beams and hence can be used as tensile reinforcement.

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6) To increase the further flexural strength of the bamboo stick-reinforced beam the waterproofing agent with more bonding should be applied.

7) Bamboo Stick is cheap and hence it can lead to low-cost housing techniques in rural areas where the cost of steel is very high.

8) A better flexural performance has been observed with an increase in several reinforcements, the diameter of the bars, and the addition of shear links to the bamboo-reinforced beams.

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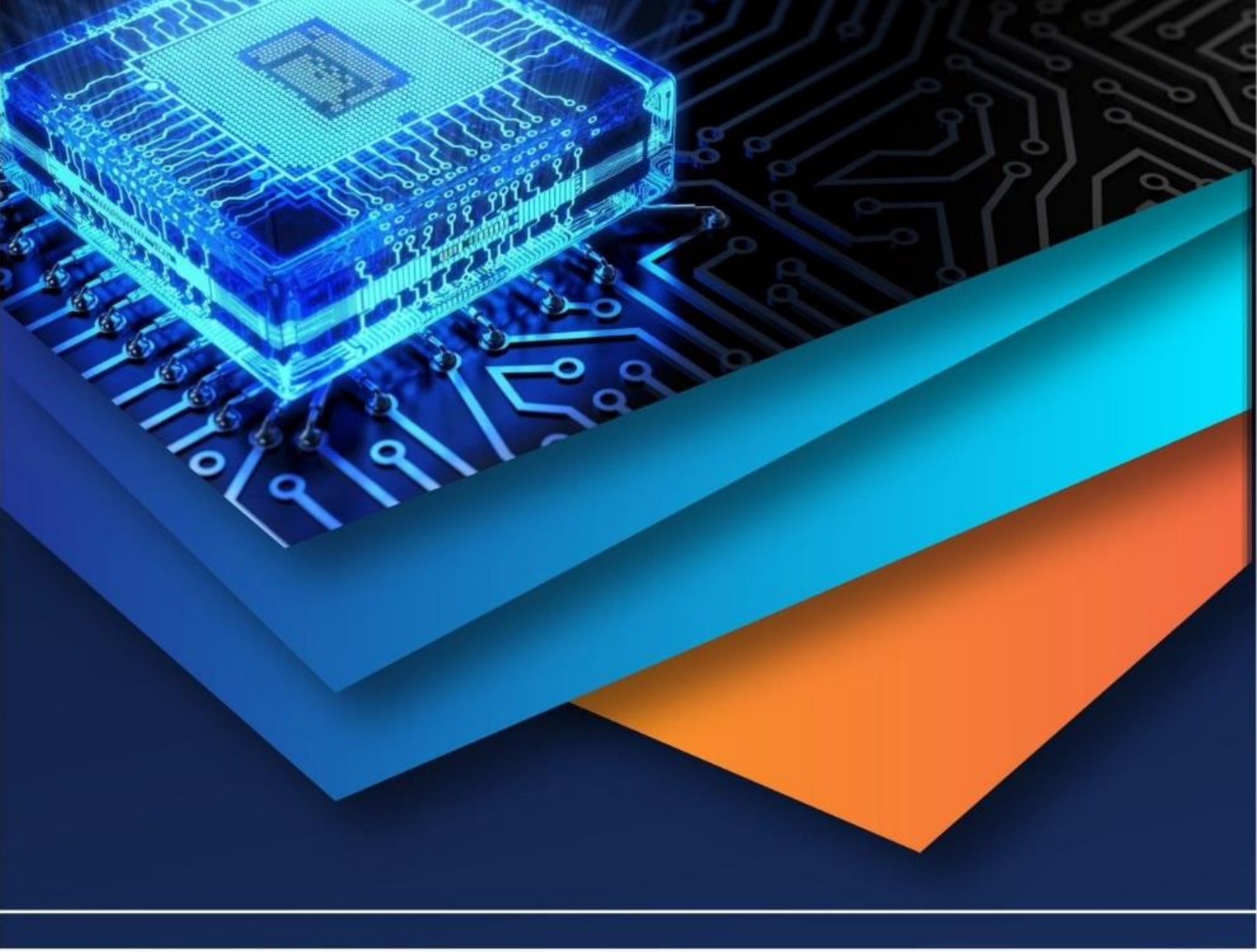
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