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A REVIEW ON DEVELOPMENMT OF BAMBOO REINFORCED ELECTRIC POLE

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ABSTRACT

Bamboo, low cost, fast growing, and broad distribution of growth, is expected to contribute significantly to earthquake-resistant construction and seismic retrofit technology in the developing countries. In this study an attempt has been made to understand the mechanical behaviour of bamboo reinforced concrete pole and clarifying the differences of structural properties from steel reinforced concrete and bamboo reinforced concrete. From these experimental works, the possibility of effective using of 'Bamboo' is discussed. The mechanical properties of bamboo and its availability in developing regions has led to its empirical use as reinforcement in concrete structures. The proposition of its widespread use as a sustainable alternative to steel in reinforced concrete structures, poses key questions to builders, engineers and researchers with regards to its structural capacity and compatibility, as well as constructability and sustainability issues. The motivation for such replacement is typically cost—bamboo is readily available in many tropical and sub-tropical locations, whereas steel reinforcement is relatively more expensive—and more recently.

Keywords: Bamboo reinforcement, Bamboo-reinforced concrete, Modulus of Elasticity, Strength

1. INTRODUCTION

Steel reinforced concrete (SRC) is mostly used for construction of load bearing structures. However, factors such as high cost and non-renewability of steel are a major concern for users. Therefore, consideration is given to a low-cost and sustainable material like bamboo, which apparently possesses some physical features of steel. Bamboo has been used as a construction material in certain areas for centuries, but its application as reinforcement in concrete had received little attention. Bamboo was given recent consideration for use as reinforcement in soil-cement pavement slabs in which the slabs behave inelastically even under light loads. The mechanical properties of bamboo and its availability in developing regions has led to its empirical use as reinforcement in concrete structures. The proposition of its widespread use as a sustainable alternative to steel in reinforced concrete structures, poses key questions to builders, engineers and researchers with regards to its structural capacity and compatibility, as well as constructability and sustainability issues. This paper discusses these issues, providing a holistic review of the literature in the field and a structural comparison between steel reinforcement and bamboo reinforcement in a typical concrete structure. The use of small diameter whole-culm (bars) and/or split bamboo (a.k.a. splints or round strips) has often been proposed as an

alternative to relatively expensive reinforcing steel in reinforced concrete. Bamboo is a biodegradable and renewable in nature. It is energy efficient as it is of natural origin and environmentally sustainable in nature. These properties have forced to use this in the construction field for centuries.In recent years, many researches around the world are begun to explore the use of low-cost and low-energy substitute construction materials. Among the many possibilities for such substitutions, bamboo, which is one of the fastest growing plants, has got a great economic potential. Bamboo has been used in constructions of bridges and houses for thousands of years in Asia. Bamboo takes less energy to harvest and transport. Therefore, bamboo has low manufacturing costs compared with steel, bamboo is widely expected to be possible even in countries and regions that have no advanced manufacturing technology and construction techniques.

2. METHODOLOGY

2.1 Procurement of the material

The trial design mix for single electric pole, the following materials are required and the specification and quantity of the materials are listed below: Table 1 shows the specification and quantity of material used for designing a single electric pole.

Table 1. Specification and quantity of material

S. No.	Material	Specification/Size	Quantity
1.	Steel Mould	Top: 10m x0.15m x.10m Bottom : 10m x 0.25m.x.10m	02 piece
2.	Aggregate	20 mm	50 cubic ft
3.	Bamboo(green)	Green	6 pieces
4.	Cement	50 Kg	8 bags
5.	Sand	Coarse	30 cubic ft
6.	Steel Bars	5 mm(for stirrups)	2 length

2.2 Design mix

Design mix or concrete mixes shall be proportioned to produce the adequate strength, durability and workability according to the requirement.

Table 2. Design mix property

S. No.	Property	Required Values
1.	Maximum water/ cement ratio	**0.6**
2.	Minimum Cement Content(Kg / m^3)	**280**
3.	Nominal maximum size of aggregate (mm)	**20**
4.	Design Mix	**M20**
5.	Mix proportions	**1:1.5:3**

Optimum percentages of concrete mix ingredients are vital for establishing a relationship between the best particle distribution and the corresponding degree of packing.

Fig.1.Longitudinal reinforcement made up of green bamboo of 12mm

Fig. 2. Bamboo reinforcement of a beam

Fig. 3. Reinforcement with Mould

Fig. 4. Casting of beam Size 15cm x 15 cm x 70 cm

3. COMPARISON OF TEST RESULTS

In this study an attempt has been made to understand the mechanical behaviour of bamboo reinforced concrete member and figure out the differences of structural properties from steel reinforced concrete and bamboo

reinforced concrete. So for the above mentioned purpose, two bamboos reinforced beam Size 15 cm x 15 cm x 70 cm has been casted and checked for flexural strength and then compare with the flexural strength of steel reinforced concrete beam of same size.

3.1 Variation in Modulus of Elasticity

Based on the experimental study the modulus of elasticity of RCC beam is more than the bamboo beam. Table 3 shows the variation of modulus of elasticity of the beam cured for 14 days and 28 days. Modulus of elasticity is calculated by "$E = 23\ wl^3\ /648\delta I$" (1)

S. No.	Type of beam	Modulus of elasticity for 14days Cured sample (N/mm^2)	Modulus of elasticity for 28 days Cured sample (N/mm^2)
1.	Steel reinforced Beam	951.67	1052.45
2.	Bamboo reinforced Beam	569.80	573.89

Table 3. Comparison between the Elasticity Values

Fig. 5.Flexural Strength Testing of specimen

Fig.6. Fixing the specimen in testing machine

Fig.7. Collapse load of specimen

Fig. 8. Showing the failure of specimen

3.2 Variation of failure load

Flexural test on the two specimens shows the variation in load carrying capacity of beam. The beam with steel reinforcement was showing the higher load carrying capacity in comparison with bamboo reinforced beam . Table 4 shows the variation of failure load.

Table 4. Variation of Failure load

S.No.	Beam type	Failure loads for 14 days cured sample (in kN)	Failure loads for 28 days cured sample (in kN)
1.	Doubly reinforced beam with steel reinforcement	102.57	113.48
2.	Doubly reinforced beam with bamboo reinforcement	30.02	52.12

Fig.9. Failure Pattern of Specimen

3.3 Variation of strength

Table 5 showing the variation of strength for two different type of beams i.e. R.C.C. beam and beam with bamboo reinforcement. From the results it can observed that steel reinforced concrete beam has shown the higher strength in comparison with bamboo reinforced concrete beam.

Table 5. Variation of strength

S. No.	Beam type	Strength(kN/mm^2)
1.	Steel reinforced concrete beam	240
2.	Bamboo reinforced concrete beam	112

4. CONCLUSION

1. Bamboo is found weak to take shear stresses so it cannot be used as shear reinforcement for different elements of RCC structures.

2. Bamboo is showing very less ductility as a reinforcement material in comparison with steel. Hence it can be used as a reinforcement in compression members of RCC structure.

3. Bamboo reinforcement should be coated with some material so as to retain moisture of bamboo during hydration of Concrete.

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