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Experimental study on behaviour of Well Seasoned Bamboo as reinforced concrete in beams

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ABSTRACT

In this modern fast growing world countries like India are fast growing in both technology and infrastructure. Due to an intense rapid growth in infrastructure the demand of resources for construction has reached its peak. The major component for high raise buildings are steel which is soared and expensive. But the infrastructure cannot be stopped because of the steel.so an alternative is introduced after investigating its physical and mechanical properties. The demand for this materials is also less in rural areas since it is one of the fast growing grass. Bamboo is fully replaced with steel reinforcement. The reinforcement cannot be done with the whole bamboo for small cross section elements in construction. So it is bisected into clums and tied with binding wires. The main aim to introduce bamboo as reinforcement is preferably cost and readily available raw material. This bamboo was the basic construction material in olden days even before cement was introduced. It does not need any investment of money and time where it easily grows and easy to transport. Bamboos can be highly recommended for the rural areas where low rise buildings are raised and with cheaper rates. Steel reinforcement was used for seismic activity and tensile property.

But the manufacturing and transport cost is expensive. So an alternate is introduced and is also investigate whether it is suitable for the replacement with lower cost. This paper investigates the feasibility of bamboo reinforcement for concrete beams. If steel is replaced with bamboo then the behavior of the structure is observed and results are recorded for improving the enhancement of the structure.

Keywords: Steel Reinforcement, Bamboo Reinforcement, Flexural Strength, Deflection Test, Self Curing agent.

INTRODUCTION

Bamboo is a fast growing grass species where most of the people think that it is a tree. Bamboo is basically hollow and cylindrical in shape where it is cut into clums for reinforcements.it achieves its maximum strength when placed where the load acting parallel to the fibers and minimum strength when load acts perpendicular to the bamboo fiber. Bamboo has a stronger part in the bottom stem and light weight at the top of the stem because the fiber distribution is uniform in the bottom compared to its top part. It is considered as the strongest of all wooden timber products to precise.it is one of the

fast growing plants in the world where it grows in months and achieves its full growth within three years. Its rapid growth decreases the demand of material and also economical compared to other materials. It has some of the good aspects such as lightweight, flexibility, toughness and discretely distributed nodes and a permissible strength shows it to be a good construction material.

Bamboo has an immense number of applications such as recreation, temporary structures housing and construction.it also shows that it is more flexible than wood. Most of the populations on or below the poverty line are living in a bamboo house. A study is shown that bamboo

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is stronger by 20% than steel when is well treated and seasoned before reinforcing it to the concrete

Advantages of Bamboo Reinforcement

- Eco friendly
- Bamboo due to its hollow structure is light weight material easy to harvest transport and saves time and money
- Besides using in reinforcement it can also be used in drainage, water piping and furniture.
- When it under construction waste it can be used as a bamboo charcoal instead of landfills

Scope of this project

- To minimize the land mines.
- To introduce low cost reinforced structures.
- To bring an economic solution for rural area constructions.

MATERIALS AND PROPERTIES

The materials to be used in this research are

- Ordinary Portland Cement (53 grade)
- Coarse Aggregate
- Fine Aggregate
- Steel Bars (8 and 10 mm dia)
- Bamboo Sticks (clums 10mm avg dia)
- Curing agent (Cera Poly cure-R).
- Epoxy Resin

CEMENT

Cement is a binding substance used in construction to bind other materials together. The Ordinary Portland Cement (53 grade) conforming to IS: 8112-1989 is used. Many tests were conducted on cement and results are tabled [1-5].

Table No.1 Properties of Cement

S.No	Property	Results obtained
1.	Specific gravity	3.14
2.	Consistency	32 %
3.	Initial setting time	31 min
4.	Final setting time	600 min
5.	Fineness	6%

FINE AGGREGATE

Fine aggregate also known as river sand is a natural granular mineral particle. This river is obtained from the accordance of Zone I as per IS

383-1970. The physical properties of river sand like specific gravity, fineness modulus and water absorption are tested with results.

Table No.2 Properties of FA

S.No	Property	Results obtained
1.	Specific Gravity	3.34
2.	Fineness modulus	2.73%
3.	Water absorption	5.6%

COARSE AGGREGATE

Coarse aggregate consists of natural disintegration of rock or uncrushed gravel, as per IS: 383. Coarse aggregate used in this project is of

the size 20mm. The physical properties of coarse aggregate like specific gravity, fineness modulus and water absorption are tested in accordance with IS:2386-3.

Table No.3 Properties of CA

S.No	Property	Results obtained
1.	Specific Gravity	2.68
2.	Water absorption	0.5%
3.	Fineness modulus	3.35

STEEL

Steel is introduced to give tensile property to the building as concrete is strong in compression and weak in tension. It plays a crucial role on

earthquake resistance due to its ductile property. The physical properties of steel like young modulus, grade, density and coefficient of expansion.

Table No.4 Properties of Steel

S.No	Property	Results obtained
1.	Grade	Fe415
2.	Young's modulus	2 x 10 ⁵ N/mm ²
3.	Density	7850 Kg/m ³
4.	Co-eff. of thermal expansion	12 x 10 ⁻⁶ /o C

BAMBOO

Bamboo is a fast growing grass species which is high in strength, flexibility and toughness and is used as a substitute for steel as reinforcement in rural areas and after a few years of research it will

be introduced in the urban areas after well seasoning and treated with various techniques. Its properties such as weight, specific gravity, modulus of rupture and modulus of elasticity are resulted and tabulated.

Table No.5 Properties of Bamboo

S.No	Property	Results obtained
1	Specific gravity	0.6
2	Average weight	0.675Kg/m
3	Modulus of elasticity	1.8x10 ⁵ /mm ²

WATER

The strength workability and durability of a concrete depends on the water added to the mix. The strength is also dependent on the days of curing the concrete. Normally portable water is used in construction with a w/c ratio of 0.5

cannot be placed for curing. so a curing compound is added to avoid curing and to gain strength of the beam in earlier age. The curing agent used in this project is Cera poly cure-R.

CURING AGENT

Since bamboo is a vegetation species it expands and contracts when it comes in contact with water so epoxy resins are used to bond the bamboo and concrete. Since bamboo expands and contracts when in contact with water the beam

Properties of curing agent

- Water loss after 72 hrs. : <0.35 Kg/m²
- Appearance : Translucent White
- Dry film colour : White
- Viscosity : 5 to 10 cps
- Reflectance : >85% of MgO
- Min temp : 4oC



Fig. No.1 Cera Poly cure

EPOXY RESIN

Epoxy resin is used as a coating for bamboo to avoid the decomposition of bamboo and to provide a good bonding strength between bamboo and concrete.

Properties of epoxy resin

- Colour :pale yellow liquid
- Mix Density : 1.05 Kg/Litre

- Mix Ratio : 77:23
- Pop Life : 50 minutes at 25oC.

MIX DESIGN

The concrete mix design was proposed by using IS10262:2018.The grade of concrete used was M20 with water to cement ratio 0.55. The mix design proportions for 1 m³ of concrete.



Fig. No.2 casting of concrete

REINFORCEMENT DETAILS

The beams are casted in two different lengths but with same cross section and two different reinforcement materials are a used such as steel bars and bamboo clums .The dimensions of the first beam is 1200mmx150mmx150mm and the second beam is of 700mmx150mmx150mm in

dimension. The area of reinforcement for the first beam as $A_{st} = 314\text{mm}^2$.The grade of steel used is Fe415 as 10mm bars as longitudinal bars and 8mm bars as stirrups. Where in bamboo average dia is of 10mm and tendon wires are used as stirrups.



Fig. No.3 Bamboo reinforcement

EXPERIMENTAL INVESTIGATION

There are two tests carried out for this Project. They are

- Flexural strength test
- Deflection test

Flexural Strength:

- The test is performed in the accordance as per

the code IS: 516-1959.

- Since most of the materials have small and large defects in them in which the load acts concentrated on the beam at one third of the spans.
- For the test the beam's length should be atleast three times its depth to determine its strength.



Fig. No.4 Casted beam with curing agent

CONCLUSIONS

It is resulted that bamboo acts as a substitute for steel when the demand of steel is at the peak and if there is no other alternate way to sustain it. Bamboo can be used for reinforcement in rural

areas but further research is to be done on for avoiding decomposition, expansion and contraction of bamboos and an idea of using pesticides to avoid insects penetrating on bamboos.

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