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Well Preserved Bamboo Exploration As a Beam Stimulation

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Abstract--- *In this modern world, India is one of the fast growing countries in technology as well as infrastructure. Due to an intense rapid growth in infrastructure the demand of resources for construction has reached its peak. Steel is the major component for high rise buildings, Sky scrapers and modern structural elements etc. Steel is soared and expensive. But the infrastructure cannot be stopped because of the steel. So Bamboo is an alternative reinforcement material instead of steel. Bamboo is introduced in concrete after investigating and studying its physical and mechanical properties. The demand for these materials is also less in rural areas since it is one of the fast growing grasses. 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--- *Bamboo Reinforced Concrete, Steel, Deflection Test.*

I. INTRODUCTION

In recent years, steel costs have soared. For developing countries, steel is tough to get owing to costly costs, and for the development business, usage of steel is presently restricted. The assembly of steel has high consumption of fossil fuels. So, the steel discharge within the construction of structures has been conferred, showing the probabilities of forceful reduction by analysis institutes.

Meanwhile, for developing countries, it's vital to create the event of buildings construction; low value, no demand of subtle technologies and reliable construction ways. Environmental destruction like pollution of air and water has been occurring in some regions by fast development and production of materials like iron, steel, glass, cement and metallic element that use restricted natural resources.

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On the opposite hand, plants and fibers are annually reproducible clean resources. Bamboo may be distinctive cluster of large grasses the stalk of that originates in underground rhizomes.

It grows naturally in several components round the world country however some species are unnaturally planted. Bamboo forests are found across tropic and climatic zone zones between latitudes of regarding 40o south, i. e. areas with mean annual temperatures of from 20°C to 30°C.

Bamboo appropriate for water pipes grows at altitudes from twenty to three, 000 meters. The plant is absolutely mature at an age of 3 to 4 years. In recent years, several researches round the world are begun to explore the employment of inexpensive and low-energy substitute construction materials.

Among the various potentialities for such substitutions, bamboo that is one in every of the quickest growing plants possesses an excellent economic potential.

Bamboo has been utilized in constructions of bridges and homes for thousands of years in Asia. Bamboo takes less energy to reap and transport. Therefore, bamboo has low producing prices compared with steel; bamboo is wide expected to be potential even in countries and regions that haven't any advanced producing technology and construction techniques.

Even nowadays there exists a necessity for a lot of economical and without delay accessible substitute reinforcement for concrete. In some components of the planet several building is created solely with concrete or mud-bricks. This is often dangerous just in case of seismic activity. These building have very little hope of standing within the case of an earthquake.

Steel reinforcement would be a perfect resolution; however, value may be a right smart downside. Scientists and engineers are perpetually seeking for brand new materials for structural systems; the thought of mistreatment bamboo as potential reinforcement has gained quality.

II. BAMBOO AS A CONSTRUCTION MATERIAL

Bamboo reaches its full growth in just few months and reaches its maximum mechanical strength in just few years. Its abundance in tropical and subtropical regions makes its an economically advantageous material. some of the positive aspects such as a lightweight design, better flexibility and toughness due to its thin walls with discretely distributed nodes and its great strength make it a good construction material. Bamboo is used as structural material for scaffolding at construction sites in India, china and other countries as it is tough, flexible, light weight and low cost material. In nature when bamboo is covered with heavy snow, it will bend until it touches the ground without breaking. This implies that bamboo has greater flexibility than wood.

The tensile strength of bamboo is very high and can reach 54 ksi (370 N/mm^2). This makes bamboo an alternative to steel tensile loading application. This is due to the fact that the ratio of tensile strength to specific weight of bamboo is six times greater than steel.

AIM AND OBJECTIVES

- The goal of this analysis is to see the feasibleness of bamboo reinforcement for the concrete beams.

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- Whereas the mechanical properties and behavior of steel ferroconcrete are completely studied and well documented, there exists no comprehensive information describing Bamboo ferroconcrete.
- Therefore, the aim of this study is to supply a preliminary contribution toward the gathering of the mechanical properties and behaviors of bamboo strengthened beams.
- In concrete, reinforcement is bamboo is to be used as concrete reinforcement, it's necessary to grasp however bamboo behaves in tension.

III. PROPERTIES OF MATERIALS

Cement

- Cement, in general, adhesive substances of all kinds, but, in a narrower sense, the binding materials used in building and Civil Engineering construction

S.No	Property	Values Obtained
1	Specific gravity	3.14
2	Consistency	32 %
3	Initial setting time	31 min
4	Fineness	6%

Fine Aggregate

Sand, mineral, rock, or soil particles that range in diameter from 0.02 to 2 mm (0.0008–0.08 inch). This river sand 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:

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

Coarse Aggregate

Coarse Aggregates a broad category of coarse to medium grained particulate material used in construction, including sand, gravel, crushed stone, slag, recycled concrete and geosynthetic aggregates. Aggregates are also used as base material under foundations, roads, and railroads. In other words, aggregates are used as a stable foundation or road/rail base with predictable, uniform properties (e.g. to help prevent differential settling under the road or building), or as a low-cost extender that binds with more expensive cement or asphalt to form concrete.

S.No	Property	Values obtained
1	Specific gravity	2.68
2	Water absorption	0.5%
3	Impact value	15.23
4	Crushing strength	21.32

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.

S.No	**Property**	**Values obtained**
1	Specific Gravity	0.6
2	Average weight	0.675 kg/m
3	Modulus of elasticity	$1.8*10^5$ N/mm^2

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. It is shaked well before use and is applies with a brush to avoid contact with the skin. Since bamboo is prone to bacteria and fungi this resin helps to prevent from microbial actions on bamboo which makes its weak.

S.NO	**Property**	**Values obtained**
1	Colour	Pale yellow
2	Mix density	1.05 kg/litre
3	Mix ratio	77:23
4	Pot life	50 minutes at 20°C

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 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.

Properties of curing agent

Water loss after 72 hrs. : <0.35 kg/m^2

Appearance : Translucent White

Dry film colour : White

Viscosity : 5 to 10 cps

Reflectance : >85% of MgO

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Properties of Epoxy Resin

- ✓ Colour :Pale yellow liquid
- ✓ Mix Density : 1.05 kg/ litre
- ✓ Mix Ratio : 77:23
- ✓ Pot Life : 50 minutes at 25^{o}C.

Mix Design

Mix Design for M20 Grade Concrete by IS Recommended Method of Concrete Mix Design as per Design Code IS 10262-1982

Design Stipulations		
a	Characteristic Compressive Strength	
b	Maximum Size of Aggregate (Angular) 20mm	
c	Degree of Workability	0.8
d	Degree of Quality Control	Good
e	Type of Exposure	Mild
Test Data for Materials		
a Cement Used		OPC
b Specific Gravity of Cement		3.14
1	Specific Gravity of C.A.	2.668
2	Specific Gravity of F.A.	2.55
c	Compaction factor	0.88
1	Coarse Aggregate	1%
2	Fine Aggregate	0.09%
Free (Surface) Moisture		
1	Coarse Aggregate	0.086
2	Fine Aggregate	0.11%
Sieve Analysis		
1	Coarse Aggregate:	Conforming to Table 2 of IS: 383-1970
2	Fine Aggregate:	Conforming to Zone III

Table 1: Mix Design Table

Cement	**F.A.**	**C.A.**	**Water**
1	1.48	2.96	0.5

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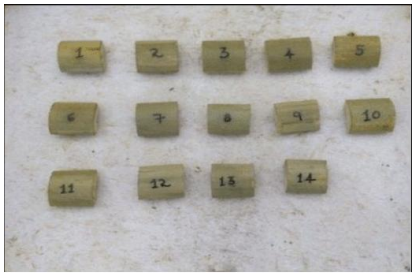
IV. TESTS ON BAMBOO REINFORCED SPECIMENS

Density Test

The density check was performed to search out out the fundamental mass per volume or density of bamboo. The density of bamboo may be used as associate applicable parameter for classification of bamboo as a result of not like different physical and mechanical properties of bamboo, it depends solely on the inexperienced volume and therefore the kitchen appliance dry mass. The specimen for crucial the fundamental mass per volume was taken from totally different positions of the clum (base, middle, top). The inexperienced volume (V) was measured by water displacement technique. once crucial the inexperienced volume the check specimen were dried during a hot kitchen appliance for twenty-four hours at 1000°C to get the kitchen appliance dry mass (m).



Specimen No.	Oven dry mass (gm)	Volume of the specimen(cm^3)	Mass density (gm/cm^3)
1	1.60	2.70	0.593
2	1.60	2.80	0.571
3	1.50	2.60	0.577
4	1.85	2.60	0.712
5	2.25	3.50	0.643
6	2.30	3.55	0.648

Water Absorption Test

Bamboo like wood changes its dimension once it loses or gains wetness. Bamboo could be a absorptive material, tending to soak up wetness from air and surroundings. The water absorption capability of bamboo splints is quite five hundredth by weight; thence it absorbs and reduces a locality of water further in concrete combine for association reactions. In inexperienced concrete bamboo splints absorb wetness and swells once the concrete becomes dry the bamboo splints contracts and creates areas between the bamboo that contracts the bamboo-concrete bond strength decreases and member fails in bond.

Initial Moisture Content Test

Bamboo is a hygroscopic material which means moisture content changes with change in relative humidity and temperature of surroundings free and bound water exists in bamboo, however the amount of free water is small as compared to bound water hence bamboo starts to shrink as soon it loses moisture. The shrinkage of bamboo occurs in the direct proportion to the amount of water content lost. When the bamboo splints shrinks creating additional stresses and creating spaces or gaps between the bamboo and concrete, eventually decreasing the bamboo concrete band and member fails in bond.

S.No	Nodes	Thickness	Initial weight (gm)	Oven dry weight (gm)	Moisture content %
1	0	0.6	20	17.35	13.25%
2	0	0.7	20	17.30	13.50%
3	1	0.5	50	41.95	16.10%
4	1	0.6	30	26.85	11.24%
5	2	0.7	70	59.95	14.36%
6	2	0.6	60	55.75	7.08%

Tensile Test

Tensile take a look at were conducted on specimen having nodes at the top. Nodes are weak and brittle in resistance to tensile force as referred. This take a look at was performed on specimens with nodes at gauge position and its main purpose was to see modulus of snap of the required bamboo. It's been determined that principally the failure occurred at middle height. The failure occurred feels like the ripping of the fibres. The overall tensile take a look at results are summarized.

Load (kN)	Elongation (mm)	Strain	Stress (N/mm^2)
0	0	0	0
10	0.10	0.0008	47.300
12	0.20	0.0015	56.870
14	0.50	0.0038	66.351
16	0.50	0.0038	75.829
18	1.00	0.0075	85.308
20	2.00	0.0150	94.787
22	2.50	0.0188	104.265

BEAM TEST

In doubly bolstered beam the crack developed in flexure. 2 cracks were generated within the beam. The crack developed at a really slow rate. The cracks shaped triangular formed. Throughout the failure the bamboo within the bottom was unsuccessful by node splot failure. The beam unsuccessful at load of twelve. 5 kN Lack of riveting between the bamboo and also the concrete was determined. The failure pattern and also the development of the

crack area unit shown .the load verses deflection graph is additionally obtained and also the readings determined as shown.

Fig. 2: Yield failure of Beam (Bamboo Reinforcement)

V. CONCLUSION

A. The experimental work shows the various results

- The preliminary tests for bamboo and concrete materials are completed.
- Conventional and bamboo reinforced concrete beans were casted and tested.
- Epoxy resin is applied on bamboo and the bonding is investigated comparing the steel and concrete structures.
- The curing agent is introduced to reduce the curing time and to enhance the strength in short duration of time.
- It is widely appreciated in rural areas for one storey buildings.
- The stirrups are made of steel wires of 1mm diameter to counteract bamboo strength comparing steel stirrups.
- The shear strength of the reinforced bamboo sections is comparatively lower than that of the completely steel reinforced beams.
- Replacement of steel with bamboo in a larger amount will make the structure lighter as the percentage of bamboo reinforcement that has given increases and the density of bamboo reinforced concrete beam decreases.

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