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Experimental Study on Bamboo Reinforcement in Structural Concrete Element

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ABSTRACT: *Recently, in the attention in response to global warming issues and sustainable society, the manufacturing using natural material has become actively, Bamboo low cost fast growing, and broad distribution of growth, is expected to contribute significantly to earthquake resistance construction and seismic retrofit technology in the developing countries. The authors also have been studied for understanding the mechanical behaviour of Bamboo reinforced concrete member and clarifying the differences of structural properties from steel reinforced concrete and bamboo reinforced concrete .in this study trials have been made for the use of bamboo reinforced concrete beams which are simple , efficient and economical for rural construction .this comparative study of bamboo reinforced concrete beam with various frictional properties ,the web material essentially consist of steel stirrups which help in resistance shear of Bamboo reinforced concrete beam ,such beam have been tested to failure bend test, flexural strength of 7, 28, and days has been taken into consideration for comparison purpose ,should be taking the cube test 7, and 28, days compare the result, ordinary using material in construction, Hence it can be recommended that bamboo can act as a good potential reinforcement low cost housing and can replace steel conveniently thereby saving natural resources to considerable extent.*

KEYWORDS: *Bamboo reinforced concrete beam, flexural strength*

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I. INTRODUCTION

India one of the most popular country in the world is a home to many sections of people who are below average poverty line shortage or housing facilities among them due to many unaffordability has become a matter of concern in the recent Indian scenario As a matter fact an anempe has been made to introduce low cost houses which are durable safe and affordable bamboo one of the oldest construction material has been considered to have high tensile strength and is being used as main structure component for this low cost houses bamboo bearing the scientific names Bambusa Tulda Bambusa Balcoon cto.is the fastest growing woody plant belonging to gross family they are capable 00cm or more in a day an can grow up to 30m or even more they can be grow in any climatic condition and soil and type which is major factor for considering it the rate of grow of bamboo depend upon the local climatic condition and soil type Bamboo is considered to be matured after three years of its plantation and it is always advisable to choose matured bamboo for construction purpose Bamboo is generally as organic and to mitigate this problem treatment is being provided to the bamboo sample make it free from pest and other insect attacks . One of the most important factors to be considered is that bamboo shows its efficiency in climate which haves at least a little amount of humidity studies have been carried out on the engineering properties of bamboo and found it suitable to be used as a substitution for steel although it has lesser tensile strength than traditional steel reinforcement In recent year , steel prices have soared for developing countries steel is difficult to obtain because of expensive prices and for the construction industry , usage of steel is currently limited heavily the production of steel has a high consumption of fossil fuels so the steel discharge in the construction of structure has been presented , showing the possibility of drastic reduction by research institutes meanwhile for developing countries it is important to make the development of building construction low cost no requirement sophisticated technologies and reliable construction methods . In recent year 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 substitutions bamboo, which 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.

II. LITERATURE REVIEW:

1. Terai and Minami (2012): Investigated that the tensile strength filled with cement paste cured w/c=80% and 100% significantly increase with aging time. The behaviour of pull-out test with bamboo is almost the same as the plain steel bar; however, the bond strength with bamboo was higher than the one with plain steel bar. It can be expected that the bond strength covering with full treatment shows the high value 1.2-1.35 MPa. Bamboo reinforced concrete slab: When fresh concrete is poured, its water will moisten the bamboo; then, the concrete will harden and lose water so that the bamboo will again dry out. This drying process will completely break any bond between the bamboo and the concrete. It can be considered that underground humidity is high at any times therefore supply of water to the concrete can be accomplished.
2. Naznin and Chetiya (2015): Found that the failure pattern of bamboo splints in tension a sharp peak followed by a sudden fall in the graph has been observed which is due to lack of ductility in bamboo unlike steel – provided by molecular slippage resulting in more elongation percentage. Nevertheless bamboo provides a high tensile strength of about 440 N/mm2which actually depends on the species, cultivation area and the cross sectional area. A better flexural performance has been observed with increase in number of reinforcements, diameter of the bars and addition of shear links to the bamboo reinforced beams. A better bond strength has been found in the bamboo bars providing an improvement in flexural strength of maximum of 1.81 times and a minimum of1.19 times to that unreinforced beam sections observed in 28 days strength test.
3. Mardjono (1998): provided research with the effort to give some sort of organization of a system to building with Bamboo between cultures, species, and countries having varying designs. The objective of their research was to improve the functions of Bamboo buildings by this organization to provide privacy, safety, comfort, durability, and accessibility. Overall Bamboo used as a structural material suffers from an incredible disadvantage due to inadequate applied scientific research. They do feel that Bamboo products should be brought to the level of acknowledged and received building materials. The results of their research will be published as a thesis and guide for designing Bamboo structures to be dispersed to people in developing countries.
4. Ghavami (1995): investigated the mechanical properties of Bamboo, specifically pertaining to Bamboo in concrete. His study showed that the ultimate load of a concrete beam reinforced with Bamboo increased 400% as compared to un-reinforced concrete. It was found that, compared to steel, there was lower bonding between the bamboo and concrete, and the Bamboo had a Modulus of elasticity 1/15 of steel. Bamboo's compressive strength was much lower than its tensile strength, and there was high strength along the fibres, but a low strength transverse to the fibres. He stated that there is a need for the development of a simple design code for the application of Bamboo as a construction material.

III. MATERIALS USED

1. Portland pozzolana cement:

We Used Ultratech PPC Cement (The Engineer's Choice)

2. Sand (fine aggregate):

The sand most of which pass through 4.75mm IS sieve are termed as fine sand or fine aggregate. We used locally available Manjra River Sand which pass through 4.75mm IS sieve

3. Coarse Aggregate:

The aggregate which retain above 4.75 mm IS sieve are termed as coarse Aggregate. The crushed stone or metal, called khadi or gitti comes under coarse aggregate. We used 12.5 mm to 15mm size Angular Shape Coarse Aggregate.

4. Reinforcement Steel:

We used Fy -500 grade of Steel -8 mm and Stirrups -6mm

5. Bamboo:

Dry bamboo was splitted into several pieces of 14mm diameter straight sticks and using stirrups of 6mm dai. At 125mm the bamboo sticks are reinforced.

6. Concrete:

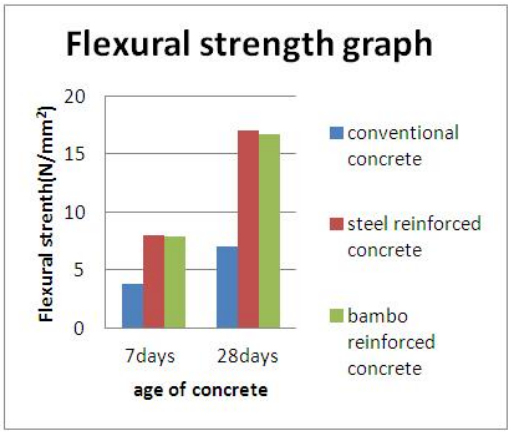
We used M30 grade of concrete for experiment.

IV. RESULTS

1. Flexural strength:

to calculate flexural strength the beam of size 150mmX150mmX700mm is casted.

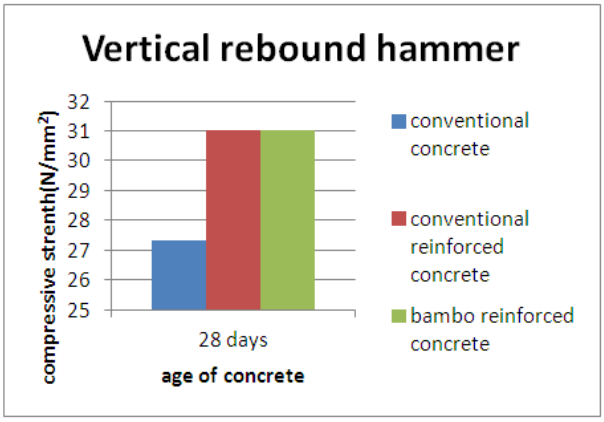
Number of specimens	Age of concrete (days)	Average flexural strength(N/mm^2)		
		Conventional concrete	Conventional reinforced concrete	Bamboo reinforced concrete
3	7	3.79	7.91	7.82
3	28	6.96	17.01	16.80



2. Rebound hammer test:

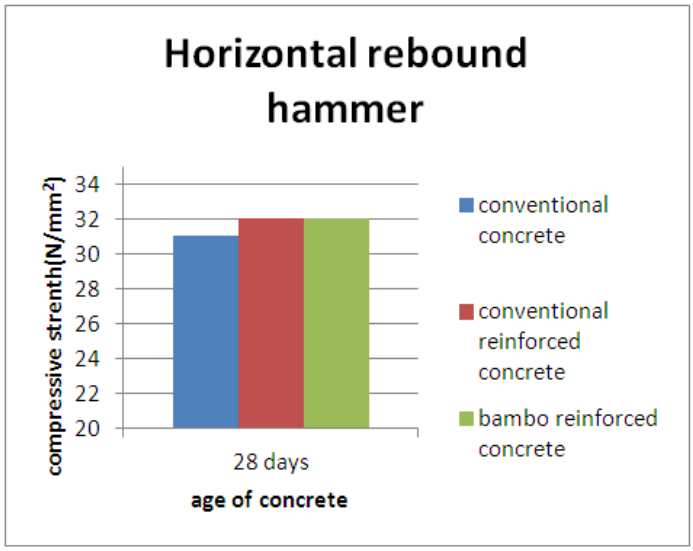
(a) Vertical rebound hammer test: The rebound hammer test carried out on beam for 28 days

Number of specimens	Age of concrete (days)	Average compressive strength(N/mm^2)		
		Conventional concrete	Conventional reinforced concrete	Bamboo reinforced concrete
3	28	27.33	31	31



(b) Horizontal rebound hammer test

Number of specimens	Age of concrete (days)	Average compressive strength(N/mm^2)		
		Conventional concrete	Conventional reinforced concrete	Bamboo reinforced concrete
3	28	31	32	32



V. CONCLUSION

1. The flexural strength of conventional reinforced concrete and bamboo reinforced concrete at the age of 7 days is to be found 7.91N/mm^2 and 7.82N/mm^2 respectively. The flexural strength of bamboo reinforced concrete almost equivalent to conventional reinforced concrete by using 0.42w/c ratio and aggregate to cement ratio 4.04in concrete mix.
2. The flexural strength of conventional reinforced concrete and bamboo reinforced concrete at the age of 28 days is to be found 17.01N/mm^2 and 16.80N/mm^2 respectively. The flexural strength of bamboo reinforced concrete almost equivalent to conventional reinforced concrete by using 0.42w/c ratio and aggregate to cement ratio 4.04in concrete mix.
3. The vertical rebound hammer test carried out on beam in which the compressive strength of conventional reinforced concrete and bamboo reinforced concrete at age of 28 days is to be found 31N/mm^2 and 31N/mm^2 respectively so The compressive strength of bamboo reinforced concrete is equivalent to conventional reinforced concrete.
4. The horizontal rebound hammer test carried out on beam in which the compressive strength of conventional reinforced concrete and bamboo reinforced concrete at age of 28 days is to be found 32N/mm^2 and 32N/mm^2 respectively. The compressive strength of bamboo reinforced concrete is equivalent to conventional reinforced concrete.
5. The use of bamboo for environmentally friendly construction materials more quickly implemented and added value in terms of cost and environmental sustainability is very interesting to further studied.
6. No fungal attack and minimum loss of ultimate tensile strength was observed in the bamboo splints which were wetted in nacl. solution making bamboo a prominent material to be used as reinforcement in concrete subjected to costal environments.
7. Plain cement concrete beam failed suddenly it has shown brittle failure bamboo strip reinforced concrete beam failed gradually and showed ductile failure.
8. Bamboo strip is having more flexural strength than plain concrete beam can be used as tension member.
9. Bamboo strip is cheap and hence it can lead to low cost housing technique in rural areas where the cost of steel is very high.
10. Given results shows the satisfactory anticipation and possibilities of using bamboo reinforcement as a replacement of steel reinforcement in concrete structures may be feasible in terms of low cost green construction. Other factor like strength of the bamboo reinforced concrete is also increasing with the age. In the field of green construction use of bamboo as steel replacement where the availability of steel material is low and also the cost is high can be the better solution. It is also suggested that the involvement of bamboo in green construction can lower the use of steel and can become one of the best solution with limited resources in remote areas for needy people.
11. Bamboo, on using as reinforcement in concrete deflects more due to low density; but it attains flexural strength almost equivalent to Steel reinforced concrete. Hence it can be used in member taking fewer loads such as roof slabs of parking area, public toilets, watchman cabins and sunshades. It also helps in cost effectiveness and reduces environmental effects that are cost by steel production. Using Bamboo, we can reduce the cost of the construction by 25%. Bamboo concrete composite structural members can provide tailored solutions to the eco-housing initiatives at cheaper costs.

12. In future if the production of steel is less because row material less availability, we can use bamboo as alternative material in RCC as reinforcement.

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