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Study and Development of Bamboo Concrete Composite Structure for Tribal Area

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Abstract

Concrete is the most consumed material, with three tons every year used for every person in the world. Two fold the amount of concrete is used being developed as any excess design materials united. Concrete has magnificent brand name in compressive strength, yet low in unbending nature. Steel commonly used in supporting material by virtue of high flexibility. The use of steel as supporting material is limited in light of the fact that it is excessive and moreover has an effect on air defilement during its collecting collaboration. As a decision to vanquish this issue, bamboo material has been used as a replacement of help in concrete. Bamboo is a sensible material since it is a trademark material, unassuming and besides open material. In this exploration, the presentation of bamboos as an elective material in upheld concrete has been surveyed. Versatility preliminary of bamboos has been performed to perceive the yields pressure of bamboos. The usage of gainful cementations materials, for instance, fly debris has seen a steady improvement among the new examinations as a moderate and feasible solution for mostly substantial replacement. A troublesome issue while replacing concrete is that the significant materials impact significant properties contrastingly as shown by various elements, for instance, the grade of concrete, the degree of replacement, reestablishing periods and environment condition.

Keywords: *Bamboo, Fly ash, Reinforcement, Economical, Durable.*

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INTRODUCTION

Concrete is a comprehensively elaborate improvement material for its various advantages, for instance, insignificant cost, openness, impenetrability to fire, etc. Nevertheless, it can't be used alone any place considering its low versatility. The plain concrete has an especially low unbending nature, confined adaptability, and little insurance from breaking. Along these lines, generally, steel is used to help the significant considering the way that steel has a high inflexibility to enhance the low versatility of concrete. Being developed, the usage of steel is over the top and caused such a ton of energy-consuming in its collecting cycle. Along these lines, a sensible material ought to be used to substitute steel being developed. The material ought to give openness a negligible cost, innocuous to the biological system and besides less energy-consuming. Settling this large number of issues, bamboo is one of the sensible replacements of developing bar in concrete for negligible cost advancements. Bamboo is successfully open as it is available in basically every tropical and subtropical area.

Bamboo has wide use since old events as simplicity material for housing and scaffolds. In current days it is used as arranging material for ground surface and housetop and boards. Bamboo is endless and versatile resource depicted by great also, low weight. It is surveyed that there are 1200 species creating in 14.5 million hectors regions. Bamboo is world fastest creating woody plant; it is a 4.5 to 40 cm everyday

Scope of Work

The scope of work is for buildings beam, column, slab this work consists of preparing concrete with using bamboo to achieve nearly equal strength as steel. To minimization of cost and time of the construction of buildings. To increase knowledge about designing method by using bamboo.

Need of Study

For constructing structures which are light weight we want to achieve nearly equal strength of steel reinforcement. So it comes with the effort of designing of reinforcement, placing of reinforcement and many other things. So we can reduce the quantity of reinforcement with using of bamboo reinforced concrete. But in India BRC is not commonly used product or some people are don’t know about the concept therefore we want to study on this topic.

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MATERIALS

Bamboos: - For the Sample choice of bamboo, the earthy color shade of bamboo with longer and incredible width culms has been chosen. Bamboos culms are barrel shaped shells and are separated by hubs as strong cross-over stomachs. The strength circulation is more uniform at the lower part of bamboo than at the top or at the centre of it since it is exposed to most extreme bowing pressure due to wind at the top part of the culms. Following criteria have been measured in this research for the selection of bamboo culm for use as reinforcement in the concrete structures.

a. The bamboo showing a brown colour with at least three years old is selected.

b. The whole culm of green bamboo is not being used.

c. Avoid cutting the bamboo in spring or early summer because the bamboo is weaker due to increase in fibre and moisture content.

d. The accessible biggest diameter of the culm is being selected.

Species of Bamboo:-There are number of species found in India from this some of the species is useful for reinforcement in concrete as well as construction material.

a **Bambusa Balcooa:-**Bambusa balcooa is a very large, thick-walled, clumping or symposia bamboo growing up to a height of 25 metres (80 feet), and a thickness of 150 millimetres (6 inches).

b **Bambusa Nutans:-**Bambusa nutans is a tropical plant found in Southeast Asia that grows up to 6-15 m tall. It is a graceful bamboo that can be used as an ornamental.

c **Bambusa Wamin: -** Bambusa Wamin is an ornamental bamboo used in garden landscaping or as erosion control. The culms are often used for handicrafts.



Fig.01:- Bamboo

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Steel Bar: - High yield steel deformed (HYSD) were used in this study in order to identify the performance of standard reinforcement used in concrete and to make a comparison with the bamboo reinforcement.

Water Proof Materials: - The characteristic of bamboos showed high water absorption and low bonding strength between bamboos surface and concrete when used as reinforcement in concrete. In order to prevent this problem, 'Tack coat' has been used to minimize the swelling of bamboo and to increase the bonding strength. The coated has been applied one day before the bamboos being used as reinforcement in the beam sample.

Ant termite Chemicals: - Natural predators such as ladybugs, lacewings, predatory mites and parasitic wasps help prevent problematic infestations of bamboo insects and mites. Cultural and chemical treatments are usually enough to manage the pests when they become damaging. Following are the some chemicals used for ant termite:-

a Chlorpyrifos
b Cypermethrin
c Deltamethrin
d Fipronil
e Imidaclopride

Cement:-Cement is one of the binding materials in the construction work. In this project we used 53 grades Ordinary Portland Cement (OPC) From the IS: 8112-1989.

Course Aggregate:-It is most important construction material in the concrete which interconnect to each other. The aggregate which retains on the 4.75 mm sieve is known as Natural Course Aggregate.

Fly Ash:-Fly ash is the finely divided residue that results from the combustion of pulverized coal and is transported from the combustion chamber by exhaust gases.

Types of Fly Ash

a **Class F fly ash:-**It is designated in originates from anthracite and bituminous coals. It consists mainly of alumina and silica and has a higher.
b **Class C fly ash:-**Class C fly ash is designated in originates from sub bituminous and lignite coals. Its composition consists mainly of calcium, alumina, and silica.

Preparing Mix Design

Preparation of concrete mix design, we decide to use or make M-20 and M-25 grade concrete using 20 mm size aggregate and using sand. With referring IS 456-

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2000 we made the concrete mix design for M-20 and M-25 grade concrete having proportion 1:2.06:2.97 and 1:1.82:2.62 which is having W/C ratio 0.53 and 0.45 respectively. With respect to calculated concrete mix design that we decide to cast 12 beam, 6 beams for M-20 and other is for M-25.

Experimental Setup

We have done an experimental study on the Steel reinforced concrete (RCC) with bamboo reinforced concrete (BRC). Here we replace the steel by bamboo as reinforcement in concrete. Thus it reveals about the strength of bamboo reinforced concrete.

Methodology

The methodology divided into two parts namely.

1. Compare Tensile Strength of bamboo and steel
2. Compare Beam Specimen

Compare Tensile Strength of bamboo and steel:-

The purpose of this chapter is to investigate the maximum load that a material can support without fracture when being stretched, divided by the original cross-sectional area of the material. Tensile strengths have dimensions of force per unit area.

Structure of Specimen:- For this investigation take three no's 17mm dia or 20mm dia bamboo and take 12 mm dia HYSD bar each having length 1 m.

Objective:-To find out how strong a material is and also how much it can be stretched before it breaks.

Procedure:- As per IS 5816 (1999).

Specimen to be Test

Table No.01:-Test Readings of Tensile Strength Test

Sr. No	Specimen Type	Identification mark	Size of Specimens	Average size of specimen	Ultimate load (In KN)
1.	17mm or 20 mm dia Bamboo	B-01	17 mm	17.16 mm	34.01
			17 mm		
			17.5 mm		
		B-02	19 mm	18.33 mm	32.04
			18 mm		

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			18 mm		
		B-03	17.5 mm	17.83 mm	35.49
			18 mm		
			18 mm		
2.	12 mm dia bar	SB-01	12 mm	12 mm	41.30
			12 mm		
			12 mm		

Specimen Calculation

Table No.02:-Test Readings of Tensile Strength Test

Sr. No	Specimen Type	Identification mark	Ultimate load (KN)	Diameter of Specimen (d)	Area (A) mm^2	Tensile Stress σ= P/A
1.	BRC (Bamboo Rainforest Concrete)	B-01	34.01	17.16 mm	231.27	147.05
		B-01	32.04	18.33 mm	263.88	121.41
		B-01	35.49	17.83 mm	249.68	142.14
2.	RCC (Reinforce Cement Concrete)	SB-01	41.30	12 mm	113.09	365.19



Fig.02:-Tensile Strengths of steel and Bamboo

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Compere Beam Specimen

In this comparison we compare BRC (Bamboo Rainforest Concrete), RCC (Reinforce Cement Concrete) in this we make three Beam of each BRC (Bamboo Rainforest Concrete) and RCC (Reinforce Cement Concrete) for Destructive testing: Flexural Strength Test.

Structure of specimen: - For this investigation make each beam having size 15cm X 15cm X 70 cm with include various grade of concrete with 4 no's of bamboo reinforcement having dia 17mm or 20mm with 6 mm dia stirrups at 150 mm center to center, with 4 no's of reinforcement having dia 12mm with 6 mm dia stirrups at 150 mm center to center, and without reinforcement for BRC and RCC specimen respectively with using 15% of fly ash with cement.

Objective

To measure flexural strength and flexural modulus.

For M-20

- Procedure:-As per IS: 516-1959.
- Casted Date and Time:- 08/02/2022 @ 11.00 AM
- Testing Date and Time (after 28 days):- 06/03/2022 @ 12.00 Noon
- Size of Specimen:- 700mm X 150mm X 150mm.

Specimen to be Test for 15% of Fly Ash

Table No.03:-Test Readings of Flexural Test for M-20

Sr. No	Specimen Type	Identification mark	Curing (In Days)	Grade of concrete	Breaking load (In KN)	Average(In KN)
1.	BRC (Bamboo Rainforest Concrete)	BRC	28 Days	M-20	78.20	77.87
					77.50	
					77.90	
2.	RCC (Reinforce Cement Concrete)	RCC	28 Days	M-20	99.20	98.93
					98..90	
					98.70	

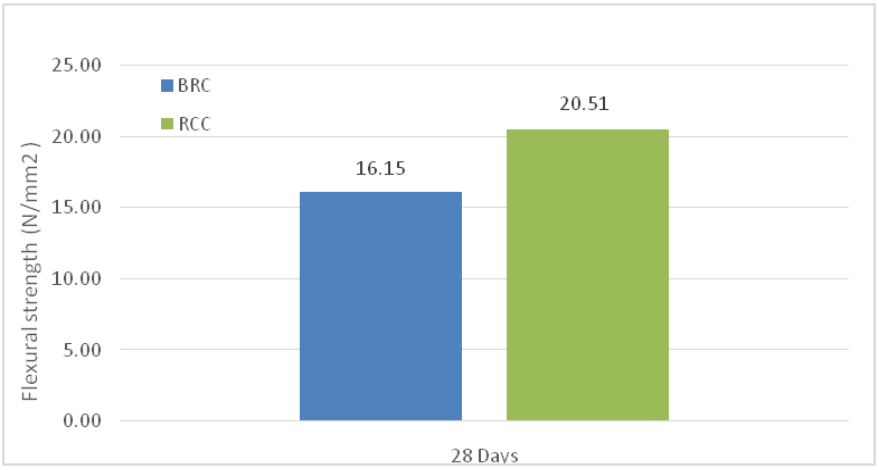
Specimen Calculations

Table No.04:-Test Result of Flexural Test for M-20

Sr. No	Specimen Type	Curing (In Days)	Breaking load (P)	Effective span of the beam (L)	Breadth of the beam (b)	Depth of the beam (b)	Flexural strength $F= PL/ (bd^2)$
1.	BRC (Bamboo Rainforest	28 Days	$77.87x10^3$	700 mm	150 mm	150 mm	16.15

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	Concrete)						
2.	RCC (Reinforce Cement Concrete)	28 Days	$98.93x10^3$	700 mm	150 mm	150 mm	20.51



Graph No.01:- Compare BRC and RCC for M-20

For M-25

Specimen to be test for 15% of fly ash

Table No.05:-Test Readings of Flexural Test for M-25

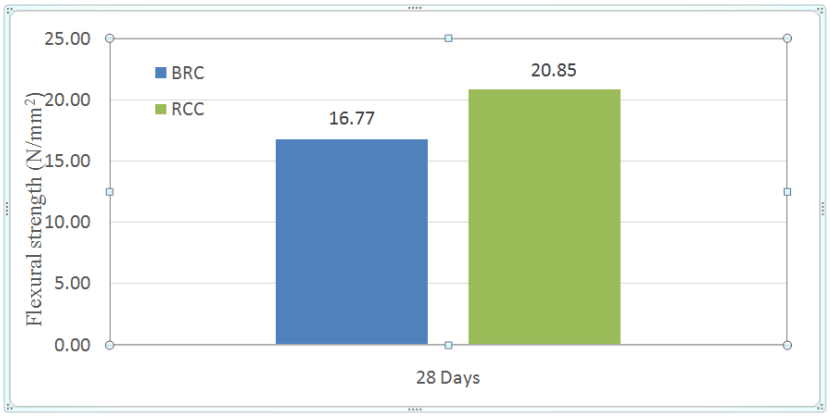
Sr. No	Specimen Type	Identification mark	Curing (In Days)	Grade of concrete	Breaking load (In KN)	Average (In KN)
1.	BRC (Bamboo Rainforest Concrete)	BRC	28 Days	M-25	80.20 81.50 80.90	80.87
2.	RCC (Reinforce Cement Concrete)	RCC	28 Days	M-25	101.20 99.90 100.50	100.53

Specimen Calculations

Table No.06:-Test Result of Flexural Test for M-25

Sr. No	Specimen Type	Curing (In Days)	Breaking load (P)	Effective span of the beam (L)	Breadth of the beam (b)	Depth of the beam (b)	Flexural strength $F= PL/ (bd^2)$
1.	BRC (Bamboo Rainforest Concrete)	28 Days	$80.87 x10^3$	700 mm	150 mm	150 mm	16.77
2.	RCC (Reinforce Cement Concrete)	28 Days	$100.53 x10^3$	700 mm	150 mm	150 mm	20.85

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Compare BRC and RCC for M-25



Fig.03:-Execution of Flexural Test

Results

We created a BRC (Bamboo Rainforest Concrete), RCC (Reinforce Cement Concrete)In this we make three Beam of each BRC (Bamboo Rainforest Concrete) and RCC (Reinforce Cement Concrete) of 15% percentage of fly ash replace with the cement.

For M-20

Specimen - BRC with 15% fly ash

- As per wet curing method- Flexural Strength after 28 days = 16.15 N/mm2

Specimen - RCC with 15% fly ash

- As per wet curing method- Flexural Strength after 28 days = 20.51 N/mm2

For M-25

Specimen - BRC with 15% fly ash

- As per wet curing method- Flexural Strength after 28 days = 16.77 N/mm2

Specimen - RCC with 15% fly ash

- As per wet curing method- Flexural Strength after 28 days = 20.85 N/mm2

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CONCLUSION

This study gives bamboo as a potential material to be used as reinforcement for low load bearing structures. Based on the experimental observation, the following can be concluded: -

1. The Tensile strength of bamboo reinforcements is about 147.05 N/mm2, about one-third of that of steel, with low modulus of elasticity.

2. The load carrying capacity and flexural strength of the BRC beams are found low with respect to RCC beam. It was found less strength than RCC beam when using Four bamboo reinforcements of 17 mm diameter.

3. Deflection of BRC beams is higher with respect to RCC beams at same loading condition and after initial crack RCC beams can withstands a large deflection than BRC beams before failure.

4. Steel reinforcements has a great bond strength with concrete than BRC, therefore RCC structures can resist more deflection and compression than others.

5. Gaining better strength with low cost rate BRC is superior to the others at same conditions. For moderate loaded structures BRC construction is more economical.

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