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Study on Flexural Behaviour of Beam with Coconut Shell Aggregate Concrete and Bamboo Reinforcement

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ABSTRACT:
Coconut shell which is waste material and largely available mainly in India is used as aggregate for preparing light weight concrete. Also bamboo which is also largely available material is used as replacement of conventional reinforcement. Beams using conventional materials and coconut shell aggregate and bamboo reinforcement are made and their flexural behavior is been compared.

Key words:
Light weight concrete, coconut shell concrete, bamboo reinforcement

1. INTRODUCTION

1.1 Bamboo
Bamboo is natural, cheap, widely available material. It is strong both in tension and compression. The tensile strength of bamboo is relatively high. Bamboo is a composite material with long and parallel cellulose fibers in its structure. Also, it exhibits good flexibility and toughness characteristics. The most surprising thing is its growing speed as most growth occurs during the first year and almost all growth ceases by the fifth year. The strength of bamboo does increase with its age, but the maximum strength occurs at 2.5-4 years. Bamboo nodes are spread along the giant grass, and their function is to prevent buckling. In fact, bamboo can bend as much as touching the ground without breaking

1.2Coconut Shell
Concrete is the widely used number one structural material in the world today. The demand to make this material lighter has been the subject of study that has challenged scientists and engineers alike. The challenge in making a lightweight concrete is decreasing the density while maintaining strength and without adversely affecting cost. Introducing new aggregates into the mix design is a common way to lower a concrete's density. Normal concrete contains four components, cement, crushed stone, river sand and water. The crushed stone and sand are the components that are usually replaced with lightweight aggregates. Lightweight concrete is typically made by incorporating natural or synthetic lightweight aggregates or by entraining air into a concrete mixture.

Coconut is grown in more than 93 countries. South East Asia is regarded as the origin of coconut. India is the third largest, having cultivation on an area of about 1.78million hectare. Annual production is about 7562 million nuts with an average of 5295 nuts per hectare. The coconut industry in India accounts for over a quarter of the world's total coconut oil output and is set to grow further with the global increase in demand. However, it is also the main contributor to the nation's pollution problem as a solid waste in the form of shells, which involves an annual production of approximately 3.18 million tones. Coconut shell represents more than 60% of the domestic waste volume. Coconut Shell, which presents serious disposal problems for local environment, is an abundantly available as an agricultural waste from local coconut industries. In developing countries where abundant agricultural and industrial wastes are discharged, these wastes can be used as potential material or replacement material in the construction industry. This will have the double advantage of reduction in the cost of construction material and also as a means of disposal of wastes.

Coconut shell concrete with bamboo as reinforcement in a beam

1.3 Concrete Mix
The design of mix (normal concrete of grade M-25) in the laboratory is carried out by IS method following IS 10262-2009.The ratio for 1: 2.22: 3.66/0.5.The cube strength achieved is mix at 28 days 35.16 N/mm².

For coconut shell concrete mix design particulars are taken from **GUNASEKARAN** et.al (2011) [3].The ratio for the mix M25 is 1:1.47:0.65/0.42 In the above mix the CSC aggregate are to be in saturated surface dry condition (SSD).The Coconut shells are be soaked in water for 24 hour before it is used. The strength achieved at the end of 28 days using this proportion is 26.7N/mm².

1.3.1 Materials Used
The materials used in bamboo reinforced concrete are

i) Cement - OPC 53
ii) Fine aggregate - River sand
iii) Coarse aggregate -20mm size

iv) Water
v) Coconut shell aggregate – 12.5mm
vi) Epoxy adhesive

Table 1.Mechanical Properties

Mechanical Properties	Conventional concrete	Coconut shell concrete(CSC)
Compressive strength in N/mm^2 at		
7 days	15.3	11.3
14 days	26.3	12.46
28 days	35.16	26.7
Split Strength in N/mm^2		
7 days	2.9	1.4
14 days	3.12	1.5
28 days	3.35	2.7

2. TESTS ON BAMBOO

2.1 Moisture content
2.2 Tension test on bamboo

2.1 Moisture Content

Bamboo was kept in oven for 2hour interval and moisture content was checked for every interval until no change occurred. After 6 hours there was no change in moisture content

2.2 Tension test on Bamboo

The direct tension is conducted on the bamboo specimen by using UTM with capacity of 40 tonnes.

Figure 1. Tension Test

Table 2.Tension test On one bamboo specimen

Load in N P	Specimen	Stress in N/mm^2 P/A	Strain $\times 10^{-4}$	Modulus of elasticity in N/mm^2
0	d = 9 mm A = $\pi d^2/4$ A = π x $(9)^2/4$ = 63.62 mm^2	0	0	2.09×10^4
981		15.42	6	
1962		30.84	13	
2943		46.24	21	
3924		61.68	29	
4905		77.10	35	
5886		92.52	44	

3. SPECIMEN PREPARATION

This paper intends to compare flexural strength of beams with conventional concrete with conventional steel and coconut shell concrete with bamboo as reinforcement. Eighteen beams with different types of reinforcement. A nine is conventional concrete with steel-reinforced, nine coconut shell concrete with bamboo reinforcement. Details of reinforcement are shown were tested under flexure test. All specimens have the same cross-section of 150 mm x 230 mm and are 1500 mm in length. Longitudinal reinforcements were prepared separately for steel reinforcement a bamboo. Bamboo about five years of age were split with a wedged knife and shaped into sections 20mm width and 10 mm in thickness.
All beams have the same transverse reinforcements 8mm in diameter. Longitudinal and transverse reinforcements were built up depending on the type and the number of longitudinal reinforcements. Two steel formworks were used to cast these concrete specimens. They were cast horizontally with an open surface on the top. Three standard concrete cubes were cast at the same time to determine the compressive strength of the mix. After the concrete had set the next day, formworks were taken off and all specimens were continuously cured with water for 28 days, under wet gunning bags.

Cross section in mm	Leng th in mm	Concrete	Number of specimen
150 x 230	1500	Conventional concrete M_{25} grade	9
150 x 230	1500	Coconut shell concrete M_{25} grade	9

4. CONCLUSION

In this project casting of the 18 beams with conventional materials and also coconut shell concrete and bamboo reinforcement were casted and curing process is going on.

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