

COMPARISON IN CHARACTERISTICS OF BAMBOO AND STEEL REINFORCEMENT

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Abstract - Traditionally steel is used as reinforcement in concrete structure. But because of cost and availability, replacement of steel with some other suitable materials as reinforcement is now a major concern. It is a fact that the construction industry is the main consumer of energy and materials in most countries. Though bamboo has been used as a construction material, especially in developing country, until today its use as reinforcement in concrete structure is very limited due to various uncertainties. Since bamboo is a natural, cheap and also readily available material, it can be a substitute of steel in reinforcing of concrete structure. Experiments on bamboo strips are for validation and justification of these results confirm the application of bamboo as reinforcement element. Problems faced in using bamboo as construction material are water absorption and moisture content. This paper shows the investigation of use of bamboo reinforcement in beam and cylinder for M20 grade of concrete. To study the effect of replacement of steel reinforcement by bamboo, tests have been conducted Flexural strength and split tensile strength. Using Bamboo, we can reduce the cost of the construction by 25 percent. Bamboo concrete composite structural members can provide tailored solutions to the eco-housing initiatives at cheaper costs

Key Words: Steel Reinforced Concrete, Bamboo Reinforced Concrete, Flexural behaviour, Tensile behaviour, Cost reduction, Sustainable construction etc...

1. INTRODUCTION

Bamboo is a natural source of fiber and one of the fastest growing giant's plants with great economic potential. Bamboo gets fully mature within 4years consuming less energy to harvest and transport. For constructions of bridges and houses and for scaffolding bamboo has been used for thousands of years in Asia.

Due to its superior properties like low weight to strength ratio, high tensile strength and factors like low cost, easy availability and environment friendly during service, bamboo has constantly attracted the attention of scientists and engineers for use as reinforcement in concrete in construction industries. Bamboo has several unique advantages like ability to grow fast with a high yield and also it matures quickly. Additionally, bamboo can be grown

abundantly and that too at a lower cost which makes it more economical.

The use of bamboo strips as reinforcement in concrete column increased the load carrying capacity of the column compared to unreinforced concrete. Bamboo is a traditional building material throughout the world's tropical and sub-tropical regions. Bamboo is a renewable and versatile resource, with high strength and low weight. That's why it is widely used in different forms of construction, particularly for housing in rural areas. It can also be used to make traps, cages, tools, weapons, bridges, rafts, towers, fences, water wheels, irrigation pipe, and thousands of other items

1.1 BAMBOO AS A BUILDING MATERIAL

It is fastest-growing renewable natural building material. The material is easily available & Eco friendly. Bamboo is a viable alternative for steel, concrete and masonry as an independent building material. It is cost effective and easy to work. Cellulose is the main component present in bamboo which is the main source of mechanical properties of bamboo. Some specific properties of Bamboo are as given below:

- Specific gravity - 0.575 to 0.655
- Average weight - 0.625kg/m
- Modulus of rupture - 610 to 1600kg/cm²
- Modulus of Elasticity - 1.5 to 2.0 x10⁵kg/cm²
- Ultimate compressive stress- 794 to 864kg/cm²
- Safe working stress in compression - 105kg/cm²
- Safe working stress in tension - 160 to 350 kg/cm²
- Safe working stress in shear- 115 to 180 kg/cm²
- Bond stress - 5.6kg/cm²

2. MIX DESIGN

Table -1: DESIGN STIPULATION

Grade Designation	M-20
Type of cement	O.P.C-53grade
Fine Aggregate	Zone-I
Sp. Gravity Cement	3.15
Gravity Fine Aggregate	2.60

Material	Cement kg/m ³	FA kg/m ³	CA kg/m ³	Water litre
Mix proportion for 1 m ³	383	547	1187	191.6
Ratio by weight	1	1.43	3.09	0.50

For ratio 1:1.43:3.09
 Cement = 383 kg/m³
 Fine Aggregate = 547 kg/m³
 Coarse Aggregate = 1187 kg/m³
 Water = 191.6 lit/m³
 Beam Size = 0.7x 0.15x 0.15 = 0.01575 m³
 Cylinder Size = $\pi/4 \times 0.15 \times 0.15 \times 0.3 = 0.0053 \text{ m}^3$

3. RESULTS

Table- 2: Flexural Strength Test on Beams

S.NO	SPECIMEN DETAILES	7Days (N/mm ²)	14 Days (N/mm ²)	28 Days (N/mm ²)
1	STEEL	2.75	3.29	3.76
2	BAMBOO + STEEL	2.64	2.98	3.36
3	BAMBOO	2.53	2.74	3.14

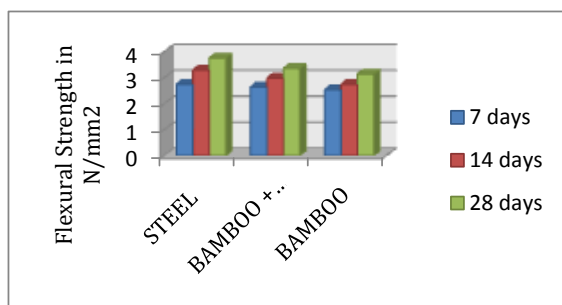


Chart -1: Comparative Results on Reinforced Beam at 07, 14, 28 Days

Table- 3 Split Tensile Strength Test on Cylinder:

S.NO	SPECIMEN DETAILES	7 Days (N/mm ²)	14 Days (N/mm ²)	28 Days (N/mm ²)
1	STEEL	1.68	2.59	2.97
2	BAMBOO + STEEL	1.49	2.45	2.75
3	BAMBOO	1.35	2.38	2.68

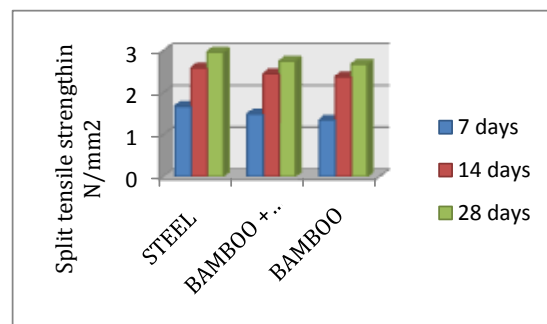


Chart -2: Comparative Results on Reinforced cylinder at 07, 14, 28 Days

4. CONCLUSIONS

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

- The sample concrete beam increases its flexural strength while adding the steel reinforcement.
- Bamboo is also use for manufacturing non load bearing portico beams and columns in low cost.
- Steel will be corroded, so the partial replacements of the bamboo can reduce the cost of concrete.
- It helps in reducing the pollution in environment.

REFERENCES

- [01] Sanjeev Gill and Rajiv Kumar (2016), "To experimental study and use of bamboo in civil structure as reinforced concrete", International Journal of Latest Research in Science and Technology, Vol. 5, pp 102-105.
- [02] I. K. Khan (2014), "Performance of bamboo reinforced concrete beam", International Journal of Science, Environment and Technology, Vol. 3, pp 836 – 840.
- [03] Jigar K. Sevalia and Nirav B. Siddhpura (2013), "Study on bamboo as reinforcement in cement concrete", International Journal of Engineering Research and Applications Vol. 3, pp 1181-1190
- [04] M. Usha Rani (2017), "Investigation on the flexural behavior of bamboo reinforced concrete beams", International Journal of Research in Science and Technology, Vol. 7, pp 9-24
- [05] Efe Ikponmwoosa and Funso Falade (2014), "Flexural performance of bamboo-reinforced foamed aerated concrete beams", American Journal of Materials Science, pp 56-63
- [06] James Kariuki and Richard A. Shuaibu (2014), "Flexural strength of laminated bamboo beams", International Journal of Advances in Engineering & Technology. pp -1531-1538.
- [07] I. K. Khan (2014). "Bamboo sticks as a substitute of steel reinforcement in slab", International Journal of Engineering and Management Research, Vol. 4, pp 836-840
- [08] Anurag Nayak and Arehant S Bajaj (2013), "Replacement of steel by bamboo reinforcement", IOSR Journal of Mechanical and Civil Engineering, Vol. 8, PP 50-61.
- [09] Ajinkya Kaware and Prof. U. R. Awari (2013), "Review of bamboo as reinforcement material in concrete structure", International Journal of Innovative Research in Science, Engineering and Technology, Vol. 2. pp 2461-2464
- [10] Jigar K. Sevalia and Nirav B. Siddhpura (2013), "Performance evaluation of axially loaded element using bamboo as reinforcement", International Journal of Engineering and Advanced Technology, Vol. 2, pp 413-415

- [11] K. Ghavami (2003), "Bamboo functionally graded composite material", Asian Journal Of Civil Engineering (Building and Housing) Vol. 4, pp 281- 288