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# Review Paper on Bamboo as Reinforcement in Structural Concrete Elements

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***Abstract:*** *Present study reviews the research and studies pertaining to use of bamboo as a construction material .our ancestors used bamboo as construction material in many structures .most prominent being as the struts, posts, roofs etc. Now a day's concrete is used as the basic materials for the construction works .it is brittle and shows good resistance in against compressive force but week in tensile strength. So steel is used as reinforcement in the concrete to achieve the tensile strength .Bamboo is a readily available material in many tropical and sub-tropical region of India. This paper reviews the results of some of the resent studies of the microstructure of bamboo as a functional gradient material. Where bamboo reinforcement concrete may be considered is used to illustrate bamboo reinforcement concrete design and as a basic for life cycle assessment of bamboo. These studies establish bamboos as a sustainable construction material. using it in construction save construction cost ,promote ecofriendly construction and improve strength and durability properties .this report has been compiled from various research generals and case studies conduct around theglobe.*

## I. Introduction

Bamboo has a long and well-established tradition as a building material through out the world's tropical and sub- tropical regions. It is widely used for many forms of construction, in particular for housing in rural areas. Bamboo is a renewable and versatile resource, characterized by high strength and low weight, and is easily worked using simple tools. It is widely recognized as one of the most important non-timber forest resources due to the high socio- economic benefits from bamboo based products. It is estimated that there are 1200 species growing in about 14.5 million hectares area. Most of them grow in Asia, Africa and Latin America. While bamboo attains maturity in 3-5 years, wood takes more than 20 years. It grows faster than any other plant, .It grows approximately 7.5 to 40cm a day, therefore, cutting down this timber substitute may not affect the ecological balance at all. Bamboo has the superior adaptability to the most climatic condition than the other fast growing woods and it has smooth surface, straight grain, toughness and good abrasion resistence. Bamboo is very light in weight, easy to handle, transport and store due to its hollow section and circular shape. It has been used successfully to rehabilitate soil ravage by brick making in India, and abandoned tin-mine sites inMalaysia.

## II. Feasibility Tests

To check the feasibility and reliability of using bamboo splints as reinforcing material in concrete elements & to select and prepare the most appropriate kind of bamboo specimen to be used in concrete element as reinforcement. The following tests were performed till date on different bamboo specimens: -

1) Densitytest.
2) Tensiontest.
3) Initial moisture contenttest.
4) BondTest
5) Compressiontest.
6) Water absorptiontest

| PROPERTIES | BAMBOO |
|---|---|
| Specific gravity | 0.575 to 0.655 |
| Modulus of Elasticity | 1.5 to 2.0 x105 kg/cm$^2$ |
| Modulus of rupture | 610 to 1600 kg/cm$^2$ |
| Safe working stress in tension | 160 to 350 kg/cm$^2$ |
| Safe working stress in compression | 105 kg/cm$^2$ |
| Safe working stress in shear | 115 to 180 kg/cm$^2$ |
| Average weight | 0.625 kg/m |
| Ultimate compressive stress | 794 to 864 kg/cm$^2$ |
| Bond stress | 5.6 kg/cm$^2$ |

## III. Literature Survey

1). Ayesha Syeda, BarvaliyaShrujalJayesh Kumar, A Case Study on Bamboo as Green Building material, International Journal of Engineering and Advanced Technology (IJEAT), Volume-4 Issue-2, December 2014 Bamboo is lighter in weight than bird but is stronger than steel. It takes carbon dioxide in and releases 30% more oxygen than tree. It grows a meter in one year and is mature in almost 3 years. Houses constructed using this bamboo are cool in summer and stays warm in wintry weather and more over it can resist earthquakes and can stand forever. The environmental and financial comparison demonstrates that bamboo can compete with building material. Bamboo is anatural product and will therefore always have some extent of irregularity. It is therefore suggested that the bamboo culm should be used in functions were the measurement requirements are not entirely precise or fixed, as in temporary buildings (e.g., pavilions and tents) or small civil projects. Furthermore, bamboo can play a role as a non supporting or finishingmaterial

2). AvulaGanesh Reddy, A. Joshua Daniel, "Study on Behaviourof Bamboo as Reinforcement with Coconut Shell as Aggregate Concrete in Compression Member with Different Lengths", International Journal of Innovative Research in Engineering & Management (IJIREM), Volume-3, Special Issue-1, April-2015 In this study, Short columns of a range of lengths were studied in this work. The columns with replaced coconut shell aggregate with bamboo reinforcement and columns with replaced coarse aggregate with steel reinforcement were compared with the conventional concrete with steel reinforcement specimens. The ultimate load carrying capacity of the columns decreased with the increase in length. The stiffness of the columns also decreased with the replacement of aggregate and reinforcement. The ultimate load carrying capacity for the column of 1m length with coconut shell aggregate and steel reinforcement was about 86% of the column with conventional aggregate and steel reinforcement and coconut shell with bamboo reinforcement was about 63%. The ultimate load carrying capacity for the column of 1.3m length with coconut shell aggregate and steel reinforcement was about 77.5% of the column with conventional aggregate and steel reinforcement and coconut shell with bamboo reinforcement was about67.5%.

3). Sani Haruna, M. Lakshmipathy, Ductility Behaviourof Bamboo Reinforced Coconut Shell Concrete Beams, International Journal of Scientific Engineering and Research, Volume 3 Issue 5, May 2015.From their research work and experimental result obtained the following conclusions they havemade:

- Tension test performed on bamboo strip revealed elastic behaviour and its ultimate strength was 112.05N/mm2
  The modulus of elasticity of coconut shell concrete was found to be 12075.2N/mm2 which represents 54%, 57%, 43.88% and 60.36% that of modulus of elasticity of conventional concrete for IS 456, ACI-318, EU and BS 8110 codesrespectively.
- The load carrying capacity of the NWC beams were slightly higher than CSCS, BCSC, and BCSCBbeams
- The stiffness behaviourof CSC beam showed similar trend as that of NWC up tofailure
- Energy absorption was more for BCSC than NWC, BCSC and BCSCB beams. This is attributed due to the high deflections due to applied loads.

4). Jigar K. Sevalia, Nirav B. Siddhpura, ChetanS.Agrawal, Deep B. Shah, Jai V. Kapadia, "Study on Bamboo as Reinforcement in Cement Concrete", International Journal of Engineering Research and Applications, Vol. 3, Issue 2, March -April 2013, pp.1181-1190

In this study presents the assessment of the viability of the employ of Bamboo as reinforcement in concrete members. In this research the Bamboo was used as a reinforcing material without any treatment andstirrups. Based on the experimental study, the following conclusions are made,

- Tension test performed on Bamboo strip revealed elasticbehaviour
- Both Singly and Doubly Reinforced Beam has shown elastic behaviour while performing flexural tests onthem
- Doubly Reinforced Beam has performed more elastically than Singly Reinforced Beam while performing flexural tests.
- Load carrying capacity in Doubly Reinforced Beam increased by 29.31 % as compared to Singly ReinforcedBeam.

5). P. Sharma, K. Dhanwantri and S. Mehta, Bamboo as a Building Material, International Journal of Civil Engineering Research. Volume 5, Number 3 (2014), pp. 249-254 In view of the fact that time immemorial, bamboo has played a significant role in the growth of mankind. It is used for a wide variety of day-to-day

purposes, both asa woody material and as food. It has been the spine of much of the world's rural life and will stay up so as the population increases. Its high valued consumption not only promotes the economic development, but also saves jungle resources to protect our ecological environment as a wood substitute. As an cost-effective building material, bamboo's rate of productivity and cycle of annual harvest outstrips any other naturally growing resource, if today you plant three or four structural bamboo plants, then in four or five years later you will have mature clumps, and in eight years you will have enough mature material to build a comfortable, low cost house.

## IV. Conclusion

From this literature study about bamboo, we can conclude that the bamboo is natural and ecofriendly material. Though it has low stiffness and strength compared to steel, , it can be used as a reinforcement in limited storeys and before using bamboo as a reinforcement it must be treated.

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