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Behavior of Bamboo Reinforced Concrete Beam: A Review

Mayuri A. Chandak[1], Rohan Wadaskar[2], Sanjivani Kunghadkar[3], Amit Talokar[4], Rutuja Zade[5]

[1]Project Guide, Department of Civil Engineering, Priyadarshini Collage of Engineering, Nagpur
[2345]Students, Department of Civil Engineering, Priyadarshini Collage of Engineering, Nagpur

ABSTRACT :

Botanically, bamboo belongs to the "Poaceae" family. It takes only a few months for it to reach full maturity, and it takes three years overall. With remarkable tensile and compressive strength, it is available in several species and is impacted by temperature and geographic location. Two prominent species are known for their strength in such areas: Dendrocalamus strictus and Bamboo schard. But bamboo has problems with moisture and with water absorption, therefore it has to be properly treated or seasoned. This research examines the possible advantages of cement beams reinforced with bamboo for rural construction, taking into account their cost, efficiency, and convenience of use. Through experimental research on bamboo-reinforced concrete supports, scientists want to assess the structural performance by examining elements including flexural strength, ductility, or crack propagation under various loading scenarios. The goal of the study is to shed light on the new composite material's structural efficiency and useful applications.

Keywords: Bamboo Reinforcement, Bamboo Reinforced Concrete Beam, Tensile Behavior, Cost Reduction etc.

Introduction :

Steel is being used more and more as a form of reinforcement in building projects in developing nations, but issues with supply and pricing need looking at other materials. When supply of steel cannot keep up with demand, it becomes imperative to find a viable substitute. Bamboo has become a widely used alternative resource, especially in nations like India where it is frequently used to build modest homes and other tiny constructions. Bamboo is a good substitute for steel because of its availability, strength, and capacity to act as reinforcement. When contrasted with other materials like steel, its remarkable tensile strength—which is crucial for reinforcement—is apparent. Bamboo's strength is derived from its distinctive tubular structure, which is inherently resistant to wind forces. There is a lot of promise in addressing the drawbacks of bamboo and encouraging its innovative replacement of structural steel with it. The goal of the current study is to evaluate the viability of employing bamboo reinforcement for reinforced concrete structures by analysing the body of existing literature. Although much research has been done on the mechanical properties and behaviour of steel-reinforced concrete, little is known about bamboo-reinforced concrete. In order to address specific problems with inexpensive housing, this study attempts to offer preliminary insights into the mechanical properties and behaviour of bamboo- reinforced concrete.

Literature Review

As this study has shown, the writers of each publication and article described different goals for using bamboo as a building material or as reinforcement. These goals are crucial to understanding the importance of clean development techniques. The practical application of natural fibre as a form of reinforcement for HYSD bars is also explained by this research. We have also included details on the mechanical characteristics and applications of bamboo.

- Abhijeet Dey and Dr.(Mrs) Nayanmoni Chetia (2018), Through a series of experiments on both bamboo and steel, the authors of this research compared bamboo reinforcement beams built of concrete with varying frictional qualities. They came to the conclusion that bamboo might serve as a very good potential reinforcement for inexpensive housing and could easily replace steel, saving a significant amount of natural resources.

- Ajinkya kaware, Prof. U.R. Awari, Prof. M.R. Wakchare (2013). In this study, the authors assess the physical and mechanical characteristics of bamboo and the outcomes of tests on bamboo reinforcing beams and columns in order to avoid problems with water absorption and moisture content in bamboo construction.

- Amada and untao (2001), The study's author reported that the tensile strength of bamboo fibres was comparable to that of steel. Furthermore, the source of a fracture is the main factor affecting bamboo's fracture properties. Moreover, bamboo node fibres have little role in breaking resistance.

- Atul agarwal and Damodar maity (2014) , The surface treatment for the bamboo involves the employment of many chemicals, according to the writers of this paper. When an element is subjected to axial stress, bamboo has
sufficient ductility to provide for a warning before the component fails. It was discovered that under axial overall transverse stresses, columns reinforced with 8% treated bamboo demonstrated the same strength and behaviour as conventional RCC columns.

- Bhavna Sharma, Ana Gatóo, Maximilian Bock, Michael Ramage (2015), The work contributes to the growing body of information on modified bamboo and identifies areas that need further investigation. It has been shown that engineered bamboo products have attributes that are on par with or even better than wood and wood-based products. Potential limitations for use in structural design are also discussed.

- Esti Asih Nurdiah (2016) , The purpose of this study is to investigate the use of bamboo in naturally formed structures. The relationships between shape, structure, construction, the joint system are demonstrated through a series of case studies. It will classify bamboo's curved shape, giving it an organic form. The results of this study will show that bamboo is able to be utilised in place of steel and concrete for building organic-shaped buildings.

- Ghavami, K. (1995), The author of this research claims that a bamboo-reinforced concrete structure can support 400% more weight than an unreinforced cement beam. Bamboo's tensile strength is far higher than its compressive
strength, and it has a modulus of elasticity which is one-fifth that of steel.

- Ghavami, K. (2005), The bamboo used in this study is known as a dynamically graded combination since the author found that it had exceptional strength when orientated parallel to the fibres. Additionally, it was found that
using 4% bamboo as a reinforcement inside the concrete beam will yield the greatest results. Furthermore, experiments on bamboo-reinforced columns and floor slabs showed that bamboo may be a practical, less expensive alternative to steel.

- Harish Sakaray, N.V. Vamsi, Krishna Togati, I.V. Ramana Reddy (Feb 2012), The constitutive relationships of the nodes are explained by the study's author as being distinct from those seen in inter-nodal zones. Because bamboo absorbs water quite quickly, waterproofing is recommended. Bamboo can take the place of steel reinforcement, according to test results on diseases. Emissions of carbon dioxide will be reduced by using less steel because bamboo is a material that is beneficial to the environment. In the framework of green construction ideals, using reinforced bamboo concrete may be recommended.

- J. Atanda (2015), The information provided by the author of this paper regarding bamboo, particularly its qualities
and benefits for the environment, may be useful to Nigeria's construction sector. The main objective of this article was to assess bamboo's adaptability for use in construction and look into how Nigeria's environment impacts thoseabilities.

- J. Janssen (2000), The disadvantages of using bamboo in reed-reinforced concrete building were examined by the study's author. The restrictions were the bond strength, the water-absorbing capacity of the bamboo, and the smooth surface inside the bamboo culm. The greatest issue out of all the limitations was found to be inadequate binding strength.

- K. F. Chung and W. K. Yu (2002), The mechanical properties of two bamboo species that are often used in access

  scaffoldings across South East Asia, especially in Hong Kong and Southern China, are investigated in this work: Bambusa Pervariabilis, also known as Kao Jue, and Phyllostachys Pubescens, also known as Mao Jue. A pilot research was carried out for both species of bamboo to examine the variation in compressive strength over the culms' length with regard to certain physical attributes.

- M.R. Wakchaure and S.Y. Kute, (Feb 2012) , This study's author describes how bamboo's moisture content is influenced by its geography and seasoning period, which in turn impacts all of its mechanical and physical characteristics. It is one of the most important factors in determining how long bamboo will survive. The author conducted an experimental evaluation of the Dendrocalamus strictus bamboo species' mechanical and physical properties to discover whether or not it may be utilised as a building material in its whole or in split form.

- M. Mahdavi and S. R. Arwade (2012), Therefore, the primary contribution of this research is the finding that structurally reliable LBL may be constructed using hand tools, screw-driven motorised presses, and easily accessible, moderately cost adhesives.

- Musbau Ajibade Salau , Ismail Adegbite , Efe Ewaen Ikponmwosa, (Jan 2012), The hypothesis that the failure mode is more dependent on the longevity of the reinforcement and concrete matrix than it is on the materials used for reinforcement was examined by the author of this paper. Thus, the main goal should be to strengthen the connection between the concrete matrix and reinforcement. There is significant bending and cracking in the bamboo-strip reinforced column, especially in the 12No.-strips.

- Olumoyewa Dotun Atoyebi, Samson O. Odeyemi and Joy A. Orama (2018), The authors of this research reported on a range of lateritic concrete tests conducted on bamboo. After testing a range of bamboo culm diameters and sizes under varied conditions, the average value for tensile strength at splitting of the lateritic concrete reinforced with bamboo was computed.

- P. van der Lugt, A.A.J.F. van den Dobbelsteen, J.J.A. Janssen (2005), The results of these investigations are reported in this article, which demonstrates that bamboo is a very ecologically friendly building material in Western nations that can rival more commonly used materials under specific conditions and after considering the case study's suggestions.

- P. Sharma, K. Dhanwantri, and S. Mehta (2014), This study shows that because bamboo is strong, resilient, and lightweight, it is the ideal material for roofing. Bamboo will continue to be essential for company expansion and rural community development.

- Rashmi Manandhar, Jin-Hee Kim & Jun-Tae Kim (2019), In order to assess how sustainable bamboo construction is, this review critically looks at both the environmental and social and economic effects of employing bamboo.

- S. Karthik a, P. Ram Mohan Rao, P.O. Awoyera (2017), In this experiment, bamboo strips were used as support in a concrete made with extra cementitious components, and river sand was partially substituted with manufactured sand (m-sand).

Conclusion

It was clear from reviewing the available literature that there has been a lot of study done on the subject of using bamboo as reinforcement in concrete. But as we've seen, bamboo is mostly used for scaffolding and decorative purposes. Bamboo is not a common reinforcing material. As a result, we need to let people know that bamboo can replace steel and that it emits less pollution overall. Therefore, software for bamboo reinforcement in concrete has to be developed. Additionally, bamboo is less expensive than steel, thus we ought to encourage the use of bamboo as an affordable building material.

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