

Study and Use of Bamboo Reinforcement in Concrete

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Abstract: Bamboo being a grass and botanically belongs to family of “Poaceae”. Bamboo completes its growth within months time and gets mature within 3 years. within the Maharashtra State it's commonly named as “velu”. Species of bamboo are change as per topography and climatic conditions. it's excellent tensile and compression strength. As per the review dendrocalamus strictus, bamboo scharde are species of bamboo which has highest value of tensile and compression strength. Problems which faced in using bamboo as construction material are water absorption and moisture content. To avoid these problems proper seasoning or treatment should run to those bamboo. During this study trials are made to be used of bamboo concrete beams which are simple, efficient and economical for rural constructions. The major application of bamboo are for construction and housing. keep with this study it is estimated that one billion people within the world sleep in bamboo houses. Since bamboo has been utilized in construction and also currently they're used as props, foundations, framing, scaffolding flooring, walls, roofs and trusses. Bamboos are tied together to form grid reinforcement and placed in soft clay to resolve the deformation problems in embankments. In rural a component of India mostly bamboos are use as reinforcement in mud walls .

Keywords: Poaceae, velu, dendrocalamus strictus, etc.

1.INTRODUCTION

India, one in every of the foremost popular country within the world may be a home to several sections of individuals who are below average personal income. Shortage of housing facilities among them because of unaffordability has become a matter of concern within the recent Indian scenario. As a matter of fact, an endeavor has been made to introduce low cost houses which are durable, safe and affordable. Bamboo, one in all the oldest construction material has been considered to possess high tensile strength and is getting used as main structural component for these low cost houses. Bamboo, bearing the scientific names Bambusa Tulda, Bambusa Balcooa etc. is the fastest growing ligneous plant belonging to Gramineae. Bamboo are capable of growing 60cm or more in a very day and may get older to 30m or even more. they will be grown in any climatic condition and soil type which is major factor for considering it. the speed of growth of bamboo depends upon the local climatic condition and soil type. Bamboo is taken into account to be matured after three years of its plantation and it's always advisable to decide on matured bamboo for construction purpose. In below fig. 1.1 Typical picture of bamboo is shown. Bamboo generally considered as organic and to mitigate this problem treatment is being provided to the bamboo samples to create it free from pest and other insect attacks. one in every of the foremost important factors to be considered is that bamboo shows its efficiency in climate which haves at least a bit amount of humidity. Studies are dispensed on the engineering properties of bamboo and located it suitable to be used as substitution for steel although it's lesser durability than traditional steel reinforcement.

2. LITERATURE REVIEW

In every paper and article authors gave many objectives of use of bamboo as a reinforcement or as a building material which we have stated in this report. These objectives are very important for studying usefulness of clean development mechanism. This report also defines about the natural fiber utilization as reinforcement and a convenient option for HYSD bars. We also have stated mechanical properties of bamboo and treatments on bamboo.

2.1. COLLECTION OF DATA

1. Abhijeet Dey and Dr.(Mrs) Nayanmoni Chetia (2018). “Experimental study of Bamboo Reinforced Concrete beams having various frictional properties.” J. ELSEVIER, Vol 5, Issue 1, Part 1, pp 436-444.

In this paper authors recommended that bamboo can act as a good potential reinforcement for low cost housing and can replace steel conveniently thereby saving natural resources to considerable extent authors studied the comparative study of bamboo reinforcement concrete beams with various frictional properties by taking various tests on bamboo and steel.

.2. Ajinkya kaware, Prof. U.R. Awari, Prof. M.R. Wakchare (2013). "Review of bamboo as reinforcement material in concrete structure." International Journal of Innovative Research in Science, Engineering and Technology. Vol. 2, Issue 6, pp 2461-2464.

In this paper authors describes results on mechanical, physical properties as well as bamboo reinforcement column & beams are reviewed to avoid problems faced in bamboo construction i.e. water absorption and moisture content proper seasoning or treatment given to bamboo and then test was conducted.

3. Amada and untao (2001) "Tensile strength of bamboo is good and can be used as reinforcement in R.C.C structure for low cost housing project." J. ELSEVIER, Vol. 32, Issue 5, pp 451-459.

In this paper author observed that the tensile strength of bamboo fibres was comparable to steel. Further, the origin of fracture is the main reason on which the fracture properties of bamboo depends. Also, the fibres in the nodes of bamboo do not have any role in fracture resistance.

4. Atul agarwal and Damodar maity (2014) "Experimental investigation on behaviour of bamboo Reinforced concrete members" 16th International Conference on Composite Structures (ICCS 16). J. ELSEVIER, Vol 71, pp 610-617.

In this paper authors mentioned the treatment on the bamboo surface is done with the use of some chemicals. When a member is subjected to axial loading the bamboo gives sufficient ductility so that there is a warning before the failure of members. It was observed that the columns which are reinforced with 8% treated bamboo gives the same strength and behaviour under transverse and axial loading as that of normal RCC columns.

5. Bhavna Sharma, Ana Gat6o, Maximilian Bock, Michael Ramage (2015). "Engineered bamboo for structural applications." J. ELSEVIER, Vol 81, pp 66-73.

The study contributes to a growing body of research on engineered bamboo and presents areas in which further investigation is needed. It is shown that engineered bamboo products have properties that are comparable to or surpass that of timber and timber-based products. Potential limitations to use in structural design are also discussed.

6. Esti Asih Nurdiah (2016) "The Potential of Bamboo as Building Material in Organic Shaped Buildings." J. ELSEVIER, Vol 216, pp 30-38.

This paper attempts to discuss how bamboo is being used in organic shaped building. Several case studies are taken to describe the relation between shape, structure, construction and joint system. It will classify how bamboo is formed in curved thus result is an organic form. The paper result will show that bamboo can be a potential building material for organic shaped buildings and become an alternative building material other than steel and concrete.

7. Ghavami, K. (1995) "Ultimate Load Behaviour of Bamboo-Reinforced Light weight Concrete Beams," Cement & Concrete Composites. J. ELSEVIER, Vol. 17, Issue 4, pp 281-288.

In this paper author observed that the ultimate load carrying capacity of bamboo reinforced concrete beam is 400% of the un-reinforced concrete beam. The modulus of elasticity for bamboo is 1/15 of steel and the tensile strength of bamboo was much higher than its compressive strength.

8. Ghavami, K. (2005) "Bamboo as Reinforcement in Structural Concrete Elements", Cement & Concrete Composite. J. ELSEVIER, Vol. 27, Issue 6, pp 637-649.

In this paper author observed that the bamboo in the direction parallel to fibres showed high strength and is termed as a functionally graded composite. Also concluded that the use of 4% bamboo as a reinforcement in the concrete beam is ideal for maximum efficiency. Apart from these columns and floor slabs reinforced with bamboo were also tested which showed that bamboo can be an effective cheap substitute for steel.

9. Harish Sakaray, N.V. Vamsi, Krishna Togati, I.V. Ramana Reddy (Feb 2012) " Investigation on properties of bamboo as reinforcing material in concrete" International Journal of Engineering Research and Applications Vol. 2, Issue 1, pp 077-083. 34.

In this paper author describes the constitutive relationship of the nodes differs from those of inter-nodal regions. Water absorption of bamboo is very high and waterproofing agent is recommended. From the test conditions, bamboo can potentially be used as substitute for steel reinforcement. As bamboo is eco-friendly material, limiting the use of steel can reduce carbon dioxide emissions. In the green building concept use of bamboo reinforced concrete may be recommendable.

10. J. Atanda (2015). "Environmental impacts of bamboo as a substitute constructional material in Nigeria." J. ELSEVIER, Vol 3, pp 33-39.

In this paper author describes information about bamboo i.e. its properties and qualities also its environmental benefits, which can be utilized in the constructional sector in Nigeria. Authors main objective of this paper was to identify capabilities of bamboo for construction use, examine the effect depends upon the environment in Nigeria.

11. J. Janssen (2000) "Designing and building with bamboo", International Network for Bamboo and Rattan (INBAR 2000), a Project on Bamboo Structures at the Technical University of Eindhoven.

In this paper author Studied that the limitations while using bamboo in the building made with bamboo reinforced concrete. The limitations observed were bond strength, absorption of water in the bamboo, smooth wall of the bamboo culm. Out of all the limitations, improper bond strength was found out to be the biggest issue.

12. K. F. Chung and W. K. Yu (2002) "Mechanical properties of structural bamboo for bamboo scaffoldings." J. ELSEVIER, Vol 24, Issue 4, pp 429-442.

This paper presents an investigation on the mechanical properties of two bamboo species, namely *Bambusa Pervariabilis* (or Kao Jue) and *Phyllostachys Pubescens* (or Mao Jue), which are commonly used in access scaffoldings in the South East Asia, in particular, in Hong Kong and the Southern China. A pilot study was carried out to examine the variation of compressive strength against various physical properties along the length of bamboo culms for both bamboo species.

13. M.R. Wakchaure and S.Y. Kute, (Feb 2012) "effect of moisture content on physical and mechanical properties of bamboo" Asian journal of civil engineering (building and housing)" vol. 13, No. 6, pp 753-763.

In this paper author describes the moisture content of bamboo varies along its topography and with seasoning period, which affects all physical and mechanical properties. It is one of the important factors in deciding the life of bamboo. The author made experimental investigations to evaluate the physical and mechanical properties of the bamboo species *Dendrocalamus strictus* and its utilization potential as building material may be as whole or in the split form.

14. M. Mahdavi and S. R. Arwade (2012) "A low-technology approach toward fabrication of Laminated Bamboo Lumber." J. ELSEVIER, Vol 29, pp 257-262.

The key contribution of this paper, therefore, is the conclusion that structurally reliable LBL can be fabricated using hand tools, screwdriven mechanical presses, and widely available, economical adhesives.

15. Musbau Ajibade Salau , Ismail Adegbite , Efe Ewaen Ikponmwosa, (Jan 2012) "Characteristic Strength of Concrete Column Reinforced with Bamboo Strips" Journal of Sustainable Development Vol. 5, No. 1, pp 133-143.

In this paper author studied that Failure mode is independent of the materials used for reinforcement but rather on the strength of the reinforcement/concrete matrix. Hence, attention should be on enhancement of the reinforcement/concrete matrix bond. The bamboo-strip reinforced column shows excessive cracking and deflection especially 12No.-strips.

16. Olumoyewa Dotun Atoyebe, Samson O. Odeyemi and Joy A. Orama (2018). "Experimental data on the splitting tensile strength of bamboo reinforced lateritic concrete using different culm sizes." J. ELSEVIER, Vol 20, pp 1960-1964.

In this article authors gave data about various tests conducted on bamboo with lateritic concrete. Test was conducted on different culm sizes, diameters of bamboo for each conditions and at last averages value computed for splitting tensile strength of bamboo reinforced lateritic concrete.

17. P. van der Lugt, A.A.J.F. van den Dobbelsteen, J.J.A. Janssen (2005). "An environmental, economic and practical assessment of bamboo as a building material for supporting structures." J. ELSEVIER.

This paper presents the results of these studies, which indicate that within certain boundary conditions and with consideration of the recommendations following the case study, bamboo is a very sustainable building material for Western countries and can be competitive to materials more commonly used.

18. P. Sharma, K. Dhanwantri, and S. Mehta (2014) "Bamboo as a Building Material." International Journal of Civil Engineering Research. ISSN 2278-3652, Vol 5, No. 3, pp. 249-254.

In this paper, bamboo is ideal as a roofing material- it is strong, resilient and light weighted. Bamboo will continue to play an important part in the development of enterprises and the transformation of rural environments.

19. Rashmi Manandhar, Jin-Hee Kim & Jun-Tae Kim (2019). "Environmental, social and economic sustainability of bamboo and bamboo-based construction materials in buildings." JOURNAL OF ASIAN ARCHITECTURE AND BUILDING ENGINEERING, VOL. 18, NO. 2, pp 49-59.

This review critically studies not only the environmental aspects when bamboo is used as a building material but also its social and economic aspects, to understand its sustainability impact.

20. S. Karthik a, P. Ram Mohan Rao, P.O. Awoyera (2017). "Strength properties of bamboo and steel reinforced concrete containing manufactured sand and mineral admixtures." Journal of King Saud University – Engineering Sciences, Vol 29, pp 400-406.

In this study, bamboo strips were used as reinforcement in a concrete that was made with supplementary cementitious materials and partial replacement of riversand with manufactured sand (m-sand).

3.METHODOLOGY

In this project we are studying the use of bamboo as reinforcement in concrete. First of all we have to study the properties of bamboo and also its uses at different ages of it. Then we have to select the bamboo sizes and for better results we can treat it with various treatments to protect it from swelling and shrinkage also from insect attack to create a serious limitations in the bamboo reinforced concrete. Bamboo concrete construction follows same design, mix proportion and construction techniques as used for steel reinforced. Properties of bamboo reinforcement are almost like that of STEEL REINFORCEMENT. Bamboo has used for scaffolding works, formwork supporting stand and lots of in building construction work. These are limited to medium-large projects. Although the existence of bamboo has been found from centuries, bamboo as reinforcement material is an innovation within the civil engineering construction field. Bamboo may be a bio-degradable and renewable. It's energy efficient because it is of natural origin & environmentally sustainable in nature.

4. CONCLUDING REMARK

After reviewing whole literature it was seen that extensive Research has been carried out about study and use of bamboo reinforcement in concrete. But we observed that bamboo is mostly used as scaffolding and as decorative material. Bamboo as reinforcement is not used widely. So we have to aware people that bamboo can be used instead of steel and it does not cause pollution as much as steel do. Therefore, we should make software for bamboo to use as reinforcement in concrete. And bamboo is cheaper than steel so we should tell people that bamboo is good option for economical construction.

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