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International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Efficacy of Bamboo Fiber Along with Lime

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ABSTRACT:

Bamboo is one of the oldest construction material and has been used in the fabrication of rural houses and other structures in the concrete. On the other hand plants and fibers are clean resources that can be reproduced annually. Bamboo is naturally fibrous, inexpensive and readily available. This study determines the influence of fiber bamboo on both compressive and split tensile strength of concrete. The parameters used in this study are fiber aspect ratio (l/d ratio) and percentage of addition of bamboo fibre form 0% to 2% by weight of cement.in adition to that 0% to 20% lime also used in the bamboo fibres as reinforced concrete for 1.0% to 1.5% are the best ratio of mix designation that have significant increase in compressive and tensile strength that tested and reviewed after 28 days of curing. A statastical analysis tool called minitabs was used in this experiment to make the results more accurate. This study investigates the influence of different percentages of bamboo fiber in concrete through the compressive strength and split tensile strength results.

Key words:- Compressive strength, Split tensile strength, Bamboo fibers, Lime

INTRODUCTION:

Environmental destruction such as pollution of air and water has been occurring in some regions by rapid development and production of materials like iron, steel, glass, cement and aluminium that use limited mineral resources. Plain concrete is a brittle material, with low tensile strength and strain capacities. To help overcome these disadvantages, there has been a steady increase, since the late 1960s, in the use of fiber reinforced concrete (FRC). The fibers can be divided into "synthetic (polymeric) fiber" made from various materials processed by chemical means, and "natural fibers" processed and purified materials taken from part of the mineral, plants and animals. Bamboo is a unique group of gigantic grasses the culm of which originates in underground rhizomes. It grows naturally in many parts around the world country but some species are artificially planted. Among the many possibilities for such substitutions, bamboo, which is one of the fastest growing plants, has got a great economic potential. Bamboo has been used in constructions of bridges and houses for thousands of years in Asia and it takes less energy to harvest and transport. Fiber has been used as reinforcement material from old times since Biblical period. The addition of fibers in the plane concrete not only improves strength but also help in reducing the cracks due to repeated load, Fiber improves the post peak ductlity perfomance ,precrack tensile strength,fatigue strength and impact strength. Fiber classified to many types not only bamboo but also there are many fibers like jute,glass,coconut fiber.

LITERATURE REVIEW:

1) **Masakazu TERAI, Koichi MINAMI , Basic Study on Mechanical Properties of Bamboo Fiber Reinforced Concrete.** In the world of construction materials, fibre reinforced concrete is becoming more and more common. There is research being done on the use of fibres such as asbestos, grass, polyester, rayon, steel, and more as reinforcement in fiber-reinforced composites.

2) **Karthikeyan Kumarasam, GShyamal, Haftom Gebreyowhanse and Kumarasamy4 Strength Proper of Bamboo Fiber Reinforced Concrete**. A comparison of the experimentally determined characteristics of concrete with various ratios of natural fibre to concrete are estimated in this research.

3) **Chang Zhang, Zhen Huang, and Guowei Chen, Experimental Research on Bamboo Fiber Reinforced Concrete.** By a variety of compression, splitting, and flexural tests, the mechanical performance of bamboo fibre reinforced concrete was examined in this work. The comparative variables are the length and volume ratio of the bamboo fibre. The test results reveal that adding bamboo fibres to concrete significantly improves its splitting tensile properties, but not its compression or flexural properties.

4) **A Yusra , T Triwulan , M Safriani and M Ikhsan, Use of bamboo fiber on the relationship between compressive strength and split tensile strength of high strength concrete.** This study sought to understand the link between compressive and tensile strengths as well as the impact of bamboo fibre on the split tensile strength of concrete. This study sought to understand the link between compressive and tensile strengths as well as the impact of bamboo fibre on the split tensile strength of concrete.

5) **Can Mark Bittner , Vincent Oettel, Fiber Reinforced Concrete with Natural Plant Fibers—Investigations on the Application of Bamboo Fibers in Ultra-High Performance Concrete.**Due to their suitable mechanical properties, affordable availability, and theoretical

carbon neutrality, natural plant fibres represent a sustainable alternative to traditional fibre reinforcement materials in cementitious materials. The test results demonstrate a markedly improved load-bearing behaviour of the fibres as well as the tremendous potential of the UHPC and bamboo fibre combination.

6) **Durgesh Kumar Gupta, R. C. Singh, An Experimental Evaluation of Mechanical Properties of Bamboo Fiber Reinforced Concrete.** In this study the mechanical properties of bamboo fibre reinforced concrete by analysed. The strength and potential of bamboo fibre increased.The fibres serve as a fracture resistor, increasing the load capacity. Reduced fracture width and concrete deflection under the same load as conventional concrete With the length and proportion of bamboo fibre above 1.5%, workability declines.

7) **Alireza Javadian, Ian F. C. Smith , Nazanin Saeidi and Dirk E. Hebel, Mechanical Properties of Bamboo Through Measurement of Culm Physical Properties for Composite Fabrication of Structural Concrete Reinforcement.** In this paper the mechanical potential of bamboo for use in the creation of novel bamboo-based composite materials applications in the architecture and construction industry can be estimated using the physical characteristics of the bamboo culm. As culm wall thickness is increased, bamboo section mechanical characteristics frequently drop. As culm diameter rises, the volumetric ratio of cellulose fibres to lignin decreases, which is related to this.

8) **Feng Qi , Jianyun Pan, Bo Yang, Research on Strengthening Mechanism of Bamboo Fiber Concrete under Splitting Tensile Load**. In this paper the strengthening mechanism of bamboo fibre concrete cannot be explained by the composite material hypothesis. On the other hand, fibre spacing theory not only has superior precision but also reflects the effect of fibre content and length-radius-ratio \son the splitting tensile strength of concrete. In order to explore the strengthening mechanism of bamboo fibre to concrete, the fibre spacing theory is modified.

9) **Siew Choo Chin, Jacky Neing Sheng Moh,Shu Ing Doh , Fadzil Mat Yahaya, Jolius GimbunStrengthening of Reinforced Concrete Beams Using Bamboo Fiber/epoxy Composite Plates in Flexure**. The ability of bamboo fibre composite plate (BFCP) to strengthen reinforced concrete (RC) beams in flexure is discussed in this research. The fibre was produced from Dendrocalamus asper bamboo, and the fiber-to-volume ratio was fixed at 2:5. Bamboo strands were bound together with epoxy using a hand-lay-up technique to create the composite plate. All of the beams underwent a four-point bending test to the point of failure, and the flexural and tensile strengths of the BFCP were measured.

10) **M Y Yuhazri , A J Zulfikar and A Ginting Fiber Reinforced Polymer Composite as a Strengthening of Concrete Structures: A Review.** This review paper's goal is to teach readers on the use of FRP composites for concrete structure reinforcing in both new construction and repairs. FRP composite materials were initially utilised as reinforcing materials for column-beam joints made of reinforced concrete. Due to the applied load, the resulting structure's flexural ability has grown. Jute, a natural fibre, increases the hardness of concrete by adding to it. This paper discusses additional studies on the use of FRP composites in concrete to increase strength performance. The method of encasing FRP composites in concrete is also covered in the study in an effort to boost the performance of the final construction.

METHODOLOGY:

In this study we have used minitabs a data analytics software for analyse and to reduce the number of samples. By using the software we have got 26 samples in which 13 cubes and 13 cylinders of different combinations of lime along with bamboo fiber.

Table1: Combinations obtained from minitabs software

Mix designation	Lime (%)	Bamboo fibres (%)
CLB01	15	2.41421
CLB02	15	1.0
CLB03	15	1.0
CLB04	30	0
CLB05	0	1.0
CLB06	15	1.0
CLB07	15	1.0
CLB08	0	2
CLB09	0	0
CLB10	36	1.0
CLB11	15	0
CLB12	30	2.0
CLB13	15	1.0

TEST METHODS:

The concrete specimens were casted in cubical mould of size 150x150x150mm for compressive test and cylindrical mould of diameter 150mm, height 300mm for split tensile strength test. Easy demoulding and obstruction of the adhesion of concrete were ensured by greasing the moulds. Concrete is placed into the mould in 3 layers giving 25 blows per each layer with a tamping rod. The concrete specimens were removed from moulds after 24hrs drying at room temperature and after that they were promptly kept in a container of clean water for 28 days to have wet curing. A total of 26 concrete specimens were made for testing experimentally, (13 each for compressive and split tensile tests). At least three specimens were prepared for each mix proportion to obtain the mean value of mechanical properties of concrete after each curing period. After 28 days, the concrete specimens were removed and tested using Universal Compression Testing machine for compressive and split tensile tests.

RESULTS AND DISCUSSIONS:

Effect of bamboo fiber on compressive strength

The bamboo fiber is added in various percentages along with lime to enhance the compressive strength. The results of the experiments carried out with varying mixing volume of bamboo fibers and lime have shown that the compressive strength of concrete significantly decrease at some particular value of lime and bamboo, for some value of bamboo and lime the compressive strength is improved . The results of the experiments carried out with varying mixing volume of bamboo fibers have shown that the compressive strength of concrete significantly changed with an increase and decrease in volume fraction of fibers.

Effect of bamboo fiber of split tensile strength

The split tensile strength increased with the addition of bamboo fiber, which shows that the brittle nature of concrete can be overcome by addition of bamboo fiber and lime. This improvement in the tensile strength of concrete was observed due to the bamboo fiber and lime. The bamboo fiber is added in various percentages along with lime to enhance the Split tensile strength. The results of the experiments carried out with varying mixing volume of bamboo fibers have shown that the split tensile strength of concrete significantly increased with an increased volume fraction of fibers.

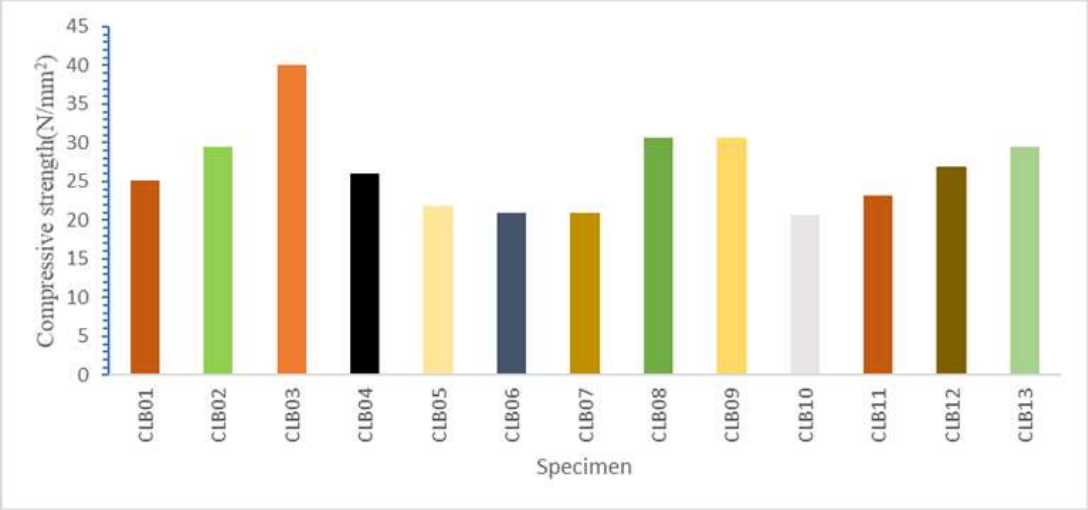
Table 2: Experimental results of compressive and split tensile strengths

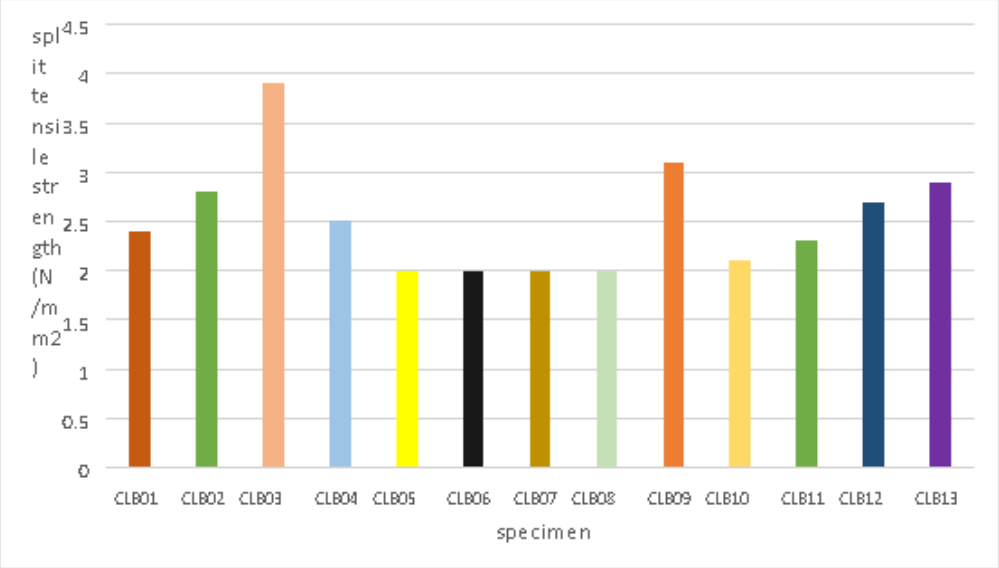
Mix designation	Lime (%)	Bamboo fibres (%)	fcs_{28}	$fSTS_{28}$.
CLB01	15	2.41421	25.06	2.4
CLB02	15	1.0	29.51	2.8
CLB03	15	1.0	40	3.9
CLB04	30	0	26.01	2.5
CLB05	0	1.0	21.91	2
CLB06	15	1.0	20.93	2
CLB07	15	1.0	20.93	2
CLB08	0	2	30.62	2
CLB09	0	0	30.62	3.1
CLB10	36	1.0	20.65	2.1
CLB11	15	0	23.2	2.3
CLB12	30	2.0	26.9	2.7
CLB13	15	1.0	29.51	2.9

Where

fcs_{28}=Compressive strength of specimen at 28 days

$fSTS_{28}$ =split tensile strength of specimen at 28 days





CONCLUSIONS:

1) The present work explores the usage of Lime powder and Bamboo fiber as an additional material in concrete to improve strength.
2) Experimental values of compressive strength and Split tensile strength are taken to predict the mechanical properties of natural fiber reinforced concrete through response surface methodology.
3) From the results, the optimum values for compressive and split tensile strengths were observed at 15 percent lime and 1.0 percent bamboo fiber.
4) The compressive strength at 28 days curing of the fiber reinforced mixes were found to produce a maximum of 23% higher than the coventional mix.
5) The Split tensile strength at 28 days curing of the fiber reinforced mixes were found to produce a maximum of 20.5% higher than the coventional mix.
6) By all the above results we can conclude that inclusion of Natural fibers improves the mechanical properties of the concrete which is an innovative low cost material which can be promoted in construction field.

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