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Experimental analysis for the study of effect of Bamboo fiber and polypropylene fiber in concrete

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ABSTRACT

One of the commonly used building materials is concrete since it has many advantages. But due to its low tensile strength, it cannot be used alone everywhere. Therefore, steel is widely used to reinforce concrete. But due to its high cost, bamboo is one of the ways to replace reinforcement bar in concrete for low-cost construction. Due to its renewable nature and eco-friendly benefit, it plays a vital effort to prevent air pollution because it absorbs nitrogen. Bamboo grows in a few years and reaches its maximum strength and it is a natural fiber that helps to improve the strength of concrete and thereby used to reinforce concrete materials. In this research work, fiber reinforced concrete is produced using bamboo as a reinforcing block material. Tests are done with M25 grade concrete and the compressive strength of bamboo fibers are tested and compared with plain concrete.

Keywords- Bamboo fiber, polypropylene, compression test, X-RAY DIFFRACTION.

1 INTRODUCTION

1.1 CONCRETE:

Concrete having brittle property with less value of tensile strength and strain capacities, hence is preferred with fibers. Fiber reinforced concrete (FRC) had overcome this problem since 1960s. In past fibers were widely used in many types of mortar and concrete for providing stability. Steel, organic polymers, glass, carbon, asbestos, and cellulose are most commonly used fibers. Adding fibers to concrete matrix has been long recognized as a way to enhance the energy absorption capacity and crack resistance of the plane concrete, Consideration of toughness and the fracture energy is important since it determines the ductility and crack resistance of the structure assuring the safety and integrity of the structural element prior to its complete failure. Bamboo Fiber shows good potential and increased strength when used in the Fiber reinforced concrete and the fibers acts as a crack resistor, **hence take up a lot more load as compared to the conventional concrete. The mechanical properties of Bamboo in the physical, as well as mechanical properties vary with respect to diameter, length, age, type, position along column, and moisture content of bamboo and studies showed that the ultimate load of a concrete beam reinforced with bamboo increased by 400% as compared to un-reinforced concrete. Also the thorough investigation into the** structure and purposes of the nodes, which they found to be strengthen by the bamboo fiber.

In my project we use M20 grade concrete whose composition of cement, sand and aggregate ratio 1:1.5:3 Slump value of M20 grade concrete is 100 to 160mm and minimum compressive strength after 7 days is 13.5 N/mm2 and

specified standard compressive strength after 28 days is 20 N/mm2.

Fig. 1. Dry Mixing of fine aggregate, cement, coarse aggregate.

1.2 BAMBOO FIBER:

Bamboo grows in the tropical and subtropical area. Due to the cheaper cost bamboo houses can be built for people in the world. Because of the successful construction of bamboo houses, companies and researchers has observed for using bamboo as structural element of construction, such as bamboo reinforced concrete. Bamboo plants has the potential to develop of innovation in construction. Several studies have been carried out on the use of raw bamboo as reinforcing material to replace conventional steel. Usually, bamboo was used for construction and home furnishings. Bamboo pieces were used for toothpicks, skewers, and the wicker. This furniture manufacturing process produces waste in the form of bamboo fiber. Therefore, bamboo fiber will be observed for repairing cracks in concrete. Chemical components of bamboo fiber have same chemical components of wood which consists of cellulose, hemicellulose, lignin and water. Cellulose [(C6H10O5)n] is a polysaccharide consists of glucose monosaccharide . This glucose strong binding hydrogen in stabile crystalline form. Cellulose aggregates which form tiny fiber together into a matrix of coarse fiber. Another component is hemicellulose similar to cellulose but contains other types of monosaccharide and different bonding. This hemicellulose has non-uniform structure and a weak strength. Lignin is a complex natural polymer and a tentacle, carbon from the air. Lightning is not easily destroyed and became a buffer cell wall. Lignin accounted compressive, strength on bamboo. Cellulose is the main fiber to the natural fiber that absorbs a lot of water. To reduce the absorption of water, the hydrophilic element and flour should be reduced by rinsing of NaOH, KMnO4, and H2O2.

Fig.2. bamboo fibers.

Table 1. Percentage of world bamboo resources by continent.

Country	*Bamboo resources in percentage*
India	*30*
China	*14*
Indonesia	*05*
Ecuador	*04*
Myanmar	*02*
Vietnam	*02*
Others	*43*

1.2.1 PHYSICAL PROPERTIES OF BAMBOO FIBER:

Bamboo is one of the fastest growing plants in the world, due to a unique rhizome dependent system. Certain species of bamboo can grow 910 mm (36 in) within a 24-hour period, at a rate of almost 40 mm (1 1⁄2 in) an hour (a growth around 1 mm every 90 seconds, or 1 inch every 40 minutes).Giant bamboos are the largest members of the grass family.

Table 2. physical property of bamboo fiber.

s\no	properties	data
1.	Dry tensile strength (cN/dtex)	2.33
2.	Wet tensile strength(cN/dtex)	1.37
3.	Dry elongation at break(%)	23.8
4.	Linear density (% deviation)	1.8
5.	Percentage length deviation	1.8
6.	Overlength staple fibers (%)	0.2
7.	Whiteness (%)	69.6

1.2.2CHEMICAL COMPOSITION OF BAMBOO**:**

Bamboo is a lingo-cellulosic bast fiber. Chemical composition and properties are similar to the other bast fibers like jute, flax. It contains cellulose(70-74)%, hemicellulose(12-14)%, lignin(10- 12)%, extractives like protein, pectin, wax (2-3)%.

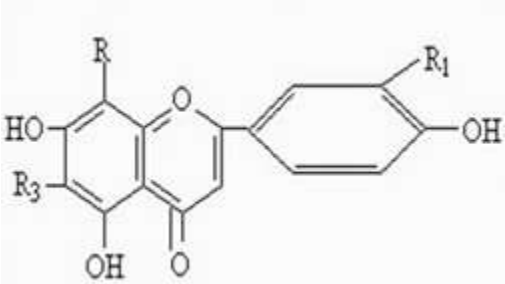


Fig. 3.Polymeric Structure

2 LITERATURE REVIEW

1. Jigar K. Sevalia, Nirav B. Siddhpura, Chetan S. 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 and stirrups. Based on the experimental study, the following conclusions are made.

2. Avula Ganesh Reddy, A. Joshua Daniel, "Study on Behaviour of Bamboo as Reinforcement with Coconut Shell as Aggregate Concrete in Compression Memberwith 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.

3. 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 as a 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. The properties as peak grade building material and increased availability of bamboo in our country makes it potential to use, bamboo in the field of construction broadly. Its high valued consumption not only promotes the economic development, but also saves jungle resources to protect our ecological environment as a wood substitute.

4. Ogunbiyi et.al (2015) has made a comparative analysis of the strength of bamboo and reinforcement steel bars as structural members in building construction. High yield and mild steel bars of size 10mm, 12mm, 16mm, 20mm and 25mm are produced. Bamboo culms of size 10mm, 12mm, 16mm, 20mm and 25mm was made. Tensile test is conducted on all the three samples of various diameters. Based on the result obtained, we are concluding that bamboo has a very low tensile strength and undergoes brittle failure when load is applied due to low breaking force. It used inplace of partition walls, roofs other areas of light weight construction but it is not recommended for heavy engineering works

5. V. Ashwin et.al (2015) conducted an experimental investigation on deformations of bamboo reinforced concrete columns. The conventional steel column is prepared as per specification. The bamboo reinforced column is prepared by cutting the splints of bamboo culms as per specification. A thin coating of epoxy resin which is a water proofing chemical is applied on the splints to achieve good bonding. The compression and axial load tests are conducted on conventional steel column andthe bamboo reinforced column and the results are compared.

3. Methodology and Experimental study

These are method for doing this experimental study. We are first collected the resources, the collection of composite material that means sand, cement, aggregate and water in grade of M-20 his ratio is (1:1.5:3) and mix the 0.1 % of bamboo fiber. Now sieve the all composite material and specific gravity test on coarse and fine aggregate, and mix the all material is dry form then fill the cubes and start tamping and doing tamping in a three layers. casting of cube and cylinder with normal mix design and design mix. Now startthe compression test after initial test 7 days, 14 days and 28 days of curing. All days of compressive test is calculated. Now compare the results of normal mix design with design mix. Concluding the above results and verifying the usage of bamboo as fiber inconcert design. Providing a theoretical report of the project with the Tabulation of the results.

Fig 4: compressive testing machine.

Fig 5: concrete block casting.

Fig 6. Failure of cube during strength testing in CPM.

3.1 MATERIALS:

The used materials are natural bamboo fiber, natural coarse aggregates, fine aggregate, cement, sand, are used in composition of 1 cement, 1.5 sand, 3 aggregate.

3.2 MIX DESIGN:

The bamboo reinforced concrete CUBE with 15cm x 15cm x 15cm was used in this study. The fiber content is used as variation for each specimen. The variations of fiber contentare 100gr/volumes and 110gr/volumes. The reinforcement ratio for the test specimens are created equal 1%, and the aggregate composition is 1 cement; 1.5 sand; 3 aggregate. The control test objects made without the addition of fiber, with the composition of cement: sand: aggregate are 1: 1.5: 3 and 1% bamboo reinforcement ratio. The length of fibers may vary from 1 to 2 in. (25 to 500 mm). Because natural fibers are naturally available materials, they are not uniform in diameter and length. The diameter is varied from 0.004 to 0.03 in.

3.3 CASTING, CURING, AND TESTING:

Mechanical properties of the concrete mixes were tested at 7, 14, 28 days. For each mix, six cubes of 15cm x 15cm x 15cm in size, 24 cubes where cast and compacted by vibrating machine. The specimens were kept in laboratory ambient temperature for 24 hours. After 24 hours, the specimens were placed in water in water for 28 days curing. In intervals of 7, 14 and 28 days strength of cubes were tested by compacting machine.

3.4 XRD (X-RAY DIFFRACTION) TEST:

“X-ray diffraction, frequently abbreviated as XRD, is a non-destructive test method used to analysis the structural of crystalline materials. XRD analysis, by way of the study of the crystal structure, is used to identify the crystalline phases present in amaterial and there by reveal chemical composition information.”

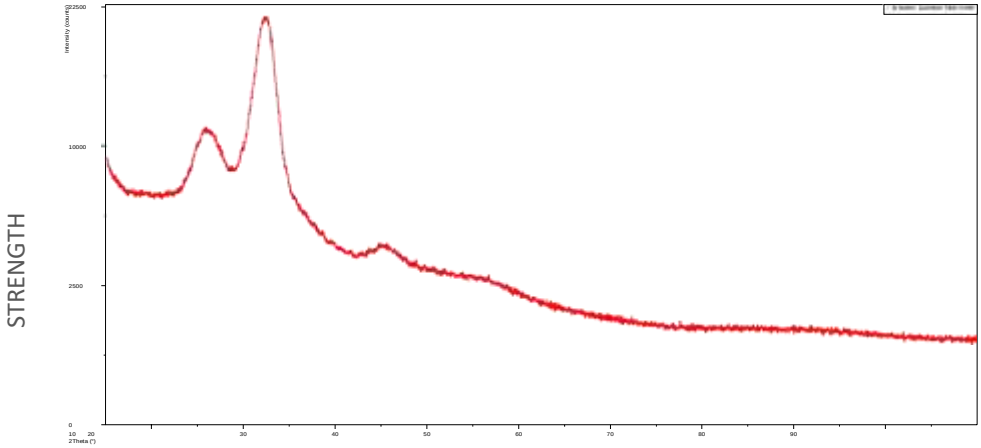
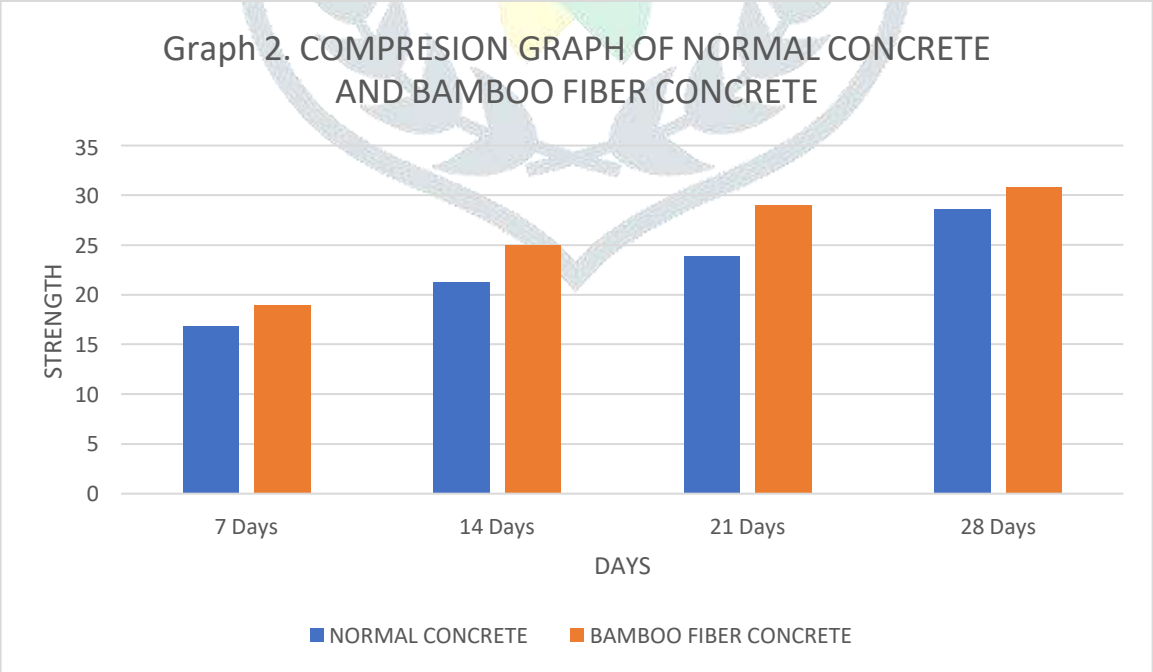


Fig 7: XRD graph for concrete using bamboo fiber as reinforcement

4. RESULT

TABLE 3. ordinary concrete compressive strength (n/mm^2).

s/no.	*name*	*Strength (n/mm^2)*			
		7 days	*14 days*	*21 days*	*28 days*
01.	*Ordinary concrete*	*16.856*	*21.264*	*23.897*	*28.589*



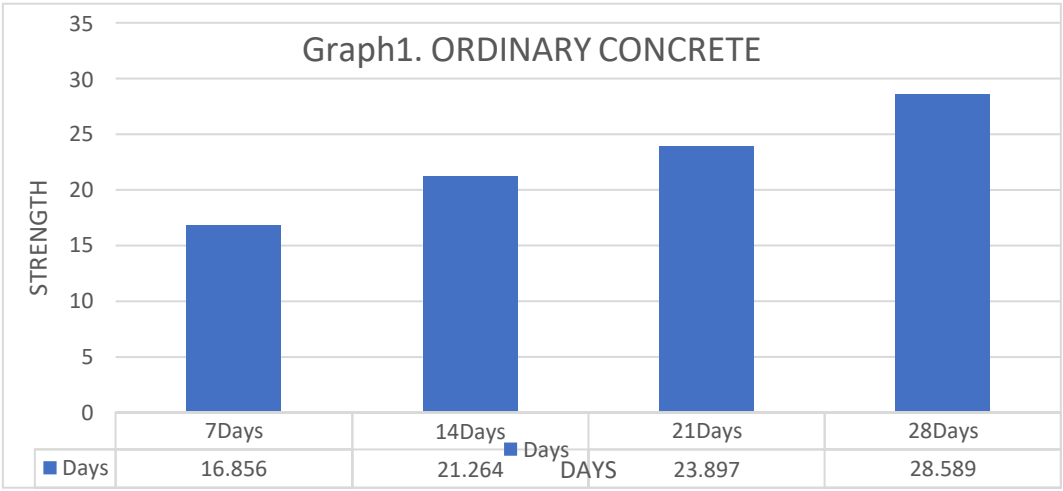


TABLE 4. Bamboo Fiber Concrete Compressive Strength (N/mm^2).

S.NO	*FIBER*	*STRENGTH(N/mm^2)*			
		7 Days	*14 Days*	*21 Days*	*28 Days*
01.	*Bamboo Fiber*	*18.963*	*24.936*	*28.986*	*30.786*

TABLE 5. Chemical Fiber Concrete Compressive Strength (N/mm^2).

S.NO.	*FIBER*	*STRENGTH(N/mm^2)*			
		7Days	*14DAYS*	*21Days*	*28Days*
01.	*Chemical Fiber(Poly propylene)*	*18.886*	*23.555*	*26.258*	*29.564*

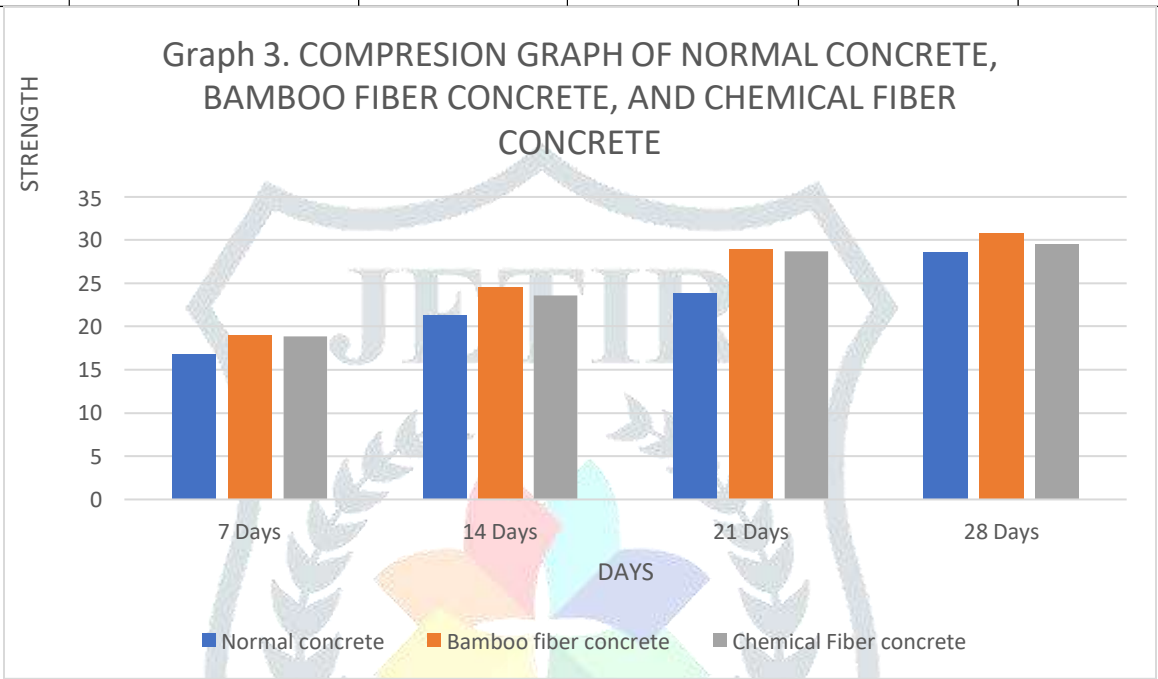
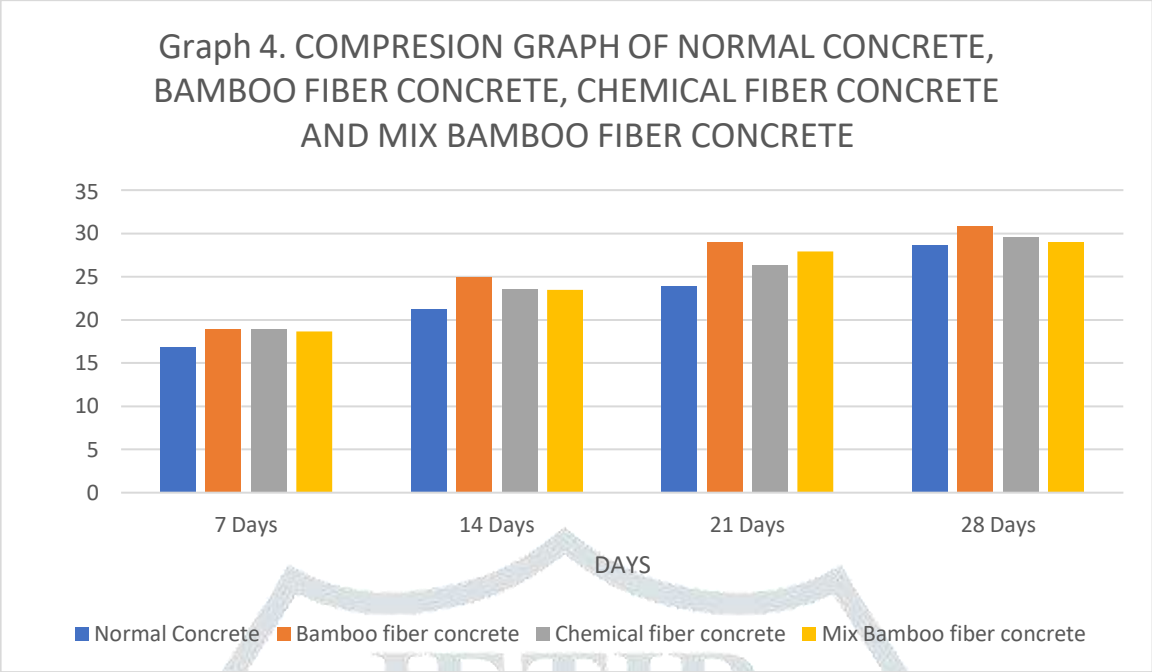


TABLE 6. Mix Type Bamboo Fiber Compressive Strength(N/mm^2).

S.NO.	*FIBER*	*STRENGTH(N/mm^2)*			
		7Days	*14Days*	*21Days*	*28Days*
01.	*Mix Type Bamboo Fiber*	*18.666*	*23.423*	*27.885*	*28.985*



NOTE:

From the above all type of graph we can clearly see that bamboo fiber is better than other fiberwhich have been used.

5. CONCLUSION

The utilization of bamboo in composite material provide usefullsolution for new developmwnt in the material industries. Bamboo trees are renewable sources that grow quikly and mature in a very short period of time. Therefore, there is a confermedcountinious supply of bamboo fibers with low production cost compare with other convensional fibers. furthermore, the compressive properties of bamboo fibers are very good, and they can replace convensional glass in reinforcing polymer matrices. However, different factors and properties affect the performance of bamboo composite.

- Bamboo Fiber showed good potential and increased strength.
- The fibers acts as a crack resistor, hence bears more load as compared to the conventionalconcrete, with reduced crack-width and deflection of concrete
- Workability decreases with the increase in the length and percentage of the bamboo fiberabove 1.5%.
- Flexural strength and Modulus of elasticity increased as compared to conventionalconcrete.
- Flexural strength of maximum of 1.80 times and a minimum of 1.20 times to thatunreinforced cube and prism specimens observed in 28 days strength .

REFERENCES

- [1] Balagur PN, Shah SP. “Fiber reinforced cement composites”. Civil EngineeringSeries. McGraw-Hill; 1992.
- [2] Reinhardt HW, Naaman AE. “High performance fiber reinforced cementcomposites”. Mainz (Germany): Third International RILEM Workshop; 1999.
- [3] Bentur A, Mindess S. “Fibre reinforced cementitious composites”. ModernConcrete Technology Series. Taylor & Francis; 2007.
- [4] Bazant Z, Planas J. “Fracture and size effect in concrete and other quasi brittlematerials”. Boston, New York, Washington: CRC Press; 1997.
- [5] Bindu M, Dr. Narendra B.K, Manjunatha J.K “Bamboo Fiber Reinforced Concrete - A Review” International Journal of Science Technology and Management, Volume5, Issue - 6: June 2016, Page No. 189-193.

- [6] Dr. Shakeel Ahmad "Mechanical Properties of Bamboo Fibre Reinforced Concrete" 2nd International Conference on Research in Science, Engineering and Technology (ICRSET' 2014), March 21-22, 2014 Dubai (UAE).
- [7] Yukseloglu, SM, Yoney, H, "Bamboo fibre reinforced composite structures and their mechanical properties", TekstilveKonfeksiyon, 2009, 19, 4, Page 261-264.
- [8] Sanjeev Gill "To Experimental Study and Use of Bamboo in Civil Structure as Reinforced Concrete" International Journal of Latest Research in Science and Technology Volume 5, Issue2: March-April 2016, Page No. 102-105.
- [9] Kavitha S and T Felix Kala "Effectiveness of Bamboo Fiber as a Strength Enhancer in concrete" International Journal of Earth Sciences and Engineering, Volume 09, No. 03, June 2016, Page. 192-196.
- [10] Sri MurniDewi, "The Use of bamboo Fiber in Reinforced concrete Beam to Reduce Crack" Green Construction and Engineering Education for Sustainable Future, page- 020003-1–020003-8.
- [11] R. S. P. Coutts "Autoclaved Bamboo Pulp Fibre Reinforced" Cement and Concrete Composites Volume 17, Issue 2, 1995, Pages 99-106.
- [12] Humberto C. Lima Jr. Æ Fabio L. Willrich Æ "Durability analysis of bamboo as concrete reinforcement" Materials and Structures (2008) 41: page 981- 989.