"Study Feasibility of Preservative chemicals & its effect on Load Carrying Capacity of Bamboo"

Mr. Anand Chavan[1], Dr. A.C. Attar[2]

[1] Student of M.Tech. Civil- Construction and Management, [2]Professor Rajarambapu Institute of Technology, Rajaramnagar, Islampur.

Email: - 27maitra@gmail.com[1], acattar@rediffmail.com[2]

Abstract

Bamboo is a natural material of organic origin. Bamboo can be destroyed by fungi and insects in a relatively short period of time. Without any protective treatment its durability is less than five years. Therefore, it is necessary to protect and preserve the bamboo culms when good quality and durability are required. The presence of starch makes it more attractive to microorganisms. Biological degradation can affect the usage, strength, utility and value of the bamboo & bamboo product leading to a) decay and disintegration b) splits or cracks c) unsightly stains and blotches. Preservation Treatment is absolutely necessary when bamboo is used as a structural member where safety is of major concern. Increasing life by treatment is more economical in the long run.

Keywords

Degradation of Bamboo, Durability of Bamboo, Physical properties of Bamboo, Preservative Chemicals, Preservation of Bamboo.

1. General

Steel, cement, glass, aluminium, plastics, bricks, etc. are energy-intensive materials, commonly used for building construction. Extensive use of these materials can drain the energy resources and adversely affect the environment and increases cost of material, Other hand it is difficult to meet the increasing demand for buildings .So it is necessary to study alternative material for construction of buildings which are locally available, economical, energy efficient & traditional (like soil, straw bale, bamboo etc.). Hence, there is a need for optimum utilization of available energy resources and raw materials to produce simple, energy efficient, environment friendly and sustainable building alternatives and technique use to satisfy the increasing demand for buildings. Bamboo is naturally available green & eco-friendly material. Bamboo requires less energy for production as compared to material like steel plastic etc. Bamboo acquires maturity in 4 to 5 years & having highest growth rate up to 90 cm/day .It contributes in reduction of greenhouse effect. Bamboo is best alternative for steel, cement, glass, aluminum, plastic & bricks, which issued as main component of modern construction system & helpful for low cost housing system. *(Figure 1 Decaying of Bamboo)*

2. Bamboo Preservation treatment

Various treatment processes like water leaching, application of paint coating, brushing, swabbing, spraying, dipping, smoking, baking, etc. are practiced for the protection of bamboo. Water leaching and baking result in partial removal of starch which attracts insects.

Fig. 1 Decaying of Bamboo

The other treatments do not impart much toxicity because of poor penetration and retention of chemicals. Leaching, Smoking and lime washing are age-old treatment methods. Sometimes protection is also given by use of natural dyes.

From all this various treatment processes, dipping process is used for the treatment of bamboo by considering parameters like availability of space and equipment, labour, facility etc. In this dipping process, chemicals are used such as boric acid, copper sulphate and sodium die-chromate are mixed with water in suitable proportion (Proportion – Sodium dichromate – 400gm, Copper Sulphate – 300gm, Boric Acid – 150gm). This chemical mixture is filled in tank. Chemicals are thoroughly mixed in the tank. After mixing, bamboo is drilled by 4 mm ø bit near knot portion. For insertion of chemical within bamboo, drilling is done near each knot of bamboo & same on alternate position on other side. Drilling is avoided over knot because knot is a portion of bamboo where bamboo has more load carrying capacity & strength.

Drilled bamboo inserted in that chemical tank and is covered with black paper. After 7 days, treated bamboo removed from tank. Now this treated bamboo was dried in sun protected shades about 5-7 days. *(Figure 2 Bamboo Preservation by Dip Diffusion Method)*

Fig.2 Bamboo Preservation by Dip Diffusion Method

3. Physical Properties of Bamboo

3.1 General

Mechanical properties are very important for using any material in construction and design. Mechanical properties of bamboo were determined by conducting the following tests,

(1) Tensile strength test, (2) Modulus of Elasticity (3) Compressive strength test (4) Pull-out test, (5) Shear test and (6) Water absorption test.

In above mentioned test we conducted Compressive test on Bamboo For this test we use total three types of Bamboo specimens. One specimen type is withought preservation treatment, second specimen type is with treatment with chemicals & third one is specimen treated with chemicals before seven years. There test results are as follows.

3.2 Compressive Strength Test

Aim: To determine Compressive strength of bamboo

Procedure: The culms of 152mm length are cut for compressive test. Three different types of specimens are selected for the test. The first type of specimens contains central node, second type contains end node and third type

without nodes. The dimensions of samples are measured and samples were placed in compressive testing machine. The load is applied parallel to fibers of bamboo in gradual increments until the sample failure. From the ultimate load, compressive strength is determined. From the ultimate load, compressive strength is determined before and after bamboo treatment. *(Fig. 3 Bamboo sample at the time of testing)*

Without node **Central node** **End node**

Fig. 3 Bamboo sample at the time of testing

3.2.1Observation Table

Table No.1 (Before bamboo treatment)

Sr. No.	Type of sample	Sample No.	Diameter of sample (mm)	Area (mm^2)	Load in N	Strength (N/mm^2)	Avg. strength (N/mm^2)
1.	**Without node**	1A	40	1256.63	42900	34.138	37.86
		1B	39	1194.59	43000	35.995	
		1C	35	962.11	41800	43.446	
2.	**Central node**	2A	40	1256.63	42700	33.979	38.00
		2B	39	1194.59	39500	33.065	
		2C	35	962.11	45100	46.876	
3.	**End node**	3A	40	1256.63	40000	31.831	29.24
		3B	39	1194.59	30000	25.113	
		3C	35	962.11	29600	30.765	

Calculation

The maximum compressive strength (N/mm^2) shall be determined as follows:

Maximum compressive strength = F_{ult} / A

Where, F_{ult} = Maximum load in N

A = Area of sample in mm^2

Behavior of bamboo sample is observed as shown in fig. 1.

Table No. 2 (After bamboo treatment)

Sr. No.	Type of sample	Sample No.	Diameter of sample (mm)	Area (mm^2)	Load in N	Strength (N/mm^2)	Avg. strength (N/mm^2)
1.	Without node	1A	40	1256.63	55650	44.285	46.349
		1B	39	1194.59	50500	42.274	
		1C	35	962.11	50500	52.488	
2.	Central node	2A	40	1256.63	58600	46.632	49.322
		2B	39	1194.59	55000	46.041	
		2C	35	962.11	53200	55.295	
3.	End node	3A	40	1256.63	51300	40.823	44.576
		3B	39	1194.59	53000	44.366	
		3C	35	962.11	46700	48.540	

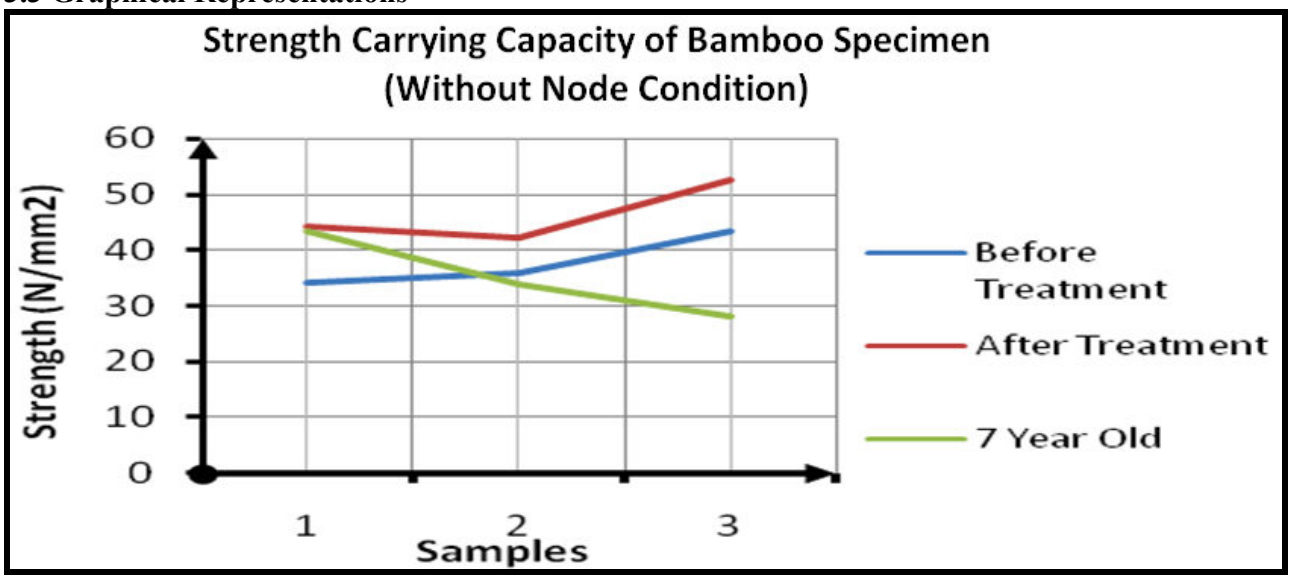
Table No. 3 (7 year old Bamboo specimens of Bamboo house, Hubalwadi, Tal Walwa,District - Sangli)

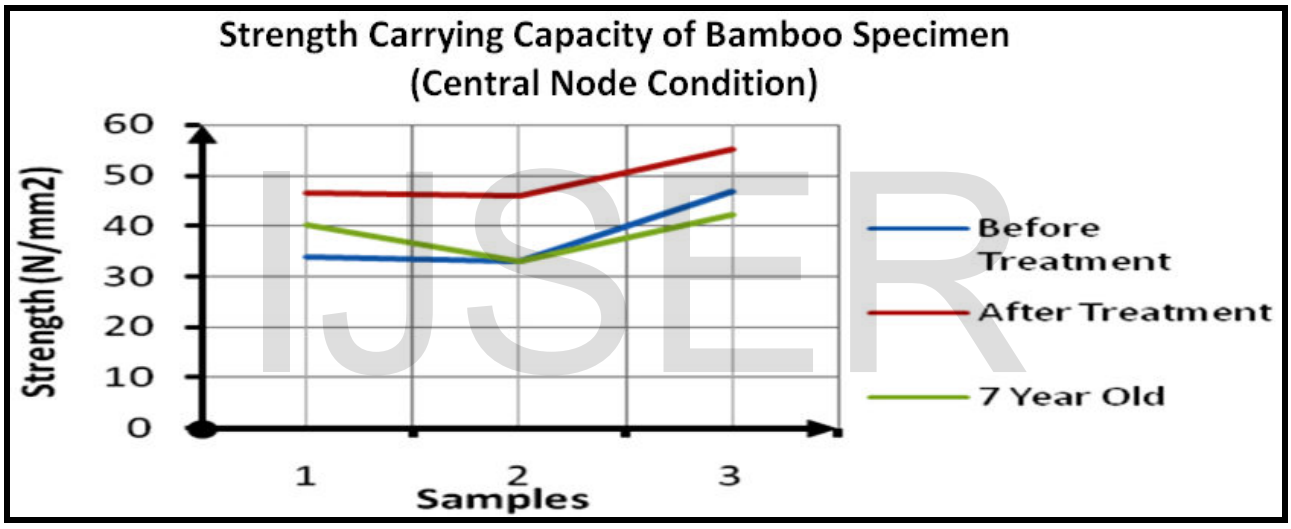
Sr. No.	Type of sample	Sample No.	Diameter of sample (mm)	Area (mm^2)	Load in N	Strength (N/mm^2)	Avg. strength (N/mm^2)
1.	**Without node**	1A	36	1017.87	41000	43.227	35.034
		1B	34	907.92	30000	33.813	
		1C	35	962.11	40700	28.063	
2.	**Central node**	2A	36	1017.87	44000	40.280	38.541
		2B	34	907.92	30700	33.042	
		2C	35	962.11	27000	42.302	
3.	**End node**	3A	36	1017.87	41000	40.280	32.430
		3B	34	907.92	26000	28.636	
		3C	35	962.11	27300	28.375	

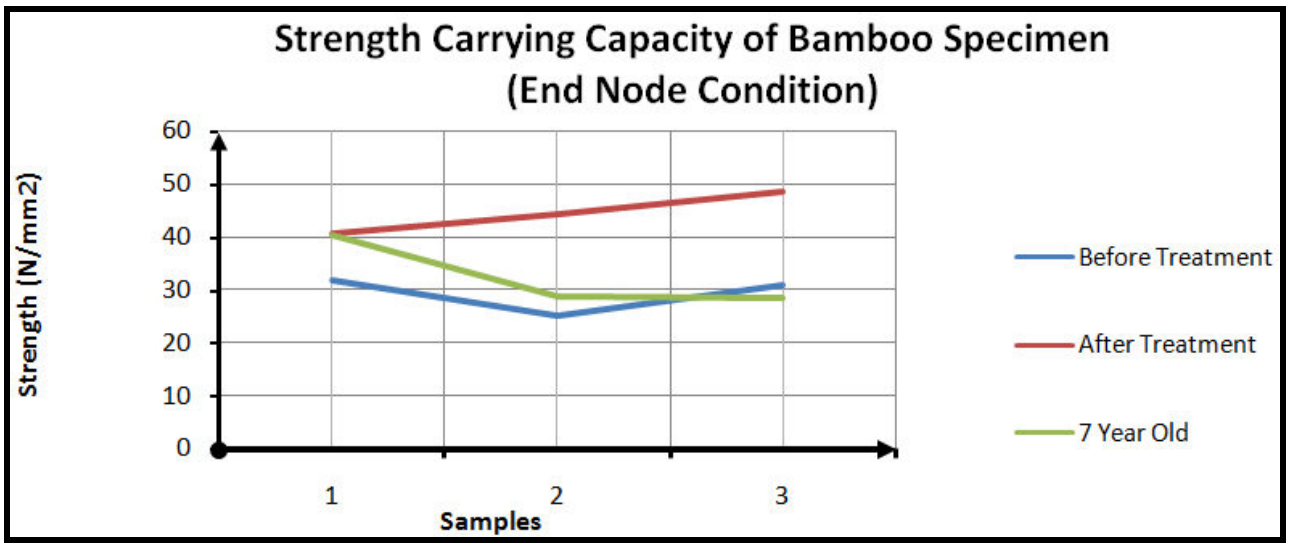
Conclusion

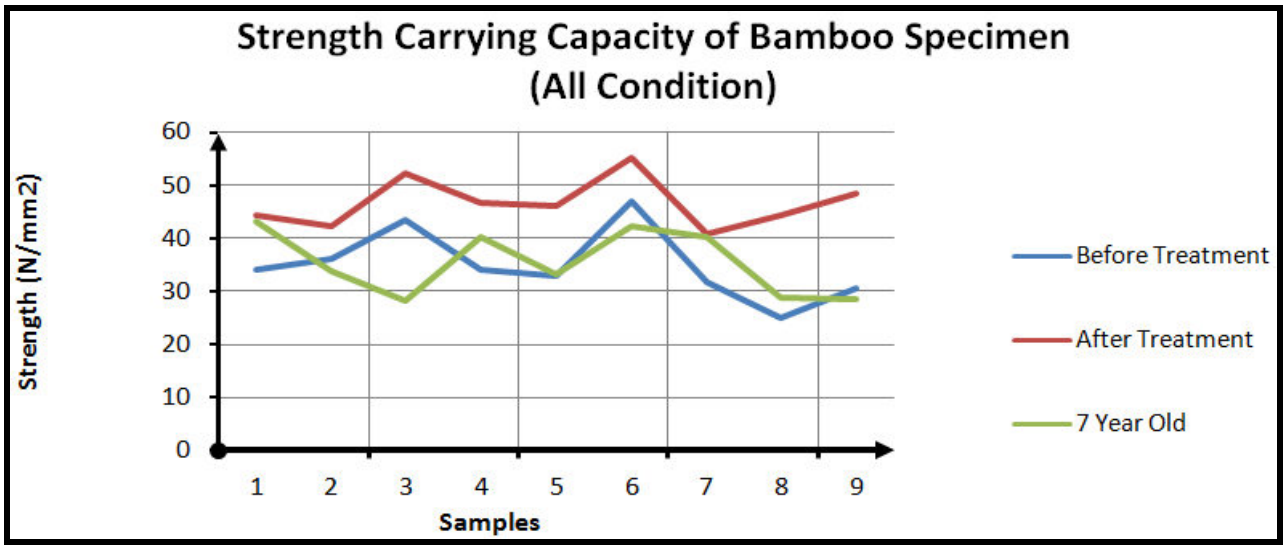
1. The stress values obtained for central node is greater than that of an end node and without node samples.
2. The stress values obtained before Bamboo treatment is less than that of an after Bamboo treatment.
3. The stress values obtained of Bamboo Specimen after 7 year is somewhat similar to stress value obtained before treatment Bamboo Specimen.

3.3 Graphical Representations









4 Conclusion

This paper highlights on research carried out for finding physical behavior of Bamboo when treated with preservative chemicals. The chemical composition of bamboo is similar to that of wood. It contains about 2-6% starch, 2% deoxidized saccharide, 2-4% fat, 0.8-6% protein, cellulose, carbohydrates and lignin. The carbohydrate content of bamboo plays an important role in its durability and service life. Durability of bamboo against mold, fungal and borers attack is strongly associated with its chemical composition. The presence of large amounts of starch makes bamboo highly susceptible to attack by staining fungi and powder-post beetles. Therefore if we preserve this inner portion of bamboo against fungi, microorganism by applying poisonous chemical preservatives we avoid weakening & decaying inner as well as outer body portion of Bamboo, Then this can directly affect on physical & Mechanical properties of Bamboo. From our experimental data we find that load carrying capacity of Bamboo increase after chemical preservative treatment.

5. References

1. An experiment with a locally constructed boucherie treatment plant in Nepal, by - Nripal Adhikary. Co-director, ABARI (Adobe & Bamboo Research Institute), Kathmandu, Nepal.
2. Affordable bamboo housing in earthquake prone area. An International workshop organized by - Cane & Bamboo Technology Center (CBTC), Government of Mizoram. International Network for Bamboo & Rattan.
3. International Workshop cum Exhibition on Emerging Housing Technology journal, Nov. 24-25, 2008
4. Bamboo: Modern Suburbia by - June Tran
5. Wonder Grass journal by - Wonder Grass Initiative Pvt. Ltd., NSRCL, Indian Institute of Management, Bangalore – 560076.
6. Bamboo Preservation Techniques : A Review by – Mr. Satish Kumar,Mr. K. S. Shukla, Mr. Tndra Dev,Mr. P.B. Dobriyal.
7. International Network for Bamboo and Rattan & Indian Council of Forestry Research Education. Published jointly by INBAR and ICFRE 1994.
8. An experiment with a locally constructed boucherie treatment plant in Nepal, by - Nripal Adhikary. Co-director, ABARI (Adobe & Bamboo Research Institute), Kathmandu, Nepal.
9. Physical & Chemical & Mechnical Properties of Bamboo & its utilization potential for fiberboard manufacturing by Xiaobo Li