

## **Bamboo as a Building Material**

**Suchampa Bagchi,**

*Assistant Professor,  
Department of Civil Engineering. JSRREC*

**R Rashmi Mano,**

*Assistant Professor,  
Department of Civil Engineering. JSRREC*

**N Thangam,**

*Assistant Professor,  
Department of Civil Engineering. JSRREC*

**Abstract:** This paper presents a review on use of bamboo as a building material. Bamboos belongs to grass family poaceae. It is a woody species form tropical regions and includes giant bamboos. In this present world, many researches are going on to replace the standard building concrete material. Bamboo has high compressive and tensile strength as compared to normal building material. Bamboo is cheap as compared to other construction materials which makes it easy for the low income group people to access it. Bamboo is one of the worlds fastest growing grass. This paper presents the various research done using bamboo as a building material.

**Keywords:** Bamboo, Compressive strength, fire resistance, Tensile strength

### **1. Introduction**

In present world scenario with increase in the number of population, there is a need of advancement in every sector. Resources are being used at a faster rate, therefore it is very important to find the alternative solution to those resources. In construction various researches are going on to replace the standard building concrete material. Various tests are conducted to reuse construction waste in new construction in addition to other industrial by products and admixtures.

One of the material which can be used in construction is bamboo. Bamboo belongs to the family of grass. It has high compressive as well as tensile strength as compared to concrete and steel. It is cheaper than concrete. Hence suitable for low income groups. If used properly in building construction

### **2. Properties of Bamboo**

The various properties of bamboo which makes it suitable for building material. Purpose of bamboo differs with its age. Less than 30 days bamboo is used for eating, age between six to nine months it is used for making baskets. when the age of bamboo is more than three years it is suitable for use in construction. Beyond six years of age the bamboo gradually loses its strength as it grows old. Because of the excellent properties of bamboo it is a good alternative for steel, concrete and masonry.

Bamboo is able to resist more tension than compression. The bamboo fibres run axially and has a higher tensile strength than steel but using bamboos, construction of connections which can transfer this tensile strength is not possible. Bigger tubes has less compressive strength than slimmer ones. Shrinkage properties of bamboo is not as good as wood, bamboo shrinks more than wood. Therefore when used in construction appropriate measures should be taken to prevent water loss from bamboo. It has very good fire resistance due to the presence of silicate acid. Bamboo scaffolding are used in greater scale due to its high strength and resilience. Bamboo can be used in foundation also but it has to be treated in prior.

### **3. Experimental Investigations**

**Ghavami (1995)** has discussed the mechanical properties of bamboo when used in concrete. Many studies were conducted and the results showed that the load carrying capacity of concrete reinforced with bamboo increases by 400% as compared to un reinforced concrete but the bonding was weaker as compared to bonding between steel and concrete. The compressive strength of bamboo is much lower than its tensile strength. Its strength is high along the direction of fibres whereas it had low strength transverse to the fibres.

**The United States Naval Civil Engineering Laboratory(2000)** provides set of instruction on methods and way of using bamboo in construction for variety of structural elements. Study showed that green and unseasoned bamboo should not be used for construction. Bamboo should be properly coated with water repellent coating before using it for construction. The mix design used for conventional concrete can be used for concrete reinforced with bamboo. Bamboo is an alternative to light and low cost construction.

**Amada S, Y. Ichikawa, T. Munekata, Y. Nagase, and H. Shimizu.(1997)** investigated the various physical and mechanical properties of bamboo. Investigations were conducted on the bamboo and its nodes. The advantages of bamboo were compared with the conventional building material given bamboo is cost effective and naturally available.

**Lo TY, Cui HZ and Leung HC** investigated the mechanical and physical properties of bamboo in detail. They found that the properties of bamboo varies with their types, diameter, age, length and moisture content present in the bamboo.

**Masani, N.J, Dhamani, B.C., Sing, B** studied the ways of utilization of bamboo in construction and listed some proper ways of using bamboo in construction with examples with respect to its cost, mechanical, physical and environmental properties. The study suggested the various precautions to be taken like water proofing of bamboo, pressure treating, concrete design etc while using bamboo in building construction. The study showed that when bamboo is used as a reinforcement in concrete as a replacement of steel, its area of reinforcement should be 5 times the area when steel reinforcement is used. Study also revealed that even when in the presence of fine crack in bamboo reinforces concrete, the load carrying capacity of the member does not reduce. The disadvantages mentioned in the study is the attack of bamboo by insects, fungi etc and that the dry bamboo is not fire resistant.

**Amada and Unta** investigated the fracture properties of bamboo and stated that the tensile property of the bamboo is almost same as that of the steel. The main finding was that the fracture property of bamboo depends upon the origin of the fracture and that the fibers present in the nodes has no contribution to resistance to fracture.

International Network for Bamboo and Rattan (INBAR) presented study on the comparison of bamboo to other plants regarding how fast it grows and its uses in the present world. A tree takes several years to replace while the bamboo takes only days. A single bamboo can spread 15km in its lifetime. Bamboo belongs to grass family and spreading over a wide area. Research was conducted with the aim to determine how effectively bamboo can be used a building and engineering material.

International Standard Organization (ISO) provided a study and standards on bamboo structure based on their performance and on limit state design. The two limit states were split into ultimate limit state which is related to the failure of the structure and serviceability limit state. Indian standard concerns about the serviceability, resistance and durability of the structure. If bamboo is used as a composite material then it may require additional considerations beyond the general specifications by Indian standard organization.

#### **4. Bamboo as a Building Material**

Basic needs of human being involve, food, clothing and shelter. In the present scenario the cost of living is increasing day by day. Shelter is an important basic need of human being. Conventional concrete is a costly affair and is difficult for the low income group to afford. We need cost effective housing and the best example is bamboo.

- Fastest-growing natural building material.
- Easily available & Eco friendly.
- An alternative for steel, concrete and masonry.
- Cost effective and easy to work.
- Bendable, gives desired shape.
- Elastic in nature therefore makes useful where there is high risk of earthquakes.
- Locally available material to some areas.

## **5. Advantages and Disadvantages of Bamboo**

### **Advantages**

1. It is light in weight and Environmental friendly.
2. It is very cheap and easily available.
3. It is easy to cultivate and produce in the farm.
4. It is a strong and versatile material.
5. It is easily Accessible to the poor.
6. It grows fast.
7. It is highly productive.

### **Disadvantages**

1. Bamboo requires preserving otherwise it will lose its strength
2. It is shaped by nature
3. Bamboo needs coating as it is attacked by fungi, insects etc.
4. Even with high strength its joints are always weak.
5. It needs advanced guidance with detailed study and codes.
6. They are not fire resistant.

## **7. Conclusions**

The literatures collected from the various investigation carried out suggests that bamboo is good as a building material given its high strength and less cost. The disadvantages of bamboo can be eliminated if precautions are taken. Before using it as a structural material it is essential to carry out tests on the particular bamboo species to find out its properties as the bamboo type differs from place to place and hence properties of different bamboo are different from place to place. Bamboo is comparatively cheaper than the conventional concrete and hence it can be effectively used by low income group.

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