

Importance of Bamboo in Building Construction

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Abstract - Bamboo is a renewable and versatile resource, characterized by high strength and low weight, and is easily worked using simple tools. It is widely recognized as one of the most important non-timber forest resources due to the high socio-economic benefits from bamboo based products. Bamboo is the world's fastest growing woody plant. Bamboo grows three times faster than most other species. Housing is one of the priority items and sensing the current shortage of the dwelling units, the present administrative leaders around the world find tough to hit upon a solution for. Apart from the other substances already in practice, bamboo appears to be the most promising material. Bamboo building construction is characterized by a structural frame approach similar to that applied in traditional timber frame design and construction. In this case, the floor, the wall, the roof elements are all interconnected and often one dependent on the other for overall stability. The use of bamboo for foundation is rather restricted. This is mainly due to the fact that like timber when in contact with damp ground, they deteriorate and decay very quickly unless treated with some very effective preservatives. The most extensive use of bamboo in construction is for the walls and partitions. The major elements, the posts and beams, generally constitute part or structural framework. The roof offers protection against extremes of weather including rain, sun and wind, and to provide shelter, clear and usable space beneath the canopy. Above all it must be strong enough to resist the considerable forces generated by wind and roof coverings. In this respect, 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.

Key Words: Bamboo, Renewable, Environment, Cost-Effective, Economical, Building Material

1. INTRODUCTION

Bamboo is a traditional building material throughout the world's tropical and sub-tropical regions. Bamboo is a renewable and versatile resource, with high strength and low weight. That's why it is widely used in different forms of construction, particularly for housing in rural areas. It can also be used to make traps, cages, tools, weapons, bridges, rafts, towers, fences, water wheels, irrigation pipe, and thousands of other items. It is widely recognized as one of the most important non-timber forest resources due to the high socioeconomic benefits from bamboo based products. It is estimated that there are 1200 species of bamboo. Most of them grow in Asia, Africa and Latin America.

The world's fastest growing woody grass is Bamboo. It grows approximately 7.5 to 40cm a day, with world record being 1.2m in 24 hours in Japan. Bamboo grows three times faster than most other species. Species of bamboo which are commercially used usually mature in four or five years time, after which multiple harvests are possible every second year, for up to 120 years in some species and indefinitely in others. Bamboo is also good in biomass production. It is often introduced into the banks or streams or in other vulnerable areas, for rapid control of soil erosion; one bamboo plants closely matted roots can bind up to six cubic metre of soil.

2. WHY BAMBOO IS USED AS A BUILDING MATERIAL?

Housing is a basic need for human being, and is now becoming a burden for low and medium income group. Thus, we need cost effective housing and bamboo is the best building material, result for that as:

- 1.1 It is fastest-growing renewable natural building material.
- 1.2 The material is easily available & Eco friendly.
- 1.3 Bamboo is a viable (if not better!) alternative for steel, concrete and masonry as an independent building material.
- 1.4 It is cost effective and easy to work.
- 1.5 It can be easily bend, give desired shape and can provide joints to suit the construction.
- 1.6 Its enormous elasticity makes it a very useful building material in areas with very high risks of earthquakes.
- 1.7 Local available material to some areas, which tries to carry the local tradition & vernacular Architecture of that place.

3. MAIN PROPERTIES OF BAMBOO

As discussed before that Bamboo is a viable alternative for steel, concrete and masonry, it is so because of its properties which are clearly mention below.

3.1 TENSILE STRENGTH

Bamboo is able to resist more tension than compression. The fibers of bamboo run axially are of highly elastic vascular bundle that has a high tensile strength. The tensile

strength of these fibers is higher than that of steel, but it's not possible to construct connections that can transfer this tensile strength. Slimmer tubes are superior in this aspect too. Inside the silicate outer skin, axial parallel elastically fibers with a tensile strength up to 400 N/mm² can be found. As a comparison, extremely strong wood fibers can resist a tension up to 50 N/mm².

3.2 COMPRESSIVE STRENGTH

Compared to the bigger tubes, slimmer ones have got, in relation to their cross-section, a higher compressive strength value. The slimmer tubes possess better material properties due to the fact that bigger tubes have got a minor part of the outer skin, which is very resistant in tension. The portion of lignin inside the culms affects compressive strength, whereas the high portion of cellulose influences the buckling and the tensile strength as it represents the building substance of the bamboo fibers.

3.3 ELASTIC MODULUS

The accumulation of highly strong fibers in the outer parts of the tube wall also work positive in connection with the elastic modulus like it does for the tension, shear and bending strength. The higher the elastic modulus, the higher is the quality of the bamboo. Enormous elasticity makes it a very useful building material in areas with very high risks of earthquakes.

3.4 SHRINKAGE

Bamboo shrinks more than wood when it loses water. The canes can tear apart at the nodes. Bamboo shrinks in a cross section of 10-16 % and a wall thickness of 15-17 %. Therefore it is necessary to take necessary measures to prevent water loss when used as a building material.

3.6 FIRE RESISTANCE

The fire resistance is very good because of the high content of silicate acid. Filled up with water, it can stand a temperature of 400° C while the water cooks inside.

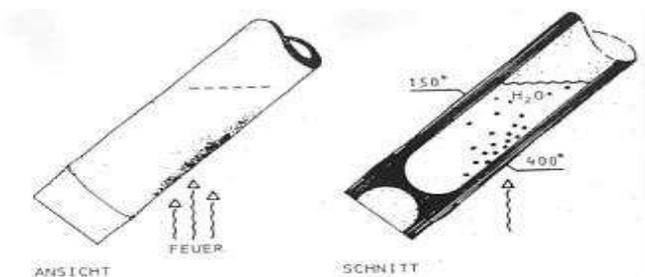


Fig 1: Fire resistance of bamboo cane when filled with water

4. BAMBOO AS A BUILDING MATERIAL

Bamboo is a versatile material because of its high strength-to weight ratio, easy workability and availability. Bamboo needs to be chemically treated due to their low natural durability. It can be used in different ways for roof structure as purlins, rafters and reapers, for flooring, doors and windows, walling, ceiling, man-hole covers etc.

4.1 Bamboo Trusses

The bamboo has strength comparable to that of Teak and Sal. A frame is made using bamboo rafters, purlins etc for fixing the roof.



Fig 2: Bamboo truss

4.2 Bamboo Roofs Skeleton

It consists of bamboo truss or rafters over which solid bamboo purlins are laid and lashed to the rafter by means of G.I. wire. A mesh of halved bamboo is made and is lashed to the purlins to cover the roof.



Fig 3: Bamboo roofing

4.3 Bamboo walling/ceiling

As the bamboo material is light in weight it is beneficial for earthquake prone areas as its chances of falling are very less due to flexibility and even if it falls it can be re-erected easily with less human and property loss with least efforts and minimum cost. Bamboo walls can be constructed in different ways like

Whole stem halved or strips of bamboo can be nailed to one or both the sides of the bamboo frame.

Split bamboo mats can be fastened to the bamboo posts or mats can be woven, mud can also be applied to both sides of such mats.

Bamboo strips nailed to bamboo frame or posts for interior walling.

Cement or lime plastering can be done on the mud covering for better appearance and hygiene. It has been found that the bamboo in the vertical position is more durable than in horizontal direction. For partition walls only single layer of bamboo strips are used.



Fig 4: Bamboo wall

4.4 Bamboo Doors and Windows

Bamboo frames can replace timber frames appropriate to function. Bamboo mat shutters fixed to bamboo frame which is hinged with wall can be used as door. Small bamboo frame hinged to the top in the wall can serve as windows.

4.5 Bamboo Flooring

Bamboo can be used material due to its better wear and tear resistance resilience properties. Whole culms act and the floor covering is done using bamboo boards, mats etc by means of wire to the frame.



Fig 5: Bamboo flooring

4.6 Reed Boards

Reed boards are made by reed at high temperatures. These reed boards elements like flooring, walls, ceiling and can also be used for partitions, doors, windows.

4.7 Scaffolding

Bamboo poles lashed together have been used as scaffolding in high rise structures due to their strength and resilience. The timber planks can be replaced with bamboo culms and these can be lashed to the vertical culms.



Fig 6: Scaffolding

4.8 Foundations

For use as foundation, the bamboo poles are directly driven into the however, be pre-treated for protection from rot and fungi. This prolongs the life of the foundation beyond that of an untreated bamboo pole.



Fig 7: Bamboo Foundations

5. ADVANTAGES & DISADVANTAGES OF BAMBOO.

5.1 ADVANTAGES OF BAMBOO:

The various advantages of bamboo are as follows:

1. It is Light, strong and versatile.
2. It is Environment friendly.
3. Easily Accessible to the poor.
4. Self renewing resource of nature.
5. Speedily growing
6. Highly productive.
7. Low Cost Material

5.2 DISADVANTAGES OF BAMBOO

The major disadvantages of bamboo are as follows:

1. It requires preservation.
2. Shaped by nature
3. Durability- bamboo is subjected to attack by fungi, insects; for this reason, untreated bamboo structures are viewed as temporary with an expected life of not more than 5 years.
4. Jointing- although many jointing techniques exist, their structural efficiency is low.
5. Lack of design guidance and codes.
6. Prone to catch fire very fast by the friction among the culms during wind, and is seen to cause forest fires.

6. CONCLUSIONS

Bamboo is used for a wide range of day-to-day purposes, both as a woody material and as food. It has been the backbone of much of the world's rural life and will remain so as the population increases. Bamboo will continue to play an important part in the development and the transformation of rural environments, in all regions of the developing world where it grows.

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