

Bamboo as a Building Material

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Abstract—Bamboo has established itself in sustainable and traditional building material group since ages. It is the largest members of the grass ancestry and one of the fastest-growing in the world. In fact, there are species which can grow up to a height of 4 feet in 24 hours, example certain species in Japan. Bamboos are notable economic and cultural significance in South Asia, Southeast Asia and East Asia, being used for building materials, as a food source, and as a versatile raw product. Bamboo has a higher compressive strength than wood, brick or concrete and for a matter of fact it possess a tensile strength that rivals with steel. Being renewable, environment friendly and wide availability, rapid growth, adaptability to most climatic conditions and properties, bamboo is emerging as a very sustainable alternative in construction field of Green Development. It can be a substitute of steel in reinforcing of concrete in low volume road it replace steel hence road surface can be constructed like rigid pavement. It is found that life span of bamboo reinforced surface is more than unpaved road and less than rigid pavement reinforced with steel. This article deals with why and how bamboo can be used as a sustainable material, alternative to steel, an iconic disaster structure builder and its pros and cons. Bamboo could turn the world's construction trade on its head

1. INTRODUCTION

Bamboo is a primitive material used for construction of core structures and supplementary elements in a building most common to world's tropic and sub tropic regions. Bamboo is a renewable and versatile resource, with high strength and low weight which made its presence felt widely in different forms of construction particularly rural and sustainable housing. It is also used for making traps, cages, tools, weapons, bridges, rafts, towers, water wheels, irrigation pipes and millions other. There are near 1200 species of bamboo, mostly in Asia, Africa and Latin America. Species of bamboo which are commercially used usually mature in four to five year time, after which multiple harvests are possible every second year for up to 120 years in some species. Bamboo is also good in biomass production. It is often introduced into banks or streams or contours for rapid control of soil erosion.

2. WHY TO USE BAMBOO AS A SUSTAINABLE BUILDING MATERIAL?

Housing is a primary need of humans and as a construction material it has been associated with the cultures of South Asia, East Asia and the South Pacific, to some extent in Central and

South America, notably the 'nipa huts' are the typical example of the most basic sort of housing where bamboo is used; the walls are split and woven bamboo, and bamboo slats and poles may be used as its support.



TYPICAL NIPA HUT

It is fastest growing renewable natural building material and is easily available and eco-friendly which is viable alternative for steel, concrete and masonry as an independent building material. It is can be easily bend, give desired shape and can proved joints to suit the construction fairly used in parts of the world where its presence dominates.

Its awareness needs to be raised as bamboo is not just an aesthetic element as in Japanese architecture, or a symbol of some culture and art but in today's modern world it stands profoundly as a green, sustainable and disaster relief shelter material. Structures at time of disaster can be easily raised using bamboo from simple tents to an architect designed shelter in very less time. It has capacity to again raise a calamity demolished settlement in a short span so that normal life can be continued without a long break.



BAMBOO FALSE CEILING

2.1 MAIN PROPERTIES OF BAMBOO

1. Age Factor: Bamboo is useful for different purposes at different ages. It acts as an eatable when less than thirty days old, from six to nine months it is used to weave baskets, two to three years bamboo boards and laminations can be obtained, three to six years old it is used as a construction material and after six years it loses its strength and cannot be used.
2. Tensile Strength: It can resist more tension than compression with its axial fibres forming a high elastic and vascular bundle which is higher than that of steel.
3. Compressive Strength: smaller the diameter of cross section of bamboo greater will be its compressive strength.
4. Anisotropic Properties: There are cellulose fibres in the longitudinal direction which makes it strong and stiff, this is also related to its soft and brittleness when bamboo's diameter raises it becomes weak.
5. Shrinkage: It shrinks enormously when it subjects to water loss, hence measures have to keep in mind while using it as a building material.

2.2 BAMBOO AS A SUSTAINABLE BUILDING MATERIAL

Bamboo's versatility has made it very popular worldwide in various forms, from furniture to musical instruments; facades of building to interiors of a structure; acting as a supporting element in a building to being a core material in a building.

Bamboo is used in various components of building like trusses for roof, roof skeleton, wall and ceiling (core and artificial), door-window frames, flooring, boards, scaffolding (common in Asia) etc.

2.3 Eco Huts, Dhanolti, Uttarakhand, India



ECO HUT, DHANOLTI-VIEW

Dhanolti is 24km from the popular hill station of Mussooire where stands Eco Huts. These are bamboo structures maintained by Dhanloti Eco Tourism and Eco Development Committee at an altitude of 2,286m. Tourists often come to

hill stations to get closer and sleep in the lap of nature, these are the cottages built for one such reason and are must watch bamboo structures which are standing in a place with heavy snowfall.



ECO HUT, DHANOLTI-VIEW

These cottages have solid base and are covered with two feet aluminium sheets on outer sides. Bamboos has been used irresistibly with the surroundings as a core construction material maintaining the natural grace of contours and forest around. Walls, floor, roof parapet of the small veranda in front is all been gripped with solar panels on the roof making the structure sustainable, only the attached toilets are masonry based.



RESTURANT: BAMBOO CONCRETE BLEND

There is also a restaurant made from fine blending of bamboo with concrete, yet the roof is complete bamboo based with ribbed interior ceiling.



RESTAURANT CEILING

Bamboo based furniture is placed.



FURNITURE AT ECO HUT

3. BAMBOO AS AN ALTERNATIVE TO STEEL REINFORCEMENT

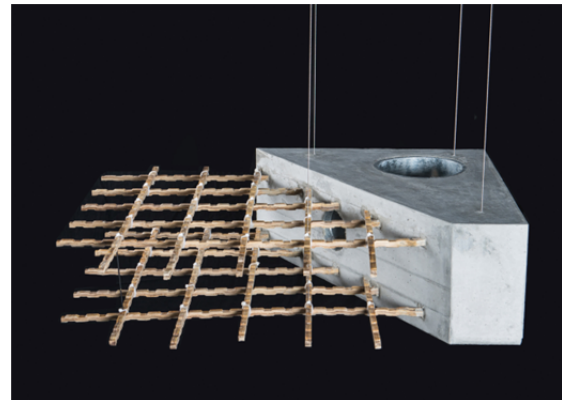
Developing countries have the highest demand for steel-reinforced concrete, but often do not have the means to produce steel to meet that demand and put them on mercy of a global market dominated by developed countries and to counter this bamboo is being witnessed as an ideal replacement with its potentials. In trials of tensile strength bamboo out performs most other materials including steel. It achieves high strength even after being hollow.



BAMBOO REINFORCEMENT IN A TEMPORARY STRUCTURE

Due to its incredibly rapid plant growth cycle and raise in construction field would increase its cultivation hence large quantities of CO₂ will be absorbed hence less effect on climate.

The high availability of modern design methods and engineering data of the mechanical properties of structural bamboo, architects and engineers needs to be encouraged to make design consideration keeping in mind bamboo as a building material.

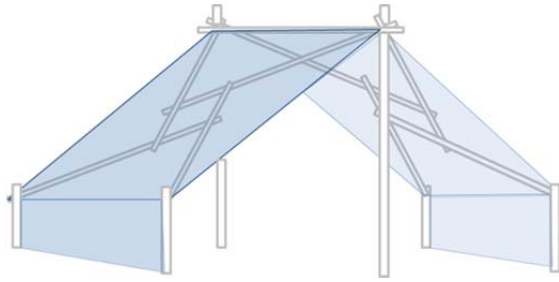


BAMBOO REINFORCED FOOTPATH: DEMONSTRATION

Construction and design of footpaths in India using steel is definitely costly, hence to enhance economy and buildability if we replace steel with bamboo we can have good riding quality road with low cost.

4. BAMBOO AS DISASTER RELIEF MATERIAL

In 2004 Indian Ocean tsunami Andman Islands were devastated, at that time about 4,000 prefabricated bamboo houses provided a quick and effective way to give shelter to thousands made homeless by the disaster.



TYPICAL BAMBOO DISASTER RELIEF STRUCTURE

Dubbed the "fastest-growing plant on earth", bamboo provides structures that are durable, cost-efficient and easy to construct and transport and could revolutionise the provision of shelter for millions of people displaced by natural disasters and conflict, manufacturers say.

Due to plant's strength and flexibility, bamboo houses can withstand earthquakes of up to 6 on Richter scale and if a building collapse it will cause minimal injury due to its light weight and elastic properties unlike concrete structures.



EASY KNOTTING OF JOINTS FOR POST-DISASTER SHELTER

Natural disasters such as cyclones, earthquakes, floods as well as civil war one of the biggest challenges is providing shelter which are durable, cost effective and easy to construct and transport: BAMBOO fits the criteria, hence bamboo as a construction material has a role to play in post-disaster rehabilitation

Not only in India, bamboo is well known for earthquakes resistant and landslide-proof housing widely used in Latin

America, and more recently in China for rebuilding after the Sichuan's earthquake. Looking at its properties and wide range of uses, this plant has a far more potential to benefit livelihoods in conflict and disaster- but today is not yet well-known or specified as a material of choice for a number of useful applications

5. ADVANTAGES OF BAMBOO

- Light weighted, strong and versatile.
- Environment friendly.
- Fast growth and high productivity.
- Low cost material.

6. DISADVANTAGES OF BAMBOO

- Requires preservation.
- Low durability.
- Lack of design guidance and codes.

7. CONCLUSION

We all know bamboo as a decorative element in a building in various forms but now is a core material in many types of structures like resorts and schools. Apart from the houses constructed in the Andamans after the tsunami, some were also built in Kashmir after 2005 earthquake. The Indian army also uses around 50 igloo shelter made from bamboo and jute in Siachen glacier and in Sikkim. It has acted as backbone of rural areas and will remain one with increase in population and wide range of crisis, thus needs to be a defined part of our modern field.

We need to be exposed to various uses of bamboo, with timber getting scarce bamboo being accepted will create new paths to counter not only in field on construction but eco system and promote economic development.

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