Earthquakes in various parts of India, especially North and North Eastern parts, the Kedarnath disaster in Uttarakhand and the frequent floods in the rivers across northeastern and southern most parts of India have really set the alarm bells ringing.

The estimated loss is in billions of US dollars. Over more than 500,000 houses have been destroyed completely and more than 110,000 partially. Scientists think that these natural disasters are Earth’s way of responding to anthropogenic pressures and cannot be avoided. However, the loss of money and material can be reduced by using environmentally sound practices in building and construction of residential and commercial buildings. There is an effort to study and explore novel materials for the construction industry.

The construction industry today is under severe pressure to use ecofriendly and low-energy consuming materials in buildings. The Indian Green Building Council (IGBC) recommends the use of alternative materials that are cheap and environmentally sound and sustainable for construction purposes.

Bamboo has been suggested as an important substitute for cement and steel. The use of bamboo wood in construction of houses dates back to ancient times as it was freely and readily available all across in a tropical country like India and could easily be planted and harvested. India is the second largest producer of this important genetic resource. Species diversity of this particular plant is also very high in India. It is roughly estimated that 130 species belonging to 20 genera are found in the tropical forests of India. Thirteen percent of the total forest area is under bamboo cultivation.

Bamboos are evergreen, woody grasses that have a long life span. They are also referred to as ‘green-gold’ or ‘giant grasses’ and are put to a number of uses. Bamboos are important natural resources found in forest as well as non-forest areas in the country. They show enormous diversity.

The key attribute important for making it an excellent material for the construction industry is culm/stem morphology and anatomy. Many ancient buildings built with bamboo still survive in many parts of South East Asia (China, Japan, Indonesia, Thailand, Bhutan, Burma, and Nepal) and in India as well.

Some of the common species that have been studied for their wood anatomy are Bambusa bambos, Bambusa tulda, Dendrocalamus brandisii, Dendrocalamus hamiltonii, Dendrocalamus longispathus and Dendrocalamus strictus.

However, the pattern of growth, the depositions in wood, cellulose and fibre amount vary from plant to plant. Agroclimatic conditions and edaphic factors of the region where the plants grow also affect the various properties and attributes of the wood.

Bamboos are the fastest growing plants in the world. Certain species grow up to three feet within a span of 24 hours. Some bamboo plants in the tropical forests are about 30 meter tall and 35 centimeters in diameter. Bamboo stems (culms) emerge from the rhizomes and many culms grow simultaneously. Bamboo flowering takes place rarely but it is profuse. Many hypotheses have been proposed to reveal the science behind this unique behavior.

“A man is born in a bamboo cradle and goes away in a bamboo coffin. Everything in between is possible with bamboo!”

AMIT MOZA AND MONIKA KOUL

Short Feature

Bamboo Green Gold

Bamboo houses can be safe in earthquake-prone areas
Bamboo has long been used as scaffolding material. In ancient India, China and many Islands off the Indian coast bamboo has primarily been used as a supplemental and/or decorative element in buildings such as fencing, fountains, poles and gates. Bamboo can be grown in a particular way by using wires and wood panels so that less work is required to be done. Huts and small houses constructed by local inhabitants used bamboo as pillars, to lay down the foundations, flooring and ceilings. This is due to the high availability of the material in the areas where these grow incurring low cost to the consumers.

Bamboo is considered to be the most effective wood species and sought after material in terms of carbon sequestration capacities. Bamboo can be an integral part of CDM (Clean Development Mechanism) projects and can help in mitigating the negative aspects of global warming hence complying with the essence of the Kyoto Protocol.

The inputs required for mass cultivation of bamboo for construction material in terms of chemical fertilizers are also minimal. Besides, the rhizome system spreads across the rhizosphere and increases the water catchment area in the adjacent zones thus helping in conservation of this important natural resource as well.

The principal characteristic features that make bamboo a potential building material are its high tensile strength and very good weight to strength ratio. The material is easy to work on with machines and tools and is used for laying foundations of huts, houses and cottages in coastal areas that are flood prone. The strength-to-weight ratio of bamboo supports its use as a highly resilient material against forces created by high velocity winds and earthquakes. The light weight of bamboo also helps it resist the tremor and earthquake after-shocks. The material is also a good conductor of heat and electricity so other eventualities associated with the disasters are minimal.

Because of its varied uses and applications in building construction bamboo has been established as an environment-friendly, energy-efficient and cost-effective construction material. Some specific properties of Bamboo that make it an excellent material for construction of doors, window frames, floorings and decorative ceilings are:

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific gravity</td>
<td>0.575 to 0.655</td>
</tr>
<tr>
<td>Average weight</td>
<td>0.625 kg/m</td>
</tr>
<tr>
<td>Modulus of rupture</td>
<td>610 to 1600 kg/cm²</td>
</tr>
<tr>
<td>Modulus of Elasticity</td>
<td>1.5 to 2.0 x105 kg/cm²</td>
</tr>
<tr>
<td>Ultimate compressive stress</td>
<td>794 to 864 kg/cm²</td>
</tr>
<tr>
<td>Safe working stress in compression</td>
<td>105 kg/cm²</td>
</tr>
<tr>
<td>Safe working stress in tension</td>
<td>160 to 350 kg/cm²</td>
</tr>
<tr>
<td>Safe working stress in shear</td>
<td>115 to 180 kg/cm²</td>
</tr>
<tr>
<td>Bond stress</td>
<td>5.6 kg/cm²</td>
</tr>
</tbody>
</table>

Studies carried out by many scientists reveal that despite bamboo becoming a favorite material for construction of green buildings there are associated constraints in the utilization of bamboo. Bamboo culm has a short life span as it absorbs a lot of moisture that leads to infestation by fungal pathogens and other organisms under storage conditions.

However, latest techniques by students of IIT-Delhi have resulted in increasing the life span of Bamboo plants. The use of varnishes and extracts from other plants has also been recommended to save these from insects. Scientific validation of water leaching and smoke treatment methods for bamboo would help in strengthening the confidence of the scientific community in traditional knowledge system of the rural people.

For enhancing the service life of bamboo, application of copperised neem oil at 2 bar pressure is considered an excellent eco-friendly alternative to harmful chemical preservatives. It has great potential for business entrepreneurship in rural housing and artisan sector. Through several technologies mat-based composites from bamboo have been developed like Bamboo Mat Board (BMB), Bamboo Mat Veneer Composite (BMVC) and Bamboo Mat Corrugated Sheets (BMCS).

The mat composites are manufactured by hot pressing the woven strips of bamboo. Thin bamboo strips, called “slivers”, of width 0.6 to 1.0 mm are manually woven into a mat of different sizes and patterns of which herringbone is the most common pattern in which the slivers are at an angle of 45° with respect to the edges of the mat.

Bamboo-reinforced beams, columns, and veneers are also being formed these days to help in construction. Casting of bamboo reinforced slabs and panels are the latest thing in business. Fibres isolated from other plant parts are also being used in casting of bamboo-reinforced slabs. Bamboo-reinforced wall beams are much stronger, more durable and resilient to floods than mud walls.

The Government of India is supporting several projects and initiatives to promote the cultivation of bamboo forests and conserve species that yield material for the construction industry. With new techniques taking shape and technology advancements in processing industry, many problems associated with bamboos have been tackled.

The National Bamboo Mission is also working hard to increase the production of bamboo and catalyse start-up industries to make bamboo panels and veneers to boost construction business. Investing in this material for construction purposes can solve several problems and also help in disaster management. As they say, “Earthquakes don’t kill but buildings do”.

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