



Bamboo as a sustainable material in the construction industry: An overview

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Abstract

India is the second-biggest producer of bamboo worldwide. The increased dependency on conventional construction materials is held responsible for the degradation of the environment and reduced wood resources, which has led to thought on using bamboo as a substitute for wood and steel. Bamboo is perceived as a sustainable, quickly developing, and crude economic material. The investigation endeavors to legitimize selecting bamboo as an appropriate material for efficient and judicious development and evaluating the literature on how it could be utilized in the construction industry. Bamboo as a composite material can be used for various interior and exterior purposes in buildings like foundation, flyovers, dwellings, multistory buildings, large span structures, and interiors of airports, recreational buildings.

Introduction

India supplies a large percentage to the total world's bamboo forest land. Approximately, 123 species in 23 genera are located in India. [12]. More than 39% of the entire region under Bamboo is out there within the North Eastern states, which is additionally the chief in availability of dense bamboos, in green

sound culms and number of green sound weight. Results show that green sound bamboos are obtained in most abundance in Arunachal Pradesh (26660 lakhs), then by Assam (20460 lakhs), Manipur (20350 lakhs) and Mizoram (19530 lakhs) [4]. Bamboo community lives nearby the plantations and conventionally depends on bamboo for their sustenance. Due to the climate difference across India, the species of bamboo and the building materials found in varied climatic zone are quite diverse. Hence, the conventional building systems and classification that has grown around some centuries in reaction to the available building materials and local climate are also quite diverse.

Since, in the North Eastern region, approachability is a huge issue, people construct with locally available materials to the greatest extent, like- Mizo houses, Adi Gallong houses, and Rieng houses which uses bamboo as the principal material for construction. These are classic houses on hills that are built on stilts made of bamboo and have woven mats of bamboo for walls. In Bihar, Bengal, and Orissa, houses built on the river planes with bamboo are found in rural and tribal areas. Reinforcement material in lime surki flat slabs were made out of bamboo, whereas mats of splits or flattened bamboo was used for the walls. Conventional dwelling houses in Central India, has walls that made out of broad bamboo mats layered with mud plaster with broad bamboos used for vertical support. The roof of these houses were made out of purlins of bamboo and layering of country tile or dried grass with wooden trusses. In the desert areas, bamboos are used as reinforcement in boundary walls, walls, and in the principal roof structures [9]. It is also used for walls in a wattle and daub system in South India, accompanied by compounded mud layering or plastering and pitched roofs in village areas whereas in cities, it was used mainly in roofs for both flat lime surki and pitched roofs.

Traditional materials are being reformed and treated to escalate their strength and durability and one such material is bamboo. In contest of this research, regarding how sustainable bamboo is as a construction material, it can be said that bamboo is a functional rated composite plant with a brief regenerative growth cycle which makes it a green material for construction.

Characteristics of bamboo alters due to the large-scale variety of genera families and species. It is a 'grass' that is hollow-stemmed, firm, woody, enduring, and perennial in nature. Due to a peculiar rhizome-dependent process, bamboos are one of the most rapid-growing plants and their growth is three-times more rapid than a number of other plant species. Some bamboo species could reach their final length of between 20 and 30 m high in a few weeks and with a growth-speed of 50 cm every day throughout the season while other species are ascertained to rise skyward as fast as 8 in. in a day. It belongs to the family of the true grass called 'Poaceae' and is actually the greatest family member of the Poaceae, with about 91 genera and greater than 1000 species. Bamboos are a sustainable and extremely adaptable resource with multipurpose uses, traditionally associated with Southeast Asia and South America region for finest suited cultivating environment.

As a construction material, bamboo has a solid fiber and its compressive strength is twice more in comparison with concrete and its tensile strength is almost equal to steel. Experimental studies have shown that the ultimate tensile strength of bamboo and mild steel varies between 140 N/mm^2 – 280 N/mm^2 [11]. Findings show that full-growth of bamboo during cultivation depends on the species and it obtains its hardwood like properties (i.e. hardness, strength, stability) as compared to the growing years of hardwood which takes (50–100) years to mature completely.

Even though the construction industry in recent years has known the potentials of bamboo in varied constructional works, the bigger question remains is how sustainable is the bamboo material? Bamboo is a really exceptional green building material. It is a sustainable material that requires very less energy to nurture, restrains soil erosion, supplies biofuel, extends wildlife refuge, and manufactures a wholesome food source for both humans and wildlife. It offers crucial restoration from the consequences of global climate change by producing oxygen a lot more than other species of plants and traps high quantities of CO_2 . The primary harvesting often takes 3 to 5 years, considerably quicker than wood forests which usually

want twenty-five years. It produces twelve times more green building material than wood and provides a great variety of functional commercial items for eco-friendly daily use along with shelter and transportation, thus, decreasing the rate of timber consumption. Additionally, bamboo roots help in restraining erosion as it creates barrier for water which the developed countries use as a defensive component for their agricultural crops and villages from washing constantly [14].

Maturity & purpose of bamboo

Bamboo is functional for various intentions at different stages:

Less than 30 days is fit for consumption

Between 6 and 9 months for weaving baskets

2 to 3 years for making ply boards or lamination

3 to 6 years for use in construction works

Greater than 6 years bamboo slowly lacks its strength up till 12 years old.