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BAMBOO- AN ECOFRIENDLY APPROACH IN INTERIOR DESIGN: A REVIEW

Id. SHAMBHAVI DIXIT
Assistant Professor
Department of Interior Design
College of Non-conventional Vocational Courses for Women,
Kolhapur **[MS] INDIA**

ABSTRACT

Today, sustainable interior isn't just a trend but an indoor style that has become a "revolution." The shortage of interior focus within the tactic of sustainable architectural development has created a niche between architects, interior designers, clients, or those wishing to live during a responsible construction environment. The diminishing wood resource and reduction in natural forests, particularly within the tropics, have focused world attention on the necessity to spot a substitute material that requires to be renewable, environment friendly and widely available. In sight of its rapid climb, a ready adaptability to most climate and properties, superior to most new fast growing wood, bamboo emerges as a really suitable alternative. This paper deals with a number of the most properties and therefore the major uses of bamboo and its culms in interiors. It focuses on various bamboo joineries utilized in bamboo furniture.

Keywords: *Sustainable interiors, Bamboo, Bamboo products, Techniques, Bamboo joinery, Interior Design.*

INTRODUCTION

Bamboo features an extended and well-established tradition as an artifact throughout the world's tropical and sub-tropical regions. It's widely used for several kinds of construction, especially for housing in rural areas. Bamboo could also be a renewable and versatile resource, characterized by high strength and low weight, and is certainly worked using simple tools. It's widely known together of the foremost important non-timber forest resources because of the high socio-economic benefits from bamboo based products. It's estimated that there are 1200 species growing in about 14.5 million hectares area. Most of them grow in Asia, Africa and Latin America. In past bamboo was used to build houses due to its natural strength and adaptability. Within the modern context the aesthetics of bamboo also plays an

important role. Sustainable, environmentally friendly use of materials is a crucial goal of many interior design and construction companies. Among the sustainable building materials that researchers have focused on bamboo which is known to be the foremost distinctive material in its role in architectural and interior design. Because of its high rate of growth and easy processing, bamboo could also be a promising renewable resource that would potentially replace slow growing hardwood. Bamboo's good mechanical Sustainable, environmentally friendly use of materials is a crucial goal of many interior design and construction companies. Among the sustainable building materials that researchers have focused on, bamboo is known to be the foremost distinctive material in its role in architectural and interior design. Because of its high rate of growth and easy processing, bamboo could also be a promising renewable resource that would potentially replace slow growing hardwood. Bamboo's good mechanical properties, low costs, abundant availability in developing countries, and potential use during a mess of applications show the potential of this versatile resource for income generation through commercialization of the resource. Moreover, thanks to its rapid growth and extensive root network, Bamboo as a plant could also be an honest carbon fixator, erosion controller, and water level preserver. From past, the image of bamboo is extremely familiar to the people of India in rural coastal areas. Few people think that the gentle bamboo dust is extremely durable and powerful to be utilized within the earth of architecture, construction, and particularly within the earth of furniture.

The bamboo plant is an eminent means to start out up reforestation, because the plant often features a positive effect on water level and soil improvement through the nutrients within the plant debris. Recently, bamboo has been hailed as a super-new material, which can be used for a spread of purposes from textiles to construction. Bamboo also has the facility to take in large amounts of CO2, the foremost important greenhouse gas, and help many poor people make money. Many people even call bamboo "wood of the 21st century". Today, in India, bamboo is used during a good selection of home items, becoming a neighbourhood of the load-bearing structure of home designs.

Objective:

1. This study would emphasize on the applications of bamboo materials to interior components, like ceilings, walls, floors. With superior features, bamboo deserves to be the material that has got to be incorporated into the design and outline future directions for sustainable development in India.

2. To review on bamboo joineries when used as an interior element.

Methods:

Step1. The concept of sustainable interior design and sustainable materials.

Step 2. Introduction bamboo materials.
Step 3. Characteristics and values of bamboo materials.
Step 4. Compare bamboo materials with wood.
Step 5. Applications of bamboo in interior design in Viet Nam.
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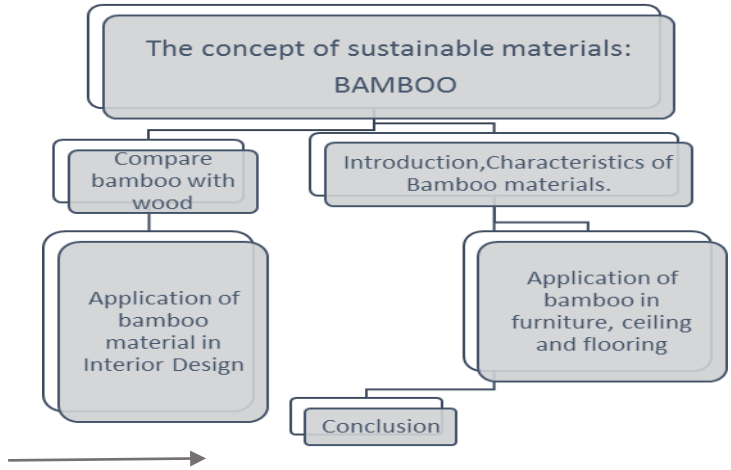
Step 4. Compare bamboo materials with wood.
Step 5. Applications of bamboo in interior design in India.



Step 1. The concept of sustainable interior design and sustainable materials:
Environmentally sustainable interior design (ESID):

Environment interior design and sustainability are sort of the more popular buzzwords that are bandied around over the past few years. As interior projects specialists are recognized that whilst sustainability is critical, it must be melded into a healthy and productive working environment. Sustainable interior design creates interior spaces using design principles, like functionality, accessibility, and aesthetics and expands the foremost target to include environmental considerations. As an example, sustainable design projects are influenced by such factors as planning efficient use of space, choosing materials with low environmental impacts, and reducing energy consumption, pollution, and waste. Sustainable interior designers are committed to finding ways to balance aesthetics and functionality with choices that reduce the environmental impact of their designs.

Sustainable materials:

Sustainable products are getting popular within the globe today and attract more interest than before. A sustainable product is one which protects the environment during its entire life. That is, from the moment the raw materials are extracted from the source to the time the last product residue is disposed of, there must be no permanent damage caused to the

environment. A sustainable material or a sustainable resource are some things whose production is supported indefinitely naturally , which suggests that the resource is employed up at an equivalent speed that it's renewed. Bamboo and wood are the sustainable resources when the trees are harvested at an equivalent rate as new trees are planted. The key to use this resource wisely selecting bamboo and wood from responsibly managed forests, substituting engineered wood and alternative materials where appropriate, reusing salvaged wood, and minimizing waste, therefore the method is caught up and provides the trees time to mature. Sustainable materials are something that you simply hear more and more when it involves buildings, your house and even smaller structures. As we are responsible for our planet, we'd wish to seem after it and use non-renewable fuel and materials. We cause much more harm than was previously thought. Nowadays, we are more inclined to settle on the sustainable route rather than one which can pump many CO2 into the atmosphere or use materials that are detrimental to the environment.

The Sustainability of Bamboo:

Earlier, the image of bamboo is extremely familiar to the people of India. Bamboo usage is abundantly within the village, an equivalent among people for wood. The gentle bamboo dust is so durable, so strong within the sector of construction. Due to its widespread availability in developing countries, bamboo offers many opportunities for sustainable development, especially in developing countries, including India, where this development is required most. Furthermore, bamboo can easily be processed manually or industrially, and features a low cost thanks to its abundant availability. Bamboo must be treated well before being put to use to limit insect infestation and increase bamboo life. The common practice among people within the past was to soak in mud ponds for 3-6 months. Additionally, bamboo features a waterproof layer, therefore the paint has many obstacles, but this has been overcome because of some special paint. Due to its superior properties, bamboo is a good solution to heat up the building, while ensuring aesthetics and increasing the worth of the building thanks to the local character of the material.

Introduction to bamboo material:

Bamboo material is a traditional material that's particularly good for construction in India as bamboo is a rich source of material and can be utilized in just five years. The traditional bamboo family is attached to Indian coastal architecture, from the downstream domain to the lowland. Bamboo is used as a housing and production tool. Today in rural India, we still see some houses made from rough materials like clay mixed with straw and bamboo leaves. Bamboo is related to the history and culture of the nation, bamboo goes alongside the childhood of each Indian person within the coastal areas, and when thinking of the applications of bamboo, we immediately consider fine arts and crafts. Beautiful visuals or tables and chairs, rustic bamboo houses. The species number of this group is extremely large,

and is taken into account to be the most important within the Ministry. Bamboo is additionally an angiosperm, but only blooms once at the top of life. Usually bamboo features a blooming time of about 5 - 60 years. Bamboo is attached to the lifetime of most of the people through the image of ancient bamboo villages that are related to memories of the many generations. For the old generation, it's hard to forget a rest within the bamboo hammock during the noon by coastal regions.

Characteristics of bamboo material:

Bamboo is one among the foremost important nature's substitute for the endangered rainforest hardwoods. It's a quick-growing, versatile, non-timber forest product whose rate of biomass generation is unsurpassed by the other plants. With a 10-30 % annual increase in biomass versus 2-5 you take care of trees, bamboo creates greater yields of staple to be used. It's utilized extensively for a good range of purposes. The strength of the culms, their straightness, smoothness, lightness combined with hardness and greater hollowness; the power and regularity with which they will be split; the various sizes, various lengths and thickness of their joints make them suitable for varied end products/purposes. The flexibility of bamboo outmatches most tree species. It's known to be a natural and excellent staple for manufacturing strong and durable furniture, handicrafts, and novelty items. Bamboo is extremely strong whilst remaining flexible meaning it's often used as an artifact and making of furniture. Due to its water resistant property, it's a perfect material for toilet and sanitary wares. Bamboo is also one of the fastest growing plants in the world with bamboo stems emerging from the ground in reaching their full height in a single growing season of around three to four months. This makes bamboo highly sustainable as once it has been cut down it grows back readily. Some of the characteristics of bamboo are listed below:

• An effective erosion control plant and natural control barrier due to its widespread root system and enormous canopy.
• Reduces runoff, prevents massive soil erosion.
• Keeps twice the amount of water within the watershed.
• Sustains riverbanks.
• Protects surrounding environment during typhoons due to its height.
• Regenerates and resilient even after strong typhoons.
• Helps mitigate pollution due to its high nitrogen consumption.
• Minimizes CO2 gases (sequesters up to 12 plenty of CO2 from the air per hectare) and
• Generates up to 35% more oxygen compared to other trees. Bamboo is a crucial component of development wherein all kinds of individuals have adequate access to. It requires little attention during its growing and production cycle and can occupy an equivalent niche as that of trees. It's compatible for agroforestry and healthy ecosystems. It requires only a modest capital investment to get a gentle income. Round the globe, tons of people and communities are hooked in to bamboo for his or her subsistence, shelter, and every-day utilities.

Bamboo is one of the most important nature's substitute for the endangered rainforest hardwoods. It is a quick-growing, versatile, non-timber forest product whose rate of biomass generation is unsurpassed by any other plants. With a 10-30 % annual increase in biomass versus 2-5 % for trees, bamboo creates greater yields of raw material for use. It is utilized extensively for a wide range of purposes. The strength of the culms, their straightness, smoothness, lightness combined with hardness and greater hollowness; the facility and regularity with which they can be split; the different sizes, various lengths and thickness of their joints make them suitable for numerous end products/purposes. The versatility of bamboo outmatches most tree species. It is known to be a natural and excellent raw material for manufacturing strong and sturdy furniture, handicrafts, and novelty items

Comparison of Bamboo with Wood:

The plant is capable of consuming CO2 at a better rate than most hardwood plants. It's also ready to produce more oxygen than most hardwood plants. The specialty of bamboo as an eco-friendly material is reinforced by the very fact that it's not a tree. Bamboo is a grass and hence, it is often renewed endlessly. Due to this reason, cutting it doesn't have an incredible impact on the environment. As a grass, bamboo doesn't have sapwood, heartwood, or growth rings. Its texture is uniform and can range from medium to fine counting on density. The colour is usually straw to almost white. Bamboo differs from wood because it features a hollow stem and lacks rays or visible pores. So as to process bamboo as a timber, the bamboo fibers are pulled, soaked then pressed alongside adhesives. However, as most bamboo is processed in its original country, the standards may vary. Hence, some manufactures may use cheap adhesives to process the bamboo, which can emit into the air and harm the owners. It's advisable to see the formaldehyde content of the fabric before acquiring. It's also slightly difficult to figure with bamboo, because it tends to separate and pull out when being cross-cut. Furthermore, bamboo is extremely high in silica which can cause dulling of blades and processing tools.

It takes a bamboo shoot only five years to reach in complete maturity. It's also renewable because it doesn't have to be planted again after harvesting. A replacement plant develops from the pre-existing remains of the shoot. Bamboo shoots take a mean of 60 days to get replaced, whereas hardwood trees like oak take nearly 60 years. Bamboo is stronger than oak and doesn't expand or shrink like wood obtained from most hardwood trees.

Bamboo lumber:

Bamboo lumber is pressed from bamboo strips which have already been well treated, including boiling, drying, gluing. Bamboo lumber are often milled for the building and projects as hardwood. Bamboo lumber is harder than most of wood due to its high density

750 kg / m3 in horizontal and vertical, 1200 kg / m3 in strand woven. Bamboo lumber is pressed with low VOC resin and 100% renewable resources - bamboo under high and heat. Bamboo lumber are often pressed in horizontal grain, vertical grain and strand woven. Horizontal or vertical is most utilized in the interiors and buildings. Strand woven is employed for outdoor building, like house, wall panels. Bamboo lumber in strand woven is cold pressed process, durable and consistent quality.

Bamboo lumber is employed across the planet in construction and is becoming increasingly more popular for building purposes thanks to its versatility, beauty, sustainability, flexibility and its incredible strength.

Bamboo lumber comes during a sort of dimensions and lengths. Colors include natural and caramel.

Length: 3000mm, 2400mm, 2000mm
Thickness: 16mm, 20mm, 32mm, 40mm, 42mm
Application of Bamboo in Interior Design in India:

1. **Use of bamboo as flooring:**

Use	Percent Consumption
Paper Pulp	35.0
Housing	20.0
Non-Residential	5.0
Rural uses	20.0
Fuel	8.5
Packing, including baskets	5.0
Transport	1.5
Furniture	1.0
Other wood industries	1.0
Others, including ladders etc.	3.0

One of the foremost antiquated and versatile uses of bamboo are within the sort of material used for flooring. The primary demand for flooring material is that it should be unaffected by environmental conditions such as expansion and contraction. Bamboo possesses all these properties. Even hardwood floors are prone to climate changes. Hence it is perfect for the construction of floors and home furnishing such as furniture and wall decor. Bamboo also had a tensile strength that is greater than that of steel. **This is the rationale why bamboo is employed to construct houses in earthquake-prone areas.** Bamboo floor is good for health too. Bamboo material doesn't produce heat or absorb heat so it's possible to make coolness in summer and warm in winter. Living with bamboo floor for while will help to scale back the danger of diseases, like arthritis, cardiovascular, etc. Bamboo floor also absorb the ultraviolet rays and radiation, alongside elegant pattern should be beneficial. For vision, minimize myopia. Besides, the elastic bamboo flooring combined with 8 layers of UV and 2 layers of aluminium oxide will reduce the slipperiness for the user,

especially good for elderly family and young children. Finally, using bamboo flooring will create lebensraum on the brink of nature, help to relax spirit, dispel all fatigue, tension. The price of bamboo floor is reasonable. Bamboo flooring is one among the natural flooring types, with natural beauty due to the random arrangement of unique and different bamboo eyes known for ordinary wood flooring. Many people think that bamboo flooring prices are expensive. However, the 5-year-old bamboo has given good quality to place into bamboo flooring, not only bamboo can reproduce quickly, so bamboo materials are abundant and available for production. **The price of bamboo flooring is cheaper than the natural wood flooring in the market.** Besides, bamboo flooring usually features a yin-yang style, so it's easy to repeat the bamboo flooring quickly during the day, saving time and money on installation.

2. **Bamboo used for the construction of bathrooms:**

Wood made up of bamboo shoots features a greater density and provides low conductivity of warmth combined with thermal insulation. Hence it's gained popularity in its usage in the construction of bathtubs in tropical countries. It's also great material for the development of toilet floors as its fibres prevent water from soaking in. Such bathrooms are quite relaxing because the light amber interiors give off an aura that's quite 'Zen'-like.

3. **Bamboo used as a furniture:**

Bamboo home furniture comes in various sorts of styles and finishes than before. Furniture designers prefer using bamboo in innovative designs, either in all-bamboo or composite materials. Bamboo furniture can withstand everyday use. It's much more immune to damage than traditional hardwoods. Bamboo is even utilized in cutting boards for this reason; it can take the beating of repeated knife use and still remain beautiful, and bamboo is gentler on knife blades than other woods. This comes in handy if you plan on giving a bamboo chair a deal of use. Lately, Bamboo furniture is undergoing a revolution. The country furniture of the sixties and seventies, made up of unmilled bamboo shoots and poles, remains available. There's also a replacement face to the present sort of furniture too. Milled, sanded, and finished bamboo furniture rivals any hardwood furniture in durability and wonder. Increase in the very fact that bamboo is one among the world's most environmentally-friendly resources to boost , harvest and use, and it's clear why bamboo has become one among the most well liked furniture and building materials in the market.

Research and development in making advanced bio-based furniture products around the world are able to produce continuous improvement in product innovation success. Initiatives to increase the use of bio-composite value highly praised and encouraged for these materials to reduce environmental impact, improve innovation and advanced technology in the manufacturing process. Besides the rustic furniture, it's more likely that you've been drawn to bamboo furniture by the newer, more finished bamboo furniture hitting the market. If that's the case, here are a few basics about building fine furniture with bamboo so you're well-informed when you hit the show floor.

- Colour: Furniture made from bamboo is available in two colours. The shade referred to as natural bamboo is akin to the light colour of maple. That's the colour of bamboo if it is manufactured into furniture without utilizing any techniques to alter its natural appearance. The other shade is carbonized bamboo. Carbonized bamboo is the result of a steaming process that brings out a darker, amber shade in the wood.

- Composition: The smooth, fine furniture look you're drawn to is accomplished by cutting the bamboo stalk (bamboo is actually a grass, not a tree, hence a stalk, not a trunk) into small, narrow sections and then gluing those pieces of wood together. Depending on which face is used, the end result is bamboo plywood or vertical grain bamboo panels. Panels are a little bit sturdier, though visually there is little difference between the two.

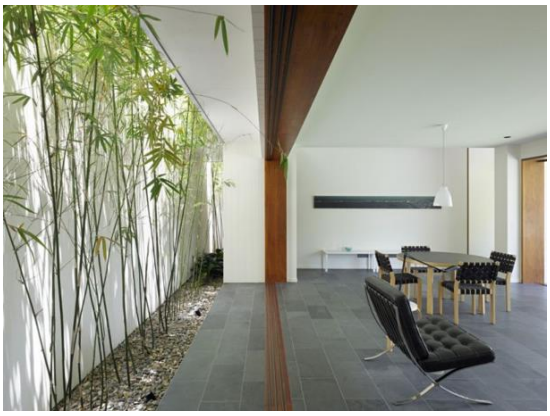
- **Using bamboo as decoration in the living room:**

There are a number of wall decoration ideas related to use of bamboo in living rooms. Most of these include wall inserts such as bamboo poles installed into a panel in the living room. These panels are then provided with LED lights which emanates a warm and welcoming glow. This bamboo-laced wall will give off a tropical yet modern oriental feel to the living space.

A simple yet elegant and minimalistic way to brighten any living space is to decorate it with potted bamboo plants. Bamboo takes very little sunlight to grow and looks extremely aesthetic in a muted living space. Chinese bamboo can also be used for this purpose since they are harbingers of good luck according to Chinese tradition. Using bamboo sofas and chairs as statement furniture is also another way to incorporate bamboo into the decor.

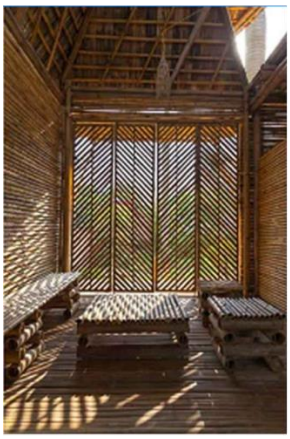
- **Use of bamboo in interior design as an indoor garden:**

Bamboo is a plant that requires little maintenance and hence, it might be possible to construct tiny bamboo gardens indoor. As discussed earlier, bamboo is extremely versatile. It absorbs more atmospheric carbon dioxide than most hardwood trees and emanates 30% more volume of oxygen. In order to facilitate better ventilation, it might be a good idea to construct and maintain such indoor bamboo gardens. Not to mention that bamboo trees definitely blend in with their surroundings and decor. Thus it is a really good option to use Bamboo in interior design.



- **Bamboo used as Home décor element in Interiors:**

Decorative panels and screens/blinds: Raw thick bamboo can be used for floor-to-ceiling as a unique divider between two rooms. For a moisture resistant and low maintenance panel, bamboo canes are embedded in a protective resin.

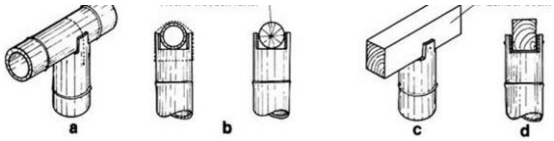



Vertical and horizontal blinds are used to protect sun rays directly falling inside the room. It is of very low maintenance and cost effective.

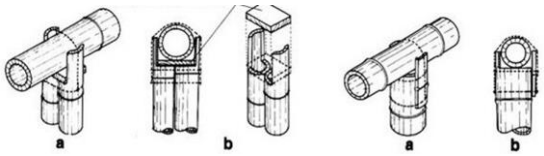

Bamboo Joineries:

Making good and aesthetically pleasing bamboo joints is rather complicated because bamboo is hollow, tapered, has nodes at varying distances, and it is not perfectly circular. It is important to keep all these constraints in mind when designing a bamboo joint. Although traditions, local practices and publications give some information on bamboo joinery, this information is far from complete as essential data is missing in most cases. Many traditional joinery techniques suffer from weakness or deformation, where the strength of the bamboo culm itself is lost. Only if the problem with bamboo joinery can be satisfactorily addressed, and simplified, we can expect to see much more bamboo in Western buildings, bridges and furniture. Types of bamboo joineries illustrations as follows:

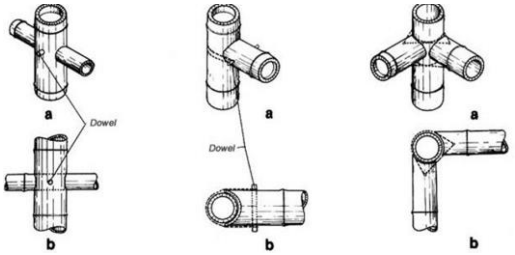
Joining horizontal with vertical elements



1.2. Joint with one or two ears is used to join bamboo rafters, logs or lumber.



1. Flap joint is used when there is no lashing wire available. The flap can be secured with bamboo strips.
2. Fish mouth joint.



a) Joint with double wooden wedge.
b) Joint with dowels and clamping fitters.
c) Cross joint with dowel.
d) Lateral joint with dowel.
e) Corner joint.

CONCLUSION:

Since industrialisation, bamboo has played an important role in the development of mankind. It's used for a wide range of day-to-day purposes, both as a building material and food. It has been the backbone of most of the world's rural life and will remain so because of the increase in population. Bamboo will still play an important part within the limits of enterprises and thus the transformation of rural environments, altogether regions of the developing world where it grows. On account of the enforcement of our natural forest protection project, wood is becoming increasingly scarce. The assumption that bamboo is that the foremost potentially important non-timber resource and fast-growing woody biomass, has evoked keen interest within the processing, preservation, utilization and thus the promotion of bamboo as an alternate to wood. The properties as top grade material and increased availability of bamboo in our country makes it possible to use, bamboo within the sector of construction extensively. Its high valued utilization not only promotes the economic development, but also saves forest resources to protect our ecological environment as a wood substitute. As an economic material, bamboo's rate of productivity and cycle of annual harvest outstrips the opposite naturally growing resource, if today you plant three or four structural bamboo plants, then in four or five years later you will have mature clumps, and in eight years you will have enough mature material to make a convenient, low cost house and interiors with eco-friendly furniture.

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