



Bamboo Chair Design by using Locally Available Bambusa Bambos, Integrating Traditional Craftsmanship with Contemporary Aesthetics in South Gujarat.

¹Mr. Ankitkumar Mukeshchandra Changawala

¹Assistant Professor

¹Department of Interior Design

¹Veer Narmad South Gujarat University, Surat, Gujarat, India.

Abstract: Bamboo has long been an integral part of South Gujarat's traditional craftsmanship, yet its potential for modern furniture design remains underutilised. South Gujarat has a rich history of bamboo craftsmanship. Kotwalia, a tribal community in South Gujarat, is solely dependent on the bamboo industry. Their work involves producing numerous household goods: baskets, containers, brooms, supadas, and other useful items. This study investigates the development of the Bambusa bambos chair, designed to promote awareness and skill development among bamboo craftsmen in the South Gujarat region. By leveraging locally available Bambusa bambos, this research highlights the material's durability, sustainability, economic viability and light weight in contemporary furniture production. These findings aim to integrate traditional craftsmanship with modern design, promoting a sustainable and eco-friendly future for furniture and products in South Gujarat.

Keywords: Bambusa bambos, Bamboo Chair, eco-friendly, sustainable furniture, bamboo, South Gujarat, traditional bamboo craftsmanship, contemporary aesthetics

1.0 Introduction:

1.1 Background:

Bamboo, belongs to the grass family Poaceae, is a versatile, fast-growing, and sustainable resource. There are over 1,500 species across the world and 136 species in India, extensively used in furniture, construction, paper, textiles, handicrafts, and biofuel industries. India is the second largest producer of Bamboo in the world after People's Republic of China. Bamboo has significant ecological and socio-economic importance, especially in countries like India, where it is closely linked to livelihoods and traditional practices. The South Gujarat region has a large patch of forest where a Kotwalia community, known for its traditional bamboo craftsmanship and contributing to local economies. Bambusa bambos and Dendrocalamus strictus are two major species grows naturally in the South Gujarat region. D. strictus is used to make containers, brooms, supadas and other useful items of household. Bambusa bambos is used as structural member—such as posts, trusses, and rafters etc. for bamboo houses & machans, as it is having well compressive, tensile, shear and anti-bacterial properties. The South Gujarat region, rich in Bambusa bambos, presents an opportunity to revitalize traditional bamboo industries by integrating contemporary furniture design, improved processing techniques, and skill development programs. Contemporary design frameworks often miss this embedded knowledge due to the lack of integration between the design institutions and the tribal artisans.

1.2 Scio-Economic and Environmental Aspects

Bamboo artisans of south Gujarat region dependent on bamboo-based enterprises. These craftsmen possess good knowledge of bamboo processing, working, tools & techniques. Their traditional knowledge of bamboo crafts makes them unique artisans but the demands of contemporary times are different. The unfavorable ratio of traditional products to present demands affects their economy, which, in turn, results in the migration of artisans. Today, the demand for household products and furniture traditionally made of wood necessitates finding alternatives to wood to mitigate the effects of global warming. Bamboo is the fastest-growing natural resource with excellent structural and mechanical properties that make it a viable wood replacement. It may also support a circular economy; increase employment for rural artisans, which may help to reduce migration.

1.3 Aim of Research

The current training provided to bamboo craftsmen has only introduced them to non-native bamboo species. Consequently, they have not explored the potential of the native species, *Bambusa bambos*. While the craftsmen are being trained in traditional products, they have not yet had the opportunity to work with modern designs and furniture. The primary aim of this research is to explore *Bambusa bambos* for designing and creating sustainable and modern aesthetically pleasing furniture. Ultimately, this research seeks to up skill the craftsmen and enhance their ability to view the material from a different perspective.

2.0 Materials and Treatment

2.1 Selection of Material:

Bambusa bambos is one of the native species easily available in south Gujarat region. It is having properties similar to locally available hard wood, Teakwood.

Property	<i>Bambusa bambos</i> (Bamboo)	Teakwood (<i>Tectona grandis</i>)
Density (kg/m ³)	600 - 800 kg/m ³	650 - 750 kg/m ³
Tensile Strength (MPa)	140 - 280 MPa (along the grain)	70 - 140 MPa (along the grain)
Compressive Strength (MPa)	40 - 80 MPa (parallel to fibers)	50 - 60 MPa (parallel to fibers)
Shear Strength (MPa)	8 - 20 MPa	10 - 15 MPa
Bending Strength (MPa)	80 - 150 MPa	90 - 130 MPa
Bending Elasticity Modulus (GPa)	9 - 12 GPa	9.5 - 11 GPa

Table: 01 Comparison: Mechanical Properties of *Bambusa bambos* & Teakwood

A teak (*Tectona grandis*) tree must grow for 20 to 25 years before it can be harvested for furniture. *Bambusa bambos*, at only 3 to 5 years old, can already be utilized for furniture and structures. Bamboo grown in non-forest area has been omitted from the definition of trees in the Indian Forest (Amendment) Act 2017. Furthermore, as per the Felling and Transit Regulation (2022-23) of Gujarat, *Bambusa bambos* (arundinacea) exempted from the regulations governing tree species grown on non-forest/private lands. Preferred tree and bamboo species planted under agro-forestry... are also exempted from both the transit permit and felling regulations.

2.2 Processing and Treatment:

Bamboo naturally contains soluble sugar content, which makes it highly susceptible to termite attacks. The treatment of bamboo is essential for removing these soluble sugars, ensuring its durability and strength, and mitigating negative environmental factors. As bamboo is naturally prone to decay, insect infestations, and moisture damage, proper treatment helps to extend its lifespan and enhance its performance in various applications. Treatment that provides additional benefits, such as improving its aesthetic appearance, and increasing its fire and moisture resistance.

2.2.1 Bamboo treatment methods:

I. Natural treatments

- Water Leaching (Submersion):** This is a traditional preservation method where freshly cut bamboo poles are immersed in running water for 2 to 3 months. This process naturally leaches out starch and sugars, which are food sources for pests and fungi.
- Air-Drying:** Bamboo is left under shade for 6 to 12 weeks to naturally reduce its moisture content to acceptable levels.
- Smoking / Burning Method:** Traditionally, bamboo culms are stored over a cooking area or fireplace. The resulting smoke reduces the moisture content in the culms, preventing biological degradation. Additionally, built-up deposits from the smoke form a protective layer on the culm, and smoke drying is known to reduce splitting.

II. Artificial Treatments

- Borax-Boric Acid Treatment:** Bamboo is treated with an aqueous solution of boric acid and borax (typically in ratios such as 1:1:100 or 1:1.5:100, referring to Boric Acid, Borax, and Water). This treatment provides protection against most insects and fungi.
- Copper-Chrome-Boron (CCB) or Copper-Chrome-Arsenic (CCA):** These are strong chemical preservatives that offer excellent protection from fungi, termites, and marine borers. Due to their toxicity, they are not recommended for indoor or household use, but are effective for outdoor or structural bamboo applications.
- Pressure or Vacuum Pressure Impregnation:** In this method, liquid preservatives are forced deep into the bamboo structure under high pressure, resulting in maximum penetration and longevity.

- d. **Boiling water:** In this method, bamboos are kept in boiling water for at least 3 to 4 hours. This process is often used to enhance durability and properties, as it reduces moisture content, improves dimensional stability, and potentially increases resistance to decay. Salt can also be added to the boiling water for additional prevention against termites.

3.0 Design & Prototype:

3.1 Idea generation & Conceptualization:

Bambusa bambos is a native species to the South Gujarat region. It is typically used for structural and furniture purposes. Furniture from Bambusa bambos are too bulky and heavy. This bamboo species has been under-explored by the local artisans. Due to Covid-19 pandemic bamboo supply from North-East was disturbed and craftsmen without material to work with, as they were trained to use 'tulda' bamboo (Bambusa tulda) during their training. Bambusa bambos has a good wall thickness, which allows for the extraction of bamboo battens. These battens are comparatively light in weight and have a good load-bearing capacity due to the short internode length of the species.

Department of Product Design, Universitas Kristen Duta Wacana, Indonesia, designed a bamboo chair combined with newspaper material to make it light in weight as 5.8 kg. The general size of a single-seater bamboo chair is 600 mm X 600 mm X 600 mm, with a weight between 7 to 12 kg depends upon use of various bamboo species.

Bamboo is naturally cone-shaped, being wider and having a thicker wall at the base, and narrower with a thin wall at the top.



Fig. 01 Traditional Bambusa Bambos Chair

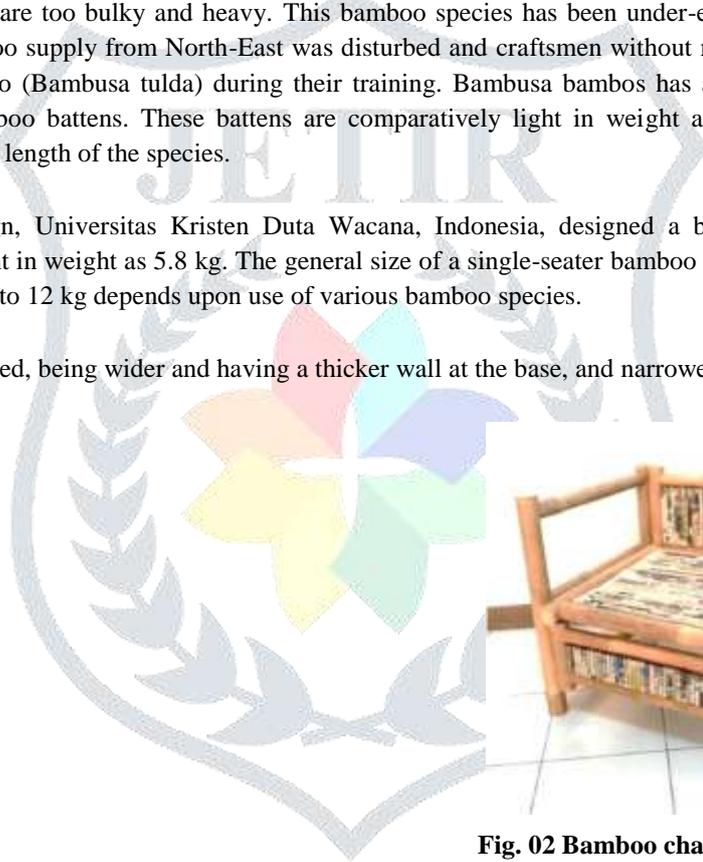


Fig. 02 Bamboo chair by Universitas Kristen Duta Wacana, Indonesia.

Given that bamboo battens are lightweight, possess good strength, and offer durability, conceptual sketches were developed to make a furniture piece out of the battens. Considering both the limitations of the material and the needs of the present day, several product and furniture concepts have been created. Bamboo can effectively replace other contemporary materials that harms to the environment, such as plastic, and materials that are a limited resource, such as wood. Since the individual battens have low thickness, they can be combined together to achieve better thickness or organized in a way that allows them to carry more load. By combining and interlocking the bamboo battens, the resulting structure can carry a good load and ensure the furniture remains stable. The demand for traditional bamboo furniture is decreasing due to the minimizing room sizes in urban residences. In urban cities, there is a greater demand for minimalist, lightweight, and sustainable furniture. This shift motivated the conceptualization of sitting elements, furniture and other products that are specifically sought after in urban spaces.

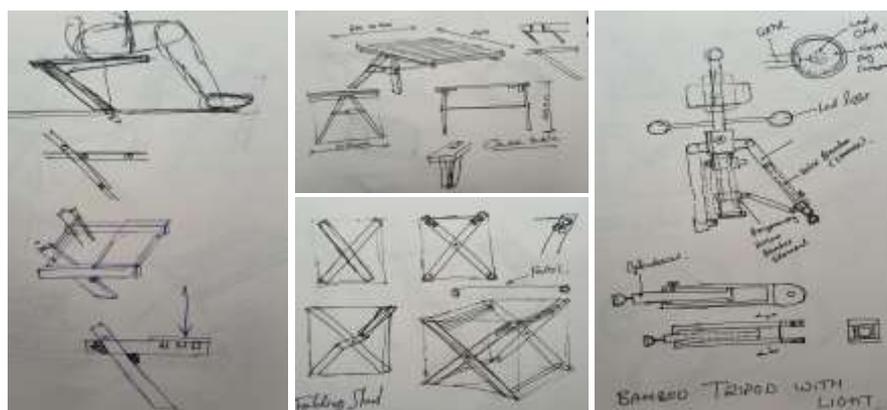


Fig. 03 Conceptual Sketches

3.2 Traditional Details and Tools:

When working with traditional craftsmen, it's essential to understand their way of working and detailing. By observing the surroundings, we've learned about their work process and the details they are familiar with the tools used in the bamboo craft are limited to: a Koita (a type of cleaver), a knife called a churi, a handsaw, an iron rod used for hammering called a karadi or a mallet, and marking and measuring tools are locally available from blacksmiths and carpentry stores.



Fig. 04 Traditional Details

				
Koita	Knife (Churi)	Handsaw	Hammer (Karadi)	Measuring tools

Fig. 05 Traditional Tools

3.3 Prototype Making Process:

Bambusa bambos is good in compression because its internode length is short. By splitting the bamboo we get flat bamboo battens of 20 to 30 mm wide and 6 to 10 mm thick with length from 450 to 600 mm as this particular species does not grow very straight. Considering these limitations and the traditional knowledge of the artisans, we have utilized traditional detailing. Furthermore, by analyzing urban demand, we have conceptualized a chair that is combination of the traditional knowledge, craft and contemporary form.



Fig. 06 Anatomy of Bamboo Culm



Fig. 07 Conceptual sketch



Fig. 08 Joinery (Mortise & Tenon)

3.3.1 Cutting and splitting:

A naturally dried and processed *Bambusa bambos* culm is split using a koita (Fig. 09a) or a manual/hydraulic splitter. Once split, the segments retain a naturally curved form (Fig. 09b). As shown in Figure 06 and Fig. 09b, bamboo battens are carried out from these split pieces. Due to the species not growing very straight (Fig. 09d), the resulting battens have a typical size of 20 to 30 mm wide and 6 to 10 mm thick, with lengths ranging from 450 to 600 mm. Generally, the longer the required length, the lesser the thickness that can be consistently achieved. The final flat batten is produced using a planing machine Fig. 09c.



Fig. 09 (a)

Fig. 09 (b)

Fig. 09 (c)

Fig. 09 (d)

3.3.2 Construction:

The *Bambusa bambos* battens are started composing and joining as shown in Figure 07. Battens are joined by using bamboo nail Fig.10 (a,b) rather than metal nails. These bamboo nails, which are made from the same bamboo waste, help ensure the joint is homogenous with the rest of the structure. To prevent buckling—since the vertical members are in compression—two battens have been used for the vertical supports. A horizontal batten (beam) is then placed between these two vertical battens, which effectively interlocks the structure (Fig. 10e). First, both side frames are prepared (Fig. 10c). These frames are then connected and held together using a mortise and tenon joint (Fig. 08, 10d).

The basic form of the chair is now ready. It is strong, stable, and capable of carrying a heavy load of approximately 150 kg, which was tested manually (Fig. 10f, 10g). Flat battens have been fixed to form the seating surface, and round bamboo rods are used for the back support. The chair prototype was constructed using 30 bamboo battens and 3 bamboo rods, resulting in an approximate weight of only 2.5 kg. It is lighter as a plastic chair than yet as sturdy as a wooden chair. The contemporary form of the bamboo chair suits to the urban residence having small rooms.



Fig. 10 (a)



Fig. 10 (b)



Fig. 10 (c)



Fig. 10 (d)



Fig. 10 (e)



Fig. 10 (f)

Fig. 10 (g)

Fig. 10 (h)



Fig. 11 Prototype chair with dimension and other details

4.0 Conclusion:

Bamboo, a versatile, fast-growing, and sustainable resource belonging to the grass family Poaceae, holds significant socio-economic and ecological importance, especially in India. South Gujarat has a rich history of traditional bamboo craftsmanship, primarily practiced by the Kotwalia tribal community. However, the potential of locally available species like *Bambusa bambos* for contemporary furniture design has been largely underutilized, often due to a lack of awareness and training focusing on non-native species. The research effectively demonstrated the feasibility and benefits of designing sustainable, light-weight, and aesthetically modern furniture using the indigenous *Bambusa bambos* of South Gujarat. The findings offer a bridge between traditional craftsmanship and contemporary design, promoting skill enhancement among local artisans and fostering an eco-friendly approach to furniture production.

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