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Exploration of Bamboo as Vernacular Material in Residential Furniture Design

Penerokaan Buluh sebagai Bahan Vernakular dalam Reka Bentuk Perabot Kediaman

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ABSTRACT - For centuries, bamboo has held a vital role in Indonesia's traditional construction, furniture, crafts, and even musical instruments. However, bamboo remains underutilized within urban consumer segments. This can risk the decay of traditional Indonesian craftsmanship. The study aims to explore the application of bamboo material in interior and furniture construction by producing lightweight, multi-functional furniture that respects the cultural context of Indonesia. The research highlights Desa Jambu Kulon in Ceper, Klaten, a prominent bamboo crafts center in Indonesia, where we found insights into the potential and challenges of bamboo products. The study first identifies the characteristics of bamboo, including its biology, aesthetic, economic, social, and environmental aspects. It is found that bamboo's renewability, flexibility, and durability have made it applicable for earthquake-prone areas like Indonesia, and its natural aesthetic enhances the space, bringing warmth and a sense of connection to nature. Moreover, design exploration was made for a residential interior project that created 8 furniture that is made entirely out of bamboo. Each piece of furniture is inspired by traditional philosophy and pattern. The result demonstrates that bamboo can be a suitable vernacular material for residential interiors that fuse cultural heritage and incorporate multifunctional modules for maximizing space that meets the standard of modern practicality.

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INTRODUCTION

Bamboo is classified as a Non-Wood Forest Product, which primarily grows in tropical, subtropical, and mild temperature zones. (Lobovikov, Ball, & Guardia, 2007). Bamboo is part of the family Poaceae or the grass family (Grass Phylogeny Working Group, 2001). Bamboo is widely found across regions in Indonesia. More than 160 species of Bamboo are found in the landscape of Indonesia, 95 of which are found in the region of West Java (Ministry of Foreign Affairs of the Republic of Indonesia). Bamboo has long been used as a resource in construction, furniture, utensils, agronomy, and horticultural activities, especially in rural areas across Indonesia. With the integration of local weaving techniques that carry local philosophies that embody harmony with nature.

Bamboo itself was established as a rapidly renewable material capable of lowering embodied emissions in the building sector, while also highlighting the necessity of technical guidelines to ensure responsible application (Gan et al., 2022). From a disaster resilience perspective, Experimental and numerical studies have demonstrated favorable seismic responses in multi-story bamboo frames, suggesting potential for developing interior systems and furniture that are lightweight, safe, and easy to assemble in tropical earthquake-prone environments (Zhao & Qiu, 2022).

Figure 1. Desa Jambu Kulon, Ceper, Klaten, Central Java

Vernacular design refers to practices that have been passed down for generations that represent the local identity from available resources to respond to the geographical context that has been recognized as the best practice for sustainability in construction (Rashdan & Mhatre, 2022). More contemporary designs have adapted the practice of vernacular design in recent times. In this context, bamboo shows potential as a vernacular material that can extend from traditional practice to more modern, practical, and contemporary applications.

This study explores the integration of vernacular bamboo techniques into modular and multifunctional furniture design for residential interiors. The novelty of this research lies in presenting an innovative framework that combines bamboo's sustainable potential with cultural heritage, an approach that has not been extensively investigated in previous literature.

PROBLEM STATEMENT

The advancement of other cheap, industrialized, and mass-produced materials has displaced bamboo in interior and furniture construction, with the perception that these materials are durable and convenient, which poses a threat to the traditional craftsmanship of bamboo in Indonesia. Despite bamboo's many ecological benefits and aesthetic excellence, bamboo is often strongly associated with the rural environment, making it harder to break through the urban market. Previous research has explored bamboo's properties and its implementation in architecture but there is a lack of exploration

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on how bamboo can be translated into multifunctional furniture designed for compact residence. Furthermore, in the case of Desa Jambu Kulon in Ceper, Klaten shows limited product innovation that urges the need for product innovation to sustain the livelihood of the craftsmen in the village and enhance their competitiveness in modern markets.

OBJECTIVES

The study aims to achieve the following objectives:

1) To identify biological, aesthetic, economic, social, and cultural aspects of Bamboo that grows locally in Central Java.
2) To understand the challenges and potential of bamboo furniture and crafts in Desa Kulon Jambu, Ceper, Klaten, Central Java.
3) To develop multifunctional furniture made entirely out of bamboo that showcases traditional craftsmanship but is also practical for modern use.
4) To establish bamboo as a sustainable alternative to furniture material in earthquake-prone and space-limited areas.

METHODS AND MATERIALS

This study employs a qualitative approach with a descriptive-exploratory nature. The aim is to obtain a systematic understanding of the utilization of bamboo as the main material in furniture design. The initial stage of the research is conducted through a literature review to examine the characteristics of bamboo in Jambu Kulon Village, Ceper District, Klaten Regency, Central Java, Indonesia, both in terms of its physical properties and the traditional values attached to its use. Furthermore, a visual and cultural value analysis is carried out by examining the forms and patterns of bamboo within the design context, as well as exploring bamboo as a traditional weaving pattern. This analysis aims to identify the potential, limitations, and visual richness of bamboo as a local material. The next stage involves conceptual design exploration by applying the Design Thinking methods.

Through Design Thinking, knowledge related to design processes can be enhanced to support the development of environmentally friendly products (Giardino et al., 2023. Design Thinking, as a framework for generating innovation, consists of three main aspects: inspiration, ideation, and implementation (Brown, 2008). Another study written by Stanford Design School provides a detailed explanation of the Design Thinking process through five stages: empathize, define, ideate, prototype, and test. For this study, researchers have used the design stages that were created by Stanford Design School. The process involves empathizing, understanding how bamboo is used in everyday life, particularly in interior design. Then, the defined phase begins, where all the information gathered is used as a reference for formulating the problem. The third phase, ideate, involves generating several alternative solutions that can be developed into design concepts. The final outcome is 3D modeling and rendering. By integrating these stages, this study not only provides a comprehensive understanding of bamboo's material properties but also establishes a foundation for developing sustainable furniture design concepts.

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Figure 2. Methodology Process

RESULTS AND DISCUSSION

Locally sourced Bamboo that are widely available and used for this research are Gigantochloa apus or Tali Bamboo. Gigantochloa apus are often processed into strips and splits in the handicraft industry to create woven patterns. Gigantochloa apus consists of vascular bundles and parenchymal ground tissue that give this type of bamboo its mechanical strength. They also varied in radial direction, which affects the density and tensile strength of the Bamboo Strips (Darwis et al., 2023). The practical application of Tali Bamboo also relies on its harvesting and treatment process. Bamboo takes 3-5 years to mature. Only the best quality bamboo is chosen, with straight figures and no signs of insect intervention. The bamboo is then soaked with natural salts of borax and boric acid and set aside to lose its moisture for around 3 - 4 weeks to achieve a moisture content below 20%. These treatments play a vital role in ensuring the durability and stability of bamboo to turn it into furniture or other structures.

The aesthetic value of bamboo for interiors has been widely recognized for shaping the spatial perception of the user. Interiors featuring light bamboo laminate flooring were perceived to provide a warmer, brighter, and more spacious environment. Respondents also associated these interiors with qualities of friendliness, harmony, good planning, openness, simplicity, minimalism, and orderliness (Yilgrim et al). The distinctive texture of bamboo contributes to a natural atmosphere that integrates seamlessly with contemporary design approaches (Gunawarman et al., 2025).

While highlighting the aesthetic elements of bamboo, in effective implementation in the contemporary context, we must consider the social, cultural, and economic factors that influence it to create sustainable industry development. In the case of Desa Jambu Kulon, one of the barriers identified is the lack of variation of the product. Craftsmen in this area only sell animal sculptures, and some sell bamboo gazebos. The absence of collaboration with professional designers has constrained product innovation, resulting in significant challenges for these artisans in competing within contemporary markets.

Using design thinking methods, this research produces 8 pieces of furniture for residential interiors. The process began with empathizing with the user, defining the problems, and ideation of the design. The site of the project is in a mountainous area where bamboo is found in abundance. It is a two-story building with the goal of sustaining the life of a family of 4 with 2 small children. The interior must accommodate basic needs such as a comfortable sleeping area, a proper kitchen, a living room for entertainment, and a praying area for religious activities, as well as being able to serve as a temporary and permanent stay for the family.

Inspirations are drawn from the local belief of asah, asih, and asuh. Asah, asih, and asuh are the three aspects of the system by Ki Hajar Dewantara. Asah emphasizes intellectual development, asih refers to love and kindness, while asuh relates to guidance and nurture (Utami et al., 2024). On implementing this philosophy, our team focuses on creating an intimate atmosphere through multi-functional, space-saving furniture. Our team also took Batik Kawung, a traditional cloth pattern found in Central Java, as the main visual inspiration. Kawung is a type of palm tree that society uses

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the entire plant for its livelihood. The pattern is one of Indonesia's oldest traditional patterns that has a deep philosophical meaning within the circle of nobility in the Java region. (Parmono, 2013).

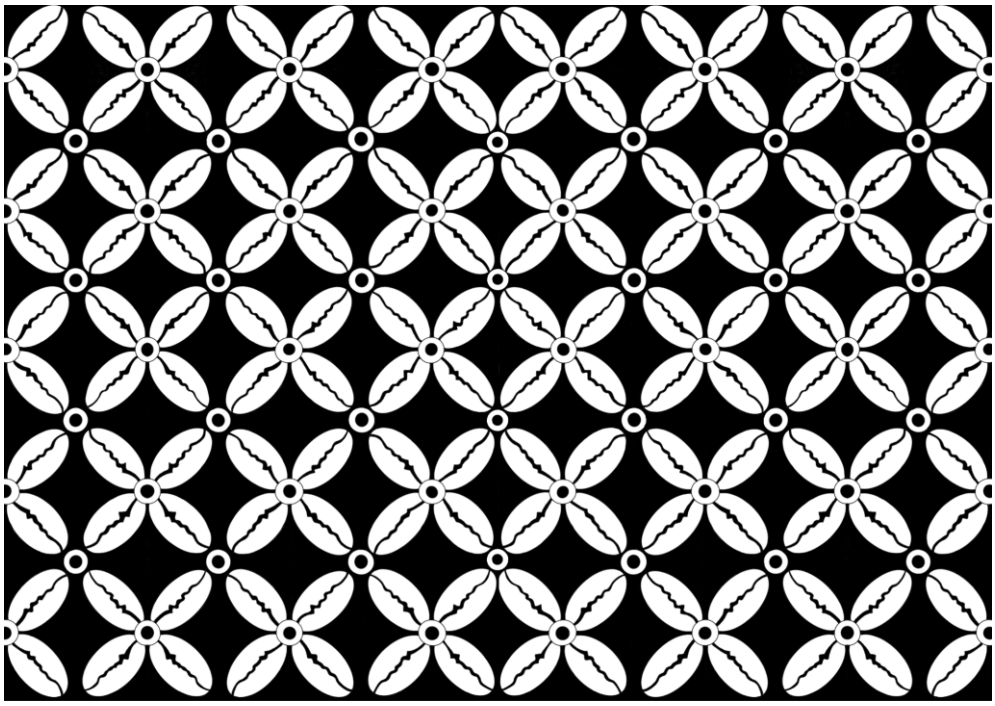

Figure 4. Batik Kawung Pattern

Figure 5. Bedroom Furniture

The bedroom furniture consists of a king-sized bed, a side table, and a bunk bed that doubles as a wardrobe. The primary construction material selected is bamboo poles from Gigantochloa apus (commonly known as Bamboo Tali). The king-sized bed arranges bamboo poles in rhythmic sequences to function both for structure and aesthetics. The bunk bed used a multifunctional approach to save more space with main bamboo poles to ensure durability with a bamboo weaving pattern, and stairs leading up to the top on one side. The side table integrates the Batik Kawung pattern to serve as an ornament and cultural narrative.

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Figure 6. Living Room Furniture

Lesehan is a culture of floor sitting in Indonesia that is used by people at home, cafes, and even restaurants. This culture reflects unity, modesty, and harmony (Sufyan & Suciati, 2017). Based on the habit, the living room furniture is specifically designed to align with the user's natural eye level while seated on the floor. The seating modules are integrated with foam to ensure ergonomic support and enhance comfort while the user is seated. The TV cabinet also functions as both shoe storage and extra seating storage to optimize space.

Figure 7. Kitchen Furniture

The pantry is compact but highly functional, with multiple storage compartments beneath and above the cabinet. There is a sink to make the pantry area serve as a practical workstation for daily household activities.

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Figure 8. Outdoor Furniture

For balconies and porches, a hanging daybed is designed to serve as a relaxing gateway. It is suspended with a metal bracket and bamboo ropes for stability and decorated with pillows for aesthetic. The daybed's purpose is to support social interaction and leisure activity.

The findings show that bamboo has significant potential for residential furniture design. Gigantochloa apus, which is found in abundance in Indonesia, can be durable and long-lasting if using the appropriate harvesting, treatment, and design integration. This aligns with previous studies that have highlighted Gigantochloa apus' ecological advantage and technical durability (Gan, et al., 2022) (Suardika, Widnyana, & Artana, 2023). This research extends the discourse into modern multifunctional furniture in the residential context.

The outcomes incorporate an interpretation of Javanese philosophy and Batik Kawung motifs into functional products without compromising modern practicality, to prove that cultural heritage and modernity can coexist through the reinterpretation of traditional symbolism. This approach resonates with the notion of vernacular sustainability (Rashdan & Mhatre, 2022), which therefore demonstrates how design can reinforce cultural heritage through innovations.

However, the utilization of bamboo as modern furniture found several barriers, such as the stigma of bamboo as rural and outdated, and the lack of innovations in local bamboo craft,s with a case study in Desa Jambu Kulon, Ceper, Klaten. The research suggests that future research should investigate consumer behavior and marketing strategies for bamboo as high quality and eco-friendly material for residential furniture.

Lastly, this is only a conceptual exploration of bamboo furniture design and is limited only in prototype visualization. Future studies can explore more on physical production and the topics of material, ergonomic, and long-term durability assessment

CONCLUSION

Bamboo plants are one of the resources that are widely found in Indonesia and have a long history in Indonesian culture. From several studies, it is proven that bamboo is a highly renewable and durable material. However, bamboo lacks popularity in modern furniture markets, and many bamboo craftsmen also lack innovation and diversification of bamboo products, like the case of Desa Jambu Kulon, Ceper, Klaten, which highlights the importance of collaboration between designers and craftsmen.

The study integrates cultural heritage into modern practical furniture through vernacular design practice and design thinking method that results in furniture pieces that are inspired by traditional beliefs of asah, asih, asuh, and Batik Kawung motifs. The research shows the potential of local bamboo variants, especially Gigantochloa apus, which is suitable to be adapted into modern residential furniture. In

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conclusion, bamboo can be a sustainable material and become the medium to preserve cultural heritage. Future studies should advance this work through physical prototyping to prove the effectiveness of the design, partnering with craftsmen from Desa Jambu Kulon.

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CONFLICT OF INTEREST
The authors declare no conflicts of interest.

AUTHORS' CONTRIBUTION
Author 1.: Conceptualization, Methodology, Software, Visualization. **Author 2.**: Data curation, Writing- Original draft preparation, Visualization. **Author 3.**: Writing- Review and Editing. **Author 4.**: Supervision.

AVAILABILITY OF DATA AND MATERIALS

Data available on request due to privacy/ethical restrictions.

DECLARATION OF GENERATIVE AI

During the preparation of this work, the author(s) used ChatGPT and Grammarly to enhance the clarity of the writing. After using ChatGPT and Grammarly, the author(s) reviewed and edited the content as needed and took(s) full responsibility for the content of the publication.

ETHIC STATEMENTS

Not applicable

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