

# Introducing Bamboo as a Building Material in Architecture Education of Aspiring Young Building Designers for Sustainable Community Development

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**ABSTRACT:** To address global challenges like climate change, pollution, and social inequality, we must broaden our thinking and train the next generation of leaders—young students. Introducing bamboo as a building material through architecture education is one way to explore its potential and promote sustainable practices. This paper focuses on the role of architectural education in teaching aspiring students about bamboo materials for sustainable community development, through a participatory bamboo installation project. In this initiative, a group of students worked in five teams, each consisting of five members, to design structures using bamboo—a sustainable, indigenous material. Over time, their designs evolved during review sessions, from simple to complex, and from basic forms to more creative, student-generated structures. They moved from small-scale models to larger ones, eventually constructing a real-scale structure. These hands-on, interactive exercises fostered great enthusiasm among the students and professors, moving beyond theoretical learning. Workshops, talks, and presentations were held to explore the stability of skeletal systems in creative ways. The newly built models, featuring different joists, knots, weaving patterns, and construction techniques, allowed the students to test their theoretical ideas. The tactile qualities and construction potential of bamboo and other locally available materials became evident, highlighting their practicality. This study also aims to identify gaps in research on bamboo as a sustainable material for community development. While bamboo has been explored in some areas, it remains underinvestigated in others. By considering bamboo as an eco-friendly building material, this project aligns with the low-carbon movement and encourages young leaders to adopt sustainable practices. The practical experience provided a deeper understanding of these issues than theoretical lectures ever could, making the students and instructors more aware and knowledgeable about bamboo's potential for sustainable architecture.

**KEYWORDS:** architecture and education, installation, bamboo, building material, sustainable community development

## INTRODUCTION

In the pursuit of sustainable architecture and community development, the introduction of bamboo as a building material holds immense promise. This initiative seeks to transform architectural education for aspiring young building designers by integrating the principles of sustainability and innovation. Bamboo, renowned for its rapid growth and eco-friendly properties, emerges as a viable alternative to conventional construction materials (Rampal et al. 2023).

This shift in architectural education aims to equip future designers with a deep understanding of bamboo's structural capabilities, versatility, and environmental benefits. Students will explore bamboo construction, applying sustainable design principles through hands-on learning. Integrating bamboo into the curriculum aligns with the global push for eco-friendly construction and sustainable development.

This initiative not only addresses the environmental footprint of traditional building materials but also nurtures a sense of responsibility among young designers to create structures that harmonize with nature. The ultimate goal is to produce a new generation of architects who can contribute to the development of communities that thrive in harmony with their ecological surroundings (Behnejad 2022). Unfortunately, the use of bamboo in traditional houses is declining, replaced by materials like concrete and steel. Bamboo is often seen as less practical, modern, and durable, with some considering it suitable only for lower-middle-class homes. This shift is reflected in the decreasing number of bamboo houses in local communities. A prevailing assumption exists that bamboo dwellings are unsuitable for habitation and are exclusively associated with poverty (Lopez 2003).

Hence, architecture education emerges as a potential avenue to acquaint the community with bamboo, presenting it as a regional resource that is eco-friendly, abundantly available, and possesses exceptional aesthetic qualities. This initiative, represented by the installation, serves as a means to familiarize students with bamboo, encouraging them to envision a sustainable future and integrate this versatile material into their design considerations (Xiang et al. 2021).

Through this introduction of bamboo as a fundamental building material, architecture education becomes a catalyst for positive change, inspiring young designers to forge a path toward a more sustainable and resilient future in community development.

## 1.0 BACKGROUND AND RATIONALE



**Figure 1:** Using Bamboo as construction material. Source: (Ryan 2023)

### 1.1 Evolution of bamboo use in construction

Bamboo has a rich history as a construction material, evolving over centuries to become a sustainable and versatile option. In ancient civilizations, bamboo was utilized for its inherent strength and flexibility, supporting structures and providing shelter. The simplicity and abundance of bamboo made it an accessible choice for various building needs. Over time, traditional building techniques were refined, and bamboo became a staple in vernacular architecture (Mohan, Dash, and Boby 2022). In contemporary contexts, the evolution of bamboo as a construction material has been influenced by ecological awareness and sustainable design principles. Modern engineering and treatment methods enhance bamboo's durability, making it an attractive alternative to conventional materials. Architects and builders today recognize bamboo's potential in creating eco-friendly, resilient structures, contributing to a more sustainable built environment (Fahim et al. 2022). The utilization of bamboo necessitates a creative approach and an openness to natural materials, positioned as fundamental elements in the future economy. These materials not only embody the shifts occurring due to innovative ideas and solutions but also align with the transformative industrial evolution and technological progress (Wu and Fan 2021).

### 1.2. Contemporary challenges in building material choices

Contemporary architecture faces an array of challenges in selecting building materials, driven by dynamic considerations such as environmental sustainability, technological advancements, and societal demands. One central challenge lies in mitigating environmental impact, addressing issues like carbon emissions, resource depletion, and waste generation. This necessitates a shift towards materials that contribute to a more sustainable and eco-friendly built environment (McDonough and Braungart 2002). In its function, architecture intentionally harmonizes with the environment of each region and historically develops innovative solutions when faced with challenges. Occasionally, these challenges become opportunities, transforming architecture into a form of art. Climate change has significantly influenced the adaptation of shelter and materials in this region. Vernacular architecture has evolved and integrated itself into the welfare of its inhabitants through a profound understanding of the environment and responsive human systems (Doza and Ema 2019). Hence, There is a need to explore the challenges of integrating green building principles into construction practices. It emphasizes the need for environmentally responsible material choices and offers insights into sustainable design strategies (Maslucha et al. 2020).

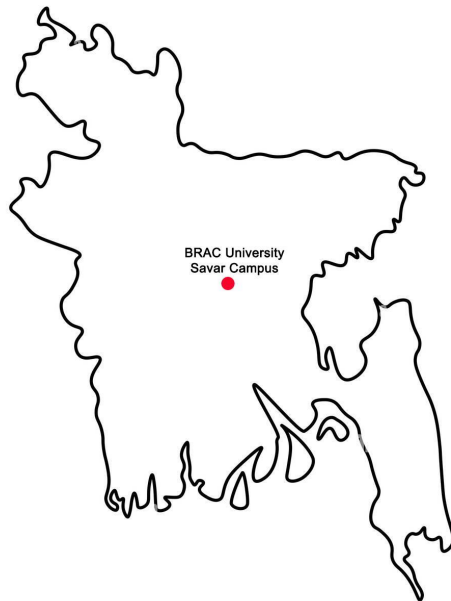
### 1.3. Need for sustainable alternatives in architecture

The imperative for sustainable alternatives in architecture has become increasingly pronounced as global awareness of environmental issues continues to grow. In endorsing the cradle-to-cradle philosophy, architects are prompted to rethink their material choices, focusing on those that offer not only durability and functionality but also environmental responsibility. The shift towards perpetually recyclable or biodegradable materials in building design aligns with contemporary ecological imperatives, fostering a holistic approach that considers the entire lifecycle of architectural elements (McDonough and Braungart 2002). The integration of sustainable materials further enhances the ecological sustainability of bio-climatic design. By prioritizing materials with low environmental impact and long-term durability, architects can contribute to reducing the overall ecological footprint of buildings. This aligns with the broader goals of sustainable architecture, emphasizing a holistic approach that considers both immediate energy efficiency and the long-term environmental implications of architectural decisions (Chen et al. 2009). Encouragement is given to transcend a narrow focus on green building technologies and materials. Instead, architects are prompted to adopt a more inclusive and socially conscious approach. The adoption of this comprehensive framework positions architects to contribute to the creation of built environments that not only

minimize their environmental impact but also promote social inclusivity and ensure economic sustainability (Souza and Meirelles 2021). This shift in perspective signifies a departure from the conventional concentration solely on environmentally sustainable aspects in architecture. Furthermore, the call for economic sustainability underscores the importance of ensuring that architectural decisions contribute positively to the long-term financial viability of projects. Architects are encouraged to consider the economic implications of their designs, fostering the development of built environments that are not only environmentally conscious and socially inclusive but also economically resilient (Elkington 1997).

## 2.0 INSTALLATION PROJECT DESIGN AND CONCEPT

This bamboo installation project at BRAC University's Savar campus serves a dual purpose: introducing bamboo as a viable building material in architecture education and creating sustainable learning spaces.



**Figure 2:** Location of BRAC University Residential Campus. Source ( Author 2024)

Through hands-on experience, students explore bamboo's structural capabilities, environmental benefits, and potential in modern design. Workshops and faculty-led talks enhance their skills in sustainable architecture. The installation serves as a living laboratory, fostering creativity and aligning with the university's holistic education approach. The project highlights bamboo's versatility, with designs like archways and shelters, while faculty reviews ensure safety and durability. Students also learn to source bamboo responsibly and use eco-friendly construction techniques, minimizing waste and promoting reusability. Informative signage educates the community about bamboo's benefits. This project encourages students to take ownership of sustainable initiatives beyond the classroom.

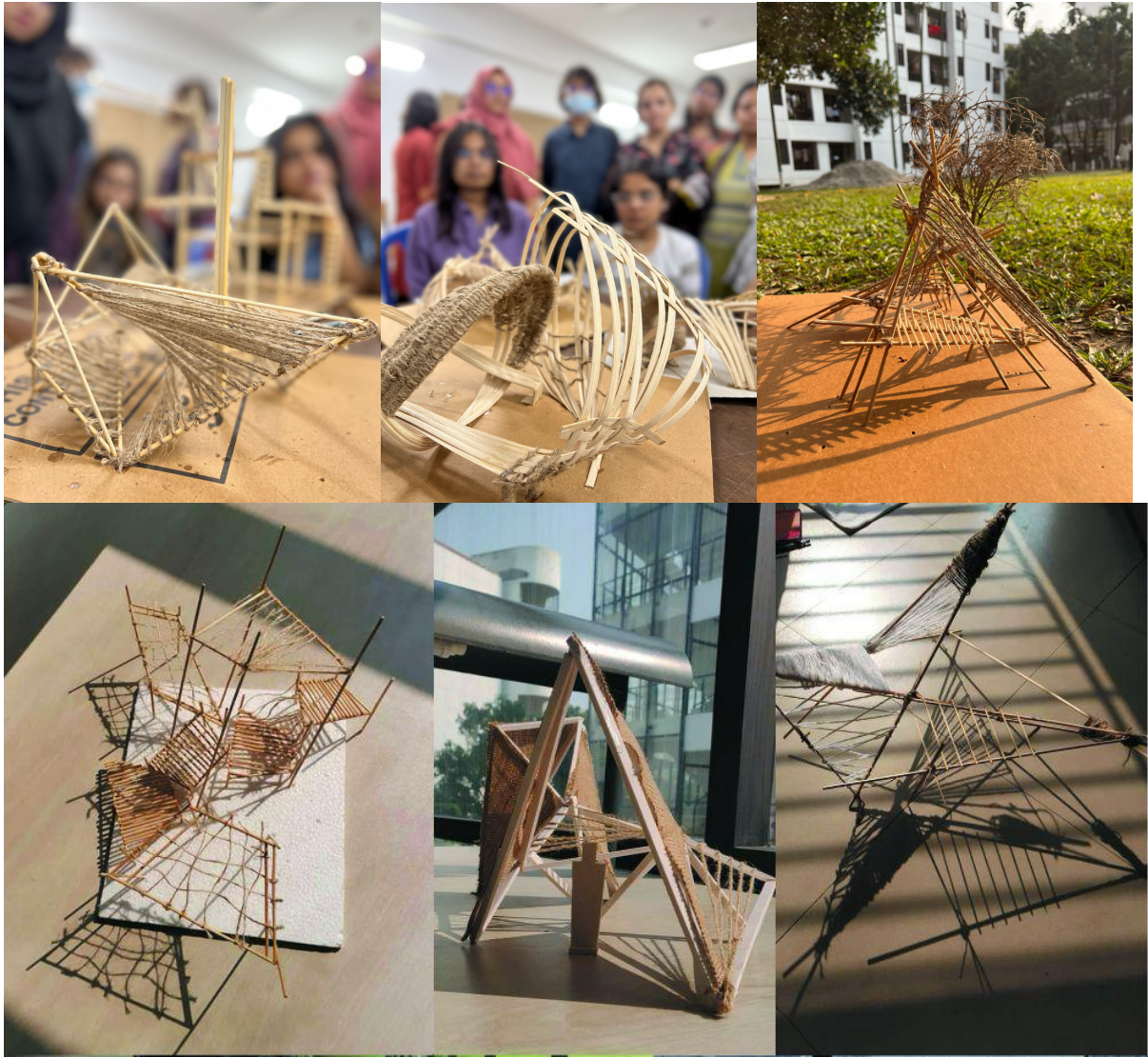
## 3.0 METHODOLOGY

The installation project aimed to introduce bamboo as a building material to aspiring young designers at BRAC University through a collaborative, student-centered approach. It began with a review of scaled models and existing studies on bamboo construction and sustainable architecture, followed by hands-on design sessions to engage students with bamboo techniques. Briefing sessions on bamboo's cutting and knotting processes allowed students to explore its structural and aesthetic potential. Local market surveys and literature reviews gathered feedback on students' learning experiences, ensuring the project was responsive to their needs. The project concluded with a public exhibition showcasing sustainable designs, raising awareness about bamboo as a viable building material for sustainable architecture.

## 4.0 IMPLEMENTATION

### 4.1. Execution of the installation project

The execution of the installation project by students, commencing with concept generation and progressing through the design process to construction, is a dynamic and participatory endeavor. In the initial phase, students are encouraged to unleash their creativity in generating innovative concepts for the project. Collaborative brainstorming sessions foster a collective spirit where diverse ideas are shared and refined, emphasizing sustainability and community-centric design principles.



**Figure 3:** Preliminary scaled models for the installation project. Source: (Author and Students 2021-2024)

Students participate in hands-on workshops to turn their concepts into detailed plans, often using digital modeling tools to refine designs while considering bamboo's structural and environmental benefits. They then create small-scale prototypes for practical experimentation. During the construction phase, students actively engage in on-site activities, bringing their designs to life under expert guidance. Community involvement is essential, fostering local support and understanding. The project concludes with a final exhibition, where students present their completed installations, sharing insights and sustainable design principles. This experience enhances their technical skills and deepens their understanding of architecture's social and environmental impacts.

#### **4.2. Student involvement and learning outcomes**

Student involvement in the installation project offers a transformative learning experience, fostering creativity through collaborative brainstorming and enhancing design skills with workshops and digital tools. The hands-on construction phase develops practical bamboo construction, planning, and execution skills. Collaborative teamwork promotes effective communication and shared responsibility, while engaging with local communities helps students understand the social impact of their designs.

The project also serves as a conduit for developing project management competence, as students actively participate in material sourcing, planning, and execution. Encouraging documentation and reflection throughout the process promotes critical thinking, allowing students to assess challenges, celebrate successes, and internalize valuable lessons.



**Figure 4:** Students actively participate in each step of construction. Source: (Author and Students 2021-2024)

The final presentation and exhibition provide a platform for students to refine their presentation and communication skills, articulating design concepts and the sustainable aspects of their installations to diverse audiences. Ultimately, the sense of achievement and pride derived from successfully completing the installation project solidifies students' confidence and readiness to contribute meaningfully to the fields of architecture and sustainable community development.



**Figure 5:** Completed installation projects. Source: (Author and Students 2021-2024)

#### 4.3. Contribution to sustainable community development

The installation project promotes eco-friendly architecture and community engagement by incorporating bamboo as a sustainable building material. Students contribute to environmentally conscious design, while interactions with local communities foster inclusivity and social responsibility.



**Figure 6:** Students engaging with the construction techniques . Source: (Author and Students 2021-2024)

The installations serve as prototypes, demonstrating resilient architectural solutions and promoting the creation of sustainable communities that balance environmental, social, and innovative needs.

#### **4.4 Long-term effects on architecture education**

The installation project's long-term impact on architecture education is transformative. By immersing students in hands-on experiences with bamboo construction, it reshapes traditional pedagogical approaches. The emphasis on sustainable design principles becomes ingrained, influencing future architects to prioritize eco-friendly solutions. Integrating digital tools enhances technological literacy, ensuring graduates are well-versed in innovative practices.

The collaborative nature of the project cultivates teamwork and communication skills, preparing students for the interdisciplinary demands of the architectural profession. Overall, the project sparks a paradigm shift, fostering a new generation of architects who approach education with a holistic understanding of sustainability, practical skills, and community engagement.

#### **5.0. LEARNING OUTCOME AND ASSESSMENT METHOD**

Students gained proficiency in bamboo joinery techniques, mastering skills like lashing, weaving, and structural connections while exploring bamboo's renewable nature and low carbon footprint. They were encouraged to innovate within sustainable design constraints and collaborate across disciplines. Critical thinking was fostered through reflective practice on environmental and social impacts.

Assessment focused on both practical skills and theoretical knowledge. Students' construction abilities were evaluated based on precision and integrity, while design presentations assessed their sustainability solutions. Peer evaluations and instructor feedback guided collaboration and innovation.

Overall, the project enhanced students' bamboo construction skills, fostering collaboration, critical thinking, and innovation to address global challenges and position them as future leaders in sustainable architecture.

#### **6.0. RESULTS AND DISCUSSION**

The exercise exerts a profound influence on sustainable design practices within the context of architecture. It shifts paradigms by introducing students to bamboo as a viable and eco-friendly building material, fostering a fundamental change in their approach to design. The exercise cultivates a heightened awareness of sustainable principles as students engage in hands-on experiences and collaborative design processes. The influence extends to the integration of sustainable elements in architectural designs, where bamboo becomes a central feature. The exercise prompts students to consider not only the aesthetic aspects of their creations but also the environmental impact, resource efficiency, and resilience. This newfound perspective encourages innovative solutions that prioritize sustainability in building practices.



**Figure 7:** Introducing students to bamboo as a viable and eco-friendly building material. Source: (Author and Students 2021-2024)

Moreover, the exercise encourages a holistic understanding of sustainability, encompassing social, economic, and environmental dimensions. By engaging with local communities during construction, students recognize the importance of designing structures that harmonize with the socio-cultural context, reinforcing the interconnectedness of sustainable architecture and community well-being. In summary, the exercise significantly influences sustainable design practices by instilling a deep appreciation for eco-friendly materials, fostering interdisciplinary collaboration, and promoting a holistic approach to architecture that aligns with the principles of sustainability.

## 7.0. LIMITATIONS

A limitation of these installation projects is their potential lack of scalability and generalizability beyond specific educational settings or localized contexts. While they offer valuable hands-on experiences and insights into bamboo construction techniques, the outcomes and lessons learned may not easily translate to broader applications or diverse geographical regions. Therefore, while these installation projects are beneficial for educational purposes, their broader impact and applicability in sustainable community development initiatives may require further consideration and refinement.

## 8.0. FUTURE DIRECTIONS

There are several promising avenues for further research and development within the initiative focused on bamboo construction. Firstly, advancing bamboo construction techniques through innovative joinery methods, structural systems, and treatment processes is crucial for enhancing efficiency and applicability in diverse architectural contexts. Secondly, integrating bamboo into architectural education demands comprehensive efforts such as developing educational frameworks and interdisciplinary courses to ensure students receive thorough training on this sustainable material. Lastly, conducting longitudinal studies to assess the long-term impact of bamboo construction on sustainable development goals, including environmental, social, and economic outcomes, will provide valuable insights into its contributions to sustainability. These areas of focus promise to advance the adoption of bamboo as a sustainable building material and underscore its role in global sustainable development efforts.

## CONCLUSION

In conclusion, this research has yielded valuable insights into the potential of bamboo as a sustainable building material and its implications for architecture education. The key findings highlight the versatility, durability, and eco-friendliness of bamboo, underscoring its importance in addressing pressing environmental challenges and promoting sustainable architecture. By integrating bamboo into architectural education, students are empowered to prioritize sustainability, nurture creative thinking, and engage with local communities, thereby shaping a more resilient and equitable built environment. Moving forward, there is a clear call to action for future initiatives. It is imperative to continue refining bamboo construction techniques, integrating bamboo into the architectural curriculum, and assessing its long-term impact on sustainable development goals. By embracing these initiatives, we can accelerate the adoption of bamboo as a sustainable building material and pave the way for a more sustainable and socially responsible future in architecture.

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