



## APPLICATION AND INNOVATION OF MODULAR DESIGN IN BAMBOO WEAVING PRODUCTS

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*This study addresses the transformation challenges of traditional bamboo weaving products in terms of industrialized production, modern aesthetic adaptation, and functional extensibility. It explores a modular design approach based on structural innovation, along with its underlying principles. The research validates the feasibility of modular design in driving the transition of traditional bamboo weaving products toward a sustainable paradigm.*

**Key words:** bamboo weaving product, modular design, structural innovation, sustainable design, design methods and principles

### INTRODUCTION

Traditional bamboo weaving products have a long history and diverse varieties. However, in contemporary society, they face multiple challenges, including the imbalance between manual production efficiency and industrial manufacturing demands, the disconnection between inherent morphological language and modern aesthetic preferences, and the difficulty of traditional single-function designs in accommodating diverse usage scenarios [1]. Nevertheless, the natural mechanical properties and ecological attributes of bamboo provide a material foundation for structural innovations that can overcome these challenges. As an essential approach to structural innovation, modular design deconstructs traditional weaving logic and establishes a standardized, replicable bamboo weaving unit system, transforming complex bamboo weaving products into independently assemblable modules. Through detachable structures and flexible combination mechanisms, modular design facilitates the formation of a closed-loop system for material recycling, thereby extending the product lifecycle of bamboo weaving. The modular innovation pathway, grounded in sustainability principles, reconstructs the spatial form and functional boundaries of bamboo weaving products, demonstrating the feasibility of transforming traditional bamboo weaving through modern design thinking [2].

### PURPOSE

This study aims to reconstruct the production paradigm and value dimensions of bamboo weaving products through modular design, addressing the challenges of modern adaptation in terms of efficiency, aesthetics, and functionality. It focuses on elucidating modular design methods and principles based on structural innovation to establish a sustainable design framework for bamboo weaving products.



## RESULTS AND DISCUSSION

Modular design enhances the functional extensibility and environmental adaptability of bamboo weaving products through a detachable, replaceable, and expandable unit system. The modular innovation of bamboo weaving products is typically achieved through four strategies: modular reconstruction based on weaving techniques, modular replication of standardized units, multifunctional modularization, and nested modularization [3]. Bamboo weaving products, based on interwoven warp and weft structures, exhibit rich textural variations and visual depth. Integrating differentiated weaving techniques with modular design often results in product systems with gradient density and multidimensional structural tension.

As shown in Fig.1, the bamboo-woven screen designed by Da-Yu Shi demonstrates mechanical innovation through asymmetric woven unit reconstruction. This design departs from traditional vertical structures, achieving stability and balance through irregular geometric forms and inclined structural arrangements. By integrating an interlocking inclined frame with seven heterogeneous woven surfaces, the design forms a dynamic equilibrium. The modular combination of various weaving techniques creates a synergistic structural network. This weaving technique-based modular innovation establishes a sustainable pathway from material efficiency optimization to user experience transformation, providing a reference for the contemporary adaptation of traditional bamboo weaving.

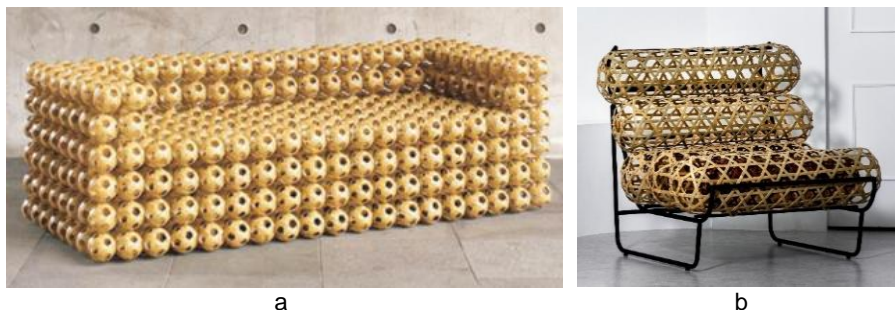


**Fig.1.** Modular Bamboo Screen Design Based on Weaving Techniques: “Seven Sages Screen”, Da-Yu Shi, China, 2012

Standardized modular design decomposes products into uniform units in size, shape, and function, creating a system that balances production efficiency with morphological flexibility. In bamboo weaving design, deconstructing fundamental techniques such as interwoven warp and weft structures and hexagonal weaving extracts standardized units that function independently while allowing flexible combinations. As shown in Fig.2, a, the “Bubble Sofa” designed by Chou Yu-Jui



connects bamboo-woven spheres using mortise-and-tenon joints to form a self-similar fractal structure. The hexagonal units can extend into planar decorative surfaces or stack into three-dimensional furniture. Additionally, as shown in Fig. 2, b, the cross-material integration of bamboo modules with metal enables a replaceable and expandable product system. Repetitive modular connections reduce manual production costs, while the detachable design extends product lifespan, facilitating maintenance, upgrades, and material recycling. Standardized modular design infuses bamboo weaving products with modern design semantics, enhancing adaptability and sustainability.



**Fig.2.** Shape-based Standardized Modular Design of Bamboo Weaving Products: a – “PAOPAO”, Yu-Jui Chou, YII design, China, 2011; b – “Mua Lau Lounge Chair”, Brian Chang, China, 2023

Multifunctional modular design extends functionality through the combination and transformation of modules, emphasizing multidimensional adaptability and morphological variability. As shown in Fig.3, a, the BAMAGIC bamboo lighting series integrates the flexibility of bamboo with modular thinking to create transformable bamboo lamps. By stretching, folding, and reconfiguring the modules, a single lamp can transition into a pendant light, table lamp, or spatial installation, overcoming the functional limitations of traditional lighting. Users can customize geometric forms or switch functional modes by adjusting the number of modules or modifying connection methods, enhancing user engagement through interactive design. Similarly, the Parallel Forest furniture series (Fig.3, b) expands product functionality through the topological combination of bamboo modules, generating diverse furniture forms such as seating, shelving, and partitions. This approach balances customization with scalable manufacturing, demonstrating the potential of modular bamboo weaving in contemporary design.

Nested modular design constructs compact spatial structures through hierarchical containment between modules, emphasizing geometric adaptability and systematic combination logic. The “B@mboo” furniture series as follows in Fig.4., designed by Hsiao-Ying Lin and Chin-Tuan Chiu exemplifies this design approach. By precisely calculating the nesting proportions between modules, the series enables seamless integration of large and small stools, maximizing space utilization



without compromising functionality. The modular application of bamboo weaving further enhances product value: the seat surface employs circular weaving techniques, maintaining the breathability and tactile comfort of traditional bamboo craftsmanship while incorporating standardized interfaces for quick detachment from the frame. This detachable structure facilitates nested compression for transport and storage, allowing users to replace worn seat surfaces or adjust weaving density without dismantling the entire structure. Through the dual innovation of nested logic and modular craftsmanship, this design integrates aesthetic appeal, spatial efficiency, and material performance, offering a systematic solution for enhancing the functionality and sustainability of bamboo weaving products.



**Fig.3.** Multifunction-based Modular Design of Bamboo Weaving Products: a – “BAMAGIC”, Shen W.J, China, 2016; b – “Parallel Forest”, Xu M.Y, China, 2023.



**Fig.4.** Structure-based Nested Modular Design of Bamboo Weaving Products: “B@mbuu”, Hsiao-Ying Lin & Chin-Tuan Chiu, China, 2013



## CONCLUSIONS

This study systematically categorizes four modular design approaches in contemporary bamboo weaving products: modular innovation based on weaving techniques, standardized modular design through unit replication, multifunctional modular design for expanded utility, and nested modular design for optimized space utilization. The findings indicate that modular thinking, through the deconstruction and reconfiguration of traditional bamboo weaving techniques, effectively overcomes the limitations of conventional craftsmanship focused on object replication. This shift advances bamboo weaving toward a sustainable design paradigm characterized by systemic innovation.

In the future, as digital technologies and eco-friendly materials continue to integrate, modular design is expected to further expand the application scope of bamboo weaving products. This approach has the potential to unlock the contemporary value of traditional craftsmanship in diverse fields such as smart home systems and public art, providing a more universal and systematic pathway for the dynamic preservation and innovation of intangible cultural heritage.

## REFERENCES

1. Zuo, Y.Y., Li, Q. Research on the Strategy of Creating Xiangxi Bamboo- Weaving Brand under the Precise Poverty Alleviation Strategy – Taking "Benshun Bamboo Art Cooperative" in Bier Village, Baojing County, Xiangxi as an Example. *Art Paronama*.2018. №02(07) P.76-77.
2. Deng W., Lin H., Jiang M. Research on Bamboo Furniture Design Based on D4S (Design for Sustainability). *Sustainability*. 2023. Vol. 15, no. 11. P. 8832. DOI: <https://doi.org/10.3390/su15118832>.
3. Zhang, Q.Q., Chen. S. Y., Ye, L.& Wang, J. Ideas and Practices of Modular Design of Bamboo Furniture. *World Bamboo and Rattan*. 2022. №20(06):74-78.

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## **ЗАСТОСУВАННЯ ІННОВАЦІЙ МОДУЛЬНОГО ДИЗАЙНУ В ПЛЕТЕНИХ ВИРОБАХ З БАМБУКУ**

У цьому дослідженні розглядаються проблеми трансформації традиційних виробів з бамбукового плетіння з точки зору індустріалізованого виробництва, сучасної естетичної адаптації та функціонального розширення. В роботі досліджено модульний підхід до проектування, заснований на структурних інноваціях, разом із його основними принципами. Дослідження підтверджує доцільність модульного дизайну для переходу від традиційних виробів із бамбукового плетіння до стійкої парадигми.

**Ключові слова:** виріб з бамбуку, плетіння, модульна конструкція, структурна інновація, стійкий дизайн, методи та принципи проектування.