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## DESIGNING EDUCATIONAL CONSTRUCTION TOYS WITH TRADITIONAL LUBAN LOCK STRUCTURES: A CASE STUDY OF “PHOENIX STAMP”

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*This paper examines the “Phoenix Stamp,” an educational construction toy based on the traditional Chinese Luban lock structure. The research explored the materials, structural innovations and cultural significance of toy design, and cultural significance, highlighting its role in preserving Chinese heritage while providing an engaging, educational experience. This work emphasizes the potential of traditional craftsmanship to inform modern toy design.*

**Key words:** design, educational construction toys, souvenir design, wood, Luban lock, Chinese culture.

### INTRODUCTION

In modern design, it is important to use traditional culture in modern products, in particular souvenirs and toys. Gao and Yezhova [1] explore the design of tourism souvenirs inspired by Chinese intangible cultural heritage to propose principles and strategies for preserving and innovating traditional cultural elements in souvenir design. The tenon-and-mortise structure is a connecting mechanism. The “tenon” (榫) refers to the protruding part, while the “mortise” (卯) is the recessed slot that fits with the tenon. It is a typical structure of traditional Chinese craftsmanship, commonly found in ancient wooden architecture and furniture. This technique, characterized by interlocking joints, has become a symbol of Chinese culture. The Luban lock is a special form of the mortise-and-tenon structure and is also an ancient Chinese puzzle toy. Unlike popular construction toys like LEGO, which use modular components, the Luban lock requires complex assembly, with the final piece locking the structure in place, preventing any movement of the whole. This distinction highlights the complexity of the Luban lock.

### PURPOSE

The purpose of this study is to analyze the educational toy “Phoenix Stamp” in terms of its visual appeal, structural integrity, and cultural significance. This case study will demonstrate how a well-designed cultural product can harmoniously integrate artistic and cultural factors, offering both aesthetic enjoyment and educational value.



## RESULTS AND DISCUSSION

**Design Inspiration** The designer of this toy is Guo Fei, a Chinese expert in mortise-and-tenon structure design and a successor of the traditional Luban lock craft. The overall design of the “Phoenix Stamp” is inspired by the ancient bronze vessel “Bird Zun” from the Western Zhou Dynasty in ancient China (Fig.1). It is assembled using the mortise-and-tenon structure (Fig. 2). The innovative aspect of the design lies in ensuring that the assembly respects both the structural integrity of the lock and the aesthetic integrity of the bird form (Fig. 3). This structural design differs from traditional Luban lock structures and represents an original system created by Guo Fei for this product.



Fig. 1 Jin Hou Bird Zun [2]



Fig. 2 Phoenix Stamp (Guo Fei, 2020)



Fig. 3 Comparison of Jin Hou Bird Zun and Phoenix Stamp

[<https://www.hehekaiwu.com/?p=404>]

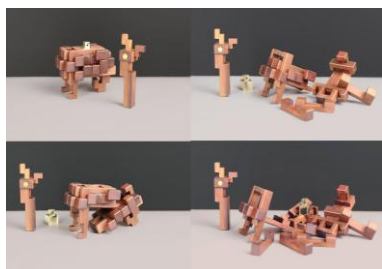


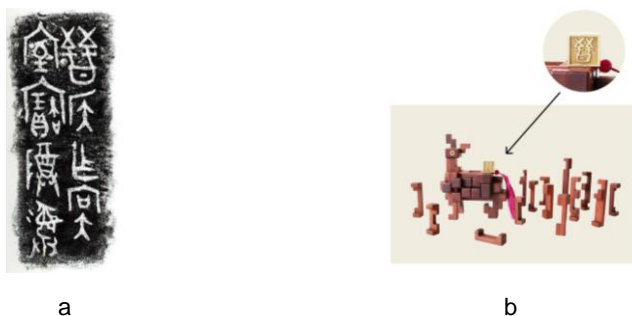
Fig. 4 Internal structure of Phoenix Stamp (Guo Fei, 2020)

**Material Selection.** The designer chose wood as the primary material for its durability and aesthetic qualities. The wood selected is a type of hardwood. The untextured wood enhances the clarity of the interlocking structure and avoids any visual clutter. Additionally, the hardness of the wood ensures long-lasting durability, with the material not susceptible to expansion or contraction over time. The tactile experience of assembling the pieces is enriched by the pleasing sound produced when the wooden components come into contact, further enhancing the user experience.



**Structural Design** The “Phoenix Stamp” consists of 20 wooden pieces, each with a unique interlocking design (Fig. 4). The cross-section of the wood pieces is square, and when viewed from the side, they create a mosaic-like visual effect. This arrangement evokes the rhythms and patterns found in traditional Chinese architecture, such as decorative dougong (a typical structure in ancient Chinese buildings). The abstract geometry in the visual design contrasts sharply with the internal, intricate interlocking structure, preserving the mathematical complexity of traditional mortise-and-tenon while also embodying the formal beauty principles of repetition, approximation, symmetry, and rhythm.

**Functional Transformation: The Bronze Seal** The final component of the “Phoenix Stamp” is a copper seal, which is inserted into the back of the bird form. The inspiration for this seal comes from the lid of the “Bird Zun” (a Western Zhou bronze ritual vessel), which is engraved with the character “晉” (Fig. 5, b), referencing the original inscription on the bronze (Fig. 5, a). In Chinese culture, the “seal” has also been a common feature in ancient calligraphy and painting. This addition not only provides functionality but also adds a layer of historical and cultural significance.



**Fig. 5. The Bronze Seal:** a-Inscriptions on bronze artifacts [3], b-The bronze stamp on “Phoenix Stamp” [4]

**Dual Cultural Attributrs** The “Phoenix Stamp” bridges two cultural realms. First, it revitalizes the ancient “Bird Zun” through a modern interpretation, thereby contributing to the preservation and appreciation of cultural heritage. Second, the toy incorporates the ancient Chinese mortise-and-tenon structure in a creative way, pushing the boundaries of traditional design while preserving its core principles.

**Design Contribution.** The structure of the “Phoenix Stamp” differs from traditional Luban locks (Fig. 6), as it combines the integrity of the mortise-and-tenon structure with the organic form of the “Bird Zun.” This departure from traditional models creates a unique asymmetrical structure, adding artistic depth and cultural significance to the toy.



**Fig. 6** Traditional Luban Lock— Six Classic Styles (Guo Fei, 2022)

## CONCLUSIONS

The “Phoenix Stamp” is a compelling example of how traditional Chinese design can be reinterpreted in the context of modern educational toys. By merging the ancient art of mortise-and-tenon construction with a historical artifact, this product successfully combines cultural heritage with innovation. The design not only serves as a functional toy but also as a cultural artifact that encourages users to explore the rich history of Chinese craftsmanship. Through its material choices, structural design, and cultural connections, the “Phoenix Stamp” demonstrates how educational toys can foster both artistic appreciation and intellectual growth.

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## **ДИЗАЙН РОЗВИВАЮЧИХ ІГРАШОК-КОНСТРУКТОРІВ З ТРАДИЦІЙНИМ ЗАМКОМ ЛУБАН: ПРИКЛАД «ПЕЧАТКИ ФЕНІКСА»**

*У статті розглядається «Штамп Фенікс» - розвиваюча іграшка-конструктор, заснована на традиційній китайській структурі замка Лубан. Досліджено матеріали, структурні інновації та культурне значення дизайну іграшки, підкреслюючи його роль у збереженні китайської спадщини, забезпечуючи захоплюючий освітній досвід. Ця робота підкреслює потенціал традиційної майстерності для формування сучасного дизайну іграшок.*

**Ключові слова:** дизайн, розвиваючі конструктори, сувенірний дизайн, дерево, замок Лубан, культура Китаю.