

# Research on the Inheritance and Innovation of Mortise and Tenon Structure in the Design of Daily Ceramics

Yuwei Liu\*

Jingdezhen Ceramic University, Jingdezhen, Jiangxi, 333000, China

\*Corresponding author

**Abstract:** As an excellent traditional culture of China, mortise and tenon structure is a national intangible cultural heritage, and it is particularly important to inherit and innovate the mortise and tenon structure in the design of daily ceramics. This paper analyzes the morphological and cultural characteristics of mortise and tenon structure, and integrates the mortise and tenon structure into the design of daily ceramics through the reconstruction of shape and the extraction of cultural connotation, aiming to broaden the design ideas of daily ceramics and inherit the tenon and tenon structure culture.

**Keywords:** Mortise and tenon structure, Daily ceramics, Traditional culture, Inheritance and innovation

## 1. Introduction

Ancient China possessed many world-leading techniques, the most outstanding of which was the mortise and tenon and tenon technique. Mortise and tenon are unique connecting structures of ancient Chinese wooden architecture, reflecting China's excellent traditional culture and craftsman spirit, this structural form does not pursue superfluous decoration, but pays attention to the fit of form and practical aesthetics. The introduction of mortise and tenon structure into the design of daily ceramics is not only a reference to the modeling form, but also requires a deep understanding of the cultural connotation and craftsmanship spirit behind it, and the mortise and tenon structure form reflects the hard work and practical aesthetic pursuit of the Chinese nation[1-2].

## 2. Morphological Characteristics of the Mortise and Tenon Structure

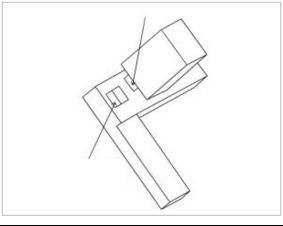
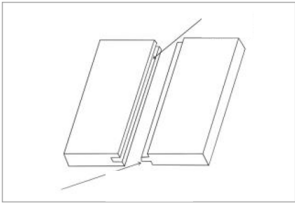
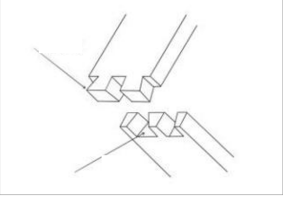
The mortise and tenon structure is a fixed structure composed of a mortise and a mortise. The mortise is the protruding part, and the mortise is the concave part. The two parts are accurately matched to achieve the purpose of connecting and fixing the two wooden structures. In the mortise and tenon structure, the precise manufacture and matching of the mortise and tenon are very important. If the size or shape of any part deviates, the connection will fail.

### 2.1. The Modeling Characteristics of Mortise and Tenon Structure Form

The mortise and tenon structure is common in ancient architecture and Ming-style home design. The common mortise and tenon structures are lattice mortise and tenon, supporting mortise and tenon, zongjiao mortise and tenon, dovetail mortise and tenon, shoulder mortise and tenon, wedge nail mortise and tenon, insertion mortise and tenon, fence mortise and tenon, sleeve mortise and tenon, hanging mortise and tenon, half mortise and tenon, etc. According to the classification of mortise and tenon structure, it can be divided into three categories: surface and surface combination, point combination and construction combination[3-4].

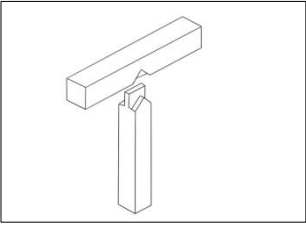
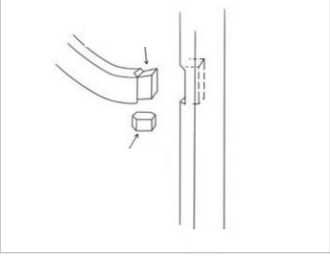
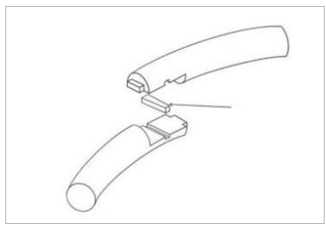
In the first category, the combination types of face and face are "notch tenon", "tongue and groove tenon" and "dovetail joint" (Table.1).

Table 1: Mortise and tenon structure of face-to-face combination

Name	Example	Modeling features
Notch tenon		Combination of tenon and mortise.
Tongue tenon		Similar to the notch tenon, the tenon is pulled through.
Dovetail		When two flat plates are connected at right angles, in order to prevent them from being pulled apart, the tenon is made into a ladder-like shape like a dovetail, so it is called "dovetail joint".

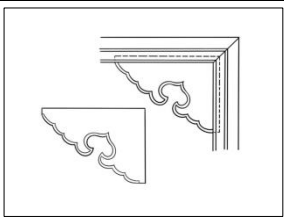
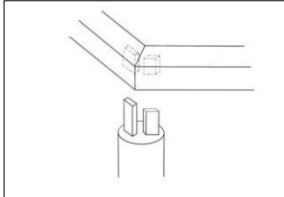
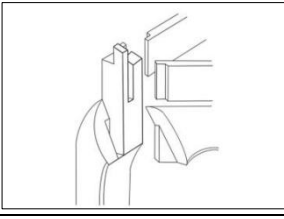
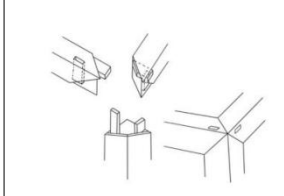
In the second category, the types of point joints are "grid shoulder tenon", "hook tenon" and "wedged nail tenon" (Table. 2).

Table 2: Mortise and tenon structure of the point structure class

Name	Example	Modeling features
Grid shoulder tenon		The grid shoulder tenon is in the middle, and there are tenons on both sides.
Hook tenon		Insert the tenon from the lower part of the mortise, push it upward and catch the gap below to form a barb, and then fill the gap in the mortise with wedge-shaped material.
Wedge tenon		The common mortise and tenon structure used to connect the arc-shaped material cuts the arc-shaped material into two pieces, intersects the two pieces of tenons, and makes the small tongue on the tenon enter the groove. Then, a square hole is drilled in the middle of the buckle, and a square cross-section wedge is inserted from the thick side through the whole buckle.

In the third category, there are many types of construction combinations, such as "dowel tenon", "long tenon", "shoulder tenon" and "zongjiao tenon" (Table.3).

Table 3: Mortise-tenon structure of multi-component combination

Name	Example	Modeling features
Dowel tenon		The horn teeth and the leg feet are connected by slotting on the leg feet, and then the tooth or face is combined with the leg feet and the horn teeth by tenoning and inserting the pile head.
Length tenon		A double tenon joint mode is adopted between the tripod and the panel, and a mortise is formed on the panel and the double tenon is inserted into the mortise.
Shoulder tenon		A triangular mortise is cut on the 45-degree inclined shoulder, and then the embedded tooth strip and the leg foot form the same level. The cross section of this tenon is half silver ingot, which is called "hanging pin" and is sleeved with the notch opened on the back of the tooth strip.
Zongjiao tenon		Each angle is combined with three square lattice angles, so that each angle is combined to form six 45° lattice angle slashes.

## 2.2. The Cultural Characteristics of Mortise and Tenon Structure Form

The morphological and cultural features of mortise-and-tenon structure embody the philosophical thought of "people-oriented", emphasize the cooperation between people and the harmonious relationship between man and nature, and embody the agricultural civilization characteristics of ancient civilization in China. Compared with the western civilization that pursues eternity and takes a long time to build stone buildings, China's mortise-and-tenon structure pays more attention to the needs of users, makes people-oriented and makes buildings warmer. China culture attaches importance to the relationship between people and things, and its thinking on architecture is also evaluated on the basis of people, which makes the oriental architecture represented by China form a unique style, pay more attention to people's feelings, make the architecture more integrated into the natural environment, and reflect the harmonious coexistence between people and nature.

The morphological characteristics of mortise and tenon structure embodies the ancient philosophical thought of "harmony between man and nature", which conforms to the principle of modern sustainable design. The tenon-mortise structure makes full use of the natural characteristics of wood, realizes the coordination of function and form, and shows the simplicity and true beauty. This structure is conducive to the protection of natural resources, the pursuit of sustainable development, in line with the environmental protection concept of modern society. The combination of tenon and mortise forms a flexible framework, which is convenient for maintenance and disassembly. It is an excellent green design strategy and provides useful inspiration and reference for modern design.

The concave-convex structure of tenon and mortise embodies the craftsman spirit that has remained unchanged for years. This structure was invented in ancient times, not only to meet people's aesthetic needs at that time, but also to improve the technological level and production efficiency. The appearance of tenon-mortise structure has greatly improved the manufacturing technology of ancient architecture and furniture, and left us many valuable cultural heritages, which embodies the wisdom, exquisite skills and the spirit of pursuing perfection and Excellence of ancient craftsmen[5-7].

### **3. The Inheritance of Mortise and Tenon Structure in Daily Ceramic Design**

#### ***3.1. The Inheritance of Artistic Expression Forms***

Art needs to be expressed through specific forms. Form is the basic language for artists to express their thoughts, feelings and creative intentions, and it is also the fundamental means to reflect the elegance and artistic pursuit of artistic works. After a long development process, while exploring the mystery of tenon-mortise structure, we taste the unique form of tenon-mortise structure, showing unique composition and formal beauty. The tenon-mortise structure is criss-crossed, and curves and straight lines are combined. The wood is arranged and combined in different ways to form a harmonious and unified structural aesthetic feeling, and the corner treatment can be rounded and elegant. This beauty comes from its powerful practical function and structural wisdom, without deliberate modification, and the structure itself overlaps and is strewn at random, showing natural rhythm and rhythm as well as stable form and modeling characteristics. The introduction of tenon-mortise structure into the design of daily-use ceramics is not only a simple reference to a modeling form, but also a profound understanding of the technical concept, aesthetic concept and even philosophical implication behind it. Combined with our own design thinking and creative attitude, the images of tenon and mortise can be interpreted and extended in the design language of daily-use ceramics in various ways, which will expand the new field of daily-use ceramics design and inject new impetus and vitality into daily-use ceramics design.

#### ***3.2. The Cultural Heritage***

The concave-convex tenon-mortise structure seems to be contradictory, but it can fit perfectly in the hands of the creator, forming a whole with you and me, which contains the philosophical thought of "people-oriented" and "harmony between man and nature" "tenon" and "mortise" are yin and yang, mutually reinforcing and balanced, and the absence of either side cannot form a whole. In the design of daily-use ceramics, the modeling relationships such as plane, concave-convex, inside and outside emphasize the idea of creation that Yin and Yang are integrated, inside and outside, inspiring and transforming each other. The modeling of daily-use ceramics tries to reflect the internal relationship between Yin and Yang. Plane and elevation are often combined in the same modeling, and one is not enough for the whole modeling. They are interdependent and complementary, reflecting the combination of light dynamics and steady static, which is combined with tenon and mortise. Incorporating mortise and tenon culture into the design of daily-use ceramics can not only expand the aesthetic value of daily-use ceramics, but also stimulate the design concept and aesthetic interest with national characteristics.

The tenon-mortise structure has a long history of thousands of years, and it is developing with the progress of human civilization and the development of craftsmen. Today's mortise and tenon has not only appeared as a kind of pieced production method used by craftsmen, but has become a cultural symbol and carrier of Chinese civilization. Mortise and tenon is not only a production process, but also reflects the traditional culture of China and the crystallization of the wisdom of the people of China. Mortise and tenon structure used to be used in wood structures that are difficult to preserve, and daily-use ceramic products are corrosion-resistant and easy to preserve. By using daily-use ceramic products as cultural communication media, applying mortise and tenon structure to daily-use ceramic design is the inheritance and protection of mortise and tenon culture.

### **4. The Innovation of Mortise and Tenon Structure in the Design of Daily Ceramic**

Implicit expression of tenon-mortise structure is an aesthetic habit formed by China people after a long historical development. Implicit expression is also the embodiment of cultural differences between China and the West, which permeates all aspects of our lives, not only in China's poetry, music, calligraphy, painting and gardens, but also in tenon-mortise structure. There are open tenons and hidden tenons in furniture. The hidden tenons are used to hide the traces of tenon-mortise structure, while the open tenons are used to expose tenon-mortise structure. Although the workmanship is complicated, the ancients still like the hidden tenon. With the change of the times, modern designs use more open tenon, and current designers try to show the external structure of tenon and mortise more directly[8-10].

#### 4.1. The Reconstruction on Modeling

With the rapid development of economy and society, the psychological pressure and emotional needs of modern people are gradually increasing, which stimulates the general needs in the spiritual field. We urgently need to find ways to relax in our daily life and infiltrate it into all aspects of life. For example, modern children's toys (Fig.1) designed with tenon-mortise structure as the element show fun and interactivity through color change and freely combinable structure. In the design of daily-use ceramics, we can also innovate from the point of interest and interaction, so that users can have more fun when using daily-use ceramics, which can meet the emotional needs of users, meet the high-level needs of modern people and bring spiritual enjoyment and pleasure to users. This design can not only break the original form, but also sublimate daily-use ceramic products from simple product design to human design, enriching its connotation and design level, and showing the diversity and individuality of modern design.

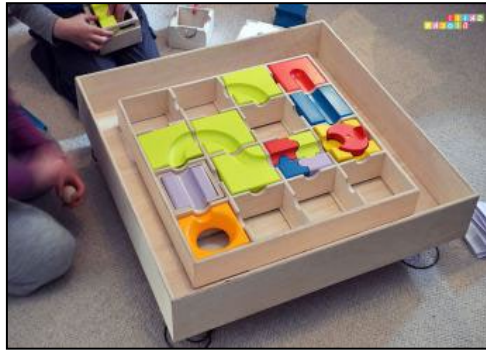


Figure 1: Mortise and tenon structure toys (Image source: [www.puxiang.com](http://www.puxiang.com))

#### 4.2. The Extraction of Cultural Connotation

The most famous one among the mortise and tenon toys is "Luban Lock" (Fig.2), which is composed of different mortise and tenon structures. Because of the complexity of mortise and tenon structure, some mortise and tenon toys are very educational. By disassembling and combining them to solve puzzles, people can understand the knowledge contained in mortise and tenon structure. This process has made tenon-mortise toys have two characteristics, namely, intelligence and knowledge. In the design of daily-use ceramics, intelligence and knowledge can also be added, and the morphological elements of tenon-mortise structure can be applied to the design of daily-use ceramics, so that people can increase their knowledge and understanding of tenon-mortise structure, a traditional culture, when using ceramic products in daily life. This design can not only inherit and carry forward the traditional culture of China, but also meet the aesthetic needs and lifestyle of modern people, showing the innovation and times of daily-use ceramic design.



Figure 2: Luban Lock (Image source: taken by the author)

## 5. Conclusions

Now, let's talk about tenon and mortise again. It is not only a structural form and a connecting part, but also represents the thousand-year inheritance and design essence of traditional wooden handicrafts in China. Mortise and tenon has become a symbol of China culture. New explorations and attempts have been made in the aspects of modeling, materials, functions and culture, providing more design ideas for the development and application of mortise and tenon structure. We can't let tenon-mortise structure exist only in traditional solid wood furniture and ancient buildings, but also let it play a more wonderful role in modern design. Applying the artistic features of tenon-mortise structure to the design of daily-use ceramics can make people feel the inner structural beauty of things. By designing daily-use ceramic design works that meet the needs of the public, are full of Chinese cultural connotation, and have a sense of tradition and the times, we can expand the new vision of daily-use ceramic design. This design idea can not only inherit and carry forward the traditional culture of China, but also meet the aesthetic needs and lifestyle of modern people, showing the innovation and times of daily-use ceramic design.

## References

- [1] Tongtong Jiang. *Craftsman spirit in China's design-taking mortise and tenon structure as an example [J]*. *Western Leather*, 2021, 43(22):19-20.
- [2] Jie Wang. *Innovative research on tenon-mortise structure [J]*. *Journal of Nanjing Art Institute (Art and Design)*, 2018(05):165-168.
- [3] Jiahui Liu, Song Shasha. *Inheritance and development of tenon-mortise structure in wooden buildings [J]*. *Forest Products Industry*, 2019, 46(03):54-59.
- [4] Yanan Wang. *Research on modeling elements of modern daily-use ceramics design [D]*. *Shandong Institute of Arts and Crafts*, 2013.
- [5] Zhuo Shen. *Research on Emotional Design of Household Ceramics [D]*. *Jingdezhen Ceramic Institute*, 2010.
- [6] Fangyi Sun. *On the application of traditional cultural elements in the design of modern daily-use ceramics [D]*. *Jingdezhen Ceramic Institute*, 2012.
- [7] Xin Li. *On the creative thinking of daily-use ceramic design [D]*. *Jingdezhen Ceramic Institute*, 2009.
- [8] Yajie Zhou. *Extension of tenon and mortise language in modern ceramic creation [D]*. *Qingdao University of science and technology*, 2021.
- [9] Ke Tang. *Application of tenon-mortise structure in product design [D]*. *Beijing University of chemical technology*, 2017.
- [10] Zhirui Zhao. *Exploration of toy design based on tenon-mortise structure [D]*. *Shandong Institute of Arts and Crafts*, 2019.