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The Application Research of Mortise and tenon structure in Cultural and Creative Products

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Abstract. This paper takes the form of Mortise and tenon structure as the entry point, analyzes the structural characteristics, style and use advantages, studies the application of Mortise and tenon structure in Cultural and Creative products design, discusses the development of the following products in current and Development issues such as shape, function, and practicality of future products. By combining the Mortise and tenon structure in the design of the product design, the application of Mortise and tenon structure in the product design should follow the rules and principles of the design in order to realize the application and research combination of the Mortise and tenon structure. It provides reference for the design practitioners in the application of Mortise and tenon structure and product design.

1. Preface

Since the development of product design, the Mortise and tenon structure is the essence and foundation of classical architecture and furniture in China. The unique connection structure method makes China's architecture and furniture have unique structural styles and characteristics in the world. Mr Liang Sicheng once said: "No matter which ancient city building, or the cornerstone of the foundation, there is history in virtually telling and even singing about the changes of time. "Architecture is the history and life of a nation, and structure is the foundation of architecture. The structure of architecture and furniture created by the experience of life and the crystallization of wisdom, which is closely related to people's lives, is the most intuitive and true way to understand this nation. The research and mastery of Mortise and tenon structure is of great significance in the research of product design that seeks the characteristics of Chinese culture.[1]

2. Mortise and tenon structure

The Mortise and tenon structure refers to a combination of bumps and joints used on two wood members. This is the main structural form of ancient Chinese architecture, furniture and other wooden equipment. Due to the high requirements for the material processing accuracy of the Mortise and tenon structure, it has not been commonly used in other fields except construction and furniture.[2] Nowadays, with the continuous updating of processing equipment and the continuous advancement of process technology, The components and products of the Mortise and tenon structure are more and more well known and applied.

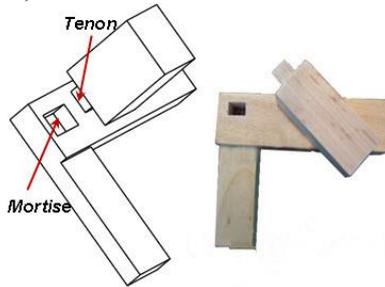
Mortise and tenon structures can be classified into three types:

2.1. Surfaces of objects joint:

The Surfaces of objects joint is mainly through the two or more surfaces joint of different objects, or



two edges of the joint, or the surface and the edge of the joint. Such as 'rabbet tenon' (pic.1), 'dovetail tenon' (pic.2).



pic.1 rabbet tenon



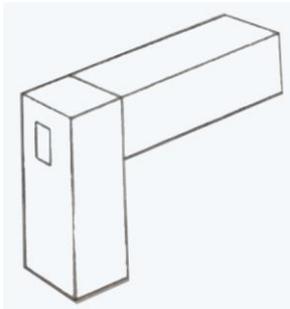
pic.2 dovetail tenon

2.2. Point joint

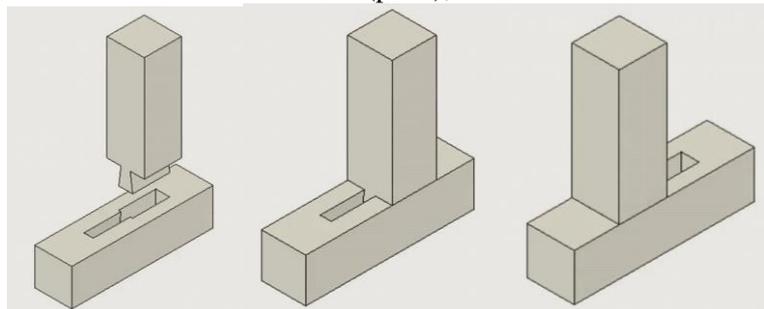
Point structure joint is mainly used for t - joint, corner joint, cross joint and extension joint of straight and arc wood. Such as "transparent tenon" (pic.3), etc.

2.3. Component combination

There is also a kind of construction method that combines three components and links them together. This method is more complex and special except for using some of the mortise and tenon joint structures mentioned above. Such as the common "horse sales" (pic.4), etc.



pic.3 transparent tenon



pic.4 horse sales

Through the above research, it can be found that the mortise and tenon structure has strong pertinence in the joint mode, and different applications have the corresponding joint mode.[3] Therefore, under the corresponding conditions of use, the product presents a unique shape and style. The application of mortise and tenon structure in product design provides a variety of joint modes. Increased the flexibility and pertinence of mortise and tenon structure products greatly.

3.The advantages of tenon and tenon structure using in product design

By studying and considering the characteristics of mortise and tenon structure, the mortise and tenon structure has the following advantages in product design:

3.1. Modular design

The biggest characteristic of mortise and tenon joint structure is not to need to use other affiliated nails or glue, but by using the principle of mortise and tenon joint natural joint way objects can be strong together, each fittings has independent function, geometric connection with a consistent interface and consistent input and output interface unit, in a series of products can be reused and swaps, related modules of permutation and combination to form the final product. Through the combined configuration of modules, products with different requirements can be created to meet customers' customized requirements. The reuse of similarity can simplify the procurement, logistics, manufacturing and service resources in the whole product life cycle, facilitate the update of worn parts in use, and extend the service life of products. On the one hand, modular design can shorten product

development and manufacturing cycle, increase product series, improve product quality, and quickly respond to market changes; On the other hand, it can reduce or eliminate the adverse impact on the environment, and facilitate reuse, upgrading, maintenance and disassembly, recycling and disposal of discarded products.

3.2. Structural modeling innovation

The components of mortise and tenon are various in types and shapes. The rational application of components has a strong combinability. Different components can be combined flexibly. Many fittings have similarity in connection elements, it also makes the similar products on the premise of meet the use function on the modelling with the possibility of a variety of style, can highlight the fittings in product structure makes the product on the modelling is novel and chic, out of the modelling of products in the people's cognitive habits can overlay the features of the product at the same time the potential function of mining products, even in today's increasingly improve the processing technology, structure of mortise and tenon joint fittings through the improvement of the processing is simple, fast and keep the traditional structure inheritance and conforms to the contemporary people's aesthetic pursuit, Breaking through the limitations of previous modeling, it also has the function expansion and transformation to adapt to people's needs for new life products and personal preferences for personalized improvement design.

3.3. Green design

The structure of bismuth is mainly wood, and the science of structure can be revealed by the characteristics of wood itself. With the continuous maintenance of materials maintenance and construction technology, material processing technology is becoming more and more perfect. Many old wood materials appear in people's lives. The processed concrete components can be used as secondary processing of the structural parts of the product, which also fits the trend and principle of sustainable design. In addition, in modern product design, whether in terms of product form or functional structure, it should be consistent with the selected materials, and use the characteristics of natural products to follow the natural laws. Fully consider regional environmental factors, save energy, reduce pollution, and fully integrate natural materials with design ideas, show products that are integrated and harmonious, and show environmentally friendly green design concepts.

4.Application analysis of mortise and tenon structure combined with cultural and creative product design

Cultural and creative industry is an emerging industry with creativity as the core under the background of economic globalization, which emphasizes the development and marketing of intellectual property rights through technology, creativity and industrialization by individuals or teams depending on main culture or cultural factors.[4] Advanced cultural product design has entered an era that emphasizes more on personality, culture and function. People begin to consciously seek for cultural products that can reflect their cultural identity, the evolution and development of folk customs and national culture. Master graphic design master hara kenzai once advocated "defamiliarization of known things is a kind of creation". Abandon the existing product solidification thinking, start from the product essential function, and then shape its image. Restore the product to its original attractive appearance in the "material" dimension. In fact, digging into the roots of different perspectives, such as nationality, regionalism and culture, is an in-depth study of a nation and a civilization.

Nowadays, there are a lot of cultural and creative products combine their functions with tenon and mortise structures skillfully in design. Combining mortise and tenon structure, the product design is more durable and novel than similar products in terms of modeling and installation. Works as the "design culture" in a card case design, for example (pic.5), the product is very clever combination of mortise and tenon joint structure and a business card case, refining the function of the card case, in the design adopted the sycee tenon mortise and tenon joint structure (dovetail) way to split, will be split into two responsible for serving the card's box. Use the weight of the tenon to replace the function of

the clamp of the business card to prevent the business card from slipping. The whole convenient installation and disassembly, suitable for the use of all age groups, dovetail tenon trapezoid design and interface interlocking, in the transverse can make the business card structure will not produce displacement resulting in product structure broken, component fall off and other problems. The two components that hold business CARDS are designed to be portable and easy to handle. Product parts easy to update, extend the service life of the product, with the series of product parts can also carry out replacement, combination, simple design is also convenient for future product function upgrade, exquisite and practical.



pic.5 card case design

"NUDE" (pic.6), which has won the red point award from Germany, the golden point award from Taiwan and the red cotton award from China successively in 2014, adopts the component concept of luban lock (yin and yang lock). Lu ban lock is a traditional civil and architectural fixed binding device in ancient China. It is completely supported by the connection of its own structure without nails and ropes. Design adopted three: the NUDE coatrack is short of a total of six after cutting cutting sticks, each on a long wooden stick has two different directions corresponding to the notches of short stick diameter above to connect fully, can make the short stick, for notches below, as a short stick support, products with a short stick as connectors, the connection between each other can have the support of the entire product, oblique slot can increase the force area of sticks, and at the same time change short stick force direction makes the short stick won't because of the heavy compression fracture, six stick after combination mutually share the stress make products more durable, At the same time, the concise components make the product development cycle, parts update, reuse and replacement more convenient, which is conducive to the extension of the service life of the product.



pic.6 NUDE coatrack

According to the analysis of the above product examples, the application of mortise and tenon structure in product design should consider the following aspects:

First of all, to design a detailed analysis of the features of the product from the problems of existing products, and the corresponding to the solution of the question, at the same time to conduct the thorough research to the functional aspects of mortise and tenon joint structure, with existing mortise and tenon joint structure fitting, a configuration to solve actual problem as the breakthrough point, develop fitting the actual effect to solve the problems need to be solved by products.

Secondly, the design direction of mortise-and-tenon structure products should pursue diversification of products, rather than limit the inherent style and style of mortise-and-tenon structure. Give full play to the advantages of mortise and tenon structure modeling, appropriate to the original structure of the transformation to adapt to the actual needs of the product, the final product should be convenient, simple, practical as the design criteria.

Thirdly, in the design, more consideration should be given to the changes in materials and structures, so as to break through the previous commonly used materials and seek for changes in the texture of products to enrich the changes in the products themselves.[5]

5.Research conclusions

Through the above product case summary, mortise and tenon joint structure in the application of the product, we should first consider the mortise and tenon joint structure in product design which should be aimed at the application of mortise and tenon joint structure mining its internal design ideology, the mode of thinking to solve the problem of the mortise and tenon joint structure to the real application of mortise and tenon joint structure to solve the problems which encountered in the design and creative points. Secondly, in the direction of product design should not blindly pursue "Chinese feeling". The primary significance of product design and production is that it should have functions and can solve the problems brought to users in daily life. Only when it can be truly accepted and used can it subtly make people accept and think about its internal cultural symbols. Therefore, how to make people accept is the essence of product production and design, we should not emphasize too much "Chinese elements", "Chinese style", but should pay more attention to the value of the product itself. Finally, in terms of design, more consideration should be given to changes in material and structure application. Mortise and tenon structure that is in line with product functions should be reasonably selected and the mortise and tenon structure should be redesigned in response to changes in functions. Only by breaking through the conventional thinking mode, can mortise and tenon structure be better used to solve corresponding problems.[6]

To sum up, we can find that the application of mortise and tenon structure in the design of cultural and creative products is not simply the superposition and solution of design, modeling, materials and other problems, but a problem that can be raised to a higher level of design thinking and design philosophy. The application and research of mortise and tenon structure in product design still need to be studied and discussed in the future, which is not only a design process, but also the result of the "re-shaping" of culture.

References

- [1] Hara,K.(2006) Designing Design.Shandong people's publishing house,Shandong.
- [2] Wang,S.(2003) Ming Style Furniture Treasure.Cultural relics press,Beijing.
- [3] Wang,S.(2010) Research on Ming-style Furniture.SDX joint publishing company,Beijing.
- [4] Su,Y.(2010) Product form design;.Shanghai Scientific & Technical Publishers,Shanghai.
- [5] Lefteri,C.(2017) Materials for Design.Publishing House of Electronics Industry,Beijing.
- [6] Brunner,R.(2012) Do You Matter?:How Great Design Will Make People Love Your Company.China Renmin University Press,Beijing.