COMPARISON BETWEEN THE WOOD CONSTRUCTION OF CHINESE ANCIENT BUILDINGS AND FURNITURE — TENON-MORTISE, THE CORE OF CHINESE WOOD CONSTRUCTION

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ABSTRACT: With the evolution of the building style development, the standardization and technique of the furniture has been gradually separated from the limitation of the building, making the transition from a subordinate status to the building to a relatively independent systems engineering. The wood construction system with the distinct characteristics of the period and unique style has thus been formed. However, both are closely correlated in the aspect of the use of wood and the structure of mechanics, as well as the standardization style. Especially the tenon-and-mortise work, which has always been the dominate in the field of Chinese big or small wood-structure and the way of joining different parts for thousands of years, finally became one of the core technology in the making of Chinese ancient building and furniture. In China, the joint between the different parts of the ancient furniture or between the building and the component is almost completely dependent on various tenon-and-mortise structure, forming a firm and durable whole which can be seen everywhere. There is certainly the inseparable similarity and necessity between the Chinese ancient furniture and ancient building in addition to their respective independence. The article deals with the tenon and mortise, outlining the status and role of ancient furniture and wood-structured building in the big and small wood structure for thousands of years in China. The subtle relationship and making technology of the design of the tenon-and-mortise work used in ancient furniture and ancient building has also been emphatically explored.

KEYWORDS: Chinese Wood Construction, Tenon-and-Mortise Work, Ancient Building Furniture

1 INTRODUCTION

The building culture in China can actually be called woodiness culture, and the timber-framed building system in China has also been the important part of the ancient building system in China. The timber-framed building system, from the combination of mud with wood at first stage to the combination of brick with wood in later period, has always been carrying on the construction tradition with the timber-frame as the main structure and the technology of wood structure as the main craft. During the period of the whole process in which Chinese ancient building appeared and developed, the Chinese ancient furniture thus came into being and then has always been with it. Since the appearance of the wood-structured building, the activity that making the furniture coming with the building has gradually come into being, causing a big effect on the housekeeping and living mode of the Chinese. The Chinese ancient building and furniture, the important part of the group life of the whole Chinese nation, has got continuous development, deepening and reached maturity with the evolution of people’s living style.
2 THE WOOD CONSTRUCTION RELATIONSHIP OF THE CHINESE ANCIENT BUILDING AND FURNITURE

Chinese ancient building is not only about the image, but also is the appreciation of the practical space art. The identity of Chinese ancient building lies in the traditional curved roof with wood construction and the capitals supporting the building load, as well as the tenon-and-mortise work used to join all the timber components. The main part of the ancient building is composed of stylobate, column and wall (Xieshan Style: the elevation of wood construction doors and windows ). The part of roof has absolutely been the complex combination of wood construction, which is different from the buildings in foreign countries. The way of traditional curved roof has been developed by the primitive building, which is the continuation of the cave dwelling of the ancient people and later has been divided into many wood construction patterns such as Tailing Style, Chuandou Style, Jinggan Style, Ganjian Style, and Chonglou Style. However, all of these wood constructions has displayed the complex beauty with the help of capitals and tenon-and-mortise work.

Chinese ancient furniture adopts the frame type as the structure system with the enlightenment from Chinese ancient building, using the tenon-and-mortise work to join various components, making the furniture not only firm and durable but also beautiful and generous. Chinese ancient furniture craftsmen have created and invited many kinds of practive of tenon-and-mortise work, which are scientific, reasonable, firm and beautiful, some of them even can not be found outside China.Gejiao tenon, wedge tenon, Zongjiao tenon, Dovetailed tenon, sycee tenon are the ones that could be found in the making of the furniture in foreign countries, while collet model tenon, pothook tenon, fold shoulder tenon, hang tenon, hold shoulder tenon, long or short tenon and hold angle tenon are the special ones that could only be found in the making of furniture in China. Chinese ancient furniture with wood construction and ancient building have been complementary to each other, and they have the congenial relations in the aspect of construction. Furniture is chronologically the continuation and refinement of the building function. In this way, they have the construction similarity in the structure principles and standardization. The furniture and building of the same period will have effect on each other and be complementary to each other.

In ancient China, the furniture is attached to the building, that is to say, the small wood construction of the furniture which is nonstructural has nothing to do with the big wood construction of the building which the main structure supporting the weight of the building’s main part. However, the flourishing of the small wood construction used in the building has completely come from the inspiration of the tenon-and-mortise work used in the furniture. Especially after the A.D. 5 Century, the living style has changed from kneeling sitting on the ground turning into sitting in chiar, which has caused great changes in the former standardization of the furniture. The height of the furniture has changed from being low to being high. From then on, the furniture has gradually become the important part of the small wood construction. Especially later, the components in the wood construction building and the decoration role of the small wood construction have become the compulsory technical means to perfect Chinese ancient building pattern as well as the decoration beautification.

3 THE TRANSITION PROCESS OF THE ANCIENT FURNITURE TO THE BUILDING STRUCTURAL PATTERN AND STANDARDIZATION

The combination change of the furniture from being made in the way of boxes and boards to the way of frame has inevitably affected its structure. To be more specific, since about A.D. 4 Century, the popular way of kneeling and sitting has changed, so the high style furniture which adapts to new way of sitting with erect lower legs has replaced the low style furniture. After A.D. 9 Century, the frame structure of beam and column has gradually gained the popularity and become the major style of the standardization structure. The frame structure of beam and column has been adopted by most of the making of furniture till the time about A.D. 14 Century. In the aspect of style and composition, The outward change of the furniture has caused the change of structure principles. The technology progress of the furniture composition structure has actually been from the imitation and specific guiding role of the structure principle of the big wood construction used in buildings. The wood construction of furniture had the tendency of being more like the building. This important tendency has been inspired by learning the reachness of building style. The high-leg furniture which appeared after the A.D. 5 Century to A.D. 11 Century imitated the structure of beam and column in building. The framework of beam and column which was obviously learned from the construction mode of beam and column in the building appeared in the style and structure of the furniture at that time. For example, the round legs of the wood high chiar and the round columns in the inner or outer eaves of a veranda in a building set each other off. They had the great similarity in the appearance, what’s more, the whole combination of the furniture has changed from pucker style to plank style. The origin of the tenon and mortise work in the furniture could be found in building. The development of furniture was the transition from pucker style to frame style. Hence, the pressure point and holding power of the wood had changed. In this way, the rail used to connect the legs of the furniture is the minification of the FangZi used to connect the columns in the building. The auxiliary supporting components such as the decorative border used to increase the stability is made up as the imitation of the Timu and Queti(be provided with decoration function’s bearing component) in the
The tenon and mortise work in China is the joint core for the building and furniture components. Early in the New Stone Age, the archaeological evidence in Hemudu Culture has found that there were many various tenon-and-mortise work in the large number of wood constructions excavated from the building ruins in the far ancient time. What is the tenon-and-mortise work. Tenon is the convex shape of the wood construction, while mortise is the concave shape. The combination of convex and concave is tenon and mortise work, which has great seismic resistance after the tests for the ancient building in the earthquake for thousands of years. The principle is that the ancient building could dissolve the great power with the tenon and mortise work under the wave of the earthquake. For example, the Liao Dynasty Wood Tower, 67-meter-high, in Ying County, Shanxi Province, Gunyin Attic, Duyue Temple in Jin County, Tianjin, 23-meter-high, remained sound and safe after thousands of earthquake for thousands of years with the flexible frame of tenon and mortise work.

The tenon and mortise work, used in the all the furniture, gained its popularity in A.D. 15 Century when mariner Cheng Ho’s expeditions to South-east Asia took place, introducing the fine-textured and firm hard wood which made the delicate-structured wood construction required by the new style furniture. Many complicated and smart tenon and mortise work has been made according to the designer’s intention. The joint of the components in wood construction is not dependent on the use of nails, but on the special structure principle in addition to the use of swimming bladder, which is absolutely a kind of precise, watertight handicraft. However, the furniture maker had to increase the level of design and making craft because the hardwood was hard and fragile lack flexibility.

The furniture model has the style of being fresh and delicate as well as being neat and pleasing simplicity as the design of furniture usually has adopted the precise and smart craft—tenon and mortise work. Scientific and reasonable tenon-and-mortise technology as well as the rigor and fine design craft makes it possible for some furniture to be firm after hundreds of years, which let us have serious consideration and deep research.

Wood frame work is the main skeleton of the roof and walls, which is the frame work made up of beam and column. The minimum unit is called Jian, which is the inner space four columns surrounded, and the whole building is made up of several Jian. Doors, windows and walls used for surrounding are built between the columns, at the same time, the capital has been used as the transition part between the walls and roof of the big wood construction building. Both help to disperse the pressure from the roof, decrease the load. The capital is a very special kind of tenon and mortise work. In the aspect of mechanical structure, the capital, located between columns and beams, can disperse the load of roof to the basica part of the building serving as the connecting link and role of disperse the load. The capital in wood frame and the tenon-and-mortise work both have the retractility, which entiles the wood frame have the earthquake resistant capability. On the other hand, in the appearance, the capital can extend outside the walls and turn up having the decorative function and making the building look far and magnificent.

China is one of the earliest countries that have studied the technology of furniture, which has been learned from the traditional furnitrue to be firm after hundreds of years, which let us have serious consideration and deep research.

There are many catalogues playing different roles in the tenon-and-mortise work used in the building and furniture.

The tenon and mortise work in the traditional furnishue has developed from the structure technology in ancient building. For example: appear top Tenon in early peirod, still remaining the characteristics of the big beam wood construction with Ming Style. And the application of Visible Tenon (aslo called Guo Tenon, that is to say the visible part of the tenon) could fill up a deficiency caused by the adhesive in the ancient processing technology. The Invisible Tenon (Half Tenon), although with beautiful outlook and not affecting the whole effect of the surface texture, has its
own weakness, virtual tenon, which will have a negative effect on the firmness and durability.

5.1.1 DOVETAILED TENON
The making inspiration for the wood pot cover is from the joint of wood beam in the building. It has dovetail shape, with one end big and the other small. While the back of chair has adopted the half-dovetailed tenon, fasten the back of the chair and the arms.

5.1.2 WEDGE TENON
It is used to join the most difficult part in the furniture--circular arcs part. It goes like this: the material of arc be cutted and skived by twain patches, parallelogram wood wedge nail be embed in the middle part that can boost up wood part component stableness and tightness.

5.2 COMPLICATED TENON AND MORTISE WORK
The tenon and mortise joint in the mature period of the furniture has reached the peak. The standardization norm of the various tenon and mortise work has made the wood construction in Chinese building and style classical and beautiful.

5.2.1 ASSEMBLE MARGIN-KINK ANGLE TENON
It is applied in the combination of frame and board, which combined by frame tenon-kink angle and boards, with no effect on the beauty and firmness of the frontage texture.

5.2.2 HOLD SHOULDER TENON
It is applied in the combination of the legs of the tunic furniture and threaded rod. The leg under the tunic furniture be sawed 45° angle and be chiseled triangle mortice, and combine with tenon lingua.

5.2.3 COLLET TENON
Is a kind of tenon and mortice work with the furniture of desk style. Four corners exceed tenon on the top, coalescent with mortice underside of desk. All fours join pane for bear the the top of the desk.

5.2.4 INSERT SHOULDER TENON
It is connect with crura and the top of the desk, hatch the top of the desk and embed or nip the Yatiao and winkle the trough, come into being steady and reasonable configuration.

5.2.5 DRAGON-PHOENIX TENON
It is a method for link up the table-board panel. Dragon board dig with coattail long tenon and phoenix board dig with mortice, dragon and phoenix boards insert to each other, tightness and the facing of a quilt pull on the belt. The board will not inflector and distortion.

5.2.6 FASTENER TENON
Four corners base timber be sawed 45° angle. Simultaneity, four angle be sawed the four trough with the same breadth and depth, they all anastomose and insert for each other with the same breadth triangle board.

6 CONCLUSION
Building is the important carrier of the national cultural tradition, which has been unconsciously influencing people’s cultural idea. It is very important for the development of a country. Only with the study on the structure of Chinese ancient building and furniture as well as the clear idea about objective rules for the development of Chinese ancient building and furniture can we get the right comprehension of the criterion for Chinese ancient building and furniture to serve the life and be adapt the life which has been inspiring in soft science for the new building design to learn from historical experience.

REFERENCES