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Tel: 00852-28150191

Fax: 00852-25445670

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Tools of Chinese Carpenter

Degang Wang

Suyi Design Group Co., Ltd, Nanjing, 210012, China

Abstract: This Paper attempts to explain that, in China, the traditional building designer is the carpenter. Through the description and use of the main Chinese traditional tools, such as measuring tools, chisels & drills, and planes, tools are the link between practice and principle in China. It is a custom or rule bearing on social operation and determine the styles or forms of thinking of the designer. Also, through the analysis of Chinese fetishes and superstitions, the secret system of building methods and tools of Chinese carpenter profession, the paper briefly discusses the evolutionary process of tools, especially in vernacular level.

Keywords: Carpenter; Traditional tools; Building designer; Evolutionary process; Vernacular

1. Introduction

Tools are the Chinese carpenter's means of life. They are the media between the carpenters and buildings and the link between man, materials and methods. The most important thing is that tools are the way for designs from the carpenter's mind to be transported into construction [1]. For understanding their ways, it is necessary to describe briefly about the building method of Chinese carpenters.

Tools are the link between practice and principle in China. The way of design is the mode of doing something. Furthermore, it is a custom or rule bearing on the social operation, which is looked upon as a guide-line, path and preach. It determines the styles or forms of thinking of the designer.

In China, the building designer is the carpenter. There are two implications of this remark. The first is that the carpenters makes use of the set rules of construction to design a building which would be left to posterity by both verbal and written on word. There were literal records of Qing Tingzhao Fashi, Song Yingzhao Fashi (the rules of construction in Qing and Song dynasty), Ruban Jing (the classical work of carpenter written by Ruban) in recorded history of China. The second is that the carpenters were more than the manual workers because the process of designing and setting up a building was more than a usual construction procedure. There is a relationship between the process of creating buildings and the spiritual dimension of human soul, The process of construction has close relation with the religious belief [1]. The organization, sequence and order of design and the structure and hierarchy of a building were complied with the influence of custom and metaphors of faith which expressed in a dimension system and a professional pithily formula. For instance, the most important ceremony in the process of construction at the stage of completion of assembly of timber-frame was ridge-raising. It means the ceremonial raising and good-

fortune position of the ridge-pole, also the prayers for the long life and well-being of building and inhabitants. The symbols of construction in such process are tools of the Chinese carpenters. The created and used a variety of tools in the accomplishment of these procedures.

2. Measuring Tools (Luban Chi)

In view of this, there were the tools of carpenters for designing the building. The layout dimension was controlled by chi (a unit of length in China, 1/3 meter, Luban Chi) which was a kind of folding ruler, one section was one chi, and the joint of the timber construction was mostly controlled by doukou (the width of one eaves bracket) which was a variable unit of length hinged upon the scale system of a building. The ruler is marked with different segments, each of them symbolizing misfortune or good fortune. For instance, the length of the poster, beam, purlin or rafter and the width and height of windows or doors so far as to the dimension the furniture should be located at the good fortune positions. As for the layout dimension and the height of eaves and ridge-pole of a building were the most carefully located at the apt position. These all were decided or designed by the carpenters. A set of rulers as a design component was the most important tools of carpenters, which was usually held in the master carpenters' hand, and was the instrument of the minds of carpenters. Freedman writes: "The chi, the cosmic breaths which constitute the virtue of the site, are blown about by the wind and held by the waters. An ideal site is one which nestles in the embrace of hills standing to its rear and its flanks" [2]. The procedures of the designing tool use were the fundamental means for the carpenter who realized the form of architecture. The interaction between the carpenters and their tools and between their tools and the materials formed the basis for customs and rules. In other words, the tools were created and used both for the materials which were used in construction and the set rules which reflected the customs and the religions.

There are a large number of tools that the Chinese carpenters used for timber constructions. Generally, the Chinese traditional carpenters' tools are classified in two categories: one is the tools for designing, which are described above, are the spirit of the carpenters, particularly the laying tools such as the ruler and many other measuring tools (no further interpretation here), of which the ruler is the most important. Another set of tools for the Chinese carpenters was their daily professional work which were created for the technical necessities of erecting building construction, such as standing the posts, joining between the beams and posts or other members, cantilevering the eaves of roof or finishing and dressing the timber. Chinese carpenters, on the basis of suiting the feel of their hand and the balance of their body, made the chisels, drills and saws with handles, the wooden blocks of planes and etc. Each of them with different shapes and sizes used different skills to set different forms of the building.

3. Chisels & Drills (Zhuozi & Shou Yao zhuan)

In timber construction of traditional Chinese architecture, the conjunctions of assembling and holding each member together are very complex and intricate.

The timber structure in China, which is known to be different from that in Europe, is not a triangular truss system. To a certain extent, the structure can not be fixed solidly enough, which means that joinery holding and connecting need little movement for adapting the deformation of the raw materials. The Chinese building structure with many moving joints in timber construction form an integrated system adjusting the variations of influences of internal stress and external climate. The Chinese carpenters created a set of chisels and drills to fit each member of timber construction with the intricate joinery together.

The chisels were used to make the mortises and tenons and the drills were used to form the joint of mortises and tenons by boring a hole through both the mortises and tenons with a wooden stopper (Mu Xiaozhi) forced in. The concept of the joint catering to the need of the structural movement is named "the soft touch" in China. The chisels and drills have a series of sizes for making different patterns of the mortise and tenons on the basis of the positions or sizes of timber members. The size of the chisels are marked with feng ranging by half changing rank from 1 feng to 9 feng (1 feng about 0.004 meter). Drills are similar as the head of the chisel is made by the chilled steel. When the size is smaller than 3 feng (about 0.002 meter), it is forged to form a cutting bevel and when the size of the chisel is larger than 4 feng (about 0.016 meter), it is forged to form both the cutting bevel and shoulder bevel. The wooden handle is designed by the feel of hand to reduce the force of resilience and to

deliver the striking pressure onto the head for cutting when the forceful sock is struck by a hammer at the end of the handle. The bit of the drill is made in the same way as the chisel. The shape of the bit is quite like the three cone. There is a metal box pulley to connect the steel bit and the wooden handle. In order to make the bit turning to and fro, a bent bamboo drill bow with two strings is used. One of the drill bow strings is fixed at the top of the wooden handle and another is hitched up at the end of the steel bit where a channel is forged. When the bow is pulled and pushed back and forth, the bit is brought to turn to and fro; therefore a hole is drilled with a pressing force at the wooden handle.

4. Planes (Bao zi)

The function of the planes is to polish the surface after the saw cuts the pre-pattern of the timber construction members and to adjust the dimensions of each member before they are assembled together.

The planes are also designed into a series of sizes to adapt different shapes or patterns which are necessary for erecting the construction (plate 6). The forming elements of the plane are the wood and the steel cutting blade, which are almost the main materials of the tools family in China. The Chinese plane makes use of a rectangular block of camphor wood into which is cut an aperture or "mouth" to take the cutting blade. The cutting blade is forged using chilled steel and works mutually with a capping iron locked by a blade retaining pin affixed at the wooden block. The function of the capping iron is to adjust the cutting edge of the blade in order to make a planing action directing wood and shaving away. The carpenters usually coax to shock the wooden block, the cutting blade or the capping iron with a hammer to set the cutting edge carefully which results in long, continuous ribbons of shavings. The cutting blade and capping iron should be positioned in a moderate degree for the different wood qualities and desired cutting depth.

To polish the various sections of the timber construction members, such as the sharp corner intersection, the sunken channel section, the convex or concave section etc., the planes are designed in a variety of special shapes (plate 7), the Chinese carpenters change the shape of the wooden block of the plane and the size or little form of the cutting blade for fulfilling the different purposes and creating a special effect. Because their number is too large and many of them are made by the carpenter himself in his practicing work, there is no further introduction one after another.

It is difficult to analyze or infer the genuine evolution of the Chinese tools in short, because it is necessary to illustrate a series of results of the archeological discoveries in ancient China and to discuss the evolution of the Chinese history and society. The interpretation of why some of the major Chinese traditional tools are still used or

used together with modern tools by carpenters today, especially in vernacular level, is most important and distinctive in the evolutionary process of tools.

The first is that traditional fetishes and superstitions are still existent in most of the rural areas or popular in part of the urban areas in China. In rural areas, there are a large number of houses which belong to the vernacular level, and are built and designed by the carpenters. Although some of the building materials and techniques in some areas are changed into the reinforced brick masonry and reinforced concrete, but measuring tools for designing are widely used by the carpenters to locate the dimensions in a lucky-fortune positions, needless to say the houses built in timber construction areas. In urban areas, the measuring tools are out of the traditional shape into modern tape measures which are composed with two measuring systems, metric and traditional "chi", for comparison. The tape measure is marked on the misfortune and good fortune segments on the basis of the traditional unit length. They are popular to be used at interior design of houses and buildings to satisfy the auspicious requirement of the owners and clients.

The second is the secret system of the building methods and tools of Chinese carpenter profession. The daily work of Chinese carpenter include careful organization of laying building and construction, management of the clients and owners and paying stress on intensive training of and prudent entailing the profession on the next generation. To pass on the building methods and tools from the master to apprentice was a secret process. The selected apprentices, who must be of the male sex and the same family or tribe lineage as their master, became the inheritor of their profession and were handed down in a direct line from the master himself. Such kind of secret and circumscribed word resulted in the modifications and innovations of the tools as well as building methods for timber construction only being in a limited region, They were lacking in exchange with others, in other word, lacking in outside influences. That is one of main reason for some of the tools without many changes to be used today.

In traditional Chinese tool families, the chisels and planes are widely used together with other modern tools at present without many changes, the measuring tools are used with great innovations; the saws are still used

for adjusting the dimensions of some timber members with several kinds; drills and axes are replaced by the mechanic tools and the other supplementary tools are mostly abandoned. That is why the measuring tools to be the designing tool and chisels and planes to be the technical tool are discussed here. The drills which have close relation with chisels work in mortise and tenon joint are included.

5. Conclusion

Why does the timber construction of traditional Chinese architecture require the use of their specific tools to erect? Why are some of the traditional tools of carpenters inherited without many changes and little innovation is employed today?

Many aspects of Chinese culture could be noted as "the imprint of a particular taste and genius upon a structure intrinsically capable of responding" [3]. The interpretation of the building method of the Chinese carpenters and the timber construction and structure itself require the measuring tools to be the design tools and professional tools to settle the technical necessities which were created and made by Chinese carpenters in their daily work. The religious belief or the faith in China and the secret system of the building methods and tools of Chinese carpentry profession result in some traditional tools employed together with the modern tools at present.

In China, the development of the rural enterprises, the speedy increases in rural income levels and the use of new technology as well as materials in recent years bring about many expression in new housing construction. The evolution of the tools will be different from the past. There are no secret systems any more. The innovation of the traditional tools with many influences should pay more attention to have a further research.

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