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OPEN BUILDING AND THE ROLE OF CRAFTSMANSHIP IN ANCIENT CHINA ---- A HISTORICAL LITERATURE INTERPRETATION OF CONSTRUCTION

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Abstract

The open building, although a new term of architecture that appeared at the end of the 20th century, is not a new concept as far as traditional and has allowed changes and improvements in structure space and function through generations. This paper discusses the relationship between the main building structures, infill elements, and space through examples in ancient China. It then describes the roles of owners, users, and craftsmen via examples from historical records. In studying these examples, this paper concludes that the craftsmen in ancient China are not merely involved in the period of construction but also in the whole period of use. Thus, the relationship between craftsmen and owners or users can continue for generations in some cases. Finally, this paper suggests one possible strategy for the building industry and technology in the context of sustainable development.

Keywords: traditional buildings, flexibility, roles, craftsman

INTRODUCTION

With today's concern on the global environment and more demand for environmental protection, we often encounter "sustainability" and "recycling" in our daily lives. People have begun to realize the significance of the balance between developments in all respects. In the fields of architecture and construction, rapid urbanization around the world has resulted in large numbers of buildings being torn down and rebuilt, no matter how structurally sound they are, when they cannot satisfy the needs of urban transformation. This brings about huge waste of both materials and labor force. In the 20th century, the concept of open building was brought forward and considered as one of the solutions to this problem. Architects tried to make buildings more flexible, changeable, and adaptable by separating building construction to two major parts: support and infill. This concept has been carried out in some residential projects around the world (Kendall and Teicher, 2000). Residents can "design," change, and/or reorganize indoor space by adding or removing infill parts to satisfy various needs through generations. By doing so, the service life of the buildings can be maximized.

In addition, the separation of users, designers, and developers in the design and building process makes the final constructions largely mismatched with users' actual needs. Designers

and developers narrowly understand the functions of certain buildings and space by either their own experience or commercial profit. These “functions” may not be what users actually need. Users often have to adapt to the buildings rather than be serviced by them. Design and construction are considered to be tasks completed in a relatively short period. After a building is built, neither the architect nor the developer concerns the further development of either the building or the users. This problem has been realized since the mid-20th century when some architects invited and encouraged their clients to participate in the design and construction process of their residential projects in many countries (Kendall and Teicher, 2000).

The concept of open building is not new in China. Owing to the materials used in construction, a distinctive wooden construction type has been developed since about 7,000 years ago. In this ancient building, walls are not the part of the supports; they are very thin or even replaced by doors, windows, or other furniture. The first part of this paper demonstrates the flexibility of traditional Chinese buildings by exemplifying on the three aspects: structure, space, and function. The builders in ancient China were considered as craftsmen with a special professional status. They established relationships with the owners and users directly and sometimes took responsibility for certain constructions all their lives. The second part of this paper tries to describe this relationship by narrating some stories and archives. In the third part, the paper analyzes two famous construction regulations in the Song and Qing Dynasties, which gave birth to the standardization of ancient construction.

Most of the examples in this paper were taken from a series of book collections called *Jian Yuan Shi Ying*, which was edited by a group of Chinese architectural historians. They intended to collect systematically all the architecture and civil engineering records scattered in all the historical books on ancient China. According to the principles of choosing entities, it is no doubt that this series presents most of the contexts on Chinese traditional constructions in all respects.

OPEN BUILDING IN ANCIENT CHINA

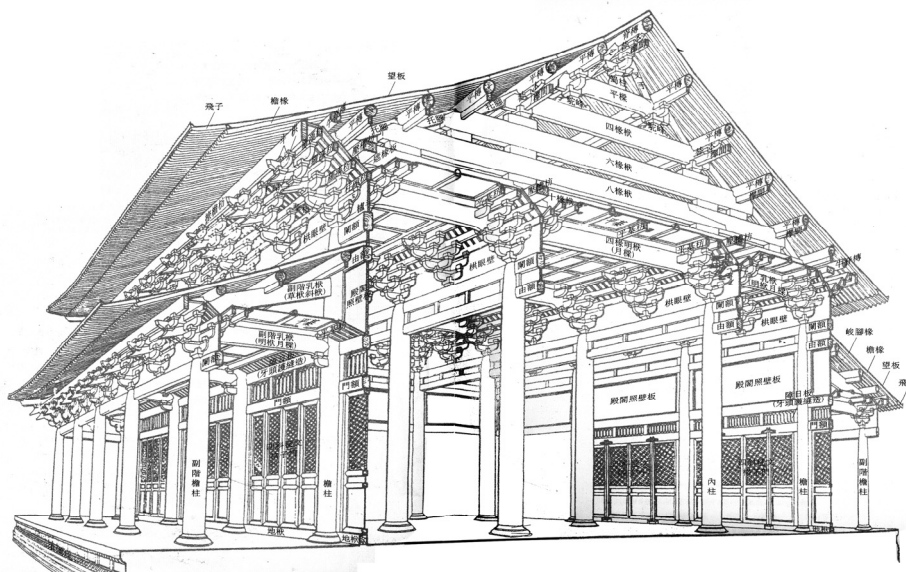


Figure 1: Large and Small Wood Work of a traditional Chinese building

Source: Zhao, G. *Bu zhi zhongguo mu jian zhu* (不只中国木建筑=More than Chinese Wooden Architecture), Hong Kong, Joint Publishing(Hong Kong) Ltd, 2000, 58-59.

Structural Flexibility

The traditional Chinese building structure can be divided into two parts: Large Wood Work for the main building structure and Small Wood Work including an all fit-out construction (Jia, 2001, pp.3).(Figure 1) Large Wood Work is the primary structure composed by beams, columns, bracket sets, and roofs, which are connected together without any nails. The weight of the upper floors and roof is concentrated and transferred down to the beams and columns using bracket sets (Figure 2). All the parts belonging to the Large Wood Work can be changed independently. The following is from a historical record.

There was a carpenter named Huai Bing in Zhending. Once, the center pillar of a 13-storey pagoda was broken. Huai Bing measured and produced a new column with the help of other

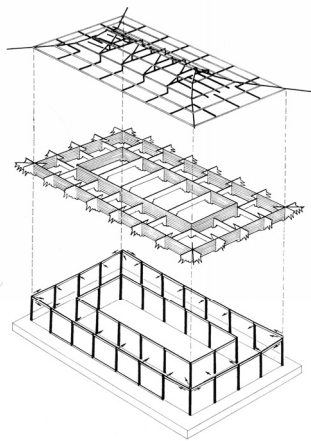


Figure 2: 3 levels of Large Wood Work
Source: Pan, G. & He, J. *Ying zao fa shi jie du* (《营造法式》解读= Decipherment of Construction Regulations), Nanjing, Dongnan University Press, 2005, 26.

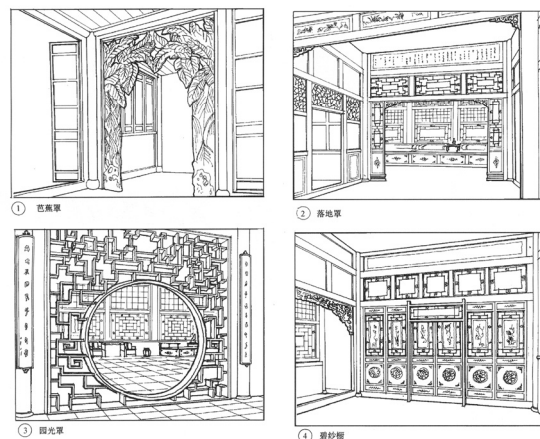


Figure 3: Diversity of infill constructions

Source: Sun, D. (Ed.) *Zhongguo gu dai jian zhu shi: Qing dai jian zhu* (《中国古代建筑史：清代建筑》= The Architectural History of Ancient China: Qing's Architecture), Beijing, China Architecture and Building Press, 2002, 483.

carpenters, and then changed the column all by himself; meanwhile, the people outside the pagoda did not hear any chopping sound. (History of Song Dynasty, cited by Li et al., 1990)

Du narrates the method of restoring Chinese ancient buildings by analyzing the construction technique and experience from old carpenters. He mentions the way of changing a column or a bracket set in an ancient building, the key to which was to support the weight from the upside, and no matter which part it was, that part could be replaced by a new one (Du, 1993).

The narrations above clearly demonstrate the two most important characteristics of Chinese wooden buildings: Large Wood Work bears the supporting function, while Small Wood Work deals with the changeability. As a result, there exists great flexibility on two aspects: one is renewing the building by changing necessary parts, rather than rebuilding the whole structure; the other is choosing the materials for walls, doors, windows, and other separators to satisfy the requirement of various usage and aesthetics. For example, wall hangings and curtains of various materials are always used in or around a building with the same function as that of walls. They were used in private gardens with beautiful sceneries and in some imperial palaces, as well as when the queen mothers would prevent their young emperors from being seen in court by others. Additionally, Jia (2001) describes some other kinds of internal and external partitions and their functions.

If the Large Wood Work decides the scale and size of a building, the Small Wood Work determines the outlook and the inside function of the building. The Small Wood Work includes manufacturing and installing infill and fit-out. The infill constructions in traditional buildings vary. According to their usage, they can be classified into several types (Liu, 2000; Jia, 1998): complete separator as wall; translucent separator, which can be opened or closed such as lattice doors and screen doors; semi-separators with furniture functions such as bookcase and antique shelves; partial separators as the subsection symbol, and so forth. Their forms and shapes can also be diverse (Figure 3). Except for the walls, the other kinds of separators inside or around buildings can be moved when it is necessary, for instance, during the change in seasons and climate, users would change the size of the rooms to improve ventilation or keep warm by removing or adding infill. The following are two real examples. *An open house is suitable in the summer when all the latticework partition and doors can be taken away. As a result, there are no walls for hanging drawings* (Position of Studio, cited by Li et al., 1990, pp.361).

Lu Zizhi built a 28-chi (a Chinese unit of length)-long house to the north side of his living room. There was a big door on the southern wall and a small door on the southwestern wall. In the winter, the house and the living room were divided into two single rooms through the small door. In the summer, the two rooms were integrated together by the big door for ventilation (Notes of Living Room, cited by Li et al., 1990, pp.180).

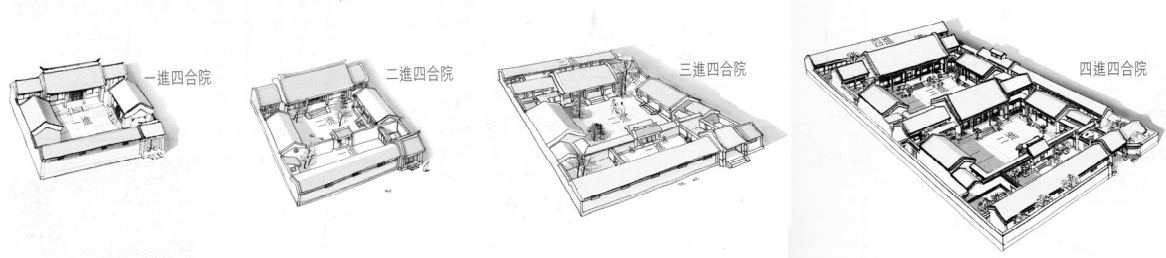


Figure 4: The enlargement of a courtyard

Source: Zhao, G. *Bu zhi zhongguo mu jian zhu* (不只中国木建筑=More than Chinese Wooden Architecture), Hong Kong, Joint Publishing(Hong Kong) Ltd, 2000, 142-143.

Spatial extensibility

The scale of a set of buildings become extensible because of the characteristics of Chinese ancient buildings. Taking the courtyard house as an example, a set of buildings around one court is a unit called one “*jin*.” The primary courtyard with one unit can accommodate a family with five members. With the development of the family, several units can be added along the north–south axis or west–east axis (Figure 4). If the land is enough, this expansion can be endless while always maintaining a temporarily completed form.

Such kind of phenomenon can also be found in some other types of residential buildings in China, for instance, the enclosed Hakka dragon-style house (Weilong-wu) (Figure 5). Owing to the strong

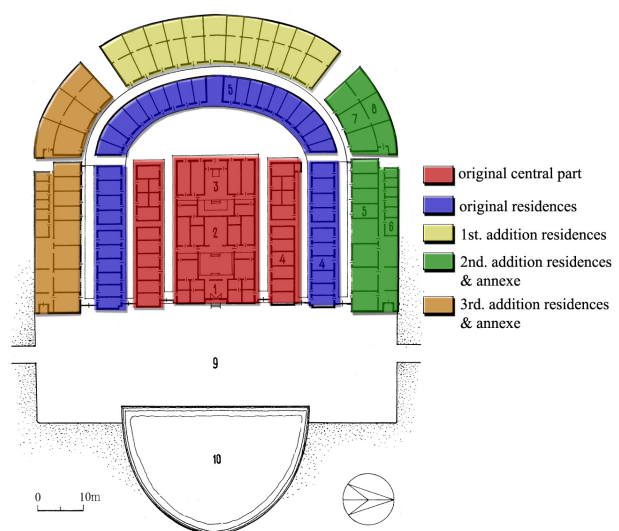


Figure 5: Hakka dragon-style house

ideology of living in a compact community with kinship, Hakka need large-scale buildings, which can not be finished at one time. Usually, at the very beginning, they build the houses along the center axis. Then residences around the center are built for the members of the family at that time. Several years later, another part of residences would be built outside the existing ones for additional members. This construction process would last with the development of the family.

Functional Adaptability

The best manifestation of the flexibility of ancient buildings is their functional adaptability, the number of which is much more than the above two in the historical records. It is another character of Chinese traditional buildings: neutrality of space, which means a room or a set of rooms can be multi-functional (Jia, 1998). There are two kinds of neutrality: several functions overlaying in one space and one function replacing another completely. With regard to the former, the following is a record pertaining to the palace in Hangzhou.

The Hangzhou government was located at the former King Qian palace, which then became the palace of Southern Song Dynasty (1131–1162 AD). The name of the hall left of the back hall depended on the activity held in it. For example, it was called Duancheng Hall when offering sacrifice, Jiying Hall when collecting and consulting, Chongde Hall when dining, and Jiangwu Hall when commission. (Notes of Palaces, cited by Li et al., 1990, pp.258)

Southern Song Government was special because it fled from the north and hurriedly established its new state organ in Hangzhou city; thus, the government had to transform the original buildings to look like its palace. Owing to the lack of halls for various purposes, the hall mentioned above had at least four functions, all of which required different facilities and furnishings. Furthermore, all of these four activities were held at least once a year. Obviously, the function of this hall repeatedly changed; thus, only an “open building” with flexible infill could satisfy all the activities.

Among the people, the function of buildings was usually changed completely from one function to another. Most of the transformations recorded were from residential buildings to temples or schools. Here are some examples.

At the beginning of the Ming Dynasty (1368–1644AD), Censor Cheng Fu proposed to admit the children of military officers studying in schools, and it was approved by the government. Thus, he donated one of his residences to become a school (Records of Hejian Government, cited by Li et al., 1997b, pp.174).

Kaixian Temple, located at the foot of Lu Mountain, was bought by one of the princes of the Southern Tang Dynasty (937–975AD) as a school. After his enthronement, this school was changed into a temple called Kaixian (Records of Nankang Government, cited by Li et al., 1997a, pp.160).

Jianzhong Temple was transformed from the house of Liu Sheng in 531AD. Liu Sheng was a eunuch. His house was more luxurious than that of any of the other Royal class. During 525–528 AD, the house was given to King Yong. In 528 AD, the royal secretary transformed the house to a temple. The lobby was changed to a Buddha hall, while the back hall was changed into a lecture room (Records of Temple Part, cited by Li et al., 1999, pp.397).

Moreover, there are also some legends and stories about functional adaptability.

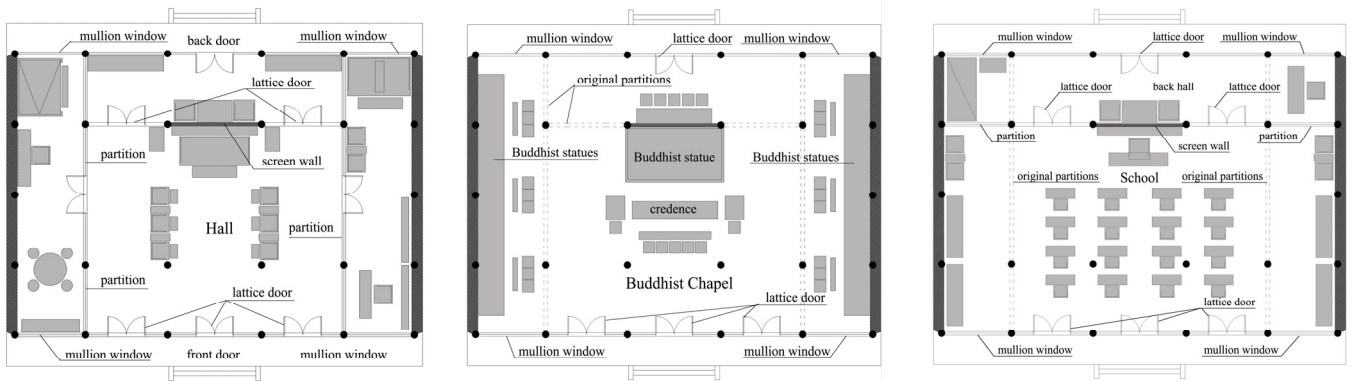


Figure 6: A example of alternations from a hall to a Buddhist chapel and a school

Once, a head named Huang Shougong dreamt that a monk persuaded him to donate his house. Huang said that he would if a lotus would grow on a mulberry tree. Several days later, lotus flowers bloomed in all the mulberry trees. Huang was very surprised. Thus, he donated his house to become a temple called Lotus Temple (Records of Quanzhou Government, cited by Li et al., 1997a, pp.315).

A possible explanation to the above examples is that traditional buildings were functionally flexible. At the beginning of the construction or design, there was no confirmed idea for the spatial function and separation. The differences in the bedroom, living room, and hall were only evident in the types of furniture used inside the rooms. They shared a similar spatial dimension of building depth and width. Furthermore, the separators between two rooms were almost removable. Therefore, a functional change could easily be reached by altering furniture, removing the separators when necessary, but retaining the whole structure (Fig. 6).

THE ROLES IN CRAFTSMANSHIP

There were no so-called professional architects in ancient China. The people doing the design and construction work were craftsmen. The book *Kaogongji* explains that craftsmen are the skillful people who can present and produce the things invented by geniuses; they pass on their knowledge and skill by oral transmission and practice, and live on this skill through generations. All the craftsmen were strictly enrolled with obvious marks in census registration and classified as “residents craftsmen,” and no generations were allowed to shift to other jobs. The following is the earliest record of craftsmen:

King Fu Xi began to set up positions about 7,000 years ago. He named all positions after dragons and called all of them the Dragon Division. He named Da Ting as the Residential Dragon (Ju-Long), who was in charge of building constructions, and called Yin Kang as the Land Dragon (Tu-Long), who was responsible for land and agriculture (Construction Department Records, cited by Li et al., 1999, pp.243).

The craftsmen working for the ruling classes belonged to some of the workshops controlled by the central government. According to the archives called “*Zhou Guan*” and “*Zuo Zhuan*,” the central government of the Western Zhou Dynasty before 10th BC established positions called “*Sikong*” (Master of Construction) to manage architectural design and construction organization. From then on, these positions had been kept and further developed to comprise a systemic department in the succeeding dynasties.

In the Later Han Dynasty (25-220 AD), Sikong was set up among the three most important posts. Sikong took charge of constructions including urban planning, building cities and palaces, dredging canals and ditches, and constructing fortifications and tombs. All his works were evaluated by the central government annually. (Construction Department Records, cited by Li et al., 1999, pp.255-256) Construction masters in the Song Dynasty (960–1127 AD) answered for all the constructions of palaces, halls, city walls, bridges, and managing the construction craftsmen. (Construction Department Records, cited by Li et al., 1999, pp.277) They were ranked from very high positions to low positions. Their jobs involved not only planning and design but also construction, some aspects of architecture, structure, landscape, overall management, and future maintenance.

Among the people, the craftsmen played the role of engineers. Who, then, was the architectural designer of all the projects? Below are some records.

The storage building of Boye Town was designed and built by the Sheriff Wang Shangzhi, following the pattern of the inspector bureau in 1527 AD (Records of Baoding Government, cited by Li et al., 1997b, pp.169).

Sheriff Wu Ruxian was good at feng shui. He considered Ji Gate as a good place with a nice atmosphere for studying. He donated his salary, measured the land, designed the school, and supervised the construction process all by himself (Records of Yanzhou Government, cited by Li et al., 1997b, pp.304).

Jiang Xingben was a careful and clever craftsman. Every time he had a construction or restoration task, he would first consult the owners and users carefully and repeatedly (Biography of Jiang Xingben, cited by Li et al., 1999, pp.305).

In the first two cases, it is clear that regional municipal engineering works such as schools and official buildings were actually designed by the people who used them or who at least deeply understood them better than the craftsmen. In the case wherein a craftsman would take charge of the design, the craftsman would not be all willing to design the building. Even though the craftsman was gifted, he needed to consult the actual users and owners. The owners and users were the leading roles in the process of construction, meanwhile, the craftsmen acted much more like their assistants.

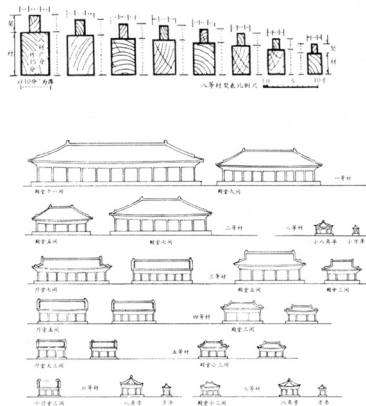


Figure 7: “Cai” and the scales of buildings
Source: Zhao, G. *Bu zhi zhongguo mu jian zhu (不只中国木建筑=More than Chinese Wooden Architecture)*, Hong Kong, Joint Publishing(Hong Kong) Ltd, 2000, 37.

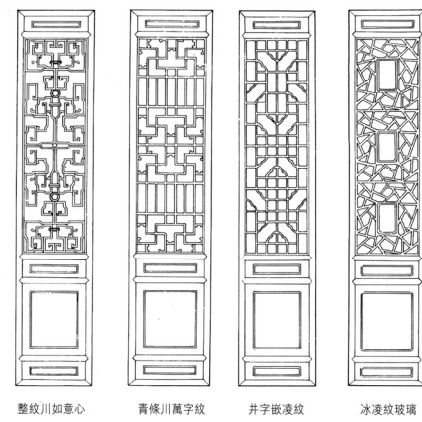


Figure 8: Diversity of lattice door
Source: Zhao, G. *Bu zhi zhongguo mu jian zhu (不只中国木建筑=More than Chinese Wooden Architecture)*, Hong Kong, Joint Publishing(Hong Kong) Ltd, 2000, 37.

CONSTRUCTION REGULATIONS IN ANCIENT CHINA

During the development of ancient architecture, there appeared to be some construction regulations from the Song Dynasty to the Qing Dynasty. Their purposes were to control the cost of construction and normalize the styles of the different types of buildings. However, their effect went further beyond these. They began the construction standardization in China.

The construction regulation of the Song Dynasty was called “*Ying Zao Fa Shi*,” and it was written by Li Jie and published by Minister Wang Anshi, who was the pioneer of the reformers. This construction regulation was part of the political reformation whose purpose was to economize on fiscal spending. The most important contribution of this regulation was the concept of a modulus with eight ranks for different buildings in order to reduce the waste of materials. The primary unit of this modulus was called “cai” (Figure 7), which is actually the section of a ledger without fixed sizes. It clearly presents in the following table (Pan and He, 2005, pp. 46) that the size of unit “cai” in buildings is various, even the buildings in the same rank, their “cai” are different from each other. The standardization only exists among the construction parts in a single building. It is used to unify all the production methods of all the parts for integration. Just as “*Ying Zao Fa Shi*” concluded the reason for the failure of prevenient regulations: Each building, as their locations and surrounding were various, had diverse construction conditions. According to the certain particular circumstances, it is appropriate to have some modification based on the regulation so as to satisfy various requirements. (*Ying Zao Fa Shi*, cited by Pan and He, 2005, pp. 268)

Building	time	Size of “cai”(cm)	Ratio	Ranks
Yuhua Hall in Yongshou Temple, Shanxi	1008AD	24X16	1/1.5	3 rd .
Tripurity Hall, Putian, Fujian	1009AD	29X9.5~12	1/3~1/2.4	3 rd .
Hall of Baoguo Temple, Ningbo, Zhejiang	1013AD	21.5X14.5	1/4.8	4~5 th .
Saintly Mother Hall in Jinci Memorial Temple, Shanxi	1023-1031AD	21.6X16	1/1.34	4 th .
Guangde Longevity Pagoda, Anhui	1102AD	16.3X10.5	1/1.55	7 th .
Moni Hall in Longxing Temple, Hebei	1052AD	21X16	1/1.31	4 th .
Chuzu Buddhist Convent in Shaolin Temple, Henan	1125AD	18.5X11.5	1/1.61	6~7 th .
Tripurity Hall, Suzhou, Jiangsu	1179AD	23.8X16.5	1/1.44	3 rd .
Upper eaves		19X9	1/2.11	6 th .
Bottom eaves				

(Source: Pan, G. & He, J., *Ying zao fa shi jie du* (《营造法式》解读= Decipherment of Construction Regulations), Nanjing, Dongnan University Press, 2005, 46)

In 1734 AD, based on the regulation of the Song Dynasty, the Qing Dynasty published its own construction regulation called “*Gong Cheng Zuo Fa Ze Li*.” The most obvious development was in the modulus system called “tou-kou” with fixed size. As soon as the rank of a building was determined, the size, and the quota of labor and materials of all the construction parts were all confirmed. All parts could be produced independently and synchronously, and installed together. Compared with the regulation of the Song, this one paid more attention to the some particular design of construction parts, for instance, lattice door and window (Figure 8). The form of buildings in Qing Dynasty was enriched a lot.

The standardization, which originated from the Song Dynasty and developed in the Qing Dynasty by the regulations, made the process of construction as shown in the following figure (Figure 9). Using the diagram pattern introduced by Dr. Stephen Kendall, there are

four stages in the process. For one building, the foundation, Large Wood Work, and tile work can commence at the same time in various sites and then installed in the main construction. Afterwards, the Small Wood Work or infill parts can be produced and affixed to the main structure to complete the building. As all the size of parts is confirmed by a certain modulus unit, except for some special requirements, all the parts can be made offsite.

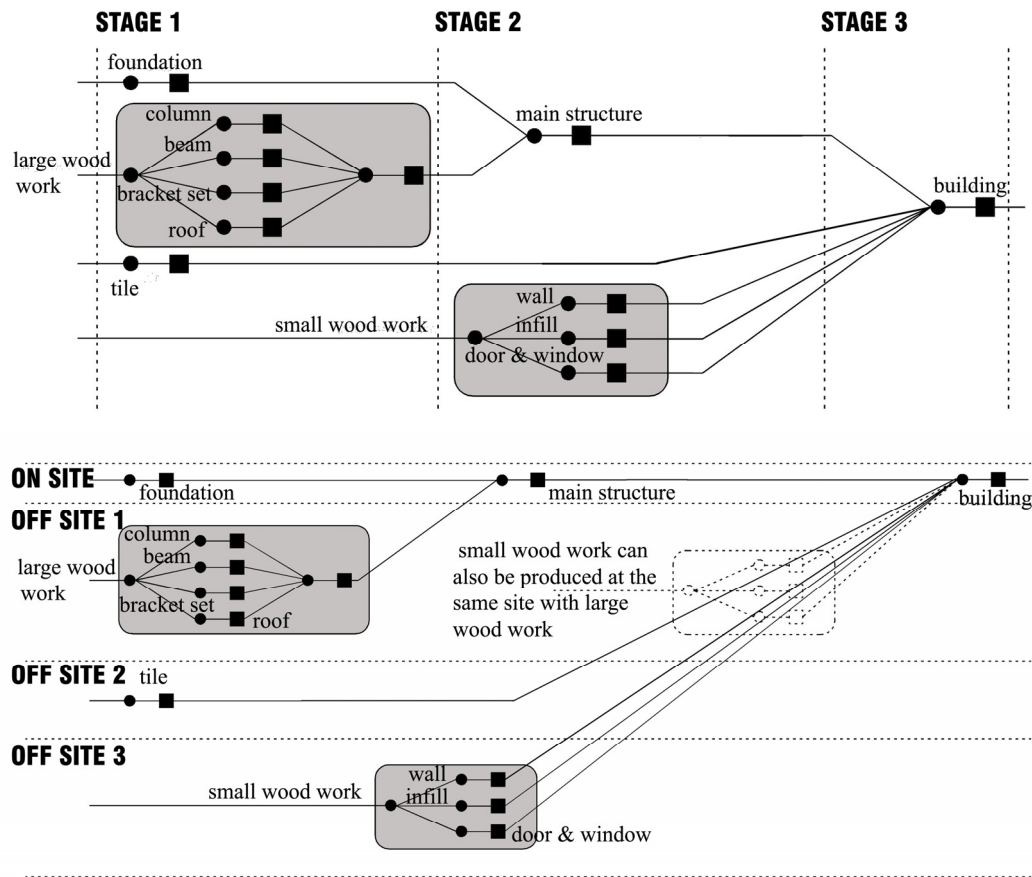


Figure 9: The "maps of control" in traditional Chinese construction chains

CONCLUSION

In today's architecture design and construction, all the buildings and the dimensions of the rooms are designed based on their functions. The locations of every function are clearly separated, and sometimes even the positions of every piece of furniture are already fixed at the design stage. Almost all the parts are immobile to the structure so that they cannot be renewed. The information previously mentioned makes the current buildings and constructions very suitable for a single function with only one dimension but without any adaptability to future development. Furthermore, the service life of a building is calculated through the earliest aging parts rather than the main structure, which may be used much longer. Additionally, the distant relationship between the architectural designers and users leads to a trend wherein designers and developers are more likely to pursue superficial beauty than practicability, or to attend to the current issue rather than future development. Thus, today's architectural designers should, at least, partly take responsibility for the construction waste.

For nearly 5,000 years, Chinese traditional buildings and constructions have been distinct from other kinds of constructions all over the world. On the aspect of structure and

construction, its three-level structure makes it flexible and extensible. This structural character provides functional adaptability or multifunctional adaptability. The particular regulations on scales and sizes of constructions in the Qing Dynasty further led the construction production to the direction of standardization. On the aspect of craftsmanship, craftsmen and their relationship with owners and users are relatively stable and closed. Sometimes this relationship is developed beyond employment. During the process of architectural design, owners or users always played important roles as designers. On the other hand, the skillful craftsmen acted more like assistants helping the owners and users to realize their expectations on the buildings and their lifestyles.

The historical literature and materials on architecture and buildings of ancient China obviously provide some inspiration on the above issues. While investing a great amount of advanced architectural concepts, knowledge, and technology, we should also take some time to look back at some of the useful experiences and methods from the ancient time. Sustainable development in the field of architecture is reachable by merely doing some small changes on our roles and concepts.

ACKNOWLEDGMENTS

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