

CONSTRUCTION OF CHUANDOU TIMBER HOUSES IN SOUTHWEST CHINA: TECHNOLOGY AND COMMUNITY

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Abstract

For people living in the rural mountainous areas in Southwest China, building a chuandou timber house means more than merely making a shelter in which to live. Constructing a house involves multiple events and rituals that bestow an emblematic quality on the dwelling. In addition, these varied activities unite the home owner, the carpenters and the villagers who participated in the construction as an integral community. By studying the role of each group in the construction process, we can understand how this mutual building system is sustainable in a less developed society with fewer commodities. Mountain settlements are rich in forest resources but depend mainly on manual labour and suffer from a lack of building space. This research focused on the construction technology system involved. The research also investigated the rituals that the master carpenter performs, with the aim of establishing how he cooperates with other helpers and how he establishes his role as a spirit medium on the construction site. We found that the mark-ink craftsman holds the knowledge of certain building skills, which are passed down to disciples and relatives and are unique to the areas they are practised. In addition, the mark-ink craftsmen hold power in their relationship with home owners because of their ability to curse the house. This affects fee negotiations and conflict resolution. We examined the special techniques that mark-craftsmen use to mark mortise dimensions and match tenons and how these skills are performed with precision and agility. In addition, the skills and tools used for this vary from culture to culture in the mountainous regions. Chuandou timber houses currently face two problems: They need to be reformed to meet the needs of modern life but also need to maintain their original features to maintain their relevance for the tourism industry. Nowadays, many houses that are made of concrete and bricks are being covered with timber boards to make them look like traditional timber houses. Through this research, we hoped to show that chuandou timber houses, along with their technologies, are products of the living culture of the mountain villages. These houses have their own vitality and the potential to be adapted to the needs of modern society.

Keywords: Chuandou, Technology system, Rituals, Community, Carpentry

1. Introduction

1.1. Concept of *Chuandou*

The term *chuandou* was initially borrowed from the local carpenter vocabulary in Sichuan Province. The term was noted by Zhiping Liu (刘致平), who was a part of one of the first groups of Chinese architectural historians (营造学社) to investigate vernacular building types in Southwest China (Zhiping, 1990). Later, by the time *Building types and structures in China* (《中国建筑类型与结构》) was first published in 1957, *chuandou* had become an important timber structure term (Zhiping, 1957).

Chuandou houses are widely distributed in South China, located mainly to the south of the Qinling mountain range and the Huai River (秦岭、淮河以南). Some are found in the southern areas of Shanxi (陕西) (Qiang Zhang and Peng Yong, 2010) and Henan (河南) Provinces (Ying Fan et al., 2009).

Unlike the *tailiang*, a term created by architectural historians to describe the building structures that originated in North China, *chuandou* is a different type of building that originated in the South China (Xunxiang Qiao 乔迅翔, 2014). With the evolution of these influential approaches distinguishing between the timber structures of *tailiang* (official buildings in North China) and *chuandou* (residential buildings in South China), some hybrid structures evolved, the origins of which are difficult to define (Dazhang Sun 孙大章, 2001). Thus, a new trend in architectural research has emerged that attempts to re-examine the historical origins of traditional timber structures.

Unlike many other historical building, the construction of *chuandou* structures is still occurring in many places, with the most well-known place being the Dong people's community located at the juncture of Guizhou, Hunan and Guangxi Provinces. This area has attracted the attention of both domestic and foreign scholars.

Klaus (2012, p.269) summarised *chuandou* structures as "*Vertical elements, posts or columns bearing purlins at their upper ends, play a visually dominant role. In its basic form, each purlin is born by a column standing on the ground*". He also insightfully noted the following: "*The principle attraction of this construction lies in the ability to use timber elements with a very slender cross section. The drawback is that the floor plan is rigidly determined*". The structure of a *chuandou* home is limited by various engineering elements, which will be discussed in this article.

1.2. Study Methodology

In this study, we examined *chuandou* houses from the perspective of its construction process, rather than its architectural appearance. We focused on the engineering technology that was and still is used by carpenters who specialise in the structures. According to Pfaffenberger (1988, pp.236-252), technology is basically a social phenomenon—it is 'Humanized Nature'. He termed the concept of the 'technology system'. In this study, we examined each factor in the engineering technology system used for building *chuandou* houses, such as the role of different people in various construction activities, their relationship with each other and the utilised tools. In addition, we examined the natural environment surrounding the settlements and the rituals that were conducted during the construction process. As Klass (1993) pointed out in his research regarding the Lu Ban jing (鲁班经), 'Yet from all available sources it appears that in the building field, technique, ritual and magic were linked closely from the beginning'. We are inclined to view the development of *chuandou* houses as a derivative of a particular traditional timber building technology system- what we refer to as *chuandou* system. Go a step further, we compare the *chuandou* system with different technology systems found in Dai people (傣族) settlements located in Yunnan Province (云南版纳地区). Even though research examining the building technology used by the Dai people has only recently begun, we illustrate distinctions between the two systems. By doing so, we hope to connect traditional Chinese architectural techniques with the overall development of construction technology in China.

2. Case Study of *Chuandou* Houses' Construction Process

The construction process of a *chuandou* house is recorded in the historical writings related to anthropological methods of ethnographic fieldwork. The time required to construct a *chuandou* house can vary from several months to years. We investigated and combined several field work materials to form an understanding of the construction process of a *chuandou* house, which is completed in four phases.

Our main field work took place in the Dong people settlement of Dali Village in Rongjiang County, Guizhou Province. We visited the settlement twice in July and November, 2016, and at the second visiting we were able to observe two assembly processes. The remaining field work for this study took place in Hunan and Guangxi of

the Sichuan and Yunnan Provinces (Table 1). The extent of the *chuandou* technology system covered all the four provinces mentioned above.

We got to know details in phase 1 and phase 2 mainly through interviews. For phase 3 and 4 we were able to witness the process at the construction site. We marked each sources used in the progress' description, one can inquire its reference in Table 1.

Time	Places	Interviewee		
		Name	Age	Profession
07-15/11/2016	Dali Villiage, Rojiang County, Guizhou Province (贵州省黔东南州榕江县大利村)	Shengwen Yang (杨胜文)	70s	Mark-ink craftsman
		Youguang Chen(陈有光)	40s	
		Xianming Yang(杨显明)	70s	Cooper
		Shengan Long(龙胜安)	50s	Fengshui master
10-15/08/ 2016	Tongdao County, Hunan Province& Sanjiang County, Guangxi Province (湖南省通道县-广西省三江县)	Fengan Li (李奉安)	70s	Mark-ink craftsman
		Yunqing Yang(杨云青)	30s	
12-20/11/2016	Dali Villiage, Rojiang County, Guizhou Province (贵州省黔东南州榕江县大利村)			
11-15/12/2016	Junlian County, Sichuan Province(四川省宜宾筠连县)	Chunze Zhang (张春泽)	70s	Mark-ink craftsman
12-17/04/2017	Xishuangbanna County, Yunnan Province(云南省西双版纳景迈)	Maiwen Zhang (张迈文)	70s	Carpenter
14-25/06/2017	Tongdao County, Hunan Province& Sanjiang County, Guangxi Province (贵州省黔东南州-广西省三江县)	Yonghua Wu (吴永华)	70s	Mark-ink craftsman

Table 1, Field work area and time

2.1. Phase 1: Material Preparation 伐木备料

As mentioned, it was found through field work that the construction of a *chuandou* house occurred in four phases. Phase 1 comprised log harvesting and preparations. Dali Village residents harvest trees from their own mountain lands for building purposes. This practice is also prevalent in other mountainous areas where Chinese firs grow in great quantities and people own their land. Logging is usually carried out at the end of spring, when the bark is easy to peel off. Prior to logging, a ritual is usually conducted to pacify the mountain spirits.

When harvested, peeled logs were transported to the village and stored to dry in the air, as shown in Figure 1. It takes at least six months for logs to be ready for use, which is why logging usually occurs in the spring. Thus, construction can begin in the winter.



Figure 1. Logs stored on the ground at a construction site, Dali Villiage, 13/11/2016

2.2. Phase 2: Design and Processing of Timbers (设计下料)

After the logs were harvested, peeled and dried, a mark-ink craftsman (掌墨师傅) was invited to the site. The home owner (主人) showed the craftsman the site and they discussed the design together. The choice of a site location is often omitted because new homes are built on previous sites in most cases given the lack of land usable for construction in mountainous villages. The design of the village was previously determined in accordance to Taoist fengshui theory. This occurred when the area was first settled. Only new land used for housing requires a fengshui master (风水先生), who chooses the right direction (depth direction) for the home owner. In this case, he used a compass (风水罗盘, shown in Figure 2) along with the home owner's birthday to choose the best direction. There is a fengshui algorithm that corresponds to a person's birthday to find his or her good fortune direction.

According to the wishes of the homeowner and the limits of the site, the mark-ink craftsman designed the timber frame of the home. The layout and façade was designed in Phase 4. One section drawing (水卦图, shown in Figure 3, which is a 1:10 section drawn on a paper box) was included. This drawing expresses the mark-ink craftsman's design adequately. Later, all the vertical dimensions from the section drawing were transcribed in a 1:1 ratio on to a long pole (杖杆, shown in Figure 4) made of bamboo or timber. Each bay's width dimension was determined by the width of the site. There were usually three bays in the longitudinal direction, and the middle bay was wider than the bays on either side. When all the component dimensions were decided, logs were processed according to the correct measurements.

The design process may seem rather simple, but it embodies the basic methodology of timber structure design. The design and construction process belongs to a profound technological tradition which has a long history and wide applications in China. According to Yuyu Zhang (2010), its more sophisticated application and achievements are evident in the monumental buildings of Fujian Province (福建).

After the dimensions were decided, logs were ready to be cut into the necessary components. First, according to each log's size, they were either rough planed for column material or split into slabs for beam material. After the rough work had been done by either the home owners or helpers they had employed, the mark-ink craftsman and his disciples processed timbers into their final components. Their professional work included the marking of ink lines on to each column according to the dimension pole (杖杆), the drilling of mortise holes to columns and the crafting of tenons on to the ends of the beam planks. The detail of the technology used in this process will be discussed in Section 3. The work in this phase always began with a grand ritual called Xinggongfamo (兴工发墨), which means to begin the ink work, conducted by the mark-ink craftsman. The research team was unable to witness this ritual, but we did observe a rest-on-beam short column covered with an unusual number of horizontal ink lines, which was evidence that ritual had been performed (Figure 5).

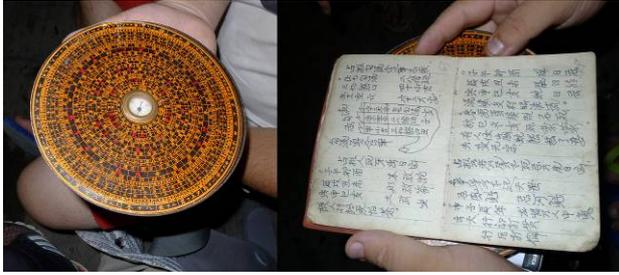


Figure 2. Fengshui compass and notes, photo taken from fengshui master Shengan Long's home, Dali Villiage, 14/07/2016
(大利龙胜安师傅家的风水罗盘和马前卦笔记)



Figure 3. 1:10 Section drawing, photo taken from mark-ink man Youguang Chen's home, Dali Villiage, 09/07/2016 (大利陈有光师傅家的水卦图和弯尺、直尺)



Figure 4. Dimension pole, photo taken from a construction site, Tongdao County, 12/08/2016 (木制杖杆, 拍摄于湖南通道某建筑工地)



Figure 5. Short column marked with numerous ink lines, Dali Villiage, 18/11/2016

2.3. Phase 3: Assembling and Erecting the Structure (组装立架)

The rituals performed that are associated with the erection of the timber structure (立架) and the placement of the middle beam (上梁) are crucial to the homeowner's happiness. The time these rituals are conducted were carefully chosen by a *fengshui* master. He calculated the best time for these rituals down to the hour of day. The two rituals were usually separated by 12 hours. For example, if the erection time was 2 am, then the beam would be placed at 2 pm the next day.

Prior to the selected day, the mark-ink craftsman arrived with his disciples. They assembled the components of the trusses and leaned them on temporary supports, waiting for the appropriate assembly time (Figure 6).

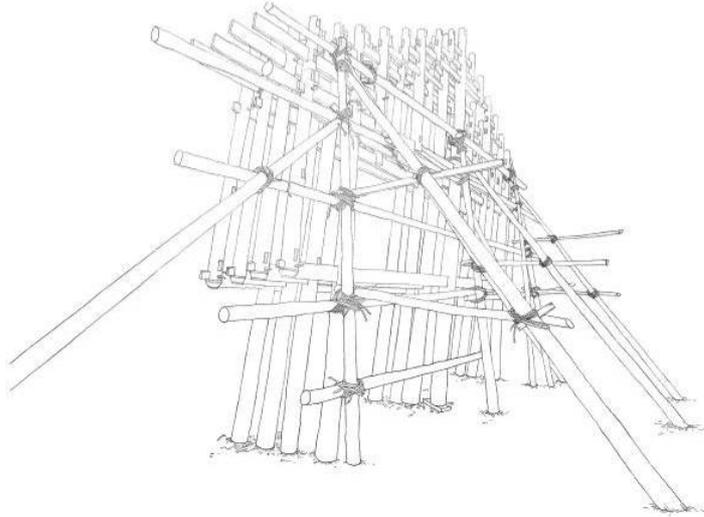


Figure 6. Trusses leaning on the supports, sketched by Ruchen Bian, Daili Village, 14/11/2016

During the proper ritual time, people gathered from the village and relatives came from other villages and stayed for at least three days to finish the work as helpers. In the four Southwest provinces we investigated, the erection time occurred between midnight and dawn. The erection work for a two-story building usually required about 30 men, working simultaneously. When people were ready, the mark-ink craftsman performed the Fachuishuzhu ritual (发槌竖柱, which means the erecting of columns), which consisted of a series of activities, including a dedication tribute to the gods, the chanting of spells while simultaneously writing them in the air and the cutting of a rooster's throat and pouring its blood over the roots of each column. After the ritual was completed, people began to work together under the mark-ink man's instructions (Figure 7).

With 30 labourers, the work of erecting the trusses, connecting them with the beams and placing them in the right places was completed in a few hours. This work needed to be finished by the morning so that people had time to go home and rest before attending the Shangliang ritual (上梁: the placement of the beam on the top) in the afternoon, when all members of the village joined the ritual. The mark-ink craftsman assumed the responsibility of performing the ritual. He first dedicated some tributes to the gods and blessed the 'beam', which played an important role in this ritual. It was regarded as the tree of heaven and its selection and felling had to follow a certain rule. It was placed right above the ridge of the middle bay. The beam was then no longer a structural component but a symbol. After the placement, the mark-ink craftsman took a pair of new shoes from the owner of the house and began to climb the structure using his bare hands while chanting spells. When he reached the top, two men needed to be waiting there. One had to be a cousin from the owner's father's family and the other a cousin from his mother's family. These men pulled the beam up while the mark-ink craftsman threw candies to the crowd below. This was the climax of the ritual.

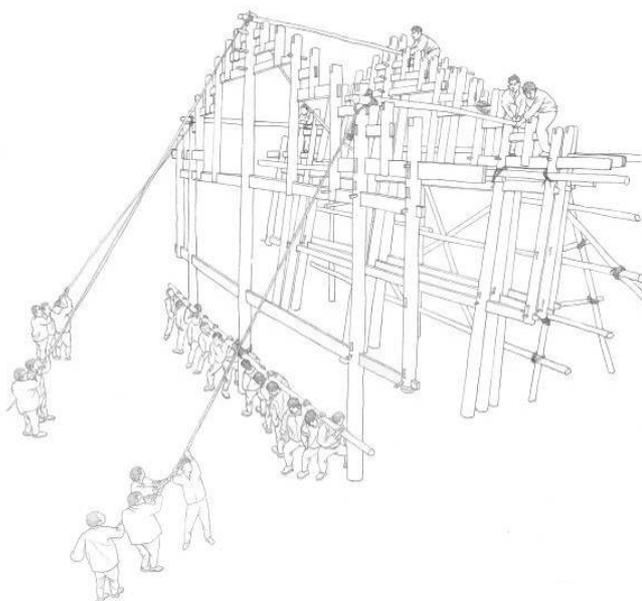


Figure 7. Erecting the structure, sketched by Ruchen Bian, Daili Village, 14/11/2016

2.4. Phase 4: Completion (装修)

On the next day of the Shangliang ritual and the third day of the whole event, after a feast at noon, people went to their own mountain land to cut a Chinese fir as a gift for the home owner. It was quite an experience to hear the logging sounds emanating from all directions at once during that time.

The completion of the *chuandou* house included the work necessary to make all the walls, roofs and floors. Thus, a large quantity of wood was needed. Gifts of wood helped the home owner a great deal. The final carpentry required for the completion of the construction is an expertise different from that of the mark-ink craftsman. There was no ritual or magic involved in the finish work. Usually, local carpenters are hired for this work because they do not need to be paid for their accommodation. Finishing work usually takes more than three months, depending on how many carpenters the home owner hires.

3. Mark-ink Craftsman in the Community

In this chapter, we attempt to interpret the role of the mark-ink craftsmen as the leader of carpenters and their relationship with other people involved in the construction activities to show how their professions are established as architects.

Mark-ink craft is one of China's oldest professions and one that requires high skill levels in multiple areas such as engineering, organising and chanting. Their organisational abilities are highly appreciated in a piece of ancient Chinese prose called 梓人转 ('A biography of a mark-ink craftsman') by Zongyuan Liu (柳宗元), a famous littérateur during the Tang Dynasty (唐). In this prose, the excellent organisational skills of a mark-ink craftsman are even compared to the management of a government.

In this study, through field observation and a literature review, we found that the charismatic capacity of mark-ink craftsmen comes from their magic practice used in rituals. The rituals of the mark-ink craftsman are described in recent books by Fengan Li (2015) and Shiwu Li (2016). As seen in Figure 8, each ritual is acted before the skilled work is begun. The purpose of the rituals differs depending on the occasion, but they include conciliating spirits, praying for safety and blessing the residents, among others. The most important purpose appears to be what could be called a *séance*, which is used to invite the patron saint of carpenters, Lu Ban (木匠祖师爷鲁班), to infuse the divine power to the mark-ink masters. Thus, their role as a carpenter is combined with the role of a Taoist priest, and this enhances their authority at the construction sites.

Figure 8 shows the different groups of people involved in the construction, the rituals they perform and the steps in the construction process. The solid lines link the people with their jobs, whereas the broken lines link the people who are the ritual executors. We can see clearly that the whole network is a mutual building system. However, people's identities are not fixed in such systems. As Xi Pan (2015) pointed out in a study of the Naxi people's building activities, people's roles as home owner, mark-ink craftsman, helper and even the *fengshui*

master can be converted for different occasions. People who have expertise in only one particular field are limited in their job opportunities. Therefore, experience in a variety of roles allows them to have jobs throughout the season. It is the same in other Southwest mountainous villages. This is also why the major construction events take place during winter, which is the inactive period. In rural societies, a complete differentiation of occupation has not been achieved, at least in the field of construction.

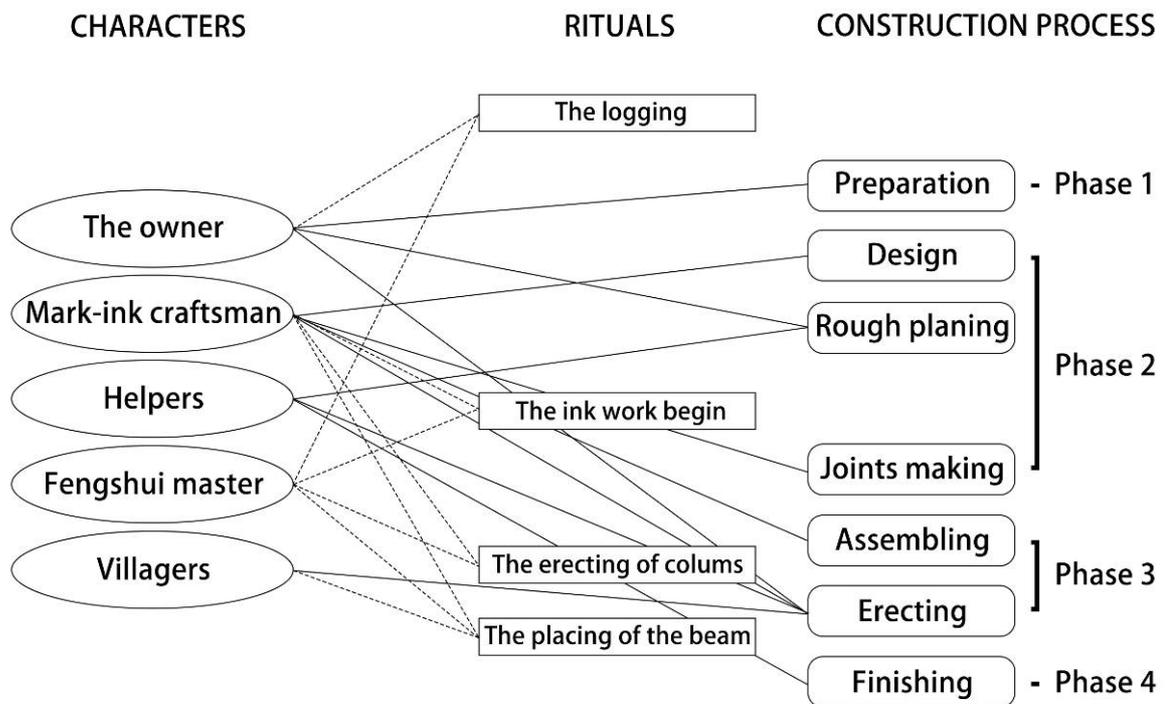


Figure 8. Social network in the Chuandou technology system

3.1. Mark-ink Craftsmen and Home Owners

In a majority of these relatively isolated country villages, people tended to hire mark-ink craftsman from other villages that their acquaintances had recommended. If they did hire a local mark-ink craftsman, fee negotiations could prove to be troublesome, especially when it came to commission work.

When a conflict between the owner and the invited mark-ink craftsman did occur, it was usually regarding money. The mark-ink craftsman is also regarded as a Taoist master and he has the power to curse a home owner if treated unjustly. We found from many sources that this mark-ink craftsmen’s exorcism (the so-called 厌胜) does exist. Shiwu Li (2016) has reviewed many literature records regarding this subject.

3.2. Mark-ink Craftsmen and Their Competitors

The competition between mark-ink craftsmen can be intense. There exists anecdotal evidence relating instances on how mark-ink craftsmen sabotage their competitors’ work. On some occasions, two mark-ink craftsmen were purposely invited to the same project. Each of them was in charge of half of a house. They then started to work at the same time from both sides of the house to see who was better and faster. Sometimes, they even hung a piece of cloth in the middle of the house so that their competitor could not see their work.

3.3. Mark-ink Craftsmen and Their Disciples

Taoqian-Jiaoqian (套签-交签) is the technique used to survey the form of a mortise hole drilled in a column using a stick and mark the dimensions on it (套签). According to the marked stick, ink lines were drawn on the end of a beam plank, which would cross the same hole later (交签). It is a demanding job. For a typical dwelling, there are hundreds of holes to be surveyed and even more for public buildings, such as towers and bridges. Each stick represents one hole and a notation system was used to number sticks.

Why bother using this one-to-one survey method to make joints?

Chuandou houses rely on strong joints to maintain their stability, instead of using braces. In addition, the columns are made of natural peeled fir. These cylinder-like trunks are highly asymmetric. To make each tenon perfectly match the mortise to achieve the maximum friction force requires the development of this Taoqian-Jiaoqian skill.

On the construction site, the mark-ink carpenter is the only one who masters this skill. Disciples follow his ink lines and process the timbers. The mastery of this skill becomes the watershed moment that defines a mark-ink craftsman from an ordinary carpenter.

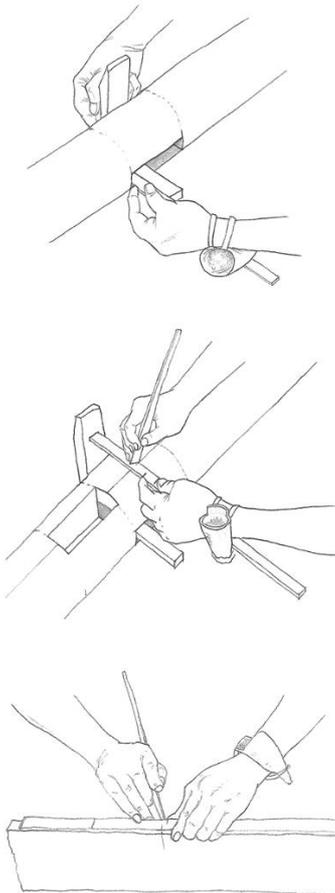


Figure 9. The Taoqian-Jiaoqian technology

The techniques used to master the skill are usually kept secret in one carpentry genealogy. The mark-ink craftsmen we interviewed in our field work informed us that they each have their own way to number the sticks (Figure 11). Carpenters from other genealogies would find the writings of others hard to recognise.

The *Taoqian-Jiaoqian* technology requires both mental ability and physical skill. Figure 9 illustrates the decomposition movements of the mark-ink man's hand. In reality, the whole process was done in just seconds. The mark-ink craftsman placed a *douchi* (斗尺) and a stick across the column. Then, he used his finger nail to mark the position for the depths of the hole (both the higher and lower edges, so he must use both his thumb and his index finger). He then pulled the stick out, with the position of both fingers maintained and drew the marks with ink. The mark-ink craftsman's speed was directly related to the number of disciples and helpers he could work with at once. Only after he marked the ink lines on to the beams could wood processing begin. One mark-ink craftsman we interviewed told us proudly that he could work with 11 helpers at one time.



Figure 10. Tools used for the mark-ink work (left). Douchi (right).



Figure 11. Different kinds of measuring sticks

4. Comparison With other districts

4.1. Other *Taoqian-Jiaoqian* Tools



Figure 12. *Taoqian-Jiaoqian* tools in Dongyang, Zhejiang



Figure 13. *Taoqian-Jiaoqian* Tools in a Naxi settlement, Yunnan

The *Taoqian-Jiaoqian* skill is the core technology for *chuandou* building and is practised in different ways in other districts. Despite using different tools and techniques, the purpose of the *Taoqian-Jiaoqian* skill is the same—to obtain the dimensions of a mortise hole from a round column and mark them correctly on the beam. However, different ways lead to different accuracies in the processing of the tenons.

As seen in Figure 12, the mark-ink craftsman in Dongyang, Zhejiang (浙江东阳), used two plates connected with strings that are fixed at the both ends of a column. Instead of using a *douchi*, he measured the distance

between the string and the surface of the column to get the depth's dimension. This was more accurate than using a *douchi* because a string is much thinner and can be held steadier than with finger nails.

As seen in Figure 13, in the Naxi people's settlement of Yunnan (云南丽江), the mark-ink craftsman used a plank (套榫板) to do his *Taoqian-Jiaoqian* work. This plank can be regarded as a combination of a *douchi* and a stick. It is rewritable and can be reused multiple times. The drawback is that the craftsman must move from column to beam and back and forth. The number of round trips between columns and beams equals the number of mortise holes. Fortunately, the structure of the *manlou* (蛮楼) in a Naxi settlement is rather simple and there are not many joints.

As long as it is a post-and-tie structure and the structure uses round posts, the *Taoqian-Jiaoqian* skill is useful. This unique skill requires occupational education and occupation differentiation subsequently arises.

4.2. Zhulou: A Different Technology System



Figure 14. Zhulou in the Dai settlement and the joint details



Figure 15. Tools to make a Zhulou

Zhulou (竹楼), used in the Dai (傣族) people's settlement, illustrates a different technology system. Instead of Chinese fir, this system requires beech wood in buildings. By using a rectangular cross section, the mortise holes for the columns can be standardised. Thus, the *Taoqian-Jiaoqian* skill is of no use in this system.

Craftsmen can use axes, as shown in Figure 15, to build the entire house. In a technology system such as this, the division of labour is not obvious. In addition, we did not find the belief in Saint Luban (鲁班) in this area.

Zhulou's appearance, along with the building technology system used in this area, perhaps indicates its roots in a rather primitive building system called *Ganlan* (干栏). According to Hongxun Yang (杨鸿勋 1999), *Ganlan* architecture may date back to the age of Emperor Huangdi and the spread of the Empire to Japan. Further research is needed to understand the biogeography of building system types in China and Japan.

5. Conclusion

We found that belief in Saint Luban still prevails in the rural societies of the Southwest mountainous areas in China. As early as the 15th century, according to the carpenter's manual, *Lu Ban jing*, both the technical and non-technical aspects of building are described. The mark-ink craftsman, the master of builders, is also in charge of Taoist priest work and is sometimes even the *fengshui* master. The mark-ink craftsman's style of work is limited by principles of Taoist theory. Therefore, the building types are also limited. For example, houses with four bays or with any braces can never be built. Any diagonal constructional element is seen as an ill-omen in Taoist theory. This explains why trusses for large spans have never developed extensively in China. More research on the period and application range of this combined construction expertise with the Taoist belief system is needed.

In this article, we attempted to decode the conventional architectural term *chuandou* as a timber structure type. We considered this word to be two verbs combined together, expressing the very core technology of building: to cross a beam through a column and to meet two beams in the middle of a column. This technology guarantees stiffness of the wood joints, which assures that the parallelogram timber frames will be steady in *chuandou* houses.

In other regions where the typical *chuandou* house is not the prevalent structure, there existed similar technologies for surveying mortise holes, such as those adopted for *manlou* (蛮楼) in Lijiang, Yunnan (云南丽江), or residential houses in Dongyang, Zhejiang (浙江东阳). The tools they used were different, but their purpose was the same. It was interesting to compare them to *zhulou* (竹楼) in Banna, Yunnan (云南版纳), which is also considered to be a *chuandou* type of structure. However, we could clearly see the differences from the tools that local carpenters used for the joint details. Further, we did not find any belief in Saint Luban in these areas. Local carpenters began to use saws and planes only after the 1980s, when carpenters from Sichuan brought these tools to the area.

We tend to call the architecture seen in Figure 16 as architecture without an architect. In fact, mark-ink craftsmen are the traditional architects in China. Their expertise, along with their belief in Saint Luban (鲁班), makes them craftsmen of a unique profession in society. If given autonomy and information from the outside world, they could possess the ability create modern houses that are different from any other building types in the world.



Figure 16. Architecture created without an architect

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