Yingzao fayuan: The Conflicts and Harmonies between Two Chinese Architectural Education Systems in 1923-1937

by Jianyu Chen

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To the memory of my supervisor
Prof. Peter Blundell Jones
(01.1949 – 08.2016)

my Chinese supervisor
Prof. Zhang, Lianggao 張良皋
(05.1923 – 01.2015)

my grandfather
Jiang, Changlian 姜昌濂
(03.1917 – 05.2010)

Abstract

This thesis focuses on the earliest architectural education in China of the early modern period (with major phases of development from the beginning of 1840 to 1937), which was a period of dramatic social, political and academic changes. Modern architecture came into China from the West through foreign architects and returning Chinese architects who had received their architectural education overseas. The impact of new ideas made Chinese traditional carpenters try to catch up with the times, and the co-operation between carpenter and architect happened in the first collegiate education institutes of architecture.

The thesis attempts to outline from existing research what kinds of roles the traditional Chinese carpenters and the returning Chinese architects played in this period, and how the two different education systems attempted to work together. The paper also describes the main characteristics of the two education systems, investigating their influence on the book *Yingzao fayuan* 營造法原 (Basic Rules for Building).

After that, this study aims to introduce the *Yingzao fayuan*, a book which has been ignored for many years, but can fill the gap of correlational research between these two education systems. The combined hard work of carpenters and architects, it can be regarded as an architecture research book of carpenters and a book to understand the construction process of one type of Chinese local traditional building. In contrast Western influence came through the adoption of the modern architecture method, and with it came Western concepts of architectural history. Thus, it is concluded that the teaching of the modern architecture method and the research of the carpenters work were the earliest foundation of Chinese collegiate architecture education in early modern times.

Keywords:
Early collegiate architectural education in China, Chinese traditional master-apprentice education, Carpenter, Architect, *Yingzao fayuan*.

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Without the deep support of my supervisor Professor PBJ, I might have given up on the May of 2010, when I lost my dear grandfather and did not have chance to say goodbye, or on the last day of 2012, when my laptop and two backups were stolen, I lost all the works I had done for two years, and fresh data I had just gathered from Suzhou. Professor PBJ was reassuring about how I felt, and sent me all my prior works which he had retained, so encouraged me towards the chance to restart. The accident made me re-think my thesis, and the trust in high technology. It enhances my belief that craftwork or traditional method is not only necessary but also irreplaceable in some cases.

I shall extend my thanks to Professor Zhang Lianggao 張良皋, who was my supervisor when I was an undergraduate student, and had kept directing me through all these years on my teaching and studying. Professor Zhang was a famous Chinese architect and scholar, and having graduated from the National Central University, belonged to the third generation of Chinese architects who trained in China. His experience and knowledge gave me lots of help in my research career.

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My sincere appreciation also goes to the employees and carpenters from the Xiangshan Base Group Co., Ltd. 香山工坊, especially Chen Yuming 陳玉明 and Zhou Huimin 周惠民 who participated in this study with great cooperation, and were very generous in sharing their data and experiences of craft work of the Xiangshan Group.

Last but not least, I'd like to thank all my family, especially my parents, my husband, and my lovely son, for their encouragement and support for all those years.

Contents

PROLOGUE

Yingzao fayuan

What is the Yingzao fayuan?

Research Origin

In the West, the meaning of life is frequently expressed in three questions: "Where do we come from? What are we? Where are we going?" These questions are also suited to the meaning of architecture, especially for Chinese modern architecture.

An undergraduate student who received training in Chinese architectural collegiate education from the 1980s would be taught to design architecture in modern or postmodern ways during the whole four or five years of his or her study; at the same time he or she would be asked to investigate and draw Chinese traditional carpentry buildings in year three. Any student who hopes to pursue his or her studies after obtaining the first degree needs to get enough knowledge on both western and Chinese architectural history. These two completely different architecture systems easily confuse them: How did the magnificently decorated traditional Chinese carpentry buildings give way to the rational modern skyscrapers? When, where and why did the changes happen? Who made the changes?

An educator in Chinese architectural collegiate education might know the history of it, and understand that the whole of Chinese architectural collegiate education came from the West, so that every western modern or postmodern architecture movement influenced China profoundly or superficially. But instead of answering a student's questions, this knowledge strengthens the doubt, leaving a need for insights not only into the transformation of architecture in China but also into the exchange between Chinese traditional and Western modern cultures in early modern China. Without an understanding of the origin of Chinese or Western architectural culture, designs would be weird and ridiculous, just like the commonly found buildings which are superficial copies, whether of Chinese traditional or Western modern style in Chinese cities today.

Research on early Chinese architectural collegiate education would lead people to pay attention to the Chinese carpenters in early modern China. There is plenty of research on the earliest Chinese architects, but the roles played by carpenters are underestimated. The book *Yingzao fayuan* 營造法原 and its manuscript drawing provide the best examples for a case study to clarify part of the students' questions.

The *Yingzao fyuan* 營造法原 is a book written between 1923 and 1937 in co-operation by a Chinese carpenter and an architect (but not published until 1959), which studies Chinese traditional local carpentry of the "Xiangshan Group" 香山幫. It is a book that has been long neglected by Chinese architects, but was regarded as the "Basic Rules for Building" by the

carpenters in the Xiangshan Group. It is an architectural research book on the Xiangshan Group's building skills and the rules of Chinese traditional carpentry building, compiled on the basis of a local carpenter's secret family manual.

Research Subjects

In *Carpentry and Building in Imperial China: A Study of the Fifteenth-Century Carpenter's Manual Lu Ban jing*, Klaas Ruitenbeek wrote: "A modern successor of the *Yingzao fashi* 營造法式 is the *Yingzao fayuan* 營造法原."[1] He mentioned two books here: the *Yingzao fashi*[2], "Treatise on Architectural Methods"[3] or "State Building Standards"[4], and the *Yingzao fayuan*, "Source of Architectural Methods"[5] or "Basic Rules for Building".

These are two typical types of Chinese ancient books and documents on carpentry and building. One type is concerned with imperial orders or records by government officials, such as the *Yingzao fashi* in the Song Dynasty (960-1279), and the *Gongbu gongcheng zuofa* 工部工程做法, "Building Methods of the Board of Works"[6] in the Qing Dynasty (1644-1911). These books laid down architectural standards for imperial China, in order to unify construction standards, control costs, and prevent corruption. The other type of book is the carpenter's manual, used by master carpenters and scholars throughout the country. These books were a non-governmental craftsman's working standard or record of their working experience. They were used as a craftsman's guide to building (including sacred rituals), and included such works as the *Lu Ban jing* 魯班經, "Classic of Lu Ban"[7] in the Song and Yuan Dynasties (1279-1368). There were also secret carpenters' family books which were only given to blood relations, such as the early copies of the *Yingzao fayuan* in the late Qing Dynasty, and the *Mujing* 木經, "Timberwork Manual"[8]. Apart from these, Chinese traditional wooden building records can only be found in books written by scholars. The *Yuan Ye* 園冶, "The Garden Treatise"[9] or "The Craft of Gardens"[10], in 1635, under the Ming Dynasty (1368-1644), is a special example. The life story of the author Ji Cheng

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[1] Klaas Ruitenbeek, *Carpentry and Building in Imperial China: A Study of the Fifteenth-Century Carpenter's Manual Lu Ban jing*, (New York: Leiden, 1996), p. 29.

[2] The *Yingzao fashi* 營造法式, "Treatise on Architectural Methods" or "State Building Standards", is a technical treatise on architecture and craftsmanship written by Li Jie 李誡 (1065-1110), the directorate of buildings and construction during the middle Song Dynasty of China.

[3] "The best known and most comprehensive work on architecture published in China, compiled by Li Jie on imperial orders on the basis of a draft prepared in the Xining 熙寧 Period (1068-1077) and completed in 1091." See Klaas Ruitenbeek, *Carpentry and Building in Imperial China*, p27.

[4] Liang Sicheng, 梁思成, *A Pictorial History of Chinese Architecture* 圖像中國建築史, (Tianjin: Baihua Literature and Arts Publishing House, 2001), p.95.

[5] Klaas Ruitenbeek, *Carpentry and Building in Imperial China*, p. 29.

[6] "The *Gongbu gongcheng zuofa* 工部工程做法, 'Building Methods of the Board of Works', seventy-four *juan*, 1734, compiled by a board headed by Yinli 胤禮 (Prince Guo, *Guoqinwang* 果親王, 1697-1738)." See Klaas Ruitenbeek, *Carpentry and Building in Imperial China*, p.27.

[7] "The *Lu Ban jing* 魯班經, 'Classic of Lu Ban', is a carpenter's manual compiled in the fifteenth century on the basis of materials dating from Song and Yuan Dynasties." See Klaas Ruitenbeek, *Carpentry and Building in Imperial China*, p.1.

[8] "The *Mujing* 木經, 'Timberwork Manual', traditionally attributed to Yu Han 喻浩, who lived in the second half of the tenth century." See Klaas Ruitenbeek, *Carpentry and Building in Imperial China*, p. 25.

[9] Klaas Ruitenbeek, *Carpentry and Building in Imperial China*, p.30.

[10] The *Yan Ye* 園冶 is a work on garden design by Ji Cheng 計成 of the late Ming Dynasty in 1631. It is translated by Alison Hardie, publishing English edition *The Craft of Gardens* in 1988. It is now considered the definitive work on garden design of many productions during that period, and has been labelled as the first monograph dedicated to Chinese garden architecture.

(1582-?), especially his early life, is uncertain. Chinese scholar Zhang Wei 張薇 and British scholar Alison Hardie get the situation sorted out with part of his life[11] and his friendship with Ruan Dacheng 阮大鋮 (1587-1646).[12] From their descriptions, Ji Cheng was a special garden designer: He did not like a normal craftsman learn his life skill at a young age, but had good education, and showed a talent for arts and design. He also did not take civil examinations like a normal scholar, but kept up a good relationship with the well-known scholar Ruan, who was one of Ji's most important patrons, and finally helped him to publish his work the *Yuan Ye*. The author of *Yuan Ye* was neither an official nor a craftsman, so the book is a unique type in Chinese ancient works.

None of these Chinese classic works about wooden buildings could be completed only by scholars or officials. The compilers must have had direct and close relationships with master carpenters. There is no doubt that the *Yingzao fashi* and the *Gongbu gongcheng zuofa* were both based on working experience. Without a craftsman's help, there would neither be all the details of parts and members of the structure found in the *Yingzao fashi*, nor the estimation of materials and labour in the last twenty-four chapters of the *Gongbu gongcheng zuofa*. In the latter, the arching of the beam, the shaping of its sides, the carving of ornaments on pedestals and balustrades, and the size of each structural member in each building type are carefully specified.[13] We cannot imagine that both of the national building standards were written only by government officials.

In *A Pictorial History of Chinese Architecture*, Liang Sicheng 梁思成 (1909-1972) described these two books as "two 'grammar books' on Chinese architecture",[14] because both of them paid a great deal of attention to the details of wooden buildings: How to make them? What does the shape of each part of the structure look like? How to manage and arrange the projects? This is just like a grammar book teaching how to write correctly. The *Yingzao fayuan*, as an introduction and research on the "Xiangshan Group" timber building's rules, in many respects follows on from these books, as the grammar book of the "Xiangshan Group" craftsmen.

If the *State Building Standards* could not be compiled without a master carpenters' help, the craftsman's secret family experience could not be handed down through generations without scholars' help. Oral education is restricted to generations, careers, and areas, and is easily lost. Even when some master carpenters wrote or drew on paper, without careful safekeeping by scholars most of it was lost. The *Mujing* for example, was first mentioned in the *Guitianlu* 歸田錄, "Notes Written after Retirement", of Ouyang Xiu 歐陽修 (1007-1072). It is described as a story about Yu Hao 喻浩 and his ten year old daughter, and the author believed that the *Mujing* was a family book of the master carpenter.[15] Only a small part of the content of the *Mujing* could be acknowledged in the *Mengxi bitang* 夢溪筆談, "Dream Pool Essays", by Shen Kua 沈括

[11] Zhang Wei, "On the Author Ji Cheng and the Book *Yuanye*: The Culture View of *Yuanye* (1) 論計成其人與《園冶》其書——《園冶》文化論之一", *Chinese Landscape Architecture* 中國園林, 07 (2005), 45-48.

[12] Ji Cheng, Alison Hardie, trans., *The Craft of Gardens: The Classic Text on Garden Design*, (New York: Better Link Press, 2012), p.12. Also see Alison Hardie, "The Relationship between Ji Cheng and Ruan Dacheng, and the Publication of *Yuan Ye* 計成與阮大鋮的關係及《園冶》的出版", *Chinese Landscape Architecture* 中國園林, 02 (2013), 49-52.

[13] Liang Sicheng, *A Pictorial History of Chinese Architecture*, p.109.

[14] Ibid., p.95-109. Liang summaries the contents of these two classic books.

[15] "Each night before going to bed she showed building constructions to her father, by making gestures with her fingers. After one year had passed in this way, Yu Hao had finished the three chapters of his Timberwork Manual." Klaas Ruitenbeek, *Carpentry and Building in Imperial China*, p.26.

(1031-1095). He quoted, or more likely summarized, parts of the *Mujing* in his book. Without these two famous scholars, none of the content of the *Mujing* would be known.

All ancient literature about Chinese wooden buildings, whether written by scholars or officials, was based on craftsmen's work, especially carpenters' work. But because of their different educational background, social position, and writing purposes, carpenters and scholars (or officials) described their work in different ways. For example, the *Mujing* has the distinction of the *Mengxi bitan*. Yu Hao was a master carpenter, and Shen Kuo was a famous scholar. It would be interesting to contrast and analyse their differences of working focus, if the original texts of the *Mujing* could be found.

The *Yingzao fayuan* gives us a chance to offset the loss of the *Mujing*. Its original author, Yao Chengzu 姚承祖 (1866-1938), was the famous leading master carpenter of the Xiangshan Group in the 1920s. Although the original texts were lost, the original drawings by Yao were preserved in a book named *Yao Chengzu Yingzao fayuan tu* 姚承祖營造法原圖, "The Original Drawings of the Source of Architectural Methods by Yao Chengzu". The first editor of Yao's book was Zhu Qiqian 朱啟鈐 (1871-1964), a well-known official, scholar, and reformer of the late Qing Dynasty, the founder and patron of the Society for Research in Chinese Architecture 中國營造學社, and the discoverer of the *Yingzao fashi* and *Yuan Ye*. The book known today as the *Yingzao fayuan* was edited by architect Zhang Zhigang 張至剛 (1909-1983), who was one of the first generation of Chinese architects trained in China. The last editor of the modern edition was Liu Dunzhen 劉敦楨 (1897-1968), who was a well-known architect like Liang Sicheng, and was an architect and architectural educator who had been trained in Japan. Without any exaggeration, the *Yingzao fayuan* was born prominently, and represented the highest level of research on Chinese traditional carpentry building at that time.

From table 0-1 we can understand the time line of the *Yingzao fayuan*. Its life experience has been varied and legendary. The book was written in 1923, compiled in 1929, completed in 1937, but not actually published until 1959. During this period, it experienced continuous wars, fire, and the establishment of a new political power. After a period of post-war reconstruction and everything starting from scratch, it was miraculous that Yao and Zhang's draft manuscripts of the book were preserved by Liu, and that the Yao's original drawings of the book were kept by his homeland craftsman Zhang Heshang 張和尚, then rediscovered by professor Chen Congzhou 陳從周 (1918-2000) in 1978. The devoted protection by these figures meant that the book and original drawings could later be published and researched. There are only two editions of the *Yingzao fayuan*, of 1959 and 1986. The dates of the editions dovetailed nicely with two culturally prosperous times of modern China.

These two editions of the *Yingzao fayuan* are good choices for case study that run through this thesis, both for clarifying the relationship between the "Xiangshan Group" carpenters and the earliest Chinese architects, and for understanding carpenters' and architects' architectural education systems in early modern China.

Time	People	Terrain	Event	Comment	
1840			The end of the Opium War.		
1911			The Republic of China was found.		
?	Yao Canting 姚燦庭, carpenter.	Family carpenter workshop, either in Suzhou 蘇州 or Xukou 胥口.	Yao's grandfather wrote the *Ziyeyishu* 梓業遺書, "Traditions of Carpentry". The **important source** of the *Yingzao fayuan*.	A Carpenter's **secret family skills manual**: the *Ziye yishu* 梓業遺書, "Traditions of Carpentry".	
1923-1927			The Suzhou Engineering School 蘇州工業專科學校		**Conflicts**
1923 -1929	Yao Chengzu 姚承祖, (1866-1938) carpenter.	The Suzhou Engineering School 蘇州工業專科學校, Suzhou, (Before 1927).	Yao wrote **the manuscript** of the *Yingzao fayuan* 營造法原.	A **text book** for the course 本國營造法, "national building method".	
1928-1937			The National Fourth Zhongshan University 第四中山大學 The National Central University 國立中央大學		
1929	Liu Dunzhen 劉敦楨 (1897-1968), architect.	National Central University 國立中央大學, Nanjing.	Yao asked Liu to givesome advice on his manuscript. Liu hoped to do so but was too busy to start.		
1932	Zhu Qiqian 朱啟黔 (1871-1964), scholar.	The Society for Research in Chinese Architecture 中國營造學社, Beijing.	Liu brought the manuscript to Zhu. Yao sent his original drawings and the *Drawing of Buyun Xiaozhu* 補雲小築圖 to Zhu.		
1933	Zhu Qiqian 朱啟黔	The Society for Research in Chinese Architecture 中國營造學社, Beijing.	Zhu wrote an essay to record their friendship and his evaluation of the manual.	A **Scholar's review**: *essay on drawing of Buyun Xiaozhu* 題補雲小築圖	
1935-1937	Zhang Zhigang 張至剛 (1909-1983), architect.	National Central University 國立中央大學, Nanjing. (Working with Yao in Suzhou.)	Zhang helped Yao to complete **the formal draft** of the *Yingzao fayuan*.	A formal draft of the **architecture research book**.	
1937			The star of Sino - Japanese War		
1949			The People's Republic of China was found.		
1937-1953	Liu Dunzhen 劉敦楨	National Southwest Associate University 西南聯大, Changsha, Kunming, Lizhuang 李莊; National Central University 中央大學, Nanjing ; Nanjing Technology School 南京工學院, Nanjing.	Liu kept the formal draft well with him throughout half of China.		**Harmonies**
1956-1957	Zhang Zhigang 張至剛 Liu Dunzhen 劉敦楨	Nanjing Technology School 南京工學院, Nanjing.	Liu was asked and helped Zhang to accomplish **the modern edition**, and edited it.	The modern edition of the **architecture research book**: *the Yingzao fayuan* 營造法原.	
1959		China Architecture & Building Press 中國建築工業出版社, Beijing.	The *Yingzao fayuan* was published as the first printed edition	The first edition, first print.	
1966-1976			The Cultural Revolution in China.		
1979	Chen Congzhou 陳從周 (1918-2000), architect.	Tongji University 同濟大學, Shanghai.	Chen obtained Yao's manuscript of drawings, and organized and printed it.	A pressure collection of the manual drawings: the *Yao Chengzu Yingzao fayuantu* 姚承祖營造法原圖.	
1986	Zhang Zhigang 張至剛	China Architecture & Building Press 中國建築工業出版社, Beijing.	The *Yingzao fayuan* was published as the second printed edition. Zhang re-edited it.	The Second edition, first print.	

Table 0-1 Chronology of the *Yingzao fayuan*

Structure of the Thesis

The following chapter presents a Literature Review which introduces previous research from related general research to the studies on the *Yingzao fayuan*. It explains how the literature that I have reviewed is used in this thesis, and how my own work responds to this. My research fills the gap in understanding concerning the relationship between the modern architect and Chinese traditional carpenters in early modern China, and the gap between two Chinese architectural education systems behind them. My study on the *Yingzao fayuan* is an original contribution to knowledge, for it compares two editions of the book, one by the carpenter and the other by the architect, not by following these page by page, but focusing on the carpenter and architect's different ways of thinking as these are evident in the main text and in the drawings.

Two main parts of this thesis are concerned with the historical context and literary contents of the *Yingzao fayuan*: it explains why a book came to be co-written by a Chinese carpenter and an architect in Suzhou in 1923-1937; it analyses the two Chinese architectural education systems that trained the carpenter and architect in that era; and demonstrates how the conflicts and harmonies between these two educational systems are reflected in the book's texts and drawings.

The first part focuses on the question: How did the book come about and evolve? Three Chapters answer this question, first from the general background of the people, time and terrain; then in relation to the two specific architectural education systems in Suzhou in 1922-1927; then in relation to the specific history of the *Yingzao fayuan*: the authors and editors and the different editions. First, I explain why the book could not have been produced earlier than the 1920s or later than the 1930s. The period of China opening the treaty ports and of foreign architects coming to China decided the moment of meeting between the Chinese traditional carpenter and the foreign modern architect. It could not have happened later because the Second Sino-Japanese War broke out in 1937 and ended the flourishing construction period of the Republic of China. Second, I point out that although there was cooperation between carpenters and architects who had built in many cities, a book completed by both could only happen in Suzhou because this is where the first Chinese architecture department was established. Third, I introduce the two architectural education systems in Suzhou of the 1920s, to explain the requirement of the new beginners, the education background of the masters or teachers, and the basic education plan in each system. The difference between these two education systems was reflected in the book. Fourth, along with the specific background of the *Yingzao fayuan*, processes and different editions, I clarify two misunderstandings of each type of education: one is that the education of a craftsman was not sufficient to write a book, the other is that the earliest Chinese architectural education was influenced by Beaux-Arts. In fact, the carpenter had enough traditional Chinese education to write a craft manual, though to make an architectural research book he still needed the help of an architect. The earliest Chinese architectural education was not influenced by the Beaux-Arts directly, but indirectly from Japan, which made those teachers, who returned from Japan, to pay more attention to carpenters' work.

The second part of this thesis focuses on the question: What is in the book? Another three chapters answer the question by comparing the carpenter's manuscript with the architect's modern edition, also from general propositions to specific description in texts and drawings. For the general propositions, the contents of the two books show how the modern edition maximizes

respect for the original organizational logic of the manuscript. The main text only exists in the modern edition, but the drawings have two versions: the carpenter's original drawings and the architect's redrawing. Almost all of the original ones have been redrawn using the modern architectural method. As for the specific description in texts, the full translations of all the prefaces tell the reader about the processes, so the history of the book is not an idle report, but presents salient historical facts confirmed by the authors and editors. And the special relationship between them is just like another master-apprentice relationship, which also can be found in the studio of the Pennsylvania University under the Beaux-Arts education. The master was not just an architect, but also a local carpenter. The mnemonic rhymes, dialects and jargon were typical features of a carpenters' oral education, which waned with the advent of modernism but carry important memories of meanings. For the specific description in drawings, the Chinese measures and Suzhou numerals in the original drawings are the characters attracting most attention. Only with Chinese measures such as the Lu Ban foot-rule could "building magic" be engaged. Suzhou numerals are a symbol of local tradition. It is interesting to compare the craft diagram by the carpenter and the scientific representation by the architect: the craft diagram is not as accurate as the scientific representation, but useful and clear enough, and easily shows the emphasis of the drawing's purpose; while the science representation is accurate with all the necessary details, which could guide architects to rebuild at any time or place, no matter the meaning or how to use it. That is also the primary difference between carpenter and architect: How to use it, how to make it, versus how to build it, what does it look like.

The thesis concludes by considering how to treat the book. It is not only an architectural research book on a single set of traditional local building skills of a group of craftsmen by a master carpenter, but also a book recording the conflicts and harmonies between two Chinese architectural education systems in early modern China. In China, the craftsman's master-apprentice education and modern architecture education coexisted since early modern China. Even though the former is not as popular as before, it will never be replaced or annexed by the latter. These two education systems meet each other at another point in history now. What can we, as architects, learn from the carpenter? It is time to pause and reconsider this through the research of the *Yingzao fayuan*.

Translation Strategies and Methods

As this is a thesis researching Chinese traditional building skills and techniques, inevitably there is a problem raised by the translation strategies and methods chosen. The German theologian and translator Friedrich Schleiermacher's lecture *Ueber die verschiedenen Methoden des Uebersetzens* (1813), "On the different methods of translating", is a highly influential treatise on translation.[16] He divided methods of translation into two: "There are only two (choices), either the translator leaves the writer alone as much as possible, and moves the reader towards the writer; or he leaves the reader alone as much as possible, and moves the writer towards the reader".[17]

[16] Lawrence Venuti, "Genealogies of Translation Theory: Schleiermacher", *TTR : traduction, terminologie, rédaction*, Vol. 4, No. 2 (1991), 128.
[17] Lawrence Venuti, *The translator's Invisibility: A history of Translation*, (London and New York: Routledge, 1995), pp. 19-20.

Later Lawrence Venuti developed the theory to the concepts of "Domestication" and "Foreignization". He suggested that the strategy of foreignization, which aims at "sending the reader abroad", is better than domestication, which aims at "bringing the author back home".[18]

I have to agree with Venuti, not only because it is difficult to domesticate the technical terms of a unique Chinese carpentry building system, but also because I think foreignization is the best choice to keep the culture and the thinking mode of a Chinese carpenter. In this case, sometimes the translation may not be smooth to an English reader. It would be an unprecedented reading experience to them. It was just a case of trying, and I recognised how to keep the balance of "foreignization" and "domestication" in translation remains an important question for my future work.

About the translation methods, I will give some examples below:

(1) Literal Translation

In order to convey the original meaning of the technical terms, I use literal translation as much as possible, especially on the patterns and styles. For example:

"鴛鴦廳之式" is translated as "the style of mandarin duck hall". Different from other birds, "mandarin duck" has a symbolic meaning in Chinese culture, and local usage, which are consistent with the function of this special style of hall.[19]

"鶴頸軒" is translated as "crane's neck deputy rafter". The shape of the deputy rafter is curved, the line shape looks like a special crane's neck. The original name of this type is very vivid.

Some other translation were made in this way are: "旱船廳之式" is translated as "the style of fixed boat pavilion"; "駱駝川" is translated as "camel short tenoned beam", etc.

(2) Transliteration

Sometime a special structural part could not find a corresponding English character, and could not be explained in a simple way. Transliteration is the only choice. A well known example is "**斗拱**". Although Liang Sicheng translated this as "**Bracket Sets**"[20] when he described a particular part of the bracket sets "**斗**", he had to use a transliteration method, translated as "**tou**"[21].

To give instances of my translation,"***jie* 界**", "***bu* 步**", "***jian* 間**", "***tie* 貼**", "***feng* 縫**", are basic technical terms used in sections of buildings, which are all transliteration. When these words are shown only in characters they seem not easy to understand, but with the explanations and drawings, they all become clear. A special example that has to be mentioned here is the translation of "***jin*** column". Because the different Chinese characters "**今/金/襟**" with the same pronunciation are used in the original drawings of *Yingzao fayuan*, the modern edition of *Yigzao fayuan*, and *The Craft of Gardens*, each with its own reason for the character: the character "**金**" is original used in the Stats

[18] Lawrence Venuti, The translator's Invisibility: A history of Translation, (London and New York: Routledge, 1995), pp. 20-21.
[19] Detail explanations see Chapter Seven, p.194.
[20] Liang Sicheng, *A Pictorial History of Chinese Architecture*, p.84.
[21] Ibid., p.90.

Building Standard, the *Yingzao fashi*, which should be the correct word; the character "**今**" is used by master carpenter Yao Chengzu in his drawings, which I believe it just for the simple word to mark on the columns; the character "**襟**" is used by Ji Cheng, in his book *Yuan Ye*, which I support it refer to the column is not on the first line of the building but the second line. Ji is a gardener, not a carpenter; he might use the word as his understanding. Transliteration is the best way to keep the original pronunciation.[22]

(3) Explication

Explication could help readers to grasp the implicit meaning of the technical terms. For example:

"川" is unreadable for readers either native or foreign. A translation as "**short tenoned beams**" makes sense of it as part of the structure.

"**廊枋**" translated as " **tie-beam between eaves columns**", and "**步枋**" as "**tie-beam between *bu* columns**" are also explication, which make it clear by showing the place and function of the construction.

(4) Substitution

To make the meaning readable and accepted, some words are replaced bycultural expressions. For example:

"雖有圖樣……置**篋**中矣。"

"although having the drawings… …(I) put the book on the **shelf**."[23]

The "篋" refers to a bookcase in literature. The original sense is to put the drawings in a bookcase. Translation as "put the book on the shelf" has the same meaning, but reflects a more common usage.

(5) Omission

"**規模法度**，得慶重見，而歷劫不彌，自有**神**護。"

"I am glad **the manuscript** could be shown to us today, I believe that **God** protected it through difficult, perilous times."[24]

Here the "規模法度" literal translation should be "the scale and rules (of buildings)", but in the preface, Prof. Chen refers to "the scale and rules (of buildings) in the original drawings by Yao in the manuscript". So I simplified in view of the context. The Chinese "god" of course is not the same as the Western, but here I just keep the cultural expressions, without further explanation.

(6) Annotation

Some special Chinese cultural expressions need to be explained to the reader, to help understand the cultural background.

[22] Detail explanations see Chapter Seven, p. 183.
[23] See Chapter Six, pp. 147-148.
[24] See Chapter Six, pp. 142-143.

One example is in Chinese literary expression, to show respect to another person, it is usual to address him (or her) by "nom de plume 號" or "style name 字" (if he does not have a nom de plume), not his real forename, surname, or title.[25] Every time this situation occurs, I add a footnote to explain who he is.

Another example is the Chinese calendar used in the text. I give a footnote to clear which year it is. Such as the "**甲子**" refer to the "Jiazi Year in the era", which is "the year **1924"**.[26]

To sum up, most of the translations in this thesis are technical terms, which I tend to translate by "foreignization" translation strategies. But no matter whether "foreignization" or "domestication", the most frequent six translation methods can all be found in the thesis. The first principle of my translation is to make sense of the source text, to keep the original meaning and culture, and to use architectural expressions as much as possible. Thus, literal translation is always the first choice. Second is explication, corresponding to English architectural terms. Although it is a method of domestication translation strategies, it is the most important way to make the translation readable and understandable. Such as "柱" is "column", "梁" is "beam", "磉石" is "plinth", and so on. In some cases, more than one method is adopted to achieve the aim of technical terms, for instance: "鶴頸軒" is "crane's neck deputy rafter", which uses both literal translation and explication. It describes the shape and the function of the structure. Third is the transliteration, used for those unique Chinese structural parts for which I could not find the correct corresponding English architectural term. For example "步柱" if translated literally, should be "span column", but would lead to misunderstanding about why only this column refers to the "span". In fact it just refers to a place where the column is. That is the reason I use transliteration to translate it as "Bu column". And the "Jin column" has different Chinese characters. Using a literal translation would arouse unnecessary arguments; the transliteration is the best choice in these cases. Annotation, as one of the foreignization translation strategies, is also used in some special places to explain the needs of Chinese traditional culture. Two other methods of domestication translation strategy are used: substitution and omission are used relatively less than the former translation methods, but are of some use in the main text or preface translations.

Before giving the translation of drawings in the appendix, I discuss my translation editorial principles first. Because these principles relate especially closely to the drawings, I have put them with the drawings.

[25] See detail in Chapter Four, p.91.
[26] See detail in Chapter Four, p.101.

Chapter One

Literature Review: General Related Researches and Studies on the *Yingzao fayuan*

How does my research on the book fill the research gap between carpenter and architect?

1.1 General Related Researches

1.1.1 Theoretical base, general background researches

To accomplish research on the conflicts and harmonies between two architectural education systems, many of the works consulted are based on the relationship between carpenter and architect. The sociologist Richard Sennett's *The Craftsman* guided my work.[27] He is obviously a big opponent of slights on craftsmen, and gave large amounts of evidence to prove that his teacher Hannah Arendt's point of view on "*Animal laborans*" and "*Homo faber*" is wrong. He made a connection with thinking and making, and thus answered his research question: "what the process of making concrete things reveals to us about ourselves". Sennett is, if not the first person then perhaps the one to set out the most sustained attempt to show such a deep understanding on craftsmen and craft, and gives a clear explanation of the characters of craftsmen: being engaged practically, keeping the hand in consistency with the head, grasping well the virtues of long developed practices, feeling fully and thinking deeply at the same time. The most ethical issue of craft is pride in the work.

Sennett's identity of "craftsman" is not only what people normally recognise, but also some other professions, such as lab technician, conductor, architect, etc, because their working attitudes are the same as craftsman: to produce good work for its own sake. He is familiar with architects' work. He showed plenty of examples of architects. Although he treated the architect as a kind of craftsman, which might have confused readers like me trying to distinguish the difference and connection between carpenter and architect, his way of thinking leads me to rethink the different contents of two editions of the *Yingzao fayuan* in texts and in drawings: the different educational methods of carpenter and architect; the different knowledge types they use; the different purposes of their work because hand and head are divided. At the beginning of Chapter Two I start my research with Sennett's description of a carpenter's workshop, and in the end, I conclude my research with reference to Sennett's way of thinking.

Sennett's research on craftsmen beyond time and place expressed the thinking and seeking

[27] Richard Sennett, *The craftsman*, (London: The Penguin Group, 2009).

towards the philosophy of crafts, so the analytical method could be used in any craft example, which made me research further evidence of his view in a special book on early modern China. Sennett's view on crafts and craftsmen gave me a theoretical base for this thesis.

The way the modern professional architect originated in the West and in China should be general knowledge. Every piece of research in this area discusses the Royal Institute of British Architects (RIBA) and Chinese State Labourer System. The following three books give plenty of facts on the history of British architectural education: *Architecture, art Or Profession? : Three Hundred Years of Architectural Education in Britain*,[28] *The Development of the Architectural Profession in Britain, a Sociological Study*,[29] and *Architecture in Britain, 1530 to 1830*.[30] On the ancient history of the Chinese architecture system, besides Chinese scholar Liu Jicheng 劉紀成,[31] Zhang Yingying 張映瑩[32] and others' researches, *A Dictionary of Official Titles in Imperial China*[33] also gives every official position a concise explanation in terms of responsibility and date. These facts support each other and supplied the general background research of this thesis set out in section 2.1.[34]

1.1.2 Chinese modern time and Chinese pre-modern building

There are differing views about historical Chinese modern time and architectural Chinese modern building. In *The Rise of Modern China* (fifth edition, 1995), Immanuel C. Y. Hsü wrote a section to answer the question "When does modern China begin".[35] He showed two opinions on this question: some scholars believe that the arrival of European explorers and missionaries during the transitional period from the Ming (1368-1644) to the Qing (1644-1911) is a justifiable starting point, while others regard the Opium War (1939-1942) as the beginning of the new era. He gives a reconciled answer that treats the Opium War as a viable point of departure, but the context should look back to the 1600s. It is a reasonable answer, but still on the side of most historians and Chinese common partition, which think of an external force as marking the intrusion of modernism and Western culture into the old closed country.

About modern architecture, there is a symbolic book that identifies the concept of "modern architecture": Kenneth Frampton's *Modern Architecture: A Critical History*. I agreed with his view that modern architecture should be based on appropriate culture, territory, and technique.[36] That means Chinese architecture could not step into a new era simultaneously with the historical

[28] Mark Crinson and Jules Lubbock, *Architecture, Art Or Profession? : Three Hundred Years of Architectural Education in Britain*, (Manchester: Manchester University Press, 1994).
[29] Barrington Kaye, *The Development of the Architectural Profession in Britain, a Sociological Study*, (London: George Allen & Unwin Ltd., 1960).
[30] John Summerson, *Architecture in Britain, 1530-1830*, (Yale: The Yale University Press Pelican History of Art Series, 1993).
[31] Liu Jicheng 劉紀成, "*Baigong*, *Gongguan* and Early Chinese State Labourer System 百工、工官及中國社會早期的匠作制度", *Journal of Zhengzhou University (Philosophy and Social Sciences Edition)* 鄭州大學學報(哲學社會科學版) ,Vol. 48, 03 (2015), 102-109.
[32] Zhang Yingying 張映瑩, "Chinese Ancient State Labourer System 中國古代工官制度", *Traditional Chinese Architecture and Gardens* 古建園林技術, 01 (1997), 51-52.
[33] Chartes O. Hucker, *A Dictionary of Official Titles in Imperial China*, Taiwan Edition (Stanford: Stanford University Press, 1985. Repr., Taipei: Southern Materials Center, INC., 1988).
[34] See Chapter Two, pp. 29-33.
[35] Immanuel C. Y. Hsü, *The Rise of Modern China*, 5th edn., (Oxford: Oxford University Press,1995). pp.4-7.
[36] Kenneth Frampton, *Modern Architecture: A Critical History*, 3rd edn, (London: Thames and Hudson Ltd, 1992), p.12.

time partition. Existing scholarship on the architecture of modern China is rich and complex. Three books should be noted: Jeffrey W. Cody's *Building in China: Henry K. Murphy's "Adaptive Architecture", 1914-1935*,[37] Janfei Zhu's 朱劍飛 *Architecture of Modern China: A historical critique*,[38] and Lai Deling's 賴德霖 *Studies on Modern Chinese Architectural History* 中國近代建築史研究.[39] Due to the different terms these books used to refer to the Chinese architecture, which put Chinese form on a modern or Western content, I chose the term "pre-modern Chinese architecture" to identify this design era.

Building in China is a study on American architect Henry K. Murphy's designs: "Adaptive Architecture" in early modern China. Murphy is typical of the first group of architects who worked in China. His designs started in Changsha, but appeared also in Shanghai, Beijing, Nanjing, and other places. He also influenced the first generation of Chinese architects directly or indirectly.[40] Like most biography, the book introduces Murphy's work in an annalistic style, so the growth of his "adaptive architecture" is shown with a reading, from dependent buildings in Changsha and Beijing to city planning and even a pagoda in Nanjing. Murphy was not the first foreign architect to combine Chinese architecture with western modern space, but produced some of the best designs, and was accepted by the Chinese. Each design is full of details, from processes to design drawings. In his early projects, the buildings of St. John's University and Yale-in-China looked somehow ridiculous, like western people wearing a Long gown and a mandarin jacket the wrong way.[41]

Zhu's book *Architecture of Modern China* selects six historical periods in typical places, such as Beijing and Nanjing, to analyse the modern architecture of China. The time line in the book is really long, maybe too long, stretching from 1729 to 2008, from "Perspective symbolic form" to Olympic symbolic form in Beijing. It is an ambitious work, because its chronological coverage is complete, although it avoids the awkward time from the 1960s to the 1970s. For the same reason, there are some criticisms of this book both in China and abroad. Grand narrative is used to become tough, boring and loosely joined, especially for foreign people. The historian Ralph Croizier criticised the book in his *Review Article: Modern Chinese Architecture in Global Perspective*,[42] but for my research, the description and analysis in Zhu's book on the style "promoted by state authority" in Chapter 3: "*The architect and nationalist project, Nanjing, 1925-1937*" give evidence for my research period, 1923-1937. What I do not understand is that, in a study on the architecture of modern China, he could ignore Shanghai (there is no specific chapter in Zhu's book on Shanghai).

Lai Deling's *Studies on Modern Chinese Architectural History* 中國近代建築史研究 is a Chinese book familiar to most Chinese architecture students and researchers. Lai's research does not just follow the time line, but found some different research topics, beginning with the international settlements in Shanghai, "new politics" in late Qing Dynasty, then the subject of

[37] Jeffrey W. Cody, *Building in China: Henry K. Murphy's "Adaptive Architecture", 1914-1935*, (Hong Kong, Seattle: The Chinese University Press, University of Washington Press, 2001).
[38] Zhu Janfei, *Architecture of Modern China: A historical critique*, (London: Routledge, 2009).
[39] Lai Delin 賴德霖, *Studies in Modern Chinese Architectural History* 中國近代建築史研究, (Beijing: Qinghua University Press, 2007).
[40] Jeffrey W. Cody, *Building in China*, pp.182-188.
[41] Ibid., pp.37-41.
[42] Ralph Croizier, "Review Article: Modern Chinese Architecture in Global Perspective," World History Connected June 2012 <http://worldhistoryconnected.press.illinois.edu/9.2/br_croizier.html> [accessed 28 Feb. 2016].

architecture transplant from abroad, continued with the Mausoleum of Dr. Sun Yan-sen, the design method of the first-generation architects: Yang Yanbao 楊延寶 and Liang Sicheng couple, ending with the city planning of Guangzhou in the early 20th century. Lai's research is full of historical facts and his own thoughts. From the beginning, it shows more critical analysis than the other two. Besides this book, Lai has numerous, more detailed, articles to support his research. His section study on Lu Yanzhi 吕彦直 "*The Sun Yan-sen Memorial Auditorium: A Preaching Space for Modern China*" was in the book *Chinese Architecture and the Beaux-Arts*.[43] Lai called pre-modern Chinese architecture the "Chinese classicism renaissance style modern building 中國古典復興式現代建築". Lai's research and Zhu's research are very complementary to modern Chinese architecture, which is supportive historical context for my research on the *Yingzao fayuan*.

As for other background introductions on buildings in treaty ports, especially studies on the modern architectures of Shanghai, there are rich sources in English. Tess Johnston and Deke Erh published a series of books on these buildings. *Modernism in China: Architectural Visions and Revolutions* also focus on modernist buildings in that era.[44] *Shanghai Modern, 1927-1937: Municipal Power, Locality and Modernization*,[45] and *Things Modern: Material Culture and Everyday Life in China*,[46] are books on the social and cultural background.

Most of the books are interested in the architecture, a few notice the designers, but none of them pay attention to the builders, which is the centre of my research. In Part One of the thesis, it is not a coincidence that the title of Chapter Two puts "people" before "time, and terrain". All the time and terrain topics are auxiliary instructions for the special people: architects and crafts builders in early modern China, who built the pre-modern buildings in that period. Their conflicts and harmonies could be found in the book *Yingzao fayuan*, which is discussed in the second part of this thesis. Therefore, my research on Chinese early modern period and pre-modern architecture is undertaken through a totally new angle: through a book, by two different kinds of builders.

1.1.3 Chinese architects and early Chinese architectural collegiate education

There are many books and research works devoted to the history of Chinese architectural collegiate education. The most influential are the following: The PhD thesis of Qian Feng 錢鋒, *Modern Ideals in Collegiate Education of Architecture in China (1920s-1980s)* 現代建築教育在中國 (1920s-1980s) is a serious and deep research full of rare historical material.[47] *The Beginning of Chinese Modern Architecture* 近代中國建築學的誕生, written by Xu Subin 徐蘇斌,[48] gives lots of valuable detail of the establishment of Chinese architectural collegiate education, which was deeply influenced by Japan. *The Chinese Architecture and the Beaux-Arts*,

[43] Jeffrey W. Cody, ed., *Chinese Architecture and the Beaux-Arts*, (Honolulu: University of Hawai'i Press, 2011), pp.279-300.
[44] Edward Denison and Guang Yu Ren, *Modernism in China: Architectural Visions and Revolutions*, (Chichester: John Wiley and sons, 2008).
[45] Christian Henriot, Noël Castelino, tran., *Shanghai Modern, 1927-1937: Municipal Power, Locality and Modernization*, (Berkeley, Los Angeles, London: California Press, 1993).
[46] Frank Dikötter, *Things Modern: Material Culture and Everyday Life in China*, (London: Harst & Company, 2007).
[47] Qian Feng 錢鋒, "Modern Ideals in Collegiate Education of Architecture in China (1920s-1980s) 現代建築教育在中國 (1920s - 1980s)", (unpublished doctoral thesis, Tongji University 同濟大學, 2005).
[48] Xu Subin 徐蘇斌, *The Beginning of Chinese Modern Architecture* 近代中國建築學的誕生, (Tianjin: Tianjin University Press, 2010).

especially the article by Gu Daqing 顧大慶, *An Outline of Beaux-Arts Education in China: Transplantation, Localization, and Entrenchment* in the book,[49] helps in searching for the roots of Chinese architectural collegiate education from the West. In contrast, Nancy Shatzman Steinhardt gives a whole history of it including Hong Kong and Taiwan in her article *China: Designing the Future, Venerating*.[50] Wu Jiang's book *A History of Shanghai Architecture (1840-1949)* 上海百年建築史 (1840-1949) discusses the beginning and development of modern architectures in Shanghai from 1840 to 1949.[51] The research of Chinese architectural historian Lai Deling 賴德霖 make an ambitious plan about Chinese modern architecture, from the architects to their works. He would never forget the first Chinese architectural college, the Suzhou Engineering School. He described it in his article *The Forerunner of Chinese Architectural Collegial Education: The Architecture Department in the Suzhou Engineering School* 中國現代建築教育的先行者——江蘇省立蘇州工業專門學校建築科.[52] Then, another article *The Cradle of Chinese Architectural Collegial Education: The Establishment of Architecture Department in the Suzhou Engineering School* 我國高等建築教育的發源地——蘇工創辦建築科史料補遺 by Shi Yong 施用 gives lots of missing information concerning the first generation of students who graduated from the Suzhou Engineering School.[53] These books and articles give plenty of details of the early, especially the first Chinese, architecture education system in Suzhou, which are the basic material of my research (for example the education plans of different universities at that time).

I have noticed that many of these previous researches come from the Architecture School of Tongji University in Shanghai. Professors Lai Deling 賴德霖 and Wu Jiang 伍江 were born in the 1960s, while Doctor Qian Feng 錢鋒, Shen Li 沈黎 and Yang Lifeng 楊立峰 were born in the 1970s: together, they made an echelon on researches of Chinese architectural history in early-modern time. These researches partly reflect the geographical relationship between Shanghai and Suzhou, and partly reflect the higher research level of Tongji University nowadays.

For the Beaux-Arts Education in China, the *Chinese architecture and the Beaux-Arts* is a good source of Western influence in modern Chinese architecture. Besides Gu's essay, Tony Atkin's essay *Chinese Architecture Students at the University of Pennsylvania in the 1920s: Tradition, Exchange, and the Search for Modernity* explains the early history of Sino-Western exchange, the characters of the Beaux-Arts, the education studio in Penn University, and the excelling Chinese students who were represented by Liang Sicheng and Lin Huiyin.[54] The other essays introduce Yang Yanbao 楊延寶, Dong Dayou 董大酉, Liang Sicheng, Lü Yanzhi 呂彥直, Zhang Bo 張鎛 and Zhang Kaiji's 張開濟 architecture design careers, which were influenced by the Beaux-Arts directly abroad or indirectly in China (National Central University 中央大學

[49] Jeffrey W. Cody, ed., *Chinese Architecture and the Beaux-Arts*, pp.73-90.
[50] Nancy Shatzman Steinhardt, "China: Designing the Future, Venerating the Past", *The Journal of the Society of Architectural Historians*, Vol. 61, No. 4(2002), 537-548.
[51] Wu, Jiang 伍江, *The History of Shanghai Architecture (1840-1949)* 上海百年建築史 (1840-1949), (Shanghai: Tongji University Press, 2008).
[52] Lai Delin 賴德霖, "The Forerunner of Chinese Architectural Collegial Education: The Architecture Department in the Suzhou Engineering School, 中國現代建築教育的先行者——江蘇省立蘇州工業專門學校建築科", *The Architecture History and Theories* 建築歷史與理論, 05(1993), 71-77.
[53] Shi, Yong 施用, "The Cradle of Chinese Architectural Collegial Education: The Establishment of Architecture Department in the Suzhou Engineering School 我國高等建築教育的發源地——蘇工創辦建築科史料補遺", *South Architecture* 南方建築, 01(2000), 63-66.
[54] Jeffrey W. Cody, ed., *Chinese Architecture and the Beaux-Arts*, pp.45-72.

in Nanjing). Although few data from such research were used in my research, they provided a useful educational background guide, prompting me to think and check what is different between the earliest architecture department influenced by Japanese education and the later ones influenced by the Beaux-Arts from America. Then I made a comparison of four different architectural education plans both in Japan and in China at that time in section 3.2.3,[55] which extends Xu's and Qian's research.

Wilma Fairbank's *Liang and Lin: partners in exploring China's architectural past* may be another book more familiar to English readers. It is a fascinating biography rather than rigorous academic research. The best thing about the book is that it is full of detailed description about Lin and Liang's different life stages. I believe many researches on Lin and Liang depended on her book. As a close friend to both, Fairbank was helping them with their research and lives in a difficult time during the war. She wrote the book with strong personal feeling of appreciation and concern for her friends. But her book focuses on the family background, the course of their schooling in America, the career and lives of their work in China. All texts on Lin and Liang, spare no efforts to describe their contributions, but seldom mention the limitations (for example they paid less attention to common buildings), and other people's work who worked with them at the same time (such as Liu Dunzhen's contribution to Chinese architectural history research). Therefore, I can only quote a few words from Fairbank's book as complementary evidence of some historical facts.

1.2 Studies on the *Yingzao fayuan* and Related Researches

1.2.1 Chinese vernacular houses, the "Hui" and "Su" traditions

Concerning Chinese vernacular houses, Ronald G. Knapp led the research on Chinese common dwellings, houses, and even bridges in rural areas. His *The Chinese House: Craft, Symbol, and the Folk Tradition* is definitely one of the best outlines on different types,[56] basic craft building techniques and materials, common symbols and traditions of houses all around China, and he does not ignore trends in contemporary China. This book was published in 1990, terse and concise to point out the substantive characteristics of Chinese houses in regional types, general techniques and cultures. It can be seen as the research sketch of Knapp, because of its short length. It is found in the general background of Chinese houses, but just pays attention to different forms of buildings of regional distinctions.

To extend his research, Knapp wrote *Chinese Landscapes: The Village as Place* in 1992;[57] *China's Living Houses: Folk Beliefs, Symbols and Household Ornamentation* in 1998;[58] *Chinese Houses: The Architectural Heritage of a Nation* in 2004[59] and *House Home Family: Living and*

[55] See Chapter Three, pp.84-87.
[56] Ronald G. Knapp, *The Chinese House: Craft, Symbol, and the Folk Tradition*, (Hong Kong: Oxford University Press, 1990).
[57] Ronald G. Knapp, ed., *Chinese Landscapes: The village as Place*, (Honolulu: University of Hawai'i Press, 1992).
[58] Ronald G. Knapp, *China's Living Houses: Folk Beliefs, Symbols and Household Ornamentation*, (Honolulu: University of Hawai'i Press, 1998).
[59] Ronald G. Knapp, *Chinese Houses: The Architectural Heritage of a Nation*, (Hong Kong: Tuttle Publishing,

Being Chinese (with Kai-yin Lo) in 2005.[60] The *Chinese Landscapes* is composed of several essays by different researchers. The book focuses on the rural areas in China currently, concerned with the traditional Chinese cultures in the villages. The book is most like a contemporary historical introduction of different places from south to north: southern areas such as Hong Kong 香港, Taiwan 臺灣, Hainan 海南, Guangdong 廣東 (2)[61], Fujian 福建 (2); western areas such as Sichuan 四川, Shanxi 山西 (3), Gansu 甘肅; eastern areas such as Anhui 安徽, Zhejiang 浙江, Jiangsu 江蘇 (2); northern areas such as Shandong 山東; and Henan 河南 in the middle. It can hardly be seen as a complete investigation of China, but a selection of research. Both the time and area in this book are different from my research, although one village Zhouzhuang 周莊 is also in the Taihu Lake Region 太湖流域, but the building style of a village beside a river is different with buildings in Suzhou. The latter two books are much more interesting than the former. *China's Living Houses* is a kind of detailed edition of *The Chinese House*. Here Knapp has plenty of space to discuss his concerns about Chinese houses, traditional Chinese culture and its changes. No matter whether south or north, west or east, he still pays attention to the common aspects of Chinese culture in different places on each topic. To cover the lack of building design analysis in *China's Living Houses*, *Chinese Houses* is a book on architectural design and the use of Chinese houses. After describing the general classification of house types, building techniques, building rituals, living spaces, symbols, and household ornamentation, Knapp gives specific examples of China's fine heritage houses in different places: Beijing (2), Jiangsu (2), Zhejiang, Hunan, Anhui (2), Fujian (2), Guangdong, Hong Kong, Hunan (2), Sichuan (2), Shanxi (4). The places don't seem as wide as *Chinese Landscapes*, but the types are more typical, and his analysis on architectures is deeper than the essays in the book on villages. The section on "Jiangnan canal houses" in *Chinese Houses*[62] is useful regional background for my research.

The limitation of Knapp's research, and actually not only of him, but also of other English researchers, is not being conscious enough of the local craft building teams. He noticed different types of house in China, but has not divided them between different local building "Tradition 派" and building "Group 幫". He says nothing to point out how the building teams are normally divided by regions, and seldom had liquidity concerns in early modern time, because of local guild organisations. This thesis has an independent section, 2.3.1, to explain the different definitions between architectural "Tradition" and crafts "Group". Some researchers introduce carpenters' work, such as *Ying Yu Tang*[63] and *World Lies Beyond: Creating Liu Fang Yuan, the Huntington's Chinese Garden*.[64] These two books are the closest to taking care of the carpenter's work as they are both based on building projects in the West. They recorded carpenters and other builder's work processes, but are not concerned with the craftsman's group, educational background and education method. The research on *Yingzao fayuan* can fill this blank. This thesis introduces a specific local carpenter group, the Xiangshan Group 香山帮, in Suzhou, in section

2004).

[60] Ronald G. Knapp and Kai-yin Lo, ed., *House Home Family: Living and Being Chinese*, (Honolulu: University of Hawai'i Press, 2005).

[61] The numbers in brackets refer to the number of examples in the area.

[62] Ronald G. Knapp and Kai-yin Lo, *Chinese Houses*, pp.120-131.

[63] Nancy Berliner, *Yin Yu Tang: The Architecture and Daily Life of a Chinese House*, (Hong Kong: Tuttle Publishing, 2003).

[64] T. June Li, ed., *Another World Lies Beyond: Creating Liu Fang Yuan*, *the Huntington's Chinese Garden* (San Marino CA: Huntington Library, 2009).

2.3.3;[65] and describes their training and organisation methods in section 3.2.[66]

From all these English researchers on Chinese local buildings, another situation has to be noticed: There are many researches on the "Hui Tradition 徽派" houses that are located in Huizhou Region 徽州地區, Anhui,[67] such as Hongcun Village 宏村 in the *Chinese Landscapes*[68]; also Hongcun as the opening full page photograph of the *House Home Family*; the "Swallow's Wing Hall" 燕翼樓 in Chengkan 呈坎[69] and "Hall of Inheriting Ambition" 承志堂 in Huizhou[70] in the *Chinese House*. All of them are found in rural villages in the mountains built by merchants. Some research on the "Su Tradition 蘇派" buildings, which are located in "Taihu Lake Region",[71] also known as Jiangnan, centred on Suzhou, Jiangsu:[72] Such as Zhouzhuang 周莊 in the *Chinese Landscapes*[73] and the *Chinese House*[74]. Other places Luzhi 甪直, Tongli 同裡 also mentioned in the later one, and Wuzhen 烏鎮, Nanxun 南潯 and Xitang 西塘 in Zhejiang have been put forward as a group in the revised List of China's Candidates for UNESCO World Cultural Heritage at the end of 2006. All of them are found as water towns.

Mudu 木瀆 and Suzhou (hometown and main working place of the Xiangshan Group) have been classified as the same type, but without any developed examples, summarising the building type as the "Su Tradition".[75] There are many researches on dwellings and houses in Suzhou, but all with interest in describing the house as "life in a Garden", such as Joseph C. Wang's essay the *House and Garden* in the *House Home Family*,[76] and numerous landscape researches on Chinese gardens. Buildings are treated as appurtenant to the garden, which is totally misconceived in relation to the "Su Tradition" buildings. The dwellings and houses were settlements of daily life; the gardens a luxury for the retired officials, scholars and gentry. Although the "Hui Tradition" houses look similar in elevation to the "Su Tradition" houses, the architecture organisation of spaces is entirely different in terms of storeys and courtyards. The backgrounds of owners belong to different social hierarchies: merchant vs. retired officials, scholars and gentry. The "Su Tradition" buildings in Suzhou need more attention in terms of forms, building techniques, building rituals, living spaces, symbols, etc. The study on the book *Yingzao fayuan* gives an entire building system of "Su Tradition", from general houses to temple halls, from the base stones to the roof structures, from the bracket sets to garden paving, etc. Meanwhile, the building mnemonic rhymes and carpenter's jargons also could be found in the book. All the analyses and comparisons of these contents are in Part Two of this thesis.

1.2.2 The classic books on Chinese traditional building standards

The classic books: *Lu Ban jing* 魯班經 and *Yuan Ye* 園冶 are of course very important resources of the book on craftsmen's experience. The English introduction and translated editions

[65] See Chapter Two, p.54-60.
[66] See Chapter Three, p.75-87.
[67] Nancy Berliner, *Yin Yu Tang*, Maps and Names, pp.2-5.
[68] Ronald G. Knapp ed., *Chinese Landscapes*, pp.119-127.
[69] Ronald G. Knapp, *Chinese Houses*, pp.156-165.
[70] Ibid., pp.166-175.
[71] Ronald G. Knapp ed., *Chinese Landscapes*, pp.139-140.
[72] Ronald G. Knapp, *Chinese Houses*, pp.120-123.
[73] Ronald G. Knapp ed., *Chinese Landscapes*, pp.139-150.
[74] Ronald G. Knapp, *Chinese Houses*, pp.120-139.
[75] Ibid., p.120.
[76] Ronald G. Knapp and Kai-yin Lo ed., *House Home Family*, pp.73-97.

of these two books are: the *Carpentry and Building in Imperial China: A Study of the Fifteenth-Century Carpenter's Manual Lu Ban jing* by Klaas Ruitenbeek, and *The craft of gardens* translated by Alison Hardie. These English editions give guides for English readers to understand Chinese buildings, gardens, and the work and beliefs of the crafts builders. The former one is "a carpenter's manual compiled in the fifteenth century", and "at the beginning of the twentieth century the *Lu Banjing* was considered to be a book full of ritual meaning and loaded with magical potency."[77] The normal edition of the book was edited by Wu Rong 午荣, named as *Xinjuan jingban gongshi diaozhuo zhengshi Lu Ban jing jiangjiajing* 新鐫京版工師雕斫正式魯班經匠家鏡, "Official Classic of Lu Ban and Artisans' Mirror for Carpenters and Carvers" in Ming Dynasty, which is still used by some carpenters today. As mentioned before, the author of the *Yuan Ye* was Ji Cheng, born in the Ming Dynasty (1582), in Tongli Town 同裡鎮, Wujiang 吳江, Jiangsu. The book "was written between 1631-1634",[78] teaching the skills of garden design. Alison Hardie points out "many of the finest artists of the late Ming were native to the Jiangsu region, often from wealthy landowning families", and Ji Cheng had some great artist friends. But she does not notice that Ji Cheng grew up in a place abounding with crafts builders. "The master carpenter Kuai Xiang 蒯祥 (1398-1481), who was the leader in building the Forbidden City, finally became an official of the Ministry of Works. He and other masters, such as Cai Xin 蔡信, Yang Qing 楊青, were also Wu people."[79] Tongli and Xiangshan (Kuai Xiang's hometown) are both in the Wu area of the Taihu Lake region, close to Suzhou. Furthermore, "at the beginning of the Ming, all the artisans in the country were registered. The artisans were not allowed to change their profession, the trades being hereditary".[80] Therefore, since the beginning of the Ming, the Xiangshan Group crafts builders were organised. Although there was no written record that Ji Cheng was a member of the Xiangshan Group, he definitely worked with the Xiangshan Group carpenters, so his crafts skills and experiences of gardens are valuable references of the Xiangshan Group carpenters' building technology.

Another book which cannot be forgotten is Liang Sicheng's *A Pictorial History of Chinese Architecture* 圖像中國建築史,[81] which introduced Chinese traditional building to the West. The book was compiled in 1943, but the manuscript was lost for more than thirteen years, finally thanks to Wilma Fairbank's insistent effort, being found in Singapore, and then published by Massachusetts Institute of Technology Press in 1984. This book must be the earliest book on Chinese architectural history written in English by a Chinese scholar. The descriptions in the book are rather brief, but it provided a foundation about how to introduce Chinese buildings to the West. Jiren Feng's *Chinese Architecture and Metaphor: Song Culture in the Yingzao Fashi Building Manual* definitely continues Liang's will to introduce and analyse the *Yingzao fashi* 营造法式 for the West.[82] Jiren Feng devoted himself to the research of Chinese traditional architecture and the *Yingzao fashi*. The ancient texts and original drawings are related with clear photographs in the book, which make complicated Chinese traditional carpentry constructions understandable to the reader, and took the author many years to accumulate. Guo Qinghua's *Visual Dictionary of*

[77] Klaas Ruitenbeek, *Carpentry and Building in Imperial China*, pp.1-2.
[78] Alison Hardie, *The Craft of Gardens*, p.11.
[79] Zhu Qiqian, The essay on drawing of Buyun Xiaozhu, see Chapter Three, p.140.
[80] Klaas Ruitenbeek, *Carpentry and Building in Imperial China*, p.16.
[81] Liang Sicheng 梁思成, *A Pictorial History of Chinese Architecture* 圖像中國建築史, (Tianjin: Baihua Literature and Arts Publishing House, 2001).
[82] Jiren Feng , *Chinese Architecture and Metaphor: Song Culture in the Yingzao Fashi Building Manual*, (Hawai'i: University of Hawai'i Press, 2012).

Chinese Architecture gives explanations and translations to the Chinese traditional architectural terms, based on the *Yingzao fayuan*.[83] Although the terms might have different names in the state building structure and the local ones, it is still a useful dictionary for my research. In this thesis, I compare the basic technical terms of structures between the above books and the *Yingzao fayuan* in Chapter Seven, to make a clue for future research.

Therefore, all these classical books have close relationships with the Xiangshan Group. But without comparisons and analyses, it is hard to find their architectural differences and similarities. In section 7.2.2,[84] the explanations of technology terms, figure 7-10, and table 7-1 are the original research achievements by the author, which fills the blank of the relationship between these classical books and the *Yingzao fayuan*. It helps the readers understand the position of the book in the well-known Chinese traditional building standards system.

1.2.3 Xiangshan Group and its Chinese traditional master-apprentice training

Although no English research specifically studies Chinese local craft building skills, such as the "Xiangshan Group" in Suzhou (Taihu lake region), Chinese scholars have embarked on research in recent years. Doctor Shen Li 沈黎 is a qualified and mature researcher. Her thesis *A Study of Historic Evolution of Xiangshan Group Carpenters* 香山幫匠作系統變遷研究[85] digs deep into the history of the Xiangshan Group, and records two projects of their works nowadays. Her research is more on the building technology of carpentry building than on the *Yingzao fayuan* and the crafts training, which made me sharpen the aim of my research. Another PhD thesis by Yang Lifeng 楊立峰, *Construction, Field and Style of Craftsmen: the Investigation and Researches on the Construction of Traditional Vernacular Dwellings of Yunnan Province (Yi Ke Yin)* 匠作、匠場、手風——滇南"一顆印"民居大木匠作調查研究[86] although not a research on the Xiangshan Group craftsmen, also gives us a view on crafts builders' work nowadays. It is useful to check the general character of crafts builders. A thesis for the Degree of M.A. in Arts Design by Ma Quanbao 馬全寶, *Field Trips and Methods of Protection in Traditional Architectural Craftsmanship of Xiangshan School* 香山幫傳統營造技藝田野考察與保護方法探析,[87] is another thesis on the Xiangshan Group. But limited by the research level and the visual angle, the statement concentrates on cultural protection, and the description is too general.

The Buildings of Suzhou Xiangshan Group 蘇州香山幫建築 is a popular book on the Xiangshan Group crafts builders and their works. It was written by a local researcher on literature and history, Cui Jinyu 崔晉餘.[88] It is not an academic book, but gives plenty of sources and legends of the Xiangshan Group, which helps academic research to find more details. *The Cheng*

[83] Guo Qinghua, *Visual Dictionary of Chinese Architecture*, (Australia: The Images Publishing Group Pty, 2002).
[84] See Chapter Seven, pp. 177-187.
[85] Shen Li, 沈黎, "A Study of Historic Evolution of Xiangshan Group Carpenters 香山幫匠作系統變遷研究", (unpublished doctoral thesis, Tongji University 同濟大學, 2009).
[86] Yang Lifeng 楊立峰, "Construction, Field and Style of Craftsmen: the Investigation and Researches on the Construction of Traditional Vernacular Dwellings of Yunnan Province (Yi Ke Yin) 匠作、匠場、手風——滇南"一顆印"民居大木匠作調查研究", (unpublished doctoral thesis, Tongji University 同濟大學, 2005).
[87] Ma Quanbao 馬全寶, "Field Trips and Methods of Protection in Traditional Architectural Craftsmanship of Xiangshan Grope 香山幫傳統營造技藝田野考察與保護方法探析", (unpublished master thesis, Chinese National Academy of Arts 中國藝術研究院, 2010).
[88] Cui Jinyu 崔晉餘, *The Buildings of Suzhou Xiangshan Group* 蘇州香山幫建築, (Beijing: China Architecture & Building Press, 2004).

Xiang Lu: Xiangshan Group Traditional Architectural Craftsmanship 承香錄：香山幫營造技藝實錄 is the newest book on a real project of Xiangshan Group's work,[89] which was compiled by the Suzhou Xiangshan Base Group Co. Ltd. 香山工坊, and published in April 2012. Writing the book was a cultural and business activity, which reflects how the new Xiangshan Group crafts builders know the value of their work, and hope to record their building processes. The craft genealogies in the book are very precious.

All of these researches on crafts builder's work and the Xiangshan Group provided the materials for this research. Shen's research guided my research towards many useful sources, such as *The Inscriptions of Industry and Commerce in Jiangsu Province in the Ming and Qing Dynasty* 明清江蘇工商業碑刻集,[90] and other records in the Suzhou local chronicles. The inscription records are the most reliable evidence of the Xiangshan Group. I checked the original source of each fact. And because of different research purposes, the same materials might help the researchers in different ways. Regarding issues like the craftsmen's contract of master-apprentice, the original record came from Zhang Lina's research, and Shen used it as evidence for ritual in the master-apprentice relationship, but I hope to prove the deeper relation between master and apprentice, which Sennett called "a stronger father figure".[91]

Cui is a local researcher on the Xiangshan Group in Suzhou. Compared to other researchers, he is more familiar with the local culture and customs. His research can be supported by documents from Suzhou local chronicles and other research. The Suzhou Xiangshan Base Group Co. Ltd. is a company that provides business consisting of the traditional garden and buildings, modern wood construction, the construction of culture, and the construction of scenic areas and towns. It organises many small carpenters' workshops together in Xukou 胥口, Suzhou, hometown of the Xiangshan Group craftsman. Nowadays, the crafts workers not only come from Xukou, but many of them live in the Taihu lake region and some crafts families still keep their family career. For example among the carpenter's families of Lu Yaozu 陸耀祖, and Xue Fuxin 薛福鑫, until today, the youngest generation still have young men studying civil engineering or architecture in university. The documents that come from the carpenter's shop are the most credible, especially on the projects in Suzhou, or by the Suzhou Xiangshan Group carpenters. They tell the names of specific carpenters which may not be recorded on the building or on any formal documents. The great contribution of the Xiangshan Base Group is not only to inherit the local carpentry building skills, but also to make efforts to collect and record the genealogy of master craftsmen in the history of the Xiangshan Group, cooperating with Tongji University and other universities to develop research on the Xiangshan Group, and trying to grasp a new wooden technology to keep up with the time. The investigation in the Suzhou Xiangshan Base Group can find the craftsman's spirit of pride in their work. The research on the Xiangshan Group and their Chinese master-apprentice architectural education system is based on the information above.

It is an honour to do research based on these great existing researches on the Xiangshan

[89] Feng Xiaodong 馮曉東, *Cheng Xiang Lu: Xiangshan Group Traditional Architectural Craftsmanship* 承香錄——香山幫營造技藝實錄, (Beijing: China Architecture & Building Press, 2012).

[90] Suzhou Museum, The Department Of History of Jiangsu Normal School, and Institute of History of the Ming and Qing Dynasty of Nanjing University 蘇州博物館江蘇師範學院歷史系南京大學明清史研究室合編, *The Inscriptions of Industry and Commerce in Jiangsu Province in the Ming and Qing Dynasty* 明清江蘇工商業碑刻集, (Nanjing: Jiangsu People's Publishing House, 1981).

[91] Richard Sennett, *The craftsman*, p.64.

Group. Section 2.3.3 the history of the Xiangshan Group, section 3.1 Chinese traditional master-apprentice training of the Xiangshan Group,[92] and section 6.3 the dialects of the Xiangshan Group carpenters are all drawn from the above resources.[93] They provide unique examples for my study, such as the divided work functions of different building crafts, the carpenters' guilds, the family tree of the carpenters, the local carpenter dialects, and so on. My research is an extension of their works, putting the examples into the right places to prove my opinions.

1.2.4 Studies on the *Yingzao fayuan*

As a long-neglected book, it is no surprise that only few researchers study on *Yingzao fayuan* specifically, either in articles or in books. Besides different editions of the *Yingzao fayuan*, only two books were published as the explanatory notes of the book. Both of them were published in recent years (2012 and 2014), one is written by an architect, Zhu Ji'nan 祝紀楠, entitled *Explanation of the Yingzao fayuan* 《營造法原》詮釋;[94] the other is written by carpenter father and son: Hou Hongde 侯洪德 and Hou Xiaoqi 侯肖琪, *Diagrams on specifications for the Yingzao fayuan* 圖解《營造法原》做法.[95] The authors are all Suzhou people, and working in architecture (design, research, or building) since the beginning of their career. They are experts on "Su tradition" buildings and carpenters of the Xiangshan Group, practitioners and thinkers who have plenty of practical experiences.

Explanation of the Yingzao fayuan is purely an explanatory book. It is organised entirely based on the *Yingzao fayuan*, from the contents to the chapters, even the order of every single word. It reads almost like the newest translation of the *Yingzao fayuan*, which is much easier to understand than the old one for readers living in the 21st century. Although the *Yingzao fayuan* was written in modern Chinese from 1920s to 1950s, which seems not such a long-time ago, it is necessary to make an explanatory edition, because lots of jargon used by local carpenters were kept in the book. Zhu's book not only explained the book sentence by sentence, but also adds plenty of notes to explain the technical terms in the book. It replaced all the photographs of the old book, but kept the hand drawn illustrations, and deleted all the plates of *Yingzao fayuan* which were at the end of the book. In other words, Zhu's book never redraws a single picture of the *Yingzao fayuan*, neither the illustrations nor the plates.

Diagrams on specifications for the Yingzao fayuan focuses on the building structure of the *Yingzao fayuan*. It is also organised based on the contents of the book, but pays more attention to the different parts of structures. It accomplishes this aim by the drawings. First of all, it redraws all the pictures of the *Yingzao fayuan* by computer drawing, both the illustrations and the plates. Secondly, it adds plenty of new computer drawings, not only in plane, in elevation, in section, but also in different axonometric drawings. Finally, it rearranges all the drawings to follow the old structure of the *Yingzao fayuan*. Not a single photo is kept in Hou's book. Rather than explaining the technological terms in text, the author prefers to use drawings. The diagrammatic method is

[92] See Chapter Three, pp. 63-75.
[93] See Chapter Six, pp. 187-198.
[94] Zhu Ji'nan 祝紀楠, *Explanation of the Yingzao fayuan* 《營造法原》詮釋, 1st edn., (Beijing: China Architecture & Building Press, 2012).
[95] Hou, Hongde 侯洪德 & Hou, Xiaoqi 侯肖琪, *Diagrams on specifications for the Yingzao fayuan* 圖解《營造法原》做法, 1st edn. (Beijing: China Architecture & Building Press, 2014).

the most intuitive manner for people: the readers, carpenters, and architects. The texts in Hou's book are not the notes of the old book. It is rather a new introduction and analysis of local traditional building structures, than an explanatory book of the *Yingzao fayuan*.

It is interesting to find out: after nearly 30 years of the last edition of the *Yingzao fayuan* was published, the book still made special links with the project managers, the local carpenters, and the architects. They express their different understandings of the book, made new conflicts: Zhu's book and Hou's book are very complementary, could support and complement each other; as well as made new harmonies: architect's and researches' attention is always on the texts and what does it look like, while carpenter's and project manager's attention is always on the drawings and how to make it. Even they are not being analysed in this thesis, still give new evidences to prove the point of view in section 7.3.[96]

Furthermore, the *Explanation of the Yingzao fayuan* is my reliable source to explain the text in the *Yingzao fayuan* in Part Two of the thesis, especially useful for the explanations of selection technical terms in the 2nd part of the appendix in this thesis. The *Diagrams on specifications for the Yingzao fayuan* gives me strong support for my translation work in *The illustration: The Yingzao fayuan Original Drawings and Modern Drawings* in the 1st part of the appendix in this thesis. Both of them are my most important resources. This thesis confirms and extends their research by the analyses presented in Part Two, and the translations in the appendix.

1.3 Filling the Gaps and Making Original Contribution

1.3.1 The gap between existing researches

From the general related researches we could see: There is an obvious gap between the Royal Institute of British Architects (RIBA) and Chinese State Labourer System (CSLS), which led to the gap between western modern architect and Chinese traditional crafts builder. These two different organisations met in early modern China, and made a special building style, so-called "adaptive architecture" or some other names.

Most research on RIBA or CSLS usually approaches their work separately, like the books mentioned in Section 1.2.1.[97] Keeping the study in the same context culture and history is an understandable research method for these two topics. Because each of them has a complete system, which includes training, examine, organisation, and full of history changes. In this thesis, I put them together at the beginning of Chapter Two, in section 2.1,[98] hoping to guide readers' thinking about the different education systems behind these two types of professional architect or crafts builder system, which are discussed in detail in Chapter Three.

The existing research on buildings and architects in early modern China could be divided into three angles: firstly, the new building style built in early modern China, in different places (Peking, Shanghai, Nanjing, Hong Kong, etc.) by different architects (Western architects, first

[96] See Chapter Seven, pp.187-198.
[97] See Chapter One, pp.16-18.
[98] See Chapter Two, pp. 29-33.

generation of Chinese architects, trained abroad or in China) such as Zhu's book *Architecture of Modern China*. Secondly, the western architects who built "adaptive architecture" in China, such as *Building in China*. Thirdly, the Chinese architects who trained abroad or in China and built new "Chinese classicism renaissance style" in China, such as Lai's book *Studies on Modern Chinese Architectural History*. These books are all mentioned in section 1.2.2.[99] and become the background researches of section 2.2.[100] In this thesis, this previous research helps me to define the time scope of my research, and reach some conclusions: The conflicts and harmonies between modern architects (whether foreign or native) and Chinese traditional carpenters could only happen in China in this period. Moreover, from 1927 to 1937 is the "golden decade" for both of them.

The existing research on Chinese vernacular houses is much more limited than on buildings and architects in early modern China, especially in English. Ronald G. Knapp is one of the best scholars in this area. His books give me a previous research framework. Nancy Berliner's *Yin Yu Tang* and T. June Li's *Another World Lies Beyond* made some essential supplement. Through these books, I found the blank of research on the dwellings' or buildings' builder, none of the English research cares about their organisation, their building standards, and their education. Furthermore, there are some misunderstandings about Chinese building "Tradition" and "Group", and the "Hui Tradition" and "Su Tradition". I discussed these books in section 1.3.1.[101] In response, I define the terrain scope of my research in Section 2.3,[102] and reach some conclusions: The Chinese crafts builders and foreign modern architects met in treaty ports in early modern China, but the *Yingzao fayuan* is the only book linking them together. The reason is the earliest Chinese architectural collegiate education was established in Suzhou. Both architect and carpenter served in the Suzhou Engineering School at that time (1923-1924), and the book is a textbook for the course "National (Chinese) building method".

The Gap between two Chinese architectural education systems is another core topic of this thesis in Part One.

Few Chinese researches pay attention to Chinese traditional master-apprentice training, neither English researches can be found on this topic. I mentioned them in Section 1.2.3.[103] The only two researches that note the Chinese traditional master-apprentice training are the PhD thesis by Yang Lifeng 楊立峰, *Construction, Field and Style of Craftsmen: the Investigation and Researches on the Construction of Traditional Vernacular Dwellings of Yunnan Province (Yi Ke Yin)*, and the PhD thesis by Shen Li, *A Study of Historic Evolution of Xiangshan Group Carpenters*. Help with two other books: *The Buildings of Suzhou Xiangshan Group* and *The Cheng Xiang Lu: Xiangshan Group Traditional Architectural Craftsmanship*, I could finally describe the Chinese traditional master-apprentice training of the "Xiangshan Group" in section 2.1,[104] and correct a normal misunderstanding of lower education level of carpenters. In fact, most of them had a good education, not only could they read and write, but they were also good at counting and drawing. It explains why the original author of the *Yingzao fayuan*, Yao Chengzu, was employed as a teacher in a collegiate education school, and even wrote the textbook and drew the building

[99] See Chapter One, pp. 18-20.
[100] See Chapter Two, pp. 33-48.
[101] See Chapter One, pp. 23-25.
[102] See Chapter Two, pp. 48-54.
[103] See Chapter One, pp. 20-22.
[104] See Chapter Two, pp. 29-33.

drawings.

Many Chinese researches focus on the history of Chinese architectural collegiate education. Some of them are interested in the processes of the early Chinese architectural collegiate education, such as Xu Subin's *The Beginning of Chinese Modern Architecture*, and Qian Feng's *Modern Ideals in Collegiate Education of Architecture in China (1920s-1980s)*; others pay attention to the training of first generation Chinese architects who were trained abroad. The book *Chinese architecture and the Beaux-Arts* is a good example in this area. For most typical people, like Liang Sicheng, Lin Huiyin, Liu Dunzhen, Yang Yanbao, and others, there are some special books or articles to interpret their works and lives. I have to mention Wilma Fairbank's *Liang and Lin: partners in exploring China's architectural past* in section 1.3.1,[105] because it may be the most familiar book for English readers, but it is really helpful for my research as they supposed. All these books gave me detailed information on early Chinese architectural collegiate education; what I have done in Section 3.2[106] in Chapter Three in this thesis is analyse the clues, find the evidence to answer why the textbook *Yingzao fayuan* was desperately needed in the earliest Chinese architecture department in the Suzhou Engineering School, and why it had to be written by both carpenters and architects.

All the existing research on the two Chinese architectural education systems focuses on either one or the other: my research is the first one to link them together through the book *Yingzao fayuan*. Chapter Four is the response of two preceding Chapters and all the previous research: it not only introduces the four authors and proof-readers, but also analyses the chequered history of the book. The *Yingzao fayuan* fills the gaps between architect and carpenter, between the two Chinese architectural education systems. Through the study on the book, they are shown to be closely connected with each other.

1.3.2 The connections by study on the *Yingzao fayuan*

Except the previous research on the *Yingzao fayuan* which has been mentioned in section 1.2.4,[107] and the classic books on Chinese traditional building standards which are mentioned in section 1.2.2,[108] Part Two of this thesis is based on the carpenter's manuscript of drawings of the *Yingzao fayuan*, and the architect's organisation of the published book. This part of the thesis could be considered as original research and a significant contribution of my work, also extending research and responding to previous scholars. It first compares two editions of the *Yingzao fayuan* according to their contents, main texts, and drawings (Chapter Five), then compares the carpenter's thinking and architect's adaptation in the text (Chapter Six): finally, it compares what the carpenter lost and the architect found in the drawings (Chapter Seven).

To study a book, it is better to start with the contents, because it must reflect the inner organisation logic, which is what section 5.1 aimed to figure out.[109] After that a summary of main texts is necessary, which is discussed in section 5.2.[110] Data in a table comparing drawings in two

[105] See Chapter One, pp. 23-25.
[106] See Chapter Three, pp. 75-87.
[107] See Chapter One, pp. 22-23.
[108] See Chapter One, pp. 18-20.
[109] See Chapter Five, pp. 109-126.
[110] See Chapter Five, pp. 126-136.

editions of the book in section 5.3 supports future research,[111] either in this thesis in Chapter Seven or in future works beside the thesis.

In Chapter Six, through studying on the carpenter's and architect's main text, we could see the different purposes of each edition from the prefaces. 13 building mnemonic rhymes were kept, chosen by the architect, because it is easy to remember, and reflects the building principles for basic structures, chosen timbers or logs, keeping the proportion, and rising the roof frames in order. The other rhymes are not recorded for less connection with building principles, such as the ritual rhymes for putting the main beams, and so on. The dialects and jargons are corrected by the architect to make them more understandable to most readers. But the local context of carpenters' is a kind broken by this means. Thanks to the records in Suzhou local chronicle selection anthology, and Li Zhoufang's article, we can still find some of them, and the culture behind them.

In Chapter Seven, through comparing the carpenter's and architect's drawings, we can find the different ways of thinking. Richard Sennett's view of the craftsman directs me in this chapter, my research on the drawings could be a new support material to his famous words "making is thinking". Because more familiar with the building material and building processes, carpenter might serve as architect's guide. The history of the *Yingzao fayuan* also proved this view. The Chinese measures and Suzhou numerals were changed to the metric units and Arabic numerals, which lost the scale relations between human and buildings. Klaas Ruitenbeek's previous work in *Carpentry and Building in Imperial China: A Study of the Fifteenth-Century Carpenter's Manual Lu Ban jing* gives some explanations on this point in Section 7.1.[112] The mixed use of Suzhou numerals, Chinese characters, and Arabic numerals by the carpenter's drawing for different functions are also analysed in the same section.

In section 7.2,[113] people might find that carpenter's diagrams also seem more easy to understand, giving more information in one piece of drawing. Architect's scientific representations lack a means of building processes thinking and practical experiences in site. Comparing the same drawing by the carpenter and the architect, it is easy to find evidence. The drawings come from the two editions, the explanations of technical terms come from the book and the *Explanation of the Yingzao fayuan*. Table 7-1 Technical terms' contrasts in Chinese and English is a useful tool to understand the differences between local carpenters' jargon and national building standard, between carpenters' and gardeners'. Eight classical books shown on the table. It is the first time all of them have been put together to find out the similarities and differences in their technical terms, which could lead to future researches in this topic.

In section 7.3,[114] people might find that the reason why the carpenter's attention is definitely different to the architect's, is the difference between builder and designer. Typical examples were chosen from the two editions, which show that the carpenter's concerns are how to use it, how to make it, while the architect's concerns are what is the plan, what does it look like. This section is one of the totally original parts of the thesis. It shows that although the carpenters do not need drawings before they build, Chinese traditional carpenters could draw, and would draw at some necessary moments (for example, to discuss design styles with the owner, or to record secret

[111] See Chapter Five, pp. 136-138.
[112] See Chapter Seven, pp. 169-174.
[113] See Chapter Seven, pp. 174-187.
[114] See Chapter Seven, pp. 187-197.

building skills). Both drawings, whether by carpenter or by architect, reveal the languages of their thinking. The view that considers craftsman only to be absorbed in their task, and that they do not know when they should stop and think about the task, is wrong. Carpenters are thinking by making, the same as architects are thinking by drawing.

The research on Chinese architectural history in China, and the historic building textual research are basically still stuck in the supplement materials stage for the Society for Research in Chinese Architecture. This research was started by Liang Sicheng and Liu Dunzhen, the investigation and study continued after the 1980s, and the value judgment on the ancient architectural books continues. Chinese state architecture and their building standards are always the focus of study. Correspondingly, the same research methods are applied to regional dwellings. Most of the researchers are concerned with investigation and survey drawing, or with analysis of the existing buildings; few pay attention to building progress and builders, much less to craft experiences. On the landscape research, because no state standard was found, the researchers have had to set their sights on *The Craft of Gardens*. The precious common building classics, such as *Lu Ban jing* and *Yingzao fayuan*, were neglected, the former because it involved "feudal superstition", the latter because it was only a summary of a local carpenter's experiences. They were both marginalised in the research undertaken in China until recently. It seems to have been regarded as a kind of original sin by Western architecture and Chinese culture. At the beginning, the word "architecture" referred to monumental buildings in the West, and the architect did not design humble dwellings. In Chinese traditional culture, the builders were neglected because of their lowly social status. The names on the buildings were normally the owner or the writer of the inscriptions: the scholars. The Chinese craftsmen could leave their names on the brick or the main ridge, which symbolised responsibility rather than honour. In the records of hundreds of Chinese gardens in Suzhou, all that we find are the owners, not the builders. Fortunately this situation has started to change for the better in recent years. At least the authors of the Chinese local Chronicles of Suzhou are trying to find out more builders' names, and making genealogies of Xiangshan Group craft builders.

In contrast with the neglect from architecture experts, we can find the *Yingzao fayuan* on most worktables of carpenters in south-east China. On one hand, to the carpenter or other craft builder, the architects' designs are the ideal sizes and styles, but *Yingzao fayuan* tells the builders about everything from timber selection and budgeting, to the details of construction for the building style. It is not only about styles and sizes, but also the processes of how to build a building. Obviously until now the status and function of the *Yingzao fayuan* are irreplaceable for the craft builders. But on the other hand, as the Chinese master-apprentice training was interrupted for a time, and some of the craft secrets were lost. The new craftsmen have to learn from the *Yingzao fayuan* to re-recognise the methods of building construction. Without the book, what we have today are only the surviving traditional buildings, but we do not know the real building methods or the way they were ordered.

No matter which authors or contents, or even which edition, the *Yingzao fayuan* is a good example for a case study of research on both the Chinese traditional carpentry buildings in south-east China in early modern times, and the different roles that architects and carpenters took in the earliest Chinese architectural education in the 1920s and the 1930s. The contributions of my

research are discussed in detail in the Conclusion, in the section "Research points" and "Research purpose".[115]

[115] See Conclusion, pp.203-210.

PART ONE

Form Carpenter's Workshop to Architecture School

How did the book come about and evolved?

CHAPTER TWO

People, Time, and Terrain

Yingzao fayuan was written as a co-operation by a Chinese carpenter and an architect. The first draft of it was completed in Suzhou in 1923-1937.

2.1 Carpenter, Architect, and Two Architectural Education Systems

In his famous book *The Craftsman* Richard Sennett included the following description: "Peering through a window into a carpenter's shop, you see inside an elderly man surrounded by his apprentices and his tools. Order reigns within, parts of chairs are clamped neatly together, the fresh smell of wood shavings fills the room, the carpenter bends over his bench to make a fine incision for marquetry. The shop is menaced by a furniture factory down the road"[116]. When I first read this, I almost thought he must have visited a Chinese carpenters' workshop. Because by changing only the word "chairs" into "structures", and "a furniture factory down the road" into "an architecture firm in the city", what he said is almost exactly what I saw in the Suzhou Xiangshan Base Group Co. Ltd,[117] in October 2011, and in Henan, Hubei rural areas in summer 2015. Of course Sennett did not refer, in particular, to a Chinese carpenters' workshop, but it told me that carpenter's workshops are always similar all over the world from the past to present, no matter whether making furniture or building's structure parts, or whatever.

A similar view might also be glimpsed at an architecture school. There, an architecture teacher is surrounded by his students and design papers. He is drawing on the vegetable parchment, correcting the students' crafts drawing. Sometimes he stops, and goes to the front of classroom, using the blackboard or whiteboard to explain the principles of design to all the students. He might even ask students to read some classical books afterschool. What he or she does is trying to train an eligible architect for an architecture firm. No matter when and where, this is a typical sight in an architecture school. At the same time, it is not strange to see it in an architecture firm in the city.

Although life in the western world is not like in China, the carpenter did not point to the craftsmen who build the buildings, instead of it, a stonemason might be the one who does the work. Whether carpenter or stonemason, they are pursuing crafts, working and learning skills in crafts workshops, trained by apprenticeship. Therefore, the scenes above represent two types of architectural education systems in the world. Carpenter and architect come respectively out of

[116] Richard Sennett, *The Craftsman*, p.19.

[117] The Suzhou Xiangshan Base Group Co.Ltd. 香山工坊 is a company whose business consists of the traditional garden and buildings, modern wood construction, the construction of culture the construction of scenic area and towns. It organises many small carpenters' workshops together. Also see the website link: <http://w2.0208.cn/xsgf2013en/page/html/index.php>[accessed 20 February 2016].

crafts workshop or architecture school and will work in a crafts workshop or an architecture firm. (*Carpenter* does not, clearly, mean furniture maker, but generically refers to crafts building builder. Throughout this thesis, when I have to deal with a furniture maker, I'll try to make it clear.) Most of the time it might be that only one education system exists in an area, or at least one of them dominates, such as in ancient China or western developed countries today. But sometimes, both of them exist together. During some special eras of history, when carpenter and architect were both needed, conflicts and harmonies between the two architectural education systems occurred, and the communication between them is interesting.

The relationship and exchange between carpenter and architect is different between the Western and Eastern counties. The situations of Britain and China in the history are the most representative examples, because Britain was the first country that established a special professional institute of architects, and China had a complete unique system of traditional architecture system in ancient time in Asia.

2.1.1 In Britain

The English word "architect" as presented in the *Oxford English Dictionary* was born of John Shute's book *The First and Chief Groundes of Architecture* published in 1563.[118] But it was not popular at that time, and has a different meaning from the modern one. According to Barrington Kaye's research, most early British architects in the 16th and the 17th century came from the crafts (stonemason or carpenter) who can offer architecture design with "platts and uprights" (effectively "plans and elevations").[119] A few of them were officials who worked in the King's Works, such as Inigo Jones (1573-1652).[120] Other talented amateurs, such as Sir Roger Pratt, started the work because of personal interest, and made designs as a hobby.[121] In that period, from crafts to officer, even royal family members could become or be treated as architects. There is no doubt the work they were doing was not the same. And most architects emerged from crafts. Architect, surveyor and civil engineer were separated step by step with the development of science. Until the end of the 18th century, the term architect referred to the person who focused on designing buildings.[122]

At the end of the 18th century and the beginning of the 19th century, the modern professional architect appeared in Britain. The Institute of British Architects in London, the first architects' union in the world, was formed in 1834, which was a sign of the independence of the professional architect. It became the Royal Institute of British Architects in London in 1837, and was known as the Royal Institute of British Architects (RIBA) from 1892 until today. After a long period of development, the Architects (Registration) Act was effected from 1931.[123] That marked the establishment of the earliest modern professional architect system.

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[118] Barrington Kaye, *The Development of the Architectural Profession in Britain, a Sociological Study*, (London: Allen & Unwin, 1960), p.32.
[119] Ibid., p.109.
[120] John Summerson, *Architecture in Britain, 1530 to 1830*, (London: Penguin Books, 1963), p.74.
[121] Ibid, p.38.
[122] Zheng Shiling 鄭時齡, *Architecture Criticism* 建築批評學, (Beijing: China Architecture & Building Press, 2001). p.276.
[123] "Architects (Registration) Act, 1931", *About Architects Registration in the UK*: AARUK online<http://www.aaruk.info/Legislation/Act31.PDF> [accessed 20 February 2016].

Architectural education was developing with the professionalism of the architect. The education of architects remained the medieval type of "apprenticeship" until the end of the 19th century. The young man who wanted to be an architect had to be an apprentice or assistant in an architecture firm, learning design skills by practice after an architect. In 1847, 13 years after the Institute of British Architects in London was formed, the first architectural school of Britain was established in London, the Architectural Association (AA), which still offers one of the best architectural collegiate educations in the world. After the middle of the 19th century, the RIBA established the Architects Registration system. In 1863 the exam was taken by volunteers, but in 1882, people who wanted to join RIBA needed to pass the exam to get a qualification. This registration system promoted a series of births of architectural collegiate education. In 1895, the first architecture school was established in the University of Liverpool.[124] From 1901 to 1919, in the Edwardian Period, more architecture schools proliferated.

In Britain, from the second half of the 16th century to the early 20th century, there was change from crafts to architect, and the crafts type workshop apprenticeship changed to modern architecture school, so the development of the RIBA and the Architects Registration system was a matter of natural progress. The relationship between carpenter and architect was similar in other western countries.

A completely different approach was taken in China during the early 20th century.

2.1.2 In China

The Chinese traditional architecture system is totally different from those in the West. It is a unique system with its own origins, not based on the traditional Western cultural origins of Athens or Rome. Chinese traditional buildings were made by wood. The structure of Chinese traditional carpentry buildings appears simple, peaceful and rigid, and sometimes could be thought of as lacking in variation. The Chinese traditional carpentry buildings shared a similar plan, and adapted to different functions by changing the inner division walls. The Chinese traditional architecture history would never be a question of "holding in stone". It is generally appreciated that in imperial China there was no architect, only carpenters.

2-1 The book cover of *Building Construction*

The Chinese word "建築 *jianzhu*", as the translation of "architecture", came from Japan in the early twentieth century, and was created by the well known Japanese architect Ito Chuta 伊東忠太 in 1897.[125] The word refers to a particular modern science subject: architecture, or building with artistic design by an architect; in order to differentiate it from the traditional word "*yingzao* 營造", which means building process, or the building skill of a craftsman.

The first person who introduced the modern architecture and the

[124] Mark Crinson and Jules Lubbock, *Architecture, art Or Profession? : Three Hundred Years of Architectural Education in Britain*, (Manchester: Manchester University Press, 1994), p.89.

[125] Ito Chuta 伊東忠太 (1867-1954) was a Japanese architect, architectural historian, and critic. He is recognized as the leading architect and architectural theorist of early twentieth-century Imperial Japan. He proposed the word "建築" as the translation of "architecture" to the AIJ (Architectural Institute of Japan, founded in 1866) in 1897.

word "建築" into China was Zhang Yingxu 張鎤緒. He was born in 1877 in Tianjin 天津, went to study in Japan in 1899, graduated from the mechanical engineering department, Imperial University, Tokyo in 1902, then returned to China. When he taught architecture in the Higher Industrial School of the Agriculture, Industry and Business Department 農工商部高等實業學堂, he wrote the book *Building Construction* 建築新法 (figure 2-1) in 1910, which introduced this new subject from the name to its connotations, and brought the practice into Chinese higher education. Most importantly, it described a modern design method based on function and construction. His education practice was unsuccessful, but his book opened a door to the new kind of architecture method.[126]

Nancy Shatzman Steinhardt has given an explanation for the purer and primary meaning of these two words, but did not point out their etymologies.

"*Jianzhu* is the word used in China today for architecture. This modern word is formed from the character *jian*, which may mean to build, construct, erect, or establish, and *zhu*, which may also mean to build, but in its purer meaning refers to beating or ramming hard, a technique common in Chinese wall construction since the Neolithic period. Pre-modern Chinese employs the word *yingzao* for what is best translated as to construct. The first character (*ying*) takes as its primary meaning to regulate or manage, and *zao* can mean to build, but also may mean to institute."[127]

Over thousands of years of the Chinese traditional wooden building system, the building process was done by the cooperation of scholars and craftsmen. The State Labourer System 工官制度, in charge of the craftsman who worked for the government, was founded from ancient time, some believe in the Shang Dynasty (1600-1046 B.C.) 商朝,[128] but Chartes O. Hucker noted it as in the Han Dynasty (206 B.C.-220 A.D.) 漢代.[129] The ssŭ-k'ŭng 司空 "in charge of digging",[130] and the tŭng-kuān 冬官 or tūng-ch'īng 冬卿 was "top-echelon agencies in the central government, headed by a Minister of Works (ssu-k'ung) ranked as a Minister (ch'ing)", in charge of building.[131] Other official titles also known as "chiāng-tsd tà-chiàng 將作大匠" (from the Han to Sui Dynasty 從漢至隋朝),[132] "chiàng ch'ing 匠卿" (in the Sui Dynasty 581-618),[133] "chiâng tsd chiĕn 將作監" (in the Song Dynasty),[134] "kuăn-chiàng 管匠" (in the Ming Dynasty 1368-1644),[135] and so on. No matter whether it was for the palace buildings or others, under the rigid social hierarchy and regimentation, the scholars devised a conception, sometimes even acting as a Feng-shui master 風水師, and then the craftsmen arranged and built a series of buildings, and finally the scholars embedded meanings into the buildings through texts.[136] In this

[126] Lai Delin 賴德霖, "The History Materials on modern Chinese Architectural Education 關於中國近代建築教育史的若干史料", South Architecture 南方建築, 03(1994), p.9.
[127] Nancy Shatzman Steinhardt, "China: Designing the Future, Venerating the Past", *The Journal of the Society of Architectural Historians*, Vol. 61, No. 4(2002), p. 537.
[128] Liu Chengji 劉成紀, "*Baigong*, *Gongguan* and Early Chinese State Labourer System", p.102. Also see Zhang Yingying 張映螢, "Chinese Ancient State Labourer System", p. 51.
[129] Chartes O. Hucker, *A Dictionary of Official Titles in Imperial China*, p.293. In the explanation of the term "kūng-kuăn 工官", refers to the officer served in Han Dynasty.
[130] Ibid, p.450.
[131] Ibid, p.552.
[132] Ibid, p.140.
[133] Ibid, p.139.
[134] Ibid, p.140.
[135] Ibid, p.289.
[136] Xie Jing, "Transcending the limitations of physical form: a case study of the Cang Lang Pavilion in Suzhou,

sense, building 營造 *yingzao* is a kind of skill; the art of building is not a particular science.

Therefore no particular architect or architectural education was needed in Imperial China. The Chinese master carpenter, as an inter-mediator (or manager) between the owner and craftsmen, designed the drawing of the building, organized the building team, and controlled the budget, just as their western counterpart, the master-stonemason, did in the Middle Ages. The master-apprentice training of craftsman was similar to the apprenticeship approach to education in architecture in 19th century Britain.

Although the book *East Meets West: The Jesuits in China, 1582-1773* tells us that the cultural intercourse, which spread through religions, started very early, the Chinese traditional carpenter and the western architect did not meet each other before the 16th century. Some architects came to China from the West, but only a few of them working in the south of China, in Guangzhou, Hong Kong and Macao; most came to China after 1840, working in the cities that opened as treaty ports.[137] The Chinese traditional building system met the western architecture system first, and then the modern industrial system soon after. Modern Chinese architectural collegiate education was established in 1927 in Suzhou, after plenty of first generation Chinese architects had returned from abroad.

In the West, the role of modern professional architects developed from ancient craftsmen and old artists; while in China, because of the completely different building structures and systems, the modern architect's role was learned and transplanted from the West. Generally speaking, Chinese craftsmen never became architects. For a variety of reasons, the Chinese Architects Registration system was not founded until 1995.

This is the general historical background of the performers of the research subject.

2.2 Early Modern and Pre-modern, 1927-1937

In the history of modern China, historians have identified five years that could be called turning points: 1840, 1912, 1927, 1937, and 1949, which are shown in the Prologue (table 1-1).

The year 1840 was the eruption of the First Opium War (1840-1842). In *The Rise of Modern China* (fifth edition, 1995), Immanuel C. Y. Hsü wrote a section to answer the question "When does modern China begin"[138] in Chapter 1: A Conceptual Framework of Modem China. He suggests "accrediting the Opium War as a viable point of departure" for modern China, and the development from 1600 to 1800 as "providing the background information necessary for a sound understanding of modern China".[139]

The year 1912 was the first year of the Republic of China. It marks the end of Imperial China,

China", *The Journal of Architecture*, Volume 18, 11(2013), p. 303.

137 Peng Changxin 彭長歆, *The Famous Modern Architects in Lingnan* 嶺南近代著名建築師, (Guangzhou: Guangdong People's Press, 2005), p. 124.

138 Immanuel C. Y. Hsü, *The Rise of Modern China*, pp.4-7.

139 Ibid, p.7.

which had governed China for thousands of years; and the beginning of the Chinese modern republic system.

The year 1927 marked the establishment of the Nanjing Government of the Nationalists. It unified the whole country, and the administrative, judicial, educational, military, diplomatic systems were coordinated. The Republic of China was in a developing period after 1927.

The year 1937 saw the eruption of the Second Sino-Japanese War (1937-1945). It was a part of the Second World War. The full-scale invasion made turbulent times through eight years in modern China. Hsiung, James C. describes the damage of the war in China in *China's Bitter Victory: The War with Japan, 1937-1945*.[140] The Chinese civil war and revolution broke out soon after the victory.

The year 1949 saw the founding of the People's Republic of China. China took a very different course under Socialist transformation.

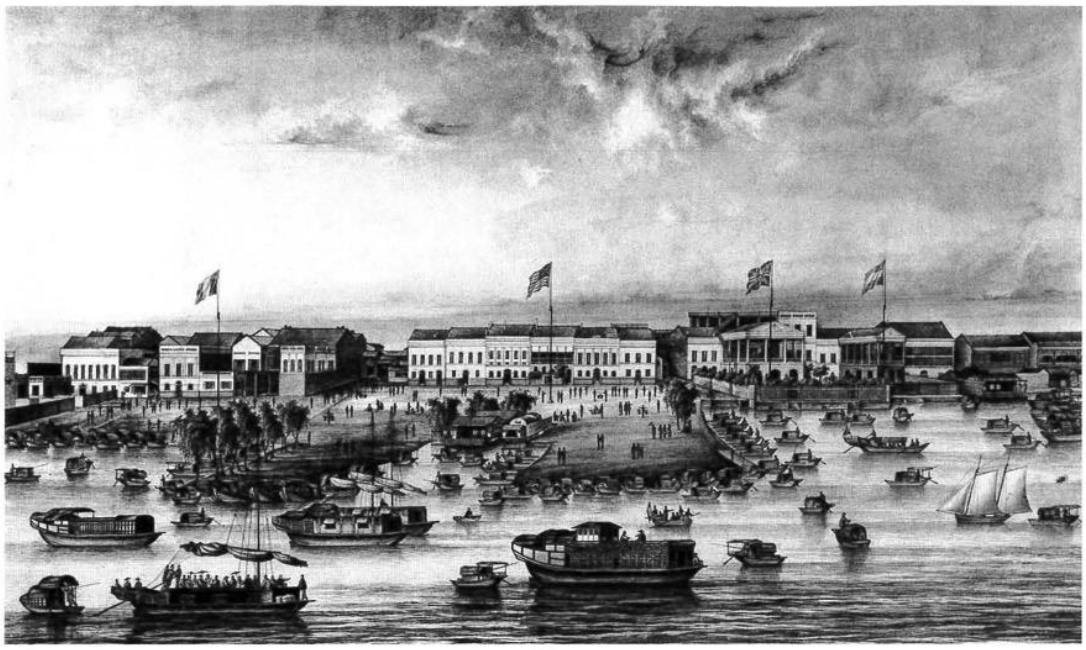
All the events above governed the processes of Chinese modernism.

2.2.1 Early modern period and pre-modern architecture

In history things are always going like this: the wheel of history has rolled on into a new period, but our living conditions still stayed in the old one. It is difficult to synchronise the physical environment and the cultural atmosphere in the same step. Changes in the physical environment are usually slow and behind the development of culture and science. Architecture and buildings, as one of the most remarkable signs of the physical environment, are no exception.

As Kenneth Frampton notes in *Modern Architecture: A Critical History*, modern architecture is based on the "cultural transformations, territory transformations, and technical transformations".[141] What is modern? What is modernism in architecture? These questions are very complicated in many research areas, and do not offer a simple clear answer on the timeline or date. As Ralph C. Croizier mentioned, when he reviewed the book *Modernism in China*, "How much of this was 'modern'? All of it if we mean new; not much before the 1980s if we mean modern in style, 'modernism'."[142] Although Ralph claimed in humility that he is a historian of modern China, not an architectural historian, he, Denison and Ren all pointed out that before 1927, there were very few but "Western styles and fashions (and, of course, the technology behind them in the skyscraper age) continued to dominate the new urban landscape. Very little of this penetrated the vast Chinese countryside where, until very recently, traditional building techniques remained unchallenged."[143]

[140] James C. Hsiung, *China's Bitter Victory: The War with Japan, 1937-1945*, (New York: M.E. Sharpe publishing, 1992).
[141] Kenneth Frampton, *Modern Architecture: A Critical History*, Chapter one, pp.12-19.
[142] Ralph Croizier, "Review Article: Modern Chinese Architecture in Global Perspective," World History Connected June 2012 <http://worldhistoryconnected.press.illinois.edu/9.2/br_croizier.html> [accessed 28 Feb. 2016].
[143] Ibid.



2-2 French, American, British and Dutch Factories, Canton, circa 1830.

2-3 The Danish Legation possibly at Canton, circa 1840.

At first, most of the architecture built by western architects in the southern cities of China in early modern time were just western style buildings moved into China. Most of them were trade buildings, factories, or legations, as shown in figure 2-2, "view of the waterfront at Canton with French, American, British and Dutch Factories with numerous figures and vessels, circa 1830".[144]

[144] Christie's Swire (Hong Kong) Ltd., *Fine Chinese Works of Art, Jade and Jadeite Carvings, Fine China Trade Pictures*, (Hong Kong: Christie's Swire Ltd. 1994), p. 165.

The buildings in the "view of the Danish Legation possibly at Canton, circa 1840" were also of a totally western architectural style, making an interesting contrast with the one on the right, which is a local building (figure 2-3).[145] Other drawings of Macao and Hong Kong in the same period were painting the same situations.[146]

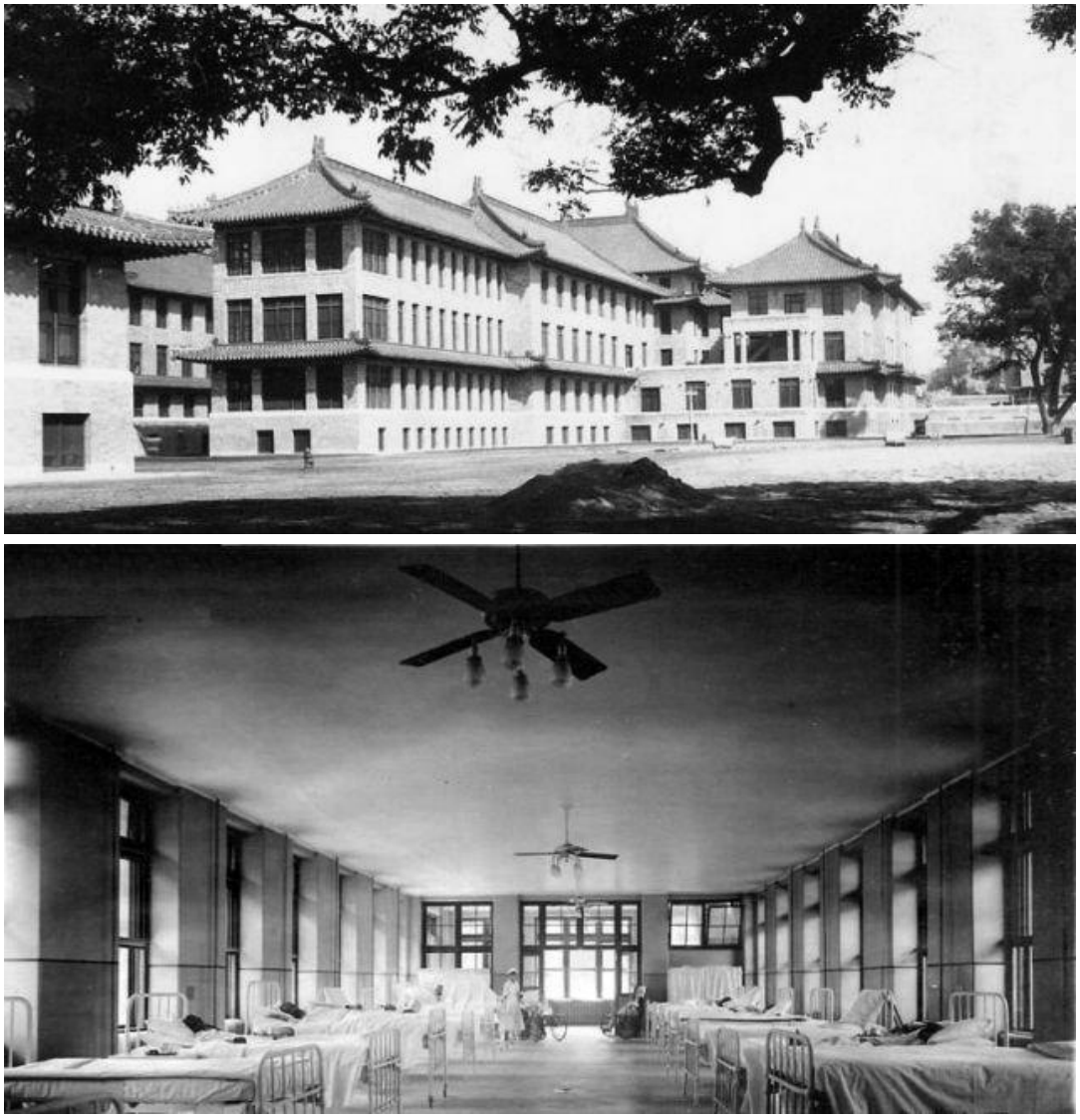
Until all the reform had been well prepared, modern architecture appeared. Therefore it is not strange that in the early 20th century, in early modern China, the physical and living environment remained tied to the traditional or pre-modern buildings. Even when Chinese society was accepted and influenced by the West, stepping into the "modern time", most Chinese buildings were still kept in the forms of traditional carpentry structures. For a certain period, the traditional and modern were mixed, both of them offering physical and living environments to exist together.

A new style of architecture was born in China: pre-modern architecture. Here the word "pre-modern" refers to those buildings that were neither purely traditional nor really modern. The word "pre-modern" is used to point out the time when the architecture style was born. But in order to explain the forms of this architecture style, it was also known by some other names: for example, the Peking Union Medical College Hospital 北京協和醫院, 1916-1918, designed by Canadian architect Harry Hussey, who was American architect Henry K. Murphy's (1877-1954) strongest competitor. Both of their designs were "adaptive architecture".[147] Chinese architecture scholar Lai Delin 賴德霖 called it the "Chinese classicism renaissance style modern building 中國古典復興式現代建築", grouping it with other architecture designs which put Chinese traditional characteristics (the style of curved roof, bracket sets, columns, and so on) on western modern building space (big inner space with new technology, material and construction).[148] Another Chinese scholar Zhu Jianfei 朱劍飛 noted it as the style "promoted by state authority".[149]

The contrast between inner space and outside appearance of the Peking Union Medical College shows the spirit of these buildings (figure 2-4).[150] After 1927, the Nanjing national government was founded, and eagerly encouraged the Chinese traditional culture renaissance to build a new Chinese national image, which could be contrasted with the old Qing dynasty. Building the city in the Chinese classicism renaissance style modern building was chosen as an effective direction by the government. They wanted to put the Chinese classicism renaissance style buildings into the western commemorative urban plan to give a new look to Chinese cities. After designed some successful campuses, Henry K. Murphy, with help of Zhu Qiqian, made the Chinese classicism renaissance style modern building into a mature style. He was invited to be the counsellor for the Capital Plan of Nanjing 南京首都計畫 in 1929. His assistant Huang Yuyu 黃玉瑜 designed the office building and city gate of the capital city (figure 2-5).[151] From his design, we can see that the Chinese traditional building style was kept as an important aspect of national character, and that concrete and reinforced concrete were used as new technology

[145] Christie's Swire (Hong Kong) Ltd., *Fine Chinese Works of Art, Jade and Jadeite Carvings, Fine China Trade Pictures*, p. 167.
[146] Ibid., pp. 165-177.
[147] Jeffrey W. Cody, *Building in China: Henry K. Murphy's "Adaptive Architecture", 1914-1935*, p.70.
[148] Lai Delin, *Studies in Modern Chinese Architectural History*, p.112-199.
[149] Zhu Jianfei, *Architecture of Modern China: A historical critique*, p. 56.
[150] Photographs in figure 2-4 came from "Old Photographs", Peking Union Medical College Hospital <http://www.pumch.cn/news1/lsyg/xhlzp/2010/09/06/1421213739.html> [accessed 10 Feb. 2016]
[151] Jeffrey W. Cody, *Building in China: Henry K. Murphy's "Adaptive Architecture", 1914-1935*, pp.182-195. Also see Lai Delin, *Studies in Modern Chinese Architectural History*, p.112.

materials and construction. Lü Yanzhi 呂彥直[152] and Dong Dayou 董大酉[153] were Murphy's assistants. Their project for the Mausoleum of Dr. Sun Yat-sen 中山陵 (1925-1929) in Nanjing (figure 2-6)[154], and the Shanghai Municipality 上海市政府 (1931-1933) were the pinnacle of this style (figure 2-7). [155]



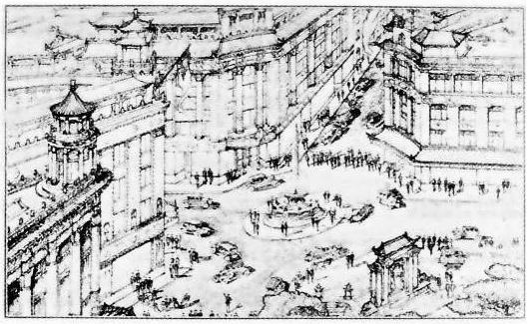
2-4 The out looking and inner space of the Peking Union Medical College, Harry Hussey, Peking, 1916-1918

[152] Lu Yanzhi 呂彥直 (1894 - 1929), Chinese architect, "A graduate of Cornell University (1918), who had established his office in 1921 in Shanghai." See in Zhu Jianfei, *Architecture of Modern China*, pp. 54. Also see Lai Delin, "The Sun Yat-sen Memorial Auditorium: A Preaching Space for Modern China", in *Chinese Architecture and the Beaux-Arts*, ed. by Cody, Jeffrey W., pp.279-300.

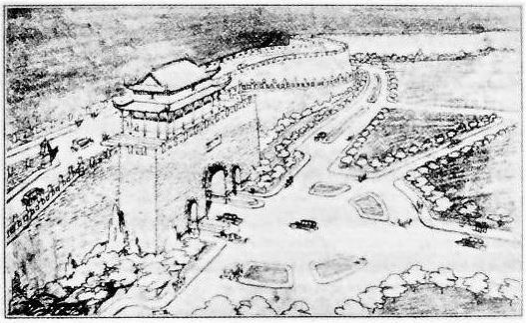
[153] Dong Dayou 董大酉 (1899 – 1973), Chinese architect, graduated from the University of Minnesota and Columbia University, who returned to China in 1928, and established his office in 1929 in Shanghai. Also see Seng KUAN, "Between Beaux-Atrs and Modernism: Dong Dayou and the Architecture of 1930s Shanghai", in *Chinese Architecture and the Beaux-Arts*, ed. by Cody, Jeffrey W., pp.169-192.

[154] Figure 2-5 and 2-6 come from Lai Delin, *Studies in Modern Chinese Architectural History*, p.199 and 144.

[155] Zhu Jianfei, *Architecture of Modern China: A historical critique*, pp. 54-57. Figure 2-7 come from p.56.

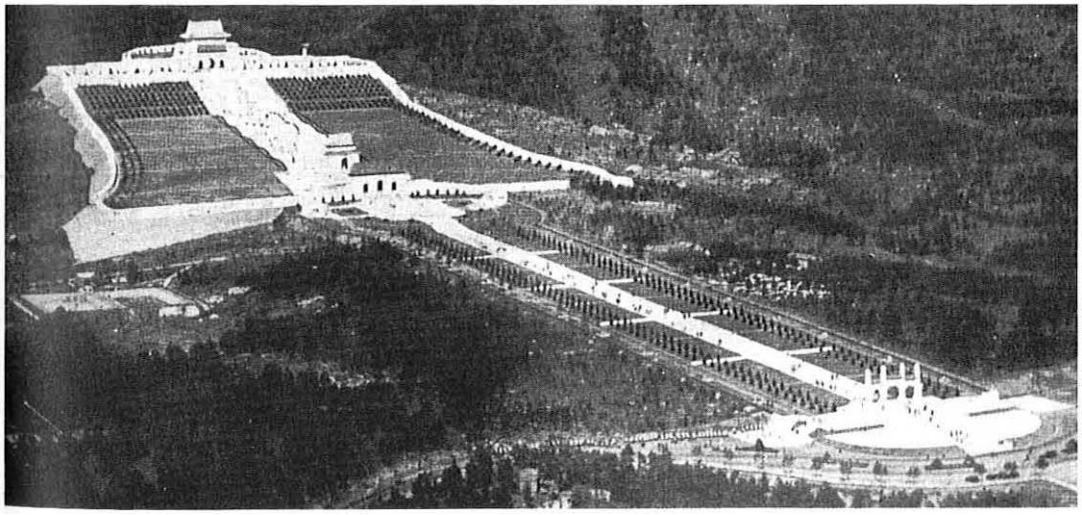


The National Capital City Offices (in planning), Huang Yuyu, 1929



The National Capital City Gate (in planning), Huang Yuyu, 1929

2-5 The office building and city gate of capital city, Huang Yuyu, 1929.



2-6 The Mausoleum of Dr. Sun Yat-sen, Nanjing, Lü Yanzhi, 1925-1929

2-7 The Shanghai Municipality, Dong Dayou, 1931-1933

All the examples above show that the conflicts and harmonies between traditional and modern were activated in the era of the early 20th century. Zhu used plenty of examples to prove that "a large number of buildings of this style with different design approaches soon emerged in the 1930s and 1940s".[156] Whatever these architectures are called, the special style evidences that the Chinese traditional building style met the West modern architecture style, and was then blended into a new architecture style, which was designed by either foreign or Chinese architects, satisfied both the users and the government.

Furthermore, modernism on architecture never went through smoothly in China. As Zhu commented in his book, both in the old China, and the Republic of China, then even in the People's Republic of China, modernism was "curtailed and suppressed".[157] Zhu believed this situation was caused by "the overall socio-economic and political condition [which] was weak and vulnerable", and the "low level of industrialization and standardization".[158] He might be right on these two points, but besides those reasons, I believe it was also caused by the stronger Chinese traditional culture, and the still complete Chinese traditional carpentry building system.

From the beginning with Murphy's design in 1916-1918[159] through promotion by state authority in 1925, then emerging at a larger scale in the 1930s and 1940s, the designers of these pre-modern works will be discussed in the next two sections.

2.2.2 Foreign architects in early modern China

There is plenty of research on the foreign architects and their works in early modern China. One example is Chapter Three in Zhu Jianfei's *Architecture of Modern China: A historical critique*,[160] Tess Johnston and Deke Erh published a series book on western architecture in old China: *A Last Look – Western Architecture in Old Shanghai*,[161] *Near to Heaven–Western Architecture in China's Old Summer Resorts*,[162] *God and Country–Western Religious Architecture in Old China*,[163] *Far From Home – Western Architecture in China's Northern Treaty Port*,[164] *The Last Colonies – Western Architecture in China's Southern Treaty Ports*.[165] All of these books give descriptions of the western works built in the early modern times across old China. But only a few of them focus on the architects: such as Jeffrey W. Cody's book mentioned

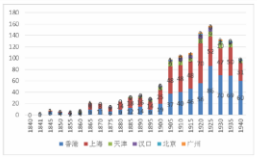
156 Zhu Jianfei, *Architecture of Modern China: A historical critique,* pp.56-60.
157 Ibid, p. 73.
158 Ibid, pp. 72-73.
159 Some researchers, such as Lai Delin thought the Scherechewsky Hall 施懷堂 of the St. Johns University, designed by British architect Brennan Atkinson, in 1895, in Shanghai, was the first Chinese classicism renaissance style modern building. But the Peking Union Medical College was the earliest one found positive acceptance.
160 "Chapter Three: The architect and a nationalist project, Nanjing, 1925-27", in *Architecture of Modern China: A historical critique*, Zhu Jianfei, pp.41-74.
161 Tess Johnston and Deke Erh, *A Last Look – Western Architecture in Old Shanghai,*（Hong Kong: Old China Hand Press,1993).
162 Tess Johnston and Deke Erh, *Near to Heaven–Western Architecture in China's Old Summer Resorts*, (Hong Kong: Old China Hand Press, 1998).
163 Tess Johnston and Deke Erh, *God and Country – Western Religious Architecture in Old China*, (Hong Kong: Old China Hand Press,1996).
164 Tess Johnston and Deke Erh, *Far From Home - Western Architecture in China's Northern Treaty Port*, (Hong Kong: Old China Hand Press,1998).
165 Tess Johnston and Deke Erh, *The Last Colonies - Western Architecture in China's Southern Treaty Ports*, (Hong Kong: Old China Hand Press, 1997).

before, the *Laszlo Hudec and the Park Hotel in Shanghai, China*,[166] and the *László Hudec* 鄔達克.[167] Jeffrey W. Cody also wrote a chapter "From studio to Practice: Chinese and Non-Chinese Architects Working Together" in the *Chinese Architecture and the Beaux-Arts*.[168] He gives a introduction of several architecture studios in Shanghai, and a figure of architects practicing in Shanghai in 1926. Zheng Hongbin 鄭紅彬 gives more attention to the numbers, names, nationalities, and workplaces, also working firms in his PhD thesis: *Research on British Architects in Modern China (1840-1949)*.[169] According to incomplete statistics by Zheng, at least 507 foreign architects worked in modern China between 1840 and 1940,[170] and about 600 British architects worked in old China in that era.[171] This research result is believable because his information is based on the English trade directories and name lists published in China in the early modern time, and Tony Lam Chung Wai's 林中偉 *From British Colonization to Japanese Invasion: The 100 Years Architects in Hong Kong 1841-1941*.[172]

Of all the foreign architects serving in old China, the numbers of British were definitely the greatest, first in Hong Kong, then Shanghai, Tianjin, Hankou 漢口, Peking, and other cities.[173] The second largest group was Russian architects, nearly 190, mostly in Harbin 哈爾濱.[174] The third was German, 96, mostly in Qingdao 青島, then Shanghai, Hankou, Peiping, and Dalian 大連.[175] American architects were 54, mostly in Shanghai and Peking.[176] Japanese were 80, most of them in Manchuria 東北.[177]

In the books mentioned above, the dates listed nearly all fall between 1840 and 1940, or between the beginnings of the 1920s and1937. Henry K. Murphy's "Adaptive Architecture" was from1914-1935; Laszlo Hudec from1919-1927; the architect and a nationalist project was in 1925-27; and Zhu noted "a particularly unified China lasting not more than ten years (1927/8-37) while the rest of China in the same period, and the whole of China in periods before and after, was in war and disarray."[178] Looking back to the four remarkable years cited earlier, 1840 marked the start of Chinese modernism, 1912 marked a new political system founded in China, after developing more than ten years, 1927 to 1937 was the "golden decade" for Chinese modernism in old China. After the war and disarray, 1949 marked the time when "new China" was founded.

166 Lenore Hietkam, *Laszlo Hudec and The Park Hotel in Shanghai*, *China*, (Shawnigan Lake: Diamond River Books, 2012).
167 Luca Poncellini and Júlia Csejdy, Hua xiehong 華霞紅 and Qiao zhengyue 喬爭月, tran., *László Hudec* 鄔達克, (Shanghai: Tongji University Press, 2013).
168 Jeffrey W. Cody, "From studio to Practice: Chinese and Non-Chinese Architects Working Together", in *Chinese Architecture and the Beaux-Arts*, Jeffrey W. Cody, ed., pp.207-222 .
169 Zheng Hongbin 鄭紅彬, "Research on British Architects in Modern China (1840-1949) 近代在華英國建築師研究 (1840-194)", (unpublished PhD Thesis, Tsinghua University 清華大學, June 2014).
170 Ibid., pp.24-25.
171 Ibid., pp.382-450. In appendix B, Zheng gives a table of details on each architect's working time in China, name, time of birth and death, education background, and the working firm.
172 Tony Lam Chung Wai 林中偉, "From British Colonization to Japanese Invasion: The 100 Years Architects in Hong Kong 1841-1941", *HKIA Journal*, Issue 45, 01(2006), 44-55.
173 "Chapter Three: The development of British architects in modern Chinese cities", in *Research on British Architects in Modern China (1840-1949)* 近代在華英國建築師研究 (1840-194), Zheng Hongbin, pp.34-124.
174 Ibid., p.25.
175 Ibid., p.25. Zheng gives all the 96 architects names in the note.
176 Ibid., p.25. Zheng gives most of the 54 architects names in the note
177 Ibid..
178 Zhu Jianfei, *Architecture of Modern China: A historical critique*, p72-73.



HongKong Shanghai Tianjin Hankou Peiping Guangzhou

Table 2-1 The Distribution of British architects in early modern China (1840-1940)

As the largest number of foreign architects working in Old China, Zheng made a table based on the research on the British architects in China at that period, which proves the conclusion of a "golden decade". Table 2-1 was drawn by Zheng, with added English translation of cities by the author.[179] From the table, we can see that from 1840 to 1865, there were no more than 10 British architects coming to work in China on average. From 1865 to 1900, there were around 20 British architects working in China every year, mostly in Shanghai and Hong Kong. From 1900 to 1940, about 100 British architects worked in China, five times more than before, and the number in1925 topped that with more than 150. The working places were also extended to other cities. After 1940, because of the Second Sino-Japanese War and World War II, most British architecture firms were closed or moved to other countries.

To sum up, merely citing British architects as typical of foreign architects, although some of them came to work in China ever since 1840, by 1920 they had reached large numbers servicing the big opening Chinese cities, and could exert more influence on architectural design than ever before. After 1940, few stayed in China. In other words, the meeting of Chinese traditional carpenters and foreign modern architects could never happen before 1840, nor later than 1940 in old China. And the most active period of the foreign architects was the most fruitful era for conflicts and harmonies between them, which focused around the "golden decade", 1927-1937.

2.2.3 Chinese architects in early modern China

After the discussion of the foreign architects who worked in old China, we should look at the first generation of Chinese architects who trained abroad.

[179] Zheng Hongbin, "Research on British Architects in Modern China (1840-1949)", p.133.

The earliest study abroad was organized by missionary schools in modern China. The memoirs of Yung Wing 容閎 (1828-1912), *My life in China and America*,[180] records their strenuous efforts in the process of studying and living abroad:[181] In 1847, Yung Wing, Huang Sheng 黃盛 (1827-1902)[182] and Huang Kuan 黃寬 (1829-1878) were led to the USA by the principal of the Morrison Memorial School 馬禮遜紀念學校, Rev. Samuel Robbins Brown. Yung Wing was the first Chinese student to graduate from Yale College, and he went back to China to promote the Chinese educational mission (1872-1881). Huang Sheng returned to Hong Kong in 1848, and became a famous educator and newspaper worker. Huang Kuan went to Scotland in 1850, studied at the University of Edinburgh from1850 to 1855, and was an intern until 1857. He was the first Chinese person to study medicine abroad, and gained a Doctoral Degree. He went back to Hong Kong and one year later moved to Guangzhou 广州 (Canton) in 1858, and educated a new generation of doctors who saw a wealth of knowledge in Western medicine. This was only the minimum scale of private study abroad, and the government of the Qing Dynasty started to dispatch students abroad from 1872.

There were four waves of studying abroad in the late Qing Dynasty:

The loss of the First Opium War made Chinese officials of the self-strengthening movement hope to "Learn Merits from the Foreigners to Conquer the Foreigners 師夷之長以制夷"; and tried to enact reforms as "Western learning for practical application, Chinese learning as a base 中學為體, 西學為用". Both of these intentions required the young to be sent to study abroad. The Chinese Educational Mission to America (1872-1875), the Foohow Navy Yard School 福建船政學堂 mission to Europe (1877), the wave of studying abroad in Japan (1896-1906), and study abroad in the Boxer Indemnity 庚子賠款 period (1909-1911), were four waves of studying abroad in the late Qing Dynasty. These were the beginning of the eastward transmission of western culture to early modern China.

From 1872 to 1875, with unremitting efforts by Yung Wing, presided over by the Chinese self-strengthening movement officials Li Hongzhang 李鴻章 and Zeng Guofan 曾國藩, the Qing government made a 15 year plan for the Chinese educational mission to America. Yung Wing and Huang Kuan were the organizers and managers in America.[183] 126 teenage boys from 11 to 15 were sent to America in four instalments. More than fifty of them went to the Ivy League universities after graduating from high school, such as Harvard University, Columbia University, Yale University, and Massachusetts Institute of Technology. In 1881, due to the obstructive attitude of Chinese conservative officials, 94 students returned to China, another 32 having discontinued studying or died. The plan failed because of conflict and misunderstandings between Chinese and western culture. It was highly regrettable that only two of the students graduated from university, for most of the others just needed two more years study when they were forced to return.[184] Even so, these returning students who had accepted western education and the influences of western culture devoted themselves to their country, helping to create an early modern China. The first batch of 21 students was sent to the department of cable telegraphy; the

[180] Yung Wing, *My life in China and America*, (New York: Henry Holy Company, 1909).
[181] Yung Wing 容閎, also known as "Rong Hong". He was one of the first Chinese students who studied abroad in the late Qing Dynasty.
[182] Also translated as Wong Shing, and known as 黃達權, Wong Tat-kuen.
[183] Yung Wing, *My life in China and America*, pp. 59-74. In the book, Yung Wing used three chapters to explain the Chinese Educational Mission.
[184] Ibid.,p.71.

23 students from the second and third batches worked in the Fujian shipping and polity department 福建船政局 or the Shanghai machine department 上海機械局; the other 50 students were sent to Beiyang Navy 北洋水師.[185] Among these 94 returning students who later made important careers were the first Chinese engineer Zhang Tianyou 詹天佑, who designed the first Chinese self-built railway; the first Chinese mining and metallurgy engineer Wu Yangzen 吳仰曾; the first president of Beiyang University 北洋大學 Cai Shaoji 蔡紹基; the first president of Tsinghua University 清華大學 Tang Guoan 唐國安; the first generation of Chinese diplomatists Liang Cheng 梁誠 and Ouyang Geng 歐陽庚; the first prime minister of the Republic of China Tang Shaoyi 唐紹儀. Besides these people, there were 3 railway directors, 5 railway officers, 6 railway experts, 9 mining experts, 12 diplomatic officers, 2 Navy marshals, and 14 navy officers.[186]

After the Chinese educational mission to America, the Fujian shipping and polity department began to send apprentices and students to Europe. Led by the Chinese Self-Strengthening Movement officials in the Beiyang Navy, the school of shipping and polity was set up, in order to train the navy professional personnel, and strengthen naval defence. At the same time, they sent apprentices and students to Europe with the purpose of learning modern technology to self-strengthen. In 1877, 28 apprentices and students went to Britain from Fuzhou 福州, and 5 others went to France. They returned in 1878 to 1880, and soon became technical experts in the department of the Beiyang Navy. Their success led to three other batches of 49 young men being sent to Europe: besides Britain and France, they were also sent to Germany. These apprentices and students were older than 15, with a clear task, and they studied hard. Half of them became officers in the Beiyang Navy; many of them died in the service of their country in the Sino - Japanese War of 1894. Knight Biggerstaff introduces the Foohow Navy Yard School and their influence on the Beiyang Navy in his *The Earliest Modern Government Schools in China*.[187]

Japan was made rapidly prosperous and powerful from the latter half of the 19th century by the Meiji Restoration. As a result, the loss of the First Sino-Japanese War of 1894-1895, the disastrous defeat of the Beiyang Navy, and "the Treaty of Shimonoseki 馬關條約" which China was forced to sign, shocked the Qing government, and brought a Chinese awakening. Japanese strengthening had stimulated Chinese people to hope to follow the example of Japan. The First Sino-Japanese War caused study abroad to develop exceptionally swiftly, ending the situation of pausing and pondering, which had lasted more than 20 years. The next year, in 1896, the Qing government sent 13 students to Japan. The number rose to more than 2000 in 1904. But others went independently at their own expense, and in1903, there were more than 6000 students studying in Japan, and in 1906, the peak number was around 13000.[188] Most students studied political science and law, or military affairs, but a few of them studied science and engineering.

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[185] Huang Bo 黃波, *The Truth of the Late of Qing Dynast* 晚清真相, (Nanjing: Jiangsu Literature and Art Publishing House 江蘇文藝出版社, 2011), p. 95.

[186] Rong, Yingyu 容應萸, "The comparison between the boys of Qing Dynasty studying in America in 1870 and the students of late Qing studying in Japan in 1900 1870 年代清朝留美幼童與 1900 年代清末留日學生之比較", *Journal of Xuzhou Normal University (Philosophy and Social Science Edition)* 徐州師範大學學報 (哲學社會科學版), Vol. 30, 06 (2004), p.6.

[187] Knight Biggerstaff, *The Earliest Modern Government Schools in China,* (New York: Cornell University Press, 1961).

[188] Sanetou Keishuu 實藤惠秀, Tan Ruqian 譚汝謙 and Lin Qiyan 林啟彥, tran., *History of Chinese People Studying in Japan* 中國人留學日本史, (Beijing: Joint Publishing Company 生活・讀書・新知三聯書店, 1983), p.36.

They were enrolled in short courses, and only 1% of them went to university. These students gradually became organised as an important political power, and later led the Revolution of 1911 in China that ended the Qing Dynasty.

After 1908, following the suggestion of American president Theodore Roosevelt, the Boxer Indemnity Scholarship Program was set up as a scholarship programme funded by Boxer Rebellion indemnity money paid to the United States. It provided for Chinese students to study in the U.S. It has been called "the most important scheme for educating Chinese students in America and arguably the most consequential and successful in the entire foreign-study movement of twentieth century China."[189] In 1909, the first 47 students went to America. This was the other big organized arrangement for studying in America after 1872, and started another phase of study abroad in the West. From 1909 to 1911, 196 students were sent by the government of the late Qing Dynasty. A batch of scholars, scientists, educators, and social activists evolved out of these students after they returned to the Republic of China.

To sum up, the Chinese students studying abroad began with personal individual's action, and ended with governmental action. Yung Wing and his fellows came from the poorest of Chinese farmer families. They went to America as orphans. They had no choice, for they might have had no future if they had stayed in China. The students in the Chinese educational mission to America came from middle-class families, which inhabited the coastal cities, and had some knowledge about life abroad. The parents of such students had to sign their son's life away.[190] When the Fujian shipping and polity department began to send apprentices and students to Europe for the first time, two of them came from noble families. After the First Sino-Japanese War and the revelation of the example of Japan, it took almost half a century for the idea of study abroad to be accepted by Chinese members of the gentry and ordinary people. Although the reason for Imperial China's disintegration was complicated, there is no doubt that the returning students from these four waves of studying abroad in the late Qing Dynasty opened the door of Imperial China to the western modern new world, introduced western science and engineering to China, built a new social system and political system in China, and pushed forward the Chinese process of modernization.

The students returning from the first and second waves worked for the Qing government as they were supposed to do. Although none of them were architects, they led China into a modern phase, and prepared it to accept a new school system. The students returning from the third and fourth waves were luckier than their senior fellows. Most of them returned after 1912 to find a new society, in which they had more opportunities to use the knowledge and skills they had learned abroad. The first generation of Chinese architects were all in the last two waves.

From the record in Sanetou Keishuu's *History of Chinese People Studying in Japan*, and the dates of *The Documents of the History of Chinese Modern Education: Studying Abroad*,[191] the

[189] Ye Weili, *Seeking Modernity in China's Name: Chinese Students in the United States*, (Stanford, CA: Stanford University Press, 2001), p. 10.

[190] Huang Bo 黃波, *The Truth of the Late of Qing Dynast*, p.122. The father of Zhan Tianyou 詹天佑 was persuaded by his neighbour who had lived abroad. The contract of study abroad was recorded in the biography of Zhan Tianyou.

[191] Chen Xuexun 陳學恂 and Tian Zhengping 田正平, *The Documents of the History of Chinese Modern Education: Studying Abroad* 中國近代教育史資料彙編留學教育, (Shanghai 上海: Shanghai Education Publishing House 上海教育出版社,1991).

earliest Chinese students studying abroad were doing so in 1905. Until 1938, the Chinese architects followed: 3 in Britain, who were Qian Baozong 錢寶琮, Li Yishi 李毅士, and Bei Jimei 貝季眉; 3 in France, whowere Lu Yanzhi 呂彥直, Liu Jipiao 劉既漂, and Yu Binglie 虞炳烈; 2 in Germany, whowere Bei Jimei 貝季眉 and Bei Shoutong 貝壽同; 4 in Japan, who were Liu Shiying 柳士英, Liu Dunzhen 劉敦楨, Zhu Shikui 朱士圭, and Huang Zumiao 黃祖淼; 1 in Italy, whowas Shen Liyuan 沈理源; and 37 in America, half of them in the University of Pennsylvania, including Zhuang Jun 莊俊, Fan Wenzhao 範文照, Zhu Bin 朱彬, Yang Yanbao 楊廷寶, Chen Zhi 陳植, Liang Sicheng 梁思成, Lin Huiyin 林徽因, Tong Jun 童寯, and Tan Huan 譚垣. Most of them devoted themselves to Chinese modern architectural education, as shown in table 2-2 and 2-3, while others became famous architects working on Chinese modern or pre-modern architecture.[192]

As shown in table 2-1 and 2-2, the earliest of the first generation Chinese architects to return was Qian Baozong in 1912. Bei Shoutong followed (in 1913), Bei Jimei (in 1914), Li Yishi (in 1916), and Lu Yanzhi (in 1918). In the early years after returning, all of them worked as architects in Shanghai. When the people who trained in Japan returned from 1919 to 1925, and established the first Chinese architecture department in the Suzhou Engineering School in 1927, most became architecture teachers. Soon after the American students returned, architecture departments were set up in National Northeast University 國立東北大學 in Shengyang 瀋陽, National Peiping University 國立北平大學 in Peking, and National Arts School 國立杭州藝術學院 in Hangzhou 杭州, all in 1928.

Therefore, before 1912, no Chinese architect had trained abroad; and their active time in China started in the 1920s. Before 1930, no Chinese architect was professionally trained in China, which could be why the most active building period in early modern China was in the 1920s and 1930s.

This concludes the general historical survey and people's background for the performers of the research subject.

[192] Lai, Delin, "Who's Who in Modern Chinese Architecture (4) 中國近代時期重要建築家（四）", *World's Architecture* 世界建築, 08 (2004), 82-85.
Lai, Delin, "Who's Who in Modern Chinese Architecture (7) 中國近代時期重要建築家（七）", *World's Architecture* 世界建築, 11 (2004), 100-103.
Lai, Delin, "Who's Who in Modern Chinese Architecture (8) 中國近代時期重要建築家（八）", World's Architecture 世界建築, 12 (2004), 102-107.

	Name	Date of Birth and Death	Gender	Native Place	Time to Study	Country	University/School Department	Degree	Time to Return to
Suzhou engineering school	柳士英 Liu Shiying	1893-1972	Male	江蘇蘇州 Suzhou, Jiangsu	1915	Japan	Tokyo School of Higher Education, Architecture	Bachelor Teshima Scholarship	1920
	劉敦楨 Liu Dunzhen	1897-1968	Male	湖南新寧 Xinning, Hunan	1916	Japan	Tokyo School of Higher Education, Architecture	Bachelor	1921
	朱士圭 Zhu Shikui	1893-1981	Male	江蘇無錫 Wuxi, Jiangsu	1915	Japan	Tokyo School of Higher Education, Architecture	Bachelor	1919
	黃祖淼 Huang Zumiao	1891-?	Male	浙江余姚 Yuyao, Zhejiang		Japan	Tokyo School of Higher Education, Architecture	Bachelor	1925
	錢寶琮 QianBaozong	1892-1974	Male	浙江嘉興 Jiaxing, Zhejiang	1908	Britain	University of Manchester, Civil Engineering, Architecture	Bachelor,1911 Associate,1912	1912
National The Forth Zhongshan Univer	呂彥直 LuYanzhi	1894-1929	male	安徽滁州 Chuzhou, Anhui	1901 1914	France America	Paris, Junior Primary School Cornell University, Architecture	Bachelor	1908 1918
	劉福泰 Liu Futai	1899-1952	male	廣東寶安 Bao'an,	1923	America	Oregon State University, Architecture	Master	1925
	李毅士 Li Yishi	1886-1942	Male	江蘇武進 Wujin, Jiangsu	1904	Britain	Glasgow School of Art, Watercolour, University of Glasgow, Physics	Bachelor,1912 Bachelor,1916	1916
	盧樹森 Lu Shusen	1900-1955	Male	浙江桐鄉 Tongxiang,	1923	America	University of Pennsylvania, Architecture	Bachelor	1926

Table 2-2 Teachers' education background abroad in the early Chinese architectural collegial education-1

	Name	Date of Birth and Death	Gender	Native Place	Time to Study	Country	University/School Department	Degree	Time to Return to
National North-eastern University	梁思成 Liang Sicheng	1901-1972	Male	廣東新會 Xinhui, Guangdong	1924	America	University of Pennsylvania, Architecture	Master	1928
	林徽因 Lin Huiyin	1904-1955	Female	福建福州 Fuzhou, Fujian	1920 1924	Britain, America	London · High School University of Pennsylvania, Fine Arts	Bachelor	1928
	陳植 Chen Zhi	1902-2002	Male	浙江杭州 Hangzhou,	1923	America	University of Pennsylvania, Architecture	Master	1928
	童寯 Tong Jun	1900-1983	Male	遼寧瀋陽 Shenyang, Liaoning	1925	America	University of Pennsylvania, Architecture	Master	1928
	蔡方蔭 CaiFangyin	1901-1963	Male	江西南昌 Nanchang,	1925	America	Massachusetts Institute of Technology · Architecture	Master	1928
National Central University	劉既漂 Liu Jipiao	1900-1992	Male	廣東興寧 Xingning,	1920	France	Écolenationalesupérieure des beaux-arts, Architecture	Bachelor	1927
	虞炳烈 Yu Binglie	1895-1945	Male	江蘇無錫 Wuxi, Jiangsu	1921	France	Écoled'architecture de Lyon	Bachelor, The Best Degree Award 1930	1933
	譚垣 Tan Yuan	1903-1996	Male	廣東中山 Zhongshan, Guangdong		America	University of Pennsylvania, Architecture	Bachelor	1929
	貝季眉 BeiJimei	1887-1941	Male	江蘇蘇州 Suzhou, Jiangsu	1904 1906 1910	Japan Britain Germany	Waseda University, political economics TechnischeUniversität Berlin,	Bachelor	1914
	鮑鯨			湖北蒲圻			University of Illinois,		

Table 2-3 Teachers' education background abroad in the early Chinese architectural collegial education-2

2.3 "Tradition 派" and "Group 幫", Suzhou

The foreign concessions and settlements in the treaty ports of China were 104 cities, also sometimes cited as 110 cities, including Hong Kong, Macao, and four other cities. Among the numerous researches on Chinese treaty ports, the famous sinologist Frances Wood (吳芳思) gives detailed descriptions with deep sympathy for Chinese people in her *No Dogs, & Not Many Chinese: Treaty Port Life in China 1843-1943*.[193]

In 1942, because of China's defeat in the First Opium War, according to the Treaty of Nanjing 南京條約, Shanghai, Ningbo 寧波,[194] Xiamen 廈門,[195] Fuzhou 福州,[196] along with the original single treaty port Guangzhou,[197] were the first five cities opening to the West, especially to the British. Hong Kong was leased to Britain in the same year. Including the earliest colony, Macao, which was leased in 1557, in the middle of the Ming Dynasty, in total six cities were the first opened to the foreigners, shown as red points in figure 2-8.[198]

In 1858, after China's defeat in the Second Opium War, according to the Treaty of Tianjin 天津條約, ten more cities became treaty ports: Niuzhuang 牛莊 (late "Yingkou 營口"),[199] Taiwan Fu 臺灣府 (late "Tainan 台南"), Chaozhou 潮州 (late "Shantou 汕頭"), Dengzhou 登州 (late "Yantai 煙臺"), Danshui 淡水, Qiongzhou 瓊州 (late "Hainan 海南"), Hankou 漢口,[200] Jiujiang 九江,[201] Nanjing 南京,[202] Zhenjiang 鎮江.[203] shown as green points in figure 2-8. And in 1860, according to the Treaty of Beijing 北京條約, Tianjin 天津 and Dagu 大沽 were to join the opening cities, the pink points in figure 2-8. The waterfront cities along with the Yangzi River, and cities in Taiwan were also included.

In 1876, the Treaty of Yantai 煙臺條約 added four more cities: Yichang 宜昌,[204] Wuhu 蕪湖, Wenzhou 溫州,[205] and Beihai 北海,[206]purple points in figure 2-8. Chongqing 重慶[207] joined in 1890, the blue point in figure 2-8.

From 1893 to 1909 more treaties were signed with Britain, Russia, France, Germany, America, and Japan, cities in Tibet, in the north-west, and in the north-east, and some more cities along the Yangzi River, in the south of China, were opened to foreigners.

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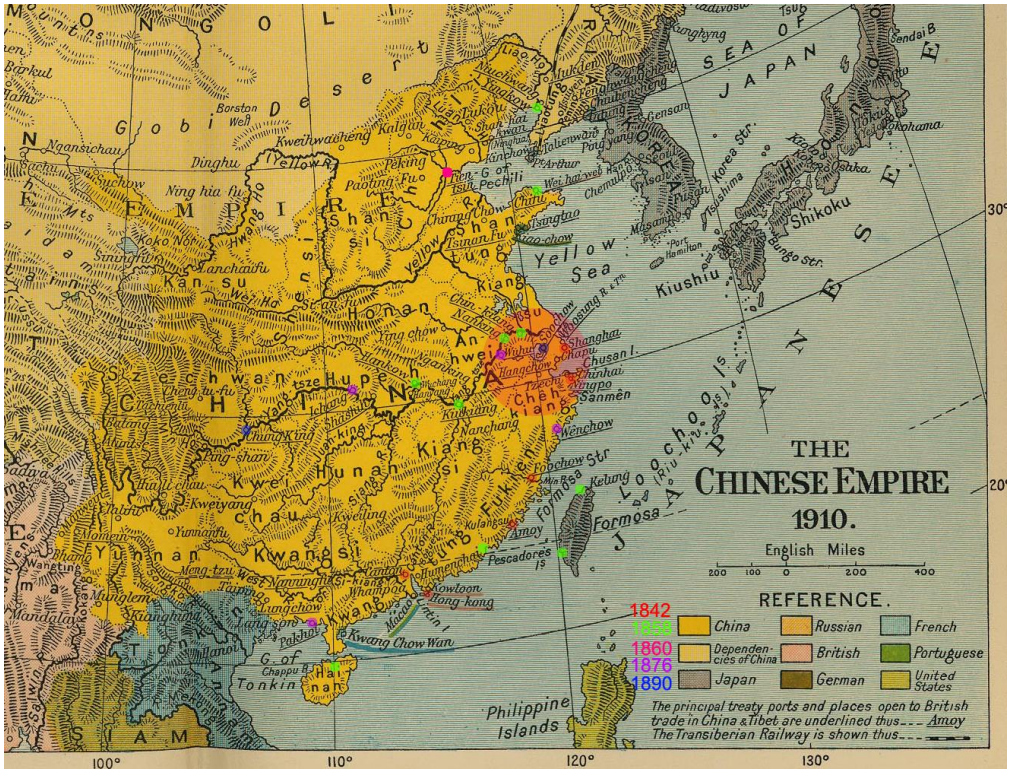
193 Frances Wood, *No Dogs & Not Many Chinese: Treaty Port Life in China 1843-1943*, (London: John Murray Ltd., 1998).
194 The map of "The Chinese Empire 1910", *The Cambridge Modern History*, (Cambridge University Press, 1912). Ningbo 寧波 also known as "Ningpo". See
195 Ibid., Xiamen 廈門 also known as "Amoy".
196 Ibid., Fuzhou 福州 also known as "Foochow".
197 Ibid., Guangzhou 廣州 also known as "Canton". .
198 Ibid., the map was adding the marks of the treaty ports base on "The Chinese Empire 1910".
199 Ibid., Yingkou 營口 also known as "Yingkow".
200 Ibid., Hankou 漢口 also known as "Hankow".
201 Ibid., Jiujiang 九江 also known as "Kiukiang".
202 Ibid., Nanjing 南京 also known as "Nanking".
203 Ibid., Zhenjiang 鎮江 also known as "Chin-kiang".
204 Ibid., Yichang 宜昌 also known as "Ichang".
205 Ibid., Wenzhou 溫州 also known as "Wenchow".
206 Ibid., Beihai 北海 also known as "Pakhoi".
207 Ibid., Chongqing 重慶 also known as "Chung King".



2-8 Chinese treaty ports before 1890

2-9 The most Chinese assembled area of the treaty ports around Shanghai

From figure 2-8 we can see that it took nearly half a century, from 1842 to 1890, for the foreigners to make 22 cities (including Hong Kong and Macao) into treaty ports. These ports were first dispersed on the south-eastern coast of China, then the eastern coast, and gradually permeated along the Yangzi River, through into the mainland of China. The cities made two lines in vertical and horizontal directions, meeting in Shanghai. Around Shanghai, there was a more concentrated area of treaty ports, shown by the red circle area in figure 2-9, which made Suzhou[208] and Hangzhou[209]especially the centre of the circle. Although Suzhou and Hangzhou opened and traded with foreigners until 1895, because surrounded by six treaty ports, and the international settlement of Shanghai, these two cities were definitely influenced by foreign trade for a long time, since 1842, which made Suzhou and Hangzhou different to other treaty ports. Nearly 80 years later, the first Chinese architectural collegiate education school was set up in Suzhou, and another one in Hangzhou one year later.[210]

2.3.1 Architectural "Tradition 派" and crafts "Group 幫"

Through thousands of years' development, the Chinese carpentry building system was very complete. Thanks to Liang Sicheng and his *Pictorial History of Chinese Architecture*, the history and building rules of Chinese traditional "State Architecture" were well known in the West. But besides the state style, there was plenty of local style architecture all over the country. Ronald G. Knapp gives brief descriptions of some of them in *The Chinese House: Craft, Symbol, and the Folk Tradition*. From North to South, and from West to East, according to the direction of the national rules, every place might have its own local characters, craft skills, symbol system, and the folk tradition, which gave rise to different Chinese carpentry architectural "traditions 派". Such as the "Hui Tradition 徽派" buildings, popular in Anhui 安徽 province;[211] the "Su Tradition 蘇派" buildings, popular in Jiangsu 江蘇 and Zhejiang 浙江 province, especially in Suzhou;[212] the "Jing Tradition 京派" buildings, stayed in Peking.[213] The "Min Tradition 閩派" buildings in Fujian province;[214] "Jin Tradition 晉派" mostly in Shanxi 山西 province,[215]and so on. The pre-modern architecture style in Shanghai can also be called the "Hai Tradition 海派". To sum up, the word "tradition 派" here means a kind of local building style within an area. The different Chinese local carpentry "traditions" are combined as the "Chinese traditional architectural craftsmanship for timber-framed structures" got into the UNESCO Intangible Cultural Heritage Lists in 2009.[216] In the application documents each of them is refer to as

[208] The map of "The Chinese Empire 1910", *The Cambridge Modern History*. Suzhou 蘇州 also known as "Soochow". See the map of note 75.
[209] Ibid., Hangzhou 杭州 also known as "Hangchow".
[210] Chapter Three, p.78.
[211] Such as Nancy Berliner's book *Yin Yu Tang: The Architecture and Daily life of a Chinese House*, is a book analysing a traditional "Hui Tradition" house in Huizhou 徽州.
[212] The "Su tradition" buildings are well known as their beautiful Chinese Gardens. See Tun-chen Liu, *Chinese Classical Garden of Suzhou* 蘇州古典園林, (US: McGraw-Hill Inc., 1993).
[213] Courtyard dwellings (siheyuan 四合院) is the typical style of the "Jing Tradition". See Ronald G. Knapp, *The Chinese House*, p.12.
[214] Circular multi-storey communal residences (tulou 土樓) is the typical style of the "Min Tradition". See Ronald G. Knapp, *The Chinese House*, photograph 8.
[215] Sunken courtyard dwellings (yaodong 窯洞) is the typical style of the "Jin Tradition". See Ronald G. Knapp, *The Chinese House*, p.16, and photograph 2.
[216] "Chinese traditional architectural craftsmanship for timber-framed structures", UNESCO Intangible Culture Heritage , <http://www.unesco.org/culture/ich/en/RL/Chinese-traditional-architectural-craftsmanship-for-timber-framed-structures-00223> [accessed 20 February 2016].

regional "tradition 派".

Each of these local architectural styles was built by local carpenters and masons. Like their counterparts in the West, they would have local craft guilds to organise, arrange trades, and hold rituals. To found a guild of this kind was an original requirement by the Chinese craft builders, which made them belong to a big team, a close group. Their relationships in the guild were mostly based on the regions where they were born and living. In Chinese, it would be called "*bang* 幫". There are some English terms to translate the Chinese word "幫", such as "gang, group, school" ("clique, band, class, fraternity, party, clan" are obviously not a match).[217] In *Mathews' Chinese-English Dictionary* by R. H. Mathews (1956), the three characters "帮/幇/幫" are explained together: "(a) N.A. for a class, a group, a fleet, etc. (b) A class, a group, a fraternity."[218]According to the *Oxford Dictionary of English Etymology* (1966), "gang" might have the closest meaning of Chinese word "幫",[219] but it has tended to be used to describe a criminal group in modern times. Since the spelling of its Chinese pronunciation "bang",[220] has a totally different meaning in English; and the word "school" would lead to confusion with the education system, here I chose the word "group" as the translation of the Chinese word "bang 幫", meaning a Chinese traditional local carpentry craft organization.

In Chinese, the characters "*pai* 派" and " *bang* 幫" have the same meaning when they refer to a group of people. But in this case they have completely different meanings: The word "*pai* 派" means a special kind of Chinese traditional local building style, which could translate as "tradition"; while the word "*bang* 幫" means an organization of Chinese local carpenters and masons, which could only be translated as "group" . To make it clear, by way of illustration, a "Hai tradition" building in Shanghai, could be built by different crafts "groups": the "Xiangshan Group 香山幫", "Ningshao Group 寧紹幫"[221], or "Local Group (of Shanghai) 本幫", or some other "crafts group".[222] Two within a trade never agree. The crafts groups were divided based on their native places, made up by fellow-townsmen who could help each other and make a life together.

2.3.2 The craft builders and modern designers in treaty ports

The numbers of different treaty ports and the Chinese craft "tradition" meant that the meetings between Chinese traditional craft builders and western modern designers happened in

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[217] The author checked in several different English dictionaries to compare the meanings of each word. Besides two mentioned in the texts, the dictionaries also include *Longman Dictionary of the English Language* (1984), *A New Practical English-Chinese Dictionary* 最新實用英漢辭典 (1973), An English-Chinese Glossary of Social Sciences and Education 英漢社會科學教育學詞彙 (1975), Longman Contemporary English-Chinese Dictionary 朗文現代英漢雙解詞典(1988).

[218] R.H. Mathews, *Mathews' Chinese-English Dictionary*, (Harvard University Press, 1956), p.680.

[219] C. T. Onions, ed., *Oxford Dictionary of English Etymology*, (Oxford: OUP Oxford 1966), p.388. "gang: A. going, journey, way, road; B. set of articles of one kind; company of workmen, band ofpersons.....Hence gangster member of a criminal gang. (orig. U.S.).",

[220] Richard M. Barnhart, and others, *Three Thousand Years of Chinese Painting*, (Yale University Press, 2002), p.11. James Cahill used the word "school" (*pai* 派) to refer to the different genres of Chinese drawings, such as "the Wu (Suzhou) School in the Ming, the Nanjing School in the early Qing". But he had noted that here "school" had different meaning with "some schools in the modern European Painting".

[221] "Ningshao Group 寧紹幫" refers to the craftsmen that came from Ningbo 寧波 and Shaoxing 紹興.

[222] Institute of History of Shanghai Building Trade, *History of Shanghai Building Trade* 上海建築施工志, (Shanghai: The Shanghai academy of social sciences press 上海社會科學院出版社,1997).

many places, and much earlier than the meetings of professional architects between the West and China. For reasons mentioned in section 1.2, the "Western modern designers" may, or may not, be a professional architect. In the early period, most of them were un-professional architecture designers. Furthermore, due to the requirements for building in the foreign concessions and settlements, meetings of un-professional ones could occur in many cities, such as Hong Kong, Shanghai, Guangzhou, or Peking. Therefore, the people at the forefront of construction had the earliest conflicts and harmonies, directly in their works.

There are many records or reports describing such interesting conflicts and harmonies. The earliest article might be E. Ashworth's *How Chinese Workmen Built an English House*.[223] Mr. Ashworth was a British scholar not an architect, came from Exeter, his English house builder was a Chinese "ship carpenter", not a traditional Chinese building carpenter. He lived in Hong Kong for two years (1844-1845). Mr. Ashworth directed the ship carpenter with no experience on western building skills, and was, at last, satisfied with the result: "I was pleased to observe a proper English mason's level employed in place of the clumsy water-trough generally used by the Chinese."

A similar situation could be found in Shanghai. In 1849, the first British professional architect George Strachan went to Shanghai from Hong Kong to design the trade house of George Barnet& Co. In order to keep the project going smoothly, he trained a group of Chinese traditional carpenters whose native place was Ningbo, which should be the "Ningshao Group" of carpenters.[224] Guided by Strachan, the building projects in Shanghai didn't depend on the builders who came from the south of China any more.[225] These carpenters of the "Ningshao Group" became fresh troops of workmen later in Shanghai, Hankou, and other cities. This is the earliest record of professional conflicts and harmonies between Chinese traditional carpenters and Western modern architects. The Modern architectural training Chinese workmen were available, but not in sufficient numbers to satisfy demand. C. H. Godfrey's night school was set up in 1934, and proved popular in 1936.[226]

As time ran on, there were certainly more co-operated projections between architects and carpenters in China. Since 1840, the conflicts and harmonies had happened in many cities of China, but why did the processes of those co-operations not produce a book to record or introduce a Chinese local carpentry building skills? And why were articles or reports written only by foreigners? The different education level of the craftsmen and the architects might be part of the reason, but not a decisive factor. It is a misunderstanding to underestimate Chinese traditional crafts builders' literacy, which I will discuss in the next chapter.

First of all, for the Chinese craft builder, whether a carpenters or a mason, their career experiences in Chinese traditional buildings were seldom needed for modern building processes. So there was no need for them to write about their traditional building skills. Secondly, for the foreign designers, whether professional or not, they were interested in how to build a western

[223] E. Ashworth, "How Chinese Workmen Built an English House", *The Builder*, Vol.456, 11 (1851), 686-688.
[224] T. W. Kingsmill, "Early architecture in Shanghai", *The North-China Herald and Supreme Court & Consular Gazette*. 23 November 1893, 825-827.
[225] Ibid., p.825. "The work on these houses was executed either in the South or by Cantonese workmen introduced from the South."
[226] T. Bunt, presidential address, *The Engineering Society of China, Proceedings of the Society and Report of the Council 1903-1904*, Volume III, (Shanghai: North-China Daily News and Herald Ltd, 1904), p. 25-26.

modern building in China, not how to keep up Chinese traditional building skills. Even for Henry K. Murphy, Chinese traditional building was only a good resource for creating a new architecture style using Chinese traditional building characters in the plan and elevation design. The cultural identity made the new style welcome to the users, which was the best encouragement to the architect. As for the construction skills of Chinese local carpenters, it was not their responsibility. Even if they had an interest to know about it, it would be hard work to understand the complicated rules, rituals, and cultural assumptions behind the technical knowledge. Finally, the most crucial reason is that the earliest Chinese collegiate architectural education school was not set up by that time in those cities.

Only after the Suzhou Engineering School was established in 1923, in the modern education system, the craft experience of teaching by oral education in practice needs to change to written texts and drawings. The appearance of a Chinese collegiate architectural education system created an urgent need for a textbook on Chinese traditional carpentry building skills. The leader of local carpenters had to accept this mission with the help of the first generation of Chinese architects and students, so the book *yingzao fayuan* was born in Suzhou.

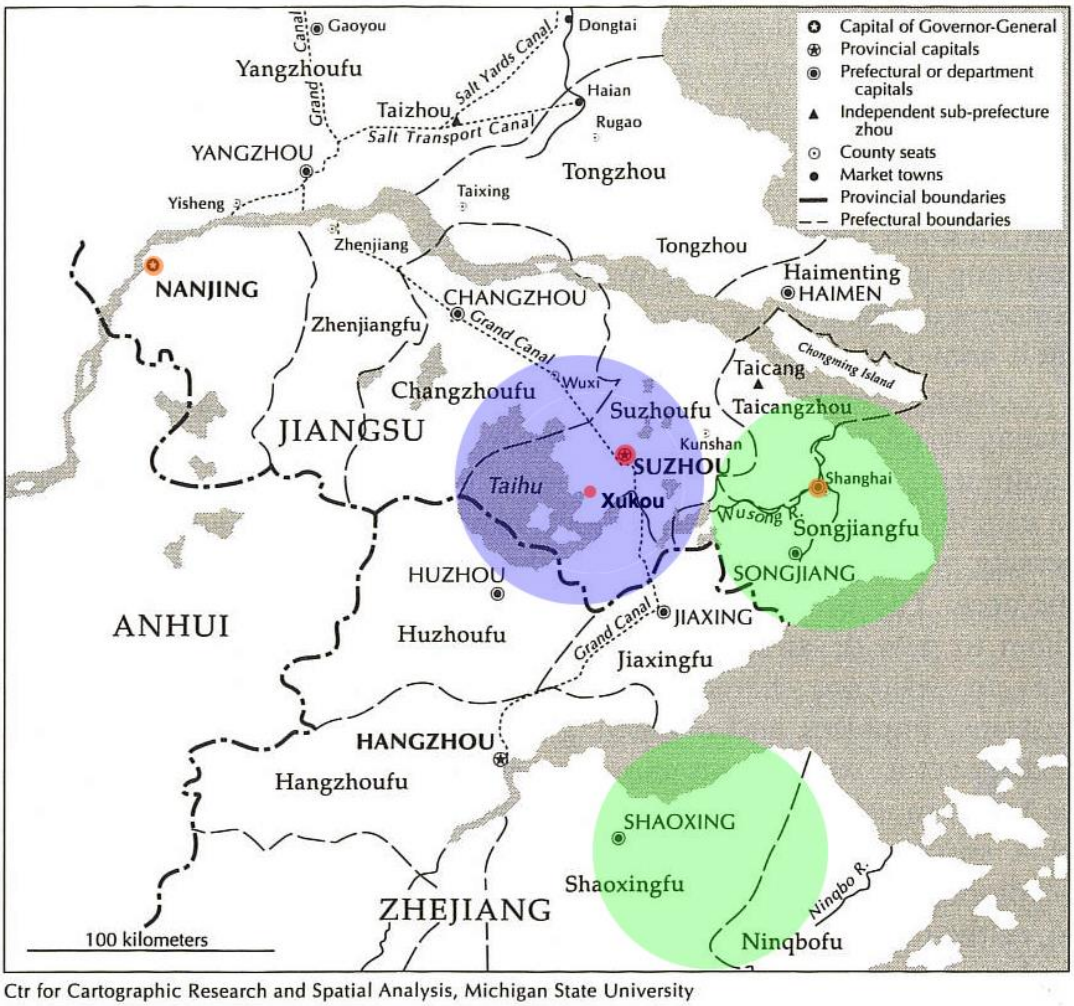
Why was the first Chinese architecture department set up in Suzhou, not Hong Kong or Shanghai? Checking back to the table 2-2 and 2-3, the native place and the working place of the earliest returning Chinese architects would give the answer. Most of them were born in Jiangsu or Zhejiang province, and Shanghai was their first choice of work place after their return, because the international settlements and urban development in Shanghai produced a continued requirement for new buildings.[227] Compared with the fast development in Shanghai, Suzhou was a more peaceful city, with a deep educational background culture, and furthermore it accepted modern things quickly enough. In the *Cities of Jiangnan in Late Imperial China*,[228] there are two chapters (Chapter 1 and 3), on the history of Suzhou, introducing the city very clearly from the very beginning (1127-1550) to the late imperial time. At the end of Chapter 3, it says as a conclusion: “The examples gathered here are emblematic of social and economic development in Suzhou, a city whose impulses towards industrial manufacturing and trade had long age altered its identity as a purely administrative centre.”[229] This evaluation is very reasonable for the city position of Suzhou in late imperial China. The Second Technology School of Jiangsu Province 江蘇省立第二工業學校 already existed in Suzhou since 1911,[230] which made it the best place to find the first Chinese architecture department.

The location of Suzhou, as shown in figure 2-10, is nearly in the centre of the treaty ports circle, close to Shanghai (only about 120km) and Nanjing (about 200km). These distances made it possible for are turning architect, such as Liu Dunzhen, to work as a part time teacher in the first year of the school;[231] and later after 1927, when the school moved to Nanjing, the fulltime architect teacher Liu Dunzhen and his assistant Zhang Zhigang 張至剛 could keep in touch with

[227] “Town Planning”, in *Shanghai, 1923-1937, Municipal Power, Locality, and Modernization*, Christian Henriot, (London: University of California Press, 1993), pp. 168-184.
[228] Linda Cooke Johnson ed., *Cities of Jiangnan in Late Imperial China*, (Albany: State University of New York Press, 1993.)
[229] Ibid., pp.115-116.
[230] The Second Technology School of Jiangsu Province 江蘇省立第二工業學校 (1911-1923) was the predecessor of the Suzhou Engineering School established in 1923.
[231] See details in Chapter Three, p.83.

the carpenter Yao Chengzu 姚承祖, who stayed in Suzhou.[232]

After discussion between the architects in early modern China, and the location of the first Chinese architecture department, the local Chinese traditional craft builders "Xiangshan Group" should be introduced.



2-10 The map of Jiangnan in late Imperial China, and original working area of the Chinese traditional building groups: the Xiangshang Group (blue), the Ningshao Group (green), and the Local Group (of Shanghai) (green)

2.3.3 The "Xiangshan Group" of craft builders in Suzhou

In his preface of the *Cities of Jiangnan in Late Imperial China*, Johnson identifies "Jiangnan area" as "a major component of the Lower Yingzi macro region".[233] Four primary cities are discussed separately: Suzhou, Hangzhou, Yangzhou, and Shanghai. Figure 2-10 is based on the map "Jiangnan in the Qing dynasty" in that book.[234]

[232] See details in Chapter Three, p.84.
[233] Linda Cooke Johnson, *Cities of Jiangnan in Late Imperial China*, p. ix.
[234] Ibid., p. 116.

"Taihu Lake Region", pivots around Suzhou today. It has a total area of about 43,000 square kilometres, and forms a single whole in terms of geography, hydrology, natural ecology, and economy, which makes it a complete economic area. This area is also the centre of the "Xiangshan Group" craft builders' activities, where connections between the communities depend on the Taihu lake system, shown as a blue circle in figure 2-9. Joseph C. Wang gives a detail introduction of the "Taihu Lake Region" in his essay "Zhouzhuang, Jiangsu: A historic Market Town".[235]

The "Xiangshan Group" was a famous craft building genre in Jiangnan in Late Imperial China. This name referred to a formal crafts builders' organization that first appeared in 1850 in an inscription of the establishment of carpenters and bricklayers institute in Suzhou 水木匠業興修公所辦理善舉碑. It says: "The best of the carpenters and bricklayers institutes are the Xiangshan (Group). For instance, they enshrined and worshiped the Lu Ban God in ××××(the words are missing) of the Xuanmiao Temple in Changyi, and made it their business office. 水木匠業，香山為最，向在長邑玄妙觀□□□□中，供奉魯班先師，為辦公之所。"[236] This is the earliest record of the name of "Xiangshan Group" in the literature found so far. The name seems already well known to the people at that time. As the best craftsman's genre, the Xiangshan Group must have developed much before that. They were building teams, led by carpenters, but including bricklayers, stonemasons, gardeners, and so on, normally working in the Taihu Lake Region in south-eastern China. Most of the craftsmen's families lived in Xukou twon 胥口, Xiangshan 香山, and the Suzhou area.

The history of the Xiangshan Group could be traced back to ancient time as described in the *essay on drawing of Buyun Xiaozhu* 題補雲小築圖 by Zhu Qiqian 朱啟鈐.[237] But most Chinese researchers agree to treat the master carpenter Kuai Xiang 蒯祥 (1398-1481) as the first well known leader of the Xiangshan Groups. Kuai Xiang led his building group to build the Forbidden City in the Ming Dynasty.

In Huangpu Lu's 皇甫錄 book, the *Record of the Ming Dynasty* 皇明紀略[238] Kuai Xiang and Xiangshan building craftsmen are described as follows:

"The national capital has the assistant minister Kuai. Kuai was born in Xiangshan, Wu area. He is a carpenter, and was required to build the imperial palace in the Yongle period. Every palace, belvedere, tower, and gazebo, or winding corridor drawn by Kuai, satisfied the emperor. His highest position is the vice-minister in the

2-11The Map of Ming Imperial Palace

帝都圖卷 (1500)

[235] "Zhouzhuang, Jiangsu: A historic Market Town", in *Chinese Landscape: The village as Place*, Ronald G. Knapp, ed., pp.139-140.

[236] Suzhou Museum, The Department Of History of Jiangsu Normal School, and Institute of History of the Ming and Qing Dynasty of Nanjing University, ed., 蘇州博物館江蘇師範學院歷史系南京大學明清史研究室合編, *The Inscriptions of Industry and Commerce in Jiangsu Province in the Ming and Qing Dynasty* 明清江蘇工商業碑刻集, (Nanjing: Jiangsu People's Publishing House, 1981), p.122.

[237] Zhu Qiqian, *The essay on drawing of Buyun Xiaozhu*, pp.138-140.

[238] The *Record of Emperor of Ming* 皇明紀略 is a history record of the Ming Dynasty by Huangpu Lu 皇甫錄 in about 1510.

Ministry of Works, and his descendants still worked as carpenters. One of his descendants was heard to be the servant of a vice-chamberlain in the Hongzhi period. Now the skilful carpentry craftsmen all come from Xiangshan.

京師有蒯侍郎衙衙，蒯為吳香山人，斫工也。永樂間召建大內．凡殿閣樓榭以至回廊曲宇。隨手圖之，無不稱上意者。位至工部侍郎，子孫猶世其業。弘治聞有仕為太僕少卿者。今江南木工巧工皆出於香山。”[239]

Kuai Xiang relied on his excellent technical skills, was called by the emperor “Kuai Luban 蒯魯班”,[240] and became official to “the vice-minister in the Ministry of Works 工部侍郎”,[241] the highest position held by a craftsman in ancient China. Some researcher believes that his portrait was even drawn on the map of the Ming Imperial Palace (predecessor of the Forbidden City) to memorialise his contributions (figure 2-11, the man dressed in red). But cording to Shen Li’s research, it is not unauthentic. Anyway, there is no doubt that the Map of Ming Imperial Palace is an as-built drawing of the Forbidden City. At this time, the Xiangshan building craftsmen were organized, had team leaders like Kuai Xiang and some others; had representative works, such as the palaces in the Forbidden City; had a high reputation; and as it was possible to become a beginning of a single genre, was regarded as the “Xiangshan Group”.

Some researchers argue that the literature record of the “Xiangshan Group” is in 1850, later of Qing Dynasty, many years later than the early of Ming Dynasty. But just like history does not begin with the literature record, when an event has been written down, it always happened early than that time. Although the record marked the “Xiangshan Group” was been formally acknowledged as a local building group, the source of the “Xiangshan Group” has to trace back to the Ming Dynasty.

According to the Annals of Suzhou 蘇州市志, Volume Three 卷三, the unions in Suzhou at that time had a Ziyi Union (carpentry and masonry), a Stonemasonry Union 石業公所 (stonemasonry 石作), and a Dalong Union 大隆公所 (timber trade 木業). The crafts of these building trades were carpenter, mason, stonemason, painting, rockery worker, and sculptor (figure 2-12).[242]

The carpentry can be divided into structural carpentry 大木[243] and joinery and non-structural carpentry 小木[244]. Structural carpentry refers to building the mainframes, roofs, bracket sets, normally both making and installing at the construction site. In contrast, joinery and non-structural carpentry refers to making the decorative doors, tall windows, windows, decorative overhangs, wooden balustrades, and other building accessories. Sometimes joinery work also included

[239] Huangpu Lu 皇甫錄, “The *Record of Emperor of Ming* 皇明紀略”, Chinese Text Project 中國哲學書電子化計畫 <http://ctext.org/wiki.pl?if=en&chapter=735675> [accessed 20 February 2016].

[240] Zhu, Qiqian 朱啟黔, ed., *Zhejiang lu* 哲匠錄 (The compendium of Crafts Builders), (Beijing: China Architecture & Building Press, 2005), p.148.

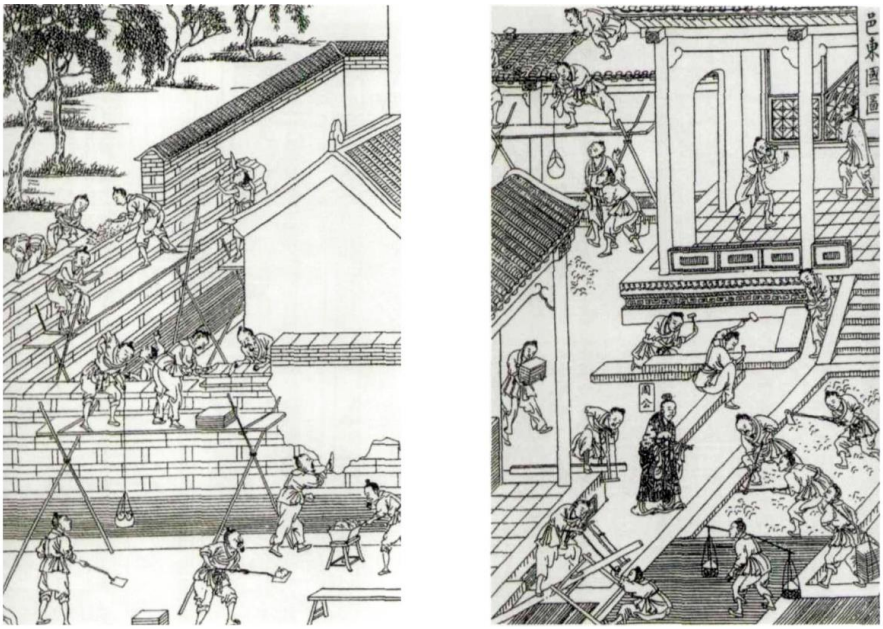
[241] Chartes O. Hucker, *Oxford Dictionary of English Etymology*, p.294. “Ministry of Works, one of the top-echelon agencies (from Sui on collectively called the Six Ministries, liu pu 六部) under the Department of State Affairs(shang-shu sheng 尚書省).”

[242] Sun Jiading 孫家鼎 and Zhang Baixi 張百熙, *Imperial Drawings of Classical Books* 欽定書經圖說, (Peking: Imperial University of Peking,1905), Vol. Tree 卷三, p.33.

[243] Guo Qinghua, *Visual Dictionary of Chinese Architecture*, p.28.

[244] Ibid., p.84.

making furniture and horizontal inscribed boards. They could work in their workshop.



2-12 The crafts builders at work, from *Imperial Drawings of Classical Books* 钦定书经图说, 1905

The masonry can be divided into plaster 泥水 and brick-masonry 磚細. Plaster work refers to making the foundation, walls, plastering, roof tiles, eave tiles, and the fire gable. The works of brick-masonry are much more meticulous: the brick is treated with a similar skill to the wood worker making a door or window frame. The brick-mason can overlay tapestry bricks, lay decorated garden walls, use carved bricks to make agate frame (figure 2-13) or a screen wall, and so on. They even built brick pagodas, brick halls, and other religious buildings.

Stonemasonry can be divided into rough stone work 粗石 and finished-off stone work 細石. The rough job is mainly quarrying and carrying stone materials, while the finishing-off one is handling stone materials to become columns, column bases, thresholds, side cover stones, plinths, floor tiles, steps, and other stone building accessories. The finishing-off stonemason can build all the stone parts of buildings, normally also the foundations. Like a brick-mason, they can also build stone buildings like a stone gateway, stone tower, stone monument, stone house, stone bridge, and others.

2-13 The brick gate frame in The Master-of-Nets Garden 網師園 in Suzhou

The painter's work includes normal painting 油漆 and the decorative color painting 彩畫. We need not discuss normal painting, but decorative color painting is a kind of art work. The workers have a whole theory and rules about color matching skills, the decorative patterns, and the decorative classification. The decorative color painting style of Suzhou 蘇式彩畫 is a mature separate decorative genre in Chinese carpentry building decorations. In one of the outstanding works of Liang Sicheng, *Qing Structural Regulations* 清式營造則例,[245] there are only two types of decorative color painting: style of Suzhou 蘇式 (figure 2-14) and style of palace or temple 殿式. Statue work is similarly specialized, also art work with a strong regional flavour. It normally shows on the tops of gables or roofs of a hall (figure 2-15). But because it was not applied in general, statue work of Suzhou craftsmen did not have a written theory so far.

2-14 The decorative color painting style of Su 蘇式彩畫[246]

2-15 The decorative statues work 合和二仙 on gable in Hanshan Temple 寒山寺, Suzhou

Rockery work is another unique aspect of the Suzhou traditional garden, which must be mentioned in appreciation of the Xiangshan Group craftsmen. With the help of Chinese traditional

[245] *Qing Structural Regulations* 清式營造則例 is a monograph on the Qing Dynasty architecture by the Chinese architect Liang Sicheng, first published in 1934.

[246] Figure from the "decorative color painting 彩畫作" in the *Encyclopedia of China* 中國大百科全書, second edition.

scholars, their building theories were well developed in ancient China. There is no doubt that the skill of Chinese rockery work influenced the surrounding countries, including Japan (although the Japanese developed the skill in a completely different direction from the late Chinese one). The undisputedly famous work of Xiangshan Gang *The Craft of Gardens*, used a fair amount of ink on rockery work.

From the Chinese painting *Prosperous Suzhou* 姑蘇繁華圖 (figure 2-16), we can see a panorama of prosperous city Suzhou, in its golden age, in 1759. It was painted by the Qing Dynasty painter Xu Yang 徐揚 over 24 years. Xu was born in Wu town, the homeland of Xiangshan Group craftsmen. He worked on a horizontal hand scroll[247] that stretches an astonishing 12.25 meters. As the introduction of the modern printing of the drawing says: "As the scroll unrolls, the viewer is spirited from the tree-covered mountains and fields of the city's periphery to the shop-lined streets, palatial courtyards, crowded waterways and majestic Taoist temples of this beautiful southern city." It is either a great city's landscape, or an amazing achievement of local craft builders. Xu drew the craft builders at the very beginning of his painting (figure 2-17). The place is recognized just before the Lingyan Mountain 靈岩山, the hometown of Xu and the craftsmen. Although the builders might not have been known as the Xiangshan Group at that time, they were the forefathers of the later fellows.

Therefore, among all the treaty ports of the late imperial China, the Chinese traditional carpenters and the Western modern architects met in many cities. But because the first Chinese architecture department was founded in Suzhou, that made it a more special place than all the others. The local crafts builders in Suzhou, "Xiangshan Group" also became the only Chinese traditional craft builder group who had a book to record their building skills.

This concludes the general historical terrain and people's background on the performers of the research subject.

[247] Richard M. Barnhart, James Cahill, Wu Hung, p.10.

2-16 The *Prosperous Suzhou* 姑蘇繁華圖 (1759)

2-17 The beginning part of the *Prosperous Suzhou* 姑蘇繁華圖卷首

Conclusion of Chapter Two:

This chapter has focused on the background of the research subjects: the Chinese traditional carpenters and the Modern architects (foreigner or native) in early modern China. Analysing people, time and terrain, this chapter moved from a general description of modern architects in the West and China to a specific introduction of Chinese traditional carpenters: the "Xiangshan Group" and modern architects in Suzhou in the 1920s-1930s.

The *Yingzao fayuan* is a book made in cooperation by a Chinese carpenter and an architect. The first draft was completed in Suzhou in 1923-1937. Some basic research questions have been discussed in this chapter. We asked who the people were who did the work: How did modern architects and architecture emerge in China? We questioned the time when the book was born: Why was the first draft written in 1923-1927? Could the cooperation between Chinese traditional carpenters and modern architects (foreigners or native) have happened earlier or later? We looked at the terrain where the book was born: Why did the cooperation of the book happen in Suzhou, not in other cities? Why is the book on the "Xiangshan Group" building skills?

Through the introduction about carpenters and architects in Britain and China in history, the first section in this chapter discussed how the relationship and exchange between carpenter and architect is different between the Western and Eastern countries. Furthermore, it proves that the meeting of Chinese carpenters and modern architects, whether foreign or native, could happen only after 1840. From then on, the conflicts and harmonies between them exist together in China for a long time. *Yingzao fayuan* is a book by a Chinese carpenter and architect, so it could not possibility have happened before 1840.

In the second section, the discussion focuses on the architects, either foreign or native, who worked in early modern China. The purpose was to find out when architects worked in China, and the most prosperous era for them. The foreign architects could be traced back to 1840, the beginning of China's modern history. The best time for them in China was the "golden decade", 1927-1937. As for Chinese architects, the earliest one, Qian Baozong, started his career in 1912. After 1920, especially after 1927, the national government in Nanjing was established, and the predecessor of the National Central University was composed. It was the time for the first generation of architects trained abroad to show off their professional quality in early modern China. After 1930, the first generation of architects who trained in China came to help their teachers. Of course there were some Chinese people who worked for the foreign architects, then worked as independent architects in early Modern China, but their educational background was not in the modern architectural education system, and their numbers and influence were limited. It was essential that the active time of this kind of architect was based on the active time of foreign architects, keeping step with the "golden age".

The first manuscript of the *Yingzao fayuan* was written during 1923-1937, exactly the period of the "golden age" of the foreign architects, the most active time for Chinese architects. This was no coincidence, but an inevitability of history.

In the third section, the discussion focused on the places where the conflicts and harmonies occurred, and pointed out that although the meeting and co-operation of Chinese carpenters and modern architects also happened in some other treaty ports such as Hong Kong and Shanghai,

without the establishment of Chinese modern architecture collegiate education, there was no need and no chance for research on the local Chinese carpentry building skills. The first Chinese architecture department in Suzhou gave an opportunity for cooperation between Chinese traditional carpenters and architects. Based on the good location surrounded by six other treaty ports, including the international settlement of Shanghai and the late capital Nanjing, the co-operation could continue from 1923 to 1937. The social and economic development in Suzhou, especially the foundation of modern education, made Suzhou the best place to set up the first Chinese architecture department. Furthermore, as the old Chinese saying goes: “The time isn't as important as the terrain ; but the terrain isn't as important as unity with the people 天時不如地利，地利不如人和”, the Chinese local carpenters and architects gathered in Suzhou, and the abundant “Su tradition” style buildings built by the “Xiangshan Group” could provide enough good examples for research.

While this chapter gave a general background for the birth of the *Yingzao fayuan*, the next two chapters describe more specific background on the *Yingzao fayuan*: Two Chinese architectural education systems, and authors, readers, editions of the book.

CHAPTER THREE

Two Chinese Architectural Education Systems

The Yingzao fayuan is a study book on traditional carpentry of the "Xiangshan Group". The manuscript was used as a textbook in the Suzhou Engineering School.

3.1 Chinese Traditional Master-apprentice Training of the "Xiangshan Group"

As I noted in Chapter One, the Xiangshan Group is only one of the groups of local craft builders of Chinese traditional carpentry traditions. Therefore, the local character of that craftsmen's organization had close links with the era. The local characters of popular education by apprenticeship had close links with the region. The national character on master-apprentice education is a representative sample for oral architectural education in practice.

This section will give a general description of the Xiangshan Group carpenters and their master-apprentice education.

3.1.1 The "Xiangshan Group" craft builders

Like all other craftsmen in history, both the master and the apprentices of the Xiangshan Group had to belong to a certain kind of professional organization. Before introducing the organisation of these Chinese traditional craft builders, we should first know about the guild of the Xiangshan Group.

In the early Ming Dynasty (1368-1644), according to the *Official Classic of Lu Ban and Artisans* 魯班經匠家鏡, after the Ming imperial palace was completed, Lu Ban Temples and worship could be found.[248] As the master carpenter Kuai Xiang served as the vice-minister of the Ministry of Works,[249] the craftsmen were organised. Besides continually serving their duty for the government, they therefore had to be in regular contact with each other through the worship of Lu Ban. In Chinese traditional custom, on the first and fifth day of every month, people would worship in the temple, and even the Yamen 衙門 (the local government office, like a town hall) and would issue decrees or discuss issues with common people on those days. We can imagine that the carpenters and later masons converged regularly to worship, to share some activities, and to organise themselves well. That made the Lu Ban temple their earliest guild office.

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[248] "*A Biography of Lu Ban* (*Lu Ban xianshiyuanliu* 魯班仙師源流", in *Xinjuan jingban gongshi diaozhuo zhengshi Lu Ban jing jiangjia jing* 新鐫京版工師雕斫正式魯班經匠家鏡, "Official Classic of Lu Ban and Artisans' Mirror for Carpenters and Carvers", Wu Rong 午榮, (Hainan Publishing House,2003), pp. 220-221. Also see Klaas Ruitenbeek, p.117 and p.144.

[249] See Chapter Two, pp.55-56.

In the late Qing Dynasty, in Suzhou, the former Lu Ban temple became the Suzhou carpentry and masonry profession's union, "Ziyi Union 梓義公所", which means "Builder's guildhall". It was in front of the Qingzhou Temple 清洲觀, Zhusi Lane 洙泗巷, Changjing town 長境縣, which is north-east of the Xuanmiao Temple 玄妙觀 in the city centre of modern Suzhou. This was the place where carpenters and masons had sacred shrines to Lu Ban and Zhang Ban[250], and also the office of craft builders. At that time, the craft builders had to report to the government officials whenever there was an important event. After obtaining the government's authority to make an announcement, in order to keep it official, the announcement would frequently be engraved on a stone to pass it on to later generations. These activities left valuable materials about the professional situation in the past for us to study. From *The Inscriptions of industry and commerce in Jiangsu Province in the Ming and Qing Dynasties*, we can find 11 inscriptions which were originally kept in the Ziyi Union.

The earliest inscription was the 1850 (the thirtieth year of Daoguang period in the Qing Dynasty 清・道光三十年), as mentioned in Chapter one.[251] Besides what we already know, the announcement also says:

"Due to lack of funds, the temple was worn down over years without repair……. Now it is announced to the local official and the trade people of carpentry and masonry profession: all the Xiangshan Group masonry ××××× (the characters were lost) has been repaired at the place in Zhuxi Lane, Changjing town as the (Ziyi) Union.

嗣因經費不敷，年久失修，一切公舉，漸次廢弛。……仰該地保及匠作同業人等知悉：所有吳邑香山幫水□□□□□葺長境洙泗巷地公所。"

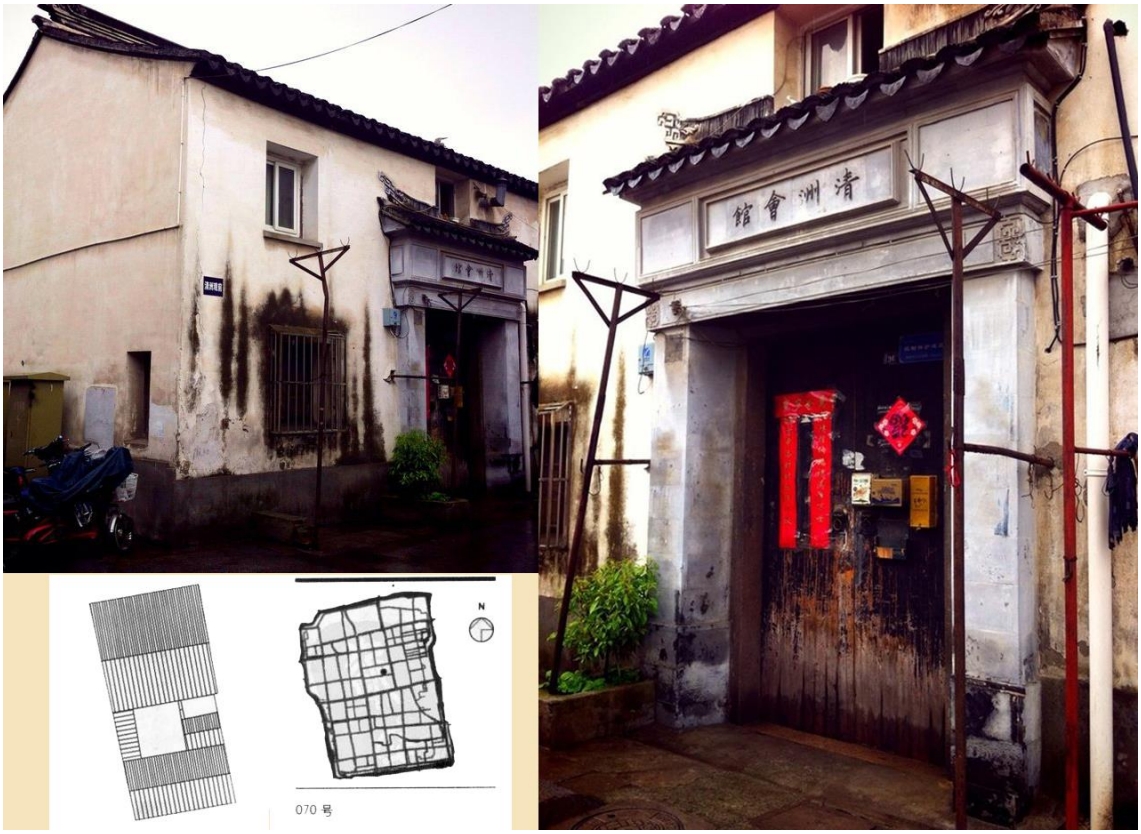
In other words: the Ziyi Union was an office for both carpenters and masons; from 1850, the Ziyi Union replaced the Luban temple serving as office for the guild, (the Lu Ban temple might have still been kept in some other place, but just for worship); and the union belonged only to the Xiangshan Group.

The Ziyi Union was rebuilt in 1887, adding a theatre stage inside for the craftsmen's celebration activities. Just one courtyard and buildings surrounding it still exist nowadays, and the theatre stage is on the upper floor, facing north. The main gate frame is original, but the name on it as rebuilt was "Qingzhou Huiguan 清洲會館", Qingzhou Guild Hall, the ancient name of Qingzhou guan 清洲觀 (figure 3-1). It can no longer be visited because the building is used as a private residence.

After the Daoguang 道光 period, with the guild developing, the Union had less regionalism but more professionalism. In the *Inscription of Chang, Yuan and Wu three towns order that each of the carpentry and masonry professions donate three thousand wen monthly* 長元吳三縣規定水木兩作每作每月捐錢三千文按月存儲公所辦理同業善舉碑 in 1886 (the twelfth year of Guangxu period of Qing Dynasty 清•光緒十二年) , it says: "Each member of the carpentry and masonry professions, no matter whether in the city or in the town, has to donate three thousand *wen* monthly. 水木兩作，無論在城附廓，每作每月捐錢三千文。" Here it does not mention the Xiangshan Group any more, but "the carpentry and masonry professions", which means there might craft builders who came from other places. From then on, the builders who worked as

[250] Local craftsman believes that Lu Ban is the leader of carpenters, while Zhang Ban is the leader of masons.
[251] Chapter Two p.55.

carpenters or masons, whether or not they belonged to the Xiangshan Group, would be treated the same.



3-1 The Ziyi Union 梓義公所[252]

For any craft guilds, the purpose of the organization is to protect the crafts skills and the member's benefit of living, so it is always a close group that refuses strangers, but it is based on the blood relationship or region. That is one of the important reasons why the traditional Chinese building groups have strong regionalism. The Xiangshan Group guild was just like the medieval guild in the West, "male authority was incarnate in the three-tiered hierarchy of master, journeymen, and apprentices."[253]

Along with the gradual establishment of the modern construction system, the guild system went into decline. When the traditional carpenter and mason changed the name of their workshop into "building firm 營造廠", they accepted modern organization step by step. In the 1920s, the Ziyi Union was changed to the Construction Trade Union 營造業同業公會. The construction trade refers to all the workers in the building industry, similar to modern construction firms today. In June 1920, the Construction Trade Union of Wu town was established, located at 27 Niujiao Bin Road 牛角浜, behind the Xuanmiao Temple. It had a membership of 497 building firms. No unregistered firm could take on a project in Suzhou. The Union was commonly known as "Great Union 大行" in Suzhou. In July 1929, the Suzhou Building Trade Union was established, commonly known as "Small Union 小行". The members of this Building Trade Union were mostly Xiangshan Group crafts builders, and thousands of builders came from neighbouring

[252] The plans come from the *Yuan Zong* 園蹤, (The Gardens' Track), Feng Xiaodong 馮曉東, ed., (Beijing: China Architecture & Building Press, 2006), p.86; Photographs by Liu Tieming 劉鐵明.
[253] Richard Sennett, *The craftsman*, p.58.

places. They stayed in 42 teahouses all over Suzhou, such as Shuangfeng in Oriole Workshop Bridge 雙風 (黃鸝坊橋), Qiyuan in HulongRoad 齊園 (護龍街), Chunxing Yuan in Feng Gate Road 春心園 (葑門), Yi'an in Xu Gate Road 亦安 (胥門), and so on. They met and bargained for work in the teahouses until the Sino-Japanese War broke out. In March 1946, by requirement of the government of Wu town, the Carpentry and Masonry Profession Union of Wu Town was re-organized.[254]

To summarise, from the 1920s to the 1930s, after being controlled by firms' unions, the crafts union existed with the firms' union for several years until interrupted by the war.

3.1.2 The master and apprentice

The master along with his assistants and apprentices made a team, sometimes a guild 行會, *Hang-hui*. *Hang* 行 refers to a trade; while *Hui* 會 is a group of people. The master-apprentice training bound them together, just like a family. From the beginning, because of the "all the artisans in the country were registered. The artisans were not allowed to change their profession, the trades being hereditary", the Chinese crafts builder will "hand down craft practices intact from generation to generation".[255] Another tradition likes the West medieval craftsman. They also drew a master-apprentice tree to help craftsmen find their position in the system. Even now, a craftsman who belongs to a famous master system likes to tell people which generation he is. In 2004, the Xiangshan Group craftsmen made a genealogy of the master craftsmen who were still alive and working through their skill. They hope to keep the system going[256].

Appreciating the clear master-apprentice relationship, today we can still find names, generations, and the introduction of craftsmen in *Xiangshan Group Traditional Architectural Craftsmanship*.[257] Depending on their different works, they are recorded as several genealogies, with generation, gender, name, date of birth, education, training record, and work. The gender and training record seems unnecessary, because all of them were male and had master-apprentice training. Although in the legend of Lu Ban, it says he had a daughter, who later became a craftswoman when she grew up, she was definitely not a carpenter. A woman can give minor help to her carpenter husband, such as holding the timber, but cannot become a real carpenter. In fact, the small bracket on the carpenter's working table to hold the wood is called "Ban Qi 班妻", which means Lu Ban's wife. Until now, there is no female carpenter. Some people still believe that women are unlucky for building projects.

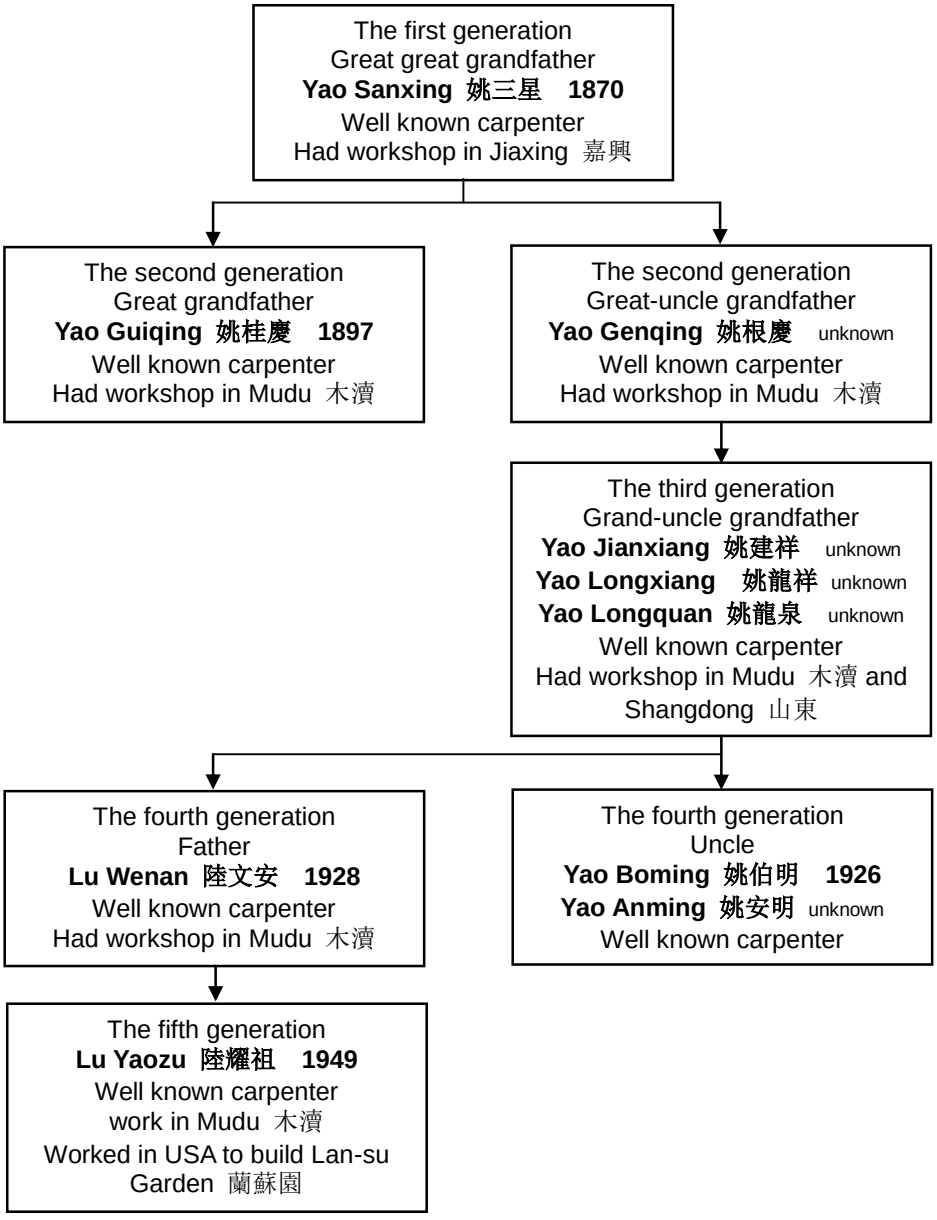
Figure 3-2 is an example of a carpenters' family master-apprentice training.[258] The oldest of the first generation was born in 1870, named Yao Sanxing 姚三星, carpenter; the youngest of the fifth generation was born in 1965, named Xue Lingeng 薛林根, designer and sketcher.

Like craft families everywhere, people were unequal in craftsmen's guilds, with different

[254] He Daming 何大明, "History of the Ziyi Union 梓義公所話滄桑", *Suzhou Daily* 蘇州日報, 13 August 2008, A.p.8. Also see Cui Cui, Jinyu 崔晉餘, *The Buildings of Suzhou Xiangshan Group* 蘇州香山幫建築, p.14.
[255] Richard Sennett, *The craftsman*, p.60.
[256] Feng Xiaodong 馮曉東, *Cheng Xiang Lu: Xiangshan Group Traditional Architectural Craftsmanship*, pp. 137-169.
[257] Ibid., 133.
[258] Based on the biography of Lu Yaozu 陸耀祖. See Feng Xiaodong, *Cheng Xiang Lu: Xiangshan Group Traditional Architectural Craftsmanship*, pp. 152-154.

grades. Master-apprentices and master-worker were graded as such: workers were ranged and assigned by the master, and apprentices were guided by the master.

Shen Li's research shows that before the year 1500, craftsmen's workshops were a family industry:[259] Normally there were four or five people in one workshop, with a father and son or and nephew relationship between them. They did not have an employer to employee relationship. In contrast with their social position, their economic position was equal. Master and worker received the same pay in service for the government. There was no extra payment for organisation to the master.



3-2 A carpenters' family master-apprentice training

[259] Shen Li, "A Study of Historic Evolution of Xiangshan Group Carpenters", p.30 and p.118.

In later periods, in service for private clients, the economic relationship between master and worker depended on the way they undertook the project. According to Shen Li's research, there were two ways:[260] either all the craftsmen were directly employed by the owner, or the master alone was employed by the host. In the first condition, from master to normal worker, they got paid by their work. The master organised the team, but did not get extra pay from the employer. This pattern of employment existed from the beginning until today. The owner, who wants to build or rebuild a house, will look for a master, and discuss the project with him. Then the master carpenter or mason will find each other, budget for building materials and building time, and get the agreement of the host. Then they will call for workers, arrange works, and make a team. After having completed all the works, every worker including the master receives pay from the employer. In the second condition, the master gets the project from the employer, then he hires other workers. The master works like a project manager, becoming another employer. This pattern of employment existed after the 1500's. When the master-apprentice escalated to a master-worker relationship, the workshop became bigger, not being limited by family size. The master could get preferential treatment for undertaking projects. Another kind of employer-employee relationship existed.

In the Qing dynasty, the master of a building workshop in a city would rather play the role of project manager than skilful master craftsman. In the reign of Emperor Yongzheng 雍正, a master was driven to suicide by the pressure of paying wages to other workers, because the host's payment was short. At the Shizong Xian emperor's behest 世宗憲皇帝谕旨 was written:[261]

"On the case of the dismissed officer Zheng Yuheng being responsible for the death of craftsman QiuYi'er: Yi'er undertook the garden project of Yuheng, but Yuheng refused to pay the agreed wage for his services. Yi'er hanged himself because of debts due to other workers' wages. There is no reason for his death, except for Yuheng's bullying. He is to receive a heavy flogging (Yuheng as his punishment)".

"題在案又革職員外郎鄭玉珩致死匠作邱義二一案。緣義二包造花園，玉珩短少工價，義二以各行欠帳催迫縊死，審無致死別情，仍擬玉珩威逼，重杖。"

From this case, we know that the master craftsman took the project from the owner. As a labour contractor, he would pay the wages for others.

In the late Qing dynasty, in the craftsmen's guild, the master (workshop owner) 作頭 and worker 工夥 were doubtless in an employer-employee relationship. From the inscriptions of Zhiyi Union, in Suzhou 蘇州, we can see several struggles between master and worker. The builders guildhall was the place for master and worker to discuss wages. The majority of written records concern working wage and working time. From the records in *Registers of Suzhou building guild* 蘇州營造業同業公會登記冊 in the early Republic of China, there were a few employees in every workshop. Most workers were temporary, not permanent staff. In this case, a new middle rank of the carpenters was created: *Bazuo Shifu* 把作師傅 or *Dangshou Shifu* 當手師傅, "skilful craft master". They developed really good skills, and could take charge of projects independently. But instead of having their own workshops, they were employed by workshops.

[260] Shen Li, "A Study of Historic Evolution of Xiangshan Group Carpenters", pp.120-121.
[261] *Wenyuan ge The Imperial Collection of Four, History, Zhaoling Zouyi lei* 文淵閣四庫全書・史部・詔令奏議類, vol. 11 (I) 卷十一上. (Taiwan: The commercial press, 1983), p.53.

They worked like a modern chief engineer. Normally they received double pay, and had their own team of several apprentices or workers.

For a carpentry or masonry apprentice to become a workshop owner, the young man had to get his master-apprentice training, and then became a worker. In this period, he could not work independently, but had to follow a master. After obtaining enough experience and public praise, he might be a senior worker or a skilful craft master. Now he could have apprentices and his work team. If he saved enough money and found an opportunity, he might have his own workshop, which would raise him to the top class of craftsman.

3.1.3 Master-apprentice training

From the inheritors of the Xiangshan Group, in the *Xiangshan Group Traditional Architectural Craftsmanship*,[262] we discovered that most masters and apprentices had blood relationships from the late Qing Dynasty until today.

Like other social arrangements in traditional China, the traditional master-apprentice training of the Xiangshan Group referred to general apprenticing customs. Cui Jinyu gives this description in his book: "The new apprentice should be a boy at age thirteen or fourteen, normally with some relation to the master: son, nephew, neighbour, fellow villager."[263] Shen Li proved Cui's opinion, and added more in her thesis:" He would come from a good family which had stable finances, so the boy had time to study, had no need to support any other family member, and had already received a basic education: so he could read, write and count."[264] The master and the apprentice's parents normally knew each other well. The teenage boy in imperial China was already prepared to learn a skill for life. Most of them were bright, diligent, obedient, and proven popular. The master was also expected to be popular, as well as skilful and respected by others. The most favoured master-apprentice relationships were father and son, uncle and nephew, then neighbourhood. A Craft industry register system in late imperial China kept the skill in the family by inheritance, and generated many families distinguished in crafts, such as carpenters, mason-plasterers, and stonemasons. That was one of the reasons for the forming of the Xiangshan Group.

After the collapse of the craft industry register system, an apprentice could come from a slightly wider range, beyond family and neighbours, but needing an introduction and a guarantor. Most of the time, the introducer and guarantor were the same person, who was socially significant and fully trusted. He was responsible for the apprentice's behaviour during the training period. In other words, he would be liable for any damage caused by the apprentice's misconduct. Here is the situation that Sennett points out: "The medieval workshop was a home held together more by honor than by love."[265]

Even now, craft masters are careful in choosing an apprentice. In Dr. Yang Lifeng's thesis *Construction, Field and Style of Craftsmen* 匠作、匠場、手風, he interviewed four carpenters in Tonghai 通海 Yunnan 雲南 about how to choose an apprentice in 2004. The master-

[262] FengXiaodong, *Cheng Xiang Lu: Xiangshan Group Traditional Architectural Craftsmanship*, pp.137-150.
[263] CuiJinyu, *The Buildings of Suzhou Xiangshan Group*, p.15.
[264] Shen Li, "A Study of Historic Evolution of Xiangshan Group Carpenters", pp.118-119.
[265] Richard Sennett, *The craftsman*, p.64.

apprentice relationship is still kept as it was a hundred years ago. According to his record, a master named Jiang Xuefu 蔣學富 had accepted only 5 or 6 apprentices in his whole life. All were either relatives or neighbours, just as his own master was his uncle-in-law. He said:

"Without a master who is a relative, you cannot learn any real skill. Some people who learned three to four years know only how to even a surface with a plane. Only a master who is a relative would teach you and answer your questions about the skill. For example, you may ask him if the chisel would be better handled straight or oblique, and he could teach you which way is useful. The carpentry skill was handed down from the Master Lu Ban, and one should be very cautious about teaching it."

"如果不是親戚做師傅，你一輩子都學不會。有些人學了三四年也只會推刨。親戚做師傅嘛，你又什麼不會就去問他，他才將給你聽。比如你問他扶鑿子是歪些好還是正些好，他才會告訴你。因為木匠手藝是魯班師傅傳下來的秘方，他不會輕易傳人。"[266]

The other three master carpenters told him about their standards for choosing apprentices, which are as strict as with the Xiangshan Group, despite thousands of kilometres distance between the two areas. Any master would really regret ever having a misbehaving apprentice.

Concerning choice of an apprentice, Cui and Shen's descriptions are similar as the author heard from the local carpenters in Suzhou Xiangshan Base Group Co., Ltd.: Before being accepted as an apprentice, a master would engage the young boy for a three to six months trial period. If the young boy was intelligent and diligent, the master would sign a master-apprentice training contract with the parents and guarantor to formalize their relationship. Signing a contract was a really serious thing. Except for family members, such as father-son or uncle-nephew, a contract and a ceremony were needed. It used to be usual to have three steps to bind promising boys: sign a master-apprentice training contract, have a master-apprentice training ceremony, and have a master-apprentice training banquet.

In *Folklore Studies* 民俗研究, ZangLina 臧麗娜 gives an example of the craftsmen's contract:[267]

"The contract signatory ×××(apprentice's name) was introduced by ×××(introducer's name), and guaranteed by ×××(guarantor's name) to apprentice to ×××(master's name) for × years. During this time, the contract signatory should study hard and comply with the master. If any accident happened to the contract signatory, life comes by destiny, and it is not the master's fault. If the contract signatory escaped, or stopped halfway, it is the guarantor's responsibility. Words of mouth being no guarantee, a written statement is hereby given."

"立規書人×××(即學徒姓名)經××× (中保人名)保薦，拜×××為師，為期×年。在此期間，自當勤奮學藝，尊師聽命。若有工傷不測等情，生死自由天命，與師無涉。若外逃走失，半途而廢，均由中保人負責。恐後無憑，轉立此據存照。

[266] Yang Lifeng, "Construction, Field and Style of Craftsmen: the Investigation and Researches on the Construction of Traditional Vernacular Dwellings of Yunnan Province (Yi Ke Yin), p.43.

[267] Zang, Lina 臧麗娜, "The architectural arts of Dongshan and Xiangshan Group architecture in Suzhou in the Ming and Qing dynasty 明清時期蘇州東山民居建築藝術與香山幫建築", *Folklore Studies* 民俗研究, 01(2004), p. 136.

The parents of apprentice: ××× Sign a cross

The guarantor: ××× Sign a cross

Date

學徒父母：×××畫押

中保人：×××畫押

×年×月×日”

The contract was used to protect the master's benefits, and to be sure of getting an honest apprentice. The parent, normally the father, signed the contract on the young boy's behalf, then "signed a cross 畫押" and made an inked thumbprint to show respect. It was not a fair contract, and was also known as a "life and death contract 生死文書", but it was willingly accepted by people in that period. As with the students who trained abroad, parents had to sign their son's life away before sending their child to study. The father of the first distinguished Chinese railway engineer Zhan Tianyou 詹天佑 signed a training contract for training abroad[268]:

"My son Tianyou will be sent to America by the industry department to study engineering. After graduation, he will come back to China as soon as possible, and be compliant with arrangements. If he gets sick during the period, his life follows destiny."

"茲有子天佑，情願送赴憲局帶往花旗國 美國, 肄業學習技藝，回來之日，聽從差遣，不得在國外逗留生理。倘有疾病，生死各安天命。”

From the contract, we can see what Sennett called "the surrogate father" and "a stronger father figure".[269] In Chinese old saying, it is "he who teaches me for one day is my father for life. 一日為師，終身為父。" The master taught the apprentices not only skills, but also arranged the young man's life, opening their view to the career and the society. The knowledge was "passed on by imitation, ritual, and surrogacy".[270] So the rituals of the master-apprentice training ceremony are also an important part of the master-apprentice education.

The master-apprentice training contract would be kept by the master to avoid disputes in the future. The master-apprentice training ceremony would be held on the same day. As the record in *The Buildings of Suzhou Xiangshan Group* 蘇州香山幫建築 shows, the master-apprentice training ceremony was very orthodox. The process had to fall into a strict pattern:[271]

The place of the ceremony used to be the apprentice's home. If his home did not have enough room, the master's home or workshop could be used instead. A main altar would be put in the centre of the main hall, with red candles flickering on it. A Chinese traditional armchair would be put in front of the main altar, with a red rug lying on the floor. During the ceremony, the young boy knelt three times before the image of Lu Ban 魯班仙師, then knelt three times to the master who was sitting in the armchair. If he was in the master's home, he also needed to kneel three times before the master's wife. After 1919, kneeling was changed to bowing.

[268] Huang Bo, *The Truth of the Late of Qing Dynasty* , p. 122.
[269] Richard Sennett , *The craftsman*, p.63-64.
[270] Ibid..
[271] Cui Jinyu, *The Buildings of Suzhou Xiangshan Group*, p.16.

After the master-apprentice training ceremony, a generous master-apprentice training banquet would be held. The size of the banquet depended on the master's social relationships, normally including one or two tables, paid for by the apprentice's family. At the banquet, the master announced to others his receipt of the new apprentice; and the young boy needed to propose a toast to every predecessor. After the banquet, the apprentice's parents had to give a gift or an allowance in a red packet to the master as their premium. At this point the master-apprentice relationship began.

A famous master could lead a guild. His apprentices would be very proud of their master, and he had to be strict with their training to make sure that the future craftsmen could afford to retain their posts. [272] The most severe punishment for an incompetent apprentice or craftsman was a repudiation of the master-apprentice relationship by the master, which in some cases meant being barred from the guild, or even from the entire local craft industry. That is as same as "the single most pressing earthly obligation of every medieval artisan was the establishment of a good personal reputation."[273] The carpenter's career and life were dependent on the acceptation of their guild.

Cui also gives the details of the apprentice's daily life: "During his study period, the apprentice did not receive any pay. Some rich masters would give a little pocket money monthly, called "haircut pocket money 剃頭錢" or "footwear pocket money 鞋襪錢". At the end of the year, the master would give every apprentice a suit of short wear 短衫褲子(it could be work-wear), and some travelling expenses for returning home for the Spring Festival. Normally, the apprentice worked with the master to build a building. When it came to the special days of putting on the main ridge beam[274], they may receive some lucky money 利事錢. There were no rest days during the study period, and they could not go back home, except sometimes in busy farming seasons, apprentices could go home for a few days to help their parents with the harvest. The Spring Festival was an off-season. Apprentices could visit their homes for ten days to half a month. Anew apprentice was expected to do house work and other menial jobs until another apprentice came to replace him."[275]

"Master-apprentice training time was not always the same: the shortest time was two or three years, but it could be five to six years. There was no textbook, no training plan, as the apprentice was learning by doing. A well known Chinese saying was 'Teaching a brilliant apprentice will result in starving the master 教會徒弟餓死師傅'. There were no surprises, for the masters generally liked to keep some secret skills for themselves. Some important work the master accomplished alone, while the apprentice was sent off to do some simple work, such as moving bricks or stirring sand. An apprentice who wanted to learn areal skill had to know that observation is the best teacher, besides being humble to the master. When a master was satisfied with an apprentice, he would teach the apprentice hand by hand, and explain a key skill by allowing

[272] Shen Li, "A Study of Historic Evolution of Xiangshan Group Carpenters", p.125.
[273] Eric S. Raymand, The Cathedral and the Bazaar: Musings on Linux and Open Source by an Accidental Revolutionary, (Canbridge, Mass.: O'Reilly Linux, 1999).
[274] Putting on the main ridge beam symbolizes that building the carpentry structure has been completed. It is the end of the carpenter's work, and the birth of the building. The date would be chosen by a Fengshui master. It always has a special ritual led by the master carpenter to celebrate his good work. Also see Ronald G. Knapp, *The Chinese House: Craft, Symbol, and the Folk Tradition*, p.62.
[275] Cui Jinyu, *The Buildings of Suzhou Xiangshan Group*, p.16.

observation of the work."[276] On the other hand, both of them also believed "a great teacher produces a brilliant student 名師出高徒". The whole training period was just the preliminary time. The real improvement should be obtained in practice after graduation. Practice makes perfect, and work makes a workman. The master would keep a brilliant apprentice to work for him, who thereby became his right hand.

The most popular Chinese classic textbooks of literacy education were the *Three Character Classic* 三字經,[277] *Hundred family Surnames* 百家姓,[278] and *Thousand Character Classic* 千字文.[279] Concerning the above literacy and arithmetical education, the Jiangnan local chronicles of the Qing Dynasty report that, "the young peasant boys learned farming, and also went to village private school at the age of seven to eight. During the rest of the time, they would collect grass for goats, or help their parents by doing some easy work. 鄉民習耕作, 男子七八歲時亦從師讀書, 有暇則斫草飼羊, 或隨父母作輕便工".[280] "The young peasant boys went to village private school, and ended studying at age fifteen, to be a farmer. 子弟就塾, 率十五罷就農".[281] Then these students became young famers or apprentices to their parents or relatives. In the Taihu Lake Region, even the fishermen who lived on their seven-mast-schooners in Taihu Lake, had a schooner school 船學 for their children on a boat.[282] Twelve to twenty students studied and lived together with a teacher. The parents took turns to supply the schooner school on their own schooner for 20 days. As for carpenters or other craftsmen, the carpentry apprentices of the Xiangshan Gang certainly came from among the educated youth. Besides the need for writing and reading, if a boy could not count, it would be difficult for him to become a competent carpenter.

Although it was learning by doing, master-apprentice training would follow stages from easy to difficult. For instance, for a carpenter, the training processes would be (table 3-1):

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[276] Cui Jinyu, *The Buildings of Suzhou Xiangshan Group*, p.17.

[277] The *Three Character Classic* 三字經 is one of the first book for children as an enlightenment teaching materials in ancient Chinese. The author and the completion time are uncertain. It was probably written in the 13th century during the Song Dynasty. The author could be Wang Yinglin (王應麟, 1223-1296) or OuShizi (歐適子, 1234-1324). The book is a rhyming poem in lines of three characters, which including the literature, history, philosophy, astronomy, geography, ethical principles of Chinese traditional culture.

[278] The *Hundred Family Surname* 百家姓 is both an enlightenment teaching materials, and a book on Chinese surnames. It was written in the early Song Dynasty (906-1279), and based on the developing history of Chinese surname. The work is a rhyming poem in lines of eight characters.

[279] The Thousand Character Classic 千字文 is a Chinese poem enlightenment teaching materials. It was written by 周興嗣 in the Liang Dynasty (502-549). The work is a rhyming poem in lines of four characters, totally one thousand characters without repeat words.

[280] Cai Rongsheng 蔡蓉升, *Shuanglin Zhen Zhi* 雙林鎮志 (History of the Shuanglin Town), Volume Fifteen: Custom 卷一五 風俗,(Shanghai: The Commercial Press, 1917), p.272.

[281] Sun Zhilu 孙之騄, *Nan Zhang Zi* 南漳子, Two Volumes 二卷, (Shanghai: Shanghai Bookshop Publishing House, 1994), p.3.

[282] Chen, Juncai 陳俊才, "The Boat School of Fishermen on the Seven-mast-boat 七桅船上的漁家船學", *Suzhou local chronicles selection dates* 蘇州地方誌史志資料選集 <http://www.dfzb.suzhou.gov.cn/zsbl/1770727.htm> [accessed 20 February 2016].

STEPS			AGE and TIME
1	Formally become an apprentice to a master	拜师	
	apprentice		**14~16** **no tuition and salary**
2	How to cut the logs or planks	粗加工，断料	First year
3	How to Stack timber	叠放	First year
4	How to pre-install and install	预装与拼装	First year
5	How to make different parts of structures	细加工，做构件	Second & third year
6	How to choose materials (logs or planks)	选材	Second & third year
7	How to mark them out for use	划线	Second & third year
8	Formal thanks to the master	谢师	Three or four years later
	carpenter		**17~20** **receives a salary**
9	How to budget	预算	After becoming a carpenter
10	How to organise a carpenter team	组织与管理	After becoming a carpenter
11	How to work with other workers	工种协调	After becoming a carpenter
12	How to design	设计	After becoming a carpenter
	master carpenter		

Table 3-1 The training processes of a master-apprentice training of carpenters

Every apprentice began with the saw and plane, learning how to control basic tools. If an apprentice used tools in the wrong way, the master would correct him. How much the master taught the apprentice depended on how quickly the apprentice understood and achieved the right way. At first, the apprentice would cut at a point some distance away from the drawn line, to leave an opportunity to adjust for his mistakes. For carpentry, "an error , the breadth of a single hair, can lead you a thousand *li* astray 差之毫釐，謬以千里". After practising thousands of times, he could make it perfect in one go, which means he understood his hand sensations, and could learn more elaborate work. After mastering all the tools, it was time to learn how to mark up timber by drawing lines. Drawing lines is one of the most important skills for the carpenters, because it involves deciding how to use the timber, and recognising which part of the structure the timber is suited to. The apprentice could help the master by handing him the tools needed. At the same time, a clever young man would remember what the master was doing, and try to analyse why he did it like that. Sometimes the master would explain to the apprentice once or twice, but most of the time the master would let the apprentice try it for himself, then check and ask him questions to examine his knowledge. The apprentice could graduate when he attained the skill of drawing accurate lines on the log.

After serving his apprenticeship, the young man was expected to hold a thanks-giving banquet to the master to announce his graduation. The master would then prepare a set of basic carpentry tools, which were called the "living stuff 吃飯家什", with which the young man could begin his career.[283]

[283] Cui Jinyu, *The Buildings of Suzhou Xiangshan Group,* p.17.

The master-apprentice training is a kind of oral transmission. Training under this education system, a carpenter does not need drawings to direct how to do it and what to do next. They can imagine what the building will be like after it is finished by their long-term experience. But the fact that they did not need drawings did not mean that they could not draw. With a pretty good basic education, and a long period of training in making, many carpenters and other craftsmen such as stonemasons and brick-masons were good at handwriting and drawing. Some of them deserved to be called calligraphers or artists. Copying scholars' handwriting and drawings were part of their work. Besides, drawing an imagined plan would help them to discuss it with their employer. That is one of the reasons why the master carpenter Yao Chengzu 姚承祖 could draw all the plans and sections of Chinese traditional buildings to teach the architecture students.[284] And it is also one of the reasons why the stonemason Zhang Heshang 張和尚[285] kept Yao's drawings for scores of years.[286] Even though they were not strictly necessary, drawings were still helpful for craftsmen's work. But all the same, the carpenters were not scholars. Nearly all of them were without higher education. Nor did they have any knowledge of modern science, such as structural mechanics. Concerning building construction, they followed building standards and "rule of thumb". For some new style they had never built before, they would like to make a small-scale model to test it, and learn from failures.

Oral training and transmission also includes passage by customary demonstration and imitation. The rhymes and experience helped them to remember how to make something with a prescribed number of prefinished parts to the structure.[287] Besides the work, the way a master treated and dealt with people, as well as his body language, would be imitated by apprentices.

3.2 The Earliest Chinese Architectural Collegiate Education

As noted in Chapter One, the Suzhou Engineering School set up the first architecture department in China in 1923. As we all know, it cannot all be done in one go. Four New School Systems 新學 between 1902 and 1922 brought in reforms to the Chinese education system, which was the system leading to early Chinese modern education. The first generation of Chinese architects returning from abroad were the people preparing the way for the early Chinese modern education in architecture. The education plan in the Suzhou Engineering School is a representative sample for modern architectural education in the classroom.

This section will give a general description of the earliest Chinese architectural college: the Suzhou Engineering School and the modern architectural education at the school.

[284] See Appendex 1 for details.

[285] Zhang Heshang 張和尚 was born in 1932, into a sculptors' family. He learned from his father, and then worked in GaoShijun's 高士俊 workshop in Hu Shu 滸墅. After several years learning Yao's drawings, he became a master builder, rebuilt and protected many historic buildings, and worked in USA and Singapore. See Feng Xiaodong, *Cheng Xiang Lu: Xiangshan Group Traditional Architectural Craftsmanship*, p.140.

[286] See the preface of the *Yao Chengzu Yingzao fayuan tu*, by Chen Congzhou, p.1.

[287] See Chapter Six, pp.158-162.

3.2.1 The Suzhou Engineering School

Chinese architectural collegiate education did not grow following the Chinese carpentry building system. In contrast with the master-apprentice education, it was a totally different form of architectural education, training students to design and build modern buildings in order to change the living environment, and keeping pace with the times.

Before discussing architectural education in China, we should examine the background of the general Chinese education system. Between1902 and1922, it went through the School System of *Renyin* 壬寅學制 of 1902, the School System of *Guimao* 癸卯學制 of 1904, the School System of *Kuichou* 癸醜學制 of 1912-1913, and the School System of *Renxu* 壬戌學制 of 1922.[288] Wolfgang Franke gave details of these school systems, and explained them in *The reform and abolition of the traditional Chinese examination system*.[289] In January 1904, the Qing government promulgated the "Presented School Regulation" 奏定學堂章程, which was the School System of *Guimao*. This new school system spread across the whole country, and was normally known as *XinXue* 新學, "the New school system". It offered a complete plan for the establishment of a school: the discipline arrangements, the school administration, and many other aspects. It established the Chinese modern educational system's basic pattern and frame, also opening the Chinese modern educational organisation. It was influenced by the Japanese modern school and education system. In the following year, 1905, the Qing government ordered the end of the imperial examinations, which had existed for more than a thousand years. This marked the end of Chinese traditional education and a move towards modern science and technology.

For many decades scholars and laymen alike have been inclined to believe that after the loss of the Sino-Japanese War in 1894, the self-strengthening movement, 洋務運動 or 自强運動, gained impetus. The Qing government hoped to recapture "Sea power" in Asia.[290] With the railway built from Shanghai to Ningbo in 1906, an upsurge in industry was in the making. In 1905, the Jiangsu education department was set up in Shanghai, which called for building new schools and training new students, in order to save the country through industry and science.

In the "Presented School Regulation" of 1904, eight subjects were identified for collegiate education: study of Confucian classics 經學科, political science 政法科, literature 文學科, business studies 商學科,modern science 格致科, engineering 工科, agriculture 農科, and medical science 醫科. Architecture 建築工學門 and civil engineering 土木工學門 both belonged to the engineering department.[291] Although for various reasons, the architecture department was not set up rapidly after the education policy, it was the first time architecture had been brought into the Chinese higher education system.

Suzhou, as the capital city of Jiangsu province, led the changes in the education system reform as usual. The demand for technical talents was enhanced when the Viceroy of Liangjiang 兩江

[288] All the school systems were named following the Chinese record of years when the systems began to run.
[289] Wolfgang Franke, *The reform and abolition of the traditional Chinese examination system*, (Cambridge MA: East Asian Research Center, Harvard University, 1960).
[290] PO, Chung-yam, pp.21-26.
[291] Qu Xingui 璩鑫圭 and Tang Liangyan 唐良炎, *The Documents of the History of Chinese Modern Education・The Change of school system* 中國近代教育史資料彙編・學制演變, (Shanghai: Shanghai Education Publishing House), p.387. "Zhang Baixi 張百熙, Zhang Zhidong 張之洞, and others, Presented School Regulation 奏定大學堂章程"..

總督 Zhang Zhidong 張之洞 petitioned to build the Suzhou silk factory and Suzhou cotton factory.[292] Dongwu University 東吳大學, also known as "Soochow University", was established in 1901 by the American Methodist Episcopal Church.

The railway school of Jiangsu province 蘇省鐵路學堂 was established in 1904, and Suzhou middle technology school 蘇州官立中等工業學堂 was established in 1907.[293] Departments of construction, weaving and dyeing were set up in these two schools. In 1911, the two schools were amalgamated to become the Second Technology School of Jiangsu Province 江蘇省立第二工業學校.[294] In 1912, 96 older students and 38 freshmen were studying in three departments of the school. This was the first generation of Chinese technology students. Eleven years later in 1923, the year after the change to the School System of *Renxu*, the school's name was changed to the Suzhou Engineering School 蘇州工業專科學校, and two departments were added: architecture and practical chemistry.[295] The school also changed from a higher middle school to a higher college school, and then amalgamated with other colleges to makeup the Fourth Zhongshan University 第四中山大學 in 1927 (the predecessor of National Central University 國立中央大學).[296]

Generally, although the Suzhou Engineering School existed for only a few years in Suzhou, it is regarded as the place of origin of early Chinese architectural collegiate education.

As mentioned in Chapter One, after the first Chinese architecture department was built in the Suzhou Engineering School 江蘇省立蘇州工業專門學校 in 1923, three other universities had architecture departmentsby1928 (figure 3-1): National Northeast University 國立東北大學 (in Shenyang), National Peiping University 國立北平大學 (in Peiping), and National Arts School 國立藝術院 (in Hangzhou). At the same time, the department in Suzhou Engineering School moved to National Fourth Zhongshan University 國立第四中山大學 (in Nanjing), called National Central University after 1928: (for abbreviation, the "national" in the title has often been omitted). The Northeast University was suspended in late 1931 because of the Mukden Incident 九一八事件 (18.09.1931). Students and teachers moved to Shanghai, renting the schoolhouse of the Daxia University 大夏大學 or moved to Nanjing National Central University to continue their education. The Peking University changed its name to Beijing University in 1931. The architecture department was also suspended for the onset of the Second Sino-Japanese War in 1934, and reopened in 1938.[297] The National Arts School changed its name to National Hangzhou Arts School 國立杭州藝術專科學校, and moved to inner cities of China in 1938 during the

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[292] Zhang Zhidong 張之洞 (04.09.1837-05.10.1909) was an eminent Chinese politician during the late Qing Dynasty. He served as the Governor of Shanxi, the Viceroy of Huguang, Viceroy of Liangguang, the Viceroy of Liangjiang, and also as a member of the Grand Council. See details in Arthur. W. Hummel, *Eminent Chinese of the Ch'ing Period (1664-1912)*, pp.27-32.

[293] Shi Yong 施用, "The Cradle of Chinese Architectural Collegial Education: The Establishment of Architecture Department in the Suzhou Engineering School 我國高等建築教育的發源地——蘇工創辦建築科史料補遺", *South Architecture* 南方建築, 01(2000), p.63.

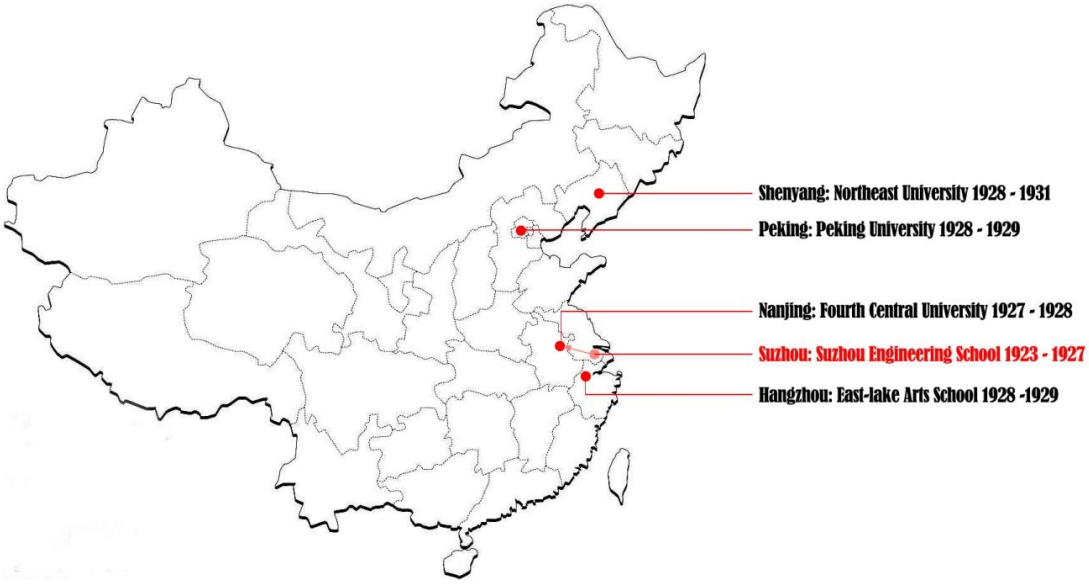
[294] Lai Delin, *The Forerunner of Chinese Architectural Collegial Education: The Architecture Department in the Suzhou Engineering School* 中國現代建築教育的先行者——江蘇省立蘇州工業專門學校建築科, *The Architecture History and Theories* 建築歷史與理論, 05(1993), p.72. "*The Second Chinese Education Almanac* 第二次中国教育年鉴, 1948".

[295] Shi Yong, "The Cradle of Chinese Architectural Collegial Education: The Establishment of Architecture Department in the Suzhou Engineering School", p.63.

[296] Lai Delin, *The Forerunner of Chinese Architectural Collegial Education: The Architecture Department in the Suzhou Engineering School* 中國現代建築教育的先行者——江蘇省立蘇州工業專門學校建築科, p.72.

[297] QianFeng, "Modern Ideals in Collegiate Education of Architecture in China (1920s-1980s)', pp.34-48.

Second Sino-Japanese War.[298]



3-3 The Earliest Chinese architectural collegiate education (till 1928)

According to XuSubin's 徐蘇斌 research, if architecture could be divided into two parts: architecture as a science and architecture as a fine art, then Suzhou engineering school and Hangzhou arts school were respectively the two leaders of the earliest Chinese architectural collegiate education. The department of National Central University was the most famous one in the Republic of China. They were all located in Jiangnan area 江南. There was a succession from Suzhou Engineering School to the National Fourth Zhongshan University, and then on to the National Central University. Our later discussion will focus on the earliest Chinese architectural education as a science. The details of its progress as a fine art can be found in *the Beginning of Chinese Modern Architecture* 近代中國建築學的誕生, written by XuSubin, and published in 2001.

3.2.2 The teachers and students

The school system of *Guichou* 癸醜 of 1912-1913 was the first school system of the Republic of China 中華民國. It was a transitional education system between the old and the new system, with different kinds of normal schools, cramming schools, and specialized vocational departments. For the eligibility of examination, according to *The College Ordinance*《大學令》of 1912[299] and *The rules of College*《大學規程》 of 1913,[300] the qualifications for admission to graduate school was an academic degree from a university or passing an exam equivalent to that qualification. The qualification for admission to preparatory university, technology school, or

[298] XuSubin, *The Beginning of Chinese Modern Architecture*, pp.188-189.

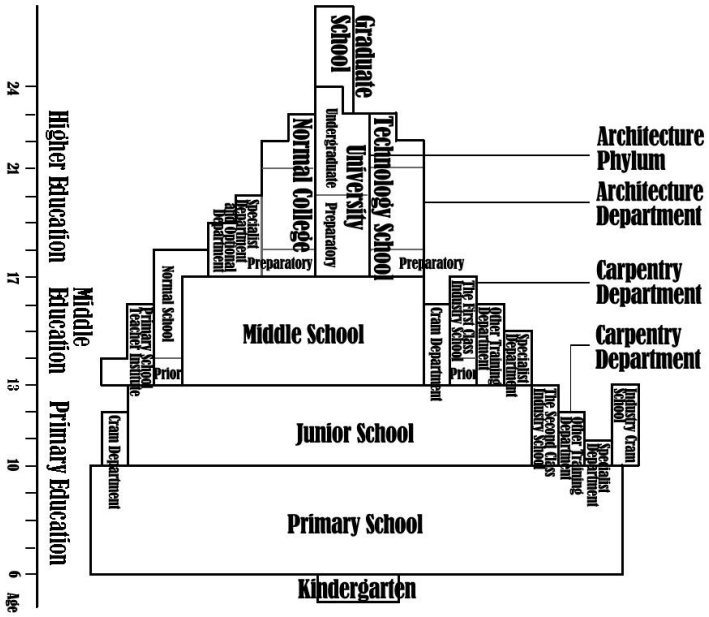
[299] *The CollegeOrdinance*《大學令》 was issued by the Education Department on 24. Oct. 1912. See *the Education Rules of the Republic China*《中華民國教育法規》edited by the education department of the Republic China (May.1919).

[300] *The rules of College*《大學規程》was issued by the Education Department on 12. Jan. 1913. See *the Education Rules of the Republic China*《中華民國教育法規》edited by the education department of the Republic China (May.1919).

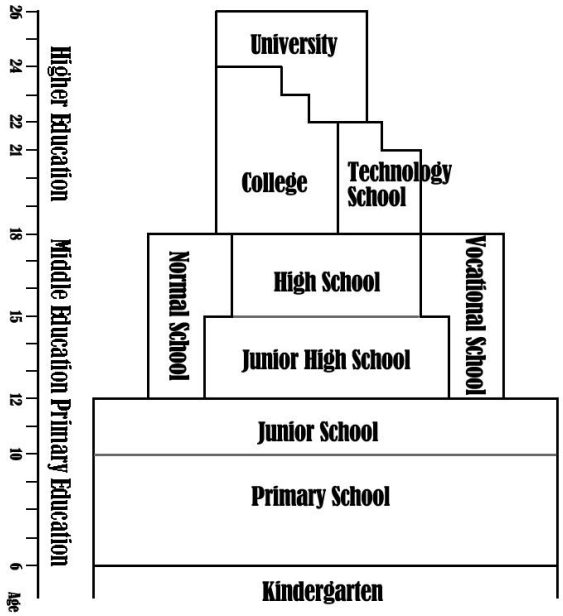
normal school were graduation from high school or passing an exam of equivalent qualification. The other qualifications for admission from middle education followed the same pattern. Here the equivalent qualification was specially mentioned for every degree, which could compensate for a student's shortage, and gave an opportunity for people who were in a career and still needed or hoped for a more modern education.

It required that, except for undergraduate education, a normal college had to have a specialized department to train a specialist teacher in essentials (2-years-education), and an optional department to widen their knowledge (3-years-education).Normal school had a primary teacher Institute (1 to 3-years-education) attached to the school. The other training department 别科 was especially for politics and law school. The first class industry school's preparatory department accepted students over 14 who had graduated from junior primary school, or people who had passed an exam equivalent to those qualifications. The second-class industry school was for students over 12 who had graduated from primary school or for people who had passed an exam equivalent to the qualifications. The industry cramming school accepted people who had already, or hoped to, work in industry.

After several years of changes in the Chinese education system, a far-reaching new education system, the school system of *Renxu* 壬戌*,* was finally instituted in 1922 (figure 3-4). It was simpler and clearer than the previous one. Whether under the school system of *Guichou* or that of *Renxu*, the technology school belonged to higher education, while the vocational school belonged to middle education. Furthermore, in the plan of the school system of *Guichou*, the architecture department and carpentry department belonged to different education degrees. But the plan was not carried out until the school system of *Renxu.*



The School System of *Guichou* 癸醜學制 of 1912-1913



The School System of *Renxu* 壬戌學制 of 1922

3-4 The Chinese school system in 1912-1913 and 1922

The Suzhou Engineering School became a technology school in 1923, following the school system of *Renxu*. It offered a 3-year-education after 3years of education in high school, which means it was a collegiate education. From 1923 to 1927, the earliest Chinese architecture department of the school trained students under this plan. Before 1927, two classes of 1923 and 1924 had graduated. The other two classes of 1925 and 1926 graduated from the Central University.[301] In 1927, based on the South-eastern University 東南大學, the school was merged with seven other schools. [302] The students were treated in the same way as other undergraduates. Those qualifying for entry were announced in the local paper, and would face another exam after a term to be made full members of the university. The classes of 1925 and 1926 were led by teacher Liu Dunzhen and teaching assistant Pu Qicai 濮齊材, and became the first and second graduating classes of the department of architecture of the Central University.

The Suzhou Engineering School was strict with its students. When it was the Second Technology School of Jiangsu Province 江蘇省立第二工業學校 (1911-1923), the first class 甲種班 had 4-years-education. Then in order to improve the education quality, one more year was added from 1920, so the training changed to 5-years-education. From 1923, when the school

[301] Shi Yong, "The Cradle of Chinese Architectural Collegial Education: The Establishment of Architecture Department in the Suzhou Engineering School", p.65.

[302] Haihe Technology University 河海工科大學, Shanghai Business University 上海商科大學, Jiangsu Politics and Law University 江蘇法政大學, Jiangsu medical university 江蘇醫科大學,Nanjing Engineering School 南京工業專門學校, Nanjing Agriculture School 南京農業學校, Shanghai Business School 上海商業專門學校.All of them making upthe Fourth Zhongshan University. See in Wang Dezi 王德滋, and others, *100 Years history of Nanjing University* 南京大學百年史, (Nanjing: Nanjing University Press, 2002), p. 28.

was upgraded to the Suzhou Engineering School, the president Liu Xunlin 劉勳麟 (1879-1941)[303] announced: "in order to avoid the difficult training due to the students' different education backgrounds, we set up a high school department in the school, to enhance the basic knowledge learning. 恐招生程度不齊，施教為難，于校附設高中部以植其基。"[304] The inner high school was a kind of preparatory school for the school. Many students graduated from this inner high school, then became full member students of the school, including the second author of *Yingzao fayuan*, Zhang Zhigang 張至剛. The famous artists Wu Zuoren 吳作人 (1908-1997) and Zhang Xinjia 張辛稼 (1909-1991), the well-known chemist Yang Tingxiao 楊廷孝 (1908-?) and the father of the Chinese electronics industry Wang Zheng 王諍 (1909-1978) were all graduates from the inner high school, which offered a really good education in that time.[305] Besides the inner high school, from then on, all students were expected to be high school graduates, with enough science knowledge to prepare them for an engineering training. In another words, the first generation of architecture students grew up under the new school education system.

The eligibility of examination for college in that time depended on each school. In 1923, 11 years after the school system of *Guichou*, the Suzhou Engineering School had the opportunity to accept the first generation of students who had graduated from high school. Now we cannot find the eligibility of examination for the Suzhou Engineering School in 1920's,but there is a record of requirements in *Education Magazine* 教育雜誌 vol.5. No. 3. (March. 1912).The eligibility of examination for technology or industry school (preparatory or undergraduate) in Peking required five subjects: Chinese 國文, English 英文, mathematics 數學, physics and chemistry 理化, drawing 繪圖[306]. In 1929 and 1930, the number of subjects for the national university's entry exam rose from 5 to 12.[307] (table 3-2)

The students of the earliest Chinese architectural collegiate education must have had a very good modern basic education. As recorded, nearly 90% of them came from middle or upper class families. Although the entry exam depended on each school, the schools were strict about students' quality. They would rather go without than take on anyone under-qualified. The class size of architecture was around 10 persons in the Suzhou Engineering School, and even later in the Central University they still kept to this size in the earliest years. According to Zhang Yuquan's 張玉泉 memory, there were only 3 male and 3 female students in her class in 1930, then 5 more male students were transferred from the North-eastern University in 1932. So the class size increased to 11 students.[308] Some of the first Group of graduated students became teaching assistants in the university, such as Zhang Zhigang, Dai Zhiang 戴志昂, Sun Qingyang 孫青羊,

[303] Liu Xunlin 劉勳麟 (1879-1941) was a well-known educator born in Wujin 武進, Jiangsu 江蘇. He was the first president of the Suzhou engineering school from 1911 to 1925. He went to America, Europe, Egypt and South Asia to investigate industrial education twice in 1917 and 1919. He was an important contributor to the school's improvement.

[304] Shi Yong, "The Cradle of Chinese Architectural Collegial Education: The Establishment of Architecture Department in the Suzhou Engineering School", p.64.

[305] Ibid..

[306] Hu Xiangdong 胡向東, "The Transformation and Reconstruction of the Examination System during the Period of the Republic of China 民國時期中國考誠制度的轉型與重構", (unpublished doctoral thesis, Central China Normal University, 2006), p.166

[307] Meng Lingzhan 孟令戰, "The Rightto Freedom of Teaching in Republic of China 民國時期教學自由權研究", (unpublished doctoral thesis, Wuhan University 武漢大學, 2011), p.87

[308] Zhang Yuquan 張玉泉, "Reminiscence of Zhang Yuquan: The first generation of architect in China 九十春秋憶滄桑——我國第一代女建築師張玉泉的回憶篇", *New Architecture* 新建築, 03(2003), 77-79. p. 77.

and PuQicai.[309]

Year	University	Subjects	Total
1929	Peiping University	Chinese, English or French or German, Chinese History, Foreign History, Chemistry.	5
	Wuhan University	Chinese, Party Constitution, English, Mathematics, History, Geography, Chemistry, Physics.	8
	Zhongshan University	Chinese (divided for literal arts or science department), The prime minister's teaching, Zoology, Botany, History and Geography (for re-text), Mathematics (divided for literal arts or science department), Physics, Chemistry, Ethics, English.	10
1930	Wuhan University	Chinese, Party Constitution, English, Mathematics (divided for literal arts or science department), Chemistry, Physics, History, Geography, Natural History, Ethics.	10
	Zhongshan University	Chinese (divided for literal arts or science department), The prime minister's teaching, English, German, Mathematics (divided for literal arts or science department), Physics, Chemistry, Logic, Biology, Chinese History, Foreign History, Ethics, Geography.	12

Table 3-2 The exam subjects in the eligibility of examination of college of the main national universities from 1929 to 1930

The students of the earliest Chinese architectural collegiate education must have had a very good modern basic education. As recorded, nearly 90% of them came from middle or upper class families. Although the entry exam depended on each school, the schools were strict about students' quality. They would rather go without than take on anyone under-qualified. The class size of architecture was around 10 persons in the Suzhou Engineering School, and even later in the Central University they still kept to this size in the earliest years. According to Zhang Yuquan's 張玉泉 memory, there were only 3 male and 3 female students in her class in 1930, then 5 more male students were transferred from the North-eastern University in 1932. So the class size increased to 11 students[310]. Some of the first Group of graduated students became teaching assistants in the university, such as Zhang Zhigang, Dai Zhiang 戴志昂, Sun Qingyang 孫青羊, and PuQicai.[311]

From Lai Delin, XuSubin, and Shi Yong's research, teachers in the architecture department of the Suzhou engineering school included two presidents of the Suzhou engineering school: Liu Xunlin 劉勳麟 and Deng Bangti 鄧邦逖 (1886-1962)[312] both of whom attached importance to the quality of education and teachers. Plenty of good teachers gathered in the architecture department. The founders Liu Shiying 柳士英, Liu Dunzhen 劉敦楨 and Zhu Shikui 朱士圭 were returning students from Japan in 1920,1922, and 1919. Huang Zumiao 黃祖淼 joined in 1925 when he returned from Japan. The famous artist Chen Jiaxian 陳迦仙 and master carpenter

[309] Zhang Yuquan 張玉泉, "Reminiscence of Zhang Yuquan: The first generation of architect in China", p.77.
[310] Ibid..
[311] Ibid..
[312] Deng Groupti 鄧邦逖 (1886 - 1962), was a famous educator and textile expert, born in Jiangning 江寧, Jiangsu. He was sent to Great Britain in 1905, graduated from the textile department of University of Manchester, and was then trained at the University of Leeds. He came back to China in 1912, became teacher in the textile department of the Suzhou engineering school in 1913, and was president in 1925.

Yao Chengzu 姚承祖 were invited to teach in the school. Qian Baocong 錢寶琮, ShenMuceng 沈慕曾, GaoShiguang 高士光 were the teachers of the basic courses.

According to the memories of Li Shounian 李壽年, a second class graduate of 1927, Liu Shiying was the dean of the department and teacher of building construction, architectural design, western architectural history, and urban planning. Liu Dunzhen was the teacher of Chinese architectural history and garden design. Zhu Shikui was the teacher of building material engineering, structure and construction, as well as engineering calculation. Yao Chengzu was the teacher of national building methods. Huang Zumiao was the teacher of interior decoration and health, Shen Muceng of civil engineering introduction and applied mechanics. Gao Shiguang was tutor of metalwork and woodwork experience, Qian Baocong was the teacher of descriptive geometry and shadow perspective. Chen Jiaxian was the teacher of fine arts. The students had a second foreign language course as well as English. Li Shounian had chosen French.[313]

Liu Shiying was born in November 1893, and graduated from the Tokyo School of Higher Education (in 1929, it changed its name to Tokyo Engineering University) in 1920. On his return to China he was employed in an architectural firm run by Japanese in Shanghai. In 1922, he and his schoolmates Wang Kesheng 王克生 (1892 - ?), Zhu Shikui, and Liu Dunzhen set up the first architectural and engineering firm run by Chinese in Shanghai, named Huahai Architects Associates 華海建築師事務所. Affected by the views of his brother Liu Boying 柳伯英,[314] he recognised the importance of architectural education, and dedicated himself to it. He recalled: "I was working as an architect and part time teacher in Shanghai. I recognised the importance of architectural education because of the needs of society. 我當時在上海執行建築業務，半工半教，由於那時社會逐漸對這門專業的需要，我才意識到建築教學的重要。"[315] The other three schoolmates Liu, Zhu, and Huang were invited by him to be teachers in Suzhou engineering school. Besides Liu Shiying, at first most of the teachers were part time architects, until Liu Dunzhen and Huang Zumiao were given full-time jobs in 1925 and 1926.

Later, in the Fourth Zhongshan University in 1927, the intended dean of the architecture department was to be Lü Yanzhi, but he was too busy working on his famous design for the Mausoleum of Dr. Sun Yat-sen 中山陵. Then the returning Oregon State University master student Liu Futai 劉福泰 was invited to take the post. The other teachers had different training backgrounds abroad, such as Li Yishi 李毅士 who returned from Great Britain, Lu Shusen 盧樹森 who returned from America, and Bei Shoutong 貝壽同 who returned from Germany.[316]

In 1928, Liang Sicheng and his wife Lin Huiyin were returning from the University of Pennsylvania, and set up an architecture department in the North-eastern University, which was called "a branch Penn" by Gu Daqing.[317] It was a beginning of a transplant from the American

[313] Shi Yong, "The Cradle of Chinese Architectural Collegial Education: The Establishment of Architecture Department in the Suzhou Engineering School", p.64.

[314] Liu Boying 柳伯英 (1884 - 1926) graduated from Jiangsu Normal School, and went to study physical education in Japan, connected with Sun Zhongshan 孫中山, and followed him.

[315] Shi Yong, "The Cradle of Chinese Architectural Collegial Education: The Establishment of Architecture Department in the Suzhou Engineering School", p.63.

[316] Qian Feng, "Influences of Overseas Returned Architects on Architectural Education in Modern China 近現代海歸建築師對中國建築教育的影響", *Time and Architecture* 時代建築, 04(2004), p.21.

[317] Gu Daqing, "An Outline of Beaux-Arts Education in China: Transplantation, Localization, and Entrenchment", in Chinese Architecture and the Beaux-Arts, Jeffrey W. Cody, ed., p.75.

architectural collegiate education system.[318]

The education background of teachers of the Suzhou engineering school and National The Forth Zhongshan University are shown in table 2-2.[319] From the above and the table, we can see that the earliest Chinese architectural collegiate education was led by teachers who had trained abroad. First it was in Japan, then Europe, and finally America. After the teachers who return from American, especially from Penn, the architectural education method followed Beaux-Arts. In 1930, the architecture department of National Central University had teachers who had graduated from the world's top architectural universities, and the first generation of Chinese trained architectural students had joined the teaching team, such as Zhang Zhigang, Pu Qicai and his colleagues. From then on, the Chinese architectural collegiate education got into a routine. These different education backgrounds definitely influenced the education systems they built. Most of the teachers had architectural design experience, or were also part-time architects. Their live design experiences were very helpful for their teaching.

Furthermore, the Suzhou engineering school was the only one that invited a master carpenter to teach the national building method, which was an obvious influence by Japan, not the Beaux-Arts (see the next section) After that, in the Central University, the course was taught by Liu Dunzhen. The reason for this change was that the school moved to Nanjing, while Yao was living in Suzhou. After the move, Yao's close colleague Liu taught the course instead of him.

3.2.3 The architectural education plan

According to Zhang Zhigang, the aim of the architecture department was training students in a full knowledge of architecture, and to cover adequately the whole process from design to field work. It was equal to the educational aim of the Tokyo School of Higher Education. The course at the Suzhou engineering school was developed from that of the Tokyo School of Higher Education and the plan of the school system of *Kuichou* 癸醜 of 1912-1913. From the form of courses in different times, we can see that because the teachers Liu Shiying and his colleagues had accepted education in 1915 in Tokyo, their educational background became the classic example for the earliest Chinese architectural collegiate education. Under supervision of the planned courses by the education department in 1912-1913, they finally built the first Chinese architectural collegiate education course system. It was a difficult but successful beginning.

Compared with the planned courses in the late Qing dynasty, the Suzhou Engineering School, following the Japanese school and enhancing the understanding of Chinese traditional buildings, set up courses like national (Chinese) building methods and Chinese architectural history. They kept their attention especially on the construction of Chinese traditional buildings, invited the well-known master carpenter as school teacher, and learned about Chinese traditional timber buildings from him. They also added courses like garden design and urban planning, which made greater progress than in the old Japanese school. The Tokyo Imperial University added garden design only in 1917, and urban planning only in 1919 (Table 3-3).

[318] See Chapter Two, table 2-3, p.47.
[319] See Chapter Two, p.46.

The planned courses by the education department in the school system of *Kuichou* of 1912-1913	**The courses of the Tokyo School of Higher Education in 1914**	**The courses of the Suzhou Engineering School in 1924**	**The courses of the Central University of 1933**
Mathematics	Algebra, analytic geometry, differential calculus	Differential calculus	Differential calculus
Heat engines	Physics, physics test	Higher physics	Higher physics, electrothermics.
Mechanics	Material construction	Mechanics	Mechanics
Geography		Geography	
Building materials	Building materials	Building materials	Material mechanics
Building construction	Western building construction	Western building construction	
Architectural design		Architectural design	Architectural design
Descriptive geometry and cartography			Descriptive geometry and cartography
Measurement science and practice	Measurement science	Measurement science and practice	Measurement science
Cartography	Japanese building cartography, western building cartography	Architectural patterns	Architectural patterns
Building health	Building health	Building health	
Water mechanics			Water supply and drainage
Construction methods	Construction methods (including engineering calculation)	Construction methods and engineering calculation	Architectural organization
Field practice	Field practice	Design project field practice	Field practice
Metallurgy and houseware making			
Architectural history	Japanese architectural history, western architectural history	Chinese architectural history, western architectural history	Chinese architectural history, western architectural history
Building objective view	Fine arts drawing, architecture fine arts.	Shadowgraphdrawing, perspective drawing, fine arts drawing, architecture fine arts.	Shadowgraphdrawing, perspective drawing, water colour drawing, architecture drawing.
Decoration methods		Interior decoration	Interior decoration
Mechanics			

Chinese architecture method	Japanese building method	**National (Chinese) building method**	National (Chinese) building method
Architectural rules		Architectural rules and management	Architectural duty and rules
Industrial economics	Industrial economics	Industrial economics	Project budgeting
Reinforced concrete construction	Special buildings	Reinforced concrete and steel construction	Reinforced concrete and steel construction
	Geometric construction	Geometric construction	
	Industrial bookkeeping	Industrial bookkeeping	
	Industrial health		
		Civil engineering instruction	HVAC Engineer
		Garden design	Garden design
		Urban planning	Urban planning
		Metalworking and woodworking experience	
			Arts history

Table 3-3 The courses of the education plan of different universities at different times[320]

These new courses marked the Chinese architectural collegiate education by trying to follow Japan and yet keep Chinese traditional characters. The Tokyo School of Higher Education had special courses on Japanese buildings, while the plan made by the education department had only Chinese architectural methods. Although in the late Qing Dynasty, Zhang Yingxu's book *Building Construction* had mentioned Chinese building structure, there was no course to teach it. The national (Chinese) building method and Chinese architectural history made significant advances in the history of Chinese architectural collegiate education, bringing a new understanding of Chinese traditional buildings and building methods.

Liang Sicheng also "gave an ambitious course on the history of Western as well as Chinese architecture" in the North-east University in 1928.[321] Base on Liang's research on *Yingzao fashi*, his course paid more attention to the Chinese state architectures, which is different of what Liu Dunzhen taught in the national (Chinese) building method. Liang and Liu both contributed in the researches on Chinese architecture history, but from beginning they were in different ways, which had extensive contacts with their architectural education background abroad.

The Suzhou Engineering School was the first and only one to invite a well-known master carpenter to teach the course, and Yao Chengzu wrote the first draft of *Yingzao fayuan* as the textbook for the second year students.[322] In spite of the short time for which this course existed, the work continues to influence later generations of Chinese architecture students. Thirty years later, in the 1950s, the Tongji University invited two other Suzhou master carpenters as teaching assistants: Xu Yongpu 徐永甫 (1920s-1970s) and Xu Hesheng 徐和生 (1918-1970s). Both of

[320] Based on table 4-4 in *The Beginning of Chinese Modern Architecture*, XuSubing, p.120; and table 4.10 in Modern Ideals in Collegiate Education of Architecture in China (1920s-1980s), QianFeng, p. 58.
[321] Wilma Fairbank , *Liang and Lin: partners in exploring China's architectural past*, (Philadelphia: University of Pennsylvania Press, 1994), p.42.
[322] Details see Chapter Five, p.101.

them were XiangshanGroup master carpenters. Their names could find in the genealogy of the Xiangshn Group master craftsmen.[323] Xu Hesheng had been Xu Yongpu's apprentice. In the Cultural Revolution 文化大革命 Xu Hesheng was persecuted for his traditional Chinese carpenter's rule that no nails should be used in building structures, and committed suicide. He died for his great carpentry skill and belief. They were both invited by the *Yao Chengzu Yingzao fayuan tu*'s finder, Professor Chen Congzhou, to make several models of Chinese traditional buildings for the department (figure 3-5). The time of carpenters' and architects' cooperation was limited, but the result was fruitful.

3-5 The models made by carpenters XuYongpu and XuHesheng in Tongji University

a b c

a: Interior decoration design: Let's restore our lost land (a Chinese fireplace)
b: Architecture design: Chinese Post Office in Tokya
c: Design: the Monument of Sun Zhongshan

3-6 The course designs by Fei Kang when he was a student of the Central University in 1930s[324]

The Central University basically followed the Suzhou Engineering School, but paid more attention to architectural drawings, and deleted the courses of crafts, such as metalworking and woodworking practical. From Fei Kang's school design programme (figure 3-6), we can find lots of Chinese character in the western usage, which reflected the key educational points, and the design period (the Japanese had occupied North China). The interior decoration design put a fireplace in a traditional Chinese room, but in Chinese buildings the fireplace had never been used. The post office came from the western world, using the modern view with the western column type, but with Chinese doors set between the columns. Monuments for memory were designed in a totally western way (the Chinese way was a temple), but Fei's design had Chinese decoration on it. All the designs tried to "continuation of Chinese 'form' with modern Western 'content'," which also what the Chinese architecture students' idea in the University of Pennsylvania in the 1920s. And that makes the feature of Chinese pre-modern architectures, designed by the first generation architects trained abroad and in China.

[323] Feng Xiaodong, *Cheng Xiang Lu: Xiangshan Group Traditional Architectural Craftsmanship*, pp. 150-151.

[324] Fei Lin 費麟, "Recall my father Fei Kang: a Chinese architect who died in his wisdom prime 追憶我的父親費康：一位英才早逝的中國建築師", *Architecture Creation* 建築創作, 10 (2005), p. 145.

Conclusion of Chapter Three:

This chapter has focused on the Chinese traditional crafts builders: the "Xiangshan Group", and the first Chinese collegiate architectural education: the Suzhou Engineering School, in Suzhou, in the early 20th century. The course of the "National (Chinese) Building Method" was a result both of the people and the education system, and the manuscript of the *Yingzao fayuan* was the gratifying result.

Four basic research questions are discussed in this chapter. For the carpenter: How were the Xiangshan Group carpenters organized? What was the local traditional master-apprentice education system like? For the architect: How was the Suzhou Engineering School established? What was the earliest Chinese architectural education system like? In order to answer these questions, the historical context had to be discussed first, so research on both of them started from the late Qing Dynasty, and ended in the 1930s.

The guild, Ziyi Union, was founded in the Lu Ban Temple in Suzhou, in 1850. It organized the crafts builders as the formal name "Xiangshan Group" until it changed name to "the Construction Trade Union" in the 1920s. It organized worship, arranged payments, kept the order of master carpenter and master-worker, and limited the entry of craft builders from other places. In a word, it protected the craft builders of the Xiangshan Group, and kept up the social relationships between the craft builders of the Xiangshan Group.

The traditional master-apprentice education of the carpenter in the Xiangshan Group was an oral education in practice. Generally, the master/apprentice relationship was based on a blood or geographical relationship. The routine education of the apprentice was good enough for basic reading, writing, and numeracy skills. These were basic abilities for their future learning of carpentry work. A master carpenter, such as Yao Chengzu, might receive a better education. He was sent to study literature with an old scholar.[325] It is understandable that among the several carpentry building companies in Suzhou, Yao Chengzu's grandfather could write a secret family carpentry book, and Yao could make drawings of buildings and write a textbook for college students.[326] It could also explain why a master carpenter of the Xiangshan Group could organise and run a building team without any problem. Oral education in practice and the Chinese traditional education are two characteristics of the master-apprentice education for the Xiangshan Group of carpenters.

The new school education system between1902 and1922 paved the way for the modern collegiate education in humanities and science. The first Chinese architecture department was established at the Suzhou Engineering School in 1923. Although the department stayed in Suzhou for only four years, its influence remained for a long time, including the production of the book *Yingzao fayuan*.

The earliest Chinese architecture collegiate education stood under the influence of Japan. Most teachers who serviced the architecture department in the Suzhou Engineering School had received their training in Japan. Comparing the education plan of the Japanese (in 1914) with the Chinese one (in 1924) shows how deep the influence was. Furthermore, the first generation

[325] See in Chapter Four, p. 92.
[326] Zhu Qiqian, *The essay on drawing of Buyun Xiaozhu*, p. 140.

students who accepted Chinese architectural collegiate education were trained by the new school education system, and had a different educational background from their teachers and the old fashions. Modern architectural training was the characteristic of the earliest Chinese architectural collegiate education for the first generation architects, whether they trained abroad or in China.

The course "National (Chinese) Building Method" was a specific course in modern architectural education. Obviously it was set up by learning the course "Japanese building method" of the Tokyo School of Higher Education. There was no doubt that, at that time, none of the architectural teachers or the architects in China could teach this course because of their educational background. But the knowledge of this course was necessary for both the teachers and the new generation of students. The best way to solve this problem was by asking for help from the local carpenters' guild. In the 1920s, Yao Chengzu was regarded as the leader in the Xiangshan Group, and the first trustee of Ziyi Union.[327] From that it followed logically that Yao became the first teacher of this course. And Yao's knowledge and experiences prepared him to write a textbook for the second year collegiate students, which was the manuscript of the *Yingzao fayuan*.

To sum up, this chapter gives the specific background to the birth of the *Yingzao fayuan*. It explains why a book of study on a local Chinese traditional carpenter's work was needed in the early 1920s, in Suzhou. It fills in the personal societal attributes and education backgrounds of the author and readers at that time.

A Chinese traditional master carpenter who served as a teacher in a modern college, must have made interesting conflicts and harmonies. The colleagues he worked with changed from master carpenters to architects who returned from training abroad; the young men he taught were changing from apprentice to collegiate student; the education method he used was changing from oral education in practice to modern education in the classroom. The conflicts and harmonies between two Chinese architectural education systems in 1923-1937 gave birth to *Yingzao fayuan*. All the above things are reflected in the history of the *Yingzaofayuan*, in the processes by which the book grew from a secret traditional carpenter's family book to a textbook, then to an academic research book on carpenters' skills. These questions will be discussed further in the next chapter.

[327] "*Wuxian Zhishi Gongshu Bugao Di Er-si-yi Hao* 吳縣知事公署佈告 第二四一号", in *The Inscriptions in Jiangsu Province in the Ming and Qing Dynasty* 江蘇省明清以來碑刻資料選集, Suzhou Museum, ed. 蘇州博物館編, (Beijing: SDX Joint Publishing Company, 1959), p.85.

CHAPTER FOUR

Conflicts and Harmonies

The history of the *Yingzao fayuan* not only reflects the co-operation of traditional carpenter and modern architect in early modern China, but also a communication between two education systems, and the indelible hallmark of the era.

4.1 The Authors and Editors

As noted in the Prologue, the *Yingzao fayuan* has two authors: Yao Chengzu and Zhang Zhigang. Yao Chengzu was the author of the original work, while Zhang Zhigang was the author of the modern edition, who added text and photos, and redrew all the illustrations from the original work. The *Yingzao fayuan* also has two editors: Zhu Qiqian and Liu Dunzhen. Zhu Qiqian was the first editor. He not only gave important advice to Yao Chengzu, but also added an essay about the picture of Buyun xiaozhu 補雲小築, "Buyun House" in 1933. This essay helps us to know the worth of Yao Chengzu's work[328]. The second and last editor is Liu Dunzhen. He was the first reader of Yao's work in 1933, and was the one who encouraged Yao to complete it. He was the teacher of Zhang Zhigang, and a close friend of Zhu Qiqian. In the end, he used his power to help to publish the modern edition of the *Yingzao fayuan* in 1959.

4.1.1 Yao Chengzu 姚承祖 (1866-1938)

The original author of the *Yingzao fayuan*, Yao Chengzu, was an outstanding leading master carpenter of the "Xiangshan Group" around 1900. After Kuai Xiang (1397-1481), the principal designer and chief builder of the Forbidden City in Beijing[329], Yao Chengzu was the next best-known member of the "Xiangshan Group" celebrated both for his building works and for the *Yingzao fayuan*.

Yao Chengzuis also known by his style name (*zi* 字)[330] "Hanting 漢亭", also "漢庭",[331] and the nom de plume (*hao* 號)[332] "Buyun 補雲", "The upkeep and maintenance of clouds", or another nom de plume "Yangxing Jushi 養性居士", meaning "Lay Buddhism of self-cultivation".

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328 See Chapter Six, pp.144-146.

329 See Chapter Two, p.55.

330 A Chinese style name (*zi* 字), sometimes also known as a courtesy name, is a given name to be used later in life."*zi* 字 (given on coming of age)" , See in Endymion Wilkinson, *Chinese History: A Manual*, p.99.

331 "漢亭" and "漢庭" are pronounced the same way in Chinese. Both of them can be found in his drawings. "亭"generally means "pavilion", and "庭" means "courtyard" or "hall".

332 A Chinese nom de plume (*hao* 號) is an alternative courtesy name. "*hao* 號 (nicknames for adules)" , see in Endymion Wilkinson, *Chinese History: A Manual*, (Cambridge and London: Harvard University Press, 1998), p.99. But more like pseudonyms or pennames, rather than nicknames. A *hao* was usually self-selected, and it was possible to have more than one.

In China, the style name is mostly disyllabic (comprises two characters) and is usually based on the meaning of the given name, and the nom de plume is usually based on one's career or religion. The given name of Yao is "Chengzu 承祖", and means "inheriting the family fortune". He was born in a carpenter's family, the son and grandson of master carpenters. The *Yingzao fayuan* is derived from his family's secret book. Yao's style name "Hanting" relates to his work, because the word "*ting* 亭" generally means "pavilion", and "*ting* 庭" refers to "courtyard" or "hall". Both of them are connected with buildings. The word "*han* 漢"indicates the river in heaven or perhaps signals his nationality.[333] Obviously Yao Chengzu's nom de plume reflects the Chinese story of Nüwa 女媧. In the *Huainanzi* 淮南子,[334] a book of collected essays blending different religions of ancient China before 139B.C., Nüwa 女媧 was the goddess who created mankind and repaired the pillar of heaven, best known as two stories named "女媧造人" and "女媧補天" in ancient Chinese mythology. Her unbelievable craft skills were worshipped by craftsmen. Yao used his nom de plume to show his ambition: If Nüwa could keep and maintain heaven (Bu Tian 補天), then he hoped he could (help her) keep and maintain the cloud in heaven (Bu Yun 補雲). "補" means "repair, maintain"; "天" and "雲" are "heaven" and "cloud". The other nom de plume "Yangxing Jushi", was used in his later years, reflecting his sincere commitment to Buddhism. "*xiushen yangxing* 修身養性", cultivate one's mind, are the spirit pursuance of Chinese gentry. This nom de plume showed his attention to cultivating his moral character and nourishing his inborn nature.

Yao Chengzu was born in Shuli village 墅裡村, Xukou town 胥口, Wu Xian 吳縣, Jiangsu Province 江蘇省, on May 2nd 1866, the late Qing Dynasty. He died on June 18th 1938, which was the year after the outbreak of the Second Sino-Japanese War.[335] In 1911, the beginning of the Republic of China, he was 45 years old. As a well-known master carpenter of the "Xiangshan Group", he worked in Suzhou, which is only about 120 kilometres from Shanghai, and 200 kilometres from Nanjing. The seventy-two years of his life were in a changing time, from imperial China to republican China, and from a traditional world to a modern world. Yao Chengzu devoted his life to working in Chinese carpentry, and tried his best to protect and carry on the carpentry skills.

Like most of the Xiangshan Group craftsmen, Yao Chengzu began to study carpentry at the age of eleven, under his uncle Yao Kaisheng's 姚開盛 direction, in the Kaisheng Building Company 開盛營造廠 in Suzhou. He was diligent and eager to learn. Besides the family carpentry education, he was sent to study literature with an old scholar Zhong Zhongtian 鐘仲田 for several years, [336] which gave him a better education than most other craftsmen. When he was sixteen, he became a carpenter in his uncle's company. He worked hard to perfect his craft, and

[333] For western researchers, "Hanting 漢亭" may easily make a misunderstanding that connects in the mind of the title of "Hanshou Tinghuo 漢壽亭侯", Guang Yu 關羽 (?-220), a well-known General in the late Eastern Han Dynasty in China. Although two words in the names are the same they are actually totally different. The title of Guan means "Marquis of Hanshou Village". Marquis of a Village is lower than the rank of marquis in the Eastern Han Dynasty; Hanshou 漢壽 is a geographical name at the time in Guangyuan 廣元, Sichuan Province 四川. See in Pan Ku, Homer H. Dubs,tran., *The History of the Former Han Dynasty*, Vol. Three, (Baltimore: Waverly Press, 1938), p. 160.

[334] "*Lanmin xun* 覽冥訓" , in "*Huainan zi* 淮南子", Liu, An 劉安 (179 -122 B.C.), ed. Chinese Text Project 中國哲學書電子化計畫 < http://ctext.org/huainanzi/lan-ming-xun> [accessed 20 February 2016].

[335] Cui Jinyu, *The Buildings of Suzhou Xiangshan Group*, p.148. Also see Shen Li, "A Study of Historic Evolution of Xiangshan Group Carpenters", p.130.

[336] Li, Zhoufang 李洲芳, and Ma Zuming 馬祖銘, "The famous carpenter Yao Chengzu 一代宗匠姚承祖", *Techniques of Traditional Chinese Architecture and Landscape* 古建園林技術, 02(1986), p.63.

before his 20th birthday, he had become a good master carpenter of the "Xiangshan Group" in Suzhou. A few years later, he inherited his uncle's company, and changed its name to Yao Kaitai Building Company 姚開泰營造廠.[337]

In 1912, he was the head of the Lu Ban guild of Suzhou 蘇州魯班社.

In the 1920's, Yao Chengzu was one of the best carpenters of the Xiangshan Group. His name appears in official documents, for example in *Wuxian Zhishi Gongshu Bugao DiNianyi Hao* 吳縣知事公署佈告第廿一號, "No. 21 proclamation of county administration of Wuxian", on July 29th 1920, it is recorded:

"This case according to the standing director of Ziyi Union 梓義公所 (institution of carpentry) Yao Chengzu's report,…"

"案据梓义公所理事姚汉廷……等呈称，……"[338]

In all the proclamations about the Ziyi Union of the 1920's, Yao Chengzu's name appears at the top of the staff list, meaning that he was the leader of the institution of carpentry at that time. When the Building Trade Union of Wu Xian 吳縣營造業同業公會 was established on June 25th 1931, Yao Chengzu was elected one of the executive members, and became chairman after eleven days, on 6th July 1931.[339] He became a supervisor after 1933. Until 1935, at the age of sixty-nine, three years before his death, he still worked in the institution.[340]

At the same time, as a master carpenter, Yao Chengzu was engaged to teach the national building method 本國營造法 at the architecture department of the Suzhou Engineering School 蘇州工業專科學校 in 1923. The drafts of the *Yingzao fayuan* were the textbook of this course, which he wrote for students there. He worked for the first school of Chinese collegiate education of architecture for three years, until the architecture and engineering division of the school moved to Nanjing. After that, Yao Chengzu continued to co-operate with architects and professors at the universities in Nanjing.

Yao Chengzu built many buildings throughout his life. Unfortunately, because most of his works are traditional residences or gardens, after the wars and changes of government, almost none of them have survived. Based on the record in the preface of *the Yao Chengzu yingzao fayuan tu* 姚承祖營造法原圖 by professor Chen Congzhou 陳從周, today, in many sources, it says there are just four of his works to be found: the Plum Blossom Pavilion 梅花亭 in the Xiang Xuehai 香雪海, "scented snow sea", in Suzhou; Ouxiang Xie 藕香榭, "the Lotus Fragrance Anchorage", in the Yi Yuan 怡園, "the Garden of Pleasure", in Suzhou; the Main Hall of Lingyan Temple 靈岩寺 in Mudu 木瀆; and the Yan Garden 嚴家花園 in Mudu. But the preface was written in October 1979, and in the 1980's, there was more rebuilding of Chinese traditional buildings' than ever before. Through investigation in November 2012, the author found that only the Main Hall of Lingyan Temple is possibly an original Yao's work. The Plum Blossom Pavilion was rebuilt by another nameless carpenter in the 1980's. It has been changed in location, and

337 Shen Li, "A Study of Historic Evolution of Xiangshan Group Carpenters", p.131.
338 Found in the collection file of Suzhou Archives, No. I14-047-0059-001.
339 "The notes of the Record to country government and party branch on July 21st 七.廿一呈縣政府/黨部備案", in *the drafts of paper of the Building Trade Union of Wuxian* 吳縣營造業同業公會送文稿底, in the collection file of Suzhou Archives.
340 The name of Yao Chengzu can be found in the staff list as a supervisor of the Building Trade Union of Wu Xian in 1935, in the collection file of Suzhou local chronicles.

rebuilt only from an old black and white photograph. Similar events have occurred at The Ouxiang Xie and Yan Garden.[341] There is a misunderstanding by Chinese officials, who thought that no matter how the materials changed, the construction changed, and it was rebuilt by other workers, if the building kept its original shape it still could be called "the original one". For the same reason, no record has been made of the names, times, and works of the rebuilders.

In the research of Shen Li, she found from the collection of files in Suzhou Archives, that some of Yao's life details could be revealed:[342] As a master carpenter, Yao's outstanding achievements depended on his excellent skills and good education. He was not only a master carpenter, but also a business manager. He was familiar with every aspect of the building programme, which gave him the ability to take charge of a big carpentry company. According to records in the Suzhou Archives, Yao's company had nine employees, and was located at No. 1 Youlan Xiang (幽蘭巷 1 號), in 1937. Since most carpentry companies only had three to five employees, his company must have been one of the biggest carpentry companies in Suzhou at that time.[343] He was well educated, so he could sum up his experience, then become a teacher and write a textbook. He had good social skills, a strong sense of social responsibility, and a well-developed historical perspective. He recognised that no matter how the world changed, education is the best way to protect the craftsman's skills and prevent them being lost. For this reason, early in the 1910's, he set up two primary schools free to the children of craftsmen: One was at Guanqian Road 觀前街 in the city centre of Suzhou, named Ziyi Xiaoxue 梓義小學, "Craftsmen's Primary School"; the other was in his hometown, also the craftsmen's hometown, in Shuli valley, named Shufeng Xiaoxue 墅峰小學, "Shufeng Primary School".[344] He was hired in a higher education school to teach the first generation of Chinese architects how to understand Chinese traditional building. He wrote the book *Yingzao fayuan* to handthis knowledge down to further generations, whether to carpenters or architects.

He was the only person who worked both as a master carpenter and as an architectural educator. He had taught both carpentry apprentices and architecture students. He was one of the earliest Chinese carpenters to work with architects, while pursuing architectural education at the same time. His works made him known as one of the greatest craftsmen among the "Xiangshan Group" of carpenters.

4.1.2 Zhang Zhigang 張至剛 (1909-1983)

The adaptor/editor of the modern edition of the *Yingzao fayuan*, was Zhang Zhigang. He was one of the first generation of Chinese architects trained in China, and joined the Chinese architectural collegiate education system as soon as possible. He had participated in some design projects, but most of his works were connected with studies of traditional Chinese wooden

[341] This information was obtained from the manager Chen Yuming 陳玉明 of the Suzhou Xiangshan Base Group Co., Ltd 蘇州香山工坊, who in charge of keeping culture and history documents, and has a close relationship with the local traditional carpentry building teams. The author's investigation of all these four places, for the scale and some part of structure of the buildings, proved his words. The scale of the buildings in the Yan Garden is obviously too large for private use by a family.

[342] Shen Li, "A Study of Historic Evolution of Xiangshan Group Carpenters", p.131-132.

[343] Based on *the Name list of members of the Building Trade Union of Wuxian in1931* 1931 年度吳縣營造業同業公會營造業會員名冊, Suzhou Archives.

[344] Cui Jinyu, *The Buildings of Suzhou Xiangshan Group,* p.149.

buildings or the training of young architects in Chinese higher education institutions.

He was also known by his style name Yongsen 鏞森. The word "yong 鏞" means a large metallic bell used as a musical instrument, while the word "sen 森" should signal luxuriant vegetation, or a solemnly managed ceremony. It has a similar meaning to his given name Zhigang 至剛, which indicates a will of iron, because a good bell can only be made of the best metal thoroughly tempered.

He was a student of the first Chinese college department of architecture, Suzhou Engineering School in 1926. Liu Dunzhen and Yao Chengzu were his teachers. One year later, he transferred to National Central University 中央大學. After graduating in 1931, he became a lecturer in the department of architecture of his alma mater. Meanwhile, from 1932 to 1940, he worked as an architect, participating in the design of the Sun Zhongshan Mausoleum 中山陵 in Nanjing and some other projects. After 1949, the focus of his work shifted to teaching and research in Nanjing Technology School 南京工學院.[345]

Because of his talent, at the request of Liu Dunzhen, in 1935, Zhang became the assistant of Yao Chengzu to help him write his great work, the *Yingzao fayuan*.Like Yao, Zhang was born in Wu Xian. They spoke the same Wu dialect 吳語, and shared the same local culture, which made it easy for them to understand each other, free of all obstacles. That is one of the main reasons why Liu asked him to help Yao. It was necessary because in the original texts of Yao, many names of the parts of building constructions were written in the phonetics of Wu dialect, which is one characteristic of oral education. Wu dialect belongs to the south Chinese language branch, while Chinese words are based on the north Chinese language branch, which can mean that the same words have quite different phonetics. Using *Yingzao fashi* and *Gongbu gongcheng zuofa* as standards, many terms in Yao's texts are quite misleading. Zhang helped Yao to make several necessary corrections. For instance, in the preface of the modern edition, Zhang wrote:

"3. Correction errors of words: The carpentry terms of Suzhou craftsmen had been misrepresented one by one, without ending. Now I just correct errors of what I know. …… And changed words 'Mian Yan 面沿', 'Jin Zhu 今柱', 'Tong Zhu 同柱', 'Zi Ban 字板', 'Ba Feng 八風', etc. to the words 'Mian Yan 眠沿', 'Jin Zhu 金柱', 'Tong Zhu 童柱', 'Zi Bei 字碑', 'Bo Feng 博風'. …"[346]

On the other hand, Yao had recorded a number of examples of rhymes used as mnemonics in carpenters' work. These rare phrases needed somebody who could understand Wu dialect to check and correct them. Even as a fellow townsman, Zhang thought the rhymes hard to understand by an outsider.[347]

He discussed the contents with Yao, made surveys, took the photographs for the illustrations, and redrew all the buildings that were mentioned in the *Yingzao fayuan*. They finally finished the formal draft in the summer of 1937. War conditions prevented the publishing of the book until the 1950's. Zhang adapted the draft again with the help of Liu Dunzhen, and published the modern

[345] Lai Delin 賴德霖, "Who's Who in Modern Chinese Architecture (7) 中國近代時期重要建築家（七）", *World's Architecture* 世界建築, 11 (2004), p.103.

[346] Yao, Chengzu 姚承祖, Zhang Zhigang 張至剛, ed., *Yingzao fayuan* 營造法原 (Basic Rules for Building), 2nd ed., (Beijing: China Architecture & Building Press, 1986), p.4.

[347] Ibid., p.3. "And there are several mnemonic rhymes in the book, which were not understandable by fresh man…".

edition in 1959.

As training for architecture, Zhang Zhigang had many academic opinions about the *Yingzao fayuan*, including how the book should be organised, and the provision of academically correct drawings with scale. With his work, the *Yingzao fayuan* became more understandable, especially with photographs of the buildings included. But at the same time, the original meanings of buildings were lost through modern practices. For example, the measurement system was converted from the traditional Chinese system of lengths into the metre system. The specific meanings of numbers in traditional Chinese building were therefore lost.

Zhang Zhigang devoted the best two periods of his life, from twenty-six to twenty-eight, and from forty-six to fifty, to the *Yingzao fayuan*. It was the climax of his career.

4.1.3 Zhu Qiqian 朱啟鈐 (1871-1964)

Zhu Qiqian, the first editor of the *Yingzao fayuan*, was a capable administrator, a successful businessman, and a most learned scholar. He made an outstanding contribution on the research into traditional Chinese wooden building. Zhu was the creator of the Society for Research into Chinese Architecture 中國營造學社, and the discoverer of the *Yingzao fashi* and *Yuan Ye.* Without any exaggeration, he was a founder of Chinese architectural history.

Zhu had the style name Guixin 桂辛. The word "Gui 桂" means osmanthus, which is one of the favourite plants for a Chinese scholar, and "Gui 桂" has the same pronunciation of "Gui 貴", which is the short name of Zhu's hometown Guizhou 貴州. The word "Xin 辛", has the meanings of bitter, toilsome, and laborious. His nom de plume, Huo Gong 蠖公, means a gentleman who withdraws to let his ambition emerge later. The style name and the nom de plume described the condition of a patriotic statesman who lives in modern China.

Zhu Qiqian was born on November 12th 1872, Xinyang city 信陽, Henan province 河南, in an aristocratic family. His roots were in Guizhou province. His father, Zhu Qingyong 朱慶鏞, was a high official in the Henan Yamen, and the husband of his maternal aunt, Qu Hongji 瞿鴻禨, was a Grand Minister of State 軍機大臣[348] in the Qing Dynasty. From 1891 to 1893, when the young Zhu was only twenty years old, he followed Qu Hongji travelling through many areas as a follower and assistant, and learned how to get along with people. At the same time he recognized the political opinions of his uncle: encouraging the creation of a modern education system, studying maths and science instead of focusing mainly on Confucian texts, and hoping to rapidly industrialize with the goal of China "self-strengthening".[349]

In the late Qing Dynasty, Zhu Qiqian successively held the posts of supervisor in Jingshi School 京師大學堂, chief of the police substation of Beijing, and diplomat for Mongolian political affairs. After China became a republic, he became supervisor of the Jinghu Railway 京滬鐵路 (from Beijing to Shanghai), Minister of Communication, Interior Secretary, and representative of the Prime Minister. In the People's Republic of China, he was a cultural adviser

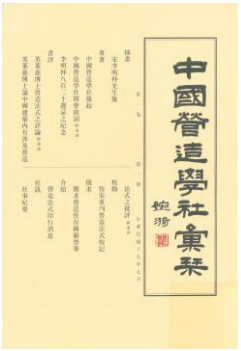
[348] Chartes O. Hucker, *Oxford Dictionary of English Etymology*, p.200.
[349] Lin Zhu 林洙, *The History of the Society for Research in Chinese Architecture* 中國營造學社史略, (Tianjing: Baihua Literature and Arts Publishing House, 2008), p.8.

to the government.

Lin Zhu 林洙, the second wife of Liang Sicheng, introduced Zhu's life and contributions in detail.[350] From 1912 to 1916, as the Minister of Communication, Zhu planned four railway lines from east to west of China. In 1914, he was in charge of building the first Chinese public park, Peking Centre Park 北平中央公園, and establishing the first publicly owned Chinese museum, the Palace Museum, which spread his interest in traditional building methods, and gave new life to old traditional buildings. In 1915, he invited the German architect Curt Rothkegel[351] to renovate the Qianmen 前門, "Front City Gate", of Peking, and made Tiananmen Square, changing the road system of Peking.

In 1918, when he was Vice President of the senate in the Chinese Congress, he called for the project to develop the summer retreat of Beidaihe 北戴河[352].

Zhu had a long-standing amateur interest in Chinese architecture. From the 1920's, he devoted his attention to the common participation in social welfare, and was involved in research on Chinese architecture. When he was fifty-three, in 1925, he planned to set up the Society for Research in Chinese Architecture, realizing his expectation three years later. He discovered a copy of the *Yingzao fashi* in 1919 at Jiangnan library 江南圖書館 in Nanjing, and encouraged Li Sicheng to read, analyse and explain this book. He offered a job to Liang Sicheng as director in his Society for Research in Chinese Architecture in 1930; and two years later, he invited Liu Dunzhen to join this private institution to share the work with Liang Sicheng. In 1932, Liang Sicheng was the leader of the department of *fashi*, to focus research on the *Yingzao fashi*; while Liu Dunzhen was the leader of the department of literature, to take charge of reading and studying other classical documents of Chinese architectural history. By leading with these three experts, with the literature review and site survey, the Society for Research in Chinese Architecture published some ancient Chinese literature, including the *Yingzao fashi* and *Yuan Ye*. They also published seven volumes of a journal, named the *Transactions of the Society for Research in Chinese Architecture* 中國營造學社彙刊 (figure 4-1), and investigated several older craftsmen, such as Yang-Shi-Lei 樣式雷[353], and Suan-Fang-Liu 算房劉[354], keeping many original drawings by the craftsmen. Zhu Qiqian wrote several studies of Chinese cities based on information in the classical texts. Wilma Fairbank point out Zhu had close relationship with the old craftsmen, and Liang followed with him. But she made a comment misunderstanding said "the carpenters were generally



4-1 The cover of the first issue of the *Transactions of the Society for Research in Chinese Architecture*

[350] Lin Zhu 林洙, *The History of the Society for Research in Chinese Architecture*, pp.7-41.

[351] Curt Rothkegel (1876-1946) was a German architect who came to China at the turn of the 20th century. In 1920s, Rothkegel designed many buildings in Beijing, Tianjin, Shengyang, etc., and he went back to Germany in 1929.

[352] The Beidaihe 北戴河 is a district in Qinhuangdao 秦皇島 municipality, Hebei 河北 province on the coast of the Bohai Sea in North China. In 1898, the Qing government official confirmed Beidaihe as "a summer retreat for people all over the world".

[353] Yang-Shi-Lei 樣式雷 also known as the famous Lei family of Beijing architects. It was a family who worked for the imperial palace for about 200 years, in charge of maintaining and repairing buildings inside the palace. They kept lots of drawings of palace buildings, and ordered builders to repair buildings when necessary.

[354] Suan-Fang-Liu 算房劉 was a member of Liu family who worked in the Department of Works of the Imperial Household Department, in charge of cost estimating buildings.

illiterate."[355] From the later research on Lei family and Liu family, they all have good eduction. People of Lei family, not only could draw architecture design drawings, but also could manage the building projects. Even a normal carpenter, he had to have ability of basic calculations for his working. Of cause, basic literates were needed for marking different part of structures.

This private institution has remained an effective research institution on Chinese architecture. Its ambitions are tied to Zhu Qiqian's well-developed taste for arts and effective organization. He used every resource, and mobilized all non-governmental sectors, to show his concern for Chinese architecture.

In August 1932, Liu Dunzhen brought the manuscript of the *Yingzao fayuan* by Yao Chengzu to Beijing, and handed it to Zhu Qiqian. As the first editor, Zhu found that the text "can be sourced to the Northern Song Dynasty (960-1126), and was still in use in the Ming and Qing Dynasties 上承北宋，下逮明清", and "It is worthwhile to hand on the real orders of unofficial architecture in the south of China 足傳南方民間建築之真相".[356] Although his name does not appear in the modern edition of the *Yingzao fayuan*, Zhu Qiqian gave some rare advice to Yao Chengzu, as shown by his contribution to the book.

Zhu Qiqian died in February 1964 at the age of ninety-three, having lived almost one century.

4.1.4 Liu Dunzhen 劉敦楨 (1897-1968)

Liu Dunzhen, the last editor of the *Yingzao fayuan*, a leading architect, was an expert of the history of Chinese architecture and one of the best architectural educators. He was a pioneer of historical research on Chinese ancient architecture, and a founder of Chinese collegial education of architecture. Liu was also known by the style name Shineng 士能, and the nom de plume Dazhuang Shi Zhuren 大壯室主人, "the host of Strong Room". His nom de plume is simple but tasteful, showing his deepening love of architecture.

Liu Dunzhen was born on September 19th 1897, in Xingning 新寧, Hunan province 湖南, in an official's and scholar's family. He was the youngest of three sons. When he was eleven, his elder brother took him to Changsha 長沙, the provincial capital of Hunan, to gain an education. This experience opened his mind, and he decided to study technology in order to help strengthen China[357].

In 1913, when he was sixteen, he went abroad to Japan, with the help of a state scholarship. Three years later, he entered the mechanics department of the School of Engineering at the Tokyo School of Higher Education (in 1929, it changed its name to Tokyo Engineering University). In his second year, he transferred to the Department of Architecture. Graduating in 1921, Liu Dunzhen worked briefly as an assistant for one of his professors before returning to China. After he got back, as mentioned in Chapter Two, he worked with his classmate Liu Shiying in Huahai Architects Associates, in Shanghai.

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[355] Fairbank, Wilma, *Liang and Lin*, p. 50.
[356] Zhu Qiqian, *The essay on drawing of Buyun Xiaozhu*, p. 139.
[357] Liu Xujie 劉敘傑 (Liu's oldest son), "Memory of the life of architect Liu Dunzhen 記建築學家劉敦楨的一生", in *Four outstanding architects: Liu Dunzhen, Tong Yu, LiangSicheng, Yang Yanbao* 建築四傑: 劉敦楨·童寯·梁思成·楊廷寶, (Beijing: China Architecture & Building Press, 1998), pp.1-21.

In June 1925, Liu left Shanghai for Changsha 長沙 to become a professor in the Department of Construction at Hunan University 湖南大學. By invitation of Liu Shiying, in 1926, he became a professor in the first Chinese architecture department at Suzhou Engineering School, which had been founded by Liu Shiying in 1923. A year later, the architecture and engineering division of the school moved to Nanjing, combined with the Engineering Department of Jiangsu University, later becoming the Fourth Central University, and then National Central University in 1927. Liu kept moving with the school, and along with four other architects who had trained abroad,[358] he founded the well-known architecture department in South China, as famous as the department of Tsinghua University 清華大學 which was founded by Liang Sicheng at the same time.

Liu Dunzhen recognised the skills of Yao Chengzu at Suzhou Engineering School, where they worked together as colleagues. He studied old architecture in the city, and did research on ancient Chinese architecture. In 1929, he published the bulk of his architectural history research in *Transactions of the Society for Research in Chinese Architecture*. This work made him a careful text-reader and scholar. Quite apart from his research, Liu also received major design commissions, one of which was the commemorative pillars in front of the Sun Zhongshan Mausoleum in Nanjing. Liu's fame as a researcher led him to join the Society for Research in Chinese Architecture in 1930, and he moved to live in Beijing in 1933. With the Society for Research in Chinese Architecture as a base, Liu made study trips throughout China, sometimes together with Liang Sicheng and his wife Lin Huiyin, sometimes with other members of the society.[359]

In 1937 the Japanese invasion forced Liu's family out of Beijing, and they subsequently fled also from major cities like Nanjing and Shanghai, so they ended up in Kunming 昆明 and Lizhuang 李莊 in 1938, for a period living in the same neighbourhood as Liang Sicheng's family.[360] It was a period of high production for both architects. By 1945, Liu was back in Nanjing, teaching at the National Central University, as head of the department of technology. Liu spent the remaining nineteen years of his life in the university. National Central University became Nanjing University in 1949, and is today Southeast University. In 1953, he began research on Chinese gardens in Suzhou, published as the *Chinese Classical Garden of Suzhou* 蘇州古典園林. In 1958, he led the work of editing the *History of Ancient Chinese Architecture* 中國古代建築史稿, the *History of Modern Chinese Architecture* 中國近代建築史稿, and *Architecture in the ten years of the People's Republic of China* 中華人民共和國建築十年. In 1959, he worked with Liang Sicheng on the *General History of World Architecture* 世界建築通史. The final draft was completed in 1966, but because of the Cultural Revolution from 1966 to 1976, the book was only published in 1980, after his death in 1968, and Liang's death in 1972.

Through his life, Liu, like Liang, devoted himself to research on ancient Chinese architecture. They not only read the classic documents, but also surveyed traditional Chinese buildings, which were also studied by craftsmen. Yao Chengzu was a representative of the craftsmen. They were colleagues, so Yao showed his manuscript of the *Yingzao fayuan*to Liu, asking for advice. Liu

[358] The other four architects were: Liu Futai 劉福泰, Lu Fengzhang 盧奉璋, Bei Jimei 貝季眉, Li Yishi 李義士.

[359] Wilma Fairbank introduced most of the important investigations of Liang and Lin, but unfortunately, she did not record any of the work Liu and Liang were doing together. But they were working together in the Society for Research in Chinese Architecture. And Lin proved that Liu did well on his work. See Wilma Fairbank, *Liang and Lin,* p.128.

[360] Ibid., Wilma Fairbank described this period as "the stress of poverty".

brought the draft to Zhu Qiqian. Based on Zhu's advice, Liu found Zhang Zhigang, a young fellow-townsman of Yao, to help Yao with the adaptation of the book. In the war years, Liu lost many important documents, but he kept the final draft of the *Yingzao fayuan* with him throughout his travels. He was the one who asked Zhang to edit the book again in the 1950's. He was the final editor of the book. In simple words, without Liu, the *Yingzao fayuan* would, like *Mujing*, have been destroyed by time, allowing only a few words to be retrieved from scholars' quotations.

4.2 The History of the *Yingzao fayuan*

The history of the *Yingzao fayuan* is a history of conflicts and harmonies between traditional carpenter and modern architects.

As stated above, the *Yingzao fayuan* has two editions: the original work by Yao Chengzu was compiled in 1929. The original texts were lost during the wars, but the original drawings were kept and printed in 1979 as an internal document of Tongji University. The modern edition by Zhang Zhigang was compiled in 1937, the first edition published in 1959, and the second edition in 1986. Nowadays we can find two books based on Yao's work: the *Yao Chengzu Yingzao fayuan tu* and the *Yingzao fayuan*.

In accordance with the preface of the modern edition by Zhang, we can draw the timeline of the *Yingzao fayuan*:

(1) From 1923 to 1929, Yao Chengzu wrote a textbook for the second-year-students of the course named "national building method", in the architecture department of the Suzhou Engineering School, which moved to the National Fourth Zhongshan University in Nanjing, in 1928. This is the original work and the manuscript of the *Yingzao fayuan*.

(2) In 1929, Yao Chengzu asked his friend and ex-colleague Liu Dunzhen to give some advice on his manuscript. Liu Dunzhen, as a founder of the architecture department of the Suzhou Engineering School and at the time a young man preparing for his marriage, was too busy to read it immediately. With his first son born in 1931, Liu Dunzhen was busier than before.

(3) In 1932, when Liu Dunzhen accepted the job of the Society for Research in Chinese Architecture, he brought Yao's manuscript to Beijing, and asked Zhu Qiqian to be the first editor.

(4) In 1933, after reading the manuscript for months, Zhu Qiqian received a painting named*the Drawing of Buyun Xiaozhu*, "Buyun House", by Yao Chengzu, as an attachment for his work (figure 6-4).[361] The real Buyun Xiaozhu was Yao's dwelling house, which was designed and built by himself in Yingyang Lane 鷹揚巷, Suzhou.[362] But this drawing is Yao's ideal house, to record his works and experiences on carpentry.[363] Proceeding from respect for Yao's work, Zhu Qiqian wrote an essay to record their friendship and his evaluation ofthe *Yingzao fayuan*. This essay and the

[361] See Chapter Six, p.145.
[362] Shen Li, "A Study of Historic Evolution of Xiangshan Group Carpenters", p.131.
[363] See the essay written by Yao Chengzu on *The Drawings of Buyun Xiaozu*, pp.142-143.

painting were kept in the *Yao Chengzu Yingzao fayuantu*. At the same time, Zhu Qiqian gave advice to Yao Chengzu, requiring him to improve his work.

(5) In 1935, Zhang Zhigang was selected by Liu Dunzhen as assistant to Yao Chengzu. From 1935 to 1937, Zhang and Yao worked for three years to re-organize the texts, redo the drawings, and take photographs of ancient buildings. They finished the work and handed it to Liu in the summer of 1937. This was the formal draft of the modern edition.

(6) Between1937 and 1953, Liu Dunzhen kept the formal draft safe, despite the wars.

(7) By the early 1950's, Zhang Zhigang and Liu Dunzhen were working in Nanjing Technology School together. They used this peaceful era to digest the drafts. With another adaptation, Zhang accomplished the modern edition in 1956, and Liu edited it in 1957.

(8) In 1959, the *Yingzao fayuan* was published as the first printed edition.

(9) In 1979, professor Chen Congzhou 陳從周 (1918-2000) obtained the manuscript of drawings by Yao Chengzu from Zou Gongwu 鄒宮伍 (1934-1994).[364] Zou had found the manuscript in the possession of a "Xiangshan Group" craftsman named Zhang Heshan 張和尚.[365] Chen edited and printed it as an internal document of Tongji University, named *Yao Chengzu Yingzao Fayuan tu*. This book was never formally published in itself, but appeared as an appendix in *The Buildings of Suzhou Xiangshan Group* 蘇州香山幫建築 in 2004.[366]

(10) In 1986, the *Yingzao fayuan* was published in a second edition, re-edited by Zhang Zhigang.

4.2.1 The manuscript and the original work

At first, the purpose of the *Yingzao fayuan* was to providea textbook for second-year-students in the architecture department of Suzhou Engineering School. In his preface, Yao Chengzu stated:

"In the spring of Jiazi Year 甲子年 (1924)[367], I was teaching the national building method in Suzhou Engineering School. I'm not a qualified teacher, and was afraid of neglecting my duty. Over four to five years, I drew more than eighty plates, and edited a book named *Yingzao fayuan*, in one volume."[368]

These "more than eighty plates" were those that were later edited by Chen Congzhou, and printed as *Yao Chengzu Yingzao fayuantu*. "Four to five years after the spring of Jiazi Year" works out as 1929, so that was the year Yao Chengzu produced the manuscript. In the preface of the

[364] Chen Congzhou 陳從周 and Zou Gongwu 鄒宮伍 were both leading experts on Chinese gardens. They worked together for years to design gardens and research on history of the Chinese garden. Chen was a professor of Tongji University in Shanghai; while Zou was a chief of the department of parks and gardens in Suzhou.

[365] See the preface of the *Yao Chengzu Yingzao fayuan tu*, by Chen Congzhou, p.1.

[366] Cui Jinyu 崔晉餘, *The Buildings of Suzhou Xiangshan Group*, pp.227-274.

[367] Jiazi Year 甲子年 of the Chinese Calendar (in that era)along with correspondence to the Western (Gregorian) calendar is 1924. The Traditional Chinese Calendar uses the heavenly stems 天干 and the earthly branches 地支 (a decimal system and a duodecimal system) to reckon years, every full 60-yearsis a cycle. See Joseph Needham, *Science and Civilization in China: Volume 3, Mathematics and the Sciences of the Heavens and the Earth*, (Cambridge: Cambridge University Press, 1986). pp. 109-110. About the Ganzhi 干支 Cycle, also see Endymion Wilkinson, *Chinese History: A Manual*, pp.181-183.

[368] Yao Chengzu, *The Preface of the Yao Chengzu Yingzao fayuan tu*, p.1. Chapter Six, pp. 147-148.

modern edition of *Yingzao fayuan*, Zhang Zhigang also confirmed: "The original texts have up to thirty-two thousand words and eighty plates, … and have several mnemonic rhymes of carpenters."

Yao based the work on his secret family book and his experiences at work.

For a carpentry family with a good traditional Chinese education, it is not unbelievable that they had a secret skill manual to teach the family inheritors how to keep their special skills. Zhu Qiqian told the reader that Yao's grandfather Yao Canting 姚燦庭 had written a manual on carpentry, called *Ziye yishu* 梓業遺書, "Traditions of Carpentry", which was in five volumes, but is now lost.[369] We have reason to believe that Yao's book must have been written with reference to his grandfather's book. As Klaas Ruitenbeek said, "Many of its materials must have been passed on in Yao's family for generations. This is especially true for the mnemonic rhymes contained in the book."[370]

Zhu Qiqian also reported that, "I believe Yao's great work, both the book and his designs, were based on his family education as he claimed. The rules of carpentry in Mudu 木瀆, Xiangshan 香山, are all in this book."[371]

Teaching the "national building method" gave Yao an opportunity to sum up his carpentry skill and write a textbook for the first generation of Chinese architecture students. Although none of Yao's original scripts survive, we can take it that his manuscript is not only the rules passed down from his family, but also his personal summary of his work. Because he was nearly sixty when he wrote the book, he had run his own carpentry company for almost thirty years, and he was the leader of the "Xiangshan Group" carpenters for more than ten years, so he must have had frequent communication with other carpenters, learning from them, and he presumably added these experiences to the book.

Even if it had all been based on his personal experiences, it is still a rare text of real work by a carpenter. It is not mere quotations from other books or editions by scholars or architects; it was written by a leading carpenter with outstanding working skills in the local culture. That is the reason Zhu Qiqian wrote, "It is worthwhile to hand on the real orders of unofficial architecture in the south of China."[372] Klaas Ruitenbeek said, "The book, which is profusely illustrated, is important as a comprehensive encyclopaedia of building techniques and terminology current in Jiangnan."[373]

As a technological introduction of the "Xiangshan Group" craftsmen, we can also believe it has been influenced by other classical carpentry books, such as the *Lu Ban jing* 魯班經 and *Yuan Ye* 園冶. Although the text of Yao's manuscript was lost, from the original drawings: *Yao Chengzu Yingzao fayuan tu*, we can deduce the influence of these books. The *Lu Ban jing* was the Bible of the crafts builders in China at that time. On the first page of Chapter One of Klaas Ruitenbeek's book, he gives two examples of how the Chinese traditional crafts builders showed their respect for the *Lu Ban jing*: One in 1910, in Sichuan, at the same time as Yao's working period; the other was in Zhejiang, the same geographical area, Jiangnan area, of Yao's work place.

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369 Zhu Qiqian, *The essay on drawing of Buyun Xiaozhu*, p.139.
370 "On *Yingzao fayuan*", in *Carpentry and Building in Imperial China: A Study of the Fifteenth-Century Carpenter's Manual Lu Ban jing*, Klaas Ruitenbeek, p.29.
371 Zhu Qiqian, *The essay on drawing of Buyun Xiaozhu*, pp. 138-140
372 Ibid.
373 Klaas Ruitenbeek, *Carpentry and Building in Imperial China*, p.29.

So even though we do not have direct evidence that Yao had read the *Lu Ban jing*, we can still deduce that Yao not only learned from the *Lu Ban jing*, but also made the skills, techniques, and rituals his second nature. The *Yuan Ye*, in another way, is not as popular as *Lu Ban jing* in the carpenters' workshops. It was written between 1631 and 1634, as "a general manual on landscape gardening in the Chinese tradition", which "pays close attention to architecture".[374] Most of the author Ji Cheng's 計成 work was done in his native Jiangsu, the same province where the "Xiangshan Group" lived and worked. The garden and building style of both belongs to the Suzhou Tradition. Furthermore, because the carpenter and the landscaper were always working together in traditional China, there is no doubt that Yao was familiar with the book, or at least not a stranger to it. At the same time, as a book based on a secret family book, it had to abide by the building standards of the time, the *Gongbu gongcheng zuofa* 工部工程作法, which has a close connection with the *Yingzao fash* 營造法式 of the Song Dynasty.

The loss of the original manuscript of *Yingzao fayuan* is unfortunate for research into traditional buildings of south-east China. Fortunately, we have the original drawings and a modern edition of the *Yingzao fayuan*.

4.2.2 The modern edition: *Yingzao fayuan*

The modern edition of the *Yingzao fayuan* is obviously not a textbook, but an architectural academic research book.

On the cover of the modern edition of the *Yingzao fayuan* the names of authors are given: Yao Chengzu, the original author; Zhang Zhigang, the editor; Liu Dunzhen, the second editor.

In the preface, Zhang Zhigang introduces the history of the book, and describes his work on it.[375] Zhang Zhigang received Yao's manuscript from Liu Dunzhen in the autumn of 1935. Liu required Zhang to edit the manuscript, and said:[376]

"These were Mr. Yao Buyun's text book at the architecture department of the Suzhou Engineering School. It was according to his secret family book and drawings, written by him in his sunset age. It is worthwhile to hand on the real appearances of unofficial architecture in the south of China."

"I was entrusted by Mr. Yao in 1929 to arrange the manuscript, but I was too busy. Then I introduced this book to SRCA in 1932. The president Mr. Zhu Guiting proofread the scripts personally. However, the terms applied in the book were different from palace architecture in Beijing, and there were other in comprehensions about the drawings as well. Relying solely on correspondence could hardly enable us to discuss examples or revise the drawings. Due to the reasons above, the publication of the book was delayed by a few years."

As Yao's fellow-townsman, working in Nanjing near Suzhou, where Yao lived, Zhang Zhigang began to write an adaptation of the manuscript, together with Yao Chengzu. They discussed many problems. Zhang surveyed and took photographs of buildings mentioned by Yao,

[374] Ji Cheng 計成, Alison Hardie, trans., *The Craft of Gardens: The Classic Text on Garden Design*, (New York: Better Link Press, 2012) p.11.
[375] See details in Chapter Six, pp.151-156.
[376] Yao Chengzu, Zhang Zhigang, ed., *Yingzao fayuan*, p.3.

and redid all the drawings.

In the summer of 1937, the formal draft was complete with twenty-four chapters, about one hundred and twenty thousand words, fifty-two photos, and seventy-one drawings. As the Second Sino-Japanese War broke out in the same year, this draft was never published.

In the 1950's, with the encouragement of Liu Dunzhen, Zhang Zhigang re-edited the draft, cut it down to sixteen chapters, and added notes and drawings. It became one hundred and thirty-five thousand words, fifty-one photos and one hundred and twenty-eight drawings. The section "orders of measurement" was adopted as an appendix, because the length measurement was changed to the metre system. This is the first modern edition of *Yingzao fayuan*, published in 1959.

The second modern edition of *Yingzao fayuan* was published in August 1986. The text was largely unchanged, but pictures were attached at a reduced scale from double pages to one page for the sake of easy preservation.[377]

In others words, the modern edition of the book, like most other Chinese classical architectural documents, was rewritten by scholars, in order to record and review carpentry skills from the past. It is more than a textbook, and Yao's thirty thousand words were expanded by four times. As it was readopted by and for architects, the original drawings without scale became architectural plans, elevations and sections. A Chinese carpenter's manual was changed into a modern academic architecture book.

Unlike other Chinese classical architectural documents, this modern edition includes the permission of the original author, and was completed by a leading carpenter and some architects together. A carpenter, a Chinese trained architect, a foreign trained architect, and an expert of Chinese arts history, each played different roles in the progress of the modern edition. It helps us to understand not only the buildings in the south of China, but also the changing roles of carpenters and architects. In addition to the experiences of carpenters in the manuscript, the modern edition demonstrates an architect's understandings of Chinese traditional building. It somehow reflects the level of measurement and architectural collegiate education in that era.

The modern edition of *Yingzao fayuan* is a book linking the sensibilities of carpenter and architect. As a leading carpenter of the famous "Xiangshan Group", Yao Chengzu saw that times were changing, and wrote the book to protect traditional carpentry techniques and skills; as leading architects and experts, Liu Dunzhen and Zhu Qiqian recognized the worth of Chinese traditional building, and helped to write the book to hand on the understanding of traditional Chinese buildings; as one of the first generation architects trained in China, Zhang Zhigang used his efforts to realize the dreams of Yao and Liu.

4.2.3 The original drawings: *Yao Chengzu Yingzao fayuantu*

When the manuscript texts went missing in the war, the manuscript of drawings was kept by the "Xiangshan Group" carpenter. Perhaps the drawings were unintelligible to architects, but they must have been easy to read by "Xiangshan Group" carpenters. Most master carpenters could draw. They used drawings to discuss works with employers and other carpenters. Unlike architects,

[377] Yao Chengzu, Zhang Zhigang, ed., *Yingzao fayuan*, p.2.

they knew all scales of building, and they knew the rules to which they should abide. So there was no need for them to draw to scale. What they needed was the important data on structure for each style, and the secret of the sections. These things are exactly shown on Yao's drawings. That was the reason why the carpenter kept them.

As mentioned in the timeline at the beginning of this section, in the autumn of 1978, after many turbulent years, the original drawings were fortunately found by Zou Gongwu, an expert on Chinese gardens. He borrowed the drawings from a "Xiangshang Group" craftsman, and showed them to his work partner, the professor of Tongji University, Chen Congzou. It was a thrill and a pleasant surprise for Chen. He wrote in the preface of *Yao Chengzu Yingzao fayuan tu*:

"Since my youth, I have been mesmerized by Mr. Yao and his works for a long time, since I saw the essay on the drawing of Buyun Xiaozhu by Mr. Zhu Qiqian. Over thirty years, I have been to Wu area several times, and wandered around the buildings made by Mr. Yao,which provoked deep thought. I have learned a lot from reading Mr. Yao's book (the *Yingzao fayuan* modern edition). Today, reading his original drawings, I feel as if I am talking with him. To allow this fragment of a highly treasured relic be saved forever, I edited the drawings, and print it as a reference for the book, *Yingzao fayuan* modern edition."[378]

Chen Congzhou added the drawing of Buyun Xiaozhu and Zhu's essay at the beginning, and two design drawings of Yunyan Temple at the end. The drawings had been drawn in 1933 by another "Xiangshan Group" carpenter, Yu Youqin 郁友勤, who was Yao's capable assistant. The internal documents include a preface by Chen Congzhou, an essay by Zhu Qiqian, part of a preface to the original texts by Yao Chengzu, and an essay by Yao to explain how to make *Paike* 牌科, which is the name of "Bracket Sets" in the South of China, also known as "Dougong 斗拱" in the North.

The texts were quite limited in the book. But they have enough drawings, in total fifty-four, from the style of buildings to details of *Paike*, roof, wall, and so on. Yao Chengzu used many pages to explain *Paike* and roof, which were the most typical characteristics of Chinese buildings.

The printed version was named *Yao Chengzu Yingzao fayuan tu*. This was an internal document, limited in numbers and readers. Until 2004, the book was formally published as an appendix, in *The Buildings of the Suzhou Xiangshan Group*.

As part of a carpenter's manual, the original drawings are in the style of the craftsman, including no scale, and using a code to record measurements. Comparing them with architects' drawings, it is interesting to notice the different points of view of carpenter and architect, and to see what is lost and found by the architect, as they translate and redraw the drawings.

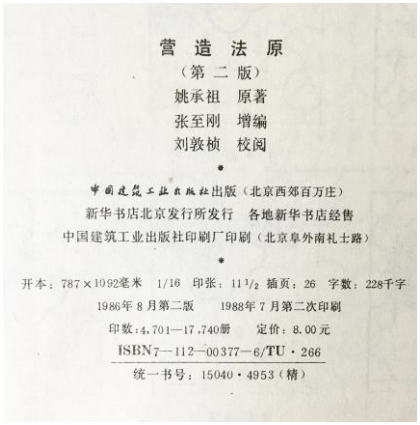
4.3 Modern Editions and Prints

As described above, the modern edition of *Yingzao fayuan* evolved over more than twenty tough years (almost 22 years) from the formal draft to the first edition published by China

[378] See the preface of *Yao Chengzu Yingzao fayuan tu*, by Chen Congzhou, p.1. Chapter Six, pp.143.

Architecture & Building Press. Checking on all the copyright pages of each edition and printing, we could get the information below:

In July 1959, the first edition of the book was published in traditional Chinese characters, only 1045 copies in paperback and 1020 copies in hardcover. In August 1986, the second edition of the book was first printed in simplified Chinese characters, only 1400 copies in paperback, no hardcover. One year later, in June 1987, the second edition was printed for the last time in traditional Chinese characters, and only in hardcover (we do not know the number of copies, but it was certainly no more than 1400). The next year, in July 1988, the second edition of the book was printed again in simplified Chinese characters. This was the most large-scale publication, running to 4701- 17740 copies[379] in hardcover (figure 4-2), and some (nearly 4000) in paperback. In September 1992, the second edition of the book was printed for the third time in simplified Chinese characters in paperback, (I do not know the number of copies because it is hard to find in a public library). Another 22 years has passed, but there has been no new edition or reprint of the *Yingzao fayuan* so far (figure 4-3).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4-2 The copyright page of the second print of the second edition

1959 The first edition

1986 1988 The second edition

1992 The second edition

4-3 The different editions and prints of the *Yingzao fayuan*[380]

On 28 January 1956, The People's Republic of China issued its first round of official character simplifications, including 515 Chinese characters and 54 Chinese character components. In 1964, the State Council issued the *Simplified Chinese Characters List* 簡化字總表, including 2236 characters, which are the simplified Chinese characters used in mainland China.[381] The 1950s and 1960s are a transitional period. There is still confusion about the simplified characters, some nonstandard Chinese characters combined with simplified parts and traditional parts. A second round of simplifications was promulgated in 1977, but was later retracted for a variety of reasons. In 1986 the authorities retracted the second round completely. Later in the same year, the

[379] The numbers of copies are the original ones shown in the "produce details" on the book; I do not know the exact meaning of it. I suggest it might refer to one of the ranks of publishing scales.

[380] The photos come from the largest second hand bookshop website: http://www.kongfz.com 孔夫子舊書網

[381] "*Simplified Chinese Characters List* 簡化字總表", Guangdong province science and technology journal edition society 廣東省科學技術期刊編輯學會 <http://www.kjqk.gd.cn/HTML/zlzx/127855173189151205618750117435l5.html.> [accessed 22 February 2016].

authorities promulgated a final list of simplifications, which is identical to the 1964 list, and announced that the form of Simplified Chinese characters should be kept stable for a period of time[382]. In this context, the *Yingzao fayuan* was first printed in simplified Chinese characters in 1986, and last printed in traditional Chinese characters in the following year.

To sum up, the copies of the *Yingzao fayuan* are limited in the past half century, and most of them are in the simplified Chinese characters. On the one hand, in the Chinese mainland, few architect experts pay attention to the carpenter's experience; on the other hand, the copies of the book available in Traditional Chinese characters have been limited to 3500, which has had a negative impact on its spread across all places except the Chinese mainland.

Since the second print of the second edition of the *Yingzao fayuan* in Simplified Chinese characters was the most popular one, the research of this thesis is based on this edition. Meanwhile, learning from the example of the book, all the Chinese in this thesis is set in Traditional Chinese characters in order to help researchers who are interested in Chinese traditional carpentry building and carpenters' work.

Every edition of the book was black and white printed on glazed printing paper, in sixteenmo size, by letterpress printing and normal horizontal composition. The first edition has 178 pages, which increased to 223 pages in the second edition. The initial preface and the preface for the second edition by Zhang Zhigang are discussed in detail in this chapter. In brief, there are 223 pages, 228 thousand words, 26 figures, 170 photographs, and 51 plates in the second edition of the *Yingzao fayuan*.

Conclusion of Chapter Four:

Three research questions are discussed in this chapter: Who wrote the *Yingzao fayuan*? What was the writing and publishing processes of the book? How many editions and prints of it were there, and why?

Although the thesis makes a clear announcement from the very beginning that the *Yingzao fayuan* is a co-operation of Chinese carpenters and architects, not until this chapter in section 3.1 did particular introductions of the authors and editors appear in detail. It proves the point of view in Chapter two: the persons who wrote the book are four major figures of local traditional carpenter (Yao), the first-generation architect who trained in China (Zhang), the first-generation architect who trained abroad (Liu), and the Chinese traditional scholar who accepted western science and pressured Chinese culture (Zhu). The book would have had no chance to exist, if Yao did not teach the course in the first Chinese architectural school; no chance to be understood by modern students, if Zhang had not made surveys and discussed with Yao, and then edited the whole draft; it would not have been published, if Liu did not keep the formal draft through the

[382] The P.R. of China began collecting public comments for a modified list of simplified characters, in August 2009. *The New List of Commonly Used Standardized Characters* 通用規範漢字表 consisting of 8105 (simplified and unchanged) characters was promulgated by the State Council of the People's Republic of China on 5 June 2013.

war, and insist on publishing it in 1959; it would not be treated seriously, if Zhu did not have the expert eye to pick up the manuscript as a unique project for Liu. Lacking any of them, the *Yingzao fayuan* might not survived.

The section 3.2 describes the history of the *Yingzao fayuan*, and summarizes how a carpenter's family secret manual became a textbook, and was then published as a modern academic architecture book. As a case study on a book, it is relatively easy to get the formal published edition, but difficult to find the manuscript and the original work. Furthermore, for an architecture book, the most precious thing is the original drawings. It is really lucky that Yao's original drawings were well kept in the Tongji University, and a copy was printed as the *Yao Chengzu Yingzao fayuan tu.* Some essays and prefaces by Zhu and Yao were collected at the same time. This made an opportunity to contrast the different viewpoints of carpenter and architect, the influence of different educational backgrounds on them, and the different methods of architectural education between the two education systems of Chinese carpenter and architect, which are the purposes of Part Two.

The third question is answered in section 3.3. It is a short introduction to two editions and all the prints of the modern edition of the *Yingzao fayuan*. The different editions make clear signs of Chinese culture changes. The year of 1959, ten years after the founding of PRC, with stable politics, was in the first culture boom period. Most of Liu's academic research works were published in the 1950s. The *Yingzao fayuan*'s publishing was also directed by him in this period. The year 1986, ten years after the Culture Revaluation in China, after eight years of the Reform and Opening-up Policy, is in the second culture boom period. The second edition was published in 1986, with further prints in 1988 and 1992. It was published in both simplified and traditional Chinese characters; both hard cover and paper cover, which allowed the possibility of a popular edition. The second print of the second edition of the book in 1987 is the basic resource of this thesis, which will be quoted in analysis of the *Yingzao fayuan* in Part Two.

By answering the three research questions, this Chapter explains that the history of the *Yingzao fayuan* results from the conflicts and harmonies between a Chinese traditional carpenter and a first-generation modern architect in early modern China (in Suzhou, mainly from 1923 to 1937, but lasting many years afterwards). It is also a communication between two education systems, and the indelible hallmark of the era.

PART TWO

From Carpenter's Family Secrets to an Architectural Academic Research Book

What is in the book?

CHAPTER FIVE

Carpenter's Manuscript and Architect's Organization

The original drawings: Yao Chengzu Yingzao fayuan tu;
The modern edition: Yingzao fayuan.

In this chapter, the two editions refer to the modern edition *Yingzao fayuan* by Zhang Zhigang and the manuscript *Yao Chengzu Yingzao fayuan tu* by Yao Chengzu. As mentioned in Chapter Three, only Yao's manuscript kept the original drawings, and printed them as Yao's original drawings. There is no doubt that the modern edition of the *Yingzao fayuan* moved some distance from the original one. This distance is reflected in the contents, main texts, and drawings between traditional carpentry and modern architecture.

5.1. The Contents

5.1.1 Limited original content of the Carpenter's manuscript

As is stated in Chapter Four, the original drawings by Yao Chengzu, the *Yao Chengzu Yingzao fayuan tu*, was the only surviving manuscript of drawings by the "Xiangshan Group" master carpenters. In 1979, professor Chen Congzhou of Tongji University, "who is one of the great modern authorities on Chinese gardens"[383], edited and printed it as an internal document of Tongji University, named *Yao Chengzu Yingzao fayuan tu*. This book was never formally published, but appeared as an appendix in *The Buildings of Suzhou Xiangshan Group* 蘇州香山幫建築 in 2004.[384]

These drawings are Yao's manuscript for his teaching career in Suzhou Engineering School, for the course "national building method". The drawings were made for a textbook. Apart from Yao, none of the teachers could teach students how to build a Chinese traditional timber building at the school. Until today, among architecture teachers who research Chinese traditional buildings for more than one decade, few can design a real Chinese traditional building, such as a normal carpenter does every day. After three years' practice, an apprentice can at least build a common timber house well or badly. But even after ten years research, an architecture researcher cannot build a single timber house by himself. That is the difference between the two educations, and that is the reason we have to look back and try to learn from master carpenters today, just as Wang

[383] Ji Cheng, Alison Hardie, trans., *The Craft of Gardens: The Classic Text on Garden Design*, p.12.
[384] Cui Jinyu, Cui 崔晉餘, *The Buildings of Suzhou Xiangshan Group* 蘇州香山幫建築, (Beijing: China Architecture & Building Press, 2004.)

Shu 王澍 (born in 4 November 1963), the first Chinese recipient of the Pritzker Architecture Prize in 2012, did[385].

Because the *Yao Chengzu yingzao fayuan tu* is an internal document, and not a commercially published book, it does not have any contents list or page numbers for the drawings, which makes it less easy for reference and discussion. It begins with Chen's preface to explain the history of these original drawings and their great value. Then Chen collected Zhu Qiqian's essay on the drawing of Buyun Xiaozhu, and Yao's original preface. After gathering all the drawings by Yao, Chen also put in the drawing of Buyun Xiaozhu, and two other drawings by Yao's assistant, "skillful crafts master 當手師傅", Yu youqin 喻友勤.

In Chen's preface, he announced: "Fifty years ago, Mr. Yao made the drawings of Buyun Xiaozhu, I have seen it. The styles and structures of the buildings are quite similar to the ones discussed in the manuscript. Unfortunately the drawings of other buildings were destroyed, but a copy of the drawing of Buyun Xiaozhu survived. 五十年前姚先生曾繪《補雲小築圖》余曾見及， 所列諸屋架勢，與此集相若，惜已亡佚，而小築之圖影印本存。" Of Yao's essay, he said: "Mr. Yao was worried that the book was incomplete, so he sent me an **album** of his original drawings and a **handscroll** of the landscape drawing of Buyun Xiaozhu, asking me to write this essay. 姚君又慮是書所圖，或有遺漏，複以畫冊與補雲小築繪卷見寄，並屬為題。" Therefore, the drawing of Buyun Xiaozhu should be not just a single drawing attached in the printing, but a set of design paintings on a handscroll (*juan* 卷), since unfortunately destroyed. The copy of the drawing of Buyun Xiaozhu survived. The original drawings of *Yingzao fayuan* must have been an album (*ce* 冊) of paintings.

All the paintings of Yao were of Chinese traditional type in black and white, drawn with brush and ink on paper. These special painting tools are described by James Cahill in his *Approaches to Chinese Painting*, in *Three Thousand Years of Chinese Painting*.[386] The paintings of Yao belong to a style "*jiehua* 界畫", boundary painting.[387] It is a special painting method of Chinese architectural drawing. As Cahill said: "The reservoir in the brush can hold enough ink to allow the drawing of a long, continuous line, which since the tip is so fine and the brush is held perpendicular to the surface, can move in any direction without altering in breadth." Besides normal painting tools, aided by the ruler, the carpenter can draw architecture in accurate depiction.

In traditional Chinese painting, the handscroll or album was a long horizontal continuous paper, rolled up or folded to keep. It is a facility for viewing and keeping, "much as a book is opened, read, and closed".[388] That means Yao made his drawings as a succession of pieces of paper, all joined together by paste and a long continuous paper backing. The order of scenes was arranged in this way. In other words, Yao must have planned and organised all his Chinese buildings' structure drawings and explanations. The order could not be changed after completion. The order we see today was his real intention. Only in this way can the analysis and classification

[385] Wang Shu 王澍 was born in 1963 in Ürümqi, Xinjiang Uyghur Autonomous Region, China. He is a famous controversial architect and architectural educationist. After graduating from the Nanjing Institute of Technology (now Southeast University) in 1988, he spent ten years learning from craftsmen.

[386] Barnhart, Richard M., and others, *Three Thousand Years of Chinese Painting*, (Yale University Press, 2002), pp. 8-9.

[387] Ibid., pp. 102-105. Also known as "ruler painting", Guo Qinghua, *Visual Dictionary of Chinese Architecture*, p.48.

[388] Ibid., p.10.

of his original drawings in this Chapter constitute a significant piece of research.

The *Yao Chengzu Yingzao fayuan tu* has in total 36 pages, including one tile page, preface and forewords, and one end page. The 45 drawings make up 33 pages. For the research I have divided them into different topics: designing and plans (2 pages), styles of halls (4 pages), gable and base (1 page), bracket sets (3 pages), details of structures (8 pages), corner roofs (5 pages), main ridges (3 pages), main gate and walls (3 pages), and appendix (3 pages). I will give their contents and page numbers below:

Contents of Original Drawings

5.1.2 The three contents lists of the architect's edition

As a modern edition of a study book on traditional carpentry of the "Xiangshan Group", the *Yingzao fayuan* has three contents lists at the front. The arrangement of the book is made clear by these lists: The first one lists the main texts, the second the illustrations of black and white photographs in the book, including some inserted in the main texts and some attached following the main texts. The third and last one lists architectural drawings of the plates, which are the drawings depending on Yao's original ones but redrawn by Zhang.

The photographs were printed on finer and smoother paper, therefore thicker than the rest of pages, in order to allow better views of the photos. Some were taken in the 1920s and 1930s, of buildings later destroyed in the wars. These photos are valuable for historical researchers.

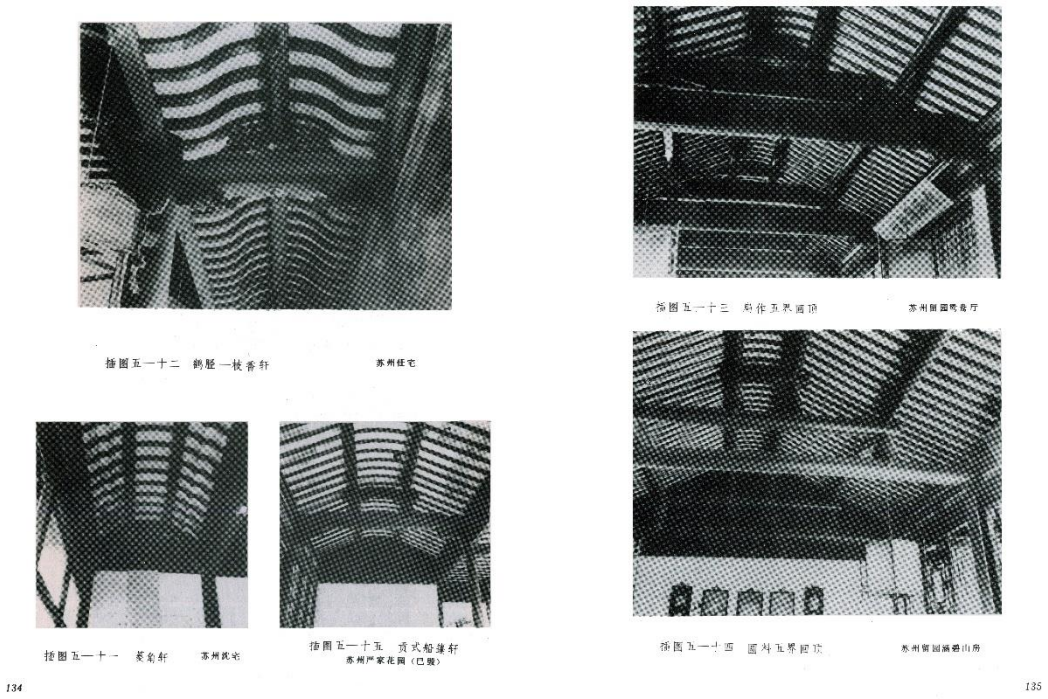
From the three contents lists we can see that the book has 89 pages of main text, 25 pages of appendix text, 54 pages of photographs, and 55 pages of plates. In other words, the book is made attractive by its simple language and the clear style of its architecture, and nearly half of it is made up of valuable photographs and indispensable drawings.

At the beginning, *Yingzao fayuan* was a textbook for the students of the first Chinese architecture department in Suzhou Engineering School. With the help of one of the students, Zhang Zhigang, hundreds of photographs and drawings were attached to the end of the book. All the examples existed in Suzhou during that time, and plans and sections were drawn by Zhang Zhigang according to surveys executed with Yao Chengzu. Yao's original standard drawings were redrawn by Zhang, replacing the survey drawings as much as possible.

I attached the contents list of the illustrations, most of them are the names of buildings taken as examples (all the small size characters in the content). From the content list of figures and the 44 pages of black and white photographs printed on the thick paper (figure 5-1), we can see that Zhang took most of the 110 black and white photographs of existing buildings in the 1920s (a few of them were provided by the Chinese Architectural Institution 中國建築研究[389]), to help us understanding the complicated Chinese carpentry structures in detail. They are useful to read with

[389] The Chinese Architectural Institution 中國建築研究室 was established in April 1953 by the department of Architecture of Nanjing University of Technology 南京工學院 and the Eastern China Architecture Design Firm 華東建築設計公司. It was led by Prof. Liu Dunzhen from early 1955 until the end in 1968 (when it was forced to close down). See Liu Xujie, "Memory of the life of architect Liu Dunzhen 記建築學家劉敦楨的一生", in *Four outstanding architects*, pp.58-60.

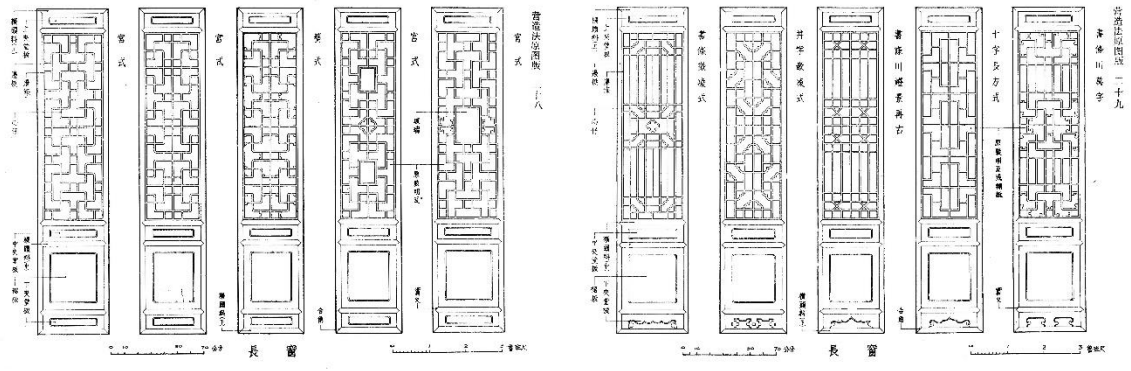
the main texts and the plates. If there is still some confusion about the structures, the real photographs are the most reliable evidences. And the photographs can help the reader to understand the structures easier and readable than texts and drawings. It is an effective method for changing the obscure technical terms and drawings to visible imagine. Alison Hardie added a plenty of colourful photographs in her translation book of the *Yuan Ye*, *The Craft Gardens*, which make boring original book vivid, especially for the Western readers. In Zhang's time, the 1930s, he could not have a colour camera, the black and white photographs are his best choice.



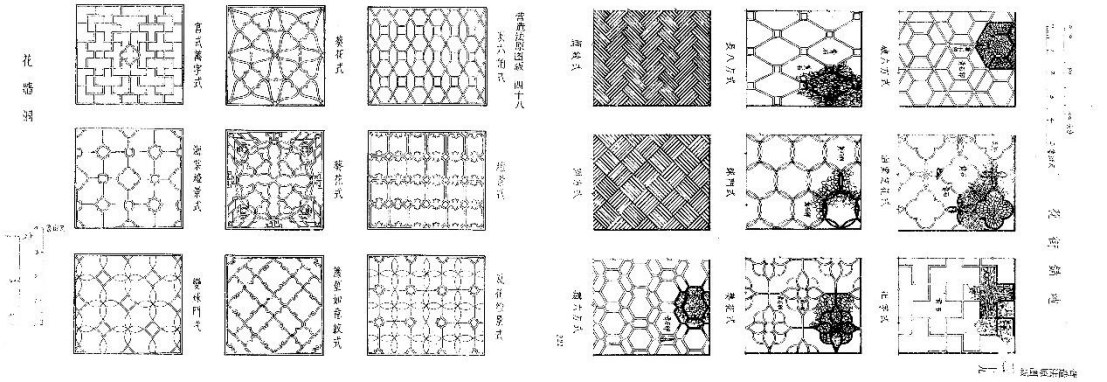
5-1 The example of page 134 to 135, the figures in the *Yingzao fayuan*

From the contents list of the plates, we find that there are 36 pages of carpenters' work in 51 drawings (from plates one to thirty-five), including 9 pages of joinery and non-structural carpentry's decoration work[390] (from plates twenty-eight to thirty-five); 9 pages of mason's work (from plate thirty-six to forty-four); and 7 pages of landscape gardener's work (from plate forty-five to fifty-one). In 36 pages of carpenters' work, 17 examples (more than half) are survey drawings based on existing buildings. The other real example is for important work by the mason: the front main gate. In 9 pages of joiner's work, carpenter's decorative works, and 7 pages of landscape gardener's works, just like *The Craft of Gardens*, it gives plenty of detailed drawings of different styles of windows, decorative overhangs, balustrades, walling, brick buttress heads, decorative garden walls, and garden paving schemes (figures 5-2 and 5-3). The names of patterns are always based on the shape, such as "宮式 linked squares style", "葵式 Mallow plant style", "十字 cross pattern", "丁字 T pattern", "萬字 Chinese reversed swastika pattern ", "井字 check pattern", "書條川 parallel straight rectangles pattern", and so on.

390 See Chapter Two, p.56.



5-2 The example of page 200 to 201of the *Yingzao fayuan*, patterns of Tall Windows



5-3 The example of page 220 to 221of the *Yingzao fayuan*,
patterns of Decorated Garden Walls and Garden Paving

All these drawings make the book into a dictionary for the reader to understand traditional buildings in south-eastern China. That is one of the main reasons why the book is still popular among master carpenters in Suzhou. The craftsmen are keeping their copies of the *Yingzao fayuan*. In October 2012, I saw a copy on the master carpenter Zhou Huimin's (周惠民, the carpentry skill inheritor of the Xiangshan Group) working desk, which was practically falling apart, and was open at pages of plates. It was the second printing of the second edition of the book in simplified Chinese characters. He told me that the book had been his real teacher until now, through twenty years' work as a master carpenter, and he can't work without it.

14 of the 51 plates in the modern edition have been translated by the author in detail, and are shown in Appendix. In other words, Zhang redrew 14 drawings (and 4 figures) out of Yao's 32 original drawings. They use a modern architectural method, clearer, more condensed, and with additional details.

Contents (of main texts)

目錄

Catalogue of Illustrations

插圖目錄

Contents of the Plates

图版目录

[391] *Paike* 牌科 is the local name of bracket set, which is also one of the remarkable different technical terms between South-eastern carpentry and the official ones (The official name of it is "*dou-gong* 斗拱").

5.2 The Main Texts

The sixteen chapters of the main text in the *Yingzao fayuan* run from the basic structural types to the details, then cover other craftsmen's work. The logic of organisation is the same as with the original drawings by Yao. Since the modern edition of the book is based on Yao's original texts, we can believe that the organisational order has come from Yao.

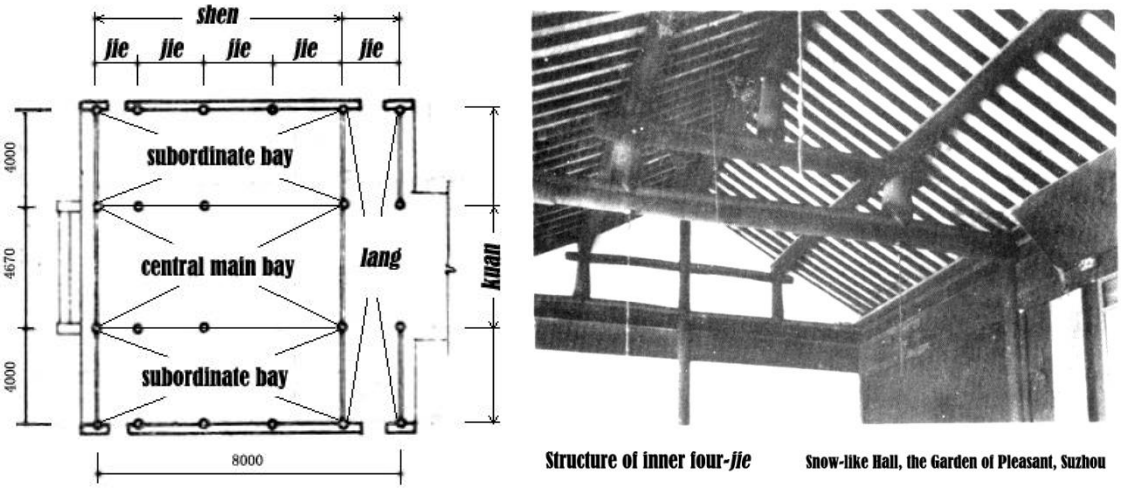
Because timber is the principal material used in Chinese traditional buildings, and the master carpenter is the master builder in those projects, the chapters on basic forms and rules are the most important part of the book for understanding the carpenter's work. Other craftsmen's works were only incidentally covered in the book and are not expounded in this thesis. The essentials of the buildings described may be summed up as follows:

5.2.1 Plan and foundation

In *Chapter One: Foundation Overview* of the *Yingzao fayuan*, first of all, there comes an introduction of basic forms and conceptions of Chinese traditional buildings in carpenters' jargon (technical terms).

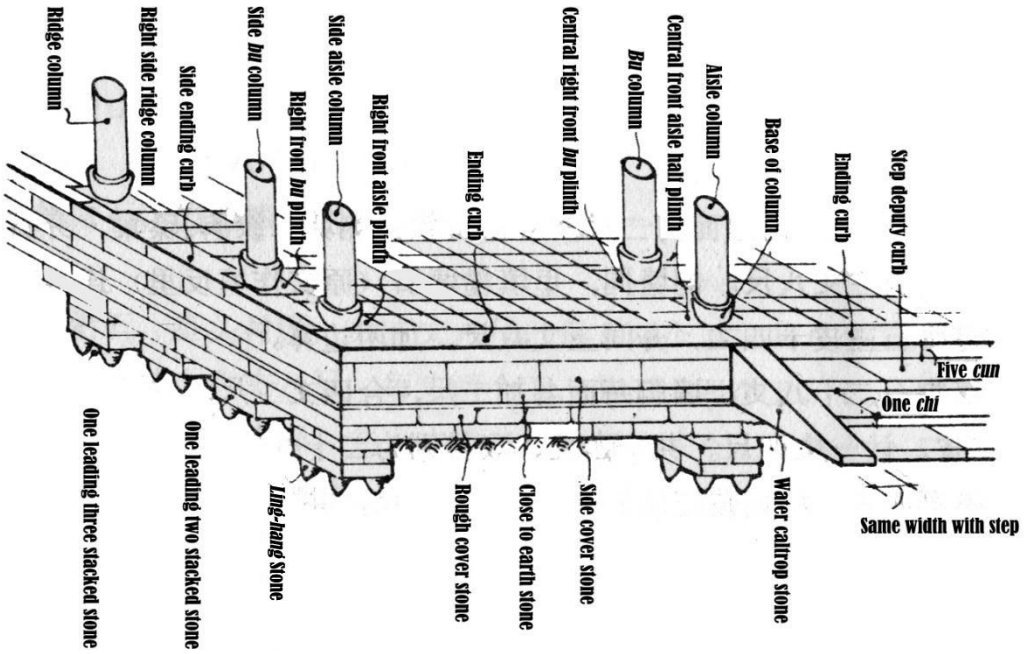
The plans of Chinese traditional buildings have different forms, such as square, circle and rectangle, however the rectangle is most popular for plans. The long side of the rectangle is called *kuan* (寬, length); while the short is *shen* (深, depth)[392]. Based on these two terms, the concept of *jian* (間, bay[393] or span) is defined by the product of *shen* and *kuan* between two columns on the long side. The distances between two beams is called *jie* (界), which can be used as calculation unit of *shen*. In the south of China, most buildings may have the form with four-*jie* inside the building, and one or two outside. The title of the *jie* varies according to the numbers outside, which is *lang* (廊, aisle or corridor) for one *jie* outside and *shuang-bu* (雙步, double-span) for two *jie* outside. In the plan shown in figure 5-4, the building has three *jian*, the one in the middle being the central main bay (正間, *zheng-jian*), and the two others subordinate bays (次間, *ci-jian*). So it has four-*jie* (内四界) inside, and one *jie* (aisle) outside. This is a representative plan of a Chinese traditional building in the South of China.

[392] See "深，進深 ***shen, jinshen*** (s) lit. 'depth': The total transverse length of a building." Guo Qinghua, p.70.
[393] See "間 jian (s) bay: 1. A basic spatial unit define by four columns and beams within a structure." Guo Qinghua, p.46.



5-4 Basic plan of a Chinese traditional building[394]

The size of each bay has a certain proportion. Generally, the width of the central main bay is one *zhang* four *chi* (一丈四尺，about 4.67 metres), and the width of the subordinate bay is one *zhang* two *chi* (一丈二尺，about 4.00 metres); therefore the total width (*gong kaijian* 共開間, also called *tong miankuo* 通面闊) of the building is three zhang eight chi (三丈八尺, about 12.67 metres). The length of the inner four-*jie* is one *zhang* six *chi* (一丈六尺, about 5.33 metres), and the aisle is eight *chi* (八尺, about 2.67 metres), which means the total length of the building is two *zhang* four *chi* (二丈四尺, about 8.00 metres). The reason for using an example of this size and form at the beginning of the book is that this size of building is the most common of all.



5-5 The foundation of Chinese traditional building

Then the chapter goes into the foundations, although this is mason's work rather than

[394] Drawings by the author, photograph from the *Yingzao fayuan*, p.125.

carpenter's. All Chinese traditional buildings, no matter of what materials, had a stone foundation under the ground. The depth of foundation depended on the loading on the earth. The foundations were made of stone, which under a column is always deeper than beneath other parts (figure 5-5)[395]. In *Yingzao Fayuan*, *Chapter One*, there is a detailed record of the foundation making process, including the size of stone, the three methods of assembling the stones, and the proportion between the foundation and the building. It specially reminds us that if the building has to be built on soft earth, the builders must dig deep enough to touch the hard earth, and then build the foundation on that.

5.2.2 Section

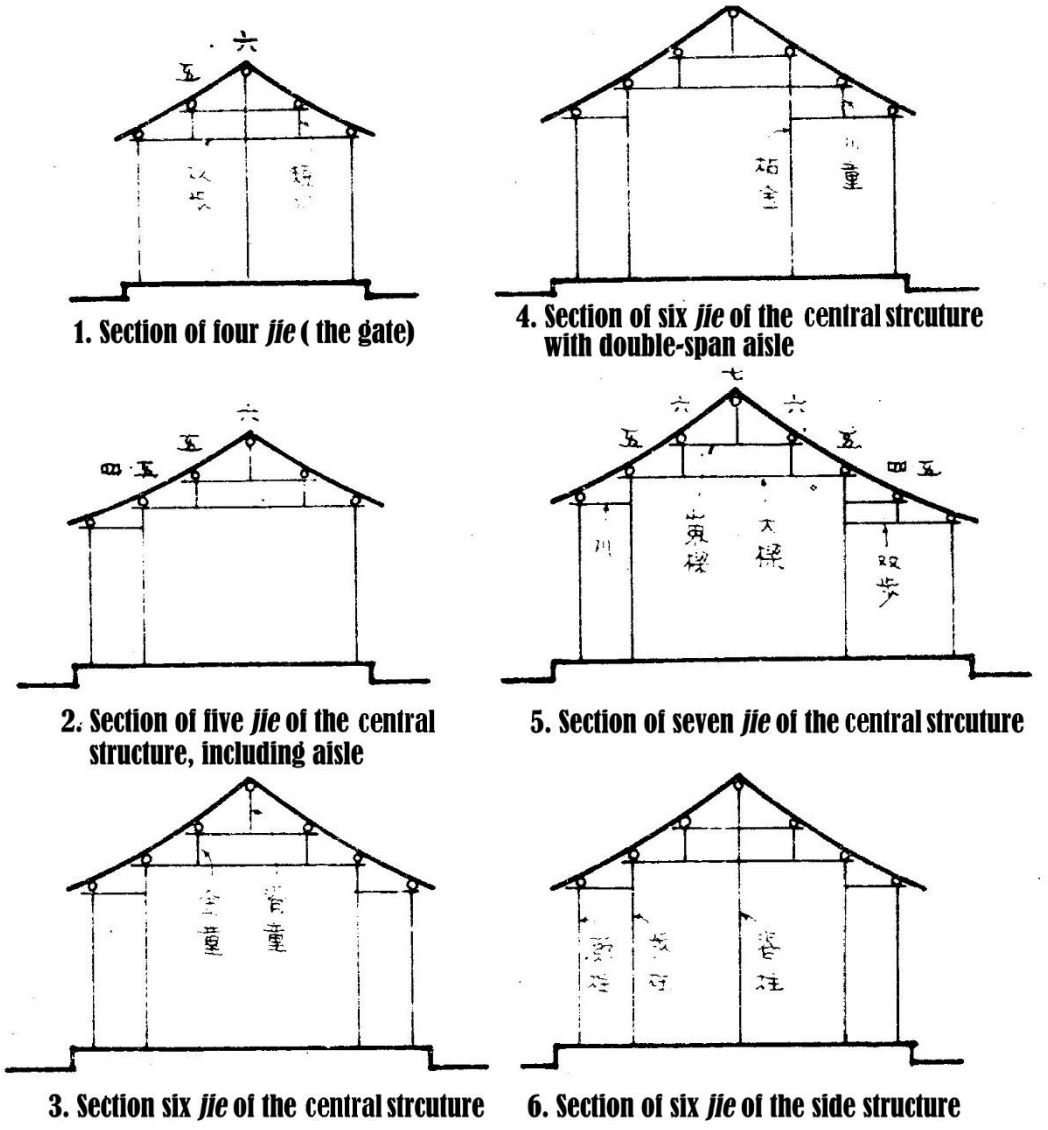
From the appendix of this thesis, and *Chapter two*: *The Structures of Single-storey House and Double-storey House* of the *Yingzao fayuan*, we find that different types of Chinese traditional building can be shown by these sections.

First of all, the chapter explains the technical terms for building structures in texts:

According to the different uses and functions of buildings, Chinese traditional buildings can be grouped into three types: single-storey building 平房, hall 廳堂, and temple 殿庭. A single-storey building has a simple structure, small size, and functions as a normal habitation for living. Hall is "a collective name of *ting* 廳 and *tang* 堂",[396] which has a more complex structure and more beautiful decoration, functioning as the living room or office of rich families. The temple has the most complex structure with large size and decoration of highest level. According to the number of storeys, Chinese traditional buildings can be divided between single-storey building and mansion (multi-storied building).

The unique character of a Chinese traditional building is the division between its timber structure and the boundary wall. The timber structure takes the whole load of the building, while the wall acts as separation or weather proofing. Because of their different working conditions, the timber elements can be roughly classified into three kinds: column, beam, and bearing block. In the north of China, the bearing block is well known as *dougong* (斗拱 bracket sets); while in the south of China, it called *paike* (牌科). Whether it uses the bracket sets or not depends on the size of the building. None of the single-storey building types uses bracket sets, but they are widely employed in halls and temples.

[395] Yao Chengzu, Zhang Zhigang, ed., *Yingzao fayuan*, p.1.
[396] Guo Qinghua, *Visual Dictionary of Chinese Architecture*, p.79.



5-6 The sections of different types of single storey Chinese traditional building

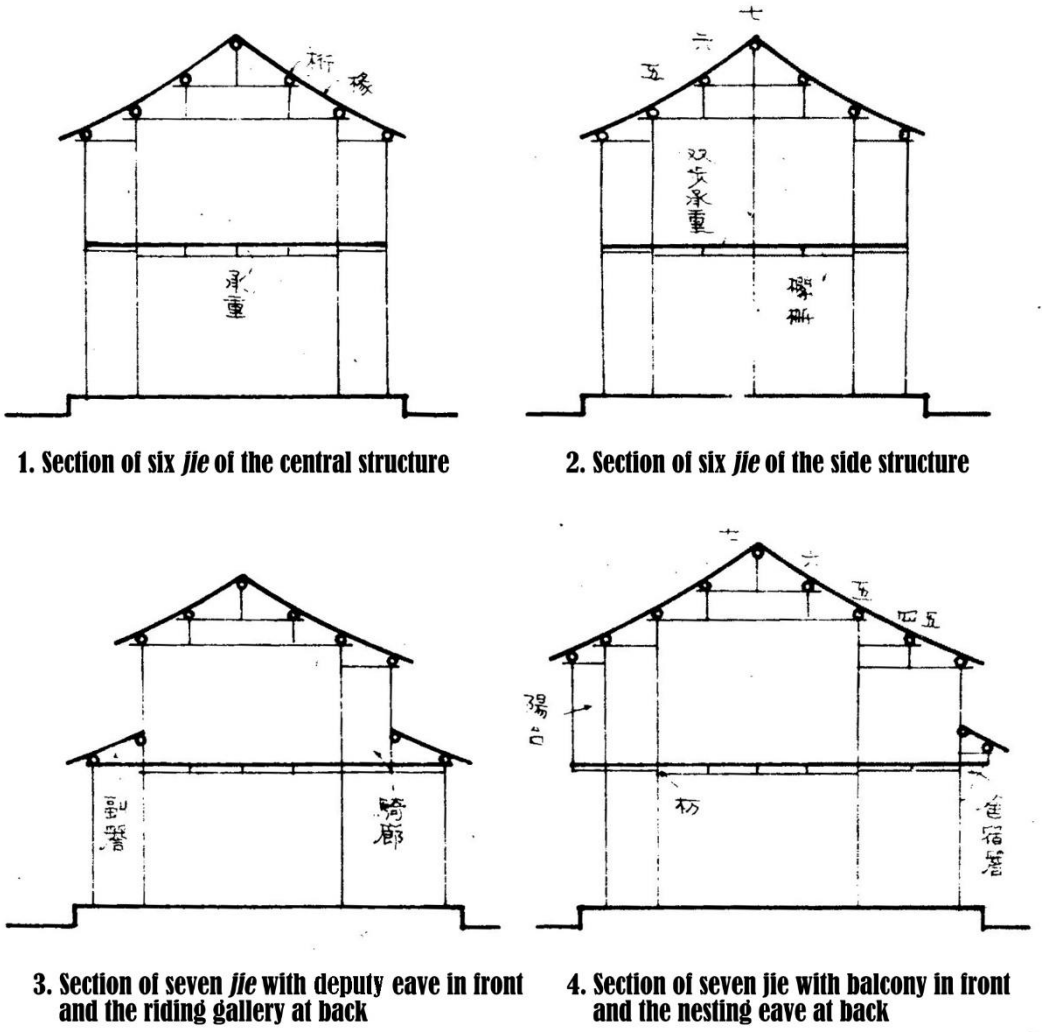
Secondly, the chapter explains each type of building by illustrations of sections and rhymes.

The section, taken parallel to the gable side of the building, is named *tie* (貼) in *Yingzao fayuan*, and also called *feng* (縫) in *Yingzao fashi*. *Chapter Two* of the *Yingzao fayuan* gives an overview of typical examples of major carpentry in buildings: six types of section of single-storey buildings or halls, and four types of section of two storey buildings are shown (figure 5-6[397] and 5-7[398]), which include the most widespread forms of Chinese traditional building. Besides these schematic sections, there are nine examples from Suzhou with formal plans and sections and full details in the plates at the end of the book. From the record, it can be concluded that the schematic sections were what the carpenters used at that time, and the formal plans and sections were drawn later by Zhang Zhigang.

Finally, the chapter ends with the description of budgeting and the selection of timbers and

[397] Yao Chengzu, Zhang Zhigang, ed., *Yingzao fayuan*, p.5.
[398] Ibid.,p.7.

logs by rhymes, which will be discussed in Chapter Six.[399]



5-7 The sections of different types of double-storey Chinese traditional buildings

5.2.3 Roof

Chapter Three: Raising the Roof Frames in Order Overview in the *Yingzao fayuan* explains how to make the curved roof of Chinese traditional buildings.

Liang Sicheng has stated the Chinese structural system in *A Pictorial History of Chinese Architecture*:

"The immediately outstanding feature of Chinese monumental architecture is the curved roof with overhanging eaves, which is supported by a timber skeleton based on a raised platform.……The section drawings show us that the roof supports in Chinese timber–frame construction differ fundamentally from the conventional Western triangular roof trusses that

[399] See Chapter Six, p.159-160.

dictate the rigidity of our straight pitched roofs. The Chinese frame is, instead, markedly flexible. ……By manipulating the heights and widths of the skeleton, a builder can produce a roof of whatever size and curvature are required." [400]

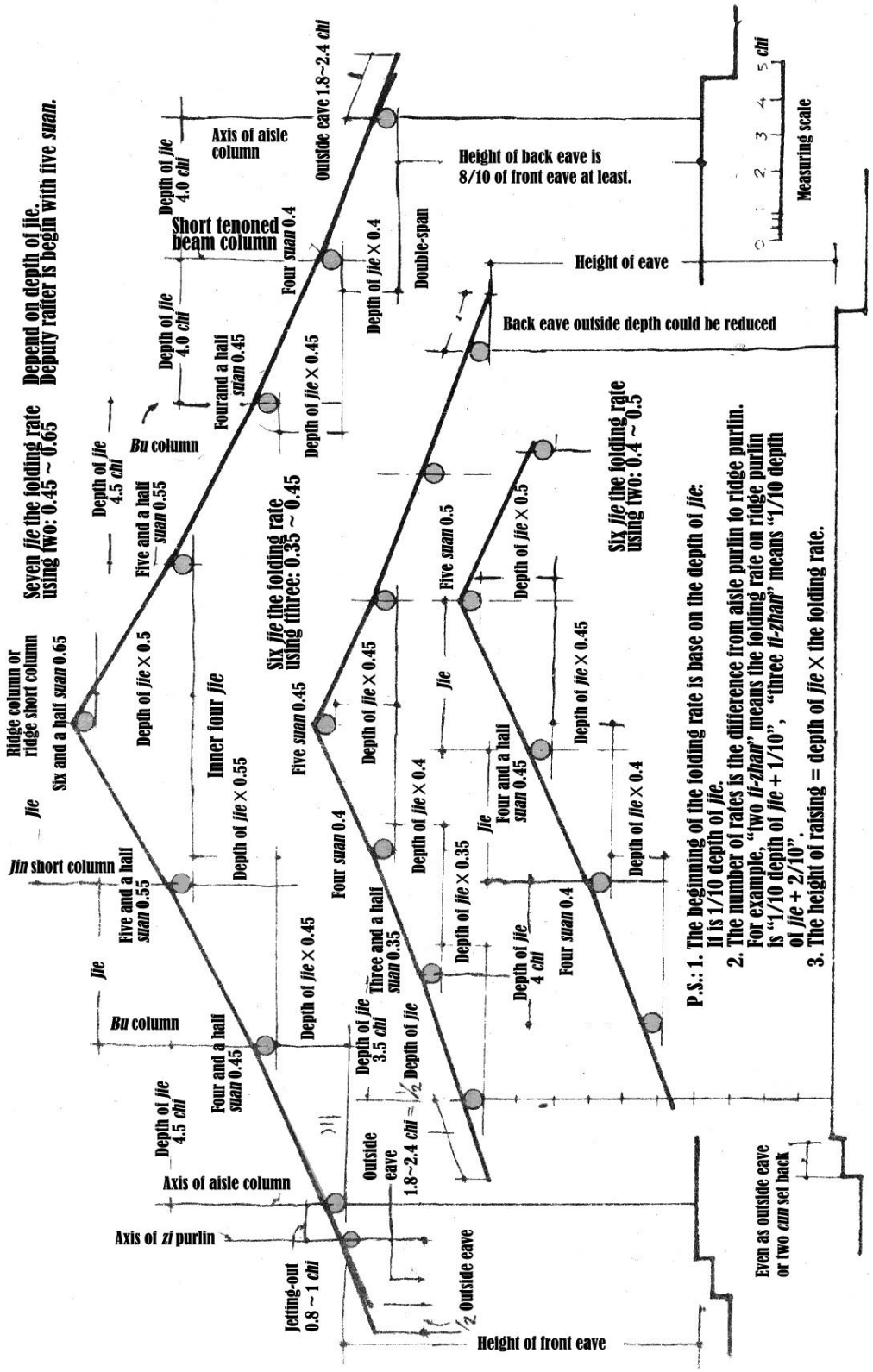
Nowadays, people in rural areas are still citing the shape of roof in judging a carpenter's work. The line of a roof is like a carpenters' personal signature. Even if they have the same rule for the ratio of each part; the roof looks different when it is finished. In other words, the roof turns a Chinese traditional building from a building into an artwork.

It is no surprise when *Yingzao Fayuan Chapter Three* gives examples of six-*jie* and seven-*jie* in detailed explanation of calculating roof styles. First, it explains that the three different names of the curved roof: *ju-zhe* (舉折, *Yingzao fashi*, Building Standards), *ju-jia* (舉架, *Qing gongcheng zuofa zeli*, Structural Regulations), and *ti-zhan* (提棧, *Yingzao fayuan*), are the same concept, which means the method to make the profile of the roof. Second, except for their different names, the basic method of "bending the roof" is quite similar to that in the other two books. The change of height between purlins depends on the width of *jie* or the total *shen* (depth) (figure 4-8[401]).

Thirdly, a rhyme of the rule of ratios was quoted. It says that for single-storey buildings, the first ratio is 1/10 of the number of the length of *jie*. That is, when the *jie* is 3.5 *chi* (尺, Chinese unit of length, equal to 0.33m), the first ratio is 0.35; while when the *jie* is 4 *chi*, it is 0.4; and when it is 4.5 *chi* the ratio is 0.45 (confirmed by figure 7-9). From bottom to top, if the change of ratio adds 0.05 each time, it is called 1 *suan* (算, a unit); while if adding 0.1, it is called 2 *suan*, and so on. The bigger the building, the larger is the change of ratio. The most radically changing ratio is 10 *suan*, only to be used in the roof of a pavilion. Though this rule was normally followed, carpenters could make fine adjustments during their working practice.

In the plates, six real examples show the carpenters' practices in different kinds of buildings from hall to pavilion. All are in Suzhou, and some of them can still be checked today.

[400] Laing Sicheng, *A Pictorial History of Chinese Architecture*, pp.85-92.
[401] Yao, Chengzu 姚承祖, Zhang Zhigang 張至剛, ed., *Yingzao fayuan* 營造法原, p.13.



5-8 The rules of *ti-zhan* (curved roof)

5.2.4 Bracket sets

As mentioned before, *paike* (牌科) is the name of bracket Sets used in the *Yingzao fayuan*. It is also known as *dou-gong* (斗拱). *Chapter Four: paike (bracket sets)* is a special introduction to this topic. The most important thing is that, in the north of China, the size of *dou-gong* depends on an inter columnar bracket set, which is known as *dou-kou* (斗口). Because the size of building depends on the *dou-gong*, the width of *dou-kou* is the basic module for the construction of buildings from the Song dynasty. But in the south of China, the rules of *paike* are much simpler than in the north. They have several styles of *paike* with a specific size.

Firstly, there is a conceptual introduction. Hundreds of names describe different parts and different kinds of bracket sets. The classical types are the two shown in figure7-10. The Cross *paike* type with *gong* running in the purlin's direction is close to the styles of the north of China as used in official government buildings. The cross *paike* type of *fenggong* (楓栱) is a particular style used for residences in the south of China. It looks more active and flexible with a piece of board instead of a *sheng-gong* (升栱), and always has higher level of decoration.

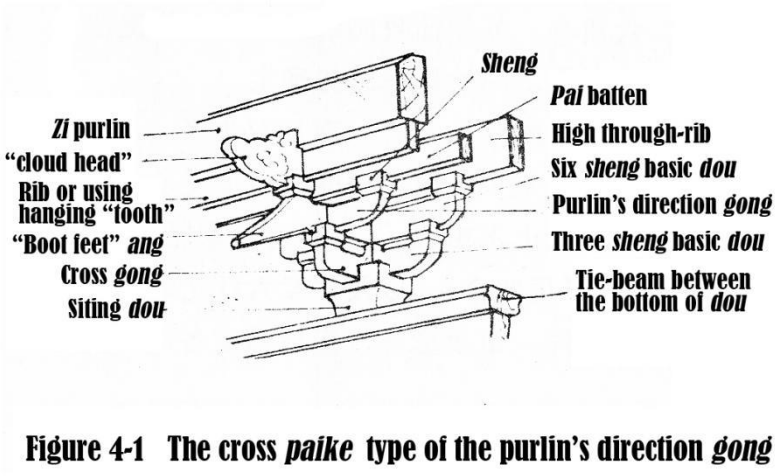


Figure 4-1 The cross *paike* type of the purlin's direction *gong*

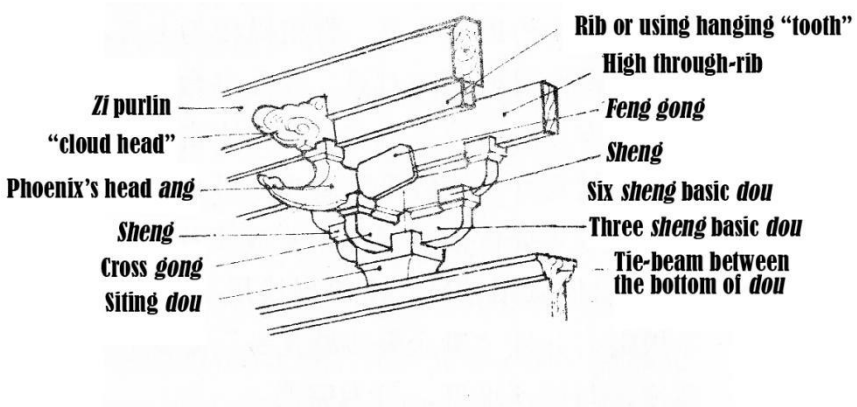


Figure 4-2 The cross *paike* type of the *feng gong*

5-9 Two classical types of *paike* in the *Yingzao fayuan*

Secondly, there is an introduction of six kinds of bracket sets from simple style to complex with presentation of real examples in Suzhou in texts and photographs. Although the kinds are limited, the style of bracket sets appears in more varieties than are usually counted in China.

Thirdly, the sizes of bracket sets can be grouped in only three types under the carpentry system of building in the Jiangnan area. The bottom piece of a bracket set is a piece of square wood with the small side facing down. The section at the bottom is a square. The width of the square on the bottom is used for the name of the type. There are 5 by 7 *cun* size type (五七式), 4 by 6 *cun* size type (四六式) and double 4 by 6 *cun* size type (雙四六式). 5 by 7 *cun* size type means the square height is 5 *cun* (one *cun* is nearly 3.3 cm), while the width of square on the top is 7 *cun*, and the width of square at the end of it is 5 *cun*. 4 by 6 *cun* size type is smaller than five-seven type, and the double four-six type is the largest one, used in huge buildings such as a temple.

Fourthly, it gives the scale of each part of the bracket sets, and emphasizes the need to deal with the weather: only good hard woods can be used as bracket sets to avoid deformation.

Finally, three special buildings with bracket sets breaking the rules are discussed in detail. They were all built in temples and have existed for a long time. That should be the reason for the difference.

5.2.5 Miscellaneous

Chapter Five: The Halls Overview gives eight types of halls, which are discussed in Chapter Seven of this thesis.[402] It explains the technical terms, such as inner four-*jie* 內四界, rear double-span 後雙步, the deputy rafters 軒, and so on, one by one carefully and thoroughly described. The figures, photographs, and plates help to make this chapter full and understandable.

Chapter Six: The Batching Parts of the Structures of Halls is an extension of the last chapter. Besides giving a figure for making a column out of two or three timbers, it gives every detail for counting the timbers of a structure. The carpenter's rhyme of the ratio of each part of structure to the circumference of timber in *Chapter two* becomes a table in this chapter, which can be translated as follows:[403]

beams		columns		purlins and others	
name	perimeter	name	perimeter	name	perimeter
main beam	2/10 of the length of the inner four-*jie*	aisle column	9/10 of the *bu* column of deputy rafter	aisle tie-beam	the height is 1/10 of that of aisle column; the thickness is 1/2 of the *dou* or the height of tie-beam
three-purlin beam	8/10 of the main beam	aisle column of the side structure	9/10 of the central aisle column		
double-span	7/10 of the main beam	*bu* column of the deputy rafter	9/10 of the bu column	tie-beam of deputy rafter	the height is 1/10 of that of the *bu* column of the deputy rafter

[402] See Chapter Seven, p. 193-196.
[403] Yao, Chengzu, Zhang Zhigang, ed., *Yingzao fayuan*, p.31

double-span of the side structures	7/10 of the main beam	*bu* column of the deputy rafter of the side structure	9/10 of the *bu* column of the deputy rafter of the centre	*bu* tie-beam	the height is 1/10 of that of the *bu* column, or the same as the tie-beam of deputy rafter
short tenoned beam of the central main structures	6/10 of the main beam	*bu* column	9/10 of the main beam or 2/10 of the width of the central bay	purlin	1.5/10 of the width of the bay
short tenoned beam of the sidestructures	6/10 of the main beam	*bu* column of the side structure	8/10 of the *bu* column	*zi* purlin	8/10 of the aisle purlin forthe cylindrical structure; 8/10 of the *dou* for the cuboid structure.
beam of deputy rafter	2/10~2.5/10 of the length of the deputy rafter	ridge column	the same as the three-purlin beam, or the aisle column		
beam of deputy rafter of the side structures	7/10 of the main beam	*jin* short post	the same as the main beam	rib	The length is 2/10 of the width of the bay
pouch beam	8/10 of the beam of deputy	*jin* short post of the side structure	8.5/10 of the *jin* short post of the central structure	rafter of inner *jie*	2/10 of the length of the bay, 0.8 *chi*; the section is pouch shape.
pouch beam of the side structure	8/10 of the beam of deputy	ridge short post	the same as the three-purlin beam	outside-eave rafter	2/10 of the length of the bay, 1.01 *chi*.
deep-thrust lintels under double-span beam	8/10 of the double-span, sawing to two parts	short post of the short tenoned beam	the same as the double-span beam	flying rafter	1.2 *chi*, rectangle. the width is 8/10 of the circumference of the outside-eave rafter; the thickness is 8/10 of that of the outside-eave rafter
deep-thrust lintels under short tenoned beam	9/10 of the short tenoned beam, sawing to two parts	short post of the short tenoned beam of the side structure	the same as the double-span beam of the side structure		
				bending rafter	3~3.6 *chi*, 2.5~3 *cun* in width; 1.6~1.8 *cun* in thickness
				supporting ridge stick	6/10 of the ridge purlin

Notes： *1. The timbers of a single-storey building can be counted by the above rules, or cut down according to the circumstance.*

2. The timbers of a hall or palace hall structures can be counted by the above rules, except that the main beam is 3/10 of the length of the inner four-jie, and the circumference of the bu column can be 1/10 of the width of the aisle.

Table 5-1 The table of the timbers' circumferences in the structure of a hall

From the table above, we can see that the sizes of timbers are not unalterable. They have relationships with each other. The regular rule is: the main beam depends on the width of the bay; and other parts depend on the main beam. The size of purlins, rafter and rib may be in a relationship with that of the main *dou*.

After the table and explanation, the chapter gives examples of the common sizes of cylindrical structures and cuboid structures in every particular size.

Chapter Seven: The Palace Hall Overview is like the former chapters an exact description for the structures of palace halls: from the technical terms to the types, then on to the detailed parts of structures (here is the rising angle ridges at corner roofs), ending with an example of a popular double-storey palace hall with a table of sizes of each part. Plates twenty-five and twenty-six are attached at the end of book to illustrate this chapter.

5.3 The Drawings

Comparing the drawings in the two editions

As we know, most of Yao's drawings have a corresponding one in Zhang's work. The comparison of the drawings in the two editions is as follows:

Title	The *Yao Chengzu yingzao fayuan tu*		The *Yingzao fayuan*		
	drawings	page	plat or figure	page	
Designing and Plans					
Plan of a residence	1	1	One	171	√
Plan and section of a residence	2	2			×
Styles of Halls					
Structures of single-storey hall	3	3	Figure 2-5	5	※
The style of cuboid structure hall	4	4	Two	172	√
			Figure 5-8	25	※
			Figure 5-5,6,7	23,24	◎
The style of nesting eave with "soft" shelters	5	4	Figure 2-6	7	※
The style of riding gallery	6	5	Nine	180	√
			Figure 2-6	7	※
The mandarin duck hall	7	6	Four	174	√
The "basket of flowers" hall			Six	176	√
The fixed boat pavilion	8	6	Seven (one & two)	177,178	※
(The "return" roof of tortoiseshell hall)			Eight	179	※
The foundation and ground floor	9	7	Figure 1-1	1	√
The five-mountain partition gable	10	7	Thirty-seven	209	√
Bracket Sets					
Type of bracket sets	11	8	Figure 4-1,2	16	※
Side view of a bracket set	12	9	Twenty	192	√
The bracket set between the purlins	13	10	Eighteen	190	√
Details of Structures					
Patterns of tenons of structures	14	11	Fourteen (part)	186	√
The jointed style of the central aisle column and the end of the short tenoned beam	15	11	Fourteen(part) & Sixteen (part)	186 188	※

The "standard" purlin	16	12	Thirteen (one) (part)	184	√
One *dou* "*pu* toe cap" and one *sheng*	17	12	Thirteen (one) (part) & Sixteen (part)	186 188	√
The front view of tenons between purlin, column, middle-filling board, and through-rib	18	13	Fourteen (part)	186	√
The section of tenons between beam, rafter, column, and purlin in the central structure	19	13			
The plane of rafters and purlins	20	14			×
Raising the roof frame and other details	21	14	Figure 3-1 Fourteen (part)	13 186	※
Front elevation of the style of *shan-wu-yun* in the halls	22	15	Twelve (part)	184	√
Side elevation of the style of *shan-wu-yun*	23	15	Twelve (part)	184	√
Section of the central structure of hall	24	17	Fourteen (part)	186	√
The jointed style of upper section through left side frame	25	18	Fifteen & Sixteen (part)	187 188	√
The standard styles of front section through left side frame	26	19			
Section of the standard joints by purlins, through-ribs and short post	27	19			
Corner roofs					
The pattern of rising angle ridges' order	28	20	Seventeen	189	√
The order of rising angle ridges' rate net rafters	29	21			
The standard bracket set	30	22			×
The wood-bone rising angle ridge	31	22	Forty (part)	212	√
The carpentry and masonry frames of the hall's rising angle ridge	32	23			×
The side and front view of the rising angle ridge of a hall	33	24	Forty (part)	212	√
Main Ridges					
Dragon holding ridge	34	25	Thirty-nine	211	√
Dragon holding ridge	35	25			√
Feeding dragon ridge	36	26			√
Feeding chicken ridge	37	26			√
Soft feather ridge	38	27			√
Feeding chicken ridge	39	27			√
Some other types of main ridge					◎
Main gate and walls					
The central gate	40	28	Forty-one	213	√
The integration of different kinds of walling	41	29	Thirty-eight	210	√
Types of walling	42	30			
Appendix					
Landscape of *Buyun Xiaozhu*	43	31			
Front elevation and timber structures of double-eaved roof great hall and the style of the water-bone of rising angle hips	44	32	Twenty-six	198	√
Side elevation and inner timber structures of double-eave roof great hall and the style of materials and construction	45	33			√

Notes: 1. √ -- exactly redrawn; 2. ※-- redrawn in other ways; 3. × -- not redrawn; 4. ◎–added something new.

Table 5-2 A comparison of the drawings in the two editions of the *Yingzao fayuan*

Table 5-2 gives an index for checking how the original drawings have been redrawn in the modern edition. From it we know that most of Yao's drawings were exactly redrawn by Zhang, only changing the drawing method; some of them are redrawn in other ways to match the architect's thinking; only five of them were not redrawn, but all can be found in the description of the main texts, except the Landscape of *Buyun Xiaozhu*. Two drawings of new types are added among Zhang's drawings. All these drawings (totally 15 pages) in the modern edition book have been translated in this thesis as an appendix. But besides that, the other drawings (37 pages) which were added by Zhang, give us very good, clear, and fully detailed examples, and do not have translations.

From the different page numbers, we can find that Yao's arrangement of the drawings depended on the structures, from common to the different styles, then going on into details, and ending with high level building. Zhang kept Yao's arrangement in principle, but changed the order to separate carpenters' work from that of others, because the modern edition of the book also paid much attention to other works. There are other complete chapters to introduce them in detail as much as possible. In other words, there is no doubt that the modern edition book formed an integrated system of Chinese Traditional carpentry building in the south-east of China in the 1920s.

The modern edition allows the crafts building skills to be read, understood, and learned in modern times until today. It helped the Xiangshan Group traditional crafts building skills to absorb the impact of modernization, and survive through it. Although nobody could stop the times changing, we could have lost the descent of a live tradition, and the modern edition made a bridge between old-fashioned skill and modern technology, between craftsman and architect. It helped the old skill to find a place in modern life. The Xiangshan Group became the only Chinese carpentry group to possess a summary document of its technical experiences. Without it, the Xiangshan Group would not still exist in the generation of today.

The *Yingzao fayuan* is not only a book for carpenters, but also for masons and stonemasons. *Chapter fourteen: Estimation of Time and Labour* and *Chapter sixteen: Others* makes the book more comprehensive than others. In that chapter the estimation is divided to four groups: carpenter, mason, stonemason, and brick mason. *Chapter Sixteen* records the building standards of two special buildings: the tower and the city wall. At the end of this chapter, all the crafts tools are listed, also in four groups: masons' tools in 23 types; carpenters' tools in 42 types; staging Tools to build scaffolding in 23 types; and tools for lime-sand mortar in 15 types. These details reflect the real facts of Xiangshan Group crafts builders, and tell the reader of the technical background at that time. Without it, the researchers into Chinese traditional buildings would have lost a precious historical record of the work of normal builders in the early 1900s. As the only architectural academic book on local carpentry building skills, based on personal summary of Chinese traditional buildings, the details in the book are of continuing significance for today.

The *Yingzao fayuan* fills the gap between the Chinese traditional carpenter and the modern architect in many ways.

Conclusion of Chapter Five:

This chapter has focused on one basic general research question: What is in the *Yingzao fyuan*?

From Part I, we already knew that there were two editions of the *Yingzao fayuan*: the carpenter's manuscript drawings and the architect's modern architectural research book. This chapter gives its contents in detail, the summary of the main texts in the modern edition, and a comparison of the drawings in the two editions, to explain and analyze what is in them and how they compare with each other.

From the contents, we found the inner organizational logic. Although the content of the *Yao Chengzu Yingzao fayuan tu* was divided and added to by the author, the original thoughts of the master carpenter could still be traced in it: the drawings proceed from the general to the specific, from the whole to the parts. Some special characters of Chinese traditional buildings are described separately, such as the styles of *paike* 牌科 (*dougong* 斗拱 bracket sets), and the order in the pattern of rising angle ridges. The same logic can be found in the modern edition of the *Yingzao fayuan*.

Besides the addition of photographs and redrawing of all the pictures, the 16 chapters are organized in the same way following the 33 drawings, which proves the *yingzao fayuan* to be a work of cooperation by carpenter and architect. Because the carpenter's original text manuscript was lost, the summary of the 16 chapters of the modern edition is the only way to introduce the detailed content of the book.

The organizational logic is suited to the cognitive development of people who know nothing about the building skill of Chinese traditional buildings. Whether the learner is an apprentice or an architecture student, the original drawings are a good text book including the style patterns. Even when an apprentice is learning skill in practice without a text book, and when he could not choose to learn the building styles from common to special or from normal to custom-made, he still needs to learn the skill from easy to difficult, collecting fragments of knowledge together into a complete system step by step. To write a family secret skill book, Yao's grandfather must have organized his experience in the same way as in the book. The architecture students are luckier than carpenter's apprentices. They received a text book helping them to combine the knowledge of Chinese traditional building skills, so they could achieve the basic knowledge in a short time. An architecture academic research book needs more details on the ins and outs of local carpentry building skills, so the modern edition has got three contents lists to help in understanding such an obscure and abstruse skill.

Elaborate efforts were made over the comparison of the drawings in the two editions of the *Yingzao fayuan*. This gives a clue for comparing the carpenter's drawings with the architect's redrawing. Furthermore, it proved that the carpenter's concentrations were not lost, but kept in the new form of an architectural view.

To carpenters, drawings were used to discuss designs with the owner, or to keep some important information about a building. The drawings are more like craft schematics than scientific representations. But to architects, on the contrary, architectural drawings are the very centre of their work and creativity. The drawings carry all the necessary information, intended to

communicate with another professional person without further discourse. To appear in an academic architectural research book, the drawings had to be professional.

To sum up, two editions of the *Yingzao fayuan* are two leaves on a tree, sharing one piece, but providing different features, so each has its own uniqueness and personality.

CHAPTER SIX

Carpenter's Thinking and Architect's Adaptations in the Texts

The original manuscripts are full of dialect and carpenter's jargon;
The modern edition explains and edits it in architectural language.

In this chapter, the two editions of *Yingzao fayuan* are analyzed in terms of texts, to explain the specific conflicts and harmonies between traditional carpenters and modern architects in literal expressions.

The original manuscripts written by the local traditional carpenter were full of dialect words and regional carpenter's codes. Some of them are difficult to understand by outsiders. That's the reason Zhang Zhigang was selected to help Yao. One of Zhang's great contributions was to explain and edit the text book, made it a modern architectural study book on local carpenter's building skills. He made the book readable, understandable by modern architects, and he tried his best to keep the carpenter's style of thought.

The prefaces of the two editions recorded the process of the conflicts and harmonies in the text; the rhymes and jargon are interesting examples of their co-operation.

6.1 The Prefaces

6.1.1 The prefaces of the Carpenter's manuscript

Along with Zhu Qiqian's essay, there are three prefaces before the drawings by Yao Chengzu: the preface of the *Yao Chengzu Yingzao fayuan tu* by Chen Congzhou (figure 6-1); the essay on drawing of Buyun Xiaozhu by Zhu Qiqian (figure 6-2); and the original preface of the the *Yao Chengzu Yingzao fayuan tu* by Yao Chengzu (figure 6-3).

The first two have been mentioned many times, but we have not looked at the full texts until now. The last one records Yao's thoughts of the organisation of the text book. It is first hand of information of Yao's opinion on the book.

The preface of Chen introduces the purpose of Yao's drawing, and how the original drawings were kept and found, Yao's carpentry career and great works are also mentioned. In the end, he shows the reader the reason why he added three drawings as an appendix. These three depict the landscape drawing of Buyun Xiaozhu and the designs of the great main-hall of Yun Yan Temple 雲岩寺. The former is a planning design by Yao, the latter is the highest rank of building which could be designed by a local master carpenter such as Yao or his assistant Yu Youqin.

姚承祖营造法原图序

陈从周

香山姚承祖先生课徒作《营造法原》，此即是书所绘原图也。其时在一九二四年始，四五年间。邹生宦伍得之苏州，携以示余，余悲欢交集，规模法度，得庆重见，而历劫不靡，自有神护。早岁见紫江朱启钤先生撰《题补云小筑图》，心仪其人其术者久之。三十年来屡客吴中，徘徊于先生诸遗构下，思绪万千。复读先生遗著，惠我多矣。兹观斯篇，更亲切如侍几席。吉光片羽，长留人间。爰为整理，公诸于世。足与晚近刊本《营造法原》互相参证也。

先生字汉亭，别号补云，先世安徽歙县人，占籍江苏吴县香山，诞于一八六六年（清同治五年）农历三月十八日。祖灿庭，著《梓业遗书》。十一岁随叔开盛习木作，经岁营建于乡郡间，苏州邓尉香雪亭、怡园藕香榭、灵岩寺大殿等，皆其结构之著者。一度教授苏州工业专科学校，并任苏州鲁班会会长，江南耆匠也。于一九三八年农历五月二十一日弃世。子开泰世其业。

五十年前姚先生曾绘《补云小筑图》余曾见及，所列诸屋架式，与此集相若，惜已亡佚，而小筑之图影本幸存，故录朱先生原题及云岩寺大殿设计图于后，图作于一九三三年夏，绘图者郁友勤，乃姚先生当手师傅，助其设计营建多年。谨述其概略如上。一九七九年十月陈从周识于上海同济大学建筑系。

6-1 The preface by Chen Congzhou, in 1979 (original)

Translation:

"**Preface to the Yao Chengzu Yingzao fayuan tu Chen Congzhou**

Mr. Yao Chengzu 姚承祖 of Xiangshan (Group) wrote the book Yingzao fayuan as a text book. These are the original drawings by him for the book. From 1924, he took four to five years to accomplish the work. Mr. Zou Gongwu 鄒宮伍 found the manuscript in Suzhou, and brought it to me. I accept it with mingled feelings of grief and joy. I am glad the manuscript could be shown to us today, and I believe that God protected it through difficult, perilous times. Since my youth, I have been mesmerized by Mr. Yao and his works for a long time, since I saw the essay on the drawing of Buyun Xiaozhu 題補雲小築圖 by Mr. Zhu Qiqian 朱啟鈐. Over thirty years, I have been to the Wu area several times, and wandered around the buildings made by Mr. Yao, which provoked deep thought. I have learned a lot from reading Mr. Yao's book (the *Yingzao fayuan* modern edition). Today, reading his original drawings, I feel as if I am talking with him. To allow this fragment of a highly treasured relic be saved for ever, I edited the drawings, and print it as a reference for the book, *Yingzao fayuan* modern edition.

Mr. Yao is also known by his style name (zi 字) Hanting 漢亭, and the nom de plume (hao 號) Buyun 補雲. He was born in Xiangshan 香山, Wu Xian 吳縣, Jiangsu 江蘇, on May 2nd 1866 (late Qing Dynasty), and of She Xian 歙縣, Anhui 安徽 descent. His grandfather Yao Canting 姚燦庭 had written the Ziye Yishu 梓業遺書. Yao began to study carpentry at the age of eleven, under his uncle Yao Kaisheng's 姚開盛 direction. He spent his career in the countryside and Suzhou city. Some of his works can be found today: the Plum Blossom Pavilion 梅花亭 in the Xiang Xuehai 香雪海, "scented snow sea", in Suzhou; the Ouxiang Xie 藕香榭, "The Lotus Fragrance Anchorage", in the Yi Yuan 怡園, "The Garden of Pleasure", in Suzhou; the Main Hall of Lingyan Temple 靈岩寺 in Mudu 木瀆, etc. He was engaged as a teacher in the Suzhou Engineering School 蘇州工業專科學校, and was the head of the Lu Ban Guild of Suzhou 蘇州魯班會. He was a well-known master carpenter in Jiangnan 江南. He died on June 18th 1938. His son Yao Kaitai 姚開泰 took over his trade.

I have seen the (handscroll) drawing of Buyun Xiaozhu 題補雲小築 made by Mr. Yao fifty years ago. The styles and structures of the buildings are quite similar to the manuscript. Unfortunately the buildings were destroyed, but the copy of the drawing of Buyun Xiaozhu exists. I attached the drawing of Buyun Xiaozhu and the designs of the main-hall of Yun Yan Temple 雲岩寺 at the end of this book. The drawings of the main-hall of Yun Yan Temple were drawn by Yu Youqin 郁友勤, who was Yao's right-hand man, and worked with him for many years. I respectfully record an outline (of the book's origins) as above.

Chen Congzhou, October 1975, Architecture Department, Tongji University, Shanghai."

Zhu's essay is a simple Chinese architectural and craftsmen's history. He was using his immense collection of facts in this essay to explain the impressive contribution of Yao's work. Furthermore, from Zhu's essay, we know that these original drawings had been sent to him with the handscroll landscape drawing of Buyun Xiaozhu by Yao. It was for him a great honour and privilege to keep both of them in the book.

According to Chinese traditional writing habits, I believe that the original essay had no

paragraph breaks and no punctuation either. The punctuation may have been added by Chen Congzhou when he printed the book, and the paragraph breaks have been made by me in the translation.

朱启钤　题补云小筑图

民国壬申（一九三二年）秋余因刘士能（敦桢）君之介，得知吴门姚君补云所著《营造法原》一书。姚君旧执教鞭于苏州工业学校，是书其平日课本也。书中所辑住宅祠庙佛塔泊岸，及量木计围诸法，未见官书，足传南方民间建筑之真象，数月来余躬自整比，校订一过。姚君又虑是书所图，或有遗漏，复以画册与补云小筑绘卷见寄，并属为题署。余维我国南北建筑之式样，北以雄健胜，南以秀丽纤巧见长，俱如其气俗人情。数千年来，此二者互相挹注揉合，其关系亦有可得而言者。姬周之世，吴越俱属于楚，建筑制度依地理气候材料之别，如临水基筑，响屟为廊，系舫名轩，与中原稍异。自始皇并六国，放写其宫室于咸阳北阪上。汉高复营新丰，效丰沛故乡风物，放牛马鸡犬于途，识其故居，是为楚人习尚输入关中之证。永嘉乱后，衣冠南渡，建筑艺术亦随之俱来。迨隋文混一海内。炀帝开邗沟，幸江陵，其大匠何稠项升，皆南人，《迷楼记》所言，幽房曲室，互相连属，回环四合，胥南式庭园之特征。而北宋喻皓建汴京开宝寺塔，著《木经》行世，皓亦南人。绍兴以后，中原工艺随国都南徙，萃于江浙一隅，遂成近世人文之盛。其时李明仲《营造法式》一书重刊于平江。明清以来，写本流传，亦以江浙故家为最，故今苏杭建筑，若月梁、琵琶斗等，犹如宋制，而北方转失其传焉。嗣洪武营南京，采木江西，大匠集于苏之木渎，董役诸臣、如陆祥陆贤昆仲，隶籍苏之无锡。永乐北迁，征南匠营北京，蒯祥以匠工跻身卿贰，与蔡信、杨青等俱吴人，于是南式建筑远被幽燕，演为明清二代制度，迄今彩画作犹有苏画之名。清康乾间内庭装修开雕于金陵，归楠木作雷氏承办，雷氏亦原籍江西而迁居金陵者，故落地罩园光罩诸称，南北如出一辙。补云祖父灿庭先生，曾箸《梓业遗书》五卷，惜未得寓目，而补云题记之所称述承先启后之思，实有所本。是其平生目营心计，咸出其祖若父之手法。木渎香山之遗规，其在斯乎。夫匠家秘授，术语为方言所限，素以艰涩见称，但师承所自，能有纪述，便属可珍，非若词人作赋，儒家释经，穿凿附会，徒为架空之论者。故《营造法原》一书，虽限于苏州一隅，所载做法，则上承北宋，下逮明清，今北平匠工习用之名辞，辗转讹误，不得其解者，每于此书中得其正鹄。然则穷究明清二代建筑嬗蜕之故，仰助此书正多，非谨传苏杭民间建筑而已。因姚君索书，并著其原委于此。中华民国癸酉（一九三三年）紫江朱启钤识。

6-2　The essay on drawing of Buyun Xiaozhu by Zhu Qiqian, in 1933 (original)

Translation:

"**Zhu Qiqian　　Essay on the drawing of Buyun Xiaozhu**

In the autumn of 1932, I heard about the book *Yingzao fayuan* by Mr. Yao Buyun[404] through Mr. Liu Shineng (Dunzhen). Yao was engaged as a teacher in the Suzhou Engineering School. This is his usual text book. The dwellings 住宅, temples 祠廟, pagodas 佛塔, embankments 泊

[404] Buyun 補雲 was Yao Chengzu's nom de plume. Zhu used the nom de plume to show his regards. The same usage was shown when he mentioned Liu Dunzhen.

岸, and the skills of carpentry measurement have never been found in official books (or regulations). It is worthwhile to hand on the real appearances of unofficial architecture in the south of China. I spent several months proofreading the book, and edited it. Mr. Yao was worried that the book was not complete, so he sent me an album of his original drawings and a handscroll of the landscape drawing of Buyun Xiaozhu, asking me to write this essay.

From north to south, I saw the buildings of our country just like the local manners and feelings: the north are known as powerful and vigorous, while the south are admired for being graceful and dainty. Over thousands of years, these two were absorbed into each other, and the relationship is worth discussing: In early history, the Wu and Yue 吳越 areas belonged to Chu 楚, and buildings were different in location, weather and materials. For example, the buildings beside water in this area were known as step echo wooden covered corridor[405] and fixed boat pavilion, which were somewhat different from those of the Central Plain[406] 中原. Qin Shi Huang 秦始皇[407] became the first emperor of a unified China in 221 BC, and this recorded that he built his palace to the north of Xian Yang 咸陽[408]. Then the Emperor Gaozu of the Han 漢高祖[409] expanded the palace to copy his homeland in Jiangsu 江蘇[410]. He even raised cattle, horses, poultry, and dogs to symbolize his home. This is the evidence of the Chu 楚 culture which influence Guan Zhong 關中[411]. In 311, the struggle for the Chinese throne forced many people, especially the scholars and officials, to leave their homeland, moving from the Central Plain to the South of China[412]. The building culture moved along with the people from centre to south. In 589, founded by Emperor Wen of Sui 隋文帝, the Sui Dynasty saw the reunification of Southern and Northern China. The Emperor Yang of Sui 隋煬帝 ordered the construction of the Grand Canal 京杭大運河[413], and visited Jiangling 江陵. The master carpenters He Chou 何稠 and Xiang Sheng 項升, who were in charge of the Grand Canal, were both born in the South. The *Milou ji* 迷樓記[414] says that "The rooms are connected, (made courtyard in the central) winding on all sides." It is a typical style of southern dwelling and garden. During the Northern Song 北宋 (960-1127), the master carpenter Yu Hao 喻浩 built the tower in Kaibao Temple 開寶寺 in Bianjing 汴京[415]. He wrote the *Mu jing* 木經, "Timberwork Manual", to record his skill. He was also a southern carpenter. After the Northern Song, the craftsmen moved south with the change

[405] Step echo wooden covered corridor 響屧廊, was a well-known place in King Fuchai of Wu's 吳王夫差 garden, who made it for his concubine Xishi 西施 around 490 B.C. The floor of the covered corridor was built over a void, in order to hear the steps echo.

[406] The Central Plain or Zhongyuan 中原 of China, refers to the area on the lower reaches of the Yellow River which formed the cradle of Chinese civilization. It forms part of the North China Plain.

[407] Qin Shi Huang 秦始皇 (259 B.C.-210 B.C.), personal name Ying Zheng 嬴政, was king of the Chinese State of Qin from 246 B.C. to 221 B.C. during the Warring States Period.

[408] Xian Yang 鹹陽 is a former capital of China in Shaanxi 山西, on the Wei River, a few kilometers upstream (west) from Xi'an 西安, western of China .

[409] Emper Gao (256 B.C. or 247 B.C.-1 June 195 B.C.) of Han Dynasty 漢朝, commonly known within China by his temple name Gaozu 高祖, personal name Liu Bang 劉邦, was the first emperor of the Han Dynasty, ruling over China from 202 B. C. to 195 B.C..

[410] Jiangsu 江蘇 located along the east coast of China. Wu area is in Jiangsu.

[411] Ganzhong 關中 or Guanzhong Plain, is a historical region of China corresponding to the lower valley of the Wei River. Xian Yang 鹹陽 belongs to Ganzhong.

[412] Because of the disorders and chaos of wars, this is the first time of Han People large-scale moving to South of China in the fifth year of Emperor Yongjia (311C.E.). Chinese called "Yongjia Rebellion, Gentries moving to the South 永嘉之亂, 衣冠南渡".

[413] The Grand Canal in China, also known as the Beijing-Hangzhou Grand Canal, is the longest canal or artificial river in the world.

[414] A novel which is believed to have been written during the Northern Song Dynasty (960-1127) 北宋.

[415] Bianjing 汴京, also known as Pyankung, is now Kaifeng 開封, Henan 河南, in the central Plain of China.

of capital[416]. The craftsmen's culture developed in the joint area of Jiangsu and Zhejiang which became the cultural centre of recent history. At the same time the *Yingzao fashi* was published in Pingjiang 平江[417]. But during the Ming and Qing Dynasties[418], the handwritten copies of the *Yingzao fashi* were most widespread in the joint area of Jiangsu and Zhejiang. We find that the building structures in Suzhou and Hangzhou nowadays, such as the Slightly Arched Beam 月梁 and Pipa bracket 琵琶鬥, still obey the rules of the Song Dynasty, while they have changed in the north of China. The Ming Dynasty established its capital in Nanjing 南京 in 1368. To prepare for great works, they felled timber from Jiangxi 江西, and convened carpenters and craftsmen in Mudu town 木瀆, Suzhou 蘇州, in Jiangsu 江蘇. From official to builder they were all people of the south. For example the master carpenters the brothers Lu Xiang 陸祥 and Lu Xian 陸賢 were born in Wuxi 無錫, Jiangsu 江蘇. In 1421, the capital of the Ming Dynasty changed to Peking. The government called for carpenters and builders from the south to build the new capital. The master carpenter Kuai Xiang 蒯祥, who was the leader in building the Forbidden City, finally became an official of the Ministry of Works. He and other masters, such as Cai Xin 蔡信, Yang Qing 楊青, were also Wu people. Since then, the south building style has influenced the north, and it dominated the rules of construction in the Ming and Qing Dynasties. Until now, in Chinese decorative painting 彩畫作 there is a special style called the Suzhou style pattern 蘇式彩畫. In the 1700's, the Lei family from Nan Jing led the workers of building, decoration, and maintaining the palace. In fact, the Lei family originally lived in Jiangxi, then moved to Nanjing. Because of this background, the ornaments inside buildings, such as the Luodi Zhao 落地罩, and Yuanguang Zhao 園光罩, have the same names in both south and north.

Yao's grandfather Yao Canting 姚燦庭 wrote the *Ziye Yishu* 梓業遺書, in five volumes. Unfortunately, I have not had an opportunity to read it, but I believe Yao's great work, both the book and his designs, were based on his family education. The traditional rules of carpentry in Mudu, Xiangshan, are all in this book. As we know, the craftsmen's secret skills in an education limited by the craftsmen's code and dialect are difficult to understand. Since we now have the record of a master carpenter, it is very precious. It is not mentioned by scholars, unlike some classical books which were explained by people in ways full of misunderstandings and useless for research. Above all, although the *Yingzao fayuan* is just a local carpentry record, it can be sourced to the Northern Song Dynasty (960-1126), and was still in use in the Ming and Qing Dynasties (1368-1912). In many ways terms used by carpenters of Peking today have become confused or erroneous, but the original source of correct words can be traced in the book. That means this book not only teaches us the traditional rules of carpentry in Suzhou, but also can help us to research the changes in rules for Chinese wooden buildings in the Ming and Qing Dynasties.

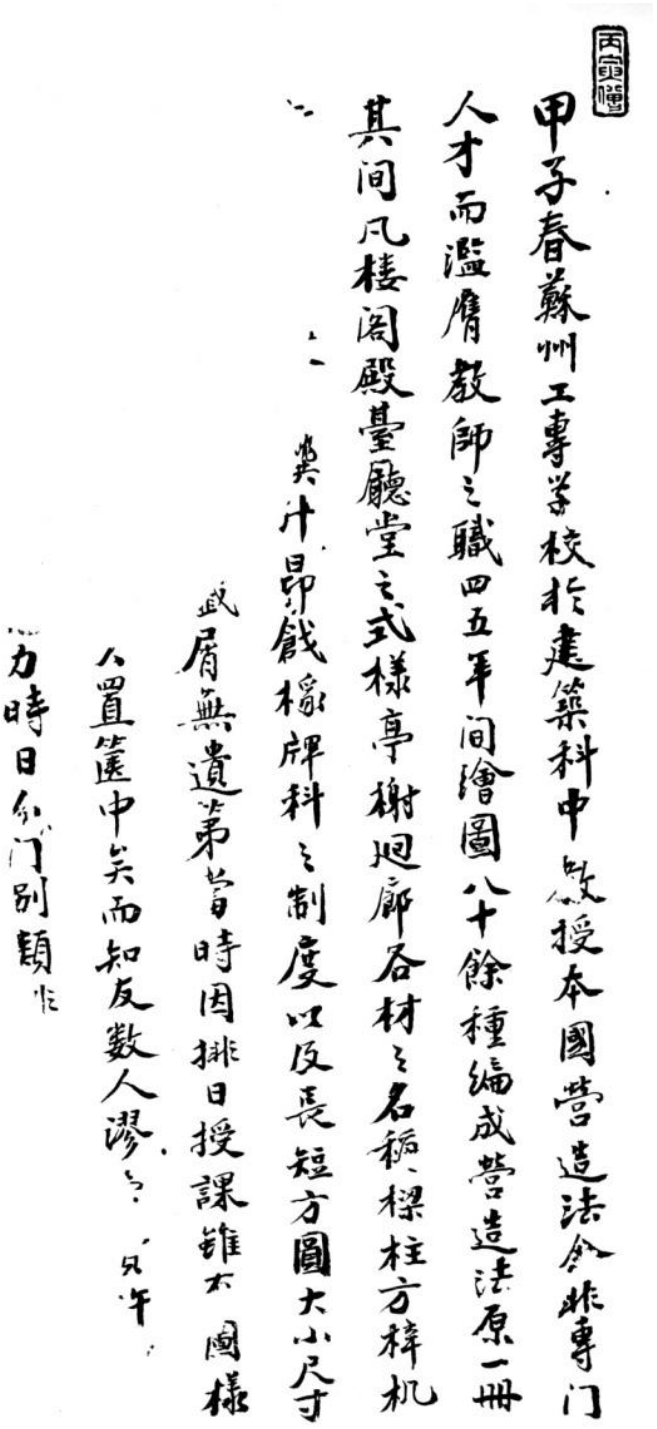
This essay was written at Mr Yao's request, and I also explained the reasons why this book has such important contribution to make.

Zhu Qiqian of Zijiang, in 1933."

[416] The Southern Song 南宋 (1127-1279) refers to the period after the Song lost control of northern China to the Jin Dynasty 金, establishing their capital at Lin'an 臨安 (now Hangzhou), Zhejiang.
[417] Pingjiang 平江, is now Suzhou, Jiangsu.
[418] The Ming Dynasty 明朝, also Empire of the Great Ming, was the ruling dynasty of China from 1368 to 1644. The Qing Dynasty 清朝 was the last dynasty of China, ruling from 1644 to 1912.

Even though some words are missing, the preface by Yao Chengzu is a standard foreword by the author. Yao wrote down his purposes and the experiences of this work, noted the contents of the book, and made acknowledgments to his friends.

This preface should apply to his book *Yingzao fayuan*, not just to his drawings. Since the original texts were lost in the war, the original drawings take on added value.



6-3 The original preface by Yao Chengzu for the Yingzao fayuan tu, in the 1920s (original)

The preface was written in Chinese classical prose, without punctuation marks, which are quite easy to misunderstand, so we need to add punctuation marks:

"甲子春，蘇州工業學校於建築科中教授本國營造法。余非專門人才，而濫膺教師之職。四五年間，繪圖八十餘種，編成營造法原一冊。其間凡樓閣殿台廳堂之式樣，亭榭回廊各材之名稱，樑柱方梓機……昂戧椽牌科之制度，以及長短方圓，大小尺寸……幾屑無遺第。當時因排日授課，雖有圖樣……置篋中矣。而知友數人謬……力時日，分門別類……"

Translation:

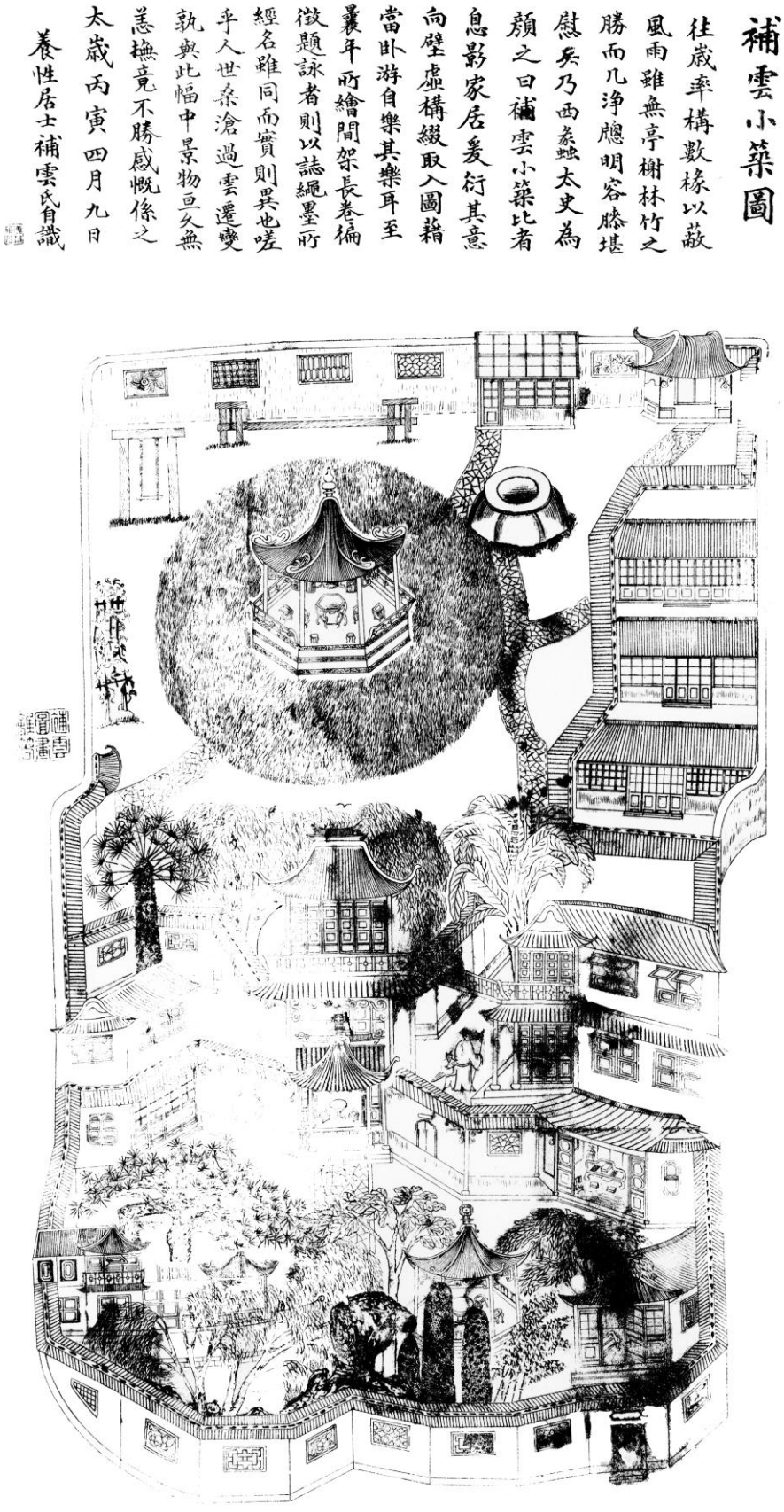
"In the spring of Jiazi Year 甲子年[419], I was teaching the national building method in Suzhou Engineering School. I am not a qualified teacher, and was afraid of neglecting my duty. Over four to five years, I drew more than eighty plates, and edited a book named *Yingzao fayuan*, in one volume. The book introduces the styles of towers, belvederes, palaces, towers, terraces, and halls (*ting* and *tang*) 樓閣殿台廳堂之式樣; the construction terminology for pavilions, gazebos, and covered corridors 亭榭回廊各材之名稱; … …of beams, columns, purlins, and short ribs 樑柱枋梓機; … …the rules of rising angle ridges, and brackets 昂戧椽牌科之制度；and the lengths, forms, sizes 以及長短方圓大小尺寸;… …nothing missed 無遺第. For the course, although having the drawings… …(I) put the book on the shelf, but my friends encouraged (me to) … … use time to classify… …"

From Yao's preface we can see these drawings were drawn for the course: the national building method, and edited for the book *Yingzao fayuan*. But he did recognize these drawings for this edition: *The Yao Chengzu Yingzao fayuan tu*.

Another essay that should be attached here is Yao's inscription of the drawing of Buyun Xiaozhu (figure 6-4). "The inscription on a painting accentuates and complements the image."[420] This inscription was written on the drawing as a letter sent to Zhu Qiqian[421]. But it can be seen as Yao's postscript to his drawings and his textbook *Yingzao fayuan* (original). We can see how eager he was to keep his carpentry skills alongside the challenge of modern architecture. He was not falling back to a defensive line, not resisting, but devoting himself to cooperate actively with modern architecture education.

Just as he foretold, "in the vicissitudes of life, nothing could be protected and exist forever except the buildings in these paintings", hundreds of his works, well known buildings in Suzhou, were all destroyed by the wars or movements over the next seventy years, but his drawings and the modern edition of *Yingzao fayuan* have survived.

[419] The year 1924. See Chapter Four, p. 101.
[420] See Yang Xin's *Approaches to Chinese Painting*. Richard M. Barnhart, and others, *Three Thousand Years of Chinese Painting*, p.4.
[421] See Chapter Five, p. 110.



6-4 The drawing of Buyun Xiaozhu by Yao Chengzu, in the 1920s (original)

The inscription was also written in Chinese classical prose, without punctuation marks, which are quite easy to misunderstand, so we need to add punctuation marks and translate into modern Chinese as well:

Original:

"往歲率構數椽以蔽風雨，雖無亭榭林竹之勝，然几淨窗明，容膝甚慰矣。乃西蠡太史為顏之，曰補雲小築。

比者息影家居，援衍其意，向壁虛構，綴取入圖，藉當臥游，自樂其樂耳。

至曩年，所繪間架長卷，編繪題詠者，則以誌繩墨所經。名雖同，然實則異也。

嗟乎，人世滄桑，過雲遷變，孰與此幅中景物恒久無恙。撫之竟不勝感慨系之。

太歲丙寅四月九日

養性居士補雲氏自誌"

Modern Chinese translation:

"多年前我為自己曾經建造小屋以居住，雖然沒有亭榭林竹的美麗勝景，但是也還窗明几淨，足以容身。於是西蠡太史費念慈[422]為我題門上匾額，稱之為"補雲小築"。

現在我已退休在家，援引他的意思，向壁虛構，綴取美景入圖，權當臥遊，自娛自樂而已。

至於前此若干年，我所畫的房屋間架長卷，並且編繪題詠，都是希望籍此記錄我作為木匠的經驗。名字雖然相同，但其實內容不同。

唉！人事滄桑，過眼雲煙變化，怎能比得上這幅畫中景物那樣永恆，不招破壞？展卷拂觀，不勝感慨。

太歲丙寅四月九日

養性居室補雲氏自誌"

Translation:

"Years ago, I built a small house for myself to live in. Although without deluxe buildings and varieties of plants, it was bright and clean, and good enough for my family. My friend Xi-Li (a famous scholar), wrote a plaque for it, and named it "Buyun Xiaozhu", a simple house of Buyun.

Now I am retired and stay at home. I'm following the meaning (of the name) in drawing a house, and making a beautiful landscape, as a spiritual journey that I'm living inside to please

[422] Fei Nianci 費念慈 (1855-1905), style name Qi Huai 屺懷, nom de plume Xi Li 西蠡. He was a Presented Scholar 進士 in 1889, lived in Suzhou, and well known on his research on epigraphy.

myself. I also call it Buyun Xiaozhu.

These two buildings have the same name, but different existences for different purposes.

In recent years, I have drawn a long handscroll, which has several Chinese buildings' structure drawings and explanations. I drew the handscroll and this painting to record my work and my experiences of carpentry.

Oh, the world is changing so fast. In the vicissitudes of life, nothing can be protected and exist forever except the buildings in these paintings. I'm looking at the drawings and sighing with emotion.

18.06.1926

By Yangxing Jushi 養性居士 Buyun 補雲"

Above all, the four drawings jointly show the processes of the *Yingzao fayuan* in carpenter's working, and follow the detailed descriptions in Chapter Four.

6.1.2 The prefaces of the modern edition

In the preface of the *Yingzao fayuan*, Zhang Zhigang gave a detailed account to his work with Yao Chengzu's permission.

"Author's Preface

At the very moment the book is going to be published, I appreciate the judicious leadership and the devotion to scientific research by our party and government with much excitement, which enabled this old formal draft finished nearly 20 years ago to finally meet her readers.

This can be traced back to the autumn of 1935, when Professor Liu Dunzhen came southwards from the Society for the Society for Research in Chinese Architecture (SRCA) in Beijing, showed me the original manuscripts of *Yingzao Fayuan,* and told me to arrange it. Professor Liu also informed me: "This was Mr. Yao Buyun's text book at the architecture department of the Suzhou Engineering School. It was according to his family's secret book and drawings, written by him in his old age. It is worthwhile to hand on the real appearance of the unofficial architecture in the south of China." He also said: "I was entrusted by Mr. Yao in 1929 to arrange the manuscript, but I was too busy. Then I introduced this book to SRCA in 1932. The president Mr. Zhu Guiting proofread the scripts personally. However, the terms applied in the book were different from palace architecture in Beijing, and there was further incomprehension about the drawings as well. Relying solely on correspondence could hardly enable us to discuss examples or revise the drawings. Due to the reasons above, the publication of the book was delayed by few years." Because Mr. Yao and I were both from Suzhou, and I served at former National Central University at that time, the task was committed to me in consideration of abilities and position as well.

The name of Mr. Yao Buyun is Chengzu. His style name is Hanting, and Buyun is his nom de plume. His family was devoted to architecture for generations. There were numerous dwelling houses, temples, and gardens built at Suzhou over decades which were designed by him. He was the president of Luban Union and the honourable leader of local craftsmen in his twilight years. I was touched by the eager entrustment of Prof. Liu at that time. The book was the only work recording Jiangnan Architecture and I couldn't let it buried in history, so I accepted this task.

After that, I utilized holidays and spare time after class to do work like arrangement, survey mapping, drawing and photography. Mr. Yao was always discussing questions about the book with me in the meantime. When the scripts were finished in the summer of 1937, the book consisted of 24 chapters, with a total of 120,000 words, and had 52 plates and 71 illustrations. Prof. Liu took the scripts with him to the north when the work was finished. However, the Japanese army invaded China and SRCA had to move to inland, first to Yunnan then to Sichuan. The book was then not published due to financial and printing problems. I could not spare myself to this matter under conditions of war and disease. It was a pity that Mr. Yao passed away after an illness at *Wumen* (Suzhou) in 1939 and couldn't see to the publishing of his own book.

For a long decade or more, I was concerned that the book had not been published. After the Liberation, leaders gave much concern and encouragement to me. I did some arrangement again, condensed the book to 16 chapters and added annotations to some parts. The whole book was of 135,000 words, had 128 illustrations and the plates were simplified to 51. Only the chapter on "The Rules of Measuring Timber" was put into appendix and used for reference only, because it confronted current regulations after the measurement system's evolution following the Liberation.

As for the rearrangement work: the original book had about 32,000 words and 80 or more pictures. But the terms used were limited to those current in Suzhou, and difficult to understand due to the lack of annotations. Let alone the numerous rhymes that were too esoteric for beginners. All the carpentry schemas followed traditional carpentry practice, had no proportions, and expressed the patterns and styles only. My methods of arrangement then were basically a matter of investigating cases, drawing new architectural drawings, and takng some necessary photographs. So I travelled around all the temples, ancestral halls, dwelling houses and gardens, selecting the style and construction coincident with the original manuscripts, surveying and mapping, and I drew the plates. There are the Hall of Great Achievement of The Confucius Temple 文廟大成殿, The Daoist Trinity Hall in the Daoist Temple 玄妙觀三清殿, The Hall of Great Achievement in The Confucius Temple in Huqiu 虎丘禪院二山門, Lingyan Temple in Mudu 木瀆靈岩寺; The Guild Houses of Quanjin, Anhui, Fengzhi, etc. 全晉、安徽、奉直等會館; the dwelling houses of Reng, Zhang, Cheng, Shen, etc. 任、張、程、沈諸氏住宅; and then the Lingering Garden 留園, the Garden of Pleasure 怡園, the Surging waves pavilion 滄浪亭, The Yan Garden (already destroyed in the Second Sino-Japanese War) 嚴家花園, The Garden of the Master of Nets 網師園, the Humble Administrator's Garden 拙政園, the Lion Grove Garden 獅子林, the Gengyin Manor 耕蔭義莊 (The Garden of The Wang Ancestral Halls 汪園), and other garden buildings; and the decorated archways of the City God's Temple 城隍廟. I also visited the Fire God's Temple 火神殿, the Temple of Guan Yu 關帝廟, etc. I investigated the qualities and production areas of materials as well. I am collating the words at last. Retaining the original text as much as possible, for example, the calculations for use in building, the estimation of time and labour, and the mnemonic rhymes which are the spirit of the book. I never changed a word,

but made sure to arrange or systematize them to be easy to read, systematized, and in conformity with drawings. By discussing this with Mr Yao, I completed the first draft with his permission. The details of some changes are listed below:

1. Adaptation of the original words: The original book is like a carpenter's manual, unsuited for modern needs. The fourteenth chapter *Gongxian* 工限,"estimation of time and labour" and the sixteenth chapter *Zazu* 雜俎, "miscellaneous", are combined with his words on Building Pagodas, Revetments, and the City Wall, to which I just added some notes. All other chapters are rewritten, reorganizing the carpentry terms of carpentry and meaning of words, re-explained and analyzed in easier language. The sixth chapter, divided into three parts in the original text, is now combined, and named "The Batching Parts of the Structures of Halls 廳堂升樓木架配料之例". The ninth section Shi Zuo 石作, "Stone work", was combined with two original chapters: The orders of stone work and Stone gateway. The twentieth chapter has a long title, "Using brick, tile, mortar, and examples of mortar and sands for walls", is now simply titled as "examples of using mortar". Forgive me if I don't list other changes.

2. Supplement omission: The original drawings have a wide scope, but the explanations are simple. For example, the main parts of building, like Paike, beams, and frames of windows and internal doors, are just given in the drawings, without explanation of the styles, or just have a few words without drawings, sometimes even with self-contradiction or omission. The original book was used as a textbook, and could be orally translated in the classroom. In a different form of literature, the adaptation has to avoid all those shortcomings. I added new materials one by one, or totally rewrote it, in order to make the texts and drawings complement each other. The hardest work went into the fourth, fifth, eighth and fifteenth chapters. Talking about materials, the original texts just gave the names, now we have added the quality and the place of origin.

3. Correction errors of words: The carpentry terms of Suzhou craftsmen had been misrepresented one by one, without ending. Now I just correct errors of what I know. Such as: "*Jiadiao* 夾鍦" is *Geshua* 隔刷 (plastering); "*Saoliang* 搔亮" is *Zhaoliang* 罩亮 (plastering with wax); "*Duomu* 奪木" is *Diemu* 疊木 (placing wooden elements); "*Gong* 龔" is *Gong* 栱 (arch); "*Sun* 筍" is *Sun* 榫 (tenon); "*Yan* 沿" is *Yan* 簷 (eaves); "*Ji* 几" is *Ji* 機 (a small part of frame under the beams). And I changed the words "*Mian Yan* 面沿", "*Jin Zhu* 今柱", "*Tong Zhu* 同柱", "*Zi Ban* 字板", "*Ba Feng* 八風", to become "*Mian Yan* 眠沿", "*Jin Zhu* 金柱", "*Tong Zhu* 童柱", "*Zi Bei* 字碑", "*Bo Feng* 博風". I changed the words "*Douding Chuan* 豆定椽", "*Xingxiang Gong* 行香栱", "*Jinang Zhuan* 橘囊磚", to become "*Touting Chuan* 頭停椽", "*Hengxiang Gong* 桁向栱", "*Junang Zhuan* 橘瓤磚", etc. But some other words even followed the pronunciation of the Wu dialect, because of the custom of Suzhou craftsman, and I didn't change them without Yao's agreement. They are "*Chuan* 川", "*Jie* 界", "*Suyao* 宿腰", "*Ximei* 細眉", "*Yuta* 雨撻", and obviously should be "*Chuan* 穿 (a kind of beam)", "*Jia* 架 (frame)", "*Shuyao* 束腰 (a kind of decoration of base)", "*Xumi* 須彌 (decorated mouldings)", and "*Yuda* 雨搭 (cornice of wall or window)".

4. Incremental editing and interpretation of terms and phrases: although the original texts have a chapter called Shiming 釋名 (interpretation), but without explanation, it was

enlarged as Cijie 辭解, "interpretation of terms and phrases", and added at the end of book in order to make a comparison with the terms and phrases used in relation to the official buildings of the Qing Dynasty.

5. Using forms: Using forms as much as possible, no matter whether in original texts or from my surveys.

6. Redrawing the Plates: Based on the drawings of the original book, after surveying, adding and deleting some, acceding to the real building measures, I redrew fifty-one plates to scale.

7. Adding photographs and illustrations: There are totally one hundred and twenty-eight photographs and illustrations in this book. They were all added by me, and I wrote texts to conform to the pictures.

In the end, the manuscript was just based on the experiences of Yao and his family, although arranged and adapted by me, limited by my ability. Errors and omissions come with the book, and I hope that domestic experts will kindly point out my errors. Besides the constant help from my wife Wang Huiying 王蕙英, Prof. Liu Dunzhen kept directing my work. Because time was limited in the second arrangement, all the plates were trusted to the colleagues of Chinese architecture research division in Nanjing Institute of Technology. Due to damage of the original films, parts of the illustrations have drawn on materials of Chinese architecture research division and architecture department of Nanjing Institute of Technology. Thanks to Zhu Jiabao 朱家寶 from the architecture department for printing the photographs.

Zhang Zhigang Yongsen written in Nanjing, 1956."

自　　序

当此书将要出版之际，我以无限兴奋的心情感谢党和政府的正确领导，重视科学研究工作，使脱稿将近二十年的旧著，得与读者见面。

事情的经过是远在一九三五年秋天，刘敦桢老师从北京中国营造学社南来，出示"营造法原"原稿，嘱我整理。谓："这是姚补云先生晚年根据家藏秘笈和图册，在前苏州工专建筑工程系所编的讲稿，是南方中国建筑之唯一宝典"。并谓："一九二九年受姚先生之托，整理此书，但因无暇，于一九三二年介绍该书与营造学社，经社长朱桂辛先生亲自校阅，但书中所用术语与北京官式建筑不同，其他图说难解之处也很多，想商榷义例，改订图释，又不是函札往来所能解决，迁迟数载，没有付印"。以我与姚先生同是苏州人，当时又在前中央大学服务，人地较宜，所以将此任务交给了我。

姚补云先生名承祖，字汉亭，补云乃其别字。他家世袭营造业，而苏州近数十年许多住宅、寺庙、庭园经他擘划修建的不少，晚年担任鲁班会会长，巍然为当地匠师的领袖。当时我一方面因刘师殷勤付托，另一方面也因此书是纪述江南建筑的唯一著作，不能任其湮没，所以接受了这项工作。

之后，就利用课余假期，着手编著、测绘、摄影等工作，并不断与姚先生商讨书中问题，到一九三七年夏脱稿，全文计二十四章，约十二余万言，图版五十二幅，插图七十一张。杀青之日，刘师携稿北上，不幸日寇侵华，营造学社内迁，由滇而川，因经费与印刷等关系，未能付印，我以兵乱和疾病，无暇过问。姚先生亦于一九三九年病逝吴门，不能亲见此书出版，真是一件憾事。

在漫长的十余年中，眼看着此书无法付梓。解放后在领导的重视与鼓励下，我再作一次整理，将全书精简为十六章，有些部分再加注解，文字约十三万五千余言，插图增为一百二十八幅，图版则并为五十一幅。唯原书"量木制度"一章，因解放后改变材积量制，与法令不符，故编入附录，仅供参考。

至于整理工作：原书约三万二千余言，附图式八十余种，可是书中所用术语仅限于苏州一地，未予注释，苦涩难解，且书中有若干歌诀，更不是初学通读的，所有图式悉循旧法，没有比例可循，不过表示式样形状而已。当时我的整理方针，以调查实例，另绘新图与补摄照片为前提。因此遍访苏州寺观、祠庙、住宅、庭园、择其式样结构与原书符合的，逐一测量，制为图版。计有文庙大成殿；玄妙观三清殿；虎丘云岩寺二山门；木渎灵岩寺；全晋、安徽、奉直等会馆；任、张、程、沈诸氏住宅；以及留园、怡园、沧浪亭、严家花园（毁于抗战沦陷时期）、网师园、拙政园、狮子林、耕荫义庄（汪园）等处庭园建筑；和城隍庙、火神殿、关帝庙等牌楼。复调查材料品质及出产地点。最后着手整理文字，对原文尽量保存，如用料、工限、歌诀为原书精

6-5　The preface of Yingzao fayuan by Zhang Zhigang (1), in the 1956 (original)

神所寄，未改只字，但务使文字通俗化，系统化，且能与图式结合为原则。初稿编成后，曾就商姚先生并得其同意。详细情形如下：

1.改编原文：原书体制，类匠家记录，不合现代需要，内除十四章工限，十六章杂俎系合并筑塔、驳岸、城垣组成。仅加以文字注释仍存旧观外，其余各章，皆重新编著。分别章节，依其术语及文意，演绎申论，使定义与举例明晰，易于了解。其第六章原分为三章，现并为厅堂升楼木架配料之例。第九章石作系合石作制度和石牌坊而成。第十二章原名"砖瓦灰应用诸法，及筑墙用砂及筑墙化纸筋用灰之例"，嫌其冗长，改为砖瓦灰纸筋应用之例。其他厘订之处，恕不备举。

2.补充遗漏：原书图式，所涉甚广，但说明过于简略，如牌科、梁架、装折等为建筑的主要部分，每仅举图例，未述制度；亦有仅有文字，未加图释、甚至有相互矛盾或遗漏的。该书因仅供当时讲授之用，可随时口释，所以与普通书籍体裁不同。改编时尽量避免这些缺点，几乎逐项增加新材料，或全部新编著，且务使图文相辅，无所偏废。尤以第四、五、八、十五等章为最。至于材料一项，原书仅举其名称，现已加注品质和产地。

3.订正讹误：苏州匠工所用术语，每以讹传讹，莫可穷究。兹就见闻所及，加以改正。例如"夹漏"之为隔扇；"搔亮"之为罩亮；"夺木"之为叠木；"樸"之为栱；"笋"之为榫；"沿"之为檐；"几"之为机。以及"面沿"、"今柱"、"同柱"、"字板"、"八风"等改为眠檐、金柱、童柱、字碑、搏风。"豆定椽"、"行香栱"、"橘囊砖"等改为头停椽、桁向栱、橘瓤砖等等。但是"川"、"界"、"宿腰"、"细眉"、"雨挞"等以吴语读之，显然与穿、架、束腰、须弥、雨搭相同，因为没有得到原著者的同意，同时苏州习用已久，因而没有擅改。

4.加编辞解：原书虽有释名一章，但无解释。现重加增订，改为辞解，置于篇末，使与清官式术语对照。

5.加添表格：凡原书可列成表格者，都改为表格，并将本人调查所得，一并列入。

6.重绘图版：原书图式，经测量实物后，加以增减，依实测尺寸，按比例绘成图版五十一幅。

7.加照片及插图：照片与插图共一百二十八幅，均系新增，俾与文字相对照。

最后本书原稿限于姚先生一家之言，虽经本人增补改编，但因能力有限，难免有遗漏或错误处，希国内专家指正。此书完成除爱人王蕙英始终参予工作外，经常蒙刘敦桢老师指正。第二次整理时因时间关系，所有图版经托南京工学院中国建筑研究室同仁协助绘印，其余插图照片，一部分因底片损坏，乃采用中国建筑研究室和南京工学院建筑系的资料，并承该系影印室朱家宝同志印放，并此致谢。

张至刚镛森　序于南京

一九五六年

6-6　The preface of Yingzao fayuan by Zhang Zhigang (2), in the 1956 (original)

From Zhang's words, we can understand that his edition was based on his own education.

He was farsighted to keep the calculations for preparing a building, the timeframe of the building, and the mnemonic rhymes, treating them as the spirit of the book. Now we can find thirteen mnemonic rhymes in his book. Most of them are to explain the order of wooden parts of different building styles. The calculations refer to materials and labour. As the leader of a building team, only the master carpenter was well-informed about the calculations for the buildings, in order to make a comprehensive arrangement. With this knowledge, the timeframe of building could be arranged without doubt.

We have to admit the value of Zhang's work in simplifying the original text, and adding explanations about the system of building styles, terms and phrases. Otherwise the book would be too difficult for us today. He gave a modern logic to the book, from introducing building styles to describing the important parts of the structure, analysing the details, and adding introductions to other kinds of work at the end, including those of plasterer, stonemason and gardener.

We can see that Zhang was very careful to correct errors in words. Most of the words he changed were wrongly written characters because of the limited education of the carpenters, and the Wu dialect. Some of them, if kept in the original, would have caused misunderstanding. Even so, with Yao's permission he kept several terms in carpenter's dialect, to show his respect for the craftsmen, and keep the regionalism of the technical terms.

The chapter about interpretation of terms and phrases especially, like a dictionary for the reader, gives us an opportunity to compare the carpenter's dialect with the formal terms or codes in the building standards produced by the government. That makes a link between official building and the vernacular; also between a carpenter's manual and national building standards; and thirdly a link between ancestors and offspring of the "Xiangshan Group" craftsman.

Using the tabulation in articles is one of the modern scientific methods to analyse the research, which makes all the dates clear to compare, calculate and understand. Zhang used at least eighteen forms to show the measurements and the numbers of each part of a building.

Furthermore, all these prefaces show that the relationships of Yao with Zhang, Liu, and Zhu. Zhu were like that of an outside evaluator or expert, giving advice to others. The other three person made a group, in some ways like a mini Beaux-Arts studio: the studio master was Yao, assistant was Liu, the student was Zhang. The projects were organized around the manuscript, the organization, and the drawings, with tremendous rigour applied to the idea of an architecture research book on a Chinese traditional local building structure and skills. In another way, the three of them fulfilled the idea of Confucius who said: "In a party of three there must be one from whom I can learn. 三人行必有我師焉." They helped and learned from each other: Zhang and Liu helped Yao to transfer his manuscript to an academic book; at same time, Yao taught Liu and Zhang his life experiences of Chinese traditional buildings. Only with Yao's help, could Liu teach the National (Chinese) Building Method instead of Yao when the school moved to Nanjing. And Zhang could gain the opportunity to investigate, survey and record the typical buildings in Suzhou in that era. They provide the best example of co-operation between carpenter and architects.

6.2 The Mnemonic Rhymes

Carpenters should not only know how to choose the style of each building, but also how many there must be of each part in the structure; how much timber is needed to make the parts; how to choose and use the logs; and the difference in size of these logs. Without further education, the carpenter's apprentice would try to remember some classical carpentry mnemonic rhymes from the very beginning. Those rhymes are easy to remember, having only a few words, but describing all matters.

Totally 13 rhymes are recorded in the *Yingzao fayuan*. Most of them are in *Chapter Two: The Structures of Single-storey House and Double-storey House*, which is an overview of basic structures of common buildings. Besides two figures of a single-storey house (figure 6-8)[423] and a double-storey house (figure 6-9)[424], it gives three rhymes of different sized structures for each type of house. Then there is one rhyme for counting timber, one for choosing logs, the other four for keeping the proportion of the whole building and courtyard. In *Chapter Three: Raising the Roof Frames in Order Overview*, another rhyme is recorded to remember how to choose the curve of the roofs of different buildings. Accompanied by the figure of the section of *ti-zhan* 提栈[425], the rhyme is understandable.

The mnemonic rhymes are simple and brief. It is understandable when an apprentice is learning it in practice, with a master carpenter teaching and explaining every meaning of it. But it is really obscure to a reader who is total innocent of carpenter skills or building standards. That is the reason Zhang Zhigong gives an exhaustive explain for every rhyme he recorded. The translations of rhymes below are based on Zhang's explanations.

6.2.1 Rhymes of basic structures

For instance, the simplest structure is a single bay in the total width with six *jie* (bays) in the total length of a single-storey building 一開間深六界平屋, which is the right one at the bottom of figure 6-15. The rhyme uses only 56 Chinese characters, just like Classical Chinese Poetry (seven characters make a line, totally eight groups), to point out the numbers of each part of the structure. It says that[426]:

"One bay has two gable sides and two main columns,	一間二貼二脊柱；
Four *bu* (span) columns, four aisle columns, four dwarf posts.	四步四廊四矮柱；
Four double-*bu* beams and eight short tenoned beams on gable side,	四條雙步八條川；
Two lintels between *bu* columns and the same for aisle columns,	步枋兩條廊用同；
Six ends of short ribs between ridge columns and *jin* columns,	脊金短機六個頭；
Seven purlins and four through-ribs on the facade side,	七根桁條四連機；

[423] See Chapter Seven, p. 181.
[424] Ibid.
[425] Yao Chengzu, Zhang Zhigang, ed., *Yingzao fayuan*, p.189.
[426] Ibid., p.7.

Six *jie* need one hundred and two rafters,	六椽一百零二根；
Four sets of end liners and intermediate liners in use.	眠簷勒望用四路。”

Just as with the above rhyme, two others are quoted for two and three bays in total width with six *jie* (bay) in the total length of single-storey building 兩或三開間深六界平屋; three other longer ones are used for one, two, and three bays in total width with six *jie* (bay) in the total length of double-storey buildings. The first two rhymes for double-storey buildings have 84 Chinese characters, four more groups than the former. The longest one is the last one for three bays of a single-storey building, which has 20 groups, 140 characters. The one for the double-storey building has 16 groups, 112 characters. Normally, the bigger the building, the longer the rhyme is, because many more different parts need to be explained, including the eaves.

6.2.2 Rhymes for timbers and logs

The rhyme on selecting the logs and judging the materials says[427]:

“How to judge the materials of a building structure?	屋料何谓真市分？
When the removal of the outer layer of the timber results in the loss of less than ten percent it can be called good (The first-grade).	围篾真足九市称（上等）；
The outer layer of the timber is around twenty to thirty per cent waste and can be called common (The medium grade).	八七用为通行造（中等）；
The outer layer of the timber is about forty to fifty per cent waste on the rules and can be called basic (The low-grade).	六五价是公道论（下等）。
Wood grows over time, based on the Five Elements and Five Tones,	木纳五音评造化，
Metal and water are the “mutual generation” of the wood.	金水一齐贯相生。
The nanmu, the hickory, the schima wood,	楠木山桃并木荷，
the cypress, the beech, the camphor wood, and the chestnut wood,	严柏椐木香樟栗，”
they are all hard wood in straight shape, easy to use.	性硬直秀用放心，
The judgments of these materials can allow for fifteen per cent less than the order above.	照前还可减加半（即除去加一半）。
Only the cedar wood, the pine wood,	唯有杉木并松树，
The Juniper wood, the tallow wood, and the catalpa wood,	血柏乌绒及梓树，
They are soft woods, and one has to add to the size when using it.	树性松嫩照加用。
Pay attention to the knots, warts, and worms' holes on the timber.	还有留心节斑痈，
At the knot it is easily broken; the worms' holes are never single;	节烂斑雀痈入心，

[427] Yao Chengzu, Zhang Zhigang, ed., *Yingzao fayuan*, p.10

the wart comes from the pith.

The scar always comes with a hollow or broken ends, but the worst thing is inner rot. 疤空头破糟是烂，

The wooden beams, whether in the total width or length, are chosen in respect to the bending strength. 进深开间横吃重，

Do not use timber with the above problems to make a beam. 务将木病细交论。”

There are two rhymes about timber in the book. The above one is a guideline on considering how to use different kinds of wood. Of course, the hard wood, such as machilus nanmu 楠木, camphorwood 樟木, and so on, are good to use, but too expensive for general use; on the contrary soft woods, such as cedar wood, pine wood, and tallow wood are more in use.

The other rhyme is about the ratio of each part of structure to the circumference of the timber chosen to make it. For example, the perimeter of a main beam is 1/5 of the total length of building; and the circumference of a sub-beam is 1/10 of the total width of building. The size of a side column is 4/5 of that of a main column; and the height of a lintel is 1/10 of a peripheral column. In this rhyme, it also mentions that the best carpenters leave the fewest chips. These ratios were based on experience carried down from ancestors, and made up the basic rules of the Chinese traditional timber building systems.

6.2.3 Rhymes on keeping the proportion

In China, the central axis is important for all kinds of buildings. All the rooms on the axis are called "the main room" or "main bay" 正間, which is always wider than the other rooms on both sides. For a mansion in the Jiangnan area, in the south of China, from outside to inside, the buildings on the main axis are as follows: Main gate, Tea hall, Main hall, Double-storey building. The meeting hall and study hall are set to the side, as the wing-buildings. Kitchen and service rooms are set behind all the other buildings on the end of each side. This example was shown as the first Plate of the *Yingzao fayuan*, as well as in the original drawings by Yao Chengzu. The heights of all the buildings from the ground to the bottom of the eaves, have their own standard. The mnemonic rhymes for the height standard says[428]:

"The height of the Tea Hall is ninety per cent of the Main gate, 門第茶廳簷高折（茶廳照門樓九折）；

and the height of the Main hall is 1.2 times the Main gate. 正廳軒昂須加二；

The height of ground floor of a double-storey buildings is ninety per cent of the Main gate, while that of the first floor is eighty per cent; 廳樓減一後減二；

The kitchen can be as high as the Tea hall or the Main gate, both will be good. 廚照門茶兩相宜。

The height of the side buildings is ninety per centre of the centre ones, 邊旁低一樓同減；

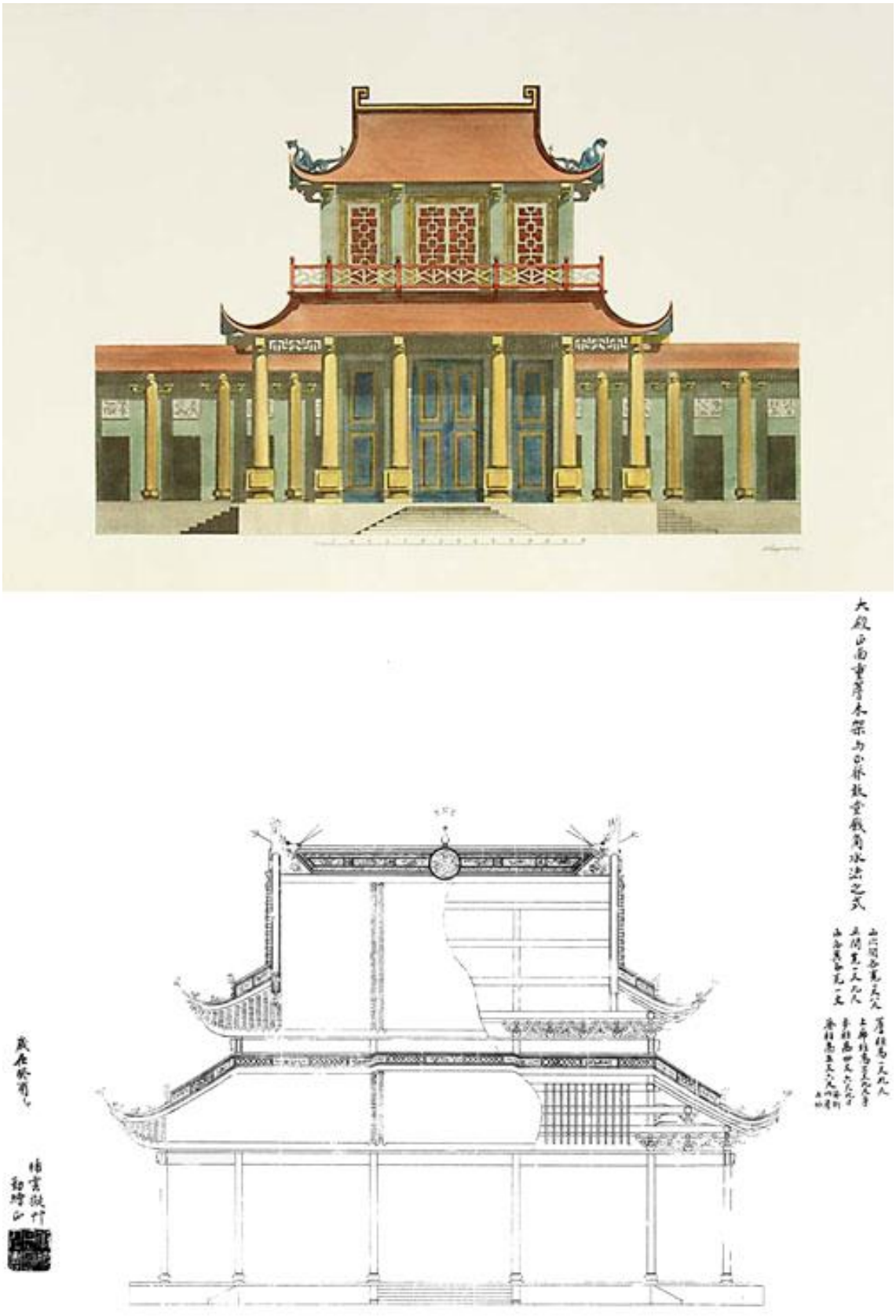
[428] Yao Chengzu, Zhang Zhigang, ed., *Yingzao fayuan*, p.11.

including double-storey buildings;	
The ground level of buildings gets higher and higher from the first courtyard to the last.	地盤進深疊疊高。
The highest building is the double-storey building; it should be placed at the back of the residence.	廳樓高止後平坦；
If more than one mountain forms the roofs,	如若山形再提步，
not let the back one be lower than the front.	切勿前高與後低。
All the builders should be reminded of the first rule of buildings:	起宅興造切須記：
The centre main bay of all the buildings is the widest one,	廳樓門第正間闊，
The height of the building is eighty per cent of the width of the main bay.	將正八折准簷高。"

In this rhyme, the last sentence is very important. There is another idiom which is well known in China, it describes this most typical feature of Chinese traditional building is that: "The height of the eave columns would never be more than the width of the central bay 柱高不越肩廣." Most Chinese style buildings which were designed by foreign architects abroad, are rejected by the Chinese people at first sight, because of the unusual height of the eave columns. For instance, if we compare the famous illustration of a temple from Sir William Chambers "*Designs of Chinese Buildings, Furniture, Dresses, Machines and Utensils*" (London 1757)[429] with Yao's real design (figure 6-7), we can see that the eave columns destroyed the whole feeling of the building style. But we cannot blame Sir William Chambers for this misunderstanding. He was a foreign architect, not a Chinese. Even some Chinese architects made the same mistake in their designs. Because they were not carpenters, the rhymes or the idiom were not in their education, so they did not pay attention to this first rule of Chinese buildings. Except for the building materials, the ratio of height to width of the colonnade reflects the basic different building rules. The Chinese buildings are sprawled across the ground, while western ones rise from the earth, which came from a different aesthetic standard.

The other three rhymes controlling the proportion of the whole building and courtyard tell us that the size of courtyards between the buildings on the central axis also has a specific standard depending on the depth of the main hall. The ratio of single-storey building, hall and temple are different. In normal conditions, the width of a courtyard is the same as the depth of the central main room, but the one in front of the main hall is twice the depth. The courtyard in front of the main hall of a temple is triple the depth.

[429] There are more descriptions on Chinese buildings designs by Sir William Chambers (1723-1796) and others in Tony Atkin's "Chinese architecture students at the University of Pennsylvania in the 1920s", in *Chinese Architecture and the Beaus-Arts*, Jeffrey W. Cody, ed., pp. 46-47.



6-7 Comparing designs for a temple by Sir William Chambers and Yao Chengzu

6.2.4 Rhymes on raising the roof frames in Order

Ti-zhan 提棧 is rising the roof frames in order. In the *Yingzao fashi* 營造法式, "Treatise on Architectural Methods" or "State Building Standards" in Song Dynasty, it was called *ju-zhe* 舉折; while in the *Gongbu gongcheng zuofa* 工部工程做法, "Building Methods of the Board of Works" in Qing Dynasty, it was called *ju-jia* 舉架. The word "*ti* 提" means rising, "*zha*n 棧" means frame. In the same way, "*ju* 舉" refers to upper, "*jia* 架" refers to frame, and "*zhe* 折" means folding. Every term of this roof structure, no matter when and where, using the formal or the folk name, is pointing out the most important feature of Chinese carpentry building: The roof is not flat, but sloping, and seldom straight, but curvilinear.

To make a curved roof, you just need to change the folding rate on the purlins of each column: from outside to centre, the rate is getting higher. The rate can be used from three and a half to ten. For example, the ratio of rising height to the depth of the bay is 4 to 10. The recorder is only the word "four", and the folding rate is called "four *suan* 算". The Chinese word "*suan* 算" means calculate. From the three and a half *suan* to the six and a half *suan* is suitable for the normal halls, the higher rate is for the official halls, and the ten *suan* is only for pavilions.

A carpenter's rhyme was recorded in modern edition Chapter Three. It runs:

"Normal building six *jie* uses two (rates' different);	民房六界用二個；
The double-floor hall and cylindrical inner upper structure hall uses front deputy rafter;	廳房圓堂用前軒；
Seven *jie* uses three (rates' different);	七界提棧用三個；
And eight *jie* of official hall uses four (rates' different).	殿宇八界用四個。
The beginning of the folding rate is based on the depth of *jie*,	依照界深即是算，
From hall to official hall the rate is raised.	廳堂殿宇遞加深。"

The rhymes are treasured magic keys for oral education. They are procedural in nature, recording a construction process that evolves with time and needs to be accomplished in stages. In that way they are quite different from a set of architects' drawings, which represent the building as if it is already achieved. This is partly because the designer is also the maker, but it also reflects a different way of thinking, in which the problems of each stage can be tackled and if necessary readjusted one by one. The carpenters were familiar with the rhymes, and built the buildings with great facility. They could be flexibly adapted according to the actual situation, when budgeting, selecting materials, and building. All the craftsmen were learning from practice. At that time, although most of the apprentices had received a popular education in literacy and mathematics[430], they still needed the rhymes to help them remember and confirm their skills.

The rhymes can be divided into two parts: one has rhyming ends to each sentence (normally two lines) in the rhyme; the other has a set rhythm like poetry. The first sentences of "rhyme on

[430] See Yao, Chengzu, Zhang Zhigang, ed, *Yingzao fayuan*, Chapter Three, p.73.

selecting the logs and judging the materials"[431] is of the former type. The end characters in the sentences are: "*fen* 分", "*cheng* 稱", "*lun* 論", "*sheng* 生". But most of rhymes are of the latter type. They do not have rhyming ends to each sentence, but a set rhythm like poetry. Each of the rhymes is in lines of seven characters, with matching of both words and sense in at least two sentences. Those which are full of number rhymes are just like the multiplication table, makes them memorable by the set rhythm. For example, the rhyme of basic structure is all about the numbers of the different parts of the structure.

The rhymes make complicated things simple, earn the trust of the carpenters, and imbue them with confidence. From the above examples, we can deduce that far more rhymes must have existed in the past. But because they were lost through changes in time, the inheritors could not know more rhymes than were in the *Yingzao fayuan*. The rhymes are truly helpful for the carpenters, but useless for others, such as architects. Because all these rhymes were combined with practices on site, for those who are not carpenters, even if he or she could remember the "rhyme on selecting the logs and judging the materials", they still would not know how to choose the log and materials. They would have no sense of the wood, of the difference between materials, and of how to choose suitable ones. For a carpenter who has grown up with the rhymes which guide them on how to use different wood materials, it is unforgettable. Thanks to Zhang's great work, these thirteen rhymes in the book are the only record of them for the Xiangshan Group carpenters.

Other rhymes on the rituals of building processes are included in Shen Li's thesis.[432] Since these rhymes have nothing to do with how to build a house, they are not recorded in the *Yingzao fyuan*. But in fact, the rituals are really important not only for good wishes of both the owner and carpenter, and also to express the love of the new building in its reverence for nature and the carpentry vocation. The rhymes help carpenters pride in their work.

6.3 The Dialects and Jargons

From the prefaces of the *Yao Chengzu Yingzao fayuan tu*, the essay of Zhu Qiqian, and the preface of the second edition of *Yingzao fayuan* by Zhang, we know that the dialects of Yao on the traditional carpentry building terms caused numerous confusions and misunderstandings for modern architects. Zhang Zhigang gave plenty of examples in his preface of *Yingzao fayuan* to explain his work on changing the carpenter's dialects to the understandable modern architectural terms. He made the changes carefully and seriously, checked every term's meaning with Yao, and changed it with his permission, which made the work not only valuable but also authentic.

The master-apprentice training was the main educational mode for craftsman, both in the West and in the East. In imperial China, in the Jiangnan area, in places such as Shanghai, Suzhou, and Ningbo, learning a craft skill used to be called "learning a livelihood 學生意", because acquiring craft is a skill that people would live by. The family and manufacturing values of the

[431] See p.159.
[432] Shen Li, "A Study of Historic Evolution of Xiangshan Group Carpenters 香山幫匠作系統變遷研究", pp. 113-116.

agricultural society made the inheritance of skills absolutely secret, unique and exclusive.

Most crafts businesses had their "trade code 暗語" and jargon 行話 to keep their secrecy. In the Wu area, the code and jargon were called "切口 *qie-kou*", "Business code", which meant using some special Chinese characters instead of numbers, through a series of pliable changing rules, in order to keep price or business bargaining secret. Jargon was used in crafts and industry, using metaphors to refer to the point, which was often impenetrable to an outsider. According to the local chronicles of Suzhou, the industries of Chinese medicine 中藥行, silk and dry goods 綢緞行, local native products 山地貨行, and the department store 百貨行 each had its own code and jargon[433]. In the investigation of the Xiangshan Group craftsman by local writer Li Zhoufang 李洲芳[434], he gave several examples for the carpenter's jargon: a craftsman 匠人 was called "*liang-xiang-niu-jin* 兩象牛筋"; a carpenter 木匠 was called "*mu-jiao-liang* 木角兩"; a plasterer 泥水匠 was called "*shui-luo-li* 水落裡"; a master 工頭 was called "*she-liu-zi* 蛇流子"; a master's assistant 工頭助手 was called "*tie-bi-shou* 鐵臂手"; an apprentice 小工 was called "*ye-long* 葉龍", etc.

Xiangshan Group craftsmen had countless *qie-kou* in their work. It seems everything had an unexpected name. This was an interesting phenomenon of both language and culture. The jargon-building technique mainly consisted of slowly pronouncing 緩讀, Chinese phonetic symbols 反切, hiding the character 藏字, character separation 拆字, homonym 諧音, metaphor 隱喻, metonymy 借代 or explaining a word in another way. For example, "*mu-jiang*" (carpenter) was changed to "*mu-jiao-liang*", which was a usage combining slow pronunciation and Chinese phonetics. When you speak "*mu-jiao-liang*" fast, it returns to the pronunciation of "*mu-jiang*", even if you have a Wu dialect accent. Using two Chinese characters to indicate the pronunciation of another Chinese character is a traditional method for Chinese phonetic symbols. The first Chinese character has the same consonant as the given character and the second has the same vowel. So here "jiang" is changed to "jiao" and "liang". Water was an indispensable part of plasterers' work. "*shui-luo-li* 水落裡" means "inside water". It was metonymy to refer to the craftsmen's work. The master's assistant was the right hand of the master. "*tie-bi-shou* 鐵臂手" means "iron arms and hand". This again was a metaphor for the requirement and contribution of master's assistant. A master must be a capable person who can deal with lots of difficult situations, not only in the work, but also when dealing with different people. Masters were called "*she-liu-zi* 蛇流子", slippery snake, which was metonym for their operational capability.

Although there was a lack of written records, oral transmission from master to apprentice over hundreds of years made the trade code and jargon development endlessly richer. The coteries could communicate in the *qie-kou*, while an outsider could not understand a single word. It was an antiquated way to protect a craftsman's skill in an agricultural society. Furthermore, carpenters could talk in *qie-kou* to discuss business or complain about the owner without fear of eavesdropping. This condition was broken when the modernism came to China, and the carpenters' union was opened to the craftsmen coming from other places.[435] The uses of *qie-kou* diminished.

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433 See the *Suzhou local chronicles selection anthology* 蘇州地方誌史志資料選集 No. 21, 23, 26, and 33. < http://www.dfzb.suzhou.gov.cn/zsbl/List/43_1.Htm > [accessed 20 February 2016].

434 Li Zhoufang 李洲芳 was born in 1931. He was a local writer who worked in culture, antique, and landscape departments, and was known as "living map of the Wu area" 吳地活地圖. Li Zhoufang, article 1995.

435 Chapter Three, pp.40-41.

When Li Zhoufang investigated in 1995, only a few of them were still remembered.

Because of this limitation by communication vehicles, a crafts group was a local skill organization consisting of people in the same craft and from the same hometown in imperial China. The core of the organisation was first the master-apprentice relationship, then the blood relationship, and finally the neighbourhood. In order to avoid competition, craft groups or unions set strict rules for their members. Craft skill was the craftsman's meat and potatoes. Just like the medieval guild in the West, they needed control the number of people entering the carpentry in local area, to keep the basic benefit of craftsmen. As noted in Chapter Three, the master craftsman would only accept an apprentice on strict terms. The master-apprentice relation would make up a pedigree. The dialects and jargon were another way to keep the craft skill inside the group. In another words, consanguinity and geopolitical relationship formed the traditional Chinese craftsmen's group. These relationships were broken step by step in modern China.

Conclusion of Chapter Six:

This chapter has focused on one specific research question following the title: What are the carpenter's imprint and architect's adaptation in the texts of the *Yingzao fayuan*?

Through translation and analysis of the prefaces of two editions, the mnemonic rhymes in the modern edition, and the dialects and jargons of the Xiangshan Group carpenters, we can simply answer the questions as follows: The jargon was not shown in the modern edition, and no longer used by the Xiangshan Group in modern China; The dialect carpentry building terms were changed to more normal modern architecture terms, which could be understood by most people. The mnemonic rhymes on the basic rules of carpentry buildings were kept in the modern edition.

The preface of Chen Congzhou, the essay of Zhu Qiqian, and the preface of Zhang Zhigang, repeatedly told the reader that the original book (carpenter's manuscript) of the *Yingzao fayuan* was not easy to understand as it was full of carpenters' secret skills concealed in carpenters' codes and dialects. For a family secret skill book, that was a good method to keep the experiences within the apprentice relationship based on consanguinity and geopolitical relationship. For a text book, that was not big issue, because even if the student or the learner had any questions or confusions, they could discuss them with their teacher, the master carpenter Yao Chengzu, face to face. But for a modern architectural academic research book study on local carpentry building skills, the dialect terms and carpenter's jargon (or code, or "*qiekou*") became to the biggest obstacle. The reader cannot discuss it with the author. An academic research book should be clear enough to be understood by anyone without knowledge or educational background on this area.

The jargons disappeared as time passed on. The more open the trade, the less jargon in the business. The carpenter's dialect building terms were changed by the architect, with careful improvement, so that the reader today can still find, understand, enjoy, and be interested in the modern edition of *Yingzao fayun*, such as "the mandarin duck style hall 鴛鴦廳". The term "mandarin duck style" in Suzhou dialect is frequently used colloquially to mean things that "differ

only in small points", a mixture of two different types of the same category. For example, people who wear a pair of socks in different colours will be called the person who are wearing "mandarin duck style" socks. The special structures of the mandarin duck style hall have "one room with two styles of deputy rafter beams 一屋兩翻軒", which was exactly the dialect building term for the Xiangshan Group. Of course, the mandarin duck has some other good symbolic meanings, such as a life-time couple, which made this buildings style more welcome in that era.

The mnemonic rhymes are very popular in oral education for craftwork. All the detailed rules, basic scales, number of structural elements, and other important information are kept in the rhymes. It is really useful for an apprentice to know all the necessary mnemonic rhymes to direct his work, and finally they became part of his career memory. In fact, there are many other mnemonic rhymes on constructions, on the rituals, on the "building magic", and so on. Shen Li recorded ten mnemonic rhymes of rituals of "putting the plinths 平磉" and "putting the main ridge purlin 上樑".[436] The former is a symbol of starting work by the masons, and the latter a symbol of ending work by the carpenters. Ronald G. Knapp gives an example of the *Lu Ban jing* as the "building magic". There also some rhymes on the drawings, taught how to make the "building magic".[437] Almost half of Klaas Ruitenbeek's the *Carpentry and Building in Late Imperial China* is research on the "building magic" rhymes.

Zhang Zhigang, as an architect, paid more attention to the rhymes reflecting knowledge of buildings than to others on rituals or "building magic". The modern edition of *Yingzao fayuan* keeps 13 mnemonic rhymes of basic rules on structures of traditional common buildings. Deep understandings are needed to avoid breaking basic principles. For the apprentice, every rhyme would be used again and again in their career; they needed to say them easily and used them constantly in their work. For the students, the rhymes would be helpful for their design, when they hoped to do a Chinese traditional style building. For the reader, who is interesting in the local carpenter's skills, the rhymes are good examples to help in understanding carpenters' work quickly.

By answering the specific research question on the text of *Yingzao fayuan*, we have seen how a carpenter's textbook became an architect's research book. Different requirements and situations made for different choices by carpenter and architect.

[436] Shen Li, "A Study of Historic Evolution of Xiangshan Group Carpenters", pp. 111-116.
[437] Ronald G. Knapp, *The Chinese House*, p.66.

CHAPTER SEVEN

What the Carpenter Lost and the Architect Found in the Drawings

The original drawings reflect the attention of traditional carpenters;
The modern redrawings follow the standards of modern architecture.

In this chapter, the drawings in the two editions of the *Yingzao fayuan* will be compared and analyzed, to explain the specific conflicts and harmonies between traditional carpenters and modern architects in their pictorial expressions.

The original drawings, drawn by the local traditional carpenter, reflect the educational level, cultural standing, and working attention of Chinese traditional carpenters. There are boundary lines, not precisely to scale, noting the measure in Chinese units with Chinese characters. None of these can be accepted by modern architecture. That's the reason Zhang Zhigang had to redraw all the drawings, to make them follow the standards of modern architecture, and be understandable through pictorial means.

These changes must lose some typical characteristic of carpenters, while adding modern understandings for the attention of architects.

7.1 The Chinese Measures and Suzhou Numerals

7.1.1 The Chinese measures

Chinese traditional carpenters used different kinds of ruler for different purposes. In the *Lu Ban Jing*, a book of introduction for a non-governmental craftsman's working standard and record of their working experience, one finds advice to carpenters on how to use the Lu Ban *chi* 鲁班尺, Lu Ban ruler. The Lu Ban ruler is a special tool of the carpenter, used together with *quchi* 曲尺, and the carpenter's square 角尺. Klaas Ruitenbeek reproduces the plate and explains in his *Carpentry and Building in Imperial China: A Study of the Fifteenth-Century Carpenter's Manual Lu Ban jing* [438]:

"*The system described in the Lu Ban jing makes use of two footrules (Plate 10). The first is the quchi 曲尺, i.e., the graduated shorter leg of the carpenter's square. It is one chi long and subdivided into ten inches (cun). Each inch is designated by the name of a colour……*

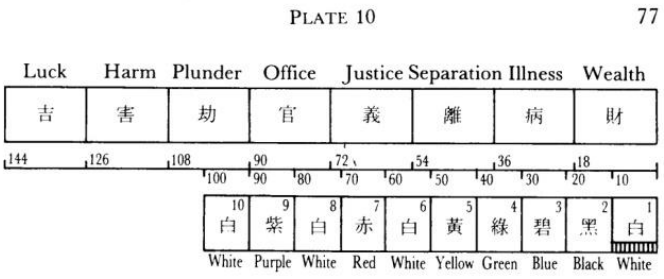
The other foot-rule is much longer than the common chi, measuring 14.4 cun, or about 43 cm.

[438] Klaas Ruitenbeek, *Carpentry and Building in Imperial China: A Study of the Fifteenth-Century Carpenter's Manual Lu Ban jing*, p.76 & 90.

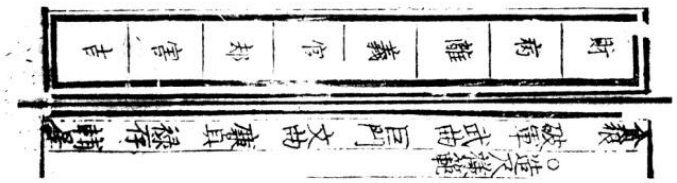
It is called the 'true footrule of Lu Ban' (Lu Ban zhenchi). It is subdivided into only eight inches, each measuring 1.8 cun on the carpenter's square rule. Again the inches are designated by a series of symbols, namely……"

"*Foot-rules and measuring systems*

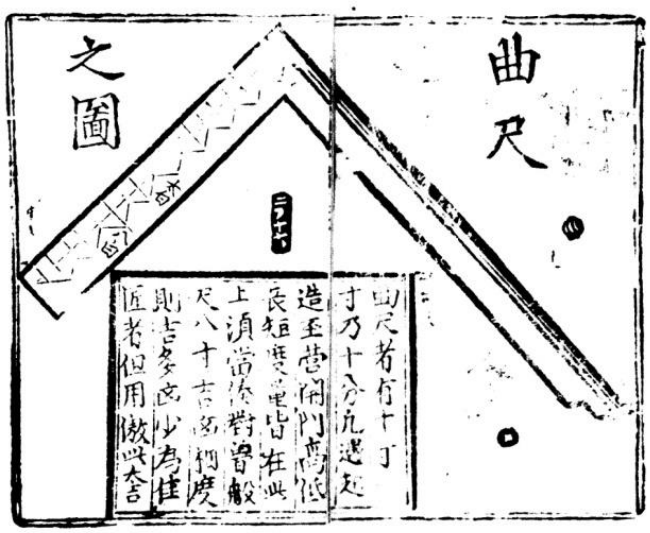
The measuring system of the Lu Ban jing, in which two foot-rules are used simultaneously, each with favourable and unfavourable inches, is not the only one which existed. So far, I have found at least twenty different types of foot-rule mentioned in texts from the Yuan to the Qing dynasties or still in use today."



1. *Lu Ban chi* and *quchi*.



2. Oldest known illustration of the *Lu Ban chi* (*Shilin guangji*, *bieji* 6:5a).



3. Carpenter's square (*Lu Ban yingzao zhengshi* 16ab).

7-1 Klaas Ruitenbeek's Plate 10 in the *Carpentry and Building in Imperial China: A Study of the Fifteenth-Century Carpenter's Manual Lu Ban jing*.

From his statements and the plate (figure 7-1), we can understand that there were at least two measuring systems in a carpenter's everyday work. If we kept looking, more different carpenter's rulers would be found. To understand this complex system of carpenter's rulers, it is essential to know something of the Chinese measuring system.

As in most countries in the world, before the metric measuring system came from the West in the 1900's, China had its own measuring units of length: *fen* 分, *hao* 毫, *cun* 寸, *chi* 尺, and *zhang* 丈, which were based on the relative lengths of body parts, especially the foot and the finger segment. The classifiers of Chinese length units began in the Qin Dynasty (221-207 B.C.), and developed and matured in the Western and Eastern Han Dynasty (206 B.C. - 220 A.D.). *Cun* is the basic unit used for measuring length, which is 1/10 chi, analogous to an inch. In the *Commentary of Gongyang* 公佯傳,[439] He Xiu 何休 noted: "*Pressing the bent middle finger makes one cun.* (側手篇膺，按指為寸)". *Zhang* is a length unit which is 10 *chi*. In *shuowen jiezi* 說文解字,[440] it says: "10 *chi* make one *zhang* (丈，十尺也。)" Its length was derived from the height of a normal male. The Chinese word "man" is *Zhang Fu* 丈夫, supposedly "a male with the height of one *zhang*". Not until 1929 were measures unified between the Chinese system and the metric system, when 1 *zhang* became 3 metres.

Although explanations in the texts are clear, the measurement of length changed with locality and time. In Chinese history, there were three attempts to unify weight, length and volume: in the Qin dynasty, the Han dynasty, and the Tang dynasty. Each time there was a new unified official foot (*guanchi* 官尺) published. The Han official foot was shorter than the Qin official foot, the rate was 1:1.2. It was mentioned in the *Huai Nan Zi* 淮南子[441], which was written in the Western Han dynasty (209 B.C.-9A.D.) that the Lu Ban *chi* is 1.2 times the foot-rule. In the Tang dynasty, for the first time by official permission, two length systems could be used together, called "big ruler 大尺" and "small ruler 小尺". The *Six Ministries' Orders of Tang Dynasty* 唐六典[442] ordered the length: "*In measurements of length, the width of north middle size millet is one fen. Ten fen is one cun; ten cun is one chi, twelve cun is one big chi; ten chi is one zhang.* 凡度，以北方櫜黍中者，一黍之廣為分，十分為寸，十寸為尺，一尺二寸為大尺，十尺為丈。" It also ordered that the big ruler be used for everyday life, including building; while the small ruler be used only for making clocks, measuring Chinese medicine, and making clothes. The recorders mentioned the 1.2 times between different length measures. Furthermore, in the encyclopaedia *Shilin Guangji* 事林廣記, "Extensive Notes from the forest of Facts", it said: "*A Lu Ban chi with*

[439] In an ancient book of traditional Chinese medicine *Nanjing variorum* 難經集注 (original written by Wang Weiyi 王惟一, in the Song Dynasty) Volume One, it explains the measure of "cun 寸", "chi 尺". And noted as "何休注公羊傳雲。側手為膚。按指為寸。" The *Commentary of Gongyang* 公佯傳 is part of the *Spring and Autumn Annals* 春秋, which is the official chronicle of the State of Lu covering the period from 722 B. C. to 481 B.C.. Wang Jiusi 王九思 (1468-1551), ed. "*Nanjing variorum* 難經集注", Chinese Text Project 中國哲學書電子化計畫 < http://ctext.org/wiki.pl?if=gb&chapter=448385> [accessed 24 February 2016], No.45.

[440] Xu Shen 許慎 (58-148), *Shuowen Jiezi* 說文解字, "Explaining and Analysing Characters", often shortened to *Shuowen*, was an early 2nd-century Chinese dictionary from the Eastern Han Dynasty (25-220). And it was explained by Xu Xuan 徐鉉 (916-991), republished in 1873.

[441] Liu An 劉安 (179 -122 B.C.), ed. "*Huainan zi* 淮南子", Chinese Text Project 中國哲學書電子化計畫 < http://ctext.org/huainanzi/lan-ming-xun> [accessed 20 February 2016].

[442] "The *Six Ministries' Orders of Tang Dynasty* 唐六典", Vol. Three: *Shangshu Hubu* 卷三·尚書戶部, Chinese Text Project 中國哲學書電子化計畫 < http://ctext.org/wiki.pl?if=gb&chapter=726245> [accessed 24 February 2016], No.30. The *Six Ministries' Ordinances of Tang Dynasty* 唐六典 is a standard of government's administrations, which was published in 738.

a length of 1 chi 2 cun according to the official foot, is divided into eight inches of equal length."[443]

From the above, we can see the *Lu Banchi* is 1.44 times of the *quchi,* proving that the *Lu Ban chi* was a very ancient carpentry tool. It might have been created before the Qin dynasty. When the Qin official foot was established, the *Lu Ban chi* was kept as a special tool of carpentry for ritual use in Daoism. The length of *Lu Ban chi* was 1.44 times that of the Qin official foot; and 1.2 times the Western Han dynasty official foot. Then it got its rightful place in the Tang dynasty as "big ruler". Although as Klaas Ruitenbeek mentions, the meaning, name, and length of *Lu Ban chi* have differed with the vicissitudes of time, the rate between *Lu Ban chi* and *quchi* was preserved. The length of *quchi* was based on the official foot and local tradition.

Briefly speaking, for every piece of carpenter's work, they had two measuring systems, *quchi* and carpenter's square was the measure for the building; while the *Lu Ban chi* was the measure for ritual checking of whether it was favourable or unfavourable. The *Lu Ban chi* is longer than *quchi*, and still used by carpenters today. Without knowledge of the changes in the Chinese measuring system, some carpenters used the Lu Ban ruler as the diagonal line length of the square of *quchi*. That can be another way of using the *Lu Ban chi* in practice.

The Chinese measure of double ruler might be a great surprise for the westerners. If only for the building purposes, there is no need to make thing complex. The simpler and clearer standards are, the easier and quicker to build a building. The reason for keeping use double ruler can be justified as for ritual purpose: In some places, the house-warming ritual involves the carpenter explaining at length the propitious dimensions. Even not explaining in the ritual, the carpenter always need to discuss the length propitious dimensions with the owner with several times to make sure satisfied their employer. It is part of master carpenter's work. Carpenters surely would kept it a strong social purpose and needs. Double ruler suited them to make the spiritual dimensions different from the practical ones, and make other people respect carpenter's work.

All the drawings in the *Yao Chengzu Yingzao fayuan tu* are noted in the Chinese measure for buildings. However, most of the drawings in the *Yingzao fayuan* in the version redrawn by Zhang Zhigang, are noted in the metric system, but with line scales both in the *Lu Ban chi* and the metric system. Zhang's notes are based on his survey, and must be more reliable for the existing situation of the buildings, and clearer for readers, especially for the architects. This tiny change led to a big loss of the meaning of numbers in Chinese. There are many secret lucky or unlucky beliefs about numbers in every culture, but especially in China, where they are involved in a whole series of rituals about building. In Klaas Ruitenbeek's book, he gives a section explaining Joinery and Chinese measurements using numbers.[444] While the measure system converted relatively easily from the Chinese traditional system of lengths into the metre system, the specific meanings of numbers in Chinese traditional building were lost. Those meanings of numbers combined sometimes with the use of Lu Ban ruler carry the "building magic" of carpenters.

[443] Chen Yuanjing 陳元靚 (1200-1266), *Shilin Guangji bieji* 事林廣記別集, "Extensive Notes from the forest of Facts", Vol. 5 卷之五, *Lu Ban Chifa* 魯班尺法, No. 59. Chinese Text Project 中國哲學書電子化計畫 < http://ctext.org/wiki.pl?if=gb&chapter=454120#新編纂圖增類群書類要事林廣記卷之五> [accessed 20 February 2016].

[444] Klaas Ruitebeek, *Carpentry and Building in Imperial China*, p. 76.

7.1.2 The Suzhou numerals

The original drawings used Chinese characters, Arabic numerals, and Suzhou numerals to record numbers measured. Suzhou numerals are a numeral system used in China before the introduction of Arabic numerals. Although nowadays (in China) Suzhou numerals are seldom used, we can still find them being used in Chinese towns abroad.

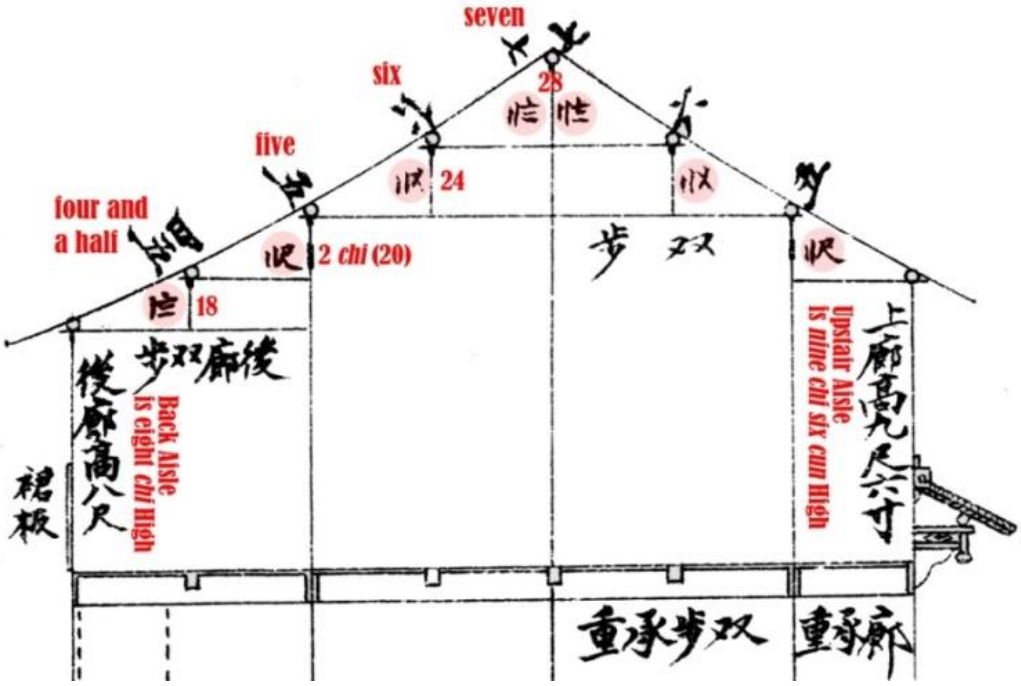
The "Xiangshan Gang" carpenters used Suzhou numerals to record numbers. In Chinese words, writing down a big number, the record will be really long, because every unit of the decimal system[445] should be written. Without Arabic numerals, craftsmen and business man created simple ways to write the number: Suzhou numerals.[446] The Chinese researchers believe that Suzhou numerals came from Chinese counting rod 算籌, which have vertical style and lateral style. In the Ming and Qing Dynasty, the Suzhou numerals were widely used as shorthand in commerce area, such as accounting and bookkeeping, and market places (figure 7-2). Some carpenters even created their own codes to keep the secret, but the Suzhou numerals were the most popular one used in China. We can find Suzhou numerals all over Yao's drawings (figure 7-3). He used the code to note the measure of each part of the structure. Sometimes, to avoid misunderstanding, the Suzhou numerals would be combined with simple Chinese words. For instance, number twenty-two, in Chinese is "貳拾壹" or simply as "廿一", in Yao's drawing, it would be "II 一". instead of "〃丨" which can be confused with "3" (川). Normally, the first character is used in the Suzhou numeral, and the second one is used the Chinese character.

7-2 Numbers of Suzhou numerals

Most codes were without units, because the unit was implied to be *Cun* 寸. But the word "II 尺", gives the unit, because the unit is changed to a larger one. One *Chi* 尺 is ten *Cun* 寸. So the "II 尺" is 20 *Cun* in figure 7-3. The Chinese words of number on the top of the roof are the height-width ratios of the small column and the bay. Number seven means the height-width ratio is zero point seven. Other numbers follow the same system.

[445] In the well-known BBC documentary: "The Story of Maths (the first episode)", the mathematician Marcus Du Sautoy (from the University of Oxford) mentioned that China was the first county to adopt a decimal system, before 1100 B.C.

[446] The Suzhou numeral system is also known as "*hua shu* 花數", "*cao ma* 草碼". It is the only surviving variation of the rod numeral system, also mentioned by Marcus Du Sautoy.



7-3 The Suzhou numerals and Chinese characters of number used in Yao's drawing

The mixed use of Suzhou numerals, Chinese characters, and Arabic numerals by Yao, a master carpenter, is an interesting situation. Suzhou numerals as shorthand were very convenient in use. As these were widely used in number-intensive areas of commerce, they were no doubt welcome in carpenter's daily work. In fact, I have seen some of the Suzhou numerals noted on the old structures of buildings in Suzhou, when they were removed for maintenance. It is no surprise that Yao used Suzhou numerals on his drawings for marking measures. Chinese characters are usually present in the fixed standards, such as the ratios of raising the roof frames in order in figure 7-3. This seems more serious than Suzhou numerals. Arabic numerals are used the least in Yao's drawings, but are shown in some drawings, such as the drawing of a buildings' platform (figure 7-5). This demonstrates that the Arabic numerals were also accepted by the carpenter in early modern China.

After redrawing by Zhang Zhigang, Chinese characters and Arabic numerals are also used in architectural drawings. The Arabic numerals are used to note measures, while the Chinese characters are always used to note the fixed standards. When the Suzhou numerals were abandoned, the cultural background and periods were lost as well.

7.2 Craft Diagrams versus Scientific Representation

7.2.1 Direction of the sections

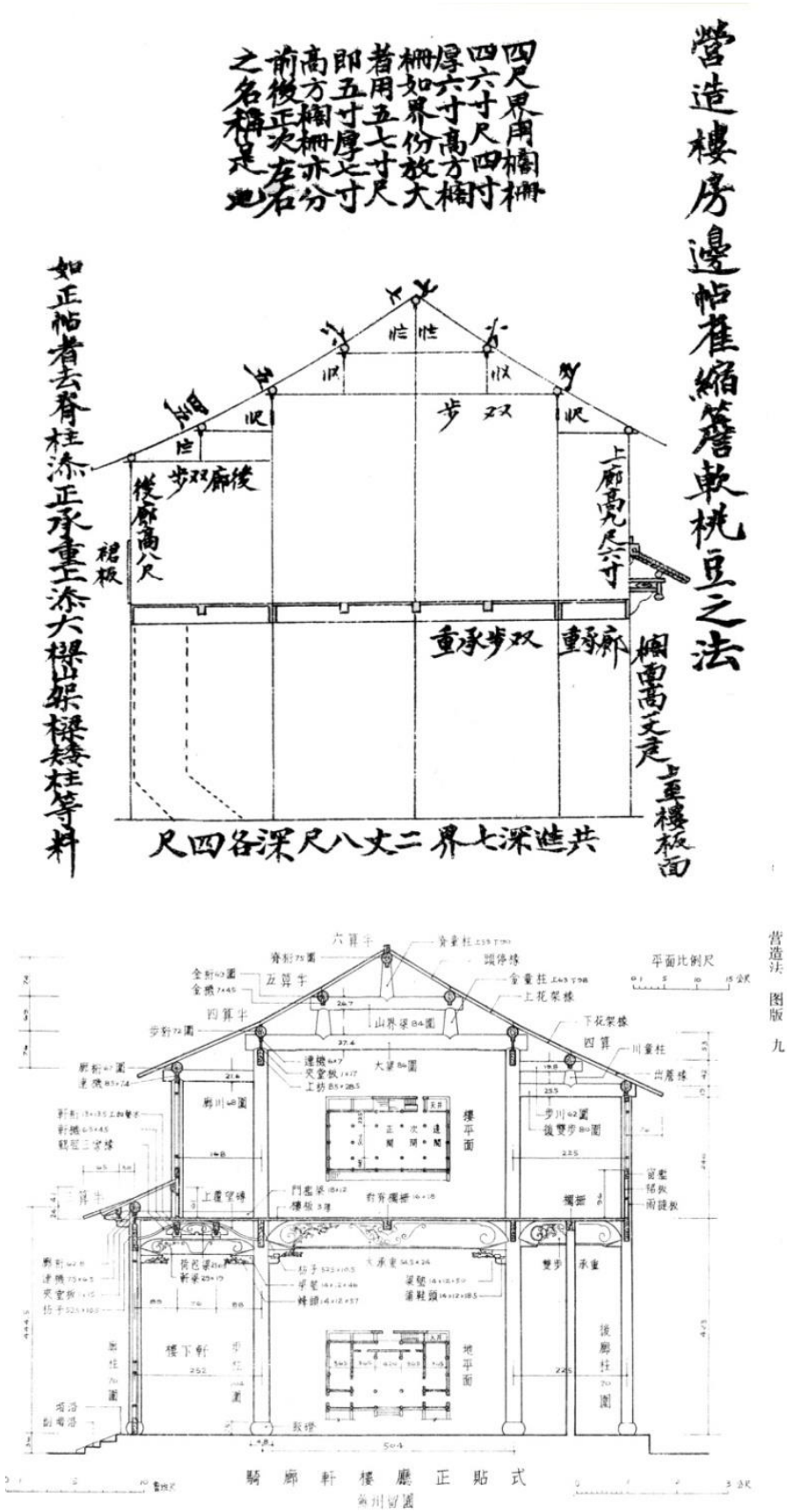
Comparing all the original and redrawn sections, another interesting thing will be shown

clearly. All the sections are facing opposite directions. This could not have happened by accident, but reflects the different attitudes of carpenter and architect.

Every architectural student has the experience that the most common mistake in first learning to design is drawing the section in the wrong (opposite) direction. The direction of sections reflects the way you treat the building in your design. The carpenter and architect must have had different attitudes regarding the construction of the buildings, which can be found in the sections. The carpenter imagined himself as within the building, while the architect looks at it as an object being observed from outside. So every section of a building style, in these two editions, sees things from opposite sides, as if in a mirror (figure 7-4)[447]. This view originates from Chinese pantheistic religion: everything has its spirit, even a building. When Chinese people talked about a building's good location, they would say: "The house is sitting on the north, facing the south." The carpenter supposes the building to be himself in order to esteem the building that he is drawing.

Another reason for such opposite presentation of sections is the different reading habits trained by different educations. In all the sections, Yao put the entrance of a building on the right side, while Zhang preferred to put it on the left. Since in the plans, both carpenter and architect put the south side at the bottom and the north side at the top, these drawing habits of sections might come from different reading habits. Yao had received a Chinese traditional education, and lived in late imperial China. His reading, writing, and drawing habits were from right to left. Zhang was trained in the new western educational system. Although he was living in a changing time with both Chinese and modern (western) ways in use, his reading, writing, and especially drawing habits changed. When he redrew the sections, he put the entrance on the left to fit the modern reading habit: from left to right. A small scale plan is shown on the same page. Without section symbols and the North Arrow, the plan also set the entrance on the left.

[447] Cui Jinyu, *The Buildings of Suzhou Xiangshan Group*, p235. Also see Yao, Chengzu, Zhang Zhigang, ed., *Yingzao fayuan*, p.180.



7-4 Sections of a same style of double-storey Hall

7.2.2 Intuitive perception

Carpenters' drawings show a different kind of intuitive perception. They used to mix all kinds of views in one picture, but the architects' pictures conformed to a strict science, with the plan, elevation, and section all used to reflect different views of the building. Here is an example of ground floor and steps of a building (figure 7-5). Yao's drawing is a mixture of plan, elevation, section, and perspective view combined[448]. Zhang changed it into an axonometric drawing[449]. But somehow, Yao's drawing has more information about the whole building platform.

Carpenters' drawings used to mix different views in one picture, but the architects' representations conformed to a strict science. It is a drawing of the base and the platform of a hall (ground floor), and steps are attached to the building. Yao's drawing is a mixture of plan, elevation, section, and perspective view combined.

The plan is the ground floor plan. In Yao's drawing, it shows the plinths which are prepared for the columns, and the three walls surrounding the hall. The inner space and each bay are very clear. The elevation is for the platform. There are three layers made up of curb 階沿, bottom side cover stone 側塘石, and close to earth stone 土親石. The section is for the base of the building, but only shows the condition of the borderline. There are also three layers: rough cover stone 糙塘石, three stacks stones 三疊石, and the *Ling-hang* stone 領夯石. The perspective view of steps gives the view of the outside steps and the rate of height and width of each step, which is quite comfortable for the user. As an attached part, the steps are more independent and separated, without any base.

In Zhang's drawing (fig 7-5 lower image), the basic stones are shown in more detail: the depth of base is dependent on the weight which it would bear. The base under the columns is much deeper than that of the walls. The corner and ridge columns have deeper bases than the normal one. Compared with the base, the plinths are less important. With only a quarter of the ground plan shown, it is hard to imagine the whole plan and the inner space. Zhang's axonometric drawing needs the help of his explanatory text, to give an introduction of how to make a base and platform of a building.

The original drawings of the carpenter are craft schematic, while the modern architectural drawings are scientific representation. Since "a schematic drawing does not show the actual process of construction; therefore it is not good enough to serve as a basis for actual work"[450], the modern drawings of architectural science representation are needed by architects. But for carpenters, who knew every part of the structure and every process of construction, a craft schematic was sufficient. The mixed drawing is clear enough for beginning learners, and concentrates all necessary information in one piece. Just like the rhymes of carpenters, the mixed drawing is impressive to the reader, and easy to remember. The architectural drawing is more complete than the carpenter's, but creates less impression.

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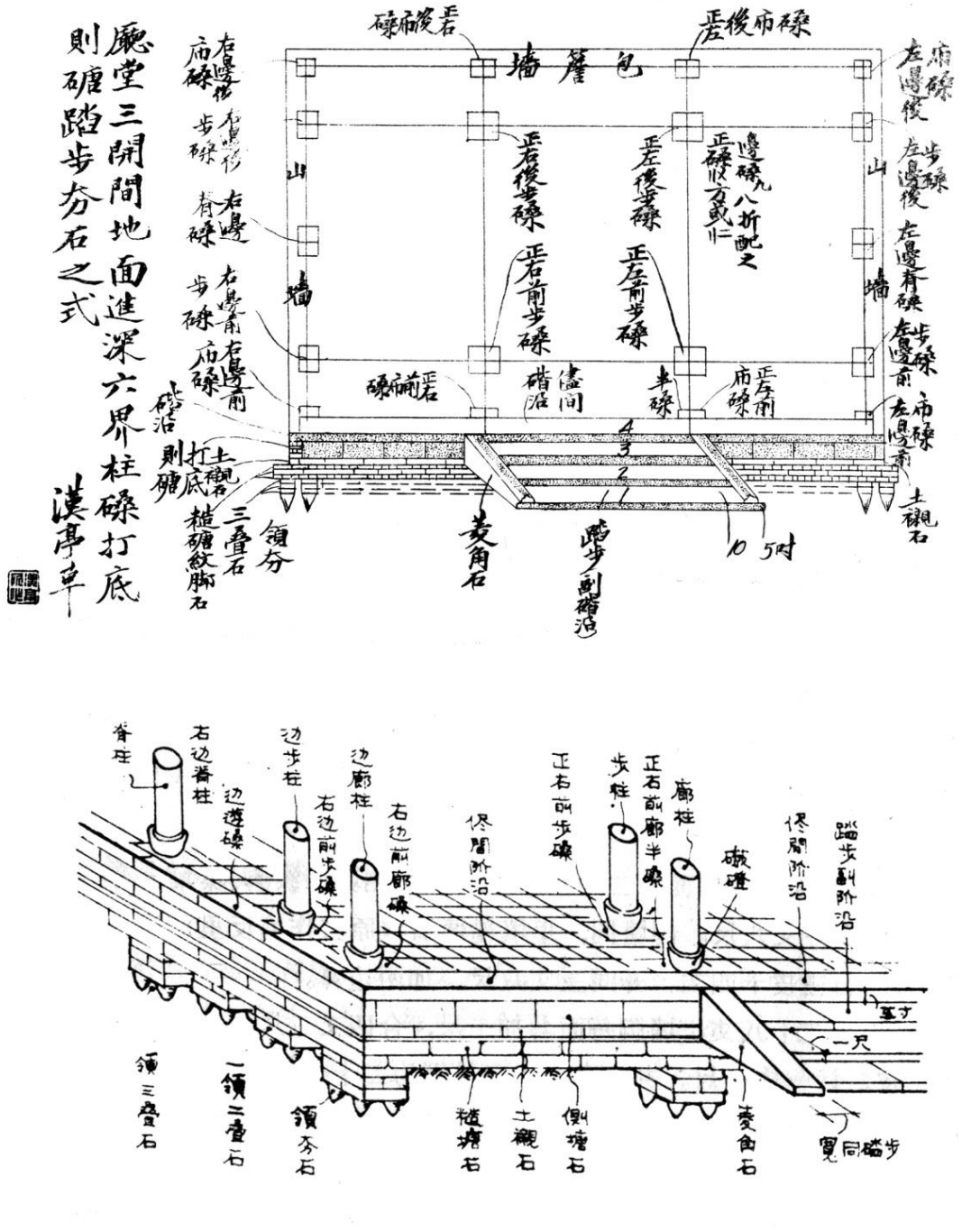
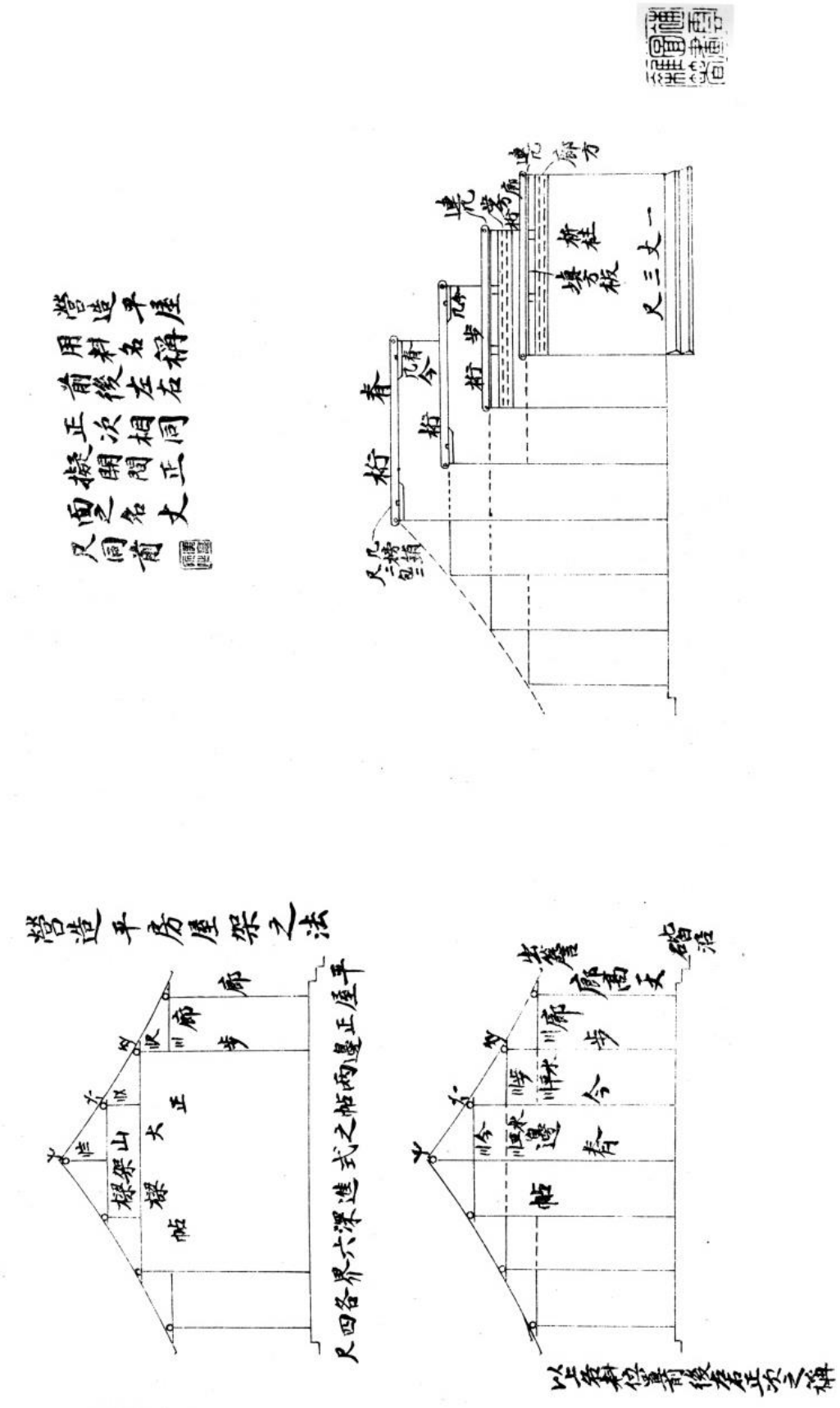
448 Cui Jinyu, *The Buildings of Suzhou Xiangshan Group*, p242.
449 Yao, Chengzu, Zhang Zhigang, ed., *Yingzao fayuan*, p1.
450 Institute of The History of Natural Sciences Chinese Academy of Sciences, chief ed., *History and Development of Ancient Chinese Architecture*, p.475.

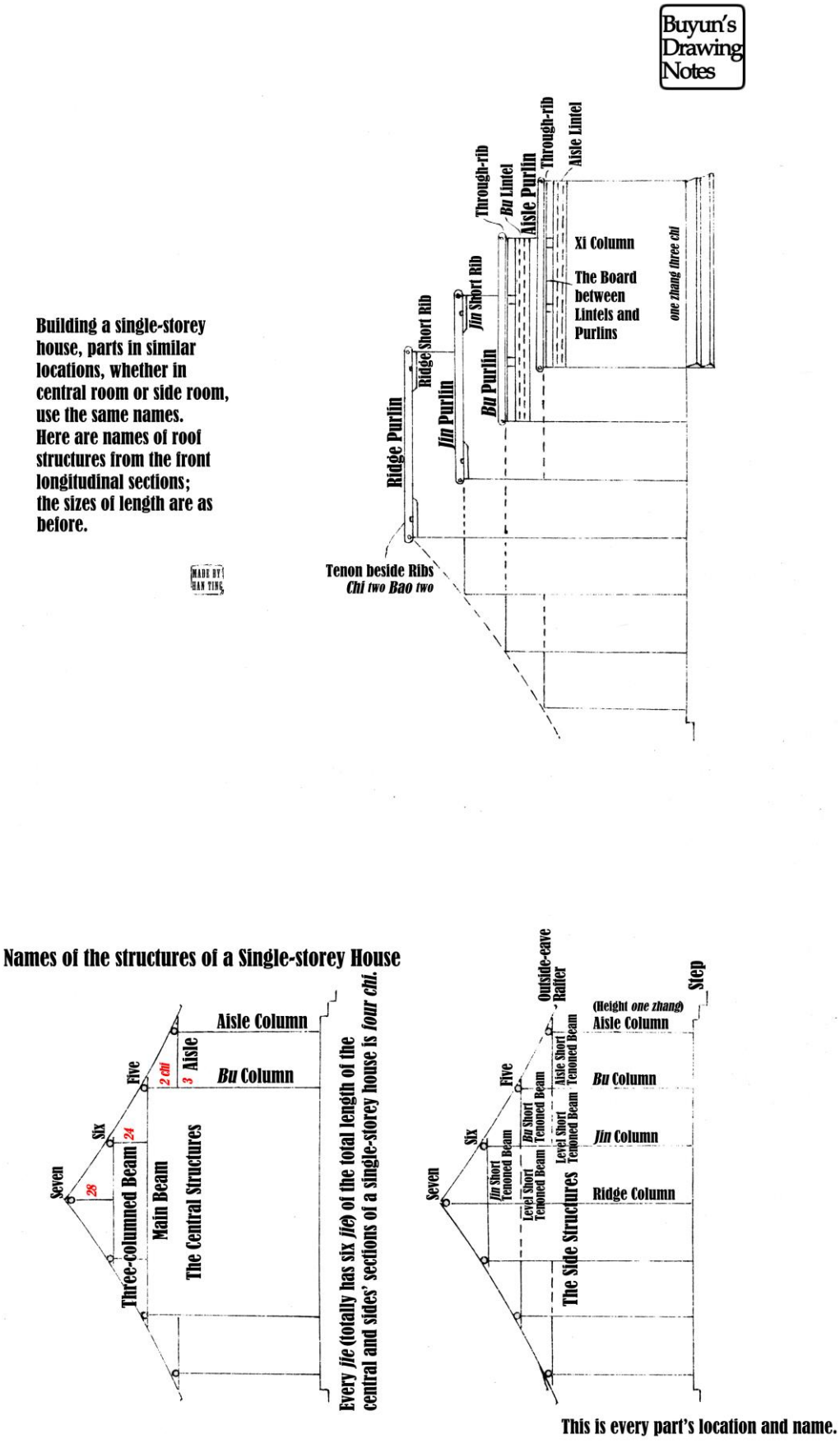


7-5 The names of columns, plinths, basic stones and steps of a platform

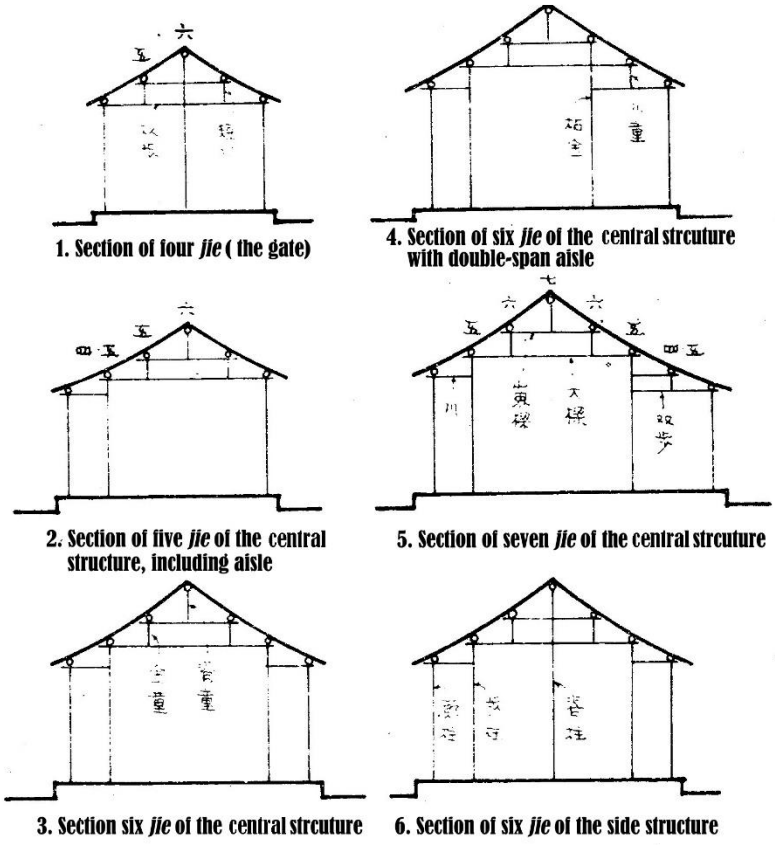
Another example of a carpenter's mixed craft schematic is the drawing to introduce parts and names of the structure of a single-storey house (figure 7-6, translation figure 7-7). It is an overview schematic, not particularly for a style. This time the drawing is not readable as easily as the names of columns, plinths, basic stones and steps of a platform. But when you realize it just puts two vertical directions of sections in one plane, the drawing suddenly becomes clear enough.



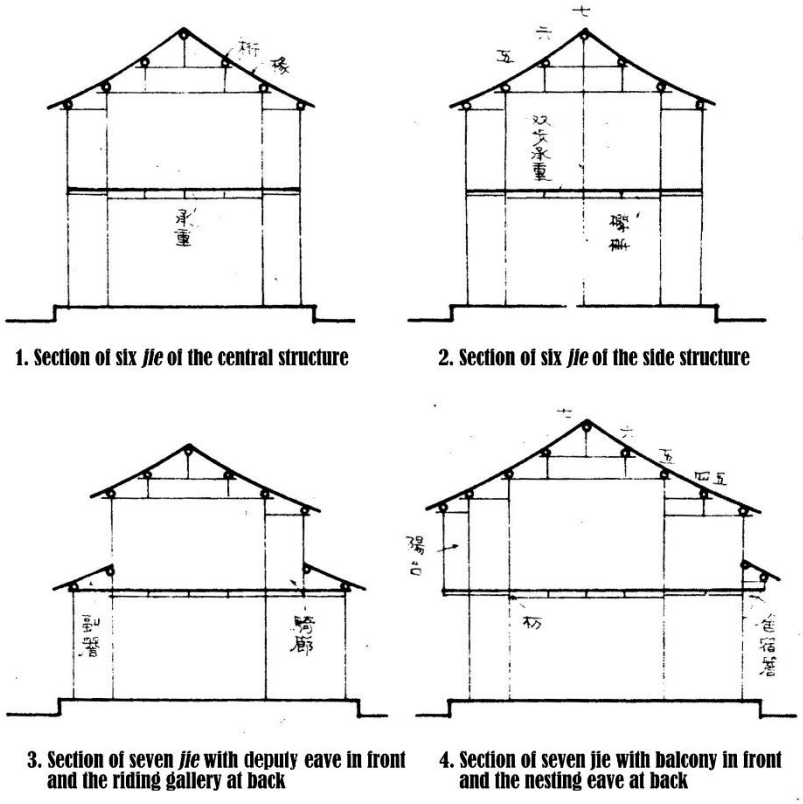
7-6　Parts and names of the structure of a single-storey house (original)



7-7 Parts and names of the structure of a single-storey house (tanslation)



7-8 Parts and names of the structure of a single-storey house



7-9 Parts and names of the structure of a double-storey house

In order to explain the parts and names of the structure of a building, Zhang wrote a separate chapter, *Chapter Two: The Structures of Single-storey House and Double-storey House*. He drew two schematics with a total of ten sections to explain the structures of single-storey house and double-storey house (figure 7-8 and 7-9). The drawing of the single house is shown as figure 5-6 in Chapter Five of this thesis, but for a different purpose, so here it is re-used again. As a general introduction, Zhang, like Yao, used a schematic to give the different style of single-storey house. But as an architect, he would never put two vertical directions of sections in one plane.

The carpenter's notes became a section of the modern edition's main text. But as an architect, when I try to introduce this basic information about parts and names of the structure of a single-storey house to English readers, explaining the drawings will become even more complex. Based on Yao's notes and Zhang's main texts, along with their drawings, I will try as below:

These sections are basic definitions for the parts and names of structures of single-storey ancient Chinese traditional timber buildings in south-east China. Three sections are: On upper left, a cross-section through the centre of the plan, called the central structures (*zheng tie* 正貼); On lower left, a cross-section through the side of the plan, called the side structures (*bian tie* 邊貼); and on the right, a longitudinal section through the centre of the plan. This is the only longitudinal section in the *Yingzao fayuan*, including in the modern edition.

In Chinese traditional buildings, each bay across the width of a building was called the standard width (*kaijian* 開間), the bays together being called the total width (*miankuan* 面寬). Each bay along the depth of a building was called *jie* 界, and together they were called the total length (*jinshen* 進深). These are Chinese traditional names of two directions of a building, which is absolutely different from the Western habit: Normally the West called the shorter side of a plan as width, and the longer side as length. But in China, the standard width is definitely longer than the total length. The western reader should remember this point when they read a Chinese traditional building. Klaas Ruitenbeek says: "*Duan* 段. The horizontal span between two successive purlins. In south China, the common term is *jie* 界 (cf. *Yingzao fayuan*, p.13); in north China, *bu* 步 or *bujia* 步架 (cf. Liang Sicheng, Qingshi Yingzao zeli, p.79, plate 15). About its length, the *Bazhai zaofu zhoushu* says: 'In large houses, the *bu* measures seven or nine chi, in small houses, three or five *chi*. the number should always be odd.'"[451] In Liang's book, each bay is designated using another Chinese word: *jian* 間; also known as *bu* 步. "step or span, the distance from purlin to purlin".[452]

The single-storey house is normally three standard width units (*kaijian* 開間), and is six *jie* in length. The three sections belong to such a house. As the explanation of the sections, noted by Yao, says:

"*Every jie (there should be six jie in all) of the total length of the central and side sections of a single-storey house is four chi. Totally it adds up to 28 chi.* 平屋正邊兩貼之式，進深六界，各四尺。"

"*This is every part's location and name.* 以上各料位置前後左右正次之稱。"

[451] Klaas Ruitenbeek, *Carpentry and Building in Imperial China*, p.177.
[452] Liang Sicheng, *A Pictorial History of Chinese Architecture*, p.506

"*Building a single-storey house, parts are in similar locations, whether in a central room or a side room, and use the same name. Here are the names of roof structures from front longitudinal sections; the sizes of length are as before.* 營造平屋用料名稱前後左右正次相同，擬開間正面之名，丈尺同前。"

The numbers on the roof record the means to control the curve, as will be discussed later.

The names of roof structures and columns are based on their locations. But because of differences between the south and north of China, between the state buildings and the private houses, and between the different dynasties, the same part of a structure may have different names either in Chinese or in English. Such as:

Three-columned beam (*san jia liang* 三架梁) is a top beam that crosses two bays, having three short columns on the beam. In *A Pictorial History of Chinese Architecture*, it is described as "3-purlins beam".[453] The main beam (*da liang* 大樑) is also known as five-columned beam, and there can be seven-columned beams or nine-columned beams in a large house[454]. But a three-columned beam is called mountain-columned (*shan jia liang* 山架梁) in Yao's drawing, and *shan jie liang* 山界梁 in the modern edition. These names are due to the shape, which looks like the Chinese character "山 (mountain)". *San* and *shan*, just like *jia* and *jie*, have the same pronunciation in southern China.

Aisles (*lang* 廊) are also called verandas. In *A Pictorial History of Chinese Architecture*, this is explained as a "roofed open corridor usually connecting two buildings"[455]. In *The Craft of Gardens*, it is called "Covered Corridors".

Klaas Ruitenbeek and Liang Sicheng used the word "columns (*zhu* 柱)" in their books, which only Alison Hardie translates as "pillars". Here we choose the word "columns". The same usage is shown in short ones for superstructures. In Chinese, they are called "*aizhu* 矮柱" or "*tongzhu* 童柱". The Chinese characters "矮 short" and "童 child" are all used to describe the length of these structures, which are short. In this thesis, we shall simply use "short post" instead of "dwarf posts" and "baby pillar".

The *Jin* column (今柱) is also known as "golden column 金柱" or "lapel 襟" column . In Chinese, the words "金/今/襟" all have the same pronunciation "*jin*". As professionally written in books published by the government it is "金 gold"; while in Yao's drawing, it is presented as "今 today". In the modern edition of *Yingzao fayuan*, it is "金 gold"; and in *The Craft of Gardens*, it is "襟 lapel"[456]. Furthermore, the *jin* column in the *Yingzao fashi* and *Qingshi Yingzao zeli*, is the column named the *bu* column in the *Yingzao fayuan*. As we know, the *Yingzao fashi* 營造法式, "Treatise on Architecture Methods" was a book of building standards published by the government in 1103, written by Li Jie 李誡. The *Qingshi Yingzao zeli* 清式營造則例, "Building Examples of Qing Dynasty" is a book based on building standards of the Qing Dynasty by Liang Sicheng in 1934. Both of these books describe building standards for state building in the north of China, while *Yingzao fayuan* is a carpenters' manual for private houses in the south of China. The varying terminology for the same components is thus reasonable, and can be accepted.

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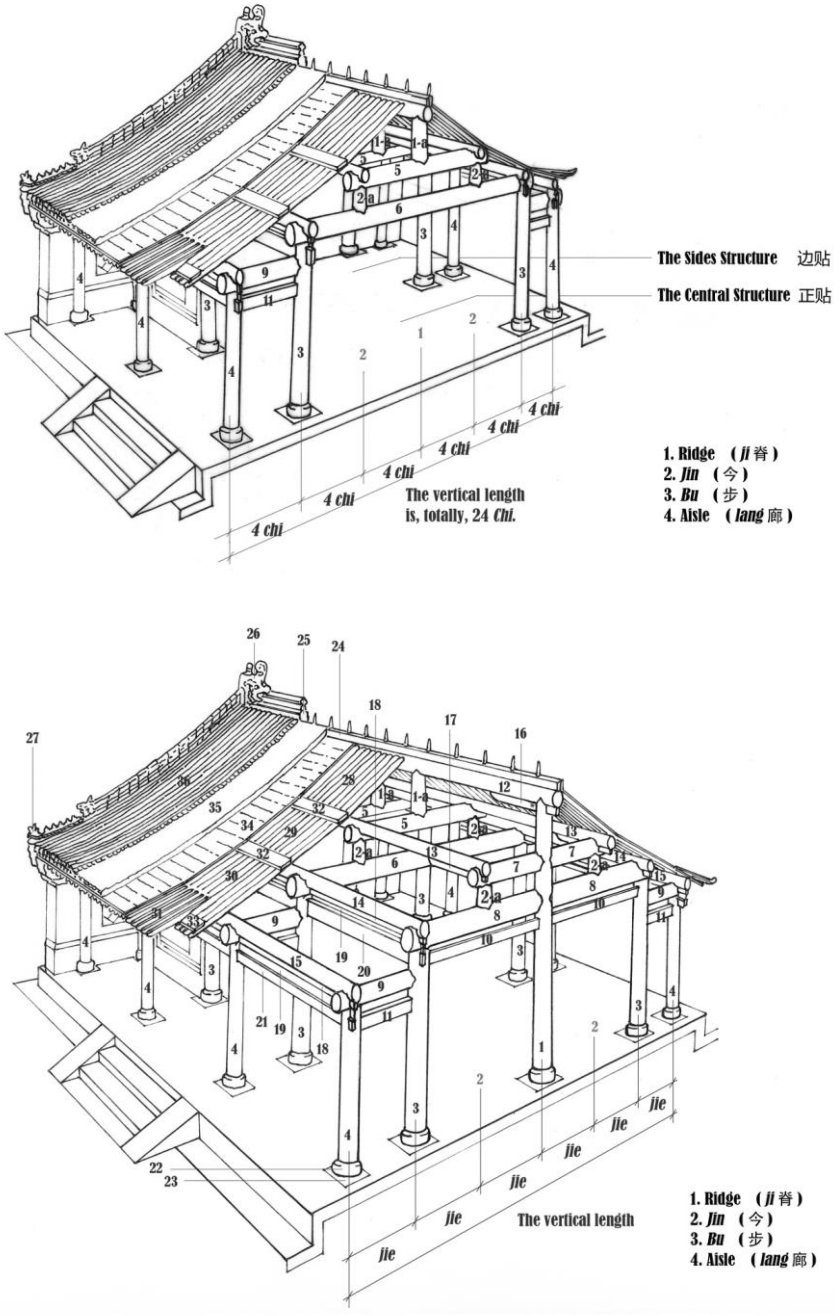
[453] Liang Sicheng, *A Pictorial History of Chinese Architecture*, p.111.
[454] Ji Cheng, Alison Hardie, trans., *The Craft of Gardens*, pp.71-72.
[455] Liang Sicheng, *Liang Sicheng's Complete Works (Volume 6)*, *Qingshi Yingzao Zeli*, p.504.
[456] Ji Cheng, Alison Hardie, trans., *The Craft of Gardens*, p.74.

The short tenoned beams (*chuan* 川) are of one bay length, with one end bearing on a purlin, the other end set on the columns. When used for verandas, they are called the verandas *chuan* 水平川; When used for the double-*bu*, they are called the short *chuan* or *chuan*.[457] In *Qingshi Yingzao zeli*, they are called "cover the head" beams 抱頭梁[458].

In order to make the names and the structures more clear, a perspective drawing of the structure will be helpful. Two cross-sections are shown as perspective drawings (figure 7-10):



7-10 Parts and names of structure of single-storey house

[457] Yao Chengzu, Zhang Zhigang, ed., *Yingzao fayuan*, p.96.
[458] Liang Sicheng, *Liang Sicheng's Complete Works (Volume 6)*, *Qingshi Yingzao Zeli*, p.101.

1. ridge column 脊柱 1-a. ridge short post 脊童柱	2. *jin* column 今柱/金柱 2-a.*jin* short column 金童柱	3. *bu* column 步柱	4. aisle column 廊柱 eave column 簷柱
5. three-purlin beam 山架梁/山界梁	6. main beam 大樑	7. *jin* short tenoned beam 今川/金川	8. *bu* short tenoned beam 步川 8-a. double-span beam 雙步
9. aisle short tenoned beam 廊川	10. deep-thrust lintels under double-span beam 雙步夾底	11. deep-thrust lintels under aisle 廊夾底	12. ridge purlin 脊桁
13. *jin* purlin 今桁/金桁	14. *bu* purlin 步桁	15. aisle purlin 廊桁	16. ridge short ribs 脊幾/脊機
17. *jin* short ribs 今幾/金機	18. through-ribs 連幾/連機	19. middle-filling board 填枋板/夾堂板	20. tie-beam between *bu* columns 步方/步枋
21. tie-beam between eaves columns 廊方/廊枋	22. base of column 鼓墩/鼓磴	23. plinth 磉石/磉	24. supporting ridge stick 幫脊木
25. the main ridge 築脊	26. top bend ridge 脊威	27. roof-tile animal 脊獸	28. top end rafters 豆定/頭停椽
29. "pergola" rafters 花界/花架椽	30. lower "pergola" rafters 下花界	31. outside-eave rafters 出簷/出簷椽	32. intermediate liner 勒望
33. end liner 眠簷	34. 望板 roof boards	35. roofing paper 油氈	36. tiles 瓦

Other contrasts in the uses of technical terms' are shown below, both in Chinese and English:

Yingzao fayuan **(Thesis)**	***Yao Chengzu Yingzao fayuan tu*** **《姚承祖營造法原圖》**	***Yingzao fayuan*** **《營造法原》**	**Carpentry and Building in Late Imperial China**	***Lu Ban jing*** **《魯班經》**	**The Craft of Gardens**	***Yuan Ye*** **《園冶》**	**A Pictorial History of Chinese Architecture**	***Qingshi Yingzao zeli*** **《清式營造則例》**
Chen Jianyu 陳劍宇	Yao Chengzu 姚承祖	Zhang Zhigang 張至剛	Klaas Ruitenbeek	Wu Rong 午榮	Translated by Alison Hardie	Ji Cheng 計成	Liang Sicheng 梁思成	Liang Sicheng 梁思成
2012	1926	1956	1996	the 15th century	1988	1631	1991	1934
columns	**柱**		**column**		**pillars**		**column**	
ridge column	脊柱	脊柱	ridge column	脊柱	backbone pillars	脊柱		中柱 山柱
ridge short post		脊童柱	矮柱 short post				蜀金柱 king post	脊瓜柱
jin column	今柱	金柱		金柱	"lapel" pillars	襟柱	hypostyle column	金柱
jin short post		金童柱						金瓜柱
bu column	步柱	步柱	*bu* column		Walkway pillars			
aisle column eave column	廊柱 簷柱	廊柱 簷柱	aisle column the columns under the eaves		ranking pillars	列柱	peristye column peripheral	簷柱

beams	**梁**		**beam**		**beams**		**beam**	
three-purlin beam	山架梁	山界梁			three-pillared structures	三架梁	3-purlin beam	三架梁
main beam	大樑	大樑			five-pillared structures	五架梁		五架梁
jin short tenoned beam	今川	金川	川 short tenoned beam		joist			
bu short tenoned beam	步川							
double-span beam	雙步	雙步	double-span beam					
aisle short tenoned beam	廊川	廊川					簷桷 beam	挑尖梁 抱頭梁
deep-thrust lintels under double-span beam	雙步夾底	雙步夾底						隨梁枋
deep-thrust lintels under aisle	廊夾底	廊夾底						穿插梁
purlins	**桁**		**purlins**				**槫 purlin**	**桁**
ridge purlin	脊桁	脊桁						脊桁 脊檁
jin purlin	今桁	金桁						上金桁 金檁
bu purlin	步桁	步桁						下金桁 老簷桁 老簷檁
aisle purlin	廊桁	廊桁					闌額 lintel	正心桁 簷檁
ribs and tie-beam	**機與枋**		**ribs and tie-beam**				**枋 tie**	
ridge short rib	脊幾	脊機	短機 Short ribs					
golden short rib	今幾	金機						
through-rib	連幾	連機	through-ribs					
middle-filling board	填方板	夾堂板						墊板
tie-beam between *bu* columns	步方	步枋	tie-beam between *bu* columns					老簷枋
tie-beam between eaves column	廊方	廊枋	tie-beam between eaves columns					簷枋
base of column	**柱礎**							
base of column	鼓墩	鼓磴					base	
plinth	磉石	磉	sang				plinth	磉
skirting block	勒腳							
end of gable	垛頭牆							
roofs	**屋頂**							
supporting ridge stick	幫脊木	幫脊木						扶脊木
the main ridge	築脊							正脊
top bend ridge	脊威							正吻獸
roof-ridge animal		脊獸	將軍瓦 roof -tile general					戧脊

rafters	**椽**		**rafters**		**rafters**			
top end rafters	豆定	頭停椽						腦椽
“pergola” rafters	花界	花架椽						花架椽
lower “pergola” rafters	下花界						eave-rafters	簷椽
outside-eave rafters	出簷	出簷椽					flying-rafters	飛簷椽
intermediate liner		勒望	intermediate liner					
end liner		眠簷	end liner					
roof boards		望板						望板
roofing paper								
tiles		瓦						筒瓦或板瓦
deputy rafters	**軒**	**軒**			**diagonal rafter**			

Table 7-1 Technical terms’ contrasts both in Chinese and English

This table of terms and the drawings above are intended to help readers gain a basic knowledge of the most common style of house in the south-east of China in the later Qing Dynasty era. It will also be a guide to understanding the other drawings of many different styles varying from the basic one. Most of these technical terms turn up over and over again in the drawings and in the text of the *Yingzao fayuan*. For example with “columns”, no matter which style the structure is, the names of columns depend on their locations. The names of beams and purlins depend on which columns they are set on.

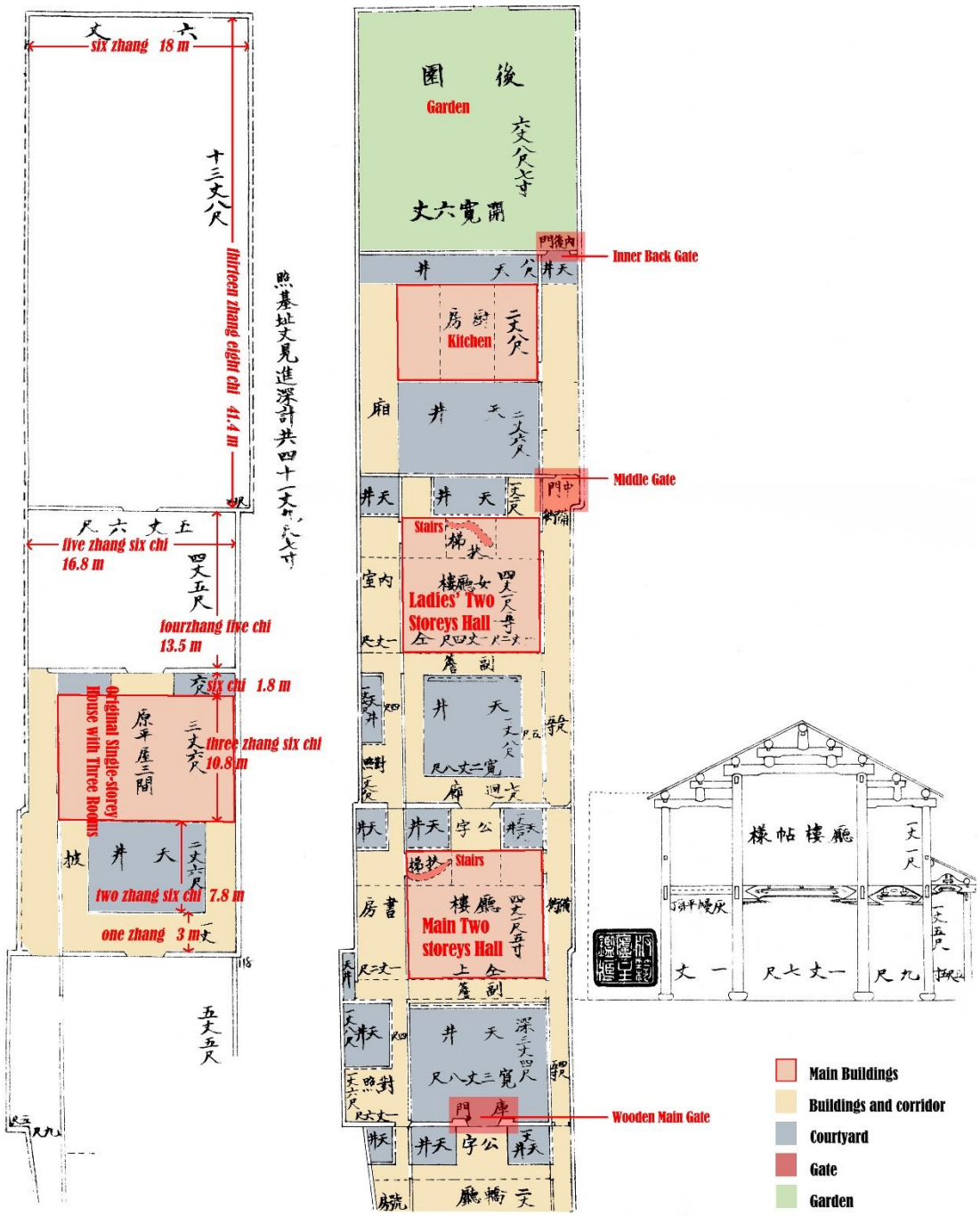
From Yao’s mixture craft schematic to Zhang’s architecture section schematic, then my architecture axonometric drawings, the stranger the reader is to the Chinese traditional buildings, the more complex drawings are needed.

7.3 Carpenter’s attention and architect’s attention

7.3.1 How to use it vs. what is the plan

The original drawings reflect the process of a carpenter’s accepting a project[459] (figure 7-11): There are two plans of a vernacular house.[460] The one on the left is the site plan of the original house before adding new buildings. The one on the right was designed by Yao Chengzu. He used these two drawings to discuss with the host and for competitive bidding against other carpenters. He designed a full-rigged mansion with two halls, four courtyards and a garden. The original single-storey house becomes two double-storied houses. All the length measurements are written with Chinese traditional measures, the basic unit is “*chi* 尺”.

[459] Cui Jinyu, *The Buildings of Suzhou Xiangshan Group*, p.232.
[460] Yao Chengzu, *Yao Chengzu Yingzao fayuan tu*, p. 2.



7-11 Plans and section of a Residence, by Yao Chengzu

Concerning the Carpentry and building in late imperial China, Klaas Ruitenbeek says:

"*2. Designing, plans: In designing a building, use was made of models, and of drawings and plans… …More important than models were drawings and plans. Chinese carpenters seem to have relied mainly on cross-sections, and paid less attention to ground-plans. At all events, Ji Cheng complains in his Yuanye that "ordinary carpenters only know how to draw a cross-section (lietu 列圖). Those who can draw a ground-plan (ditu 地圖) are few. On the other hand, both the Lu Ban jing and the Lu Ban yingzao zhengshi state that a ground-plan should be drawn, and*

the latter work even has an illustration of a ground-plan."[461]

In accordance with Klaas Ruitenbeek's words, there is no doubt that Yao was a wonderful master carpenter, who worked strictly under the direction of *Lu Ban jing*. He not only drew the ground-plan, but also the site plan. The cross-section is important for Chinese timber building because it determines the style of the building. In the *Yingzao fayuan*, "*The cross-section of a plan, which shows the purlins and beams of the structure, called tie 貼. In Yingzao fashi, it is called feng 縫. The style of cross-section is called tie yang 貼樣.*"[462] The ground-plan is useful for carpenters when discussing the project with owners. The site plan, in contrast, provides a carpenter's working notes. From this drawing, the site plan tells us of the original building and the ambient environment of this site.

Although carpenters did not need drawings to direct their working step by step, they still needed drawings to record, design, and communicate with other people, either the employers (i.e. their client) or other craftsmen. This drawing is precious evidence of a carpenter's working processes, and it is unfortunate that it was deleted in the modern edition. It is the most direct medium for design, similar to architects' work. In large projects, the carpenters used miniature models to help themselves, such as those produced by the Lei family for the Forbidden City in Beijing. It is reasonable, because even today, besides different computer-aided design software, architects still like using models to keep control of their projects.

As the plan was fairly standardized, it could be quite easily described in some kind of formula about bays and courtyards, and this is what we read in novels. Fro example, in *A Dream of Red Mansions* 紅樓夢 (*The Story of the Stone* 石頭記), there is a whole chapter describing the buildings in the Grand View Garden 大觀園: Chapter Seventeen. According to my tutor, a well-known architecture scholar, Zhang Lianggao 張良皋, he believes Cao Xueqin 曹雪芹, the author of *A Dream of Red Mansions*, must have had a plan of the Grand View Garden when he wrote his great work.[463] But the standardised nature of it would make it less necessary to have a plan, or to keep one later, and it would also mean that the carpenters could work systematically according to the same set of rules.

The plan of a building maybe less necessary, but the plan of the whole residence is needed both for the employees and the builders, including carpenters. Also in *A Dream of Red Mansions*, we can find the words that mention the plan of the Grand View Garden: "Now I'll tell you what to do. Before they started on the construction of this Garden, they made a very detailed drawing of the layout. It was only an artist's impression, but the measurements shown on it were all accurate. Why don't you ask Lady Wang for that drawing and then ask Cousin Feng to give you a piece of heavyweight pongee of the same dimensions?"[464]

To sum up, carpenters used plans to record their designs. Furthermore, "in a number of cases, the working drawing is the only means which can be satisfactorily employed".[465]

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[461] Ruitenbeek, Klaas, *Carpentry and Building in Imperial China*, p.49.

[462] Yao Chengzu, Zhang Zhigang, ed., *Yingzao fayuan*, p.4.
"在一縱線上，即橫剖面部分，梁桁所構成之木架謂之貼，營造法式稱為縫。其式樣成為貼式。"

[463] Zhang lianggao 張良皋, "Study on Restoration on Craft drawings of the Grand View Garden in *A Dream of Red Mansions* 紅樓夢大觀園匠人圖樣復原研究", Architecture 建筑师, Vol.86,02 (1999), pp.90-104.

[464] See Cao Xueqin 曹雪芹, *A Dream of Red Mansions*, near the end of Chapter Forty-two.

[465] Institute of The History of Natural Sciences Chinese Academy of Sciences, *chief ed., History and Development of*

Two contract plans of the same building, with carpenter's and architect's focal points, are shown. This example shows two plans of the east mansion of Lingering Garden 留園 in Suzhou (figure 7-12). The left one is Yao's drawing[466], while the right one is Zhang's drawing[467]:

Clearly, these are different designs for the same building. Because Zhang Zhigang declared that all his drawings were based on his measures, his drawing must have been done between 1935 and 1937. The original drawing by Yao Chengzu was drawn between 1927 and 1929, so nearly ten years divide these two presentations. As he was a carpenter, Yao's drawing may be also his design of the house, but Zhang's drawing is the plan of the existing building. That means the carpenter cares about the design, and the architect records the real building as part of Chinese traditional building.

Yao's drawing notes how to use the house, including the server's passageway, the guest passageway (the words noted on the yellow long passageway of the left drawing), and the four wells in the yards (the red dots). The carpenter's drawing shows the bays of every building without columns, because every carpenter knows how many columns are needed in such bays; while the architect's drawing carefully includes every column with no idea about the orders of bays, or fear of missing columns.

As mentioned at beginning of this section, in Yao's drawing, he notes every measure on the Chinese traditional length measurement system, which has the basic unit "*chi* 尺". Zhang made a scale ruler alongside his drawing to show the scale of the plan on the meter system, which is used by modern architecture.

With Zhang's drawing, he gave a detailed explanation about the house, which shows the architect's care about the life of a traditional building:

"Explanation:

The East Mansion of Lingering Garden in Suzhou belonged to the Sheng family in Guangxu 光緒 Period of Qing Dynasty (1875-1908), made as his family house. On the south, outside the main gate and within the screen-wall, there was a square for parking. Inside the mansion, south of the main hall, were Chinese traditional style buildings; while north of the main hall, it mixed Chinese and Western style. Even in the western style part, the plan of buildings followed a type belonging to south China. Inside the walls, there was a square plot of about 2668 square metres intended for a garden, but the work was not completed. Now it is all deserted.

說明：

留園東宅清末盛氏所有，擬作別墅之用。南向，牆門以外，照牆之內，開廣場為停車馬之所。大廳以南，其平面佈置，結構，裝修，悉依中式；大廳以北，雖參酌西式，但平面佈置仍不失為南方住宅規範之一。內院後有空地，廣袤四畝許，想當時備建苑囿之用。後無意經營，現僅荒蕪滿園矣。"

Ancient Chinese Architecture, Beijing: Science Press, 1986, p.475.

466 Cui Jinyu, *The Buildings of Suzhou Xiangshan Group*, p 231.

467 Yao Chengzu, Zhang Zhigang, ed., *Yingzao fayuan*, p.171.

7-12 Plans of the east mansion of Lingering Garden[468]

From the modern edition, we know that the example was a live project: The East Mansion of the Lingering Garden in Suzhou. The two plans look different in many details, especially the buildings for the host's family. Checking the drawing dates, the original drawing by Yao was made in 1927, while the modern one was drawn by Zhang Zhigang in 1935 to 1937. Yao's drawing was presumably a design plan for the residence, but Zhang's drawing was made under his modern architectural training. It has the correct scale, based on field survey of the residence. In ten years, the ownership had changed. The residence had been rebuilt in some parts.

The front yard, wells and Chinese units of measure are missing in the modern edition, losing information on daily life and on the Chinese traditional cultural meaning of measures. The

[468] Yao Chengzu, *Yao Chengzu Yingzao Fayuan tu*, p.1. And Yao Chengzu, Zhang Zhigang, ed., *Yingzao fayuan*, p.171.

explanation and scale rules are attached, which help us towards an easy understanding today.

The real building changes to the design are as below:

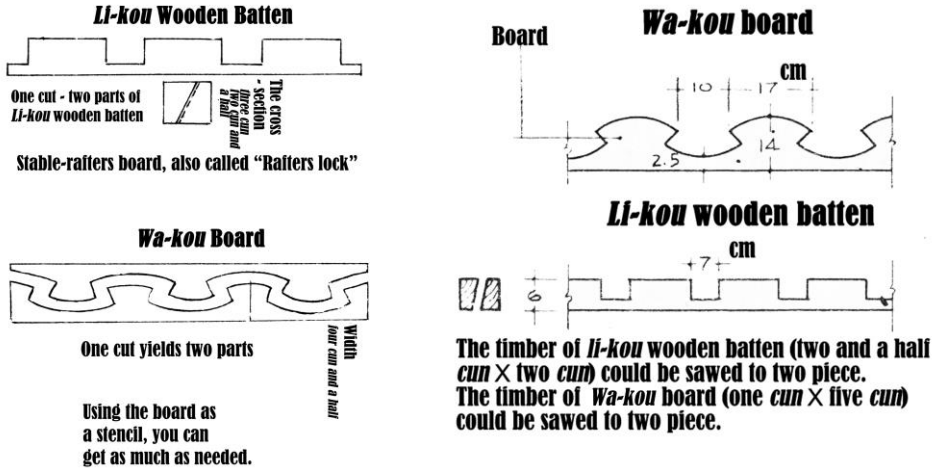
(1) In addition to the main gate, there is an added side gate in the servants' part.
(2) The right servant passage is changed in location and has become a straight line.
(3) The two buildings of two storeys are changed in location; a western style building is added on the end of the left side; and a females' meeting room on the right side.

The clear layers in the main part become more completed in the back. The family living area is more flexible.

No Suzhou numeral is shown on Zhang's drawings, no well or the guest passageway has been noted: the note of server's passageway is kept, but is not as conspicuous as in Yao's drawing. On the other hand, scale ruler and columns of each building were added in Zhang's drawing. From what has been lost and found in this example, we know not only the changes in the buildings, but also the different focal points of the draftsmen.

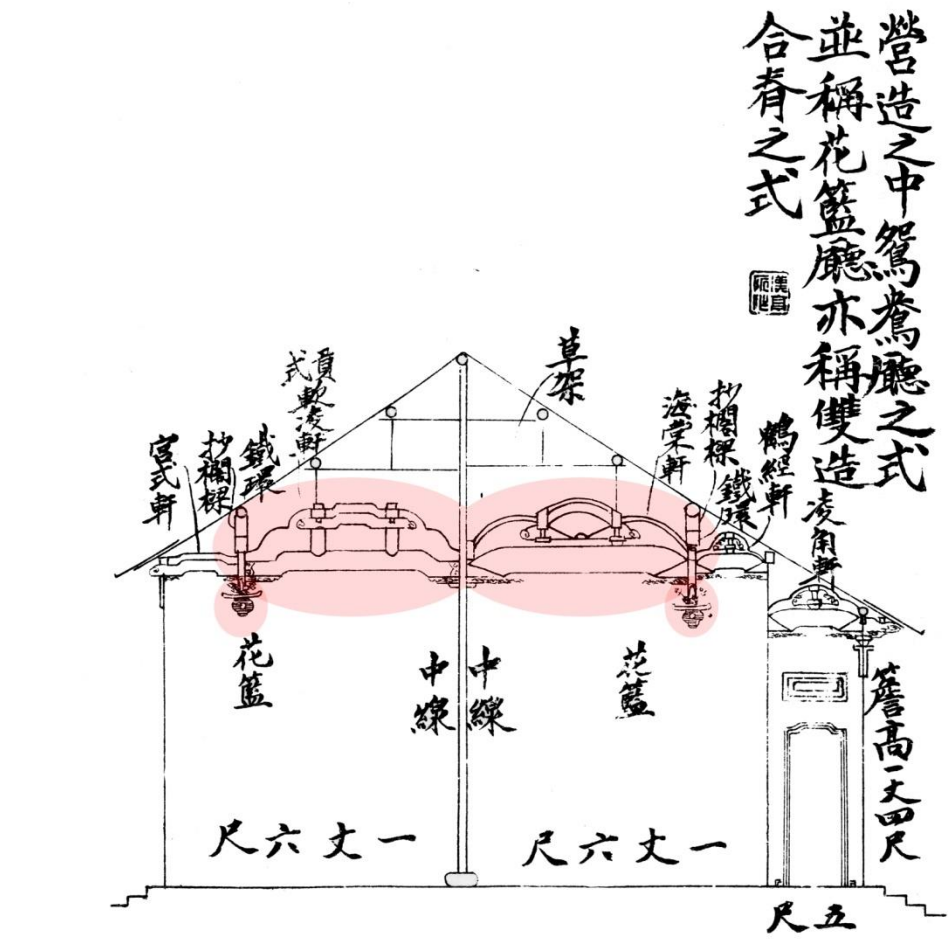
7.3.2 How to make it vs. what does it look like

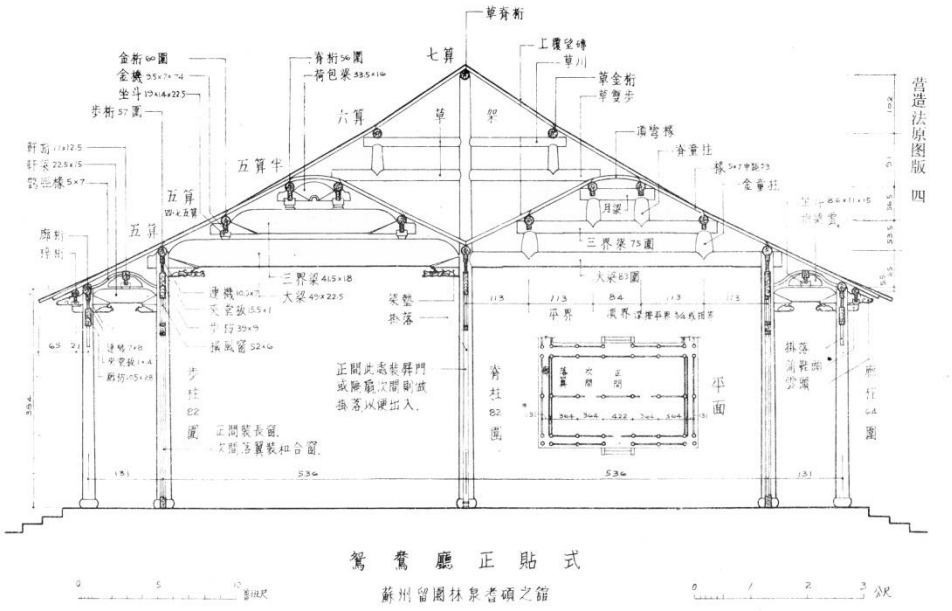
Looking at the details of building, the carpenter pays attention to how to make it, while the architect focuses more on what it looks like. Figure 7-13 is about the forms of eaves. Yao especially notes that the form can be made by one cut, giving two pieces.[469] But in Zhang's drawing, there is no information about cutting, which is only noted in words.[470] On the other hand, in Yao's drawing, the sizes are noted in words, while Zhang, as architects tend to do, marked dimensions on the drawings.



7-13 *Li-kou* wooden batten 裡口木 and *Wa-kou* board 瓦口板 (The forms of eaves)

469 Cui Jinyu, *The Buildings of Suzhou Xiangshan Group*, p.253.
470 Yao Chengzu, Zhang Zhigang, ed., *Yingzao fayuan*, p.186.





7-14 Sections of the Mandarin Duck Style Hall

A parallel instance is on the section. Yao's drawings exaggerate the features of every style of building, to define each in contrast with another.[471] But Zhang's drawings rigidly adhere to scale.[472] The difference in style is almost ignored if the reader is not making a careful search. In figure 7-14, the style of hall is called the "mandarin duck style hall (*yuanyang ting* 鴛鴦廳)", because it is divided into two spaces, each side having a good wish attached to it. To distinguish these different spaces, the main beams have different styles. Chinese people believe mandarin ducks are faithful to their partner for ever. They therefore treat the mandarin duck as a favourite. So the Mandarin Duck Hall is very welcome in a Chinese vernacular house. Accepting good wishes, the host has two views in one hall. Beside the good wishes, the meaning of "mandarin duck style" in Suzhou dialect had discussed in the end of Chapter Six.[473]

The mandarin duck style hall is a tall hall divided by the ridge column. The front and back upper structure are symmetrical, but one uses rectangular timbers, the other cylindrical timbers[474]. Two kinds of hall structures, the cuboid inner upper structures hall, *bian-zuo* hall 扁作, and the cylindrical inner upper structures hall, *yuan-tang* hall 圓堂, are combined in one hall. It is called "one room has two styles of deputy rafter beams, 一屋兩翻軒" by local carpenters. To keep a uniform appearance, the ridge columns sometimes are made half cuboid half cylinder. For this reason, it is also called " double-structures combined with one ridge 雙造合脊". In Yao's drawing, compared with all the other simplified structures, emphasis is given to the ridge column and the difference between the two deputy rafter beams. By including a deputy rafter attached to the cylindrical or cylindrical inner upper structures, it is kept consistent with the main part. A deputy eaves has been set in front of the hall.

The second point of this section is the "basket of flowers" style hall (*hua-lan ting* 花籃廳). It is a hall with floating *bu* columns, and instead of the columns has a "basket of flowers" end. It is also called the "hanging lotus" columns (*chui lian zhu* 垂蓮柱). If this type of column is used in a hall individually without the mandarin duck structures, it is a "basket of flowers" style hall.

Here Yao gave us a case combining two types of specific structures: the mandarin duck structures and the "hanging lotus" columns. He noted: it is the "mandarin duck" and "basket of flowers" hall, which is also called "double-structures combined with one ridge".

As we shall see, it is not the only case in Yao's drawings, in which the master carpenter tried to give as many styles as possible in one drawing. For a text book, it is a good choice to give more information about similar definitions to the students at one time.

Mandarin ducks are referred to by the Chinese as *Yuan-yang*, where yuan (鴛) and yang (鴦) respectively stand for male and female mandarin ducks. The behaviour of a mandarin duck couple is "stay and fly together 雙宿雙飛", and "playing in water (鴛鴦)戲水".

Hence mandarin ducks are well known symbol of a healthy and fidelity relationship between couples. A famous metrical verse in China is "Willing to be mandarin ducks, not to envy immortals 願做鴛鴦不羨仙", which refers to the happy life of a sweet couple. The Mandarin Ducks are also frequently used in Chinese weddings, to show good wishes to the newly married

471 Cui Jinyu, *The Buildings of Suzhou Xiangshan Group*, p.240.
472 Yao Chengzu, Zhang Zhigang, ed., *Yingzao fayuan*, p.174.
473 Chapter Six, p.166.
474 Yao Chengzu, Zhang Zhigang, ed., *Yingzao fayuan*, p.107.

couple, symbolize eternal love. (The local dialect use of "mandarin duck style" had been discussed in Chapter Six. It also refers to the different functions of the special style of hall.)

From these three special meanings, we can expose a wealth of information about the mandarin duck hall in its structures and plan.

As a favoured element in Chinese gardens in the south of China, the mandarin duck style hall is a place for the owner to relax and to meet guests. There are two styles of hall covered by one roof. Being divided along the central long axis, it has male and female halls, or south and north halls. The two halls are set back to back with a screen wall in the middle.

Although the male and female halls are in one building, there is a great discrepancy inside: The male hall is facing south, using ornately decorated rectangular timbers, which symbolise "yang 陽"; while the female hall is facing north, using simply processed cylindrical timbers, which symbolise "yin 陰". (also nature versus culture?) There is also another justification, for the mandarin duck style hall is also called "yin-yang" hall. The magnificent male hall affirms the host's pride, and the chaste female hall expresses the host's humility. These are two impressive attributes of Chinese scholars. Other decorations follow in the same way, such as the floor tiles, which are larger in the male hall than in the female hall. And the carvings on the windows and doors also have the contrasts of complex and simple.

As for use, the south and north halls can be used in different seasons or weather. They allow visitors to enjoy the sunshine in winter and the shade in summer or to keep warm in the south and cold in the north. The male hall is a perfect place for meeting guests, and the female hall is a favourite place to share with family, especially with the hostess. The youngest lovers are willing to make a solid promise in the mandarin duck style hall. Sometimes the male and female halls are for the host and hostess greeting their close friends. It has variable functions depending on the social context.

We can adduce a lot of examples of the mandarin duck style hall in the south of Chinese gardens. The famous ones in Suzhou are:

The 36 Pair of Mandarin Duck's Hall 卅六鴛鴦館 and the 18 Datura Flower's Hall 十八曼陀羅花館 in the Humble Administrator's Garden (Zhuozheng Yuan 拙政園). These two halls are the south and north sides of a single mandarin duck hall, which has a pool to the south and a garden to the north. Supposedly 18 pairs of mandarin ducks were being fed in the pool, and 18 camellias were planted in the garden. The numbers 18 and 36 are both lucky numbers in China. But in the modern edition of the *Yingzao fayuan*, the survey drawing by Zhang Zhigang, the hall was not represented as a mandarin duck style hall, but another style called "full deputy rafters style"[475]. The hall which exists today must have been rebuilt in the 1980s, with a change of style to match the name of "mandarin duck's hall".

The Yan-yu Hall 燕譽堂 is the main hall of the Lion Grove Garden (Shi-zi Lin 獅子林). Yan-yu means venerable (scholar). The male hall has windows on the side walls, and tall windows with clear glass on the south; while the female hall has no windows on the side walls, and tall windows with stained glass to the north. Because of the colour of stained glass in the female hall, it has another name: the "Jade hall, 綠玉青瑤之館". Unlike western stained glass, the Chinese

[475] Yao Chengzu, Zhang Zhigang, ed., *Yingzao fayuan*, Plat of *Yingzao fayuan* Five, p.181.

kind is much simpler, and seldom used in buildings. The expensive price could not be afforded by a normal family.

The "Old Hermit Scholars' House" 林泉耆碩之館, in the Lingering Garden (Liu Yuan 留園), is another instance of the mandarin duck hall (figure 7-14). The hall is on the south of the Cloud Capped Peak 冠雲峰. The Cloud Capped Peak is one of the Four Astonishing Rocks in Jiangnan 江南四大名石, that were found in the 1100's and moved to the Lingering Garden after 1876 by Sheng Kang 盛康[476]. In this case, because the main view is from the north of the hall, the north hall becomes the male hall, called the "Old Hermit Scholars' House". The south hall is the female hall, called "Astonishing Stones Longevity Hall 奇石壽太古軒". This is an exceptional case of the mandarin duck hall, making the male and female halls substitute for each other.

Many other cases can be found in the gardens of the south of China. It was a popular style in Suzhou Gardens. As a carpenter, Yao made it one of two special styles of halls, the other being the boat roof style hall, *chuan ting* 船廳, also introduced to the reader. But In the modern edition of *Yingzao fayuan*, Zhang redrew the mandarin duck hall and the "basket of flowers" hall separately by surveying real buildings. In the text, he treated the structures of the halls as eight types in six groups[477]:

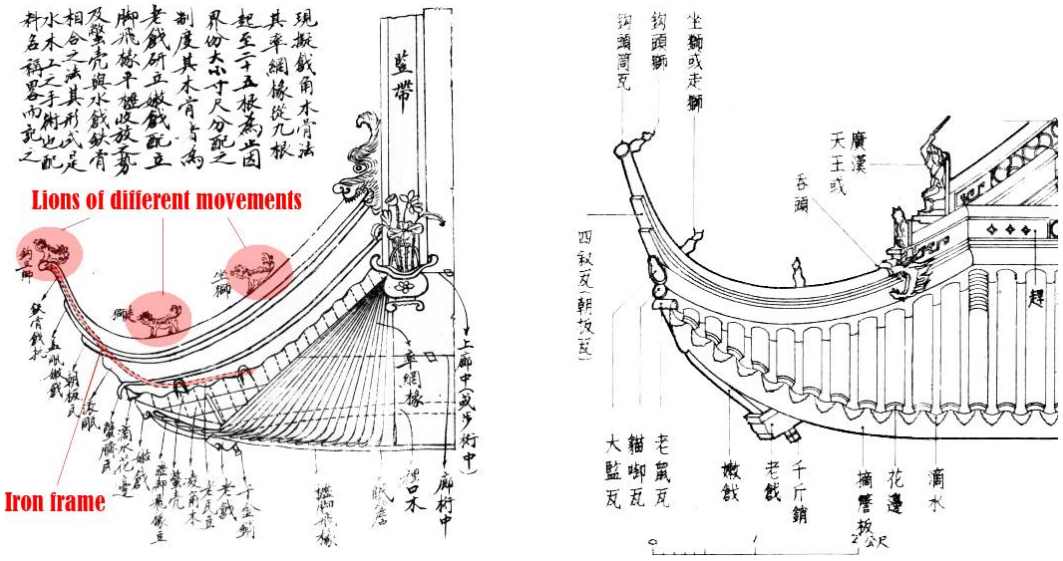
(1) The cuboid inner upper structures hall, bian-zuo hall 扁作, and the cylindrical inner upper structures hall, yuan-tang hall 圓堂;
(2) The boat roof style hall, *chuan ting* 船廳 and round ridge roof, *juan peng* 卷棚;
(3) The palatial style hall 貢式廳;
(4) The mandarin duck style hall 鴛鴦廳;
(5) The "basket of flowers" style hall 花籃廳;
(6) The full deputy rafters style hall 滿軒.

There was a separate drawing of each type in the plates of the *Yingzao fayuan*.

Last but not least, the drawings of a roof corner.

The animals on the roof hips and ridges are special in Chinese traditional building, following styles and sequences which have their rules. Carpenters cared much about these details, but architects are less concerned (figure 7-15). Look at the movements of three lions on the roof by Yao[478]: From left to right, the first one is an overlooking lion, which is on the top of the angle; in the middle is a walking lion; the last one is a sitting lion. They have a set of actions, making a story about protection of the building. In the similar drawing about the roof angle by Zhang[479], we just know there is something on the building. Although the notes give the names of each lion, we can't imagine exactly what characters they have.

[476] Sheng Kang 盛康, a close friend of General Li Hongzhang 李鴻章. His son, Sheng Xuanhuai 盛宣(4/11/1844-27/4/1916) was the Minister of Transportation during the late Qing Dynasty. He bought the Lingering Garden from the previous owner in 1873, and spent three years rebuilding it.
[477] Yao Chengzu, Zhang Zhigang, ed., *Yingzao fayuan* p.21-28.
[478] Cui Jinyu, *The Buildings of Suzhou Xiangshan Group*, p262.
[479] Yao Chengzu, Zhang Zhigang, ed., *Yingzao fayuan*, p.212.



7-15 The lions on the roof angle

The wood-bone rising angle ridge[480] (*mu-gu fa* 木骨法) refers to the wooden frames of the rising angle ridge.Yao made a very clear drawing, which describes how the wooden frames are fixed under the mason's frame, with the different tiles and *wen-shou* 吻獸 upper tiling on the roof. The *wen-shou* is an ornamental group of roof tiles set on the corner roof ridges and at both ends of the main ridge.

The only iron component was drawn particularly: actually, it does not belong to the wood-bone frames. Chinese carpenters would consider it a shame to use iron nails or junctions. So the iron bone has to stand clear of the roof structures. In the modern edition book, the drawing about the tiles on the roof belongs to the *Plate 40 of Yingzao fayuan*: *The Mason's Work on the Roof of Halls*[481].

Yao tirelessly drew the order of rising angle ridges' rate with a net of rafters 戧角率網椽, which actually could not be seen outside. But it is an important skill of the carpenter to make a rising angle ridge. A series of rafters, more than fifteen, are installed together, the angle of each part is rigorous, and otherwise the corner of the building roof would be strange and odd. Without this skill, a Chinese roof could not end in a rising line. Even today, when I visit a carpenter's workshop in Suzhou, they still use the traditional method: drawing the net of rafters on the ground as 1:1 ratio. Then they make all the rafters one by one, and check them against the line on the ground.

Zhang's drawing is an elevation of the roof corner. What is the sharp angle of the roof ends? How did the tiles go onto the roof? These are the questions the architect is concerned about. The rising angle ridges are covered by the roof, showing just the tip of the iceberg.

480 Yao Chengzu, Zhang Zhigang, ed., *Yingzao fayuan*, p. 37.
481 Ibid., p. 212.

Conclusion of Chapter Seven:

This chapter focuses on the other specific research question followed the title: What are lost by the carpenter and found by the architect in the drawings of the *Yingzao fayuan*?

As discussed in Chapter One Literature Review,[482] because most of the previous researches on architect and carpenter are separated, led to a gap between western modern architect and Chinese traditional crafts builders, this chapter is filling the gap and making original contribution. Through contrast and analysis of the same drawings, between original drawings and modern editions, we can simply answer the question: the Chinese measure and Suzhou numerals which were used by carpenter are lost; the carpenter's craft diagrams are changed to the architect's scientific representations, the modern way of expressing of traditional buildings is founded; the carpenter's perception is lost, replaced by that of the architect.

The Chinese measure and Suzhou numeral are lost not only because of the new presentation method of architecture, but also with the development of time. It is a pity that parts of Chinese traditional culture were lost with them, such as the "building magic" of carpenters, the *Fengshui* meanings of numbers, and the special local characters for numerals. But that is the flip side of modernisation, not only in China, but also in the whole world. To make a Chinese local carpentry building skills record and understand it in the modern world, transferring the carpenter's drawings into architectural drawings is the only way. It has been the basis for the subsequent development of the Xiangshan Group. After more than ten years beaten back by social and political upheavals from the 1960s to 1970s, the Xiangshan Group could continue its development from the 1980s: the *Yingzao fayuan*, especially the drawings of the book, made a great contribution. The worn-out book of the *Yingzao fayuan* on the working desk of master carpenter Zhou Huimin 周惠民 proved the fact.[483] Zhou is of the new generation of the Xiangshan Group carpenters. Without any family inheritance, he told me: "The book is my teacher!" And to cooperate with architects, metric units and Arabic numerals are his working choices.

Drawing is one of the most basic skills for an architect. Expressing design ideas in drawing language instead of oral or written language is the purposes of architectural drawings. For an architect, the more drawings that can be made with a clear logical organization, the less notes are needed. For example, compare page 16 with page 45 in the Appendix 1: in order to explain how to made a special part of the roof structure "Shan-wu-yun" 山霧雲, Yao made simple side elevation drawings and gave a long explanation as well, while Zhang tended to drawing more elevations in correct scale and full of details as much as possible, with some simple notes. The best design is to let the drawings talk by themselves, so that the reader can understand the main idea and the unique thoughts of the designer. For modern design, that is the reason why new presentation of drawings still emerges endlessly and remains popular in the discipline of architecture until today. The drawing assistant software has demonstrated a commitment to make the drawings ever more precise and realistic. That is the aim for architecture drawings whether in early modern China, or the current time. Proportion and scale are the most important elements to keep an architectural drawing operative.

[482] See Chapter One, Section 1.2. and Section 1.3. pp.16-28.

[483] I visited the Suzhou Xiangshan Base Group Co. Ltd. in 2011. I stayed in Zhou Huimin's workshop for several days, watching his work, and questioning him in many ways. The worn-out book of *Yingzao fayuan* first impressed me. And it was the second edition of the book, which was published in 1986.

But for the carpenter, drawing is only one of the high standards. It is an extra skill even, not a necessary life skill for them. A master carpenter with a good educational background or artistic gift, needs the drawing skills to discuss the design with their employer. And the skill can help them to keep their skills and inheritance within a carpenter's family. Just like Yao's family, which was discussed Section 4.1.1 *Yao Chengzu*,[484] 4.2.1 *The history of the Yingzao fayuan*,[485] and shown in Table 0-1,[486] he and his father, his uncle were all master carpenters, owned well known workshops. They can draw and his father's *Ziye yishu* was his secret family skills manual. But for a normal carpenter, the drawing skill does not influence his building skills. His carpentry skills are all in his mind, and even remembered by his body, particularly his hands. Their oral education, learning in practice, made them pay more attention to materials, tools, methods for handling materials and tools, and production of the structure they needed. The aim of the carpenter's drawing is to make a schematic diagram to describe the site, plan, shape, style, etc. The most important thing is expressing the section of structure correctly. Proportions and scales just need a fair idea. As we have seen in this chapter above, and in the Appendix 1.

Different purposes bring different drawings and concerns between carpenters and architects. When Yao drew the original drawings for his second year students in Suzhou Engineering School, he was preparing a textbook, which meant he would also explain the knowledge to the students face to face. It was acceptable that the drawings were not professional architectural drawings, and the mixed drawings could give all necessary information on one page. But for a modern architectural research book, professional drawings were needed. Without any teacher or master carpenter to explain, the book had to make the drawings precise. The general drawings of style like Yao's drawings were not convincing enough, and survey mapping drawings of real buildings would be much better. Most of Zhang's drawings are architectural drawings of real buildings in Suzhou.

Some examples, such as the parts and names of the structures of single-storey buildings, the plans of the east mansion of Lingering Garden, and the Mandarin duck style hall, are given a detailed introduction and more analysis, because these are the most typical examples through which we can understand the regionalism of the local carpentry building, the local building terms on parts and names of the structure, the plan of design and survey of a Suzhou garden, and the unique building style created in Suzhou. All these made the Xiangshan Group carpentry buildings different from others in China.

By answering these specific research questions on the drawings of *Yingzao fayuan*, we can see the differences between the carpenter's diagrams and architect's professional drawings. Different requirements and purposes made for different choices by carpenter and architect.

[484] See Chapter Four, pp.91-94.
[485] See Chapter Four, pp.100-101.
[486] See Prologue, p.5.

CONCLUSION

Yingzao fayuan, Two Architectural Education Systems,

Carpenter and Architect

Why study the book today in English?

Research Motive

This study has sought, through the book *Yingzao fayuan*, to introduce and analyse a unique co-operation between a Chinese traditional carpenter and an architect in early modern time. This co-operation was underestimated and neglected for a long time.

As the only book made in cooperation by a carpenter and an architect, *Yingzao fayuan* is easily neglected, partly because of the name of the book. As mentioned in the Prologue, there are two typical types of ancient Chinese books and documents on carpentry and building: *Yingzao fayuan* 營造法原, "Basic Rules for Building" or "Source of Architectural Methods", and the *Yingzao fashi* 營造法式, "Treatise on Architectural Methods" or "State Building Standards", which shared a number of similarities. First, there was only one Chinese character different in the names. The word "*yuan* 原" refers to "original" or "former", while the word "*shi* 式" means "pattern, type" or "method, model". Here we see that even the one different Chinese character has the same kind of meaning. There is no surprise, therefore, that plenty of people, including some architectural experts, have confused these two books. Second, while these two books were attracting Mr. Zhu Qiqian's attention in the 1920's, almost at the same time, Zhu gave them respectively to Liu Dunzhen and Liang Sicheng.[483] Both were first generation architects who had trained abroad, and each devoted himself to the book he had received. Third, forty years later, the *Yingzao fayuan* was published as Liu's famous editorial work, while the *Yingzao fashi* was introduced to the West by Liang.

There is no doubt that Liang Sicheng was the first Chinese architect to introduce a preliminary outline of Chinese architectural history to the West, especially the carpentry building structures of Chinese traditional buildings. Because of their architectural education background, both Liang and Lin stood under the influence of "Beaux-Arts" architectural education,[484] their research tended to study historical heritage according to fine arts models, which focused on the forms and structures of Chinese traditional buildings. They kept the faith of their choice from studenthood, and made the *Yingzao fashi* into the basic grammar book of Chinese traditional

[483] In fact, the *Yingzao fayuan* was brought to Zhu by Liu. But Zhu's evaluation confirmed his decision to help the book become an architectural study book.
[484] Wilma Fairbank, *Liang and Lin*, p.26.

buildings. Following them, besides what is mentioned in the Literature Review in section 1.2.2 *The classic books on Chinese traditional building standards*,[485] there has been more and more English researchers studying the *Yingzao fashi* and Chinese State Buildings. For instance, Guo Qinghua's two books: *Chinese Architecture and Planning* and *A Visual Dictionary of Chinese Architecture* in 2005. *Chinese architecture and Metaphor: Song Culture in the Yingzao fashi Building Manual* by Jiren Feng, in 2012.

But apart from State Buildings, China has many different kinds of building styles in different places. Both Chinese and Western scholars noticed that, and have made different efforts to fill the void since the 1980s. Chinese scholars of different universities led surveys and mappings in local areas. Research into Chinese local building traditions bloomed in China, and many typical traditions were found, such as the "Hui Traditions" in Anhui. The Literature Review in section 1.2.1 *Chinese vernacular house, the "Hui" and "Su" tradition* introduced part of the researches.[486] Ronald G. Knapp is a prolific researcher on the cultural and historical geography of China's countryside. His research includes Chinese traditional common dwellings, houses, even bridges, arts and culture in daily life. Nancy Berliner, a student of John King Fairbank, is another American scholar interested in Chinese traditional rural architecture. Her magnificent feat was moving an intact Chinese dwelling of "Hui traditions" Yin Yu Tang 蔭餘堂 (the building and all the furniture, even decorations) to an American museum: Peabody Essex Museum. The transport was in 1997, with relocating and rebuilding completed in 2003. All of these are irreplaceable contributions on Chinese local buildings. The book *Yu Yin Tang* was also published in 2003.

Except for the above, as mentioned in the Literature review, there is still a lack of English research focused on one specific Chinese traditional carpentry building tradition. Although Knapp and Berliner used certain sections to describe the Chinese traditional carpenter's work, neither of them introduced the basic rules of local carpentry building skills in such detail as in the *Yingzao fayuan*. Even different Chinese architectural traditions show distances in terms of building styles, forms, and some parts of constructions, so a book with clear and understandable research on one of the local traditions is a good choice not only for the craft builders group, but also for the culture and education system and the conflicts and harmonies behind it. The thesis is a case study on a specific local carpenter group, the Xiangshan Group, not only their building standards, which was discussed in the *Yingzao fayuan*, but also the background of the time and the education of the authors. As such, it begins to fill a gap the research into Chinese traditional State Building Standards, the *Yingzao fashi*, and pays attention to the Chinese local traditional Basic Rules, the *Yingzao fayuan*. At the same time, the thesis also gives an opportunity for the people who are interested in the "Hui" and "Su" tradition, maybe by Knapp's or Berliner's works, to know more about the craft builder groups who made those buildings.

The *Yingzao fashi*, a book of State Building Standards in the Song dynasty, was known in English. The *Lu Ban jing*, a carpenter's manual of Chinese carpenters in late imperial China was introduced and translated in English; The *Yuan Ye*, a book on the craft of Gardens in Ming Dynasty was translated into English. It is time to do the research and introduce the *Yingzao fayuan*, a book in co-operation by the Xiangshan Group carpenter and first generation of architects in early modern China, in English.

[485] See Chapter One, pp. 18-20.
[486] Ibid., pp. 16-18.

Research Points:

The argument I have presented in this thesis is summarised in the title: The *Yingzao fayuan* is a book produced in 1923-1937, by the conflicts and harmonies between two Chinese architectural education systems. The biggest challenge to the book's existing reception that I have made in the thesis is that: The book was written by carpenters and architects, and should not be slighted as a book only on one tradition of local building skills from a craftsmen group by a master carpenter.

The manuscript of *Yingzao fayuan* was started in 1923, and a formal draft of *Yingzao fayuan* was completed in 1937. Although the book was published in 1959, all the foundation work was done from 1923-1937. It was part of the modernisation processes of early modern China. Even though it did not have the opportunity to meet readers at that time, it was still a book studying that era. The establishment of the first Chinese architecture department in Suzhou was the decisive factor for the book. We can imagine that if the course of "national (Chinese) building method" was first needed in another place, maybe another local carpenter group would have received a book studying their building skills. But that is just imagination, history being made by contingency and necessity. The influence of Japanese architecture educational plans promoted this co-operation between the Chinese carpenter and architect. The other three universities which set up architecture departments did not have a course like the "national (Chinese) building method".[487] As mentioned before: Only Liang Sicheng "gave an ambitious course on the history of Western as well as Chinese architecture" in Northeast University. Liang taught the course by himself, with no record of help from any local carpenter.[488] In his later research on the *Yingzao fashi*, Liang was helped by carpenters, but not in Northeast University at this time.

We have to say that Zhu Qiqiang was a discerning scholar, for he helped two books, *Yingzao fayuan* and *Yingzao fashi*, to find the right people, the best choices for each. Liang's erudition on Chinese culture and well-informed view from East to West suited the research on Chinese traditional "State Building Standards"; while Liu's earnest work manner and exact research attitude made him a good editor and proof-reader of the Chinese traditional "Basic Rules for Building".

Part One of the thesis used three chapters to explain that the *Yingzao fayuan* was a book produced at the right time, in the right place, and with the right people. Two education systems of carpenter and architect were also introduced as the supporting background of the *Yingzao fyuan* and its authors. From a carpenter's family secrets to a text book of the first architecture department, then an architectural academic research book, two different education backgrounds were the existing environment.

Part Two of the thesis focused on the specific contents, such as texts and drawings, and did not keep mentioning the education systems, as the discussions were based on the acquiescent education systems, which enhanced the evolution of the *Yingzao fayuan*. In other words, the book

[487] According to Xu Subin's research, the architecture departments in Peking University and Hangzhou Arts School in 1929 all belonged to "fine arts architecture". The education plans of Peking University in 1929, Hangzhou Arts School in 1934) were shown in his book, but no course on Chinese building methods, p. 186 and 192.
[488] Wilma Canon Fairbank, *Liang and Lin*, p.42.

is a product of the conflicts and harmonies between two education systems.

Here, I would like to follow Richard Sennett's view on craftsman again to analyse the essential difference between the carpenter's manuscript and the architect's edition: the process of evolving into the *Yingzao fayuan* is a conversion of tacit knowledge into explicit knowledge.The communications between the sender (or initiator) and receiver (or beginner) are quite different between a secret family book, a textbook, and a study book. The purpose, motive, and method of teaching are different each time.

For master-apprentice relationship, the oral education depends on practice taking place physically side by side. The practices of building are more important than the drawings, never mind the texts. Just keeping up practices can result in "embedding (which) stands for a process essential to all skills, the conversion of information and practices into tacit knowledge".[489] It changes the skill as part of the craftsman's body, or extends fulfilment of the senses. The drawings are more like design patterns on a workshop wall (as ancient carpenters always had), rather than a book. Knowledge can be taught and remembered by mnemonic rhymes, rather than by writing words. For both texts and drawings, only important messages need to be written or drawn. These are the features of the master-apprentice education system. For a carpenter, "making is thinking",[490] hand and head are coincident. Furthermore, the craftsman has to "take lasting ownership of the skill",[491] it cannot be grasped in a short time. Other tacit knowledge, such as the culture and rituals of traditional carpentry, can also be learned during their long-term study. Normally, it takes three to five years as an apprentice, and five more years to be a carpenter. To be a master carpenter who can organise a workshop needs half of a career. Relatively little explicit knowledge is needed in the master-apprentice education system.

In a teacher-student relationship, the modern education depends on face-to-face classes. The practices of design rely on drawings. Learning the drawing language, finding the best method of expressing through drawing, and analysing the design's size, scale and type through drawings are the entirety of an architect's basic daily life. When he is a beginner, learning knowledge through drawings is his first choice. The architectural teacher teaches through drawings. An architecture textbook must therefore depend on drawings. The manuscript of *Yingzao fayuan* is a textbook which makes the drawings clear enough, with integrity on different parts of building, and organised cautiously following cognitive logic. Although made by a master carpenter, the drawings do not take the standard architectural form. With a master carpenter explaining at the side, it is acceptable. At that time, in an architecture department, the tacit knowledge of carpentry had been transformed into half tacit knowledge and half explicit knowledge, because most of the drawings still needed oral explanation to help students understand the building skills. The drawing skills of architecture students are part of their tacit knowledge. Sennett gives very vivid instances of architecture students who misuse CAD nowadays in their studies, and have lost the craftsman's approach of thinking and doing at the same time.[492] But in learning through drawings, tacit knowledge, such as the culture and rituals of traditional carpentry is already lost. Hand and head are divided by the textbook. A student who has learned carpentry skills might know how to draw a building, but does not know how to build it. Modern architectural education courses only permit

[489] Richard Sennett, *The Craftsman*, p.50.
[490] Ibid., acknowledgments.
[491] Ibid., p.295.
[492] Ibid., pp.39-45.

a short time for students to obtain the knowledge of such Chinese carpentry building methods. In a term of 20 weeks at most, students can only get the explicit knowledge of it, which treats Chinese traditional carpentry building skills as a kind of building style to be used in their future designs.

For the author-reader relationship, modern education depends on publishing books across space and time. Without anybody beside the reader to teach or explain, all the knowledge needs to be shown as explicit knowledge; the tacit knowledge can only depend on the reader's thinking and imagining. Hand and head are totally divided. The architecture drawings as a scientific expression are the most reliable things, which at least could restore the shape of the building, if we did not already know how to use it. The main texts written in the book help the reader to understand the obscure part of the drawings, and could record part of the tacit knowledge in words, such as the ritual, the processes of building, and the oral education mnemonic rhymes. In an architectural academic research book, the invisible traditional carpentry building skills are changed into black and white texts and drawings, which can be studied and analysed over and over in different times and places, by different people, from different angles. All these are based on the uniform standard architectural drawings of modern architectural education.[493] If you ask me what the architects found in the *Yingzao fayuan*, I have to say that making the book in a modern edition is the greatest contribution of architects.

From contents to form, the *Yingzao fayuan* evolved from a book only on one tradition of local building skills of a craftsmen group by a master carpenter to a book that reflects the conflicts and harmonies between two Chinese architectural education systems.

Research Purpose

In the Literature review, I established there were two gaps: between architect and carpenters, and between two Chinese architectural education systems. The thesis not only fills these gaps but also makes an original contribution to knowledge in these areas.

For the General Related Researches

1. Theoretical base, general background researches

As mentioned several times in different parts of the thesis, Richard Sennett's *The Craftsman* is my theoretical base. Carpenters and architects' co-operation and their contributions in the *Yingzao fayuan* confirm Sennett's views on the craftsman. The value of the craftsman had been misunderstood and underestimated for many years, whether in China or in the West. The thesis tries to move the researchers' eyes from well-known architects to the everyday carpenters.

Sennett wrote *The Craftsman* "to rescue *Animal laborans* from the contempt with which Hannah Arendt treated him".[494] He gives explanations of Arendt's "*Animal laborans*" and "*Homo faber*" in the Prologue, and points out his different view on this question.[495] I totally agree with

[493] Although there are different architecture drawing standards in details, basically architecture drawing methods are similar.
[494] Richard Sennett, *The Craftsman*, p.286.
[495] Ibid, pp. 6-8.

Sennett, but this simple division and misunderstanding are popular across the world, especially when people think about the carpenter and the architect. Sennett quoted Aristotle in the Metaphysics: "We consider that the architects in every profession are more estimable and know more and are wiser than the artisans, because they know the reasons of the things which are done."[496] In this view, carpenter and architect "live in two dimensions": and the carpenter is "*Animal laborans*", fixed in the question "How?", while the architect is "*Homo faber*", who asks "Why?"[497] This sounds right if we just consider the modern edition of the *Yingzao fayuan*, in which the architect works helping the carpenter to explain their work in a modern scientific method. But Sennett points out that: "*Animal laborans* might serve as *Homo faber*'s guide."[498] The processes of the history of *Yingzao fayuan* (explained in detail in Chapter Four) have proved Sennett's view. It told us that the carpenter was not just "absorbed in his task",[499] only following the "State Building Standards", trying to make a useful building. They were not only capable of thinking about their work, but also engaged in the mind after the labour was done. Yao's secret family book proves the thoughts of carpenters on their work. Because Yao's family was just one of the Chinese carpentry families, we can deduce that there must have been some other family books like Yao's which did not have the opportunity to become an architectural research book (the reason for this situation was analysed in Chapter Two). From Zhang's preface of the *Yingzao fayuan* (translation in Chapter Six), we don't hesitate to say: Yao's manuscript guided Zhang's modern edition. If there was still any doubt on this point, just contrast the contents of the original drawings and the modern edition of the book (explained in detail in Chapter Five).

Normally, researches on the Royal Institute of British Architects (RIBA) or Chinese State Labourer System are separate, such as the books I mentioned in Chapter One[500]. The thesis extends their work, links them together in Chapter Two, analyses the reasons and results of the first meeting of the modern professional architect organisation and Chinese traditional professional carpenter and official organisation in early modern China.

2. Chinese modern time and Chinese pre-modern buildings

One of the original contributions of the thesis is to offer clear explanations of "Chinese early modern time" and "Chinese pre-modern buildings". To give definitions to these concepts is important for my research, because the research time background (1923-1927) is in Chinese early modern time, which is also the reason why the *Yingzao fayuan* was written at exactly this time, not earlier or later. Furthermore, there are plenty of researches on "Chinese pre-modern buildings" with different terms, to describe the Chinese architecture, which put Chinese form on a modern or Western content. I chose three typical books introduced in the Literature Review[501]: Jeffrey W. Cody's *Building in China: Henry K. Murphy's "Adaptive Architecture", 1914-1935*, Janfei Zhu's 朱劍飛 *Architecture of Modern China: A historical critique*, and Lai Deling's 賴德霖 *Studies on Modern Chinese Architectural History* 中國近代建築史研究. The thesis admits these researches, and extends the research on "Chinese pre-modern buildings" from the architects to the builders. The first two sections in Chapter Two give detailed analysis on this point, and the rest of Part One confirms the relationship between them and the *Yingzao fayuan*. Because people

496 Richard Sennett, *The Craftsman*, p.23.
497 Ibid., p.7.
498 Ibid., p.8.
499 Ibid., p.6.
500 See Chapter One, p.12.
501 Ibid., pp.13-14.

in Chinese early modern times welcomed the pre-modern buildings, such as Murphy's "adaptive architecture" and the first generation of Chinese architects' "Chinese classicism renaissance style modern building", teachers in the first Chinese architecture department would like to provide courses helping students to understand Chinese traditional architecture design. "National (Chinese) building method" is one of these courses, which gave local master carpenter Yao Chengzu the opportunity to be a teacher for the first-generation Chinese architecture students (who were trained in China), and the *Yingzao fayuan* was written as a textbook for the course.

3. Chinese architects and early Chinese architectural collegiate education

Here comes the Chinese architects and early architectural collegiate education. The books of Qian Feng and Xu Subin, which are mentioned in Literature Review,[502] are the most comprehensive and meticulous references for Chinese early architectural collegiate education, while Gu Daqing's article *An Outline of Beaux-Arts Education in China: Transplantation, Localization, and Entrenchment* made a timeline of the theoretical base of Chinese early architectural collegiate education from the beginning to the first decade of new century. These researches give me details of how the first Chinese architecture department was established, what education system or theory it was based on, who was in charge of teaching, and their education backgrounds, etc. As a research on the relationship between two architecture education systems, the educational background of architects or carpenters is necessary information for further research. Tony Atkin's essay *Chinese Architecture Students at the University of Pennsylvania in the 1920s: Tradition, Exchange, and the Search for Modernity* is a good resource for seeking the education influence to the Chinese first-generation architects who trained in America, while the influence from Japan could be found in Xu's book. Based on these resources, I made Table 2-3 *Teacher's education background abroad in the early Chinese architectural collegial education* in Chapter Two.[503] It includes all the well-known architect teachers who trained abroad in the earliest four Chinese architecture departments. This table includes everyone's name, date of birth and death, gender, native place, time and country to study abroad, university or school department, degree, and date returned to China. This table gives a clue of further research in the relative area.

By comparing the planed courses, the thesis extends Qian and Xu's researches in Chapter Three, in order to find out the reason a specific course "National (Chinese) building method" was needed at that time in the earliest Chinese architecture Department. Shi Yong's articles help me to confirm many details of the course, such as how long the course lasted, who taught the course first (the local master carpenter Yao Chengzu), why did the teacher change (to the first-generation Chinese architect Liu Dunzhen). The history of the course is important, because it was the reason the *Yingzao fayuan* was born, and why the carpenters and architects had been linked together by the book.

An eagle-eyed reader will have noticed that I seldom mention the architectural term "modern architecture" and "Beaux-Arts", but I never talk about "Bauhaus" in the thesis. In Chapter Two, in order to explain the pre-modern architecture in early modern China, I described modern architecture's meaning in the architecture research area, and pointed out that there were few modern buildings in China from the 1920s and 1930s. The "Bauhaus" appeared in 1919-1932

[502] See Chapter One, pp.14-15.
[503] See Chapter Two, pp.46-47.

Germany.[504] Although this architectural education system had been mentioned in Liang Sicheng's letter to the president of Tsinghai University Mei Yiqi 梅貽琦, for the education plan of the department of architecture, in 1946,[505] the influence of "Bauhaus" sprung up in China only half a century later, after the Cultural Revolution and China's opening to the West, which of course brought a series of impacts on Chinese modern architectural education. This has nothing to do with the research of the *Yingzao fayuan*. The "Beaux-Arts" architectural education system was founded in 1803 in France,[506] and was the foundation of modern architectural education. All the first-generation architects received this training abroad. We can trace the shadows of the "Beaux-Arts" training in the modern edition drawings, through the great importance attached to drawings, and the atelier education method was taken up by Zhang, Liu and Yao. But the most typical "Beaux-Arts" training was transplanted from the University of Pennsylvania to the Northeast University by the Liang couple and their schoolmates after 1928. They emphasised the classical aesthetic composition of drawings, and paid more attention to form, style, proportion, and symmetry. The education plan of the Suzhou Engineering School (in 1924) was in contrast transplanted from the Tokyo School of Higher Education (in 1914), which was not a pure "Beaux-Arts" architectural education, but included some reforms by the Japanese, such as paying more attention to the building method and building management.[507]

As we know, the Beaux-Arts method of teaching "emphasised plan, program, and section as the generators of building form, with the studio problem as the primary pedagogical tool".[508] Zhang's beautiful drawings shows he got good training in the Beaux-Arts method. They are attractive and clear drawings, full and balance of the composition, strict and conscientious in details. It is a pleasure to fill the compelling Chinese traditional building characters which are shown in his drawings. But comparing with Liang's drawings in his *A Pictorial History of Chinese Architecture*, clear differences will be found: Liang's drawings are more skilful and visually pleasing, but all the measurements are in metres.

For the Studies on the *Yingzao fayuan* and Related Researches

1. Chinese vernacular houses, "Tradition" and "Group"

Chinese vernacular houses' "Tradition" and the local craft builders' "group" are the other pair of concepts have to be offered clear explanations at the beginning of the thesis.[509] Just like "Chinese early modern time" and "Chinese pre-modern buildings", there is some confusion and misunderstanding about two Chinese characters: "tradition 派" and "group 幫". To give definitions to these concepts is important for my research, because these are the basic research definitions for the researches in this area.

[504] Kenneth Frampton, *Modern Architecture*, *A Critical History* pp.123-129.
[505] Liang Sicheng, *Liang Sicheng Complete Works (Volume 5)*, p.2. Liang received "Beaux-Arts" training, and just missed the "Bauhaus", see also Wilma Fairbank, p.26.
[506] Donald Drew Egbert, Van Zanten, ed., *The Beaux-Arts Tradition in French Architecture,* (New Jersey: Princeton University Press, 1980), p. xxi.
[507] See Table 2-3, the courses of the education plan of Suzhou Engineering School in 1924 and Central University in 1933.
[508] Tony Atkin, "Chinese Architecture Students at the University of Pennsylvania in the 1920s", in *Chinese Architecture and the Beaux-Arts*, p.57.
[509] See Chapter Two, pp.48-51.

Ronal G. Knapp wrote a series of books on Chinese vernacular houses since 1960's. He introduces different Chinese houses "traditions" by "types". His works help English readers pay more attention to the common houses rather than the special buildings, such as palaces, temples, or buildings in private gardens. At the same time, as mentioned in Literature Review,[510] the limitation of Knapp's research is that he is more concerned with different form types, not the local building "tradition", and nothing about local crafts builders' "group". Nancy Berliner's *Yin Yu Tang: The Architecture and Daily Life of a Chinese House*, and T. June Li's *Another World Lies Beyond: Creating Liu Fang Yuan*, *the Huntington's Chinese Garden* filled the blank of descriptions and records on carpenter's work. But there is still a blank of English researches on Chinese local carpenters group: the organisation of the group, the education background of craft builders, and the abilities the master carpenter had. The thesis filled that blank, and gives an example of how to study such a group. Therefore, the thesis is also an extension of Knapp's and Berliner's researches.

2. The classic books on Chinese traditional building standards

The *Yingzao fayuan* has extensive contacts in other classic books on Chinese traditional building standards, such as the *Yingzao fashi*, *Lu Ban jing*, and *Yuan Ye*.

The relationship between the *Yingzao fashi* and *Yingzao fayuan* has been described at the beginning of this Chapter. The research statuses of these two books are different. As a book of basic rules for south-eastern Chinese building in the late Qing Dynasty based on a master carpenter's experience, the *Yingzao fayuan* is always seen as a book on just one tradition of local building skills. This is true of the contents of the *Yingzao fyuan*; but it neglects the value of the craftsman's thoughts, and the architect's additions. At the same time, as a book of state building standards for the official buildings in the Song Dynasty under the promotion and interpretation of Liang Sicheng, the *Yingzao fashi* has become well-known in both the East and West. The two books were treated very differently by architectural experts in the years following Liang and Liu's era. Plenty of researches were made on the latter book, but few on the former one. Liang and his wife Lin Huiyin's irreplaceable family and educational background, their important roles in Chinese architectural history research, the great influence of their famous western friends Wilma Canon Fairbank and John King Fairbank,[511] all helped push Liang's research into the world. Liu did not have such enormous clout. Little success with the *Yingzao fayuan* came of Liu's striving. This one-sided fate also reflected the architectural scholars' value judgments as literati, preferring statute over technology, officialdom over ordinary people, and scholars over craftsmen.

This thesis attempts to make the first step to bring the *Yingzao fayuan* to the English research area. With the *Lu Ban jing* and *Yuan Ye*, these four classical Chinese traditional building standards make a series, including the national building standards, local carpenters' group building standards (or experiences), the carpenters' traditional building skills and rituals, and national gardening standards. These four books could be treated as basic Chinese building theories on four aspects: official buildings, local buildings, ritual, and gardening. Without any part of the series, it seems incomplete. Many other researches could be explored based on the books. Different technical terms are the biggest obstacles of new researches, so I made Table 7-1 in Chapter Seven

[510] See Chapter One, p.17.
[511] Wilma Fairbank, *Liang and Lin: partners in exploring China's architectural past,* (Philadelphia: University of Pennsylvania Press, 1994).

to compare the technical terms in four classic books both in Chinese and English.[512] It would be a useful table for those who are confused by different names of the same technical term in the building structure. That is an original contribution for other researches.

3. Xiangshan Group and its Chinese traditional master-apprentice training

For the Xiangshan Group and Chinese traditional master-apprentice training, the thesis not only made the first English research of the *Yingzao fayuan*, but also found a new angle to study the book. Not limited by every single word or every piece of drawing, the thesis focused on the different edition of carpenter's manuscript and architect's organisation. Without analysing live examples like Doctor Shen Li shows in her *A Study of Historic Evolution of Xiangshan Group Carpenters*, and without plenty of sources and legends like Cui Jinyu shows in his *The Buildings of Suzhou Xiangshan Group*, carpenter's and architect's different choices are the core research of the thesis.

After rapid evolution of modernism and urbanisation, China now has slowed her step; rethinking the direction of development, especially in rural areas. Research on the Xiangshan Group carpentry building skills has grown in recent years. Besides Shen Li, Cui Jinyu, and Feng Xiaodong, already mentioned in Literature Review in section 1.2.3 *Xiangshan Group and its Chinese traditional master-apprentice training*,[513] architect Zhu Jinan 祝紀楠 and carpenter father and son Hou Hongde 侯洪德 and Hou Xiaoqi 侯肖琪, their work should not be forgotten. I put the introduction in the Literature Review in section 1.2.4 *Studies on the Yingzao fayuan*.[514] working in Suzhou, wrote *Diagram Building Method of the Yingzao fayuan* in 2014. The Suzhou Xiangshan Base Group Co. Ltd. and Suzhou Nationality Architecture Society 蘇州民族建築學會 keeps organising seminars with craft builders and scholars, and publishes a bimonthly magazine named "The Journal of Landscape Methods 景原學刊" since 2004. These researches were not engaged with in the thesis because they focus on technical problems of practice building skills, but they do reflect the ascendance of research on the Xiangshan Group in China. Therefore, the thesis could make a research in a new angle: not only limited by the book or the Xiangshan Group, but also linking them with the different education systems and the Chinese first generation architects.

Further Work

Since 2013, when "The Beautiful Countryside" construction plan was enacted in the 5th Plenary Session of the 16th Central Committee, I believe that not only more practice and theory projects of the Xiangshan Group will take place in China, but there will also be another opportunity for carpenter and architect to co-operate with each other. Hundreds of projects in co-operation with them are in progress in rural areas of China right now. While we might speculate whether another book like the *Yingzao fayuan* or in other forms be produced, because the two architectural education systems exist together in China from early modern China until now, it is

[512] See Chapter Seven, pp. 185-187. In the table *Yingzao fashi* is instead of by the *Qingshi Yingzao zeli*, because the latter one is based on the former one, but more recently.
[513] See Chapter One, pp. 20-21.
[514] Ibid., pp. 22-23.

certainly time to look back and rethink the relationship between carpenter and architect.

1. The translation of the *Yingzao fayuan*

The thesis is a research on the *Yingzao fayuan*, not translation. I recognised that in my current research I do not tend to entirely translate the Chinese traditional carpentry building skill terms given in the *Yingzao fayuan*. The full translation could be a future work, but is not necessary for my current research. The research point and research purpose have been discussed above. All the necessary translation has been done in the main texts, and I have attached the draft translations of Yao's original drawings and contrasted them with Zhang's plates as an appendix, which was just a preliminary trial. Even though there are errors and omissions in the translations of those drawings, I have still attached it, because it was a part of my research work, and could be useful for research on the Xiangshan Group carpenter's building skills.

The illustration of the *Yingzao fayuan* original drawings and modern drawings both in Chinese and English are put into the Appendix, which does not mean the translation is less important. All the research done for this thesis proves that it would be valuable to translate the whole book. I spent more than a year on the trial translation, and recognised that a complete translation and explanation of all the drawings in *Yingzao fayuan* would need the help of English native speaker sinologists, with long discussion on each specific building method, which could not have been done in a short time.

Besides translating the book, there is another necessary work needed, which is giving a list, or an introduction to the technical terms of the translations of Chinese traditional construction. As shown in Table 7-1 "Technical terms" contrasts their use in Chinese and English in different books, which could help foreigners understand the basic translations, rather than confusing them. That table is simply a limited list of only the most basic parts of structural frames, without explanations. Hundreds of other technology terms need introduction, explanation, and translation. A book, just like *Recording Timber-framed Buildings: an Illustrated Glossary*[515] does for the timber-framed English Building, is needed for the researchers on Chinese ones. Guo Qinghua's *Visual Dictionary of Chinese Architecture* had done these works based on the *Yingzao fashi*; it is time to make another dictionary based on the *Yingzao fayuan*. Because, compared with the *Yingzao fashi*, the *Yingzao fayuan* is more recent, and easier to find existing building to confirm the traditional structure and technology terms.

2. Live projects research of the Xiangshan Group today

As mentioned before, the craft builders of the Xiangshan Group built some new projects in China and abroad (mostly in South Asia). They are consciously recording their projects, from the building processes to the builder. The book *Xiangshan Group Traditional Architectural Craftsmanship*[516] is a record of the newly built mandarin duck style hall in the Xiangshan Base. But this project is only one of a number of their works today. More case studies on the living projects of the Xiangshan Group could give us the living change of the crafts builders, such as how are they using electric tools? How do they exchange the units between *metre* (the

[515] N W Alcock, M W Barley, P W Dixon and R A Meeson, Illustrations by R A Meson, *Recording Timber-framed Buildings: an Illustrated Glossary*, the Council for British Archaeology, 1996.

[516] Feng Xiaodong 馮曉東, *Cheng Xiang Lu: Xiangshan Group Traditional Architectural Craftsmanship* 承香錄——香山幫營造技藝實錄, Beijing: China Architecture & Building Press, 2012.

International System of Units) and *chi* (the Chinese Traditional Length System of Units)? What kind of rituals are they still doing secretly? How about Luban belief (as far as I know, women are still forbidden in lots of field work places, even including the hostess)?

There are not only traditional works by the Xiangshan Group builders today, but also modern ones. Just behind the ChengXiang Hall 承香堂, there is the Xiangshan Traditional Building Museum in a modern carpentry structure. They deliberately place these two kinds of building together, to show their skill is not eliminated by time, but they also know well about the new technologies. But in fact, how many new technologies do they have? How did they accept training in modern technologies? What is the new master-apprentice education today (The Xiangshan Base has a crafts builder technical school since 2007, and Suzhou has the carpentry technical school in the 1990s)?

The Chengxiang Hall and the Xiangshan Traditional Building Museum in the Xiangshan Base[517]

Much research work is still needed on the living projects and the real lives of the craft builders today.

3. The architects influenced by the *Yingzao fayuan*

First of all, the design drawings and building designs by Liu Dunzheng and Zhang Zhanggang could be studied. Liu made designs before and after 1927, when he worked with Yao Chengzu in the Suzhou Engineering School. Zhang's designs must be after 1927, after he worked with Yao to prepare for the modern edition of the book. The *Yingzao fayuan* must have influenced their designs in an overt or covert way. It is worth finding out, because even though lots of research was done on Liu Dunzhen as he was one of the founders of Chinese architectural education, none

[517] Photos come from the website of the Xiangshan Base.

of them did it from this point of view. With Zhang, on the contrary, there is little research about him, because he was not in good health after the 1950s. Few of his works or papers were left, except the *Yingzao fayuan*.

Not only the designs, but also the articles, books, or the courses taught from them are suitable research material. Furthermore, the research might be expanded to their students and their works.

As an architect, what can we learn from a carpenter? Wang Su 王澍, the famous first Chinese recipient of the Pritzker Architecture Prize in 2012, used his life experience to answer the question. He was learning from craft carpenters for more than ten years, "to gain experience at actual building", then using his knowledge of Chinese traditional culture and building skills to design modern buildings. His designs connect with craft builders in spirit.[518]

Let us end the thesis with Sennett's answer: We should learn from craftsmen knowing when one "can pause in the work and reflect on what he or she is doing. These pauses need not diminish pride in the work; instead, because the person is judging while doing, the result can be more ethically satisfying".[519] This thesis is ending, but rethinking and continuing works are just starting. I hope to have time to improve my research in future work and take pride in my work like a craftsman.

[518] "Announcement: Wang Shu of the People's Republic of China is the 2012 Prizker Architecture Prize Laureate", The Prizker Architecture Prize <http://www.pritzkerprize.com/2012/announcement> [accessed 24 February 2016].
[519] Richard Sennett, *The Craftsman*, p.296.

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APPENDIX

1. The illustration: The *Yingzao fayuan* Original Drawings and Modern Drawings

2. Selection Technical Terms in the Original Drawings

3. Date of the Chinese Dynasties

Contents of Original Drawings

Main Ridges

Main gate and walls

Appendix

Contents of Contrast Modern Drawings

Notes:

1. This volume is better to read with the thesis, especially Chapter Six. Most of the technical terms are explained in the thesis, such as "*paike*" , 牌科, brackets sets.
2. This volume was bound on the left side, which suits modern reading habits. But the Chinese traditional reading habit is reading from right to left, so the author reorganized the pages which have two drawings, to keep them in the original order.
   (Yao Chengzu 姚承祖, *Yao Chengzu Yingzao fayuan tu* 姚承祖營造法原圖, Shanghai 上海: Tongji University internal press 同濟大學內部印刷, 1979/10.)
3. All the contrasting modern drawings are translated from the plates of the modern edition of *Yingzao fayuan* 營造法原, the original numbers are kept, and the original pages are attached in the brackets.
   (Yao Chengzu 姚承祖著, Zhang Zhigang 張至剛增編, Liu Dunzhen 劉敦楨校閱, *Yingzao fayuan* 營造法原, Beijing 北京: China Architecture & Building Press 中國建築工業出版社, 1986, 2nd ed.)

Translation Principles

The translation of this chapter attempts to keep the original form as much as possible, not only as regards the words, but also the typesetting. An explanation follows:

(1) According to original handwritten matter and Chinese traditional reading habits, many sentences use horizontally reversed text, reading from right to left. This is not suitable for modern people, even for Chinese. But this way of writing and reading is an important part of Chinese traditional culture and way of life. I believe it is reasonable to keep it.

(2) The original drawings used Chinese characters, Arabic numerals, and Suzhou numerals to record numbers of measure. In my translation, I use English words instead of Chinese characters, keep the Arabic numerals, and use Arabic numerals instead of Suzhou numerals in red colour as special notes. Suzhou numerals are a numeral system used in China before the introduction of Arabic numerals. Although nowadays (in contemporary China) Suzhou numerals are seldom used, we can still find them being used in Chinese towns abroad.

(3) The measures of original drawings are kept in the Chinese units: *zhang* 丈, *chi* 尺, *cu* 寸. As we know, Chinese carpenters and Taoists had a very particular concern for numbers used in buildings. They believed that the number of measure along with *Fengshui* 風水 theories, can bring good or bad luck for the owner's family. Using a modern metric measure system will lose all the meanings of the numbers. Even though I cannot analyse all the numbers or measures; it is worth keeping them for readers.

(4) For the translation of technical terms: I compared three books: *The Craft of Gardens: The Classic Chinese Text on Garden Design*, *Carpentry and Building in Imperial China: A Study of the Fifteenth-Century Carpenter's Manual Lu Ban jing*, and *A Pictorial History of Chinese Architecture*. As a result I chose *Carpentry and Building in Imperial China: A Study of the Fifteenth-Century Carpenter's Manual Lu Ban jing* as the standard book, using the same translations in this thesis as much as possible. That is not only because Klaas Ruiteenbeek mentioned *Yingzao fayuan* specifically many times, but also because *Lu Ban jing* is a carpenter's manual compiled in the fifteenth century, and influenced the south-east of China from then to the early 20th century. Yao was a carpenter who worked in the south-east of China in the early 20th century. Many of his technical terms must come from the *Lu Ban jing*. Ji Cheng's book, *The Craft of Gardens: The Classic Chinese Text on Garden Design*, is translated by Alison Hardie. It is also a craftsman's manual from the *Xiangshan Gang* in south-east of China, and was completed in 1631. But it is rather a gardener's manual than a carpenter's manual. The same problem arises with *A Pictorial History of Chinese Architecture* written by Liang Sicheng, which is based on the state buildings and building standards in the north of China. In these two books, some technical terms are different even in Chinese, so the translations are even more diverse in English. I made a table to point out their differences to help people to check the basic terms if necessary (table 6-1).

(5) The order of all the drawings also keeps to the original style. I never change any contents of a page, or delete a drawing which looks as if shown twice in the book, as *The Buildings of Suzhou Xiangshan Gang* does. I believe that the original order reflects the organization by the author, either Yao Chengzu or Chen Congzhou. For the drawing repeated in the book, it is obviously not reprinted by mistake, but for some reasons was drawn twice. Since we don't know the reason, I think keeping all of them is a better choice.

(6) The original book is not a published book, just a private print, so it has not any page numbers. For ease-of-use, I added content numbers and page numbers to them and made a contents list. That is my biggest change so far.

The *Yao Chengzu Yingzao fayuan tu* has 36 pages totally, including one tile page, preface and forewords, and one end page. The drawings make up 32 pages, I divide them as: designing and plans (2 pages), styles of halls (4 pages), gable and base (1 page), bracket sets (3 pages), details of structures (8 pages), corner roofs (5pages), main ridges (3 pages), main gate and walls (3 pages), and appendix (3 pages).

In this appendix, I will show the drawings one by one, the original drawings and the contrast modern re-drawings: The original drawings and the translation drawings. First, presenting the contents of each page; second, providing a list of technical terms in each page, and give a simple explanation base on the modern edition of *Yingzao fayuan*; at last, giving a simple comment of each drawing. The main goals of this appendix are giving a trial of translation, revision and exegesis of the original drawings by Yao Chengzu, and a clued of comparing the drawings with the illustrations in the modern edition of *Yingzao fayuan*.

Tongji University, Department of Architecture
Edition by Chen Congzhou

Yao Chengzu Yingzao fayuan tu

Inscription by Ye Sheng Tao

姚承祖营造法原图序

陈从周

香山姚承祖先生课徒作《营造法原》，此即是书所绘原图也。其时在一九二四年始，四五年间。邹生宣伍得之苏州，携以示余，余悲欢交集，规模法度，得庆重见，而历劫不雁，自有神护。早岁见紫江朱启钤先生撰《题补云小筑图》，心仪其人其术者久之。三十年来屡客吴中，徘徊于先生诸遗构下，思绪万千。复读先生遗著，惠我多矣。兹观斯篇，更亲切如侍几席。吉光片羽，长留人间。爰为整理，公诸于世。足与晚近刊本《营造法原》互相参证也。

先生字汉亭，别号补云，先世安徽歙县人，占籍江苏吴县香山，诞于一八六六年（清同治五年）农历三月十八日。祖灿庭，著《梓业遗书》。十一岁随叔开盛习木作，经岁营建于乡郡间，苏州邓尉香雪亭、怡园藕香榭、灵岩寺大殿等，皆其结构之著者。一度教授苏州工业专科学校，并任苏州鲁班会会长，江南耆匠也。于一九三八年农历五月二十一日弃世。子开泰世其业。

五十年前姚先生曾绘《补云小筑图》余曾见及，所列诸屋架式，与此集相若，惜已亡佚，而小筑之图影本幸存，故录朱先生原题及云岩寺大殿设计图于后，图作于一九三三年夏，绘图者郁友勤，乃姚先生当手师傅，助其设计营建多年。谨述其概略如上。一九七九年十月陈从周识于上海同济大学建筑系。

朱启钤　题补云小筑图

民国壬申（一九三二年）秋余因刘士能（敦桢）君之介，得知吴门姚君补云所著《营造法原》一书。姚君旧执教鞭于苏州工业学校，是书其平日课本也。书中所辑住宅祠庙佛塔泊岸，及量木计围诸法，未见官书，足传南方民间建筑之真象，数月来余躬自整比，校订一过。姚君又虑是书所图，或有遗漏，复以画册与补云小筑绘卷见寄，并属为题署。余维我国南北建筑之式样，北以雄健胜，南以秀丽纤巧见长，俱如其气俗人情。数千年来，此二者互相挹注揉合，其关系亦有可得而言者。姬周之世，吴越俱属于楚，建筑制度依地理气候材料之别，如临水基筑，响屟为廊，系舫名轩，与中原稍异。自始皇并六国，放写其宫室于咸阳北阪上。汉高复营新丰，效丰沛故乡风物，放牛马鸡犬于途，识其故居，是为楚人习尚输入关中之证。永嘉乱后，衣冠南渡，建筑艺术亦随之俱来。迨隋文混一海内。炀帝开邗沟，幸江陵，其大匠何稠项升，皆南人，《迷楼记》所言，幽房曲室，互相连属，回环四合，胥南式庭园之特征。而北宋喻皓建汴京开宝寺塔，著《木经》行世，皓亦南人。绍兴以后，中原工艺随国都南徙，萃于江浙一隅，遂成近世人文之盛。其时李明仲《营造法式》一书重刊于平江。明清以来，写本流传，亦以江浙故家为最，故今苏杭建筑，若月梁、琵琶斗等，犹如宋制，而北方转失其传焉。嗣洪武营南京，采木江西，大匠集于苏之木渎，董役诸臣，如陆祥陆贤昆仲，隶籍苏之无锡。永乐北迁，征南匠营北京，蒯祥以匠工跻身卿贰，与蔡信、杨青等俱吴人，于是南式建筑远被幽燕，演为明清二代制度，迄今彩画作犹有苏画之名。清康乾间内庭装修开雕于金陵，归楠木作雷氏承办，雷氏亦原籍江西而迁居金陵者，故落地罩园光罩诸称，南北如出一辙。补云祖父灿庭先生，曾著《梓业遗书》五卷，惜未得寓目，而补云题记之所称述承先启后之思，实有所本。是其平生目营心计，咸出其祖若父之手法。木渎香山之遗规，其在斯乎。夫匠家秘授，术语为方言所限，素以艰涩见称，但师承所自，能有纪述，便属可珍，非若词人作赋，儒家释经，穿凿附会，徒为架空之论者。故《营造法原》一书，虽限于苏州一隅，所载做法，则上承北宋，下逮明清，今北平匠工习用之名辞，辗转讹误，不得其解者，每于此书中得其正诂。然则穷究明清二代建筑嬗蜕之故，仰助此书正多，非谨传苏杭民间建筑而已。因姚君索书，并著其原委于此。中华民国癸酉（一九三三年）紫江朱启钤识。

一

Preface to the Yao Chengzu Yingzao fayuan tu

Chen Congzhou

Mr. Yao Chengzu 姚承祖 of Xiangshan (Group) wrote the book Yingzao fayuan as a text book. These are the original drawings by him for the book. From 1924, he took four to five years to accomplish the book. Mr. Zou Gongwu 鄒宮伍 found the manuscript in Suzhou, and brought it to me. I accept it with mingled feelings of grief and joy. I am glad the manuscript could be shown to us today, and I believe that God protected it through difficult, perilous times. Since my youth, I have been mesmerized by Mr. Yao and his works for a long time, since I saw the essay on the drawing of Buyun Xiaozhu 題補雲小築圖 by Mr. Zhu Qiqian 朱啟鈐 . Over thirty years, I have been to Wu area several times, and wandered around the buildings made by Mr. Yao, which provoked deep thought. I have learned a lot from reading Mr. Yao's book (the Yingzao fayuan modern edition). Today, reading his original drawings, I feel as if I am talking with him. To allow this fragment of a highly treasured relic be saved for ever, I edited the drawings, and print it as a reference for the book, Yingzao fayuan modern edition.

Mr. Yao is also known as his style name (zi 字) Hanting 漢亭 , and the nom de plume (hao 號) Buyun 補雲 . He was born in Xiangshan 香山 , Wu Xian 吳縣 , Jiangsu 江蘇 , on May 2nd 1866 (late Qing Dynasty), and of She Xian 歙縣 , Anhui 安徽 descent. His grandfather Yao Canting 姚燦庭 had written the Ziye Yishu 梓業遺書 . Yao began to study carpentry at the age of eleven, under his uncle Yao Kaisheng's 姚開盛 direction. He spent his career in the country side and Suzhou city. Some of his works can be found today: the Plum Blossom Pavilion 梅花亭 in the Xiang Xuehai 香雪海 , "scented snow sea", in Suzhou; the Ouxiang Xie 藕香榭 , "The Lotus Fragrance Anchorage", in the Yi Yuan 怡園 , "The Garden of Pleasure", in Suzhou; the Main Hall of Lingyan Temple 靈岩寺 in Mudu 木瀆 , etc. He was engaged as a teacher in the Suzhou Engineering School 蘇州工業專科學校 , and was the head of the Lu Ban Guild of Suzhou 蘇州魯班會 . He was a well-known master carpenter in Jiangnan 江南 . He died on June 18th 1938. His son Yao Kaitai 姚開泰 took over his trade.

I have seen the (handscroll) drawing of Buyun Xiaozhu 題補雲小築 made by Mr. Yao, fifty years ago. The styles and structures of the buildings are quite similar of the manuscript. Unfortunately the buildings were destroyed, but the copy of the drawing of Buyun Xiaozhu exists. I attached the drawing of Buyun Xiaozhu and the designs of the main-hall of Yun Yan Temple 雲岩寺 to the end of this book. The drawings of the main-hall of Yun Yan Temple were drawn by Yu Youqin 郁友勤 , who was Yao's right-hand man, working with him for many years. I respectfully record an outline (of the book's origins) as above.

Chen Congzhou, October 1975, Architecture Department, Tongji University, Shanghai.

Zhu Qiqian Essay on the drawing of Buyun Xiaozhu

In the autumn of 1932, I heard about the book Yingzao fayuan by Mr. Yao Buyun through Mr. Liu Shineng (Dunzhen). Yao was engaged as a teacher in the Suzhou Engineering School. This is his usual text book. The dwellings 住宅 , temples 祠廟 , pagodas 佛塔 , embankments 泊岸 , and the skills of carpentry measurement have never been found in official books (or regulations). It is worthwhile to hand on the real appearances of unofficial architecture in the south of China. I spent several months proofreading the book, and edited it. Mr. Yao was worried that the book was not complete, so he sent me an album of his original drawings and a handscroll the landscape drawing of Buyun Xiaozhu, asking me to write this essay.

From north to south, I saw the buildings of our country just like the local manners and feelings, the north are known as powerful and vigorous, while the south are admired for being graceful and dainty. Over thousands of years, these two were absorbed into each other, and the relationship is worth discussing: In early history, the Wu and Yue 吳越 areas belonged to Chu 楚 , and buildings were different in location, weather and materials. For example, the buildings beside water in this area were known as step echo wooden covered corridor and fixed boat pavilion, which were somewhat different from those of the Central Plain 中原 . Qin Shi Huang 秦始皇 became the first emperor of a unified China in 221 BC, and this recorded that he built his palace to the north of Xian Yang 咸陽 . Then the Emperor Gaozu of Han 漢高祖 expanded the palace to copy his homeland in Jiangsu 江蘇 . He even raised cattle, horse, poultry, and dog to symbolize his home. This is the evidence of the Chu 楚 culture which influence Guan Zhong 關中 . In 311, the struggle for the Chinese throne forced many people, especially the scholars and officials, to leave their homeland, moving from the Central Plain to the South of China . The building culture moved along with the people from centre to south. In 589, founded by Emperor Wen of Sui 隋文帝 , the Sui Dynasty saw the reunification of Southern and Northern China. The Emperor Yang of Sui 隋煬帝 ordered the construction of the Grand Canal 京杭大運河 , and visited Jiangling 江陵 . The master carpenters He Chou 何稠 and Xiang Sheng 項升 , who were in charge of the Grand Canal, were both born in the South. The Milou Ji 迷樓記 mentioned: "The rooms are connected, (made courtyard in the central) winding on all sides." It is a typical style of southern dwelling and garden. During the Northern Song 北宋 (960-1127), the master carpenter Yu Hao 喻浩 built the tower in Kaibao Temple 開寶寺 in Bianjing 汴京 . He wrote the Mu Jing 木經 , "Timberwork Manual", to record his skill. He was also a southern carpenter. After the Northern Song, the craftsmen moved south with the change of capital . The craftsman's culture developed in the joint area of Jiangsu and Zhejiang which became the cultural centre of recent history. At the same time the Yingzao fashi was published in Pingjiang 平江 . But during the Ming and Qing Dynasties , the handwritten copies of the Yingzao fashi were most widespread in the joint area of Jiangsu and Zhejiang. We find that the building structures in Suzhou and Hangzhou nowadays, such as the Slightly Arched Beam 月梁 and Pipa bracket 琵琶門 , still obey the rules of the Song Dynasty, while they have changed in the north of China. The Ming Dynasty established its capital in Nanjing 南京 in 1368. To prepare for great works, they felled timber from Jiangxi 江西 , and convened carpenters and craftsmen in Mudu town 木瀆 , Suzhou 蘇州 , in Jiangsu 江蘇 . From official to builder they were all people of the south. For example the master carpenters Lu Xiang 陸祥 , Lu Xian 陸賢 , and Kun Zhong 昆仲 were born in Wuxi 無錫 , Jiangsu 江蘇 . In 1421, the capital of the Ming Dynasty changed to Peking. The government called for carpenters and builders from the south to build the new capital. The master carpenter Kuai Xiang 蒯祥 , who was the leader in building the Forbidden City, finally became an official of the Ministry of Works. He and other masters, such as Cai Xin 蔡信 , Yang Qing 楊青 , were also Wu people. Since then, the south building style has influenced the north, and it dominated the rules of construction in the Ming and Qing Dynasties. Until now, in Chinese decorative painting 彩畫作 there is a special style called the Suzhou style pattern 蘇式彩畫 . In the 1700's, the Lei family from Nan Jing led the workers of building, decoration, and maintenance the palace. In fact, the Lei family originally lived in Jiangxi, then moved to Nanjing. Because of this background, the ornaments inside buildings, such as the Luodi Zhao 落地罩 , and Yuanguang Zhao 園光罩 , have the same names in both south and north.

Yao's grandfather Yao Canting 姚燦庭 wrote the Ziye Yishu 梓業遺書 , in five volumes. Unfortunately, I have not had an opportunity to read it, but I believe Yao's great work, both the book and his designs, were based on his family education. The traditional rules of carpentry in Mudu, Xiangshan, are all in this book. As we know, the craftsmen's secret skills in an education limited by the craftsmen's code and dialect are difficult to understand. Since we now have the record of a master carpenter, it is very precious. It is not mentioned by scholars, unlike some classical books which were explained by people in ways full of misunderstandings and useless for research. Above all, although the Yingzao fayuan is just a local carpentry record, it can be sourced to the Northern Song Dynasty (960-1126), and was still in use in the Ming and Qing Dynasties (1368-1912). Many region used by carpenters of Peking today have become confused or erroneous using, the original source of correct words can be traced in the book. That means this book not only teaches us the traditional rules of carpentry in Suzhou, but also can help us to research the changes in rules for Chinese wooden buildings in the Ming and Qing Dynasties.

This essay was written at Mr Yao's request, and I also explained the reasons why this book has such important contribution to make.

Zhu Qiqian of Zijiang, in 1933.

甲子春蘇州工專学校於建築科中設授本國營造法今非專门
人才而濫膺教師之職四五年间繪圖八十餘種編成營造法原一冊
其间凡楼阁殿臺廳堂之式樣亭榭廻廊各材之名稱、樑柱方梓机
與斗昂戧椽牌科之制度以及長短方圓大小尺寸
靡屑無遺第皆時因排日授課雖有圖樣
人置篋中矣而知友數人謬之 只午
力時日分门别類作

The Monk of Bingyin Year

In the spring of Jiazi Year 甲子年 (1924) , I was teaching the national building method in Suzhou Engineering School. I am not a qualified teacher, and was afraid of neglecting my duty. Over four to five years, I drew more than eighty plates, and edited a book named Yingzao fayuan, in one volume. The book introduces the styles of storeyed dwellings (towers and belvederes), and halls (ting and tang) 樓閣殿台廳堂之式樣; the construction terminology for pavilions, gazebos, and covered walkways 亭榭回廊各材之名稱;

… …of beams, columns, purlins, and short ribs 樑柱枋梓機;

… …the rules of rising angle ridges, and brackets昂戧椽牌科之制度;

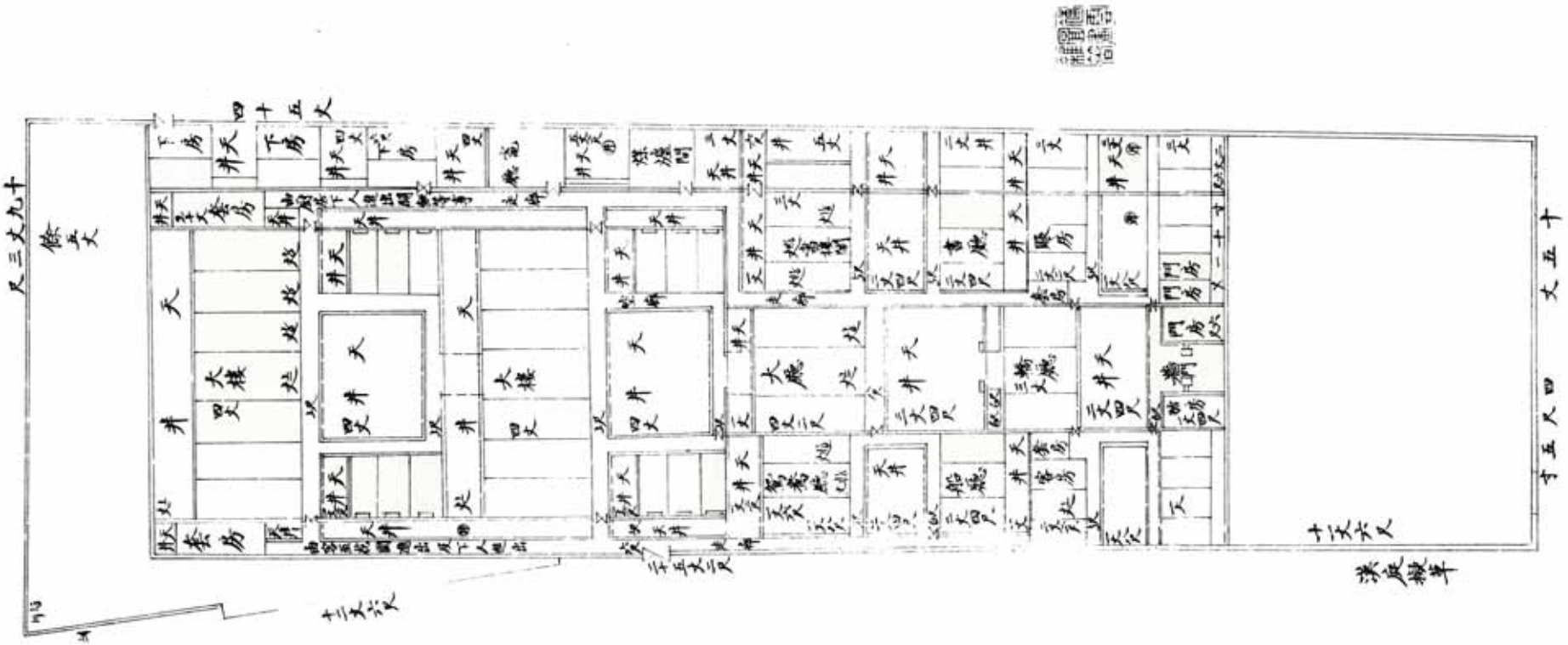
and the lengths, forms, sizes以及長短方圓大小尺寸;

… …nothing missed 無遺第. For the course, although having the drawings

… …(I) put the book on the shelf, but my friends encouraged (me to)

… … using time to classify … …

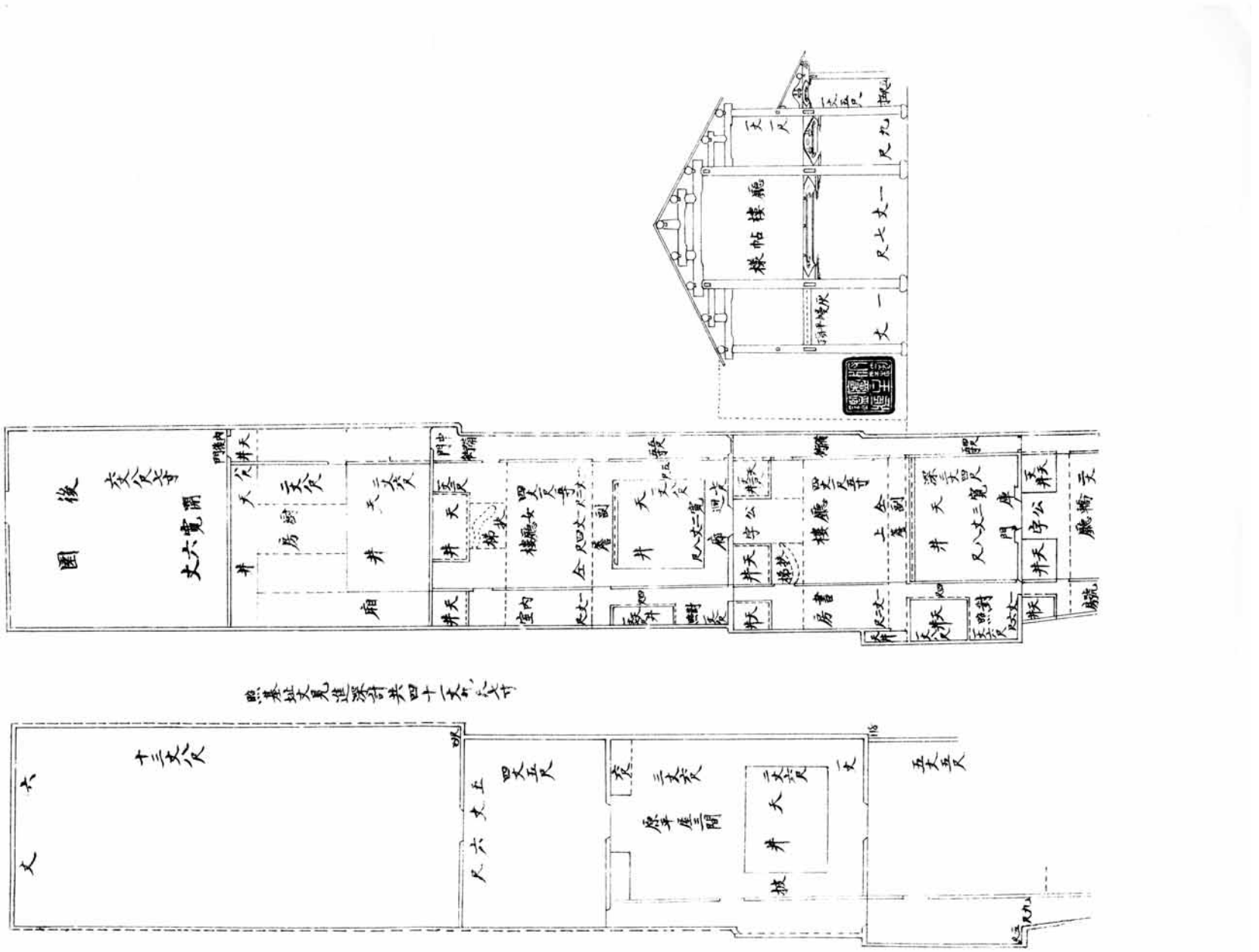
Appendix 1
The illustration: The *Yingzao fayuan* original drawings and modern drawings

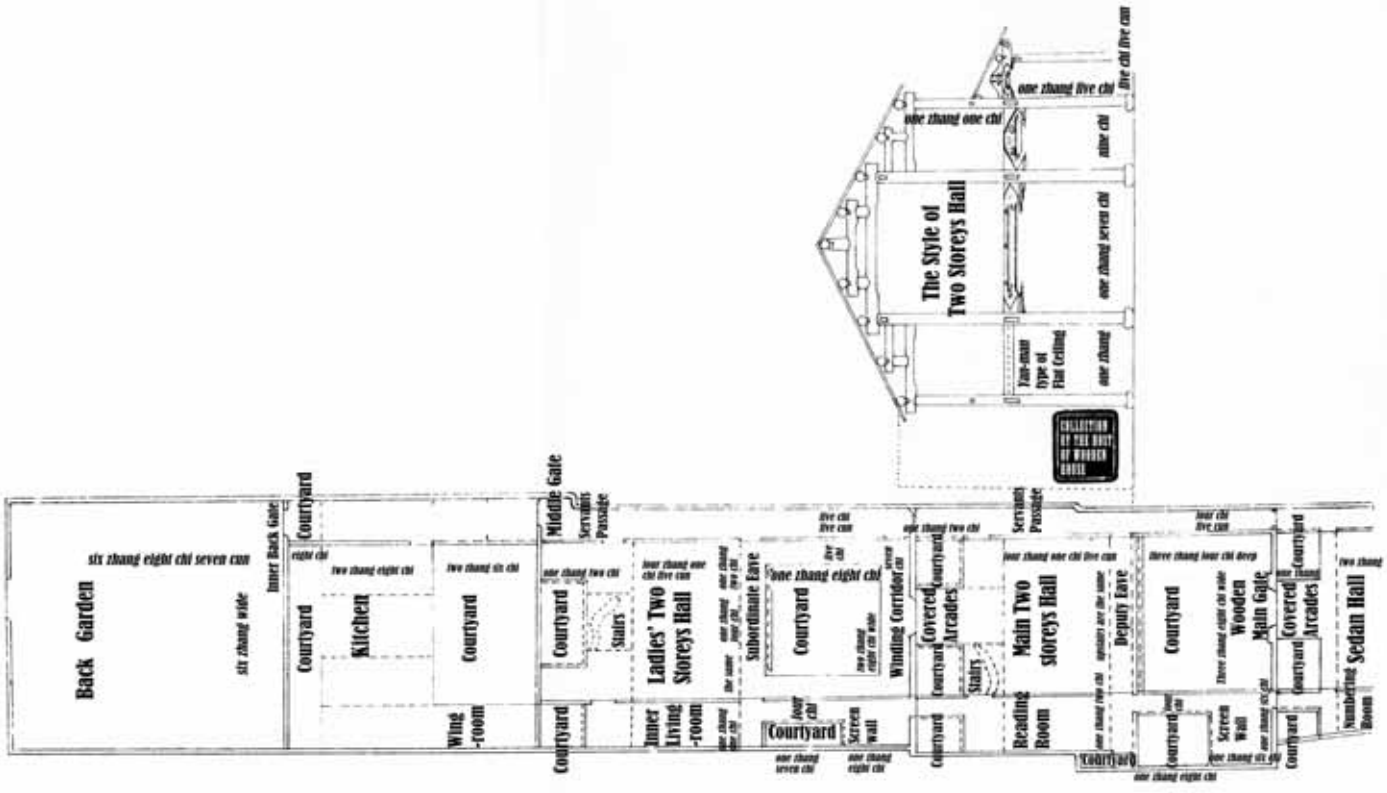



Buyun's Drawing Notes
forty-five zhang
nineteen zhang three chi
five zhang excess
Servants' room
Servants' room
Servants' room
Kitchen
Boiler Room
Wing-room
For servants going to the kitchen and preparing dinners
The passage
Courtyard
Book Collection Belvedere
Reading Room
Counting Room
Porter's Room
Porter's Room
Porter's Room
A Building of Two Storeys
Courtyard
Court-yard
A Building of Two Storeys
Passage
Main Hall
Sedan Chair Hall
Wall Gate
Reception Room
Mandarine Duck Style Hall
Boat Style Hall
Guest's Room
Wing-room
For guests visiting garden and use of servants
eleven zhang six chi
fifty zhang four chi five cun
twenty-five zhang two chi
twelve zhang six chi
365
72
Sketched by (Yao) Hanting

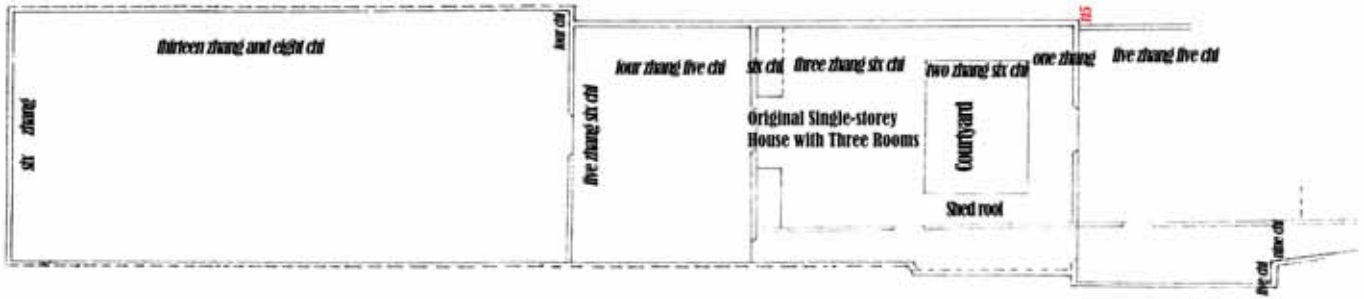
1

Appendix 1
The illustration: The *Yingzao fayuan* original drawings and modern drawings

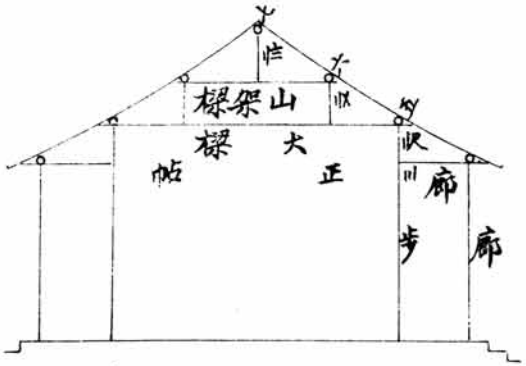




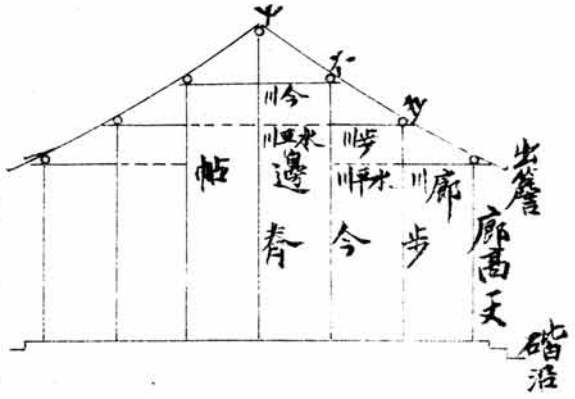
According to measure, the whole house length is forty-one zhang nine chi seven cun



營造平房屋架之法

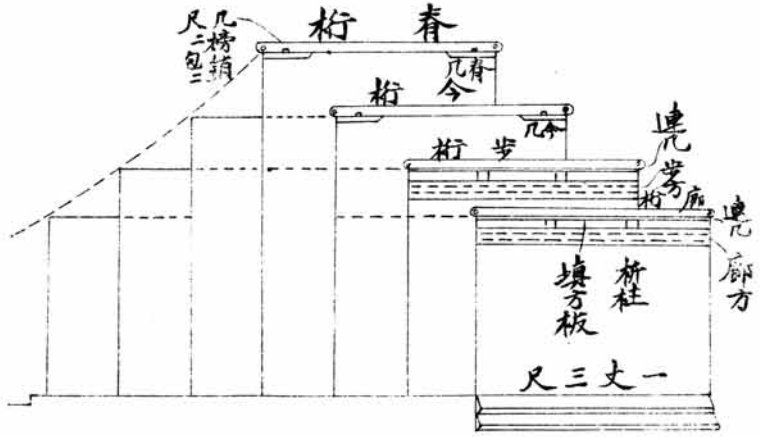


平屋正邊兩帖之式進深六界各四尺



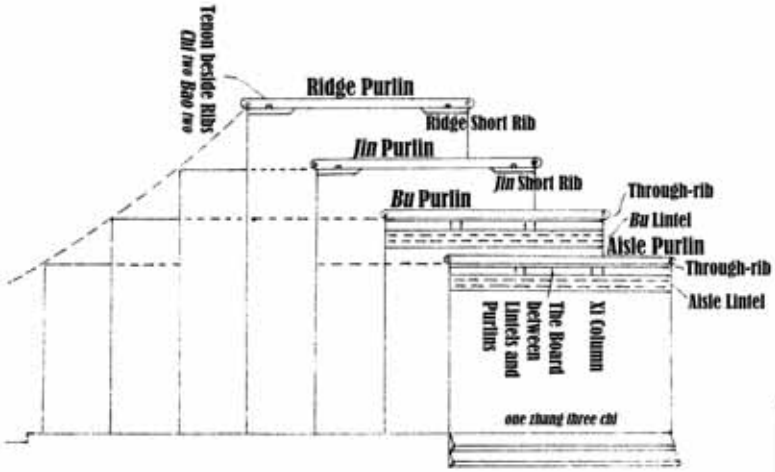
以上各料位置前後左右正次之稱

營造平屋
用料名稱
前後左右
正次相同
擬開間正
面之名丈
尺同前

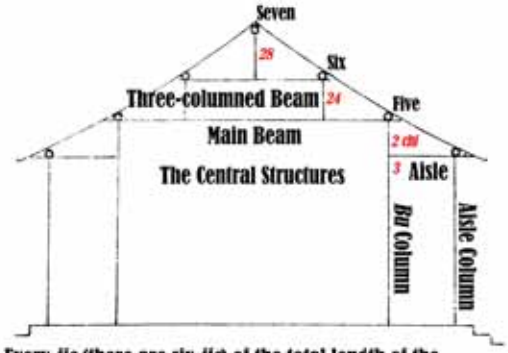


Buyun's Drawing Notes

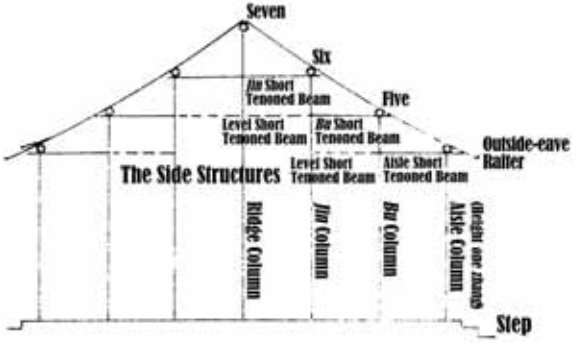
Building a single-storey house, parts in similar locations, whether in central room or side room, use the same names. Here are names of roof structures from the front longitudinal sections (in the same single-storey house as before).



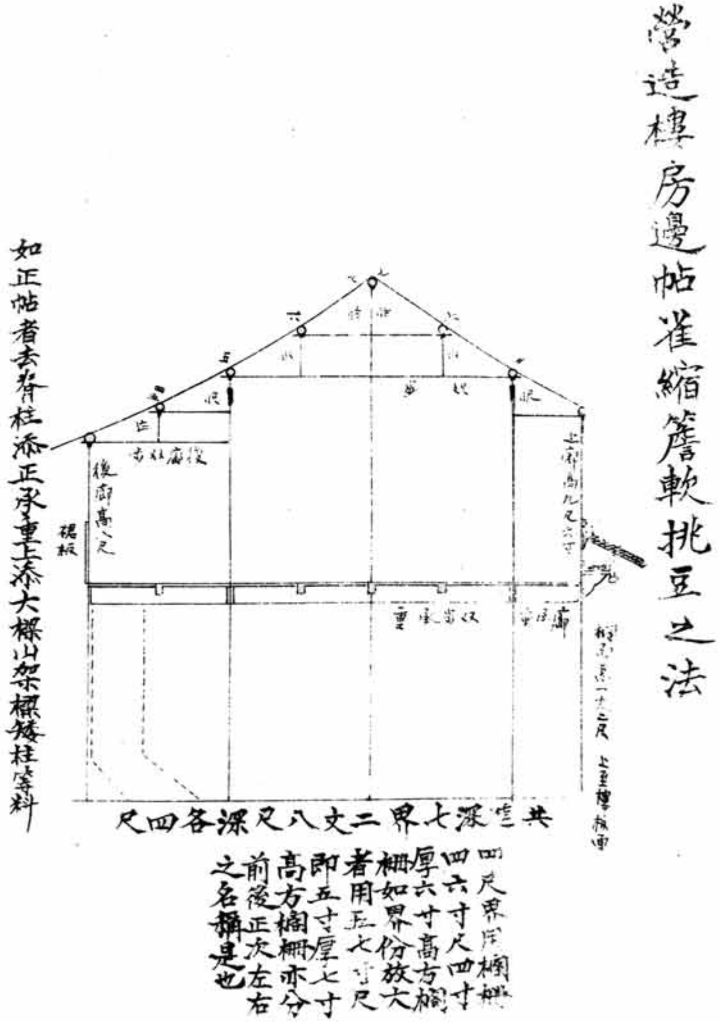
Names of the structures of a Single-storey House

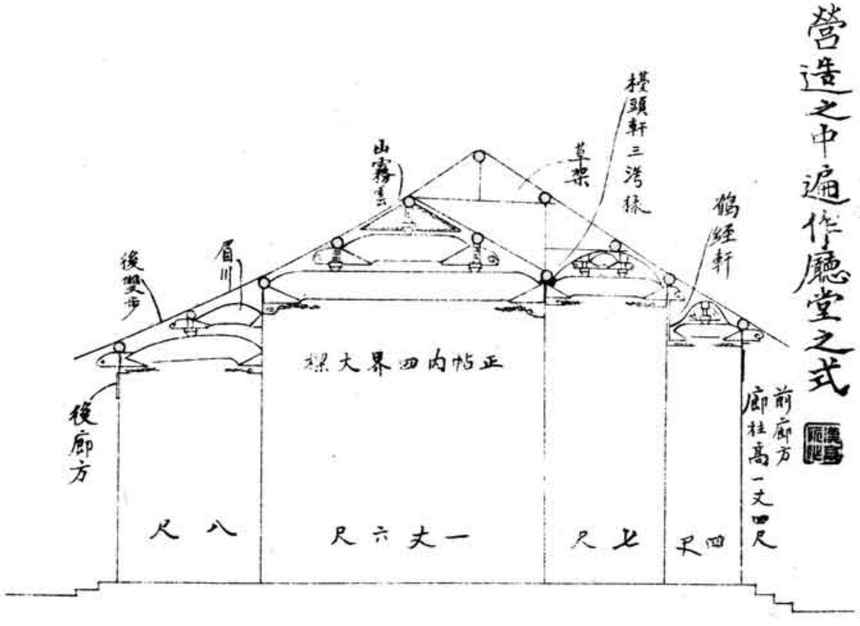


Every *jie* (there are six *jie*) of the total length of the central and sides' sections of a single-storey house is *four chi*.

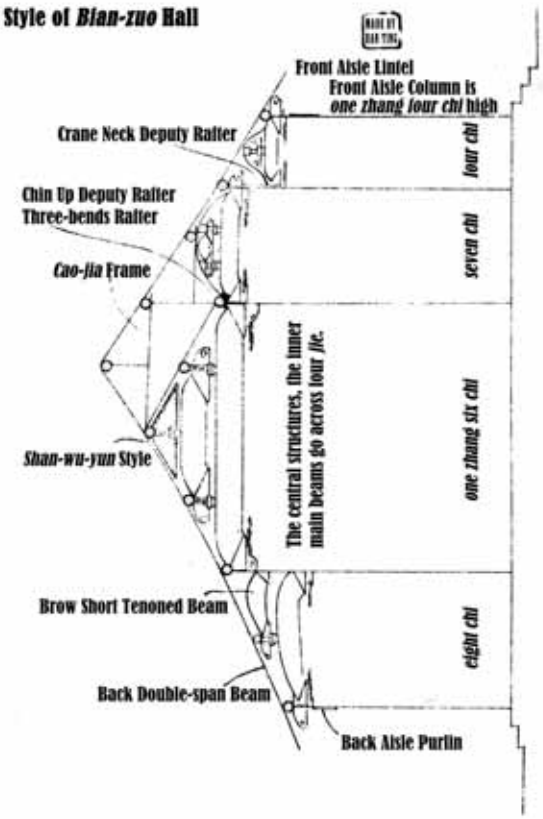


This is every part's location and name.

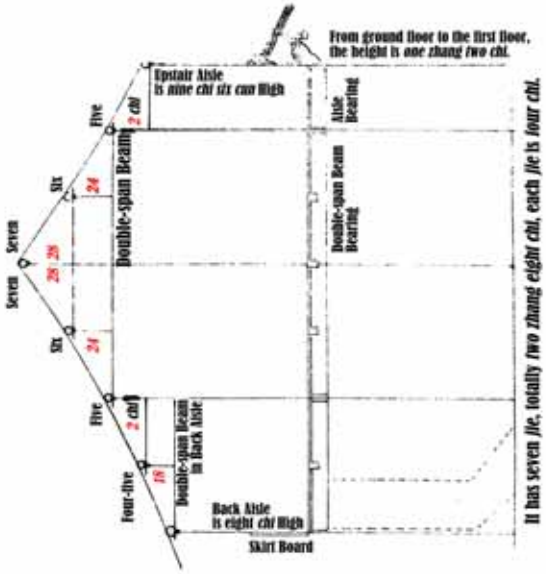

營造樓房邊帖雀縮簷軟挑豆之法
如正帖者去脊柱添正承重上添大樑山架標矮柱等料
共進深七界二丈八尺深各四尺
四尺界用欄柵四六寸尺四寸厚六寸高方欄柵如界份放大者用五七寸尺即五寸厚七寸高方欄柵亦分前後正次左右之名稱是也


營造之中遍作廳堂之式
正帖內四界大梁
八尺
一丈六尺
七尺
四尺
前廊方
廊柱高一丈四尺
後廊方
後雙步
眉川
山霧雲
草架
樓頭軒三灣椽
鶴脛軒

The Style of *Bian-zuo* Hall

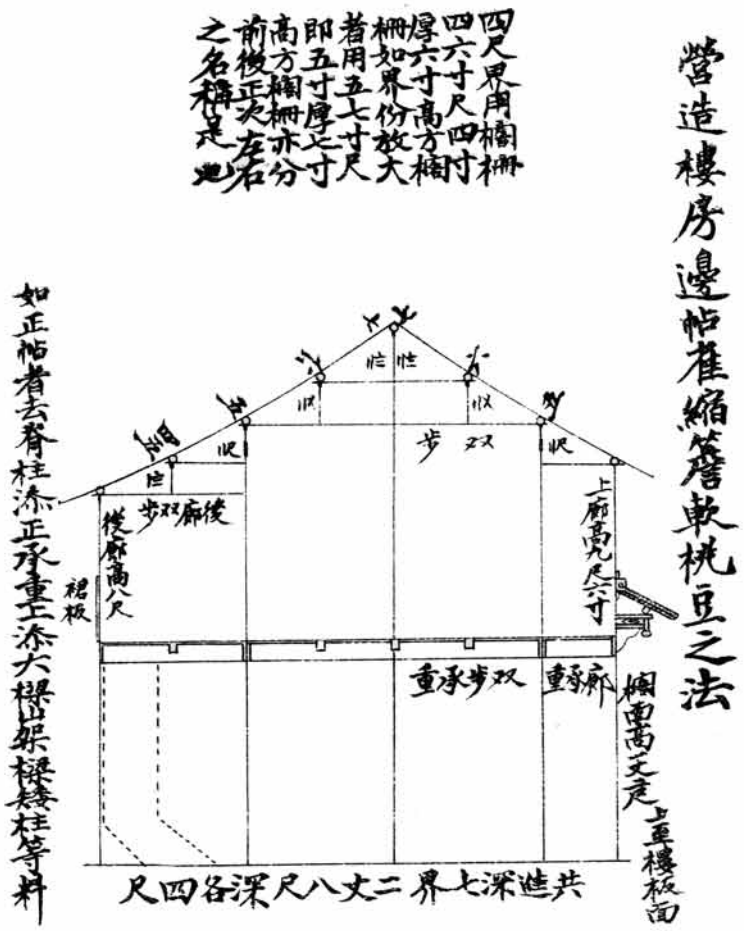


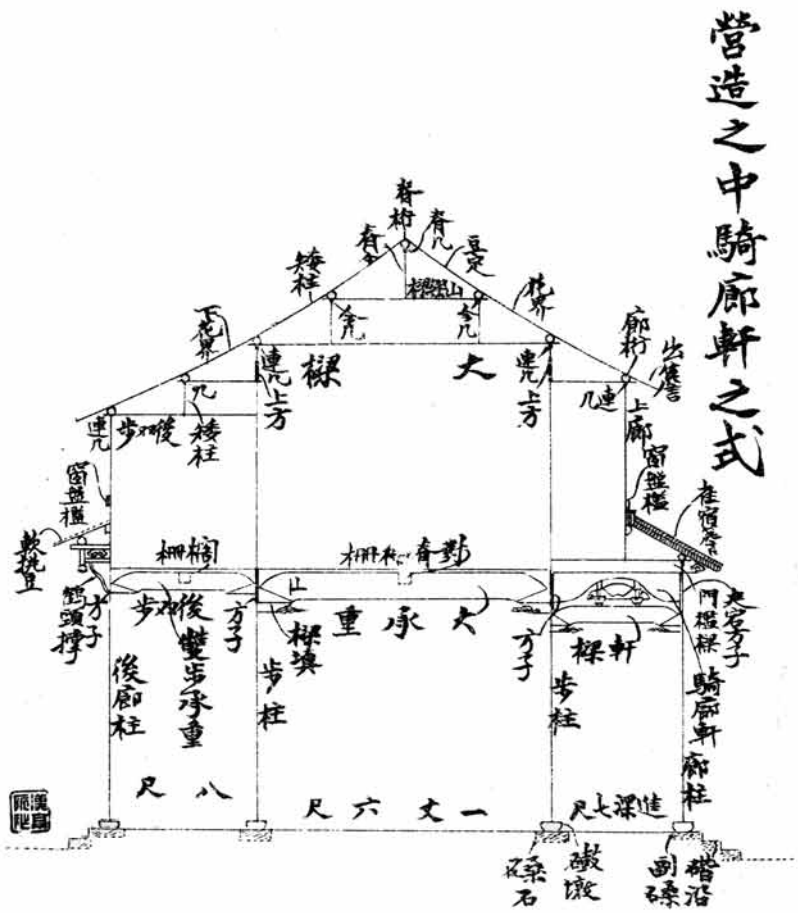
Section through Side of Double Floors Building Plan, the Style of Nesting Roof with "Soft" Shelters



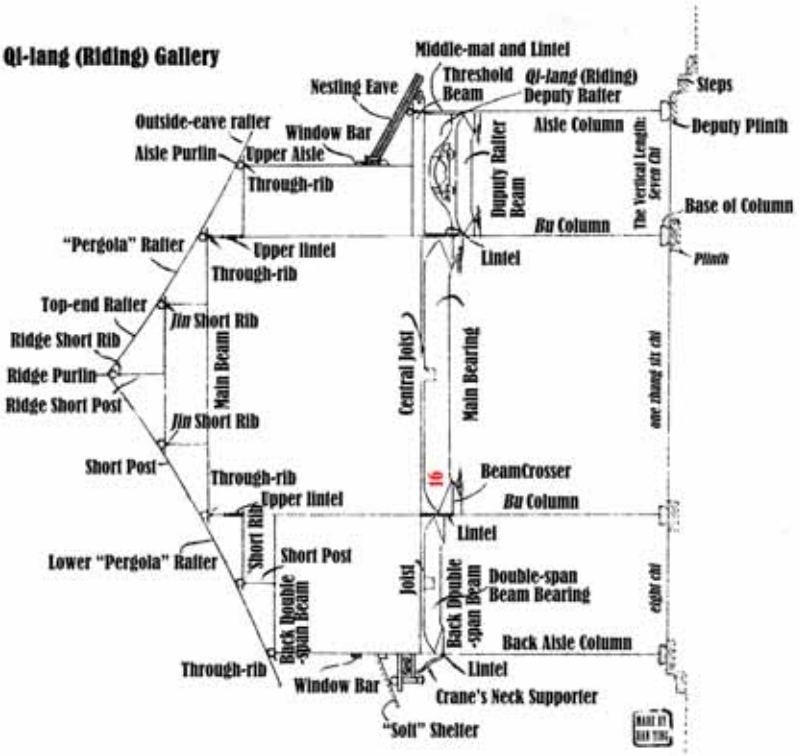
When each *jie* is *four chi*,
the timber of floor joist should be
four cun wide and *six cun* high,
called four-six size.
When each *jie* is wider,
the timber of floor joist should be
five cun wide and *seven cun* high,
called five-seven size.
The name of each part of joist is
also based on its location.

If the ridge columns are removed from the central structure, the main beam, three-columned beams, dwarf posts, and other structures should be added to bear the weight of the roof.


營造樓房邊帖推縮簷軟桃豆之法
四尺界用欄柵
四六寸尺四寸
厚六寸高方欄
柵如界份放大
着用五七寸尺
即五寸厚七寸
高方欄柵亦分
前後正次左右
之名稱是也
如正帖者去脊柱添正承重上添大樑山架樑矮柱等料
裙板
後廊高八尺
後廊
雙步
雙步
上廊高九尺六寸
雙步承重
廊重
欄高文定
上重樓板面
共進深七界二丈八尺深各四尺


營造之中騎廊軒之式
脊桁
脊枋
脊几
脊令
矮柱
下花界
令几
大樑
連几上方
廊桁
出簷
上廊窗盤檻
連几
後步
矮柱
窗盤檻
軟桃豆
才子
鶴頭撐
欄柵
脊對
後雙步承重
後廊柱
尺八
方子
止
大樑填步柱
重承大
尺六丈一
方子
軒樑步柱
進深七尺
大宅方子
門檻樑
騎廊軒廊柱
磉沿
剔槽
磉石
礎墩

The Style of Qi-lang (Riding) Gallery



Section through Side of Double Floors Building Plan, the Style of Nesting Roof with "Soft" Shelters

When each *jie* is *four chi*,
the timber of floor joist should be
four cun wide and *six cun* high,
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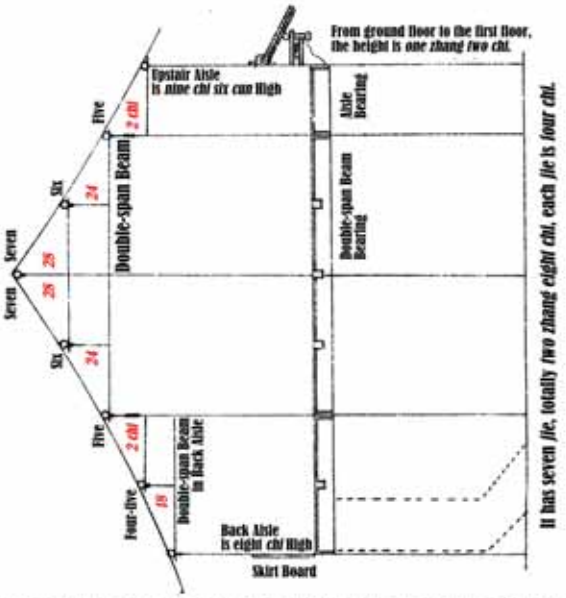
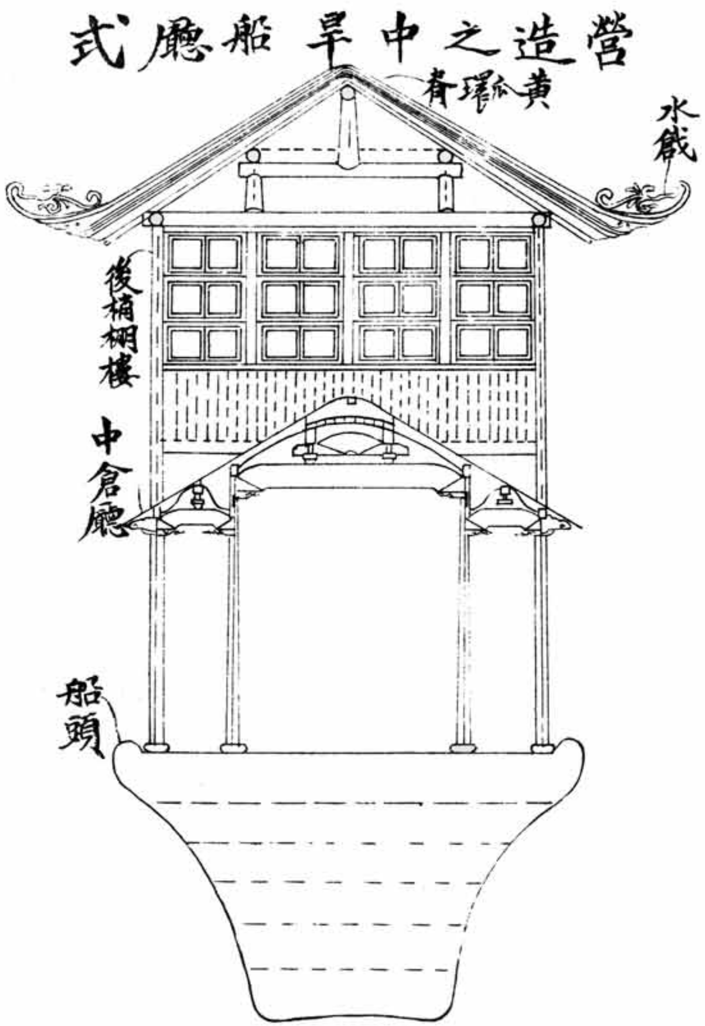
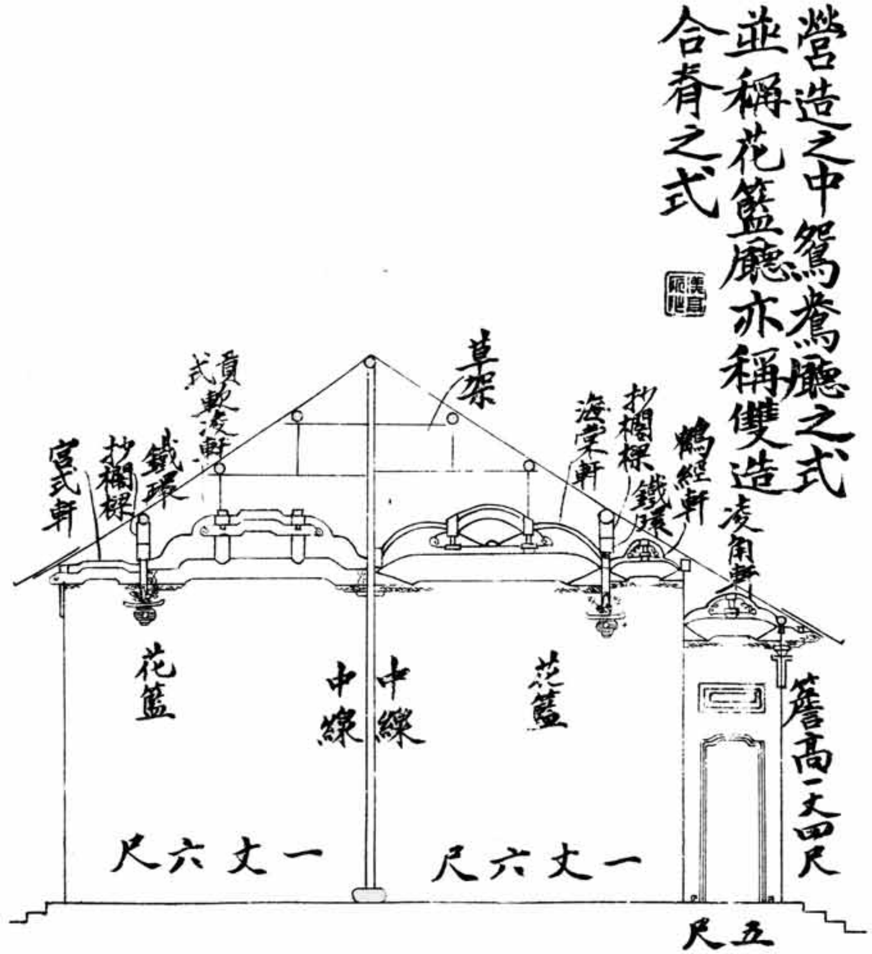
When each *jie* is wider,
the timber of floor joist should be
five cun wide and *seven cun* high,
called five-seven size.
The name of each part of joist is
also based on its location.



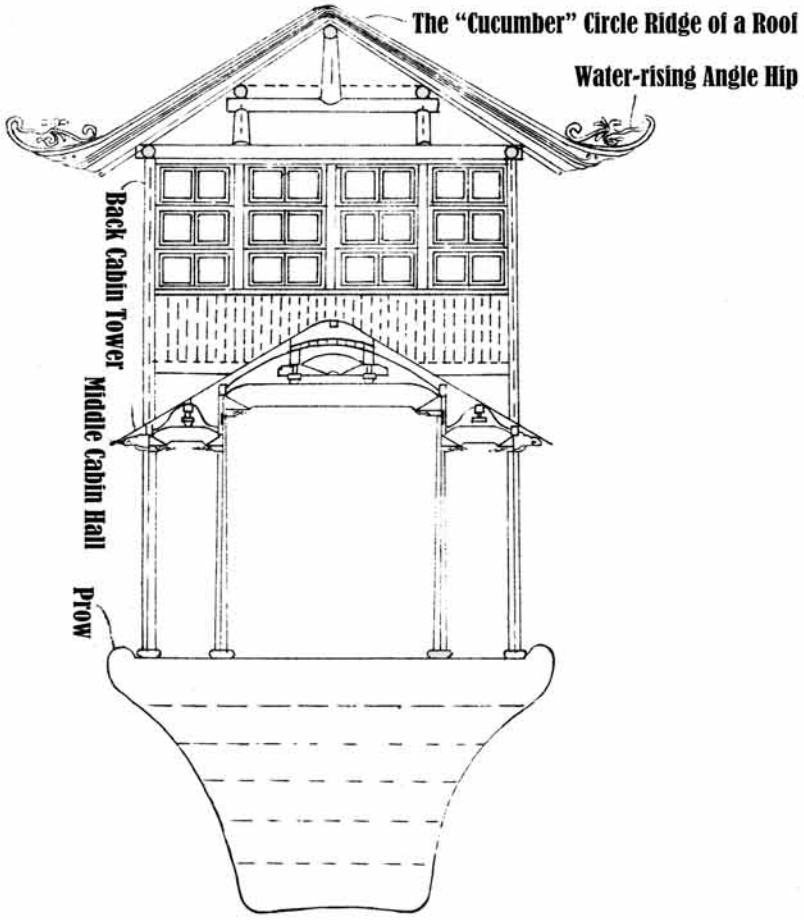
Note: This drawing is double shown in the original drawings book. But the drawing is clearly not the same one as the last. I still keep it in my translation version.

If the ridge columns are removed from the central structure, the main beam, three-columned beams, dwarf posts, and other structures should be added to bear the weight of the roof.

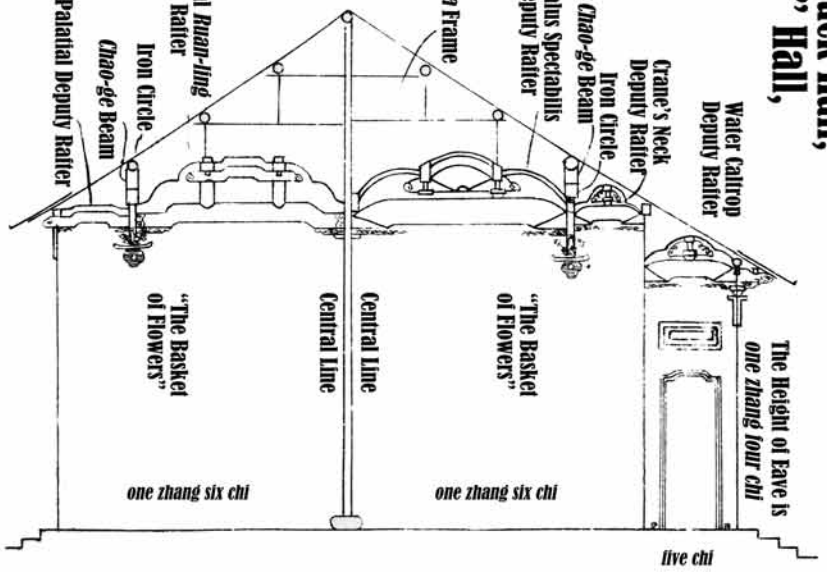

營造之中旱船廳式
黃瓜環脊
水戧
後楠桐樓
中倉廳
船頭


營造之中鴛鴦廳之式
並稱花籃廳亦稱雙造
合脊之式
草架
花籃
中線
中線
花籃
一丈六尺
一丈六尺
簷高一丈四尺
五尺
鶴經軒
菱角軒
海棠軒
宮式軒

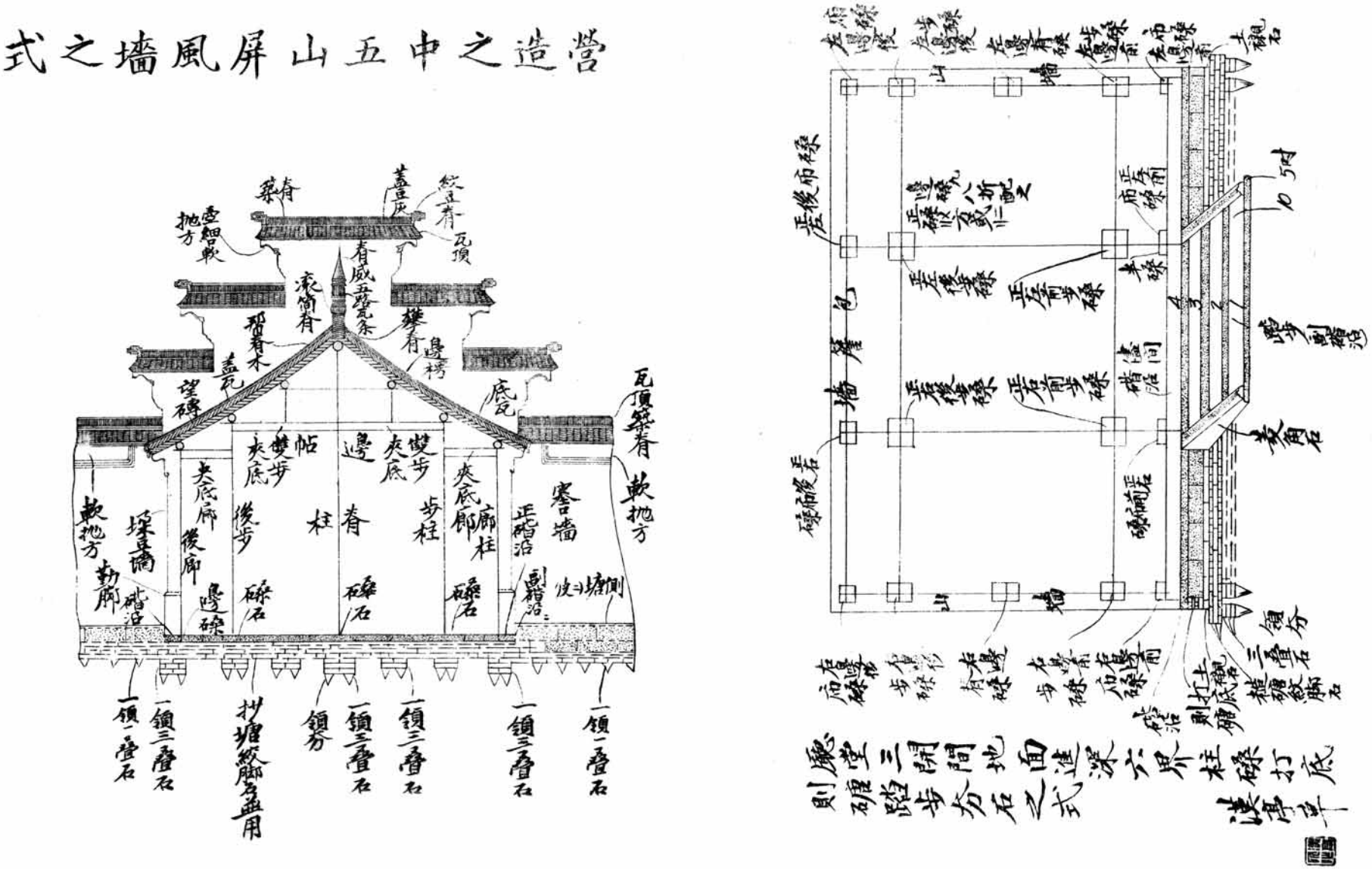
The Style of Fixed Boat Pavilion



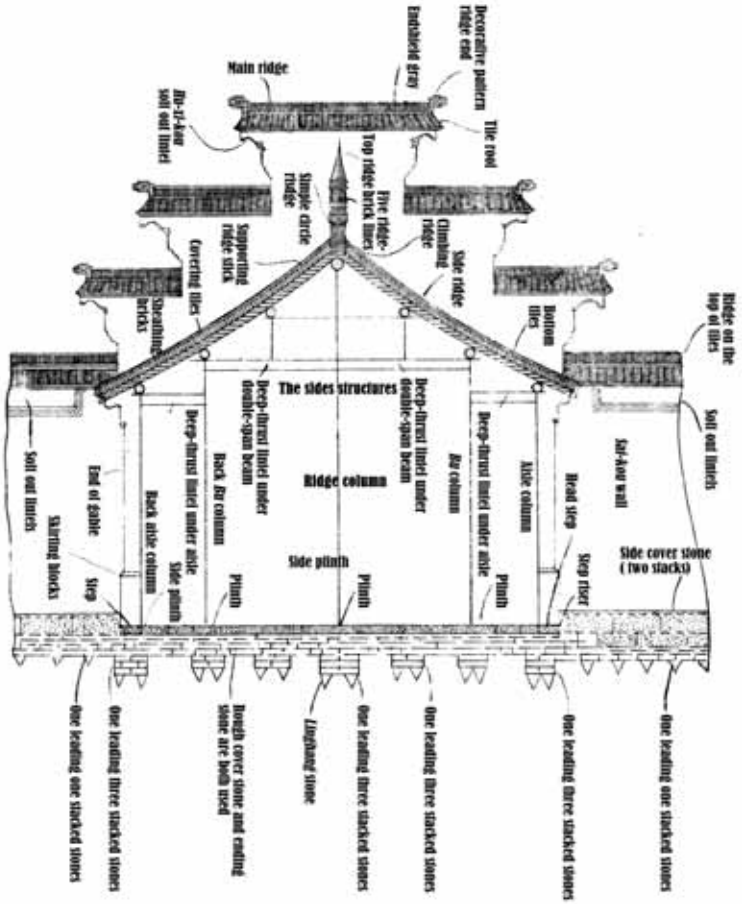
The Style of Mandarin Duck Hall, and "Basket of Flowers" Hall, Also called "Double-structures Combined with One Ridge".

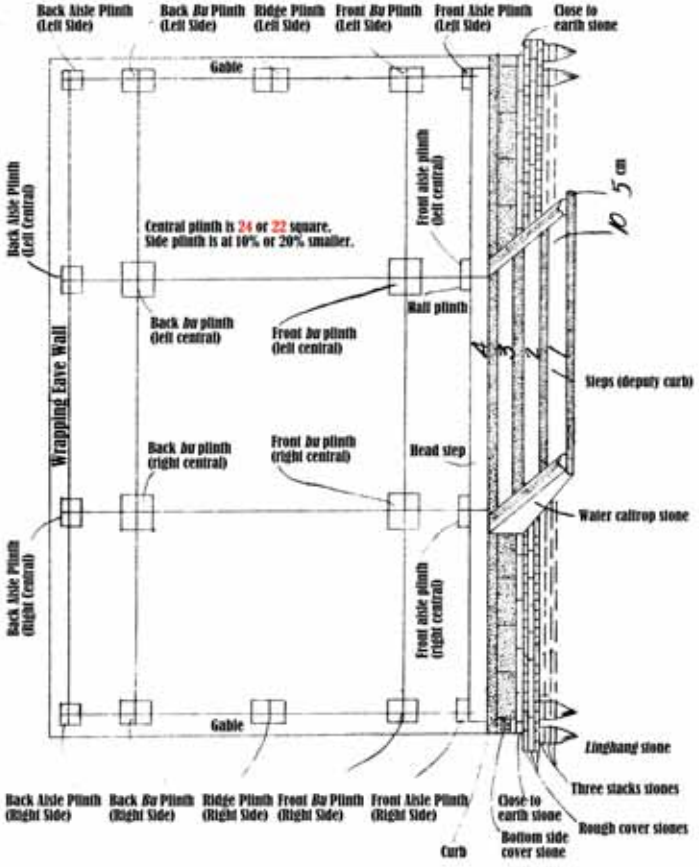


Appendix 1
The illustration: The *Yingzao fayuan* original drawings and modern drawings



The Style of Five-mountain-shaped Wall





Triple standard width of a hall, having six *Jie* in the total length.
The style of columns, plinths, basic stones and steps.

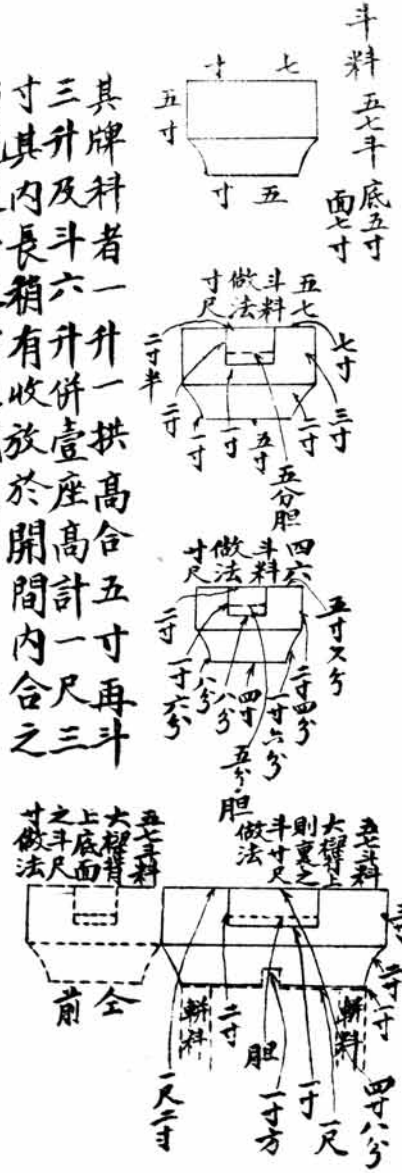
by Hanting

MADE BY HAN TING

營造之中牌科分類說

雲頭挑梓桁做法有三種一斗六升一斗三升一單用斗蒲鞋豆一升子是也其雲頭出參均在廂軒樑放長豆出雲頭或即在廂穿豆放長出雲頭其雲豆之用為出簷豆之外用飛椽因份量之重墜下之勢故用梓桁承之其梓桁兩個其頭垂依之處以此出雲豆襯之梓桁兩豆底用短几上鏨花枝或水浪或福雲隨之其几亦襯梓桁之勢

一種斗六升其材料有三種一五寸七寸又將此尺寸八折用名為四六又雙四六為八寸即八寸十二寸



其牌科者一升一拱高合五寸再斗三升及斗六升併壹座高計一尺三寸其內長稍有收放於開間內合之仍規定斗之寸尺哉

又斗料五七寸尺在柱頭上用者其斗底照柱豆經寸即斗底之大小如六寸柱豆經者即斗底六寸方斗面即八寸方高合五七之寸即五寸高如柱豆經大小分寸以此推算再行間牌科者但柱豆上之斗依柱之大小經寸餘座均照五七寸尺落料慎之

又斗料五七寸尺在大樑背上者如大樑厚一尺其斗底長一尺斗面長一尺二寸底面五寸上口仍七寸如山架樑厚八寸其斗底八寸斗面長一尺底面仍五寸上口仍七寸或有寸尺大小者照推算之如用四六斗又雙四六斗依此推算

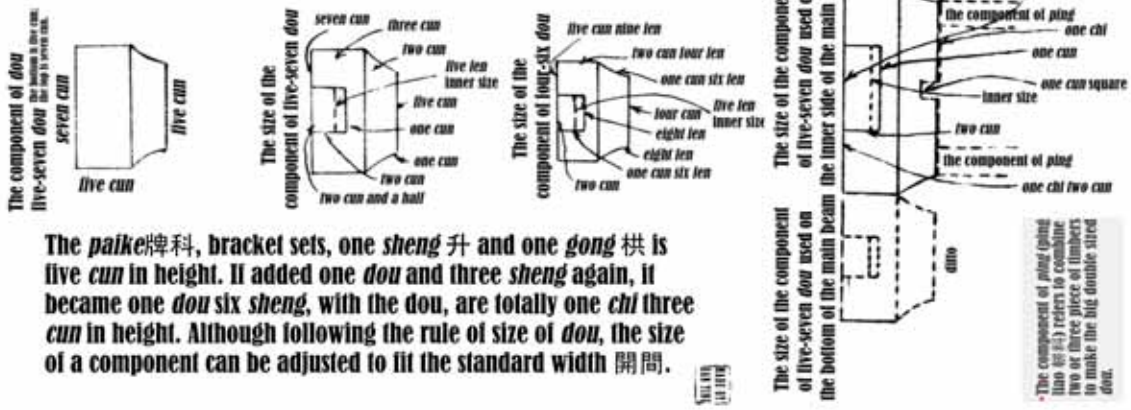
五七拱料厚二寸五分高三寸五分其升料將拱料兩用活者三寸半高二寸半

又拱料五七斗上  拱料照斗面濶七寸加兩豆出各二寸半計五寸又加兩升底五寸計拱豆第一級長一尺七寸第二級着再加長八寸計長二尺五寸是行間之拱料如柱頭上拱料是實拱之料

正帖雲頭加峯豆邊帖雲頭勾用峯豆(平豆)

Types of *Paike* 牌科 (bracket sets)

There are three bracket sets using the "cloud head 雲頭" to bear the *zi* purlin 梓桁: one *dou* six *sheng* 一斗六升, one *dou* three *sheng* 一斗三升, and one single *dou* 單用斗. The "*pu* toe cap 蒲鞋頭" is one single *sheng* 一升子. Its "cloud head" and the outside bearings 出參 are both under the aisle deputy beam. A "cloud head" can be made by the top of a longer beam or a longer aisle short tenoned beam. At the end of roof, out of the outside-eaves rafters, there are the flying rafters. To bearing the weight of the flying rafters, the zi purlin has to be used. Causes the zi purlin does not have any columns to support, the "cloud head" is used to connect with bracket sets. Two short ribs 短機 are used under the top of zi purlin, decorated with the flowers patterns or waves patterns or lucky clouds patterns. The situations of two short ribs are depended on the zi purlin.
The type of one dou six sheng has three kinds of sizes: five-seven cun, four-six *cun* (which is 80% of five-seven *cun*), and eight-twelve *cun* (which is double of four-six *cun*).

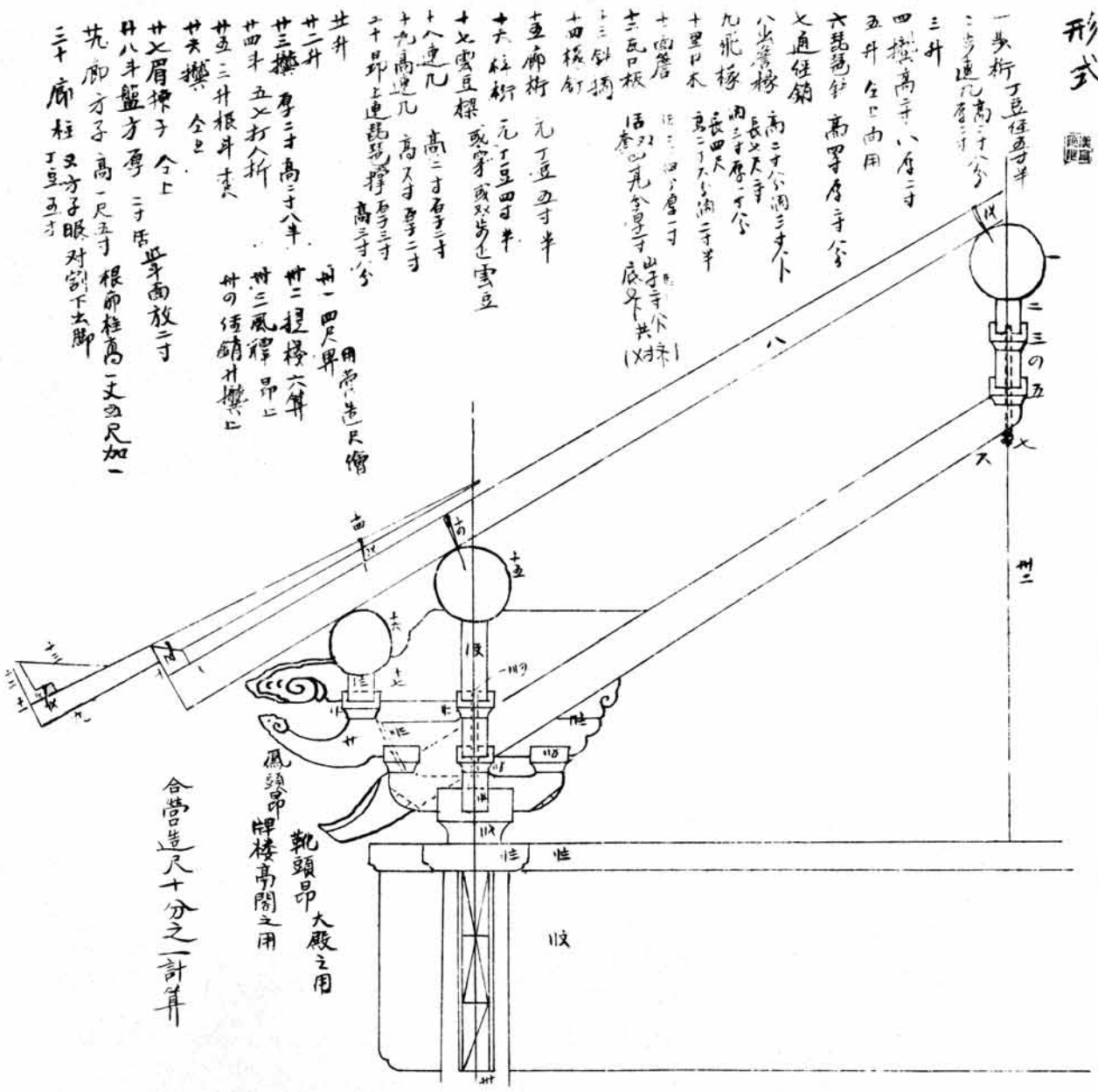


The *paike*牌科, bracket sets, one *sheng* 升 and one *gong* 栱 is five *cun* in height. If added one *dou* and three *sheng* again, it became one *dou* six *sheng*, with the dou, are totally one *chi* three *cun* in height. Although following the rule of size of *dou*, the size of a component can be adjusted to fit the standard width 開間.

A component of five-seven *cun* size *dou*, if on the top of column, the size of its bottom is based on the size of diameter of the column. In an other words, the size of the column's diameter is the bottom size of the *dou* upon it. For example, if a column's diameter is six *cun*, then the bottom size of the *dou* is six *cun*, and the top size of the *dou* is eight *cun*, the height of the *dou*, abided by the size of five-seven *cun*, is five *cun*. For different sizes of columns, the size can be calculated in the same manner. For the paike between the purlins, the one on the top of columns, should be abided by the diameter of column, the others should use the size of five-seven *cun*. Pay attention to the size when cutting the timber.
A component of five-seven *cun* size *dou*, if on the back of main beam, when the main beam is one *chi* in thickness, the size of bottom of the *dou* is one *chi*, the top of the *dou* is one *chi* two *cun*, but the size of bottom square is still five *cun*, and the size of top square is still five *cun*.
If the three-purlin beam is eight *cun* in thicknesses, then the bottom of the *dou* is eight *cun*, while the top of the *dou* is one *chi*, but the size of bottom square is kept five *cun*, and the size of top square is kept five *cun*. For the different size of beams, the size can be calculated in the same manner. Other types such as four-six size *dou* and double four-six size *dou*, is also calculated in the same manner.
Five-seven size *gong* is two *cun* and five *fen* in thickness, and three *cun* and five *fen* in height. The five-seven size *sheng* on the contrary, is three *cun* and five *fen* in thickness, and two *cun* and five *fen* in height. The component of *sheng* is laying the component of *gong*.
Five-seven size *gong* is seven *cun* in width, and the outside parts of each top is two *cun* and a half, totally added five *cun*. Then plus the bottom of two *sheng* which is five *cun*, the whole width of the first degree is one *chi* seven *cun*. The second degree is eight *cun* longer, which is two *chi* five *cun* in width, and can be added in the same manner. The component of *gong*, such as the *gong* on the top of column, is solid, and using the "cloud head" and the "phoenix's head 鳳頭" in the central structure, and only the "cloud head" in the side structure, no the"phoenix's head" or the "crop head 平頭".

牌科側面形式

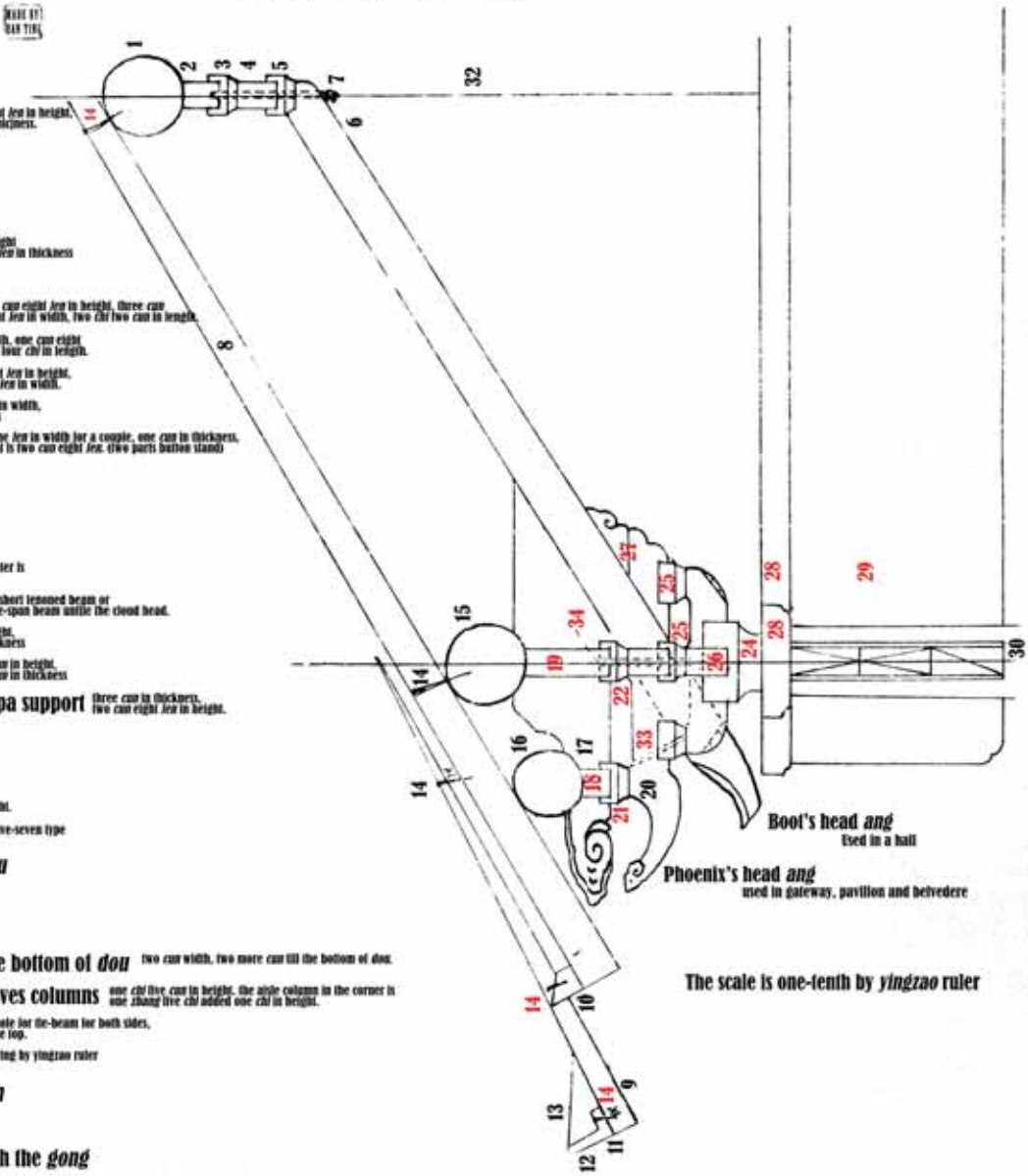
仿照大殿簷下斗六升十字牌科昂撥內用琵琶抱一事之式



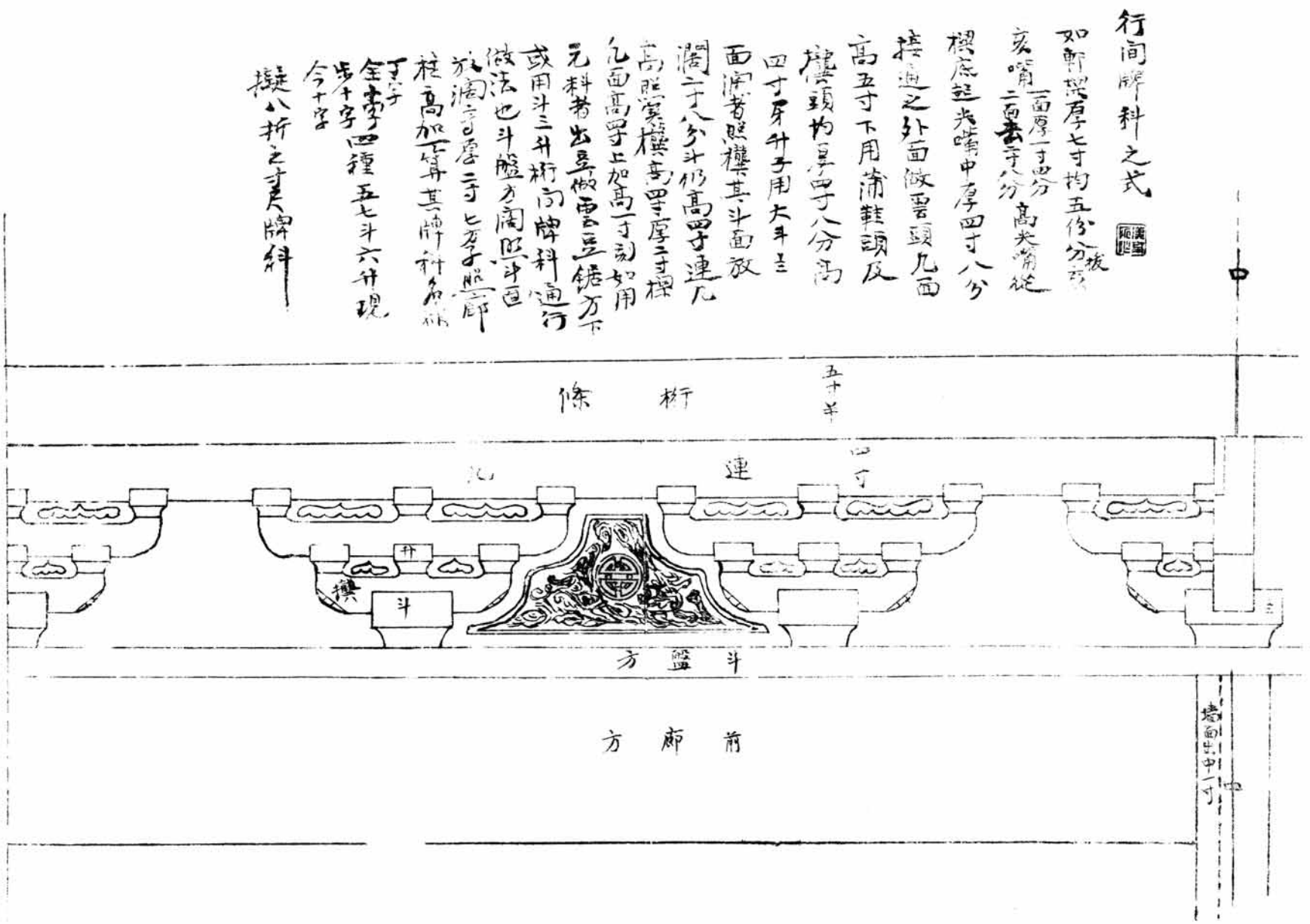
Side view of *paike* (bracket sets)

An imitation of an audience hall, a dou under the eaves, which is a six-*sheng* cross *pai-ke* style, with *ang*, *gong*, and a *pi-pa* supporting inside.

1. ***Bu*** purlin ending diameter is five *cun* and a half
2. ***Bu*** through-rib two *cun* eight *fen* in height, two *cun* in thickness.
3. ***Sheng***
4. ***Gong*** two *cun* eight *fen* in height, two *cun* in thickness.
5. ***Sheng*** used for left upper
6. ***Pi-pa*** support four *cun* in height, two *cun* eight *fen* in thickness
7. ***Tong-jing*** bolt
8. Outside-eaves rafter two *cun* eight *fen* in height, three *cun* eight *fen* in width, two *chi* two *cun* in length.
9. Flying rafter three *cun* in width, one *cun* eight *fen* in thickness, four *chi* in length.
10. ***Li-kou*** batten two *cun* eight *fen* in height, two *cun* five *fen* in width.
11. Face-eaves two *cun* four *fen* in width, one *cun* thickness
12. ***Wa-kou*** board four *cun* nine *fen* in width for a couple, one *cun* in thickness, ridge height is two *cun* eight *fen*. (two parts button stand)
13. Iron nail
14. Rafter nail
15. Aisle purlin
16. ***Zi*** purlin round, ending diameter is four *cun* and a half.
17. Cloud head beam using short lessened beam or double-span beam untile the cloud head.
18. Through-rib two *cun* in height, two *cun* in thickness
19. High through-rib two *cun* in height, two *cun* in thickness
20. ***Ang***, connect with pi-pa support three *cun* in thickness, two *cun* eight *fen* in height.
21. ***Sheng***
22. ***Sheng***
23. ***Gong*** two *cun* in thickness, two *cun* eight *fen* in height.
24. Dou twenty per cent smaller of five-seven type
25. Three ***sheng*** basic ***dou***
26. ***Gong***
27. Lintel plug-in board
28. Tie-beam between the bottom of ***dou*** two *cun* width, two more *cun* till the bottom of dou.
29. Tie-beam between eaves columns one *chi* five *cun* in height, the aisle column in the corner is one *zhang* five *chi* added one *chi* in height.
30. Aisel column drilling the hole for tie-beam for both sides, five *cun* at the top.
31. One ***jie*** is four ***chi*** drawing by yingzao ruler
32. The ***ti-zhan*** is six ***suan***
33. ***Feng gong***
34. ***Tong-jing*** bolt through the ***gong***



Appendix 1
The illustration: The *Yingzao fayuan* original drawings and modern drawings



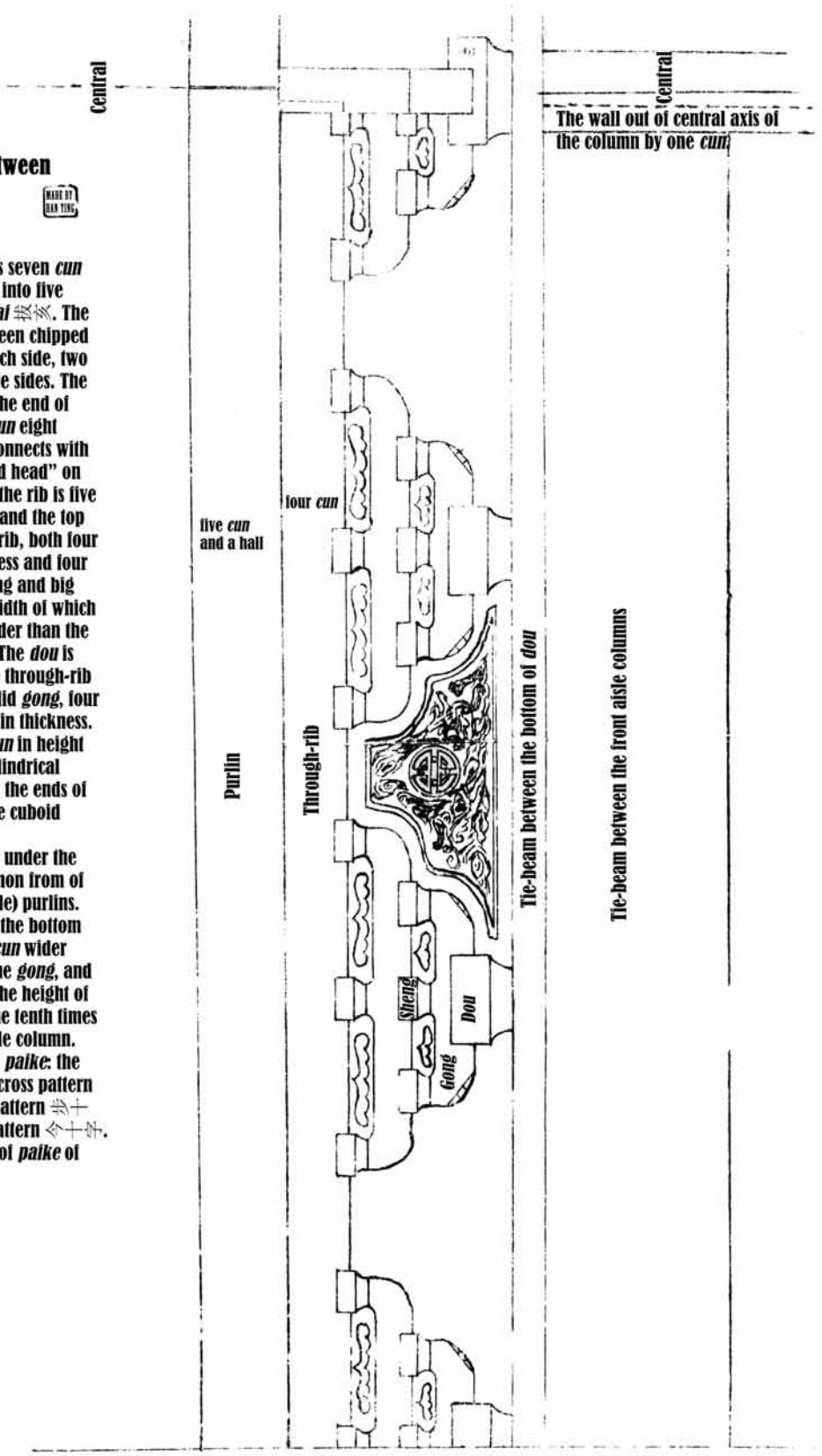
10

The Style of Paike between the (Aisle) Purlin

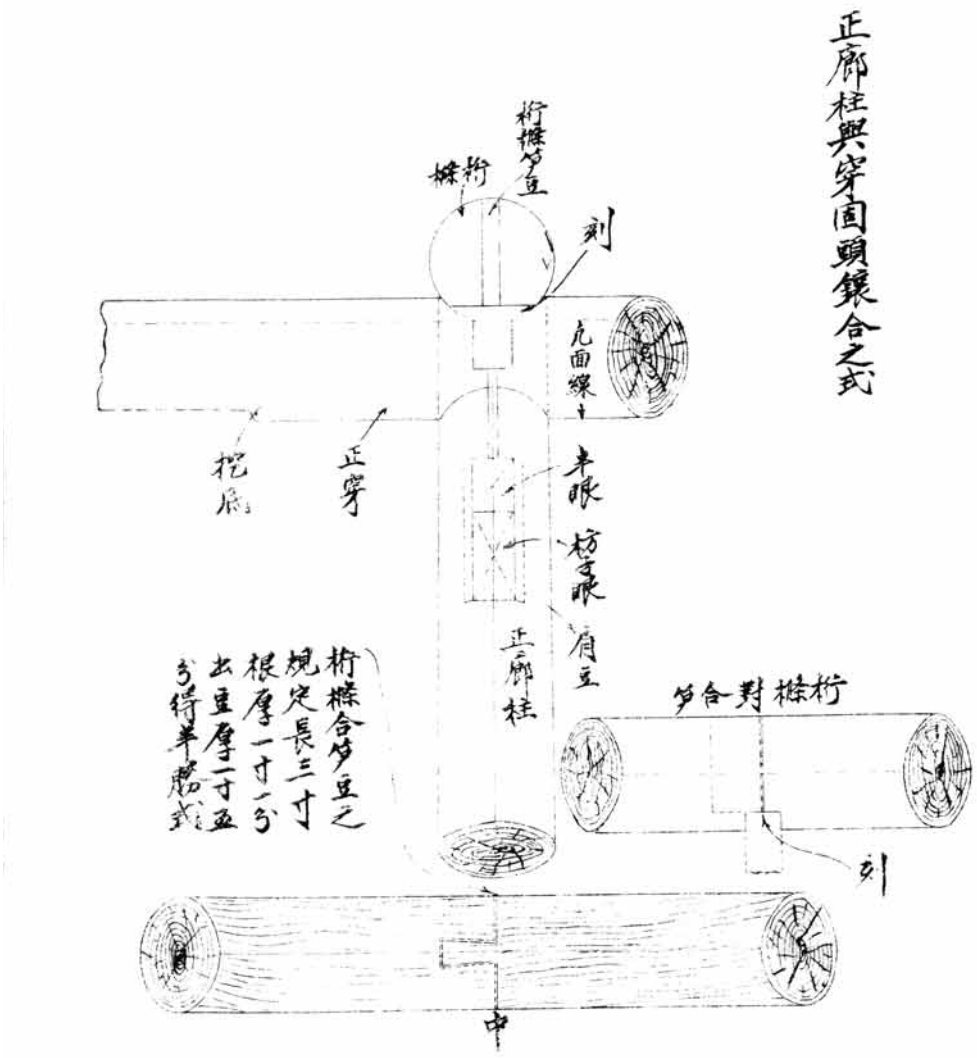
MADE BY HAN YING

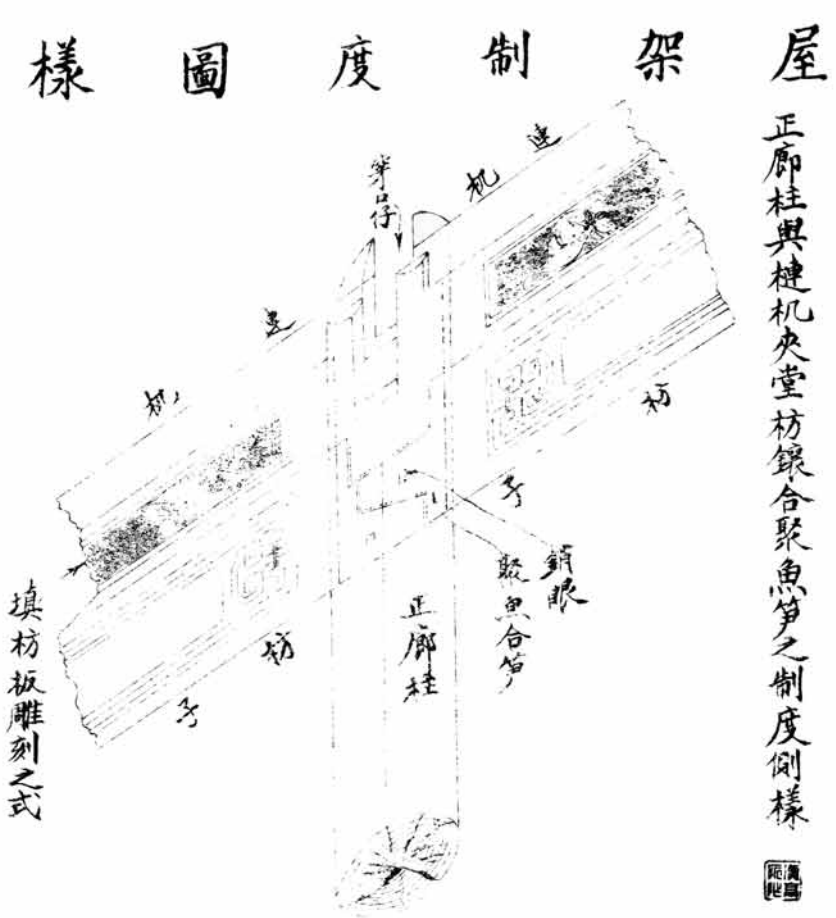
If the deputy beam was seven *cun* thickness, then divid it into five parts to make the ***bahai*** 拔亥. The top of the ***bahai***, has been chipped off one *cun* four *fen* each side, two *cun* eight *fen* for double sides. The top of ***bahai*** made by the end of deputy beam, is four *cun* eight *fen* in thickness, and connects with ***paike***, made the "cloud head" on the end. The height of the rib is five *cun*. The "***pu*** toe cap" and the top of ***gong*** are under the rib, both four *cun* eight *fen* in thickness and four *cun* in height. The sheng and big ***dou*** is also used, the width of which is two *cun* eight *fen* wider than the thickness of the ***gong***. The ***dou*** is four *cun* in height. The through-rib is dependent on the solid ***gong***, four *cun* in height, two *cun* in thickness. The beam rib is four *cun* in height plus one *cun*. In the cylindrical inner upper structures, the ends of beam are sawn into the cuboid ends.

One ***dou*** three ***sheng*** is under the beam. This is the common from of ***paike*** between the (aisle) purlins. The tie-beam between the bottom of ***dou*** 斗盘枋 is two *cun* wider than the thickness of the ***gong***, and two *cun* in thickness. The height of tie-beam is one and one tenth times of the height of the aisle column. There are four types of ***paike***: the "T" pattern, the quan cross pattern 全十字, the bu cross pattern 步十字, and the ***jin*** cross pattern 令十字. Now drawing the style of ***paike*** of eighty percent scale.



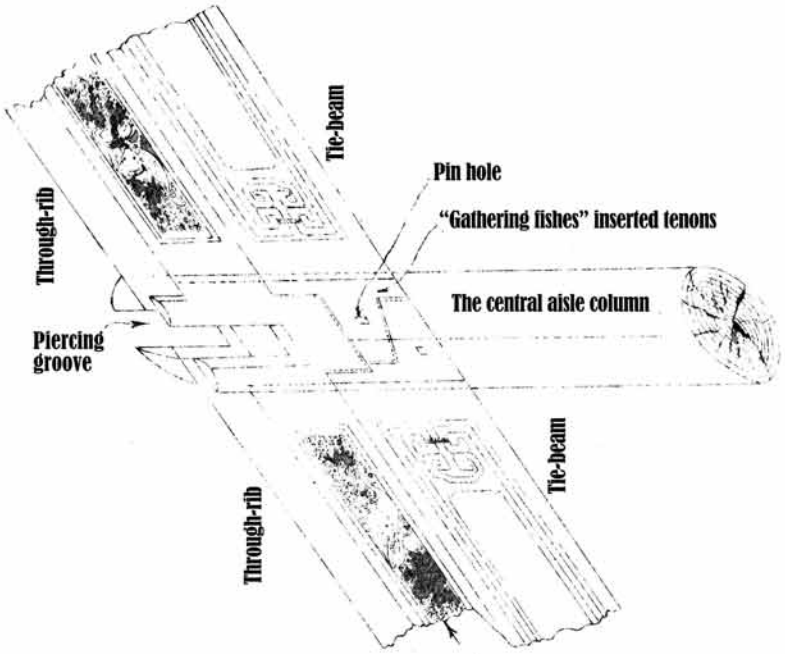
Appendix 1
The illustration: The *Yingzao fayuan* original drawings and modern drawings





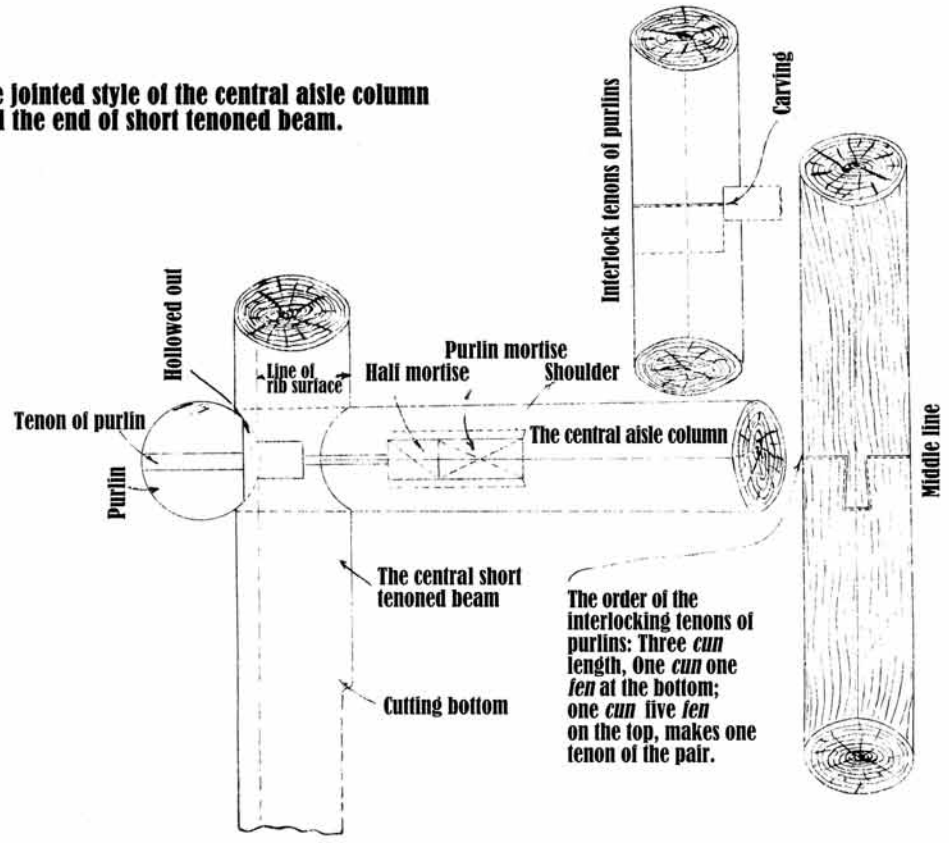
The Patterns of Building Structures

The side view of the "gathering fishes" jointed style of central aisle column, through-rib, middle-filling board and tie-beam

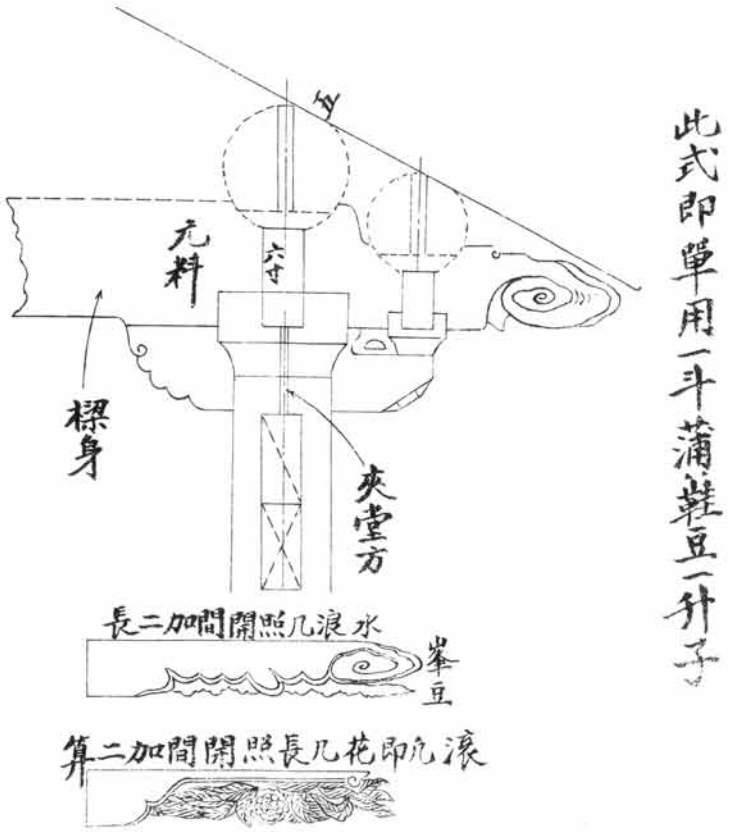


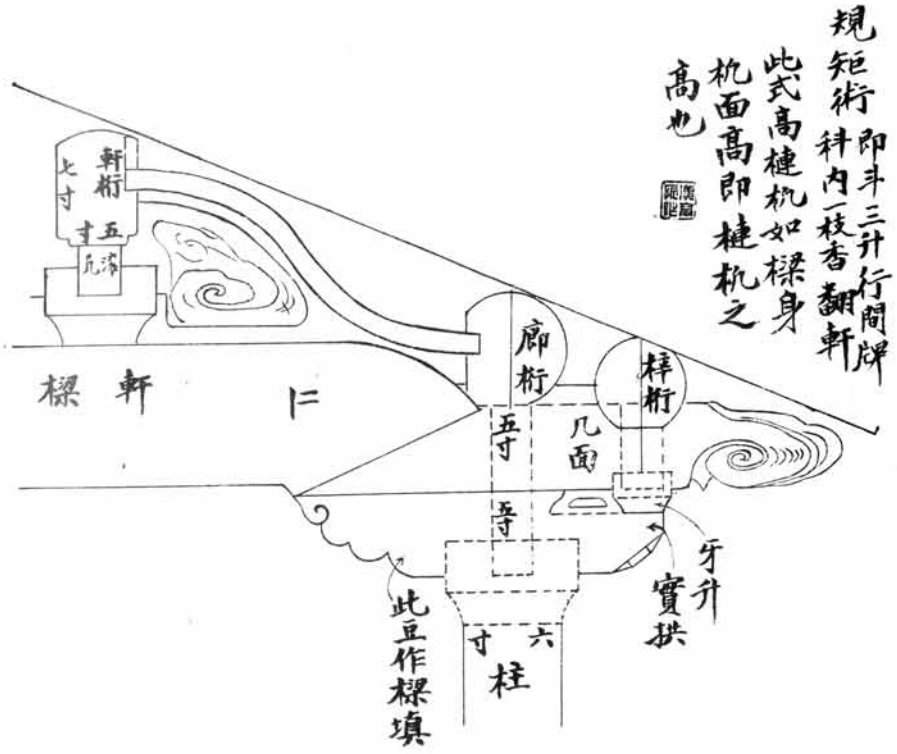
The pattern of carvings on the middle-filling board

The jointed style of the central aisle column and the end of short tenoned beam.

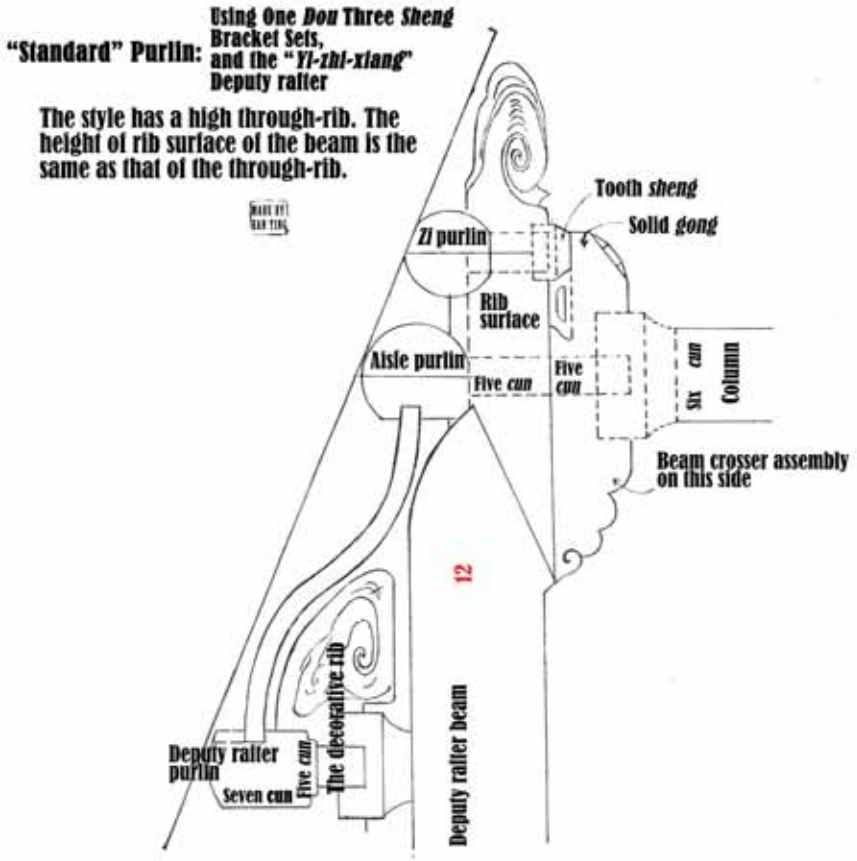


Appendix 1
The illustration: The *Yingzao fayuan* original drawings and modern drawings

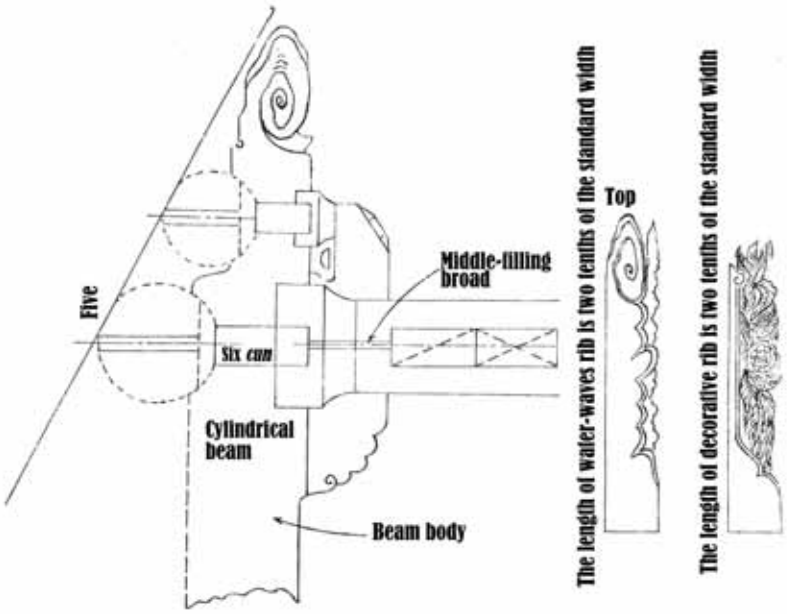


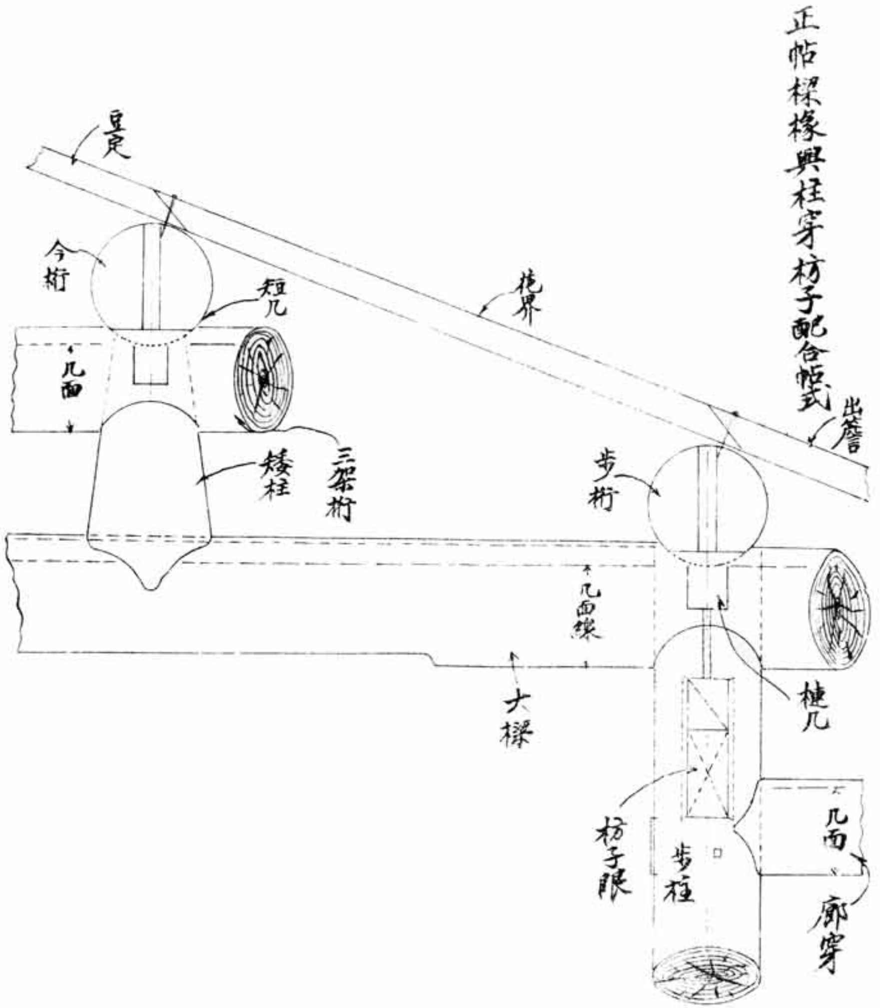


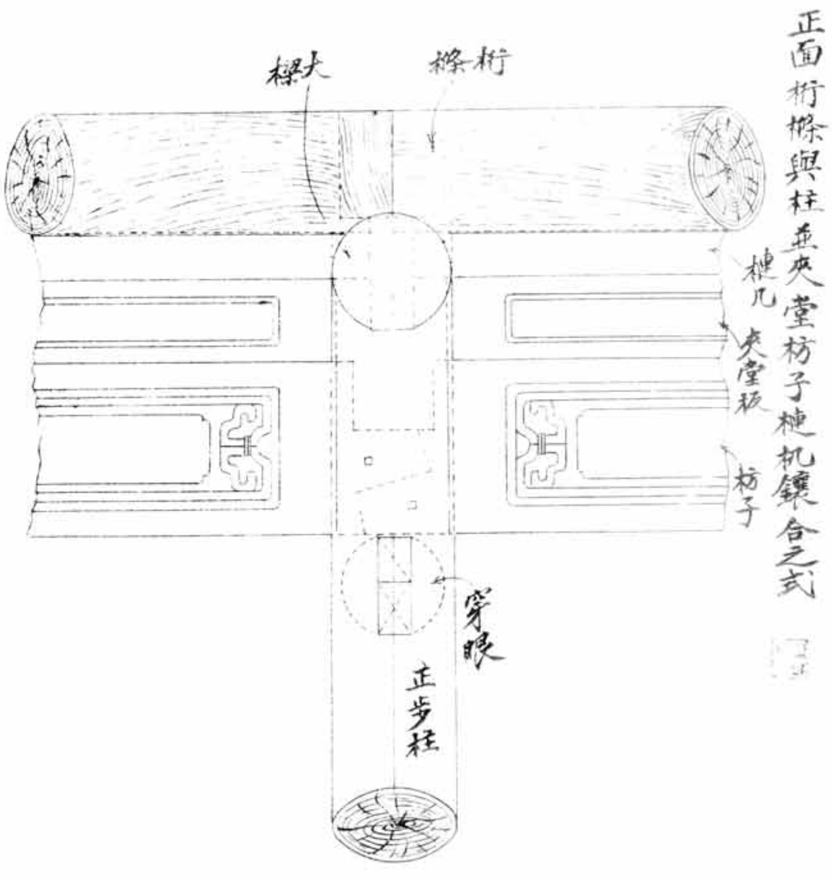
12



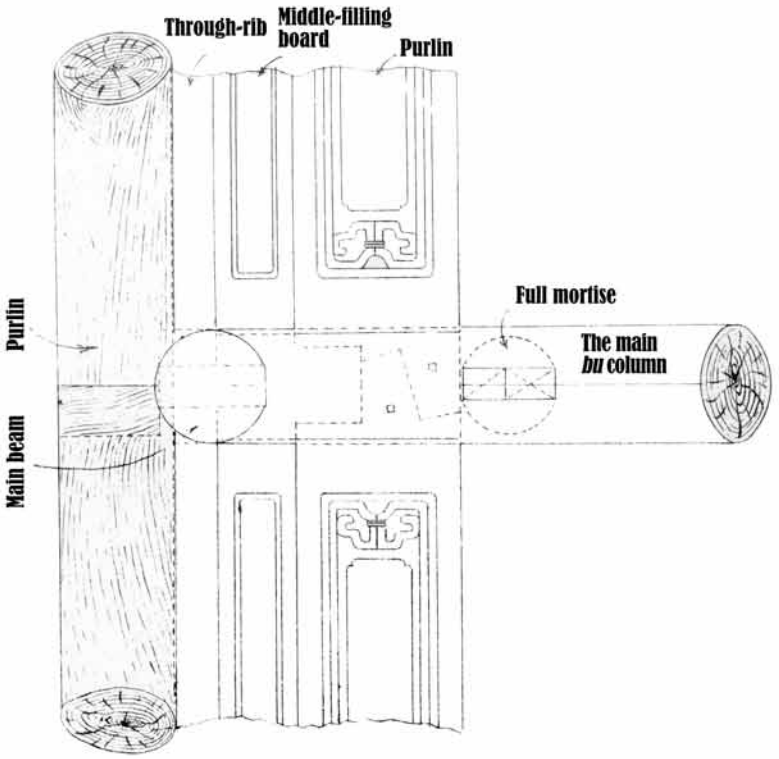
The style has just a single one *dou* "pu toe cap" and one *sheng*



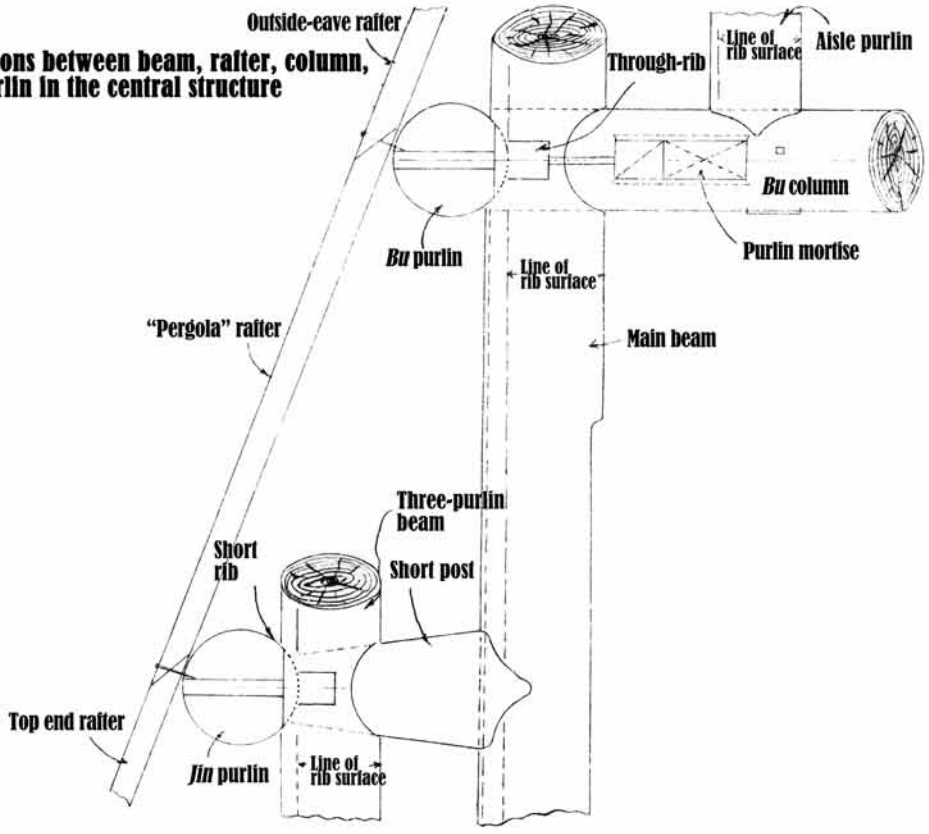

今桁
三架桁
矮柱
出簷
步桁
大樑
步柱
廊穿


夾堂板
枋子
穿眼
正步柱

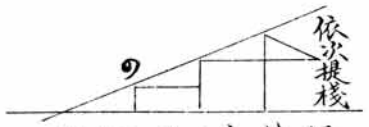
The Front view of tenons between purlin, column, middle-filling board, and through-rib



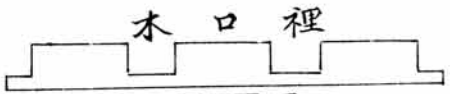
The tenons between beam, rafter, column, and purlin in the central structure



屋椽之式規定
短長之分寸須
照提栈



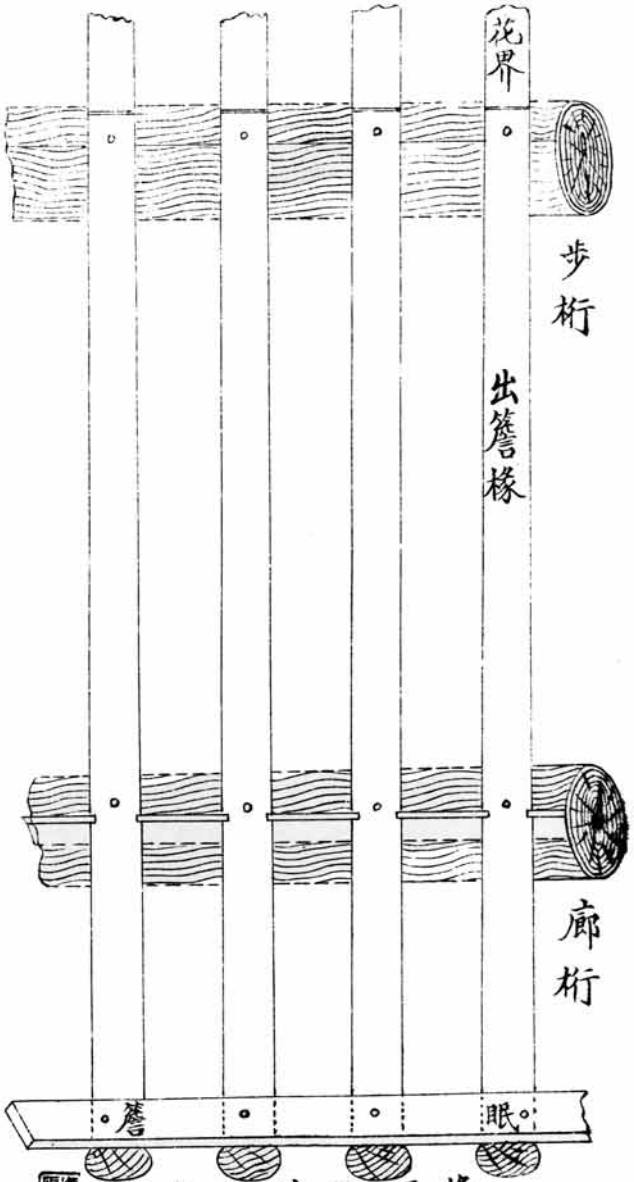
規營造尺比例



椽穩板又閘椽

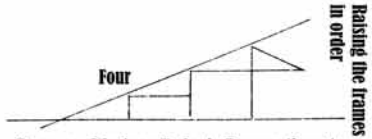
可一鋸兩得

將此一輪之樣可套輪得數為數總劃若是



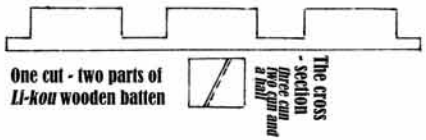
椽豆做此荷包式

The Rule of Rafters is that the Sizes of Rafters Must be Based on the "Raising the Frames of a Roof"



Base on *Yingzao* Ruler's Proportionate

***Li-kou* Wooden Batten**

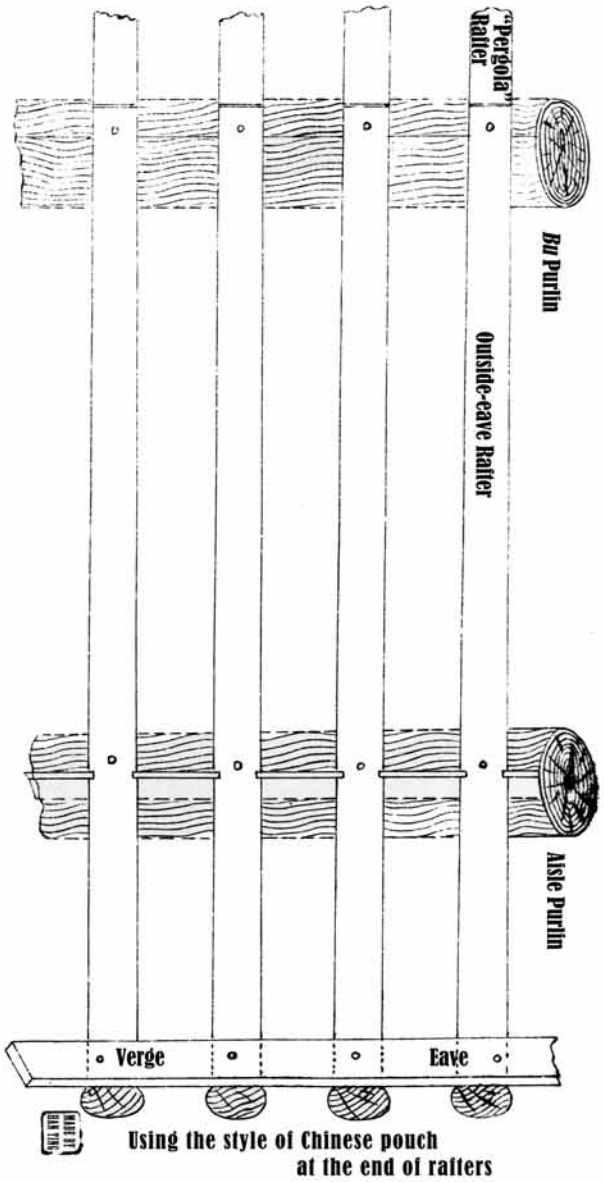


Stable-rafters board, also called "Rafters lock"

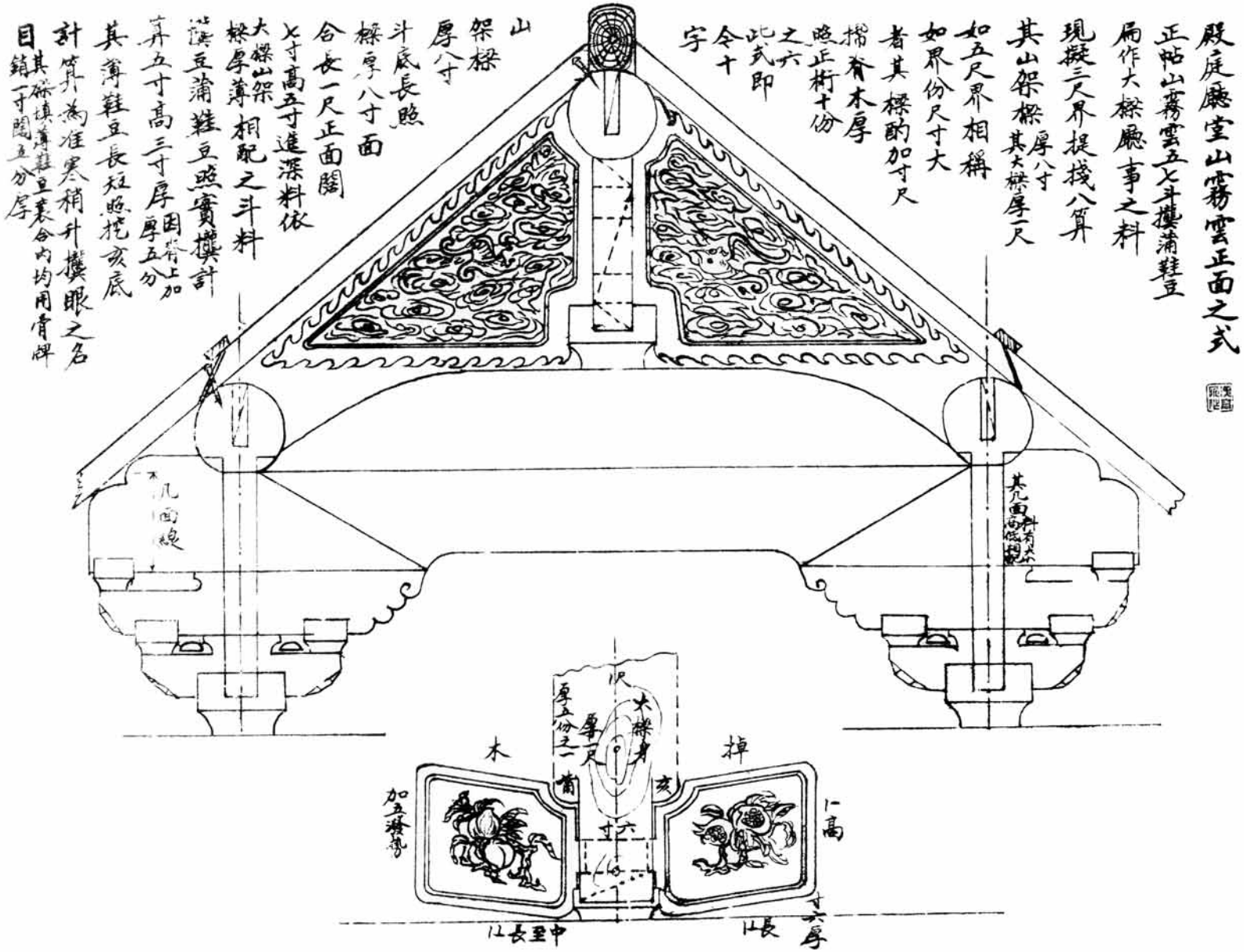
***Wa-kou* Board**

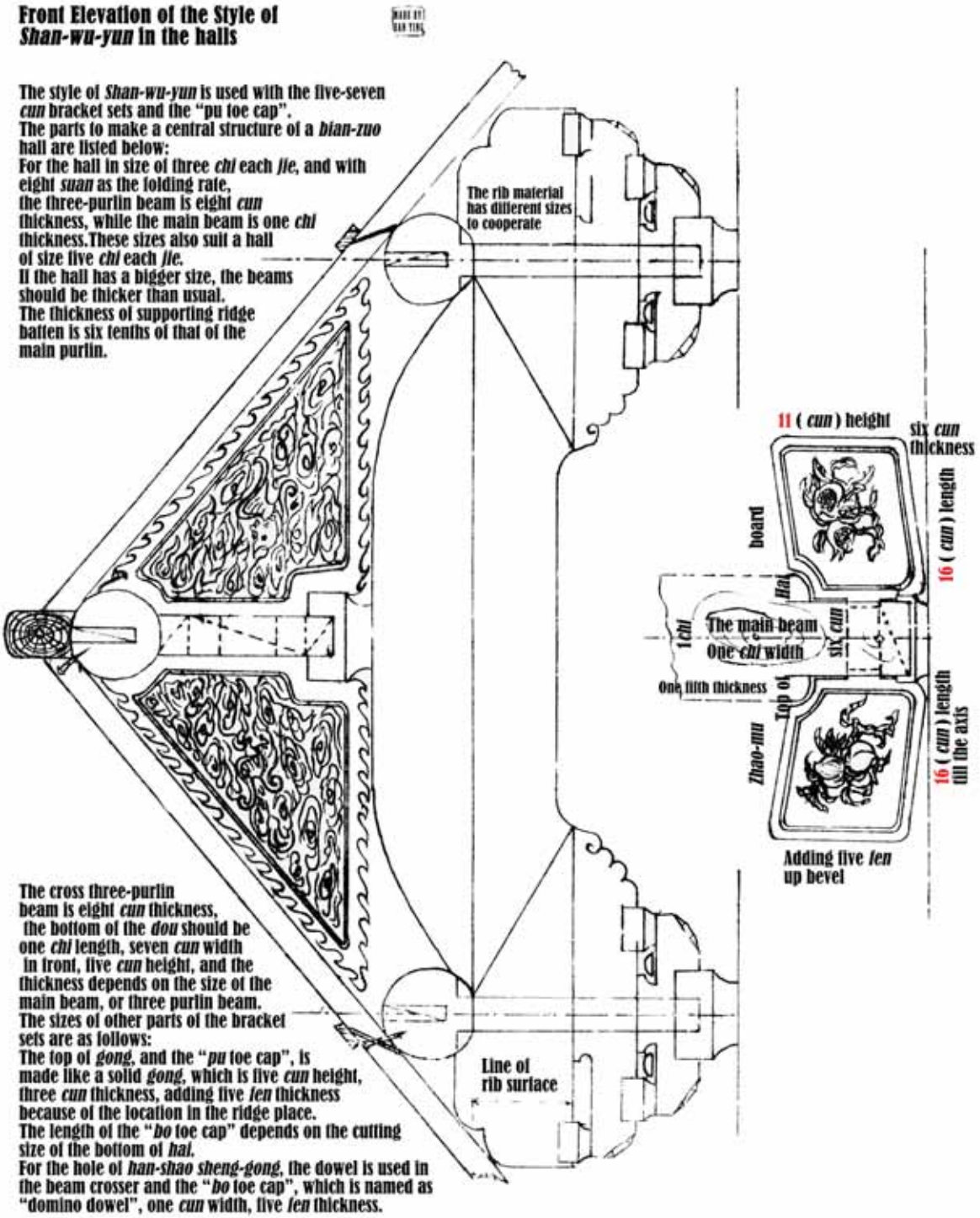
One cut yields two parts

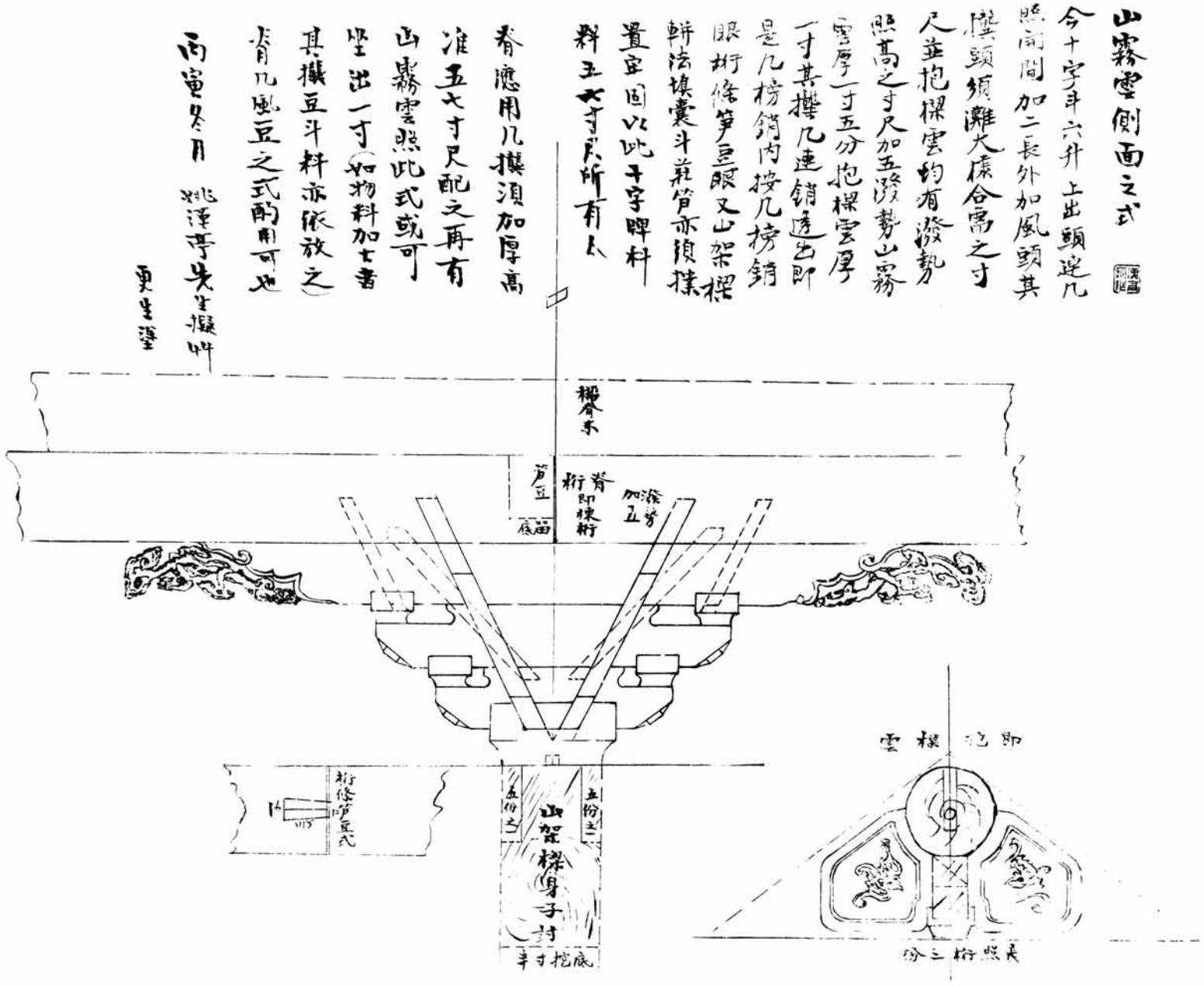
Using the board as a stencil, you can get as much as needed.



Using the style of Chinese pouch at the end of rafters


殿庭廳堂山霧雲正面之式
正帖山霧雲五七斗攢蒲鞋頭
扁作大梁廳事之料
現擬三尺界提栿八算
其山架梁厚八寸
如五尺界相稱
如界份尺寸大
者其梁酌加寸尺
梢看本厚
照正梢十份
之六
此式即
令十
字
山
架梁
厚八寸
斗底長照
梁厚八寸面
合長一尺正面闊
七寸高五寸進深料依
大梁山架
梁厚相配之斗料
攢蒲鞋頭照實攢計
算五寸高三寸厚因有上加
厚五分
其薄鞋頭長短照挖底底
計算為准寒梢升攢眼之名
目
其梁栿薄鞋頭裹合內均用骨牌
錢一寸闊五分厚
大梁身
厚一尺
寸六
木
掉
高
厚
長
中至長

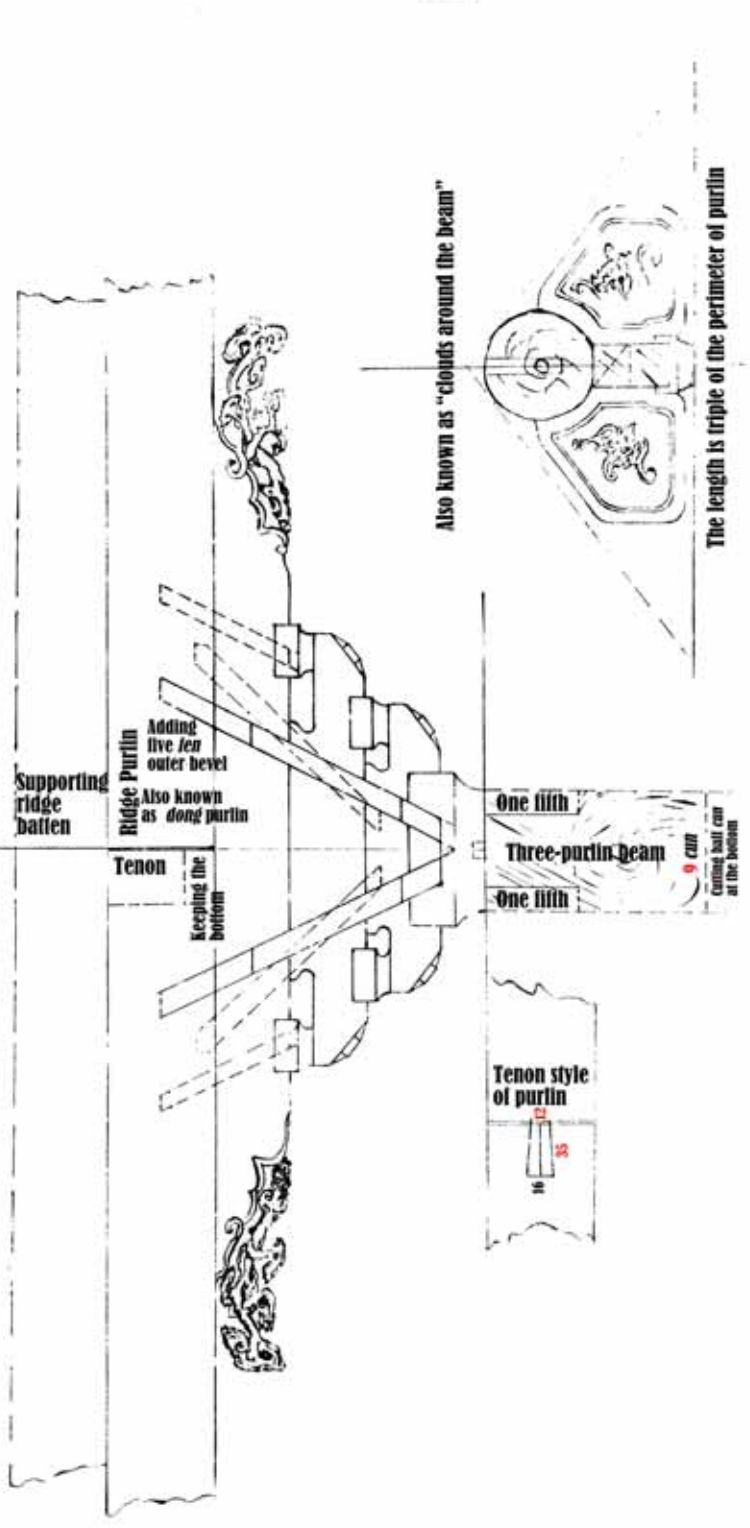

Front Elevation of the Style of *Shan-wu-yun* in the halls
The style of *Shan-wu-yun* is used with the five-seven *cun* bracket sets and the "pu toe cap".
The parts to make a central structure of a *bian-zuo* hall are listed below:
For the hall in size of three *chi* each *jie*, and with eight *suan* as the folding rate, the three-purlin beam is eight *cun* thickness, while the main beam is one *chi* thickness.These sizes also suit a hall of size five *chi* each *jie*.
If the hall has a bigger size, the beams should be thicker than usual.
The thickness of supporting ridge batten is six tenths of that of the main purlin.
The rib material has different sizes to cooperate
11 (*cun*) height
six *cun* thickness
board
16 (*cun*) length
1 *chi*
The main beam
One *chi* width
six *cun*
One fifth thickness
Top of
Zhao-mu
16 (*cun*) length till the axis
Adding five *fen* up bevel
The cross three-purlin beam is eight *cun* thickness, the bottom of the *dou* should be one *chi* length, seven *cun* width in front, five *cun* height, and the thickness depends on the size of the main beam, or three purlin beam.
The sizes of other parts of the bracket sets are as follows:
The top of *gong*, and the "*pu* toe cap", is made like a solid *gong*, which is five *cun* height, three *cun* thickness, adding five *fen* thickness because of the location in the ridge place.
The length of the "*bo* toe cap" depends on the cutting size of the bottom of *hai*.
For the hole of *han-shao sheng-gong*, the dowel is used in the beam crosser and the "*bo* toe cap", which is named as "domino dowel", one *cun* width, five *fen* thickness.
Line of rib surface

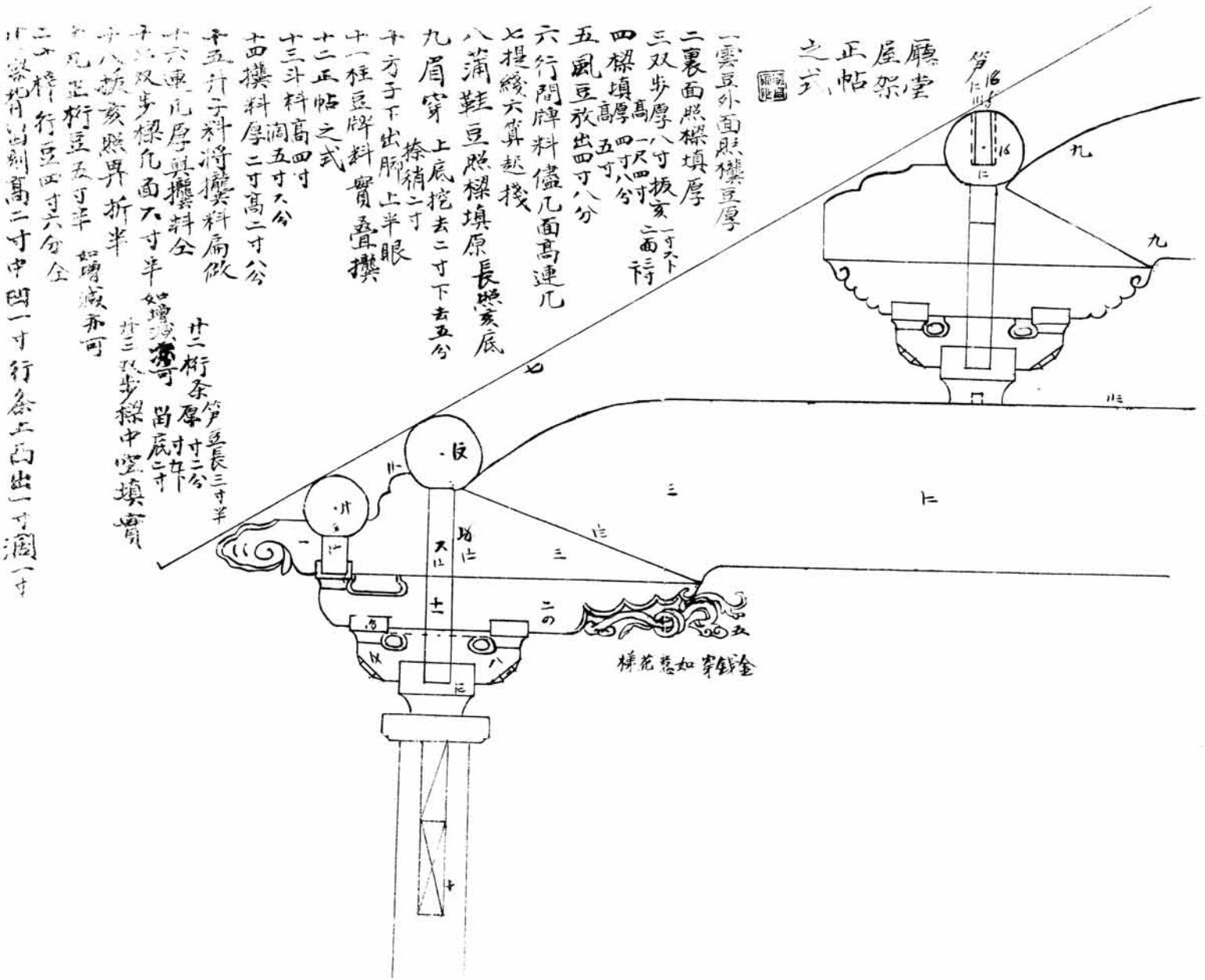

山霧雲側面之式
令十字斗六升上出頭逆几
照兩間加二長外加風頭其
樸頭須灘大底合需之寸
尺並抱樑雲均有潑勢
照高之寸尺加五潑勢山霧
雲厚一寸五分抱樑雲厚
一寸其攢尖連銷透出即
是几榜銷內按几榜銷
眼桁條筍豆眼又山架樑
軒法填裹斗栱筍亦須揍
置宜固以此干字牌料
料五寸寸尺所有長
脊應用几摸須加厚高
准五七寸尺配之再有
山霧雲照此式或可
坐出一寸（如物料加七者
其攢豆斗料亦依放之）
脊几攢豆之式酌用可也
雨亭冬月 姚承祖雨亭先生擬稿
梁生堂
榱眷木
筍豆
脊桁即棟桁
滴勢加五
桁條筍豆式
山架樑身子封
雲樑 即抱
照桁三分長

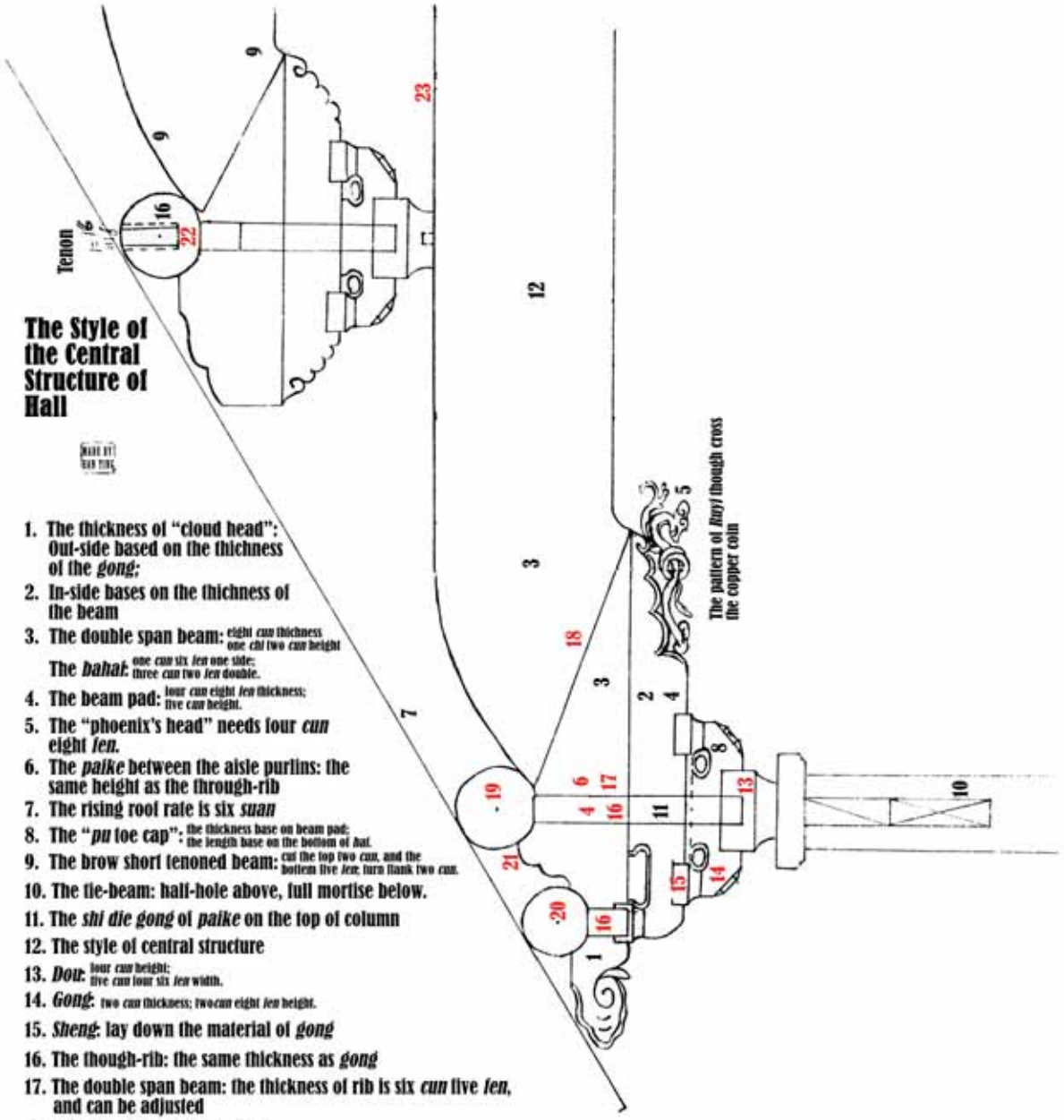
The Side Elevation of the Style of *Shan-wu-yun*

The cross pattern one *dou* six *sheng* has a through-rib upward, whose length is the standard width adding two tenths of it, and adding the length of the "phoenix head" as well.
The top of *gong* requires full size drawing on the ground, and calculating the real size.
The "clouds around beam" has an upward bevel, which is the height adding five *fen*.
The "*shan-wu-yun*" is one *cun* five *fen* thickness, while the "clouds around beam is one *cun*. The *gong*, ribs, and other parts in the area should in out beyond the "*shan-wu-yun*" and the "clouds around beam".
The holes of ribs, purlins and tenons, are used to fix the three-purlin beam tightly and firm.
If the cross pattern bracket sets is five-seven *cun* size, all the ridge ribs should have added thickness and height based on the five-seven *cun* size.
The cross pattern bracket sets of the "*shan-wu-yun*" adds one *cun* outsider, longer than the five-seven *cun* size (if the basic cross pattern bracket set is of bigger size, the upper bracket sets should also be magnified in order); The ridge ribs and the "phoenix head" change in size with it.

1926. 12. Sketch by Yao Hanting; Drawing by Geng-sheng.







The Style of the Central Structure of Hall

1. The thickness of "cloud head": Out-side based on the thichness of the *gong;*
2. In-side bases on the thichness of the beam
3. The double span beam: eight *cun* thichness one *chi* two *cun* height
   The *bahai*: one *cun* six *fen* one side; three *cun* two *fen* double.
4. The beam pad: four *cun* eight *fen* thickness; five *cun* height.
5. The "phoenix's head" needs four *cun* eight *fen*.
6. The *paike* between the aisle purlins: the same height as the through-rib
7. The rising roof rate is six *suan*
8. The "*pu* toe cap": the thickness base on beam pad; the length base on the bottom of *bai*.
9. The brow short tenoned beam: cut the top two *cun*, and the bottom five *fen*; turn flank two *cun*.
10. The tie-beam: half-hole above, full mortise below.
11. The *shi die gong* of *paike* on the top of column
12. The style of central structure
13. *Dou*: four *cun* height; five *cun* four six *fen* width.
14. *Gong*: two *cun* thickness; twocun eight *fen* height.
15. *Sheng*: lay down the material of *gong*
16. The though-rib: the same thickness as *gong*
17. The double span beam: the thickness of rib is six *cun* five *fen*, and can be adjusted
18. The *bahai*: half size of *sheng*
19. The top of main purlin: five *cun* five *fen*, can be adjusted
20. The top of zi purlin: four c*un* six *fen*
21. The groove on the back of beam: two *cun* height; one *cun* thickness; the purlin has one *cun* higher than the beam and one *cun* width.

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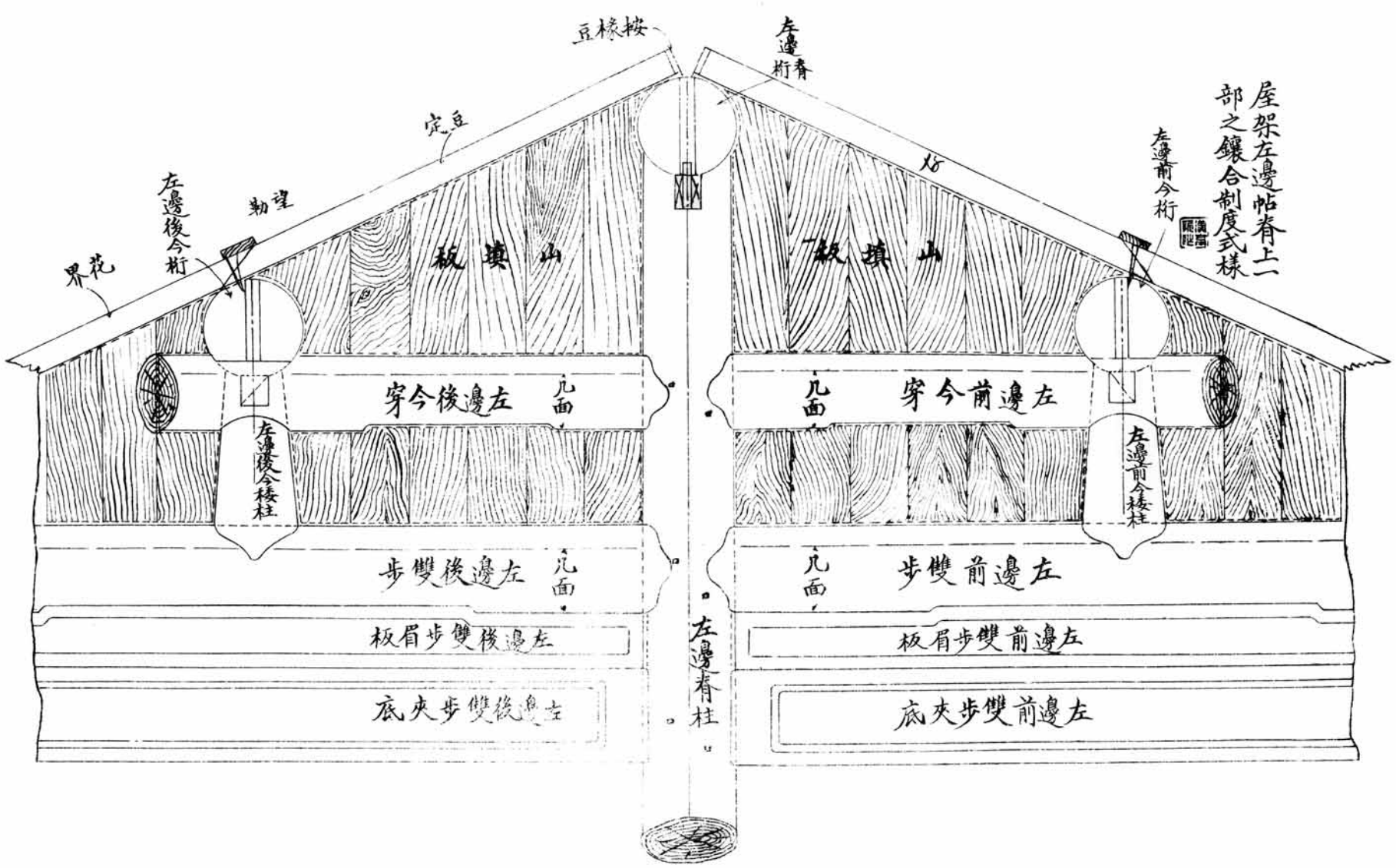
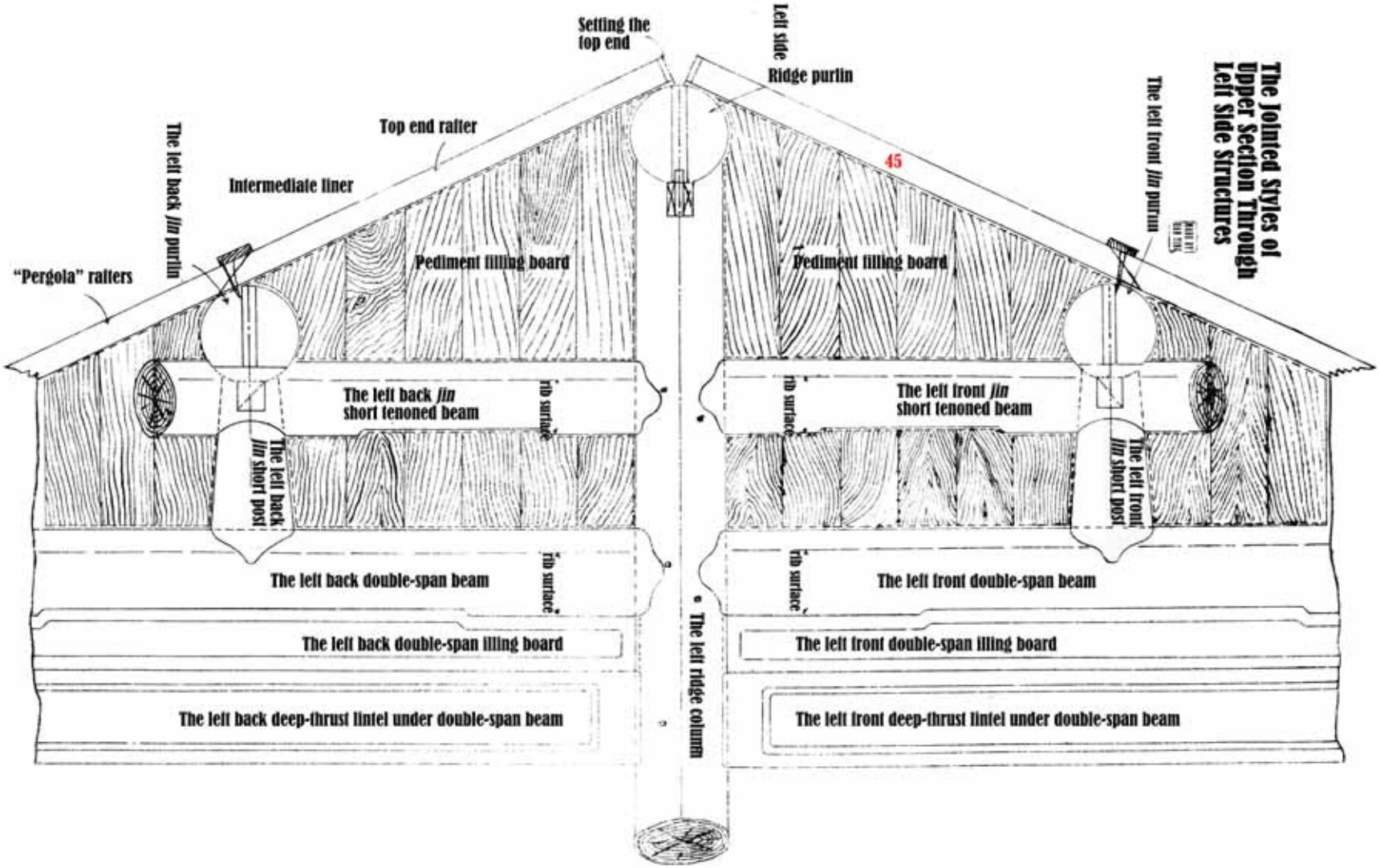
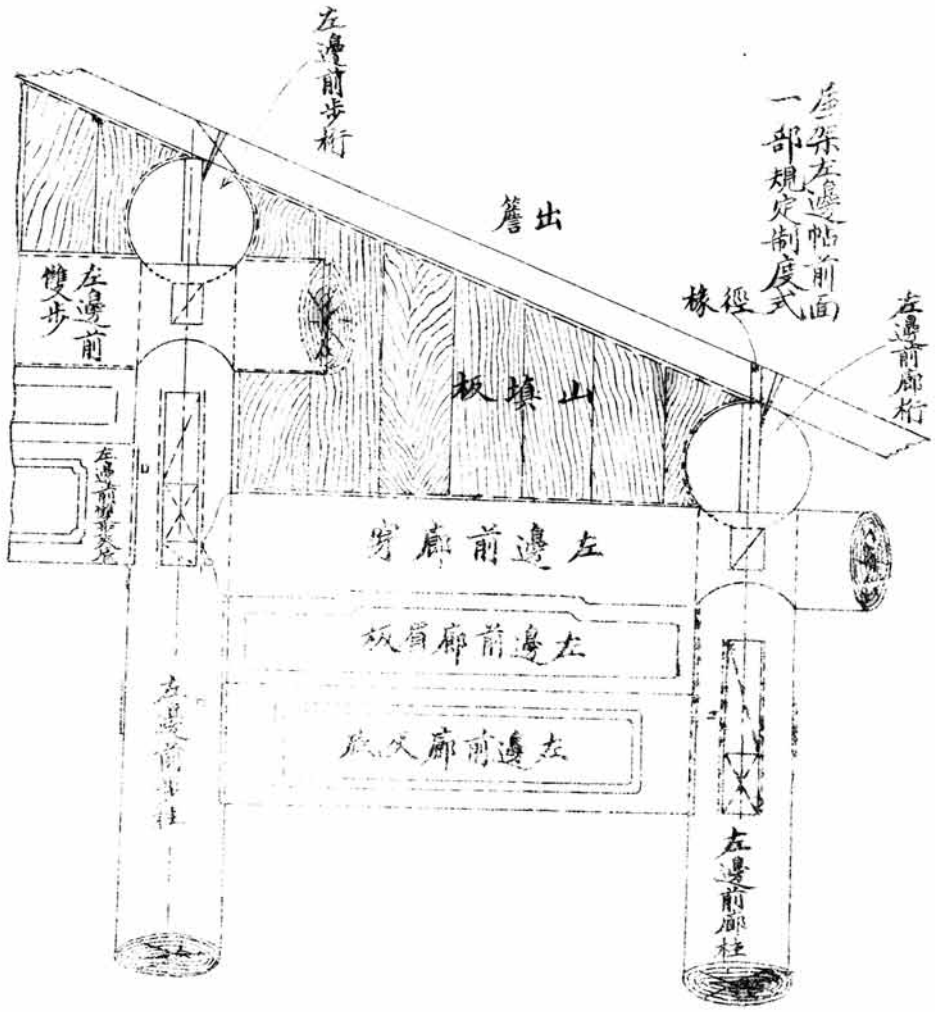
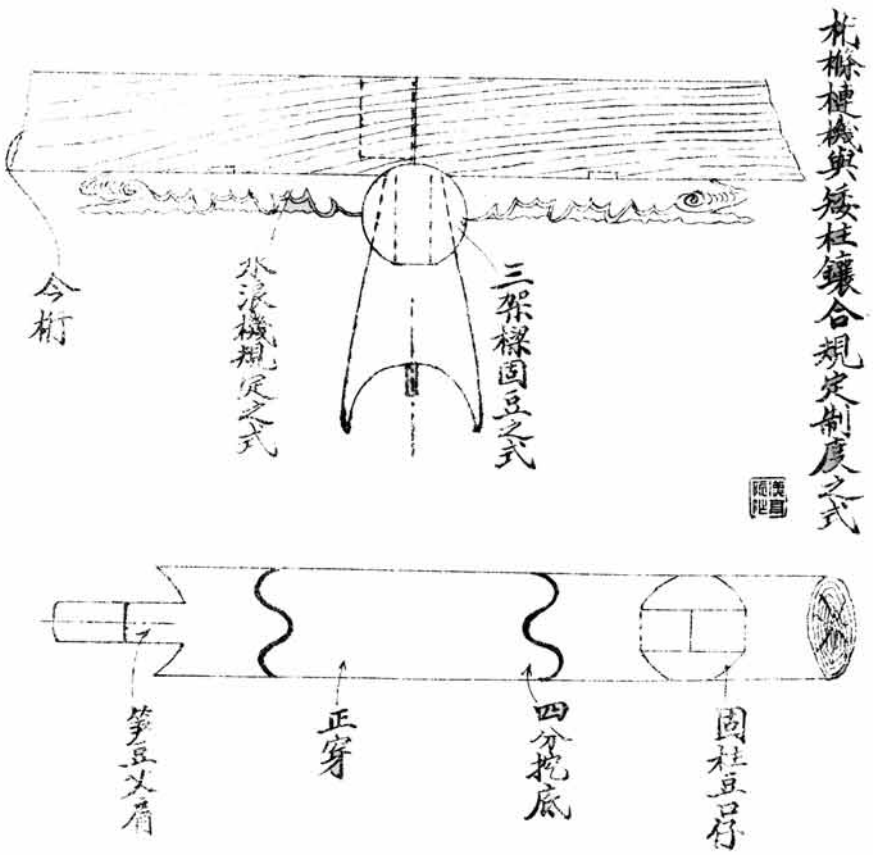
The illustration: The *Yingzao fayuan* original drawings and modern drawings



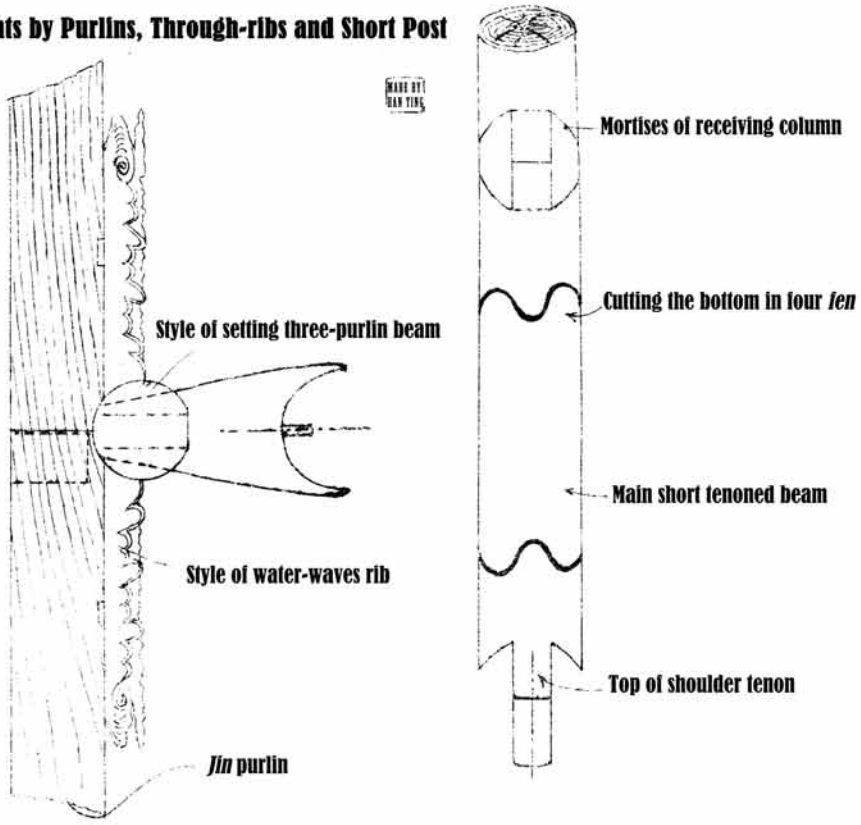

The Jointed Styles of Upper Section Through Left Side Structures
Setting the top end
Left side
Ridge purlin
Top end rafter
Intermediate liner
The left back *jin* purlin
"Pergola" rafters
Pediment filling board
45
The left front *jin* purlin
Pediment filling board
The left back *jin* short tenoned beam
rib surface
The left front *jin* short tenoned beam
rib surface
The left back *jin* short post
The left front *jin* short post
The left back double-span beam
rib surface
The left front double-span beam
rib surface
The left back double-span filling board
The left front double-span filling board
The left back deep-thrust lintel under double-span beam
The left front deep-thrust lintel under double-span beam
The left ridge column

Appendix 1
The illustration: The *Yingzao fayuan* original drawings and modern drawings

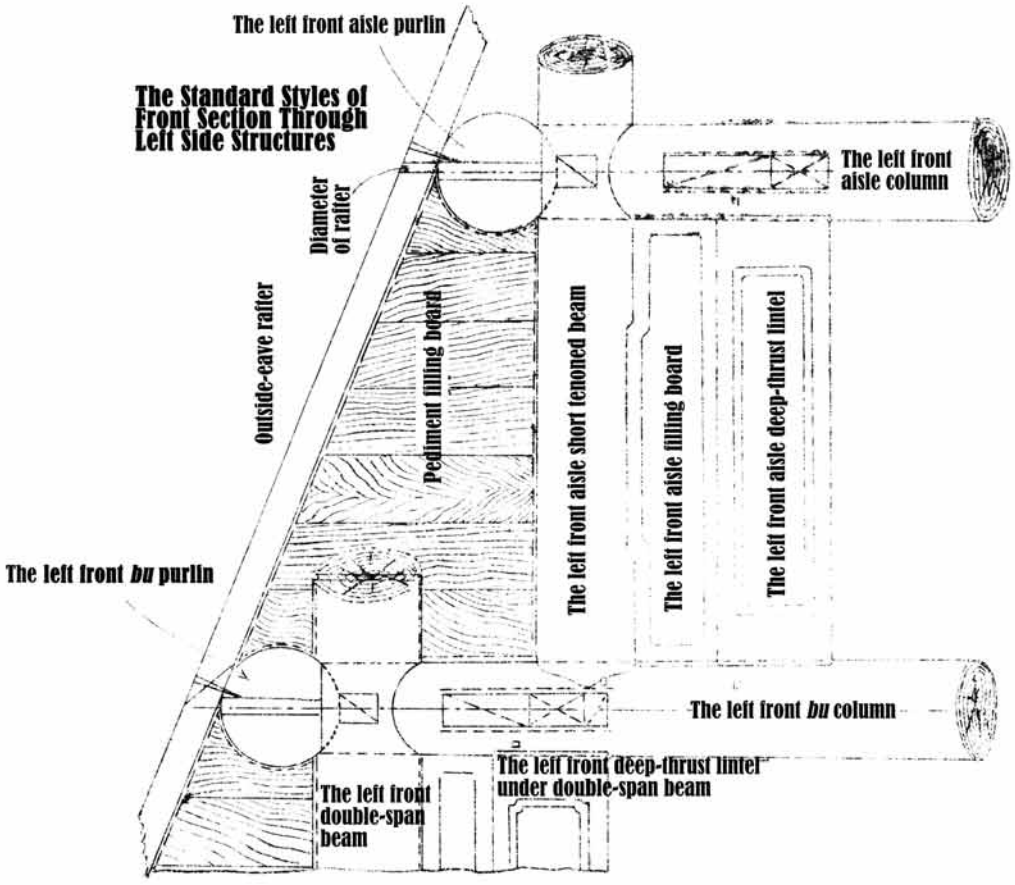




Section of the Standard Joints by Purlins, Through-ribs and Short Post



The Standard Styles of Front Section Through Left Side Structures



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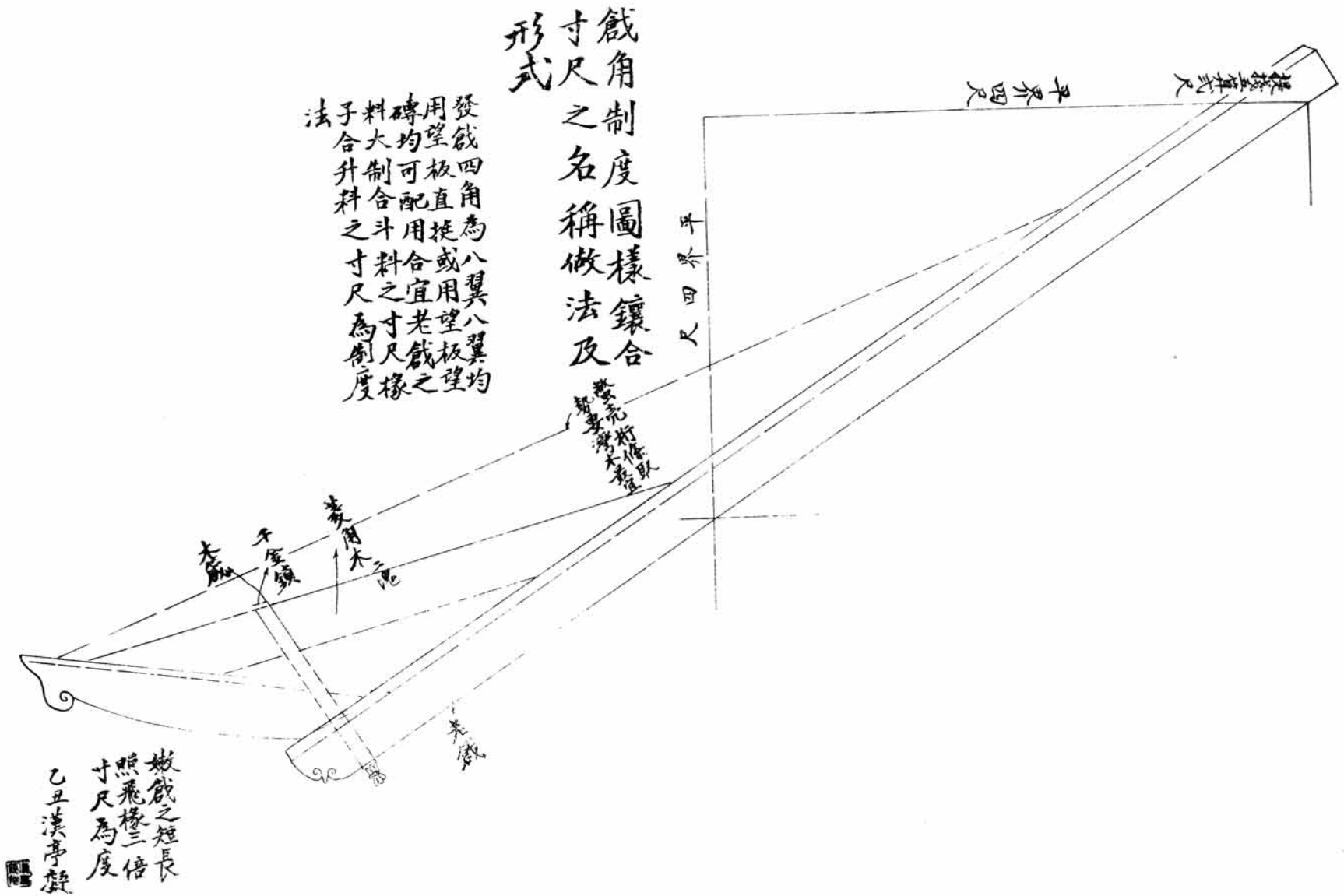

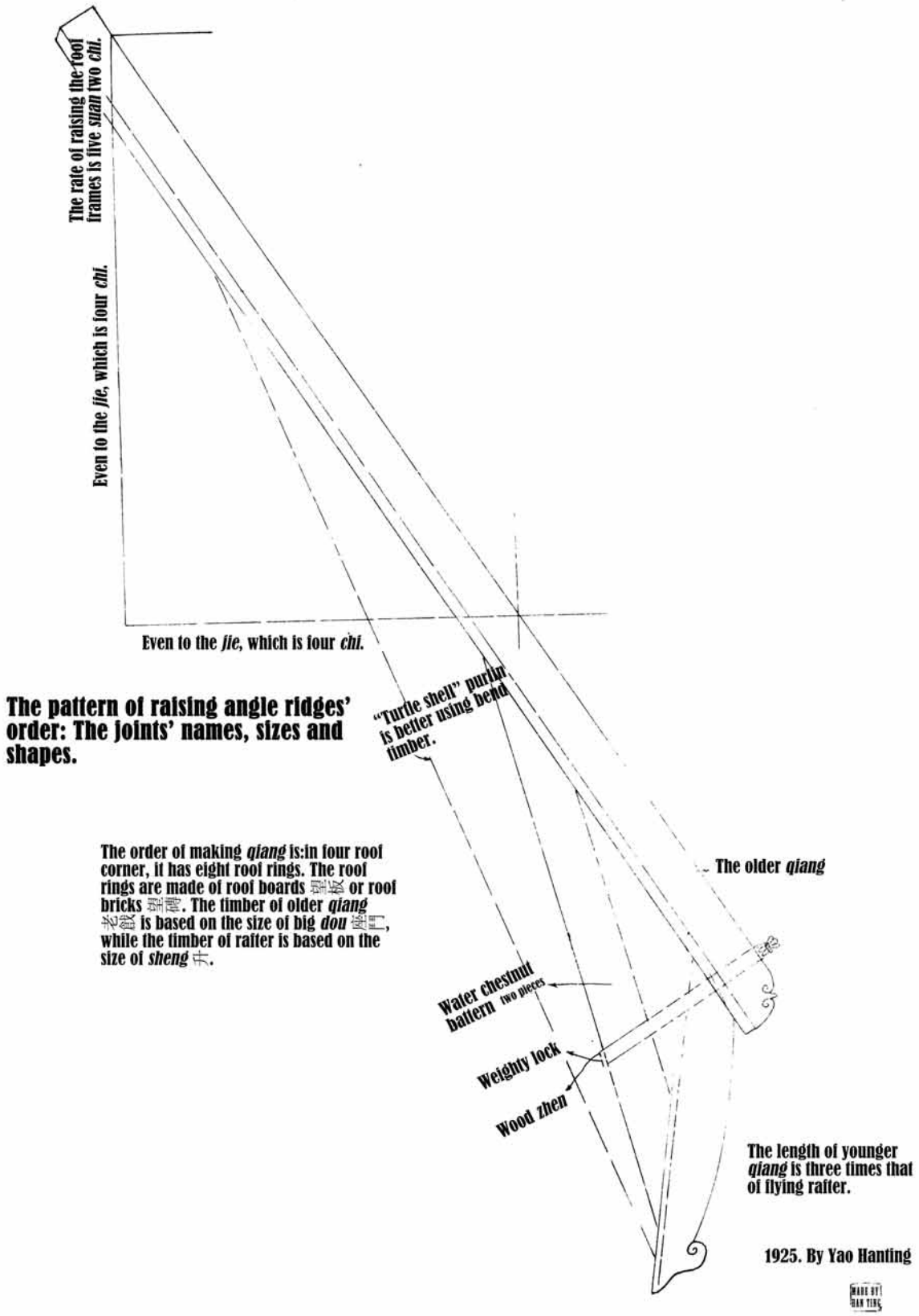

The pattern of raising angle ridges' order: The joints' names, sizes and shapes.

The order of making *qiang* is:in four roof corner, it has eight roof rings. The roof rings are made of roof boards 望板 or roof bricks 望砖. The timber of older *qiang* 老戗 is based on the size of big *dou* 斗, while the timber of rafter is based on the size of *sheng* 升.

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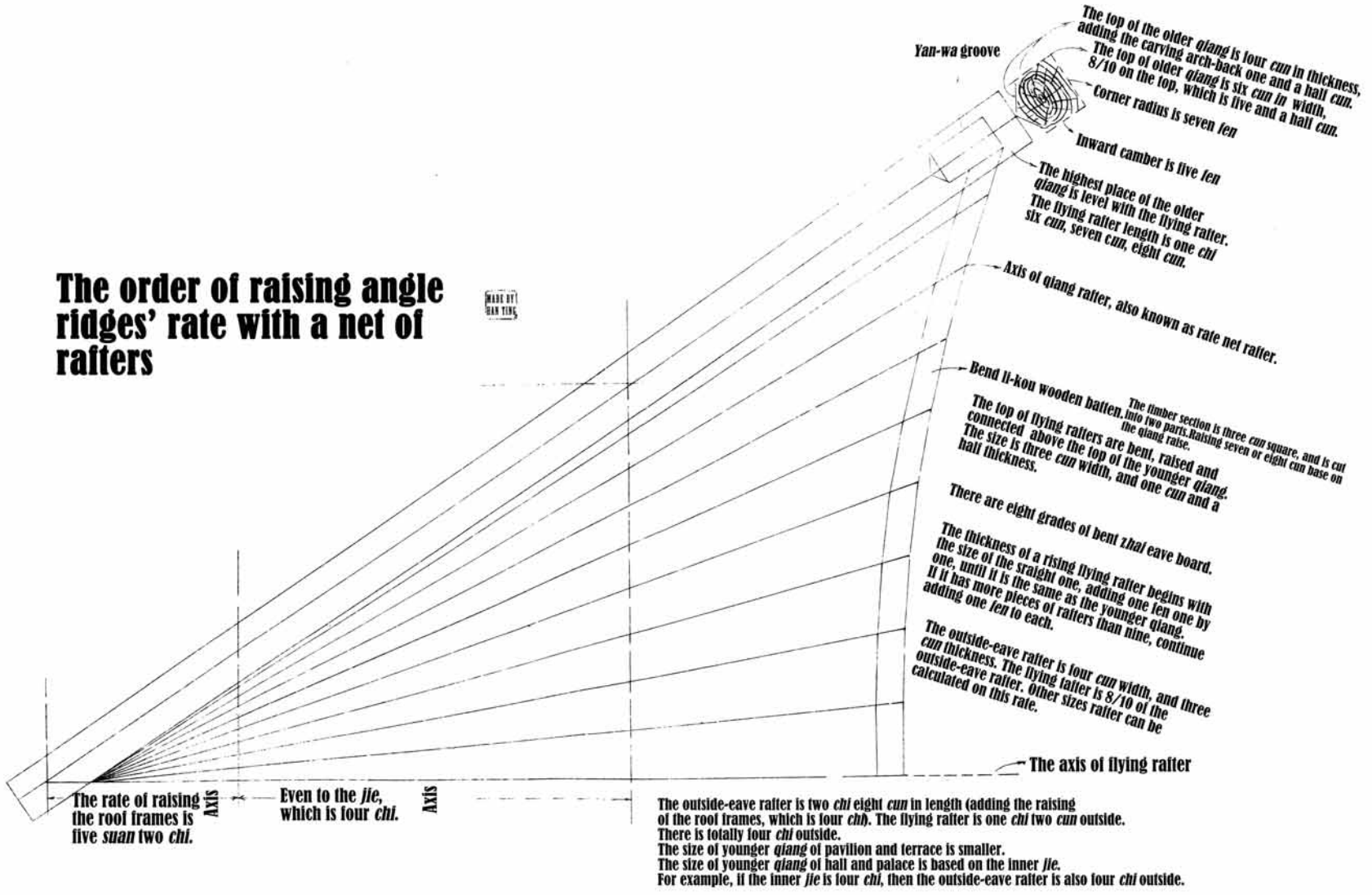
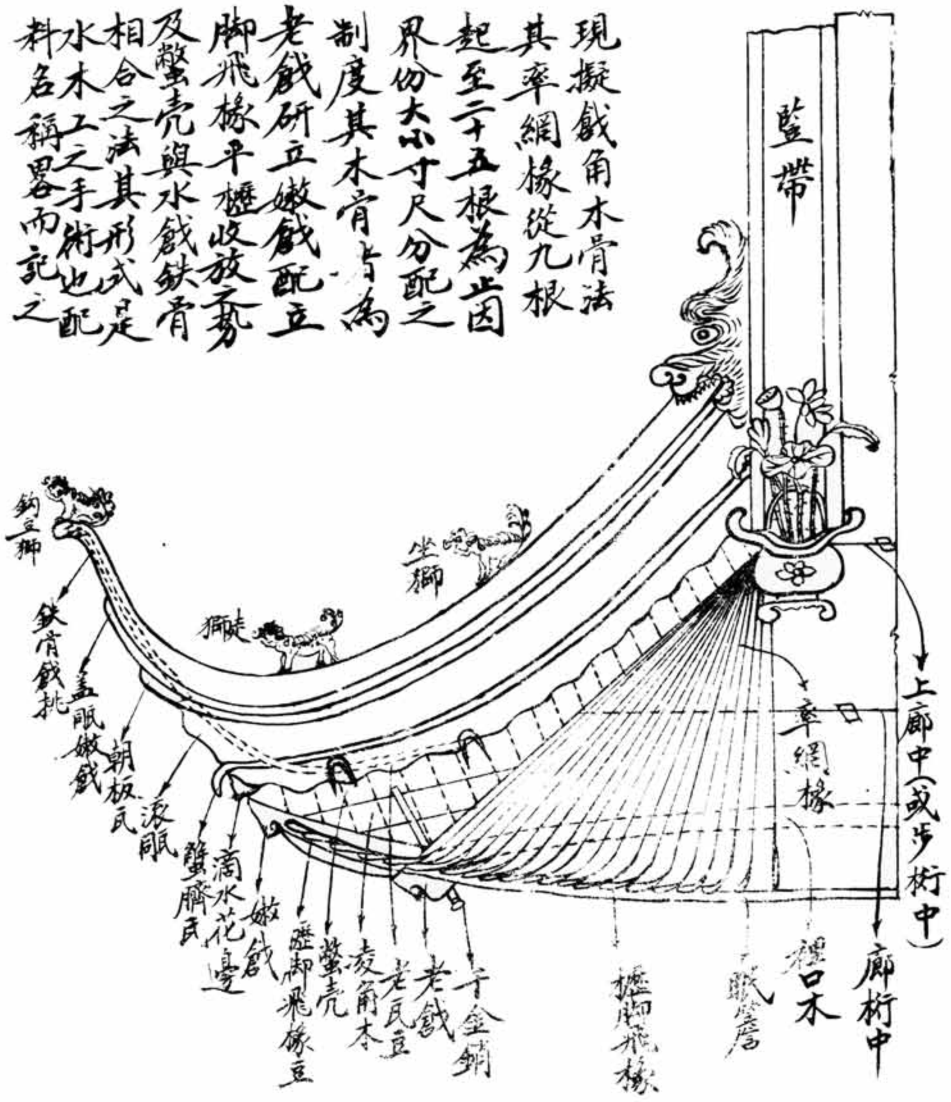
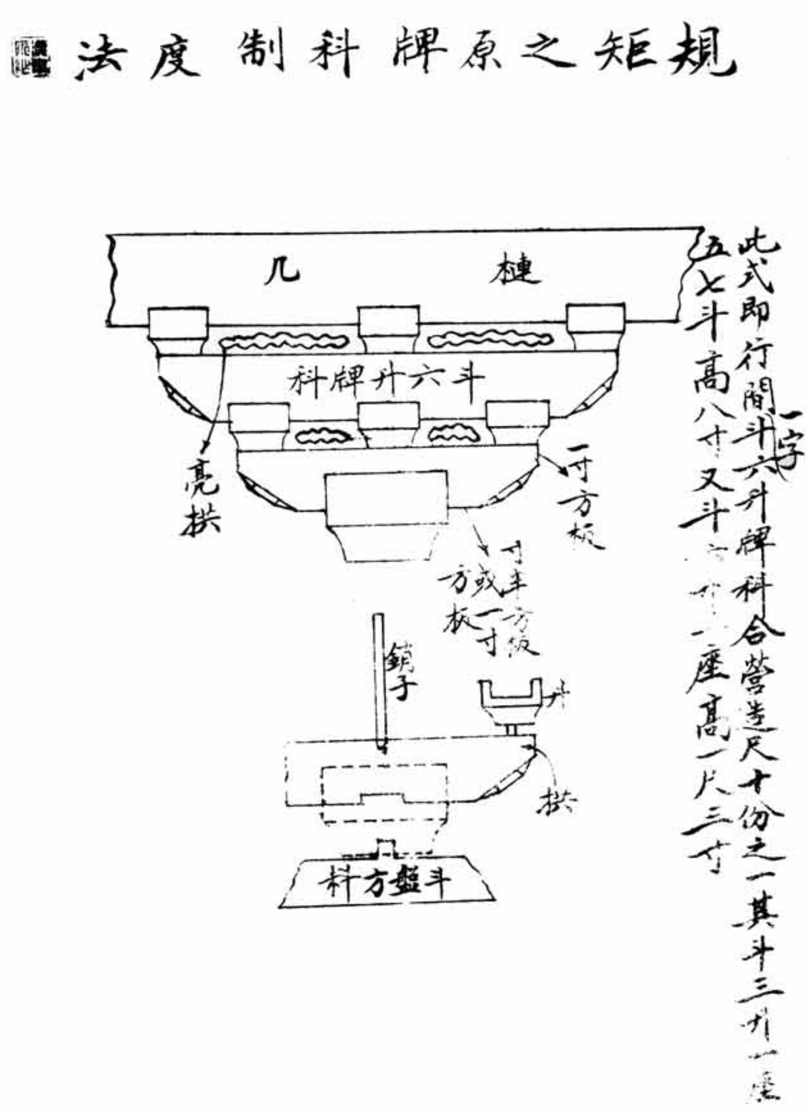
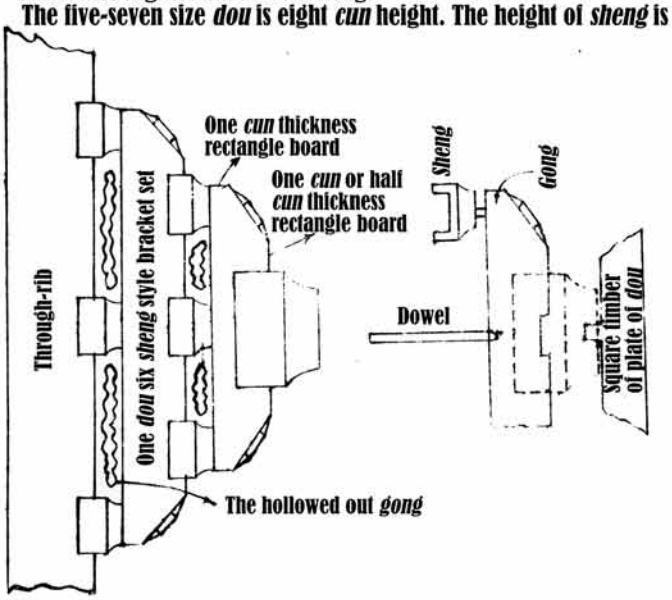

The order of raising angle ridges' rate with a net of rafters
MADE BY HAN TING
Yan-wa groove
The top of the older qiang is four cun in thickness, adding the carving arch-back one and a half cun.
The top of older qiang is six cun in width, 8/10 on the top, which is five and a half cun.
Corner radius is seven fen
Inward camber is five fen
The highest place of the older qiang is level with the flying rafter.
The flying rafter length is one chi six cun, seven cun, eight cun.
Axis of qiang rafter, also known as rate net rafter.
Bend li-kou wooden batten. The timber section is three cun square, and is cut into two parts. Raising seven or eight cun base on the qiang raise.
The top of flying rafters are bent, raised and connected above the top of the younger qiang.
The size is three cun width, and one cun and a half thickness.
There are eight grades of bent zhai eave board.
The thickness of a rising flying rafter begins with the size of the sraight one, adding one fen one by one, until it is the same as the younger qiang.
If it has more pieces of rafters than nine, continue adding one fen to each.
The outside-eave rafter is four cun width, and three cun thickness. The flying rafter is 8/10 of the outside-eave rafter. Other sizes rafter can be calculated on this rate.
The axis of flying rafter
The rate of raising the roof frames is five suan two chi.
Axis
Even to the jie, which is four chi.
Axis
The outside-eave rafter is two chi eight cun in length (adding the raising of the roof frames, which is four chi). The flying rafter is one chi two cun outside.
There is totally four chi outside.
The size of younger qiang of pavilion and terrace is smaller.
The size of younger qiang of hall and palace is based on the inner jie.
For example, if the inner jie is four chi, then the outside-eave rafter is also four chi outside.


現擬戧角木骨法
其率綢椽從九根
起至二十五根為止因
界份大小寸尺分配之
制度其木骨皆為
老戧硏立嫩戧配立
腳飛椽平櫏收放勢
及鰲殼與水戧鉄骨
相合之法其形式足
水木工之手術也配
料名稱畧而記之
監帶
上廊中(或步桁中)
廊桁中
坐獅

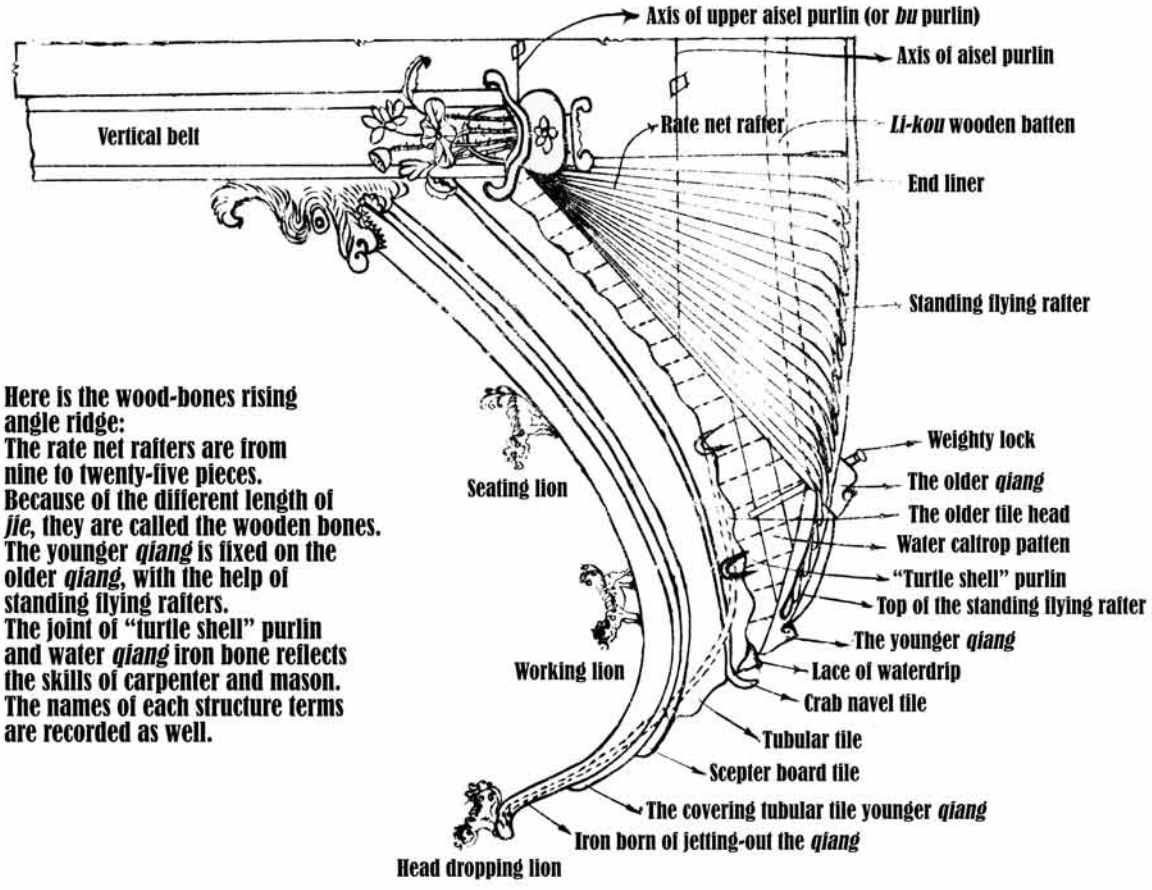

規矩之原牌科制度法
棟
几
斗六升牌科
亮拱
一寸方板
銷子
斗盤方料
拱
此式即行間斗六升牌科合營造尺十份之一其斗三寸一墨

The standard bracket set

This is the one *dou* six *sheng* style bracket set. The scale is 1:10.
It has one big *dou* and three *sheng*.
The five-seven size *dou* is eight *cun* height. The height of *sheng* is six *cun*.

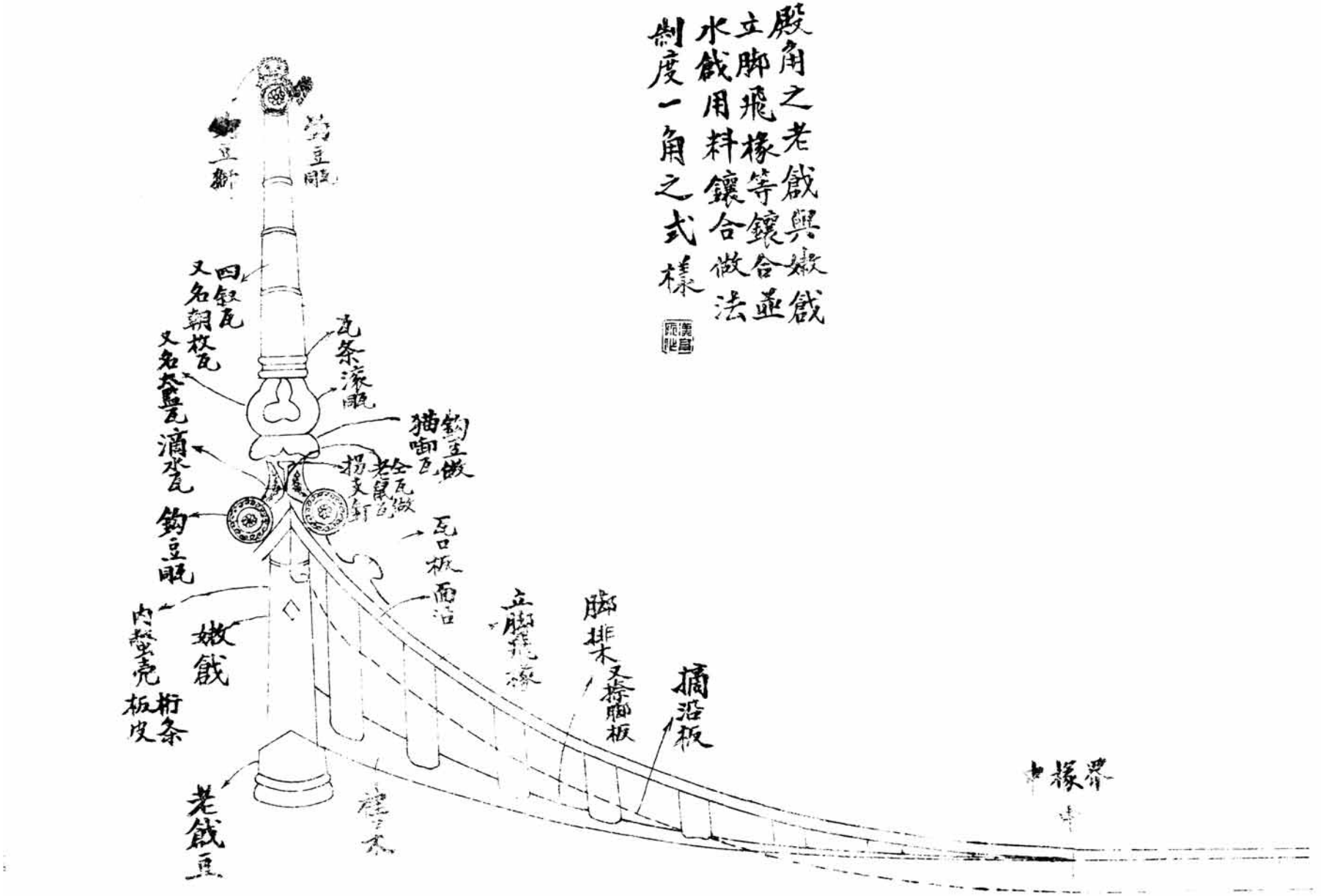


MADE BY DAN TING

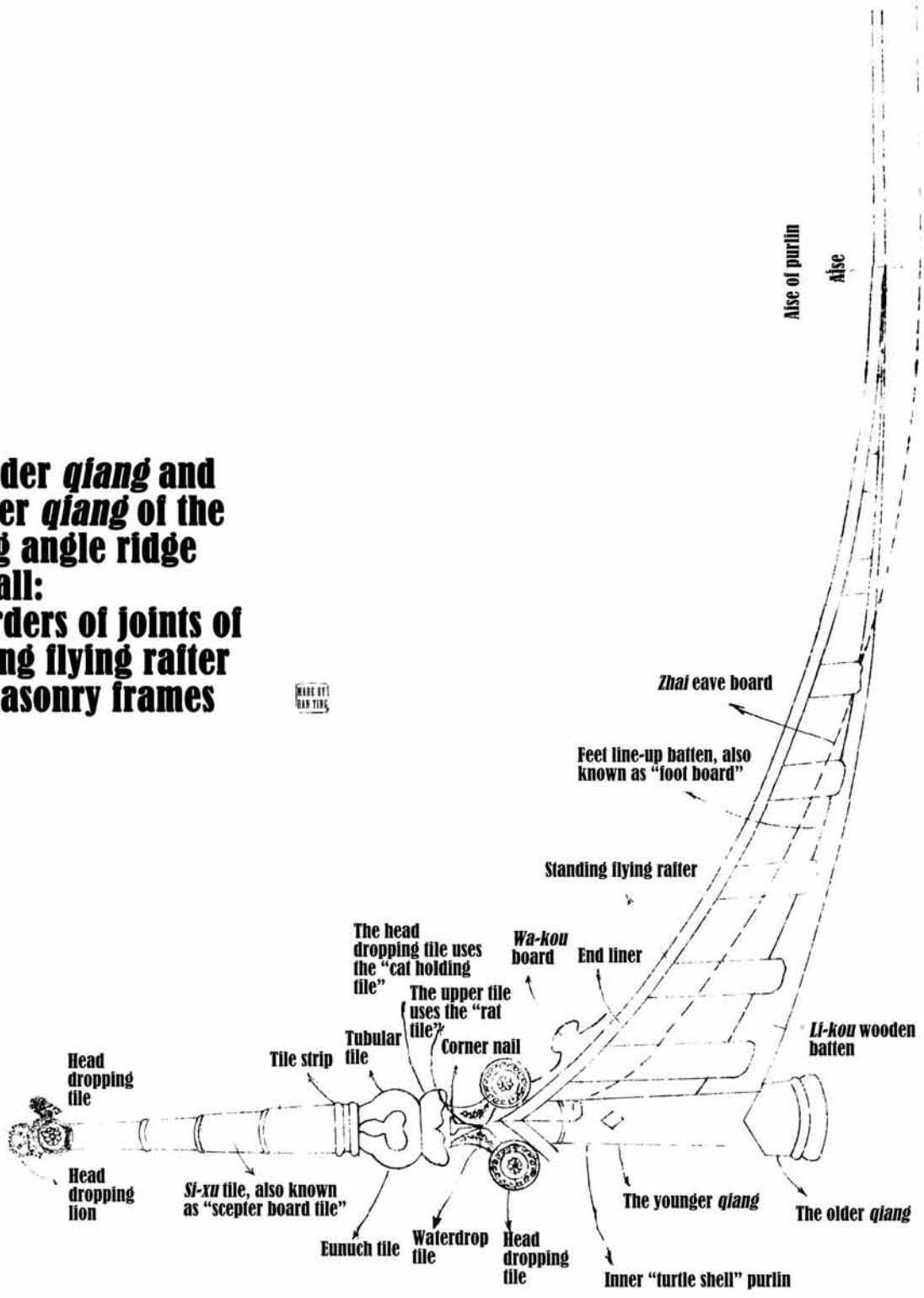


Here is the wood-bones rising angle ridge:
The rate net rafters are from nine to twenty-five pieces.
Because of the different length of *jie*, they are called the wooden bones.
The younger *qiang* is fixed on the older *qiang*, with the help of standing flying rafters.
The joint of "turtle shell" purlin and water *qiang* iron bone reflects the skills of carpenter and mason.
The names of each structure terms are recorded as well.

Appendix 1
The illustration: The *Yingzao fayuan* original drawings and modern drawings



The older *qiang* and younger *qiang* of the raising angle ridge of a hall: The orders of joints of standing flying rafter and masonry frames



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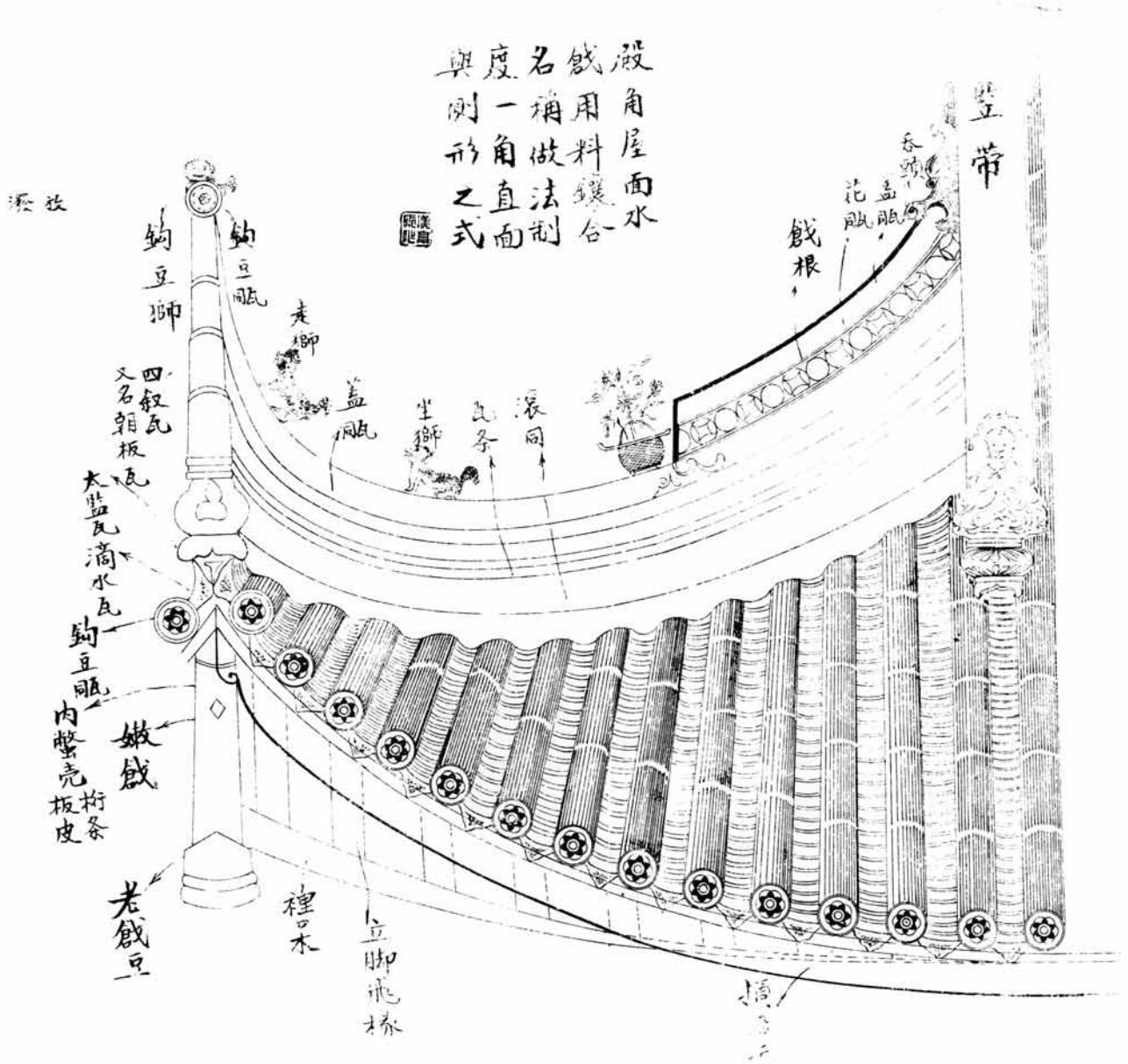
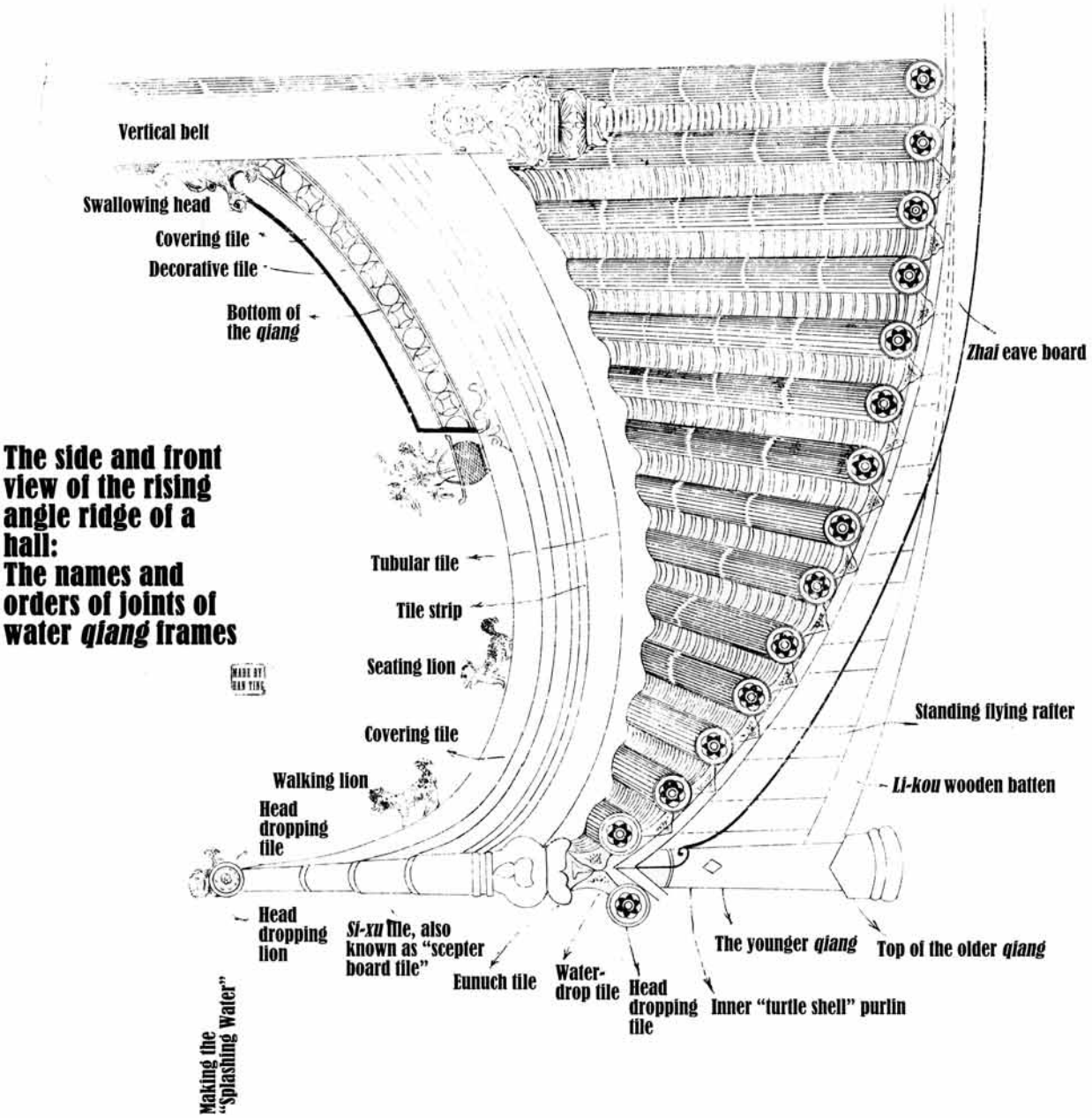
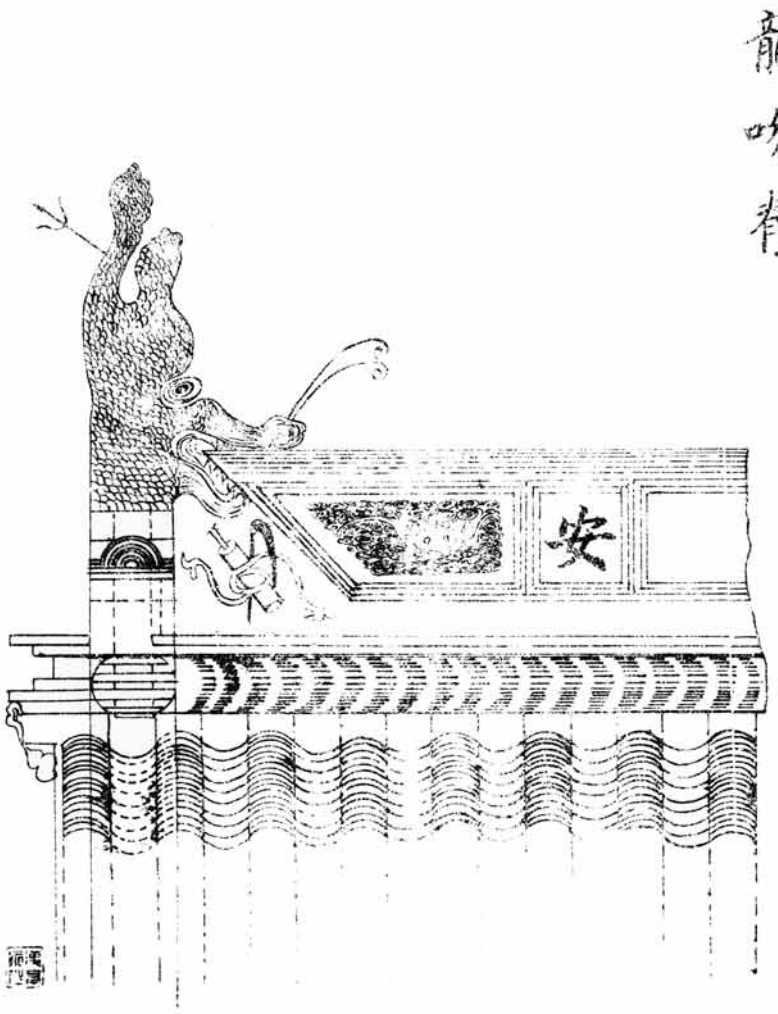
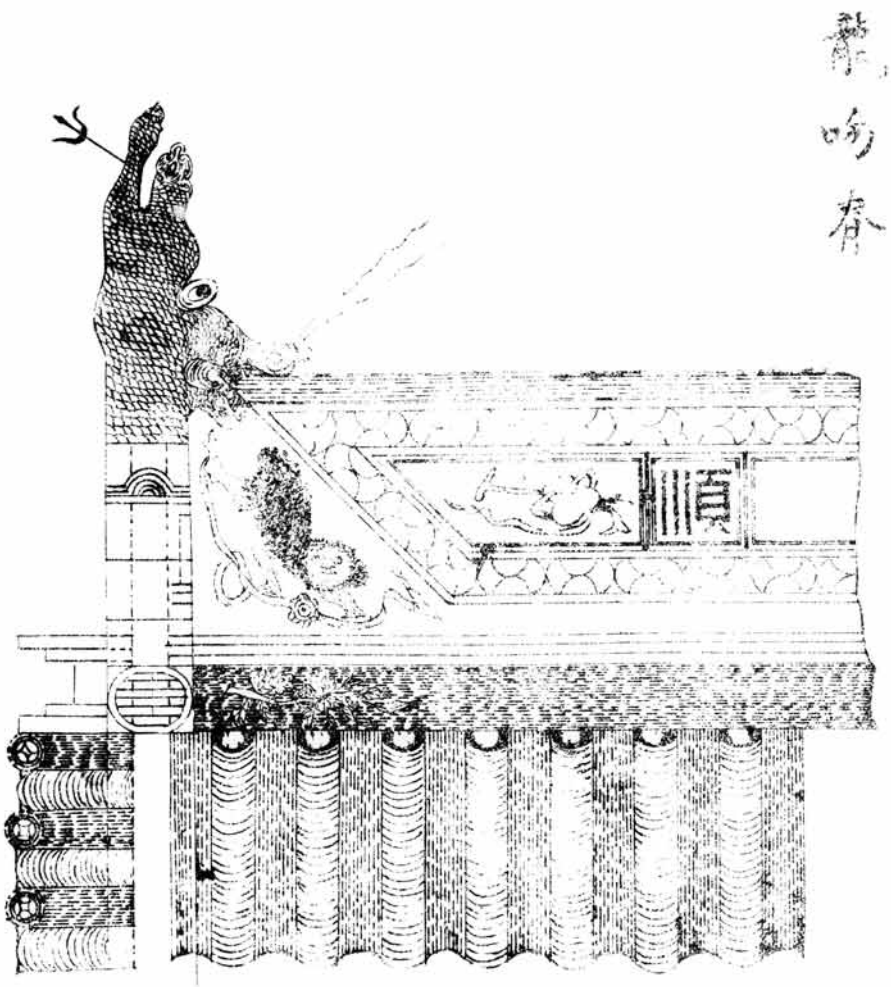


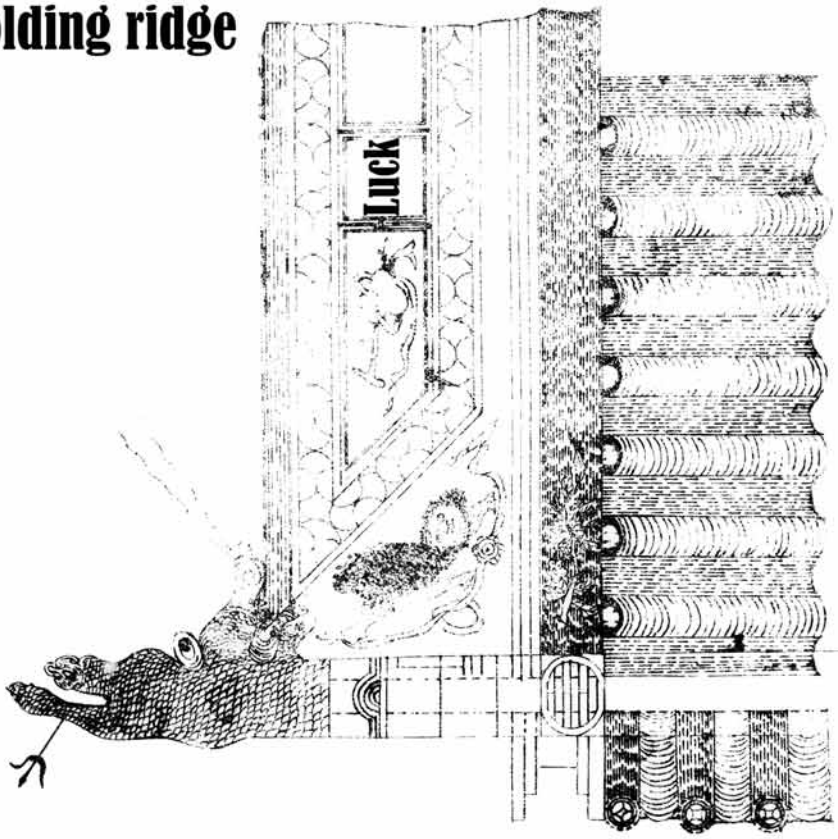

The side and front view of the rising angle ridge of a hall:
The names and orders of joints of water *qiang* frames
Vertical belt
Swallowing head
Covering tile
Decorative tile
Bottom of the *qiang*
Zhai eave board
Tubular tile
Tile strip
Seating lion
Standing flying rafter
Covering tile
Walking lion
Li-kou wooden batten
Head dropping tile
Head dropping lion
Si-xu tile, also known as "scepter board tile"
Eunuch tile
Water-drop tile
Head dropping tile
The younger *qiang*
Top of the older *qiang*
Inner "turtle shell" purlin
Making the "Splashing Water"

Appendix 1
The illustration: The *Yingzao fayuan* original drawings and modern drawings

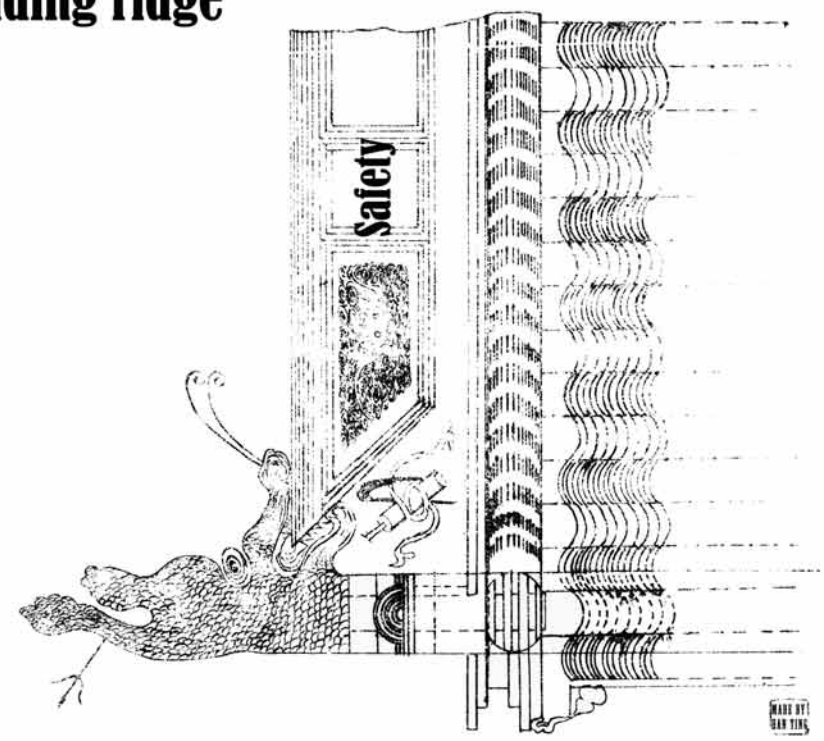


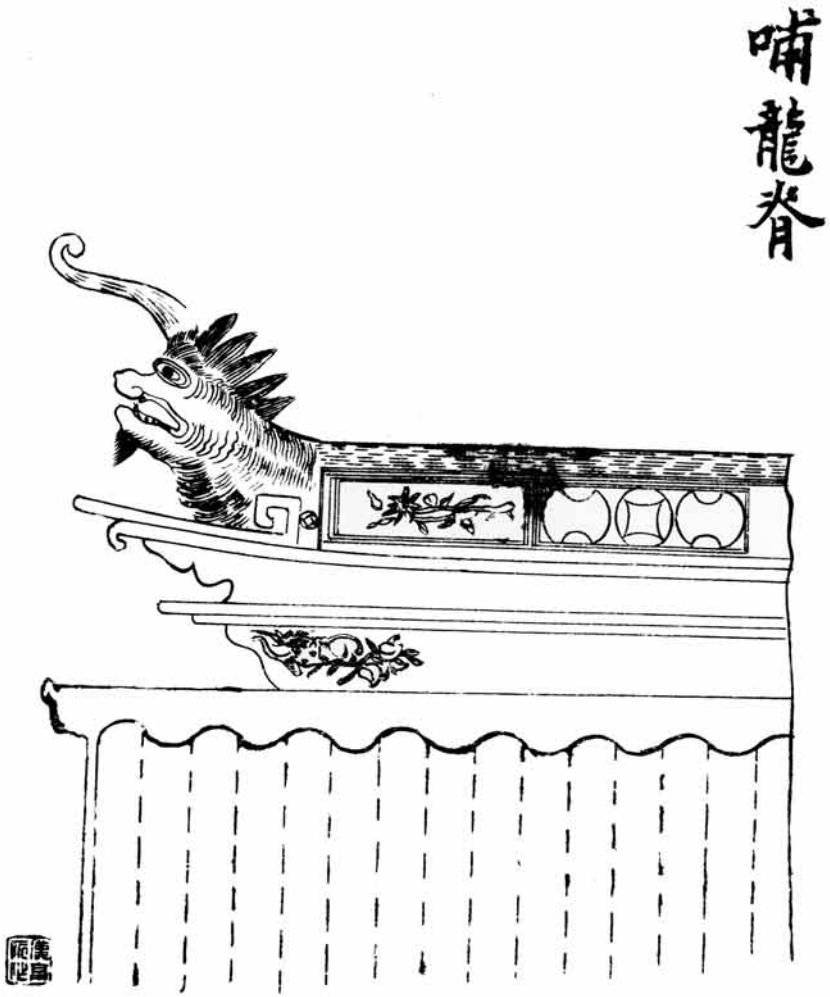


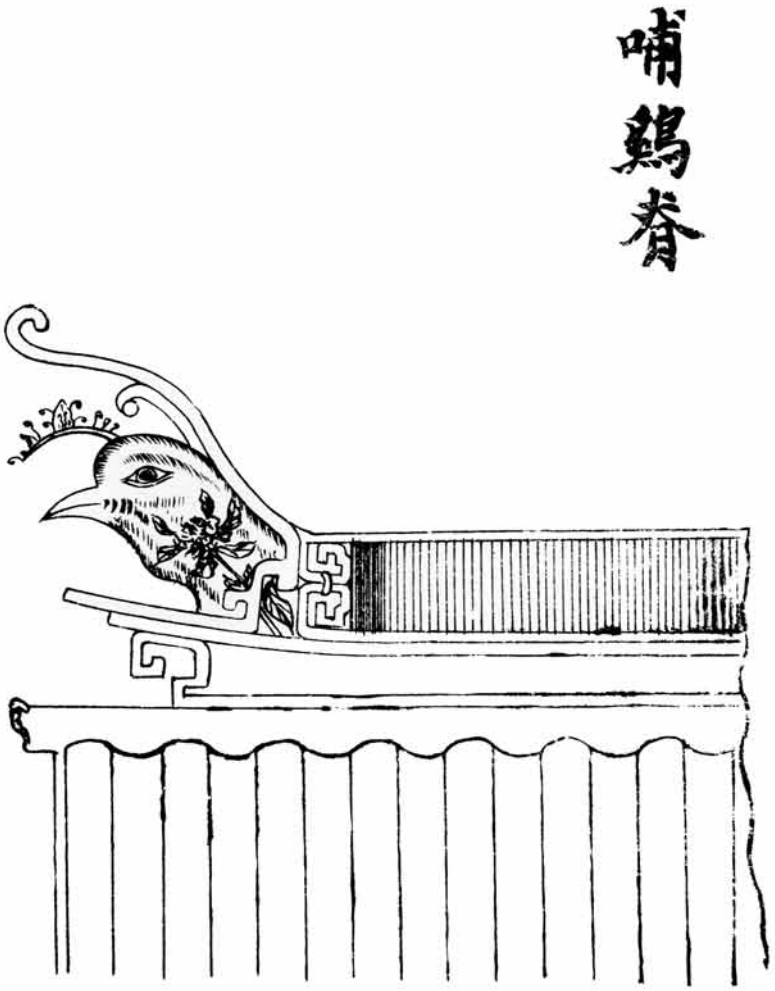
Dragon holding ridge



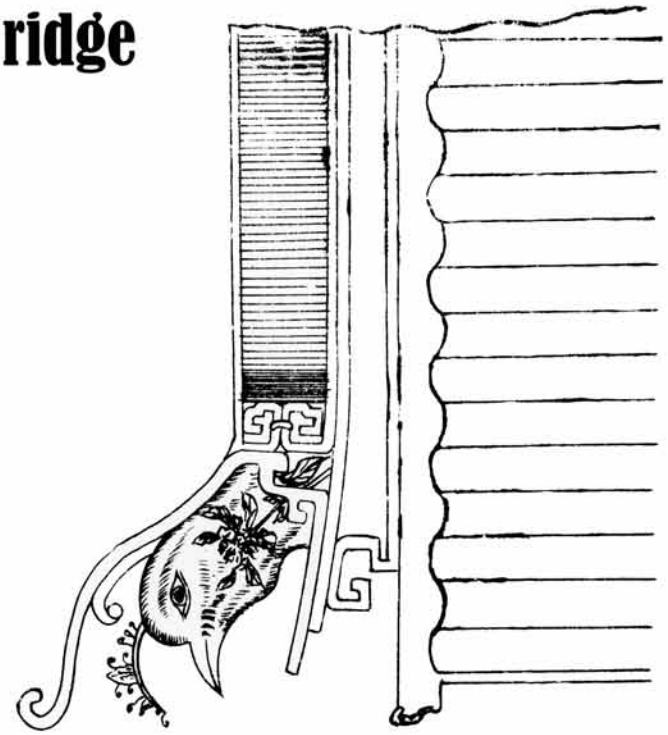
Dragon holding ridge



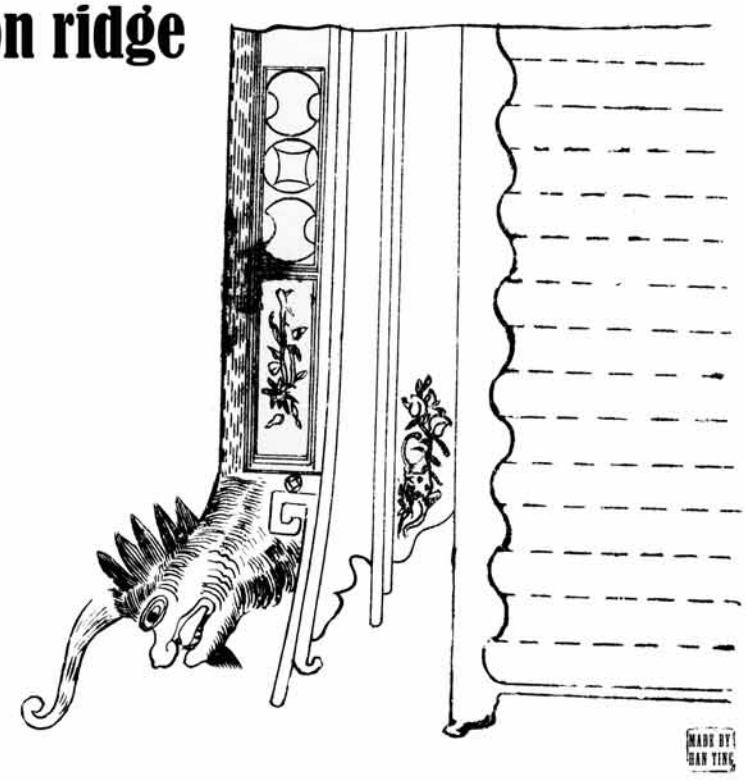

哺龍脊


哺鴟脊

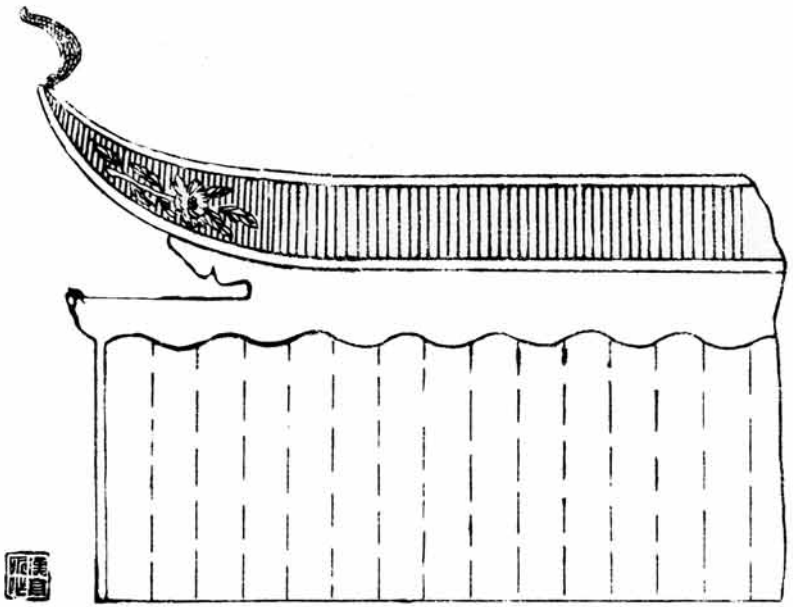
Feeding chicken ridge



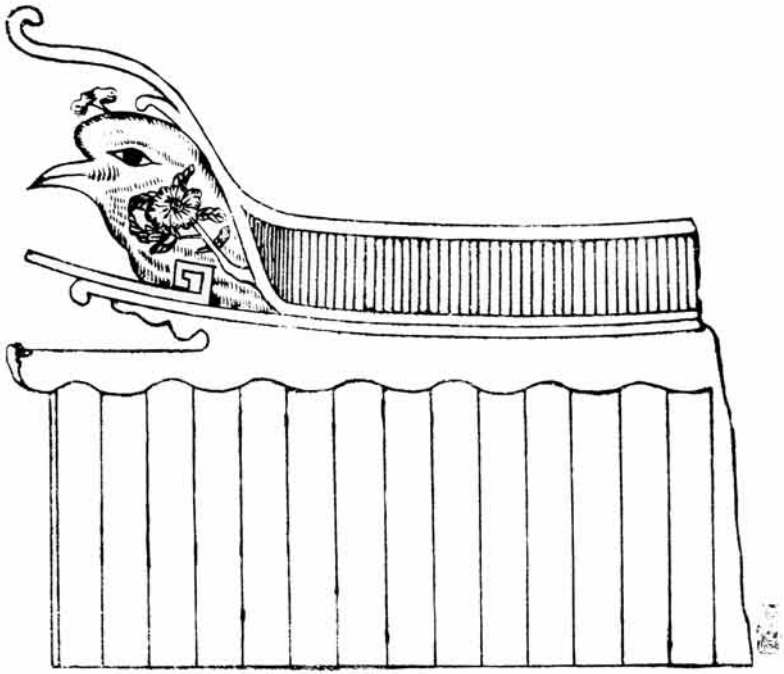
Feeding dragon ridge



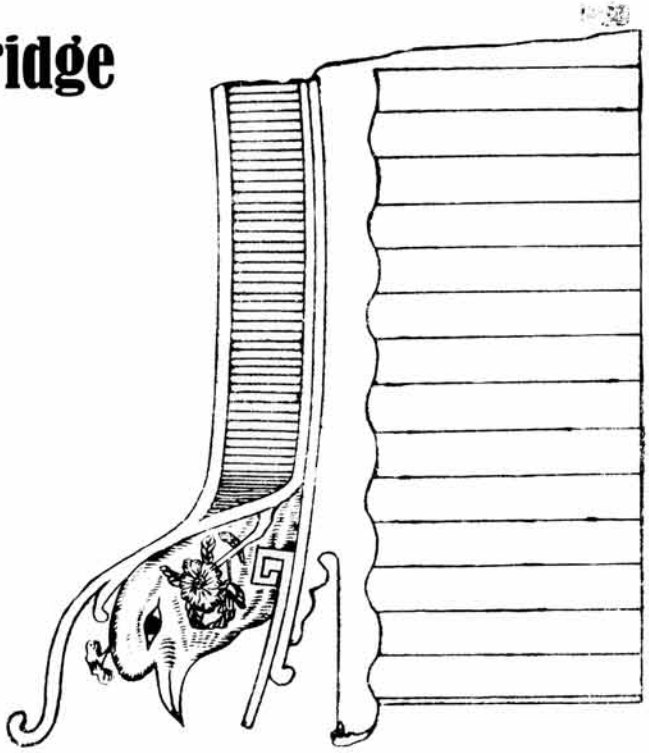
雌毛脊



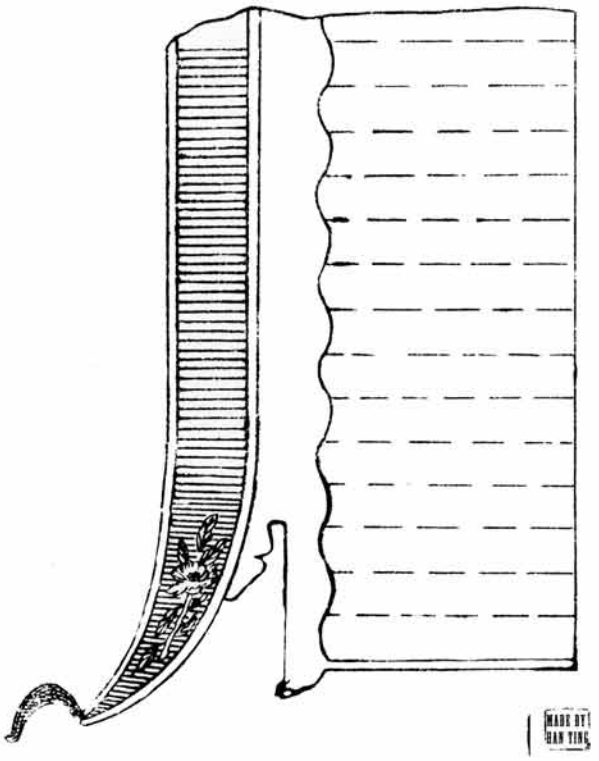
哺鷄脊



Feeding chicken ridge



Soft feather ridge



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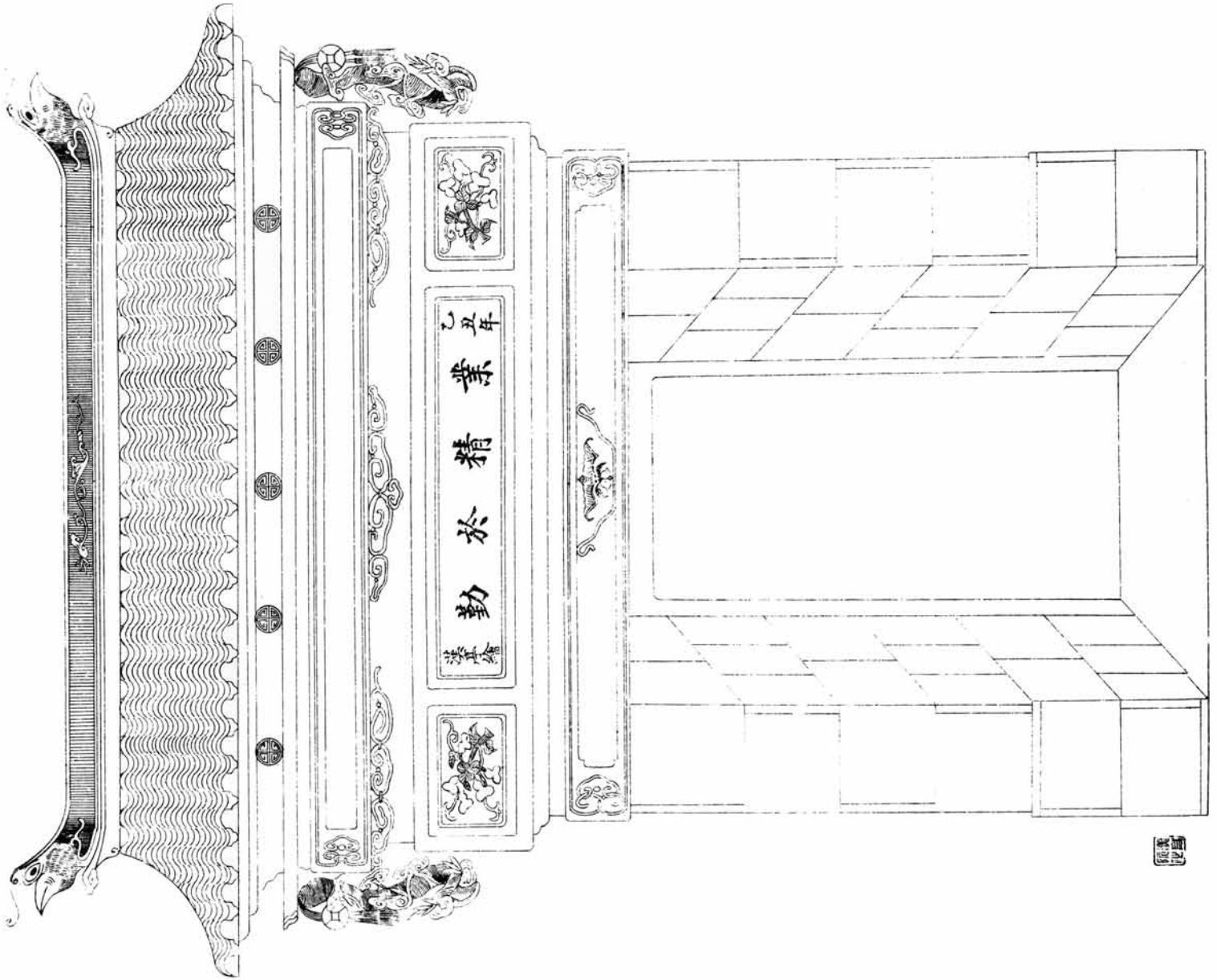
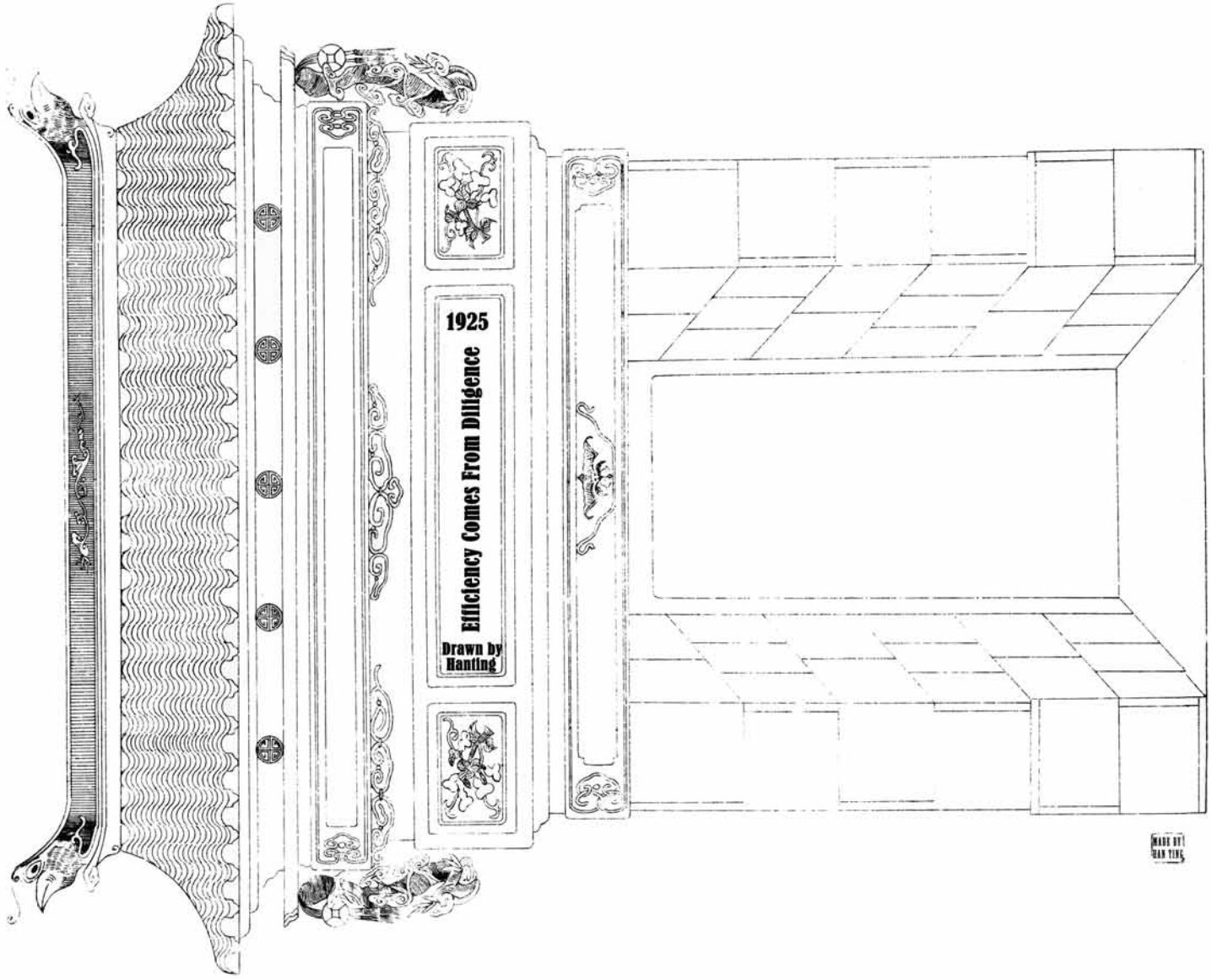
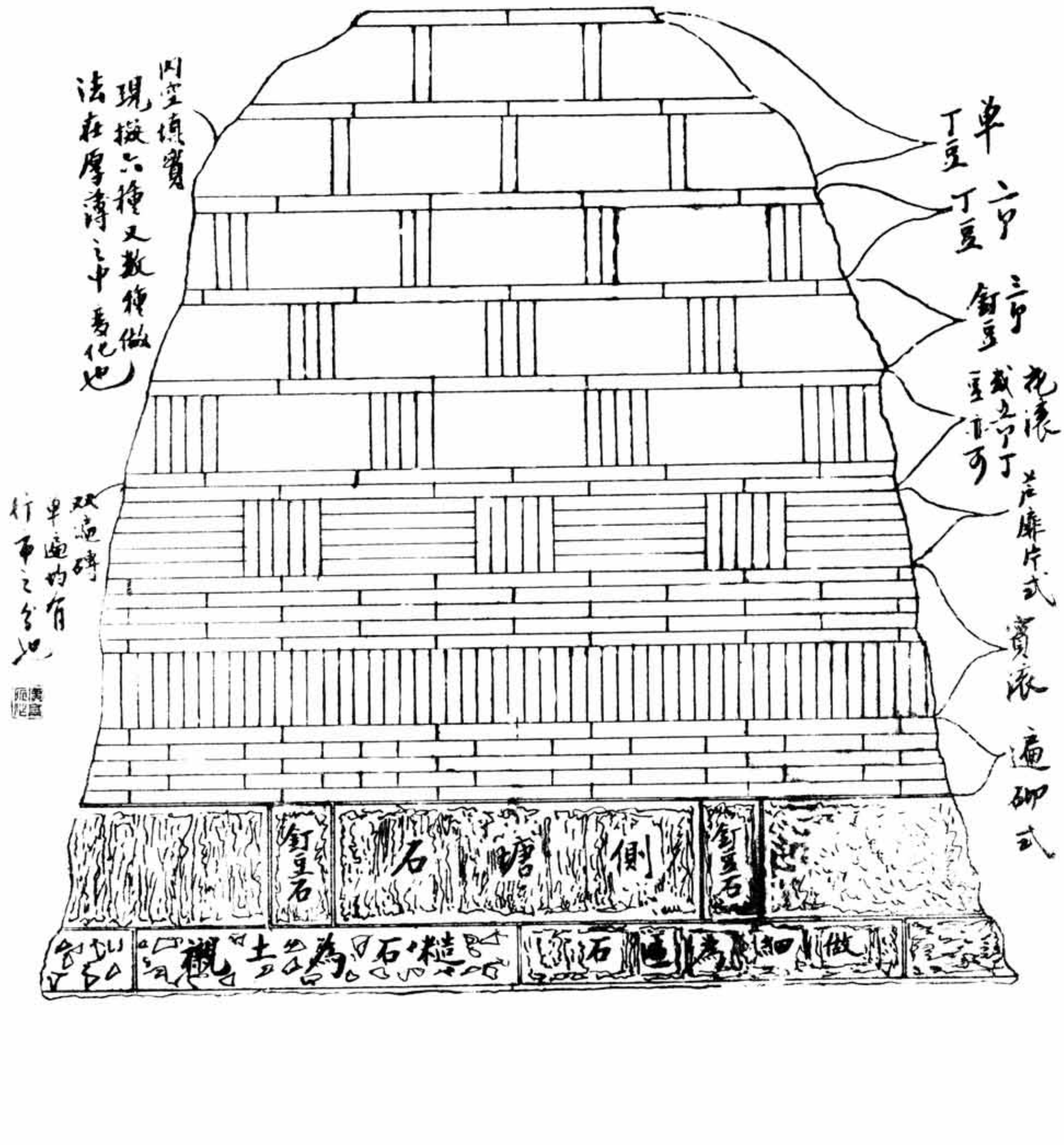
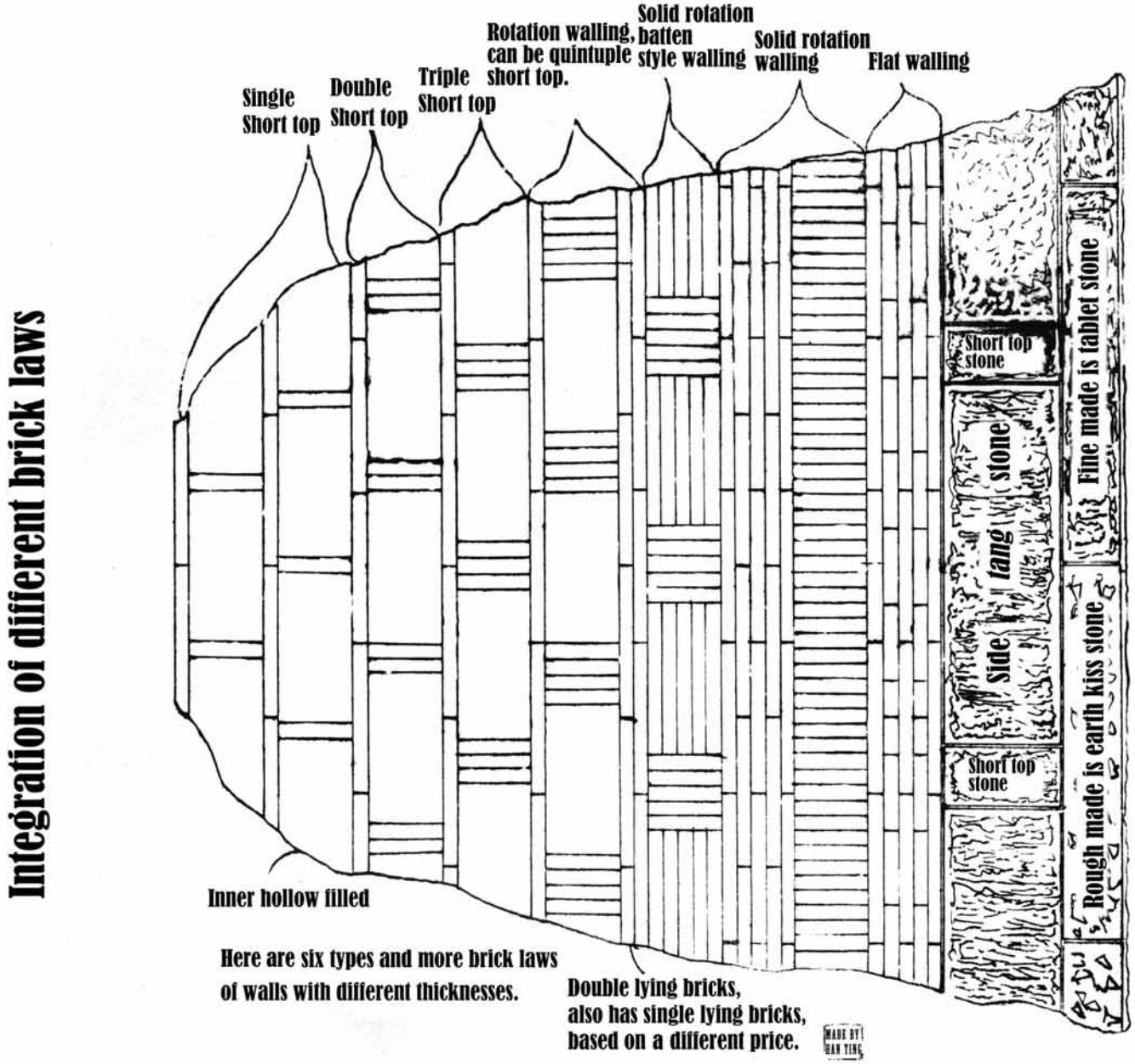


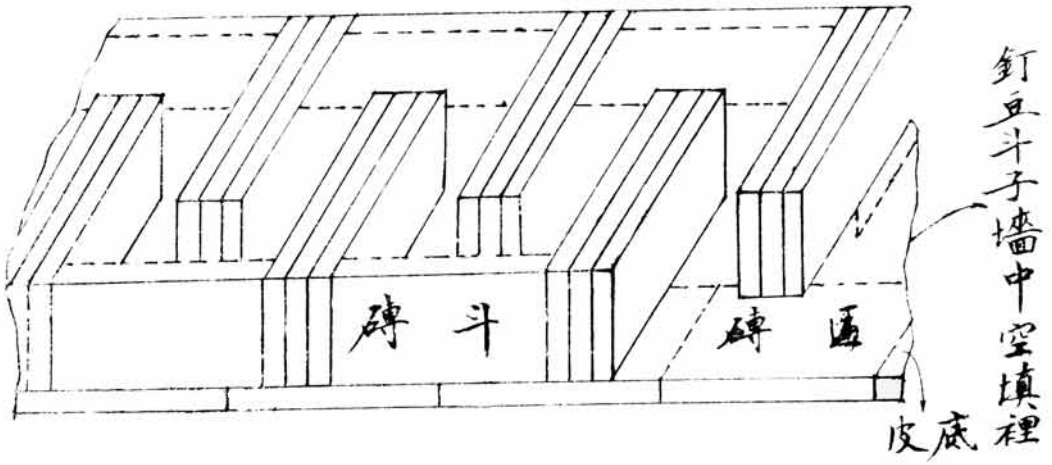

1925
Efficiency Comes From Diligence
Drawn by
Hanting

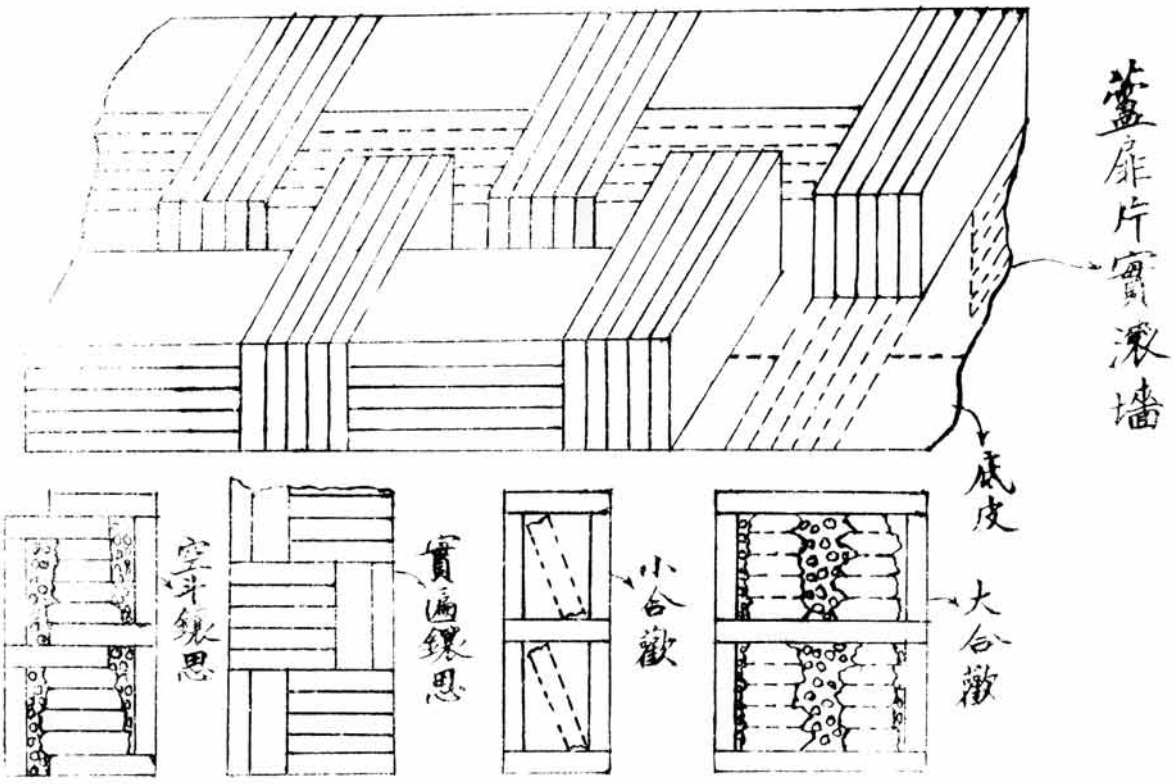
墻垣砌法擬數種之鑲合



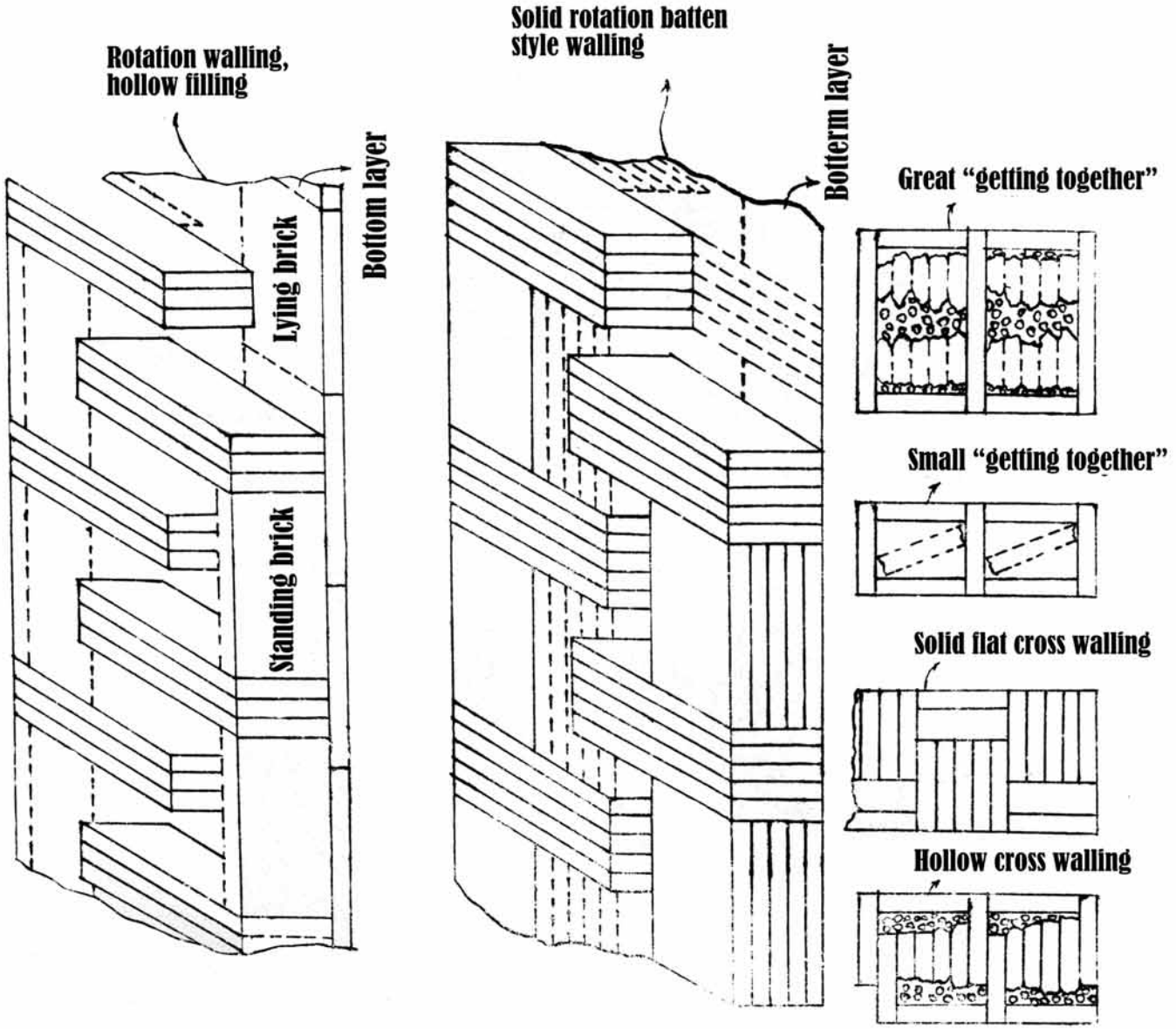

Integration of different brick laws
Single Short top
Double Short top
Triple Short top
Rotation walling, can be quintuple short top.
Solid rotation batten style walling
Solid rotation walling
Flat walling
Short top stone
Side tang stone
Short top stone
Fine made is tablet stone
Rough made is earth kiss stone
Inner hollow filled
Here are six types and more brick laws of walls with different thicknesses.
Double lying bricks, also has single lying bricks, based on a different price.
MADE BY HAN TING

茲擬墻填式樣數種說明添建改造之原因其間常用墻身厚薄寸尺行市空實斗墻應用若干材料惟磚之分寸有大小厚薄之別故依次制配式樣數種但原有斷頭殘塊瓦碟均當檢而用之庶不致拋棄物力妥費經濟是亦研究斯術者可不加諸意乎





Here is the introduction of some types of walling, which could explain the reasons for adding or rebuilding, including the widths and sizes of walls, and some hollow or solid walls. The differences in walling types are based on the material: the size of bricks, now is shown as below. The original broken bricks should also be used, never be thrown away, to avoid waste. Can any researcher pay less attention to the building economy?

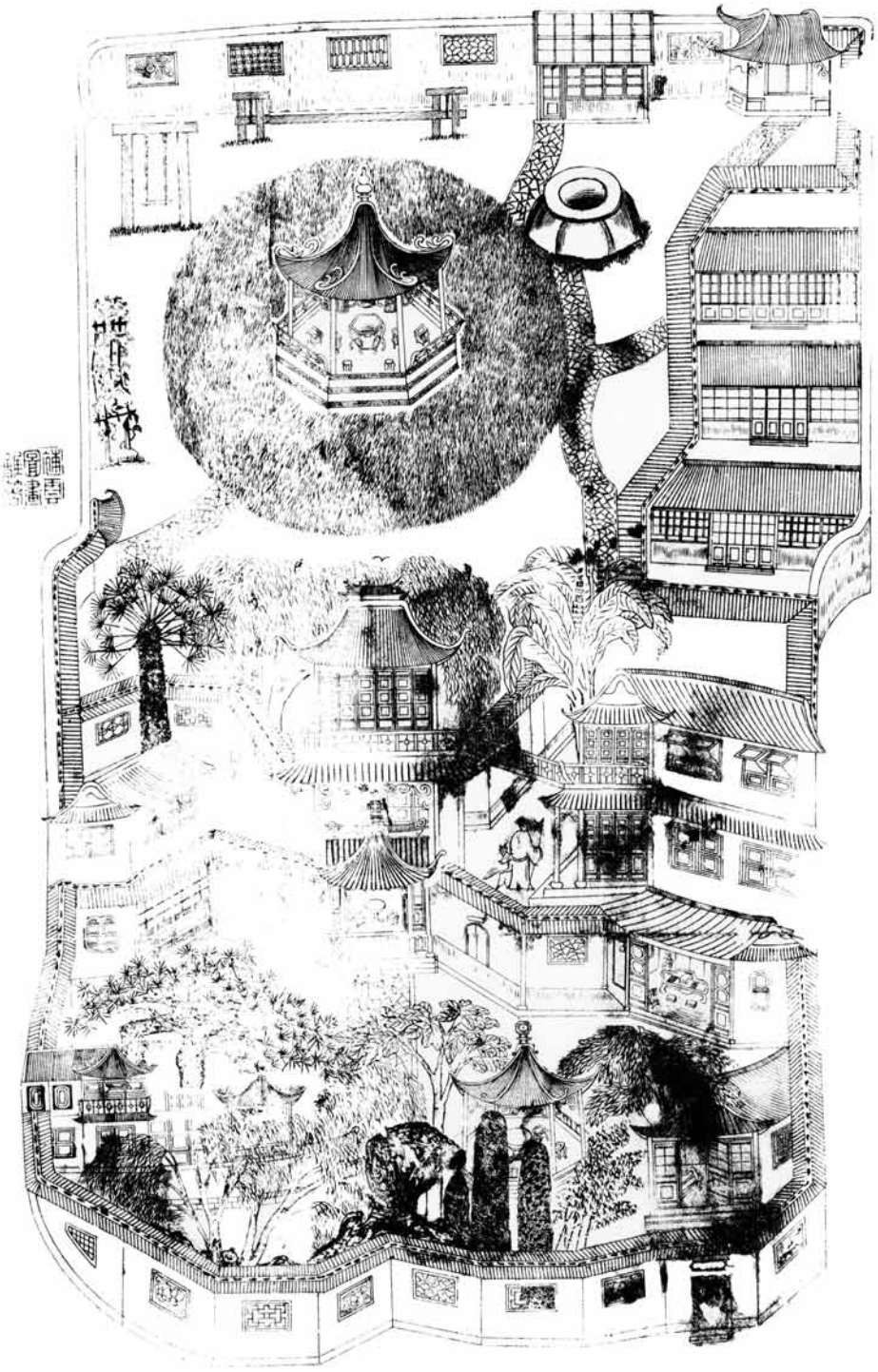


補雲小築圖

往歲率構數椽以蔽風雨雖無亭榭林竹之勝而几淨牖明容膝堪憩矣乃西泠蝕太史為顏之曰補雲小築比者息影家居爰衍其意向壁虛構綴取入圖藉當卧游自樂其樂耳至囊年所繪間架長卷徧徵題詠者則以誌繩墨所經名雖同而實則異也嗟乎人世桑滄過雲遷變孰與此幅中景物亘久無恙撫竟不勝感慨係之

太歲丙寅四月九日

養性居士補雲氏自識



The Drawing of Buyun Xiaozhu

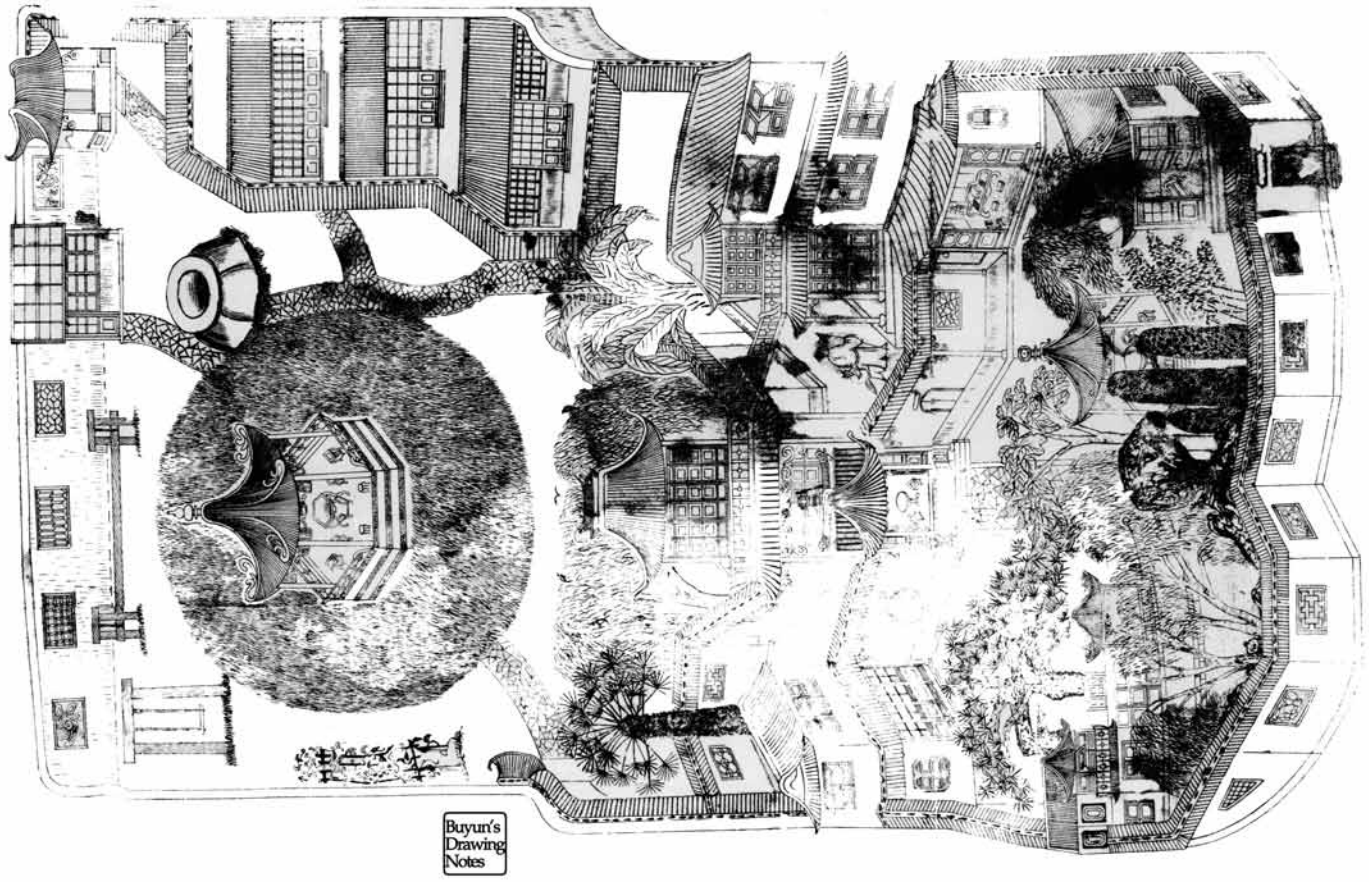
Years ago, I built a small house for myself to live in. Although without deluxe buildings and varieties of plants, it was bright and clean, and good enough for my family. My friend Xi-Li (a famous scholar), wrote a plaque for it, and named it "Buyun Xiaozhu", a simple house of Buyun.

Now I am retired and stay at home. I'm following the meaning (of the name) in drawing a house, making beautiful landscape, as a spiritual travel that I'm living inside it to please myself. I also call it Buyun Xiaozhu.

These two buildings have the same name, but different existences for different purposes.

In recent years, I have drawn long handscroll, which has several Chinese buildings' structure drawings and explanations. I drew the handscroll and this painting to record my work and my experiences of carpentry.

Oh, the world is changing so fast. In the vicissitudes of life, nothing can be protected and exist forever except the buildings in these paintings. I'm looking at the drawings and sighing with emotion.



Appendix 1
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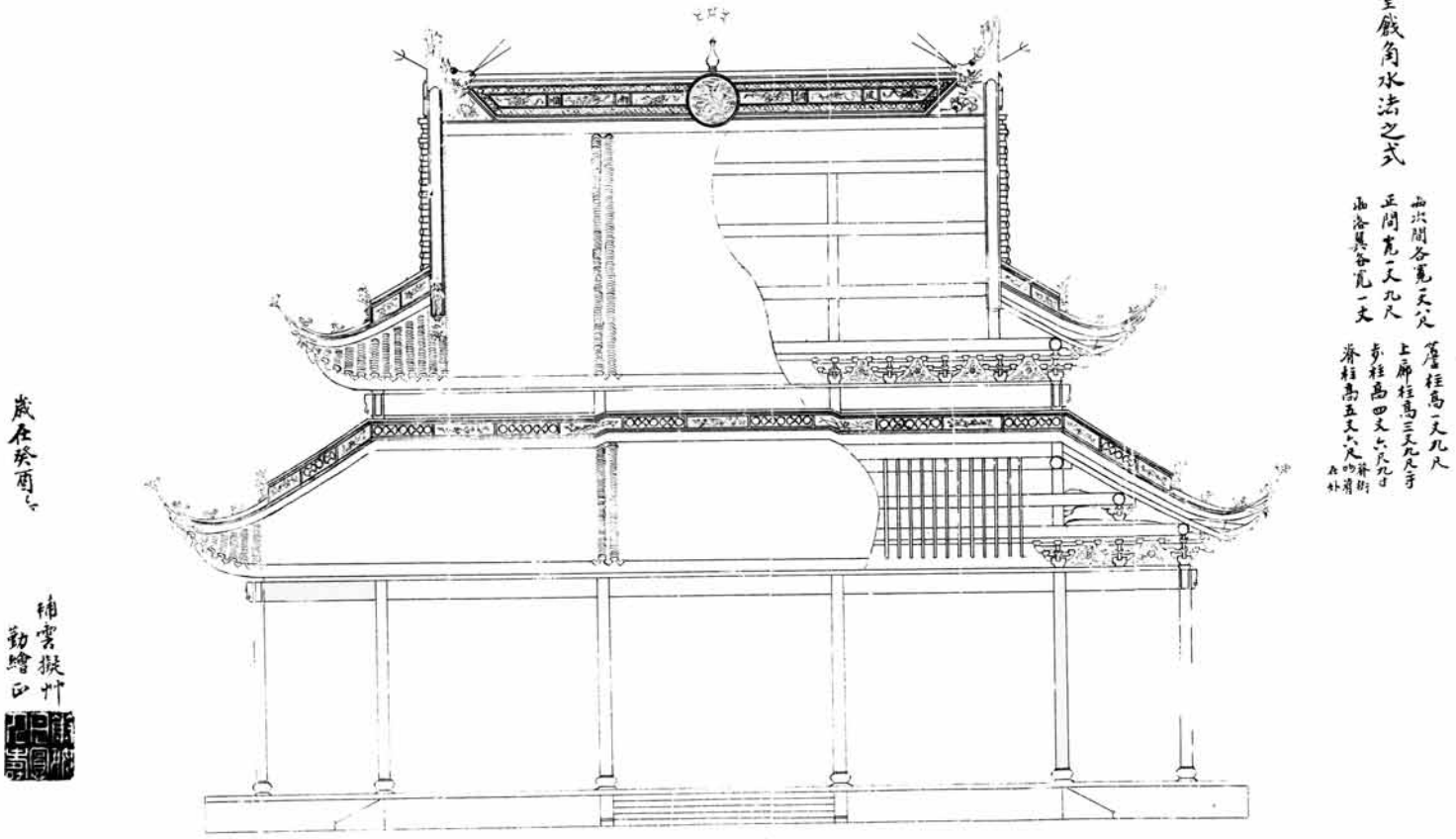
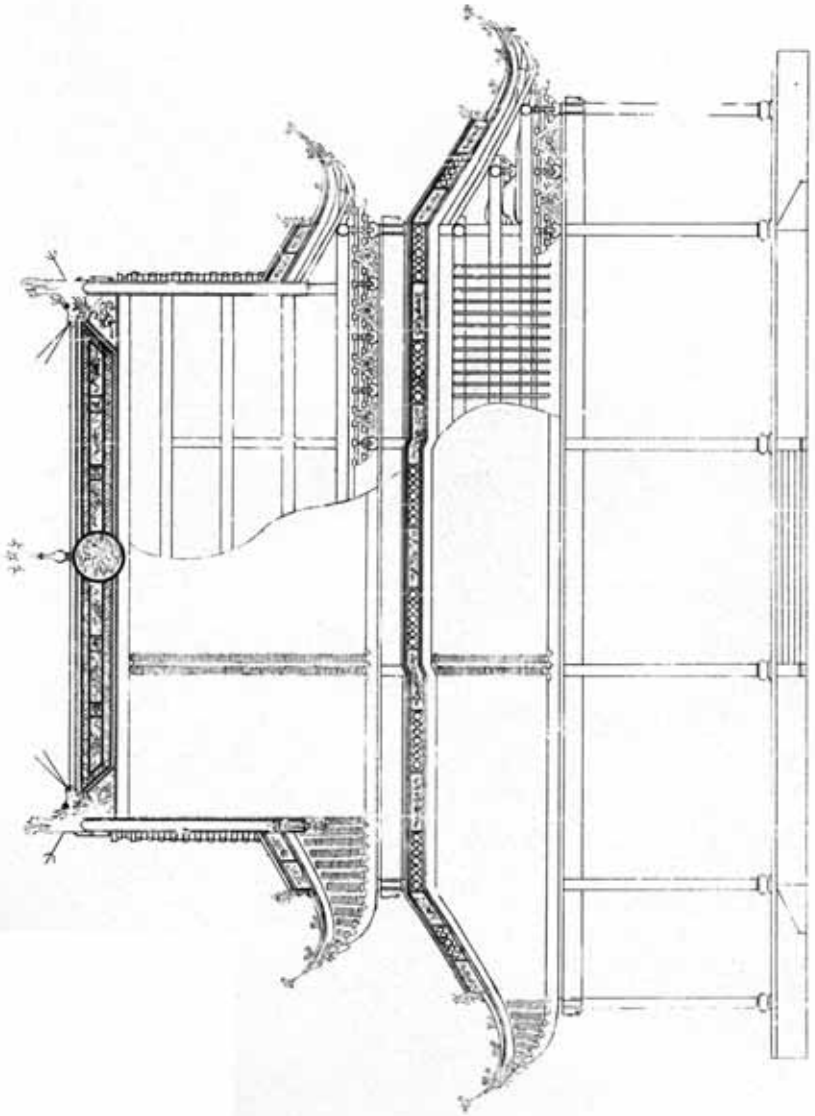


The front elevation and timber structures of double-eaved roof great hall and the style of the rising angle hips

The standard width of two sides is one *zhang* eight *chi*.
The standard width of central room is one *zhang* nine *chi*.
The standard width of two wings is one *zhang*.

The height of eave column is one *zhang* nine *chi*.
The height of upper aisle column is three *zhang* nine *chi* two *cun*.
The height of *bu* column is four *zhang* six *chi* nine *cun*.
The height of ridge column is five *zhang* six *chi* (except ridge purlin and main ridge).



In 1933 _

Sketch up by ...Ruyun
Drawn by ...Fouqin

Blooming Flowers And Full Moon With Longevity People

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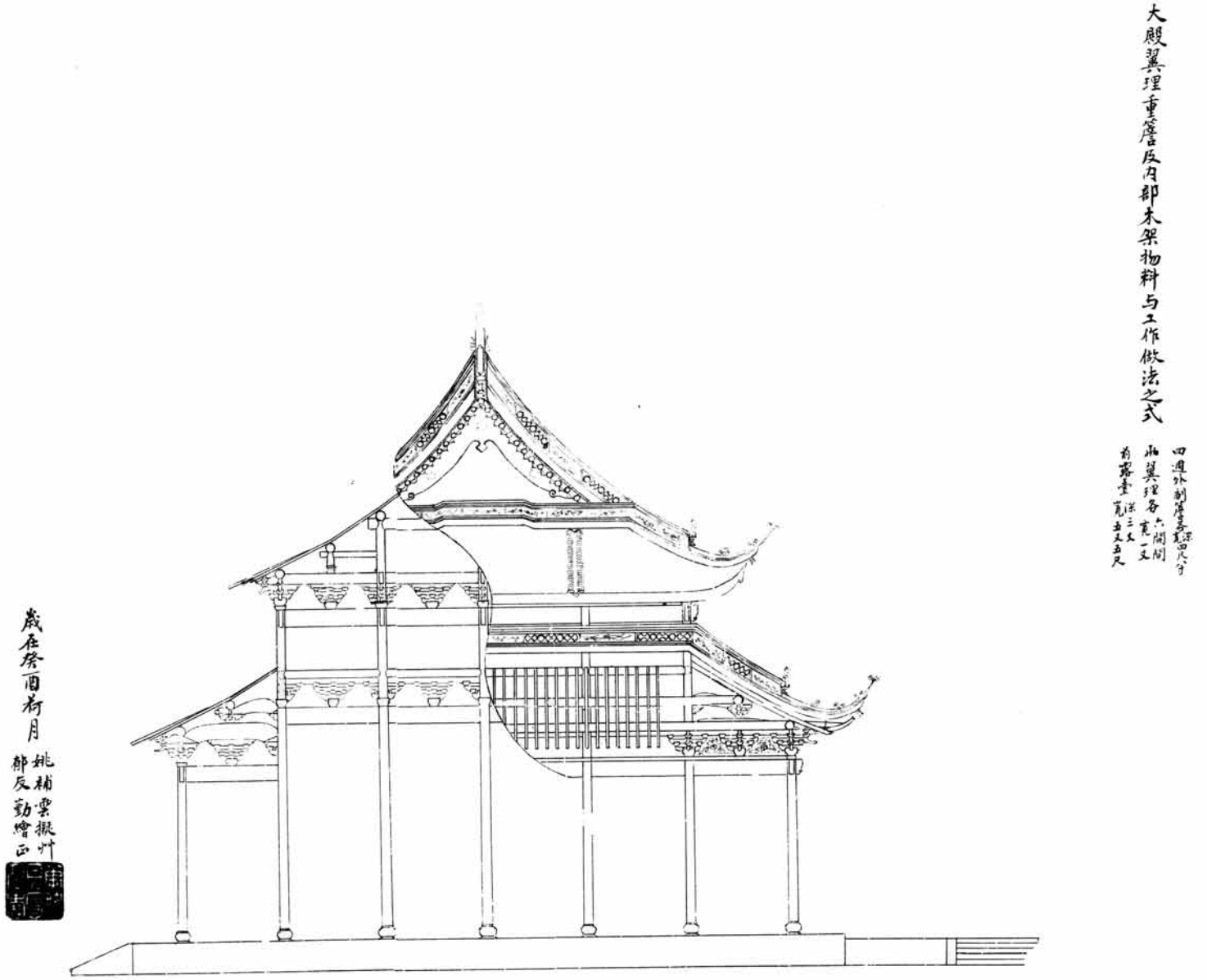
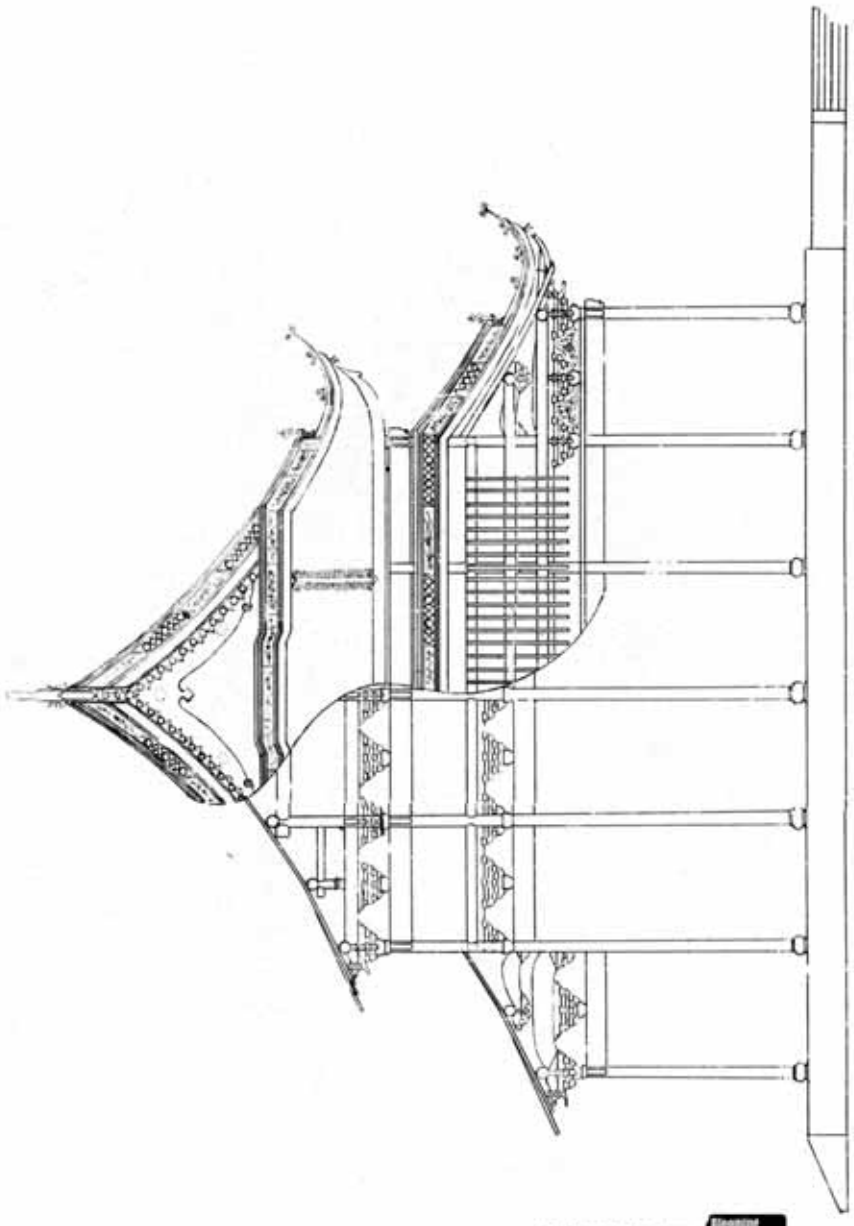


The side elevation and inner timber structures of double-eaved roof great hall and the style of materials and making

The width of deputy out-eave is four *chi* eight *cun*.
The wings have six standard widths, one *zhang* each.
The front platform is three *zhang* deep and five *zhang* five *chi* wide.



In July 1933

Sketch up by *Tao Buyun*
Drawn by *Fu Tongjin*

Blossomed Flowers And Full Moon With Longevity People

姚承祖营造法原图

（图文三十五页）

陈从周整理

同济大学建筑系刊行

同济大学印刷厂印

一九七九年十月　中国　上海

Yao Chengzu *Yingzao fayuan* tu

(Text and drawings are thirty-five pages.)

Edited by Chen Congzhou

The architecture department of Tongji University

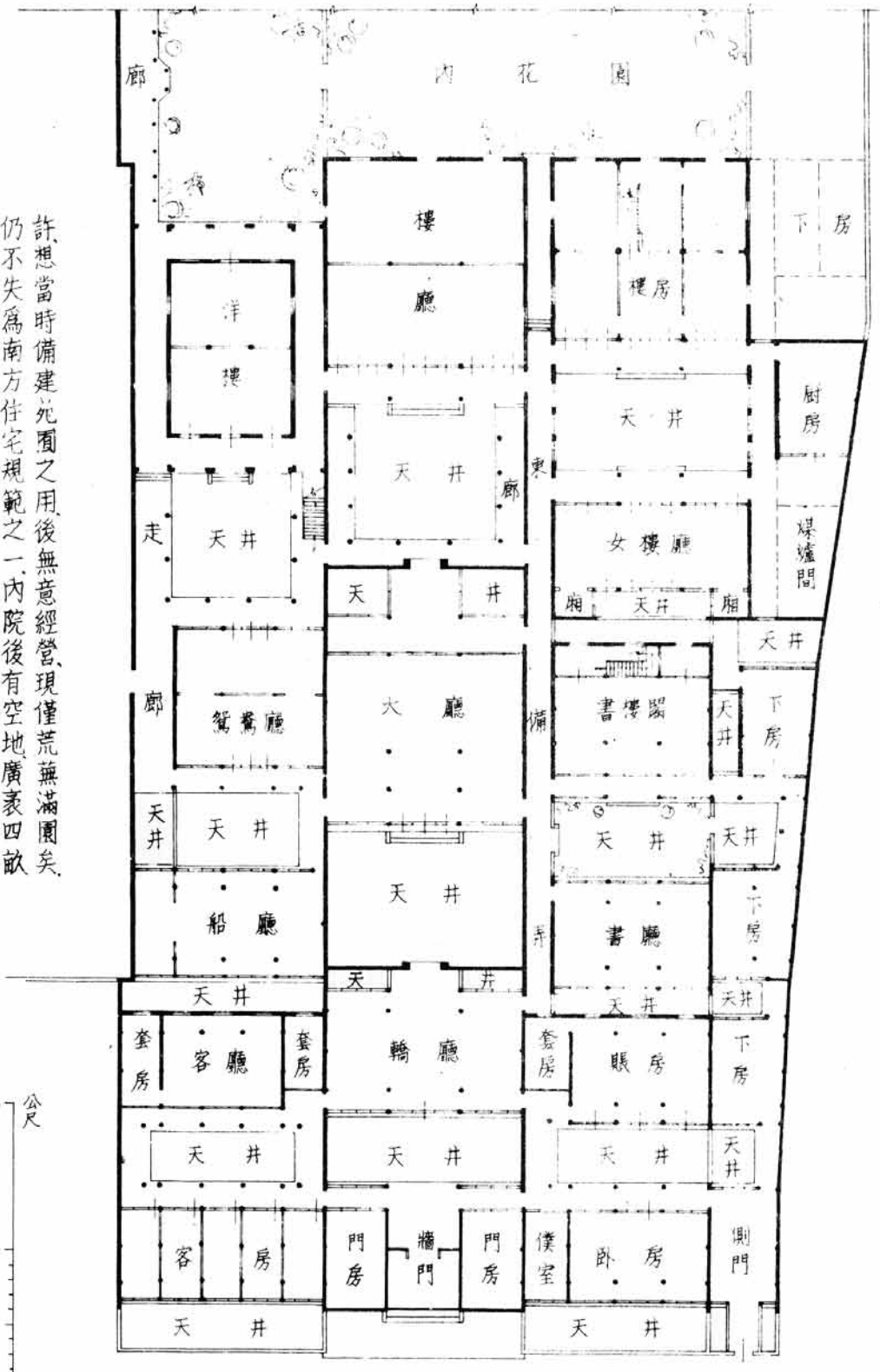
Print by the Press of Tongji University

Oct. 1979, China, Shanghai

The Plates of *Yingzao fayuan*

(Translation of the contrast parts)

營造法原图版 一



說明：

許、想當時備建死覆之用、後無意經營、現僅荒蕪滿園矣、仍不失爲南方住宅規範之一、內院後有空地、廣袤四畝、結構裝修、悉依中式、大廳以北、雖參酌西式、但平面佈置照牆之內、闢廣場爲停車馬之所、大廳以南、其平面佈置、留園東宅清末盛氏所有、擬作別墅之用、南向、牆門以外、

住宅平面佈置圖

（蘇州留園東宅）

Explication: The East Mansion of Lingering Garden in Suzhou belonged to Sheng's family in the Guangxu Period of the Qing Dynasty (1875 - 1908). Sheng made alterations and additions to his family house from 1873 to 1876, after his retirement. On the south, outside the main gate and within the screen-wall, there was a square for parking. Inside the mansion, south of main hall, were Chinese traditional style buildings; while north of the main hall, it was a mixture of Chinese and Western style. Even in the western style part, the plan of buildings followed a type belonging to south China. Inside the walls, there was a square plot of 2668 square metres intended for a garden, but the work was not completed. Now it is all deserted.

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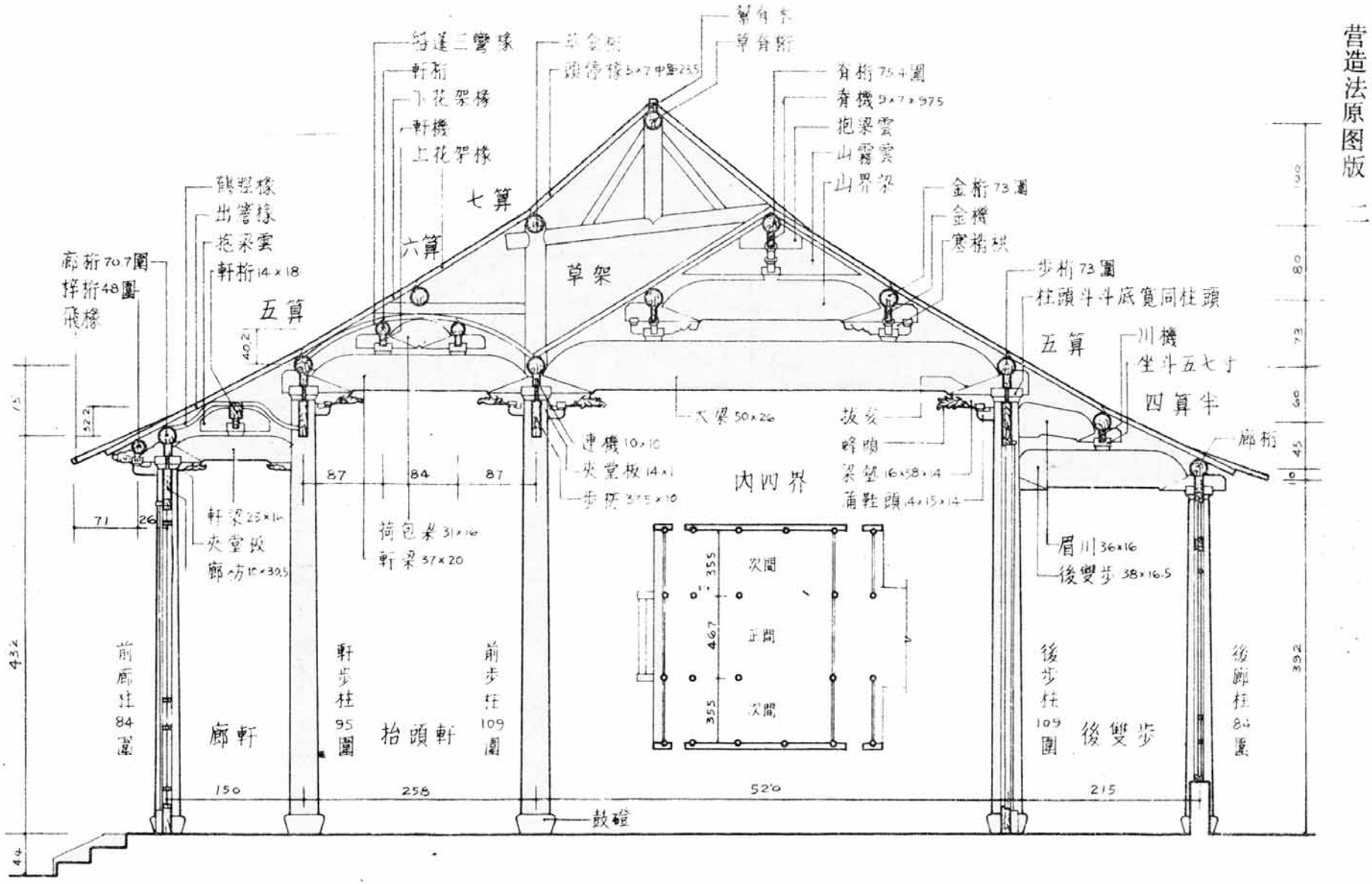
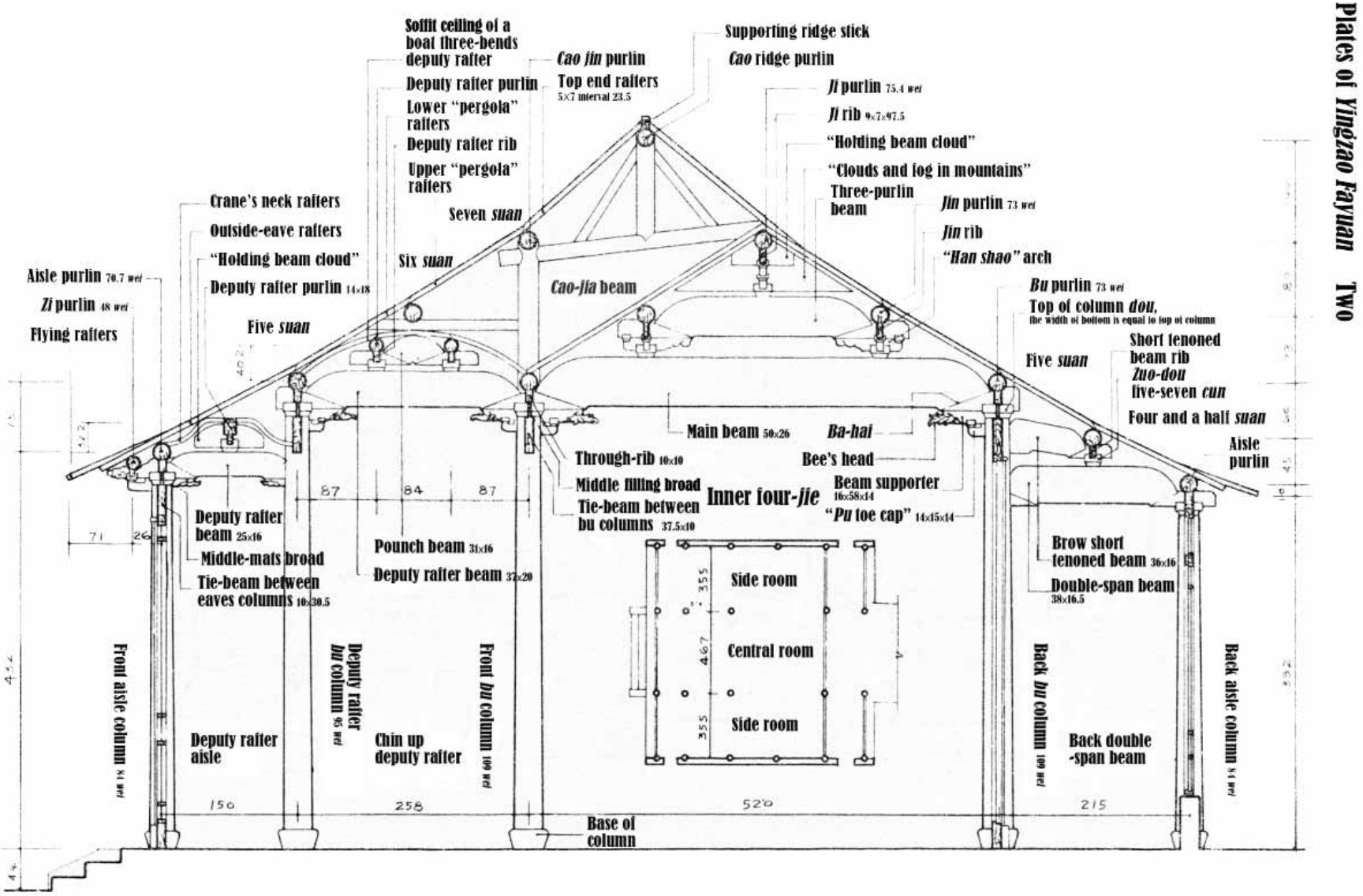


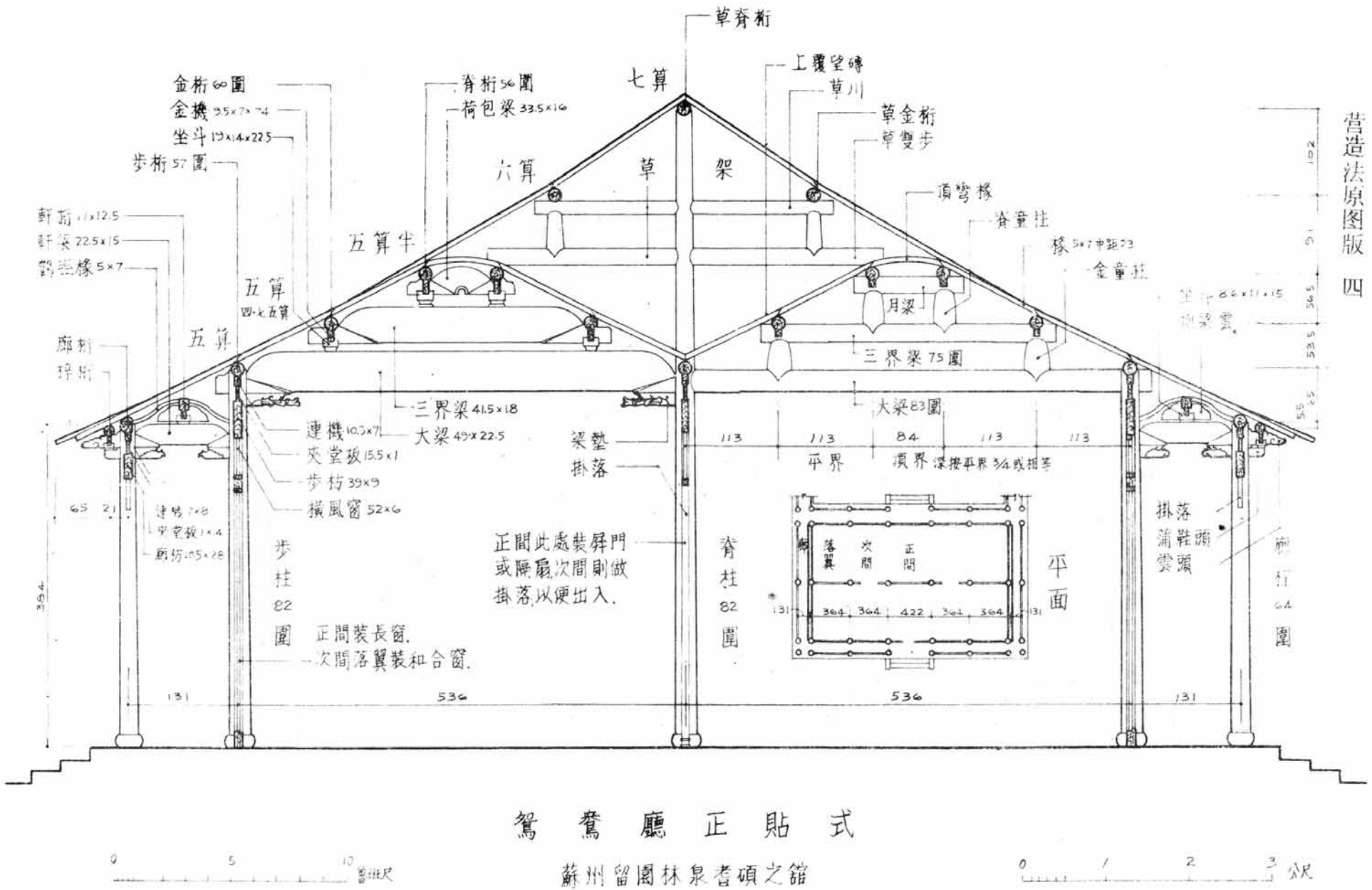


The central section of the *bian-zuo* hall with the chin up deputy rafter
(The Ren residence, Suzhou)

Scale of the plan
0 5 10 Metre

0 1 2 3 Metre
0 1 5 10 Lu Ban Chi

Appendix 1
The illustration: The *Yingzao fayuan* original drawings and modern drawings

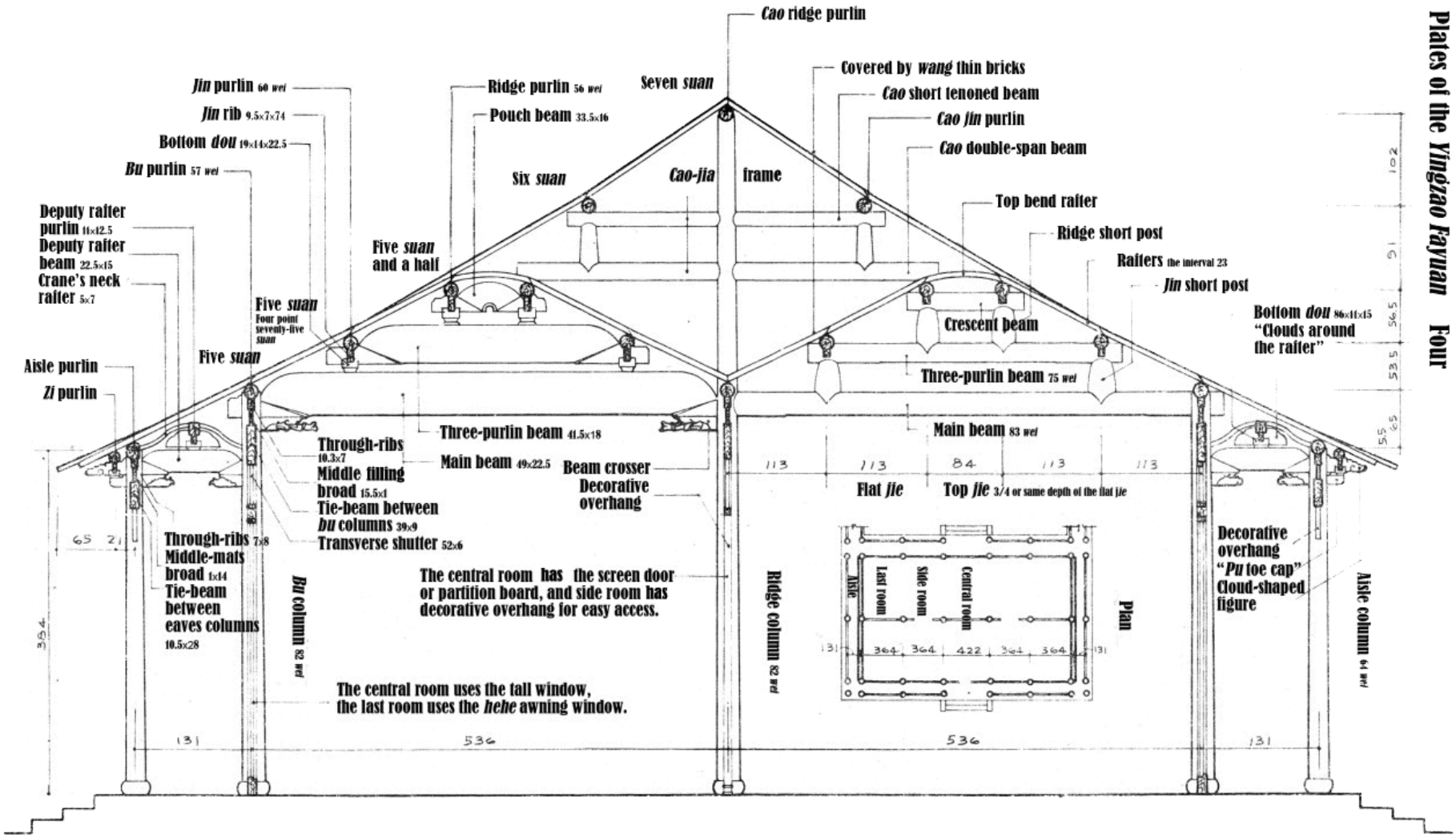


鴛鴦廳正貼式

蘇州留園林泉耆碩之館

0 5 10 營造尺

0 1 2 3 公尺



The central section of mandarin duck style hall

0 5 10 Lu Ban Chi **The "Old Hermit Scholars' House", Lingering Garden, Suzhou** 0 1 2 3 Metre

Appendix 1
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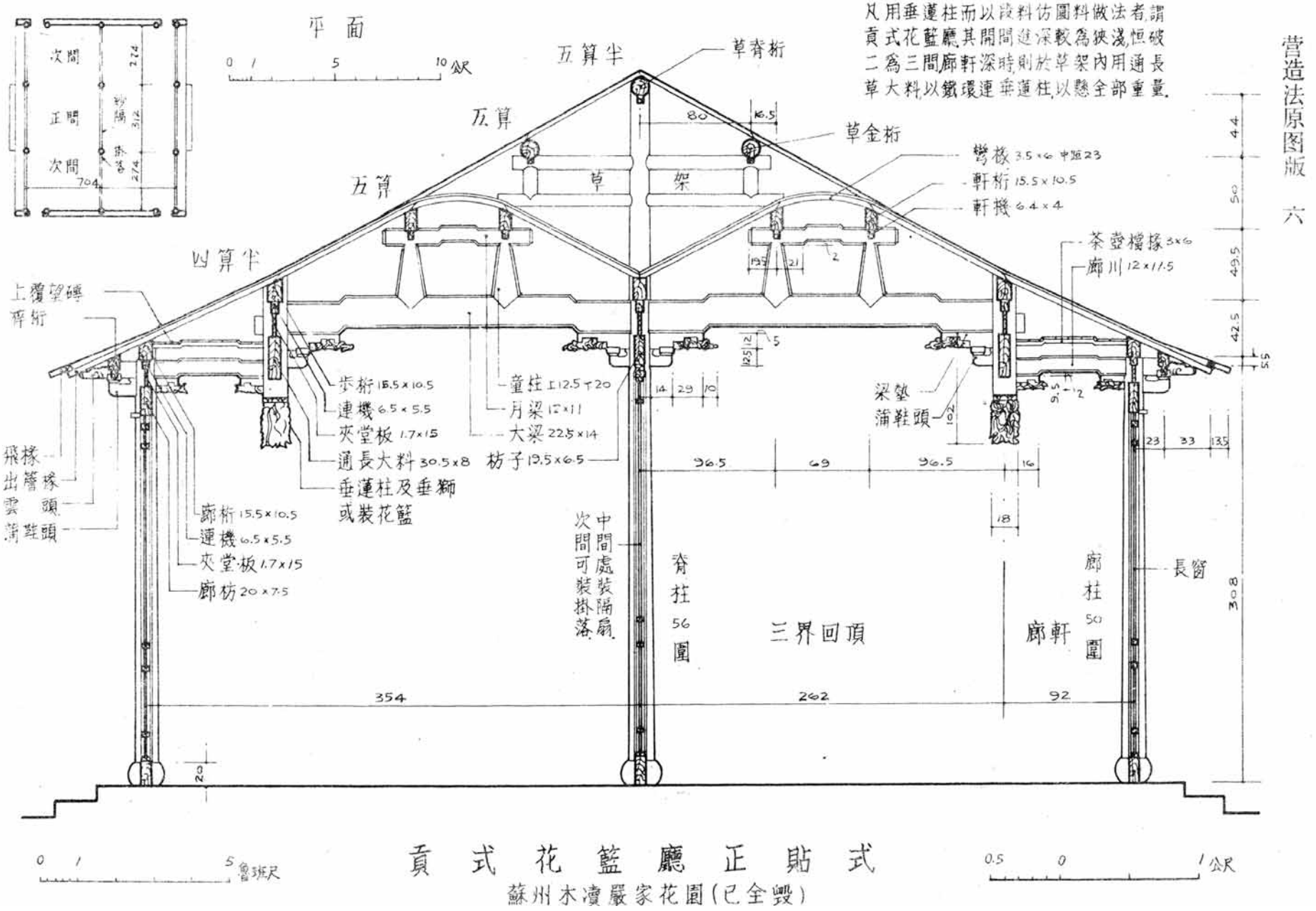
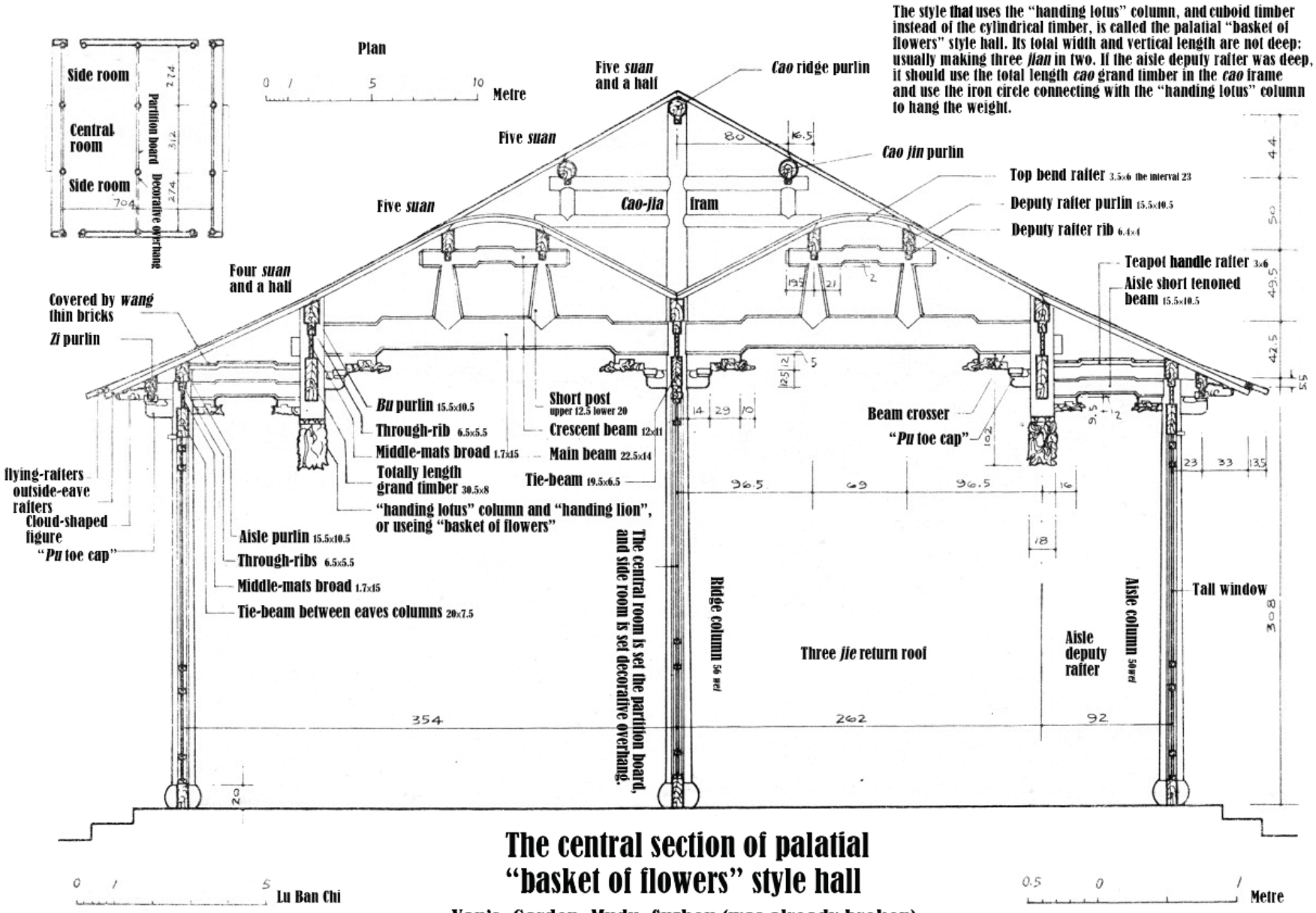
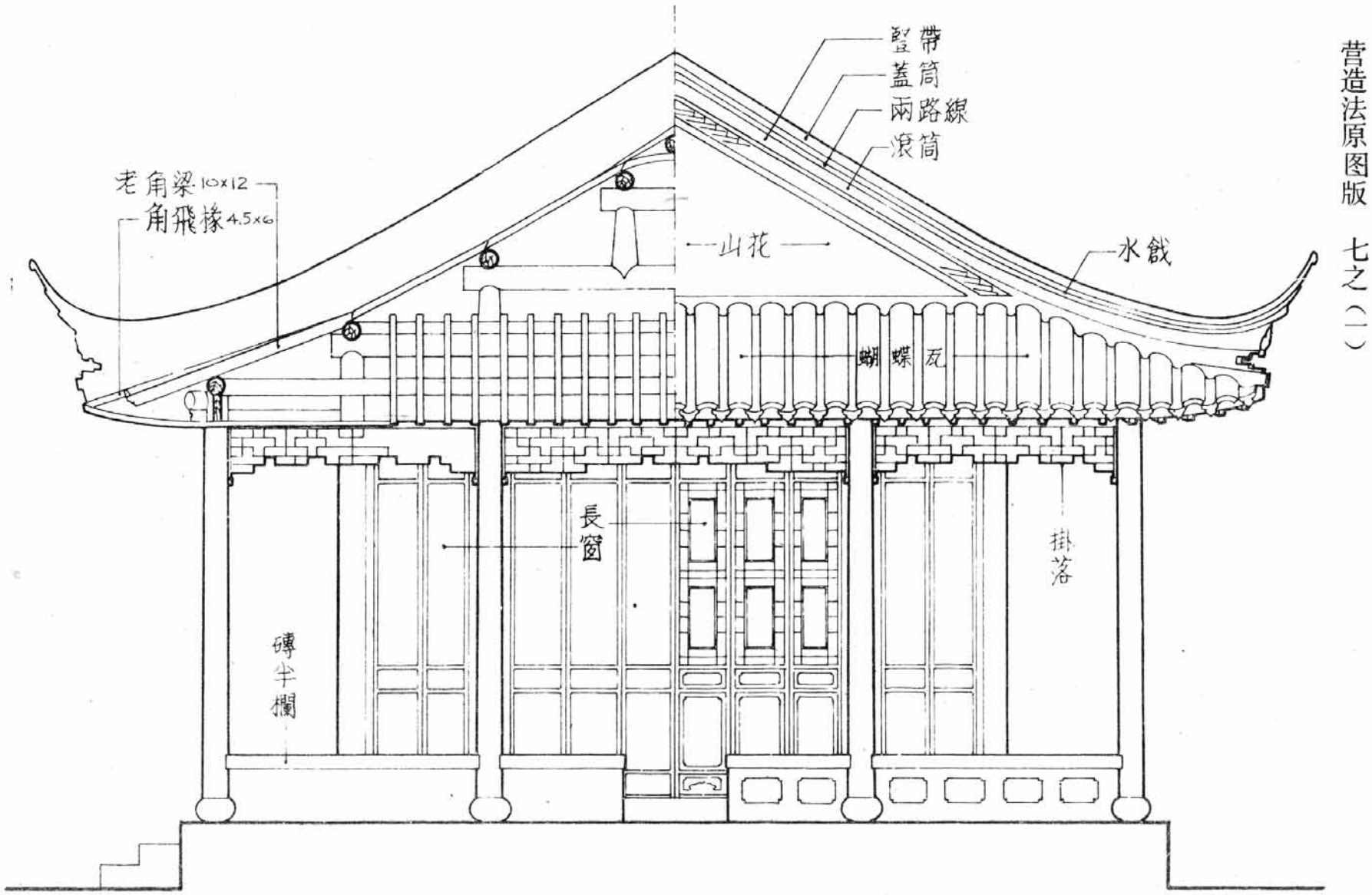


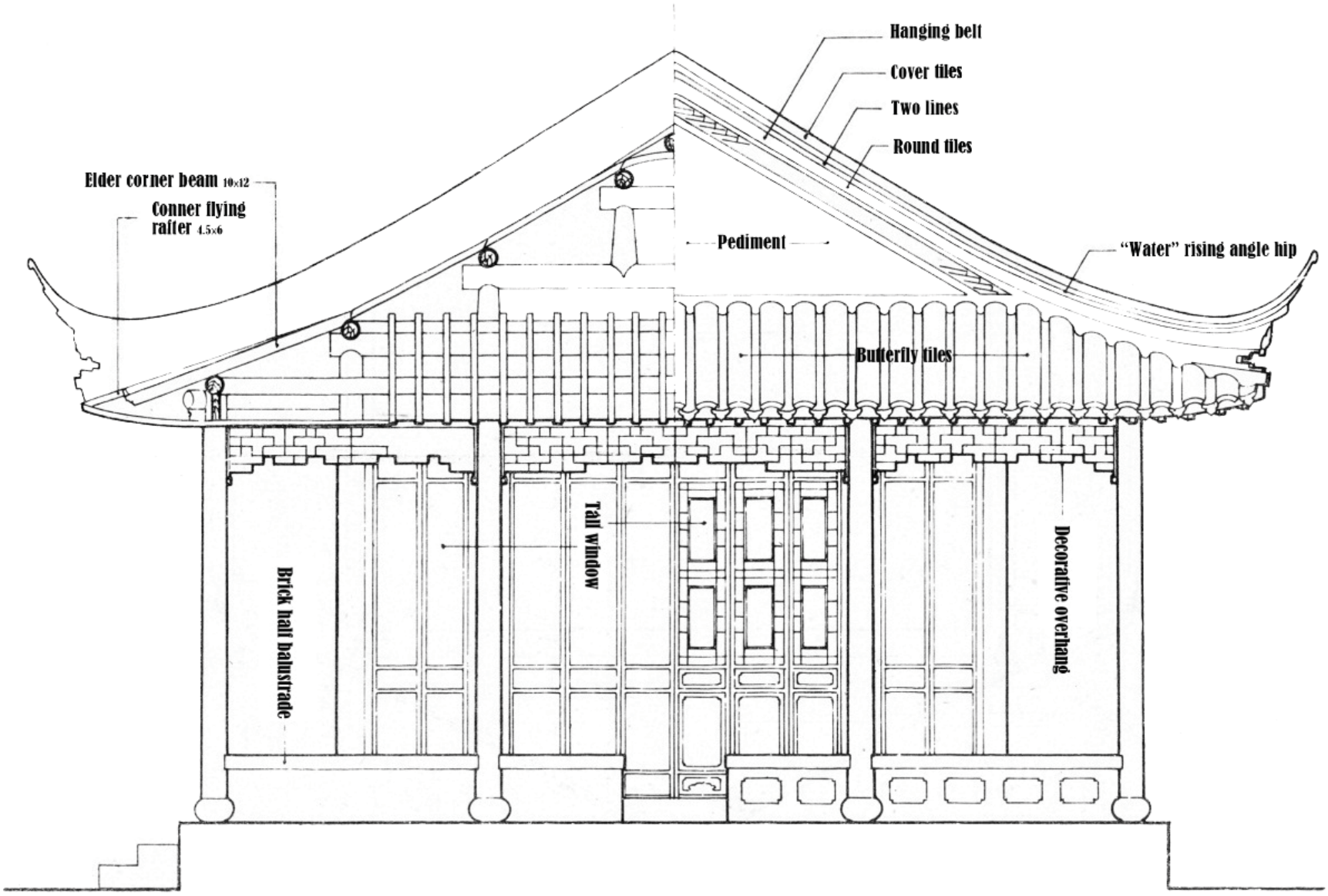


The style that uses the "handing lotus" column, and cuboid timber instead of the cylindrical timber, is called the palatial "basket of flowers" style hall. Its total width and vertical length are not deep: usually making three *jian* in two. If the aisle deputy rafter was deep, it should use the total length *cao* grand timber in the *cao* frame and use the iron circle connecting with the "handing lotus" column to hang the weight.

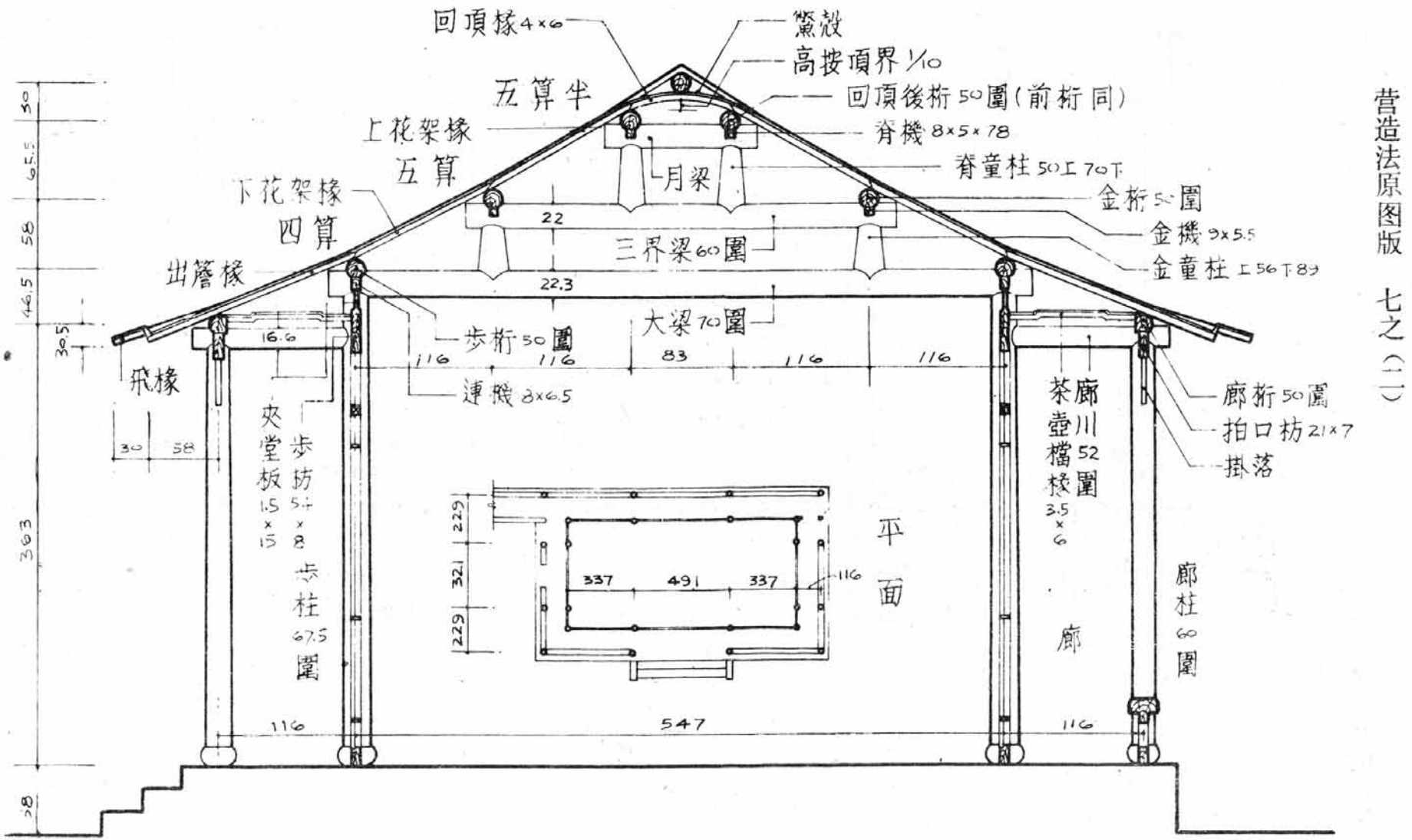
The central section of palatial "basket of flowers" style hall

Yan's Garden, Mudu, Suzhou (was already broken)


營造法原图版 七之(一)
壓帶
蓋筒
兩路線
滾筒
老角梁 10×12
角飛椽 4.5×6
山花
水戧
蝴蝶瓦
長窗
掛落
磚半欄



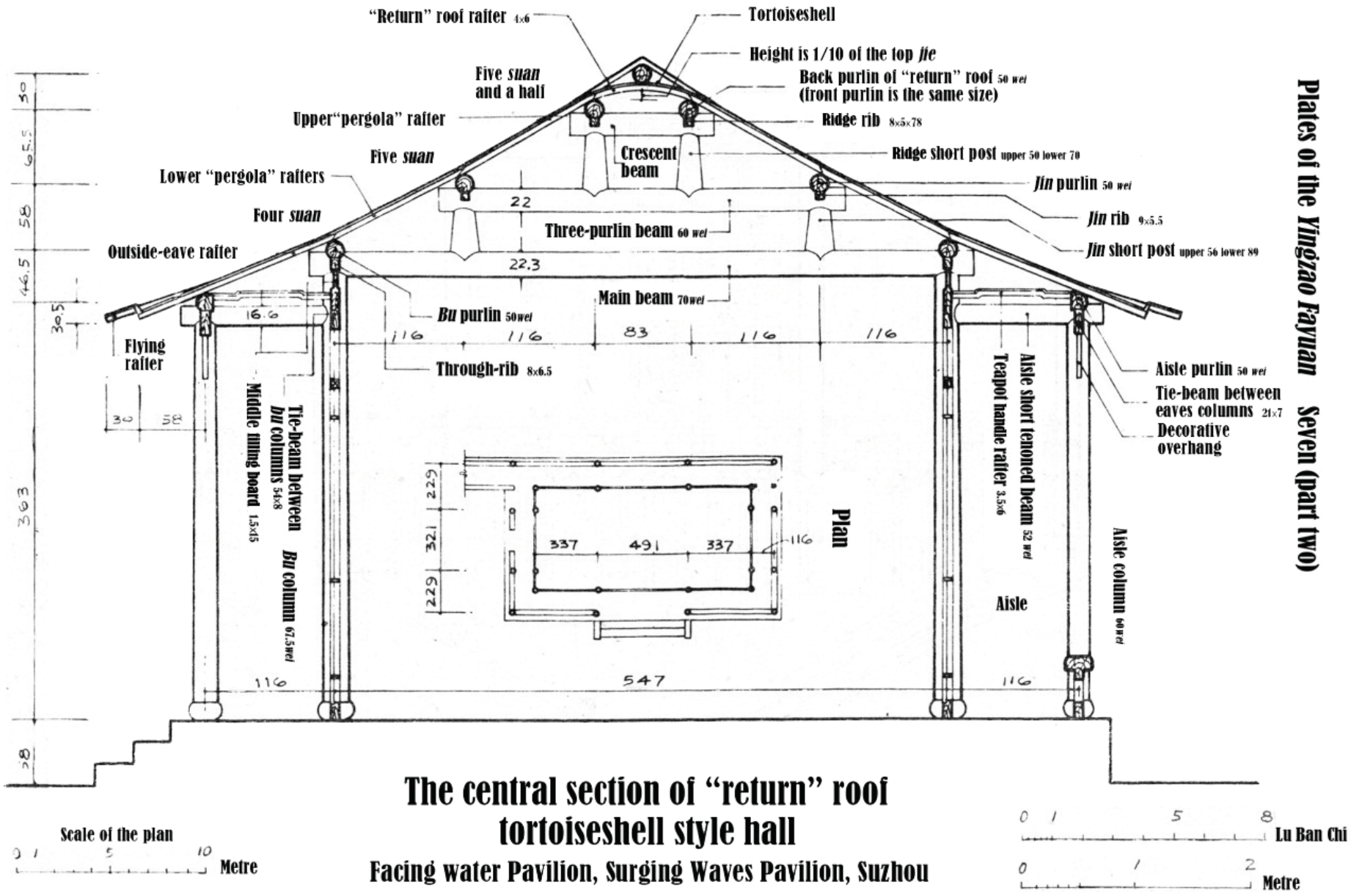
Plates of the *Yingzao Fayuan* Seven (part one)

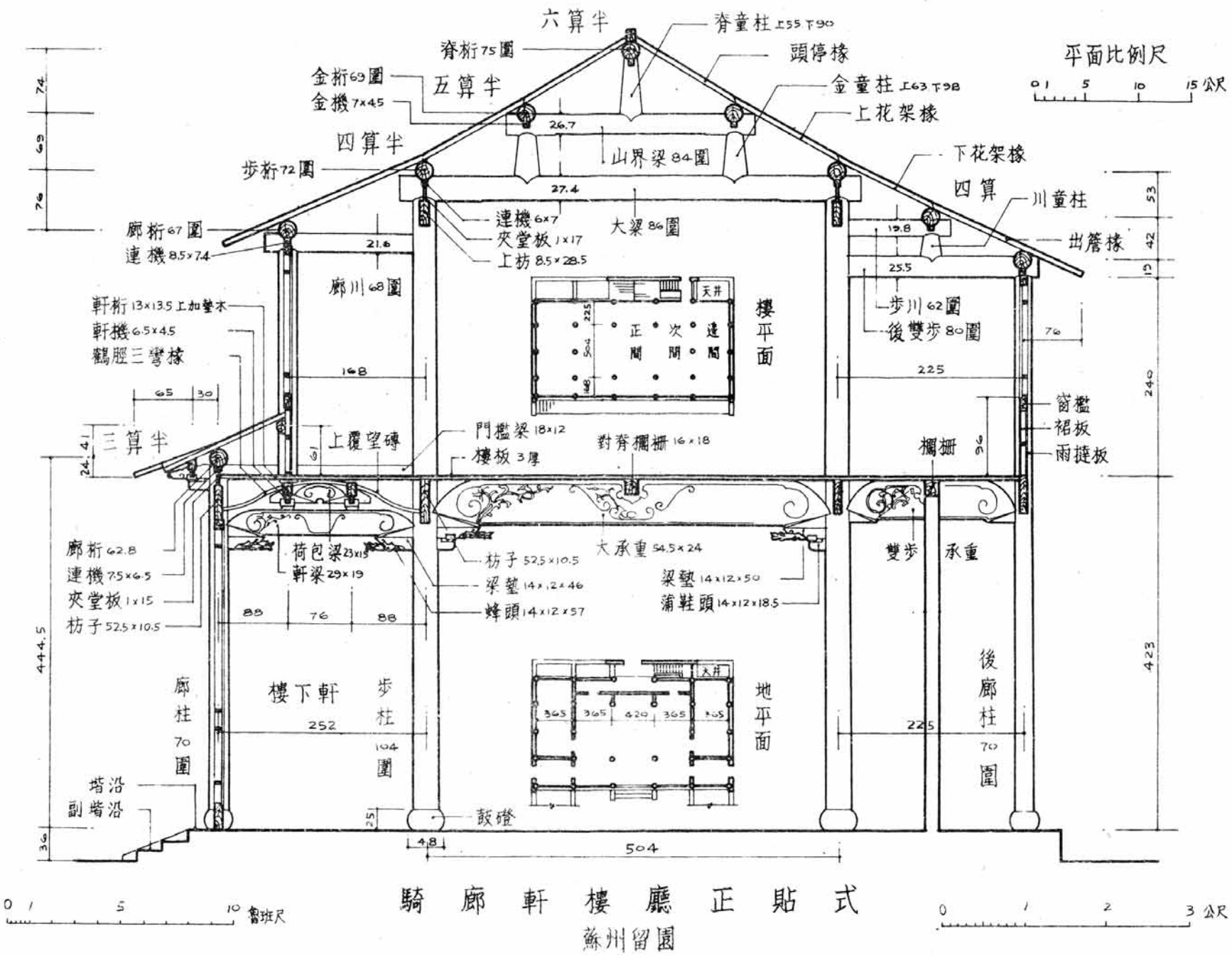


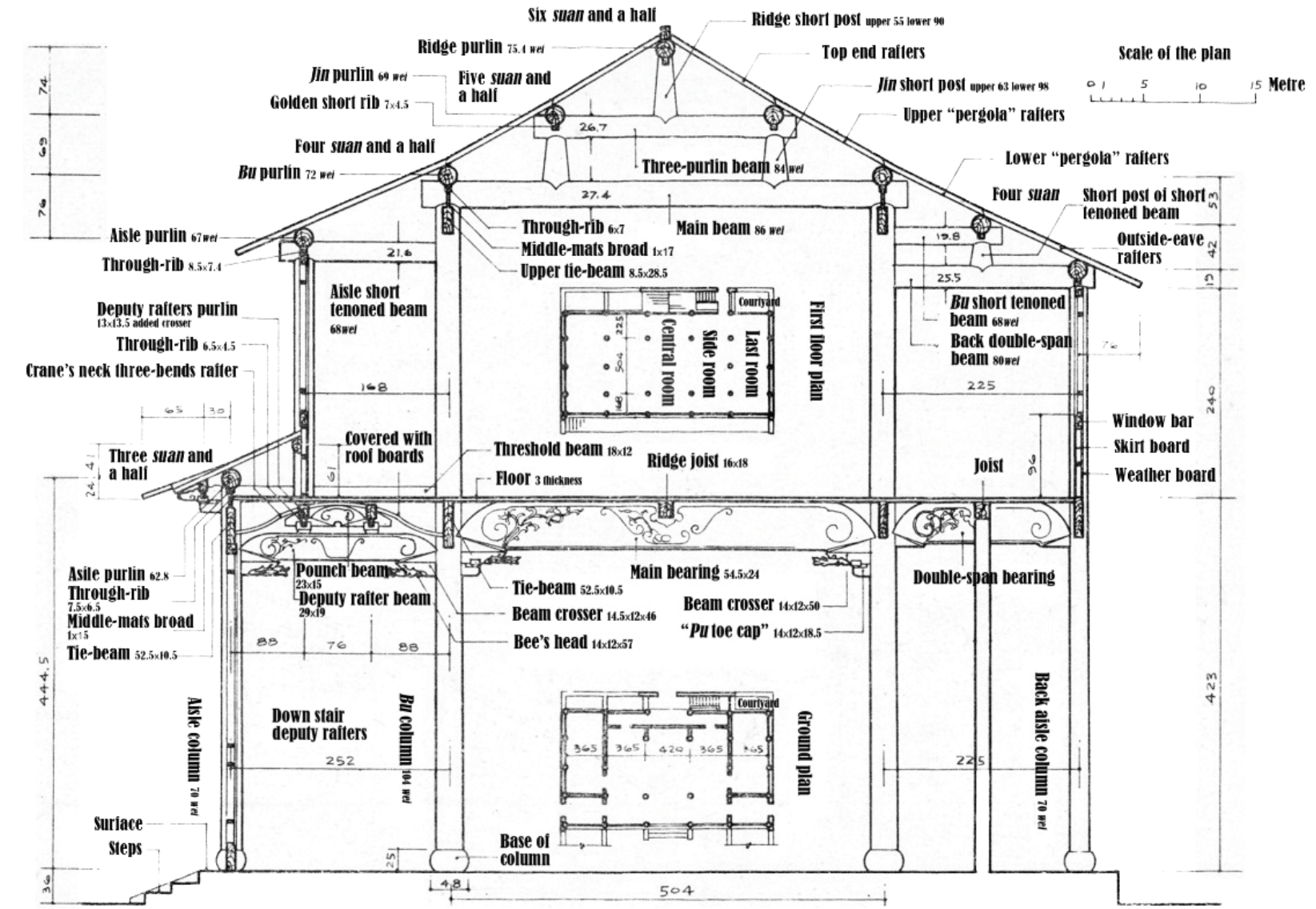
营造法原图版 七之(二)

回頂簷殼正貼式

蘇州滄浪亭面水軒


"Return" roof rafter 4x6
Tortoiseshell
Height is 1/10 of the top *jie*
Five *suan* and a half
Back purlin of "return" roof 50 *wei* (front purlin is the same size)
Upper"pergola" rafter
Ridge rib 8x5x78
Five *suan*
Crescent beam
Ridge short post upper 50 lower 70
Lower "pergola" rafters
Jin purlin 50 *wei*
Four *suan*
22
Jin rib 9x5.5
Three-purlin beam 60 *wei*
Outside-eave rafter
Jin short post upper 56 lower 89
22.3
Main beam 70 *wei*
Bu purlin 50 *wei*
16.6
116
116
83
116
116
Flying rafter
Through-rib 8x6.5
Aisle purlin 50 *wei*
Tie-beam between eaves columns 21x7
Decorative overhang
Teapot handle rafter 3.5x6
Aisle short tenoned beam 52 *wei*
Middle tiling board 1.5x45
Tie-beam between *Bu* columns 54x8
Bu column 67.5 *wei*
Aisle column 60 *wei*
Plan
337
491
337
116
229
321
229
Aisle
547
116
116
30
58
30
65.5
58
46.5
30.5
363
28
Plates of the *Yingzao Fayuan* Seven (part two)
The central section of "return" roof tortoiseshell style hall
Facing water Pavilion, Surging Waves Pavilion, Suzhou
Scale of the plan
0 1 5 10
Metre
0 1 5 8
Lu Ban Chi
0 1 2
Metre

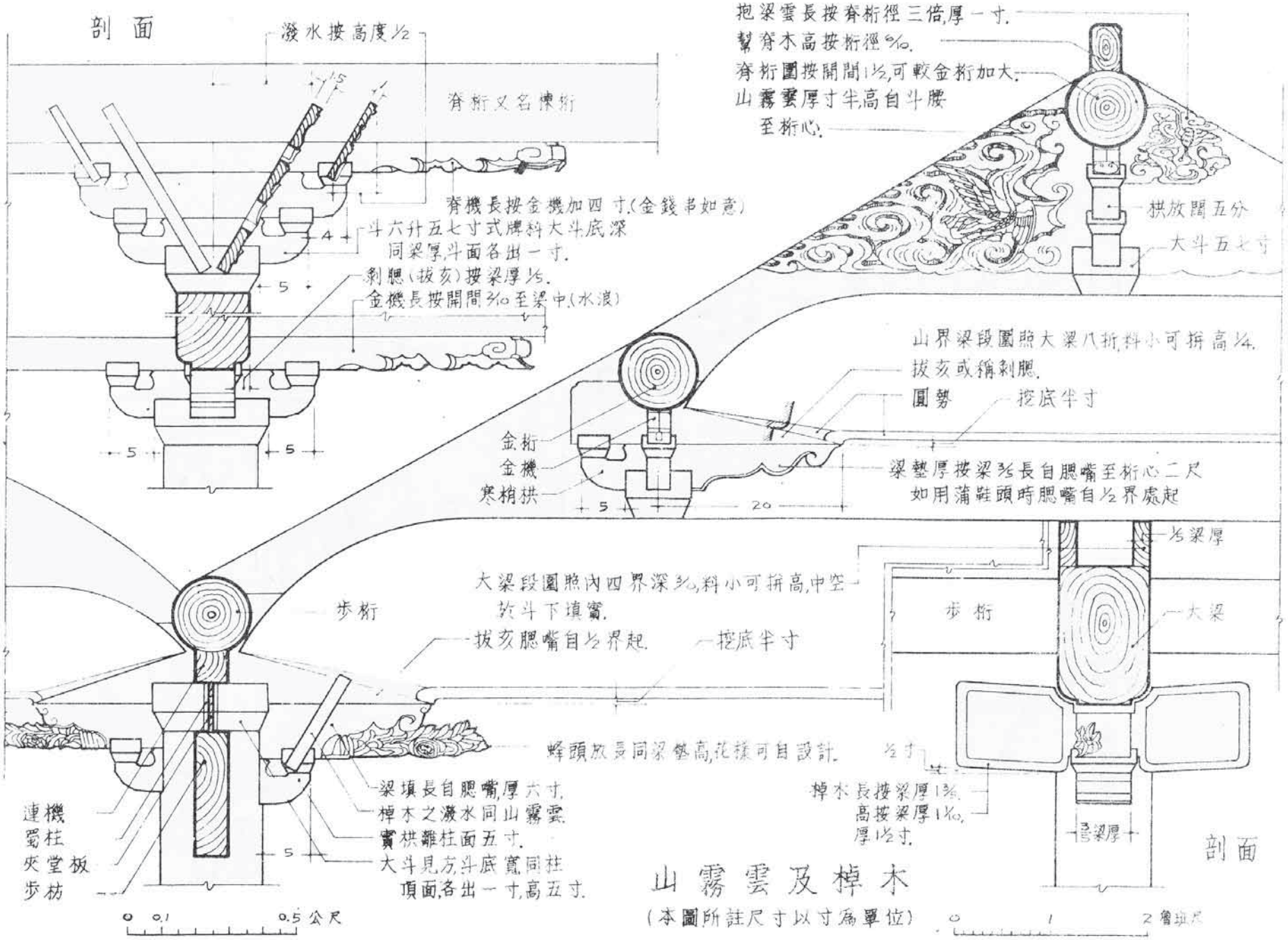

營造法 图版 九
180
六算半
脊童柱 上55 下90
脊桁 75 圓
頭停椽
平面比例尺
0 1 5 10 15 公尺
金桁 69 圓
五算半
金機 7×4.5
金童柱 上63 下98
上花架椽
四算半
山界梁 84 圓
下花架椽
步桁 72 圓
四算
川童柱
廊桁 67 圓
連機 8.5×7.4
連機 6×7
夾堂板 1×17
上枋 8.5×28.5
大梁 86 圓
出簷椽
廊川 68 圓
步川 62 圓
後雙步 80 圓
軒桁 13×13.5 上加墊木
軒機 6.5×4.5
鶴脛三彎椽
樓平面
天井
正間
次間
連間
三算半
上覆望磚
門檻梁 18×12
樓板 3 厚
對脊欄柵 16×18
欄柵
窗檻
裙板
雨搥板
廊桁 62.8
連機 7.5×6.5
夾堂板 1×15
枋子 52.5×10.5
荷包梁 23×15
軒梁 29×19
枋子 52.5×10.5
梁墊 14×12×46
蜂頭 14×12×57
大承重 54.5×24
梁墊 14×12×50
蒲鞋頭 14×12×18.5
雙步
承重
樓下軒
廊柱 70 圓
步柱 104 圓
後廊柱 70 圓
地平面
大井
塔沿
副塔沿
鼓磴
504
騎廊軒樓廳正貼式
蘇州留園
0 1 5 10 魯班尺
0 1 2 3 公尺

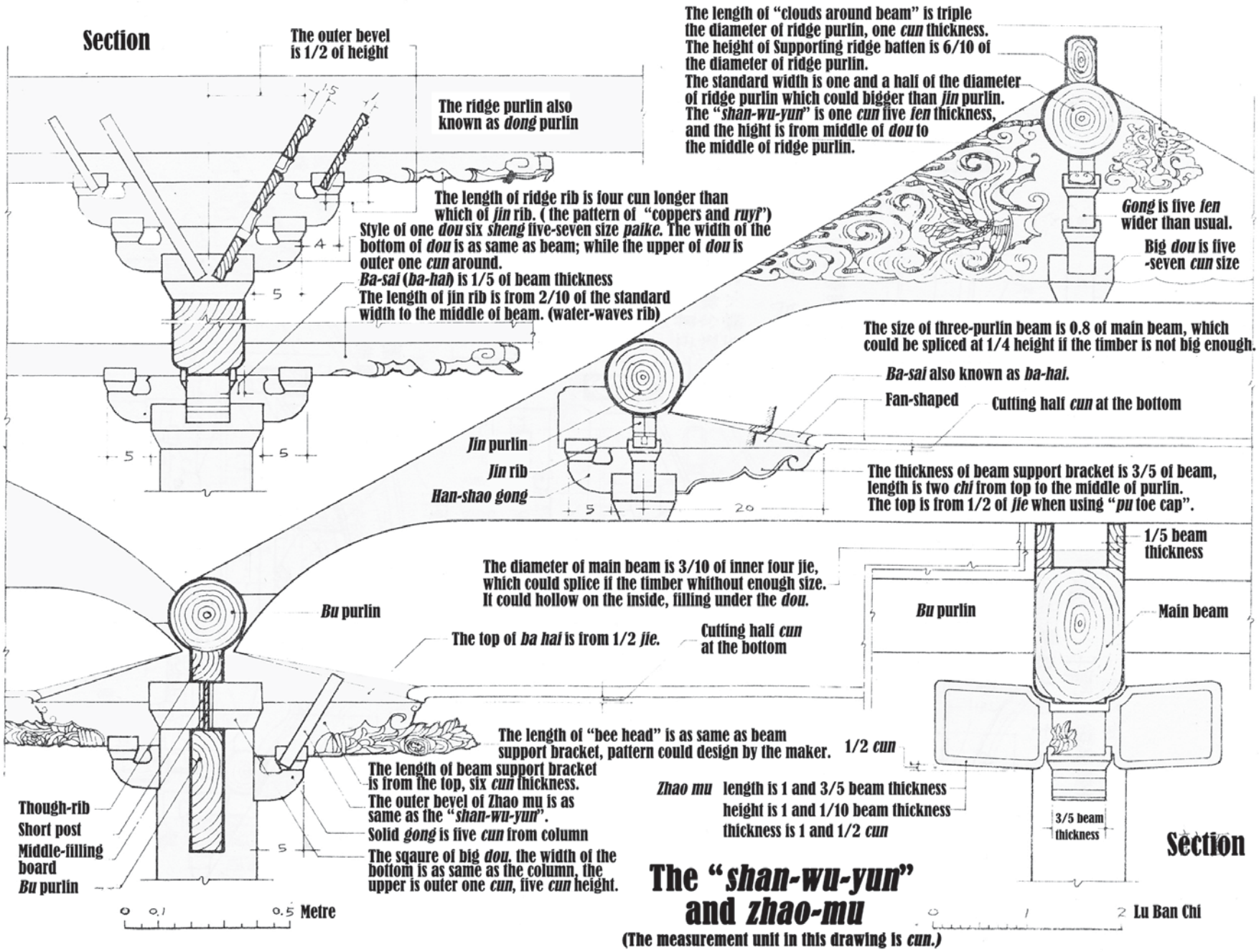


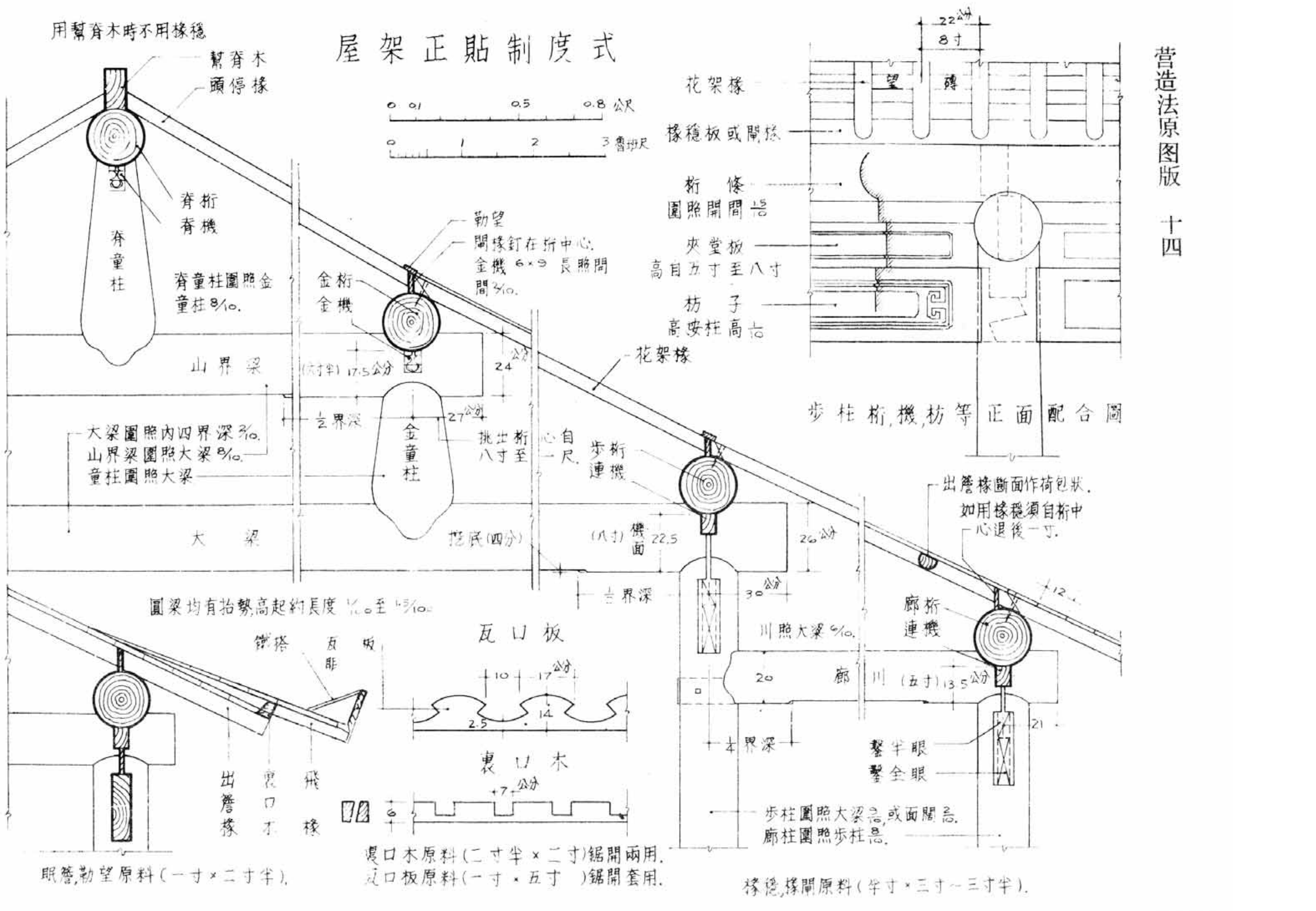
The central section of riding gallery

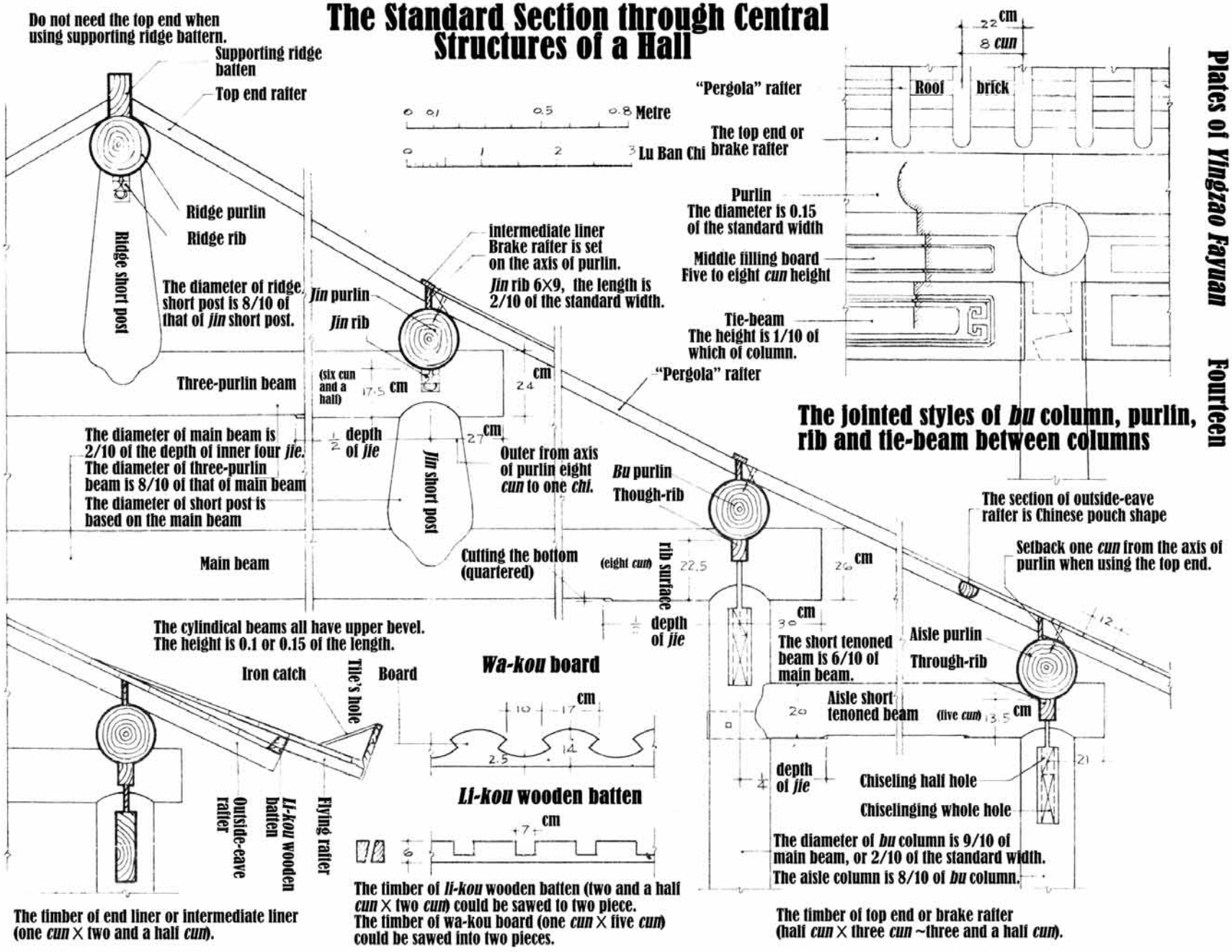
Lingering Garden, Suzhou

Appendix 1
The illustration: The *Yingzao fayuan* original drawings and modern drawings

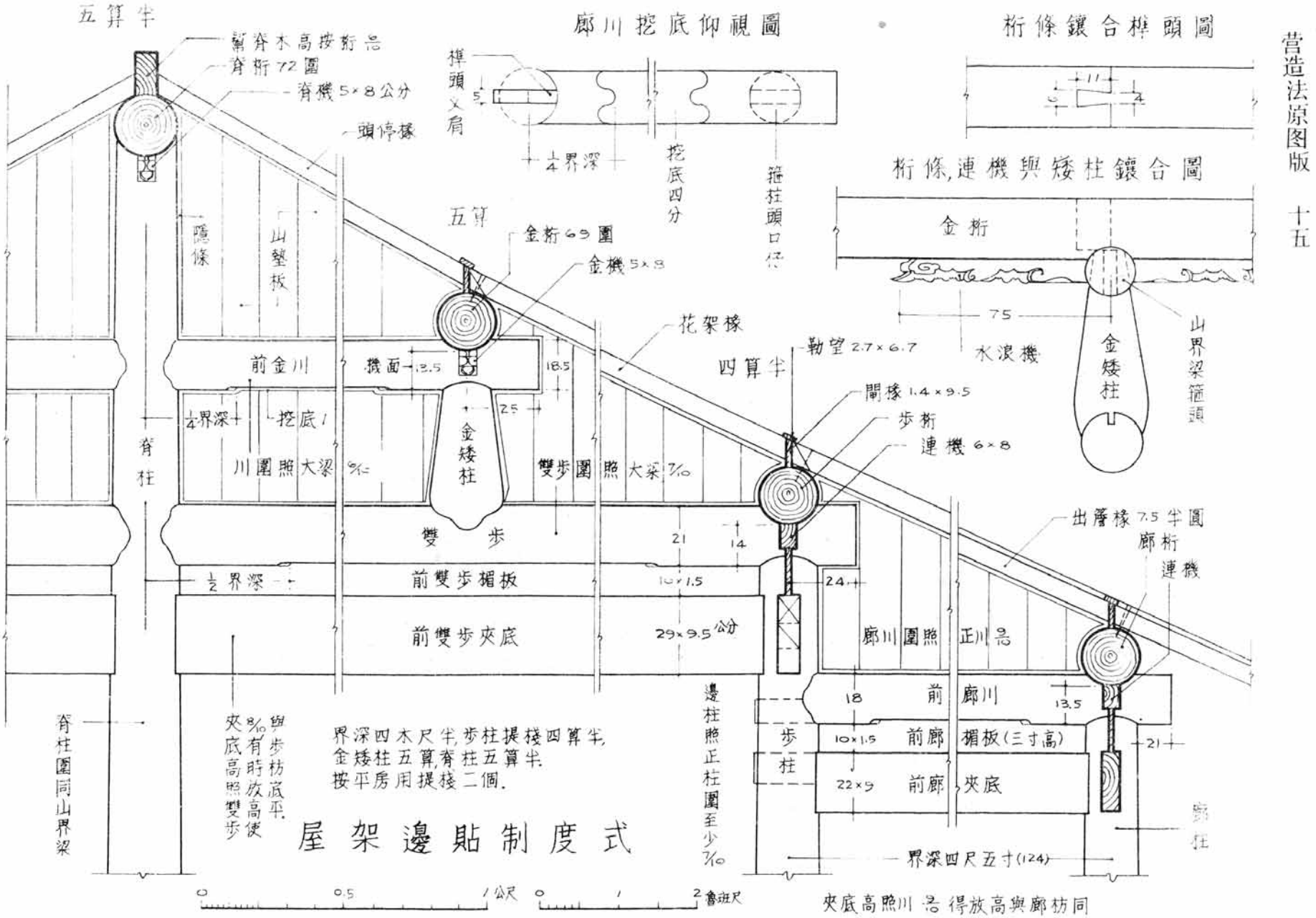


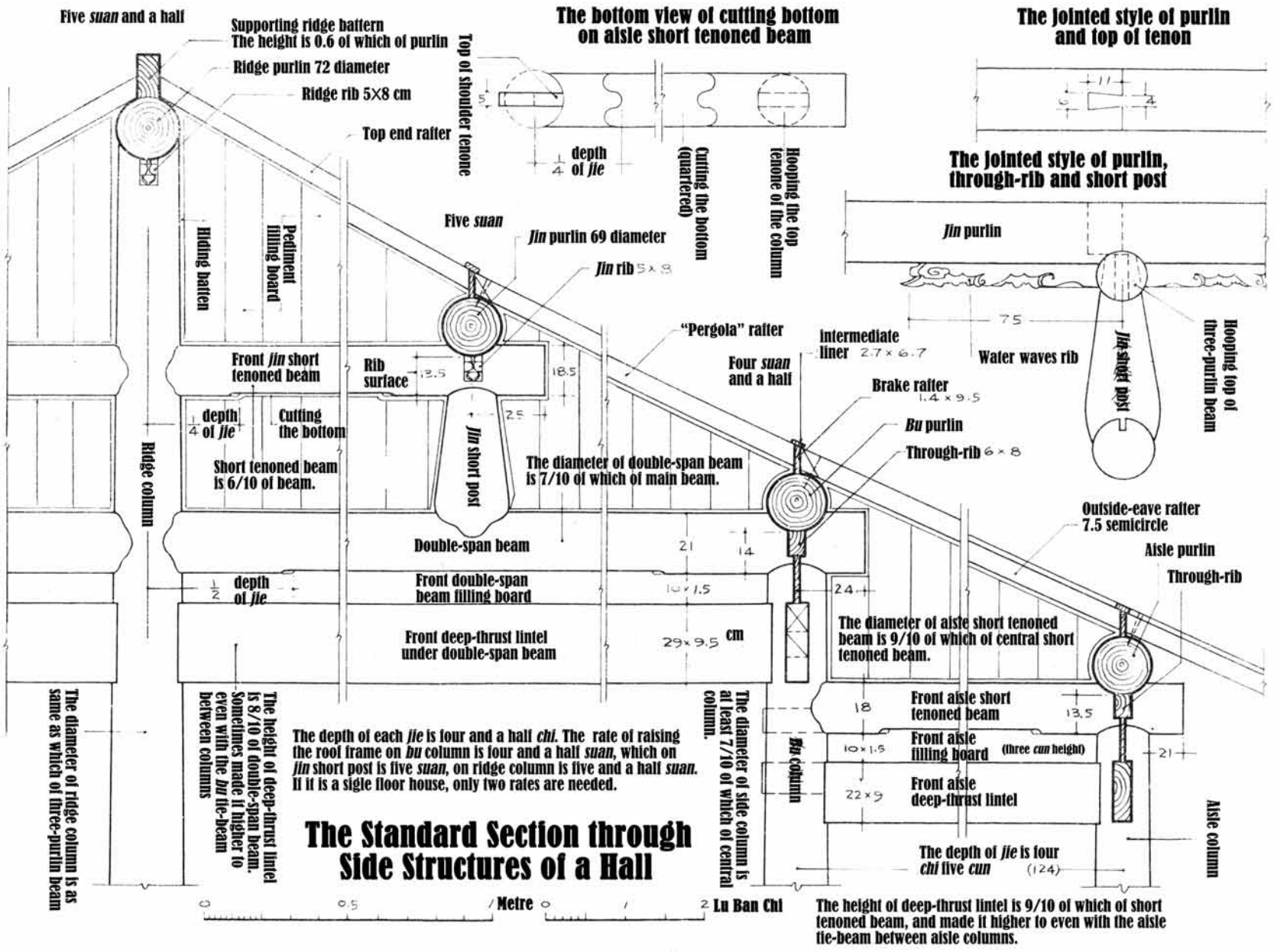

Section
The outer bevel is 1/2 of height
The ridge purlin also known as *dong* purlin
The length of "clouds around beam" is triple the diameter of ridge purlin, one *cun* thickness.
The height of Supporting ridge batten is 6/10 of the diameter of ridge purlin.
The standard width is one and a half of the diameter of ridge purlin which could bigger than *jin* purlin.
The "*shan-wu-yun*" is one *cun* five *fen* thickness, and the hight is from middle of *dou* to the middle of ridge purlin.
Gong is five *fen* wider than usual.
Big *dou* is five -seven *cun* size
The length of ridge rib is four cun longer than which of *jin* rib. (the pattern of "coppers and *ruyi*")
Style of one *dou* six *sheng* five-seven size *paike*. The width of the bottom of *dou* is as same as beam; while the upper of *dou* is outer one *cun* around.
Ba-sai (*ba-hai*) is 1/5 of beam thickness
The length of jin rib is from 2/10 of the standard width to the middle of beam. (water-waves rib)
The size of three-purlin beam is 0.8 of main beam, which could be spliced at 1/4 height if the timber is not big enough.
Ba-sai also known as *ba-hai*.
Fan-shaped
Cutting half *cun* at the bottom
Jin purlin
Jin rib
Han-shao gong
The thickness of beam support bracket is 3/5 of beam, length is two *chi* from top to the middle of purlin.
The top is from 1/2 of *jie* when using "*pu* toe cap".
1/5 beam thickness
The diameter of main beam is 3/10 of inner four jie, which could splice if the timber whithout enough size. It could hollow on the inside, filling under the *dou*.
Bu purlin
Bu purlin
Main beam
The top of *ba hai* is from 1/2 *jie*.
Cutting half *cun* at the bottom
The length of "bee head" is as same as beam support bracket, pattern could design by the maker.
1/2 *cun*
The length of beam support bracket is from the top, six *cun* thickness.
The outer bevel of Zhao mu is as same as the "*shan-wu-yun*".
Solid *gong* is five *cun* from column
The sqaure of big *dou*, the width of the bottom is as same as the column, the upper is outer one *cun*, five *cun* height.
Zhao mu length is 1 and 3/5 beam thickness
height is 1 and 1/10 beam thickness
thickness is 1 and 1/2 *cun*
3/5 beam thickness
Though-rib
Short post
Middle-filling board
Bu purlin
Section
0 0.1 0.5 Metre
0 1 2 Lu Ban Chi
The "*shan-wu-yun*" and *zhao-mu*
(The measurement unit in this drawing is *cun*.)


營造法原图版 十四
屋架正貼制度式
用幫脊木時不用椽穩
幫脊木
頭停椽
脊桁
脊機
脊童柱
脊童柱圍照金童柱 8/10.
勒望
閘椽釘在桁中心.
金機 6×9 長照間
間 2/10.
金桁
金機
花架椽
山界梁
17.5公分
24公分
27公分
金童柱
大梁圍照内四界深 2/10.
山界梁圍照大梁 8/10.
童柱圍照大梁
挑出桁心自八寸至一尺.
步桁
連機
大梁
22.5
26公分
圓梁均有抬勢高起約長度 1/10至 1.5/10
瓦口板
10
17公分
14
2.5
裏口木
7公分
出簷椽
裏口木
飛椽
瓦版
眠簷,勒望原料(一寸×二寸半).
裏口木原料(二寸半×二寸)鋸開兩用.
瓦口板原料(一寸 × 五寸)鋸開套用.
30公分
川照大梁 6/10.
20
廊川
13.5公分
21
廊桁
連機
鑿半眼
鑿全眼
步柱圍照大梁 2/10,或面闊 2/10.
廊柱圍照步柱 8/10.
椽穩,椽閘原料(半寸×三寸~三寸半).
出簷椽斷面作荷包狀.
如用椽穩須自桁中心退後一寸.
12
花架椽
椽穩板或閘椽
桁條
圍照開間 1.5/10
夾堂板
高自五寸至八寸
枋子
高安柱高 1/10
望磚
22公分
8寸
步柱桁,機,枋等正面配合圖
0.01 0.5 0.8 公尺
0 1 2 3 營造尺

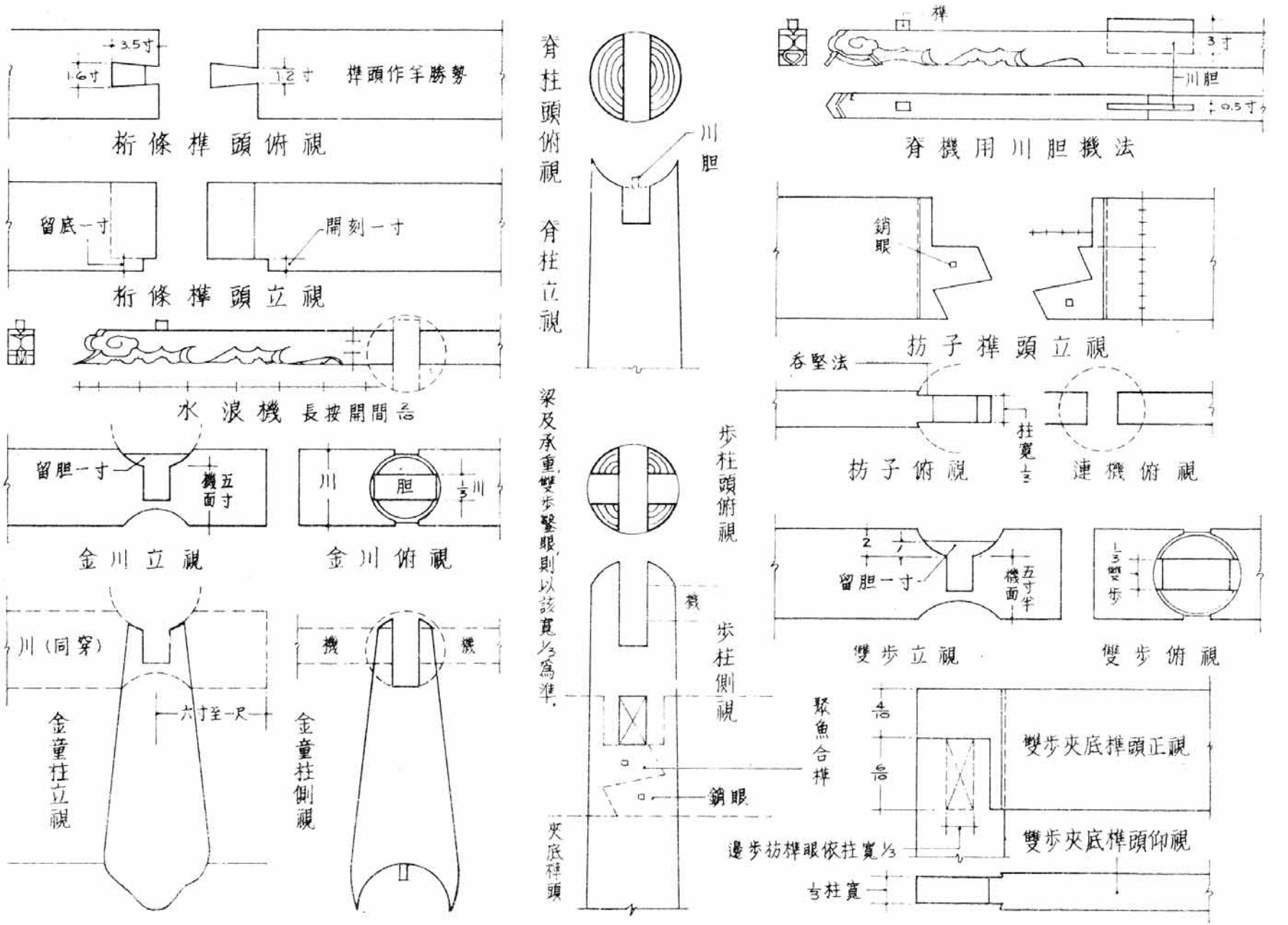

The Standard Section through Central Structures of a Hall
Do not need the top end when using supporting ridge battern.
Supporting ridge batten
Top end rafter
Ridge purlin
Ridge rib
Ridge short post
The diameter of ridge short post is 8/10 of that of *jin* short post.
Three-purlin beam
The diameter of main beam is 2/10 of the depth of inner four *jie*.
The diameter of three-purlin beam is 8/10 of that of main beam
The diameter of short post is based on the main beam
Main beam
0 0.1 0.5 0.8 Metre
0 1 2 3 Lu Ban Chi
Jin purlin
Jin rib
(six cun and a half) 17.5 cm
intermediate liner
Brake rafter is set on the axis of purlin.
Jin rib 6×9, the length is 2/10 of the standard width.
cm 24
cm 27
1/2 depth of *jie*
Jin short post
Outer from axis of purlin eight *cun* to one *chi*.
Cutting the bottom (quartered)
"Pergola" rafter
The top end or brake rafter
Purlin
The diameter is 0.15 of the standard width
Middle filling board
Five to eight *cun* height
Tie-beam
The height is 1/10 of which of column.
22 cm
8 *cun*
Roof
brick
"Pergola" rafter
The jointed styles of *bu* column, purlin, rib and tie-beam between columns
Bu purlin
Though-rib
The section of outside-eave rafter is Chinese pouch shape
Setback one *cun* from the axis of purlin when using the top end.
rib surface
(eight *cun*) 22.5
cm 26
cm 30
1/4 depth of *jie*
The short tenoned beam is 6/10 of main beam.
Aisle purlin
Through-rib
Aisle short tenoned beam
(five *cun*) 13.5 cm
20
depth of *jie*
Chiseling hali hole
Chiselinging whole hole
The diameter of *bu* column is 9/10 of main beam, or 2/10 of the standard width.
The aisle column is 8/10 of *bu* column.
The timber of top end or brake rafter (half *cun* × three *cun* ~three and a half *cun*).
The cylindical beams all have upper bevel.
The height is 0.1 or 0.15 of the length.
Iron catch
Tile's hole
Board
Wa-kou board
cm 10 17 2.5 14
Li-kou wooden batten
cm 7 6
Outside-eave rafter
Li-kou wooden batten
Flying rafter
The timber of li-kou wooden batten (two and a half *cun* × two *cun*) could be sawed to two piece.
The timber of wa-kou board (one *cun* × five *cun*) could be sawed into two pieces.
The timber of end liner or intermediate liner (one *cun* × two and a half *cun*).
Plates of *Yingzao Fayuan* Fourteen

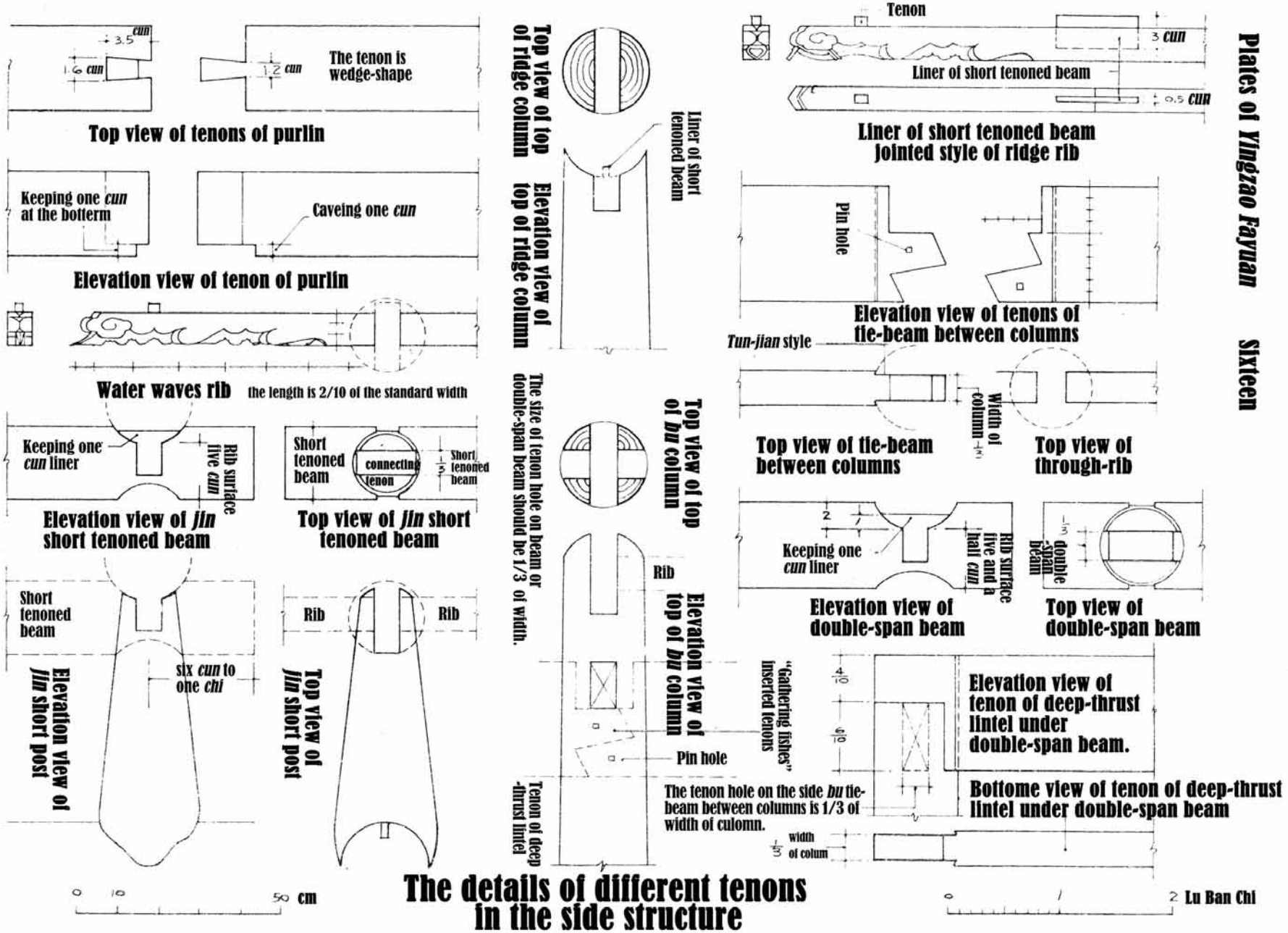
Appendix 1
The illustration: The *Yingzao fayuan* original drawings and modern drawings

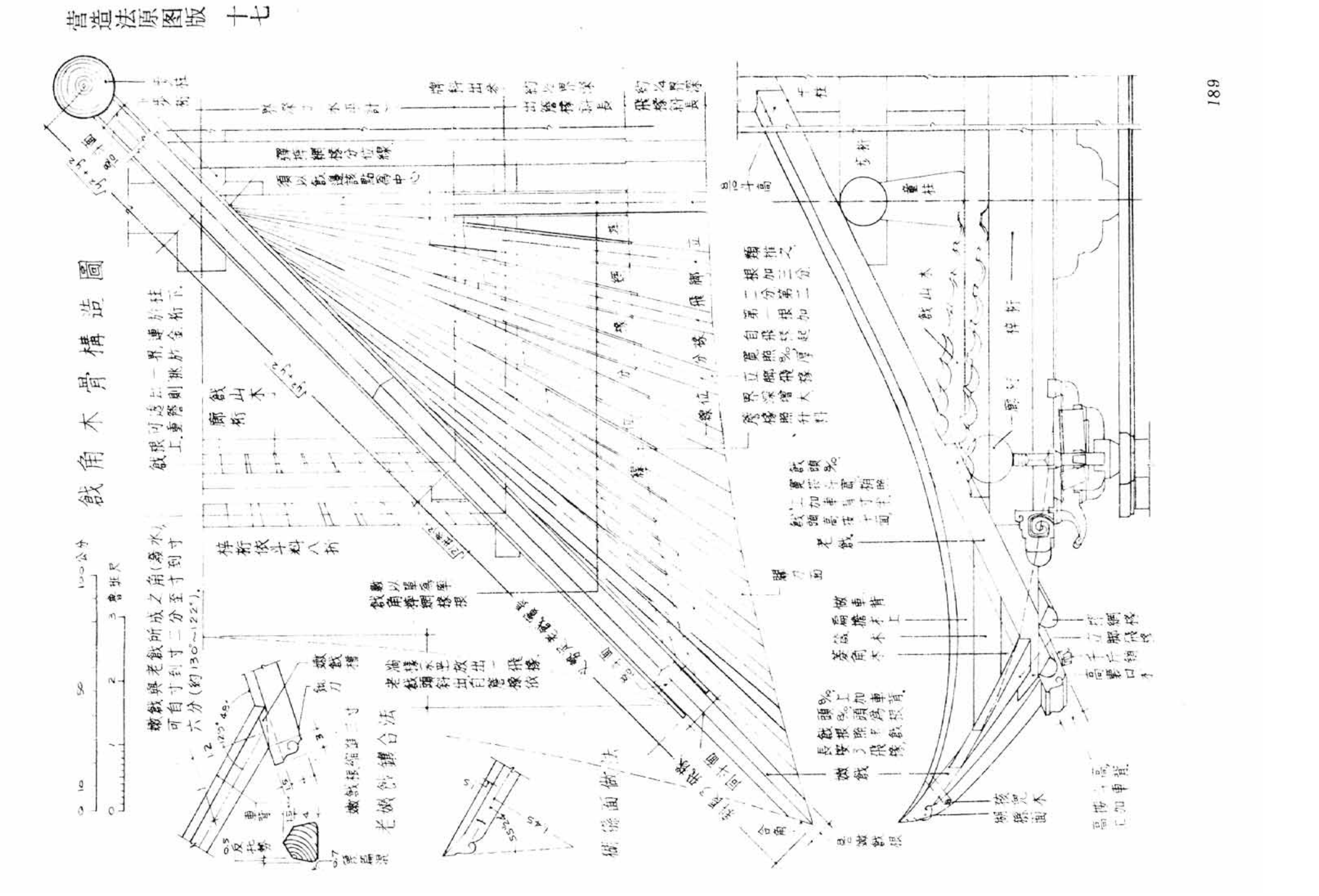


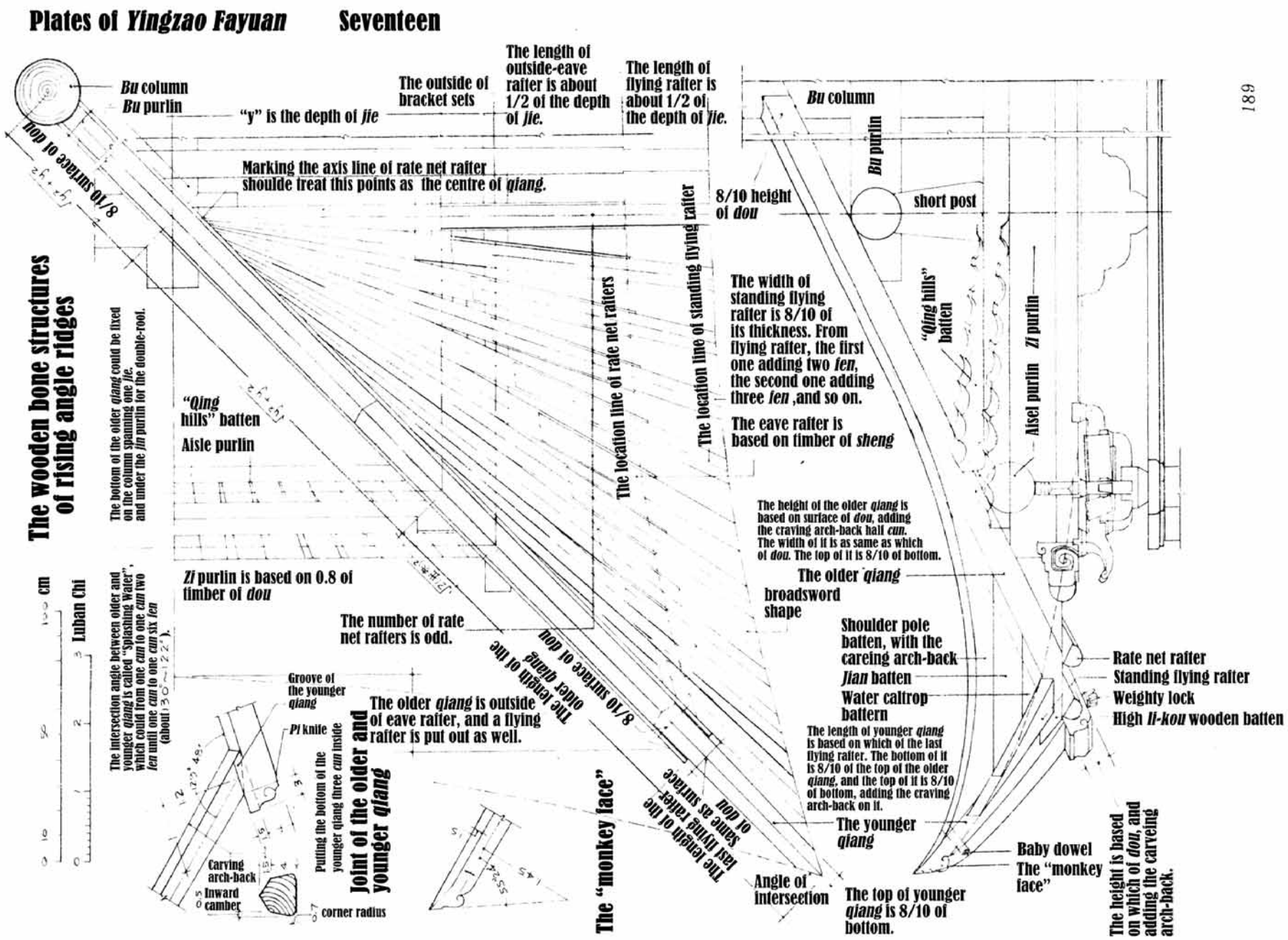


Plates of *Yingzao Fayuan* Fifteen


營造法原圖版 十六
3.5寸
1.6寸
1.2寸
栱頭作羊勝頭
桁條栱頭俯視
留底一寸
開刻一寸
桁條栱頭立視
水浪機 長按開間各
留胆一寸
機面五寸
金川立視
川
胆
金川俯視
川（同穿）
六寸至一尺
金童柱立視
金童柱側視
脊柱頭俯視
川胆
脊柱立視
梁及承重，雙步鑿眼，則以該寬⅓爲準。
步柱頭俯視
步柱側視
銷眼
夾底栱頭
栱
3寸
川胆
0.5寸
脊機用川胆機法
銷眼
抗子栱頭立視
吞堅法
抗子俯視
連機俯視
柱寬⅓
留胆一寸
機面五寸半
雙步立視
⅓雙步
雙步俯視
聚魚合栱
雙步夾底栱頭正視
雙步夾底栱頭仰視
邊步抗栱眼依柱寬⅓
⅓柱寬
0 10 50公分
0 1 2魯班尺
邊貼各部栱頭做法詳圖


Plates of Yingzao Fayuan Sixteen
Top view of tenons of purlin
The tenon is wedge-shape
Elevation view of tenon of purlin
Keeping one cun at the botterm
Caveing one cun
Water waves rib
the length is 2/10 of the standard width
Elevation view of jin short tenoned beam
Keeping one cun liner
Rib surface five cun
Top view of jin short tenoned beam
Short tenoned beam
connecting tenon
Elevation view of jin short post
Short tenoned beam
six cun to one chi
Top view of jin short post
Rib
Top view of top of ridge column
Elevation view of top of ridge column
Liner of short tenoned beam
The size of tenon hole on beam or double-span beam should be 1/3 of width.
Top view of top of bu column
Elevation view of top of bu column
Rib
Pin hole
Tenon of deep-thrust lintel
"Gathering fishes" inserted tenons
The tenon hole on the side bu tie-beam between columns is 1/3 of width of culomn.
Tenon
Liner of short tenoned beam
Liner of short tenoned beam jointed style of ridge rib
Pin hole
Elevation view of tenons of tie-beam between columns
Tun-jian style
Width of column
Top view of tie-beam between columns
Top view of through-rib
Keeping one cun liner
Rib surface five and a half cun
Elevation view of double-span beam
double-span beam
Top view of double-span beam
Elevation view of tenon of deep-thrust lintel under double-span beam.
Bottome view of tenon of deep-thrust lintel under double-span beam
width of colum
0 10 50 cm
0 1 2 Lu Ban Chi
The details of different tenons in the side structure


营造法原图版 十七
戧角木骨構造圖
189
嫩戧與老戧所成之角(箬水)
可自寸到寸三分至十寸到寸
六分(約130°~122°)
老嫩戧鑲合法
枓桁依斗料八扣
一界


Plates of Yingzao Fayuan Seventeen
The wooden bone structures of rising angle ridges
Bu column
Bu purlin
"y" is the depth of jie
The outside of bracket sets
The length of outside-eave rafter is about 1/2 of the depth of jie.
The length of flying rafter is about 1/2 of the depth of jie.
Marking the axis line of rate net rafter shoulde treat this points as the centre of qiang.
8/10 surface of dou
The bottom of the older qiang could be fixed on the column spanning one jie. and under the jin purlin for the double-rool.
"Qing hills" batten
Aisle purlin
Zi purlin is based on 0.8 of timber of dou
The number of rate net rafters is odd.
The location line of rate net rafters
The location line of standing flying rafter
The width of standing flying rafter is 8/10 of its thickness. From flying rafter, the first one adding two fen, the second one adding three fen ,and so on.
The eave rafter is based on timber of sheng
8/10 height of dou
short post
"Qing hills" batten
Zi purlin
Aisel purlin
The height of the older qiang is based on surface of dou, adding the craving arch-back half cun. The width of it is as same as which of dou. The top of it is 8/10 of bottom.
The older qiang broadsword shape
Shoulder pole batten, with the careing arch-back
Jian batten
Water caltrop battern
Rate net rafter
Standing flying rafter
Weighty lock
High li-kou wooden batten
The length of younger qiang is based on which of the last flying rafter. The bottom of it is 8/10 of the top of the older qiang, and the top of it is 8/10 of bottom, adding the craving arch-back on it.
The younger qiang
Baby dowel
The "monkey face"
The top of younger qiang is 8/10 of bottom.
Angle of intersection
The height is based on which of dou, and adding the carveing arch-back.
The intersection angle between older and younger qiang is called "splashing Water", which could from one cun to one cun two fen until one cun to one cun six fen (about 30°~12.21°).
cm
Luban Chi
Groove of the younger qiang
Pi knife
Putting the bottom of the younger qiang three cun inside
Carving arch-back
Inward camber
corner radius
Joint of the older and younger qiang
The older qiang is outside of eave rafter, and a flying rafter is put out as well.
The length of the older qiang
8/10 surface of dou
The length of the last flying rafter same as surface of dou
The "monkey face"
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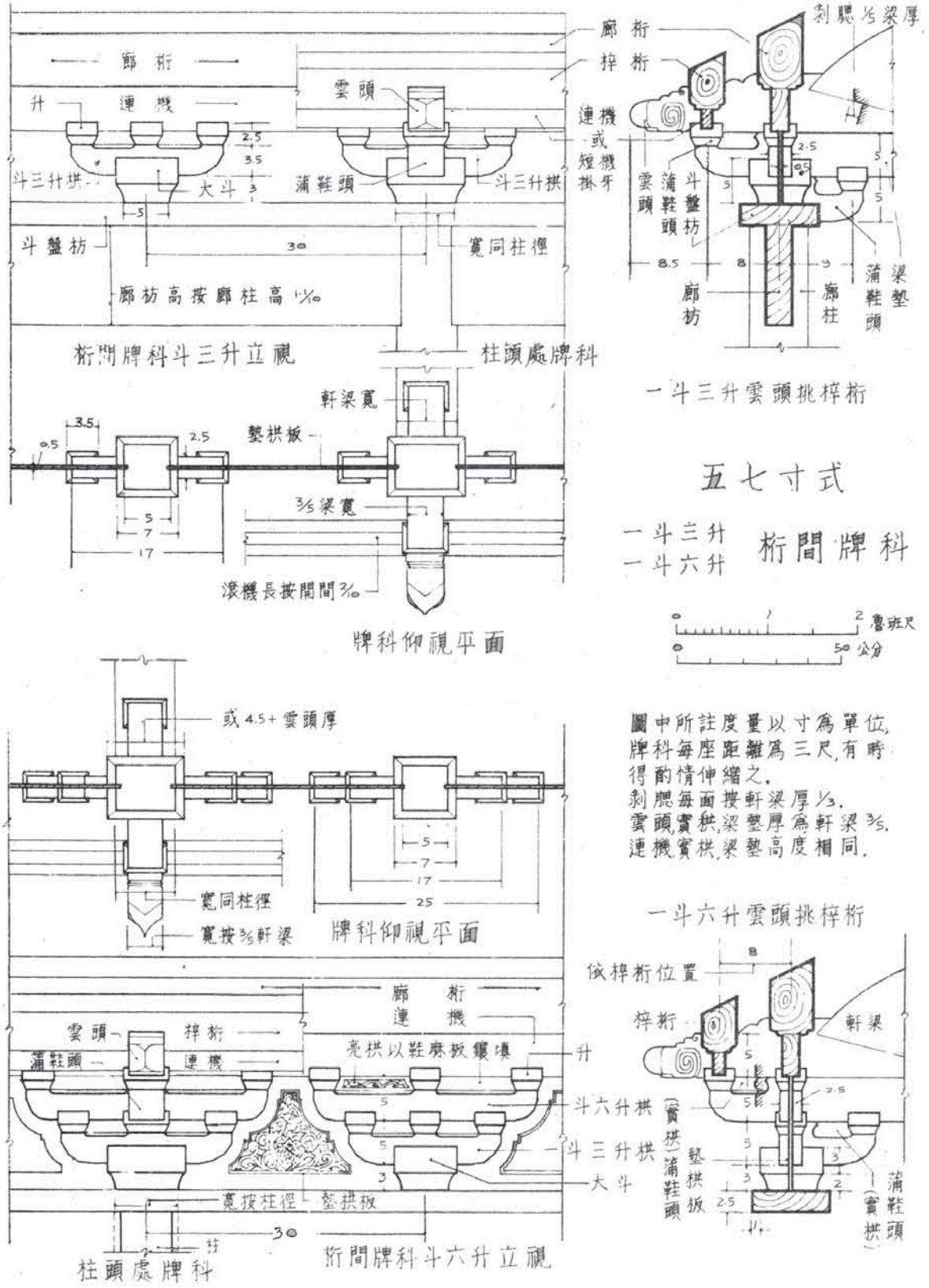
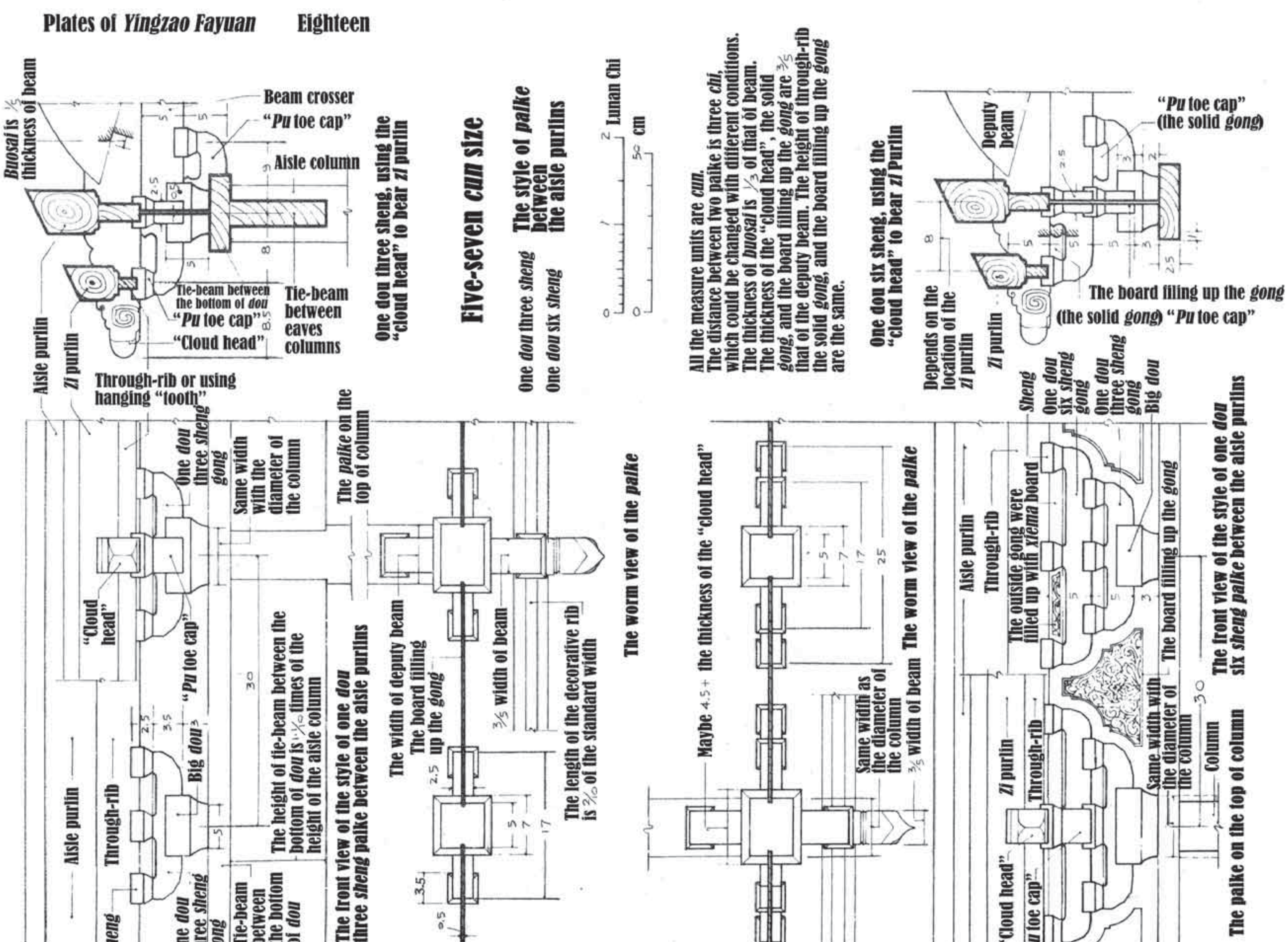
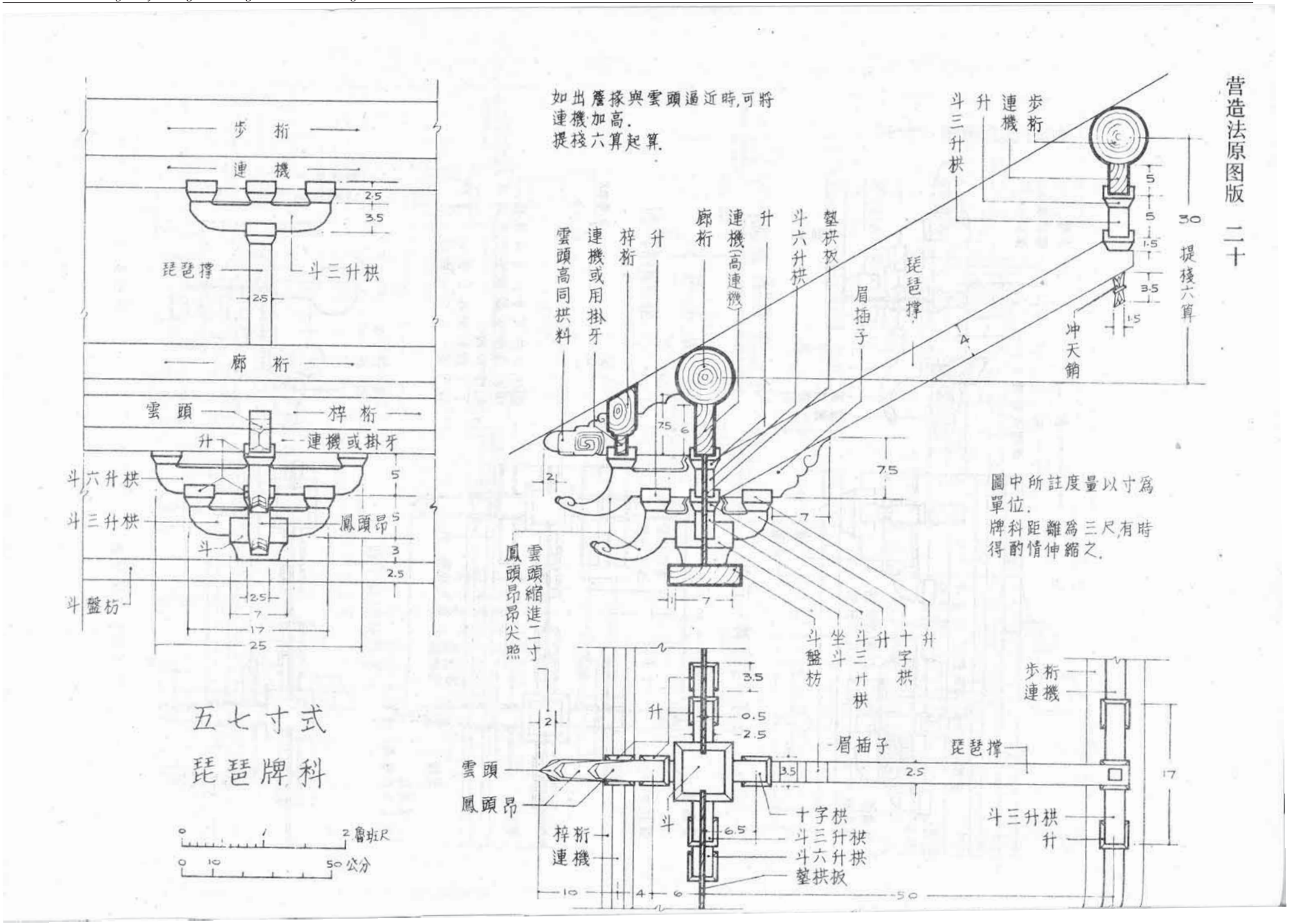
营造法原图版 十八

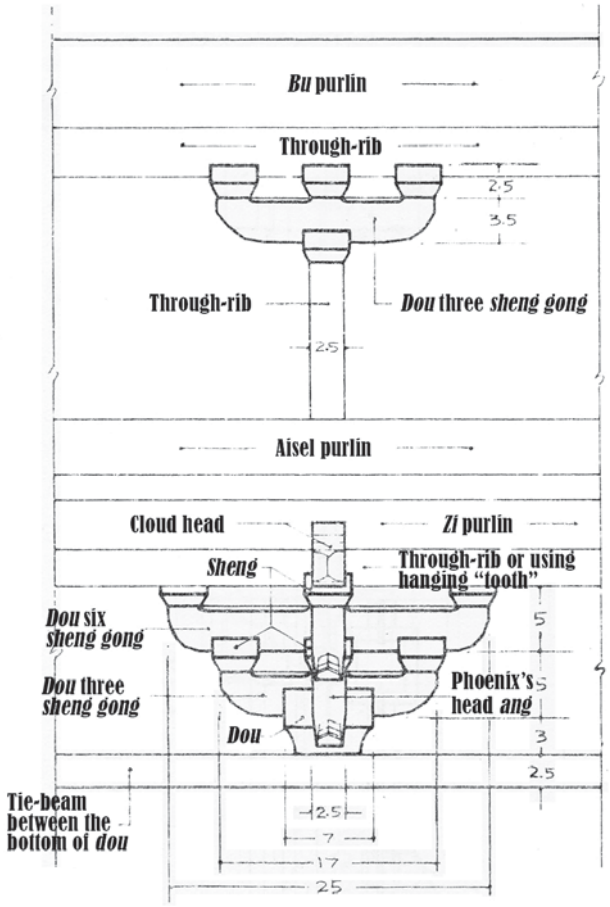

廊桁
升
連機
雲頭
斗三升拱
大斗
蒲鞋頭
斗三升拱
斗盤枋
寬同柱徑
廊枋高按廊柱高1/10
桁間牌科斗三升立視
柱頭處牌科
軒梁寬
墊拱板
3/5梁寬
滾機長按開間2/10
牌科仰視平面
或4.5+雲頭厚
寬同柱徑
寬按3/5軒梁
牌科仰視平面
廊桁
連機
雲頭
桁桁
蒲鞋頭
連機
亮拱以鞋麻板鑲填
升
斗六升拱
一斗三升拱
大斗
寬按柱徑
墊拱板
柱頭處牌科
桁間牌科斗六升立視
廊桁
桁桁
連機或短機牙
雲頭
蒲鞋頭
斗盤枋
廊枋
廊柱
蒲梁墊
蒲鞋頭
剁腮1/3梁厚
一斗三升雲頭挑桁桁
五七寸式
一斗三升
一斗六升
桁間牌科
魯班尺
公分
圖中所註度量以寸爲單位,
牌科每座距離爲三尺,有時
得酌情伸縮之.
剁腮每面按軒梁厚1/3.
雲頭,實拱,梁墊厚爲軒梁3/5.
連機,實拱,梁墊高度相同.
一斗六升雲頭挑桁桁
依桁桁位置
桁桁
軒梁
墊拱板
(實拱)蒲鞋頭
(實拱)蒲鞋頭


Plates of *Yingzao Fayuan* Eighteen
Five-seven *cun* size
Buosai is ⅓ thickness of beam
Beam crosser
"*Pu* toe cap"
Aisle column
Tie-beam between the bottom of *dou*
"*Pu* toe cap"
"Cloud head"
Tie-beam between eaves columns
Aisle purlin
Zi purlin
Through-rib or using hanging "tooth"
One dou three sheng, using the "cloud head" to bear *zi* purlin
One *dou* three *sheng*
One *dou* six *sheng*
The style of *palke* between the aisle purlins
Lunan Chi
cm
All the measure units are *cun*.
The distance between two paike is three *chi*, which could be changed with different conditions.
The thickness of *buosai* is ⅓ of that of beam.
The thickness of the "cloud head", the solid *gong*, and the board filling up the *gong* are ⅗ that of the deputy beam. The height of through-rib the solid *gong*, and the board filling up the *gong* are the same.
One dou six sheng, using the "cloud head" to bear *zi* Purlin
Deputy beam
"*Pu* toe cap" (the solid *gong*)
The board filling up the *gong* (the solid *gong*) "*Pu* toe cap"
Depends on the location of the *zi* purlin
Sheng
Through-rib
One *dou* three *sheng* *gong*
"Cloud head"
"*Pu* toe cap"
Big *dou*
Same width with the diameter of the column
The height of tie-beam between the bottom of *dou* is 1.1/10 times of the height of the aisle column
Tie-beam between the bottom of *dou*
The *palke* on the top of column
The front view of the style of one *dou* three *sheng* palke between the aisle purlins
The width of deputy beam
The board filling up the *gong*
⅗ width of beam
The length of the decorative rib is 2/10 of the standard width
The worm view of the *palke*
Maybe 4.5+ the thickness of the "cloud head"
Same width as the diameter of the column
⅗ width of beam
One *dou* six *sheng* *gong*
The outside gong were filled up with *xiema* board
The board filling up the *gong*
Column
The front view of the style of one *dou* six *sheng* *palke* between the aisle purlins
The palke on the top of column

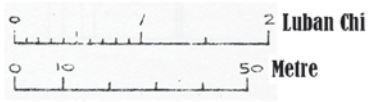
Appendix 1
The illustration: The *Yingzao fayuan* original drawings and modern drawings

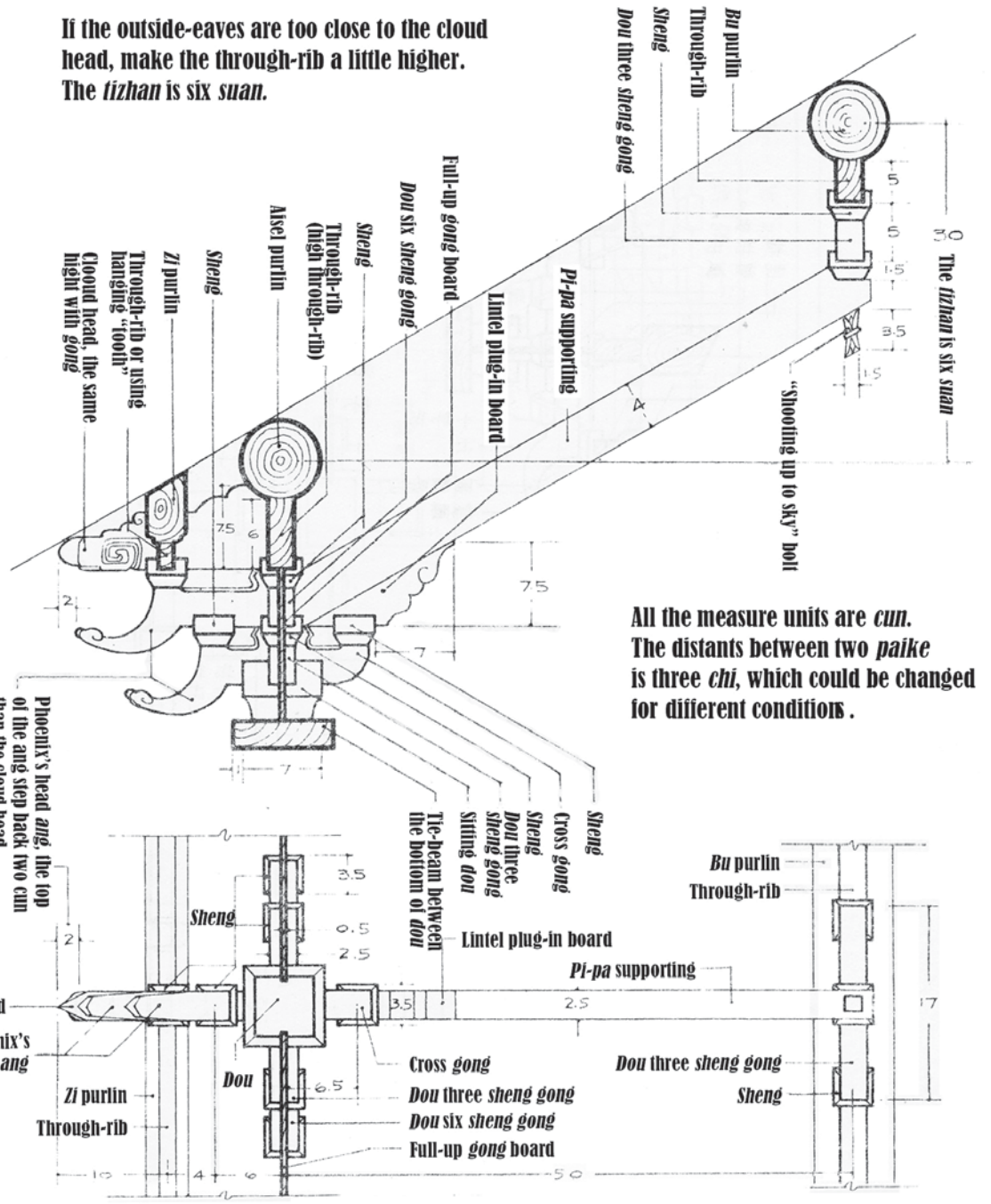


Plates of the *Yingzao Fayuan* Twenty

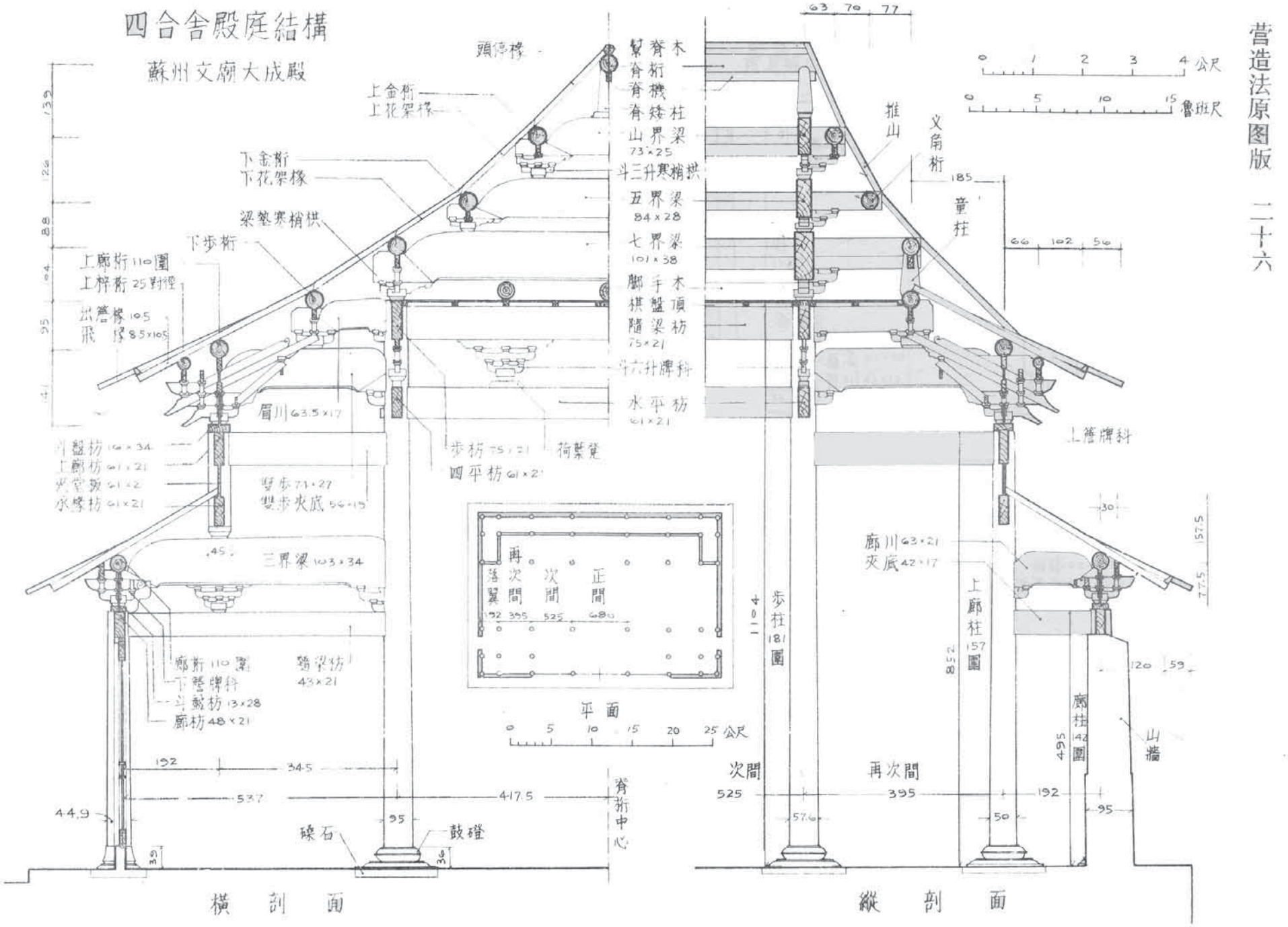


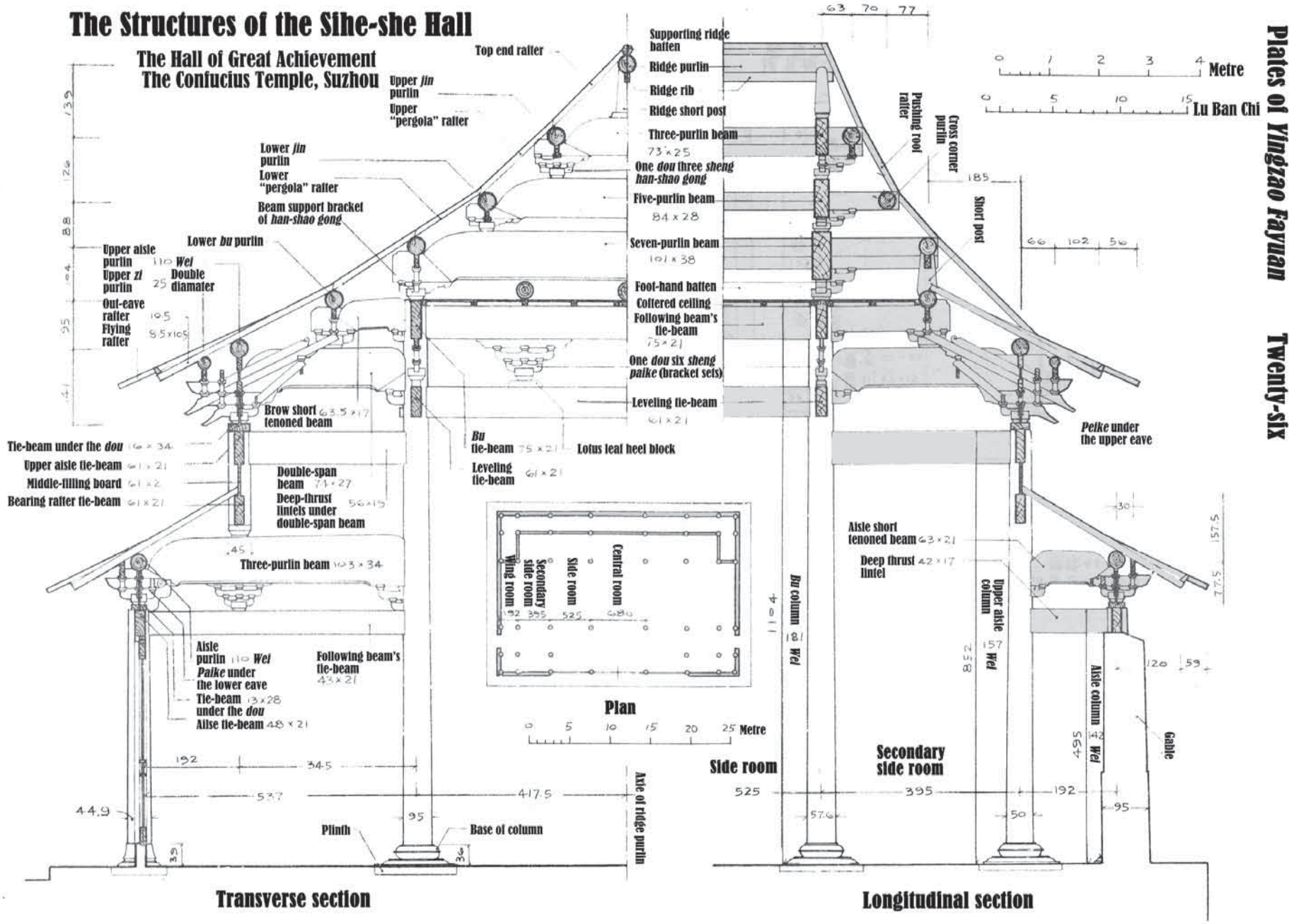
The type of *pi-pa paike* in five-seven *cun* size



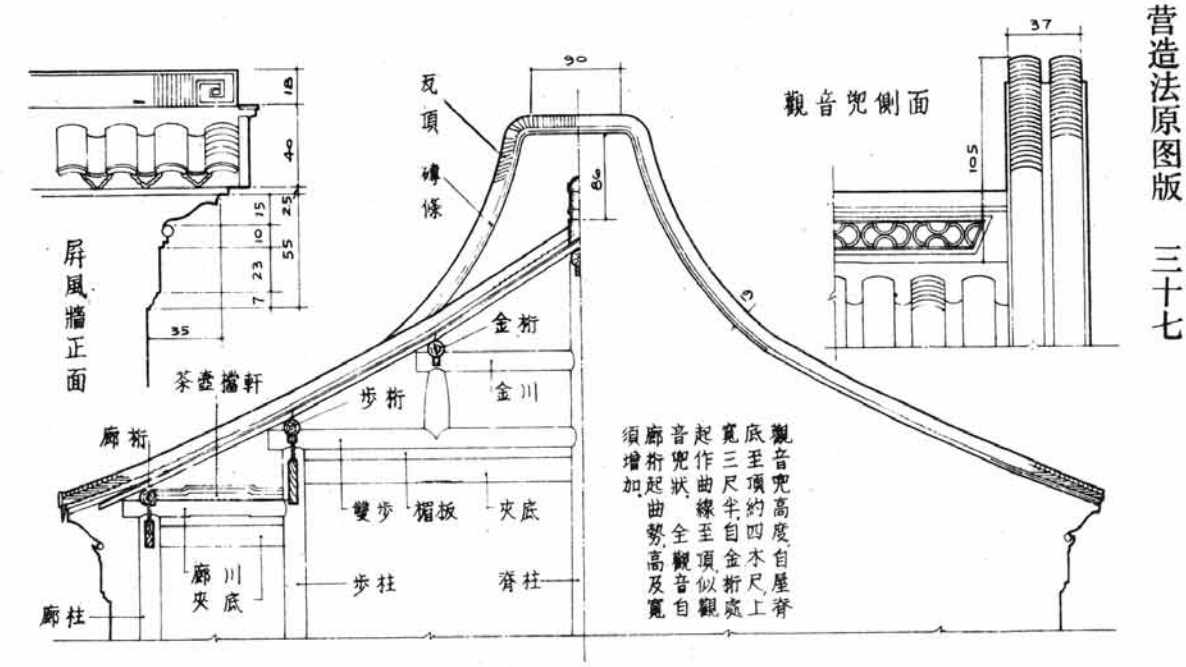


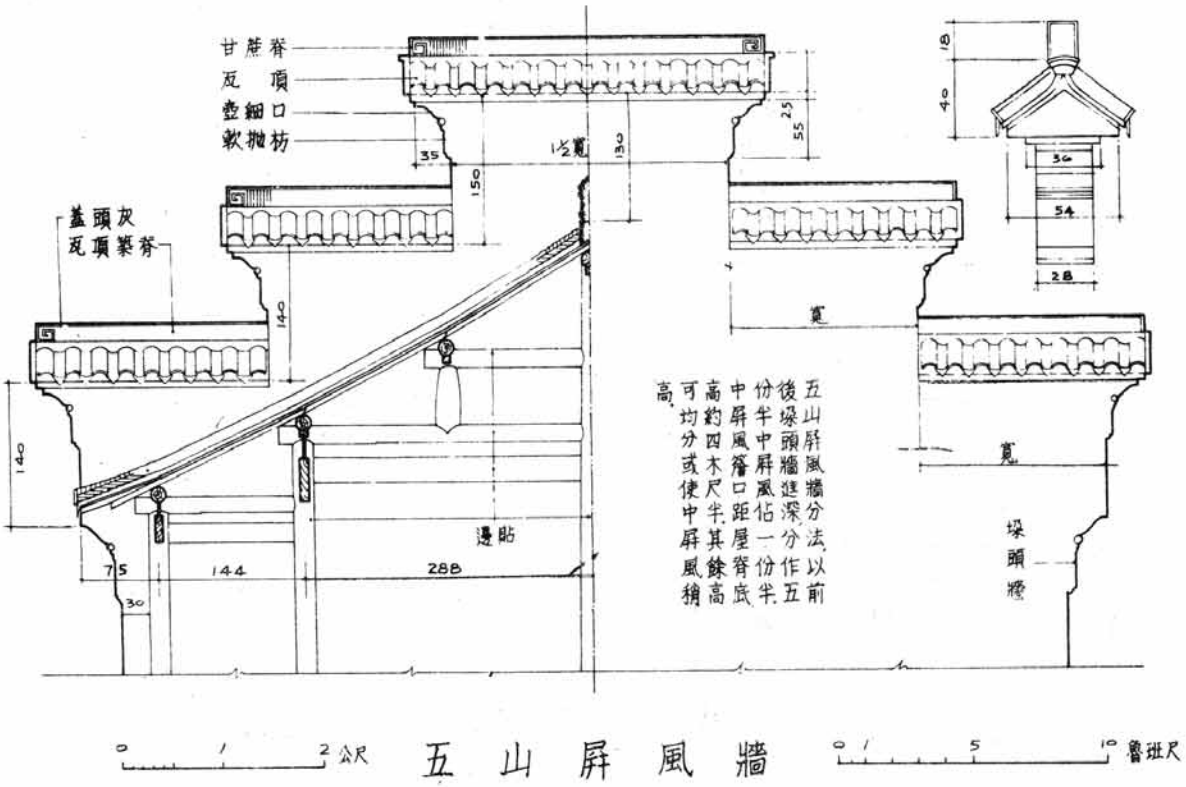
Appendix 1
The illustration: The *Yingzao fayuan* original drawings and modern drawings




The Structures of the Sihe-she Hall
The Hall of Great Achievement
The Confucius Temple, Suzhou
Top end rafter
Upper jin purlin
Upper "pergola" rafter
Lower jin purlin
Lower "pergola" rafter
Beam support bracket of han-shao gong
Lower bu purlin
Upper aisle purlin 110 Wei
Upper zi purlin 25 Double diamater
Out-eave rafter 10.5
Flying rafter 8.5x10.5
Brow short tenoned beam 63.5x17
Tie-beam under the dou 16x34
Upper aisle tie-beam 61x21
Middle-filling board 61x2
Bearing rafter tie-beam 61x21
Double-span beam 71x27
Deep-thrust lintels under double-span beam 56x15
Three-purlin beam 103x34
Aisle purlin 110 Wei
Paike under the lower eave
Tie-beam under the dou 13x28
Ailse tie-beam 48x21
Following beam's tie-beam 43x21
Supporting ridge batten
Ridge purlin
Ridge rib
Ridge short post
Three-purlin beam 73x25
One dou three sheng han-shao gong
Five-purlin beam 84x28
Seven-purlin beam 101x38
Foot-hand batten
Coffered ceiling
Following beam's tie-beam 75x21
One dou six sheng paike (bracket sets)
Leveling tie-beam 61x21
Bu tie-beam 75x21
Lotus leaf heel block
Leveling tie-beam 61x21
Plinth
Base of column
Axle of ridge purlin
Transverse section
Central room
Side room
Secondary side room
Wing room
Plan
Metre
Lu Ban Chi
Pushing roof rafter
Cross corner purlin
Short post
Peike under the upper eave
Aisle short tenoned beam 63x21
Deep thrust lintel 42x17
Bu column 181 Wei
Upper aisle column 157 Wei
Aisle column 142 Wei
Gable
Side room
Secondary side room
Longitudinal section

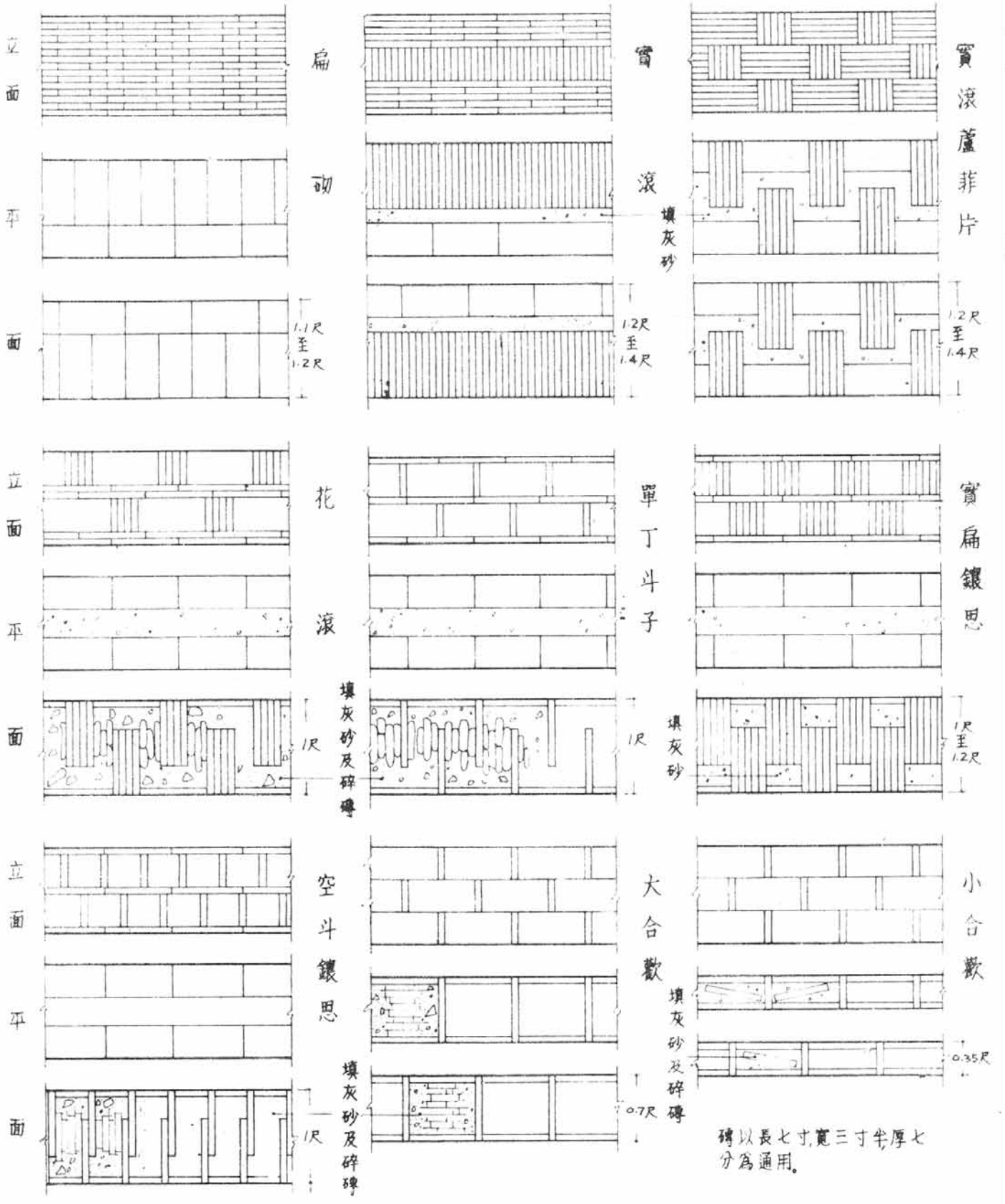
营造法原图版 三十七


觀音兜側面
瓦頂
磚條
屏風牆正面
金桁
金川
步桁
軒廊
茶壺擋
廊桁
雙步
楣板
夾底
廊川
夾底
步柱
脊柱
廊柱
觀音兜高度自屋脊底至頂約四本尺上寬三尺半自金桁處起作曲線至頂似觀音兜狀全觀音自廊桁起曲勢高及寬須增加
觀音兜
詳部比例尺

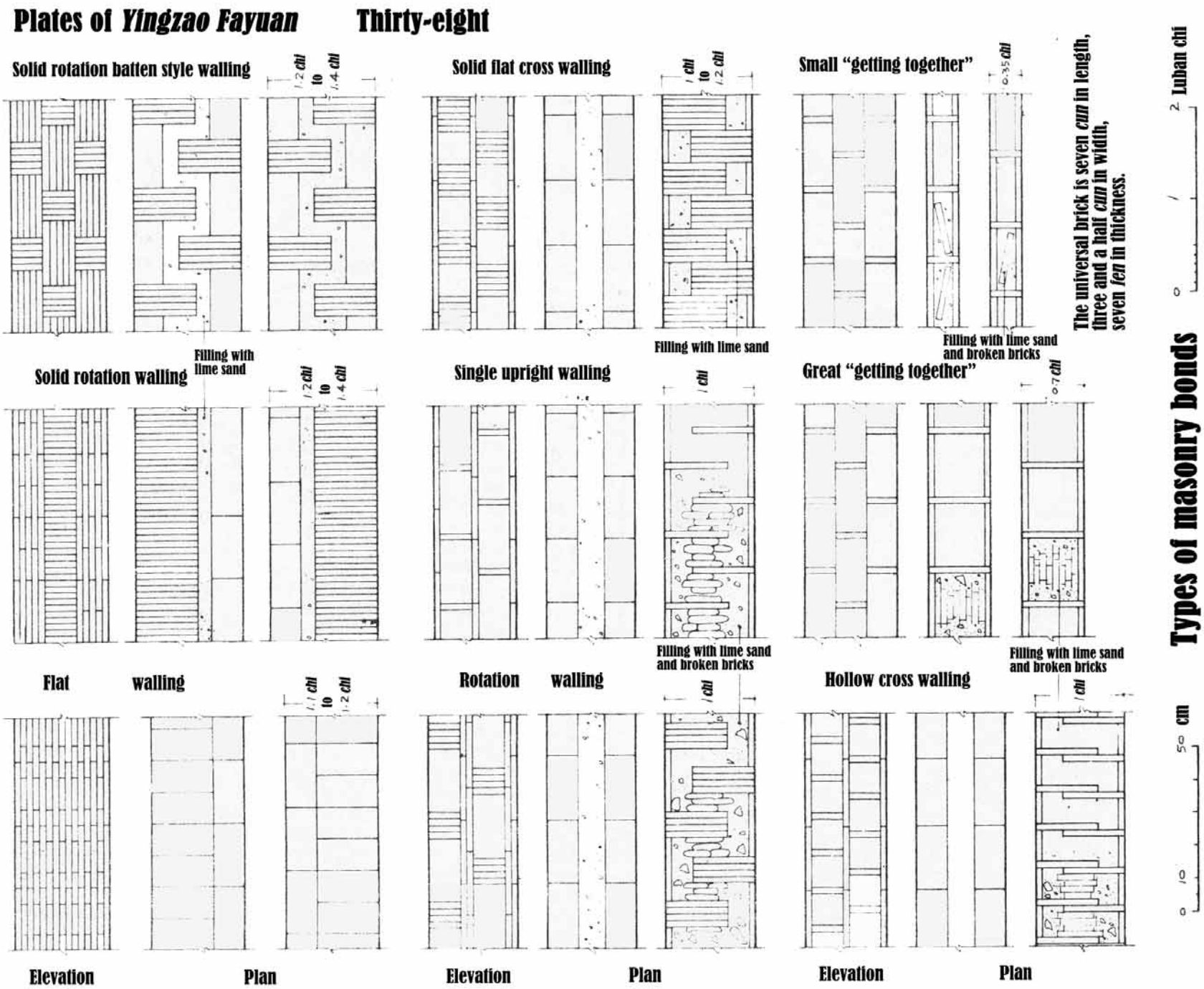

甘蔗脊
瓦頂
壺細口
軟抛枋
蓋頭灰
瓦頂築脊
邊貼
五山屏風牆分法以前後垛頭牆進深分作五份半中屏風佔一份半中屏風簷口距屋脊底高約四本尺半其餘高可均分或使中屏風稍高
梁頭
五山屏風牆

Plates of the Yingzao Fayuan Thirty-seven
Front view of partition gable
"Teapot handle" deputy beam
Aisle purlin
Aisle short tenoned beam
Aisle column
deep-thrust lintels
Double-span beam
Mei board
Bu column
Ridge column
Jin purlin
Bu purlin
Jin short tenoned beam
Tile roof
Brick strip
Side view of the style of Bodhisattva Ruanyin's hood
The height of the bodhisattva Guanyin's hood from the top to the top of the roof ridge should be four wooden ruler chi. The width of the top is three chi and a half. From the Jin purlin made a curve line to the top,with looks like the bodhisattva Guanyin's hood. The whole line of bodhisattva Guanyin's hood begins from the aisle purlin, the height and width raised till the end.
The style of Bodhisattva Guanyin's hood partition gable
Meter
Detail's measuring scale
Sugarcane ridge
Tile roof
Hu-xi-kou
Soft out linlel
Endshield gray
Tile roof with ridge
Width
The total width of the five-mountain partition gable is divided into five parts, the central part is one and a half width, while others has the same width. The height of central part from the end of eaves to the top of roof ridge is four wooden ruler and a half. others' height could be the same, or less than the central one.
Duo-tou wall
The side structure
The style of five-mountain-shaped wall
meter
Ia Ban Chi

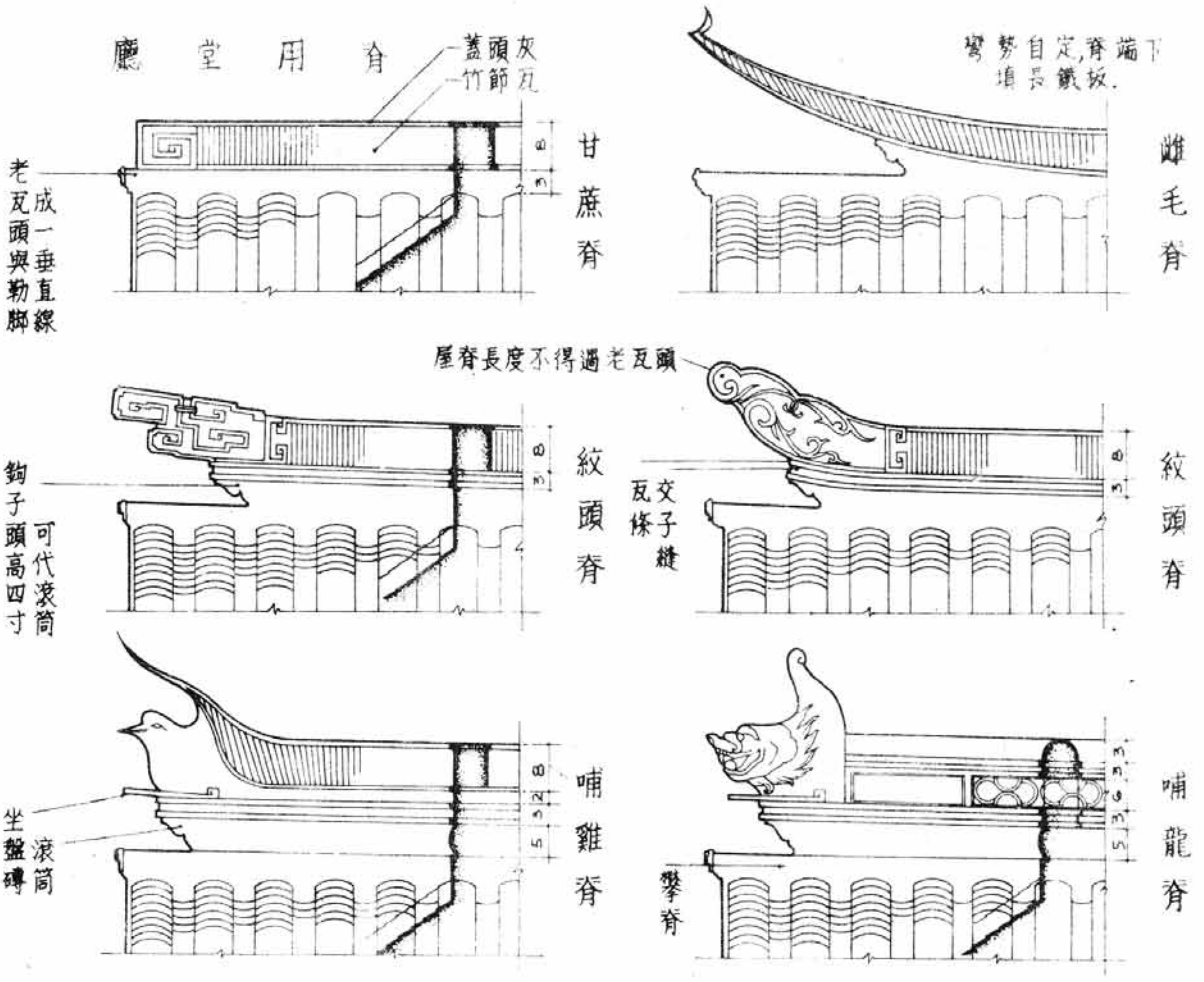
营造法原图版 二十八



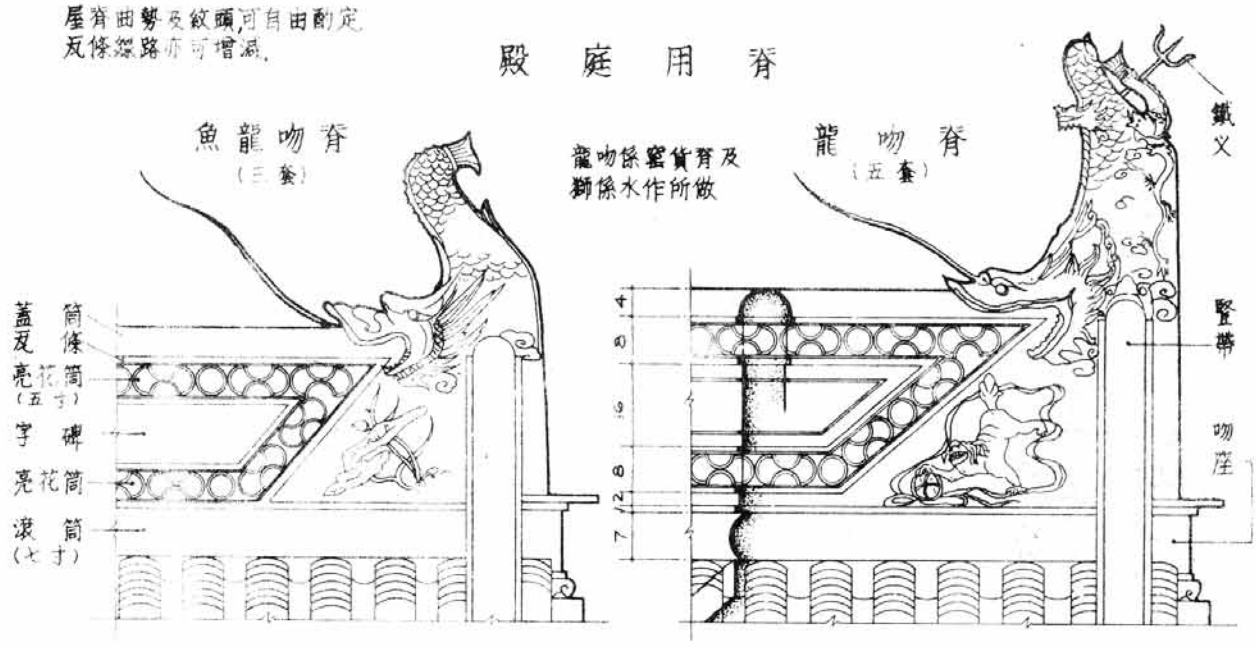
牆垣砌法


Plates of Yingzao Fayuan Thirty-eight
Types of masonry bonds
Solid rotation batten style walling
Solid flat cross walling
Small "getting together"
The universal brick is seven cun in length, three and a half cun in width, seven fen in thickness.
Filling with lime sand
Filling with lime sand and broken bricks
Solid rotation walling
Single upright walling
Great "getting together"
Flat walling
Rotation walling
Hollow cross walling
Elevation
Plan
Elevation
Plan
Elevation
Plan
2 Luban chi
0
1
50 cm
0
10

營造法原图版 三十九

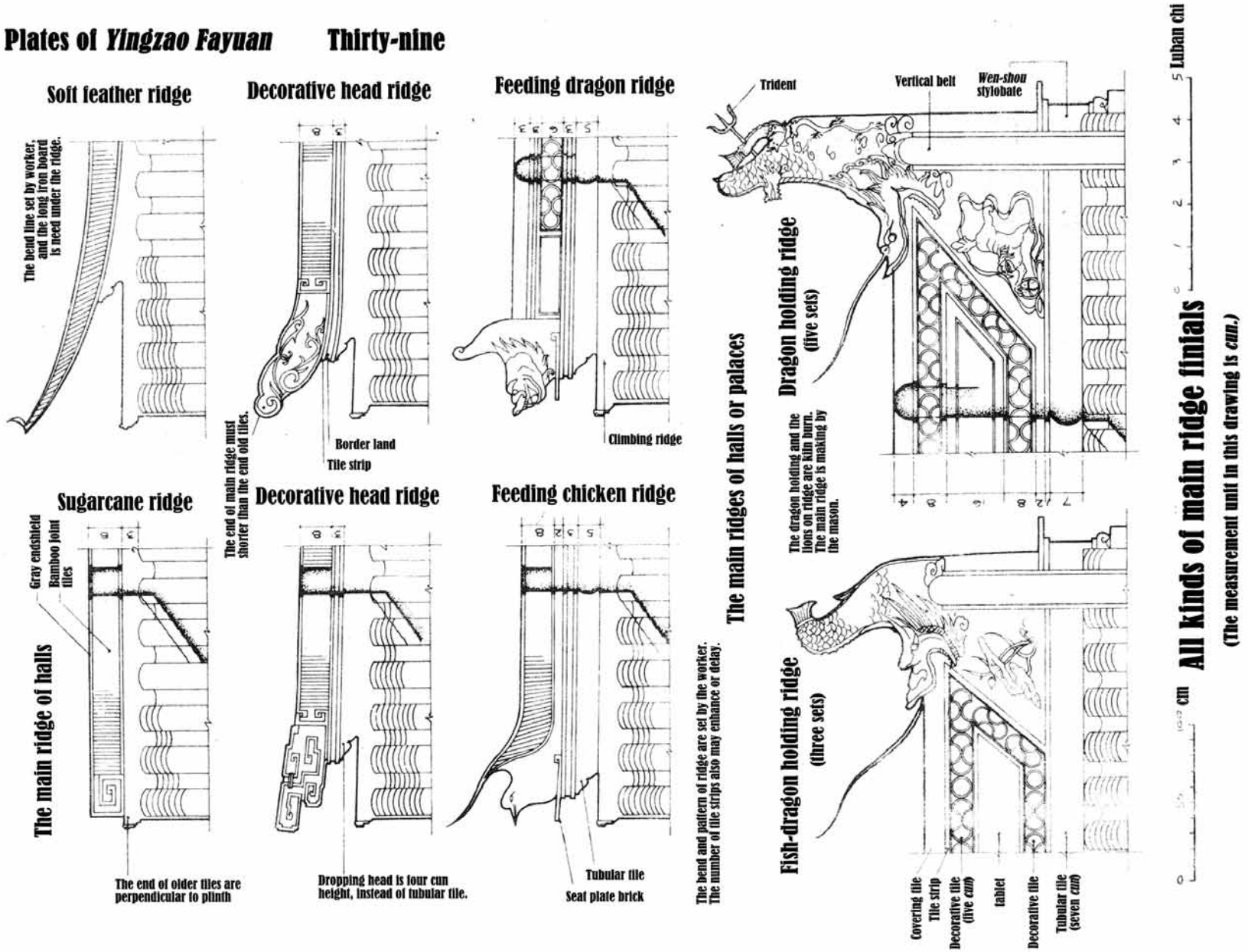


殿庭用脊

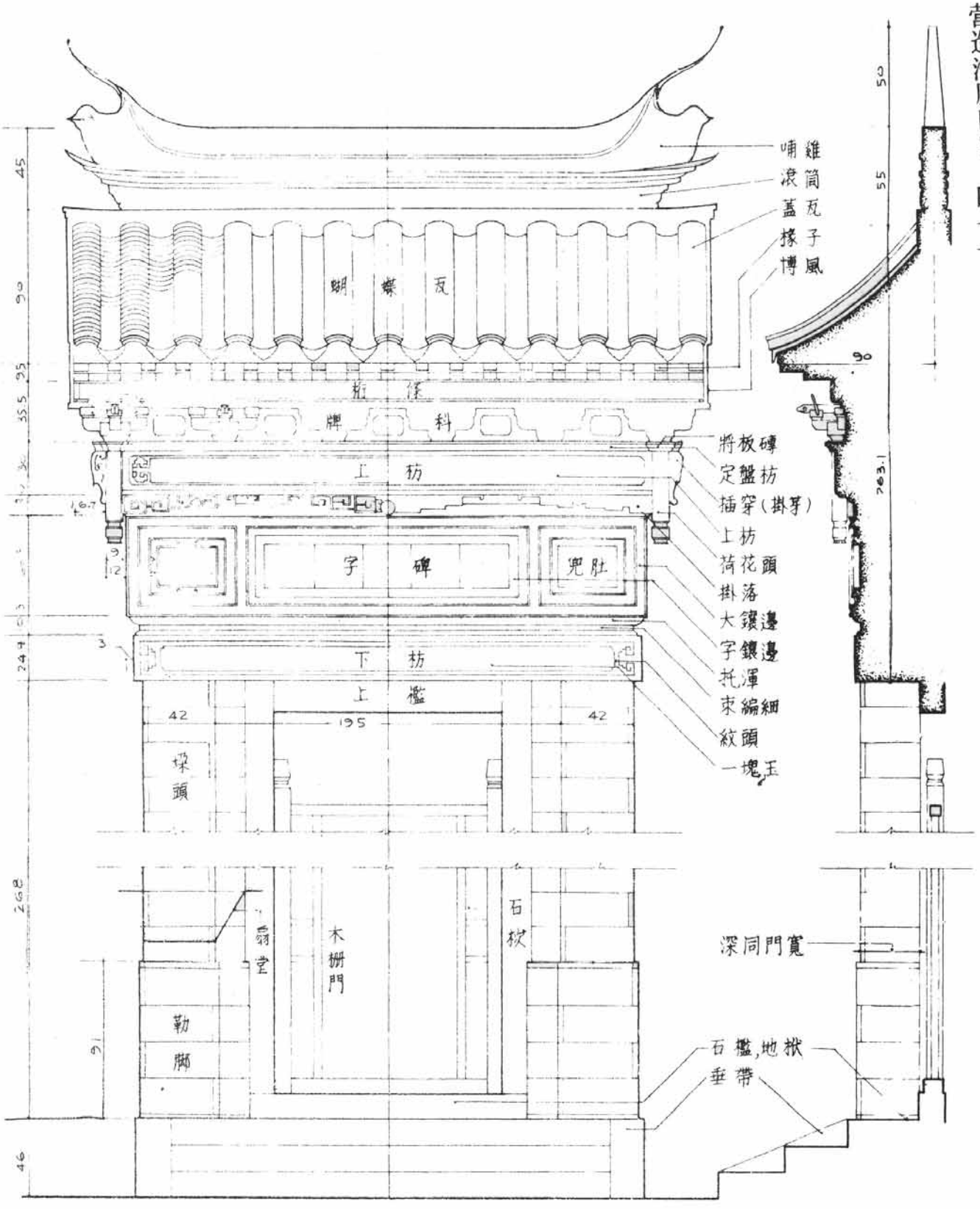


各式屋脊

本圖所註尺寸以寸爲單位

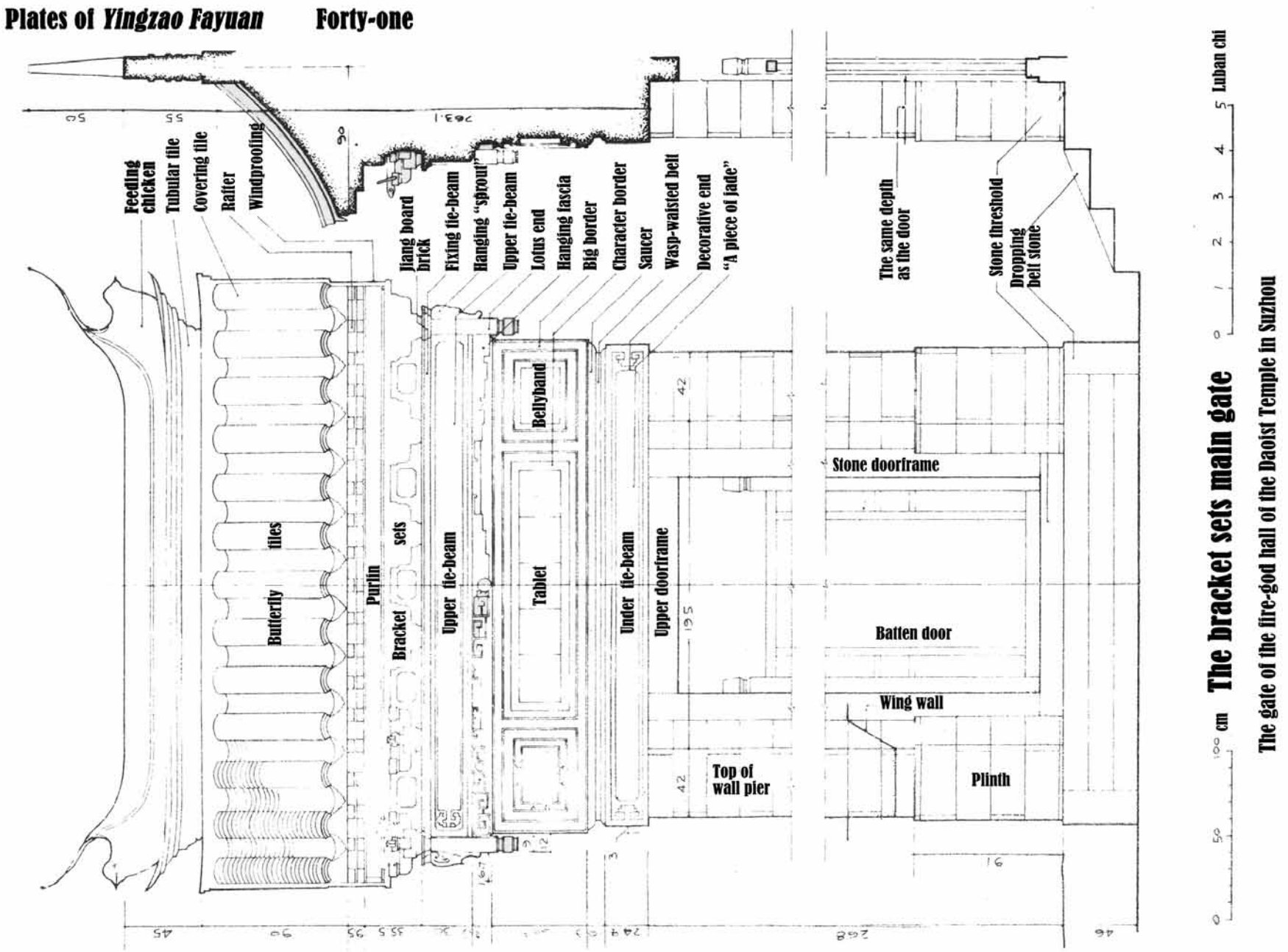

Plates of Yingzao Fayuan Thirty-nine
Soft feather ridge
The bend line set by worker, and the long iron board is need under the ridge.
Decorative head ridge
The end of main ridge must shorter than the end old tiles.
Border land
Tile strip
Feeding dragon ridge
Climbing ridge
Sugarcane ridge
Gray endshield
Bamboo joint tiles
The main ridge of halls
The end of older tiles are perpendicular to plinth
Decorative head ridge
Dropping head is four cun height, instead of tubular tile.
Feeding chicken ridge
Tubular tile
Seat plate brick
The bend and pattern of ridge are set by the worker. The number of tile strips also may enhance or delay.
The main ridges of halls or palaces
Trident
Vertical belt
Wen-shou stylobate
Dragon holding ridge
(five sets)
The dragon holding and the lions on ridge are kiln burn. The main ridge is making by the mason.
Fish-dragon holding ridge
(three sets)
Covering tile
Tile strip
Decorative tile (five cun)
tablet
Decorative tile
Tubular tile (seven cun)
All kinds of main ridge finials
(The measurement unit in this drawing is cun.)
Luban chi
cm

营造法原图版 四十一



0 50 100 公分 牌科門樓 0 1 2 3 4 5 魯班尺

蘇州玄妙观火神殿


Plates of Yingzao Fayuan
Forty-one
Feeding chicken
Tubular tile
Covering tile
Rafter
Windproofing
Jiang board brick
Fixing tie-beam
Hanging "shroud"
Upper tie-beam
Lotus end
Hanging fascia
Big border
Character border
Saucer
Wasp-waisted belt
Decorative end
"A piece of jade"
The same depth as the door
Stone threshold
Dropping bell stone
Luban chi
Butterfly tiles
Purlin
Bracket sets
Upper tie-beam
Tablet
Bellyband
Under tie-beam
Upper doorframe
Stone doorframe
Batten door
Wing wall
Plinth
Top of wall pier
The bracket sets main gate
The gate of the fire-god hall of the Daoist Temple in Suzhou
cm

Appendix 2

Selection Technical Terms in the Original Drawings

1.1 Counting room (*zhangfang* 帳房) was the butler's or a master male servant's office, and the host and hostess could come here to supervise his work.
1.2 Kitchen (*zao ting* 竈廳) is for use of the cook and maids who help in the kitchen.
1.3 Reception room (*haofang* 號房) is where the men work in numbering room were door keepers.
1.4 Janitors' room (*menfang* 門房) is the place for doorman working.
1.5 Mandarin duck style hall (*yuanyang ting* 鴛鴦廳) meant good wishes and two different meeting rooms sharing one building.
1.6 Boat roof style hall (chuan ting 船廳) is a boat shape building, usually in the garden, near the pool.
1.7 Wall gate (*qiang men* 牆門) is the main gate.
1.8 Sedan chair hall (*jiao ting* 轎廳) is where the sedan chair hall is the place for the guests' chair men to have a cup of tea and relax.
1.9 Reading room (*shu ting* 書廳) is the study room for the host
1.10 Book collection belvedere (*shu lou ge* 書樓閣)is the working room for the host.

2.1 Covered arcade (*gong zi* 公字) is the structure which is attached to a gate, having a plan shape likes the Chinese word "工", and a section shape likes the Chinese word "公".
2.2 Wooden main gate (*ku men* 庫門) is "a style of wooden main gate, built inside of a wall gate".
2.3 Subordinate eave (*fu yan* 副簷) is shown clearly in the cross-section. It is attached to the two-storey tower, but just has one storey.
2.4 Circular corridor (*hui lang* 回廊) is a typical Chinese corridor, which runs around buildings, usually not straight, irregular with or without rooms in one side.
2.5 Visiting covered corridor (*you lang* 遊廊) is the irregular covered corridor used in the garden.
2.6 The ladies' tower (*nv ting lou* 女廳樓) is for the female's social life and daily life.
2.7 Inner living room (*nei shi* 內室) is for the female's social life and daily life.
2.8 *Tie 貼 is the cross-section of a plan, which shows the purlins and beams of the structure.*
2.9 *Tie yang 貼樣 is the style of cross-section.*

3.1 The central structures (*zheng tie* 正貼) is a cross-section through the centre of the plan.
3.2 The side structure (*bian tie* 邊貼) is a cross-section through the side of the plan
3.3 The standard width (*kaijian* 開間) is each bay of the width of a building.
3.4 The total width (*miankuan* 面寬) is each bay of the width together with the bays of the building.
3.5 *Jie* 界 is each bay along the depth of a building.
3.6 The total length (*jinshen* 進深) is each bay along the depth together with the bays of the building.
3.7 *Jian* 間 means each bay.

3.8 *Bu* 步 is step or span, the distance from purlin to purlin.
3.9 Three-columned beam (*san jia liang* 三架梁) is a top beam that crosses two bays, having three short columns on the beam.
3.10 Main beam (*da liang* 大樑) is also known as five-columned beam, and there can be seven-columned beams or nine-columned beams in a large house.
3.11 Mountain-columned (*shan jia liang* 山架梁) is a three-columend beam in Yao's drawing.
3.12 *Shan jie liang* 山界梁 is modern edition of *shan jia liang*.
3.13 Aisles (*lang* 廊) are explained as a "roofed open corridor usually connecting two buildings".
3.14 Short post is used to describe the length of these structures.
3.15 The *Jin* column (今柱) is also known as "gold column 金柱" or "lapel column 襟柱".
3.16 Short tenoned beams (*chuan* 川) are of one bay length, with one end bearing on a purlin, the other end set on the columns.
3.17 Verandas *chuan* 水平川 is used for verandas short tenoned beams.

4.1 *Ting* hall 廳 uses rectangular timbers to divide halls.
4.2 *Tang* hall 堂 uses cylindrical timbers to divide halls.
4.3 *Bian-zuo* hall 扁作 is another name of the ting hall.
4.4 *Yuan-tang* hall 圓堂 is another name of the tang hall.
4.5 *Subordinate rafter* 軒 is the part which is added in front of the inner four-*jie* to make the total length of the building deeper.
4.6 Double-span beam (*Shuangbu* 雙步) is a beam that crosses two bays, with one end bearing on a purlin and the other end set on a column.
4.7 Crane's neck subordinate rafter 鶴頸軒 is a style of bent rafters, and has the shape of a Chinese crane's neck.
4.8 Chin up subordinate rafter is a kind of subordinate rafter, in which the ceiling of the subordinate rafter has same height as the ceiling of the inner four-*jie*.
4.9 Three-bends rafter 抬頭軒三灣椽 is another style of curved rafter, which has three bends.
4.10 Kowtow subordinate rafter 磕頭軒 is the style that the ceiling of the subordinate rafter is lower than that of the inner four-*jie*.
4.11 *Shan-yun-wu* style 山雲霧 is a superstructure board with "clouds and fog in mountains" decorative pattern.
4.12 Brow short tenoned beam 眉川 is on a back double-span beam.
4.13 Camel short tenoned beam 駱駝川 is another name of brow short tenoned beam.
4.14 *Cao-jia* frame 草架 is also called the "Rough-frame" superstructure in *the craft of gardens*, makes the top of the roof above all the beams.
4.15 *Lou-ting* 樓廳 is the big size double storey hall with subordinate rafters up and downstairs
4.16 Soft overhanging (*ruan tiaotou* 軟挑頭) uses a short material to connect with the column, and a diagonal bracing to support the projecting parts so that it looks like a canopy
4.17 Hard overhanging (*ying tiaotou* 硬挑頭) uses a beam or other outrigger beams to support a balcony or canopy.
4.18 Nesting eaves (que suo yan 雀縮簷) is a structure which is connected to the main structures with a short tie-beam, supported by a diagonal bracing, covered with an eaves.

5.1 The riding gallery (*qi-lang* 騎廊) is the gallery which the upper front aisle columns are held-back further than the lower front aisle columns.

6.1 Mandarin duck style hall (*yuanyang ting* 鴛鴦廳) is a tall hall which is divided by the ridge column.
6.2 Basket of flowers" style hall (*hua-lan ting* 花籃廳) is a hall with floating *bu* columns, instead of with a "basket of flowers" end.
6.3 Hanging lotus" columns (*chui lian zhu* 垂蓮柱) are floating *bu* columns.
6.4 Screen door (*pingmen* 屏門) is used to set the central room.
6.5 Partition board (*ge shan* 隔扇) is used to set the central room.
6.6 Tall window (*chang chuang* 長窗) is used in the tall window.
6.7 *Hehe* awning window (*he-he chuang* 和合窗) is used in the last room.
6.8 *Palatial "basket of flowers" style hall 貢式花籃廳 uses the "handing lotus" column 垂蓮柱, and the cuboid timber instead of the cylindrical timber.*
6.9 Fixed boat style pavilion (*han chuan ting* 旱船廳) is a parlour imitating a fixed boat beside the bank of the lake.
6.10 Stone boat (*chuan ting* 船廳) is also known as the "return" hall, *hui* ting.

8.1 The "cloud head" is a part of a *paike*, which is used to support the *zi* purlin.
8.2 Component of *ping* (*ping liao* 軿料) refers to combine two or three piece of timbers to make the big double sized one.
8.3 *Dou* 斗 is a cubic component, with shape like the standard measurement tool *dou*, and it has a wide top and a narrow bottom.
8.4 *Gong* 栱 is a piece of board with a quadrate cross section and arched shape.
8.5 *Sheng* 升 is similar toa *dou*, but smaller. The shape is like the standard measurement tool *sheng*.
8.6 *Ang* 昂 is a kind of *gong* which is perpendicular to the purlin, and one of it stop arms is extended and carried down.
8.7 Sitting *dou* 坐斗 is the square on the bottom of the *paike*
8.8 The outside bearings (chu shen 出參) refers to the *paike* bracketing out inlayers to bear the weight of the eaves.

10.1 *Bahai* 拔亥 is the end of a beam, which has been chipped off to make it easy to place on the top of the sitting *dou* or the columns.
10.2 Solid *gong* 實栱 is a type of *gong*, with a greater capacity of bearing, to which has been added as much height as the *sheng*.
11.1 Gathering fishes" jointed style (*ju-yu he-sun* 聚鱼合榫) is a group of inserted tenons which are used to joint different parts of upper structures resting on an eave column of a hall.
11.2 Pin hole (*xiao-yan* 銷眼) is a tiny hole for driving in a small wooden peg to fix the tenon.
11.3 Piercing groove (*chuan-kou-zai* 穿口仔) is a kind of connecting tenon.
11.4 Line of rib surface (*ji-mian xian* 几面线) shows how deep the groove must be for the purlin.
11.5 Cutting bottom (*wa di* 挖底) makes the beam more light and elegant, just like pillars contract.

14.1 *Ti-zhan* 提棧 is rising the roof frames in order.
14.2 *Li-kou* wooden batten 里口木 is a batten between outside the eave and flying eave to fill the gaps between rafters.
14.3 *Wa-kou* board 瓦口板 is a board carved to follow the waves of tiles to stabilize the tiles at

the end of the eaves.

15.1 The style of *shan-wu-yun* 山雾云 is used with the five-seven *cun* bracket sets and the "*pu* toe cap".
15.2 *Zhao-mu* 棹木 is a decorative carved board put on the bottom of the main beam, and up on the "pu toe cap".

16.1 "Clouds around beam" 抱梁雲 is a kind of pure ornamental decorative carving board, which is put besides the beam and purlin.

20.1 Making *qiang* (*fa qiang* 發戧) means making the corner roof in a rising angle ridge.
20.2 The older *qiang* (*lao-qiang* 老戧) is the corner beam at the roof corner, which is always fixed on the aisle purlin or *bu* purlin.
20.3 The younger *qiang* (*nen-qiang* 嫩戧) is the smaller corner beam, which is fixed on the older *qiang.*

21.1 Rate net rafters (*shuai-wang chuan* 摔網椽) is a set of rafters extending from the outside eave rafter to the flying rafter at the corner of the frame

22.1 Wood-bone rising angle ridge (*mu-gu fa* 木骨法) refers to the wooden frames of the rising angle ridge.
22.2 *Wen-shou* 吻獸 is an ornamental group of roof tiles set on the corner roof ridges and at both ends of the main ridge.

28.1 The wing wall 扇堂 is a couple of splayed walls, which are the supports for the opening doors.
28.2 Gate building (*men lou* 門樓) is the gate with a brick tie-beam or bracket sets, and having roof on the top
28.3 Wall gate (*qiang men* 牆門) is another name of gate building.

Date of the Chinese Dynasties

Xia Dynasty	夏朝	2070 – 1600 B.C.	470
Shang Dynasty	商朝	1600 – 1046 B.C.	554
Zhou Dynasty	周朝	1046 – 256 B.C.	790
Western Zhou Dynasty	西周	1046 – 771 B.C.	
Eastern Zhou Dynaty	东周	770 – 256 B.C.	
Spring and Autumn Period	春秋	770 – 476 B.C.	294
Warring States Period	战国	475 – 221 B.C.	254
Qin Dynasty	秦朝	221 – 206 B.C.	15
Han Dynasty	汉朝	206 B.C. – 220 A.D.	426
Western Han Dynasty	西汉	206 B.C. – 25 A.D.	
Eastern Han Dynasty	东汉	25 – 220	
Three Kingdoms	三国	220 – 280	60
Wei	魏	220 – 265	
Shu Han	蜀	221 – 263	
Wu	吴	222 – 280	
Jin Dynasty	晋朝	265 – 420	155
Western Jin Dynasty	西晋	265 – 316	
Eastern Jin Dynasty	东晋	317 – 420	
Southern and Northern Dynasty	南北朝	420 – 589	169
Southern Dynasty	南朝	420 – 589	
Liang Dynasty	梁朝	502 – 557	
Northern Dynasty	北朝	439 – 581	
Sui Dynasty	隋朝	581 – 618	37
Tang Dynasty	唐朝	618 – 907	289
Five Dynasty and Ten Kingdoms	五代十国	907 – 960	53
Five Dynasty	五代	907 – 960	
Ten Kingdoms	十国	902 – 979	
Song Dynasty[1]	宋朝	960 – 1279	319
Northern Song Dynasty	北宋	960 – 1127	
Southern Song Dynasty	南宋	1127 – 1279	
Yuan Dynasty	元朝	1279 – 1368	89
Ming Dynasty	明朝	1368 – 1644	276
Qing Dynasty	清朝	1644 – 1911	267

[1] "Dates of the Chinese Dynasties" in *The Craft of Gardens: The Classic Text on Garden Design*, Ji Cheng, Alison Hardie,tran., (New York: Better Link Press, 2012), p.139. There still had the Liao Dynasty 遼, Jin Dynasty 金 and Xixia 西夏 Dynasty exist at the time of the Song Dynasty. They all did not belong to the Han nationality and out of Central Plains of China 中原, so do not be shown in the table.