Fan-Shaped Bracket Sets and Their Application in Religious Timber Architecture of Shanxi Province

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Abstract
The dissertation challenges one of the most distinctive features in traditional Chinese architecture, the bracket set known as dougong 斗栱, and discusses diverging stylistic variations that actually existed in Shanxi province 山西省 between the eleventh and nineteenth centuries against the background of official-style building. The key challenge was to see beyond the long lasting stereotypes in China that did not allow full acknowledgement of the wide range of corbelled clusters with bracket-arms projecting at acute or obtuse angles to the wall plane i.e. xiegong 斜栱, and the importance of such non-conformity. The scope of research was limited to the extant pool of timber structures in Shanxi officially designated as key national heritage conservation units between 1961 and 2006. Through visual and textual study and especially through on-site field work the author collected quantitative and qualitative data with regard to the possible containment of fan-shaped bracket sets, hereafter named shanshi dougong 扇式斗栱, and the tightly spaced, grid-like scepter bracketing known as ruyi dougong 如意斗栱. As a result, the thesis formulates the necessary nomenclature and appropriate methodology along with proper guidelines for discussing the rich pool of xiegong-architecture in the future. With special emphasis on the Jindongnan area in southeast Shanxi, it proves the highly flexible, underlying concept of yielding to different regional and local construction methods, and to environmental and economical conditions.

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FAN-SHAPED BRACKET SETS
AND THEIR APPLICATION IN RELIGIOUS TIMBER
ARCHITECTURE OF SHANXI PROVINCE

Alexandra Harrer

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Degree of Doctor of Philosophy
2010

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PROVINCE

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Alexandra Harrer
For my parents and to the best of all possible worlds
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Alexandra Harrer
Dissertation Supervisor: Nancy Shatzman Steinhardt

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1 Most of the photographs are taken by the author, but some are published by courtesy and permission of Ju Kaifu 巨凯夫, Liu Yan 刘妍, Shi Fei 是菲, Sun Can 孙璨, and Xiang Rui 相睿.
INTRODUCTION

The Amitābha Hall or Mituodian 弥陀殿 (d. 1143 C.E.) of Chongfu Monastery 崇福寺 in the prefecture seat of Shuozhou 朔州, a majestic, large-scale Buddhist complex, is the pinnacle of medieval timber craftsmanship in the former Khitan ruled part of present-day Shanxi province. The desire for perfection is ubiquitous and dominates the modular design of the awe-inspiring hall as well as the artistically carved lattice shutters for its windows and doors.

By contrast, the undated Main Hall at the Temple of the Two Transcendents 二仙庙 just outside Xiaohui village 小会村 in Lingchuan county 陵川县, Jincheng prefecture 晋城市, a typical one-courtyard complex affiliated with popular folk religion in southeast Shanxi, is embedded in the rugged, unspoiled countryside. It looks humble and modest measuring only a fifth of the length and less than a third of the depth of the grand structure in Shuozhou.¹

At first glance, the two buildings seem as different as night and day, both in terms of monastery design and history. However, closer inspection reveals a most astonishing similarity. Both structures use a special type of the eye-catching Chinese bracket set, where bracket-arms stick out at a 45 degree angle to the wall plane.

Generally speaking, bracket sets are the most noteworthy features in traditional Chinese architecture and among the most telling characteristics for distinguishing between the different building traditions of dynasties or geographic regions. Whereas regular bracket sets usually consisted of bracket-arms that were parallel and

¹
perpendicular to the façade, the addition of angled bracket-arms became common with the Liao dynasty 辽朝 (947-1125 C.E.). Up to the present, the puzzling phenomenon of such unorthodox bracketing that mimics the shape of an open fan has caused confusion in the field of Chinese art history.

The individual fan-shaped bracket sets certainly differ in design. The larger Amitābha Hall displays more than twice the amount of corbelled clusters as the Main Hall of Xiaohuiling Erxianmiao, among which are nine angular arrangements. The latter comprises the highest number of fan-shaped bracket sets among all of Shanxi’s cultural relics dating prior to the mid-thirteenth century that are protected at the national level in China. The contrast could hardly be starker since the Main Hall of Xiaohuiling Erxianmiao features only a single angular arrangement that perches in-between the flanking columns of the front façade’s central bay.

This thesis presents my study of bracket sets with angled bracket-arms and their application in present-day Shanxi from the formative periods before the Yuan dynasty 元朝 (1267-1368 C.E.) to their flourishing in late imperial China. A goal of this study is to solve their thrilling mystery.

1 The author owes gratitude to the Research Institute for Traditional Architecture and Conservation in Taiyuan for providing preliminary information and architectural plans that made it possible to discuss the bracketing of Xiaohuiling Erxianmiao.
I  PART ONE

Chapter 1:  Fundamentals of Chinese bracketing

1. General terminology and definition of bracketing

   a) Nomenclature of the Chinese bracket set

       Much has been written about the skillful mounting of bracket-arms and the intricate terminology of individual bracketing members, which is why this thesis just provides a short summary of the fundamental principles of bracketing and assemblage.

       In the first place, in terms of methodology it is imperative to differentiate between the individual component of the bow-shaped timber “bracket” that consists of two symmetrical bracket-arms and the organic (i.e. organized) bracketing unit of the complex “bracket set”.¹ Nancy Steinhardt writes of the Chinese bracket set as “composed of dou (blocks) and gong (arms). These two terms combine to make the modern word for bracket set, dougong. The term used in the Yingzao fashi is puzuo, which was also employed in combination with a number to designate the rank and associated complexity of a corbel-bracket cluster.”² In other words, the Chinese bracket set of the past was known under various names, including the term puzuo 铺作 in official twelfth century Song dynasty architecture, douke 斗科 in official eighteenth century Qing dynasty terminology, and paike 牌科 in the technical language of late imperial craftsmen in the regional workshops of Suzhou 苏州, Jiangsu province 江苏省. Modern scholarship uses
the names alternately including the term “bracket set” or “puzuo-set” and the colloquial expression “dougong 斗拱”.3

To be more precise, Guo Daiheng explained that three basic components were crucial for corbelled clusters to qualify as official bracket sets of the Song dynasty, namely the large bearing block called ludou栌斗, the “trifling-tip” or decorative nose called shuatou耍头, and the “uppermost perpendicular timber in a bracket set” called chenfangtou衬枋头 (Figure 1-1).4 In fact, if there was no ludou, the arrangement could not be considered a “bracket set” in the strictest sense, because the compressive stress was not evenly transmitted onto the column shaft since it lacked abutment. If there was no shuatou, the stable position of the uppermost bracket parallel to the building wall could not be guaranteed. Likewise, if there was no chenfangtou, the necessary support of the eaves (-raising) joist or liaoyanfang撩檐枋 could not be provided.

It is telling that several examples of regional architecture in Shanxi province, which are discussed in part two and three of this thesis, show deviation from this standard rule. In fact, the technical terminology of the imperial building codes cannot fully capture the creative way of bracketing in non-official buildings.

To complicate matters, the term puzuo also refers to architectural design and hierarchical rank of the bracketing unit, since it can indicate the number of transversal bracket or slanting cantilever arms that step out directly perpendicular to the wall plane, namely four-puzuo, five-puzuo, six-puzuo, seven-puzuo, and eight-puzuo (Figure 1-10). In the spirit of the early twelfth century architectural grammar book Yingzao fashi 营造法式 by the Northern Song dynasty scholar-official Li Jie 李诫 (courtesy name 字
Mingzhong 明仲, ?-1110 C.E.), the smallest possible variation of least importance was a corbelled cluster of four-*puzuo* that consisted of the three basic components plus one perpendicular extension that projected at a right angle to the building façade.\(^5\) This general principle can be expressed by the simple equation below:

\[ \text{出跳数} + 3 = x-(\text{层}) \text{puzuo} \]

E.g. one step of projecting arms: \(1 + 3 = \text{a bracket set of 4-puzuo} \) (i.e. four layers)

\[ b) \text{ Composition of official Song dynasty bracket sets and their individual members} \]

To start with, the early twelfth century *Yingzao fashi* (Treatise on Architectural Methods) lists five basic types of bow-shaped brackets or half-brackets (i.e. bracket-arms) that are distinguished according to their placement within the corbelled cluster (Figure 1-2; Figure 1-3; Table 1-1).\(^6\)

The first group of brackets comprises *huagong* 华拱 or “petal bracket-arms” (with a length equal to 72 sections), which are structurally the most important members and usually step out directly perpendicular to the wall plane. Hereafter *huagong* are also referred to as “perpendicular bracket-arms” or “transversal bracket-arms.” In fact, angled bracket-arms called *xiegong* 斜栱 belong to this category.

By contrast, the remaining four types are all placed within or parallel to the façade. Hereafter such brackets are also referred to as “parallel brackets” or “longitudinal brackets”. In Chinese scholarship they are often referred to as *henggong* 横栱. The name is somehow misleading since the Chinese expression of *henggong*, which literally translates as “cross-wise brackets,” does not refer to their placement with regard to the
wall plane (i.e. parallel) but rather to their direction with regard to the basic brackets called *huagong* that carry them.

First, *nidaogong* or “plaster channel brackets” are symmetrical bow-shaped timbers within the wall plane that directly rest on the large bearing blocks (with a length equal to 62 sections).

In contrast, the second group of brackets called *guazigong* or “melon-seed brackets” (shortest in length, with a length equal to 62 sections) is not part of the building plane itself but rather installed at a distance. These brackets rest on the small bearing blocks on top of the first step of perpendicularly projecting bracket-arms or *huagong*. If there is a second layer of parallel brackets above them, they are called *mangong* or “extended brackets” (longest in length, with a length equal to 92 sections) and form the next group. Fourth, *linggong* or “lead brackets” (with a length equal to 72 sections) are the uppermost parallel bow-shaped brackets that carry longitudinal joists, namely *liaoyanfang*, at the exterior and *suantingfang* at the interior of the building.  

Likewise, the *Yingzao fashi* lists four main types of bearing blocks that act as the points of intersection between the multiple horizontal layers of interlocking brackets (Figure 1-4). First, the large bearing block called “cap block” or *ludou* (with a ratio of length to width equal to 32x32, 20 sections high) that is directly tenoned into the top of the column or the body of the architrave when there are intercolumnar bracketing. Second, the small rectangular bearing blocks with cruciform openings (i.e. four “ears”) called “connecting blocks” or *jiaohudou* (usually with a ratio of length to width equal to 18x16 sections, 10 sections high) that are placed on top of *huagong* or *ang* and which in
turn support a second bracket (guazigong or linggong). Third, the small square bearing blocks called “center blocks” or qixindou 齐心斗 with openings of varying shape (with a ratio of length to width equal to 16x16 sections, 10 sections high) that are placed at the mid-point of a bow-shaped bracket perpendicular to the wall plane or at the central axis of the whole bracketing unit to support another bracket, lintel, or joist above. Fourth, the smallest bearing blocks called “end blocks” or sandou 散斗 with one-dimensional opening (with a ratio of length to width equal to 16x14 sections, 10 sections high) that guard the two end-points of the brackets parallel to the wall plane.

Officially, there are two main types of structural, true slanting cantilevers, namely the downward pointing cantilever called xia’ang 下昂 and the upward pointing cantilever called shang’ang 上昂 (Figure 1-5). Additionally, the tail of the true descending cantilever at intercolumnar bracketing of timber halls without interior ceiling is known as tiaowo 挑斡 if it supports the lowest eave purlin. To complicate matters, the same term also refers to an interior slanting cantilever arm that does not pierce through the building plane and project at the outside. Furthermore, there are the inserted descending cantilever arm called cha’ang 插昂, the first layer of descending corner cantilevers called jiao’ang 角昂, and the second layer called you’ang 由昂.

c) Assemblage of official Song dynasty bracket sets

Bracket sets can be differentiated in manifold ways including the visual placement within the building, such as corbelled clusters that rest on exterior eave columns or interior columns, or those that are placed on top of beams. Usually, they are
further distinguished according to their intercolumnar or column-top position, and in case of the latter, between the locations on top of regular eave columns or corner columns.

A key question is the nature of the individual members and their arrangement in the organic unit. For instance, *xia’angzao* 下昂造, or *shang’angzao* 上昂造 are two different ways of bracketing that use the descending or ascending cantilever, and if such slanting members are completely omitted, the formation is known as *juantouzao* 卷头造 (Figure 1-5). More importantly, it is necessary to pay attention to the direction in which the bracket-arms are applied and consider whether they step out of the bearing blocks parallel or perpendicular to the wall plane. Assuming an ideal case with orthogonal design, regular eave bracketing of the Song dynasty comprised projections along the four cardinal directions within the same horizontal (projection) plane (i.e. two arms parallel to, one arm at the exterior of the building perpendicular to, and one arm at the interior of the building perpendicular to the wall plane). In the period of formation, transversal bracket-arms did not yet project symmetrically from the large bearing block (toward the) outside and inside of the building. In fact, even upon maturation, the design of the exterior projection called *waitiao* 外跳 and the interior projection called *litiáo* 里跳 could differ (Figure 1-6).

Additionally, the use of brackets that are placed parallel to the wall plane is significant, especially in identifying pre-Song dynasty architecture or Southern Chinese building style. Broadly speaking, “stolen-heart” design or *touxinzao* 偷心造 refers to the lack of parallel brackets such as *guazigong* or *mangong* (Figure 1-44; Figure 1-47). Strictly speaking, it describes the corbelled clusters where only the uppermost transversal
member (i.e. *huagong* or *ang*) supports a bracket parallel to the façade called *linggong*\(^\text{14}\).

In case of the more advanced “filled-heart” design or *jixinzao* 计心造, the “perpendicular bracket-arms (*huagong*) hold both a parallel bracket-arm (usually *guazigong* or *linggong*) and the next level of perpendicular extension (either another *huagong* or a descending cantilever).”\(^\text{15}\)

Simple forms of bracketing did neither necessarily follow such rules nor apply “true” perpendicular extensions in the narrower sense (Figure 1-7).\(^\text{16}\) This includes the arrangement called *dantouzhiti* 单斗支替,\(^\text{17}\) which lacks bracket-arms and reduces the complex layering to the large bearing block, and one longitudinal timber called *timu* 替木.

It can be seen at exterior eave bracketing along the façade in early period architecture at the Northern Wei 北魏 Yungang cave 云冈石窟 number nine, Shanxi province, or at the Northern Song stone bridge called Zhaofeiliang 鱼沼飞梁 in front of the Sage Mother Hall 圣母殿 at Jinci 晋祠 in Taiyuan 太原, Shanxi province. Additionally, it is known as *daito hijiki* 大斗肘木 in Japan, for example at the eighth century Denpōdō 伝法堂 in the East Precinct of Hōrūji 法隆寺 in Ikaruga, Nara prefecture (the earliest extant example of residential architecture in East Asia). In fact, it is also a cost-saving construction method that becomes common in late imperial China. The Song dynasty manual lists another form of simple bracketing called *batoujiaoxiangzuo* 把头绞项作, an arrangement where the *timu* acts as *linggong*, and the head of the cross-beam that pierces through the building plane forms the *shuatou*. In practice, this non-projecting bracket complex is better known under the Qing dynasty name of *yidousansheng* 一斗三升 or “three-on-one”
and matches the Japanese (hira)mitsudo (平三斗) (also called mitsudo tokyō 三斗斗きょう or mitsudogumi 三斗組) at the Large Lecture Hall 大講堂 of Hōryūji (Heian period, 990 C.E.). By contrast, the term doukoutiao 斗口跳 describes a third way of simple bracketing with seemingly regular transversal projections. Nevertheless, at closer inspection, it is not a bracket-arm but rather the head of the beam that steps out of the wall plane and carries the next layer in bracketing (equal to the liaoyanfang).

d) Problems in defining (official) Chinese bracket sets

One of the key problems in research of traditional Chinese bracketing is the intricate technical terminology (Table 1-1). Not only because the official vocabulary is often insufficient to explain the hybrid forms or local variations in regional style building but also because the official language itself underwent change (Figure 1-8). Just as a reminder, whereas the twelfth century Yingzao fashi used the term puzuo, the eighteenth century counterpart Gongbu gongcheng zuofa 工部工程做法 (Building Methods of the Board of Works) of ca. 1734 used the term cai 踩 to describe architectural design of successive tiers of huagong and ang and hierarchical rank of the Chinese bracket set. Their “rules of thumb” read as follows:

Song dynasty manual entitled Yingzao fashi:

Once the number of projecting steps 出数 + 3 = x-(layered) puzuo 铺作
E.g. one step of projecting arms: 1 + 3 = a bracket set of 4-puzuo (i.e. layers)
E.g. two steps of projecting arms: 2 + 3 = a bracket set of 5-puzuo (i.e. layers)
E.g. three steps of projecting arms: 3 + 3 = a bracket set of 6-puzuo (i.e. layers)
E.g. five steps of projecting arms: 5 + 3 = a bracket set of 8-puzuo (i.e. layers)
Qing dynasty manual entitled *Gongbu gongcheng zuofa*:

Twice the number of projecting steps in Chinese is given by the formula: $2 \times n + 1 = a$ bracket set of $y$-cai 踩.
- E.g. one step of projecting arms: $2 \times 1 + 1 = 3$-cai 踩 (i.e. layers)
- E.g. two steps of projecting arms: $2 \times 2 + 1 = 5$-cai 踹 (i.e. layers)
- E.g. three steps of projecting arms: $2 \times 3 + 1 = 7$-cai 踹 (i.e. layers)
- E.g. five steps of projecting arms: $2 \times 5 + 1 = 11$-cai 踆 (i.e. layers)

To put it into plain English, the simplest type of bracket set, known as *sipuzuo* 四铺作 in the *Yingzao fashi*, is known as *sancai* 三踩 in the *Gongbu gongcheng zuofa* (Figure 1-9). If we take a further advanced corbelled cluster with three perpendicular extensions as an example, or to be more precise, with one single bracket-arm and two tiers of descending cantilevers that step out directly perpendicular to the wall plane, then the official Song dynasty arrangement known as *danchao shuangxia’ang liupuzuo* 单抄双下昂六铺作 corresponds to the Qing dynasty design called *danqiao zhong’ang qicai* 单翘重昂七踩. Likewise, if we take a bracket set with five perpendicular extensions as an example, or to be more precise, with two bracket-arms and three tiers of cantilevers, then the official Song dynasty arrangement known as *shuangchao sanxia’ang bapuzuo* 双抄三下昂八铺作 matches the Qing dynasty design called *zhongqiao san’ang shiyicai* 重翘三昂十一踩.

Additionally, the workshops of Suzhou in Jiangsu province used local language to count the number of horizontally piled up bracketing layers and perpendicularly projecting arms. They represent the rich body of regional building traditions south of the Yangtze River in late imperial China. For example, *puzuo* or *cai* was known as *chucan* 出参 but the way of counting was similar to the official Qing dynasty language in the north.
The following table gives a rough idea of the varying terminologies that were used in different Chinese dynasties and geographical areas.

In Japanese, bracket sets are called *masugumi* 斗組, *tokyō 斗きょう*, or *kumimono 組物*. Bracket-arms are generally referred to as *hijiki 肘木*, bearing blocks as *masu 斗*, and descending cantilevers as *odaruki 尾垂木*. More importantly, the *puzuo*-projection is known as *degumi 出組*. In contrast to the Chinese ways of counting bracketing layers, only the bracket-arms that eventually step out perpendicular to the wall plane are taken into consideration. For example, a Chinese bracket set of five-*puzuo* that is composed of two transversal steps and three basic components (i.e. *ludou*, *shuatou*, and *chenfangtou*) is called *futatesaki tokyō 二手先斗きょう*, *futatesakigumi 二手先組*, or *futatesaki kumimono 二手先組物* in Japanese, a name that emphasizes the two perpendicular extensions. Likewise, a Chinese bracket set of six-*puzuo* that is composed of three steps is known in Japan as *mitesaki tokyō 三手先斗きょう* or *mitesakigumi 三手先組*.

It is important to keep in mind that traditional Chinese and Japanese bracketing cannot fully match, neither in methodology nor terminology. Even though the building style of China greatly influenced neighboring regions and adjacent countries, Japanese architecture shows distinctive features that have no counterpart in extant timber structures of China or the official language of Chinese building. More importantly, the literal translation of certain bracketing members is often misleading. For example, the Chinese term *huagong 华拱*, usually translated as “flower or petal bracket-arm” in English, refers to the only transversally projecting and structurally most important bracket-arm in
corbelled clusters of traditional Chinese architecture. By contrast, in Japanese carpentry a “flower bracket” or *hanahijiki* 花肘木 describes a decorative, bow-shaped bracket that is parallel or placed within the wall plane, for example at the Great South Gate of Hōryū-ji 南大門 (Muromachi period 室町時代, 1438 C.E.) (Figure 1-11). In fact, it runs directly perpendicular to the Chinese counterpart. This Japanese feature is rather similar to the design of Chinese *yidouersheng* 一斗二升 or “two-on-one” bracketing that is called *narabito* 双斗 or *futatsudo tokyo* 二斗斗きょう in Japanese language.

In the past, different theories and methods of translation caused considerable damage and confusion when paraphrasing the original Chinese terminology into secondary languages. At this point, the author would like to emphasize the urgent need for a digital database that provides an alphabetical arrangement of the words and their standardized definitions in multiple languages including (at least) classical and modern Chinese, English, German, French, and Japanese. In the meantime, it seems reasonable to use the common national romanization system for Chinese language in Western publications and phonetically transcribe the highly specialized technical terms of bracketing that otherwise remain unexplainable.

2. **Basic principles of angular bracketing and angled bracket-arms**

Whereas bracket sets usually consisted of bracket-arms that were parallel and perpendicular to the wall plane, in the medieval periods, the addition of angled bracket-arms became common. Known as fan-shaped bracket sets or scepter bracket sets, they
consisted of members that projected in various directions, including acute and obtuse angle.

Due to the lack of a standardized definition for fan-shaped bracket sets, there is confusion among authors whether some buildings actually apply such angular arrangements and what kind. This thesis tackles the problem and formulates an accurate definition of the fan-shaped bracket set and the angled bracket-arm called xiegong 斜栱 against the whole body of differing terminology in Chinese and English, such as jiaogong 角栱, mojiaogong 抹角栱, xiaxugong 虾须栱, and especially ruyi dougong 如意斗栱.

a) Methodology for angular bracketing

In the first place, in terms of methodology it is necessary to differentiate between the individual member of a bracket-arm, the organic unit of a bracket set, and the dense bracketing of a grid-like system (Table 1-2; Table 1-3). They all can follow cardinal directions and exclusively consist of orthogonal members or further incorporate angled bracket-arms.

b) Nomenclature of the angled bracket-arm called xiegong

To be precise, in Chinese timber architecture, there are eventually several brackets that project at an angle different than 90 degree to the wall plane and thereby contrast the regular bracket-arms called huagong that step out directly perpendicular to the façade. Up to the present, the term xiegong literally translated as “angled, angular or oblique brackets” is only vaguely defined in Chinese and English scholarship. On the one hand, if taken literally, xiegong refers to the whole concept of angular brackets, but on the
other hand, especially in Chinese scholarship, it often describes a specific type of angled bracket-arm. The author of this thesis suggests further differentiating and introducing a hierarchical concept of whole-part relationships: strictly speaking, xiegong is a generic umbrella name and superordinate term that represents the whole body of individual bracket-arms projecting at acute or obtuse angles to the vertical wall plane. It encompasses several subordinate terms that refer to a certain sub-type of specific design, function or placement within the building. These are listed below by way of example but are not intended to be exhaustive.

Most importantly, the “angled bracket-arm in the strictest sense” or “genuine xiegong” is a narrower term for a bracket that steps out at an acute or obtuse angle to the wall plane if placed at the exterior steps of a regular eave bracket set along the façade. In terms of fabrication, it can be made of long bow-shaped timbers that symmetrically extend at the outside and the inside of the building or short half-brackets that are only visible at the outside.

Furthermore, the superordinate concept includes “angular bracket-arms in the broader sense “which are stylistic variations that are usually named after their specific structural function or placement in the building, for example mojiaogong and jiaogong. It also includes xiaxugong and the group of “no-name” angled bracket-arms that cannot be captured systematically and reduced to a few categories but rather must be distinguished and “named” case by case, e.g. angular bracket-arms applied at bracket sets placed along the inner column grid or bracket-arms which angled application results from the octagonal floor plan of the building.
In practice, Chinese scholarship often simplifies matters and refers to the subgroup of “angled bracket-arm in the strictest sense” or “genuine xiegong” simply as “xiegong,” using the short form without indication of the hierarchical whole-part relationship.

c) **Nomenclature of the fan-shaped bracket set and introduction of the term**

*“shanshi dougong扇式斗栱”*

Having defined the angled bracket-arm as the individual member of the fan-shaped bracket set, this thesis would like to break new ground and introduce the technical term “*shanshi dougong扇式斗栱*” as the appropriate and much needed Chinese translation for the English phrase “fan-shaped bracket set”, an expression that was first defined by American scholars and became common in the technical language of traditional Chinese timber architecture in English publications. It is necessary to establish its importance within the body of *dougong*-vocabulary as a special and individual kind of bracket set next to the well-known clusters such as *ruyi dougong* or *liujin douke溜金斗科* (to be explained in the following chapters).

Therefore, this thesis hereafter defines a fan-shaped bracket set called *shanshi dougong扇式斗栱* as an eave bracket set placed along the exterior building façade that mimics the shape of an open fan and applies outward projecting *xiegong* at the exterior steps and optionally, at the interior steps. All *shanshi dougong* intersect in a single focal point in the wall plane or along the main axis of the large bearing block.

In contrast, the angular grid-like bracket system called *ruyi dougong* is a kind of tightly spaced (surface) bracketing that successfully overcame the limitations of
individual bracket-arms or sets and merged all of the members to a strong structural and decorative grid system. It equally employs bracket-arms parallel or at right-angle to the wall plane and bracket-arms at acute or obtuse angles (usually 45 degree), all of which are “intertwined”, i.e. closely connected with the adjacent members at the side, below and above, and mutually upholding each other. In contrast to fan-shaped sets, there is no single focal point of bracket-arms or point of intersection.

Part three of this thesis provides an in-depth analysis of these two different bracketing concepts. At this point, to further emphasize and differentiate between the most important kinds of angular bracket-arms, bow-shaped brackets, and bracketing concepts that are used accordingly hereafter, table 1-4 summarizes the basic definitions of xiaxugong, genuine xiegong, shanshi dougong, and ruyi dougong.
Chapter 2: Importance and function of bracketing in Chinese culture and traditional art and architecture

1. Cultural importance

a) Past Chinese scholarship on bracketing

Bracket sets are the most eye-catching features in traditional Chinese architecture and among the best studied topics in the field of East Asian building history.

Liang Sicheng 梁思成, one of the founding fathers of this discipline in China, once described them as the principal components of the Chinese timber framework and put (the study of) their development on the same level with (the study of) the evolution of Chinese culture:

“斗栱后来虽然变成构架中极复杂之一部，原始却甚简单，它的历史竟可以说与华夏文化同长。”22 (Although the bracket set afterwards developed into an extremely complicated part, at the beginning it was very simple; its history after all, we may say, is as long as [the history of] Chinese culture.)

It is not surprising that the Society for Research in Chinese Architecture or Zhongguo yingzao xueshe 中国营造学社 established in the 1930s, the first institution for research on architectural history on a professional level in China, focused its attention on this one aspect of Chinese building traditions.23 This is especially true because the society’s members were fascinated by the breathtaking discovery of the Song dynasty manuscript Yingzao fashi 营造法式 by Zhu Qiqian 朱启钤 in 1919, which recorded official building rules for 2200 pieces with 90% of the entries related to bracket sets.24
The society’s nickname was “Dougong xueshe 斗栱学社”, which literally translated means “Bracket-set Society”.  

Nevertheless, in the first part of the twentieth century, the work of Chinese architectural historians of the first and second generation including Liang Sicheng and Liu Dunzhen 刘敦桢 was not all-embracing. Not only because of the difficult political situation before and during World War II and the Japanese occupation of China that resulted in limited research material, but also because it was not done methodically. Oftentimes, the society accidentally stumbled across an old building, such as the Tang dynasty Foguang Monastery 佛光寺 at Mount Wutai 五台山 in Shanxi province 山西省. Then, some of their lifework was not published until the 1980s, including the Yingzao fashi zhushi 营造法式注释 by Liang Sicheng and the Zhongguo gujianzhushi 中国古建筑史 by Liu Dunzhen.

Additionally, in the second part of the twentieth century, scholars like Liu Zhiping 刘致平 established the field of Chinese building technology as its own category within the general study of architectural history. Between 1980 and 1995, the Chinese Science Press published four major reference works on Chinese architecture, among them the most comprehensive work on traditional building technology entitled Zhongguo gudai jianzhu jishushi 中国古代建筑技术史 and the five-volume work on chronological architectural history entitled Zhongguo gudai jianzhu jishushi 中国古代建筑史, both of which address the technical background of bracketing. In 2008, the Science Press came forward with the Chinese view of the century-long history of science and technology in China entitled Zhongguo kexue jishushi jianzhujuan 中国科学技术史·建筑卷. The
whole series was inspired by Joseph Needham’s famous multi-volume work *Science and Civilization in China* also known in Chinese as *Zhongguo zhi kexue yu wenming* 中国之科学与文明, of which the fourth volume (part three) exclusively discusses architecture. The main editor of this volume Fu Xinian 傅熹年, another foremost Chinese scholar who usually includes archaeological field work and Japanese examples to draw conclusions on early Chinese bracketing, applied mathematical principles of component and building proportions to explain the design process of monastery layout s and virtually reconstruct palaces and temples that are known only from their foundations.\(^{29}\)

Since the 1990s, the focus of bracketing-research was broadened in the field of civil engineering and individual bracket-arms, sets and systems were analyzed from the angle of modern statics and mechanics (not including the finite element method), for example, the year 1992 saw the exploration of statics in traditional Chinese timber framework by Wang Tian 王天 entitled *Gudai damuzuo jingli chutan* 古代大木作静力初探.

At the beginning, the study of Chinese bracket sets was closely linked to the research of official building manuals that recorded the set rules of fabrication, assemblage and necessary manpower in the past (for a detailed bibliography see part 3 of this thesis). Xu Bo’an 徐伯安 and Guo Daiheng 郭黛姮, for example, published widely on official Song dynasty bracket sets in the *Yingzao fashi* and paved the way for future research, for example with their 1984 article “Song *Yingzao fashi* shuyu huishi - haozhai shizuo damuzuo zhidu bufen 宋营造法式术语汇释－毫寨石作大木作制度部分” or the 1985 article, “Song *Yingzao fashi* dougong xingzhi jiedu, tanwei 宋营造法式斗拱形制
Pan Guxi 潘谷西 and He Jianzhong 何建中 further enhanced our understanding of the difficult formalized language and its implementation with their *Yingzao fashi jiedu* 营造法式解读.

In other words, the way of bracketing at extant buildings was usually compared with and judged with regard to its compliance with the written building codes from the twelfth or eighteenth century. Unfortunately, the majority of surviving relics neither match the requirements nor exactly follow the official guidelines which became known to the public through the painstaking restoration reports in Chinese journals like *Wenwu* 文物 and *Kaogu* 考古, or, for example, through publications of Chai Zejun 柴泽俊 and Qi Yingtao 祁英涛. In 1966, Chen Mingda 陈明达, one of Liang’s students, contributed to the field with his treaty on the Timber Pagoda, Yingxian Muta 应县木塔 of Fogongsi 佛宫寺, in Shanxi province, a treasure hoard for architectural historians that revealed fifty-four bracket sets.

In practice, bracket sets result from the multilayer mounting of interlocking timber pieces with pre-fabricated notches, which is why the knowledge of timber carpentry, craftwork, and especially structural joinery is crucial. Ma Bingjian 马炳坚 analyzed bracketing as part of the greater timber carpentry in imperial China from the angle of reconstruction and introduced the necessary hands-on methods for mending and rebuilding. Likewise, Pan Dehua 潘德华 analyzes official Song and Qing dynasty bracketing based on his own year-long practical experience, and his two-volume work
entitled *Dougong*斗栱 supplies actual measurements and detailed figures of every mortise-and-tenon joint.

Furthermore, Fu Xinian led the field to a new direction when discussing the juxtaposition of official and local styles from the Tang to the Song periods. In this spirit, Zhang Shiqing 张十庆 stressed the building traditions in the Jiangnan region 江南 and discovered patterns of transmission from the south to the north of China (which helped to decode the otherwise unexplainable differences within bracketing of the same dynasty). In fact, the focus of this thesis also lies on regional architecture and the unusual method, style, or formation of angled bracketing in the historically important province of Shanxi, for which abundant material dealing with historical architecture, art history and culture is available that will be introduced in part two of this thesis. Liang Sicheng once published a survey report on extant Buddhist architecture in Datong 大同 and the local bracketing style of the Liao and Jin dynasties, in northern Shanxi province. In contrast to the north, the small monasteries in the south are less published and difficult to access, especially in Jindongnan region 晋东南, which provided one of the challenges for this thesis. The basic research of eminent Chinese scholars of the last century including Qi Yingtao, Zhang Yuhuan 张驭寰, Chai Zejun, Yang Zirong 杨子荣 and Du Xianzhou 杜仙洲, as well as the excellent recent work of Li Huizhi 李会智 and Xu Yitao 徐怡涛, provided helpful tools for assessing the timber structure and bracketing of this region.

The total number of scholarly articles that solely focus on *dougong* is overwhelming. It is difficult to narrow down the most important publications in one paragraph, since bracket sets relate to every aspect of Chinese art and architecture (thus
they are incorporated in the thesis piece by piece). Among them are for example, Liang Sicheng’s chronological discourse of bracket sets entitled “Dougong jianshu 斗栱简说”, Yu Zhuoyun’s 于倬云 discussion of their function entitled “Dougong de yunyong shi wo guo gudai jianzhu jishu de zhongyao gongxian 斗栱的运用是我国古代建筑技术的重要贡献”, and two treatises on their origin and development, namely “Dougong de qiyuan yu fazhan 斗栱的起源与发展” by Han Baode 汉宝德 and “Dougong qiyuan kaocha 斗栱起源考查” by Yang Hongxun 杨鸿训. Furthermore, the excellent examinations of bracketing in specific dynasties, for example regarding Han dynasty bracketing, namely Liu Xujie’s 刘叙杰 “Handai dougong de leixing yu yanbian chutan 汉代斗栱的类型与演变出探” or the two articles by Zhou Xueying 周学鹰 entitled “Handai jianzhu damuzuo jishu tezheng-dougong 汉代建筑大木作技术特征—斗栱”, regarding Tang dynasty bracketing, namely Wang Guixiang’s 王贵祥 “Guanyu Tang Song jianzhu waiyan puzuo ji dian chubu tantao 关于唐宋建筑外檐铺作的几点初步探讨” or Li Baijin’s 李百进 “Tangfeng jianzhu dougong chutan 唐风建筑斗栱初探”, or regarding Ming dynasty bracketing, especially the research by Guo Huayu 郭华瑜. Finally, there are abundant articles that investigate the individual members of the organic bracket set unit, for example the discussion of specific bracket-arms such as “Wangong yu mangong xinzheng-gudai damu goujian mingcheng yanjiu 万棋与慢棋新证-古代大式大木构件名称研究” by He Junshou 何俊寿 or “Chagong yanjiu 插棋研究” by Li Xiangdong’s 李向东.
Finally, a small number of articles, which exclusively address the angled bracket-arm called *xiegong*, have been published since the 1980s including Chen Wei’s 陈薇 “Xiegong fawei 斜栱发微” and Zhu Xiaonan’s 朱小南 “Xiegong suyuan 斜栱溯源” both in 1987, or Shen Yuzhi’s 沈聿之 “Xiegong yanbian ji pupaifang de zuoyong 斜栱演变及普拍枋的作用” in 1995.39

**b) Past Western scholarship on bracketing**

In the past, the observation of historians was often limited to an external perspective and passive recording in bits-and-pieces. Thus past Western scholarship on the subject differs fundamentally from its Chinese counterpart since a wide pool of knowledge and understanding for bracketing always existed in China itself but not beyond its borders. In fact, one of the fundamental problems of past Chinese scholarship was not the lack of research on existing palaces and first-class structures but the inability in transmitting the knowledge outside of China, at least with regard to official style corbelled clusters with bracket-arms that project parallel and directly perpendicular to the wall plane.

Historically speaking, there was political contact and artistic exchange between the Western and Eastern hemispheres since the Han dynasty and an increasingly larger market for Asian products in Europe since the Medieval Ages. The vision of a country called Cathay stirred the desire of the state and the church, and attracted European monks and merchants to travel to the Far East. Their travelogues give first evidence of Chinese building traditions such as the *Ystoria Mongalorum quos nos Tartaros appellamus* about the two-and-a-half-year voyage to Khara-Khorum (1245-1247 C.E.) by the Friar...
Giovanni da Pianô Carpine aka John of Plano Carpini or the *Itinerarium fratris Willielmi de Rubruquis de ordine fratrum Minorum* about the two-year journey through Mongolia (1253-1255 C.E.) by Friar William of Rubruck. Unfortunately, their records were usually not detailed enough for a thorough discussion on Chinese architecture much less bracketing.

The situation did not change much in the sixteenth century, when the Roman Catholic order of the Jesuits 耶稣会 sent well-educated missionaries to China to convert non-Christians to Catholicism. Additionally, the leading European sea nations such as Great Britain established chartered companies for the trade with India and Asia. The records of their journeys were widely published and well received in Europe, such as the illustrated travelogue by Joan Nieuhof 纽浩夫 (1618-1672 C.E.), who visited Nanjing as a steward of the Dutch East India Company in the middle of the seventeenth century. Such records of religious and economic missions did further the interest of European countries in Chinese art that reached a peak with the *Chinoiserie* movement in the seventeenth and eighteenth centuries, and they also started the more than three-hundred-year long European tradition of art historical and architectural research of China and its neighboring countries.

In 1721, the Austrian architect Johann Bernhard Fischer von Erlach 费舍尔·冯·埃尔拉赫 (1656-1723 C.E.), the leading master-builder of the Habsburg Monarchy during the Baroque Period in Europe, published the first manual on world architecture in Europe, entitled *A Plan of Civil and Historical Architecture* (Figure 1-12). In addition to Austria, Italy, Spain and the Near East, this impressive collection of copper engravings that
entirely relied on secondary sources included China and Thailand for the first time into the comparative discussion of global architecture. In 1757, Sir William Chambers published his work *Designs of Chinese Buildings, Furniture, Dresses, Machines, and Utensils: To Which is Annexed a Description of Their Temples, Houses, Gardens*. In Europe, it became fashionable for the religious and secular nobility to furnish their estates and town mansions with “Indian cabinets”, small rooms that were decorated with genuine Chinese artwork or Chinese-style imitations. The people of the seventeenth and eighteenth centuries called them “*Chinoiserie*” or “Chinese-style” architecture, but they had not much in common with the genuine building traditions of China not to mention bracket sets.

In fact, even free-standing architecture neither paid attention to the distinctive feature of *dougong* nor did it implement the basic principles of Chinese timber framing. The Chinese Pagoda in Munich for example, one of the East Asian “accessories” in the public English Garden, was designed by the German military architect Joseph Frey (1757-1812 C.E.) in 1789 and built by two local German craftsmen (Figure 1-13). It applied mechanical fasteners such as iron shoes and diagonal struts instead of traditional bracket sets that would have relied on a complex system of wooden mortise-and-tenon joints. Unfortunately, the interest in Chinese architecture was subdued by Neoclassicism, a new style in Western art that opposed every kind of *Chinoiserie* even in landscape design. The influence of Chinese culture was reduced to children’s’ toys, such as kites or shadow plays, as well as comic theatrical plays.

Since the beginning of the twentieth century, Western scholars became interested in the building traditions of China again. Their professional work is still of great value for
architectural research today, since some of the monasteries discussed are no longer extant and the old photographs are the only evidence of their original design including bracketing. Such publications from the first part of the last century include, for example, Bannister Fletcher’s 弗莱切尔 A History of Architecture on the Comparative Method from 1896, Ernst Boerschmann’s 鲍希曼 Chinesische Architektur in two volumes (1925), James Ferguson’s 弗各生 Survey of Chinese Art in ten volumes (1939), Osvald Siren’s 喜仁龙 A History of Early Chinese Art in ten volumes (1929-1930), or Alexander Soper and 素帕 and Laurence Sickman’s 斯格曼 The Art and Architecture of China (1956).

Nevertheless, no matter if intended or not, their research often focused on certain geographical regions or failed to differentiate enough between official and regional building styles. Ernst Boerschmann for example, misunderstood the complex nature of bracket sets and the advanced bracketing technology that successfully managed to generate different kinds of corbelled clusters and apply them accordingly, because he mainly relied on late imperial architecture from Sichuan and Hunan provinces in the south and Beijing and Hebei provinces in the north.\textsuperscript{44}

Additionally, Japanese scholars were among the first to pay respect to the building traditions of China such as Itō Chūta 伊东忠太 and his work on decoration entitled Shina kenchiku sōshoku 支那建筑装饰. Furthermore, especially Takuichi Takeshima 竹島卓一 and Tanaka Tan 田中淡, who were aware of the great importance of bracket sets for Chinese culture, and their highly scientific research included a methodical discussion of the nature of bracket sets as well as numerous (at that point still) extant examples.\textsuperscript{45}
Generally speaking, in the second part of the twentieth century, the second and third generation of Western scholars shifted interest from the comprehensive art historical discussion with architecture being one part of the rich Chinese culture to the scientific discourse of specific problems,\textsuperscript{46} including urban or landscape design such as Andrew Boyd’s \textit{Chinese Architecture and Town Planning} (1962), Victor Xiong 熊存瑞, \textit{Sui – Tang Chang’an} (2000), or Maggie Keswick’s 麦吉·凯斯韦克 \textit{The Chinese Garden: History, Art and Architecture} (1978), burial rites and funerary architecture such as Dieter Kuhn’s 狄特·库恩 \textit{A Place for the Dead} (1996), or the publications by Ronald Knapp 那仲良 on rural dwellings and folk architecture.

More importantly for the discussion of bracketing, foremost scholars like Paul Demiéville 戴密微 (1925), Else Glahn 顾迩素, Lothar Ledderose 雷德侯 (2001), Joseph Needham 李约瑟, who compiled the seminal work on Chinese science (1954-2004), Nancy Steinhardt 夏南希, and Perceval Yetts 颜慈 (1927) opened the discussion on Chinese building standards and technology.\textsuperscript{47} They introduced the complicated architectural language of Song and Qing dynasties’ carpentry to the West, as well as the existence and transmission of the official building codes, namely \textit{Yingzao fashi} 营造法式 or \textit{Treatise on Architectural Methods} (1103) and the \textit{Gongbu gongcheng zuofa} 工程工程做法 or \textit{Building Methods of the Board of Works} (1743). Additionally, English translations of Chinese technical literature contributed greatly to the field, such as Wilma Fairbank’s 费 慰 梅 publication of Liang Sicheng’s \textit{Pictorial History of Chinese
Architecture in 1984 and Klaas Ruitenbeck’s work on the Luban jing in 1993.\textsuperscript{48}

At present, we are challenged to become further specialized. The Republic of China not only represents a cultural region with more than 5,000 years of ancient civilization, but also a vast area that borders fourteen countries and stretches about 5,000 kilometers (3,100 miles) from east to west and 5,500 km (3,400 miles) from north to south. It is necessary to distinguish architecture in general and bracketing in particular according to the different geographical and climatic conditions. In this respect, the author of this thesis would like to emphasise the current research of Tracy Miller 梅晨曦 who investigates the local building traditions in Shanxi and Hebei provinces and questions the rich architectural heritage.\textsuperscript{49}

c) Current cultural importance

Modern Chinese and Western scholarship acknowledged that bracket sets were just one part of the rich Chinese building traditions. Other structural and decorative features of greater and smaller carpentry were included in the discussion, not the least since bracket sets can only be understood in their (wider) structural, decorative and symbolic context. Additionally, it became important how to apply the theory to practical situations, and the preservation of monuments and historic buildings on-site rose to importance next to the intellectual field of building history.

Nevertheless, recent publications show that bracket sets continue to be of great interest for Chinese scholars and still attract attention as a topic of academic research. This may be explained by the close association of dougong with Chinese culture itself.
For example in 2008, Wang Yilin 王艺林 drew attention to the symbolic meaning of bracket sets for different classes in society regardless of their social status, ethnic background, or level of education ranging from literati culture on the one hand to peasant culture on the other hand. Generally speaking, similar to the placement in the building as a cushion between the square roof and the (circular) column, the Chinese bracket set was seen as the mediator between heaven and earth. Their underlying notion of piling up multiple layers followed a certain order and showed a preference for horizontally leveled brackets instead of slanting, angular or crooked members. It was reminiscent of the Confucian system of rank and social hierarchy that cultivated a man, ordered the household, governed the state, and pacified all under Heaven. Likewise in 2008, Ji Hong 季宏 and Zhu Yongchun 朱永春 stressed the allegorical meaning of oversized bracket clusters in Han dynasty underground Daoist art as a symbolic path to the transcendental realm of Heaven. The association with immortal celestial beings and their ascending or descending through imagery like the cosmic axis or Mount Kunlun 昆仑 nourished the popularity and further development of the Chinese bracket set thereafter.

In essence, if there were no bracket sets, Chinese traditional architecture would lack the distinctive East-Asian quality and the spirit of a brilliant past, at least in the eyes of the Chinese scholar Han Yicheng 韩一城:

“没有斗栱，便没有中国传统建筑强烈的‘东方文化属性’；没有斗栱，也便没有了‘中国建筑精神’完整体现的历史辉煌。” (If there were no bracket sets, there would be no strong ‘Eastern cultural quality’ in traditional Chinese architecture; if there were no bracket sets, there would also be no ‘Chinese architectural spirit’ that embodied the brilliant past.)
Nancy Steinhardt argued that Chinese architectural culture showed an exaggerated reverence for its past, stating that “three fourth of a century of study has passed since the establishment of the Society for Research in Chinese Architecture in 1929, but longstanding notions of Chinese architecture, that it is in essence a historical and it is a codified, formulaic system of iconic archetypes, have not faded”. The East Hall of Faguang Monastery 佛光寺 on Mount Wutai in Shanxi province (857 C.E.) for example, is such “an architectural icon, a sacrosanct structure” that owes its iconic nature to the application of certain stereotypical features. It is not surprising that bracket sets are one of them.

2. **Symbolic meaning and function as a marker**

In the past, bracket sets were visual status symbols for the importance of the building within the monastery layout or the patron’s rank in society, especially in a feudal system like the one in China that emphasized Confucian culture and social harmony through rituals and class distinction:

“统治阶级也以斗栱层数的多少来表示建筑物的重要性，作为制定建筑等级的标准之一。” (The ruling class also expressed the significance of the building with the number of dougong layers, and accomplished to formulate a criterion for the rank of architecture.)

In the Tang and Song periods, column-top dougong indicated social rank by means of eight different grades (based on the modular caifen-system 材分), the size of their individual members, and the complexity in design, in particular the number of exterior projecting steps and the application of slanting cantilever arms. In the Ming
period, the intercolumnar bracket set superseded the column-top set, and the number of corbelled clusters in-between columns became the new expression of rank and status.

Furthermore, “stereotypical Chinese” features such as the eye-catching bracket set can be found in adjacent Asian countries as well. Especially with regard to the changing political borders throughout the last 2500 years, Chinese building technology has to be seen within the whole framework of East Asian architecture. In China, bracket sets were used as a marker of native Han culture and the larger zone of China’s political and cultural influence (Figure 1-14). From Central Asia in the west to Korea and Japan in the east, underground tombs, murals and timber halls featured Chinese-style bracket sets, no matter if they were cut of wood, carved in stone and brick, worked in metal, or even two-dimensionally painted on plaster. Especially in the centuries between the Han and Tang dynasties, i.e. in the initial phase of Buddhism, there was a stress on conformity and uniformity in design. A new set of architectural vocabulary, including bracket sets, became increasingly popular and was not only used to mark the Chinese realm but also to claim Buddhist territory. Moreover, it was also a tool for alien conquest regimes from the north to express their desire of building a Chinese-like empire and legitimizing their claim for power.

Finally, Chinese bracket sets and their specific way of design and assemblage are certainly powerful symbols of a specific time period or dynasty in the history of China. They display such distinctive features as the application or absence of certain components (e.g. the use of a flat square board called minban 真板, true and false descending cantilevers, or structural and decorative huatouzi 华头子), the shape of certain members (e.g. the tip of descending cantilever or shuatou), or the style of the decorative painting.
applied. Moreover, they are also markers of a certain geographical region or local area in China. For example, despite the publication of the *Yingzao fashi*, no timber building survived that fully matched the standard construction methods of the Song dynasty. The official imperial grammar book of architecture reflected the state of the arts in building technology and the aesthetic sense at court. Their practical implementation on the other hand, was also subject to local taste and craftsmanship.

3. **Structural function**

   a) **Short introduction to the Chinese timber framework**

      Broadly speaking, the three basic ways of erecting the timber frame in historical Chinese buildings are the *tailiang* 抬梁 or “column-beam-strut” design, the *chuandou* 穿斗 or “column-and-tie-beam” design, and the *jinggan* 井干 or log-cabin design (Figure 1-15). In fact, *tailiang*, *chuandou*, and log-cabin are just general technical terms that apply to architecture of several east and southeast Asian countries.

      In the *tailiang* design, the most common system in traditional Chinese architecture of the north, northwest and northeast, main transverse beams are used, which are directly placed on top of column-top bracket sets. The slope of the roof is achieved by erecting lateral frames of successively smaller beams or *liang* 梁, which are placed on top of short struts (e.g. columns, camel humps, bracket sets). These main cross-beams directly support the longitudinal roof purlins also known as *tuan* 檐 in Song dynasty terminology and *heng* 枋 or *lin* 檎 in Qing dynasty terminology, which carry one or two transverse sets of rafters or *chuan* 檐.
In the *Yingzao fashi*, Chinese architecture is further divided into different building types, including *diantang* 堂 or “palace type”, *tingtang* 厅堂 or “mansion type”, and “small pavilions” or *xiao jian tingxie* 小尖亭榭.\(^5^9\) The main differences between the first two categories become evident in the third dimension and the sectional drawings. The key point is the sequence of erection, and to put it in a nutshell, horizontality versus verticality (or ground plan versus transverse section).

In other words, a building that follows the *diantang* plan consists of three individual horizontal layers that are added on top of each other (Figure 1-16).\(^6^0\) Although they seem structurally independent, the whole building can only reach the necessary stability to resist earth-quakes, if all three parts are working together.\(^6^1\) The three structural layers are, first, the column framework or *zhukuangceng* 柱框层 that is formed by several rings of columns and tied together by one or two horizontal architraves called *lan’e* 阑额 and *you’e* 由额;\(^6^2\) second, the bracket set layer or *puzuoceng* 铺作层 that includes the corbelled clusters themselves, as well as the horizontal boards and the main transverse beams that connect them; and third, the roof layer or *wugai* 屋盖. In this horizontally distinctive division, the exterior columns are usually as tall as the interior columns, and all bracket sets are placed at the same height. A subordinate structure or corridor called *fujie* 副阶 that encircles the main hall provides further stabilization for the entire building.

The *tingtang* plan on the other hand, consists of a number of prefabricated transverse frameworks along the lateral building axis that are erected in sequence (Figure 1-17). Since the columns do not have the same construction height, no distinctive
horizontal bracket set layer can be distinguished. The individual frames are stabilized by horizontal tie-beams. The longitudinal roof purlins still rest on top of cross-beams. In contrast to the *diantang*, which usually applies a decorative lattice ceiling that hides the rough, unfinished top beams, the structural roof members in a *tingtang* are usually visible and often decoratively carved with a “moon-shaped” finishing. This system is more flexible. In terms of floor plan, a theoretically unlimited amount of bays and thus transverse frameworks could be added until the desired length of the building front is achieved. In terms of cross-section, the varying height of the interior columns offers a more accommodating interior design and distinctive interior spaces.

The above-mentioned *chuandou* design, which is prevalent in China’s East, South and Southwest, greatly influenced the *tingtang*-style. Both systems use lateral tie-beams, which stabilize the column network and which are inserted into the shaft of the columns that continuously rise towards the ridge line. The main difference is the placement of the longitudinal roof purlins. Due to absence of main cross-beams in *chuandou*-architecture, the purlins cannot be supported by them, and are thus placed directly on top of the successively taller columns. Usually only bracket-arms that project transverse to the wall plane are applied to support the overhanging eaves. A typical Chinese example of *chuandou* design in the Southern Song dynasty is Nan’an Pavilion 南安阁 of Ganlu Hermitage 甘露庵 in Taining 泰宁, Fujian province 福建省 (Figure 1-18). Strictly speaking, *chuandou* design neither uses heavy timbers nor belongs to the group of (heavy) timber framing or half-timbering but is rather similar to the North American light-frame constructions of balloon- or platform-framing.
It is noteworthy to mention that in practice, there are numerous hybrid forms that combine typical features of diantang and tingtang design, or in other words, tailiang and chuandou style. A well-known example that incorporated the characteristics of chuandou design located in the north is Daxiongbaodian 大雄宝殿 at Fengguosi 奉国寺 in Yixian of Liaoning province 辽宁省 (1019 C.E.), and located in the south, Sanqingdian 三清殿 of Xuanmiao Daoist Monastery 玄妙观 in Suzhou 苏州, Fujian province 福建省 (1176 C.E.).

In fact, an unorthodox way of construction that neither faithfully implements the official construction rules nor distinguishes between diantang and tingtang design contains a reference to regional building traditions and is usually characteristic for a certain geographical area. This is also true for Shanxi province regional architecture, and the unusual way of building in the Jindongnan area is further discussed with regard to fan-shaped bracket sets in part two of this thesis.

b) Structural function of bracket sets

Yu Zhuoyun explained that in the formative stages of timber construction the Chinese bracket set with multiple steps of perpendicular extensions was crucial to the interplay of forces and equilibrium among the structural members. In detail, they performed the following functions.

First, column-top bracket sets connected vertical columns with horizontal beams along the façade and provided an additional cushion by enlarging the area of bearing:

“改进了木构架中纵向构件与横向构件的搭接方，加强了梁栱与立柱的搭接点，扩大了支座的承压面。” ([This] improved the overlapping area of

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lengthwise and crosswise components in the timber frame, strengthened the contact point between beam and vertical column, and enlarged the abutment pressure zone.)

Wood is a heterogeneous, anisotropic cellular material. Therefore, its innate material properties are different along different directions. It is stronger when stress is applied longitudinally (i.e. along the grain) than when stress is applied in a radial or tangential direction (i.e. across the grain). It became necessary to further support the beam in the weaker direction to avoid that it would break under pressure. This structural problem is well known in architecture and neither restricted to the Chinese realm nor to timber buildings of the past. However, the complex Chinese system of bracketing results from a conscious choice (of critical awareness) rather than from structural necessity alone. There are other ways to join vertical and horizontal timbers, some of which were already known in ancient China. An alternative solution that eventually became the most common way in timber framing of the twentieth and twenty-first centuries is the use of L- or T-shaped metal joiners. Prototypes of such iron shoes in the form of small bronze connectors that were probably used as decorative joints at windows and doors were discovered at the early Qin dynasty 秦朝 Fengxiang palace 凤翔 in Yongcheng 雍城, Shaanxi province 陕西 (Figure 1-19).75

Second, brackets sets reduced the distance of the lateral beams that spanned across the structure and decreased the bending moment and shear stress. In fact, bending moment and parallel or tangentially applied shear stress are the second major challenge for the equilibrium of forces in the building structure next to normal stress that is transmitted perpendicularly. The multiple interior steps of perpendicularly projecting
bracket-arms provided further support for the head of the cross-beam in this matter. At the same time, they increased the beam’s ability to carry load. In the Qing dynasty, the individual bracket members and sets were smaller in size, but the column-top clusters (still) skillfully piled up multiple layers of projecting arms or horizontal timbers to make up for the lacking strength in abutment and bearing area through the sum of their parts.76

Third, bracket sets supported the projecting eaves of the roof. A typical Chinese building can be divided into the stone platform to guard against moisture from underneath, the main body of the timber structure itself, and the concave wooden roof with ceramic tiles that sheltered the structure against wind and rain.77 The deep slope and the upward turned eaves fostered water-shedding, and the latter additionally provided more light for the inside of the hall. In detail, in the early periods, large, overhanging eaves stopped the wooden walls from becoming wet. Over time, the fragile timber structure was encircled by ceramic brick walls that were more resistant against the weather, which is why in the Ming and Qing periods, the length of the roof projection decreased. The way to uphold the eaves underwent considerable change throughout the centuries including the development of jiaogong and mojiaogong, which is further discussed in the succeeding chapters (Figure 1-20). The application of the structural or true descending cantilever called zhénxià’àng 真下昂 became the standard feature until the Song and Jin dynasties. It was arranged in such a way that the weight of the projecting eaves at the lower end balanced the weight of the roof at the upper end.78 In detail, the lever effect was achieved by the well-thought arrangement of load at both ends of the cantilever. Its fulcrum rested safely at the vertical architrave or lan’è 阑额 and was
held in place through the weight of the wall construction above (e.g. zhutoufang 柱头坊, huagong 华栱, and fubigong 扶壁栱). Its lower end received compressive stress by the liaoyanfang and the eave construction above. Its upper end reached either below the rough transverse beam or caofu 草栿 or directly below the lowest ridge purlin or xiapingtuan 下平栿 and was stressed by the weight of the main roof truss inside the building.

Fourth, just as a reminder, (one-storied) high-rank architecture of diantang-style usually consisted of three clearly distinguishable horizontal divisions, namely the framework of vertical columns, the bracketing layer or puzuoceng, and the wooden roof truss. The sum of bracket sets formed a strong coherent layer that was responsible for the stability of the entire building and in which they strengthened the interplay between the different horizontal members. It consisted of individual corbelled clusters as well as large-sized beams, small joists, and thin boards. For example at the East Hall of Foguangsi, lateral beams called rufu 乳栿 that spanned the length of two rafters were not only an integral part of the horizontal bracketing layer but moreover, also of the complex bracket set units themselves. Their heads extended beyond the building plane and formed the second step of huagong at column-top dougong along the exterior façade, and likewise, their tails formed the matching counterpart at column-top dougong of interior columns. The way of integrating a transverse beam and its possible intersection with the corbelled cluster changed throughout the centuries, especially with regard to the different height of exterior eave columns and interior columns. The examples discussed in part two of this thesis give important evidence of this phenomenon. Furthermore, the corbelled
clusters of the bracketing layer also incorporated the large body of subsidiary components into the greater carpentry system that were lodged into column-top or intercolumnar bracketing. This included lintels such as vertical architraves or *lan’e* and horizontal architraves called *pubaifang* 普柏枋, as well as joists such as *zhutoufang* 柱头枋, *luohanfang* 罗汉枋, *liaoyanfang* 撇檐枋, *yacaofang* 压槽枋 or *pingqifang* 平棋枋, and finally boards such as *gongyanban* 根眼板. Broadly speaking, joists provided additional structural support, but boards were just used to fill the visual space in-between the sets.

Fifth, bracket sets increased the building’s resistance against earthquakes, in detail against surface waves and body waves such as longitudinal P-waves and transverse S-waves. In the past, *diantang*-style timber halls were penetrated by seismic waves of different velocities, but the column-beam-strut construction did not collapse under such earthquake exposure. The individual members might have cracked or not performed well under seismic loading, but in sum, the tectonic entity was earthquake-resistant even if the walls moved temporarily. This proves the profound understanding of dynamics and building materials of Chinese craftsmen in the past. They found ways to protect against earthquakes including a proper ratio of building width to length, an emphasis on the tectonic system and equilibrium of forces in the entire building structure instead of individual components, a preference for interlocking tenon-and-mortise joints, and a large bracketing layer that was able to transmit the seismic loading onto the columns. In general, *diantang*-style architecture with its distinct division in three structurally individual, horizontal building layers is less likely to resist seismic waves than *tingtang*-style structures. Moreover, in terms of safety it would be better if the column, bracketing,
and roof layers were not strictly separated, such as many extant examples in regional architecture of the Jindongnan area in Shanxi province that combine diantang- and tingtang-style characteristics. In this respect, it is not surprising that the Yingzao fashi records fourteen examples in tingtang-style out of the total of twenty-seven timber structures, a fact that proves the superiority of tingtang-construction, where beams are directly inserted into the column shaft.

Sixth, the application of bracket sets was not restricted to the placement at the top of exterior eave columns, corner columns, and in-between columns along the building façade. Interior columns and longitudinal or transverse beams of the roof truss also featured bracket sets. Else Glahn once explained that “one of the most important functions was to support the key timbers of the roof frame: the purlins that spanned the long axis of the structure and the beams that bridged the short axis”. Comparatively speaking, they were simpler in design which becomes evident in a lower puzuo rank, less perpendicularly projecting steps, and a preference for leveled brackets arms. They also differed from exterior corbelled clusters since they did not necessarily apply the three basic components such as the shuatou or chenfangtou that were crucial to the well organized arrangement and smooth functioning of column-top or intercolumnar sets.

4. Aesthetic and art historical importance

The artistic treatment of structural components is one of the defining qualities of traditional Chinese architecture. This is especially true for the eye-catching Chinese bracket set.
Whereas smaller carpentry, for example door or window shutters, were easily adorned with wood carving that removed large chunks of the material, it was unreasonable to likewise weaken the load-bearing capacity of the main structural members such as bracket-arms or beams. Consequently, the surface of brackets and bearing blocks became skillfully painted to enhance the inherent, decorative effect of the sprawling bracket sets. Additionally, the multiple layers of paint protected the wooden pieces against rainwater intrusion or overexposition to sunrays. Chronologically speaking, the tradition of decorative, protective coating known as caihua 彩画 evolved gradually since the Han dynasty with the earliest extant examples of actually painted brackets in rendongjuan caowen 忍冬卷草纹 and zaowen 藻纹 design dating to the Northern Wei period; for example cave 251 and cave 254 in Dunhuang, Gansu province.90

The general advancement in building technology and especially, the rising importance of beams as the main load bearing members, finally paved the way for the lavishly carved dougong of late imperial times. The heads and sometimes even the whole bodies of individual timbers such as shuatou or huagong were playfully embellished and transformed into sculptural or figurative ornaments.

5. Importance for modular design

In architecture, modularity is the idea that the entire building is based on the same, small design unit. In an ideal case, all members or building parts are generated as multiples of the basic module. Else Glahn summarized the advantage for greater carpentry by stating that “the virtue of having units and sections rather than specific measurements in feet and inches, of course, is that proportional descriptions are
applicable to a structure of any kind and size". Fu Xinian used the modular system to let historical architecture that was already destroyed come to life in the mind’s eye. Andrew Li, a professor at the Chinese University of Hong Kong, stressed the idea of “shape grammar”, an analytical tool to create designs in the age of information that is based on the formal rules and modular principles in tingtang-style architecture of the Yingzao fashi.

The standardized modular system in China gradually developed since the Northern- and Southern Dynasties 南北朝, and provided a continuous thread until the twentieth century. Due to the lack of architectural drawings in a modern sense, the modular regulations of the past guaranteed that a building would fulfill the structural requirements of size and strength and did not collapse. Moreover, the proportional method did not depend on the different systems of length for specific measurements (expressed by the units of zhang 丈, chi 尺, cun 寸, and fen 分) that eventually changed with geographic area and time (Figure 1-21). Additionally, standardization of all structural members allowed budget control through prefabrication and easy assemblage.

The Yingzao fashi and the Gongbu gongcheng zuofa, the two official grammar books dating prior to the twentieth century that survived until present, recorded two different systems of modular design for the structures that applied bracket sets. In fact, they were based on the carpenters’ experience that accumulated over the years before being finally codified in the official manuals. They both represented the wisdom of previous dynasties (Figure 1-22). Nevertheless, modern scientific theories can support the wisdom of the historical body of experimental knowledge (which is known as “rule of thumb”).
Both grammar books eventually used modules for structural carpentry that derived from the width of the bracket-arm (Figure 1-23; Figure 1-24).\textsuperscript{100} The bracket-arm was not only the smallest structural timber to manufacture but also the member that was needed in the highest quantity. Furthermore, Fu Xinian suggested the existence of an “expanded modular system” called \textit{kuodamoshu}扩大模数.\textsuperscript{101} For example in the case of single- or multi-storied monastery halls, the height of eave columns was the module that generated the building’s height in medieval timber architecture.

The twelfth century \textit{Yingzao fashi} defined the module \textit{cai}材, a timber block of standard width that was equal to the cross-section of a bracket:

\begin{quote}
“凡构屋之制，皆以材为祖，材有八等，度屋之大小，因而用之。”\textsuperscript{102} (“Regarding rules for building construction, \textit{cai} is the key of prime importance. \textit{Cai} is divided into eight grades, to be used according to the size of the building.”)\textsuperscript{103}
“各以其材之广，分为十五分[\textdegree], 以十分[\textdegree]为其厚，凡屋宇之高深，名物之短长，曲直举折之势，规矩绳墨之宜，皆以所用材之分[\textdegree], 以为制度焉。”\textsuperscript{104} (“For each grade of \textit{cai}, the height is divided into 15 \textit{fen}, with 10 \textit{fen} as the breadth. The height and depth of a building, the length of each member, straight or curved, raise or depress, appropriate application of the regulations in an actual job, all are governed by the number of \textit{fen} of the lumber used.”)\textsuperscript{105}
\end{quote}

The eighteenth century \textit{Gongbu gongcheng zuofa} defined the module \textit{doukou}斗口, a mortise of standard width that conformed to the opening for bracket-arms at the cap block of intermediate sets:

\begin{quote}
“凡算斗科上升、斗、棋、轚等件长短、高厚尺寸，俱以平身科迎面安轚、昂斗口宽尺寸为法核算。斗口用头等才，二等才以至十一等才之分，头等才迎面安轚、昂斗口宽六寸，二等才斗口宽五寸五分，自三等才以至十一等才各处减五分，即得斗口尺寸。”\textsuperscript{106} (When calculating \textit{douke}, the dimensions for the length and thickness of members such as \textit{sheng}, \textit{dou}, or \textit{qiao} all derive from the measurement for the width of the \textit{doukou} [opening] of the \textit{qiao} and \textit{ang} within
a pingshenke [that are] installed head-to-head [i.e. along the front façade]. [The module of] doukou uses a classification [ranging] from first grade cai, second grade cai to eleventh grade cai; in the case of first grade cai, the doukou width of the qiao and ang along the front facade is six cun; the doukou width of second grade cai is five cun and five fen; in as for third grade cai to eleventh grade cai, each time it [i.e. doukou width] decreases by five fen; this is [the way] to get the dimensions of doukou.)

Broadly speaking, they both used two standard units for timber, namely the “single standard unit dancai 单材” and the larger “full standard unit zucai 足材”. Both units were divided into modular sub-units or sections called fen 分. Dancai and zucai reflected the different types of stress in a building and the different load-bearing strength of the members. For example, due to their exposed position as transversally projecting, increased load-bearing members, huagong applied the larger unit of zucai.

In detail, the Yingzao fashi applied the system of caifen 材分. One spatial unit of dancai always measured 15 fen 分 in height and 10 fen 分 in width, and one zucai always equaled 21 fen 分 by 10 fen 分. In fact, the Song manual explicitly listed a third standard unit called zhi 栋 (equal to 6 fen 分 by 4 fen 分), which was added to the measurements of dancai to achieve the full standard unit zucai. Furthermore, the manual listed eight different grades for cai, which can best be understood as successively smaller cross-sections of the basic blocks. In other words, a high grade such as the first grade resulted in a large structure, whereas a low grade such as the eighth grade led to a proportionally smaller building. The different grades were linked to building types, with a diantang usually applying the first to third grades, the tingtang using the fourth to sixth grades, and small pavilions the seventh to eighth grades.
The six-hundred years younger Gongbu gongcheng zuofa recorded twenty-three buildings in dashi-style 大式 and four examples in xiaoshi-style 小式 (Figure 1-56). Only six of the dashi structures eventually applied bracket sets, so that they became applicable for a modular system based on doukou. The remaining twenty-one buildings used the length of the central bay as the design module (e.g. for height and diameter of eave columns). The manual listed eleven different grades for doukou. Broadly speaking, the width of the single standard section dancai conformed to one doukou. One spatial unit of dancai measured 1.4 doukou in height and 1 doukou in width (or 14 koufen 口分 by 10 koufen 口分); the zucai was equal to 2 doukou by 1 doukou (or 20 koufen 口分 by 10 koufen 口分). In general, Qing dynasty greater carpentry preferred timber of two doukou (i.e. zucai). In contrast to the Song manual, this full standard unit was not composed of two pieces, a dancai block plus a separate small block of zhi, but rather consisted of one timber piece in the size of zucai.

Modern scholarship voices some concern about the accomplishment of (total) modularity in the two official grammar books. On the one hand, it is necessary to distinguish between different degrees of modularity or in other words, the notion to regulate the individual structural members, the whole building, or even the entire monastery layout. In this respect, the twelfth century Yingzao fashi belongs to an early stage that focused on individual members and their convertibility. For example, although the basic modular unit was equal to the cross-section of the main structural members, it was not linked to the length of a bay, the depth of the building, or the height of the columns. Nevertheless, it was certainly useful as a limited modulus for engineering
projects.\textsuperscript{116} By comparison, it seems that this idea of modularity in the eighteenth century Gongbu gongcheng zuofa finally reached perfection. For buildings with dougong, not only the structural timbers but also the length and depth of a building, column height, or distance between two bracket sets were multiples of the same basic module and expressed in doukou. This distance was called cuandang 攒挡 and can be understood as the auxiliary unit of the expanded modular system or kuoda moshu for timber architecture in the Qing period.\textsuperscript{117}

On the other hand, the rational concept of modularity in the Gongbu gongcheng zuofa was not as strong as in the Yingzao fashi. Although the individual members were calculated on the basis of doukou, they did not reflect the same slender proportions as the original module (that roughly followed the Song dynasty ratio of height to width equal to 3:2). For example, the width of a beam for a seven-rafter house in the Qing dynasty was the sum of the interior column’s diameter (i.e. six doukou) plus the addition of four extra cun. For the height of the beam, the width was further multiplied by 120\%. Therefore, beams showed a ratio of height to width equal to 12:10 and appeared comparatively compact and stout.

Furthermore, there was an emphasis on simplification in order to facilitate the work of carpenters and craftsmen. For example, the grades of cai in the Yingzao fashi were divided unevenly, because their difference in proportional width ranged from 0.2 to 0.6 fen 分.\textsuperscript{118} The grades of doukou in the Gongbu gongcheng zuofa were divided evenly. The gap between their widths was always equal to the constant value of 0.5 cun (and between their heights always equal to 0.7 cun).\textsuperscript{119}
Chapter 3: Evolution of dougong and achievements in bracketing technology

1. Theories of origin

The question of where and how bracket sets evolved is still up to scholarly debate. There are several morphological theories that stress the formal and structural similarities of dougong with natural or built environment. Liu Zhiping for example, suggested that bracket sets derived from natural tree crotches that were used as vertical columns in primitive timber buildings. Horizontal beam were lodged into the forked end of the poles and fixed with strings. Due to the lack of archaeological evidence, the theory is still up to speculation and so are the reconstruction drawings of rectangular houses at Banpo village 半坡 in Shaanxi province 陕西省 (d. Neolithic Yangshao culture 仰韶文化) by Liu Xujie. Han Yicheng drew attention to the fact that official Song dynasty bracket sets with multiple transversal steps resembled the inverted tailiang-style roof truss on a smaller scale, which was expressed by the underlying notion of both to pile up layers of individual, horizontally leveled members (i.e. bracket-arms or cross-beams respectively). Yang Hongxun emphasized the evolutionary aspect and explained that dougong in the strictest sense did not exist before the Tang dynasty. Nonetheless, from the early-Qin period to the Northern and Southern Dynasties, an embryonic form of such bracket hubs was used. The members, which projected across and along the façade, evolved independently from each other and only gradually developed into the mature standardized array of perpendicular and parallel bracket-arms or slanting cantilevers.
First, the transversal bracket-arm or *huagong* derived from a curved half-bracket called *chagong* 插栱 that was directly inserted into the column shaft to support a beam or the roof eave (Figure 1-25). Based on archaeological data of Neolithic and Bronze Age sites (including the Hemudu culture 河姆渡文化 in Zhejiang province, the Daxi culture 大溪文化 at the middle Yangtze River in Hubei and Sichuan provinces, or the Erlitou 二里头文化 and Erligang cultures 二里岡文化 in Henan province), as well as today’s regional folk architecture 民族建筑 in Shandong and Hubei provinces 山东湖北省, Yang Hongxun traced the *chagong* back to a curved, slanting brace that derived from an auxiliary eave column. In the first stage, the auxiliary eave column that upheld the roof eave was vertically inserted into the ground at a certain distance from the core column. Later, it was replaced by a diagonally slanting strut with its foot lodged into the base of the core column. Afterwards, the foot moved upward along the core column’s shaft and turned into a straight, diagonal waist strut or *yaocheng* 腰撑. It was replaced by a curved strut that finally took the shape of an individual bracket-arm. The archaeological data included for example, the Neolithic Hemudu culture 河姆渡文化 in Zhejiang province, the Neolithic Daxi culture 大溪文化 at the middle Yangtze River in Hubei and Sichuan provinces, the Bronze Age culture at Erlitou 二里头文化 in Henan province, or the Panlongcheng archaeological site 盘龙城 of the Bronze Age culture at Erligang 二里岡文化 in Hubei province.

Second, the brackets that extended along or parallel to the building façade derived from horizontal boards. In this respect, scholars like Li Yunhe 李允和 and Pan Dehua
drew attention to pre-Han dynasty bracketing, which usually only consisted of rectangular timbers that were placed parallel to the wall plane. Such curtailed versions of *dougong* without perpendicularly projecting bracket-arms evolved through the maturation of the Chinese column (Figure 1-26).

In Li Yunhe’s opinion, the Chinese column was originally composed of three parts, namely column-top or “chapiter” known as *zhutou* 柱头, column-shaft or *zhusheng* 柱身, and column-base or *zhuchu* 柱础. In fact, Li Yunhe followed in the footsteps of Liang Sicheng who compared Eastern with Western building traditions and first introduced the controversial idea of a Chinese “order” or *zhushi* 柱式 that was comparable to the five classical column styles in ancient Greek and Roman architecture. The column-top eventually developed into *dougong*.

From the Zhou dynasty to the Han periods, the column was embellished with a block-shaped or even with a simple block-and-bracket-shaped top. In case of the latter, such a primitive form of *dougong* called *luluan* 栜栾 or *bolu* 栐栌 consisted of two main parts, namely the *dou* 斗-shaped chapiter or *lu* 栜, which developed into the large bearing block glossed as *ludou* 栐斗 in the *Yingzao fashi*, and additionally, a timber called *bo* 栳 or *xianluan* 栢栾. Chronologically speaking, these originally straight horizontal boards became curved, interestingly in Chinese and also in Western architecture. The bow-shaped Asian bracket with its upward turned arms mirrored the downward pointing volute of the ancient Ionic order. The Greek counterpart was curled in the opposite direction and the eye-catching volute became mere decoration since it was unnecessary to
support other structural members (for example, to connect the top of the column with a cross-beam).

2. Chronological development throughout the centuries

Since the angular fan-shaped bracket set is a stylistic variation of the orthogonal corbelled cluster, it is vital to consider the prime examples of dougong and their chronological development. Chinese bracketing is one of the most distinctive features for dating buildings since the arrangement of transversal and parallel bracket-arms underwent constant change for more than three millennia and evolved only gradually into the multi-layered system of interlocking parts that extended in multiple directions. The following chronology focuses on government-style even though bracketing not only played a crucial role in official architecture of the imperial family and local administration but also in non-official architecture of the common people and regional folk architecture (regional style building is further discussed in part three of this thesis).

a) First period or experimental stage of formation

From the Zhou dynasty to the Han period

Although the first evidence of large bearing blocks or ludou on top of vertical columns was found on the pedestal of a ritual bronze vessel called Linggui 令簋 from the Western Zhou period 西周朝 (1045-771 B.C.E.) at Mount Mang 邙山 near Luoyang 洛阳, Henan province 河南省, the first bracket-arms that extended along the wall plane did not appear before the Spring and Autumn period 春秋时代 of the Eastern Zhou dynasty 西周朝 (770-256 B.C.E.)
东周朝 (770-256 B.C.E.) (Figure 1-27).\textsuperscript{132} Since these examples show individual blocks and arms but did not yet form an organic structural unit, they cannot be considered “bracket sets” in the strictest sense. Therefore, the first prototypes of dougong (were) dated to the Warring States period 战国时代 and were discovered in the Zhongshan necropolis 中山王墓铜方案, Pingshan county, Hebei province.

In the Eastern Zhou period, the fabrication of new iron made tools including the axe or \textit{fu} 斧, saw or \textit{ju} 锯, adze or \textit{jin} 斤 (today also known as \textit{ben} 锛), chisel or \textit{zao} 凿 and gimlet or \textit{zhui} 锥 revolutionized the craftsmen’s ability to produce structural timber and complicated mortise and tenon joints called \textit{sunmao} 榫卯.\textsuperscript{133} It was now possible to join wooden pieces firmly together at an angle of 90 degree by inserting the cheek of one member into the hole in the shoulder of the second member. This increased the productivity of woodworking. Palaces and high-rank \textit{gaotai} architecture 高台建筑 were built in the capital cities.\textsuperscript{134} The wooden sarcophagi from Changsha 长沙, Hubei province 湖北省 proved that structural timber joinery of many different kinds was already common, at least in smaller carpentry of the Warring States period 战国时代 (475-256 B.C.E) (Figure 1-28).

In the politically important but short-living Qin dynasty 秦朝 (221-206 B.C.E.), architecture bloomed since the “First Emperor of the Qin” or Qin Shihuangdi 秦始皇帝 commissioned great palaces in Xianyang 咸阳, Shaanxi province, ambitious civil engineering projects such as the building of streets and canals or the fortifications of the frontiers, and his own imperial graveyard housing the famous Terracotta Army.\textsuperscript{135}
Unfortunately, little archaeological evidence can pinpoint the way of bracketing, and much is still left to speculation. The Qin period paved the way for the succeeding Western Han dynasty (206 B.C.E.-24 C.E.).

Architecture became the marker of the Han Chinese realm. Today, abundant “quasi-architectural evidence” in stone or brick still meticulously displays corbelled clusters and reflects the timber construction methods at that time in spite of the adaption to a different building material. The examples include small-scale pottery objects or mingqi 明器, que 阙 towers, and painted or carved architectural embellishment in underground tombs (Figure 1-29).

In the Han dynasty, there was still diversity in bracketing (i.e. a lack of uniformity in design or placement within the structure) (Figure 1-30). Generally speaking, the simple, stocky bracket-arms parallel to the wall plane provided an additional buffer and abutment to connect the horizontal beams with the vertical columns. The following paragraph lists some of the manifold variations that eventually foreshadowed what occurred later on in the general evolution of the Chinese bracket set (Figure 1-31).

First (5-1, 5-6), a bracket with two S-shaped curved arms that symmetrically extend from the large bearing block parallel to the wall plane, each of the arms carrying an end-block or sandou. The prototype of shuatou is placed at the mid-point of the bracket in the form of a square block called fangtou 方头.

Second (5-2), a bracket similar to the first type but additionally, with a short perpendicular extension that is carved out of the rock above the large bearing block and which in turn carries a small bearing block. Thus it is rather meant as a bracket-arm than
a decorative nose or shuatou. An additional cushion in the shape of a flat, square board called minban 轉板 is squeezed in-between arms and blocks, a method that represents an alternative way in bracketing but never became a standard feature.

Third (5-3), a variation of corner bracketing, where two separated bracket-arms step out at a right angle to the front façade and the side façade respectively and together uphold the roof eave (but they are not yet joint together as liegong 列栱). Generally speaking, before the Tang dynasty, corner bracketing showed great variety in design which is further analyzed in part three of this thesis. Since the Warring States period, the mojiaogong, a “span-corner bracket” that stretches across the corner at an angle of 45 degrees to the building façade, propped up the overhanging area of the roof eaves. The funerary bronze object from the ruler of the Zhongshan Kingdom 中山国王, excavated in Pingshan 平山, Hebei province, shows a horizontally leveled structural timber that is directly placed on top of a small corner column called douzi shuzhu 斗子蜀柱 (with ludou and minban) and spans the corner stretching from the column shaft towards both sides in diagonal direction (Figure 1-32). It continued to be popular until the Northern and Southern Dynasties and can be seen at numerous mingqi, such as the multistoried Eastern Han period watchtower excavated in Sangzhuang 桑庄, Fucheng county 阜城县, Hebei province (Figure 1-33; Figure 1-34). In contrast to the vertically and horizontally leveled members of Zhou dynasty bracketing, the mojiaogong is the archetype for non-orthogonal, angular use of building material.

Fourth (5-4), a convex bracket with simple entasis or juansha 卷杀 that created an elliptic profile in the shape of an intersected line composed of two linear segments. The
artistic treatment of tapering is further advanced than the bulging like an S-shaped curve and became finally codified in the twelfth century grammar book *Yingzao fashi* (although the number of segments increased).

Generally speaking, in the Eastern Han period 东汉朝 (25-220 C.E.), we can see further differentiation in design. The bracket clusters that are placed on top of corner columns were distinct from those along the building façade. In Sichuan province, Qu county 渠县, the Shenfujun Watchtower 沈府君阙 displays a prototype of the elongated paired bracket called “(male and female) mandarin duck bracket” or *yuanyang jiaoshougong* 鸳鸯交手栱 in the *Yingzao fashi* (Figure 1-35). Such timbers that “appear like two bracket-arms which cross over and share a single arm-end block where they meet” are usually applied at corbelled corner clusters and also at angular fan-shaped bracket set of succeeding dynasties.142

In essence, the most common designs in Han dynasty bracketing were *yidouersheng* 一斗二升 or “two-on-one” and *yidousansheng* 一斗三升 or “three-on-one” (Figure 1-36). They are distinguished by the total number of bracket-arms involved. The names derive from the specific number of small end-blocks called *sandou* in the Song dynasty and *sheng* 升 in the Qing dynasty that were placed on top of the bracket-arms projecting parallel to the wall plane and additionally, in case of *yidousansheng* at the third transversal extension. In terms of building technology, despite the structural stability through triangular shape the design of *yidouersheng* was still weak. The distance between large and small bearing blocks was limited (i.e. between the mid- and end-points of the bow-shaped bracket) to avoid that the body of the bracket would break under shear
stress and bending moment. The design was modified in the Eastern Han period by adding a third arm at the mid-point of the bow-shaped bracket to provide further support and directly transmit most of the shear stress into the column shaft.\textsuperscript{143} Function wise, there was a clear separation between transversal and parallel brackets. Whereas the parallel brackets were locked into the large bearing blocks along the wall plane to support the horizontal beams, in most cases, the perpendicular brackets were still directly inserted into the column shaft to uphold the roof eaves. It was not before the Tang dynasty that they both finally merged into one organic bracket set unit.

\textbf{From the third century to the Northern and Southern Dynasties}

The period between the Han and Tang dynasties was stimulated by new artistic trends from India, Central Asia and the Western Regions. The different ethnic minorities and their indigenous cultural traditions gradually blended together.

The arrival of Buddhism in China and the new vocabulary for religious architecture was adopted and adapted to the local conditions on Chinese soil.\textsuperscript{144} For example, the absence of a standardized model and the influence of regional taste and craftsmanship led to an abundant variety of religious tower architecture. Generally speaking, there were four basic design schemes in Chinese architectural history, namely the single-storied pagoda or \textit{dancengta} 单层塔, which flourished in the Tang dynasty, the multi-storied pagoda in pavilion style or \textit{lougeshi duocengta} 楼阁式多层塔, which was popular with the beginning of Buddhism in China, the densely-placed eaves pagoda or \textit{miyanta} 密檐塔, which especially peaked in the Liao and Jin dynasties, and the stupa 窟
堵坡，especially the bottle-shaped stupa that was increasingly popular since the rise of Lamaism in the Yuan dynasty.\textsuperscript{145}

The complex layering of the Chinese bracket set with multiple perpendicular extensions was not necessarily reflected in such free-standing architecture, especially before the Liao dynasty. For example the twelve-sided, hollow-shell stone pagoda with densely-placed eaves of Songyue Monastery 嵩岳寺 in Dengfeng 登封, Henan province (520 C.E.), featured engaged exterior corner columns at the ground floor that were crowned by simple Indian-style lotus buds (Figure 1-37).\textsuperscript{146} This is especially interesting since architectural stone relics of that time and especially cave temples in North and Northwest China can illustrate the rich body of timber bracketing including the distinctive shape of individual members.\textsuperscript{147} For example, in the Central Plains at the Yungang grottoes, the square-shaped bearing blocks were already divided into the three characteristic parts of ear or er 耳, waist or ping 平, and bottom or base called yi 傾 that afterwards became codified in the official twelfth century grammar book Yingzao fashi. In the Western Regions at the ancient oasis city of Loulan 楼兰古城, today’s autonomous region of Xinjiang 新疆 on the other hand, we can find circular bearing blocks (dating to the fourth century C.E.).\textsuperscript{148} Additionally, numerous small art objects such as soul jars or duisuguan 堆塑罐,\textsuperscript{149} or the breathtaking discoveries of Sogdian funerary couches in the last decades contributed considerably to our knowledge of bracketing in this period.\textsuperscript{150} Unfortunately, no timber building survived from the ambitious building projects at that time including the establishment of the capital city Ye 邺城 located in today’s Linzhang county of Hebei province and Anyang county of Henan province by the military
commander Cao Cao 曹操, posthumously known as Emperor Wu of Wei 魏武帝, in the beginning of the third century. Likewise, little is left from the religious landscape of more than four-hundred Buddhist monasteries located in the newly moved capital of the Northern Wei dynasty 北魏朝 (386-534 C.E.) as known from A Record of Monasteries in Luoyang 洛阳伽蓝记 by the Eastern Wei scholar 东魏朝 (534-550 C.E.) Yang Xuanzhi 杨衒之.

In essence, in this “period of (political) disunion” or rather “period of (cultural) variety”, the individual members of the Chinese bracket set began to work closer together. The perpendicular and parallel bracket-arms began to form an organic unit with interlocking cross-shaped joints into which the cross-beams gradually became incorporated. Nevertheless, the sum of the corbelled clusters did not yet form a coherent, structurally independent, horizontal surface layer. In terms of puzuo design, it was not before the Northern Qi dynasty 北齐朝 (550-577 C.E.) that yidousansheng replaced the simpler counterpart without a third bracket-arm called yidouersheng. Additionally, the number of perpendicular extensions increased, such as the complex arrangement of five-puzuo with two steps of transversally projecting bracket-arms at the imperial Northern Qi caves of Northern Xiangtangshan 北响堂山 or “Mountain of Echoing Halls”, Fengfeng Mining District 峰峰矿区, southern Hebei province (Figure 1-38).\(^\text{151}\)

The most exciting change took place in-between exterior eave columns, where inverted-V-shaped braces created intercolumnar bracketing, sometimes in combination with a short column (Figure 1-39).\(^\text{152}\) In Chinese, the name of such an “A-shaped intercolumnar bracket set formed by two slanting struts rising toward the center where
they join together to hold a bearing block” refers to the visual shape of the Chinese character “ren 人”. It is usually known as renzigong 人字棋 or renzipuzuo 人字铺作 but occasionally also called chashou(bujian)puzuo 叉手(补间)铺作 after the shape of its fork-like braces. Chronologically speaking, straight timbers were used at first but eventually replaced by rounded braces with upward turned feet and entasis (Figure 1-40; Figure 1-41). To some extent, the preference for bent profile was a question of artistic expression. Alternating with yidousansheng, their visual reiteration between the architrave and the eave purlin evoked the idea of a decorative horizontal band, but in case of straight brackets, it seemed too rigid. By the early Tang period, inverted-V-shaped bracket-arms were abandoned, not least because they were unable to deal with the increasing pressure from above and their top joints cracked.

b) Second period or stage of maturity

Sui and Tang dynasties

In the end of the sixth century, the short-living Sui dynasty 隋朝 (581-619 C.E.) established a newly unified Chinese empire and political leadership that ended the centuries of turmoil in the Central Plains. “The thriving economy and international culture of the Sui and especially the Tang dynasty stimulated a period of tremendous architectural creativity”. Due to the lack of extant timber buildings in China dating prior to the Tang period (precisely, second part of the seventh century), we still rely on secondary evidence like cave number sixteen at Tianlongshan 天龙山 near Taiyuan, Shanxi province, with simple “one-on-three” bracket clusters and curved inverted-V-
shaped braces, or contemporary wooden structures from Japan such as the Hōryū-ji nucleus in Nara (Figure 1-41).\textsuperscript{160}

Generally speaking, Sui dynasty craftsmen followed the building traditions of the preceding dynasties. Moreover they completed the important transition that started in the Northern and Southern Dynasties from a lengthwise timber framework with emphasis on longitudinal load-bearing members to a crosswise technique that stressed lateral beams spanning across the building’s depth (Figure 1-42).\textsuperscript{161} The advancement in greater carpentry paved the way for the sophisticated standardized system of layered interlocking brackets in the succeeding Tang and Song dynasties that equally extended in both directions at the same time, i.e. along and across the building façade.

Although the twenty-eight wooden relics from the sixth to the eighth centuries in Japan outweigh the contemporary Chinese resources by more than six times, there are finally a handful timber halls on Chinese soil, exactly in Shanxi province, which give first-hand evidence of the political, social and cultural summit of the Tang dynasty 唐朝 (618-907 C.E.) that stimulated art and architecture.\textsuperscript{162} More importantly, such material helps us to differentiate between official and non-official building styles and pinpoint local construction methods.\textsuperscript{163}

In general, the number of perpendicular projections of Tang dynasty bracketing varied from one step to four steps, or in other words, it ranged from simple bracketing like doukoutiao to complicated column-top corbelled clusters of seven-puzuo. The slanting cantilever was a visual status symbol but at the same time, an eminent part of the timber frame that became structurally more and better-rounded. The decorative tip of the descending cantilever became an important indicator for a certain time period,
geographical region, or political power such as the vast international Tang Empire that
overcame physical and cultural boundaries. Likewise, the *shuatou* began to play an
important role in medieval architecture, which is why function and design of both
features are further discussed in part two of this thesis (Figure 1-43). To give a specific
example, chronologically speaking until the early-Tang period, *xia’ang* with square-
shaped heads called *fangtou* were used such as at the Kondō of Tōshōdaiji 唐招提
寺 in Nara, Japan, which was founded by the Chinese monk Jianzhen or Ganjin 鑒真
(688-763 C.E) in 759 C.E. Heads with split-bamboo profile called *pizhuxing* were popular in the Tang dynasty and thereafter, such as at the eighth century East Hall
of Foguangsi in Shanxi province and also at contemporary Dunhuang Grottoes 敦煌石窟
in distant Gansu province 甘肃省.164

The breathtaking bracketing at the eighth century East Hall of Foguangsi at
Mount Wutai proves that one of the most fundamental developments in bracketing was
not yet completed, namely the transition from “stolen-heart” design or *touxinzao* to
“filled-heart” design or *jixinzao* (Figure 1-44). The column-top bracket sets of seven-
puzuo consist of four layers with two tiers of horizontally leveled *huagong* and two tiers
of slanting *xia’ang*. Nevertheless, each of the lower steps of perpendicular bracket-arms
and descending cantilevers lacks brackets parallel to the wall plane. Only the upper levels
follow *jixin*-style and “hold both a parallel bracket-arm (usually *guazigong* or *linggong*)
and the next level of perpendicular extension (either another *huagong* or a descending
cantilever”).165
Furthermore, the upper steps in the Chinese bracket set that had consisted of a single timber gradually changed into double-tier brackets called *chonggong* 重栱, where a *mangong* was placed above a *guazigong* (Figure 1-45).\(^{167}\) The application of one intercolumnar bracket sets became increasingly common and was most often formed by either inverted-V-shaped braces, short columns called *(douzi)* *shuzhu*, or a combination of both (Figure 1-46).\(^{168}\) The mural at the lintel 门媚石刻 of the Great Goose Pagoda 大雁塔 (Sui dynasty, rebuilt 648 C.E.) at the Cien Monastery 慈恩寺 in the city of Xian, Shaanxi province, depicts two horizontal bands of bracketing with inverted-V-shaped braces at the lower division and small columns at the upper division. In essence, intercolumnar bracketing possessed little allegorical importance and still differed greatly in design from the counterparts on top of eave columns, leaving alone exceeding them as a status symbol such as in the Ming and Qing dynasties.\(^{169}\)

**Five Dynasties and Ten Kingdoms period**

The architecture of the Five Dynasties 五代 (907-960 C.E.) and Ten Kingdoms 十国 (891-979 C.E.) continued the longstanding building traditions of China but emulated the greater carpentry of the Tang dynasty on a smaller scale.\(^{170}\) At the Ten Thousand Buddha Hall 万佛殿 (d. 963 C.E.) of Zhenguosi 镇国寺, Pingyao county 平遥, Shanxi province, the unproportional huge column-top bracket sets of seven-*puzuo* provided a sharp contrast to the design of the humble timber hall itself, which measured three-by-three bays (Figure 1-47). In fact, even if the rank of the *puzuo* matched the number of the eminent Tang dynasty East Hall at Fuguangsi, the structure of the Later Han period 后汉...
(947-950 C.E) applied smaller sized timbers of a lower grade, i.e. five cai. The lack of grandeur may be explained by the difficult political situation in the north during the tenth century, a period of short-lived political powers in rapid succession and constant warfare that allowed less building material, manpower, and financial funds for construction projects.\textsuperscript{171} Under such circumstances, corbelled clusters were meant to visually express high rank and social status (without much effort), for example by means of applying multiple perpendicular extensions and several true descending cantilevers.

In the south, the political landscape was fragmented into regional kingdoms that concurrently ruled neighboring geographical areas. Unfortunately, no Tang dynasty relic survived in the Jiangnan region, because the South of China such as today’s provinces of Jiangsu 江苏省, Zhejiang 浙江省, or Fujian 福建省 played a leading role in economy since the end of the seventh century which most likely stimulated a regional building style. Likewise, the blooming economy of Sichuan province and the secluded location attracted local sponsorship by monks and ordinary people and set artistic trends different from the official government style in the Central Plains, such as at the Northern Mount 北山 of the Dazu Rock Carvings 大足石刻 in Sichuan province that peaked after the fall of the Tang dynasty.\textsuperscript{172} It is more than fortunate that the Main Hall of Hualin Monastery 华林寺 in Fuzhou 福州 (964 C.E.) dating to the Wuyue Kingdom survived together with the Main Hall of Baoguosi 保国寺 in Ningbo 宁波, Zhejiang province dating to the early Northern Song dynasty (built in 1013 with later repairs in 1078 C.E.), which can illustrate the rich (official) architectural language and high level workmanship of local craftsmen in the south during the Five Dynasties and Ten Kingdoms period (Figure 3-5).\textsuperscript{173}
Based on the handful timber relics that survived from the tenth century until present, it seems that most bracket sets still incorporated “stolen-heart” design (both, into the exterior and interior perpendicular extensions) and lacked any brackets parallel to the wall plane except the linggong that was placed at the uppermost perpendicular extension. Corbelled clusters at intercolumnar positions were still not able to blend perpendicular and parallel brackets into one puzuo-unit at the same time (Figure 1-47).

**Song dynasty**

Bracketing of the Northern Song dynasty 北宋朝 (960-1127 C.E.) is one of the “iconic” features in Chinese architectural history. In the second part of the tenth century, the Later Zhou dynasty 后周 (907-960 C.E.), one of the regional powers in North China during the Five Dynasties and Ten Kingdoms period, successfully reunified most of the Northern and Southern territories, and in 960, General Zhao Kuangyin 赵匡胤 better known by his temple name Emperor Taizu of Song 宋太祖 (r. 960-976 C.E.) founded the new dynasty in Bianliang 汴梁, today’s city of Kaifeng 开封, Henan province. The Northern Song dynasty is not only known for the rapid economic growth that resulted in new wealth, a population size doubled by the eleventh century, and magnificent large scale city planning but also for the emphasis on learning and scholarship by a large educated literati class. Moreover, the merge of science and art generated a new interest in technical details and the accurate even painstaking depiction of trivia, such as in the famous silk painting “Along the River During the Qingming Festival 清明上河图” by Zhang Zeduan 张择端 (1085-1145 C.E.) or the “ruler-lined painting” style called jiehua
that peaked under the imperial Northern Song patronage of art.\textsuperscript{174} It is not surprising that the \textit{Yingzao fashi}, the most influential grammar book for official Chinese architecture, was commissioned by the Northern Song court in Bianliang, where it was first published in 1103. (It was reprinted in 1145, the fifteenth year of the Shaoxing reign period 南宋绍兴十五年, at the newly moved Southern Song court of Lin’an 临安, today’s city of Hangzhou 杭州, Zhejiang province.) To be precise, the evolution of bracketing was an ongoing process of trial and error that started centuries before the notion of final recording. The language in the imperial building manual incorporated (official and unofficial) technical literature of preceding periods and rather summarized the structural achievements and experimental knowledge that was handed down through generations of craftsmen. In brief, in contrast to the contemporary Liao dynasty that preserved the original Tang period construction methods, it also built on new artistic trends from the south, in particular the local building style of the Jiangnan region.\textsuperscript{175} Furthermore, the ability to level rough-cut wood and produce smooth surfaces enhanced and opened new vistas for the time-saving and cost-efficient fabrication of structural timber, especially bracket-arms and bearing blocks.\textsuperscript{176}

For the first time in Chinese history, bracket sets were delicate and showed a high degree in differentiation that met the diverse needs of (different locations within) the timber frame system and catered to the aesthetic taste of different patrons. In fact, the high degree in differentiation had resulted in a rich body of technical vocabulary with puzzling names and too many interchangeable members or construction methods (which probably was one of the possible reasons for the publication and spread of the official
building manual). In summary, column-top *puzuo* were usually complicated interlocking hubs with several perpendicular extensions in “filled-heart” design, or at least a mixed style, and double-tier parallel brackets or *chonggong* (Figure 1-48; Figure 1-3; Figure 1-9). The application of the “uppermost perpendicular timber in a bracket set” called *chenfangtou* became one the three basic requirements for defining the mounting of layered bracket-arms as a *puzuo*-set in the strictest sense. Similar to the slanting cantilever, the *chenfangtou* underwent change and became torn between structural and decorative function since the Song dynasty. Creative variations of this official architectural feature that can be seen in southeastern Shanxi province are further discussed in part two of this thesis. More importantly, after the mid-Song period, the corbelled clusters in-between columns became finally equally important to the column-top clusters and similar in design. In contrast to the Tang or Liao dynasties, intercolumnar bracket sets were now placed at the same height as the column-top counterparts within the wall plane and applied the same number of perpendicular extensions. The number of sets that filled the space in-between two columns along the building façade was now restricted with two. The two-set regulation became possible through the introduction of a second, horizontal architrave in the north in the eleventh century called *pubaifang* 菩拍枋, which eventually had considerable impact on the use of fan-shaped bracket sets. In essence, the additional *pubaifang* successfully distributed the load of bracketing more evenly along the façade and increased building consolidation and stability, especially if both ends extended sideward beyond the wall plane, a method called *chutou* 出头 (Figure 1-49).
For further distinction, a key question is the different placement of the two architraves, the way they were connected to the vertical column shafts, as well as their different diameters. The diameter of the horizontal architrave or *pubaifang* was larger in width than in height. It was placed above the upright/edgewise vertical architrave or *lan’e* 阑额 and “joined between column tops and the cap block”. The vertical architrave was not an end-to-end tie-beam but rather consisted of several short segments that were individually lodged into the shafts of two flanking columns.

The genuine slanting cantilever, the eminent feature of Tang dynasty bracketing, slowly but surely lost its traditional meaning. A beautiful example is the trend-setting design at the Sage Mother Hall (1038-1067 C.E.) of the Jin Shrines near Taiyuan, Shanxi province, where the *zhennxia’ang* shifted to the intercolumnar position and the column-top bracketing anticipated the horizontally leveled application of *ang* in late imperial China (Figure 1-50). In fact, a true descending cantilever and genuinely slanting member provided a time-consuming challenge for wood joinery and assemblage. There still was need for its lever-effect in Chinese history thereafter, but the builders of the Song, Jin and Yuan dynasties started to experiment with unconventional construction methods and found new ways to uphold the eaves and to balance the load. Nevertheless, the distinctive aesthetic form of *zhennxia’ang* remained popular and was reflected in the decorative, horizontally leveled false cantilever or *jia’ang* 假昂, a method not mentioned in the twelfth century grammar book since it probably was considered folk architecture at that time. In practice, *jia’ang* were increasingly fashionable since the Jin dynasty. Even the genuine flower head bud or *huatouzi* 华头子, a tapered wedge-shaped device to support
the structural descending cantilever at the point of intersection with the bracket set, was reproduced as a false “flower head bud” or \textit{jiahuatouzi} 假华头子 and eventually decoratively carved from the same piece of timber like the \textit{jia’ang} arm (Figure 1-51).\textsuperscript{183}

Finally, two of the earliest extant examples of fan-shaped bracket sets along the building façade date to the native Chinese Song dynasty, namely the Middle Hall of Nanjixiang Monastery 南吉祥寺 in Lingchuan county 陵川县, southeastern Shanxi province (1030 C.E.), and Moni Hall 摩尼殿 of Longxing Monastery 隆兴寺 in Zhengding 正定, Hebei province (1052 C.E.) (see part two of this thesis).

Official architecture in the Southern Song period 南宋朝 (1127-1279 C.E.), which was roughly contemporary with the Jin dynasty, was similarly influenced by the powerful and prevailing Northern Song government style. Due to the regional influence of Zhejiang area, it nevertheless showed some technical and aesthetic improvement and became the influential factor for official late imperial Chinese architecture:

\begin{quote}
“
故南宋建筑是推动这一时期建筑发展的主要力量。”\textsuperscript{184} (Therefore Southern Song architecture was the major force that pushed the architectural development of this period forward.)
\end{quote}

\textbf{Liao dynasty}

With the decline of the Tang Empire starting from the end of the ninth-century, the north of China became shattered by powerful Chinese generals and regional warlords of non-Han origin, and divided among a few short-lived military regimes until 960.\textsuperscript{185} The Khitans, a former Tang tributary state, gradually rose to power with the military as the backbone of their society. In the mid-tenth century, they established the Liao empire
辽朝 (947-1125 C.E.), and ruled not only in the north including today’s Liaoning province and Inner Mongolia Autonomous Region, but also sixteen prefectures in Hebei and Shanxi provinces, the heartland of Chinese culture. The gradually expanded their zone of influence towards the Chinese territory and the border of the contemporary, rivaling Song dynasty, which becomes evident by the southwards move of their five capital cities. In the southernmost capital at Datong, today’s Shanxi province, two eminent Liao monasteries namely Huayansi 华严寺 and Shanhuasi 善化寺 are well-preserved (despite repair in the Jin dynasty) and provide excellent examples of fan-shaped bracket sets together with the Timber Pagoda 木塔 at Fogongsi 佛宫寺 in Ying county 应县, Shuozhou prefecture 朔州, Shanxi province (1056 C.E.), or numerous other contemporary stone pagodas (Figure 3-6). It is interesting that the accumulation of Chinese territory eventually was not achieved by an aggressive invasion. The strong military forces that were to be mobilized at any time played an important role in the diplomatic relation with neighboring states. The emphasis on a large military backbone thus provided not only a considerable financial burden for the state household, but also a profitable diplomatic tool with benefits such as the 1004 Liao-Song Treaty of Shanyuan. Similar to other confederations of medieval Northern steppe, the Liao dynasty was torn between the trend for sinification and the desire to preserve their Khitan customs once they rose to power.

In terms of timber construction, although different “in their purposeful conception and symbolic purposes”, the craftsmen continued the Northern style building traditions of the Tang dynasty. Moreover, they preserved them even better than the concurrent
native Chinese Song dynasty. The structural descending cantilever was widely used to uphold the eaves and balance the load. It is not surprising that we can see bracketing of similarly large-sized timbers in early-Liao period buildings that are reminiscent of the majestic corbelled clusters at the East Hall of Foguangsi. In contrast to the “distinctively delicate details” of the Song dynasty, Liao dynasty architecture “sought an aesthetic of power through larger, structurally stronger and more complicated buildings”. The bracket sets were logically organized and structurally differentiated, and their specialization reflects the specific location and function within the greater carpentry system of the timber hall. For example at the non-imperially sponsored tenth century architecture of Dulesi 独乐寺, Ji county 蓟县, Hebei province, the two-storied Guanyin Pavilion 观音阁 (984 C.E.) reveals more than twenty kinds of bracket sets, and at the imperially patronized, five-storied Timber Pagoda of Fogongsi, we can discern about sixty different types (Figure 3-4).

Late-Liao period architecture became influenced by the radiating official style of the Northern Song dynasty such as the razed Guanyin Hall 观音殿 of Kaiyuansi 开元寺, Hebei province.

**Jin dynasty**

The Jin dynasty 金朝 (1113/1115-1234 C.E.) was founded by one of the three Jurchen tribes, a semi-nomadic Tungusic people from Manchuria. The Wanyan clan 完颜 of the wild Jurchens that succeeded in the early tribal power struggle, “had both agricultural and pastoral resources, a distinct cultural and religious tradition, and had benefited from their neighboring sinicized Po-hai and Koryo”. Upon military success in Korea and during the military campaign against the Liao empire, Aguda 阿骨打
established the Jin dynasty as “a powerful symbol of legitimacy in their competition with rivals in North China” in 1115. In the second phase of tribal expansion, the Jurchen conquered territory from the neighboring Liao and Northern Song empires. They followed the Khitan model of dual administration, and applied a centralized Chinese-style government for the newly conquered territories in the south, but improved the traditional tribal *mengan mouke* 猛安谋克 in their own homeland. The distribution of land among tribal chieftains was part of the policy to reduce the high costs of the military of the Jin dynasty, and intended to establish the *mengan mouke* as self-sufficient, economically independent units in peace times and war. Franke describes them as settlements within a fortified walled village, and hence implies a kind of sedentary lifestyle based on more intensive cultivation of farmland than other northern steppe peoples. This reveals a different image than the “ideal” nomad-warrior of the steppe such as in the Khitans or Mongol society, who derived from a pasturing, hunting, fishing and only basic agricultural background. Xiao Qiqing 萧启庆 argues that the characteristic nomadic aspects such as rigid training in archery, riding, warfare, and the practice of the annual great hunt still played an important role in the semi-nomadic lifestyle of the Jurchens.

Despite the political rivalry, official Jin dynasty architecture followed the sophisticated style of the Northern Song dynasty but enhanced it with local features, including the distinctive building style of the former Liao dynasty territory in the north of Shanxi province around the city of Datong:

“但由于北宋官式比这些地方传统先进，故以它为主，形成金之官式。”(... but since the Northern Song official style was further advanced than these local traditions, it was given the first place when forming the official style of the Jin.)
Jin dynasty architecture was also similar to the Northern Song counterpart in such that local workshops and regional methods became increasingly important for the non-official architecture of the time (which is further analyzed in part two of this thesis).

Against (common) expectations, Jin dynasty bracketing actively contributed to the technical and aesthetic advancements of the Chinese bracket set. Yu Zhuoyun drew attention to the well-thought use of horizontally leveled timbers, which is further discussed in part two of this thesis.196 For example, at intercolumnar bracketing of the second-to-last bays at Sanshengdian 三圣殿 of Shanhuasi 善化寺 in Datong, Shanxi province, the craftsmen applied a *shuatou* that appeared as a regular, horizontally leveled member at the exterior building façade (see part two of this thesis). However, once having pierced through the wall plane, it was substituted by two tiers of upward slanting cantilever-arms at the interior which tails upheld the lowest eave purlin. (Such a combined feature of horizontally leveled and slanting parts is known as *zhexionxing lianxu gangan* 折线形连续杆杆.)

In fact, these corbelled clusters were the prototype of *liujin douke*, a distinctive type of interior bracketing that became a standard feature of official style architecture in late imperial China. Furthermore, the Main Hall of Puzhaosi 普照寺, Qin county 沁县, Shanxi province, provides an early example of fortified bracket clusters at the corners known as *fujiaodou* 附角斗 that were about to come into vogue (see part two of this thesis).197 Jin dynasty bracketing also used fan-shaped bracket sets, both at intercolumnar and column-top positions of greater carpentry and also in smaller carpentry, including sutra cabinets and interior ceilings. Additionally, according to present knowledge the
corbelled stone clusters of Jishan 稷山, southwestern Shanxi province, are the only examples of shanshi dougong in fangmu-style 仿木 that were found in underground tombs (Figure 1-52).

In general, extant Jin dynasty architecture includes a rich pool of timber structures ranging from the fanciful and magnificent seven-by-four-bay Amitābha Hall 弥陀殿 (1143 C.E.) of Chongfusi 崇福寺 in Shuozhou 朔州, northern Shanxi, to humble three-by-three-bay timber halls of small-scale monasteries in the southeast, many of which apply fan-shaped bracket sets.198

The examples in Shanxi province that are discussed in part two of this thesis further contribute to the understanding of Jin dynasty bracketing and acknowledgment as the necessary link between the official bracketing terminology of the Northern Song dynasty and the technologically even more advanced government building styles of the Ming and Qing dynasties (see part two of this thesis).

Yuan dynasty

The Mongols were not the first powerful confederation of medieval steppe tribes to emerge from the northern frontier region in the second millennium C.E. and succeed in conquering vast territories in central and northeast Asia. From the tenth-century on, the Khitans, the Jurchens, and finally the Mongols, established non-Chinese dynasties on Han Chinese soil, the Liao, the Jin, and the Yuan Dynasty 元朝 (1267-1368 C.E.) respectively.199 It is noteworthy to consider that the northern frontier had moved after the twelfth-century. Despite their distance from the original Tang border, the Jurchen, “a dependent people on the border of the Liao’s (Khitan) Chinese style empire”, and the
Mongols, “a frontier dependent people of Jin (Jurchen) for years”, thus had contact with the “Chinese” empire of the time prior to their military campaigns. When Khubilai Khan finally established his unified empire and the Yuan dynasty, he did not just emulate the Chinese way of life or the Han style building traditions. The Mongols respected the Chinese builders and craftsmen but also invited multi-national artists from Central Asia or Nepal and Tibet. Thus, Yuan dynasty architecture is the result of Northern Song, Southern Song, and Jin dynasty building traditions mixed with the indigenous Mongolian heritage and spiced by new trends from Central Asia.

Yuan dynasty bracketing was influenced by the qualitative change between the Chinese bracket set and the cross-beam that slowly occurred in the greater carpentry system in North China. The cross-beam was no longer a mandatory, integral part of the layered organic puzuo-unit but rather placed on top of it. It still could extend beyond the building façade as a shuatou, but in any case, the diameter of shuatou gradually increased until it was equal in size to the head of the cross-beam. Whereas in the Song dynasty the complex interlocking system of individual bracket-arms and cantilevers upheld the roof eave, it was now the horizontal cross-beam that provided the main support. This is not to say that the Yuan builders invented such methods. Many features that we can see in Yuan dynasty architecture, especially in Shanxi province, are eventually elements of the local building traditions or defang zuofa 地方做法 and were already used for many generations (such as jia’ang or tatou 峙头). Yuan architecture in Shanxi province also extensively used fan-shaped bracket sets.

Nevertheless, there was an important shift of positions in the Yuan dynasty. For instance, the use of horizontally leveled huagong in the shape of decorative false
cantilevers such as at Sanqingdian of Yonglegong 永乐宫, Ruicheng county 芮城县, southwestern Shanxi province (1252-1262 C.E.), proves that such features were now socially acceptable and widely used for important large-scale architecture (Figure 1-53). Generally speaking, the traditional idea of the cantilever was still popular and appeared in a great variety of designs, ranging from the simple inserted cantilever-arm or cha’ang to the ascending cantilever or shang’ang. It also included various decorative profiles of the tip such as the phoenix head or fengtou 风头 that were still fashionable in the succeeding dynasties. If the true structural descending cantilevers or xia’ang was used, it was usually placed at the intercolumnar position and often complimented by the false counterpart at the column-top position. In spite of the selective and occasionally even arbitrary application of different types of ang within the same puzuo-unit, such bracketing was the logical continuation of Song and Jin dynasty construction methods and led the field to the next step of dougong technology in late imperial China. Finally, the building material in the Yuan period was often naturally crooked and of lower quality, but timber architecture of that time further differed from official architecture of the Song dynasty in a lower consumption of raw materials. High-quality timber was expensive and increasingly less available, especially for non-official style building. Although the modular proportions of the basic design unit still followed the Song dynasty with a ratio of width to height (being) equal to 3:2, the actual size and numerical value of the timber decreased. Thus the height of bracketing layer or bracket sets also decreased. Furthermore, the puzuo design was often simpler than in the Song dynasty, for example fewer bracket-arms or interior steps at the column-top position, or even the substitution of
transversal brackets by a single step of horizontal timber, a method called tatou沓头.\textsuperscript{207}

In conclusion, the simplification of bracket sets starting in the thirteenth century was a step forward and challenged the traditional heritage of the Yingzao fashi through unconventional methods, more flexibility and freedom.\textsuperscript{208}

c) **Third period or stage of change and decorative opulence**

The establishment of the Ming dynasty 明朝 (1368-1644 C.E.) in the fourteenth century finally ended the century-long dominance by confederations of medieval Northern steppe tribes. In reverence to the glorious past and native Han Chinese culture, the early Ming dynasty experienced a revival of the iconic Tang and Song dynasties, especially in the fields of art and architecture. There was a desire to follow the old building style that was codified in the twelfth century Yingzao fashi:

“因此在大木作技术上大量吸收和延用宋营造法式的建筑规范及技术特点。”\textsuperscript{209} (Therefore, with regard to the greater carpentry system, they generously absorbed and continued to use the architectural standards and characteristic technological features of the Song Yingzao fashi.)

The Ming dynasty was an era of economic prosperity (including international sea trade) and the rise of a new social class with roots in rural culture or commerce as the new patrons for art and architecture. Although local building traditions had always existed and had played a role in the formulation of official architectural styles, there was a greater acceptance for distinct regional features since the fourteenth century. The further distinction among neighboring areas was better known and more accessible to the public, such as the famous landscape architecture in the gardens of Suzhou or the typical residential architecture in Jiangsu, Zhejiang, or Anhui provinces.\textsuperscript{210} In the seventeenth
century, the Manchus, a non-Han Chinese people from the North who claimed
themselves the successors of the medieval Jurchen tribes and the Chinese Jin dynasty,
seized power and established the last pre-modern dynasty on Chinese soil in 1644, the
Qing dynasty (1644-1912 C.E.). They ended the declining rule of the already
weakened and nearly bankrupt Ming Empire that was shattered by epidemics and
intrigues of powerful eunuchs and bureaucrats. Even though they faced resistance by
Ming loyalists and led military campaigns in the south until 1681, a peaceful period of
prosperity and blooming arts began in China, especially under the regency of the Kanxi
Emperor (r. 1662-1722 C.E.), the Yongzheng Emperor (r. 1723-1735
C.E.), and the Qianlong Emperor (r. 1736-1795 C.E.).

Despite their different ethnic, political and social nature and in spite of certain
differences in their greater carpentry systems, the bracketing of the Ming and the Qing
dynasties (1644-1912 C.E.) show great similarities and is often discussed
together. Not least, because in the early Qing period, there was a restoration of
Beijing’s traditional architecture in the old Ming dynasty style. Additionally, the timber
craftsmanship continued, and the builder’s knowledge was handed down from the older
generations of the family beyond the political fall of the Ming dynasty reign. Ironically,
Qing dynastic style architecture is better known than its predecessor. In fact, Qing
dynasty bracket sets are among the best known icons in Chinese architectural history
today, probably thanks to the publication of the second official grammar book in Chinese
timber architecture. To be exact, the eighteenth century Building Methods of the Board of
Works by the Ministry of Public Work or Gongbu gongcheng zuofa eventually utilized
mid- to late-Ming and early Qing period construction methods.\footnote{212} It finally officially codified the smaller size of bearing blocks and designated them as the new basic module called *doukou* that replaced the design system of the Song dynasty.\footnote{213}

The technical achievements in the greater carpentry system that occurred since the publication of the twelfth century *Yingzao fashi* affected the development of column-top *dougong* and thus their design. Since the Ming period, length- and cross-wise beams in high-rank architecture developed together into a coherent structural grid that was more stable than before and elevated above the (detached) bracketing layer (Figure 1-54). The head of the cross-beam extended beyond the wall plane and directly upheld the eaves joist or *tiaoyanheng* 挑檐桁, a method referred to as *tiaojian liangtou* 挑尖梁头 (Figure 1-55). The qualitative change between the Chinese bracket set and the cross-beam that had started in the preceding centuries was thus finally fully accomplished.

Just as a reminder, the *Gongbu gongcheng zuofa* introduced two kinds of greater carpentry systems, namely *dashi* and *xiaoshi* (Figure 1-56). Bracket sets were not structurally necessary for *xiaoshi* or small-size architecture in late imperial China, if the equilibrium of forces in the building structure was accomplished otherwise. By contrast, there was still structural need for the application of the cushion-like corbelled clusters at intercolumnar positions in *dashi* or large-scale architecture. It is generally agreed that two additional points of support in-between columns, or in other words two intercolumnar bracket sets, were sufficient in the Song dynasty to fulfill the structural shortcomings of length-wise beams that were triggered by the innate material characteristics of wood and their limitations.\footnote{214} The seemingly unnecessary supplement of up to six more corbelled clusters in late imperial China needs further explanation. Guo Huayu argued that the
increased length of each bay, the lower rank and grade and thus smaller size of blocks and bracket-arms (i.e. smaller surface of projecting members and less ability to project outwards), and the increased roof load provided too much stress for one or two intercolumnar dougong since the Ming dynasty.\textsuperscript{215} Especially the large bearing block or ludou was endangered and unable to bear the increased concentrated stress or to respond properly unless the number of intercolumnar sets was increased.\textsuperscript{216}

For another example of the change that occurred in bracketing of late imperial China, the idea of slanting members at intercolumnar corbelled clusters underwent modification by the introduction of liujin douke 溜金斗科 (Figure 1-57). To put it in a nutshell, liujin douke was a new way to balance the eaves with the lowest (roof) purlin that transmitted the load of the roof. It provided plenty of room for decorative wood carving at the bottom side of the slanting timbers that was visible to the eye of the viewer from the inside of the hall. In the Ming dynasty, the latter could either ascend smoothly and uninterrupted in one piece or start rising not till they had pierced through the wall plane into the inside of the hall. In the Qing dynasty, liulin douke always consisted of multiple layers of slanting members with broken line profile that completely superseded the true xia’ang of the Tang and Song dynasties and brought the combination of structural function with aesthetics to perfection.\textsuperscript{217}

Just as a reminder, column-top dougong before the Ming dynasty were important symbols for rank and social status expressed by their size and complexity in design such as the number and nature of outwards projecting steps including xia’ang. Ming dynasty column-top dougong on the other hand shed the function as a status symbol, and the
status of the patron or the importance of the building was thereafter articulated by the number of intercolumnar sets:

“而宋法式中规定的建筑斗口尺寸与等级的对应关系，在明代随着斗栱用材等的降低，建筑斗口取值得相对集中，斗口取值作为严格的等级划分标志逐渐变得不明确，失去了作为等级标准的主导地位。而平身科数目的多寡则逐渐变成为决定斗栱等级，进而使建筑物等级的更加重要的标志。”218

(Furthermore, regarding the corresponding relationship between architectural rank and the dimensions of *doukou* [i.e. a bearing block opening] regulated in the Song *Yingzao fashi*, *doukou* became comparatively stressed in the Ming dynasty following the decreasing size of *cai*; the gradual change of *doukou* into the indicator for strict gradation was not explicit, and it lost the dominant role in functioning as the standard sign for rank. Also, the increased number of *pingshenke* gradually became the decisive factor for the *dougong* rank, and proceeded to turn the building’s rank into an even more significant sign.)

It is often wrongly assumed that Ming and Qing dynasty *dougong* degenerated towards mere decorative elements, since they showed a higher degree of embellishment than in the previous periods and lacked the eye-catching structural descending cantilever to uphold the eaves and balance the load.219 On closer inspection, it is rather the case that column-top *dougong* in late imperial China shed some of their traditional functions such as to support the roof eaves, but they still had to perform other tasks. Furthermore, it is more accurate to say that they merely emphasized the innate decorative function of the Chinese bracket set. In essence, such change was not necessarily the downfall of bracketing but rather a re-definition of column-top and intercolumnar *dougong* and the final step forward in bracketing technology.220

**d) Short summary and concluding remarks**

In conclusion, the evolution of the Chinese bracket set is a complex and complicated process that gradually took shape over several thousand years. The iconic
Song dynasty *dougong* with its logical arrangement of interlocking members that orderly projected perpendicular and parallel to the wall plane was not the starting point but rather the result of a century-long progress and period of experimentation. It was one of the peaks in timber bracketing technology but not necessarily the final point. In essence, the evolution of the Chinese bracket set took several important steps that are roughly summarized below.

Generally speaking, the main function of column-top bracketing during the first period or experimental stage of formation from the Western Zhou dynasty to the Northern and Southern Dynasties was to connect the vertical columns with the horizontal beams and provide an additional buffer and abutment. At the same time, such clusters supported the gradually outward protruding roof. Especially the building corners provided a challenge for the ancient craftsmen, and this period’s architecture reveals several unconventional ways to tackle the problem of carrying the roof and upholding the eaves including the *mojiaogong*.

In the second period or stage of maturity from the Sui to the Yuan dynasties, column-top bracket sets successfully mastered their traditional tasks. In fact, their ability to project outwards and uphold the overhanging eaves was drastically enhanced. The loose arrangement of bracket-arms evolved into the complex layered system of interlocking parts that equally extended into multiple directions with ease. Their surface was skillfully painted and provided additional embellishment. They were powerful status symbols and their size and design visually indicated the social rank of the building or the patron’s social esteem. The bracket-arm became the standard unit of the highly-sophisticated modular design system of *caifen*. Individual members and construction
techniques became officially codified including the corbelled clusters at the corners. Intercolumnar bracketing arose and mimicked the intricate design of the column-top, moreover they even foreshadowed the important shift in symbolic value that was about to come.

In the third period or stage of change and decorative opulence during the Ming and Qing dynasties, the majestic size of bracketing and its individual members faded. Likewise, column-top *puzuo* lost their traditional function to uphold the eaves and balance the load with the help of slanting structural cantilevers. In late imperial China, it was necessary to respond to the technical achievements in timber frame technology that had gradually occurred since the Song dynasty. Bracketing in large-scale architecture eventually showed same exciting new designs. The intermediate *dougong* outshined the column-top counterparts in design, function, and most importantly, in the number of sets that were aligned along the building façade. Freed of some traditional structural duties, Qing dynasty *dougong* became lavishly decorated and adorned with exquisite carvings. In fact, their embellishment occasionally seem too exuberant and flamboyant to the eye of today’s viewer.

In the following pages, this thesis investigates the notion of angular bracketing, and at the same time, provides new data for the general discussion of bracket sets, especially with regard to regional architecture in Shanxi province and distinctive local features. Therefore, part two of this thesis discusses fan-shaped bracket sets and selected members of the greater carpentry system, links them to the general development of bracketing in Shanxi province pre-Yuan dynasty architecture, and pinpoints some important trend-setting phenomena.
The notion of tracing contemporary names of architectural elements back to classical and early literature was based in the desire of Li

In this thesis, the English names of brackets usually follow Miller, 6 as the uppermost perpendicular timber of the bracket sets with concealed front and exposed tail placed on top of puzuo to link interior and exterior joints. Up to the present, there is no English equivalent that fully captures the meaning in one word, which is why this thesis uses the phonetically transcription.

The relevant passage of the Shuowen jiezi reads as follows: “凡作件自柱头以上作曲枅内出一枅或一昂，皆谓之一跳；传至五跳止。” (Whenever a puzuo protrudes one gong or ang forward from the opening of the column-top ludou, all [the extensions] are called a tiao [i.e. one jump]; [they] build up until [they reach] five tiao, [then] they stop.) See also Liang Sicheng 梁思成, Liang Sicheng quanjji 梁思成全集 7: 104.

In this thesis, the English names of brackets usually follow Miller, Constructing Religion, who modified the technical language that was translated and successively introduced by Western scholars during the twentieth century. For a modern Chinese explanation of the relevant entries of bracket-arms, blocks and slanting cantilevers as recorded in the Yingzao fashi (entries on gong 枟, fei’ang 飞昂, and ke 科; juan 4, 76-88) see Liang Sicheng, Liang Sicheng quanji 梁思成全集 7: 81-103. Among the rich pool of secondary literature on historical Chinese texts on architecture, see, for a seminal English reference work, Michael Loewe ed., Early Chinese Texts Texts: A Bibliographical Guide, or for a recent Chinese publication Cheng Guozheng 程国政 ed., Zhongguo gudai jianzhushi 中国古代建筑文献精选.

The Yingzao fashi actually gives alternative names for the main bracketing members different from their names in preceding dynasties. The following paragraph briefly introduces such names and by exception uses traditional characters to capture the meaning of the historical language in Classical Chinese. By way of example, bearing blocks in general were addressed as ke 科 and alternatively as jie 杰 (筋), er 椎, lu 棱, or tu 椅 in the Northern Song dynasty manual; likewise, jiaobuke as changkaike 長開科, qixinke as huaxuke 華心科, and sundao as xiaoakoe 小科 shapes were common. In fact, the terms jie and er are already listed in the glossary of the Erya 爾雅, juan 5 entitled shigong 露宮, which exclusively deals with architecture. The Erya, the oldest lexicographical, but anonymous, work and one of the Thirteen Chinese Classics since the Northern Song dynasty, provides an advanced organization of content in comparison to the compilation method of the Shuowen jiezi 説文解字 (Explanation of Words) by Xu Shen 許慎 (55-149 C.E.). The Shuowen jiezi, the earliest comprehensive Chinese character dictionary arranges the entries by the structure of the characters and lists architectural terms, for example, under the radicals of mu 木 or shi 史 with respect to the relevant building material wood or stone, respectively. The term lu in the Yingzao fashi is mentioned in the Shuowen jiezi. More importantly, in the Eastern Han dynasty work Shiming 靈名 (Explanation of Terms) by Liu Xi 劉熙 (D 200 C.E.), chapter seventeen entitled shigong 露宮, similar to the Erya, there is a specialized chapter on construction and an enriched glossary of architectural terms in the Erya with alternative names. Likewise, brackets are called gong 枟 in the Yingzao fashi but also biaan 碑, bu 柱, xuanian 曲班, or tiao 棩. Huagou are known as miao 秒, juantou 卷頭, or tuaotou 夙頭, nidaogong as kekoutiao 科口跳, mangong as shenggong 眶拱, and linggong as dangong 单拱. The true or structural descending cantilever is addressed as xia’ang 下昂 and flying cantilever or fei’ang 飛昂, as well as juan 碑, ying’ang 英昂, or xiejiao 矢角. To be precise, between the lines in the historical text of the Yingzao fashi and also in practice at extant timber buildings, we find even more variations of bracket-arms such as jifugong 側樑拱, jiaofugong 交樑拱, or dinghuamokengou 磕頭樑拱. If applicable to this thesis’ research, they are further explained in the following chapters.

Those explained include dingtonggong 溝頭樑, liegong 列樑, yanwangkengou 燕翼樑拱, jiaogong 角拱, and moguogong 玫樑拱. The notion of tracing contemporary names of architectural elements back to classical and early literature was based in the desire of Li Jie to find the orthodox and norm. However, his compilation of 72 texts in this respect and the repetition of passages dating mainly to the pre-Qin and Han periods (with a preference for dictionaries and lexicata) were rather selective, because it also had to serve his personal goals. He aimed to establish a consistent line of meaning and claim legitimacy for his own writings and the architecture of the twelfth century (Feng Jiren 冯焕仁, The Song-Dynasty Imperial Yingzao fashi (Building Standards, 1103) and Chinese Architectural Literature: Historical Tradition, Cultural Connotations, and Architectural Conceptualization 190). For example, he followed the older third century commentary on the Erya by Guo
Pu 郭璞 entitled Erya Zhu 端雅注 than the (roughly) contemporary, imperially commissioned but less-prestigious Commentaries and Annotations on the Erya or Erya zhushu 端雅注疏 by the tenth century scholar Xing Bing 喜賓 (Ibid., 187). In total, the terms that were recorded in official or unofficial literature before the Northern Song dynasty neither fully matched the architectural features in the Yingzao fashi nor exactly conveyed the same meaning, another reason why Li Jie listed classical names next to their modern counterparts of the twelfth century (Ibid., 201). Additionally, certain elements in the Yingzao fashi had no predecessors and were penned by Li Jie, such as the term puzuo 須作 (Guo Daiheng, Zhongguo gudai jianzhushi 3: 634). In essence, Li Jie successfully managed to bridge the gap between the historical language of the intellectual class (focus on early and classical texts) and the modern colloquial language of the artisan class (unwritten technical terms and expressions of that time) (Wang Qixiang 吴其祥 and Liu Jiangfeng 刘江峰, “Yingzao fashi wexian bianzuan chengjiu tansuo 营造式式文献编纂尝试探” 266, 271). Wang Qixiang and Liu Jiangfeng emphasize the living technological language and suggest a causal relationship between the oral traditions of today's craftsmen and the written language of the future (Loc.cit). In this respect, Feng Jiren draws attention to the role of craftsmen in naming brackets not least because scholars were usually not familiar enough with the specific terms for architectural elements, their function and meaning (The Song-Dynasty Imperial Yingzao fashi Building Standards, 1103) and Chinese Architectural Literature 197-201). For example in the case of linggong and mangong, they combined their professional knowledge in timber carpentry with the popular practice of ci 詞, a flourishing kind of poetry with fixed line and word numbers based on music that attracted attention of all social ranks in the Song dynasty. In order to recall the specific length of the two brackets, they associated linge 令词, which contained fewer words and tunes with the shorter of the two brackets called linggong. Likewise, they identified mangong as the longer bracket through free association with the longer melody of mian 面词 (Ibid., 196).

Pan Guxi and He Jianzhong Pan Guxi and He Jianzhong 263: "算桯枋: 須作里跳枋上的枋子, 承平棋." (The suantingfang is a joist that is placed above the linggong at the interior projection of the bracket set and supports the pingqifang.)

The English names of bearing blocks usually follow Glahn, “Chinese Building Standards in the 12th Century” 172. For an insightful analysis of the nomenclature and specific function of each block in Chinese, see for example Guo Daiheng, Zhongguo gudai jianzhushi 3: 638-640. To be precise, in the Yingzao fashi and at extant timber structures, we can find even more variations of bearing blocks including juanhuadou 連珠斗, pingzangdou 平盤斗, jiaosudou 交棋斗, or qifudou 骑方斗.

Furthermore, there are two kinds of wedge-shaped abutments for slanting cantilevers. If applied at the exterior projection of the puzuo-unit, it is known as huaotou 华头子, a “timber which supports a structural descending cantilever at the point of intersection with the bracket set” (Miller, Constructing Religion 436). If applied at the interior projection, it is called xuesi 付嵌 (Guo Guxi and He Jianzhong 261). For a picture of xuesi, see Liang Sicong, Liang Sicong 7: 101.

See for example Guo Daiheng, Zhongguo gudai jianzhushi 3: 643.

The term juantsouqiao refers to the decorative tip of the huagong that is carved in juansha design. In other words, it applies entasis technique with tapered, rounded off head and tail. Entasis or juansha 卷 ска is the “artistic treatment of rounding off the ends of a bracket-arm, beam or tapered column to create an elliptic or convex profile; i.e.: dividing the perpendicular sides of a piece of timber into the same number of equal parts, and clockwise connecting the intersections of one side to the other respectively, the intersections of the straight lines give the points through which the curve is drawn” (Guo Qinghua, Visual Dictionary of Chinese Architecture 50).

At present, there is still some controversy about the exact definitions of touxinzuo and jinxinzuo, especially if the bracket sets lack any regular parallel bracket such as mangong or guazigong but still apply the upper most parallel bracket called linggong. Miller follows the definition by Xu Bo’an 徐伯安 and Guo Daiheng (“Song Yingzao fashi shuyu huishi - haozhai shizuo damuzuo zhidu bufen 宋营造式式术语释义-毫寨石作大木作制度部分” 25) and considers such bracketing as “stolen-heart.”

Miller, Constructing Religion 437.

See for example Guo Daiheng, Zhongguo gudai jianzhushi 3: 644. To be precise, the listed dantouzhi 单头雀替 is a way of interior bracketing to carry the roof purlin (Pan Guxi and He Jianzhong 254). In practice, it is also seen at exterior bracketing along the façade in early period architecture. The two designs of bateqijiaoxiangzuo and doukoutou are listed for tingtang-style architecture in the Yingzao fashi (Pan Guxi and He Jianzhong 246, 251).

Also written 象替雀替 (dantouzhi) or 单斗雀替 (dantouzhi).

Sun Dahang, Zhongguo gudai jianzhushi 5: 420. Numerous studies discuss the architecture of Hōryū-ji including Machida Köichi’s 町田甲一, “A Historical Survey of the Controversy as to Whether the Hōryū-ji was rebuilt or not”, Takeshima Takeuchi’s 竹島卓一, “The Kondo and the Pagoda of Hōryū-ji”, Mizuno Seicho’s 水野滋, “The Baroque Tendencies in the Hōryū-ji Style of Architecture”, or the work by Itō Nobuo 伊藤信夫, Mitsuo Inoue 井上信男, Mizuno Keizaburo 水野克郎, and for the work by Chinese scholars, see for example: Fu Xinian 傅新彦, “Riben Feimiao, Neiliang shiqi jianzhu zhong suofanyingxue de Zhongguo Nanbeichao, Toutang jianzhu tedian 日本飞鸟、奈良时期建筑中所反映出的中国南北朝，隋唐建筑特点”, Su Bai 宿白, “Notes on Visits to the Hōryū-ji Temple in Nara, Japan”. For the work by North American scholars, see for example: Kidder, The Lucky Seventh: Early Hōryū-ji and Its Time; Steinhardt, “The Monastery Hōryū-ji.”

For the Chinese influence on early Japanese timber architecture, see for example Steinhardt, “Seeing Hōryū-ji through China” and “The Monastery Hōryū-ji.” A good example is the cloud-patterned bracket-arms called kumohijiki 雲肘木 or kumogata
Broadly speaking, the French term "Chinoiserie" describes a style in Western art that reflects the European vision of the Orient and in Ikaruga (Figure 1-10).

See publications by Nancy Steinhardt and Tracy Miller.

See publications by Nancy Steinhardt and Tracy Miller.

Usually, Liang Sicheng, Liu Dunzhen, Yang Hongxun, Pan Guxi and He Jianzhong.

Glahn, "On the Transmission of the Indian Temple to China.", which introduced comparative tables of characteristic features and measurements for early extant timber structures in Ikaruga (Figure 1-10).

The Song-Dynasty Imperial Yingzao fashi (Building Standards, 1103) and Chinese Architectural Literature 213-276).

For recent articles on Song dynasty bracketing and the Yingzao fashi, see for example: Han Yicheng, "Yingzao fashi damuzuo guanli tanxi", which introduced comparative tables of characteristic features and measurements for early extant timber structures in China.

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Among the many articles by Fu Xinian, see for example: Fu Xinian, Zhengguo jixie jishu yuanliu jiqi yu Jiangnan jianzhu de guanlian tanxi.

In fact, the meaning of flower, which matches the modern Chinese character of 花, was just one of its possible meanings in the past. (The Song-Dynasty Imperial Yingzao fashi (Building Standards, 1103) and Chinese Architectural Literature 213-276).

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the middle of the seventeenth century but spread to other European countries such as England, Germany and Austria. It included many different fields, such as ceramics, textiles, furniture, painting, and architecture.


43 The design was a reference to the “Great Pagoda” in the Royal Botanic Garden of London by William Chambers. The current pagoda was rebuilt in 1952 upon destruction in the Second World War. In fact, it is a wonderful example of “German traditional building technology.”

44 Boerschmann, Chinesische Architektur 1: 60 or 1:67. „Besteht das Grundgerüst der chinesischen Halle aus einer klaren Stützenstellung und dem Gebälk, so ist nachdrücklich darauf hinzuweisen, dass bei den meisten und den besten Beispielen Säulen und Gebälk nicht wie bei dem griechischen Tempel, oder auch bei den italienischen, zwei tektonisch scharf voneinander geschiedene Einheiten darstellen, sondern dass sie in China in innigster Verbindung und Durchdringung stehen, auseinander herausgewachsen und organisch in den Dachstuhl und in die Dachfläche übergehen. Dieses wird durch zwei Grundsätze erreicht. Erstens liegen die Architrave, entgegen dem griechischen Gebrauch, nicht auf den Säulen auf, die in China keine gebildeten Kapitäle tragen, sondern sie spannen sich zwischen die Säulenhäupter und tragen mit diesen gemeinsam und unmittelbar die Fußfette für die Dachsparren oder das zwischengeschobene Konsolengesims oder endlich, im Inneren, die starken Rahmen für die großen Felder der Kassettendecken” (Boerschmann, Chinesische Architektur 1: 60).


46 Takuchi Takeshima. Eizi hōshiki no kenkyū 营造法式の研究 ([The significance of the Yingzao fashi: a valuable historical material]. Tanaka Tan. Chigokoku kenchi kushiki no kenkyū 中国建築史の研究 ([Research on Chinese Architectural History]).

47 For an interesting analysis of this trend, see for example Zhao Chen 赵辰. Limian de cuohui 面的误会. "Jianzhu yu dongfang zhuyi, guojiazhuyi 东西方建筑与东方主义, 国家主义" 117. Wang Yilin 王艺林. “Qiantan dougong saoyunhan de Zhongguo chuantong wenhua 浅谈斗拱所蕴含的中国传统文化” 117.

48 Ji Hong 季宏, and Zhu Yongchun 朱永春. “Han huaxiang shengxiantu zhong dougong de wenhua yiyi jiedu 汉画像升仙图中斗栱的文化意义解读”. These arguments are very interesting, but I have yet to see convincing evidence. Han Yicheng, “Dougong de jiegou, qiyuan, yu Yingzao fashi ‘puzuo’ yu ‘tiao, puzhizuo’ bianxi” 14.


50 Liu Dunzhen, Zhongguo gaijianzhu shi 中国古建筑史 3.

51 Steinhardt, “From Kogoryo to Gansu and Xinjiang: Funerary Worship Space in North Asia 4th -7th Centuries”.

52 Several studies point to this conclusion, see for example the articles in: Hsueh-man Shen, Gilded Splendor: Treasures of China’s Liao Empire (907-1125) or Wu Hung, Between Han and Tang: Cultural and Artistic Interaction in a Transformation Period 汉译之间的文化艺术的互动与交融. Guo Qinghua argued for a kinship of Chinese bracket sets with the log house construction, especially with regard to the mezzanine level called pingzao 平坐 (The Structure of Chinese Timber Architecture 40).
In terms of construction, “small pavilions” or xiao jian tingxie 小尖亭榭 belong to the category of diantang architecture. Their timber frame system implements the principle of tailinggong style and shows three distinctive horizontal layers, but the roof layer shows some special characteristics (Pan Guxi and He Jianzhong 28). Strictly speaking, the Yingzao fashi distinguishes between three different structural types of official architecture, namely: first, diange 殿阁 including diantang 殿堂, louge 楼阁, diannen 殿门, chengmen louge 城门楼阁 and tingxie 亭榭 buildings; second, tingtang 亭堂 that can also include timber halls, gates or multi-storied buildings; and third, yuwan 余屋 or “ordinary houses” which includes secondary architecture such as corridors but the Song dynasty text does not discuss this type in detail (Pan Guxi and He Jianzhong 16). Furthermore, Chen Mingda introduced another categorization by dividing the timber structures into the following three types, namely Haihui Hall design 海会殿形式, Fougou Monastery design 傅光寺形式, and Fengguo Monastery design 奉国寺形式 (Zhongguo gudai mugoujie jianzhu shuzhi 中国古代木构架建筑技术: 唐至北宋) 464, 466-467.

The best known example of diantang style is the Tang dynasty East Hall of Fougouasi at Mount Wutai. As a rule of thumb, the three main characteristics of diantang architecture are the distinctive puzuo layer (i.e. use of puzuo on top of exterior and interior columns, the equal height of all column shafts, and the two-layered framework of beams in combination with an interior coffered ceiling. Consequently, tingtang architecture lacks the interior ceiling which is called cheshangmingzao 鍵上明造, and consists of several laterally connected frameworks, and the columns are not crowned by bracket sets or at least apply simpler designs of bracketing (See for example, Guo Daiheng, Zhongguo gudai jianzhu shuzhi 3: 654).

For an insightful discussion, see Wang Tian 王天, Gudai damuzo jingli chutan 古代大木作静力初探 (1013 C.E.), even though the hall is decorated with a zaojing-style 褐井 interior ceiling. For architectural drawings of Baogouasi, see for example Fu Xianian, Zhongguo kexue jishushi jianzhujuan 中國科學技術建筑卷 457 or Guo Daiheng, Donglai diyi shan 东来第一山: 保国寺 464.

According to the Yingzao fashi, a diantang is a two-layered framework with a lower section of visible beams called mingfu 明樑 and a top section of concealed rough and unfinished beams or caofu 糠樑 (Guo Daiheng, Zhongguo gudai jianzhu shuzhi 3: 654).

With nineteen examples, sectional drawings of tingtang style outnumber the diantang drawings in the Yingzao fashi. A good example of the tingtang-style lateral framework is the Main Hall of Baogouasi 保国寺 in Ningbo 宁波, Zhejiang province 浙江省 (1013 C.E.), even though the hall is decorated with a zaojing-style 褐井 interior ceiling. For architectural drawings of Baogouasi, see for example Fu Xianian, Zhongguo kexue jishushi jianzhujuan 457 or Guo Daiheng, Donglai diyi shan 东来第一山: 保国寺 464.

For an insightful discussion of local building traditions with regard to hybrid forms of diantang and tingtang architecture in Southeastern Shanxi province, see Liu Yan 刘妍 and Meng Chao 孟超, “Jindongnan xueshan xianzhu de liangjiaguo zuo zongshu yu tongzi fenxi - Jindongnan diqu Tang zhi Xin xianshan xianzhu jianzhu yanjiu zhi yi - Jindongnan xueshan xianzhu ju diantang zuo fa bian Ji - Jindongnan diqu Tang zhi Xin xianshan xianzhu jianzhu yanjiu zhi yi” 唐遼東南山建築的研究之一 - 唐遼東南山建築的研究之一 (173). The focus lies on diantang-style 山頭式 roof construction. The main difference between balloon- and platform-framing is the height and number of horizontal layers. The platform-framing style with a height of two sections shows some special characteristics (Pan Guxi and He Jianzhong 28).

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76 Yu Zhuoyun, “Douong de yunyong shi woguo gudai jianzhu jishu de zhongguo gongxian” 175.

77 Further characteristics of traditional Chinese architecture are for example, the tapering of the column tops called entasis or juansha, the distinctive concave profile of the front façade that is achieved through the successive increase in height of columns along the façade from the central bay outwards also known as shengqi 生起, and finally, the slight incline of the axes of corner columns towards the center of the whole structure called cezhao 侧脚 (the column foot is eventually slightly moved outward).

78 The question of which member, namely liuyaozuo or xiapianguan, was a result of the other seems similar to the finicky question of “Who comes first, hen or egg?”. Based on computer simulations, Wang Tian provided new insight by suggesting that the liuyaozuo was the counterbalance of the lowest ridge purlin and not the other way round. By contrast, people in the past believed that the lowest ridge purlin was placed on top of the structural descending cantilever in order to to balance the weight of the liuyaozuo (Wang Tian, Gudai damuzuo jingli chutan 54).

79 Guo Qinghua refers to the bracket set layer as the structural unit of juanlunliang 图梁 (The Structure of Chinese Timber Architecture 40). She suggest that the notion of puzuo derived from the stabilizing function as a gird or “ring beam” that was well secured by the superimposed high compressive load of roof tiles and timber joints.

80 Steinhardt, Chinese Traditional Architecture 13.

81 Yu Zhuoyun, “Douong de yunyong shi woguo gudai jianzhu jishu de zhongguo gongxian” 173.

82 Chen Mingda defined yarcoufang as “a member on top of a fubigong, which levels the whole bracketing system, and on which the end of the main beam rests” (Yingzao fashi damuzuo yanjiu 263). Guo Qinghua defined gongxianjuan also known as gongdianbian 拱垫板 as the “interbracket-set board” or “the area between two puzuo sets that is infilled with a wooden panel, or a bamboo basketwork rendered with plaster, usually colorfully painted” (Visual Dictionary of Chinese Architecture 39).

83 Generally speaking, wood possessed good innate material characteristics such as shrinkage and expansion to withstand earthquakes and absorb seismic stress. The longitudinal earthquake resistance of the timber building mainly relied on the mortise-and-tenon joints between lan’e and column-top. The tenoned joints were able to deal with short-term, temporary stress, bending moment, or angular deflection to a certain extent. Wang Tian, Gudai damuzuo jingli chutan 137. For further readings on earthquake resistance of traditional Chinese architecture, see for example: Li Jixing 李济生, “Qiantan Zhongguo gudai jianzhu de xingneng 谈中国传统建筑抗震性能”; Luo Zhewen 罗哲文, “Tan Dulesi Guanyinge jianzhu de xingneng wendi 谈独乐寺观音阁建筑的抗震性能问题”; Yu Zhuoyun and Zhou Suqin 周素琴, “Zhongguo gudai jianzhu juanlunliang qianhe changzheng chutan 中国古代建筑抗震性能初探”; Zhu Xiangdong 朱向东 and Zhang Tongle 张同乐, “Qiantan Zhongguo chuantong jianzhu mujiegou de kanzheng jishu tedian 谈中国传统建筑木结构的抗震技术特点”.

84 Wang Tian, Gudai damuzuo jingli chutan 137.

85 Loc. cit. The ideal case was a (nearly) square-shaped floor plan such as the three-bay wide and four-, six-, or eight-rafter deep halls of Nanchanshi 南禅寺, or Hualinsi 花林寺, and the worst case scenario, if the building length far outnumbered the building depth. Nine-bay wide halls were also still reasonable such as at the Daxiongbaodao 大雄宝殿 of Fengguosi 法国寺 or Huayan寺 华严寺, both with a length-to-depth ratio of 1.9:1. Hypothetically speaking, the same was true for eleven-bay wide halls. Additionally, a solid wall that encompassed the exterior eave columns increased the ability to resist earthquakes, especially in case of gable walls. Finally, the inwards inclined columns of cezhao was not just decoration but also enhanced stability.

86 Ibid., 154; “殿基结构, 水平分层不算是致命缺点” (In case of the dianzhuang-style frame system, the horizontally leveled division was not fatal shortcoming).

87 Chen Mingda, Yingzao fashi damuzuo yanjiu 154.


89 Pan Guxi and He Jianzhong 94-95: Under certain circumstances such as a high-rank bracket set of eight-puzuo, seven-puzuo, or six-puzuo, the Yingzao fashi explicitly allowed to reduce the number of interior projecting steps by one or two levels or decrease the length of these transverse extensions by a certain number of sections or fen.

90 Fu Xinian, Zhongguo gudai jianzhushi 2: 253-255.

91 Fu Xinian, Zhongguo gudai jianzhushi 2: 170.

92 Such as Fu Xinian, “Yuan dadu dadi gongjian de fuyuan yanjian 元大都大内宫殿的复原研究”.

93 Li Andrew I-kang, “The Yingzao fashi in the Information Age” 299: The house-shaped sarcophagus of the Northern Qi dynasty 北齐朝 (500-577 C.E.) nobleman Sheduhiuluo 库狄回落 (died in 562 C.E.), who was buried in Gujiazhang 贾家庄, Shouyang county 寿阳县, Jinzhong prefecture 介休市, Shanxi province, shows proportions for structural timber that foreshadowed the succeeding Tang and Song dynasties. Fu Hung 胡鸿 argued for a Southern origin of such small-scale architecture including the Shouyang county example (“A Case of Cultural Interaction: House-Shaped Sarcophagi of the Northern Dynasties” 37-38). They represented a funerary tradition from Sichuan province that was culturally transmitted to the North since the third century C.E. by the Danyi movement called the Way of the Celestial Masters or Tianshishou 天师道, in particular the Way of the Five Bushels of Rice or Wudoumidao 五斗米道, and which became increasingly popular at the Northern Wei court and even “official norm”. Since human bones were not necessarily stored inside the house-sarcophagi or on stone couches, their function in the period between the Han and Tang dynasties
Guo Daiheng, Fu Xinian proved that the building length and the column height of buildings such as the East Hall of Foguangsi corresponded to the

See also, Harrer, Alexandra

To be precise, the design system based on the bracket set was not the only one in traditional Chinese architecture. Large-scale building projects such as city planning or the layout of an entire monastery complex used a different set of design

were not written down but still existed such as the Japanese carpenter’s square or sashigome 尺, a variation of the Lu Ban尺 that probably came to Japan in the Kamakura period 藩閥幕府 (1185-1333 C.E.) (Ibid., 90). For an insightful discussion on the minor role of the Lu Ban尺 as a module and standard unit of proportion, see Carpenter and Building in Late Imperial China 81.

In China, the situation in the past was rather complicated. Not only did the official foot change with a new dynasty, but there were also several carpenters’ foot-rules as independent, non-official systems of measurement. Since foot-rules were “considered to be a secret attributed to the carpenter”, they were not recorded in official manuals but rather “passed on from carpenter to apprentice” or listed in geomantic treatises, carpenter’s manuals or popular encyclopedias (Klaas Ruitenbeek, Carpenterry and Building in Late Imperial China 79). Klaas Ruitenbeek further suggested the existence of more than twenty different carpenter’s foot-rules that were mentioned in historical texts between the Yuan and Qing dynasties. Some of which were used simultaneously. They were divided into favorable and unfavorable inches, and the number of divisions ranged from eight to thirteen. “Whereas this system of choosing favorable inches was meant for the measurements of doors in the first place, it was also applicable to other parts of the house, especially the main members of the wooden framework. As may be seen in Appendix I, a great variety of foot-rules existed in different regions and periods. The earliest reference is found in the Shilin guangji 事林广记 (Extensive Notes from the Forest of Facts), by Chen Yuanjing (ca. 1200-ca.1266). They are not mentioned in the Yingzao fashi of 1103, so their use may not yet have been widespread by that time” (Ibid., 78).

However, Klaas Ruitenbeek pointed out that the Gonghu gongcheng zuo fa listed 124 measurements for doors that were not only based on the foot-rule of Lu Ban but also ended on a favorable inch (Loc. cit.). Furthermore, there were foot-rules that were not written down but still existed such as the Japanese carpenter’s square or sashigome 尺, a variation of the Lu Ban尺 that probably came to Japan in the Kamakura period 藩閥幕府 (1185-1333 C.E.) (Ibid., 90). For an insightful discussion on the minor role of the Lu Ban尺 as a module and standard unit of proportion, see Carpenter and Building in Late Imperial China 81.

See also, Harrer, Alexandra 荷雅丽, “Timber Technology in Pre-Modern Chinese Architecture”: Modern steel structures of the twentieth century apply the same design principles as their medieval Chinese predecessors, although they are built several hundred years later. Due to the absence of solid shearing walls in the strictest sense, they rely on columns and beams as the main load-bearing members. More importantly, they stress standardization of all structural members that allows budget control through prefabrication and easy assembly. Such consistency requires a building code and a construction system that emphasizes a basic unit on which all individual members of the building are based. It furthermore requires a political system that implements and supervises the correct execution. In order to avoid shrinkage or swelling in dry or moist climate respectively, structural timber needed to dry for several years before being applied to the frame structure. Else Glahn explains that “it seems logical to assume that one reason for defining the eight categories was to allow the stocking of structural timbers precut to size required for each category” (“Chinese Building Standards in the 12th century” 169).

They both were tools to assist the official ministries in the management of imperial construction projects and by no means intended “to teach officials how to become architects, for the craftsmen knew how to build” (Glahn, “Unfolding the Chinese Building Standards: Research on the Yingzao fashi” 48).

Fu Xinian proved that the building length and the column height of buildings such as the East Hall of Foguangsi corresponded to the modular regulations in the Yingzao fashi. “这表明在营造法式中所在的以分为模数地设计方法设计在中唐已经成熟了” (This shows that the regulations that refer to the use of the fen as basic modular unit for design were written down in the Song Dynasty manual, but they were already matured in at least the middle Tang period) (“Riben Feimiao, Neiliang shiqi jianzhuzhong suofanyangchufu de Zhongguo Nanbeichao, Sui Tang jianzhuzhedian” 41).

Guo Daiheng, Zhongguo gudai jianzhu shi 3: 662-663. A good example of such a rule of thumb is the height to width ratio of 3:2, which is close to the optimum value of 3:2:1 for the ideal cross-section of beams based on the bending strength of a rectangular beam within the range of elastic behavior.

To be precise, the design system based on the bracket set was not the only one in traditional Chinese architecture. Large-scale building projects such as city planning or the layout of an entire monastery complex used a different set of design principles. For example, straight diagonal lines were applied to divide the floor plan of monasteries in the Song, Liao and Jin dynasties and to place the important structures properly in the center or at the points of intersection (Fu Xinian, Zhongguo jianzhu jianshi jianzhu jishu 415-418). Additionally, the eight different grades of cai in the Yingzao fashi that resulted in larger or smaller buildings could also assure the architectural scale of the entire temple site. The Shanhua Monastery in Datong for example, applies the second to third grades for the main halls, namely Sanshen and Daxiongbao, but the fourth grade for the Entrance Gate or Shamman, and the fifth grade for the less important Puxiang 僧房. This distinction between different building types according to their importance within a monastery complex is a

remained unclear until such architecture finally “resumed its traditional Chinese function of enclosing a dead body” (Ibid., 41). In this respect, it is necessary to emphasize the influence of Sogdian culture as discussed by Judith Lerner, “Aspects of Assimilation: The Funerary Practices and Furnishings of Central Asians in China”. In her article, she analyzed the mutual influence of Sogdian and Chinese culture and explained the varying degree of assimilation as the personal choice of the deceased. She further suggested funerary beds or couches deriving from Chinese domestic furniture and sarcophagi from Chinese architecture. The types of monuments included for example, sarcophagi or shixiang 史享 often with stone beds or shiguanchuang 屏风床 inside, screened stone funerary couches or weiping shita 围屏石榻, or screened mortuary beds 屏风石榻.
typical architectural feature of the Northern Song, Liao, and Jin dynasties (Guo Daeheng, Zhongguo gudai jianzhuishi 3: 626-627).

101 See for example: Fu Xinian, Zhongguo kexue jishushi jianzhujuan 315 or “Riben Feiniao, Neiliang shiqi jianzhu zhong suofanyingchu de Zhongguo Nanbeichao, Sai Tiang jianzhu tudian”. Fu Xinian discovered that early extant timber buildings of the Tang and Liao periods in China and also in Japan applied the cai as a basic modular unit and additionally, used the column height as basis for an “expanded modular system” or kuoda mosha to design the entire building height, especially in case of multi-storied structures. For example, at the Tang dynasty Main Hall of Nanchansi at Mount Wutai and the Liao dynasty Main Gate of Dulesi 兴乐思 in Jilin province, Beihai county, the height of the ridge was twice the height of the column. Multi-storied architecture in lounge-style 楼阁 used the column height of the ground floor columns for the expanded modular system. The elevation of the column top at the upper level of the Guanyin Pavillon 观音阁 at Dulesi is exactly three times the lower floor’s column height. The body of the Timber Pagoda of Fogongsi 楼阁 eventually recorded more than eight grades of cai-fen 份 as recorded in 903. In this quote, the Chinese character of cai-fen 份 refers to the two different sections for standard timber in the Qing dynasty (For example, Pan Dehua, Dougong 55). The problem becomes evident when analyzing the different meaning of the Chinese characters that are romanized as fen. The fen 分 without any distinguishing features is part of the chi-fen 尺分 system of length that refers to absolute linear units of measurement. The fen 分 with the Chinese radical of ren 人 is part of the modular cai-fen 册分 system. Whereas the English language translates the two different Chinese characters of fen 分 and fen 分 simply as fen, they differ in their Chinese meaning and pronunciation. Most likely, the current problem derives from a typo in the original text of the Yingzao fashi, a manual that was copied several times in the last nine hundred years and circulated over centuries in various editions. For details see Else Glahn’s painstaking article “On the Transmission of the Ying-tao fa-shih”. The entry on ch-fen 尺分 in the broadest sense, the height of the column was also subject to the modular system, because it was theoretically possible to convert the absolute measurements of cross-section and building façade and express them by the modular unit of fen (Fu Xinian, Zhongguo kexue jishushi jianzhujuan 315). In this spirit, Liang Sicheng explained that the width of cai was equal to 1/3 of the column diameter in the Song dynasty and 1/6 in the Qing dynasty respectively (Liang Sicheng, “Dougong (Yuan Ming Qing) jianshuo” 203). In general, in the Northern Song dynasty, the height of the regular eave column was used as a module, but in the late-Liao period and the Jin dynasty, the use of the corner column was also common (Fu Xinian, Zhongguo kexue jishushi jianzhujuan 419).

102 Yingzao fashi entry on cai, juan 4, 73. See footnotes 108 and 109 for explanation of the modifying ring of fen. The underlying desire for standardization becomes evident in the whole text of the twelfth-century building manual. “Throughout the manual the basis for calculation is some specific unit”, which could be a workday for calculating the necessary labor of each type of construction, or in terms of greater timber carpentry, a specific unit called caifen 份 (Glahn, “Unfolding Chinese Building Standards” 49).

103 The English translation is a direct quote from Chen Mingdu, Yingzao fashi damuzuo yuanjiu 237.

104 Yingzao fashi entry on cai, juan 4, 75.

105 Yingzao fashi entry on cai, juan 4, 75.

106 Gongbu gongcheng zuofa 343a; juan 28. In this quote, the Chinese character of cai 分 refers to the term cai 分. See also Guo Daeheng, Zhongguo gudai jianzhuishi 3: 633-634.

107 Although the Gongbu gongcheng zuofa did not explicitly mention the terms dancai and zucai, modern scholarship uses these names to refer to the two different sections for standard timber in the Qing dynasty (For example, Pan Dehua, Dougong 55).

108 Recent Chinese historiography refers to this fen 份 as fen 份 with a modifying letter ring above or “fen 分” with double quotation marks. Liang Sicheng introduced the new character fen 份 to clearly distinguish it from any other sub-unit.

109 There is an ongoing debate about the confusing use of the term fen. The problem becomes evident when analyzing the different meaning of the Chinese characters that are romanized as fen. The fen 分 without any distinguishing features is part of the chi-fen 尺分 system of length that refers to absolute linear units of measurement. The fen 分 with the Chinese radical of ren 人 is part of the modular cai-fen 册分 system. Whereas the English language translates the two different Chinese characters of fen 分 and fen 分 simply as fen, they differ in their Chinese meaning and pronunciation. Most likely, the current problem derives from a typo in the original text of the Yingzao fashi, a manual that was copied several times in the last nine hundred years and circulated over centuries in various editions. For details see Else Glahn’s painstaking article “On the Transmission of the Ying-tao fa-shih”. The copy of the manual that was available to Liang Sicheng and thereafter to the general public contained the term fen 分 without any distinguishing features. Since it was originally meant as fen 分 with the Chinese radical of ren 人, Liang Sicheng suggested marked the erroneous character with a modifying letter ring above or double quotation marks to indicate that he understood its inappropriate use.

110 The Yingzao fashi eventually recorded more than eight grades of cai. Additionally to the commonly well-known grades, there were two further varieties that were squeezed in-between the seventh and eighth grades, namely wucun cai 五寸材 for yinglingwuzi 宾居屋 as recorded in juan 19, and yicunbafen cai 一寸八分材 for interior ceilings called zuojing 蒂井 as recorded in juan 8 (Pan Guxi and He Jianzhong 45-46).

111 For the definition of dashi and siyao, see Fu Xinian, Zhongguo kexue jishushi jianzhujuan 727. For information on doukou, see also Pan Daizhang, Zhongguo gudai jianzhuishi 5: 410, 411.

112 Li Yunhe 李允和, Huaxia yijiang 华夏意匠 214.

113 Guo Huayu, Mingdai guanshi jianzhujuan 11: Whereas in the Song dynasty, the height of the full standard unit was the complex mathematical sum of the measurements for dancai plus the measurement of zhi, the Qing dynasty counterpart was the result of a simple multiplication. Its height measured twice the width, a ratio that was already used in the Ming dynasty.

114 Zhang Shiquing, “Bu fen yu zhengti 部分与主体”, or “Gudai jianzhu de sheji jishu ji jiqi bijiao – shihuo cong Yingzao fashi zhi Gongcheng zuofa jianzhu shenji jishu de yanbian he fazhan 古代建筑设计技术及其比较 - 初论从营造法式至工程设计建筑设计技术的演变和发展”.

115 A further analysis of the twelfth-century text and the extant structures proves that strictly speaking, the medieval modular system was fully applied only to individual members. The bay length or column height for example, was not well-defined in modular units. It was rather listed in absolute measurements of the time and recorded in a different chapter of the
The origin of the grades and their uneven division is still a topic of controversy among scholars. Some argued for a division based on the load-bearing capacity and the bending strength of the members, whereas others emphasized the desire to indicate different social status, rank and building type. Chen Mingda, Wang Tian and Qinghua Guo for example, advocated the engineering aspect, whereas Zhang Yuhuan emphasized the use as a status symbol. Pan Guxi argued that these uneven divisions were based on the underlying desire to limit the material consumption: The first and second grades were seldom used and only applied to large-scale architecture with huge timbers. The third, fourth, fifth, and sixth grades were more common and thus a smaller gap between adjacent grades limited the material consumption. The seventh and eighth grades were common too, and in fact, two additional grades were added in-between (Pan Guxi and He Jianzhong 45-46).

Furthermore, some theories stressed direct foreign influence and explained the Chinese bracket sets and the massive stone columns and corbelled brackets in India or Central Asia as sharing the Roman heritage and architectural vocabulary that existed in this region beyond the decline of ancient Roman civilization (Xiao Mo 程默, Dunhuang jianzhu yanjiu 莫高窟建筑研究).

However, this thesis suggests that the idea of a buffer zone and additional abutment in-between columns and beams is not unique to Roman culture. It eventually shared by numerous civilizations worldwide including Ancient Egypt, Mesopotamia, the Greek or Roman Empires or ancient cultures in India. The notion is probably part of the evolution of architecture per se.

Liu Zhiping 刘致平, Zhongguo gudai jianzhu leixing yu yanbian chutan 中国传统建筑类型及演变考察 (237).

Pan Guxi and He Jianzhong 45-46.

The history of the Chinese bracket set is usually divided into three stages of development and terminated at the fall of the Qing dynasty. In fact, even though the dynastic history of China came to a sudden end at the beginning of the twentieth century, the interest in bracket sets or their use in Chinese architecture did not.

The traditional feature of dougong did not succumb to the age of modernization. For information on this fourth stage that dates from the establishment of the Republic of China in 1912, see the excellent, self-critical discussion on traditional architecture in modern China by Peter Rowe and Seng Kuan, Architectural Encounters with Essence and Form in Modern China.

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See for example, Feng Jiren, Zhongguo gudai mupu jianzhu de kaoguxue duandai 中国古代木构建筑的考古学断代 43.

Li Zhen 李浈, Zhongguo cun cun yu jianzhu 北京传统建筑木作工具 28-32, 36-39. In his in-depth analysis of tools for tree felling, wood cutting and surface smoothing, structural joinery, and wood carving, Li Zhen pinpointed seven stages of chronological development in China until the end of the Qing dynasty (257). The Iron Age corresponded to the third stage that lasted from the Warring States period to the Western Han dynasty. Technically speaking, the craftsmen built upon the major achievements of the preceding Bronze Age but spread the technology and enhanced the quality of the tools, for example by increasing the length of the cutting edge of the simple one-man crosscut saw or daoju 刀锯 and the number and shape of the teeth along the serrated blade. In the next or fourth stage, the period until the end of the Northern and Southern Dynasties, the protruding blade of the saw was stabilized by a timber frame that put the blade under tension. The bow-shaped saw with a semi-circular timber frame emerged. Together with the invention of the rectangular frame saw, it was possible to achieve the highest quality of wood working and guarantee exact timber dimensions in the fifth stage that lasted until the Southern Song dynasty. (Ibid., 99, 103-104, 257) Generally speaking, the advancement in saw technology had considerable impact on Chinese art and architecture. In fact, the ability to cut lumber into smaller pieces enhanced drastically, and consequently, the size of the individual bracketing members such as brackets, blocks, or joints decreased gradually since the Tang dynasty. In essence, Li Zhen suggested that the use of large structural timber or large size of cai
was based in the shortcomings of the wood working technology and the technical tools to produce accurate, smaller dimensions on a large scale without much effort (Bud., 104).  

174 For the evolution of multistoried buildings in China with regard to building material, especially the use of mixed materials such as earth and wood in contrast to pure timber frames see: Wang Guixiang 王贵祥, “Luelun zhongguo gudai gaoceng mugu jianzhu de fazhan 略论中国古代高层木构建筑的发展”; Ma Xiao 马晓, Zhongguo gudai louge 国古代楼阁.

175 For basic information on the Bronze and Iron Ages and the architectural principles of the Qin and Han dynasties see Thorp, "Origins of the Chinese Architectural Style: The Earliest Plans and Building Types", "Architectural Principles in Early Imperial China: Structural Problems and Their Solution".

176 This notion of adopting and adapting the characteristics of timber architecture to another material, such as stone, brick, porcelain or metal, is called jiangmu 仿木. It proves the importance of wood in the architectural culture of China. The term “quasi-architectural evidence” was first introduced by the Japanese scholar Tanaka Tan （“Zuichō kenchikusha sekkei to kōshō 朝建築者設計と考証” (Architectural Designs and Studies by Sui Architects)) and in Western publications by Nancy Steinhardt (“The Mizong Hall of Qinglongsi” 30). Multistoried Han dynasty mingqi usually reflected a mixed-style of building that combined timber and clay (Ma Xiao, Zhongguo gudai louge 50).


178 Pan Dehua, Donggong 5-6, 8. For the marvelous Eastern Han cliff tombs at Pengshan 彭山, Sichuan province, see also the 1991 publication by the Nanjing Museum, Sichuan Pengshan Hanhuadatu 彭山漢代崖墓, or the insightful discussion of the tombs and their bracketing by Chen Mingda, “Yamu jianzhu (shang) 墓墓建筑（上）”. In fact, several hundred cliff tombs from the first to the third centuries C.E. were discovered in Sichuan province until present, see for example the 2005 survey report about the Eastern Han group at Qijiang 邛江, Sanyi County 台县,”Sichuan Sanyi Qijiang muqian Bolinpo 四川三台江墓群柏林坡”.

179 Fu Xinian, “Zhanguo Zhongshan wang Cuo mu chutu de zhaozheji ji lingyuan guizhi de yanjiu 战国中山王墓出土的兆域图及其陵园规划的研究”; Yang Hongxun, “Zhanguo Zhongshan wangling ji zhaoyutu yangjiu 战国中山王陵及兆域图研究”; Wang Tao, “The blueprint for the Zhongshan King’s graveyard”. In Chinese scholarship, the term douzi shuza is used to indicate a “block-and-strut” construction in many respects. Strictly speaking, the term appears in the technical language of the Yangzao fashi with regard to stone or timber balustrades with top and bottom rails and one carved panel (Pan Guxi and He Jianzhong 246; Qiu Guxiang, Visual Dictionary of Chinese Architecture 34).

180 Steinhardt, Chinese Architecture 56. This pottery object also illustrates the use of vertically slanting struts that occasionally supported roof eaves or balconies and rose directly from the four corners of the building. To be precise, the bracket clusters with mojiangong are placed on top of such ascending timbers and used to uphold the projecting area of the second floor’s balcony.

181 Yingzao fashi entry on gong, juan 4, 80; Pan Dehua, Donggong 6, 10.

182 Miller, Constructing Religion 428.

183 Zhang Dan 张丹, Donggong xiasha ya jiegou jineng yanbian lishi de yanjiu 斗拱艺术与结构机能演变历史的研究张丹 33.

184 Steinhardt, “Early Chinese Buddhist Architecture and Its Indian Origins. Nancy Steinhardt identified three stages in the cultural transmission of Buddhism and religious architecture of worship. The first and second stages took place in the Northern and Southern Dynasties, namely the increasing desire to build a foreign pagoda or in other words, a structure to house Buddhist relics, and the notion to enlarge the monastery layout with a worship hall. In the final stage, the one-storied rectangular hall gradually replaced the tall pagoda as the architectural and religious focus. Next to the stupas 塔 and its gradual development into the Chinese pagoda, typical features of Indian origin included the monastery courtyard or vihāra विहार and the horse-shoe shaped lintel or chaitya-style चैट्य arch that sparked interest of varying degrees. For the reflection of the two different building types of pagoda and worship hall in Chinese cave architecture see also Li Chongfeng 李崇峰, Zhong Yinfotashixiabianjinyanju yi taimaoke weizhongxin 中印佛教石窟寺比较研究: 以塔庙窟为中心.

185 Furthermore, there were one-storied pagodas in small-pavilion style, flower pagodas, Asoka pagodas, pagoda forests or five-pagoda clusters (Liang Sicheng, A Pictorial History of Chinese Architecture). Other publications usually followed Liang Sicheng’s terminology, but further analyzed the nature of the pagoda body. For example, Guo Qinhua divided the group of multi-storied pagodas into five subtypes, namely the wooden pavilions, the earthen-core-and-timber-frame structures, the brick towers with wooden veranda, the pagodas with pingcao balcony substructure and double concentric column network, and finally the solid masonry tower. (Guo Qinhua, Chinese Architecture and Planning). Liao Zhenwen focused on the structural differences and distinguished between examples with solid core pagoda body or shixinxin 实心 and hollow core pagoda body or kongxin 空心. The latter was further divided into six subtypes based on the nature of the pagoda body: First, multi-storied timber pagodas in pavilion-style or muzi lougeshi ta 木造樓閣式塔, second, pagodas with exterior brick walls and timber stair cases or zhanbi malouceng ta 磚磚木樓層式塔, also called kongting ta 空頂塔 after their internal cavity, third, pagodas that apply a central column made of wood or mumouxingta ta 木柱性塔, fourth, pagodas with ceramic exterior walls but timber eaves and balconies or zuanmuwangta ta 砖木混合塔, fifth, brick or stone pagodas with a ceramic central pillar or zhanbi taizhuxia ta 石柱性塔, sixth, five-pagoda clusters where the main pagoda body is shaped like a rectangular platform or guotaizha ta 高台塔 body (Luo Zhenwen 罗哲文 and Chai Fushan 柴福善, Zhonghua mingta daguan 中华名塔大观).
At first glance, the Indian-style elements such as lotus bud or chaitya arch above door openings seem to outweigh the indigenous Han Chinese vocabulary. On closer inspection it becomes evident that despite the local lack of Chinese-style bracketing, the craftsmen adapted the stereotypical Buddhist architecture of India to the local building traditions. The notion of “sinification” can be seen at the curved profile of the pagoda body that mimicks the entasis of vertical pillars in traditional carpentry or the “non-circular” twelf-sided floor plan (Cong Wen, “Songyuetu tati quxian de yanju 崖岳塔体曲线的研究”, Fu Xinian, Zhongguo gudai jianzhu 2: 577). In the succeeding Sui and Tang periods, one-story-small-pavilion style brick or stone pagodas also often lacked Chinese-style bracketing on top of engaged columns. The most famous example is probably the Sui dynasty Simen Pagoda of Shuozhou in Shangdong province (rebuild in 611 C.E.), where a simple layered cornice replaced the complex bracketing layer (Fu Xinian, Zhongguo gudai jianzhu 2: 516).

Among the several hundred caves at Maijishan 麦积山, Gansu province, the Northern Zhou 北周 (556-581 C.E.) cave number four at the West cliff called Upper Seven Buddha Hall 上七佛阁 emulates a three-bay or six-rafter timber hall and was originally furnished with a seven-bay wide gallery in front of the seven cave niches. Until present, only two engaged end columns survived. Fu Xinian used the cave to explain the advancement in timber architecture in North China, such as the increased depth of a building or the gradual shift from longitudinal to lateral beam construction (“Maijishan shiku zhong suofanyingchu de beichao jianzhu” 131). Furthermore, the inside of the cave exquisitely displayed the design of an imperial Buddhist canopy (Ibid., 128).

Soul jars mimicked large-scale architecture and were decorated with auspicious symbols such as the image of the Buddha, but their meaning and function is still under debate. For a possible explanation as a dwelling place for the 佛 脊-spirit if the physical body was absent, which was a pre-318 practice of the Wu Kingdom 吴国 during the Three Kingdoms period 三国时期 (220-265/280 C.E.), see Dien, “Development in Funerary Practices in the Six Dynasties Period: The Diuishgugan 堆塑窟 ‘Figured Jar’ as a Case in Point”.


In fact, the decorative horizontal band possessed structural meaning (Fu Xinian, “Maijishan shiku zhong suofanyingchu de beichao jianzhu” 131). It was similar in function to the modern trussed beam that is “braced by one or more vertical posts supported by inclined rods attached to the ends of the beam” (Harris, Dictionary of Architecture and Construction 1020). The two were either placed inside the building on top of the pingliang 平梁 to support the ridge purlin (usually referred to as chashou) or along the front façade above the architrave that was lodged in-between columns (usually called renzhuzhang) (Fu Xinian, “Maijishan shiku zhong suofanyingchu de beichao jianzhu” 131).”

151. Shen Lin 阿林, Wei Jin Nabeichao shinei huanjing yishu yanjiu 《魏晋南北朝室内外环境艺术研究》, 57.
152. Pan Dehua, Donggong 12.
154. Fu Xinian explained that fork-like braces were commonly applied at two different positions within the timber frame structure. They were either placed inside the building on top of the pingliang 平梁 to support the ridge purlin (usually referred to as chashou) or along the front façade above the architrave that was lodged in-between columns (usually called renzhuzhang) (Fu Xinian, “Maijishan shiku zhong suofanyingchu de beichao jianzhu” 131).
155. Zhang Dan, Donggong yishu ya jiegou jingeng yunbian lishi de yanjiu 《从建筑结构的演变-从建筑历史的研究》, 133, 135.
It proves the flourishing cultural exchange between the North and the South at that time (Zhao Lin, Wei Jing Nabeichiao shunei huangqin yishu yunqiu 53).

There is an ongoing controversy about the number of relics dating to the Tang dynasty or the Five Dynasties and Ten Kingdoms period respectively. Most scholars agree that at least three Buddhist structures belong to Tang dynasty architecture, all of which are located in Shanxi province. Fu Xinian listed the Main Hall of Mianchansi at Mount Wutai (782 C.E.), the Hall of Foguangsi at Mount Wutai (857 C.E.), and the Main Hall of the Tiantai Hermitage which are located in Shanxi province. Fu Xinian listed the Main Hall of Nanchansi at Mount Wutai (782 C.E.), the East Hall of Fangguangsi at Mount Wutai (857 C.E.), and the Main Hall of the Tiantai Hermitage in Pingyao county (undated) (Fu Xinian, Zhongguo gudai jianzhushi 2: 540). With regard to post-Tang dynasty architecture, most scholars agree on at least four structures, namely the Later Tang (923-936 C.E.) West Side Hall in Longmen, Pingyao county, Shanxi province (d. 925 C.E.), the Later Jin period halls in Pingyao county (d. 936-946 C.E.) Main Hall of Dayunyuan, Pingyao county, Shanxi province (d. 938-940 C.E.), the Northern Han Gaozong Hall in Pingyao county, Shanxi province (d. 962-963 C.E.), and the Main Hall of Hualin in Fuzhou, Fujian province (d. 964 C.E.) from the Way of the King of the Ten Kingdoms period in the south (682-979 C.E.). To complicate matters, He Dalong suggested a Five Dynasties’ date for the following two halls that are not yet designated as key national heritage conservation units or quanguo zhongguo wenwu baohu danwei (National Key Cultural Relics Protection Unit) by the State Administration of Cultural Heritage up to the present (February 2010). These are the Main Hall of Biyunsi in Pingyao village, Xiaochang village, Xian county (undated), Changzi county (2005), and the Front Hall of Yuhuangmiao in Pingyao county, Shanxi province (2005).

To be precise, it is difficult to find a common denominator for Tang dynasty architecture. The extant examples are not representative for the entire architectural style at that time. For example, the two monasteries at Wutaishan, Nanchansi and Fongguangsi, represent different sub-styles, namely the humble non-official style of the early-Tang period and the magnificent official style of the mid-Tang period: “The two buildings are both situated at Wutaishan, Nanchansi mostly reflects a local form and architectural standard of Shanzhi; Fongguangsi probably rather reflects the official architectural styles and architectural standards of the two Tang capitals” (Fu Xinian, Shilun Tang zhi Mingdai Wutaishan, Nanchansi mostly reflects a local form and architectural standard of Shanxi; Fuoguangsi probably rather reflects the official architectural styles and architectural standards of the two Tang capitals) (Fu Xinian, Shilun Tang zhi Mingdai Wutaishan, Nanchansi mostly reflects a local form and architectural standard of Shanxi; Fuoguangsi probably rather reflects the official architectural styles and architectural standards of the two Tang capitals) (Fu Xinian, Shilun Tang zhi Mingdai Wutaishan, Nanchansi mostly reflects a local form and architectural standard of Shanxi; Fuoguangsi probably rather reflects the official architectural styles and architectural standards of the two Tang capitals) (Fu Xinian, Shilun Tang zhi Mingdai Wutaishan, Nanchansi mostly reflects a local form and architectural standard of Shanxi; Fuoguangsi probably rather reflects the official architectural styles and architectural standards of the two Tang capitals). (Fu Xinian, Shilun Tang zhi Mingdai Wutaishan, Nanchansi mostly reflects a local form and architectural standard of Shanxi; Fuoguangsi probably rather reflects the official architectural styles and architectural standards of the two Tang capitals) (Fu Xinian, Shilun Tang zhi Mingdai Wutaishan, Nanchansi mostly reflects a local form and architectural standard of Shanxi; Fuoguangsi probably rather reflects the official architectural styles and architectural standards of the two Tang capitals) (Fu Xinian, Shilun Tang zhi Mingdai Wutaishan, Nanchansi mostly reflects a local form and architectural standard of Shanxi; Fuoguangsi probably rather reflects the official architectural styles and architectural standards of the two Tang capitals). Back to the main text.
In essence, the five-capital system of the Liao dynasty was modeled after the Kingdom of Bohai. Twitchett and Franke, Fu Xinian, “Shilun Tang zhi Mingdai guanshi jianzhu fazhan de mailuo jiqi yu difang chuantong de guanxi” 90. Miller, **Constructing Religion** 437. Furthermore, the High-Tang dynasty cave number 172 at Dunhuang reveals painted corbelled clusters of seven-panzuo with four transversal projections in jixin-style and hints the advanced level of bracketing technology at that time, at least in theory and two-dimensional depictions. One of the most exaggerated examples for a high number of piled up brackets in touxin-style are the the seven-panzuo bracket sets at the tenth century Main Hall of of Hualinsi 华林寺 in Fuzhou 福州, Fujian province (964 C.E.), that are placed along the exterior façade and display five transversally projecting huagong at the interior projection (Fu Xinian, Zhongguo gudai jianzhu 2: 503). Strictly speaking, the Tang dynasty East Hall of Fougansu displays the same number of huagong in touxin-style but only on top of the interior columns.


Fu Xinian, “Shilun Tang zhi Mongdai guanshi jianzhu fazhan de mai luo jiqi yu difang chuantong de guanxi” 85, 88; Steinhardt, *Liao Architecture*. Several studies point to the impact of traditional timber craftsmanship in Jiangnan region on the Yingzao fashi such as Zhang Shiqing’s “Yingzao fashi de jishu yuanyi jiu yu Jiangnan jianzhu de guanlian taxii” or Pan Guxi and He Jiapzhong’s “Yingzao fashi jiedu 5-14. The Yingzao fashi represented the imperial government style that did not fully incorporate the rich body of local architecture. For a further discussion of official and non-official building styles, see part two and three of this thesis.

Li Zhen, Zhongguo chuantong jianzhu muzuo gongju in the metropolitan city of Taiyuan, central Shanxi province, and the Main Hall of Longmensi 龙门寺 in the rolling countryside of Pingshun county. In 960, the Song Dynasty was founded. For history and culture of the Liao dynasty, see also Wittfogel and Feng Chia-Sheng, *History of the Chinese Society: Liao*.

In essence, the five-capital system of the Liao dynasty was modeled after the Kingdom of Bohai 北海 or Balhae 發韓 in Northeast China and today’s North Korea. It included the establishment of the following administrative centers, namely the northermmost Upper or Supreme Capital 上京 in Linhuang 延慶, (Barin Left Banner 巴林左旗) Inner Mongolia (918 C.E.), the Eastern Capital 東京 in Liaojiang 江京, Liaoning province (918 C.E.), the Southern Capital 南京 in Yanjing 燕京, today’s Beijing (938 C.E.), the Central Capital 中京 or Dading 大定 near Ningsheng 宁城, Inner Mongolia (1002 C.E.), and the Western Capital 西京 at Datong, Shanxi province (1044 C.E.). The Jin dynasty built upon the multiple-capital system of their predecessors except for the Upper Capital located southeast of Harbin 哈尔滨, Heilongjiang province (1123-1135 C.E.), that was partly transferred to Ningsheng 宁城 under the reign of the posthumously named Prince Hailing 海陵王 in 1153 C.E. By comparison, the process of urbanization under the new Jurchen rule and their southward move of administrative centers were faster than the Khitan’s, not least because they completed their territorial conquest within the initial thirty years of ruling. They revived former Liao dynasty sites for their (short-lived) Western Capital at Datong (1125 C.E.), the Eastern Capital at Liaoyang (1144 C.E.), the Central Capital in today’s Beijing (1151 C.E.), which was the actual center of power, and the (nominal) Southern Capital in Bianliang, today’s Kaifeng (1153 C.E.). Steinhardt, *Imperial City Planning* 123-136.

The transformation of the military nobility into a productive part of the population was one of the major obstacles of the time. The path towards a sedentary society under a centralized civil administration, and the idea of legitimation by adopting Chinese-style governmental structures had to be considered carefully. The constant struggle between the tribal elements and a
central military bureaucracy thus, is a common feature of the the three medieval conquest societies, namely the Liao, Jin and Yuan empires. It is telling that there was no universal answer, since the political background of the time stimulated different solutions.


Fu Xinian, “Shilin Tang zhi Mingdi guanshu jianzhu fa zhan de mai luo jiqi yu difang chuantong de guanxi” 87.


Yu Zhourun, “Douguong de yunyong shi wo guo gudai jianzhu jishu de zhongyao xingxiang” 165.

Fu Xinian, “Shilin Tang zhi Mingdi guanshu jianzhu fa zhan de mai luo jiqi yu difang chuantong de guanxi” 84.

Hok-lam Chan, Legitimation in Imperial China 54. See also Jing-shen Tao, The Jurchen in Twelfth-Century China.

The basic unit of the mengan mouke was the mouke or “Hundertschaft”, which ideally referred to a group of three-hundred households, although their actual number was probably smaller. Ten mouke formed a larger contingent of mengan or “Tausendschaft”. After 1145, some mengan mouke units were moved to the conquered Liao territory in North China to guard the military garrisons. The distribution of land among tribal chiefains was part of the policy to reduce the high costs of the military of the Jin dynasty (Xiao Qinging, The Military Establishment of the Yuan Dynasty 9).

Franke explains the term mengan mouke as follows. Whereas mengan derives from the number “one thousand”, mouke could be translated in two different ways. One the one hand, as “one hundred”, on the other hand, it probably refers to the Manchu term mukan for family, clan, village and is similar to the Chinese term baihu 百戸 (Franke, Nordchina am Vorabend der Mongolischen Eroberungen 19).

Fu Xinian, “Shilin Tang zhi Mingdi guanshu jianzhu fa zhan de mai luo jiqi yu difang chuantong de guanxi” 90.

Yu Zhourun, “Douguong de yunyong shi wo guo gudai jianzhu jishu de zhongyao xingxiang” 188.


For a preliminary discussion on Jin dynasty architecture, see also Steinhardt, “A Hall at Jingtusi: Architecture in Search of Identity.”

In this context the Tangut Empire, a former province of the Tang dynasty that became a multinational state under the rule of the Western Xia dynasty 西夏 (1038-1227 C.E.), should be mentioned. Since they left no written records of their history, they are usually not officially recognized within the framework of Chinese dynasties. Up to the present knowledge, there are no extant examples of timber architecture dating to this period.


For Yuan dynasty architecture in North China see Zhang Yuhuan, “Shanxi Yuandai diantang de damu jiegou.” For Yuan dynasty architecture in the south, see Zuo Lala 左拉拉, From Jiangnan to Sichuan: Yuan Architecture Along the Yangtze River.

Feng Jiren, “Zhongguo gudai mougou jianzhu de kexue xue jia de yanjiu” 65.

Zhang Yuhuan, “Shanxi Yuandai diantang de damu jiegou” 99. In the spirit of the Yingzao fashi, Pan Guxi and He Jianzhong defined tatou 替头 as the condition, when the head of a rectangular timber or the interior projection of tingtang-style bracketing extended toward the inside of the hall in the shape of zuizi 替子 (i.e. a timber with simple entasis or even without tapered edges and similar in function to the supporting board called timu 替) and upheld the cross-beam (Pan Guxi and He Jianzhong 249).

Pan Guxi emphasized the outstanding religious and cultural importance of Yonglecong as the major site of the Quanzhen Daoist Paradise of Bhai 巴海. In the Sichuan region, the influence of the Northern Song dynasty and the Yingzao fashi is less evident. Bracket sets in Sichuan also applied xiegong and sometimes omitted linggong and shuatou, two of the three basic components required for official Northern Song bracketing (Zuo Lala 144-145, 183-184, 337).

Most interesting, the earliest example of
xiegong in the architecture along the Yangtse River is found in the underground tomb of the Southern Song official Anbing in Huaying, Sichuan province (Zuo Lala 145; Sichuan sheng wenwu kaogu yuan, Huayin Anbingmu 华蓥安丙墓).

210 Steinhardt, Chinese Architecture 200.
211 Including seminal reference works such as Pan Dehua’s Dougong.
212 Guo Huayu, Mingdai guanshi jianzhu damuzuo 7.
213 Fu Xinian, “Shilun Tang zhi Mingdai guanshi jianzhu fazhan de mailuo jiqi yu difang chuantong de guanxi” (The shrinking of dougong and the repeatedly increased number of pingshenke indicate that doukou became the modular unit; the new modular system of using zandang to regulate building length and depth superseded the old system that started with the Tang and Song dynasties and used cai and fen as modules; it already took shape in the official Ming style.)
214 See Wang Tian, Gudai damuzuo jingli chutan loc. cit.
215 Guo Huayu, Mingdai guanshi jianzhu dougong tedian yanjiu 201. Yu Zhuoyun pointed out that the rising importance of intercolumnar bracketing since the publication of the Yingzao fashi was reflected in its new name. In the Gongbu gongcheng zuofa, bracket sets in-between columns were known as pingshenke 平身科, which literally translated refers to the action of “standing up after kowtowing” (“Dougong de yunyong shi woguo gudai jianzhu jishu de zhongyao gongxian” 182). Pan Dehua reminded us that the shift in importance and the new preference for intercolumnar bracketing also built on the general change that occurred since the Song dynasty, including the trend towards simplification, the increasingly smaller size of individual members and puzuo layer (if applicable), and the increasing number of sets in-between columns (Dougong 44).
216 See for example Liang Sicheng, “Dougong (Yuan Ming Qing) jianshuo” 205: “由结构的观点上看, 清式斗栱只余柱头科与角科尚勉强称为结构部分, 平身科只是纯粹的装饰品。斗栱原始的功用与美的, 至清代已丧失残尽了。” (From the angle of construction, among Qing style dougong only eave column-top and corner column-top douke remain to be called structural parts, [and even so just] with difficulties; pingshenke are just pure decoration. The original function of dougong and its beauty are already lost and extremely incomplete by the Qing dynasty.)
217 Guo Huayu, Mingdai guanshi jianzhu dougong tedian yanjiu 206: “本文从桁、檩所承受弯矩与受弯应力, 斗栱承载面与自身承载能力, 木构架整体性, 抗震性及装饰, 等级意义几个方面分析认为, 明清官式建筑中平身科攒数骤增并非单纯为了装饰, 亦非木构架发展的停滞、倒退, 而是明代木作技术的进步及木构架整体受力情况需要的必然结果。” (Based on the analysis of several aspects including the significance of beams, purlins, and all members bearing bending moments or receiving bending stress, the bearing surface of dougong and self-weight bearing capacity, the entity the wooden framework, the earthquake resistance, and the decoration and rank, this text argues that the sudden increase of pingshenke in Ming-Qing official style architecture was not at all purely decorative, also not a stagnation or fall back in development of timber framing, but rather the natural and necessary outcome of the advanced technology of Ming carpentry and of a timber framework that (by now) entirely received stress.)
Chapter 1: Situation of historical architecture in Shanxi

1. Historical, cultural, and political background of Shanxi province

Present-day Shanxi province is located in the heart of the People's Republic of China and consists of a territory equal to 150,000 square kilometers divided into eleven prefectures.¹

Modern art and archaeological research started in the early twentieth century has determined 271 key national heritage conservation units or quanguo zhongdian wenwu baohu danwei 全国重点文物保护单位 that are protected on a national level and several hundred additional sites on provincial or city levels in Shanxi (Table 2-1).² Three of China’s thirty-eight UNESCO World Heritage Sites are located in the province, the Yungang grottoes that include Northern Wei architecture, the well-preserved late imperial city complex of Pingyao, and the renowned Buddhist peaks of Wutaishan that successfully sheltered two of the oldest wooden buildings in China for nearly 1200 years.³ More than one-thousand academic articles and monographs have been published on archaeological excavations and field surveys of Shanxi.⁴

The remnants of the long eventful history of Shanxi province range from Paleolithic art objects and Neolithic/Bronze Age settlements to the theater of military operations in the mid-twentieth century war between the Communist and Nationalist
Parties. The following paragraphs can only give a glimpse of the turbulent political and complex administrative history.

Modern Shanxi province is still known by its historical name of “Jin 晋”. The powerful State of Jin was founded by King Cheng of Zhou 周成王 in the mid-eleventh century B.C.E., split six centuries later into three parts known as the Three Jins 三晋, namely the Zhao 赵, Han 韩, and Wei 魏 clans, and finally incorporated into the mighty Qin Empire at the end of the Warring States period.

During the following centuries, present-day Shanxi was called Bingzhou 并州 but often torn apart and attached to other administrative districts. It became the battleground for the fast changing military powers until the rise of the Tuoba Northern Wei, a non-Chinese dynasty founded by a confederation of nomadic tribes that gradually advanced from the northern borders into the Chinese heartland. After having unified war-shattered North China for one and a half centuries from their powerbase at Pingcheng 平城 (present-day Datong) in northern Shanxi, Northern Wei rule ended in 534 C.E. Subsequently Eastern and Western Wei, Northern Qi, and Northern Zhou fell, followed by the short-lived Sui and Tang, a long lasting dynasty that ruled a unified China, which had been separated since the third century C.E. In central Shanxi, the city of Taiyuan had gradually risen to power as a political and religious center and at the end of the Sui period, the former governor of Taiyuan launched a successful military campaign and ascended the throne as the first Tang Emperor Gaozu 高祖 (r. 618-626 C.E.), the founder of the dynasty. His son, the Tang Emperor Taizong 太宗 (r. 626-649 C.E.), re-arranged the empire into ten regional circuits or dao 道 in 627 C.E., and the territory of Shanxi to
which north and central Shaanxi, northeast Gansu, and parts of Inner Mongolia were added became known as the circuit east of the Yellow River or *hedongdao* 河东道 with nearly two dozen prefectures.⁸

In the Five Dynasties and Ten Kingdoms period, Shanxi was home to several of the short-lived regimes that seized power in rapid succession, namely the Later Tang (923-936 C.E.), Later Jin (936-947 C.E.), and Later Han (947-951 C.E.) dynasties. In contrast to their far-reaching influence in North China, the independent regional Northern Han Kingdom (951-979 C.E.), concurrent with the Later Zhou dynasty (951-960 C.E.), was centered in north and central Shanxi itself.⁹

From the tenth-century on, the Khitans, the Jurchens, and finally the Mongols, established non-Chinese dynasties on Han Chinese soil, the Liao (947-1125 C.E.), the Jin (1113/1115-1234 C.E.), and the Yuan dynasty (1267-1368 C.E.), respectively. By this time, the northern frontier of China had moved southward.¹⁰ The Sixteen Prefectures or *Yanyun liushizhou* 燕云六十洲, the northernmost part of the Chinese territory during the Tang dynasty was already lost to the Khitan tribes in 1005.¹¹ They contained the strategically important passes for entering the Chinese heartland stretching from present-day Beijing in Hebei province westward. They also included northern Shanxi, the prefectures of Yunzhou 云州 (around Datong), Yingzhou 应州, Shuozhou 朔州, and Huanzhou 寰州, and embraced the city of Datong, which would serve as the Western Capital in the Liao (beginning in 1044 C.E.) and Jin dynasties (beginning in 1125 C.E.). The southern border of the Sixteen Prefectures remained until the twelfth century, separating the Liao and Northern Song states politically and culturally until the conquest
of Shanxi by the Jurchen. The Northern Song dynasty had reformed the governmental system of the Tang dynasty. They centralized political power and undercut the longstanding influence of aristocratic lineages in civil service and the impact of military governors or campaign commanders that had fostered the rise of regional warlords during the Five Dynasties and Ten Kingdoms period. They divided the Chinese realm into fifteen routes or lu 路, and the south, central part, and a fraction of today’s northern Shanxi including Mount Wutai became hedonglu 河东路 together with parts of the neighboring provinces. The succeeding Jin dynasty split the newly unified territory of Shanxi into three routes, namely, hedongbeilu 河东北路 centered around Taiyuan, hedongnanlu 河东南路 in the southeast, and finally xijinglu 西京路 in the far north around Datong.

In the military campaigns during the first three decades of the thirteenth centuries that preceded the ultimate conquest of China in 1279, the Mongols already entered today’s Shanxi province and attacked several cities including Datong, Lu’an and Taiyuan. Generally speaking, the wars fought on Shanxi soil by the Northern alien conquest dynasties did less harm to the rich cultural heritage compared to the neighboring provinces of Hebei, Henan, and Shaanxi. Upon seizing power, the Yuan dynasty further elaborated the levels of administrative division, but it was not before late imperial times that the historical boundaries came to match the post-imperial province of Shanxi.

When Chen Mingda coined the catch-phrase of “treasure trove/treasury for architectural historians” in 1954, he identified nineteen buildings of Shanxi province as pre-thirteenth century timber structures, but the number of national protected relics had
already quadrupled. Modern Shanxi province accounted for 70% of the wooden pre-Yuan dynasty buildings that were discovered by 1981, and in 2008 for more than 80% of the relics dating to the Tang and Five Dynasties’ periods. The rich pool of extant architecture was one of the reasons for selecting Shanxi province as the source of angular bracketing, especially the arrangement in the shape of an open fan.

2. Quantitative research of monasteries in Shanxi province and its methodology

Up to the present, there has been no comprehensive study or database for architecture with angular bracketing in China, much less Shanxi province. In fact, there is a surprising lack of information about the total number of structures with angled bracket-arms in the strictest sense and its stylistic variations let alone the complex formations of fan-shaped or scepter bracketing. Moreover, the wide geographic range of the thrilling phenomenon is completely unknown, not to mention its detailed distribution and chronological clustering. Therefore, it was extremely important to gather information on a large scale, and for the first time to identify all the eligible regions within the territory of an entire province. The author thus conducted basic large-scale research that was crucial for further discussion and in-depth analysis of shanshi dougong and ruyi dougong herself.

The first challenge was to set limits for research, which is why the author narrowed the scope on the formative stages of fan-shaped bracketing in Shanxi province. Accordingly, special emphasis was paid to the Liao, Jin and Northern Song periods with the goal of establishing a solid pool of references and formulating a set of universal standards. Thereupon, the basic classification can be applied to architecture of the
succeeding periods in Shanxi itself or in other Chinese provinces as well as “quasi-architectural evidence” such as the Jin dynasty brick tombs of the Jishan region.

In terms of methodology, the author collected quantitative and qualitative data of extant pre-Yuan buildings with regard to their possible containment of fan-shaped bracket sets. In detail, the scope of the large-scale research was limited to the pool of timber structures in Shanxi province designated as key national heritage conservation units quanguo zhongdian wenwu baohu danwei by the State Administration of Cultural Heritage since 1961 (Table 2-1).21 Additionally, the finally released 2006 Atlas of Chinese Cultural Relics or Zhongguo wenwu dituji: Shanxi fence 中国文物地图集·山西分册 provided the basic geographical and chronological framework for beginning the task. It was certainly necessary to refine the search and enhance the information of the basic two reference works with detailed scholarly studies and survey reports.

In brief, among the 271 key national heritage conservation units of Shanxi province are more than eighty monasteries with timber buildings that date prior to the Yuan dynasty.22 Through a year-long visual and textual study and especially through on-site field work, the author investigated the possible application of fan-shaped bracket sets. In other words, those relics that did not apply genuine xiegong as defined by this thesis were eliminated and not eligible for detailed study (Table 1-2; Table 1-3). It was especially important to consider visual images and illustrations, because the lack of proper technical terminology and classification of fan-shaped bracket sets caused considerable confusion among authors and their written accounts.

As a result, the author successfully verified the use of shanshi dougong at twenty-two wooden buildings located at twenty different monasteries in Shanxi province until
the mid-thirteenth century. This included twenty one-storied timber halls, one multi-
storied timber pavilion, and one multi-storied wooden pagoda. Additionally, three
monasteries used *shanshi dougong* for their smaller carpentry in the form of sutra
cabinets or other storage devices. Strictly speaking, only twenty-one large-scale timber
structures were eligible for the case-by-case study in the next chapter, precisely all the
rectangle or square timber halls plus the square multi-storied pavilion (Table 2-2).\(^{23}\) Due
to different design rules in erecting architecture with octagonal floor plans, the Yingxian
Muta is not further considered at this point of discussion.

In the following chapters, the author distinguished three levels of observation to
explain the nature of fan-shaped bracketing: first, the environmental level of architecture,
which included the geographic location within Shanxi province, the monastery layout,
and the function of the buildings that eventually applied fan-shaped bracket sets; second,
the object level, which included the placement of the fan-shaped bracket sets at column-
top or intermediate position and the greater carpentry system of the single timber hall;
and third, the detail level, which comprised the individual elements of the bracket set
such as design and function of genuine *xiegong, shuatou, or chenfangtou*. 
Chapter 2: Fan-shaped bracket sets in pre-Yuan dynasty architecture of Shanxi

With the goal of establishing a system that can explain the diverse types of fan-shaped bracket sets, their application, function and development prior to the Yuan dynasty, the following paragraphs investigate the two dozen monasteries that became applicable through the research of chapter one based on textual records, visual images, and personal field work (Table 2-2; Map 2).

1. Introduction to monasteries with fan-shaped bracket sets in the Liao, Northern Song, and Jin dynasties and description of their angular bracketing

a) Northern Shanxi

Datong prefecture 大同市

Shanhua Monastery 善化寺

Shanhuasi, (inventory number 1-0088-3-041) also known as Southern Monastery or Nansi 南寺, is one of the two prominent Buddhist monasteries in Datong during the Liao and Jin dynasties and probably the best-published site with fan-shaped bracketing in Northern Shanxi. This is not least because the north-south oriented layout perfectly implements the idea of modular design on a large scale, and the different grades of cai 材 that were used for the construction of the individual buildings assure the architectural scale of the entire temple site.
Established through imperial patronage in the eighth century (during the Kaiyuan reign period of the Tang dynasty)，the complex underwent continuous repair in the succeeding periods. However, only the mid-twelfth century repair at the beginning of the Jin dynasty from 1128 to 1143 C.E. is important for this thesis’ discussion. Today three of the handful of historical timber structures aligned around two courtyards display bracket sets with genuine xiegong.

**Shanhuasi Daxiongbaodian 善化寺大雄宝殿**

The Daxiongbaodian is the largest and oldest extant structure at Shanhuasi and reflects the style of the Liao dynasty in northern Shanxi province (Figure 2-1). The seven-by-five-bay structure with majestic hip roof or *si’eding* of ten rafters’ depth recalls the architecture of Huayansi, the second important Buddhist monastery in Datong during the Liao-Jin transition. This is not least due to the unusual placement of intercolumnar bracket sets: at the Liao dynasty Daxiongbaodian of Shanhuasi and the Jin dynasty Daxiongbaodian of Huayansi, the intercolumnar bracket sets rest on small cushions called camel humps or *tuofeng* that perch at the architraves rather than directly resting on the latter.

There are fifty-six bracket sets at Shanhuasi Daxiongbaodian that are evenly distributed along the four building walls. Usually, one corbelled cluster of five- *puzuo* with two tiers of *huagong* in “filled-heart” design (applicable to orthogonal and angular bracketing) rests in-between two eave columns except for the end bays that feature two clusters. Six of the intercolumnar bracket sets use angled timbers.
There are two types discernible: first, the intercolumnar corbelled clusters of the front and rear façades’ central bays implement the rare pattern of a semi-circular fan without perpendicular ribs that would stick out at a right angle to the wall plane. Next to Huayansi and Yingxian Fogongsi, Shanhuasi is the only pre-Yuan dynasty site in Shanxi province where genuine xiegong symmetrically project at 60 degree angles toward the exterior and interior and at the same time lack perpendicular bracket-arms.

Second, at the adjacent side bays along the front and rear façades, intercolumnar corbelled clusters reveal an even more peculiar design. In contrast to the central bays, genuine xiegong do not project at the ground level directly from the large bearing blocks called ludou. Pairs of angled timbers rather jut out at the third level (i.e. the third layer of zhutoufang), where their mid-points rest on the small end blocks on top of the first parallel brackets known as guazigong. Their placement corresponds to the position of the orthogonal shuatou, but they step out at 45 degree angles to the building plane. Their tails do not extend beyond the wall construction or fubigong 扶壁栱 toward the inside of the hall.

Finally, the smaller carpentry of the interior zaojing-style ceiling applies a stylistic variation of fan-shaped bracketing.

*Shanhuasi Puxiange 善化寺普贤阁*

The next building at Shanhuasi that applies angled bracket-arms is the Samantabhadra Pavilion or Puxiange 普贤阁, the only example of medieval multi-storied timber structure with fan-shaped bracket sets apart from the Timber Pagoda at Fogongsi in Yingxian (Figure 2-2). The square two-storied structure with mezzanine level, or
pingzuo, and single-eaved hip-and-gable roof of four rafters’ depth was rebuilt in the 1950s but still conveys the architectural style of the Liao dynasty in northern Shanxi.\textsuperscript{34}

There is one intercolumnar bracket set in each of the three bays all around the building. The angular bracketing is restricted to the upper floor. Among the total twenty-two corbelled clusters at the second floor are two intercolumnar \textit{shanshi dougong} of five-puzuo with double \textit{huagong} in “filled-heart” design. They are well-placed at the dead center of the front and rear façades and similar to the first type of angular bracketing at Daxiongbaodian, which is situated to the northeast. Just as a reminder, at both Liao-style buildings, genuine \textit{xiegong} step out at 60 degree angles from the \textit{ludou} and extend symmetrically toward the exterior and interior. Perpendicular \textit{huagong} are completely omitted.

Additionally, the corner columns at the second floor incorporate a stylistic variation of angled bracket-arms known as \textit{majiaogong} into their organic bracketing units.

\textit{Shanhuasi Sanshengdian 善化寺三圣殿}

Finally, the most opulent fan-shaped bracket sets are found at Sanshengdian 三圣殿, a five-by-four-bay wide and eight-rafter deep Jin dynasty structure with single-eaved hip roof that is located in front of the Daxiongbaodian (Figure 2-3).\textsuperscript{35}

Among the total forty-six bracket sets of Sanshengdian are four intercolumnar sets with genuine \textit{xiegong}. Usually two corbelled clusters divide the intervals between the columns along the four building sides, but the first side bays 次间 of the front and rear façades use a single eye-catching \textit{shanshi dougong} instead.
At their exterior projections, angled bracket-arms step out in pairs from the ludou and from the small bearing blocks at the second and third steps. Whereas regular eave column-top and orthogonal intercolumnar bracketing are six-puzuo units in “filled-heart” design with single huagong and double ang, the intercolumnar fan-shaped counterparts substitute the descending cantilevers at their perpendicular extensions with horizontally leveled huagong. At the interior, the design is much simpler with genuine xiegong that exclusively project from the ludou.

**Huayan Monastery 华严寺**

In the Liao and Jin periods, the second major Buddhist complex in the city of Datong was Huayansi 华严寺 (inventory number 1-0091-3-044), an east-west oriented site that was divided into the Lower Monastery and Upper Monastery in the Ming dynasty. The oldest surviving building, the Bhagavat Sutra Repository 薄伽教藏殿 at the Lower Monastery, can be traced back to the year 1038 C.E. and preserved exquisite smaller timber carpentry with fan-shaped bracketing (i.e. the breathtaking multi-storied wall cabinets or bizang louge 壁藏楼阁 that were used to store Buddhist sutras). It is associated with the Liao Emperor Xingzong 辽兴宗 (r. 1031-1055 C.E.), who sponsored extensive construction work at the “Flower Garland” Monastery that was probably established in the Tang dynasty.

This chapter’s discussion focuses on the large-scale carpentry of the majestic nine-by-five-bay wide, ten-rafter deep, hip-roofed Main Hall, also known or Daxiongbaodian, of the Upper Huanyan Monastery (Figure 2-4). The structure conveys the architectural taste of the imperial Khitan patrons in northern Shanxi despite rebuilding
in the early Jin dynasty (third year of the Tianjuan reign period 天眷三年, 1140 C.E.).\textsuperscript{39}
At the same time it illustrates the changes in timber carpentry that had occurred since the mid-eleventh century.\textsuperscript{40}

Among its sixty-four bracket sets are six units of five-\textit{puzuo} in “filled-heart” design with angled timbers that remind of Shanhuasi Daxiongbaodian. The intercolumnar bracket sets in the central bays of the front and rear façades at both buildings consist exclusively of genuine \textit{xiegong} that project at 60 degree angles from the \textit{ludou} symmetrically toward the exterior and interior.\textsuperscript{41} Additionally, the bracket sets in-between the columns of the front and rear façades’ side bays at both buildings share the same peculiar design of angled timbers.\textsuperscript{42} Nevertheless, only the Main Hall at Huayansi follows through with the idea of perfect symmetry. The angled timbers at the side bays’ bracketing at Huayansi are not terminated by the wall plane but rather extend similarly toward the exterior and interior of the building.

\textit{Shuozhou prefecture} 朔州市

\textit{Chongfu Monastery} 崇福寺

The diverse and interesting history of Chongfusi 崇福寺 (inventory number 3-0117-3-065), a north-south oriented large-scale monastery with five courtyards in the prefecture seat of Shuozhoushi 朔州市, goes back to 665 C.E., when the Tang dynasty Emperor Gaozong 唐高宗 (r. 649-683 C.E.) established a Buddhist worship place.\textsuperscript{43} It was secularized under Khitan rule and transformed into a government residence of the local authorities called Linyataishifushu 林衙太师府署. In the end of the tenth century, it
was transferred from civil to ecclesiastical ownership again and served as a monks’ dormitory known as Linyayuan 林衙院, before the Jin dynasty Emperor Xizong 金熙宗 (r. 1138-1150 C.E.) commissioned the restoration and erection of new timber halls in 1143 C.E. (third year in the Huangtong reign period of the Jin dynasty 金皇统三年). In 1150, the Prince of Hailing 海陵王 (r. 1150-1161 C.E.) bestowed the name Chongfuchansi 崇福禅寺 on the monastery. Only the Amitābha Hall or Mituodian 弥陀殿 (d. 1143 C.E.) and Guanyindian 观音殿 to its north retained the original shape of the twelfth century.45

The architecture at Chongfusi is the pinnacle of medieval timber craftsmanship in Northern Shanxi, and the desire for perfection is ubiquitous. It dominates the modular design of the general layout, the measurements of individual buildings and structural components, and the smaller timber carpentry such as the artistically carved lattice shutters for windows and doors at Mituodian.46

It is not surprising that the notion of skillfully merging aesthetic and functional needs is also evident in the bracketing of Mituodian. No other building of Shanxi province pre-Yuan dynasty architecture shows a higher number of fan-shaped bracket sets than the seven-by-four-bay wide, eight-rafter deep, hip-and-gable roofed Amitābha Hall, where nine out of forty-four corbelled clusters apply genuine xiegong (Figure 2-5).47 Additionally, the corner column-top bracket sets incorporate multiple jiaogong and mojiaogong.

Looking at the floor plan, the placement of shanshi dougong with their well-balanced exterior and interior projections is rather astonishing.48 While fan-shaped
bracket sets crown every eave column along the front façade, they accentuate the space in-between columns of every other bay at the rear façade. To be precise, even though there is intercolumnar bracketing all around the building, only the intercolumnar bracket sets at the central bay and second to last side bays 稚间 of the back wall mimic the shape of an open fan.

As a general rule, the building’s seven-puzuo units differ according to their specific positions along the façade rather than their (possible) application of angled bracket-arms. Whereas the column-top bracketing of the front, rear, and side facades consists of double-layered (orthogonal or angled) huagong and two tiers of structural xia’ang, the intercolumnar bracketing all around substitutes the vertically slanting members with additional horizontally leveled zhenghuagong 正华栱 at their perpendicular extensions.

Just like the other pre-Yuan dynasty examples with fan-shaped bracketing in northern Shanxi province, the genuine xiegong at Chongfusi are horizontally leveled bow-shaped brackets or half-brackets with well-tapered rounded heads rather than pointed tips. Their artistic treatment that is known as juansha 卷杀 in the Yingzao fashi created a shuttle-shaped, elliptic profile in the shape of an intersected line composed of several linear segments (even if the perpendicular extensions (i.e. zhenghuagong) were false cantilevers (i.e. jia’ang) with decoratively carved lute-face or split-bamboo profiles).

Furthermore, all forty-four bracket sets mix jixinzao and touinxao no matter if they apply orthogonal or angled bracket-arms. Every other jump of their four exterior
extensions either completely omits parallel brackets or displays “wing-shaped brackets” known as *yixinggong* 翼形栱, which replaced the regular bow-shaped *guazigong*.49

In the case of fan-shaped bracket sets, such alternating twofold design is taken to extremes. In detail, the first jump of perpendicular bracket-arms carries *yixinggong*, and the second jump supports an elongated parallel bracket in “(male and female) mandarin duck” style, also called *yuanyang jiaoshougong* 鸳鸯交手栱. Genuine *xiegong* project from the *ludou* towards the left and the right, and each of such a “*xiegong wing*” consists of three layers, i.e. two angled bracket-arms and one angled *shuatou* that are piled up on top of each other. Thanks to the angled trifling tips this arrangement already looks like a self-contained (*five-puzuo*) bracketing unit. Nevertheless, it becomes more complicated if we continue to examine the last two perpendicular extensions. The third jump of *zhenghuagong* omits parallel brackets, and the fourth jump carries a short *linggong* that does not intersect with the angled bracket-arms.50 Again, genuine *xiegong* project from the lower of these two layers, i.e. from the small bearing blocks on top of the second jump of *zhenghuagong*. Like before, each wing of *xiegong* consists of two angled bracket-arms and one angled *shuatou* that are piled up on top of each other. Moreover, since the second arrangement evokes the same idea of a self-contained (*five-puzuo*) bracketing unit, the whole clustering looks like two individual *shanshi dougong* that were arranged in a staggered manner so that they blended into one another and became intertwined.51 Such intricate bracketing perfectly matches the high-standard timber craftsmanship that is omnipresent at Chongfusi.
Xinzhou prefecture 忻州市

Hongfu Monastery 洪福寺

Hongfusi (inventory number 5-0251-3-057) in Eastern Beishe village 北社东村, Hongdao township 宏道镇, Dingxiang county 定襄县, is one of the four pre-Yuan key national heritage conservation units in Xinzhou prefecture that employs fan-shaped bracket sets. In contrast to the previously discussed three monasteries that were part of medieval urban life, Hongfusi was situated in the countryside at an important Buddhist pilgrimage route. It eventually maintained close contact with the nearby religious center of Mount Wutai in the Northern Song and Jin dynasties. Elevated on a high earth embankment, the simple north-south oriented one-courtyard complex was auspiciously embedded between the Ninao River 汐泊河 in the south and Longshan 龙山 and Fengshan 凤山 in the north.

The Main Hall or Sanshengdian, dedicated to the Three Deities, the northernmost five-by-three-bay structure with a single-eaved gable roof of six rafters’ depth, reflects the architectural style of the late Northern Song dynasty (1096-1126 C.E.) and probably preserved its original shape despite repair in the succeeding periods (Figure 2-6).

Five huge fan-shaped bracket sets are placed at intercolumnar positions along the front façade, one in each bay. Their design is well-balanced and symmetrical with genuine xiegong projecting from the ludou at the exterior and interior. They are five-puzuo units in “filled-heart” design similar to their column-top counterparts. However, in contrast to the latter they replaced the true slanting cantilevers with a second level of huagong resulting in two tiers of horizontally leveled timbers. Due to the gable-shaped
roof there is no bracketing at the east and west walls. The bracketing along the rear façade is much simpler and corresponds to the arrangement of *batoujiaoxiangzuo* 把头绞项作 in the *Yingzao fashi* (see part one).

**Dingxiang Guanwangmiao 定襄关王庙**

Guanwangdian 关王殿 is the only surviving structure of a north-south oriented complex in the county seat of Dingxiangxian 定襄县, Xinzhou prefecture that was known as the Buddhist Shousheng Monastery 寿圣寺 during the Yuan dynasty. The rest of the religious site was incorporated into the local middle school 定襄县第二中学.

Guanwangdian, originally the West Side Hall 西配殿, is dedicated to the God of War and today commonly referred to as Guanwangmiao 关王庙 or Guandimiao 关帝庙 (inventory number 6-0368-3-071) (Figure 2-7). The popular cult around the historical figure of General Guanyu 关羽 flourished in Shanxi province during the eleventh and twelfth centuries, after the Northern Song Emperor Huizong 徽宗 (r. 1100-1126 C.E.) posthumously bestowed him with the title of King Guan 关王, and again in late imperial China upon deification as the Daoist Saintly Emperor Guan 关圣帝君.

The greater carpentry system of the three-by-two-bay timber hall with single-eaved hip-roof of four rafters’ depth was probably erected in 1123 C.E. (the fifth year in the Xuanhe reign period of the Northern Song dynasty 北宋宣和五年) and preserved the local building style of the late Northern Song dynasty until today.
There are twenty corbelled clusters well-distributed along the four building walls. Currently, one intercolumnar bracket set divides the span in-between two columns except for the front façade. In order to enlarge the latter’s central bay, the eave columns in the middle stepped aside and shifted toward the outer ends of the wall. As a result, the central bay of the front façade consists of three intercolumnar sets, but its flanking side bays lack intercolumnar bracketing.

There are six genuine *shanshi dougong* among the twenty corbelled clusters. One intercolumnar bracket set in the shape of an open fan adorns each of the three bays at the rear wall, and a prominent fan-shaped cluster is placed at the mid-point of the front wall’s central bay. Two more *shanshi dougong* crown the latter’s flanking columns.

Looking at the floor plan of the building, it becomes evident that the seemingly arbitrary mix of four intercolumnar and two column-top *shanshi dougong* follows a logical pattern. It was caused by the re-arrangement of columns (described above). In fact, the two column-top fan-shaped bracket sets in the front sit at the same lateral axis as their intercolumnar counterparts in the rear. Moreover, they share the same two-layered design of *zhenghuagong* and *xiegong* that project symmetrically from the *ludou* at the exterior and interior. Strictly speaking, their outermost angled timbers at the interior projection are acting as *mojiaogong* and stretch at a right angle to the “diagonally” projecting bracket-arm at the corner called *jiaogong*.

It is noteworthy to mention that the intercolumnar bracket sets along the side walls of the building also apply *mojiaogong* at their interior projections. Their tails penetrate the building plane but stick out awkwardly at the exterior. The short truncated
looking tails enhance the structural stability but stand in sharp contrast to the structurally and aesthetically appealing idea of *mojiaogong* being a part of fan-shaped bracket sets.\(^{63}\)

In order to emphasize the building’s entrance, the fan-shaped bracket set above the front gate (i.e. in the central bay of the front façade) applies an additional set of angled bracket-arms that step out from the small bearing block on top of the first *zhenghuagong*.\(^{64}\)

**Foguang Monastery 佛光寺**

The east-west orientated three-courtyard complex of Foguangsi 佛光寺 at Mount Wutai (inventory number 1-0080-3-033) was established during the reign of the late fifth century, Northern Wei Emperor Xiaowen 北魏孝文帝 and although well-sheltered in Foguang village 佛光村, Doucun township 豆村镇 of Xinzhou prefecture, it suffered from the Buddhist persecution of 845 C.E.\(^{65}\) It is best known for the mid-eighth century East Hall (857 C.E.), the archetype and showpiece of Chinese high-rank *diantang*-style architecture in the North.

More important for this thesis’ discussion, it successfully preserves the twelfth century Wenshudian 文殊殿 that is located to the north of the Tang dynasty Main Hall (Figure 2-8). The seven-by-four wide hall with single-eaved gable roof of eight rafters’ depth that was dedicated to Mañjuśrī, a bodhisattva in Mahāyāna Buddhism and enlightened deity in Esoteric Buddhism, was erected in the fifteenth year of the Tianhui reign period during the Jin dynasty 金天会十五年 (1137 C.E.).\(^{66}\)

The thirty-six corbelled clusters of five-*puzuo* employ two perpendicular extensions that differ in nature first and foremost according to the column-top or
intercolumnar placement of the individual bracket set. In detail, column-top units use one
zhenghuagong and one xia’ang, but intercolumnar bracketing replaced the true slanting
cantilevers with a second layer of horizontally leveled perpendicular bracket-arms.

There are eight intercolumnar corbelled clusters with genuine xiegong, one in
each of the seven bays at the front wall plus one in the central bay at the rear wall.
Angled bracket-arms project from the ludou symmetrically toward the exterior and
interior. The central three corbelled clusters of the front façade mark the three main
entrance doors of the building and display a more elaborated design with additional
xiegong stepping out from the small bearing blocks on top of the first jump of
zhenghuagong.

The outward appearance of bracketing at the twelfth century structure recalls the
nearly three-hundred-year older East Hall to some extent. Similar to the (partly) “stolen-
heart” design of the latter, the thirty-six corbelled clusters of the Mañjuśrī Hall lack fully
functional, parallel bow-shaped timbers that could uphold the next level of bracketing. Or,
in the case of the central three shanshi dougong at the front façade, they reinforce the
comparatively fuller fan-out with elongated, decorative yixinggong.

Yanqing Monastery 延庆寺

A desolate seven-meter Buddhist stone pillar 经幢 from 1035 C.E. and the three-
by-three-bay Main Hall are the solemn pre-Qing period remnants of the north-south
oriented three-courtyard complex of Yanqingsi 延庆寺 (inventory number 6-0381-3-084)
at Mount Wutai in Shanwen village 善文村, Yangbai xiang 杨柏(或阳白)乡 of Xinzhou
prefecture (Figure 2-9).67 Visually striking are the mask-like demon faces attached to the
upper part at the two central columns of the front façade. The greater carpentry system of
the undated timber hall with single-eaved hip-and-gable roof of six-rafters’ depth is
associated with the Jin dynasty.68

There is a desire for symmetry and balance that becomes evident in the nearly
square floor plan, the six-rafter beams that span across the building’s depth without the
help of interior columns, or the twenty-four bracket sets well-spaced all around the
building with one intercolumnar corbelled cluster per bay.

Each central bay displays a well-rounded shanshi dougong of five-puzuo with
genuine xiegong extending from the ludou symmetrically toward the exterior and interior.
Mojiao beams span across the four building corners, but they do not interfere with the
bracketing layer. The intercolumnar bracket sets consist of two horizontally leveled
extensions in contrast to the column-top sets with single huagong and single xia’ang.
Bracketing all over the building equally follows the “stolen-heart” design.

Apart from the use of xiegong, the visual key difference between the various types
of bracket sets is the form and function of shuatou and chenfangtou. The decorative nose
occasionally mimics the shape of descending cantilevers, for example at the column-top
positions all around the building. To complicate matters, the chenfangtou of the front
columns and the fan-shaped bracket sets of the south and north walls look like shuatou.
The corbelled clusters appear richer and of higher rank, which is one of the
characteristics in Shanxi regional style building that is analyzed in the following chapter.
b) Central Shanxi

Yangquan prefecture 阳泉市

Linli Guanwangmiao 林里关王庙

The local Guanwangmiao 关王庙 (inventory number 4-0099-3-021) also known as Guandimiao 关帝庙 or Laoyemiao 老爷庙 in Linli village 林里村, Mengying township 萌营镇, Yangquan prefecture, is situated southeast of the Yangquan prefecture seat and embedded in the gently inclined landscape. An excavated Northern Song stone pillar from 1072 C.E. (fifth year of the Xining reign period in the Northern Song dynasty 北宋熙宁五年) proves that the small southwest-northeast oriented two-courtyard complex was already in place in the second part of the eleventh century. More importantly, a roof beam under the ridge of the Main Hall reveals building activity in the first part of the twelfth century and pinpoints 1122 C.E., the fourth year of the Xuanhe reign period in the Northern Song dynasty 北宋宣和四年, as the relevant date of (re-)construction.

The floor plan of the three-by-three-bay timber structure with single-eaved hip-and-gable roof of six rafters’ depth implements the perfect square with matching measurements for the building’s length and depth. Nevertheless, the idea of balance and symmetry resulted in a different placement of shanshi dougong than at the Main Hall of Yanqingsi. The fan-shaped bracket sets of the latter equally accentuated the four cardinal directions and marked the mid-points of the four building walls (i.e. the points of
intersection with a smaller rhombus that can be inscribed into the floor plan’s quadrangle).

At Linli Guanwangdian, each bay of the building possesses one intercolumnar corbelled cluster, but all of them reveal orthogonal bracketing. It is rather the flanking pair of eave columns at the front façade’s central bay that mimic the shape of an open fan (Figure 2-10). The two corbelled clusters of five-puzuo use genuine xiegong that project from the ludou symmetrically at the exterior and interior (and likewise apply angled shuatou). What is more, the first of the three lateral building bays creates an open corridor, a popular spatial design in regional architecture of southeastern Shanxi province that further emphasizes one-directional alignment and focus at the front.

All twenty-four bracket sets around the building exclusively use horizontally leveled timbers in jixin-style for their exterior projections. The first and second jumps of zhenghuagong or xiegong uphold the next level of perpendicular or angled bracket-arms and additionally, a parallel guazigong.

**Yuxian Daiwangmiao 孟县大王庙**

The cultural site in the county seat of Yuxian 孟县, Yangquan prefecture, has a longstanding secular history as the temporary palace of Zhao Wu 赵武 (also known as Zhao Meng 赵孟), a senior government official of the Jin Kingdom 晋国 in the sixth-century B.C.E. during the Spring and Autumn Period. A valuable late-Northern Song bronze bell (d. 1124 C.E.) and nearly a dozen Ming and Qing period stone steles suggest modern sacred activities and religious life (at least) since the twelfth century.
The north-south oriented two-courtyard complex of Daiwangmiao (inventory number 5-0255-3-061) underwent reconstruction and repair in 1172 C.E., the twelfth year of the Dading reign period of the Jin dynasty, and again in the succeeding Ming and Qing dynasties. The northernmost structure known as Qingong, a three-by-one-bay rectangular hall with single-eaved gable roof of four rafters’ depth, reflects the local Jin dynasty building style (Figure 2-11). Because of the gable-shaped roof, bracketing is restricted to the front and rear walls, where six of the building’s fourteen corbelled clusters are placed in-between columns, one in each bay.

A sprawling intercolumnar shanshi dougong draws attention to the main entrance in the central bay of the front façade. Genuine xiegong project from the ludou symmetrically at the exterior and interior.

It is noteworthy that both types of bracket-arms, the angled and perpendicular ones, are (carved as) decorative false cantilevers. They have horizontally leveled pointed tips, which is a special type of jia’ang called zhi’ang that was popular in central Shanxi province since the middle of the Northern Song dynasty. The fan-shaped bracket set is visually further distinguished by the use of double zhi’ang for all the exterior extensions (i.e. in angled and orthogonal direction). Orthogonal bracketing of the other thirteen corbelled clusters consists of a lower tier of huagong and an upper tier of zhi’ang. Furthermore, bracketing all around the building follows jixin-style, but the shanshi dougong fudges the “filled-heart” design and reveals an elongated yixinggong rather than a fully bow-shaped guazigong as the first parallel bracket.
At first glance, the fan-shaped corbelled cluster of five-
puzuo looks like a puzuo
unit of higher rank, because a perpendicular chenfangtou pierces the wall plane and
emulates a second decorative nose on top of the genuine exterior shuatou. (Most of the
thirteen orthogonal column-top and intercolumnar bracket sets implement the same
design.)

c) Southeastern Shanxi

Changzhi prefecture 长治市

_Dongyi Longwangmiao_ 东邑龙王庙

The local Longwangmiao 龙王庙 (inventory number 6-0378-3-081) in Dongyicun 东邑村, a small village just southeast of the county seat in Lucheng 潞城, Changzhi prefecture, is a north-south oriented site dedicated to the Five Dragon Kings, a
popular cult that flourished in the Jindongnan area since the Northern Song dynasty.77
Twice a year, the villagers still host a temple festival 赛社活动 in the original two-
courtyard complex to offer sacrifices as a token of thanks to the gods.78 The lively five-
day activity is rooted in the desire for good weather and rain that could nourish the crops.

Generally speaking, Dragon King temples were traditionally built near wells such
as at Dongyi village, or close to springs and pools, because in Chinese popular religion,
the dragon was the spiritual animal, mythical creature, and supernatural power 神龙 to
control the element water.79

At Dongyi Longwangmiao, the Main Hall or Longwangdian 龙王殿 is a three-by-
three-bay structure with single-eaved gable roof of six rafters’ depth (Figure 2-12). To a
certain extent it still conveys the style of the Jin dynasty, but the continuous mending and repair in the succeeding periods left their marks on the greater carpentry system. Due to the gable-shaped roof and especially because the transverse beams are directly inserted into the rear wall, bracketing is limited to the front façade with seven corbelled clusters of five-puzuo in “filled-heart” design. Each of the three front bays features one intercolumnar shanshi dougong with genuine xiegong projecting from the ludou at 45 degree angles toward the exterior.

The fan-shaped bracket set in the central bay elaborates the basic design with additional angled bracket-arms extending from the ludou also toward the interior and from the small bearing block on top of the first exterior jump of zhenghuagong. Although the visual form of the gable roof with its broad side facing south theoretically emphasizes linear alignment with the secondary building axis, the complex central shanshi dougong bundles the attention into a single focal point at the middle bay.

Interestingly, the design of the perpendicular extensions neither changes with column-top or intercolumnar position nor with the application of additional angled bracket-arms. The seven bracket sets consistently apply one step of zhenghuagong and one step of jia’ang. All xiegong are horizontally leveled bracket-arms with well-tapered rounded heads rather than pointed tips.

**Lingzewangmiao 灵泽王庙**

The north-south oriented one-courtyard complex of Lingzewangmiao in Taiping village 太平村, Xiadian township 夏店镇, Xiangyuan county 襄垣县, Changzhi prefecture (inventory number 6-0373-3-076) is another good example of the omnipresent
dragonking cult in the folk belief of Shanxi province. Established in the second year of the Da’an reign period during the Jin dynasty 金大安二年 (1210 C.E.), the name of the temple reveals its affiliation with the black dragon called Lingzewang 灵泽王, a popular representation of the godlike Five Dragon Kings in religious architecture of the Jindongnan area after the Northern Song dynasty. 82

In the past, the timber architecture of Lingzewangmiao did not receive much scholarly attention, but in 2006, it was designated a key national heritage conservation unit by the State Administration of Cultural Heritage. In 2007, the Research Institute for Traditional Architecture and Conservation in Taiyuan 太原古建筑保护研究所 commissioned a large-scale field survey. 83

The bracketing of the Main Hall, a rectangular three-by-three-bay structure with gable roof of four rafters’ depth, is restricted to the corbelled clusters of the front façade similar to Dongyi Longwangmiao (Figure 2-13). 84 Nevertheless, at Longzewangmiao fan-shaped bracket sets crown the top of columns rather than their intercolumnar intervals. In fact, there is no bracketing in-between columns.

The central two of the total four front columns that create a narrow one-bay corridor use genuine xiegong. They project from the ludou symmetrically toward the exterior and interior and additionally, at the exterior from the small bearing blocks above (i.e. on top of the first jump of zhenghuagong). All four corbelled clusters are five-pu zuo units with perpendicular extensions of double jia’ang in “filled-heart” design. All xiegong are horizontally leveled bracket-arms with well-tapered rounded heads rather than pointed tips.
Longmen Monastery 龙门寺

Longmensi 龙门寺 in Longmensi village 龙门寺村, Shicheng township 石城镇, Pingshun county 平顺县, Changzhi prefecture 江西省, is a well-published three-courtyard complex that preserved the characteristic layout of Northern Song dynasty Buddhist monasteries. Situated in the lavish nature of the northwest-southeast oriented valley of the Zhuozhang River 浊漳河, it successfully blends the gently inclined topography of the local environment with the mandatory monastery alignment along the cardinal axes. It is a treasure house for architectural historians not least because of the more than two dozen traditional timber buildings that survived since the mid-tenth century Later Tang dynasty.

The mid-Jin dynasty Tianwangdian 天王殿, a three-by-two-bay structure with gable roof of four rafters’ depth, currently functions as the monastery gatehouse and displays two intercolumnar fan-shaped bracket sets of five-puzuo in jixin-style (Figure 2-14). Genuine xiegong project from the ludou symmetrically at the exterior and interior and at the front façade’s shanshi dougong additionally, at the exterior from the small bearing blocks above. Each of the two shanshi dougong is placed in the central bays of the front or rear façades, but the adjacent side bays lack any intercolumnar bracketing.

Generally speaking, the front façade’s corbelled clusters consist of two tiers of false cantilevers, whereas their counterparts at the rear wall replaced one layer of jia’ang with zhenghuagong. As expected, the placement of the individual cluster within the building is more important than the possible application of angled bracket-arms. Hence, the shanshi dougong at the front wall adopts the two-layered jia’ang-style for its perpendicular extensions, and the one at the rear exchanges one jia’ang for one
zhenghuagong. All xiegong are horizontally leveled bracket-arms with juansha rather than false cantilevers with pointed tips.

**Fotou Monastery 佛头寺**

The Main Hall of Fotousi 佛头寺 (inventory number 6-0366-3-069) in Dongdang village 东车当村 of Yanggaoxiang 阳高乡, northeast Pingshun county 平顺县, Changzhi prefecture, is the solitary relic of a north-south oriented two-courtyard complex nestled at the foot of Fotuoushan 佛头山. The undated three-by-four-bay structure with hip-and-gable roof of four rafters’ depth was repaired in the Qing dynasty, but despite the late nineteenth century mending at the beginning of the Guangxu reign period 光绪年间 it still reflects the local building style prior to late imperial times. For example, the height of the majestic bracket sets measures half the height of the column shafts, which is a ratio reminiscent of the Tang dynasty East Hall at Foguangsi.

Only front and rear façades of the nearly square building feature one intercolumnar corbelled cluster per bay. The east and west walls make up for their lack of support in-between columns with additional eave columns and comprise four narrow bays rather than three elongated compartments.

Among the total twenty bracket sets are two shanshi dougong that mark the entrance gates in the center of the front and rear walls (Figure 2-15). Genuine xiegong extend from the ludou exclusively toward the exterior and lack any matching opposite hand at the inside of the hall. Bracketing all around the building are five-puzuo units with double jia’ang in “filled-heart” design regardless if the clusters sit on top of columns or in-between them. Just like the previously discussed pre-Yuan dynasty examples in
Changzhi prefecture, the angled bracket-arms of the Main Hall at Fotousi are horizontally leveled timbers with well-tapered rounded heads even though their perpendicular counterparts are false cantilevers with pointed tips. The latter survived as truncated stumps with their tips chopped off sometime in the past.

**Wuxiang Huixianguan 武乡会仙观**

Huixianguan 会仙观 in Linzhang village and township 临漳镇临漳村, Wuxiang county 武乡县 of Changzhi prefecture (inventory number 5-0254-3-060) is a north-south oriented three-courtyard complex that was established in 1229 C.E. and rebuilt in the first parts of the sixteenth and eighteenth centuries.\(^90\) Just like Yonglegong in Ruicheng county, Wuxiang Huixianguan was affiliated with the Quanzhen School 全真, a branch of Daoism founded by Wang Chongyang 王重阳 (1112-1170 C.E.) in the twelfth century that was especially popular in Shanxi province during the Jin and Yuan periods.\(^91\) In the republican period (1912-1948 C.E.) it was temporarily used as a school building, and the Jin dynasty Main Hall or Sanqingdian 三清殿, the oldest extant structure and southernmost building dedicated to the Three Purities, the highest representations of Daoist deities, was one of the classrooms.\(^92\)

The five-by-five-bay Sanqingdian consists of a three-by-three-bay core structure that is enlarged with a two-bay front corridor in the south and a one-bay side corridor in the east and west (Figure 2-16). It is a rare example of genuine tingtang-style structures in the Jindongnan area that is crowned by a single-eaved hip-and-gable roof of six rafters’ depth. There is no bracketing at the rear wall or at intercolumnar position all around the building.
Among the total twelve bracket sets are two *shanshi dougong* that adorn the flanking columns of the central bay at the front corridor. The arrangement of their angled arms within the organic bracketing unit is interesting. Genuine *xiegong* do not project directly from the *ludou* but step out from the small bearing blocks on top of the first jump of perpendicular bracket-arms. Exactly, they extend beyond the back of the small bearing blocks on which they rest until they meet the wall plane, where they finally are terminated. As a result, the angled half-brackets are invisible from the inside of the hall. Additionally, the interior projections exclusively use perpendicular timbers.

Eave bracketing always consists of five-*puzuo* units with one tier of *zhenghuagong* and one tier of *jia'ang* in “filled-heart” design including the fan-shaped varieties. Not surprisingly, their *xiegong* are horizontally leveled bracket-arms with well-tapered rounded heads in contrast to the perpendicular counterparts with pointed tips.

**Puzhao Monastery 普照寺**

Puzhaosi 普照寺 (inventory number 6-0394-3-097) in Kai village 开村, Guocun township 郭村镇, just 7.4 kilometer west of the Qin county seat 沁县 in Changzhi prefecture is the northernmost site among the ten pre-Yuan dynasty examples with fan-shaped bracket sets in southeastern Shanxi.93

The abandoned Main Hall of the north-south oriented one-courtyard Buddhist complex was temporarily used as a school building and village committee storehouse (Figure 2-17).94 At the end of the twentieth century, the large-scale wooden construction was in a dilapidated state, and individual members of the front façade’s bracketing such as the small bearing blocks or *sandou* had been split or lost.95 Starting in the 1990s, the
three-by-three-bay timber hall with single-eaved hip-and-gable roof of six rafters’ depth was restored to its original condition.\textsuperscript{96} In spite of the longstanding history, no stone steles survives at the monastery, but it is mentioned in the Qianlong edition of *Qingzhouzhi* 沁州志, *juan* 9, which records rebuilding in the Dading reign period of the Jin dynasty 金大定年间 (1162-1189 C.E.) and repair in the succeeding Ming and Qing periods.\textsuperscript{97}

The floor plan of the nearly square Jin dynasty Main Hall shows eighteen corbelled clusters of five-*puzuo* in “filled-heart” design. The front and rear walls feature one intercolumnnar bracket set per bay, among which only the one in the central bay of the front façade possesses genuine *xiegong* projecting from the *ludou* toward the exterior. Column-top bracketing uses one tier of *zhenghuagong* and one tier of *jia’ang* at the exterior projection. The intercolumnnar corbelled clusters replace the false cantilevers with a second layer of tapered bracket-arms. Even the *shanshi dougong* complies with the rules. Moreover, all its perpendicular and angled two-layered extensions have rounded heads rather than pointed tips.

**Jincheng prefecture 晋城市**

**Nanjixiang Monastery 南吉祥寺**

Established in Songjiachuan 宋家川, Beiyi township 礼义镇, Lingchuan county of Jincheng prefecture in the seventh century, the imperially patronized Jixiang Monastery 吉祥寺 (inventory number 4-0101-3-023) was rebuilt at a nearby site in the Tiansheng reign period of the Northern Song dynasty 宋天圣年间 (1023-1032 C.E.).\textsuperscript{98}
Today, it comprises two separated parts known as Nanjixiangsi 南吉祥寺 in Pingchuan village 平川村 and Beijixiangsi 北吉祥寺 just a few kilometers north in Xiejie village 西街村. Whereas the north-south oriented two-court yard Buddhist complex of South Jixiang Monastery provides striking examples of *shanshi dougong*, its northern equivalent does not show such divergence from official style building.  

It is generally agreed that the Middle Hall or *guodian* 过殿 of Nanjixiangsi conveys the taste of the mid-Northern Song dynasty even if Xu Yitao had second thoughts and challenged the eleventh century date for the greater carpentry system. Assuming that the Middle Hall was built in 1030 C.E. as indicated on a stone stele of the same year, it is the earliest extant example with genuine *xiegong* in the former Northern Song territory. Moreover, it antedates the stereotypical fan-shaped bracket sets of the Monidian 摩尼殿 at Longxingsi 隆兴寺 (1052 C.E.) in Zhengding 正定, Hebei province by nearly twenty years.

The Middle Hall is a small rectangular three-by-three-bay timber hall with single-eaved hip-and-gable roof of six rafters’ depth (Figure 2-18). Against expectations, it reveals the highest density in angular bracketing of Shanxi province pre-Yuan dynasty architecture. Among the total twenty bracket sets are eight intercolumnar *shanshi dougong* in the strictest sense and four additional column-top corbelled clusters that apply angled half-brackets at their interior projections.

By definition, the latter do not truly qualify as fan-shaped bracket sets since their angled half-brackets neither pierce the wall plane nor are visible at the outside of the building. Likewise, such timbers do not function as genuine *mojiaogong*. The corbelled
clusters in question crown the east and west walls’ columns that stand in closest proximity to the building corners. Even though their xiegong project at 45 degree angles to the building plane, they are neither interlinked with each other nor supportive of the corner beams. In other words, they cannot enhance building stability and structural integrity at the corner positions.

The shanshi dougong in the strictest sense comprise all the building’s intercolumnar bracket sets and can be divided into two groups. First, the central bays all around the building feature one paramount corbelled cluster with genuine xiegong that step out from the ludou symmetrical at the exterior and interior. Second, the side bays along the front and rear façades use genuine xiegong that project from the small bearing blocks on top of the first jump of zhenghuagong. Their tails extend beyond the rear of the small bearing blocks on which they rest but do not protrude inside the hall. Their interior projections emulate the arrangement at the exterior as if in a mirror.

Orthogonal and angular dougong are five-puzuo units in “stolen-heart” design. Column-top bracketing uses one huagong and one xia’ang for their perpendicular extensions, but at the intercolumnar positions all around the building, a second layer of horizontally leveled bracket-arms replaces the true descending cantilevers. As expected, the application of angled timbers has no influence on design and nature of the basic bracketing components at the corbelled clusters in-between columns in this matter. Furthermore, zhenghuagong and xiegong of the fan-shaped bracket sets are regular bracket-arms with tapered heads.
Xiaohuiling Erxianmiao 小会岭二仙庙

The Temple of the Two Transcendents also known as Xiaohuiling Erxianmiao 小会岭二仙庙 (inventory number 5-0265-3-071) in Xiaohui village 小会村, Fucheng township 附城镇, Lingchuan county 陵川县 of Jincheng prefecture is a north-south oriented one-courtyard complex that proves the importance of popular religion and folk belief in the local culture of southeastern Shanxi. 103

The Two Transcendents’ cult started during the late-Tang dynasty in Huguan county 壶关县 of modern Changzhi prefecture just north of Lingchuan county; it combined various legends but centered around two native sisters, who successfully overcame all worldly hardship and became immortal beings. 104 It especially flourished in the Northern Song dynasty at local and imperial levels, and most of the innumerable Erxianmiao in Lingchuan county were established prior to the Yuan period. 105 The lack of intellectual climate in the secluded mountainous environment in southeastern Shanxi meant that interest in the Two Transcendents has been largely restricted to the Jindongnan area. Prolific in the eleventh to fourteenth centuries, it still caters to the needs of the local people. 106

The engraved stone tablet from the eighth year of the Jiayou reign period in the Northern Song dynasty 北宋嘉祐八年 (1063 C.E) proves the existence of Xiaohuiling Erxianmiao in the second part of the eleventh century. 107 The greater carpentry system of the undated Main Hall is usually associated with this period, 108 even though the decorative painting of its structural members and the roof construction derive from late imperial China.
The nearly square three-by-three-bay structure with single-eaved hip-and-gable roof of six rafters’ depth recalls the greater carpentry of the Middle Hall at Nanjixiangsi (Figure 2-19; Figure 2-22). The bracket sets of both halls are five-\textit{puzuo} units in “stolen-heart” design. Intercolumnar bracketing usually consists of double \textit{huagong}, whereas the column-top corbelled clusters use slanting cantilevers at the upper layer/second step. Nevertheless, angular bracketing at the local Temple of the Two Transcendents can come nowhere near the unsurpassed density of the Buddhist architecture in Pingchuan village. Among the eighteen \textit{dougong} at the Main Hall of Xiaohuiling Erxianmiao is only one fan-shaped arrangement. Genuine \textit{xiegong} with rounded heads project from the \textit{ludou} symmetrically at the exterior and interior. The eye-catching \textit{shanshi dougong} prominently marks the entrance in the central bay of the front façade.

\textit{Shizhang Yuhuangmiao 石掌玉皇庙}

The Temple of the Jade Emperor or Yuhuangmiao 玉皇庙 at the western edge of the secluded Shizhang village 石掌村, Lucheng township 潞城镇, Lingchuan county, Jincheng prefecture (inventory number 6-0377-3-080) was built in accordance with the local natural settings.\textsuperscript{109} The popular cult of the Jade Emperor or Yuhuang, one of the supreme deities in Daoism and ruler of Heaven, received imperial patronage from Northern Song dynasty emperors, particularly from Emperor Zhenzong 真宗 (r. 997-1022 C.E.) for his spiritual support in the war against the invading Khitan tribes and also from Emperor Huizong.\textsuperscript{110} The altitudinal steps of the gentle sloping terrain reverberate in the north-south oriented two-part division of the layout. Located 7.5 kilometers southeast of the county seat and way-off the main communication road, the site was used
as a secular headquarters 大队部 and school complex before designation as a key national heritage conservation unit by the State Administration of Cultural Heritage and in 2006.\footnote{111}

The northernmost and highest elevated structure is the three-by-three-bay Main Hall with single-eaved hip-and-gable roof of six rafters’ depth (Figure 2-20). The greater carpentry system is associated with the Jin dynasty.\footnote{112} Bracketing appears incoherent, in particular the various shapes of \textit{shuatuou}, and lacks consistency in design among the corbelled clusters of similar positioning along the façade.

Broadly speaking, intercolumnar bracketing of the central bays consists of four-\textit{puzuo} units with single \textit{huagong}.\footnote{113} Column-top bracketing and the intercolumnar bracketing of the side bays enhance the basic design of their horizontally leveled perpendicular extensions with decoratively carved pointed tips.

Among the thirteen \textit{doujong} in the southern half of the square floor plan is one simplistic \textit{shanshi doujong} that draws attention to the mid-point/center of the one-bay wide front corridor. Genuine \textit{xiegong} with rounded heads extend from the \textit{ludou} symmetrically at the exterior and interior. (Even if the outward appearance such as the dragon- headed \textit{shuatuou} conveys the playful taste of late imperial China, the basic idea and (structural) function of fan-shaped bracketing at the intercolumnar position of the front façade’s central bay goes along with the regional building style of the Jindongnan area.)

Additionally, intercolumnar bracketing of the side bays discloses a stylistic variation of \textit{xiegong} at the interior projection. The angular bracket-arms in the broader sense function as \textit{mojiaogong} and support the large corner beams in the front corridor.
They jut out from the small bearing blocks on top of the interior zhenghuagong and project exclusively at the inside of the building toward the inner corner. Their arrangement is highly asymmetrical not only because exterior counterparts are missing. There is, in addition, a single wing of interior xiegong, without the expected symmetrical set that usually completes a pair of angled bracket-arms.

**Nanshentou Erxianmiao 南神头二仙庙**

The nearby Nanshentou Erxianmiao 南神头二仙庙 in Shigelian village 石圪恋村 of Lucheng township 潞城镇 (inventory number 6-0390-3-093) is another interesting example of Chinese popular religion in Lingchuan county of Jicheng prefecture that coincides with the application of fan-shaped bracketing.\(^{114}\) The north-south oriented one-courtyard complex was renovated in the mid-seventeenth century and first part of the nineteenth century and is probably best known for its marvelous Qing dynasty wall paintings that tell stories of the “Two Immortals” cult.\(^ {115}\) At closer inspection, the greater carpentry system of the Main Hall shows typical features of pre-Yuan period architecture in the Jindongnan area and conveys the local style of the Jin dynasty.\(^ {116}\)

The three-by-three bay structure with single-eaved hip-and-gable roof of six rafters’ depth displays eighteen bracket sets with one intercolumnar set per bay (Figure 2-21). The exception to the rule are the side bays of the east, west, and north walls that are decorated with incised carvings in the style of yidousansheng instead of three-dimensional corbelled clusters. Similar to Shizhang Yuhuangmiao, the front of the
rectangular hall is emphasized by a spacious one-bay wide corridor and a sprawling *shanshi dougong* in its central bay.

The distinctive form of bracketing and use of slanting or horizontally leveled members often depends on column-top or intercolumnar position along the façade no matter if the bracket-arms extend perpendicular or at an acute angle to the building plane. At the Main Hall of Nanshentou Erxianmiao, the symmetrical well-balanced *shanshi dougong* of five-*puzuo* in “filled-heart” design does not bend with the rules and stands in sharp contrast to the orthogonal (column-top and intercolumnar) bracketing all around. Its perpendicular and angled exterior extensions consist of double *huagong*, whereas the column-top corbelled clusters apply one *huagong* with well-tapered heads and one *jia’ang* with pointed tips. It also differs from the intercolumnar bracketing at the front corridor, where true slanting cantilevers replace the second step of horizontally leveled timbers.\(^{117}\)

At the exterior, genuine *xiegong* step out directly from the *ludou* and the small bearing block above. At the interior, they exclusively jut out from the large bearing block on the ground level. The innermost pair of angled *shuatou* is missing, which is why the number of decorative noses does not match the number of *xiegong*. Finally, there is no *zhutoufang*, as at Shizhang Yuhuangmiao.
2. Conclusions: basic typology of pre-Yuan dynasty fan-shaped bracket sets in Shanxi province

a) Short summary and preliminary assessment

In the previous paragraphs, the author introduced the nineteen key national heritage conservation units in Shanxi province that preserves rectangular timber halls with fan-shaped bracketing and according to the greater carpentry system dated to the Liao, Northern Song, or Jin dynasties. Despite carefully mending in the succeeding periods such as at Chongfusi or Shanhuasi, partial rebuilding such as at Shizhang Yuhuangmiao and Nanshentou Erxianmiao, and belated surface treatment through decorative painting or carving, such as is found in the flashy interior painting at Xiaohuiling Erxianmiao, their way of bracketing still conveys the theoretical mind-set of medieval timber architecture.

The core question that must be asked is whether the nineteen monasteries and their twenty-one buildings with fan-shaped bracket sets had something in common that could help us to understand the circumstances and purpose of their genesis in Shanxi province. It is tempting to search in the history of the monasteries, their political and religious affiliation, or their environmental conditions for the most basic subset of common factors inherent to all of them.
Geographic location in Shanxi province and characteristic monastery layout

At first glance, the nineteen monasteries are scattered to the four winds in today’s Shanxi province, but at closer inspection they concentrate in certain geographic areas with two clusters in the north, one in the central part, and two in the southeast (Map 2-2).

The two clusters in the north reflect the political situation from the conquest of Liao through the Jin dynasty. The awe-inspiring large-scale sites of Shanhuasi and Huayansi were part of the western circuit or *xijingdao* 西京道, the southernmost part of the Khitan-ruled territory in the eleventh and twelfth centuries. As expected, the craftsmen implemented the monumental design with massive timbers inherited from the Tang dynasty, and their fan-shaped bracket sets displayed the *xiegong-* tradition of the northern Khitan heartland (examples of which are discussed in part three). A borderline running along the east-west oriented mountain range just north of the Hutuo River 滹沱河, before cutting across the Lüliang Mountains 吕梁山, separated the Khitan relics politically and culturally from those of the rivaling Northern Song dynasty. To its south but geographically speaking still in northern Shanxi, the four smaller sites of Dingxiang Guanwangmiao, Yanqingsi, Hongfusi, and Foguangsi nestled on the secluded mountain plateau of Wutaishan or flanked the pilgrim road leading to the religious center at the sacred Buddhist mountain.

Next, Linli Guanwangmiao in Yangquan and Yuxian Daiwangmiao in central Shanxi were part of a small depression sheltered in the Taiheng mountain range that provided the missing link on the transition route from Taiyuan in the west to the plains of Hebei province in the east. It was a corridor of cultural exchange between the
neighboring provinces. Not surprisingly, Longxingsi in Zhengding, the site with the best-known fan-shaped bracket sets outside of Shanxi province, is located just west of Yangquan prefecture. It probably was the second channel by which the idea of fan-shaped bracketing entered Shanxi territory. Together with the clustered monasteries at Mount Wutai, the relics in central Shanxi belonged to the Jin dynasty commandery of hedongbeilu. The administrative district of hedongnanlu encompassed the remaining ten sites with fan-shaped bracketing in the southeast.

Southeastern Shanxi comprised two geographic clusters with six sites in Changzhi prefecture, namely Dongyi Longwangmiao, Lingzewangmiao, Longmensi, Foutousi, Wuxiang Huixianguan, and Puzhaosi, and four sites in Jincheng prefecture. In fact, the latter, namely Nanjixiangsi, Xiaohuiling Erxianmiao, Shizhang Yuhuangmiao, and Nanshentou Erxianmiao, were all in Lingchuan county. Generally speaking, the Jindongnan area reveals a rather special topography. In the east, the foothills of the Taiheng Mountains, which stretched along Shanxi’s eastern border from north to south, built a solid barrier against today’s Hebei and Henan provinces. In the west, the Taiqiushan 太丘山 formed a similar but smaller obstacle that impeded cultural exchange and the flow of traffic moving from east to west. Furthermore, more mountains blocked the northeastern edge, and only the south was wide open to the fertile plains of Henan. Even though the main north-south passage of Shanxi province ran along the Fen River 汾河 valley in the southwest, the southeast still provided the most direct shortcut from Taiyuan to the prestigious city of Kaifeng, and thus was a strategically important military route to the Central Plains and South China.119
No examples of pre-Yuan dynasty timber architecture with fan-shaped bracket sets survived in the plains of southwestern Shanxi, but the marvelous brick tombs of Jishan give vivid evidence of the existing local taste for angular bracketing in the Jin dynasty.

To sum it up, even though all the examples belonged to the category of religious architecture, their individual layout and monastery design largely depended on the geographic location within the province and the prevailing regional and local conditions. Large multi-courtyard monasteries with great timber halls of five, seven, or nine bays’ width clustered in the north, particularly in the Khitan-ruled area, in contrast to the smaller complexes with humble three-bay timber halls in the former Northern Song territory of central and southeastern Shanxi. Accordingly, the social and cultural background ranged from urban prefecture- or county-level cities to dead-end villages with simple life such as the local Longwangmiao in Dongyi, where a temple festival usually provided the only cheer in the dreary course of annual events. Some sites were in close contact with their surrounding nature including the Buddhist Longmen Monastery or the Temple to the Lord of War in Yangquan, which were both embedded in the gently inclined landscape. The geographic location also influenced the way of worship and interaction with the people of faith. Some sites offered service to a stationary/sedentary local community. Others were places of excursion and catered to the specific needs of pilgrims on their way to pay homage to their gods. What is more, they venerated different principal deities and adhered to various religious concepts, including the strict practice of Buddhism or a certain local cult as well as the change of affiliation over time.
The single timber hall and its angular bracketing

At closer inspection, the twenty-one timber halls also differed in building type, function, and location within the monastery layout ranging from Front Halls or guodian such as at Nanjixiangsi, Main Halls such as at Dongyi Longwangmiao, and Rear Halls such as at the Sleeping Palace at Daiwangmiao in Yuxian.\textsuperscript{123} Fan-shaped bracket sets were even applied at Side Halls that were not placed along the cardinal axis of the monastery such as Dingxiang Guanwangdian or Wenshuidian of Foguangsi. Most often, they were seen at single-storied buildings, but in fact the mid-twelfth century Puxian Pavilion at Shanhuasi already employed fan-shaped bracket sets. The examples also include the building type of a gatehouse such as at Tianwangdian of Longmensi.

There was a continuous preference for \textit{shanshi dougong} in-between columns beyond the restrictions of political borders or chronological affiliation with a certain time period. For example, Nanjixiangsi, the earliest Northern Song dynasty timber hall with \textit{shanshi dougong}, and the Khitan relics in Datong all applied them at the intercolumnar positions. In the Jindongnan area, fan-shaped bracket sets placed intermittently between columns developed into a regional trademark in late imperial China starting with the Northern Song dynasty, especially in the case of a sprawling corbelled cluster at the midpoint of the front façade’s central bay.

Interestingly, column-top \textit{shanshi dougong} were instead used at twelfth century Jin period architecture including Chongfusi Mituodian in the north or in the southeast the Main Hall of Lingzewangmiao and Sanqingdian of Wuxiang Huixianguan. To be precise, the Northern Song dynasty structure at Linli Guanwangmiao in Yangquan also employed
column-top *shanshi dougong* but antedated the official start of the Jin dynasty by just four years.

Next to genuine *xiegong*, a handful of examples additionally applied stylistic variations of angled bracket-arms such as *mojiagong* that are discussed in part three of the thesis. In brief, Shahuasi Puxiange and Chongfusi Mituodian in the north integrated true “corner spanning brackets” into their corner column-top corbelled clusters. Yanqingsi at Wutaishan replaced the *mojiagong*-brackets for “corner spanning beams”, but they were elevated above the bracketing layer. Dingxiang Guanwangmiao, another site in the north, and two monasteries in the southeast, namely Nanjixiangsi and Shizhang Yuhuangmiao, preserved buildings with additional angled bracket-arms that were installed along the façade at the corbelled clusters in closest proximity to the building corners.

To draw a preliminary conclusion, there was no least common denominator that could capture the purpose of fan-shaped bracketing and explain dissemination and diversity if quickly looking just at the visual and environmental similarities and differences. (The majority of structures is undated and was successively repaired, which is why it is difficult to discern a noticeable pattern. For an overview of the architectural styles associated with the greater carpentry of each hall, see Table 2-3).
b) Different types of pre-Yuan dynasty fan-shaped bracket sets: eight-pointed star (⋆), cross (×), triangle (∧), and complex form of intertwined stars (⋆+⋆+⋯)

The next goal is to establish a stylistic typology that encompasses the diverse kinds of fan-shaped bracket sets in Shanxi province prior to the Yuan dynasty and create a tool for discussing the puzzling phenomenon in greater depth.124 Just as a reminder (Table 1-4), by definition a fan-shaped bracket set called shanshi dougong 扇式斗栱 is an eave bracket set placed along the exterior building façade that mimics the shape of an open fan and applies outward projecting xiegong at the exterior steps and optionally, at the interior steps. They all intersect at a single focal point within the wall plane or along the main lateral axis of the large bearing block.

In essence, before the thirteenth century there are four prototypes of shanshi dougong that are distinguished according to the distinctive shape of their ground plan (Table 2-4). In this thesis, they are named after geometric forms, namely the shape of an eight-pointed star (⋆), a cross (×), a triangle (∧), and the complex form of intertwined stars (⋆+⋆+⋯). The key differences are the nature of the applied bracket-arms such as the angle of projection to the wall plane (usually either 45 or 60 degree) and their placement at the exterior or interior projection of the organic unit.

The first type embodies the ideal image of a well-balanced symmetrical fan-shaped arrangement with horizontal projections along eight different directions (Table 2-4). Such shanshi dougong equally comprise orthogonal and angular projections that step out directly from the ludou at the exterior and interior. In detail, there are namely two
bracket-arms parallel to the wall plane (i.e. *nidaogong*), one arm perpendicular to the wall plane at the exterior and one arm perpendicular to the wall plane at the interior (i.e. *zhenghuagong*), as well as one exterior set and one interior set of two arms (i.e. two wings) at 45 degree angles with the wall plane (i.e. genuine *xiegong* or *mojiaogong*). The ground plan resembles the graphic symbol for an eight-pointed star (\(\star\)) with each bracket-arm symbolizing one point of the polygon.

The second type follows the rare design pattern of a fan without perpendicular ribs that would stick out at a right angle to the wall plane (Table 2-4). Genuine *xiegong* symmetrically project at 60 degree angles toward the exterior and interior but lack perpendicular bracket-arms. Colloquial language usually describes them as cross-shaped figures (\(\times\)) neglecting the *nidaogong* or “plaster channel bracket-arms”, which are the symmetrical bow-shaped parallel timbers within the wall plane that directly rest on the large bearing blocks.

The third type are triangle-shaped clusters (\(\wedge\)) that display angled bracket-arms in the strictest sense exclusively at their exterior projection (Table 2-4). The short half-brackets usually extend from the *ludou* at 45 degree angles to the wall plane toward the exterior without protruding inside. Their asymmetrical design lacks the matching opposite hands at the interior projection, which solely installs perpendicular timbers (usually *zhenghuagong*).

Finally, the fourth type describes the elaborate design that employs a sequel of intertwined stars (\(\star+\star+\ldots\)) (Table 2-4). Strictly speaking, it is a sub-type of the eight-pointed star and exemplified by the intricate bracketing at Mituodian of Chongfusi. It consists of several strongly pronounced star-shaped arrangements with orthogonal and
angled bracket-arms, each of which already appears as a small self-contained bracketing unit. They are staggered along the cardinal *doulong* axis (i.e. through the *ludou*) to achieve the complex form.

Furthermore, the author would like to point out several aspects of pre-Yuan dynasty fan-shaped bracket sets related to the distinctive shape of the ground plan.

To start with, angled bracket-arms usually came in twos and were grouped in matching pairs to form symmetrical “wings” that faced each other. In this context, a “wing” is the collective term to describe the accumulation of angled timbers that were piled up on top of each other to achieve the same building height as their perpendicular counterparts (if applicable). It is useful to count the wings that set up the angular bracketing unit. Two wings of *xiegong*, either in the form of elongated bow-shaped brackets or short half-brackets, usually stepped out directly from the *ludou* to the left and right sides and performed the same number of jumps as *zhenghuagong* (if applicable). Often more wings of *xiegong* were added at the upper levels and emanated from the small bearing blocks above the *ludou* (i.e. on top of the first or second jumps of *zhenghuagong*). The additional wings enhanced the density and achieved a fuller fan-out. Often, there was a mismatch between the exterior and interior design such as at Shanhua Shi Sanshengdian or Dingxiang Guanwangdian, where the eight-pointed star-like *shanshi doulong* reveal more wings and a higher number of *xiegong* at the outside of the building than at the inside.

Furthermore, column-top and intercolumnar positions equally employed the star design, but cross and triangle were restricted to *shanshi doulong* in-between columns.
The eight-pointed star was the most common design pattern among the nearly two dozen buildings and appeared in “stolen-heart” and “filled-heart” mode. For example, the star-like bracketing at the Main Halls of Nanjixiangsi and Xiaohuiling Erxianmiao followed *touxin*-style, but the Main Halls at Hongfusi used *jixin*-style. Some timber halls mixed both techniques such as Foguangsi Wenshudian. The rare cross-shape, the only pattern with 60 degree projections, was exclusively applied at the midpoint of the front or rear façades’ central bays. It usually fortified the exterior projections with parallel brackets such as the “filled-heart” design at the front and rear façades’ central bays of Daxiongbaodian at Shanhuasi or Huayansi. Triangle shaped arrangements were also likely to use *guazigong* and *mangong*, for example at the Main Halls of Puzhaosi or Foutousi. Generally speaking, the additional parallel brackets enhanced integrity and overall stability of the cross and triangle-shaped clusters.

Lastly, the cross was limited to the Liao dynasty influence zone in the north. By contrast, the examples in the Northern Song territory were more likely to use the eight-pointed star with symmetrical well-balanced projections. Nevertheless, the density of fan-shaped bracket sets greatly differed ranging from multiple *shanshi dougong* evenly spaced all around the hip-and-gable-roofed buildings such as Yanqingsi or Nanjixiangsi to a single corbelled cluster at Xiaohuiling Erxianmiao. Additionally, the triangle design became increasingly fashionable with the Jin dynasty. What is more, the examples of such asymmetrical arrangement in southern Shanxi outnumber those in the north by three-to-one.\(^{128}\)
Chapter 3: Shanxi regional building styles and their influence on the formative stages of fan-shaped bracketing

The stylistic typology of four prototypes provided the basic tool to capture characteristic images of fan-shaped bracketing but still needs further refinement regarding to the function of bracketing and its impact on the greater and smaller carpentry system.

1. Cause and effect of shanshi dougong defined by past scholarship

Past Chinese scholarship did neither explicitly use the term “fan-shaped bracket set” nor did it acknowledge the concept of shanshi dougong as a category of its own within the technical language of traditional Chinese architecture. Consequently, it is necessary to read between the lines of general literature about angular bracketing in China and discern the most appropriate meaning with regard to those sets that eventually used genuine xiegong. The following paragraphs summarize the quintessence of past scholarship on cause and effect of shanshi dougong on the carpentry system regardless of the geographic location. The stylistic variations of mojiaogong and xiaxugong are not part of the discussion, since they are further analyzed in part three of this thesis.

First, starting with the Northern Song dynasty, intercolumnar corbelled clusters became equally important to their column-top counterparts and their new rank and social status was expressed by their matching size, their placement at the same height within the wall plane, and the same number of perpendicular extensions. Shanshi dougong
embodied this general achievement in building technology and illustrated the new equal footing through the arrangement of multiple angled bracket-arms as visually impressive and voluminous as their column-top equivalents. They eventually exceeded the latter in complexity of design and space-consumption through their dispersing fan-out. At the same time, their angled bracket-arms emphasized the natural decorative effect of Chinese bracketing. Most scholars drew attention to the increased desire for embellishment under Jurchen rule and suggested that the structural and aesthetic qualities of *shanshi dougong* broke down even in the Jin dynasty.

Second, one of the general tasks of Chinese bracketing was to uphold the roof and ceiling and transmit their load onto the columns. The extended bay length and monumental roof in medieval architecture challenged the stability of the horizontal joists that ran along the façade and made it necessary either to increase their diameter adding more dead-weight or to provide further abutment against sagging. In detail, the angled bracket-arms of *shanshi dougong* were additional points of support for the longitudinal joists and beams above them such as *liaoyanfang* 撩檐枋 at the exterior or *panjianfang* 襦间枋 at the interior. They reduced their distance, bending moment, and shear stress.

In 1982, Yu Zhuoyun already explained the staggered use of angled timbers at different positioned *shanshi dougong* with the stepwise decrease of the bay length along the façade. For example at Shanhuasi Daxiongbaodian, the front and rear walls’ central bays of 7.02 meters length symmetrical installed exterior and interior genuine *xiegong* (at 60 degree angles), whereas the smaller first side bays of 6.34 meters length applied angled timbers only at their exterior projections (at 45 degree angles). The second to last and last side bays measuring just 5.45 meters and 4.82 meters respectively finally
omitted angled bracket-arms. In other words, if a sprawling *shanshi dougong* with wide-stretching projections was placed in-between columns, a single corbelled clusters per bay was still sufficient to guarantee the building’s safety.\(^{137}\) Otherwise it would have been necessary to add a second bracketing unit. In essence, one fan-shaped corbelled cluster matched two *dougong* with orthogonal bracketing at the intercolumnar position.

Third, the higher number of timbers needed for two complete sets or the additional angled bracket-arms in the case of a single set increased the dead weight of intercolumnar *dougong* perching at the vertical architrave known as *lan’e* 阑額 or the column-top joist (i.e. *zhutoufang* 柱头枋). Under too much pressure/excessive load, the tenons at both ends of the *lan’e* that secured the individual segments of the tie-beam in-between two columns would break or disengage with the mortise openings.\(^{138}\) In order to distribute the load more evenly, a second, horizontal architrave called *pubaifang* 普拍枋 was elevated onto the top of the column shafts continuously running along the façade. The introduction of *pubaifang* was such a crucial step in building consolidation and stability that Shen Yuzhi explained the rise of *xiegong*-architecture by the mid-Liao period with the genesis of the horizontal architrave in the end of the tenth century.\(^{139}\) As a “rule of thumb”, relics with a single intercolumnar *shanshi dougong* would accordingly also use a *pubaifang*.\(^{140}\)

In conclusion, if we compare theory with praxis, the fan-shaped bracketing of the surviving key national heritage conservation units in Shanxi province prior to the Yuan dynasty further confirms the premises previously stated.
In 1103 (1145) C.E., the Yingzao fashi officially raised the number of bracket sets in-between columns to a two-set standard, but the key national heritage conservation units in Shanxi province with pre-Yuan dynasty shanshi dougong did not comply with the rules. In fact, not a single building among the nineteen timber halls ranging from the eleventh to thirteenth centuries or in other words, pre and post publication of the Northern Song dynasty building manual, consistently used a pair of corbelled clusters in every bay along the façade. On the contrary, they rather allotted a single set with either orthogonal or angular bracketing to each bay.

The only exception among the examples with intercolumnar shanshi dougong was the Jin dynasty structure of Sanshengdian at Shanhuasi, which employed two corbelled clusters in the front and rear façades’ central bays. However, they were not the respective units with genuine xiegong. Among the examples of column-top shanshi dougong, the buildings at Lingzewangmiao and Wuxiang Huixianguan omitted intercolumnar bracketing, whereas Chongfusi Mituodian and Linli Guanwangmiao still used one bracket set per bay.

It is especially the unofficial “rule of thumb” by Shen Yuzhi that perfectly applies to the greater carpentry of the pre-Yuan dynasty key national heritage conservation units in Shanxi province with shanshi dougong. Twenty of the buildings eventually used vertical and horizontal architraves alike. Just the Main Hall of Puzhaosi made up for the lacking pubaifang with a larger sized lan’e in chutou 出头 style. Based on their roof type, the twenty-one timber halls installed architraves either just at the front and rear façades if gable-roofed or all around the building in case of a gable or hip-and-gable roof.

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2. Typical design features in Shanxi province regional architecture with focus on the building traditions in the Jindongnan area

In his three-part survey of Shanxi province pre-Yuan dynasty wooden architecture, Li Huizhi identified regionalism as the driving force behind building from the Tang to the Jin dynasty. He concluded that the key to understanding was to understand the natural environment, the local history, and the local people and their culture. All these factors contributed to a diverse architectural culture with distinctive styles in north, central, southeast, and southwestern Shanxi prevailing for centuries beyond the institutional changes of global politics. Tracy Miller suggested that the patrons of eleventh century Buddhist monasteries in southeastern Shanxi for example, “did not conceive of themselves as subjects of the Song dynasty, but rather as people of the Shangdang region, with dynastic identity occurring only secondarily”. Not surprisingly, fan-shaped bracket sets were also subject to the strong regional flavors and local tastes.

a) Column-grid and floor plan design

In Shanxi province, the building traditions in the north, the central part, the southeast and southwest influenced the general layout of architecture and particularly, the choice for column movement inside the building, also known as displacement or 移柱, or column reduction and omission, known as 减柱. The availability, usability, and functionality of interior space became more important in the Liao, Northern Song, and Jin dynasties, which brought about new religious and ritual requirements. In order to create a suitable spacious environment, the interior columns of timber halls often shifted along the building axes, were positioned completely off-axis, or even vanished.
from the inner column grid that provided abutment for lateral and longitudinal beams and the roof structure above. As a consequence, the floor plans looked patchy and erratic.

In practice, some unusual column alignments in Shanxi province regional architecture breached the official guidelines that were formulated in the beginning of the twelfth century, and others were officially allowed. For example, four of the twenty-one pre-Yuan dynasty timber halls with *shanshi dougong* were hip-and-gable-roofed three-by-three-bay structures that completely lacked interior columns, namely Shanhuasi Puxiange, Yanqingsi Zhengdian, Nanjixiangsi Guodian, and the Main Hall of Xiaohuiling Erxianmiao. Strictly speaking, they did not omit columns, because they were not even supposed to provide support for their lateral beams at the inside of the hall. Their greater carpentry system reflects a special type of *tingtang* plan known as *sichuanfu tongda qianhouyan tongyan erzhu* 四椽栿通达前后檐通檐用二柱 in the *Yingzao fashi* that by definition exclusively relied on the abutment of exterior eave columns (Figure 2-22).  

Against common expectations, the official building code of the *Yingzao fashi* did not just permit symmetrical layouts with fully occupied column grids or *cao* 槽 but also acknowledged a few asymmetrical arrangements. One of the four modes for *diantang*-style architecture, namely *dancaoshi* 单槽式, combined a concentric outer ring of eave columns and a single longitudinal row of interior columns that was aligned parallel to the wall plane of the front façade (Figure 2-23). Additionally, four of the total nineteen *tingtang* sections in the *Yingzao fashi* spaced their interior columns asymmetrically within the prefabricated transverse frameworks.
In very general terms, the floor plans in northern Shanxi appear as the most flexible, and the majestic wooden halls with five, seven, or nine bays’ width occasionally reveal column movement and column omission within the same building (Figure 2-24). This includes arrangements where the interior columns shifted along the longitudinal building axis to the left or right. For example, the floor plan of Chongfusi Mituodian still reflects the prestigious diantang design of jinxiangdoudi caoshi 金箱斗底槽式, but the front row of the inner column ring sacrificed two columns for the sake of more space. The remaining pair moved slightly to the left and right (i.e. half a bay in length) to divide the distance more evenly. Furthermore, it also includes arrangements where the interior columns shifted along the lateral building axis further to the front or back. For example, Shanhuasi Daxiongbaodian altered the basic design of shuangcao jinxiangdoudi caoshi 通过 recess of the inner front row by one bay and Huayansi Daxiongbaodian by re-arranging the front row and additionally the back row at half a bay’s length further toward the center of the hall.¹⁵¹ In the end, the visual effect and perception of space was not always the same. Shanhuasi Daxiongbaodian increased the interior space/legroom right at the front upon entering the hall. Huayansi Daxiongbaodian achieved more freedom in the front and the back. Hongfusi enlarged the core area in the center and moved the back row of columns along the central building axis half a bay closer to the rear wall.

By contrast, the humble halls in southeastern Shanxi decrease the total number of interior columns rather than move them around as suggested by Li Huizhi.¹⁵² Probably because the latter was more complicated and required technical adjustments that might have been unnecessary if the building was small enough for free-spanning beams to cover
the newly enlarged distance between the remaining columns. The majority of pre-Yuan dynasty timber halls with fan-shaped bracket sets in the Jindongnan area and also, Linli Guanwangmiao in central Shanxi, confirm Li Huizhi’s theory. There is only one exception to the rule, namely Tianwangdian of Longmensi, which neither intentionally omitted interior columns nor implemented a design without interior columns in the first place (Figure 2-25).

In conclusion, the column network in medieval timber architecture often showed divergence from the idealized diantang or tingtang plans as recorded in the Yingzao fashi. At first glance, some designs of the pre-Yuan dynasty timber halls with shanshi dougong might resemble a ragbag with arbitrarily omitted or moved columns, but there usually is a logical thread. The underlying desire for functional space was achieved through legal design measures in accordance with the official building style or creative altering.

b) Greater carpentry system and merging of diantang and tingtang plans

In traditional Chinese architecture the floor plan is less significant than the cross-section. Only with regard to the third dimension of building, we can explain whether the greater carpentry system influenced the choice for angled bracket-arms and if so to what extent.

The architecture in southeastern Shanxi shows distinctive features and perfectly illustrates the idea of a regional building style that underwent discernible change in the Northern Song-Jin transition. It comprises the buildings in today’s Changzhi and Jincheng prefectures, which basically match the historical districts of Luzhou 潞州 and Zezhou 泽州. In very broad terms, the regional building style followed the Yingzao fashi
but merged diantang and tingtang characteristics with the local building traditions of Changzhi and Jincheng into a reasonable, technically doable, and resource-efficient framework.\textsuperscript{154}

Moreover, the Jindongnan area accounts for more than 50\% of the pre-Yuan period architecture in Shanxi province and also for half of the relics with shanshi dougong.\textsuperscript{155} Therefore, it serves as an excellent example to challenge the nature of fan-shaped bracketing and discuss its feasibility and flexibility.

**Brush-up on technical terminology of tingtang-style**

In the Northern Song dynasty, the depth of a Chinese building and its roof were usually measured in horizontally projected rafters called chuan, correctly the total number of the individual segments between them. Likewise, the length of the cross-beams that generated the lateral framework of the roof was also given in horizontally projected rafter-spans such as sichuanfu 四椽栿 or liuchunafu 六椽栿. One- and two-rafter beams had special names and were referred to as zhaqian 削牵 and rufu 乳栿, respectively. As discussed in part one of the thesis, the technical terminology and methodology changed over time. In late imperial China, the actual number of roof purlins, known as tuan 槫 and heng 柱 or lin 檐, became more important than the horizontally projected distance between them. For example, the term sichuanfu 四椽栿 in the Yingzao fashi and the expression wujialiang 五架梁 in the Gongbu gongcheng zuofa both describe a transverse beam of four-rafter length that carried five longitudinal purlins running parallel to the roof ridge on top of the rafter segments.\textsuperscript{156}
Additionally, the total number of columns aligned along the lateral building axis was crucial in tingtang architecture and indicated the way and amount of support for the transverse beams. Just as a reminder, the term tongyan 通檐 referred to a “clear span”, i.e. a prefabricated transverse framework without interior columns that solemnly rested at two exterior eave columns. The expression fenxin 分心 or “centrally divided” indicated the addition of a third column at the mid-point of the building’s depth, i.e. right in-between the pair of exterior columns.

**Increased height of interior columns**

The regional building styles in Shanxi province challenged the most defining features of diantang and tingtang, first and foremost the column height. In absolute figures, fourteen of the twenty-one timber halls with shanshi dougong among the key national heritage conservation units in Shanxi province possess interior columns that exceed their exterior counterparts in height.\(^{157}\)

One of the requirements for diantang-style was the equal height of exterior and interior columns to guarantee the three-part division of column, bracketing, and roof layers (Figure 1-16). The underlying idea was to secure the vertical columns with a ring-like system of tie-beams such as architraves, and provide a stable, horizontally leveled platform for the heavy roof construction above. Then, the lateral beams of the tailiang-style roof were mounted and piled up on top of each other, a method usually called cengdieshi 层叠式.\(^{158}\) By contrast, tingtang architecture followed a different sequence in erecting, and first assembled the individual, prefabricated transverse frameworks including the roof beams, a method known as lianjiashi 连架式 (Figure 1-17). To
enhance integrity, it was reasonable to tie the shorter eave columns to the taller interior columns by inserting head or tail of lateral joists or beams into the shafts of the latter.\textsuperscript{159}

To discern reason and cause for the increase in column height reminds of the rhetorical question “Who comes first, chicken or egg?” The timber construction in traditional Chinese architecture is a highly functional, technologically advanced system with settings that directly depend on each other and closely interact with each other, which makes it difficult to pinpoint what eventually pulled the trigger for development. In their insightful discussions about typical hip-and-gable roofed architecture in the Jindongnan area, Liu Yan and Meng Chao identified taller interior columns as one of several measures to facilitate the integration of cross-beams and simplify their joints. By contrast, He Dalong 贺大龙, who focused on Five Dynasties’ architecture in Changzhi, put the cart before the horse and recognized the rise in column height as the direct result of the way in which the cross-beams were placed.\textsuperscript{160} In any case, column height and elevation of beams both played an integral part in the regional and local building traditions of southeastern Shanxi province.

\textit{Decreased number of jumps at column-top bracketing inside the hall}

Let us assume the worst case scenario for humble three-by-three-bay timber halls that could not afford to enlarge building size. If the exterior column and opposite interior column along the lateral axis matched in height and design of bracketing, the corbelled clusters’ near sides would almost meet and significantly reduce the free span of the cross-beam.\textsuperscript{161} The awkwardly short remnant that was left in-between was visually unappealing; further, too much abutment was overcautious and economically unjustified. In other
words, a sprawling column-top *dougong* with a high number of piled up extensions consumed a considerable amount of space and created a circumference with far-reaching offshoots that curtailed the precious interior room.\(^{162}\)

In the case of prestigious exterior eave bracketing of *diange* architecture with seven- or eight-*puzuo*, the *Yingzao fashi* demanded reduction of the interior projection by one jump.\(^{163}\) With the goal of saving labor and material, the interior columns should furthermore use at least one jump fewer than their counterparts at the front or rear walls.

In the southeast of Shanxi province, the craftsmen of the past put the theory into practical effect even if the corbelled clusters were usually lower in rank. Most importantly, not only numerous examples with orthogonal bracketing proved the case such as the Northern Song dynasty Longmensi Daxiongbaodian (Figure 2-26). Moreover, all the pre-Yuan dynasty structures with *shanshi dougong* equal to five-*puzuo* also reduced the bracketing on top of their taller interior columns by one perpendicular extension.\(^{164}\) However, there was a twist to the story. To give a significant, self-explaining example, *waitiao* and *neitiao* of the front columns at Lingzewangmiao consisted of double *huagong* and the matching side at the interior columns just of a single bracket-arm (Figure 2-27). Due to the extremely short distance between the columns, the front corridor was so densely packed that not even the solution with inferior rank would have been possible if the interior columns had not grown in height.

**Simplification of the hip-and-gable roof and segmentation of lateral beams**

The rising height of interior columns and lower rank of their bracketing shaped the way the lateral beams were placed and consequently, the roof framework above.
Local construction methods in the Jindongnan area simplified the arrangement of roof beams and skillfully substituted shorter segments for heavy solid, end-to-end timbers in one piece. In essence, they did not abandon the basic design principle of diantang architecture in this matter and still piled up layers upon layers to generate a tailiang-style roof.

For example, the Yingzao fashi required ten-rafter structures in diantang-style to mount successively smaller beams with step-wise decreasing length on top of a monumental beam that spanned the whole building depth (Figure 2-28). In total, there were five layers of heavy solid timber beams, namely shichuanfu, bachuanfu, liuchuanfu, sichuanfu, and pingliang, the length of which progressively shrunk by two rafters’ length at a time. Their dead weight far exceeded genuine tingtang or local building styles, which neglected the strict sequence of mounting to spare timbers and save building material.

The underlying notion of the typical resource-efficient building in southeastern Shanxi is also evident in the pre-Yuan dynasty architecture with shansi dougong. Five of the seven six-rafter structures with hip-and-gable roof either completely omitted one layer in the consecutive mounting of transverse beams (Figure 2-29). For example, the Middle Hall of Nanjixiangsi employed a six-rafter beam next to the topmost pingtuan but skipped the required four-rafter beam in-between. Or, the timber halls substituted the beam with the longest span stretching across the full depth of the building by two smaller segments that made up for the lack of a continuous, one-piece wooden member. For example, the Main Halls of Puzhaosi and Nanshentou Erxianmiao replaced the six-rafter beams at the bottom layer by a combination of sichuanfu plus rufu in the rear or front.
Generally speaking, the most common way to span the depth of six-rafter hip-and-gable roofed buildings in the southeast was to use a four-rafter beam or *sichuanfu* and a two-rafter beam or *rufu* that was added in the front or rear, a method known as *sichuanfu dui rufu* 四椽栿对乳栿. The key question was the elevation of the two beams with regard to each other and their structural joinery (Figure 2-30). First, they were both installed at equal height, a method usually referred to as *duijie* 对接, for example at Longmensi Daxiongbaodian (orthogonal bracketing). They often did not fully match in size, because the beam that spanned the longer distance of four rafters was usually larger in diameter. Second, starting with the mid-Song dynasty the method further advanced and the *sichuanfu* was elevated above the shorter *rufu*, for example at the Main Hall of Beijixiangsi (orthogonal bracketing) and at the Main Hall of Shizhang Yuhuangmiao (with *shanshi dougong*). The lower beam provided additional abutment to enhance stability through enlarged contact surface, a method known as *yajie* 压接. Due to their different elevation the way the beam heads encountered the bracketing at the front or rear façades differed and consequently their way of interaction.

Finally, another characteristic in the building styles of the Jindongnan area was to adopt one more defining feature of the *tingtang* concept, a tie-beam arrangement that caused tensile stress. The Main Hall of Xiaohuiling Erxianmiao took advantage of this principle and illustrates a third way to position the segments of cross-beams (Figure 2-31). An end-to-end six-rafter timber log provided the stable basis of the roof construction. The next horizontal layer that usually matched a four-rafter beam was reduced to a pair of short *zhaijian* that could only cover a one-rafter span in the front and rear of the building.
Their heads were inserted into the shafts of two small columns that rested on top of the six-rafter beam and carried the pingtuan above. There was an additional two-rafter timber that spanned the distance between the short columns and tied them together.

c) Column-top shanshi dougong

Integrating transverse beams into front and rear wall eave bracketing

The pre-Yuan dynasty timber halls with fan-shaped bracket sets in southeastern Shanxi province embraced the regional building style and prevailing local building traditions for their greater carpentry system second to none/not inferior/similar to the key national heritage conservation units without genuine xiegong. This led to the question how the local mélange of diantang and tingtang eventually influenced the column-top bracketing along the building façade, particularly in the case of shanshi dougong.

In the ideal drawings of the Yingzao fashi, the bracket sets of diantang provided abutment for the strictly separated transverse beams of which the heads were elevated above the chenfangtou, the topmost timber in the puzuo-unit. In the tingtang sections, the heads of the cross-beams were integrated into the corbelled clusters and penetrated the wall plane in the form of shuatou, and occasionally, also as chenfangtou. The body of extant architecture has shown that there was a greater variety in design that existed before, during, and after the publication of the written building manual.

He Dalong identified three basic ways of interaction before the Yuan dynasty, namely zuheshi 组合式, dajiaoshi 搭交式, and dayashi 搭压式, that reflected the gradual upward move of the cross-beams and differed in the extent to which they integrated the beam into the column-top eave bracketing (Figure 2-32). The methods ranged from
“active involvement” as exterior huagong at the East Hall of Foguangsi to “passive involvement”, where the head of the beam terminated inside the hall below the tail of true descending cantilevers such as at Zhenguosi Wanfodian, and finally to the position on top of the whole corbelled cluster or at least, the placement above the core body of extensions.

Guo Daiheng emphasized the structural task the head of the beam performed. She distinguished four techniques by which the latter was integrated into the column-top eave bracketing and a fifth behavior that described its complete detachment as required for diantang in the Yingzao fashi.\(^{176}\) In essence, the penetrating head could act as huatouzi, huagong, or shuatou including the formation of batoujiaoxiangzuo, or, in case it did not pierce the wall plane, as chenfangtou.

In southeastern Shanxi, only two of the ten pre-Yuan dynasty timber halls with fan-shaped bracket sets followed the standard diantang plan for the most part in this respect. The Main Halls of Nanjixiangsi and Xiaohuiling Erxianmiao, with no interior columns, applied lateral beams that were placed above the puzuo unit and strictly separated from the eave bracketing (Figure 2-33).\(^{177}\) Additionally, their design roughly matched the idea of dayashi as described by He Dalong, but they used structural descending cantilevers. One reason for the flourishing of dayashi in Shanxi province during the Northern Song, Jin, and Yuan dynasties was the replacement of zhenxia’ang with horizontally leveled false cantilevers or jia’ang.\(^{178}\)

Most of the pre-Yuan dynasty timber halls with shanshi dougong eventually revealed two tiers of horizontally leveled timbers but applied a stylistic variation of dayashi reminiscent of tingtang style (Figure 2-33). The beam heads penetrated the wall plane and extended outward as one of the three basic bracketing components, specifically
shuatou or chenfangtou. Interestingly, the examples in southeastern Shanxi were more likely to employ them as decorative noses or any other shuatou-like member,\textsuperscript{179} but the Liao dynasty relics in the north often converted the upper part of the beam into chenfangtou such as Huayansi Daxiongbaodian.

To summarize, the way of integrating cross-beams and their possible intersection with the corbelled clusters along the façade reflected the diversity of local building traditions in the Jindongnan area prior to the Yuan dynasty. Yet, they had no direct impact on the application of genuine xiegong, probably because all but two examples in the southeast did not use shanshi dougong at the column-top positions in the first place.\textsuperscript{180}

d) Composition of non-official style bracket sets in the regional architecture of Shanxi province and the qualities of shi 式 and xing 形

Starting with the Northern Song dynasty, corbelled clusters were officially required to contain two distinguishable parts, namely the three basic components of ludou 枵斗, shuatou 耍头, and chenfangtou 衬枋头, plus one to five perpendicular extensions in the form of horizontally leveled huagong 华栱 or vertically slanting ang 昂 (Figure 1-1). In practice, the creative way of bracketing in Shanxi province regional architecture often defied the written regulations of the Yingzao fashi in this matter. The numerous extant examples comprised orthogonal and angular bracketing alike as well as the periods before and after the publication of the written manual.
Downward pointing cantilever or xia’ang

First and foremost, we have to challenge the feature of the downward pointing cantilever, the flagship of traditional Chinese bracketing and visual status symbol of the powerful Tang dynasty. The structural or true descending cantilever or zhenxia’ang 真下昂 was a standard feature in official style building and still the core of the organic bracketing unit until the publication of the Yingzao fashi; but it was hardly seen thereafter (Figure 1-5; Figure 2-34). In fact, Geng Liling 耿莉玲 and Li Huizhi observed that zhenxia’ang were used in central and southern Shanxi rather during the Northern Song dynasty than in the succeeding Jin period. Only in the former Liao territory of northern Shanxi, the Jurchen patrons continued the local flavor for true descending cantilevers to some extent.

It is important to note that neither its distinctive visual shape nor intrinsic structural function were completely lost. It is rather that these two tasks split apart and were independently adopted by other building components.

Probably the best-known example to mimic the outer appearance of zhenxia’ang is the decorative, false cantilever or jia’ang 假昂, a horizontally leveled bracket-arm with decoratively carved head that visually emulates the downward pointing tip. In the mid-Northern Song dynasty, a further stylistic variation called zhi’ang 直昂 became fashionable in central Shanxi province, for example at the column-top bracketing of Jinci Shengmudian’s lower eaves. More importantly, the corbelled clusters of Yuxian Daiwangmiao, including the fan-shaped bracket set at the front façade’s central bay displayed such bracket-arms, where core body and tip were both horizontally leveled and
extended straight forward. It proved that the application of angled bracket-arms was not a hindrance to the local building styles but rather absorbed its qualities and adjusted accordingly.

In other words, it was not the visual design of the head that defined a bracketing member as a structural or true descending cantilever in the literal sense. It rather depended on the angle at which the timber body was placed and the task that the tail performed. For example, the inserted cantilever arm known as cha’ang 插昂 in the *Yingzao fashi* was a short, vertically slanting timber that basically emulated the idea of zhenxia’ang. Its tail was truncated and simply plugged onto the bottom surface of the exterior shuatou in a four-puzuo bracket set, which is why it lost the ability to act as a lever at the inside of the hall (Figure 2-35).

In modern Chinese language, the character “shi 式”, which translates as “pattern, way, or method”, and the character “xing 形” for “shape or look” capture the two basic qualities of downward pointing cantilevers and help to describe their stylistic variations. Since the notion of attaching pointed cantilever tips was not restricted to bracket-arms alone, it is crucial to distinguish between “angshi 昂式” and “angxing 昂形” or putting it differently, between the members that acted ang-like and performed structural functions and those that were just visually designed in the shape of xia’ang (Figure 2-36).^{184}

**Decorative nose or shuatou**

In Shanxi regional architecture, the lines between ang and shuatou are frequently blurred, which makes it a challenge to distinguish between the timbers acting as the basic
components of the bracket set and those that provide the core extensions in-between (Figure 2-37). In short, it becomes difficult to discern the accurate rank of *puzuo*.

One of the defining differences in *puzuo* is the placement with regard to the *linggong*, the uppermost parallel bracket. Whereas *xia’ang* usually uphold the *linggong* above, *shuatou* are those timbers that are elevated to the same level and intersect with it. The *shuatou* body could take the form of horizontally leveled or vertically slanting timbers and additionally, its head could feature different designs including the profile of *xia’ang*. He Dalong noticed that if true descending cantilevers were applied at Northern Song dynasty architecture in Shanxi province, the *shuatou* was more likely to adjust in design visually or structurally.

There are numerous examples of bracket-arms or decorative noses with pointed tips in Shanxi province that visually look like *xia’ang* including fan-shaped arrangements. More important for this discussion, among the pre-Yuan dynasty key national heritage conservation units with *shanshi dougong* are several examples that applied slanting timbers for the benefit of the lever effect including true descending cantilevers or its structural variations that acted *ang*-like (Figure 2-38). As a general rule, pre-Yuan dynasty fan-shaped bracket sets usually displayed multiple decorative noses that corresponded to the number of their angled bracket-arms, but their angled *shuatou* never were vertically slanting timbers and the central perpendicular *shuatou* in-between hardly ever.

Not surprisingly, the Jin dynasty Mituodian at Chongfusi in northern Shanxi reveals the most sophisticated and complex arrangement of *ang* and *shuatou*. It is the only example that directly incorporated double *ang* as perpendicular core extensions into
the fan-shaped bracketing at those of its shanshi dougong that crowned the top of the front façade’s columns.\textsuperscript{187} Strictly speaking, the upper of these slanting timbers was just an inserted cantilever arm or cha’ang. It further enhanced the impression with shuatou visually shaped like slanting cantilevers. To name a few more examples in the north, the front and rear façades of Foguangsi Wenshudian or the bracketing all around the Main Hall of Yanqingsi used a single tier of zhensia’ang at the column-top positions plus angxing shuatou above. However, their column-top corbelled clusters did not apply genuine xiegong.

Furthermore, the column-top bracket sets at the Main Halls of Nanjixiangsi and Xiaohuiling Erxianmiao are rare examples of structural, slanting timbers for both, xia’ang and shuatou, in the southeast.\textsuperscript{188} Finally, the column-top bracketing at the front façade of Dongyi Longwangmiao lacked true descending cantilevers but still used decorative noses that structurally acted like ang.\textsuperscript{189}

**Chenfangtou**

To step it up one more notch, the chenfangtou adopted the fashion of shuatou to mimic another bracketing component. It occasionally appeared as decorative noses, especially among the pre-Yuan dynasty key national heritage units with fan-shaped bracketing in northern Shanxi province. The reason for such disguise is often simple and rooted in the desire for higher rank with least effort or waste of material, and to emphasize certain positions along the façade such as the front walls’ central bay.

For example at Hongfusi Sanshengdian, the orthogonal column-top bracket sets of the front façade display five horizontal layers, namely the ground layer with ludou, then
one zhenghuagong, two slanting timbers, and finally the cross-beam, which carved head penetrates the wall plane (Figure 2-39). At first glance, the two descending members might equally appear as true descending cantilevers with visually similar, pointed tips, but they differ in purpose and function. Strictly speaking, only the lower timber reaches into the inside of the hall and qualifies as zhenxia‘ang, whereas the upper slanting member intersects with the uppermost parallel bracket i.e. linggong and corresponds to the shuatou. The wing-shaped head of the cross-beam above matches the chenfangtou that just mimics the decorative effect of regular shuatou.\footnote{190}

In conclusion, the official classification in the Yingzao fashi as “n-puzuo units with n-tiers of perpendicular projections” is insufficient for Shanxi province regional architecture that mixed and matched the individual bracketing members. The standard expression of “five-puzuo units with double tiers of huagong or ang in jixin-style” cannot adequately describe the bracket sets at the majority of timber halls with shanshi dougong discussed in part two of this thesis (including orthogonal and angled arrangements).

The underlying reasons for the liberal use and not statutory interpretation of ang, shuatou, and chenfangtou were diverse. Xu Yitao concluded that bracketing of southeastern Shanxi and the corbelled clusters of the surrounding Northern Song territory in the Jinzhong and Taiyuan prefectures or in Hebei province showed great variety in design that came to a temporary end with the spread of the Yingzao fashi.\footnote{191} It took about fifteen years for the building manual to become effective, and only from the end of the Northern Song to the mid-Jin dynasty, the bracketing of Changzhi and Jincheng followed the official building rules. However, the resource-efficient, practice-oriented local
building traditions were never fully abandoned and revived. Starting with the mid-Jin period, they became increasingly prevalent and the gap between the different regional and local building traditions became wider again.

e) **Intercolumnar shanshi dougong**

**The way of upholding the lowest roof purlin**

The wooden buildings at pre-Yuan dynasty key national heritage conservation units with *shanshi dougong* in-between columns far outnumbered those that applied them on top of columns. The local building traditions in the southeast that gradually simplified the greater carpentry system also advanced the bracketing at the intercolumnar positions. Orthogonal and angular bracketing alike embraced the technical improvements.

In the ideal *diantang* plan of the *Yingzao fashi*, the distinctive division into three horizontal layers strictly separated the columns from the roof construction, and the inner column grid was not reverberated in the placement of the roof purlins. The latter usually rested at both ends of the successive, rough cross-beams that generated the roof slope. The crude roof construction was skillfully shielded from the eye of the viewer by a decorative interior coffered ceiling.

In the Jindongnan area, the timber halls with *shanshi dougong* did not afford such luxury (except for the Middle Hall of Nanjixiangsi, which discloses empty sockets of joists that once spanned the *pingqi*-style 平棊 coffered ceiling). Moreover, the need for simplification and succinct techniques caused the interior columns to rise and the roof purlins to adjust accordingly. Based on the concept of *tingtang* for which the *Yingzao fashi* demanded the closer relation between purlin and column, the purlins were placed at
the tall interior columns or short auxiliary/subsidiary columns that rested at the back of roof beams and did not stretch to the ground level.

Over and above, the rising importance of intercolumnar bracketing and its gradual refinement led to the shift of zhenxia’ang from the top of columns to the positioning in-between them.\(^{193}\) As a consequence, the column-top corbelled clusters started to resume juantouzao 卷头造 and abandon slanting timbers. The intercolumnar bracketing took advantage of the lever effect to uphold the lowest roof purlin with the help of true descending cantilevers or other structural, slanting timbers such as angshi shuatou. In essence, it disburdened the xiapingtuan from the immediate need of a column and made it possible to use the column-free space underneath.

Among the seventeen pre-Yuan dynasty timber halls with intercolumnar shanshi dougong are seven that used the interior projections of their fan-shaped bracket sets to support the lowest roof purlin.\(^{194}\)

**Slanting members and the triangular space at the interior projection**

The high-angled, steep slope of any structural, vertically slanting timber within the organic bracketing unit caused an awkwardly looking triangular space underneath the descending tail known as sanjiao kongjian 三角空间 at the inside of the hall.\(^{195}\) The awe-inspiring Jin dynasty Amitābha Hall at Chongfusi, the only example with genuine xiegong and true descending cantilevers in the same puzuo-unit among the Shanxi province pre-Yuan dynasty timber halls, tackled the problem in a formidable way second to none (Figure 2-40). The alternating twofold design described in the previous chapter, which resembled two self-contained bracketing units arranged in a staggered manner,
made even more sense if discussed from the angle of concealing the undesirable triangular space. The upper part of the skillful arrangement at the front façade’s column-top corbelled clusters successfully shielded the descending body of the xia’ang and filled the empty space created by its ascending slope at the exterior and interior. The Middle Hall of Nanjixiangsi reveal a similar design with xiegong filling the empty space underneath the slanting timbers at the interior projections of the gable sides’ column-top bracket sets.

Even though the descending tail of a slanting timber and the resulting triangular space underneath was a general problem in designing bracket sets, it was especially challenging for shanshi dougong and even more so for those that upheld the lowest roof purlin.

A sensible way to hide the gap certainly was the installation of pingqi with artistically treated beams or mingfu, but it was usually not an option for the succinct construction techniques in the southeast.

A complex and resource-consuming way to close the gap between shuatou and xiapingtuan was to wall up a high number of horizontally layered bracket-arms at the interior projection (Figure 2-41).

The practical skills and hands-on experience of the craftsmen in the southeast led to another fast and simple way and fixed the wide open gap with a crude timber cushion generally referred to as xuexie such as at the Main Halls of Dongyi Longwangmiao or Shizhang Yuhuangmiao (Figure 2-42). Similar to the much smaller wedge-shaped
device at the exterior known as flower head bud or *huatouzi* 华头子, it provided abutment for the slanting timbers.

**Horizontally leveled members and the conquest of the triangular space**

Another possibility was to combine *zhēnxiá’āng* with the upward pointing cantilever or *shāng’āng* 上昂 that could substitute the piled up stack of bracket-arms underneath the descending tail with a single piece of timber (Figure 2-43). By definition, *xiá’āng* and *shāng’āng* were two kinds of perpendicular extensions and still fully integrated into the core body of the bracket set. They required difficult structural joinery, which is why traditional Chinese architecture surely but slowly abandoned the slanting members or at least, replaced them partially with horizontally leveled timbers. Moreover, the latter avoided the problem of triangular space in the first place.

In this matter, Shanhuasi Sanshengdian and Puzhaosi Zhengdian are not only the most thrilling examples among the pre-Yuan dynasty *shānshí dougong* but also the perfect paradigms to illustrate the tipping point of such technical and aesthetic advancement. The two Jin dynasty structures applied ingenious bracket arrangements that anticipated *liújīn douke* 溜金斗科, a distinctive type of interior bracketing to uphold the lowest eave purlin that became a standard feature of official style architecture in late imperial China (Figure 1-57).

The key difference with the intercolumnar *shānshí dougong* previously discussed was the run of the curve. The intercolumnar corbelled clusters at the front and rear façades’ second-to-last bays of Shanhuasi Sanshengdian and the front façade’s central bay of Puzhaosi Zhengdian disclosed a broken line, since they combined horizontally
leveled timbers at the exterior projection with slanting parts at the interior. They slightly differed from each other in such that the prototype at Shanhuasi applied an additional, second layer of *tiaowo* 挑斡, which both rose upward from the level of exterior *shuatou* (Figure 2-44). It was flanked by two wings of genuine *xiegong*, but the latter did not contribute to the structural task. By contrast, the *shanshi dougong* at Puzhaosi omitted angled bracket-arms at the interior and generally speaking, simplified the concept and condensed the design (Figure 2-45; Figure 2-46).

**Short remark on “(male and female) mandarin duck” brackets and the stabilization through horizontal joists**

In essence, the majority of angled bracket-arms in the strictest sense had no direct impact on the greater carpentry system regarding supporting beams or purlins (Figure 2-47). The only exception was the cross-shaped ground plan design, where the mounting on top of the genuine *xiegong* upheld the lowest roof purlin (Figure 2-48). In the case of the eight-pointed star or asymmetrical triangle, the interior perpendicular bracket-arms usually performed the structural task if necessary.

However, the examples among the pre-Yuan dynasty key national heritage conservation units with *shanshi dougong* confirm that genuine *xiegong* were involved in the smaller carpentry system and to a certain degree indirectly responsible for load-bearing and overall building stability. They provided abutment as additional points of support for the longitudinal joists above as suggested by past Chinese scholarship and introduced at the beginning of this chapter.
Most importantly, *shanshi dougong* adopted the feature of “(male and female) mandarin duck brackets” or *yuanyang jiaoshougong*. *Yuanyang jiaoshougong* were used at the exterior or interior projection, usually for *mangong* or *linggong*. Originally, such elongated timbers bridged the narrow gap between the parallel brackets at the corner column-top corbelled clusters, but they were also especially useful in the case of a sprawling semi-circular fan-out along the façade. They successfully bundled together orthogonal and angled *xiegong* or *shuatou* and strengthened the integrity of the organic bracketing unit better than several short, detached brackets. Generally speaking, the concept of “(male and female) mandarin duck brackets” was quite important for the technological advancement of *dougong* and thanks to the structural advantages, developed into one of the three characteristics in official Ming dynasty corner bracketing.

In detail, the elongated “(male and female) mandarin duck” brackets together with longitudinal timber joists that ran along the front and rear walls or all around the building established an auxiliary system of stabilization at the exterior or interior projections. To some extent, the design depended on the roof shape. Timber halls with hip-and-gable roof or hip roof rather applied a circular ring system of stabilization all around the four walls, including Shanhuasi Puxiang or the Main Halls of Yanqingsi, Fotousi, or Nanjixiangsi. Gable-roofed architecture focused on the front and rear walls and aligned the connective timbers in the form of a linear string or line system such as Foguangsi Wenshudian, Hongfusi Sanshengdian, or Longmensi Tianwangdian. The ring system was not always closed at every level. The humble halls in the southeast for example, sometimes revealed several corbelled clusters at the front façade that were closely tied
together but not necessarily fully linked to the building corners and their flanking bracket sets.  

Basically, the connective timbers were either genuine bow-shaped *linggong* in *yuanyang jiaoshougong* design with their lower edge being cut in the shape of curved bracket bodies, or, the elongated *linggong* just visually mimicked the shape of *yuanyang jiaoshougong* through relief carving on the surface of a rectangular end-to-end joist. For example, the central *shanshi dougong* at the front façade’s central bay of Nanjixiangsi Guodian displays an elongated bow-shaped *linggong* to support the *liaoyanfang* at the exterior but an incised end-to-end joist at the interior to carry the *pingqifang* (Figure 2-49). Starting with the mid-Ming dynasty, *yuanyang jiaoshougong* were further simplified and usually reduced to joists with rectangular cross-sections, and the skillful application of color achieved the visual effect of carving.
3. Conclusions: pre-Yuan dynasty fan-shaped bracket sets and their ability of cultural assimilation

One out of four pre-Yuan dynasty key national heritage conservation units in Shanxi province used *shanshi dougong*.

The theoretical concept of fan-shaped bracketing was not inferior to the sample with perpendicular and parallel bracket-arms. At the intercolumnar position, a single *shanshi dougong* rather measured up to the resource-intensive and time-consuming application of two regular corbelled clusters per bay without genuine *xiegong*.

Similar to orthogonal bracketing, *shanshi dougong* were also subject to the general advancement in building technology. They followed for example, the fundamental shift from *touxinzao* to *jixinzao* or the evolution of *pubaifang*, which had considerable impact on the feasibility of sprawling fan-shaped corbelled clusters. Moreover, they actively contributed to the technical improvement, and among the prototypes of *liujin douke*, a crucial feature in late imperial architecture, were two Jin dynasty bracket sets with genuine *xiegong*.

The majority of the twenty-one nationally protected, pre-Yuan dynasty timber halls with *shanshi dougong* in Shanxi province embraced the positions in-between columns. As a consequence, they also experienced the slow but steady rise of intercolumnnar bracketing as the new status symbol and defining feature for the building’s greater carpentry system. In fact, the angular arrangements surpassed the standard ones at the top of columns in complexity of design and space-consumption through their dispersing fan-out.
Yet, today’s Shanxi province does not necessarily correlate to the political or cultural situation of the past. In the formative stages of fan-shaped bracketing, the territory was split into a northern Khitan-ruled area and a southern indigenous Han Chinese influence zone, but modern scholarship rather emphasized the different geographic regions as the cultural driving force. In fact, the north, central part, and southeast of Shanxi preserved timber halls with fan-shaped bracketing that reflected distinct regional styles and local customs. For example, the awe-inspiring great monasteries in the north incorporated orthogonal and angular bracketing that both tell the story of wealth and desire to impress through sheer size and monumental design. In contrast, the humble timber halls with *shanshi dougong* in the southeast adopted and adapted the prevailing succinct techniques that aimed to save on labor and material.

By way of example, the author paid special attention to the Jindongnan area and its stable wood-frame architecture to prove the case and confirm the flexibility of the fan-shaped concept. The local builders in the Changzhi or Jincheng prefectures skillfully merged the ideal *diantang* and *tingtang* plans of official architecture into a practical, creative, and liberal building style that took advantage of the best parts of both. Their carpentry system adapted to the local needs and available resources and even if it did not fully abide by the imperial regulations, it often exceeded the official construction style in practicability and feasibility. As hoped for, the timber halls with *shanshi dougong* incorporated typical features such as the rise of interior columns or simplification of the *tailiang*-style roof construction similar to the buildings with strict orthogonal bracketing.

One of the major challenges for discussion was the lack of appropriate technical terminology, since the language of the *Yingzao fashi* could not fully capture the non-
official way of bracketing in Shanxi province regional architecture between the tenth and thirteenth centuries. In addition to the absence of a stylistic typology for *shanshi dougong*, orthogonal and angular bracketing both showed divergence from the official rules of construction. For example, the three basic components of the standard bracket set and the core of perpendicular extensions often mixed and matched. *Shuatou* and *chenfangtou* were omitted or mimicked other bracketing members, which is why it was crucial to differentiate between the way or “shi 式” in which the timbers structurally acted and their visual shape expressed by the modern Chinese character of “xing 形”.

Furthermore, the classic feature of the true descending cantilever or any of its stylistic variations that likewise descended at a vertically sloping angle produced an awkwardly looking triangular space underneath the descending tail at the inside of the hall. In this matter, fan-shaped bracket sets faced a special challenge, in particular at the intercolumnar positions when upholding the lowest eave purlin. *Shanshi dougong* had to incorporate vertically sloping and also horizontally slanting timbers at the same time. And again, the diverse practical solutions in different regions of Shanxi province confirmed the flexibility of the fan-shaped concept and its ability of cultural assimilation.

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1 Zhongjia wenwuju 中家文物局, *Zhongguo wenwu dituji: Shanxi fence* 中国文物地图集·山西分册 1: 1.
2 Up to the present, the State Administration of Cultural Heritage announced six batches of key national units protected as cultural relics with the first batch issued on March 4th 1961, the second on February 23rd 1982, the third on January 13th 1988, the fourth on November 20th 1996, the fifth in 2001, and the sixth on May 25th 2006 (Guojia wenwuju 国家文物局, *Diyi zhi di liu pi quanguo zhongdian wenwu baohu danwei tongji ziliao tongce* 第一至第六批全国重点文物保护单位·统计资料简册).
5 The territory of the Three Jin stretched beyond the boundaries of today’s Shanxi province and included parts of the neighboring provinces of Inner Mongolia, Hebei, Henan, and Shaanxi.
Due to the complex development of China’s hierarchical system of administrative divisions, the meaning of the Chinese term *zhou* that translates as “province” or “prefecture” changed over time, and was used to describe a first-level, second-level, or third-level administrative unit at different times throughout history. The Qin dynasty codified the multi-level administrative system that was basically followed through until the Tang dynasty. It abandoned the idea of fiefs controlled by single families and propagated the commandery-county division. It divided the whole territory into thirty-six commanderies or *jun*郡 that were subject to the central authority among which Shanxi comprised five, including Taiyuanjun 太原郡 in central Shanxi, Shangdangjun 上黨郡 in southeastern Shanxi, or Yamenjun 雁門郡 in the north. (For the Qin commandery-county system, see, for example, Twitchett and Fairbank, *Cambridge History of China* 1: 54-55). During the Han dynasty, the number of commanderies increased from thirteen to more than eighty, and at the end of the second century B.C.E., thirteen regional inspectors were appointed. They did not yet govern the territories they supervised in the strictest sense, but their establishment introduced a third level to the system of administrative divisions in China (Ibid., 157). The regional inspector responsible for present-day Shanxi province was known as Bingzhou ilita ilita 紫州刺史. For the local government in the Western Han dynasty, the constituent units of the provinces, and the major units of provincial government see also Twitchett and Fairbank, *Cambridge History of China* 1: 470-478.

Since the *dao* lacked permanent administration, “they were not new administrative divisions but convenient circuits of inspection for imperial commissioners sent out at irregular intervals to inspect the operation of local government in the prefectures within the circuit” (Ibid., 203-205).

Despite their distance from the original Tang border, the Jurchen, “a dependent people on the border of the Liao’s (Khitan) Chinese style empire”, and the Mongols, “a frontier dependent people of Jin (Jurchen) for years” (Ibid., 10). They had contact with the “Chinese” empire of the time prior to their military campaigns (Ibid., 10).

Threatened by the invading Jurchen tribes, the Northern Song court in Kaifeng finally fled to Hangzhou in South China, and the borderline with the newly established Southern Song Empire shifted southward out of Shanxi province.

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For an exact match of the three historical routes recorded in the *History of the Jin dynasty* or *Jinshi* 金史, juan 24 and 26, with the prefecture- and county-level districts of today’s Shanxi province see Wang Wanzhi 王万志, *Jindai Shanxi quy়u wenhua 金代山西区域文化* 4-10. The Jin dynasty basically followed the Chinese model for local government in the former Northern Song territories but re-established the importance of the military (Twitchett and Franke, *Cambridge History of China* 6: 270).

In very broad terms, the relevant part of *hedongguo* 河东路, located in modern Shanxi province, comprised the following prefectures during the Northern Song dynasty with their (roughly) matching present-day location given in parenthesis: Bingzhou ilita ilita 紫州 (Taiyuan 太原, Taiyuan prefecture), Fenzhou 汾州 (Fenyang 汾阳, Lüliang prefecture), Jinzhou 晋州 (Linfen 临汾, Linfen prefecture), Jiangzhou 江州 (Xinjiang county 新绛县, Yuncheng prefecture), Cizhou 晋州 (Ji county 吉县, Lüliang prefecture), Xianzhou 谦州 (Jingle county 芒县, Yuncheng prefecture), Daizhou 代州 (Dat county 代县, Xinzhou prefecture), Xinzhou 新州 (Xinjiang county 新绛县, Yuncheng prefecture), Shaohua 沙湖州 (Zhongxi county 中吉县, Yuncheng prefecture), Luzhou 潞州 (Changzhi 长治, Changzhi prefecture), Xizhou 西州 (Lüliang 离县, Lüliang prefecture), Shihouzhou 椿州 (Lizi 县, Lüliang prefecture), Lanzhou 乱州 (northern Lan county 兰县, Lüliang prefecture), and additionally Pingdingjun 平定军 (Pingding county 平定县, Yangguan prefecture), Huoshanjun 火山军 (southwest Pianjuan county 偏关县, Xinzhou prefecture), Rongjiangjun 容江军 that was later renamed Baodejun 保德军 (Baode county 保德县, Xinzhou prefecture), Ninghuajun 宁化军 (southwest Ningwu county 宁武县, Xinzhou prefecture), Kelanjun 靶箭军 (Kelan county 起灵县, Xinzhou prefecture), Weishengjun 威胜军 (Qin county 泉县, Changzhi prefecture). In the Jin dynasty, the route southeast of the Yellow River or *hedongguo* compiled of Pingyangfu 平阳府 (in modern Linfen prefecture), Xizhou 潞州 (Ji county 吉县, Herzongfu 侯中府 (in modern Yuncheng prefecture), Jiangzhou 江州, Xiezhou 解州 (modern Yuncheng prefecture), Zizhou 汲州, Lanzhou 潞州, Pingchunfu 潞州, Xianzhou 谦州.


Zhang Yuhuan, “Shanxi Yuandai jianzhu baokü 古代山西区域文化* 4-10. The Jin dynasty basically followed the Chinese model for local government in the former Northern Song territories but re-established the importance of the military (Twitchett and Franke, *Cambridge History of China* 6: 270).

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Past scholarship focused on northern Shanxi. Although monasteries like Shanhuasi, Chongfusi, or the Timber Pagoda of Yingxian provide valuable examples to study the application of *shanshi dougong*, they are not the only medieval timber structures that arranged bracket-arms in the shape of an open fan.

Guojia wenwuju, *Diyi zhi shi lu pi qu guojia wenwu baohu danwei tongji ziliao tongce*.
22 This thesis’ research considered only those key national heritage conservation units that contained extant wooden buildings and not the estimated number or dark figure of destroyed architecture. Other building tasks such as stone and brick pagodas or tombs were eliminated. The author then searched for the structures with a greater carpentry system that dated to the Liao, Northern Song, and Jin dynasties or at least still possessed defining features of pre-Yuan dynasty building. Relics associated within the Ming, Qing periods, or post-imperial times were taken away. As a rule of thumb, if the periods of construction given by the two basic reference works were contemporaneous, the site was specifically focused for further research to verify the dynastic affiliation and (re-)construction activity. As a result, more than eighty key national heritage conservation units were eligible for the final challenge and inspection of their bracketing.

23 The design of Shanhuasi Puxiang followed the principle of diantang for multi-storied architecture as known as diantang louge 殿楼阁. The two regular floors and the pingzao sub-structure in-between were piled on top of each other to form three structurally detached, individual stories. Since only the second floor of Shanhuasi Puxiang applied angled bracket-arms in the strictest sense, it was understood as a single-storied timber hall.

24 The interest was triggered by the fieldwork of Takeshima Takuichi (1902-1930s) and Liang Sicheng, who searched for secondary literature see additionally, Steinhardt, Liao Architecture 141-142. The matching East Pavilion dedicated to the Bodhisattva Mañjuśrī was still classified with the principal hall at the central axis, but the third grade for the Main Gate or Tianwangdian 天王殿 and the fourth grade for the Puxiang that was placed at the secondary axis. See also the 1876 edition of the Datong fashi 大同府志, but also notes about the Shanhuasi Puxiang.

25 This distinction between different buildings and building types according to their placement and importance within the monastery complex is a typical feature of the Northern Song, Liao, and Jin dynasties (Guo Daiheng, Zhongguo gudai jiayingshi 3: 331-334; Luo Zhewen, “Yanbei gujianzhu de kanc ha”; Steinhardt, Liao Architecture 141-142). The Shahu Monastery applies the second of the eight grades for cai cai officially list the Yuan, Ming, Qing periods or post-imperial times were taken away. As a rule of thumb, if the periods of construction given by the two basic reference works were contemporaneous, the site was specifically focused for further research to verify the dynastic affiliation and (re-)construction activity. As a result, more than eighty key national heritage conservation units were eligible for the final challenge and inspection of their bracketing.

26 The name Shanhuasi derives from the Ming dynasty and before the mid-fifteenth century, it was known as Kaiyuansi 凯语院. Hereafter, the classification of bracketing, especially the rank of eave bracket sets. Hereafter, the total number of bracket sets refers to the bracketing visible at the outside of the building and includes corner column-top, eave column-top, and intercolumnar bracket set.

27 Dating according to the stone stele entitled “Xijing Dapu'ensi zhongxiu dadian bei xianshi yiyi” from the sixteenth year in the Dading reign period of the Jin dynasty 金大定十六年 (1176 C.E.) by the Southern Song scholar Zhu Bian 朱弁 (Cong Yanlì 从彦丽). “Tangfeng guyuan Pu'ensi: 唐风古韵善化寺” 31; Liang Sicheng, “Datongshi gujianzhu diaocha baogao” 77; Steinhardt, Liao Architecture 141-142.

28 It is a characteristic of early period architecture that bracketing in-between columns was smaller in size and symbolically less important than column-top bracketing. See also the Liao dynasty Bhagavat Sutra Repository 从大同上华严寺大雄宝殿的抢修看古建筑保护的现实意义 薛刚 文殊大雄宝殿脊槫增长构造与营造法式制度之比较 31; Liang Sicheng, “Datongshi gujianzhu diaocha baogao” 77; Steinhardt, Liao Architecture 141-142.

29 The Main Gate or Tianwangdian (Jin dynasty) applied a stylistic variation of angled bracket-arms in the strictest sense that is known as xiayong and discussed in part three of this thesis.

30 Hereafter, the total number of bracket sets refers to the bracketing visible at the outside of the building and includes corner column-top, eave column-top, and intercolumnar bracket set.

31 Hereafter, the classification of bracketing, especially the rank of puca, number of projecting steps, and “filled-heart” or “stolen-heart” design, describes the exterior projection or waitiao of eave bracket sets.

32 Steinhardt, Liao Architecture 147. The matching East Pavilion dedicated to the Bodhisattva Mahāsattva Wenshu 文殊 was still under construction in the summer of 2008, when I visited the site.

33 Fu Xinian emphasized the strong Song dynasty impact on the greater carpentry system of this Jin dynasty building in contrast to concurrent structures that rather preserved the prevailing local style of the former Khitan patrons in northern Shanxi 从大同华严寺大雄宝殿的抢修看古建筑保护的现实意义; Liang Sicheng, “Datongshi gujianzhu diaocha baogao” 77-78; Luo Zhewen, “Yanbei gujianzhu de kanc ha”; Shanhuasi Daxiongbaodian 王辅宏 and Wu Fuhong 王辅宏. The name Shanhuasi derives from the Ming dynasty and before the mid-fifteenth century, it was known as Kaiyuansi 从大同华严寺大雄宝殿的抢修看古建筑保护的现实意义 薛刚 文殊大雄宝殿脊槫增长构造与营造法式制度之比较 31; Liang Sicheng, “Datongshi gujianzhu diaocha baogao” 77; Steinhardt, Liao Architecture 141-142.

34 For information about the well-published Huayan Monastery and the Daxiongbaodian see for example, Chai Zejun, “Datong Huayansi Daxiongbaodian jiegou xinzhi yanjiu” 大同华严寺大雄宝殿结构新制研究; Guo Daiheng, Zhongguo gudai jiayingshi 3: 311-331; Jiao Chunlan 焦如兰, “Cong Datong Shanghuayansi Daxiongbaodian de qianguang kan gujianzhu de kanc ha” 大同华严寺大雄宝殿的抢修看古建筑保护的现实意义; Liang Sicheng, “Datongshi gujianzhu diaocha baogao” 77-78; Luo Zhewen, “Yanbei gujianzhu de kanc ha”; Shanhuasi Daxiongbaodian 王辅宏 and Wu Fuhong 王辅宏. The name Shanhuasi derives from the Ming dynasty and before the mid-fifteenth century, it was known as Kaiyuansi 从大同华严寺大雄宝殿的抢修看古建筑保护的现实意义 薛刚 文殊大雄宝殿脊槫增长构造与营造法式制度之比较 31; Liang Sicheng, “Datongshi gujianzhu diaocha baogao” 77; Steinhardt, Liao Architecture 141-142. The matching East Pavilion dedicated to the Bodhisattva Mahāsattva Wenshu 从大同华严寺大雄宝殿的抢修看古建筑保护的现实意义 薛刚 文殊大雄宝殿脊槫增长构造与营造法式制度之比较 31; Liang Sicheng, “Datongshi gujianzhu diaocha baogao” 77; Steinhardt, Liao Architecture 141-142.
Shanxi tongzhi, juan 169, by Wang Xuan et al., or the 1776 edition of the Datongfu zhi, juan 15, by Wang Feizao and Wu Fuhong.

33 For a recent discussion of the art and architecture of the bizang louge see, Zhang Li 张丽, “Datong Huayansi Bojiaozhongdian de bizang jianzhu yishu 大同华严寺佛教藏殿的佛像建筑艺术.” Dating of the Bhagavat Sutra Repository of the Lower Huayan Monastery according to the inscriptions at the underside of four-rafter cross-beams inside of the hall.

34 See also the imperial patronage of Huayansi by his successor, Liao Emperor Daozong 辽道宗 (1055-1101 C.E.). Liang Sicheng, “Datongshu guanžhu jianzhu diaocha baogao” 7-10. Tang dynasty date according to the stone stele from the first year in the Chenhuang reign period of the Ming dynasty 明洪武元年 (1465 C.E.) entitled “Zhongguan Dahuayuanzhan ganying beiji 重建大华严寺感应碑记.”

35 Dating according to the stone stele from 1162 C.E., the second year in the Dading reign period of the Jin dynasty 金大定二年, entitled “Dajingguo Xijing Dahuayansi zhongji bojiajiao ji bili chutan 大定京西大华严寺重修伽教及比例初探.” For the controversy of this stele and the dating see Steinhardt, Liao Architecture 137.

36 Liang Sicheng, “Datongshu guanžhu jianzhu diaocha baogao” 75, 76.

37 Moreover, the exterior projections of both halls follow the “filled-heart” design, since every step of xiegong upholds both a parallel bracket-arm (usually guixingqiong or lingqiong) and the next level of angled extension. By contrast, their interior projections blend jinxiao with touxinzao.

38 Precisely, the first side bays at Shanhuasi Daxiong baodian and the second side bays of Huayansi Daxiong baodian. The slightly different placement is probably caused by the larger size of the timber hall at Huayansi, which front and rear façades incised by the following compared to Shanhuasi Daxiongbaodian.

39 Among the rich pool of literature about Chongfusi, see especially, Chai Zejun, Shuzhou Chongfusi, and Shuzhou Chongfusi Mituodian xishan gongcheng baogao 朔州崇福寺弥陀殿工程质量报告; Guo Daheng, Zhangguo gudai jianzhu 3: 399-406; Lin Zhe 林哲, “Yi guankuo baoyou you yide — Shanxi Shuozhou Chongfusi Mituodian madauzao yangzaochao ji bili chutan 以管窥豹犹有一得 — 山西朔州崇福寺弥陀殿木作营造及比例初探”; Steinhardt, Liao Architecture 229-231; Zhao Da 赵达, “Shuozhou Chongfusi 朔州崇福寺.” Similar to the other great monasteries in northern Shanxi including Shanhuasi, Huayansi, or Fougansui, the monastery in Shouzhou is also discussed in the basic surveys of Li Huzhi (“Shanxi xiancun zuoqi muzheng jianzhu yuyu tezheng qian tan (shang, zhong, xia)”), Liu Enhui 刘恩惠 (“Shanxi de Liao Jin jianzhu 山西的辽金建筑”), Liao Zhenwen (“Yanbei gujuzhu de kancha”), Qi Yingtao (“Lingxianwai shuoxi xuancheng gua guanjuzhu”), and Yang Zirong (“Lun Shanxi Yuandai yiqian mugou jianzhu de baobu 卢山西安元代原料木构建筑的保存”).

40 For the best overview of historic events and construction activity at Chongfusi, see Chai Zejun, Shuzhou Chongfusi 402-406. Dating of Chongfusi Mituodian according to the inscriptions of craftsmen inside the hall, especially the ridge purlin that revealed the year 1143 C.E. which was verified by historical writings such as the eighteenth-century edition of the Shouzhou shi 朔州志, juan 12, or the 1892 edition of the Shanxi tongzhi 落西通志, juan 170, by Wang Xuan.

41 Lin Zhe, “Yi guankuo baoyou you yide — Shanxi Shuozhou Chongfusi Mituodian madauzao yangzaochao ji bili chutan 以管窥豹犹有一得 — 山西朔州崇福寺弥陀殿木作营造及比例初探”.

42 Chongfusi Mituodian and the contemporary Fougansui Wenshudian, which is introduced below, used a (partly) lengthwise framework of interior architraves or nei’e 内栱与 extended useful span and “queen-post truss” design. The latter is a term of modern civil engineering and describes a rigid framework “having two vertical posts between the rafters and the tie beam; the upper ends of the vertical posts are connected by a straining piece such as a tie rod or cable” (Harris, Illustrated Dictionary of Architectural History 442).

43 Note that the interior projections of the intercolumnar bracketing are not linked to the lowest eave purlins, which is discussed in the following chapter of the thesis.

44 Xingqiong 翼形栱 are short, artistically carved boards that neither carry small bearing blocks nor uphold the next level of extensions.

45 Precisely, only the column-top fan-shaped bracket set of Mituodian apply lingqiong, and these short timbers reminds of the second type of angular bracketing at Shanhuasi, i.e. the intercolumnar corbelled clusters in the first side bays along the front and rear façades.

46 If looking from afar, such eave bracketing appears as two horizontal bands that run along the façade. Compare with the Tang dynasty mural at the lintel of the Great Goose Pagoda in Xian that also depicts two horizontal bands of bracketing.

47 For information on Hongfusi see Li Youcheng 李有成, “Shanxi Dingxiang Hongfusi 山西定襄洪福寺”; Miller, Constructing Religion 142-146.


49 The height of the bracket set is equal to one third the column height, which matches the ratio of the nearby Tang dynasty East Hall of Fougansui (Li Youcheng 李有成, “Shanxi Dingxiang Hongfusi” 24).

50 Li Youcheng and Tracy Miller described the bracketing of the front façade at Sanshengdian of Hongfusi as six-puzuo with simple huacheng and double xia’ang, but this thesis argues for corbelled clusters of five-puzuo with one tier of huacheng and one tier of xia’ang. The problem with unofficial bracketing and the proper way of defining the rank of puzuo is further discussed in the following chapter of the thesis.

51 Li Youcheng, “Dingxiangxian Guanwangmiao gouzao qian tan 定襄县关王庙构造浅探” 4. To be precise, the site was established in the Tang dynasty, when it was called Minzhongci 昭惠州志, juan 4; Xu Babao 萧宝超, “Dingxiangxian Guanwangmiao gouzao qian tan” 4; Xu Babao 萧宝超, “Dingxiangxian Guanwangmiao zhi mi 定襄关王庙之谜” 52). The affiliation of the monastery changed over time, and accordingly, the objects of worship in the already destroyed Main Hall...
included historical figures of popular Chinese religion or Buddhist deities. For general information on Dingxiang Guanwangmiao see additionally, Qi Yingtao, “Liangnian lai Shanxisheng xinxiandian de gujianzhuzhu” 46-48; Zhang Qiang 张强, Guandimiao jianzhu de ba ju ji kongxian xintai fenxi - yi Shanxisheng jingnei xiancun de Guandimiao weili, 关帝庙建筑的布局及空间形态分析 - 以山西省境内现存的关帝庙为例 71-73.

67 Loc.cit.
68 For the popular cult see, for example, Liu Haiyan, Cong minjuan dao jingdian: Guanyu xingshiyang guanyu chongbai de shengchelong yunbian shilun 从民间到经典: 关羽形象与关羽崇拜的生成演变史论.
69 The dating of the hall was problematic since neither the extant temple steles nor the Dingxiang xian zhibi 定襄县志 of 1616 or 1712 revealed the exact year of construction. In 1954, Qi Yingtao identified the greater carpentry system as a Yuan dynasty relic from 1346 C.E. (“Liangnian lai Shanxisheng xinxiandian de gujianzhuzhu” 46, 47, 48). Four decades later, Li Youcheng suggested “an early date” of erection but did not narrow down the time period (Li Youcheng, Dingxiangxian Guanwangmiao gouzao qiantan 69, 8). In 1995, Xu Babao finally established the late Northern Song construction date of 1123 C.E. (“Dingxiang Guanwangmiao zhi mi” 51), which was officially confirmed by the State Administration of Cultural Heritage 2002. He succeeded in proving that building activity in the succeeding centuries was mere repair than reconstruction or at least in did not interfere with the greater carpentry system (Ibid., 53). Nevertheless, in 2006 Zhang Qiang still attributed the hall to the eighth year in the Taihe reign period of the Jin dynasty 金泰和八年 (1208 C.E.). His misjudgment was based on the misleading text of the contemporaneous stone stele entitled “Xinchuang Guanwangmiao ji 新创关王庙记” that recorded the making of a statue for Lord Guan. (Zhang Qiang, Guandimiao jianzhu de ba ju ji kongxian xintai fenxi 71). Hereafter, the two front column-top shanzhi dougong of Dingxiang Guanwangmiao are considered from the perspective of intercolumnar bracket sets.
70 By definition, such bracketing fully qualifies as shanzhi dougong.
71 Li Youcheng blamed such irregularity with the unorthodox methods of local building traditions (“Dingxiangxian Guanwangmiao gouzao qiantan” 69, 8). The problem of such non-official style bracketing in the regional architecture of Shanxi province is further addressed in the next chapter of this thesis.
72 Unfortunately, the architectural drawing of the floor plan published by Li Youcheng missed depicting the difference between the central fan-shaped bracket sets at the front and rear façades (Ibid., 5).
73 The technical terminology of the Yinggao fashi is not sufficient to describe this irregular way of bracketing. There are no shuzhou, one of the three basic components for official style bracketing, and no appending parallel bracket of linggeng. Chinese scholarship refers to it as four-puzuo or five-puzuo units. Li Youcheng already argued for a strong influence of local construction methods that could explain the divergence from the official rules in the building manual (Li Youcheng, “Dingxiangxian Guanwangmiao gouzao qiantan” 69, 8). The problem of such non-official style bracketing in the regional architecture of Shanxi province is further addressed in the next chapter of this thesis.
74 For the popular cult see, for example, Liu Haiyan, Cong minjuan dao jingdian: Guanyu xingshiyang guanyu chongbai de shengchelong yunbian shilun 从民间到经典: 关羽形象与关羽崇拜的生成演变史论.
75 For general information on Yangquan Linli Guanwangmiao see also Liu Huizhi, “Shanxi xiancun Yuandao yiqian mujiegou jianzhu quyu tezheng qiantan (zhong)” 14-15; Geng Liling 234, 237. Additionally, the author owes gratitude to the Research Institute for Traditional Architecture and Conservation in Taiyuan for providing preliminary information and architectural plans that made it possible to discuss the bracketing of Yangquingsi.
76 Zhao Peicheng 赵培成, “Wutaishan lidai simiao jianzhu de fengge he tedi an 五台山历代寺庙建筑的风格和特点” 36; Qi Yingtao, “Liangnian lai Shanxisheng xinxiandian de gujianzhuzhu” 43. For general information on Yangquingsi see also Li Huizhi, “Shanxi xiancun Yuandao yiqian mujiegou jianzhu quyu tezheng shanshi dougong - tongyong shanshi dougong” 234, 237. Additionally, the author owes gratitude to the Research Institute for Traditional Architecture and Conservation in Taiyuan for providing preliminary information and architectural plans that made it possible to discuss the bracketing of Yangquingsi.
77 It is surrounded by nature including Mount Yuquan 玉泉山 in the south and the Lini River in the northeast (Shi Guoliang 史国亮, “Yangquanguan Guanwangmiao 沿泉关王庙大殿” 40). For general information on Yangquanguan Linli Guanwangmiao see also Huang Shuangpeng 黄双鹏, “Guanyu Lini Guanwangmiao wenwu chuantan 关于林里关王庙文物保护情况” 14; Zhao Zenggui 赵增贵, “Linli Guanwangmiao 林里关王庙”. For a discussion of its greater carpentry system, see additionally Li Huizhi, “Shanxi xiancun zaoqi mujiegou jianzhu quyu tezheng shanshi dougong - tongyong shanshi dougong” 14-15; Geng Liling 234, 237. Additionally, the author owes gratitude to the Research Institute for Traditional Architecture and Conservation in Taiyuan for providing useful information that made it possible to discuss the bracketing of Linli Guanwangmiao.
78 Shi Guoliang, “Yangquanguan Guanwangmiao” 40.
79 Loc.cit.
80 Shanxisheng wenwu 山西省文物局, Shanxi zhongdian wenwu baohu danwei 叁条重点文物保护单位 392; Zhongjia wenwuju, Zhongguo wenwu dituji: Shanxi fenge 671-68; Zhongjia wenwuju, Zhongguo wenwu dituji: Shanxi fenge 1: 468.
Guo Junming, Loc.cit. Additionally, the author owes gratitude to the Research Institute for Traditional Architecture and Conservation in Taiyuan for providing preliminary information and architectural plans that made it possible to discuss the bracketing of Dongyi Longwangmiao.

Shen Danli, “Luchengshi Dongyicun Longwangmiao ji yingshen saiweishi kai” 56.

In brief, the dragon is probably the most complex and versatile symbol of Chinese cultural history and still stands for supreme authority representing the former Chinese emperor and the Chinese people as its descendants. In the past, the people of southeastern Shanxi blended the well-known idea of the Four Dragon Kings as divine rulers of the Four Seas and cardinal directions with the perception of the dragon as a supernatural being and mystical animal in control of the local environment. Especially after the Northern Song dynasty Emperor Huizong (r. 1100-1126 C.E.) conferred the title of royalty on these places, the status and social esteem in the local communities increased rapidly. For further analysis and the Indian influence on the Tang dynasty perception of the Four Dragon Kings in the culture of North China, see Yuan Li 宛利, “Shen Danli, “Luchengshi Dongyicun Longwangmiao ji yingshen saiweishi kai” 56.

In very broad terms, the Quanzhen Daoist belief incorporated basic elements of Buddhism and Confucianism, a notion that is reflected in the architecture of Wuxiang Huixianguan. Ye Jianhua, “Wuxiang Huixianguan jianzhu yanjiu” 10-14.

Chen Yu (昔羽), Changzhi, Jincheng diqu de Wudai, Song, Jin simiao jianzhu 89, 90), who suggested a mid-Jin dynasty reconstruction for the undated timber hall based on the 1470 C.E. stone stele entitled “Chichi Longmenshan huiyin zhongxin beijing zhuguo Wulongmiao Jin siyin shenghui zhiyao” 56. See the insightful discussion of Xu Yitao (Zhongshan, Zhongshan 2002: 305). For general information on the Jin dynasty temple stone stele from the seventh year of Jiajing reign, see also Ji Chengming, “Longwangmiao laikao” 65.

In the Jindongnan area further adapted the official, three-thousand-year old rites and rituals of water worship to the specific requirements and needs of the local communities (Ji Chengming, “Longwangmiao laikao 56; Yuan Li 宛利, “Shai longwang qiyu yishi yankao (晒龙王祈雨仪式研究)” 56). The local places of worship were known as Longshenniaomen 龙神庙, Longwangmiao 龙王庙, Wulongmiao 五龙庙, or if dedicated to a single deity as Guangrenwangmiao 敬仁王庙 in case of the red dragon, Huaweizhongwangmiao 善泽王庙 in case of the yellow dragon, Tianwangmiao 天王庙 for the white dragon, and finally Lingzwangmiao 灵泽王庙 for the black dragon (Ji Chengming, “Longwangmiao laikao” 65).

Ye Jianhua, “Wuxiang Huixianguan jianzhu yanjiu” 85. Dating of the Wuxiang Huixianguan’s Mahmudian according to the text of the Ming dynasty temple stone stele from the seventh year of Jiajing reign 明嘉靖七年 entitlement “Zhongxu Huixianguan ji 重修会仙记” (Ye Jianhua, Shanxi Wuxiang Huixianguan jianzhu yanjiu 76).
Ma Jikuan, “Lingchuan Beijixiangsi qiandian weixi sheji zongshu”. For general information on Nanjixiangsi, see Beijing daxue kaogu wenbo xueyuan, Loc. cit. Ibd., 36. Ibid., 43. Ibid., 58, 64. Xi Yitao, “Shanxi zhongdian wenwu baohu danwei, Song, Jìn simiao jinzhua 58, 64.

For general information on Nanjixiangsi, see Beijing daxue kaogu wenbo xueyuan, Shangdong xia yu - lishi jianzhu cehui wu xiao lianzhan 80-82; Ceng Chenyu, Ninggu de yishu hanpu: Jindongnan diqu zaodai gujianzhu kaotou de lianzhan 266-273; Shanxisheng Lingchuanxian wenwu guanliju, Lingchuan wenwu lansheng 2; Shanxisheng wenwuju, Shanzhi zongdian wenwu baoshu dadian 622; Zhongjia wenwuju, Zhongguo wenwu dituji: Shanxi fenge 2: 511. Additionally, the author owes gratitude to the Research Institute for Traditional Architecture and Conservation in Taiyuan for providing useful information to discuss the bracketing of Nanjixiangsi.

Ma Jikuan, “Lingchuan Beijixiangsi qian bian weixi shui shenghua gujianzhu” 50. Xu Yitao, Changzhi, jinzheng dianwu de Wudai, Song, Jìn simiao jinzhua 58, 64.

For general information on Xiaohuiling Erxianmiao, see Ceng Chenyu, Ninggu de yishu hanpu: Jindongnan diqu zaodai gujianzhu kaotou de lianzhan 266; Zhang Weiwei, “Jindongnan diqu erxian zongshu” 51. Additionally, the author owes gratitude to the Research Institute for Traditional Architecture and Conservation in Taiyuan for providing preliminary information and architectural plans that made it possible to discuss the bracketing of Xiaohuiling Erxianmiao.

For the Two Transcendents’ cult in southeastern Shanxi, see Zhang Weiwei 张伟伟, “Jindongnan diqu erxian wenhun de lishi yuanyuan ji miao yao fenbu” 50. Ibd., 49-50. For historical and political reasons of its popularity, see Hansen, Changming Gods in Medieval China, 1127-1276.

Zhongjia wenwuju, Zhongguo wenwu dituji: Shanxi fenge 2: 511.

For general information on Shizhang Yuhuangmiao, see Ceng Chenyu, Ninggu de yishu hanpu 274-278; Feng Junjie, Shanzhi shenmiao juchang kao 277-280; Shanxisheng Lingchuanxian wenwu guanliju, Lingchuan wenwu lansheng 9; Shanxisheng wenwuju, Shanzhi zongdian wenwu baoshu dadian 126; Zhongjia wenwuju, Zhongguo wenwu dituji: Shanxi fenge 2: 513-514.

For the historical development and cultural value of the Jade Emperor cult in Chinese folk culture, see for example Chen Jianxian 陈建宪, “Lun Yuhuang wenhun de qianyuan, jiegou yu gongneng 论玉皇文化的起源、结构与功能”.

Feng Junjie, Shanzhi shenmiao juchang kao. Ibd., 277. Shanxisheng wenwuju, Shanzhi zongdian wenwu baoshu dadian 126; Zhongjia wenwuju, Zhongguo wenwu dituji: Shanxi fenge 2: 513-514. The undated Main Hall of Shizhang Yuhuangmiao reveals design principles of pre-Yuan dynasty architecture in southeastern Shanxi including the deep projecting roof eaves or square stone columns with rounded edge at the front corridor (Ibd., 278). However, the wooden carving and decorative painting of the structural components imply building activity in late imperial China, such as the theatrical figures and varnished flowers at the cushion blocks in-between the architraves or the dragon-headed shutou of the front façade’s bracketing. Additionally, the bracket sets lack column-top joints, which is a typical feature in Shanxi regional folk architecture since the Ming dynasty (Zuo Guobao, Shanxi Mingdai gujianzhu 96). In fact, the Qing dynasty stone stele from the thirteenth year of the Tongzhi reign period 同治十三年（1874 C.E.）entitled “Zhongxu Yuhuangmiao bei ji 重修玉皇庙碑记” recorded rebuilding and repair in 1853, 1854, and again twenty years later in 1874 C.E. (Zhongjia wenwuju, Zhongguo wenwu dituji: Shanxi fenge 2: 514).

During the field survey in summer 2008 it was impossible to enter the Main Hall and identify the total number of bracket sets at the Main Hall of Shizhang Yuhuangmiao. At this point, this thesis research refers to the corbelled clusters in the front part i.e. in the southern half of the building that were visible from outside and add up to thirteen douqiang: There were six column-top bracket sets, in detail two on top of the front wall’s eave columns, two on top of the side walls’ eave columns, two corner columns; Additionally, there were seven intercolumnnar bracket sets, in detail three in-between the columns along the front façade, four in-between the columns at the side façades.

Shanxisheng Lingchuanxian wenwu guanliju, Lingchuan wenwu lansheng 10; Shanxisheng wenwuju, Shanzhi zongdian wenwu baoshu dadian 127; Zhongjia wenwuju, Zhongguo wenwu dituji: Shanxi fenge 2: 511-512. See also Li Huizhi, “Shanzhi xiancun zaodai gujianzhu quanguo tianzhe qianyuan (xian) 25, and the research by Liu Yan and Meng Chao (“Jindongnan xieshan jianzhu de lianzhan xiaohuiling zongshu yu tongji fenxi - Jindongnan diqu Tang zhi Jin xieshan jianzhu yanju zhi shi yu” “Jindongnan xieshan jianzhu de lianzhan xiaohuiling zongshu yu tongji fenxi - Jindongnan diqu Tang zhi Jin xieshan jianzhu yanju zhi shi yu”)

Feng Junjie, Shanzhi shenmiao juchang kao. Ibd., 277. Shanxisheng wenwuju, Shanzhi zongdian wenwu baoshu dadian 126; Zhongjia wenwuju, Zhongguo wenwu dituji: Shanxi fenge 2: 513-514. The undated Main Hall of Shizhang Yuhuangmiao reveals design principles of pre-Yuan dynasty architecture in southeastern Shanxi including the deep projecting roof eaves or square stone columns with rounded edge at the front corridor (Ibd., 278). However, the wooden carving and decorative painting of the structural components imply building activity in late imperial China, such as the theatrical figures and varnished flowers at the cushion blocks in-between the architraves or the dragon-headed shutou of the front façade’s bracketing. Additionally, the bracket sets lack column-top joints, which is a typical feature in Shanxi regional folk architecture since the Ming dynasty (Zuo Guobao, Shanxi Mingdai gujianzhu 96). In fact, the Qing dynasty stone stele from the thirteenth year of the Tongzhi reign period 同治十三年（1874 C.E.）entitled “Zhongxu Yuhuangmiao bei ji 重修玉皇庙碑记” recorded rebuilding and repair in 1853, 1854, and again twenty years later in 1874 C.E. (Zhongjia wenwuju, Zhongguo wenwu dituji: Shanxi fenge 2: 514).
Shen Yuzhi, “Xiegong yanbian ji pupaifang de zuoyo ng” 183: “In part one of this thesis, the author already drew attention to the whole body of angular brackets and suggested to distinguish the See for example, the intercolumnar bracketing at the front façade’s side bays of Dongyi Longwangmiao, the front façade’s central bay at the Main Hall of Puzhaosi, and the front and rear façades’ central bays at the Main Hall of Foutousi, or the intercolumnar bracketing at the front and rear façades’ side bays of Shanhuasi Daxiongbaodian.

As a rule of thumb, two more wings of construction, we can define them as a type of huagong construction, their design and function. For example, the village temple or jiaojiao, or jiamiao 詳見 and associated with Confucianism. Finally, the term miao 寺 and shenmiao 神廟 describes places to worship one deity or many gods of popular Chinese religion. By definition, the four concepts differ in religious and social functions. For example, the village temple or cunmiao 村廟 of southeastern Shanxi is a typical manifestation of the need for public space where the local people can interact with each other. By contrast, shrines or citang 祠堂 are rather tools of self-promotion and means of self-expression for a single family or social community. However, in the Jindongnan area the terms of si 寺 and quan 賽, ci 寺 and miao 寺 overlapped to a certain degree. The different concepts often merged and one monastery complex fulfilled several tasks at the same time (Zhu Xiangdong 朱向东, Wang Chongen 王崇恩, and Wang Jingping 王金平, “Shanxi xiegong ci quanmiao jianzhu de jianzhu xingzhi yanjiu”, “Xiegong xiegong ci yu jianzhu de yanjiu jishu sprincing zhenghuagong” 16, 7).

Especially in the Jindongnan area, the religious centers dedicated to local cults were buried in the heart of the country, in the reposed setting near a secluded village, in the rugged unsupposed countryside exemplified with Xiaohuling Erxianmiao.

Based on the sharp structural and visual contrast between the intercolumnar bracket sets of the front façade’s central and side bays (including the shuatou profile in the shape of a dragon head that was popular in the Qing dynasty) and through comparison with local architecture nearby, the author suggests that the shanshi dougong of Nanshentou Erxianmiao was most likely mended and replaced in late imperial China. The name of the site often indicates its religious affiliation. Architecture of Buddhism is usually referred to as xiegong 釋宮 through stricter use of technical language and introduction of additional terminology.

The Liao dynasty Yingxian Timber Pagoda of Fogongsì and the Jin dynasty Amitābhasāsana pagoda, were understood as tectonic variations of this recent study. 

For a preliminary division of shanshi dougong according to the distinctive shape of their ground plan see Guo Daiheng (Zhongguo gudai jianzhu shilüe 3: 787), and for a division simply based on the different angle of projection see for example, Shen Yuzhi (“Xiegong yanbian ji pupaifang de zuoyo ng” 176) or Pan Dehua (Dougong 1:17).

Likewise, the desire for fan-shaped bracketing was not tethered to a certain roof type. Three halls were crowned by a hip roof, six by a gable roof, and twelve by a hip-and-gable roof.  

For a saucer-shaped dougong, their task is to rise through transmitting steps and support the upper construction."

Shen Yuzhi, “Xiegong yanbian ji pupaifang de zuoyo ng” 183: “斜栱是补间铺作的一种形式,它的出现,证明了补间铺作在重量和体量方面不但可以与柱头铺作相同，而且可以超越之，为辽宋以来两朵补间铺作的出现，论证了结构上的可能和理论上的可能性。”

For a saucer-shaped dougong, their task is to rise through transmitting steps and support the upper construction. 
Generally speaking, the civilization of modern Shanxi province is the result of a multi-national society that was continuously
and continuously developed into mature form.)

For the decorative effect of shanshi dougong, the author would like to draw attention to Feng Jiren’s insightful discussion of the floral-tree-based terminology for bracketing as reflected in the Yingzao fashi (Building Standards, 1103) and Chinese Architectural Literature 213-276. He proved the visual and semantical resemblance of orthogonal bracket sets to flowers and flowering trees, and compared the skillful array of bracket-arms and bearing blocks to the natural system of “branches protruding front-and-rear and leaves growing left-and-right” (Ibid., 276). The nature-based analogy is even more striking for shanshi dougong with their angled bracket-arms arranged in the shape of an open fan. The (semi-)circular fan-out perfectly embodies the idea of a central flower ovary or tree stem with radiating branches, shoots, sprays, leaves, petals, or buds.

Yu Zhiyou, “Dougong de yunyong shi woguo gudai jianzhu jishu de zhongyao gongxian” 182.

Loc. cit.

The distance of each bay is measured between the tops of its flanking columns.

See for example, Chen Wei, “Xiegong fawei” 44; Shen Yuzhi, “Xiegong yanbian ji pufa fang de zuoyong” 180; Zhang Dan, Dougong yushu yu jiegou jineng yanbian lishi de yanjiu 46; Zhang Yuhuan, “Shanxi Yuandai diantang de damu jiegou” 99.

Shen Yuzhi, “Xiegong yanbian ji pufa fang de zuoyong” 180.

Shen Yizhi even suggested that the absence of fan-shaped bracketing in the Tang dynasty was caused by the lack of pufa fang (Loc. cit.).

Ibid., 183.

To be precise, religious architecture in Datong except Shanhuasi Puxiangzi usually fortified the corners with an additional corbelled cluster in the end bays next to the four building corners. Also, Dingxiang Guanwangmiao misleadingly exhibits three intercolumnar bracket sets in the front façade’s central bay as a result from the outward shift of the central two eave columns. These examples can be neglected and do not interfere with the general two-set rule for eave bracketing along the façade.

The relevant timber halls at Dingxiang Guanwangmiao and Wuxiang Huixiangguan modified the double-layered arrangement and replaced the lower level of architraves in the last side bays of the front or rear façades with chuomufang, a feature officially recorded in the Yingzao fashi and forerunner of the late imperial qie pi. The short supporting timbers provided additional abutment for the architraves above and their heads usually penetrated the flanking columns’ shafts (Liang Sicheng, Liang Sicheng quanji 7: 133-137).

Li Huizhi, “Shanxi xiancun zaqiqi mengjie gianzhu yu tezheng qian dan” (shang) 22, 24.

Generally speaking, the civilization of modern Shanxi province is the result of a multi-national society that was continuously stimulated by external effects. From the traditional angle of political history, the north of the province was mainly influenced by the culture of North China or beifang wenhua 北方文化 and the central parts and south by the culture of the Central Plains or zhongguo wenhua 中原文化. From a more recent angle of geography, the north, central part, southeast, and southwest of Shanxi province produced distinct regional cultures and local traditions that cannot be fully captured with the general terms of beifang wenhua or zhongguo wenhua. For the cultural melting pot in Shanxi province and the strong influence of different regional traditions, see Zhang Wenchang 张文昌, “Qianxi Shanxi chuanton diytu wenhua 徐新东西方文化影响”, “Qianxi Shanxi chuanton diytu wenhua 徐新东西方文化影响” and “Shanxi xiancun zaqiqi mengjie gianzhu yu tezheng qian dan” (shang) 22-24.

Note that the three one-storyed examples differed from the Yingzao fashi in such that they were halls of six rafters’ depth instead of four rafters’ depth.

The nature-based analogy is even more striking for shanshi dougong with their angled bracket-arms arranged in the shape of an open fan. The (semi-)circular fan-out perfectly embodies the idea of a central flower ovary or tree stem with radiating branches, shoots, sprays, leaves, petals, or buds.

Li Huizhi, “Shanxi xiancun zaqiqi mengjie gianzhu yu tezheng qian dan” (shang) 22.


Zhu Xiyuan, “Jindongnan gujianzhu ganxiang” 525.

For instance, religious architecture in Datong except Shanhuasi Puxiangzi usually fortified the corners with an additional corbelled cluster in the end bays next to the four building corners. Also, Dingxiang Guanwangmiao misleadingly exhibits three intercolumnar bracket sets in the front façade’s central bay as a result from the outward shift of the central two eave columns. These examples can be neglected and do not interfere with the general two-set rule for eave bracketing along the façade.

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See also footnote 62.

Pan Guxi and He Jianzhong, 29-40.

Thus the individual lateral frames are inconsistent with regard to the number of their interior columns.


See for example the work by Li Huizhi, Liu Yan and Meng Chao, Tracy Miller, Xu Yitao, Zhu Xiyuan. Moreover, within the larger framework of Jindongnan’s regional style, there were sub-styles generated by local building traditions and different workshops.

Several studies point to this conclusion, see for example Xu Yitao, Changzhi, Jincheng diyu de Wudai, Song, Jin xiu cun gianzhu 124; Zhu Xiyuan, “Jindongnan Luan, Pingshun, Gaopingshe Jincheng xian cun gianzhu” 26-28. or Liu Yan and Meng Chao, “Jindongnan xian cun gianzhu yu Yingzao fashi diantang zuofa bijiao - Jindongnan diyu Tang zhi Jin xian cun gianzhu yanjiu zhi er” 8: “Therefore, this text defines the method of wooden hip-and-gable roof construction in the Jindongnan area between the Tang and Jin dynasties as a comparatively flexible way of building a diantang, precisely, a diantang construction that blends yingtang technique with local characteristics.”

This thesis’ research further confirms the figure introduced by Yang Wei (“Jindongnan gujianzhu baohu ganxiang” 525).
One of the reasons for the rich pool of extant timber architecture in southeastern Shanxi today was its geographic location within the province in addition to special topographic and climatic attributes including the high elevation above the sea level, the inconvenient traffic and transport connection, and the dry climate beneficial to historic building material (Zhu Xiyuan, “Jindongnan Luan, Pingshun, Gaoping he Jincheng sijingzhu” 28; Zhang Yuhuan, “Shanxi Yuandai dianzhang de jiegou” 29). The natural conditions might have protected the wooden relics from rapid degeneration, but the poor economic conditions in the Jindongnan area did harm to the historic structures prior to their official designation as key national heritage conservation units when their timber was used as firewood (Yang Wei 明玮, “Jindongnan gujianzhu baohu ganxiang 保护感想” 525). In the past, wood was an increasingly precious and scarce natural resource in Shanxi province (Zuo Guobao, Shanxi Mingdai gujianzhu 28). Lumber was already unavailable in the capital city of Xian during the Tang dynasty and thus imported from the mountain ranges in north and central Shanxi that were still covered with huge forests such as at Lüliangshan 吕梁山 or Kelanshan 卡岚山. The vast building projects of the great Buddhist monasteries in the Liao dynasty purchased their building material from nearby areas such as Hengshan 恒山 or Wutaishan 五台山, which decimated the northern forests of Shanxi. The ambitious construction activity in the Northern Song capital of Kaifeng explored the forests of Taquishan 太丘山 and Taihengshan 太行山 in the southeast. Due to the extensive clearance, they had considerably shrunk in size by the Jin period, and it became necessary to go deep into the mountains to fell trees. The situation became even worse in later imperial times.

Generally speaking, the social standing and economic development of the Jindongnan area was not inferior to the Jinnan area during the Tang dynasty (Xu Yitao, Changzhijinzhichu de Wudai, Song, JN sijinzhichi 5, 6). Strictly speaking, it was only Lucheng prefecture i.e. modern Changzhi prefecture that could keep with the pace. The once radiating influence of Changzhi and thus the whole Jindongnan area vanished thereafter. In the Northern Song dynasty, the population in the southeast and southwest still matched, but starting with the Jin dynasty, the rapidly developing southwest far outshone the southeast. 156

Note that in late imperial China, the term bu 步 or “step” still referred to the distance of horizontally projected rafters. For example, the Song dynasty two-rafter beam or rufu 匹梁 matched the Qing dynasty shuangbuliang 双步梁 as described before a beam of three purlins or sanjialiang 三架梁. 157

The only true exceptions in the southeast are Shizhang Yuhuangmiao and Nanshentou Erxianmiao, two nearby structures with open exterior and interior columns. Their greater carpentry system, especially the front corridor, is typical of a certain building type prevalent in non-Buddhist architecture of southeastern Shanxi (Liu Yan and Meng Chao, “Jindongnan xieshan jianzhu de shanxihua de yuanyue” 19). See for example, Pan Guxi and He Jianzhong 23.

Eighteen of the total nineteen tingzhang plans in the Yingzao fashi eventually use taller interior than exterior eave columns with the only logical exception being the “clear span” type (Ibid., 39).

He Dalong, Changzhi Wudai jianzhu xinkao 86-91. 158

Ibid., 89. 159

Loc. cit.: “如果内柱斗栱采用与檐柱斗栱里转相同出跳的做法，将构成一组巨大的斗栱，乳栿仅跨一缝椽架，无论在结构和观感上都不能做到合理美观，因此只有用内柱抬高、出跳减少的做法加以解决。” (If an interior column-top dougong adopts the same method for its projecting steps as the interior projection of a column-top dougong, it will compose a huge dougong, the rufu will freely span only one-rafter, from a structural or aesthetic viewpoint it cannot create a reasonable, visually appealing appearance; thus only by increasing the height of interior columns and decreasing the number of projecting jumps it [i.e. this problem] can be solved.) 160

See for example Yingzao fashi entry on huagong, juan 4, 76; Pan Guxi and He Jianzhong 94.

Precisely all examples in the Jindongnan area except those without interior columns or equal column height all over the building. See for example, the Main Hall of Dongyilongwangmiao for the typical arrangement known as yitiaohengtima 一排承替木 that was popular in the Jindongnan area. The orthogonal bracketing of its front columns applied one huagong that in turn carried a second layer in the form of a longitudinal timber called timu. To its opposite, the interior columns used the formation of dantoucha 单斗交替, which due to the lacking bracket-arms reduced the layering to the large bearing block plus one timu-styled board and thus corresponded to one layer of huagong.

The two examples in the southeast with equal interior and exterior column height, namely the Main Halls of Shizhang Yuhuangmiao and Nanshentou Erxianmiao, matched design and nature at the interior projection of their eave column bracketing with the bracketing at the near side of the interior column. Liu Yan and Meng Chao, “Jindongnan xieshan jianzhu yu Yingzao fashi dianzhang zuofa bijiao - Jindongnan diqu Tang zhi Jindongnan xieshan jianzhu yu yuanjie zhi 9.

The mounting of beams refers to the rough beams or caofu 草栿 that are placed above the artistically treated beams or mingfu 明栿, which are exposed to the eye of the viewer inside the hall and carry the interior ceiling. For a modern interpretation of the four sectional drawings of dianzhang (Yingzao fashi, juan 31, 5-8), see Chen Mingda, Yingzao fashi damuzuo yanjiu drawing or tu 图 28-31; Pan Guxi and He Jianzhong 23-27, 281-283. 161

Theoretically speaking, the dianzhang design in the Yingzao fashi allowed piecing together two or three rough beam segments to achieve a span of ten or eight rafters’ length, but such a piecemeal bottom layer was always concealed with an interior coffered ceiling (Figure 2-28) (Chen Mingda, Yingzao fashi damuzuo yanjiu drawing or tu 图 28-31). The regional architecture in southeastern Shanxi usually substituted beams of fewer rafters’ length and lacked the device of interior ceiling.
The second common way was a combination of three-rafter beam plus one-rafter beam in the front or rear known as sanchuanfu dai zhaqian. Several studies point to this conclusion ranging from Zhu Xiyuan’s field work in the 1950s ("Jindongnan Luan, Pingshen, Gaoping he Jincheng si xian de gujianzhu" 27) to the fifty-year younger article by Liu Yan and Meng Chao ("Jindongnan xianshian jianzhu de liang jia zuofa zongshu yu tongji fenxi - Jindongnan diqui Tang zhi Jin xieshan jianzhu yu jianzhu zuo yu yi yue 8").

Another example provides the hip-and-gable roofed, four-rafter Main Hall of Fotousi (with shanshi douqong), which also reveals a piecemeal bottom layer of two beam segments, precisely a three-rafter beam or sanchuanfu in the rear plus a one-rafter zhaqian in the front.

For an insightful discussion of Song Dynasty architecture and the Jinci temple complex see Miller, In brief, three decorative styles for structural descending cantilevers are mentioned in the the High-Tang dynasty murals in Dunhuang, for example at the East Hall of Foguangsi and short split-bamboo or pizhu shuatou that visually resembles an ang' and homof orm with one that is installed in a slanting way on top of a chen'ang).

He Dalong, Changzhi Wudai jianzhu xinkao 109: [昂式] ‘身尾压在平梁或劄牵下，具有昂杠杆作用，除出跳外与昂无异’; [昂形] ‘耍头已不具有杠杆作用，是斜置于真昂上与其同形的’ '昂式' [in the case of angshi] the body of the tail is placed under a pingliang or zhaqian, and possesses the balancing lever effect of ang; except for the fact that it does not project outward, it is not different from ang; [在 case of angxing] the shuatou does not possess a balancing lever effect anymore; it is a 'shuatao that visually resembles an ang' and homomorphic with one that is installed in a slanting way on top of a chen'ang'.

Just a reminder, the first prototypes of leveled shuatou without pointed tips appeared at column-top bracketing of Eastern Han dynasty tombs in Sichuan province and those with xiao'ang pointed profile (i.e. angxing) at the intercolumnar positions of High-Tang dynasty murals in Dunhuang, for example at the Southern wall of cave 172 (Pan Denua, Dougong 5-6, 8). The period between the Tang and Jin dynasties produced two more horizontally leveled varieties with distinctively curved noses in Shanxi province, namely wing-shaped or yixing shuatou 翼形耍头 such as at the East Hall of Foguangsi and short split-bamboo or pizhu shuatou such as at the Main Hall of Nanchansi. Starting with the Northern Song dynasty, the visual design of mazhaxing 蚂蚱形 emerged, usually formed by the (partly) protruding head of a transverse beam, a method that foreshadowed late imperial timber technology.

He Dalong, Changzhi Wudai jianzhu xinkao 114.
To be precise, Shanhuasi Sanshengdian also used double ang but only for its orthogonal bracketing. At the intercolumnar positions, both slanting timbers functioned as structural descending cantilevers, but at the column-top positions they were cha'ang.

See also the intercolumnar corbelled clusters without angled bracket-arms at the front and side façades of Nanshentou Erixianniao.

The Main Hall of Shizhang Yuhuangmiao is the only example in the southeast that applied structural, slanting timbers at the intercolumnar position that correlates with the fan-shaped arrangement (even though they were structural variations of chenxiang that just acted ang-like).

This thesis argues for corbelled clusters of five-puzuo with one tier of huagong and one tier of xia'ang at the front façade of Hongfusi Sanshengdian, even if authors like Li Youcheng described them as six-puzuo with single huagong and double xia'ang ("Shanxi Dingxiang Hongfusi"). Likewise, you author of this thesis cannot fully agree with Li Youcheng's assessment of the bracketing at Dingxiang Guanwangmiao, where the front façade's central shanshi dougong omitted the uppermost parallel bracket or linggong and also the exterior shuatu ("Dingxiangxian Guanwangmiao gouzao qiantan"). In fact, the chenfangtou functions as shuatu, and its penetrating head crowns the peculiar mounting of angled bracket-arms. Similar arrangements can be seen at late imperial architecture of Huizhou region 湖州 in South China that are discussed in part three of the thesis.

Xu Yitao, Zhangchi, Jincheng diqu de Wudai, Song, Jin simiao jianzhu 124.

Except for the jitaowu 脚托 under the roof ridge and niutoutou 牛头托 above the front and rear walls of the building.

See for example the intercolumnar bracketing at the lower eaves of the eleventh century Jinci Shengmu dian in Yingzhou, and also the intercolumnar bracketing at the Main Hall of Puzhaosi and Shizhang Yuhuangmiao.

The historical text of the Yingzao fashi recorded four ways to connect xia'ang with the greater carpentry system (Guo Daiheng, Zhongguo gudai jianzhushi, 3: 641). In three cases, the tail of the structural, slanting timbers upheld the lowest eave purlin in the eave plane and in the fourth case, the head of the cross-beam. The gap between the interior shuatu and the bottom surface of the xia'ang was filled with small bearing blocks, at least in theory. The original, sectional drawings in the Yingzao fashi that illustrate the use of structural descending cantilevers are ambiguous in this respect (Yingzao fashi, juan 31, 5-26). Modern re-drawings could also not tackle the problem and rather added to the confusion by offering different interpretations (Liang Sicheng, Liang Sicheng quanji 7: 455; Pan Guxi and He Jianzhong 33).

Note that the intercolumnar positions all around the building used juantouzao 假昂.

See also Longxingsi Monidian in Zhengding, Hebei province.

For the notion of employing beams reminiscent of mingfu in the regional architecture of southeastern Shanxi without interior beam coffered ceiling, see Liu Yan and Meng Chao, “Jindongnan xieshan jianzhu yanjiu zhi er” 11: “Therefore, cha'ang were replaced by jia'ang; next to the comprehensible, general goal to simplify manual work, another reason probably was their inability to properly handle the triangular space underneath the an joint.”

Dongyi Longwangmiao further used a small suspended column or chuilianzhu to uphold the tail of the single-layered slanting timbers, a method common in the Yuan dynasty.

If the xuesi 薛楔 did not terminate at the wall plane but further extended outward acting as exterior huatou, it should be called xiexinggong 十形拱. (Zhang Yuhuan, “Shanxi Yuandai dianzang de damu jiegou” 100).


For example, the central shanshi dougong at the front façade of Dingxiang Guanwangmiao piled up four perpendicular bracket-arms. See also the Main Hall at Baoguang for a well-known example with orthogonal bracketing. The interior projections of the front façade’s intercolumnar corbelled clusters piled up four steps of zhenghuagong and a decoratively carved board to reach the bottom surface of the lowest slanting timber that supported the sianqiuang (Figure 1-6). The column-top bracketing also used double ang and filled the gaping space with five huagong. See furthermore Shanhuasi Duxiongbao and Huayansi Duxiongbao, the two rare examples of cross-shaped shanshi dougong. They stacked up multiple layers of angled bracket-arms to bridge the gap between their shuatu and lowest eave purlins even though they not use vertically slanting timbers.

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Liu Yan and Meng Chao, “Jindongnan xieshan jianzhu yu Yingzao fashi dianzang zuofa bijiao - Jindongnan diqu Tang zhi Jin xieshan jianzhu yanjiu zhi er” 11: “Therefore, the lowest eave purlin was replaced by jia’ang; next to the comprehensible, general goal to simplify manual work, another reason probably was their inability to properly handle the triangular space underneath the ang joint.”

See Zhang Yuhuan for the use of structural, slanting timbers or xieliang 斜梁 in Shanxi province regional architecture of the Yuan dynasty (“Shanxi Yuandai dianzang de damu jiegou” 93). In particular, he identified three designs for tiawo, namely dajuoshki tiawo 迭曲式挑斡, wanboshi tiawo 曲尺式挑斡, and xiangianshi tiawo 產軸式挑斡, the latter of which also applies to the slanting timbers at Shanhuasi Sanshengdian’s fan-shaped bracketting. To be precise, the intercolumnar shanshi dougong of Dingxiang Guanwangmiao reveal a similar design concept.

For a discussion of tiawo in official Northern Song dynasty bracket sets of four-, five-, and six puzuo, see Pan Guxi and He Jianzhong 87-90. See also the Main Hall of Shaolins Chuzu’an 少林寺初祖庵 (d. 1125 C.E.) in Dengfeng county, Henan province, for another example of an additional, second layer of tiawo at the interior projection (Guo Daiheng, Zhongguo gudai jianzhushi 3: 409-410). However, the intercolumnar five-puzuo bracket sets at the Hermitage of the First Patriarch still applied one tier of structural or true descending cantilevers without broken line.

Hua Chenlong, “Qinxiu Puzhaosi diduian kancha biaogao” 38.
In the case of symmetrical *shanshi dougong* with a ground plan shaped like an eight-pointed star, the interior angled bracket-arms added horizontally slanting members to the vertically sloping ones. In this respect, the asymmetrical triangle-shaped design of the ground plan was more reasonable and a less potential cause of defect and smaller source of construction errors.

For *mojiagong* and their impact in solidifying the corner construction, see part three of the thesis.

Except for the fan-shaped bracketing at Shanhuasi Puxiange, where the interior *shuanggi* carried horizontal joists and did not support the lowest roof purlin.

*Yuanyang jiaoshougong* “appear like two bracket-arms which cross over and share a single arm-end block where they meet”, a feature officially recorded in the *Yingzao fashi* that was usually applied at corbelled corner clusters (Miller, *Constructing Religion* 428; Pan Dehua, *Dougong* 6, 10). As discussed in part one of the thesis, for early representations in stone or two-dimensional depictions see for example, the Eastern Han Shenfujun Watchtower, Qu county in Sichuan province, or the Tang dynasty mural at the lintel of the Great Goose Pagoda at the Cien Monastery in Xian, Shaanxi province.

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Especially if lacking *mojiào* brackets or beams, the corner construction of the building was rather weak and needed fortification through horizontal joists to tie the corner column-top and the adjacent bracket sets at the front and side walls closer together.

The specific design and nature of the stabilizing system reflected the state of the arts in bracketing technology. For example, at Foguangsi Wenshudian, the exterior *linggong* of the fan-shaped bracket sets were linked to the matching uppermost parallel brackets of the adjacent orthogonal clusters, resulting in a longitudinal joist that ran along the front façade. Its lower edge was cut in a curved, bow-shaped manner. A similar but shorter joist spanned the central bay of the rear façade. By contrast, at the Main Hall of Yangqingsi orthogonal and angular eave bracketing both used exterior *linggong* that were not connected with each other. They exclusively supported the exterior *shuatou* that belonged to their own bracketing unit and did not establish a linear or circular system at the outside of the building.

In the case of an inner stabilization system inside the hall, the second jumps of *huagong* usually carried the connective timbers, but the great monasteries in the north often doubled the layers and applied multiple joists at the interior projections to connect the bracket sets along the façade.

See for example, the Main Hall of Xiaohuiling Erxianmiao, which simplified the circular ring system of stabilization through fewer *shanshi dougong*, omission of interior ceiling, and less connective timbers if compared with the nearby Middle Hall at Nanjixiangsi. In essence, the twenty bracket sets at Nanjixiangsi Guodian were closely linked together through double-layered joists that ran all around the building at the interior projections. The lower one of these end-to-end joists intersected with interior *shuatou* acting as connective *linggong*. At the Main Hall of Xiaohuling Erxianmiao, only the upper level of horizontal joists fully linked the interior bracketing of the front, rear, and side façades. The lower level still provided the necessary *linggong* but was split up into three sections, a linear string stretching along the front wall to the first column-top corbelled clusters at the gable sides and two insular arrangements around the corner columns in the rear of the building. The three segments were detached from the short, parallel brackets that formed the *linggong* of the remaining corbelled clusters.

Regarding the Song and Jin method of column reduction, these two dynasties mostly omitted exterior front columns or interior columns; in terms of design, their beam frameworks more often than not consisted of three columns and a four-rafter beam that was placed on top of a front or rear *rufu*; compared to the stipulated “four-rafter beam against *rufu*” design in the *Yingzao fashi* it was more stable and resource-efficient.)


Li Huizhi, “Shanxi xiancun zaoqi mujiegou jianzhu quyu tezheng qiantan (zhong)” 22: “其宋、金两代建筑所施减柱造多减去前或内柱, 梁架结构多为四椽栿前或后压乳栿用三柱的结构形制, 较营造法式中规定的‘四椽栿对乳栿’稳固而节

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III PART THREE

Chapter 1: Official and non-official building styles

1. Technical manuals

Since the first millennium B.C.E., China was a country that respected the written word and fostered literati officialdom, which can be seen in the notion of meticulously recording the successive official reign periods in standard histories since the second century B.C.E.¹ However, writing about architecture, especially the technical aspects, was not necessarily regarded as a proper subject for educated men, and the architectural profession only gradually developed into the esteemed job description of designing and supervising building projects in the modern sense.

The rich body of Chinese historiography is composed of official writings including the main dynastic histories and other official works such as essential government documents called huiyao 会要 or government sponsored encyclopedias on the one hand, and private histories collected by individual, private citizens on the other hand.²

Likewise, there are similar kinds of historical Chinese literature dealing with architecture that can roughly be divided into “works with a strictly technical nature, mainly belonging to the realm of official building; and works in which technical materials are mixed with materials pertaining to ritual, geomancy and divination”.³ The latter ones were not official writings since they were not published by the official Board
of Works and included (popular) encyclopedias called (riyong) leishu (日用)类书, geomantic works for proper siting and perception of space for the living and the dead, and finally almanacs for choosing favorable building times. The most prominent example that shows the concept/perception/idea of traditional Chinese architecture as a complex interwoven system of structural techniques, rituals and magic is the Luban jing 鲁班经 or Classic of Luban, a carpenter’s manual that was anonymously compiled in the fifteenth century and attributed to Luban 鲁班 in the early Ming dynasty. It introduced building methods and technologies of the preceding Song and Yuan dynasties but with emphasis on non-technical information/aspects.

In the broadest sense, the earliest official work that specifically deals with building traditions is the Zhouli kaogongji 周礼考工记 (Craftsmen’ Records of the Zhou Rituals), one of the Confucian classics originally dating to the Eastern Zhou Period. The text introduces six categories of craftsmanship and general design principles for imperial city planning but does not yet give specific information of size, design, or construction method of greater timber carpentry.

The following paragraphs summarize the most important historical literature that deals with timber technology in the broadest sense and construction methods in China until the twentieth century.

In detail, the Mujing 木经 or Timberwork Manual, was probably compiled by an anonymous carpenter and thus was a private, non-official publication. However, it probably had considerable influence on the official manual of the Song dynasty. It first addressed the characteristic Chinese modular design system of official timber carpentry.
in detail, but its proportions and units differed from the succeeding building manuals. The eleventh century scholar Shen Kuo 沈括 (1031-1095 C.E.) fortunately recorded fragments of the lost original work in his *Dream Pool Jottings* or *Mengxi bitan* 梦溪笔谈, in which he attributed the *Mujing* to Yu Hao 喻皓 (fl.965-989 C.E.), a legendary master carpenter from Southern China, Zhejiang province 浙江, in the second half of the tenth century.

The twelfth century *Yingzao fashi* or *Treatise on Architectural Methods* by the government official Li Jie, and the eighteenth century *Engineering Manual for the Boards of Works by the Ministry of Public Works* also called *Gongbu gongcheng zuofa* are the only two comprehensive official technical building manuals dating prior to the twentieth century that survived until present. They both were tools to assist the official ministries in the management of imperial construction projects, but by no means intended “to teach officials how to become architects, for the craftsmen knew how to build”. The *Yingzao fashi* replaced the *Mujing* as a scholarly, technical treatise and in the end, consisted of thirty-four chapters addressing several different aspects of construction work, such as the rules and methods of construction, the work units and daily workload per artisan, the amount of material for each type of work, and finally architectural drawings, namely *zongshi* 总释 or “General Terminology” (juan 1, juan 2), *zhidu* 制度 or “Methods” (juan 3 to juan 15), *gongxian* 功献 or “Corveé” (juan 16 to juan 25), *liaoli* 料例 or “Materials” (juan 26 to juan 28), and *tuyang* 图样 or “Drawings” (juan 29 to juan 34). The Song dynasty manual collected the knowledge of the time that was based on practical methods and generation-long observations; moreover, it increased the value of
these building traditions, standardized and codified them for the first time in a print version.

Similar to the medieval documentation of technical achievements, the Gongbu gongcheng zuofa 工程工程做法 or Building Methods of the Board of Works officially recorded the building traditions that developed since the Ming dynasty in seventy-four chapters. In the same year (1734 C.E.), the Qing Board of Works also published a list of prices of building materials, entitled Wuliao jiazhi 物料价值 to stop the increasing fluctuation. Therefore, Klaas Ruitenbeek suggested a comparatively stronger emphasis on economy and conservation of materials in the Qing manual, “both the Yingzao fashi and the Gongbu gongcheng zuofa give long lists of parts and measurements, but in the former they are given to ensure that a building of right proportions is made, using the proper constructional methods; in the latter to ensure that no materials and money are wasted.”

Furthermore, in contrast to the Gongbu gongcheng zuofa, the Yingzao fashi was not only a comprehensive text that tackled the question of economical manufacturing or assemblage and provided answers to technical problems. Li Jie was certainly versed in the supervision of building construction, but he was also a well-respected writer. His work was a written account of architectural theory, a formal and orderly expression of logical thinking that elaborated Chinese design principles that started with the Zhouyi 周易 also called Book of Changes or Yijing 易经 and the Zhouli 周礼 or Rites of Zhou.

Yingzao suanli 营造算例 or Model Calculations for Use in Building refers to several small manuscripts that were handed down for generations of craftsmen on-site who were engaged in official construction projects. They were based on the official
technical terminology of the contemporary Gongbu gongcheng zuofa but focused on a single topic such as bracketing or bricklaying (with non-coherent terminology and titles). They can be understood as supplements to the Qing manual since they eventually stressed practical design principles and calculations for professional builders. Klaas Ruitenbeek suggested the existence of similar treatise in the preceding dynasties, but such manuscripts are lost today.

Finally, the Yingzao fayuan 营造法原 or Source of Architectural Methods by Yao Chengzu 姚承租 (1866-1939 C.E.), a professional architect from Suzhou, South China, continued the tradition of writing official technical building manuals. Nevertheless, it was the first real “textbook” in the literal sense. It aimed not only to preserve the architectural vocabulary and building traditions in the Jiangnan region 江南 (i.e. the region south of the Yangtse River including the southern parts of Jiangsu 江苏 and Anhui 安徽 provinces, the northern parts of Jiangxi 江西 and Zhejiang 浙江 provinces, and important cities like Shanghai 山海, Nanjing 南京, Ningbo 宁波, Hangzhou 杭州, Suzhou 苏州, or Wuxi 无锡) but also to teach architectural students how to build.

2. Shortcomings in the official building manuals and the missing definition of angled bracket-arms

What we know today about the official building traditions in North China during the eleventh and twelfth centuries is based on the revised edition of the Yingzao fashi that was published by the Southern Song court in 1145 C.E. Besides short citations in secondary sources such as the twelfth century work entitled Xutanzhu 续谈助 (d. 1106
C.E.) by Chao Zaizhi 晁载之, three whole chapters of text as well as nine single, detached pages survived.22

After the Northern Song empire in North China, the fall of their traditional capital Bianliang 汴梁 to the invading Jurchen troops, and the establishment of Hangzhou 杭州 also called Lin’an 臨安 as the new imperial capital city of the Southern Song dynasty, the reprint of the Yingzao fashi was politically motivated and based in the urgent need of standardized building regulations for the imperial building projects in South China. Interestingly, the new edition by the Chen Gang 陈纲 and the prefect of Suzhou, Wang Huan 王喪, comprised two chapters less than the original by Li Jie, i.e. thirty-four instead of thirty-six chapters of which only thirteen instead of fifteen dealt with building methods.23 In fact, the transmitted edition of the manual does not address certain questions and architectural features of greater carpentry, especially at the corners of structures including the way to apply mojiaofu 抹角栿 or dingfu 丁栿, or the manufacturing of angled bracket-arms. Although we might long for more information, unfortunately, we do not know about the subject matter of the missing two chapters, which is left to speculation.

Fan-shaped bracket sets as a specific category of bracketing are not mentioned in any of the official building manuals (as far as we know). In fact, not even the angled bracket-arm xiegong is explicitly listed by name. For example, the relevant chapters of the Yingzao fashi, juan 1 and juan 2, entitled zongshi or “General Terminology”, list forty-eight technical terms of building and aim to put them into historical context and discuss their origin by citing various texts from the Zhou dynasty to the Northern Song
dynasty. Similarly, the important part of the text that codifies the rules for manufacturing, entitled *zhidu* or “Methods”, introduces the various subject matters in twelve chapters (namely *juan* 3 on moats, walls and stonework, *juan* 4 to 6 on greater carpentry, *juan* 6 to 11 on smaller carpentry or joinery, *juan* 12 on wood carving and bamboo work, *juan* 13 on roof tiling and the use of mortar and plaster for walls, *juan* 14 on preparation of paint and decorations, and finally *juan* 15 on brick and tile fabrication). Both parts bring no more light to the topic. Other than the discussion of the corner bracket-arm or *jiaogong* 蛙须栱 and the short comment on the *xiaxugong* 蛙须栱, neither the Song nor the Qing text addressed the existence of angular bracketing.\(^2\) Likewise, they did not explain the different ways of manufacturing, assemblage, or placement within the building structure even though we can see this feature at extant architecture dating from the Liao dynasty to present. (For a detailed list of bracket-arms that extend at acute or obtuse angles to the façade and their possible mentioning in the official building manuals, see part one of this thesis).

Eventually, the authors and editors of the official manuals relied to a varying degree on the expertise of craftsmen to explain the building methods and technical language that was used in imperial construction. However, it is not only their notion of writing down traditional building methods and compiling lists of technical terminology or even the notion of codifying them as official building standards that set the stage for future building. It is also the degree of implementation and compliance with the rules that relied on the local craftsmen engaged in the construction project, especially outside the capital cities in the remote, distant countryside. Interestingly, no Chinese timber building survived that fully embodied the rules of the *Yingzao fashi*. The extant examples rather
show greater variety and flexibility and give a more diverse impression of timber bracketing than originally was put forward in the text.

Therefore, it seems logical to ask if the regulations were ever carried out and how effective they eventually were.

From the tenth century on, there was prolific building activity and continuous improvement in North China’s timber technology that resulted in a diverse body of architecture with various design and construction methods. Else Glahn argues that “the records about the *Mujing* indicate that the developments within Chinese architecture during the eleventh century were both rapid and conscious”.²⁵ Feng Jiren further explains that the unofficial building manual was “a prevalent text from the early Song period to the 1060s, which spans some one hundred years.”²⁶ Nevertheless, even for such a limited period of time, it neither captured the sum of Northern Song building technologies nor addressed the more advanced modular systems that were already in practice.²⁷

There certainly was good reason for the publication of such an extraordinary, high-sophisticated work like the *Yingzao fashi*, moreover there probably was an urgent need in medieval North China. Xu Yitao 徐怡涛 analyzed the implementation of the twelfth century building manual and emphasized its gradual, slow spread. After a period of about fifteen years, the *Yingzao fashi* became the standard for architecture in Shanxi 山西 and Henan 河南 provinces even though the alien Jurchen regime already replaced the indigenous Northern Song dynasty and ruled over North China. (In other words, there was a trend towards uniformity away from individual architectural styles with distinctive local features). In detail, between the tenth and the thirteenth century, there were three stages of development in monastery architecture of the region. The first stage lasted from
the Five Dynasties to the first year of Xining 熙宁 in the Northern Song dynasty (tenth century-1068 C.E.), the second stage from the first year of Xining to the first year of Xuanhe 宣和 of the Northern Song dynasty (1068-1119 C.E.). The third stage was roughly equal to the reign period of the Jin dynasty (from 1119 to 1234 C.E.; Jin dynasty from 1113/1115-1234 C.E.), in which two sub-phases can be further distinguished: first, from 1119 C.E. to the Dading 大定 years of the Jin dynasty (1162-1189 C.E.), and second, from the Dading period to 1234 C.E. Interestingly, in the first stage which refers to the years before the compilation of material for the first edition of the Yingzao fashi, the regional differences were not as outstanding as in the second stage. Eventually, it was just in the period of preparing and publishing the medieval building manual that regional features of vernacular architecture, especially in the Jindongnan area 晋东南, showed great divergence from official architecture in the area under Northern Song rule (Taiyuan and Jinzhong prefectures Shanxi province, relevant parts of Hebei province), in particular during the reign of the emperors Shenzong 神宗 (r. 1067-1085 C.E.) and Zhezong 哲宗 (1085-1100 C.E.).

In addition, the question arises whether the regulations eventually reflected the whole body of bracketing starting from the Five Dynasties Period, since they address only a selected number of timber features. In the past, Chinese scholars liked to discuss subject matter against the background of the official building manuals. Only recently, a new generation of scholars started the discussion of non-official architecture, regional styles, and local building traditions regardless of the religious affiliation or the building task.
In general, Xu Yitao argued that both the beginning stage and end stage prior to the Yuan dynasty had conformity in bracketing, but the middle stage had not. On the other hand, the larger timber frame building structure differed widely until the early Song period when it was regulated by the final spread of the mandatory rules in the *Yingzao fashi* (after 1119 C.E.). Nevertheless, local building traditions in Shanxi province continued to a certain degree. Moreover, after the mid-Jin dynasty they became increasingly prevalent. The gap between the different regional and local building traditions became wider again. For example, in the Northern Song and Jin dynasties Central Shanxi (Taiyuan 太原 and Jinzhong 晋中 prefectures) still adhered to an early architectural style that was already lost in the southeast (Changzhi 长治 and Jincheng 晋城 prefectures), where the most change occurred. There certainly was mutual exchange. For example, the feature of beveled 抹斜 bracket-arms parallel to the façade spread to the above mentioned prefectures of Central Shanxi after the Jin dynasty, probably radiating from the Southeast. In the Southeast on the other hand, the vertical architrave or *lan’e* was influenced by the longstanding building traditions of Jinzhong and Taiyuan and stopped to project beyond the corner columns in the late-Northern Song and mid-Jin dynasties.

In summary, the shortcoming of the existing official building manuals is that they represent only one side of traditional Chinese architecture. They recorded the imperial building styles and the highly-selective view at a court that either intentionally neglected the diverse body of existing construction methods in folk architecture or unconsciously omitted regional and local styles which they might not even been fully aware of. After all,
the goal of the *Yingzao fashi* was not to give a general idea of contemporary architectural design in the Northern Song Empire but rather to facilitate the construction process of imperial building projects through budget control and possible prefabrication. Interestingly, the (revised 1145 C.E Southern Song reprint of the) *Yingzao fashi* was greatly influenced by local building traditions outside the ancestral homeland in the north and the Central Plains. On closer inspection, it becomes evident that such impact focused on the geographical region south of the Yangtze River, home to the Southern Song capital of Lin’an in today’s Zhejiang province.33 Typical architectural features of the Jiangnan area include for example, the design and layout of three-bay wide timber halls in *tingtang*-style especially in combination with crescent beams or *yueliang* 月梁 that are supported by bracket-arms called *dingtougong* 丁枓栱.34 Thus we can assume that there was prolific exchange and interaction between the building traditions of the North and the South, including the design of bracket-arms and sets that must have taken place before or during the Song dynasty.35

3. Angled half-brackets recorded in the *Yingzao fashi*

   a) Half-brackets or *banjie huagong* 半截华栱

   In the first scholarly discussion of angled bracket-arms in the strictest sense, Chen Wei emphasized two (technical) pre-conditions for the evolution of genuine *xiegong*, or in other words, two “potential prototypes” namely *mojiao* brackets and *banjie huagong* 半截华栱.36 Literally translated, the term *banjie huagong* means “half (the section) of a ‘flower’ bracket” and describes a feature that corresponds to a single bracket-arm. Just as
a reminder, similar to the descending cantilever xia’ang that vertically projects at a slanting angle to the regular perpendicular bracket-arms, xiegong are just a tectonic variation of huagong that horizontally project at an acute or obtuse angle to their regular orthogonal counterparts. Broadly speaking, huagong regardless of their angled or orthogonal application derived from bow-shaped half-brackets that were inserted into the column shaft (as discussed in part one of this thesis). To simplify matters, two individual half-brackets usually became united and blended together to form a long, continuous standard bracket with two symmetrical arms that was carved out of one piece of wood. The symmetrical design in which such huagong equally projected inside and outside from the large bearing block as a fulcrum achieved a balancing lever effect and enhanced the structural equilibrium and stability.

This was true for angled bracket-arms as well. For example, the 1970s repair of the bracketing of Moni Hall 摩尼殿, Longxing Monastery 隆兴寺 in Zhengding 正定, Hebei province(1052 C.E.), revealed such symmetrical timber pieces that were used for genuine xiegong (Figure 3-1). However, there were exceptions to the rule. Especially in the south of China, half-bracketing in the form of chagong always played an integral role in the building traditions and can be seen at timber buildings of tingtang-style in the Jiangnan area that recall characteristic features of chuandou-style 穿斗 architecture. Eventually, inserted half-brackets influenced the northern style in the Central Plains and also the Great Buddha Style or daibutsuyō 大仏様 of the Kamakura period 鎌倉幕府 (1185-1333 C.E.) in Japan, for which the Great South Gate 南大門 of Tōdaiji or Great Eastern Temple 東大寺 in Nara (1181 C.E.) provides one of the most beautiful and
exaggerated extant examples (Figure 3-2). In Shanxi province, we can see both, and xiegong were used in the form of long timbers with two symmetrical bow-shaped bracket-arms or in the form of asymmetrical short half-brackets.

b) Nomenclature of half-bracketing

In modern scholarship, the three terms banjie huagong 半截华栱, dingtougong 丁头栱, and chagong 插栱 are often confused and used alternately. In this respect, it is helpful to recall the necessary architectural language (For the definitions of T-shaped half-brackets called dingtougong by various authors see table 3-1).

In terms of visual design, the term banjie huagong matches the term dingtougong. They both refer to the outward appearance of a T-shaped half-bracket of which the ground plan resembles the Chinese character “ding 丁”. In particular, such bracket-arms contrast cross-shaped bracket joints that are usually called shizigong 十字栱, since their visual design recalls the Chinese character “shi 十”. From the angle of visual design, chagong also appears as dingtougong and follows the shape of the Chinese character “ding”.

In terms of assemblage and wood joinery, there are two different kinds of banjie huagong. Xu Bo’an equated banjie huagong with dingtougong and applied the terms to half-brackets that were tenoned into the mortise of the vertical column shaft and those that were directly linked to (the head of) a horizontal beam or the organic unit of a three-dimensional bracket cluster (Figure 3-3). In other words, from the angle of wood-joinery the definition of banjie huagong embraces the term chagong and lists it as one possible kind.
Finally, the term *chagong* literally describes a special type of structural building joinery and indicates the specific way of assemblage. In the strictest sense, it only applies to bracket-arms that are directly inserted into another member such as the column shaft. Li Xiangdong 李向东 explained that the Chinese term “*chagong*” theoretically did not exist in traditional architecture and classical writings. It rather derived from the modern translation of the Japanese name *sashihijiki* 插肘木 for a bracket-arm that was directly inserted into the column shaft without abutment of the large bearing block. In practice, small pottery objects from the Han dynasty already applied such bracketing, which in the Eastern Han period evolved into a cluster of multiple timber arms (Figure 1-29; Figure 1-30). Chronologically speaking, from the seventh to the tenth century, *chagong* were hardly used, but they became popular again starting in the Song dynasty. In essence, *chagong* lacked the opposite hand and did only correspond to one half of regular symmetrical bow-shaped brackets; which is probably why they did not qualify for official style but rather belonged to folk architecture, especially during the Ming and Qing dynasties. In fact, the Song dynasty manual *Yingzao fashi* did not explicitly address *chagong* but rather paraphrased it as “*dingtougong*”. 

Chronologically speaking, in the Jiangnan area *dingtougong* and *chagong* were similar in design and size during the Song dynasty. Due to the general development of the timber frame system and the technical achievements in greater carpentry, they became more specialized and in the Ming period, they already differed widely in function, form and diameter. In detail, *chagong* usually supported the eave joist or *liaoyanfang* and were closely linked to the organic unit of the bracket set. When the *cai* 材 of *dougong*
gradually decreased in size, they equally shrunk in proportion. *Dingtougong* on the other hand, were used to uphold (longitudinal) beams, boards and joists, and since these members became increasingly important in bearing stress and carrying load after the Song dynasty, it was impossible to reduce the size of *dingtougong*. Additionally, in Ming dynasty official style and Jiangnan regional style the feature of *dingtougong* regressed steadily and developed into *queti* 雀替-style boards.

In theory, all of the above introduced bracket-arms can follow the cardinal directions or can be placed at acute or obtuse angles to the wall plane (usually 45 or 60 degree). In practice, in the north of China including Shanxi province, *banjie huagong* regardless of the direction or angle were rather integrated into the bracket set unit than inserted into the column shaft, especially before the Ming and Qing dynasties. Some extant timber structures in the north display a stylistic variation of oblique bracket-arms that possesses the qualities of asymmetrical half-bracketing. For example, the tenth century Guanyin Pavilion 观音阁 at Dulesi 独乐寺 in Ji county 蓟县 of Tianjin city 天津市 in Hebei province, a multi-storied rectangular structure of the Liao dynasty with *pingzuo* and two sets of eaves, displays *banjie huagong* that are not inserted into the column-shaft at the mezzanine level but integrated into the mounting on top of the large bearing block (Figure 3-4). In detail, the interior column-top bracketing of five-*puzuo* 铺作 in stolen-heart design applies two steps of half-brackets that project at an oblique angle of 52 degree. The bracket-arms do not qualify as genuine *xiegong* or angled bracket-arms in the strictest sense. Nor do the bracket clusters qualify as fan-shaped bracket sets, since they are placed at the inner column grid and resulted from the
geometric layout of the six-sided opening in the center of the hall that connects the regular floors and the mezzanine level.

c) **The feature of xiaxugong 虾须栱**

The only kind of angular bracketing along the façade eventually recorded in the official building manuals is a stylistic variation of genuine xiegong known as xiaxugong 虾须栱 or literally translated “shrimp antennae brackets” that are listed in the *Yingzao fashi* under *huagong*.⁴⁸

The prime example of xiaxugong is preserved at the Main Hall of Baoguosì 保国寺 in Ningbo 宁波, Zhejiang province (built in 1013 with later repairs in 1078 C.E.).⁴⁹ The 3-bay wide relic from the Northern Song dynasty additionally preserved melon-shaped columns or *gualengzhu* 瓜棱柱, a feature listed in/of the *Yingzao fashi* that is rarely seen among the extant examples of traditional timber architecture in China and associated with Southern style. In fact, two other relics in Fujian province 福建 that reflect Southern style building during the Northern Song dynasty also preserved angular half-bracketing, namely the Main Hall of Hualin Buddhist Monastery 华林寺 in Fuzhou 福州 (964) dating to the Wuyue Kingdom and Sanqingdian of Xuanmiao Daoist Monastery 玄妙观 in Putian 莆田 (1016 C.E.) dating to the Northern Song dynasty.⁵⁰ To be precise, two early timber structures in Shanxi province also applied angular half-bracketing at the inside of the hall, namely Tianwangdian 天王殿 at Shanhuasi 善化寺 in Datong 大同 (1128-1143 C.E.) from the Jin dynasty and the already destroyed Main Hall at Yuhua Palace 雨花宫 of Yongshousì 永寿寺 in Yuanwo township 源涡镇, Yuci
county 榆次县 (1008 C.E.) from the Northern Song dynasty. In both cases, the angular half-brackets were integrated into column-top bracket sets and used to uphold corner beams or mojiao beams.

By definition, xiaxugong are a certain kind of dingtougong (i.e. half-brackets which ground plan resembles the Chinese character “ding 丁” but not necessarily chagong) that project at acute or obtuse angles to the wall plane if placed at a T-shaped inner column grid (For the definitions of xiaxugong by various authors see table 3-2).

More precisely, xiaxugong must be applied at the interior steps of a bracket set that is located at the T-shaped intersection point of regular eave columns with (a row of) interior columns. In other words, the key question is the placement of the column that was crowned with dougong using angled half-brackets. It cannot be enough emphasized that xiaxugong and bracketing at the four exterior corner columns are mutually exclusive, for two reasons. First, in the Song dynasty, corner brackets or jiaogong of exterior eave columns are usually not asymmetrical, short half-brackets but rather long timbers that symmetrically project outside and inside the hall. Second, more importantly, corner columns are not located at a T-shaped interior column grid but rather at the outer column grid that matches the external perimeter of the rectangular or square-shaped hall.

To illustrate this by way of example, at the Main Hall of Baoguosi, the bracket sets on top of the eave columns labeled “B1” and “B4” eventually applied xiaxugong with the goal to support the zaojing-style藻井 domed coffered ceiling at the front (Figure 3-5). Likewise, at the Main Hall of Hualinsi xiaxugong are used to support the pingqi-style平棊 flat coffered ceiling.
Chapter 2: Angled brackets called *mojiaogong* – Archetype of *xiegong* or a league of its own

1. **Nomenclature of *mojiao* brackets 抹角椅**

   Although the Chinese term *xiegong* can literally be translated as “angled, angular or oblique brackets”, the English translation is somehow misleading. As discussed in part one of this thesis, it is not exclusionary enough and used as a generic name for the whole group and narrower term for a specific sub-type (i.e. superordinate and subordinate term) at the same time. In Chinese timber architecture, there are eventually several brackets that project at an angle different than 90 degree to the wall plane and thereby contrast the regular bracket-arms called *huagon* that step out directly perpendicular to the façade. Besides “genuine *xiegong*” or “angled bracket-arms in the strictest sense”, this group also includes *jiaogong* and *mojiaogong*, (the latter of) which are often placed at bracket clusters on top of corner columns. Just as a reminder, a *mojiaogong* is a structural timber stretching at a right angle to the “diagonally” projecting bracket-arm at the corner of a rectangular hip-and-gable roofed timber building called *jiaogong*.

2. **Affinity and distinction of *dougong* with *mojiao* brackets and *jiaogong* corner brackets to fan-shaped bracket sets**

   a) **Apparent visual resemblance of corner bracket sets with fan-shaped bracket sets**

   At first glance, fan-shaped bracket sets along the façade appear similar to the corbelled clusters at the corners of some buildings. Position and angle of (both of) their
brackets recall the ribs of a semi-circular fan and evoke the illusionary effect of the opened fan stripped of the covering material (silk, paper, feathers).

In the first scholarly discussion of *xiegong*, Chen Wei eventually introduced the idea of a chronological development from column-top to intercolumnar position starting at the corner column. Zhu Xiaonan further suggested that intercolumnar fan-shaped bracket sets followed the shape of their counterparts at the corner to bring them into visual alignment and balance the “corner-heavy” appearance of the hall. In essence, Chinese scholars including Shen Yuzhi all emphasized that fan-shaped bracket sets along the façade intentionally emulated the corner clusters that applied *jiaogong* and *mojiaogong* if placed at rectangular timber halls with hip-and-gable roof. Genuine *xiegong* were thus understood as the latter’s visual, structural and symbolical enhancement.

Tracy Miller proposed a possible religious reason for the reproduction. Since fan-shaped bracket clusters first appeared in a Buddhist context, they may have had a Buddhist association. In detail, they were the adoption and adaption of octagonal timber pagodas from North China and their underlying idea of rotation as part of Buddhist ritual practice. Fan-shaped bracket sets aimed to imitate the turning of a corner and were the architectural manifestation of the patrons’ overwhelming sense of apprehension and fear in the age of the Final Dharma. The emphasis on rotation may have been related to a desire to perpetuate the teachings of Buddhism by "turning the wheel of the law," in an age of potential Buddhist decline.

Nevertheless, some seemingly fan-shaped corner sets are just the result of a simple visual misunderstanding caused by the building’s geometry. This becomes
evident in the octagonal floor plan of Buddhist pagodas that resulted in two adjacent building planes spanning a corner of 135 degree angle rather than 90 degree angle as in rectangular or square halls (Figure 3-6). To the eye of the untrained viewer, the brackets at such corner positions spuriously appear similar to genuine xiegong but without having their actual qualities. In terms of technical terminology, they are just liegong 列栱 literally translated as “aligned brackets” that project beyond the corner of the 8-sided pagoda at an acute angle (rather than at a right angle as seen at comparable rectangular or square timber halls). Such bracket-arms do not qualify as angled bracket-arms in the strictest sense nor do the clusters qualify as true fan-shaped bracket sets.

The question arises to what degree jiaogong and mojiaogong qualify as xiegong in the narrower sense and consequently, under what circumstances such corner clusters qualify as fan-shaped bracket sets.

b) Way of viewing corbelled corner clusters

The way of viewing is very important in discussing angled bracket-arms and fan-shaped bracket sets. By simply looking at the architectural floor plan, fan-shaped bracket sets along the façade basically comprise projections along up to eight different directions within the same horizontal (projection) plane. Assuming an ideal case with symmetrical design at the exterior and interior of the hall, there are namely two parallel arms to the wall plane, one arm perpendicular to the wall plane at the exterior and one arm perpendicular to the wall plane at the interior, as well as one exterior set and one interior set of two arms at a 45 or 60 degree angle with the wall plane. Based on a preliminary visual analysis, the
same is true for the corner bracket sets with *jiaogong* and *mojiaogong* in a rectangular hip-and-gable roofed hall.

Nevertheless, in terms of general design, the situation at the corner of a wooden building is rather special and even more complicated than the situation along the facade. The corner construction including column shaft and column-top bracketing is part of the front façade and simultaneously, the side façade. The longitudinal bracket-arms of the corner *dougong* such as *nidaogong*, *mangong*, or *linggong* eventually are “aligning brackets” or *liegong* that extend beyond the edge of the corner. They do not just belong to the body of parallel bracket-arms that run along the front façade (i.e. *henggong* 横栱), but at the same time, they also form the projecting bracket-arms that are perpendicular to the wall plane at the side façade (i.e. *huagong*). Therefore, from which angle do we view the bracket-arms at the corner?

Generally speaking, the direction of viewing determines the orthographic projection in architectural drawings and leads to different projection planes of the building (i.e. the building planes correspond to the directional idea by which the structure can be analyzed today). To be more precise, floor plans capture (or even reduce) three-dimensional objects in two dimensions, which is called parallel or orthographic projection. In the same way, elevations display the appearance of the exterior, or in the case of sections, the interior construction along a vertical cutting plane. They are important architectural tools that can fully communicate the necessary qualities of bracketing, but the key question is the direction of viewing and projection plane.

Whereas the view direction of the front or the side façade corresponds to the building plane and simply runs at its right angle, the appropriate direction of viewing the
corner runs at a 45 degree angle to both of them (which does not match any wall plane but rather the diagonal building axis in case of a square floor plan). Accordingly, in terms of architecture and civil engineering, the way of viewing bracket-arms differs widely. In fact, at the corners it eventually is reversed: *huagong* (or *liegong* in general) are perceived as “angled” members, whereas *jiaogong* step out directly perpendicular to the projection plane at the corner, and *mojiaogong* appear as parallel brackets. This thesis follows such a way of viewing and does not consider *jiaogong* or *mojiaogong* if integrated into corner *dougong* as angled bracket-arms that are similar in nature to genuine *xiegong*. Likewise, such corner bracket sets do not qualify as fan-shaped bracket sets in the strictest sense.

Against expectations, *mojiaogong* were not tethered to the corbelled clusters at the corners but rather capable of shifting along (the bracketing axis of) the façade (and settled at column-top or intercolumnar exterior eave bracket sets in the end bay). For further discussion, we have to consider the specific function of *mojiao* brackets and additionally, *mojiao* beams in the greater carpentry system and the possible placement at bracketing along the façade.
3. Situation at the four corners of rectangular timber halls with hip-and-gable roof in tailiang-style

   a) Basic methods of corner construction in tailiang-style architecture and regional influences

   It goes without saying that corner bracket sets are similar to regular (eave) column-top bracket sets (including fan-shaped sets) in such that they both are placed directly on top of columns, where they incorporate the (horizontal) beams into the bracket set layer. They both support the projecting roof which protects the building against rain. More importantly, the corner set is responsible for the upturning, gently sloping curve of the roof eaves. The eaves’ curve resulted from the individual placement and arrangement of corner beams, including the optional application of mojiao features in hip roof, hip-and-gable roof, or pointed pyramidal roof architecture.\textsuperscript{61}

   Basically, hip-and-gable roof architecture in North China followed the tailiang-style 台梁式 and relied on the large corner beam called dajiaoliang 大角梁 in official Song dynasty terminology or laojiaoliang 老角梁 in official Qing dynasty terminology, above which were put a zijiaoliang 子角梁 or small corner beam and usually a yinjiaoliang 隐角梁 or hidden, concealed corner beam.\textsuperscript{62} The latter two differed in such that only the head of the small corner beam pierced through the wall plane and was visible from the outside. In the Qing dynasty, they blended together into a single timber known as zijiaoliang 仔角梁.

   The corner construction is another good example that vividly illustrates the local traditions and the influence of regional culture and style on official building technology.\textsuperscript{63}
To put it in a nutshell, similar to the problem of xiegong and fan-shaped bracket sets in general, the way to build up the corner was not clarified enough in the official Song dynasty building manual. In fact, the Yingzao fashi listed possible construction methods for the upturning roof at the corner in particular dajiaoliang and yinjiaoliang, but the key question of how to support the tail of the corner beam at the inside of the hall still remained a puzzle. Broadly speaking, at the exterior, the head of the large corner beam was laid at the eave purlin, and at the interior, the tail was laid on top of a beam. In detail, the tail could be placed at a “diagonal” mojiaofu or a longitudinal dingfu that ran parallel to the front façade (which were called mojiaoliang 抹角梁 and shunbaliang 顺扒梁 in Qing dynasty terminology), or, an additional horizontally leveled rough beam 草栿 called yin(muzheng jixin)chen jiaofu 穩 (木正彐心) 补角栿 was placed below the ascending large corner beam and matched the Qing dynasty’s dijiaoliang 递角梁 (Figure 3-7).

Additionally, extant architecture in Hebei and Shanxi provinces brought light to a fourth possibility that relies on the support of bracket sets. The corner cluster and its two adjacent intercolumnar sets formed a structural unit at the inner corner/inside the hall, with the projecting steps of ang or huagong joined together to uphold the tail of dajiaoliang from three directions. As discussed in part two of this thesis, this way of interior bracketing not only provided structural support for the corner beam but also strengthened the overall stability and integrity of the timber frame structure, especially in combination with the loose or partial ring system of sufang 素枋 common in the
southeast of Shanxi province. Comparatively speaking, it was still structurally weaker than the use of *mojiaogong*.

In other words, there were several possibilities to place the tail of *dajiaoliang* but not all of the local building methods could provide the best and strongest structural support or complied with the official rules in the *Yingzao fashi*. It is not surprising, that especially in Shanxi regional architecture of the Song and Jin periods, we can see such divergence. The tail of *dajiaoliang* was laid comparatively low, which caused the roof corner to upturn steeper and higher than in official architecture of the Song dynasty and even of the Qing dynasty. 68

### b) Chronological development of corner beams

In terms of chronological development, the basic mode until the Song dynasty was to symmetrically apply an ascending large corner beam with its head and tail equally put above a purlin (or joist) that ran parallel to the ridge. (In detail, either both were placed at the eave purlin (or joist), or the head was placed at the ox-spine purlin or *niujituan* 牛脊榑 and the tail at the lowest roof purlin). 69

They both received load from the roof structure above, but the ability of the latter to carry it was comparatively smaller. The tail of *dajiaoliang* fully relied on the interior steps of the corner *puzuo*-unit or the lowest eave purlin as the main point of support (especially in case of “stolen-heart” design), a technique that can be seen at various monasteries in North China ranging from the Tang to the Yuan dynasties including the Main Hall of Nanchansi 南禅寺 (782 C.E.) and the East Hall of Foguangsi (857 C.E.),
both at Wutaishan, or the Bhagavat Sutra Repository of the Lower Huayan Monastery (1038 C.E.) in Datong, Shanxi province (Figure 3-8).  

This simple method was not stable enough to resist against distortion triggered by earthquakes, wind, or snow. Therefore, the tail of the *dajiaoliang* moved downward beneath the lowest roof purlin. The distance in elevation between purlin and beam gradually increased with the latter developing into a nearly horizontally leveled timber. In other words, the large corner beam came to act as a lever that better transmitted force (when load was applied at its two end points) with its head still placed above a purlin but the tail now placed under a purlin. At the same time, in order to generate the sloping curve of the roof and put weight on the lowest roof purlin, an additional rising beam called *yinjiaoliang* was added, which was placed above the rear part of *dajiaoliang* and invisible from the outside. The earliest extant example dates to the Five Dynasties period, the Ten-thousand Buddha Hall of Zhenguosi in Pingyao (963 C.E.), but the *yinjiaoliang*-technique was more common from the Song and Jin periods until the Qing dynasty.  

Furthermore in North China, a small suspended column called *chuilianzhu* 垂連柱 became common in the Yuan dynasty that succeeded to link the large corner beam closer with the interior steps of the corbelled corner cluster, in particular the slanting members. It resulted in a tighter, three-dimensional inner corner structure in the shape of a triangle, for example at Wujimen 无极门 of Yonglegong in Ruicheng county of Yuncheng prefecture 运城市 (1295 C.E.) (Figure 3-9).
In the Ming and Qing dynasties, the *yinjiaoliang* technology advanced (e.g. by using a horizontally leveled corner beam) and was the common building method in the north except for Beijing and Qufu in Shandong province, where the large corner beam still resembled a large slanting rafter or *dachuan* 大椽 and the small corner beam or *zijiaoliang* 子角梁 a large flying rafter or *dafeichuan* 大飞椽 respectively.

In the north, generally speaking, the tail of (the combined and thus now called) *zijiaoliang* 子角梁 increased in length and height and was permanently fixed with nails onto the large corner beam, for instance the Main Hall at the Altar of Earth and Harvests or Altar of Land and Grain in Beijing called *shejitan* 社稷坛 (early-Ming dynasty) (Figure 3-10). More importantly, the placement of the lowest roof purlin changed again. It now rested neither above nor beneath the corner beams but was rather squeezed in-between them. In other words, it was safely embedded between the large and the small corner beams, a technique that became the official standard method in the Qing dynasty (Figure 3-11).

In the South, Ming and Qing dynasty small pavilion architecture also used a method similar to the original *dajiaoliang*-method in the north during the Northern Song dynasty that relied on a rising (large) corner beam called *laoqiang* 老戗 with both ends equally resting on top of purlins. It was adapted to the local needs, especially the smaller corner beam, that resulted in a steeper and more abrupt but less projecting curve of the roof eaves (Figure 3-12).
The relation between *mojiao* beams and *mojiao* brackets

a) Chronological development of *mojiao* features: the beginnings

Just as a reminder, a *mojiaoliang* 抹角梁 literally translated as a “span-corner beam” is “laid at an angle of 45 degrees to the façade in a corner of a timber building to support the end of a *jiaoliang*.” In contrast to *mojiao* brackets, *mojiao* beams were listed in the *Yingzao fashi* and the *Gongbu gongcheng zuo fa*. In fact, both *mojiao* features, i.e. *mojiao* brackets and *mojiao* beams, were not a mandatory part of the greater carpentry system but rather one of many possible ways in roof construction of traditional Chinese building technology. Broadly speaking, the main difference lies in their different diameter and length, because smaller dimensions are used for the timbers of *mojiao* brackets than those of beams. In terms of function, they both derived from the same three-thousand year old prototypes but developed into two separate features in hip-roof or hip-and-gable roof architecture of North China. They finally were adopted and adapted to various building tasks, including “circular” or octagonal shaped small timber pavilions with pointed roof in the south.

As discussed in part one of this thesis, bracket sets only gradually evolved, and so did the corbelled clusters at the corners including those that applied *mojiao* features (Figure 3-13). In detail, the earliest example of a *mojiao* bracket dates back to the Warring States period. The funerary bronze object from the ruler of the Zhongshan Kingdom, excavated in Pingshan, Hebei province, shows a structural timber that is directly placed on top of a small corner column called *douzi shuzhu* (with *ludou* and *minban*) and spans the corner stretching from the column shaft towards both sides in
diagonal direction. Interestingly, it was already similar in shape to the triangular structure known as *yidouersheng* that became the standard design for *dougong* until the Northern and Southern Dynasties.

For centuries, *mojiaogong* continued to be popular, but in fact, they were just one possible way to uphold the roof eaves at the corner. Examples from the Han to the Tang dynasties alternatively show two detached bracket-arms or clusters of brackets that prop up the overhanging roof area but are placed separately along the façade at short distance to the edge of the corner, for example the small Han dynasty pottery object in the shape of a multi-storied watchtower from Sangzhuang in Fucheng county, Hebei province that was discussed in part one of this thesis (Figure 1-34). The bracket-arms step out at a right angle to the wall plane but are not yet joined together forming *liegong*. The mortise-and-tenon joints were comparatively simple since corner bracketing did not yet combine members that projected in three different directions into one *puzuo*-set. Northern Dynasties’ architecture occasionally used a prototype of *jiaogong* that stepped out at a 45 degree angle to the front façade. Nevertheless, it was not before the Sui dynasty that the new way of corner bracketing with *jiaogong* replaced the *mojiaogong* method to a greater extent. In the Tang dynasty, *jiaogong* were finally applied together with perpendicularly and transversally projecting bracket-arms in the same *puzuo*-unit.

b) **Chronological development of *mojiao* features: Liao, Northern Song and Jin dynasties**

Liao dynasty craftsmen inherited the building traditions of the Tang dynasty, but against expectations, *mojiao* brackets became fashionable again in the second part of the
tenth century. However, their position gradually changed from (corner) column-top to (adjacent) intercolumnar set, and so did their placement and elevation within the puzuo-set. Guo Daiheng identified two chronological stages of development for mojiaogong if still integrated into the corbelled corner clusters that reflected the general advancement in bracketing technology and the crucial change from touxinzao to jixinzao-style (Figure 3-14): 80

First, tenth century buildings in Hebei province applied mojiaogong in stolen-heart-style at the upper levels of the exterior projection of corner bracket sets (usually at the 3rd jump). This feature is seen at the Guanyin Pavilion and the Main Gate at Dulesi (984 C.E.) and Wenshudian 文殊殿 of Geyuansi 阁院寺 in Laiyuan 涞源 (twelfth century repair of the original Liao structure). 81 Second, extant timber halls from the first third of the eleventh century display mojiaogong that moved downwards to the lower steps and rested together with the orthogonally projecting bracket-arms directly at the large bearing block, such as the main halls of Kaishansi 开善寺 in Xincheng 新城 (1033 C.E.) and Guangjisi 广济寺 in Baodi 宝坻 (1024 C.E.) both in Hebei province, or at the Bhagavat Sutra Repository of the Lower Huayan Monastery (1038 C.E.) in Datong, Shanxi province. In fact, the interior steps of bracketing along the façade, at the corners and at intercolumnar positions still followed touxinzao-style, but the exterior steps used the new advanced technique of filled-heart style.

To take it a step further, mojiao brackets developed from a single piece of long timber stretching at a right angle to the diagonal building axis, for example at the Main Hall of Kaishansi or at the second regular floor of Puxiange at Shanhuasi (rebuilt 1154
C.E.), into two full brackets or half-brackets that were placed separately at a certain distance behind the corner and integrated into regular eave bracketing along the façade by the Northern Song dynasty, such as at Monidian of Longxingsi, in Zhengding, Hebei province (1052 C.E.) (Figure 3-15).

At Moni Hall, the corbelled bracket sets with *mojiaogong* are well-balanced arrangements of eight bracket-arms consisting of orthogonal members and those that symmetrically step out in four directions at 45 degree angles to the wall plane (Figure 3-16). Assuming that *shanshi dougong* 扇式斗栱 are defined as column-top or intercolumnar clusters along the façade with outward projecting angled bracket-arms at the exterior steps and optionally, at the interior steps, the corbelled clusters at Monidian truly qualify as fan-shaped bracket sets. The definition eventually applies to genuine *xiegong* as well as angular bracket-arms that function as *mojiaogong* if applied at bracketing along the façade. In any case, it excludes such members that act as *mojiaogong* or *jiaogong* at the corbelled corner clusters. In detail, there are basically two types of *shanshi dougong* at the outer column grid along the perimeter of the cross-shaped hall that apply genuine *xiegong* or *mojiaogong*, namely those placed at the core hall and those at the small projecting porticos called *baoshā* 抱厦. To be more precise, not all of the four *baoshā* buildings follow the same design pattern; only the comparatively larger northern and southern ones reveal a complex design with *mojiaogong*. For example, the three-bay wide *baoshā* in the south displays five-*puzuo* bracket sets with *mojiaogong* at column-top positions along the front façade and at intercolumnar positions along the two side façades. At the exterior, two tiers of *mojiaogong* step out directly from the large bearing block and are complemented by
genuine xiegong as their mirror image. At the interior, the first step of angled huagong supports an elongated piece of timber that spans across the corner from one puzuo-set to the other, thereby structurally connecting the front with the side façade.

In comparison, the angular bracketing at Tianwangdian also known as shanmen of Shanhuasi in Datong, one of the prominent Liao dynasty monasteries in the north of Shanxi province, appears rather asymmetrical (Figure 3-17). In fact, the Jin dynasty building is not adorned with any fan-shaped bracket set at the exterior facade, which is why this important monument was not part of the in-depth discussion in part two of this thesis. The rectangular timber hall of five-bay width and two-bay depth reveals a curtailed version of mojiaogong at the interior. It eventually applies angled half-brackets to support the mojiao beams, (the latter of) which stretch across the back of the inner corners and support the tail of the dijiaoliang-style corner beam under the monumental hip roof. In detail, two wings each with two tiers of banjie huagong are integrated into the five-puzuo bracket sets on top of the central columns at the side façades and project at an acute angle to the wall plane.84

Since their ground plan resembles the Chinese character “ding 丁” and they are placed at a T-shaped inner column grid, they qualify as xiaxugong or “shrimp antennae brackets” (i.e. the only kind of angular bracketing along the façade eventually recorded in the official building manuals as discussed in the previous chapters).85 Interestingly, the end bays at the front-, back and side façades are equal in length and display two intercolumnar sets in each bay. The intercolumnar dougong in closest proximity to the corner dougong shifted closer towards the latter, and consequently, these three adjacent sets formed an interlinked cluster called fujiaodou 附角斗 (to be discussed in the
following chapters). Neither *mojiao* brackets nor beams were part of this kind of corner fortification. Moreover, they also skipped the second intercolumnar set in the end bays and shifted further away onto the next column-top *dougong*.

Let us recall the pre-Yuan dynasty examples in Shanxi province that display fan-shaped bracket sets along the façade, as discussed in part two of this thesis.

Two Jin dynasty buildings that are located in the former Liao territory in the north of the province integrated *mojiaogong* into the column-top corner clusters, namely Puxian Pavilion at Shanhuasi and Mituodian 弥陀殿 of Chongfusi 崇福寺 in Shuozhou city 朔州. Three timber halls applied *mojiaogong* at column-top or intercolumnar bracket sets along the façade, namely in the north in Xinzhou prefecture 忻州, Guanwangdian 关王殿 of Guanwangmiao 关王庙 in Dingxiang county 定襄县 and in the southeast in Lingchuan county 陵川县 of Jincheng prefecture 晋城市, the Middle Hall of Nanjixiangsi 南吉祥寺 and the Main Hall at the Jade Emperor Temple 玉皇庙 in Shizhang 石掌. Interestingly, the Jade Emperor Temple in Shizhang used *mojiao* brackets in the front and *mojiao* beams in the rear part of the building. Additionally, the Main Hall of Yanqingsi 延庆寺 in Wutai county 五台县, Xinzhou prefecture, and the Main Hall of Puzhaosi 普照寺 in Qin county of Changzhi prefecture used *mojiao* beams.

c) **Chronological development of *mojiao* features: late imperial China**

In brief, the larger part of Liao, Northern Song and Jin dynasty timber halls discussed in part two did not apply *mojiao* brackets and genuine *xiegong* at the same time.
Moreover, the use of *mojiaogong* was greatly affected by the change that occurred in the greater carpentry system after the Song dynasty, including the trend towards simplification in the Yuan dynasty, the smaller size of the *puzuo* layer (if applicable) and individual bracketing members or the increasing ability of beams to uphold the eaves and carry the roof load.

Nevertheless, in theory, *mojiao* features and *shanshi dougong* were still not mutually exclusive, and in practice, eventually co-existed. The Gatehouse of Cuifujunmiao 崔府君庙 in Liyi township and village 礼义镇礼义村, Lingchuan county, Jincheng prefecture, is good example of Shanxi province regional style architecture and reveals *mojiao* beams that are placed above the fan-shaped bracket clusters (Figure 3-18). Whereas the central part of the Gatehouse is a relic of the Jin dynasty (1184 C.E.), the adjacent small gates to the East and the West called *yemen* 掖门 are additions of the succeeding periods which, not least becomes evident in the playful decoration of the exterior *shuatou*. Each one-bay wide side structure is flanked by a pair of angled brick screen walls and crowned by a hip-and-gable roof. In fact, each of their front and rear facades displays two intercolumnar fan-shaped bracket sets (of five-*cai* 踩) with two tiers of brackets projecting perpendicular to the wall plane next to genuine *xiegong*. At the interior, the orthogonal bracket-arms support the roof purlin via *chuilianzhu*, but their angled counterparts are not connected with the greater carpentry system and merely stick out like ribs of an open fan. Finally, even though *mojiaoliang* run parallel to the angled *shuatou*, to uphold the ascending corner beams, they are neither integrated into the
organic bracket set unit underneath them nor supported by *mojiao* brackets or angled half-brackets.

Whereas the *mojiao* beams are hidden to the eye of the viewer standing in front of the Gatehouse of Cuifujunmiaojiao, their use at the Main Hall in the second courtyard of the City God’s Temple in Yuci 榆次城隍庙, Jinzhong prefecture, is visually indicated by *mojiao* brackets that pierce through the wall plane and project outward (Figure 3-19). In fact, the five-bay wide hip-and-gable roofed rectangular timber hall with front corridor reveals *mojiaoliang* that stretch across the four inner corners of the core hall and are placed above the bracketing layer. Interestingly, the *mojiao* brackets lack the matching opposite hand that usually completes the pair of angled bracket-arms at the exterior façade. Their asymmetrical, one-sided arrangement does not embody the idea of an open fan anymore, which is why these clusters are not considered *shanshi dougong*.

However, this was not the beginning of the downfall of *mojiao* features. They just became less visible in the Ming and Qing dynasties’ bracketing along the façade, at least in official architecture. Guo Huayu suggested typical qualities of official style corner bracketing in the Ming dynasty and drew attention to the combination of two features in *tingtang*-style architecture, namely the *mojiao* beam and the interior bracket arrangement called *liujin dougong* 溜金斗栱. The *mojiaoliang* at Taisuidian 太岁殿 at the Temple of Agriculture or *Xiannongtan* 先农坛 in Beijing (1532 C.E. with Qing dynasty repairs) perfectly embodies the new elegant way to uphold the corner beams and tackle the construction problem at the corners (Figure 3-20). At the inside of the hall, the beam carries a camel hump and a large bearing block to uphold the lowest eave.
purlins (of front- and side façades), an arrangement that left plenty of room for decoration and served as additional interior embellishment of the timber hall. More importantly, the joint with the lowest eave purlin moved from the tail to the middle of the upward pointing corner cantilevers (at the tail, they were inserted into a small vertical column together with the two corresponding slanting members of the adjacent intercolumnar puzuo-sets). Generally speaking, it also illustrates a stage in the transition of the mojiao beam towards its final placement above the bracketing level and its complete detachment from the puzuo-unit. Interestingly, it is not a mojiao bracket but rather a mojiao beam that extends outward, although the latter is still supported by one step of half-brackets at the interior of the hall. Eventually, both heads of the mojiao beam pierce through the wall plane in such a way that they are hidden behind the perpendicularly and parallel projecting bracket-arms and hardly discernible from the outside.

To sum it up, mojiao brackets and mojiao beams played a crucial role in the development of the corner construction and the overall stability of the building structure. Broadly speaking, mojiaoliang superseded mojiaogong if placed at column-top or intercolumnar bracket sets along the façade. Such mojiao brackets were subject to the general development in greater carpentry and the decreasing importance of dougong that came along with it. In the “worst case scenario”, they were neither needed for abutment nor an integral part of the timber frame structure. However, the Liao dynasty fashion to place mojiaogong directly on top of corner columns revived and multiple layers of mojiao brackets adorned the complex corbelled clusters at the four corners of Ming and Qing dynasty architecture, such as at Xixi Erxianmiao 西溪二仙庙 in Lingchuan county of Jincheng prefecture (to be discussed in the following chapters) or at the numerous
examples with *fujiadou* (where *mojiagong* were incorporated into the dense arrangement of bracket-arms and bearing blocks).
Chapter 3: Fan-shaped bracket sets in post-Jin dynasty architecture of Shanxi

One of the key questions of this thesis is whether xiegong-architecture in general and fan-shaped bracket sets in particular has the ability to symbolize the architectural style of a specific dynasty.

On the one hand, this premise touches upon ideological aspects such as the Chinese deprecation of the Northern alien conquest dynasties (especially the Liao and Jin dynasties) and their aversion to “orthogonal culture” that contrasts the indigenous Han Chinese preference for orderly geometric design and exclusively straight, horizontal or vertical lines.92

On the other hand, it also stirs scholarly discussion of the actual situation of building in the succeeding periods, in other words, the possible existence of xiegong-architecture in the Yuan, Ming and Qing dynasties, and its popularity in Shanxi province.

In brief, fan-shaped bracket sets or shanshi dougong in their strictest sense are often misunderstood as pure decoration and characteristic of the building tradition of the Liao and Jin dynasties. In fact, two sites, where some of the best examples of fan-shaped bracketing date to the Song dynasty, are Longxingsi in Zhengding, Hebei province and Nanjixiangsi in Lingchuan county, southeastern Shanxi province.93 Succeeding dynasties continued the medieval tradition of fan-shaped bracket sets, not only under the rule of the Yuan and Qing dynasties such as at Shuishenmiao 水神庙 and Guangshengsi 广胜寺 in Hongdong county 洪洞县 but also under the rule of the indigenous Ming dynasty, such as at Xixi Erxianmiao in Lingchuan county. Moreover, the numerous examples of Yuan,
Ming and Qing dynasty architecture vividly prove that the application of bracket clusters in the shape of an open fan had become a characteristic feature of Shanxi province regional building traditions in the post-medieval periods.

1. Approach to xiegong in Chinese historiography

Eventually, it was Liang Sicheng who stressed the preference of medieval Northern dynasties for angled bracket-arms in the narrower sense, explaining that at Monidian of Longxingsi, “although there is only one intercolumnar set in each bay, the diagonal kung, which was a favorite of the Liao architects, is used” (“虽然每间只用补间铺作一朵，但有辽代惯用的斜栱”). Nevertheless, with this in mind he deliberately introduced the hall to the Chinese academic community as a paradigm of Song dynasty building style and the flagship of the monastery complex that he and his wife prodigiously had discovered in person. He got out of the affair by explaining the use of xiegong at Monidian as the foreshadow of a new era and a herald of the building tradition of the (succeeding) Jin dynasty, an alien, semi-nomadic Tungusic people from Manchuria. The Liao dynasty structure of Daxiongbaodian and especially, the Jin dynasty structure of Sanshengdian at Shanhuasi in Datong, neighboring Shanxi province, seemed to confirm the increased popularity of genuine xiegong under Khitan and Jurchen rule. In English, Liang Sicheng described the Daxiongbaodian as follows: “the bracketing of this large structure is quite simple. One significant characteristic is the use of diagonal kung in the intercolumnar sets of the three central bays, which was first seen in the sutra cabinet in the Library of Hua-yen Ssu and was to become quite a fad in the Chin dynasty”, “斗栱较简单，但有一个重要特点，即在当心三间的补间铺作上使用了斜栱。这一
In essence, Liang Sicheng considered genuine xiegong or “diagonal kung” at intercolumnar bracket sets as a stylistic feature of the Jin dynasty and in terms of design and structure, as an additional, unnecessary burden to the architrave, since its application only further complicated matters. As discussed in the previous chapters, Chinese architectural historians of the third and fourth generation, since Liang Sicheng such as Chen Wei, already adjusted this assertion and proved otherwise.

2. The use of genuine xiegong and fan-shaped bracket sets in Chinese architectural history

Just as a reminder, there is no factual evidence of fan-shaped bracket sets dating (prior) to the Five Dynasties period, neither in the form of extant timber architecture nor in the form of two-dimensional paintings. The earliest, extant wooden example in China is the Middle Hall of Nanjixiangsi in Lingchuan county, southeastern Shanxi, which dates to the Northern Song dynasty (1030 C.E.). Other early examples are situated in the former Khitan-ruled territory of northern Shanxi such as the Liao dynasty Timber Pagoda of Fogongsi (1056 C.E.).

Part two of this thesis eventually proves that there are more extant buildings with genuine xiegong and fan-shaped bracket sets dating to the Song dynasty than originally assumed by scholars of the first generation of Chinese architectural historians. This thesis’ research further confirms the continuous use of angled bracket-arms in the strictest sense throughout the Jin dynasty. The marvelous smaller timber carpentry called “flying celestial cabinet” or feitianzang 飞天藏 at the Daoist Yunyan Monastery 云岩寺 in
Jiangyou 江油 at Mt. Douchuan 窦圌山, Sichuan province 四川 (1180 C.E.), gives further evidence of their existence during the Southern Song dynasty (Figure 3-21).^99

In fact, even though scholars like Pan Dehua argued for the disappearance of genuine xiegong with the end of the Jurchen rule,^100 this thesis suggests that they had already become an integral part and a standard feature of non-official style architecture and were used until present, at least in Shanxi province (to be discussed in the following chapters). Occasionally, some scholars addressed the existence of fan-shaped bracket sets after the mid-thirteenth century, but generally speaking, too often such ideas remained unheard.^101 Interestingly, Zhang Yuhuan stressed the desire for fan-shaped bracket sets with angled bracket-arms in the Yuan dynasty or at least, the longing for their perceptible visual effect that was achieved through beveling of brackets and small bearing blocks, especially in the Jinzhong and Jinnan areas of Shanxi province:

“此外还有一种斜面栱，如在多斗栱中瓜子栱、慢栱、令栱三条横栱前面，按栱之底线将 90 的方棱砍去，做成 45 度斜面栱，这有可能受到 45 度斜栱做法的影响。因做 45 度斜栱制作麻烦不易施工，故在外跳各横栱面砍成 45 度斜面，这是在斗栱上增加的变化。这种形式在元代中晚期的建筑上，使用比较普遍。尤其是晋中，晋南区实例最多，它与元代中晚期斗栱的装饰艺术性增加有密切的关系。”^102 (Besides, there is another kind of beveled brackets; in many extant dougong, the heads of the three henggong [i.e.] guazigong, mangong, and linggong, are treated like the bottom surfaces of regular brackets that are cut at 90 degree angles; they form 45 degree beveled brackets which probably was influenced by the 45 degree xiegong technique. Because it was cumbersome to produce [genuine] 45 degree xiegong, the exterior projections of each henggong were cut along a 45 degree surface, a method that enhanced the change of dougong. The use of this kind of profile was comparatively common in mid- to late-Yuan dynasty architecture. Especially in the Jinzhong and Jinnan areas, where there are the most examples, this notion is closely related to the emphasis on decorative art in mid- to late-Yuan dynasty dougong.)
Unfortunately, it is beyond the limit of this thesis to shed full light on the direction of cultural transmission of genuine xiegong, fan-shaped bracket sets, or scepter bracket sets from the North to the South of China or vice versa in the Ming and Qing dynasties. It is rather the goal of this chapter to draw attention to the long lasting popularity of xiegong-architecture in the central Chinese province of Shanxi.

3. General trends in post-Jin dynasty xiegong-architecture in comparison to pre-Yuan architecture

Since the focus of discussion lies in religious timber architecture of Shanxi province that dates prior to the Yuan dynasty, it is beyond the scope of this thesis to conduct the same quantitative and qualitative large-scale research for late imperial architecture as introduced in part two. There, this thesis already pinpointed twenty pre-Yuan one-storied timber halls, one multi-storied timber pavilion, and one multi-storied wooden pagoda that applied fan-shaped bracket sets. Nevertheless, here the author chooses a handful of Yuan, Ming and Qing dynasty structures in Shanxi province to link the phenomenon of fan-shaped bracket sets to the larger framework of Chinese architectural culture. These selected examples also belong to the pool of timber structures designated as key national heritage conservation units or quanguo zhongdian wenwu baohu danwei 全国重点文物保护单位 by the State Administration of Cultural Heritage since 1961. The author discovered more than fifty post-Jin dynasty monasteries that contain at least one timber structure with angled bracket-arms in the strictest sense (either in the form of fan-shaped bracket sets or scepter bracket sets).
In fact, numerous other timber buildings in Shanxi province that are not listed as national heritage units by the State Administration of Cultural Heritage up to the present also used genuine *xiegong* in their post-Jin dynasty architecture, such as the Sacrificial Hall of Sanjiaotang 三教堂 in Zezhou county 泽州县 of Jincheng prefecture. Even though not yet designated, it still sheds light on the importance of the angled bracket-arm as a non-official architectural feature in regional style building of Shanxi province.

The aim of the following case-studies is to reassess the perception of fan-shaped bracket sets as a regional feature of Liao dynasty territory in northern Shanxi. Eventually, this thesis located other regional clusters, workshops and channels of distribution throughout the entire territory of the province. To draw a preliminary conclusion, in the north of Shanxi province (i.e. Datong, Shuozhou and Xinzhou prefectures) *xiegong*-architecture was more common in the Liao and Jin dynasties than in the succeeding periods. In the central part of the province (Taiyuan, Yangquan, Jinzhong, and Lüliang prefectures), fan-shaped bracket sets were hardly used before the end of the Jin dynasty but became increasingly popular since the Yuan period. Exception to the rule is Yangquan prefecture, where every timber structure designated as key national heritage conservation unit applies bracketing in the shape of an open fan. Interestingly, the number of pre-Yuan dynasty buildings matches exactly the number of post-Jin dynasty buildings. In the Southwest (Linfen and Yuncheng prefectures), there are eventually no examples that qualified for the detailed research of pre-Yuan dynasty *xiegong*-architecture in part two of this thesis, but quite a number of buildings employed angled bracket-arms in the strictest sense at the building façade since the Yuan dynasty. Finally, in the southeast (Changzhi and Jincheng prefectures), *xiegong*-architecture remained
fashionable throughout the centuries with the number of post-Jin buildings by far outnumbering their pre-Yuan counterparts.

In other words, in nearly every prefecture of Shanxi province (except the North), we can find fan-shaped bracketing that date to the periods after the fall of the Jin dynasty. This includes examples in monasteries that were established before the conquest of the Yuan dynasty as well as those that were established after the mid-thirteenth century in the Yuan, Ming, and Qing dynasties.

4. Selected examples of post-Jin dynasty buildings with fan-shaped bracket sets at monasteries in Shanxi province that were established before the Yuan dynasty and contain pre-Yuan dynasty buildings with fan-shaped bracket sets (i.e. the monasteries discussed in part two of this thesis)

Among the twenty sites in Shanxi province that contain pre-Yuan dynasty buildings with fan-shaped bracket sets (discussed in part two of this thesis), three monasteries preserved further buildings with genuine xiegong that date to the succeeding Yuan, Ming or Qing dynasties. They are all located in the southeastern part of Shanxi province, and display genuine xiegong in the form of shanshi dougong 扇式斗栱 rather than ruyi dougong 如意斗栱 (their differences will be explained in the next chapters) (Map 2).

Longmensi 龙门寺

Longmensi 龙门寺 in Longmensi village 龙门寺村, Shicheng township 石城镇, Pingshun county of Changzhi prefecture, not only preserves precious examples of early
timber architecture with orthogonal bracketing, namely the tenth century West Side Hall 西配殿 from the Later Tang dynasty (925 C.E.), the eleventh century Daxiongbaodian (1098 C.E.) from the Northern Song dynasty, and the Rear Hall 燃灯佛殿 from the Yuan dynasty, next to the Jin dynasty Tianwangdian, the East Side Hall 东配殿 known as Guanyindian 观音殿 also display angled bracket-arms in the strictest sense (Figure 3-22). The latter is a gable-roofed, rectangular hall of three bays in width with front and rear corridor that probably was rebuilt during the Ming dynasty in the end of the fifteenth century (Hongzhi reign period 弘治十一年至十七年, 1498-1504 C.E.). In detail, the central bay at the exterior front façade displays an eye-catching corbelled cluster of four-puzuo with genuine xiegong that step out directly from the large bearing block. At the first jump, a false cantilever arm provides support for the cross-beam that pierces through the wall plane and projects as a shuatou perpendicular to the façade. It is flanked by a pair of angled exterior shuatou. In fact, each of the six cross-beams that are laid parallel (to each other) along the façade are incorporated into a dougong unit regardless of having a column-top or intercolumnar position and orthogonal or angled bracketing.

Wuxiang Huixianguan 武乡会仙观

After the thirteenth century Main Hall or Sanqingdian of Huixianguan 会仙观 in Linzhang village and township 临漳镇临漳村, Wuxiang county 武乡县 of Changzhi prefecture, the second largest hall just lower in rank to the Jin dynasty structure also applies column-top fan-shaped bracket sets. The three-by-three-bay relic of the Yuan dynasty is known as Yuhuangdian 玉皇殿 (Figure 3-23). The central columns at the
front and rear façades are both adorned with a pair of corbelled clusters that apply genuine xieqong projecting from the small bearing block at the first jump of bracket-arms perpendicular to the wall plane, and in contrast to Sanqingdian, also apply genuine xieqong projecting directly from the large bearing block below. Similar to Sanqingdian, the five-puzuo sets with double tiers of huagong or in case of the angled arms, false cantilevers, display xieqong only at the exterior. The four-rafter beams of the greater carpentry system are integrated into the bracket set units and project beyond the façade as orthogonal shuatou being escorted by four angled ones.

Shizhang Yuhuangmiao 石掌玉皇庙

Shizhang Yuhuangmiao 石掌玉皇庙 in Lucheng township 潞城镇, Lingchuan county of Jincheng prefecture, preserves two buildings with fan-shaped bracket sets and genuine xieqong at intercolumnar positions. Whereas the Jin dynasty frame structure of the Main Hall appears modest in design and bracketing, the two-storied undated Gatehouse with stage at the rear, a design called daozuo xitai 倒座戏台, exhibits three lavishly decorated shanshi dougong of five-cai 踏 along the front façade, one in each bay of the three-bay wide baosha 抱厦 (Figure 3-24). In fact, the Gatehouse with stage is not a free-standing building but rather integrated into the masonry wall that surrounds the high platform or gaotai 高台 upon which the Jade Emperor Temple is placed. Broadly speaking, the fan-shaped clusters at the Gatehouse and Main Hall are well-balanced, symmetrical arrangements with angled bracket-arms in the strictest sense at the exterior and interior steps. In both cases, interior zhenghuagong 正华栱 i.e. bracket-arms
perpendicular to the wall plane uphold the lower eave purlin even though the way differs
how they provide support and reflects the different periods of erecting and state of the
arts in building technology.

5. Selected examples of post-Jin dynasty buildings with fan-shaped bracket sets at
monasteries in Shanxi province that were established before the Yuan dynasty
and do not contain pre-Yuan dynasty buildings with fan-shaped bracket sets

In general, there are more than eighty sites among the key national heritage units
of Shanxi province that were established before the Yuan dynasty and preserved pre-
Yuan dynasty buildings currently. Even if the extant timber architecture from the Tang to
the Jin periods did not use fan-shaped bracket sets and thus, were not considered in the
previous chapters of this thesis, other extant structures that were newly erected or re-built
in the same monastery complex after the Yuan dynasty can display bracketing in the
shape of an open fan. This includes the following examples (Map 3).

a) Southeastern Shanxi: Changzhi 长治市

郑觉寺 正觉寺

Zhengjuesi 正觉寺 in Sudian township 苏殿镇, Kansi village 看寺村, Changzhi county 长治县 of Changzhi prefecture (inventory number 5-0228-3-034) is best known
for its Main Hall and Rear Hall that date to the Jin dynasty and Song dynasty,
respectively. Both have orthogonal bracketing. The Yuan dynasty East and West Side
Halls on the other hand, display fan-shaped bracket sets of five-puzuo design in jixin-
style with triangle-shaped ground plan that crown the two central columns along the three-bay wide front facades, with gable roof (Figure 3-25). At the exterior, angled bracket-arms in the strictest sense are applied that project directly from the ludou and also from the small bearing block above. At the interior, there is only a single horizontally leveled bracket-arm that directly supports the cross-beam.

b) Southeastern Shanxi: Jincheng 晋城市

Chongmingsi 崇明寺

Chongmingsi 崇明寺 also called Hengusi 狠谷寺 in Hexi township 河西镇, Guojiazhuang village 郭家庄村, Gaoping municipality 高平市 of Jincheng prefecture (inventory number 5-0268-3-074) displays fan-bracketing at the Rear Hall located just north of the famous tenth century Main Hall. The Rear Hall is a five-by-three-bay wide, gable-roofed structure with one intercolumnar bracket set per bay aligned along the bulky, circular, large architrave called da’e 大额 (Figure 3-26). The central bay at the exterior front façade employs a dominant, eye-catching bracket cluster of five-cai 踩 with angled, dragon-head shuatou (with the most exterior flanking pair missing) that emulates an open fan. The ground plan appears like a symmetrical 8-pointed star, but in contrast to the interior, genuine xiegong project from the ludou and additionally, from the small bearing block above at the exterior. At the interior projection, neither the horizontally leveled brackets perpendicular to the wall plane nor the ones applied at 45-degree angles are directly connected to the greater carpentry system. They rather form interior shuatou. A slanting timber that ascends from the shuatou level upwards supports the lower roof
purlin, a construction method that was discussed in part two of this thesis with regard to Fotousi 佛头寺 and Puzhaosi 普照寺.

**Xilimen Erxianmiao 西李门二仙庙**

In contrast to the extant mid-twelfth century Main Hall, the three-by-three-bay wide Gatehouse at Xilimen Erxianmiao 西李门二仙庙 in Hexi township 河西镇, Xilimen village 西李门村, Gaoping municipality of Jincheng prefecture (inventory number 6-0374-3-077), applies five-cai 踩 bracketing on top of the horizontal architrave or pupaifang 普拍枋 that emulates the shape of an open fan (Figure 3-27). The gable-roofed structure embodies a common design scheme in southeastern Shanxi that was popular next to the application of a single fan-shaped corbelled cluster in-between the central bay columns at the front façade in hip-and-gable architecture. At the Shanmen of Xilimen Erxianmiao, every intercolumnar position along the front and back facades is adorned with shanshi dougong in jixin-style and ground plans that recall the shape of an 8-pointed star. Except from the omission of angled shuatou at the interior, the exterior and interior projections match and show angled bracket-arms in the strictest sense. They project from the ludou and also from the small bearing blocks above. At the interior, the timbers perpendicular to the building plane carry a short subsidiary column which supports the lowest eave purlin. There is no visual distinction between the fan bracketing at the front and the rear facade.
Gaoping Erlangmiao 二郎庙

Erlangmiao 二郎庙 in Gaoping municipality of Jincheng prefecture (inventory number 6-0387-3-090), a one-courtyard complex north of Wangbao village 王报村 in Sizhuang township 寺庄镇, preserved the original timber structure of the earliest stage building in Shanxi province, which dates to the twenty-third year of the Dading reign period in the Jin dynasty (金大定二十三, 1183 C.E.). Despite the high cultural value of the stage, for this discussion the Main Hall, a rectangular five-bay wide gable-roofed hall with a narrow front corridor and no interior columns is more interesting (Figure 3-28). In fact, the design of the xitai at Wangbao Erlangmiao recalls the architecture of the Main Hall at Xilimen Erxianmiao, and the Main Hall at Wangbao resembles the Gatehouse at Xilimen.

At Gaoping Erlangmiao, the current reconstruction of the Main Hall and its adjacent Sacrificial Hall in the front date to the fourteenth year of the Kanxi reign period (康熙四十年, 1701 C.E.) based on the inscription on a board under the roof ridge in the Main Hall. Each bay along the front façade of the Main Hall features one bracket set in-between columns, all of which imitate the shape of an open fan. In detail, their five-cai 踩 design with two steps of bracket-arms perpendicular to the wall plane is well-balanced and symmetrical with genuine xiegong projecting from the ludou at the exterior and interior. Nevertheless, only at the exterior, additional angled bracket-arms extend from the small bearing blocks above. At present, neither orthogonal nor angled huagong are connected to the lower roof purlin or the cross-beam. In contrast, the front façade appears
rather as a curtain wall that is only loosely and “carelessly” attached to the greater
carpentry system.

Furthermore, bracketing at the Main Hall can serve as an exquisite example for
the general development of *dougong* and the increasing desire for decoration to which
fan-shaped bracket sets were subject to. The exterior orthogonal *shuatou* emulate the
head of a dragon holding a bead in its mouth, a design called *hanzhu longtou* 含珠龙头,
and the angled *shuatou* symbolize its claws *longzau*. The playful Qing dynasty style is also
reflected in the carving of other architectural members such as *queti* 雀替 or *you’e* 由额
which are lavishly embellished with dragons, phoenixes or peonies.

**Xixi Erxianmiao 西溪二仙庙**

Xixi Erxianmiao 西溪二仙庙 also known as Zhenzegong 真泽宫 in Chongwen
township 崇文镇, Xixi village 西溪村, Lingchuan county of Jincheng prefecture
(inventory number 5-0267-3-073) not only preserved the mid-twelfth century Rear Hall
(金皇统二年, 1142 C.E.) in the second courtyard and the multi-storied Shuzhuanglou 梳
妆楼 to its East, both valuable examples of regional Jin dynasty architecture in
southeastern Shanxi, but also the Main Hall in the first courtyard that dates to the Ming
dynasty.¹¹⁹

Both, the three-by-three-bay wide Main Hall as well as the three-by-two-bay wide
*xianting* 献亭 or *xiangting* 香亭, which was attached to its front in the Qing dynasty,
display symmetrical fan-shaped bracket sets with their ground plan shaped like an 8-
pointed star (Figure 3-29; Figure 3-30). Whereas the *xianting* features three simple
shanshi dougong of three-cai 踩 at intercolumnar positions along the front façade, the hip-and-gable roofed core structure from the Ming dynasty shows angled bracket-arms on top of every column. Today, looking from outside, the fan-shaped corbelled clusters at the front of the core hall are not discernible since they are hidden behind planks and concealed by the crude ceiling of the xianting. Only at the side and rear façades reveals the building “classical” fan-shaped sets of five-puzuo in Song dynasty terminology (equal to five-cai 踩 in Qing dynasty terminology) with xiegong that project from the ludou and from the small bearing block above. Nevertheless, standing inside the Main Hall and looking back at the front facade, the interior angled bracket-arms become visible. They extend from the ludou, and only the horizontally leveled zhenghuagong directly support the extremely large cross-beams, or in case of the two side facades, the longitudinal beams respectively. Despite the re-construction in the Ming period and repair in the Qing period, Li Huizhi explained that certain features of the greater carpentry system still reflected the style of the preceding dynasties, for example the design of the dingfu that was popular in the Jindongnan region during the Jin dynasty.120 The timber dimensions of 15.5 by 10.5 centimeters for dancai 单材 and the length-width ratio of 3:2 would have matched only the lowest rank i.e. eighth grade in the Yingzao fashi. However, in the Song period, such a low rank for the Main Hall would have been rather unusual and unlikely. The corbelled corner clusters show multiple mojiaogong, which at first glance seem to revive Liao and Song dynasty style building but in fact, express a new emphasis on decoration.121 In conclusion, the monastery layout of Xixi Erxianmiao probably included a structure that was similar to the extant building in floor plan design and roof slope since
the Jin dynasty. It underwent repair in the succeeding periods for instance in the Yuan dynasty which included bracketing at the eaves columns as well as the interior columns.\textsuperscript{122}

**Fucheng Yuhuangmiao 府城玉皇庙**

The Temple of the Jade Emperor in Fucheng village 府城村, Jincun township 金村镇 (inventory number 3-0113-3-061), is the largest Daoist site in today’s Zezhou county of Jincheng prefecture which derives its name from the historical government prefecture of Danchuan 丹川府 during the Tang dynasty.\textsuperscript{123} The North-South oriented monastery complex of three courtyards was established in the Song dynasty (1076 C.E.) and still preserves Song, Jin and Yuan dynasty relics with orthogonal timber bracketing. More than thirty stone steles give evidence of the continuous repair in the past centuries, and in fact, the current architecture of the first gatehouse was rebuilt in the Yuan, Ming, and Qing periods upon destruction by the Jurchen army in the beginning of the thirteenth century.\textsuperscript{124} The *toudao shanmen* 头道山门 is a three-by-three-bay gable-roofed structure with three intercolumnar clusters of seven-*cai* 踩 and genuine angled bracket-arms that are symmetrically arranged in the shape of an 8-pointed star (Figure 3-31). In detail, genuine *xiegong* project from the *ludou* and from the small bearing blocks at the second and third exterior steps. At the interior, where *xiegong* step out only from the *ludou*, the orthogonal *shuatou* are linked to short suspended columns or *chuilianzhu* that support the lowest eave purlin.
The Gatehouse is a good example of the hierarchical system in traditional Chinese architecture that put emphasis on the center and the central bay. The design of the intercolumnar corbelled clusters along the façade is not the same. The fan-shaped bracket set in the central bay is the most prominent feature with flanking pairs of _xiegong_ being carved as false cantilevers in split bamboo style, whereas those at the side bays just feature _shanshi dougong_ with regular bow-shaped bracket-arms.

c) Central Shanxi: Jinzhong 晋中市

Zhenguosi 镇国寺

Tianwangdian of Zhenguosi 镇国寺 in Haodong village 郝洞村, Nangyuan township 囊垣镇, near the historical city of Pingyao in Jinzhong prefecture (inventory number 3-0111-3-059) is a three-bay wide gable-roofed rectangular gatehouse of the Yuan dynasty with one intercolumnar bracket set in each bay (Figure 3-32). The monastery was established in the Five Dynasties period and still comprises a rare example of Northern Han architecture. As expected, the Ten-thousand Buddha Hall or Wanfodian that dates to the seventh year of the Tianhui reign period (北汉天会七年, 963 C.E.) applies only orthogonal bracketing.

The ground plan of the fan-shaped bracket set in the central bay of the front façade at Tianwangdian follows the shape of an 8-pointed star with genuine exterior _xiegong_ in the shape of false cantilevers. At the interior, they are just regular _huagong_. In both cases, the angled arms project directly from the _ludou_. Similar to the orthogonal counterparts, the fan-shaped bracket set of five- _puzuo_ seemingly possesses two levels of
shuatou but eventually applies a genuine shuatou and a shuatou-style chenfangtou. The latter corresponds to the head of the four-rafter-beam that pierces through the wall plane. Furthermore, neither orthogonal nor angled bracket-arms are connected to the greater carpentry system at the interior.\textsuperscript{126} Structurally speaking, such an arrangement is still useful, since the angled bracket-arms provide two additional points of support for the eaves (-raising) joist or liaoyanfang. In comparison to dougong with triangle-shaped ground plan that are not connected to the greater carpentry system, the 8-pointed star layout achieves equilibrium and structural balance through the placement of genuine xiegong at the interior steps.\textsuperscript{127}

d) Central Shanxi: Lüliang 吕梁市

Taifuguan 太符观

Taifuguan 太符观 in Shangmiao village 上庙村, Xinghuacun township 杏花村镇, Fenyang municipality 汾阳市 in Lüliang prefecture (inventory number 5-0243-3-049), was founded in the beginning of the thirteenth century (金承安五年, 1200 C.E.) but the relevant architecture with shanshi dougong dates to the succeeding periods.\textsuperscript{128} The West Side Hall also called Wuyuedian 五岳殿 is dedicated to the Gods of the Five Peaks 五岳山神 and the Four Rivers 四渎河神. The matching East Side Hall venerates the Holy Mother of the Earth and is also known as Houtushengmudian 后土圣母殿. Both Ming dynasty relics display fan-shaped bracketing at intercolumnar positions in the central bay of the five-bay wide gable-roofed structures (Figure 3-33). The symmetrical ground plan follows the shape of an 8-pointed star with genuine xiegong projecting from the ludou,
and at the front façade, additionally from the small bearing block above. At the rear side, zhenghuagong support the lowest eave purlin. In contrast to the other column-top or intercolumnar bracket sets, the angled arms of these shanshi dougong are designed as false cantilevers which highlights their importance.

6. **Selected examples of post-Jin dynasty buildings with fan-shaped bracket sets at monasteries in Shanxi province that were established after the Yuan dynasty**

Finally, among the more than two-hundred relics of traditional timber architecture protected on a national level in Shanxi province, there are abundant examples of monasteries that were established after the Yuan dynasty in their current (architectural) form and preserved post-Jin dynasty building. It vividly proves the continuous use of fan-shaped bracketing. This includes the following monasteries.

a) **Southeastern Shanxi: Jincheng 晋城市**

**Chongansi 崇安寺**

Similar to monasteries and temples that were established before the end of the Jin dynasty and preserved timber architecture dating prior to the mid-thirteenth century, or at least with rebuilding that followed the traditional “old” style of the preceding dynasties such as Xixi Erxianmiao, the current site of Chongansi 崇安寺 in the capital of Lingchuan county in Jincheng prefecture (inventory number 6-0402-3-105) dates back to the Yuan dynasty even though the idea of a monastery can be traced to the Northern and Southern Dynasties period. Several timber halls that reflect Yuan, Ming and Qing period style display fan-shaped bracketing.
The Guodian 过殿 which is located on the central axis north of the multi-storied Main Gate in the first courtyard is a five-bay wide, hip-and-gable roofed hall with six eave columns in the front (Figure 3-34). Four of which are crowned with five-cai 踵 bracket sets in the shape of an open fan. The most exterior level of angled shuatou is omitted. Genuine xiegong project from the ludou and from the small bearing block above. At the interior, the symmetrical layout in the shape of an 8-pointed star is reduced to a single jump of xiegong that steps out directly from the large bearing block. The orthogonal zhenghuagong provide support for the cross-beams. Guodian and also Daxiongbaodian, which is located in the second courtyard to its North, both feature one intercolumnar bracket set in each bay along the front façade, but only the latter, a five-bay wide, gable-roofed hall, displays shanshi dougong in-between the columns (Figure 3-35). Generally speaking, the fan-shaped bracket sets of both timber halls are similar in design, but Guodian applies bow-shaped bracket-arms and Daxiongbaodian false cantilevers.

**Dayang Tangdimiao 大阳汤帝庙**

Dayang Tangdimiao 大阳汤帝庙 in Dayang township 大阳镇 Xidayang village 西大阳村, Zezhou county of Jincheng prefecture (inventory number 6-0410-3-113) is an interesting example regional style architecture in Shanxi province and embodies typical features that contrast the official rules in the Yingzao fashi including the use of unprocessed naturally crooked building material, flexible design and construction methods in the greater carpentry system, or the omission and shifting of columns. In particular, some features are specifically associated with the Yuan dynasty such the long
and sturdy, circular, large architrave called *da’e* and the sparse application of eave columns along the façade.

The central bay at the front façade of the three-bay wide, gable-roofed first gate or Shanmen 山门 and the side bays at the rear façade of the three-fold second gate or Zhongmen 中门 apply intercolumnar fan-shaped bracket sets (Figure 3-36). The most impressive architecture is the Main Hall or Chengtangdian 成汤殿, a three-bay wide timber structure with unusually large bay-length that was originally built in the fifth year of the Qiande reign period of the Song dynasty (宋乾德五年, 967 C.E.) but upon destruction in the early Jin period, was reconstructed in the Yuan dynasty (Figure 3-37). In total, there are fifteen *dougong* placed along the front façade, which high number but traditional size (one *dancai* 单材 equal to 16.5 by 9 centimeters) marks the transition period from the Jin to the Ming dynasties.

In detail, one intercolumnar bracket set of five-*puzuo* in each of the three bays applies angular bracketing, but their placement does not reflect the placement of the eave columns or the partitioning of the front facade. In fact, one prominent *shanshi dougong* still marks the center of the building and is flanked by two pairs of regular corbelled clusters at the more than eight meter wide central bay. In a skillful way, the outward rounded curve of the long and sturdy architrave corresponds to the central fan-shaped bracket set above and further emphasizes the symbolic center and actual entrance of the hall. At the more than five meter wide side bays, *shanshi dougong* are put in close proximity to the central bay columns rather than at the spatial center of the side bays. Visually, their placement matches the end of a short horizontal timber called *tatoumu* 榻.
that is inserted into the column heads and supports the main architrave decreasing the span length through the additional layer of abutment. On closer inspection it becomes apparent that the unusual rhythm of angular and orthogonal bracketing follows the axes of the cross-beams rather than the eave columns. Every second corbelled cluster eventually supports a cross-beam or the lowest eave purlin respectively. As expected, the interior zhenghuagong of the three fan-shaped bracket sets always uphold the eave purlin.

b) Southeastern Shanxi: Changzhi 长治市

Luanfu Chenghuangmiao 潞安府城隍庙

The “Temple to the Prefecture City’s God” in Changzhi prefecture 潞安府城隍庙 (inventory number 5-0233-3-039) is a fairly large monastery site of three courtyards with well-preserved Ming dynasty architecture including the northernmost structure called Sleeping Palace or qingong 寝宫 (Figure 3-38).\textsuperscript{133} The first gate or damen 大门 and the pavilion for sacrifices or xianting in front of the Main Hall date to the Qing dynasty.\textsuperscript{134} The Main Hall is the only architectural relic of the Yuan dynasty during which the monastery was established.

The xilou 戏楼 belongs to the category of shanmen wulou 山门舞楼 that combines a gatehouse (in this case, the second gate or Erdaoshanmen 二道山门) with a multi-storied pleasure building (including stage) called wulou 舞楼 (Figure 3-40).\textsuperscript{135} The integrated stage or xitai 戏台 that is located at the rear was probably erected in the mid-sixteenth century (1555 C.E.) as suggested by the inscription on the colored glazed roof tiles of the ridge.\textsuperscript{136} The bracket sets of the stage are seven-cai 踩 with two tiers of
huagong and one tier of false cantilevers which tips are carved in the shape of an upward turning snout. To be precise, the huagong are placed above the false cantilevers, which is unusual and reflects local building style. One eye-catching corbelled cluster in the shape of an open fan is adorning the central bay. The wulou displays highly decorated bracket sets and exquisitely carved architraves, which indicates construction technology and style of the late Qing dynasty (first half of the nineteenth century). The inscriptions of the temple’s stone steles recorded repair work in 1774 and 1834 C.E. Additionally, there are fan-shaped bracket sets at the first gate or damen as well (Figure 3-39).

Generally speaking, Changzhi Chenghuangmiao can serve as a wonderful example for the flexibility of corbelled clusters with genuine xiegong placed along the exterior facade.

First, at the xianting and the qingong, we can observe the same alternating rhythm in dougong design that we noticed at the Tangdidian of Dayang Tangdimiao (Figure 3-41; Figure 3-42). Regardless of their placement at column-top or intercolumnarly, the interior zhenghuagong of every bracket set along the façade is connected to the greater carpentry system. However, only every second dougong supports a cross-beam and every other dougong upholds a roof purlin. (There are no true descending cantilevers or any other slanting members just horizontally leveled huagong that are inserted into a suspended column or chuilianzhu). The distinction between a bracket set “on top of a column” or “in-between columns” became less important. In other words, (the design features of) floor plan and column-grid were replaced by the frame and the axes of transverse beams that reshaped the idea of the “intercolumnar set” and defined the corbelled clusters along the façade as a bracket set “on top of a beam” or “in-between-beams”. In other words,
shanshi dougong are usually placed either at the center of the bay (in case of intercolumnar dougong) or on top of columns. If we recall Dayang Tangdimiao, their placement does not correspond to the columns or the space in-between and seems arbitrary and at first glance even without logic. Xianting and qingong at Chenghuangmiao apply fan-shaped bracket sets of five-cai 踮 at column-top and intercolumnar positions within the same building. Again, their unusual placement at both positions within the same building reflects the new rhythm and a shift of decisive factors in design.

Second, xianting and qingong also reflect the local building traditions of the Jindongnan area that adopt certain features of tingtang-style architecture for diantang-style buildings as discussed in part two of this thesis.

c) Central Shanxi: Jinzhong 晋中市

Pingyao Chenghuangmiao 平遜城隍庙

The extant architecture of the City God’s Temple 平遜城隍庙 in the historical city of Pingyao in Jinzhong prefecture (inventory number 6-0483-3-186) dates to the restoration between the third and the eighth year of the Tongzhi reign period in the Qing dynasty (清同治三至八年, 1864-1869 C.E.) even though the site was established in the previous centuries.\(^{139}\)

The five-bay wide xiandian is crowned by a flush gable–roof or yingshan juanpeng 硬山卷棚 and features one intercolumnar fan-shaped bracket set of five-cai 踮 with genuine xiegong at the exterior and interior projections at the one-bay wide baosha in the front (Figure 3-43). The exterior shuatou mimic a dragon head which is the
common carving method of the decorative nose in Pingyao municipality during the Qing period. Similar bracketing, in particular the carving of cantilever and *shuatou* tips, can be seen at another monastery complex of the same period in Pingyao, the Wuliao 武庙 also called Guandimiao 关帝庙. Despite several restorations during the Qing dynasty (1765, 1840, and 1872 C.E.), only the Main Hall and the *yuelou* 乐楼 survived until present (Figure 3-44). The latter displays a dominant fan-shaped bracket set at the intercolumnar position of the central *baosha* at the front façade. Furthermore, one of the two stage buildings at the Temple to the City God in Pingyao also employs five-cai 踩-double-xia’ang fan-shaped bracket sets: the Shanmen at Caishenmiaojiao 财神祠, a sub-temple that is attached at the core monastery’s West, displays one of such intercolumnar dougong at the baosha of the central bay. It also dates to the 1860s.

d) Southwestern Shanxi: Yuncheng 运城市

**Guangshengsi 广胜寺**

Water was a precious commodity in the arid climate of China’s North. It is not surprising that people of the past appreciated the merits of water and venerated its embodiments. They built monasteries to worship water next to mountains and peaks as natural phenomena in the form of rain, springs, rivers or lakes or in their anthropomorphic or zoomorphic form as local deities. Especially in the Yuan dynasty, large halls were built to offer sacrifices to water deities and worship nature, such as Mingyingwang Hall 明应王殿 at Shuishemiao 水神庙 in, Guangshengsi village 广胜寺
Shuishengmiao is located west of the Lower Guangsheng Monastery at the foot of a mountain and along with the lower and upper parts of the monastery comprises the third part of the large monastery layout. Being rebuilt in the sixth year of the Tingyou reign period, the hall dedicated to the God of the Huo Spring gives vivid evidence of the exquisite Yuan dynasty painting style. Nevertheless, it not only provides shelter to more than two-hundred square meters of thrilling frescos from the fourteenth century. It is also an important cultural relic of this period’s architecture itself. The hall is three-by-three-bay wide with single hip-and-gable roof, but the double-eaved visual effect is achieved by a lower, second set of eaves that belongs to the five-bay wide surrounding corridor. The intercolumnar dougong at the central bay of the front corridor applies genuine xiegong that directly step out from the ludou. The ground plan of the four-puzuo bracket set is shaped like an 8-pointed star with two layers of angled shuatou at the exterior. The orthogonal decorative nose is carved like the head of a dragon, and the second, top-most layer of angled shuatou symbolizes its extended limbs. Surprisingly, the angled shuatou at the interior do not just stick out as the ribs of a semi-circular stripped off the covering material but rather support a horizontal timber joist that connects the core hall with the corridor in a diagonal way. Among all the extant buildings of the Guangsheng Monastery only Mingyingwangdian and the Feihong Pagoda 飞虹塔 display fan-shaped bracket sets, the latter being an extraordinary example of Ming dynasty Maiolica architecture located at the Upper Guangsheng Monastery on top of a nearby mountain (Figure 3-46).
e) Central Shanxi: Lüliang 吕梁市

Fenyang Wuyuemiao 汾阳五岳庙

Fenyang Wuyuemiao 汾阳五岳庙, which was established in Beiyuyuan village 北榆苑村, Sanquan township 三泉镇, Fenyang municipality 汾阳市 in Lüliang prefecture (inventory number 6-0408-3-111) during the Dade reign period in end of the thirteenth and beginning of the fourteenth century of the Yuan dynasty (元大德三至十年, 1299-1306 C.E.), is best known for its marvelous Yuan dynasty wall paintings. Nevertheless, the Temple to the Five Peaks is not only important for the discussion of Chinese painting but also for the better understanding of traditional architecture.

Today, Wuyuedian 五岳殿 and Shuixiandian 水仙殿 are three-bay wide halls with gable roof that display one fan-shaped bracket set with genuine xiegong at the intercolumnar positions of their central bays (Figure 3-47). Both structures retain the Yuan dynasty style despite the monastery’s repair in the succeeding Ming and Qing dynasties. In comparison with the pre-Yuan dynasty examples discussed in part two of this thesis, the interior projection of these shanshi dougong is particularly interesting. It is not surprising that the interior zhenghuagong are involved in the greater carpentry system. It is rather astonishing that (they are rare examples in which) a true descending cantilever is used in combination with the symmetrical design in the shape of an open fan and 8-pointed star. The tails of the slanting cantilevers uphold the lowest eave purlin.
7. Conclusions: fan-shaped bracket sets in Shanxi province in the Yuan, Ming, and Qing dynasties

a) General concluding remarks

Selected Chinese publications with focus on Shanxi province addressed the use of *xiegong* after the Yuan dynasty. For example, Zhao Ming 赵鸣, who discussed the regional character of building methods and technologies in Shanxi, listed the angled bracket-arm in the strictest sense among the typical features in this province:

“元代以后，斜栱在其他地方很少再见到，而在山西各地，直至清末还大量的使用斜栱。” 146 (After the Yuan dynasty, *xiegong* were hardly seen in other regions, but at various places in Shanxi, *xiegong* were still largely used until the end of the Qing dynasty.)

Or, Zuo Guobao 左国保, Li Yan 李彦, and Zhang Yingying 张映莹, who published a general survey of Ming dynasty architecture in Shanxi province, stressed the continuous use of genuine *xiegong* in the Ming period against the background of official architecture (especially in contrast to Chongshansi 崇善寺, the prime example of the official monastery style in this period). 147 Past scholarship correctly identified some basic qualities of *xiegong*-architecture but underestimated the wide-ranging scope (and the need of further classification and typologies).

It cannot be emphasized enough that the angled bracket-arm in the strictest sense is one of the most popular features in regional, non-official architecture of Shanxi province since the Liao dynasty. It is further beyond doubt that fan-shaped bracketing remained popular in the Yuan, Ming, and Qing dynasties regardless of the dynasty’s affiliation to indigenous Han-Chinese culture.
In fact, fan-shaped bracketing is still in vogue and appeals to the taste of the people in Shanxi province. For example, the most recent addition at Jiwangmiao 稷王庙 in Jishan county 稷山县 (inventory number 6-0430-3-133) displays fan-shaped bracketing in the form of smaller timber carpentry (Figure 3-48). The modern shrine inside the Houjilou 后稷楼, a multi-storied structure from the Qing dynasty with orthogonal bracketing, dates to the beginning of the twenty-first century and was produced in the local workshop. It applies shanshi dougong of three-cai 踩 at intercolumnar and column-top positions, and despite the simple design such bracketing can satisfy the desire for decoration and adorn the empty space along the front façade.148

Finally, the author would like to draw the following preliminary conclusions with regard to design.149

First, fan-shaped bracketing at the intercolumnar position of the central bay at the front façade is one of the dominant design schemes in Shanxi province, regardless of the geographical prefecture or religious affiliation. It can be seen at pre-Yuan dynasty buildings but also at architecture of various roof design that dates to the Yuan, Ming or Qing periods respectively, for example Tianwangdian of Zhenguosi from the Yuan dynasty, or East and West Side Halls of Taifuguan and the Rear Hall of Chongmingsi from the Ming dynasty, or the Sacrificial Hall of Pingyao Chenghuangmiao from the Qing dynasty.

Second, against expectations, column-top bracketing in the shape of an open fan did not vanish into thin air.150 On the contrary, not only relics of the Yuan dynasty such as the side halls at Zhengjuesi, but also several Ming dynasty buildings show a new
fondness for this position. The latter includes, for example, the Seven-Buddha Hall 七佛殿 at Youxiansi 游仙寺 or the Main Hall at Xixi Erxianmiao. Angled bracket-arms were integrated into the organic, star-shaped clusters on top of columns, but the protruding gong shed the structural function and was reduced to decoration of the interior design; usually, just the interior zhenghuagong provided abutment for the longitudinal or transverse beams. Additionally, such bracketing was occasionally placed around the hall along the four building façades. Nevertheless, such bracketing conveyed the idea of the past and probably followed a traditional design in the style of the preceding Song dynasty; most of the relevant buildings are located at monastery sites that are affiliated with previous prototypes and are re-constructions of previously destroyed timber structures.

Third, generally speaking, there is no causal relationship between the roof shape and the placement of fan-shaped bracket sets at the top of columns or in-between them. Architecture with hip-and-gable roof as well as architecture with gable roof applies fan-shaped bracketing at column-top position as well as at intercolumnar position. It seems rather safe that if a rectangular hall is covered by a gable roof, the application of fan-bracketing at the intercolumnar position of every bay along the façade is more likely. For example, the front and rear facades of the gatehouse at Xilimen Erxianmiao display shanshi dougong in-between columns of the central bay and additionally, the two side bays.

Fourth, generally speaking, symmetrical and asymmetrical ground plan designs with fan-shaped bracket sets continued to co-exist but with a new preference for balance and symmetry. In other words, the symmetrical arrangement of angled bracket-arms that equally projected from the large bearing block inside and outside the hall was
comparatively popular (in comparison to the pre-Yuan dynasty examples discussed in part two of this thesis). An exception to the rule was a special kind of fan-shaped bracketing with triangle-shaped ground plan that applied xiegong exclusively at the exterior façade and linked the orthogonally projecting interior huagong at the inside of the hall to the greater carpentry system. In detail, the following two scenarios were possible at the inside of the building: in the first case, if there was only one step of horizontally leveled interior huagong, it was used as an abutment for the cross-beam; or in the second case, if several horizontal timbers were piled up to achieve a certain height or if a slanting member was involved, the interior zhenghuagong usually supported the lower eaves purlin. This type of bracketing was dominant in the Jindongnan area ever since and became one of the most typical designs in the local architecture of Shanxi’s Southeast, especially if the application was limited to a single set at the intercolumnar position of the central bay at the front façade. The beginnings of which are discussed in detail in part two of this thesis.

Fifth, the craftsmen in Shanxi province have used fan-shaped bracketing from the eleventh century until present. On closer inspection it becomes evident that fan-shaped bracket sets were subject to the general development in traditional Chinese architectural throughout the centuries and conveyed the style of a certain dynasty or the flavor a certain local workshop (through structural details or decoration). For example in the Yuan dynasty, the use of large, seemingly oversized, large architraves called da’e that were made of natural rough lumber logs not only changed the greater carpentry system itself but also the definition of column-top and intercolumnar bracket set.\textsuperscript{152} For example at the xitai of Niandui Yuhuangmiao 坻堆玉皇庙 in Yuanqu county 垣曲县 of
Yuncheng prefecture or at the Main Hall of the Linjin county government office 临晋县衙 in Yuncheng prefecture, the placement of columns does not match the placement of bracket sets, and the distinction between dougong at column-top and in-between columns is less obvious. Additionally, similar to orthogonal bracketing, fan-shaped bracket sets became the playground for decoration. Shuatou, cantilevers, and even regular zhenghuagong reflect the carving method of specific dynasties, for example the playful Qing dynasty style at the Main Hall of Gaoping Erlangmiao.

b) Different types of post-Jin dynasty fan-shaped bracket sets: simple-V-shaped type, multiple-V-shaped type, O-shaped type, Y-shaped type

At this point, based on the visual and textual analysis of selected Yuan, Ming and Qing dynasties’ examples, the author would like to emphasize the elevation of shanshi dougong and introduce four characteristic types of fan-shaped bracket sets in Shanxi province since the thirteenth century. Generally speaking, we can distinguish between the ways the angled bracket-arms are integrated into the corbelled cluster. For better comparison, the different designs are associated with capital English letters, namely the single-V-shaped type, the multiple-V-shaped type, the O-shaped type, and the Y-shaped type (Table 3-3). Furthermore, the W-shaped type will be introduced in the following chapters taking Wanrong Dongyuemiao 万荣东岳庙 as an example).

In detail, the most basic form is the simple-V-shaped type (four-puzuo in touxin-style or five-puzuo in jixin-style) with two arrays of angled bracket-arms that start directly at the basic bearing block ludou. The protruding lines of vertically piled up genuine xiegong consist of one step or two steps and are crowned by angled shuatou.
The multiple-V-shaped type is a further enhancement of the basic simple-V-shaped type. Additional xiegong (or angled shuatou in case of four-puzuo sets) are placed at the second level, extending from the small bearing block on top of the orthogonal huagong of the ground level. Looking at the elevation drawing of such a bracket cluster, it is easy to discern the underlying notion of multiple, diverging lines that generate two V-shaped figures with the inner-most one being proportionally smaller than the exterior flanking one.

Both V-shaped types evenly apply angled shuatou either of the same number as the angled bracket-arms or of a higher number if an additional pair of angled shuatou is directly inserted into the regular orthogonally projecting decorative nose. By comparison, the O-shaped type omits the most exterior flanking pair of shuatou and interrupts the design of evenly diverging lines that come to an abrupt end before the shuatou-level.

The Y-shaped type refers to the “procrastinated/delayed” application of angled bracket-arms in the strictest sense, since there are no xiegong that directly project from the ludou at the ground level. Their application starts not before the second level where they extend from the small bearing block at 45 degree angles to the wall plane. (Due to their well-balanced rear extensions) Their design seems especially playful. It skillfully evokes the underlying idea of a delicate open fan without betraying the regular design of orthogonally projecting huagong at the first level. Both V-shaped types play the dominant role in the architectural landscape of Shanxi province, whereas the Y-shaped type is comparatively seldom used.

In most cases, there is the desire to distinguish between the different placement and position of dougong along the façade according to their architectural, cultural and
visual importance and to express it visually. This notion is a general characteristic of bracketing in traditional Chinese architecture and can certainly also be seen at regular orthogonal bracketing without xiegong. In the case of shanshi dougong, such grading becomes evident in the application of more members (higher number of bracket-arms or shuatou), the general distinction between true and false cantilevers, or the carving method of the tips of cantilevers and shuatou. In detail, the multiple-V-shaped type is the most complex and complicated design that put the most emphasis on the nature of the open fan; it is followed by the O-shaped design, the single-V-shaped design and finally, the Y-shaped design. In other words, bracket clusters within the same building can apply the most lavish design i.e. multiple-V-shaped design at the intercolumnar position of the central bay, but at intercolumnar positions of the adjacent side bays, they just use the simpler single-V-shaped or O-shaped design. Likewise, there is more value attached to the exterior than the interior projections of the bracket clusters which is why the multiple-V-shaped design is hardly found at an eave bracket set’s interior projection at the inside of the hall. An exception to the rule is the Shanmen at Kaihuasi 开化寺 that put more emphasis on the courtyard of the monastery.\textsuperscript{155} The fan-shaped bracket set at the front façade of the multi-storied gate house follows the O-shaped style with regular angled huagong, but the rear façade (facing the interior courtyard) follows the multiple-V-shaped design with split bamboo-styled false cantilevers.

Finally, although many of the pre-Yuan dynasty examples discussed in part two of this thesis follow the simple-V-shaped design, it is not correct to assume an absolute chronological shift towards the multiple-V-shaped type in the succeeding dynasties.
Chapter 4: Angular grid-like bracket system of ruyi dougong

1. Nomenclature: xiegong versus shanshi dougong and ruyi dougong

Similar to fan-shaped bracket sets, ruyi dougong 如意斗栱 also applied the angled bracket-arm in the strictest sense or genuine xiegong, and the questions of origin, development and typology were likewise uncertain. Since the term “ruyi dougong” or “(ceremonial) scepter bracket set” describes a full, complex system of bracketing rather than an individual bracket-arm, the author strongly suggests discussing it with regard to “shanshi dougong 扇式斗栱” (i.e. “fan-shaped bracket sets”) rather than comparing it with “xiegong” (i.e. angled bracket-arm) alone (as usually done by past Chinese scholarship). In other words, in terms of methodology it is necessary to differentiate between the organic unit of a bracket cluster and the individual member of a bracket-arm.

2. Definitions of ruyi dougong 如意斗栱 by past Chinese scholarship

Up to the present, there was no standard definition in Chinese or English that could describe the phenomenon of ruyi dougong accurately. Modern scholarship relied on the terminology that Liang Sicheng introduced in the beginning of the last century. He first listed ruyi dougong in the glossary of terms when discussing the Gongbu gongcheng zuofa. In essence, he vaguely defined them as the bracket sets that were formed by arms or cantilevers at 45 degree angles to the façade and orthogonal members that mutually supported each other:

“。。。在平面上除互成正角之翘昂与栱外，在其角内四十五度线上，另加翘昂者。”157 (…with regard to the floor plan, next to qiao and ang that mutually
support each other running at right angles to each other; along the 45 degree angle line between them, there are other qiao and ang added.)

Moreover, based on his field survey and academic research in North China, especially in Hebei and Shanxi provinces, he introduced them as the further development of genuine xiegong. As the showcase of ruyi dougong, he listed the eastern timber archway near the White Pagoda at Beihai in Beijing (Figure 3-49). Liu Zhiping took it a step further and even suggested ruyi dougong simply being the corresponding, equivalent term for xiegong in Qing dynasty technology. Scholars like Liu Dunzhen 刘敦桢 on the other hand emphasized the existence of ruyi dougong in the south, in particular in the following regions: first, especially in Hunan province (also referred to as the region of Xiang 湘) and Hubei province (region of E 鄂), second, also in Fujian province (also referred to as the region of Min 闽), Jiangxi province (region of Gan 赣), and Zhejiang province, and finally, occasionally in the cities of Nanjing and Xi’an (“此类斗栱之起源，迄未明了，其分布状况，亦未经精密调查；仅知湘、鄂，用者较多，赣、闽、浙诸省次之，南京、西安亦偶见其踪迹”).

In Southern terminology, ruyi dougong was traditionally called wangxing paike 网形牌科, a term that literally referred to its grid-like nature. Zhu Yongchun 朱永春 and Pan Guotai 潘国泰 recently drew special attention to the difference between xiegong and ruyi dougong in this respect and stressed the network quality of the latter in their article “Ming Qing Huizhou zhong dougong ruogan diyu tezhen 明清徽州中斗栱若干地域特征”. 264
3. The basic idea of grid-like bracketing

In fact, ruyi dougong represented just one kind of grid-like bracketing or dougong wangge 头棋网格 in traditional Chinese architecture. The innovation of tightly spaced (surface) bracketing was only possible after the dougong technology reached a certain level of scientific knowledge which roughly corresponds to the end of the Ming dynasty. In theory, it could follow the cardinal directions and exclusively apply orthogonal members or further incorporate angled bracket-arms. In other words, two designs were possible, namely the orthogonal grid-like bracket system with bracket-arms applied parallel or at a right angle to the wall plane and the angular grid-like bracket system with bracket-arms additionally applied at an acute angle or obtuse angle to the wall plane.

Chinese scholarship before the end of the twentieth century usually did not differentiate enough between the various kinds of grid-like bracketing. In 1998, Zhu Yongchun classified the extant examples in Huizhou region into three different sub-types, namely the grid-like arrangement of inserted T-shaped half-brackets called dingtougong wangge 丁头棋网格 (including those that exclusively applied orthogonal members and those that additional used angled arms), the grid-like bracketing for interior ceilings called zaojing dougong 藻井斗棋, and finally ruyi dougong. In the case of dingtougong wangge, the grid system relied on touxin-style or “stolen heart” design without bracket-arms parallel to the façade that were placed at each step of perpendicular projecting gong. In tingtang-style Huizhou architecture, the central bay was usually formed by orthogonal brackets and the side bays by angled T-shaped bracket-arms respectively.
In terms of modern engineering, grid-like bracketing recalls the idea of geometric surface or space frames that are popular in today’s industrial and commercial large-scale (steel) architecture. The “Water Cube”, the Beijing National Aquatics Center 北京国家游泳中心 for the 2008 Olympic Games in China that was built by PTW Architects, Arup international engineering group, and Chinese design groups, is currently one of the best examples of three-dimensional space structures with interlocking struts that take full advantage of the triangular frame, its strength, stability and rigidity. Such structures follow a geometric design pattern that consists of basic three-dimensional polygons. They cannot transmit the bending moment but rather transform load into compression and tension stress.

Traditional Chinese grid-like bracketing was technically not as advanced as the modern counterparts. Nevertheless, in comparison to the previous separated singular bracket sets, historical grid-like bracketing appears as a technical novelty that conveys the desire for simplification: the dense network of evenly placed (orthogonal or angular) pieces was able to omit basic brackets that were necessary for detached fan-shaped clusters (for example, exterior guazigong and mangong also called waiye guagong 外拽瓜栱 and waiye wangong 外拽万栱 in Qing dynasty terminology). At the same time, this grid-like bracketing also appears as a highly complex, complicated system and a structurally even more advanced building technology. Every bracket-arm was “intertwined” i.e. closely connected with the adjacent members at the side, below and above, which mutually upheld each other. To some extent, grid-like bracketing created an exaggerated decorative effect that was achieved by the aesthetic sum of all pieces, their
repeated orderly geometry, and densely interwoven arrangement rather than the quality of carving, embellishment, or style of painting at the individual bracket-arm body.\footnote{167}

In the 1920s, the phenomenon of grid-like bracketing grabbed the attention of the German sinologist Ernst Boerschmann who understood it as a special, beautiful kind of architectural cornice that horizontally ran around the perimeter of a timber hall or adorned the building façade. In his opinion, the so-called “Konsolengesimse” emphasized the aesthetic aspect but derived from the same structural idea as separated bracket sets: both features fulfilled the task of upholding the roof eaves.\footnote{168}

In summary, grid-like bracketing existed in the past all over China, in the south as well as in the north. The size of blocks and brackets was extremely small (even if compared to the dimensions of contemporary Ming and Qing dynasty regular bracketing), but at the same time, the number of projecting jumps was unproportionally increased. This was necessary to achieve the same structural strength and to make up for the shortcoming in timber size. The horizontally leveled bracket-arms of each floor were intertwined like the Chinese character “jing 井”, and additionally, xiegong or xie’ang and chagong or cha’ang formed projections in two non-orthogonal directions.\footnote{169} Most importantly, in the supreme form of opulence, adjacent (orthogonal or angled) brackets mutually shared the small bearing blocks between the vertical levels of projecting steps and formed a continuous, flawless woven network of blocks and arms that covered a large area along the façade.

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4. Comparison of fan-shaped bracket sets with scepter bracket sets

For further explanation, it is reasonable to compare fan-shaped bracket sets with *ruyi dougong* and define their typical qualities. In essence, they both were stylistic variations of the regular bracket sets that followed cardinal directions and used orthogonally projecting members. Furthermore, they both were nourished by the technical achievements in corner bracketing but did not necessarily directly result from them. In other words, the evolution of *jiaogong* and *mojiaogong* was crucial for the development of fan-shaped bracket sets in the same way as the appearance of *fujiaodou* paved the way for the rise of *ruyi dougong*.

a) The feature of *fujiaodou*

The feature of *fujiaodou* refers to the fortification of corner bracketing by adding large bearing blocks (with full mounting of bracket-arms, cantilevers and small blocks) to both sides of the corner *ludou* in such a way that the bracket-arms parallel to the building plane become structurally intertwined and dependent from each other (Figure 3-50; Figure 3-63). The Song dynasty manual *Yingzao fashi* already mentioned the possibility of (three) interlinked bearing blocks at the corners of the mezzanine level called *pingzuo* with regard to *chanzhuzao* 缠柱造, a certain type of construction method for multistoried *louge*-type 楼阁 buildings.  

In fact, the earliest extant example dates to the Liao dynasty and is located at the Daxiongbaodian at Fengguosi in Liaoning province (1020 C.E.). The Liao and Jin dynasty buildings of Shanhuasi in Datong provide further early examples (Figure 3-52).
In theory, *fujiaodou* are just a certain kind of intercolumnar bracket sets from which they derived; which is why they appeared only after the clusters in-between columns had become technically mature and fully developed.\(^{173}\) They are dependent on the roof type and usually applied in combination with hip-and-gable design as well as the *tailiang*-style roof construction. The intercolumnar sets in the last bay along the facades simply shifted closer towards the corner *dougong*. Their bracket-arms joined as *liegong* and increased the stability of the corner as the weakest point of the building and consequently the integrity of the entire building structure, a problem which was discussed in part two of this thesis with regard to *liangongjiaoyin* 连栱交隐.\(^{174}\) *Fujiaodou*-architecture flourished since the Yuan dynasty, and goes hand in hand with the preference of horizontally leveled bracket-arms instead of true descending cantilevers with balancing lever effect. Such fortified corner cluster could solve the problem of overhanging eaves in large scale architecture at a time when bracketing underwent considerable change, shed their traditional meaning, and developed into the cushion of the roof frame with decreased size and less ability to project outwards.\(^{175}\) Additionally, they were increasingly popular in the Ming and Qing dynasties since they were able to satisfy the new emphasis on aesthetics, visual effects, and decoration. They made up for the lack of *cejiao* 侧脚 and *shengqi* 生起, two features that had evoked the idea of strong corners carrying the dominant, heavy Chinese roof in the past. Furthermore, they helped to distribute the space evenly. Traditionally, the last bay was the smallest, but the placement of *ludou* next to the corner should still followed the rigorous rules and maintained the mandatory intervals (measured in *doukou*) between the individual bracket sets along the façade. Finally, they enhanced the integrity of bracketing at archways, where a close and
well-functioning connection between the individual bracket-arms or clusters was of utmost importance to prevent the entire structure from tumbling down.

In essence, the idea of *fujiaodou* paved the way. From an ideological point of view, it eased the acceptance of interlinked bracket sets and interwoven bracket-arms. From a technological point of view, it paved the way for the spread of *ruyi dougong* and its final structural maturation. For example, a common construction method of *fujiaodou* since the Ming dynasty was to carve the bearing blocks involved out of one piece of wood, the result of which is called *lianbanke* 连瓣科 in the *Gongbu gongcheng zuofa* (Figure 3-51). Ruiyi dougong made also use of this design principle.

Generally speaking, *fujiaodou* did not become part of the official architectural language before the Ming dynasty. Even then, Ma Xiao pointed out that the use of *fujiaodou* was less popular in places distant from the cultural centers of Beijing or Qufu in Shandong province, where patrons and craftsmen still adhered to old building traditions and adapted the official guidelines to their local needs such as in southeastern Shanxi province. It is not surprising that numerous examples all over China, but especially in such depauperate parts as Jindongnan, do not apply complicated bracketing like *ruyi dougong*; which vividly proves that their application was only optional and never mandatory. Likewise, their use was sometimes reasonable but never absolutely necessary from a structural point of view.
b) Development of *shanshi dougong* and possible advancement toward *ruyi dougong*

Theories about the place of origin of *ruyi dougong*

To summarize, some theories stress the Northern building traditions, others argue in favor of the Southern ones.\textsuperscript{179} Let us recall the controversy about the place of origin of *ruyi dougong* that Liang Sicheng and Liu Dunzhen once started. Liang Sicheng and Liu Dunzhen both were eminent scholars of the first generation of researchers in Chinese architectural history, but they also represented two different philosophies, namely the Northern school represented by Tsinghua University in Beijing and the Southern school represented by Southeast University in Nanjing.\textsuperscript{180} Their opposite standpoints were probably influenced by ideological factors and more importantly, geographical factors that were based on their specialized area of research and the resulting pool of available material. More recently, Zhu Yongchun and Pan Guotai argued for the origin of *ruyi dougong* in the historical region of Huizhou 徽州 also called Wannan 皖南 mountainous region.\textsuperscript{181} In their opinion, *xiegong* had a longstanding tradition in the south and were used in the form of angled half-brackets that were inserted into the column shaft.\textsuperscript{182} They were as common as their orthogonal counterparts in late-Ming to early-Qing period architecture of today’s southernmost Anhui province 安徽, especially around Huangshan 黄山 and Xuancheng 宣城市 (e.g. Jixi county 绩溪县), as well as today’s northeastern Jiangxi province 江西, in particular Wuyuan county 婺源县.\textsuperscript{183} Specifically, typical examples included the residential houses of Qiankou village 潜口民宅 and the
Baolun Pavilion in Chengkan village 呈坎宝纶阁 which are both located in She county 歙县 (Figure 3-53; Figure 3-54; Figure 3-55; Figure 3-56). Moreover, Zhu Yongchun and Pan Guotai inferred that skilled craftsmen from the South could have played the leading part in introducing *ruyi dougong* to the North. In the 1930s, Liu Dunzhen already drew attention to the possible impact of regional craft guilds outside the imperial capitals and the constructing system in the Ming dynasty that was based on work levy. Groups of craftsmen from each region were on duty by turns and annually fulfilled their service duty; they were relieved upon expiration of their term of office (“意者明代营造有征工制度，各地匠工，轮班供役，按年瓜代，此式逐随征工之制，流传北方，殊未可知”).

In other words, the key-questions include the following: first, whether *ruyi dougong* and *shanshi dougong* are identical architectural features but just two technical terms of addressing the same phenomenon in different dynasties; second, whether they evolved individually in detached geographical regions but stylistically still comprise the same architectural feature; third, whether they are two architectural features that mutually influenced each other’s design; or finally, whether they developed completely independently without any causally determined relation.

To give a preliminary conclusion, in essence, the author came to believe that *shanshi dougong* and *ruyi dougong* were two (equally important,) different approaches to bracketing that produced two different, fully matured concepts and designs of *dougong*. Nevertheless, they derived from the same underlying notion of applying angled bracket-arms. Chronologically speaking, *shanshi dougong* antedated *ruyi dougong* with the latter
eventually developing out of the fan-shaped clusters, at least in the central Chinese province of Shanxi. In detail, both types showed some similarities in assemblage and shared certain structural qualities, even if fan-shaped clusters displayed such typical characteristics only in an “embryonic” form. Thus we can infer that *ruyi dougong* was a by-product of *shanshi dougong*’s advancement, but it was not necessarily the exclusive actual result of their enhancement in the Ming and Qing dynasties.

**Theories about the chronological development of *ruyi dougong* in past scholarship**

Lü Songyun 吕松云 estimated that the first examples of *ruyi dougong* dated to the Song dynasty. Unfortunately, he left out further details to pinpoint a specific monastery building or at least a specific geographical region in China:

“如意斗栱：每攒斗栱除了纵横四向各出翘、栱之外，还在 45°方向挑出斜栱；多攒斜栱组成复杂的网格状。这就叫如意斗栱。这种斗栱多于木牌楼上和藻井中，最早出现于宋代。”

(Ruyi dougong: every set of dougong also possesses *xiegong* projecting at a 45 degree angle next to its longitudinal and lateral *qiao* and *gong* that extend in four directions; several *xiegong* together generate a complex, grid-like system. This is called ruyi dougong. This kind of dougong often appears in timber *pailou* and *zaojing*, and emerged first in the Song dynasty.)

In his fundamental work on Chinese architectural decoration, Itō Chūta 伊东忠太 pinpointed six stages of *dougong* development that illustrated the changes in the increasingly complicated way in which the orthogonal or angled bracket-arms in a *dougong* unit stepped out directly from the building plane of the front façade (Figure 3-57). In detail, the bracket-arms projected perpendicular to the front and also to the sides in the first stage, such as at the brick pagoda of Linjisi 临济寺 in Zhengding, Hebei.
province. Second, the same pagoda displays bracket-arms that project at an angle to the facade. The same building gives further evidence of the third stage of development that is formed by a combination of the first and the second type. Fourth, the brick pagoda at Tianningsi 天宁寺 in Beijing shows orthogonal and angled bracket-arms that carry additional small blocks on their top, which further support transverse timber pieces. Fifth, Itō Chūta suggested that the angled bracket-arms consolidated and created the new geometric form of a four-sided rhombus, such as at the Chongshen Shrine 崇圣祠 of Fuxuegong 府学宮 in Qujiang 曲江, Guangdong province. Finally the fourth and the fifth type became mixed, such as in the case of the bracketing at the eastern pailou near the White Pagoda at Beihai in Beijing. In this sixth stage, the rhombus-like clusters blended together and formed a large grid-like system that ran along the façade. To each small sub-center, a bracket-arm that projected perpendicular to the building plane was added.

His main goal was to establish a continuous, chronologically and causally determined logical thread that could explain the typological evolution from the singular projecting bracket-arm to a complex grid-like bracketing system. He explained (diverging) stylistic variations as the result of sub-developments and mutations, such as the bracketing at Haoling Hall 瀛灵殿 of Xiyuemiao 西岳庙 in Tongguan 潼关, Shaanxi province 陕西. His theory was limited to the visual analysis of two-dimensional ground plans, which is why his categorization can only serve as a starting point for further discussion.
Tomfoolery or technical gimmick: construction method and way of assemblage of angled half-brackets and the short rear extension

To begin with, we have to recall the nature of fan-shaped bracket sets. Just as a reminder, the author also used the ground plan design of *shanshi dougong* to pinpoint several basic types (in part two of this thesis) (Table 2-4).

In brief, fan-shaped bracket sets in pre-Yuan dynasty architecture of Shanxi province followed a ground plan that was shaped like the geometrical form of a cross (×), an 8-pointed star (⋆), a 6-pointed star (☆), a triangle (▲), or like the complex form of intertwined stars that were pushed along the cardinal *dougong* axis (⋆+⋆+⋯). Regardless of their projecting at a 30, 45, or 90 degree angle to the building plane, the preliminary visual analysis indicates either the use of long timbers with symmetrical bow-shaped brackets arms or the use of short half-brackets that are asymmetrically applied only at the exterior boiling façade. Additionally, the author paid special attention to the elevation of *xiegong* within the organic unit of the fan-shaped bracket cluster, i.e. the individual placement expressed by the number of jumps (i.e. whether the angled bracket-arms are applied at the lowest level as the first jump or the upper levels as the second, third, or fourth jumps). For example, triangle-shaped clusters in stolen-heart design displayed angled bracket-arms at the lowest level of the exterior projection that directly rested in the mortise opening of the large bearing blocks. These half-brackets did not protrude inside, and their tails were completely invisible at the interior of the hall. Likewise, fan-shaped bracket sets in filled-heart design applied angled half-brackets at the upper jumps that were also completely hidden to the eye of the viewer at the inside of
the hall. Nevertheless, the bracket-arms occasionally extended beyond the rear side of the small bearing blocks on which they rested (Figure 3-58).

This is not just tomfoolery but a technical gimmick that plays an important role in the further development of *shanshi dougong* and *ruyi dougong*. In brief, the tails of angled half-brackets were cut off either right at the small bearing blocks (in case of stolen-heart design) or at short distance behind the small bearing blocks (in case of filled-heart design). In the latter case, the *xiegong* were lodged by a mortise-and-tenon joint into the body of the outermost flanking bracket-arm by which they were terminated.

Fan-shaped bracketing of the monasteries discussed in part two of this thesis such as Sanshengdian of Shanhuasi or Mituodian of Chongfusi give vivid evidence of this detail that paved the way for the further advancement toward *ruyi dougong* (Figure 3-58). Likewise, the short rear extension is clearly visible at the architecture of Xiezhou Guandimiao (Figure 3-74; Figure 3-75) or the Shaanxi Guild Hall in Liaochen, Shandong province (Figure 3-80), which lavishly display the mature form of such grid-like arrangements with repeated, densely placed, adjoining bracket-arms that extend beyond the small bearing blocks by which they are supported. Thus we can assume that the concept of *ruyi dougong* gradually developed since the Song dynasty, when the foundation was laid by a simple technical gimmick for such lavish, exuberant, and exaggerated design that seemingly went over the top of structural necessity.

c) **Hybrid forms: fan-shaped-style vs. *ruyi dougong*-style**

In the strictest sense, *shanshi dougong* are understood as the bracket sets that contain none or just one stack of central *huagong* (starting at the first jump), which rest
on the axis of the central bearing block/ludou and step out directly perpendicular to the building plane. Its angled bracket-arms converge toward the same center or focal point. Their design immediately recalls the shape of an open semicircular fan. In contrast, the timber brackets of *ruyi dougong* do not intersect at a single point of convergence or focus. On the contrary, several adjacent brackets, which are projecting at 90 degree angles to the building plane, are spaced parallel to each other (Since these parallel arms start at the first jump, they need an enlarged ludou or several of the large bearing blocks being placed next to each other). The only exception is the outermost pair of flanking bracket-arms that are applied in an angled way.

In Shanxi province, there are beautiful examples that can illustrate the stylistic transition from *shanshi dougong* to *ruyi dougong*. It is important to emphasize that not all of the fan-shaped bracket clusters intend to emulate the mature concept of *ruyi dougong* and its grid-like nature. On the contrary, they still possess the basic, visible qualities of the fan-shaped design and follow the artistic pattern of an array of angled arms that converge at a single focal point. Therefore, the author suggests to further distinguishing between bracketing that is mainly influenced by *shanshi dougong* and mimics its typical shape on the one hand, and the kind of bracketing that stresses the repeated arrangement of parallel brackets and rather follows the grid-like appearance of *ruyi dougong* on the other hand. Thus we can conclude that there are at least four basic types of bracketing that apply angled bracket-arms in Shanxi province during the Ming and Qing dynasties: *shanshi dougong* and *ruyi dougong* in the strictest sense, and their stylistic variations, namely bracket clusters in *shanshi dougong*-style or *ruyi dougong*-style, examples of which are discussed from the angle of building types in the following chapter.
d) Concluding remarks

This thesis defines the angular grid-like bracket system called *ruyi dougong* as a kind of (surface) bracketing that successfully overcame the limitations of individual bracket-arms or sets and merged all of the members to a strong structural and decorative grid system. It equally employs bracket-arms parallel or at a right angle to the wall plane and bracket-arms at an acute or obtuse angle (usually 45 degree), all of which are “intertwined”, i.e. closely connected with the adjacent members at the side, below and above, and mutually uphold each other. In contrast to fan-shaped sets, there is no single focal point of bracket-arms or point of intersection.

It was the goal of this chapter to draw attention to the popular building tradition of *xiegong* that generated two architectural forms of *dougong* architecture in Shanxi province, namely the concept of *shanshi dougong* and the concept of *ruyi dougong*. It is beyond the limit of this thesis to pinpoint the place of origin of *ruyi dougong* or define the chronological development from demure prototype to tentative hybrid form and the pinnacle of lavish, exuberant, and exaggerated design in the Qing dynasty.

Nevertheless, it is possible to formulate a catalogue of qualities that does not just describe *ruyi dougong* in mature form but rather emphasizes the necessary pre-conditions for emergence.

First, angular grid-like bracketing became fashionable in Late Imperial China (i.e. end of the fourteenth century to beginning of the twentieth century). It was a true product of its time. It is necessary to consider the architectural climate out of which it came into being since certain political, social and cultural change had to take place before this advancement in bracketing technology could finally occur. This includes the restoration
of political unity under native Chinese rule in the end of the fourteenth century, the
flourishing of economy, population growth, and relaxation of centralized court authority
after the early Ming dynasty that resulted in the bloom of personal culture by the mid-
sixteenth century, the international trade and globalism since the late Ming period, the
emerging culture of regional and local centers of commerce and art (e.g. Anhui province)
and the resulting exchange of culture and migration of the general population, including
craftsmen. Especially, the arts of pleasure, leisure time activities, and material culture
flourished and enhanced the increasing desire for decoration in a new consumption-based
secular culture. In terms of traditional Chinese architecture, there was a shift in what was
considered a status symbol. Corbelled clusters were always a means to express the
affiliation with China and the rank and social esteem within the native Chinese culture,
but the way to express such status changed. Broadly speaking, in the Ming dynasty,
column-top *dougong* (and the large grades of *cai* 材) lost their importance and were
replaced by larger numbers of intercolumnar bracket sets. In fact, for example the early-
Ming dynasty Hall of the Eminent Favor or Ling’edian 禧恩殿 of Changling 长陵 at the
imperial necropolis near Beijing 明朝十三陵 squeezed up to eight intercolumnar bracket
sets in the central bay of the front façade with (nearly) no space left in-between. This
notion reached its climax in opulent surface bracketing.187

Second, as discussed before, the innovation of tightly spaced (surface) bracketing
was only possible after the *dougong* technology reached a high level of scientific
knowledge which roughly corresponds to the end of the Ming dynasty. Some basic
technological prerequisites for manufacturing and assemblage were necessary that were

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indispensable as a whole even though individual features and techniques were already known before the Ming dynasty. Broadly speaking, angled bracket-arms for *ruyi dougong* were timbers that intersected at the small bearing blocks but often extended beyond them with their tails inserted into the body of the adjacent brackets. The short rear extension was a structural device to interlace the multiple arms and generate the dense network. In Shanxi province, many pre-Yuan dynasty fan-shaped bracket sets already applied this technique. Furthermore, the method of half-bracketing and the use of *chagong* played a leading role since additional bracket-arms were often inserted into the scepter bracket unit for further compression and to achieve the maximum visual effect. Most importantly, the phenomenon of interlinked bearing blocks and bracket sets at the corners called *fujiaodou* prepared the field for the advent of grid-like bracketing along the façade.

Third, the overall development in the greater carpentry system paved the way for angular grid-like bracketing. In fact, only the advancement in beam science and technology and the decreased dimensions of bracket sets and arms that came along with it made the “plug and play”-technique in grid-like bracketing possible. The measurements of *cai* greatly diminished across the Ming dynasty and bracket-arms came to resemble “paper-thin boards” rather than self-supporting cantilevers. It was necessary to make up for the shortcoming in timber size of the individual members within the corbelled clusters and multiply the amount of bracket-arms and bearing blocks to achieve the same structural strength.
Chapter 5: Post-Jin dynasty xiegong-architecture with regard to building types

Until the beginning of the thirteenth century, we can see angled bracket-arms in the strictest sense at stone or brick pagodas, rectangular timber halls, and smaller carpentry such as at the coffered ceiling at the Main Hall of Jingtusi. They were used for bracketing regardless of the affiliation, function, and location of the hall within the monastery site, i.e. at Front Halls or guodian such as at Nanjixiangsi, Main Halls such as at Dongyi Longwangmiao, and Rear Halls such as at the Sleeping Palace at Daiwangmiao in Yuxian. Fan-shaped bracket sets were even applied at Side Halls that were not placed along the cardinal axis of the monastery such as Wenshudian of Foguangsi. Most often, they are seen at single-storied buildings, but in fact, the mid-eleventh century Timber Pagoda at Fogongsi and the mid-twelfth century Puxian Pavilion at Shanhuasi already employed fan-shaped bracket sets. The examples also include the building type of a gatehouse such as at Tianwangdian of Longmensi.

In the succeeding dynasties, Chinese architectural culture flourished. Angled bracket-arms were still fashionable after the fall of the Jin dynasty in Shanxi province, and many Buddhist or Daoist monasteries or temples for local deities continued to use fan-shaped bracket sets. In the Ming and Qing dynasties, social and cultural changes led to the increasing demand of secular buildings as well as to the enhancement of technology and the evolution of new building types. For example, louge-style 楼阁 buildings incorporated new functions and became more diverse (e.g. military watchtowers at the Forbidden City in Beijing). In particular in the Ming dynasty, the
ideas of amusement and pleasure underwent change and merged with multi-storied architecture such as at Shizhang Yuhuangmiao or Changzhi Fuchenghuangmiao. In other words, the multi-storied gatehouse became multi-functional. Angled bracket-arms adapted well to these new challenges and were applied in the form of fan-shaped bracket sets and scepter bracket sets.

Therefore, post-Jin dynasty *xiegong*-architecture contains multi-storied buildings with gatehouse and stage, interior ceilings for visual embellishment and enhanced acoustics, and monumental archways. Furthermore, it includes “quasi-architectural evidence” at various building types, where bracket sets in stone or ceramic building material emulated the timber archetypes, such as at the Beamless Hall 无梁殿 of Yongzuosi 永祚寺, a two-storied brick structure from the sixteenth century in the compound of the Twin Pagodas 双塔 in Taiyuan (Figure 3-59), the Ming dynasty Feihong Pagoda of the Upper Guangsheng Monastery (Figure 3-46), or at the Qing dynasty shadow wall of Jiexiu Houtumiao 介休后土庙 (the latter temple is further discussed below). They adapted and adopted the idea of fan-shaped bracketing to bricks or glazed ceramic tiles, a building material that came in vogue in the Ming dynasty.
1. Multi-storied louge buildings

a) Fan-shaped bracketing in Jinzhong prefecture

In Jinzhong prefecture, there are two key national heritage conservation units in the city of Jiexiu 介休 that both preserved multi-storied buildings with angled bracket-arms in the form of fan-shaped bracket sets.

**Jiexiu Houtumiao 介休后土庙**

Houtumiao 后土庙 in Jiexiu 介休 (inventory number 5-0227-3-033) was founded in the Ming dynasty through consolidation with another already existing monastery complex from the Yuan dynasty called Sanqingguan 三清观. Opposite the Main Gate is an impressive Qing dynasty brick screen wall 影壁 of nine meters width with nine bracket sets of three-cai 踩, out of which three clusters emulate the shape of an open fan (Figure 3-60).

In the Ming dynasty, the demand of architecture that could provide shelter for the increasingly popular theater plays resulted in new design concepts. Since there were no restrictive design regulations, it was not always necessary to erect a free-standing stage in small pavilion-style as often seen in the preceding Jin and Yuan dynasties. The stage was often built as an addition onto existing architecture to satisfy the immediate need, or the builders retrofitted traditional building types such as the so-called louge guolushi xitai 楼阁过路式戏台 at Jiexiu Houtumiao. Whereas the stage was usually combinend with a gatehouse, the xitai at Jiexiu Houtumiao merged with the multi-storied Hall of the Three Purities or Sanqingdian 三清殿, a tingtang-style structure with hip-and-gable roof,
double eaves, *tianhua*-style天花 interior ceiling, and tall columns in which *dingtougong* were directly inserted. Half of the building’s depth was dedicated to the stage that became located at the rear of the core building and was erected at the beginning of the sixteenth century.\(^{193}\) To increase the size of the stage, a *baosha* was added at the central bay of the rear façade and adorned with an eye-catching *shanshi dougong* at intercolumnnar positions (flanked by regular, orthogonal intercolumnnar sets, one at each side). The fan-shaped bracket set is designed as *five-cai* 蹴 with two tiers of false cantilevers and upward turning snout called *xiangbi shangjuan* 象鼻上卷. Additionally, short ear walls called *yinbi* 音壁 were attached at both sides and projected at an obtuse angle to the building plane to enhance acoustics.

Furthermore, the ritual hall for the Holy Mother of the Earth or *Houtushengmudian* 后土圣母殿 in the third courtyard also applies fan-shaped bracketing;\(^{194}\) the five-bay wide hip-and-gable roofed hall is architecturally linked to its ear buildings at both sides by a common three-fold front corridor. The central bay of each part of the corridor is decorated with one bracket cluster in the shape of an open fan.

**Xianshenlou 祆神楼 of Sanjieyi Monastery 三结义庙 in Jiexiu**

In the Qing dynasty, the well-known building type that combined the gatehouse with a stage underwent further change. It was adapted to local needs and often combined with a temple dedicated to a deity. Xianshenlou 祆神楼 at the Sanjieyi Monastery 三结义庙 in Jiexiu (inventory number 4-0168-3-090) for example, was a fire temple for the worship of Zoroastrianism but the local character of its architecture 地方性 becomes
evident in the skillful nesting of three different functions (Figure 3-61): a stage called xitai 戏台, a pleasure house called yuelou 乐楼, and a connecting passage for traffic called guojielou 过街楼; they blended together into one compact multi-storied structure.

It was reconstructed several times with the most current repair dating to the end of the last century; the current timber architecture dates to the fifteenth year in the Qianlong reign period of the Qing dynasty (1786 C.E.). The architectural design embodies the different functions perfectly: the two-storied timber building with pingzuo and three set of eaves (i.e. erceng sanyan 二层三檐) appears as a passageway at the front and a stage at the rear, following a T-shaped floor plan which central part or wulou is crowned by a cross-shaped hip-and-gable roof called shizi xieshanding 十字歇山顶.

Since the Ming dynasty, traditional Chinese building technology advanced rapidly and made great progress in the arts. Architecture became increasingly complex and the floor plan design of multi-storied buildings more and more complicated. Fan-shaped bracket sets were used as a visual sign or an identification marker of the different architectural functions and parts of the building. At Xianshenlou, there are several different kinds of fan-shaped bracket sets, the most important among them are listed below.

First, at the front part of the building, fan-shaped bracket sets seem to mark the entrance to the passage way and the direction of walking. The front part corresponds to the web or shaft of the T-shaped floor plan and is used as an urban thoroughfare. Each side of the web employs shanshi dougong at intercolumnar positions. In detail, there is one set in the central bay of the ground floor’s South, East and West façades. At the
upper floor, a second fan-shaped bracket set is located exactly above its counterpart on
the first floor, i.e. at the center of the baoshā of the encompassing corridor.

The second type of fan-shaped bracket set is found at the rear side of the building,
where a single bracket cluster in the shape of an open fan is employed at the
intercolumnar position in the central bay of the 3-bay wide xitāi. It draws the attention
and leads the direction of viewing into one focal point i.e. the center of the stage.
Additionally, the two ear walls that are placed at an obtuse angle to the façade of the
stage enhance acoustics but moreover, they further emphasize this visual effect. The
ground plan of both types (of shānshí dougong) follows the shape of an 8-pointed star,
but the fan-shaped cluster at the xitāi conveys higher rank (five-cai 踩 with two tiers of
false cantilever arms instead of three-cai 踩 with a single tier). In both cases, the
cantilever tips are equally carved in the shape of an upturning snout.197

Finally, the third type of shānshí dougong is the result of the special floor plan
that combines a rectangular hall in landscape format measuring three-by-two bays with a
smaller hall in portrait format measuring one-by-two bays. The two columns at the points
of intersection are embellished with xiegōng of 45 degree angles, the design of the
bracket cluster following a symmetrical 8-pointed star. The angled arms are not involved
in the greater carpentry, only zhēnghuāgōng support the large cross-beams. From a
structural point of view, the application of fan-shaped bracket sets with bracket-arms that
project in multiple directions is reasonable and can be explained by (the special situation
of) the clashing of the two hall structures. Therefore, it is not surprising that the three
other walls of the hall that do not show such special bracketing but rather display regular
bracket sets with orthogonal timbers.
b) Hybrid bracketing of *shanshi dougong* and *ruyi dougong* in Yuncheng prefecture

In contrast to the examples in Jinzhong prefecture, two of the most famous key national heritage conservation units in Wanrong county of Yuncheng prefecture display angled bracket-arms in the form of *ruyi dougong*, or at least merge certain characteristic features of the two design concepts.

**Wanrong Dongyuemiao 万荣东岳庙**

Dongyuemiao in the capital of Wanrong county 万荣东岳庙 in Yuncheng prefecture (inventory number 3-0129-3-077) is a good example for the secularization and technical progress in multi-storied architecture that took place since the Liao dynasty. Whereas the Timber Pagoda or Puxiange at Shanhuasi are the expression of religious Buddhist architecture, their multi-storied successors incorporated secular functions and blended with a gatehouse, an urban thoroughfare, or a stage. Nevertheless, multi-storied buildings in the Ming and Qing dynasties often imitated the exterior appearance of early Chinese timber architecture, even though the interior construction system had already changed. Such technical achievements included the omission of the subsidiary mezzanine level called *pingzuoceng* 平坐层 as well as the new arrangement of tall columns called 通柱 that spanned the distance from the ground floor through the upper stories and connected several layers.

The architectural focus of Wanrong Dongyuemiao is Feiyunlou 飞云楼, a more than twenty-three meters tall building which current architectural form dates to the
eleventh year of the Qianlong reign period in the Qing dynasty (清乾隆十一年, 1746 C.E.) (Figure 3-62). Its design follows a simple rectangular floor plan with three-bay-wide *baoshā* at the second and the third floors, the latter of which is supported by suspended columns or *chuiliánzhu* and each part is crowned by a hip-and-gable roof. Looking from outside, it appears as a traditional multi-storied timber structure with three regular floors and two mezzanine levels or *píngzuòcēng* and four sets of roof eaves. The exterior appearance conveys the idea of an “old dynastic style” that is depicted in Song dynasty painting and achieves height by piling up stories on top of each other. Furthermore, the *fǔjiàodòu* at the corner embody the traditional idea of *chánzhuzào* that is recorded in the Song dynasty manual *Yīngzào fāshì* (Figure 3-63). In fact, the interior of Feiyunlou reveals four tall interior columns that destroy the illusion of structurally independent floors and only loosely connected subsidiary construction levels that increase stability. Interestingly, the tails of the *huágōng* of the corner set and the adjacent *fǔjiàodòu* are directly inserted into the column shaft, which confirms the method of *chánzhuzào* as a kind of *tóngzhuzào*.

In summary, despite its construction date in the Qing dynasty, the building shows some affinity with the architecture of the preceding dynasties. Additionally, the central bay of the North, South, East and West *baoshā* at the second floor apply a “classical” fan bracket set at intercolumnar positions, a feature that was already an integral part of the architectural language in Shanxi province. Against expectations, the bracket sets lack column-top joists called *zhútóufāng* 柱头枋 in Song terminology or *zhèngxīnfāng* 正心枋 in Qing terminology, which is a typical feature in Shanxi regional folk architecture since
the Ming dynasty. Furthermore, the ground floor reveals a kind of bracketing with angled bracket-arms in the strictest sense that was not seen in pre-Yuan dynasty architecture of Shanxi province. In the central bay of the five-bay wide corridor at the ground floor, two separated dougong merged into a more complex and concentrated organic bracket cluster. The large bearing blocks of both sets moved closer together, and the upper steps of the inner wings of genuine xiegong were omitted. They were replaced by (a third line of) orthogonal timbers that ran parallel to the (two) regular zhenghuagong and projected directly perpendicular to the building plane. Ma Xiao referred to these as shuanglian xiegong which literally translated means “duplex angled bracket-arm”. The author would like to draw attention to the different nature of bracket-arms and clusters, and thus change the name into “duplex fan-shaped bracket set” or “W-type” (Figure 3-62).

Furthermore, the seven-bay wide, hip-and-gable roofed building north of Feiyunlou called Niumen displays five-puzuo bracket sets on top of interior columns that roughly recall the shape of an open fan.
Wanrong Houtumiao 万荣后土庙

The Temple to the Goddess of the Earth in Wanrong county 万荣后土庙 also known as Fenyn Houtuci 汾阴后土祠 (inventory number 4-0167-3-089) located in Ronghe township 万荣河镇庙前村 of Yuncheng prefecture was established in the Qing dynasty; its current architecture reflects the style of the last decades of the nineteenth century. Dougong with angled bracket-arms are applied at several buildings, including xitai, xiandian, and Qiufenglou 秋凤楼 (Figure 3-64; Figure 3-65). Although they roughly emulate the shape of an open fan, they blend certain characteristics of fan-shaped bracketing with ruyi dougong. In particular, they reduce the number of angled bracket-arms in the strictest sense and except from the outermost flanking pair, replace them by orthogonal ones. Generally speaking, they convey the desire for more simplification in manufacturing and assemblage and roughly recall the modular assembly system of Lincoln logs.

The three-bay wide xitai displays such bracket sets at the intercolumnar position of the central bay at the rear façade. Similar bracketing is also applied at the side bays at the front façade of the xiandian. More importantly, at the rear façade, there is one of the most beautiful examples of Qing dynasty carving in combination with fan-shaped bracketing. The simple three-cai 踩 set displays two genuine xiegong that step out directly from the ludou and are topped by angled shuatou. At the intersection points of angled shuatou and linggong (eventually a continuous board is applied at linggong position along the facade), there are two additional orthogonal shuatou that project from the small bearing block outwards in perpendicular direction to the building plane.
Therefore, the number of decorative noses increased. In multiple-V-design angled *shuatou* usually outnumber the orthogonal ones. However, this cluster possesses more orthogonal than angled *shuatou* (i.e. three orthogonal as well as two angled *shuatou*). These three parallel, horizontally leveled timbers that pierce through the building plane symmetrically project as interior *shuatou* at the rear. This is a typical characteristic of *ruyi dougong*, but in this case the construction technique was applied to fan-shaped bracketing.

The three-storied triple-eaved Qiufenglou (i.e. *sanceng sanyan* 三层三檐) is adorned with different kinds of fan-shaped bracket sets. All the three stories are surrounded by a corridor and additionally, at the first two levels, there are *baosha* that project outward from the surrounding corridors along the cardinal directions. It is interesting that not all of these clusters can be seen from afar. Only the ones at intercolumnar positions of the one-bay wide *baosha* on the ground floor are visible. The bracketing clearly shows similarities to the above described way of construction that is used for the rear façade of the *xiandian* which faces Qiufenglou. The bracket sets that are applied at intercolumnar positions of the core building’s façade on the third floor also show such *ruyi dougong* characteristics i.e. parallel, horizontally leveled timbers that pierce through the building plane and symmetrically project as interior or exterior bracket-arms and *shuatou*. We have to recall that the corridor is placed in front of the façade. The fan-shaped bracket set of the core hall is thus partly hidden behind the corridor’s bracketing. Structurally speaking, these two are connected and the corridor’s orthogonal bracket-arms are an integral part of the entire cluster. These *shuatou* extend beyond the corridor’s rear side into the core building, where they form the interior
orthogonal *shuatou* of the fan-shaped bracket set. Standing at the inside of the hall, such bracketing appears as a coherent organic cluster and the angled interior *shuatou* support the *mojiao* beams of the cross-shaped hip-and-gable roof or *shizi xieshanding*. Finally, inside the hall on the second floor, there are simple *dougong* with angled arms at intercolumnar positions of each *baosha* that roughly reflect the shape of an open fan but without any characteristics of *ruyi dougong*. Strictly speaking, due to their placement inside the hall, they cannot be considered fan-shaped bracket sets which are usually restricted to architecture at the exterior façade.
2. Cross-shaped hip-and-gable roofs and interior ceilings

Cross-shaped hip-and-gable roof at the Drum Tower in Huozhou 霍州鼓楼

Although the Drum Tower or *gulou* 鼓楼 in Huozhou 霍州 also called *Wenchangge* 文昌阁 is not yet designated as a key national heritage conservation unit by the State Administration of Cultural Heritage, it can illustrate how to erect a cross-shaped hip-and-gable roof on top of a square floor plan (Figure 3-66).

The multi-storied sixteenth century building follows the four cardinal directions and links the major north-south and east-west thoroughfares of the city. The second floor, a square, three-by-three-bay wide, double-eaved structure with surrounding corridor and *baoshā* at each side, is especially important for the discussion. There is one intercolumnar *shanshi dougong* of five-*puzuo* in each central bay with *xiegong* that pierce through the wall plane and symmetrically project as interior or exterior bracket-arms.

The hip-and-gable roof is trimmed to fit to the square floor plan and has a cross-shaped ridge line and triangular gables pointing in each of the four cardinal directions. Broadly speaking, the characteristic form of the roof results from the intersection of two regular hip-and-gable roofs and provided a new technical challenge for Chinese craftsmen. A horizontal square frame of four *mojiao* beams that meet at a right angle at the mid-point of each façade is the backbone of the roof construction. The skillful design provides structural support for the weight of the roof above, and at the same time, together with a smaller staggered layer of diminished size (i.e. second horizontal frame of four beams that are turned by 45 degree) creates a fascinating interior ceiling that is fully visible to the eye of the viewer. The point of intersection of the *mojiao* beams
corresponds to the placement of the four fan-shaped bracket sets. In detail, at the uppermost level of the bracket unit, angled *shuatou* follow the direction of the *mojiao* beams above and provide the necessary abutment.

**Domed interior ceiling at Runcheng Dongyuemiao 润城东岳庙**

An extraordinary example of small pavilion architecture with a square ground plan and octagonal interior ceiling is provided by the Runcheng Dongyuemiao 润城东岳庙 in Runcheng village and township 润城镇润城村 of Yangcheng county 阳城县 in Jincheng prefecture (inventory number 6-0375-3-078). The Sacrificial Pavilion or *xianting* is a masterpiece of Ming dynasty timber craftsmanship and illustrates the difficult job that *xiegong*-architecture faced and which it mastered superbly (Figure 3-67).

Angled bracket-arms are applied in two ways: first, each of the four building facades display a symmetrical five-*puzuo* bracket set in *jixin*-style at the intercolumnar position with pairs of *xiegong* projecting from the *ludou*. To emphasize the front façade, there are additional angled bracket-arms projecting from the small bearing block above. At the interior, the orthogonal *shuatou* provide support for the timber frame of the *zaojing* 藻井. Most importantly, it is one of the few examples, where angled arms and angled *shuatou* are both connected to the construction system. At the point where the angled *shuatou* intersect with the angled timbers of the flanking sets, they are inserted into suspending *chuilianzhu* that mark the eight corners of the interior ceiling’s octagonal timber frame. Furthermore, at Runcheng Dongyuemiao, the idea of *xiegong* reaches a new dimension. Angled bracket-arms appear not in twos within fan-shaped bracketing at intercolumnar positions. Most surprisingly, they appear as single members. This becomes
immediately evident if one recalls Liao dynasty bracketing at Datong, where shanshi dougong consisted exclusively of paired bracket-arms that stepped out at a 60 degree angle to the building plane. In both cases, there are no zhenghuagong, but at Runcheng Dongyuemiao, the side clusters further omitted the opposite hand of the angled bracket-arms and rather display a single xiegong and not a symmetrical pair. Structurally speaking, the unusual design provided the necessary abutment needed for the timber dome of the interior ceiling. Stylistically speaking, the design emphasized the three-dimensional visual effect of the open fan.

To draw a preliminary conclusion, angled bracket-arms in the form of fan-shaped bracket sets and zaojing-style domed interior ceilings seemed to be the perfect match for small pavilion architecture, especially stage buildings. They were aesthetically appealing to the eye and additionally, enhanced acoustics. Generally speaking, decorative interior ceiling have a long tradition in Chinese traditional architecture and as such, can be seen in manifold representations including two-dimensional murals at the Mogao caves in Dunhuang, Gansu province (e.g. Eastern Wei cave number 285, Tang dynasty cave number 320), or three-dimensional domed stone ceiling with layers of successively diminishing size at tombs of the Goguryeo Kingdom 고구려 (e.g. the fifth century Twin Pillars Tomb in Ryonggang-kun 룡강군 of Nampo 남포특급시, South P’yŏngan province of North Korea), and exquisite smaller timber carpentry from the medieval periods (e.g. Liao dynasty Guanyin Pavilion of Dulesi, Jin dynasty Main Hall of Jingtusi, Northern Song dynasty Main Hall of Baoguosı) to late imperial China (Hall of Supreme Harmony at the Forbidden City in Beijing). They visually combined the two geometric forms of the square and circle and symbolized the co-existence and unification of Heaven
and Earth in Chinese philosophy. Consequently, they were used underground in funerary architecture as well as aboveground in religious architecture at Buddhist monasteries or Daoist temples and secular architecture ranging from official palaces to secular stage buildings. Nevertheless, not every xitai in Shanxi province made use of genuine xiegong or displayed bracket clusters in the shape of an open fan along the façade even if the stage was a free-standing building in xiaoting-style 小亭式. For example, the Yuan dynasty stage at Niuwangmiao 牛王庙 in Linfen 临汾 (inventory number 4-0116-3-038), a structure with interior mojiao brackets and beams that span a perfect square and provide bracing for the basic frame of the interior ceiling, displays orthogonal bracketing that strictly follows the cardinal axis.214
3. Monumental archways

a) General remarks on the (new) building type of *pailou* 牌楼

It is generally agreed that in late imperial China angled bracket-arms were occasionally used in the form of *ruyi dougong* at monumental archways called *pailou* 牌楼 or *paifang* 牌坊. Broadly speaking, *paifang* derive from the traditional Chinese ward or block system called *lifang* 里坊 that divided the city into several government controlled residential or market spaces called *fang* that comprised a group of one hundreds families called *li* equal to four neighborhoods called *lin*. In particular, they developed from the entrance gates of the individual blocks that usually were walled until the Northern Song dynasty. Having shed the adjoining wall structure, Ming and Qing dynasty archways still conveyed the idea of the entrance and became architectural landmarks that set the religious and secular boundaries of temples, tombs, residential quarters, markets, government offices, or the beginning of a certain street. Additionally, they embodied the idea of Han-dynasty gate towers known as *que* 阙 and served as a memorial for commemoration. Such *que* towers not only became an integral part of the spirit-road at imperial tombs, where in the Tang and Song dynasty for example, such undecorated, "purely architectural features acted as territorial markers and symbols of status". Moreover, since the Northern and Southern Dynasties period they also marked the entrance to the Chinese city, especially, the inner city, for example at the Eastern Wei and Northern Qi capital of Ye 邺城 in today’s Hebei province. Finally, they reflected the shape of *wutoumen* 乌头门 also known as *lingxingmen*棂星门 or *wutou chuoxiemen*
乌头绰楔门，a kind of free-standing gate building that was used in traditional Chinese architecture (since the Han dynasty) and recorded in *A Record of Monasteries in Luoyang* and *Yingzao fashi*.

By way of example, this thesis analyzes the differences between fan-shaped bracketing and scepter bracketing at monumental archways and discusses the possibility of a piecemeal transition or at least of hybrid forms. Generally speaking, in the first scholarly work on the subject entitled *Pailou suanli* (first published in 1933), Liu Dunzhen listed seven types of archways with respect to the number of jian间 or bays between the tall columns on the ground, the number of zhu柱 or tall columns, and the number of lou楼，a term that counted every bay even if it was spanned by short columns that did not reach onto the ground and were placed on top of the architrave.

In brief, after the Yongle reign period in the Ming dynasty, the number of kaijian increased steadily, but the most common design remained the arrangement of four tall columns that spanned either three or five lou (i.e. sizhu sanlou or sizhu wulou四柱三楼 or 四柱五楼). Today, the largest extant structure is the stone archway at the Imperial Tombs of the Ming dynasty near Beijing with six tall columns and a total of eleven lou (i.e. liuzhu shiyilou六柱十一楼), equal to a width of twenty-nine meters and a height of fourteen meters. Furthermore, pailou incorporated the regional building traditions of China as well as the changes in society and architectural culture throughout the centuries. For example, the timber archways in North China were usually taller and reflected social status and rank, whereas the stone archways in the south were more delicate and decorative. Generally speaking, since the end of the Yuan dynasty and the beginning of
the Ming dynasty, there was a shift in building material. Stone archways partly replaced
the wooden prototypes even though after the mid-Ming period, the use of glazed ceramic
tiles became also fashionable. Furthermore, there was a trend towards simplification,
especially since the mid-Ming dynasty in the south, where bracket sets of stone pailou
were reduced to stolen-heart design and consisted of large vertical slabs rather than
horizontal layers of intertwined individual bracket-arms.

b) Selected examples

Daixian Wenmiao 代县文庙

The Confucius Temple 文庙 (inventory number 6-0457-3-160) in the capital of
Dai county 代县 in Xinzhou prefecture was established in the late Yuan dynasty (1358
C.E.) but reconstructed in the early years of the Ming dynasty (second year of the
Hongwu reign period 明洪武二，1369). It provides excellent examples for the
discussion of monumental archways of the Ming dynasty. Whereas the front pailou at the
entrance to the temple site uses orthogonal bracketing, the second archway along the
central North-South axis displays multiple angled bracket-arms that recall the shape of an
open fan to some extent. In fact, the bracketing shows a new density in design and some
timbers seem to complement each other by creating a net-like system of bracket-arms.

In detail, the individual bracket sets at the three-bay wide front pailou called
Wanrenfang 万仞枋 (in sizhu sanlou 四柱三楼 design) are still clearly discernible
(Figure 3-68). Besides the two exterior corner clusters that consist of two large bearing
blocks, there are three intercolumnar sets at the central bay and one intercolumnar set at
each of the side bays. Nidaogong, mangong, or linggong are not yet linked together and form individual, structurally separated bracket-arms that are parallel to the façade.

The second archway called lingxingmen (in liuzhu wulou 六柱五楼 design) consists of dominant corner clusters that seem to overwhelm the space in-between (Figure 3-69). In fact, in the central bay of the five-bay wide front façade, there is only room to indicate intercolumnar bracketing. At the outermost side bays, a full intercolumnar shanshi dougong is squeezed into the phalanx of corner bracket-arms with (wings of) xiegong projecting form the ludou and from the small bearing block above. Furthermore, the main architecture at Daixian Wenmiao is the hip-and-gable roofed Dachengdian 大成殿, a seven-bay wide and five-bay deep rectangular hall of the Ming dynasty (Figure 3-70). The most striking features are the bracket sets with mojiaogong that are placed at the second-to-last columns of the front and the side facades respectively. They display a variation of jiucai dantiao san’ang-style 九踩单挑三昂 bracketing but show just one wing of angled bracket-arms without the matching opposite hand.

**Guandimiao in Xiezhou 解州关帝庙**

The Guandimiao 关帝庙 in Xiezhou village and township 解州镇解州村 in Yuncheng county (inventory number 3-0130-3-078) is dedicated to the historical figure of Guanyu 关羽, a politically influential Chinese general of great deeds and loyalty who lived in the Eastern Han and Three Kingdoms periods and was posthumously deified as the Daoist Saintly Emperor Guan 关圣帝君 in late imperial China. Broadly speaking, the monastery in Xiezhou reflects the idea of imperial Chinese palace design (e.g.
arrangement of que towers at the Forbidden City of the Ming and Qing periods) but adapts it to the needs of a saintly emperor (Figure 3-71).\textsuperscript{228} Jieyiyuan 结义园, a large garden with west and east ponds, is located directly south of the core monastery complex to which side palaces are attached to the left and the right. Despite the underlying connotation to official palace architecture, many buildings of Emperor Guan’s residence display fan-shaped bracket sets or apply angled bracket-arms including monumental archways and multi-storied buildings. Nevertheless, the Main Hall called Chongningdian 崇宁殿 neither follows such regional style nor does it deviate from the orthogonal principle.

Xiezhou Guandimiao is the perfect example to discuss the use of angled bracket-arms at Chinese pailou, since the monastery provides abundant examples that illustrate the different stages of development and distinctive designs of the basic architectural types.\textsuperscript{229}

The timber archway at Jieyiyuan or Jieyiyuan mupaifang 结义园木牌坊, a three-fold pailou of 11.88 meters height and 16.44 meters width in sizhu sanlou 四柱三楼 design, embodies the idea of grid-like orthogonal bracketing (Figure 3-72). It is dated to the twenty-seventh year in the Qianlong reign period of the Qing dynasty (清乾隆二十七年, 1762 C.E.).\textsuperscript{230} Individual bracket sets are no longer visible to the naked eye of the viewer. Rather, they merged together and form a continuous surface that consists of end-to-end joists for the bracket-arms that are parallel to the building plane i.e. nidaogong and mangong.
Its grid-like nature becomes especially evident in comparison with the stone archway called *Wandaizhanyang pailou* 万代瞻仰牌坊 in front of the Bell Tower at the east entrance (Figure 3-73). It is a showpiece of Ming dynasty stone craftsmanship and built in the *sizhou wulou* 四柱五楼 design that uses four columns to generate five bays (dated to the ninth year of the Chongzhen reign period of the Ming dynasty 明崇祯九年, 1636 C.E.). The five-*cai* 踩 clusters exclusively use orthogonal timbers for the two tiers of bracket-arms and the three intercolumnar sets and two corner sets of the central bay are clearly discernible.

In front of the Drum Tower at the west entrance towers the *Weizhenhuaxia pailou* 威震华夏牌坊, a Qing dynasty timber structure that miraculously survived the fire in the Guanxu reign period of the Qing dynasty (清光绪三年, 1877 C.E.) but underwent constant repair (in 1762, 1869, and 1919 C.E.) (Figure 3-74). The archway is 19.98 meters wide, 12.44 meters tall, and four columns are spanning three bays 四柱三楼. Angled bracket-arms are applied in two ways: first, a fifteen-*cai* 踩 fan-shaped bracket set with seven tiers of false cantilevers dominates not only the intercolumnar position of the central bay but also the entire building façade. It is flanked by two similar corner sets. Second, more importantly, the space in-between the three *dougong* is filled by small timbers that project in eight different directions, i.e. orthogonally and at obtuse angles to the building plane, weaving a dense net of intertwined arms and small bearing block. They rest on eleven adjacent large bearing blocks called *lianzhudadou* 连珠大斗 that are placed along the architrave. Whereas *Weizhenhuaxia pailou* shows such characteristics of *ruyi dougong* only to some extent, the *Shanhaizhongling* 山海锺灵 timber archway
brings it to perfection. It was rebuilt in the twenty-third year of the Qianlong reign period in the Qing dynasty (清乾隆二十三年, 1758 C.E.) (Figure 3-75).\textsuperscript{234} There is a total of twenty-three large bearing blocks that are placed in an orderly row along the architrave. \textit{Yixinggong} 翼形栱 or “wing-shaped bracket-arms” are placed in-between the regular, orthogonally projecting bracket-arms. The sum of these repeated, densely placed, adjoining timbers that extend beyond the small bearing blocks create such an even surface of flawless grid-like bracketing that individual sets are no longer distinguishable. As defined in this thesis, this is the (perfect) embodiment of (the idea of) \textit{ruyi dougong}.

Furthermore, several multi-storied buildings display fan-shaped bracket sets in the strictest sense (Figure 3-76). The eighteenth century \textit{yushulou} 御书楼 of the Qing dynasty employs \textit{shanshi dougong} at intercolumnar positions along the \textit{baosha} of the rear façade.\textsuperscript{235} Additionally, the \textit{zaojiang} coffered ceiling at the inside of the building uses a variation of fan-shaped bracketing. The nineteenth century \textit{chunqiulou} 春秋楼 of the Qing dynasty, the northern-most building at the central axis of the core monastery complex, applies \textit{shanshi dougong} on top of the four central columns of the seven-bay wide corridor around the ground floor and on top of the columns at the second floor of the five-bay wide core building.\textsuperscript{236} Some of these show bracket-arms that project at 45 degree angles but at the same time, their \textit{shuatou} project at an obtuse angle different than 45 degree. The flanking \textit{daolou} 刀楼 and \textit{yinlou} 印楼 use \textit{shanshi dougong} at intercolumnar positions of the central bays at the ground floor.
c) **Conclusions: shanshi dougong and ruyi dougong with regard to different building types**

In conclusion, the angled bracket-arm was used at diverse building types and adapted to various building materials in Shanxi province since the Liao dynasty. It was still applied at individual, structurally detached clusters in the form of fan-shaped bracketing. It was additionally used to generate grid-like surface bracketing.

Generally speaking, the well-established idea of *shanshi dougong* was easily adjustable and conformed to new conditions and designs since the mid-thirteenth century, including multi-storied gatehouses with stages such as Xianshenlou in Jiexiu or monumental timber archways. Today, examples of fan-shaped bracketing in the strictest sense are located all over Shanxi province.

One should not talk in absolutes when analyzing a limited pool of examples, but it seems that *ruyi dougong* can be associated with certain building types and geographical areas. Broadly speaking, the new concept of *ruyi dougong* was a highly complex, complicated system and a structurally even more advanced building technology. It was the perfect match for monumental timber archways, a new building task that required bracketing to balance along a row of (nearly) free-standing columns without additional support.

More importantly, the two bracketing concepts were not exclusive, since it was possible to apply *shanshi dougong* at one structure and *ruyi dougong* at another structure within the same monastery complex. For example, Xiezhou Guandimiao preserved archways with fan-shaped as well as scepter bracketing in the strictest sense. Furthermore, regardless of orthogonal or angular design grid-like surface bracketing in general is
hardly seen at rectangular timber halls in Shanxi province. An exception to the rule are hybrid forms which can be seen at the intercolumnar position in the central bay of the building façade, the most prestigious position of “classical” fan-shaped bracketing. In this case, they seem interchangeable with *shanshi dougong* to some extent, for example at Qiufenglou of Wanrong Houtumiao.

In terms of manufacturing and cost-effectiveness, despite the possible omission of individual bracket-arms that were necessary for fan-shaped bracket clusters in the strictest sense, the overall consumption and total demand of timber was even higher. Comparatively speaking, more bracket-arms and small bearing blocks were needed to achieve the grid-like structure of *ruyi dougong*, fill the gaps in-between, and create the close mesh without grid holes along the facade.

The regions around Changzhi and Jinzhong for example, show abundant examples of angled bracket-arms but seem to prefer the simpler fan-shaped style rather than the lavish scepter style.²³⁷ It is not surprising that scepter bracketing is less likely in the remote areas of the Southeast including Changzhi or Jincheng prefectures, which are separated by the Taiyue mountains 太岳山 from the series of valleys in the center of the province that form the main north-south thoroughfare. Such tightly spaced bracketing is more complex to build and requires much more material, which is less available in these areas. Broadly speaking, the main passage runs from the North of Shanxi, where it connects the Sanggan River valley around Datong with the Hutuo River valley around Fanzhi, Daixian, or Dingxiang city, along the Fen River 汾河 valley towards the South, where the cities of Taiyuan 太原, Pingyao 平遥, Jiexiu 介休, Huozhou 霍州, Hongdong
洪洞，Linfen 林汾，and Yuncheng 运城 are placed like pearls on a string. In the Southwest, the valley of the fertile Fen River deepens and includes such cities like Jishan 稷山 and Wanrong 万荣. Other than the Wenmiao in Daixian, Xinzhou prefecture, in the north, some of the best examples of mature ruyi dougong and hybrid forms are located in Yuncheng prefecture, including Xiezhou Guandimiao, Wanrong Dongyuemiao and Wanrong Houtumiao.

Thus we can conclude that shanshi dougong and ruyi dougong were two different concepts of bracketing that evolved at different periods in time, but once formulated, they coexisted and were used according to the specific needs, the local taste and the skills of patrons and craftsmen.
Chapter 6:  *Xiegong*-architecture outside of Shanxi province and the question of regionalism (for building traditions with angled bracket-arms, fan-shaped bracket sets, and scepter bracket sets)

In Shanxi province, the use of *xiegong* continued despite the introduction of the official building code *Yingzao fashi* in the twelfth century. Likewise, architecture that contains fan-shaped bracket sets or scepter bracket sets can also be found in other regions of China. Their individual shape and size was subject to stylistic change and local flavor. The notion of using them can be seen as part of a “regional”, “non-official style” in traditional Chinese architecture that uses more natural timbers with material defects and applies features of oblique, not perfectly straight shape. The goal was not just to simplify matters or ease the regulative and formalized language of official architecture and constitutive authority, but rather to break up the impression of stiffness and orthogonality and express local culture by decorative carving and individual aesthetic design.

To the West just opposite the Yellow River 黄河 in neighboring Shaanxi province 陕西 lies the historical city of Hancheng 韩城. It is not surprising that we find *xiegong*-architecture in such close proximity to the angular grid-like bracketing of Wanrong and Xiezhou in Yuncheng prefecture of Shanxi province. Generally speaking, in Hancheng angled bracket-arms are applied in hybrid form at the intercolumnar position in the center of the front façade and recall Ming and Qing period styles, for example at the stage of the Temple to the City God 韩城城隍庙, or the monumental timber archway or *lingxingmen* and the Five-dragon brick Screen of the local Confucius Temple 韩城文
tem, or among the well-preserved Yuan dynasty timber architecture of Puzhaosi 普照寺 (Figure 3-77).

One should not talk in absolutes when analyzing a limited pool of examples, but it seems that the feature of angled bracket-arms and the phenomenon of fan-shaped bracket sets in general started north of today’s Shanxi province. Numerous tenth and eleventh centuries’ pagodas that antedate the timber structures of Shanxi province followed the regional “Liao style 辽式仿木构式” in North China that mimics the tailiang-style column-beam-strut architecture and displays specific wood-alike features. They differ only in proportions from the wooden counterparts due to the limitations of the different medium such as stone or brick. The number of relics with 3-dimensional fan-shaped bracket sets also reflects this regional building tradition, for example, the Liao pagoda at Jiafusi 嘉副寺塔 (1020 C.E.) in Yi county 义县, Liaoning province 辽宁, or the Wanbu Huanyanjingta 万部华严经塔 (1055-1100 C.E.) in Hohhot, the capital of the Inner Mongolia Autonomous Region 内蒙古, or the Tianning Pagoda 天宁寺塔 in Beijing 北京 (1119-1120 C.E.). Even the Flower Pagoda 花塔 at Guanghuisi 广惠寺 in Zhengding 正定, Hebei province 河北, an unusual multi-storied stone construction restored in the Jin dynasty (1161-1189 C.E.), follows this building tradition (Figure 3-78; Figure 3-79).

Additionally, the North of China preserved important xiegong-architecture in wood, such as Monidian 摩尼殿 of Longxingsi 隆兴寺, an outstanding example from the Northern Song dynasty with fan-shaped bracketing in the strictest sense. Furthermore, monumental timber archways from the Ming and Qing dynasties embody the archetype
of *ruyi dougong*, such as the *paifang* at the Northern Lake in Beijing 北海牌坊, or at the Shaanxi Guild Hall 山陕会馆 in Liaocheng 聊城, Shandong province 山东 (Figure 3-49; Figure 3-80). The latter is the main entrance gate located at the east-west oriented cardinal axis of the well-preserved site that eventually merged with a Daoist monastery dedicated to the Saintly Emperor Guan. Originally built in the eighth year of the Qianlong reign period in the Qing dynasty (清乾隆八年, 1743 C.E.), the current architecture dates to the Daoguan reign years in the mid-nineteenth century (道光幸丑年, 1841 C.E. and 道光二十五年, 1845 C.E.). Comparatively speaking, the ground plan is rather complicated and implements a design called *bazhu sanlou* 八柱三楼. Due to its concurrent functions (as an archway and a gatehouse), the *pailou* at Liaocheng was given more depth, so that the hip-and-gable roofed timber structure is generated by two parallel rows of four columns and measures three bays in width but also one bay in depth. At first glance, the angular grid-like bracketing of thirteen-*cai* 踩 at the central bay and eleven-*cai* 踩 at the side bays seems overly exuberant and exaggerated, but in fact, it was necessary to support the wide overhanging eaves.

South of Shanxi province, the mountains of Wudang 武当山 in northwestern Hubei province 湖北 preserved two excellent examples of *shanshi dougong* and *ruyi dougong* (Figure 3-81). Due to the longstanding affiliation with Daoism, it is not surprising that many of the scattered monasteries and scenic spots are close to nature, including layouts that were adapted to the local topography or the use of various building materials such as wood, natural rock and stone, earth and copper. In detail, “classical”
fan-shaped bracket sets in the strictest sense are evenly placed along the solid stone-block wall of the front façade at Tianyi shenqinggong 天乙真庆宫 also known as Dasheng nanyangong 大圣南岩宫, which is located at the Temple of the South Cliff 南岩 established in the Yuan dynasty.\textsuperscript{249} Wudangshan became the imperial center of Daoist worship in the early fifteenth century, and the Ming dynasty Emperor Yongle 明永乐 (r. 1403-1424 C.E.) commissioned and sponsored monastery sites and scenic spots by imperial decree.\textsuperscript{250} However, the architecture of the thirteenth century at Wudangshan was based on the charity of private donors that offered money to the temples for prayers or even got involved themselves,\textsuperscript{251} which is reflected in architectural style and design including fan-shaped bracketing, and the long, tedious building period.\textsuperscript{252} Furthermore, Huangjingtang 皇经堂, a three-bay wide timber structure at the monastery complex of Dayue taihegong 大岳太和宫, reveals angular grid-like bracketing along the front façade. Despite the original boiling date in the early fifteenth century, the current architecture recalls the style of the Qing dynasty. More importantly, it reflects the building traditions of China’s South such as the typical way of turning up the roof eaves.

As discussed before, the historical region of Huizhou 徽州 also called Wannan 皖南 provides abundant examples of angled bracket-arms in the form of inserted half-brackets. Such local building tradition and Southern style can be seen in Ming and Qing period architecture of Anhui province 安徽, especially around Huangshan 黄山市 in She county 歙县 and Yi county 黟县, and Xuancheng 宣城市 for example in Jixi county 绩
溪县，as well as architecture of Jiangxi province 江西，in particular Wuyuan county 婺源县 (Figure 3-53; Figure 3-54; Figure 3-55; Figure 3-56).

In Sichuan province 四川，fan-shaped bracket sets were not only applied at Buddhist architecture such as Guangdesi 广德寺 in Suining 遂宁，but also at religious architecture of the Hui ethnic minority 回族 during the second half of the Qing dynasty, such as the Main Hall of Babasi 爸爸寺 in the historical city of Langzhong 阆中，a multi-storied timber building with gongbei 栋北 cupola instead of the traditional hip-and-gable roof and column-top bracketing in the shape of an open fan at the ground floor (Figure 3-82). 253

Similar bracketing can be found in Gansu province 甘肃 at Linxia Dagongbei 临夏大拱. 254 Both examples of Islamic shrine architecture with graves of spiritual leaders of the Hui minority called menhuan 门宦 added local flavor and adapted the original design and arrangement of angled bracket-arms. Furthermore, the largest Confucius Temple in Sichuan province called Qianwei Wenmiao 犍为文庙，gives evidence of angular grid-like bracketing and displays ruyi dougong 如意斗拱 along the five-bay wide front façade of Dachengmen 大成门 (Figure 3-83). 255 Most interestingly, the dormer-like projection that pierces through the sloping gable-roof above the central bay reveals a hybrid form i.e. intercolumnar bracket sets that roughly emulate the shape of an open fan but apply intertwined bracket-arms to a certain extent.

In Yunnan province 云南，angled bracket-arms were used at religious Buddhist monasteries and Confucius temples in Han-Chinese style such as the angular grid-
bracketing at the Qing dynasty archway of Jiangcheng Confucius Temple in South Yunnan, Jiangchuan prefecture, as well as secular buildings including commercial architecture such as the ruyi dougong at the Qing dynasty stage at the Jiangxi Guild Hall or Jiangxi huiguan in Huize county, Northeast Yunnan (Figure 3-84).  

Even today, shanshi dougong and ruyi dougong in the strictest sense or in hybrid form embellish the front façades of residential courtyard architecture as well as the palatial architecture of the Mu family in Lijiang, Northwest Yunnan, who successfully governed a large area in the far southwest of China starting in the early Ming dynasty (Figure 3-85). Located at the old Tea Horse Road, the indigenous Naxi people, one of the ethnic minorities in the cultural melting pot of Yunnan province and traditional residents around Lijiang, merged Han-Chinese style with local culture. Wanjuanlou for example, a multi-storied tower in the historical Mu Residence applies angled bracket-arms but faces the East, the cardinal direction of sunrise associated with wood or mu in popular religion.  

Likewise, angled bracket-arms can be seen at small timber carpentry outside of Shanxi province for example, the Shakyamuni Hall at the Ming dynasty Assembly Hall or Jihuidian of Palcho Monastery (also called Baijusi in Chinese) in Gyantse (also called Jiangzi in Chinese), Tibet Autonomous Region (Figure 3-86). A single fan-shaped bracket set of six-puzuo is placed below the flat coffered ceiling and adorns the intercolumnar position of the central bay at the interior of
the hall. Exempt from structural function, the angled bracket-arms complement the interior design and draw attention to the large Buddha statue underneath.

1 Sima Qian’s 司马迁 (ca.145-86 B.C.) Shi ji 史记 (Records of the Grand Historian) is recognized as the first dynastic history and served as a model for later historiography, even though it was compiled privately and not by official imperial order. In detail, each of the twenty-five official dynastic histories beginning with the Western Han Dynasty records the annals of the emperor’s reign, the biographies of influential persons, and monographs on various specialized subjects such as geography.

2 Official histories are understood as works that were either compiled by direct official order or on the basis of imperial documents or by a committee. However, some of which were originally written as private histories and only later recognized as official writings, such as the Shi ji or the Houhanshu 后汉书 (History of the Later Han). Furthermore, some private histories were also written with official approval or at least some kind of acknowledgement by the imperial court. Among the rich body of secondary literature see for example, Goldin, “The Thirteen Classics”.

3 Ruitenbeek 25. In essence, Chinese official architectural writings included four different categories (Feng Jiren, The Song-Dynasty Imperial Yingzao fashi (Building Standards, 1103) and Chinese Architectural Literature 11-13). First, two comprehensive architectural monographs, namely the Yingzao fashi and Gongbu gongcheng zaofa. Second, official documents of various lengths that discussed general building principles, including the Kaogongji 考工记 (further discussed in endnote 6), the eighth century Yingshanling 营缮令 (Rules of Construction and Repair) of the Tang dynasty, the gongdian 工典 section of the Yuan dynasty Jingshi dadian 经世大典 (Great Encyclopedia of the Contemporary World), the gongbu 工部 section of the late sixteenth century Ming huidian 明会典 (Rules and Regulations of the Ming), the Ming dynasty Gongbu changku 工部库须知 (Essential Information for Workhouses and Warehouses by the Ministry of Construction); and the yingshanling 《营造司》 section of the nineteenth century Gongbu zeli 工部则例 (Construction Regulations and Previous Examples by the Ministry of Construction) in the Qing dynasty; especially the short official document Yingshanling revealed the strict architectural standards and official rules for woodworking combined with social rank that already formulated a Chinese building code in the Tang dynasty. Third, the rich body of official documents commenting the actual built environment or practical construction methods of that time, such as the Taixiang mingtang 太享明堂 in the mid-Tang encyclopedia Tongdian 通典 (Comprehensive History of Regulations) (801 C.E.) by Du You 杜佑 (735-812 C.E.) or the Qing dynasty record of Gongping zhuxingzui zeli 宫廷装修则例 (Standard Methods of Architectural Ornaments in the Court). Fourth, literary texts in prose or verse on historical or contemporary architecture such as the mid-sixth-century Luoyang qiliang 叛阳伽蓝记 (A Record of Monasteries in Luoyang) by Yang Xuanzhi 杨衒之, an account of Buddhist monasteries during the Northern Wei period, or the juchu 居处 section in the Taiping yulan 太平御览, an imperially commissioned massive encyclopedia compiled by Northern Song scholars and completed in 983 C.E. To be precise, especially the category of literary texts eventually included a rich pool of unofficial reference works and essays.

4 The building sections of riyang leishu were usually called yingzaomen 营造門 or yingzao chuangyao 营造房耀 (Ruitenbeek 34). “Encyclopedia’ is the stock translation of a term with a slightly different sense namely leishu 立书, which originally denotes a collectanea of textual material organized by category (lei)” (Goldin, A Guide to Sinological Methods 99). Since they included criticisms and comments of succeeding periods, in the end, their content and function came to be similar to real encyclopedias in the literal sense.

A league of its own is the body of hujì 笔记, “brush records” or “miscellaneous notes” with loosely arranged content that “was meant to be a divertissement for the scholar during his hours of leisure” (Ruitenbeek 34). They were especially popular since the Song dynasty. Although not intended for professionals such as ancient builders, craftsmen or government officials supervising construction projects, they still provided useful information including lists of official technical terminology for greater carpentry mixed with personal comments and observations of local building traditions. For example, the 1797 published Yangzhou huabanlu 扬州画舫录 (Pleasure Boats of Yangzhou) by Li Dou 李斗 reflected the state of the art at the Qing court but introduced the official building regulations of the Qing dynasty to a wider/amateur readership (Ruitenbeek 33).

5 Ruitenbeek 26. For more information, see the excellent, word by word English translation in Klaas Ruitenbeek’s Carpenter and Building in Later Imperial China. Other unofficial treatise included the Tang dynasty Mating 木经 (Timberwork Manual) that is discussed in the following paragraph or the late Ming dynasty Yuanye 园冶 (Classics of Gardens). In the 1635 Yuanye, the painter and amateur landscape architect Ji Cheng 詹成 (1582-?) discussed pavilion construction, smaller carpentry, ornamental masonry and pavements accessories in classical Chinese gardens of South China. For the first time, emphasis is put on aesthetics and design rather than geometry and rituals (Ruitenbeek 30). Furthermore, there is Xue Jingshi’s 薛景石 1264 work entitled Ziren yizhi 造人遗制 (Traditions of the Joiner’s Craft), next to the Luhuan jing another important source for furniture building. Unfortunately, only the discussions of doors, carriages, looms, or utensils for preparing weaving yarn survived as fragments in the early fifteenth century Yongle dadian 永乐大典, the largest and most comprehensive imperially commissioned general encyclopedia (Yongle dadian, juan 3518 and 18245).

6 The Zhouli, Kaogongji is the present version of the Kaogongji, an originally anonymous and untitled text that was compiled in the Eastern Zhou Period and rediscovered in the Western Han dynasty, when it was preserved as the last chapter entitled dongguan 冬官 in the Zhongguan 周官 (Government Posts of the Zhou), one of the Confucian Classics and later renamed Zhouli 周礼 (Rites of Zhou). The Han version is a substitute for the original Zhouli that was lost in the movement of
Feng Jiren questioned the impact of the English title after Ruitenbeek 25-33.

In fact, the surviving fragment is not a word by word record of the original text but rather a summary by Shen Kuo (Altars of Soil and Grain. In the front is the Hall of Audience and behind the markets.) The translation follows Steinhardt, esteemed literati officials. As an assistant in the Directorate of Buildings and Construction under the Song Emperor Huizong (r.1100-1126 C.E.). He did not compose the text from scratch but rather arranged already compiled material during the reign periods of Emperor Shenzong (r.1085-1100 C.E.), who ordered the recompilation. Since its content only deals with the imperial past” (Ibid., 4). A new emperor desired to use the construction of the capital as a tool to legitimize his rulership by meticulously implementing the traditional urban design. Local rivers and mountains that eventually deviated from the ideal plan provided obstacles, but they were depicted as fitting into the rectangular plan that justified the dynasty’s claim for power – at least on paper. In other words, Chinese historical mapping was biased because the underlying expectation of how the ideal city of an emperor should look determined its two-dimensional depiction.

The surviving fragment is not a word by word record of the original text but rather a summary by Shen Kuo (Mengxian bitan 76-77, juan 18, 1b-2a). For a discussion of the authorship, see Feng Jiren, The Song-Dynasty Imperial Yingzao fashi (Building Standards, 1103) and Chinese Architectural Literature 138-157. In fact, it neither recorded the totality of construction methods between 960 and 1066 C.E. nor did it accurately reflect the far more complex modular design system that eventually was used since the Tang dynasty. It rather was an outstanding example of architectural writing in China that for the first time since the Kaogongji successfully managed to combine the genre of theoretical literature with actual building practice.

The most important passage for architecture is the section on craftsmen called jiangren that reads as follows: “匠人营国, 方九里, 贡三门, 国中九经九纬, 经涂九轨, 左祖右社, 前朝后市。” (The Jiangren constructs the state capitals. He makes a square nine li on each side. Each side has three gates. Within the capital are nine northsouth and nine eastwest streets. The northsouth streets are nine carriage tracks in width. On the left is the Ancestral Temple, and to the right are the Altars of Soil and Grain. In the front is the Hall of Audience and behind the markets.) The translation follows Steinhardt, Chinese Imperial City Planning 33. In fact, most major Eastern Zhou settlements were based on the double-city scheme and did not follow the idea of one central walled palace compound. However, even though the archaeological remains of that time and moreover of imperial cities in succeeding dynasties did not necessarily confirm the idealized layout, it became the basic reference and standard model for urban projects. The political rise of a new dynasty was a threat to the Chinese idea of stabilization and continuation, and the “alteration of an accepted design therefore considered a challenge to the imperial past” (Ibid., 4). A new emperor desired to use the construction of the capital as a tool to legitimize his rulership by meticulously implementing the traditional urban design. Local rivers and mountains that eventually deviated from the ideal plan provided obstacles, but they were depicted as fitting into the rectangular plan that justified the dynasty’s claim for power – at least on paper. In other words, Chinese historical mapping was biased because the underlying expectation of how the ideal city of an emperor should look determined its two-dimensional depiction.

The Song-Dynasty Imperial Yingzao fashi (Building Standards, 1103) and Chinese Architectural Literature 138-140; Xia Nan 畏楠, “Mengxi bitan zhong de Yuhao 梦溪笔谈中的喻藻木末”.

In fact, the Yingzao fashi was lost until the twentieth century, but in 1919 the Ding 丁氏 manuscript was re-discovered in the national library of Nanjing, Zhejiang province, by Zhu Qiqian 朱启钤, leader of a peace delegation from North China. Due to the textual shortcomings, he aimed for a better reconstruction of the original 1103 edition from the Northern Song dynasty, or at least the 1145 edition of the Southern Song dynasty. It was not before the 1950s that all the necessary fragments were discovered to re-establish the 1145 edition and finally correct some of the wrong assumptions in the 1925 print. For the 1925 edition, the architectural drawings were already reconstructed by the master builder He Xinglong 贺新春 but they were wrongly based on Qing dynasty building technology and finally corrected by Liang Sicheng. The latter’s alma mater, Qinghua University 清华大学 in Beijing, first published this part of his lifelong research on the Yingzao fashi entitled Yingzao fashi tuza 宋营造法式图注 (Glahn, “On the Transmission of the Ying-tsoo fa-shih” 265). See also Cui Yong, Zhongguo yingza xueshe yanjiu guan 中国营造学社研究管.

Today, it is generally agreed that Li Jie was not an architect in the modern sense or a descendent from a traditional carpenters’ family but rather a government magistrate from Henan province, who continued the family tradition of well-educated and high-esteemed literati officials. As an assistant in the Directorate of Buildings and Construction 营缮司, he was asked to edit the text of the 1091 manuscript and prepare the final draft that was published in 1103. He explained the background of printing and the circumstances the book came into being in the directive entitled Zhuzi 礼子. In his lifetime, he also wrote other books on a range of topics, was good at calligraphy in all styles of script, collected several thousands of books, excelled at management and organization, supervised nearly a dozen building projects, and was promoted Director of the Directorate of Buildings and Construction under the Song Emperor Huizong (r.1100-1126 C.E.). He did not compose the text from scratch but rather arranged already compiled material during the reign periods of Emperor Shenzong 神宗 (r. 1067-1085 C.E.) and Zhezong 孝宗 (r. 1085-1100 C.E.), who ordered the recompilation. Since “its content only deals with the shapes of materials, not the different ways of adaption or use” (Glahn, “On the Transmission of the Ying-tsoo fa-shih” 265). He made some additions with regard to the way of manufacturing and better restrictions for construction materials, and on the one hand, further researched the Chinese classics and history, but also the living language and technical terminology used by the craftsmen of the time. For further discussion that might vary to some extent reflecting the individual standpoint of the author or the state of the art at the point of writing, see the seminal work of Yetts, Glahn, Qinghua Guo, Miller, Steinhardt, Liang Sicheng, Chen Mingda, Pan Guxi and He Jianzhong, Guo Daheng, or Takeshima Takuichi. For research in the twenty-first century, see for example the proceedings of the 2003 conference on Chinese architectural history to commemorate the nine-hundredth anniversary of the Song dynasty Yingzao fashi and the nine-
hundred-ninetieth anniversary of the Main Hall at Baoguosi in Ningbo 纪念宋营造法式刊行 900 周年暨保国寺大殿建成 900 周年国际研讨。

13 See Liang Sicheng’s seminal research Qingshi yingzao zeli 清式营造则例 from 1934 that was recently republished in Liang Sicheng quanji 6.
14 Ruitenbeek 28.
15 His professional interest in writing was not limited to one subject. He edited several books including treatises on pipa 琵琶曲 or horses 马经 but also the Continuation of the Classics of Mountains and Seas 续山海经, a ten-chapter text that followed the classical Chinese writing style. These texts are all lost today (Glahn, “On the Transmission of the Ying-tshao fa-shih” 238).
16 For a recent discussion see Zou Qichang 邹其昌, “Yingzao fashi lilun tixi qianshuo 营造法式理论体系浅说” 400.
17 For a modern reprint of selected manuscripts see the 2001 edition of Liang Sicheng quanji 6.
18 Liang Sicheng, Liang Sicheng quanji 6: 123.
19 Ruitenbeek 29.
20 See, for example, the modern reprint from 1959 or 1986 (Yao Chengzuo, Yingzao fayuan, 2nd ed. Beijing: Zhongguo jianzhu gongye chubanshe, 1986).
21 Else Glahn once suggested that “nothing seems to remain of the 1103 edition” today (“On the Transmission of the Ying-tshao fa-shih” 264).
22 Ibid., 242, 232.
23 Else Glahn referred to the revised 1145 edition as a “serious backdraw”, because it was uncertain to what extent the two editors were familiar with the necessary technical terminology or versed in writing scholarly treatises. She further opposed the argument that the number of thirty-six chapters could be explained as the sum of the thirty-four chapters of main text plus the table of context and the foreword or kanshian 看评 at its head (Ibid., 242).
24 For both gong, see Yingzao fashi entry huagong, juan 4, 77.
25 Ibid., 241.
26 Feng Jiren, The Song-Dynasty Imperial Yingzao fashi (Building Standards, 1103) and Chinese Architectural Literature 141.
27 Ibid., 156.
28 See the in-depth analysis of Buddhist monasteries in the Northern Song dynasty, their architectural layout and construction methods in Changzhi and Jincheng prefectures of Shanxi province by Xu Yitao, Changzhi, Jincheng diqu de Wudai, Song, Jin simian jianzhu.
29 Ibid., 124.
30 Loc.cit.
31 Loc.cit.
32 Loc.cit.
33 See also the above discussed relation of Yingzao fashi and Muqing and the role of the master carpenter Yu Hao, who worked for the royal family of the Wuyue Kingdom, a region in the Jiangnan area around the city of Shuzhou encompassing parts of Jiangsu and Zhejiang provinces, but became engaged in official building projects at the Northern Song dynasty court in Bianliang.
34 Zhang Shiqing, “Yingzao fashi de jishu yuanliu juji yi Jiangnan jianzhu de guanli tanxi” 5; Pan Guxi and He Jianzhong 5-14; Fu Xinian, “Shihun Tang zhi Mingdai guanshu jianzhu fazhan de maihuo juji yi dangfeng chuantuog de guanxi” 85. See also Xiang Longyuan 畅隆源, Yingzao fashi yu Jiangnan jianzhu 营造法式与江南建筑.
35 Zhang Shiqing, “Yingzao fashi de jishu yuanliu juji yi Jiangnan jianzhu de guanli tanxi” 1-3, 9-10., Fu Xinian identified three waves of cultural exchange between the North and South that each stimulated a new architectural building style and took place upon political unification in the Sui and early Tang dynasties, the early Northern Song dynasty, and the early Ming dynasty respectively (“Shihun Tang zhi Mingdai guanshu jianzhu fazhan de maihuo juji yi dangfeng chuantuog de guanxi” 92). Despite the interaction since the Five Dynasties period and the re-publication of the Yingzao fashi at the Southern Song court, the official styles in North and South China differed in the end. In essence, the official Northern Song dynasty style was a combination of imperial architecture at the capital Bianliang and the trickle flow from the Jiangnan region. It rather neglected the rich pool of local building traditions that existed in the north itself, especially the local styles in Shanxi province. The Southern Song dynasty style was rooted in the mature Northern Song official style, but there was a stronger local influence of today’s Jiangsu, Zhejiang, and Fujian provinces that rapidly increased for early Ming official architecture.
36 Chen Wei, “Xieqiong fawer” 41, 42.
37 Ibid., 40. “新侧是与正心枋向不垂直的栱，从它的造法和结构上分析，当定义为华栱的一类别，且与正是华栱方向夹角为一锐角的栱。” (Xieqiong are brackets that are not perpendicular to the normal direction of the right center; from the angle of their manufacturing method and construction, we can define them as a type of huagong, being installed at an acute angle to the orientation of regular huagong.)
38 Zhu Xiaoman 69.
39 Zhang Jingxian, “Dougong de yunyong, anzhuang ji sunmao 斗拱的运用、安装及榫卯”. For details about the specific types of mortises and tenons for the angled bracket-arms of Monidian, see also Nie Jindu 聂金度 and Lin Xinzheng 林秀珍, “Zhengding Longxingsi Monidian dougong xiupu yi anzhuang jishu 正定隆兴寺摩尼殿斗拱修配与安装技术” 44. For a general overview of the woodworking joints at Monidian, see also Kong Yanhong 孔衍红, “Monidian zhuyao mugoujianchengzai nengli he jiedian sunmao yanjiu 牟尼殿主要木构件承载能力和节点榫卯研究”.
40 The eminent Japanese scholar Ōta Hirotarō 太田博太郎 strongly suggested replacing the outdated name tenjikuyō 天竺様 or “Indian style” with the more appropriate term daibutsuyō 在日本 or daifugō 大佛様 in Chinese, because there was
no direct relation to the building traditions of India (Nihon kenchikushi jōsetsu 日本建築史序説). For an insightful discussion of the relation to China, see Fu Xinian, “Fujian de ji nü Songdai jianzhu ji ji yu Riben Liangang daofyang jianzhu de guanxi 福建的幾座宋代建築及其與日本長廊大模様建築的關係” 41. However, the multi-directional tenoned joinery that is necessary to lodge the different brackets into the large bearing block is a challenge building task in terms of fabrication and assembly regardless if it is a corner cluster or a fan-shaped bracket set along the façade.

41 Xu Bo’an and Guo Daiheng, “Song Yingzuo fashi shuyu huishi - haozhai shizuo damazu zuo bufen” 8.
42 Li Xiangdong 11.
43 Loc.cit. 12: “到了晚唐，斗栱进入了完全成熟的阶段，偷心斗栱已向逐跳计心造斗栱发展并且间中也出现了出跳的斗栱。从初唐的偷心斗栱到晚唐的计心造斗栱是不是说明偷栱已经消失了，现存的唐代木构中也未发现偷栱。但从宋代和明代木构中确有大量的偷栱。这说明这两种结构功能强装饰简单的斗栱不论作为一种文化还是工艺, 一直处于延续的。” (However, the development and perfection of the dougong with strong structural function and simple decoration creates not only a [certain] kind of culture but also a craft that was continued all along.)
44 Loc.cit.: “而抬梁式结构的发展和完善，则满足了统治阶级的需要。而栱虽然能与抬梁式建筑结合，却不似计心造斗栱那样完美。栱自然处于次要地位。” (However, the development and perfection of the tailiang construction satisfied the demand of the ruling class, and became the paradigm for official style architecture; although chagong could be integrated into tailiang style architecture, they were [perceived as being] inferior to jixin dougong, and chagong naturally settled for less at a subordinate position.)
45 Yingzuo fashi entry on huaguang; juan 4, 77. Li Xiangdong identified three different kinds of chagong in his seminal article: First, dinguangoung as defined in the Yingzuo fashi being equal to a half-length bracket (or multiple steps of half-brackets) that projects perpendicular to the wall plane and lacks bracket-arms parallel to the façade. Comparatively speaking, such dinguangoung are a certain type of bracket clusters, whereas huaguang that also step out at right angle to the building plane are just individual bracketing members (i.e. bracket-arms). Second, chagong are grouped by 45 or 60 degree angle to the wall plane. Third, chagong clusters being formed by multiple steps of bracket-arms that equally project perpendicular and parallel to the building plane (“Chagong yanju” 13-14). The last kind is also known as dinguangoung that was also not discovered. However, Song and Ming timber structures actually have chagong in great quantity. This explains that such a kind of dougong with strong structural function and simple decoration creates not only a [certain] kind of culture but also a craft that was continued all along.)

46 Pan Guxi, Zhongguo gudai jianzhushi 中國古代建築史 4: 441.
48 The key problem is the vague definition of xiaxugong in the text of the Yingzuo fashi (entry on huaguang; juan 4, 77). Even foremost Chinese scholars like Liang Sicheng, Xu Bo’an, Guo Daiheng, or Wang Xiaoqing could not fully tackle the problem of definition and left some open questions, especially with regard to which extant buildings besides the Main Hall of Baoguosi eventually applied this feature.
49 Guo Daiheng, Zhongguo gudai jianzhushi 中國古代建築史 3: 296. For further information on architecture and history of Baoguosi, see her monograph entitled Donglai diyi shan: Baoguosi 東來第一山: Baoguosi. Baoguosi is often associated with the architectural style of the short-lived Wuyue Kingdom, because the Main Hall was built only three decades after the fall of the local kingdom.
50 Steinhardt, “Chinese Architecture, 983-996” 48-51; Fu Xinian, “Shihun Tang zhi guanxi jianzhu fuzan de maiyou” 89-98; for floor plan and section of the Main Hall at Huahnsi, see Fu Xinian, Gudai jianzhushi 明代建築史 2: 503-505; for floor plan and section of Sanqingdian at Putian Xuanmiaoguan, see Guo Daiheng, Gudai jianzhushi 中國古代建築史 3: 537-540.
51 Mo Zongjiang 莫宗江, “Shanxi Yuci Yonghoushi Yuhuanggong 山西榆次永壽寺雨花宮”.
52 With modifications, this thesis follows the definitions by Liang Sicheng (Liang Sicheng quanji 梁思成全集 7: 81), Xu Bo’an and Guo Daiheng (“Song Yingzuo fashi shuyu huishi - haozhai shizuo damazu zuo bufen” 55), and especially Wang Xianqian 王效青 (A Dictionary of Technical Terminology for Ancient Chinese Architecture 中国古代建築術語辭典 7), who emphasized that xiaxugong originally came in twos as a matching pair.
53 Guo Daiheng, Gudai jianzhushi 中國古代建築史 3: 298, 309.
54 Chen Wei, “Xiegong fawi” 41.
55 Zhu Xiaonan 朱晓南 61.
56 Shen Yuzhi, “Xiegong yanbian ji zuoyoung”.
57 Miller, “Perspective and Rotation: Fan Bracket Sets and the Decorative in the Architecture of Medieval North China”.
58 Chen Wei, “Xiegong fawi” 42.
59 This suggestion is based on the personal discussion with Dr. Zhang Shiqing at Southeast University in Nanjing, China, in June 2008.
60 Liang Sicheng, Liang Sicheng quanji 梁思成全集 6: 34: “角栱在角柱之上，地位特殊，普通的斗栱只有一个外面一个里面，角栱却同时有两个外面，而且同时左右的正面就是右方的侧面，右方的正面也是左方的侧面。” (A jiaoke is placed at a corner column, its position is special. Ordinary dougong just have one exterior and one interior surface, but jiaoke have two exterior surfaces at the same time; what is more, the left hand’s front façade coincides with the side right façade, the right hand’s front façade also is the left side façade.)
61 Generally speaking, mojiao beams are applicable to several roof types except the gable roof. Chinese roof types include the following basic types: (not overhanging) gable roof known as yingshan 楮山; overhanging gable roof known as xuanshan 悬山, in case of tingtang-style 廟堂 architecture also called busha liangtouzao 不厦两头造; hip roof known as sipo
Beijing daxue kaogu wenbo xueyuan

At the front and rear façades, one wing of angular half-brackets was placed at the second to last column-top. The northern one-bay wide structure also called jiaozhong 九脊殿 and in case of tongtian-style 天堂 called shaliangtouzuo 卷头造, pointed roofs for octagonal or circular floor plans called zanjin 半尖; especially in the Qing dynasty, the flush gable roof called juanpeng 皇冠; complex roofs that result from the combination of the basic roof types; furthermore, the application of several additional sets of eaves is possible e.g. double eaved hip-and-gable roof.

62 See the definitions by Pan Guxi and He Jianzhong of dajiaoliang 大角梁 and zanjin 尖顶 (244) and yinjiaoliang 雷火尖 (259), and for further discussion, the two successive articles by Zhang Jingxian, “Feiyan yijiao 飞檐翼角”.

63 Zhong Zhihao 朱志浩, “Cong Nanchansi wujiao bufen zuofa fenxi qita de wujiao bufen de fazhan yanbian 从南禅寺屋角部分做法分析其他的屋角部分的发展演变” 35.

64 Yingzao fashi entry on yingmao 阴马, juan 5, 10-11. Pan Guxi and He Jianzhong 63.

65 Similar to the corner beams, the mojiao beams can either consist of a single piece of timber or multiple tiers such as the interior corner construction at the Main Gate of Fengshenshi 伏圣寺 at Jinci near Taiyuan, Shanxi province. The Yuan dynasty structure applied two mojiao beams that were laid parallel to each other and supported the mid-point and the end-point of the secondary corner beam called dajiaoliang (Zhang Zhihao 36).

66 Pan Guxi and He Jianzhong 63.

67 Loc.cit. For the advantages of mojiaogong in this matter, see Chen Wei, “Xiegng fawer” 44, 45. For an insightful analysis in local architecture of southeastern Shanxi, see Liu Yan and Meng Chao, “Jindongnan xieshan jianzhu dianxing zuofa de gouzao guilü - Jindongnan diqu Tang zhi Jin xieshan jianzhu yanjiu zhi san 唐至金歇山建筑研究之三”.

68 Pan Guxi and He Jianzhong 63.

69 Guo Qinghua defined the ox-spine purlin as “a purlin placed directly above the center line of the first projecting step in a puzuo with xia’ang to support the eaves-rafters” (Visual Dictionary of Chinese Architecture 61).

70 Li Huizhi pointed out that hip-and-gable roof architecture in Shanxi province blended the official way of constructing the roof with local building traditions (except for the region of Beijing) (“Gujianzhu jianding yu fenxi buyi -technique showed a great variety in design that was stimulated by the technical improvements over the years. A good example is the Jin dynasty Sacrificial Hall in front of the Sage Mother Hall at Jinci, where the interior projections of the corner bracket sets still followed the “stolen-heart” design, but the slanting cantilever arms of the intercolumnar sets next to the corbelled corner clusters were linked to the large corner beams in order to uphold the hidden corner beams above (Zhang Zhihao, “Cong Nanchansi wujiao bufen zuofa fenxi qita de wujiao bufen de fazhan yanbian” 37).

71 In current scholarship, the small suspended column known as chuitianzhu is sometimes called zuxu 虚柱, even if strictly speaking, the latter term belongs to the technical terminology of smaller carpentry in the Yingzao fashi (Pan Guxi and He Jianzhong 258).

72 Pan Guxi, Zhongguo gudai jianzhu shijian 4: 437.

73 Fu Xianian, Zhongguo kexue jishu jianzhu jianzhujuan 675. For the most common, late imperial roof construction techniques in North China, see Ma Bingjian, “Xieshan jianzhu de ji zhong goutou xingsha 晋东南地区典型做法的构造规律”.

74 Zhu Guangya, Gujianzhu jianding yu fenxi buyi 古建筑鉴定与分析补遗 11.

75 Generally speaking, the yinjiaoliang-technique showed a great variety in design that was stimulated by the technical improvements over the years. A good example is the Jin dynasty Sacrificial Hall of the Sage Mother Hall at Jinci, where the interior projections of the corner bracket sets still followed the “stolen-heart” design, but the slanting cantilever arms of the intercolumnar sets next to the corbelled corner clusters were linked to the large corner beams in order to uphold the hidden corner beams above (Zhang Zhihao, “Cong Nanchansi wujiao bufen zuofa fenxi qita de wujiao bufen de fazhan yanbian” 37).

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77 Pan Guxi, Zhongguo gudai jianzhu shijian 4: 437.

78 Fu Xianian, Zhongguo kexue jishu jianzhu jianzhujuan 675. For the most common, late imperial roof construction techniques in North China, see Ma Bingjian, “Xieshan jianzhu de ji zhong goutou xingsha 晋东南地区典型做法的构造规律”.

79 Zhu Guangya, Gujianzhu jianding yu fenxi buyi 11.


81 Mojiao beams are listed as mojiaogou 架鼓 framework in the twelfth century manual (Yingzao fashi entry pingqi, juan 5, 5).

82 Peng Jiren, “Zhongguo gudai mojiao zuofa de kexue xuzhu” 48.


85 Ibid., 362. See also Liang Sicheng, “Zhengding jianzhu duocohu jieheng 正定古建筑调查纪略”; Chai Zhen, Chai Zhenj jianzhu wendi 柴泽俊古建筑文集; Zhang Xiusheng 张秀生, Zhengding Longxingsi 正定隆兴寺; Li Shilian 李士连, “Shitan 試談摩尼殿的建筑构造与修缮原则”; Nee Jmlu and Lin Xuhenh, “Zhendong Longxingsi Monidian dougong xupei ya zuanzhu jishu”; Kong Yanhui, “Monidian zhuyao mugujian 斛竹木构架的结构技术”; Zhang Jinxian, “Douguang de yunyong, anzhuang ji sunmao yanjiu”. For the most common, late imperial roof construction techniques in North China, see Ma Bingjian, “Xieshan jianzhu de ji zhong goutou xingsha 晋东南地区典型做法的构造规律”.

86 At the front and rear façades, one wing of angular half-brackets was placed at the second to last column-top dougong but lacked the opposite hand, or in other words those angled bracket-arms that at Monidian reflected the mojiaogong as if in a mirror.

87 Xu Bo’an and Guo Daheng, “Song Yingzao fashi shuyu huishi - houzhui shuzao damoza zuhubu bufen” 48, 49, 55.


89 Beijing dauxe kaogu wenbo xueyuan 北京大学考古文博学院, Shang dong xia yu - liushi jianzhu cehui wu xiao liuhan 上撰下 试谈摩尼殿的建筑构造与修缮原则 (Pan Guxi and He Jianzhong 258).
Past Chinese scholarship had repeatedly suggested that Five Dynasties period murals at Dunhuang such as the wall painting in cave 108 (in Chinese), 227 (in English).

Liang Sicheng, "Dougong jianshuo (Han – Song)" 155.

To put it in a nutshell, the underlying ideological assumption is that straight and especially leveled lines symbolize the qualities of “legitimate”, “ordered”, and “harmonious”, whereas angled, oblique, diagonal, or crooked lines refer to “illegitimate”, “lacking order”, and “dynamise”.

In 1985, Xu Bo’an admitted that the architecture of Longxingsi, in particular Monidian, had been wrongly associated with the Jurchen tribes because of its fan-shaped bracket sets. He further suggested that such angular bracketing was not restricted to Northern conquest dynasties such as the Liao, Jin, and Yuan but rather appealing to craftsmen in various periods including the indigenous Han Chinese Song dynasty (“Yingzuo fashi dougong xingzi jieyi, tanwei” 27).

Liang Sicheng, Liang Sicheng quanj 8: 89 (in Chinese), 228 (in English).

Liang Sicheng, "Dougong jianshuo (Han – Song)” 155.

Past Chinese scholarship had repeatedly suggested that Five Dynasties period murals at Dunhuang such as the wall painting in cave 1/6 of the Mogao Grottoes including the indigenous Han Chinese Song dynasty (“Yingzuo fashi dougong xingzi jieyi, tanwei” 27).

Liang Sicheng, "Dougong jianshuo (Han – Song)” 155.

Liang Sicheng, Liang Sicheng quanj 8: 77 (in Chinese), 226 (in English).

Liang Sicheng, "Dougong jianshuo (Han – Song)” 155.

Past Chinese scholarship had repeatedly suggested that Five Dynasties period murals at Dunhuang such as the wall painting in cave 1/6 of the Mogao Grottoes including the indigenous Han Chinese Song dynasty (“Yingzuo fashi dougong xingzi jieyi, tanwei” 27).

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For Chongmingsi see Chai Zejun, “Shanxi gujianzhu gushi” 44; Ceng Chenyu, Ningde de yishu hampa 161-176; Miller, Constructing Religion 89-96; Zhongjia wenwuju, Zhongguo wenwu ditui: Shanxi fense 2: 423; Zhu Xiyuan, “Jindongnian Lu’an, Pingshun, Gaoping he Jincheng xixian de gujianzhu” 35-36.

For association of the da-e-style 大额式 with the greater carpentry system in the Yuan dynasty, see Pan Guxi, Zhongguo gudai jianzhu shili 4: 308-309, or Zhang Yuhuan, “Shanxi Yuandai diantang de damu jiegou” 89-96. However, an inscription at the interior columns of the Rear Hall reveals a date of the Wanli reign period during the Ming dynasty (明万历十九年, 1591) (Zhongjia wenwuju, Zhongguo wenwu ditui: Shanxi fense 2: 423).

For Xili Erxianmiao see Ceng Chenyu, Ningde de yishu hampa 188-193; Zhongjia wenwuju, Zhongguo wenwu ditui: Shanxi fense 2: 424. In past Chinese scholarship, there was confusion about the colloquial name of Xili Erxianmiao 西李门二仙庙, which is also known as Zhenze Erxiangong 真泽二仙宫. In contrast, XiXi Erxianmiao 西溪二仙庙 is also called Zhenzegong 真泽宫 (Zhongjia wenwuju, Zhongguo wenwu ditui: Shanxi fense 2: 424, 512). For example, Chai Zejun mixed up the two names and judging from the content, rather described the latter monastery in his article “Shanxi juchu zhongyao gujianzhu shili” (170-173).

Feng Junjie, Shanxi shenniaojia juchang kao 49-54; Zhongjia wenwuju, Zhongguo wenwu ditui: Shanxi fense 2: 425; Qiao Yanzhi, “Shanxi Gaopingshi Erlangmiao xitai baohu yu xiufu duice chutan” 山西高平市二郎庙戏台保护与修复对策初探”.

Feng Junjie, Shanxi shenniaojia juchang kao 49.

Loc.cit.

Loc.cit: Xue Linping 薛林平 and Wang Laqing 王季卿, Shanxi chuantong xichang jianzhu 山西传统戏台建筑 57.

For Xii Erxianmiao see especially Li Huizhi, “Shanxi Lingxuan Xixi Zhenze Erxianmiao” 山西陵川西溪真泽二仙庙” but also for example, Chai Zejun, “Shanxi juchu zhongyao gujianzhu shili” 170-173; Zhongjia wenwuju, Zhongguo wenwu ditui: Shanxi fense 2: 512.

Li Huizhi, “Shanxi Lingxuan Xixi Zhenze Erxianmiao” 8.

Ibid., 9.

Ibid., 10.


The Gatehouse probably underwent repair in 1814 (Feng Junjie, Shanxi shenniaojia juchang kao 145).


Jiao Yang 48.

Ibid., 82.

For Taiyuguan see Zhang Yuhuan, “Shanxi Yuandai diantang de damu jiegou” 76; Zhongjia wenwuju, Zhongguo wenwu ditui: Shanxi fense 1: 471, 3: 1206. According to Zhang Yuhuan, the monastery layout consisted of two courtyards, with a main hall or zhongmen 中殿 in the first yard and a main hall or zhengdian 正殿 in the second yard. He considered the latter a relic of the Yuan Dynasty (Loc.cit.).

Ma Xiao discussed the unsophisticated and simple Ming dynasty architecture of the five-bay wide, two-storied, triple-eaved bracket sets and the Second Gate or zhongmen 中門, which is also known as Zhongzangyi 聚陽寺 (Zhongguo gudai louge 中國古代樓閣 269-270). The only hall that eventually survived from the Yuan dynasty is Zangjinglou 藏經樓, but it does not display fan-shaped bracket sets. See also Li Yuming, “Shanxi juchu zhongyao gujianzhu tonglan” 223; Zhongjia wenwuju, Zhongguo wenwu ditui: Shanxi fense 2: 514; Shaexjinheng Lingchuanxian wenwu guanliu 7.16.

For Dayang Tangdimiao see Li Yuming, “Dazhuo ruoqiao - mantan Zhezou Dayang Tangdimiao changdangji changzhansu fenqi 坦州大陽唐突娘竈殿建築風格”: Shanxi shengwenju 山西文物局, Shanxi zhongdian wenwu baohu danwei 山西重点文物保护單位 115.

The First Gate or shamen 山門 displays a rare example of Y-type 5-puzuo bracket sets and the Second Gate or zhongmen a simple-V-type 4-puzuo bracket set with truncated shuatou.

Dating based on the Ming dynasty stone stele from the seventh year of the Wanli reign period entitled “Zhouxiong Wangdimiao dongfangfang jiang 重修陽信東方房記” that was found at Chongwangdian 鳳王殿 to the East of Chengtangdi (Chai Zejun, “Dazhuo ruoqiao - mantan Zhezou Dayang Tangdimiao changzhansu fenqi” 35).


Pan Guxi, Zhongguo gudai jianzhu shili 4: 147.

Feng Junjie, Shanxi shenniaojia juchang kao 219.

Xue Linping and Wang Laqing, Shanxi chuantong xichang jianzhu 116.

Feng Junjie, Shanxi shenniaojia juchang kao 224.

Ibid., 225.

For the City God’s Temple in Pingyao see Feng Junjie, Shanxi shenniaojia juchang kao 303-308; Zhongjia wenwuju, Zhongguo wenwu ditui: Shanxi fense 3: 795.

For Shuishengmiao see Chai Zejun, “Hongdong Guangshengsi 洪洞广胜寺” 131-132; Jing, The Water God’s temple of the Guangsheng Monastery: Cosmic Function of Art, Ritual, and Theater; Pan Guxi, Zhongguo gudai jianzhu leixing ji jiegou 84; Liu Dunzhen wenji 1: 203, 208. Youxiansi is famous for its Song dynasty Front Hall or Piludian 梓榆殿 and the Jin dynasty Middle Hall or Sanfodian 森佛殿, but both relics lack xiegong 如意头造.

For Kaihuasi and Architectural Style in Southern Shanxi’s Shangdang Region “(Pan Guxi and He Jianzhong 250; Wang Xiaoqing 170). Qinghua Guo defined ruyi 如意头造 displaying eigeng that project at 45 degrees, although it started in the time of the Liao and Song, the craftsmen of these periods, I fear, probably never imagined that it could develop into the construction method of the pai lou at the bridge near the Shameleon of Beihai.)

Likewise, Liu Dunzhen described the eastern timber archway near the White Pagoda at Beihai as a prime example (Liu Dunzhen wenji 3: 927). It is noteworthy that the painstaking 2003 article entitled “Fenyang Yuchengguan Wuyuemiao Wuyuedian jiegou fenxi ji shidai kao” by Li Huizhi et al. (Wenwu shijie 文物世界 5 (2003): 23-31) referred to a site protected at provincial level but not yet designated as a key national heritage conservation unit. In other words, Li Huizhi did not discuss the architecture of Wuyuemiao in Beiyuanyuan.

Liu Yongsheng and Zhang Xingliu on page 2, 8, and 11 (photo of Shuixiandian).

Likewise, Liu Dunzhen described the eastern timber archway near the White Pagoda at Beihai as a prime example (Liang Sicheng “Dougong jianshuo (Yuan Ming Qing)” 205: “Qingshi yingzao zeli (Pan Guxi and He Jianzhong 250; Wang Xiaoqing 170). Qinghua Guo defined ruyi 如意头造 displaying eigeng that project at 45 degrees, although it started in the time of the Liao and Song, the craftsmen of these periods, I fear, probably never imagined that it could develop into the construction method of the pai lou at the bridge near the Shameleon of Beihai.)

Liu Dunzhen wenji 1: 203, 208. Youxiansi is famous for its Song dynasty Front Hall or Piludian 梓榆殿 and the Jin dynasty Middle Hall or Sanfodian 森佛殿, but both relics lack xiegong 如意头造.

For Kaihuasi (inventory number 5-0269-3-075) see C hai Zejun, “Shanxi juchu zhongyao gujianzhu shili” 163-166; Xu Yitao, Zhongguo gudai jianzhu leixing ji jiegou 84; Liu Dunzhen wenji 1: 203, 208. Youxiansi is famous for its Song dynasty Front Hall or Piludian 梓榆殿 and the Jin dynasty Middle Hall or Sanfodian 森佛殿, but both relics lack xiegong 如意头造.

Pan Guxi, Zhongguo gudai jianzhu leixing ji jiegou 84: 308-309. For a photo of the bracketing at Niandui Yuhuangmiao (inventory number 6-0436-3-139) see Shanxisheng wenwu, Shanxi zhongdian wenwu baohu danwei 3: 1206. It is noteworthy that the painstaking 2003 article entitled “Fenyang Yuchengguan Wuyuemiao Wuyuedian jiegou fenxi ji shidai kao” by Li Huizhi et al. (Wenwu shijie 文物世界 5 (2003): 23-31) referred to a site protected at provincial level but not yet designated as a key national heritage conservation unit. In other words, Li Huizhi did not discuss the architecture of Wuyuemiao in Beiyuanyuan.

Liu Yongsheng and Zhang Xingliu on page 2, 8, and 11 (photo of Shuixiandian).

Likewise, Liu Dunzhen described the eastern timber archway near the White Pagoda at Beihai as a prime example (Liu Dunzhen wenji 3: 927). It is noteworthy that the painstaking 2003 article entitled “Fenyang Yuchengguan Wuyuemiao Wuyuedian jiegou fenxi ji shidai kao” by Li Huizhi et al. (Wenwu shijie 文物世界 5 (2003): 23-31) referred to a site protected at provincial level but not yet designated as a key national heritage conservation unit. In other words, Li Huizhi did not discuss the architecture of Wuyuemiao in Beiyuanyuan.

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169 Guo Hanquan, *Gu Jianzhu mugong* 189: “网格牌科：常用于牌楼上的牌科，所用的拱斗升较小，再加上牌科出参多，层层牌科相透刻并加，且由于再用上斜栱、斜昂和插栱、插昂等，平面上多为两个方向出参的网格形牌科。” (Wangxang paike: often used for paike at monumental archways; all the gong, dou, and sheng are comparatively small; additionally the chusan number is high; all paike layers are interlinked and intertwined like the Chinese character jing 几; furthermore because of the additional use of xiegong and xie'ang as well as cha'ang and cha'ang, the floor plan becomes a grid-like paike with chusan extending in two directions.)

170 Ma Xiao, “Fujaodou de yuanyi” 104. In theory, it is possible to add numerous large bearing blocks, but the most common arrangement is the addition of a single bearing block to the left and the right of the corner block.

171 Yingzhao fanzi entry on pingzuo, juan 4, 93. See also Liang Sicheng, *Liang Sicheng quanji* 7: 116; Ma Xiao, “Fujaodou yu chanzhu”.

172 Ma Xiao, “Fujaodou de yuanyi” 106. Ma Xiao explained that at the Gatehouse of Dulesi the corner dougong and adjacent side clusters misleadingly appeared as fujiaodou. At first glance, they visually seemed connected because they were placed in such close proximity to each other, but they eventually lacked the necessary structural integrity. In comparison, the adjacent dougong at the second floor of Puxiang at Shanhuasi were placed at such a distance from the corbelled corner clusters that the arrangement does not resemble fujiaodou if looking from outside. However, at the inside of the building, it becomes evident that the pavilion made full use of the principle of interlinked large bearing blocks.

173 Ma Xiao, “Fujaodou de yuanyi” 104.

174 Loc.cit.

175 Ma Xiao, “Fujaodou de lubian – Yuan Ming Qing shiqi fujiaodou de gongneng ji qi yanjiu”.

176 Ma Xiao, “Fujaodou de yuanyi” 106.


178 Ma Xiao, “Fujaodou de lubian – Yuan Ming Qing shiqi fujiaodou de gongneng ji qi yanjiu” 132.

179 See also Feng Jiren, who argued for the spread of xiegong from North to South (“Zhongguo gudai mugou jianzhu de kaoguxue yanjiu” 67).

180 Chen Wei, “Yuedu laingbu Zhongguo jianzhu tongshi tiwei yige sheji shixue mingmai” 183. See also Zhang Zhongyi, *Zhongguo gudai mugou jianzhu de kaoguxue yanjiu* 5: 532. See also Zuo Guobao (Ibid., 220).

181 Zhu Yongchun and Pan Guotai, “Ming Qing Huizhou zhuangshi jianzhu limian goutu bili qianxi yanjiu” 61. For the existence of xiegong in the period, see also Zhang Zhongyi, *Huizhou Mingdai zhuangshi* 151.

182 Ma Xiao, “Fujiaodou de yuanqi (xu)” 106. Ma Xiao explained that at the Gatehouse of Dulesi the corner dougong and adjacent side clusters misleadingly appeared as fujiaodou. At first glance, they visually seemed connected because they were placed in such close proximity to each other, but they eventually lacked the necessary structural integrity. In comparison, the adjacent dougong at the second floor of Puxiang at Shanhuasi were placed at such a distance from the corbelled corner clusters that the arrangement does not resemble fujiaodou if looking from outside. However, at the inside of the building, it becomes evident that the pavilion made full use of the principle of interlinked large bearing blocks.

183 The historical region of Huizhou that comprises all of the above mentioned regions furthermore includes the two ancient villages of Hongcun 黛村 and Xidi 西递 in Yi county 邻县 of southern Anhui province that are well-preserved and culturally outstanding examples of traditional Chinese folk dwellings. They are both inscribed on the UNESCO World Heritage List since 2001.

184 Liu Dunzhen, *Liu Dunzhen wenji* 1: 208. For the multi-cultural and multi-directional exchange in late imperial China and the special impact of Jiannan area on the transfer of knowledge and skills to the North, see also Sun Dazhang, *Shanxi Mingdai gujianzhu* 3: 789.


187 For example, the placement of eight intercolumnar bracket sets at the early Ming dynasty Ling’endian 玲恩殿 at Changling 长陵, one of the Three Tombs of the Ming Dynasty near Beijing 明朝三陵 (Guo Huayu, *Mingdai gujianzhu* 132).

188 Guo Hanquan, *Gu Jianzhu mugong* 218.


191 For Jiecui Houtumiao see Chai Zeyuan (Shanxi juchu zhongyao gujianzhu shih 187-190; Feng Junjie, *Shanxi shenmiao juchang kao* 205-210; Xue Linping and Wang Liqing, *Shanxi chuantong xichang jianzhu* 158-159).


193 Dating according to the stone stele entitled “Chuanian xianlou zhi ju”  from the fourth year in the Zhengde reign period 正德十四年 of the Ming dynasty (1519 C.E.) (Feng Junjie, *Shanxi shenmiao juchang kao* 208).

194 Feng Junjie, *Shanxi shenmiao juchang kao* 208.

195 For Xianshenlou of Sanjieyimiao see for example, Chang Yeping 常亚平, Ma Jikuan 马吉宽, and Chai Yuhai 白玉梅, “Jiecuix Xianshenlou 介休兴善楼; Ma Xiao, *Zhongguo gudai mugou* 209-211; Feng Junjie, *Shanxi shenmiao juchang kao* 459-462; Wei Kewei 韦克威, “Ming Qiong louge jianzhu limian goutu bili qianxi yanjiu” 61. See also Li Xiangdong, “Chagong yanjiu” 13-14.
For Wanrong Dongyuemiao, especially Feiyunlou, see for example, Chai Zejun, “Shanshi juchu zhongguo gujianzhu shili” 204-206; Cheng Aiai, in his “Pailou suanli” eventually depicted the eastern timber archway near the White Pagoda at Beihai (Ibid., 203).

For structural details see Ma Xiao, Zhongguo gudai louge 239.

For structural comments on Beihai, see Chai Zejun, “Linfen Weicun Niuwangmiao Yuandai xitai pouxi” 202-205; Zuo Guobao, Shanxi Mingdai gujianzhu 94-95.

To be precise, the subsidiary construction level pingzuoceng regressed towards a mere decorative feature at the facade called pingzuo that was formed by the balcony with railing.

For Wanrong Houtuci, especially Qiufenglou, see Chai Zejun, “Shanxi juchu zhongyao gujianzhu shili” 202-204; Zhongjia wenwuju, Zhongguo gudai louge 285-287; Cheng Aiai and Zhang Pugang 20.

For the most common construction methods of multi-storied buildings in the Qing dynasty, see also Sun Dazhang, Zhongguo gudai jianzhu shili 5: 432-433.

For structural details see Ma Xiao, Zhongguo gudai louge 285.

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For the Drum Tower in Huozhou see Shanxisheng wenwuj 2: 502.

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For the Drum Tower in Huozhou see Shanxisheng wenwuj 285.

For the Drum Tower in Huozhou see Shanxisheng wenwuj 212. Established in the 11th year of the Wanli reign period in the Ming dynasty (1583 C.E.).

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To be precise, the definition of *ruyi dougong* by Chai Zejun differs from this thesis in such that Chai Zejun did not stress the special situation at the corners of a structure. For his definition of *ruyi dougong*, he included the two corner bracket sets that flanked the end-points of the architrave in the central bay of Weizhenhuaxia paifang (Ibid., 38).

Ibid., 60-71, 419.

Ibid., 85-96, especially 86.

In total, there are eight monumental archways, half of which is located outside the core monastery, namely Jieyiyuan paifang Feng Junjie, “Shanxi shenmiao juchang kao” 587; Chai Zejun, Jiezhou Guandimiao 109.

In a way, the small Daoist monastery of Jiutian Shengmumiao by Chai Zejun differs from this thesis in such that Chai Zejun did not stress the special situation at the corners of a structure. For his definition of *ruyi dougong*, he included the two corner bracket sets that flanked the end-points of the architrave in the central bay of Weizhenhuaxia paifang (Ibid., 38).

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Ibid., 39.

Ibid., 38.

Ibid., 41.

Ibid., 51, 52.

Ibid., 39-40.


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For Jiangcheng Confucius Temple (d. 1779), in particular the impressive timber archway with
Pan Guxi,
See for example, Xiao Hui
For Yunnan Buddhist monasteries see Wang Haitao
See for example, Xiao Mo
Xiao Mo, Zhongguo jianzhu yishushi 2:1029.
Xiao Mo,
A three-bay wide timber structure is currently attached to the column-free front façade of the solid stone core hall. Design and dimensions of fan-shaped bracketing recall timber counterparts in Shanxi province, such as the five-prong arrangements with ruyi that project directly from the ludiou and the small bearing block above. Nevertheless in this case, there are no shatuou and the second steps of bracket-arms directly support the liaoyanfang.

Li Cheng, “Wudangshan de Daqiao gujianzhu ji qi tezhen” 84.

For the involvement of Zhang Shouqing

For the Temple of the South Cliff, see Ding Yongyuan
张佐

For the top of Tianzhu Peak

For the involvement of Zhang Shouqing

For the top of Tianzhu Peak

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For the involvement of Zhang Shouqing

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FINAL CONCLUSION

Eye-catching corbelled clusters were not only powerful status symbols for the importance of the building within the monastery layout or the patron’s rank in society but also visual markers of China’s political influence and cultural realm in Central and East Asia. They successfully combined the basic human desire for decoration with necessities of civil engineering and architectural design.

The main objectives of this research has been to challenge the bracket set, the most distinctive feature of traditional Chinese architecture, and to discuss the diverging stylistic variations that actually existed in the form of fan-shaped or scepter bracketing against the background of official-style building.

To start with, this thesis explained the basics of the imperial construction methods and introduced nomenclature and composition of official-style bracketing in pre-modern China as well as its basic functions and chronological development. To complicate matters, the technical terminology and methodology not only changed with different dynasties or geographic regions, but was also often mistranslated from Chinese into secondary Asian and Western languages.

The key challenge of this thesis was to see beyond the long lasting stereotypes in China that did not allow fully acknowledging the wide range of angular bracketing and importance of such non-conformity. In other words, it was critical to create an understanding of the notion of yielding to authority and following imperative rules in society as well as art and architecture, and not to differentiate between theory and
practice. Two-dimensional sketches and the written word of the imperial building codices, particularly the twelfth century *Yingzao fashi* and the eighteenth century *Gongbu gongcheng zuofa*, were powerful tools. However, out of structural or economic necessity, the builders of the past created visionary and aesthetically beautiful architecture that did not fully comply with them. Despite that, or perhaps because of it, such architecture became an integral part of “regional”, “non-official style” historical building.

Generally speaking, the addition of angled bracket-arms known as *xiegong* 斜栱 became common in north and central China after the tenth century even if ordinary bracket sets still consisted of members that were just parallel and perpendicular to the wall plane. The bizarre arrangements of timbers that stuck out in various directions including acute and obtuse angles were not specifically mentioned in the pre-modern, official building manuals. If addressed at all by scholarship of the twentieth century, they were dismissed as a marginal phenomenon without great cultural value. As a consequence, there still was a lack of a comprehensive database for architecture with angled bracket-arms in China let alone the specific area of present-day Shanxi province. The author conducted two years of field work from September 2007 to August 2009 to collect the necessary visual and textual data that provided the basis for this discussion.

Due to the rich pool of extant buildings in present-day Shanxi, the province was ideally suited for academic research. Moreover, the thrilling cultural phenomenon of angular bracketing was so popular there that a fourth of the extant pre-Yuan relics revealed fan-shaped bracket sets. In absolute figures, among its 271 officially designated heritage sites were more than eighty key national conservation units with buildings dating prior to the mid-thirteenth century. Nineteen of them preserved a total of twenty-one
wooden halls with fan-shaped bracket sets. Additionally, the octagonal Timber Pagoda in Yingxian and the smaller timber carpentry of several sutra cabinets further confirmed the immense popularity of such unorthodox bracketing.

What is more, this thesis aimed to formulate a new code of practice with proper guidelines for discussing the rich pool of xiegong-architecture in the future. In past Chinese and English scholarship, the term xiegong literally translated as “angled, angular or oblique brackets”, was ambiguous and only vaguely defined. Therefore, it was extremely important to distinguish between its uses as the superordinate term for angular bracket-arms in general encompassing mojiaogong, jiaogong, or xiaxugong and the subordinate term for a specific type which was defined as “genuine xiegong”. The next goal was to establish a stylistic typology that encompassed the diverse kinds of fan-shaped bracket sets in Shanxi province and created a tool for discussing the puzzling phenomenon in greater depth. To be precise, two of such classifications were necessary: first, according to the distinctive shape of their ground plan that was associated with geometric forms, namely the eight-sided star (★), cross (X), triangle (▲), and complex form of intertwined stars (★+★+…), four prototypes of fan-shaped bracket sets could be distinguished prior to the mid-thirteenth century. Second, to capture their qualities during the succeeding Yuan, Ming, and Qing dynasties, it was reasonable to add a second categorization based on the nature of projecting xiegong-wings and their elevation within the bracketing unit. The different designs were expressed by capital English letters, namely the single-V-shaped type, the multiple-V-shaped type, the O-shaped type, and the Y-shaped type.
Throughout the thesis, it was also crucial to differentiate between the individual element of a single bracket-arm such as genuine *xiegong*, the organic unit of a complex bracket set, or accurately fan-shaped bracket sets, and the tightly spaced bracketing of a grid-like system namely scepter bracketing. The latter was already well-known as *ruyi dougong* 如意斗栱 in modern Chinese language. Since fan-shaped bracket sets still lacked an appropriate term for the catchy English phrase, this thesis emphasized the term *shanshi dougong* 扇式斗栱 to specifically describe the eave bracket set that was placed along the exterior building façade and mimicked the shape of an open fan. The key difference between *shanshi dougong* and *ruyi dougong* was that the *xiegong* of fan-shaped bracket sets all intersected in a single focal point of the wall plane or along the main axis of the large bearing block. In contrast, *ruyi dougong* successfully overcame the limitations of individual bracket-arms or even sets and merged all of the brackets and blocks along the façade including *xiegong* to become intertwined.

With the help of such meticulous definitions and painstaking typologies, the author succeeded in proving that fan-shaped bracket sets were not only popular before the Yuan dynasty in Shanxi province but continued to be fashionable in late imperial China, especially in the Jindongnan area. Moreover, the two different concepts of complex angular arrangements, namely *shanshi dougong* and *ruyi dougong*, coexisted and included a range of embryonic or hybrid forms.

It should be made clear that fan-shaped bracketing in Shanxi province neither was restricted to a particular period in Chinese history nor could the mere notion of applying them symbolize a specific dynasty. On the contrary, it was rather that they became subject to the general technical advancement that gradually transformed the entire greater
carpentry system. Similar to their orthogonal counterparts, shanshi dougong continually changed and adapted accordingly. They followed for example, the fundamental shift in bracketing from touxinzao to jixinzao or the evolution of pubaifang, which had considerable impact on the feasibility of sprawling fan-shaped corbelled clusters prior to the Yuan dynasty. Over and above, they actively contributed to technical improvement, and among the prototypes of liujin douke, a crucial feature in late imperial architecture, were Jin dynasty bracket sets with genuine xiegong. In the end, they developed into mere decoration without impact on the greater carpentry system when not paired with mojiaogong.

In essence, the defining characteristic of fan-shaped bracketing was the highly flexible underlying concept that was easily adaptable to new uses or different local conditions ranging from environmental or economical factors to building materials and modular size. Like the standard bracket sets without xiegong, the individual design pattern of shanshi dougong absorbed and reflected certain building traditions prevalent in a specific geographic region or time period. To illustrate their ability to yield to the regional and local construction methods, this thesis discussed the distinct building traditions of southeast Shanxi province prior to the Yuan dynasty. In essence, the local builders in present-day Changzhi and Jincheng prefectures skillfully merged the ideal diantang and tingtang plans of official-style architecture into a feasible, ingenious, and liberal building style that took advantage of the best parts of both. They tailored the imposing idea of monumental diantang to the needs of the local patrons and available resources, since the original design was reserved for high-rank, large-scale building projects that could afford adequate supplies of manpower and huge timbers in sufficient
quantity. Needless to say, these changes also influenced the way of bracketing. As hoped for, the timber halls with *shanshi dougong* in southeast Shanxi incorporated typical features of the greater carpentry system such as the rise of interior columns or simplification of the *tailiang*-style roof construction similar to the buildings with strictly orthogonal bracketing. Furthermore, the specific design of their individual components echoed/reiterated the unorthodox composition of non-official style bracket sets in the southeast. For example, the three basic components of the standard bracket set and the core of perpendicular extensions often mixed and matched. *Shuatou* and *chenfangtou* were omitted or mimicked other bracketing members, which is why it was crucial to differentiate between the way or “*shi 式*” in which the timbers structurally acted and their visual shape expressed by the modern Chinese character of “*xing 形*”. Furthermore, the classic feature of the true descending cantilever or any of its stylistic variations that likewise descended at a vertically sloping angle produced an awkwardly looking triangular space underneath the descending tail at the inside of the hall. In this matter, fan-shaped bracket sets faced a special challenge, precisely at the intercolumnar position when upholding the lowest eave purlin. *Shanshi dougong* had to incorporate vertically sloping and also horizontally slanting timbers at the same time. And again, the diverse practical solutions in different regions of Shanxi province confirmed the flexibility of the fan-shaped concept and its ability of cultural assimilation.

In summary, the concept of angular bracketing overcame political and geographical obstacles and was not tethered to the architecture of the Liao, Jin, or Yuan conquest dynasties. Against common expectations, it also appealed to the taste of indigenous Chinese patrons of the Song or Ming dynasties. In Shanxi regional building,
the use of *xiegong* for fan-shaped or scepter bracketing continued despite the introduction of the official building codices. What is more, architecture with angular arrangements can be found in other regions of China such as Hebei, Hubei, and Sichuan provinces. Again, the individual design was subject to stylistic change and local flavor. The notion of using them can be seen as part of a “regional”, “non-official style” in traditional Chinese architecture that used angled bracket-arms as well as more natural timbers with material defects or applied features of oblique, rather than perfectly straight shape. The regional style is by no means inferior to the architecture that flawlessly embodied the official building standards.

The use of genuine angled bracket-arms, fan-shaped bracket sets, or scepter bracketing was not a mandatory structural requirement for load bearing or safety. It was rather an exciting, deliberate choice.
### Table 1-1 Terminology of the official bracketing in the Song and Qing dynasties, and regional building style in South China


<table>
<thead>
<tr>
<th>Song-style</th>
<th>Qing-style of the North</th>
<th>Suzhou-style of the South known as “Su Su”</th>
<th>English terminology</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>铺作 puzuo</strong></td>
<td>(斗科 douke)</td>
<td>(牌科 paike)</td>
<td>bracketing unit (Guo 64), bracket set</td>
</tr>
<tr>
<td>(檐)柱头铺作 yanzhutoupuzuo</td>
<td>柱头科 zhutouke</td>
<td>(檐)柱头科 langzhutouke</td>
<td>(eave) column-top bracket set</td>
</tr>
<tr>
<td>补间铺作 bujianpuzuo</td>
<td>平身科 pingshenke</td>
<td>外檐桁间牌科 waiyan hengjianpaike</td>
<td>intermediate bracket set</td>
</tr>
<tr>
<td>转角铺作 zhuanjiaopuzuo</td>
<td>角科 jiaoke</td>
<td>角牌科 jiaopaike</td>
<td>corner (column-top) bracket set</td>
</tr>
<tr>
<td>楼阁铺作 panjianpuzuo</td>
<td>栈架科 gejiak</td>
<td>架间牌科 hengjianpaike</td>
<td>panjian bracket set (panjian = &quot;over-bay straining-tie&quot;, wing beam, Guo 61)</td>
</tr>
<tr>
<td><strong>朵 duo</strong></td>
<td>改 cai</td>
<td>座 zuo</td>
<td></td>
</tr>
<tr>
<td>x-铺作 x-puzuo</td>
<td>y-踩 ycai dougong</td>
<td>2-出参 2chucan</td>
<td>descriptive expression to capture the multiple layers of a bracket set/measure a layered bracket set</td>
</tr>
<tr>
<td>四铺作 sipuzuo</td>
<td>三踩 sanchucan</td>
<td>三出参 sanchucan</td>
<td>a bracket set of four layers with one perpendicular extension</td>
</tr>
<tr>
<td>外跳 waijiao</td>
<td>外拽 urye</td>
<td>外出参 waichucan neichucan</td>
<td>exterior projections - interior projections</td>
</tr>
<tr>
<td>抄 chao</td>
<td>踩 cai</td>
<td>参 can, 级 ji</td>
<td>measuring word for projecting steps (or layers) within a bracket set (e.g. one-step of huagong or ang)</td>
</tr>
</tbody>
</table>

332
<table>
<thead>
<tr>
<th>斗斗 dou</th>
<th>升升 sheng</th>
<th>斗斗 dou, 升升 sheng</th>
<th>bearing block (Guo 33), bracket block (Steinhardt, Chinese Architecture 190)</th>
</tr>
</thead>
<tbody>
<tr>
<td>栌斗 ludou</td>
<td>坐斗 zuodou, 大斗 dadou</td>
<td>坐斗 zuodou, 大斗 dadou</td>
<td>large bearing block (Harrer), capital block (Guo 56), bearing block (Miller 422), cap block (Steinhardt, Chinese Architecture 190)</td>
</tr>
<tr>
<td>耳 er</td>
<td>斗耳 dou'e</td>
<td>上斗 (或升) 腰 shangdou(or, sheng)yao</td>
<td>ear, waist, and bottom/base of a bearing block (Harrer)</td>
</tr>
<tr>
<td>翘 yi</td>
<td>斗腰 douyao</td>
<td>斗底 douli</td>
<td>“connecting blocks” (Glahn 172), “cross-link block” (Guo 47) placed at huagong or ang to support brackets</td>
</tr>
<tr>
<td>交互斗 jiaohudou</td>
<td>十八斗 shibadou</td>
<td>十字升 shizisheng</td>
<td>“center blocks” (Glahn 172), “central-block” (Guo 66) placed at the center of a bracket set to support lintel above</td>
</tr>
<tr>
<td>齐心斗 qixindou</td>
<td>十字升 shizisheng</td>
<td>中心升 zhongxinsheng</td>
<td>“end blocks” (Glahn 172), separate block or small block (Miller 441) placed on each end of a longitudinal bracket</td>
</tr>
</tbody>
</table>

**棋 gong**

<table>
<thead>
<tr>
<th>华栱 huagong, 卷头 juantou</th>
<th>齐 qiao</th>
<th>十字棋 shizigong</th>
<th>“petal bracket-arm”, bracket-arm projecting perpendicular to the building plane; hereinafter also referred to as “perpendicular brackets” or “transversal brackets”</th>
</tr>
</thead>
<tbody>
<tr>
<td>横栱 henggong</td>
<td>华头子 huatouzi</td>
<td>横 gong</td>
<td>general term for bow-shaped brackets parallel to the wall plane such as nidaogong, guazigong, mangong or linggong, hereafter also referred to as “parallel brackets” or “longitudinal brackets”. To be precise, the Chinese name of henggong which literally translates as “cross-wise brackets” does not refer to their placement in regard to the wall plane (i.e. parallel) but rather to their direction in regard to the basic brackets called huagong that carry them.</td>
</tr>
<tr>
<td>泥道栱 nidaogong</td>
<td>正心瓜栱 zhengxinguagong</td>
<td>(一) 斗三升栱 (yi)dousanshenggong</td>
<td>“plaster channel bracket” (Harrer), “plaster channel bracket-arm” (Miller 439)</td>
</tr>
<tr>
<td>泥道慢栱 nidaomangong</td>
<td>正心万栱 zhengxinwangong</td>
<td>(一) 斗六升栱 (yi)douliushenggong</td>
<td>“melon-seed bracket” (Harrer), “melon-seed bracket-arm” (Miller 436)</td>
</tr>
<tr>
<td>瓜子栱 guazigong</td>
<td>单材瓜栱 guagong</td>
<td>子栱 zianggong</td>
<td>extended bracket (Harrer), extended bracket-arm (Miller 438)</td>
</tr>
<tr>
<td>慢栱 mangong</td>
<td>单材万栱 wanggong</td>
<td>令栱 linggong</td>
<td>“lead bracket” (Harrer), “lead bracket-arm” (Miller 438)</td>
</tr>
<tr>
<td>下昂 xia'ang</td>
<td>昂 ang</td>
<td>东 ang</td>
<td>descending cantilever (Miller 443), down-pointing cantilever (Steinhardt, Chinese Architecture 190)</td>
</tr>
<tr>
<td>华头子 huatouzi</td>
<td>蚂蚱头 mazhatou</td>
<td>蒿头 shuatou</td>
<td>flower bud (Miller 436)</td>
</tr>
<tr>
<td>垂头 shuatou</td>
<td>背头 maizhatou</td>
<td>垂头 shuatou</td>
<td>“trifling-tip” (Miller 441), decorative nose (Steinhardt, Liao Architecture 73)</td>
</tr>
<tr>
<td>杵枋头 chenfangtou</td>
<td>撑头木 chengtoumu</td>
<td>水平枋 shuipingfang</td>
<td>chenfangtou, uppermost perpendicular timber of the bracket sets with concealed front and exposed tail placed on top of shuatou to link interior and exterior joists (Harrer after Pan Guxi and He Jianzhong 254, and Chen Mingda 263)</td>
</tr>
<tr>
<td>Balk sufang</td>
<td>joist, plain tie-beam, lintel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>--------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>柱头枋 zhoutoufang</td>
<td>正心枋 zhengxinfang</td>
<td>(高)连机 (gao)lianji</td>
<td>column-top joist (Harrer), column-top lintel (Guo 99), column-top beam (Miller 445), axial tie-beam (Steinhardt, Chinese Architecture 190)</td>
</tr>
<tr>
<td>罗汉枋 luohanfang</td>
<td>挽枋 yeafang</td>
<td>脊条 paihuo</td>
<td>arhat joist (Harrer), “arhat beam” (Miller 438)</td>
</tr>
<tr>
<td>平綦（或）枋 pingqifang</td>
<td>门口枋 jingtoufang</td>
<td>脊条 paihuo</td>
<td>paneled ceiling tie-beam (Steinhardt, Chinese Architecture 190)</td>
</tr>
<tr>
<td>挑檐枋 liaoyanfang</td>
<td>挑檐枋 (或) tiayancheng(or, lin)</td>
<td>柱桁 zheng</td>
<td>eaves (-raising) tie-beam/joist (Harrer), eaves (-raising) beam (Miller 438), eave purlin (Steinhardt, Chinese Architecture 190)</td>
</tr>
<tr>
<td>隘磐 lan'e</td>
<td>(大)隔枋 da'e fang</td>
<td>平替枋 langfang</td>
<td>vertical architrave (Miller 437)</td>
</tr>
<tr>
<td>由额 you'e</td>
<td>小隔枋 xiaoefang</td>
<td>平替枋 pingfang</td>
<td>lower vertical architrave (Harrer)</td>
</tr>
<tr>
<td>普拍或板枋 pupai(or, bo)fang</td>
<td>平板枋 pingbanfang</td>
<td>斗盘枋 doupanfang</td>
<td>horizontal architrave (Miller 440)</td>
</tr>
<tr>
<td>板 ban</td>
<td>board, panel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>遮棱板 zhechenban</td>
<td>盖斗板 gaidouban</td>
<td>盖板 gaiban</td>
<td>rafter-screening panel (Miller 444)</td>
</tr>
<tr>
<td>椽眼壁板 gongyanbian</td>
<td>椽垫板 gongdianban</td>
<td>盾板 diangongban</td>
<td>interbracket-set-board (Guo 39)</td>
</tr>
</tbody>
</table>
Table 1-2 Selected pictorial examples of the basic ways of bracketing: bracket-arm, bracket set, and grid-like bracket system

<table>
<thead>
<tr>
<th>Subject matter</th>
<th>Orthogonal direction</th>
<th>Angled direction</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>bracket-arm</strong></td>
<td><img src="image1" alt="Main Hall of Chuzu’an" /></td>
<td><img src="image2" alt="Shanhuasi Shanmen" /></td>
</tr>
<tr>
<td></td>
<td>初祖庵</td>
<td>善化寺山门</td>
</tr>
<tr>
<td><strong>bracket set</strong></td>
<td><img src="image1" alt="Main Hall of Chuzu’an" /></td>
<td><img src="image3" alt="Tianwangdian of Longmensi" /> <img src="image4" alt="Main Hall of Dongyi Longwangmiao" /></td>
</tr>
<tr>
<td></td>
<td>初祖庵 天王殿龙门寺 东邑龙王庙</td>
<td></td>
</tr>
<tr>
<td><strong>grid-like</strong></td>
<td><img src="image5" alt="Yushulou of Xiezhou Guandimiao" /></td>
<td><img src="image6" alt="Shanhaizhongling of Xiezhou Guandimiao" /> <img src="image7" alt="Huangjingtang at Wudangshan" /></td>
</tr>
<tr>
<td></td>
<td>御书楼解州关帝庙 山海锺灵解州关帝庙 皇经堂武当山</td>
<td></td>
</tr>
<tr>
<td>Subject matter</td>
<td>Orthogonal direction i.e. bracket-arms applied parallel or at right-angle to the wall plane</td>
<td>Angled direction i.e. bracket-arms applied at acute angle or obtuse angles to the wall plane</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>------------------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| bracket-arm                    | bracket-arms projecting perpendicular to the wall plane called huagong 华栱, bracket-arms parallel to the wall plane generally referred to as henggong (i.e. nidaogong 泥道栱, guazigong 瓜子栱, mangong 慢栱, linggong 令栱) | xiegong 斜栱  
1. generic name and broader term for “angled, angular or oblique brackets”, a superordinate term for bracket-arms projecting at acute or obtuse angles to the wall plane, including:  
“angled bracket-arm in the strictest sense” or “genuine xiegong”, a bracket-arm that steps out at acute or obtuse angles to the wall plane if placed at the exterior steps of a regular eave bracket set along the façade  
“angular bracket-arms in the broader sense”, stylistic variations usually named after the specific function or placement e.g. mojiaogong 抹角栱, jiaogong 角栱, xiazugong 虾须栱, and the group of “no-name” angled bracket-arms that cannot be captured systematically and reduced to a few categories but rather must be distinguished and “named” case by case  
2. narrower term for “angled bracket-arm in the strictest sense” or “genuine xiegong” (often simply referred to as “xiegong” in Chinese scholarship, using the short form without indication of the hierarchical whole-part relationship) |
| bracket set (excluding corner sets) | eave bracket sets placed at the outer column grid along the exterior façades i.e. regular eave bracket set interior bracket sets placed at the inner column grid | fan-shaped bracket set called shanshi dougong 扇式斗栱, an eave bracket set placed along the exterior façade with outward projecting xiegong at the exterior steps and optionally at the interior steps  
stylistic variations with angled arms exclusively applied at the interior steps, stylistic variations at the inner column grid |
| grid-like bracket system       | orthogonal grid-like bracket system                                                             | angular grid-like bracket system called ruyi dougong 如意斗栱 |
Table 1-4 Overview of definitions for the different kinds of angular bracketing: jiaogong, mojiaogong, xiaxugong, genuine xiegong, shanshi dougong, ruyi dougong (Guo Qinghua, Visual Dictionary of Chinese Architecture 47; Harrer, Fan-shaped Bracket Sets and their Application in Religious Timber Architecture of Shanxi Province)

<table>
<thead>
<tr>
<th>Name of the angular bracket-arm, set, or system</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>corner bracket called jiaogong 角栱 角栱 角栱 角栱</td>
<td>literally translates as “corner bracket”, “a bracket used diagonally with respect to a building plan in a corner puzuo-set” (Guo Qinghua, Visual Dictionary of Chinese Architecture 47)</td>
</tr>
<tr>
<td>“corner spanning bracket” called mojiaogong 抹角栱 抹角栱 抹角栱 抹角栱</td>
<td>literally translates as “span-corner bracket, corner spanning bracket”, a structural timber placed at an angle of 45 degrees to the building façade that stretches at a right angle to the “diagonally” projecting bracket-arm called jiaogong; either a single piece of long timber directly integrated into the corbelled corner cluster, or divided into two pieces that are placed separately at a certain distance behind the corner and incorporated into the regular eave bracketing along the façade (Harrer, Fan-shaped Bracket Sets and their Application in Religious Timber Architecture of Shanxi Province)</td>
</tr>
<tr>
<td>angular half-brackets called xiaxugong 虾须栱 虾须栱 虾须栱 虾须栱</td>
<td>literally translates as “shrimp’s antenna bracket”, a certain kind of dingtougong (i.e. half-brackets which ground plan resembles the Chinese character “丁” but not necessarily chagong) that projects at acute or obtuse angles to the building plane if placed at a T-shaped inner column grid; more precisely, xiaxugong must be applied at the interior steps of a bracket set that is located at the T-shaped intersection point of regular eave columns with (a row of) interior columns (Harrer, Fan-shaped Bracket Sets and their Application in Religious Timber Architecture of Shanxi Province)</td>
</tr>
<tr>
<td>“angled bracket-arm in the strictest sense” or “genuine xiegong” called (zhen)xiegong (真斜栱</td>
<td>literally translates as “genuine or true angled bracket-arm”, the narrower term for a bracket-arm that steps out at acute or obtuse angles to the wall plane if placed at the exterior steps of a regular eave bracket set along the façade; in terms of fabrication, it can be made of long timbers that symmetrically extend at the outside and the inside of the building or short half-brackets that are only visible at the outside. (Harrer, Fan-shaped Bracket Sets and their Application in Religious Timber Architecture of Shanxi Province)</td>
</tr>
<tr>
<td>fan-shaped bracket sets called shanshi dougong 扇式斗栱 扇式斗栱 扇式斗栱 扇式斗栱</td>
<td>literally translates as “fan-shaped bracket set”, an eave bracket set placed along the exterior building façade that mimics the shape of an open fan and applies outward projecting xiegong at the exterior steps and optionally, at the interior steps.; they all intersect in a single focal point in the wall plane or along the main axis of the large bearing block (Harrer, Fan-shaped Bracket Sets and their Application in Religious Timber Architecture of Shanxi Province)</td>
</tr>
<tr>
<td>angular grid-like bracket system called ruyi dougong 如意斗栱 如意斗栱 如意斗栱 如意斗栱</td>
<td>literally translates as “ceremonial scepter bracket set”, a kind of tightly spaced (surface) bracketing that successfully overcomes the limitations of individual bracket-arms or sets and merges all of the members to a strong structural and decorative grid system; it equally employs bracket-arms parallel or at a right angle to the wall plane and bracket-arms at acute or obtuse angles (usually 45 degrees), all of which are “intertwined”, i.e. closely connected with the adjacent members at the side, below and above, and mutually uphold each other; in contrast to fan-shaped sets, there is no single focal point of bracket-arms or point of intersection. (Harrer, Fan-shaped Bracket Sets and their Application in Religious Timber Architecture of Shanxi Province)</td>
</tr>
</tbody>
</table>
Table 1-5 Definitions of (zhèn) xiegong (真) 斜栱 in Chinese and English scholarship

<table>
<thead>
<tr>
<th>Author</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chen Wei</td>
<td>“斜栱是与正心方向不垂直的栱，从它的造法和结构上分析，当定义为华栱的一类时，且与正心华栱方向夹角为一锐角的栱。它的功能和华栱一样，起传递并支承上部结构的作用。” (Chen Wei, “Xiegong fawei” 40) (Xiegong are brackets that are not perpendicular to the normal direction of the right center; from the angle of their manufacturing method and construction, we can define them as a type of huagong, being installed at an acute angle to the orientation of regular huagong. Their ability is the same as huagong, their task is to rise through transmitting steps and support the upper construction.)</td>
</tr>
<tr>
<td>Guo Daiheng</td>
<td>“这一时期建筑的非转角铺作中出现了不少使用斜华栱的建筑，最早者为北宋皇佑六年（公元1054年）的摩尼殿，以后直至金天会年间（公元1128年—43年）的善化寺三圣殿为最后一例，主要分布在山西、河北地区。从平面看有 형태形、*形和求形等多种，它们的技术意义在于减少两朵铺作间木方的跨度，但发展到后期已经成为玩弄技巧的产物。” (Guo Daiheng, Zhongguo gudai jianzhushi 3: 767) (Among the architecture of this period, which applied many xiegong that appeared not at the corner puzuo, the earliest example is the Northern Song Monidian, built in the 6th year of the Huangyou reign period (1054 C.E.), thereafter Shanhuasi Sanshengdian, [under construction] until the Tianhui reign period of the Jin dynasty (1128-1143 C.E.) is the last example, [the examples are] mainly scattered in the Shanxi and Hebei regions. Looking at the floor plans, there are several designs including those shaped like *, *，or the Chinese character qiu 求, their technological significance lies in their ability to reduce the span of timber joists in-between two puzuo sets, but their development in the succeeding periods turned them a preposterous idea of the [original] technical craftsmanship)</td>
</tr>
<tr>
<td>Guo Hanquan</td>
<td>“斜栱(南北方地区): 在坐斗上内外斜出不同角度之栱。” (Guo Hanquan, Gujianzhu mugong 235) (Xiegong (in northern and southern regions): a bracket placed at the zuodou (i.e. large bearing block) that projects outward and/or inward at various angles.)</td>
</tr>
<tr>
<td>Liang Sicheng</td>
<td>“斗栱种类，散见前文者，无虑三十余种，可谓尽意匠变化之能事，然其中最特别者，无如斜栱一类。斜栱之产生与其发达之过程，虽尚不明，若其应用范围，则辽代遗物中，仅于转角作及补间作二类，至金出善化寺山门，始如正定隆兴寺摩尼殿，用于柱头作之抹角栱，与补间作之四十五度或六十度斜栱，皆能使荷重分布，较普通斗栱，更为安全。” (Liang Sicheng, Liang Sicheng quanji 2: 163) (Out of the different kinds of dougong, seen at scattered places in previous texts, approximately thirty kinds are left, we might well say they represent the craftsmen’s attempt to adapt the [original] creative concept in the best way they can, certainly the most special kind among them, is none other than the type of xiegong. The course of their emergence and flourishing, although still not clear, it seems possible [to discuss] their application in the Lia dynasty there are just two types, the corner column-top and intercolumnar positions, [such as] the pre-Jin Shanhuasi Shannen; starting with Longxingsi Monidian in Zhengding, they are applied at column-top puzuo. The arrangement of xiegong)</td>
</tr>
<tr>
<td>Author</td>
<td>Text</td>
</tr>
<tr>
<td>-----------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Lü Songyun and Liu Shizhong 刘诗中 | “斜栱：呈 30°、60°斜出之斗栱，始见于宋代建筑，在辽、金建筑中用于得较多，尔后，逐渐减少。” (Lü Songyun and Liu Shizhong, *A Dictionary of Traditional Chinese Architecture* 76)  
Xiegong: a bracket set stepping out in an oblique way forming 30 or 60 degree angles; first seen in Song dynasty architecture, it was comparatively often used in Liao and Jin architecture; afterwards, it was subsequently less used.) |
| Pan Dehua 潘德华 | “斜栱角度有 45°与 60°两种，在金代建筑中使用普遍，如建于金天眷三年（公元 1140 年）山西华严寺大雄宝殿, 补间铺作用 45°斜栱。建于金天会十五年（公元 1137 年) 佛光寺文殊殿, 补间铺作用 45°斜栱。建于金皇统三年（公元 1143 年) 朔州崇福寺弥陀殿前沿柱头铺作, 后檐补间铺作用 45°斜栱。此类较多, 不一赘举。在金代之前, 他们有出现, 如善化寺大雄宝殿, 补间铺作用 60°斜栱。山西应县木塔, 补间铺作用 60°与 45°两种斜栱。金亡元兴, 斜栱渐少使用, 已废去斜栱之制, 斜栱是金代建筑的一大特征。” (Pan Dehua, *Dougong* 17)  
The angles of *xiegong* include two kinds, namely 45 and 60 degree angles; in the Jin dynasty their use was common, such as at Huayansi Daxiongbaodian, which was built in the 3rd year of the Jin Tianjuan reign period (1140 C.E.) which *bujian puzuo* use 45° *xiegong*. [Another example is] Foguangsi Wenshudian, built in the 15th year of the Jin Tianhui reign period (1137 C.E.), which *bujian puzuo* use 45° *xiegong*. [A example is] Chongfusi Mituodian in Shuozhou, which *bujian puzuo* use 45° *xiegong*. [A example is] Yingxian Muta, which *bujian puzuo* use both kinds, the 60° and 45° *xiegong*. Upon fall of the Jin and rise of the Yuan, *xiegong* became gradually less used; the scheme *xiegong* had already been abolished, [which proves that] *xiegong* are a defining feature of Jin dynasty architecture. |
| Pan Guxi 潘谷西 and He Jianzhong 何建中 ( Yingzao fashi jiedu) | “考斜栱有两种形式: 一是 60°度斜栱, 构造方法是在栌斗上左右斜出与泥道栱成 60°度的华栱两条, 两条华栱上的瓜子栱做成一条共用一个散斗的鸳鸯交手栱, 华栱外跳上的令栱或各自独立或做成鸳鸯交手栱, 梁栱二层檐上当心间补间铺作、华栱三层檐上当心间补间铺作等均有此式, 斜栱尾尾与前面出跳对称布置或较前面多出若干跳以承托室内平棋（图 1）。另一种是 45°度, 由正出的条华栱和左右斜出的与泥道栱成 45°度的斜栱组成了…” (Shen Yuzhi, “Xiegong yanbian ji pupaifang de zuoyong” 176)  
(If examining *xiegong*, [we find that] there are two types: the first one encompasses 60 degree *xiegong*; their structural principle is that two *huaong* project at a certain angle from the *ludou* to the left and right forming 60 degree angles with the *nidaogong*; the *guazigong* on top of the two angled *huaong* create a *yuanyang jiaoshougong* that shares the *sandou*; the *linggong* on top of the angled *huaong*’s outermost steps is either an individual timber or also a *yuanyang jiaoshougong*; the eave *bujian puzuo* of the central bays at the second floor of the Shijiata, the Daxiongbaodian at Huayansi, or the Daxiongbaodian at Shanhuasi all have this type; the tails of their *xiegong* and the frontally projecting steps are either symmetrically designed or with a higher number of projections in the front to support the *pingqi*-style ceiling inside the building. Another type are 45 degree [xiegong]; [bracket sets with this type] are composed of perpendicularly projecting *huaong* and angled *huaong* that step out to the left and right forming a 45 degree angle with the *nidaogong*…)

“斜栱是补间铺作的一种形式。它的出现，证明了补间铺作在重量和体量方面不但可以与柱头铺作相同，而且可以超越之，为辽宋以来两朵补间铺作的出现，论证了结构上的可行性，它的受力情况意味着斗栱层已形成并成熟形式发展。” (Shen Yuzhi, “Xiegong yanbian ji pupaifang de zuoyong” 183)  
(*Xiegong* are a form of *bujian puzuo*; their appearance proves that *bujian puzuo* not only can be equivalent to)
column-top *puzuo* with regard to weight and body quantity but also can surpass the latter; on account of the emerging [rule of] two *bujian* *puzuo* sets that started with the Liao and Song, they [i.e. *xiegong*] testify the structural feasibility; the circumstances of their exposure to stress imply the progress of the *dougong* layers that already took shape and developed into mature form.

<table>
<thead>
<tr>
<th>Author</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wang Xiaqing 王效青</td>
<td><em>(A Dictionary of Technical Terminology for Ancient Chinese Architecture)</em></td>
</tr>
<tr>
<td>Zhang Dan 张丹</td>
<td>&quot;在金代也大量使用,而且更加复杂。斜栱的排列,平面上与主轴线成45°或60°,有的斜栱内外对称,依据杠杆原理,可起支撑檐部重量的作用。由于支点增加,荷重分布比一般斗栱更加均匀。但若斜栱没有对称的延长时,这一优点就没有了。随着斜栱的使用,内外跳头上的横栱栱头及栱上散斗不得不随着抹料,以取得外观上的协调和统一。金亡元兴,斜栱也减少使用,直至消亡。” <em>(Zhang Dan, <em>Dougong yishu yu jiegou jineng yanbian lishi de yan jiu</em> 46)</em></td>
</tr>
<tr>
<td>Zhu Xiaonan 朱小南</td>
<td>“斜栱,就是自斗栱中心与华栱或泥道栱呈45度或60度夹角斜向出跳的栱。” <em>(Zhu Xiaonan, “Xiegong suyuan” 65)</em></td>
</tr>
<tr>
<td>Guo Qinghua 郭庆华</td>
<td><em>(Visual Dictionary of Chinese Architecture)</em></td>
</tr>
<tr>
<td>Miller, Tracy</td>
<td>“The angled bracket-arm is different in that it does not step out directly perpendicular to the building façade, but rather it extends as an extra element at an angle to the façade, and immediately one wonders the reason for this development.” <em>(Miller, “Perspective and Rotation: Fan Bracket Sets and the Decorative in the Architecture of Medieval North China”)</em></td>
</tr>
<tr>
<td>Steinhardt, Nancy</td>
<td><em>(Chinese Architecture; Liao Architecture)</em></td>
</tr>
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Table 1-6 Definitions of fan-shaped bracket sets in Chinese and English scholarship

<table>
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<tr>
<th>Author</th>
<th>Definition</th>
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<td><strong>Guo Hanquan 过汉泉</strong> <em>(Guo Hanquan, Gujianzhu mugong 235)</em></td>
<td>&quot;&quot;</td>
</tr>
<tr>
<td><strong>Liang Sicheng 梁思成</strong> <em>(Liang Sicheng quanji)</em></td>
<td>&quot;&quot;</td>
</tr>
<tr>
<td><strong>Lü Songyun 吕松云 and Liu Shizhong 刘诗中</strong> <em>(A Dictionary of Traditional Chinese Architecture)</em></td>
<td>&quot;&quot;</td>
</tr>
<tr>
<td><strong>Pan Guxi 潘谷西 and He Jianzhong 何建中</strong> <em>(Yingzao fashi jiedu)</em></td>
<td>&quot;&quot;</td>
</tr>
<tr>
<td><strong>Wang Xiaoqing 王效青</strong> <em>(A Dictionary of Technical Terminology for Ancient Chinese Architecture)</em></td>
<td>&quot;&quot;</td>
</tr>
<tr>
<td><strong>Miller, Tracy</strong></td>
<td>“The fan bracket set is formed from angled bracket-arms or xiegong 斜栱, and is a variation of the corbelled bracket set used primarily to support the eaves in China’s large-scale timber frame architecture.” (Miller, “Perspective and Rotation: Fan Bracket Sets and the Decorative in the Architecture of Medieval North China” 2)</td>
</tr>
<tr>
<td><strong>Steinhardt, Nancy</strong></td>
<td>(Fan-shaped bracketing) “In these clusters, projection is along five directions – two parallel to, one perpendicular to, and two at 60-degree angles from the building façade.” (Steinhardt, <em>Liao Architecture</em> 138-139)</td>
</tr>
</tbody>
</table>
### Table 1-7 Selected definitions of *ruyi dougong* 如意斗栱 in Chinese and English scholarship

<table>
<thead>
<tr>
<th>Author</th>
<th>Definition</th>
</tr>
</thead>
</table>
| Guo Hanquan 过汉泉       | “网形牌科: 常用于牌楼上的牌科, 所用的栱扱升较小, 再加上牌科出参多, 层层牌科相通系井交, 且由于再用上斜栱、斜昂和插栱、插昂等, 平面上多为两个方向出参的网状牌科。” (Guo Hanquan, *Gu Jianzhu mugong* 189)  
  (Wangxing paike: often used for paike at monumental archways; all the gong, dou, and sheng are comparatively small; additionally the chusan number is high; all paike layers are interlinked and intertwined like the Chinese character jing 井; furthermore because of the additional use of xiegong and xie’ang as well as chugong and cha’ang, the floor plan becomes a grid-like paike with chusan extending in two directions.) |
| Liang Sicheng 梁思成     | “如意斗栱: 在平面上除互成正角之翘昂与栱外, 在其角内四十五度线上, 另加翘昂者。” (Liang Sicheng, *Liang Sicheng quanji* 7: 71)  
  (Ruyi dougong: with regard to the floor plan, next to qiao and ang that mutually support each other running at right angles to each other; along the 45 degree angle line between them, there are other qiao and ang added.) |
  (Ruyi dougong: every set of dougong also possesses xiegong projecting at a 45 degree angle next to its longitudinal and lateral qiao and gong that extend in four directions; several xiegong together generate a complex, grid-like system. This is called *ruyi dougong*. This kind of dougong often appears in timber pailou and zaojing, and emerged first in the Song dynasty.) |
| Guo Qinghua             | “Ruiyi dougong (M-Q) A type of bracket unit consisting of bracket projecting at 45 degrees to the façade, usually employed in pailou牌楼 or coffer ceilings藻井.” (Guo Qinghua, *Visual Dictionary of Chinese Architecture* 68) |
| Steinhardt, Nancy       | “It [fan-shaped bracketing] is a feature found in Liao and Song brick pagodas (see fig. 359) and in Qing architecture, at which time it is called *ruyi* (scepter) dougong.” (Steinhardt, *Liao Architecture* 203) |


Table 2-1 Key national heritage conservation units in Shanxi province or 全国重点文物保护单位

1. Taiyuan prefecture 太原市, central Shanxi

Taiyuan 太原市 (10 relics), Gujiao 故交市 (0 relics), Qingxu county 清徐县 (2 relics), Yangqu county 阳曲县 (1 relic), Loufan 娄烦县 (0 relics)

In total 13 relics

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<tr>
<td>4-0192-4-004</td>
<td>Taiyuanshi 太原市</td>
<td>Longmen shiku 龙山石窟</td>
<td>Stone cave and carving 古洞石刻</td>
</tr>
<tr>
<td>5-0010-1-010</td>
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<td>Jinyang gucheng yizhi 晋阳古城遗址</td>
<td>Ancient site 古遗址</td>
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<td>Dou Daifuci 善大夫祠</td>
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<td>Tianlongshan shiku 天龙山石窟</td>
<td>Stone cave and carving 古洞石刻</td>
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<td>6-0233-2-013</td>
<td>Taiyuanshi 太原市</td>
<td>Wangjiafeng muqun 王家峰墓群</td>
<td>Ancient tomb 古墓葬</td>
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<tr>
<td>6-0380-3-083</td>
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<td>Qingyuan Wenmiao 清源文庙</td>
<td>Traditional architecture 古建筑</td>
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<td>6-0362-3-065</td>
<td>Qingxuxian 清徐县</td>
<td>Hutusi 狐突庙</td>
<td>Traditional architecture 古建筑</td>
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<tr>
<td>6-0397-3-100</td>
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<td>Bu’ersi 不二寺</td>
<td>Traditional architecture 古建筑</td>
</tr>
</tbody>
</table>

2. Datong prefecture 大同市, northern Shanxi

Proper city of Datong 大同市 (9 relics), Datong county 大同县 (0 relics), Yanggao county 阳高县 (3 relics), Tianzhen county 天镇县 (2 relics), Guangling county 广灵县 (1 relic), Lingqu county 灵丘县 (3 relics), Hunyuan county 浑源县 (4 relics), Zuoyun county 左云县 (0 relics)

In total 22 relics

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<tr>
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<td>Datong Meikuo Wanrenfeng 大同煤扩万人坑</td>
<td>Modern site 近现代</td>
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---

1 Guojia wenwuju 国家文物局, Di yi zhi di liu quanguo zhongdian wenwu baohu danwei tongji ziliao tongce 第一至第六批全国重点文物保护单位统计资料简册; Shanxisheng wenwuju 山西省文物局, Shanxi zhongdian wenwu baohu danwei 山西重点文物保护单位.

In this table, the dating is based on the information provided by the State Administration of Cultural Heritage (Guojia wenwuju, Di yi zhi di liu quanguo zhongdian wenwu baohu danwei tongji ziliao tongce).

This is a preliminary list of dates that needs further refinement. The relics that contain architecture dating prior to the Yuan dynasty are highlighted in grey in case of timber structures, in blue in case of stone or brick pagodas, and in pink in case of tombs or other relics. The grey-highlighted monasteries were applicable for further research, and part two of this thesis investigates their date of construction and possible application of fan-shaped bracketing. The asterix indicates the monasteries that are considered for the conclusions in part three of this thesis, because they contain post-Jin dynasty structures with genuine xiegong in the form of fan-shaped bracket sets or scepter bracketing.
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4. Yangquan prefecture 阳泉市, central Shanxi

Yangquan 阳泉市 (1 relic), Pingding county 平定县 (0 relics), Yu county 孟县 (3 relics)
In total 4 relics

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In total 33 relics²

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² The relic entitled “Balujun zongsiling jiuzhi 八路军总司令旧址”, inventory number 1-0026-5-026, is listed for Lucheng 麗城市 and Wuxiang county 武乡县. This thesis counts such double listings only as one heritage unit.

³ The site is usually referred to as Dayunyuan 大云院, not Dayunyuan 大云院 (Guogia wenwu, Di yi zhi di liu quanguo zhongdian wenwu baohu danwei tongji ziliao tongce 79).
6. Jincheng prefecture 晋城市, southeast Shanxi

Jincheng 晋城市 (3 relics), Gaoping 高平市 (11 relics), Zezhou county 泽州县 (also called “Nancunzhen 南村镇”) (5 relics),
Qinshui county 沁水县 (4 relics), Yangcheng county 阳城县 (6 relics), Lingchuan county 陵川县 (13 relics)
In total 42 relics

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*Nanjixiangsi 南吉祥寺 and Beijixiangsi 北吉祥寺 are listed as one heritage unit and thus have the same inventory number.

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### 7. Xinzhou prefecture 忻州市, northern Shanxi

Xinzhou 忻州市 (1 relic), Yuanping county 原平县 (0 relics), Dingxiang county 定襄县 (4 relics), Wutai county 五台县 (7 relics), Daixian county 代县 (4 relics), Fanshi county 繁峙县 (4-5 relics), Ningwu county 宁武县 (0 relics), Jingle county 静乐县 (0 relics), Shenchi county 神池县 (0 relics), Wuzhai county 五寨县 (0 relics), Kelan county 岢岚县 (0 relics), Hequ county 河曲县 (0 relics), Baode county 保德县 (0 relics), Pianguan county 偏关县 (0 relics)

*In total 19 relics*

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*The relic entitled “pingxingguan zhanyi yizhi 平型关战役遗址”, inventory number 1-0025-5-025, is listed for Fanshi county 繁峙县 in Xinzhou prefecture and Lingqiu county 灵丘县 in Datong prefecture. This thesis counts such double listings only as one heritage unit.*

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The already lost Northern Song dynasty structure of Yuhuagong (8 relics), Jinzhong prefecture

Zuoquan county (2 relics), Pingyao county (2 relics), Yuncheng county (2 relics), Zuoquan county (2 relics), Heshun county (2 relics), Xiyang county (2 relics), Shuozhou county (2 relics), Taiyuan county (2 relics), Pingyao county (2 relics), Lingshi county (5 relics)

In total 44 relics

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6 The already lost Northern Song dynasty structure of Yuhuagong (8 relics) in Yuncheng county, was located in Yuci county (2 relics) of Jinzhong prefecture.

7 The relic entitled “Balujun yì'erjushì sìlingbu jūzhì 八路軍一二九師司令部舊址”, inventory number 4-0242-5-044, is listed for Zuoquan county (2 relics) in Shansi province and She county (2 relics) in Hebei province. This thesis counts such double listings only as one heritage unit.
9. Linfen prefecture (historically also known as “Pingyang 平阳”), southwest Shanxi

Linfen 林汾 (6 relics), Houma 候马市 (1 relic), Huozhou 霍州市 (4 relics), Quwo 倪沃县 (1-2 relics), Yicheng 翼城县 (3 relics), Xiangfen 襄汾县 (4 relics), Hongduo 洪洞县 (2 relics), Ji 古县 (0 relics), Anze 安泽县 (0 relics), Fushan 浮山县 (1 relic), Ji 吉县 (1 relic), Xiangning 乡宁县 (1 relic), Puxian 蒲县 (1 relic), Daning 大宁县 (0 relics), Yonghe 永和县 (0 relics), Yi 隰县 (1 relic), Fenxi 汾西县 (1 relic)

In total 28 relics

The relic entitled "Qucun yi tianma yizhe 曲村一天马遗址", inventory number 4-0026-1-026, is listed for Quwo 倪沃县 and Yicheng 翼城县.
10. Yuncheng prefecture 运城市, southwest Shanxi

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<td>Pujiudu, Puzhou goucheng yizhi 蒲津渡蒲州古城遗址</td>
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11. **Lüliang prefecture 吕梁市, central Shanxi**

Lüliang 吕梁市 (3 relics), Xiaoyi county 孝义市 (1 relic), Fenyang 汾阳市 (4 relics), Wenshui county 文水县 (1 relic), Zhongyang 中阳县 (0 relics), Xing county 兴县 (1 relic), Lin county 临县 (3 relics), Fangshan county 方山县 (1 relic), Liulin county 柳林县 (1 relic), Lanxian county 岚县 (0 relics), Jiaokou county 交口县 (0 relics), Jiaocheng county 交城县 (1 relic), Shilou county 石楼县 (1 relic)

In total 17 relics

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### Table 2-2 Pre-Yuan dynasty timber halls with fan-shaped bracket sets in Shanxi province

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<td>Shijiata 释迦塔</td>
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<td>Changzhi prefecture 长治, Lucheng 潞城市</td>
<td>Dongyi Longwangmiao 东邑龙王庙</td>
<td>Dadian 大殿</td>
</tr>
<tr>
<td>Changzhi prefecture 长治, Xiangyuan county 襄垣县</td>
<td>Lingzxyangmiao 灵泽王庙</td>
<td>Dadian 大殿</td>
</tr>
<tr>
<td>Changzhi prefecture 长治, Pingshun county 平顺县</td>
<td>Longmen Monastery 龙门寺</td>
<td>Tianwugongdian 天王殿</td>
</tr>
<tr>
<td>Changzhi prefecture 长治, Pingshun county 平顺县</td>
<td>Fotou Monastery 佛头寺</td>
<td>Dadian 大殿</td>
</tr>
<tr>
<td>Changzhi prefecture 长治, Wuxiang county 武乡县</td>
<td>Lihuihuixiaoguan 临润会仙观</td>
<td>Sanqingdian 三清殿</td>
</tr>
<tr>
<td>Changzhi prefecture 长治, Qux county 兮县</td>
<td>Puzhao Monastery 普照寺</td>
<td>Dadian 大殿</td>
</tr>
<tr>
<td>Jincheng prefecture 晋城, Zezhuo county 泽州县</td>
<td>(Xianxian) Jincheng Erxianmiao (小南村) 晋城二仙庙</td>
<td>Zhengdian 正殿</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(smaller carpentry 木雕神龛)</td>
</tr>
<tr>
<td>Jincheng prefecture 晋城, Lingchuan county 陵川县</td>
<td>Nanxian Monastery 南县市</td>
<td>Guoian 过殿</td>
</tr>
<tr>
<td>Jincheng prefecture 晋城, Lingchuan county 陵川县</td>
<td>Xiaohuiling Erxianmiao 小会岭二仙庙</td>
<td>Zhengdian 正殿</td>
</tr>
<tr>
<td>Jincheng prefecture 晋城, Lingchuan county 陵川县</td>
<td>Shizheng Yanghuangmiao 石璋玉皇庙</td>
<td>Zhengdian 正殿</td>
</tr>
<tr>
<td>Jincheng prefecture 晋城, Lingchuan county 陵川县</td>
<td>Nanshentou Erxianmiao 南神头二仙庙</td>
<td>Zhengdian 正殿</td>
</tr>
</tbody>
</table>

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* Note: light grey color indicates not eligible structures i.e. smaller carpentry or the octagonal Timber Pagoda.
Table 2-3 Building style of the pre-Yuan dynasty timber halls with fan-shaped bracket sets in Shanxi province (with regard to the greater carpentry system)

<table>
<thead>
<tr>
<th>North Shanxi</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Datong prefecture</td>
<td>Shanhua Monastery 善化寺</td>
<td>Sanshengdian 三圣殿</td>
<td>Jin dynasty (d. 1128-1143 C.E.)</td>
</tr>
<tr>
<td></td>
<td>Datong prefecture Upper</td>
<td>Daxiongbaodian 大雄宝殿</td>
<td>Liao style</td>
</tr>
<tr>
<td></td>
<td>Huayan Monastery 上华严寺</td>
<td>Puxiange 普贤阁</td>
<td>Liao style successively rebuilt (Jin -20th C.)</td>
</tr>
<tr>
<td></td>
<td>Datong prefecture</td>
<td>Daxiongbaodian 大雄宝殿</td>
<td>Jin dynasty (d. 1140 C.E.)</td>
</tr>
<tr>
<td></td>
<td>Shuozhou prefecture Fogong Moanstery 佛宫寺</td>
<td>Shijiata 释迦塔</td>
<td>Liao dynasty (d. 1056 C.E.)</td>
</tr>
<tr>
<td></td>
<td>Shuozhou prefecture</td>
<td>Chongfu Monastery 崇福寺</td>
<td>Jin dynasty (d. 1143 C.E.)</td>
</tr>
<tr>
<td></td>
<td>Shuozhou prefecture</td>
<td>Hongfu Monastery 洪福寺</td>
<td>Late-Northern Song style with successive repairs</td>
</tr>
<tr>
<td></td>
<td>Xinzhou prefecture Guanwangmiao 关王庙</td>
<td>Guanwangdian 关王殿</td>
<td>Late-Northern Song style (1123 C.E.) with successive repairs</td>
</tr>
<tr>
<td></td>
<td>Xinzhou prefecture</td>
<td>Yangquing Monastery 延庆寺</td>
<td>Jin style</td>
</tr>
<tr>
<td></td>
<td>Xinzhou prefecture</td>
<td>Sanshengdian 三圣殿</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Xinzhou prefecture</td>
<td>Tianwangdian 天王殿</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yangquian prefecture</td>
<td>Linli Guanwangmiao 林里关王庙</td>
<td>Late-Northern Song dynasty (d. 1122 C.E.)</td>
</tr>
<tr>
<td></td>
<td>Yangquian prefecture</td>
<td>Duiwangmiao 大王庙</td>
<td>Jin style with successive repairs</td>
</tr>
<tr>
<td></td>
<td>Changzhi prefecture</td>
<td>Dongyi Longwangmiao 东邑龙王庙</td>
<td>Jin style with successive repairs</td>
</tr>
<tr>
<td></td>
<td>Changzhi prefecture</td>
<td>Lingzewangmiao 灵泽王庙</td>
<td>Jin style (1210 C.E.) with successive repairs</td>
</tr>
<tr>
<td></td>
<td>Changzhi prefecture</td>
<td>Longmen Monastery 龙门寺</td>
<td>Mid-Jin dynasty</td>
</tr>
<tr>
<td></td>
<td>Changzhi prefecture</td>
<td>Fotou Monastery 佛头寺</td>
<td>Undated (associated with style prior to late-13th C)</td>
</tr>
<tr>
<td></td>
<td>Changzhi prefecture</td>
<td>Lizhang Huixianguan 临泽会仙观</td>
<td>Jin dynasty (d. 1229 C.E.)</td>
</tr>
<tr>
<td></td>
<td>Changzhi prefecture</td>
<td>Puzhao Monastery 普照寺</td>
<td>Jin dynasty (d. 1162-1189 C.E.)</td>
</tr>
<tr>
<td></td>
<td>Jincheng prefecture</td>
<td>Nanjixiang Monastery 南吉祥寺</td>
<td>Mid-Northern Song style (1030 C.E.)</td>
</tr>
<tr>
<td></td>
<td>Jincheng prefecture</td>
<td>Xiaohouling Erxianmiao 小会岭二仙庙</td>
<td>Undated (associated with Northern Song style, 1063 C.E.)</td>
</tr>
<tr>
<td></td>
<td>Jincheng prefecture</td>
<td>Shizhang Yuhuangmiao 石掌玉皇庙</td>
<td>Undated (associated with Jin style, with successive repairs)</td>
</tr>
<tr>
<td></td>
<td>Jincheng prefecture</td>
<td>Nanshentou Erxianmiao 南神头二仙庙</td>
<td>Undated (associated with Jin style, with successive repairs)</td>
</tr>
</tbody>
</table>

Note: light grey color indicates not eligible structures i.e. smaller carpentry or the octagonal Timber Pagoda.
<table>
<thead>
<tr>
<th>Basic Types</th>
<th>Image</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Six-sided star (※) or cross (※)</td>
<td><img src="image1.jpg" alt="Image" /></td>
<td>Puxiange of Shanhuasi 善化寺, second floor, intercolumnar set</td>
</tr>
<tr>
<td>Eight-sided star (※)</td>
<td><img src="image2.jpg" alt="Image" /></td>
<td>Main Hall of Shizhang Yuhuangmiao 石掌玉皇庙, front façade, intercolumnar set</td>
</tr>
<tr>
<td>Triangle (▲)</td>
<td><img src="image3.jpg" alt="Image" /></td>
<td>Main Hall of Puzhaosi 普照寺, front façade, intercolumnar set</td>
</tr>
<tr>
<td>Complex form of intertwined stars (※+※+… )</td>
<td><img src="image4.jpg" alt="Image" /></td>
<td>Mitudian of Chongfusi 崇福寺, front façade, column-top set</td>
</tr>
</tbody>
</table>
Table 3-1 Definitions of T-shaped half-brackets called *dingtougong* 丁头棋 in Chinese and English scholarship

<table>
<thead>
<tr>
<th>Author</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guo Daiheng 郭黛姮</td>
<td>“丁头棋是嵌于内柱柱身以承托梁尾的半截华栱，因其与柱成‘丁’字形而得名，丁头棋长 33 分，用两跳时则加一跳。” (Guo Daiheng, <em>Zhongguo gudai jianzhu</em> 3: 637) (<em>A dingtougong is a banjie huagong</em> that is inserted into the column shaft of an interior column to support the beam tail; it is named after the fact that together with the column it creates the form of the Chinese character ding; a <em>dingtougong</em> measures 33 fen in length; if two steps are used its length will increase by one.)</td>
</tr>
<tr>
<td>Lü Songyun 吕松云 and Liu Shizhong 刘诗中</td>
<td>“丁头棋：前段挑出，后尾截断的栱叫丁头棋。它是半截华栱，作用亦与华栱同。有入柱、不入柱、正置、斜置等多种，虾须栱即属于斜置的丁头棋。” (Lü Songyun and Liu Shizhong, <em>A Dictionary of Traditional Chinese Architecture</em> 76) (*Dingtougong: an outward stepping bracket with cut-off tail is called a <em>dingtougong</em>. It is a <em>banjie huagong</em>; its function is similar to huagong; it has many different types, some enter a column, some do not, some project at a right angle to the wall plane, some at a slanting angle, <em>xiaxugong</em> belong to the [group of] <em>dingtougong</em> that are arranged in an angled way.)</td>
</tr>
<tr>
<td>Pan Guxi 潘谷西 and He Jianzhong 何建中</td>
<td>“丁头棋：只有一卷头的半截栱。” (Pan Guxi and He Jianzhong, <em>Yingzao fashi jiedu</em> 243) (<em>Dingtougong: it is a <em>banjie huagong</em> that has just one tapered head.</em>)</td>
</tr>
<tr>
<td>Xu Bo’an 徐伯安 and Guo Daiheng 郭黛姮</td>
<td>“丁头棋：前端挑出，后尾插入柱中或不插入后尾截断的栱，叫做丁头棋。这种栱实际上是华栱的一种，即半截华栱。它和华栱一样都起传跳并支承其上不结构的作用。丁头棋的种类很多，从它的固定部位分：丁头棋有入柱和不入柱在梁上或柱中的两种，从它的形式上分：丁头棋有正，阴之别，插入柱中和平座铺作上用的半截华栱是正置的丁头棋，虾须栱和平座铺作上斜置的半截华栱，是斜置的丁头棋，从它的构造上分：丁头棋有单跳，双跳，乃至多跳的种种。” (Xu Bo’an and Guo Daiheng, “Song Yingzao fashi shuyu huishi – haozhai, shizao, damuzuo zhidu bufen” 8) (*Dingtougong: a <em>banjie huagong</em> with outward projecting head and a tail either inserted into a column or not inserted into a column is called a <em>dingtougong</em>. This kind of bracket eventually is a kind of huagong, precisely a <em>banjie huagong</em>. It is similar in task to huagong; it rises through transmitting steps and at the same time, supports the construction above. <em>Dingtougong</em> have many different types; with regard to the position in the building: there are two kinds, the <em>dingtougong</em> that enter a column and those that do not but are rather applied on top of a beam or within [the organic unit of] a <em>duougong</em>. With regard to the visual shape: there are perpendicular or angled <em>dingtougong</em>; those <em>banjie huagong</em> that enter a column or <em>pingzuo puzuo</em> are <em>dingtougong</em> projecting at a right angle to the wall plane. <em>Xiaxugong</em> and the <em>banjie huagong</em> that step out from an exterior eave bracket set in a slanting way are <em>dingtougong</em> projecting at an angle different than 90 degrees to the wall plane. With regard to their construction: there are one- and two-tiered <em>dingtougong</em> and also those with multiple steps.)</td>
</tr>
</tbody>
</table>
丁头栱：宋式建筑大木作构件名称。是栱尾设榫入柱或铺作正心的半截华栱。建筑实物中单、足材者皆有使用。丁头栱只向前传递，主要用以承托梁栿首尾或枋木端头。在抹角栿下或抹角枋下的丁头栱，往往斜置，从而成为斜丁头栱（斜丁头栱成对出现，称虾须栱）。根据栱栿跨度的大小决定铺作层次的多寡，可出单跳、双跳乃至多跳。亦有顺栿串、襻间枋出柱制成丁头栱，隔间相闪，裁承相邻构件的做法。丁头栱的施用，可以缩短梁栿净跨，分解梁端剪力。（Wang Xiaoqing, A Dictionary of Technical Terminology for Ancient Chinese Architecture 7）

丁头栱：It is the name for a member of the greater carpentry system in Song-style architecture. It is a banjie huagong which tail is either inserted into a column or into the right center of a puzuo set; architectural buildings employ it in the size of dancai or zucai. A dingtougong projects only toward the front; its wooden head is mainly used to support the head or tail of a beam or joist. The dingtougong that are placed below a mojiao beam or joist are often applied in a slanting way, thereby becoming angled dingtougong (if such xiedingtougong come in a pair, they are called xiaxugong). Based on the fact that the size of the beam span decides the number of puzuo rank, dingtougong can step out once, twice, or multiple times. Also, the intersection of shunfuchuan or panjianfang with a column can result in the need for a dingtougong to separate and support the adjoining members. The application of dingtougong can reduce the free span of beams and solve the [problem of] shear stress for the beam heads.)

Whenever [there is] a dingtougong, (footnote 25), it is long 33 fen ° (footnote 26), it produces a mortise [that is] long five fen °; if it is one that steps out just at the inside of a corner, it is called xiaxugong, it uses tenon and mortise to reach the center, it takes the slant to add length. If it is one that enters a column, it uses a pair of mortises; they are long six fen ° to seven fen °.

(See also the footnotes to this paragraph in Liang Sicheng (Liang Sicheng guanji 7: 90): “（25）及（26）丁头栱就是半截华栱，只有一卷头，‘出卯到相交的栱的中线 - 心。按此推算，则应长 31 分 °，才能与其他华栱取齐。但原文作‘三十三分 °’，提出存疑。” (A dingtougong eventually is a banjie huagong; it has just one tapered head. [The historical saying] ‘it produces a mortise [that is] long five fen °’ [means that] it produces a mortise to reach the main axis of the bracket – the center - with which it connects; according to this calculation, it should be long 31 fen °, and only if so, it can assembled with other huagong. However, the original text reads ‘33 fen °’, which raises an unanswered question.)

“Dingtou gong (S), chuagong (Q) lit. ‘T-shaped bracket’, half bracket: a half huagong with its tenon at the rear inserting into a column.” (Guo Qinghua, Visual Dictionary of Chinese Architecture 32)
<table>
<thead>
<tr>
<th>Author</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guo Daiheng 郭黛姮</td>
<td>“半截华栱有时也用于铺作之中，即‘跳转角者，谓之虾须栱，用股卯到心（指铺作中心）’。这里的铺作位于丁字形分槽之上，在丁字形槽的两个内转角上，需将 45°斜出一缝半截华栱，即为虾须栱。” (Guo Daiheng, Zhongguo gudai jianzhushi 3: 637) (A banjie huagong is sometimes also used within the puzuo set, what is described as the ‘one that steps out just at the inside of a corner, it is called xiaxugong, it uses tenon and mortise to reach the center (referring to the center of the puzuo set).’ The above described puzuo is located at a T-shaped column grid, both of the T-shaped column grid’s inner corners must have a 45 degree angled projection [in the form] of a banjie huagong wing, which is the xiaxugong.)</td>
</tr>
<tr>
<td>Lü Songyun 吕松云, Liu Shizhong 刘诗中</td>
<td>“虾须栱：斗栱里跳内转 45°角斜出的半截华栱，叫虾须栱。” (Lü Songyun and Liu Shizhong, A Dictionary of Traditional Chinese Architecture 76) (Xiaxugong: a banjie huagong that is applied at the interior steps of a corner bracket set and steps out in a slanting way at a 45 degree angle is called xiaxugong.)</td>
</tr>
<tr>
<td>Pan Guxi 潘谷西和 He Jianzhong 何建中</td>
<td>“虾须栱：身槽内转角铺作里跳上 45°的半栱。” (Pan Guxi and He Jianzhong, Yingzao fashi jiedu 256) (Xiaxugong: it is a banjie huagong applied at the interior steps of a corner bracket set, which is located at the column grid of the core [building].)</td>
</tr>
<tr>
<td>Wang Xiaoqing 王效青</td>
<td>“虾须栱：宋式大木作斗栱构件名称，丁头栱的一种，特指铺作里转角处 45°斜出的半栱。宋《营造法式》规定，虾须栱用股卯到心，以斜长加之。虾须栱往往用于铺作两翼成对使用，层层跳起，形成虾须。故名。在现存宋元时期的建筑实例中，虾须栱不乏实例。” (Wang Xiaoqing, A Dictionary of Technical Terminology for Ancient Chinese Architecture 288) (Xiaxugong: it is the name for a dougong member of the greater carpentry system in Song-style architecture. It is a kind of dingtougong, particularly referring to a banjie huagong in a corner puzuo set, which projects at an angle of 45 degrees. The Northern Song Yingzao fashi stipulates that a xiaxugong ‘uses tenon and mortise to reach the center; it takes the slant to add length’. Xiaxugong often come in a pair with two wings; they project outward layer by layer and are shaped like shrimp antennae, thus their name. Among the extant Song-Yuan period architecture, xiaxugong do not lack concrete examples.)</td>
</tr>
<tr>
<td>Xu Bo’an 徐伯安 and Guo Daiheng 郭黛姮</td>
<td>“虾须栱：铺作（科栱）里跳内转 45°角斜出的半截华栱，叫做虾须栱。” (Xu Bo’an and Guo Daiheng, “Song Yingzao fashi shuyu huishi – haozhai, shizao, damuzuo zhidu bufen” 55) (Xiaxugong: it is a banjie huagong projecting in a slanting way at a 45 degree angle and applied at the interior steps of a puzuo (paike) that is located at the inner corner [of a building]; [such a banjie huagong is] known as a xiaxugong.)</td>
</tr>
<tr>
<td>Yingzao fashi 营造法式, chapter four entitled “Damuzuo zhidu yi 大木作制度一”, section huagong 华栱</td>
<td>See entry on dingtougong.</td>
</tr>
<tr>
<td>Guo Qinghua</td>
<td>“Xiaxu gong (S) corner-half bracket: a dingtou gong 丁头栱 used at the inner part of a corner-bracket set which projects diagonally from the corner column towards the interior.” (Guo Qinghua, Visual Dictionary of Chinese Architecture 85)</td>
</tr>
</tbody>
</table>
Table 3-3 Basic types of fan-shaped bracket sets according to the distinctive shape of elevation (names after English capital letters): simple-V-shaped type, multiple-V-shaped type, O-shaped type, Y-shaped type, W-shaped type

<table>
<thead>
<tr>
<th>Type</th>
<th>Pre-Yuan dynasty example</th>
<th>Post-Jin dynasty example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple-V-shaped type</td>
<td><img src="image1" alt="Main Hall of Nanjixiangsi 南吉祥寺, rear façade, intercolumnar set" /></td>
<td><img src="image2" alt="Shuzhuanglou of Jiutian Shengnumiao 九天圣母庙, ground floor front façade, column-top set" /></td>
</tr>
<tr>
<td>Multiple-V-shaped type</td>
<td><img src="image3" alt="Sanshengdian of Shanhuasi 善化寺, front façade, intercolumnar set" /></td>
<td><img src="image4" alt="Toudaomen of Fucheng Yuhuangmiao 府城玉皇庙, front façade, intercolumnar set" /></td>
</tr>
<tr>
<td></td>
<td><img src="image5" alt="Tianwangdian of Longmensi 龙门寺, front façade, intercolumnar set" /></td>
<td><img src="image6" alt="Shanmen of Kaihuasi 开化寺, rear façade, intercolumnar set" /></td>
</tr>
<tr>
<td>Type</td>
<td>Pre-Yuan dynasty example</td>
<td>Post-Jin dynasty example</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td><strong>O-shaped type</strong></td>
<td>Shanmen of Kaihuasi 开化寺, rear façade, intercolumnar set</td>
<td>Yemen of Cuifujianmiao 崔府君庙, front façade, intercolumnar set</td>
</tr>
<tr>
<td><strong>Y-shaped type</strong></td>
<td>Main Hall of Nanjixiangsi 南吉祥寺, side façade, intercolumnar set</td>
<td>Shanmen of Tangdimiao 汤帝庙, front façade, intercolumnar set</td>
</tr>
<tr>
<td><strong>W-shaped type</strong></td>
<td>Feiyunlou of Wanrong Dongyuemiao 万荣东岳庙, front façade, intercolumnar set</td>
<td></td>
</tr>
</tbody>
</table>
ILLUSTRATIONS

Figure 1-1 Three basic components for official bracket sets of the Song dynasty: *chenfangtou* 衬枋头 (1), *shuatou* 耍头 (2), and *ludou* 栎斗 (4) (Guo Daiheng, *Zhongguo gudai jianzhushi* 3: 634)
Figure 1-2 Schematic drawing of Song dynasty bracketing by Liang Sicheng. (Liang Sicheng, *Liang Sicheng quanji* 8: 23)
Six-puzuo bracket set with double-tiers of brackets, *chonggong* and three perpendicular extensions (i.e. one *huagong* and two *xia'ang*)

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Bracketing with **tiaowo** (Guo Daiheng, *Zhongguo gudai jianzhushi* 643)

Bracketing with **shang’ang** (Guo Daiheng, *Zhongguo gudai jianzhushi* 6443)

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*Sancai* 三踩

Three perpendicular extensions:  
*Liupuzuo* 六铺作  
*Qicai* 七踩

Five perpendicular extensions:  
*Bapuzuo* 八铺作  
*Shiyicai* 十一踩

Song dynasty bracketing  
Qing dynasty bracketing

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Porcelain Tower of Nanjing without bracketing
(Johann Bernhard Fischer von Erlach, *A Plan of Civil and Historical Architecture* 3, plate XII)

General design principle of Chinoiserie-style bracketing
(William Chambers, *Designs of Chinese Buildings, Furniture, Dresses, Machines, and Utensils: To Which is Annexed a Description of Their Temples, Houses, Gardens* plate XI)

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Eastern Han dynasty tomb in Holingol 霍林郭勒, Inner Mongolia Autonomous Region, China (University of Pennsylvania image collection, call number 113/H7325/8a6nn, accession number n2002100238)

Tomb of the Wrestlers from the Goguryeo Kingdom in Ji’an, Jilin province, China (University of Pennsylvania image collection, call number 153.1/T926/8Wr6j2, accession number n2005050059)

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Sanqingdian of Xuanmiao Daoist Monastery in Suzhou, Fujian province (Fu Xinian, *Zhongguo kexue jishushi jianzhujuan* 468)

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唐・佛光寺東大殿
遼・獨樂寺觀音閣
遼・奉國寺大殿
遼・應縣佛宮寺釋迦塔
宋・保國寺大殿
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第三節 宋《營造法式》材、分制

材 其名有三，曰斗，曰居，曰材，三材方桁。
凡營造之制，皆以材為祖，材有八等，皆以之大小，因而用之。各以其材之厚，分為十五分，以十
分為其厚，材寬六分，厚四分。材上加架者，謂之足材。

Song dynasty module of *cai*材 (Pan Dehua, *Dougong* 91)

第三節 清《工程做法》斗口制

斗口：斗口有頭等才（材），二等才，以至十一等才之分。頭等才斗口寬六寸，二等才斗口寬五
寸五分，自三等才以至十一等才各遞減五分，即得斗口尺寸。

Qing dynasty module of *doukou* 斗口 (Pan Dehua, *Dougong* 363)

Figure 1-23 Song and Qing modules and measurements (Pan Dehua, *Dougong* 91, 363)

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Zucai and dancai of the Song dynasty (left) and the Qing dynasty (right)

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Chinese column with a block-shaped or even a simple block-and-bracket-shaped column-top

Upward and downward pointing volutes in Greece (left) and China (right)

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Five-storied small pottery building, early Eastern Han, Henan Provincial Museum in Zhengzhou (University of Pennsylvania image collection, call number 113/3ff4a, accession number n2005031628)

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Main Hall of Zhenguosi in Pingyao, Shanxi province

Figure 1-35 “Mandarin duck bracket” or *yuanyang jiaoshougong* 鸳鸯交手栱 (Pan Dehua, *Doulong* 10; Harrer photo collection)
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Front facade

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Engaged exterior corner columns with simple Indian-style lotus buds

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Yungang cave 9, lintel above north entrance

Yungang cave 9, lintel above north entrance, detail

Yungang cave 12, east wall of the front corridor

Yungang cave 12, west wall of the front corridor

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Five different types of lengthwise or crosswise timber framework systems

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Five-puzuo design of dangongzao with two perpendicular extensions (Guo Daiheng, Zhongguo gudai jianzhushi 3:625)

Simple design of chonggongzao without perpendicular extensions (Pan Dehua, Dougong 23)

Five-puzuo design of chonggongzao with two perpendicular extensions (Guo Daiheng, Zhongguo gudai jianzhushi 3:625)

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Intercolumnar bracketing in the Tang dynasty

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Column-top bracketing, Ten Thousand Buddha Hall at Zhenguosi

Intercolumnar bracketing, Main Hall of Dayunyuan

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Shanhuasi Daxiongbaodian, front façade
(University of Pennsylvania image collection, call number 153/D232/2Sh1f, accession number n2004111562)

Floor plan with bracketing (Guo Daiheng, Zhongguo gudai jianzhushi 3: 336)

Intercolumnar *shanshi dougong* of the front and rear façades' central bays, line drawings
(Guo Daiheng, Zhongguo gudai jianzhushi 3: 336)
Intercolumnar *shanshi dougong* of the front and rear façades’ first side bays (bottom line drawing: Guo Daiheng, *Zhongguo gudai jianzhushi* 3: 337)

Interior view of the hall with *shanshi dougong*

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Intercolumnar *shanshi dougong* of the front and rear façades’ central bays
(bottom line drawing: Guo Daiheng, *Zhongguo gudai jianzhushi* 3: 344)

Figure 2-2 Puxiange of Shanhuasi (Harrer photo collection; Guo Daiheng, *Zhongguo gudai jianzhushi* 3: 344)
Front façade

Intercolumnar *shanshi dougong* of the front and rear façades’ first side bays
(bottom line drawing: Guo Daiheng, Zhongguo gudai jianzhushi 3: 349)

Figure 2-3 Sanshengdian of Shanhuasi (Harrer photo collection; Guo Daiheng, Zhongguo gudai jianzhushi 3: 349)
Huayansi Daxiongbaodian, front façade

Floor plan with bracketing (Guo Daiheng, Zhongguo gudai jianzhushi 3: 316)
Intercolumnar *shanshi dougong* of the front and rear façades’ central bays, line drawings
(Guo Daiheng, *Zhongguo gudai jianzhushi* 3: 319)

Intercolumnar *shanshi dougong* of the front and rear façades’ second side bays
(bottom line drawing: Pan Guxi, *Dougong* 41)

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Chongfusi Mituodian, front façade

Floor plan with bracketing (Chai Zejun, *Shuzhou Chongfusi* 144)
Smaller timber carpentry

Southwest corner of the building

Column-top shanshi dougong along the front façade
(bottom line drawing: Chai Zejun, Shuzhou Chongfusi 146)
Intercolumnar *shanshi dougong* along the rear façade
(bottom line drawing: Chai Zejun, *Shuzhou Chongfusi* 146)

Figure 2-5 Mituodian of Chongfusi (Chai Zejun, *Shuzhou Chongfusi* 144, 146; Harrer photo collection)
Temple complex of Hongfusi

Sanshengdian, front façade
Intercolumnar *shanshi dougong* along the front façade

Simple bracketing at the rear façade

Figure 2-6 Sanshengdian of Hongfusi (Harrer photo collection)
Dingxiang Guanwangmiao, front façade

Floor plan with bracketing (Li Youcheng, “Dingxiangxian Guanwangmiao gouzao qiantan” 5)

Rear façade, intercolumnar *shanshi dougong*
Front façade, intercolumnar *shanshi dougong* of the central bay
(bottom line drawing: Li Youcheng, “Dingxiangxian Guanwangmiao gouzao qiantan” 6)

Front façade, column-top *shanshi dougong* of the side bays
(bottom line drawing: Li Youcheng, “Dingxiangxian Guanwangmiao gouzao qiantan” 7)
Truncated bucket-arms at the intercolumnar position of the gable sides’ end bays

Perspective view of the interior corner with *mojiaogong*

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Foguangsi Wenshudian, front façade

Floor plan with bracketing
(Hua Chenlong, “Foguangsi Wenshudian de xianzhuang ji xiusan sheji” 40)

Rear façade, intercolumnar shanshi dougong of the central bay
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Main Hall of Yanqingsi, front façade

Front façade i.e. south façade, intercolumnar *shanshi dougong* of the central bay
Intercolumnar *shanshi dougong* all around the hall
(top left: east façade, exterior view; top right: east façade interior view; bottom left: west façade; bottom right: north façade)

Figure 2-9 Main Hall of Yanqingsi (Harrer photo collection)
Figure 2-10 Main Hall of Linli Guanwangmiao (Harrer photo collection; Shi Guoliang, “Yangquan Guanwangmiao” 43)
Intercolumnar *shanshi dougong* of the front façade’s central bay, exterior projection (top) and interior projection (bottom)

Figure 2-11 Qingong of Yuxian Daiwangmiao (Harrer photo collection)
Front façade

Intercolumnar *shanshi dougong* of the front façade’s central bay

Intercolumnar *shanshi dougong* of the front façade’s side bays

Figure 2-12 Main Hall of Dongyi Longwangmiao (Harrer photo collection)
Figure 2-13 Main Hall of Lingzewingmiao (Harrer photo collection; He Dalong, *Changzhi Wudai jianzhu xinkao* 112)

Column-top *shanshi dougong* of the front façade
(bottom line drawing: He Dalong, *Changzhi Wudai jianzhu xinkao* 112)
Front façade: intercolumnar shanshi dougong of the central bay

Rear façade: intercolumnar shanshi dougong of the central bay

Figure 2-14 Tianwangdian of Longmensi (Harrer photo collection)
Front façade

Front façade, intercolumnar *shanshi dougong* of the central bay

Rear façade, intercolumnar *shanshi dougong* of the central bay

Figure 2-15 Main Hall of Foutousi (Harrer photo collection)
Front façade

Column-top *shanshi dougong* at the front façade
(bottom line drawing: Ye Jianhua Shanxi Wuxiang Huixianguan jianzhushi yanjiu 63)

Figure 2-16 Sanqingdian of Wuxiang Huixianguan (Harrer photo collection; Ye Jianhua Shanxi Wuxiang Huixianguan jianzhushi yanjiu 63)
Intercolumnar *shanshi dougong* of the front façade’s central bay
(bottom line drawing: Hua Chenlong, “Qinxian Puzhaosi dadian kancha baogao” 38)

Figure 2-17 Main Hall of Puzhaosi (Harrer photo collection; Hua Chenlong, “Qinxian Puzhaosi dadian kancha baogao” 38)
Middle Hall of Nanjixiangsi, front façade

Intercolumnar shanshi dougong of the central bays
Intercolumnar *shanshi dougong* of front and rear façades’ side bays

Perspective view of the interior corner without genuine *mojiaogong*

Figure 2-18 Middle Hall of Nanjixiangsi (Harrer photo collection)
Front façade of the Main Hall at Xiaohuiling Erxianmiao with attached Sacrificial Hall in the front
Intercolumnar *shanshi dougong* of the front façade’s central bay

Figure 2-19 Main Hall of Xiaohuiling Erxianmiao (Harrer photo collection)
Main Hall of Shizhang Yuhuangmiao, front façade

Intercolumnar *shanshi dougong* of the front façade’s central bay
Different kinds of bracket sets along the front façade, exterior view (top) and interior view (bottom)

Figure 2-20 Main Hall of Shizhang Yuhuangmiao (Harrer photo collection)
Main Hall of Nanshentou Erxianmiao, front façade

Intercolumnar shanshi dougong of the front façade’s central bay
Different kinds of bracket sets of the front façade, exterior view (top) and interior view (bottom)

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Middle Hall of Nanjixiangsi, perspective view of the interior

Main Hall of Xiaohuiling Erxianmiao, perspective view of the interior

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Middle Hall of Nanjixiangsi without four-rafter beam in-between bottom and top layers

Main Hall of Puzhaosi with segmented bottom layer i.e. *sichuanfu* plus *rufu* in the rear

Figure 2-29 Simplification of consecutively mounted transverse beams in *tailiang* style, hip-and-gable roofed architecture (Harrer photo collection)
Longmensi Daxiongbaodian (Guo Daiheng, *Zhongguo gudai jianzhushi* 3: 332)

Main Hall of Foutousi

*Duìjie* 对接 with *sichuanfu* and *rufu* installed at the same elevation

Front Hall of Beijixiangsi  Main Hall of Shizhang Yuhuangmiao

*Yajie* 压接 with *sichuanfu* elevated above the shorter *rufu*

Figure 2-30 Elevation of beam segments at the bottom layer of consecutively mounted roof beams in *taillang* style, hip-and-gable roofed architecture (Guo Daiheng, *Zhongguo gudai jianzhushi* 3: 332; Harrer photo collection)
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Huayansi Daxiongbaodian, front façade

Main Hall of Puzhaosi, front façade

Longmensi Tianwangdian, rear façade

Main Hall of Foutousi, front façade

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Beam head placed at the exterior shuatuou level of column-top bracketing
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Extending tails

Extending tails

Extending tails

No extending tails

Extending tails
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<td>昂式</td>
<td>“acting ang-like”, the pattern, way, or method of a timber within a bracket set that acts like the true descending cantilever and performs structural functions</td>
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<td>angxing</td>
<td>昂形</td>
<td>“ang-shaped”, the shape or look of a timber within a bracket set that visually mimics the descending cantilever; often a carving style for the tips of ang or shuatou</td>
</tr>
<tr>
<td>baosha</td>
<td>抱厦</td>
<td>small projecting portico of the core building</td>
</tr>
<tr>
<td>banjie huagong</td>
<td>半截华拱</td>
<td>single bracket-arm; literally translates as a “half (the section) of a ‘flower’ bracket”</td>
</tr>
<tr>
<td>batoujiaoxiangzuo</td>
<td>把头绞项作</td>
<td>simple, non-projecting bracketing arrangement where the timu acts as linggong and the head of the cross-beam that pierces through the building plane forms the shuatou; better known under the Qing dynasty name of yidousansheng or “three-on-one”</td>
</tr>
<tr>
<td>bizang louge</td>
<td>壁藏楼阁</td>
<td>smaller timber carpentry of multi-storied wall cabinet to store Buddhist sutras</td>
</tr>
<tr>
<td>bujian puzuo</td>
<td>补间铺作</td>
<td>intermediate bracket set</td>
</tr>
<tr>
<td>busha liangtouzao</td>
<td>不厦两头造</td>
<td>overhanging gable roof in tingtang-style architecture</td>
</tr>
<tr>
<td>cai</td>
<td>材</td>
<td>modular unit of the Yingzao fashi; a timber block of standard width that is equal to the cross-section of a bracket</td>
</tr>
<tr>
<td>Term</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>cai</td>
<td>measuring word for the projecting steps or layers within a bracket set in Qing terminology</td>
<td></td>
</tr>
<tr>
<td>y-cai (dougong)</td>
<td>descriptive expression to capture the multiple layers of a bracket set in Qing terminology, following the “rule of thumb”: twice the number of projecting steps $(2x + 1)$ = a bracket set of y-cai 踩</td>
<td></td>
</tr>
<tr>
<td>caihua</td>
<td>decorative, protective coating of architectural components</td>
<td></td>
</tr>
<tr>
<td>caifen system</td>
<td>modular system of the Yingzao fashi based on the standard units of dancai, zucai, and zhi that are expressed in fen; consisting of eight grades for different building sizes, types of building, and social status</td>
<td></td>
</tr>
<tr>
<td>caofu</td>
<td>rough transverse beam</td>
<td></td>
</tr>
<tr>
<td>cao</td>
<td>column grid</td>
<td></td>
</tr>
<tr>
<td>can</td>
<td>measuring word for the projecting steps or layers within a bracket set in Suzhou terminology</td>
<td></td>
</tr>
<tr>
<td>cengdieshi</td>
<td>method of mounting the tailiang-style roof in diantang architecture by piling up several layers of beams on top of each other</td>
<td></td>
</tr>
<tr>
<td>cejiao</td>
<td>slight incline of the axes of corner columns towards the center of the whole structure, with the column feet eventually slightly moved outward</td>
<td></td>
</tr>
<tr>
<td>cha’ang</td>
<td>inserted descending cantilever arm</td>
<td></td>
</tr>
<tr>
<td>chagong</td>
<td>bracket-arm directly inserted into another member such as the column shaft</td>
<td></td>
</tr>
</tbody>
</table>
a certain type of construction method for multistoried louge-type 楼阁 buildings whereby each upper floor is successively smaller than the floor below through recess of the upper floor columns that are placed on a joist or beam, and at the corners wound by three large bearing blocks.

measuring word for the projecting steps within a bracket set; similar in meaning to tiao 跳

a certain type of construction method for multistoried louge-type 楼阁 buildings where each column of the upper floor directly rests atop the lower floor column, specifically on the column-top ludou 上面的水平木方

uppermost perpendicular timber of the bracket sets with concealed front and exposed tail that is placed on top of shuatou to link interior and exterior joists

a unit of length; part of the different systems of length for specific measurements expressed by the units of zhang 丈, chi 尺, cun 寸, and fen 分 that eventually changed with geographic area and time; for example, one chi shifted from 31.6 or 32.9 centimeters in Song times to a value of 33.3 centimeters nowadays

double-tier bracket parallel to the wall plane where, for example, a mangong is placed above a guazigong

roof rafter carried by the longitudinal purlins that run parallel to the ridge

“column-and-tie-beam” design
| **n-chuanfu** | **n-椽栿** | name for a beam of “n” horizontally projected rafter-spans; e.g. a four-rafter beam called *sichuanfu* 四椽栿 or a six-rafter beam called *liuchunafu* 六椽栿 |
| **a-(chuan)fu dui b-(chuan)fu** | **a-(椽栿对 b-(椽栿)** | descriptive expression to capture the construction technique of a transverse timber framework which is described by the type of beam used in the front and rear parts; e.g. a transverse framework consisting of a four-rafter beam in the front and a two-rafter beam in the rear is called *sichuanfu dui rufu* 四椽栿对乳栿 |
| **z-chucan** | **z-出参** | descriptive expression to capture the multiple layers of a bracket set in Suzhou terminology |
| **chutiao** | **出跳数** | number of projecting steps in the bracket set |
| **chuilianzhu** | **垂连柱** | small suspended column |
| **chutou** | **出头** | method where both ends of an architrave extend sideward beyond the wall plane |
| **cuandang** | **攒挡** | auxiliary unit of the expanded modular system for timber architecture in the Qing period that describes the distance between two bracket sets; expressed in *doukou* |
| **dachuan** | **大椽** | large slanting rafter |
| **da’e** | **大額** | bulky, circular, large architrave |
| **dafeichuan** | **大飞椽** | large flying rafter |
| **dajiaoliang** | **大角梁** | large corner beam |
| **dajiaoshi** | **搭交式** | one of the three basic ways of interaction between beams and brackets before the Yuan dynasty after He Dalong (*Changzhi Wudai jianzhu xinkao* 83) that reflect the
gradual upward move of the transverse beams, and differ in the extent to which they integrate the beam into the column-top eave bracketing; in detail, the method of “limited interaction” or “passive involvement”, for example, with the beam head terminating inside the hall below the tail of a true descending cantilever

greater carpentry or structural carpentry, one of the thirteen types of building work in the Yingzao fashi including cutting, shaping, and joining of wooden members and framing of buildings

“single standard unit”, a spatial unit of the modular caifen system with 15 fen 分” in height and 10 fen 分” in width

one of the four different layouts for diantang halls in the Yingzao fashi, consisting of one outer ring and a single longitudinal row of interior columns that is aligned parallel to the wall plane of the building façade

single-storied pagoda

single-tier bracket parallel to the wall plane that consists of a single timber

simple bracketing arrangement which lacks bracket-arms and reduces the complex layering to the large bearing block and one longitudinal timber called timu

two-storied gatehouse with stage at the rear

construction method in the Gongbu gongcheng zuofa where cushion-like corbelled clusters i.e. bracket sets were (structurally) necessary for the greater carpentry system

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one of the three basic ways of interaction between beams and brackets before the Yuan dynasty after He Dalong (Changzhi Wudai jianzhu xinkao 83) that reflect the gradual upward move of the transverse beams, and differ in the extent to which they integrate the beam into the column-top eave bracketing; in detail, the method of “exerting pressure” where the beam head moved up to the position on top of the whole corbelled cluster or at least, the placement above the core body of bracketing extensions (i.e. huagong and ang)

dayashi 搭压式

“palace type” architecture, one of the main building types in the Yingzao fashi
diantang 殿堂

difang zuoфа 地方做法 building traditions of a certain geographic region
dijiaoliang 递角梁 Qing term for yin(muzheng jixin)chen jiaofu
dingfu 丁栿 longitudinal, short tie-beam that runs parallel to the front façade spanning the distance between the eave columns at the gable side and the interior columns; in the ground plan, its T-shaped intersection with transverse beams resembles the Chinese character “ding 丁”; additionally, it may optionally be used to support the tail of a corner beam instead of mojiaofu or mojiaoliang
dingtougong 丁头栱 T-shaped half-bracket of which the ground plan resembles the Chinese character “ding 丁”
dingtougong wangge 丁头栱网格 grid-like bracket system without parallel brackets consisting of inserted, T-shaped half-brackets in touxin-style that are placed at each step of perpendicularly projecting brackets
**dou**
- 斗
  - General term for a bearing block

**dougong**
- 斗栱
  - Modern word for bracket set i.e. corbelled cluster

**dougong zuzhi wangge**
- 斗栱组织网格
  - General term for a grid-like bracket system (with angular or orthogonal projections)

**douke**
- 斗科
  - Qing terms for a bracket set

**doukou**
- 斗口
  - Modular unit of the Gongbu gongcheng zuofa, a mortise of standard width that conformed to the opening for bracket-arms at the cap block of intermediate sets

**doukoutiao**
- 斗口跳
  - Simple bracketing arrangement with seemingly regular transversal projections where instead of a bracket-arm the head of the beam steps out of the wall plane and carries the next layer in bracketing

**jiahuatouzi**
- 假华头子
  - False "flower head bud"

**er**
- 耳
  - "Ear" of a bearing block referring to its topmost part between the two- or four-directional openings

**fangmu-style**
- 仿木
  - Notion of adopting and adapting the characteristics of timber architecture to another material, such as stone, brick, porcelain or metal

**fangtou**
- 方头
  - Square block

**feitianzang**
- 飞天藏
  - Smaller timber carpentry literally translate as a “flying celestial cabinet”

**fen**
- 分
  - A unit of length; part of the different systems of length for specific measurements expressed by the units of zhang 丈, chi 尺, cun 寸, and fen 分 that eventually changed with geographic area and time

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fen 份, 分, “分” modular sub-unit or section of the caifen system

fenxin 分心 quality of a transverse timber framework where a third column is added at the midpoint of the building’s depth right between the pair of exterior columns; literally translates as “centrally divided”

fenxin caoshi 分心槽式 one of the four different layouts for diantang halls in the Yingzao fashi, consisting of an outer column ring that is further divided into six small compartments by one longitudinal central axis and two symmetrical lateral axes

tongyan 通檐 quality of a transverse timber framework in tingtang architecture that lacks interior columns and solemnly rests at the two exterior eave columns; literally translates as “clear span”

feng 缝 “wing” of xiegong, the collective term to describe the accumulation of angled timbers that are piled up on top of each other to achieve the same building height as their perpendicular counterparts (if applicable)

fubigong 扶壁栱 arrangement of parallel brackets, blocks, and longitudinal joists placed within the wall plane i.e. the wall plane directly above a row of columns; literally translates as a “wall-supporting-bracket”

fujiaodou 附角斗 interlinked corner bracket set that is fortified with additional large bearing blocks (with full mounting of bracket-arms, cantilevers and small blocks) to both sides of the corner ludou in such a way that the bracket-arms parallel to the building plane become structurally intertwined and dependent from each other
<table>
<thead>
<tr>
<th>Character</th>
<th>Pinyin</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>fujie</td>
<td>副阶</td>
<td>subordinate structure or corridor attached to the core building</td>
</tr>
<tr>
<td>gaotai</td>
<td>高台</td>
<td>high platform</td>
</tr>
<tr>
<td>gong</td>
<td>栋</td>
<td>general term for a bow-shaped bracket</td>
</tr>
<tr>
<td>gongyanban</td>
<td>棧眼板</td>
<td>“interbracket-set board” or “area between two puzuo sets that is infilled with a wooden panel, or a bamboo basketwork rendered with plaster, usually colorfully painted” (Guo Qinghua, Visual Dictionary of Chinese Architecture 39)</td>
</tr>
<tr>
<td>gualengzhu</td>
<td>瓜棱柱</td>
<td>melon-shaped column</td>
</tr>
<tr>
<td>guazigong</td>
<td>瓜子栱</td>
<td>“melon-seed bracket”, the parallel bracket shortest in length, with a length equal to 62 sections, that is not part of the building plane itself but rather installed at a distance; it rests on the small bearing blocks on top of the first step of perpendicularly projecting huagong</td>
</tr>
<tr>
<td>hanzhu longtou</td>
<td>含珠龙头</td>
<td>dragon holding a bead in its mouth, a design</td>
</tr>
<tr>
<td>henggong</td>
<td>横栱</td>
<td>general term for a bow-shaped bracket parallel to the wall plane such as nidaogong, guazigong, mangong or linggong; in this thesis also referred to as “parallel bracket” or “longitudinal bracket”; the Chinese name of henggong which literally translates as a “cross-wise bracket” does not refer to the placement with regard to the wall plane (i.e. parallel) but rather to its direction with regard to the basic brackets called huagong that carry it</td>
</tr>
</tbody>
</table>
| huagong   | 华栱   | “petal bracket-arm”, bracket-arm projecting perpendicular to the building plane; in this thesis also referred to as “perpendicular brackets” or “transversal brackets”; other Chinese names include
<table>
<thead>
<tr>
<th>Term</th>
<th>Spanish translation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>juantou</td>
<td>卷头</td>
<td>“flower head bud”, a tapered, wedge-shaped device to support the structural descending cantilever or other structural, vertically slanting timbers at the exterior point of intersection with the bracket set</td>
</tr>
<tr>
<td>qiao</td>
<td>翘</td>
<td>(Qing terminology)</td>
</tr>
<tr>
<td>shizigong</td>
<td>十字栱</td>
<td>(Suzhou terminology)</td>
</tr>
<tr>
<td>huatouzi</td>
<td>华头子</td>
<td>“flower head bud”, a tapered, wedge-shaped device to support the structural descending cantilever or other structural, vertically slanting timbers at the exterior point of intersection with the bracket set</td>
</tr>
<tr>
<td>jia’ang</td>
<td>假昂</td>
<td>decorative false cantilever, a horizontally leveled timber without lever effect</td>
</tr>
<tr>
<td>m-jialiang</td>
<td>m架梁</td>
<td>name for a beam in late imperial China that measures “m-1” horizontally projected rafter-spans and carries “m” longitudinal purlins running parallel to the roof ridge on top of the rafter segments; e.g. a transverse beam of four-rafter length carrying five purlins called wujialiang 五架梁</td>
</tr>
<tr>
<td>jian</td>
<td>间</td>
<td>bay</td>
</tr>
<tr>
<td>jianzhu</td>
<td>减柱</td>
<td>reduction and omission of interior columns</td>
</tr>
<tr>
<td>jiao’ang</td>
<td>角昂</td>
<td>first layer of descending corner cantilevers</td>
</tr>
<tr>
<td>jiaogong</td>
<td>角栱</td>
<td>“corner bracket”, “a bracket used diagonally with respect to a building plan in a corner puzuo-set” (Guo Qinghua, Visual Dictionary of Chinese Architecture 47)</td>
</tr>
<tr>
<td>jiaohudou</td>
<td>交互斗</td>
<td>“connecting block”, the small rectangular bearing blocks with cruciform openings i.e. four “ears” (usually with a ratio of length to width equal to 18x16 sections, 10 sections high) that are placed on top of huagong or ang and which in turn support a second bracket (guazigong or linggong)</td>
</tr>
<tr>
<td>jinggan</td>
<td>井干</td>
<td>log-cabin design</td>
</tr>
</tbody>
</table>
jinxiangdoudi  
caoshi  
金箱斗底槽式
most prestigious of the four different layouts for diantang halls in the Yingzao fashi, consisting of two concentric column rings that are a two-rafter span apart.

“filled-heart” design refers to the use of parallel brackets in a bracket set such as guazigong or mangong, and describes a corbelled cluster where the “perpendicular bracket-arms (huagong) hold both a parallel bracket-arm (usually guazigong or linggong) and the next level of perpendicular extension (either another huagong or a descending cantilever)” (Miller, Constructing Religion 437)

jixinzao  
计心造
“filled-heart” design refers to the use of parallel brackets in a bracket set such as guazigong or mangong, and describes a corbelled cluster where the “perpendicular bracket-arms (huagong) hold both a parallel bracket-arm (usually guazigong or linggong) and the next level of perpendicular extension (either another huagong or a descending cantilever)” (Miller, Constructing Religion 437)

juansha  
卷杀
entasis; “artistic treatment of rounding off the ends of a bracket-arm, beam or tapered column to create an elliptic or convex profile; i.e.: dividing the perpendicular sides of a piece of timber into the same number of equal parts, and clockwise connecting the divisions of one side to the other respectively, the intersections of the straight lines give the points through which the curve is drawn” (Guo Qinghua, Visual Dictionary of Chinese Architecture 50)

juantouzao  
卷头造
bracketing method of piling up horizontally leveled huagong without vertically slanting timbers; the name refers to the visual shape of huagong which tips are decoratively carved in juansha style with tapered, rounded off heads

koufen  
口分*
sub-unit of the Qing module doukou

kuoda moshu  
扩大模数.
“expanded modular system”

lan’e  
阑额
vertical architrave

laojiaoliang  
老角梁
large corner beam in Qing terminology
laoqiang 老戗 rising (large) corner beam in Suzhou terminology with both ends equally resting on top of purlins

lianbanke 连瓣科 interlinked bearing blocks for fujiadou in late Imperial China that are carved out of one piece of wood

liang 梁 modern colloquial term for a beam; Qing term for fu beam; term used in the Yingzao fashi for selected kinds of beams

fu 栉 method of erecting the individual, prefabricated transverse frameworks that already include roof beams along the lateral building axis of tingtang-style architecture

lianjiashi 连架式 method of erecting the individual, prefabricated transverse frameworks that already include roof beams along the lateral building axis of tingtang-style architecture

liaoyanfang 撩檐枋 eaves (-raising) joist with square section running above the linggong parallel to the exterior wall plane to support the eave rafters

liegong 列栱 “aligning brackets” extending beyond the edge of a corner that belong to the body of parallel bracket-arms running along the front façade (i.e. henggong) and at the same time, also form the projecting bracket-arms perpendicular to the wall plane at the side façade (i.e. huagong)

linggong 令栱 “lead bracket”, the uppermost, parallel bow-shaped bracket with a length equal to 72 sections that carries longitudinal joists, namely liaoyanfang, at the exterior and suantingfang at the interior of the building

litiao 里跳 interior projection of the bracket set
<table>
<thead>
<tr>
<th>Term</th>
<th>Chinese</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>liujin douke</td>
<td>溜金斗科</td>
<td>distinctive type of interior bracketing to uphold the lowest eave purlin that became a standard feature of official style architecture in late imperial China</td>
</tr>
<tr>
<td>lougeshi duocengta</td>
<td>楼阁式多层塔</td>
<td>multi-storied pagoda in pavilion style</td>
</tr>
<tr>
<td>louge guolushi xitai</td>
<td>楼阁过路式戏台</td>
<td>multi-storied building with connecting passage for traffic that is combined with a stage</td>
</tr>
<tr>
<td>ludou</td>
<td>杵斗</td>
<td>cap block or large bearing block (with a ratio of length to width equal to 32x32, 20 sections high) that is directly tenoned into the top of the column or the body of the architrave when there is intercolumnar bracketing</td>
</tr>
<tr>
<td>luohanfang</td>
<td>罗汉枋</td>
<td>“arhat joist”</td>
</tr>
<tr>
<td>mangong</td>
<td>慢栱</td>
<td>“extended bracket”, the bracket longest in length, with a length equal to 92 sections, that forms the second layer of parallel brackets above the guazigong</td>
</tr>
<tr>
<td>mazhatou</td>
<td>蚂蚱头</td>
<td>Qing term for a shuatou</td>
</tr>
<tr>
<td>mazhaxing</td>
<td>蚂蚱形</td>
<td>locust head shape, a carving style for the tips of ang or shuatou</td>
</tr>
<tr>
<td>minban</td>
<td>皿版</td>
<td>flat, square board</td>
</tr>
<tr>
<td>mingfu</td>
<td>明栿</td>
<td>artistically treated beam</td>
</tr>
<tr>
<td>mingqi</td>
<td>明器</td>
<td>small-scale pottery object</td>
</tr>
<tr>
<td>miyanta</td>
<td>密檐塔</td>
<td>densely-placed eaves pagoda</td>
</tr>
<tr>
<td>mojiaofu</td>
<td>抹角栿</td>
<td>“span-corner beam”, a structural timber listed in the Yingzao fashi that may be placed at an angle of 45 degrees to the building façade to support the tail of a corner beam in hip roof, hip-and-gable</td>
</tr>
</tbody>
</table>
roof, or pointed pyramidal roof architecture

“span-corner bracket”, a structural timber placed at an angle of 45 degrees to the building façade that stretches at a right angle to the “diagonally” projecting bracket-arm called *jiaogong*; either a single piece of long timber directly integrated into the corbelled corner cluster, or divided into two pieces that are placed separately at a certain distance behind the corner and incorporated into the regular eave bracketing along the façade

*mojiaogong* 抹角栱

“span-corner bracket”, a structural timber placed at an angle of 45 degrees to the building façade that stretches at a right angle to the “diagonally” projecting bracket-arm called *jiaogong*; either a single piece of long timber directly integrated into the corbelled corner cluster, or divided into two pieces that are placed separately at a certain distance behind the corner and incorporated into the regular eave bracketing along the façade

*mojiaoliang* 抹角梁

Qing term for *mojiaofu*

*moxie* 抹斜

beveled, a quality of a bracket which contour is cut with a slanted edge of different bevel angles and styles

*nidaogong* 泥道栱

“plaster channel bracket”, the symmetrical bow-shaped bracket within the wall plane that directly rests on the large bearing blocks and measures 62 sections in length

*niujituan* 牛脊榑

“ox-spine purlin”, “a purlin placed directly above the center line of the first projecting step in a puzuo with xia’ang to support the eaves-rafters” (Guo Qinghua, Visual Dictionary of Chinese Architecture 61)

*paike* 牌科

bracket set, bracketing unit in Suzhou terminology

*pailou* 牌楼

or *paifang* 牌坊, a monumental archway

*ping* 平

waist of a bearing block referring to the straight profile of its solid middle part below the ears

*pingshenke* 平身科

intermediate bracket set in Qing terminology
pingqi  平棊(or 棋)  “chessboard ceiling”, a flat, coffered ceiling consisting of a comparatively large grid framework with a surrounding frame and panels shaped like squares, rectangles, or polygons that are artistically decorated

pingqifang  平棊(或 棋)枋  paneled ceiling joist

pizhuqinmianxing  批竹琴面形  lute-face/split bamboo shape, a carving style for the tips of ang or shuatou

pizhuxing  批竹形  split-bamboo shape, a carving style for the tips of ang or shuatou

pupai(or bo)fang  普拍(或 柏)枋  horizontal architrave

puzuo  铺作  bracketing unit; term used in the Yingzao fashi for a bracket set
descriptive expression to capture the multiple layers of a bracket set in the Yingzao fashi; in detail, a bracket set composed of “x” layers directly indicating the number of perpendicular extensions (i.e. bracket or cantilever arms); it follows the “rule of thumb”: once the number of projecting steps (1x 出跳数) + 3 = Y-(layered) puzuo 铺作

x-puzuo  x-铺作

puzuoceng  铺作层  bracket set layer, one of the three horizontal layers in diantang-style architecture

que  阙  gate tower

“sparrow brace”, a short supporting board for additional abutment of architraves that superseded the chuomufang 绰幕枋 of the Yingzao fashi in late imperial China

queti  雀替

qinmianxing  琴面形  lute-faced shape, a carving style for the tips of ang or shuatou
“center block”, the small square block (with a ratio of length to width equal to 16x16 sections, 10 sections high) with openings of varying shape that are placed at the mid-point of a bow-shaped bracket perpendicular to the wall plane or at the central axis of the whole bracketing unit to support another bracket, lintel, or joist above

a pair of fork-like, A-shaped braces consisting of two slanting struts with bent or straight profile that are joint together at the top and visually resemble the Chinese character “ren 人”; occasionally, also called renzipuzuo 人字铺作 or chashou(bujian)puzuo 叉手(补间)铺作

two-rafter beam

angular grid-like bracket system, a kind of tightly spaced (surface) bracketing that successfully overcomes the limitations of individual bracket-arms or sets and merges all of the members to a strong structural and decorative grid system; it equally employs bracket-arms parallel or at a right angle to the wall plane and bracket-arms at an acute or obtuse angle (usually 45 degrees), all of which are “intertwined”, i.e. closely connected with the adjacent members at the side, below and above, and mutually uphold each other; in contrast to fan-shaped sets, there is no single focal point of bracket-arms or point of intersection

(Qing dynasty) “end blocks” (Glahn 172), separate block or small block (Miller 441) placed on each end of a longitudinal bracket
“end block”, the smallest bearing block with one-dimensional opening (with a ratio of length to width equal to 16x14 sections, 10 sections high) that guard the two endpoints of the brackets parallel to the wall plane

triangular space at the inside of the hall underneath the descending, high-angled tail of any structural, vertically slanting timber within the organic bracketing unit

hip-and-gable roof in tingtang-style architecture

upward pointing or ascending cantilever

bracketing method that integrates the vertically slanting, ascending cantilever into the organic bracketing unit

fan-shaped bracket set, an eave bracket set placed along the exterior building façade that mimics the shape of an open fan and applies outward projecting xiegong at the exterior steps and optionally, at the interior steps; they all intersect in a single focal point in the wall plane or along the main axis of the large bearing block

general term for a bearing block in Qing terminology

distinctive concave profile of the front façade that is achieved through the successive increase in height of columns along the façade from the central bay outwards

pattern, way, or method
shizigong 十字栱 bracket of a cross-shaped bracket joint that recalls the Chinese character “shi 十”; also an alternative name of huagong in Suzhou terminology

shizi xieshanding 十字歇山顶 cross-shaped hip-and-gable roof

shuangcaoshi 双槽式 one of the four different layouts for diantang halls in the Yingzao fashi, consisting of one outer column ring and two symmetrical longitudinal rows of interior column that run parallel to the wall plane of the front façade

shuatou 耍头 “trifling-tip” or decorative nose

shunbaliang 顺扒梁 Qing term for dingfu

sichuanfu 四椽栿 see n-chuanfu

si’eding 四阿顶 hip roof, one possible name

suantingfang 算桯枋 longitudinal joist placed above the linggong at the interior projection of a bracket set supporting the pingqifang

suduo 窿堵坡 stupa

sufang 素枋 general term for a joist, plain tie-beam, lintel

sunmao 楣卯 complicated mortise and tenon joints

tatou 杳头 head of a rectangular timber or interior step of tingtang-style bracketing that upholds the cross-beam without a small bearing block squeezed in-between; it extends toward the inside of the hall in the shape of a tazi 塍子, i.e. a horizontally leveled timber with simple entasis or even without tapered edges that is similar in function to a timu
tatoumu 榻头木
short horizontal timber, usually for smaller carpentry, that is inserted into the column head and supports the main architrave decreasing the span length through the additional layer of abutment

tailiang 抬梁
“column-beam-strut” design

tianhua 天花
Qing term for pingqi

tiao 跳
a measuring word for the projecting steps within a bracket set (e.g. one-step of huagong or ang)

tiaojian liangtou 挑尖梁头
late imperial construction method where the head of the cross-beam extends beyond the wall plane and directly upholds the eaves joist or tiaoyanheng

tiaowo 挑斡
tail of the true descending cantilever at intercolumnar bracketing of timber halls without interior ceiling if it supports the lowest eave purlin; the same term also refers to an interior slanting cantilever arm that neither pierces through the building plane nor projects at the outside

tiaoyanheng 挑檐桁
eaves (-raising) joist in Qing terminology, roughly equivalent to liaoyanfang

timu 替木
rectangular sectioned, bracket-like timber with tapered ends, often used between linggong and purlin to provide support for the latter

tingtang 厅堂
“mansion type” architecture, one of the main building types in the Yingzao fashi

tongzhu 通柱
tall vertical column that spans the distance from the ground floor through the upper stories and connects several layers
<table>
<thead>
<tr>
<th>Term</th>
<th>Pinyin</th>
<th>English</th>
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</thead>
<tbody>
<tr>
<td>tongyan</td>
<td>通檐</td>
<td>quality of a transverse timber framework without interior columns that solemnly rests at the two exterior eave columns; literally translates as “clear span”</td>
</tr>
<tr>
<td>touxinzao</td>
<td>偷心造</td>
<td>“stolen-heart” design refers to the lack of parallel brackets in a bracket set such as guazigong or mangong, and describes a corbelled cluster where only the uppermost transversal member (i.e. huagong or ang) supports a bracket parallel to the façade called linggong</td>
</tr>
<tr>
<td>tuan</td>
<td>檩</td>
<td>longitudinal roof purlin parallel to the roof ridge that carries one or two transverse sets of rafters; also known as heng桁 or lin檩 in Qing terminology</td>
</tr>
<tr>
<td>tuofeng</td>
<td>驼峰</td>
<td>camel humps</td>
</tr>
<tr>
<td>waitiao</td>
<td>外跳</td>
<td>exterior projection of the bracket set</td>
</tr>
<tr>
<td>wugai</td>
<td>屋盖</td>
<td>roof layer, one of the three horizontal layers in diantang-style architecture</td>
</tr>
<tr>
<td>wujialiang</td>
<td>五架梁</td>
<td>see m-jialiang</td>
</tr>
<tr>
<td>xia’ang</td>
<td>下昂</td>
<td>general term for a downward pointing or descending cantilever</td>
</tr>
<tr>
<td>xia’angzao</td>
<td>下昂造</td>
<td>bracketing method that integrates the structural or true descending cantilever with lever effect into the organic bracketing unit</td>
</tr>
<tr>
<td>xiangbi shangjuan</td>
<td>象鼻上卷</td>
<td>late imperial, decorative carving of brackets or false cantilevers in the shape of an upward turning snout</td>
</tr>
<tr>
<td>xiao jian tingxie</td>
<td>小尖亭榭</td>
<td>“small pavilion” architecture, a building type in the Yingzao fashi</td>
</tr>
</tbody>
</table>
slower carpentry or non-structural carpentry, one of the thirteen types of building work in the *Yingzao fashi* including the interior and exterior finishing of buildings with doors, windows, or boards, and minor small-scale carpentry for indoor and outdoor use such as fences or sutra cabinets

collection method in the *Gongbu gongcheng zuofa* where cushion-like corbelled clusters i.e. bracket sets were not structurally necessary for the greater carpentry system

lowest ridge purlin

a certain kind of *dingtougong* that projects at acute or obtuse angles to the building plane if placed at a T-shaped inner column grid; more precisely, *xiaxugong* must be applied at the interior steps of a bracket set that is located at the T-shaped intersection point of regular eave columns with (a row of) interior columns

term with two meanings:

first, the generic name and broader term for all the “angled, angular or oblique brackets”, i.e. a superordinate term for brackets projecting at acute or obtuse angles to the wall plane, including “genuine *xiegong*”, and “angular bracket-arms in the broader sense”; the latter are stylistic variations usually named after the specific function or placement e.g. mojiaogong, jiaogong, or *xiaxugong*

second, the narrower term for *zhengxiegong* that are often simply referred to as “*xiegong*” in Chinese scholarship, using the short form without indication of the hierarchical whole-part relationship
**xieshan** 阁山  hip-and-gable roof, one possible name

**xing** 形  shape or look

**xuanshan** 悬山  overhanging gable roof

“boot wedge”, a crude timber cushion to support the true descending cantilever or other structural, vertically slanting timbers at the interior point of intersection with the bracket set

**xuexie** 鞍楔

“boot wedge”, a crude timber cushion to support the true descending cantilever or other structural, vertically slanting timbers at the interior point of intersection with the bracket set

**yacaofang** 压槽枋  a member on top of the *fubigong* which levels the whole bracketing system, and on which the end of the main beam rests

**(yan)zhutoupuzuo** (檐)柱头铺作  (eave) column-top bracket set

**yatiao** 压跳  condition whereby the interior projection of *tingtang*-style bracketing supports a beam and acts as *tatou*

**yaocheng** 腰撑  straight, vertically slanting waist strut

**yemen** 掖门  adjacent small gates to the sides of a Main Gate or *shanmen* 山门

**yi** 斝  bottom or base of a bearing block referring to curved or straight slanting profile of its lowest part

**yidouersheng** 一斗二升  “two-on-one”

**yidousansheng** 一斗三升  “three-on-one”

**yinbi** 音壁  short ear walls

**yingshan** 硬山  (not overhanging) gable roof

**yingshan juanpeng** 硬山卷棚  flush gable roof
<table>
<thead>
<tr>
<th>Chinese Characters</th>
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<th>English Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>隐角梁</td>
<td>yinjiaoliang</td>
<td>hidden, concealed corner beam with head invisible from the outside</td>
</tr>
<tr>
<td>稳 (木正彐心) 衬角栿</td>
<td>yin(muzheng jixin)chen jiaofu</td>
<td>additional horizontally leveled rough beam placed below the ascending large corner beam that matches the Qing dynasty’s dijiaoliang</td>
</tr>
<tr>
<td>翼形</td>
<td>yixing</td>
<td>wing shape; term often used to describe the carving style of brackets or the tips of ang or shuatou</td>
</tr>
<tr>
<td>翼形栱</td>
<td>yixinggong</td>
<td>“wing-shaped bracket”, a short, artistically carved board that neither carries small bearing blocks nor upholds the next level of extensions</td>
</tr>
<tr>
<td>移柱</td>
<td>yizhu</td>
<td>movement and displacement of interior columns</td>
</tr>
<tr>
<td>由昂</td>
<td>you'ang</td>
<td>second layer of descending corner cantilevers</td>
</tr>
<tr>
<td>由额</td>
<td>you'e</td>
<td>lower horizontal architrave</td>
</tr>
<tr>
<td>鸳鸯交手栱</td>
<td>yuanyang jiaoshougong</td>
<td>“(male and female) mandarin duck bracket”</td>
</tr>
<tr>
<td>月梁</td>
<td>yueliang</td>
<td>crescent beams</td>
</tr>
<tr>
<td>藻井</td>
<td>zaojing</td>
<td>domed coffered ceiling</td>
</tr>
<tr>
<td>剖牵</td>
<td>zhaqian</td>
<td>one-rafter beam</td>
</tr>
<tr>
<td>正华栱</td>
<td>zhenghuagong</td>
<td>narrower term for a huagong that steps out directly perpendicular to the wall plane in order to contrast it from a genuine angled bracket-arm</td>
</tr>
</tbody>
</table>
structural or true descending cantilever, a vertically slanting timber with lever effect that balances the weight of the roof at the upper end with the weight of the projecting eaves at the lower end

“angled bracket-arm in the strictest sense” or genuine xiegong; a narrower term for a timber that steps out at acute or obtuse angles to the wall plane if placed at the exterior steps of a regular eave bracket set along the façade; in terms of fabrication, it can be made of long timbers that symmetrically extend at the outside and the inside of the building or short half-brackets that are only visible at the outside; often simply referred to as “xiegong” in Chinese scholarship, using the short form without indication of the hierarchical whole-part relationship

structural timber in a bracket set that combines horizontally leveled and slanting parts to uphold the lowest eave purlin at the inside of the hall

column-top joist in Qing terminology

auxiliary, spatial standard unit of the modular caifen system with 6 fen 分 in height and 4 fen 分 in width which is added to the measurements of dancai to achieve the full standard unit zucai

a special type of the decorative false cantilever with horizontally leveled, pointed tip

corner (column-top) bracket set

column-base, one of the three parts the Chinese column was originally composed of
<table>
<thead>
<tr>
<th>Chinese Character</th>
<th>Pinyin</th>
<th>English Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>zhukuangceng</td>
<td>柱框层</td>
<td>column grid layer, one of the three horizontal layers in <em>diantang</em>-style architecture</td>
</tr>
<tr>
<td>zhusheng</td>
<td>柱身</td>
<td>column-shaft, one of the three parts the Chinese column was originally composed of</td>
</tr>
<tr>
<td>zhushi</td>
<td>柱式</td>
<td>Chinese “order” similar to the five orders of Classical architecture in the West</td>
</tr>
<tr>
<td>zhutou</td>
<td>柱头</td>
<td>column-top or “chapiter”, one of the three parts the Chinese column was originally composed of</td>
</tr>
<tr>
<td>zhutoufang</td>
<td>柱头枋</td>
<td>column-top joist</td>
</tr>
<tr>
<td>zijaoliang</td>
<td>子角梁</td>
<td>small corner beam with head visibly piercing through the wall plane</td>
</tr>
<tr>
<td>zijaoliang</td>
<td>仔角梁</td>
<td>corner beam in the Qing period that blended together the small corner beam called <em>zijaoliang</em>, and the hidden, concealed corner beam or <em>yinjiaoliang</em></td>
</tr>
<tr>
<td>zucai</td>
<td>足材</td>
<td>“full standard unit”, a spatial standard unit of the modular <em>caifen</em> system with 21 fen 分 in height and 10 fen 分 in width</td>
</tr>
<tr>
<td>zuheshi</td>
<td>组合式</td>
<td>one of the three basic ways of interaction between beams and brackets before the Yuan dynasty after He Dalong (<em>Changzhi Wudai jianzhu xinkao</em> 83) that reflect the gradual upward move of the transverse beams, and differ in the extent to which they integrate the beam into the column-top eave bracketing; in detail, the method of “active involvement” with the beam head being a crucial part of the organic bracketing unit (e.g. extending outward in the form of an exterior <em>huagong</em>)</td>
</tr>
</tbody>
</table>
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1 The glossary focuses on the technical language of the Song dynasty used in this thesis. Terms referring to the official language of the Qing dynasty or the local language of the workshops in Suzhou, Jiangsu province, are noted. For a detailed comparison of the three different sets of vocabulary, see Table 1-1.
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