Material Expressions of Legitimacy among Nomadic Regimes in the Northern and Sui-Tang Dynasties: Focusing on Roof Tiles Unearthed from Royal Buddhist Temples

中国北朝隋唐時代における正統性
－皇室寺院の瓦を中心に－

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Abstract

Roof tiles are the most frequently unearthed remains from architectural sites of ancient cities in China. As a type of traditional building material, roof tiles contain static information about the style or rank of the buildings but also reflect the dynamic processes involved in the buildings' construction. Previous studies on roof tiles in China focus on the collection of material and typological analysis. However, this study is based on a large number of first-hand materials, and in addition to the style of the roof tiles, to reconstruct the lifecycle of the roof tiles, it focuses on information about "production," from the production traces left on the surfaces of the roof tiles, and "usage," from the excavation position of the roof tiles. Subsequently, this study can be extended from a typological study to an analysis of the construction process of the buildings related to roof tiles and their historical background.

The research objects of this study are roof tiles unearthed from royal Buddhist temples of the Northern and Sui-Tang Dynasties. These include the Yungang Buddhist Temple in the West Zone in Pingcheng, the Yongning Buddhist temple in Luoyang, the Dazhuangyan Buddhist Temple in Yecheng, the Ximing Buddhist Temple, and the Qinglong Buddhist Temple in Chang'an. It also included materials from other temples of this period recorded in archaeological reports. As royal Buddhist temples, the construction of these buildings was influenced deeply by the political setting of the period, and subsequently, the design and building materials of these temples, especially the roof tiles, function to express the legitimacy of the dynasty. Therefore, studies on roof tiles, including analysis of the style of the roof tiles, and the production and utilization processes, can be used to understand the details of the construction processes of the temples and can reflect the social setting of the period.

This study focuses on the Northern and Sui-Tang Dynasties when the nomadic people from the northern steppe of China established their dynasties in the settlements of the Han. Consequently, proving the legitimacy of their rule became an important political problem for nomadic rulers. According to Wuxing Theory, Emperor Xiaowen of the Northern Wei Dynasty determined that "water" would be the ritual element and "black" would be the ritual color of his dynasty. As a result, the style of polished-black roof tiles created in the ruling period of Emperor Xiaowen was shaped by the concept of Wuxing. Furthermore, most of the rulers of the Northern Wei Dynasty were devout Buddhists, and so the lotus patterns on the tile-ends are a reflection of the religious policy of "State Buddhism." This new style of roof tiles, with polished-black surfaces and lotus patterns created at the end of the Pingcheng Period of the Northern Wei Dynasty, was influenced by the Wuxing Theory of Confucianism and the motifs of Buddhism, which were deeply related to the political concepts of the rulers of the time.

In the construction processes of the large cities of Luoyang, Yecheng, and Chang'an, which were the capital cities of medieval China, the demand for roof tiles increased substantially. To satisfy the demand for the new styles of roof tiles, which were designed as an expression of the rulers' political concepts and symbols of legitimacy, new techniques and management methods for roof tile production were also developed. For example, the technique of using double-level mold made the mass production of tile-ends possible, and the main body of artisans altered from vassals to ordinary citizens, which led to an increase in labor in official workshops. The utilization of these roof tiles was also analyzed partially in this study. The rank of the roof tiles used in royal Buddhist temples was similar to the roof tiles laid on the roofs of palaces or ritual buildings in both style and size, demonstrating that these temples were in the same rank of other traditional royal buildings. Meanwhile, different buildings in the temples were built with roof tiles of different

patterns and sizes, which implies a distinction in both the rank and construction sequence of the buildings in a temple.

The development of roof tile production satisfied the increasing demand for polished-black roof tiles and tile-ends with lotus patterns in medieval China, but it also made roof tiles more common. In the Sui-Tang Dynasties, the affiliation of the Zhenguan Bureau changed from the Taifu Court to the Jiangzuo Court, demonstrating that roof tiles were treated as building materials instead of the property of the royal family during this period. Moreover, the roof tiles made in the later period of the Tang Dynasty generally became rougher, and the traditional supervision method based on the signatures of the artisans was replaced by supervision that was conducted directly in the workshops. In the construction process of some royal temples, roof tiles were not provided by the official workshop, but instead, they were bought, indicating that the expression of the political concepts of the rulers as a function of the roof tiles generally declined in the Tang Dynasty.

This study describes the roof tiles that were used in royal Buddhist temples during the Northern and Sui-Tang Dynasties and examines their style, production, and utilization, and how these changed. It also examines many of the details of the construction processes of temples using roof tiles. The importance of the roof tiles, however, declined when they became common building materials in the Tang Dynasty. The history of the roof tiles used for royal Buddhist temples in the Northern and Sui-Tang Dynasties is only a small part of the vicissitude of nomadic dynasties, but it is a vivid episode of changing society in medieval China.

Keywords: the Northern and Sui-Tang Dynasties, roof tile, royal Buddhist temple, legitimacy

要旨

瓦は中国古代都城の建築遺構から最も多く出土する遺物である。伝統的な建築材料である瓦は、建物の様式や等級など静的な情報だけではなく、造営工程に関する動的なプロセスも反映する。しかし、中国における瓦の先行研究は、その大部分が資料の収集や型式学研究に集中している。本研究では瓦の様式を分析した上で、表面に残る製作痕などの検討を通じて瓦の生産過程を明らかにした。さらに、出土状況の検討を通じて瓦の使用状況を解明し、瓦のライフサイクルを復元した。以上の通り、本研究では瓦の型式学研究から、瓦と関連する造営工程及びその歴史的背景の復元まで広い範囲で分析を行った。

研究資料は北朝隋唐時代の皇室寺院から出土した瓦である。対象となる寺院は、平城雲崗石窟窟上寺院、洛陽永寧寺、鄴城大荘厳寺、長安西明寺と長安青龍寺の５遺跡である。これらの資料を中心に、発掘報告書に記載された同時代の他の寺院の情報も合わせて分析を行った。皇室寺院の造営工程は政治情勢に強く影響されたため、寺院の造営計画、さらに瓦を含む建築材料は、その時代の正統性を表現する機能を持つ。したがって、様式と生産・使用状況をめぐる瓦研究を通して、寺院の造営過程、さらにその背景となる社会的様相をより深く理解できると考える。

北朝隋唐時代には、中国北部の草原地帯から南下した少数民族が漢族の居住地で政権を建てた。自らの政権の正統性を構築することは、少数民族の統治者にとって、最も重要な政治的課題であっただろう。北魏は五徳終始説を基に、自らの徳運を水徳に、服色を黒色に改めることで、先行する五胡国家の正統性を否定するとともに、西晋の金徳を継ぎ、晋王朝の継承者を自任したのである。したがって、北魏孝文帝時代に創出された黒色磨研瓦は、五徳終始説から影響を受けた可能性がある。一方、大部分の北魏の皇帝は敬虔な仏教徒である。蓮の花のモチーフを瓦当文様に使用する点は、北魏時代の「国家仏教」政策の結果だと考えられる。総合的に見れば、北魏平城時代末期に創出された黒色磨研瓦と蓮華文瓦当は、儒教の五徳終始説と仏教のモチーフの両方から影響を受け

ており、これらは政権の正統性構築の一環として北魏の統治者に利用されたのである。

新たな様式の瓦は、洛陽、鄴城、長安など中世中国における巨大都市の造営工程で大量に使用された。この需要を満たすため、造瓦手工業では、製作技術と管理方法の変革が行われた。例えば、瓦当製作技術は木笵技術から子母笵技術へ変化し、瓦生産の主体が世襲の職人から、徭役が課された平民に移行した。その結果、生産管理体制がより効率化された。そして、技術と生産管理の向上により、北朝晩期と隋唐時代における皇室寺院の造営工程において、黒色磨研瓦と蓮華文瓦当を広く使用することが可能となった。さらに、本研究では、瓦の使用状況についても若干の検討を加えた。北朝隋唐時代に皇室寺院で使用された瓦は、王権の象徴である宮殿や明堂の瓦と極めて類似するため、ともに同じ等級に属すると考えられる。また、一つの寺院の異なる建物に使われた瓦の中にも、様式、法量、製作痕に差異が見られる。その差異は、建築の等級差と造営順を示すと考えられる。

造瓦手工業で生じた技術と生産管理における革新は、瓦に対する高い需要を満たした。その結果、瓦は政治的意味を持つ象徴物から一般の建築材料へと変化した。そして、それに応じるように、隋唐時代では、瓦生産を管轄する甄官署の所属が、皇室の宝物を保管する太府寺から、造営工程を管理する将作署へと移る。唐代晩期に至ると、瓦の作りは粗雑になり、工人の銘文に基づく個人責任制（物勒工名）も工房ごとの生産管理に取って代わられた。つまり、唐代になると黒色磨研瓦と蓮華文瓦当が持つ政治的意味は徐々に希薄化したのである。

本研究では北朝隋唐時代の皇室寺院に使用された瓦を整理・分析し、瓦の様式、生産・使用状況およびそれらの変化を検討した。そして、それらの分析結果を基礎として、寺院の造営工程とその背景となる社会的様相についても考察を加えた。北朝隋唐時代の皇室寺院に使われた瓦は、長い歴史のほんの一部にすぎないが、中世中国における社会変遷を鮮明に反映するのである。

キーワード：北朝隋唐、瓦、皇室寺院、正統性

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PART I. Background

CHAPTER 1. Preface

Section 1. Research Perspective

This study focuses on roof tiles unearthed from royal Buddhist temples in the Northern and Sui-Tang Dynasties (北朝隋唐) and analyzes the production and utilization of these roof tiles, as well as the related construction processes. In this way, this research sheds light on the material methods used by the nomadic rulers of the Northern and Sui-Tang Dynasties to express the legitimacy of their regimes.

Legitimacy is the rights and acceptance of an authority that legally allows a regime or a ruler to inherit a leadership position from a former regime or ruler. During the Northern and Sui-Tang Dynasties, the society, including the ethnic groups, political setting, and culture, changed substantially, and there were continuous debates over legitimacy and arrogation. At the end of the 4th century, Tuoba (拓跋), a Xianbei (鮮卑) clan that once resided in the eastern Eurasian steppe, established the Northern Wei (北魏) regime, and expanded their power rapidly within Northern China. As a nomadic regime, apart from military conquest, the establishment of legitimacy was also an important method for stabilizing their rule, and subsequently, the ruler of the Northern Wei created various methods to express the legitimacy of their regime.

The Northern Wei Dynasty was separated into two regimes in the early period of the 6th century, including the Eastern Wei-Northern Qi (東魏北齊) and Western Wei-Northern Zhou (西魏北周), and both thought that they were the legitimate inheritor of the Northern Wei. At the end of the 6th century, the Sui Dynasty (隋朝) was established, followed by the foundation of the Tang Dynasty (唐朝) at the beginning of the 7th century. The aristocrats of the Northern Zhou founded the Sui and Tang Dynasties, but most of their systems and culture were inherited from the Northern Qi and originated in the Northern Wei. The methods to establish political legitimacy were also inherited and changed through the Northern and Sui-Tang Dynasties. This process was illustrated by the promotion of sinicization, and the development of Buddhism, implying that the rulers of nomadic regimes inherited the Confucian tradition of the Han and followed the contemporaneous religious setting. The rulers pursued the legitimacy of the dynasty throughout the feudal ages, and this is fundamental in understanding the societies of the Northern and Sui-Tang Dynasties. Legitimacy was related to the intangible systems of the country, but it also influenced the style or size of tangible objects such as clothes, flags, utensils, and roof tiles. Therefore, by observing the material objects of a specific period, specifically the remains of the high class, the methods used by a specific dynasty to express its political legitimacy can be determined.

This study uses roof tiles unearthed from royal Buddhist temples as the research objects. Roof tiles are the most frequently unearthed remains from the sites of ancient cities in China, and as they were laid on the roofs of buildings, roof tiles can illustrate the landscape of buildings and provide details of their rank or function. The lifecycle[1] of the roof tiles, from production to usage,

[1] Schiffer: "While one may readily visualize the flow of pottery, or food, or even projectile points, through a cultural system, it is the case that all elements enter a system, are modified, broken down, or combined with other elements, used, and eventually discarded. This is so even for those elements, such as houses, which at certain points in time appear to be permanent features. This observation can provide the basis for the construction of a simple flow model with which to view the life history of any element, and

and then to disposal, can shed light on the construction processes involved in the preparation of building materials and construction and destruction of the buildings, to a certain degree. Two standards, rank and function, were used to classify the buildings. The royal Buddhist temples were classified as “high class” and “religious” buildings. Temples in the Northern and Sui-Tang Dynasties were built under the religious policy of State Buddhism, while high class was deeply influenced by political settings. The royal Buddhist temples were the confluence of the power of Buddhism and the rulers’ political concepts. Therefore, this study focusd on the roof tiles unearthed from royal Buddhist temples, including the Yungang Buddhist Temple in the West Zone (YBTWZ, 雲崗石窟窟上西区寺院) in Pingcheng, the Yongning Buddhist Temple (YBT, 永寧寺) in Luoyang, the Dazhuangyan Buddhist Temple (DBT, 大莊嚴寺) in Yecheng, the Ximing Buddhist Temple (XBT, 西明寺), and the Qinglong Buddhist Temple (QBT, 青龍寺) in Chang’an, and other contemporenous royal temples, to understand the establishment of legitimacy during the Northern and Sui-Tang Dynasties from the viewpoint of material culture.

Section 2. Structure of the Dissertation

This dissertation can be divided into five parts. The first part is the research background of this study. After explaining the research perspective, previous studies, methods, origins of materials, structure, and significance of this study, the historical background of the establishment of legitimacy will be briefly introduced.

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account behaviorally for the production of the archaeological record” (1972).

The second, third, and fourth parts are the main body of this dissertation and discuss the roof tiles and relevant construction processes of the temples in detail. The three parts will be arranged in the following order: Northern Wei, Eastern Wei-Northern Qi, and Sui-Tang. In each part, the first chapter will give a brief introduction of Buddhism and the Buddhist temples of that period, and then, the next chapters include a case study of the roof tiles unearthed from specific temples. The chapter after the case study is a summary of the roof tiles unearthed from other sites of the same period that have not been excavated completely or that provide limited information about the roof tiles. In the last chapter, by considering the analysis of the roof tiles and historical records, the construction process of the temples from a specific period can be reconstructed to a certain extent.

The fifth part will describe the features and changes of the roof tiles, as well as the roof tiles' technique system, production management, and usage, from the Northern Dynasties to the Sui-Tang Dynasties, and then, explain the establishment of legitimacy from the viewpoint of the development of material culture, such as roof tiles and the construction of royal Buddhist temples. The last part also includes the conclusion and expansion of this study.

Section 3. Previous Studies

1. Royal Buddhist Temples in the Northern and Sui-Tang Dynasties

Previous studies on royal Buddhist temples in the Northern and Sui-Tang Dynasties can be divided into two types: spatial planning and architectural style.

Spatial planning research focuses on the distribution of temples in a city or the layout of individual

temples. Some researchers have considered temples as a part of cities and used historical records to analyze the changes in urban planning and the meaning of the temples' location (Su 1978; Xin 1992; Shi 1994). Other researchers chose individual temples as research objects and focused on the position relations among different buildings in one temple. In recent years, the excavation of Buddhist temples increased gradually, and researchers now mainly use excavation results to analyze the layout of the temples (Su 1997; Gong 2006; Li 2009; He 2010; He 2010).

Previously, studies on architectural style were based on historical records and existent temples, but with the increase in excavations, reconstruction studies of temples have increased. For example, by analyzing excavation results, historical records, and existing temples in Japan, the architectural style of the No. 4 Architectural Site in the QBT was hypothesized (Yang 1984). The structure of the tower of the YBT was also analyzed from its rammed-earth foundation (Yang 1992; Zhong 1998). Moreover, by counting the proportion of the different types of building materials, which was sourced from the *Chinese Buddhist Canon*, the structure of the Wenshu Pavilion of the Xingshan Buddhist Temple (興善寺文殊閣) was deduced (Li 2012).

Overall, there have been many achievements in the archaeological excavation of royal Buddhist temples, but researches have focused on the static analysis of their spatial planning or architectural style. Moreover, these studies were mostly based on historical records or excavation plans and paid less attention to the building materials.

2. Roof Tiles in the Northern and Sui-Tang Dynasties

2.1 Typological Study

Most studies on the roof tiles of the Northern and Sui-Tang Dynasties have been typological

studies that have specifically focused on tile-ends. Some researchers conducted analysis of the roof tiles from the whole country. For example, both Shen and Murakami examined the tile-ends of different periods unearthed from different areas of China (Murakami 1996; Shen 2006), and Yamasaki summarized the development of roof tiles around East Asia (2011). There have also been studies that have focused on samples from specific cities.

In Pingcheng (平城), roof tiles of the Northern Wei Dynasty were unearthed from the sites of Caochangcheng (操場城), Mingtang (明堂), Piyong (辟雍), Siyuan Buddhist Temple (思遠寺), YBTWZ, and Xicetian (西冊田) Kiln. Typological studies about these roof tiles are found in papers written by Liu and Xu. Their studies arranged different types of roof tiles, including imbrices and tegulae (Liu 2009; Xu 2014). Meanwhile, other papers have discussed the features of tile-ends (Wang 2003).

In Luoyang (洛陽), roof tiles of the Northern Wei Dynasties were unearthed from the sites of Taihe Palace（太和殿), Changhe Gate (閶闔門) in the Royal City, No.1 House, YBT, Jianchun Gate (建春門) of the Inner City, Dashi (大市), and Mingtang (明堂). Roof tiles from the Tang and Song Dynasties were unearthed from the sites of royal buildings and the dwellings of the residents. Typological studies on roof tiles unearthed from Luoyang have mostly been about tile-ends. For example, the changes in the tile-end patterns from the Han Dynasty to the Northern Wei Dynasty were analyzed by Qian Guoxiang (Qian 1996, 2014), while Chen Liangwei analyzed the differences between tile-ends from the Sui-Tang Dynasties and the Song Dynasty (Chen 2003).

In Yecheng (鄴城), the roof tiles from the Eastern Wei and Northern Qi Dynasties were retrieved from excavations around Yecheng that began in the 1980s, especially the excavations of the sites

of Zhaopengcheng Buddhist Temple (趙彭城寺), DBT, and Zhuming Gate (朱明門). Zhu's analysis, collected in *Kodai higashi ajia no zōga gijutsu*, is typological studies on the tile-ends collected in recent years (Zhu 2010). Mukai and Yamasaki also classified the roof tiles found in Yecheng (Mukai 2004; Yamasaki 2011).

In Chang'an (長安), roof tiles from the Sui and Tang Dynasties were unearthed from the sites of Daming Palace (大明宮), Xingqing Palace (興慶宮), XBT, QBT, as well as markets and dwellings. The typological studies of the roof tiles in Chang'an have mostly been analyzed in archaeological reports. It is worth mentioning that the report, *Qinglongsi yu Ximingsi*, recorded the data on the size of all of the collected samples, which is very important information for studies on roof tiles in Chang'an (Zhongguo shehui kexue yuan kaogu yanjiusuo 2015).

2.2 Research on Specific Subjects

In addition to typological studies, researches on the characters on roof tiles, production techniques, kilns, and other specific subjects have increased in recent years, and these researches also extended to the production systems and culture related to roof tiles.

Characters. The inscribed roof tiles from Pingcheng were analyzed in Yin's papers, who deciphered the characters and discussed their meaning (Yin 2000, 2009). The inscribed roof tiles from Luoyang, especially the samples from the No. 1 House Site, were analyzed by Zhang and Huang. The characters with the artisans' name and production steps were deduced to manage the production and labor involved (Zhang 1989; Huang 2000). There was also a large number of roof tiles with stamped characters unearthed from Yecheng. The decipherment and classification of these samples were completed by Wang (2013) and Iijima (2012). The roof tiles found at

Chang'an also had samples with stamped characters, and they were analyzed in a paper written by Gong, who described the production and supply of the roof tiles in Chang'an through these samples (2006). In addition, Mukai discussed the appearance and development of characters on roof tiles around East Asia (Mukai 2011).

Production technique. Mukai discussed the development of roof tile production during the Northern Dynasties, while Sagawa focused on the innovation of roof tile production from the Medieval Period to the Early Modern Period (Mukai 2004, 2012; Sagawa 2012). Moreover, in a symposium held by the Nara National Research Institute for Cultural Properties, the production technique of the roof tiles unearthed from the main cities of China, including Pingcheng, Luoyang, Yecheng, Chang'an, Jiankang (建康), and Yangzhou (揚州) were analyzed, and the results were published in 2010 (Nara kokuritsu bunkazai kenkyūsho 2010).

Kilns. Wang and Li analyzed the kilns used to make roof tiles or bricks in the Sui and Tang Dynasties, but they usually focused on the structure of the kilns and not the remains found inside them (Wang 2012; Li 2015). In addition, Mukai's research examined the production system of the Xicetian Kiln of the Northern Wei Dynasty, and the supply between the kilns and Pingcheng were deduced (Mukai 2014).

2.3 The Features of Previous Studies on Roof Tiles

Previous studies on roof tiles of the Northern and Sui-Tang Dynasties have four features as follows: (1) Typological studies have mostly focused on tile-ends, and studies on imbrices and tegulae are comparatively rare. (2) Studies on specific subjects, such as production techniques or management, are insufficient. (3) The relations between roof tiles and buildings have been

neglected. (4) Most of the studies were on roof tiles unearthed from only one city. Studies on the roof tiles of the Northern and Sui-Tang Dynasties are still in the material collection and classification stages. However, while the essential information about these roof tiles is already known, the analysis of the relations among the roof tiles, buildings, and society are rare.

3. Legitimacy in Chinese History

Legitimacy is a keyword to understand Chinese history. It is the rule for historians in ancient period to write official historical books, in which the most important thing was to rank the previous regimes by the concepts of legitimacy. Therefore, legitimacy is not only a topic for academic research today, but also a constantly discussed theme in ancient China.

According to Ouyang Xiu (欧陽修) of the Song Dynasty (宋朝), the discussion about legitimacy originated to the chronicle, *Chunqiu* (春秋), written in the Chinqiu period. After that, many historicans named their books as "統" or "紀"[2] and gave their opinions about legitimacy. Rao Zongyi (饒宗頤) thought that there were two main opinions in ancient China, which prevailed in different periods separately. The opinion before the Song Dynasty was based on the Wuxing (五行) Theory, which was created by Zou Yan (鄒衍) in the Zhanguo (戦国) period. According to the Wuxing Theory, the transformation of five elements (metal, wood, water, fire, earth) is the rule of the world, so the legitimate regime must have the feature or omen of the present element. After the Song Dynasty, Confucians, such as Ouyang Xin, Su Shi (蘇軾), turned their opinion of legitimate regime to "unity". If a dynasty could unify the territory of China, it should be legitimate regime, even thought they were originated from nomadic groups (Rao1996). Apparently, in

[2] The characters, "統" and "紀", originally mean the main thread of silkworm cocoon, and the extended meaning of the characters is the law of a society or the legitimacy of a regime.

ancient China, legitimacy is both a subject for historical studies and an important political proposition.

In modern times, the discussion on legitimacy is also the core of academic research of Chinese history, because traditional historical studies, based on narrative records, always focus on political history. The studies of material culture, however, rarely touch on this topic. This study will develop a new perspective and use a wide range of methods to explore the legitimacy of medieval China by material objects, such as roof tiles.

Section 4. Research Methods

There are three features of this study: (1) This study was based on firsthand materials. (2) The materials were analyzed from three viewpoints: styles of roof tiles, production traces, and excavation information. (3) This study paid attention to the historical background and culture related to the roof tiles. This section explains the methods used in this study from three points: the arrangement methods, analysis methods, and explanation methods.

1. Arrangement Methods

The arrangement of roof tiles was conducted in two ways. Samples with at least one measurable item, or with special features, were observed and measured carefully. Meanwhile, the fragments of the roof tiles were gathered or randomly selected for statistical analysis. The items from the roof tiles that should be arranged are listed below (Figure 1, Table 1).

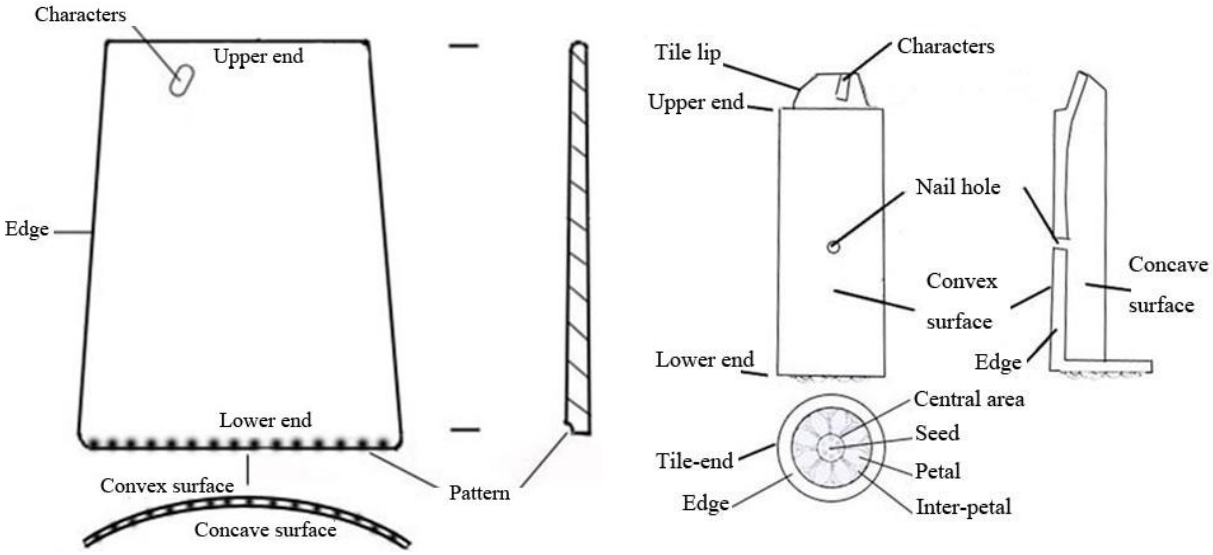

Figure 1 The Structure of a tegula and an imbrex

(Source: Made by the author)

Table 1 Roof tiles' items

Type	Item	Measurement	Observation	Statistical Analysis
Tegula	Exposed surface		Features on concave surface	
	Size	Length, width (lower end, upper end), thickness		Proportion of roof tiles with different patterns
	Pattern		Lower end of the tegula	
	Character	Length, width, distance from the upper end or edge of the roof tiles to the characters	Direction of stamping; content of characters	
	Trace	Number of warps and wefts in one area (1cm*1cm)	Production traces; trimming traces	
	Weight	Weight of unbroken sample		Proportion of roof tiles with different exposed surfaces
	Location			Distribution in different trenches; location in one trench

Imbrex	Main body	Exposed surface		Features on the convex surface	
		Size	Length (total length; length of tile lip), diameter (inner diameter, outer diameter), thickness (average thickness, thickness of shoulder, thickness of lower end)		
		Character	Length, width	Direction of stamping; content of characters	
		Trace	Number of warps and wefts in one area (1cm*1cm)	Production traces; trimming traces	
		Weight	Weight of the unbroken sample		Proportion of roof tiles with different exposed surfaces
		Location			Distribution in different trenches; location in one trench
	Tile-end	Pattern		Features on the front surface	Proportion of tile-ends with different patterns
		Size	Total diameter, diameter of the central area, diameter of seeds, length of petal, width of petal, length of inter-petal, width of edge, thickness of edge, thickness of petal, thickness of the central area		proportion of edge in diameter
		Trace		Traces on the back surface	
		Location			Distribution in different trenches; location in one trench

The concrete arrangement methods of this study were borrowed from the roof tile studies in Japan, which indicate how to observe the features or production traces of roof tiles, how to measure roof tiles and how to do statistical analysis. These items that were measured, observed or counted carefully can provide clear details about the lifecycle of roof tiles and buildings, which can bridge the material objects to social settings (Table 2).

Table 2 The relations between arrangement methods and analysis methods

<table>
<tr><td>Methods</td><td colspan="2">Items</td><td>Lifecycle of roof tiles</td><td colspan="2">Lifecycle of buildings</td><td>Social settings</td></tr>
<tr><td>Measurement</td><td colspan="2">Size</td><td colspan="4" rowspan="3">Style</td></tr>
<tr><td rowspan="3">Observation</td><td colspan="2">Exposed surface</td></tr>
<tr><td colspan="2">Pattern</td></tr>
<tr><td colspan="2">Traces</td><td>Production</td><td>Preparation of building materials</td><td>Technique; Management; Artisans</td><td>Economic settings</td></tr>
<tr><td colspan="2">Characters</td><td colspan="4"></td></tr>
<tr><td>Statistical analysis</td><td>Weight of different kinds of roof tiles</td><td rowspan="3">proportion and function of different kinds of roof tiles</td><td>Usage</td><td>Construction and Destruction</td><td>Landscape; Rank</td><td>Political settings</td></tr>
<tr><td>Length of the lower ends of different kinds of roof tiles</td><td colspan="4"></td></tr>
<tr><td colspan="2">Location of different kinds of roof tiles</td><td colspan="4"></td></tr>
</table>

2. Analysis Methods

The information gathered from the arrangement stage was analyzed from three viewpoints: style of roof tiles, production trace, and excavation setting (Figure 2).

The style of roof tiles includes the features that were made intentionally and would be shown to users as the exposed surface, size, and patterns. The classification of the roof tiles was based on these features, and typological studies were the foundation for the analysis of the production and usage of the roof tiles below.

Production traces are the traces left on the surface of the roof tiles unintentionally and would not be shown to users. These can be separated into two groups: tool traces and trimming traces. The tool traces are the first-time traces left when the tiles were shaped by tools, such as fabric

impressions on the concave surface or the traces made by pottery paddles on the convex surface. Trimming traces are the traces left when the first-time traces were erased, such as the scraping traces. The characters on the roof tiles were left intentionally, but they were used for production management. Moreover, most of these characters were curved or stamped on the convex surfaces of the tegulae, the tile lips of the imbrices, or the back surfaces of the tile-ends. This means that they were not obvious features for users, so the characters should be treated as production traces. The analysis of the production of the roof tiles, such as the technique, artisans involved, and supervision, were based on these traces.

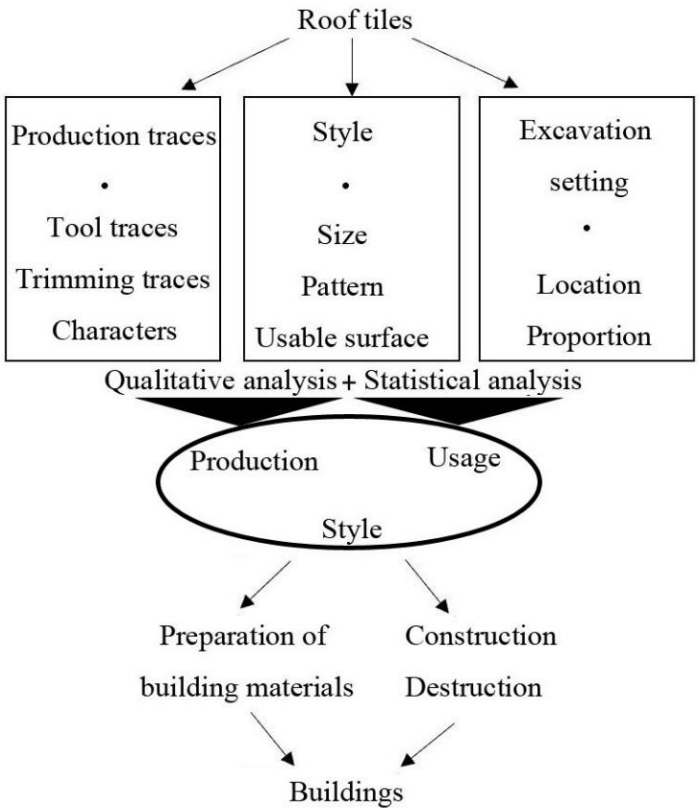

Figure 2 The diagram of analysis methods

The excavation setting is the relation between the roof tiles and architectural sites, including the location of the unearthed roof tiles and the proportion of different types of roof tiles. If the deposit of the site was not disturbed heavily, the location of the remains could reflect the position of the buildings before they were destroyed. The proportion of the roof tiles can provide evidence to separate the main materials from the repair materials. Therefore, information on the excavation

setting can demonstrate the usage of the roof tiles among different buildings or different parts of one building.

In summary, these three viewpoints describe the lifecycle of the roof tiles, from production to usage, which was also the lifecycle of buildings, from the preparation of building materials to construction and destruction.

3. Explanation Methods

Information about the roof tiles was collected during the arrangement of the firsthand materials, while regularities in the production of the roof tiles and usage were summarized in the analysis stage. In the explanation stage, the regularities in the last stage became the basis for explaining the roof tiles, construction of temples, and historical background.

The classification of the roof tiles was used to answer the question “What types of the roof tiles were used on buildings?” This analysis formed the basis for the examination of the roof tiles and provided information on the production and usage of the roof tiles.

From the viewpoint of the roof tiles, the construction of a temple is essentially a process of the production and usage of building materials. Therefore, the analysis of the production and usage of the roof tiles were used to answer the question “How were the temples built?” This is related to several subjects such as the technique system, production management, ranking of the roof tiles, and construction sequence, which will be discussed in further sections.

The construction of temples is influenced by the historical background. Important historical

events influenced the intangible social settings and tangible objects, such as roof tiles and temples. The analysis of the related historical background were used to answer the question “Why were the temples built in this specific way?” For example, why did the roof tiles used for high-rank buildings changed from untrimmed/simply-trimmed style to polished-black style at the end of the Pingcheng Period of the Northern Wei Dynasty? Why could Buddhist temples use the same rank of building materials as palace and ritual building? The answers can be found in the alteration of social settings. In this way, material culture can be used to observe a society and how it changes historically.

Section 5. Research Materials

1. Archaeological Objects

The first-hand archaeological objects were from five sites of royal Buddhist temples, including the YBTWZ in Pingcheng, the YBT in Luoyang, the DBT in Yecheng, the XBT, and the QBT in Chang’an. Information on these five sites and their remains are listed below in Table 3. The data from the first-hand archaeological objects of the five sites were the main research materials for this study, while information about roof tiles from other sites recorded in archaeological reports were used as supplementing materials.

Table 3 The main origin of the research materials

Period	City	Site		Sample[3]	Fragment[4]	Remains in total
Northern Wei	Pingcheng	YBTWZ	Tower, rooms for monks, kilns	Tegulae: 139; imbrices: 189; tile-ends: 121		180000
	Luoyang	YBT	Tower, gate	Tegulae: 298; imbrices: 106; tile-ends: 69		? (not too many)
Northern Qi	Yecheng	DBT	Tower	Tegulae: 272; imbrices: 273; tile-ends: 781; roof tiles with stamped characters: 5	Tegulae (randomly selected): 3092; imbrices (randomly selected): 1241	28500
			Main hall	Tegulae: 34; imbrices: 39; tile-ends: 242; roof tiles with stamped characters: 991		? (great quantity)
			Gate	Tegulae: 16; imbrices: 67; tile-ends: 115; roof tiles with stamped characters: 522	Tegulae: 10534; imbrices: 2840	13374
Sui, Tang	Chang'an	QBT	Tower, main halls, attached buildings, gates, kilns	Tegulae: 70; imbrices: 134; tile-end: 188; roof tiles with stamped characters: 1		? (great quantity)
	Chang'an	XBT	Main halls, attached buildings, courtyards	Tegulae: 116; imbrices: 151; tile-ends: 460; molds of the tile-ends: 1; roof tiles with stamped characters: 1		? (great quantity)

2. Historical Records

The historical records on Buddhist temples, the handicraft industry, and objects were also important research materials. Historical literature from the Northern Dynasties is limited, but the amount of literature increased during the Sui-Tang Dynasties. In addition to official historical

[3] Samples are remains that keep at least one kind of measurable dimensions or have special features. The samples should be observed and measured.

4 Fragments are broken remains that cannot be measured or have no obvious feature. The fragments can provide data for statistical analysis.

books, chorographies, Buddhist literature, and books on the social system and political policies can also provide important information. The origins of the historical records used in this study are listed below in Table 4.

Table 4 The origins of the historical records

Category	
Official historical books	*Wei shu, sui shu, beiqi shu, bei shi, wei shu, zizhi tongjian*
Chorographies	*Luoyang qielan ji, yedu yizhi jijiaozhu, dushi fangyu jiyao, taiping huanyu ji, zengding liangjing chengfang kao, chang'an zhi*
Books on the social system and political policies	*Yingzao fashi, tang huiyao, tongdian, tang liudian*
Buddhist literature	*Xu gaoseng zhuan, fayuan zhulin, lidai sanbao ji, kaiyuan shijiao lu, dazangjing bukong zhibiao ji*

Section 6. The Significance of this Study

First, this study analyzes the establishment of the legitimacy of the Northern and Sui-Tang Dynasties from the viewpoint of material objects. In previous studies, political concepts, such as legitimacy, were mostly discussed based on narrative records, while the studies of material culture rarely touch on this kind of topic. In ancient China, however, the political concepts of rulers not only existed in intangible policies or system, but also influenced the design, production and usage of material objects. The roof tiles used in royal Buddhist temples should be deeply influenced by ideas on legitimacy during these periods, because several new styles of these materials objects were created together with the alteration of political settings. The production and usage of the roof tiles also developed to meet the demand for appropriate building materials. Therefore, this study provides a new viewpoint, a direct and vivid way to analyze the political legitimacy of the

Northern and Sui-Tang Dynasties, as well as the society of these nomadic dynasties.

Second, this study is also a significant case study for material objects, which developed a range of new methods to arrange and analyze the roof tiles of the Northern and Sui-Tang Dynasties. It is based on information gathered from first-hand research materials that have been carefully arranged. And then, different from previous studies, which have mostly focused on typological studies, this study paid attention to the style of the roof tiles, their production traces, and excavation setting. The relations among the roof tiles, producers, and buildings were discussed, which bridged the material objects to the analysis of intangible social settings.

Third, this study is not limited in the field of roof tile. It extends the research field of other studies, such as urban archaeology and culture exchange in East Asia. Previous studies on urban archaeology focused predominantly on the spatial planning of the city or the architectural style, which are the results of the construction. Compared to previous studies, this study instead focuses on the construction processes. By analyzing the lifecycle of the roof tiles, from production to usage, the details of the construction process can be reconstructed to a certain extent. Furthermore, as this study arranged the roof tiles of medieval China comprehensively and carefully, in future studies, the analysis of roof tiles can be extended to the contemporaneous cities in other countries in East Asia and become the basis of studies on cultural exchange.

CHAPTER 2. The Establishment of Legitimacy in the Northern and Sui-Tang Dynasties

Legitimacy, pursued by every ruler in Chinese history, is the legality of authority. After the Han Dynasty, the Chinese dynasties changed frequently, and it became important for rulers to demonstrate the legitimacy of their dynasty and prove the legality of their authority.

1. Legitimacy and Wuxing Theory in Confucianism

Before the Song Dynasty, legitimacy was closely related to Wuxing Theory. According to Gu Jiegang (顧頡剛), Wuxing Theory began in the later period of the Warring States by Zou Yan. At that time, kings of these states wanted to become emperors, and so Zou Yan developed a theory about the conditions and omens of emperors based on the thoughts of Wuxing (Gu 1930). The Confucians improved the theory continuously during the Qin and Han Dynasties, and it became the complicated but widely believed theory of legitimacy.

The rulers of the Northern Wei Dynasty came from the steppe in the north of China, and they were not familiar with the Wuxing Theory of Confucianism. When Emperor Daowu (道武帝) moved his capital city to Pingcheng, however, he determined that it was necessary to rule the Han using the traditions of the Han. Subsequently, he used Wuxing Theory to prove the legitimacy of his dynasty using advice from the ministers of the Han. According to *Wei shu*, Emperor Daowu chose the element earth as the virtue of his dynasty (deyun 德運), which indicates the foreordained destiny of the dynasty, and he used yellow as the ritual color.[5] Emperor Xiaowen

[5] *Wei shu*: "（天興元年）定都平城，即皇帝位. ……羣臣奏以國家繼皇帝之以後，宜為土德，故神獸如牛，牛土畜，又黃星顯曜，其符也. 於是始從土德，數用五，服尚黃，犧牲用白." Wei shou, *Wei shu*, vol.181, p. 2734.

(孝文帝), however, gave the order to redraw the deyun of his dynasty in 490 AD and chose the element water. The element water is related to black, and so the Northern Wei Dynasty used black as their ritual color after 490 AD.

In the earlier period of the 6th century, the Northern Wei was separated into two parts. The rulers of the Eastern Wei moved their capital to Yecheng, while the rulers of the Western Wei chose Chang'an as their capital. They all claimed that they were the legitimate inheritors of the authority of Northern Wei, and subsequently, they still used the element water as their deyun. The Northern Qi replaced the Eastern Wei in 534 AD, and according to the Wuxing Theory, their deyun was the element wood. According to *Tongdian*, however, although the deyun of the Northern Qi changed to wood, their clothes and color followed the tradition of the Northern Wei.[6] This meant that the system of objects (名物制度) in the Northern Qi was similar to the system in the Northern Wei. For example, the Southern Inner City of Yecheng was a replicate of the Inner City in Luoyang.[7] It followed the urban plan of Luoyang and the same building materials were reused in Yecheng.[8]

In theory, the deyun of the Sui, who were the inheritors of Northern Zhou, should have been fire, while the deyun of the Tang should have been earth. In the period of Emperor Wu Zetian (武則天), however, the deyun of earth was replaced by the deyun of fire, and then, in the period of the Emperor Xuanzong (唐玄宗), there was a discussion to change the deyun to metal. The idea of legitimacy based on Wuxing Theory changed many times in the Tang Dynasty and began to decrease. According to Chen Yinque, the political and social systems of the Tang Dynasty,

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[6] *Tong dian*: "北齊木德, 正朔服色, 皆如後魏." Du you, *Tong dian*, vol.55, p. 1546.
[7] *Wei shu*: "遷鄴之始，起部郎中辛術奏曰：今皇居徙御，百度創始，營構一興，必宜中制. 上則憲章前代, 下則模寫洛京." Wei shou, *Wei shu*, vol.84, p. 1862.
[8] *Zizhi tongjian:* "（梁武帝大同元年二月壬午）東魏使尚書右僕射高隆之發十萬夫撤洛陽宮殿，運其材入鄴. " Sima guang, *Zizhi tongjian*, vol.157, p. 4864.

however, were still basicly inherited from the systems of the Northern Wei Dynasty, which were at first followed by the Eastern Wei and Northern Qi, and then, absorbed by the Sui and Tang (Chen 2001). The system of objects in the Tang Dynasty should also follow the traditions of the Northern Wei Dynasty.

After the Tang Dynasty, however, the concept of legitimate regime changed from “deyun” to “unity” gradually, and the Wuxing Theory was no longer the core of legitimacy. When the concept of legitimacy altered completely in the Song Dynasty, the material culture, such as the style of roof tiles, also changed largely.

2. Legitimacy and the Acceptance of Buddhism

According to the *Shilao zhi* in *Wei shu*, the Xianbei clan did not come across Buddhism until the periods of Emperor Shenyuan (神元帝), Emperor Wen (文帝) and Emperor Zhaocheng (昭成帝). Emperor Daowu expanded the boundary of Northern Wei to the Northern China Plain and began to have contact with Buddhists frequently. Emperor Daowu gave the order to build the first Buddhist temple in Pingcheng in 398 AD. The attitude of Emperor Taiwu (太武帝) toward Buddhism can be separated into two periods. He believed in Buddhism in the earlier period and forced many Buddhists to emigrate to Pingcheng after he conquered Liang Province (涼州). In the later period, however, he converted to Taoism and gave the order to persecute Buddhists. Although many Buddhist temples and sculptures were destroyed during this period, the Buddhist Persecution ended after the enthronement of Emperor Wencheng (文成帝). Emperor Wencheng was a devout Buddhist who gave orders to build the Yungang Grottoes (雲崗石窟). The construction of Buddhist temples was still conducted frequently during the period of Emperor Xianwen（獻文帝) and Emperor Xiaowen. According to historical records, more than 100

temples were built in Pingcheng, and 6,578 temples were built around Northern Wei before 477 AD.

Emperor Xiaowen was a devout Buddhist, but he was also a sagacious ruler. After moving the capital city of Northern Wei to Luoyang, he gave the order to control the construction of Buddhist temples. Subsequently, all Buddhist temples had to be built outside Luoyang City, except for one temple that was built for monks in the Inner City and one temple for nuns in the Outer City. His orders, however, were not followed completely. The emperor that proceeded him, Emperor Xuanwu (宣武帝), built the Longmen Grottoes (龍門石窟), and then Emperor Xiaoming (孝明帝) built the YBT next to Taishe (太社) in the Inner City. As a result, according to King Rencheng (任城王), there were more than 500 temples in Luoyang City in 518 AD.

After the division of the Northern Wei Dynasty, the Eastern Wei Dynasty moved their capital city to Yecheng. Although the rulers wanted to control Buddhism at the beginning of the new dynasty and forbade the construction of new temples, the emperors in the later periods broke these rules completely. They built new temples and donated their palaces and pavilions to religious monks. At the end of the Northern Qi Dynasty, there were approximately 30,000 temples and 2,000,000 monks within the boundary of the dynasty. The Buddhism of the Western Wei and Northern Zhou Dynasties was not as prosperous as it was in the east, but the rulers, Yuwen Tai (宇文泰) and Yuwen Hu (宇文護) believed in Buddhism and built many temples in Chang'an. The Buddhism of the Northern Dynasties peaked and then began to decrease. Emperor Wu of the Northern Zhou Dynasty（北周武帝) began another Buddhist Persecution in 574 AD, and after he conquered the Northern Qi Dynasty, the temples to the east of Taihang Mountain (太行山脈) were also destroyed.

Emperor Wen of the Sui Dynasty (隋文帝) had a profound belief in Buddhism, and so he rebuilt the old temples that were destroyed in the Northern Zhou Dynasty and then built a series of new temples. His son, Emperor Yang (隋煬帝), was initiated into monkhood and financed the translation of Buddhist literature and the construction of many temples. Subsequently, at the end of the Sui Dynasty, there were 3,985 temples. In the Tang Dynasty, Buddhism was still prosperous, but the influence of Taoism also increased. In the period of the Early Tang, the development of Buddhism was controlled by the government. For example, a registration system of temples was created, and all temples had to apply for a permit before the construction process began. In the period of the High Tang, the power of Buddhism increased, especially during the time of Emperor Wu Zetian. She supported Buddhism because of the Buddhist literature, *Dayun jing*, which had proclaimed that Wu Zetian was the reincarnation of the Maitreya Buddha and should rule China. After the An-Shi Rebellion (安史之乱), Esoteric Buddhism and Chan Buddhism became more prosperous, and many temples, including the Wenshu Pavilion and the Jinge Temple (金閣寺) in Mount Wutai (五台山), were built or rebuilt at that time. The development of Buddhism, especially the economy of Buddhist temples, however, collided with the interests of the country, so Buddhist persecution by Emperor Wuzong (唐武宗) began in 842 AD. Apart from four important royal temples, all of the temples in Chang'an were destroyed. The persecution ended after the enthronement of Emperor Xunazong (唐宣宗) in 846 AD, but the power of Buddhism, as well as its temples and art, did not recover again in the Late Tang period.

Most of the rulers of the Northern and Sui-Tang Dynasties saw Buddhism as a useful tool to control their country. They financed the construction of Buddhist temples, encouraged the translation of Buddhist literature, and admired eminent monks, but when the power of Buddhism

extended too far, they changed and controlled or persecuted Buddhism. In a country with a diversified culture, Buddhism, which was believed by both nomadic people and the Han, was a religious bond, and subsequently, the rulers of the Northern and Sui-Tang Dynasties emphasized the legitimacy of their power by sponsoring and controlling Buddhism.

3. The Establishment of Legitimacy in the Northern and Sui-Tang Dynasties

The rulers of the Northern and Sui-Tang Dynasties were the descendants of nomadic people, who once settled in the northern steppe. It became very important to prove the legitimacy of their power when they began to rule the area settled by the Han. They chose two different methods to legitimize their rule: Wuxing Theory from Confucianism and Buddhism. Emperor Xiaowen was fundamental to this process. He moved the capital city of the Northern Wei to Luoyang and gave the order to follow the customs of the Han. The deyun of the Northern Wei changed into the element water during his ruling period, and the features of the element water, for example, its black color, influenced the system of objects in the Northern Wei Dynasty. Meanwhile, most of the rulers also chose Buddhism as the tool to govern the country, because it was believed by both the Han and Xianbei People. However, the system of Buddhism was controlled by the rulers. They sponsored the construction of Buddhism, including numerous temples and sculptures, but when the power of Buddhism became excessive, they began to restrain it. The policy of "State Buddhism"[9] that used methods of both support and control was created in the Northern Wei Dynasty and was then developed into a system to consolidate the rule of nomadic regimes in medieval China.

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[9] Kenneth K.S. Chen treated Buddhism in the Northern Dynasties as "State Buddhism," and the Buddhism in the Southern Dynasties as "Gentry *Buddhism*" (1972).

PART II. Roof Tiles and the Construction of Royal Buddhist Temples in Pingcheng and Luoyang during the Northern Wei Dynasty

CHAPTER 1. Buddhist Temples in the Northern Wei Dynasty

1. The Capital Cities of Northern Wei and Buddhism

Pingcheng is north of present-day Datong (大同), the capital city of Shanxi (山西) province. Pingcheng was constructed in the Han Dynasty, as a county seat. Emperor Daowu of the Northern Wei, however, moved the capital city from Shengle (盛楽) to Pingcheng in 398 AD, and Pingcheng became a large city with millions of residents after the domination of its six emperors. In 494 AD, Emperor Xiaowen moved the government of Northern Wei to Luoyang and ended the 97 years-history of Pingcheng as a capital city.

Luoyang of the Northern Wei is located in the east of present-day Luoyang in Hebei（河北）Province and was the capital city of several dynasties. Comparing to other cities, the history of Luoyang as the capital city of Northern Wei is shorter. Following the disintegration of the Northern Wei, Emperor Xiaojing (孝静帝) of the East Wei moved the capital city to Yecheng in 534 AD, while the rulers of West Wei chose Chang'an as their new capital. Over 40 years, Luoyang was reconstructed and expanded repeatedly, with its total area increasing to 100 square kilometers.

Buddhism in these two capital cities during the Northern Wei dynasty developed rapidly. According to historical records, the first emperor, Daowu, believed in Buddhism and built the first Buddhist temple in Pingcheng in 398 AD.[10] He also appointed Sramana Faguo (法果) as the leader of the Buddhist mission and developed a system to control Buddhism. The positive religious policies of Buddhism ended after the enthronement of Emperor Taiwu, who was a Taoist. He launched the Buddhist Persecutions in 446 AD and gave orders to destroy all of the temples in the country. The Buddhist Persecutions, however, were ended by Emperor Wencheng who took the throne in 452 AD. Emperor Wencheng and all of the emperors after him were devout Buddhists. They built Buddhist temples, especially cave temples and encouraged monks to translate Buddhist Scriptures. After the capital city moved to Luoyang, although the government issued many decrees to control the religion, Buddhism became more prosperous. For example, Emperor Xiaowen gave an order that only one temple for monks and one temple for nuns could be built within Luoyang City.[11] The construction of Buddhist architecture was so prevailing in Luoyang at that time that even the government could not prevent it. According to historical records, at the end of the Northern Wei, especially after the Slaughter in Heyin (河陰之変), nearly all of the residences in Luoyang had become Buddhist temples.[12] Overall, from Pingcheng to Luoyang, the rulers of Northern Wei used Buddhism to control people, and meanwhile, Buddhists drew support from the rulers to extend their sphere of influence. As a result, the concept of State Buddhism formed during this time.

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[10] *Wei shu*: "（天興元年）始作五級佛圖，耆閣崛山及須彌山殿，加以繢飾．別構講堂，禪堂及沙門座，莫不嚴具焉." Wei shou, *Wei shu,* vol. 114, p. 3030.
[11] *Wei shu*: "（神龜元年冬）司空公，尚書令，任城王乘奏曰：……故都城制云，城內唯擬永寧寺地，郭內唯擬尼寺一所，餘悉城郭之外." Wei shou, *Wei shu,* vol. 114, p. 3044.
[12] *Wei shu*: "未幾，天下喪亂，加之河陰之酷，朝士死者，其家多捨居宅，以施僧尼，京邑第舍，略為寺矣." Wei shou, *Wei shu,* vol. 114, p. 3047.

2. Buddhist Temples in Pingcheng

Yungang Grottoes. Emperor Wencheng began the construction of the Yungang Grottoes in 460 AD, and the construction was completed in 524 AD. The grottoes include approximately 45 caves and 252 niches. There are two sites of Buddhist temples on the top of the Yungang Grottoes, and in 2010, the temple site within the west zone was excavated by the Yungang Joint Archaeological Team. It consists of a pagoda base, 20 house bases, and two kiln sites (Yungang shiku yanjiuyuan 2016). The excavation of the temple site within the east zone was conducted in 2011. Archaeologists found a pagoda base and a casting workshop site (Zhang, Jiang 2012). Numerous remains of building materials, including roof tiles, were unearthed at these two sites.

Siyuan Buddhsit Temple. The Siyuan Buddhist Temple, which was built in 479 AD by Emperor Xiaowen, is in the north of present-day Datong. This temple, consisting of a tower, a main hall, several monks' rooms, and four gates was built on a huge mound. The Buddhist tower is in the middle of the temple, with the main hall to the north. Around the tower and main hall, many remains of building materials of the Northern Wei Dynasty were found. The monk's rooms were in the northwestern part of the temple, with a remaining fireplace (Datongshi bowuguan 2007).

Only the Yungang Grottoes and Siyuan Buddhist Temple have been excavated, but according to the *Shilaozhi* of *Wei shu*, there were more than one hundred temples and over 2,000 monks in Pingcheng before the relocation of the capital city.[13] The Buddhist temples recorded in historical books include Yongning Buddhist Temple (Pingcheng), built-in 399 AD; Tiangong Buddhist

[13] *Wei shu*: "（承明元年八月）高祖於永寧寺，設太法供……. 自興光至此，京城内寺新舊且百所，僧尼二千餘人." Wei shou, *Wei shu,* vol. 114, p. 3039.

Temple (天宮寺), which included a Buddhist statue; and Luye Buddhist Temple (鹿野寺), built by Emperor Xianwen.

3. Buddhist Temples in Luoyang

YBT was built in 516 AD by Empress Dowager Ling (靈太后), who was Emperor Xiaoming (孝明帝)'s mother and a devout Buddhist, but it was destroyed by fire in 534 AD. The archaeological prospection of YBT began in the 1960s and clarified the basic structure of this temple. According to the results, YBT consisted of a tower, which was in the middle of the temple, the main hall, located to the north of the tower, and a wall, which surrounded the temple. The excavation from 1979 to 1981 provided more information about these buildings, and archaeologists found that the foundation of the tower was a square with 38-meter long sides above the ground. Many remains, including building materials and Buddhist statues, were unearthed from this area, and there were gates in all directions. The southern gate was the main gate, and it was square-shaped, 45.5 meters long from east to west, and 19.1 meters wide from north to south. Meanwhile, the foundation in the West gate looks like the Chinese character "凸," and it was 18.2 meters wide from east to west, and 24–30 meters long from north to south. Other gates and the main hall were destroyed so heavily that archaeologists have not been able to clarify their basic structure, but there were still some remains found in these areas. (Zhongguo shehui kexue yuan kaogu yanjiusuo 1996)

According to the book, *Luoyangqielanji*, more than 1,000 temples were built in Luoyang during the Northern Wei Dynasty,[14] including royal Buddhist temples, as well as small temples made by ordinary citizens. Originally, most of the temples were built on a huge scale under the order of

[14] *Luoyang qielanji*: "京城表裏，凡有一千餘寺，今日寥廓，鐘聲罕聞." Yang xuanzhi, with commentaries assembled by Zhou zumo, *Luoyang qielanji jiaoshi,* p. 25.

the emperors. In the last period of the Northern Wei, however, people began to donate their dwellings to make private temples. At the end of the Northern Wei Dynasty, temples in different sizes were scattered all around Luoyang. Today, there are many places in Luoyang where Buddhist statues were found in the past. There may have also been Buddhist temples in the Northern Wei, but only the YBT has been excavated.

4. The Research Objects of this Dissertation

Roof tiles unearthed from the royal Buddhist temples of the North and Sui-Tang Dynasties were chosen as the research objects of this dissertation. There are a large number of temples in Pingcheng and Luoyang, but only a few have been excavated. The remains of the roof tiles from the YBT and the YBTWZ was arranged systematically in 2017 and 2018. Therefore, this part will focus on the roof tiles used in these two temples to clarify the production and utilization of the roof tiles, as well as the construction system of royal Buddhist temples in the Northern Wei Dynasty. Roof tiles from other contemporaneous archaeological sites will be discussed synoptically at the end of this part.

CHAPTER 2. Roof Tiles and the Construction of the Yungang Buddhist Temple in the West Zone

Section 1. Site of the Yungang Buddhist Temple and its Roof Tiles

1. Yungang Buddhist Temple in the West Zone

The Yungang Grottoes are in Yungang County in the southwestern suburban area of modern Datong. The YBTWZ was built on the top of Cave No. 35 and Cave No. 39 in the western zone of the grottoes. The construction of Yungang Grottoes dates back to 460 AD in the Northern Wei Dynasty when Monk Tanyao (曇曜) advised Emperor Wencheng to build the grottoes on the cliff of Wuzhou Mountain (武周山). After Emperor Xiaowen moved his capital to Luoyang, the construction of Yungang Grottoes on a large scale was almost halted, but small niches were still developed by the aristocracy, governmental officials, and ordinary citizens who remained in Pingcheng and this continued until 524 AD when the Northern Wei Dynasty ended.

The archaeological excavation of the YBTWZ provided more information about the temples on top of the grottoes. This was conducted in 2010 by the Yungang Joint Archaeological Team. Researchers located a Buddhist temple site from the Northern Wei Dynasty, room sites from the Liao-Jin Dynasties, and several pits from the Ming-Qing Dynasties. The Buddhist temple from the Northern Wei Dynasty included a pagoda, 20 rooms, and two kilns (Figure 3). The foundation of the pagoda is a square, measuring around 14.5 meters on each side, with 40 pillar holes on its surface and steps in the middle of the southern side, and it is located in the southeast part of the site, facing the south. The rooms can be divided into four parts. The northern part consists of 13

rooms, some of which were divided into several areas. Three rooms were found on the east side of the site, while two rooms are in the middle and two rooms in the west were excavated. The kilns, found in the southwestern part of the site, were deduced to be the source of the roof tiles and bricks used in the construction of the temple. Four layers of stratified deposits were found at this site, and the remains of the building materials of the Northern Wei Dynasty were found in the fourth layer.

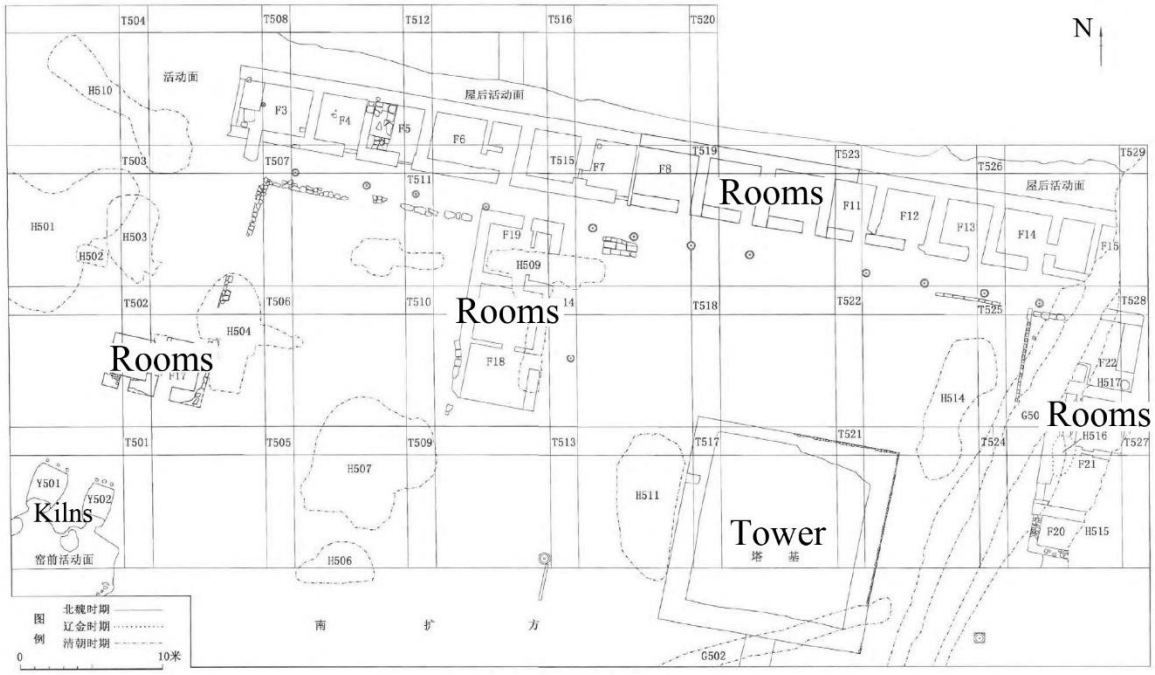

Figure 3 The layout of the YBTWZ
(Source: Yungang shiku yanjiuyuan 2016, Fig. 3)

2. Information about the Roof Tiles

A large number of the roof tiles were unearthed from the YBTWZ. According to the archaeological report, nearly 100,000 tegula fragments (flat roof tile, 平瓦) and 80,000 imbrex fragments (semi-cylindrical roof tile, 丸瓦) were found, but only a few of these remains were collected, including 554 tegulae, 236 imbrices, and 374 tile-ends, which are unbroken samples

(Yungang shiku yanjiuyuan 2016). These roof tiles were arranged in June and July 2018, and some of the typical remains, including 139 tegulae, 189 imbrices, and 121 tile-ends, were recorded systematically.

2.1 The Clay Bodies of the Roof Tiles

The clay bodies of the roof tiles unearthed from this site were mainly two colors, blue-gray and reddish-brown, which are related to two different types of roof tiles. The bodies are impure, with many impurities such as small sand particles, which indicates that the clay to make these products was not washed carefully (Figure 4). Moreover, the shaping and firing of these tiles were also of poor quality, resulting in deformations that appeared on many of the roof tiles.

Figure 4 The clay body of a tile-end with impurities (Source: Photo by the author)

2.2 The Exposed Surfaces of Roof Tiles

The exposed surface are the concave surfaces of the tegulae and convex surfaces of the imbrices, which were laid upward when the roof tiles were installed on the roof. The imbrices used in this site have two different types of surface styles: simply-trimmed surfaces (無文) and polished-black

surfaces (黑色磨研). The tegulae have three types of surface styles: untrimmed surfaces (布目), polished-black surfaces, and glazed surfaces. Most of the tile-ends from this site have simply-trimmed surfaces, which indicates that the tile-ends were mostly joined to the imbrices with the simply-trimmed surfaces (Figure 5).

Figure 5 The surface styles of roof tiles (Source: Photos by the author)

1. Polished-black imbrex; 2. Polished-black tegula; 3. Glazed tegula; 4. Simply-trimmed imbrex; 5. Untrimmed tegula; 6. Tile-ends with inscription or lotus pattern

2.3 The Size of the Roof Tiles

Due to the deformation of the roof tiles, the diameter of the imbrices was harder to measure. After the trimming step, the lower ends of the imbrices are usually pulled more than previously, which

the artisans may have believed would make it easier to connect to another imbrex during the installation process. However, the upper end of the imbrices, which was less affected, can provide data for the imbrices' diameter. The analysis in this section were based on the data from the upper end of 49 imbrices.

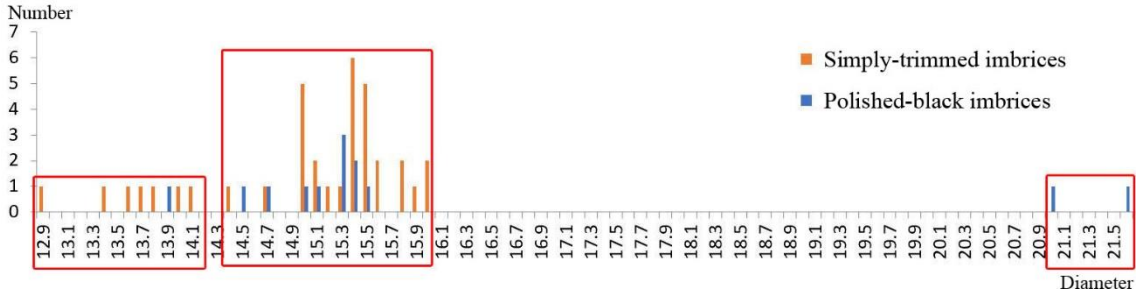

Figure 6 The diameter of the imbrices (Source: Made by the author)

According to Figure 6, the imbrices unearthed from the YBTWZ can be divided into three groups by diameter: 1. 13.5±0.5cm, 2. 15±1cm, and 3. 21cm. The accurate rate of the different types of the imbrices cannot be calculated, because the data were not from whole remains, but size 2 may have been the main group for both the simply-trimmed imbrices and polished-black imbrices. In size 1, most of the samples were the simply-trimmed type. Size 3 has only two samples, and both of them were the polished-black type. These two samples, however, were produced without tile-lips, which made them different from the others in shape, so they may not have been used as general imbrices. Overall, the diameters of the imbrices found in the YBTWZ are mainly around 15±1cm, while a few of the simply-trimmed samples are smaller than the others.

There were 47 samples of the imbrices whose length was measurable, and by analyzing the scatter diagram of the imbrices' length, two clusters were found. One cluster included imbrices with a

diameter in size 1, whose length ranges from 40cm to 44cm. The other imbrices are in size 2 in diameter, with a length ranging from 44cm to 47cm. Some samples were not within these two clusters demonstrating that the production of the roof tiles used in this temple was not strictly standardized (Figure 7).

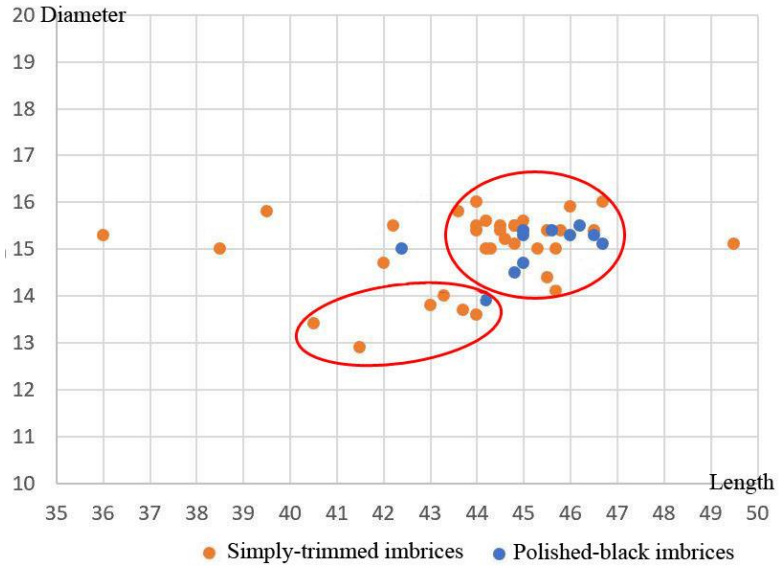

Figure 7 The length and diameter of the imbrices (Source: Made by the author)

Most of the unbroken tile-ends unearthed from this site are decorated with the inscription "傳祚無窮" (108 samples), which states that the throne of the royal family will last forever, and only a few unbroken samples are decorated with a lotus pattern (2 samples) or lotus-Buddha pattern (1 sample). The diameters of the tile-ends with inscriptions are between 14.2cm and 15.8cm, which are similar to the diameter of the imbrices in size 2. Tile-ends with lotus patterns and lotus-Buddha patterns are mostly smaller than the former, which may have been joined to the imbrices in size 1 (Figure 8).

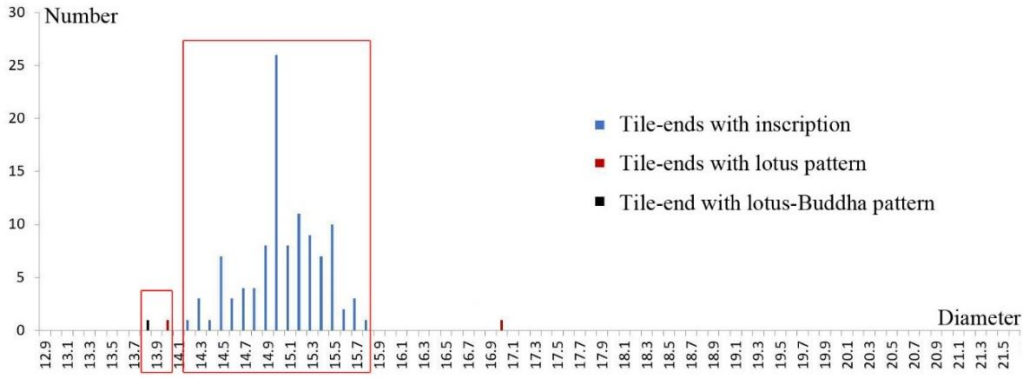

Figure 8 The diameter of the tile-ends (Source: Made by the author)

There were 22 samples of the tegulae whose length or width were measurable (Table 5). The sizes of the polished-black tegulae and glazed tegulae from this site are similar, which are approximately 30*50cm^2, but the data of untrimmed tegulae may belong to several groups because the differences between the minimum and maximum of sizes are around 10cm. According to the sizes of simply-trimmed imbrices, the sizes of untrimmed tegulae may also be divided into two groups. In addition, the widths of the ridge tiles are smaller, which is usually one third or half of the general tegulae.

Table 5 The sizes of the tegulae

	Length (cm)	Width of upper end (cm)	Width of lower end (cm)	Thickness (cm)
Polished-black tegulae	47.6–50.8	27.5–30.5	29.5–32.4	1.1–2.05
Glazed tegulae	45.5–46	23.5–25.5	29.5–32	1.1–1.7
Untrimmed tegulae	43–52.5	22.5–31.4	26.5–35.8	1.2–2.15
Ridge tiles	34.7 (fragment)	9.5–10		

2.4 The Patterns of the Roof Tiles

2.4.1 The Pattern of the Tegulae

The lower end of the tegulae, including the untrimmed type, polished-black type, and glazed type,

are mostly decorated with a simple finger-pinched pattern (Figure 9). This type of pattern was made using finger pressure, pressed onto the convex side of the lower end.

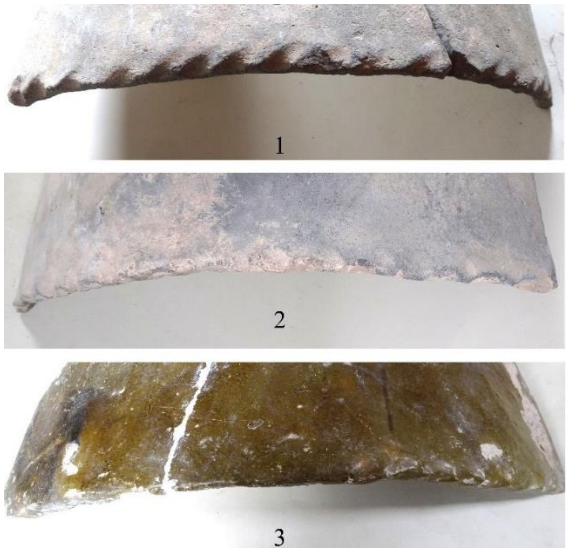

Figure 9 The finger-pinched pattern on the lower end of the tegula (Source: Photos by the author) 1. Untrimmed tegula; 2. Polished-black tegula; 3. Glazed tegula

2.4.2 The Pattern of the Tile-Ends

Most of the tile-ends unearthed from the YBTWZ are samples decorated with inscriptions. The front surface of these tile-ends is divided into nine parts by two raised horizontal lines and two raised vertical lines. A big circular knob is in the central part, with four traditional Chinese characters, "傳祚無窮," and four small circular knobs alternatively distributed around it. Moreover, the edges of the tile-ends are simply-trimmed.

There are also a few tile-ends decorated with lotus patterns and lotus-Buddha patterns (Figure 10). Lotus pattern A consists of one big circular knob, surrounded by beads, which is the symbol of the lotus seedpod, and a circle of compound lotus petals. Each compound lotus petal is surrounded by a raised line, whose end is convex, and has two small semi-petals, separated by a raised line. In addition to the lotus petals, there are also small inter-petals. Lotus pattern B consists of a central

circular knob and compound lotus petals. The petals are also surrounded by raised lines, but the two small semi-petals in the compound petal are not separated. There is no inter-petal in this style. Lotus pattern C consists of a central circular knob and compound lotus petals. The small semi-petals in the compound petal are large and they are not separated, and the inter-petals in this style look like buds. Lotus pattern D is similar to pattern A, but its outer area is decorated with raised lines and beads. Moreover, there is only one type of lotus-Buddha pattern, which consists of a central Buddha and 11 compound lotus petals with convex ends. The small semi-petals in each compound lotus petal are separated and surrounded by raised lines. The inter-petals of this style are inverted triangles in shape.

Figure 10 The pattern of the tile-ends (Source: Photos by the author)

2.5 The Classification of the Roof Tiles

The basic classification of the roof tiles unearthed from the YBTWZ is described below (Figure 11; Figure 12).

First, the imbrex and tegula were distinguished from fragments, and both imbrices and tegulae were subdivided by their lower ends. The imbrices with tile-ends were used for eaves, and samples without tile-ends were general roof tiles for the slope of the roof. The decoration of the lower ends of the tegulae is simple, with only the finger-pinched pattern on the end so that the eave-used tegulae and general tegulae cannot be separated from each other. The narrow untrimmed tegulae were used as ridge tiles.

Second, the exposed surfaces of the tegulae have three styles: untrimmed surfaces, polished-black surfaces, and glazed surfaces. The imbrices only have two styles: simply-trimmed surfaces and polished-black surfaces. In addition, most of the tile-ends have simply-trimmed surfaces.

Third, the roof tiles were also classified by size. The sizes of the polished-black tegulae and glazed tegulae are similar, which are approximately 30*50cm^2. The data of untrimmed tegulae may belong to several groups, but it is difficult to separate the limited samples. Meanwhile, the imbrices were divided into three groups. The samples with 15±1cm diameters were the main building materials of the imbrices in this temple, which have two styles of useable surfaces. The imbrices with 13.5±0.5cm diameters are mostly the simply-trimmed style. Moreover, the tile-ends with inscriptions were matched to the imbrices with 15±1cm diameters, while the tile-ends with lotus patterns and lotus-Buddha patterns were matched to the smaller imbrices.

Lastly, the roof tiles' patterns were subdivided. The tile-ends of the imbrices have several patterns, including one inscription style, four lotus styles, and one lotus-Buddha style. Meanwhile, the lower ends of the tegulae only have a simple finger-pinched pattern.

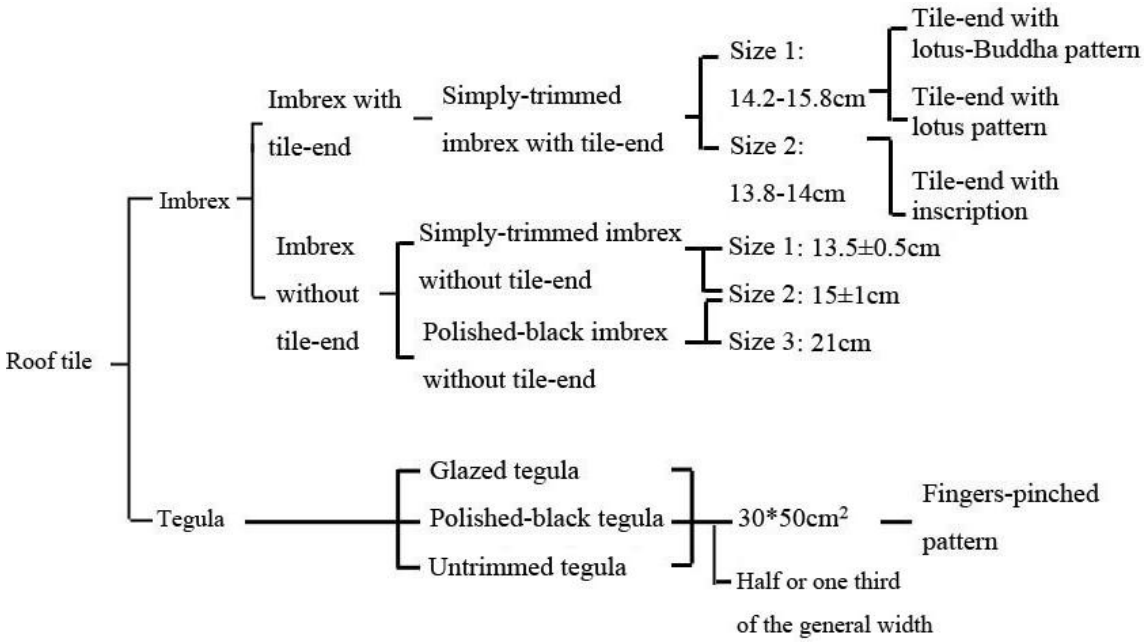

Figure 11 The classification of the roof tiles from the Yungang Buddhist Temple in the West Zone

(Source: Made by the author)

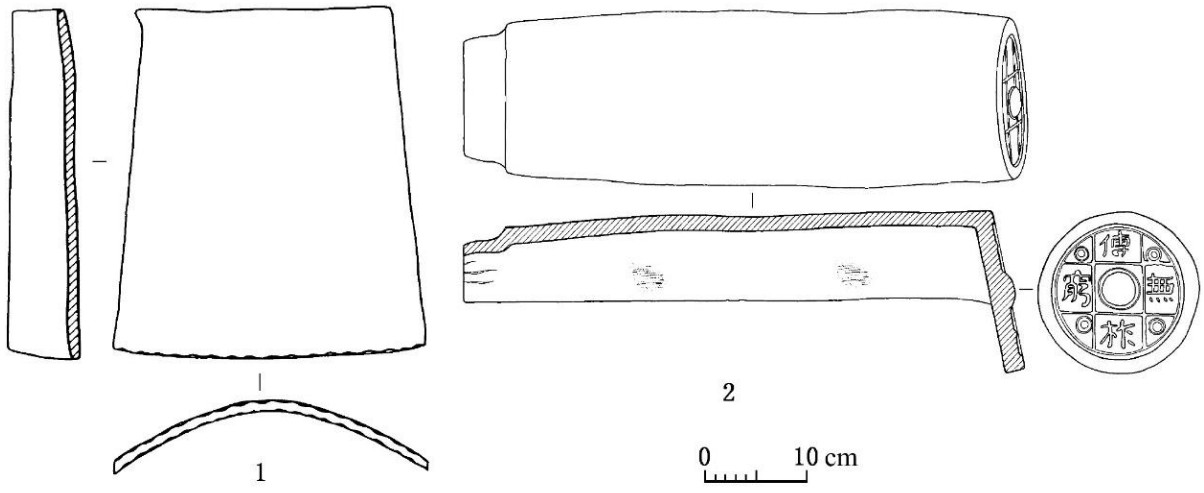

Figure 12 The plan and cross-section of the roof tiles

(Source: Yungang shiku yanjiuyuan 2016, Fig. 17)

Section 2. Traces Left in Production and the Production Process of Roof Tile

1. Traces and Production Processes

1.1 Pre-Processing of Raw Materials

The gathering and pre-production of clay is the start of the production process for roof tiles. As mentioned in the previous section, the clay used to make the roof tiles unearthed from the YBTWZ is impure and mixed with sand particles. The texture of the clay is similar to the soil around the Yungang Grottoes, and subsequently, the raw material for the roof tiles might have been collected locally and used without careful elutriation.

1.2 Shaping of the Roof Tiles' Clay Bodies

The fabric impressions on the concave surfaces of the tegulae were created during the shaping step of the production process. Most of the samples from the YBTWZ have these impressions, even in some corners of the polished-black tegulae or glazed tegulae. Vertical impressions of the wooden strips and joint lines of clay-strips can also be found on the concave surfaces. The traces mentioned above illustrate that the tegula mold was like a barrel, wrapped with a cloth cover, and the clay-strips were twined around the mold, which formed the body of a tegula (Figure 13).

The shape of the imbrices is like a cylinder with a narrow upper end. Fabric impressions were also left on the concave surfaces of the imbrices, and these types of traces extend to the concave surfaces of the tile lips, indicating that the mold used was in the shape of a bottle, and the upper end of the mold was also wrapped with a cloth cover. There was no vertical impression of the wooden strips on the concave surfaces of the imbrices, implying that the bottle-shaped mold of the imbrices might have been integral. As the joint line of the clay-strips can be observed on the

concave surfaces, it is clear that the imbrices were also made of clay-strips (Figure 14).

The fabric impressions left on the concave surfaces of the roof tiles were made by the cloth cover twining around the mold, which was used to avoid the adhesion between the tile bodies and the molds. This technique of cloth cover emerged in the West Han (西汉) Dynasty and was still used during the Northern Dynasties. The traces of the cloth cover's seam can also be found on the concave surfaces of the imbrices, as well as on the traces of the cloth cover's creases.

Figure 13 Vertical impression of the wooden strips and joint line of clay-strips on the concave surface of a tegula (Source: Photo by the author)

Figure 14 Joint line of clay-strips and traces of the cloth cover's seam on the concave surface of an imbrex (Source: Photo by the author)

Among the roof tiles, the convex surfaces of some samples retain traces left from the shaping step, which are mostly impressions of thick ropes (Figure 15). These traces illustrate that the convex surfaces of the roof tiles were shaped with a tool, which may have been a pottery paddle wrapped with thick ropes. Most of these traces were erased during the surface-trimming step, and only a few traces were left accidentally.

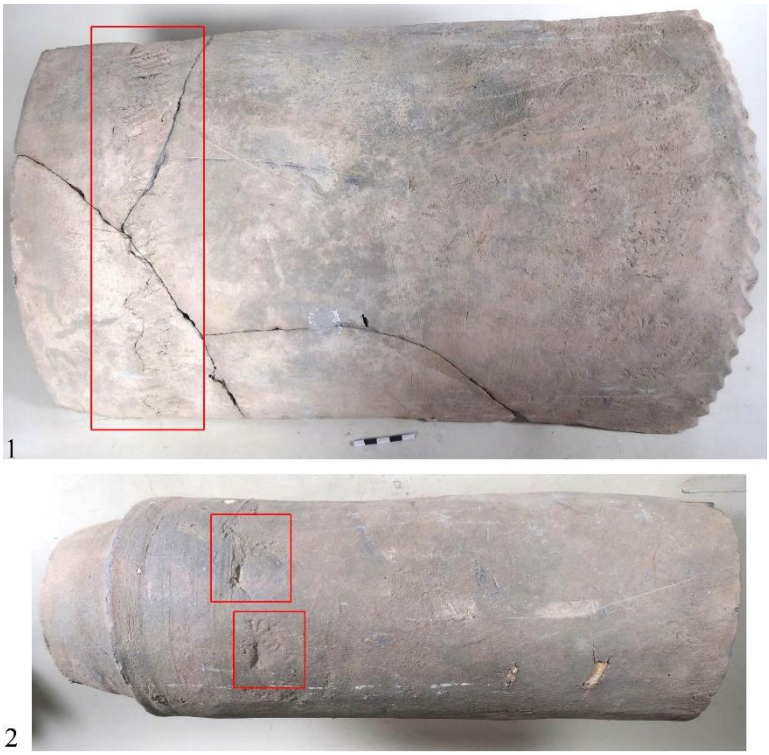

Figure 15 The pottery paddle traces on the convex surface of roof tiles (Source: Photos by the author) 1. Tegula; 2. Imbrex

1.3 The Trimming Step

After the bodies of the roof tiles were formed, the convex surfaces of the bodies were still very rough, with many traces left, and these need to be erased during the trimming step. The trimming method of the tegulae convex surfaces was most likely the scraping treatment, with the upper end

smoothed using a finger. The tools for the scraping treatment could have been plates, 2–6cm wide. The imbrices were also scraped to erase the traces left in the shaping step, and on the convex surface of some samples, slight parallel scratches can be found. The surfaces of some types of roof tiles had been specifically processed, such as the glazed roof tiles and polished-black roof tiles, so the initial trimming traces were not retained, but the trimming method used would be similar to the method mentioned above.

1.4 Decoration of the Lower End of the Tegulae

The lower ends of the tegulae unearthed from the YBTWZ were decorated with finger-pinched patterns. These obvious, neat patterns were made on the convex side of the lower end by finger pressure. All of the roof tiles, including the glazed type, polished-black type, and untrimmed type were decorated with the same patterns, so the eave tiles could not be separated from the general roof tiles by the decorations on their lower ends.

1.5 Treatment for Edges

The clay bodies of the roof tiles from this site were cut from the inside so that the incisions were on the concave side of their edges. The body of a tegula was divided into four pieces, and the body of an imbrex was divided into two pieces. The edges of most of the roof tiles were not trimmed, and the incisions and fracture surfaces had been retained. Only the edges of the glazed tegulae were processed carefully: the surfaces of the edges were scraped, and the ridgelines on the concave side of edges were cut off (Figure 16).

Figure 16 Treatment for roof tiles' edges (Source: Photos by the author)
1. Untrimmed tegula, 2. Polished-black tegula, 3. Glazed tegula, 4. Simply-trimmed imbrex, 5. Polished-black imbrex

1.6 Traces on the Back Surfaces of the Tile-Ends

The traces on the back surface of the tile-ends with inscriptions are uniform. They are all irregular scratches, left on the half-circle of the tile-end, which was joined to the imbrex directly (Figure 17). When an imbrex and tile-end were joined to each other, the clay on the lower end of an imbrex would have been pressed into the scratches of the back surface of the tile-end, from which these two pieces can be stuck together firmly. Sometimes, the tile-end was pressed so hard by the imbrex, that the edge of the tile-end was flattened. Moreover, extra clay was placed around the joint of the tile-end and imbrex from both sides, which made the joint more secure.

Figure 17 The traces on the back surface of the tile-end with inscriptions (Source: Photos by the author) 1. The front surface of tile-end; 2. The back surface of tile-end

There are also irregular scratches on the back surface of the tile-ends with lotus patterns. For tile-ends with lotus-Buddha patterns, besides irregular scratches, a long-scribed line in the middle of the back surface can also be found. This long-scribed line is usually at a right angle to the Buddha statue on the front surface, which could be the baseline when the tile-end was joined to the imbrex (Figure 18).

Figure 18 The traces on the back surface of the tile-end with lotus-Buddha pattern and lotus pattern (Source: Photos by the author)
1. Tile-end with lotus-Buddha pattern; 2. Tile-end with lotus pattern

1.7 The Treatment for an Exposed Surface

After installation, the upward surface of a roof tile was the exposed surface, including the concave surface of the tegulae and the convex surface of the imbrices. According to the previous analysis, the tegulae have three types of exposed surfaces: untrimmed surface, polished-black surface, and glazed surface. The imbrices have two types of exposed surfaces: simply-trimmed surfaces and polished-black surfaces. The untrimmed surfaces of a tegula retained the fabric impression left in the shaping step, and the simply-trimmed surface of an imbrex was only scrapped to erase the traces left by the pottery paddle. The treatments for the polished-black surfaces and glazed surfaces were more complicated and required further analysis.

The polished-black treatment had two basic steps, blackening and polishing. The clay body of the roof tile was dyed black and polished with stick-like tools. Vertical polishing marks with a width of several millimeters can be found on the surface of polished-black roof tiles, overlapping each other.

The polished-black roof tiles unearthed from this site are relatively rough, especially the tegulae. The entire concave surfaces of the tegulae were blackened, but only the central part of the concave surface was polished. The parts near the edge or lower end retained the fabric impressions (Figure 19). These features illustrate that the technique of the polished-black treatment for the roof tiles in the YBTWZ was still at the early stages of development.

Figure 19 The polished-black treatment for tegula (Source: Photos by the author) 1. The concave surface of polished-black tegula; 2. The convex surface of polished-black tegula

A few tegulae unearthed from the site are glazed, and their bodies are reddish-brown and smoothed carefully. The glaze was yellow and only applied to the concave surfaces and edges of the tegulae. After glazing, the bodies of the tegulae could have been placed upright, with extra glaze flowing on the convex surfaces of some of the samples (Figure 20).

Figure 20 The glazing treatment for tegulae (Source: Photos by the author)
1. The concave surface of glazed tegula; 2. The convex surface of glazed tegula

2. The Technique System of the Roof Tiles

According to the analysis mentioned above, there were three technique systems used in the roof tile workshop of the YBTWZ, made up of the untrimmed/simply-trimmed group, polished-black group, and glazed group. The untrimmed/simply-trimmed group produced tegulae, imbrices, and tile-ends; the polished-black group only made tegulae and imbrices; and the glazed group only made tegulae. Therefore, the untrimmed/simply-trimmed group would have been the main group within the roof tile workshop because its products are fully functional.[15] The roof tiles from these three technique systems are all general types for this temple, and so the differences might imply a distinction in the period or ranking. The basic production process is summarized below:

1. Mold wrapped with cloth cover was used in the shaping step. The mold of a tegula consisted of several narrow wooden strips, and the mold of an imbrex may have been a bottle-shaped integral mold.
2. Clay-strips were twined around the mold to make the body of the roof tile, and the convex surface of the roof tile's body was shaped with a pottery paddle and trimmed with a plate.
3. The lower end of the tegula was decorated with a finger-pinched pattern before the clay body was divided.
4. The clay body was cut from the inside.
5. The back surface of the tile-end was processed to stick the tile-end and imbrex together firmly. The processing techniques for the back surface between the tile-ends with inscriptions and tile-ends with lotus-Buddha patterns were different.
6. Special treatment was applied to the exposed surface of some sampes. The exposed

[15] According to the archaeological report, there were 334 glazed tegulae, 20 polished-black tegulae, 200 untrimmed tegulae, 36 polished-black imbrices, and 200 simply-trimmed imbrices from this site. The glazed tegulae and polished-black roof tiles were more precious and nearly all of the remains were collected and restored. However, only a few of the untrimmed/simply-trimmed roof tiles were collected. The exact number of untrimmed/simply-trimmed roof tiles should be far more than the former two types.

surfaces of the polished-black roof tiles were polished and blackened, while the concave sides of the edges of the glazed tegulae were cut off and glazed together with the concave surface.

7. The clay bodies of the roof tiles were burnt in the kilns. The firing methods of these three technique groups might also have been different. Compared with the untrimmed/simply-trimmed roof tiles, the polished-black roof tiles were carburized during firing, and the kilns for the glazed roof tiles required a higher temperature.

Section 3. The Traces and Production Management of Roof Tiles from the Yungang Buddhist Temple in the West Zone

The roof tiles unearthed from the YBTWZ can provide a large amount of information about the production processes. This information is contained within the traces and characters on the surfaces of the roof tiles, which can be used to analyze the production techniques of the roof tiles and shed light on the details of the production management. This section will discuss the subdivision and complexity of the roof tile workshop in the YBTWZ by analyzing the traces left from production.

1. Traces on the Surfaces of the Tegulae and Imbrices

The method used to divide the artisan groups was borrowed "Dōgu no konseki (道具の痕跡)," a research method that means the traces of tools, and "Saibu chōsei kon (細部調整痕)," which means trimming traces. Both of these were mentioned in the book, *Kokubunji kawara no kenkyū*, by Kajiwara Yoshimitsu (2010). The differences in the tools could demonstrate the differences in

the artisan groups, but because there may have been more than one tool of the same kind in a group, the difference in the tool's traces should be the maximum number of artisan groups. The trimming traces indicate the different techniques used. As the same technique can be used by different artisan groups, the difference in the trimming traces represents the minimum number of artisan groups. The appearance and combination of the different types of traces could indicate the management method of the roof tile production of the workshop of the YBTWZ.

Table 6 Traces on the surface of the tegulae and imbrices

Features of the roof tiles		Shaping traces on convex surfaces	Trimming traces on convex surfaces	Shaping traces on concave surfaces (fabric impression 1cm*1cm)[16]	Trimming traces on concave surfaces	Traces on edges
Glazed tegulae		Unknown	Scraping traces	Unknown	Glazed	Glazed
Polished-black tegulae		Traces of pottery paddles	Scraping traces	9/12–13	Middle: polishing traces; sides: fabric impression	Cutting traces, fracture surfaces
Untrimmed tegulae (including ridge tiles)		Traces of pottery paddles	Scraping traces	8–9/13	Untrimmed	Cutting traces, fracture surfaces
Simply-trimmed imbrices with tile-ends	Small	Unknown	Scraping traces	11–12/11 10/9 15/12 12/13–14	Untrimmed	Cutting traces, fracture surfaces
	Middle					
Simply-trimmed imbrices without tile-ends	Small	Unknown	Scraping traces		Untrimmed	Cutting traces, fracture surfaces
	Middle					
Polished-black imbrices without tile-ends	Middle	Unknown	Polishing traces	12/11–12 14/12	Untrimmed	Cutting traces, fracture surfaces
	Large					

[16] There are 50 imbrex samples for the analysis of fabric impressions, including 14 polished-black imbrex samples and 36 simply-trimmed imbrex samples. Meanwhile, the tegula samples include two polished-black tegulae, eight simply-trimmed tegulae, and one ridge tile.

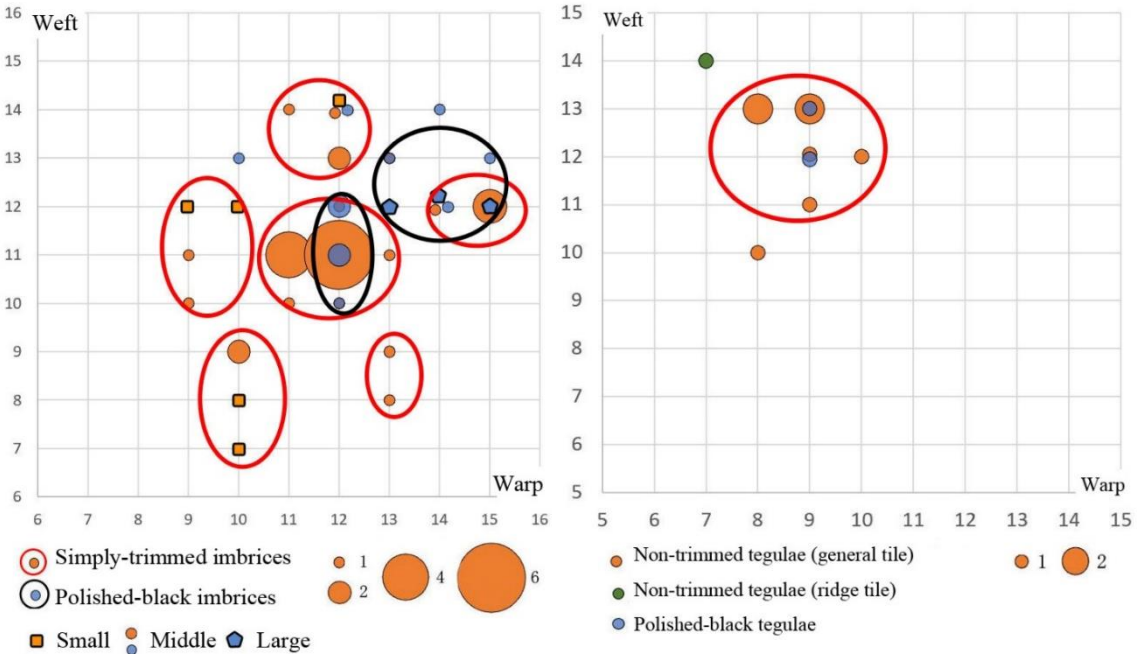

Figure 21 Fabric impressions on the concave surface of the imbrices and the tegulae (1cm*1cm) (Source: Made by the author)

The tool traces are related to the tools used in the production processes. On the concave surfaces of all of the imbrices and a part of the tegulae, fabric impressions can be found, and on the convex surfaces of some tegulae, there are traces of pottery paddles. Traces from other tools were mostly erased in the process of surface trimming (Table 6).

According to the fabric impressions, there was more than one type of cloth cover used in the production (Figure 21). The simply-trimmed imbrices in the middle size group have six types of cloth covers, and the number of warps and wefts of these cloth covers is as follows: 1. 11–13/10–12, 2. 10/7–9, 3. 13/8–9, 4. 14–15/12, 5. 11–12/13–14, and 6. 9–10/11–12. Cloth cover 1 was mostly used. The simply-trimmed imbrices in the small size group were made by cloth cover 2, cloth cover 5, and cloth cover 6, most of which have fewer warps than wefts. The cloth covers of polished-black imbrices in the middle-sized group were made by cloth cover 1 and cloth cover 4,

and only cloth cover 4 was used to make polished-black imbrices in the large-sized group. Imbrices of the same type and the same size were made by different types of cloth covers, which implies two possibilities. First, different types of cloth cover belonged to different artisan groups, which can then indicate the maximum number of artisan groups. Second, the production of the roof tiles lasted for a long time, and the tools used in one production group were worn down and replaced. However, the tegulae of this temple seem to be made by the same type of cloth cover.

The trimming traces are related to the production method of the roof tiles. Among the untrimmed roof tiles, polished-black roof tiles, and glazed roof tiles, not only the method of trimming but also the technique for firing the kilns was different. The distinction in the technique system means that there were different artisans, and this indicates the minimum number of artisan groups. Therefore, there might have been 2–8 artisan groups that made the imbrices and three artisan groups that made the tegulae in the workshop.

2. Traces on the Surface of the Tile-Ends

2.1 The Molds of the Tile-Ends with Inscriptions

Most of the tile-ends unearthed from this temple were decorated with inscriptions “傳祚無窮,” and the handwriting of these characters among the different tile-ends is almost the same. Moreover, there are obvious traces left by the cracks on the molds near the character “祚,” and all of the samples unearthed from this site have mold traces in the same place. This means that all of the tile-ends were made using the same mold. In addition, the traces of several vertical lines can be seen on the front surface of the tile-ends, especially in the area near the characters “傳” and “窮.” The traces may have been the texture of a wooden mold, which became more obvious, demonstrating that the mold was worn down over time. The tile-ends with the traces of vertical

lines were also found in the site of the Xicetian Kiln, and researchers speculated that they were made using a wooden mold (Mukai 2014). The products from the Xicetian Kiln were used in the royal palaces in Pingcheng.

2.2 The Development Process of the Tile-End Mold Traces

During the production process, the mold of the tile-ends was worn down, and more mold traces appeared on the front surfaces of the tile-ends. As all of the tile-ends unearthed were made using the same mold, the production sequence of the tile-ends can be deduced from the developing process of the mold traces. There are three steps in the developing process of the mold traces (Figure 22).

In the first step, a mold trace appeared next to the small circular knob near the character "祚." In the second step, besides the mold trace next to the small circular knob near the character "祚," mold traces appeared at the bottom of the raised vertical line near the character "祚." In the third step, all of the mold traces are large and very apparent.

Figure 22 The developing process of the tile-ends' mold traces (Source: Photos by the author) 1. Mold trace in the first step; 2. Mold traces in the second step; 3. Mold traces in the third step

2.3 Traces on the Front Surface of the Tile-Ends with Lotus Patterns

A few samples unearthed at the YBTWZ are tile-ends with lotus patterns and lotus-Buddha patterns, which usually have a smooth front surface without any mold traces. Moreover, ceramic molds for the tile-ends with lotus-Buddha patterns or monsters pattern were found in Pingcheng, which means that the technique to make tile-ends with lotus patterns, lotus-Buddha patterns, and monster patterns may have been different from the technique to make tile-ends with inscriptions.

2.4 Traces on the Back Surfaces of the Tile-Ends

On the back surfaces of the samples with inscriptions and lotus patterns, there are irregular scratches, while on the back surfaces of the tile-ends with lotus-Buddha patterns, irregular scratches, and a long-scribed line that divides the half-circle with scratches were also evident. The differences in the processing methods for the tile-ends' back surfaces also implies the existence of different technique systems.

3. Traces and Production Management

The differences in tool traces were caused by differences in the production tools, which demonstrates the maximum number of artisan groups. Meanwhile, the differences in the trimming traces were related to the variety of the technique systems, which is the minimum number of artisan groups. Therefore, according to the analysis on the tool traces and trimming traces, there were likely 2–8 artisan groups making imbrices and three groups making tegulae in the roof tile workshop of the YBTWZ. In addition, artisans with different techniques might use the same tools to develop their products. For example, the cloth covers used to make polished-black imbrices are similar to the cloth covers used to make a part of the simply-trimmed imbrices. This means that in the roof tile workshop of this temple, the materials to make tools were under a unified allocation.

The tile-ends unearthed from this site are mostly tile-ends with inscriptions, which were made using the same wooden mold. There are also four kinds of tile-ends decorated with lotus patterns and one kind of tile-end decorated with lotus-Buddha patterns. Because the tool to make the tile-ends (the mold of the tile-end) is influenced by its pattern and size, which should be removed from the analysis of production traces, using the differences among the molds to speculate the maximum number of artisan groups has no meaning, but the minimum number of artisan groups can be calculated. The techniques to make the tile-ends with lotus patterns and lotus-Buddha patterns are different from the tile-ends with inscriptions, so the artisans might also be different. Moreover, the traces on the back surface of the tile-ends with lotus patterns and tile-ends with lotus-Buddha patterns are different, demonstrating that they may have been made by distinct artisan groups. Therefore, there were at least three groups making tile-ends for this temple.

Section 4. The Kilns from the Yungang Buddhist Temple in the West Zone

Two kilns were found in the southwestern part of this site. They were constructed deep in the natural earth and built with adobes made of soil and hay. The kilns consist of a working area, gate, firebox, firing chamber, combustion chamber, and stacks. The working area was 4.4–5.3 meters long and approximately 4 meters wide, and the ground had been compacted because of the long-lasting production activities. Under the arched gate of the kilns, there was a firebox in the shape of the character "凵." The firing chamber was in the shape of a trumpet, and the combustion chamber was a square with three stacks in the north wall (Figure 23, Yungang shiku yanjiuyuan 2016).

Many adobes, fragments of the roof tiles, and fragments of pottery were found in these two kilns. The roof tiles unearthed from the kilns are similar to the samples from the architectural sites. For example, the tile-ends with inscriptions unearthed from the kilns were made with the same mold as the samples found in the architectural sites, because their mold traces appeared in the same places (Figure 24). This means that the roof tiles used in the YBTWZ were supplied by two kilns, which were once located in the southwestern part of the temple.

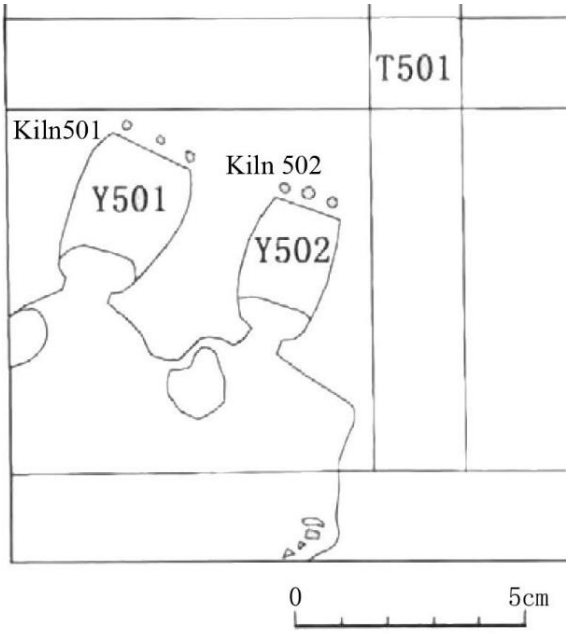

Figure 23 Kilns in the southwestern part of the temple (Source: Yungang shiku yanjiuyuan 2016, Fig. 3)

Figure 24 The tile-ends unearthed the from the kilns and building sites, made from the same mold (Source: Photos by the author)

1. Mold from the kiln sites; 2. Mold from the archaeological sites

Section 5. The Utilization of Roof Tiles in the Yungang Buddhist Temple in the West Zone

According to the previous analyses, untrimmed tegulae and simply-trimmed imbrices were the main materials for the YBTWZ. A few polished-black roof tiles and glazed tegulae were also found at this temple. This section will discuss the utilization of different types of roof tiles by analyzing their distribution[17].

1. The Exposed Surfaces and the Distribution of Roof Tiles

Inside the YBTWZ, the distribution of untrimmed tegulae and simply-trimmed imbrices were the most extensive. They were found throughout the site, indicating that the untrimmed/simply-trimmed types were the most important materials for the roof tiles used in this temple.

The distribution of polished-black roof tiles was limited. Figure 25 and Figure 26 illustrates that the polished-black roof tiles were mostly unearthed from Trench T516, where the rooms F6 and F7 were built. According to the results of the excavation, F7 was the largest room on this site. It was divided into several areas and its walls were painted red. The structure and total area of F6 room were similar to F7. There were also some Buddhist utensils unearthed from these two sites, as well as accessories for daily use (Yungang shiku yanjiuyuan 2016). Therefore, the F6 and F7 rooms may have been the rooms of the highest-ranked monks, and polished-black roof tiles were used for high-rank buildings.

[17] According to the report (Yungang shiku yanjiuyuan2016), the deposit of the site was destroyed by human activities, but the distribution of roof tiles has obvious regularities. Therefore, the deposit of the Layer 4 (the layer of the Northern Wei Dynasty) was not disturbed seriously. Around 180000 remains of roof tiles were unearthed from this site, while 139 samples of tegulae, 189 samples of imbrices and 121 samples of tile-ends were collected for the analysis of distribution.

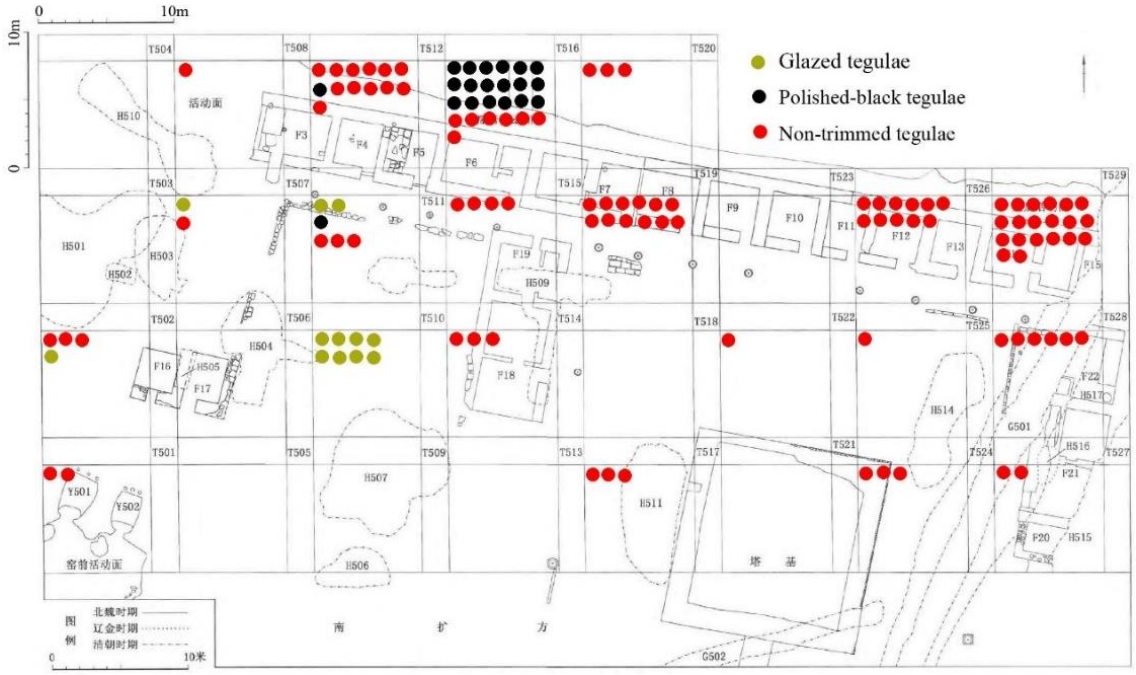

Figure 25 The distribution of the different types of tegulae (Source: Made by the author)

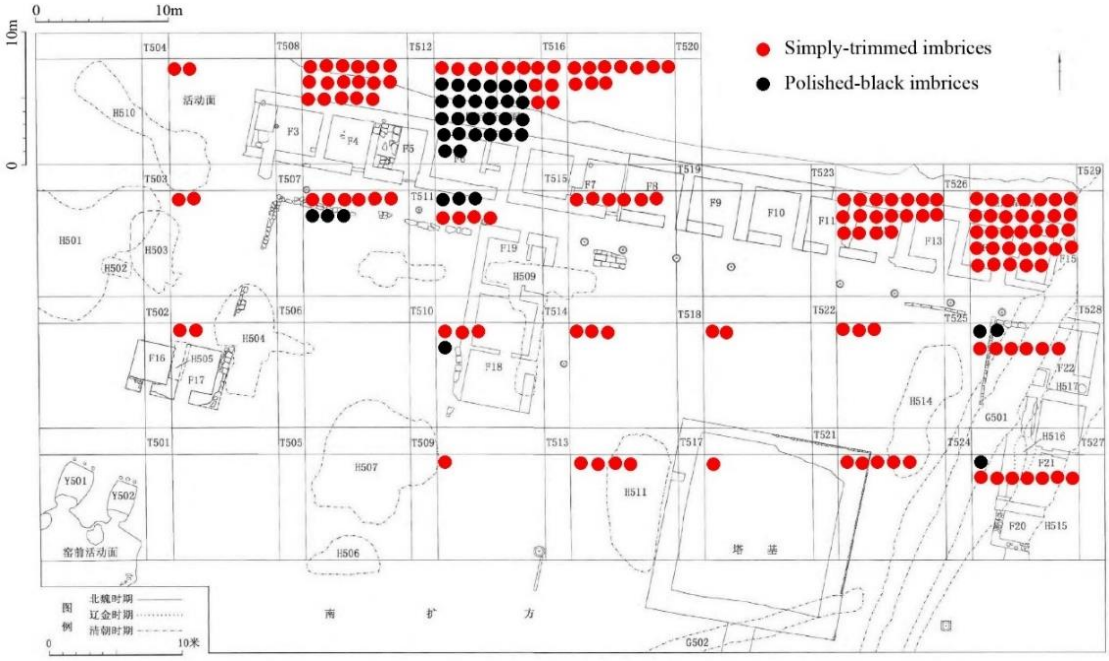

Figure 26 The distribution of the different types of imbrices (Source: Made by the author)

Different to the other types of roof tiles, glazed type roof tiles only have tegulae and they were mostly unearthed from Trench T510. Glazed tegulae were used for high-rank buildings, but no

site for a high-rank building was found in this area. Experts have speculated that these glazed tegulae might have originally been used on the top of the tower and fell into Trench T510 for some reason.

2. The Development of Mold Traces and the Construction Sequence of the Buildings

According to the previous analysis, all of the tile-ends with inscriptions unearthed from this site were made from the same mold. During the production processes, the mold was worn out gradually, so the mold traces left on the front surfaces of the tile-ends increased and became more apparent. By analyzing the development of the mold traces, the production sequence of the roof tiles, and the construction sequence of the buildings can be conjectured. There are three steps in the development of the mold traces of the tile-ends with inscriptions.

In the first step, a mold trace appeared next to the small circular knob near the character "祚." In the second step, besides the mold trace next to the small circular knob near the character "祚," mold traces appeared at the bottom of the raised vertical line near the character "祚." In the third step, all of the mold traces are large and very apparent.

When marking these tile-ends to their unearthed position at this site, the tile-ends in the first step of mold traces were mostly unearthed from the eastern part and southeastern part of this site, where the tower, eastern rooms, and the eastern part of the northern rooms were located. The tile-ends with the second step of mold traces were found all around the site, and the tile-ends in the third step of mold traces were mostly unearthed from the northwestern part, where the middle rooms and the western part of northern rooms were built (Figure 27). Therefore, from the southeastern part to the northwestern part of this site, the mold traces on the front surfaces of the tile-ends became more apparent, illustrating that the tile-ends used in the southeastern part of this

site were made earlier than the others. According to the production sequence of the tile-ends, the construction project of the YBTWZ must have begun from the tower, and the rooms around the tower must have been built at the same time. The rooms in the northwestern part of this temple must have been built later than the other rooms. Moreover, the polished-black roof tiles were unearthed from the F6 and F7 rooms, which were in the western part of the northern rooms. Previous studies have demonstrated that the polished-black roof tiles were largely found at the Caochangcheng No. 1 Archaeological Site and the Mingtang Site, which were built at the end of the Pingcheng Period. Therefore, compared with the untrimmed/simply-trimmed roof tiles, the polished-black roof tiles must have been produced later, and the F6 and F7 rooms, as well as the buildings around them, must have been built later than the rooms in the southeastern area.

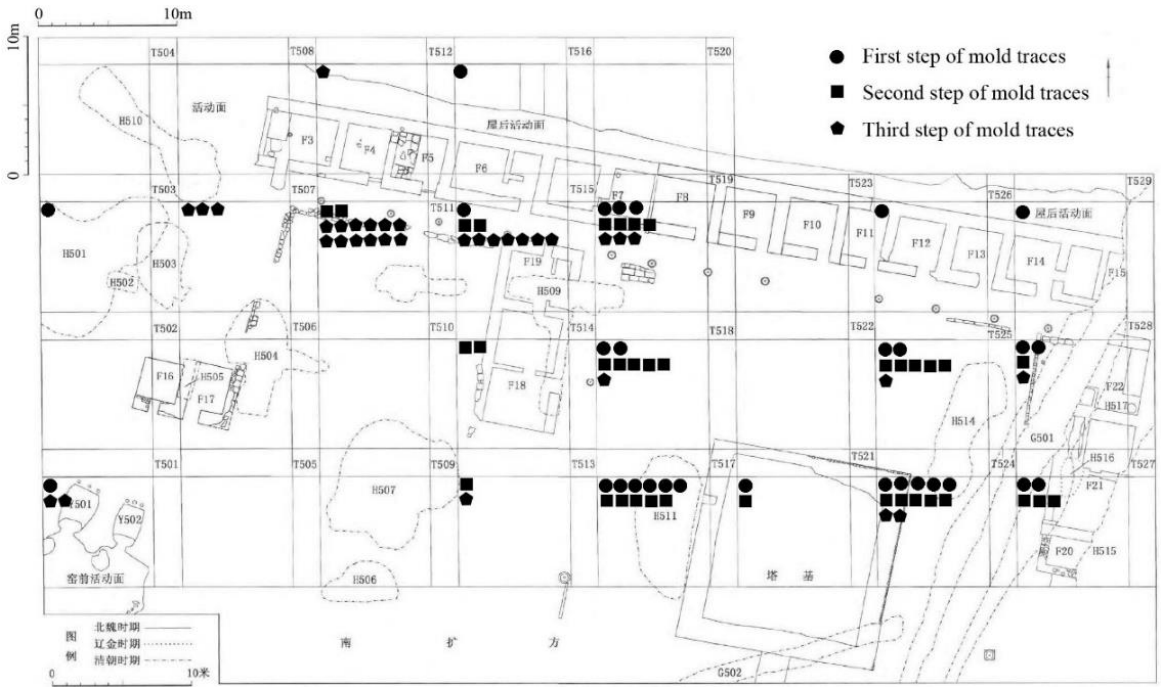

Figure 27 The distribution of the tile-ends in the different mold traces steps (Source: Made by the author)

Section 6. Roof Tiles and the Construction Process of the Yungang Buddhist Temple in the West Zone

The excavation of the YBTWZ began in 2010, and the excavation results demonstrate that the temple consisted of one tower and four groups of rooms. The tower was in the southeastern part of the site; the northern rooms, located in the east-west direction, had 13 rooms, and some in the western part were larger than the other rooms. Other groups of rooms had only two or three rooms, with the eastern rooms, middle rooms located in the south-north direction, and the southwestern rooms located in the east-west direction. There were also two kilns in the southwestern part of this temple. The deposits of this site are relatively simple. Layer 1, layer 2, and layer 3 were formed from the Liao-Jin (遼金) Dynasties to the modern period, and layer 4 was formed in the Northern Wei Dynasty. Due to human activity, the deposits of layer 4 were disturbed partly, but the horizontal disturbance was not too substantial. The observation and measurement work for this research on the roof tiles unearthed from the YBTWZ were conducted in May and June 2017.

Previous analysis demonstrate that the main types of the roof tiles used in the YBTWZ were untrimmed tegulae and simply-trimmed imbrices. There were also a certain number of polished-black roof tiles and glazed roof tiles found at this site. Most of the tile-ends are decorated with the characters “傳祚無窮,” and some had lotus patterns or lotus-Buddha patterns. The lower end of the tegulae all had simple finger-pinched patterns, and so it is difficult to distinguish the general tegulae and eave tegulae. The imbrices can be divided into three groups according to their diameter: 1. 13.5±0.5cm, 2. 15±1cm, and 3. 21cm. Most of the samples belong to size 2, including both the polished-black type and simply-trimmed type. The samples in size 1 are the simply-trimmed type, while the samples in size 3 are the polished-black type, which were made without

tile lips and may have been used in special places. The tile-ends with inscriptions were mostly joined to the imbrices of size 2, and the imbrices of size 1 were matched to the tile-ends with lotus patterns and lotus-Buddha patterns. The tegulae unearthed from this site are around 30cm wide and 50cm long, and the width of the ridge tiles are one third or half of the general tegula.

The untrimmed/simply-trimmed roof tiles, polished-black roof tiles, and glazed roof tiles were made using three different technique systems, but their basic production processes were similar:

1. Molds wrapped with cloth covers were used in the shaping step. The mold of a tegula consisted of several narrow wooden strips, and the mold of an imbrex may have been bottle-shaped integral mold.
2. Clay-strips were twined around the mold to make the body of the roof tiles, and the convex surface of the roof tile's body was shaped by pottery paddles and trimmed with a plate.
3. The lower end of the tegula was decorated using finger-pinched patterns before the clay body was divided.
4. The clay body was cut from the inside.
5. The back surface of tile-end was processed to stick it to imbrex firmly.
6. Special treatments were used for the exposed surfaces of some roof tiles.
7. The roof tiles were fired in the kilns.

Further details can be extracted from the surface traces and the distribution of these samples, which can tell us more about the production and utilization of the roof tiles, as well as the construction processes of this temple. According to previous analysis, the roof tiles used in this temple were supplied by the kilns located in the southwestern part of this site, which were the

exclusive kilns of the temple. The differences in the technique systems demonstrate the minimum number of artisan groups, while the variety in the production tools imply the maximum number of artisan groups. In this workshop, there were 2–8 artisan groups to make the imbrices, at least three groups to make the tile-ends, and three groups to make the tegulae. Therefore, the roof tile workshop of the YBTWZ was sub-dividable and complicated. Similar tools, however, were used among several groups, who belonged to different technique systems, demonstrating that the tools used in this workshop were under a unified allocation. In addition, by observing the traces on the front surfaces of the tile-ends, it is clear that the tile-ends with inscriptions were made using the same wooden mold. The mold traces appeared at the same places and became more apparent.

In discussing the utilization of the unearthed roof tiles, there are two main factors to consider: the distribution and production sequence. The untrimmed/simply-trimmed roof tiles were used all around the temple, while the polished-black roof tiles were mainly found in the western part of the northern rooms. The glazed roof tiles, which may have been used on the top of the tower, were found in an open space surrounded by rooms in the west of the temple. Meanwhile, the production sequence of the tile-ends with inscriptions can be inferred from the development of the mold traces. The samples with a few mold traces were mostly unearthed from the southeastern part of the site, and the samples with more mold traces, which were made later, were mainly found in the northwestern part. This means that the construction process of the YBTWZ began with the construction of the tower, while the rooms around the tower were built at the same time. The rooms in the northwestern part of this temple were then built after this.

Not all of the roof tiles in the site of the Yugang Buddhist Temple in the West Zone were collected, so it is impossible to perform statistical analysis on the different types of roof tiles. However,

most of the collected roof tiles are typical samples with obvious production traces and exact unearthed positions. This information can be used to speculate the production and utilization of the roof tiles and reconstruct some details on the construction process of the temple.

CHAPTER 3. Roof Tiles and the Construction of the Yongning Buddhist Temple

Section 1. The Yongning Buddhist Temple and its Roof Tiles

1. The Yongning Buddhist Temple

The YBT is in the southeastern part of Luoyang, Henan (河南) Province, which was the southwestern part of Luoyang's inner city during the Northern Wei Dynasty. The YBT was built in 516 AD by Empress Dowager Hu, who was Emperor Xiaoming's mother. According to historical records, the temple was located on the west of Tongtuo Avenue (銅駝大街), adjacent to Taiwei Fu（太府), Zhaoxuan Cao (昭玄曹), and other bureaus.[18] There was a nine-floor tower and other decorative buildings in this temple, but the tower was destroyed in 534 AD by a fire. After the Northern Wei Dynasty divided into two states, East Wei and West Wei, the YBT fell to ruin.

The investigation of the YBT was conducted in 1963 by the archaeological team at the Archeology Institute, Chinese Academy of Social Sciences. The land area of the YBT was a rectangle, with the southern gate, tower, and main hall as the axis of the planning. The site was excavated from 1979 to 1981. The foundation of the tower, located in the middle of the site, was formed by rammed earth and wood, with five circles of pillar holes at the surface. The southern gate was the main gate of the temple, whose foundation was also a rectangle, and it had seven bays from east

[18] *Luoyang qielanji*: "永寧寺，熙平元年靈太后胡氏所立也，在宮前閶闔門南一里御道西……其寺東有太尉府，西對永康里，南界昭玄曹，北鄰御史臺." Yang xuanzhi, with commentaries assembled by Zhou zumo, *Luoyang qielanji jiaoshi*, vol. 1, pp. 1–2.

to west and two bays from north to south. The foundation of the western gate was in the shape of "凸," with two bays from east to west. The eastern gate and the main hall were destroyed, so it is difficult to obtain more information about these two sites (Figure 28, Zhongguo shehui kexue yuan kaogu yanjiusuo 1996).

The deposits at the YBT are simple. Under the modern layer (layer 1) of most areas, the rammed earth of the buildings' foundation appears. Only in the areas around the foundation of tower and wall are there two thin layers of deposits from the Northern Dynasties (layer 2 and layer 3). According to archaeological reports, the deposits of the Northern Dynasties were disturbed after the destruction of the temple, so the distribution of building materials unearthed from layer 2 and layer 3 is not their original location.

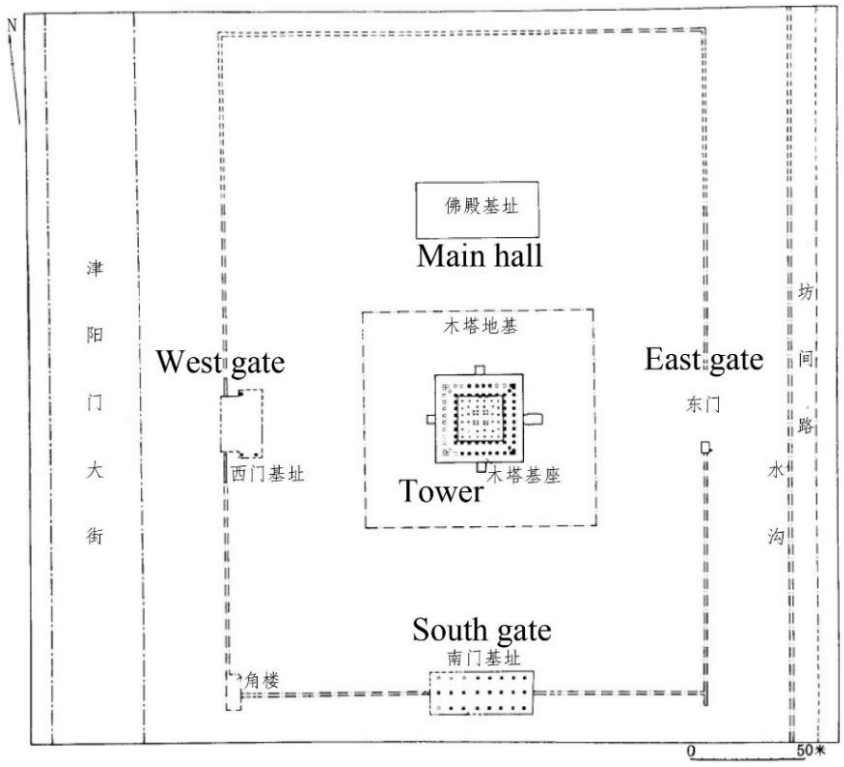

Figure 28 The layout of the Yongning Buddhist Temple
(Source: Zhongguo shehui kexue yuan kaogusuo 1996, Fig. 4)

2. Roof Tiles

Not many remains were unearthed from the YBT. The archaeological report of the YBT only records 60 tegula samples, 30 imbrex samples, and 85 tile-end samples. Most were remains of the Northern Wei Dynasty, but some, such as the tile-ends with cloud patterns and roof tiles with rope impressions, were made in periods earlier than the Northern Wei. Some remains of the roof tiles have not been discussed in archaeological reports. To avoid losing information, all of the remains of the Northern Wei Dynasty unearthed from this site were observed and measured in October 2017, including 298 tegula samples, 106 imbrex samples, and 69 tile-ends samples.

2.1 The Clay bodies of the Roof Tiles

The color of the roof tiles' clay bodies can be divided into two groups: blue-grey and reddish-brown. Most are blue-grey, demonstrating that they were the main materials for the roofs of the temple. Only some of the samples are reddish-brown, and their color is not stable. Half of the samples in Figure 29-3 is blue-grey, and the other part is reddish-brown. This may indicate that it was originally the blue-grey roof tiles. There may have been two reasons why the color changed in the roof tiles: the condition of the kilns or the fire that destroyed the temple. This chapter assumes that all of the samples are originally the blue-grey roof tiles.

2.2 The Exposed Surfaces of the Roof Tiles

The exposed surfaces are the concave surfaces of the tegulae and convex surfaces of the imbrices, which were laid upward on roofs. The imbrices used in the YBT had two different types of surface style: simply-trimmed surface (Figure 29-7) and polished-black surface (Figure 29-2). The tegulae also had two types of surface styles: untrimmed surface (Figure 29-6) and polished-black

surface (Figure 29-1). Most of the tile-ends from this site have polished-black surfaces, joined to the polished-black imbrices. Furthermore, the surfaces of the roof tiles with reddish-brown bodies are polished and red (Figure 29-4; Figure 29-5), and their original color might have been black but changed because of the reasons mentioned above.

Figure 29 The exposed surface of the roof tiles (Source: Photos by the author)
1. Polished-black tegula with blue-grey body, 2. Polished-black imbrex with blue-grey body, 3. Tegula with color changing body, 4. Polished-red tegula with reddish-brown body, 5. Polished-red imbrex with reddish-brown body, 6. Ridge tile, 7. Simply-trimmed imbrex

2.2 The Sizes of the Roof Tiles

Most of the roof tiles unearthed from the YBT are broken, and subsequently, only a few samples can provide exact data about their size. For the imbrices, to avoid counting them repeatedly, only the samples with the upper end were used to analyze the size of the imbrices. By analyzing the diameter of 20 samples, the imbrices unearthed from this site can be divided into two groups: 1. 13cm and 2. 15±1cm. Most of the samples are in size 2, whose surfaces are polished-black, and a few samples are in size 1, which are simply-trimmed imbrices (Figure 30).

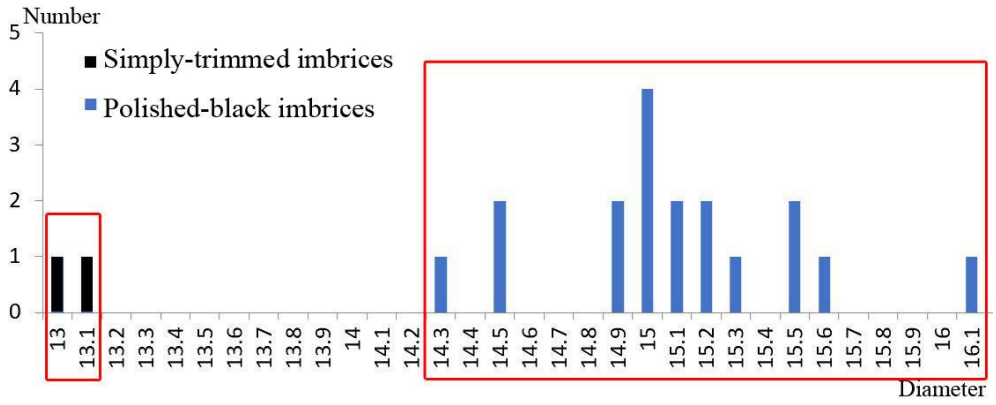

Figure 30 The diameter of the imbrices (Source: Made by the author)

There are 13 measurable samples of the tile-ends, including three tile-ends with lotus patterns, four tile-ends with lotus-Buddha patterns, three tile-ends with palmette patterns, and two tile-ends with monster patterns. Figure 31 illustrates that most of the tile-ends with lotus patterns are 15±1cm in diameter, and only one sample is 13cm in diameter. The diameter of the tile-ends with other patterns are approximately 15cm. Overall, most of the tile-ends are joined to the polished-black imbrices.

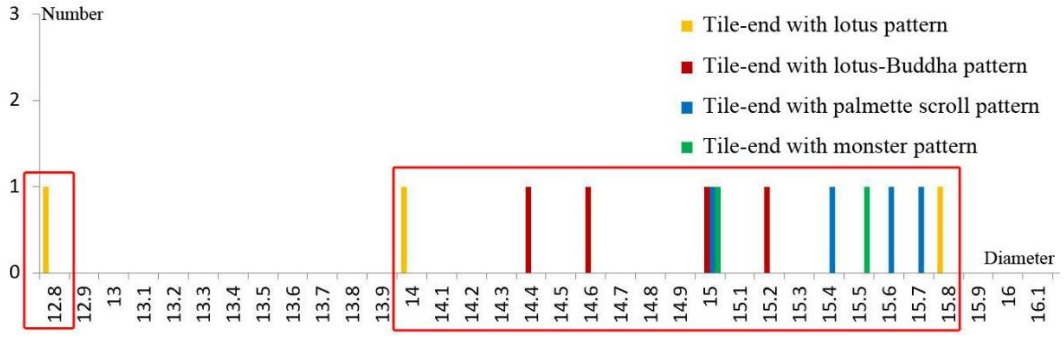

Figure 31 The diameter of the tile-ends (Source: Made by the author)

The length of the imbrices was not clear because there was no undamaged sample. The longest sample, with its lower end broken, is approximately 34.5cm, so the exact length of the imbrices must have been longer.

There is no undamaged sample of a tegula from this site. The data of 298 samples of the tegulae are listed in Table 7, but most of them can only provide the data about thickness.

Table 7 The size of the tegulae

	Length (cm)			Width of lower end (cm)			Width of upper end (cm)			Thickness (cm)
	Number of undamaged samples	Data from undamaged samples	Maximum	Number of undamaged samples	Data from undamaged samples	Maximum	Number of undamaged samples	Data from undamaged samples	Maximum	
Polished-black tegulae	0	-	31	1	27.5	-	-	-	-	1.9–3.1
Polished-black eave tegulae	0	-	35.8	1	31.5	34.5	-	-	-	1.6–4.3
Untrimmed tegulae	1	34.5	-	1	13	-	1	13	14	1.2–1.8

The polished-black eave tegulae are larger than the polished-black tegulae, and it is difficult to subdivide the limited samples. The length of the untrimmed tegulae, which were used as ridge tiles, are similar to the polished-black tegulae, but the width of the untrimmed tegulae are approximately one third or half of the size of the latter.

2.3 The Pattern of the Roof Tiles

The polished-black tegulae unearthed from the YBT are decorated with double wave-shaped patterns (Figure 32-1) or single wave-shaped patterns (Figure 32-2). To make the double wave-shaped pattern, the lower end of the tegula was cut into four layers of clay, and then, the second layer and the fourth layer from the concave side were pinched to make the wave-shaped pattern. Meanwhile, the lower end of the tegulae with the single wave-shaped pattern was cut into two layers of clay, and the second layer was pinched. There are also many samples that have no pattern or only have irregular finger-pinched patterns on their lower ends (Figure 32-3). In addition, the lower ends of the untrimmed tegulae are undecorated.

Figure 32 The pattern of the tegulae (Source: Photos by the author)
1. Tegula with double wave-shaped pattern, 2. Tegula with single wave-shaped pattern, 3. Tegula with irregular finger-pinched patterns

Figure 33 The pattern of the tile-ends (Source: Photos by the author)
1. Tile-end with lotus pattern; 2. Tile-end with palmette pattern; 3. Tile-end with lotus-Buddha pattern, Type A; 4. Tile-end with lotus-Buddha pattern, Type B; 5. Tile-end with lotus-Buddha pattern, Type C; 6. Tile-end with monster pattern, Type A; 7. Tile-end with monster pattern, Type B

Some of the imbrices were made without tile-ends, and their lower ends are flat and smooth. Other imbrices were joined to tile-ends with various patterns, including the lotus pattern, lotus-Buddha pattern, palmette pattern, and monster pattern. The lotus pattern only has one type with simple oval petals (Type A, Figure 33-1). The tile-ends with lotus-Buddha pattern have three types. Type A has beads on the outer area, and its Buddha statue was made without an Aureola (Figure 33-3). Type B has beads on the outer area, and its Buddha statue was made with a round Aureola (Figure 33-4). Type C has beads and a circle of a raised line in the outer area, and its Buddha statue was

made realistically without an Aureola (Figure 33-5). The palmette pattern also has one type (Type A, Figure 33-2), which consists of a flower-shaped design in the central field, palmette-shaped leaves and cloud-shaped design in the outer area. The monster pattern has two types. Type A samples were made as a relief, and there is no decoration in the outer area (Figure 33-6). Meanwhile, the Type B monster's face is flat, and its outer area is decorated with beads (Figure 33-7).

2.4 The Classification of the Roof Tiles

The basic classification of the roof tiles unearthed from the YBT is discussed below (Figure 34):

First, the imbrex and tegula were distinguished from the fragments, and both the imbrices and tegulae were subdivided by their lower ends. Imbrices with tile-ends were used for eaves, and samples without tile-ends were used as general roof tiles for the slope of the roofs. Meanwhile, the tegulae with wave-shaped patterns were matched to the imbrices with tile-ends, used for eaves, and the undecorated tegulae were laid on the slope of the roofs. The narrow untrimmed tegulae were used as ridge tiles.

Second, they were subdivided according to exposed surfaces. The exposed surface of the tegulae has two types, untrimmed type and polished-black type, while the imbrices' exposed surfaces are the simply-trimmed type or polished-black type. Moreover, the front surfaces of the tile-ends are mostly polished and blackened. Although there are only a few remains unearthed from this site, the polished-black roof tiles comprise a significant proportion of these remains.

Third, they were subdivided according to size. The division of the polished-black tegulae are not

clear, but the eave-used tegulae must be larger than the general tegulae. The width of the simply-trimmed tegulae are around one third or half of the size of the polished-black samples. The imbrices were divided into two groups according to size. The samples with 15±1cm diameters are the main building materials of the imbrices in this temple, which are all polished-black type. While the imbrices with diameters of approximately 13cm are the simply-trimmed type. Moreover, most of the tile-ends are matched to the imbrices with a diameter of 15cm.

Last, they were subdivided according to the roof tiles' pattern. The tile-ends of the imbrices have seven patterns, including one lotus motif, three types of lotus-Buddha motif, one type of palmette motif, and two types of monster motif. Meanwhile, the lower ends of the polished-black eave tegulae are decorated with wave-shaped patterns, and the general tegulae are speculated to be undecorated. Lastly, the ridge tiles were made without decorations.

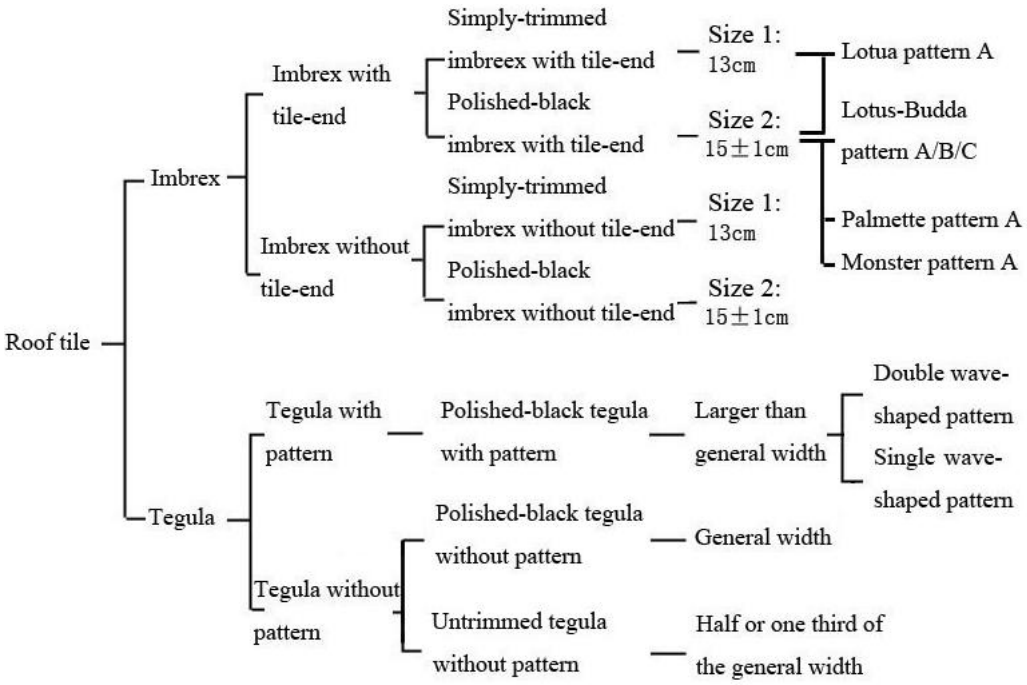

Figure 34 The classification of the roof tiles in the YBT
(Source: Made by the author)

Section 2. Traces Left Through the Production Processes of the Roof Tiles

The basic production process of the roof tiles in the workshop of the YBT was similar to the process in the YBTWZ, so only the special techniques particularly used in the roof tile production of the YBT will be introduced.

1. The Shaping Step of the Imbrex

According to the traces on the concave surface of the imbrices, there are two types of molds for imbrices in the roof tile workshop of the YBT (Figure 35). The first type were bottle-shaped molds, with a cloth cover wrapped up from the bottom to the tile lip. Therefore, the fabric impressions on the concave surface of the imbrices made by this type of mold were left from the bottom to the tile lip. Moreover, in production, clay-strips should be continually twined around the mold, so the boundary between the main body and tile lip of the imbrices could not be found. The second type of mold was a cylinder-shaped mold, which is also wrapped up with a cloth cover, but there was no mold for the tile lip of the imbrices. The tile lip was made separately with the main body of the imbrices and without fabric impressions on their concave surface.

All of the imbrices made by the first type of mold are the polished-black type, while samples made by the second type of mold are the simply-trimmed type. This means that the difference in production tools and methods as related to the classification of the imbrices, and therefore, the technique to make polished-black and simply-trimmed imbrices may have belonged to different systems.

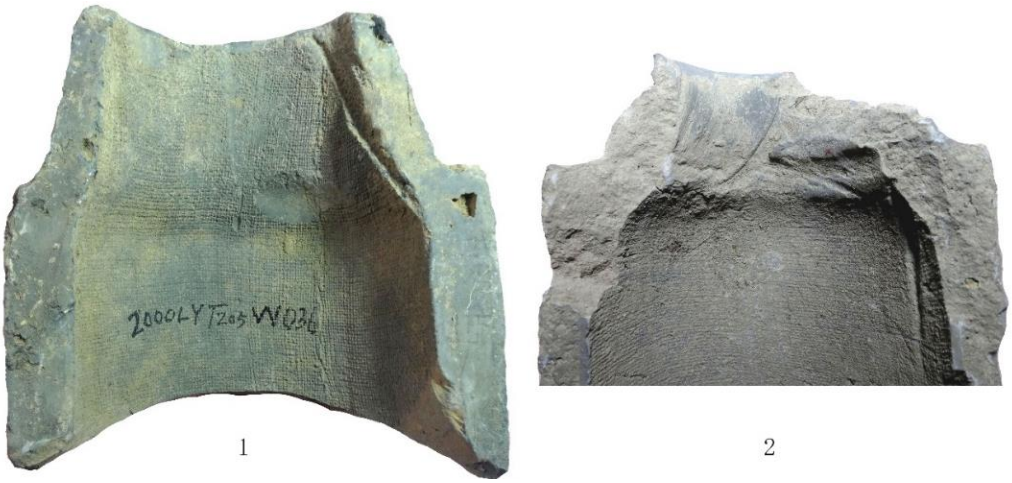

Figure 35 The concave surface of the imbrices made by two types of molds
(Source: Photos by the author)
1. Imbrex made by the bottle-shaped mold; 2. Imbrex made by the cylinder-shaped mold

All of the remains were unearthed from layer 2 and layer 3 of this site, which were deposits of the Northern Dynasties. As the deposits of this temple had been disturbed, the production period of the simply-trimmed imbrices is unclear. They may have been the remains of the Sixteen Kingdoms because similar imbrices were found in the Yecheng site of the Sixteen Kingdoms (Figure 36). Therefore, the distinction between the polished-black roof tiles and simply-trimmed imbrices may have been caused by the difference in periods. However, if they belong to the same period, there must have been at least two artisan groups in the roof tile workshop of the YBT.

Figure 36 The imbrex of the Sixteen Kingdoms unearthed from Yecheng
(Source: Photo by the author, Yecheng Museum)

2. The Technique for Tile-Ends

The lotus patterns of the tile-ends, unearthed from the YBT are apparent, and their surfaces are polished smoothly. The vertical traces, left by wooden molds, which are commonly observed on the surface of the tile-ends with inscriptions, were not found. According to the previous analysis, the molds for tile-ends with lotus patterns should be ceramic.

3. The Technique for the Decoration on the Lower End of Tegula

The decoration on the lower end of the tegulae from the YBT is more complex than the samples from the YBTWZ. There are three types of lower ends for the tegulae; undecorated, double wave-shaped pattern, and single wave-shaped pattern. To make a double wave-shaped pattern, the lower end of the tegula was cut into four layers of clay, and then, the second and fourth layer from the concave side were pinched. Meanwhile, the lower end of the single wave-shaped pattern was cut into two layers of clay, and the second layer was pinched. The clay of the tegulae was still wet and soft when they were decorated because cutting traces and finger impressions can be found on the lower end of the tegulae.

Only a few remains were collected from this site, so the exact proportion of the different types of roof tiles is unclear. Overall, the undecorated samples might have been laid on the slopes of the roofs, and the samples with a wave-shaped pattern may have been the materials for the eaves. The tegulae with a double wave-shaped pattern may have been used for the eaves of lower floors, and the tegulae with a single wave-shaped pattern might have been for the eaves of higher floors.

4. The Technique System of the Roof Tiles

The basic production process of the roof tiles of this temple is similar to the samples from the YBTWZ. It included shaping, trimming, decoration, cutting and firing, and so this section only introduces the differences in the production techniques. Moreover, according to the previous analysis, there should have been two technique systems in the roof tile workshop of the YBT for producing the polished-black imbrices and simply-trimmed imbrices. Because the samples of simply-trimmed imbrices found at this site only account for 8.5 percent of the remains, the polished-black roof tiles, including tegulae, imbrices, and tile-ends, were the main materials for this temple.

Section 3. The Traces of Roof Tiles from the Yongning Buddhist Temple and Production Management

1. Traces on the Surface of the Tegulae and Imbrices

This section will focus on the traces left on the surface of the roof tiles during production. These traces can be divided into two groups; tool traces and trimming traces. The appearance and combination of different types of traces can indicate the management method of the roof tile production at the workshop of the YBT. The traces on the surface of the tegulae and imbrices will first be analyzed.

Table 8 Traces on the surface of the tegulae and imbrices

Feature of the roof tiles		Tool traces on the convex surface	Trimming traces on the convex surface	Tool traces on the concave surface [19] (fabric impression 1cm*1cm)	Trimming traces on the concave surface	Traces on edges
Polished-black tegulae with double wave-shaped pattern		Traces of pottery paddle wrapped with ropes	Polishing traces, black	9/14	Polished traces, black	Scraping or polishing traces
Polished-black tegulae with single wave-shaped pattern			Scraping traces			Scraping traces
Undecorated polished-black tegulae						Scraping traces
Untrimmed tegulae (including ridge tiles)				7–12/11–16 6–7/8	Untrimmed	Cutting traces, fracture surfaces
Polished-black imbrices	Large	Unknown	Polishing traces	(fabric impressions on the concave surface of tile lip) 10–13/7–9 13–15/10–13 10–12/12–13	Untrimmed	Polishing traces, (for some samples, the ridge on the concave side was cut off)
Simply-trimmed imbrices	Small	Unknown	Scraping traces	(no fabric impressions on the concave surface of tile lip) 12–13/7–10 16/12	Untrimmed	Cutting traces, fracture surfaces

[19] Imbrices with an upper end were used for the analysis of fabric impressions, including 40 polished-black imbrices and four simply-trimmed imbrices. They were all individual samples. Meanwhile, all of the tegula samples with fabric impression were observed in this section, including fragments that might be from the same tegula, so they cannot be used for the statistical analysis.

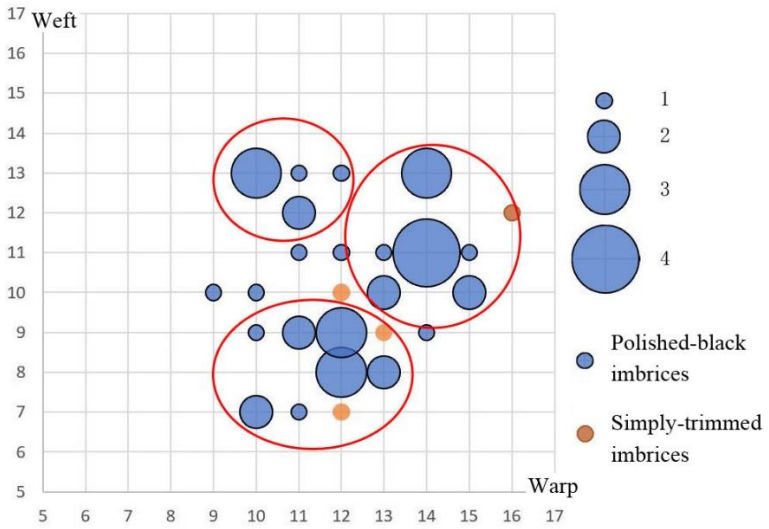

Figure 37 Fabric impression on the concave surface of the imbrices (1cm*1cm)
(Source: Made by the author)

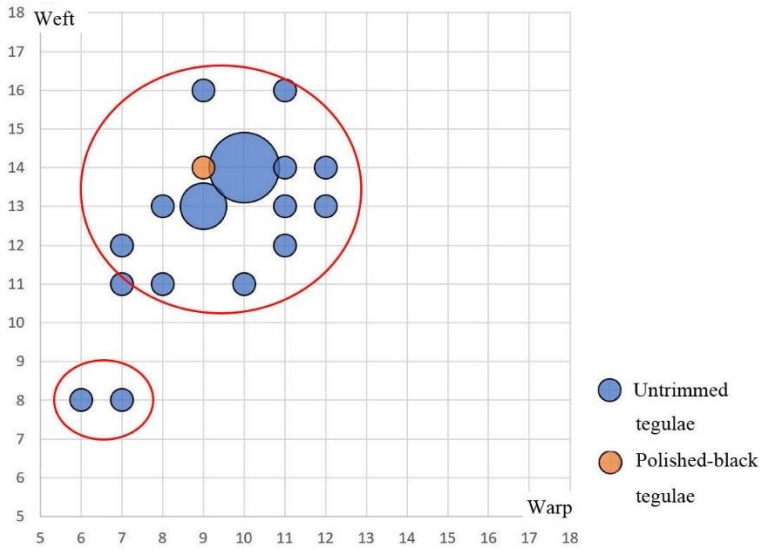

Figure 38 Fabric impression on the concave surface of the tegulae (1cm*1cm)
(Source: Made by the author)

Tool traces are related to the tools used in the production process. On the concave surface of all of the imbrices and a part of the tegulae, fabric impressions can be found, and on the convex surface of some tegulae, the traces of pottery paddles can be observed. Other tool traces were mostly erased in the process of surface trimming (Table 8).

By observing the traces left on the concave surface of the imbrices' tile lip, it was clear that there are two types of molds in the roof tile workshop of the YBT. The first type of mold was a bottle-shaped mold, and the other one was a cylinder-shaped mold. The main body and tile lip of the imbrices made by the bottle-shaped mold were shaped unitedly, by twining clay-strips continually around the mold from the bottom to the lip. The main body and tile lip of the imbrices made by the cylinder-shaped mold were shaped separately. According to the previous analysis, the bottle-shaped molds were used for polished-black imbrices, and the cylinder-shaped molds were used for simply-trimmed imbrices. This demonstrates that the artisans who made polished-black roof tiles and simply-trimmed roof tiles were from different groups.

According to fabric impressions, there was more than one type of cloth cover used in the production process (Figure 37, Figure 38). The polished-black imbrices have three types of cloth covers, and their weft and warp in an area of 1cm*1cm are 1. 10–13/7–9, 2. 13–15/10–13, and 3. 10–12/12–13. The cloth covers of the simply-trimmed imbrices are similar to cover 1 and cover 2. Meanwhile, there are two types of cloth covers to make tegulae, whose weft and warp are 1. 7–12/11–16 and 2. 6–7/8. Roof tiles of the same type and the same size were made by different types of cloth covers, which implies two possibilities. First, different types of cloth cover belonged to different artisan groups, which indicates the maximum number of artisan groups. Second, the production of the roof tiles lasted for a long time, and the tools used in one production group were worn down and replaced.

The trimming traces are related to the production method of the roof tiles, which indicate the minimum number of artisans in the group. The molds and the trimming methods of polished-

black imbrices and simply-trimmed imbrices were different, so it was clear that at least two artisan groups made the imbrices. The differences in the trimming traces among some types of roof tiles, however, were not caused by the different artisan groups, but instead by their function, such as the different treatments for the convex surface of the tegulae and eave tegulae. Meanwhile, the polished-black tegulae were laid on roofs, and the untrimmed tegulae were used on the ridge of roofs so that the distinction of their concave surfaces was also caused by their function. Therefore, there may have been 2–5 artisan groups to make the imbrices and 1–2 artisan groups to make the tegulae in the workshop of the YBT. The fabric impressions between some polished-black imbrices and simply-trimmed imbrices are similar, which means that a few tools might have been shared between the two artisan groups.

2. The Traces on the Front Surface of the Tile-Ends

There are seven types of patterns for the tile-ends in the YBT, including one lotus pattern, three lotus-Buddha patterns, one palmette pattern, and two monster patterns. They were all made by ceramic molds, but the features of the molds are not clear due to the limited amount of unearthed remains. In addition, because the tool to make the tile-ends (the mold of the tile-end) is influenced by its pattern and size, which should be removed from the analysis of production traces, using the differences among the molds to speculate the maximum number of artisan groups has no meaning. On the other hand, the traces on the back surface of the tile-ends from this site are similar to each other. They are all radial scratches, left on the half-circle of the tile-ends. The same processing method of the tile-ends indicates that the minimum number of artisan group to make the tile-ends in the workshop at the YBT should be one.

Section 4. The Characters on Roof Tiles in the Yongning Buddhist Temple

The characters on the convex surface of the tegulae and imbrices from the YBT were made using two different methods: stamping and inscribing. Only one stamped character was found from this site. The stamp is a square with a side length of 1.8cm, and inside the stamp, there is a character "王." It was stamped twice on the convex surface of an imbrex's tile lip. In addition, various inscribed characters were found on the convex surface of the roof tiles from this site, but most of them are too broken to be identified (Figure 39).

Figure 39 The characters on roof tiles from the Yongning Buddhist Temple (Source: Photos by the author)

There are ten types of characters recorded in the archaeological report of the YBT. The inscribed characters include "朋," "生," "貴," "鳳," "朱," "**羊**," "直," and "問," but the stamped characters are not clear (Zhongguo shehui kexueyuan kaogu yanjiusuo 1996). Overall, the characters on the

roof tiles at the YBT can be summarized as follows. First, most of the characters are the inscribing type. Second, there is usually only one character in one unit, which may have been the symbol of the artisans.

Section 5. The Utilization of Roof Tiles in the Yongning Buddhist Temple

According to the archaeological report of the YBT, the deposits from the Northern Wei Dynasty was heavily disturbed, especially in the horizontal direction (Zhongguo shehui kexue yuan kaogu yanjiusuo 2016), so it was difficult to determine the original position of the remains unearthed from this site. Therefore, this section will focus on the basic setting of the roof tiles from an integrative view.

1. The Size and the Exposed Surface of the Imbrices and their Distribution

The previous analysis demonstrate that the imbrices unearthed from the YBT can be divided into two groups, including simply-trimmed imbrices with 13cm diameters and polished-black imbrices with 15±1cm diameters. The polished-black type were the most unearthed imbrices, matching all types of the tile-ends. This means that they must have been the main materials used in this temple, together with the polished-black tegulae, which were also found all around the site.

Some simply-trimmed imbrices were unearthed from this site. Most of them were found around the sites of the southern gate, western gate, and the wall, demonstrating that they were used on the roofs of the gate or the wall. A record in the book *Luoyangqielanji* illustrates that the rafters

on the roofs of the wall surrounding the YBT were short and covered by roof tiles.[20] Nevertheless, polished-black roof tiles were also unearthed from these areas, so the simply-trimmed imbrices might have been used in limited areas of the gates or walls.

2. The Pattern of the Tile-Ends and their Distribution

Most of the tile-ends were found around the foundation of the Buddhist tower, including lotus patterns, lotus-Buddha patterns, palmette patterns, and monster patterns, demonstrating that these four types of tile-ends were used for tower.

3. The Pattern of the Tegulae and their Distribution

The tegulae unearthed from the YBT can be divided into three groups using the pattern on the lower end, including undecorated tegulae, tegulae with double wave-shaped patterns, and tegulae with single wave-shaped patterns. The concave surfaces and convex surfaces of the tegulae with double wave-shaped patterns are all polished and blackened, and so they may have been used on the eaves of the lower floors of the tower. Tegulae with single wave-shaped patterns, whose concave surfaces were polished and blackened, could have been laid on the eaves of higher floors. Meanwhile, undecorated tegulae were used on the slopes of roofs, so that the number of undecorated tegulae should be larger than other types.

4. The Usage of Untrimmed Tegulae

The untrimmed tegulae found at this site are very narrow, with a width of less than 14cm, so they cannot be used as general tegula on roofs. The two edges of untrimmed tegulae were all cut

[20] *Luoyang qielanji*: “寺院牆皆施短椽，以瓦覆之，若今宫牆也.” Yang xuanzhi, with commentaries assembled by Zhou zumo, *Luoyang qielanji jiaoshi*, vol. 1, p. 6.

intentionally. The cutting traces on one of them remained, but the other edge was trimmed and smoothed (Figure 40). This means that the narrow untrimmed tegulae were made purposely and used in a special place. According to the records in the book, *Yingzaofashi*, general tegulae were cut in half or into three parts lengthways to make ridge tiles.[21] These untrimmed tegulae may have been used as ridge tiles, with the concave surface laid face down on the ridge, so that the fabric impressions on the concave surface was not erased.

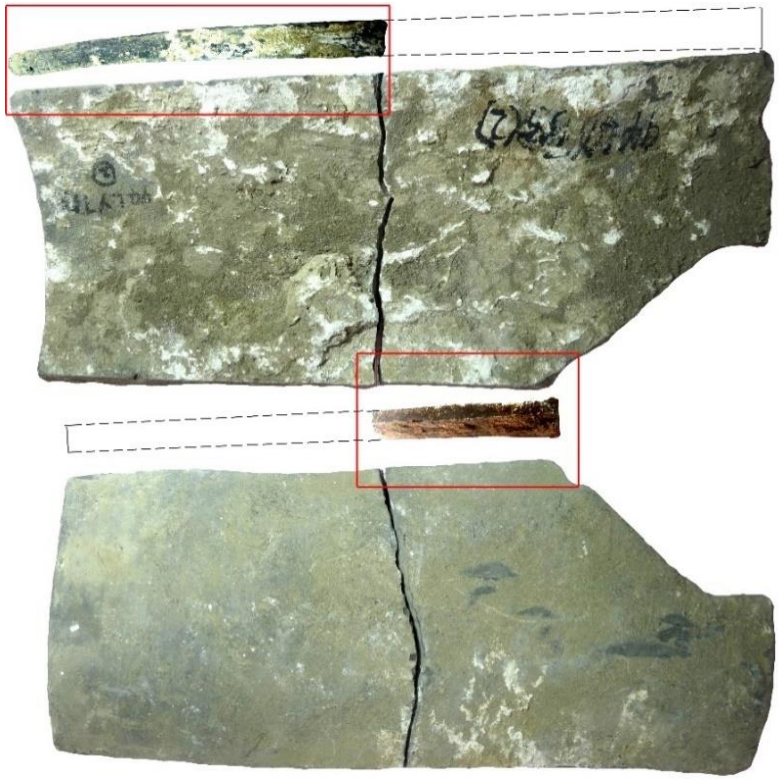

Figure 40 The ridge tile unearthed from the Yongning Buddhist Temple (Source: Photo by the author)

[21] *Yingzao fashi* : "宋代的屋脊，是用甋瓦壘成的，所用的瓦就是結瓦屋頂用的瓦，按屋的大小和等第决定用瓦的尺寸和層數." Li jie, with commentaries assembled by Liang sicheng, *Yingzao fashi Zhushi*, in *Liangsicheng quanji*, vol. 7, p. 258.

Section 6. Roof Tiles and the Construction Process of the Yongning Buddhist Temple

The main archaeological excavation at the YBT was conducted from the 1960s to the 1980s. The results demonstrate that the temple consisted of one tower, one main hall, four gates, and its surrounding walls. The Buddhist tower, located in the middle, is the most outstanding building in this temple, while the main hall was built to the north of the tower. The deposits of the YBT were heavily disturbed, with limited unearthed remains, which were arranged in October 2017, and so the information about the distribution of the roof tiles is inaccurate.

According to the previous analysis, the main materials for this temple are polished-black tegulae and polished-black imbrices, which can both be subdivided into two groups; eave roof tile, and general roof tiles. The tile-ends of the eave imbrices have four main styles, including lotus patterns, lotus-Buddha patterns, palmette patterns, and monster patterns. Each of these can be subdivided into different groups, but the proportion of these types cannot be calculated because most of the samples are broken. The decoration on the lower end of the eave tegulae includes double wave-shaped patterns and single wave-shaped patterns. The imbrices without tile-ends and undecorated tegulae are general roof tiles, used on the slopes of roofs. Furthermore, the diameters of polished-black imbrices are approximately 15cm, and polished-black tegulae were made with a width of around 30cm. The untrimmed tegulae, which retained their fabric impressions on their concave surfaces, are narrower than general tegula and were used as ridge tiles. Only a few simply-trimmed imbrices were found at this site, and they were made with a diameter of 13cm. Moreover, there are two technique systems in the workshop of the YBT, producing the polished-black imbrices and simply-trimmed imbrices separately, whose shaping and surface treatment methods

are distinct, but the production process of the roof tiles is similar. In summary, the process contains seven steps:

1. The mold is wrapped with the cloth cover. The mold of a tegula consists of several narrow wooden strips, and the mold of an imbrex is bottle-shaped or cylinder-shaped integral mold.
2. Clay-strips were twined around the mold, the body of the roof tile was patted with the pottery paddle, and its surface was trimmed with a plate.
3. The lower end of the eave tegulae was decorated before dividing the clay body.
4. The clay body was cut from inside.
5. The back surface of tile-end was processed to stick it to imbrex firmly.
6. Special treatments for the exposed surface of polished-black roof tiles were made.
7. The roof tiles were fired in the kilns.

Further details can be determined from the surface traces and distribution of these samples, which can tell us more about the production and utilization of the roof tiles, as well as the construction process of this temple. According to the previous analysis, because of the differences in their exposed surfaces, sizes, and shaping methods, the polished-black imbrices and simply-trimmed imbrices found at this site belonged to two different technique systems. Therefore, there were at least two artisan groups in the workshop of the YBT to make the imbrices. Considering the difference in the production tools, the maximum number of the imbrices' artisan group was five. Meanwhile, there are 1–2 artisan groups making tegulae, and at least one artisan group making tile-ends. Overall, several artisan groups with different techniques were working in the workshop of the YBT when it was built, so the organization of the workshop must have been complex.

The usage of the roof tiles in the YBT is not very clear. Only four points can be deduced using the available information. First, the polished-black roof tiles were most used at the YBT, and they were unearthed all around the site, while the simply-trimmed imbrices might have only been used on the roofs of the gates and walls. Second, around the foundation of the tower, four types of tile-ends were found, including tile-ends with lotus patterns, tile-ends with lotus-Buddha patterns, tile-ends with palmette patterns, and tile-ends with monster patterns. Third, the tegulae decorated with double wave-shaped patterns and single wave-shaped patterns were laid on the eaves of the roofs, and undecorated tegulae were used for the slopes of roofs. Fourth, the narrow untrimmed tegulae were used as ridge tiles.

The roof tiles at the YBT site have not been fully collected, so it is impossible to complete a statistical analysis of the different types of roof tiles. Furthermore, the available samples from this site are limited and mostly broken, so the information can only be used to do simple speculations.

CHAPTER 4. The Roof Tiles Unearthed from Other Sites of the Northern Wei Dynasty

Apart from the YBTWZ and the YBT, there are still many Buddhist temples built during the Northern Dynasties, but only a few of them were excavated, and the information about the roof tiles unearthed from them are not clear. This chapter will provide a brief introduction to these temples and their roof tiles. For reference, the roof tiles unearthed from other types of sites in the Northern Wei Dynasty will also be discussed.

1. Roof Tiles from the Yungang Buddhist Temple in the East Zone

The excavation of the Yungang Buddhist Temple in the East Zone (雲崗石窟窟上東区寺院) was conducted in 2011, and many sites were found in this area, including the foundation of a tower, as well as ruins of a well and furnace. The sites related to the melting workshop were from the Liao Dynasty, while the central part of the tower foundation was from the Northern Wei Dynasty. Some roof tiles from the Northern Wei Dynasty were found around this foundation, most of which are tile-ends with inscriptions. Based on the available samples, four points can be made about the roof tiles used in the Yungang Buddhist Temple in the East Zone.

First, similar to the YBTWZ, the simply-trimmed imbrices and tile-ends with inscriptions were the most used type of roof tiles at this temple. The tile-ends have two types of inscription, “傳祚無窮” and “萬歲富貴,” but the latter cannot be found in the temple in the West Zone. Moreover, the diameters of the imbrices unearthed from this site were 14–16cm, similar to the size 2 samples in the temple in the West Zone. Although tegulae were not found at this site, according to the imbrices and tile-ends, they would have been the untrimmed type with fabric impressions on their

concave surface.

1 2 3

Figure 41 Tile-ends with inscription “傳祚無窮” made by three types of molds (Source: Photos by the author)

Second, the tile-ends with “傳祚無窮” were made by three molds. One mold is likely to have been used in the workshop in the West Zone after the construction of the temple in the East Zone. The mold traces of some of the tile-ends from the East Zone are similar to the samples from the West Zone, but traces of the former are smaller than the latter, which means that the mold had not been worn out when they were used in the workshop of the East Zone (Figure 41-1). The inscriptions from the second mold were in different handwriting styles, and the mold was worn out, demonstrating that it had been used for a long time (Figure 41-2). The inscription of the third mold also has a unique handwriting style, and the characters were clear, which means that the mold was still new when it was used to make these tile-ends (Figure 41-3). The tile-ends with the inscription “萬歲富貴” were only found in the site of the East Zone, and they can be separated into six styles by handwriting (Figure 42).

Figure 42 Tile-ends with the inscription “萬歲富貴” made by six types of molds (Source: Photos by the author)

Third, the traces on the back surface of the tile-ends with the inscription “傳祚無窮” are irregular scratches, similar to the samples from the West Zone. Meanwhile, the traces on the back surface of the tile-ends with the inscription “萬歲富貴” are different from the former. In addition to the irregular scratches, there is also a long-scribed line in the middle of the tile-ends, which is similar to the back surface of the tile-ends with lotus-Buddha patterns unearthed from the site in the West Zone (Figure 43).

Figure 43 The back surface of the tile-ends from the East Zone (Source: Photos by the author) 1. The back surface of tile-ends with inscription "傳祚無窮"; 2. The back surface of tile-ends with inscription "萬歲富貴"

Fourth, the imbrices matched to the "萬歲富貴" character tile-ends usually have a character "凸" shaped hole, carved on their front side (Figure 44). This may have been a hole for the nail, which was used to fasten down the eave imbrex.

Figure 44 The character "凸" shaped hole on the front surface of the imbrex (Source: Photo by the author)

Overall, the roof tiles unearthed from the Yungang Buddhist Temple in the East Zone are similar

to the samples from the temple in the West Zone. The similarity between them can be understood by comparing their size, pattern, exposed surface and production tools. The tile-ends with the inscription “傳祚無窮” unearthed from the West Zone were made using the same mold as some of the samples from the East Zone. Therefore, the roof tiles used in these two temples might have been made by the same artisans, but the temple of the East Zone was built earlier than the temple in the West Zone.

2. The Siyuan Buddhist Temple

The Siyuan Buddhist Temple is located in Fangshan Mountain (方山), 25 kilometers northeast of Datong. The temple was a part of the Cemetery of the Empress Dowager Feng, built in 479 AD. The excavation was conducted in 1976 and 1981 and demonstrated that the temple consisted of a tower in the middle, the main hall to the north of the tower, several rooms for monks in the northwestern corner, and a gate in the south of this temple. Numerous roof tiles were unearthed from this site. According to the archaeological reports, untrimmed tegulae and simply-trimmed imbrices were the most common remains. The tegulae are usually 41cm in length and 31–34cm in width, with their lower ends decorated with wave-shaped patterns or undecorated. Meanwhile, the imbrices are 14.5–15.7cm in diameter, and the eave imbrices usually had a square-shaped hole on the front surface. They are joined to the tile-ends with inscriptions, lotus patterns, or lotus-Buddha patterns. The tile-ends with inscription have three types of characters, including “萬歲富貴,” “□流□□” and “□賢永□,” while, the tile-ends with lotus pattern and lotus-Buddha pattern can be divided into several groups by the decoration of the outer area (Figure 45).

The classification of the roof tiles unearthed from the Siyuan Buddhist Temple is similar to the samples from the Yungang Buddhist Temple, demonstrating that the simply-trimmed imbrices

and untrimmed tegulae were the most common type of roof tiles in the early period of the Northern Wei Dynasty. The patterns of the tile-ends in the Siyuan Buddhist Temple, however, have more variations than the samples from the Yungang Buddhist Temple, and more tile-ends with lotus patterns were unearthed from this site.

Figure 45 The roof tiles unearthed from the Siyuan Buddhist Temple
(Source: Datongshi bowuguan 2007, Fig. 7, 10, 11, 12, 13, 14, 15, 16, 8)

3. The Palaces and the Mingtang in Pingcheng and their Roof Tiles

The Caochangcheng Site in Datong is thought to be the site of a palace built at the end of the Pingcheng Period of the Northern Wei Dynasty. The foundation of the palace was square, with a length of 41.4m and a width of 31.5m, and a large number of roof tiles were unearthed here. The

tegulae can be divided into two groups by their exposed surface. They include untrimmed tegulae, which are 45.6cm in length and 31–35.3cm in width, and polished-black tegulae, which have two different sizes. The small polished-black tegulae are similar to the untrimmed type, and the large polished-black tegulae are 81cm in length and 50–60cm in width. Meanwhile, all of the imbrices are polished-black, with a rectangular hole on the front surface of eave type. The small size is 50cm in length and 15cm in diameter, while the large size is 70cm in length and 20cm in diameter. The tile-ends of eave imbrices can be divided into four groups, including tile-ends with inscriptions, tile-ends with lotus patterns, tile-ends with lotus-Buddha patterns, and tile-ends with monster patterns. The tile-ends with inscriptions have four different sizes, 12.5cm, 14.5cm, 17.3cm, and 21.2cm, while the tile-end with lotus patterns and lotus-Buddha patterns are all 15cm in diameter. The tile-ends with monster pattern have two sizes, 25cm and 16.3cm. In addition, there are inscribed characters on the convex surface of the polished-black tegulae and polished-black imbrices' tile lip.

The Mingtang of Pingcheng is in the Liuhang (柳航) District of Datong, and now the sites of the south gate and west gate have been excavated. On the foundation of the sites, which were shaped with the character "凸," several pillar holes and a large number of roof tiles remain, demonstrating that there had been buildings on the foundation. The imbrices unearthed from this site are all of the polished-black types, with inscribed characters on the convex surface of the tile lip. The samples from the site in the west gate are 16.5–17cm in diameter and the samples from the site of the south gate are 18cm in diameter and 56cm in length. The eave imbrices have a square-shaped hole on the front surface, and they were joined to the tile-ends with monster patterns, which are 16.8cm in diameter. The tile-ends with lotus patterns are only 11cm in diameter, which may have been matched to smaller imbrices that have not yet been found. Meanwhile, the tegulae unearthed

from this site are also the polished-black type, and some samples had the finger-pinched patter on their lower end. There are also inscribed characters on the convex surface of the tegulae, which are the name of the artisans.

4. The Palaces, Gate, and the Mingtang in Luoyang and their Roof Tiles

The No. 2, No. 3, and No. 4 sites of the royal city of Luoyang have already been excavated, indicating that these sites may have been a series of buildings from the Taiji Palace (太极殿). The records about these roof tiles in the archaeological reports are simple, but it is clear that the polished-black roof tiles and tile-ends with lotus pattern were the main materials used in these buildings. There were also a few tile-ends with monster patterns unearthed here. In addition, the remains of the roof tiles found in the Jianchun Gate (建春門) site, at the northeastern gate of the inner city, are also the polished-black type, and the eave imbrices are joined to the tile-ends with lotus patterns. Moreover, a large number of polished-black roof tiles and tile-ends with lotus patterns or monster patterns were unearthed from the No. 1 House Site in the southern part of the Luoyang City. On the convex surfaces of the tegulae and the edges of the imbrices, many inscribed characters were found. The site is likely to be the Zongzheng Bureau (宗正府) or the Tai Miao (太廟）from the Northern Wei Dynasty.

The site of the Mingtang of Luoyang, located in Yanshi（偃師）, consisted of a rammed-earth foundation, which was a circular mound with a diameter of 61.7–61.8 meters, and subsidiary buildings and surrounding walls. Numerous remains of building materials were found on the top of the foundation. The tegulae found can be divided into two groups: the untrimmed type, and polished-black type. The untrimmed tegulae are 34.5–36.5cm in length; the width of the upper end is 24–25cm, and the width of the lower end is 19.5–25cm. Parts of them were decorated with

single wave-shaped patterns on the lower end. According to the report, some of the untrimmed tegulae have vertical cutting traces in the middle, and so they might have been divided into two parts and used as narrow ridge tiles. Meanwhile, the polished-black tegulae have two types according to the decoration on the lower ends: single wave-shaped and double wave-shaped patterns. The length of the former is approximately 39.6cm, with the lower end 26cm in width, and the width of the latter's upper end is 28–34cm. As most of the samples are broken, the data on the size of the roof tiles are limited. There may have been polished-black tegulae with an undecorated lower end, such as the remains unearthed from the YBT, but the report does not mention this. The imbrices unearthed from this site are all polished-black type, 44.5cm in length and 12.2cm or 16–16.3cm in diameter. The decoration of the tile-ends is a lotus pattern with 11 simple petals, and the diameter of the tile-ends is 15.6–16.4cm, similar to the diameter of the large size imbrices.

CHAPTER 5. The Construction Project of Royal Buddhist Temples in the Northern Wei Dynasty, From the Viewpoint of Roof Tiles

In previous chapters, the roof tiles unearthed from the YBTWZ in Pingcheng and the YBT in Luoyang were systematically arranged and analyzed. Information about the roof tiles' classification, production traces, and distribution is the foundation for the study of the production and utilization of the roof tiles. Using the results from previous analysis and literature records, this chapter will discuss the construction project of the royal Buddhist temples in the Northern Wei Dynasty and the related historical background.

1. Changes in the Style of the Roof Tiles and Technical Innovation in Roof Tile Production

The style of the roof tiles changed substantially in the Northern Wei Dynasty. During the early construction process of the Buddhist temples on the top of the Yungang Grottos, untrimmed tegulae, simply-trimmed imbrices, and tile-ends with inscription were the most used types of roof tiles, but polished-black roof tiles appeared in specific areas in later periods. Some tile-ends with lotus patterns may have also been made during this time. The style of the roof tiles used in the YBTWZ in later periods was deeply influenced by other high-ranking buildings in Pingcheng, such as the Mingtang and palaces, which were built at the end of the Pingcheng Period. According to archaeological reports, a large amount of polished-black roof tiles and tile-ends with lotus pattern were found at the Mingtang and Caochangcheng Site (Liu 2009, 2010; Xu and Lin 2014; Wang and Gao 2003; Wang 2009).

During the Luoyang Period of the Northern Wei Dynasty, the polished-black roof tiles and tile-ends with lotus patterns had become the most used building materials for the roofs of high-ranking

buildings, including royal Buddhist temples. Meanwhile, the untrimmed tegulae, simply-trimmed imbrices, and tile-ends with inscriptions, once largely used in Pingcheng, disappeared (Qian 1996, 2010; Qian and Guo 2014). At that time, the designs of the tile-ends' patterns varied and included lotus-Buddha patterns with compound petals, lotus patterns with simple petals, palmette patterns, and monster pattern. The lotus-Buddha pattern with compound petals and monster pattern were also used in the Pingcheng Period, and other patterns were created during the Luoyang Period. In addition, the decoration on the lower end of the tegulae became more exquisite.

In the YBTWZ, there are only irregular finger-pinched patterns on the lower end of the tegulae, and the tegulae and eave tegulae could not be distinguished by their decoration. In the YBT, however, the lower ends of some tegulae are decorated with double wave-shaped patterns and single wave-shaped patterns, which have been speculated to be eave tegulae, while the undecorated tegulae might have been used on the slopes of the roofs. This means that during the Luoyang Period of the Northern Wei Dynasty, eave tegulae and general tegulae were separated intentionally. As some researchers have pointed out, at the end of the Pingcheng Period, polished-black roof tiles and tile-ends with lotus patterns were created, and eave tegulae decorated with double wave-shaped patterns and single wave-shaped patterns appeared in the Luoyang period of the Northern Wei Dynasty (Mukai 2004). The roof tiles unearthed from the YBTWZ illustrate the setting before the alteration.

During the Northern Wei Dynasty, which lasted more than one hundred years, the basic production process of the roof tiles remained the same. To make imbrices and tegulae, artisans would clear the clay, shape the clay body, trim the surface of the body, and cut the body and fire roof tiles in the kilns. The inner mold for most of the imbrices was bottle-shaped wood and wrapped by cloth

cover. The inner mold of the tegulae was barrel-shaped, consisted of several narrow wooden strips, and was wrapped by cloth cover. After twining clay-strips around the inner mold, the artisans still needed to pat the body of the roof tile using pottery paddle, and their surfaces were then trimmed with a plate. The bodies of the roof tiles were cut from the inside, with imbrices cut into two pieces and tegulae cut into four pieces. According to previous studies, this basic production process of the imbrices and tegulae had already been formed in the period of the Sixteen Kingdom, (Yamasaki 2010). However, there are also changes in some specific production methods, for example, the treatments of the exposed surface. The alteration from untrimmed/simply-trimmed type to polished-black type demonstrates the significant change in both production methods and the aesthetic standard during this period. Moreover, some samples of the imbrices and tegulae were made using special methods, such as the glazed tegulae in the YBTWZ and the simply-trimmed imbrices shaped by cylinder-shaped molds in the YBT. This demonstrated the variety of production systems of roof tiles in the Northern Wei Dynasty. However, the number of specific samples was low.

The production technique of the tile-ends changed substantially during the Northern Wei Dynasty. When the Buddhist temples on the top of the Yungang Grottos were built, the tile-ends used for these temples were decorated with inscriptions, and the inscriptions were made from wooden molds. As only one wooden mold was used to produce the tile-ends with the inscription “傳祚無窮,” it was worn out continually, and the mold traces on the surface of the tile-ends increased gradually. In contrast, tile-ends with lotus patterns, lotus-Buddha patterns, and monster patterns were likely made using ceramic molds, and on the surface of these tile-ends, mold traces were rare. Compared with soft wooden molds, ceramic molds are more suitable for raised and complex lotus motif patterns, so together with the creation of the new patterns, the production technique

of the tile-ends also changed. Not many tile-ends with lotus patterns were unearthed from the YBTWZ and the Siyuan Buddhist Temple, but the setting changed at the end of the Pingcheng Period, and it is likely that wooden molds were replaced by the ceramic molds at the end of the 5th century. Ceramic molds and the related production methods became the mainstream of tile-end production during the next period.

2. The Management of Roof Tile Production at the Northern Wei Dynasty

2.1 The Formation of Roof Tile Workshops

The roof tile workshop in the Northern Wei Dynasty, formed by more than one artisan group, was a non-unified system. In the construction process of one temple, there was usually more than one type of roof tiles. For example, besides simply-trimmed imbrices and untrimmed tegulae, there were also some polished-black roof tiles and glazed tegulae unearthed from the YBTWZ. These specific types of roof tiles were regularly used in this temple, indicating that the roof tile workshop in this temple might consist of at least three artisan groups. Moreover, according to the differences in production tools, the maximum number of artisan groups to make the imbrices in the YBTWZ was eight groups, and the maximum in the YBT was five groups. Although the maximum was not the exact number of artisan groups, it illustrates the complexity of the roof tile workshops in the Northern Wei Dynasty.

According to the historical literature, the artisans in the early period of the Northern Wei Dynasty, called "Baigongjiqiao (百工技巧)," [22] had a special status.[23] They learned their occupation and

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[22] *Wei shu*: "（天興元年春正月辛酉）徙山东六州民吏及徒何、高麗雜夷三十六萬, 百工伎巧十萬餘口，以充京師." Wei shou, *Wei shu*, vol. 2, p. 32.

[23] *Wei shu*: "（和平四年十有二月辛丑）诏曰：……王公侯伯及士民之家，不得與百工、伎巧、卑姓為婚，犯者加罪. " Wei shou, *Wei shu*, vol. 5, p. 122.

techniques from their father and could not give up the occupation.[24] This meant that the technique was transmitted from generation to generation within a small group. In the roof tile workshop, different groups might use distinct tools and have different habits, and this may have caused the variety of production traces on the surface of the roof tiles.

2.2 The Characters on the Roof Tiles in the Northern Wei Dynasty

The Yungang Grottoes was built from 453 AD, and most of the roof tiles used in the temples were simply-trimmed imbrices and untrimmed tegulae, which means that these temples were built very early. In the early period of the Northern Wei Dynasty, no character was used on the surface of the roof tiles, as the real-name management system (Wulegongming, 物勒工名) had not yet been established. In the Siyuan Buddhist Temple, built in 479 AD, characters were also not found on the roof tiles.

At the end of the Pingcheng Period, characters emerged on the convex surface of the roof tiles, but all of the samples were found from the sites of the palaces and Mingtang (Qang 2007, 2013; Liu 1992; Shanxi sheng kaogu yanjiusuo 2005, 2016; Yin 2001, 2009). There is usually only one character in one unit, which may have been the surname of the artisans, such as "王," "胡," "高," "李," "齊," "侯," and "白." Some characters were numbers, such as "五," "六," and "七." Some units had more than one character, such as "范太," "阿仁," "莫問," and "毛里太," which might also be the name of the artisans. According to the statistical results, 93 percent of the characters were inscribed, and only six types of characters were stamped.

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[24] *Wei shu*: "（太平真君五年春正月庚戌）诏曰：……其百工技巧，騶卒子息，當習其父兄所業." Wei shou, *Wei shu*, vol. 4, p. 97.

The samples from the YBT inherited the feature of characters from Pingcheng, which only have one character in one unit, but the samples from the site of the No. 1 House are more complicated. These samples are inscribed on the convex surface of the tegulae, the convex surface of the imbrices' tile lip, and on the edge of the imbrices, and one unit usually includes several characters. In addition to the characters for the artisans' name, there were also characters to illustrate the production date and the duty of the artisans, such as "隤主," "匠," "輪," "削" and "昆." According to previous studies, the character "隤主" was the leader of a roof tile production team, while "匠" was a technician in this team. The characters "輪," "削" and "昆" were the steps in the roof tile production, including shaping, cutting and polishing, as well as the artisans who were in charge of these steps (Zhongguo shehui kexue yuan kaogu yanjiusuo 1973; Huang 2000; Shao 2000; Zhang 1989).

The characters on the roof tiles from Pingcheng have two features. First, most of them were inscribed characters. Second, in one unit, there was usually only one character, which may have been the surname of the artisans. The characters on the roof tiles from Luoyang were inscribed, but the content in one unit increased. In addition to the characters of the artisans' names, there were also characters used to indicate the production date or the duty of the artisans.

2.3 The Status of Artisans and Management in the Roof Tile Workshop

By observing the changes in the characters on the roof tiles, it is clear that the roof tile workshops in the Northern Wei Dynasty became more systematic and complex. Roof tiles without characters were replaced by samples with single inscribed characters at the end of the Pingcheng Period. This was because of the commencement of the real-name management system in roof tile production. After this, roof tiles with several characters, which included the meanings of both the

name and duty of artisans, appeared. This means that during the Luoyang Period of the Northern Wei Dynasty, a division of labor emerged in roof tile production, and each artisan was in charge of a specific production step.

According to historical literature, artisans during the Northern Wei Dynasty had a special status that was different from ordinary citizens. They were usually controlled by the state and had to inherit their father's occupation. The change in the management in roof tile production, illustrated by the characters on the roof tiles, might imply the development of the handicraft industry in the Northern Wei Dynasty, from simple controls to a complex production system with a division of labor.

3. The Utilization of the Roof Tiles and the Construction Plan of Temples

The structure of Buddhist temples in the Northern Wei Dynasty was almost the same, and usually had a Buddhist tower built in the center. For example, the YBTWZ only had a tower and rooms that surrounded the tower, while in the YBT and Siyuan Buddhist Temple, the tower was in the center with the main hall located to the north. The importance of the tower is further demonstrated by the roof tiles. According to previous analysis, the construction of buildings in a temple also began from the tower.

The location, construction sequence, and utilization of the roof tiles demonstrate that the tower was the most important building in a temple during the Northern Wei Dynasty. This may have been influenced by the belief in Buddha and the custom of circling tower for worship (He 2014).

4. Summary

Previous analysis demonstrated that roof tiles used in the royal temples of the Northern Wei Dynasty became more sophisticated, while the production and utilization of the roof tiles, as well as the related construction processes of the temples in Pingcheng and Luoyang, developed systematically.

The changes from untrimmed/simply-trimmed roof tiles and tile-ends with inscriptions to polished-black roof tiles and tile-ends with lotus patterns began at the end of the Pingcheng Period, and the latter became the main materials for high-ranking buildings in the Luoyang Period. This may have been related to the strategies of Northern Wei's rulers to demonstrate the legitimacy of their dynasty. The sophisticated polished-black roof tiles and beautiful tile-ends with lotus patterns imply the attitude of the northern nomadic people toward the Chinese traditional political philosophy, and this will be analyzed in the last part of this dissertation.

Together with changes in the roof tiles' style, the technique and management methods of roof tile production also altered. The ceramic mold and related techniques were likely to be the result of increasing demand for the mass production of high-quality tile-ends. In addition, the real-name management system, which was mostly used in the production of luxurious products, emerged in the production of roof tiles at the end of the Pingcheng Period. Subsequently, in the Luoyang Period, the division of labor began in roof tile production and every step of the process was undertaken by specific artisans. The number of artisans for handicraft industries, however, was limited at that time due to demands for agricultural labor. In the later period of the Northern Dynasties, however, urban construction became more frequent, and it became a big challenge to produce sufficient quantities of roof tiles for urban construction.

PART III Roof Tiles and Construction of the Royal Buddhist Temples in Yecheng in the Eastern Wei and Northern Qi Dynasties

CHAPTER 1. Buddhist Temples in the Eastern Wei and Northern Qi Dynasties

1. Yecheng and Buddhism

Yecheng, located in the southern part of the modern Hebei Province, is to the east of Taihang Mountain and north of the Yellow River. It was constructed in the Chunqiu Period and became more affluent because of its favorable agriculture conditions. At the end of the East Han Dynasty, Yuan Shao (袁紹) governed Yecheng and made it a sizable city. In the next period, Cao Cao (曹操) chose Yecheng as the capital of the country. Yecheng became a metropolis in the 3rd century, and the next dynasties, such as the Later Zhao (後趙), the Ran Wei (冉魏), the Former Yan (前燕), the Eastern Wei, and the Northern Qi, established their capital in Yecheng. The most important construction project in Yecheng in the period of the Northern Dynasties was conducted by Gao Huan (高欢), the real leader of the Eastern Wei and the Northern Qi Dynasties. He forced 400,000 families to emigrate from Luoyang to Yecheng and built the Southern Inner City, which is adjacent to the original Northern Inner City and surrounded by the Outer City. During the Eastern Wei and the Northern Qi Dynasties, the construction of Yecheng had never been stopped, but after the Northern Qi fell at the end of the 6th century, Yecheng declined and was destroyed by

the army of the Northern Zhou Dynasty in 580 AD.

Yecheng of the Eastern Wei and the Northern Qi Dynasties consisted of the Southern Inner City, Northern Inner City, and Outer City. In the middle of the Northern part of the Southern Inner City, there was the newly built Imperial City, with the main street stretching toward the south and dividing the Southern Inner City into two parts (Figure 46). The Northern Inner City held the palaces and gardens built in the period of the Cao Wei (曹魏) Dynasty and the Sixteen Kingdoms (十六国), but most of these were donated to Buddhist temples in the Eastern Wei and Northern Qi Dynasties. The Outer City was planned for building dwelling houses for residents. According to the records in *Suishu*, there were 323 Lifangs (里坊) in Yecheng,[25] and mansion houses for noble people and officials, as well as Buddhist temples, were located in these Lifangs. Overall, the construction projects in Yecheng had three features; the Imperial City in the north of the Inner City, axisymmetric design, and Lifang, which was influenced by the Luoyang City of the Northern Wei Dynasty and influenced the urban plan of Chang'an in the Sui-Tang Dynasties, as well as other contemporaneous cites in East Asia.

[25] *Sui shu*: "鄴又領右部，南部，西部三尉. 又領十二行經途尉. 凡一百三十五里，里置正. 臨漳又領左部，东部二尉，左部管九行經途尉. 凡一百一十四里，里置正. 成安又領後部，北部二尉，後部管十一行經途尉，七十四里，里置正. " Wei zheng, *Sui shu*, vol. 27, p. 761.

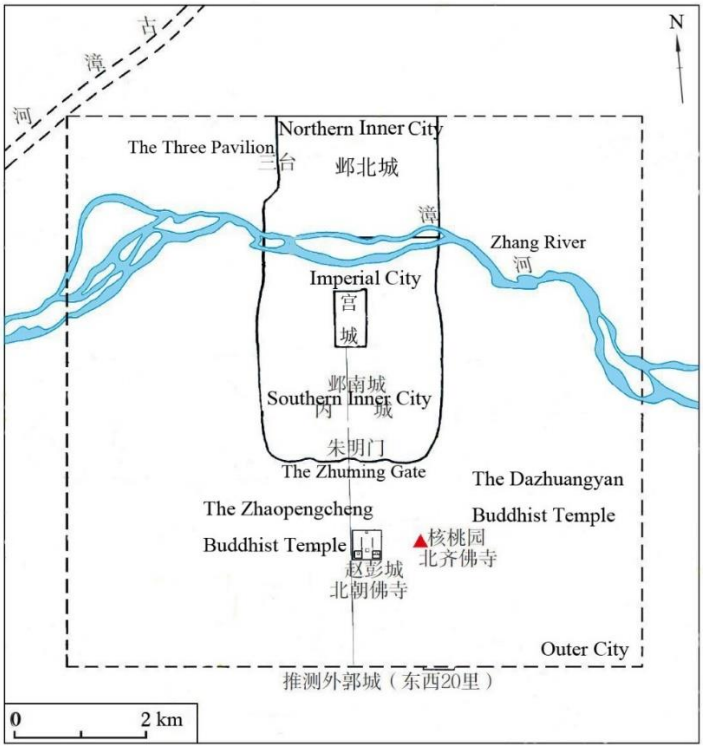

Figure 46 The urban plan of Yecheng (Source: Zhongguo shehui kexue yuan kaogu yanjiusuo hebeisheng wenwu yanjiusuo lianhe yecheng kaogudui 2018, Fig. 1)

Buddhism in Yecheng was flourishing during the Eastern Wei, and Northern Qi Dynasties and the construction of Buddhist temples in Yecheng had not stopped at that time. According to the book, *Lidai sanbao ji*, there were more than 30,000 temples and 2,000,000 monks in the Northern Qi Dynasty.[26] The book, *Xu gaoseng zhuan*, records that there were nearly 4,000 sizable temples and 80,000 monks in Yecheng.[27] The Book, *Fayuan zhulin*, says that during the Northern Qi Dynasty, 43 royal Buddhist temples were built.[28] The number of temples may have been overstated in the literature related to Buddhism, but it also illustrates the prosperousness of Buddhism in Yecheng during the Eastern Wei and Northern Qi Dynasties.

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[26] *Lidai sanbao ji*: "受東魏禪稱齊. 仍即都鄴. ……沙門二百餘萬. 寺塔出三十千." Fei changfang, *Lidai sanbao ji*, vol.9, 0082b10.
[27] *Xu gaoseng zhuan*: "屬高齊之盛，佛教中興，都下大寺略計四千，見住僧尼僅將八萬." Dao xuan, *Xu gaoseng zhuan*, vol.10, p. 337.
[28] *Fayuan zhulin*: "高齊六君二十八載，皇家立寺四十三所." Dao shi, *Fayuan zhulin*, vol.100, p. 2893.

2. The Archaeological Sites Related to Buddhism in Yecheng

Since the 1950s, more than ten sites related to Buddhism were excavated in Yecheng, with many ornately carved statues and numerous remains of building materials unearthed. Only two sites were proved to be Buddhist temples after excavation, including the DBT and the ZhaoPengcheng Buddhist Temple. Other sites may have been places where Buddha statues were hidden during the Buddhist Persecution in the period of the Emperor Wuzong (唐武宗). This section will provide a brief introduction of three important sites.

DBT. These were located to the east of the main street, outside the Southern Inner City, and since 2012, they have been researched by the Yecheng Archaeological Team of the Institute of Archaeology, Chinese Academy of Social Sciences. Five rammed-earthed foundations were found, and three of them were excavated, including the foundations of the tower, main hall, and gate (He and Shen 2016; Zhongguo shehui kexueyuan kaogu yanjiusuo 2016).

Zhaopengcheng Buddhist Temple. This also to the east of the main street, outside the Southern Inner City, and since 2002, it has been excavated by the Yecheng Archaeological Team. The temple consisted of a tower, the main hall, two courtyards, and ditches surrounding the buildings (Zhongguo shehui kexueyuan kaogu yanjiusuo, Heibeisheng wenwu yanjiusuo lianhe Yecheng kaogudui 2010).

The Hoard of Buddha Statues in Beiwuzhuang (北吳莊) Village. This was found to the east of the Southern Inner City and was excavated in 2010 by the Yecheng Archaeological Team. Nearly 3,000 fragments of Buddha statues were unearthed from this site (Zhongguo shehui kexueyuan

kaogu yanjiusuo, Heibeisheng wenwu yanjiusuo lianhe Yecheng kaogudui 2012).

3. The Distribution of Buddhist Temples in Yecheng, According to Historical Literature

Most of the previous studies on the Buddhist temples in Yecheng focused on Buddhist grottoes or the structure of individual temples (He 2014a, 2014b; Li 2014), and the distribution of Buddhist temples in Yecheng have not been fully discussed. From historical literature, 38 names of Buddhist temples were found, and the location of half have been deduced, which can shed light on the distribution of Buddhist temples in Yecheng. Based on the main street and the Southern wall of the Northern Inner City, Yecheng can be divided into three parts; the western part of the Inner City and Outer City, which belonged to Ye County (鄴県), the eastern part of the Inner City and Outer City, which belonged to Linzhang County (臨漳県), and the Northern Inner City and the northern part of the Outer City, which belonged to Cheng'an County（成安県). Outside the Outer City, there were suburban areas. According to *Weishu*, the area within 15 kilometers were still controlled by the three counties, but outside this area were the outer suburbs of Yecheng, which belonged to Qingdu Yin (清都尹).[29] The names of Buddhist temples located in these four areas are listed below (Table 9, Figure 47, Figure 48).

[29] *Beiqi shu*: "京城下有鄴，臨漳，成安三縣，輦轂之下，舊號難治." The extent of the three counties is recorded in *Suishu*: "鄴又領右部，南部，西部三尉. 又領十二行經途尉. 凡一百三十五里，里置正. 臨漳又領左部，東部二尉，左部管九行經途尉. 凡一百一十四里，里置正. 成安又領後部，北部二尉，後部管十一行經途尉，七十四里，里置正." *Weishu*: "至如三十里之郊." Li baiyao, *Beiqi shu*, vol.46, p. 646. Wei zheng, *Sui shu*, vol.27, p. 761. Wei shou, *Wei shu*, vol.55, p. 1224.

Table 9 The distribution of Buddhist temples in Yecheng

Location	Temples
Ye county	Daci Buddhist temple (大慈寺),[30] Baoming Buddhist temple (宝明寺),[31] and Baoshan Buddhist temple (宝山寺).[32]
Linzhang county	Guangfa Buddhist temple (広法寺),[33] Dazongchi Buddhist temple (大総持寺).[34] DBT (大荘厳寺),[35] Dayan Buddhist temple (大衍寺),[36] and Dajue Buddhist temple (大覚寺).[37]
Cheng'an County	Xingsheng Buddhist Temple (興聖寺),[38] Dingguo Buddhist Temple (定国寺),[39] Wenchang Buddhist Temple (文昌寺),[40] Zhongxing Buddhist Temple (中興寺),[41] Baima Buddhist Temple (白馬寺),[42] and Tianping Buddhist Temple (天平寺).[43]
Qingdu Yin	Xiuding Buddhist Temple (修定寺),[44] Lujushi Buddhist Temple (陸居士寺)[45], Hanlingshan Buddhist Temple (韓陵山寺),[46] Honggu Buddhist Temple (洪谷寺),[47]

[30] *Dushi fangyu jiyao*: "（開皇十年）復鄴縣為安陽，靈芝仍為鄴縣，縣治即故鄴都大慈寺." Gu zuyu, *Dushi fangyu jiyao*, p. 2322.
[31] *Xu gaoseng zhuan*: "釋僧雲……住寶明寺，襟帶眾理……將昇草座，失雲所在……乃於寺側三里許於古塚内得之." Cemeteries of the Eastern Wei and Northern Qi Dynasties were located to the west of Yecheng. Dao xuan, *Xu gaoseng zhuan*, vol.26, p.1003.
[32] *Xu gaoseng zhuan*: "釋道憑，姓韓，平恩人……（天保十年三月七日）卒於鄴城西南寶寺."Dao xuan, *Xu gaoseng zhuan*, vol.8, pp. 258–259.
[33] *Xiangtai zhi*: "妙福寺在彰德府臨漳縣東一百步，北齊時置於鄴縣東城公子坊内. 本名廣法寺，後移置於此，隋開皇七年改今額." Chen shenzhi, with commentaries assembled by Xu zuomin, *Xiangtai zhi*, in *Yedu yizhi jijiaozhu*, p. 200.
[34] *Beiqi shu*: "（河清二年五月壬午）詔以城南雙堂閏位之苑，廻造大總持寺." *Beiqi shu*: "（武定七年七月辛卯）王遇盜而殂. ……时太原公洋在城東雙堂，入而討賊." Li baiyao, *Beiqi shu*, vol.7, p. 91. Li baiyao, *Beiqi shu*, vol.3, pp. 37–38. Guo Jiqiao pointed out that the site of the Zhaopengcheng Buddhist Temple was the Dazongcheng Buddhist Temple in the Northern Qi Dynasty (Guo jiqiao 2014).
[35] The epigraph of Zhao Ji was found at the site of the Hetaoyuan Buddhist Temple, which recorded that Zhao Ji and his wife were buried in the area of the Dazhuangyan Buddhist Temple of the Northern Qi Dynasty. "明堂園東莊嚴寺之所" (Zhongguo shehui kexueyuan kaogu yanjiusuo 2014).
[36] *Xu gaoseng zhuan*: "侯景又於鄴東為造大衍寺." Dao xuan, *Xu gaoseng zhuan*, vol.22, p.827.
[37] *Xu gaoseng zhuan*: "釋僧範，姓李氏，平鄉人也……（天保六年三月二日）時當正午，遺誡而卒於鄴東大覺寺." Dao xuan, *Xu gaoseng zhuan*, vol.8, pp. 253-254.
[38] *Beiqi shu*: "（河清二年）秋八月辛丑，詔以三臺宮為大興聖寺." Li baiyao, *Beiqi shu*, vol.7, p. 92.
[39] *Taiping huanyuji: "*南臺，（後魏書）云:東魏遷鄴，高丞相以南臺為定國寺，作磚浮屠極高." The Dingguo Buddhist Temple was in the Northern Inner City. Yue shi, *Taiping huanyuji*, p. 1136.
[40] *Yezhongji*: "（後魏興和二年）以魏文昌殿名加為寺号." The Wenchang Buddhist Temple was in the Northern Inner City. Anonym, with commentaries assembled by Xu Zuomin, *Yezhongji*, in *Yedu yizhi jijiaozhu*, p. 132.
[41] *Beiqi shu*: "（皇建末）时丞相府在北城中，即舊中興寺也." Li baiyao, *Beiqi shu*, vol.14, p. 183.
[42]*Xu gaoseng zhuan*: "昔齊武平末，鄴古城中白馬寺，此是石趙時浮圖澄所建." Dao xuan, *Xu gaoseng zhuan*, vol.8, p.266.
[43] *Wei shu*: "（興和二年春）詔以鄴城舊宮為天平寺." Wei shou, *Wei shu*, vol.114, p. 3047.
[44] *Xiangtaizhi*: "修定寺在彰德府臨漳縣鎮西七十里合水山下." Chen sehnzhi, with commentaries assembled by Xu zuomin, *Xiangtaizhi*, in *Yedu yizhi jijiaozhu*, p. 203.
[45] *Xiangtaizhi*: "陸居士寺，在彰德府臨漳縣鄴城東南十七里." Chen sehnzhi, *Xiangtaizhi*, with commentaries assembled by Xu zuomin, *Xiangtaizhi*, in *Yedu yizhi jijiaozhu*, p. 201.
[46] The Hanlingshan Buddhist Temple was to the south of Yecheng, on the top of the Hanling Mountain. Anonym, with commentaries assembled by Xu Zuomin. *Xuxiangtaizhi*, in *Yedu yizhi jijiaozhu*, p. 302.
[47] *Xiangtaizhi*: "達性好林泉，不樂居都城，文宣乃於林慮山造寺." Chen sehnzhi, with commentaries assembled by Xu zuomin, *Xiangtaizhi*, in *Yedu yizhi jijiaozhu*, p. 211.

	Yunmen Buddhist Temple (雲門寺),[48] Jingguo Buddhist Temple (浄国寺),[49] Southern Xiangtang Buddhist Grottoes (南響堂山石窟寺), Northern Xiangtang Buddhist Grottoes (北響堂山石窟寺), and Changle Buddhist Temple (常楽寺).
Unknown	Taiyuan Princess Buddhist Temple (太原公主寺),[50] Qidi Buddhist Temple (七帝寺),[51] Miaoshengni Buddhist Temple (妙勝尼寺),[52] Xianyi Buddhist Temple (顕義寺),[53] Daji Buddhist Temple (大集寺),[54] Taixue Buddhist Temple (太学寺),[55] Guangguo Buddhist Temple (広国寺),[56] Baode Buddhist Temple (報德寺),[57] Riguangzhu Buddhist Temple (日光住寺),[58] Jiede Buddhist Temple (戒德寺),[59] Dingkou Buddhist Temple (定寇寺),[60] Dabaolin Buddhist Temple (大宝林寺),[61] Banzhou Buddhist Temple (般舟寺),[62] Jinhua Buddhist Temple (金華寺), and Changding Buddhist Temple (昌定寺).[63]

[48] *Xu gaoseng zhuan*: "（天保三年）又勑於鄴城西南八十里龍山之陽為構精舍，名雲門寺." Dao xuan, *Xu gaoseng zhuan*, vol.16, p. 576.

[49] *Xu gaoseng zhuan*： "當有齊之盛，釋教大興…….（釋曇遷）遂竄形林慮山黄花谷中浄國寺." Dao xuan, *Xu gaoseng zhuan*, vol.18, pp. 660–661.

[50] *Xiangtaizhi*: "文宣禪位，以后為太原公主，天保六年公主為尼，因置此寺於苑." Chen sehnzhi, with commentaries assembled by Xu zuomin, *Xiangtaizhi*, in *Yedu yizhi jijiaozhu*, p. 201.

[51] Zizhitongjian: "齊主初受禪，魏神主悉寄於七帝寺." Sima guang, Zizhitongjian, p. 5076.

[52] *Beiqi shu*: "犢車載送妙勝尼寺. 后性愛佛法，因此为尼." Li baiyao, *Beiqishu*, vol.9, p. 125.

[53] *Xu gaoseng zhuan*: "於鄴顯義寺請範冬講." Dao xuan, *Xu gaoseng zhuan*, vol.8, p. 254.

[54] *Xu gaoseng zhuan*: "釋明瞻，姓杜氏，恒州石邑人也. ……乃致書與鄴下大集寺道場法師令其依攝." Dao xuan, *Xu gaoseng zhuan*, vol.25, p. 935.

[55] *Xu gaoseng zhuan*: "有太學寺融智法師，大齊國統法上之神足也. " Dao xuan, *Xu gaoseng zhuan*, vol.10, p. 337.

[56] *Xu gaoseng zhuan*: "釋慧海，姓張氏，清河武城人. ……師事鄴都廣國寺囧法師." Dao xuan, *Xu gaoseng zhuan*, vol.12, p. 402.

[57] *Xu gaoseng zhuan*: "（天寶二年）又下詔曰：……廢鷹師曹為報德寺." Dao xuan, *Xu gaoseng zhuan*, vol.8, p. 261.

[58] *Xu gaoseng zhuan*: "釋法礪，俗姓李氏，趙人也……以貞觀九年十月卒于故鄴日光住寺." Dao xuan, *Xu gaoseng zhuan*, vol.23, p. 860.

[59] *Xu gaoseng zhuan*: "貞觀中，洺州宋尚禮者……罷縣還，貧無食，好乞貸。至鄴戒德寺貸粟，數與不還." Dao xuan, *Xu gaoseng zhuan*, vol.27, p.1077.

[60] *Xu gaoseng zhuan*: "達性愛林泉，居閑濟業，帝為達於林慮山黄華嶺下立洪谷寺，又捨神武舊廟造定寇寺，兩以居之." Dao xuan, *Xu gaoseng zhuan*, vol.16, p.571.

[61] *Beiqishu*: "又為胡昭儀起大慈寺，未成，改為穆皇后起大寶林寺. 窮極工巧，運石填泉，勞費億計，人牛死者，不可勝紀." Li baiyao, *Beiqi shu*, vol.8, p. 113.

[62] *Lidai sanbao ji*: "伽耶頂經論二卷，天平二年在鄴城般舟寺出. 一云文殊師利問菩提心經論，僧辯道湛筆受. " Fei changfang, *Lidai sanbao ji*, vol.9, 0086a19.

[63] *Kaiyuan shijiao lu*: "（孝靜帝元象元年戊午至武定元年癸亥）於鄴城內在金華，昌定二寺及尚書令，儀同高公第內，譯得無垢女等經一十八部." Zhi sheng, *Kaiyuan shijiao lu,* vol.6, p. 413.

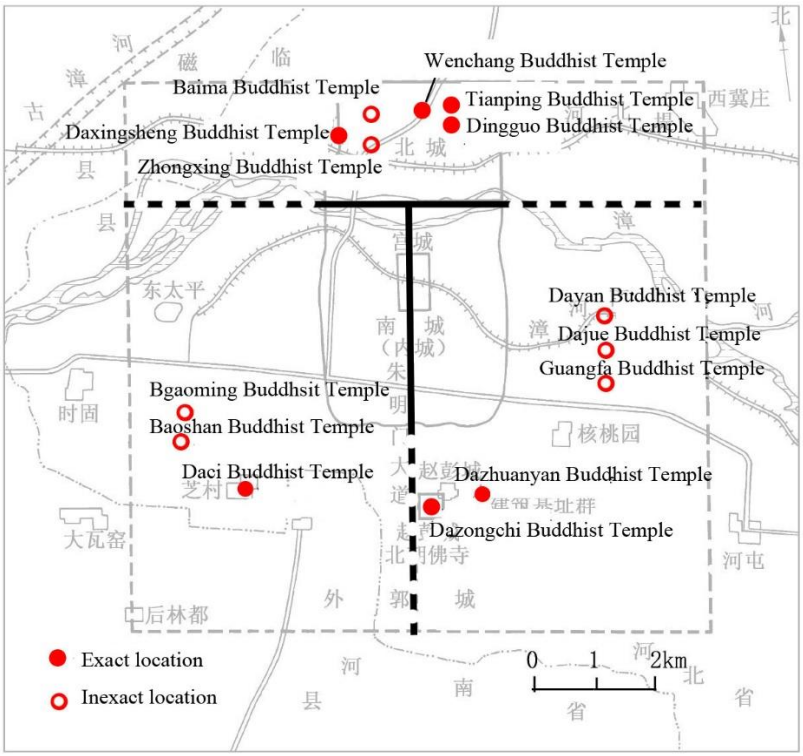

Figure 47 The distribution of Buddhist temples in Yecheng

(Source: Made by the author)

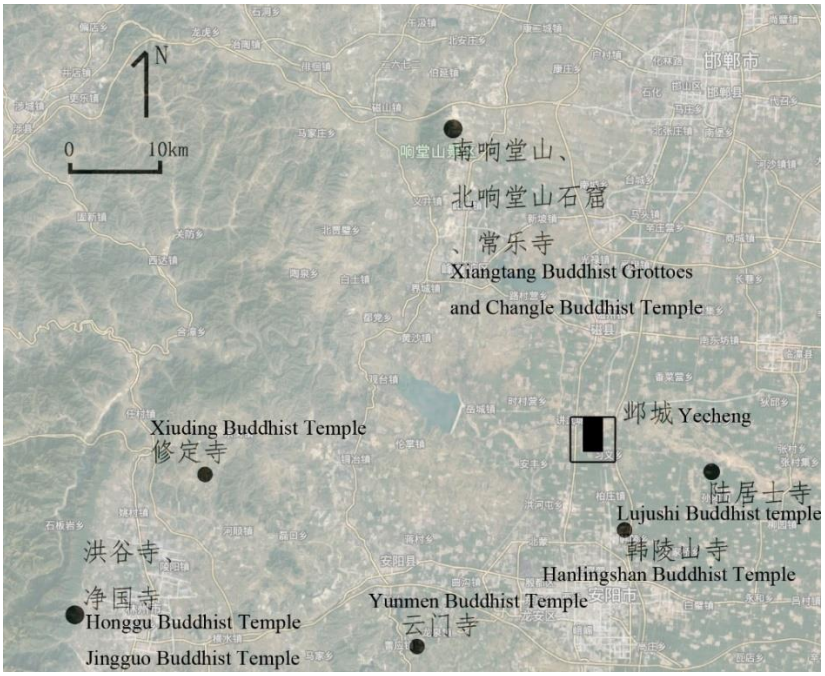

Figure 48 The distribution of Buddhist temples outside Yecheng

(Source: Made by the author)

In Yecheng and its suburban areas during the Eastern Wei and Northern Qi Dynasties, thousands of Buddhist temples were built, but the location of only a few of them is recorded in historical literature. By analyzing these records, the basic setting of the temples' distribution in Yecheng can be determined. Overall, the temples in the southern part of Yecheng were mostly built in the Eastern Wei and Northern Qi Dynasties, while the temples in the northern part were usually old palaces or houses donated by royal families and noble people. In addition, the temples outside Yecheng were in the mountains to the west of Yecheng.

According to the records in historical literature, some of the temples mentioned above were royal Buddhist temples, such as the DBT, the Dazongchi Buddhist Temple, and the Dingguo Buddhist Temple, which were closely related to the royal family. The orders to build these temples were given directly by the emperor, or the buildings of the temples were donated by the royal family. Sometimes, emperors' wives or daughters became nuns in some of the temples, such as the Miaoshengni Buddhist Temple and the Taiyuan Princess Buddhist Temple, so they were also treated as royal Buddhist temples. Funding for building these royal Buddhist temples was provided by the government, and other temples were built by noble people, bureaucrats, or rich citizens.

The royal Buddhist Temples in the Northern Inner City were mostly reclaimed the old palaces or government offices, and subsequently, the distribution of temples in this area was influenced by the location of the high-ranking buildings of the preceding dynasty. Meanwhile, the newly built royal Buddhist temples in the southern part of Yecheng were planned carefully. Most of these were built in the southern part of the Outer City, near the main street, such as the Dazongchi

Buddhist Temple and the DBT. It should be mentioned that all of the newly built royal Buddhist temples were located outside the Inner City, which may have been related to the urban plan made by the Emperor Xiaowen. He gave an order that only one temple for monks and one temple for nuns could be built within Luoyang city.[64] Although this rule was broken at the end of the Northern Wei Dynasty, the ruler of the Eastern Wei and Northern Qi Dynasties may have wanted to control the number of Buddhist temples in the same way as Emperor Xiaowen had done at the beginning of the new dynasty.

4. The Research Objects of this Dissertation

Roof tiles unearthed from royal Buddhist temples were chosen to be the research object of this study. There were more than 4,000 large-scale temples in Yecheng, but only the DBT and the Dazongchi Buddhist Temple (Zhaopengcheng Buddhist Temple) were excavated. All of the remains unearthed from the DBT were collected, which are valuable materials for research into roof tiles and the construction process of Buddhist temples. Since 2015, the roof tiles of the DBT in Yecheng have been arranged systematically many times. Therefore, this part will focus on the roof tiles unearthed from the DBT to clarify the production and utilization of the roof tiles, as well as the related construction project of this temple. To understand the construction project of the royal Buddhist temples in the Eastern Wei and Northern Qi Dynasties, roof tiles from other contemporaneous Buddhist temples or other high-ranking buildings will also be discussed synoptically at the end of this part.

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[64] *Wei shu*: "（神龜元年冬）司空公、尚書令、任城王澄奏曰：……故都城制云，城内唯擬永寧寺地，郭内唯擬尼寺一所，餘悉城郭之外." Wei shou, *Wei shu,* vol. 114, p. 3044.

CHAPTER 2. Roof Tiles and the Construction of the Dazhuangyan Buddhist Temple

Section 1. Site of the Dazhuangyan Buddhist Temple and its Roof Tile

1. Information about the Dazhuangyan Buddhist Temple

The DBT of the Northern Qi Dynasty is located to the southeast of the Southern Inner City in Yecheng. It was 1200m south of the wall of the Southern Inner City and 830m east of the Site of the Dazongchi Buddhist Temple in Zhaopengcheng Village. From north to south, there were the foundations of a tower (No. 1 Architectural Site), a gate (No. 5 Architectural Site), main hall (No. 2 Architectural Site), and two other rammed-earth foundations.

The No. 1 Architectural Site, likely the foundation of a Buddhist tower, was excavated in 2012 and 2013. It had a rammed-earth foundation with a side length of 30m, surrounded by brick ditches, 2.5m wide brick ground, Sanshui (散水), and stone fragments. Four 2.5m wide steps stretched from the foundation in four directions. All traces of the pillars on the surface of the foundation were worn away, but after the rammed earth was excavated, a stone box and a ceramic pot were found which may have been related to the central pillar of the tower (Figure 49). Numerous roof tiles were unearthed from the fourth layer, which is the deposit of broken building materials from the tower, and all of the remains were collected during excavation (Zhongguo shehui kexueyuan kaogu yanjiusuo 2016).

The No. 5 Architectural Site, located to the north of the tower, is likely to be a gate of this temple.

It has two foundation layers, and the later one, which is 23.75m long and 14.3m wide and linked to two 6m wide corridors foundations on the eastern side and western side, was built during the Northern Qi Dynasty (Figure 50). All of the remains of the roof tiles were unearthed from the fourth layer, which is the deposits of the building materials, and were collected completely during the excavation (Zhongguo shehui kexueyuan kaogu yanjiusuo 2018).

The No. 2 Architectural Site is located to the north of the gate. Two steps led from the southern side of the foundation and another one led down from the northern side. It was connected to the accessory buildings, which led in a north-south direction, by corridors on the eastern and western sides. This foundation, likely to be the main hall of the temple, was excavated in 2016, and numerous remains of the roof tiles were unearthed from the fourth layer, which is the deposit of the destroyed building, and collected completely. There are several fragments of white porcelain, which were made in the later period, found from the fourth layer. This indicated that the fourth layer might have been disturbed in the vertical direction, but the position of remains in the horizontal direction might not have changed very much (Shen 2018).

The epigraph of Zhao Ji (趙覬) was found 200m southwest to the foundation of the tower. It recorded that Zhao Ji and his wife were buried in the area of the DBT of the Northern Qi Dynasty. Subsequently, the site is thought to be the DBT of the Northern Qi Dynasty. (Zhongguo shehui xueyuan kaogu yanjiusuo 2016).

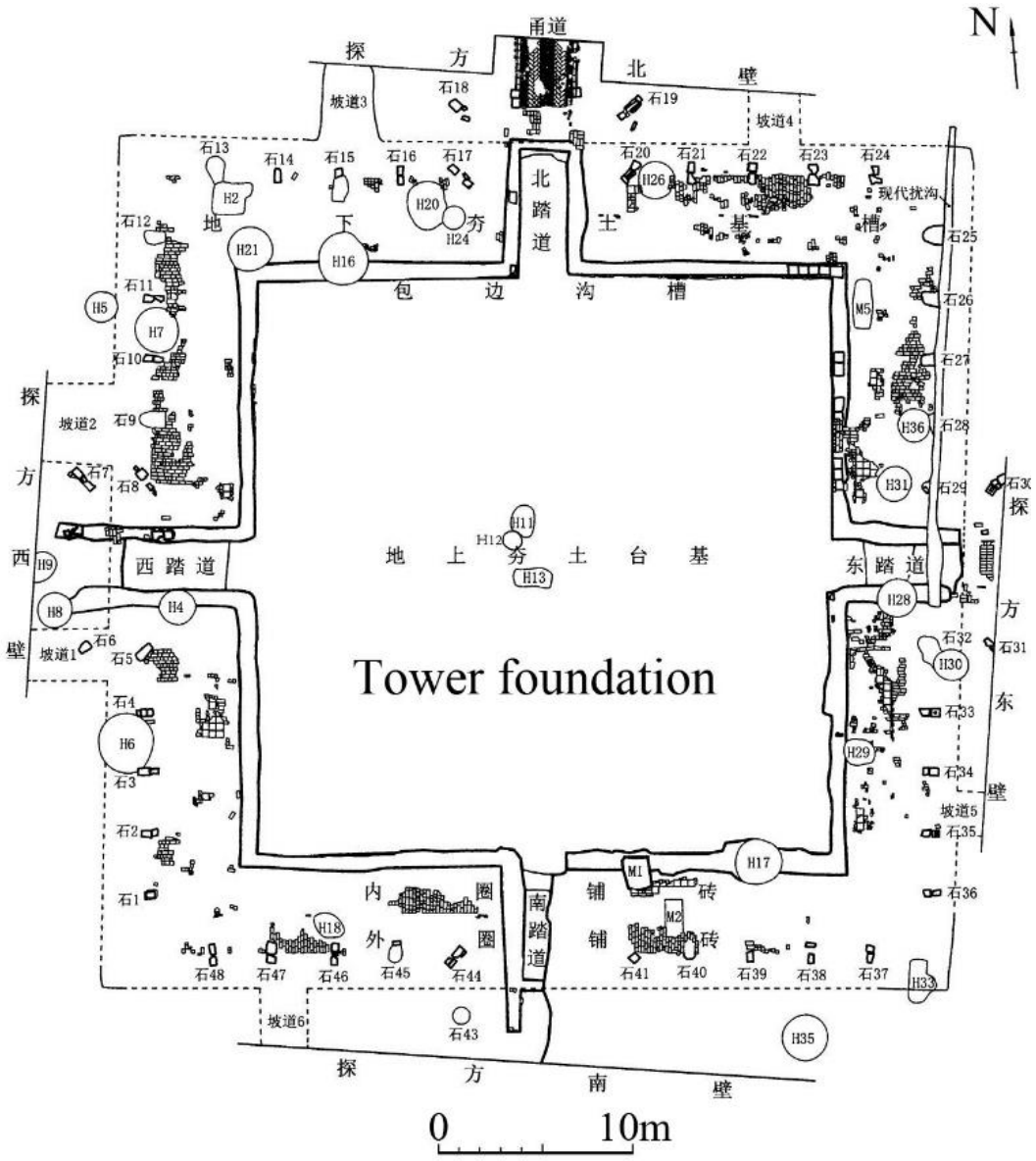

Figure 49 The layout of the No. 1 Architectural Site (Source: Zhongguo shehui kexue yuan kaogu yanjiusuo hebeisheng wenwu yanjiusuo lianhe yecheng kaogudui 2016, Fig. 7)

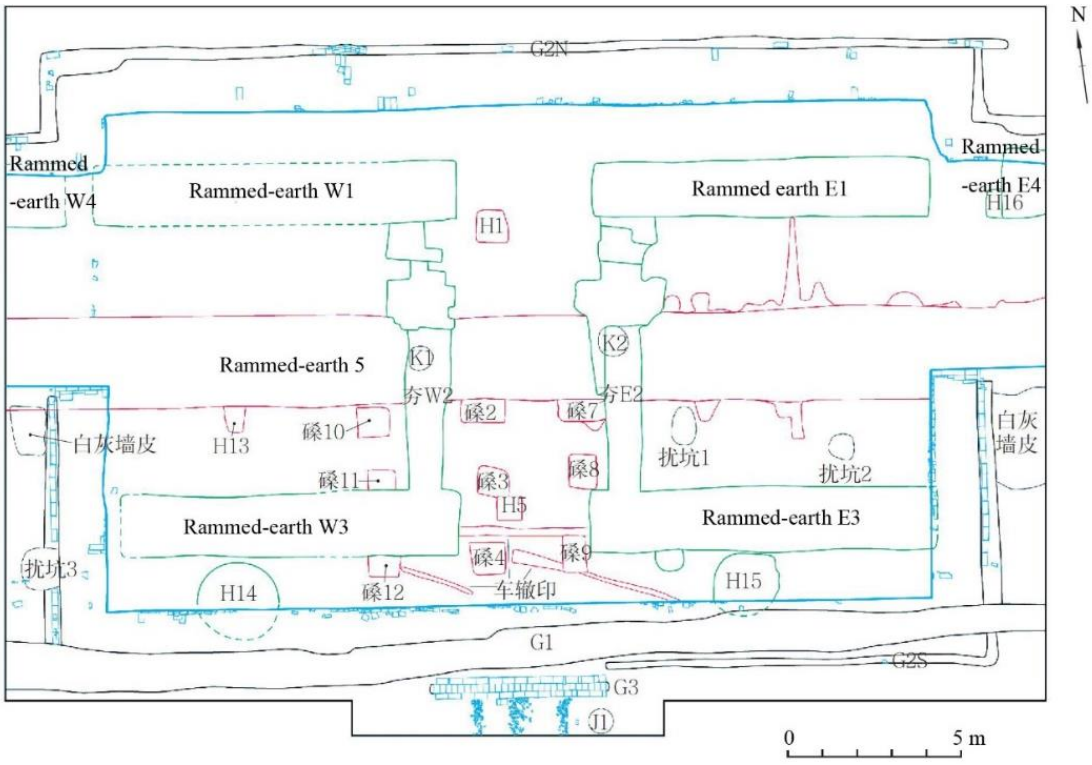

Figure 50 The layout of the No. 5 Architectural Site (Source: Zhongguo shehui kexue yuan kaogu yanjiusuo hebeisheng wenwu yanjiusuo lianhe yecheng kaogudui 2018, Fig. 6)

2. The Information about Roof Tiles

2.1 The Samples of the Roof Tiles

The roof tiles were divided into two groups according to their arrangement, which was treated in different ways. The samples of the roof tiles can provide the exact data of the sizes or have special features. Meanwhile, the fragments of the roof tiles, unearthed from the whole site or specific areas, were used to conduct the statistical analysis.

At the No. 1 Architectural Site, there are 273 imbrex samples, 272 tegula samples, five roof tiles

samples with characters, and 781 tile-ends samples with at least one petal,[65] in which the diameters of 265 samples could be measured. Fragments unearthed from the southeastern part of the foundation were also collected. Counting the number of samples and fragments, there are 1241 remains of the imbrices, 3092 remains of tegulae,[66] and 141 remains of the tile-ends, for statistical analysis.

At the No. 2 Architectural Site, there are 39 imbrex samples, 34 tegula samples, 991 roof tiles samples with characters, in which 702 samples are still legible, and 242 tile-ends samples with at least one petal, in which the diameters of 116 samples' diameter could be measured.

At the No. 5 Architectural Site, there are 68 imbrex samples, 19 tegula samples, 522 roof tiles samples with characters, in which 382 samples are still legible, and 115 tile-ends samples with at least one petal, in which the diameters of 41 samples' diameter could be measured. All of the fragments unearthed from this site were collected and counted, revealing 2,840 imbrex remains, tegulae 10,534 remains, and 215 tile-ends remains for the statistical analysis.

2.2 The Classification of the Roof Tiles

2.2.1 The Clay Bodies of the Roof Tiles

The clay bodies of most of the roof tiles unearthed from this site are blue-grey, with few impurities. There are also some imbrices with yellow-brown bodies found in the western and eastern side of the No. 5 Architectural Site.

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[65] If the sample has both tile-ends and imbrices, it was counted twice.

[66] It includes the number of danggous (当溝) made by imbrices and ridge tiles made by the tegulae.

2.2.2 The Exposed Surfaces of the Roof Tiles

The exposed surface points on the concave surfaces of the tegulae and convex surfaces of the imbrices were laid upward when the roof tiles were installed on the roofs. The imbrices used in the DBT are two different types of surface styles: simply-trimmed surface (Figure 51-4) and polished-black surface (Figure 51-3). The tegulae also have two types of surface style: untrimmed surface (Figure 51-2) and polished-black surface (Figure 51-1). Most of the tile-ends from this site have polished-black surfaces, joined to the polished-black imbrices. It is worthwhile noting that the imbrices with yellow-brown bodies only have simply-trimmed surfaces. There are also two pieces of imbrices with glazed surfaces, but they are too small to provide any further information.

1 2 3 4

Figure 51 The exposed surface of the roof tiles (Source: Photos by the author) 1. Polished-black tegula, 2. Untrimmed tegula, 3. Polished-black imbrex, 4. Simply-trimmed imbrex

2.2.3 The Size of the Roof Tiles

The information about the roof tiles' size is listed below.[67] At the No. 1 Architectural Site, there were:

[67] In order to avoid counting repeatedly, the diameter of only one end of an imbrex was measured.

- 102 imbrex samples whose diameter can be measured,
- 52 imbrex samples whose length can be measured,
- 47 polished-black tegula samples for the width of the lower end,
- 19 polished-black tegula samples for the width of the upper end,
- 21 polished-black tegula samples for the length,
- 33 untrimmed tegula samples for the width and one sample for the length,
- 265 samples of the tile-ends whose diameter can be measured.

At the No. 2 Architectural Site there were:

- 39 imbrex samples whose diameter can be measured,
- One imbrex sample whose length can be measured,
- Two polished-black tegula samples for the width of the lower end,
- one polished-black tegula sample for the length,
- Two untrimmed tegula samples for the width,
- 116 samples of the tile-ends whose diameter can be measured.

At the No. 5 Architectural Site there were:

- 19 imbrex samples whose diameter can be measured,
- 110 imbrex fragments with a lower end whose diameter can be estimated,
- Six imbrex samples whose length can be measured,
- 11 polished-black tegula samples for the width of the lower end,
- Three polished-black tegula samples for the width of the upper end,
- Two polished-black tegula samples for the length,
- Three untrimmed tegula samples for the width,
- 41 samples of the tile-ends whose diameter can be measured.

Table 10 The sizes of the imbrices and tile-ends

	Rank of the diameter	No. 1 Architectural Site		No. 2 Architectural Site		No. 5 Architectural Site	
		Diameter	Length	Diameter	Length	Diameter	Length
The main body of polished-black imbrices[68]	Size 1: <12.5	11.2–12.4	23.5–27	-	-	-	-
	Size 2: 15.5±1	-	-	14.5–16	34.9	14.4–16	33.3-41
	Size 3: 17.5±1	16.5–19	Unknown	16.4–18.5	Unknown	16.4–17.6	Unknown
Polished-black tile-ends	Size 1: >12.5	10.6–12		9.3		-	
	Size 2: 15.5±1	15		14.6–16		14.7–16.3	
	Size 3: 17.5±1	17.2–18.8		16.4–18.1		-	
Simply-trimmed imbrices		-	-	-	-	14–15	Unknown

Table 11 The size of the tegulae

	Length * width	No. 1 Architectural Site			No. 2 Architectural Site			No. 5 Architectural Site		
		Length	Width of lower end	Width of upper end	Length	Width of lower end	Width of upper end	Length	Width of lower end	Width of upper end
Polished-black tegulae with finger-pinched traces	Size 1: 30*20	27–28.2	21.5–23	19–22	-	-	-	-	-	-
	Size 2: 40*30	Unknown	29	Unknown	38.7	31–33.5	Unknown	39.5	28.9–30.5	29.6
Polished-black tegulae with double wave-shaped pattern	Size 1: 30*20	25.5–28.5	19.5–24	19–22	-	-	-	-	-	-
	Size 2: 40*30	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	29.5–32.3	28.5–30.6
	? * 36	-	-	-	-	-	-	Unknown	36	Unknown
Untrimmed tegulae with finger-pinched traces		27.5	6.5–13.5		-	-		-	-	
		Unknown	10–21		Unknown	16–18		Unknown	13.5–16.8	

[68] Including imbrices with tile-ends and imbrices without tile-ends.

Table 10 and Table 11 illustrate that the size of the roof tiles unearthed from the No. 2 Archaeological Site is similar to the samples from the No. 5 Archaeological Site. The standard imbrices are 15.5±1cm or 17.5±1cm wide, and the size of the tegulae are 40*30cm^2. The width of the untrimmed tegulae is one third or a half of the standard size. The roof tiles at the No. 1 Architectural Site have two sizes. The large size imbrices are 17.5±1cm wide, which is similar to a part of samples from the No. 2 and No. 5 Architectural Sites, while the size of the large tegulae is also 40*30cm^2. The diameter of the small size imbrices is under 12.5cm, and the size of the small tegulae are 30*20cm^2. The roof tiles of the small size cannot be found in other sites. In addition, there are also four tile-ends with a diameter of 15.5±1cm from the No. 1 Architectural Site and a tile-end with a diameter of 10cm at the No. 2 Architectural Site. However, there are no imbrices that could be joined to them so they may have been mixed in from other sites. There was also a 36cm wide tegula with a double wave-shaped pattern unearthed from the No. 5 Architectural Site, but as there is only one sample, this cannot provide enough information.

2.2.4 The Pattern of the Roof Tiles

The tegulae unearthed from the DBT are decorated with double wave-shaped patterns (Figure 52-1) or have finger-pinched traces (Figure 52-2). To make the double wave-shaped pattern, the lower end of a tegula was cut into four layers of clay, and then, the second layer and the fourth layer from the concave side were pinched to make the wave-shaped pattern. The lower end of the latter was then pinched on the convex side. When tegulae were laid on the roofs, the finger-pinched traces cannot be seen, so this could not be treated as a pattern. The tegulae with finger-pinched traces are undecorated type. Meanwhile, a part of the imbrices was joined to the tile-

ends, which can be divided into four types by patterns. Type A is decorated with 8–9 oval petals (Figure 53-1), while type B has eight round petals (Figure 53-2). In addition to oval petals, Type C has beads in the outer area (Figure 53-3), while type D has 12 thin petals (Figure 53-4).

Figure 52 The lower end of the tegulae (Source: Photos by the author)
1. Tile-end with double wave-shaped pattern; 2. Tile-end with finger-pinched traces

Figure 53 The pattern of the imbrices' tile-ends (Source: Photos by the author)
1. Tile-end of type A; 2. Tile-end of type B; 3. Tile-end of type C; 4. Tile-end of type D

2.3 The Results of the Classification

The basic classification of the roof tiles unearthed from the DBT is summarized below (Figure 54, Figure 55):

First, the imbrex and tegula were distinguished from the fragments and both imbrices and tegulae can be subdivided by their lower ends. Imbrices with tile-ends were used for eaves, and samples

without tile-ends were used as general roof tiles for the slope of the roofs. Meanwhile, tegulae with double wave-shaped patterns were matched to the imbrices with tile-ends, used for eaves, and undecorated tegulae were laid on the slope of roofs. The narrow simply-trimmed tegulae were used as ridge tiles.

Second, they were subdivided according to exposed surfaces. The exposed surfaces of the tegulae have two types: untrimmed type and polished-black type. The imbrices' exposed surfaces are the simply-trimmed type or polished-black type. Furthermore, the front surfaces of the tile-ends are mostly polished and blackened. Polished-black roof tiles comprise a significant proportion of these remains, while simply-trimmed imbrices were only found at the No. 5 Architectural Site. The untrimmed tegulae were unearthed all around the site, but they are far less abundant than the polished-black type.

Third, they were subdivided according to size. The diameter of polished-black imbrices has three types: 1. d<12.5cm, 2. d=15.5±1cm, and 3. d=17.5±1cm. The size of the polished-black tegulae has two types: 1. 30*20 cm^2 and 2. 40*30 cm^2. At the No. 1 Architectural Site, size 1 and size 3 imbrices and size 1 and size 2 tegulae were the main materials found. Meanwhile, at the No. 2 and No. 5 Architectural Site, size 2 tegulae and size 2 or size 3 imbrices were mostly unearthed. There were also simply-trimmed imbrices with a 14–15cm diameter and 36cm wide polished-black tegulae unearthed from the No. 5 Architectural Site, but they are not the main materials for this temple. The width of the untrimmed tegulae is one third or a half of the standard size.

Last, they were subdivided according to the roof tiles' patterns. The lower ends of some polished-black tegulae were decorated with double wave-shaped patterns, and they were used for eaves.

The undecorated samples were laid on the slopes of the roofs, and the untrimmed tegulae were also made without decorations. Meanwhile, the tile-ends of the imbrices have four patterns. Tile-ends with oval petals and round petals were mostly found at this temple. The former can be matched to imbrices of all sizes, but the later cannot be joined to size 1 imbrices. Only a few imbrices from the No. 2 and No. 5 Architectural Site were joined to the tile-ends with thin petals or tile-ends with oval petals and beads.

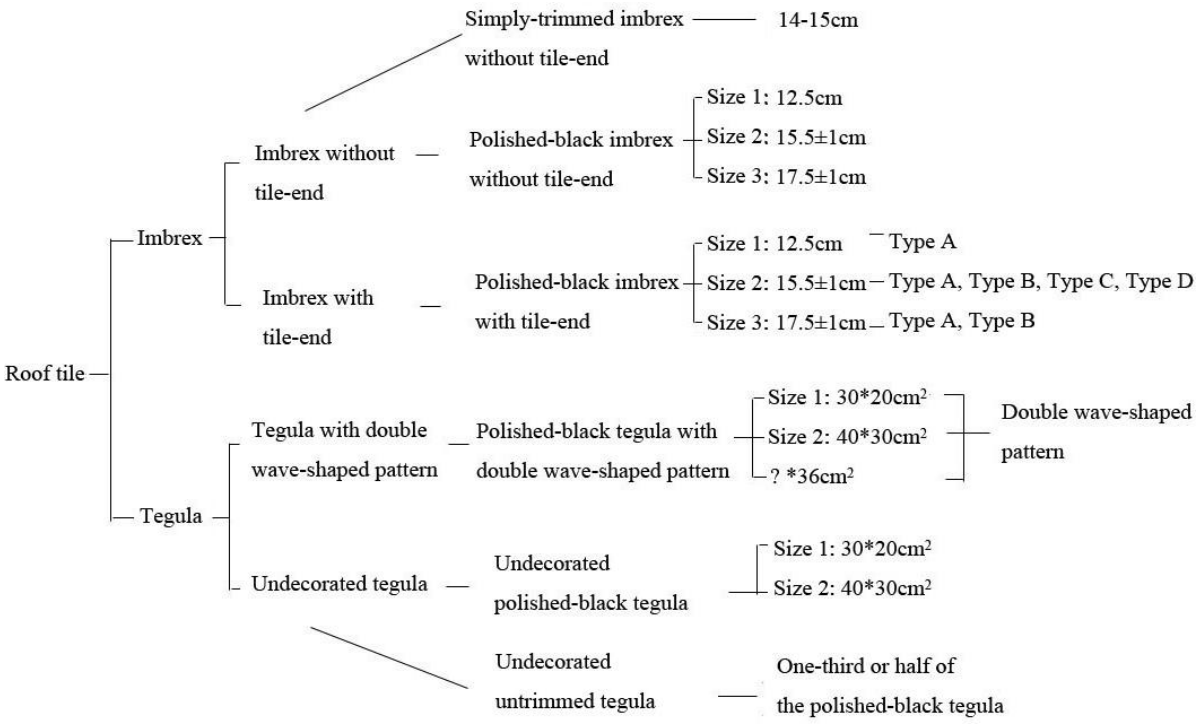


Figure 54 The classification of the roof tiles unearthed from the Dazhuangyan Buddhist Temple (Source: Made by the author)

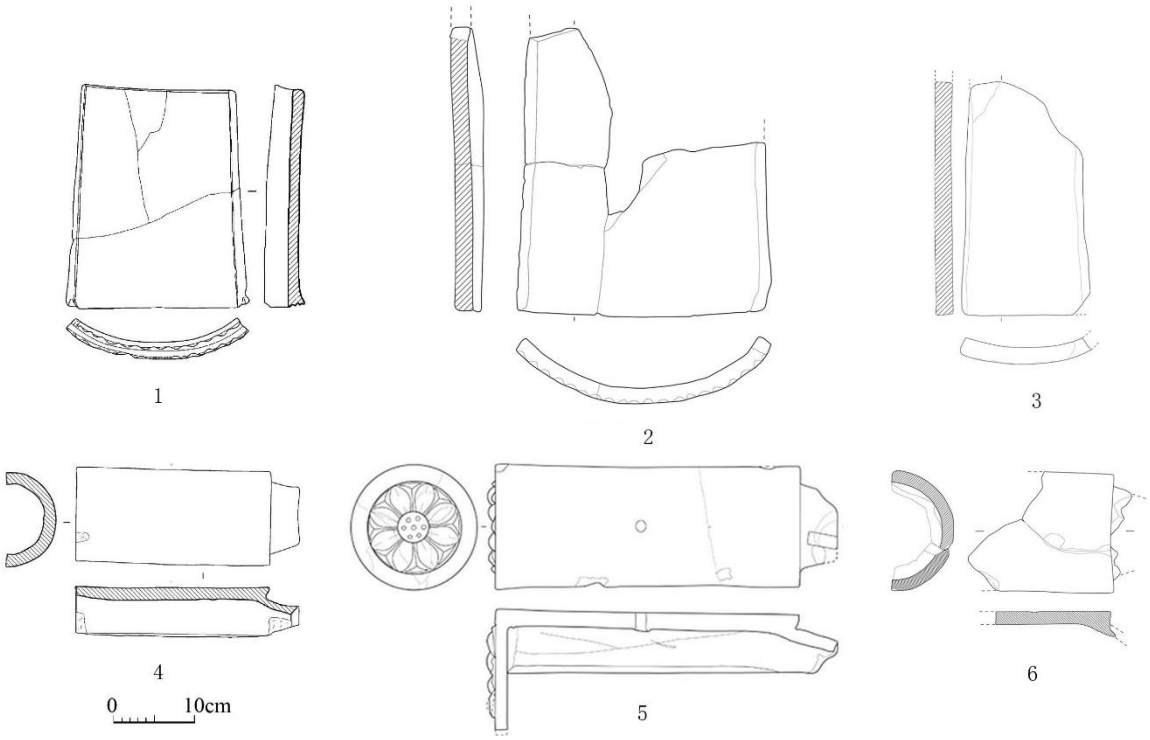


Figure 55 The roof tiles unearthed from the Dazhuangyan Buddhist Temple (Source: Zhongguo shehui kexue yuan kaogu yanjiusuo hebeisheng wenwu yanjiusuo lianhe yecheng kaogudui 2016, Fig. 14-1, 15-3, 2018, Fig. 14-6, 14-8, 16-3, 18-2) 1. Polished-black tegula with a double wave-shaped pattern, size 1; 2. Undecorated polished-black tegula, size 2; 3. Undecorated untrimmed tegula, size 2; 4. Polished-black imbrex without tile-ends, size 1; 5. Polished-black imbrex with tile-ends, size 2; 6. Simply-trimmed imbrex

Section 2. Traces Left in Production and the Production Process of Roof Tile

1. Traces and Production Processes

1.1 Pre-Processing of Raw Materials

The production process of the roof tiles began with the preparation of the clay. By observing the cross-section of the roof tiles, it is clear that the clay used to make the roof tiles unearthed from the DBT was pure. The raw material for the roof tiles must have been carefully elutriated.

1.2 Shaping the Roof Tiles' Bodies

Vertical impressions on the concave surface

On the concave surface of the tegulae unearthed from the DBT, there are vertical impressions left by a set of 4cm wide wooden strips (Figure 56), but there is no obvious impression left on the concave surface of the imbrices. According to previous research, the tegulae used in the northern part of China during the late 6th century were mostly made by barrels shaped inner molds (Zhu 2010), and the imbrices used in ancient East Asia were shaped by integral wooden molds (Ōwaki 1991). The impressions left on the concave surface of the roof tiles from this site are strong evidence for this previous research.

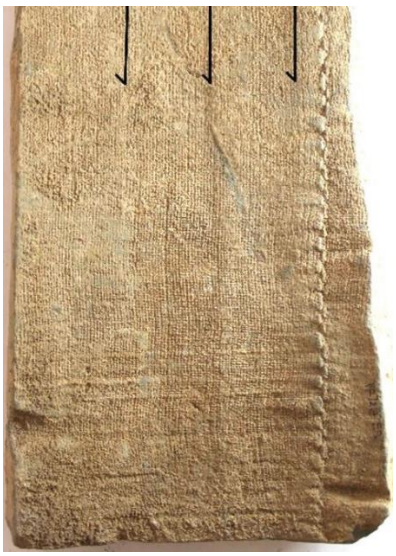


Figure 56 The vertical impressions left on the concave surface of the tegulae (Source: Photo by the author)

Fabric impressions on the concave surface

Fabric impressions were found on the concave surface of the imbrices and a part of the tegulae unearthed from the DBT (Figure 57). This means that the inner molds were wrapped up with cloth

cover, which can help the roof tiles' bodies separate from the mold easily. The concave surfaces of some tegulae had already been polished, and the fabric impressions were mostly swept out, but there are still some traces left on the corners of some samples.

Figure 57 The fabric impressions on the concave surface of the roof tiles
(Source: Photos by the author)
1. Untrimmed tegula, 2. Polished-black tegula, 3. Polished-black imbrex

The cloth cover was sewed up when it was used on a mold, and the seam left two types of traces on the concave surface of the roof tiles (Figure 58). The A Type is a line of alternating bulges, appearing on the concave surface of both tegulae and imbrices, and the B Type is a line of slanting dents, appearing on the concave surface of the tegulae. On the concave surface of some tegulae, the main seam traces appear together with auxiliary seams.

The distinction between the A Type and B Type illustrates the difference in sewing methods. If the artisans folded the cloth lengthwise, sewed the overlapping sides up with running stitches, and then, turned this inside out, a line of alternating dents would appear after the cloth cover was put on the mold and was tightened, which formed the A Type seam traces on the roof tiles'

concave surface. Meanwhile, if the artisans overlapped the two sides of the cloth, sewed them up using whipstitches, and put them on the mold directly, bulges of threads would form the B Type seam traces. The differences in the sewing methods might imply the coexistence of different technique groups.

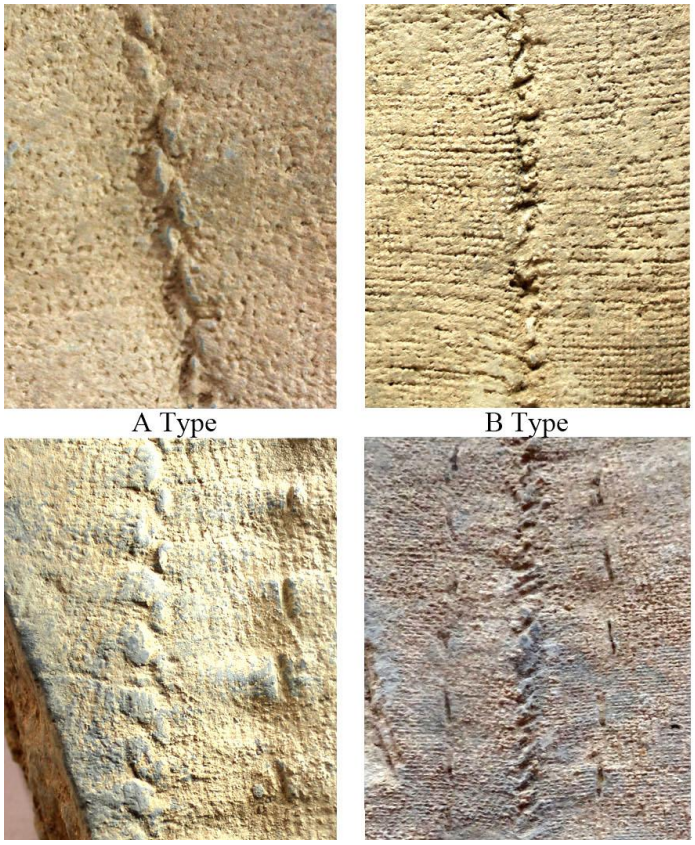


Figure 58 The seam traces on the concave surfaces of the roof tiles (Source: Photos by the author)

The horizontal traces on the concave surface

There are also 1cm wide horizontal traces on the concave surfaces of the two ends of some roof tiles, with fabric impressions left on the inside (Figure 59). These may have been formed by ropes or other types of fasteners, which were used to tie up the mold.

Figure 59 The horizontal traces on the concave surface of the roof tiles
(Source: Photos by the author)

The Joint line of clay-strips on the concave surface

The horizontal clay joint lines can be found on the concave surfaces of the roof tiles (Figure 60). According to previous studies, roof tiles in the Northern Dynasties were made using clay-strips, which were twined around a mold to form the bodies of the roof tiles (Yamazaki 2010). The horizontal joint lines left on the concave surfaces of the roof tiles may have been the traces of these clay-strips.

Figure 60 The joint lines of clay-strips on the concave surfaces of the roof tiles
(Source: Photo by the author)

1.3 Scraping and Smoothing on the Convex Surface

After the bodies of the roof tiles were formed, the convex surface of the body was still very rough, with many traces remaining, which need to be erased during the trimming step. Apart from the eave type of tile, all of the tegulae's convex surfaces were scraped, and the upper ends were smoothed with a finger, so slight parallel traces can be seen on the concave surface of the tegulae (Figure 61). The tools for scraping the tegulae may have been 2–6cm wide plates according to the traces. Except for the samples of simply-trimmed type, the convex surfaces of imbrices were polished, so that the scraping traces could not be observed.

1 2

Figure 61 The traces on the convex surface of the roof tiles (Source: Photos by the author)
1. Scraping by plate, 2. Smoothing by fingers

1.4 Decoration on the Lower End of the Tegulae

The lower ends of some tegulae unearthed from the DBT were decorated with double wave-shaped patterns. To make the double wave-shaped pattern, the lower end of a tegula was cut into four layers of clay, and then, the second layer and the fourth layer from the concave side were pinched. The lower ends of other tegulae ends were finger-pinched on the convex side. The clay

of the tegulae was still wet and soft when they were decorated, so cutting traces and finger impressions were left on the lower end of the tegulae. Moreover, the wave-shaped patterns were sometimes cut into half, which demonstrates that the decoration production step was conducted earlier than the cutting step.

1.5 Treatment for the Edges

The clay bodies of the roof tiles from this site were cut from the inside so that the incisions are on the concave side of the edges. The body of a tegula was divided into four pieces, and the body of an imbrex was divided into two pieces. The edges of most of the roof tiles were not trimmed, so the incisions and fracture surfaces were evident. The edges of some imbrices, however, were scraped carefully, with the ridgelines on the concave side of the edges cut off (Figure 62). These special imbrices are mostly joined to tile-ends or have a nail hole in the middle, indicating that they were used on eaves. Tegulae with trimmed edges are also likely to be eave roof tiles because they were usually decorated with double wave-shaped patterns.

Figure 62 The cutting traces on the edges of the roof tiles (Source: Photos by the author)
1. Traces of cutting; 2. Traces of cutting and trimming

1.6 Traces on the Back Surface of the Tile-Ends

There are two types of traces on the back surface of the tile-ends (Figure 63). The first types are long radial scratches, found on the half-circle of the tile-end, which was joined to the imbrex directly. When the imbrex and tile-end were joined to each other, the clay on the lower end of an imbrex was pressed into the scratches on the back surface of the tile-end, from which these two pieces were stuck together firmly. Moreover, extra clay was added to the joint of the tile-end and imbrex from both sides, which made the joint more secure (Figure 64). The second type of trace is only found on the back surface of the tile-ends with a special lotus pattern, whose central area is sunken. In addition to radial scratches, which were shorter and thinner than the former, there is also a long-scribed line in the middle of the tile-ends.

Figure 63 The traces on the back surface of the tile-ends (Source: Photos by the author)
1. Radial scratches; 2. Scribed line

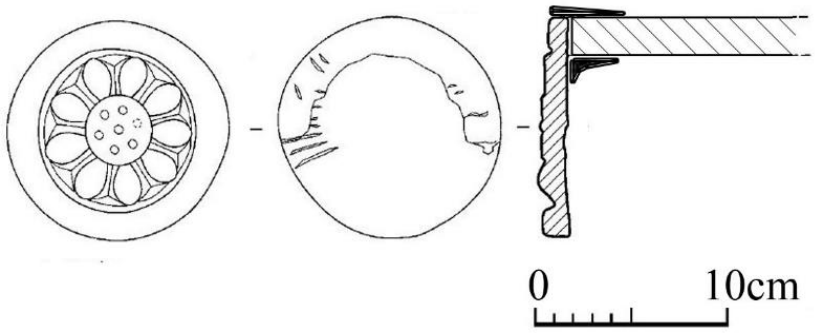


Figure 64 The way to join imbrex to tile-end (Source: Made by the author)

1.7 Polished-Black Treatment

The concave surfaces of some tegulae unearthed from this site were polished and blackened. By observing these samples, it was clear that the clay bodies of the tegulae were dyed with a black liquid, which was brushed on the concave surface of the tegulae and this sometimes overflowed to the convex surface. They were then polished using thin, stick-like tools, which left vertical traces with a width of several millimeters on the concave surface of the tegulae (Figure 65). The black and glossy convex surfaces of the imbrices were also made in this way.

Figure 65 The black liquid and polishing traces on the surface of the tegulae (Source: Photos by the author) 1. Traces of black liquid; 2. Polishing traces

2. The Technique Groups of the Roof Tiles

The technique groups at the roof tile workshop of the DBT were united because 99 percent of the

samples are polished-black type tiles made using the same method[69]. The basic production process was as follows:

1. The molds were wrapped with cloth cover for the shaping step. The tegula mold consisted of several narrow wooden strips, and the imbrex mold was probably bottle-shaped integral wood.
2. Clay-strips were then twined around the mold to make the clay body of the roof tile, and the convex surface of the body was shaped using a pottery paddle, and then it was trimmed using a plate.
3. The lower ends of some tegulae were decorated with double wave-shaped patterns before the clay bodies were cut.
4. The clay body was cut from the inside, and the edges of eave roof tiles were trimmed.
5. The back surface of the tile-end was processed to stick the tile-end and imbrex together firmly.
6. The convex surface of the imbrices and the concave surface of a part of the tegulae were polished and blackened.
7. The clay bodies of the roof tiles were fired in the kilns.

Compared with the polished-black samples, the convex surfaces of some imbrices were only simply scraped, which meant that they were likely produced using different technique groups. Only a few simply-trimmed imbrices were found at the No. 5 Architectural Site; however, they may have been mixed in from other sites. In addition, the traces on the back surface of some of the tile-ends are different from the others. The long-scribed line, which divides the half-circle

[69] The proportion is counted by the weight of different types of roof tiles.

with radial scratches, was once the feature of tile-ends with a monster pattern or lotus-Buddha pattern made in the Northern Wei Dynasty. In the Northern Qi Dynasty, only lotus patterns with simple petals were produced. This means that the artisans who once made tile-ends with a monster pattern or lotus-Buddha pattern in the last period turned to make tile-ends with lotus patterns in the workshop of the DBT. The various technique groups existing in the Northern Wei Dynasty tended to unify during the Northern Qi Dynasty.

Section 3. The Traces of the Roof Tiles from the Dazhuangyan Buddhist Temple and Production Management

1. Traces on the Surface of the Tegulae and Imbrices

The traces on the surface of the tegulae and imbrices can help us to analyze the structure of the workshop, which provided the roof tiles for the DBT. The structure of the workshop is evident from the division of the artisan groups. The artisans in the same group usually used the same batch of tools to make the roof tiles in the same way, and the roof tiles made by them have similar production traces that are different from the products made by other groups.

This section will focus on the traces left on the surface of the roof tiles from the production process. Traces can be divided into two groups: shaping traces (tool traces) and trimming traces. The appearance and combination of different types of traces can illustrate the division of artisan groups, which imply the management methods of the roof tile production at the workshop of the DBT. The traces on the surface of the tegulae and imbrices will be analyzed first.

Table 12 Traces on the surface of the tegulae and imbrices unearthed from the No. 1 Architectural Site

Feature of the roof tiles		Shaping traces on the convex surface	Trimming traces on the convex surface	Shaping traces on the concave surface[70] (fabric impression in 1cm*1cm)	Trimming traces on the concave surface	Traces on edges
Tegula	Undecorated polished-black tegulae (size 1)	Unknown	Scraping traces, smoothing traces	Unknown	Polishing traces	Untrimmed
	Undecorated untrimmed tegulae (size 1)	Unknown	Scraping traces, smoothing traces	8–11/15–17	Untrimmed	Untrimmed
	Polished-black tegulae with double wave-shaped pattern (size 1)	Unknown	Scraping traces, the parts near the lower end were polished	Unknown	Polishing traces	Untrimmed
	Undecorated polished-black tegulae (size 2)	Unknown	Scraping traces, smoothing traces	Unknown	Polishing traces	Untrimmed
	Undecorated untrimmed tegulae (size 2)	Unknown	Scraping traces, smoothing traces	11–13/15–18	Untrimmed	Untrimmed
	Polished-black tegulae with double wave-shaped pattern (size 2)	Unknown	Scraping traces, the parts near the lower end were polished	Unknown	Polishing traces	Untrimmed, a few samples were scraped or polished
Imbrex	Polished-black imbrices without tile-ends (size 1)	Unknown	Polishing traces	13–15/9–11	Untrimmed	Untrimmed
	Polished-black imbrices with tile-ends (size 1)	Unknown	Polishing traces		Untrimmed	Scraping traces, The ridge on the concave side was cut off

[70] The data for the analysis of the fabric impressions were from random fragments, including 54 small-sized fragments of untrimmed tegula samples, 190 fragments of large-sized untrimmed tegula samples, 94 small-sized black imbrex samples, and 155 large-sized polished-black imbrex samples. Imbrices with tile-ends and imbrices without tile-ends were not separated.

	Polished-black imbrices without tile-ends (size 3)	Unknown	Polishing traces	14–17/10–12	Untrimmed	Untrimmed
	Polished-black imbrices with tile-ends (size 3)	Unknown	Polishing traces		Untrimmed	Scraping traces, The ridge on the concave side was cut off

Table 13 Traces on the surface of the tegulae and imbrices unearthed from the No. 2 Architectural Site

Feature of the roof tiles		Shaping traces on the convex surface	Trimming traces on the convex surface	Shaping traces on the concave surface[71] (fabric impression in 1cm*1cm)	Trimming traces on the concave surface	Traces on edges
Tegula	Undecorated polished-black tegulae (size 2)	Unknown	Scraping traces, smoothing traces	9/15–16	Polishing traces	Untrimmed
	Polished-black tegulae with double wave-shaped pattern (size 2)	Unknown	Scraping traces, the parts near the lower end were polished		Polishing traces	Scraping traces
	Undecorated untrimmed tegulae (size 2)	Unknown	Scraping traces, smoothing traces	7–11/13–18	Untrimmed	Untrimmed
Imbrex	Polished-black imbrices without tile-ends (size 2，3)	Unknown	Polishing traces	13–16/8–11	Untrimmed	Untrimmed
	Polished-black imbrices with tile-ends (size 2， 3)	Unknown	Polishing traces		Untrimmed	Scraping traces, The ridge on the concave side was cut off

[71] The data for the analysis of the fabric impression is from samples with stamped characters, including 132 untrimmed tegula samples, 193 polished-black imbrex samples, and two polished-black tegula samples. One sample was one individual roof tile. It is difficult to distinguish the imbrices by size in this analysis, but the fabric impressions among the imbrices of different sizes are similar according to preliminary data analysis. Imbrex with tile-ends and imbrex without tile-ends were not separated.

Table 14 Traces on the surface of the tegulae and imbrices unearthed from the No. 5 Architectural Site

Feature of the roof tiles		Shaping traces on the convex surface	Trimming traces on the convex surface	Shaping traces on the concave surface[72] (fabric impression in 1cm*1cm)	Trimming traces on the concave surface	Traces on edges
Tegula	Undecorated polished-black tegulae (size 2)	Unknown	Scraping traces, smoothing traces	8–9/16–19	Polishing traces	Untrimmed
	Polished-black tegulae with double wave-shaped pattern (size 2)	Unknown	Scraping traces, the parts near the lower end were polished		Polishing traces	Scraping traces
	Undecorated untrimmed tegulae (size 2)	Unknown	Scraping traces, smoothing traces	8–10/15–18	Untrimmed	Untrimmed
Imbrex	Polished-black imbrices without tile-ends (size 2，3)	Unknown	Polishing traces	14–18/8–10	Untrimmed	Untrimmed
	Polished-black imbrices with tile-ends (size 2)	Unknown	Polishing traces		Untrimmed	Scraping traces, The ridge on the concave side was cut off
	Simply-trimmed imbrices without tile-ends	Unknown	Scraping traces, smoothing traces	13–15/9–12	Untrimmed	Untrimmed

[72] The data for the analysis of the fabric impression were from samples with stamped characters, including 122 untrimmed tegula samples and 78 polished-black imbrex samples. One sample was one individual roof tile. It is difficult to distinguish the imbrices by size in this analysis, but the fabric impressions among the imbrices of different sizes are similar according to preliminary data analysis. The data of the polished-black tegulae and simply-trimmed imbrices were fragments, including two fragments of the former and 32 fragments of the latter. Imbrex with tile-ends and imbrex without tile-ends were not separated.

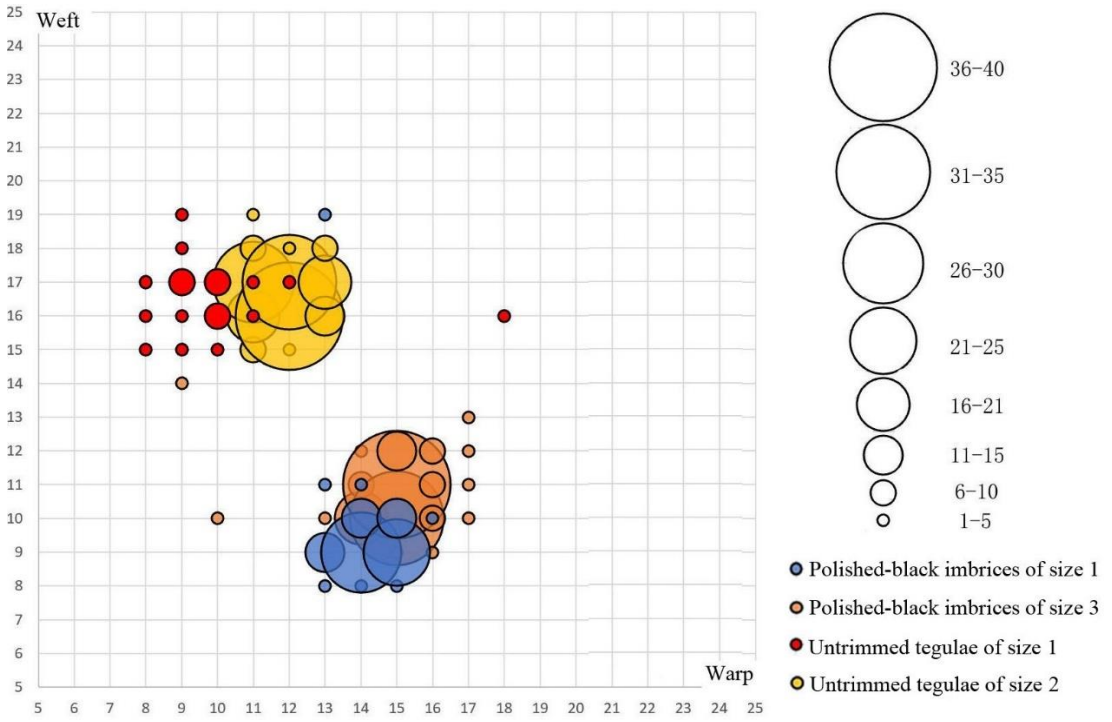


Figure 66 The analysis of fabric impressions of the roof tiles unearthed from the No. 1 Architectural Site (1cm*1cm) (Source: Made by the author)

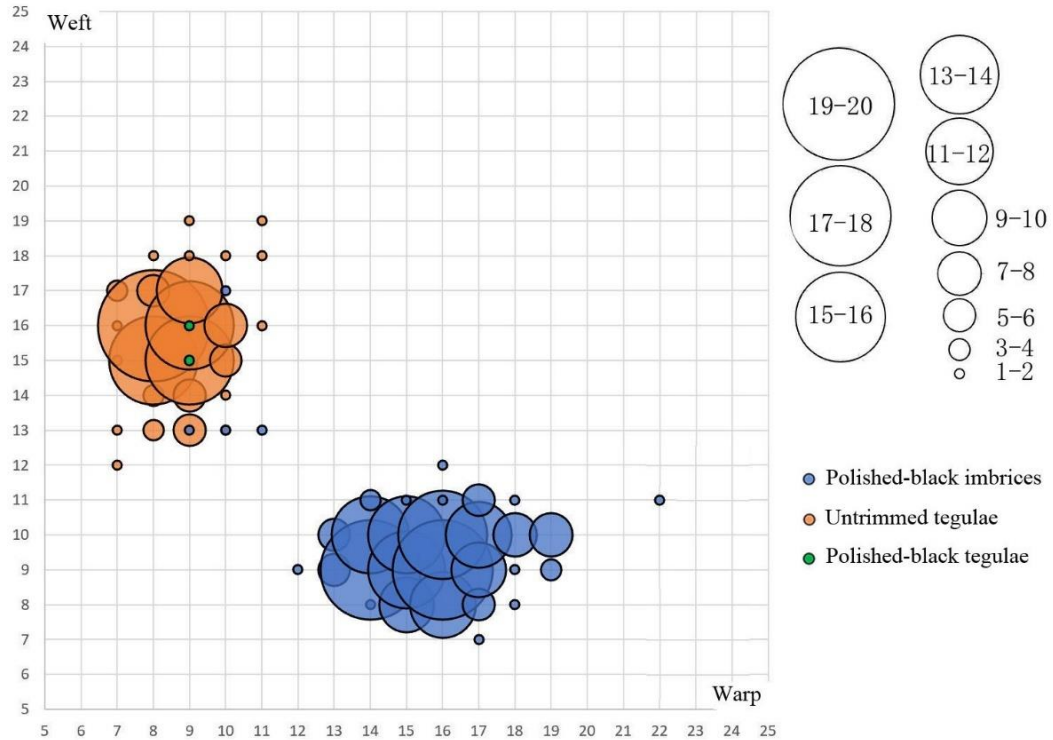


Figure 67 The analysis of fabric impressions of the roof tiles unearthed from the No. 2 Architectural Site (1cm*1cm) (Source: Made by the author)

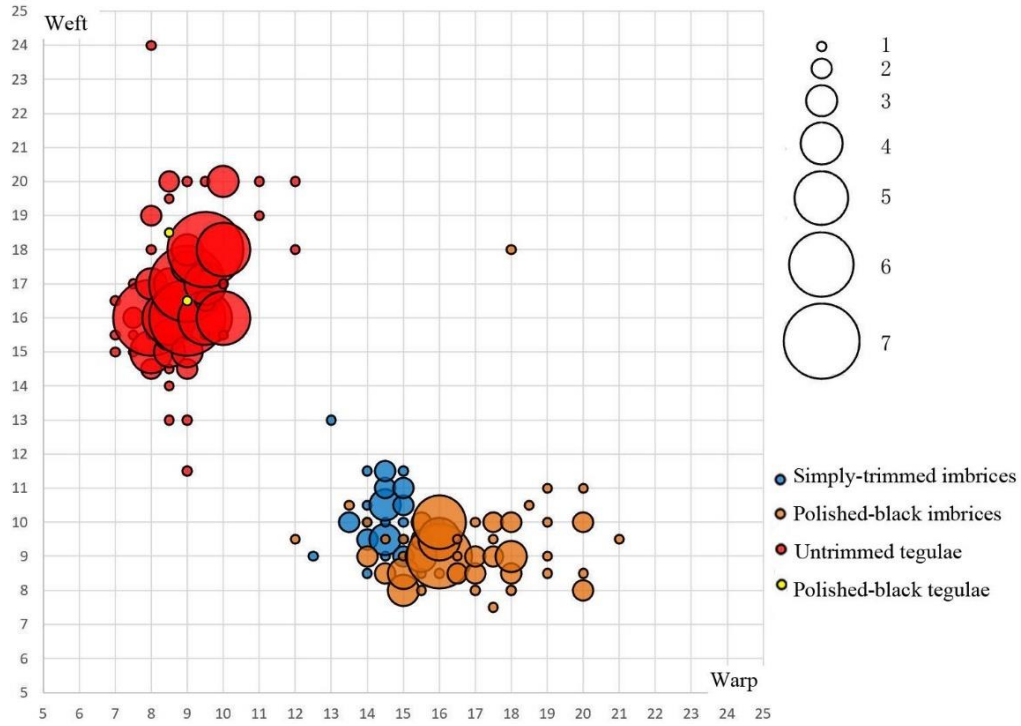


Figure 68 The analysis of fabric impressions of the roof tiles unearthed from the No. 5 Architectural Site (1cm*1cm) (Source: Made by the author)

The roof tiles unearthed from the DBT were of high quality, and the tool traces left in the shaping step of the production process were mostly erased. Only specific traces remained, such as the fabric impressions on the concave surface of the imbrices or some tegulae, which were left by the cloth cover being wrapped over the inner mold (Table 12, Table 13, Table 14). For one type of cloth cover, the number of warps and wefts in an area of 1cm*1cm are normally consistent, demonstrated by the dots congregating in the scatter diagrams above (Figure 66, Figure 67, Figure 68). By analyzing the scatter diagrams of the fabric impressions, the maximum number of cloth covers can be counted, and from this, the maximum number of artisan groups can be calculated. This demonstrated that, first, the cloth covers used for the tegulae and imbrices were different. Second, the cloth covers used for large-sized roof tiles and small-sized roof tiles at the No. 1

Architectural Site were different. Third, the cloth covers used for the polished-black imbrices and simply-trimmed imbrices at the No. 5 Architectural Site were different. Fourth, the same type and size of roof tiles were usually produced by the same type of cloth covers, especially the samples from the No. 2 and No. 5 Architectural Sites. The roof tiles unearthed from the No. 1 Architectural Site, however, are a little bit different from the others. The cloth covers used for the size 2 untrimmed tegulae from this site have more warps than the cloth covers for the samples of the same type and same size unearthed from other sites, while the cloth covers used for the size 3 polished-black imbrices from the No. 1 Architectural Site have more wefts than the others.

The trimming traces illustrate the minimum number of artisan groups, but on the surface of the roof tiles unearthed from the DBT, the trimming traces are not apparent. Except for the distinction between polished-black imbrices and simply-trimmed imbrices at the No. 5 Architectural Site, all of the differences among roof tiles were caused by the differences in functions, not makers.

Overall, by analyzing the tool traces and trimming traces, it can be conjectured that there were [1–2][73] artisan groups that made the imbrices and [1–2] artisan groups that made the tegulae for the No. 1 Architectural Site. Only one artisan group made the imbrices, and one artisan group made the tegulae for the No. 2 Architectural Site, while two artisan groups made the imbrices and one artisan group made the tegulae for the No. 5 Architectural Site. Moreover, the polished-black tegulae from the No. 2 and No. 5 Architectural Sites were made by the same artisan group, as were the polished-black imbrices from these two sites. The artisan groups that made the roof tiles for the No. 1 Architectural Site were different from the groups at the other sites.

[73] [Minimum-maximum].

2. The Patterns of the Tile-Ends and their Molds

The patterns of the tile-ends unearthed from the DBT can be divided into four types: lotus patterns with oval petals (Type A), lotus patterns with round curled petals (Type B), lotus patterns with oval petals and a decorated outer area (Type C), and lotus patterns with thin petals (Type D). The obvious differences in these four types, which are the result of different designs, can be seen even after they were laid on the roofs. However, the slight differences in one type of tile-end caused by the hand-made molds are difficult to observe. They usually appear in the number or position of the seeds, petals, or figures in the outer area. The differences caused by the designs and differences in the molds belong to two levels of classification, and this section will focus on these different molds.[74]

2.1 The Tile-Ends from the No. 1 Architectural Site

The 781 samples of tile-ends unearthed from the No. 1 Architectural Site can be divided into two types: Type A and Type B. The maximum number of Type A tile-ends with lotus patterns with oval petals was 498 and the minimum was 269. Meanwhile, the maximum number of Type B tile-ends with lotus patterns with round curled petals was 283, and the minimum was 66.[75]

Type A

The patterns on the Type A tile-ends consists of standard oval petals, sharp T-shaped inter-petals,

[74] The difference in the roof tiles' size is related to both design and mold. This section will treat the size of roof tiles as the differences in the molds.

[75] If all of the fragments of tile-ends can be pieced together, a minimum number of tile-ends can be speculated by dividing the total number of petals by the standard number of one tile-end. If all of the fragments come from one individual tile-end, the number of fragments is the maximum number of tile-ends. The exact number of tile-ends is between the minimum and the maximum.

and a raised central area with seeds (one seed is in the middle, and the other six seeds surround it). Several samples that have eight petals are 15cm in diameter, but most of the samples have nine petals and are only 11.4cm in diameter (Figure 69). The differences among the tile-ends of the same type were caused by the errors in the hand-made molds. The classification of the molds of the Type A tile-ends will first be analyzed, and because the size 2 Type A tile-ends are rare, the analysis will only include the size 1 samples.

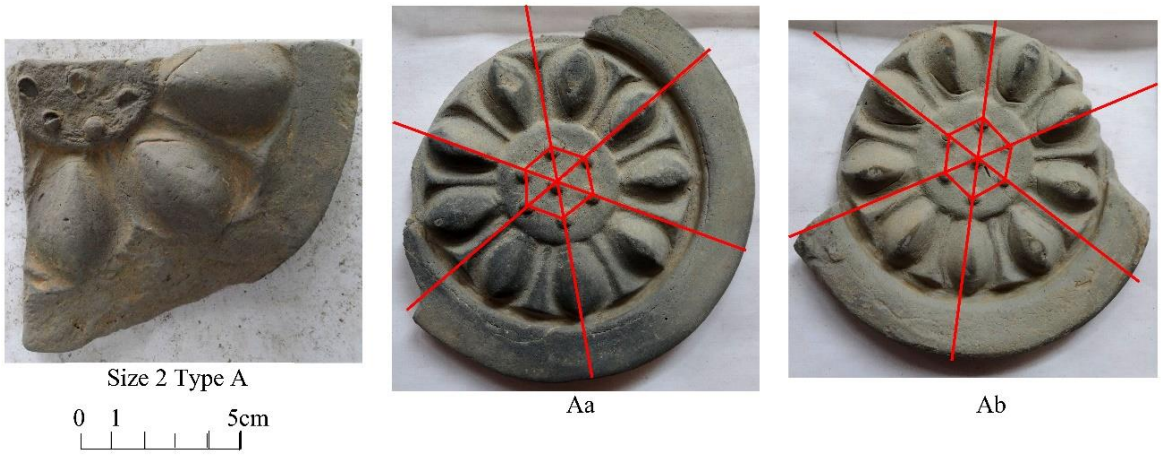


Figure 69 The differences in Type A tile-ends (Source: Photos by the author)

The size 1 Type A tile-ends shared the same pattern design, but there are also slight differences caused by the errors in the molds. There are seven seeds on the central area of the Type A tiles, with one seed in the center and six seeds surrounding it. If the outside seeds of the Type Aa tiles are joined up by strength lines, a standard hexagon will be formed. The line crossing the three seeds also crosses the axis of the petal and its opposite inter-petal. It appears that the Type Aa molds are standard with few errors. Meanwhile, if the outside seeds of the Type Ab tiles are joined up by strength lines, a deformed hexagon will be formed. The line crossing the three seeds cannot cross the axis of the petal and its opposite inter-petal, which demonstrates that the Type Ab molds

are not as standard as the Type Aa molds. The errors in the molds also caused slight differences in the size of the tiles. The data in Table 15 illustrates that the Type Ab samples are somewhat smaller than the Type Aa samples.

Table 15 The sizes of the Type A tile-ends in detail

	Pattern	Number of petals	Number of seeds	Diameter of the seeds	Length of the petals	Width of the petals	Thickness of the petals	Diameter of the central area	Thickness of the central area
Aa	Oval petals, T-shaped inter-petals	9	1+6	0.431±0.1	2.222±0.15	1.503±0.15	1.603±0.25	3.366±0.15	1.209±0.3
Ab	Oval petals, T-shaped inter-petals	9	1+6	0.416±0.15	2.208±0.15	1.503±0.05	1.582±0.6	3.364±0.25	1.203±0.7

The slight differences in the patterns of the Type A tiles demonstrates that there were at least two molds (Aa, Ab) used in the production process of Type A tile-ends at the No. 1 Architectural Site. According to the statistical analysis of the 117 unbroken samples that had at least eight petals, 69 percent of the samples are Type Aa tile-ends.

The molds of the tile-ends were worn out in the production process, and the abrasions on the mold left traces on the surface of the tile-ends. The tile-ends made by the same mold have mold traces in similar places, and the traces increased or became more obvious during the production process. Generally, one mold can only have one type of changing process of the mold traces, but the tile-ends from the No. 1 Architectural Site show that some molds had more than one type of changing process. For example, the mold traces of some Type Aa tile-ends are in the outer area of the pattern (AaI) and become larger continually (from Figure 70-1 to Figure 70-3), but for other samples (AaII), the mold traces appeared and increased around the central area (from Figure 71-1 to Figure

71-3). There are also samples without mold traces.

Figure 70 The AaI samples at the No. 1 Architectural Site (Source: Photos by the author)

Figure 71 The AaII samples at the No. 1 Architectural Site (Source: Photos by the author)

Different changing processes of one type of pattern, suh as Type Aa, indicate that there must have been two mold levels. When the design of the pattern was determined, the artisan first made several first-level molds, which had raised pattern, and then used them to make second-level molds, which were concave and used to produce the tile-ends directly. The differences among the first-level molds caused by errors in the hand-making process created the distinctions in Type Aa and Type Ab patterns, and the differences among the second-level molds caused by the abrasions

in the production processes created the distinctions in the AaI and AaII samples.

Type B

The Type B pattern consists of eight round curled petals, short T-shaped inter-petals, and a raised central area with eight seeds. The diameter of Type B tile-ends is approximately 18cm. There is only one type of first-level mold for this pattern (Type Ba), which is illustrated in Figure 72 and Table 16. At the end of a petal of some samples, there is an obvious mold trace. The samples with mold traces were marked as BaI. Other samples without mold traces might demonstrate the early stages of the second-level molds, or they could be the products of other second-level molds.

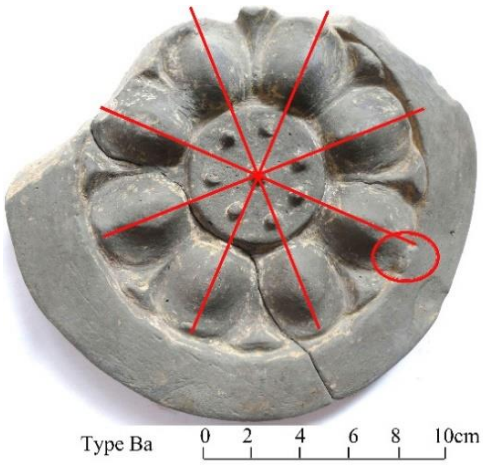


Figure 72 The tile-ends of Type B from the No.1 Architectural Site
(Source: Photo by the author)

Table 16 The sizes of the Type B tile-ends in detail

	Pattern	Number of petals	Number of seeds	Diameter	Length of the petals	Width of the petals	Thickness of the petals	Diameter of the central area	Thickness of the central area
Ba	Round curled petal	8	1+7	17.9±0.9	3.5±0.8	3.2±0.3	2.6±0.8	5.1±0.2	1.9±0.4

According to the previous analysis, the production system of the tile-ends used for the tower of the DBT is as Figure 73. The classification of the tile-ends should be conducted in three steps. First, the samples should be classified by their design, such as the tile-ends with oval petals and

tile-ends with round curled petals. Second, one pattern may have more than one mold. As slight errors may appear in the hand-making processes of molds, the samples of the same pattern should be subdivided by their different first-level molds. Third, one first-level mold may produce more than one second-level mold. The samples made by the same first-level mold should be subdivided again by the different second-level molds as the changing processes of the mold traces of these samples are different. The ceramic molds found in Pingcheng from the Northern Wei Dynasty and Chang'an from the Tang Dynasty must have been the second-level molds, and the first-level mold might have been made from wood.

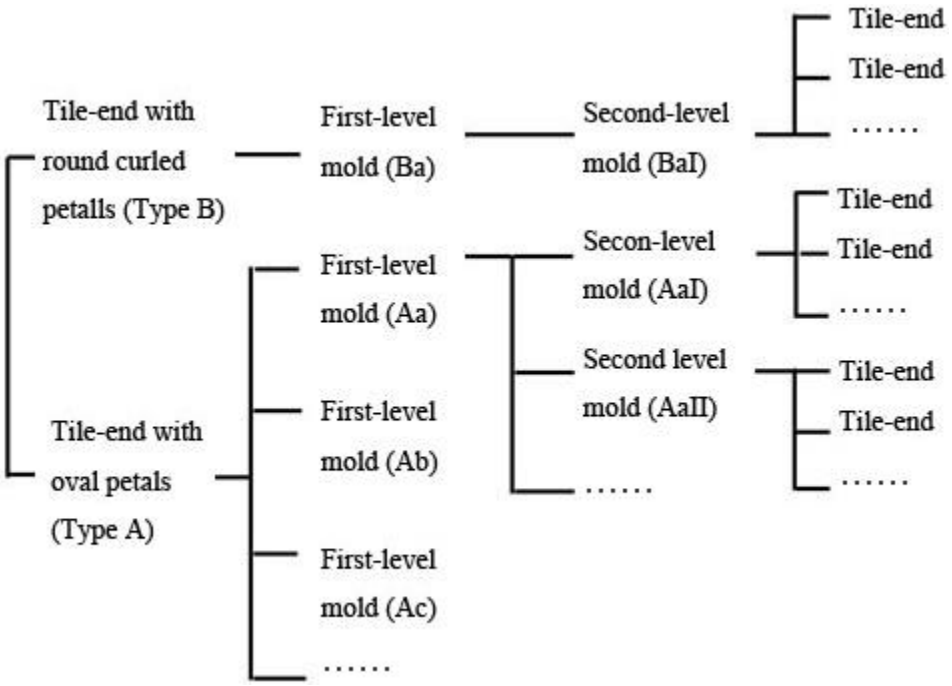


Figure 73 The production system of the tile-ends (Source: Made by the author)

2.2 The Tile-Ends from the No. 2 Architectural Site

The 242 sample of tile-ends unearthed from the No. 2 Architectural Site can be divided into four types. The maximum of Type A tile-ends with lotus patterns with oval petals was 195, and the

minimum was 88. Meanwhile, the maximum number of Type B tile-ends with lotus patterns with round curled petals was 42, and the minimum was 18. The maximum of Type C tile-ends with lotus patterns with oval petals and beads in the outer area was four, and the minimum was two. There was also one Type D sample, which has thin petals.

The Type A pattern consists of 8–9 standard oval petals, sharp T-shaped inter-petals, and a raised central area with seeds (one seed is in the middle and the other had 6–8 seeds surround it). The diameter of these tile-ends is approximately 16.9–17.5cm (size 3), 15.2–15.cm (size 2), or 9.3cm (size 1). According to the slight errors in the pattern and size, the Type A samples unearthed from the No. 2 Architectural Site can be separated into eight groups (first-level molds), as illustrated below (Figure 74, Table 17).

Table 17 The size of the Type A tile-ends in detail

	Pattern	Number of petals	Number of seeds	Diameter	Length of the petals	Width of the petals	Thickness of the petals	Diameter of the central area	Thickness of the central area
Aa	Oval petals; T-shaped inter-petals; one seed in the middle of the central area with seven seeds surrounding it closely	9	1+7	16.8 ±0.4	3.5 ±0.2	2.3 ±0.15	2.8 ±0.5	4.3 ±0.2	2.1 ±0.4
Ab	Oval petals; T-shaped inter-petals; one seed in the middle of the central area with eight seeds surrounding it loosely	9	1+8	15.2 ±0.4	3.3 ±0.2	2.2 ±0.2	2.4 ±0.4	4.4 ±0.3	1.8 ±0.2
Ac	Oval petals; T-shaped inter-petals; one seed in the middle of the central area with eight seeds surrounding it closely	9	1+8						
Ad	Oval petals; T-shaped inter-petals; one seed in the middle of the central area with six seeds surrounding it loosely	8	1+6	15.5 ±0.5	3.5 ±0.2	2.6 ±0.3	2.6 ±0.5	4.1 ±0.3	1.9 ±0.4

Ae	Oval petals; T-shaped inter-petals; one seed in the middle of the central area with eight seeds surrounding it loosely	8	1+8	17.6 ±0.5	4 ±0.2	2.8 ±0.2	3 ±0.4	4.3 ±0.2	2.3 ±0.35
Af	Oval petals; T-shaped inter-petals; one seed in the middle of the central area with seven seeds surrounding it loosely	8	1+7						
Ag	Oval petals with slightly curled end; T-shaped inter-petals with inner end recurved; central area sagged, compared to petals; the setting of the seed is unclear	8	1+8	15.5 ±0.6	3.6 ±0.25	2.6 ±0.2	2.6 ±0.6	3.9 ±0.1	1.5 ±0.4
Ah	Oval petals; T-shaped inter-petals; the setting of the seed is unclear; some samples were glazed	9	Unknown	9.3	1.9–2	1.1–1.3	1.3	2.4	1.2

Figure 74 The Type A tile-ends from the No. 2 Architectural Site

(Source: Photos by the author)

The Type B pattern consists of 8–9 round curled petals, short T-shaped inter-petals with the inner end recurved, and a raised central area with eight seeds (one seed in the middle and the others surrounding it). The diameters of the Type B tile-ends are approximately 15.6cm (size 2) or 17.5cm (size 3). According to the slight errors in the pattern and size, the Type B samples unearthed from the No. 2 Architectural Site can be separated into three groups (first-level molds) as illustrated below (Figure 75, Table 18).

Table 18 The size of the Type B tile-ends in detail

	Pattern	Number of petals	Number of seeds	Diameter	Length of the petals	Width of the petals	Thickness of the petals	Diameter of the central area	Thickness of the central area
Ba	Round curled petals; T-shaped inter-petals	8	1+8	15.6 ±0.4	2.8 ±0.25	2.6 ±0.1	2.4 ±0.25	4.2 ±0.2	1.9 ±0.1
Bb	Round curled petals; T-shaped inter-petals	8	1+7	17.5 ±0.8	3.5 ±0.3	3.1 ±0.4	2.6 ±0.4	5 ±0.3	1.9 ±0.3
Bc	Round curled petals; T-shaped inter-petals	8	1+6						

Figure 75 The Type B tile-ends from the No. 2 Architectural Site
(Source: Photos by the author)

The Type C pattern consists of oval petals, T-shaped inter-petals, a raised central area with seven seeds, and an outer area decorated with a circle of beads and raised line. The diameter of the samples is approximately 16cm. There was only one type of first-level mold used for the Type C tile-ends (Figure 76, Table 19).

Table 19 The size of the Type C tile-ends in detail

	Pattern	Number of petals	Number of seeds	Diameter	Length of the petals	Width of the petals	Thickness of the petals	Diameter of the central area	Thickness of the central area
Ca	Oval petals; T-shaped inter-petals; a circle of beads and raised line in the outer area	Unknown	1+6	16	3.3 ±0.1	1.9	2 ±0.4	4	1.4 /1.5

Figure 76 The Type C tile-ends from the No. 2 Architectural Site
(Source: Photos by the author)

Only one Type D sample was found in the rammed earth of the No. 2 Architectural Site, which means that it might have been made earlier than the other samples. The Type D sample is broken, so only seven thin petals were left, as well as some T-shaped inter-petals and a raised central area

with seven seeds. The original one should have 12 petals. The diameter of the tile-end is approximately 15.2cm (Figure 77, Table 20).

Table 20 The size of the Type D tile-ends in detail

	Pattern	Number of petals	Number of seeds	Diameter	Length of the petals	Width of the petals	Thickness of the petals	Diameter of the central area	Thickness of the central area
Da	Thin petals; T-shaped inter-petals	11(?)	Unknown	15.2	3.65	2.1	1.9	4.5	1.3

Figure 77 The Type D tile-ends from the No. 2 Architectural Site
(Source: Photo by the author)

Overall, the basic design of the tile-ends at the No. 1 Architectural Site and the No. 2 Architectural Site are similar. In these two sites, most of the samples were decorated with the Type A pattern, and there are also a few samples decorated with the Type B pattern. The Type C and Type D samples are rare and cannot be subdivided, and so they may have been mixed in from other sites. However, there are more first-level molds used in the workshop of the No. 2 Architectural Site, and the differences among these molds are obvious. The first-level molds indicated that the roof

tile workshop of No. 2 Architectural Site may have been more complex than the No. 1 Architectural Site. In addition, the distinction of the second-level molds is unclear, because the samples from the same first-level mold are limited. According to the analysis of the samples at the No. 1 Architectural Site, there may have been several second-level molds belonging to one first-level mold, but the second-level mold would have been replaced when mold traces appeared, so it is very difficult to distinct the tile-ends made by different second-level molds.

2.3 The Tile-Ends from the No. 5 Architectural Site

There are 115 samples of the tile-ends unearthed from the No. 5 Architectural Site, which can be divided into three types. The maximum of Type A tile-ends with lotus patterns with oval petals is 84, and the minimum is 38. Meanwhile, the maximum number of Type B tile-ends with lotus patterns with round curled petals is 27, and the minimum is 11. The maximum of Type C tile-ends with lotus patterns with oval petals and beads in the outer area is four, and the minimum is three.

The Type A pattern consists of 8–9 standard oval petals, sharp T-shaped inter-petals, and a raised central area with seeds (one seed is in the middle and the other 6–8 seeds surround it). The diameter of these tile-ends is approximately 14.7–16cm (size 2). According to the slight errors in the pattern and size, the Type A samples unearthed from the No. 5 Architectural Site can be separated into five groups (first-level molds) as illustrated below (Figure 78, Table 21).

Table 21 The sizes of the Type A tile-ends in detail

	Pattern	Number of petals	Number of seeds	Diameter	Length of the petals	Width of the petals	Thickness of the petals	Diameter of the central area	Thickness of the central area
Aa	Oval petals; T-shaped inter-petals; one seed in the middle of the central area with eight seeds surrounding it closely	9	1+8	15.4 ±0.5	3.3 ±0.2	2.2 ±0.2	2.3 ±0.45	4.4 ±0.3	1.5 ±0.4
Ab	Oval petals; T-shaped inter-petals; one seed in the middle of the central area with eight seeds surrounding it closely; the seeds are right in front of the petals	8	1+8	15.4 ±0.7	3.6 ±0.5	2.6 ±0.2	2.3 ±0.95	4.1 ±0.3	1.7 ±0.4
Ac	Oval petals; T-shaped inter-petals; one seed in the middle of the central area with seven seeds surrounding it loosely	8	1+7						
Ad	Oval petals; T-shaped inter-petals; one seed in the middle of the central area with six seeds surrounding it loosely	8	1+6						
Ae	Oval petals with slightly curled end; T-shaped inter-petals with inner end recurved; central area sagged, compared to petals; one seed in the middle of the central area with eight seeds surrounding it; the seeds are right in front of inter-petals	8	1+8	15.4 ±0.2	3.7 ±0.2	2.6 ±0.1	2.4 ±0.4	4 ±0.2	1.3 ±0.5

Figure 78 The Type A tile-ends at the No. 5 Architectural Site
(Source: Photos by the author)

The Type B pattern consists of eight round curled petals, short T-shaped inter-petals with the inner end recurved, and a raised central area with nine seeds (one seed in the middle and the others surrounding it). The diameter of most of the Type B tile-ends is 15–15.4cm (size 2). There is also a sample that is larger than the others. This sample is broken, and it was difficult to measure the diameter, but it may have belonged to size 3 (Figure 79, Table 22).

Table 22 The sizes of the Type B tile-ends in detail

	Pattern	Number of petals	Number of seeds	Diameter	Length of the petals	Width of the petals	Thickness of the petals	Diameter of the central area	Thickness of the central area
Ba	Round curled petals; T-shaped inter-petals; size 2	8	1+8	15.1 ±0.3	2.8 ±0.4	2.6 ±0.2	2.1 ±0.45	4.2 ±0.15	1.6 ±0.35
Bb	Round curled petals; T-shaped inter-petals; size 3	8	Unknown	Unknown	3.7	3.2	2.7	Unknown	2

Figure 79 The Type B tile-ends at the No. 5 Architectural Site
(Source: Photos by the author)

The Type C pattern consists of oval petals, T-shaped inter-petals, a raised central area with seven seeds, and an outer area decorated with a circle of beads and a raised line. The diameter of the samples is approximately 16cm. There are two types of first-level mold used for the Type C tile-ends (Figure 80, Table 23).

Table 23 The sizes of the Type C tile-ends in detail

	Pattern	Number of petals	Number of seeds	Diameter	Length of the petals	Width of the petals	Thickness of the petals	Diameter of the central area	Thickness of the central area
Ca	Oval petals; T-shaped inter-petals; a circle of beads and raised line in the outer area	8	1+6	16.3	3.45 ±0.15	2.65 ±0.05	1.95	4.5	Unknown
Cb	Oval petals; T-shaped inter-petals; a circle of beads in the outer area	Unknown	Unknown	Unknown	2.9	1.9	2	Unknown	2

Figure 80 The Type C tile-ends at the No. 5 Architectural Site
(Source: Photos by the author)

Overall, the basic designs of the tile-ends' patterns at the No. 5 Architectural Site are similar to the patterns used at the No. 1 and No. 2 Architectural Site. At these three sites, most of the samples are decorated with the Type A pattern, and there are also a few samples decorated with the Type B pattern. The Type C samples are rare and cannot be subdivided. There are also various first-level molds used in the workshop of the No. 5 Architectural Site, but the distinction of the second-level molds is unclear.

2.4 The Traces on the Back Surfaces of the Tile-Ends

On the back surfaces of most of the samples, there are deep, long radial scratches (Figure 81-2), while on the back surfaces of a few tile-ends, there is also a long-scribed line in the middle of the tile-ends (Figure 81-1). Moreover, the samples with the long-scribed line on their back surface are all from a specific pattern group. They are Type Ag tile-ends from the No. 2 Architectural Site and Ae Type tile-ends from the No. 5 Architectural Site. These samples are all decorated with lotus patterns with oval petals, but they all have special features: the oval petals have a slightly curled end, the inner end of the T-shaped inter-petals is recurved, and the central area has sagged. The Type Ag tile-ends from the No. 2 Architectural Site and the Type Ae tile-ends from the No. 5 Architectural Site, which have similar features on both the front and back surface might have been produced by the same artisan group.

Figure 81 The traces on the back surfaces of the tile-ends (Source: Photos by the author)
1. Radial scratches and long-scribed line; 2. Radial scratches

The traces on the back surfaces of the tile-ends indicate the minimum number of artisan groups. The workshops at the No. 2 and No. 5 Architectural Site have at least two artisan groups for tile-ends, and the workshop at the No. 1 Architectural Site has at least one artisan group. In addition, because the tool to make the tile-ends (the mold of the tile-end) is influenced by its pattern and size, which should be removed from the analysis of production traces, using the differences among the molds to speculate the maximum number of artisan groups has no meaning.

3. The Traces of the Roof Tiles and the Management of Roof Tile Production

The previous analysis discussed the formation of roof tile workshop in the DBT using the tool traces and trimming traces, and from this, it is clear that the workshop for this temple was unified. The roof tiles unearthed from the No. 2 and No. 5 Architectural Site have similar features and might have been made by the same artisan group. The situation of the roof tiles used for the tower (the No. 1 Architectural Site) is a little bit different from the other sites.

Among the different types of roof tiles, the artisan groups may have been different, such as the artisan groups that made the polished-black imbrices and simply-trimmed imbrices at the No. 5 Architectural Site. The simply-trimmed imbrex samples, however, are rare, and they may have been mixed in from other sites. In addition, the traces on the back surfaces of some of the tile-ends, which have a long-scribed line, are different from the others. This is a feature of the tile-ends with a monster pattern or lotus-Buddha pattern, made during the Northern Wei Dynasty. In the Northern Qi Dynasty, the artisans who once made tile-ends with monster patterns or lotus-Buddha patterns were positioned in the workshop of the DBT to make tile-ends with lotus patterns. The various technique groups existing in the Northern Wei Dynasty tended to become unified in

the Northern Qi Dynasty.

In this section, the differences in the tile-ends' molds were also analyzed. At the No. 1 Architectural Site:

- The size 1 Type A tile-ends have two types of first-level molds,
- The size 3 Type B tile-ends have one first-level mold.

At the No. 2 Architectural Site:

- There was only one sample of the size 1 Type A tile-ends,
- The size 2 Type A tile-ends have four types of first-level molds,
- The size 3 Type A tile-ends have three types of first-level molds,
- The size 2 Type B tile-ends have one first-level mold,
- The size 3 Type B tile-ends have two types of first-level molds,
- The Type C and Type D tile-ends have only one type of first-level mold.

At the No. 5 Architectural Site:

- The size 2 Type A tile-ends have five types of first-level molds,
- The size 2 Type B tile-ends have two type of first-level molds,
- The Type C tile-ends have two types of first-level molds,

Compared to other types, the Type A tile-ends have more first-level molds. This illustrates that the Type A samples were the most used tile-ends at this temple, and the first-level molds were made repeatedly. Moreover, according to the analysis of the tile-ends unearthed from the No. 1 Architectural Site, the samples made by different second-level molds could be divided according to mold traces. The Type A tile-ends at the No. 1 Architectural Site have at least two second-level molds. In the production process, however, the second-level mold with mold traces may have been replaced by a new one quickly, and subsequently, it is difficult to divide the tile-ends made

by different second-level molds. The production system of the tile-ends with first level molds and second-level molds was effective, which illustrates that the roof tile workshop at the DBT already could mass-produce tile-ends.

Section 4. The Characters on the Roof Tiles from the Dazhuangyan Buddhist Temple

The DBT consisted of a tower (No. 1 Architectural Site), main hall (No. 2 Architectural Site), and gate (No. 5 Architectural Site). There were 991 samples with stamped characters found at the No. 2 Architectural Site, from which 702 characters are legible, including 346 imbrices, 466 polished-black tegulae, and 179 untrimmed tegulae. There were 522 samples with stamped characters found at the No. 5 Architectural Site, from which 382 characters are legible, including 106 imbrices, 293 polished-black tegulae, and 123 untrimmed tegulae. Only five samples with stamped characters were unearthed from the No. 1 Architectural Site, including three imbrices and two tegulae. This section will examine the samples from the No. 2 and No. 5 Architectural Site, and analyze the stamping method, the content of the characters, and the relation between the characters and roof tiles.

1. Stamping Methods

All of the characters were stamped (horizontally, vertically, or slanting) on the convex surfaces of the tegulae and imbrices' lips. They are embossed characters, and the shapes of the stamps include squares, rectangles, bullet shapes, ovals, and trapezoids. There are 1–5 characters on each stamp, and some of them are reversed left and right. It is worth noting that the shape and direction of the

stamps varied, but the features of stamps with the same content are almost the same.

1.1 The Shape of the Stamps

According to the statistical analysis, rectangle stamps were the most commonly found stamp on the surface of the roof tiles at the No. 5 Architectural Site, and 26 percent of the stamps are bullet-shaped. Stamps with other shapes are rare. At the No. 2 Architectural Site, rectangle stamps were also the most commonly found type, but 22 percent were square stamps, and 12 percent were bullet-shaped stamps (Figure 82). The square stamps only have one character, while the other shaped stamps usually have more than one character.

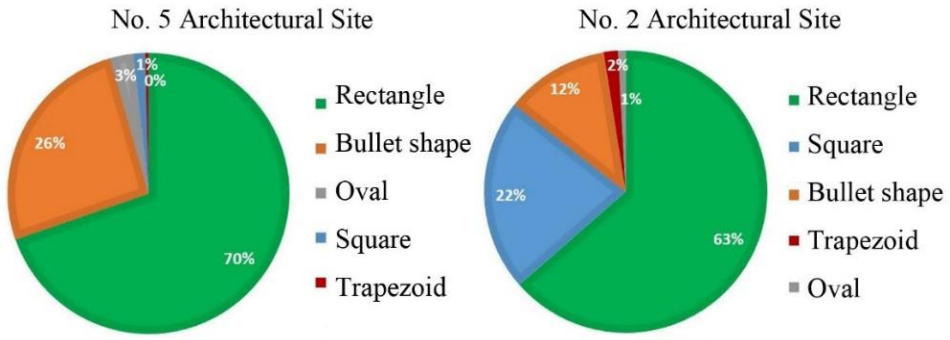


Figure 82 The shape of the stamps (Source: Made by the author)

Stamps with the same characters usually have the same shape, indicating that they were made by the same stamp, but the shape of some samples changed slightly due to the abrasion of the stamp (Figure 83). For example, the original shape of the "崔仲" and "九四[伯]" stamps should be bullet-shaped, but the top of some of the samples is missing, and the original shape of the "九四亮" stamp is a rectangle, but the corners of some of the samples were rounded off. Not very many deformed stamps remain on the roof tiles of this temple.

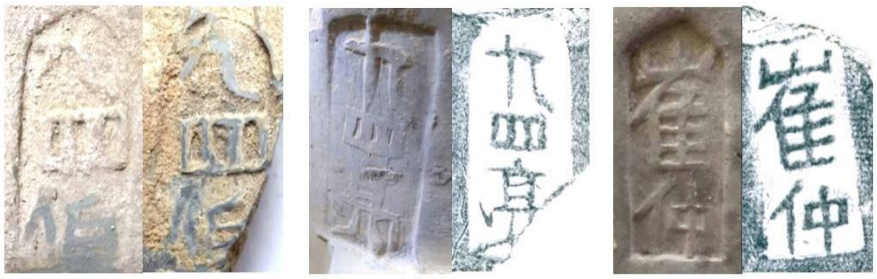


Figure 83 The changing shape of the "九四[伯]" stamp, the "九四亮" stamp and the "崔仲" stamp (Source: Photos by the author)

The sizes and shapes of some stamps were changed intentionally (Figure 84). For example, the "八一畔" stamps have two shapes, rectangle and bullet-shaped, and the size of the samples in the different shapes are different. The shape of the "趙黑" stamp is bullet shape, but the size of these samples can be divided into two groups. The length of the larger one is 6.4–6.6cm, and the length of the smaller one is only 3.6cm. The difference in the stamps with the same content implied that this type of stamp might have been used for a long time and artisans had to remake the stamp after the last one was broken.

Figure 84 The changing shape of the "八一畔" stamp and the "趙黑" stamp (Source: Photos by the author)

1.2 The Direction of the Stamps

The stamps with the same content were mostly left in the same direction (Figure 85). For example, 60 percent of the "九四貴" stamps that were mostly found on the surface of the imbrices in this temple, were stamped upward, and 30 percent of the samples were stamped downward.

Meanwhile, 80 percent of the “九三張保” stamps, which were mostly found on the surface of the tegulae in this temple, were stamped upward. The unified direction indicates that the stamps with the same content may have been the symbol of the same artisan.

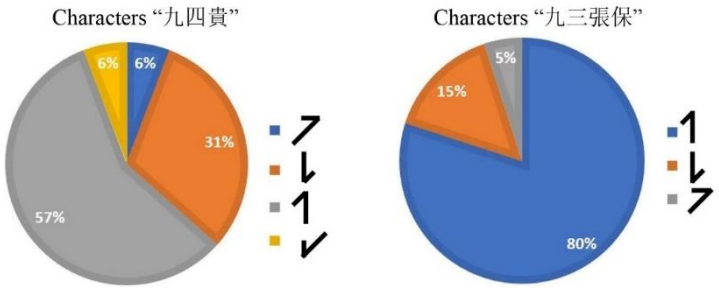


Figure 85 The direction of the stamps (Source: Made by the author)

Some stamps had characters that were reversed left and right, such as the “安,” “[庐],” “相鳳,” “教,” “二［靴］棟,” “公慈,” and “來,” “尢” stamps from the No. 2 Architectural Site and the “來,” “口子,” and “［炟］朱” stamps from the No. 5 Architectural Site (Figure 86). These unique stamps with reversed characters are mostly square stamps.

Figure 86 The reversed characters in the stamps (Source: Photos by the author)

1.3. The Production Step of Stamping and the Function of the Stamps

When the stamps were stamped on the surfaces of the roof tiles, the clay must have been wet and

soft. This means that the bodies of the roof tiles needed to be supported from the back, but there is no obvious supporting trace on the back of the roof tiles. This implies that the inner molds of the roof tiles were not removed when the stamps were stamped. Furthermore, some of the stamps were cut in half, indicating that the step of stamping took place earlier than the step of cutting (Figure 87). Therefore, these stamps were stamped in the middle of the production process. They were not the marks for quality inspection after production, but the symbols of the artisans who produced these roof tiles. They made the responsibility of each artisan clear.

Figure 87 The stamp that was cut in half and the opposite position of this stamp on the concave surface of tegula (Source: Photos by the author)

2. The Types of Stamps

Many different types of stamps were unearthed from the DBT. From the No. 2 Architectural Site, 54 different types of stamps were found on the convex surfaces of the polished-black imbrices' lips, while 94 different types of stamps were found on the convex surfaces of polished-black tegulae, and 42 different types of stamps were found on the convex surfaces of untrimmed tegulae. From the No. 5 Architectural Site, 34 different types of stamps were found on the polished-black imbrices' lips, while 52 different types of stamps were found on polished-black tegulae, and 29 different types of stamps were found on untrimmed tegulae. At the No. 1 Architectural Site, three

types of stamps on polished-black imbrices and two types of stamps on polished-black tegulae were found. This section will discuss the different types of stamps, and they can be divided into two basic groups: stamps with numbers and stamps without number.

2.1 Stamps with Numerical Characters

The stamps of these samples have numerical characters, and there are 1–2 numerical characters in each stamp, which are placed before the general characters. Among the 191 different types of stamps from the No. 2 Architectural Site, 133 stamps have numerical characters. Meanwhile, among the 115 types of stamps at the No. 5 Architectural Site, 66 stamps have numerical characters (Figure 88). A few broken samples were not counted, so there may have been more types of stamps with numerical characters.

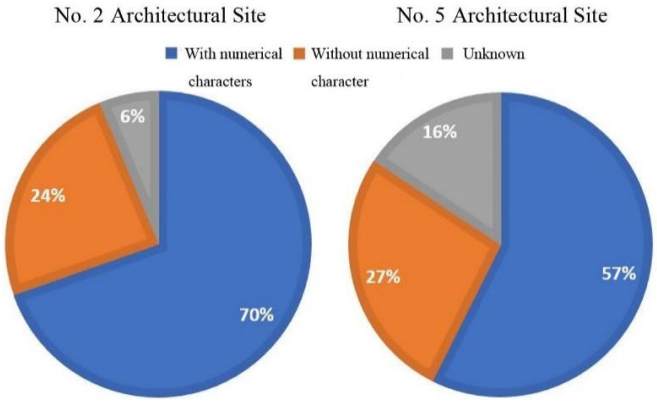


Figure 88 The proportion of stamps with numerical characters
(Source: Made by the author)

The numerical characters in these stamps include "一 (one)," "二 (two)," "三 (three)," "四 (four)," "五 (five)," "六 (six)," "七 (seven)," "八 (eight)," and "九 (nine)," as well as pairs of numerical characters. According to the numerical characters on the stamps, the stamps can be divided into several groups (Table 24).

Table 24 Stamps with numerical characters

Numerical characters	No. 2 Architectural Site		No. 5 Architectural Site	
一	一祖, 一洪*[76], 一□貝, 一仁, 一胡, 一張拐, 一拐, 一亮, 一[穎]	9		0
二	二[靴]棟*, 二張和, 二暈, 二[容], 二趙和, 二□奴, 二王天, 二李月, 二楨	9	二庶槨, 二公伯*, 二似奴	3
三	三□程, 三胡[宗], 三王仲	3		0
四	四王大, 四興, 四[恵], 四[和], 四良, 四周, 四林, 四[容], 四洪, 四達, 四方思, 四田央	12	[四扶], 四(互), 四□, 四[萃], 四洪	5
五	五[和], 五紹, 五王賓, 五解国, 五田[進], 五法, 五都業, 五貴, 五解賓, 五仲, 五□保	11	五田文	1
六	六土[宗], 六曾央, 六住羽, 六斬种, 六□[平], 六□[思], 六入田, 六田忿, 六田安憘, 六[鄴]…, 六王杲□, 六[杲]住, 六神葺, 六保才, 六洪	15	六(斬)种, 六□, 六小醜, 六相鳳, 六田安憘, 六田拐, 六□□, 六[拐]朱, 六思□, 六[珓]	10
七	七田…, 七大, 七伯, 七旦早, 七[塩]…	5		0
八	八鱼□, 八張□, 八雷明, 八閔[蓿], 八伯周, 八王□, 八張[鄴], 八慈*, 八周, 八菟[柏] , 八釗為三, 八解叔三, 八胡[宗]三, 八馮国三, 八□租三, 八甄奴三, 八崇四	26	八菟榮, 八楊(宗), 八柵, 八慈, 八土, 八挴担, 八鱼□, 八崇四	13
八一/一八	一八□貝, 八一王[祖], 一八洪*, 八一韩俱		一八仲, 一八[達], 八一[韓俱], 八一年, 八一畔	
八三/三八	八三張保, 八三釗保, 八三□習, 八三蒋習二			
八四/四八	八四慕			
九	九[容], 九忠	33	九匡, 九□, 九牛習三	25
九一/一九	一九玠, 九一[雀], 一九□, 一九鳳		一九僧	
九二/二九	[九二]田…, 二九伯, 二九□		九二[句], 二九…(1), 二九…(2)	
九三/三九	九三解石, 九三庶槨, 三九□, 九三習堆, 九三□共, 九三張保, 九三朋保, 九三牛富, 九三作…, 九三住□, 九三張拒		九三□□, 九三解石, 九三張賓, 九三習堆, 九三□, 三九□, 九三陳[作], 九三張□,	
九四/四九	九四国, 九四[伯], 九四[法], 九四…*, 九四賓, 九四[昌], 九四田□, 九四□, 四九貴, 四九和, 九四休, 四九世, 九[四頑]		九四元, 九四(国), [九四田合], 九四紹, 九四(回), 四九□, 九四休, 九四亮, 四九□, 九四堆	

[76] Stamps with "*" are reversed types.

According to this table, together with the increase in the numbers, the types of stamps increased. Half of the stamps were made with the numerical characters eight or nine, which make up 48 percent of the stamps found at the No. 2 Architectural Site and 67 percent of the stamps found at the No. 5 Architectural Site (Figure 89, Figure 90).

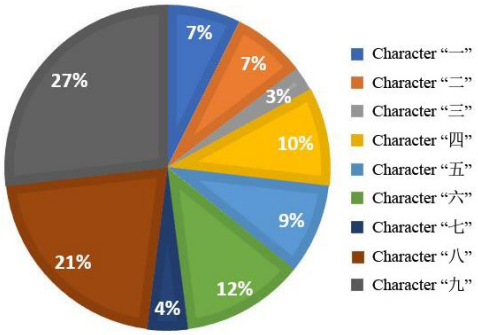


Figure 89 Stamps with different numerical characters found at the No. 2 Architectural Site (Source: Made by the author)

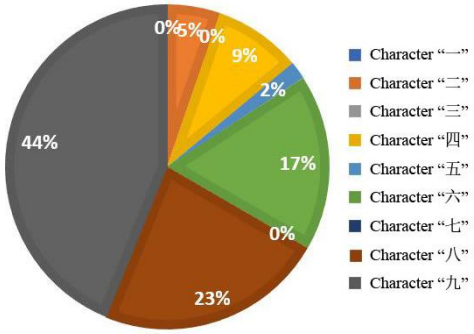


Figure 90 Stamps with different numerical characters found at the No. 5 Architectural Site (Source: Made by the author)

General characters were placed after the numerical characters, and these may have been the names of the artisans that made these roof tiles or the abbreviations of the artisans' names. According to previous analysis, the numerical character paired with a specific name is fixed. However, the names, paired with specific numerical character, are not fixed. In addition, among the stamps with only one general character, which may be the abbreviation of name, a specific general character could be paired with several different numerical characters, but the handwriting of these samples

is usually different, demonstrating that they were made by different artisans.

2.2 Stamps without Numerical Characters

Some stamps were made without numerical characters, which made up 24 percent of the stamps found at the No. 2 Architectural Site and 27 percent of the stamps found at the No. 5 Architectural Site. The broken stamps were not counted.

Table 25 The stamps without numerical characters

	No. 2 architectural Site	No. 5 Architectural Site
One character	[奴], 教*, 來*, 斥, 安*, 馬, 買, 庑*, 尤*, 子, 肱*	來*
Several characters	田[布], 田漢…, 田忿, 田**舠**, 王仲三, 王僑, 李保, 李[井], 涅口, 涅仲, 張桃, 張[寒], 楊元珎, 相鳳*, 元矢, [霍]口, 大李[孕], 拇…, 照思, [廣]平, [井]伯, 業…, [佃日]相, 都業, 尹口, [合]仲, [兒]賓, 匚平, [鄴]忠, 容担, [弋]国子休	李黑, 杢貴, 士貴, 元加生, 元旡口, 趙黑, 趙和, 田公…, 田[布], 張桃, 崔仲, 相鳳, 炟口, 傅口, 毛口, 由口, 照思, 普四, [菟伯], [步人], [炟]朱*, 涅大, 刖思, (文) 貴, (庠), 入田口, 思干二, 原[賓]

The stamps without numerical characters found in the DBT can be subdivided into two groups (Table 25): one-character stamps and several characters stamps. The stamps with one character are mostly in the shape of a square, and the samples, which are usually reserved, may have been the surnames of the artisans, such as character “馬” and character “安.” The stamps with several characters might also be the names of the artisans, such as the characters “趙黑,” “趙和,” “李黑,” “張桃,” “崔仲,” “李保,” and “楊元珎.” Moreover, the stamp “刖思” may have been related to punishment and prison.

3. The Relation between the Stamps and Roof Tiles

All of the stamps were found on the convex surface of polished-black imbrices, polished-black tegulae, and untrimmed tegulae, which were the main materials for the construction of this temple.

Different types of roof tiles usually have special groups of stamps (Table 26), and because the stamps were the symbols of the artisans, the stamps are essential for analyzing the relation between the artisans and their products.

Table 26 The relation between the stamps and the roof tiles from the No. 2 and No. 5 Architectural Site

	No. 2 Architectural Site	No. 5 Architectural Site
Polished-black imbrices	斤, 安*, 馬, 買, 庐*, 一胡, 一張拐, 一拐, 二[容], 二趙和, 四[容], 五貴, 八一韩俱, 九[容], 一九鳳, [合]仲, [兒]賓, 王傷, 匚平, 張桃, 涅仲, 一亮, 三王仲, 四洪, 四達, 四方思, 五解賓, 五仲, 九四休, 四九貴, 四九和, 八慈*, 尤*, 子, 肱*, 一[穎], 二□奴, 二王天, 二李月, 二楨, 四田央, 五□保, 八周, 八菟[柏], 九忠, [鄴]忠, □鳳, 田胠, 四九世, 九[四頑], 九三張拒, 容担, □住文, 王仲三(54 samples)	六[珒], 涅大, 崔仲, 張桃, 李黑, 四[萃], 四洪, 九三陳[作], 九四休, 九四亮, □子*, 八慈, 八土, 一八仲, 一八[達], 八一[韓俱], 八一年, 九□, 一九僧, 九三張[拒], 四九□, 九四堆, 刖思, 趙和, 入田□, (庠), 思干二, (文)貴, 原[賓], □思, □王, □大, …雷, …賓(34 samples)
Polished-black tegulae	[奴], 教*, 來*, 一柤, 二[靴]棟*, 四王大, 六土[宗], 六曾央, 六住羽, 六斬种, 六□[平], 六□[思], 六李[夲], 八鱼□, 八張□, 八雷明, 八閔[蓿], 一八□貝, 相鳳*, [霍]□, …[隹], 張[寒], 拇…, 楊元珎, 三□程, 三胡[宗], 四興, 五[和], 五紹, 七田…, 七大, 七伯, 八釗為三, 八解叔三, 八胡[宗]三, 八三張保, 八三釗保, 八崇四, 八馮国三, 九三解石, 九三庶楾, 九四国, 九四[伯], 九四[法], 照思, 李保, [廣]平, 八□租三, 一洪*, 四[恵], 四[和], 四良, 六入田, 六田忿, 六田安憘, 八伯周, 八一王[柤], 一八洪*, 九一[雀], 一九玲, 九三習堆, 三九□(2), [井]伯, □[宿]□, …[徂], …程小*, 業…, 元矢, [佃日]相, 田[布], 田漢…, 田忿, 涅□, 李[井], 四周, 五王賓, 五解国, 五田[進], 六王杲□, 六[杲]住, 七旦早, 八三□習, 八三蒋習二, 八四慕, 八甄奴三, [九二]田…, 九四…*, 九三□共, 九三張保, 九三朋保, 九四賓, 都業, □孟[陣], …[句](94 samples)	六(斬)种, 六□, 六小醜, 六相鳳, 六田安憘, 六田捐, 八菟榮, 八楊(宗), 九匡, 杢貴, 士貴, 元加生, 元乐□, 相鳳, 趙黑, 炟□, 傅□, 田[布], 二庶楾, [四扶], 五田文, 八崇四, 九牛習三, 九三□□, 九三解石, 九三張賓, 九四元, 九四(国), 六□□, 來*, 二公伯*, 四(互), 四□, 六[捐]朱, 八栅, 八一畔, 九二[句], 九三習堆, 九三□, [九四田合], 九四紹, 毛□, 由□, 照思, 普四, [菟伯], [步人], [炟]朱, □租, □九習, □□田仲, □方(52 samples)
Untrimmed tegulae	一□貝, 一仁, 二張和, 六祌萇, 六保才, 六洪, 八張□, 八閔[蓿], 二九伯, 尹□, 楊元珎, [井]伯, 五法, 八四慕, 九三張保, 九三牛富, 九三朋保, 九四[昌], 九四田□, [弋]国子休, 二[靴]棟*, 四林, 二暈, 六斬种, 八王□, 八張[鄴], 一九□, 二九□, …九[四], …大[合], 四和, 五都業, 七[塩]…, (七)大, (九三)庶楾, 九三作…, 九三住□, 九四□, □鳥, 照思, 李保, 來*, …似奴(43 samples)	二似奴, 六思□, 八鱼□, 八挴担, 八一畔, 二九…(1), 趙黑, …叔, 四□, 八崇四, 九四(回), 四(互), (六)[捐]朱, 六田(捐), 八菟榮, 二九…(2), 三九□(1), 九三□□, 九四紹, 四九□, 田公…, [炟]朱*, …遵伯, …仲, …陳, …程保, □土, □日甸, □良…(29 samples)

The relation between the stamps and roof tiles implies three points about the production management of the roof tiles in the workshop of the DBT.

First, the imbrex stamps and tegula stamps are different, which indicates that imbrices and tegulae were made by different artisan teams.

Second, some of the polished-black tegula stamps and untrimmed tegula stamps are the same type. At the No. 2 Architectural Site, 14 different types of stamps were found on the surface of both kinds of tegulae, which make up 14.9 percent of the polished-black tegula stamps and 32.6 percent of the untrimmed tegula stamps. At the No. 5 Architectural Site, 11 types of stamps were found on the surface of both kinds of tegulae, which make up 21.2 percent of the polished-black tegula stamps and 37.9 percent of the untrimmed tegula stamps. According to the previous analysis, before the production step of polishing, there were also fabric impressions on the concave surface of polished-black tegulae, and the impressions were similar to the untrimmed tegulae. This means that the two types of tegulae were likely made by the same type of cloth covers. The same tools and the same stamps prove that the polished-black tegulae and untrimmed tegulae were produced by the same artisan group. This group may have been subdivided into several artisan teams, but the tools were unified.

Third, there were a large number of stamped roof tiles unearthed from the No. 2 and No. 5 Architectural Sites, but stamped roof tiles from the No. 1 Architectural Site were rare. This implies that there were two different types of production management at the workshop in the DBT.

4. The Features of the Characters on the Roof Tiles of the Dazhuangyan Buddhist Temple

According to the previous analysis, the characters on the roof tiles of the DBT have five features. First, all of these characters are stamped. The inscribed characters, which were used in the Northern Wei Dynasty, are not found at the DBT. Second, most of the stamps consist of numerical characters and general characters, which were the name of the artisans, and a few stamps only have the general characters. Third, stamps with numerical characters increased together with the growth of the numbers, and the stamps with the characters of eight or nine make up half of these samples. Fourth, the numerical character paired with a specific name is fixed, but the names paired with a specific numerical character are not fixed. Fifth, the stamps with the same content were made in the same way, and have the same shape and direction, and all of the stamps were stamped before the production step of cutting. This means that the stamps were the symbol of artisans who made these roof tiles.

Moreover, by analyzing the relation between the stamps and roof tiles, it is clear that the artisans who made the imbrices and tegulae were different, but their works were controlled and arranged together in the workshop. It is also worth noting that different to the roof tiles with stamped characters found at the No. 2 and No. 5 Architectural Sites, the roof tiles unearthed from the No. 1 Architectural Site usually have no characters. This means that the management of roof tile production for the tower (the No. 1 Architectural Site) may have been different from the production management conducted in the construction of other buildings in this temple.

Section 5. The Unearthed Position of Roof Tiles with Characters and the Supply of Roof Tiles

According to the results of the excavation, the deposits of the No. 5 Architectural Site were undisturbed, and subsequently, the excavation results from this site indicate the original setting of the buildings when they were destroyed. Meanwhile, the No. 2 Architectural Site is more disturbed, because fragments of porcelain produced in the later period were found in the deposits of the Northern Qi Dynasty, but the stamped roof tiles were unearthed regularly from this site, indicating that there were fewer horizontal disturbances. This section will analyze the unearthed positions of stamped roof tiles to speculate the supply of the roof tiles for these buildings.[77]

1. The Unearthed Position of the Stamped Roof Tiles

By analyzing the unearthed position of stamped roof tiles, it is clear that the distribution of stamped roof tiles was influenced by the content of the stamps. Using the distribution of the stamped polished-black tegulae, the No. 5 Architectural Site can be divided into two parts, the eastern and western parts. The “元旡□, “杢貴,” “士貴,” “元加生,” “六田拐,” “八菟榮,” “六□□,” “八楊[宗],” “六□,” “六田安憘,” “傅□,” “六小醜,” “六[斬]神,” “趙黑,” “九匡,” “炟□,” “相鳳, ” “六相鳳,” and “田[布]” stamps were mostly unearthed from the eastern part of this site. Meanwhile, the “二庶楾,” “八崇四,” “九三張賓,” “九三□□,” “九牛習三,” “四扶,” “九四[国],” “九四元,” “照思, ” and “九三解石” stamps were mostly unearthed from the western part of this site. There are only two types of stamps, “五田文” and “來,” unearthed from both parts (Figure 91). Similar to the polished-black tegula stamps, the distribution of the

[77] This analysis focused on the stamp types that have more than two samples.

polished-black imbrex and untrimmed tegula stamps can also be divided into eastern and western parts.

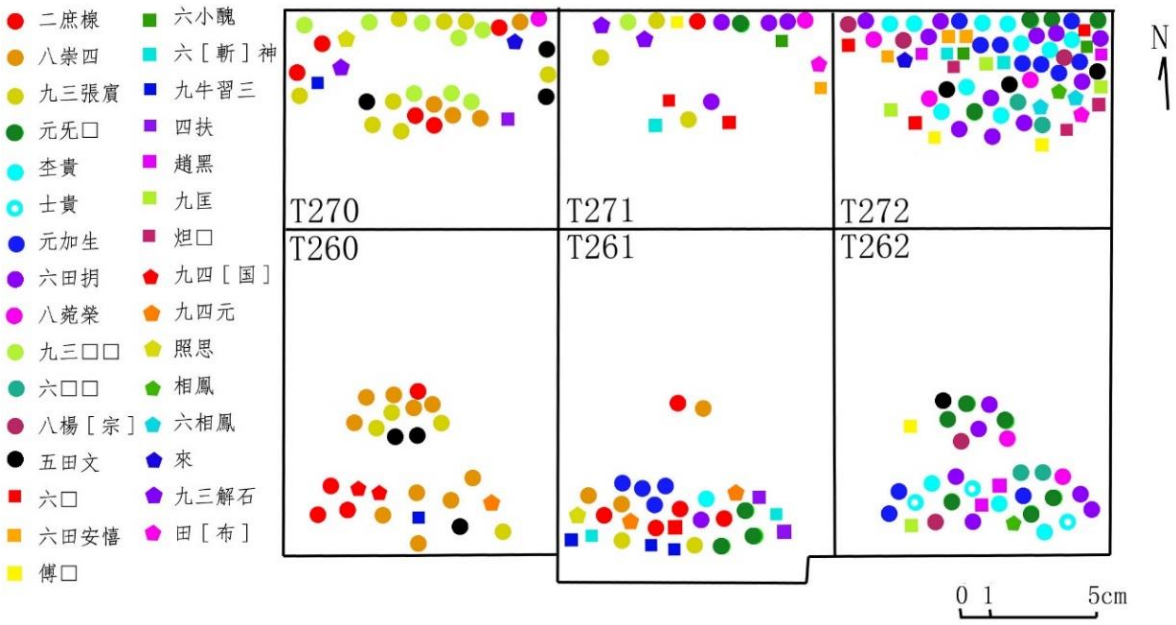


Figure 91 The distribution of polished-black tegula stamps at the No. 5 Architectural Site (Source: Made by the author)

The distribution of the stamped polished-black imbrices at the No. 2 Architectural Site can be divided into three parts: the eastern part of the main building, the eastern part of the attached building, and the western part. The “一亮,” “三王仲,” “四洪,” “四達,” “四方思,” “五解賓,” “五仲,” “九四休,” “四九貴,” “九四和,” and “八慈” stamps were mostly unearthed from the western part. The “一胡,” “一張拐,” “一拐,” “二[容], ” “二趙和,” “五貴,” “八一韓俱,” “九[容],” “一九鳳,” “[合]仲,” “[兒]賓,” “王僊,” “匚平,” “張桃” and “涅仲” stamps were found in the eastern part of the main building, while the “斥,” “安,” “馬,” “買,” “庑,” and “四[容]” stamps were found in the eastern part of the attached building (Figure 92). The distribution of the polished-black tegula stamps are similar to the polished-black imbrex stamps, but the distribution

of untrimmed tegula stamps can only be divided into two parts: the eastern part and the western part.

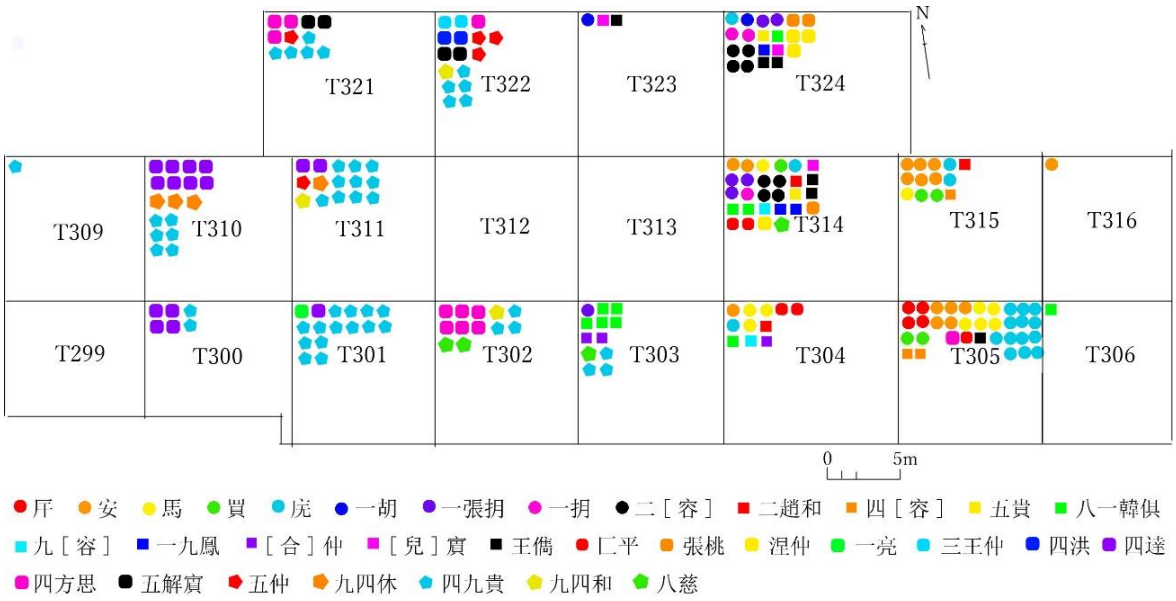


Figure 92 The distribution of the polished-black imbrex stamps at the No. 2 Architectural Site (Source: Made by the author)

The specific distribution of the stamped roof tiles in these two sites was caused by three factors. First, there was more than one source of the roof tiles for the building. Second, different parts of the roof were tiled separately. Third, roof tiles from one specific source were made by the same artisans and provided for a specific area of the roof. If the conditions of the roof tile supply were different, the distribution of the stamped roof tiles would have been more disordered.

2. The Distribution of Stamps with Numerical Characters

The stamps with numerical characters were unearthed from all of the areas of this site. The previous analysis indicated that the content of the stamps unearthed from the eastern part of this site is different from the content of those unearthed from the western part, but the numerical

characters of the stamps did not follow this pattern very strictly.

Table 27 The distribution of stamps with numerical characters

No. 2 architectural site	**Western part**	**Eastern part**
Polished-black tegulae	三, 四, 五, 七, 八三, 八, 八四, 九三, 九四	一, 二, 四, 六, 八, 一八
Untrimmed tegulae	五, 八四, 九三, 九四	一, 二, 六, 八, 二九
Polished-black imbrices	一, 三, 四, 五, 九四, 四九	一, 二, 四, 五, 八一, 九, 一九
No. 5 architectural site	**Western part**	**Eastern part**
Polished-black tegulae	二, 四, 五, 八, 九三, 九, 九四	六, 八, 九
Untrimmed tegulae	四, 八, 九四	二, 六, 八, 八一
Polished-black imbrices	四, 九三, 九四	六

From the Table 27, it is clear that the numerical characters cannot be identified as a western group or an eastern group. For example, at the No. 2 Architectural Site, “一,” “四,” “五,” and “八” stamps were found at both sides of the site, and at the No. 5 Architectural Site “二,” “八, ” and “九” stamps were also found at both sides. It means that although the characters of one specific number could be found all around the site, the names following the numerical character could be divided into the western group and eastern group. For example, at the No. 5 Architectural Site, “二似奴” stamps were only found in the eastern part, while the “二庶椋” stamps were only unearthed from the western part. The separate distribution of the roof tiles illustrates that the supply sources were different, so the “二似奴” and “二庶椋” stamps must have come from different sources. This means that the number “二 (two)” was not the serial number of the production team, and it is more likely that the numerical characters in the stamps are codes for the artisans.

3. The Distribution of Stamps without Numerical Characters

Stamps with one character were mostly unearthed from the eastern attached building of the No. 2 Architectural Site and the No. 5 Architectural Site. This implies that the attached building at the No. 2 Architectural Site might have been built together with the No. 5 Architectural Site. Meanwhile, stamps with several characters were found at both sites, and most of them were unearthed from the eastern part.

4. Roof Tile Supply for the Dazhuangyan Buddhist Temple

According to the unearthed position of stamped roof tiles and the content of the stamps, it is likely that the roof tiles used in the DBT were supplied from several sources. These roof tiles from different sources were installed separately and caused the separate distribution of the roof tiles at these sites. The separate supply of the roof tiles indicates that the production of the same type of roof tiles might have been completed by several teams. In each team, a group of specific artisans were working, and their products were provided for a specific part of the roofs.

Previous research has indicated that the artisan groups from the workshop of the DBT were unified, but this does not mean that the artisan groups cannot be subdivided. Distinctions among the artisan groups were based on the differences in the production techniques, while the distinction among the artisan teams in this section was the result of production management.

Section 6. The Classification of Roof Tiles and their Usage in the Dazhuangyan Buddhist Temple

The disturbances in the deposits of the No. 5 Architectural Site are minimal, and so the samples are suitable for the analysis of the usage of the roof tiles. Meanwhile, the No. 2 Architectural Site had more disturbances in the vertical direction, but the deposits are less disturbed in the horizontal direction. This section will focus on the usage of the roof tiles unearthed from the No. 2 and No. 5 Architectural Sites.

1. The Distribution and Function of the Roof Tiles at the No. 5 Architectural Site

The number of roof tiles unearthed from the six trenches of the No. 5 Architectural Site is unequal. Most of them were found at the western and eastern sides of this site, with only a few samples unearthed from the central area. The distribution of the different types of roof tiles was analyzed using their weight (Figure 93, Table 28).

Table 28 The weight of the roof tiles from the No. 5 Architectural Site (kg)

Trench	Part	Untrimmed tegulae	Polished-black tegulae	Simply-trimmed imbrices	Polished-black imbrices	Weight in total	Discount
T260	Southwestern part	156.45	254.75	0.15	135.45	546.8	22.4%
T270	Northwestern part	37.65	101.75	0	61.4	200.8	8.2%
T261	Central southern part	19.25	250.65	0	92.6	362.5	14.8%
T271	Central northern part	32.8	80.65	0	76.85	190.3	7.8%
T262	Southeastern part	44.8	155.75	5.75	80.25	286.55	11.7%
T272	Northeastern part	269.05	353	16.2	216.9	855.15	35.0%
Weight in total		560	1196.55	22.1	663.45	2442.1	100%
Proportion		22.9%	49.0%	0.9%	27.2%	100%	

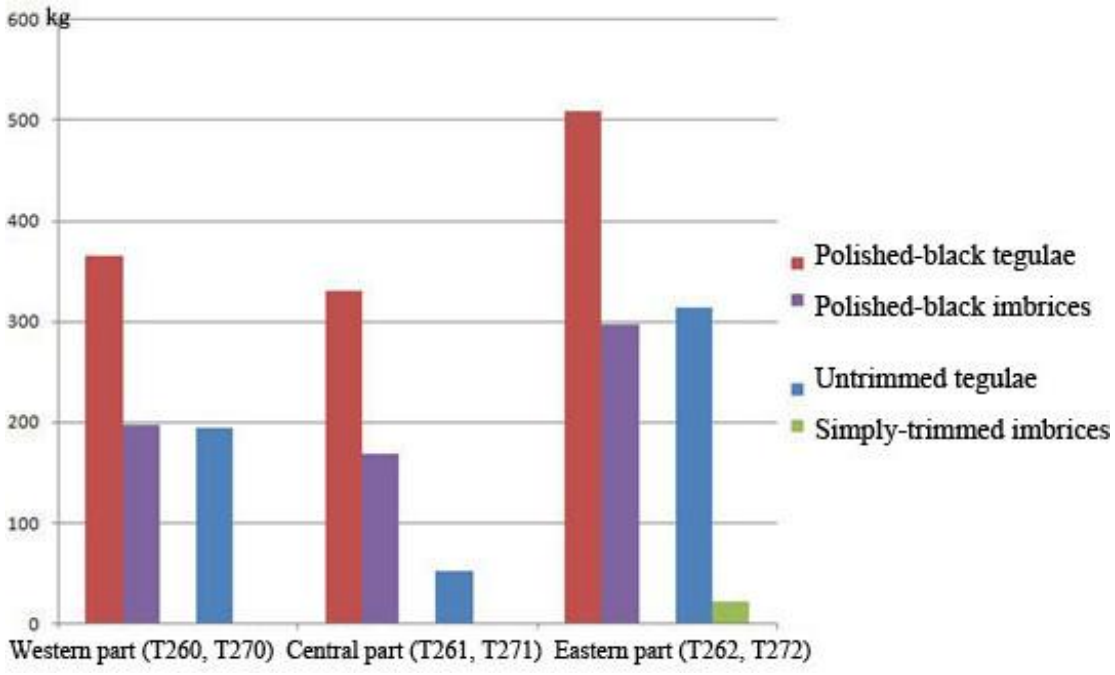


Figure 93 The weight of the roof tiles in different parts of the No. 5 Architectural Site (Source: Made by the author)

The distribution of the roof tiles in different areas of this site implies the usage of different types of roof tiles. The polished-black roof tiles were the most unearthed remains from this site. The samples unearthed from the western and eastern parts were more than the samples found in the central part, but their distribution is comparatively even. This means that the polished-black roof tiles were the main materials for the building and were laid on all areas of the roof. The untrimmed tegulae made up around 30 percent of the tegulae unearthed from this site, demonstrating that they were also used for this building intentionally. The roof style of this building is unknown, but regardless of the style, the total length of the ridges in the western or eastern part of the roof was likely to have been longer than the ridge in the central part. This means that the ridge tiles used in the central part were less in number than the ridge tiles used in the two sides. The untrimmed tegulae, which were mostly unearthed from the eastern and western parts of the site, were likely

to have been used as ridge tiles. In addition, the widths of the untrimmed tegulae are usually half or one-third of the polished-black tegulae, which are similar to the ridge tiles mentioned in the book, *Yingzao Fashi*.[78] Moreover, the simply-trimmed imbrices were only found in the eastern part of this site. Their exposed surface and size are different from the polished-black roof tiles, which means that they were not laid together. It is possible that they were used on the roofs of the attached buildings on the eastern and western sides of the gate or were mixed in from other sites.

According to the previous analysis, there were 52–115 tile-ends unearthed from this site, which means that there are 52–115 imbrices with tile-ends. The total weight of the imbrices is 663.45kg, and the weight of an imbrex is approximately 3.2kg, so the minimum number of imbrices is 207, including both imbrices with tile-ends and imbrices without tile-ends. Therefore, the imbrices with tile-ends make up one-fourth of the imbrices found at this site. Furthermore, the total length of the lower end with double wave-shaped patterns is 1,473.1cm, while the total length of all lower ends is 7,305.6cm. Subsequently, the tegulae with double wave-shaped patterns make up one-fifth of the tegulae unearthed from this site. The imbrices with tile-ends and the tegulae with double wave-shaped patterns, which were found less than the roof tiles without patterns, were likely to have been used as eave roof tiles for the roofs.

[78] *Yingzao fashi*: "線道瓦於每片中心畫一道，條子十字縴畫." Li jie, with commentaries assembled by Liang sicheng, *Yingzao fashi zhushi*, in *Liang Sicheng quanji*, vol.7, p. 278.

Figure 94 The position of different types of roof tiles (Source: Shanxisheng kaogu yanjiusuo 2015, Fig. 54; Added by the author)

Figure 94 is a wall painting of the Jiuyuangang (九原崗) Tomb in Xinzhou (忻州), Shanxi (山西) Province. The building in this painting was a gate with three entrances, and porches on both sides. The roof of this building was hip-roof style (寄棟造), with the slope of roofs laid by tegulae and

imbrices. The ridge of this building was made with several layers of ridge tiles, and there were also imbrices laid on the top of the ridge tiles. Several decorations were inserted in these imbrices. Moreover, on the two sides of the main ridge, there were Chiwei (鸱尾), and on the end of the other ridges, there were tiles with the monster face pattern. The roofs of the porches were shorter than the roofs of the main building, but the imbrices, tegulae, ridge tiles, and decorations on ridges were also very clear. The wooden structure of this building was painted in red. The Jiuyuangang Tomb was likely to be a tomb of a high-class noble person from the Northern Qi Dynasty, so the wall painting of this tomb could reflect the real setting of life during the Northern Qi Dynasty. The gate drawn on the wall of this tomb is a good example of the high-rank buildings of this period.

It is difficult to analyze the usage of the whole roof tiles unearthed from the No. 1 and No. 2 Architectural Sites. From basic observations, however, it is clear that the roof tiles used for the tower and the main hall are similar to the roof tiles used for the gate. The polished-black roof tiles were the main materials for the roofs, the untrimmed tegulae were used as ridge tiles, and the imbrices with the tile-ends and the tegulae with double wave-shaped patterns were laid on the eaves of the roofs.

2. The Usage of the Imbrices

2.1 The Usage of the Imbrices at the No. 2 Architectural Site

The imbrices unearthed from the No. 2 Architectural Site can be divided into two groups by their diameter: size 2 imbrices and size 3 imbrices. Figure 95 illustrates the distribution of these imbrices. The numbers from 0 to 5 in the abscissa axis of this figure represent the location of the trenches. The trenches numbered 0 or 5 are the areas of the attached buildings of the main hall,

while the trenches numbered 1, 2, 3, or 4 are the areas of the main building of the main hall. The vertical axis represents the diameter of the imbrices. From this figure, it is clear that the size 2 imbrices were mostly used for the attached buildings, while the size 3 imbrices were mostly found in the area of the main building. This means that the materials used for the main building are larger than the materials used for the attached buildings.

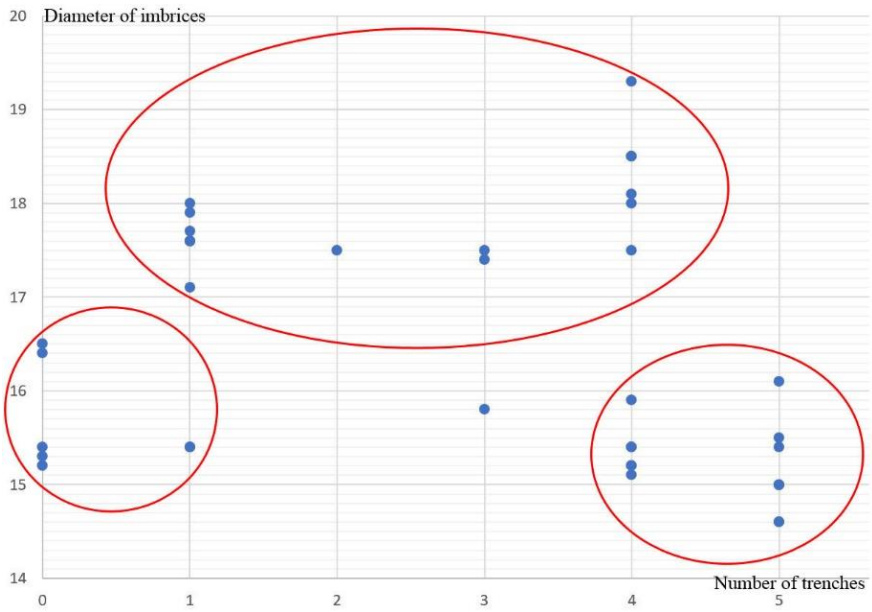


Figure 95 The diameter and unearthed position of the imbrices from the No. 2 Architectural Site (Source: Made by the author)

2.2 The Usage of the Imbrices at the No. 5 Architectural Site

The imbrices unearthed from the No. 5 Architectural Site are mostly 15.5±1cm in diameter. They were likely to have been the main materials for the roofs of the gate, and their diameter is similar to the imbrices used for the attached buildings of the No. 2 Architectural Site. Some large-sized imbrices were also unearthed that are 17.5±1cm in diameter, and these may have been used as the

materials for the ridge.[79]

2.3 The Distribution of the Imbrices at the Dazhuangyan Buddhist Temple

The relation between the imbrices' features and their distribution are illustrated below.

Table 29 The imbrices unearthed from the Dahzuangyan Buddhist Temple

	Size (diameter)	Color of the clay	Exposed Surface	Position
No. 1 Architectural Site	D<12.5cm	Blue-grey	Polished-black	Around the site
	D: 17.5±1cm	Blue-grey	Polished-black	Around the site
No. 2 Architectural Site	D: 15.5±1cm	Blue-grey	Polished-black	Attached buildings
	D: 17.5±1cm	Blue-grey	Polished-black	Main building
No. 5 Architectural Site	14–15cm	Yellow-brown	Scraped	Two sides of the site
	D: 15.5±1cm	Blue-grey	Polished-black	All around the site; the remains from the two sides were more than the remains from the central area.
	D: 17.5±1cm	Blue-grey	Polished-black	All around the site; the remains from the two sides were more than the remains from the central area.

According to Table 29, the imbrices, whose diameter are less than 12.5cm, were mostly unearthed around the foundation of the tower. The imbrices, which are 15.5±1cm in diameter, were found in the attached buildings of the main hall and the site of the gate. This implies that the attached buildings of the No. 2 Architectural Site were built together with the No. 5 Architectural Site. The imbrices, which are 17.5±1cm in diameter, are likely to be the main materials used for the main hall and the tower. There were also a few large-sized imbrices unearthed from the No. 5 Architectural Site, but there were no matching tile-ends. Therefore, these large-sized imbrices

[79] *Yingzao fashi*: "合脊甋瓦亦用本等. ［其本等用八寸，六寸甋瓦者，合脊用長九寸甋瓦］." This means that the imbrices used for the ridge were larger than the imbrices laid on the roof. Li jie, with commentaries assembled by Liang sicheng, *Yingzao fashi zhushi*, in the *Liang Sicheng quanji*, vol.7, p. 257.

might have been used as ridge tiles for the gate. Moreover, imbrices, whose diameter is 14–15cm, were unearthed from the eastern part of the No. 5 Architectural Site, and they have different colored clay and exposed surfaces than the other remains. They might have been mixed in from other sites or used on specific parts of the roofs.

3. The Usage of the Tile-Ends

3.1 The Usage of the Tile-Ends at the No. 5 Architectural Site

According to Table 30, in which an unbroken petal will be counted as an object, most of the samples unearthed from this site are Type Ab/Ac/Ad tile-ends, and they were unearthed from the whole site. Meanwhile, the Type Aa tile-ends were mostly unearthed from the western part, and the Type Ae tile-ends were found in the eastern part of this site. The Type Ba tile-ends were found all around this site, but more samples were unearthed from the eastern part than the other parts. Moreover, the diameters of the tile-ends unearthed from the No. 5 Architectural Site are 15.1–15.4cm, which is similar to the diameters of the size 2 imbrices.

Table 30 The distribution of the tile-ends at the No. 5 Architectural Site

	T260	T270	T261	T271	T262	T272
Aa	56	30	14	9	2	3
Ab/Ac/Ad	35	15	21	27	15	30
Ae	10	5			8	27
Ba	19		4	13	8	35

3.2 The Usage of the Tile-Ends at the No. 2 Architectural Site

Table 31 illustrates the distribution of many types of tile-ends unearthed from the No. 2 Architectural Site. It does not include the Type Ah, Ca, Da tile-ends, as they are too broken to be counted. The XX0 trench is located in the west of the site, while the XX5 trench is located in the

east of the site. The T300, T310, T320, T305, and T315 trenches were the attached buildings, and the other trenches covered the main building of the No. 2 Architectural Site. As most of the samples are broken, an unbroken petal was counted as an object.

According to the statistical analysis, the distribution of the Type Aa, Type Ae/Af, and Type Bb/Bc tile-ends is comparatively even, but the samples unearthed from the central part of this site are slightly more than the samples from the two sides. These tile-ends are 16.8–17.6cm in diameter, matched to the size 3 imbrices. Meanwhile, the Type Ab/Ac, Type Ad, Type Ag, and Type Ba tile-ends were mostly unearthed from the two sides of this site, especially the areas of the attached buildings. They are 15.2–15.6cm in diameter and matched the size 2 imbrices.

Table 31 The distribution of the tile-ends at the No. 2 Architectural Site

	300	310	320	301	311	321	302	322	303	323	304	314	324	305	315
Aa	**4**	**4**	**6**	**8**	**5**	**35**	**15**		**5**			**24**	**50**		**2**
Ab/Ac	4	1			1							14	8	45	17
Ad	35	20	5	13	4	2					6	4		28	3
Ae/Af	**4**	**20**		**21**	**13**	**10**		**8**	**16**	**4**	**34**	**14**	**9**	**6**	**2**
Ag	10	9									2	4	4	59	81
Ba		2								8	7	20		31	16
Bb/Bc	**12**	**14**	**6**	**3**	**2**	**5**	**7**	**2**					**3**	**1**	

3.3 The Distribution of the Tile-Ends at the Dazhuangyan Buddhist Temple

The styles of the tile-ends used in the Dahzuangyan Buddhist Temple are limited. They all have lotus patterns with oval petals or round curled petals, but the distinction of the molds (first-level mold) caused the differences of the tile-ends. The tile-ends of one type were usually unearthed from one specific area.

Table 32 The tile-ends unearthed from the Dahzuangyan Buddhist Temple

	Type	Petals	Seeds in the central area	Size (diameter)	Position
No. 1 Architectural Site	A	9	1+6	11.3±0.3	Around the site
	B	8	1+7	17.9±0.3	Around the site
No. 2 Architectural Site	Aa	9	1+7	16.8±0.4	Main building
	Ab/Ac	9	1+8	15.2±0.4	Attached building, more samples in the eastern part
	Ad	8	1+6	15.5±0.5	Attached building
	Ae/Af	8	1+7,1+8	17.6±0.5	Main building
	Ag	8	1+8	15.5±0.6	Attached building, more samples in the eastern part
	Ba	8	1+8	15.6±0.4	Attached building, more samples in the eastern part
	Bb/Bc	8	1+6,1+7	17.5±0.8	Main building, the western attached building
No. 5 Architectural Site	Aa	9	1+8	15.4±0.5	All around the site; more remains in the western part
	Ab/Ac/Ad	8	1+6,1+7,1+8	15.4±0.7	All around the site
	Ae	8	1+8	15.4±0.2	All around the site; more remains in the eastern part
	Ba	8	1+8	15.1±0.3	All around the site; more remains in the eastern part

Table 32 illustrates the information and distribution of the tile-ends in the DBT. The tile-ends can be divided into three groups—diameter 1: 12.5cm, diameter 2: 15.5±1cm, and diameter 3: 17.5±1cm. The diameter 1 tile-ends were concentrated around the foundation of the tower, the diameter 3 tile-ends were mostly unearthed from the main building of the main hall and the area around the tower, and the diameter 2 tile-ends were found from the attached building of the main hall and the area of the gate. It is worth noting that the tile-ends unearthed from the areas of the attached buildings and the gate are similar in both diameter and pattern, so it is likely that the porches connected the main hall with the gate. The buildings of the gate and porches surrounded the main hall of the temple and formed the square in front of the main hall.

4. The Usage of the Tegulae

The polished-black tegulae were the main materials used for the roofs of this temple. The small-sized tegulae (20*30cm^2) were only used at the No. 1 Architectural Site, while the large-sized tegulae (30*40cm^2) were found all around the temple.

5. Summary

The distribution of the different types of roof tiles in these sites can shed some light on the usage of the roof tiles in the DBT.

First, large-sized polished-black tegulae (30*40cm^2) were the most common found roof tiles at this temple. There were also a few small-sized polished-black tegulae (20*30cm^2) unearthed around the foundation of the tower.

Second, polished-black imbrices with a diameter of 17.5±1cm were laid on the roofs of the tower and the main building of the main hall or used as ridge tiles. Polished-black imbrices with a diameter of 15.5±1cm were used for the gate and porches, and polished-black imbrices with a diameter of 12.5±1cm were only used for the tower.

Third, the tile-ends used in this temple all have lotus patterns with oval petals or round curled petals. Tile-ends with a diameter of 17.5±1cm were laid on the roofs of the tower and the main building of the main hall. Tile-ends with a diameter of 15.5±1cm were used for the gate and porches. Tile-ends with a diameter of 12.5±1cm were only used for the tower. The distribution of the tile-ends is similar to the polished-black imbrices.

The distribution of the roof tiles can provide information about the relation of different buildings at the DBT: the gate and porches surrounded the main hall and formed a closed courtyard, and the tower was built to the south of the courtyard.

Section 7. Roof Tiles and the Construction Sequence of the Dazhuangyan Buddhist Temple

The DBT consisted of a tower (No. 1 Architectural Site), a main hall (No. 2 Architectural Site), a gate (No. 5 Architectural Site) and porches. There are also two sites to the north of the No. 2 Architectural Site that have not been excavated. The construction process of the temple must have taken a long time, and the buildings in the temple were not built at the same time. The production sequence of the roof tiles can shed light on the construction sequence of the buildings. This section will briefly discuss the construction sequence of the DBT using the roof tiles unearthed from these sites.

1. The Stamped Roof Tiles and the Production Sequence

The previous sections analyzed the management methods of the roof tile production at the workshop of the DBT using the stamped characters on roof tiles. From the stamped roof tiles, more information about the production sequence of the roof tiles used on the roofs of different buildings can be obtained.

Table 33 The stamps found at both the No. 2 and the No. 5 Architectural Sites

	No. 2 Architectural Site	No. 5 Architectural Site
Polished-black imbrices	八一韩俱 10, 九四休 8, 八慈*4, 張桃 3, 九三張拒 1, 四洪 2	八一[韓俱]1, 九四休 2, 八慈 1, 張桃 4, 九三張[拒]1, 四洪 7
Polished-black tegulae	來*9, 九四国 4, 相鳳*3, 六斬种2, 九三解石 2, 照思 2, 六田安憙 1, 九三習堆 1, 田[布]1, 八崇四 3, 八鱼□12	來*2, 九四(国)2, 相鳳 2, 六(斬)种5, 九三解石 3, 照思 2, 六田安憙 4, 九三習堆 1, 田[布] 2, 八崇四 17
Untrimmed tegulae		八崇四 8, 八鱼□4

Table 33 illustrates the stamps found at both the No. 2 and the No. 5 Architectural Sites. There are six types of stamps on the polished-black imbrices, making up 11.1 percent of the stampe types on the samples from the No. 2 Architectural Site and 17.6 percent of the stamp types on the samples from the No. 5 Architectural Site. Meanwhile, there are ten stamps on the polished-black tegulae, making up 10.9 percent of the stamp types on the samples from the No. 2 Architectural Site and 19.2 percent of the stamp types on the samples from the No. 5 Architectural Site. The stamps on the untrimmed tegulae unearthed from the No. 2 and the No. 5 Architectural Sites are different, but the "八崇四" and "八鱼□" stamps were found on the untrimmed tegulae from the No. 5 Architectural Site and the polished-black tegulae from the No. 2 Architectural Site.

Approximately 10–20 percent of the roof tiles have the same stamps between these two sites. This means that these two buildings were built at the same time, and some of the building materials were used together. The polished-black imbrices with the same stamps found from the No. 2 Architectural Site are mostly size 3 samples, which were used on the slopes of the roofs of the No. 2 Architectural Site and the ridge of the roofs of the No. 5 Architectural Site. This implies that these imbrices were mostly made for the main hall, and some of the surplus imbrices were used for the ridge of the gate. Moreover, some untrimmed tegulae from the No. 5 Architectural Site have the same stamps as the polished-black tegulae from the No. 2 Architectural Site. They

might have been surplus materials from the main hall that were reused for the roofs of the gate. Therefore, the construction process of the gate is likely to have been completed after the main hall.

2. The Tile-Ends Made Using the Same Mold and the Production Sequence

The Type Ba tile-ends (size 3), designed as a lotus with eight round curled petals, were found at both the No. 1 and the No. 2 Architectural Sites. The samples unearthed from the two sites have a mold trace in the same place, indicating that they were made with the same mold. Apart from the mold trace on the top of one petal, the samples unearthed from the No. 2 Architectural Site have more mold traces (Figure 96). This means that the samples used at the No. 2 Architectural Site were made after the samples used at the No. 1 Architectural Site. At that time, the mold making these tile-ends would have already been worn out. Therefore, the tower was likely to have been built earlier than the main hall.

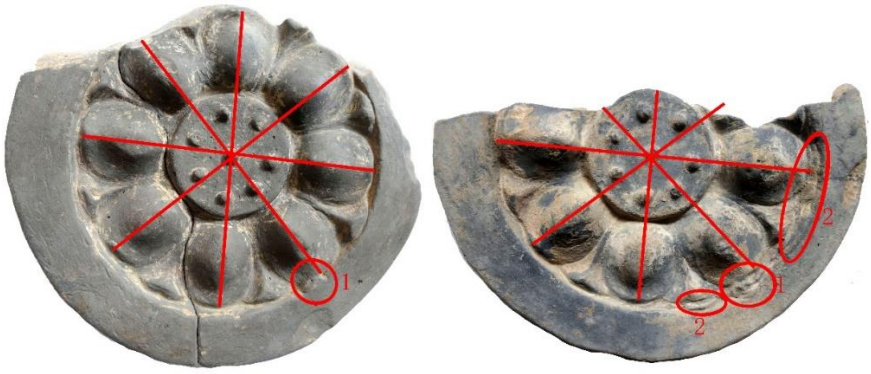


Figure 96 The tile-ends made by the same mold from the No. 1 and the No. 2 Architectural Site (Source: Photos by the author)

The construction of the DBT would have begun with the tower, then the main hall would have been built, and finally, the construction of the gate and porches would have been completed.

Section 8. The Traces of the Roof Tiles and the Installation Process

Some of the traces on the surface of the roof tiles were left when the roof tiles had been installed on the roofs, and so, they can provide important information about the installation process. Most of the roof tiles unearthed from the DBT, however, are seriously broken, so it is difficult to find complete traces of this installation process. Subsequently, this section will only discuss certain episodes of the roof tiles' installation process.

1. The Installation of Eave Tiles

The polished-black tegulae with double wave-shaped patterns unearthed from the DBT usually have a horizontal red band on their convex surface (Figure 97). In the No. 2 and the No. 5 Architectural Sites, the width of the tegulae's lower end is approximately 30cm, and the red band, whose max-width is approximately 4cm, is 9–12.5cm from the lower end. In the No. 1 Architectural Site, there are two sizes of tegulae. The red band of the smaller tegulae is approximately 0.5–4.5cm in width and 2–7.5cm from the lower end, while the red band of the larger tegulae is approximately 1.2–3.5cm in width and 11–12.5cm from the lower end.

The tegulae with double wave-shaped patterns always stretched out of the eave when they were laid on the roofs, and according to the wall painting of the Jiuyuangang Tomb, the wooden structure of the building was painted red. The red band on the convex surface of the eave tegulae might have been left when the wooden structure was painted. Subsequently, they can be used to understand the installation setting of the eave tiles: the large-sized eave tegulae (30*40cm^2) stretched out for 9–12.5cm and the small-sized eave tegulae (20*30cm^2) stretched out for 2–7.5cm, and these were around one-fourth of the whole tegulae.

Figure 97 The red band on the convex surface of the eave tegulae
(Source: Photo by the author)

2. The Reinforcement Method of the Eave Imbrices

Some of the imbrices unearthed from the DBT have a hole on their front surface (Figure 98). These imbrices were all size 2 or size 3 samples, with a length of 30–40cm, and joined with tile-ends, which indicates that they were eave imbrices. Meanwhile, the size 1 eave imbrices at the No. 1 Architectural Site seem to have no hole on their front surface (Figure 99). In addition, there are many iron nails unearthed from this site. One end of these nails is sharp, and the other end is flat, and the cross-section of the nails is square (Figure 100). These iron nails might have been inserted into the eave imbrices from the holes to fix them.

Moreover, the edges of the eave imbrices were scraped, and the ridgelines on the concave side of the edges were cut off. This may have been a way to make the contact area larger and increase the friction to prevent the imbrices from slipping off the roof.

Figure 98 A size 2 eave imbrex unearthed from the No. 5 Architectural Site
(Source: Photo by the author)

Figure 99 A size 1 eave imbrex unearthed from the No. 1 Architectural Site
(Source: Photo by the author)

Figure 100 Iron nails unearthed from the No. 1 Architectural Site
(Source: Photo by the author)

3. The Separate Installation of the Roof Tiles

According to the previous analysis, the roofs of the No. 5 Architectural site were divided into two parts: the western part and the eastern part. The roofs of the No. 2 Architectural Site were divided into three parts: the western part, the eastern part of the main building, and the eastern part of the attached building. The roof tiles for different parts of the roofs were provided from different sources, and their installation was also conducted separately.

Section 9. The Proportion of the Roof Tiles and the Destruction of the Buildings

1. The Destruction of the No. 5 Architectural Site

The size and amount of building materials, including the roof tiles, used in traditional Chinese architecture, were strictly decided. Therefore, the structure of a building or the destruction setting of the building can be deduced from the statistical analysis of the roof tiles, if all of the remains of the roof tiles from the site are collected. In the excavation work of the No. 5 Architectural Site, all of the fragments of the roof tiles were gathered, so the proportion of different types of roof tiles can be counted, which can provide more information about the setting of the building.

The proportional relation between the polished-black tegulae with double wave-shaped patterns and the undecorated polished-black tegulae was first analyzed using the width of the lower end. The total width of the lower end with double wave-shaped patterns is 1,473.1cm, while the total width of all lower ends is 7,305.6cm (Table 34). From this, it is clear that the eave tegulae made up one-fifth of the tegulae unearthed from this site.

Table 34 The width of the tegulae's lower end at the No. 5 Architectural Site

	Total width	Width of unbroken samples	Minimum number of tegulae
Polished-black tegulae with double wave-shaped pattern	1473.1	31cm	48
Undecorated polished-black tegulae	5832.5	30cm	195

From Table 35, there are 52–115 tile-ends unearthed from this site, which means that there are at least 52 eave imbrices. The total weight of the imbrices is 663.45kg, and the weight of an imbrex is approximately 3.2kg, so the minimum number of imbrices is 207, including both eave imbrices and imbrices without tile-ends. Therefore, the eave imbrices made up one-fourth of the imbrices found at the No. 5 Architectural Site.

Table 35 The number of different types of tile-ends unearthed from the No. 5 Architectural Site

Type	Maximum number	Minimum number
Aa	32	13
Ab/ac/ad	42	18
Ae	10	7
Ba	26	10
Bb	1	1
Ca	3	2
Cb	1	1

The length of the tegulae and imbrices is approximately 40cm. Even if the tegulae do not overlap, the length of the slope should be 1.6m according to the proportional relation of the eave imbrices and general imbrices, or 2m according to the proportional relation of the eave tegulae and general

tegulae. The length of the site from north to south, however, is approximately 14.3m (Zhongguo shehui kexueyuan kaogu yanjiusuo Yecheng kaogudui 2018), which means that the number of eave roof tiles is too large. As all of the remaining roof tiles were gathered during the excavation works, the shortage of general imbrices and tegulae must have been related to the destruction of the building.

From the plan and vertical section of this site, it was clear that the remains of the building materials were concentrated on the southern and northern side of this site, and the remains unearthed from the central area of this site are rare (Figure 101). This phenomenon may have been related to how the building was destroyed. If the building was destroyed by the force of nature and collapsed suddenly in a vertical direction, the remains would be well-distributed, such as the distribution of the roof tiles in the site of the Yamada Temple (山田寺, Figure 102, Nara bunnkazai kennkyuujyo 2002). Therefore, the roof tiles of the No. 5 Architectural Site might have dropped off from the roof before the demolishment of the building, and the roof tiles banked up around the foundation of the building. This means that the gate of the No. 5 Architectural Site was not destroyed suddenly by the force of nature, and it is likely that this building may have been demolished intentionally.

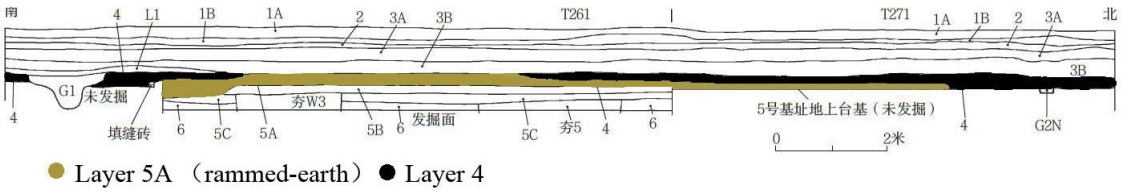


Figure 101 The vertical section of the No. 5 Architectural Site (Source: Zhongguo shehui kexue yuan kaogu yanjiusuo hebeisheng wenwu yanjiusuo lianhe yecheng kaogudui 2018, Fig. 5)

Figure 102 The well-distributed roof tiles in the eastern porch (SC060) of the Yamada Temple (Source: Nara kokuritsu bunkazai kenkyuujo 2010, Ph. 14-2)

According to historical records, Yecheng was captured by the army of the Northern Zhou Dynasty in 577 AD. The emperor of the Northern Zhou Dynasty at that time was Emperor Wu, and he gave the order to persecute Buddhists and demolish their temples. The DBT might have been demolished after Yecheng was occupied by the army of the Northern Zhou. Moreover, according to the book, *Zizhi Tongjian*, the royal buildings in Yecheng were demolished, and the building materials were reused by ordinary citizens.[80] These records demonstrate that the DBT might have been demolished intentionally after the war between the Northern Qi and Northern Zhou and its roof tiles were reused. Compared to the eave roof tiles, which were usually nailed, general imbrices and tegulae were easy to be dismantled and reused.

[80] Zizhi tongjian: "（陳宣帝太建九年元月辛丑）詔：齊之東山，南園，三臺, 并可毀撤. 瓦木諸物, 可用者悉以賜民. " Sima guang, *Zizhi tongjian*, vol.173, p. 5372.

2. The Reconstruction Study of the Roofs of the No. 1 Architectural Site

According to the report, “Evidence and Speculation, Reconstruction of Building by Roof Tile (実証与推想—瓦礫中的建築図景),” by Peng Minghao, the proportional relation among the different types of roof tiles unearthed from the No. 1 Architectural Site can demonstrate the original structure of the roofs of the tower. Among the large-sized roof tiles, the eave tegulae made up one-fourteenth of the undecorated tegulae found, the eave imbrices made up one-ninth of the undecorated imbrices, and the ridge tiles had 13 layers. Among the small-sized roof tiles, the eave tegulae made up one-third of the undecorated tegulae, the eave imbrices made up half of the undecorated imbrices, and the ridge tiles had three layers. Therefore, the large-sized roof tiles were used for the tower, while the small-sized roof tiles were laid on the roofs of attached buildings, which may have been the walls around the tower with small stupas at the four corners. Compared to the main hall and gate, it is more difficult to demolish a tower, which is usually much higher than other buildings, so more roof tiles remained in the site of the tower.

Section 10. Roof Tiles and the Construction Process of the Dazhuangyan Buddhist Temple

The archaeological excavation of the DBT was conducted from 2012 by the Yecheng Archaeological Team of the Institute of Archaeology, Chinese Academy of Social Sciences. The results of the excavation demonstrate that this temple consisted of one tower, one gate, one main hall, and two unexcavated rammed-earthed foundations from north to south. A large number of the roof tiles were unearthed from this site, and the samples and randomly selected fragments were arranged systematically.

According to the previous analysis, the main materials for this temple are polished-black tegulae and polished-black imbrices, which can both be subdivided into two groups: eave roof tiles and general roof tiles. The eave imbrex tile-ends have two main styles: lotus pattern with oval petals and lotus pattern with round curled petals. There are also lotus patterns with more than ten thin petals or decorated with beads in the outer area, but these samples are rare. The decorations on the lower end of the eave tegulae are the double wave-shaped patterns. The undecorated imbrices and undecorated tegulae are general roof tiles, used on the slopes of the roofs. The untrimmed tegulae, which are only half or one-third of the polished-black tegulae in width, were used as ridge tiles. Moreover, the diameter of polished-black imbrices can be divided into three groups, 1. 12.5cm, 2. 15.5±1cm, and 3. 17.5±1cm; and the polished-black tegulae have two sizes, 1. 30*20cm^2 and 2. 40*30cm^2. The tegulae of these two sizes and the size 1 and size 3 imbrices were used for the tower. The size 2 tegulae and size 3 imbrices were used for the main building of the main hall, and the size 2 tegulae and size 2 imbrices were used for the attached buildings of the main hall and the gate.

The production technique of the polished-black roof tiles in the workshop of the DBT was unified and belonged to the same technique group. The production process contained seven steps:

1. The molds were wrapped with cloth cover. The molds of the tegulae consisted of several narrow wooden strips, and the molds of the imbrices were bottle-shaped integral wood.
2. Clay-strips were twined around the mold, the clay body of the roof tile was patted with a pottery paddle, and its surface was trimmed with a plate.
3. The lower end of the eave tegulae was decorated before the clay body was divided.
4. The clay body was cut from the inside.

5. The back surface of tile-end was processed to strict it to imbrex firmly.
6. The exposed surface of the roof tiles was polished and blackened.
7. The roof tiles were fired in the kilns.

The technique of the surface treatment for the simply-trimmed imbrices was different from the polished-black imbrices and on the back surface of some of the tile-ends, there is a long-scribed line beside the half-circle of radial scratches. The technique groups for these special roof tiles may have been different from the others, but only a few of them were unearthed from this site.

The information on the roof tiles used in the DBT, including their classification and production technique, has been ascertained, but more details can be gathered from the surface traces and characters on these samples. This can provide more information about the handicraft industry of the roof tiles related to the construction of this temple. According to the previous analysis of surface traces, the roof tile workshop of the DBT was unified. There were only 1–2 artisan groups for the imbrices, 1–2 artisan groups for the tegulae, and at least one artisan group for the tile-ends for the tower. There was one group for the imbrices, one group for the tegulae, and at least two groups for the tile-ends for the main hall. There were two groups for the imbrices, one group for the tegulae, and at least two groups for the tile-ends for the gate. In addition, according to the distribution of the stamped roof tiles, one artisan group may have been subdivided into several teams. Every team had fixed artisans that provided roof tiles for a specific area of the roof of one building.

The characters stamped on roof tiles are another way of analyzing the roof tile production and the artisans. As these characters were the symbols of the artisans, which demonstrate the

responsibility of the artisans for the quality of their products, the status of these artisans can be deduced by their stamps. Most of the stamps consisted of numerical characters and the artisans' names. The stamps with numerical charscters increased, together with the growth of the number; and the stamps with the numerical characters eight or nine made up half of these samples. The numerical character, paired with a specific name character, is fixed, but the name characters, paired with a specific numerical character are not fixed. These features illustrate that the artisans were numbered according to specific rules. There are also some stamps made without the numerical characters. Regardless of if the stamps have numerical characters or not, they were used in the management system by indicating the responsibility of the individual artisan. There was another type of management system in the workshop of the DBT, in which the artisans did not leave their signatures on the roof tiles.

The setting of the utilization of the roof tiles of the DBT is also worth examining. According to the setting of different types of roof tiles unearthed from this site, the polished-black roof tiles were the main materials for the buildings in this temple; the narrow untrimmed tegulae and the large-sized imbrices were used as ridge tiles; and the imbrices with tile-ends and the tegulae with double wave-shaped patterns were used as eave roof tiles. Then, by analyzing the distribution of the roof tiles, the basic structure of the temple was evident. The attached buildings of the main hall were connected to the gate to the south of them, and they surrounded the main building of the main hall to form a courtyard for the main hall. The tower was located independently of the south of the main hall and its courtyard. Moreover, according to stamps with the same characters and tile-ends made by the same mold among the different buildings, the production sequence of the roof tiles, which implied the construction sequence of the different buildings in this temple, can be speculated. It is likely that the tower was built first, and then the main hall was constructed.

Finally, the construction of the gate and porches surrounding the main hall was completed. In this chapter, the construction methods and destruction of the buildings were also analyzed in detail.

The roof tiles of the site of the DBT were completely collected, and a large number of typical samples with obvious production traces and exact distribution were found. It was also possible to conduct statistical analysis of the different types of roof tiles. The information provided by these remains can be used to speculate the production and utilization of the roof tiles and reconstruct some details of the construction process of the temple.

CHAPTER 3. The Roof Tiles Unearthed from Other Sites from the Eastern Wei and Northern Qi Dynasties

In addition to the DBT site, these are also several sites from the Eastern Wei and Northern Qi Dynasty in Yecheng, from which the remains of roof tiles have been unearthed. Since the 1980s, archaeological investigations in Yecheng have been conducted frequently, but the gathered remains were mostly stamped roof tiles. As the information of the roof tiles from the excavation or investigation is incomplete, this section will only give a brief introduction of the roof tiles from other sites in Yecheng.

1. Roof Tiles Found from Archaeological Excavations

1.1 The Zhaopengcheng Buddhist Temple

The Zhaopengcheng Buddhist Temple was located to the southeast of the Inner City, near the DBT, and covering the area of one Lifang. It consisted of one tower, two courtyards, one main hall, one pond and was surrounded by a ditch. On the rammed-earth foundation of the tower, which was 30m square, there were three circles of pillar holes, and under the foundation, there was a brick box to store Buddhist relics and offerings. The southwest courtyard, a 110m square surrounded by a wall, had a rectangle foundation in the north (Zhongguo shehui kexueyuan kaogu yanjiusuo Hebeisheng wenwu kaogu yanjiusuo lianhe Yecheng kaogudui 2010).

A large number of remains were unearthed from this site, including Buddhist remains and building materials. According to the reports, the tegulae have two sizes, small (20*15cm^2) and large (40*30 cm^2). The convex surfaces of the tegulae were simply scraped, and their concave surfaces have two types: fabric impressions or polished. Meanwhile, the imbrices unearthed from this site are

35cm in length, and 13–14.5cm in diameter, and they had polished convex surfaces. The eave imbrex tile-ends were decorated with lotus patterns with several simple petals and T-shaped inter-petals. The lotus pattern can be divided into six groups by the shape and number of the petals, as well as the setting of the central area. These included a pattern with 11 thin petals and seven seeds, a pattern with nine oval petals and seven seeds, a pattern with nine round petals and seven seeds, a pattern with nine round petals with eight seeds, a pattern with eight round curled petals and two circles of seeds, and a pattern with eight round petals and beads in the outer area. These patterns were similar to the four types of tile-ends found in the DBT. Furthermore, radial scratches were found on the back surfaces of these roof tiles, which means that the method of joining the tile-ends and imbrices from this site was similar to the method used in the roof tile workshop of the DBT (He 2013).

1.2 Roof Tiles from the Area of the Three Pavilions

The Three Pavilions were built in the Cao Wei Dynasty, and they were donated to build the Daxingshan Buddhist Temple (大興善寺) by Gao Wei (高緯） during the Northern Qi Dynasty. The site of the Daxingshan Buddhist Temple (the Three Pavilions) has not yet been excavated, but a large number of fragments from the roof tiles have been gathered in investigations (Yu 1963; Xu 1990). According to reports, the polished-black roof tiles and tile-ends with lotus patterns were the main materials for these buildings. One tegula sample is 58cm in length, while the width of the lower end is 40cm, and the width of the upper end is 33cm. The imbrex sample is 55cm in length and 16cm in diameter. The roof tiles unearthed from the Daxingshan Buddhist Temples are larger than the samples from the DBT. In addition, the pattern of the tile-ends can be divided into two groups. The first group has a lotus pattern with oval petals and T-shaped inter-petals, 15.3cm in diameter, which is similar to the Type A samples from the DBT. The second group has a lotus

pattern with round curled petals, 18cm in diameter, which is similar to the Type B samples from the DBT. Moreover, the lower ends of some tegulae unearthed from this site were decorated with double wave-shaped patterns, while others only have finger-pinched traces.

1.3 Roof Tiles from the Zhuming Gate

The Zhuming Gate was located in the middle of the southern wall of the Inner City and consisted of three gateways, gate piers, and two Ques (闕). The roof tiles unearthed from the Zhuming Gate are similar to the samples found at the DBT. The concave surfaces of the tegulae were mostly polished and blackened, and their lower ends were decorated with double wave-shaped patterns or undecorated. The width of the lower end of unbroken samples is approximately 26cm or 25.5cm, and their thickness is approximately 3.3cm and 2.2cm. There are also tegulae with fabric impressions on their concave surface, whose length is 35cm, and the width of the lower end is approximately 27cm. The lower ends of some samples were decorated with double wave-shaped patterns, which means that they were not used as ridge tiles. The untrimmed tegulae unearthed from the Zhuming Gate may have been laid on the slopes of the roofs like the polished-black tegulae, but they must have been used for different buildings. The imbrices unearthed from this site are all polished-black type and have two different sizes. The large ones are 35.5cm in length and 16.5cm in diameter, while the small ones are 33cm in length and 14.5cm in diameter. The tile-ends all have lotus patterns with 9–10 oval petals and were divided into three types. Type I has Y-shaped inter-petals that were not found at the DBT. The diameter of the unbroken sample is approximately 14cm. Type II and Type III have T-shaped inter-petals, and Type III also has beads in the outer area. The diameters of unbroken Type II samples are approximately 13cm or 14.8cm, and the diameter of the unbroken Type III samples is 15cm.

Since the 1980s, investigations have been conducted all around Yecheng, and numerous remains of the roof tiles have been gathered. The results of the investigations indicate that the polished-black roof tiles and the tile-ends with lotus patterns were mostly used in Yecheng during the Eastern Wei and Northern Qi Dynasties. This means that the roof tiles unearthed from the DBT can be the representative of the roof tiles used in Yecheng at that time.

2. Stamped Roof Tiles Found in Yecheng

Nearly 440 samples of stamped roof tiles were found from Yecheng in the investigations since the 1980s. Another 110 samples were found at the beginning of the last century, and these are now kept in universities or research institutes in Japan. Table 36 provides information about the findings of the stamped roof tiles in Yecheng.

Table 36 The stamped roof tiles in Yecheng

Period	Location	Samples in total	Samples with details	Source	
1957	The area of the three pavilions and the western part of Yecheng	21	18	Yu 1963	Gathered
1970s—1980s	The area of the three pavilions and the wall of the inner city	420	180	Qiao 1983	Gathered
1980s—1990s	The inner city	Several	Undisclosed	Xu 1990, 1997	Unearthed
1986	The Zhuming gate	Several	Undisclosed	Xu 1996	Unearthed
2002—2005	The Zhaopengcheng Buddhist temple	A large number	Undisclosed	He 2014	Unearthed
Unknown	The kilns to the west of the inner city	Several	1	Zhu 2010	Unearthed
Unknown	Yecheng	30	30	Iijima 2012	Gathered
Unknown	Yecheng	82	82	The Kyoto University Museum, Institute for Research in Humanities, Kyoto University	Gathered

Among the samples mentioned above, details about 229 samples have already been published, and 82 samples kept by Kyoto University were arranged by the author of this dissertation. Therefore, there are 311 samples, in which 291 samples are legible, for the analysis of the stamped roof tiles in Yecheng.

2.1 The Style of the Stamps

The 291 samples mentioned before can be divided into 249 types, including 176 types of stamps that consist of numbers and names (Table 37), as well as 73 types of stamps that only have name characters (Table 38).

The types with numerical characters make up 70.7 percent of the stamps found in Yecheng, and they have four features. First, the numerical characters in these stamps include "一 (one)," "二 (two)," "三 (three)," "四 (four)," "五 (five)," "六 (six)," "七 (seven)," "八 (eight)," and "九 (nine)," as well as the pairs of numbers. Second, the types of stamps with numerical characters increased, together with the growth of the numbers; the stamps with the characters for eight or nine make up half of these samples (Figure 103). Third, the name characters were placed after the numerical characters; the numerical character paired with a specific name character is fixed, but the name characters, paired with a specific numerical character, are not fixed. Fourth, some stamps have date characters, such as the "八月一鳳" stamp, which may have been symbols for specific events, but this type of stamps was rare. (Figure 104)

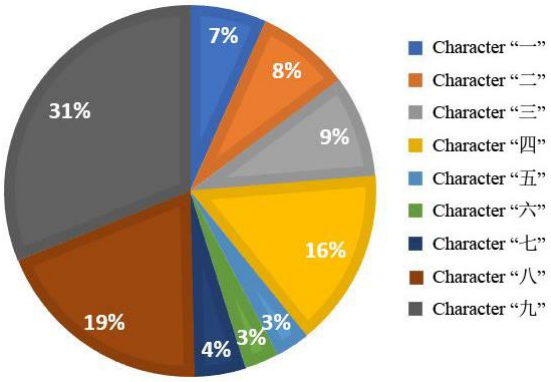


Figure 103 The proportion of stamps with different numerical characters (Source: Made by the author)

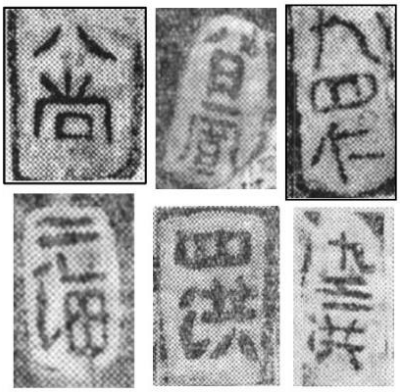


Figure 104 Stamps with numerical characters unearthed from Yecheng (Source: Qiao 1983, Fig. 6, 7)

The stamps without numerical characters made up 29.3 percent of the stamps unearthed from Yecheng. They can be subdivided into two groups: those with simple characters and those with compound characters. The stamps with simple characters mostly show the names of artisans, and they may have been the abbreviation of the stamps with numerical characters. Among these samples, some specific characters repeatedly appeared, such as "田," which might be the surname of several artisans (Figure 105). Stamps with compound characters are rare, but some have special characters, such as "军主," which is related to the military system of the Northern Qi Dynasty.

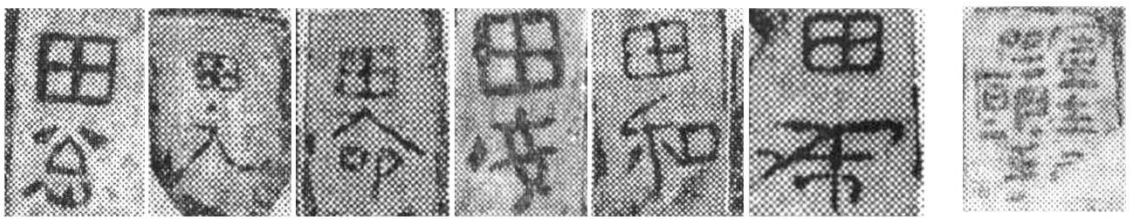
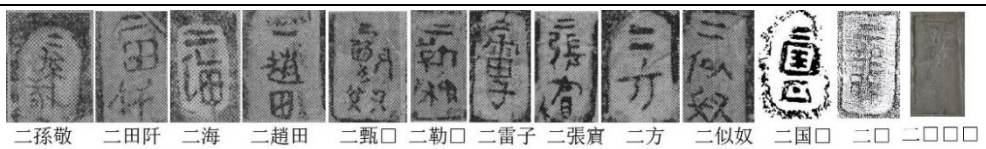
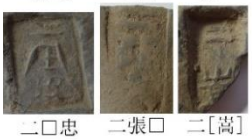
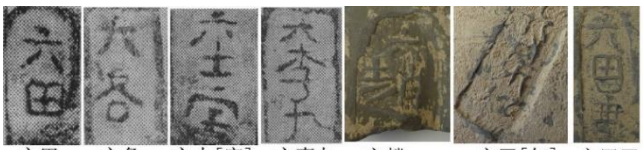
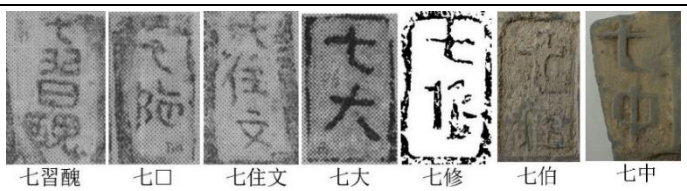


Figure 105 Stamps without numerical characters unearthed from Yecheng (Source: Qiao 1983, Fig. 6, 7)

Table 37 The stamps with numerical characters

Number	Stamps	
一 (One)	 一張相 一亮 一蘭 一暴 一始 一共 一□ 一王副 一□賓 一元 一閔僧	11
二 (Two)	 二孫敬 二田阡 二海 二趙田 二甄□ 二勒□ 二雷子 二張賓 二方 二似奴 二国□ 二□ 二□□□  二□忠 二張□ 二[嵩]	16
三 (Three)	 三甄奴 三馮国 三□□ 三曽[睹] 三張□ 三賴 三十□ 三趙桑 三曽租 三解鳳 三張保 三□保 三張[相]  三李六	14
四 (Four)	 四方思 四張貴 四顯 四礼 四洪 四普 四学 四長 四貴 四陳清 四華 四国 四黄  四興 四達 四良 四世 四皇甫 四蘭 四租 四□ 四□□ 四央 四[慕] 四亮	25
五 (Five)	 五内 五田[進] 五景 五角 五都業 五□世 五[文] 五貴 五剣保	9
六 (Six)	 六田 六各 六土[宗] 六李九 六趙… 六□[仁] 六田□	7
七 (Seven)	 七習醜 七□ 七住文 七大 七修 七伯 七中  一七	8

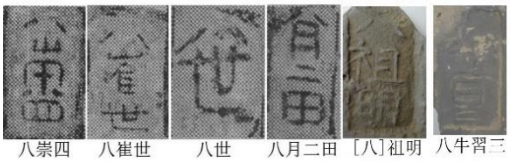
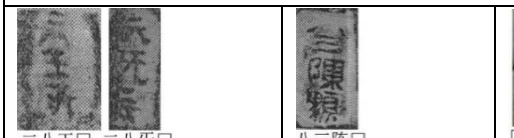
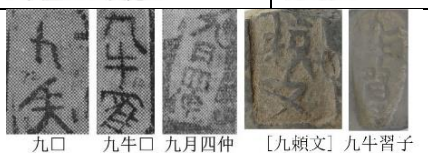
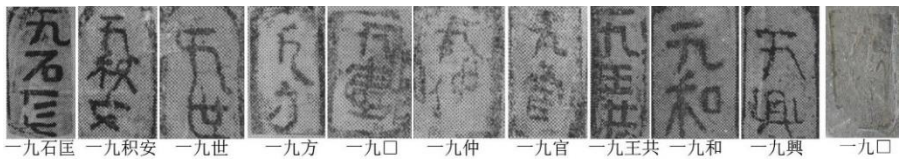
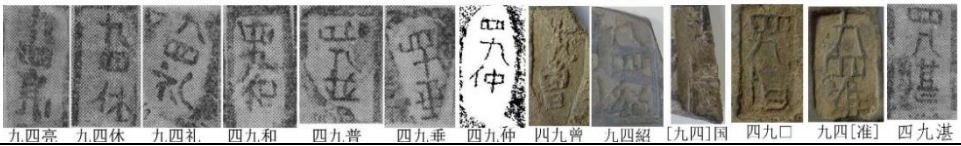
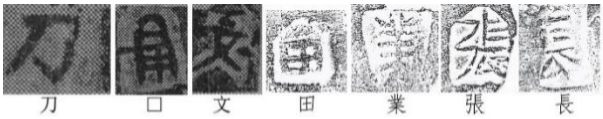
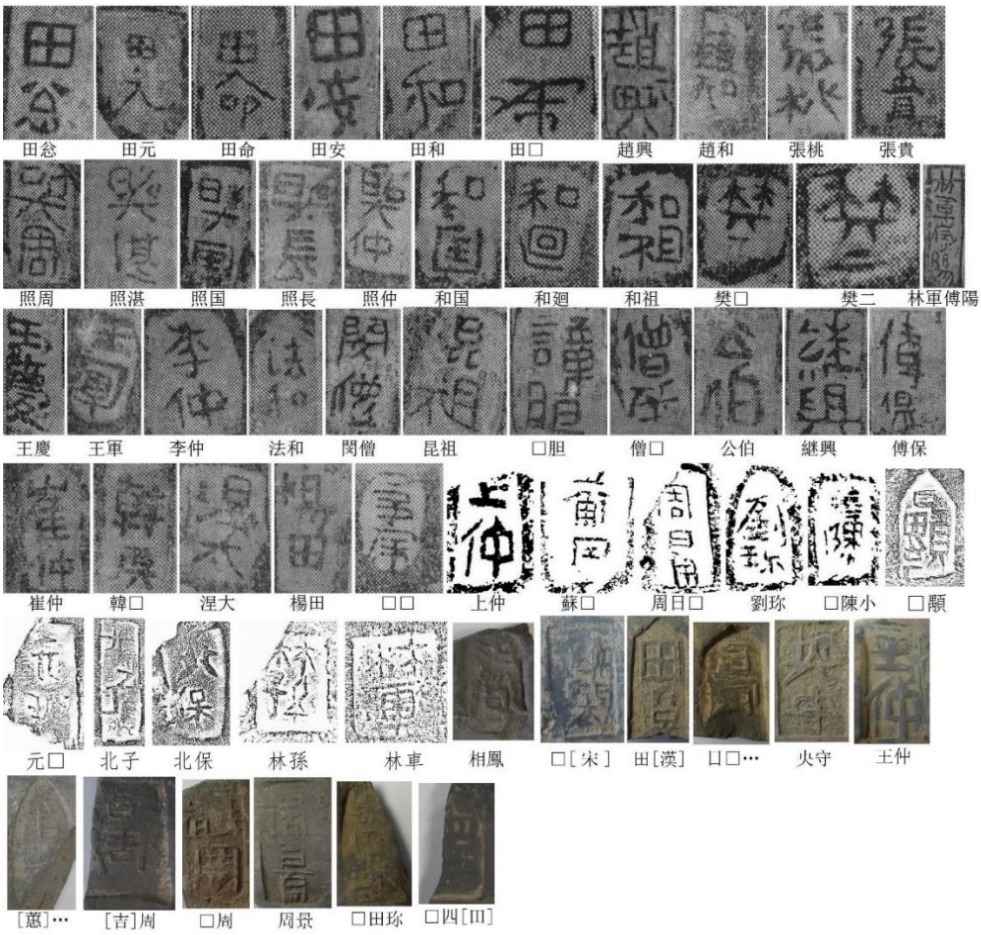
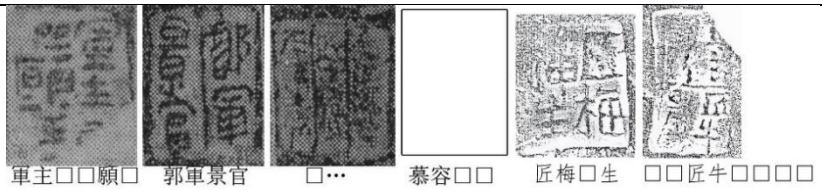
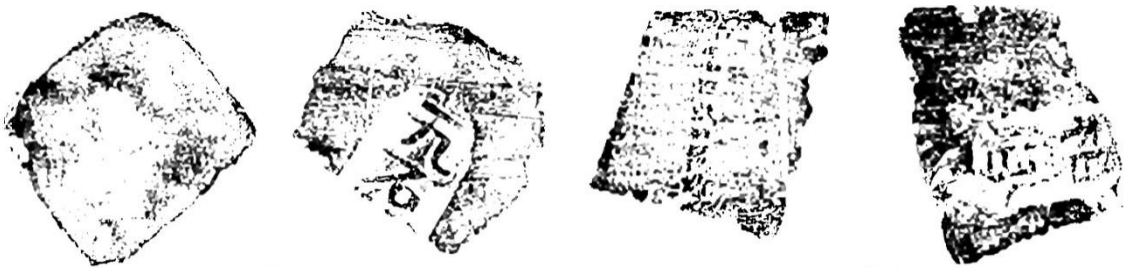
Number	Stamps	
八 (Eight)	 八郭良 八雷 八重□ 八雷明 八月四□ 八尚 八王 八月一鳳 八□鳳 八月田□二  八崇四 八崔世 八世 八月二田 ［八］祖明 八牛習二  八一王租 八一田文 八一畔 八一年 八一宣 八一楊思 一八達 一八□ 一八牛土 一八［榮］ 一八□□  二八王□ 二八死□ 八三陳□  ［八］四山	31
九 (Nine)	 九□ 九牛□ 九月四仲 ［九賴文］九牛習子  一九石匡 一九积安 一九世 一九方 一九□ 一九仲 一九官 一九王共 一九和 一九興 一九□  二九保 二九虫 二九容山 九二目 二九 九三洪 九三解石 九三五□ 九三習和 九二習堆 九二田［永］ 九三張保 九三…  九四高 九四元 九四［追］ 九四山 九四仁 九四利 九四□ 九四尚 九四□ 九四田 九四日軍 四九貴 四九世  九四亮 九四休 九四礼 四九和 四九普 四九垂 四九仲 四九曾 九四紹 ［九四］国 四九□ 九四［淮］ 四九湛	55

Table 38 The stamps without numerical character

	Stamps	
Stamps with simple characters	 刀 □ 文 田 業 張 長	7
	 田忿 田元 田命 田安 田和 田□ 趙興 趙和 張桃 張貴 照周 照湛 照国 照長 照仲 和国 和廻 和祖 樊□ 樊二 林軍傅陽 王慶 王軍 李仲 法和 閔僧 昆祖 □胆 僧□ 公伯 継興 傅保 崔仲 韓□ 涅大 楊田 □□ 上仲 蘇□ 周日□ 劉珎 □陳小 □顯 元□ 北子 北保 林孫 林車 相鳳 □[宋] 田[漢] 口□… 央守 王仲 [意]… [古]周 □周 周景 □田珎 □四[四]	60
Stamps with compound characters	 軍主□□願□ 郭軍景官 □… 慕容□□ 匠梅□生 □□匠牛□□□□	6

2.2 Stamping Methods

All of the characters were stamped—horizontally, vertically, or slanting—on the convex surface of the tegulae and imbrices' lips. They are embossed characters, and the shapes of most of the stamps are rectangle and bullet-shape. Among the 82 samples kept in the Kyoto University, 59.8 percent of the samples are rectangle shape, 14.6 percent of the samples are bullet-shaped, and the rest are unknown. The shape and direction of the stamps varied but the stamps with the same content are similar to each other. In addition, the relation between the stamps and roof tiles should also be analyzed. By observing the samples unearthed from Yecheng, two points can be summarized. First, the stamps were stamped on horizontal scraping traces (Figure 106-1), and some of the stamps were cut in half (Figure 106-2), which means that the step of stamping was later than trimming and earlier than cutting. Second, the stamps of the imbrices and tegulae are different, but some stamps of the polished-black tegulae and untrimmed tegulae have the same content.



1 2

Figure 106 The production traces on the stamped roof tiles
(Source: Mukai 2004, Fig. 10-8, 10-14)

2.3 Comparative Analysis of the Stamps from Yecheng and the Dazhuangyan Buddhist Temple

According to the previous analysis, the stamps from Yecheng have four features. First, they are embossed characters, stamped on the convex surface of the tegulae and imbrices' lips; and the

shape and direction of stamps varied, but the stamps with the same content are similar to each other. Second, the stamps consist of numbers and names, or only have name characters, and the stamps with numerical characters were mainstream; the numerical character paired with a specific name character is fixed, but the name characters paired with a specific numerical character are not fixed. Third, a few stamps have the characters of date or military rank, but they are rare. Fourth, stamps between imbrices and tegulae are different, but polished-black tegulae and untrimmed tegulae have stamps with the same content. Apart from the characters for military rank, all of the features can be found in the samples unearthed from the DBT.

In addition, there are 41 types of stamps that were found in both the DBT and other sites in Yecheng, including the “九四国,” “九牛習子,” “九三解石,” “九三習堆,” “九三張保,” “九四休,” “九四元,” “九四紹,” “四九貴,” “四九世,” “四九和,” “二九伯,” “八雷明,” “八一畔,” “八一年,” “一八口,” “八崇四,” “七大,” “七伯,” “六思口,” “六土[宗],” “五貴,” “五都業,” “五田[進],” “四洪,” “四達,” “四興,” “四方思,” “四良,” “三張[相],” “二靴棟,” “二似奴,” “一亮,” “田[布],” “田忿,” “元乐口,” “趙和,” “涅太,” “相鳳,” “張桃,” and “崔仲” stamps. They make up 16.2 percent of stamp types gathered from Yecheng, and 15.5 percent of stamp types found in the DBT.

3. Summary

The polished-black roof tiles and tile-ends with lotus patterns were mostly laid on the roofs of the buildings in Yecheng, and the narrow untrimmed tegulae were used as ridge tiles. Untrimmed normal-sized tegulae were found in some sites, but the rank of these buildings would have been lower than the buildings with polished-black roof tiles. The eave imbrices were all decorated with lotus patterns, they had oval petals or round curled petals, and a few of them had beads in the

outer area. Overall, the roof tiles unearthed from the DBT can be representative of the roof tiles used for high-class buildings in Yecheng during the Eastern Wei and Northern Qi Dynasties. In addition, only 15–16 percent of the stamp types were found in both the DBT and other sites in Yecheng, which means that most of the artisans who made the roof tiles for the construction of the buildings in Yecheng were temporary.

CHAPTER 4. The Construction Projects for the Royal Buddhist Temples in the Eastern Wei and Northern Qi Dynasties, from the Viewpoint of Roof Tiles

In previous chapters, the roof tiles unearthed from the DBT in Yecheng were systematically arranged and analyzed. The information about the roof tiles' classification, production traces, and distribution are the foundation for this study on the production and utilization of the roof tiles, as well as the construction process of the Temple. Moreover, the last chapter also demonstrated that the roof tiles unearthed from the DBT could be the representative of the roof tiles used in Yecheng. Based on the results from previous analysis and literature records, this chapter will discuss the construction project of royal Buddhist temples in the Eastern Wei and Northern Qi Dynasties and analyze the related historical background.

1. The Styles and Production Techniques of roof tiles at the Eastern Wei and Northern Qi Dynasties

The roof tiles made in the Eastern Wei and Northern Qi Dynasties in Yecheng largely inherited the style of the roof tiles used in the Northern Wei Dynasty. They were mostly polished-black roof tiles, called "Qinghunwa (青掍瓦)" in historical literature. The lower ends of the eave tegulae were decorated with double wave-shaped patterns, which were first made in the YBT from the Northern Wei Dynasty (Mukai 2004), and the lower ends of other tegulae were finger-pinched, similar to the samples found in the YBTWZ. Over time, the patterns of the tile-ends used in Yecheng simplified, although the artisans still chose the lotus as the motif, which appeared at the end of the Pingcheng period of the Northern Wei Dynasty. The tile-ends in Luoyang were decorated with the lotus pattern, the lotus-Buddha pattern, the monster pattern, and the palmette

pattern, but only lotus patterns with simple petals were found in Yecheng. The patterns of these tile-ends can be divided into four types: lotus patterns with oval petals (Type A), lotus patterns with round curled petals (Type B), lotus patterns with beads in the outer area (Type C), and lotus patterns with thin petals (Type D). The Type A, Type C, and Type D patterns were influenced by the patterns with simple petals used in Luoyang. Meanwhile, the Type B pattern with round curled simple petals was only found in Yecheng, but they might have changed from the lotus pattern with compound petals used in Luoyang because the outlines of the petals of the two types are similar. The two semi-petals in one unit of the compound petal might join and form the round curled simple petal of Type B in Yecheng.

The roof tiles workshops in Yecheng largely inherited their production techniques from Luoyang, and the production process of the roof tiles in Yecheng can be divided into seven steps:

1. Molds wrapped with cloth cover were used in the shaping step. The molds of the tegulae consist of several narrow wooden strips, and the molds of the imbrices were likely to be bottle-shaped integral wood.
2. Clay-strips were twined around the mold to make the bodies of the roof tiles, and the convex surface of the body was shaped with pottery paddles, and then it was trimmed using plates.
3. The lower ends of some tegulae were decorated with double wave-shaped patterns or finger-pinched before the clay bodies were cut.
4. The clay body was cut from the inside, and the edges of the eave tiles were trimmed.
5. The molds of the tile-ends have two levels, and the second-level molds were used to make tile-ends directly. The back surface of the tile-end was processed to stick the tile-end and imbrex together firmly.
6. The convex surface of most imbrices and the concave surface of a part of the tegulae were

polished and blackened; some tegulae retained fabric impressions on the concave surfaces.

7. The clay bodies of the roof tiles were fired in the kilns.

According to historical literature, the inhabitants in Yecheng moved from Luoyang, and the original inhabitants of Yecheng were forced to move to the area of Taihang Mountain.[81] Therefore, the artisans who worked in the roof tile workshop in Yecheng must have belonged to the same groups that once worked in Luoyang.

2. The Management of Roof Tile Production at the Eastern Wei and Northern Qi Dynasties

2.1 The Formation of Roof Tile Workshops

The previous analysis explained that the roof tile workshop in the DBT was unified. The most used materials, the polished-black roof tiles, were largely made by the same artisan group, so these roof tiles not only have the same size, pattern, and exposed surface, but they also have similar production traces. The untrimmed tegulae, whose concave surface had not been polished and blackened, have the same fabric impressions with the polished-black tegulae, indicating that they were made by the same artisan group. Some unique samples were unearthed from this site, such as the simply-trimmed imbrices from the No. 5 Architectural Site and the tile-ends with a long-scribed line on back surfaces from the No. 2 and No. 5 Architectural Site, but these were rare. The unified workshop at the DBT indicates that roof tile production in this temple was strictly controlled. The techniques and tools were unified, and the roof tiles made in this workshop were similar to each other. Stamps of military leader were found on the roof tiles unearthed in Yecheng, indicating that the artisans in the roof tile workshops of Yecheng were managed by the military.

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[81] *Wei shu*: "（天平初）是時詔下三日，户四十萬狼狽就道." Wei shou, *Wei shu*, vol.82, p. 1806. *Wei shu*: "（天平元年十有一月庚寅）徙鄴舊人西徑百里以居新遷之人." Wei shou, *Wei shu*, vol.12, p. 298.

However, the same type of roof tiles used in the DBT were usually supplied from several sources. These roof tiles from different sources were installed separately and caused the separate distribution of roof tiles in these sites. The separate supply of the roof tiles demonstrates that the production of the same type of roof tiles might have been done by several teams, which means that one specific artisan group can be subdivided. In each team, regular artisans were working together, and their products were provided for a specific part of the roof. Overall, the artisan groups in the workshop of the DBT were unified, and the minimum number of artisan group for each type of roof tiles was one, but one artisan group could be subdivided into several teams due to the management needs. The formation of the roof tile workshop in this temple demonstrates the unification and complexity of roof tile production in Yecheng in the Eastern Wei and the Northern Qi Dynasties.

2.2 The Affiliation of the Roof Tile Workshops

According to the historical literature, the handicraft roof tile industry was controlled by Zhenguan Bureau (甄官署) in the Northern Qi Dynasty,[82] and the Zhenguan Bureau belonged to the Taifu Court (太府寺) at the time.[83] There was also the Jiangzuo Directorate (将作寺) in the Northern Qi Dynasty that was in charge of the construction of royal buildings. The records in historical books indicate that the supervisors of construction projects included military leaders "軍主,"[84] and this was seen in the stamps on the roof tiles. This demonstrates that the handicraft roof tile industry in the Eastern Wei and Northern Qi Dynasties was also controlled by the Jiangzuo Directorate. In the Tang Dynasty, the affiliation of the Zhenguan Bureau changed from the Taifu

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[82] *Tang liudian*: "甄官令掌供琢石，陶土之事；丞為之貳. ……凡磚瓦之作，瓶缶之器，大小高下，各有程準." Li linfu, *Tang liudian*, vol.23, p. 597.
[83] *Tang liudian*: "北齊太府寺統甄官署." Li linfu, *Tang liudian*, vol.23, p. 597.
[84] *Sui shu*: "將作寺，掌諸營造…又領軍主，副，幢主，副等." Wei zheng, *Sui shu*, vol.27, p. 758.

Court to Jiangzuo Directorate.[85]

In the Eastern Wei and Northern Qi Dynasties, the Zhenguan Bureau belonged to the Taifu Court, which was in charge of managing the properties of the royal family. This means that the polished-black roof tiles and tile-ends with lotus patterns were first treated as luxuries for the royal family, and then used as building materials. Until the affiliation of the Zhenguan Bureau changed to the Jiangzuo Directorate in the Tang Dynasty, the construction directorate began to control the roof tile workshop directly, and the preciousness of polished-black roof tiles and tile-ends with lotus patterns may have also decreased.

2.3 The Supervision of Roof Tile Production

There were a large number of stamps unearthed in Yecheng from the Eastern Wei and Northern Qi Dynasty, which means that the supervision of the roof tile production was based on the responsibility of individual artisans. In the different buildings in Yecheng, however, the setting was more complicated. For example, in the DBT, the stamped roof tiles were mostly unearthed from the No. 2 and No. 5 Architectural Sites, and most of the roof tiles from the No. 1 Architectural Site had no character. This means that the production of the roof tiles for the former two buildings was supervised based on the responsibility of the individual artisans, but the artisans who made the roof tiles for the tower did not leave signatures on their products. The analysis in the next part demonstrates that the stamped roof tiles found in the XBT and the QBT of the Tang Dynasty were also rare, and in the Tang Dynasty, especially in the later period of this dynasty, the supervision of roof tile production may have been based on the responsibility of the whole

[85] *Tang liudian*: "隋太府寺統甄官署令，丞二人，皇朝改屬將作." Li linfu, *Tang liudian*, vol.23, p. 597.

workshop. Therefore, the setting of the No. 1 Architectural Site of the DBT in Yecheng may have been the first sign of the new supervision method.

Since the Warring States Period, the responsibility of individual artisans was the focus of the supervision of the production of luxuries, but in the Tang Dynasty, the artisans did not need to leave signatures on the roof tiles, and the workshop was accountable to the users directly. This may have also been related to the affiliation change of the Zhenguan Bureau.

2.4 The Status of Roof Tile Artisans

There is no exact record of the status of roof tile artisans in the historical literature, but the characters on the roof tiles can provide relevant information. Most of the characters on the roof tiles found in the Site of the No. 1 House were inscribed, which was a tradition inherited in Pingcheng, but in the Eastern Wei and Northern Qi Dynasty the characters on the roof tiles changed into stamps suddenly, and the inscribed characters disappeared completely. This implies that the status of roof tile artisans altered. In the Northern Wei Dynasty, artisans were usually vassals, who had a special status that was different from ordinary citizens, and they inherited their father's occupation. However, the rulers gave orders to absolve the vassal artisans and turned them into ordinary citizens at the end of the Northern Wei Dynasty[86]. This means that the artisans in the roof tile workshops of the Eastern Wei and Northern Qi Dynasties could have then become ordinary citizens. Subsequently, these artisans who had become ordinary citizens were then forced to work in roof tile workshops as corvee[87]. At the same time, the management method for the roof

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[86] *Wei shu*: "（延興二年夏四月庚子）詔工商雜技，儘聽赴農." Wei shou, *Wei shu*, vol.7, p. 137. *Wei shu*: "（普泰元年春二月）詔曰：……百雜之户，貸賜民名，官任仍舊." Wei shou, *Wei shu*, vol.11, p. 274.

[87] *Wei shu*: "（正始之末，元澄）又奏利國濟民所宜振舉者十条……八曰工商世業之户，復徵租調，無以堪濟，今請免之，使專其業." Wei shou, *Wei shu*, vol.19, p. 475.

tile production was modified, and changes in the roof tiles' characters could have been the result. The complicated inscribed characters of the production steps, date, and artisans' name changed into simple stamps with numerical characters and name characters.[88] According to the previous analysis, the numerical character that paired with a specific artisan was fixed, so they should not be treated as a date.[89] Moreover, the stamps with numerical characters made up 70 percent of the samples found in Yecheng. The numerical characters on the stamps in the DBT were from one to nine, and the proportion of stamps with different numbers is similar to that found in other sites in Yecheng. This means they were not the number of workshops,[90] and so the numerical characters on the stamps were likely the code for the individual artisans. This number system for the artisans was not found in Luoyang, and so it might have been a new method to manage the artisans who were ordinary citizens working in the roof tile workshops in Yecheng. The other 30 percent of stamps were made without numerical chanracters. Apart from several special stamps with the characters of date or military leader, the stamps without numerical characters also had the name of the artisans. They may have been an abbreviation of the stamps with numerical characters.

3. The Utilization of the Roof Tiles and the Construction Plan of Temples

All of the roof tiles unearthed from the DBT were gathered and arranged, which makes it possible to analyze the utilization of the roof tiles, including the production sequence and position of the roof tiles. Moreover, the utilization of the roof tiles can shed light on the construction process of

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[88] There are two main hypotheses about the meaning of the numerical characters in stamps, the date of production or the number of workshops (Wang yintian 2013).

[89]. If the numerical characters on the stamps recorded the YEAR of production, there must have been more "one" characters than "nine" characters because the periods of different emperors in the Northern Qi Dynasty were all very short. If the numerical characters on the stamps recorded the MONTH and DATE of production, the stamps must have been discarded and remade many times.

[90] If the numerical characters on the stamps were the number of workshops, they must have concentrated on several specific numbers from one specific site because the workshops that provided materials for one specific building would be limited.

the buildings to a certain extent.

From north to south, the DBT consisted of one tower (No. 1 Architectural Site), one gate (No. 5 Architectural Site), one main hall (No. 2 Architectural Site), and two other buildings. The previous analysis demonstrate that the roof tiles used in the attached buildings of the main hall and the gate were similar to each other in both size and pattern, so these buildings might connect and form a closed courtyard. The attached buildings of the main hall might also stretch to the north and surround the two unexcavated sites. Meanwhile, the roof tiles used for the main hall and a part of the roof tiles used for the tower were similar, but the tower was built individually to the south of the courtyard. Overall, the DBT consisted of a tower in the south, and a series of halls in the north, surrounded by porches. The spatial structure of the DBT was slightly different from the Zhaopengcheng Buddhist Temple and YBT in Luoyang. In the latter two temples, the tower was located in the middle of the land, but in the DBT, the tower was moved to the south of the land, and the location of the main hall became more important. However, the production sequence of the roof tiles indicated that the construction sequence of these buildings in the DBT was from the tower to the main hall, and then the courtyard was formed with gate and porches. This means that the location of the tower might have changed at the end of the Northern Dynasties, but the tower was still a priority in the construction process of the Buddhist temples.

The construction of Buddhist temples was considered as one of the most important aspects of religious practice, so the construction plan must have been influenced by Buddhist thoughts, including the relation between the tower and main hall. According to the historical literature, Buddhism in Yecheng flourished during the Northern Qi Dynasty. New books on the Buddhist doctrine were translated, and new sects began. These changes could have influenced the

construction plan of Buddhist temples.

4. Summary

Overall, the roof tile production and relevant construction processes of Buddhist temples in Yecheng during the Eastern Wei and Northern Qi Dynasties demonstrate characteristics of inheritance mingled with innovation.

The production technique of the roof tiles was inherited from the traditions of the Northern Wei, because of the migration of artisans from Luoyang to Yecheng, but the management methods for roof tile production changed due to the alteration of the artisans' status from vassals to ordinary citizens. In the Northern Qi Dynasty, the management of the production was still based on the responsibility of individual artisans, but the complicated supervision methods for vassal artisans were replaced by simple signature stamps. The signature stamps only displayed the number and name of the artisans, and it may have been a management method for the corvee laborers. The source of labor for roof tile production was extended in the Northern Qi Dynasty, but the roof tile workshops in the Northern Qi Dynasty became unified. In one workshop, the same types of roof tiles were made by the same technique and tools. However, there was also a setting in which the artisans did not have to leave their signatures on the roof tiles to record their responsibility. Moreover, the Zhenguan Bureau, organization for roof tile production, was controlled by both the Taifu Court and the Jiangzuo Directorate in the Northern Qi Dynasty, but the situation changed at a later period and the management method also altered.

The usage of roof tiles in Yecheng was also analyzed in the part. The tile-ends in Yecheng had a new pattern with round curled simple petals, and the patterns with simple oval petals were

inherited from Luoyang. The tegulae and imbrices with polished-black surfaces were the main materials in Yecheng, and they were also commonly used in Luoyang during the Northern Wei Dynasty. In addition, from the distribution of the different types of roof tiles, the construction plan of the temple can be analyzed. This indicated that the tower of the DBT was moved to the south and the location of the main hall, which was surrounded by porches and gate, became more important. The location of the tower in the DBT was different from the Zhaopengcheng Buddhist Temple or the YBT, which were more traditional, but the tower still had the priority in the construction process of the temples. The construction of the tower and main hall might have begun to change at the end of the Northern Dynasties due to the development of Buddhism.

Overall, the Eastern Wei and Northern Qi Dynasties was a connecting link between the Northern Wei Dynasty and the Sui-Tang Dynasties. The characteristics of the society during this period included inheritance mingled with innovation, and the roof tiles and relevant construction processes of the Buddhist temples provide us with an opportunity to observe the society from the viewpoint of archaeological materials.

PART IV. Roof Tiles and Construction of the Royal Buddhist Temples in Chang'an during the Sui and Tang Dynasties

CHAPTER 1. Buddhist Temples during the Sui and Tang Dynasties

1. Chang'an and its Buddhism

Chang'an, present-day Xi'an, was located in the middle of the Guanzhong Plain (関中平原), lying between the Qin Mountain (秦嶺) and the Wei River (渭水), connecting the Huabei Plain (華北平原) and the Hexi Corridor (河西走廊). Chang'an had been a capital city since the Zhou (周) Dynasty, and subsequently, construction in this city has been frequent and sizeable, especially in the Qin (秦) and Han (漢) Dynasties. After the establishment of the Sui Dynasty, the city was rebuilt completely, and known as Daxing City (大興城). It was inherited by the next Tang Dynasty and was extended many times during the periods of the Taizong (太宗), Gaozong (高宗), and Xuanzong (玄宗) Emperors. Chang'an was destroyed at the end of the Tang Dynasty, and after the period of the Five Dynasties and Ten Kingdoms (五代十国), the scale of Chang'an reduced, and it was not a capital city again.

The city of Chang'an in the Tang Dynasty consisted of Taiji Palace (太極宮), Imperial City (皇城), and Outer City (外郭城). The Taiji Palace, located in the north, had an obvious axis line, which connected the Taiji Hall (太極殿), Ganlu Hall (甘露殿), Liangyi Hall (両儀殿), and other buildings. The Imperial City was located in the south of the Taiji Palace, where the administration

buildings were built. Outside this area, there were 110 Lifang, as well as the Eastern Market, Western Market, and the Furong Garden (芙蓉園), which belonged to the Outer City of Chang'an. Due to the construction of the Daming Palace (大明宮) and the Xingqing Palace (興慶宮), the number of Lifang changed, but the basic structure of Chang'an, such as the location of the imperial city, axisymmetric design, and Lifang, which were inherited from Yecheng, remained until the end of the Tang Dynasty. (Figure 107)

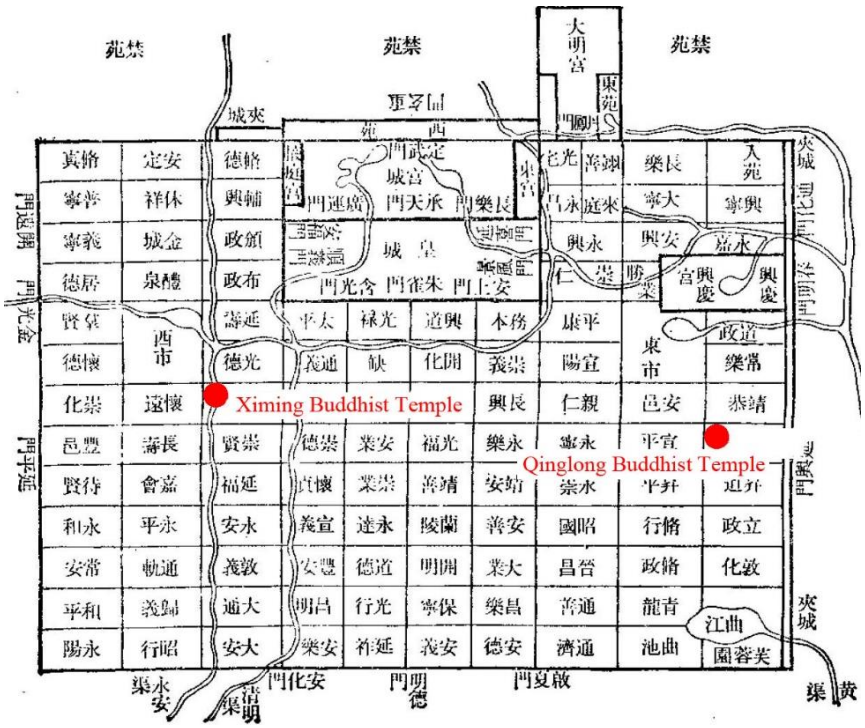

Figure 107 The urban plan of Chang'an

(Source: Xu Song, with commentaries assembled by Li Jianchao 1996, Fig. 1)

Buddhism developed substantially in the Sui and Tang Dynasties. It had been largely destroyed during the Buddhist Persecution led by Emperor Wu of the Northern Zhou Dynasty. Emperor Wen of the Sui Dynasty, who was a devout Buddhist, revived Buddhism, and his son, Emperor Yang, was also an important supporter of Buddhism. According to the book, *Fayuan Zhulin*, there were

3,985 Buddhist temples in the Sui Dynasty, and 236,200 people became monks and nuns.[91] In the Tang Dynasty, Taoism became the national religion, but Buddhism was still prosperous, especially in the period of Emperor Wu Zetian. Another Buddhist Persecution was conducted in the middle of the 9th century by Emperor Wuzong, who believed in Taoism. According to the book, *Jiu Tang Shu*, during this period, more than 4,600 Buddhist temples were destroyed, and more than 260,500 monks and nuns were forced to secularize.[92] This record also reported on how prosperous Buddhism had been in the Tang Dynasty. The policy of Buddhist persecution stopped after the death of Emperor Wuzong, and Buddhism was revived again in the period of Emperor Xuanzong.

In Chang'an, the capital city of the Sui and Tang Dynasties, Buddhist temples were constructed frequently. According to the book, *Chang'an Zhi*, Emperor Wen planned to build 120 Buddhist temples in Chang'an. Apart from the registered temples that included royal temples and private temples, there was also a large number of unregistered private temples. At the beginning of the Tang Dynasty, more than 50 temples remained in Chang'an, and according to *Chang'an Zhi*, the number increased to 91 temples in 577 AD. After the An-Shi Rebellion in the middle of the 8th century, the construction of Buddhist temples slowed down, and during the period of Buddhist Persecution in the middle of the 9th century, many temples in Chang'an were demolished, except for the XBT, Daci'en Buddhist Temple (大慈恩寺), Jianfu Buddhist Temple (薦福寺), and Zhuangyan Buddhist Temple (莊嚴寺). After the enthronement of Emperor Xuanzong in 846 AD, Buddhism revived, but the Tang Empire soon fell.

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[91] *Fayuan zhulin*: "隋代二君四十七年，寺有三千九百八十五所，度僧尼二十三萬六千二百人. " Shi Daoshi, *Fayuan zhulin*, vol.100, p. 2894.
[92] *Jiu tang shu*: "（會昌五年八月）制：天下所拆寺四千六百餘所，還俗僧尼二十六萬五百人." Liu xu, *Jiu tang shu*, vol.18, p. 606.

2. The Archaeological Sites Related to Buddhism in Chang'an

A large number of Buddhist remains were found in Chang'an, and these included Buddhist statues, inscriptions, offerings, and building materials, but the information of only four sites were published, including the QBT, XBT, kiln site of the Daci'en Buddhist Temple, and Shiji Buddhist Temple.

The site of the QBT was located in the western part of present-day Xi'an, and this area was Xinchang Fang (新昌坊) in the Tang Dynasty. The site has been excavated since 1973 by the Tangcheng Archaeological Team, and this has demonstrated that the temple consisted of two courtyards. The main buildings of one courtyard included one tower, one main hall, and attached buildings, and the other courtyard had only one main hall. There were also three sites of roof tile kilns in the northeastern part of the eastern courtyard. Most of the remains were found around the two main halls (Zhongguo shehui kexueyuan kaogu yanjiusuo 2016).

The XBT was located in the Beilin District (碑林区) of present-day Xi'an, which was Yanlang Fang (延康坊) in the Tang Dynasty. The excavation of the XBT has been conducted since 1985, and this has revealed the sites of three main halls, attached porches, a well, a kiln, and two small courtyards in the south. These excavated sites are largely in the eastern part of the XBT, and a large number of roof tiles were unearthed from this area. (Zhongguo shehui kexueyuan kaogu yanjiusuo 2016)

The kiln site of the roof tiles and bricks for the Daci'en Buddhist Temple was found at this temple, and it was located to the northwest of the main hall, 20m south of the Dayan Tower (大雁塔).

There were three kilns, from which the remains of building material, such as tegulae, imbrices, tile-ends with lotus patterns, brick with patterns, and production tools, such as molds, were found. (Han 1986)

Some remains were found in the area that was the southwestern part of the Taiping Fang (太平坊) in the Tang Dynasty. The remains include Buddhist statues, coins, and building materials, such as bricks and roof tiles. Imbrices and tile-ends with lotus patterns can be divided into two groups by size, and the tegulae only have one size. These remains were speculated to have been used in the Shiji (実際寺) Buddhist Temple of the Sui Dynasty (the Wenguo Buddhist Temple of the Tang Dynasty, 温国寺) (Li 1998).

3. The Distribution of Buddhist Temples in Chang'an

As the capital city of many dynasties, Chang'an has numerous remains related to Buddhism. The collection and arrangement of the information of these Buddhist remains began at the beginning of the 20th century by Adachi Kiroku (2003). Sekino Tadashi and Tokiwa Daijō (Tokiwa 1923; 1972) also conducted investigations on historical sites in several provinces in China, and a large part of their work was on the Buddhist remains. The arrangement of the relevant historical records was conducted by Hiraoka Takeo (1977) and Ono Katsutoshi (2011). The previous research on the Buddhist temples in Chang'an includes studies on the distribution and spatial structure of the temples, as well as studies on the buildings in the temples. For example, Su Bai focused on the basic distribution of Buddhist temples in Chang'an during the Sui and Tang Dynasties (1978; 1997), Shi Nianhai discussed the relations between Buddhist temples and Lifangs (1998), and Yang Hongxun studied the architectural style of the main hall in the QBT (1984). The most systematical study was conducted by Gong Guoqiang, whose book, *Study on the Buddhist*

Temples in Chang'an, discussed the distribution and spatial structure of these temples, as well as their influence in East Asia (2006a).

According to Gong Guoqiang's research, the distribution of Buddhist temples in Chang'an can be divided into four periods: the period of the Sui Dynasty, the period before the An-Shi Rebellion, the period from the An-Shi Rebellion to the Buddhist Persecution of Emperor Wuzong, and the period after the Buddhist Persecution. There were 113 Buddhist temples in the Sui Dynasty, and after the establishment of the Tang Dynasty, 75 temples remained. The number of Buddhist temples had increased to 127 during the period of Emperor Xuanzong, but after the An-Shi Rebellion, the construction speed of the temples reduced. The statistical analysis illustrated that only ten temples were built during the third period. Moreover, many temples were destroyed during the Buddhist Persecution ordered by Emperor Wuzong, so there were only 22 temples in Chang'an left at the end of the Tang Dynasty. According to the analysis of this book, most of the temples were located in the middle or northwest of Chang'an in the Sui Dynasty. The royal temples were built on the two sides of the Zhuque Street (朱雀大街), and the middle- and small-sized temples were built in a corner of Lifang. This means that although the Buddhist temples should have been registered in the Sui Dynasty, the location of most of the temples, except the royal temples, were not controlled by the government. Furthermore, temples for monks and nuns were not built in different areas, and the distribution of Buddhist temples in the Tang Dynasty followed the tradition of the Sui Dynasty. After Emperor Gaozong moved the royal court to the Daming Palace in northeast Chang'an, many officials moved their home to the eastern part of the city and donated their houses in the western part of the city to build Buddhist temples.

4. The Research Object of This Dissertation

The roof tiles unearthed from the royal Buddhist temples were chosen as the research objects for this study. According to the historical records, there were hundreds of registered temples in Chang'an, but only the XBT and the QBT were excavated systematically. The remains unearthed from these two sites were not collected completely, but there are enough typical samples for basic studies. Therefore, this part will focus on the roof tiles unearthed from the XBT and QBT to clarify the production and utilization of the roof tiles and the relevant construction of this temple. Roof tiles from other contemporaneous Buddhist temples or other types of high-ranking buildings in Chang'an will also be discussed synoptically at the end of this part, to understand the construction project of royal Buddhist temples in the Sui and Tang Dynasties from the viewpoint of the roof tiles.

CHAPTER 2. Roof Tiles and Construction of the Ximing Buddhist Temple

Section 1. Site of the Ximing Buddhist Temple and its Roof Tile

1. The Ximing Buddhist Temple in Chang'an

The XBT was located in the Beilin District of present-day Xi'an, which was Yankang Fang of Chang'an in the Tang Dynasty. This temple was once the house of Yang Su (楊素), who was the head of the Department of State Affairs in the Sui Dynasty, and it was bestowed to prince and princess in the Tang Dynasty. In 656 AD, Emperor Gaozong gave the order to build the XBT in this area, and the construction ended in 658 AD. The XBT was an important royal Buddhist temple, so even

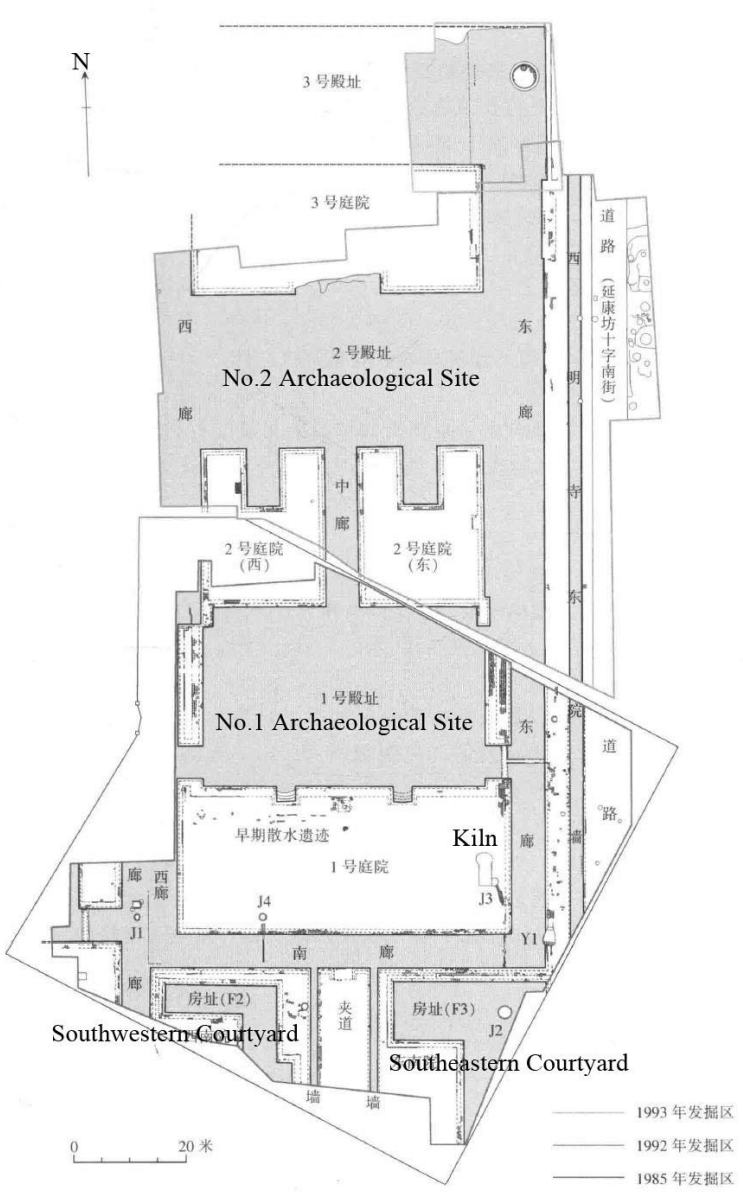


Figure 108 The layout of the Ximing Buddhist Temple (Source: Zhongguo shehui kexue yuan kaogusuo 2015, Fig. 66)

after the Buddhism Persecution of Emperor Wuzong in the middle of the 9th century, it survived. However, the XBT was destroyed during a war at the end of the Tang Dynasty.

Excavations at the XBT have been conducted since the 1980s by the Tangcheng Archaeological Team of the Institute of Archaeology, Chinese Academy of Social Sciences. The sites of three main halls, attached porches, two small courtyards in the south, and wells and pits have been found. Moreover, a kiln site in the southeast of the area was identified, and it was overlapped by the rammed-earth foundation of the eastern porch. Some of the building materials might have come from this kiln. (Figure 108)

According to the results of the excavation, these sites can be divided into two periods. The sites of the earlier period (layer 5) have not been excavated completely. Only pits and Sanshui (散水) were found, so it is difficult to speculate the structure of the earlier buildings. Meanwhile, the sites of the later period (layer 4 and layer 3b) belonged to the XBT. Layer 4 is made up of deposits from the Tang Dynasty, while layer 3b is the deposits of broken building materials after the destruction of the temple. This section will analyze the roof tiles unearthed from layer 3b.

2. Information about the Roof Tiles

2.1 The Roof Tile Samples

At this site, 98 tegulae, 95 imbrices, and 313 tile-ends samples have been recorded in archaeological reports, but many broken samples have not been arranged. To avoid losing information, all of the remains of the XBT need to be observed and measured, including the 116 tegula samples, 151 imbrex samples, 460 tile-end samples, one mold of the tile-end, and one roof tile with characters. The standards to choose roof tile samples are listed as below, and samples

must meet any one of them: the length, width or thickness of the roof tiles can be measured; special features should remain; at least half of the central area of the tile-ends should remain.[93]

2.2 The Clay Bodies of the Roof Tiles

The roof tiles unearthed from the XBT have two types of clay bodies: blue-gray bodies and reddish-brown bodies. They are all pure and dense, and the roof tiles with blue-gray bodies made up 78.8 percent of the imbrices, 92.2 percent of the tegulae, and 99.3 percent of the tile-ends. This means that most of the samples unearthed from this site are blue-gray, and so if there is no special explanation, in this chapter, the samples are roof tiles with blue-gray bodies.

2.3 The Exposed Surfaces of the Roof Tiles

The exposed surface points the concave surfaces of the tegulae and convex surfaces of the imbrices, which were laid upward when the roof tiles were installed on the roofs. The tegulae used in this temple have two types of surface styles: untrimmed surfaces and polished-black surfaces. Some of the untrimmed tegulae have vertical cutting traces on their concave surface, which means that these samples should be cut into narrow tiles. Meanwhile, the imbrices were polished-black type, and the tile-ends from this site also have polished-black surfaces (Figure 109). It is worth noting that the roof tiles with the reddish-brown bodies have glazed surfaces, but they are too few to provide more information (Figure 110).

[93] The sample keeping of at least half of the central area can be treated as one unbroken tile-end.

Figure 109 The surface of the roof tiles with blue-gray bodies

(Source: Photos by the author)

1. Polished-black imbrex and tile-end, 2. Polished-black tegula, 3. Untrimmed tegula

Figure 110 The surface of the roof tiles with reddish-brown bodies

(Source: Photos by the author)

1.2.7.8. Imbrices; 2.5. Tegulae; 3.6 Tile-ends

2.4 The Size of the Roof Tiles

There are 117 polished-black imbrices whose diameter can be measured. According to the diameters, these samples can be divided into four groups: size 1. 9±1cm, size 2. 12±1cm, size 3. 15±1.5cm, and size 4. 18±1cm. The size 3 imbrices were the main materials, making up 74 percent of these imbrices (Figure 111).

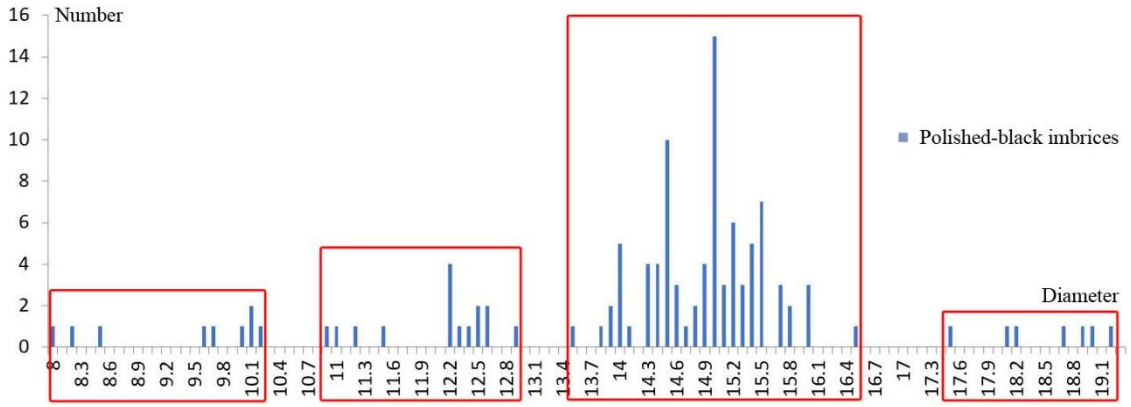


Figure 111 The diameter of the imbrices unearthed from the XBT
(Source: Made by the author)

There are 416 tile-ends with lotus patterns and nine tile-ends with monster patterns whose diameter or semi diameter can be measured. The tile-ends with lotus pattern can be divided into five groups by their diameter: 1. 9.5±1cm, 2. 12±1cm, 3. 14.5±1.5cm, 4. 17.5±1cm, and 5. 21cm. The tile-ends from size 1 to size 4 can be matched to the imbrices of four groups, while no imbrex can be jointed to the size 5 tile-ends. The monster pattern tile-ends can be divided into three groups by diameter: 10–11.2cm, 12.2–12.5cm, and 15.6cm, which are similar to the samples with size 1, size 2, and size 3 lotus patterns (Figure 112).

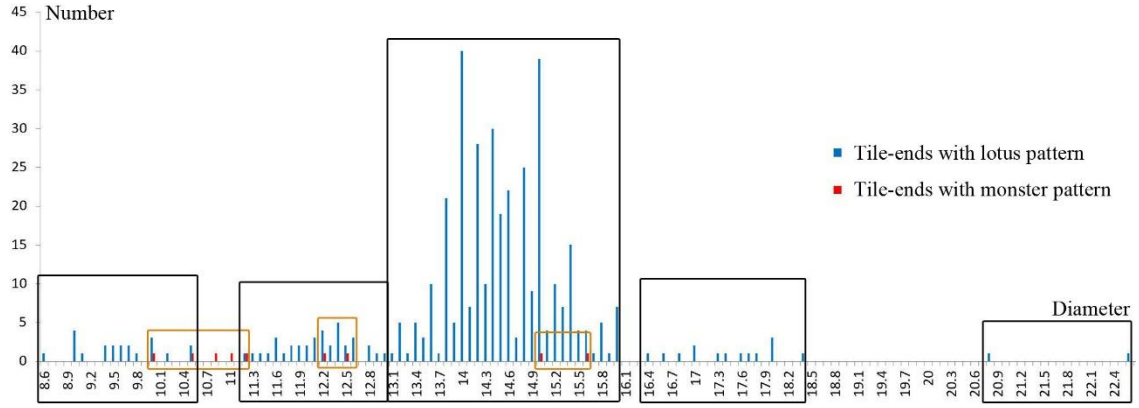


Figure 112 The diameter of the tile-ends from the XBT
(Source: Made by the author)

There are 36 samples with measurable diameter and length. According to the scatter diagram (Figure 113), the length of the imbrices positively correlates with the diameter. Specifically, the length of the size 3 imbrices is 34–39cm, the length of the size 2 imbrices is 30–32cm, and the length of the size 1 imbrices is 18–24cm.

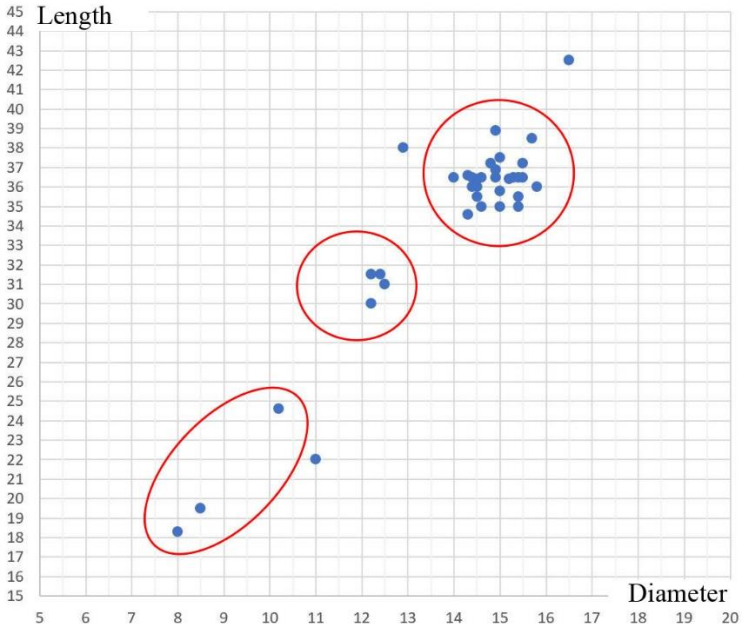


Figure 113 The relation between the length and the diameter of the imbrices
(Source: Made by the author)

There are 104 measurable tegula samples, and most of the data is about the thickness of tegulae. According to Table 39, the sizes of the untrimmed tegulae are similar to the polished-black tegulae, and the eave roof tiles are not larger than the general types. The approximately size of tegulae in this site is 25*45cm^2. Moreover, according to the sizes of polished-black imbrices, the sizes of polished-black tegulae may also be divided into several groups, but the subdivision is difficult because the number of the unbroken samples is limited.

Table 39 The size of the tegulae from the XBT

	Length	Width of the lower end	Width of the upper end	Thickness
Untrimmed tegulae without pattern	41.5cm	24–24.5cm	17.5–23cm	1.7–2cm
Polished-black tegulae without pattern	44–47cm	24–28.5cm	20–24.5cm	1.7–3.5cm
Polished-black tegulae with pattern	41–46cm	17.5–25.5cm	22cm	1.8–3.6cm

2.5 The Decoration of the Roof Tiles

2.5.1 The Tegulae Patterns

The lower ends of the polished-black tegulae unearthed from the XBT were two different types; undecorated or decorated with patterns. Most of the samples were decorated with double wave-shaped patterns (Figure 114-2). To make this pattern, the lower end of a tegula was cut into four layers of clay, and then, the second and fourth layer counted from the concave side were pinched to make wave-shaped patterns. There is also one sample with a complicated wave-shaped pattern whose lower end was cut into six layers of clay (Figure 114-3). In addition, the lower ends of the untrimmed tegulae were the undecorated type (Figure 114-1).

Figure 114 The pattern of the tegulae (Source: Photos by the author)
1. Undecorated tegula; 2. Tegula with double wave-shaped pattern; 3. Tegula with a complicated wave-shaped pattern

2.5.2 The Tile-Ends with Lotus Pattern

The imbrices unearthed from the XBT also have two types. The general imbrices laid on the slopes of roofs are undecorated, while the eave imbrices were joined to tile-ends, which were decorated with lotus patterns or monster patterns. According to the archaeological reports, the tile-end with lotus patterns can be divided into three groups: lotus pattern with simple petals (six types), lotus pattern with compound petals (eight types), and lotus pattern with deformed petals (two types). The number of samples, however, increased in the arrangement, so it is necessary to analyze them and classify them again. This section will focus on the differences in the patterns. The subdivision of the samples with the same pattern, which was created by the differences in the molds, will be discussed in the next section. The XBT was the royal Buddhist temple of the Tang Dynasty and

was not destroyed in the Buddhist Persecution undertaken by Emperor Wuzong. This means that the roof tiles made in different periods of the Tang Dynasty may have been found at the XBT. Therefore, the classification and analysis of the samples from this temple will provide information for a chronological study of the roof tiles in the Tang Dynasty.

The classification of the tile-ends was based on three standards: size, pattern, and the width of the edge. The size of the roof tiles indicates the position where the tile-ends were laid, which indicates the relation between the tile-ends and the buildings. Different places might have used the tile-ends with the same pattern, so one type of tile-ends might have several sizes. According to the previous analysis, the tile-ends can be divided into five groups by size: 1. 9.5±1cm, 2. 12±1cm, 3. 14.5±1.5cm, 4. 17.5±1cm, and 5. 21cm. Most of the samples are size 3 tile-ends.

The pattern of the tile-ends consists of three parts: the central area, petal area and outer area. Each part can be subdivided into several items, and each item has certain features (Table 40). According to the features of the pattern, size 1 tile-ends can be divided into ten types, including seven types of patterns with compound petals and three types of patterns with simple petals. The size 2 tile-ends can be divided into 22 types, including 13 types of patterns with compound petals and nine types of patterns with simple petals. The size 3 tile-ends can be divided into 50 types, including 37 types of patterns with compound petals and 13 types of patterns with simple petals. The size 4 tile-ends can be divided into 4 types, including three types of patterns with compound petals and one type of pattern with simple petals. The size 5 tile-ends have one type of pattern with simple petals.

The width of the tile-ends' edges was also measured. The proportion of edge in diameter (width of

edge ×2 / diameter) has a wide range of changes. It can be divided into three levels: the proportion of the narrowest edge is less than 20 percent of the diameter (edge I); the second level is from 20 percent to 29 percent (edge II); the third level is from 30 percent to 39 percent (edge III).

Table 40 The feature of the tile-ends' pattern

Item		Features
Edge		<20%,20%–29%,30%–39% (width*2)/diameter
Outer area	Bead	Number
	Raised line	Nothing (Figure 115-1, 115-2); one line, inside beads (Figure 115-3); one line, outside beads (Figure 115-4); two lines (Figure 115-5); three lines (Figure 115-6)
Petal area	Petal	Compound petals, simple petals
		Outline: nothing (Figure 116-1), unconnected outline (Figure 116-2, 116-4, 116-5), connected outline (Figure 116-3) Thick (Figure 116-3, 116-4), thin (Figure 116-2, 116-3) Round, with a curled end (Figure 116-2, 116-3); heart shape (Figure 116-4, 116-5)
		Shape of the compound petal's semi-petals: small, thin oval (Figure 117-1); fat, raised oval (Figure 117-2) Shape of the simple petals: oval (Figure 117-3), water-drop shape (Figure 117-4), round (Figure 117-5), crescent shape (Figure 117-6), maple leaf shape (Figure 117-7)
	Inter-petal	Nothing (Figure 118-1, 118-2), one circle, unconnected; one circle, connected (Figure 118-11); two circles, unconnected (Figure 118-3); two circles, connected (Figure 118-4)
		T-shaped (Figure 118-5), Y-shaped (Figure 118-6), triangle (Figure 118-7), bead (Figure 118-8), line (Figure 118-9), wedge-shaped (Figure 118-10)
Central area		Raised (Figure 119-1), flat (Except Figure 119-1)
		Raised line: nothing (Figure 119-8), one line (Except Figure 119-4, 119-6, 119-8, 119-10), two lines (Figure 119-4, 119-6, 119-10)
		One circle of beads: same size (Figure 119-2), different size (Figure 119-3, 119-4), special (Figure 119-5); two circles of beads (Figure 119-6, 119-7); knob: general (Figure 119-8, 119-9, 119-10), surrounded by beads (Figure 119-11); special shape: octagon (Figure 119-12), sun shape (Figure 119-13), persimmon calyx shape (Figure 119-14), chrysanthemum shape (Figure 119-15), pentagon (Figure 119-16), octagon with beads (Figure 119-17)

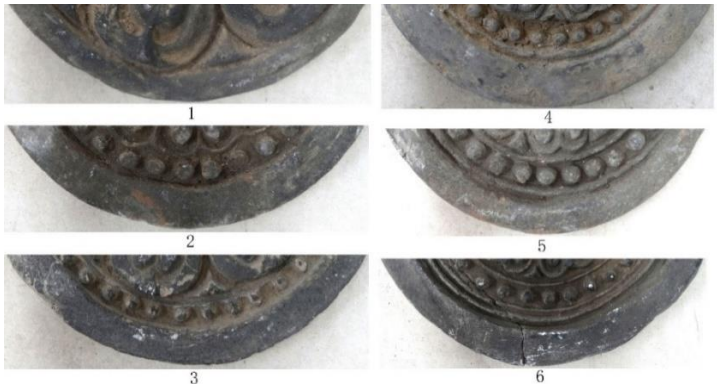


Figure 115 The raised line in the outer area (Source: Photos by the author)

Figure 116 The features of the petals' outline (Source: Photos by the author)

Figure 117 The shape of the petals (Source: Photos by the author)

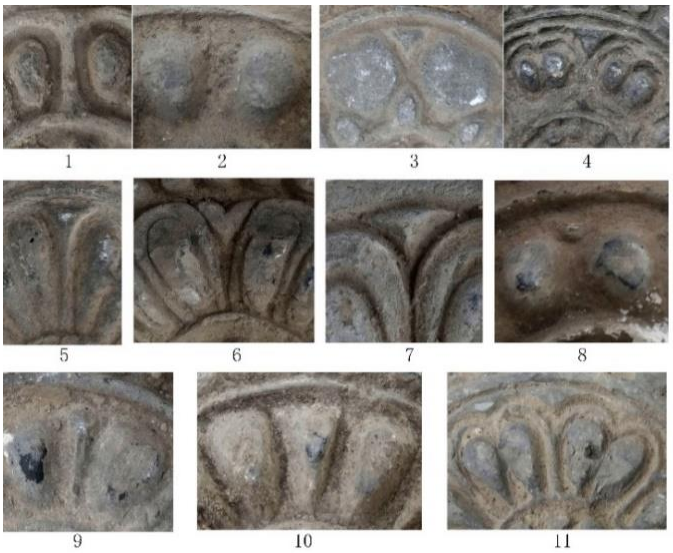


Figure 118 The shape of inter-petals (Source: Photos by the author)

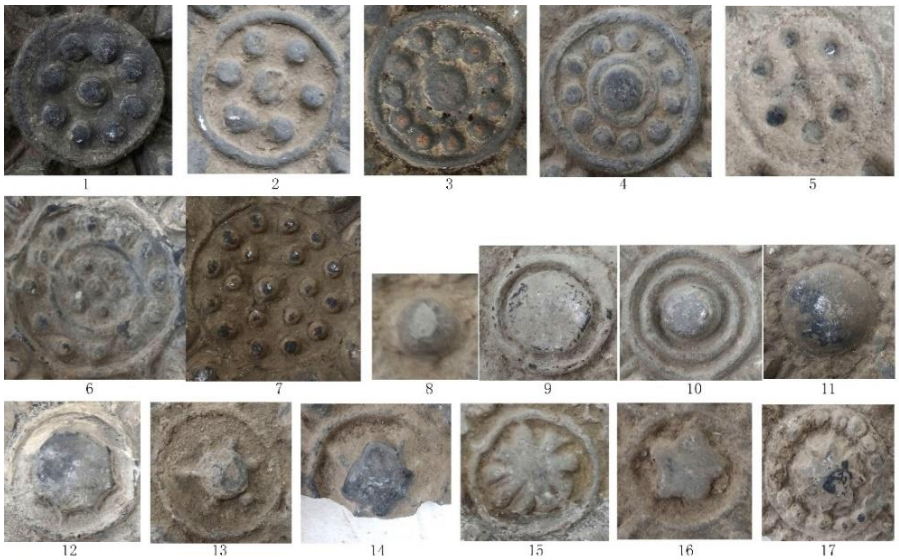


Figure 119 The features of the central area (Source: Photos by the author)

After the classification, samples unearthed from the XBT were divided into 87 types. Some types are closely correlated with each other because their petals, outline, and inter-petals are similar. According to the classification and combination work of the petal area, the tile-ends with simple

petals belong to six groups, and tile-ends with compound petals belong to nine groups (Table 41). Furthermore, a strong positive correlation can be found between the features of the petals and the width of the edge. All 78 types of the tile-ends are positioned in Table 42, 43, 44, 45, 46, 47, 48 and 49, and the vertical axis is the width of the tile-end' edge, and the horizontal axis is the groups of the petals. The analysis of the positive correlation can shed light on the change of the tile-ends' patterns in the Tang Dynasty. Meanwhile, the features of the central area and the outer area do not correlate as much and so they are features for the subdivision.

Table 41 The combination of the petals' features

	Inter-petal	Outline	Shape of the petal (semi-petal)	
Compound petals	Have	Thick, round, with a curled end	Small, thin, oval	A
		Thin, round	Small, thin, oval	B
		Thin, round	Fat, raised, oval	C
		Thin, heart shape	Small, thin, oval	D
		-	Small, thin, oval	E
	-	Thin, connected, heart shape	Small, thin, oval	F
Simple petals	Have	Thin	Oval	A
		Thin	Oval	B
		-	Oval	C
		-	Oval	D
		-	Oval, a curled end	E
	-	Thin, connected	Waterdrop shape	F
		Thin, connected or nothing	Round	G
		Thin, connected	Maple leaf shape	H
		-	Waterdrop shape	I

Table 42 The classification and combination of the size 1 tile-ends (compound petals)

	A	B	D	E
II	 1  2	 3  4  5	 6	
III	0 5cm			 7

Table 43 The classification and combination of the size 2 tile-ends (compound petals)

	A	B	C	D	E	F
II	 1  3  2  4  5	 6	 7	 9		 13
III			 8	 10  11	 12	0 5cm

Table 44 The classification and combination of the size 3 tile-ends (compound petals)

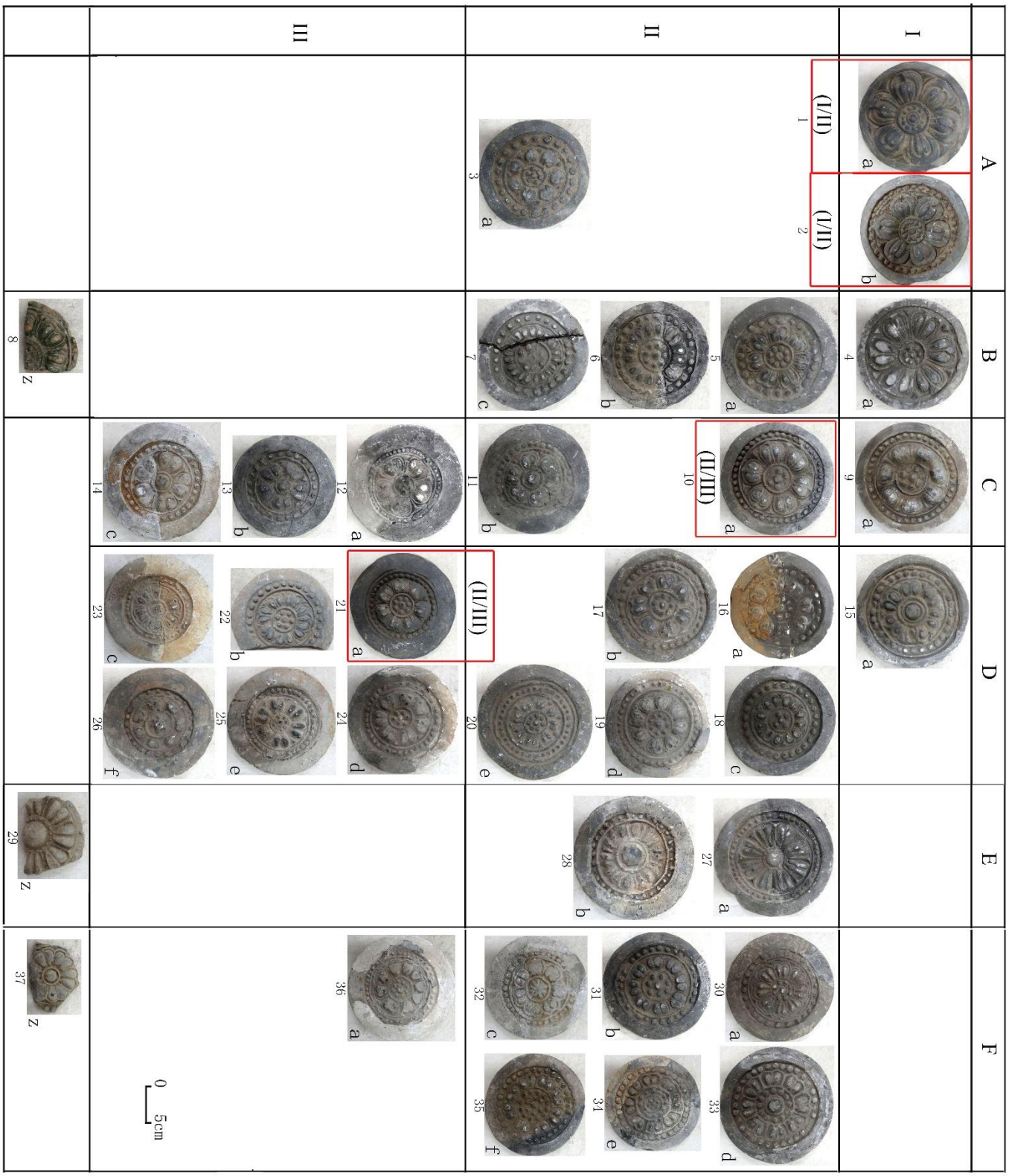


Table 45 The classification and combination of the size 4 tile-ends (compound petals)

	A	C	D
I			

Table 46 The classification and combination of the size 1 tile-ends (simple petals)

	A	E	I
III			

Table 47 The classification and combination of the size 2 tile-ends (simple petals)

	A	C	D	F	H	I
II	 					
III	 					

Table 48 The classification and combination of the size 3 tile-ends (simple petals)

	A	B	C	E	F	G	I
II	 a 1  b 2	 a 4  b 5	 a 6	 a 7		 a 10	0 5cm
III	 a 3				 a 8  b 9	 a 11	 a 12  b 13

Table 49 The classification and combination of the size 4, size 5 tile-ends (simple petals)

	A	
II	 a 1	 a 2 0 5cm

The classification and combination of the tile-ends in the previous analysis were based on three standards that included size, pattern, and the width of edge, and these can be summarized in the six points below:

1. There are more tile-ends with compound petals than tile-ends with simple petals.
2. The edges of the tile-ends with simple petals are usually very wide, while the edges of the tile-ends with compound petals have a wide range.
3. Regardless of if they have compound petals or simple petals, the large-sized samples usually have a narrow edge, while the small-sized samples usually have a wide edge.
4. Tile-ends with compound petals (Table 50): the petals of most of the samples were surrounded by raised outlines. The round outline can be divided into two types according to the thickness of the line, while the heart-shaped outline only has thin lines. The group A petals are surrounded by round, thick outlines and were usually made together with a narrow edge. The group C petals are surrounded by round, thin outlines, and the group D petals are surrounded by heart-shaped, thin outlines. The edges of group C and group D have a wide range. The group F petals are surrounded by connected, heart-shaped, thin outlines, and the group E petals have no outline. They were mostly made together with a wide edge.

Table 50 The relations among the roof tiles' size, edge, and pattern (compound petals)

	Size 1	Size 2	Size 3	Size 4
Edge I			A, B, C, D	A, C, D
Edge II	A, B, D	A, B, C, D, F	A, B, C, D, E, F	
Edge III	E	C, D, E	C, D, F	

5. Tile-ends with simple petals (Table 51): most of the samples have the group A petals, and their widths of edge are in a wide range. Apart from group A, the oval petal samples (groups B, C, D, and E) were all made together with edge II, and the special petal samples, including water-drop-shaped petals (group I, F), round petals (Group G), and maple-

shaped petals (group H) were made together with a wider edge (edge III).

Table 51 The relations among the roof tiles' size, edge, and pattern (simple petals)

	Size 1	Size 2	Size 3	Size 4 and size 5
Edge I				
Edge II		A, C, D	A, B, C, E, G	A
Edge III	A, E, I	A, F, H, I	A, F, G, I	

6. The features of the central area and the outer area did not correlate with the edge of tile-ends. The central area with a round or special-shaped knob seems to be made together with edge III, and the samples with undecorated outer areas were made with edge I, but there are also many counterexamples.

2.5.3 The Tile-Ends with Monster Patterns and Concave Lotus Pattern

There were only ten monster pattern samples found at the XBT, which is far less than the samples with lotus patterns. They can be divided into seven types according to the different designs of the monster's head. In addition, the edges of these samples are all very wide. Most of them make up more than 30 percent of the diameter, and some of them are even more than 40 percent (Figure 120).

There was only one concave lotus pattern sample unearthed from this site. It has simple oval petals and bead-shaped inter-petals. The petals of this sample are concave, but the outlines of the petals are raised.

Figure 120 Tile-ends of monster patterns and concave lotus pattern
(Source: Photos by the author)

2.6 The Classification Results

The basic classification of the roof tiles unearthed from the XBT is as follows (Figure 121, Figure 122).

First, all of the samples were divided into two groups by the color of their clay bodies, including blue-gray bodies and reddish-brown bodies.

Second, the imbrex and tegula were distinguished from the fragments. Imbrices with tile-ends were used for the eaves, and samples without tile-ends were general roof tiles used for the slope of the roofs. Meanwhile, tegulae with double wave-shaped patterns were used as eave tegulae, and undecorated tegulae were used as general roof tiles. The untrimmed tegula that has vertical cutting traces on concave surface should be used as ridge tiles.

Third, they were subdivided according to their exposed surfaces. For the samples with blue-gray

bodies, the exposed surfaces of the tegulae have two types: untrimmed type and polished-black type. All of the exposed surfaces for the imbrices are polished-black type. Moreover, the front surfaces of the tile-ends are mostly polished and blackened. For the samples with reddish-brown bodies, their exposed surfaces were mostly glazed.

Fourth, they were subdivided by size. The diameter of the imbrices has four types: 1. 9±1cm, 2. d=12±1cm, 3. d=15±1.5cm, and 4. d=18±1cm. The size of the tegulae is approximately 25*45cm^2, but the subdivision of tegulae is difficult. The diameter of most of the tile-ends is similar to the imbrices, and so they can be joined together. There are also several tile-ends with a diameter of 21cm, which are larger than all of the imbrices, but they are not the main materials for this temple.

Last, they were subdivided by the roof tiles' pattern. For the tile-ends, there are 60 types (six groups) of lotus patterns with compound petals, 27 types (nine groups) of lotus patterns with simple petals, and seven types of monster patterns. Only three samples were made with reddish-brown bodies, and the other tile-ends all have blue-gray bodies. The lower ends of a part of the polished-black tegulae were decorated with double wave-shaped patterns, which were used for the eaves.

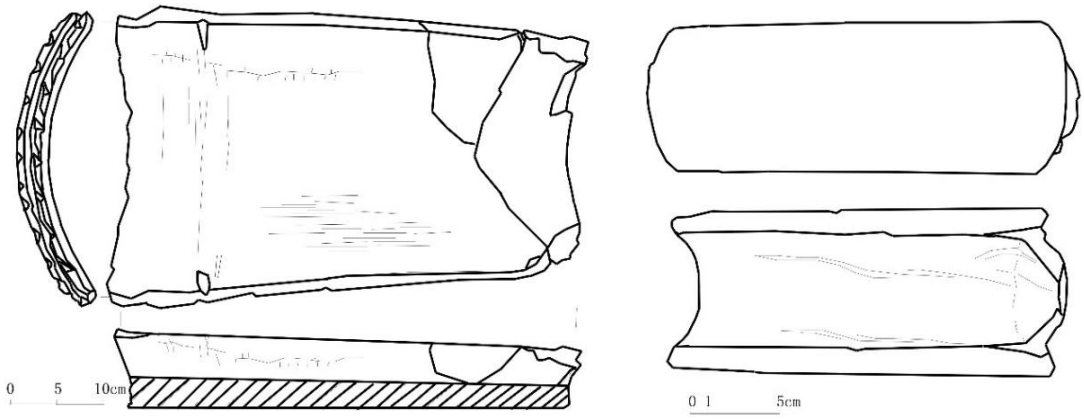


Figure 121 The tegula and imbrex unearthed from the XBT (Source: Made by the author)

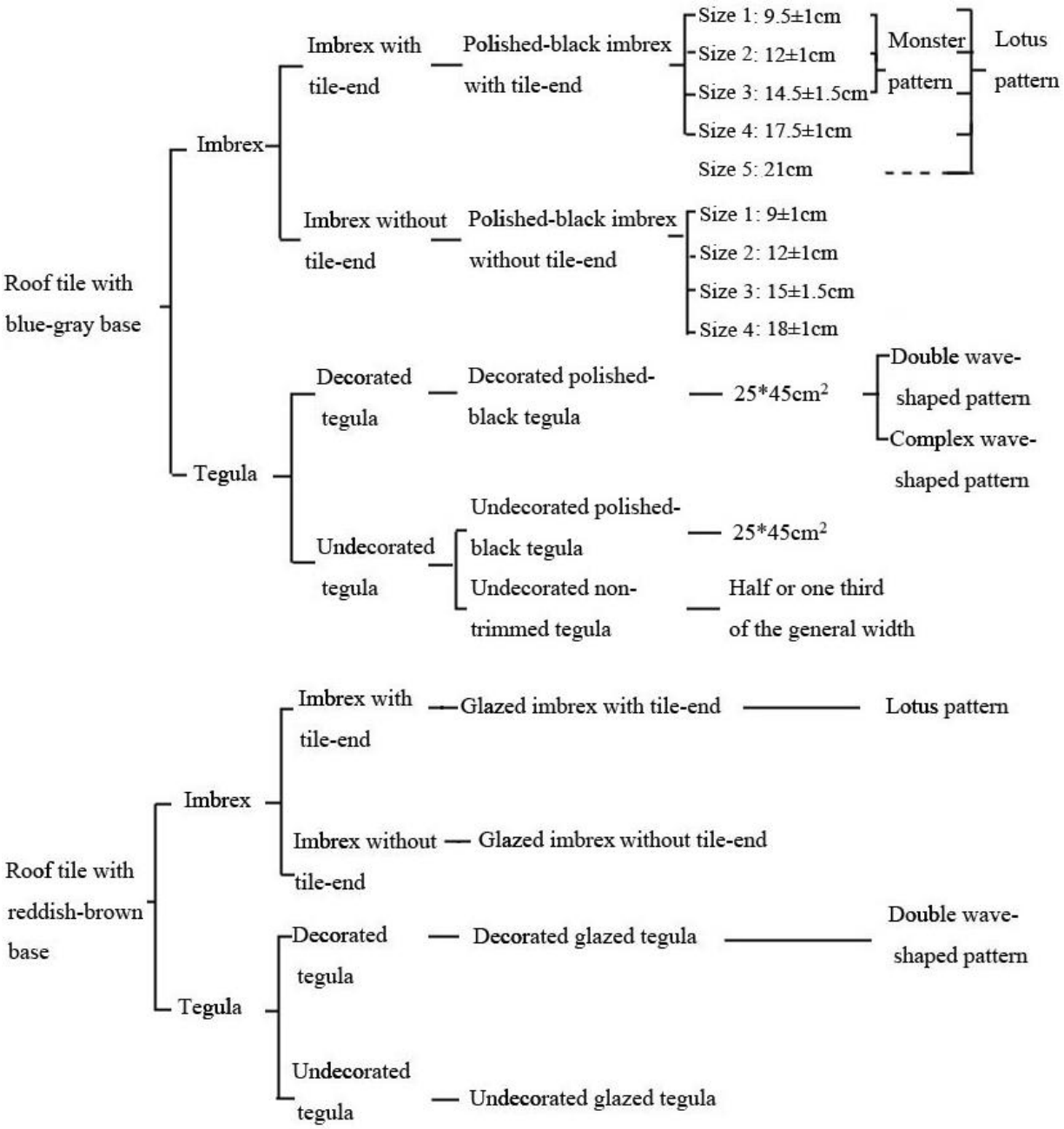


Figure 122 The classification of the roof tiles unearthed from the Ximing Buddhist Temple (Source: Made by the author)

Section 2. The Production Technique of the Ridge Tiles

The production technique of the roof tiles unearthed from the XBT is similar to the roof tiles found in the QBT, which will be analyzed carefully in the next chapter, so this section will only provide a brief introduction about the production technique of the ridge tiles.

A unique tegula sample with untrimmed surfaces was unearthed from this site. The concave surface of the sample has two vertical cutting traces that divided this tegula into three parts, and this sample may have been used as ridge tiles (Figure 123). They provided three features of ridge tiles. 1. The fabric impressions on the concave surface of the ridge tiles were not erased. 2. The width of the ridge tile is one-third of the general tegula, and in the Northern Dynasties, there were also ridge tiles that were half of the general tegula. 3. The cutting traces are shallow, and the surfaces near the cutting traces were usually cracked. This means that the traces were cut after the firing step when the surface of the tegulae had already become hard.

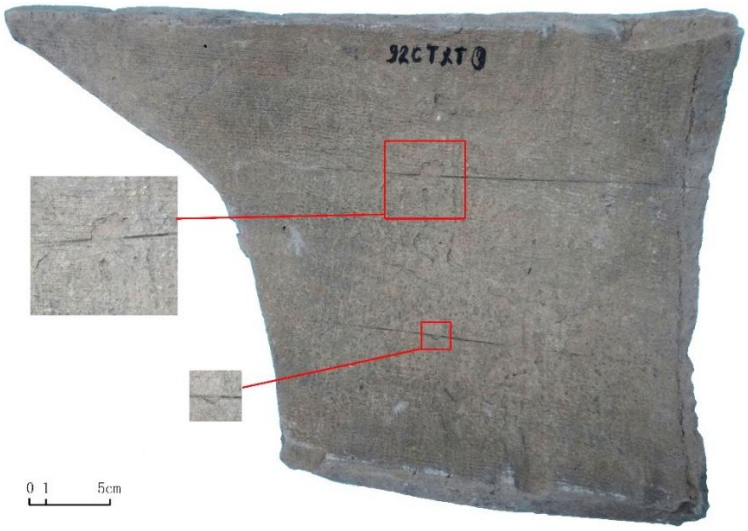


Figure 123 The traces of the ridge tiles (Source: Photo by the author)

Section 3. The Traces of the Roof Tiles from the Ximing Buddhist Temple and Their Production Management

1. Traces on the Surface of the Tegulae and Imbrices

The traces on the surface of the tegulae and imbrices can help us to analyze the formation of the workshop, which provided roof tiles for the XBT. The artisans in the same group usually used the same batch of tools to make the roof tiles in the same way, and the roof tiles made by them have similar production traces. This section will focus on the tool traces and trimming traces to analyze the formation of the workshop, as well as the management methods in this workshop.

Table 52 Traces on the surface of the tegulae and imbrices from the XBT

Feature of the roof tiles	Shaping traces on the convex surface	Trimming traces on the convex surface	Shaping traces on the concave surface [94] (fabric impressions in 1cm*1cm)	Trimming traces on the concave surface	Traces on the edges
Undecorated polished-black tegulae with blue-gray bodies	Unknown	Scraping traces, smoothing traces	Unknown, a few samples retained the fabric impressions 9/15	Polishing traces	Untrimmed
Decorated polished-black tegulae with blue-gray bodies		Scraping traces, the part near the lower end were polished			
Undecorated untrimmed tegulae with blue-gray bodies	Traces of pottery paddle with diagonal stripes pattern	Scraping traces, smoothing traces	9–10/15–17	Untrimmed	Untrimmed
Undecorated glazed tegulae with reddish-brown bodies	Traces of pottery paddles with diagonal striped pattern	Scraping traces, smoothing traces	Unknown	Glazing traces	Untrimmed

[94] The roof tiles with blue-gray bodies include a polished-black tegulae sample, seven untrimmed tegula samples, and 107 polished-black imbrex samples. One sample can be treated as one individual roof tile. The roof tiles with reddish-brown bodies include 16 imbrex samples. The samples are small fragments, so they cannot be treated as individual roof tiles.

Decorated glazed tegulae with reddish-brown bodies		Unknown	Scraping traces, smoothing traces	Unknown	Glazing traces	Untrimmed
Polished-black imbrices without tile-ends, blue-gray bodies	Ss	Unknown	Polishing traces	10–15/6–10	Untrimmed	Untrimmed
	S			7–12/12–16，10–15/6–10		
Polished-black imbrices with tile-ends, blue-gray bodies	M			7–12/12–16，10–15/6–10		Scraping traces; the ridge on the concave side was cut off
	L			7–12/12–16		
Glazed imbrices without tile-ends, reddish-brown bodies		Unknown	Glazing traces	7–10/13–15，13–15/8–9	Untrimmed	Untrimmed, glazing traces
Glazed imbrices with tile-ends, reddish-brown bodies						Scraping traces; the ridge on the concave side was cut off

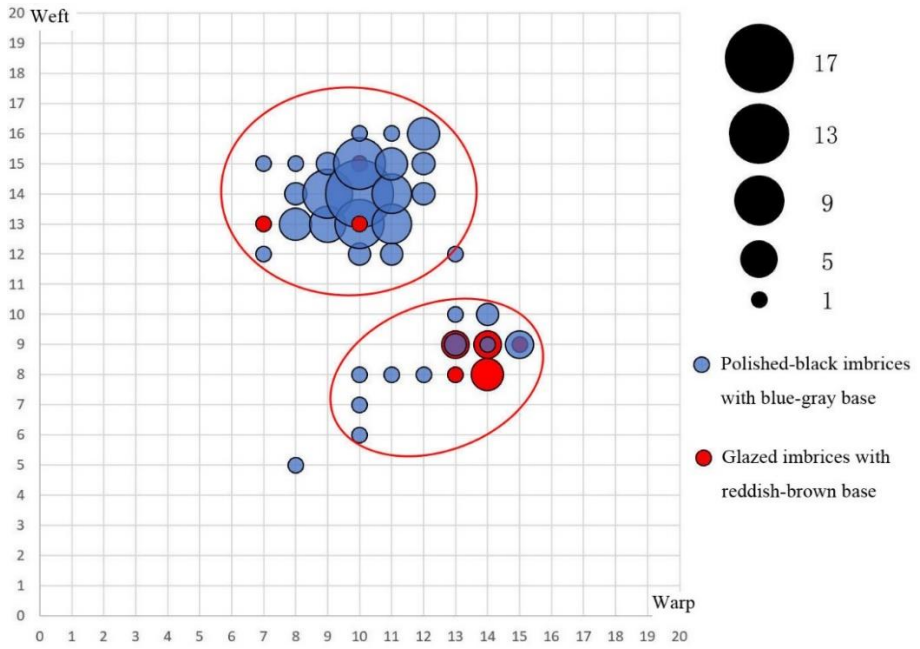


Figure 124 The analysis of the fabric impressions of the roof tiles unearthed from the XBT (1cm*1cm) (Source: Made by the author)

The roof tiles unearthed from the XBT were high quality, and the tool traces left in the shaping step of the production process were mostly erased. Only several specific traces remained, such as the fabric impressions on the concave surfaces of the imbrices or some tegulae, which were left by the cloth covers being wrapped over the inner mold, as well as traces of the diagonal stripes left by the pottery paddles (Table 52). This section will focus on fabric impressions and attempt to distinguish the different artisan groups.

For one type of cloth cover, the number of warps and wefts in an area of 1cm*1cm are normally changeless, and the dots in the scatter diagram gather. By analyzing the scatter diagram of the fabric impressions, the maximum types of cloth covers can be counted, which will then indicate the maximum number of artisan groups. According to Figure 124, there are two types of cloth covers used in the roof tile workshop of the XBT for both polished-back type with blue-gray bodies and glazed type with reddish-brown bodies: 1. 7–12/12–16 and 2. 10–15/6–10. Therefore, the maximum number of artisan groups to make imbrices should be four at this workshop. The differences in the fabric impressions, however, correlated with the distinction of the exposed surfaces. It is worth noting that 86 percent of the polished-black imbrices with blue-gray bodies were made with cloth cover 1, while 80 percent of the glazed imbrices with reddish-brown bodies were made by cloth cover 2. This means that most of the polished-black type imbrices, which were the main materials for this temple, were made by the same artisan group. Moreover, the cloth covers used for the polished-black tegulae and untrimmed tegulae were similar, which means that they were made by the same artisan group. The setting for the cloth covers used for the glazed tegulae with reddish-brown bodies is unknown. Considering the distinction of the imbrices with blue-gray bodies and imbrices with reddish-brown bodies, however, the cloth covers for these two types of the tegulae should also be different. This means that the maximum number of artisan

groups to make the tegulae are two in this workshop.

The trimming traces indicate the minimum number of artisan groups. The trimming traces on the same type of roof tiles are similar, while the differences of concave surfaces among the polished-black tegulae and untrimmed tegulae were caused by the distinction in the function, not makers. Therefore, the differences that can divide the groups of artisans only existed between the samples with blue-gray bodies and the samples with reddish-brown bodies. The exposed surfaces of the former were polished and blackened, while the exposed surfaces of the later were glazed. The differences in the trimming methods indicate that the minimum number of both the tegulae and imbrices is two in this workshop.

Overall, by analyzing the tool and trimming traces, it is likely that there were [2-4] artisan groups that made the imbrices and two artisan groups that made the tegulae for the XBT. Although the maximum number of artisan groups is four, the cloth covers of the polished-black roof tiles with blue-gray bodies, which were the main materials of this temple, mostly belonged to the same type. This means that the roof tile workshop of the XBT was comparatively unified.

2. The Traces of the Tile-Ends

2.1 The Differences among the Molds and the Tile-Ends Made from the Same Mold

In the previous analysis, the tile-ends with lotus patterns were divided into 87 types by the differences in their design, and this included 60 types of patterns with compound petals and 27 types of patterns with simple petals. There were also seven types of tile-ends decorated with monster patterns. One pattern can be subdivided based on the differences in the molds, which appeared in the number and position of the pattern items.

One ceramic mold was unearthed from this site that had a complex pattern (Figure 125). The mold was not curved by hand, because of the smooth concave surface, which was clearly made using a stamp. Therefore, the ceramic mold should be treated as a second-level mold, and there must have been a first-level mold as the stamp. The production process of the tile-ends was likely to be "design, first-level mold, ceramic second-level mold, and products." The tile-ends made by the same first-level mold must have had the same details in the pattern, but the mold traces might have changed in different ways because they might have been made by different second-level molds. In addition, the edge of the second-level mold is rough, so it may be curved and not stamped. This means that the first-level mold might exclude a part of the edge, and the edge of the second-level mold may have been made by hand. Therefore, the tile-ends of the same first-level mold might have edges of different widths.

During the construction process of the royal Buddhist Temples, a large number of tile-ends were required. The technique of using a double-level mold made it possible to produce tile-ends in a short time, because one first-level mold could provide many second-level molds, and subsequently, one second-level mold could make many tile-ends. Moreover, owing to the mass production of second-level molds, the molds could be replaced as soon as they were worn out, so the tile-ends produced in this workshop retained their high quality.

Figure 125 The ceramic mold (second-level mold) unearthed from the XBT (Source: Photos by the author)

The most unearthed type of tile-end from this site were Type 3DII/IIIa (compound petals) samples, and 34 samples of this type were mostly unbroken, so they were suitable for the analysis of the mold. The Type 3DII/IIIa sample (compound petals) has a central area with eight seeds, seven compound petals, which are surrounded by thin, heart-shaped outlines, and a circle of raised line and beads in the outer area. For these samples, there were at least two different first-level molds. The semi-petals made with mold 2 are somewhat shorter than the semi-petals made with mold 1. The differences in the first-level molds may have been because of the hand making process. Moreover, for the samples made by mold 1, at least two changing processes in the mold traces were observed, which was caused by the different second-level molds. The mold traces made by mold 1-1 appeared in the left side of the central area, and they stretched to the edge of the right side. Meanwhile, the mold traces made by mold 1-2 only appeared in the central area (Figure 126). As the second-level molds can be produced in mass quantities and the molds with traces needed to be replaced frequently, there may have been more than two second-level molds to make Type 3DII/IIIa tile-ends (compound petals), but most of them did not leave traces on the tile-ends.

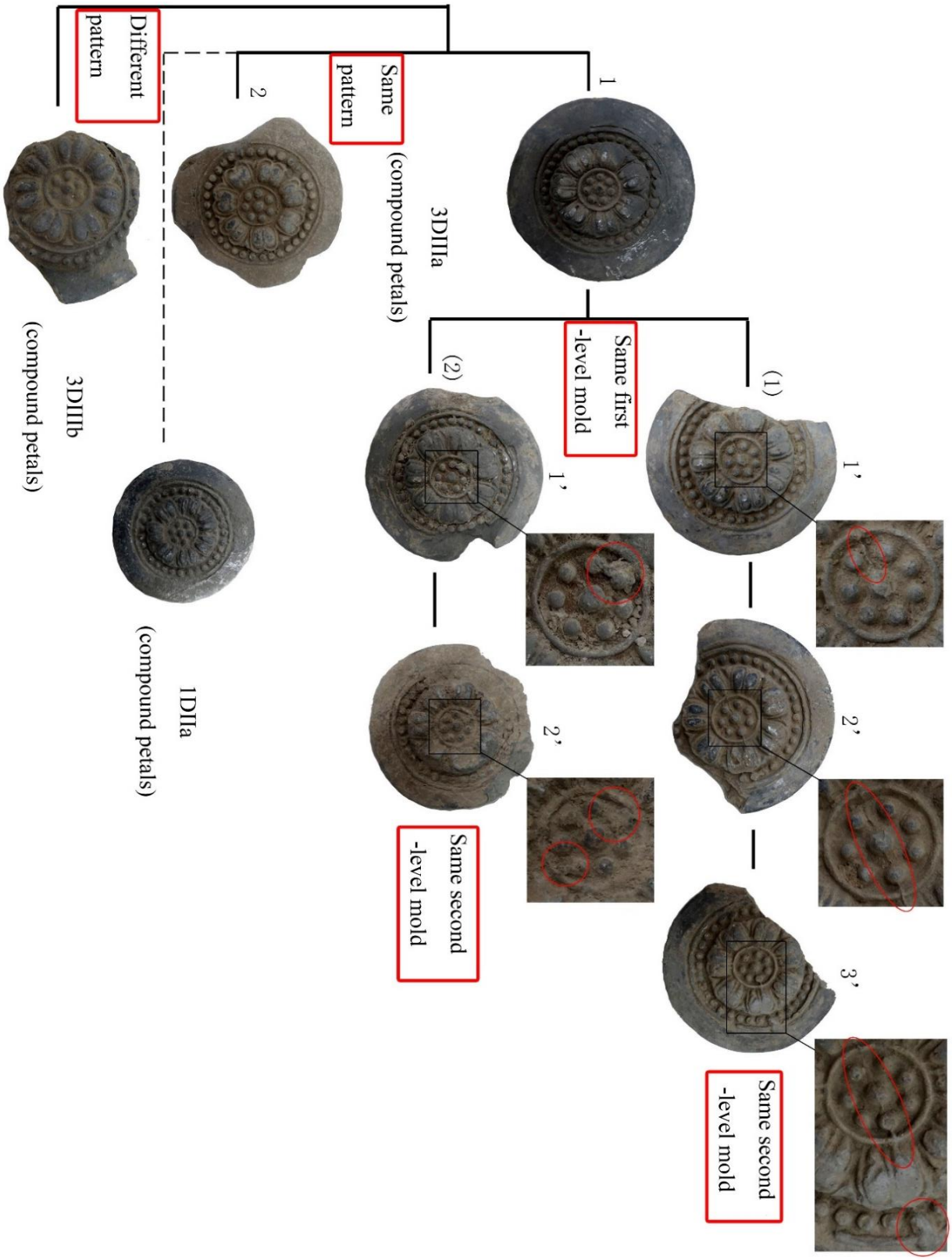


Figure 126 The slight differences of the Type 3DII/IIIa tile-ends (compound petals)
(Source: Made by the author)

The Type 3CII/IIIa samples (compound petals), which have a central area with seven seeds, six compound petals, surrounded by thin, round outlines, and one circle of raised line and beads in the outer area. They can also be divided into two groups according to the details of the patterns (Figure 127). The petals made by mold 1 were full and thick, while the patterns made by mold 2 were smaller than the former. Therefore, there were at least two first-level molds for the Type 3CII/IIIa tile-ends (compound petals).

Figure 127 The molds of tile-ends of Type 3CII/IIIa (compound petals)
(Source: Photos by the author)
1. Type 3CII/IIIa tile-end made by mold 1; 2. Type 3CII/IIIa tile-end made by mold 2

The production techniques for the double-level mold can also be observed in the tile-ends unearthed from the DBT of the Northern Qi Dynasty, which means that the techniques for the roof tile production at the workshop of the XBT were inherited from the Northern Dynasties. However, the samples from the XBT have 87 types of patterns, but most of them have only one first-level mold, while the tile-ends from the DBT have less patterns, but each pattern has several first-level molds. This means that the patterns of the tile-ends were strictly controlled in the

Northern Qi Dynasty, but in the Tang Dynasty, the design of the tile-ends varied.

2.2 The Traces on the Back Surfaces of the Tile-Ends

In order to join the tile-end to imbrex firmly, the artisans left long, thin radial scratched traces or short, wide curved traces on the back surfaces of the tile-end. When the imbrex and tile-end were joined to each other, the clay on the lower end of an imbrex would be pressed into the traces on the back surface of the tile-end, by which these two pieces could be stuck together firmly.

The traces can be divided into two groups: scratched traces and curved traces (Figure 128, Figure 129). The former were thin, radical traces that were scratched with a sharp tool, while the latter were wide, triangular traces that were curved with a knife-shaped tool. These two types of traces demonstrate the existence of different production methods to make eave imbrices, which implies that there were distinct artisan groups.

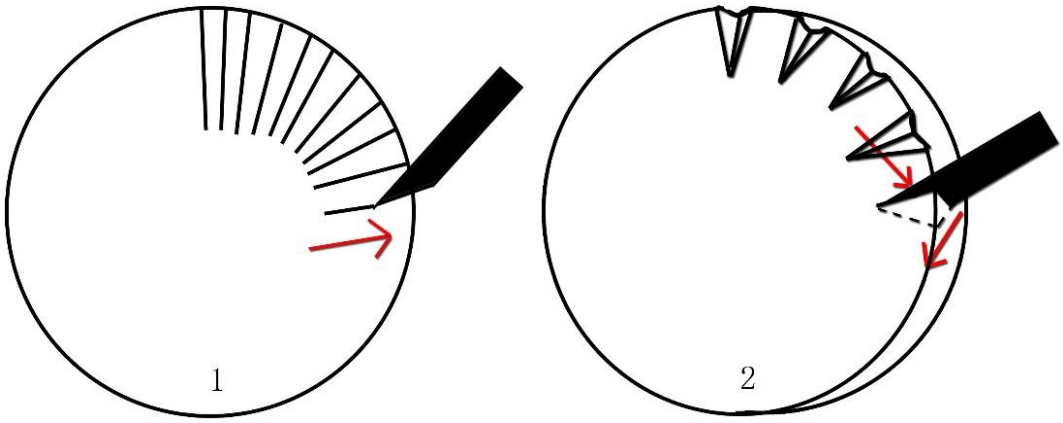


Figure 128 The methods to process the back surfaces of the tile-ends (Source: Made by the author) 1. Scratched traces; 2. Curved traces

Figure 129 The traces on the back surfaces of the tile-ends
(Source: Photos by the author) 1. Scratched traces; 2. Curved traces

The traces on the back surfaces of the tile-ends correlated with the patterns on the front surfaces. According to Table 53, the traces of the tile-ends with simple petals are mostly thin radical scratched traces, while the traces of the tile-ends with compound petals are usually wide curved traces. This proves that there were at least two artisan groups in the workshop of the XBT to make the tile-ends. One belonged to the group of "compound petals, wide curved traces" and the other belonged to the group of "simple-petals, thin radical scratched traces." There were also several types of tile-ends with compound petals that have thin, radical scratched traces. This means that the two artisan groups cooperated in the production.

Table 53 The traces on the back surfaces and the patterns on the front surfaces

	Lotus patterns with compound petals	Lotus patterns with simple petals
Thin, radical scratched traces	2AIId, 2DIIIb, 3AI/IIb, 3CIIIc, 3DIa, 3FIIc, 3FIIf, 4AIa	2AIIIa, 2DIIa, 3AIIa, 3AIIb, 3AIIIa, 3BIIb, 3EIIa, 3FIIIa, 3GIIa, 3GIIIa, 3I-IIIa, 3I-IIIb, 4AIIa
Wide, curved traces	1AIIa, 1AIIb, 1BIIa, 1DIIa, 2AIIe, 2CIIa, 2CIIIa, 2DIIa, 2FIIa, 3AI/IIa, 3AI/IIb, 3CIIa, 3CIIIc, 3DIa, 3DIIb, 3DIIc, 3DIId, 3DIIe, 3DII/IIIa, 3DIIIb, 3DIIId, 3DIIIf, 3EIIa, 3EIIb, 3FIIa, 3FIIb, 3FIId, 3FIIe, 4CIa, 4DIa	2CIIa

2.3 The Cross-Section of the Tile-Ends and the Mold Changes

Table 54 illustrates the cross-section of the tile-ends with compound petals from group A to group F. The right part of the red horizontal line touched the lowest point of the petal area and central area, and the left part of the line crossed the edge. For the edge I and edge II samples, the lowest point of the pattern is usually lower than the surface of the edge, while for the edge III samples, the lowest point of the pattern became higher than the surface of the edge. It seems that the cross-section of the tile-ends changed together with the width of the edge. When the edge became wider, the pattern of the tile-ends rose higher, and the edge of the tile-ends become lower. According to the previous analysis, the patterns of ceramic second-level mold pattern was stamped by a first-level mold, and the edge of the second-level mold was scraped by hand. The low edge of the tile-ends implies that the edge of the second-level mold was not scraped deeply. Furthermore, the patterns of the tile-ends with a wide edge are not as sharp as the samples with a thin edge, which means that the molds to make the former were relatively flat. Therefore, the tile-ends with wide edges were made by comparatively rough molds. The setting of the tile-ends with simple petals is similar to the tile-ends with compound petals, according to Table 55, but they are not as obvious as the former.

Table 54 The cross-section of the tile-ends with compound petals

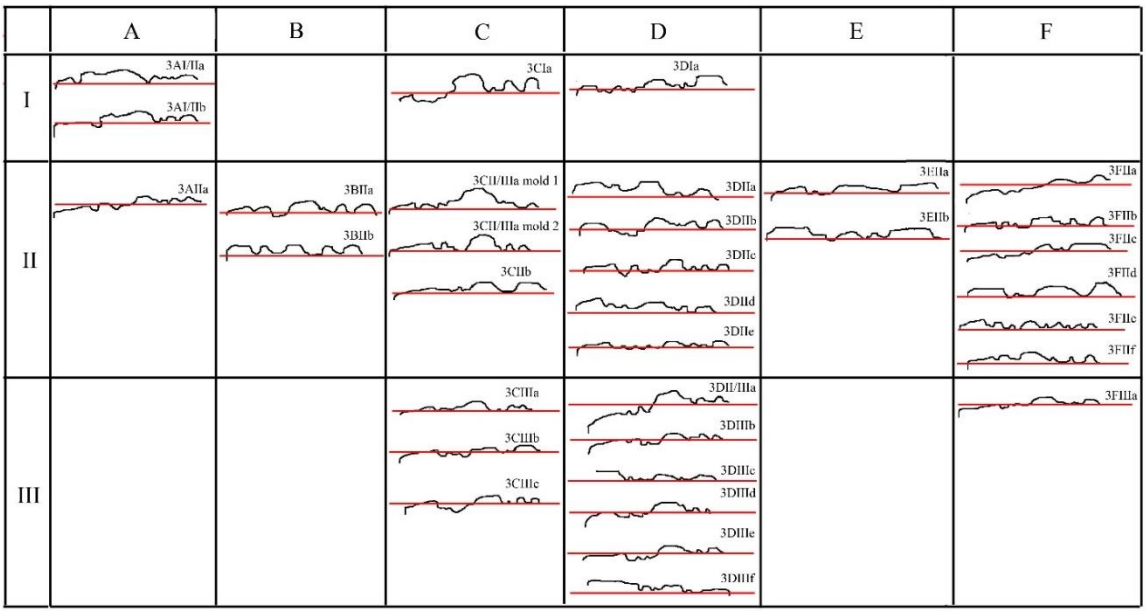
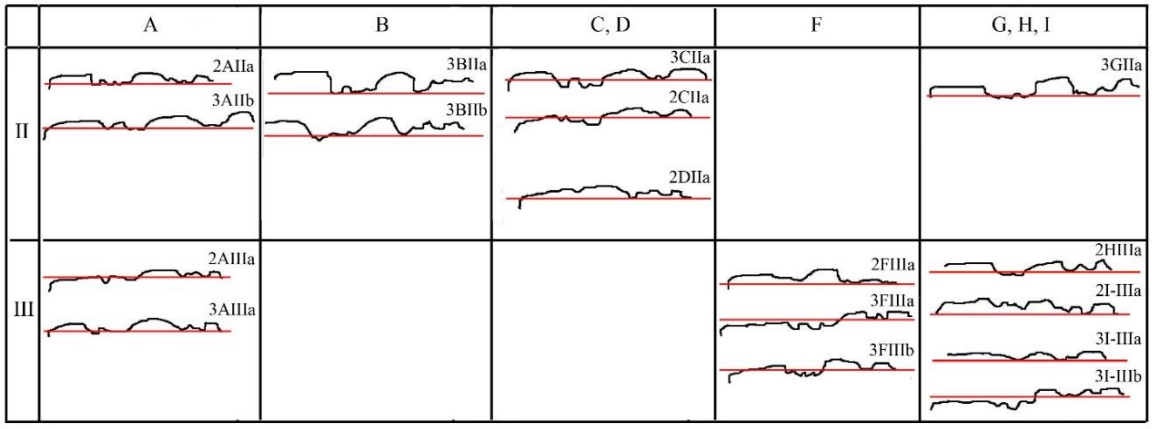


Table 55 The cross-section of the tile-ends with simple petals



3. The Traces of the Roof Tiles and the Management of Roof Tile Production

According to the traces on the surfaces of the roof tiles, the management of roof tile production at the workshop of the XBT can be reconstructed to a certain extent. The previous analysis have demonstrated that there were 2-4 artisan groups to make the imbrices and two artisan groups to make the tegulae. The roof tiles with blue-gray bodies were the most used materials for this temple, and the artisan group in charge of the production of these products was unified.

The production traces of the tile-ends can be observed as front surfaces, back surfaces, and cross-sections. The differences in the molds, appearing on the front surfaces of the tile-ends, implied the tile-end production used the double-level mold technique. From one first-level mold, many second-level molds could be made, and each second-level mold could produce many tile-ends. This mass production technique of the tile-ends appeared in the Northern Dynasties, and it was then inherited by the workshops in the Sui-Tang Dynasties. Compared with the tile-ends in the Northern Dynasties, the samples from this site had more patterns, but each pattern had fewer first-level molds. The traces on the back surfaces of the tile-ends proved the existence of two artisan groups. One made tile-ends with compound petals and left wide curved traces on the back surfaces of the tile-ends. The other one made tile-ends with simple petals and left thin radical scratched traces. Moreover, the cross-section of the tile-ends correlated with the width of the edges. When the edges of the tile-ends became wider, the edges lowered, compared to the petal area and central area, and the pattern became flatter, and it was through this process that the mold quality reduced.

Section 4. The Character on the Roof Tile of the Ximing Buddhist Temple

Only one roof tile with characters was unearthed at the XBT. It was stamped on the tile lip of a size 3 polished-black imbrex and was found at the No. 2 Architectural Site. The stamp is a rectangle, 1.7cm in length, and 1.3cm in width, and the character in this stamp is "宫." (Figure 130)

The character "宫" means palace or royal, and this implies that the roof tile workshop of the XBT belonged to the system of royal workshops. Among more than 700 samples of the roof tiles

unearthed from this site, however, only one sample with character was found, and the character may show the affiliation of the workshop. This means that the production management, especially the supervision method for the artisans, may have changed in the Tang Dynasty.

Figure 130 The character on the imbrex unearthed from the XBT
(Source: Photo by the author)

Section 5. Kiln and Roof Tiles Supplements in the Ximing Buddhist Temple

According to the archaeological report, there is a kiln site in the southeastern part of this site, overlapped by a rammed-earth foundation in the eastern porch (Figure 131). The fan-shaped kiln site is 2.05m long in the south/north direction, and 2.1m wide in the east/west direction. The kiln consisted of four parts: a firebox, combustion chamber, firing chamber, and stack. The firebox of the kiln was in the north and had a broken gate, and five stacks were built in the south of the kiln.

The western wall of the kiln site was overlapped by the rammed-earth foundation of the eastern porch, and the deposits in the chamber belong to layer 3b. This means that the kiln was built

earlier than the eastern porch and may have provided building materials for this temple. No remains have been unearthed from this kiln site, and so it is difficult to speculate what types of products it provided, but it could have been used to supply roof tiles used for building the XBT.

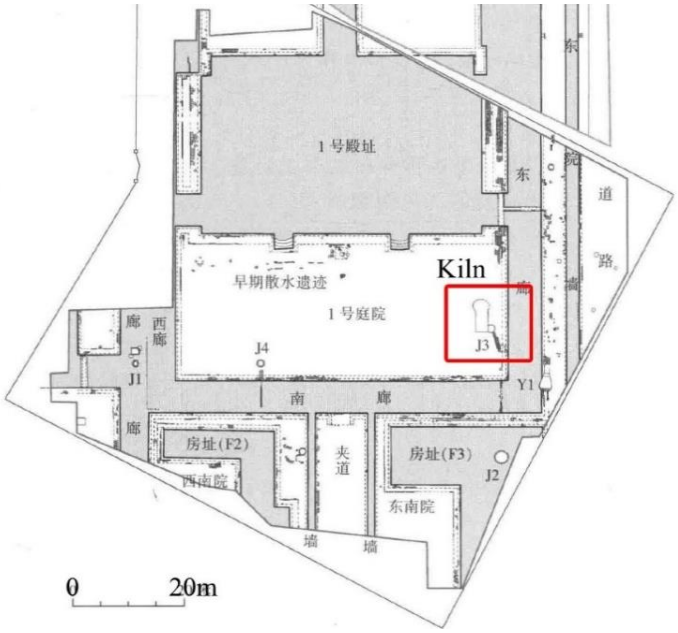


Figure 131 The kiln site at the XBT (Zhongguo shehui kexue yuan kaogusuo 2015, Fig. 66)

Section 6. The Utilization of Roof Tiles in the Ximing Buddhist Temple

1. The Position of the Roof Tiles

The excavated sites are located in the east of the XBT, and the remains unearthed from these sites indicate the setting of the building materials in the eastern part of this temple. The information about the roof tiles' distribution is not clear, but the remains found in 1985 were from the No. 1 Architectural Site and the small courtyards in the south, while the remains found in 1992 were from the No. 2 Architectural Site. Using these records, the information about the utilization of the roof tiles can be hypothesized.

1.1 The Diameter of the Imbrices and their Position

In the previous analysis, the imbrices unearthed from this site were divided into four groups by their diameter: size 1. 9±1cm, size 2. 12±1cm, size 3. 15±1.5cm, and size 4. 18±1cm.

Among the nine size 1 imbrex samples, apart from one imbrex that was found in the T105A trench of the No. 1 Architectural Site, all other samples were unearthed from the No. 2 Architectural Site. The T105A trench is in the north of the No. 1 Architectural Site, near the porch site that connected the No. 1 and No. 2 Architectural Sites. Among the 15 size 2 imbrex samples, apart from the two imbrices that were unearthed from 1985, all other samples were unearthed from 1992 from the No. 2 Architectural Site. The setting of the size 1 and size 2 imbrices demonstrates that the roof tiles laid on the roofs of the No. 2 Architectural Site and its attached buildings were mostly small-sized.

There are 86 size 3 imbrex samples, including 20 samples from 1985, 64 samples from 1992, and two samples without a date. It is clear that the size 3 imbrices were the main materials for this temple, and they were found in both sites. Among the size 4 imbrex samples, there are seven samples unearthed from 1985 and only one sample unearthed from 1992, which means that most of the large-sized imbrices were used at the No. 1 Architectural Site. Moreover, the imbrices unearthed from the southern porches or small courtyards in the south are mostly large-sized, which is similar to the samples unearthed from the No. 1 Architectural Site.

Overall, the imbrices used at the No. 1 Architectural Site were mostly size 3, together with size 4, while the imbrices used at the No. 2 Architectural Site were mostly size 3, together with size 1

and size 2. Therefore, the roof tiles for the No. 1 Architectural Site and attached buildings to the south were larger than the roof tiles for the No. 2 Architectural Site.

1.2 The Sizes, Patterns of the Tile-Ends, and their Position

The distribution of the tile-ends by size is similar to the imbrices mentioned above. The samples unearthed from 1985 make up 9.5 percent of the size 1 tile-ends, 25 percent of the size 2 tile-ends, 60.6 percent of the size 3 tile-ends, and 62.5 percent of the size 4 and size 5 tile-ends. Meanwhile, the samples unearthed from 1992 make up 90.5 percent of the size 1 tile-ends, 69.4 percent of the size 2 tile-ends, 26.5 percent of the size 3 tile-ends, and 6.3 percent of the size 4 and size 5 tile-ends. There are also a few samples whose unearthed years are not clear. The statistical data illustrates that the size 3 tile-ends were mostly used at the No. 1 Architectural Site, together with the size 4 and size 5 tile-ends, while the size 2 tile-ends were mostly used at the No. 2 Architectural Site, together with the size 1 tile-ends.

Considering the proportion of the tile-ends that had different patterns, the tile-ends with compound petals were mostly unearthed from both sites. In the No. 1 Architectural Site, 67.2 percent of the tile-ends were decorated with compound petals, and 28.6 percent of the tile-ends were made with simple petals. In the No. 2 Architectural Site, 77.1 percent were made with compound petals, and 15 percent were made with simple petals. Therefore, the tile-ends with compound petals were most used in the buildings of this temple, and the tile-ends with simple petals were used as supplements. The distribution of the main types of tile-ends is listed below (Table 56).[95]

[95] The main type of tile-ends should make up more than 4 percent of the whole tile-ends from the No.1 Architectural Site or make up more than 3 percent of the whole tile-ends from the No.2 Architectural Site.

Table 56 The main types of tile-ends

No. 1 architectural site			No. 2 architectural site		
group A (simple petals)	3AIIa	10.7 %	group A (simple petals)	3AIIa	3.9%
group F (simple petals)	3FIIIa	4.6%	group A (compound petals)	3AI/IIb	10.5%
group A (compound petals)	3AI/IIb	8.8%		3AI/IIa	10.5%
group C (compound petals)	3CIIa	5.3%	group B (compound petals)	1BIIb	3.9%
group D (compound petals)	3DIId	6.5%	group C (compound petals)	3CIIa	4.6%
	3DII/IIIa	11.1 %	group D (compound petals)	3DII/IIIa	3.3%
	3DIIe	4.6%		2DIIIb	3.3%
				3DIa	7.2%

According to the statistical analysis, the most unearthed types of tile-ends at the No. 1 Architectural Site belonged to group D (compound petals), which are patterns with small semi-petals, surrounded by thin, heart-shaped outlines. The group A samples (simple petals), patterns with oval petals, were also largely used in this site. Meanwhile, the most unearthed types of tile-ends at the No. 2 Architectural Site belonged to group A (compound petals), which are patterns with small semi-petals, surrounded by wide, round outlines. The second most used type of tile-ends at this site belonged to group D (compound petals). These types, each of which makes up more than 10 percent of all of the tile-ends, must have been the main materials for this site. The main materials were used in the construction process of the buildings, and other types of tile-ends might have been used as materials for repairing the buildings.

2. The Period of the Tile-Ends

2.1 The Width of the Edges and the Period of the Tile-Ends

According to previous studies, the width of the tile ends edges correlated with the period when it was made (Sagawa 2000; Yamazaki 2011). This section will first discuss the relation between the tile-ends' edges and production periods by analyzing samples from the sites of the Northern Qi Dynasty and the Sui-Tang Dynasties.

Table 57 The proportion of the edge in diameter

Site	Period	Proportion[96]	
The No. 1 Architectural Site in the DBT	558 AD	Simple petals: 24%–29%	Zhongguo shehui kexueyuan kaogu yanjiusuo yecheng kaogudui 2016
The No. 5 Architectural Site in the DBT	558 AD	Simple petals: 15%–28%	Yecheng kaogudui 2018
The No. 37 Hall of the Jiucheng Palace in the Sui Dynasty	593 AD	Compound petals: 22%–25% Simple petals: 24%–30%	Zhongguo shehui kexueyuan kaogu yanjiusuo Xi'an Tangcheng gongzuodui 1995
The Xing'an Gate of Daming Palace	634-663 AD	Simple petals: 34%	Xi'an Tangcheng gongzuodui 2014
The Danfeng Gate of Daming Palace	634-663 AD	Compound petals: 27% Simple petals: 28%	Xi'an Tangcheng gongzuodui 2006
The Hanyao Gate of Daming Palace	634-663 AD	Compound petals: 23-25%	Xi'an Tangcheng gongzuodui 1988
The Hanyuan Hall of Daming Palace	634–663 AD	Compound petals: 8%–32% Simple petals: 21%–38%	Xi'an Tangcheng gongzuodui 1997
The kiln site of the Daci'en Buddhist Temple	648 AD	Compound petals: 27%	Han 1986
The kiln site in Nanyaotou Village in Xi'an	From 731 AD to Middle Tang[97]	Compound petals: 25% Simple petals: 25%	Xi'an shi wen wu bao hu kao gu yan jiu yuan 2015
The Xingqing Palace	720 AD	Compound petals: 33% Simple petals: 25%–37%	Ma 1959
The QBT	852 AD	Compound petals: 19%–38% Simple petals: 24%–46%	Arranged by the author

According to Table 57, from the Northern Dynasties to the Tang Dynasty, the edges of the tile-ends became wider. In the Northern Qi Dynasty and the Sui Dynasty, the width of edge mostly

[96] Proportion= (width of edge*2)/diameter

[97] According to archaeological reports, the kiln sites and tile-ends of the Nanyaotou (南窯頭) Village are similar to the sites and remains in Guanlin (関林) County, Luoyang, and therefore, their production period should be the same. The kilns in Guanlin County are thought to have been built after 731 AD and before the Middle Tang (Luoyangshi wenwu gongzuodui 2007).

make up 20–29 percent of the diameter, and the edge of the tile-end with simple petals, which make up 25–29 percent of the diameter, was usually wider than the edge of the tile-end with compound petals. Some samples' edges became thinner at the beginning of the Tang Dynasty, but most of them still make up 20–29 percent of the diameter. Some tile-ends with simple petals made up more than 30 percent of the diameter. From the High Tang Period to the Middle Tang Period, the edge of the tile-ends became wider. The edges of compound petals samples make up 20–35 percent of the diameter, while the edges of simple petals samples make up 20–39 percent of the diameter. The tile-ends whose edges made up less than 20 percent of the diameter disappeared. The edges of the tile-ends with compound petals in the Late Tang still make up 20–39 percent of the diameter, but the edges of the tile-ends with simple petals make up 25–49 percent of the diameter. Table 58 illustrates the changes in the edges of the tile-ends from the Northern Qi Dynasty to the Later Tang Period.

Table 58 The proportion of the tile-ends' edges to diameter in the different periods

		Northern Qi 534–577	Sui 580–618		Early Tang 618–700		High Tang to Middle Tang 700–850		Late Tang 850–900 AD	
		Simple petals	Compound petals	Simple petals	Compound petals	Simple petals	Compound petals	Simple petals	Compound petals	Simple petals
I	<20%									
II	20–24%									
	25–29%									
III	30–34%									
	35–39%									
IV	40–49%									

2.2 The Main Materials and Repair Materials of the Tile-Ends

As the width of the tile-ends' edges changed along with the historical period, this can allow for a chronological study of the tile-ends. By counting the proportion of tile-ends made in different periods, it becomes possible to analyze the construction or repair of the XBT. To achieve this, only the types of tile-ends that have more than ten samples were considered.

According to the previous analysis, the tile-ends with narrow edges, which make up 10–20 percent of the diameter, were made before the 8th century. The XBT was built in 658 AD, and so the tile-ends with narrow edges must have been the materials used in the construction process of the temple. Figure 132 illustrates that this type of tile-end includes group A and group D with compound petals, and many of these were found at this site. This means that the tile-ends used in the construction process make up a larger proportion of the remains.

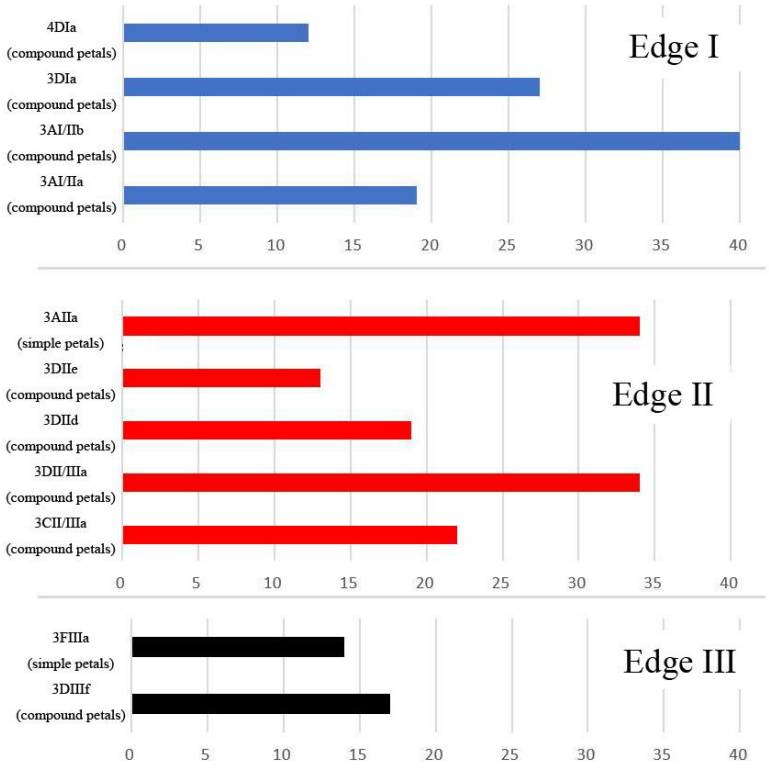


Figure 132 The edge of tile-ends and their quantity (Source: Made by the author)

The tile-ends with compound petals, whose edge make up 30–39 percent of the diameter, and tile-ends with simply petals, whose edge make up 35–39 percent of the diameter, were made after the

8th century. In Figure 132, this includes group D with compound petals and group F with simple petals. They only make up a small proportion of the whole remains.

The production period of the tile-ends whose edges make up 20–29 percent of the diameter is unclear. It includes group C, group D with compound petals, and group A with simple petals. Some of these may have been made during the construction process of the temple in the Early Tang Period, and others may have belonged to the later period. For example, the Type 3DII/IIIa and Type 3CII/IIIa tile-ends have some samples whose edges make up more than 30 percent of the diameter, so they must have been produced after the 8th century.

Overall, the tile-ends produced before the 8th century, which were used in the construction process, make up a large proportion of the samples found at the site. This means that the XBT was not destroyed and reconstructed after it was built in the middle of the 7th century. The tile-ends made after the 8th century found at this site may have been the repair materials for the buildings, demonstrating that the temple was used until the end of the Tang Dynasty. It is also worth noting that the samples with the edges that make up more than 40 percent of the diameter, such as the samples from the QBT, were not found at this site.

2.3 The Changes in the Tile-Ends' Patterns

The relation between the tile-ends' pattern and the width of the edges is indicative of the changes in the patterns during different periods. According to Table 59, the pattern of the compound petals pattern changed from groups A, B, C, and D to groups C, D, E, and F. The group A tile-ends whose petals were surrounded by wide round outlines, disappeared gradually, and the group C tile-ends, which have thin, round outlines, and group D, which have thin, heart-shaped outlines, lasted for

a longer time. The group E and group F tile-ends, which don't have outline or have deformed, connected outlines, appeared later. Table 60 illustrates the changes in the patterns with simple petals. No pattern that matched the narrow edge and this proves that the production of the tile-ends with simple petals occurred comparatively later. Moreover, the samples with standard oval petals and sharp inter-petals appeared earlier, while the samples with small, deformed petals and inter-petals were made later than the former samples.

Table 59 The pattern and the production period of the tile-ends with compound petals

	A	B	C	D	E	F
I						
II						
III						

Table 60 The pattern and the production period of the tile-ends with simple petals

	A	B	C	D	E	F	G	H	I
I									
II									
III									

3. Summary

The previous analysis demonstrate that the buildings in the XBT were used up until the end of the Tang Dynasty without destruction and reconstruction. This was evident in records from the historical literature. The XBT was one of four temples that remained in use during the Buddhist Persecution in the period of Emperor Wuzong. The roof tiles used for the No. 1 Architectural Site were larger than the roof tiles used for the No. 2 Architectural Site, demonstrating that the former were higher class tiles. The tile-ends used for this temple were mostly decorated with lotus patterns, especially the lotus patterns with compound petals. The tile-ends of group A and group

D with compound petals, as well as the tile-ends of group A with simple petals were the main materials for this temple, but there are also many types of tile-ends used as repair materials. These tile-ends, which were made later than the main materials, changed over time. For the tile-ends with compound petals, those with thin heart-shaped outlines surrounding the petals increased, and the inter-petals deformed gradually. For the tile-ends with simple petals, the types with less than ten standard oval petals were replaced with types with more than ten small, deformed petals, and the outlines surrounding the petals and inter-petals also disappeared gradually.

Section 7. Roof Tiles and the Construction Process at the Ximing Buddhist Temple

The excavation of the XBT was conducted in 1985, 1992, and 1993 by the Tangcheng Archaeological Team (Institute of Archaeology, Chinese Academy of Social Sciences). These sites are in the eastern part of the temple, consisting of three main halls, attached porches, and small courtyards in the south. The remains of building materials belonging to the XBT were unearthed from layer 3b. The XBT was built in 658 AD and was used until the end of the Tang Dynasty. It wasn't destroyed during the Buddhist Persecution conducted by the Emperor Wuzong, and subsequently, the root tiles unearthed from this temple included various types from the Early Tang Period to the Late Tang Period.

According to the previous analysis, the roof tiles with blue-gray bodies were the main materials for this temple, and they included polished-black imbrices, polished-black tegulae, and untrimmed ridge tiles. In addition, some tile-ends with reddish-brown bodies and glazed surface

were found at this site, but they only make up a small proportion of the whole tile-ends. The sizes of the polished-black imbrices can be divided into four groups: 1. 9±1cm, 2. 12±1cm, 3. 15±1.5cm, and 4. 18±1cm. The length of the imbrices in size 1 is approximately 18–24cm, while the length of the imbrices in size 2 is 30–32cm and the length of the imbrices in size 3 is 34–39cm. The diameter of most of the tile-ends with lotus pattern is similar to the imbrices, and several tile-ends have a diameter of approximately 21cm, which is larger than all of the imbrices. The tile-ends with monster patterns are matched to the imbrices in groups 1, 2, and 3. The size of tegulae unearthed from this site is approximately 25*45cm^2. The eave roof tiles were decorated on their lower end and laid on the first line of the roof. Most of the eave tegulae have double wave-shaped patterns, while the lower ends of the eave imbrices were joined with tile-ends. The decoration of the tile-ends can be divided into three groups: lotus patterns with compound petals, lotus patterns with simple petals, and monster patterns. There are 87 types of tile-ends with lotus patterns found at this site, and they belonged to six groups of compound petals and nine groups of simple petals according to the features of the petal area. These samples can also be subdivided into three groups according to the width of the edges. The relations between the features of the petals and the width of the edges illuminates the changes in the tile-ends with lotus patterns during the Tang Dynasty. The size of the tile-ends also altered together with the width of the edges. When the edges became wider, the diameter of the tile-ends decreased.

More information can be obtained from the surface traces of the roof tiles used at the XBT, which can provide more details about the roof tiles handicraft industry and the construction processes at this temple. According to the excavation results, there is a kiln site in the southeastern part of this site, overlapped by the rammed-earth foundation of the eastern porch. This kiln was built somewhat earlier than the temple, and the tile-ends used in this temple may have been provided

by this kiln. There was only one sample with a stamped character unearthed from this site. The character "宫" means that the roof tile workshop may have belonged to the royal workshop system. It is different from the supervision method used during the Northern Qi Dynasty, which was based on stamps with the names of individual artisans. According to the previous analysis, the minimum number of artisan groups is determined by the production technique, and the artisans who worked in this roof tile workshop were likely to belong to two groups, which made polished-black roof tiles with blue-gray bodies and glazed roof tiles with reddish-brown bodies separately. Meanwhile, the maximum number of artisan groups was influenced by the production tools. The cloth covers used for the imbrices illustrates that the artisans can be divided into four groups: two groups for the polished-black imbrices and two groups for the glazed imbrices. However, for the imbrices of the same type, 80–90 percent of the samples were made by the same group of artisans. The maximum number of artisan groups to make tegulae was two, and the tools to make tegulae of the same type were similar. Therefore, the roof tile workshop in the XBT was comparatively unified. Moreover, the tile-ends from this site were made using the double-molds technique, similar to the setting in the DBT of the Northern Qi Dynasty. For the samples from the XBT, there were many types of patterns, but the number of first-level molds was limited, which was different from the situation of tile-end production in the Northern Dynasties. The artisans who made the tile-ends can also be divided into two groups. One produced tile-ends with simple petals, which have thin, radical scratched traces on the back surface, and the other made tile-ends with compound petals, which have thick curved traces.

The utilization of the roof tiles in the XBT also needs to be analyzed. First, according to the distribution of the different sizes of the imbrices, the imbrices laid on the roofs of the No. 1 Architectural Site and attached buildings are larger than the imbrices used for the No. 2

Architectural Site. This means that the buildings in the southern part of this site were a higher class than the buildings in the north. Second, the width of the tile-ends' edge correlated with the periods when the tile-ends were made. From the statistical analysis of the tile-ends' edges among the samples made in the Northern Qi and Sui-Tang Dynasties, it is clear that the edges of the tile-ends became wider. The proportion of the tile-ends' edges to diameter changed from approximately 20 percent to approximately 40 percent, and from this proportion, the production sequence of the tile-ends in the XBT can be conjectured. According to the previous analysis, the tile-ends made before the 8th century, which were usually tile-ends with compound petals, surrounded by wide round outlines or thin heart-shaped outlines, made up a large proportion of the samples unearthed from this site. This means that the XBT was not destroyed or reconstructed on a large scale after it was built in the middle of the 7th century. There are still some samples that were made after the 8th century, which include various type of patterns, indicating that the temple had been used for a long time and its buildings were repaired many times. These patterns changed over time. For the tile-ends with compound petals, the types with thin heart-shaped outlines increased gradually. In the late period of the Tang Dynasty, the petals' outlines and inter-petals usually deformed or disappeared. For the tile-ends with simple petals, the types with standard oval petals were replaced by the types with small, deformed petals, and the number of the petals increased. Meanwhile, the outlines surrounding the petals and inter-petals disappeared gradually.

The roof tiles from the site of the XBT were not completely collected, however, most of the collected roof tiles are typical samples with obvious production traces. This information is sufficient for basic analysis of the production and utilization of the roof tiles, and the details of the construction processes of the XBT can also be inferred.

CHAPTER 3. Roof Tiles and the Construction of the Qinglong Buddhist Temple

Section 1. The Site of the Qinglong Buddhist Temple and its Roof Tiles

1. The Qinglong Buddhist Temple in Chang'an

The QBT is located in the southeastern part of present-day Xi'an, which was Xinchang Fang near the Yanxing Gate (延興門) during the Tang Dynasty. The temple was first built in 582 AD and was the central temple for Esoteric Buddhism. It was destroyed in the Buddhist Persecution conducted by Emperor Wuzong in 845 AD and rebuilt after the enthronement of Emperor Xuanzong. According to the historical records, the QBT may have existed until the Yuanyou (元祐) Period of the Song Dynasty.

The investigation of the QBT was conducted in 1973 by the Tangcheng Archaeological Team of the Institute of Archaeology, Chinese Academy of Social Sciences. The investigation and excavation for the QBT lasted until 1992 and revealed the basic spatial structure of this temple. The temple consisted of two groups of buildings. The western section had one gate, one tower, one main hall, the attached buildings of the main hall, and porches that surround the other buildings. The eastern part had one main hall and surrounding walls. There were also three kilns in the northeastern part, overlapped by the wall. Moreover, to the northeast of the eastern part, there was a gate, called the Northern Gate in the report (Figure 133).

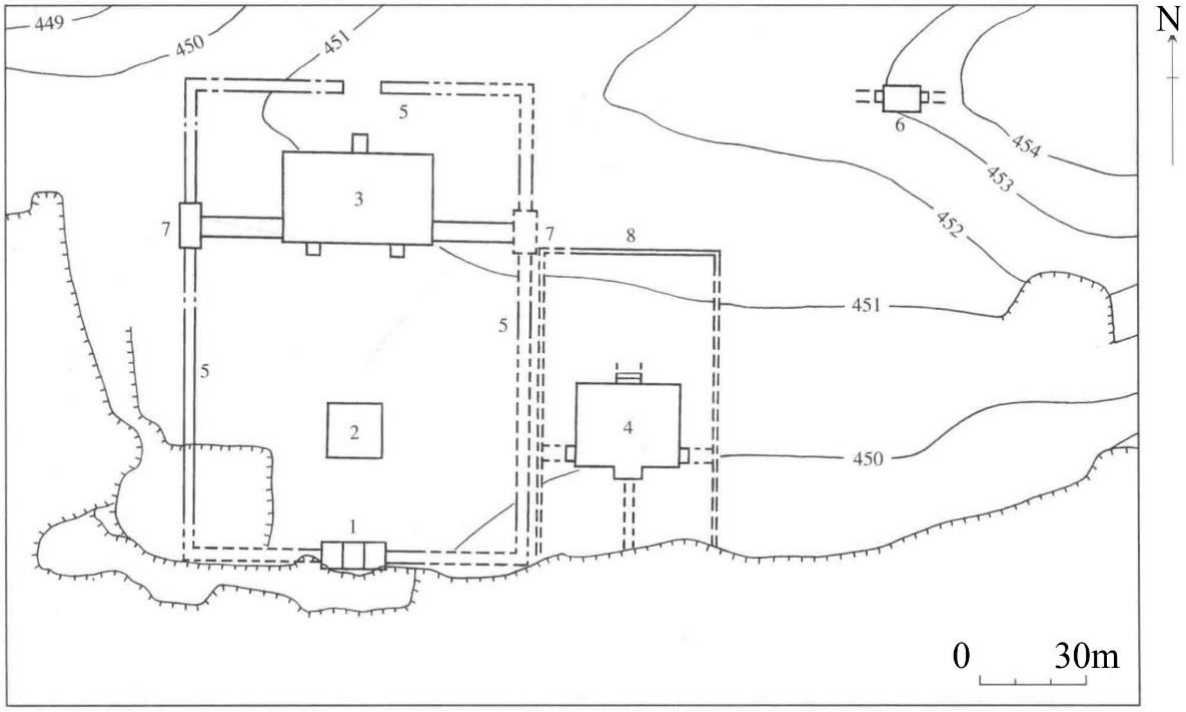


Figure 133 The layout of the QBT
(Source: Zhongguo shehui kexue yuan kaogusuo 2015, Fig. 6)
1. Gate, 2. Tower, 3. Main Hall of the Western Part, 4. Main Hall of the Eastern Part, 5. Porches Surrounding the Western Part, 6. Northern Gate, 7. Attaching Buildings of Western Part, 8. Wall Surrounding the Eastern Part

According to the results of the excavation, the Qionglong Buddhist Temple was constructed twice. All of the buildings had already been built in the earlier period and were destroyed in the middle of the 9th century. Apart from the gate, the tower in the western part, and the northern gate, most of the buildings were rebuilt after the Buddhist Persecution. Archaeological remains were mostly found from layer 3, which were deposits of the building materials used in the reconstruction of the QBT. Very few remains were unearthed from the areas near the tower in the western part or the northern gate, indicating that the land had been completely cleared before the reconstruction of the temple. Therefore, all of the building materials left at the site were made after the Buddhist Persecution (Zhongguo shehui kexueyuan kaogu yanjiusuo Xi'an tangchengdui 2015).

2. Information about the Roof Tiles

2.1 The Roof Tile Samples

There are 46 tegulae, 77 imbrices, and 94 tile-ends samples recorded in the archaeological report, but there are still many broken samples that had not been arranged. To avoid losing information, all of the remains of the QBT were observed and measured, including 70 tegula samples, 141 imbrex samples, 138 samples of tile-ends with lotus patterns, 47 samples of tile-ends with monster patterns, and one roof tile with characters. The standards to choose roof tile samples are listed as below, and samples must meet any one of them: the length, width or thickness of the roof tiles can be measured; special features should remain; the tile-ends with lotus patterns should have at least one unbroken petal,[98] and at least half of the pattern should be visible on the tile-ends with monster patterns.

2.2 The Clay Bodies of the Roof Tiles

The clay bodies of the roof tiles unearthed from the QBT are blue-gray. The texture of the bodies is pure and dense.

2.3 The Exposed Surfaces of the Roof Tiles

The exposed surface points the concave surfaces of the tegulae and convex surfaces of the imbrices, which were laid upward when roof the tiles were installed on the roof. The tegulae used in this temple have two types of surface styles: untrimmed surface and polished-black surface. Meanwhile, the imbrices only have the polished-black surface (Figure 134). Most of the tile-ends

[98] The number of the samples is the maximum number of tile-ends

from this site have polished-black surfaces, which were joined to the polished-black imbrices to make the eave imbrices. The eave tegulae, with double wave-shaped patterns on the lower ends, were also the polished-black type.

Figure 134 The surface of the roof tiles (Source: Photos by the author)
1. Polished-black imbrex, 2. Polished-black tegula, 3. Untrimmed tegula

2.4 The Size of the Roof Tiles

The size of the imbrices is based on the diameter, and the diameter of 139 imbrex samples could be measured. Using the diameter, these samples can be divided into four groups (Figure 135): size 1. 10±1cm, size 2. 12±1cm, size 3. 15±1cm, and size 4. 17±1cm. The size 3 imbrices are the main materials and make up approximately 40 percent of these imbrices.

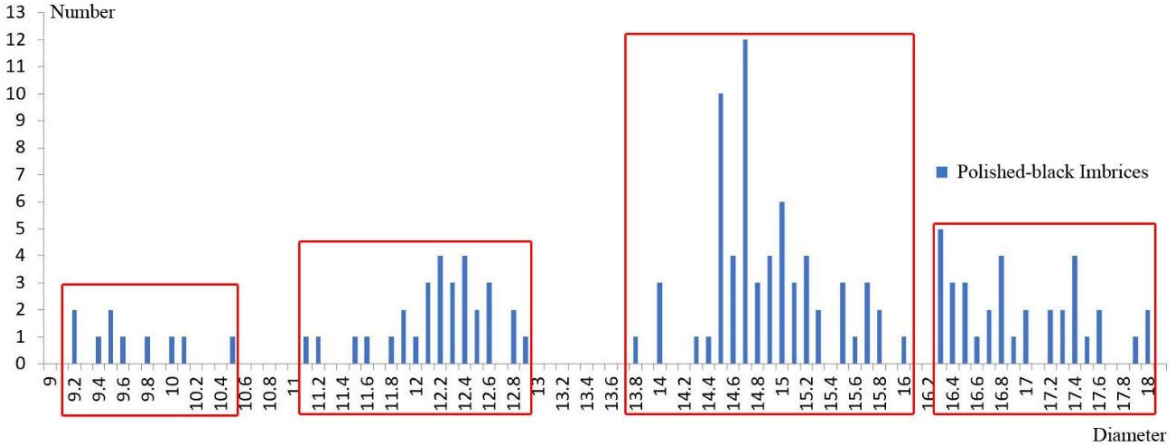


Figure 135 The diameter of the imbrices unearthed from the QBT
(Source: Made by the author)

Of the tile-ends whose diameter or semi diameter could be measured, 77 samples have lotus patterns, and 37 samples have monster patterns. The tile-ends with lotus patterns can be divided into four groups by their diameter (Figure 136): 1. 9.5±0.5cm, 2. 12±1.5cm, 3. 15±1.5cm, and 4. 17.5±0.5cm. These tile-ends can be matched to all of the four groups of the imbrices mentioned above. The monster pattern tile-ends can be divided into two groups by diameter: 10.9–12cm and 14.4–15.6cm. These are similar to the samples with lotus patterns in size 2 and size 3.

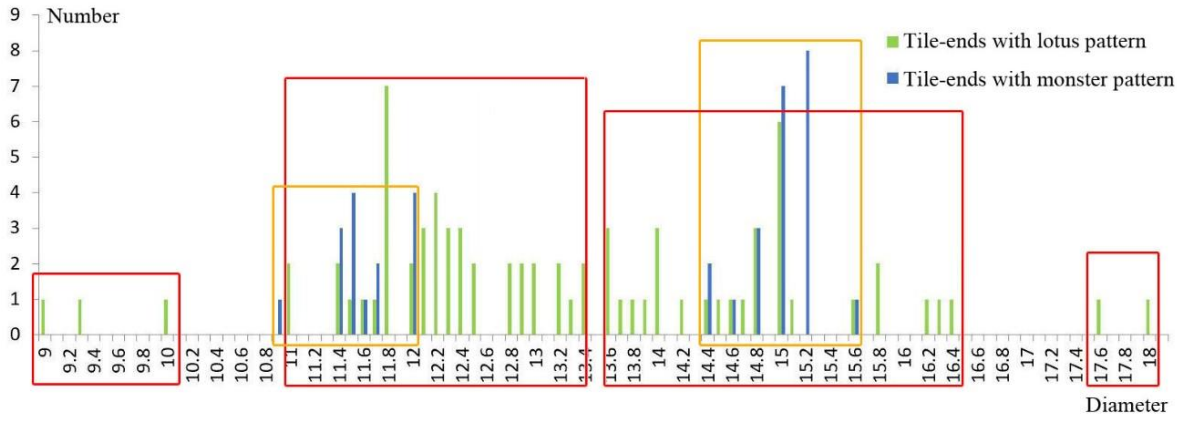


Figure 136 The diameter of the tile-ends from the QBT
(Source: Made by the author)

Only a few samples have a measurable length, including a size 2 sample, whose length is 32.3cm, and two size 3 samples, whose length are 35.8cm and 36.9cm. This demonstrates that the imbrices with a larger diameter are also longer than the others.

There are 68 measurable tegula samples, and most of the data is about the thickness of tegulae. According to Table 61, the polished-black tegulae are somewhat larger than the untrimmed samples, which are approximately 20*42cm^2, and the tegulae with double wave-shaped patterns are usually thicker than the others. Moreover, according to the division of polished-black imbrices, the sizes of polished-black tegulae may also be divided into several groups, but the samples unearthed from the QBT are mostly broken, and the measurable items are limited, so the division of tegulae by size is difficult.

Table 61 The size of the tegulae from the QBT

	length	Width of the lower end	Width of the upper end	Thickness
untrimmed tegulae	41.8-42cm	20-24cm	17-19cm	1.3-2.2cm
polished-black tegulae without pattern	Unknown	21.6-26cm	18.7-25.5cm	1.2-2.7cm
polished-black tegulae with pattern	Unknown	Unknown	Unknown	2-3.1cm

2.5 The Decoration of the Roof Tiles

2.5.1 The Pattern of the Tegulae

The lower ends of the tegulae unearthed from the QBT have two different types: undecorated (Figure 137-1) or decorated with patterns. Most of the decorated samples had double wave-shaped patterns (Type C, Figure 137-4). To make this pattern, the lower end of the tegula were cut into four layers of clay, and then, the second and fourth layer counted from the concave side were finger-pinched to make wave-shaped patterns. Some samples had deformed wave-shaped patterns,

whose lower ends were cut into two or three layers of clay (Type A and Type B, Figure 137-2, 137-3), but only a few of these samples were found at this site.

Figure 137 The pattern on the lower end of the tegulae (Source: Photos by the author) 1. Undeccorated tegula; 2. Tegula with Type A pattern; 2. Tegula with Type B pattern; 3. Tegula with Type C pattern

2.5.2 The Tile-Ends with Lotus Pattern

The imbrices unearthed from the QBT also have two different types. The general imbrices that were laid on the slopes of the roofs are undecorated, while the eave imbrices were joined to the tile-ends that were decorated with lotus patterns or monster patterns. According to the archaeological report, the tile-ends with lotus patterns can be divided into three groups: lotus patterns with simple petals (six types), lotus patterns with compound petals (seven types), and lotus patterns with deformed petals (three types). The number of samples, however, increased in the arrangement, and consequently, it was necessary to analyze and reclassify them. The QBT was the royal Buddhist temple of the Tang Dynasty and was rebuilt after the Buddhist Persecution conducted by Emperor Wuzong, and so the roof tiles used in this temple cannot have been made earlier than the middle of the 9th century. This means that the classification and analysis of the samples from this site are a good case study for roof tiles in the Late Tang.

Similar to the analysis of the tile-ends unearthed from the XBT in the last chapter, the classification of the tile-ends was based on three standards: the sizes, the patterns, and the widths of the edges. The sizes of the roof tiles indicate the position where the tile-ends were laid, which implies the relation between the tile-ends and buildings. According to the previous analysis, tile-ends can be divided into four groups by size: 1. 9.5±0.5cm, 2. 12±1.5cm, 3. 15±1.5cm, and 4. 17.5±0.5cm. Most of the samples are size 2 and size 3 tile-ends.

The patterns on the tile-ends consist of three parts: the central area, petal area, and outer area. Each part can be subdivided into several items, and each item has certain features (Table 40 in Chapter 2, Section 1). According to the features of the patterns, the size 1 tile-ends have one type of pattern with simple petals. The size 2 tile-ends can be divided into 22 types, including nine types of patterns with compound petals and 13 types of patterns with simple petals. The size 3 tile-ends can be divided into 16 types, including five types of patterns with compound petals and 11 types of patterns with simple petals. Lastly, size 4 tile-ends have one type of pattern with simple petals.

The types of edges are presented as the proportion of the edges to diameter. The proportion of the narrowest edge is less than 20 percent of the diameter (edge I). The second level is from 20 percent to 29 percent (edge II), and the third level is from 30 percent to 39 percent (edge III). The proportion of the widest edge is more than 40 percent of the diameter (edge IV).

After the classification, the samples unearthed from the QBTs were divided into 40 types. Some types are closely correlated with each other because their petals, outline, and inter-petals are

similar. According to the classification of the petal area, the tile-ends with simple petals were placed in nine groups, and the tile-ends with compound petals were placed in four groups (Table 62). Furthermore, a strong positive correlation can be found between the features of the petals and the widths of the edges. All 40 types of tile-ends are positioned in Table 63, 64, 65, 66, 67 and 68; the vertical axis is the width of the tile-ends' edges, and the horizontal axis represents the groups of the petals. The analysis of the positive correlation can shed light on the changes in the tile-ends' patterns during the Late Tang. The features of the central area and the outer area did not correlate with the widths of the edges, and so they are used as features for subdivision.

Table 62 The combination of the petals' features

	Inter-petal	Outline	Shape of the petal (semi-petal)	
Compound petals	Have	Thin, round	Small, thin, oval	B
		Thin, round	Fat, raised, oval	C
		Thin, heart shape	Small, thin, oval	D
	_-	Thin, connected, heart shape	Small, thin, oval	F
Simple petals	Have	Thin	Oval	A
		-	Round, a curled end	K
		-	Round	L
		-	Waterdrop shape	M
		-	Thin waterdrop shape	N
	Disappeared; deformed	Thin	Waterdrop shape	F
		Thin; disappeared	Round	G
		-	Waterdrop shape	I
		-	Crescent shape	J

Table 63 The classification and combination of the size 2 tile-ends (compound petals)

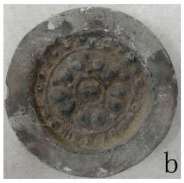
	B	C	D	F
II			 a	 a (II/III)
III	 a	 a  b	 a	 a  b
	 z			0 5cm

Table 64 The classification and combination of the size 3 tile-ends (compound petals)

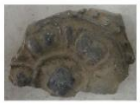
	C	D	F
I		 a	
II	 a		 a
III		 a 0 5cm	 a

Table 65 The classification and combination of the size 1 tile-ends (simple petals)

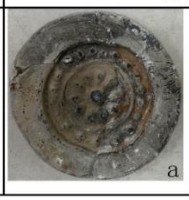
	I
III	

Table 66 The classification and combination of the size 2 tile-ends (simple petals)

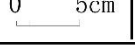
	A	F	I	J	K	L	M
III			(II/III)  				
IV							
				 			

Table 67 The classification and combination of the size 3 tile-ends (simple petals)

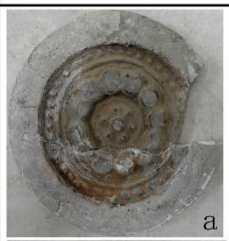
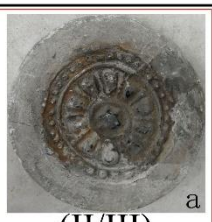
	A	F	G	J	N
III	 a  b (II/III/IV)	 a	 a  b  c (II/III)	 a (III/IV)	 a (II/III)
			 z	0 5cm	 z1  z2

Table 68 The classification and combination of the size 4 tile-ends (simple petals)

	I
	0 1 5cm  z

The classification and combination of the tile-ends in the previous analysis were based on three standards: the sizes, the patterns, and the widths of their edges. These can be summarized as follows:

1. There are more tile-ends with simple petals than tile-ends with compound petals.
2. The edges of the tile-ends with simple petals are usually very wide, and were part of the edge III or edge IV groups, while the edges of the tile-ends with compound petals are comparatively narrow, belonging to the edge II or edge III groups.
3. Most of the tile-ends are size 2 and size 3.
4. Tile-ends with simple petals (Table 69): most of the samples have the petals in group A and group I, and the widths of their edges cover a wide range. For group A samples with a wide edge, the inter-petals and outlines surrounding the petals had already deformed. The group I samples have many different types, and they might be closely related to group F, whose petals are also water-drop-shaped. Moreover, the group G and group L samples have round petals, the group J samples have crescent-shaped petals, and the group N samples have thin oval petals. They demonstrate the features of the tile-ends made in the later period of the Tang Dynasty: the shape of the petals was small and deformed, but the number of petals increased. The standard oval petals, which were usually seen on the tile-ends made during the Early Tang and High Tang, had already been replaced.

Table 69 The relations among the roof tiles' size, edges, and petals (simple petals)

	Size 1	Size 2	Size 3	Size 4
Edge I				
Edge II				
Edge III	I	A、F、I、J、K	A、F、G、J、N	
Edge IV		I、J、L		
Unknown		F、J、M	G、N	I

5. Tile-ends with compound petals (Table 70): the petals of group C were surrounded by round, thin outlines; the petals of group D were surrounded by heart-shaped, thin outlines; and the petals of group F were surrounded by connected, heart-shaped, thin outlines.

These were the most unearthed samples from this site. The outlines surrounding the petals of these samples are all thin raised lines, and some of them have disappeared. The semi-petals and inter-petals of the tile-ends with compound petals also became smaller and more deformed.

Table 70 The relation among the roof tiles' size, edges, and petals (compound petals)

	Size 1	Size 2	Size 3	Size 4
Edge I			D	
Edge II		D、F	C、F	
Edge III		B、C、D、F	D、F	
Unknown		B		

2.5.3 The Tile-Ends with Monster Patterns

Only 47 samples with monster patterns were found at the QBT, which is less than the tile-ends with lotus patterns, but more than the samples found at the XBT. They can be divided into 3 types according to the different designs of the monster's head (Figure 138). Most of the samples belong to Type B (29), which have a monster with round eyes, drooping ears, and a curled beard. There are also a few Type C samples (16), which have a monster with small eyes, upturned ears, and horns, made roughly. The Type A tile-ends were made finely, but only two broken samples were found. Moreover, the edges of these samples are all very wide. The edges in the Type B samples take up 33-42 percent of the diameter, while the edge of the Type C samples is 38-48 percent of the diameter.

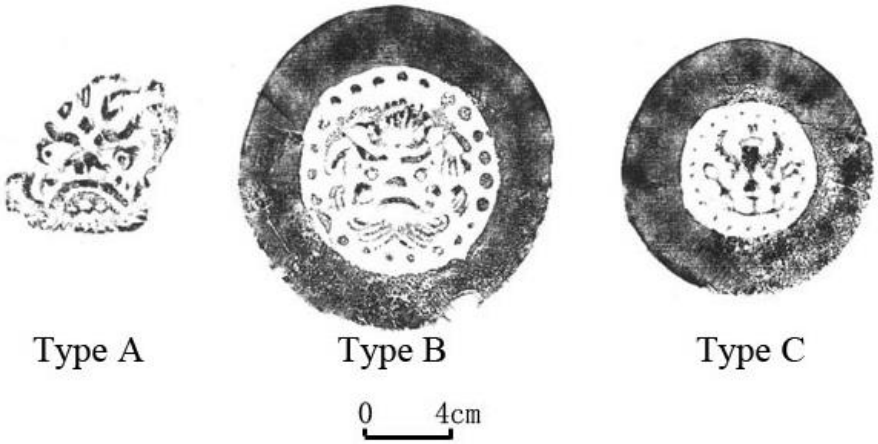


Figure 138 Tile-ends of the monster pattern
(Source: Zhongguo shehui kexue yuan kaogusuo 2015, Fig. 39)

2.6 The Results of the Classification

The classification of the roof tiles unearthed from the QBT is described below (Figure 139, Figure 140).

First, the imbrices and tegulae were distinguished from fragments. Imbrices with tile-ends were used for the eaves, and the samples without tile-ends were general roof tiles for the slope of the roof. Meanwhile, tegulae with patterns on their lower ends are eave tegulae, and undecorated tegulae are also general roof tiles. The sample of ridge tile hasn't been collected.

Second, the samples were subdivided according to their exposed surfaces. The exposed surfaces of the tegulae have two types: untrimmed type and polished-black type. The exposed surfaces of the imbrices are all the polished-black type, and the front surfaces of the tile-ends are mostly polished and blackened.

Third, the samples were subdivided according to their size. The diameter of the polished-black

imbrices has four types: 1. 10±1cm, 2. 12±1cm, 3. 15±1cm, and 4. 17±1cm. The size of untrimmed tegulae is approximately 20*42cm^2, while the polished-black tegulae are somewhat larger than the untrimmed samples. The diameter of the tile-ends is similar to the imbrices, and so they can be joined together.

Last, the roof tiles were subdivided according to their patterns. For the tile-ends of eave imbrices, there are 14 types (four groups) of lotus patterns with compound petals, 26 types (nine groups) of lotus patterns with simple petals, and three types of monster patterns. The lower ends of polished-black eave tegulae were mostly decorated with double wave-shaped patterns, while a few samples have deformed patterns on their lower end.

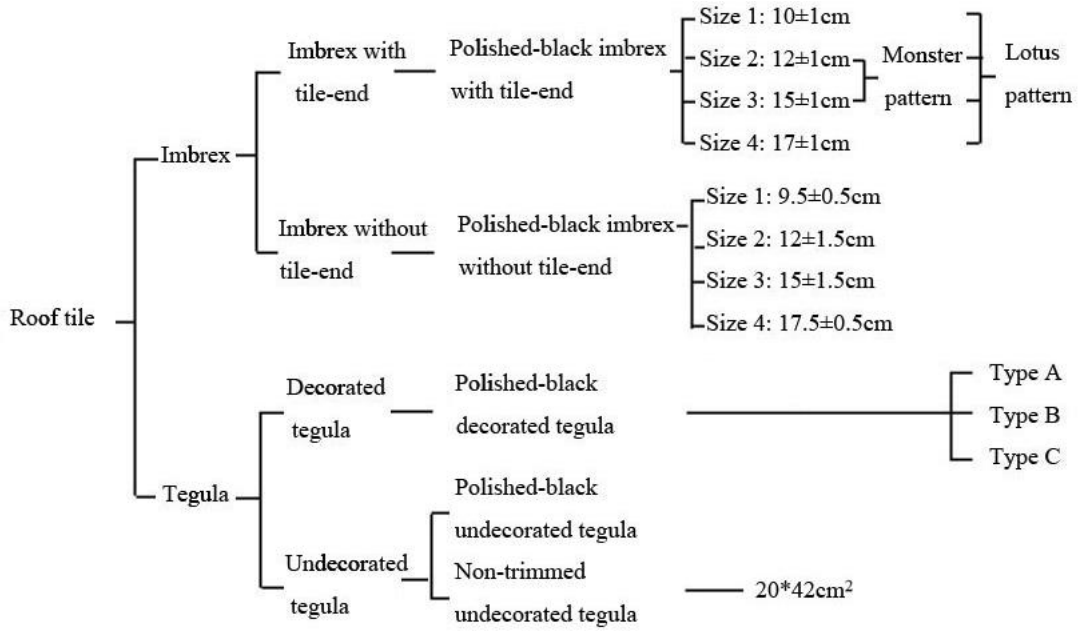


Figure 139 The classification of the roof tiles unearthed from the QBT (Source: Made by the author)

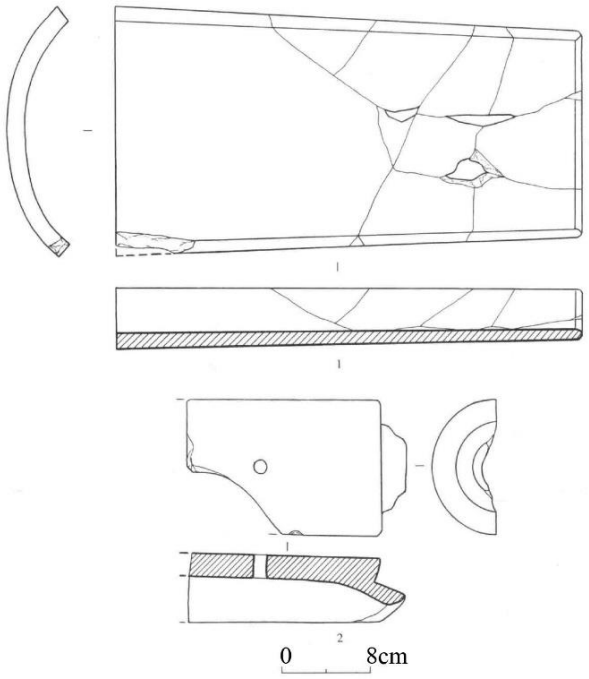


Figure 140 A tegula and imbrex unearthed from the QBT
(Source: Zhongguo shehui kexue yuan kaogusuo 2015, Fig. 31)

Section 2. Traces Left from Production and the Production Process of the Roof Tiles

1. Traces and Production Processes

1.1 Pre-Processing of Raw Materials

The production processes of the roof tiles began with the preparation of clay. By observing the cross-section of the roof tiles unearthed from the QBT, it is clear that the clay used to make these roof tiles is pure, and the texture of the roof tiles is dense, and so the raw materials for the roof tiles must have been carefully elutriated (Figure 141).

Figure 141 The clay from the roof tiles (Source: Photo by the author)

1.2 Shaping

Traces on the concave surface

The main traces on the concave surfaces of the roof tiles that were unearthed from the QBT are fabric impressions. The horizontal joint lines of clay are also evident, indicating that these roof tiles were made using clay-strips, which were twined around molds to form the clay bodies of the roof tiles. There are no obvious narrow vertical impressions on the concave surfaces that were found in the samples from the DBT in Yecheng. Previous studies have argued that the inner molds of the roof tiles in Chang'an may have been integral cylinder-shaped molds and not detachable barrel-shaped molds. The samples unearthed from the QBT verify this theory. (Figure 142)

Figure 142 The concave surface of tegula and imbrex (Source: Photos by the author)

Fabric impressions were found on the concave surfaces of the imbrices and a part of the tegulae.

The polished-black tegulae also have fabric impressions on the corners of their concave surfaces, and these must have been the original traces left from the shaping step. The cloth covers can help the bodies of the roof tiles separate from the molds easily, and the cloth covers were sewn up when they were used on the mold. Two types of seaming traces were found on the concave surfaces of the tegulae: a line of alternating bulges or a line of slanting dents (Figure 143). These are similar to the samples unearthed from Yecheng. Meanwhile, there is no clear seaming trace on the concave surfaces of the imbrices, and only creases from the cloth covers were evident (Figure 144). Cloth covers have been used in the production of the roof tiles since the Han Dynasty.

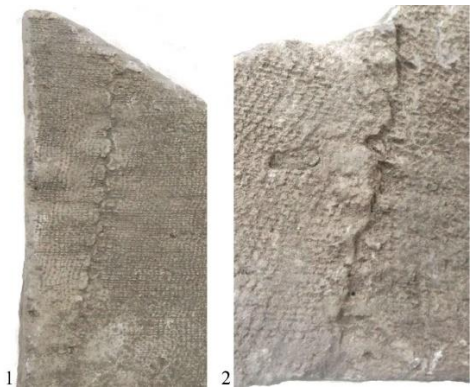


Figure 143 The seaming traces on a concave surface of a tegula
(Source: Photos by the author)
1. A line of alternating bulges; 2. A line of slanting dents

Figure 144 The impressions of cloth covers' creases on the concave surface of an imbrex
(Source: Photo by the author)

Traces from pottery paddles

On the convex surfaces of some roof tiles unearthed from the QBT, were traces of pottery paddles. The traces on the imbrices are rope-shaped, while the traces on the tegulae are diagonal stripe patterns (Figure 145). These traces were left from the shaping step by pottery paddles and should have been erased in the trimming step, but some of them remained on the convex surfaces of imperfect products.

Figure 145 The traces of the pottery paddles on the convex surfaces of the roof tiles (Source: Photos by the author) 1. Imbrex; 2. Tegula

1.3 Trimming

Traces of scraping and smoothing

After the clay bodies of the roof tiles were formed, the convex surfaces of the bodies were still very rough, with many traces left, and these needed to be erased in the trimming step. Apart from the eave type, the convex surfaces of all of the tegulae were simply-scraped, and the upper end was smoothed using hand. Slight parallel traces can be seen on the convex surfaces of the tegulae. Meanwhile, the convex surfaces of all of the imbrices were polished and blackened, so the traces left from the trimming step cannot be observed directly. However, they are likely to be similar to the traces on the convex surfaces of the tegulae.

1.4 Decorating the Lower End of the Tegula

Cutting traces and impressions from fingers or tools

The lower ends of some tegulae unearthed from the DBT were decorated with double wave-shaped patterns (Figure 146). To make double wave-shaped patterns, the lower ends of a tegula were cut into four layers of clay, and then the second and fourth layer from the concave side were finger-pinched or pressed with tools. As the cutting traces and finger or tool impression were found on the lower end of the tegulae, the clay of the tegulae must have been wet and soft when they were decorated. The finger impressions are wide and curled, while the tool impressions are narrow and sharp.

Figure 146 The decoration on the lower end of tegulae (Source: Photos by the author)

1.5 Cutting and Trimming for the Edges

Incisions and fracture surfaces, traces of scraping

The clay bodies of the roof tiles from this site were cut from the inside, so the incisions are on the concave side of the edges. The body of a tegula was divided into four pieces, and the body of an imbrex was divided into two pieces. The edges of most of the roof tiles were not trimmed, and the incisions and fracture surfaces were retained. The edges of some imbrices, however, were

scraped carefully, and the ridgelines on the concave side of the edges had been cut off (Figure 147). These unique imbrices are mostly joined to tile-ends, implying that they were eave imbrices.

Figure 147 Traces on edges (Source: Photos by the author)

1. Incisions and fracture surfaces; 2. Traces of scraping

1.6 Decorating the Lower End of the Imbrices

Radial scratched traces, wide curved traces, and long-scribed lines

There are three types of traces on the back surfaces of the tile-ends (Figure 148). The first types are thin radial scratched traces left on the half-circle of the tile-end, which was joined to the main body of an imbrex directly. This type of trace can be found on the back surfaces of nearly all of the patterns. The second are only found together with monster patterns and have a long-scribed line in the middle of the tile-ends besides the stretched traces. The third are wide, curved traces, which are only found on the back surfaces of a few tile-ends with compound petals. Extra clay was added around the joint of the tile-end and imbrex from both sides, which made the joint more secure.

Figure 148 The traces on the back surface of the tile-ends (Source: Photos by the author)
1. Scratched traces with a long-scribed line; 2. Scratched traces; 3. Curved traces

1.7 Treatment for Exposed Surfaces

Traces of polishing and blackening

The concave surfaces of the tegulae and the convex surfaces of the imbrices are exposed surfaces, which were laid upward on the roof. The exposed surfaces of the roof tiles unearthed from this site were usually polished and blackened. The bodies of the roof tiles were dyed using a black liquid, which was brushed on the concave surface of the tegulae and the convex surface of the imbrices, and polished by thin, stick-like tools. Vertical traces with a width of several millimeters were left on the exposed surface of the roof tiles, which made the texture of the roof tiles dense and glossy. For some tegulae, however, the two sides of the concave surface were not blackened and polished carefully, indicating that the roof tiles produced at this period were comparatively rough (Figure 149).

Figure 149 The traces of polishing and blackening on the concave surface of a tegula (Source: Photo by the author)

2. The Technique Groups of the Roof Tiles

The basic production process of the roof tiles unearthed from the QBT is as follows:

1. Molds wrapped with cloth covers were used in the shaping step. The molds of the tegulae and imbrices may have all been integral molds.
2. Clay-strips were twined around the molds to make the bodies of the roof tiles, and the convex surfaces of roof tile were shaped with pottery paddles, which were bound by rope or had diagonal stripes pattern, and trimmed with a plate.
3. The lower ends of the eave tegulae were decorated with double wave-shaped patterns using fingers or tools before the bodies were cut.
4. The clay body was cut from the inside. The edges of the eave imbrices were scraped, and the ridgelines on the concave side of edges were cut off.
5. The back surfaces of the tile-ends were scratched so that the tile-end and imbrex were joined together firmly.
6. The convex surfaces of the imbrices and the concave surfaces of a part of the tegulae were polished and blackened, and the concave surface of a part of the tegulae retained the

fabric impressions.

7. The clay bodies of the roof tiles were fired in the kilns.

The differences between the polished-black tegulae and untrimmed tegulae in the treatments of their exposed surfaces might imply the existence of two different technique systems. If the untrimmed tegulae were general tegulae, laid on the roof, it is likely that they were made by different artisan group from the group that made the polished-black tegulae. The samples from the untrimmed tegulae, however, are rare, and most of them were found at the kiln sites, and so they may have been unfinished polished-black type or ridge tiles. If the untrimmed tegulae were used as ridge tiles, the differences in the exposed surface is not a distinction in the makers, but a distinction in the function. Meanwhile, it is likely that there were three types of technique systems for the production of the tile-ends, and the traces on the back surfaces of the tile-ends can be divided into three groups: thin radical scratched traces, radical scratched traces with a long scribed line, and wide curved traces. The differences in the traces on the back surfaces correlated with the patterns on the front surfaces of the roof tiles.

Section 3. The Traces of Roof Tiles from the Qinglong Buddhist Temple and the Production Management

1. Traces on the Surfaces of the Tegulae and Imbrices

The traces on the surfaces of the tegulae and imbrices can help us to analyze the organization of the workshop that provided the roof tiles for the QBT. It includes tool traces, such as fabric impressions, and trimming traces, such as scraping traces. This section will focus on roof tiles

unearthed from the architectural sites of this temple, and the samples unearthed from the kiln sites will be discussed in the next section.

Table 71 Traces on the surfaces of the tegulae and imbrices from the QBT

<table>
<tr><th colspan="2">Feature of the roof tiles</th><th>Shaping traces on convex surfaces</th><th>Trimming traces on convex surfaces</th><th>Shaping traces on the concave surface[99] (fabric impressions in 1cm*1cm)</th><th>Trimming traces on concave surfaces</th><th>Traces on edges</th></tr>
<tr><td colspan="2">Undecorated polished-black tegulae</td><td rowspan="2">Unknown</td><td>Scraping traces, smoothing traces</td><td rowspan="2">Some samples retained fabric impressions 7–10/11–15</td><td rowspan="2">Polishing traces</td><td rowspan="2">Untrimmed</td></tr>
<tr><td colspan="2">Polished-black tegulae with double wave-shaped pattern</td><td>Scraping traces, the parts near the lower end were polished</td></tr>
<tr><td colspan="2">Undecorated untrimmed tegulae</td><td rowspan="2">Traces of pottery paddles with diagonal stripe patterns</td><td rowspan="2">Scraping traces, smoothing traces</td><td>7–9/11–16</td><td rowspan="2">Untrimmed</td><td rowspan="2">Untrimmed</td></tr>
<tr><td colspan="2">Untrimmed tegulae with double wave-shaped patterns</td><td>10/16</td></tr>
<tr><td rowspan="3">Polished-black imbrices with tile-ends</td><td>Ss</td><td rowspan="4">Traces of pottery paddles with rope shape patterns</td><td rowspan="4">Polishing traces</td><td>10–12/5–6,6–8/12</td><td rowspan="4">Untrimmed</td><td rowspan="2">Scraping traces, The ridge on the concave side was cut off</td></tr>
<tr><td>S</td><td>9–13/6–10,7–9/12</td></tr>
<tr><td>M</td><td>8–12/6–10,8–12/12–15,13–15/8–11</td></tr>
<tr><td>Polished-black imbrices without tile-ends</td><td>L</td><td>8–12/11–15,12–15/8–10</td><td>Untrimmed</td></tr>
</table>

[99] The roof tiles included eight polished-black tegula samples, 13 untrimmed tegula samples, and 107 polished-black imbrex samples. One sample can be treated as one individual roof tile.

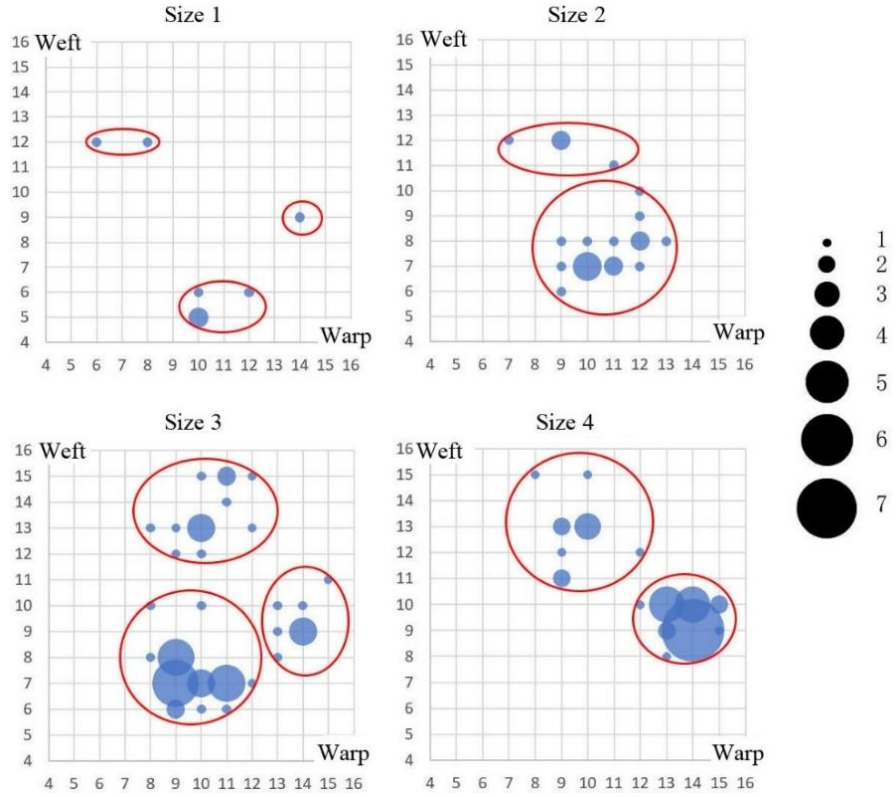


Figure 150 The analysis of the fabric impressions of the roof tiles unearthed from the QBT (1cm*1cm) (Source: Made by the author)

The roof tiles unearthed from the QBT were very high quality, so the tool traces left in the shaping step of the production process were mostly erased. Only several specific traces remained, such as the fabric impressions on the concave surfaces of the imbrices or some tegulae, which were left by the cloth covers wrapping over the inner molds, as well as rope-shaped traces or diagonal stripes-shaped traces left by pottery paddles (Table 71). This section will focus on the fabric impressions to distinguish between the different artisan groups.

For one type of cloth cover, the number of warps and wefts in an area of 1cm*1cm were normally changeless, and this is illustrated by the clustering of the dots on the scatter diagram (Figure 150). By analyzing the scatter diagram of the fabric impressions, the maximum types of cloth covers

can be counted, which indicates the maximum number of artisan groups. For size 3 imbrices, there are three types of cloth covers: 1. 8–12/6–10, 2. 8–12/12–15, and 3. 13–15/8–11. The scatter diagram of the size 1 imbrices is similar to the former sizes. The fabric impressions of the size 2 imbrices belong to cover 1 and cover 2, while the fabric impressions of the size 4 imbrices belong to cover 2 and cover 3. The differences in the cloth covers, which were production tools, can be explained from two points of view. First, they imply the existence of different artisan groups. Second, it demonstrates the changes in the tools used in one artisan group, which means that the production processes of the roof tiles lasted for a long time. Therefore, the maximum number of artisan groups to make the imbrices was three in the workshop of the QBT. The dots of the warps and wefts of the tegulae are concentrated in the scatter diagram, which means that the cloth covers used for the tegulae, including the polished-black tegulae and untrimmed tegulae, were similar. If the untrimmed tegulae were used as ridge tiles, they might have been made by the same artisan group as the polished-black tegulae.

The trimming traces indicate the minimum number of artisan groups, but the trimming traces on the same type of roof tiles are similar. For example, the convex surfaces of all of the tegulae were scrapped completely, slight scraping traces remained, and the convex surfaces of all of the imbrices were polished and blackened. Meanwhile, the differences among some of the samples may have been caused by a difference in their function, such as the concave surface of the polished-black tegulae and the untrimmed tegulae, and not by the artisan who made them. The differences in the edges between the eave imbrices and general imbrices are also related to the differences in their function.

Overall, by analyzing the tool traces and trimming traces, it can be deduced that there were [1–3]

artisan groups to make the imbrices and one artisan group to make the tegulae for the QBT. The differences in the imbrices' fabric impressions are clear, and the proportion of every group is comparatively equal, so the roof tile workshop of the QBT could be subdivided.

2. The Traces of the Tile-Ends

2.1 The Differences in the Molds

In the previous analysis, the tile-ends with lotus patterns were divided into 43 types according to the differences in their design, including 14 types of patterns with compound petals and 26 types of patterns with simple petals. There were also three types of tile-ends decorated with monster patterns. One type of pattern can be subdivided by the differences in the molds, which is evident in the number and position of the pattern items. As the samples unearthed from the QBT were mostly broken, this section will only discuss the differences in the first-level molds.

The Type 2I-IIIb tile-ends (simple petals) can be divided into two groups, which were made by different first-level molds. Both consist of water-drop-shaped petals, a central area with a big knob, and the outer area with raised line and beads. However, the samples made by mold 1 have ten petals, and the samples made by mold 2 have 11 petals. Moreover, the mold 2 samples were rougher than the mold 1 samples. The Type 4I-z tile-ends (simple petals) were also made by two first-level molds that have 10 or 11 petals. It is worth noting that the patterns in group I (simple petals) are similar to each other, regardless of the size of the tile-ends. The differences in the sizes can also be understood as the differences in the first-level molds. Therefore, the samples in group I must have been tile-ends of one design and made by different first-level molds (Figure 151). The Type 2DIIIa tile-ends (compound petals) also have two first-level molds. The samples made by mold 1 have six petals, and the samples made by mold 2 have seven petals (Figure 152).

Meanwhile, the Type 3CIIa (compound petals) and Type 2CIIIa (compound petals) patterns are almost the same, but their sizes and the widths of their edges are different (Figure 153). The setting of the 2AIIIa (simple petals) and 3AIIIa (simple petals) samples is similar to the former (Figure 154).

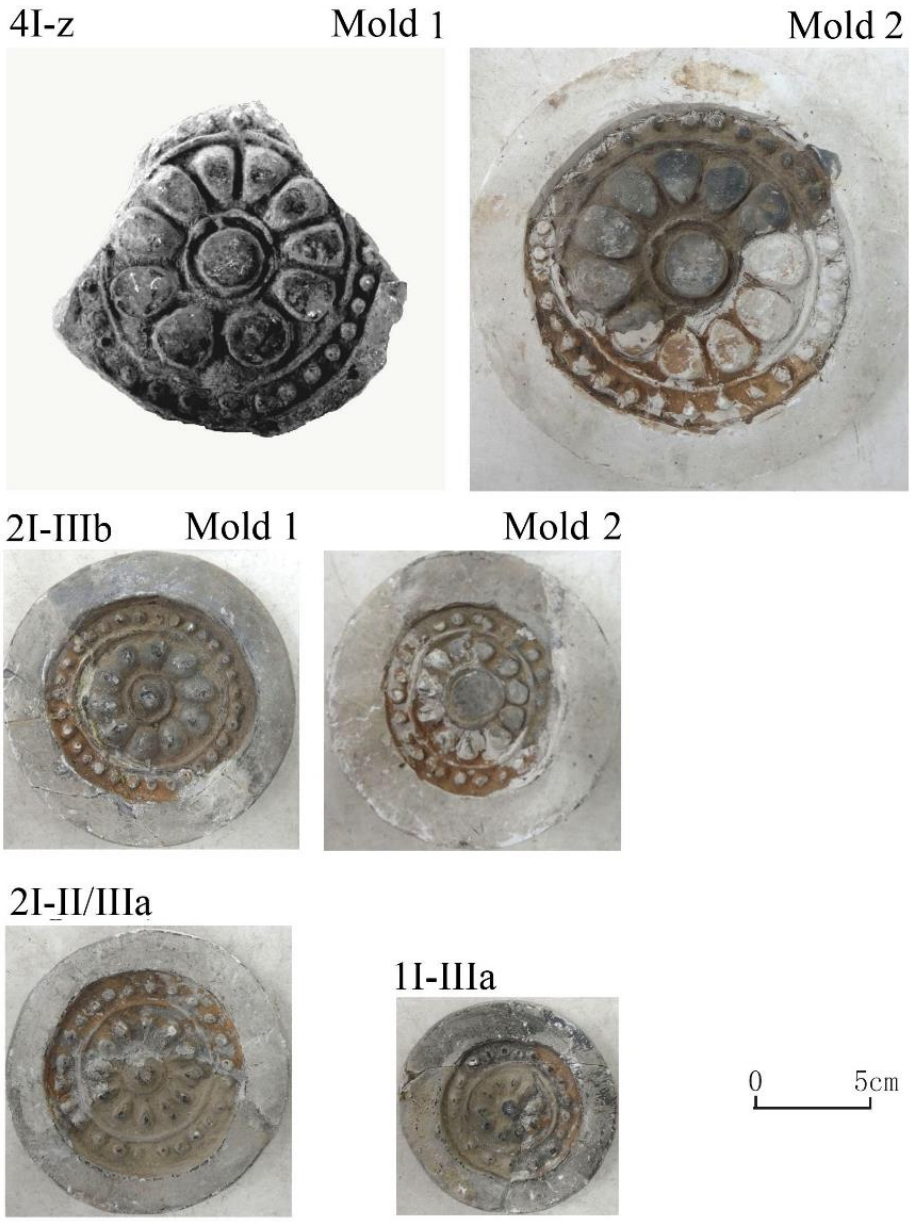


Figure 151 The tile-ends of the same pattern, made by different first-level molds. Group I, compound petals (Source: Photos by the author)

Figure 152 The tile-ends of the same pattern, made by different first-level molds. Group D, compound petals (Source: Photos by the author)

Figure 153 The tile-ends of the same pattern, made by different first-level molds. Group C, compound petals (Source: Photos by the author)

Figure 154 The tile-ends of the same pattern, made by different first-level molds. Group A, simple petals (Source: Photos by the author)

2.2 The Traces on the Back Surfaces of the Tile-Ends

To join the tile-end to the imbrex firmly, the back surface of the tile-end had to be processed in a specific way. There are three types of traces: long and thin radial scratched traces, radial scratched traces with a long-scribed line, and wide curved traces. The long and thin radial scratched traces can be found on the back surfaces of most of the samples, and for some monster pattern samples, there is also a long-scribed line. The wide curved traces were only seen on the back surface of Type 2FII/IIIa (compound petals). These three types of traces show the different production methods to make eave imbrices, which implies the existence of different artisan groups.

3. The Traces of the Roof Tiles and the Management of the Roof Tile Production

According to the tool and trimming traces on the surfaces of the roof tiles, the management of roof tile production at the workshop of the QBT can be reconstructed to a certain extent. Previous analysis have demonstrated that 1–3 artisan groups made the imbrices and one (or two) artisan groups made the tegulae. Moreover, the cloth covers of the tegulae are similar to one type of cloth

cover used for the imbrices

At the QBT, 43 types of tile-ends were found, and among the samples with the same pattern, there are slight differences in the number and position of the pattern items, which were made by different first-level molds. The patterns in group I (simple petals) can be considered as from the same design and made by different first-level molds, but for the other groups of patterns, the number of first-level molds is limited. Moreover, according to the traces on the back surfaces of the tile-ends, at least three artisan groups that made the tile-ends existed in the workshop.

Overall, although the basic technique and processing methods were similar in this workshop, according to the fabric impressions on the concave surfaces of the roof tiles, the artisans who made the imbrices were likely to have been from several groups. The differences in the imbrices' fabric impressions are noticeable, and the proportion of every group is comparatively equal, so the roof tile workshop of the QBT might not have been as unified as the workshops in the earlier periods of the Tang Dynasty. Moreover, the tile-ends from this temple have many patterns, but the number of first-level molds for one pattern is limited, which means that each pattern might have only been used for a short time.

Section 4. The Characters on the Roof Tile in the Qinglong Buddhist Temple

Only one roof tile with characters was unearthed from the QBT. It was found in Trench T801, which was located in the northeastern part of the temple. The characters were stamped on the convex surface of a polished-black tegula, near the upper end. The stamp is a rectangle, 6.4cm in

length and 2.5cm in width. The characters in this stamp are “匠王瑟,” and they were stamped vertically (Figure 155).

Figure 155 The stamped roof tile and its characters unearthed from the QBT (Source: Photo by the author)

A large number of samples were unearthed from the QBT, but only one roof tile with stamped characters was found. It is similar to the setting in the XBT of the Tang Dynasty and different from the setting in Yecheng of the Northern Dynasties. This means that the production management, specifically the supervision method of the artisans, might have changed in the Tang Dynasty. The supervision based on the signatures of the individual artisans might have been replaced by another, more effective method. The artisans with the “匠王瑟” stamp might have been a veteran or instructor in roof tile production.

Section 5. The Kilns and Supplement of Roof Tiles in the Qinglong Buddhist Temple

According to the archaeological reports, there are three kiln sites in the northeastern part of the QBT. The sites are a U-shaped cabin, consisting of a firebox, combustion chamber, firing chamber, and stack. The Y1 and Y2 sites are connected, and the Y3 site is located to the north, overlapped by the northern wall (Figure 156). These sites were likely to have been built earlier than the wall and provided the building materials for the reconstruction of the main buildings in the temple (Zhongguo shehui kexueyuan kaogu yanjiusuo 2016).

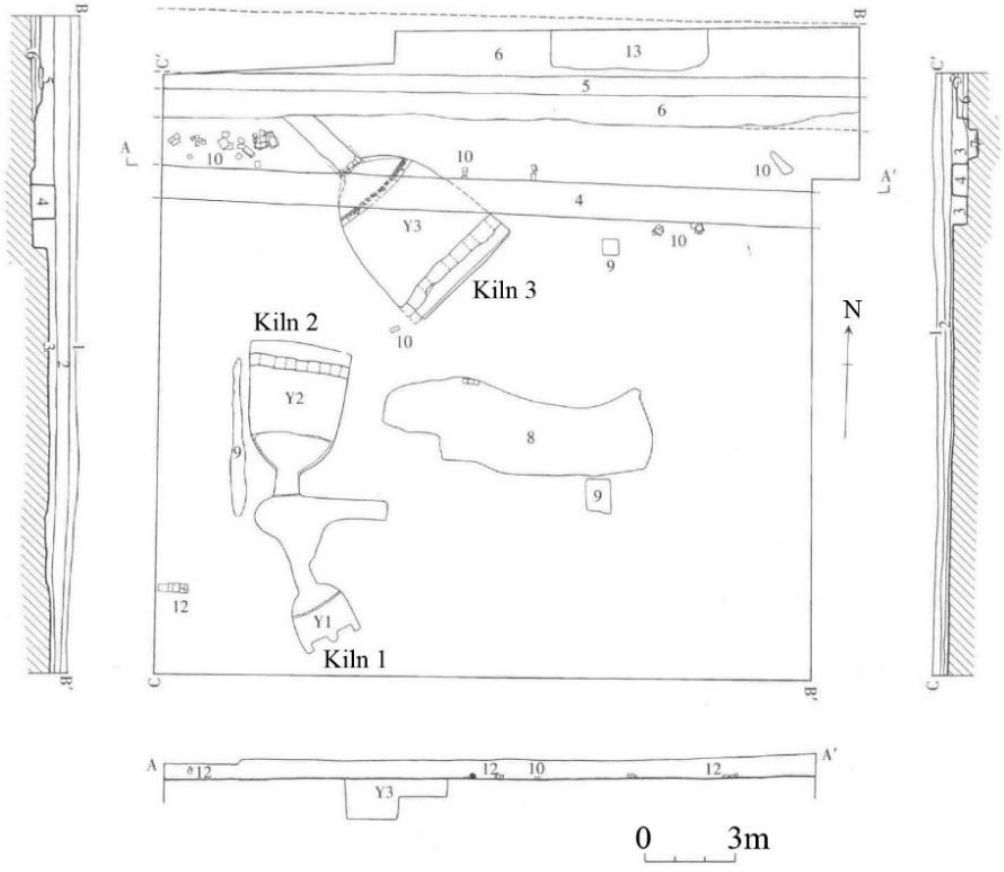


Figure 156 The kiln sites found at the QBT
(Source: Zhongguo shehui kexue yuan kaogusuo 2015, Fig. 20)

From the Y3 site, six tile-end samples were unearthed, including five untrimmed tegulae and one polished-black tegula. As illustrated in Table 72, the production traces on these samples are similar to those unearthed from the architectural sites. This means that the roof tiles laid on the roofs of the buildings were produced by these kilns.

Table 72 The production traces on the surface of the roof tiles unearthed from the kiln sites

Features	Shaping traces on the convex surfaces	Trimming traces on the convex surfaces	Shaping traces on the concave surfaces (fabric impressions, 1cm*1cm)	Trimming traces on the concave surfaces	Traces on the edges
Undecorated untrimmed tegulae	Traces of pottery paddle with diagonal stripe patterns	Scraping traces, smoothing traces	7–9/11–14	Untrimmed	Untrimmed
Undecorated polished-black tegulae	Unknown	Scraping traces, smoothing traces	Unknown	Polishing traces	Untrimmed

In the earlier period of the Tang Dynasty, the kilns for roof tiles and bricks were usually built near land where construction was conducted. In 731 AD, however, Emperor Xuanzong gave an order to forbid roof tile production inside Chang'an City.[100] The three kiln sites found in the QBT, which were built in the middle of the 9th century, indicate that this order was not strictly observed.

[100] *Tang huiyao*: "（開元十九年六月）勅京、洛兩都，是惟帝宅，街衢坊市，固須修築，城内不得穿掘为窯，燒造磚瓦. 其有公私修造，不得於街巷穿坑取土." Wang bo, *Tang huiyao*, vol.86 "street," p. 1575.

Section 6. The Utilization of Roof Tiles in the Qinglong Buddhist Temple

According to the archaeological reports, the deposits of the QBT were slightly disturbed, which means that the distribution of the roof tiles can indicate the original setting of the buildings at this temple. As the fragments in this temple were not collected completely, this section will only discuss the basic regularity of the roof tiles' utilization in the temple.

1. The Size of the Imbrices and their Distribution

According to the previous analysis, the size of the imbrices can be divided into four groups: 1. 10±1cm, 2. 12±1cm, 3. 15±1cm, and 4. 17±1cm. Figure 157 illustrates that the distribution of the different sizes of the imbrices is different, implying a distinction in the utilization of the roof tiles among the different buildings.

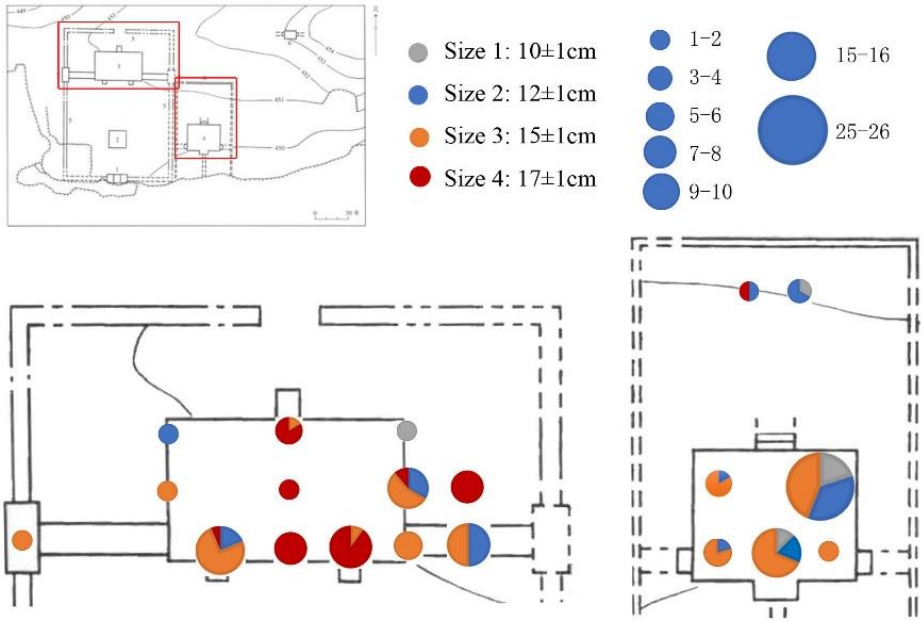


Figure 157 The distribution of the different sizes of the imbrices in the QBT (Source: Made by the author)

It is clear that the size 2 and size 3 imbrices, which were unearthed from both of the two main

hall sites, were used widely in this temple. Meanwhile, the size 1 imbrices were mostly found from the No. 4 Architectural Site in the eastern part, and the size 4 imbrices were unearthed from the No. 3 Architectural Site in the western part. It is likely that for the construction of both of the two main halls of the QBT used three sizes of imbrices, and the imbrices used for the No. 3 Architectural Site were slightly larger than the imbrices used for the No. 4 Architectural Site. Moreover, in the No. 3 Architectural Site, the imbrices found near the entrances were larger than other imbrices.

2. The Patterns of the Tile-Ends and their Distribution

2.1 The Distribution of the Whole Samples of the Tile-Ends

The patterns of the tile-ends unearthed from the QBT can be separated into three groups: lotus patterns with compound petals, lotus patterns with simple petals, and monster patterns. They can also be subdivided into 43 types according to the features of the patterned items. The distribution of different types of tile-ends at the temple can be summarized as follows: [101]

First, the lotus pattern tile-ends with simple petals were unearthed equally from both sites of the two main halls, while the lotus pattern tile-ends with compound petals were mostly found at the No. 3 Architectural Site. The monster pattern tile-ends were concentrated at the No. 4 Architectural Site. Second, at the No. 3 Architectural Site, most of the tile-ends were unearthed from the southern part of the site. In the northern part, only the area near the entrance had a few samples. Meanwhile, for the No. 4 Architectural Site, the tile-ends were found in all areas. Third, there were also some tile-ends unearthed from the kiln sites in the northeastern part of the temple,

[101] As the samples unearthed from the Qinglong Buddhist Temple were mostly broken, this section treated every sample as an individual tile-end, and focused on the distribution of the tile-ends.

including lotus pattern tile-ends with both compound petals and simple petals. This means that these two groups of tile-ends might have been provided by these kilns.

Table 73 illustrates the statistical data of every type of lotus pattern, and because the samples found in the QBT were mostly broken, the data are about the number of unbroken petals. According to this table, Type 2FII/IIIa (compound petals) and Type 3CIIa (compound petals) were the most used patterns in the No. 3 Architectural Site, while the Type 2I-II/IIIa (simple petals) were the main materials used at the No. 4 Architectural Site. They were likely to have been used for the reconstruction process of the QBT, and other types, specifically the edge IV samples, might have been used as repair materials in the later period.

Table 73 The statistical data of different types of tile-ends and their distribution

Patterns	No. 3 site	No. 4 site	Others	Patterns	No. 3 site	No. 4 site	Others
3AIIIa (simple petals)	3-7			3Nz2 (simple petals)	1		
2AIIIa (simple petals)		1		3GIIIc (simple petals)	1-3	1	1
3GIIIa (simple petals)	2			2Fz (simple petals)			1
3GIIIb (simple petals)	1			2Mz (simple petals)			1
3Gz (simple petals)	2-3			2Jz2 (simple petals)		1	
2JIIIa (simple petals)	1			2Jz1 (simple petals)	1		
3AII/III/IVb (simple petals)	2-3			3FIIIa (compound petals)	1-2	1	2
2FIII (simple petals)a	3-4	2		2FIIIa (compound petals)	1		
1I-IIIa (simple petals)		1		2DIIa (compound petals)	1		
4I-z (simple petals)	2			2DIIIa (compound petals)	3-4	3	
2I-IIIb (simple petals)	1		1	3CIIa (compound petals)	5-10		1
2I-II/IIIa (simple petals)		6-12		2CIIIa (compound petals)			1
2I-IVa (simple petals)		2		2CIIIb (compound petals)			1
2JIVa (simple petals)		1		2BIIIa (compound petals)		1	
3JIII/IVa (simple petals)	3-6			3DIa (compound petals)	2-8		
2LIVa (simple petals)	1			2FIIIb (compound petals)	1		
2KIIIa (simple petals)		1		3FIIa (compound petals)	2-4		
3FIIIa (simple petals)		2-4	1	2FII/IIIa (compound petals)	8-12		
3NII/IIIa (simple petals)	1-2	1		3DIIIa (compound petals)	2-6		
3Nz1 (simple petals)	1			2Bz (compound petals)	1		

2.2 The Distribution of the Tile-Ends with Lotus Patterns (Simple Petals)

From the QBT, 26 types of lotus pattern tile-ends with simple petals were unearthed (Figure 158). Most of them were found in the two main halls, and a few samples were in the site of the Northern Gate. It is clear that the design of the tile-ends' patterns is related to their distribution. The samples without outlines were found in both sites, but the samples with raised outlines were mostly unearthed from the No. 3 Architectural Site. This means that the samples with comparatively complicated patterns were usually used for the main hall in the western part of the temple.

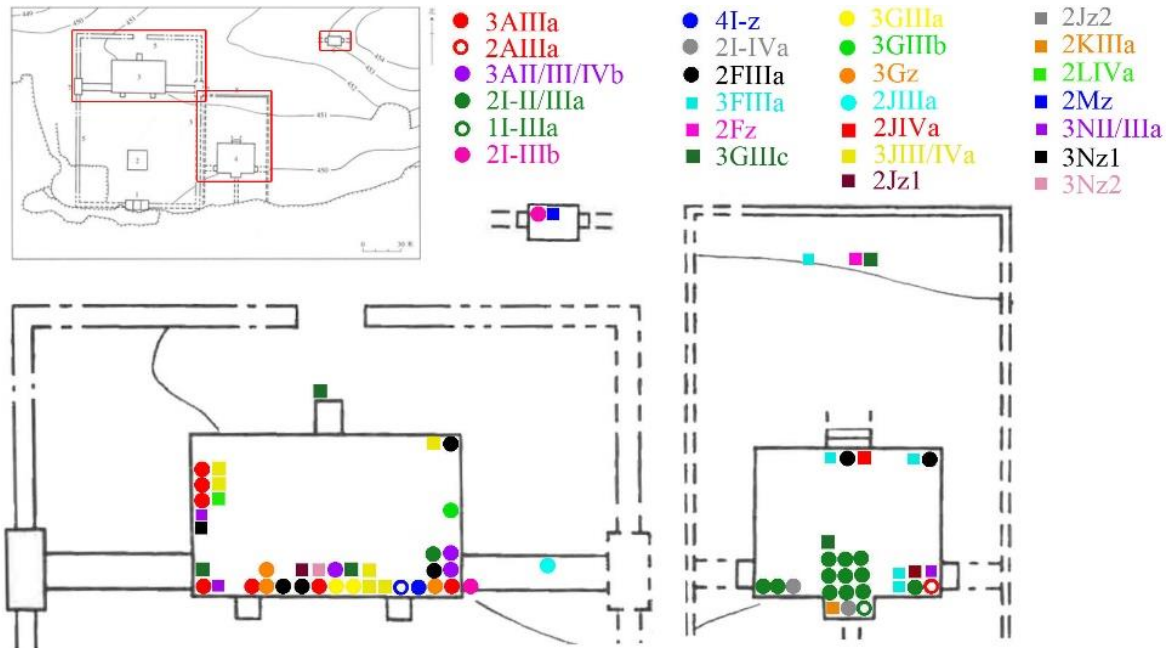


Figure 158 The distribution of the tile-ends with lotus patterns (simple petals) (Source: Made by the author)

2.3 The Distribution of the Tile-Ends with Lotus Patterns (Compound Petals)

From the QBT, 14 types of lotus pattern tile-ends with compound petals were unearthed, and most of these were found at the No. 3 Architectural Site (Figure 159). The tile-ends unearthed from the

No. 3 Architectural Site can be divided into 11 types, and of these, 10 have raised outlines that surround the petals. Meanwhile, only three types of tile-ends were unearthed from the No. 4 Architectural Site, and the most unearthed pattern, Type 2DIIIa (compound petals), have no outlines outside the petals. This proves again that the samples with comparatively complicated patterns were usually used for the main hall in the western part of the temple.

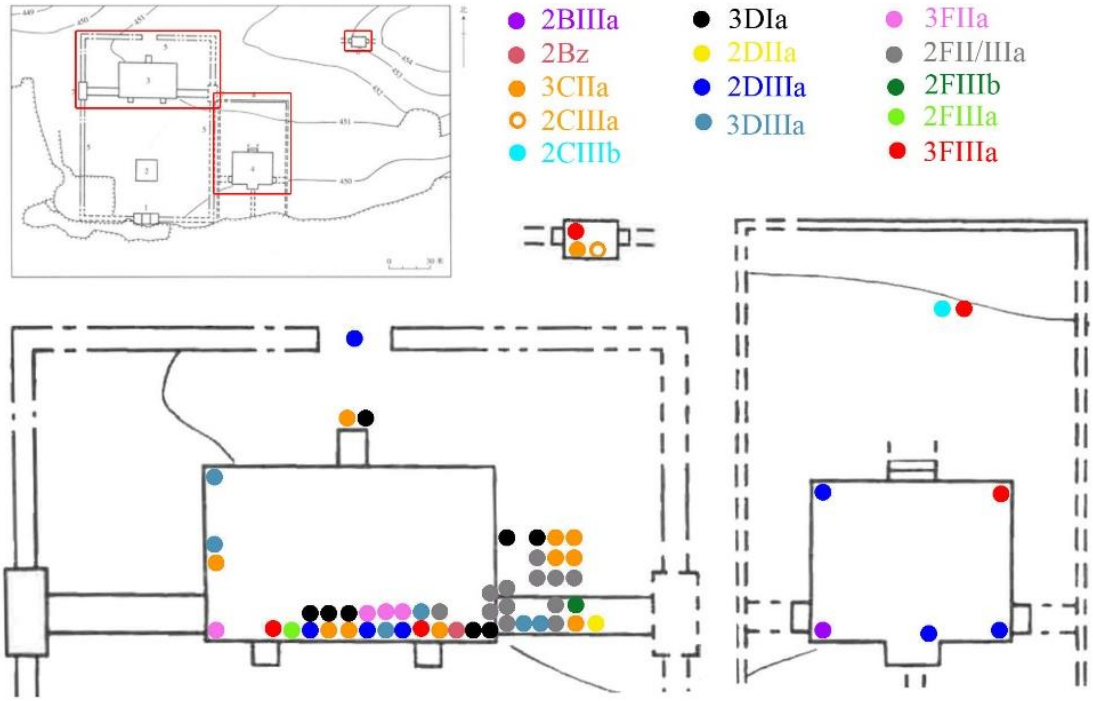


Figure 159 The distribution of the tile-ends with lotus patterns (compound petals) (Source: Made by the author)

2.4 The Distribution of the Tile-Ends with Monster Patterns

At the QBT, three types of the tile-ends decorated with monster patterns were unearthed, but most of them, including Type B and Type C, were found at the No. 4 Architectural Site (Figure 160). Only a few samples were unearthed from the No. 3 Architectural Site, such as the Type A tile-ends, which are the most well-made monster patterns found at this temple.

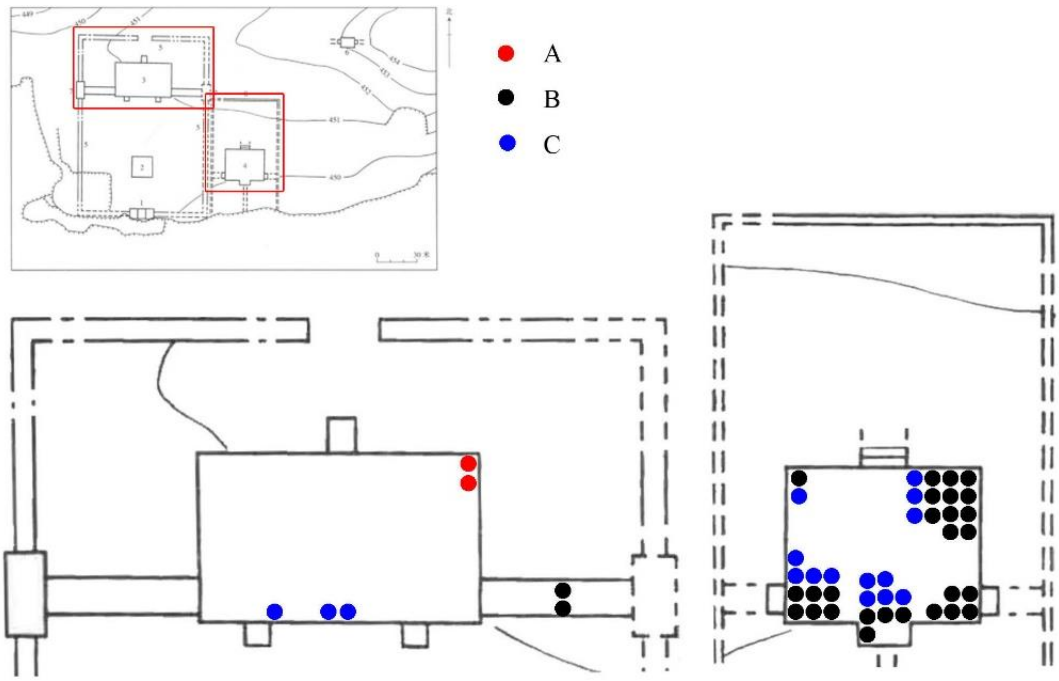


Figure 160 The distribution of the tile-ends with monster patterns
(Source: Made by the author)

3. The Exposed Surfaces of the Tegulae and their Distribution

The tegulae unearthed from the QBT have two types of exposed surfaces: polished-black surface and untrimmed surface. The polished-black tegulae include undecorated tegulae laid on the slopes of the roof and eave tegulae, which were decorated with double wave-shaped patterns, while most of the untrimmed tegulae were undecorated. The polished-black tegulae were unearthed from all areas of the temple, while the untrimmed tegulae were only found in the No. 4 Architectural Site and the kiln sites in the northeastern part of the temple (Figure 161).

It is clear that the polished-black tegulae were the main materials for the reconstruction of the temple, and the untrimmed tegulae found in the kiln sites may have been unfinished polished-black tegulae or ridge tiles. If the untrimmed tegulae were finished products, they might have

been used as tiles for the base of walls according to archaeological reports or repair materials for the No. 4 Architectural Site in the later period.

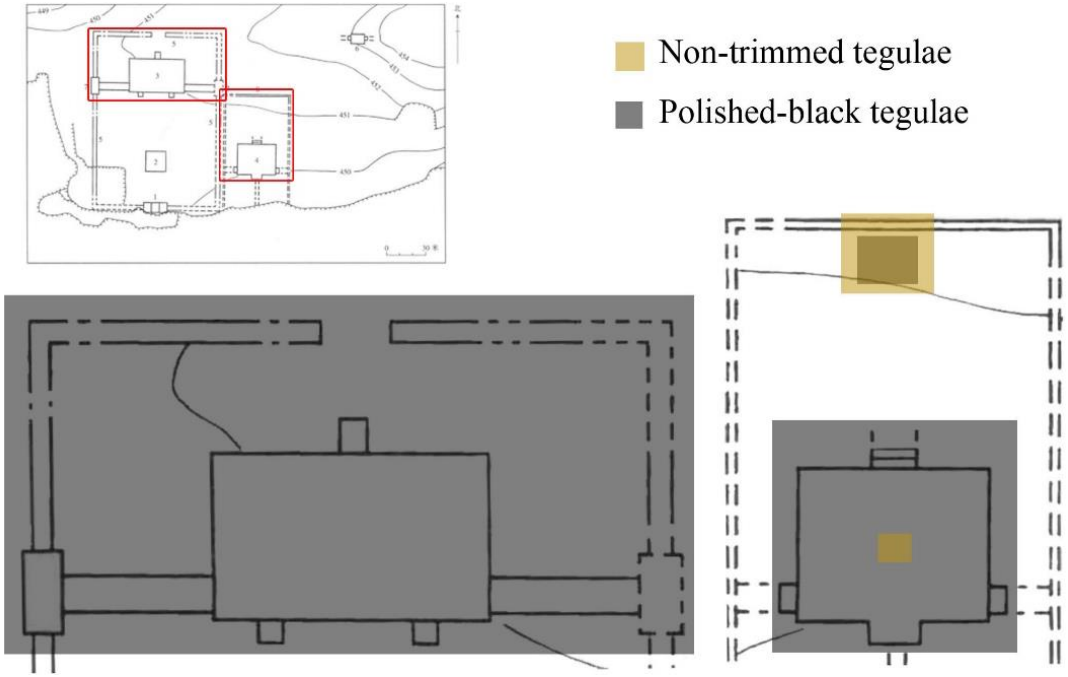


Figure 161 The distribution of the tegulae (Source: Made by the author)

4. The Construction Sequence of the two Main Halls

According to the historical literature, the QBT was destroyed during the Buddhist persecution conducted by Emperor Wuzong in the middle of the 9th century, and it was reconstructed after the enthronement of Emperor Xuanzong. The two main halls were rebuilt in this period, but their construction sequence was not recorded. This can only be deduced from the setting of the unearthed tile-ends.

According to the analysis in the last chapter, at the XBT, the lotus patterns with compound petals appeared earlier than other patterns. Meanwhile, among the lotus patterns with simple petals, the samples with standard oval petals, which were surrounded by raised outlines, were made earlier,

and the samples with small, deformed petals were made later. Moreover, the tile-ends with monster patterns were produced later than the tile-ends with lotus patterns, and their edges usually make up more than 40 percent of the diameter. According to previous studies, the tile-ends with monster patterns unearthed from Luoyang City were used during the Song Dynasty (Chen 2003). Therefore, the samples with monster patterns found at the No. 4 Architectural Site might also be the repair materials used in a later period.

Considering the distribution of the different types of tile-ends, the No. 3 Architectural Site, where the lotus pattern tile-ends with compound petals and lotus pattern tile-ends with standard oval simple petals were unearthed, were reconstructed earlier than the No. 4 Architectural Site, where the lotus pattern tile-ends with small, deformed simple petals and tile-ends with monster patterns were unearthed. The No. 4 Architectural Site may have been used until the Song Dynasty because the tile-ends with monster patterns had already appeared.

In addition, the Type 2FIIIa tile-ends, made by the same second-level mold, were found in both sites of the two main halls, but the samples found at the No. 4 Architectural Site have more mold traces than the samples found at the No. 3 Architectural Site (Figure 162). This means that the tile-ends used at the No. 4 Architectural Site were made later than the samples used at the No. 3 Architectural Site. Therefore, the main hall in the eastern part of the temple must have been built after than the main hall in the western part.

Figure 162 The lotus pattern tile-ends made by the same second-level mold: Type 2FIIIa, simple petals (Source: Photos by the author)

1. Tile-end from the No. 3 Architectural Site; 2. Tile-end from the No. 4 Architectural Site

5. Summary

According to the historical records and the setting of the sites, the QBT was destroyed during the Buddhist Persecution conducted by Emperor Wuzong. Before it was reconstructed in the period of Emperor Xuanzong, the land had been cleared carefully, so the roof tiles unearthed from the temple were mainly reconstruction materials.

The main materials for the QBT are polished-black tegulae, size 2 and size 3 polished-black imbrices, and polished-black tile-ends with lotus patterns, but the roof tiles used in different buildings also have clear differences. Some of the imbrices used in the No. 3 Architectural Site are size 4, while the size 1 imbrices were mostly found at the No. 4 Architectural Site. Moreover, the patterns of the tile-ends found at the No. 3 Architectural Site were mostly lotus patterns with compound petals and simple petals, while the patterns of the tile-ends in the No. 4 Architectural Site were lotus pattern with simple petals and monster pattern. The different patterns of the tile-

ends were used in different periods, so it is clear that the main hall in the eastern part of the temple was rebuilt after the main hall in the western part, but it lasted until the Song Dynasty.

Section 7. Roof Tiles and the Construction Process of the Qinglong Buddhist Temple

Since 1973, the investigation and excavation of the QBT were conducted by the Tangcheng Archaeological Team of the Institute of Archaeology, Chinese Academy of Social Sciences. The result of these works demonstrates that the temple consisted of two groups of buildings. The western part had one gate, one tower, one main hall, attached buildings of the main hall, and porches that surrounded other buildings, while the eastern part had one main hall and surrounding walls. There were also three kilns in the northeastern eastern part, overlapped by the wall. Moreover, to the northeast of the eastern part, there was a gate site. The QBT was destroyed during the Buddhist Persecution conducted by Emperor Wuzong in the middle of the 9th century. Most of the buildings were reconstructed apart from the tower, the gate in the south of the western part, and the Northern Gate. The remains of the roof tiles were mostly unearthed from the deposits of the third layer, and there was few remain found around the buildings of the earlier period, such as the tower. This means that the land had been cleared carefully before reconstruction, and most of the remains were made for the buildings of the later period.

According to the previous analysis, the polished-black roof tiles, including the tegulae, imbrices, and tile-ends, were the main materials used in this temple, while a few untrimmed tegulae were unearthed from the eastern part of the temple. These untrimmed tegulae were unbroken samples,

so they may have been used as general tegulae or may have been cut and used as ridge tiles. The eave tegulae were decorated with double wave-shaped patterns, while eave imbrices have tile-ends on their lower ends. The patterns of the tile-ends can be divided into three groups, including lotus patterns with compound petals, lotus patterns with simple petals, and monster petals, which can also be subdivided into 43 types. Moreover, the imbrices can be separated into four sizes according to their diameter: 1. 10±1cm, 2. 12±1cm, 3. 15±1cm, and 4. 17±1cm. The size of untrimmed tegulae is approximately 20*42cm^2, while the polished-black tegulae are somewhat larger than the untrimmed samples.

The basic technique to produce the polished-black roof tiles at the workshop of the QBT was unified. The production process contained seven steps:

1. The inner molds were wrapped with the cloth covers. It is worth noting that the inner molds are likely to be integral molds because there is no impressed vertical trace on the concave surface of the roof tiles, which is different from the samples found in Yecheng or Luoyang.
2. Clay-strips were twinned around the mold, the clay bodies of the roof tiles were patted with pottery paddles, and their surface was trimmed with a plate.
3. The lower ends of the eave tegulae were decorated before the bodies were divided.
4. The clay body was cut from the inside.
5. The back surface of tile-end was processed to stick the tile-end and imbrex together firmly.
6. The exposed surfaces of the roof tiles were polished and blackened.
7. The roof tiles were fired in the kilns.

More details can be obtained from the surface traces of the roof tiles used in the QBT, which can tell us more about the roof tiles handicraft industry and the construction process of this temple.

According to the previous analysis, 1–3 artisan groups made imbrices in the workshop of the QBT. The differences in the fabric impressions on the concave surfaces of the imbrices is apparent, and the proportion of the samples made by different types of cloth covers is equal, so the maximum number of artisan groups is likely to be an exact number. Meanwhile, the fabric impressions of the polished-black tegulae and untrimmed tegulae are similar. If the untrimmed tegulae were used as ridge tiles, they are likely to have been made by the same artisan group as the polished-black tegulae, but if the untrimmed tegulae were used as general tegulae, they might have been made by different artisan groups. The tile-ends used for this temple have many patterns, but the first-level mold of each pattern is limited. From the traces on the back surfaces, it is also likely that at least three artisan groups made the tile-ends in the workshop, but most of the products were made by the group who left scratched traces on tile-ends' back surfaces. In addition, only one tegula has characters. This means that supervision using the signatures of individual artisans might have been replaced by another, more effective method.

The utilization of the roof tiles in the QBT can also be deduced. By analyzing the distribution of the different types of the roof tiles, it is clear that although the polished-black roof tiles were the main materials for all of the buildings in this temple, the roof tiles used in different buildings had different features. The roof tiles used for the main hall in the western part (No. 3 Architectural Site) included size 2, 3, and 4 polished-black imbrices, polished-black tegulae, and lotus pattern tile-ends. The roof tiles used for the main hall in the eastern part (No. 4 Architectural Site) included size 1, 2, and 3 polished-black imbrices, polished-black tegulae, some untrimmed tegulae, lotus pattern tile-ends with simple petals, and monster pattern tile-ends. The main patterns for the No. 3 Architectural Site are Type 3CIIa (compound petals) and Type 2FII/IIIa (compound petals), and the main pattern for the No. 4 Architectural Site is Type 2I-II/IIIa (simple petals).

According to the analysis of the tile-ends' patterns, the reconstruction of the main hall in the eastern part was conducted after the main hall in the western part, but the main hall in the eastern part lasted a long time.

The roof tiles of the QBT were not completely collected; however, most of the collected roof tiles are typical samples with clear information about their production traces and excavation setting. This information is sufficient for basic analysis of the production and utilization of the roof tiles, and the details about the construction process of the QBT are also considered in this chapter.

CHAPTER 4. The Roof Tiles Unearthed from other Sites in the Sui and Tang Dynasties

According to the previous analysis, there were nearly 120 Buddhist temples in Chang'an during the Sui and Tang Dynasty. In addition to the sites of the QBT and the XBT, these are also several temples and other buildings that were excavated in Chang'an. The information about the remains of the roof tiles unearthed from these sites is limited, so this section will only provide a brief introduction about these sites and their roof tiles

1. The Shiji Buddhist Temple in the Sui Dynasty

In the 1980s, some Buddhist remains, and building materials were unearthed from the campus of the Xibei University, which was in the southwestern corner of Taiping Lifang during the Tang Dynasty. It is argued that the Shiji Buddhist Temple in the Sui Dynasty was called the Wenguo Buddhist Temple during the Tang Dynasty, and the temple may have been destroyed at the end of the Tang Dynasty. According to architectural reports (Li 1988), there were a large number of tile-ends with various lotus patterns unearthed from this temple, and the sizes of these samples are similar to the size 2 and size 3 tile-ends found at the XBT. The samples in Figure 163-1, 163-2, and 163-5 are lotus patterns with compound petals, similar to Type 3DIId (compound petals) and Type 3CIIIa (compound petals) of the XBT. The samples in Figure 163-3 and 163-4 are lotus patterns with simple petals, similar to the tile-ends in Type A (simple petals) found at the XBT.

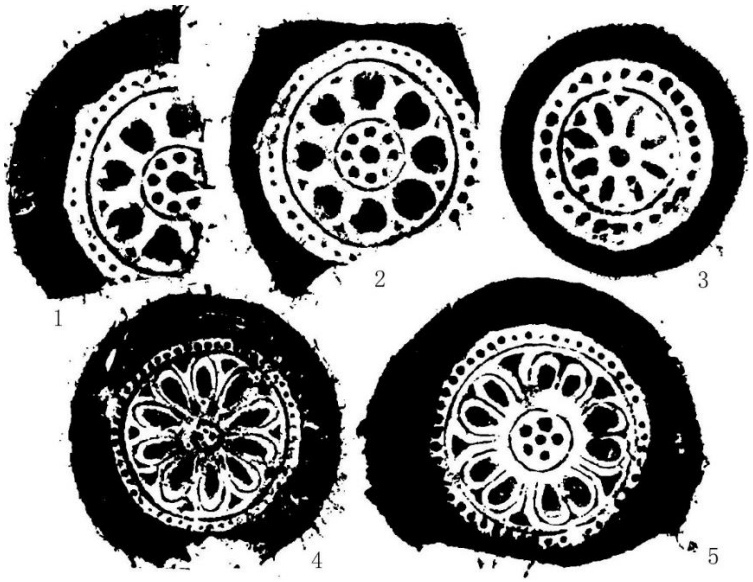


Figure 163 The tile-ends unearthed from the Shiji Buddhist Temple (Source: Li 1988, Fig. 6)

2. The Kiln Site of the Daci'en Buddhist Temple of the Tang Dynasty

The Daci'en Buddhist Temple was located in Jinchang Lifang (晋昌坊) during the Tang Dynasty. The construction process began in 648 AD, and the tower was built in 652 AD. The kiln site for the roof tiles and bricks was to the northwest of the main hall and had three U-shaped chambers. The chamber consisted of a combustion chamber, a firing chamber, and stacks. The remains unearthed from these kiln sites included tegulae, imbrices, tile-ends with lotus patterns, bricks, and production tools, such as molds for tile-ends and stone mills. The tile-ends with lotus patterns are 14.5cm in diameter, and similar to the Type 3DIIe samples (compound petals) in the XBT. The diameter of the mold is 20cm, and the width of the edge is approximately 2cm, so the tile-ends made by this mold are 15–16cm in diameter. The pattern of the mold is unclear, but it may have been a lotus pattern with obvious beads and raised lines in the outer area (Figure 164).

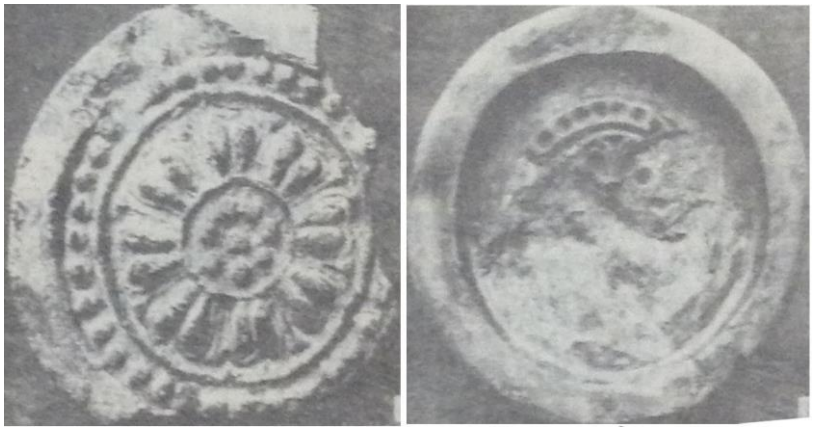


Figure 164 The tile-end and mold unearthed from the Daci'en Buddhist Temple (Source: Han 1986, Fig. 3-3, 3-4)

3. The Jingxing Buddhist Temple in the Tang Dynasty

The Jingxing Buddhist Temple (経行寺), located in Chonghua Lifang (崇化坊) during the Tang Dynasty, was built in 590 AD and lasted at least until 852 AD when its' name changed to the Longxing Buddhist Temple (隆興寺). The remains unearthed from this temple include roof tiles, bricks, porcelain, pottery, glass vessels, and coins.

According to archaeological reports, the tegulae found at this temple are mostly untrimmed type, with fabric impressions on the concave surfaces. The width of the lower end is 20.6cm, and the width of the upper end is 17.5cm. The imbrices have two types: untrimmed type and polished-black type. The diameter of the former is approximately 9.9cm or 13cm, while the diameter of the later is approximately 11cm or 12cm. The main materials for this temple may have been untrimmed types because they have both tegulae and imbrices. There were four types of the tile-ends used in the temple, and these were similar to the Type 3DIIId (compound petals), Type 2AIIIb (simple petals), Type H (simple petals) samples, and the sample of concave lotus petals found at the XBT (Figure 165).

Figure 165 The tile-ends unearthed from the Jingxing Buddhist Temple
(Source: Xibei daxue wenhua yichan yu kaoguxue yanjiu zhongxin 2006, Fig. 1, 2)

4. The Wenshu Pavilion of the Xingshan Buddhist Temple of the Tang Dynasty

The Xingshan Buddhist Temple was located in Jingshan Lifang (靖善坊) to the east of the main street, Zhuque Street. It was built in 582 AD and reconstructed after it was destroyed by fire in 669 AD. Construction of the Wenshu Pavilion of the Xingshan Buddhist Temple began in 773 AD by Bukong (不空), and it was completed in 775 AD. The Xingshan Buddhist Temple has not yet been excavated, but in the reports submitted to the emperor after the construction of the Wenshu Pavilion, the expenditure of the pavilion's construction was carefully recorded.

According to the report, the funds for the construction of Wenshu Pavilion was around 22,487 guans (貫) and 950 wens (文),[102] and this was donated by the royal family or collected by monks. The money was used in two ways; for building materials and labor costs. The cost of the ceramic building materials, such as roof tiles and bricks, was 1,491,170 wens, making up 12 percent of the material costs. It was the third-largest expenditure for the building materials after wood (38%)

[102] 1 guan is 1000 wens.

and metal materials (21%). The labor costs related to ceramic building materials was approximately 9 percent, and the money for transportation was 23 percent of the labor costs.

Three points can be made from the historical records:

1. The roof tiles used for the Wenshu Pavilion may not have been provided by official kilns. They may have been bought from private kilns, and they cost 1,491,170 wens.
2. The money for the ceramic building materials was the third-largest materials cost, while the labor costs for the installation of the ceramic building materials were lower than many items. This means that a large number of ceramic building materials were bought for this building, but the labor costs were not very high.
3. The money for transportation was 23 percent of the labor costs, which indicates that many materials, including the roof tiles, were transported across long distances.

5. The Daming Palace of the Tang Dynasty

The Daming Palace (大明宫) was located in the northern part of Chang'an City. Since the 1950s, investigations have taken place at the Daming Palace, and the main sites, such as Hanyuan Hall (含元殿) and Taiye Pool (太液池), have been excavated since the 1990s. This section will introduce the remains unearthed from the Daming Palace sites.

The Hanyuan Hall consisted of one main hall, two pavilions, one square, and other attached buildings. There are also 21 kiln sites overlapped by the foundation of the main hall. Three types of tegulae were unearthed from this site: polished-black tegulae, glazed tegulae, and untrimmed tegulae. The lengths of the untrimmed tegulae are 41.8–46.5cm, while the widths of the upper ends are 17–21.5cm and the widths of the lower ends are 23.5–26cm. The lengths of the polished-

black tegulae are 41.8–48cm, while the widths of the upper ends are 17–29cm and the widths of the lower ends are 23.5–30cm. The sizes of the glazed tegulae are unclear. The eave tegulae, whose concave surfaces and convex surfaces were all polished and blackened, were decorated with double wave-shaped patterns. The imbrices were either the polished-black type or glazed type. Similar to the samples unearthed from the XBT, the polished-black imbrices can be divided into five groups according to their diameter, and the diameter of the glazed imbrices is approximately 10.5cm. Moreover, the tile-ends are all decorated with lotus patterns, which are also similar to the patterns used for the XBT.

The Taiye Pool was located north of Daming Palace. The remains of building materials unearthed from this area were used for the buildings surrounding the pool. The roof tiles also have two types according to their exposed surface: polished-black type and glazed type. The length of the polished-black tegulae are approximately 42.5cm, and the widths of the upper ends are 22cm, and the widths of the lower ends are approximately 26.5cm. The sizes of the glazed tegulae are unclear. The lower ends of the eave tegulae were decorated with double wave-shaped patterns. The imbrices unearthed from this site also have two types: polished-black type and glazed type. The lengths of polished-black imbrices are 37.8cm or 43.5cm, and their diameters are 13.5cm or 17.2cm. The patterns of the tile-ends are also similar to the samples found at the XBT, and a few samples with monster patterns were unearthed.

The Danfeng Gate (丹鳳門) and the Xing'an Gate (興安門) were south of the Daming Palace, and the Hanyao Gate (含耀門) was in the east. The roof tiles unearthed from these three gates are mostly polished-black type, together with some glazed samples and a few simply-trimmed samples. The length of the imbrices is approximately 35–36cm and their diameters are 15cm.

According to the diameters of the tile-ends, there should also be imbrices with diameters of 9–10cm, 12–13cm, or 19cm. The patterns of the tile-ends are similar to samples found at the XBT.

6. The Xingqing Palace of the Tang Dynasty

The Xingqing Palace, mostly used during the period of Emperor Xuanzong, was in the eastern part of Chang'an City, inside the Chunming Gate (春明門). Only the southwestern corner of the palace was excavated, and a large number of building materials were unearthed. The record of roof tiles from this site in the archaeological reports are very brief, but it is clear that the tile-ends used in the Xingqing Palace were decorated with lotus patterns, which are similar to the samples in the XBT.

7. The Renshou Palace of the Sui Dynasty

The Renshou Palace (仁壽宮) was built in Linyou County (麟遊県) to the west of Chang'an in the Sui Dynasty and was called Jiucheng Palace (九成宮) during the Tang Dynasty. The No. 37 Architectural Site is the foundation of the main hall, and many building materials have been unearthed. According to archaeological reports, most of the tegulae were untrimmed type, with lengths of 50cm and widths of 29.5–32cm. There are also a few polished-black tegulae with lengths of 44.5cm and widths of 24–29cm. The patterns on the lower ends of the eave tegulae are double wave-shaped patterns. Meanwhile, the imbrices can also be divided into two groups: simply-trimmed imbrices and polished-black imbrices. The diameters of the imbrices are approximately 13cm, 14–15cm, or under 10cm. The tile-ends were all decorated with lotus patterns, and some are similar to the samples from the earlier period of the XBT.

8. The Yuanqiu Site of the Sui and Tang Dynasty

The Yuanqiu Site (圜丘) was a building used for rituals during the Sui and Tang Dynasty. It consisted of a round foundation, made of several layers of rammed-earth, and several buildings. The remains unearthed from this site include polished-black imbrices and untrimmed tegulae. The patterns on the lower ends of the eave tegulae are triple wave-shaped patterns, and the lower ends of the eave imbrices were decorated with lotus patterns.

9. The Mingde Gate of the Sui and Tang Dynasty

The Mingde Gate (明德門) was the main gate in south Chang'an. According to the archaeological reports, the roof tiles used in this site are mostly polished-black type, similar to the samples found in the Daming Palace.

CHAPTER 5. The Construction Project of the Royal Buddhist Temples during the Sui and Tang Dynasties from the Viewpoint of Roof Tiles

In previous chapters, the roof tiles unearthed from the XBT and the QBT in Chang'an were systematically arranged and analyzed. Information on the roof tiles' classification, production traces, and unearthed positions are the foundation for the analysis of the production and utilization of the roof tiles, as well as the construction process of these temples. Based on the results from previous analysis and literature records, this chapter will discuss the construction project of the royal Buddhist temples during the Sui and Tang Dynasties and analyze the related historical background.

1. The Development of the Roof Tiles' Style and Inheriting the Production Technique

The roof tiles used in the XBT and the QBT inherited the basic styles of the roof tiles from the Northern Dynasties, such as the polished-black surfaces and the double wave-shaped patterns on the lower ends of the eave tegulae. Compared to the samples from the earlier period, however, the roof tiles made during the Sui and Tang Dynasties have distinct features. For example, the style and number of glazed roof tiles increased. Moreover, different to the tile-ends used in the Northern Qi Dynasty, which were mostly lotus patterns with simple petals, the tile-ends made in the Sui and Tang Dynasties can be divided into two groups: lotus patterns with compound petals and lotus patterns with simple petals. Various styles of lotus patterns were created, and according to the features of the patterns, the widths of the edges, and the sizes of the tile-ends, the lotus patterns tile-ends unearthed from the XBT can be separated into 87 types, while the samples from the QBT have 40 types.

As the widths of the tile-ends' edge can indicate the production period of the samples to a certain extent, the changes in the tile-ends' patterns can be analyzed. It is clear that the lotus patterns with compound petals in the two temples belong to six groups, and the patterns changed from oval semi-petals with clear, raised outlines and sharp inter-petals to small semi-petals with deformed outlines and inter-petals. For some samples from the later period, the raised outlines surrounding the petals had already disappeared. Meanwhile, the lotus patterns with simple petals belong to 14 groups, and the patterns changed from standard oval petals surrounded by raised outlines to many small-deformed petals. Overall, in the Tang Dynasty, the patterns with compound petals decreased, and the simple petal patterns increased. There were more roof tiles of lotus patterns with simple petals used in the QBT, which was rebuilt in the Late Tang period. The tile-ends with monster patterns appeared in the Five Dynasties and Ten Kingdoms Period or the Song Dynasty. The tile-ends with monster patterns used for the No. 4 Architectural Site in the QBT illustrate that the building may have lasted until the Song Dynasty.

The production techniques of the roof tiles used in the workshops of the XBT and QBT in the Sui-Tang Dynasties, especially the techniques for the polished-black roof tiles, were mostly inherited from Luoyang and Yecheng in the Northern Dynasties. The production process can be divided into seven steps:

1. Molds wrapped with cloth covers were used in the shaping step. The molds for both the tegulae and imbrices may have been integral wooden molds. The cloth covers were used to separate the clay bodies of the roof tiles from the molds.
2. Clay-strips were twined around the mold to make the clay body of the roof tile, and the convex surface of the roof tile was shaped with pottery paddles and trimmed with a plate.
3. The lower ends of the eave tegulae were decorated with double wave-shaped patterns before

the clay bodies were divided.

4. The clay body was cut from the inside, and the edges of the eave tiles were trimmed.
5. The molds of the tile-ends have two levels, and the second-level molds were used to make tile-ends directly, and the back surface of the tile-ends was processed to join the tile-end and imbrex together firmly.
6. The convex surface of most imbrices and the concave surface of a part of the tegulae were polished and blackened; some tegulae retained fabric impressions on their concave surfaces, and they may have been used as ridge tiles.
7. The roof tiles were fired in the kilns.

There are several differences between the roof tiles of the Sui-Tang Dynasties and the Northern Dynasties. For example, the molds of the tegulae in the Sui-Tang Dynasties seem to be integral wooden molds, but the molds of the tegulae in the earlier period consisted of several narrow wooden strips. Moreover, the first-level molds for one pattern in the Sui-Tang Dynasties were less than the first-level molds for one pattern in the Northern Dynasties. The tile-ends made in the Sui-Tang Dynasties have two types of traces on their back surface: thin scratched traces and wide curved traces. The former was usually made together with the simple petals, which were the main tile-ends used in Yecheng during the Northern Qi Dynasty, while the latter was only found on the back surfaces of the tile-ends with compound petals. The differences in the production traces imply that the tile-ends with different petals may have been made by different artisan groups. In the Late Tang period, the samples with simple petals increased, demonstrating that the power of the relevant artisan group became stronger. As a result, the thin radical scratched traces were even found on the back surfaces of the tile-ends with the compound petals. The techniques to make the glazed roof tiles were part of another technique system. They have different fabric impressions

and were made using different methods for the surface trimming and firing steps.

2. The Management of the Roof Tile Production during the Sui and Tang Dynasties

2.1 The Formation of Roof Tile Workshops

According to the previous analysis, the roof tile workshops during this period changed from a unified structure to a separable structure. The workshops of the XBT mainly operated during the middle of the 7th century. Although there were two technique systems, producing polished-black roof tiles and glazed roof tiles, most of the roof tiles used in the temple were the polished-black type, and they were made by the same artisan group. This means that the roof tile workshop in the XBT was unified. Nearly all of the roof tiles used at the QBT belonged to the polished-black roof tiles technique system, but the fabric impressions on the concave surfaces of the imbrices can be divided into several groups. Moreover, the distinction of the imbrices' fabric impressions is clear, and the proportion of every group is comparatively equal. This means that there may have been several artisan groups in the roof tile workshops of the QBT, which was operating in the middle of the 9th century.

One sample with the character "宮" was unearthed from the XBT, and this character means that the roof tile workshop of the XBT belonged to the system of royal workshops. It would have been controlled by governement, and so the artisans would have been comparatively unified. According to historical records, however, the roof tiles used for the Wenshu Pavilion of the Xingshan Buddhist Temple, which was built in the 8th century, may have been bought from private kilns, and not provided by official kilns. This means that the system of official workshops had declined in the period of the Middle Tang. Therefore, the artisans who made roof tiles for the QBT may have belonged to different groups.

2.2 The Roof Tiles with Characters Unearthed from Chang'an and its Neighboring Areas

As mentioned above, one sample with the character "宮" was unearthed from the XBT. In addition, another sample with the characters "匠王瑟" was found in the QBT. The character "宮" identifies the affiliation of the workshop, while the characters "匠王瑟" may have been the symbols of a technique instructor at the workshop. It is clear that fewer roof tiles with characters were unearthed from the sites of the Sui and Tang Dynasties than during the Northern Dynasties, and the content of the characters changed.

Almost 300 roof tiles with stamped characters were found in Chang'an and its neighboring areas,[103] and the information of 226 roof tiles has been published. This was less than the samples found in one site from the Northern Dynasties. For example, 522 roof tiles with characters were unearthed from the No. 5 Architectural Site of the DBT in Yecheng. The published samples belong to 104 types, and the content of the characters can be divided into four parts: name, date, construction site, and production institution. The part of the name usually appears together with the characters "匠" and "官匠" or the characters of the artisans' hometown, such as "官匠楊神" and "洛州賈伽." Meanwhile, the date is often made together with the characters of the construction sites and production institutions, such as "玄武天寶五月官瓦" or "城東內作官瓦." Moreover, the roof tiles with the characters of the name were usually used for the buildings of the Sui Dynasty or the period of the Early Tang, while the roof tiles with characters of construction sites or production workshops were found in the buildings built after the Tianbao Period (天宝; Gong 2006b)

[103] This includes the Daming Palace, Xingqing Palace, Huaqing Palace, Renshou Palace, Danfeng Gate, Mingde Gate, Qinglong Buddhist Temple, Ximing Buddhist Temple, and Yuanqiu.

Overall, roof tiles with stamped characters found in Chang'an and its neighboring areas have three features. First, all of the characters were stamped. Second, the samples with name characters were usually made together with "官匠" characters. Third, apart from the characters of the artisans' name, the characters about the date and production institution or the place of construction sites were also found, but the latter appeared in the Tianbao Period of the Middle Tang.

2.3 The Status of the Artisans and Supervision in the Roof Tile Production

Previous analysis demonstrated that the artisans who worked in the roof tile workshops in Yecheng during the Eastern Wei and Northern Qi Dynasties were ordinary citizens who had to provide unpaid services for official workshops and pay land rent to the government. The artisans were also ordinary citizens during the Sui and Tang Dynasties. According to decrees made in 737 AD, recorded in the *Tiansheng ling*, the artisans had to work 20 days in a year; if the artisans worked overtime, their land rent was reduced.[104] This meant that the artisans also had to pay land rent, and so they were farmers with handicraft skills. They were very different from the artisans in the earlier period of the Northern Dynasties, who had to work full time in the workshop but did not pay land rent. The changes in the artisans' status also meant that the supervision of roof tile production changed.

In the Sui and Tang Dynasties, the artisans were divided into two groups; some were skilled artisans, and many were ordinary artisans. The stamps of the skilled artisans may have been

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[104] *Tianyigecang mingchaoben tianshengling jiaozheng, fu tangling fuyuan yanjiu (shangce)*: "諸丁匠歲役功上十日，有閏之年加二日. 須留役者，滿十五日免調，三十日租調俱免. " Tianyige bowuguan, Zhongguo shehui kexueyuan lishi yanjiusuo tianshengling zhengli ketizu, *Tianyigecang mingchaoben tianshengling jiaozheng, fu tangling fuyuan yanjiu (shangce)*, vol.22, pp. 64.

indicated by the character "官匠," and the artisans were not allowed to replace the service with money[105]. Meanwhile, ordinary artisans arrived from different counties, and their stamps were likely to have characters from their hometown. In addition, they were allowed to replace the service with money.

After the period of the Middle Tang, the content of the characters changed completely. The characters of the artisans' name disappeared, and the characters of the construction sites and production workshops increased. This implies that the management of the roof tile production based on the responsibility of the individual artisans had changed into management based on the whole workshop.

The roof tile workshop of the XBT in the period of the Early Tang was unified, with most of the roof tiles made with the same methods and same tools. The roof tile workshop of the QBT in the period of the Late Tang was not as unified as before. For example, the artisans who made imbrices may have belonged to three groups. This means that the roof tile workshop in the Sui and Tang Dynasties had become more separable.

According to the historical records, the roof tiles used for the Wenshu Pavilion of the Xingshan Buddhist Temple were not provided by official kilns. The money to buy the roof tiles and bricks took up 12 percent of the expenditure for the building materials. This means that at least in the later period of the 8th century, the commercial production of the roof tiles had been comparatively developed.

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[105] *Tang liudian*: "其巧手供内者，不得納資." Li linfu, *Tang liudian*, vol.7, p.222.

Overall, the handicraft industry of the roof tiles during the Sui and Tang Dynasty inherited many features from roof tile production of the Eastern Wei and Northern Qi Dynasties; for example, most of the artisans in the Sui and Tang Dynasties were ordinary citizens, which was similar to the setting in the earlier period. The formation of the workshops during the Sui and Tang Dynasties, however, became more separable, which means that the unified official workshop declined gradually. Different from the handicraft industry of luxuries such as lacquerware and golden ware, the production of the roof tiles required less technique, but the demand for the roof tiles was higher. Therefore, the handicraft industry of the roof tiles during the Sui and Tang Dynasties became more complicated. The skilled artisans were separated from ordinary artisans, and the commercial production of the roof tiles became an important supplement for the declining official workshops.

3. The Usage of the Roof Tiles and the Construction of Temples

3.1 The Style of the Roof Tiles and Construction

The styles of the roof tiles are determined by their exposed surfaces, sizes, and patterns. Most of the roof tiles unearthed from the buildings of the Sui and Tang Dynasties have polished-black surfaces, so the classification of the roof tiles is based on size and pattern. For example, the imbrices found in the QBT can be divided into four groups by diameter, and the imbrices from the No. 3 Architectural Sites are larger than the imbrices from the No. 4 Architectural Site. In addition, the imbrices found in the XBT can also be divided into four groups by diameter, and the imbrices unearthed from the No. 1 Architectural Sites are larger than the imbrices from the No. 2 Architectural Site. The buildings that used the larger roof tiles must have been built on a larger scale, and subsequently, they were more important buildings.

The tile-ends used for the buildings of the Sui and Tang Dynasties can be divided into three basic groups: lotus pattern tile-ends with compound petals, lotus pattern tile-ends with simple petals, and tile-ends with monster patterns. The tile-ends laid on the roofs of different buildings have different features. In the QBT, the tile-ends unearthed from the No. 3 Architectural Site were decorated with lotus patterns with compound petals and simple petals, while the tile-ends from the No. 4 Architectural Site were decorated with lotus patterns with simple petals and monster patterns. In the XBT, the lotus pattern tile-ends with compound petals were mostly used.

3.2 The Production Sequence of the Roof Tiles and Construction

According to the archaeological reports, the QBT was once built during the Sui Dynasty, but it was destroyed during the Buddhist Persecution conducted by Emperor Wuzong in the middle of the 9th century. In the reconstruction process of this temple, only the two main halls and their attached buildings were rebuilt. Considering the distribution of different types of tile-ends, the construction sequence between the two main halls can be conjectured to a certain degree. In the No. 3 Architectural Site, the lotus pattern tile-ends with compound petals and the lotus patterns tile-ends with standard oval simple petals were unearthed, while in the No. 4 Architectural Site, the lotus patterns tile-ends with small-deformed simple petals and the tile-ends with monster patterns were unearthed. The analysis of the tile-ends' patterns demonstrate that the tile-ends used for the main hall of the western part were made earlier than the main hall of the eastern part, so the main hall in the western part of the temple must have been rebuilt earlier. Moreover, the main hall of the eastern part may have been used until the Song Dynasty because that is when the tile-ends with monster patterns appeared.

The construction sequence of the XBT is not clear. The excavated part of this temple includes three main halls, attached buildings, and small courtyards in the south. According to the previous analysis of the tile-ends, a large proportion of the tile-ends unearthed from this temple were made before the 8th century. It is likely that they are the building materials used in the construction process of the temple in the middle of the 7th century. This means that the temple had not been destroyed or rebuilt after the construction. A part of the tile-ends was made after the 8th century, and it is likely that they were the repair materials for this temple; this demonstrates that the buildings of the XBT lasted for a long time.

4. Summary

From the Northern Dynasties to the Sui and Tang Dynasties, the handicraft roof tile industry that related to the construction of royal Buddhist temples changed from planned production to commercial production. This change may have also happened in the roof tile production and construction processes of other types of buildings. The artisans working in the roof tile workshops also changed from skilled vassals to ordinary citizens who only needed to work in the workshops for a limited period as corvee. The production supervision methods also changed in the Tang Dynasty. The supervision based on the responsibility of individual artisan was replaced by management based on the responsibility of the whole workshop. The system of unified official workshops, however, declined gradually after the An-Shi Rebellion in the period of the Middle Tang. In the later period of the Tang Dynasty, the commercial production of roof tiles had been comparatively developed.

In the Northern and Sui-Tang Dynasties, roof tiles, especially the polished-black roof tiles and exquisite tile-ends with lotus patterns, were unique and important building materials for the royal

family, but the importance of the roof tiles decreased due to the development of production techniques and production management that made the mass production of these roof tiles possible. At the end of the Tang Dynasty, roof tiles had already become common building materials.

PART V. Roof Tiles and Royal Buddhist Temples, the Establishment of Legitimacy in Material Culture

From the beginning of the Northern Wei Dynasty to the end of the Tang Dynasty, the social and socio-economic structure of medieval Chinese society changed substantially. By analyzing archaeological remains in detail, this dissertation discussed the regularities and development of the production and utilization of roof tiles, and the relevant construction processes, to explore the social changes of medieval China.

CHAPTER 1. The Alteration of the Roof Tiles Used in Royal Buddhist Temples

Section 1. The Alteration of the Roof Tiles' Styles

1. Tegulae and Imbrices

According to the previous analysis, the most outstanding changes in the roof tiles' styles happened at the end of the Pingcheng Period of the Northern Wei Dynasty. The exposed surfaces of the roof tiles, which are the concave surfaced of the tegulae, and the convex surfaces of the imbrices, changed from untrimmed or simply-trimmed type to polished-black type. The polished-black tegulae and imbrices were used until the end of the Tang Dynasty.

The remains unearthed from the YBTWZ exhibit the alteration of the styles. Although the roof tiles found at this site were not completely collected, and the statistical analysis of the proportion of the different types of roof tiles is impossible, it is clear that the most used roof tiles were untrimmed tegulae, with fabric impressions left on their concave surfaces, and simply-trimmed imbrices, whose convex surfaces were simply scraped. Moreover, the front surfaces of most of the tile-ends at this site were simply scraped, so they were likely joined to the simply-trimmed eave imbrices. This means that the untrimmed/simply-trimmed roof tiles were the main materials of the roof tiles for this temple. Some polished-black roof tiles were found in limited areas of this temple, but the quality of these roof tiles was low; for example, only the central part of the tegulae are polished and blackened, with obvious fabric impressions left in the corners. Therefore, the polished-black roof tiles found in the YBTWZ may have been the beginning of the new roof tile style. Compared to the samples in the Yungang Grottoes, the polished-black roof tiles in the Caochangcheng Site and Mingtang, which were built at the end of the Pingcheng Period, were high quality, and they made up a large proportion of the roof tiles used in these buildings.

After the capital city of Northern Wei moved to Luoyang, the high-quality polished-black roof tiles were widely used in the high-ranking buildings in Luoyang. The mainstream of roof tiles used in the YBT was polished-black types, including tegulae, imbrices, and tile-ends. A few simply-trimmed imbrices were found at this site, but they were only found in limited areas. Furthermore, in the DBT of the Northern Qi Dynasty in Yecheng, the remains of the polished-black imbrices make up 97 percent of the whole imbrices by weight, and most of the tegulae are the polished-black type. According to *Yezhongji*, the roofs of the buildings in the Northern Inner City of Yecheng were all laid by glossy roof tiles, which were brushed with walnut oil to prevent

the growth of moss.[106] Moreover, the remains of the roof tiles unearthed from the architectural sites in Chang'an from the Sui and Tang Dynasties are mostly the polished-black type. It is likely that the polished-black roof tiles appeared at the end of the Pingcheng Period and became the main materials for building the high-ranking buildings after the Luoyang Period of the Northern Wei Dynasty.

Some glazed roof tiles were unearthed from the architectural sites of medieval China, such as the glazed tegulae from the YBTWZ, fragments of glazed imbrices and tile-ends from the DBT, but they are rare and were all concentrated to a specific type of roof tiles. Until the construction of the XBT in the Tang Dynasty, both glazed tegulae and glazed imbrices appeared. Therefore, glazed roof tiles were already produced at the beginning of the Northern Wei Dynasty and used throughout the medieval period, but they were only made in a limited number.

2. Eave Imbrices and Eave Tegulae

The eave imbrices consist of imbrices and tile-ends, and the patterns of the tile-ends changed frequently. The tile-ends from the Yungang Buddhist Temple in the Pingcheng Period of the Northern Wei Dynasty were decorated with inscriptions. The front surfaces of the tile-ends are divided into nine parts by raised lines. A big circular knob is in the central part, with four traditional Chinese characters, "傳祚無窮" or "萬歲富貴," and four small circular knobs alternatively distributed around the center. Some fragments of the tile-ends with lotus patterns were also unearthed. In the sites of palaces and the Mingtang in Pingcheng built at the end of the Pingcheng Period, the number and styles of the tile-ends with lotus patterns increased, and the

[106] *Yezhongji*: "北齊起鄴，南城屋瓦皆以胡桃油油之，光明不蘚." Lu hui, with commentaries assembled by Xu zuomin, *Yezhongji*, in *Yedu yizhi jijiaozhu*, p. 114.

production of the tile-ends with inscriptions declined. The tile-ends with monster patterns were also created at this time. After Northern Wei moved its capital city to Luoyang, the tile-ends with lotus patterns became the main materials of the tile-ends in construction, and the tile-ends with inscriptions disappeared. Most of the tile-ends with lotus patterns made in the Northern Wei Dynasty have compound petals, with the central area decorated with knobs or statues of Buddha; the petal has two small semi-petals and is surrounded by raised outlines with a round or sharp end. The inter-petals are small rhombs or triangles, and some of the tile-ends were decorated with raised line and beads in the outer area. There are also a few tile-ends with simple petals unearthed from the YBT in Luoyang, but this type of tile-end became the mainstream of the tile-ends in Yecheng during the Eastern Wei and Northern Qi Dynasties. From the DBT and other high-ranking buildings in Yecheng, numerous tile-ends with simple petals were found. They have standard oval or round curled petals, T-shaped inter-petals, and a raised central area with small seeds. Only some samples have raised lines and beads in the outer area. Compared with the tile-ends in other periods, the patterns of the tile-ends in Yecheng are simple. In the Sui and Tang Dynasties, the styles of the tile-ends increased rapidly. According to the samples unearthed from the XBT, most of the tile-ends in the earlier period of the Tang Dynasty were made with compound petals, and the compound petals were surrounded by round or heart-shaped raised outlines. The outlines of the petals became thinner over time, and the samples with heart-shaped petals increased. The tile-ends with compound petals became rougher during the period of the Late Tang. The outlines and inter-petals of some of the samples disappeared or were deformed at this time, and the semi-petals of one compound petal became smaller. In the later period of the Tang Dynasty, however, the production of the tile-ends with simple petals increased. More tile-ends with simple petals were found in the QBT than tile-ends with compound petals, and the quality declined over time. Standard oval petals were replaced by small, deformed petals, while the outlines and inter-

petals disappeared. Together with the changes in the patterns, the edges of the tile-ends became wider. Some make up 40 percent of the tile-ends' diameter. In addition to tile-ends with lotus patterns, there are also tile-ends with monster patterns found in the Tang Dynasty sites, but the number is limited. They may have been produced in the Five Dynasties and Ten Kingdoms Period or the Song Dynasty, indicating that these buildings were still used after the Tang Dynasty.

The decoration on the lower ends of the eave tegulae are simple and were usually different types of wave-shaped patterns. In the YBTWZ, general tegulae and eave tegulae cannot be separated directly because they have similar traces, which were pinched by fingers. According to the archaeological reports, the tegulae unearthed from the Siyuan Buddhist Temple and the palaces or the Mingtang in Pingcheng also only have finger-pinched traces. The setting of the tegulae changed substantially in the Luoyang Period of the Northern Wei Dynasty. In the YBT of Luoyang, tegulae can be divided into three groups by their lower end: double wave-shaped patterns, single wave-shaped patterns, and finger-pinched traces. The tegulae with wave-shaped patterns may have been used as eave tegulae, and the tegulae with finger-pinched traces, which can also be treated as undecorated tegulae, were laid on the slopes of roofs. The tegulae produced in the Eastern Wei and Northern Qi Dynasty, as well as the Sui and Tang Dynasties mostly have two types of lower ends: tegulae with double wave-shaped patterns and tegulae with finger-pinched traces. There are also several samples with deformed patterns, such as triple wave-shaped patterns, made in the Tang Dynasty, but they are rare. Overall, the division between the eave tegulae and general tegulae emerged in the Luoyang Period of the Northern Wei Dynasty and the eave tegulae were mostly decorated with wave-shaped patterns on the lower ends.

Section 2. The Changes of Technique Systems of the Roof Tiles

1. The Technique System of the Tegulae

The roof tile production appeared early in China, so the production technique had already matured in the Northern and Sui-Tang Dynasties. Although there are a few differences in some of the production steps because of the different areas or ranks, the basic production techniques and production processes are similar.

1. Molds wrapped with cloth covers were used in the shaping step. The mold of a tegula was an integral mold or consisted of several narrow wooden strips.
2. Clay-strips were twined around the mold to make the clay bodies of the tegulae, and the convex surface of the tegulae was shaped with a pottery paddle and trimmed with a plate.
3. The lower ends of the tegulae were decorated before the bodies were divided.
4. The clay body was cut from the inside, and the edges of some eave tegulae were processed carefully.
5. Special treatments were performed on the exposed surfaces of the tegulae. Most were polished and blackened, while a few were glazed.
6. Some of the tegulae, whose concave surfaces were not trimmed, were cut into two or three parts vertically and used as ridge tiles.
7. The tegulae were fired in the kilns.

The biggest difference in the tegulae production is the treatment for the exposed surfaces. There are three types of exposed surfaces: untrimmed type, polished-black type, and glazed type. The production of these samples may have belonged to three different technique systems, but the setting of untrimmed tegulae and polished-black tegulae was more complicated. In the YBTWZ,

untrimmed tegulae and polished-black tegulae were made in different periods and used in different areas of the temple. It is likely that they were produced by distinct artisan groups based on different technique systems. At other sites, however, the untrimmed tegulae were usually cut into two or three parts and laid on the ridges of the roofs as ridge tiles. The untrimmed tegulae have a different function to the polished-black tegulae. They were usually made with the same types of cloth covers and used together, so it is likely that they were made by the same artisan group.

Another difference was with the inner molds of the tegulae. According to the production traces on the concave surfaces of the tegulae, the inner molds used in Luoyang and Yecheng during the Northern Dynasties must have been barrel-shaped molds, which consisted of several narrow wooden stripes. This type of inner mold usually left narrow vertical impressions on the concave surfaces of the tegulae, but these traces cannot be seen on the samples from the Sui and Tang Dynasties in Chang'an. This implies that the inner molds used in Chang'an may have been integral molds. Previous studies have demonstrated that the differences between the barrel-shaped mold and integral mold might indicate that there was a different technique system for roof tiles between the eastern and western sides of the Taihang Mountain (Yamazaki 2010).

2. The Technique System of the Imbrices

The basic production techniques of the imbrices made in the Northern and Sui-Tang Dynasties are similar and have a unified production process.

1. Molds wrapped with cloth covers were used in the shaping step. The mold of an imbrex was an integral bottle-shape or a cylindrical mold.
2. Most of the imbrices were made with clay-strips that continually twined around the mold,

while for a few samples, the tile lip and the main body were made separately; and the convex surfaces of the imbrices were shaped with a pottery paddle and trimmed with a plate.

3. The clay bodies of the imbrices were cut from the inside, and the edges of some eave imbrices were processed carefully.
4. The back surfaces of the tile-ends were processed to join the tile-end to the imbrex firmly.
5. Specific treatments were conducted for the exposed surfaces of the imbrices. Most of them were polished and blackened, while some were glazed.
6. The imbrices were fired in the kilns.

There are also some differences in the imbrices production; for example, the three types of exposed surfaces—simply-trimmed type, polished-black type, and glazed type—show the existence of three different technique systems. In the YBTWZ, simply-trimmed imbrices were the main materials, which were matched to the untrimmed tegulae. After the Pingcheng Period of the Northern Wei Dynasty, however, all of the imbrices were changed to the polished-black type, similar to the tegulae made in the same period. Meanwhile, the production system of the glazed type was a supplement for the roof tile workshop in the Northern and Sui-Tang Dynasties, providing a few glazed imbrices for special buildings. Furthermore, the imbrices unearthed from the YBT were made by two different types of inner molds, which probably belonged to two different technique systems. The technique system of the cylindrical mold produced a few imbrices and was not evident in the other sites of the Northern Dynasties. It might be the inheritor of the local production system in Luoyang in the Period of the Sixteen Kingdoms and became a supplement for the roof tile workshops of the YBT in the Northern Wei Dynasty. The production system of the polished-black imbrices made by bottle-shaped molds was the main system in the workshops.

3. The Technique System of the Tile-Ends

The production technique of the tile-ends changed substantially at the end of the Pingcheng Period of the Northern Wei Dynasty. According to the previous analysis, the tile-ends with inscriptions found in the YBTWZ were made with a wooden mold. This mold left vertical impressions of wood grain on the front surfaces of the tile-ends, which cannot be observed on the surface of samples made with a ceramic mold. Moreover, because all of the mold traces on the tile-ends from this site are in the same place, it is likely that these samples were made from the same wooden mold. Ceramic molds were also unearthed from Pingcheng, but these molds were used for creating the lotus-Buddha pattern or monster pattern. The surfaces of these ceramic molds are smooth, indicating that they were stamped. After the capital city was moved to Luoyang, the tile-ends with inscriptions disappeared, and the tile-ends with lotus patterns became the main materials used in construction. This means that the production system using wooden molds was replaced by the production system using ceramic molds at that time.

The tile-ends with lotus patterns unearthed from the DBT and the XBT have evidence of the tile-end production technique of the double-level mold. The tile-ends of the same pattern might have different details, such as the number and position of the seeds in the central area. These samples were made using different molds, although they have the same pattern. Some samples have the same pattern and the same details, but the mold traces changed in more than one way, indicating that there may have been two levels of molds in the tile-end production. Based on the design of one pattern, the artisans made several first-level molds, and each first-level mold could then make several second-level molds. The tile-ends, which belonged to the same first-level mold but were made by different second-level molds, might have the same patterns and details, but their mold

traces might change in different ways. The mold unearthed from the XBT is a ceramic mold with a smooth surface, so it is probably a second-level mold stamped with a stone or a wooden first-level mold.

The double level mold technique made the mass production of tile-ends possible at the end of the Pingcheng Period. In the YBTWZ, all of the tile-ends with inscriptions were produced from the same wooden mold, which left mold traces on the same places of the tile-ends. The wooden molds were carved by hand, so the number of wooden molds was limited. Moreover, the soft wooden molds broke easily, and so it was difficult to retain clear patterns for the tile-ends. The double level mold techniques, however, solved the problems of the wooden mold. One first-level mold could make several ceramic second-level molds, and then, one second-level mold could produce several tile-ends, which made the mass production of the tile-ends with lotus patterns possible. Moreover, compared to the wooden molds, the broken ceramic molds could be replaced immediately, so the tile-ends made with ceramic molds would have fewer mold traces.

The change from inscription to lotus patterns was not only an alteration of the style, but it also implied an innovation in the tile-end production technique occurred. The double-level mold technique satisfied the mass demand for high-quality tile-ends in urban construction during the later period of the Northern and Sui-Tang Dynasties. In different periods, this technique also had different features. The styles of the tile-end were limited in the Eastern Wei and Northern Qi Dynasties, but the first-level molds of one type of pattern varied. During the Sui and Tang Dynasties, however, there were many different types of patterns, but one pattern usually had only one first-level mold.

Section 3. The Changes in the Production Management of the Roof Tiles

1. The Changes in the Status of the Roof Tile Artisans

No historical record has mentioned the status of the roof tile artisans, but according to previous analysis, the change in the status of other kinds of artisans in this period was recorded in historical literature, and the characters on the roof tiles can also reflect the status of roof tile artisans.

The roof tile artisans in the Northern Wei Dynasty may have belonged to a special group of vassals who were controlled by the government and were different from ordinary citizens. The inscribed characters on the roof tiles were their names, and these indicated their responsibility for the products. In the Luoyang Period of the Northern Wei Dynasty, besides the artisans' names, the characters also recorded the production steps. This implies that there was a division of labor in the roof tile workshop at that time, and the production management of the roof tiles became more complicated.

After the capital city of the Eastern Wei and Northern Qi Dynasties moved to Yecheng, all of the characters on the roof tiles became stamped simple types that consisted of numbers and artisans' names. This implies a development in the roof tile production management. Based on historical literature, many artisans become ordinary citizens at the end of the Northern Wei Dynasty. These ordinary citizens only needed to work in the official workshops for a limited period as corvee, so the artisans in the roof tile workshop of the Northern Qi Dynasty were unfixed. This may have been the reason why the content of the characters for supervision was simplified. As ordinary citizens, besides doing corvee in a limited period, artisans also needed to pay land rent to the government.

Similar to the Northern Qi Dynasty, the characters on the roof tiles were also stamped during the Sui and Tang Dynasties, and the artisans in the roof tile workshop of this period were also ordinary citizens. The tile-ends used in the period of the Early Tang still had the characters of the artisans' names, and some of them were stamped together with the characters of "官匠" or the artisans' hometown. From the Tianbao Period, however, the characters of the artisans' names almost disappeared, and the characters of the production workshops or construction sites increased. This implies a change in the production supervision.

2. The Changes in the Supervision in Roof Tile Production

The characters on the roof tiles appeared at the end of the Pingcheng Period of the Northern Wei Dynasty. At that time, the supervision method was based on the artisans' signatures, which was usually used for the production of luxuries. The supervision method became more complicated due to the division of labor in the Luoyang Period of the Northern Wei Dynasty. In the roof tile workshops of the Eastern Wei and Northern Qi Dynasties, the production of the roof tiles was still supervised using this method, but inscribed characters changed into stamped characters and the content of the characters simplified. It is worth noting that the supervision methods in the roof tile production for the tower of the DBT may have been different from the supervision methods in roof tile production for other buildings in this temple, but they were similar to the supervision methods in the Sui and Tang Dynasties. The roof tiles made in the Sui and Tang Dynasties still have characters, but the number of characters decreased, and the content of the characters changed from the artisans' names into dates, production workshops, and construction sites. This implies that the production supervision based on the responsibility of individual artisans was replaced by the supervision conducted in the workshop. The roof tile production for the tower in the DBT

might indicate the beginning of the new supervision method.

The characters of the artisans' names were used as symbols of the supervision in the production of luxuries since the period of the Warring States. It was used in roof tile production at the end of the Pingcheng Period of the Northern Wei Dynasty, but in the later period of the Tang Dynasty, the characters of artisans' names disappeared from roof tiles. In the construction of the Wenshu Pavilion of the Xingshan Buddhist Temple in the period of the Middle Tang, roof tiles were even bought from private kilns instead of official workshops. This means that roof tile was no longer treated as a luxury, so the roof tile production at that time became less controlled. Furthermore, the Zhenguan Bureau that controlled the production of the roof tiles belonged to the Taifu Court, which was in charge of managing the property of the royal family, in the Northern Dynasties. However, after the Sui Dynasty, it became an affiliate of the Jiangzuo Court, which controlled the construction projects of all official buildings. This also demonstrates that the importance of the roof tiles decreased in the Sui and Tang Dynasty, and they went from luxury items of the royal family to common building materials.

3. The Alteration of the Formation of the Workshops

The formation of the workshops can be conjectured using the traces left on the surface of the roof tiles. The trimming traces are based on the methods of production, indicating the minimum number of artisan groups, while the tool traces provide the maximum number of groups. The previous chapters chose the imbrices as the samples for analyzing the formation of the roof tile workshops.

According to the previous analysis, the roof tile workshops of the YBTWZ and the YBT were

non-unified. By analyzing the fabric impressions on the concave surfaces of the imbrices, it is likely that the maximum number of artisan groups for these imbrices was large. However, there were only one or two types of fabric impressions on the concave surfaces of the imbrices unearthed from the DBT. This means that the maximum number of artisan groups for the imbrices was small in the workshop of this temple, and the workshop of the DBT was comparatively unified. Besides, most of the imbrices unearthed from the XBT were the polished-black type and made using the same type of cloth covers. This indicates that most of the artisans who made the imbrices belonged to the same artisan group. In the later period of the Tang Dynasty, however, the number of artisan groups increased again, and the proportion of the imbrices made by different types of cloth covers became equal. This demonstrates that the production of the imbrices was conducted by several artisan groups equally.

Overall, from the Northern Wei Dynasty to the Northern Qi Dynasty, the formation of roof tile workshops became more unified, but it declined in the later period of the Tang Dynasty. The non-unified workshop in the Northern Wei Dynasty may have been caused by the special status of the artisans. At that time, the techniques of roof tile production were transmitted from past generations to the younger generation in a family, and it may have formed several artisan groups who used specific production methods. In the Northern Qi Dynasty, however, the artisans were ordinary citizens, and they only worked in the workshop for a limited period as corvee, so the production tools and methods were controlled by official workshops and became standardized. In the later period of the Tang Dynasty, the system of official workshops declined, and the commercial production of the roof tiles increased. This may be why the roof tile workshops become non-unified again.

Section 4. The Usage of the Roof Tiles and the Construction of Temples

1. The Usage Position of the Roof Tiles

The usage position of the roof tiles includes the position of the roof tiles in a building and the position of the roof tiles in a temple. The position of the roof tiles in a building is the relation between the style of the roof tiles and their functions. Several points can be made. The undecorated roof tiles were laid on the slopes of the roofs, and the tegulae decorated with wave-shaped patterns or imbrices decorated with tile-ends were used as the eave roof tiles. The eave roof tiles were laid on the first line of the roofs, and the eave imbrices were fixed with nails. Apart from the YBTWZ, all of the temples chose polished-black roof tiles as the main materials for the roof tiles; there are also some untrimmed tegulae unearthed from these temples, which were cut into two or three parts and used on the ridge of the roofs. The samples unearthed from the No. 5 Architectural Site of the DBT indicate that the largest imbrices may have been used as ridge tiles. The samples unearthed from the No. 3 Architectural Site of the QBTs demonstrate that the roof tiles used for the southern part of a building may have been more important than the roof tiles used for the northern part.

The position of the roof tiles in one temple provides the relation between the style of the roof tiles and the rank of the buildings. The rank of the roof tiles can be determined in two ways: their exposed surface and their size. The glazed roof tiles were high ranked materials, but there are only a few glazed roof tiles found in the temples of the Northern and Sui-Tang Dynasties. They may have been used for the most important building or the most outstanding part of the roof. The polished-black roof tiles were the main materials for the roofs of the high-ranking buildings in this period. However, in the YBTWZ, the polished-black roof tiles are less than the

untrimmed/simply-trimmed roof tiles, but they were used on the roofs of the largest two rooms of this temple. Meanwhile, the sizes also provide the rank of the roof tiles from another point of view. For example, in the QBT, the imbrices unearthed from the No. 3 Architectural Site are larger than the imbrices unearthed from the No. 4 Architectural Site, so the main hall of the western part must have been more important than the main hall of the eastern part. Furthermore, the roof tiles found in the royal Buddhist temples are almost the same as the roof tiles from other types of high-ranking buildings, such as palaces or ritual buildings, in both exposed surfaces and size.

2. The Usage Sequence of the Roof Tiles

The usage sequence of the roof tiles can also be explained in two ways: the sequence of the roof tiles in a temple, and the sequence of the roof tiles in different periods. The usage sequence of the roof tiles can be speculated by the development of mold traces on the front surfaces of the tile-ends. For example, by analyzing the position and size of the mold traces, it is clear that the construction process of the YBTWZ was conducted from the southeast (tower) to the northwest (rooms for monks). The tower may have been the most important building in a temple during the Northern Dynasties, but in the Tang Dynasty, the planning of temples became more complicated. The QBT had a tower when it was first built in the Sui Dynasty, but the tower was neglected in the reconstruction of this temple during the period of the Late Tang. This means that the importance of the tower declined in the Tang Dynasty.

The sequence of the roof tiles in different periods had already been analyzed in the section “The Alteration of the Roof Tiles’ Styles.”

CHAPTER 2. The Establishment of Legitimacy in the Northern and Sui-Tang Dynasties, Focusing on Roof Tiles and the Relevant Construction Processes of the Royal Buddhist Temples

Legitimacy is the legality of authority, and during the turbulent period of the Southern and Northern Dynasties, legitimacy was pursued by every ruler, especially the rulers of nomadic groups. To impress the legitimacy of their ruling, in addition to military activities, the political system, rituals, urban construction, and material objects were all tightly controlled by the government. Previous studies have examined legitimacy as it related to political systems and rituals, but neglected the expressions of legitimacy in material objects, especially ordinary objects such as roof tiles. Although roof tiles are ordinary building materials, their styles reflect the aesthetics of the rulers, which was deeply influenced by the concepts of legitimacy at the time. Moreover, the production and usage of roof tiles are related to many parts of society, such as the economy and religion. By analyzing the lifecycle of roof tiles, as well as the relevant construction processes of royal Buddhist temples, the concept of legitimacy and the development of the society can be understood.

Section 1. Roof Tiles' Styles and Legitimacy

1. Polished-Black Roof Tiles and Wuxing Theory

The polished-black roof tiles that appeared at the end of the Pingcheng Period of the Northern Wei Dynasty may have been related to Wuxing Theory, which was created during the period of the Warring States and treated as the political philosophy that determined legitimacy in many

Dynasties. After Emperor Daowu established the Northern Wei, he chose the element earth as the ritual element (deyun) of the Northern Wei.[107] However, in 490 AD, Emperor Xiaowen thought the deyun of the Northern Wei should follow the last unified dynasty, Western Jin, and not the states founded by other nomadic people, so he changed the deyun of the Northern Wei from earth to water.[108] According to Wuxing Theory, the element water is related to the color black, and so the Northern Wei Dynasty used the color black as their ritual color after 490 AD. The rulers of the Northern Wei Dynasty considered themselves as the legitimate inheritors of China, and Emperor Xiaowen implemented Sinicization policies. Therefore, the changes in the roof tiles' exposed surface from untrimmed/simply-trimmed type to polished-black type may have been influenced by Wuxing Theory and the concept of deyun, indicating that there was a positive attitude of the nomadic rulers toward Chinese culture and Confucianism.

The ritual color, black, was not only presented in the style of roof tiles. It deeply influenced the clothes-color system (服色制度) of the Northern Wei Dynasty. According to historical records, Emperor Xiaowen usually wore a black hat during the ceremonies in Taimiao[109] and changed the color of sacrificial animals from yellow to black.[110] There is also a record in *Nanqishu* that people in Northern Wei made an image of black dragon to counteract evil force[111]. These records proved that the color of black was widely used in the material culture of the Northern Wei Dynasty,

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[107] *Wei shu*: "（天興元年）定都平城，即皇帝位. ……羣臣奏以國家繼皇帝之後，宜為土德，故神獸如牛，牛土畜，又黃星顯曜，其符也. 於是始從土德，數用五，服尚黃，犧牲用白. " Wei shou, *Wei shu*, vol.181, p. 2734.

[108] *Wei shu*: "（太和十五年正月）詔曰：……便可依為水德，祖申臘辰." Wei shou, *Wei shu*, vol.181, p. 2747.

[109] *Wei shu*: "（太和十五年十一月己未朔）帝釋禫祭於太和廟.……帝衮冕，與祭者朝服.既而帝冠黑介幘，素紗深衣，拜山陵而還宮." Wei shou, *Wei shu*, vol.181, p. 2749.

[110] *Wei shu*: "（太和十九年十一月己卯）帝又曰：……今我國家，時用夏正，至於牲色，未知何準？秘書令李彪曰：觀古用玄，似取天玄之義。臣謂宜用玄. ……帝曰：天何时不玄，地何时不黄，意欲從玄. " Wei shou, *Wei shu*, Vol.181, p. 2752.

[111] *Nanqi shu*: "胡俗尚水，又規畫黑龍相盤繞，以為厭勝". Xiao zixian, *Nanqishu*, vol.57, p.986.

especially in upper class.

2. The Usage of the Tile-Ends with Lotus Patterns

The tile-ends with lotus patterns appeared at the end of the Pingcheng Period of the Northern Wei Dynasty in Northern China. At the beginning of the Northern Wei Dynasty, the attitudes of the rulers towards Buddhism was changeable. Emperor Taiwu considered Buddhist as the heretical beliefs of other nomadic people and persecuted Buddhism in the later period of his reign.[112] Emperor Wencheng, however, was a devout Buddhist, and he announced that people in Northern Wei had always been Buddhist, and so he had to promote Buddhism to protect his country.[113] It is clear that Buddhism had already been treated as a part of the legitimacy of the Northern Wei Dynasty since this period, and this could explain the reason for the change of the tile-ends' patterns from traditional inscriptions to the new lotus motif.

3. The Demand for Polished-Black Roof Tiles and Tile-Ends with Lotus Patterns

After the capital city of the Northern Wei Dynasty was moved to Luoyang, Luoyang City was constructed many times. According to the historical records, the city was 20 li (里)[114] from east to west and 15 li from north to south.[115] There must have been the large demands for polished-black roof tiles and tile-ends with lotus patterns in the construction of Luoyang City, but the shortage of building materials in the construction was not solved. King Rencheng gave a

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[112] *Wei shu*: "（太平真君七年）乃下詔曰：朕承天緒，屬當窮運之弊，欲除偽定真，復羲農之治. ……自今以後，敢有事胡神及造形像泥人，銅人者，門誅." Wei shou, *Wei shu*, vol.114, p. 3034.
[113] *Wei shu*: "（興安元年）高宗踐極，下詔曰：……況釋迦如来功濟大千，惠流塵境……. 故前代已來，莫不崇尚，亦我國家常所尊事也. ……朕承洪緒，君臨萬邦，思述先志，以隆斯道. " Wei shou, *Wei shu*, vol.114, pp. 3035-3036.
[114] One li is approximately 0.5 kilometers.
[115] *Luoyang qielanji*: "京師東西二十里，南北十五里." Yang xuanzhi, with commentaries assembled by Zhou zumo, *Luoyang qielanji jiaoshi*, vol.5, p. 212.

suggestion in his statement to the emperor that building materials, such as bricks, can be obtained from prisoners as ransom.[116] These records imply that Luoyang City was constructed on a large scale, and the urban construction, which required the mass production of building materials, hadn't been finished at the end of the Northern Wei Dynasty.

The ruler of the Eastern Wei Dynasty regarded himself as the inheritor of the last dynasty, while the Northern Qi Dynasty still followed the systems of the Northern Wei Dynasty. Subsequently, the polished-black roof tiles and tile-ends with lotus patterns were largely used in Yecheng. According to the historical records, the Southern Inner City of Yecheng was six li from east to west and approximately eight li from north to south.[117] Another historical record described the landscape of the Southern Inner City as continuous rows of roofs with glossy black roof tiles.[118] This indicates that the demand for polished-black roof tiles and tile-ends with lotus patterns must have been very high in Yecheng.

In theory, the deyun of the Sui, which was the inheritor of Northern Zhou, should have used the element fire, while the deyun of the Tang should have been the element earth. Legitimacy based on the Wuxing Theory, however, changed many times in the Tang Dynasty and began to decrease. Previous studies have demonstrated that the political and social systems of the Tang Dynasty were mostly inherited from the systems of the Northern Wei Dynasty, which were at first followed by the Eastern Wei and Northern Qi, and then, absorbed by the Sui and Tang (Chen 2001). Therefore, the style of the roof tiles in the Sui and Tang Dynasties should also follow the tradition of the

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[116] *Wei shu*: "（正始之末）澄奏都城府寺猶未周悉, 今軍旅初寧, 無宜發衆，請取諸職人及司州郡縣犯十杖已上百鞭已下收贖之物，絹一匹，輸磚二百，以漸修造." Wei Shou, *Wei shu*, vol.19, p. 476.

[117] *Yecheng yizhi jijiaozhu*: "東西六里，南北八里六十步." Xu Zuomin, *Yecheng yizhi jijiaozhu*, p. 112.

[118] *Yecheng yizhi jijiaozhu*: "南城屋瓦皆以胡桃油油之." Xu Zuomin, *Yecheng yizhi jijiaozhu*, p. 114.

Northern Dynasties. According to historical records, Chang'an City was approximately 18 li from east to west and around 15 li from north to south.[119] The huge city required a large number of polished-black roof tiles and tile-ends with lotus patterns.

The construction of large cities was an important way to express the power of a country. As the building materials were designed to illustrate the deyun and religion of the country, polished-black roof tiles and tile-ends with lotus patterns must have been in high demand, and this would have promoted the development of techniques and management of roof tiles production to meet this demand.

Section 2. The Development of the Techniques and Management in Roof Tile Production

1. The Development of the Techniques

The largest change in the production techniques occurred in the production of the tile-ends. According to the previous analysis, the tile-ends with inscriptions were made with wooden molds. Wooden molds were very valuable at this time, and they were used repeatedly and worn out easily. Tile-ends made with wooden molds would have become rougher. Moreover, the YBTWZ indicates that all of the tile-ends with inscriptions from one site were made by the same wooden mold, and so mass production was impossible. At the end of the Pingcheng period of the Northern Wei Dynasty, however, the tile-ends with lotus patterns appeared, and the double-level mold

[119] *Tang liudian*: "東西十八里一百一十五步，南北十五里一百七十五步." Li linfu, *Tang liudian*, vol.7, p. 216.

technique was created. Based on the design of one pattern, the artisans made several first-level molds, and each first-level mold could make several second-level molds. The double-level mold technique made the mass production of the tile-ends possible. Moreover, compared to precious wooden molds, the broken ceramic mold could be replaced immediately, and this would have increased the quality of the production of the tile-ends.

Compared with tile-ends, the changes in the basic production techniques of the imbrices and tegulae are not obvious. All of the roof tiles were made by inner molds, wrapped with cloth covers, and clay-strips, which had already been used in the period of the Sixteen States. Only the exposed surfaces of the roof tiles changed from untrimmed/simply-trimmed type to polished-black type. The new techniques of blackening and polishing roof tiles, as well as the relevant firing methods, were created at the end of the Pingcheng period of the Northern Wei Dynasty. The production processes became more complicated than before, and this may have been the reason for the shortage of building materials in the construction of Luoyang City. The demand for polished-black roof tiles, however, increased continually in the construction process of huge cities, which were treated as symbols of legitimacy, and subsequently, the production management developed at the same time.

2. The Development of the Production Management

The previous chapters discussed the changes in production management in the roof tile workshop of the Northern and Sui-Tang Dynasties from three points of view: the status of the artisans, the methods of supervision, and the formation of the workshops. These changes increased the production efficiency and the quality of the roof tiles to satisfy the demand for more high-quality building materials in urban construction. The production management of the roof tiles was deeply

influenced by the social conditions of the time.

In the earlier period of the Northern Wei Dynasty, artisans were tightly controlled by the government and had a special status that was different from ordinary citizens. They were forced to work in official workshops, but did not need to pay land rent. When ordinary citizens left their land to avoid paying heavy land rent, and the income of land rent of the government decreased at the end of the Northern Wei Dynasty, the social system based on the division of status and occupation declined. Subsequently, a large number of artisans were excused by the government and became ordinary citizens at that time. They only needed to work in official workshops for a limited period as corvee, but should pay their land rent. The burden of corvee and land rent was decided by the prosperity of the family (Kusano 1999). The social development also influenced the artisans working in roof tile production. The changes in the characters on the roof tiles from inscribed types to stamped types might imply an alteration in the status of the roof tile artisans, from vassals to ordinary citizens. By excusing artisans and extending the burden of handicraft production to ordinary citizens, the labor in official workshops increased, which made the mass production of the roof tiles possible.

Together with the change in the artisans' status and the increase in labor, the supervision methods in the roof tile workshop also developed. The first sample of the roof tiles with characters was found in the sites of palaces and the Mingtang in Pingcheng, together with the appearance of polished-black roof tiles. This demonstrates that supervision based on the signatures of the artisans began at the end of the Pingcheng Period, implying that the production of the roof tiles was regarded as the production of a luxury item. In addition, the roof tile production in Luoyang was supervised by steps because the name of artisans and the step of production were all inscribed

on the roof tiles. This method of supervision based on inscribing the name and production steps could ensure the quality of the roof tiles, but it was not suitable for mass production. In the Eastern Wei and Northern Qi Dynasty, the demand for the new style of roof tiles increased largely because of the construction of Yecheng. Working in official workshops became corvee for ordinary citizens, and labor in official workshops increased. The method of supervision in this period was simplified, and the characters on the roof tiles became stamped types. These characters were only stamped once after the shaping and trimming steps, and before the cutting step, demonstrating that production efficiency may have been more important at that time. The roof tiles with characters made in the Sui Dynasty and the earlier period of the Tang Dynasty were similar to the samples from the Eastern Wei and Northern Qi Dynasties, but the number of stamped roof tiles decreased. In the later period of the Tang Dynasty, the content of the characters changed from artisans' names to the characters for dates, production workshops, or construction sites. This means that supervision based on the responsibility of the individual artisan was replaced by supervision based on the whole workshop. Polished-black roof tiles and tile-ends with lotus patterns also changed from luxuries to common building materials.

The status of the artisans and the supervision method influenced the formation of the roof tile workshop. The workshops were unified gradually from the Northern Dynasty to the Northern Qi Dynasty, and it became non-unified again from the Middle Tang period. In the earlier period of the Northern Wei Dynasty, the artisans that worked in official workshops were people with a special status, and the technique of roof tile production was transmitted within the artisans' families. This may have been the reason why workshops had several different artisan groups. Since the end of the Northern Wei Dynasty, more artisans were excused, while ordinary citizens, who only worked for a limited period as corvee, became the main labor for the official workshops

of the roof tiles. The production techniques and tools were controlled by the official workshop in this setting, and so they were unified. This unified formation lasted until the later period of the Tang Dynasty. The setting in the QBT indicates that the distinction among the artisans become apparent again, which might be evidence of the decline of official workshops in the Late Tang period.

Section 3. The Roof Tiles and Usage Rank

1. The Roof Tiles of Royal Buddhist temples

The legitimacy of objects is acquired through their styles and usage rank. During the Northern and Sui-Tang Dynasties, the usage of the roof tiles was ranked by serious rules.[120] This meant that different types of buildings built by different ranks of people would use different ranks of roof tiles. The research objects in this dissertation are roof tiles from royal Buddhist temples, which are similar to the samples from palaces, ritual buildings, and other high-rank buildings in both exposed surfaces and sizes. This means that the roof tiles used in royal Buddhist temples had the same rank as the roof tiles of palaces or ritual buildings.

2. The Roof Tiles Used for the Buildings in a Temple

The roof tiles used in different buildings of a temple also have different ranks. For example, the glazed roof tiles may have been the most precious tiles in the temples of the Northern and Sui-Tang Dynasties, but they were rare. Meanwhile, the rank of the polished-black roof tiles was

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[120] *Tang liudian*: "凡磚瓦之作，瓶缶之器，大小高下，各有程準." Li linfu, *Tang liudian*, vol.23, p. 597.

higher than untrimmed/simply-trimmed roof tiles. The size of the roof tiles was also related to the ranks of the roof tiles. The buildings of higher rank would be built on a larger scale, and larger roof tiles would have been used to lay the roof. For example, large-sized tiles were found at the No. 3 Architectural Site of the QBT, while the roof tiles from the No. 4 Architectural Site were comparatively smaller. The rank of the roof tiles in a temple indicated the priority of the buildings.

CHAPTER 3. Conclusion: Exploring the Social Changes through Material Culture

This study examined the roof tiles that were used in royal Buddhist temples during the Northern and Sui-Tang Dynasties, trying to explore the social changes of this period through material culture. The analysis of the style, production, and utilization of roof tiles shed light on the political settings and economic settings of the society in medieval China.

1. The Turning Points of Roof Tiles

During the Northern and Sui-Tang Dynasties, there were three main turning points of roof tiles: the period of Emperor Xiaowen in the Northern Wei Dynasty, the period of the Northern Qi Dynasty, and the later period of the Tang Dynasty. In the first period, the styles of the roof tiles changed substantially. The polished-black type roof tiles and tile-ends with lotus patterns appeared, and the new technique of double-level mold was created in the production of the tile-ends. The basic style and technique of a new kind of roof tiles were formed in this period. In the second period, the status of the artisans changed from vassals to ordinary citizens and working in official roof tiles workshops extended to ordinary citizens. As a result, the labor in workshops increased, and the supervision method was simplified, and the production management of the roof tiles changed in this period. In the third period, the supervision based on the responsibility of individual artisans changed into management based on the workshop, and the production in official workshops was replaced by commercial production.

2. The Changes in Political Settings

During the Northern Dynasties and the Sui-Tang Dynasties periods, different groups of nomadic

people from the northern steppe of China occupied the original habitat of the Han people and established their regimes. To control the Han people, most of the nomadic rulers accepted the systems and culture of the Han people, and the nomadic people were assimilated gradually. In this process, legitimacy was the most important concept for nomadic rulers, who needed to prove the legitimacy of their rule. Previous studies on the legitimacy of the Northern and Sui-Tang Dynasties have been conducted by many researchers, but most have focused on the relevant political system recorded in the historical literature. In the traditional society of ancient China, however, rules controlled how everything was designed and used to verify the legality of the users. This dissertation chose roof tiles unearthed from the royal Buddhist temples as research objects and attempt to speculate the rules that controlled the production and usage of the roof tiles in the Northern and Sui-Tang Dynasties. The rules are evidence of the efforts of the nomadic rulers to strengthen the legitimacy of their dynasties in a material way.

The three turning points were deeply influenced by their periods. When Emperor Xiaowen moved the capital city of Northern Wei to Luoyang and introduced Sinicization policies, it was very important for the rulers to create a new set of roof tiles and relevant techniques to confirm the legitimacy of the Northern Wei. Therefore, the polished-black roof tiles that were related to the Wuxing Theory of Confucianism and tile-ends with lotus pattern that borrowed the motif of lotus from Buddhism were created. After the destruction of the Northern Wei, to emphasize the legitimacy inherited from the Northern Wei, the rulers of the Eastern Wei and Northern Qi Dynasties built the large city of Yecheng, which was a copy of Luoyang City. The construction process of the new city required a large number of building materials, and subsequently, the production management changed to satisfy the demands. The new system of official workshops lasted for a long time, but in the later period of the Tang Dynasty, roof tile production in the

official workshops decreased at the same time as the fall of the dynasty.

The changes of roof tiles in the Northern and Sui-Tang Dynasties show the alteration of political settings that occurred during this period. Legitimacy was always the main political object for the rulers at the time. It is worth noting that the demolishment of legitimacy in the Northern and Sui-Tang Dynasties was influenced by Confucianism and Buddhism. This meant that the nomadic rulers did not just copy the methods from the Han people, but created a new system to establish the legitimacy of their dynasties, which was expressed in both political policies and tangible objects.

3. The Changes in Economic Settings

The demand for a large number of roof tiles promoted the management of roof tile production in the Northern and Sui-Tang Dynasties. There were several changes in economic settings that made the alteration in roof tiles production possible. It includes the improvement of artisans' status and the decline of official handicraft industry.

In the early period of the Northern Wei Dynasty, artisans were mostly captured Han people and their status was lower than ordinary people. In fact, the society of this regime consisted of several groups of members, such as aristocrats, farmers, who were ordinary people, as well as artisans, soldiers and other vassal groups. Artisans cannot change their occupation or get married with ordinary people. In the later period of the Northern Dynasties, however, many vassals were exempted from the feudal service and were allowed to change their occupation. Though they had to pay land rent or work in official workshop in limited period, they were treated as ordinary people. According to previous analysis, the improvement of artisans' status influenced the

management of roof tile production. For example, in the Northern Qi Dynasty, the second turning point of roof tiles, the way to make characters on roof tiles and the content of characters completely changed, indicating the alteration of the supervision methods in roof tile production.

Moreover, the decline of official handicraft industry is an inevitable trend in the later period of the Tang Dynasty, the third turning point of roof tiles. The national strength of the Tang Dynasty decreased after the An-Shi Rebellion. Following the fall of the regime, the government gradually lost control of the official workshops. Previous analysis indicated that the roof tiles made in the later period of the Tang Dynasty are comparatively rough, and the unified artisan group with standard techniques seems to have been replaced by several different groups at that period according to the changes of tool traces on the surface of roof tiles. The official handicraft industry declined, but the commercial production increased at the same time. In fact, the roof tiles used for some royal Buddhist temples in the later period of the Tang Dynasty were bought, instead of being provided by official workshop.

The changes of roof tiles in the Northern and Sui-Tang Dynasties indicate the alteration of economic settings that occurred during this period. The strict system of vassalage declined in the later period of the Northern Dynasties, and the number of owner-peasants increased. At almost the same time, a new corvee system, based on the equal-field system (均田制), was conducted. These changes improved the labor in agriculture or other industries and promoted the economy of the medieval society. It also promoted the development of commercial production, which boomed in the later period of the Tang Dynasty and increased constantly. The production of roof tiles can be representative of the handicraft industry in medieval China, showing the economic settings of the society.

4. New Questions

This study is based on information gathered from archaeological remains that have been carefully arranged and analyzes the establishment of the legitimacy of the Northern and Sui-Tang Dynasties from the information of these first-hand research materials. It provided a vivid viewpoint to observe the social alteration in medieval China. By analyzing the lifecycle of the roof tiles, from production to usage, the details of the construction process, as well as the political settings and economic settings of the society that influenced the construction of the temples, can be reconstructed to a certain extent.

Roof tiles unearthed from the royal Buddhist temples were used as research objects for this dissertation. In recent years, archaeological excavation in the sites of ancient cities has increased, numerous roof tiles have been unearthed from not only Buddhist temples, but also many other types of buildings, such as palace, ritual buildings and so on. They are important research objects for establishing the construction processes and social development of ancient cities. The research field of urban archaeology and Chinese history can be extended by analyzing these materials.

Furthermore, cultural exchanges in East Asia occurred frequently during the Northern and Sui-Tang Dynasties. The political system of the Tang Dynasty, Buddhism, and production techniques of certain objects were transmitted to the Korean Peninsula and Japan. For example, roof tiles were introduced to Japan at the end of the 6th century. Many researchers in Japan and Korea have great concern for the comparative studies on the roof tiles in East Asia, but because the research on roof tiles in China has always been neglected, the comparative studies haven't been conducted systematically. In this study, the roof tiles unearthed from five royal Buddhist temples in the

Northern and Sui-Tang Dynasties were arranged completely, and the roof tile production and relevant construction processes in this period were analyzed. This can become a base for future studies on roof tiles in China and comparative studies in East Asia. It also provides a new method for understanding social development in East Asia during the medieval period.

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