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Bidirectional Transmission Mapping of Architectural Styles of Tibetan Buddhist Temples in China from the 7th to the 18th Century

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Abstract: Architecture is the stone book of history, and the evolution of architectural styles showcases a non-verbal history constructed through images. As an important part of China's historical and cultural heritage, the architectural forms and styles of Tibetan Buddhist temples were initially modeled on Tang dynasty temple architecture and gradually evolved into the most significant architectural types in regions such as Tibet and Qinghai in China. Religious architecture has also played a significant role in shaping regional cultural landscapes. Existing research on Tibetan Buddhist temples is primarily focused on qualitative studies of individual temple buildings. This research takes the spatiotemporal evolution of architectural styles of Tibetan Buddhist temples as an entry point and, for the first time, employs ArcGIS technology to visualize the spatial and geographical distribution of Tibetan Buddhist temples from the 7th to the 18th century, establishing a comprehensive academic vision that encompasses both historical stratification and cross-regional spatial correlations. By analyzing the cultural symbolic features embodied in the construction styles of Tibetan Buddhist temples and the visual characteristics reflected in their decorative arts, we propose two spatiotemporal dimensions for the formation and transmission of Tibetan Buddhist temple architectural styles: "Westward Transmission" and "Eastward Diffusion". Firstly, from the 7th to the 9th centuries, the architectural style and construction techniques of Tang dynasty Buddhist temples were transmitted westward along the Tang–Tibet ancient road, integrating with local Tibetan elements to form the Tubo architectural style, which was further refined into the "Sino–Tibetan Combined Style" with strong visual characteristics around the 13th century. Subsequently, along with the spread of Tibetan Buddhism, this temple architectural style underwent an eastward diffusion from the 13th to the 18th century, reaching regions, such as Sichuan, Qinghai, Gansu, Inner Mongolia, Hebei, and Beijing, presenting a spatial gradient from west to east in the geographical dimension. On this basis, in this research, we construct a historical evolution mapping of Tibetan Buddhist temple architectural styles based on bidirectional transmission, attempting to elucidate that the intrinsic driving forces are religious and the cultural identity that guided the bidirectional transmission mechanism of these architectural styles under the historical context of the formation and dissemination of Tibetan Buddhism from the 7th to the 18th century.

Keywords: Tibetan Buddhist temples in China; religious architectural style; spatiotemporal evolution; bidirectional transmission; ArcGIS; mapping

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1. Introduction

Tibetan Buddhist temples[1], as an important type of historical and cultural heritage in China, are unparalleled in their vast quantity, magnificent scale, and grand design. They represent the highest achievements in the architecture of Tibet and surrounding regions in terms of both artistic aesthetics and technical standards. These religious buildings have had a significant impact on regional cultural landscapes (Zhong and Bao 2014). The establishment of the Tubo Dynasty in the 7th century AD promoted integration with tribes on the Qinghai–Tibet Plateau, such as Suppi (苏毗), Yangtong (羊同), Dangxiang (党项), and Bailan (白兰). To meet the needs of reform, Tubo introduced Buddhism from the Tang Dynasty, Nepal, and other places

(Li 1993). From the perspective of cultural communication, Buddhism in Tibet underwent a process from non-existence to existence, from import to export, and from being a receiver to a disseminator. The development of temple architecture was also based on this historical background. As a manifestation of foreign culture, there were originally no temples in Tibet (Wang et al. 2021, pp. 3–10). However, with the establishment of the Tibetan Buddhist system, Tibetan Buddhist temples evolved from imitation to forming set patterns by taking the official architectural style of Han Buddhist temples as an important reference. Coupled with the implementation of the political–religious integration system, they gradually became the most important architectural type in Tibet. They then influenced the construction of temples and the shaping of cultural landscapes in other regions as a means of cultural dissemination.

The earliest records of knowledge about the construction of Tibetan Buddhist temples can be found in temple chronicles. For example, in *dba' bzhed* 拔协, Ba Seinang (8th century) recorded, in detail, the background and twelve-year process of building Samye Temple, as well as the exchanges between Tang and Tubo in different fields such as temple construction, Buddhist cultural dissemination, and official interactions (Liu 2018). Qinze Wangbu (1820–1892) made meticulous survey records of the geographical locations of many Buddhist temples in Ü–Tsang (Central Tibet) and Kham (Eastern Tibet) in his work *Chronicles of the Holy Sites of Ü–Tsang* 卫藏道场胜迹志 (Qinze 2000, pp. 57–72). Desi Sangye Gyatso (1653–1706) made a relatively complete record and statistics of Gelug temples in Lhasa, Shigatse, Ngari, and other places during his tenure in *A History of the Gelug Doctrine: The Yellow Beryl Mirror* 格鲁派教法史:黄琉璃宝鉴 (Dikshi 2009, pp. 96–105). In the 20th century, between 1920 and 1950, G. Tucci made multiple trips to Tibet. While examining the Sanskrit scriptures and Tibetan translations preserved in temples in Gyantse and other places, he also used text mining and photographic documentation to record the conditions of some Buddhist temples, stupas, and other ancient sites in Tibet in the first half of the 20th century (Callieri and Cheng 2013). Since the 1950s, archaeologists such as Su Bai have conducted field surveys of Tibetan Buddhist temple architecture from different periods. In *Archaeology of Tibetan Buddhist Temples* 藏传佛教寺院考古, they summarized the early temple layouts in Tibet into the Jokhang Temple style and the Samye Temple style[2] (Su 2021, pp. 120–41). *Tibetan Buddhist Temples in Gansu and Qinghai* 甘青藏传佛教寺院 compiled relevant information such as the historical evolution, temple scale, and architectural status of Tibetan Buddhist temples of various sects in Gansu and Qinghai (Pu 1990, pp. 1–106). In the past two decades, works, such as *The Historical Culture of Tibetan Architecture* 西藏建筑的历史文化, *Tibetan Architecture in China* 中国藏族建筑, *Temples of Lhasa: Tibetan Buddhist Architecture from the 7th to the 21st Century* 拉萨寺庙：7–21世纪的藏传佛教建筑, and *Tibetan Buddhist Architecture in Inner Mongolia* 内蒙古藏传佛教建筑, have included surveys and mapping of Buddhist temple architecture, such as Shalu Temple (夏鲁寺), Potala Palace (布达拉宫), Tolin Temple (托林寺), Kumbum Temple (塔尔寺), Labrang Temple (拉卜楞寺), and Xilingol Temple (席力图召), from the perspective of architectural discipline. They sorted out the characteristics of Tibetan Buddhist temples in terms of spatial layout, construction techniques, and decorative components (Alexander 2005, pp. 21–89; Zhang 2012, pp. 133–62; Yang 2003, pp. 97–145). They also pointed out that due to the influence of Han Buddhist temples (Wang 2016, p. 1), the overall layout of some Tibetan Buddhist temples began to shift from the early "Mandala" model to the "Seven Halls of the Garan" (伽蓝七堂) pattern, and the architectural style was also a formal combination based on Tibetan-style architecture and central Chinese official-style architecture (Liu 2005, pp. 360–91; Chen 2007, pp. 78–84).

Simultaneously, the evolution of architectural styles also showcases a non-textual, visually constructed history, with its transformation patterns reflecting a cross-regional, holistic cultural phenomenon. However, existing textual and case studies on Tibetan Buddhist temple architecture often take administrative divisions as boundaries, focusing on qualitative research of individual temples, lacking the spatial perspective of horizontal connections in human cultural activities. Therefore, we view the emergence and spread of Tibetan Buddhist temple architectural styles as an integrated cultural–geographical process (Sopher 1981). Considering factors such as the spatial scope and temporal scale of the involved geographical

information, it pioneers the use of ArcGIS to form a technical system that combines historical and contemporary geographical information collection, analysis, and visualization. This system is employed to explore the spatial layout, evolutionary process, and underlying drivers of Tibetan Buddhist temple architectural styles.

To aid in understanding the geospatial relationships across different historical periods, we construct three research dimensions. The first is the spatial dimension, expanding the research scope beyond the traditionally conceptualized three major Tibetan regions (Shi 2014), including the Tibet region (historically belonging to Ü–Tsang, such as Lhasa, Shannan, Shigatse, and the present–day Ali, Nagqu, Nyingchi, etc.), Kham region (most of the western Sichuan plateau, northwestern Yunnan, and eastern Tibet), and Amdo region (the vast pastoral areas in the northeastern Qinghai–Tibet Plateau, Gansu, Qinghai, and northwestern Sichuan). It also includes geographically adjacent parts of Xinjiang and the main propagation areas of Tibetan Buddhism under the leadership of successive central governments, such as Inner Mongolia, Beijing (Chen 2023), Chengde, and Mount Wutai (Wang 2015; Han et al. 2021). The second dimension is time, with Tibetan Buddhism spanning over 1300 years from the Tubo period to the present. The construction of Tibetan Buddhist temples has also experienced several peaks following the development of Tibetan Buddhism, slowing down after the mid-Qing period (post-Qianlong era) with no significant changes in temple architectural styles (Chen 2007, pp. 78–84). Thus, the research takes the 7th to 18th centuries as the historical scale for studying the evolution of Tibetan Buddhist temple architectural styles, divided into five specific historical stages. The third dimension is architectural style, classifying the research data into nine style types based on the cultural symbolism and decorative art features in the construction patterns of Tibetan Buddhist temples across 1100 years. Through further statistical analysis, we conduct a visualized study on the spatial distribution patterns, spatiotemporal evolution laws, and cultural diffusion models of different style types as a cultural–geographical process (Gregory 2003, pp. 2–30), aiming to focus on the influence and shaping of architectural cultural phenomena from the complex relationships among religious, historical, cultural, political, and geographical factors in specific contexts.

2. A Spatial–Geographical Analysis of Tibetan Buddhist Temples in China from the 7th to the 18th Century

2.1. Data Sources

2.1.1. Tibetan Buddhist Temple Data

The Tibetan Buddhist temple data studied in this paper include contemporary and historical geographical information. Some of the contemporary geographical information data were obtained through field investigations by the research team, who collected images and surveyed and mapped Tibetan Buddhist temple architecture in Tibet, Qinghai, Gansu, Inner Mongolia, Hebei, Beijing, and other regions, acquiring first-hand data. The remaining contemporary and all historical geographical information data were obtained through literature research, comprehensive sorting through relevant datasets, surveying and mapping collections, historical literature, and image materials of Chinese Tibetan Buddhist temple architecture[3]. Combined with literature, images, and video materials, some important temples were restored and drawn to solve the difficulties in data acquisition and digital processing of historical geographical information (Yan et al. 2020). Ultimately, geographical location, construction year, builder, architectural style, and other data about 1720 Tibetan Buddhist temples were collected.

2.1.2. Maps and Geographical Data

In this study, all geographical processing programs use the GCS_WGS_1984 coordinate system. All maps drawn during the research process, as well as the administrative boundaries and national borders of relevant regions, use maps provided by the Ministry of Natural Resources of the People's Republic of China (https://www.mnr.gov.cn/, accessed on 15 February 2024) as base maps. The geographic elevation data were obtained from NASA's

SRTMDEM public data with a resolution of 90m and processed by a Geospatial Data Cloud site, Computer Network Information Center, Chinese Academy of Sciences (http://www.gscloud.cn/, accessed on 15 February 2024).

2.2. Methods

2.2.1. Establishing a Geographic Information System (GIS) Spatial Database

For the 1720 Tibetan Buddhist temple buildings from the 7th to 18th centuries, including those that have survived to the present, those that have been damaged (with ruins), and those that have disappeared (without ruins), this study treats them all as *point features* in geographical space (for temple buildings with records of relocation, reconstruction, or expansion in history, they are split into several point features according to their relocation points and reconstruction or expansion years). Information coding and image data entry are performed on the ArcGIS platform to associate attribute data with graphic and image data, forming a complete spatial database of the Tibetan Buddhist temple architecture geographic information system.

2.2.2. Kernel Density Estimation

Kernel Density Estimation (KDE) is a non-parametric method. Kernel density analysis is easy to implement and can well reflect the distance decay effect in the spatial distribution of geographical phenomena. Its calculation formula is as follows:

$$f(x) = \frac{1}{nh}\sum_{i=1}^{n} K\left(\frac{x - x_i}{h}\right)$$

where $f(x)$ is the kernel function; h is the bandwidth, i.e., the radius of the circular domain; and $x - xi$ represent the distance from the estimated point to the output grid. This paper uses the kernel density analysis module in ArcGIS 10.8 to analyze the density of Tibetan Buddhist temple architecture and identify the weights of distribution areas. At the same time, Kernel Density Estimation is used to analyze the spatial continuity and spatial distribution agglomeration characteristics of Tibetan Buddhist temple architecture across provinces and regions.

2.2.3. Setting Numerical Distribution Indexes

Based on the Tibetan Buddhist temple architecture geographical information database, we establish a spatiotemporal integrated mathematical analysis model by setting three indexes of "spatial distribution (S), temporal staging (T), and style type (Y)", as well as several subindexes under the three indexes, to reorganize statistical data and perform data visualization and analysis.

(1) Spatial Distribution Index of Tibetan Buddhist Temples (S)

This index includes name data (S_1), location data (S_2), and coordinate data (S_3). The name data contain all the names of Tibetan Buddhist temples at different historical development stages. The location data include the administrative division information of the province, region (prefecture), city (county), town, township, and village where the Tibetan Buddhist temples are located, for example, Zhemuji Temple in Baideng Village, Nierudui Township, Kangma County, Shigatse Prefecture, Tibet (西藏日喀则地区康马县涅如堆乡白登村哲姆寺). The coordinate data include the longitude (S_{3-1}), latitude (S_{3-2}), and altitude (S_{3-3}) of all Tibetan Buddhist temples.

(2) Temporal Staging Index of Tibetan Buddhist Temples (T)

Based on the distribution of the temple construction year information in the temple data, combined with the historical background of the formation, development, and spread of Tibetan Buddhism, as well as the records of Tibetan Buddhist temple gazetteers in various parts of China, the research specifically divides the development and evolution of Tibetan Buddhist temples into five historical periods, as shown in Table 1.

Table 1. Five temporal staging indexes of Tibetan Buddhist temple architectural development.

Stage	Temporal Scale	Description
First Stage (T_1)	633–977 AD	Includes the Tubo period (633–842 AD), also known as the pre-propagation period of Tibetan Buddhism; the period of division and fragmentation (843–977 AD)
Second Stage (T_2)	978–1246 AD	From the beginning of the post-propagation period of Tibetan Buddhism to the establishment of the Sakya local regime
Third Stage (T_3)	1247–1367 AD	From the establishment of the Sakya local regime (Tibet was incorporated into the Yuan Dynasty) to the end of the Yuan Dynasty
Fourth Stage (T_4)	1368–1643 AD	Ming Dynasty
Fifth Stage (T_5)	1644–1796 AD	From the early Qing Dynasty to the mid-Qing Dynasty

(3) Architectural Style Index of Tibetan Buddhist Temples (Y)

Combining the main architectural features of various historical development stages of ancient Chinese architecture and the regional architectural features of Tibet, Sichuan, Qinghai, Inner Mongolia, Beijing, and other places, the research identifies nine specific types of architectural style indexes for Tibetan Buddhist temples, as follows:

(Y_1) Lacan (拉康) style: Tibetan local architectural style.

(Y_2) Sino–Tibetan Combined style: The lower part of the building is in Tibetan local architectural style, while the upper part features a Chinese-style roof covered with glazed tiles or gilded copper tiles, the latter often referred to as a golden roof.

(Y_3) Lacan Style + Sino–Tibetan Combined style: Commonly used for large-scale temple complexes, with monk quarters, Dzachen (扎仓), and ancillary buildings adopting the Lacan style, while important buildings such as the main assembly hall and Buddha halls employ the Sino–Tibetan Combined style.

(Y_4) City style: After the implementation of the political–religious unity system in Tibet, this style imitates the architectural style of Chinese cities.

(Y_5) Castle style: Located on mountain peaks, blending harmoniously with the mountain body, it is often used for palace-style temples with political–religious unity.

(Y_6) Han style: Pure Chinese architectural style.

(Y_7) Tent style: A temple style consistent with the tent style of nomadic areas and herdsmen. Tent temples with a long history are converted into fixed buildings, or both coexist.

(Y_8) Other style: Combines architectural styles from India, Nepal, or other regions.

(Y_9) Unknown/Destroyed: Temples with untraceable and extinct architectural styles.

2.3. Data Distribution Analysis

2.3.1. Overall Spatial Distribution Characteristics of Tibetan Buddhist Temples

Tibetan Buddhist temples are primarily distributed across 47 prefectures or prefecture-level cities within 10 provincial-level administrative regions (including one municipality) in China. In terms of the number of temples, the top three regions are Ü–Tsang, Kham, and Amdo, the three traditional Tibetan areas, accounting for 79.1% of the total number in the country. The number of temples in other provinces gradually decreases with increasing geographical distance, indicating that geographical proximity is an important factor influencing the spatial distribution of Tibetan Buddhist temples (Table 2). Regarding the spatial distribution of temples, Figure 1 shows an overall trend of both central tendency and dispersion. Based on the average of the variable series, the central tendency reflects the common characteristics of Tibetan Buddhist temple distribution under certain spatial conditions; i.e., the central location of the data is mainly concentrated in the three traditional Tibetan areas (or three cultural subregions). However, the spatial distribution patterns of these three regions are not entirely consistent and do not completely align with the

current administrative divisions. In the Ü–Tsang region, temples are mainly distributed linearly along the Yarlung Tsangpo River and the Xiongqu River. The Kham region exhibits a highly concentrated trend in Garze, Ngawa, and Chamdo, which currently belong to Tibet. The Amdo region is primarily concentrated in the eastern part of Qinghai Province, including Xining, Haibei, Haidong, Huangnan, and the adjacent areas of Gansu Province, such as Gannan, Linxia, Lanzhou, and Wuwei. The distribution characteristics of Tibetan Buddhist temples concentrated at the provincial borders of the Kham and Amdo regions are particularly prominent, reflecting not only the residential pattern of traditional Tibetan ethnic groups but also the spatial characteristics of the historical spread and construction of Tibetan Buddhist temples along the Hexi Corridor, an important transportation route. Outside the aforementioned regions, the spatial distribution of Tibetan Buddhist temples clearly shows a dispersed trend with large fluctuations in values, reflecting the overall spatial characteristics of small concentrations and large dispersions in areas beyond the traditional Tibetan regions.

Table 2. Weighted statistics on the spatial distribution of the number of Tibetan Buddhist temples (in terms of provincial administrative districts).

Quantitative Ranking	Province/ Municipality	Number of Temples	Proportion	Average Kernel Density
1	Xizang	530	30.8%	11.15
2	Sichuan (Ganzi, Aba, etc.)	464	27%	22.95
3	Qinghai	366	21.3%	13.08
4	Gansu	105	6.1%	6.73
5	Inner Mongolia	95	5.5%	4.07
6	Beijing	74	4.3%	52.31
7	Yunnan (Diqing, Lijiang)	44	2.6%	5.84
8	Xinjiang	22	1.3%	0.56
9	Hebei (Chengde)	12	0.7%	0.72
10	Shanxi (Wutaishan)	8	0.5%	0.98

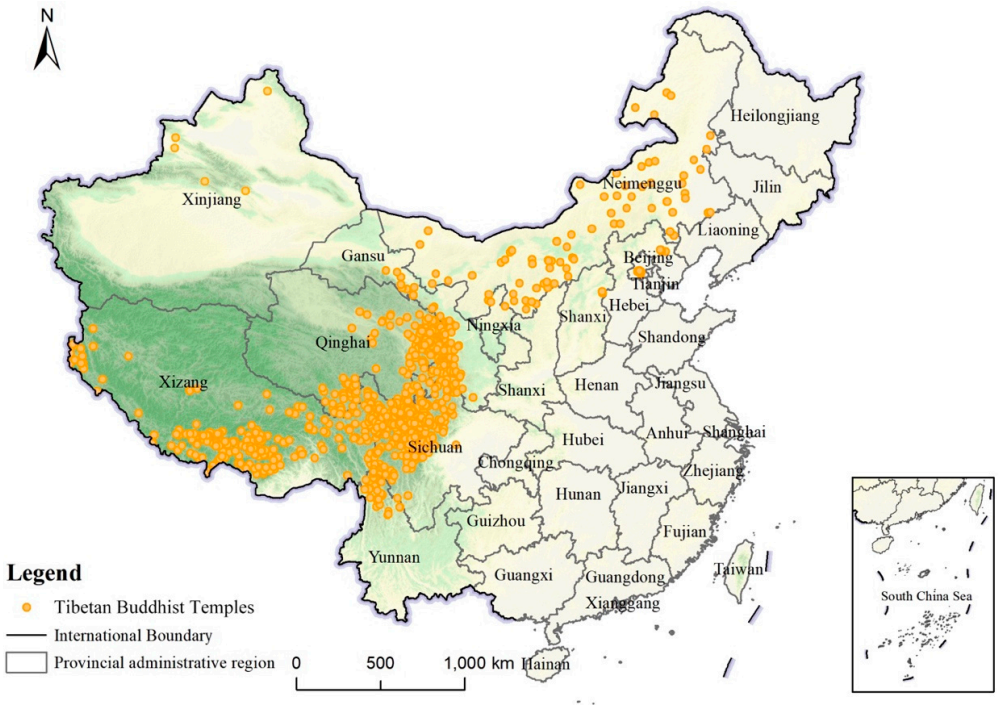


Figure 1. Spatial distribution of Tibetan Buddhist temples.

Simultaneously, according to the spatial distribution of the core density of Tibetan Buddhist temple architecture shown in Table 3 and Figure 2, the density of Tibetan Buddhist temples in Beijing ranks first in the country. One reason is that the Qinghai–Tibet Plateau has a vast area and a sparse population, with each administrative division covering a large scale, resulting in a less concentrated reflection of temple density. Another important reason is that Beijing was the capital of the Yuan, Ming, and Qing dynasties, and the rulers of these three dynasties all implemented policies of strengthening border governance by vigorously supporting Tibetan Buddhism. Therefore, under the top–down leadership of the central government, Beijing became the most concentrated area for temple distribution outside the traditional Tibetan regions.

Table 3. Weighted statistics for spatial distribution of nuclear density of Tibetan Buddhist temples (in terms of state/territory).

Kernel Density Ranking	Quantitative Ranking	State/Prefecture-Level City	Kernel Density	Number of Temples
1	8	Beijing	52.31	74
2	7	Haidong, Qinghai	45.81	89
3	10	Xining, Qinghai	43.74	39
4	5	Lhasa, Xizang	37.19	109
5	1	Ganzi, Sichuan	20.56	327
6	4	Shannan, Xizang	16.83	128
7	2	Aba, Sichuan	12.75	135
8	9	Gannan, Gansu	10.28	54
9	3	Shigatse, Xizang	11.16	133
10	5	Yushu, Qinghai	4.95	109

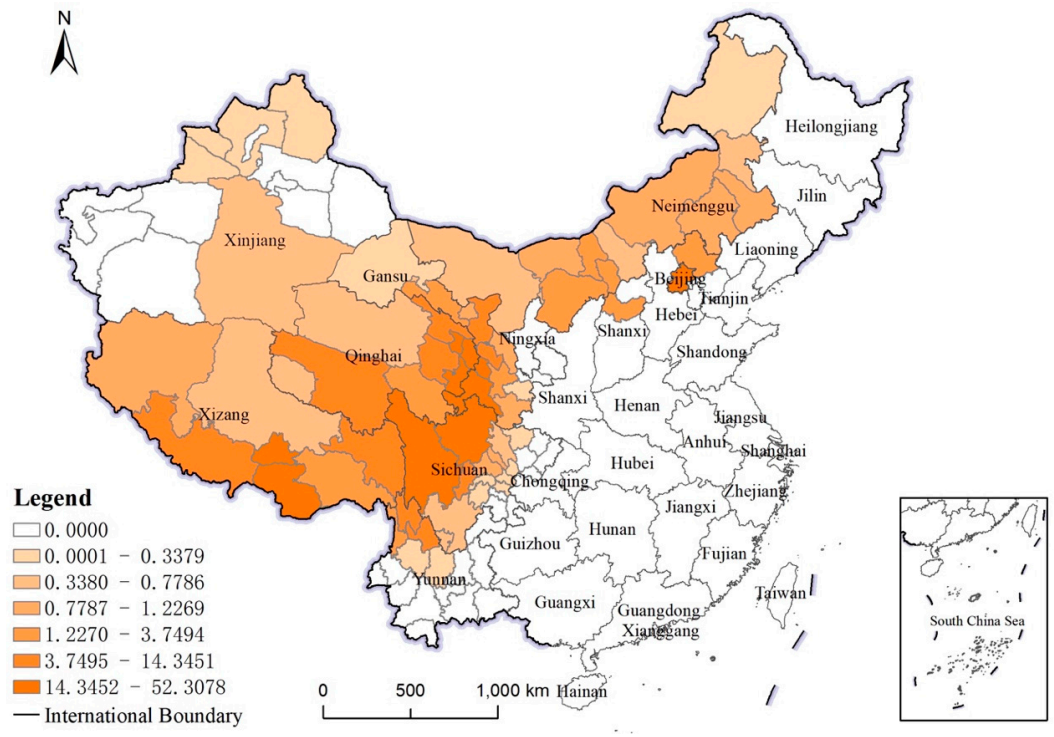


Figure 2. Spatial distribution of nuclear density of Tibetan Buddhist temples.

2.3.2. Overall Temporal Evolution Characteristics of Tibetan Buddhist Temples

Table 4 shows that the number of Tibetan Buddhist temples generally exhibits an increasing trend in the time dimension, growing from 148 temples in the Tubo period (T_1) to 1720 temples by the end of the 18th century. The average growth index across

the five periods is approximately 7.1%. The Qing Dynasty (T_5) had the highest number of temple constructions (632) and the highest construction density (4.16), followed by the Ming Dynasty (T_4) with 477 temples. Although the period from the establishment of the Sakya local regime to the Yuan Dynasty (T_3) had the shortest time span (120 years), it had a relatively high construction density (2.03), ranking second.

Table 4. Statistics on the distribution of Tibetan Buddhist temples in five historical stages.

	Time Scale	Scale Length (Year)	Number of Temples	Proportion	Construction Density
(T_1)	633–977	344	148	8.6%	0.43
(T_2)	978–1246	268	219	12.7%	0.85
(T_3)	1247–1367	120	244	14.2%	2.03
(T_4)	1368–1643	275	477	27.7%	1.73
(T_5)	1644–1796	152	632	36.7%	4.16

Figure 3 analyzes the distribution changes and transmission directions of Tibetan Buddhist temples in different time periods. For example, during the Tubo period (T_1) and the initial stage of the Later Diffusion period (T_2), Tibetan Buddhist temples were mainly distributed in the Ü–Tsang and Kham regions, showing a balanced development trend. Starting from the Yuan Dynasty, the number of temples in the Amdo and Gansu regions increased significantly, displaying a transmission trend from west to east (Beijing). The Ming Dynasty (T_4) and Qing Dynasty (T_5) not only witnessed a rapid increase in the number of temple constructions (accounting for about 2/3 of the total) but also a wider distribution range, clearly showing the expanding trend of transmission from west to east (Inner Mongolia, Beijing, context Chengde, Wutai Mountain, etc.). Meanwhile, there were corresponding transmissions and distributions in the Xinjiang region.

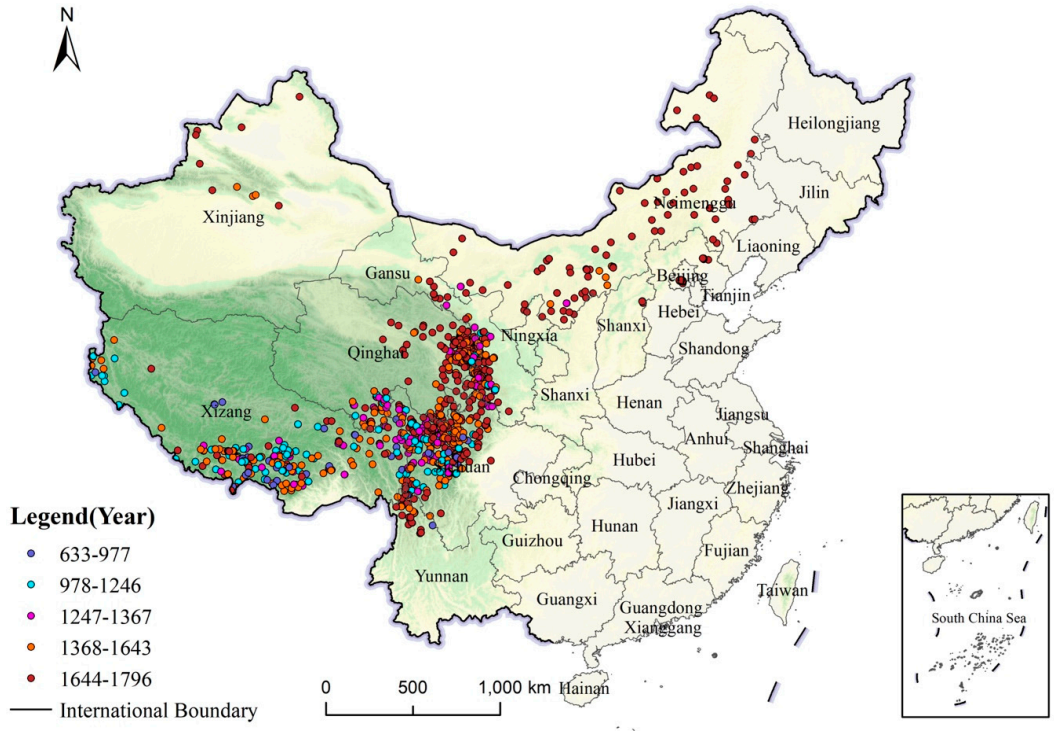


Figure 3. Spatial distribution of the number of Tibetan Buddhist temples in the five historical stages.

The most direct dominant factors for the spatiotemporal variation trends exhibited by Tibetan Buddhist temples are the political, social, and economic connections between the central and local governments in each period. Meanwhile, the coupling relationship among

various sects of Tibetan Buddhism is also an important factor influencing the spatiotemporal evolution of temple architecture. Taking the Gelug sect temples as an example, after the rise of the Gelug sect in the early 15th century, they began to widely construct temples. After the 16th century, due to sectarian disputes, the proportion of Gelug sect temples in spatial distribution decreased. It rose again during the time of the Fifth Dalai Lama, and the spatial distribution of Gelug sect temples reached its peak after the 17th century. Moreover, the diffusion patterns of Gelug sect temples varied in different periods. The Ü–Tsang region reflected a single-center diffusion pattern; the Kham region embodied a slow and variable diffusion pattern, i.e., a multi-center diffusion pattern with small and separated ranges, and the Amdo region formed the most complex cross-distribution multi-center diffusion pattern, i.e., a diffusion pattern from the outside to the inside, from point-like multi-center diffusion to tree-like.

2.3.3. Overall Evolutionary Characteristics of Architectural Styles in Tibetan Buddhist Temples

Figure 4 illustrates the overall spatial distribution of the nine architectural styles found in Tibetan Buddhist temples. Table 5 and Figure 5 provide a detailed analysis of the specific distribution of different architectural styles in each historical period.

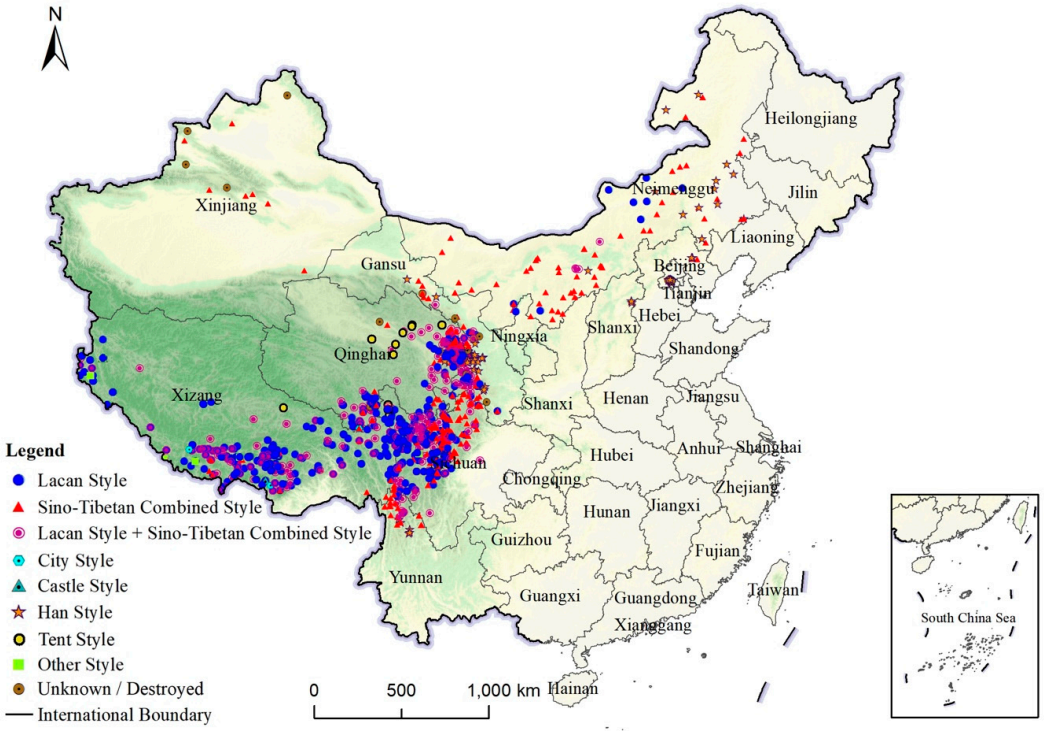


Figure 4. Spatial distribution of nine architectural styles of Tibetan Buddhist temples.

Table 5. Statistics on the number of nine architectural styles of Tibetan Buddhist temples in five historical stages.

	(Y_1)	(Y_2)	(Y_3)	(Y_4)	(Y_5)	(Y_6)	(Y_7)	(Y_8)	(Y_9)	**Total**
(T_1)	131	–	–	–	5	4	–	8	–	148
(T_2)	189	9	19	–	–	–	–	2	–	219
(T_3)	110	47	58	4	2	15	–	2	6	244
(T_4)	112	138	170	2	1	39	2	1	12	477
(T_5)	60	215	230	11	–	88	9	–	19	632
Total	602	409	477	17	8	146	11	13	37	1720

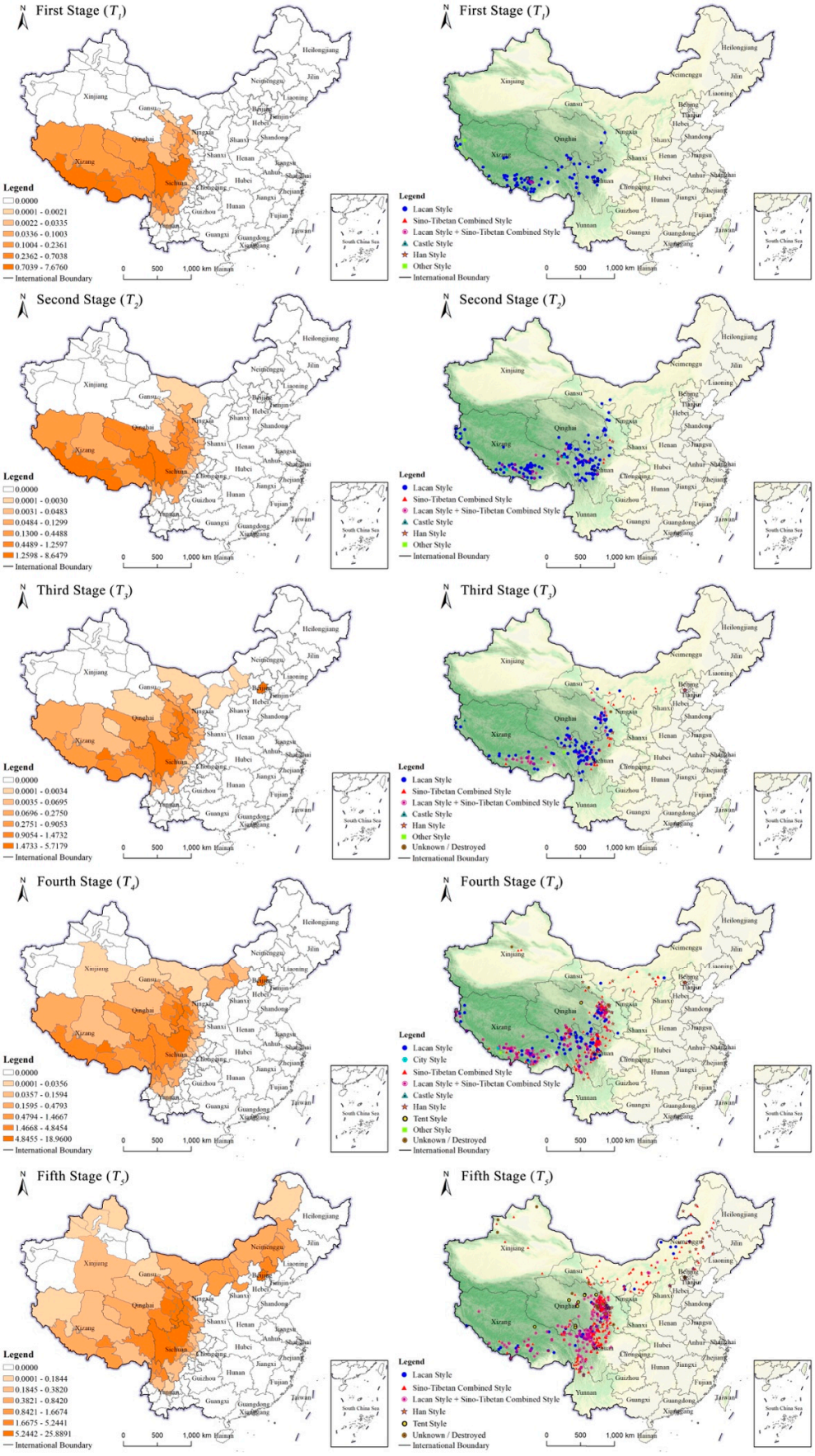


Figure 5. Distribution of 9 Tibetan Buddhist temple style types in 5 historical periods.

During the Tubo Period (T_1), the architectural style and construction techniques of Buddhist temples of the Tang Dynasty continued to spread from east to west along the Tang–Tibet ancient road[4] and were combined with local elements to form the simple Buddhist halls with only statues enshrining them, and the Lacan style (Y_1), which incorporated local Tibetan architectural features. The Lacan style (Y_1) accounted for approximately 88.5% of the temple styles in this period. Other contemporaneous styles included the Han style (Y_6), which completely imitated Buddhist temples in Han regions; the Castle style (Y_5), built on mountaintops; and the Other style (Y_8), which drew inspiration from architectural styles in Nepal, India, and other regions. In the early stage of the Later Propagation Period (T_2), temples were still predominantly in the Lacan style (Y_1). However, the Sino–Tibetan Combined style (Y_2) began to emerge, albeit in small numbers (28 temples), as construction techniques were being experimented with.

From the mid-13th century on, the Yuan government established the Sakya local regime in Tibet and revered Tibetan Buddhism as the state religion. During this period (T_3), Tibetan Buddhist temples perfected the Sino–Tibetan Combined style (Y_2) through the mutual learning of architectural styles. This style features a Chinese-style gable-and-hip roof (歇山屋顶) set atop the brick–wood structure of the Lacan style (Y_1), integrating Han-style beam-lifting wooden frame (抬梁式木构架), dougong (斗拱, bracket sets), caisson ceiling (藻井), and other carpentry work construction techniques. It presents an architectural style that combines Tibetan architectural forms and Tibetan Buddhist rituals while exhibiting Chinese architectural characteristics. Simultaneously, with the establishment of the political–religious integration system, the City style (Y_4), which imitated the Chinese city system, emerged. As the Yuan, Ming, and Qing Dynasties implemented strong support policies for Tibetan Buddhism, the Lacan style (Y_1) began to decrease in number from the (T_3) period. In contrast, the Sino–Tibetan Combined style (Y_2) and the larger temple complexes (Y_3), which combined (Y_1) and (Y_2), continuously increased over time. During the Ming (T_4) and Qing (T_5) periods, they accounted for about 2/3 (67.9%) of the architectural styles of Tibetan Buddhist temples. In terms of spatial distribution, there was a trend of continuous spread from west to east to other ethnic minority areas and the Central Plains (中原地区), with (Y_2) and (Y_3) as the dominant cross-cultural architectural styles. Consequently, a large number of Tibetan Buddhist temple buildings were gradually constructed in areas inhabited by ethnic minorities, such as Mongols, Tu, Qiang, Naxi, and Uyghurs, and in inland areas, such as Wutai Mountain, Chengde, Beijing, and Shenyang. At the same time, in places with more contact with Han populations and cultures, such as Sichuan, Yunnan, Gansu, and Inner Mongolia, there was a trend of weakening Tibetan style and increasing Chinese style from west to east. In Beijing, which has the highest nuclear density distribution of Tibetan Buddhist temple architecture, excluding the 16 temples that have no evidence to examine, the Han Style (Y_6) accounted for 94.8% of the remaining Tibetan Buddhist temples. Therefore, it can be seen that the formation and spread of Tibetan Buddhist temple architectural styles present two spatiotemporal dimensions of "Westward Transmission" and "Eastward Diffusion", and there is a spatial gradient from west to east in the geographical dimension. Based on this, this research draws a bidirectional dissemination mapping (Kong 2001) of the cross-cultural architectural style of Tibetan Buddhist temples (Figures 6 and 7).



Figure 6. Westward transmission mapping of Tibetan Buddhist temple architectural styles.



Figure 7. Eastward Diffusion mapping of Tibetan Buddhist temple architectural styles.

3. Westward Transmission: Analysis of the Formation Mechanism of Architectural Styles in Tibetan Buddhist Temples

3.1. Transplantation and Inheritance of Architectural Styles from the Han Region

From the 7th century AD, Buddhism served as a bridge for cultural exchange between the Tubo Dynasty and the Tang Dynasty. The introduction of architectural styles from the Han region became one of the important factors influencing the formation of architectural styles in Tibetan Buddhist temples during the Tubo period (T_1). In 641 AD, when Princess Wencheng entered Tubo for marriage, she brought not only Buddhist scriptures and statues but also the methods and regulations for building temples, along with a large number of architectural craftsmen. In the same year, she presided over the construction of the Ramoche Temple[5] (小昭寺), using the layout and architectural style of Han-style courtyards. According to the *Records of Tibetan Kings' Lineages* 西藏王统记 (1388), "The Han empress also summoned many carpenters and sculptors from the Han region to build the Jokhang Temple, with the temple gate facing east." (Wang et al. 2021, p. 57). The *General History of Tibet* 西藏通史 also records, "The Han-style glazed tile roof is colorful and beautiful, shining brightly; the flying eaves are magnificent." (Puncog et al. 1996, p. 215). This marked the first appearance of glazed tile roofs and flying eaves in the Tibetan region, as well as the first attempt at Han-style architecture in Tibet (Min and Zhang 2021). The Zhala Lhakhang Cave (扎拉鲁普石窟), built at the foot of Mount Yaowang in Lhasa during the same period, is a pagoda temple cave with a central pillar and shrine rooms on four sides. Its layout is identical to Caves No. 1 and 3 of the Gongyi Grottoes (巩义石窟) in Henan (Northern Wei period) and Caves No. 290 and 428 of the Mogao Grottoes (莫高窟) in Dunhuang (Northern Zhou period). It is evident that both temple and cave layouts reflect the influence of Han Buddhist architectural styles on the Tubo region from the 7th to 9th centuries AD.

The Shen–Chang–Zulakang Temple (now the Jokhang Temple (大昭寺)) is the earliest Buddhist temple in the Tibetan region that combines the Lacan layout with Tang-style wooden structures. When it was first built in the early 7th century, it only included a front courtyard and a main hall for enshrining Buddha statues, with a circumambulation corridor surrounding it for people to worship. The overall "回"-shaped Lacan layout (Figure 8) laid the foundation for the later Tibetan Buddhist temple layout. Through continuous expansion, it developed into a combination of multiple Lacan buildings resembling the multi-courtyard layout of the Han region. During the initial construction of the Jokhang Temple, Buddhism had just been introduced. The scale of the Buddha Hall was small, and the style was simple. Although the use of the Tibetan flat-roof dense-beam structure did not deviate from the local architectural system, it also took the transplantation of foreign culture as the main direction for the architectural style of Buddhist temples. The corridor columns, beams, caisson ceilings, and dougong on the first and second floors of the Sakyamuni Main Hall are all original components from the Tang Dynasty. In particular, the giant inverted V-shaped forked hands supporting dougong and Tibetan-style bearing wood on the central beam are typical components of the Tang wooden structure system (Figure 9). The transplantation and reproduction of wooden structural elements and construction techniques reflect that the architectural forms of the Han region were an important reference for the early rise of Tibetan Buddhist architecture. Under the influence of the Central Plains culture, the local architectural customs and construction techniques in Tibet also underwent some notable explorations and attempts (Table 6).

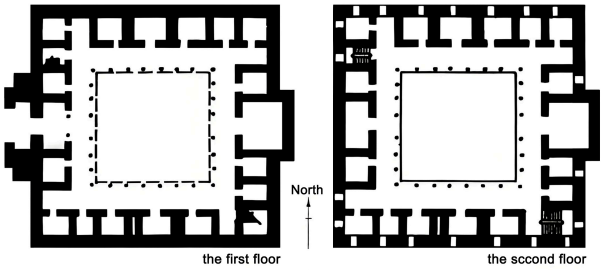


Figure 8. T'ang dynasty plan of the Jokhang Temple.



Figure 9. The giant inverted V-shaped forked hands in the Jokhang Temple.

Table 6. The giant inverted V-shaped forked hands in the Jokhang Temple.

Origin	Content	Similarities
Han Influence	Temple Site Selection	Geomancy
	Wooden Structure System: Chashou (叉手, inverted V-shaped brace), Shuzhu (蜀柱, short post), Dougong (斗拱), and other wooden components	Consistent with the form and craftsmanship of Tang Dynasty components
	Mural techniques	Consistent with the meticulous painting methods of the Han region
Tibetan Characteristics	Architectural Layout: Lacan Style	Consistent with local architecture
	Architectural Colors	
Influence from Nepal, India, and other regions	Decorative Art of Components such as Beams, Columns, and Lintels	Decorative Techniques

Samye Temple (桑耶寺), the first true temple in Tibet (complete with Buddha, Dharma, and Sangha), was built in Shannan in 763 AD. With its reproduction of the mandala layout and the scale of its temple complex with numerous halls and pagodas, Samye Temple thoroughly broke through the single Buddha hall form of the early Jokhang Temple, which was used solely for worshipping Buddha and offering scriptures (Figure 10). The second floor of the Wuzi Hall in Samye Temple was built by Han craftsmen in the architectural style of the inland, with interior furnishings consistent with the painting and Buddha statue styles of the Han region and enshrining the guardian deities unique to the inland. This is recorded in detail in the Bashe (also known as the Detailed Records of Samye Temple): "Then there is the middle-level hall, using musk and sandalwood as timber. Using the skin of wild yellow cattle as a sculpting material for statues, sculpted in the

style of the inland." (Ba 1990, p. 42). Dougong is a typical wooden element of the Central Plains (Liu 2005, p. 181), and its use in the Wuzi Hall is recorded in Bashe: "Then, walls are built, with drainage holes left outside the wall base, and column bases are installed inside, with columns erected on the bases, leaf-shaped dougong, at the top of the columns, beams on the dougong, rafters on the beams, wooden boards on top, and tiles laid on the boards." (Ba 1990, p. 45). The most numerous relics from the temple construction period at Samye Temple are Chinese-style bricks and tiles. According to the Cultural Relics Records of Zhanang County, the bricks and tiles of Samye Temple were fired locally after Han craftsmen introduced the firing techniques, and some of the tubular tiles combined with tile ends and drips are exquisite (Thorang and He 1986, p. 23).

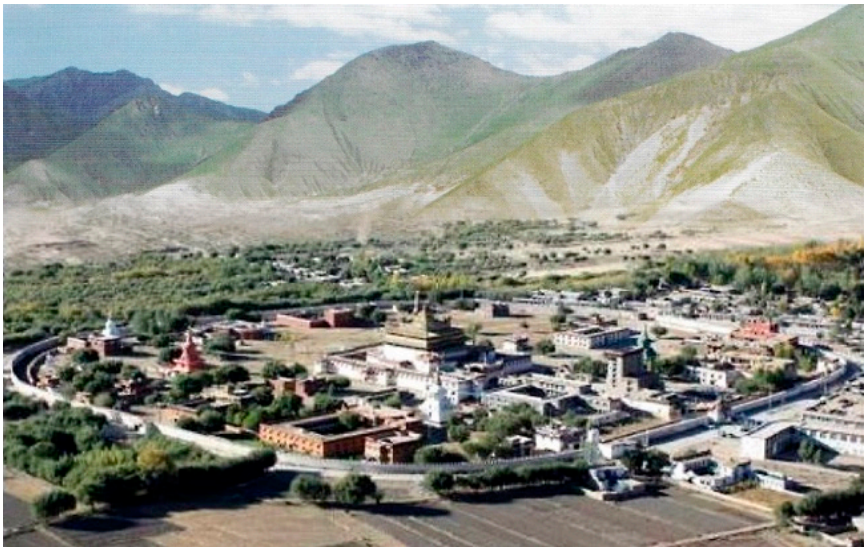


Figure 10. Sangye Temple layout.

"From then on, Buddhism began to gain the so–called 'state religion' status in Tubo." (Wang 1997, p. 101). During this period, Tubo also sought the map of Wutai Mountain from the Tang Dynasty, gathered craftsmen, and built widely constructed temples. "By this time, the Tubo kings and ministers had built one thousand and eight temples in the Han region and Tubo" (*Records of Tibetan Kings and Ministers* 西藏王臣记) (Ngawang 2002, p. 146).

3.2. Reconstruction and Innovation of Architectural Styles from the Han Region

As Buddhist culture deeply integrated into Tibetan areas, the post-propagation period became a crucial development stage for Tibetan Buddhist temples. Various sects actively constructed temples, and the architectural styles of Buddhist temples gradually formed a complete system. According to existing data, from the 10th to the first half of the 13th century (T_2), there were 140 temples of Lacan (拉康) and Gompa (贡巴) levels, including 63 in Lhasa, 22 in Shigatse, and 32 in Shannan.

After the Liangzhou Conference in 1247, the Yuan Dynasty revered Tibetan Buddhism as the state religion and established the Sakya local regime. Following the Tang–Tubo period, Buddhist culture once again played a vital role in the multi-ethnic relations of the Yuan Dynasty. The system of combining politics and religion also led to the expansion of temple functions. In 1268, the State Preceptor Phagpa directed the construction of Sakya South Temple (萨迦南寺) in Shigatse. As the earliest temple integrating politics and religion, Sakya South Temple followed the local Lacan architectural form. However, influenced by the Han region's city construction system, it adopted a city wall system consisting of moats, inner and outer walls, and corner towers, resembling a fortress-style architecture modeled after the layout of cities in the Han region (Figure 11). According to research, the dougong, beams and murals of the original Sakya North Temple (萨迦北寺) on the north

bank of the Zhongqu River also exemplified the typical official style of the Yuan Dynasty (Zhang 2017). The *Han–Tibetan Historical Collection* 汉藏史集 records that after Sangge entered Tibet in the 17th year of the Yuan Dynasty to resolve the Gongga Sangbu issue, he "constructed Dong Jia Qiong Zhang Kang in Sakya, with the gate tower adopting the Han-style." Similarly, the multi-eaved gable-and-hip roof with glazed tiles, the dougong beam frame, and some architectural decorations of the Shalu Temple (夏鲁寺) in Shigatse were crafted by artisans from the Han region and considered historical remains of the Yuan Dynasty's official architecture (Longzhu 2016, p. 220). *The Records of Tibetan Kings and Ministers* 西藏王臣记 also mentions that "Gadezeng of Gongtang Temple invited skilled artisans from the Han region to construct the central courtyard of the temple and cast the golden roof[6] and golden eave vases." (Ngawang 2002, p. 312). This indicates that after the Yuan Dynasty established the vassal relationship, the frequency of cultural exchanges between the Han and Tibetan regions surpassed that of the Tubo period.



Figure 11. Sakya South Temple layout.

Among them, the Shalu Temple[7] (夏鲁寺), the ancestral temple of the Shalu sect, has long been regarded as a typical example of the combination of Han and Tibetan architecture. By gathering the construction techniques and style features of both Han and Tibetan regions, a Han-style lifted-beam wooden frame with a gable-and-hip roof was built on top of the flat-roofed structure of the Tibetan-style Lacan at the bottom layer. Through the ingenious integration of the upper and lower structural systems, this Sino–Tibetan Combined style (Y_2) architecture, praised as the "Buddha Hall and the Halls with Large and Small Roofs of the Shalu Golden Palace", created a style that embodies the joining and reconstruction of Han and Tibetan architectural cultures. In terms of layout, the four glazed-tile gable-and-hip roofs on the second floor of the Shalu Temple form a Han-style quadrangle courtyard (Chen 1994). When the Shalu Temple was built, the main hall faced east, inheriting the mainstream practice of temples facing the Han region during the pre-propagation period. During the Yuan Dynasty reconstruction, this layout was preserved (Su 2021, p. 183). In terms of the structural system, the Shalu Temple above the second floor is virtually a Han-style Buddhist temple. The flying eaves of the main hall's roof are supported by 45° oblique arms, and the roof slope-to-span ratio is 1:4, a practice that emerged in the Liao Dynasty's Chinese architectural history (Liu 2005, pp. 360–91). The construction methods such as side feet (侧脚, a slight inward incline of the columns), rising (升起, a gradual increase in the height of the columns from the central bay toward the corners of the building), and column reduction (减柱造) used in the four Buddha halls were also the main features of official architecture during the Song and Yuan periods. In terms of materials and decorations, the interlocking dougong under the eaves of the gable-and-hip roof, the green glazed tiles, tile ends, dripping water on the eaves, the overlapping tiles on the main and secondary ridges, and the owl-tail ridge ornaments on the roof were all of Han-style (Figure 12).

"The Later Tibetan Annals" records that, due to the participation of a large number of artisans from the Han region in the construction of the Shalu Temple, "installing golden treasure vases on the ridges of the green–tiled Han-style roofs have four advantages. The houses outside the walls at the four corners are green–tiled corner towers, decorated with golden roof treasure vases. The Golden Hall has a three–story Han-style roof, and no other building has a double–layer Han-style roof format". (Dunga 2002, p. 190). Subsequently, this Sino–Tibetan Combined style was continuously refined in the practice of Tibetan temple architecture, becoming the "Sino–Tibetan Style". During the expansion of the Jokhang Temple in the 17th century, four Han-style gable-and-hip roofs were similarly added above the early Tibetan flat roof, forming a quadrangle (Figure 13). Moreover, the dougong forms used in the three-story main hall, such as the nine-step four-arch and seven-step three-arch, as well as the multi-eaved gable-and-hip roof form, were consistent with the practices in the Han region during the Ming and Qing Dynasties.

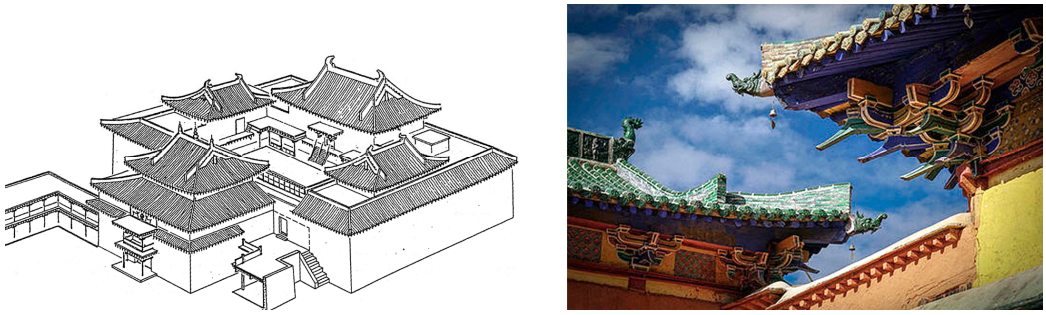


Figure 12. Shalu Temple's "Sino–Tibetan Combined Style".

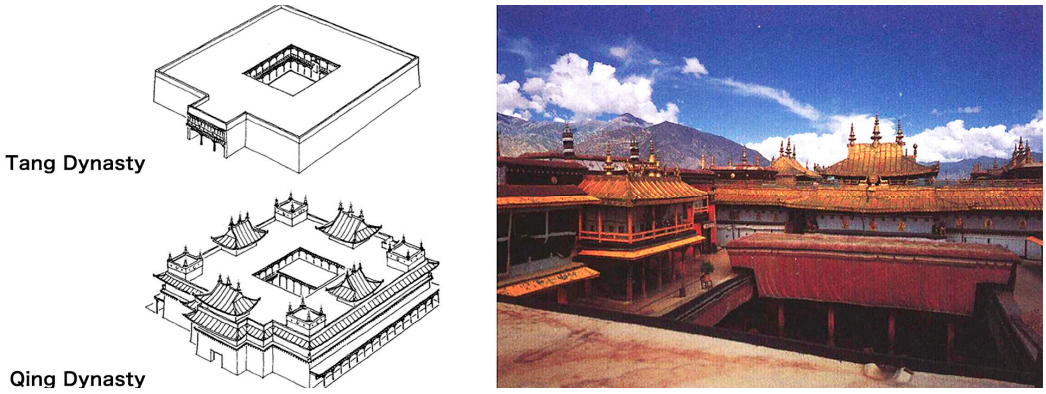


Figure 13. In the 17th century, the Jokhang Temple was expanded on the basis of the "combined Chinese and Tibetan system".

Through the comparison of architectural features of Tibetan Buddhist temples in different periods (Table **??**), early temples represented by the Jokhang Temple, Samye Temple, Sakya South Temple, and Shalu Temple did not form a unified style and pattern. In the early 15th century, the Gelug sect was founded. With the support of the Pazhu regime, Tsongkhapa carried out religious reforms. After the temples completed the transformation from Lacan (Buddha Hall) to Gompa (Temple), they gradually developed a fixed paradigm. The main manifestation is that the Coqen Hall (措钦大殿) adopts the "Dugang style" (都纲法式) layout with the front sutra hall and the rear Buddha hall, and the "Coqen–Dzachen–Khangtsang" (措钦–扎仓–康村) temple organizational structure with the Coqen Hall as the center, the numerous Dharma colleges as the main body, and the monk residence units as the grassroots organization. The temple regulations took shape and became the center of local cultural education, with the Six Great Temples being the most typical examples[8]. In the 17th century, the Fifth Dalai Lama, Lobsang Gyatso, established the Ganden Phodrang regime in Tibet with the support of Güshi Khan, the Mongol leader of Kokonor. The architectural form

and style paradigm of Tibetan Buddhist temples, represented by the three-section layout of the Gelug Temple's "Dugang style" and the "two solids with one void" facade, began to spread to areas outside Tibet. At the same time, many temples of other sects were also rebuilt and expanded according to this paradigm after converting to the Gelug sect.

Table 7. Comparison of temple architectural features in different periods.

Temple Name	Construction Time	Location	Layout	Form	Style
Jokhang Temple 大昭寺	7th century	Lhasa	Buildings facing east–west	Lhakhang Form	Lacan Style (Y_1), Han Style (Y_6), Other Style (Y_8)
Samye Temple 桑耶寺	763	Zhanang County, Shannan	Layout imitating the ideal Buddhist kingdom with Mount Meru as the center	Lhakhang Form	Lacan Style (Y_1), Han Style (Y_6), Other Style (Y_8)
Sakya South Temple 萨迦南寺	1268	Shigatse	Square city layout	Lhakhang Form	City Style (Y_4)
Shalu Temple 夏鲁寺	Rebuilt in 1329	Shigatse	Courtyard layout, buildings facing east–west	Sino–Tibetan Combined Form	Sino–Tibetan Combined Style (Y_2)
Ganden Temple 甘丹寺	1409	Dagzê County, Lhasa	Centered on Coqen Hall, layout according to the mountain	Dugang style, Sino–Tibetan Combined Form	Lacan Style + Sino–Tibetan Combined Style (Y_3)
Drepung Temple 哲蚌寺	1416	Lhasa	Centered on Coqen Hall, cascading layout according to hierarchy	Dugang style, Sino–Tibetan Combined Form	Lacan Style + Sino–Tibetan Combined Style (Y_3)
Sera Temple 色拉寺	1419	Lhasa	Centered on Coqen Hall, free layout from east to west	Dugang style, Sino–Tibetan Combined Form	Lacan Style + Sino–Tibetan Combined Style (Y_3)
Tashi Lhunpo Temple 扎什伦布寺	1447	Shigatse	Centered on Coqen Hall, layout according to the mountain	Dugang style, Sino–Tibetan Combined Form	Lacan Style + Sino–Tibetan Combined Style (Y_3)
Kumbum Temple 塔尔寺	1560	Huangzhong County, Qinghai	Centered on the Great Golden Tiled Hall	Dugang style, Sino–Tibetan Combined Form	Lacan Style + Sino–Tibetan Combined Style (Y_3)
Labrang Temple 拉卜楞寺	1709	Xiahe County, Gansu	Centered on Coqen Hall and the Great Golden Tiled Hall	Dugang style, Sino–Tibetan Combined Form	Lacan Style + Sino–Tibetan Combined Style (Y_3)

The Potala Palace (布达拉宫), a spatial landmark of Tibetan Buddhism, adopts the architectural form of the largest dzong in Tibet, reflecting its attribute of the unity of politics and religion. The White Palace, serving as the palace section, features the main hall, Chongqing Sha (崇青厦), which employs the "Dugang style" of Tibetan scripture halls. The Red Palace, functioning as the temple section, incorporates the Shusheng Sanjie Hall, a blend of Chinese and Tibetan architectural styles, where the Golden Urn ritual was performed during the Qing Dynasty. Simultaneously, the Potala Palace innovates upon the integration of Chinese architectural styles and decorative symbols. According to Tibetan historical records, after the establishment of the Ganden Phodrang regime, the Chinese-style gable-and-hip golden roof, replacing glazed tiles with gilded copper tiles, became an essential component of temples, palaces, and mausoleums, as well as the highest-grade architectural symbol in Tibet. The Potala Palace boasts the highest number of golden roofs in Tibet (Figure 14), and the decorative elements of these roofs are a unique artistic creation based on Chinese ridge ornamentation. Specific features include

the large bell-shaped treasure vase at the center of the main ridge, the small stupa-shaped treasure vases on either side, and the makara fish heads resembling elephant trunks at the four corners of the hip ridges. The "Dongga Tibetan Studies Dictionary" records that the treasure vase decorations on the roof ridges are unique to Tibetan Buddhist temples. The makara fish head motifs with elephant-trunk-like features at the four corners of the hip ridges originated from the combination of the makara fish in Buddhism and the traditional Chinese dragon mouth, which emerged in the Tang Dynasty and became a typical decorative symbol of golden roof hip ridges after being introduced to Tibet (Figure 15). It is evident that during the later dissemination period, important Chinese architectural elements, such as the gable-and-hip roof, dougong, tuomu beams, caisson ceilings, colorful paintings, and ridge decorations, were skillfully applied to Tibetan Buddhist temples (palaces). The mortise and tenon joints of the Chinese and Tibetan architectural structural systems laid the foundation for the paradigm of Tibetan Buddhist architectural styles, further forming representative combination forms and decorative systems.



Figure 14. Potala Palace consists of a cluster of seven golden domes.



Figure 15. Capricorn fish head in the form of an elephant-nosed dragon with bumped ridges and horns.

4. Eastward Diffusion: Analysis of the Transmission Mechanism of Tibetan Buddhist Temple Architectural Styles

4.1. Cultural Bidirectional Exchange Driven by the Central Government

Cultural exchange is bidirectional. Han architectural culture accompanied the "Westward Transmission" of Han Buddhism to Tibetan areas and formed a fixed pattern after local integration. Similarly, Tibetan architectural culture also "spread eastward" to areas outside Tibet with the "eastward spread" of Tibetan Buddhism. This bidirectional transmission process was both a cultural phenomenon and a social phenomenon during the period of great cultural development and integration in Chinese history (Xie 2018).

The rise of Tibetan Buddhist temples in the Mongolian region in the 13th century marked the true "eastward spread" of Tibetan architectural culture. It also established a bridge from the Mongolian region into the Central Plains. Therefore, the Yuan Dynasty became an important period for the spread of Tibetan Buddhist architectural styles to the Central Plains. The Yuan government consolidated its rule by supporting Tibetan Buddhism and widely constructing temples in areas outside Tibet and Mongolia. Consequently, Yuan Dadu (元大都, now Beijing) became the center for the gathering and dissemination of Tibetan Buddhist architecture and culture. The rapid construction of Tibetan Buddhist temples in Yuan Dadu, and the inscriptions of the "Dharani Sutra" in six languages, including Chinese, Tibetan, Tangut, Rañjanā Sanskrit, Uyghur Mongolian, and 'Phags–pa scripts on the Yuntai of Juyongguan Pass on the route from Dadu to Shangdu, all symbolized the beginning of a new era for a multi-ethnic country. At the same time, the prosperity of Sino–Tibetan political and cultural exchanges during the Yuan Dynasty greatly enriched the architectural and artistic forms of Tibet itself. Han architectural styles, sculpture, and painting techniques were brilliantly embodied in numerous temples in Tibet (Zhao 2009, pp. 15–19). Meanwhile, a unique Sino–Tibetan cultural circle also formed in Hangzhou in the 13th century. The Sakya-style stone carvings and Buddha statues in Lingyin Temple (灵隐寺) and Baocheng Temple (宝成寺) inherited the Yuan tradition, laying the foundation for the spread of Tibetan Buddhism and its artistic style in the Jiangnan region.

During the Yuan to Qing Dynasties, the Han Chinese Buddhist temples along the Hexi Corridor experienced a phenomenon of "Tibetanization". As a pivotal area for meetings and negotiations between the Yuan government and eminent Tibetan monks, as well as a convergence zone for the mutual penetration of Han and Tibetan Buddhist cultures, the Hexi Corridor region exhibited a highly flexible cultural dimension. Among the more than fifty existing Tibetan Buddhist temples in this region, over half, such as the Haizang Temple (海藏寺) in Wuwei and the Tiantang Temple (天堂寺) in Tianzhu, were converted from Han Chinese Buddhist temples to Tibetan Buddhist temples. Additionally, some temples in this region were a combination of Han and Tibetan styles. Simultaneously, there were also some Han Chinese Buddhist temples that were once Tibetan Buddhist temples. Consequently, the alternating process of "Tibetanization" or "Sinicization" reflected in the architectural styles of Buddhist temples in the Hexi Corridor region became a microcosm of their bidirectional transmission.

The Ming and Qing Dynasties marked the heyday of bidirectional exchange between Han and Tibetan architectural cultures. Due to the rapid spread of Tibetan Buddhism in the interior, during the early stages of the establishment of the Four Great Temples of the Gelug school, the Yongle Emperor of the Ming dynasty bestowed the title of "State Preceptor" upon the Gelug monk Shakya Yeshe and successively conferred the title of "Eight Great Dharma Kings" in Tibetan areas. During the same period, Tibetan Buddhism and its temple architecture began to spread to the Naxi people in Yunnan and the Tu people in Qinghai. With the interactions of eminent Tibetan monks and the enthusiasm of the nobility, the Tibetan style became the mainstream aesthetic in Beijing during the Qing Dynasty. The Eight Auspicious Symbols, the Eight Treasures, and the upturned lotus pedestal became decorative patterns deeply loved by the royal family and embraced by the common people in the capital. Tibetan Buddhist scripts were favored as decorations on daily utensils and book illustrations. Tibetan Buddhist temples in Beijing, such as the Yonghe Temple (雍和宫), Biyun Temple (碧云寺), Xihuang Temple (西黄寺), and Fuyou Temple (福佑寺), have preserved the historical traces of eminent monks such as the Fifth Dalai Lama and Panchen Lama in the capital. These temples echo the mural scenes in the West Hall of the Potala Palace and the New Palace of Norbulingka (罗布林卡) in Lhasa, depicting the Fifth Dalai Lama's visit to Beijing to pay homage to Emperor Shunzhi.

4.2. Spatial Hierarchy in the Bidirectional Transmission of Architectural Styles of Tibetan Buddhist Temples

The bidirectional transmission of architectural styles of Tibetan Buddhist temples, both the input of Han-style architecture from Central China and the output of the Sino–Tibetan Combined style (Y_2) after integration, exhibits a certain spatial hierarchy in the spatiotemporal evolution process of "Westward Transmission" and "Eastward Diffusion". On the one hand, when Han-style architecture was initially introduced, cultural transmission displayed a gradual hierarchy from east (Ü–Tsang region) to west (Ngari region) in Tibet, which was caused by the top–down cultural exchange model led by local governments. Later, when the architectural style of Tibetan Buddhist temples was exported, this cultural "feedback" phenomenon was also distributed around the political environment, forming three centers in Mainland China: Mount Wutai, Chengde, and Beijing. On the other hand, when the integrated Sino–Tibetan Combined style, as a whole, spread again to Sichuan, Qinghai, Gansu, Mongolia, and the Central Plains, due to the re–participation of Han craftsmen, it triggered a "secondary sinicization" phenomenon of architectural styles during the transmission process. Based on the original emphasis on imitating the style of Han architecture, the construction techniques became more authentic, and more Han-style components were added (Gao et al. 2019). Moreover, due to the regional differences in the direction of transmission, it presented a clear spatial hierarchy effect from west to east on a national geographical scale.

Therefore, the eastward spread of Tibetan Buddhist temple architectural styles can be considered a process of secondary sinicization, presenting four gradients of basic Tibetan style, Sino–Tibetan combined style, Sino–Tibetan juxtaposed style, and basic Chinese style from near to far. As the first level of outward transmission of Tibetan Buddhist temple architectural styles, the Kham and Amdo regions fully accepted this style due to similarities in climate and ethnic distribution. At the same time, these regions made important explorations in secondary sinicization due to the influence and varying degrees of integration of Han culture geographically. For example, this is reflected in the regulations and practices of the golden roofs (Figure 16) of Tibetan Buddhist temples. The golden roofs of Kumbum Temple (塔尔寺) in Qinghai and Labrang Temple (拉卜楞寺) in Gansu go beyond mere reference to cultural symbols and imitation of visual characteristics. The raising the purlin (举折, the method of determining the curvature of the roof) of roof trusses and eaves employ strict mainland practices (Gao et al. 2019), combined with a more standardized use of dougong, lending the flying eaves a more vivid charm of Chinese architecture. In terms of the ridge decorations on the golden roofs, in addition to inheriting the Tibetan-style main ridge decorated with gilded vases and other dharma objects, the four hip ridges of the golden roof of the Maitreya Hall at Labrang Temple feature the mainland "dragon" image as a ridge decoration for the first time (Figure 17). Its vivid and concrete visual image differs from the artistically abstracted dragons on the roof ridges of mainland palaces and is consistent with the dragon ridge decorations commonly seen in mainland temples. This change is an important marker of the eastward spread of the Sino–Tibetan Combined style. It further developed into eight golden dragons soaring up and down on the four roof ridges of the pyramidal golden roof of the Majestic Hall (妙高庄严殿) of Sumeru Longevity Temple (须弥福寿之庙) in Chengde, Hebei, which is quite spectacular (Figure 18). In terms of building materials and decoration, the front porch and gable walls of the Jiamu Yangzhi Palace (嘉木样寝宫) at Labrang Temple adopt the green brick masonry and fair-faced style of northern mainland architecture, while the rear wall remains in the Tibetan-style thick rammed earth. The doorhead also features brick and wood carvings from the mainland for the first time, with exquisite carving and skilled craftsmanship. The color painting on the surface of the brick carvings preserves and reproduces the Tibetan artistic style (Xie and Man 2021).



Figure 16. The Golden Roof of the Jokhang Temple.



Figure 17. The Golden Roof of the Maitreya Hall in Labrang Temple.



Figure 18. The Golden Roof of the Miaogao Zhuangyan Hall in the Sumeru Longevity Temple.

The architectural styles of the twelve Tibetan Buddhist temples (commonly known as the Eight Outer Temples (外八庙) in Chengde, Hebei, which served as places of worship for the ethnic-minority nobles from the borderlands when they paid homage to the emperor, underwent three stages of development (Fu and Wang 2015, p. 82). The early stage, represented by Puren Temple (溥仁寺) and Pushan Temple (溥善寺), followed the layout and style of Han

Buddhist temples, with only some attempts at incorporating Tibetan Buddhist content and themes in the architectural decorations. The middle stage saw the emergence of combined layouts, such as Puning Temple (普宁寺), where the front half adopted the "Seven Halls of the Garan" layout of Han Buddhist temples, while the rear half employed the "Mandala" layout of Samye Temple. These two layouts were organically integrated into the terraced landscape of the mountains. The later stage, exemplified by Putuo Zongcheng Temple (普陀宗乘之庙) and Sumeru Longevity Temple, broke away from the axisymmetric tradition of Han temples. Instead, they featured the Sino–Tibetan Combined style, with massive Tibetan-style red platforms topped by Han-style golden roofs. Putuo Zongcheng is the Chinese translation of the Tibetan term "Potala." It was modeled after the Potala Palace, emulating its Castle style (Y_5) by choosing a mountaintop location and its color scheme of a white base accentuating the red platform, creating a resonance of Tibetan style in the interior regions.

Finally, Yonghe Temple (雍和宫), which underwent spatial transformation and cultural conversion from a Han-style princely mansion, epitomizes the maximum spatial gradient in the transmission of architectural styles from Lhasa to Beijing. In 1735, Emperor Qianlong replaced the green glazed tiles on the main hall of Yonghe Temple with yellow ones, praising it as "My Chinese Great Temple". In 1744, Yonghe Temple was converted into a Tibetan Buddhist temple, becoming the center for the Qing government's administration of Tibetan Buddhist affairs nationwide (Liu 1996). As Yonghe Temple originated from Han princely mansion architecture, its two expansions and renovations did not alter its Han-style form but instead incorporated some architectural elements of Tibetan Buddhist temples. For example, the Falun Hall, with its cross-shaped plan, features five small pavilions on the Han-style glazed tile roof, each adorned with a Tibetan-style small gilded vase-shaped finial, forming a five-tower composition reminiscent of a mandala, reflecting the important characteristics of Tibetan Buddhist temples. At this point, the physical carrier of architecture was no longer confined to specific external manifestations, and political demands could also become a decisive factor in its stylistic orientation.

5. Conclusions

The development of Tibetan Buddhism and its temple architecture in China has spanned over 1300 years, from the Tubo period to the present day. This research delves into the spatiotemporal evolution characteristics of Tibetan Buddhist temple architectural styles, employing ArcGIS technology to visualize the spatial and geographical distribution of 1720 Tibetan Buddhist temples from the 7th to the 18th centuries. By considering three dimensions—space, time, and architectural style—the research establishes a holistic perspective that encompasses historical stratification and cross-regional spatial associations.

Through analyzing the spatial distribution patterns, spatiotemporal evolution laws, and cultural transmission modes of nine architectural style types across ten provincial- level administrative regions and five historical periods, this research proposes two spatiotemporal dimensions for the formation and propagation of Tibetan Buddhist temple architectural styles: "Westward Transmission" and "Eastward Diffusion". It elucidates the fusion mechanism of Tibetan Buddhist temple architectural styles with Han architectural styles during their formation process since the 7th century AD, as well as the top–down acculturation mechanism led by the central government during their propagation. Additionally, the research reveals a spatial gradient feature: the gradual weakening of Tibetan styles and the gradual strengthening of Han styles from west to east. Building upon this foundation, the research constructs a historical evolution map of Tibetan Buddhist temples, a cross-cultural architectural style based on bidirectional transmission. It clarifies that the recognition of religion and culture is the intrinsic driving force guiding the bidirectional transmission mechanism of Tibetan Buddhist temple architectural styles against the historical backdrop of the formation and output of Tibetan Buddhism from the 7th to the 18th century.

This research demonstrates that examining the spatiotemporal evolution of architectural styles from an objective perspective is an effective approach to clarifying and understanding the interaction, exchange, and integration of different historical periods, spatial regions, and

cultural types. The visual characteristics clearly point to the profound dialogical relationship between physical representations and cultural connotations. As witnesses to history and embodiment of culture, the bidirectional transmission of Tibetan Buddhist temple architectural styles across time and space completes the transformation from visual symbols to value systems, forming a collective memory of inter-ethnic interactions. Therefore, by utilizing the evolution and propagation patterns of Tibetan Buddhist temple architectural styles as clues and carriers for historical research, this research holds great significance for understanding the cultural exchange context oriented by religion and reproducing the cross-spatiotemporal bidirectional exchange cultural landscape between the central government and ethnic regions under their close political associations.

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Notes

1 Historically, due to the system of political–religious unity, Tibetan Buddhist temple architecture has a broad meaning, integrating various functions and roles such as temples, palaces, and schools.

2 The architectural style of the Jokhang Temple features a square courtyard surrounded by small halls, with a large Buddha hall located on the back wall. In contrast, the Samye Temple style centers around a longitudinal rectangular Buddha hall, encircled by a circumambulation corridor. A narrow, horizontal scripture hall is situated in front of the Buddha hall and the circumambulation corridor, with other buildings positioned around this core structure.

3 The data sources referenced in this article include archaeological studies on Tibetan Buddhist temple architecture, such as *Temples of Western Tibet and Their Artistic Features Part I* (1935), *Temples of Western Tibet and Their Artistic Features Part* II (1936), *Gyantse and Its* Temples (1941), *Archaeology of Tibetan Buddhist Temples* 藏传佛教寺院考古(1996), *Records of Tibet* 西藏记(1985), and *Archaeology of Tibet* 西藏考古 (1987). Additionally, the article draws from collections of Tibetan Buddhist temple architecture, including *Chinese Tibetan Buddhist Temples* 中国藏传佛教寺院 (1994), *Tibetan Buddhist Temples* 西藏佛教寺庙 (2003), *Guidelines for Traditional Tibetan Architecture* 西藏传统建筑导则 (2004), *Tibetan Buddhist Temples in Gansu and Qinghai* 甘青藏传佛教寺院 (1990), *Tibetan Buddhist Temples in Tibet* 西藏藏传佛教寺院 (2009), *Tibetan Buddhist Temples in Qinghai* 青海藏传佛教寺院 (2014), *Tibetan Buddhist Temples in Gansu* 甘肃藏传佛教寺院 (2013), *Tibetan Buddhist Temples in Beijing* 北京藏传佛教寺院 (2014), and *Tibetan Buddhist Temples in Sichuan and Yunnan* 四川, 云南藏传佛教寺院 (2014). We also consult local chronicles from various provinces, regions, cities, and counties, such as *Tibet Chronicle* 西藏志 (1936), *Lhasa City Chronicle* 拉萨市志 (2007), *Cultural Relics Chronicle of Ali Region* 阿里地区文物志 (1993), *Ganzi Prefecture Chronicle* 甘孜州志 (2010), *Hohhot City Chronicle* 呼和浩特市志 (1999), *Cultural Relics Chronicle of Zhanang County* 扎囊县文物志 (1986), *Cultural Relics Chronicle of Qonggyai County* 琼结县文物志 (1986), and *Cultural Relics Chronicle of Yadong, Kangma, Gamba, and Dingjie Counties* 亚东, 康马, 岗巴, 定结县文物志 (1993).

4 The Tang–Tibet ancient road began in Chang'an (Xi'an) and ended in Lhasa, with a total length of more than 3000 km, passing through today's Shaanxi, Gansu, Qinghai and Tibet provinces and regions.

5 The current Ramoche Temple is a reconstruction from later generations; only the ground floor shrine remains from the early construction.

6 The golden roof, also known as the golden tile roof, is commonly found in the main halls of Tibetan Buddhist temples. It is a yellow glazed–tile gable-and-hip roof that imitates the palace architecture of the Han region, replacing the glazed tiles with gold–plated copper. The golden roof is also an essential component and architectural decoration of Tibetan temples, palaces, and pagodas.

7 Due to the intermarriage between the Xia Luwan clan and the Sakya lineage, the emperors of the Yuan Dynasty held the Xia Lu lineage in high regard, referring to them as "You are the maternal uncle of the Sakya people for generations, and thus, you are also our maternal uncle." In the second year of the Tianli era of the Yuan Dynasty (1329 AD), the Xia Lu Temple suffered severe damage from an earthquake. Consequently, the central government of the Yuan Dynasty dispatched a large number of Han artisans and resources to repair and expand the temple.

[8] The six great temples of Tibetan Buddhism include: Ganden Temple, Sera Temple, and Drepung Temple in Lhasa, Tibet; Tashilhunpo Temple in Shigatse, Tibet; Kumbum Temple in Xining, Qinghai; and Labrang Temple in Xiahe, Gansu.

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