buildings

MDPI

Article

Spatial Feature Analysis of the Beijing Forbidden City and the Shenyang Imperial Palace Based on Space Syntax

Dongxu Zhang [1], Xuyang Shan [2], Xinyi Zhang [1], Hao Chen [1] and Yingsheng Zheng [1,*]

[1] School of Architecture and Urban Planning, Guangzhou University, Guangzhou 510006, China; zhangdongxu@gzhu.edu.cn (D.Z.); 2112209013@e.gzhu.edu.cn (X.Z.); 2112209006@e.gzhu.edu.cn (H.C.)
[2] College of Arts, Northeastern University, Shenyang 110819, China; shanxuyang96@163.com
* Correspondence: zhengyingsheng@gzhu.edu.cn

Abstract: As two of the most complete existing examples of royal architecture and cultural World Heritage Sites in China, the Beijing Forbidden City and the Shenyang Imperial Palace are distinctive in terms of their spatial organization. This study used the relational diagram method of space syntax theory to quantitatively analyze the spaces of these two palaces. Furthermore, the characteristics of these spaces were explored by comparing the integration and depth value of each palace space, as well as the differences in architectural culture between the different times and nationalities that they reflect. The results show that in the Forbidden City, office space had the lowest degree of spatial enclosure (depth value), while living space had the highest spatial enclosure. Moreover, there was little difference in accessibility (integration value) among office space, living space, and recreation space. In the Shenyang Imperial Palace, the accessibility of office space, living space, and recreation space showed a decreasing trend, while their spatial enclosure showed an increasing trend. The depth values of office space, living space, and recreation space were higher in the Beijing Forbidden City than in the Shenyang Imperial Palace by 245%, 109%, and 35%, respectively. The integration value of office space was 22.2% higher in the Shenyang Imperial Palace than in the Forbidden City, while the integration values of living space and recreation space were higher in the Forbidden City than in the Shenyang Imperial Palace by 13.9% and 49.2%, respectively. The degree of enclosure of the recreation spaces in both palaces was very strong, indicating that the royal family paid attention to privacy during their leisure activities. In the process of use, the functional conversion of different palaces in the Forbidden City significantly improved the accessibility of both the emperor's living space and the minister's office space and simultaneously strengthened the connection between these two spaces. Factors in the construction sequence led to the unreasonable accessibility of recreation space in the Shenyang Imperial Palace.

Keywords: Forbidden City; Shenyang Imperial Palace; space syntax theory; spatial feature; relational diagram method

check for updates

Citation: Zhang, D.; Shan, X.; Zhang, X.; Chen, H.; Zheng, Y. Spatial Feature Analysis of the Beijing Forbidden City and the Shenyang Imperial Palace Based on Space Syntax. *Buildings* **2023**, *13*, 2615. https://doi.org/10.3390/buildings13102615

Academic Editor: Haifeng Liao

Received: 10 September 2023
Revised: 6 October 2023
Accepted: 10 October 2023
Published: 17 October 2023

1. Introduction

As cultural World Heritage Sites, the Forbidden City in Beijing and the Shenyang Imperial Palace are two of the best-preserved ancient palaces in China. The Forbidden City was constructed between 1406 and 1420 by Zhu Di, an emperor of the Ming dynasty (1368–1644). It is the largest existing palace complex in the world. The Shenyang Imperial Palace is located in the northeast region of China and was built by the early rulers of the Qing dynasty (1644–1911) in 1625, followed by continuous construction by several emperors. After the ruler of the Qing dynasty overthrew the emperor of the Ming dynasty and moved into the Forbidden City in 1644, the Shenyang Imperial Palace became the emperor's largest holiday palace, located outside of Beijing. The architecture of the Shenyang Imperial Palace has strong Manchu ethnic characteristics. The two palaces differ in their spatial form due to differences in the builders' ethnic and cultural backgrounds, regional conditions, and construction techniques.

Scholars have conducted studies on the architecture of the two palaces. For the Beijing Forbidden City, Yu systematically introduced the technology and art of traditional Chinese architecture and synthesized the architectural art of the Forbidden City in terms of its construction history, planning, and design ideas [1]. Bai and Huang pointed out that the royal palaces were the sites where the monarchs lived and exercised their autocratic kingship and were also centers of state power. These authors discussed the architectural embodiment of the concept of the supremacy of the monarchy [2]. For the Shenyang Imperial Palace, Wu studied the architectural layout and decorative art [3], while Chen and Wang emphasized that different architectural characteristics reflected different political and economic backgrounds, highlighting the important role of the political and economic context in the formation of architecture through an analysis of the architecture of the Shenyang Imperial Palace [4]. Luo discussed the culture of the Shenyang Imperial Palace in three different architectural developmental stages, presenting clear cultural development and describing the basic trend of development of Manchu national culture [5]. In general, current research on the architectural spaces of the two palaces is mainly qualitative in nature and lacks quantitative analysis of the related spatial features. No study has analyzed the correspondence between palace space and use functions, which means that no previous study has accurately compared the similarities and differences between the two palace spaces.

Space syntax quantifies and evaluates the spatial form of human settlements, including buildings, cities, and even landscapes, by treating space as an independent element. This approach can analyze the relationship between spaces at different scales and reveal the internal correlation between human activity patterns and spatial structure [6,7], explain human behavior and social activities from the perspective of spatial configuration [8,9], and even make distinctive contributions to research in social and urban history [10]. Social factors also influence the production of space, creating foreground spaces that extend beyond the local and background spaces that are more supportive of local communities [11]. Yamu et al. provided a holistic and compact overview of the various concepts used in space syntax, from their basic elements to analytical techniques and theories [12]. Currently, space syntax theory is widely used in quantitative studies of various types of space, such as medical space [13], traditional village space [14], urban underground space [15], urban block space [16], urban park space [17], and historical city space [18]. This approach has also been applied in the study of palace building space worldwide. Nevadomsky used space syntax theory to conduct a quantitative analysis of the sites within Ogiamien's palace and the chiefdom of other Benin kingdoms and compared the results using qualitative analysis to confirm the traditional social nature of the use of space in the chiefdom of the former kingdom [19]. Baumanova and Smejda studied the palace building space on the Gede site near the coast of Kenya and found that the configuration and use of rooms in the palace, their position in the communication network, and the social and cultural content of the space changed with time [20]. Eyal Regev's study of Herodian palaces explored social relationships at court and showed that social interactions in the palace were hierarchical, emphasizing the privacy of the king and his control over the interactions of potential visitors [21]. These studies show that space syntax not only provides a scientific basis for the quantitative analysis of the intricate spatial organization within palace complexes but also allows for consideration of the interactions between the function of the architectural spaces and the social and cultural activities that occurred within these spaces. However, the spatial differences between Chinese and Western palaces make it difficult to directly apply or refer to relevant Western research results. To date, relatively little academic research uses the space syntax approach with regard to Chinese palace spaces. Only Zhu has used the space syntax method to quantitatively analyze and confirm that the Forbidden City was the highest-ranked, most enclosed, and most inaccessible part of Beijing City [22]. However, in Zhu's study, there is a lack of corresponding analysis of the traditional architectural and cultural differences behind the spatial features and no comparison of the spatial organization of the Beijing Forbidden City with similar domestic or foreign royal palaces.

This paper aims to quantitatively analyze the spatial features of the Beijing Forbidden City and the Shenyang Imperial Palace, as well as the similarities and differences between them. First, the relational diagram method of space syntax theory is used to obtain the integration and depth values of various spaces in the two palaces in Beijing and Shenyang. Then, the differences in spatial organization characteristics reflected by these two values are compared. Finally, this study makes a spatial comparison between traditional Chinese and Western palaces to explore the role of power, the ritual system, hierarchy, and other factors in the evolution of spatial form and function. This paper uses space syntax for the analysis of these two traditional Chinese palaces, which not only expands the research object of spatial syntax and clarifies the spatial characteristics of ancient Chinese palace buildings but can also inform the design of similar modern group buildings.

2. Research Methods

2.1. Spatial Layout of the Forbidden City and the Shenyang Imperial Palace

The Forbidden City, which is located in the center of Beijing, has a length of 961 m from north to south and a width of 753 m from east to west. It covers an area of approximately 725,000 square meters and a building area of 150,000 square meters (Figure 1a). Its axis coincides with the city's central axis, and it is basically symmetrical along the north–south axis according to the principle of "office space in the front area and living space in the back area". It is an important example of the integration of architectural art and technology in ancient Chinese palaces. To reflect the legitimate position of the emperor and the will of the ruling class, the planning and architectural design of the Forbidden City are emphasized in a hierarchical and modular layout to highlight the concept of imperial power with additional attention to the ritual system and order.

The office space is located in the southern part of the Forbidden City, with the Hall of Supreme Harmony (numbered Beijing Office Space-1, hereinafter referred to as BOS-1), the Hall of Central Harmony (BOS-2), and the Hall of Preserving Harmony (BOS-3) positioned at the center (Figure 1b). The office space is where the emperor managed government affairs and held large-scale ceremonies; therefore, it reflects the highest architectural level and grandeur to represent the authority of imperial power. The smaller Hall of Civil Glory (BOS-4) and Hall of Martial Grace (BOS-5) are symmetrically arranged on opposite sides of the office space. Neige Hall (BOS-6), located in the southernmost part of the office space, and Junji Hall (BOS-7), located near the living space, were usually used by ministers to address government affairs. The royal living space is located in the northern part of the Forbidden City with three important palaces arranged on the main axis, namely, the Palace of Heavenly Purity (Beijing Living Space-1, or BLS-1), the Hall of Union (BLS-2), and the Palace of Earthly Tranquility (BLS-3). These are the main palaces where the emperors and empresses lived. The Palace of Mental Cultivation (BLS-4) was the residence chosen by the emperor in the middle and late Qing dynasties. The Palace of Eternal Harmony (BLS-5) located on the east side and the Palace of Lasting Spring (BLS-6) located on the west side were the palaces where the emperor's wives resided, and the Northern Five Abodes (BLS-7) were the residences of the princes; thus, the building scale is relatively small. The recreation space is located on the east side of the living space (Figure 1) and mainly includes the Hall of Imperial Supremacy (Beijing Recreation Space-1, BRS-1), the Hall of Spiritual Cultivation (BRS-2), Changyinge Theatre (BRS-3), and the Imperial Garden (BRS-4).

Construction of the Shenyang Imperial Palace began in 1625, and two large-scale additions were subsequently built. As shown in Figure 2a, the spatial pattern forms three relatively independent groups of palace buildings with parallel longitudinal axes (East Road, Middle Road, and West Road palaces). The palace covers an area of 60,000 square meters and consists of over 500 rooms. The earliest East Road palaces (built in 1625) reflected the political characteristics of the military and political unity of the Manchu nomads; thus, the spatial layout did not adopt the traditional Chinese courtyard style and did not model the ritual system [23]. With the deepening influence of Han culture on the Qing dynasty, the Middle Road palaces (built from 1627 to 1635) and the West Road palaces (built starting in 1781) adopted the traditional courtyard layout of China, maintaining the Manchu ethnic characteristics only in architectural details. Thus, the style of ethnic integration was more evident in these structures [24].

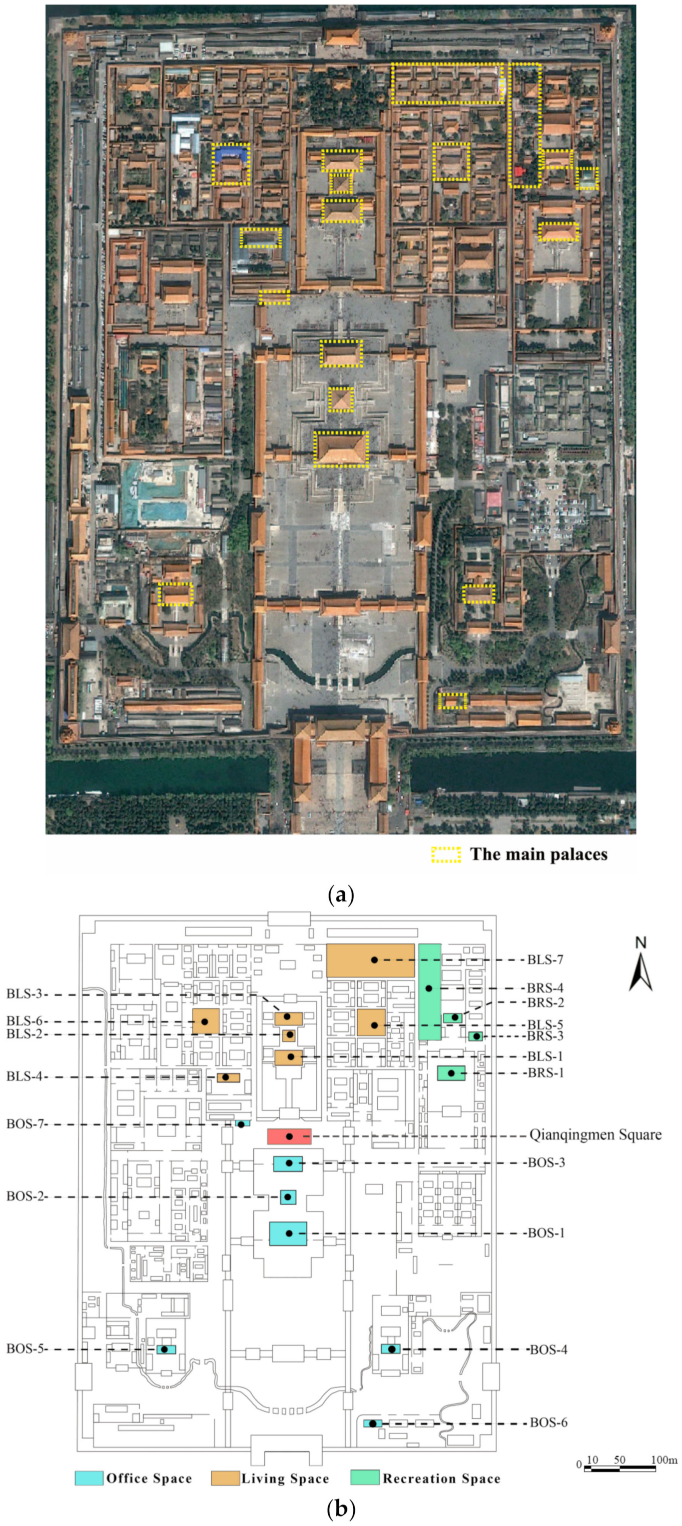
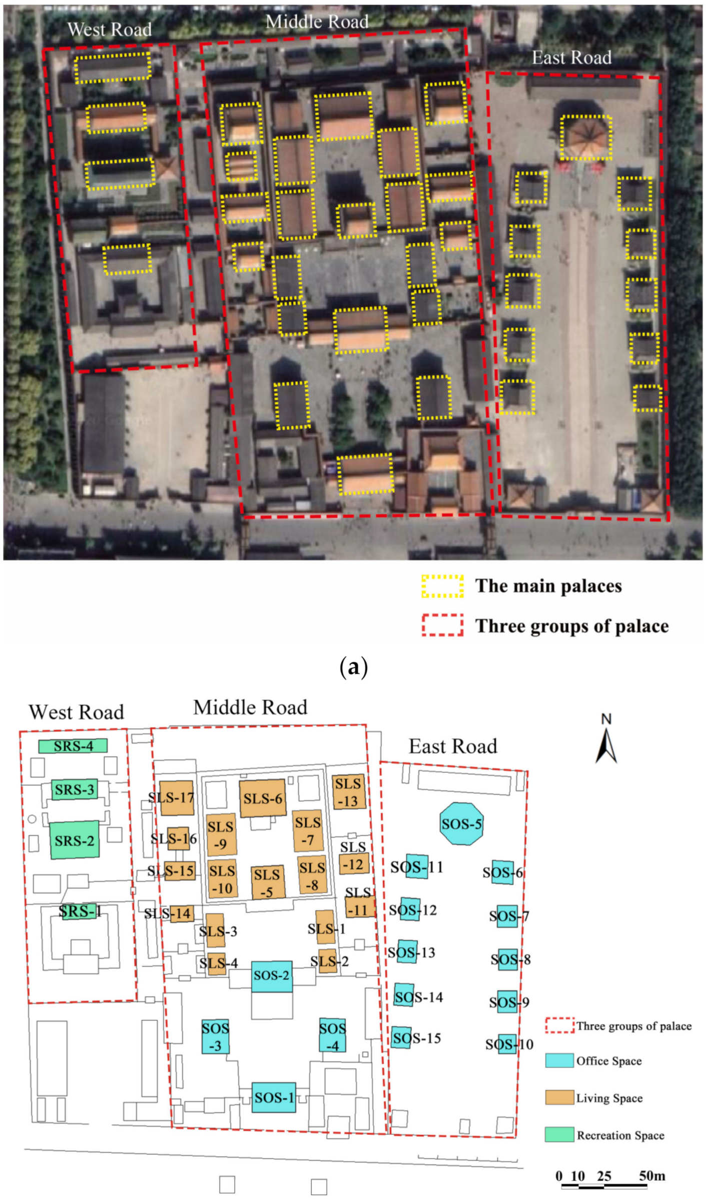


Figure 1. The map of the Beijing Forbidden City: (**a**). Aerial view of the Beijing Forbidden City; (**b**). The main space of the Beijing Forbidden City.



(**a**)

(**b**)

Figure 2. The map of the Shenyang Imperial Palace: (**a**). Aerial view of the Shenyang Imperial Palace; (**b**). The main space of the Shenyang Imperial Palace.

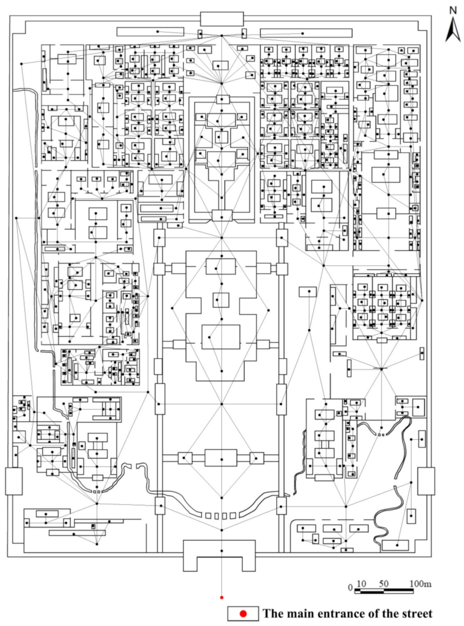
The office space is located in two areas. All of the East Road palaces are office buildings. As shown in Figure 2b, 10 small palaces (SOS-6 to SOS-15) are arranged symmetrically on both sides, centered on Dazheng Hall (SOS-5) on the north side. They were the places where celebrations, feasts, and other ceremonies were held in the early Qing dynasty. The southern portion of the Middle Road palaces was used as office space during the next period. At the southernmost end of the Middle Road palaces is the Daqing Gate (Shenyang Office Space-1, hereinafter referred to as SOS-1), which was the main entrance of the Shenyang Imperial Palace. Chongzheng Hall (SOS-2), located on the north side of the Daqing Gate on the central axis, was the most important main hall for the emperor's office in the Shenyang Imperial Palace. Two relatively low secondary office buildings, namely, Xiangfeng Pavilion (SOS-3) and Feilong Pavilion (SOS-4), were symmetrically arranged on either side of the central axis.

The living space is located in the central and northern parts of the Middle Road palaces, with the Xiaqi (Shenyang Living Space-1, SLS-1), Xiezhong Zhai (SLS-2), Rihua (SLS-3), and Shishan Zhai (SLS-4) buildings serving as educational venues for the emperor's children. The Phoenix Building (SLS-5), which is located behind the above-mentioned buildings, is a gate building that connects the front buildings and the five palaces in which the emperors and empresses lived on a high platform. Among them, the Qingning Palace (SLS-6), which is located in the center at the rear, served as the sleeping quarters of early Qing emperors and empresses. The other four important palaces for imperial concubines, namely, Yandu Palace (SLS-7), Guanju Palace (SLS-8), Linzhi Palace (SLS-9), and Yongfu Palace (SLS-10), are arranged on both sides of the central axis (Figure 2b). The palace groups for the emperor's mother and daughters are collectively known as Dong House, including the three houses numbered SLS-11, SLS-12, and SLS-13, while the palace groups for the emperor and his concubines during the late Qing dynasty are collectively called Xi House, including SLS-14, SLS-15, SLS-16, and SLS-17. The recreation space, which was constructed last, is located in the West Road palaces (Figure 2b) and has a courtyard layout, including the Royal Theatre Jiayin Hall (Shenyang Recreation Space-1, SRS-1), the Royal Library Wensu Pavilion (SRS-2), Yangxi Hall (SRS-3), and Jiujian Hall (SRS-4) as imperial study rooms.

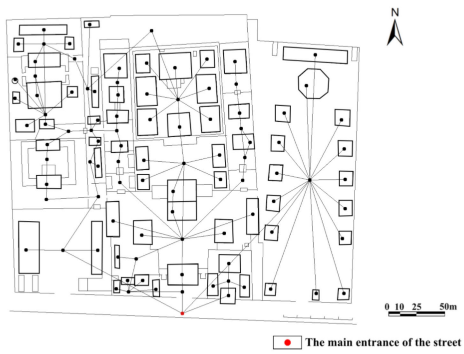
2.2. Diagram Methods and Processes

This study used the relational diagram approach of the space syntax method to quantitatively analyze the space of the two palaces located in Beijing and Shenyang. The core concept of space syntax is configuration, which is defined as a series of interdependent relationships among parts, each of which is determined by the relationship between a certain part and all the others. In our study, the buildings and courtyards are abstractly divided to form a relational diagram that reflects the spatial configuration, and a relational diagram (J-Graph) is formed using the external space as the root space. The quantitative description of space reveals the relationships among the internal organizational logic of space, human behavior, and social culture [6,25]. For spatial morphological analysis, space syntax provides a series of spatial attribute parameters [8]. The main spatial variables used in this study are the depth value and the integration value. The depth value reflects the number of spatial transformations in the system. The more conversions there are from one space to another, the greater the depth of the space is; thus, this space appears more hidden in the entire system, and the degree of enclosure of the space is higher. In contrast, the lower the depth value of the space, the more open it appears. The integration value reflects the traffic potential of a space. The higher the integration value, the stronger the accessibility of the space. In contrast, the lower the integration, the worse the accessibility. Notably, the depth value selected in this paper is the step depth that is calculated from the main entrance of the street connecting the palace to the outside. It reflects the degree of external connection of this space in the palace, while the integration value reflects the transportation accessibility of the internal space system in the palace.

In our study, first the various spaces of the Forbidden City and the Shenyang Imperial Palace were numbered (Figure 3), and spatial connections were made based on the transformation of space, with points representing the spaces and lines representing the connections between these spaces. Then, the entire spatial system was transformed into a J-Graph plot using an external space as the starting point. These rooms were arranged horizontally according to the depth of their spatial structure [26], as shown in Figure 4a,b. Finally, the depth value and integration value of each space were determined.

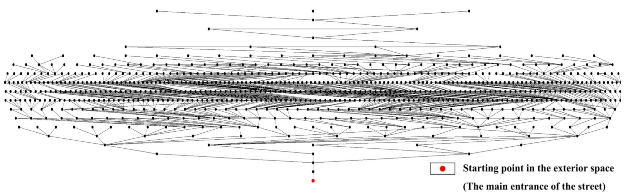


(**a**)

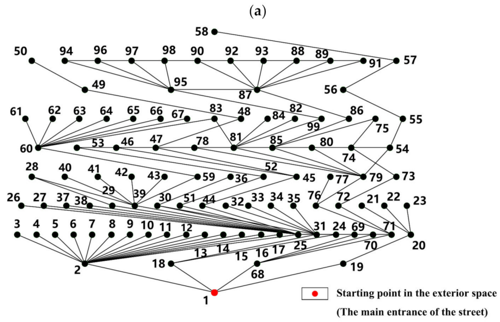


(**b**)

Figure 3. Space-numbering map: (**a**). The Forbidden City; (**b**). The Shenyang Imperial Palace.



(a)



(b)

Figure 4. J-Graph of the Two Palaces: (**a**). The Forbidden City (**b**). The Shenyang Imperial Palace.

3. Results

3.1. Results of the Beijing Forbidden City

The enclosure (depth value) and accessibility (integration value) of the office space, living space, and recreation space in the Forbidden City were analyzed. In terms of depth (as shown in Table 1), the three most important halls in the office space (BOS-1, BOS-2, and BOS-3) had an average depth of 8. The two symmetrical secondary palaces (BOS-5 and BOS-4), which functioned as spaces for small-scale ceremonies held by the emperor, had an average depth of 6.5. BOS-6 in the southeast and BOS-7 in the northwest were the main office locations for ministers during the Ming and Qing dynasties and served to communicate information between the office space in the front and the living space in the rear. Both locations had a depth of 8. Overall, the depth of the office space in the Forbidden City ranged from 6 to 9, and the average depth of the main living space in the Forbidden City was 11.7. BLS-1, BLS-2, and BLS-3, which served as the main bedchambers of the emperor and empress, had an average depth of 11.3. BLS-4, which had a certain office function, had a minimum depth of 10. The average depth of the concubine residences (BLS-5 and BLS-6) was 12. BLS-7, where the princes lived, had a maximum depth value of 14. The depth values of the four recreation spaces ranged between 9 and 12, with a mean of 10.8. Among the three types of spaces, the living space had the greatest depth and the strongest degree of enclosure, which met the requirement for the privacy of royal life. However, the recreation space in the Forbidden City was more enclosed than the office space, indicating that royal leisure and entertainment in China also required privacy and were not shared with others.

Table 1. Depth and integration values in the Beijing Forbidden City.

Code	BOS-1	BOS-2	BOS-3	BOS-4	BOS-5	BOS-6	BOS-7	BRS-1	BRS-2
Depth	7	8	9	6	7	8	8	12	11
Integration	0.90	0.93	1.05	0.82	0.74	0.65	1.23	0.92	0.85
Code	**BLS-1**	**BLS-2**	**BLS-3**	**BLS-4**	**BLS-5**	**BLS-6**	**BLS-7**	**BRS-3**	**BRS-4**
Depth	11	11	12	10	13	11	14	9	11
Integration	0.95	0.95	0.92	1.00	0.80	0.90	0.78	1.02	0.95

The integration values of various spaces in the Forbidden City are shown in Table 1. The average value for the office space was 0.90. As the main office spaces for the emperor in the Forbidden City, the average integration of the three halls (BOS-1, BOS-2, and BOS-3) was 0.96, showing a relatively high level of accessibility. The office space (BOS-7) used by ministers in the late Qing dynasty had the highest accessibility level (with an integration value of 1.23), while the accessibility level of BOS-6, which was used by ministers in the early Qing dynasty, was the lowest (0.65). The integration level of BOS-4, which is located east of the central axis of the Forbidden City, was 0.82, while the integration level of BOS-5 in the west was 0.74. The overall integration level was high in the east and low in the west (Figure 5). This result shows that although the buildings in the Forbidden City are basically symmetrically arranged along the central axis, accessibility has an asymmetric spatial layout. Regarding the order of the integration values within the living space, the emperor's residences (BLS-1, BLS-2, and BLS-3, with an average of 0.94) were first, followed by the concubines' residences (BLS-5 and BLS-6, with an average of 0.85) and the princes' residences (BLS-7′s integration value was 0.78); these results indicate that the accessibility of the living spaces of the concubines and princes was lower than that of the emperor's palaces, which could have highlighted the central position of the emperor while protecting the privacy of the lives of the concubines and princes. The average integration level of the recreation space was 0.94, among which BRS-3 (a theater) had the greatest integration (1.02) and accessibility levels, basically meeting the requirements of its performance function. Overall, there was little difference among the average integration values of the three types of spaces in the Forbidden City; however, the integration of each palace differed significantly according to the needs of different users.

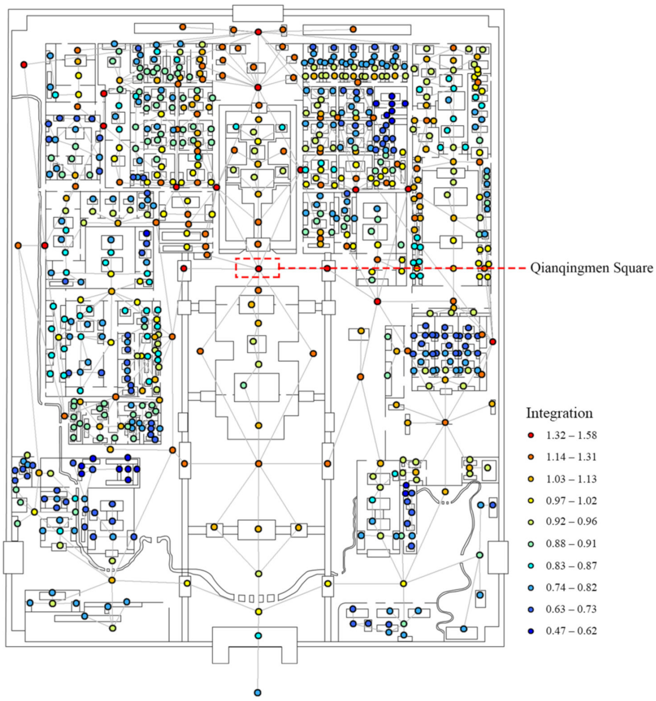


Figure 5. The integration value classification map of the Forbidden City.

3.2. Results of the Shenyang Imperial Palace

The depth values of various palaces in the Shenyang Imperial Palace are shown in Table 2. The depth of the office space ranged from 2 to 3, with an average of only 2.2, showing that the office space was open while the degree of enclosure was weak. The depth of the living space ranged from 4 to 9, with an average of 5.6. The four palaces where the princes were educated, namely, SLS-(1–4), had a depth of 4, and the space was relatively open. The depth values of palaces SLS-(6–10), where the emperor lived in the early Qing dynasty, were all 6; the average depth of the three palaces (SLS-(11–13)) in the Dong House, where the emperor's mother and children lived, was 6.3; and the average depth of the four palaces (SLS-(14–17)) in the Xi House, where the emperor lived in the late Qing dynasty, was 6.8, indicating the highest degree of spatial enclosure in the living space. The average depth of the recreation space was 8, and the degree of enclosure was the greatest in the Shenyang Imperial Palace.

Table 2. Depth and integration values in the Shenyang Imperial Palace.

Code	**SOS -1**	**SOS -2**	**SOS -3**	**SOS -4**	**SOS -5**	**SOS -(6–15)**		**SRS -1**	**SRS -2**	**SRS -3**	**SRS -4**
Depth	2	3	3	3	2	2		6	8	9	9
Integration	1.65	1.19	1.18	1.18	1.03	1.03		0.81	0.62	0.55	0.55
Code	**SLS -(1–4)**	**SLS -5**	**SLS -6**	**SLS -(7–10)**	**SLS -11**	**SLS -12**	**SLS -13**	**SLS -14**	**SLS -15**	**SLS -16**	**SLS -17**
Depth	4	4	6	6	5	6	8	5	6	7	9
Integration	0.98	1.03	0.70	0.70	0.79	0.67	0.51	1.00	0.78	0.66	0.50

In terms of integration, the average integration value of the office space was 1.10. The integration value of SOS-1, which references the gate of the Middle Road palaces, was 1.65, making it the space with the highest level of accessibility in the Shenyang Imperial Palace. The integration values of SOS-2, which references the main hall on the Middle Road, and of the two palaces on either side of it (SOS-3 and SOS-4) were very close, with an average of 1.18. The integration values of SOS-5, which is the main hall on the East Road, and of the ten secondary palaces SOS-(6–11) on either side of it were all 1.03, marking the lowest level of accessibility in the office space. The average integration value of the living space was 0.79; the integration value of SLS-5, which mainly played a role in transportation, was 1.03, marking the highest level of accessibility in the living space. The average integration value of SLS-(1–4), which was used for the imperial children's education, was similar at 0.98. The average integration value of SLS-(6–10), which references the palaces where the emperor lived before the establishment of the Qing dynasty in 1644, was 0.70. The average integration value of the four palaces in the Xi House (SLS-(14–17)), where the emperor lived in the late Qing dynasty, was 0.74. The average integration value of the three palaces in Dong House (SLS-(11–13)), where the emperor's mother and children lived, was 0.66, which marked the lowest level of spatial accessibility. In the recreation space (as shown in Table 2), the integration value of the Jiayintang Theater performance building (SRS-1) was relatively high at 0.81, while the average integration value of the remaining three recreation spaces was only 0.57, which indicated a lower level of accessibility. The results indicate that the emperor's leisure activities were kept highly private. The distribution of integration in the Shenyang Imperial Palace is shown in Figure 6.

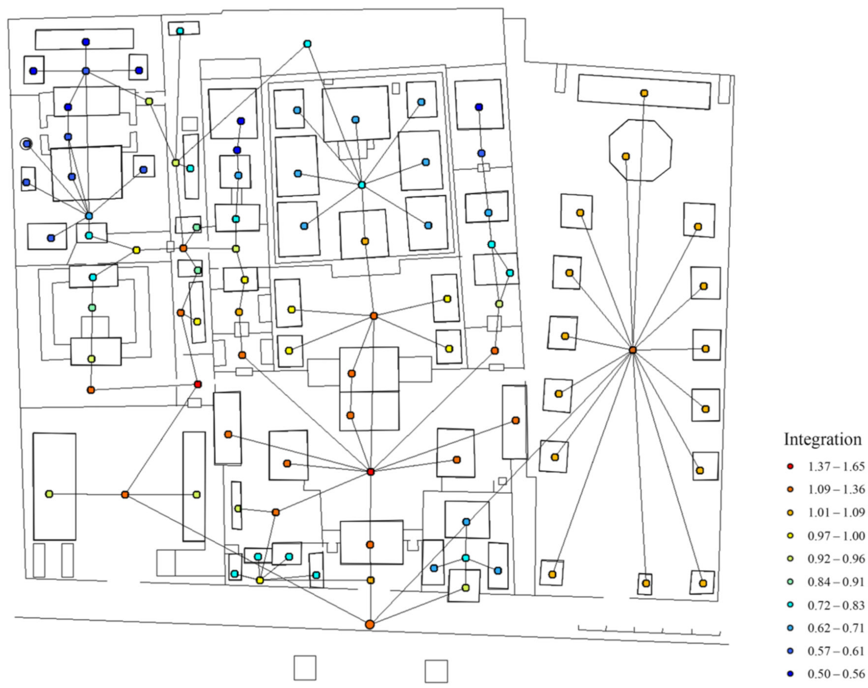


Figure 6. The integration value classification map of the Shenyang Imperial Palace.

4. Discussion

4.1. Comparison between the Two Palaces

In the office space, as shown in Figure 7a, the average depth of the emperor's three main office spaces in the Beijing Forbidden City (BOS-(1–3)) was 8 (the average integration value was 0.96), while the average depth of the emperor's two main office spaces (SOS-2 and SOS-5) in the Shenyang Imperial Palace was 2.5 (the average integration value was 1.11). These results indicated that the emperor's office space in the Forbidden City was relatively enclosed, while the emperor's office space in the Shenyang Imperial Palace had a relatively high level of accessibility. This might be because the layout of the Beijing Forbidden City was more complex and emphasized architectural hierarchy through a higher degree of enclosure. As the Shenyang Imperial Palace was an early palace, its layout was relatively simple, and the concept of hierarchy was not prominent; rather, convenient transportation and the equal relationship between the emperor's office space and other spaces were emphasized. Previous studies have shown that the more centrally an object is placed within a defined space, the more it contributes to the overall segregation of that particular space. A building that is placed in the middle of a central square adds greater overall segregation to the neighborhood than the same building that is placed at the edge of the square [12]. From this perspective, compared to the Shenyang Imperial Palace, the emperor's three main office spaces in the Forbidden City in Beijing were located more centrally, making a more prominent contribution to spatial segmentation.

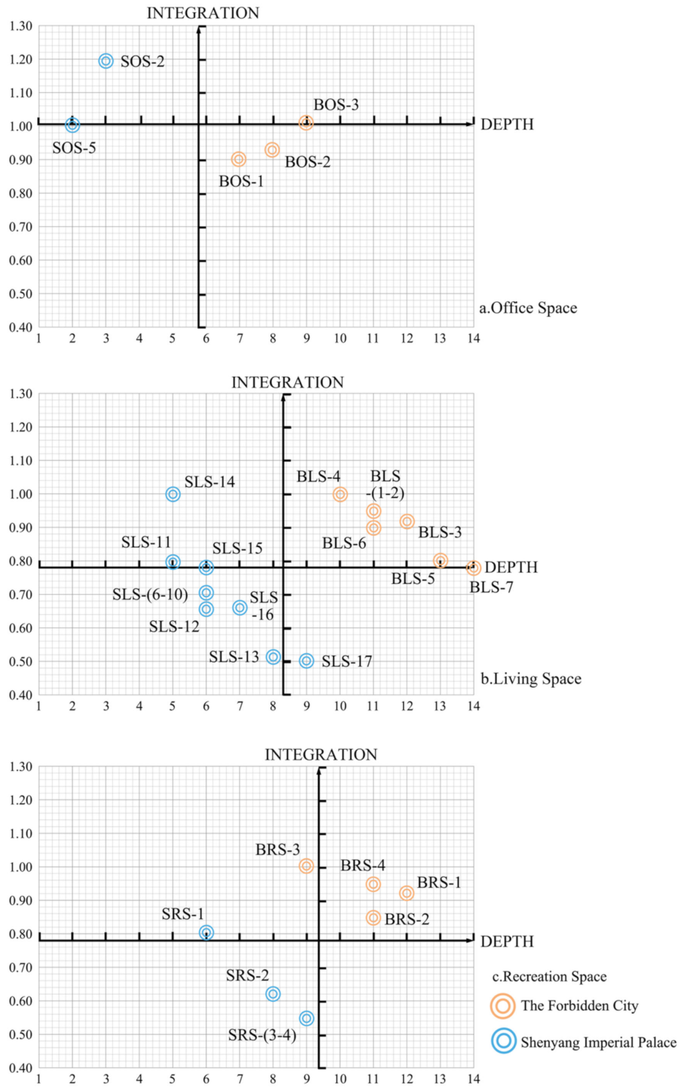


Figure 7. Comparison of the spatial enclosure and accessibility of the different spaces.

In terms of the living space, as shown in Figure 7b, in the Forbidden City, the average depth value of the emperor's three main bedchambers (BLS-(1–3)) was 11.3 (with an average integration value of 0.94), while the average depth of the concubines' bedchambers (BLS-(5–6)) was 12 (with an average integration value of 0.85). In the Shenyang Imperial Palace, the depths of the emperor's main bedchamber (SLS-6) and the concubines' bedchambers (SLS-(7–10)) were all 6 (the integration values were all 0.70), which were much lower than the values for the emperor's three main bedchambers in the Forbidden City. These results indicate that the enclosure of the bedchambers in the Forbidden City was significantly higher than that of the corresponding bedchambers in the Shenyang Imperial Palace.

In addition, the integration value (accessibility) of the emperor's bedchamber (SLS-6) was the same as that of the concubines' bedchambers (SLS-(7–10)) in the Shenyang Imperial Palace, reflecting a strong level of equality. The concept of hierarchy in traditional Chinese Confucian culture was not reflected in these spaces in the Shenyang Imperial Palace. The average integration of the emperor's bedchambers (BLS-(1–3)) was higher than that of the concubines' bedchambers (BLS-(5–6)) in the Forbidden City, which suggests that their accessibility level was higher. These results indicate an obvious hierarchical concept between these spaces.

As shown in Figure 7c, the average depth of the four recreation spaces in the Forbidden City was 10.8 (the average integration value was 0.94), while the average depth of the four recreation spaces in the Shenyang Imperial Palace was 8 (the average integration value was 0.63). Thus, the recreation space in the Forbidden City of Beijing had a higher degree of enclosure than the recreation space in the Shenyang Imperial Palace in terms of connection with external spaces and had greater accessibility, which showed that the internal transportation was more convenient.

The average depth and integration values between the various spaces of the two palaces are shown in Figure 8. The degree of enclosure of the living space, the recreation space, and the office space presented a decreasing trend in sequence in the Forbidden City, while the level of accessibility showed little difference. In the Shenyang Imperial Palace, the degree of spatial enclosure of the recreation space, the living space, and the office space decreased, while the level of accessibility increased sequentially. In both palace groups, the office space had the lowest degree of enclosure, which was in line with its functional requirements. The entirety of the Forbidden City was built at the same time after unified planning sessions; thus, it is reasonable that the degree of spatial enclosure of the recreation space was lower than (accessibility was higher than) that of the living space, which necessitated relative privacy. The construction of the Shenyang Imperial Palace was divided into three phases and completed gradually. The level of importance of the recreation space was lower than that of the office and living spaces; thus, it was the last space to be built. There was a certain irrationality in the location setting, which led to the degree of spatial enclosure of the recreation space being higher than that of the living space (the level of accessibility being lower than that of the living space).

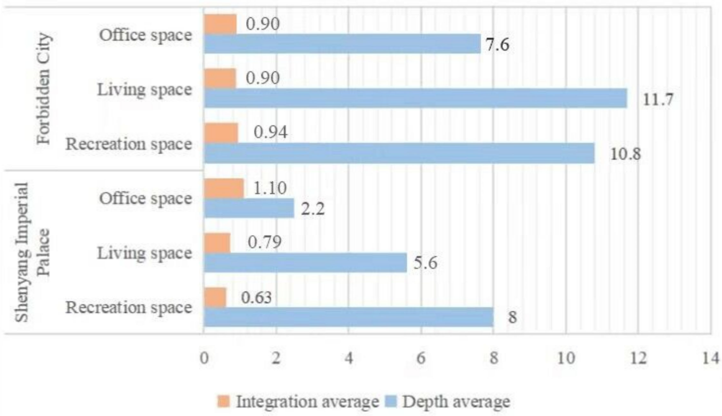


Figure 8. The parameter average of the different spaces in the two palaces.

4.2. Changes in Spatial Organization and Function

Social structuring with an unfixed rank is a method of studying political organization [27]. There is a connection between space and power levels; thus, previous research has attempted to understand both power levels in the context of space [28,29] and how spatial organizational practices have shaped the essence of political levels in architecture [30,31]. In the two Chinese traditional palace groups that emphasized imperial power, the development and changes of these spatial organizations and functions should therefore be considered.

(1) Historically, the function of many spaces in the Forbidden City changed. For example, in the late Qing dynasty, the emperor moved his bedchambers from the original palaces (BLS-(1–3)) to BLS-4 (the depth value decreased from 11.3 to 10, while the integration value increased from 0.94 to 1.00). The spatial enclosure and accessibility changed slightly. At the same time, the most important office space for the main ministers was transferred from BOS-6 to BOS-7 (while the depth was unchanged, the integration

increased from 0.65 to 1.23). The original office space group of BOS-(1–3) used by the emperor and BOS-6 used by the ministers was shifted backward as a whole to form a new "administrative power center" dominated by BLS-4 and BOS-7. This change improved the accessibility of the ministers' office space and strengthened the connection between the emperor's living space and the ministers' office space, which could have improved the emperor's efficiency in handling government affairs. However, it could also have placed the emperor and ministers farther from the external environment, which might have led to a decrease in the importance attached by the rulers to the people.

In the Shenyang Imperial Palace, when the emperor's office spaces were transferred from the East Road to the Middle Road, the average depth increased from 2 to 2.8 and the spatial enclosure was enhanced. These changes were conducive to the formation of a sense of imperial authority and dignity. At the same time, the average integration value increased from 1.03 to 1.30, the level of accessibility improved, and internal transportation connections became more convenient. In terms of increasing integration values, the conversion of office space for emperors in the Shenyang Imperial Palace was similar to the conversion of office space for emperors and ministers in the Forbidden City of Beijing, which was also very similar to the conversion of the royal office space in Seoul in the seventeenth century. The new site of the top administrative headquarters of the Joseon Dynasty, that is, the king's palaces and government headquarters, was placed in the site that had integration values higher than those for other areas [32].

(2) The construction sequence of the Shenyang Imperial Palace was East Road, then Middle Road, and finally West Road. The average depth values of the East Road, Middle Road, and West Road palaces were 2, 5.1 and 8, respectively, while the average integration values were 1.03, 0.88, and 0.63, respectively, indicating that the degree of spatial enclosure of the three groups gradually increased and the accessibility level gradually decreased according to the construction period.

The earliest East Road palace buildings were all office buildings, and the integration values of SOS-(6–15) and SOS-5 were all 1.03. There was no distinction with regard to accessibility, and the space reflected equality. This was likely because before the establishment of the Qing dynasty in 1644, the Manchu regime was composed of various tribes without any thought or consciousness of imperial supremacy; thus, there was no strict hierarchical concept in the architectural space. Therefore, the East Road buildings had the greatest level of accessibility and the greatest amount of open space. In the subsequent construction of the Middle Road palaces, the office space in the south and the living space in the north were symmetrically distributed around the axes formed by SOS-1, SOS-2, SLS-5, and SLS-6, which was in line with the traditional Chinese courtyard layout. The average accessibility value of the Middle Road palaces decreased compared to the East Road palaces. The last construction of the west road building was the least accessible, which was the same as the phased construction of some traditional Chinese villages, and the last construction house for non-primary surname and non-major surname families was often distributed in areas with poor accessibility [14].

4.3. Comparison between Traditional Chinese Palaces and Western Palaces

In the Forbidden City and Shenyang Imperial Palace, the office space was generally located near the main entrance of the palace groups in the south, while the living space was located in the north. The accessibility of the office space was higher than that of the living space. The Topkapu Palace in the Ottoman Empire also had a spatial pattern similar to that of "office space in the front and living space in the rear". This palace placed the center of accessibility in the front office space. However, the spatial development of the Topkapu Palace differed from that of Chinese palaces in regard to improving the accessibility of the backyard and strengthening the rights of women [33]. In three palaces built at different locations in three stages of Herod's empire, the average depth of the palace built in the first stage was between 4 and 5. The king placed great emphasis on the status of the royal family and had limited contact with outside visitors. The average depth of the palace built in the second stage was reduced to between 2 and 3, which strengthened the level of communication and interaction between the king and officials. Finally, the average depth of the palace in the third stage increased to between 6 and 7, reemphasizing the uniqueness of the king's space [21]. These depth changes repeated in different stages did not appear in the development of the two above-mentioned Chinese palaces. In addition, Algeria's Khdewedj El Amia Palace had an open gallery space, or "sqifa", which divided the palace into internal and external parts, giving the interior space strong control over the entry of outside visitors [34]. In this respect, the methods used in the Forbidden City were similar, as shown in Figures 1b and 5. Qianqingmen Square, with a high integration value (1.4952), was used to separate the office space from the living space, thus reducing the accessibility of the living space. Additionally, using space syntax, an analysis of the Palace at Gede in Kenya showed that its rooms were organized in seven levels of depth [17,18], while there were 19 levels of depth in the Beijing Forbidden City and 9 levels of depth in the Shenyang Imperial Palace. Generally, the greater the level of depth of space, the stronger the enclosure of the space and the weaker the external connectivity. This indicates that the two palaces in China, especially the Beijing Forbidden City, have significantly higher spatial enclosures than the Palace at Gede.

5. Conclusions

This study analyzed the spatial features of the Beijing Forbidden City and the Shenyang Imperial Palace by using the relational diagram approach of the space syntax method. First, the depth value and integration value of each space were calculated by means of diagrams. Then, the results were compared and analyzed to reveal the similarities and differences among the office space, the living space, and the recreation space in these two palaces in terms of spatial enclosure and accessibility, as well as to reveal possible underlying reasons for these similarities and differences. The specific conclusions are as follows.

(1) The space settings in the Beijing Forbidden City and the Shenyang Imperial Palace were basically in line with the requirements of the spatial functions of these areas. The office space had the lowest degree of spatial enclosure, while the living space and the recreation space had relatively high degrees of enclosure. This layout was conducive to improving the convenience of using the office space and protecting the personal privacy of the emperor and his relatives.

(2) The historical status and construction background of the two palaces caused differences in the spatial features. A comparison of the same functional spaces in the two palaces showed that the office space in the Beijing Forbidden City was more enclosed than that in the Shenyang Imperial Palace, while the office space in the Shenyang Imperial Palace was more accessible than that in the Beijing Forbidden City. The spatial enclosure and accessibility of the emperor's bedchambers were significantly higher in the Forbidden City than in the Shenyang Imperial Palace, while the accessibility of the recreation space was significantly lower in the Shenyang Imperial Palace than in the Forbidden City.

(3) Factors such as construction sequence and functional conversion during the use process also affected the rationality of the spatial layout of the two palaces. The construction of the Shenyang Imperial Palace was gradually completed in three phases. The recreation space was the last to be built, and its location was somewhat unreasonable, resulting in the spatial enclosure of the recreation space being higher than (accessibility being lower than) the living space. In the process of using Beijing Forbidden City, the transfer of functional space improved the accessibility of the office space, facilitated the connection between the emperor's living space and the ministers' office space, and improved the emperor's efficiency in handling government affairs. Compared with traditional palaces in other countries, the various spaces found in the two Chinese palaces embodied a more pronounced sense of imperial power and ritual hierarchy.

The results of this paper have implications for the contemporary design of group combination buildings with different functions. First, the space syntax can be considered to calculate the degree of integration and depth values of different types of buildings in the architectural scheme stage, compare these values with building functions, and adjust the location of individual buildings accordingly. Second, in the process of functional adjustment between different buildings in the existing building group, the method of space syntax can also be used to analyze and determine whether the adjustment is reasonable. Finally, with the help of the model relationship diagram of space, it can avoid the unreasonable location of a single building due to phased construction and other reasons. In addition, by studying the spatial characteristics of these two traditional palace groups, this paper found that the scale of the building group should be accounted for in the process of building the J-graph using space syntax. If the spatial scale of the building group is large and there are many single buildings, the model relationship diagram should not be overly complicated or cumbersome. Otherwise, it might have a negative impact on the analysis of the relationship between different functional spaces.

6. Research Limitations

There are many limitations to this study. For example, the process of building models and calculating the integration values is based only on spatial locations. However, for heavily guarded royal palaces, levels of accessibility cannot fully reflect actual spatial use situations. Therefore, further research should be conducted on the spaces of traditional Chinese royal palaces.

Author Contributions: Conceptualization, D.Z. and Y.Z.; methodology, D.Z.; software, D.Z. and X.S.; validation, D.Z. and X.Z.; formal analysis, D.Z. and X.S.; data curation, X.S.; writing-original draft preparation, D.Z. and X.S.; writing-review and editing, D.Z., H.C. and Y.Z. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Program of Humanities and Social Science Research Program of the Ministry of Education of China (22YJA760102), the Guangzhou Science and Technology Plan Project (2023A03J0080), and the Scientific Research Fund of Guangzhou University (PT252022006).

Data Availability Statement: The original contributions presented in the study are included in the article. Further inquiries can be directed to the corresponding author/s.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Yu, Z. *Palace of the Forbidden City*; People's Art Publishing House: Beijing, China, 2016. (In Chinese)
2. Bai, H.; Huang, W. The Implied Political Meaning of the Architecture of the Forbidden City. *J. Palace Mus.* **2011**, *7*, 92–100. (In Chinese)
3. Wu, B. *Palace Museum Studies and Shenyang Palace Museum*; Palace Museum Press: Beijing, China, 2017. (In Chinese)
4. Chen, B.; Wang, X. Architectural Layout under the Influence of Politics and Economy: An Analysis of the Architectural Layout of Shenyang Palace Museum East Road and Middle Road. *J. Shenyang Jianzhu Univ.* **2007**, *4*, 385–389. (In Chinese)
5. Luo, Y. Looking at the Trend of Manchu Culture from the Architecture of the Shenyang Palace Museum. *J. Shenyang Palace Mus.* **2012**, *12*, 40–49. (In Chinese)
6. Hillier, B.; Hanson, J. *The Social Logic of Space*; Cambridge University Press: Cambridge, UK, 1984.
7. Jiang, B.; Claramunt, C. Integration of Space Syntax into GIS: New Perspectives for Urban Morphology. *Trans. GIS* **2002**, *6*, 295–309. [CrossRef]
8. Jiang, B.; Claramunt, C. An integration of space syntax into GIS for modeling urban spaces. *Int. J. Appl. Earth Obs. Geoinf.* **2000**, *2*, 161–171. [CrossRef]
9. Dalton, R.; Bafna, S. The syntactical image of the city: A reciprocal definition of spatial elements and space syntaxes. In *4th International Space Syntax Symposium*; Hanson, J., Ed.; University College London: London, UK, 2003.
10. Griffiths, S.; Vaughan, L. Mapping spatial cultures: Contributions of space syntax to research in the urban history of the nineteenth-century city. *Urban Hist.* **2020**, *47*, 488–511. [CrossRef]
11. Hillier, B.; Sheng, Q. The Development Status and Future of Spatial Syntax. *J. Archit.* **2014**, *8*, 60–65. (In Chinese)
12. Yamu, C.; van Nes, A.; Garau, C. Bill Hillier's Legacy: Space Syntax—A Synopsis of Basic Concepts, Measures, and Empirical Application. *Sustainability* **2021**, *13*, 3394. [CrossRef]
13. Haq, S.; Luo, Y. Space Syntax in Healthcare Facilities Research: A Review. *HERD Health Environ. Res. Des. J.* **2012**, *5*, 98–117. [CrossRef]

14. Zhang, D.; Shi, Z.; Cheng, M. A Study on the Spatial Pattern of Traditional Villages from the Perspective of Courtyard House Distribution. *Buildings* **2023**, *13*, 1913. [CrossRef]
15. Hoeven, F.V.D.; Nes, A.V. Improving the design of urban underground space in metro stations using the space syntax methodology. *Tunn. Undergr. Space Technol.* **2014**, *40*, 64–74. [CrossRef]
16. Sheng, Q. Unraveling the Spatial Patterns of Everyday Life in Chinese Cities—A Comparative Study Between Beijing and Tianjin. *Geogr. Compass* **2014**, *8*, 601–616. [CrossRef]
17. Mahmoud, A.H.; Omar, R.H. Planting design for urban parks: Space syntax as a landscape design assessment tool. *Front. Arch. Res.* **2015**, *4*, 35–45. [CrossRef]
18. Baumanova, M. Sensory Synaesthesia: Combined Analyses Based on Space Syntax in African Urban Contexts. *Afr. Archaeol. Rev.* **2020**, *37*, 125–141. [CrossRef]
19. Nevadomsky, J.; Lawson, N.; Hazlett, K. An Ethnographic and Space Syntax Analysis of Benin Kingdom Nobility Architecture. *Afr. Archaeol. Rev.* **2014**, *31*, 59–85. [CrossRef]
20. Baumanova, M.; Šmejda, L. Structural dynamics of spatial complexity at the 'Palace of Gede', Kenya. *Azania Archaeol. Res. Afr.* **2017**, *52*, 71–99. [CrossRef]
21. Regev, E. Inside Herod's Courts: Social Relations and Royal Ideology in the Herodian Palaces. *J. Study Jud.* **2012**, *43*, 180–214. [CrossRef]
22. Zhu, J. *Chinese Spatial Strategies: Imperial Beijing 1420–1911*; Routledge: London, UK, 2004.
23. Shen, X. Inheritance and Integration: The Transformation Process of Manchu and Han Architectural Styles in the Shenyang Palace Museum. *J. Shenyang Palace Mus.* **2011**, *11*, 312–321. (In Chinese)
24. Sun, Q. Characteristics and Grades of Early Architecture in the Shenyang Palace Museum. *J. Shenyang Palace Mus.* **2009**, *8*, 88–93. (In Chinese)
25. Hillier, B. *Space Is the Machine: A Configurational Theory of Architecture*; China Building Industry Press: Beijing, China, 2007.
26. Hanson, J. *Decoding Homes and Houses*; Cambridge University Press: Cambridge, UK, 1998.
27. Moonkham, P.; Srinurak, N.; Duff, A.I. The heterarchical life and spatial analyses of the historical Buddhist temples in the Chiang Saen Basin, Northern Thailand. *J. Anthr. Archaeol.* **2023**, *70*, 101506. [CrossRef]
28. Anderson, B. *Imagined Communities: Reflections on the Origin and Spread of Nationalism*; Verso: New York, NY, USA, 2006.
29. Ashmore, W. *Construction and Cosmology: Politics and Ideology in Lowland Maya Settlement Patterns*; University of Utah Press: Salt Lake City, UT, USA, 1989.
30. Smith, A. *The Political Landscape: Constellations of Authority in Early Complex Polities*; University of California Press: Berkeley, CA, USA, 2003.
31. Monroe, J.C. *The Dynamics of State Formation: The Archaeology and Ethnohistory of Pre-Colonial Dahomey*; Department of Anthropology, University of California: Los Angeles, CA, USA, 2003.
32. Kwon, Y.; Bonghee, J.; Kim, S. The Seventeenth-century Transition of Seoul′s Spatial Structure to Functional Pragmatism. *J. Asian Arch. Build. Eng.* **2015**, *14*, 419–426. [CrossRef]
33. Şalgamcıoğlu, M.E.; Edgü, E. TOPKAPI PALACE: Reflections on Social and Spatial Order. In Proceedings of the 11th International Space Syntax Symposium, SSS 2017, Lisbon, Portugal, 3–7 July 2017.
34. Benyahia, L.; Hamouda, A.; Moffok, N. Decoding the Spatial Configuration of the Ottoman Palace "Khdewedj El Amia" in Algiers (Algeria) through Space Syntax. *Prostor* **2021**, *29*, 192–211. [CrossRef] [PubMed]