An Analysis on the Dunhuang Mogao Northern Dynasties Architectural Images

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Abstract

Research material is commonly supported by paintings. However, if paintings are viewed as the representation and re-composition of architecture, we can focus on the pattern of the selection, referencing, and re-composition of the form elements. This study applies semiotic theories to architectural studies of the Dunhuang frescoes. It extracts and analyzes the symbols (form elements) in the architectural images of the Northern Dynasties. It also interprets the underlying rules of the selection, adoption, and re-composition of the symbols by component analysis. The presence of commonly adopted components, as well as the semiotic structural system under which the components with distinctive characters can be continuously broken down, endow the seemingly simple Northern Dynasties architectural images with both unity and variation.

Keywords: Northern Dynasties; architectural images; form elements; symbols; component analysis

1. Introduction

Traditional Chinese buildings are made of wood, which perishes over time. Thus, through image interpretation ancient traditional Chinese architecture and cities have become an important research topic in the history of architecture. The construction of the Mogao Grottoes began in the Northern Liang Dynasty and continued for over 1,000 years. The most numerous cultural relics, the Dunhuang frescoes, also took the longest time to complete, and rank among the most valued artistic works in the world. The various styles of building images illustrated in the frescoes visually reflect the architecture and cities of the time.

2. Literature Study

2.1 Literature Study on Architectural Images

The architectural images discussed in this paper feature buildings as their subjects and sceneries in the background. The three styles of architectural images are Jiehua, scroll, and fresco.

(1) Jiehua is a style of Chinese painting named after the jie ruler, a tool for inscribing straight lines on a painting. Jiehua was a suitable painting style for buildings. Fu Xinian's "Paintings of Chinese Ancient Architecture" (1998) analyzed the origin, style, and development of famous Jiehua buildings in different periods¹. Wang Qijun covered the historical development of Chinese ancient architecture in the work "Architecture and Environment in Chinese Ancient Painting"².

(2) Studies of the painting "Along the River during the Qingming Festival," on the scrolls from the Song Dynasty, are closely related to architectural studies such as Qiao Xunxiang's "The Basic Studies on Song Dynasty Building Construction Techniques" (2005) and Liu Diyu's "See How the Northern Dynasty Capital City was Structured in Detail Along the River During the Qingming Festival" (2010). Japanese scholars have produced works such as "Travel and Study in Asia" special edition – "Along the River during the Qingming Festival" (1999). Nakano Miyoko and Komura Masahiko have researched the architectural images of the Song Dynasties from different perspectives³. Other studies have interpreted the historical background, image content, and civic landscape of the Qing Dynasty, exemplified in Wang Hongjun's "The Studies on the Painting 'Kangxi's Travel in the South'" (2010). Studies have also elucidated economic development in the commercial cities in the Qing Dynasty by interpreting depicted cities and buildings, such as Ma Xinmin's "The Painting of A Prosperous Era' and The Commercial Cites in the Early Qing Dynasty" (1990).

(3) Early research on the Dunhuang Frescos was conducted by the French Sinologist Paul Pelliot, who published a detailed archeological record of the Dunhaung Grottoes 1924). The Japanese scholar Matsumoto Eiichi published the iconological work "Studies on the Dunhuang Frescos – The Chapter of Images" (1937)⁴. The Dunhuang Cultural Relics
Research Institute completed "The Comprehensive Records of the Dunhuang Grottoes" in the 1980s. This work records the content of the Dunhuang Grottoes, providing a foundation for later comprehensive and more specific research.

The "Chinese Grottoes: Dunhuang Mogao Grottoes" (Vol. 1–5), published since 1982, is a compendium of research findings on the art history of Dunhuang frescoes by Chinese and Japanese scholars. These scholars have thoroughly investigated the artistic and aesthetic features of the Dunhuang frescoes painted in different eras.

Xiao Mo's "Studies on the Dunhuang Architecture" (1989) is among the most famous studies of the Dunhuang frescoes. He conducted textual research on the origin, style, and development of structures, and compared and interpreted the buildings depicted in progressive eras. The "Dunhuang Grottoes: Architecture" (2003) by Sun Ruxian and Sun Yihua included in the "The Complete Record of Dunhuang Grottoes" provides a thorough interpretation of the architectural images in the Dunhuang frescoes and describes textual research on the authenticity and reliability of the images.

2.2 Research Objectives

The existing studies focus on the interpretation and textual research of buildings from a certain era by comparing the architectural images in recorded documents, relics, and other images from the same era. These studies use building images in the paintings as historical material for restoration. However, this approach relies on the details of the illustrated buildings being accurately recorded. Therefore, in studies of relics, architectural paintings are usually used as supporting materials.

Nevertheless, the Dunhuang architectural images are not an entirely realistic portrayal. In addition, the authenticity of the images is difficult to verify by their content alone. Therefore, this paper regards the architectural images as the representation and re-composition of symbols through the semiological approach, which are integrated and quantified in novel ways to interpret the characteristics, meaning, and painting techniques of Northern Dynasties architectural images.

3. Dunhuang Frescoes' Architectural Representation and Symbol Re-composition

3.1 Characteristics of Suggestive Expression

Restricted by themes such as the idealized Buddhist World, the Mogao architectural images were usually romantic and symbolic, but they were rather primitive and lacked realistic expression. The architectural images of the Northern Dynasties were generally rather sketchy at this time. Because architecture was not the main subject of the frescoes, building scales were frequently ignored to emphasize the subject. For instance, in the Dock Wall Fresco based on the Sumati stories on the west wall of grotto #257, the dock wall was intentionally painted low to reveal the scene behind. A suggestive high-ceilinged antechamber is visible behind the dock wall, and the main figures were painted artificially large relative to the antechamber. Behind the hall, a female lies asleep on the first floor of a building, suggesting that the building is the inhabited section of the residence. A lotus bud was depicted behind the building, suggesting a garden. The antechamber, back chambers, and yard were the main components of the traditional Chinese residence, and fresco painters preserved their spatial relationships with suggestive expression. From this observation, the authors conclude that the architectural images of the Northern Dynasties accentuated the spatial features while sacrificing the realistic depiction of the scales and details of the buildings.

3.2 Paintings

Intentional differences in painting may affect the detail and realism expressed in frescoes. For example, to accommodate both greater and more complete scenes and building details within a limited space, the Dunhuang frescoes are characterized by reduced horizontal scales. The façades of buildings are depicted with very few rooms to render the buildings as towers.

Chinese architectural paintings were different from Western landscape paintings that relied on focus perspective. In the former, subjects were usually recomposed after careful observation to create a new scene, instead of being restricted to a fixed viewpoint. The painter inserts his architectural perspective into an architectural painting, and viewers can then extract the imagery of buildings from the painting. Architectural paintings can also be interpreted as the imagery of space, a means of transferring imageries or messages between painter and viewer. Such message transfer implies that the thoughts of architects, painters, and viewers are embodied in the paintings. Therefore, although judged by the extent of their realism and accuracy, paintings are not an exact reflection of reality, but rather a subjective interpretation of it.
3.3 Re-composition of Architectural Images

As shown in Fig.1., the elements in Dunhuang architectural images were intentionally re-composed by painters, based on religious needs. Therefore these architectural images reflect the fresco painters' or owners' understanding of real architecture. In general, they reflect the prominent traits of contemporary architecture. Thus, beneath the seemingly simple architectural images was an attempt to depict the Buddhist World in contemporary architectural language. Based on this theory, the analysis of architectural images becomes a probe into the selection, adoption, and re-composition patterns in the pictorial language.

3.4 Hypothesis

Based on the above discussion, it could be considered that paintings do not necessarily correspond to reality, they are fluid human creations, the result of extracting necessary forms from imagery, borrowing some elements, and intentional re-composition. The reality itself is merely an imagery of painting. Therefore, a hypothesis can be put forward that the building images in the paintings may be used as supporting materials for restoration; but cannot be considered as a direct reflection of reality. Also, we could consider paintings formed by selected, borrowed, and re-composed imagery as messages transferred from the earliest era to today. A painting reflects 1) the intentions of the painter or owner of the painting; 2) the societal mores of the time; 3) the significance of modern society.

4. Architectural Images in the Dunhuang Frescoes of the Northern Dynasties

4.1 Era Division of Northern Dynasties Grottoes

The Northern Dynasties grottos were built during the initial period of the Mogao grottos. Opinions differ with regard to defining the Northern Dynasties grottos. Based on "The Comprehensive Records of the Dunhuang Grottos," this paper identifies the Northern Dynasties grottos as the group of 38 grottos constructed from the later period of the Sixteen Kingdoms to the Northern Zhou Dynasty (ca. 400-580 AD), which encompasses the Northern and West Wei Dynasties. The shapes and structures of these grottos, as well as their architectural representation, largely influenced the grottos built later.

4.2 Forms of the Northern Dynasties Architectural Images

4.2.1 Physical Image

The authors refer to structures formed by both physical objects and images as physical images. The wooden dougong physical inserted-arches in grotto #251 are shown in Fig.2. Four wooden dougong brackets were affixed to the ridge purlins of the gable slope of the outer grotto, as well as on the joints of the eave purlins and the grotto walls. The inner ends of the physical bucket arches were inserted into the walls while the outer ends were overhung. Meantime, the bottom arches and pillars were painted beneath the physical dougong brackets, forming a complete set of architectural components.

4.2.2 Continuous Image

Portraits of female entertainers from the Heavenly Palace featured frequently in the integrated frescos of Northern Dynasties grottos. Architectural images were painted in the background of each portrait. Fig.3. shows the Heavenly Female Entertainer Fresco in grotto #435, where arches and houses alternate in the background. The arches were decorated with chapiters (which house the wall belts) and by continuous patterns of terrace railing walls underneath. These continuous images separated the portraits from each other and decorated the frescos, adding to their aesthetic appeal.

4.2.3 Independent Image

The numerous frescos depicting Buddhist Sutras or stories also featured images of buildings of various forms, either individually or in groups. In some façades, the building was relatively open and less
detailed, in order to reveal the Buddhist deities and figures inside, while other buildings were depicted as complete and independent. Buddhist temples, civilian residences, gates and their towers, courtyards, and city walls were frequently painted as independent images in the grottos. These images depicted the colorful world of the Northern Dynasties architecture, and effectively illustrated, decorated, and separated the frescos based on Buddhist stories.

5. Interpretation of the Form Elements of Architectural Images

5.1 Statistical Methods

The authors now proceed from analyzing the individual elements of architectural images to probing the language of image composition, which involves researching and compiling the statistics of all available Northern Dynasties architectural images. After carefully analyzing each of the 318 Northern Dynasties grottoes recorded in "The Comprehensive Records of the Dunhuang Grottoes," and excluding those that were later re-painted or heavily smeared by smoke, the authors found 158 architectural images suitable as research subjects. The images were labeled in chronological order of the grottoes and arranged in the order up-down-left-right. For example, the palace shown in Fig.4., displaying the façade located in grotto #285 is numbered 18.

The authors divided traditional Chinese buildings into the upper section (roof), middle section (body), and lower section (base), in accordance with the Chinese architectural technical guidance "The Wood Book." This paper further divides these three parts for quantitative and qualitative analysis.

5.2 Division and Statistics of Roof Form Elements

5.2.1 The Roof Forms

Roofs came in three forms: hip, saddle, and gable. Among the 158 images, 51% of the building images (50 cases) featured the hip roof, 33% (50 cases) the saddle roof, and 6% (9 cases) the gable roof.

Generally, the hip and saddle roofs were more difficult to construct than the gable roof forms, so they were regarded as of higher status. Roof forms of higher status are expected to be depicted in frescos, since these structures glorified the Buddhist World and the figures therein were dominated by Buddhist deities.

Architectural scholars are undecided on when the saddle roof started appearing in abundance. Its frequent appearance in the Northern Dynasties frescos implies that it had become widely adopted at that time. The authors identified two techniques for painting the fresco saddle roofs. Commonly, lines connecting the building body were painted with no distinct division. In the other technique, a double-decker saddle roof was formed by two parallel lines added to the body. Numerous examples of the latter form are observed in the Northern Zhou Dynasty grotto #296. To exemplify, the building façade of Fig.5. shows two parallel lines separating the upper hip roof from the lower saddle roof, indicating a drop. This finding provides primary evidence for the theory that the saddle roof was a combination of hip and gable roofs.

5.2.2 Structural Attachments

Structural attachments appear in the architectural images fairly infrequently, and were of two forms only: the "eave rafter" and the "corbel bracket." The eave rafters extended beneath the cornice. In Chinese traditional building structure, the corbel bracket (dougong) was a unit in which the bucket-shaped blocks and the arm-shaped ledgers overlapped on the chapiters. The statistical analysis revealed few cases of painted rafters [22 pieces (13%)] or corbel brackets [17 pieces (11%)].
The corbel bracket was a prominent status symbol in Chinese traditional architecture. However, in architectural images depicting the supreme Buddhist World, it appears very rarely. Possibly these structures presented story backgrounds, simultaneously accommodating images of the Buddhist statues or figures. For example, in the 141 independent architectural images, apart from the 7 images blocked from view, 112 buildings (79%) featured interior Buddhist images. Since most of the subjects seen on the frescos were Bodhisattvas or Buddhist statues, the structural attachments of the roof may have received less attention.

5.2.3 The Roof Tile Ornaments

The roof ornaments were constructed by piling bricks onto the body and the ends of the ridge, in an effort to cover, emphasize, and beautify the ridgeline that was subject to leaking. Four forms of roof ornaments are recognized: "pheasant-tail-shaped," "slanting ridge," "perpendicular ridge," and "perked ornament."

The "pheasant tail shape" was a high-status roof ornament that conjoined both sides of the main ridge. Its shape was based on the contour of the sea fish tail, with involute pointy ends.

In the authors' study, the "pheasant tail" was present in all but one of the building images. The exception could have resulted from limited space, since the image in question featured in an architectural image of rather small scale in grotto #285. The "pheasant tail" was the highest-status decorative element, consistent with the fact that since the frescos illustrated the Buddhist World, they were required to adopt buildings of higher status.

Roof tile ornaments were mainly of the forms "slanting ridge" [71 (45%)] and "perpendicular ridge" [50 (32%)]. The frequent appearance of these forms is attributable to the dominant hip and saddle roofs in the frescos, which required the above roof ornaments to support their structure.

Eight frescos featured "cornices perked" roof ornaments, all of which appeared in the nine images with gable roofs. The buildings of the Northern Han Dynasty, on the other hand, featured only straight and flat cornices, from which the authors infer that the abundant appearance of perked cornices succeeded the Northern Dynasties. Moreover, the perked cornices painted in the frescos indicated no lifting of structure, indicating that their sole intention was to decorate the gable roofs.

5.3 Division and Analysis of the Building Body Form Elements

5.3.1 Structural Attachments

Chinese traditional buildings were usually constructed on a base. Following erection of the wooden columns on the four sides, the beams and the architraves, which bore the weight of the roof, were placed above and between the chapters. Walls, doors, and windows were constructed between the columns according to requirements; these constitute the essential elements in all of the architectural images. The walls were depicted as consistently white and lacking brickwork joints, indicating that most buildings of that time were composed of earth. The columns of the first and second floors usually appeared rather tall and thin, a possible manifestation of the tendency to reduce the horizontal scale to emphasize building height, as discussed earlier. In the meantime, long, thin pillars could optimally reveal the building interior.

Structural attachments such as wall belts, architraves, gate beams, doors, and windows also appeared in the images.

The central part of the wall, where two architraves are depicted between short small pillars, is called a wall belt (Fig. 4.). These structures served both a decorative and a practical purpose; they increased the strength of the primitive earth-structured building body.

The structural relationship between the beam and the architrave ensured that the beam was always constructed on top of the architrave. Because most of the beams beneath the overhanging eaves were blocked from view by the latter, the authors identify parallel lines underneath the overhanging eaves architraves. Parallel lines were also painted beneath doorframes when the first floor overhanging eaves were missing. This structure is called a "gate beam."

The statistics revealed eleven wall belts (7%), twelve architraves (13%), six gate beams (4%), and two doors (1%) in the architectural images. Several characteristics of Northern Dynasty architecture appeared in these form elements, though at a rather small scale. For example, among the six structures featuring gate beams, two were watchtowers, three were gatehouses, and one was a city gate. This implies that the painters intentionally emphasized the gates by painting door beams. Meanwhile, doors were usually omitted to reveal the Buddha statues and figures within open spaces. Doors were depicted in only three images; in both gatehouse images (appearing in grottos #285 and #295), the doors on the first floor were highlighted in black, while the city gate painted in grotto #249 featured two doors oriented ajar. All three doors were depicted as square topped gates. Door beams were constructed with "beam on floor" and the doorframes were vertical bars built into the wall.

5.3.2 Decorative Elements

Despite the apparent simplicity of the Northern Dynasties architectural images, several of the images portrayed decorative elements such as sun-shading boards, curtains, and draperies. The authors identified only four instances of sun-shading and one of curtains, while draperies were observed in 23 cases (17%).

The rare appearance of the sun-shading boards and the curtains is reasonable. Such shading devices were typical in civilian residences but rare in the Buddhist temples depicted in the frescos, with their focus on
the internal Buddhist figures. It is also reasonable that draperies appeared more often as the background of the seated Buddha.

5.4 Division and Statistical Analysis of the Form Elements of the Pedestal

The pedestals investigated in this study constituted railings, staircases, square platforms, and the Xumizuo.

Pedestals located at the lowest parts of buildings were likely to be blocked from view by the objects in front. Among the architectural images, 113 were suitable for pedestal analysis. The authors identified 9 railings (8%), 17 staircases (15%), 107 square platforms (95%), and only 2 Xumizuo.

As mentioned above, 95% of the pedestals were square platforms. Most of their façades were adorned with interconnecting horizontal rectangles filled with copper green and blue, apparently denoting bricks. The square platforms were connected to the ground by staircases or slopes, and by apron bricks at the base.

The rare incidence of Xumizuo pedestals contradicts the prevalence of Xumizuo in traditional Chinese towers seen today. Along with Buddhism, this style was introduced to China after the Northern and Southern Dynasties. It was applied to Buddha pedestals only during earlier times, becoming gradually incorporated into pagodas. It became widely adopted in various architectural forms since the Tang Dynasty.

The two basic railing styles present in the images are square platforms and mullions, reflecting the flexibility of Tang and Song Dynasties. Combinations of try squares seen from the Northern and Southern Dynasties to the architectural forms since the Tang Dynasty into pagodas. It became widely adopted in various Dynasties. It was applied to Buddha pedestals only introduced to China after the Northern and Southern towers seen today. Along with Buddhism, this style was introduced to China after the Northern and Southern Dynasties. It was applied to Buddha pedestals only during earlier times, becoming gradually incorporated into pagodas. It became widely adopted in various architectural forms since the Tang Dynasty.

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Table 1. Quantitative Statistics of the Form Elements

<table>
<thead>
<tr>
<th>Division of the form element</th>
<th>No. of cases</th>
<th>Frequency of Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Form</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hip Roof</td>
<td>76</td>
<td>51%</td>
</tr>
<tr>
<td>Saddle Roof</td>
<td>50</td>
<td>33%</td>
</tr>
<tr>
<td>Gable and Hip Roof</td>
<td>9</td>
<td>6%</td>
</tr>
<tr>
<td><strong>Structural Attachment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eave Rafters</td>
<td>22</td>
<td>13%</td>
</tr>
<tr>
<td>Dougong</td>
<td>17</td>
<td>11%</td>
</tr>
<tr>
<td>Pheasant Tale Shaped</td>
<td>157</td>
<td>99%</td>
</tr>
<tr>
<td><strong>Roof Tile Ornament</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slanting Ridge</td>
<td>71</td>
<td>45%</td>
</tr>
<tr>
<td>Perpendicular Ridge</td>
<td>50</td>
<td>32%</td>
</tr>
<tr>
<td>Perked Ridge</td>
<td>8</td>
<td>5%</td>
</tr>
<tr>
<td><strong>Building Body Form Elements</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wall Belt</td>
<td>20</td>
<td>13%</td>
</tr>
<tr>
<td>Architrave</td>
<td>11</td>
<td>7%</td>
</tr>
<tr>
<td>Gate beam</td>
<td>6</td>
<td>4%</td>
</tr>
<tr>
<td>Door</td>
<td>2</td>
<td>1%</td>
</tr>
<tr>
<td>Window</td>
<td>51</td>
<td>32%</td>
</tr>
<tr>
<td>Sun-Shading Board</td>
<td>4</td>
<td>3%</td>
</tr>
<tr>
<td><strong>Decorative Element</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Curtains</td>
<td>1</td>
<td>1%</td>
</tr>
<tr>
<td>Draperies</td>
<td>23</td>
<td>15%</td>
</tr>
<tr>
<td><strong>Pedestal Form Elements</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Railing</td>
<td>9</td>
<td>8%</td>
</tr>
<tr>
<td>Staircase</td>
<td>17</td>
<td>15%</td>
</tr>
<tr>
<td>Square Platform</td>
<td>107</td>
<td>95%</td>
</tr>
<tr>
<td>Xumizuo</td>
<td>2</td>
<td>2%</td>
</tr>
</tbody>
</table>

5.5 Summary of the Form Element Statistics

In the above sections, the authors presented the statistical results of the various form elements. If we divide the number of elements of a specific form by the total number of analyzed form elements, we obtain the frequency of appearance of each form element. The results are listed in Table 1.

6. Interpretation of Symbols in Architectural Images

6.1 The Communicative Function of Architecture

Architectural symbolism has played a significant role in ancient Chinese society. Building forms usually indicated the function and social status of the building. That is, the wealth and social status of the owners or dwellers were symbolized in building forms.

Semiotics assumes that buildings are not mere structures, but play a communicative role. Therefore, buildings are both physical forms and symbols with abundant communicative functions. Architectural images can be regarded as re-compositions of the symbols and forms conveying a specific intention. To analyze architectural images from a semiotic perspective is to analyze the structure and rules underlying the selection, adoption, and re-composition of the symbols.

6.2 Symbol Extraction Methods

Whether observing actual buildings or architectural images, we usually focus on meaningful symbols rather than the whole item. In the frescos, form elements such as Buddhist temples, pagodas, and watchtowers appeared in abundance, yet through nuances between individuals, they acquired a varied and integrated architectural expression. In general, the appearance frequency of a form element, and also its importance, determines the personality of the form element. Ubiquitous form elements with distinctive characteristics were usually recognized by the majority. Therefore, this paper has proposed extraction methods for identifying commonly adopted and frequently appearing form elements as well as those with distinctive symbolic characteristics.

As shown in the above analysis of the form elements, the authors attempted to divide the form elements into sub-items of semiology, by which the characteristics of the form elements could be regarded as alternative forms of sub-items. For example, element roof is a sub-item of the roof. To enable a hierarchical, multiple-form description of building characteristics, this sub-item was further divided into three further sub-items; hip roof, saddle roof, and gable roof. Form elements that were not further divisible, such as gable roof, are regarded as symbols. Thus, the hierarchical status and traits of the building can be expressed in terms of symbols.

6.3 Collection of the Identified Symbols

The sub-sub-items of form elements listed in Table 1. were analyzed for frequent appearance or distinctive traits, yielding the collection of symbols shown in Fig. 6.
7. Component Analysis of the Symbols

7.1 Methodologies

Component analysis theory is based on the generative grammar of language. The authors adopt the component analysis module proposed by the American structural linguist Eugene A. Nida, which analyses morphology and semantics. According to this module, components that carry semantic function are the components of meaning. To decide the meaning of the language form, the elements for comparison are also required. Common meaningful components are generated by comparison with other asymmetric systems. Three component categories are recognized: a) the common component, the central one that is shared by all lexemes in a given semantic domain or lexical field; b) the distinctive component that distinguishes the meaning of a lexeme from others in the same domain; c) the auxiliary component that describes and assists a language in its semantic functions.

7.2 Component Analysis of the Symbols

The collection of symbols was formed through the displays of common and distinctive features of buildings depicted in architectural images. Component analysis effectively determines the significance of symbols that are either common or distinctive. Therefore, a component analysis approach seems eminently suited to the purpose of this study. By dividing symbols into common components, the distinctive and auxiliary components can be identified from the distribution (appearance frequency) of the symbols. The common components are those that occur ubiquitously (in 80% or more of the images), and show the similarity among the buildings. The distinctive components appear relatively rarely (in 20% or fewer of the images); these features distinguish among the buildings. The auxiliary components are not directly linked to similar and distinctive display, but serve to enrich the building images. The results of component analysis, derived from the frequency of appearance of the symbols, are provided in Table 2.

7.3 Common Components and General Features of the Buildings

From Table 2., we observe that the "pheasant-tail-shaped roof tile ornament" and the "square platform" are common building components. As the common components occur in 80% or more of the images and denote similarity, these two symbols can be said to represent the general features of the architectural images. Thus, we can conclude that the "pheasant-tail-shaped roof tile ornament," "square platform," and "pedestal" formed the general features of the Northern Dynasties architecture, while the auxiliary components, namely "hip roofs," "saddle roofs," "slanting ridges," "perpendicular ridges," and "windows," supplemented the general features.

Collectively, the shared features and the auxiliary forms ensured the integrity of a range of architectural images. By capturing these frequently shared symbols, painters could accurately present the general characteristics of the Northern Dynasties architecture. On the other hand, the general characteristics depicted in the frescos of buildings evoke a sense of integration.

7.4 Distinctive Components and Diversity of the Buildings

From Table 2., the authors identify fourteen distinctive-component symbols. These symbols were present in very few architectural images, implying that they represented the distinctive features of the buildings. Some of these distinctive components, although symbols, can be further sub-divided into different types. For example, the wall belt can be subdivided into single layered, double layered, in combination with the dougong bracket, and probably others. However, the wall belt appeared in a specific period, being seen in abundance only in the early Northern Dynasties, and disappearing thereafter.
The distinctive symbol *dougong* is also further divisible. For example, the *dougong* brackets appearing in houses or on palace walls were simple gable arches constructed between both layers of the architraves, formed by straight lines, and with their lower ends neither extended nor upturned. Meanwhile, the *dougong* brackets on the bodies of watchtowers were depicted in abundance. Aside from the gable arch, variations such as the *yidousansheng* (one cap block with three cross mortises) and the *yidouersheng* (one cap block with two cross mortises) were seen. Combinations of these structures are highly flexible; for example, *yidousansheng* brackets were observed to alternate with gable arches, and *yidouersheng* brackets were sometimes supported by king posts and gable arches.

From the component analysis of the distinctive components, the authors could see that the distinctive symbols carry numerous varieties within themselves as well developed subtle changes with time. The existence of the distinctive symbols with the ability of being broken down continuously made it possible for the seemingly sketchy Northern Dynasties architectural images to have an ever-changing symbol structural system. The inner symbol structure produces architectural images full of diversity.

8. Conclusion

Despite the apparent coarseness and primitive features of Northern Dynasties architectural images, they provided a medium through which painters could relay ideas based on their understanding of contemporary architecture. The authors consider that painters intentionally depicted the Buddhist World based on real architectural symbols. Therefore, building images in the paintings could be used as supporting materials for restoration. To support this hypothesis, this paper advanced the theory that architectural images could be transformed into the selection, adoption, and re-composition of symbols in the painting process by a semiological approach.

Based on the above hypnosis, this paper qualitatively and quantitatively analyzed the structure and ornamental characteristics of the Northern Dynasties architecture. By identifying form elements in the architectural images, the authors concluded that in Northern Dynasties buildings the traditional Chinese wooden frame symbolic style was established at that time. Contemporary painters utilized both common and distinctive symbols to depict diverse, flexible structural characteristics. Thus, the seemingly sketchy Northern Dynasties architecture is underpinned by a constantly varying and dissolving symbol structural system that enables both unity and variation. This system indirectly reflects the highly adaptable traits of Chinese architecture.

By conducting component analysis of the symbols, the authors quantified the distribution of the symbols and interpreted the meaning of each category, emphasizing that symbols functioning as common components formed the general features of the Northern Dynasties architecture, perceived by painters as common traits. However, most of the symbols functioned as distinctive components, and many symbols could be further subdivided into numerous variants. Distinctive symbols, with their transient structural characteristics, are responsible for the constantly varying and dissolving symbol structural system that underlies the seemingly sketchy Northern Dynasties architecture. These symbols enrich the architectural images with unity and variation.

The period between the Northern Dynasties and the Mid-Tang Dynasty spanned over 500 years, but left very few architectural relics and archeological data for research. Therefore, since the Dunhuang Frescoes reflect the architectural style of that period, their study can fill the research gaps introduced by the lack of physical evidence. Therefore, even if the depicted buildings were not an accurate portrayal of reality, they constitute a useful complementary tool in architectural studies. The possibilities of painting research are multifaceted. Thus, painting research is an important direction in architectural study, such as to identify the building elements and the architecture by the subjects of the grotto or other paintings.

References