



## **Application and Analysis of Axial Symmetry in Sacred Architecture**

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### **Abstract**

The sense of sacredness has an irreplaceable unique meaning for the development of social civilization and personal growth, and the sacred architecture with axisymmetric characteristics is often the catalyst for this experience. Through analysis of architectural cases, from the perspectives of architecture, philosophy, psychology and geometry, using the deductive and contrasting modes of thinking, this paper analyzes the unique sensed characteristics of the axial symmetry in architecture. The reasons for the sacredness of the buildings and its influencing factors, the in-depth study of the axial symmetry of the sacred buildings are carried out with a unique perspective.

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### **Keywords**

Symmetry; Sacredness; Architecture Design

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### **1. Introduction**

There are thousands of forms of beauty, and the sacredness that points to the ultimate meaning of life is undoubtedly the most fascinating. The sense of sacredness has an irreplaceable unique meaning for the development of social civilization and personal growth, and the sacred architecture is often the catalyst for this experience. As a form of art, architecture plays a fundamental role in providing people with the function of normal use while the highest state is to provide necessary care for the spirit of the people. From ancient times to the present, buildings such as pyramids of ancient Egypt, the Parthenon of the ancient Greek, the Pantheon of the ancient Roman, the medieval Notre Dame de Paris, the Cathedral of Saint Mary of the Flower in Florence, the Palace of Versailles in France and the Salk Institute for Biological Studies in America are the perfect places to experience sacredness. Axial Symmetry is an obviously common feature of these sacred buildings. This feature is so critical that if the symmetry is taken away, the unbeatable sacred beauty of these buildings will be totally lost. Symmetry is the most direct and effective factor in creating the sacredness in architecture and the relationship between them is worth exploring.

A geometric shape or object is symmetric if it can be divided into two or more identical pieces that are arranged in an organized fashion (Lockwood & MacMillan, 1978). There are three primary types of symmetry: reflection symmetry, rotational symmetry, and translational symmetry. If a graphic is folded along a straight line and the graphics on both sides of the line can completely coincide, then the graphic is called an axisymmetric figure while the line where the crease is located is called the axis of symmetry. Architecture, as any compositional art, makes extensive use of symmetry. If an axis could be found in the building where both the sides of the axis are mirrored, we can call it an axisymmetric building. Most sacred buildings are axisymmetric buildings.

However, there is often no absolute axial symmetry in architecture, and architectural art is often the product of harmony between symmetry and symmetry breaking. This paper does not discuss symmetry breaking, but focuses on the fundamental symmetry.

## **2. Analysis of the Reasons Why Axial Symmetry Could Be Felt in Sacred Architecture**

People's understanding of axial symmetry comes from nature, and the search for axisymmetric beauty stems from people's yearning for natural order. The most important reason why the axial symmetry can contribute to the building is that the axis of symmetry can be perceived. People can feel the axis of symmetry because of the symmetry of the human body itself.

There is symmetrical property inside the morphological structure of the human body. The limbs and the trunk are symmetrically arranged with the axis of the spine and the sternum; the eyebrows, eyes, and ears on the face are roughly symmetrically distributed along the axis of the nose. After hundreds of millions of years of evolution, axial symmetry remains as a stable and balanced nature of the biological world, without exception to human beings. The symmetrical arrangement of the eyes and ears is necessary for the stereo acceptance of the audition, while the symmetrical placement of the legs is for the convenience of walking straight forward. While being inside an axisymmetric building, someone will suddenly feel that the symmetrical property just as his/her own body, and he/she will feel belonged by the entire symmetry field. As a result, a great sense of integration arises. A scientific explanation has been made in psychology for this sense of integration: there is a "homomorphic" or "heterogeneous isomorphism" relationship inside the formal structure between the structure of the external world and the inner world, thus they correspond to each other. The formal structure of symmetrical objects causes the same electrical impulses as human physiological and psychological structures, resulting in a sense of aesthetic pleasure and even sacredness. The "sacred beauty" experience does not refer to a god imagined on the basis of a human being, or the ultimate world on the other side, but the realm of "integration with the world." As figure 1 shows, the axial symmetry of human beings participates in the axial symmetry of the building environment, and they feel the sacred realm of integration with the world.

The human body maintains balance through a complex mechanism. The balance of the human body depends on the brain's control of the complex neural network throughout the body, while the brain needs to organize and respond to information from the eyes, muscles and tendons as well as the inner ear. The human eye receives the information of the positions of the surrounding environment, after compared with the memory of the parietal lobe and the temporal lobe, thus determines the balance of the human body through other reference objects. The invisible axis of the symmetry in those building, together with the horizon, form a T-shaped overall environmental layout system, enabling people to better sense their balance.

The concepts of sublimity and grace arise from our amazement of things far beyond ordinary. They create a sense of pleasure when we realize that there is no danger in this situation. At the moment, the balance brought by symmetry makes the buildings' volumes seem so stable, and the material does not overwhelm spirit, they live in harmony. (Burke & Boulton, 2015)

## **3. Application of Axial Symmetry in Sacred Architecture Design**

Axial symmetry is an important approach in sacred architecture design. Although there are many specific methods for axial symmetry design, only six, the most important of them, are selected in this paper to analyze the application of axial symmetry in sacred architecture

### **3.1. Extending Axis Length in Architecture**

The axis length of axisymmetric buildings has a significant influence on the sense of sacredness. If the axis of symmetry is too short, it is probably that the feelings of the experiencer could not be aroused before the process is over. Obviously, only a symmetry axis with sufficient length can furnish the experiencer with ample time to brew the emotion that changes from secularity to sacredness. Nevertheless, what should be noted is that merely having a sufficient length is not enough to trigger the sense of sacredness, in that too simple and repeated experience will be tiring. Only by making appropriate changes to the process of this axis, can the experiencer slowly obtain the sense of sacredness. Taking the Forbidden City in China as an example, its north-south axis is 3,300 meters long, in which a number of nodes are set to enrich the sacredness of the palace. At the end of the axis is Jingshan Mountain on which

the whole axis can be reviewed, allowing the experienter to review the route he has experienced from a bird's eye view, which further stimulates the experienter's feelings.

### 3.2. Utilizing Multiple Symmetries in Architecture

Axisymmetric buildings often have a major axis of controlling symmetry. For the sake of enriching experience on this main axis, other axes are often superimposed on the middle part of it, and the intersection of the two axes forms the node of architectural experience. For instance, the Cathedral of Saint Mary of the Flower in Florence has a secondary axis besides the main one. As figure 2 shows, these two axes are perpendicular to each other, and at their intersecting point is the center of vault. The multiple symmetries in architecture reinforce its sense of sacredness. This approach provides the experienter with a specific position of sacredness. For instance, when the experienter realizes that he/she is at the intersection of two axes, the experience of sacredness he/she obtains has also been magnified many times.

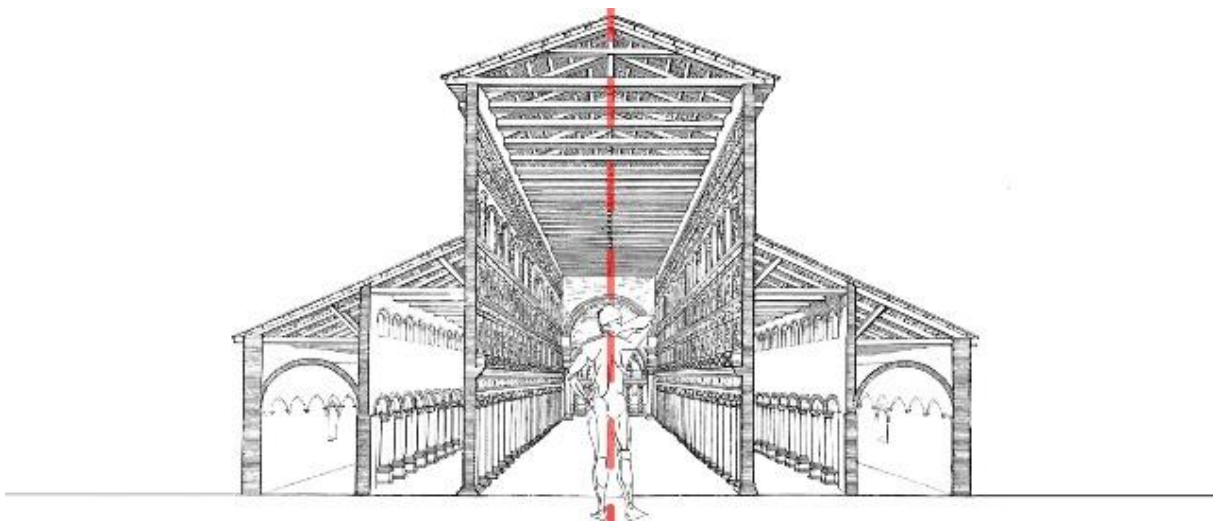


Figure 1. symmetry of human participates symmetry of the building

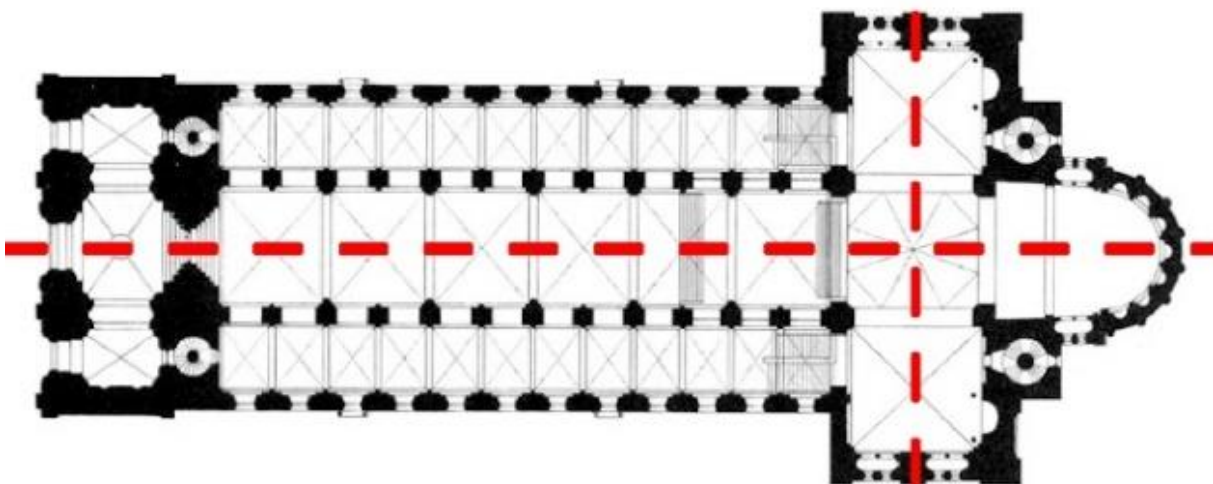


Figure 2. two axes are perpendicular to each other

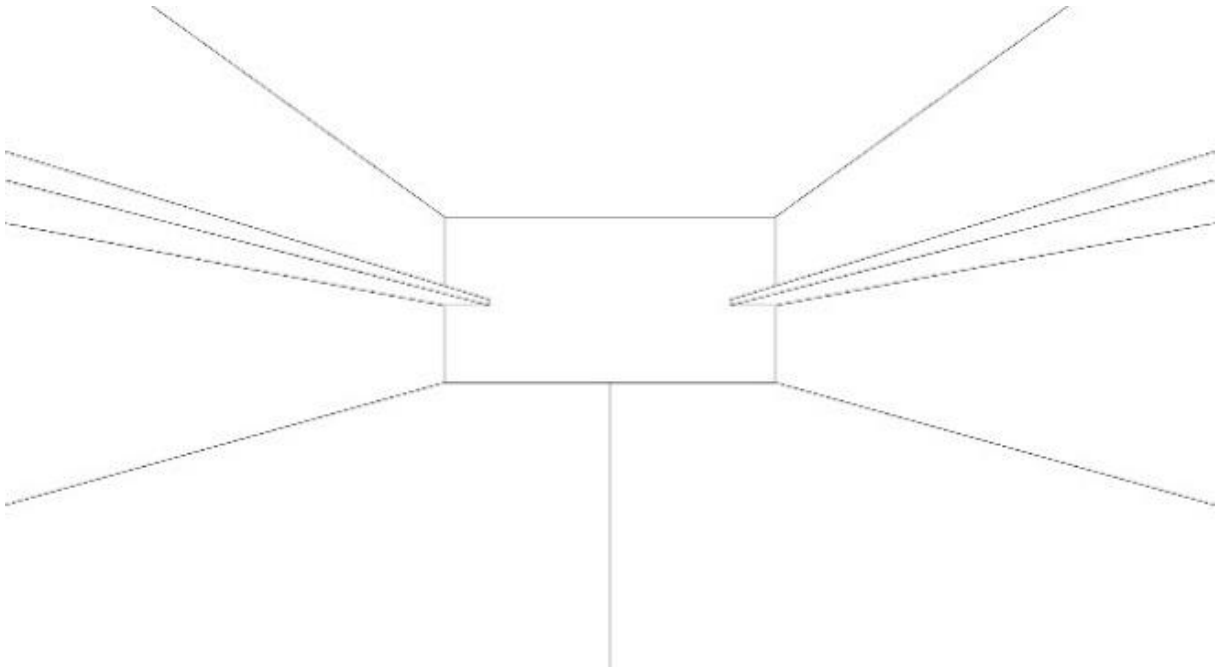


Figure 3. interior space without columns

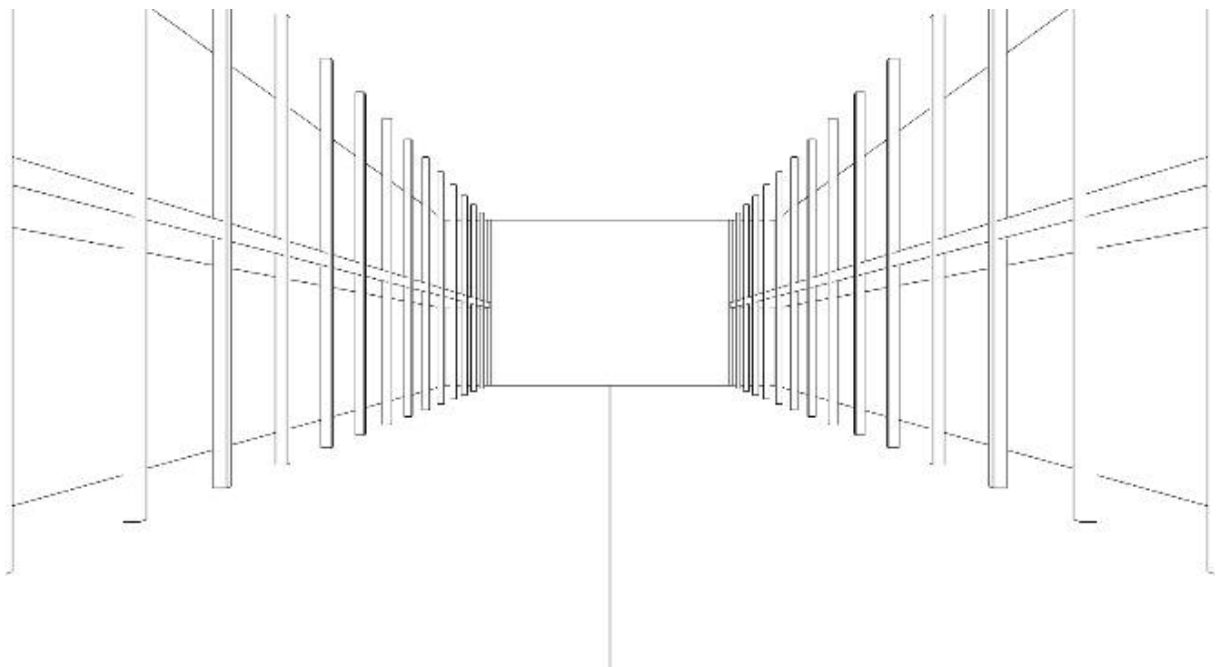


Figure 4. interior space with columns

### 3.3. Reasonably Designing the Facade Size and Proportion

The facade of the building provides the experiencer with a first impression, which is the basis for all subsequent experiences. Without enough shock or emotional accumulation given by the facade, the experiencer will hardly get the sacred feeling of the building easily. In consequence, a large enough facade, even one with oppression, would be the best start to generate the sense of sacredness. The proportion of the front facade is of equal importance. In general terms, the higher the facade is, the more likely it is to trigger the emotional resonance of the experiencer. Many churches have sky-high towers on their west facades, taking Notre Dame in Paris as an example. The material is crucial as well, for the coarse stone expresses the sacredness and solemnity well on account of its strong sense of history, while the bright and clean modern material full of industrial sense makes people feel more exquisite and gorgeous. Furthermore, the proper viewing distance enables the building to form a complete picture in the field of vision, the depth of its formation enhancing the sense of mystery and scaredness.

### **3.4. Improving the Facade Complexity**

The more complex the building facade is, the more abstract symmetry it tends to make the experienter feel with the more sacred it triggers. A simple square box building with strictly symmetry along the central axis only gives experienter no more than a sense of solemn and generous. It hardly creates a noble and sacred artistic effect, for the reason that its central axis is negatively hidden at this moment. In contrast, if what the experienters see is the complex rising and interweaving of the ribbed vault of gothic church, the intersection of its complex lines strongly indicates the position of the central axis, which becomes strong, obvious and powerful, and the lofty and sacred characteristics brought by it are fully displayed.

### **3.5. Enriching Axis Rhythm**

Repetitive elements form the rhythm, which benefits emotion generation. Enriching the rhythm on the building axis and combining their advantages can avoid the boring sense due to the long axis. As a result, the experienter better feel sacredness by means of delicacy layers. The colonnade is the most common architectural element that forms the rhythm. As shown in figure 3 and 4, for the same interior space, there is no colonnade in the left picture, leading to a bigish chance for experienter's vacuous feeling. The figure on the right shows colonnade rhythm in the axis experience, making it easier for the experienter to obtain the sense of sacredness by perceiving the space level and details.

### **3.6. Combining Symmetry Axis with Light**

In addition to the symmetry axis, light is one of important influence factors for sacredness initiation. If the light and symmetry axis can be combined, the sense of the experienter will greatly enhance. In many churches, left-right symmetrical stained glass windows introduce so colorful sunlight into the center of the church that experienters can further feel the enhancement of axial symmetry. The light comes from not only windows but also roofs specially designed. For example, the Bagsvard Church designed by Jorn Utzon introduces multiple light rays into the interior along the symmetry axis from the slope roofs to enhance the sense of sacredness.

## **4. Case Study of Application of Axial Symmetry in Sacred Architecture**

### **4.1. St. Peter's Basilica Church**

Designed principally by Donato Bramante, Michelangelo, Carlo Maderno and Gian Lorenzo Bernini, St. Peter's is the most renowned work of Renaissance architecture and the largest church in the world. All the above six symmetry axis design methods can be reflected in it. Firstly, the symmetry axis of St. Peter's is long enough, beginning from the large oval square, to the entrance square of isosceles trapezoid, ending into the inside of the church. The length of the axis is nearly 500 meters, giving us enough time and space to experience the sense of sacredness. Secondly, besides the main axis, there are at least two obvious auxiliary axes perpendicular to it. One is the axis of the oval square, and the other is the short axis of church's Latin cross plan. These three axes together form the beginning and the end node, marking the production and high tide of sacredness experience. Thirdly, the west facade of St Peter's Basilica Church is very huge, providing experienters with oppressiveness and then sacred feelings. Forthly, the west facade is complex enough and full of various columns and decorations which makes abundance of information overwhelming every observer. Fifthly, the colonnade on the centerline not only produces rhythm, but also provides multi-level space to enrich observer's experience. Sixthly, stained-glass windows bring in light, further strengthening the sense of sacredness. To conclude, St. Peter's Basilica Church is a powerful example of the great importance of axial symmetry in sacred architecture.

### **4.2. Palace of Versailles**

The Palace of Versailles offers a visual history of French architecture from the 17th century to the end of the 18th century. An east-west axis dominates the grand palace, flanked by buildings and landscapes. The main palace is the east-west trend, and its two ends are connected with the south and the north palace to form a symmetrical geometric

pattern. The central axis of the palace garden is as long as 3000m, or 14,000m if it includes the length extending to the city outside, running through the whole garden as a prominent art center, which has become the object of key decoration. The most beautiful parterres, statues and fountains are arranged in it to render, foil and strengthen it. In addition to the central axis, the Palace of Versailles forms a secondary axis layout, so that the palace contains a layer of distinct relationship between the primary and secondary levels, which also exactly illustrates the centralized monarchy. Under the pretext of the sacredness of central axial symmetry, the designer has strengthened the axial symmetry infectious quality by an enormous volume, so as to highlight the monarchy's foundation --divine right of kings.

### **4.3. Salk Institute for Biological Studies**

Salk Institute for Biological Studies is housed in a complex designed by the firm of Louis Kahn. It consists of two symmetrical buildings with a stream of water flowing in the middle that separates the two. Kahn took advantage of the local natural geographical conditions and abundant natural light to distribute the buildings in an axisymmetric form, with the same style of buildings standing quietly relative to each other along the central square axis. Each building has six floors, the lower three of which house laboratories, while the upper public facilities. In the center of the square, a narrow water passage is designed. The whole water passage is like a clear central line, strengthening the whole building complex symmetry. The Salk Institute's open environment replete with empty space is symbolic of an open environment for creation, the symmetry stands for scientific precision, and submerging crevasses allow warm, natural light to enter the buildings like the intellectual light that leads to discovery. Kahn has perfectly expressed his lofty and powerful spiritual power with his clear and reasonable structure, clear and simple form, delicate and unadorned material, powerful geometry and quiet space.

## **5. Conclusion**

The sense of sacredness has an irreplaceable unique meaning for the development of social civilization and personal growth. The perceived characteristics of axial symmetry determine its important role in generating such emotions in the field of architecture. Since modern architecture movement, many architects have pursued asymmetry at any costs, and architecture has gradually become an entertainment. As a result, there is a growing lack of sacredness. As architects, we should be good at analyzing and using the role of axial symmetry in architecture and strive to create architectural works that enable people to feel sacred and eternal.

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