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CS 39 Final Project Report

Symmetries in Chinese Architecture

An important feature that makes Chinese architecture unique is its emphasis on articulation and symmetry. Symmetric structures can be found everywhere in China, from palace complexes to humble farmhouses. Usually, there are an even number of columns and an odd number of bays to maintain the balance in Chinese architecture.

The Forbidden City was the Chinese imperial palace from the Ming dynasty to the Qing dynasty and it remained as the ceremonial and political center of Chinese government for 500 years. The layout of the Forbidden City follows a bilateral symmetry. The main buildings are at the center and secondary buildings are positioned either side of the main buildings to maintain overall bilateral symmetry. Architects even symmetrized the Golden Water River's course through the complex. Swastika and Longevity pattern (shown below in Figure 1), which has both rotational and mirror symmetries, can be found throughout the Forbidden City.

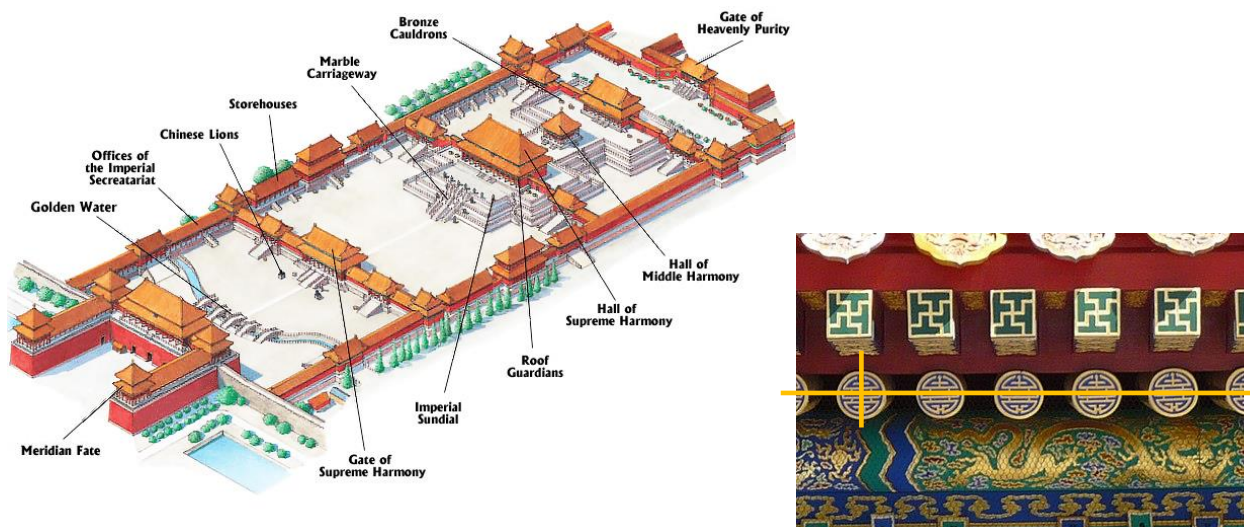


Figure 1: layout of the Forbidden City and Swastika and Longevity pattern

“Round sky and square earth” is a basic concept in the tradition of ancient Chinese geography. It is why a lot of Chinese architectures have a rectangular base. It seems very strange that the Forbidden City misses a part on the top-left corner, which makes it asymmetric in a way. No one knows why. Some people say it was a construction mistake, but many believe it was not the case. There are three common speculations: 1. The top-left corner of the Forbidden City was on the earthquake zone, so the buildings that were built there collapsed again and again. 2. It is due to Feng shui, a pseudoscience originating from China. Maybe it was considered not proper to construct a building there. 3. It was designed purposefully to avoid the accumulation of water.

Other examples of symmetric ancient architecture include the Three Pagodas of the Chongsheng Temple and the Potala Palace in Tibet. Symmetry is not only a feature in ancient Chinese architecture, but also in modern Chinese architecture. For example, the China Pavilion at Expo 2010 demonstrates the power of symmetry. Every layer is symmetric and enlarged by a scale factor. The pattern on each end has mirror symmetries (see Figure 2).



Figure 2: China Pavilion at Expo 2010

The National Aquatics Center also has symmetric structures. The mathematical model of the National Aquatics Center is composed of a number of connected polygons (see Figure 3).



Figure 3: National Aquatics Center and its 3D model

The National Stadium in Beijing is another great example. In Figure 4, each angle and line are carefully designed. The intersections of lines are represented by red dots. The structure takes advantage of the stability of triangles to keep it in balance and harmony.

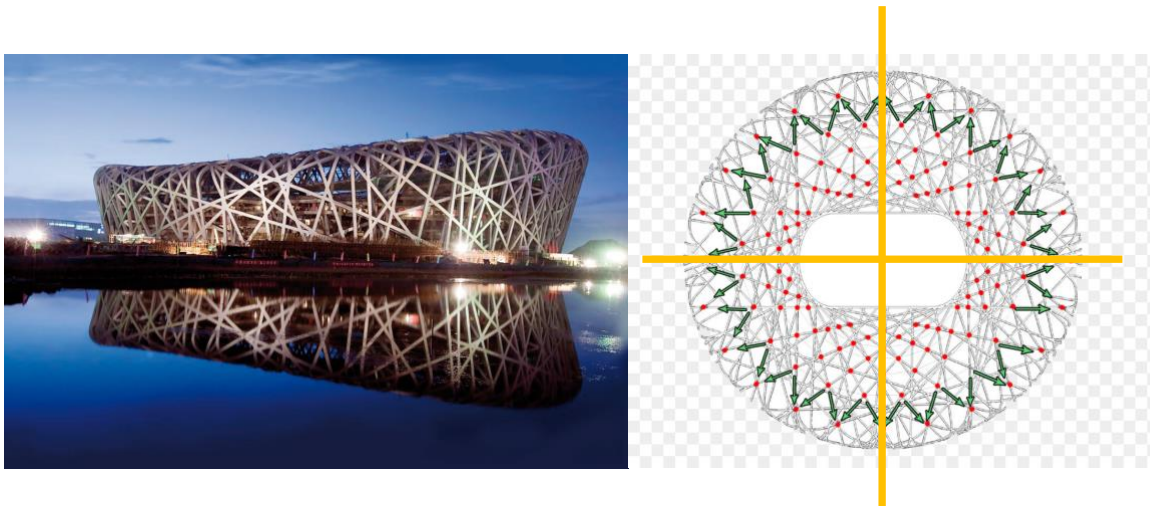


Figure 4: National Stadium and its complex structure

Why does symmetry play such a significant role in Chinese architecture? It is because of the Doctrine of Mean or Zhongyong, a fundamental idea in Chinese culture. The mean is described as “unswerving pivot”. The Chinese characters “中(zhong)” means “bent neither one way or another” and “庸(yong)” represents the state of unchanging.

Nowadays, symmetries are everywhere in China. Hotels and restaurants use symmetric designs to create beauty and attract people. People may not realize it is symmetry that makes Chinese architecture so beautiful and appealing. Many underlying principles of symmetry and topology are applied in the design of Chinese architecture.