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Design and construction of ancient timber buildings

Entwurf und Ausführung von traditio- nellen Holzbauten

Design e costruzione di vecchi edifici in legno

Document in English

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Abstract

China is situated at the North Temperate Zone. Most of its part is warm and rainy. This kind of climate is suitable for plants to grow. So there are lots of forests. For this reason Chinese ancient constructions always choose the timber as structural material.

The buildings which are constructed with timber material take on linearity character. The construction space is encircled with many straightness timber components. Therefore rectangular room which is called "Jian" is taken as the basic unit of the construction in China.

The five basic members that encircle the construction space are column, beam, "Fang", purlin and rafter. The vertical member is called column and the horizontal member is called beam or fang. The beam is the load-bearing component and "Fang" is the connecting component which ensures the structural stability. Purlin, a kind of small beam, is supported on beams and transfers the upper loads to the beams. Rafter, which is a sloping member and is put in the roof structure, not only bears the roof load but also increases the stability of the roofing. The above five members are the basic elements of Chinese ancient constructions. If a structure lacks any type of these elements, it wouldn't be a complete and safe system. So these five elements are regarded as the basic members of Chinese ancient timber buildings.

These five members are connected by tenon-and-mortise which utilizes the character that timber can be cut. Mortise is flange and tenon is concave. So that those independent timber members can be connected together and forms a structural space. The tenon-and-mortise connection used in Chinese ancient architectures is extremely complex. It can bear all kinds of forces such as tension, compression, torque, moment and shear. There are several different types tenon-and-mortise connection to bear different loads.

By means of these five basic members and the connecting methods, Our ancestors constructed the splendid folk houses, gardens, temples, palaces and so on. From the angle of archaeology, the Chinese ancient timber buildings have a history of about 8000 years. The timber members of Hemudu Culture Ruins in Zhejiang have a history of 8000 years measuring by carbon. Yin ruins of Anyang have a history of 3000 years. Bronze Musicians and House of Potang in Shaoxing have a history of about 2400 years. The quadrate table carving dragons and phoenixes from Zhongshan King Tomb has a history of about 2200 years. The timber constructions of Stone-carving in the Han Dynasty have a history of 2000 years. The main hall of the Foguang Temple of Wutai county in Shanxi province (A.D.875) is the oldest existing timber structure. The highest existing timber structure is Buddhist pagoda in Fogong Temple of Ying county in Shanxi province(A.D.1056). The structural style of Wugongqiao (A.D. 1100) is an extremely special structure which is formed by colligating all elements together without nail or mortise. By the frictional between elements, a stable structure was formed. As a style of wood arched bridge, it is used in the ravine bridge and wide-spread exists in the Chinese mountain areas in the south of the Changjiang River.