Long Weiguo
Vice President,
Director China Southwest Architectural Design and Research Institute
National Organization for Timber Construction Design Code
Shanghai, China

Timber Engineering Research Needs in China

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Abstract

In this article, development history and the present situation of Chinese timber structure is briefly introduced. As to some research works which need to develop at present, a certain description has been given.

Keywords: timber structure; light wood frame construction; dimension lumber; glued timber structure; composite material; timber framing composite wall; light timber truss

1 Development history and the present situation of Chinese timber structure

Chinese timber structure has a long history.Large double-eaved roof timber structure can be built in Western Zhou Dynasty (3000 years ago).Huge timber structure palace turned up in Qing Dynasty and Han Dynasty (2200 years ago).Tang Dynasty (more than 1,100 years ago) is the prosperous time of timber structure construction. Building technologies of timber structure have been edited in “Da Tang Liu Dian”. The technologies have also spread abroad.

Compilation of “Ancient Construction Standard” has been finished in period of Song Dynasty to Liao Dynasty (960A.D. to 1279 A.D.). The building technologies of timber structure have been improved. A mount of magnificent palaces and glorious gardens were built.
Great capital city was built in Yuan Dynasty (1279A.D. to 1368A.D.).Some large timber buildings of Ming Dynasty (500years ago) were repaired in Qing Dynasty. Fortunately, they have been preserved to nowadays.

The Ministry of Construction in Qing Dynasty (1644A.D. to 1911A.D.) promulgated “Collection of Construction Instances”. It sets engineering specifications, uniforms the system of official building, specifies 27 kinds of housing patterns, and makes the building technology more normalized.

China has a vast territory. Its architecture style presents the differences between north and south. The grand style in north and the delicate style in south formed gradually.

There are Chinese ancient timber buildings which have been preserved near millennium years, such as Ying-Xian Wooden Tower, Nanchan Temple in Wutai Mountain, Foguang Temple, Ji-Xian Dule Temple, etc. These old buildings are an important part of the historical and cultural heritage of the Chinese nation. They have enjoyed fame of high historical, artistic and scientific value in the international community, and been called the treasures of oriental architecture.

In 2 decades after 1949, because of the state's needs, timber structure was not only widely used in civilian and public buildings, but also in industrial constructions. As a local wood material, timber can be easily got. Therefore, the timber structure account for a very large proportion in many areas.

At the time, the level of Chinese wood industrialization is low. The application of timber structure was limited to the use of square timber or log. That is the traditional wooden structure. In the long process of evolution, a set of building experiences in Chinese traditional wooden structure have been summed up. It could adapt to the local climate, landform, natural resources and etc. Adequate technical means were accumulated.

However, in 30 years after that, the application of wooden structure was limited for the lack of forest resources. The research and the building technology improvement were basically stagnated.

From 1998, in order to maintain a balance between timber supply and demand, a series of measures to encourage timber imports has been adopted. Large quantities of wood are imported. Dimension lumber and engineering lumber products are widely used in construction.
Meanwhile, the relevant codes of timber structure have been gradually revised and formulated. Since then, Chinese timber structure development has entered a new period.

In the new period of development, light wood frame obtains massive applications. It is necessary for the use expanding of trees and the study of fast-growing species strength index. To expand timber structure application and optimize the rational use of wood, it is important to make the research of laminated wood structure, and develop the structure composite materials. And it is important to study timber protection so as to conserve wood and extend the life of wood.

In 2006, building energy conservation in China has started. The timber framing composite wall, used in other structures as filled wall, plays a positive role in building energy conservation.

It is effective to apply light timber truss in the program to alter plate roof to slope roof.

2 The research work needed to do at present

2.1 Research for strength index of Chinese fast-growing dimension lumber should be done

At present, domestic demand for timber has reached 300~330 million cubic meters annually. According to the forest logging quota in the "10th Five-Year Plan" period, only 140~150 million cubic meters annually are available. The forest logging quota would bring a domestic timber supply gap of 160 million cubic meters.

Chinese fir, masson pine and poplar are the most important plantation species. Plantation area of the three species is 18.184 million hectares, 59.41% of the total plantation area. Its wood volume reaches 968 million cubic meters, 65.34% of the total plantation wood volume.

The diameters of these plantation are about 25~30cm, which means they could be logged already.

How to get use of Chinese fast-growing species is extremely important. And it is also necessary to study the strength index of dimension lumber. At present, Chinese Academy of Forestry has cooperated with Canadian Forest Research Institute in order to carry out the research of dimension lumber strength index of Chinese fir.

2.2 Research for glued timber structure technologies should be done

Glued timber structure is unrestricted from natural log size. Therefore, the quality of the wood structure can be improved, the scope of application of wood could be expanded, the use of timber volume could be saved, the use of wood would be more reasonable and optimize. It does be the important direction for the development of modern timber structure.

The “Code for design of timber structure”GBJ5--88, promulgated in Oct. 1988, firstly added the content about glued timber structure.

At the time, the code for glued timber structure is basically compiled on the base of technical information of the former Soviet Union.
In recent years, techniques of developed rapidly in the region where timber structure used widely.

However, over the past 20 years, there is no any research on glued timber structure in China.

In the recension of national standard which has begun since 1999, the content of glued timber structure has not been newly changed for lack of study. It basically continues the contents of the code complied in 1988. And it is far behind the international advanced technologies.

In order to enable the glued timber structure to obtain the widespread application in the project and avoid the quality problem, the establishment work of "Code for glued timber structure" has already started this year.

At present, there are some problems which need to be resolved:

(1) The International advanced material quality classification and the intensity graduation of glued timber structure need thorough research, in order to consummates the corresponding stipulation in the code GB50005.

(2) The international design methods for glued timber structure need further study, as to complete the content of structure design.

(3) To reduce the cost, advanced and efficient glued lumber processing factories need to be established. Only in this way can we satisfy the need of unceasingly glued timber structure development in China.

(4) The construction enterprises need to be developed and be trained. So that, Chinese glued timber structure construction could be satisfied.

2.3 Research for relevant problems of structure composite material should be done

Structure composite material includes LVL, PSL, LSL, OSL and other compound wooden products which have the similar characteristic. It is usually produced with waterproof glue for external use. So, it has high strength and low water ratio, as well as small contraction distortion.

At present, structure composite material is widely used in light wood frame construction and also as beam and column in ordinary buildings.

In China, there are some timber structures which use composite material as its beam and column. However, China has no her own processing plant. All the products have to depend on import. Therefore, the cost has increased.

There some problems about composite material need to be solved:

(1) Related products standards of structure composite material need to be established.

(2) Foreign processing technology and equipment of structural composite material need to be attracted. Processing plants should be built.

(3) Cooperate with foreign timber structure research institutions and, make full use of local tree species to produce composite material.

2.4 The protection of timber structure needs to be strengthened

China is a vast territory country with various weather conditions all around. There also different kinds of harmful wood-destroying fungi and insect. Therefore, different requirements for structure defense are made.

The lumber protection quality is key factor for lengthening the lumber service life, the basic goal of timber protection.

It is necessary to conduct the new research of efficient, low-toxic, non-polluting and colorless, no smell, multifunctional and environmentally friendly wood protector. The protector should adapt to protection requirements of different conditions. It is also necessary to do some research about timber permeability and to improve the defense quality of all kinds of the timber which are difficult to be soaked.

Besides, light wood frame construction is adopted continually all over China. Its prevention of corrosion and insect corrosion can only be made according to the present standard.
There has been no maturity experience of prevention of corrosion and insect corrosion yet. Therefore, the light wood frame construction built recent years in China need specific research, in order to get the successful experiences.

2.5 As the timber is called “Green construction material”, timber structure has great prospect

At present, the area of built construction is about the 40 billion square meters. Of it 99% is high power-wasting buildings. On the contrary, energy-saving constructions only account 3%-5% in the new additional ones annually. The development of energy-saving building should be promoted by relevant policies. Then the needs of "green building materials" can be stimulated and also the new god-given business opportunity can be brought for international building industry.

The covered area of new additional buildings in China would reach 2 billion square meters annually in 10 years. Nevertheless, all the new additional buildings in town should reach the design standard of saving 50% energy in 2010, according to the relative government requirement. This means future the demand for "green building materials" will have a huge growth in China in several years.

As the request for a better work and environment unceasingly enhancing, the focus on the environmental protection, the energy conservation and the superiority of timber structure are definitely going to obtain the approval. It is necessary to get clear how to cooperate timber structure with concrete or steel structure, in order to display their respective superiority.

The “Technical code for partitions with timber framework” has been established by the end of 2003 with the cooperation of Standard Norm Department of Ministry of Construction, the National building materials bureau standard norm center, China Southwest Architectural Design & Research Institute and European Wood Products Association . This code has been put into implementation since March 1, 2006.

The main features of combination wall with timber frame are many, such as: flexible layout, light deadweight, main structure bearing lighter load, lower cost, better noise isolation, energy-saving, flexible construction, industrialize production of components, and also fabrication on the site.

2.6 Light timber truss is applied in the program to alter plate roof to slope roof along with researching corresponding problems

Light timber truss is more frequently applied in the program to alter plate roof to slope roof. Lots of examples can be found in Shanghai, Qingdao, Yingkou. The problems, such as lack of foundation bearing capacity or narrow space, can be solved in some way by using light timber truss construction. Meanwhile, due to the light deadweight, timber structure constructions are able to satisfy any structure demand with proper designing. Therefore, the applications of timber structure in other structures have greater advantages.

At present, the experts are busy with the establishment of Technical code for light wood truss and the corresponding research. The research work also includes the study on joint toothed plate in timber truss and the relative program developing.

3 Conclusion

The timber structure has a number of advantages. The thermal isolation and shock-resistant performance is great. The architecture form can be variety and flexible. It is energy-saving and beneficial to health. Besides, the construction and maintenance is easily going. The timber structure construction has the typical green ecology characteristics. As a series of encouragement measures for lumber import are taken, the timber structure construction will have a broad development space in China.

Therefore, the problem we faced in China will definitely be solved one by one with our efforts. The level of corresponding designing, researching and processing technologies will be unceasingly enhancing.