

Analysis of the Wood Frame Construction Market in China

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Abstract

Wood is a naturally produced material and has many benefits for building purposes, such as durability, thermal efficiency, and acoustic quality. Wood is also considered to be one of the best construction materials due to its durability and affordability. Wood frames are lightweight, but can hold up heavy loads due to the high ratio of strength to weight. Wood is a very reliable and safe material. Well design and built wood construction remains stable in the face of natural disasters, such as earthquakes. Wood also provides a warm, comfortable, and natural environment in contrast to other building materials.

By 2012, the wood market in China had become more profitable than ever before. The significant increase was demonstrated in the volume of wood framing produced for building construction. Furthermore, wood frame structures are economical and very durable. In major cities such as Beijing, Shanghai, and Guangzhou, new wood frame projects have received positive feedback from residents looking for greater comfort and livability. Wood frame construction is also an answer to some of China's pollution problems. However, there are also many barriers to the wood production industry in China, including unfavorable government regulations, limited technology, a shortage of skilled workers in the industry, a population density issue combined with land shortages, and limited domestic forest land. To meet these challenges, China needs to increase its man-made forests, introduce more innovative technology, promote the wood composite industry, and bring in land development reform. Meanwhile, the demand for wood products is a growing opportunity for Canada, which is now China's largest supplier at 31.9% of total imports.

List of Key Words

Wood frame construction

Globalization

Eco-Friendly Building

Chinese Marketing

Investment

Land utilization

Import

Lumber

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1.0 Global Wood Frame Marketing

In Europe and North America wood frame construction is widely used in construction. At the same time, wood structural construction technology is developing very quickly. Countries from all over the world are also interested in constructing residential buildings in more sustainable ways to increase energy efficiency and help reduce operational costs. As a result, wood frame construction will continue to be one of the major building methods in the future. In the United States, single-family housing rose by 25% in 2011. This equals to about 565,000 units. 90% of those houses are wooden structures. In October 2012, wood housing went up to 894,000 units in the USA, 42% more than the previous year (Go With CMHC-2011 Action Plan, 2011).

Japan has one of the largest housing markets in the world with about 788,000 units built per year. Wooden structural buildings make up about 430,000 units, and large-scale wood frame construction continues to grow as a new segment for wood frame technology. In Europe, wood frame construction is common in several European countries, especially in the UK, Ireland, Germany and France (Wood Market Trends in Europe-FPInnovations, 2008).

Country	Wood Frame Residential Housing	Market Share in Total	Year
UK	28000	30.0%	2006
Ireland	47500	21.0%	2006
Belgium	8244	18.0%	2004
Switzerland	7200	18.0%	2004
Austria	6300	15.0%	2004
Germany	17959	12.0%	2005
Demark	2000	10.0%	2006

Table 1 : Wood Frame Building in European Countries
Source: (Wood Market Trends in Europe-FP Innovations, 2008)

2.0 Wood Frame Construction

Currently, wood frame construction is also used to build commercial and industrial buildings. In the construction field, wood frame has been used for the last 200 years and has proved itself to be one of the most reliable materials. Additionally, it is the only renewable building material. Wood frame construction is based on combining dimension lumber, construction panels, and other wood products, which can be easily connected and insulated. Light frame construction uses studs, 2 x 4 dimension lumber, and other wood products connected together to create a stable and strong frame. Construction panels are attached to the frame to make a very strong structure. Light frame construction is widely used for residential housing in North America and Europe because it provides an exceptionally safe and comfortable living environment.

3.0 Advantages of Wood building

3.1 Earthquake Safety

Well design and built wood frame construction remains stable, providing safety in case of an earthquake. Wood has a high strength to weight ratio, so wood buildings tend to be lighter than other types of buildings. Lightness is also an advantage in case of an earthquake. A wood frame building is connected with the nailed wood connection system, which allows the building to flex. Therefore, the energy is absorbed and dissipated during an earthquake. Structural panels can be combined with joists and studs to create shear walls and diaphragms to prevent lateral force (Rainer J.Hans). These days the technology of wood frame construction is at its peak and has never been better; consequently, wood frame buildings are typically safe during most earthquakes.

Earthquake	Magnitude	NO. of total death roll	NO. of total death roll in wood frame building
Alaska,1964	8.4	130	<10
San Fernando,1971	6.7	63	4
Loma Prieta,1989	7.1	66	0
Northridge,1994	6.7	60	20
Hyogo-ken Nambu,1995	6.8	6300	0

Table 2: Overview of Casualties in Recent Earthquakes
Source: (Rainer J.Hans)

3.2 Fire Resistance

Fire is always a serious potential risk to all types of buildings, no matter what materials are used in building, such as concrete, steel or wood. In many countries, fire resistant material is normally used in buildings to prevent fire, smoke, and heat energy from transferring through walls and floors. The strength of steel will decrease rapidly in fire, but heavy timber will have higher fire resistance than steel. Wood is also a bad conductor of heat. Comparing concrete and steel to wood, the heat conductivity of steel is 400 times more than wood, and the heat conductivity of concrete is 8.5 times more than wood (Sustainability of Building Materials - Westernred Cedar Export Association). Various processing technologies allow wood to be manufactured in different material, and through the fire resistant and chemical treatment processes, the wood product becomes more durable and strong. Meanwhile, the wood frame building remains a natural, healthy, and sustainable product that can provide a comfortable environment for the inhabitants.

3.3 Moisture Content

Wood also has the ability to release or absorb moisture. The moisture content of wood can make a self-adjustment to match the air humidity. Even under a high moisture content

environment, the wood frame building demonstrates stable functionality. In addition, the wood product will have gone through a drying process to improve the structural performance, thereby reducing swelling and shrinkage. Most building standards require the moisture content of wood to be of 19% or less, to maintain a low moisture content while minimizing decay and deformation.

3.4 Eco-Friendly Building

Eco-friendly building is also extremely important for the environment, especially in times of globalization. Through the wood manufacturing process fewer gases that provoke greenhouse effects are released while less water and air pollution is emitted into the atmosphere. Furthermore, less energy is required to produce wood. Consequently, it has already become the primary material for sustainable construction. In one research study, the Canadian Wood Council compared the environmental impact of three houses, one built with a wood frame, one with steel and one with concrete. Each house was tested in a 2,600 sq. /ft. area over 20 years. The results indicated, steel required 26% and concrete 81% more resources than wood frame and more energy was wasted for construction and building maintenance, 26% more in steel and 57% more in concrete building respectively. In terms of pollution, steel produces 24% more air pollution and concrete 47% more, while steel emitted 4 times more water pollution and concrete 3.5 times more. The eco-friendly advantage of wood construction has also been proven in the field. Between 1990 and 2004, for example, the European countries were able to use wood construction to reduce greenhouse gas emissions, with Germany and the UK being among the leading countries (Energy and the Environment in Residential Construction).

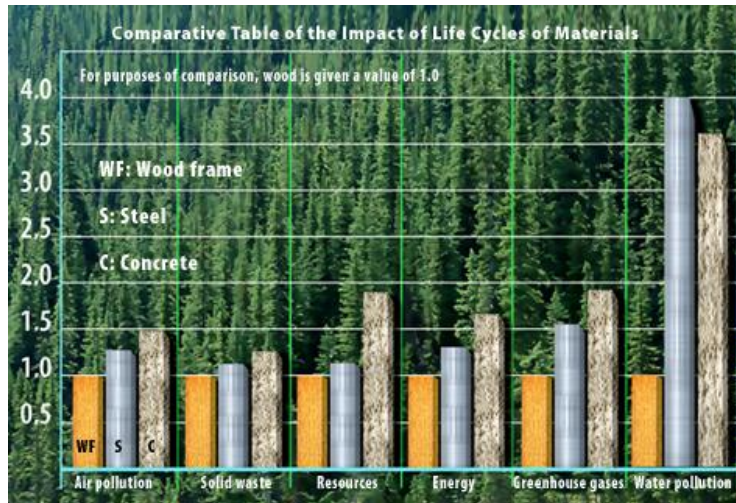


Table 3: Comparative Table of the Impact of Life Cycles of Materials
Source: (DEMTEC, 2013)

Wood frame construction also provides benefits for energy conservation during the in-service life. In comparing construction methods, more energy is required to maintain steel and concrete buildings.

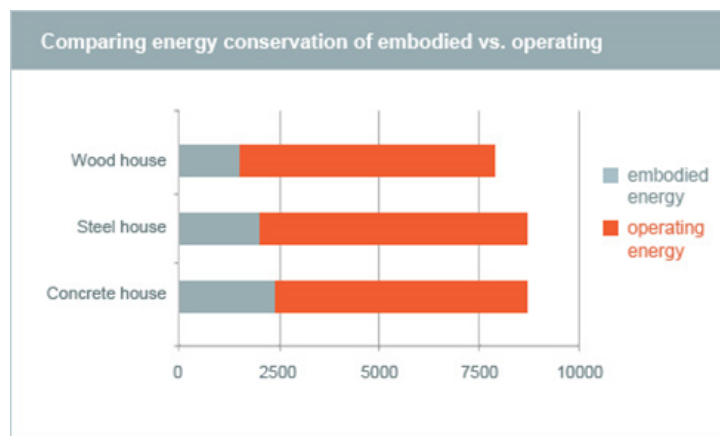


Table 4: Comparing Energy Conservation of Embodied Vs. Operating
Source: (Canfor)

4.0 Chinese Wood Market

As the Chinese economy develops rapidly so does the housing market, and the demand for high quality residential buildings is constantly increasing all over the country. Because of rapid growth in Chinese construction, industrial has become a major issue. As a result, eco-friendly sustainable building systems are in demand. Wood frame construction is the best choice for Chinese residential buildings because it provides the highest standard of safe and comfortable housing in the world. China is also focusing on improving the comfort and security of its citizens by adopting wood construction building methods.

However, there remain many challenges in China. Strict domestic controls and caps were introduced by the government over the past few decades to regulate the use of natural materials due to the shortage of forest resources. Therefore, concrete material and steel became more popular building materials. However, concrete methods cannot meet the high demand for housing any more. As a result, the Chinese economic market has opened up, and many foreign construction companies from the United States, Canada, New Zealand, and Japan have started to develop the Chinese wood construction market. In addition, due to the growing stock and limited domestic resources, China joined the WTO. This change brought the Chinese wood market to a different level. The tariff on wood and wood products was reduced from 10.6% to 3.8%, while China opened up its distribution and direct selling process to stimulate the importation of construction material into Chinese market (Center for International Trade in Forest Products, 2002). Therefore, new technologies have been introduced and popularized in China. Wood structural buildings have now been built as a demonstration of the new advanced technology. These buildings first appeared in the major cities and later were brought to peripheries and

smaller cities. In China, some domestic construction companies have also started to carry out wood frame construction plans. As a result, wood construction is growing rapidly. In 1998, wood construction was under 20,000 m², increased to 120,000 m² by 2001, and will pass 400,000m² in a few years. Meanwhile, China has issued wood frame construction building codes to ensure higher quality construction projects and fire codes are also under development (Center for International Trade in Forest Products, 2002).

Wood building is becoming increasingly popular in China because it has better properties than traditional concrete building, such as energy efficiency and sustainability. The buildings are comfortable and flexible in terms of style and design. These features can meet the requirements for high standards of comfortable living now desired in China. In major cities such as Shanghai, Beijing, Dalian and Guangzhou, the demand for wood buildings is particularly strong. As a result, the demand for wood building is creating a potentially massive market in major cities.

There is also a growing demand for government projects. In 2008, the Chinese government and the Canadian government collaborated on an \$8 million project to help rebuild Wenchuan in the Sichuan province(CANADA WOOD, 2009). An emergency need had arisen because of a magnitude 8.0 earthquake on May 12, 2008, during which 80,000 people were killed, with about 380,000 people injured and 4.8 million became homeless(Zhi Wenjun, 2008). In cooperation with the Chinese government, Canada has already built schools, hospitals, and other public facilities. All structural elements of the buildings were designed by Canadian engineers using leading technology in seismic performance and energy efficiency. In November 2008 Canada also started to develop the “Vancouver Village Green Sustainable Housing Project” in Sichuan province. Wood construction has thus increased from 80m³ to 240m³, with costs being controlled to under 800 Chinese Yuan per cubic meter (CANADA WOOD, 2009).

5.0 Analysis of the Challenge of Wood Frame Construction in China

Although the potential market for wood frame construction remains high in China, Chinese wood building codes remain a barrier and there is still some resistance to expanding wood construction in China. As a result some potential problems exist in the Chinese wood housing market.

5.1 Investment Cost

Comparing the cost of wood building and concrete building usually shows that wood building comes in at a lower cost. However, the cost of wood building is still high in China. At first, the technology for wood frame construction is not advanced and developed. Also, the wood building products created by local companies cannot meet the requirements established by the government. As a result, the companies need to invest in bringing in highly qualified technicians and purchasing better machines to improve the quality. Meanwhile, as long as China has a shortage of forest land, the wood products are highly dependent on imports and subject to government regulations. If the wood building is built with import materials, the cost is around 4500 Chinese Yuan per m³(Light Framing Construction in China), which does not include the price of land. China has lower per capita land area, especially in metropolitan areas, resulting in a major impact on the total revenue. However, the major markets for wood construction are restricted these cities. Nonetheless, in the past decades concrete building was the main material used in the Chinese housing market, so most construction workers have experience in the concrete industry. As a result, there is a shortage of workers specializing in wood materials. In the meantime, those qualified in concrete will no longer be needed and will be required to change their qualifications to continue building. Therefore, the labour cost is very high for hiring wood building employees.

In addition, wood buildings require additional processes and materials, which must meet the same standards as concrete buildings for fire resistance, thermal retardation, and sound insulation. These additional costs cannot be managed in rural regions. Fire resistance is also a challenge for wood frame construction. As China has a huge population and much of the population is concentrated in major cities, the shortage of land creates small distances between wood houses, and fire can spread very rapidly. Therefore, it is essential to have advanced fire-fighting systems installed in a wood building. In fact, the most of Chinese buildings do not have any fire-fighting systems. Fire-fighting system will be a new technology, so the innovation costs and installation costs cannot be ignored.

5.2 Land utilization

Earthquakes are common in China. In 1978 an earthquake with a magnitude of 7.8 occurred in Tanshan, killing 240,000 people and injuring 164,000 million more. Another earthquake with a magnitude of 8.0 occurred in Sichuan province on May 12, 2008, killing 450,000 people and making 4.8 million homeless (Tangshan Earthquake in 1978 , 2013). Wood building construction can be put in place to alleviate the suffering and meet the housing demand. However, Chinese national conditions must be considered. The high population density has caused a shortage of land. For example the area of Tanshan is 17040 km², and the population is 7.57 million people (The Government of Tangshan, China). If a wood building plan is carried out in Tangshan, with an assumption that 10 people will live in each wood house, each house will have a 150 m² construction area and 50 m² for roads and space between each house. The Total area required will be around 200 m² while 7.57 million people should use about 151 km². However, the agricultural area is 5800 km², and the total area is 5951 km². Therefore, half of the land is used, and the rest of the land area cannot meet the demands of industry, business, and

other utilization. The best way to solve this problem is to build up. As concrete buildings can be built higher than wood buildings, they will still be required to solve the shortage of land. At the same time, developers need to adopt effective earthquake safety systems within high density residential areas.

Overall, the total area of China is 9.60 million km², with 12.5% for agriculture, 13.36% for deserts, 22.18% for forestry, 23% for the Tibetan Plateau, 1.8% for rivers. The remaining 2,607,360 km² is for habitation (Land resources of China, 2012). Because of the large population of 1.3 billion people in China, the living area density is 498 persons per km². The land shortage is an inevitable trend. Therefore, the acceptance of wood frame buildings will have some resistance in Chinese housing markets because of low capacity.

5.3 Shortage of Forest Land

The shortage of forest land is 22.18% in China, and 3% - 4% of the global forest land area (FOREST AREA IN CHINA, 2010). In fact, the import value is more than 50% of total demand value. Until 2012, Chinese forest resources were already overwhelmingly dependent on import forest resources. Meanwhile, the technology for creating wood building materials is lower than in the developed countries. In this case, the development of wood building will have to depend on materials which are imported from other countries. The dependence on basic imported building materials has an adverse effect on profitability and on the development of the Chinese economy. For example, Russia is one of the largest countries that exports forest products. Since 2008, Russia has increased the log export tax to 25% and has proposed an 80% log export. In addition, the Chinese demand for softwood lumber has increased rapidly, and the import prices of lumber have increased as a result of the high export tax. Consequently, if China cannot supply by itself, costs will rise (Bob Flynn, 2009).

6.0 Suggestions

According to the present forestry situation in China, there remains significant resistance to the wood building material supply for the development of wood frame construction. Since China relies on imports, supply and demand is a problem. Therefore, China should carry out a plan to solve the wood supply problem. One effective way to solve the wood supply problem is to create a man-made forest. In Brazil, the volume of man-made forest production was equal to 1.5 hundred million m³ in 1999 and went up to 1.7 hundred million m³ in 2002. Today the man-made forest supply represents a 30%-40% of total demand in Brazil. New Zealand also provides 16,800,000 m³ of man-made forest every year, 99% of total production demand of production. The Chinese man-made forest land area is about 470,000 km² or 30.38% of total forest land, but only 20% of wood products comes from man-made forest (Shanghai Services Federation , 2011). Therefore, the government needs to provide an effective policy to encourage the wood industry to develop man-made forests.

If more innovative technology for wood building material is introduced, more wood products will be used in residential construction. The increased demand and huge profits will promote the development of forestry and drive the recovery in man-made forestry. These trends will form a circle of sustainable development. In addition, the mechanical industry, chemical industry, and other related industries will have the opportunity for greater development to provide new sources for economic growth. In china, wood based panel consumption increased rapidly from 1999 to 2008, more than five times in 1999(Han, 2009). The output of construction panel is a very small percentage, and it is almost a new technology in China. Along with the development of wood building, the production volume of construction panel will greatly increase.

Consequently, with increased use, wood frame construction can lead to a significant promotion and development of the forestry industry and economic growth for the country.

The wood-based industry should be encouraged to promote the growth of usage of construction panel. In the 20th century, overseas scientists have been aiming to improve the utility value of small diameter logs, which can meet the demands of the construction industry. As a result, a greater number of new wood products have been created, such as plywood, OSB, LVL and Glulam. In 2011, China produced 209 million m³ of wood-based panels, but over 60% of total production was used for the furniture industry and only 20% for construction (Solid Wood Annual 2012, 2012). In China, the main production of wood-based panel is limited to plywood, fiberboard and particleboard; however, panel construction is still ignored. Therefore, along with the gradual recovery of the wood building market, China should actively promote the development of wood composite industry engineering.

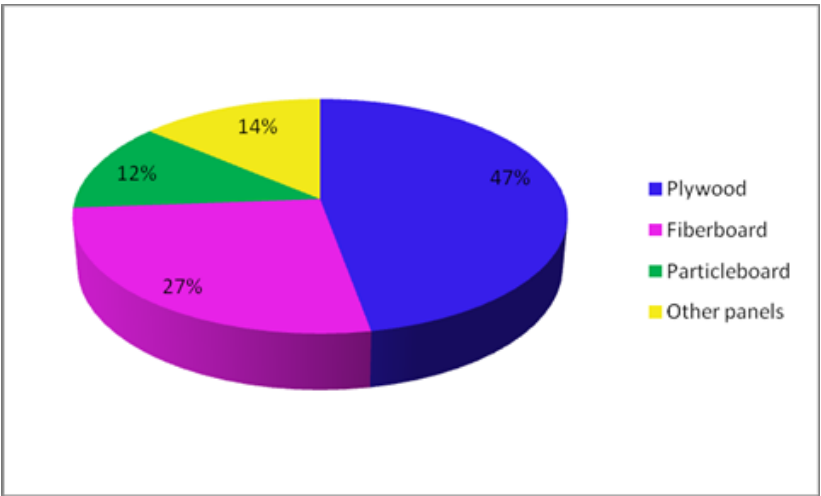


Table 5: China’s Wood-Based Panel Production In 2011
Source: (Solid Wood Annual 2012, 2012)

As a result of the government having strict control on forestry, technical innovation in wood building has been very slow during the last several decades. In recent years, China has carried out thorough research on wood frame construction, yielding some valuable results. Overall, however, the technology for wood frame construction is still very weak, and a large gap still exists in the wood materials from China and those from other countries, which use wood for construction.

Overall, the land in China should be used in more efficient ways. Since the housing market is developed rapidly in China, the housing market is causing a tremendous increase in the price of land as the general investment. Meanwhile, the cost of wood building is \$725/ m² in China, which does not include the price of land(Light Framing Construction in China). Rising land costs will have a major effect for total revenue, especially in major cities. Therefore, a development strategy needs to be carried out in the surrounding areas of major cities, and then be gradually expanded to the whole country.

7.0 Imports

China has become one of the largest producers of forestry products in addition to being a major importer and exporter. In 2010, the total production of wood products increased by 27% in comparison to the previous year. The total value of export products was greater than 26 billion American dollars and the total value of output was 392 billion American dollars. However, the shortage of Chinese forest land and the demand of the Chinese wood market have increased rapidly. China has already become one of the largest forest product importers. The quantity of wood consumption is more than 100 million m³, and the important value is more than 50% of total demand value. In 2011, the volume of importing logs increased to three times more than in 2000, about 180 million m³ (Before It's News, 2012).

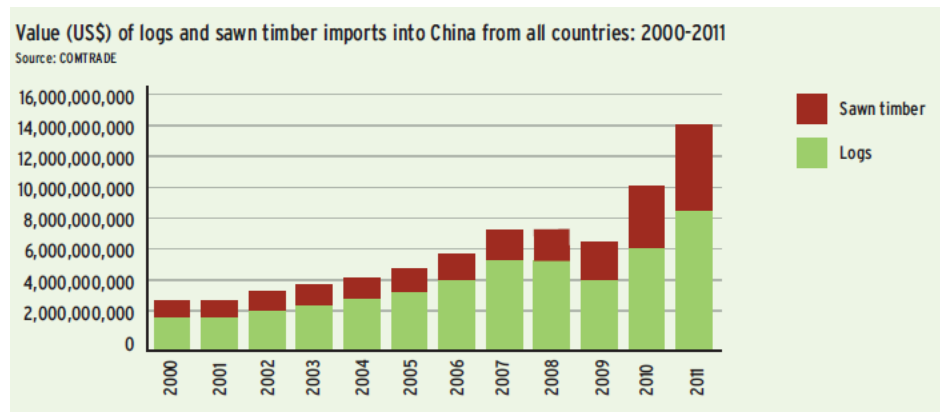


Table 6: Import into China from All Countries 2000-2011

Source:(Killing The Planet: There Are Many Economic Advantages To Destroying Forests Therefore It Won't Stop, 2012)

7.1 Canadian Wood Market

A hundred softwood species are grown in Canada to supply structural softwood lumber. The main species are White Spruce, Engelmann Spruce, Lodge pole Pine and Alpine Fir with

relatively small and sound tight knots. In lumbering producing areas, the spruce-pine-fir species are marketed as SPF. The SPF species group provides the largest proportion of dimension lumber as these species grow throughout most of Canada. Douglas Fir-Larch and Hem-Fir are the other major groups of species that are often used for construction.

As the wood housing industry has developed very quickly in China, some related industries also have experienced rising market demands. Lumber is a part of material in wood frame construction. By 2011, China was importing 21.5 million m³ of lumber, an increase of 254.6% from 2006. Canada passed Russia as the largest lumber supplier, providing 31.9%; Russia was previously supplying China with 28.2% of total demand of wood products. Currently B.C. is one of the main suppliers to China, and the total softwood lumber export value equals to 33.8% of total Chinese wood import value, and the lumber imports are also up 5800% since 2000 (A Selection Of Monthly Economic Statistics, 2012).

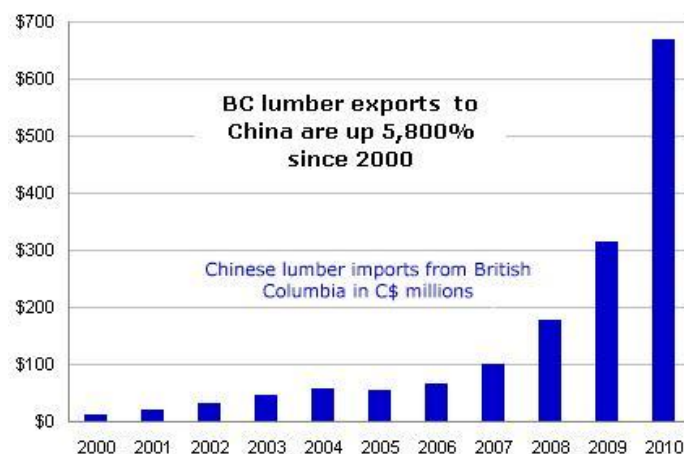


Table 7: BC Lumber Export to China
Source: (A Selection of Monthly Economic Statistics, 2012)

8.0 Conclusion

Overall, wood buildings have great advantages that satisfy the requirements for the environment and for comfortable living. However, the development of Chinese wood building construction still is at the developing stage, and is affected by several factors, such as investment costs and government policy. Today it is also necessary to develop a sustainable plan to reduce energy consumption that will help protect the environment. Therefore, the government should tackle these problems while emphasizing the development of the wood building market. This will also stimulate the development and promotion of wood related industries.

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