

C I N T R A F O R

Working Paper 86

**Report on the Taiwan Market for
Wood-Frame Construction and
Softwood Building Materials**

Rose Braden

December 2001

^ ^ ^ ^ ^
^ ^ ^ ^ ^
^ ^ ^ ^ ^
^ ^ ^ ^ ^

CENTER FOR INTERNATIONAL TRADE IN FOREST PRODUCTS
UNIVERSITY OF WASHINGTON
COLLEGE OF FOREST RESOURCES
BOX 352100
SEATTLE, WASHINGTON 98195-2100

C I N T R A F O R

Working Paper 86

**Report on the Taiwan Market for
Wood-Frame Construction and
Softwood Building Materials**

Rose Braden

December 2001

Center for International Trade in Forest Products
University of Washington
College of Forest Resources
Box 352100
Seattle, WA 98195

EXECUTIVE SUMMARY

With the help of foreign investment in the 1960s, and deregulation of Taiwan's financial sectors in the 1980s, Taiwan emerged from its agrarian roots to become one of Asia's leading producers of high-value goods. The country's strategy of producing capital and technology intensive goods for export elevated Taiwan to the position of one of Asia's leading economies. It also earned the status of one of the four Asian Tigers (with Hong Kong, South Korea, and Singapore) for its "seemingly miraculous" rate of sustained growth over the 25-year period from 1965 to 1990.

Taiwan is now one of the wealthiest of the Asian countries and the 17th largest economy in the world (CIA 2001). Gross national product (GNP) has increased 72% or almost \$110,000 million from 1989 to 1999. Per capita income also increased 58% since 1989 and the rate of personal savings is among the highest in the world. Now that Taiwan has achieved a high level of affluence the government is turning its attention to promoting leisure time, domestic tourism, and aesthetics. As part of this emphasis on aesthetics, the use of softwood logs, lumber, and building materials in urban areas and tourist areas is increasing rapidly. The Taiwan government is replacing concrete structures at city parks with wooden gazebos and benches made of treated southern yellow pine. In rural areas the government is building more walkways and viewing platforms, government administrative offices, and public buildings of solid lumber, logs, and glue-laminated (glulam) beams. Private companies are also building communities of wood frame cabins and log frame resorts in tourist areas. In 2000, Taiwan's government shortened the workweek from six to five days. Since then, domestic tourism has surged. The Taiwan government is in the process of building new roads and improving existing highways, which should improve access to vacation areas and encourage the growth of low-rise residential communities (Miller 2000). Universities are even starting to build wood frame apartments as a means to attract professors.

Particularly important to the adoption of wood frame construction is the Taiwan government's strong support of wood as a structural building material. Wood as a structural material is viewed particularly as a means to provide more earthquake resistant housing -- a concern that has become more salient since the 1999 earthquake that killed more than 2,200 and left over 100,000 homeless. The earthquake was particularly devastating in the semi-rural areas of Taichung and Nantou, where it damaged 115,000 housing units, completely destroyed approximately 60,000 units and rendered an additional 8,000 uninhabitable. In an effort to improve the quality of wood frame construction and the ease of getting projects started, the Architecture Building Research Institute (ABRI) of the Ministry of Interior (MOI), the ministry responsible for the regulatory framework of the building codes, is receiving approval from the Construction Planning Administration (CPA) to review and revise the building codes.

While the building codes do not restrict the use of wood in private homes if they are under 14 meters or 4 stories high (with the exception that wooden roof components must be covered), the codes are prescriptive and do not outline detailed engineering requirements to ensure structural performance or proper treatment of building materials to retard fire and insects. However, wood used as a structural material in public-use and multi-family buildings is considered a "special material" and requires a special building permit that can take up to two years to obtain. This is considered a major limit to the growth of the wood frame construction industry since there appears to be more immediate potential for large public buildings constructed of wood. Fire codes also restrict the use of wood as exposed trusses and beams in roof construction. However, exposed beams and trusses are a major draw for designers to use wood in public and private buildings.

The revised codes will not only recognize wood as a "standard" building material, eliminating the lengthy review process to obtain a permit to build public or multi-family buildings of wood, they will include detailed requirements for structural aspects such as proper engineering principles, materials, and treating requirements for 2x4 and post and beam construction. ABRI is looking at North American and Japanese building codes to adapt to their own codes for wood frame construction. ABRI plans to start their review by the end of 2001 and expects to complete revisions by the end of 2002.

In another effort to promote wood frame construction in Taiwan the CPA, with US\$3.5 million from the Taiwan government, also plans to include multi-story wood frame apartments, townhouses, attached single-story senior housing, and single-family homes for low and moderate-income families in its Nantou redevelopment project. Half of the buildings in the redevelopment project are planned to be 2-3 story wood frame apartments and townhouses. The wood frame projects will be exempt from the permit process and wood will not be considered a "special material" because the CPA is overseeing the project. If the public responds favorably to the model homes the CPA plans to build more. The Canadian government has already committed to build sample modular homes in the development starting in August-September 2001. The CPA has allocated US\$56/ft² (NT60k/ping) for land and US\$37/ft² (NT40k/ping) for the completed home. The inclusion of wood frame housing in the CPA's Nantou development benefits the wood frame construction industry in two ways: it provides examples of wood frame construction in Taiwan and it shows the public that the CPA endorses wood frame construction as an earthquake resistant form of housing.

Under the Agriculture Development Act, the CPA is also rezoning 150,000-200,000 acres of agricultural land surrounding Nantou to multiple-use in increments of approximately 15,000 acres per year. The CPA will install public facilities and return half to the owner for private development and the CPA will use the other half for public redevelopment projects. Medium density areas such as Nantou and Taichung counties are considered ideal for single and multi-family wood frame housing and the newly available land is considered vital to the growth of the wood frame construction industry.

There is also growing interest in using glulam beams in large public buildings. Currently, there are only two large glulam buildings in Taiwan, yet there are plans to begin building a 40-meter bridge in October 2001 and other buildings are being considered. Response to the State of Idaho Trade Office's 2000 seminar on designing and building with glulam beams was overwhelmingly positive and the number of inquiries about glulam beams reportedly surged afterward. The conference has now become an annual event held in May and jointly sponsored by Agricultural Trade Office (ATO) Taipei, APA - The Engineered Wood Association, the Softwood Export Council, the Western Wood Products Association, ABRI, the Republic of China (ROC) Sustainable Development Committee, the Forestry Research Institute (Council of Agriculture), CABC, the Taiwan Architects' Association, the ROC Wood Construction Association, the Forestry Department of the National Taiwan University, and the Economic Daily News. ABRI and CPA have been particularly enthusiastic about the conference and the use of glulam beams and wood in public buildings in rural areas. The most promising end-market for high-grade US softwoods appears to be government projects that use solid wood and glulam beams. Not only do these large public buildings use more wood than several 2x4 homes, the project review and construction process is more stringent, which provides greater assurance that the buildings are designed and built properly.

Despite the government's support for wood frame construction, there are still many obstacles to the widespread use of wood as a structural building material in Taiwan. These include 1) widespread consumer and architect concern about the susceptibility of wood buildings to fire, termites, and water and typhoon damage, 2) limited technical knowledge about how to design and build wood structures, 3) cost, 4) difficulty obtaining financing and insurance, and, 5) limited space in urban areas for single-family homes. Since there are very few examples of wood frame construction in Taiwan, most consumers do not understand what a wood frame house is, often picturing a log home instead. These misconceptions indicate a need for US industry to educate Taiwanese architects, builders, and consumers that wood frame construction is durable, resistant to the elements if constructed properly, and more comfortable than concrete housing. It may be useful to use examples of homes in Florida that are structurally sound after being exposed to termites, typhoons, and humidity.

Even in cases where wood is used as a structural material, builders, architects and manufacturers have limited understanding about the physical differences between species, often purchasing species with lower strength ratings in favor of lower price. There is only limited information available in Taiwan about US species, the advantages of using these species, and wooden building materials and wood frame construction in general. There are also no US representatives in Taiwan with in-depth knowledge about the technical aspects of using wood and wood-based building materials to respond to architect and builder questions. Promotion of US wood products has relied primarily on the State of Idaho's trade office, since there is no central office or individual employed by the US to educate architects, builders, and government officials about wood frame construction and US species. More recently, the Agricultural Trade Office in Taipei has begun to promote US wood products by meeting with ABRI and the CPA on building code issues and jointly sponsoring the annual glulam conference. Nonetheless, almost all interview respondents from wood products firms said that they must spend a great deal of time educating Taiwanese architects and builders about species differences, products, and technical aspects of building with wood because there is very little literature on the topic available in Traditional Chinese, Taiwan's native language. It is also important to produce technical literature in Traditional Chinese since ABRI will be referring to technical information from a variety of countries as it revises the building codes. Respondents raised the point that officials will be most likely to refer to the material that they can easily understand.

Although government officials are reportedly very motivated to revise the building codes, many suppliers and builders interviewed for this report were skeptical that the process would be completed by the government projected, 2002 completion date. In the meantime, US interests should continue to communicate with officials at ABRI and the CPA about building model homes and fire code issues. They should provide these organizations with information about North American building codes and standards as well as fire test results. In May 2001 Canada's Council on Forest Industries (COFI), Forintek, and ABRI signed a memorandum of understanding to cooperate on revising the building codes by providing technical evaluations and cooperating on testing of wood structures against termites, fire, and humidity. It may be helpful for the US to approach ABRI about entering into a similar agreement with the US forest products industry.

Several respondents said part of the slow progress that ABRI makes on code revisions is because ABRI is extremely evenhanded about reviewing information from various countries. Therefore, it may be effective for the US and Canada to work together to educate ABRI about North American building codes and wood frame building systems.

As mentioned earlier, a significant obstacle is cost. According to several builders, the average cost for a concrete or brick structure is US\$31/ft² (400,000 NT/ping ~ 1 NT=0.03054 US\$; 1 ping=32.67ft²) and the average cost of a wood frame structure is US\$56/ft². Even if a consumer decides to buy a wood frame home, financing and insurance is very difficult to obtain. While the availability of financing is vital to ensure the success of wood frame construction in Taiwan, banks are less willing to finance wood frame projects than steel or concrete projects. Some companies said banks will lend up to US\$22.66 (8,000NT) per square foot for steel or concrete construction, yet only US\$5.66 (2,000NT) per square foot for wood frame construction. Other firms said that since wood products have not passed Chinese National Standards fire tests, banks will finance only 40-50% of the value of wood frame projects, yet they finance up to 90% of concrete projects. In addition, to obtain financing, the developer must obtain insurance, and insurance companies are very reluctant to insure wood projects.

As a result of these findings, there are three recommendations for US industry to increase sales of high-quality lumber and building products to Taiwan. First, to strengthen the relationship that has already been established between the ATO and ABRI the US forest products industry should work with the ATO to provide ABRI with US building codes, technical information about proper design, construction, and maintenance of 2x4 structures written in Traditional Chinese. The US government may follow the precedent set by COFI and Forintek and sign a memorandum of agreement with ABRI to cooperatively work to revise the building code by providing technical evaluations and cooperating on testing wooden building materials for termites, fire, and humidity resistance. Second, it is paramount that the US forest products industry educate Taiwanese architects and builders about wooden building materials, US timber species, 2x4 technology, and about the advantages of wood frame homes such as increased earthquake resistance and comfort by producing and distributing brochures written in Traditional Chinese, and by holding seminars. It is also important to organize trade missions to bring Taiwanese architects, builders, and government officials to view projects in the US and meet with US firms. Third, to stimulate consumer demand for wood frame construction, the forest products industry should participate in trade shows and consider building a model home at the CPA's Nantou housing development. While the market for wood frame construction cannot fully take off until the building code recognizes wood as an approved building material, US industry should start developing interest at the consumer, builder, and architect level now.

TABLE OF CONTENTS

	PAGE
EXECUTIVE SUMMARY	I
SUMMARY OF ACTIVITIES.....	1
BACKGROUND ON TAIWAN AND ITS ECONOMY.....	3
ECONOMIC DEVELOPMENT.....	3
WOOD PRODUCT IMPORTS	9
IMPORTING WOOD PRODUCTS AND TARIFFS.....	13
THE WOOD FRAME CONSTRUCTION MARKET	15
CURRENT BUILDING CODES & REVISION PROCESS.....	17
OPPORTUNITIES AND DEVELOPMENTS	19
GLULAM BEAMS.....	20
CHALLENGES TO WOOD FRAME CONSTRUCTION.....	24
Consumer and Builder Misconceptions about Wood Frame Housing	24
Lack of 2x4 Technology Transfer.....	25
Insurance and Financing	25
INTERIOR WOOD PRODUCTS AND BUILDING MATERIALS.....	27
CONCLUSIONS AND RECOMMENDATIONS	29
LITERATURE CITED	33
APPENDIX A. DISTRIBUTION OF COLLAPSED BUILDINGS PER COUNTY AFTER THE 1999 JIJI, TAIWAN EARTHQUAKE.	37
APPENDIX B. MAP OF TAIWAN	39
APPENDIX C. RESULTS OF GLULAM CONFERENCE ATTENDEES' RESPONSE FORM, MAY 24, 2001, TAIPEI, TAIWAN.	41
APPENDIX D. SOFTWOOD LUMBER IMPORTERS BY SPECIES	43
APPENDIX E. WOOD FRAME HOUSING AND BUILDING MATERIALS TRADE SHOWS & SEMINARS.....	47

LIST OF TABLES

	PAGE
Table 1. Major Indicators of the Taiwan Economy.....	5
Table 2. Leading US Secondary Processed Wood Product Exports to Taiwan, 1989-1999.....	9
Table 3. US Log Exports to Taiwan by Species, 1996-2000 (cubic meters).....	11
Table 4. Taiwan's Imports of Softwood Lumber by Country of Origin (1,000 cubic meters).....	11
Table 5. US Softwood Lumber Export Volumes to Taiwan by Species, 1996-2000 (cubic meters).....	12
Table 6. Taiwan Tariff Rates for Wood Products.	13
Table 7. Taiwan Housing Starts by Type and Material, 1999-2001.....	16
Table 8. Fire Rating of Building Elements in Buildings Limited to Four Stories.	18
Table 9. US Interior and Value-added Wood Product Export Revenues to Taiwan, by Product, 1989-1999 (Thousands of US dollars).	28

LIST OF FIGURES

	PAGE
Figure 1. Leading US Primary Wood Product Exports to Taiwan, 1989-1999.....	10

LIST OF PHOTOS

	PAGE
Photo 1. Log Frame Natural Science Exhibition Center in Hualien.	6
Photo 2. Wooden Viewing Platform Construction of Treated Southern Yellow Pine Lumber at an Aboriginal Development near Hualien.	6
Photo 3. A Government Owned Greenhouse in the Hualien Area, Utilizing Southern Yellow Pine.....	7
Photo 4. A gazebo in Taipei Built of Treated Southern Yellow Pine.	7
Photo 5. Example of a Cabin Built of Structural Insulated Panels (SIPs) Located near Hualien.	17
Photo 6. The Peinan Aboriginal Culture Museum Located in Taitung, Taiwan.	22
Photo 7. Interior of the Peinan Aboriginal Culture Museum.....	23
Photo 8. Glulam Beams used in the Landscaping of the Peinan Aboriginal Culture Museum.	23
Photo 9. Ilan Traditional Arts Museum, Ilan County.	24

SUMMARY OF ACTIVITIES

This report is the result of a market research project, which took place in Taiwan from March 23 through April 5. The purpose of this trip was to complete an assessment of the Taiwan market for US softwood products, particularly wooden building materials, glue-laminated (glulam) beams, and 2x4 wood frame construction. Representatives from the Center for International Trade in Forest Products (CINTRAFOR), the Softwood Export Council (SEC), and the Western Wood Products Association (WWPA) traveled to Taiwan to interview builders, importers, and government officials involved in the wood housing construction sector to learn about tariff and non-tariff barriers to wood frame housing and wood construction materials. The researchers also investigated the prevailing building codes related to wood frame housing and future market opportunities. This report offers background information about the Taiwan market for wood products, the building construction sector, and the environment for foreign businesses, in addition to suggestions for approaching this market. The specific areas of discussion are detailed in the following research objectives:

Research Objectives:

1. Describe constraints and opportunities for wood frame housing and building materials in Taiwan.
2. Establish a baseline of wood frame housing starts and active wood frame home builders.
3. Identify what types of wood products are being imported by Taiwan from the U.S.
4. Identify leading firms that are importing and distributing building products and softwood products for interior use.
5. Describe consumer, builder, architect, and government perceptions about wood frame construction and interior use softwood products.
6. Identify market constraints (tariff and non-tariff) that impact, or may impact, the competitiveness of U.S. wooden building products and softwoods in Taiwan.
7. Identify the distribution channels for building materials within Taiwan.
8. Describe housing land development plans, home financing systems, and insurance aspects associated with wood frame construction.
9. Identify how 2x4 construction technology is transferred to Taiwanese contractors and carpenters.
10. Determine the status of the wood frame construction codes.
11. Identify recommendations for changing wood frame construction codes to facilitate the efficient adoption of this type of construction technology.
12. Identify foreign competitors supplying wooden building materials to Taiwan and provide recommendations on improving U.S. competitiveness in this industry.

BACKGROUND ON TAIWAN AND ITS ECONOMY

The island of Taiwan covers 13,814 square miles (3.5 million ha), one-fifth the size of Washington State. It is populated by 21.6 million people, or an average of 1,554 people per square mile, making it the second most densely populated area in the world. Much of the island is mountainous, forcing most of Taiwan's citizens to reside in urban areas, primarily Taipei (2.6 million), Kaoshiung (1.4 million), Taichung (876,000), Tainan (711,000), Keelung (374,000). The mountainous terrain also limits road access. Instead, many islanders travel by air or rail from one area of the island to the other. The climate is subtropical (16.6° C (62° F) in December and 26.6° C (80° F) in July with an average humidity of 82%. Taiwan can also experience typhoons during July to October and it is located in an earthquake prone zone.

Throughout much of the 20th century Taiwan's forest industry was a major contributor to the island's gross domestic product (GDP). Virgin fir, camphor, oak, and cypress forests were logged to almost complete elimination during the Japanese occupation (1895 to 1945) to fund Japan's development and make room for agricultural plantations and industrial processing. After Japanese occupation ended, logging continued as a means to fund the Nationalist Chinese regime after they fled mainland China and settled on the island in 1949 (Miller 2000). In 1992 the Taiwan government banned logging on natural stands in an effort to restore the once dense forests. Now only 1,240 acres (500 hectares) are officially designated as timber producing stands and current timber output is approximately 50,000 m³ per year. Forests cover 60% of Taiwan, 1.1 million acres (457,679 ha) of which are protected (Taiwan Forestry Bureau 2001). The quality of the domestic timber is poor however. The Taiwan Forestry Research Institute estimates that 70% of all plantation trees in Taiwan are between 10-30 cm in diameter. Most of the domestically produced logs are used in low quality applications and one-quarter of the volume is used as fuelwood (Miller 2000).

ECONOMIC DEVELOPMENT

With the help of foreign investment in the 1960s, and deregulation of Taiwan's financial sectors in the 1980s, Taiwan emerged from its agrarian roots to become one of Asia's leading producers of high-value goods. The island's strategy of producing capital and technology intensive goods for export elevated Taiwan to the position of one of Asia's leading economies. It also earned the status of one of the four Asian Tigers (with Hong Kong, South Korea, and Singapore) for its seemingly miraculous rate of sustained growth over the 25-year period from 1965 to 1990. Taiwan's per capita gross national product (GNP) rose from \$1,100 in the 1950s to \$13,200 in 1997 and \$14,500 in 2001 (Lee 2000). The island managed to avoid the full force of the 1997 Asian recession that crippled many other Asian countries largely due to strong US demand for Taiwan's information technology ranging from laptop computers to microchips.

While Taiwan's economy has exhibited robust growth and its citizens are among the wealthiest in Asia, more recently, the economy has begun to slow. Taiwan's industries have felt the effect of lagging international demand for information-technology equipment as production plants have moved to mainland China in pursuit of cheap labor. Between 1998 and 1999 Taiwan's total exports fell 9.4 percent to \$110.6 billion, the biggest drop in 43 years. As export revenues declined, bad loans held by banks soared and tightened bank credit led to a string of corporate failures (Huang 1999). In 2000, 5,000 factories closed, leaving 100,000 workers jobless (Lin and Dobson 2001)

Taiwan's financial problems may be further complicated by its recent national security dispute with mainland China. The dispute comes at a bad time for Taiwan's business economy, which was hoping for greater access to China's economy as a way to pull out of a looming recession. Despite the dispute, many Western exporters and Taiwanese businessmen view Taiwan as an inroad to trade with mainland China. According to Taiwan's Economic Ministry, in 2000 exports from Taiwan to mainland China accounted for 17.6% of Taiwan's total exports, a 25% increase from the previous year. During the same year, authorized Taiwanese investment increased 108%, making the mainland the destination for one-third of all Taiwanese foreign direct investment (Vatikiotis and Pao 2001).

Although Taiwan's economy has slowed somewhat compared to earlier years of robust growth, the country's hard-working, well-educated workforce has made Taiwan one of the wealthiest of Asian countries and the 17th largest economy in the world with a poverty rate below 1% (CIA 2001). As shown in Table 1, although annual GNP faltered slightly during the late 1990s, it increased 72% or almost \$110,000 million since 1989. Per capita income also increased 58% since 1989 and the rate of personal savings is among the highest in the world. Now that Taiwan has achieved a high level of affluence the government is turning its attention to promoting leisure time, domestic tourism, and aesthetics. To improve the aesthetics of urban areas the Taiwan government is replacing concrete structures at city parks with wooden gazebos and benches made of treated southern yellow pine. In rural areas the national and municipal governments are building walkways and viewing platforms, government administrative offices, and public buildings in rural areas that utilize both solid lumber, heavy timbers, and glue-laminated (glulam) beams. Private companies are also building communities of wood frame cabins and log frame resorts in tourist areas. Examples of these projects are shown in Photos 1-4. In 2000, the Taiwan government shortened the workweek from six to five days. Since then domestic tourism has surged. The Republic of China (ROC) is in the process of building new roads and improving existing highways, which should improve access to vacation areas and encourage the growth of low-rise residential communities (Miller 2000). Universities are even starting to build wood frame apartments as a means to attract professors. More developers are also considering the idea of building wood frame residential homes for the growing number of high-income professionals who have been exposed to wood frame housing while living in North America

Mr. Yen, the Director of the Idaho State Trade Office, who is very active in Taiwan's wood frame construction industry, estimates that while less than five percent of the wood imported and used in Taiwan is high-quality US softwoods, niches for higher quality wood products do exist. While the majority of the lumber imported by Taiwan is low-grade pallet stock, the volume of high-quality treated softwoods imported for outdoor decking, railings, and buildings at government funded tourist developments has increased substantially during the last three years. Treated Southern yellow pine dominates the outdoor construction market because it is characteristically easy to treat (compared to Douglas Fir). Mr. Yen said there might also be opportunities for treated lumber from the Western US states since the shipping time from the US West Coast to Taiwan is shorter than that of the Southern US. It reportedly takes an average of 2 1/2 months for customers to receive lumber from the South once an order is placed.

Table 1. Major Indicators of the Taiwan Economy.

Year	Economic Growth Rate (%)	GNP (million US\$)	Per Capita GNP (US\$)	Gross National Savings/GNP (%)
1989	8.23	152,565	7,626	31.10
1990	5.39	164,076	8,111	29.33
1991	7.55	183,736	8,982	29.40
1992	6.76	216,254	10,470	28.29
1993	6.32	226,243	10,852	27.79
1994	6.54	243,934	11,597	26.11
1995	6.03	262,978	12,396	25.34
I	6.92	64,932	3,071	20.25
II	6.56	65,432	3,088	27.90
III	6.21	65,756	3,096	23.94
IV	4.54	66,858	3,141	29.10
1996	5.67	274,568	12,838	24.86
I	5.04	67,690	3,174	20.06
II	5.28	65,734	3,077	26.85
III	5.53	69,710	3,257	24.31
IV	6.76	71,434	3,330	28.13
1997	6.77	284,777	13,198	24.57
I	6.65	72,902	3,390	19.70
II	6.22	69,912	3,245	25.72
III	7.06	73,300	3,394	23.23
IV	7.1	68,663	3,169	29.43
1998	5.3	262,078	12,030	25.55
I	5.86	65,871	3,035	19.80
II	5.21	62,772	2,886	26.80
III	4.95	65,653	3,010	24.93
IV	5.21	67,782	3,099	30.37
1999				
I	5.58	67,875	3,096	19.51
II	5.92	65,553	2,984	26.08

Source: The Taiwan Economic News (N.d.)



Photo 1. Log Frame Natural Science Exhibition Center in Hualien.



Photo 2. Wooden Viewing Platform Constructed of Treated Southern Yellow Pine Lumber at an Aboriginal Development near Hualien.



Photo 3. A Government Owned Greenhouse in the Hualien Area, Utilizing Southern Yellow Pine.

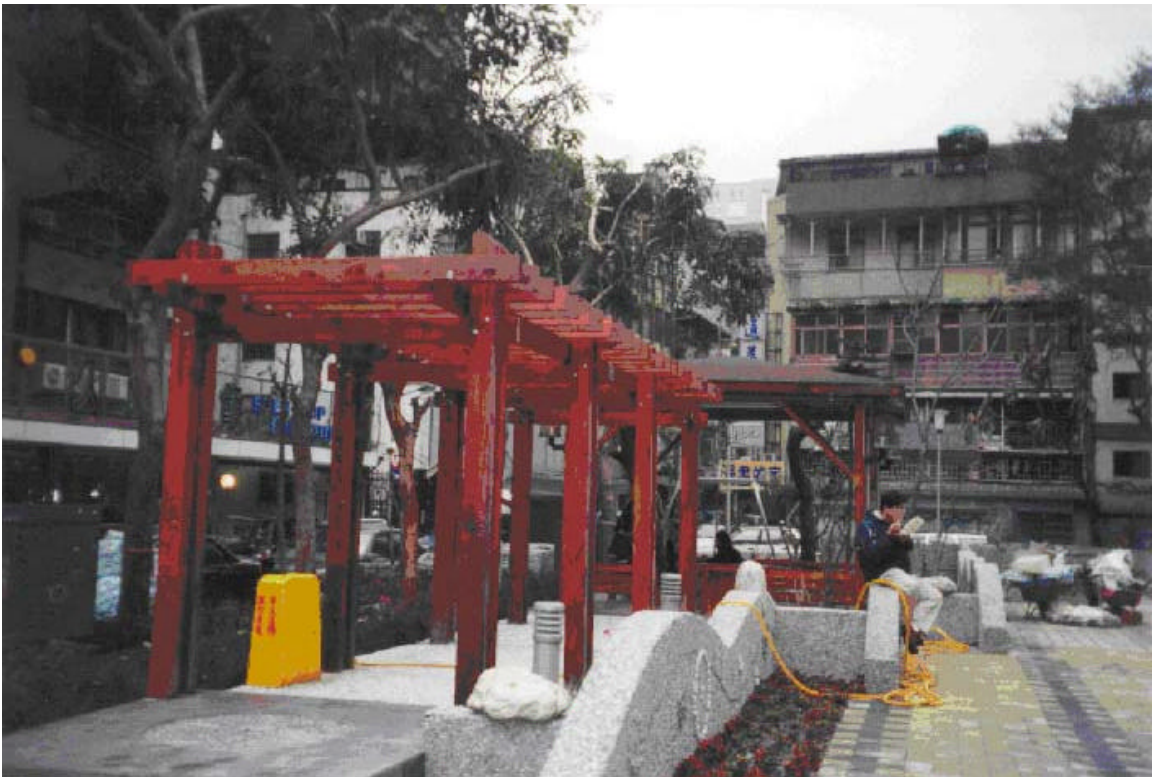


Photo 4. A gazebo in Taipei Built of Treated Southern Yellow Pine.

WOOD PRODUCT IMPORTS

Although trade statistics do not track imports by grade, the Taiwan Lumber Association estimates that over half of the lower grade SPF that Taiwan imports is used for pallets and packaging. The Taiwan Lumber Association also estimates that in 1999 the pallet sector consumed approximately 150,000 m³ of lumber (Miller 2000).

Demand for high-grade logs and lumber among Taiwan's domestic manufacturers is decreasing as Taiwan's sawmills either close or move to mainland China, where manufacturers' use lower-grade lumber. Many importers in Taiwan import products for both the Taiwan and mainland China markets and they report that, as shown in Table 4, imports of low grade SPF, western hemlock, and Douglas fir from Canada used in the pallet industry are increasing as lumber imports from the US are declining. Taiwan importers are also importing more radiata pine from New Zealand, which mainland Chinese furniture manufacturers stain to look like cherry. Figure 1 illustrates the overall decline in imports of primary processed wood products from the US to Taiwan as production moves to mainland China.

The Japanese Housing Quality Assurance Law, which requires builders to provide a 10-year warranty on the homes they build has increased demand for kiln-dried and glulam lumber. In turn, it has created an oversupply of green SPF and hem-fir green dimension lumber, which suppliers are now selling to Taiwan at a lower price. According to Taiwanese importers, the average price for SPF and hem-fir green dimension lumber in Taiwan is US\$100/m³.

The same factors that lead to the decline in the number of sawmills and wood processors; high labor costs relative to neighboring developing countries and a lack of workers willing to work in dirty conditions for lower pay than other jobs in Taiwan, has arguably contributed to the increasing demand for processed wood products. Demand for wood products is not equal among all products however, as shown in Table 2. US exports of wooden furniture and hardwood flooring have steadily increased since 1989, and products such as miscellaneous secondary processed goods, builders' joinery, wood frame seats, wooden windows, and wood kitchen cabinets have had overall growth in the 11 year period but have declined from the highs reached in the mid-1990s. It is likely that most of these products have lost market share to lower cost Southeast Asian producers. Some interview respondents said that they import finished goods, such as non-wood laminated flooring from China and solid wood flooring from other Southeast Asian countries because it is much less expensive than solid wood flooring from Western countries. Other respondents said that since door, window, and kitchen sizes are not standardized, interior fittings are built to custom specifications, forcing production to remain in Taiwan.

Table 2. Leading US Secondary Processed Wood Product Exports to Taiwan, 1989-1999.

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	% change 1989-1999
household furniture	\$2,390	\$2,439	\$1,332	\$1,688	\$4,375	\$4,101	\$4,188	\$2,960	\$7,349	\$6,188	\$5,230	119%
hardwood flooring	\$192	\$655	\$831	\$552	\$686	\$728	\$580	\$201	\$100	\$244	\$1,412	634%
misc. secondary	\$1,303	\$1,140	\$1,279	\$1,420	\$1,522	\$1,698	\$1,372	\$2,129	\$4,127	\$2,201	\$1,360	4%
other builders joinery	\$179	\$210	\$1,291	\$1,020	\$1,865	\$3,977	\$2,317	\$3,815	\$2,276	\$1,472	\$984	450%
wood/wood frame seats	\$410	\$768	\$880	\$495	\$2,425	\$985	\$720	\$1,464	\$980	\$625	\$675	65%
office furniture	\$175	\$490	\$584	\$742	\$1,407	\$582	\$420	\$705	\$1,246	\$705	\$541	210%
windows & frames	\$14	\$825	\$205	\$397	\$361	\$271	\$134	\$21	\$89	\$26	\$315	2094%
furniture parts	\$464	\$650	\$169	\$162	\$393	\$256	\$692	\$495	\$547	\$137	\$249	-46%
prefab buildings	\$0	\$470	\$147	\$660	\$454	\$356	\$269	\$360	\$400	\$159	\$198	n/a
doors, frames, etc.	\$282	\$422	\$316	\$112	\$536	\$598	\$504	\$895	\$1,045	\$859	\$163	-42%
kitchen cabinets	\$35	\$15	\$0	\$25	\$21	\$12	\$3	\$25	\$154	\$429	\$99	182%
softwood flooring	\$303	\$102	\$28	\$55	\$556	\$218	\$144	\$114	\$292	\$132	\$89	-71%
pallets & packing cases	\$11	\$43	\$20	\$72	\$119	\$60	\$120	\$5	\$171	\$43	\$83	626%

Source: US Department of Commerce, 2000.

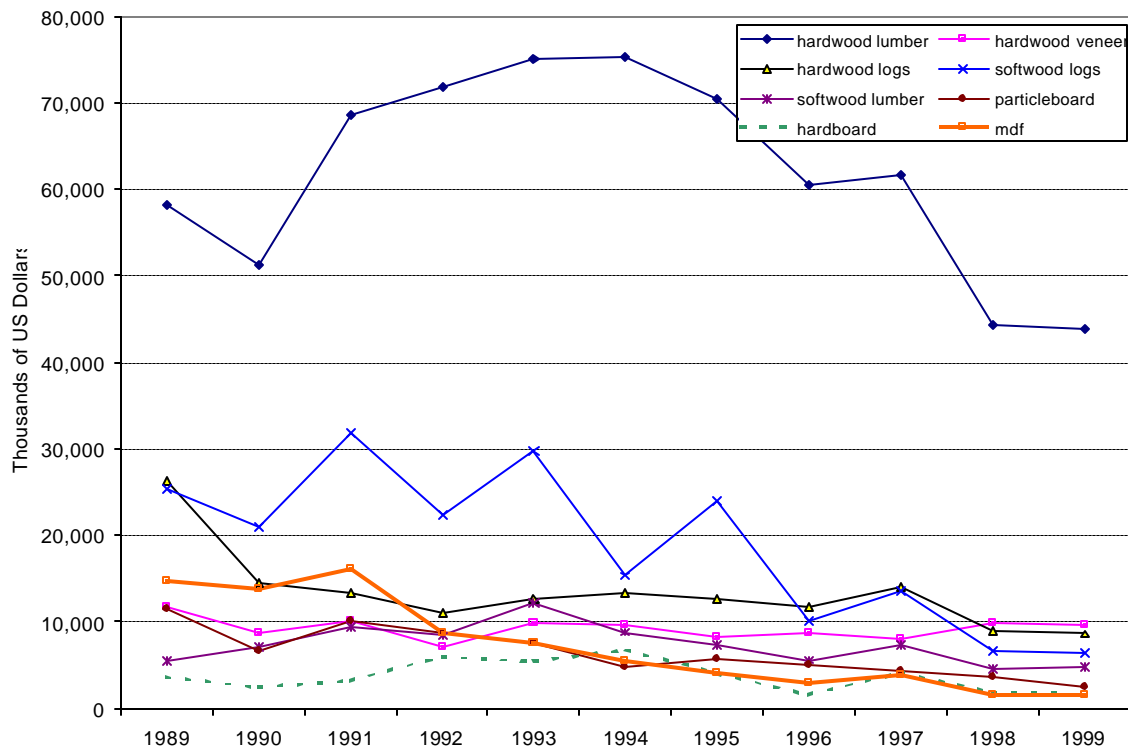


Figure 1. Leading US Primary Wood Product Exports to Taiwan, 1989-1999.

Source: US Department of Commerce 2000.

While the majority of Taiwan's wood imports are low-grade material, increased interest in wood frame recreation facilities should stimulate the demand for higher-grade logs and lumber. For example, as shown in Table 3, total imports of US logs declined in 1998, yet by 2000 they increased to the point that they are almost at the volume imported in 1996. These data also illustrate the popularity of naturally decay resistant species, such as western red cedar, used in outdoor applications. Small diameter logs are used for log homes and larger logs are remanufactured. According to Enhanced Forestry, a Taipei company that imports approximately 90% of Taiwan's red cedar logs, most of these logs are harvested in Alaska.

Table 4 shows that the US is lagging far behind its competitors in terms of lumber exports to Taiwan. The US has also lost market share over the past four years. However, as mentioned earlier most of the softwood lumber that is imported is low-grade pallet stock. As shown in Table 5, southern yellow pine leads US lumber exports yet exports of naturally decay resistant species such as cedar and redwood are rebounding after earlier declines. Dominant species from the Western US such as hemlock, Douglas fir, and western red cedar, however, have consistently declined over the past four years. If the US is to become a dominant supplier of building materials and construction grade logs and lumber, the US forest industry must educate architects and builders about the benefits of using US species. According to all of the importers interviewed, most architects and users in Taiwan are not familiar with North American wood species or the structural differences between North American species and their competitors.

Almost all interview respondents said that they spend a great deal of time educating Taiwanese architects and builders about species differences, products, and technical aspects of building with wood because there is very little literature on the topic available in Traditional Chinese, Taiwan's native language. There is also no central office or individual employed by the US to educate architects, builders, and government officials about wood frame construction and US species.

Table 3. US Log Exports to Taiwan by Species, 1996-2000 (cubic meters).

	1996	1997	1998	1999	2000
Southern yellow pine	1,431	614	472	55	239
Ponderosa pine	366	0	0	0	55
Pine, nesoi	0	725	532	57	161
Spruce	8,836	9,892	0	10,170	7,928
Douglas-fir	70	0	33	0	0
Port Orford Cedar	324	1,395	243	79	227
Western Hemlock	26,720	8,458	3,096	14,465	8,106
Western red cedar	19,630	45,681	6,945	20,638	34,634
Red oak	8,437	13,169	10,272	5,438	5,204
Oak, except red oak	2,292	3,079	717	739	1,756
Beech	27	865	16	427	725
Logs, nesoi	8,161	8,051	24,967	15,922	13,219
Total	76,294	91,929	47,293	67,990	72,254

Source: US International Trade Commission, 2001.

Table 4. Taiwan's Imports of Softwood Lumber by Country of Origin (1,000 cubic meters).

Country of origin	1997	1998	1999
Canada	234	169	208
New Zealand	130	124	137
Chile	59	49	61
China	60	64	37
Others	31	19	21
US	46	24	17
Finland	10	6	16
South Africa	9	7	16
Brazil	16	10	8
Australia	n/a	0.7	4
Sweden	11	4	3
Vietnam	5	4	3
Total Imports	615	482	530
US share of total	7%	5%	3%

Source: Miller, 2000; Liu-Belshe and Pasek 1999.

Table 5. US Softwood Lumber Export Volumes to Taiwan by Species, 1996-2000 (cubic meters).

	1996	1997	1998	1999	2000
southern yellow/long leaf/pitch/short leaf/slash/Virginia pine	2,085	3,370	2,609	4,321	5,769
lumber, non-specified	6,649	14,348	9,822	10,294	4,936
cedar, non-specified	1,191	1,140	530	301	823
redwood	724	809	292	493	817
larch	0	35	281	224	495
pine, non-specified	0	831	5,189	623	469
Sitka spruce	0	2,796	937	470	467
ponderosa pine	0	879	857	34	359
yellow cedar	318	0	0	0	318
Douglas fir	848	997	913	239	298
western red cedar	501	808	1,161	1,008	155
western hemlock & Douglas fir mixture	0	419	0	0	56
fir	127	77	69	53	53
SPF	0	245	0	13	34
spruce	2,350	0	0	0	0
eastern white pine and red pine	18	413	29	31	0
lodgepole pine	131	96	0	0	0
hemlock	15,266	15,113	4,805	1,054	0
Total	30,208	42,376	27,494	19,158	15,049

Source: US International Trade Commission, 2001. *note - numbers do not match Taiwan import statistics.

IMPORTING WOOD PRODUCTS AND TARIFFS

While high-quality US softwoods have not made significant inroads into Taiwan, Taiwan's trading environment is conducive to imports. There are several large import firms who handle various grades of lumber and building materials whose contact information is listed in Appendix D. The importers from this list who were interviewed said it is very easy to import wood products through any of the country's five major ports since Taiwan has no phytosanitary restrictions on wood products from North America. Tariff rates for most imported wood products are also low. As shown in Table 6, tariffs and taxes for unprocessed products are below 1%. Prefabricated buildings and components are also low at 8.4% and 2.9% respectively.

Table 6. Taiwan Tariff Rates for Wood Products.

Harmonized Code	Product Description	2000 Tariff	2001 Tariff	Other Taxes/Fees (%)	Total Fees (%)
4403	wood in the rough	0.0	0.0	0.4	0.4
4407	wood sawn of chipped lengthwise	0.0	0.0	0.4	0.4
4408	veneer & sheets for plywood	0.0	0.0	0.4	0.4
4409	edge/face shaped wood (as for parquet flooring, moulding, etc.)	0.0	0.0	0.4	0.4
4410	wafer/particleboard	3.0	3.0	0.4	3.4
4411	fiberboard	3.0	3.0	0.4	3.4
4412a	4412 subcategories of UNFINISHED plywood or veneered/laminated wood panels, except subcategories 1910, 9221, 9910	12.5	12.5	0.4	12.9
4412.1910	4412a with coniferous wood on both faces, each ply not exceeding 6 mm	7.5	7.5	0.4	7.9
4412.9221/.9910	Other 4412a with coniferous wood on both faces	5.0	5.0	0.4	5.4
4412b	4412b subcategories of FINISHED plywood or veneered/laminated wood panels, except subcategories 1910, 9221, 9910	17.0	17.0	0.4	17.4
4412.9222/.9920	other 4412b with coniferous wood on both faces	5.0	5.0	0.4	5.4
4418	fitted wood structural products (doors, windows/frames, parquet panels, shuttering, shingles, cellular panels, other joinery/carpentry)	2.5	2.5	0.4	2.9
9406	prefabricated buildings	8.0	8.0	0.4	8.4

Source: Miller, 2000.

THE WOOD FRAME CONSTRUCTION MARKET

While Taiwanese citizens were exposed to post and beam housing during the Japanese occupation and a few examples of 2x4 houses used by the US military remain, wooden construction in Taiwan is limited. In its place are concrete high-rise condominiums in urban areas and low rise brick and concrete apartments and single-family homes in smaller cities and rural areas. According to the Foreign Agricultural Service *Solid Wood Products Annual* for 2000, an estimated 500 wood frame housing starts were completed in 2000 (Miller 2000).

As shown in Table 7, although wood starts represent less than 1% of total construction starts, the proportion of housing starts that are wood frame has increased over the last three years. It should be noted however, that since many wood frame homes are second homes, built in rural areas or on agricultural land, building permits have not been issued, which skews the official housing start figures. The Director of the Idaho State Trade Office estimates that of these 500 starts, less than 125 are post and beam construction, 200-225 are 2x4 construction, and approximately 250 are log structures. Aside from the space saving benefits of high-rise construction, Taiwan's humid climate, almost non-existent domestic timber resources, typhoons, and its ravenous Formosan termite, make concrete and brick construction appear more suitable for Taiwan's conditions. In addition, consumers are concerned about the durability of wood frame construction. Concrete, unlike wooden construction however, tends to be hot in the summers and cold during the damp winters. There is also growing concern about the susceptibility of Taiwan's concrete buildings to earthquake damage, a concern that has gained more attention since the 7.6 magnitude earthquake centered in Nantou region of Taiwan on September 21, 1999 that killed more than 2,200 and left over 100,000 homeless. Appendix A includes a map showing the distribution of collapsed buildings in each county. The massive destruction of concrete and steel construction have raised fears among Taiwan's government officials and consumers about the safety of this type of construction. Since much of the damage appears to have occurred because building codes were not enforced, the safety of the remaining concrete buildings is being questioned. These areas, according to Taiwanese government officials and private developers, are also some of the target areas for wood frame construction due to their rural location and the increased desire for more earthquake resistant housing options.

Based on reports from industry sources, while the overall construction industry in Taiwan has declined, niche markets such as steel and wood frame construction have grown. Industry experts and builders report that over the past several years orders for wood frame construction, log cabins built of "D"-shaped logs, wide-span glulam structures, and park facilities have increased. Builders said log construction is the most popular form of wood frame construction because consumers believe the larger diameter logs are sturdier and possibly more fire resistant than 2x4 or post and beam homes. Other suppliers said sales of log siding have increased as well. Dr. Wang, President of the Wood Frame Construction Association, an association of builders, architects, and suppliers of wood frame and glulam construction, predicts that wood frame construction could increase to 10% of the residential housing market and 30% of the total construction market in approximately 20 years if it is promoted properly among Taiwan's architects and consumers. This includes technology transfer for architects and builders and education to allay the concerns of architects and consumers about the durability of wooden construction and its susceptibility to termite, water, and typhoon damage. While the wood frame housing market will likely always remain a niche market in Taiwan, it can be considered a way to diversify Pacific Rim sales of softwood lumber and minimize some market fluctuation.

Industry experts also said they think that a steel frame and wood panel 50-family housing complex built in Tokyo by the Toyota Group will influence developers and builders in Taiwan to consider wood frame construction. The project, called Universal Home, received attention from the news media in Taiwan for the fast construction time and lower cost of building with the steel and wood panel system. Dr. Wang said he thinks there is great potential in Taiwan for steel/wood hybrid systems and 2x4 construction.

Hualien, located on the west central coast of Taiwan (Appendix A), is one of the main geographic markets for softwood construction. The surrounding region is a popular resort area and the location of government funded and privately owned recreation areas. In addition to outdoor structures made of wood, cabins made of Structural Insulated Panels (SIPs) produced by Idaho-based Precision Panels, have been well received. Mr. Yen said developers of a 1,729-acre (700 ha) resort in Hualien had planned to use SIPs cabins as temporary structures then later build a 14-16 story five-star hotel of concrete. However, the project manager was so pleased with the SIPs cabins that the developer decided to build the remaining buildings of SIPs.

The oversupply of concrete high-rise apartments, due to overbuilding during the late 1980s through early 1990s can also be considered advantageous to the wood frame construction industry. Many individuals purchased apartments as investment properties, yet when the economy slowed, they were unable to sell the apartments. Many consumers are now holding on to the apartments as they wait for the real estate market to recover. Meanwhile, some companies are considering wood frame single-family homes as a way to stimulate sales and differentiate themselves from their competitors. Construction firms are also reportedly interested in catering to the high-income residents of Hsin Chu, a community located approximately 35 miles (56 kilometers) southeast of Taipei that is considered the Silicon Valley of Taiwan. The estimated 70,000 high-income workers and their families live in this area, many of whom were educated in the US, are considered a prime market for western style 2x4 homes.

Another option that Taiwanese consumers appear more comfortable with is combination concrete and wood homes. Mr. She, the in-house architect for United Forestry Products designed a townhouse project where the first three stories are concrete and the top floor is log construction. He said this design allows the homeowner to enjoy the aesthetics of a wood frame home at a lower cost than a home built entirely of wood. In addition, since the lower floors are built of concrete there is no risk of termite damage and the homeowner's concerns about durability of wood construction are allayed. This quasi-wood frame construction may be an easier way to introduce wood frame construction to Taiwanese consumers.

Finally, ABRI representatives said that once the building codes are revised, large developers will drive the advance of the wood frame construction market since these firms have the resources to properly build wood frame homes and the finances to promote their projects, which will in turn promote the whole industry.

Table 7. Taiwan Housing Starts by Type and Material, 1999-2001.

	1999	2000	2001*
Total construction starts (thousand units)	64.6	73.5	70
Of which, wood frame	0.3	0.5	0.6
Of which, steel, masonry, & other materials	64.3	73	69.4
Of total starts, residential	56.6	65	61
Of which, single-family	1.5	2.5	2.2
Of which, multi-family	55.1	62.5	59.8
Of total starts, commercial	7.3	8	8.6
wood starts' share of total	0.46%	0.68%	0.86%

Source: Miller, Jeff. USDA Foreign Agricultural Service Taiwan Solid Wood Products Annual, 2000. * - estimated.



Photo 5. Example of a Cabin Built of Structural Insulated Panels (SIPs) Located near Hualien.

CURRENT BUILDING CODES & REVISION PROCESS

According to a review of Taiwanese building regulations and how they affect the market for wood frame construction completed for the Council of Forest Industries (COFI), the structural building codes do not specifically encourage or discourage wood frame construction. There are only two sections of the building codes that cover all types of construction but may be applied to wood frame construction, which are formally known as the Architectural Technical Regulations (ATR) and the Technical Guidance of the Design and Construction of Wood Frame Buildings (referred to as the Design Manual). Within these two sections, the most significant (non-fire) building restriction to wood frame construction is the height limit of 14 meters or 4 stories. If private residences meet these height limits, the only requirement to build the home is an architect's signature and stamp. A building permit is not needed. Therefore, architects can play a key role in the adoption of wood frame housing in Taiwan and promotion and education about wood frame construction should focus largely on this group.

While the building codes do not specifically restrict the use of wood in private residences, the prescriptive nature of the codes and the outdated information in them renders them essentially useless, and few architects use the Design Manual as the basis of their engineering drawings or in the construction process (Chou 2001). This vagueness of the codes allows for great variation in the quality of wood frame construction. It also provides little guidance to builders regarding proper construction and design. As vague as the building codes are, they only address post and beam construction and not 2x4 construction, leaving no protective measures for the quality of 2x4 structures built in Taiwan. The Design Manual does require the use of preservatives and anti-termite treatment, but again, according to ABRI representatives, the code is prescriptive in its requirements for material treating.

For example, although the building codes state that wood used within one-meter of the ground should be treated with insect-resistant chemicals that meet requirements of the Chinese National Standard (CNS) it is not mandatory. In addition, the information about material requirements is vague and difficult for builders and designers to follow (Chou 2001). This lack of information can be seen as a significant barrier to the adoption of proper 2x4 construction, particularly in a country where there are no formal wood frame construction design programs and where builders may try to cut costs to make wood frame structures more cost competitive with non-wood structures.

Although the structural requirements of the building codes are limited, fire restrictions, which were adopted when post and beam construction was common, are more stringent, yet at the same time prescriptive. According to the code, all roofs must be made of, or covered, with a non-combustible material on the interior and exterior of the building. This includes rafters and trusses. However, builders and architects commonly use structural wood members in roofs. One builder said he and other builders commonly covered the exposed ceiling with non-combustible boards during the fire inspection and removed them later. Other builders, who do not want to spend the money to address the fire issue, simply do not apply for building permits (Chou 2001).

The fire code requires that every 500 m² in wood frame housing be compartmentalized with one-hour fire separation walls and include floors, doors, and windows that also have a one-hour fire rating. For non-wood structures, every 1,500 m² must be compartmentalized with one-hour fire separation walls. If a sprinkler system is installed, the compartmentalized area allowed for both wood and non-wood construction is doubled, yet ABRI is proposing a higher rating. The fire-resistance of non-structural materials is not clearly defined and the regulations are not based on the fire rating, yet in the future a classification system similar to that used in the Japanese Architectural Regulations will be used. Fire ratings for structural materials for buildings under four stories, which applies to wood frame construction since the maximum height is four stories is included in Table 8 (Chou 2001).

Table 8. Fire Rating of Building Elements in Buildings Limited to Four Stories.

Types of Structural Elements				Fire Rating
Walls	Exterior Walls	Load Bearing		1 hr
		Non-load Bearing	Within fire-resistant zone	1 hr
			Outside fire-resistant zone	1/2 hr
Beams				1 hr
Posts/Columns				1 hr
Floor				1 hr
Roof				1 hr

Source: Chou 2001.

While ABRI is reviewing the building code and developing its revisions, building materials will be tested for strength and fire resistance. ABRI representatives said that this is a good time for various interests to provide their input to ensure that all interests and factors are considered. ABRI is seeking input about building standards, testing approaches, and structural aspects of engineered wood products and wood frame construction from ATO and US associations affiliated with engineered wood products, such as APA-The Engineered Wood Association. Fire testing of building materials must be done in an American Society of Testing and Materials (ASTM)-approved facility. This implies that any such lab in the world would suffice. ABRI officials, however, add the proviso that all documents be reviewed and certified by the Taiwan representative office in that country. In the US, it is the Taiwan Economic and Cultural Representative Office. Industry experts have said however, that it may be best to conduct the fire tests in Taiwan since it may be easier to assemble the individuals in ABRI and CPA needed to witness and approve the tests.

There is widespread doubt that ABRI will complete revisions to the building codes by the end of 2002. Several respondents said part of the slow progress is because ABRI is extremely evenhanded about reviewing information from various countries. Therefore, it may be effective for the US and Canada to work together to educate ABRI about North American building codes and wood frame building systems.

In a major development, in May 2001 COFI, Forintek, and ABRI signed a memorandum of understanding to cooperate on revising the building code by providing technical evaluations and cooperating on testing of wood structures against termites, fire, and humidity.

OPPORTUNITIES AND DEVELOPMENTS

Particularly important to the adoption of wood frame construction is the Taiwan government's strong support of wood as a structural building material. Wood as a structural material is viewed particularly as a means to provide more earthquake resistant housing -- a concern that has become more salient since the 1999 earthquake that killed more than 2,200 and left over 100,000 homeless. The earthquake was particularly devastating in the semi-rural areas of Taichung and Nantou, where it damaged 115,000 housing units, completely destroyed approximately 60,000 units, and rendered an additional 8,000 uninhabitable. In an effort to improve the quality of wood frame construction and the ease of getting projects started, the Architecture Building Research Institute (ABRI) of the Ministry of Interior (MOI) is receiving approval from the Construction Planning Administration (CPA) to review and revise the building codes. The revised codes will not only recognize wood as a "standard" building material, eliminating the lengthy review process to obtain a permit to build with wood, they will include detailed requirements for structural aspects such as proper engineering principles, materials, and treating requirements for 2x4 and post and beam construction. The review is expected to begin by the end of 2001 and revisions are expected to be completed by the end of 2002. ABRI is looking at North American and Japanese building codes to adapt to their own codes for wood frame construction.

While the building code does not restrict the use of wood in private homes if they are under 14 meters or 4 stories high, (with the exception that wooden roof components must be covered) the codes are prescriptive and do not outline detailed engineering requirements to ensure structural soundness or proper treatment of building materials to retard fire and insects. However, wood used as a structural material in public-use and multi-family buildings is considered a "special material" and requires a special building permit that can take up to two years to obtain. This is considered a major limit on the growth of the wood frame construction industry since there is more immediate potential for large public buildings constructed of wood. Builders who were interviewed said it is impossible to obtain a permit to build wood frame multi-family public buildings such as hotels and apartments. Fire codes also restrict the use of wood as exposed trusses and beams in roof construction. However, exposed beams and trusses are a major draw for designers to use wood in public and private buildings.

In an effort to improve the quality of wood frame construction and the ease of getting projects started, ABRI is receiving approval from the Construction Planning Administration (CPA) to review and revise the building and fire codes. The review is expected to begin by the end of 2001 and revisions should be completed by the end of 2002. ABRI is seeking technical information from North American and Japanese sources about proper design and construction techniques for 2x4 and post and beam structures. The revised code will not only recognize wood as a "standard" building material, eliminating the lengthy review process to obtain a permit to build with wood, it will include detailed requirements for structural aspects such as proper engineering principles, materials, and treating requirements for 2x4 and post and beam construction. Once the revision process is completed, ABRI plans to include separate sections that cover both forms of construction, leaving the final decision about which technique to use to the builder.

In another effort to promote wood frame construction in Taiwan the CPA, with US\$3.5 million from the ROC, plans to include wood frame multi-story wood frame apartments, townhouses, attached single-story senior housing, and single-family homes for low and moderate-income families in its Nantou redevelopment project. Half of the buildings in the redevelopment project are planned to be 2-3 story wood frame apartments and townhouses. The wood frame projects will be exempt from the permit process and wood will not be considered a "special material" because the CPA is overseeing the project. If the public responds favorably to the model homes the CPA plans to build more. The Canadian government has already committed to build sample modular homes in the development. The CPA has allocated US\$56/ft² (NT60k/ping) for land and US\$37/ft² (NT40k/ping) for the completed home. If the BC trade office and COFI find that builders can meet the price point set by the CPA and consumer and government response is favorable, they will consider building more homes. The inclusion of wood frame housing in the CPA's Nantou development benefits the wood frame construction industry in two ways: it provides examples of wood frame construction in Taiwan and it shows the public that the CPA endorses wood frame construction as an earthquake resistant form of housing.

Under the Agriculture Development Act, the CPA is also rezoning 150,000-200,000 acres of agricultural land surrounding Nantou to multiple-use in increments of approximately 15,000 acres per year. The CPA will install public facilities and return half to the owner for private development and the CPA will use the other half for public redevelopment projects. Medium density areas such as Nantou and Taichung counties are ideal for single and multi-family wood frame housing and the newly available land is considered vital to the growth of the wood frame construction industry.

GLULAM BEAMS

In addition to an increased interest from the Taiwanese government in building log frame, post and beam, and 2x4 structures, glulam beams and heavy timbers are becoming a more popular material in large public buildings and bridges, rural museums, and parks. Pictures of the Peinan Aboriginal Culture Museum, Taiwan's largest building constructed with glulam beams are shown in Photos 6 and 7. The 2,384 m² museum, completed in 1998, is constructed of a series of open curved glulam beams that support four independent roof structures. The building itself is constructed of reinforced concrete. The museum was designed in cooperation with a Japanese architecture firm who specified the materials used in the building, most of which were produced by Japanese suppliers (Miller 2001). Curved glulam beams are also used in landscaping on the museum grounds (Photo 8). Other projects, such as the Ilan Traditional Arts Museum, in Ilan County, is almost completely constructed of solid and engineered wood products (Photo 9). Construction of a 4,100 foot glulam bridge is also slated to begin in October 2001 in the Taichung area. The bridge is being designed cooperatively by Yang's Design and Western Wood Structures of Tualatin, Oregon. The two companies started their business relationship after the president of Yang's Design was introduced to Western Wood Structures during the State of Idaho's trade mission to the US.

Some interview respondents said government officials and architects said they like using glulams for the design flexibility that they provide. Other said architects are hesitant to use glulam beams because they feel they can achieve the same designs using steel and they are concerned with the potential for water damage to timbers and glulam beams. It is obvious there is a need for additional education and promotion to overcome these concerns.

To promote the use of glulams in Taiwan, the State of Idaho Trade Office with support from the American Forest & Paper Association (AFPA), held a seminar in May 2000 to educate builders and architects about glulams. Mr. Yen, Director, of the State of Idaho Trade Office, said after the first conference, sales of glulams as well as the number of inquiries about glulams received by the Idaho Trade Office increased. The conference has now become an annual event held in May and jointly sponsored by the US Agricultural Trade Office (ATO) Taipei, APA - The Engineered Wood Association, the Softwood Export Council, the Western Wood Products Association, the Architecture & Building Research Institute (Ministry of the Interior) (ABRI), the ROC Sustainable Development Committee, the Forestry Research Institute (Council of Agriculture), CABC, the Taiwan Architects' Association, the ROC Wood Construction Association, the Forestry Department of the National Taiwan University, and the Economic Daily News.

It is apparent from conference evaluation forms that Taiwanese builders, architects, and government officials still need basic information about North American species, what wood based building materials are, how they are used, and what considerations are involved in using wood based building materials. According to conference evaluation forms from the 2001 glulam seminar, conference attendees were particularly interested in presentations that included general education about glulam beams, wooden bridge construction, and multi-story wood frame construction, case studies of other wood frame projects, and building codes and proper design techniques (Appendix C). Conference attendees also said that information about species that are applicable to Taiwan's humid conditions would be beneficial. In addition, they would like information on structural design and calculations, applications of wood frame construction, maintenance, and how to treat wood to resist insects, decay, and fire.

While there are 5-6 architecture firms in Taiwan who design and build with glulam beams and heavy timbers, Yang's Design is the largest. Mr. Yang, President of Yang's Design, said the quality of the structures built in Taiwan is highly variable. All designs for small projects are completed in-house and construction managers employed by Yang's oversee construction. On large projects, Yang's partners with Western Structures, a Tualatin, Oregon firm that Mr. Yang met during a trade mission organized by the State of Idaho. In these cases, Yang's either drafts building plans for the architects at Western Structures to review, or the firm provides Western Structures with a conceptual drawing and Western Structures drafts the building plans. Western Structures will also send a construction manager to Taiwan to oversee large construction projects. Yang's most recent project is the Buddhist Cultural Center in Hualien. The building permit for the project, which took two years to obtain since the building is a wood structure, has been issued and construction was slated to start in October 2001.



Photo 6. The Peinan Aboriginal Culture Museum Located in Taitung, Taiwan.
Photo by Eddie Yen, Idaho State Trade Office.



Photo 7. Interior of the Peinan Aboriginal Culture Museum.
Photo by Eddie Yen, Idaho State Trade Office.



Photo 8. Glulam Beams used in the Landscaping of the Peinan Aboriginal Culture Museum.
Photo by Eddie Yen, Idaho State Trade Office.



Photo 9. Ilan Traditional Arts Museum, Ilan County.
Photo by Eddie Yen, Idaho State Trade Office.

CHALLENGES TO WOOD FRAME CONSTRUCTION

Even when ABRI and CPA complete the revisions to the building code to recognize wood as a standard building material and include engineering and material requirements for proper construction, the wood frame construction industry will still face larger challenges. The three central issues hindering the adoption of wood frame construction are a lack of technical knowledge about 2x4 wood frame construction among the country's builders and architects, intense concern among the Taiwanese population about the safety and durability of wood frame homes, and cost. The second issue, concern about the safety and durability of wood frame construction translates into a larger issue. Since the widespread belief among Taiwanese individuals is that wood frame homes are highly susceptible to fire, water, termite, and typhoon damage, it is difficult to obtain financing and insurance for wooden structures.

Consumer and Builder Misconceptions about Wood Frame Housing

While consumers reportedly like the appearance of wood as an interior and structural material, they have many misconceptions and concerns about wood frame homes. They believe that wood frame buildings are expensive and that they are at risk of fire, termite, rot, and typhoon damage. The risk of fire damage is greatly feared by Taiwanese people, particularly as it relates to wood frame construction. Government officials have also recognized that Taiwan has a higher rate of fire related deaths compared to other industrialized cities. Annually, in both Taipei and Kaohsiung, 19 out of one million people are killed in fire related accidents. Comparatively the rate in Hong Kong is 7.2 per million, Tokyo is 10.6, and San Francisco is 9.7 (Graham 2000). As a result, the government passed more stringent fire regulations in 1995. Demand for fireproof building has since surged, and now accounts for 60% of building materials sales (Graham 2000).

Interview respondents also said that Chinese consumers, in particular, want homes that they can pass on to future generations, yet they reportedly believe wood frame homes will only last 2-3 years. Builders reinforce the idea that wood frame homes are not durable by telling consumers they will last approximately 10 years. The fact that there are few examples of wood frame buildings in Taiwan and there is little information about wood frame construction in the media perpetuates the mystery surrounding wood frame homes since consumers cannot see for themselves that wooden homes are comfortable, safe, and resistant to the elements.

There are several separate events that have reinforced consumer fears about the durability of wood frame construction and its fire susceptibility. First, several housing developments of imported wood frame kit-homes built during the 1980s and 1990s near Taichung were poorly constructed and the builders did not take precautions to prevent water or termite damage. For example, sill plates were placed directly on concrete slab foundations (Graham 2000). Second, a wealthy lumber importer was in the process of having five-luxury wood frame homes built for his family, one of the highest profile construction projects in Taiwan's history. The project received a lot of media attention during its construction. However, soon after the homes were completed one burned down, which was also highly publicized and increased consumer's concern about the safety of wood frame construction.

Lack of 2x4 Technology Transfer

Education at the architect, builder, and consumer level is also paramount to the success of the 2x4 wood frame construction market in Taiwan. The President of the Wood Frame Construction Association said that approximately 20 construction firms in Taiwan employ architects or carpenters who understand how to design and build 2x4 structures. He said that aside from post and beam construction built during the Japanese occupation of Taiwan, builders and architects first introduction to wood frame construction was log structures, which are now popular as vacation resorts. He added that as more builders and architects have been exposed to 2x4 technology they have begun to incorporate 2x4 techniques into their projects as modified post and beam and 2x4 construction. Other respondents, however, estimated that more than half of the architects who are designing wood frame homes are not trained in 2x4 or wood frame design. However, since there is no formal wood frame design program in Taiwan and the fact that several of the architects who were interviewed for this report were self-taught in the design of wood structures it is likely that almost all of the architects in Taiwan who are deemed "trained in wood frame design" are self-taught.

The level of training appears to be reflected in the wood frame homes that have been built. According to several respondents, the quality of the wood frame housing in Taiwan is highly variable. Many of the wood frame homes in Taiwan are built in rural areas, and out of the view of permitting officials. Therefore, they are not regulated. As a result, very few of the homes that have been built have undergone the permit process and most are poorly constructed. Examples of poor construction included gross under-use of studs (24" intervals instead of 16" intervals). Other respondents also said that many Taiwanese builders use untreated red cedar because of its naturally insect and decay resistant properties, yet these properties only last for a few years. Interview respondents said that only very expensive homes have had their building plans reviewed and have received building permits, and the quality of these homes is reportedly good. The lack of architect and builder training also hinders the increased use of wood-based building materials because architects are reluctant to include the materials in their plans since they are unfamiliar with the materials.

Proper technology transfer is particularly important in a market such as Taiwan where the public already has fears about wood frame construction and where the image of wood frame construction relies heavily on word of mouth advertising. Improper design, construction, material selection, or materials preparation and handling can result in poor construction and dissatisfied customers. Given the small size of the wood frame construction industry, the reputation of a few poorly constructed buildings can be detrimental to the entire industry.

Insurance and Financing

Concern about flammability of wood products also makes it difficult to obtain financing. Some builders stated that lending institutions have said that since wood products have not passed Chinese National Standards (CNS) fire tests, they will finance only 40-50% of the value of wood frame projects, yet they finance up to 90% of concrete projects. Other firms reported that banks lend up to US\$244 (8,000NT) per square meter for steel or concrete construction, yet only US\$61 (2,000NT) per square meter for wood frame construction.

One construction firm said it is less difficult to obtain financing for log homes than for other types of wood frame construction, although financing and insurance for wood frame projects is a significant obstacle to the adoption of wood frame construction. To obtain financing the developer must obtain insurance, and insurance companies are very reluctant to insure wood projects. Since land is expensive, however, developers typically leverage the land to finance the home project.

INTERIOR WOOD PRODUCTS AND BUILDING MATERIALS

While the US forest products industry must overcome building codes and negative consumer perceptions to increase demand for wood frame homes in Taiwan, there are no such barriers for interior use wood products. In fact, according to the Mr. Wang, Director of the Taipei Interior Design Association (TAID), the natural look of wood is a popular interior style and Taiwanese designers and consumers prefer the straight grain associated with softwoods. Hinoki, matched closely by Port Orford cedar in the US, is particularly popular. He said that many consumers remain influenced by the Japanese occupation and they have tatami rooms in their homes decorated with hinoki. Hinoki is also used for doors, tables, and veneered paneling. Since log harvests in Taiwan are forbidden, Taiwan reportedly imports most of its Port Orford Cedar from the US. TAID's Director also said consumers prefer natural products versus imitation wood products. Other designers interviewed disagreed, saying that generally, only older individuals have tatami rooms in their homes. They also said imitation wood products are replacing solid wood products. It is possible these designers cater to individuals of different income levels and demographic groups.

Consumers' choices of materials and wood species are highly influenced by interior designers. Approximately 95 percent of condominiums are sold without kitchens or interior finishing. After purchasing the unit, consumers hire an interior designer to lend decorating advice and subcontract the interior work. Most Taiwanese consumers do not have pre-existing ideas about interior design, so the interior designer is very influential in the material selection process. Therefore, educating the designer about specific materials and products is very important to accessing the Taiwan market. Brochures written in Traditional Chinese and product samples are a very effective means of educating designers about products and species. Mr. Wang said the American Hardwood Export Council distributes a brochure of veneer samples that has been well received.

The interior products market is highly competitive, however. mainland China is Taiwan's leading supplier of furniture and interior goods. Structural differences in Taiwan's housing market also make it difficult to compete in the finished goods market. Since door, window, and kitchen sizes are not standardized, interior fittings are built to custom specifications, forcing production to remain in Taiwan. While it may be difficult to access the finished interior wood products market, US producers may be able to supply veneer, plywood, panels, and lumber to custom components manufacturers in Taiwan.

According to US Department of Commerce, revenue from US exports of interior use wood products to Taiwan are very small and revenues from all products have been declining except for household furniture, hardwood flooring, and wood windows and frames (Table 9). Wood windows are most likely used in prefabricated wood frame homes since windows and doors in condominiums and single family concrete or brick homes are not standard dimensions.

Table 9. US Interior and Value-added Wood Product Export Revenues to Taiwan, by Product, 1989-1999
(Thousands of US dollars).

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	change 1989-1999
household furniture	\$2,390	\$2,439	\$1,332	\$1,688	\$4,375	\$4,101	\$4,188	\$2,960	\$7,349	\$6,188	\$5,230	119%
hardwood flooring	\$192	\$655	\$831	\$552	\$686	\$728	\$580	\$201	\$100	\$244	\$1,412	634%
misc. secondary	\$1,303	\$1,140	\$1,279	\$1,420	\$1,522	\$1,698	\$1,372	\$2,129	\$4,127	\$2,201	\$1,360	4%
other builders joinery	\$179	\$210	\$1,291	\$1,020	\$1,865	\$3,977	\$2,317	\$3,815	\$2,276	\$1,472	\$984	450%
wood/wood frame seats	\$410	\$768	\$880	\$495	\$2,425	\$985	\$720	\$1,464	\$980	\$625	\$675	65%
office furniture	\$175	\$490	\$584	\$742	\$1,407	\$582	\$420	\$705	\$1,246	\$705	\$541	210%
windows & frames	\$14	\$825	\$205	\$397	\$361	\$271	\$134	\$21	\$89	\$26	\$315	2094%
furniture parts	\$464	\$650	\$169	\$162	\$393	\$256	\$692	\$495	\$547	\$137	\$249	-46%
prefab buildings	\$0	\$470	\$147	\$660	\$454	\$356	\$269	\$360	\$400	\$159	\$198	n/a
doors, frames, etc.	\$282	\$422	\$316	\$112	\$536	\$598	\$504	\$895	\$1,045	\$859	\$163	-42%
kitchen cabinets	\$35	\$15	\$0	\$25	\$21	\$12	\$3	\$25	\$154	\$429	\$99	182%
softwood flooring	\$303	\$102	\$28	\$55	\$556	\$218	\$144	\$114	\$292	\$132	\$89	-71%
pallets & packing cases	\$11	\$43	\$20	\$72	\$119	\$60	\$120	\$5	\$171	\$43	\$83	626%
Total	\$5,758	\$8,229	\$7,082	\$7,400	\$14,720	\$13,842	\$11,463	\$13,189	\$18,776	\$13,220	\$11,398	

Source: US Department of Commerce, 2000.

The most commonly used wood product in interiors is hardwood flooring, which has become increasingly popular as personal income has risen. US interior products face fierce competition from tropical hardwoods and non-wood substitutes however. Ms. Liu, the president of Tien Peng, a Taipei flooring distributor said sales of laminated flooring from mainland China have increased steadily since the company introduced them and laminated flooring makes up 70% of the firm's sales.

Ms. Liu said she recommends materials and species to interior designers based on the designer and customers color preferences, although she said darker colored flooring is popular. She also said she recommends laminated flooring because it wears better than solid wood and it is less expensive. Many Taiwanese mop their floors with a lot of water, which also makes laminate and non-wood flooring and mouldings more practical.

Reportedly, wood flooring from the US is less attractive to importers and consumer because suppliers only produce lumber in one-inch thickness. Finished, the flooring is 2.2 cm, which makes the flooring more costly than its competitors. Ms. Liu also said that termites are attracted to oak more than other species, although she also said that termites were not a problem in apartments. While oak may not be more susceptible to termite damage than other species, the perception that it is, could be a major obstacle to the use of oak flooring in Taiwan. This is another area that highlights the need for education about US products and species in Taiwan.

CONCLUSIONS AND RECOMMENDATIONS

Primary issues related to wood frame housing that were uncovered through interviews, meetings, and site visits are: 1) although the building codes allow the use of wood as a structural material in single-family homes of less than 14 meters and 4 stories high, the engineering details and materials requirements detailed in the building codes are inadequate, and therefore, quality control is insufficient and contributes to the reluctance of architects to take on the "risk" of building with wood, 2) the use of wood as a structural building material in multi-family or public-use structures is prohibited unless a special building permit is issued, which can take up to two years to obtain, 3) there is a lack of technical knowledge and technology transfer for wood frame housing construction, 4) a lack of adequate fire test data limits expansion of wood frame multi-story construction, 5) wood frame housing is cost prohibitive at this time for the average Taiwanese consumer, and 6) most Taiwanese consumers and architects are extremely concerned with wood frame construction's susceptibility to termites, fire, water damage, and typhoons.

While the building code is a significant barrier to the wood frame construction market, there are opportunities for wood frame construction despite the designation of wood as a "special material". While ABRI and the CPA are revising the building code to remove the designation of wood as a "special material", which would eliminate the need for a time intensive special building permit, there are several opportunities to introduce wood frame construction to Taiwan. Foremost of these opportunities is the CPA's redevelopment project in Taichung, which will include wood frame housing. The CPA has waived the need for a special permit for multi-family wooden construction since the area is earthquake prone. Inclusion of single- and multi-family wood frame housing in this development should help introduce wood homes to Taiwanese residents and may be a starting point from which to educate consumers and construction professionals about the advantages of wood frame housing as well as serve as a tool for teaching 2x4 construction technology. There are also opportunities for the use of large timbers and glulam building materials in government funded public buildings. Many of these projects still require a lengthy review and permitting process, yet the quality of the construction is more regulated, and therefore, the buildings serve as examples of good wood frame construction, which is beneficial to the promotion of wood as a safe and attractive building material.

Given the growing interest in domestic tourism there also appear to be opportunities for cabins built of SIPs. These structures can use steel frame systems with SIPs to avoid the restrictions of the building code and the panel systems do not require extensive technology transfer. However, there are few individuals at this point are interested in owning wood frame homes out of fear of termite damage, fire risk, typhoon damage and high cost. There are also very few architects and even fewer builders who have been formally trained in 2x4 construction technology.

Despite the Taiwanese government's support for wood frame construction, the US wood products industry should be actively involved in the revision process by providing ABRI with engineering specifications for 2x4 construction, US building codes, fire codes, and information about selecting the proper materials and treating wood to retard rot and termite damage. Although ABRI plans to revise the design code to accept wood as a standard structural material, there are still indications that fire regulations could still hinder the wood frame construction industry if the code is not modified to accept wooden building materials. The US forest products industry should also follow the example set by COFI and sign a memorandum of understanding with the Taiwan government to cooperate in the code revision process and cooperative research on fire, rot, and insect resistance of wooden building materials.

Since ABRI reportedly attempts to be very even handed about reviewing information submitted by several countries, to the point that progress is slowed considerably, cooperation between supporters of 2x4 building technology has the potential to influence ABRI more significantly as a group rather than separately. The US forest products industry should consider working cooperatively with Canada to educate ABRI about North American wood frame construction building codes and to convince ABRI to accept UL wood building material test results or Japan fire certification test results. The Director of the British Columbia Trade Office in Taipei said he thought this would be an effective approach and agreed to talk further about how the two countries could educate ABRI together. The two countries should also consider cooperating on promotional programs for wood frame construction and building products since there are few staff people employed to promote wood products in Taiwan.

Technology transfer is another issue. Taiwan has no training for architects or builders in wood frame design or construction. If US suppliers are interested in promoting 2x4 construction in Taiwan it is imperative that proper technology transfer take place before poor quality homes are built in order to avoid negative backlash associated with improper construction techniques. This should take the form of seminars on wood frame construction technology in addition to the annual glulam seminar in Taiwan for government officials, architects, and builders. The US industry may also consider building a model wood frame home in the CPA's Nantou redevelopment project to provide an example of 2x4 construction for consumers. The project can also be used as a hands-on training program for builders.

In addition to teaching architects and builders how to design and build 2x4 structures, the US forest products industry should also concentrate on educating architects, suppliers, and builders about US timber species and building materials. The State of Idaho Trade Office promotes US wood-based building materials through promotional literature, and trade missions, and an annual seminar about building with glulam beams. The USDA Agricultural Trade Office also communicates with ABRI about code related issues. However, there is a lack of knowledge among Taiwanese architects and builders about US building materials and timber species and US wood building materials appear under promoted. The reasons for this are partly due to staffing in Taiwan to promote US building materials and wood frame construction in general. The State of Idaho is considered the primary source of information about US wood products. Since their mandate is to promote a wide range of products produced in Idaho they do not necessarily have the time or resources to devote to promoting the entire US wood products industry. It may be effective to have the ATO office coordinate promotional activities among several of the state trade offices representing states that depend heavily on wood as an export commodity. It may also be valuable to have a technical expert travel to Taiwan periodically to provide technical assistance to ABRI on the code revision and respond to technical questions about wood frame construction.

In addition to a shortage of personnel to promote US wood products in Taiwan, representatives from government offices and private firms both reported that there is very little promotional material about US products, species, or basic information about 2x4 technology available in Traditional Chinese, Taiwan's native language. Printed materials in Taiwan's native language that US trade offices can use should be a priority of the US wood products industry. Suppliers of US primary and secondary processed wood products said they spend a lot of time educating customers about the proper materials and species to use for structural applications. The lack of promotional materials in Taiwanese customer's native language makes this task extremely difficult. At the same time, the President of the TAID reported that promotional materials produced by the American Hardwood Export Council that include samples of US wood species have been very successful. Information printed in Taiwan's native language not only gives the impression that US suppliers are committed to the market, it increases the likelihood that government officials will review the information provided by US industry when they are revising the building codes. According to respondents, literature written in Traditional Chinese is also considered more advanced or sophisticated than simplified Chinese, even in mainland China.

One of the most significant barriers to the wood frame construction in Taiwan is concern from consumers and architects about the durability of wood frame construction and its susceptibility to termite, fire, typhoon, and water damage. The US wood products industry needs to educate architects and consumers that wood frame homes are more comfortable and safer than concrete or brick homes. Promotion should highlight 2x4 homes' higher resistance to earthquake damage using examples from the Kobe, Japan earthquake. It should also emphasize that if the building materials are treated properly, wood homes are resistant to termite damage. Education programs should also address consumer's concerns about the risk of fire to wood frame homes. Another important component for promoting the use of wood in construction is coverage by the news media. Dr. Tsou said Taiwanese people are highly influenced by the news and television media, yet there are no examples of wood frame construction in the local print or television media.

Another significant barrier to the use of wood frame construction in Taiwan is cost. The high cost of materials and financing restricts home ownership opportunities. Although a mortgage system exists, lending organizations will only finance 40-50% of the value of wood frame projects, compared to up to 90% for concrete projects. In addition, to secure financing the developer must obtain insurance, and insurance companies are very reluctant to insure wood projects.

As a result of these findings, there are three recommendations for US industry to increase sales of high-quality lumber and building products to Taiwan. First, a relationship has already been established between the USDA ATO and ABRI. The US forest products industry should work with ATO to strengthen this relationship and provide ABRI with US building codes, technical information about proper design, construction, and maintenance of 2x4 structures written in Traditional Chinese. The US government may follow the example set by COFI and Forintek and sign a memorandum of agreement with ABRI to cooperatively work on revising the building code by providing technical evaluations and cooperating on testing wooden building materials for termites, fire, and humidity resistance. Second, it is paramount that the US forest products industry educate Taiwanese architects and builders about wooden building materials, US timber species, 2x4 construction technology, and about the advantages of wood frame homes such as increased earthquake resistance and comfort by producing and distributing brochures written in Traditional Chinese, and by holding seminars. It is also important to organize trade missions to bring Taiwanese architects, builders, and government officials to view projects in the US and meet with US firms. Third, to stimulate consumer demand for wood frame construction, the forest products industry should participate in trade shows and consider building a model home at the CPA's Nantou housing development. While the market for wood frame construction cannot fully take off until the building code recognizes wood as an accepted building material, US industry should start developing interest at the consumer, builder, and architect level now.

LITERATURE CITED

- Central Intelligence Agency. 2000. *CIA Factbook*. [Online]:
<http://www.cia.gov/cia/publications/factbook/geos/tw.html>
- Chou, Meilin. 2001. *A Survey of Taiwanese Planning and Building Regulations Affecting the Market for Platform Wood Frame Construction*. Council of Forest Industries. Vancouver, BC. 72pp.
- Graham, David. 2000. 921 Earthquake in Taiwan Prompts Government to Consider Upgrading Wood Frame Construction Codes. Pacific Span Consultants Inc. Vancouver, BC. 26pp.
- Huang, Annie. Thursday, February 25, 1999. Small firms keep Taiwan afloat during tough times. *Detroit News*. [Online]: <http://detnews.com/1999/biz/9902/25/02250061.htm>
- Lee, Bear. 2000. Taiwan's per capita GNP to hit US\$14,500 this year. [Online]:
<http://www.taiwan.com.au/Polieco/Industry/Reports/200008/14a.html>
- Lin Mei-chun and Richard Dobson. 2001. No end to the downturn seen. Taipei Times. May 1, 2001. [Online]:
<http://www.taipetimes.com/news/2001/05/01/story/0000083865>
- Liu-Belshe, Rena and Andrew Pasek. 1999. *Taiwan Solid Wood Products Annual Situation 1999*. USDA Foreign Agricultural Service, American Institute in Taiwan. Taipei, Taiwan. 29pp.
- McKellar, Kieth. 1998. Taiwan Market Study for Softwood Lumber. Forest Industries & Building Products Branch. Industry Canada. Vancouver, B.C., Canada. 9pp.
- Miller, Jeff. 2001. *Taiwan Solid Wood Products Standards Body Visit Underscores US Effort to Achieve Regulator Acceptance of Construction Wood*. USDA Foreign Agricultural Service, American Institute in Taiwan. Taipei, Taiwan. 3pp.
- Miller, Jeff. 2000. *Taiwan Solid Wood Products Annual 2000*. USDA Foreign Agricultural Service, American Institute in Taiwan. Taipei, Taiwan. 15pp.
- N. Abrahamson, J. P. Bardet, R. Boulanger, J. Bray, Y.-W. Chan, C.-Y. Chang, C.-H. Chen, L. Harder, A.-B. Huang, S. Huang, J.W. Ju, S. Kramer, M.-J. Kuo, W. F. Lee, H.-L. Lin, C.-H. Loh, C.-Y. Ou, R. Seed, J.-D. Shen, N. Sitar, J. Stewart, L. Teng, J. I. Sun, and R. 1999. Wright. Preliminary Geotechnical Earthquake Engineering Observations of the September 21, 1999, Ji-Ji, Taiwan Earthquake. Taiwan-US Geotechnical Earthquake Engineering Reconnaissance Team. [Online]. <http://www.eerc.berkeley.edu/taiwan/geotech/intro/>
- Precision Panels. 2001. [Online]: <http://www.precisionpanel.com/taiwan.html>
- Statistics Canada. Strategis. 2001. <http://strategis.ic.gc.ca/>
- The Taiwan Economic News. N.d. Major Indicators of Taiwan Economy. The Taiwan Economic News. [Online]:
<http://news.cens.com/sample/fmarket/indicators.html>
- Taiwan Forestry Bureau. 2001. *Management of Protection Forests*. [Online]:
http://www.forest.gov.tw/web/English/english_06.htm
- US Department of Commerce U.S. Exports History. 1997, [CD-ROM]. US Department of Commerce dbase [2001, June].

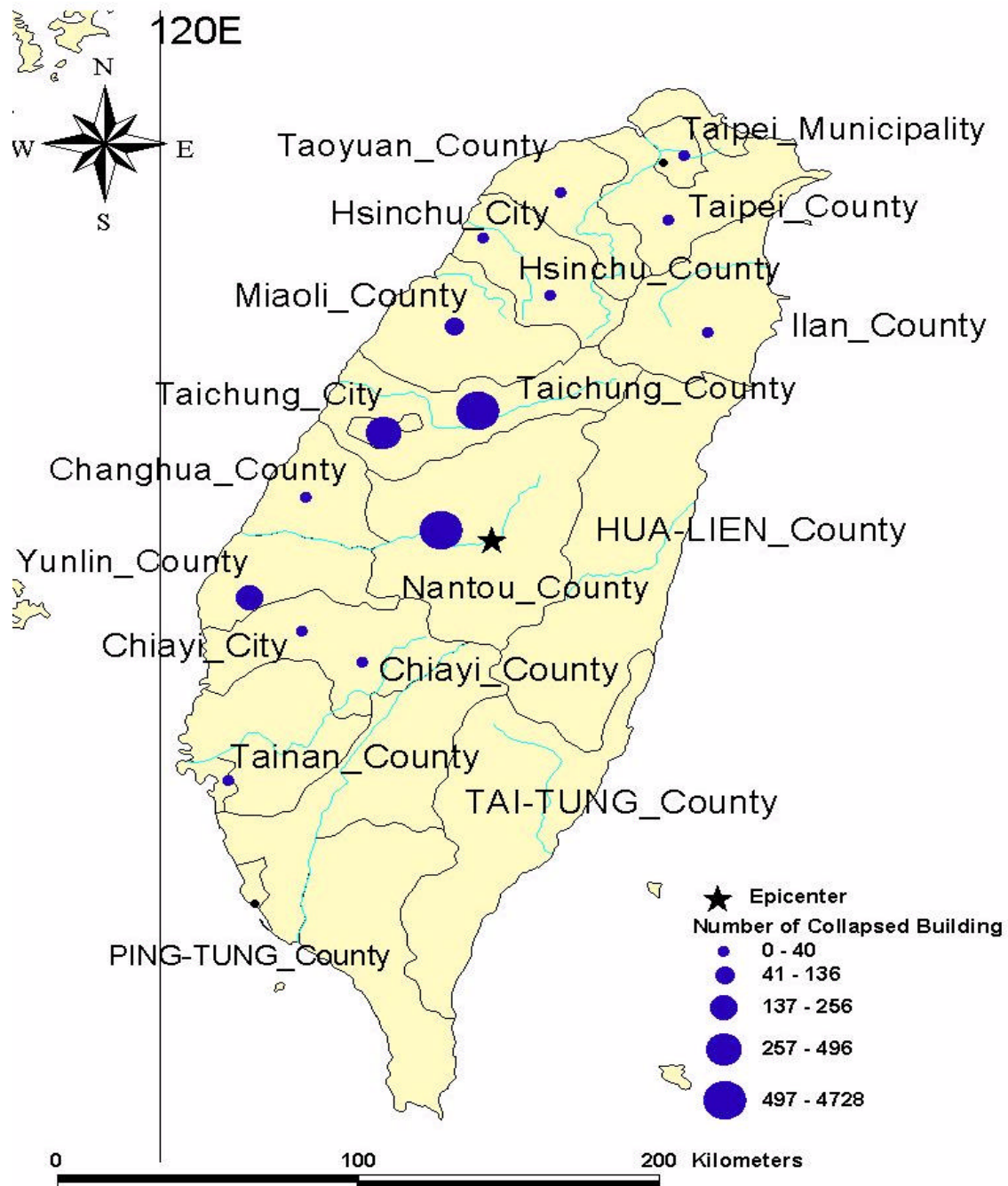
US International Trade Commission. 2001. Interactive Tariff and Trade DataWeb. [Online]: <http://dataweb.usitc.gov/>

Vatikiotis, Michael and Maureen Pao. 2001. Just a Pawn in the Superpower Game. *Far Eastern Economic Review*. April 26, 2001. [Online]: http://www.feer.com/_0104_26/p014region.html

Washington State Taiwan Office. 2001. *Taiwan's economy set for new highs in GNP and trade*. [Online]: <http://www.washingtonstate.org.tw/English/news-events/news-briefs/news-briefs-00-08.htm>

APPENDICES

APPENDIX A. DISTRIBUTION OF COLLAPSED BUILDINGS PER COUNTY AFTER THE 1999 JIJ, TAIWAN EARTHQUAKE.



Source: Abrahamson, et al. 1999.

APPENDIX B. MAP OF TAIWAN



Source: Precision Panels, 2001

**APPENDIX C. RESULTS OF GLULAM CONFERENCE ATTENDEES' RESPONSE FORM, MAY 24, 2001,
TAIPEI, TAIWAN.**

- Total number of questionnaires received: 70
- Content of workshop
 - ◇ Satisfied: 73%
 - ◇ Fair: 7%
 - ◇ Which part of the presentation is most valuable to you?
 - Overall introduction of Glulam: 70%
 - Wood bridge introduction: 63%
 - Multi-story wood frame construction: 68%
 - ◇ Others suggestions
 - Detailed case study
 - Building codes introduction of wood frame construction
- What are needed for future programs
 - ◇ Workshop annually: 53%
 - ◇ Workshop every other year: 3%
 - ◇ Topics need to be emphasized in the workshop:
 - Applications of wood frame construction: 77%
 - Structural designing and calculation: 63%
 - Treatment for bugs/decay/fire resistant: 68%
 - Other suggestions:
 - Introduction of coating and painting
 - Introduction of species and uses in special conditions like coastal and hot spring areas
 - Wood frame construction's applications in landscaping
 - Case studies of public and commercial uses of glulam and for interior uses
 - Maintenance and inspection
 - How to combine RC foundation with wood frame construction
 - Recommended species and construction methods for Taiwan's mountain area
- Information needed:
 - ◇ Introduction of wood species and applications: 43%
 - ◇ Designing standards and codes: 75%
 - ◇ Others:
 - Construction details & material standards
 - Local case study of how to apply permits and how the private sector and government work together
- Are you interested in participating in the Glulam Designing Program
 - ◇ Yes: 72%
 - ◇ No: 10%

Results of Glulam Conference Attendees' Response Form, May 25, 2001, Taipei, Taiwan.

- **Total number of questionnaires received: 60**
- **Content of workshop**
 - ✧ Satisfied: 82%
 - ✧ Fair: 12%
 - ✧ Which part of the presentation is most valuable to you?
 - Glulam applications in commercial construction: 66%
 - TJI and uses in Japan: 61%
 - Tacoma Dome: 39%
 - ✧ **Others suggestions**
 - Introduction of detailed construction procedures
 - Introduction of fire resistant nature & standards of wood frame construction plus case study
 - More introduction of glulam as a green products for ecosystem and economical values
 - More introduction of applications and uses
 - How to design glulam for Taiwan where has high humidity, typhoon and heat? And maintenance
- **What are needed for future programs**
 - ✧ Workshop annually: 58%
 - ✧ Workshop every other year: 5%
 - ✧ Topics need to be emphasized in the workshop:
 - Applications of wood frame construction: 78%
 - Structural designing and calculation: 59%
 - Treatment for bugs/decay/fire resistant: 75%
 - Other suggestions:
 - Introduction of wind resistant design
 - Case study of metal connectors
 - Comparisons of wood frame and steel frame and introduction of American and Taiwan building materials codes
 - Construction methods of large wood frame construction
 - Construction details' introduction plus on-site management
 - Case studies of Taiwan project plus what difficulties were faced and the solutions.
- **Information needed:**
 - ✧ Introduction of wood species and applications: 52%
 - ✧ Designing standards and codes: 77%
- **Are you interested in participating in the Glulam Designing Program**
 - ✧ Yes: 77%
 - ✧ No: 5%

APPENDIX D. SOFTWOOD LUMBER IMPORTERS BY SPECIES

HS 4407109011: Cypress (Chamaecyparis spp.)

ANDERSON INDUSTRIAL CORP.
7 F, 72 Sung Chiang Rd., Taipei 10449
886-2-25237866
886-2-25236676
trade@mail.anderson.com.tw
http://www.anderson.com.tw

CHEN I GLOBAL TRADING CO., LTD.
1Fl. no.846 Yu Nung Rd. E. Dist. Tainan City 70145
886-6-2568716
886-6-2558879

CHIA LIN LUMBER CO., LTD.
3F, 13, Lane 98, Ho Ping W. Rd., Sec. 2, Taipei 10052
Tel: 886-2-22961185
Fax: 886-2-22965163

HUAH LIH ENTERPRISES CO., LTD.
97 Wu Fu 4th Rd., Kaohsiung 80344
886-7-5512216
886-7-5512215

JIA HWA TRADING CO., LTD.
1F No.60 Lane 91 Kuang Fu St. Kuan Miao Hsiang Tainan 71842
886-6-5959451

WANN CHYI WOOD PROCESS WORKS
No.6 Long 34 Lane 109 Antung St. Kaohsiung 80743
886-7-3111896

HS 4407109012: Cedar (Thuja spp.)

BESTRUTH INDUSTRY CO., LTD.
7F-2 No.47 Chung Hua 4th Road Lin Yia District Kaohsiung 80243
886-7-3337488
886-7-3324835

FU SAN TIMBER CO., LTD.
968 Chung Shan E. Rd., Lo Tung Chen. I-Lan Hsien 26544
886-3-9505444
886-3-9508365

LONG HOH ENTERPRISE CO., LTD.
150 Ho Ping Rd., Lo Tung Chen. I-Lan Hsien 26544
886-3-9545065
886-3-9542263 03-9552000

LONG HAEUSER ENTERPRISE CO., LTD.
2F, 41 Chang Chun Rd., Rotong Chen, Ilan Hsien 26544
886-3-9545065
886-3-9552000

YI TSAI WOOD CO., LTD.
58 Lane 50 Chung Hsiao Rd. Sec. 3 Sanchung City Taipei Hsien 24162
886-2-24854242
886-2-24758303

HS 4407109014: Hemlock (Tsuga spp.)

CYMASUN CO., LTD.
4F, 201-2 Tun Hua N. Rd., Taipei 10544
886-2-27178400
886-2-27175286

HUANG CHUNG ENTERPRISES CO., LTD.
109 Tu Hsing Rd., N. Dist., Taichung 404
886-4-22081293

LONG HOH ENTERPRISE CO., LTD.

SONG JING WOOD CO., LTD.
16-3 F. 235 Chung Cheng 4th Rd., Kaohsiung 80144
886-7-2821194
886-7-2166003
songjing@ms15.hinet.net

UNITED FORESTRY PRODUCTS LTD.
14, Alley 28, Lane 304, Tu Cheng Rd., Tali City, Taichung Hsien 41248
886-4-24953695
886-4-24922176

YANG YWUH DEVELOPMENT CO., LTD.
No.15 Lane 471 Cheng Ching Rd. San Min Dist. Kaohsiung 80757
886-7-3867669

4407109015: Spruce (Picea spp.)

INGATERING TRADING CO., LTD.
10 Chi Hsing Rd., Sec. 1, Chian Hsiang Hualien Hsien 973
886-3-8523386
886-3-8531130

SONG JING WOOD CO., LTD.

SHAAN LONNQ ENTERPRISE CO., LTD.
No. 464 Geng Sheng North Rd. Taitung 95046
886-89-382177

TAIWAN YAMAHA MUSICAL, INST. MFG. CO., LTD.
465 Chung Fong Rd., Lungtan Hsiang, Taoyuan Hsien 32541
886-3-4793131 03-4793135
886-3-4793136
yamahat1@ms55.hinet.net yamahatw@ms22.hinet.net

HS 4407109017: Pine (Pinus spp.)

JONGSEN TIMBER ENTERPRISE CO., LTD.
201-3 Chung Ching Rd., Taichung 40749
886-4-24255833
886-4-24255922
jongsen@tcts.seed.net.tw

MAIN SHINE WOODEN CO., LTD. / MAIN JET WOODEN CO., LTD
3F, 220 Tung Ho W. St., Taipei 11162
886-3-3284136
886-3-3285648

WU CHUEN WOOD CO., LTD.
13, Lane 25, Hun-She Rd., Sec. 2, Chung-Li, Taiyuan Hsien 32045
886-3-4929677
886-3-4929676

YUNG FONG LOGGING CORP.
480 Feng Shih Rd., Sec. 1, Fengyuan City, Taichung Hsien 42048
886-4-25269133
886-4-25227300

YANGTZE RIVER INDUSTRIAL LTD.
4F, 691 Chung Shan N. Rd., Sec. 5, Taipei 11141
886-2-28311612
886-2-28311607
yanriver@ms52.hinet.net

YI TSAI WOOD CO., LTD.

HS 4407109090: Other coniferous lumber

CHIEN HSIN LUMBER & WOOD MFG. CO., LTD.
421 Chen Hsing Rd., Taichung 40143
886-4-22124913
886-4-22122777
hsiaomu@ms10.hinet.net

CHUNG SHEN ENTERPRISE CO., LTD.
201-3 Chung Ching Rd., Taichung 40749
886-4-24254900
886-4-24254912
chungsen@tcts.seed.net.tw

JIAN SHENG CO., LTD.

12, Lane 136, Wen Hua Rd., Yingko Chen, Taipei Hsien 23942
886-2-26792118
886-2-26789998

JONGSEN TIMBER ENTERPRISE CO., LTD.

201-3 Chung Ching Rd., Taichung 40749
886-4-24255833
886-4-24255922
jongsen@tcts.seed.net.tw

LONG HOH ENTERPRISE CO., LTD.

SHEN YIH LUMBER CO., LTD.

161 Chung Cheng N. Rd., Lotung Chen, I-Lan Hsien 26542
886-3-9583311 / 3277055
886-3-9581886 / 3287269

SHENG TUONG ENTERPRISE CO., LTD.

16 Chung Li Rd., Hsiaokang Dist., Kaohsiung 812
886-7-8717288
886-7-8720699
cathy027@ksts.seed.net.tw

CHERNG FENG LUMBER CO., LTD.

1-10 Chia Pa, Chiapei Li, Shanhwa Chen, Tainan Hsien 74100
886-6-5831587
886-6-5838308

HEN LI LUMBER CO., LTD.

255-28 Kai Hsuan Rd., I-Lan Hsien 26045
886-3-9586966
886-3-9586611

YUNG FONG LOGGING CORP.

TONY SINCERITY ENTERPRISE CO., LTD.

67, Lane 296, Lin Sen W. Rd., Chiayi City 60044
886-5-2758409
886-5-2238509

UNITED FORESTRY PRODUCTS LTD.

TOP-WARE WOOD PRODUCTS CORP.

252 Chung Hwa Rd., Pingtung city 90044
886-8-7390443
886-8-7390442

APPENDIX E. WOOD FRAME HOUSING AND BUILDING MATERIALS TRADE SHOWS & SEMINARS

Trade Show or Seminar	Date
Taipei International Building Materials and Furniture Exhibition	Sep 30 ~ Oct 3
Seminar and Exhibition on the Design & Application and Case Studies of Glue Laminated Timber and Wood-frame Construction	May 24 ~ 25

Contact the Agricultural Trade Organization, Taipei, Taiwan for more information.

Agricultural Trade Office
2F, 54 Nan Hai Road, Taipei, Taiwan
Tel. 886-2-2305-4883
Fax: 886-2-2305-7073