

Group A

Market Opportunities in Structural Engineered Wood & Building Components

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Group A: Market Opportunities in Engineered Wood and Building Components

Definitions

This section looks at market opportunities in the US Great Lakes for building components and structural engineered wood. It focuses on structural applications in residential construction. In addition, references are made to the demand for these products in non-residential and remodeling applications. Demand within the factory-built sub-sector is discussed later in Group C. A key feature of these products is that they are to a greater or lesser extent 'engineered' for specific purposes and designed to meet code-defined performance criteria.

Builders have a wide range of choices in the types of materials they can use for new construction and re-modeling. In roof construction, for example, they have a choice of over eight main products for rafters and/or joists. In roof beams, they can choose from at least nine basic categories. Within each of these, there are several species of wood at their disposal. Overall, the main choices of structural roof materials are either lumber or roof structural components such as wood trusses.

In wall construction, the builder has a choice of up to fourteen product options, including concrete, dimension lumber, panelized walls manufactured off-site or engineered wood products such as LVL and LSL.

Architects, designers and specifiers have a wide choice of structural building materials from which to choose. Ontario's wood product producers and their distributors have to vie for attention.

A list of possible choices in various applications is provided in Appendix B.

In this section, we consider the following types of applications and concentrate on the structural building components and structural engineered wood products ('structural EWPs') shown in Table 6. Even with the short list of choices presented in the Table, it is clear that a large number of interchangeable and often competing products exist.

**Table 6
 Main Types of Wood Components and Structural EWPs -Roof Construction**

Application	Products & Product Components
<p>Roof Systems, Rafters & Joists Roof Beams</p>	<p>Lumber rafters and joists. Wood I-Joists Open web joists OSB used as web in I-Joists Stress rated (MSR) lumber used in roof systems Dimension lumber used for components Structural EWPs (LVL, LSL/TimberStrand, Parallam, Glulam) Solid wood beams. SIPs 2nd and 3rd Generation EWP beams Wood-based modular and whole roof systems</p>

Woodbridge Associates Inc. See also Appendix B for an expanded list of products.

Ontario producers supply some of these finished products to the US Great Lakes market. In other cases, lumber and structural panelboards (OSB) are sold to remanufacturers, component producers and structural EWP plants in the Great Lakes market.

It is important to consider within this report both the extent to which primary commodity wood products from Ontario and elsewhere are sold and consumed in the eight Great Lakes states, as

well as shipments and potential markets within the region for the province's value-added structural wood products.

In Table 7, we show examples of the types of products use in structural floors. In particular, I-Joists have displaced dimension lumber joists and rafters to a considerable extent in many, but not all, areas. Others floor systems include open-web joists which are comparatively popular in states such as Minnesota.

In addition to these products, the builder has a choice of concrete or steel, particularly in first floor single family homes, multi-family first and upper floors and in commercial, office and industrial buildings.

Table 7

**Main Types of Wood Components and Structural EWPs Considered in this Report
 -Floor Construction**

Application	Products & Product Components
<p align="center">Structural Floor Systems Floor Beams</p>	<p>Dimension lumber joists Wood I-Joists (LVL and lumber flange) Open-web joists (parallel chord trusses) Floor systems, including engineered rim boards Solid wood beams Glulam Parallam LSL (TimberStrand) LVL</p>

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Engineered wood beams such as Parallam and Glulam were among the 1st generation of structural EWPs to rival timber and often displace increasingly scarce timber beams in structural floors. More recent generations of products such as LSL (TimberStrand) offer a complete engineered structural flooring approach and LVL is capturing market share.

The architect or designer has a number of fundamental choices for wall construction including various types of concrete, concrete block, stone, dimension lumber, panelized walls manufactured offsite, modular walls and structural engineered wood products. Table 8 shows the principal choices among wood-based products.

Table 8

**Main Types of Wood Components and Structural EWPs Considered in this Report
 -Wall Construction**

Application	Products & Product Components
<p align="center">Wall Systems</p>	<p>Dimension lumber LSL (TimberStrand) Wood I-Joists Panelized walls Modulized units (rooms) SIPs</p>

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Ontario already has established itself as a significant producer of structural wall panels. Many of the province's truss producers also manufacture and export wall panels. This technology is still in its formative stages and Ontario could take a leadership role in developing a globally competitive, leading-edge capability in this value-added product as part of a whole-systems supplier strategy.

The wall systems market in the US Great Lakes is of vital importance to Ontario. 35%-40% of all softwood dimension lumber consumed in North American new residential housing goes into wall construction. Much of the province's lumber output is suited to this end-use.

Another important sub-sector of the building components and structural EWP business is the headers market. This comprises a range of products ranging from comparatively short length window and door headers to longer length load bearing headers required for single and double garages. Table 9 shows the types of wood products that are used in the headers market.

Table 9

**Main Types of Wood Components and Structural EWPs Considered in this Report
 -Header Construction**

Application	Products & Product Components
Window, Door and Garage Headers	Built-up dimension lumber Solid wood beams Glulam Wood I-Joists Parallam Glued and nailed box Wood Truss and open web trusses LSL (TimberStrand and Anthony Power Beam) LVL

Woodbridge Associates Inc.

In view of the close connection between these building components and the doors and windows market, we also refer readers to the analysis of whole systems discussed in Group B (Millwork) of this report.

The US Structural Engineered Wood and Building Components Market

According to USITC estimates, apparent production of wood structural building components¹⁸ in the U.S. rose strongly by US\$2.2 billion from 1997 to nearly US\$9.7 billion by 2002.

Chart 29

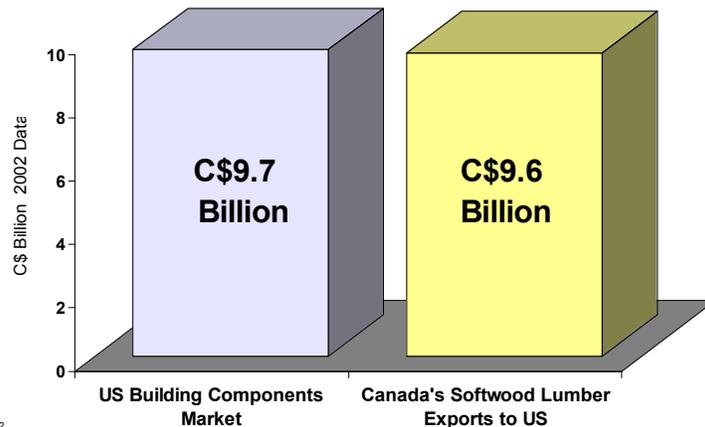
Chart 29 provides an interesting point of comparison for the Canadian lumber industry. It shows that the value of the U.S. building components market is also almost exactly equal to the aggregate value of Canada's exports of softwood lumber to the United States.

Most of the US building components market is supplied from US sources (the US is also an exporter of these products).

In practical terms, only part of the US market is available to Canadian component and structural EWP producers.

US Structural Building Components Market is Bigger Than Canada's Softwood Lumber Exports to the US

Peter Woodbridge & Associates Ltd.
Data Sources: Strategis, USITC



#03-122

The comparison provides a revealing perspective on the importance to Canada of access to the US market for its softwood lumber exports.

A growing number of wood product producers with operations in Canada and specifically in Ontario have become suppliers of building components and structural EWPs, and supply markets in the US. These include Weyerhaeuser, Buchanan, Tembec, Domtar and others.

A 2002 USITC investigation into conditions of competition in this industry provides valuable estimates of Canada's market share of the US engineered wood structural building components market. Key data are summarised in Chart 30.

Over the period 1997 to 2002, US imports of engineered wood structural building components increased. Even at their peak market share in 1999, however, imports in aggregate accounted for 6.9% of estimated U.S. domestic consumption¹⁹, or an import market valued at around US\$650 million.

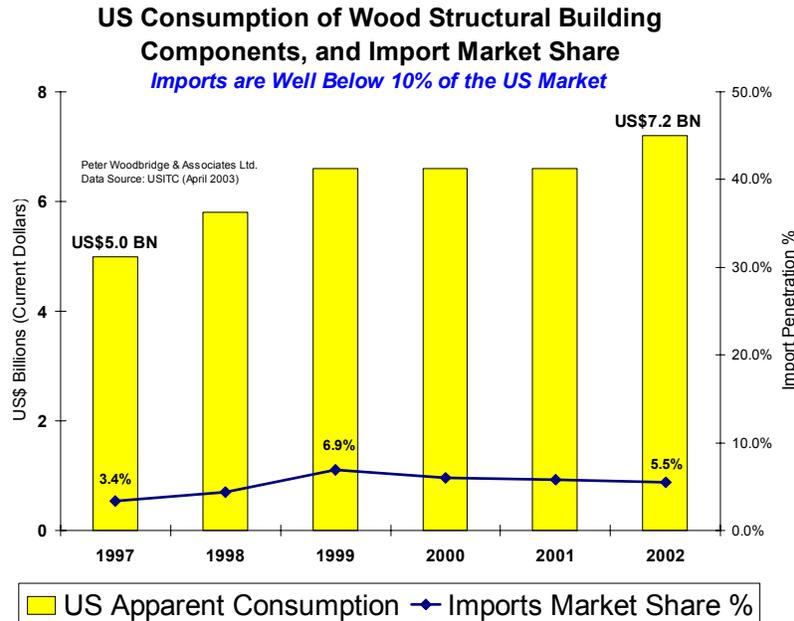
By 2002, with increased new capacity in the US, the share of imports had dropped to 5.5% for all products in aggregate.

¹⁸ Production defined by the USITC as comprising trusses and prefabricated panels plus engineered wood products. www.usitc.gov Publication # 3596 Table 3-1. Wider definitions indicate a substantially bigger market, of which wood is only part.

¹⁹ USITC Report, *ibid.* Table 4-1

Definitions vary. When imports of other products²⁰ that are not included above are taken into account, the total value of imported structural wood and allied value-added building components is estimated to have been close to US\$875 million in 2002²¹. So the import market share estimates provided above may be high.

Chart 30



I-Joists and other engineered structural building components accounted for the major part of US aggregate imports. In 2002, this was about 45% of the total (Chart 31). Another significant import item was wood trusses, notably from Ontario into the US Great Lakes area. These accounted for about 20% of aggregate imports by the US, or an import market value of around US\$76 million in 2002.

Panelized walls and partitions accounted for less than 10% of aggregate US imports or a market value of around US\$37 million in 2002, according to USITC estimates. As Chart 31 shows, there has been a steadily rising trend in US imports of wall panels.

Laminated beams and arches accounted for less than 5% of US aggregate imports and have shown very little growth over the past several years.

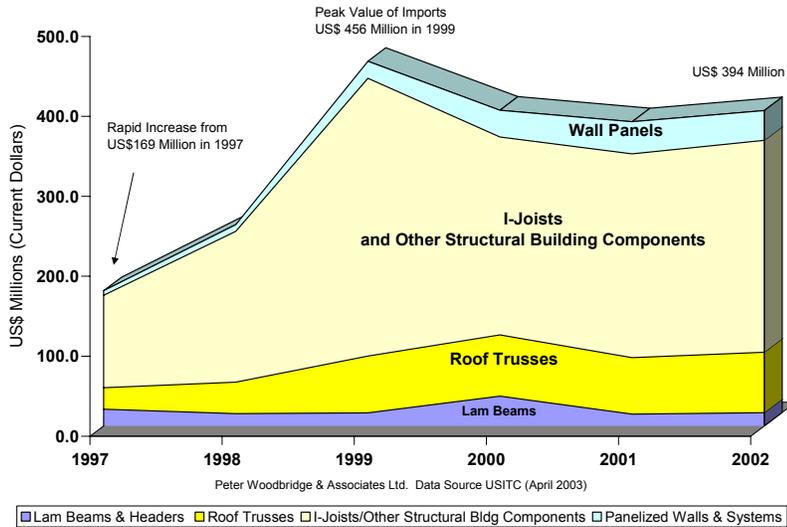
Canada is the dominant supplier of wood truss imports into the United States. These have a high bulk to value ratio and a comparatively short economic haul distance. Most suppliers have to be within a few hundred miles of consuming markets. Distances may be longer for industrial trusses and specialty orders, or where value-added services such as engineering and design are also provided. Most of Canada's truss exports to the U.S. are custom projects, frequently with extensive engineering design input.

²⁰ Includes some products within HTS 4418.90.40 and HTS 4418.90.45

²¹ US Trade data for NAICS 321213 and 321214.

Chart 31

US Imports of Structural Building Components
 Canada is Losing Market Share as US Capacity Increases



For most other products, however, other countries are important to consider as competing suppliers to Canada into the US.

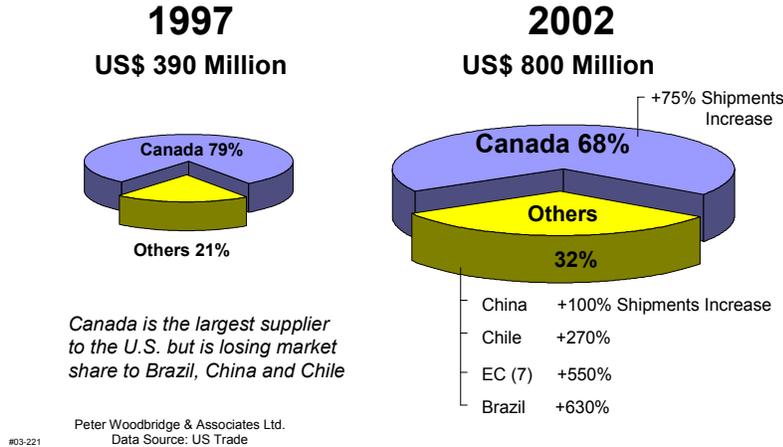
For the sake of illustration, in Chart 32, we have excluded trusses from the US import picture and show that several other countries have been expanding their share of the US import market for structural EWPs at a faster rate than has Canada.

While Canada remains the dominant volume supplier to the US, other countries such as Brazil, Finland, Chile and others have increased their share of the US import market from 21% in 1997 to 32% in 2002.

The overall inference of these analyses is that (a) Canada has not been keeping pace with US new investment and capacity in many engineered building components and structural EWPs and (b) offshore suppliers increasingly are targeting the US market and are expanding their share of US imports, currently at a low volume level but at a noticeable rate of increase. Issues relating to Canada's investment climate, and specifically the climate for advanced wood products technology investment in Ontario, are discussed in Volume 4 *Opportunities Report*.

Chart 32

U.S. Imports of Engineered Wood Products (Excluding Trusses)



Structural Engineered Wood & Building Components: Sub-Sector Analyses

For the remainder of this section, we examine the market for structural engineered wood & building components in the United States and US Great Lakes, with the goal of identifying opportunities for Ontario manufacturers. The layout of the section is as follows:

- Structural Floor Systems
- Structural Wall Systems
- Structural Roof Systems
- Rim Boards
- Structural Beams
- Headers

Structural Floor Systems

This comprises structural floor systems and floor beams. Structural materials used globally for floor construction in residential and non-residential buildings include concrete, steel, dimension lumber, large timbers and a variety of engineered wood products. In North America, the residential housing stock comprises homes with comparatively large square foot areas and large rooms requiring materials capable of long spans.

Compared with Japanese single family homes, for example, which average significantly less than 1500 square feet of floor space, American homes are substantially larger. In 2002, the average size of a single family home in the US was 2320 square feet and the median size was 2114 square feet.²² In addition, the average size of North American homes is getting larger.

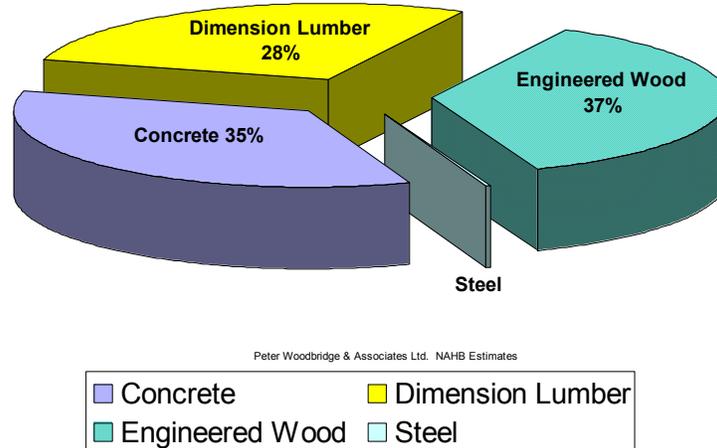
The extensive use of engineered wood, particularly products such as I-Joists, is largely a North American phenomenon. The displacement of dimension lumber by engineered wood products has been quite strong, although this appears to be reaching a saturation point in some applications.

²² NAHB data

Chart 33 shows that engineered wood is now the largest single group of materials used for structural floors in the United States, with a 37% market share. Cast-in-place and pre-cast concrete floors account for nearly 35% of all multi-family and single-family new construction. Dimension lumber and timbers account for 28% and steel less than 1%

Chart 33

Structural Floors -Materials Used



The I-Joist Business in North America

Of all engineered floor products, I-Joists (also known as I-Beams), have gained the most significant market share. From 1994 to 1997, the share of total floor area built with wood I-Joists grew from 20% to 30%²³. By 2001, I-Joists accounted for almost 45% of the raised wood floor market in the US²⁴.

As a result, North American production of I-Joists went from 36 million metres (120 million linear feet) in 1987 to more than 242 million metres (796 million linear feet) by 1999 and was expected to reach 360 million meters (1.2 billion linear feet) by 2002²⁵.

According to APA data, there were 19 firms in the North American I-Joist business in the year 2000, of which 14 were located in Canada. The nineteen firms operated 43 plants in total. Analysis shows that, geographically, these plants were distributed across a wide area, often close to major metropolitan and growth areas for residential housing and commercial/industrial activity. In several instances, however, there are plants located in close proximity to LVL and/or OSB plants.

²³ *Lumber and Value-Added Wood Products*. Special Report. Industry Canada. Prepared by Forintek Canada Corp. (Sept 2000).

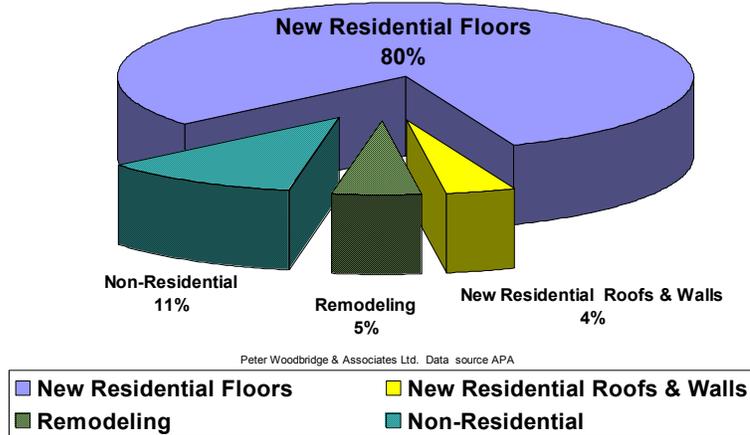
²⁴ Al Schuler, USDA, in 'Marketability of Hardwood LVL' (Feb 2002) and Craig Adair. APA (March 2001)

²⁵ RISI *Wood Products Review*, Jan 2000, cited in Industry Canada / Forintek, *ibid*.

Chart 34

I-Joist End Uses in 2001

New Residential Floors Dominate Consumption



The I-Joist business is very competitive. Historically, a few large firms (e.g. Weyerhaeuser/Trus Joist MacMillan) have dominated overall production capacity in this industry and have been the technology leaders. Some larger firms, or 'franchises' such as NASCOR, also have become significant players over the past five years or so. According to Taylor²⁶, the top I-Joist producers in 1998 included the following.

Weyerhaeuser (Trus Joist) (includes 2 Willamette plants)	10 plants
Louisiana Pacific	4 plants
Boise Cascade	2 plants
Georgia Pacific	2 plants
NASCOR	15 mini plants

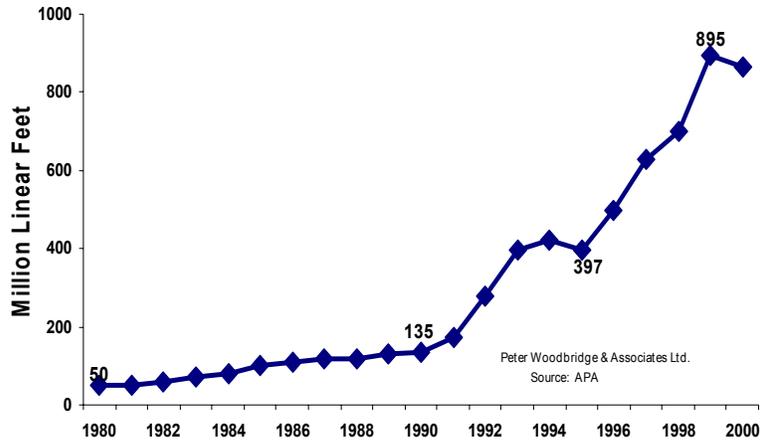
The market share of I-Joists in new residential construction has grown very rapidly, with the greatest share being utilized in multi-family housing. Regionally, I-Joists have been slow to receive market acceptance in the South compared with the US West and North²⁷. Although additional capacity has been added in all regions since 1998, the South has still lagged these other areas in terms of new capacity being installed.

²⁶ Ibid

²⁷ Source: WWPA

Chart 35

I-Joist Production in North America



According to the APA, 81% of I-Joist production is used in floor applications. Spans are variable, but tend not to exceed 40 feet (12 metres). Along with other structural EWPs in flooring and beams, I-Joists have gone a long way to facilitate the growth of longer spans and larger homes. Other attributes are discussed in the literature²⁸.

I-Joist Markets in the US

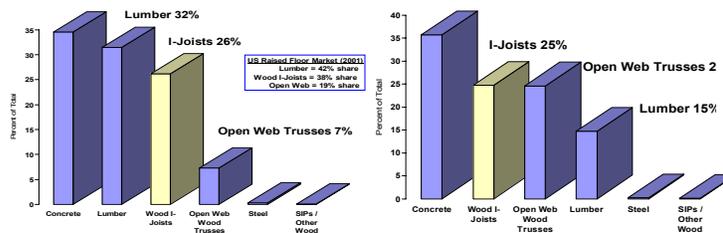
In single family new construction, wood I-Joists are used predominantly in ground and upper floors. To a lesser extent, they are used in roof framing (as rafters and trusses) and in some exterior walls.

In multi-family new construction, usage rates of wood I-Joists is proportionally lower per square foot area, but I-Joists along with open-web joists are important in upper floors where, in combination, they are the dominant material used in these applications.

Chart 36

US New Residential Construction
 Structural Flooring Systems -Market Shares
 All Floors Combined

Wood I-Joists Have a 25% Share of Each Market



Single Family

Multi Family

Peter Woodbridge & Associates Ltd. NAHB Estimates

²⁸ See, for example, Forintek report for Industry Canada (Sept 2000).

Chart 36 shows that I-Joists accounted for roughly 25% of the floor systems materials used to build single family and 25% of multi-family new construction in 2001. In both cases, concrete (including both cast-in-place and pre-cast) was the dominant material used for flooring systems.

Dimension lumber held a 26% share of single family new construction and 15% of the multi-family market. Open web wood trusses are used extensively in multi family new residential construction where they have a 25% market share compared with only 7% in the single family market.

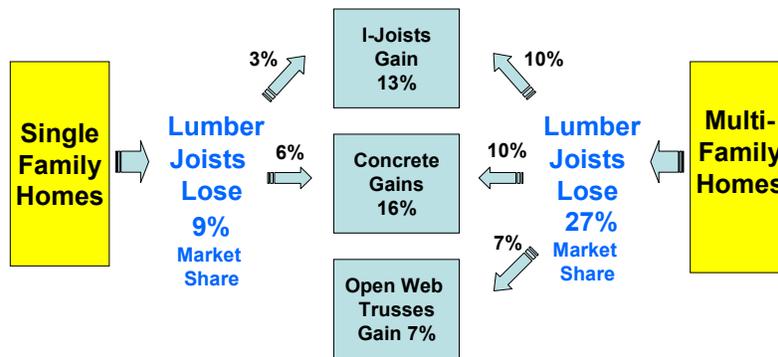
Open web trusses for flooring have been well marketed to multi-family housing unit builders, where ease of access for plumbing, electrical wiring and HVAC are at a premium in the smaller square foot areas.

Steel flooring systems accounted for only a fraction of single family new residential construction in the US during 2001, and had a similarly small market share in multi-family construction.

Dimension Lumber Continues to Lose Market Share

Dimension lumber, notably 2x10s, has lost considerable market share since the increased availability of structural EWP flooring systems. For all ground floors and raised floors in aggregate, the decline of dimension lumber for the US as a whole is illustrated in Chart 37.

Chart 37
U.S. New Residential Homes
Structural Floor Systems Market 1998-2001
Lumber Joists Lose to Concrete & Engineered Wood



Usage Rates Per Square Foot of Floor

Peter Woodbridge & Associates Ltd. NAHB Estimates

It should be noted that these are usage rates per square foot area. This is important because the chart shows a dramatic decline in usage rates of dimension lumber, but the extent of the decline is being obscured by other factors, discussed below.

Chart 37 shows that in single family new residential construction for the US as a whole, lumber joists in the bellwether structural floor systems market lost an estimated 9% market share²⁹ over the period 1998-2001 alone.

²⁹ Caution should be used with these estimates. For specific products and individual markets, the range of error can be quite wide. Readers are encouraged to contact Ed Hudson at the NAHB Research Centre to subscribe to full survey results. www.nahb.org

This was a period when exceptionally high rates of growth in single unit construction was taking place. It is widely perceived that dimension lumber is missing out in this market predominantly to I-Joists. However, the largest market share loss (6%) by 2x10 lumber was to concrete (notably on the ground floor). I-Joists gained 3% from dimension lumber.

Schuler, Adair and others have pointed that penetration of I-Joists used in the US raised floor market may be reaching a saturation point³⁰.

In multi-family new housing starts over the 1998-2001 period, dimension lumber lost a staggering 27% market share to other materials. 10% was lost to I-Joists and another 10% to concrete. Open web wood trusses gained 7% market share from 2x10 and other dimension lumber in the multi-family structural floor systems market.

So, in the multi-family market, it is clear for the US as a whole that the 17% combined loss of market share by dimension lumber to engineered wood flooring systems is sending a very strong signal from architects, specifiers, builders and framers about what they need. Remember too that flooring EWP prices are higher per lineal foot than traditional solid dimension. So there is value here for the constructors and homebuyers.

Overall gains by concrete were +16%, gains by I-Joists were +13% and gains by open web wood trusses were +7%.

Why Do Homebuilders Favour EWPs?

In part, it is because they are marketed and serviced well by the producers. Another reason is that they provide better structural performance, or at least are perceived to perform better by architects, specifiers, builders and framers.

It is also worthwhile remembering that substitution and displacement trends vary with the level of overall housing activity.

In busy times, with homebuyers waiting in the wings, keeping to the production and estimated move-in date schedule is vital. Callbacks are expensive and the homebuilder avoids them whenever possible. Accordingly, architects and specifiers (including building inspectors) define optimal engineering specifications.

The planning environment in the mid to late 1990's was conducive to increased engineered wood usage, and this coincided (not by accident) with significantly higher levels of manufacturing capacity.

Chart 38 illustrates the mindset of the time. Between 1995 and 1998, the US housing industry experienced a sharp ramp-up in single family starts. Starts rose from 1.1 million annually in 1995 to 1.3 million by 1998. The average pace of growth, around 65,000 new SF starts annually over the period, sent a 'growth and expansion' message to the industry and the supply chain.

The pace of SF activity increased yet again in the period 1998-2002, with an average 88,000 new SF units being constructed over this period. With increased shortages of skilled and semi-skilled site-labour over the 1995-2002 period (and continuing today), one of the results was a high rate of displacement of dimension lumber by engineered wood.

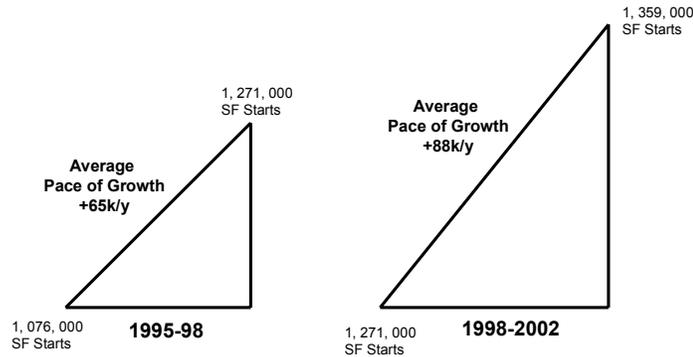
This was facilitated by related trends in specifying and distribution (e.g. whole package supply and site-assembly services by distributors, using cranes for upper floors, etc.).

³⁰ Al Schuler and Craig Adair. See APA studies. www.apawood.org

It remains to be seen what rates of displacement or substitution occur when overall housing market activity is lower and when competition between builders for available homebuyer business becomes very price and cost sensitive. Our field work indicates that this will depend on the type of builder.

Chart 38

'Ramp-Up' Curve in U.S. SF Housing Activity



Conclusion:
Homebuilders in a rapid growth environment
look for better and more-efficient building materials

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Overall, with consolidation in the homebuilding industry, we would expect that most builders, once they commit to structural EWPs, won't go back to less predictable and more variable dimension lumber. Some prefer it, but most go with what's best for the job. Price differentials are another consideration.

Structural Walls

Panelization of wall structures is one of the value-added wood products which Ontario has developed well over the past decade. It is also a vital product group for further opportunities for the Ontario integrated wood products industry and independent value-added manufacturers and wall panelizers. There are four reasons for this conclusion.

- Walls consume between 35% and 40% of softwood lumber used in residential construction. This is one of Ontario's biggest single markets.
- Most of the growth in use of off-site fabrication of wall panels is taking place in the US Great Lakes region, which Ontario logistically is well positioned to serve.
- Ontario's main strengths in primary wood products manufacturing are in narrow dimension softwood lumber (2x3s, 2x4s and some 2x6 production), structural sheathing and structural EWPs (e.g. LSL /TimberStrand).
- Ontario's future competitiveness in wood products manufacturing and distribution lies in its ability to provide building systems and technical/service support targeted to specific users, rather than merely selling its current commodity production and value-added products largely on an open market basis (LSL is an exception to the latter).

Much of Ontario's potential to expand its value-added industry will depend on its response to these challenges and opportunities. This will also depend on the industry's ability to coordinate these efforts with existing programs to promote wood use (*Canadian Wood Council* and the

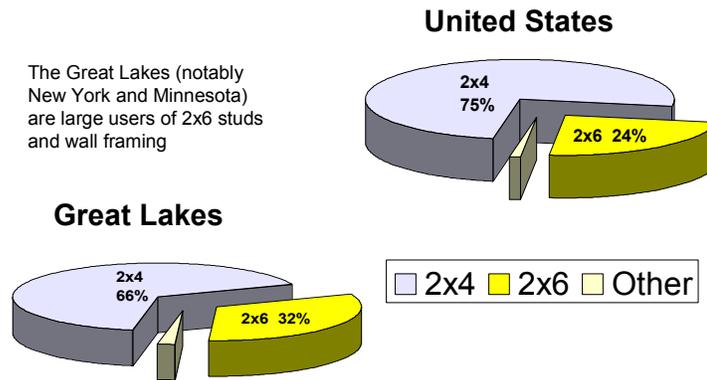
Wood Promotion Network), and for Ontario to develop a clear understanding of where its competitive advantages lie and acting on them.

Eastern SPF

Eastern SPF output and structural softwood lumber exports predominantly are in 2x3s, 2x4s and some 2x6s. As a species, SPF is preferred among many builders for its light weight, consequent ease of handling and nailability. Ontario's eastern SPF output lends itself readily both to exterior wall and interior wall construction.

Chart 39

Exterior Structural Walls: 2x4's Dominate, But 2x6's are Gaining Market Share



Peter Woodbridge & Associates Ltd.
NAHB Estimates

Exterior Structural Walls

In the United States, nearly 80% of exterior wall framing lumber used in structural applications for new residential construction is 2x4s, while 20% is 2x6s (Chart 39).

In interior walls, 2x4s again dominate with around 88% of market share. 2x6 walls are increasing their market share fairly quickly and now account for close to 6% of all structural walls.

As energy efficiency considerations develop, insulated 2x6 exterior walls become more popular and there is some growth potential also in SIPs for this purpose³¹.

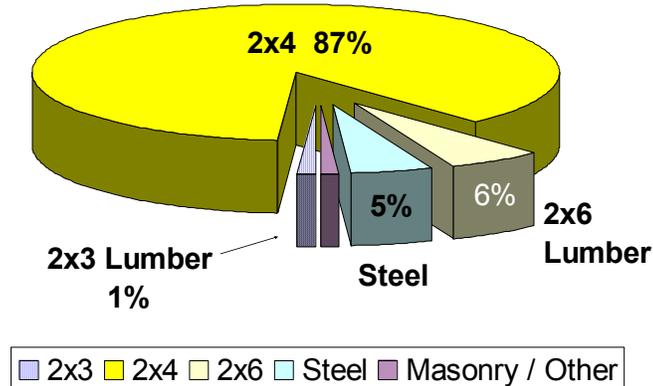
Interior Structural Walls

2x3 structural lumber has a very small share (1%) of the interior structural wall market in new housing (Chart 40), but are used for other purposes including temporary bracings and non-structural applications. As noted elsewhere in this report, Ontario's eastern SPF 2x3s are widely used in the factory-built residential and non-residential housing industry.

³¹ However, Fell and Robichaud (Forintek) found in a 2001/02 survey that the systems that a sample of builders believed they would not use in the future were prefabricated steel (76% of those surveyed) and SIPs (69%). See Forintek Canada Corp. 'Attributes Demanded in Single-Family Walls' (March 2002), Fell and Robichaud.

Chart 40
Interior Structural Walls: 2x4 Lumber
Still Has the Lion's Share

Peter Woodbridge & Associates Ltd.
NAHB Estimates



Steel has a 5% share of the residential structural interior wall market overall in the United States, but there are wide variations in the extent of its usage regionally and intra-state. Masonry and other materials account for about 1% market share.

Steel and the MF Market

In multi-family residential market, however, steel usage is much more significant and represents a formidable competitor for wood based construction. Wood and steel combinations are widespread, along with composites.

Steel and the Remodeling Market

Steel is not a significant competitor to wood in most areas of the residential single family remodeling, in either the shoulder trade or in the build-it-yourself (BIY) professional market.

Steel and the Non-Residential Market

Steel dominates many areas of new construction in light industrial, office and commercial buildings, but wood usage in concrete-steel-wood-brick/stone combinations accounts for a significant overall volume of wood use. In heavy construction, wood has only a small market share. Various initiatives are underway (e.g. *Wood is Good* and the *Wood Promotion Network*) to develop the use of wood in these non-traditional markets and a new study has been announced to look at the US non-residential market for wood^{32 33}

Structural Wall Panelization

Historically many framers and homebuilders have said that, all other things being equal, they would prefer to frame walls on site. They have better control over the materials, but their main argument is that site built fabrication allows them more scope for making timely adjustments of the walls and other parts of the building to accommodate errors (however minor, and sometimes major) made elsewhere on the structure, notably if the concrete foundations, lower floor joists and installed raised flooring are not square.

³² Wood Products Council with funding support from the US Forest Service and Forintek. Due for publication, February 2004. See *Engineered Wood Journal*, Fall 2003.

³³ See also Wood Products Council (1995) and *'Wood Opportunities in Non-Residential Buildings'* Forintek Special Publication SP-46.

Pulte has approached the problem of out-of-square concrete foundations and slabs, and has been able to utilize the economies of off-site fabrication, by using panelized foundations³⁴

With increased use of engineered floor systems, better drying and faster construction times, on-site weathering of solid lumber today is by far a lesser problem than it may have been formerly.

Off-site panelization of exterior structural walls has become a growth business. Leading production homebuilders, such as Pulte, Centex and others, now have their own production facilities to supply these products, and more capacity is predicted.

Independent panelizers are numerous, both in the United States and Canada. Some supply the production builders, but most supply the medium to smaller scale progressive builders where speed of construction and the shortage of available site labour is a growing problem.

Types of Wall Panels

There are four types. Most panelized walls comprise (1) open (2) semi-open and (3) closed. An additional product is the structural insulated panel (SIP), which is sometimes used where energy efficiency in walls (roofs and complete buildings) is required.

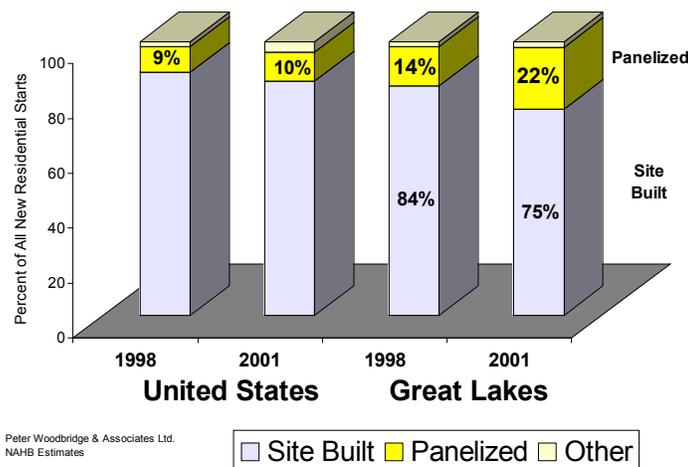
Manufacturing of panelized walls is predominantly of the semi-open type which comprise lumber and sheathing (about 65% of the total) while open panels (without sheathing) and SIPs rank about equally with 15% each. The technology of closed panels is not yet widely accepted among site-builders, although conceptually, it has many merits particularly for rural or remote areas, notably for small builders.

The Market is Shifting to Panelization

The trend to panelization varies widely by region, by state and even by local area (reflecting local circumstances and individual builder's preferences). One of the main drivers is the shortage and cost of site-labour. Another driver is the increased use of engineered wood products and the overall trend to systems building.

Chart 41

Great Lakes: Significant Shift to Panelization in Exterior Structural Walls



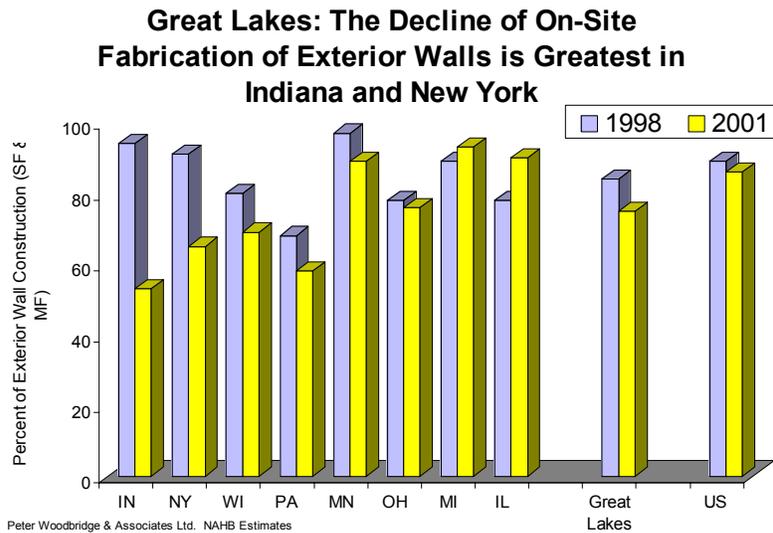
³⁴ Alan Laing, Pulte Homes presentation at 'Exploring New Paths', a conference sponsored by Forintek and BC Wood, Vancouver, Sept 2003.

In the United States overall, panelization of exterior structural walls accounted for around 9% of total linear feet of wall area in 1998. Usage increased slowly. By 2001, panels accounted for around 10% (Chart 41).

In the US Great Lakes (and in the North East) on the other hand, the adoption of off-site fabrication has been much more robust among framers and homebuilders. In 1998, for the Great Lakes region as a whole, panels had a 14% market share. This continued to grow rapidly and, by 2001, panels share had increased to 22%. In other words, panelized walls accounted for the equivalent of roughly 1 in 5 exterior structural walls used in residential new housing in the Great Lakes in 2001.

Our field surveys indicated that the level of interest in purchasing pre-fabricated wall panels was particularly strong among builders of multi-family homes, even though this market segment consumes less of the total volume than single family unit builders. Production builders are the other large user group.

Chart 42



The decline in on-site fabrication for single and multi-family combined is illustrated in Chart 42. It is readily evident in Indiana and New York, where off-site fabrication of exterior structural walls is extensive and where multi-family construction levels are high. In some areas, such as Michigan and Illinois, on-site fabrication has gained market share slightly. Some builders have their own fabrication facilities on-site, and the output of these is regarded, for the purposes of this report, as constituting off-site (or potential markets for off-site suppliers of these products).

The economics of off-site fabrication of exterior structural walls are defined as not just the shortage and hourly cost of framing labour. Other material and labour cost savings may be involved, including the pre-drilling of studs for wiring, the insulation provided in closed panels and 'whole package' supply of doors and windows.

Systems approaches to homebuilding and non-residential construction mean that designers at remote locations can respond quickly to changed specifications on site, and on-time delivery can provide savings in on-site storage of materials, ensure less pilferage and fast construction times. There can be quality considerations too, where off-site fabrication ensures a weather-sealed building envelope and reduced risk of the effects of unseasoned or high moisture content wood.

Interior Walls

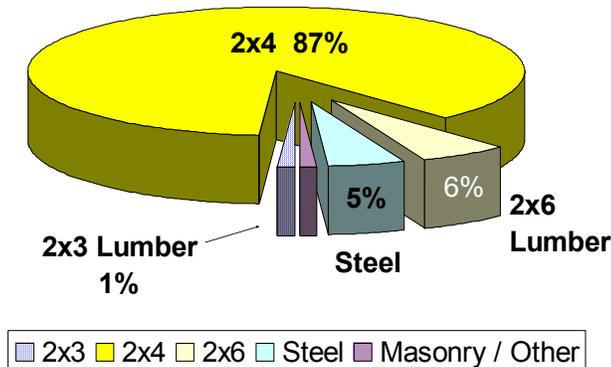
Ontario's production of 2x3 lumber is not well represented in interior structural wall construction in the new residential construction market. In the US, 2x3s account only for about 1% of materials reported by framers and homebuilders as the material they use for this application (Chart 43).

By far the lion's share of lumber sizes used is 2x4, which held an 87% market share in 2001. In addition, 2x6 lumber accounted for a further 6%. The use of 2x6 is greater in exterior than interior walls due to the nature of exterior walls for insulation and other factors.

Chart 43

Interior Structural Walls: 2x4 Lumber Still Has the Lion's Share

Peter Woodbridge & Associates Ltd.
NAHB Estimates



Product Quality Considerations

The Great Lakes interior wall market (as well as the exterior wall market) is an important consideration for Ontario's softwood lumber exports, which is a major producer of 2X3's and 2X4's.

During our field work, it became evident that the perception exists among users in the Great Lakes that eastern SPF is inferior in quality to western SPF. We believe this to more perception than reality, but it is of considerable potential concern and is addressed in Volume 4.

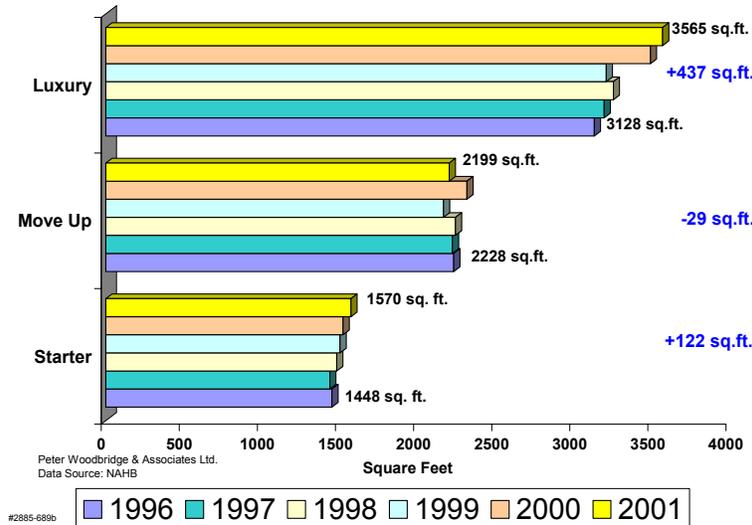
Structural Roof Systems

With increased average home sizes, higher incomes and the wider spans and other features possible with structural engineered wood products, it is no surprise that architects and designers have added considerable variety to recent new home designs.

The upward shift in average home values for new construction, and particularly the recent growth of luxury homes (Chart 44), has contributed to the homeowner's desire for more architectural features, including cathedral ceilings, higher pitches and more adventurous shapes (fewer gables and more hip roofs).

Chart 44

Size of US New Homes by Price Point



While many of the above features are found in new homes offered by builders at every price point, the number and variety of them tends to increase with the price of the home. Location and building codes also have a strong influence.

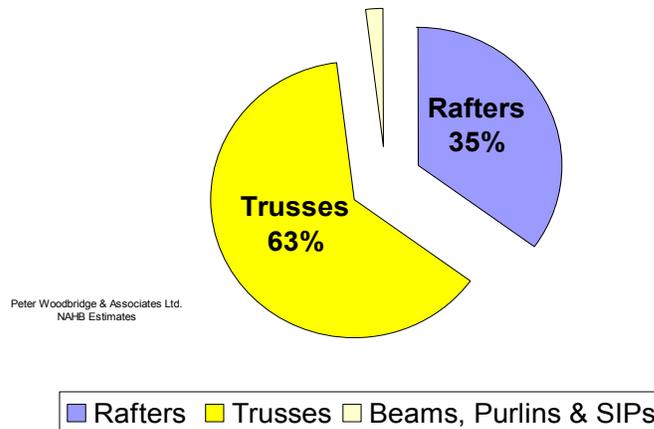
The type of construction materials used can vary with price point (notably the use of exposed beams and other features) but the use of wood roof trusses (along with I-Joists and some other structural engineered wood products) is common to new home construction at all price points.

The main differences in this respect may be on a geographical basis where ownership housing may use structural EWPs extensively while rental housing may not.

The technology of roof construction changed some time ago. Today, 63% of single family dwelling roofs in the United States are made with wood trusses. This compares with 35% for rafters and 2% for beams, purlins and structural insulated panels (SIPs) (Chart 45).

Chart 45

**US Single Family New Homes
Type of Wood Roof Construction 2001**



There are regional and local variations to this average, and differences between builders and the type of home being constructed. Many new homes involve a mix of construction methods with rafter-truss mixes being increasingly common.

There are considerable differences too in the types of wood (species, sizes) used for rafter and beam construction compared with the dominant use of 2x4s and 2x6s in most residential new construction using trusses. I-Joists and steel are used in single family new home construction, but their market shares are low.

Structural insulated panels (SIPs) are gaining in popularity with some builders, and this is a growth market in some regions. With SIPs, the approach to roof framing is different.

Roof Truss Technology

Early trusses were assembled with nailed plywood gussets until metal plates were invented around 1950. In fact, most wood truss production plants are small scale and many are independently owned. Much of the technological leadership in this field has come from the truss plate manufacturers (e.g. Mitek). Mitek and other plate suppliers also provide the truss producer (and the builder-framer) with computer software programs and mitering equipment.

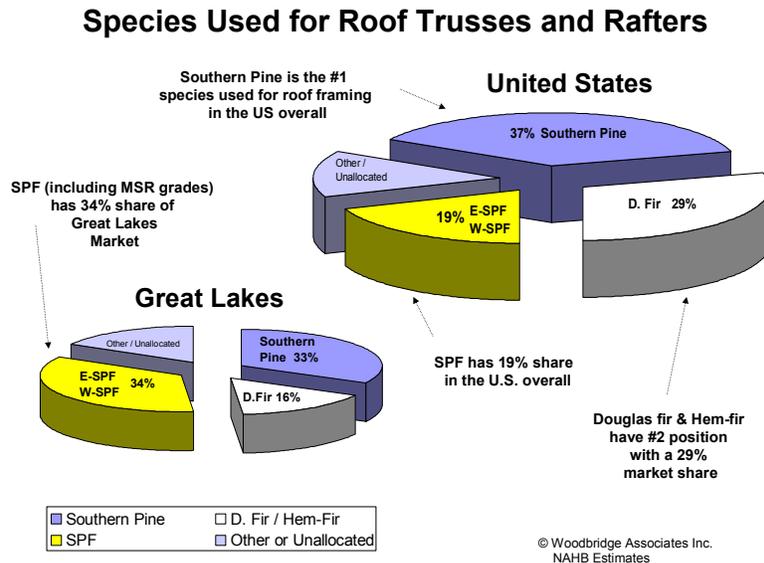
Pre-engineered, metal plate connected roof trusses are widely used also in non-residential construction including office roofs, and industrial and commercial buildings. The non-residential sector is an important market for many of Ontario's truss producers and exporters.

In particular, the agricultural market is still dominated by wood trusses even though steel trusses are making inroads into this application. Use of wood trusses in commercial buildings currently is low, but offers considerable potential and use wider dimensions of lumber.

Trusses offer long clear spans. The use of machine stress rated (MSR) lumber allows designers to reduce the over-specification of safety factors in truss design with corresponding cost savings. There are some related species implications. Southern Pine has natural strength attributes that make it very suitable for truss manufacturing. Typically it is priced below stress rated 1650f western SPF and Fir/Larch and sells for about the same level as the equivalent eastern SPF 1650f MSR grades.

A new stress rated grade is being developed by the southern pine industry. It should be noted that species considerations, code stress ratings and machine stress rating technology are very relevant to the competitive position of each of the major North American supply regions in various markets (Chart 46).

Chart 46



Sampling errors in these estimates mean that these numbers could vary by a few percentage points. Not all species of origin estimates from framers and builders are reported accurately, but the overall picture is considered to be valid.

For the US Great Lakes region, SPF is about on par with Southern Pine for market share – at around 33% to 34% each. Douglas-fir and hem-fir are found less frequently in the region, either in the form of dimension lumber used by local truss producers or in terms of trusses imported from outside the Great Lakes area.

The ability of eastern SPF from Ontario to compete with western SPF in roof truss applications is considerably enhanced if Ontario-based producers can offer an MSR grade.

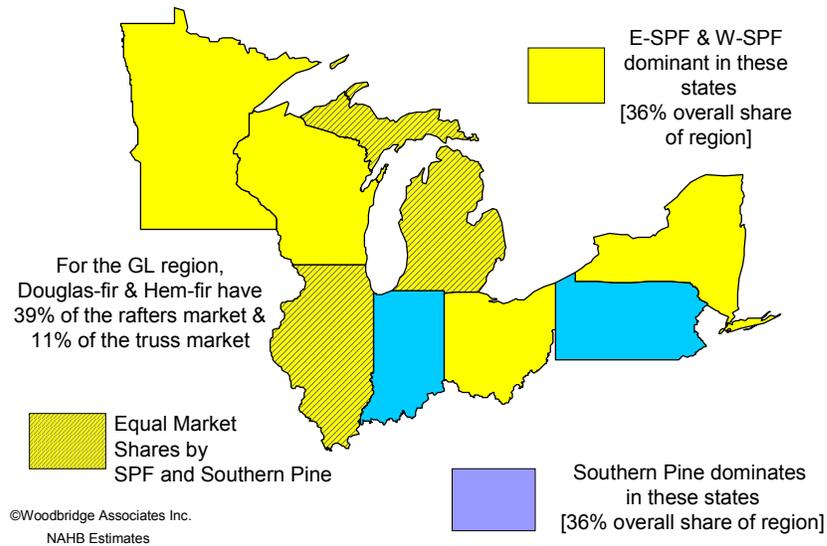
By state, there are wide and sometimes surprising variations in the dominant species used by truss producers located in the Great Lakes, and in terms of the finished trusses shipped into the region.

Chart 47 shows that Southern Pine dominates very heavily in two of the eight states – Pennsylvania and Indiana.

Southern Pine is well represented in the pattern of wood truss consumption of most states within the region and it competes about equally for market share with SPF in Illinois and Michigan (which, as noted previously, is Ontario's #1 export market for wood products).

The chart also shows that eastern SPF and western SPF (including MSR) dominate consumption in Wisconsin and Minnesota (strong markets for western SPF MSR grades), Ohio (a strong market for Ontario) and New York (well-served by producers in Quebec).

Chart 47
Great Lakes Truss Market – Consumption by Species (2001)



The Rim Board Market

A rim board is the wood component that fills the space between the sill plate and bottom plate of a wall or, in second floor construction, between the top plate and the bottom plate of the two wall sections³⁵. The rim board ties the floor joists together. It is an integral component in an engineered wood system because it transfers both lateral and vertical bearing forces.

The traditional product used for rim boards was dimension lumber. However, technological changes in building systems, and the extensive use of wood I-Joists in particular, has resulted in displacement of dimension lumber by new generations of engineered rim boards. Dimension lumber is not compatible with these new generations. APA performance rated rim boards can be manufactured using the following materials:

- Plywood
- OSB
- Glulam
- LVL
- LSL (laminated strand lumber³⁶)

These engineered boards have less shrinkage than lumber and can precisely match the depth of wood I-Joists and other engineered wood framing components. Manufacturers supply lengths up to 24 feet.

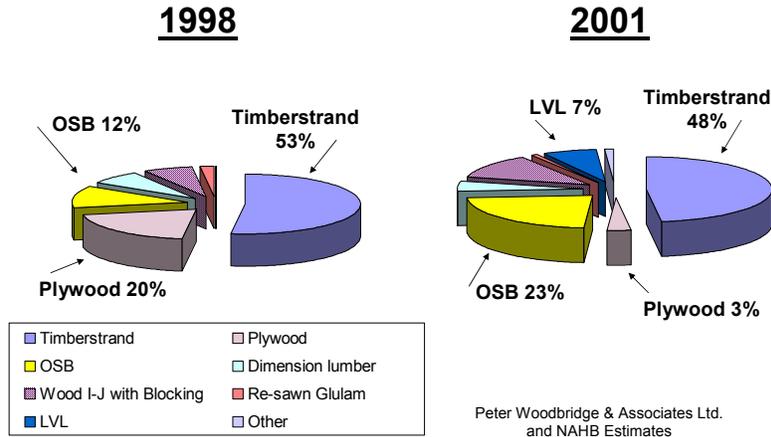
The displacement of dimension lumber by engineered wood rim boards was already extensive by 1998, as shown in Chart 48. Based on NAHB estimates, the chart shows the share of the US rim board market (used in conjunction with wooden I-Joists) accounted for by the various rim board products.

³⁵ APA

³⁶ LSL (laminated strand lumber) is widely known in the trade as 'TimberStrand' which is the registered trademark of LSL produced by Weyerhaeuser / Trus Joist. For ease of understanding in this report, we use the term LSL to mean Laminated Strand Lumber (TimberStrand). LSL can also refer to Laminated Structural Lumber, such as the Anthony Power Beam®, which we include as glulam.

Chart 48

**OSB and LVL are Gaining Market Share
 in the US Rim Board Market**



TimberStrand has been the dominant product on a national basis, accounting for 53% of usage in these applications in 1998. Plywood held a 20% market share as recently as 1998. However both products declined in market share (even though overall volume consumption was up) by 2001. Plywood now has only 3% of this market.

An increasing share of this market is being accounted for by OSB and, to a much lesser extent, LVL. In particular, OSB raised its market share from 12% of all materials consumed in this application in 1998 to 23% by 2001. LVL is an emergent product in this application in some states and by 2001, already captured 7% of the market. But LVL is a premium product in this application with a high opportunity cost in the beams and headers market which tends to be its highest and best use.

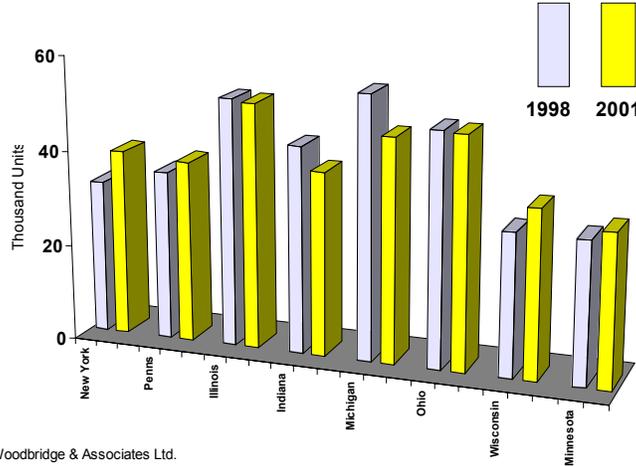
Great Lakes Rim Board Market

As already noted, the rim board market in the US has undergone significant changes over the past several years as technologies have advanced and structural EWP (I-Joists) and flooring systems usage has increased.

We estimate that, despite almost no change in aggregate housing starts levels in the US (but larger sized homes), the rim board market grew by nearly 23% over the period 1998 to 2001.

Chart 49

**US Great Lakes Housing Starts
 1998 and 2001**



Peter Woodbridge & Associates Ltd.
 NAHB Data

In the Great Lakes region, aggregate housing start levels also remained unchanged over this period (Chart 49). There were significant changes in the types of rim board products used in the region.

These also varied from state to state. Table 10 identifies the states in which consumption of these products is both dominant and growing or, alternatively, declining (Illinois and Ohio). All standard homes must use rim boards, so these rankings reflect rates of change in housing starts and other end-use applications.

Table 10
Growing and Declining Markets for Rim Boards in US Great Lakes

Dominant & Growing (1998-2001)	Declining (1998-2001)
<p><i>Minnesota</i> <i>Wisconsin</i> <i>Pennsylvania</i> <i>Michigan</i> <i>New York</i> <i>Indiana</i></p>	<p><i>Illinois</i> <i>Ohio</i></p>

Peter Woodbridge & Associates Ltd. and NAHB estimates

Table 11
US Great Lakes Rim Board Market –Key Products Only

Product	Market Penetration (market share as % of total consumption all products)		
	Low <25%	Moderate 26%-50%	High >50%
TimberStrand	Indiana (high) New York Pennsylvania (low)	Minnesota (high) Illinois Michigan	Wisconsin (high) Ohio
OSB	Wisconsin (high) Minnesota	Illinois (high) New York Michigan Ohio (low)	Pennsylvania (high) Indiana
LVL	Indiana (high) Michigan Pennsylvania Ohio Illinois New York Wisconsin (low)	Minnesota	

Peter Woodbridge & Associates Ltd. and NAHB estimates for 2001

TimberStrand

For the US Great Lakes overall, TimberStrand is well established in every state for rim board applications in single family housing associated with the use of I-Joists.

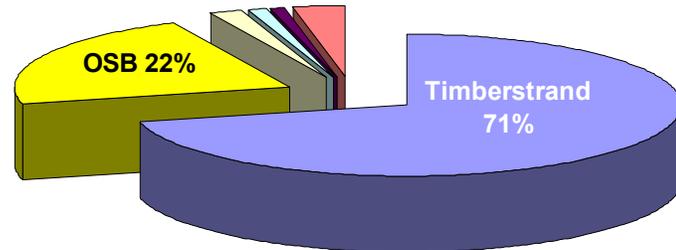
In most states, excluding Ohio, TimberStrand has lost market share over the past few years, notably to OSB and LVL.

Consumption patterns vary considerably. In Wisconsin, for example, TimberStrand dominates overall consumption (Chart 50) accounting for a 71% market share.

Comparatively low levels of market penetration for TimberStrand are found in Indiana, New York and Pennsylvania.

Chart 50

Timberstrand Dominates in the Wisconsin Rim Board Market



Peter Woodbridge & Associates Ltd. NAHB estimates for 2001



It is likely that the new state-of-the art TimberStrand plant location at Kenora, Ontario (which aims to export 70% of its output to US markets) will have a significant impact on the US Great Lakes market over the next several years, notably in structural EWP packaged sales to pro-dealers and direct sales to production builders.

OSB

The increased acceptance of OSB in North American markets was illustrated earlier and showed a market share increase for this product from 12% to 23% of total consumption in rim board applications between 1998 and 2001.

Significant levels of market share growth over this period were achieved in Indiana, Michigan and Wisconsin, much of which is supplied from Canadian OSB mills. Overall, high levels of OSB penetration into the rim board market have been achieved in Pennsylvania and Indiana.

LVL

As the new player in rim board markets, LVL has comparatively low penetration in almost all markets except Minnesota, where it accounts for about one-third of all uses.

Structural Beams

Structural beams are used in a wide variety of applications in residential and non-residential construction, and usually are classified as comprising:

- Floor beams (first and upper floors)
- Roof beams

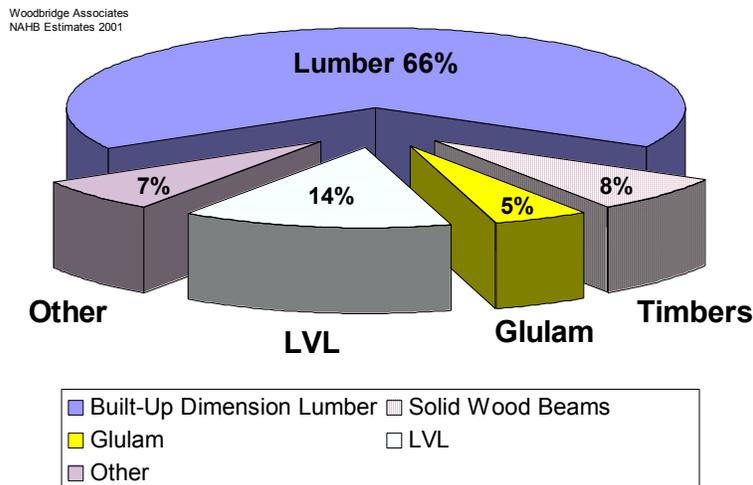
Beams used in floors include support beams, which provide a bearing point for floor joists, flush beams which are recessed into the floor and floor-edge beams that typically support the edge of a loft or stairway.

Growth in the average size of North American homes is reflected in the increased use of engineered wood beams. Formerly, wider spans were possible only with built-up dimension lumber (2x10s, 2x12s and 2x14s, when these were available) along with steel beams or glulam.

The decline in wide dimension supplies above 2x10s, reflecting the smaller diameter of timber in North America's industrial forests standing inventory, and builders' preferences for a compatible wood product, has assisted the rapid acceptance of 1st generation engineered beams such as LVL and Parallam. I-Joists and open-web beams also are used in some heavy load-bearing applications. Some 2nd generation beams are now beginning to become available, while others are in the development stage and require code approval.

Chart 51

Dimension Lumber Still Dominates the US Roof Beams Market



The three components of the US beams market, namely first floor beams, upper floor (or raised floor) beams and roof beams, vary in the types of products they use.

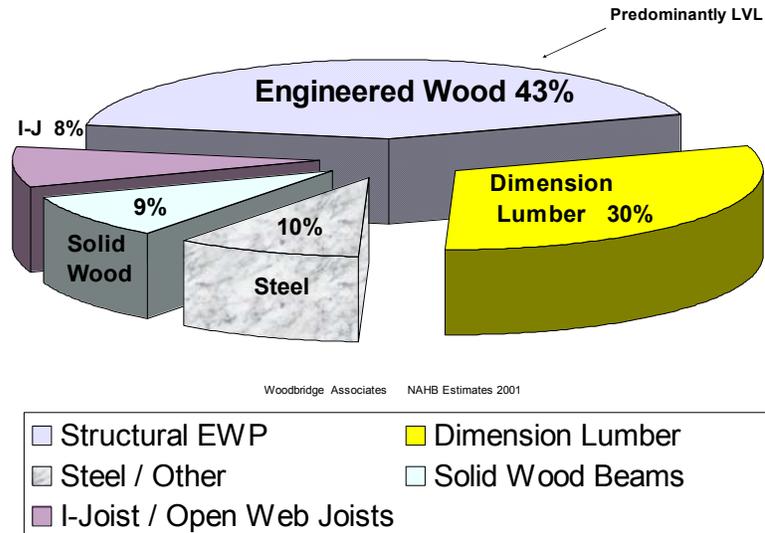
Glulam, for example, has a higher market share in the raised floor market than in first floors. The same is true of Parallam, which may be also be used as an appearance beam. Steel, on the other hand, is used more frequently in first floors than in upper floors.

In the roof beams market, dimension lumber dominates with a market share of around 66% (Chart 51).

Douglas-fir, western SPF and Southern Pine compete for this market. Ontario generally does not produce this product in dimension E-SPF lumber. LVL is the next most popular product specified by architects and, in 2001, accounted for a market share of about 14%. This is an important market for timbers, which had an 8% market share in 2001. Glulam accounted for 8% of the roof beam market.

Chart 52

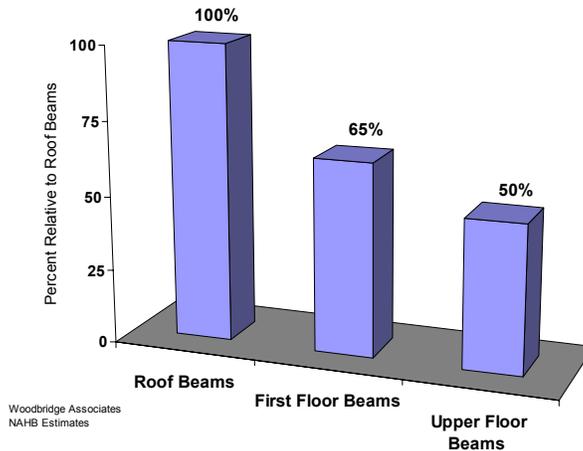
EWPs Dominate the Floor Beams Market



In the US floor beams market, structural EWPs dominate with an estimated 43% market share in 2001 (Chart 52). Of these, LVL beams account for the largest share, followed by glulam, Parallam and some TimberStrand. Steel beams have a 10% share of the US floor beams market and, as noted earlier, are used mostly in first floor applications.

Chart 53

Relative Size of the US Structural Beams Market 2001-02



Dimension lumber had a 30% market share in 2001 and solid wood beams accounted for a further 9% market share. Displacement of dimension lumber continues in this market, and further market share increases are predicted for structural EWPs.

Chart 53 provides an index of consumption with roof beams being the most important volume market, followed by 1st floor beams (65% the size of the roof beams market, in overall consumption) and upper or raised floor beams (50%).

The Headers Market in the US

Headers are structural beams used above windows, doors, garage doors and other openings.

There is a wide variety of choices of materials available for the framer, including engineered wood (LVL, Glulam, Parallam and TimberStrand) and engineered components (I-Joists and wood trusses) as well as steel and concrete. However, the market is dominated by dimension lumber which accounts for 67% to 70% of all materials used, by volume.

Chart 54

US Headers Market

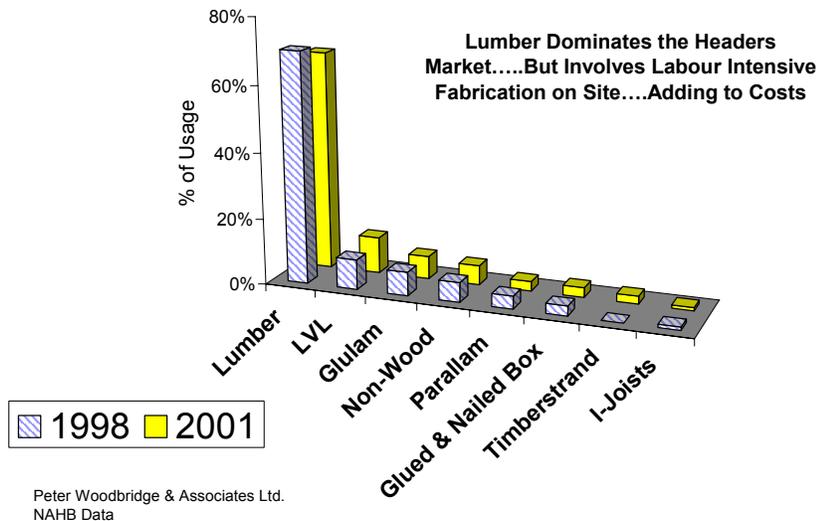


Chart 54 shows that dimension lumber really has no close rivals in this market at the present time. Over the past five years, TimberStrand (3% market share) has been introduced into the market and has displaced Parallam and glulam, notably in short spans. LVL (11%) is versatile in this market and is the closest rival to dimension lumber. Some framers use doubled-up LVL, while others use single or double I-Joists (5%) to meet the structure's span and width requirements.

Glued and nailed boxes (2%-3%) are labour intensive and indicate the underlying weakness and opportunity in the headers market. Namely, that most materials currently used in the headers market involve costly site-fabrication. We calculate that the labour-in full cost of on-site fabricated headers provides a substantial financial incentive for a better technological and labour-saving solution in this application.

Header Market Demand in Great Lakes States

The US Great Lakes region is a potential opportunity for an Ontario-based cost-effective solution to the headers situation. There are some regional variations that may alter the market potential.

In New York, for example, dimension lumber accounts for an even higher percent (75%) of the headers market while, in Michigan, LVL already has captured 20% of this market. Nevertheless, the magnitude of the opportunity and also the ability to address various common problems

associated with window (leakages) and door framing offers a challenge to lumber and building materials producers.

Systems Approach to the Headers Market

The “value-added” in windows and doors exists in the window itself, or the door. These have to meet various criteria, such as functionality and appearance or aesthetic appeal. Dimension lumber that is not properly dried and stable can lead to subsequent warping and loss of functionality.

Use of fingerjoint lumber for vertical applications (e.g. door jamb and window rough openings) can provide dimensional stability and help prevent this frequently occurring problem.

Alternatively, a systems approach that addresses the fundamental goals of the application and provides optimal wood-based materials solutions could provide a significant growth opportunity for Ontario's extensive output of narrow width lumber (2x3 and 2x4).

Looking forwards, the “value-added” of a systems approach lies in the ability of the LBM industry to supply a completely waterproof building envelope. In addition to this, to provide other construction attributes, such as effective insulation barriers to heat and cold and the supply of healthy air within the building.

Today, site construction methods comprise a loosely integrated collection of individual systems (flooring systems, framing systems, HVAC systems, window systems, sheathing systems, etc.) that frequently do not always unite together optimally. Construction costs are excessive and our previous studies³⁷ have concluded that up to 25% of single family housing construction could be driven out through:

- Elimination of excessive development costs;
- Adoption of more efficient construction methods and, ultimately, whole building technologies; and
- Reduction of overspecification of materials in building design.

³⁷ See page 15, chart 12, *Manufacturing of Value-Added Wood Products in Western North America: How Competitive is BC? (March 2003)*. Produced for the IVAWA by Peter Woodbridge & Associates Ltd. Available as a free download at www.woodbridgeassociates.com