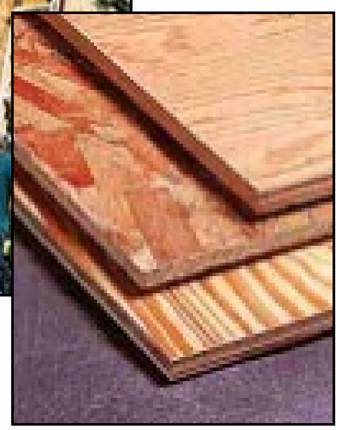
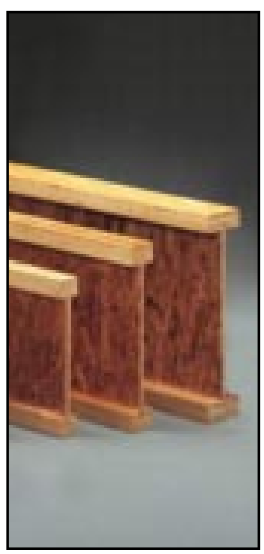
EWP Primer
Awareness Guide





American Wood Council

American Forest & Paper Association

EWP PRIMER
AWARENESS GUIDE

The American Wood Council is part of the wood products group of the American Forest & Paper Association (AF&PA). AF&PA is the national trade association of the forest, paper, and wood products industry, representing member companies engaged in growing, harvesting, and processing wood and wood fiber, manufacturing pulp, paper, and paperboard products from both virgin and recycled fiber, and producing engineered and traditional wood products. For more wood awareness information, see www.woodaware.info.

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This guide reviews the history and development of engineered wood products (EWP) in the marketplace and provides definitions that enable a fire service instructor to identify these lightweight products as they are used in building construction. This publication is one in a series of eight Awareness Guides developed under a cooperative agreement between the [Department of Homeland Security's United States Fire Administration](), and the [American Forest & Paper Association]().

Engineered Wood Products Primer

MEETING THE NEEDS OF THE FIRE SERVICE

The level of training and technical support available from the building industry has increased dramatically in the past twenty years. Engineered wood product specialists are now common in the construction industry and software has helped to communicate the intricacies of the many new products. Until now, however, the available information has not been uniformly provided to the fire service. This series of *Awareness Guides* has therefore been prepared to "train the trainer" and begin to inform the fire service in a uniform manner about new wood product construction materials and methods being used in the marketplace.

The wood products industry is committed to delivering educational material to the fire service with the goal of reducing risk of injury from structural collapse in fires. These *Awareness Guides* will address questions raised by the fire service during a series of industry visits to a number of state fire academies.

PURPOSE OF THIS GUIDE

This guide reviews the history and development of engineered wood products in the marketplace and provides definitions that enable a fire service instructor to identify these lightweight products as they are used in building construction.

BACKGROUND

As noted above, the past fifty years have seen unprecedented changes in building construction. The changes in wood frame construction during this period have also been significant, paralleling the numerous changes within the fire service. The wood industry has adapted to a number of opportunities and constraints. As a result, there are many lightweight structural products and construction techniques for building residential wood frame houses.

After World War II, the explosive growth of American suburbs was unlike any other time in history. In the 1950s, most homes were constructed with solid sawn lumber framing, with diagonal board sheathing placed on floors, walls, and roof. Hardwood plank flooring was commonplace. In the 1960s, plywood sheathing had become common for floors, roofs, and walls, and the use of trusses in roofs had replaced rafters throughout the homebuilding industry. Additionally, carpeting had become the preferred flooring choice.

Transition to Engineered Lightweight Construction

In the 1980s, both environmental limitations and consumer demand spurred the transition to engineered lightweight wood construction. Environmental constraints reduced the size of trees delivered to saw mills. With larger-diameter logs unavailable, the wood industry developed technology to "disassemble" smaller logs and glue them back together lighter and stronger. It had become impossible to make a 20-foot long 2x12 floor joist out of a 9-inch diameter tree, or plywood out of 6-inch tree tops that were full of knots. The choice was clear to the wood industry—either use smaller diameter trees or witness a significant decline in the use of dimensional lumber and panels in residential construction.

At the same time, coupled with environmental constraints, consumers expected the forest products industry to use fewer trees with greater efficiency and less waste. Meanwhile, the square footage of residential homes was increasing, along with demand for deep, long, and straight building materials.

New Design Standards

Design and material standards for new structural products also began to change. Previous standards had been prescriptive. For example, by this cookbook approach, plywood or another panel product would have to be manufactured according to a strict recipe designating adhesives to be used and type and dimension of materials. The newer standards developed were instead based

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APA – The Engineered Wood Association.
For more information, visit [www.apawood.org]()

simply on performance. A product could be manufactured with any adhesive, as well as type or dimension of material, as long as it performed in accordance with the requirements of manufacturing standards and the building code.

The evolution of performance-based standards created the ideal opportunity for product innovation in the marketplace. Building code organizations, in turn, developed evaluation services to manage approval of the influx of newer products offered as alternatives to those already listed in the building code.

(See www.woodaware.info for a link to the International Code Council's Evaluation Services.)

DEFINING ENGINEERED WOOD PRODUCTS

In response to consumer demands, the wood industry developed technologies to use smaller trees more efficiently. These technologies moved homebuilding to a new era of more fiber-efficient and lightweight engineered materials—thus the term "engineered wood products."

There are different opinions as to what is an engineered wood product (EWP). From the fire service perspective, any product consisting of a combination of smaller components into a structural member and designed using engineering methodologies should be considered engineered. Engineered products are developed to use materials efficiently. Therefore, many engineered wood products are lighter in weight than the conventional product they are designed to replace.

For the sake of definition here, engineered wood products are structural components or assemblies that are offered as alternatives to solid sawn lumber. Structural composite lumber, I-joists, and wood trusses are examples.

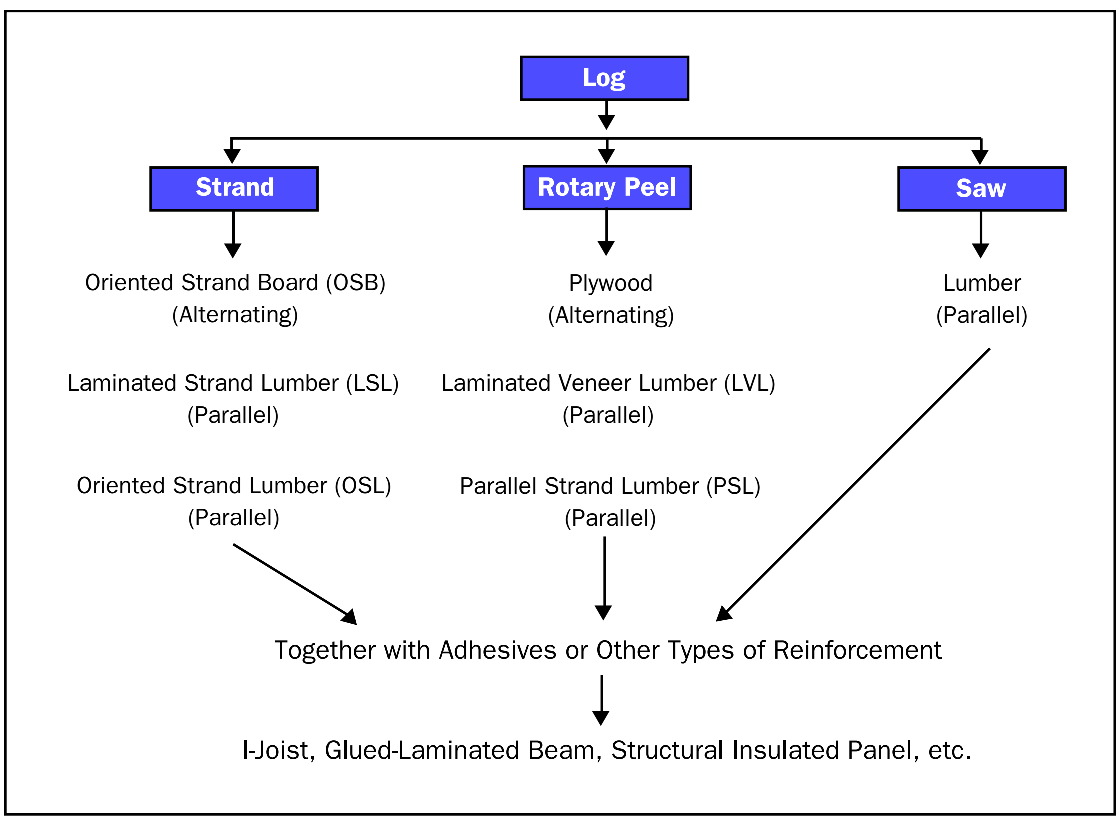
Most of these products are proprietary (uniquely designed from a specific manufacturer) and are marketed under different trade names. Each of these products, however, has to comply with building code requirements before its use in structural applications.

HOW ENGINEERED WOOD PRODUCTS ARE MANUFACTURED

There are three primary manufacturing methods to dismantle a log and reassemble it into an engineered wood product—stranding, peeling, and sawing—as shown in Figure 1.

Figure 1 EWP Manufacturing Methods

There are three primary manufacturing methods to dismantle a log and reassemble it into an engineered wood product—stranding, peeling, and sawing.



Stranding

Stranding involves slicing a log into 1-inch to 12-inch strands, similar to a cheese grater. The strands are dried in a large rotary drum, where resin is applied. The strands are then dropped into a forming bin and pressed together to form the product. These products can be thin and flat, like plywood, or long and wide, like lumber.

Stranding is the most efficient method to convert a log into an engineered wood product, because it uses the smallest pieces (Figure 2). Smaller strands pack more efficiently into rectangular sections. The net result is increased utilization of a tree and less waste delivered to the landfill. For example, a 100 cubic foot log produces only 40 cubic feet of solid lumber, but 76 cubic feet of engineered wood products. More efficient conversion of the natural resource results in benefits to the industry, consumer, and the environment.

Peeling

Rotary peeling involves placing a long knife parallel to the outside edge of a spinning log. The knife peels slices off the log like paper towels off a roll. The wood slices are then clipped into individual sheets (called veneer), which are dried, glued and pressed together to form the product. Peeling the log is not as efficient as stranding (Figure 2), but is still attractive to facilities that were established to peel logs but now want to manufacture engineered wood products.

Sawing

Sawing involves cutting a log into common rectangular sections, such as 2x3 or 2x4. The lumber is dried and cut to length before assembly as an engineered wood product, such as trusses or I-joist flanges.

Conversion Efficiency of Engineered Wood Products

The forest products industry is constantly looking for innovative ways to use more and more of each log, thereby reducing waste. How well manufacturers are able to use the fiber in a log when they convert it to a product is called “conversion efficiency” (Figure 2).

TYPES OF ENGINEERED WOOD COMPONENTS

There are many generic names and acronyms to describe engineered wood products. As a result, popular trade names are most familiar. (See www.woodaware.info for links to individual manufacturers’ websites.) Whether stranded, peeled, or sawn, EWPs are designed to meet specific stiffness and strength criteria, so that an engineer can reliably design a structure with the lightweight component.

Figure 2 Conversion Efficiency of EWP Products

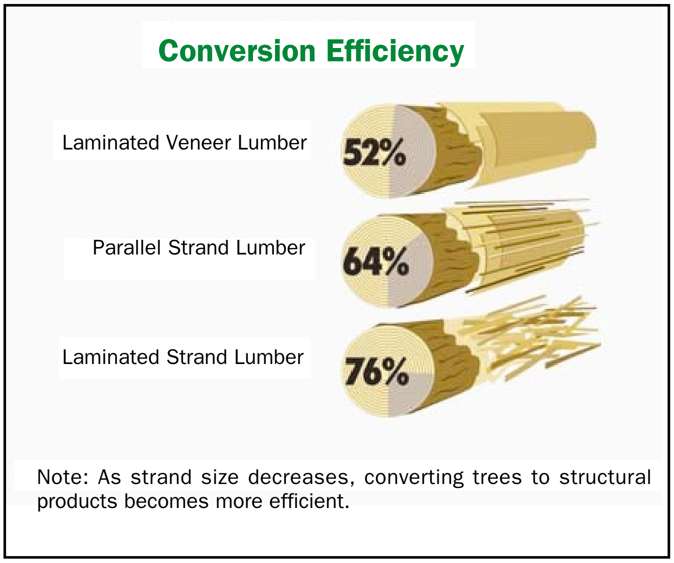


Figure 2 above shows the conversion efficiency of laminated veneer lumber (LVL), parallel strand lumber (PSL), and laminated strand lumber (LSL). These are examples of structural composite lumber (SCL).

Strand Products

There are three primary types of wood products manufactured from strands: oriented strand board (OSB), laminated strand lumber (LSL), and oriented strand lumber (OSL).

- OSB most often is used as panels and as a lumber substitute. OSB is formed by alternating the layers of strands perpendicular to the previous layer, which provides bending support in two directions. The strands are up to three inches long (see more information on this product in the *Wood Structural Panel Awareness Guide* in this series).
- LSL most often is used as a lumber substitute and as flanges in I-joists. The strands used are up to 12 inches long and in manufacture are placed parallel to each other.
- OSL has uses similar to LSL. It is fabricated with shorter strands, up to six inches long.

Peel Products

There are three primary wood products manufactured using peeling technology: plywood, laminated veneer lumber (LVL), and parallel strand lumber (PSL).

- Plywood most often is used as structural panels. Plywood is manufactured by alternating veneer perpendicular to the previous layer, which provides bending support in two directions (see more information on this product in the *Wood Structural Panel Awareness Guide* in this series).
- LVL most often is used as a lumber substitute and as flanges for I-joists. The layers of veneer are staggered to disperse the joints between veneer segments.
- PSL is manufactured from veneer clippings that are too narrow for LVL or plywood. The PSL process involves clipping the veneer to less than one inch wide, coating the clippings with resin, and forming them into large dimension cross-sections similar in size to heavy timber.

Engineered Wood Products with Multiple Components

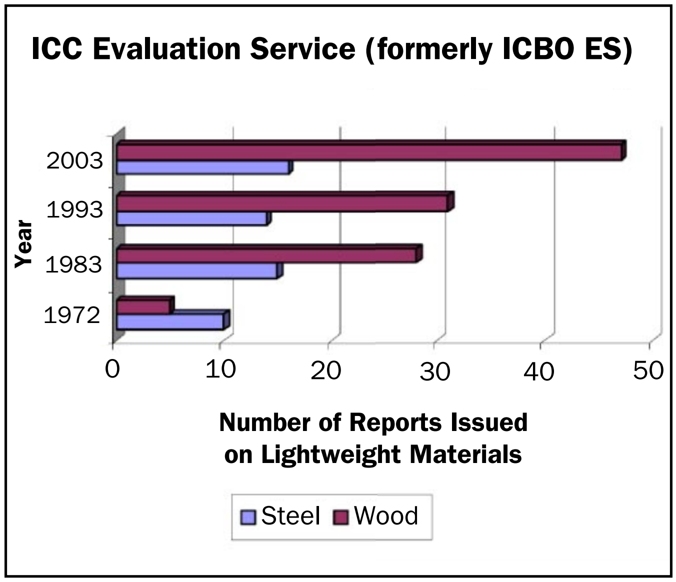
An engineered wood product may consist of multiple engineered components. For example, an I-joist can have OSB as the web, and lumber or structural composite lumber as the flanges. A glued-laminated timber beam is an engineered assembly of specially graded lumber. A truss is an engineered assembly often comprised of sawn lumber chords and wood or metal webs.

SOME ADVANTAGES OF ENGINEERED WOOD PRODUCTS

One of the most attractive features of these engineered components and assemblies is that they can be produced to longer lengths than their sawn lumber counterparts. EWPs can be cut to exact lengths prior to delivery, thereby eliminating job site waste. They also eliminate any problems related to natural defects present in sawn lumber.

EWP technology did not come without a cost. It is more expensive to peel, strand, glue, and press together a 2x12 than to cut that dimension directly from a log. Added costs, coupled with certain environmental expectations to reduce harvesting, fueled development and the resulting popularity of lightweight engineered materials. Products such as I-joists use 50% less fiber than a rectangular piece of lumber of the same width.

Figure 3 Lightweight Materials Enter Marketplace



The number of evaluation reports issued by the International Code Council Evaluation Service (formerly ICBO ES) reflects the upsurge in use of lightweight innovative products for both wood and light gauge steel over the past thirty years.

INNOVATION IN ENGINEERED WOOD PRODUCTS

As represented by the number of evaluation reports issued by the ICC ES, Figure 3 illustrates the upsurge in use of innovative products for both wood and light gauge steel over the past thirty years. While some of these products have a larger market share than others, the overall trend in their use is in increasingly complex configurations. For example, there are new construction practices such as floor and roof assemblies (see structural insulated panels in Figure 4), new connection details (hangers, straps, staples), new resources (lesser known species, hardwoods, offshore species), and new adhesives and composites (various blend of materials, plastics, and glass fiber reinforcement).

The Changing Marketplace

Lightweight components have made a significant market impact in the United States. For example, I-joists have grown from a small percentage to over a 50% market share in residential floors over the last twenty years, and can be projected to reach 70% by 2020, based on housing starts (Figure 5). The I-joist industry has already expanded manufacturing capacity to meet this anticipated demand. It is estimated that currently over 6.5 million homes contain an I-joist floor or roof system.

Figure 4 Structural Insulated Panel Roof Assembly

Structural Insulated Panels (SIPs) are composites of foam plastic [usually expanded polystyrene (EPS)] sandwiched between wood structural panels. Here, a SIP is used to build a roof.

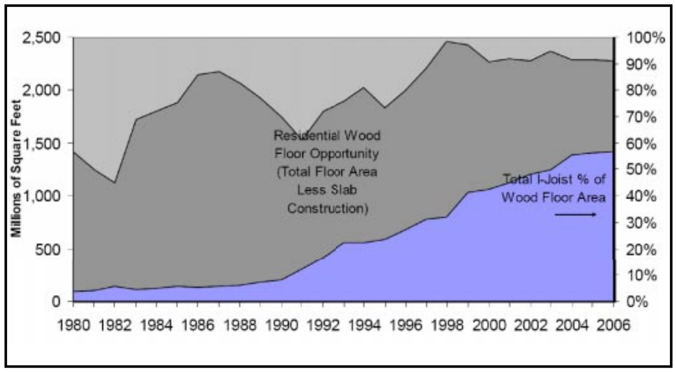
Metal-plate-connected wood trusses were introduced in the mid-1950s. These trusses are designed by engineers with specialized training in structural building component design for floors and roofs. The most common application is in a roof assembly. Trusses used to form traditional sloped roof assemblies are referred to as "pitch chord." Parallel chord trusses can also be used to form flat roof assemblies, but they are more commonly used in the construction of floors.

PERFORMANCE REQUIREMENTS FOR ENGINEERED WOOD PRODUCTS

To qualify for use in the marketplace, an engineered wood product must be classified under one or more test standards, listed on www.woodaware.info.

Typically, a new product must also meet ICC ES (International Code Council Evaluation Service) acceptance criteria. Once a product meets established acceptance criteria, ICC ES issues an evaluation report as evidence of compliance.

Figure 5 I-Joist Market Share of Wood Floors



FIRE PERFORMANCE OF ENGINEERED WOOD PRODUCTS

Fire testing of engineered wood products is required to satisfy building code provisions. For one- and two-family dwellings, there are no structural fire performance requirements. However, for multi-family housing and commercial structures, one- or two-hour fire rated assemblies may be required. To comply, a manufacturer would need to supply qualifying ASTM E119 test reports on wall or floor assemblies as proof of compliance to applicable code provisions.

BUILDING CODE CERTIFICATION OF ENGINEERED WOOD PRODUCTS

Role of Certification Agencies

Model building codes require that engineered wood products be certified by an independent third-party certification agency. That independent agency must confirm that products meet the strict performance criteria required by building codes. Before submitting samples to a certification agency for testing and certification, engineered wood products manufacturers conduct regular, extensive, and monitored performance testing.

Through regular and unannounced random audits at manufacturing facilities, certification agencies implement and closely monitor a rigorous quality control program. During the auditing process, certification agency personnel review and verify quality control test results. They also collect and test samples (small and/or large) to ensure that the engineered wood product meets required performance criteria.

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