Wood Design, Building and Construction Solutions

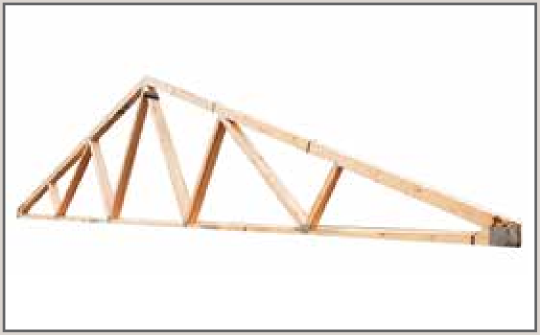
TRADITIONAL ENGINEERED WOOD PRODUCTS

Modern buildings often have open areas and high ceilings, meaning fewer supporting walls, columns and roof structures, and feature engineered components designed to handle increased loads and longer spans. Engineered wood products are stable, lightweight and offer, in some cases, greater structural strength than other typical construction materials. Two of the most recognizable and frequently used engineered products are I-joist and pre-engineered roof trusses.

WOOD I-JOISTS

Wood I-joists are made up of 2X3, 2X4 solid sawn lumber (or sometimes LVL) or Machine Stress Rated (MSR) lumber flanges and an oriented strand board or plywood web. They are manufactured in long lengths and provide a roof and floor framing system that can run continuously over a number of supports. Holes can be drilled in the web to accommodate ductwork and other services, making wood I-joists a viable alternative to open web steel or composite joists. Various profiles of wood I-joists are available.

PRE-ENGINEERED ROOF TRUSSES



Pre-engineered roof trusses are frequently used in residential and commercial roof construction and often use MSR lumber members as small as 2X3 or 2X4 for their construction. These trusses can be fabricated to various and complex geometries to accept significant loads and provide large unsupported spans. The lightweight trusses consist of structural lumber members that are joined together by metal connector plates sized to accommodate the various loading conditions to which the trusses are submitted.

ENGINEERED WOOD PRODUCTS

WOOD BEAMS AND COLUMNS

GLULAM BEAMS AND COLUMNS

Earth Sciences Building at UBC, Vancouver, BC

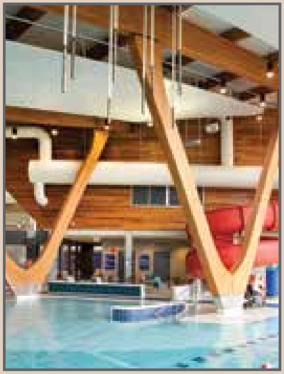
This super-structure is made from engineered timbers consisting of wood laminations that are bonded together with strong, waterproof adhesives, creating an ideal structural component. Pound for pound, glulam beams are stronger than steel so they can span long distances with minimal need for intermediate supports. Glulam can be produced in curved shapes, giving designers and builders virtually unlimited design flexibility.

PROJECTS USING GLULAM BEAMS AND COLUMNS

Whistler Public Library
Whistler, BC

VanDusen Botanical Garden
Visitor Centre, Vancouver, BC

Squamish Lil'wat Centre,
Whistler, BC



West Vancouver
Aquatic Centre,
West Vancouver, BC

WOOD BEAMS AND COLUMNS

PARALLEL STRAND LUMBER (PSL) BEAMS AND COLUMNS

Surrey Centre Mall, Surrey, BC

Parallel Strand Lumber (PSL) is made of long veneer strands of strong wood fibres laid in parallel formation and bonded together with an adhesive to form the finished structural section. PSL is commonly used for long-span beams, heavily loaded columns, and beam and header applications where high bending strength is needed.

PROJECTS USING PARALLEL STRAND LUMBER (PSL) BEAMS AND COLUMNS

Rix Centre for Ocean Discovery, Bamfield, BC

Forest Science Building at UBC, Vancouver, BC

Wood Innovation and Design Centre Prince George, BC

ENGINEERED WOOD PRODUCTS

WOOD BEAMS AND COLUMNS

LAMINATED STRAND LUMBER (LSL) BEAMS AND COLUMNS

Coldstream Elementary School, Coldstream, BC

Laminated Strand Lumber (LSL) is made from the shreds of fast-growing, low-value logs, such as aspen, birch and poplar. Engineered to specific design values, LSL has been used mainly in smaller dimension applications such as beams, lintels, base/top plates and rim boards.

PROJECTS USING LAMINATED STRAND LUMBER (LSL) BEAMS AND COLUMNS

Coldstream Elementary School, Coldstream, BC

LAMINATED VENEER LUMBER (LVL) BEAMS AND COLUMNS

Weir Jones Office Building, Vancouver, BC

Laminated veneer lumber (LVL) is made from "peeler logs", and is similar to plywood except that the grain is usually only oriented in the longitudinal direction. Engineered to precise design values and with a very high strength-to-weight ratio, LVL columns, beams and lintels are often chosen to replace dimension lumber or glulam as columns, beams and headers. They are also commonly used as truss chords and I-Joist flanges.

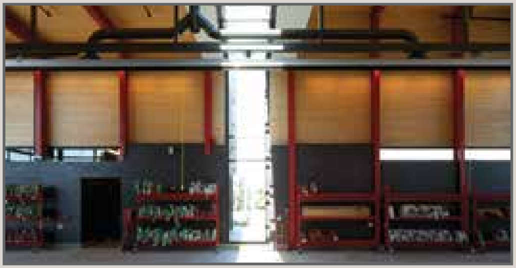
PROJECTS USING LAMINATED VENEER LUMBER (LVL) BEAMS AND COLUMNS

Wood Innovation and Design Centre, Prince George, BC

ENGINEERED WOOD PRODUCTS

MASS TIMBER PANEL SYSTEMS

GLULAM MASS TIMBER PANELS



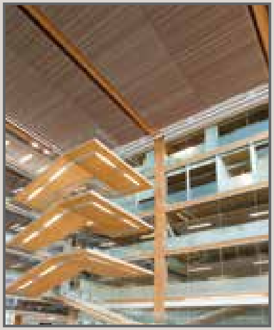
Steveston Fire Hall, Richmond, BC

Glulam (GLT) Panels

Nail-lam (NLT) Panels

Sometimes overlooked as a mass timber panel, glulam and nail-laminated floor and wall assemblies have been used for more than a century. Both long-lived buildings such as the nine-storey Landing Building (1905) in Vancouver and contemporary structures like UBC's Centre for Interactive Research in Sustainability use diaphragms of dimension lumber-on-edge for their floor assemblies. In addition to being used in floors, decks and roofs, nail-lam or glulam mass timber panels are now often used for the timber elevator and stair shafts in BC's six-storey, light-wood frame residential mid-rise apartment buildings. The product also offers the advantage of being fabricated in controlled environments based on certified manufacturing standards.

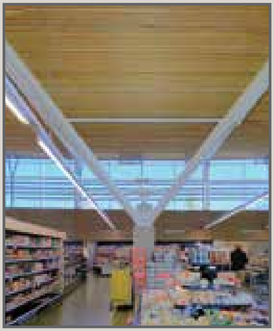
PROJECTS USING GLULAM MASS TIMBER PANELS



Earth Sciences Building at UBC, Vancouver, BC

Still Creek Operations Centre, Burnaby, BC

PROJECTS USING NAIL-LAMINATED MASS TIMBER PANELS



Askew Uptown Supermarket, Salmon Arm, BC

Samuel Brighouse Elementary School, Richmond, BC

MASS TIMBER PANEL SYSTEMS

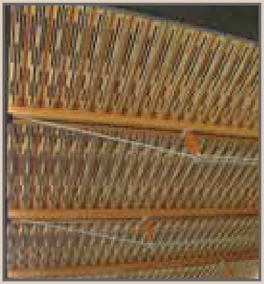
VERTICALLY LAMINATED VENEER LUMBER (LVL) PANELS

Weir Jones Office Building, Vancouver, BC

Vertically laminated veneer lumber (LVL) panels are made from "peeler logs" in the same production lines as LVL beams. Engineered to precise design values and with a very high strength-to-weight ratio, LVLs are suitable for structural wall, floor and roof applications. With the renewed interest in engineered wood products for diaphragm applications (floors, roofs, shafts), manufacturers are beginning to position LVL in full sheet format, but the most interesting configurations involve laminating LVL beams side-to-side to make thin, solid panels.

WOODWAVE STRUCTURAL PANELS

Olympic Oval, Richmond, BC



Alberni District Secondary School, Port Alberni, BC

This panel system employs conventional light frame lumber commonly used in wood frame construction, comprised of cascading 2X4's, joined together with strategically located short 2X4 splice pieces (in some cases mechanically reinforced). This unique product embodies significant technological advancements, transferring loads in an entirely new way, absorbing sound through regular acoustical openings between splices and constructed using simple dimensional lumber in a way that meets fire safety requirements.

MASS TIMBER PANEL SYSTEMS

LAMINATED STRAND LUMBER (LSL) PANELS

City of North Vancouver
Civic Centre Renovation, North Vancouver, BC

Like LSL beams and columns, LSL panels are made by shredding wood from fast-growing, low-value hardwood logs, such as aspen, birch and poplar into thin strands. These are oriented for maximum strength and glued together into 8 foot by 64 foot "billets" using a steam-injection process. When used in wide-sized format, they provide an excellent option for diaphragm applications. The LSL panels provide structural support and a unique architectural statement, as is evident in the North Vancouver Civic Centre.

HYBRID MASS TIMBER PANELS

Earth Sciences Building at UBC, Vancouver, BC - floors

In addition to pure wood panels, there are additional designs that have been used that combine wood with other materials, usually reinforced concrete. Their aim is to reduce the proportion of the carbon-intensive concrete components by allowing timber to carry the load. One recent example of hybrid panels are the floors of UBC's Earth Science Building, in which LSL panels support the reinforced concrete topping.

MASS TIMBER PANEL SYSTEMS

CROSS-LAMINATED TIMBER (CLT) PANELS

MECHANICALLY FASTENED (MF) OR GLUED

North Shore Credit Union Environmental Learning Centre, North Vancouver

Cross-laminated timber panels are created with similar steps as other engineered wood products. The panels are formed by stacking together successive perpendicular adhesive-backed layers of wood. The layered stacks are then pressed in large hydraulic or vacuum presses to form an interlocked panel. The panel is then sized and shaped in some cases with a Computer Numerically Control (CNC) machine into a fully construction-ready component. The number of layers in a panel can range from three to seven or more, and panel thickness can vary from 4 to 16 inches (10 to 40.5 cm). Panel lengths are limited only by the length of a press; the largest European press is now up to 52 feet (16 m). Panels can have door and window openings, plus routings for electrical and mechanical systems, before shipment to the building site.

By the nature of its design, CLT has inherent load-bearing strength and can serve as material for both vertical and horizontal assembly applications. Since wall, floor and roof sections made of CLT are formed off-site in a factory, it allows for a much shorter on-site construction time. CLT can theoretically be used as a structural system in tall buildings and can be used as an alternative to concrete or steel. Some projects rely on a version of CLT based on carefully engineered mechanical fastening patterns rather than adhesives and pressure. Mechanically fastened CLT is not limited by press size and so is available in any size.

MASS TIMBER PANEL SYSTEMS

CROSS-LAMINATED TIMBER (CLT) PANELS

PROJECTS USING MECHANICALLY FASTENED CLT

Fire Hall #15, Vancouver, BC

Chilliwack Secondary School
Chilliwack, BC

PROJECTS USING GLUED CLT

Elkford Community Conference Centre, Elkford, BC

UBCO Fitness and Wellness Centre,
Kelowna, BC

EXPANDED USE OF DIMENSION LUMBER AND ENGINEERED WOOD PRODUCTS

Heron's Landing, Saanich, BC

Elevator Shaft

Blocking Panel Details

Light-frame wood construction has always been known for its economy, versatility and speed of erection, and now, new materials, innovative engineering solutions and off-site prefabrication have substantially increased the quality and sophistication of light-frame wood construction. As a result of these changes, light-frame wood construction is now considered a viable, affordable and environmentally-preferable alternative to concrete and steel.

While the outward appearance of light-frame wood residential buildings may not have changed significantly over the years, the quality and precision of design and construction has certainly increased.

Several key aspects of design and building that become more critical in this new generation of buildings of a greater height like mid-rise buildings include shrinkage and differential movement between different types of materials; increased dead, live, wind and seismic loads; increased fire-resistance ratings for fire separations as required and ratings for sound transmission as required for buildings of multi-family residential occupancy as well as others.

The responses within more complex mid-rise buildings involves the adaptation of structural and architectural design details that address key building-related issues through an industry-wide research and development support network, and include the areas associated with acoustic, thermal and fire performance.

Structural Composite Lumber Product Use

Wood Design, Building and Construction Solutions

Photos:

Wood Design Awards of BC • Photography West • Structurlam Products Ltd. • Brisco Manufacturing Ltd.
Greg Dowling • FPInnovations • Weir Jones • Mitsui • KK Law • Forestry Innovation Investment
MGA | Michael Green Architecture • Naturally:wood

We thank the following wood manufacturers for their assistance:

Weyerhaeuser • Boise Cascade • Acutruss Industries Ltd. • Structurlam Wood Products
StructureCraft Builders Inc. • Brisco Manufacturing Ltd. • Western Archrib

For more comprehensive definitions and information about wood products and systems, please refer to the Canadian Wood Council Wood Reference Handbook:

A Guide to the Architectural Use of Wood in Building Construction: www.webstore.cwc.ca