MASS TIMBER IN BRITISH COLUMBIA

Technological advancements in engineered wood, as well as design and construction innovation, have allowed wood structures in B.C. to go larger and taller. Mass timber is a category of engineered wood products that allows for the construction of low- to high-rise residential, commercial and industrial buildings.

Usually fabricated off-site as panels, mass timber products are comparable in strength and durability to concrete and steel and considerably lighter in weight. Building codes in Canada and around the world are incorporating mass timber into new code provisions permitting buildings to go higher.

B.C. is a world leader in the fabrication and design of mass timber infrastructure, with many buildings showcased around the province. There is a high level of mass timber expertise in B.C., and many professionals in the field have garnered international attention.

Architect: HDR / CEI Architecture Associates, Inc., Photo: John Bilodeau Photography

The West Wing, Penticton Lakeside Resort and Conference Centre

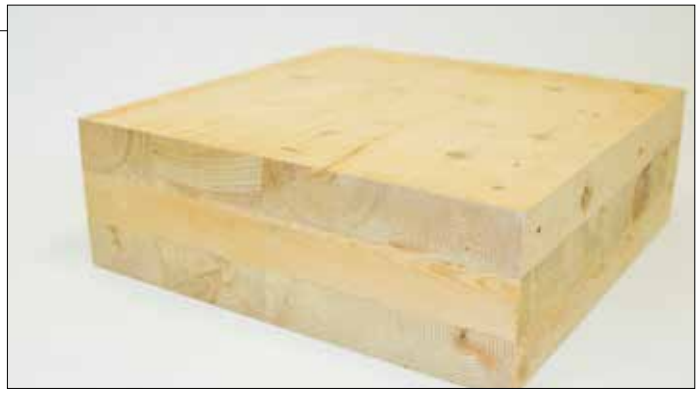
The facility sits on a flood plain at the south end of Okanagan Lake. When the owners added the west wing in 2017, they chose wood over concrete for the beauty of the exposed timber, but also because the prefabricated wood panels are lightweight and didn't require a pile foundation. In the hospitality industry, the summer months are key. Each floor took one week to install, and consists of 70 locally produced cross-laminated timber panels. The building was completed in less than a year, ready for the summer tourist season.

Types of Mass Timber

Mass timber products are formed from dimension lumber or wood fibre that is mechanically fastened or glued together in layers, under high pressure.

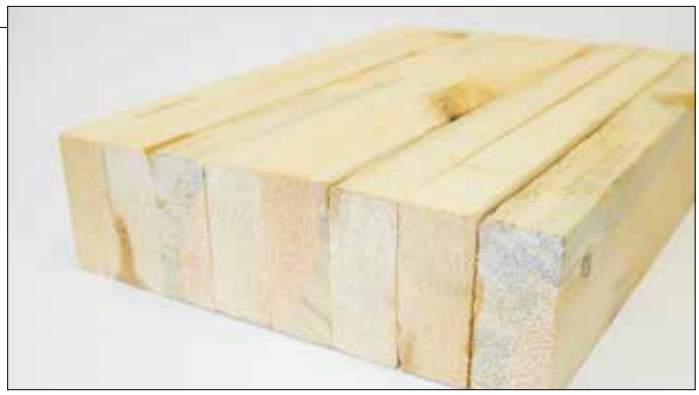
Cross-laminated Timber (CLT)

CLT is one of the most popular and versatile mass timber products. This engineered wood is formed from dimension lumber, which is planed, kiln-dried, and stacked in cross-directional layers and are glued together to form structural panels of exceptional strength. CLT is commonly used in floors, walls, elevator shafts and roofs, and is often left unfinished in interior applications. CLT is most often made from spruce-pine-fir (SPF) or Douglas-fir/Larch (DF-L).



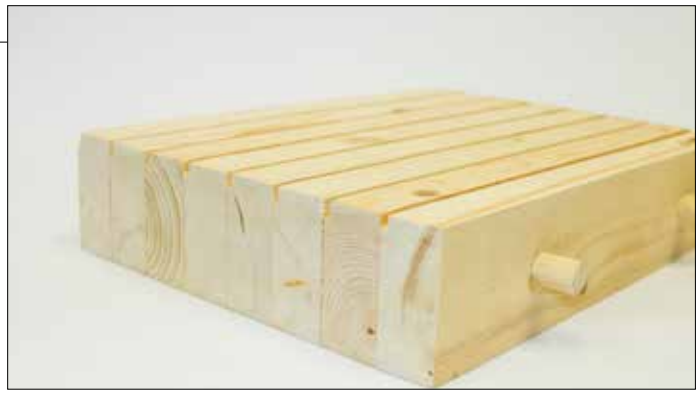
Nail-laminated Timber (NLT)

NLT is not new: it has been used for more than a century. NLT is made from dimension lumber that has been stacked on edge and fastened with nails or screws. This versatile product can be manufactured on site or prefabricated. Occasionally attached to plywood sheathing to be used as wall panels, it is also used in floors, decks and roofs, and can accommodate complex curved design features. Typical species used for NLT include SPF and DF-L.



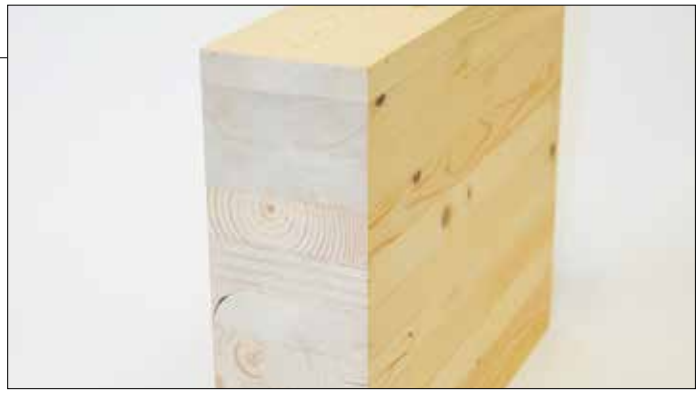
Dowel-laminated Timber (DLT)

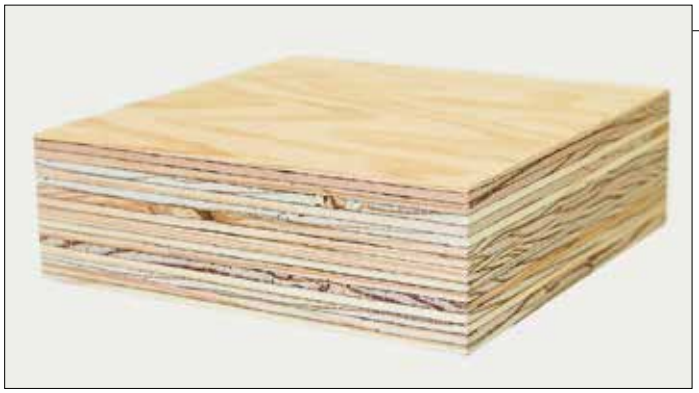
DLT is similar to NLT, but it is an all-wood mass timber product without metal fasteners. Dimension lumber is stacked on edge, and then fastened together with hardwood dowels. Because it is an all-wood product, it is easily processed using routing machinery and allows for onsite modifications. It is used in floors, roofs, walls and elevator and stair shafts, and is often left exposed on interior applications. DLT is typically made from SPF or DF-L.



Glue-laminated Timber (Glulam)

Glulam is an engineered structural wood product that consists of two or more layers of dimension lumber that are glued together with the grain of the layers running parallel to the length. Because of its size and strength, glulam is commonly used for headers, beams, columns and trusses. It can also be used as panels when used in a flat-wise position. It can be manufactured to accommodate curved designs in load-bearing arches and for bridges. Glulam has a clean aesthetic and is often left exposed on the interior. Glulam is made from SPF or DF-L.



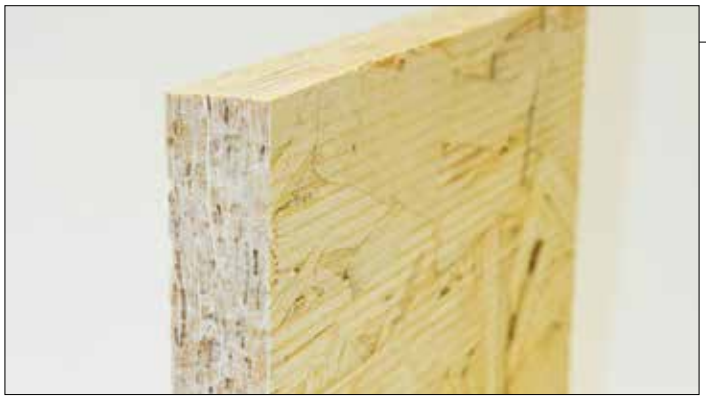


Mass Plywood Panel (MPP)

MPP is a structural engineered wood product that consists of several layers of wood veneer placed in alternating directions of grain that are then glued and pressed together. It is often used in large-scale applications such as floors, walls and roof structures. Typical species used to make MPP include Douglas-fir.

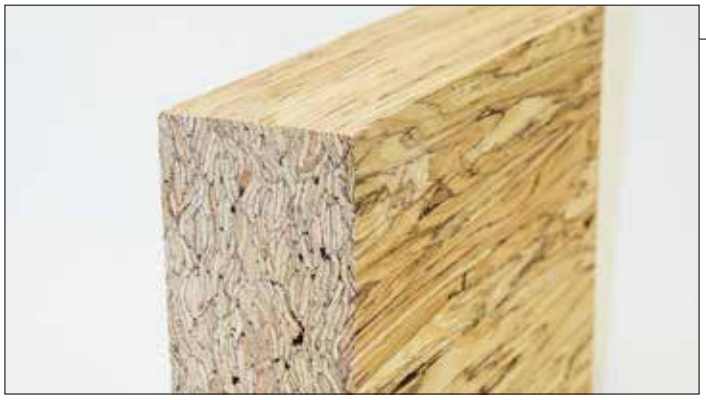
Laminated Veneer Lumber (LVL)

LVL is an engineered wood product made by gluing long layers of thin wood together in the same long grain direction, using heat and pressure. LVL offers strength, stiffness and stability for applications such as columns, beams, headers, and any place where bending strength is required. LVL beams can be bundled together on site to form wider beams. Typical species used to make LVL include DF-L and poplar.



Laminated Strand Lumber (LSL)

LSL is an engineered wood product that is made from wood strands sliced from small diameter hardwood logs with low commercial value such as aspen, birch and poplar. The strands are then glued together using a steam-injection process that was developed by a B.C. company, to create billets, or panels. It is used in columns, beams, and headers, and is also used as wall and floor panels.



Parallel Strand Lumber (PSL)

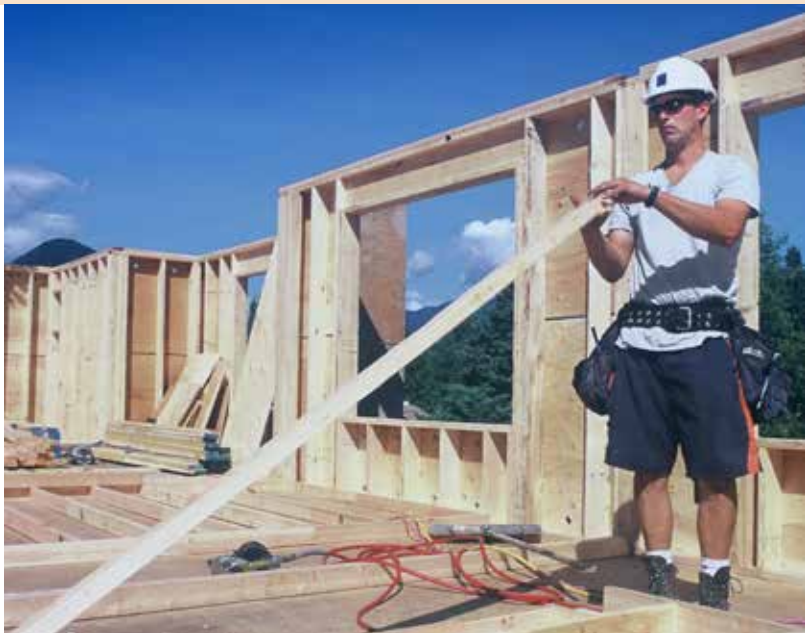
PSL—developed by a B.C. company—is characterized by long strands of wood that have been combined with adhesive and formed into a large billet, pressed together. PSL has a unique pattern that makes it an attractive structural material for applications where appearance matters. The wood strands are longer than those used to manufacture LSL resulting in a high bending strength. PSL is used for beam and header applications and also as load-bearing columns. It is usually fabricated from DF-L, western hemlock and poplar.

Content adapted from Perkins+Will's Wood 101 and Mass Timber Pocket Guide.

What is the Difference Between Mass Timber and Wood-Frame Construction?

Mass timber is not to be confused with wood-frame (or light-frame wood) construction. A mass timber building uses solid timber or engineered wood as the primary load-bearing structural element, whereas wood-frame buildings are constructed from dimension lumber and sheathing. Mass timber construction, using prefabricated panels, beams and columns made from thick, compressed layers of wood, is comparable to steel and concrete in terms of strength and performance. Because of its engineered strength, mass timber construction can go higher than wood-frame construction.

Mass timber hybrid construction, Photo: KK Law



Wood-frame construction, B.C., Photo: Peter Powles

Mass Timber and Building Codes

Building codes around the world are adapting to the growing acceptance of mass timber as a safe and sustainable type of construction. In B.C., the provincial government has encouraged municipalities to be early adopters to the new provisions in the 2020 National Building Code.

The new provisions allow encapsulated mass timber construction (EMTC) in buildings up to 12 storeys. Encapsulated mass timber is clad in fire-resistant materials. Previous to the new provisions, the National Building Code had allowed up to six storeys for wood-frame construction.

The Benefits of Mass Timber

Performance

Mass timber is lighter than steel and concrete, with a high strength-to-weight ratio, which gives it the structural ability to span long distances without supports. It is versatile in all aspects of construction, including walls, structural beams and bracing. It often has the dual role of serving both as a structural material and aesthetic finishing material.

Fire Safety

Wood construction has a proven level of safety that is comparable to steel and concrete. All buildings must conform to the same safety standard, whatever the material type used on construction. Building codes are constantly updated according to new technologies and designs that ensure safety in the event of fire and seismic activity.

Building codes recognize the safety of mass timber construction, whether residential, industrial or commercial use. The addition of sprinklers, fire-resistant wall, ceiling and floor materials and assemblies, as well as specific design features, allow for the construction of larger mass timber buildings.

Extensive fire testing has shown that mass timber chars on the outside, which forms an insulating layer protecting the interior from further damage. In the event of fire, the structure maintains its integrity, allowing occupants time to evacuate. Because it behaves predictably during a fire, mass timber is safe for tall building construction.

Seismic Safety

Wood buildings offer good behaviour under earthquake loads due to their lighter mass. Building mass is one of the determinant factors in the building's response to ground shaking, and therefore the lighter mass typically results in lower seismic forces compared to buildings of the same shape with heavier mass. The ability of a wood building to endure lateral displacements without failing comes from its ductile behaviour. In light-frame wood construction, nails connecting sheathing to framing provide the ductility, while in mass timber construction the ductility comes from properly designed connections between the rigid mass timber elements designated to resist lateral loads.

Health

Biophilic design incorporates elements of nature into the built environment, such as the inclusion of daylight, plant materials, and exposed wood. The study of biophilia suggests that people feel more positive when surrounded by natural surfaces, which makes mass timber appropriate in public buildings, such as schools and hospitals.

Environment

Wood comes from a renewable resource, and wood products from B.C. are from sustainably managed forests. Mass timber, like all wood products, stores carbon and produces fewer greenhouse gas emissions during fabrication.

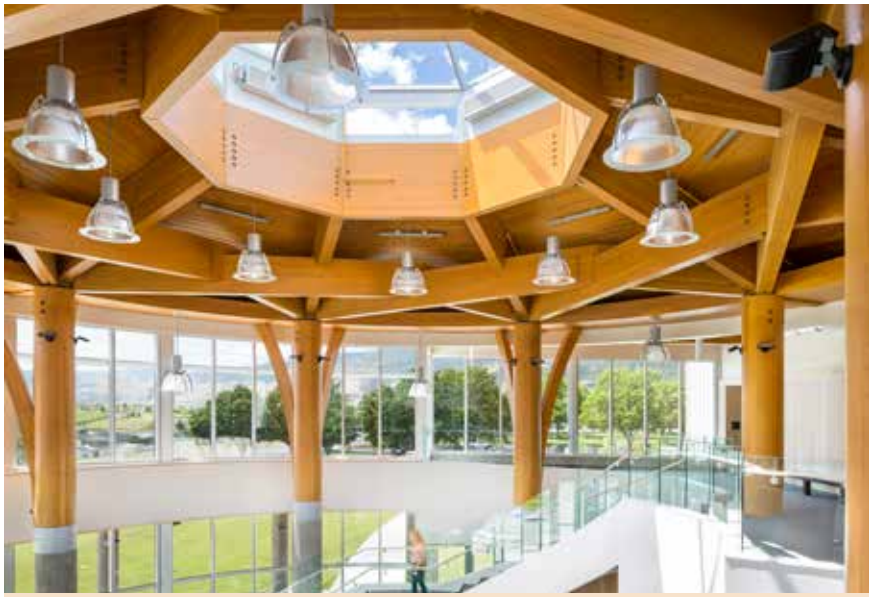
Life cycle assessment (LCA) is a performance-based approach to assessing the impacts building material choices have on the environment. When considered over a building's lifetime —from harvest of raw materials through manufacturing, transportation, installation, use, maintenance and disposal or recycling—wood performs better than concrete and steel in terms of embodied energy, air and water pollution, carbon footprint and global warming potential.

Community

Construction with prefabricated mass timber is quick and has minimal waste, meaning disruption to neighbourhoods is greatly reduced compared to conventional construction.

Value

Mass timber can be built off-site in manufacturing facilities, then transported to the job site and assembled quickly and safely. The ready-to-assemble process saves in labour costs and ensures quality control. For developers, quicker construction time leads to quicker completion, which means rental revenue can start sooner. In some cases, mass timber offices can capture higher rental rates than similar non-wood buildings.



Architects: KMBR Architects Planners Inc. and HDR / CEI Architecture Associates, Inc., Photo: Ed White Photographics

Southern Okanagan Secondary School

The renovation and expansion of this Oliver high school and community theatre complex features a dramatic lobby ceiling comprising a Douglas-fir glulam column and beam assembly that is visible from the outside. The exposed glulam, timber decking and birch plywood paneling runs throughout the school classrooms, hallways, gymnasium and school theatre.

Architect: Acton Ostry Architects Inc., Photo: KK Law

Brock Commons Tallwood House

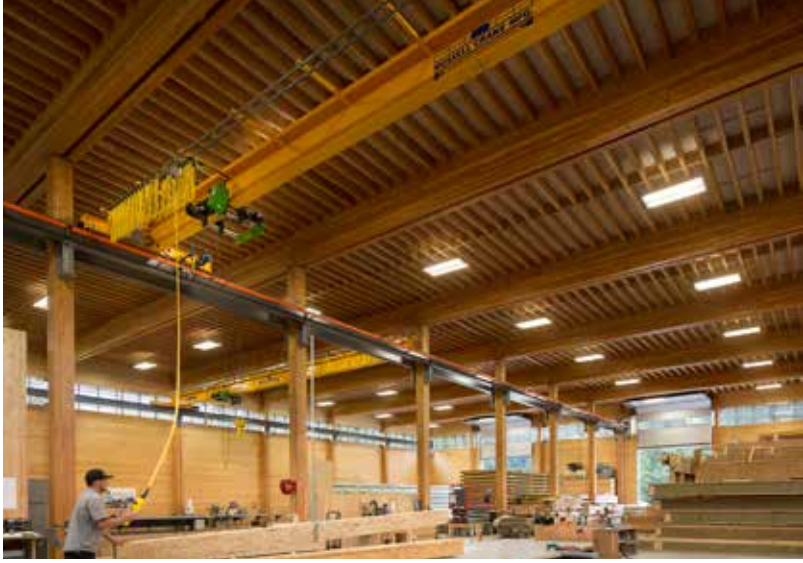
Currently one of the tallest mass timber hybrid structures in the world, the 18-storey student housing tower at the University of B.C. took about four months shorter than traditional concrete construction. Prefabricated and delivered to site, each floor consists of five-ply CLT panels supported on glulam and PSL columns. The estimated greenhouse gas emissions sequestered and avoided in the mass timber elements is equivalent to about 511 cars removed from the road for a year.

Examples of Mass Timber Buildings

Many structures in B.C. showcase the elegant beauty, safety, efficiency, versatility and value of mass timber design.

Industrial

Assembled in only eight days, **BC Passive House's** Pemberton factory demonstrates both the beauty and efficiency of prefabricated mass timber construction. The boxy, contemporary wood structure is made from Douglas-fir glulam posts and beams, CLT walls and stairs, and Douglas-fir dimension lumber fabricated into screens for cladding. The building was built according to Passive House standards, with airtight double walls and high-performance wood windows.



Architect: Hemsworth Architecture, Photo: Ema Peter Photography / Hemsworth Architecture

Architect: BR2 Engineering, Photo: Metric Modular

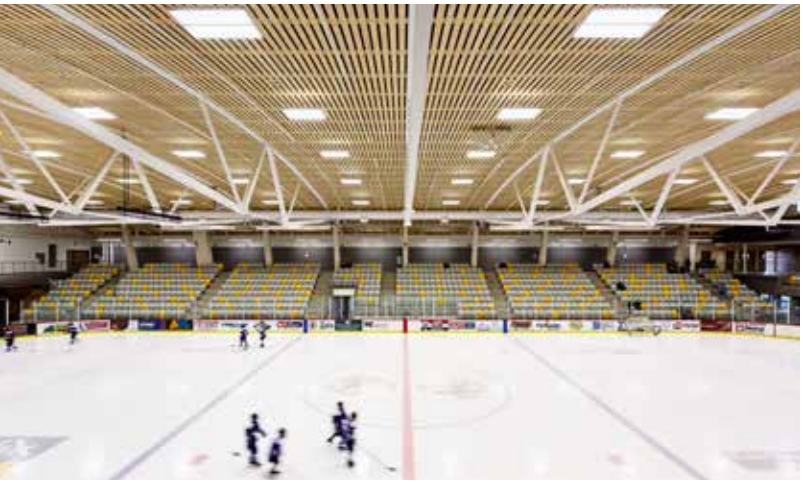
Residential

Trinity Western University's Jacobson Hall in Langley was the first five-storey wood modular building in Canada when it was built in 2018. The prefabricated construction, which also included a CLT elevator shaft, allowed for a nine-month construction schedule, the ability to stick to the budget, a high level of energy efficiency, quality control, reduced impact to the site, noise control, and little waste of time or materials.

Commercial

MEC's head office in Vancouver's False Creek Flats is a midrise open concept workspace with roof terrace. The structural engineers had considered concrete and steel frame systems, but a mass timber structure better fit with the client's environmental ethos. The plan was to use a glulam post-and-beam system, with floors constructed from CLT panels. However, the design evolved so that NLT panels with plywood sheathing could be used for the floors. The building is made of assembled pieces, which can be deconstructed and salvaged at the end of its life.

Architect: Proscenium Architecture + Interiors Inc., Photo: KK Law



Architect: HDR / CEI Architecture Associates, Inc., Photo: Sunny Jhooty

Community

Forestry is a major industry for the Quesnel region, so it made sense that the **West Fraser Centre & Quesnel Arena** would be built from wood. The two-storey facility features a lobby, stairwell, foyer and roof constructed from CLT panels, with SPF dimension lumber and plywood ceiling assembly framing the steel trusses of the arena roof. The slat ceiling design of the exposed wood, sourced from Quesnel sawmills, absorbs sounds—making it an acoustically appealing concert venue when it's not a skating rink.

Health Care

Mass timber plays a central role in the three-storey **Pacific Autism Family Centre** in Richmond. The building is constructed from a glulam post-and-beam frame system, with a combination of prefabricated NLT panels and engineered light truss joisted floors, both finished with plywood decking. The stairs are built from plywood treads and risers supported on LVL stringers. LVL features again in roof beams that support the weight of the mechanical penthouse. Wood is on display both inside and outside, creating a warm and serene experience for families.

Architect: NSDA Architects, Photo: Derek Lepper

Architect: McFarland Marceau Architects Ltd., Photo: Derek Lepper

Education

The two-storey **École au Coeur-de-l'île Elementary School** for kindergarten to grade 12 francophone students is built to a high sustainability standard. Mass timber features throughout the Comox school include a timber roof structure, exposed glulam beams and CLT panels that form unique reading alcoves and multi-purpose spaces that create a feeling of warmth and comfort within a large public space.

Transit

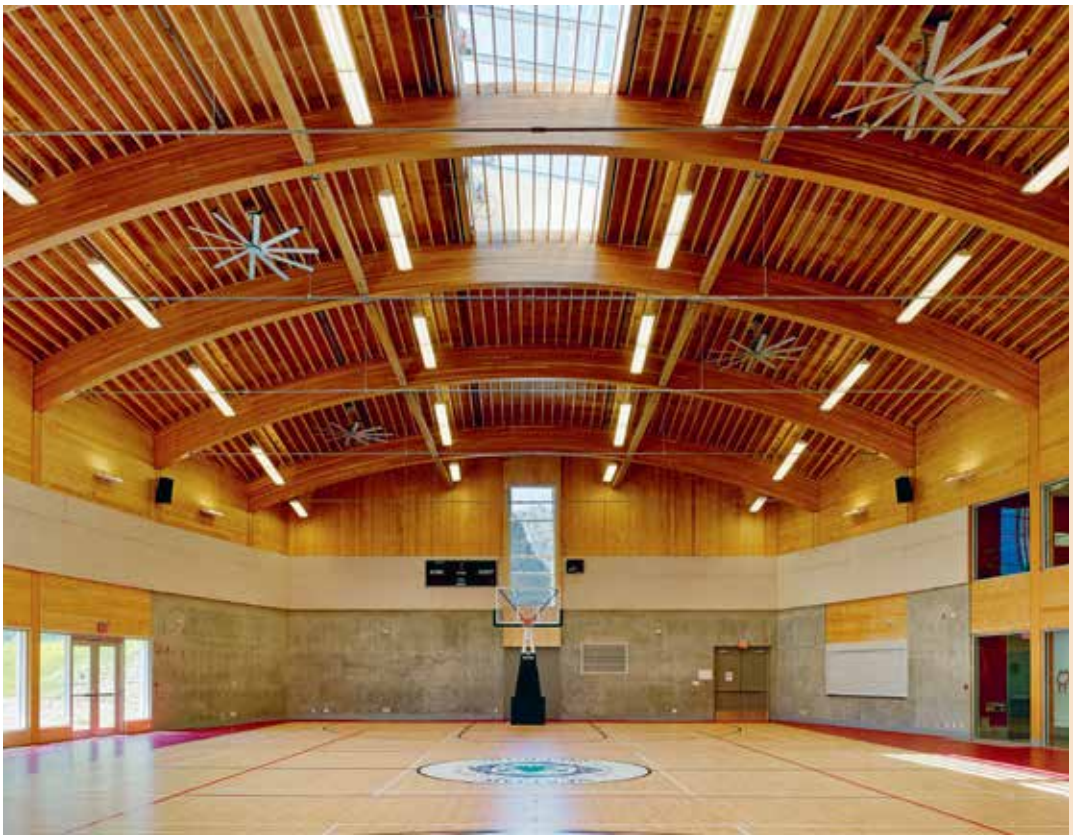
The first in a series of transit stations to incorporate wood, **Brentwood Town Centre SkyTrain Station** is a striking landmark on Vancouver's Millennium Line, set nine metres above the road. The unique curved steel and wood design incorporates a Douglas-fir NLT ceiling and glulam ribs.

Architect: Perkins+Will, Photo: Tae Ik Hwang

Architect: Patkau Architects, Photo: James Dow / Patkau Architects

Tourism

The **Audain Art Museum** in Whistler is in a forest setting, so wood was a natural choice in construction. The steep roof was built from prefabricated mass timber panels—LSL was used for sheathing, and PSL was used for the panel rafters. The soffits and exterior cladding are sourced from western hemlock, and interior walls and ceilings are tongue-and-groove clear vertical grain western hemlock, with white oak engineered floors.



Architect: Urban Arts Architecture, Photo: Martin Knowles

P'Egp'Ig'Lha Community Centre

The new community centre, band offices and health centre built for the T't'q'et First Nation in Lillooet mimics the architecture of traditional Indigenous dwellings—typical of the Central Interior/Fraser Canyon First Nation's culture. These structures are built for an extreme climate, subject to cold winters, winds and hot summers. The Centre is partially sunk into the ground and sheltered by earth berms. The main feature of the all-wood building is the domed community hall, with vertical glulam posts and glulam arches, and CLT exterior walls and plywood roof sheathing exposed within the interior.

Mass Timber Resources

The number of suppliers and professionals that work in mass timber are growing as mass timber projects acquire greater public awareness. Suppliers and construction companies in B.C. have expanded their operations in the last few years. Developers are responding to market interest by building with mass timber. Architects and engineers in B.C. are attracting global interest in their mass timber designs.

Buy B.C. Products

naturally:wood Supplier Directory
(naturallywood.com/masstimberSD)

Free Technical Support

Construction and Building System Support in B.C.
Wood *WORKS!* BC (wood-works.ca/bc)

Product Support
APA – The Engineered Wood Association (apawood.org)

Technical Information

Guides
Canadian Cross-laminated Timber Handbook
(fpinnovations.ca)

Technical Guide for the Design and Construction of Tall Wood Buildings in Canada
(fpinnovations.ca)

Nail-laminated Timber: Canadian Design and Construction Guide
(naturallywood.com/NLT)

Research
Think Wood Research Library (research.thinkwood.com)

Projects

B.C.
naturally:wood Project Gallery
(naturallywood.com/project-gallery)

International
Think Wood (thinkwood.com)

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