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The State of Mass Timber in Canada 2021

GCWOOD
GREEN CONSTRUCTION THROUGH WOOD PROGRAM

Canada

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The State of Mass Timber in Canada 2021

Canada

Photograph contributors (alphabetically)

Art Massif: page 20

BNKC Architects: page 44 (middle and bottom left)

Doublespace Photography: page 36 (background and top right)

International Timberframes: page 21

James Dow & Patkau Architects: page 31 (background and top right)

LEA Consulting Ltd.: pages 16 and 45 (middle and bottom right)

Michael Elkan Photography: page 22 (bottom right), 42 (bottom right) and 43

Nick Diamond: page 22 (bottom left)

NRCan image: pages 9 (bottom right) and 10 (top left)

P3Architecture Partnership: page 32 (background and top right)

Root Architecture Inc.: pages 39 and 40 (background and top right)

Stéphane Groleau: pages 14, 35 and 37 (background and top right)

Western Archrib: pages 33 (background and top right) and 41 (background and top right)

www.naturallywood.com: cover page and back cover (background), 2, 4, 5, 8,15, 17, 23, 24, 25, 27, 29, 30, 42, 46 and 48

Aussi disponible en français sous le titre : La situation du bois massif au Canada 2021

Cat. No. Fo1-20E-PDF (Online)
ISSN 2563-8343

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Building with wood is recognized globally as a low-carbon option to reduce the greenhouse gas (GHG) emissions associated with construction. Recent advancements in engineering, architecture, and design, combined with increased commitment to using every tool at our disposal to mitigate climate change, have resulted in a significant increase in innovative wood building projects across Canada.

The *State of Mass Timber in Canada 2021* report and the State of Mass Timber in Canada (SMTC) database feature 484 mass timber structures built since 2007. This report provides a detailed overview of Canada's mass timber history, production capacity and projects, illustrating one way that Canada's forest sector continues to innovate and thrive as the world increasingly shifts toward the new bioeconomy.

MINISTER'S MESSAGE

It is my honour to introduce the inaugural State of Mass Timber in Canada report. Together with an interactive map, this report provides the most up-to-date information on one of the most exciting sectors of the construction industry.

Canada is a world leader in building with wood, and we're building bigger and taller buildings. Mass timber construction creates new markets for Canadian wood and supports our forestry workers by creating jobs. Mass timber buildings are highly resistant to earthquakes, offer natural thermal insulation, are inherently fire-resistant, and can be rapidly installed.

They're also a critical nature-based solution to climate change, and an important part of getting to net-zero.

Mass timber construction is renewable, sequesters carbon, and lowers emissions. Buildings made from mass timber simply result in fewer emissions: the University of British Columbia's Brock Commons Tallwood House mitigates carbon emissions equivalent to removing over 500 cars from the road a year. That's a total carbon benefit of over 2,430 tonnes of carbon dioxide.

Canadian builders are increasingly recognizing the advantages of mass timber. Since 2007, structural mass timber projects in Canada have increased more than fivefold. And they're increasingly inclusive - out of almost 500 projects over 12 years, more than 30 are Indigenous-led.

Canada is well positioned to meet industry needs as the demand for mass timber grows, with over 20 facilities manufacturing more than one million cubic metres of products annually.

Support from the Government of Canada has been an important part of the mass timber story, with significant investments through Canadian Forest Service programs such as Green Construction through Wood, the Forest Innovation Program, Investments in Forest Industry Transformation, and the Expanding Market Opportunities program.

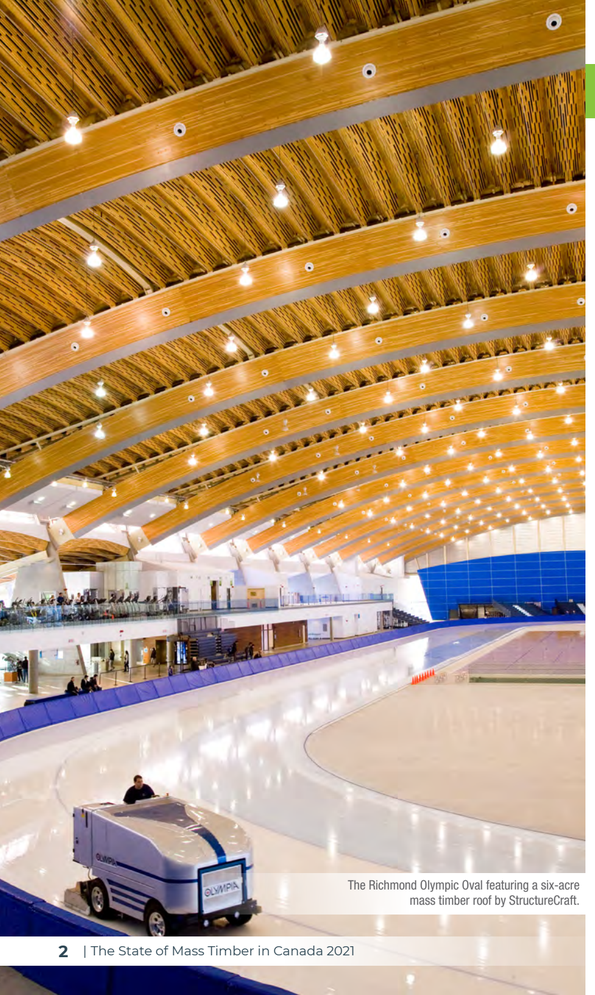
In addition, work at the National Research Council, FPInnovations, and the Canadian Wood Council have helped to accelerate adoption of mass timber construction in Canada and around the world.

With strong government support, an outstanding research ecosystem, unparalleled industry expertise, and 37% of the world's certified sustainable forests, Canada is leading this revolution in wood construction.

This past decade has seen explosive growth, and the best chapters for mass timber have yet to be written. This report, and its accompanying interactive map, will chart the industry's path towards the future.

And what a bright future it is.

The Honourable Seamus O'Regan Jr.,
Canada's Minister of Natural Resources



The Richmond Olympic Oval featuring a six-acre mass timber roof by StructureCraft.

INTRODUCTION

Mass Timber Projects in Canada*

Structures:
484

Total gross floor area:
1,498,580 m², 16,130,581 sq. ft.

Completed:
412

Under construction:
52

Planned:
20

**floor area per project: minimum 300 m²/3,230 sq. ft.*

Mass timber is a transformative technology made by affixing or gluing together many pieces of wood veneers, flakes or dimension lumber to form larger, stronger pieces such as panels and beams. With wood's natural ability to sequester and mitigate carbon dioxide (CO_2), this green building material is one of our best answers to fundamental 21st century challenges associated with climate change and GHG emissions.

Canada is a natural fit to take a leading role in this exciting new industry. Mass timber is revolutionizing the building industry as a nature-based climate solution. It presents a significant opportunity for Canada's bioeconomy and the forest sector. As high-value wood products, mass timber can play an instrumental role in the circular economy by providing a renewable source of building materials and contributing to a lower carbon footprint for the construction sector.

The SMTC database is the first of its kind to store information from a wide range of industry professionals and government agencies. To be included in the database, a project must have a minimum floor area of 300 m² and a structural use of mass timber, excluding traditional sawn timber or construction techniques (e.g., barns or log homes).

The database compiles information for 484 structures, including bridges, towers, and agricultural buildings, and also captures 21 facilities across Canada that manufacture mass timber. The SMTC interactive map includes all these projects and manufacturers. More structures that meet these criteria will be added in the future to continue tracking this fast growing sector.

The dataset that accompanies the interactive map is the first comprehensive database available publicly on the production and use of mass timber in Canada. It will enable all interested Canadians to follow key trends, find market opportunities, and make more informed decisions related to mass timber initiatives.

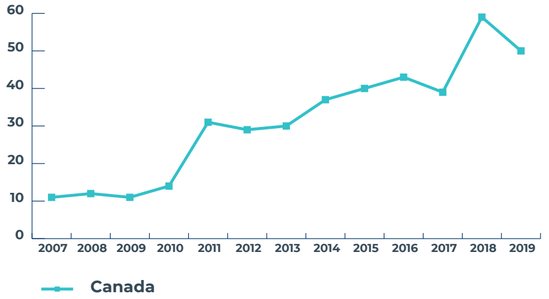
This report highlights many of the key data discoveries and important projects, firms and milestones in the Canadian mass timber industry. The aim is to communicate the benefits of mass timber, foster knowledge exchange and inspire a new generation of projects.

The first year of collected data (2007) shows that 10 mass timber projects were completed in Canada, including the Winnipeg Humane Society building (case study on page 33). Within one year, 12 additional projects had been completed – notably, the Richmond Olympic Oval, an arena with an all-timber, six-acre roof. After "Wood First" policies came into effect in British Columbia and Quebec in 2009, growth continued rapidly with 31 more projects completed in 2011 and 60 projects completed in 2018 alone.

Government support for project development and initiatives such as mass timber education and research is accelerating Canadian innovation at a rapid pace. The steady increase in mass timber projects across the country can be linked directly to the major milestones in Canadian wood policy. This increase is expected to continue as Canada's production capacity for mass timber grows.

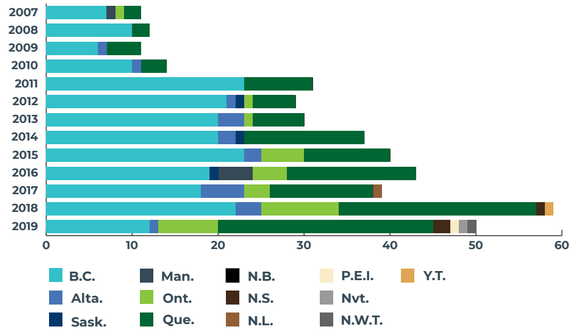
TOTAL NUMBER OF PROJECTS PER YEAR IN CANADA

(by year of completion, 2007-2019)



TOTAL NUMBER OF PROJECTS PER YEAR BY PROVINCES

(by year of completion, 2007-2019)



A close-up of the mass timber columns used in 18-storey Brock Commons building.

BASICS OF MASS TIMBER

History and timeline of mass timber

The origins of mass timber can be traced to building techniques used as long ago as 3400 BC, when Mesopotamians created an early form of plywood by gluing wood strips together at opposing angles. This idea forms the basis for modern wood composite products, including mass timber, which laminates smaller pieces of wood (often more than one type) to create thicker, larger and stronger building materials. Mass timber buildings are resilient, effective ways to lock carbon into the built landscape for up to centuries.

Although conventional light-frame construction is used for about 90 percent of homes built in Canada and the United States, it has not been approved for use in buildings taller than six storeys. This limit is imposed because of shrinkage issues and stringent fire code requirements.

Solid-sawn timber provides a greater degree of structural stability than light-frame construction, but its quality can be unreliable, and it is often unavailable in the sizes required for taller or larger buildings.

Mass timber is defined by both its size and its composite construction, which contributes to its increased strength. Because mass timber can meet or exceed fire code requirements and can be manufactured in dimensions that are suitable for taller buildings, it is revolutionizing the ways that wood can be used.

The first forms of modern mass timber appeared in the late 19th and early 20th centuries, when NLT and glulam were developed (see Mass timber types [page 8]). Some of the first innovators who contributed to developing modern mass timber were European. For example, Swiss engineer Julius Natterer reintroduced NLT to Europe in the 1970s and later helped to develop CLT prototypes that became the basis for today's mass timber products.

Over the next several decades, new technologies – such as computer-aided design and more sophisticated manufacturing methods – enabled the development of "massive" wood composites. Such composites can be much stronger and more versatile than standard solid-sawn timber products. With the rising popularity of CLT, the first North American production lines were established in Canada more than a decade ago.

To be used in tall buildings, mass timber must be both strong enough and fire-resistant. Early studies verified that the outer char layer that forms when mass timber burns is a natural barrier that protects the interior wood, in some cases resulting in a longer fire-resistance rating than steel.

When Canadian and international building codes began to develop the requirements for mass timber use, more evidence of its fire resilience was needed. Consequently, fire testing with full-scale mass timber mock-ups became a prevalent method for evaluating burn rates and overall fire performance, with recent testing in Canada, the United States and Europe.

Consistently, the results have been impressive; many codes require fire-resistance ratings of one to two hours, which mass timber often exceeds. As a result of this commitment to evidence-based testing and safety, it was not until 2017 that mass timber buildings in Canada surpassed 40 m tall.

Fire testing has been important to gain code approvals and variances in Canada. The 13-storey Origine project in Quebec (completed in 2017) underwent an 18-month approval process. The process was supported by the extensive structural and fire tests conducted by the mass timber supplier, Nordic Structures, to ensure optimal structural resilience and fire safety. One of the tallest mass timber structures in North America, Origine demonstrates the practicality of building with wood. In this case, because the site is near a river, it could not support the same height if the structure was constructed of traditional construction materials because of their weight. Projects like this demonstrate the real-world advantages of building with mass timber.

Over the past couple of decades, many Canadian government programs have funded additional mass timber research, projects, and the development of new construction methods and materials, in collaboration with Canada's leading universities and industry experts. The International Code Council (ICC) Ad Hoc Committee on Tall Wood Buildings recommended code proposals for the 2021 International Building Code in the United States. The new codes will allow wood buildings up to 18 storeys tall, based in part on fire tests of mass timber conducted at the Fire Research Laboratory at the United States Bureau of Alcohol, Tobacco, Firearms and Explosives.

Those tests confirmed that mass timber structures perform well in a fire and that fires in mass timber structures can be controlled by fire sprinkler systems.

After the ICC recommendations in 2019, several American states and Canadian provinces approved code variances for tall wood buildings. Almost immediately, an abundance of new mass timber projects were announced across North America.

It is anticipated that the 2020 edition of the National Building Code of Canada (NBCC) will allow tall wood buildings up to 12 storeys tall. A large number of mass timber projects of up to 12 storeys and much higher are being planned across Canada.

Thanks to intensive research and testing, the perception that wood is unsafe for tall structures has been disproved by mass timber. The ease of assembly, its strength and its biophilic benefits combined with its eco-friendly qualities have contributed to the uptake of mass timber, but wood's beauty continues to be a major factor in its appeal.

The 18-storey Brock Commons Tallwood House building during construction.

MASS TIMBER MILESTONES

Built in Toronto,
312 ADELAIDE STREET WEST
is an eight-storey heavy timber and brick building that is still in use today.

1895

1905

The nine-storey
LANDING BUILDING
in Vancouver, British Columbia, originally a supply warehouse for gold rush miners, is Canada's tallest heavy timber building at 30 m. It was restored and renovated in 1987.

1940

- Since the late 1800s, hundreds of Canadian factories, warehouses and manufacturing plants have been built with heavy timber. In Toronto alone, more than 60 wood buildings from this era are taller than five storeys.

1941

- The first NBCC was introduced and included provisions that limited the height of heavy timber buildings to 23 m (75 ft.).

1990

- The NBCC raised the limit on wood construction to four storeys from the three-storey limit imposed in the 1953 edition.

1997

- The first edition of the International Building Code (IBC) was released, allowing wood construction up to four storeys tall.

2005

- The NBCC made more than 800 technical changes, to become an objective-based building code. This was seen as the first major step towards a more performance-based code.

2009

- British Columbia became the first province to allow mid-rise wood construction. The province also passed "Wood First" legislation, requiring wood to be considered as a primary building material for all publicly funded projects and allowing six-storey wood construction.

2011

- FPInnovations published the first Canadian CLT Handbook, accelerating the use and acceptance of CLT in North America.
- The Canadian Commission on Building and Fire Codes recommended increasing the height limit for wood buildings to six storeys, with protective measures.

2013

- Quebec introduced the Wood Charter to encourage wood use for all publicly funded infrastructure projects, becoming the second province to allow six-storey wood buildings.

2014

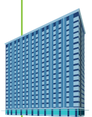
The six-storey
WOOD INNOVATION AND DESIGN CENTRE
(Prince George, British Columbia), by Michael Green Architecture, is one of the world's tallest modern wood structures, at 29.5 m.

- Calgary became the first Canadian city to accept permit applications for wood buildings of five and six storeys.
- Ontario amended the Ontario Building Code to allow wood frame buildings to reach up to six storeys.

2015

- The NBCC increased the limit on wood construction to six storeys.
- Quebec published a guide for constructing mass timber buildings of up to 12 storeys.
- To reflect the rising popularity of mass timber construction, the IBC introduced provisions for structural CLT.

2017



The 18-storey
BROCK COMMONS TALLWOOD HOUSE
(Vancouver, B.C.), by Acton Ostry Architects, became the world's tallest tower made from hybrid mass timber, at 54 m. The following year, it won the inaugural International Prize for Wood Architecture.

The 13-storey
ORIGINE BUILDING
(Québec, Quebec), by Yvan Blouin Architecte, became North America's tallest all-timber condominium structure, at 40.9 m.

- The Shane Homes YMCA at Rocky Ridge (Calgary, Alberta), by GEC Architecture, was completed with the largest free-span timber roof in North America; the structure utilizes 2,750 m³ of glulam timber.

2018

The eight-storey
CARBON 12
(Portland, Oregon), by Kaiser + Path, became the tallest commercial mass timber (CLT) building in the United States.

- Washington and Oregon became the first American states to allow mass timber buildings of up to 18 storeys, based on early adoption of the proposed changes in the IBC.

2019

The 18-storey
MJØSTÅRNET
(Norway), by Voll Arkitekter, became the world's tallest tower made from mass timber (glulam, CLT), at 85.4 m.

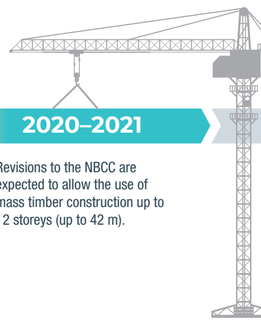
- The ICC approved a set of proposals to allow tall wood buildings up to 18 storeys in the 2021 edition of the IBC.
- British Columbia became the first province to allow mass timber buildings up to 12 storeys, with regional approval. To date, 13 municipalities have adopted the change.
- The eight-storey, three-building Arbora complex (Montréal, Quebec), by Lemay+CHA in collaboration with Provencher Roy, became the world's largest residential project using mass timber (CLT).

2020

The 24-storey
HOHO VIENNA
(Austria) became the world's second tallest building made from mass timber, at 84 m.

- Alberta approved 12-storey construction using mass timber province-wide.
- As part of its CleanBC plan, the provincial government committed further to promoting the use of mass timber.

2020–2021



- Revisions to the NBCC are expected to allow the use of mass timber construction up to 12 storeys (up to 42 m).

BASICS OF MASS TIMBER

CLT is commonly used in post-and-beam and mass timber structures, as well as wooden bridges.

Mass timber types

There are several types of engineered mass timber products on the market today under various trade names. They are generally categorized by the types of wood products involved and by the way that they are bound together.

Because layers of wood are combined to make a larger product, mass timber demonstrates a high load-bearing capacity and is able to meet fire-resistance requirements. Compared to solid sawn lumber, these engineered materials are stronger and less prone to warping or shrinkage. As well, they make efficient use of readily available wood (such as small logs) that otherwise might be underutilized.

Consequently, mass timber is a practical, eco-friendly alternative to conventional construction materials, and it can be used to build taller and larger wood structures than were possible in the past. Relatively lightweight, with exceptional strength, mass timber also enables builders to consider options that otherwise would not be possible.

For example, poor ground conditions limit the weight that it can support. A building built with mass timber weighs three to four times less than one that uses conventional construction materials. Therefore, a mass timber building can be taller than a conventional building in the same location. Each type of mass timber product has its own advantages and uses. Consequently, well over 200 projects in the database used more than one type of mass timber in their construction.

NUMBER OF PROJECTS BY MATERIAL USE

CLT: Cross-laminated timber

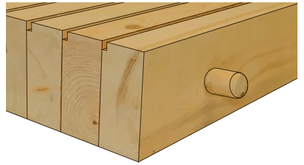
CLT has a high strength-to-weight ratio and exhibits advantages for fire, thermal and acoustic performance, which makes it suitable for floor, roof and wall applications. Panels are prefabricated using several layers of kiln-dried lumber, laid flat and glued together on their wide faces in alternating directions using structural adhesives. Door and window openings are usually precut at the factory using computer-guided machinery, so that each panel is ready for immediate installation. Originally developed in Europe, CLT started to be produced in Canada only within the past decade, and currently has seven manufacturing facilities. The SMTC database includes more than 140 projects (or nearly 30 percent) that use CLT.

NLT: Nail-laminated timber

NLT predates many modern building materials because it was originally manufactured by hand. In Canada, NLT was used for large-scale floor panels in industrial post-and-beam buildings during the early 1900s. NLT is notable because of its relative ease of fabrication and easy access to materials; it requires no unique manufacturing capabilities and can be fabricated with any "off-the-shelf" dimensional lumber.

Modern NLT is manufactured much more quickly because of machine-driven nailing and factory assembly, which allow for prefabrication. Floor panels are built from larger laminations of wood, placed on edge, spanning between beams. The laminations are nailed together, creating a solid floor panel with excellent load-bearing capabilities. In addition to floors, NLT is used for walls and roof applications. Currently, there are four large-scale manufacturers of NLT in Canada. Nearly 60 projects (12 percent) in the SMTC database utilize NLT.

DLT: Dowel-laminated timber



Manufactured without glue or nails, DLT is the only mass timber product that is 100 percent wood; therefore, it can be recycled easily. Layers of softwood are laminated edge-wise together using the friction fit created by hardwood dowels, which adds dimensional stability. DLT can be used for floor, wall and roof structures, and is ideal for acoustical applications. StructureCraft in British Columbia is one of only two manufacturers of DLT in North America. To date, four projects (less than 1 percent) identified in the database across Canada have used DLT.

Glue-laminated timber

The earliest versions of glue-laminated timber were introduced to the building industry in the early 20th century. Glue-laminated timber can be treated for outdoor use, and it easily conforms to curved shapes because of its high strength and stiffness. Glue-laminated timber is manufactured using dimension lumber glued together under pressure. All the lumber laminations run in one direction, parallel to the length of the member/panel. Most of the buildings included in the SMTC database (over 425 buildings or 88 percent of projects) use glue-laminated timber.

Glulam is one form of glue-laminated timber commonly used in load-bearing applications, including posts/columns and beams/girders (i.e., used on edge). The product has tremendous structural capacity, with some long-span beams over 2,400 mm (95 in.) deep. Used in heavy timber applications, glulam provides fire resistance similar to solid sawn timber, but with added structural capacity and minimal shrinkage. Glulam also can be treated for outdoor use, and it easily conforms to curved shapes because of its high strength and stiffness. It is commonly used for free-span roof structures and in timber bridges. Glulam is manufactured at 12 facilities in Canada.

GLT is yet another form of glue-laminated timber that is used flat as panels for decking. Therefore, it is commonly used for floors and flat roof applications. It can also be used for elevator or stair shaft walls. It is typically produced in panels that are two feet wide and of different thicknesses. Currently, seven Canadian facilities produce GLT.

Structural composite lumber

Structural composite lumber (SCL) products are manufactured from layering strands, veneers or flakes with moisture-resistant adhesive, molding them into blocks and cutting them into specified sizes. One of the key benefits of these products is the way in which they improve capacity by removing natural defects in wood, such as knots and checks. SCL products are dimensionally stable and have enhanced engineering properties. Sixteen buildings (3 percent of projects) in the STMC database use SCL products in their projects.

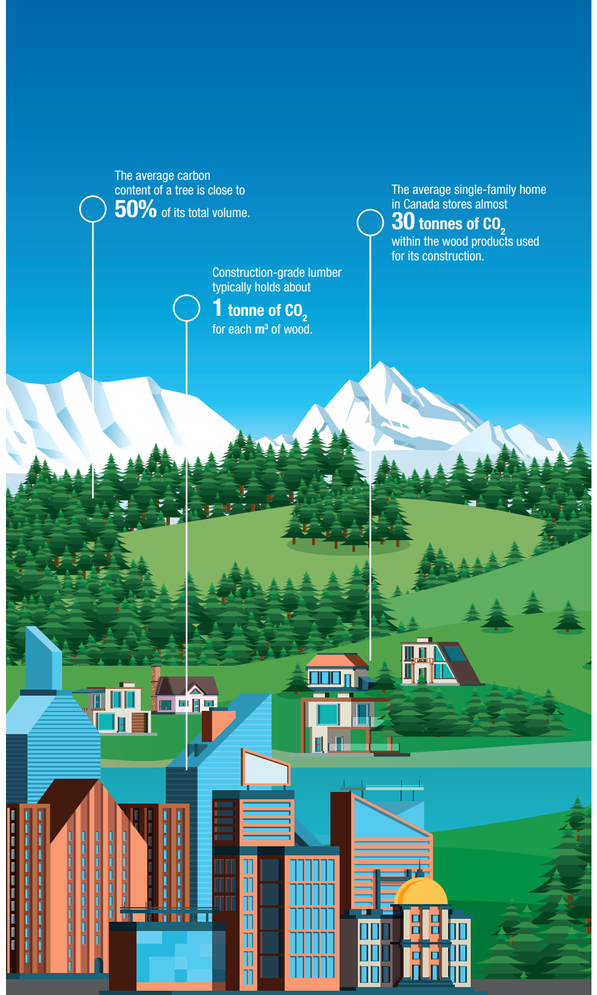
Laminated strand lumber: One of the more recent SCL products to come into widespread use, laminated strand lumber (LSL) provides attributes such as high strength, high stiffness and dimensional stability. The manufacturing process of LSL enables large members to be made from relatively small trees. It is commonly fabricated using fast-growing wood species such as aspen and poplar.

LSL is used primarily as structural framing for residential, commercial and industrial construction. Common applications include headers and beams, tall wall studs, window framing, and floor and roof decking. More recently, LSL panels have been used in large mass timber buildings. LSL also offers good fastener-holding strength. Similar to other SCL materials, LSL is made from wood strands combined with a structural adhesive. The strands are formed into a large mat or billet and pressed. Weyerhaeuser is currently the only company producing LSL in Canada.

Laminated veneer lumber: First used during World War II to make airplane propellers, laminated veneer lumber (LVL) has been used for building construction since the mid-1970s. It is the most widely used SCL product, suitable for structural framing (i.e. columns, beams, walls and floors) because of its strength and stiffness. LVL is made of wood veneers that are coated with a waterproof structural adhesive, then formed into billets by curing in a heated press. The manufacturing process enables large members to be made from relatively small trees, most commonly Douglas fir, larch, Southern yellow pine and poplar. The panels are sawn to desired dimensions and can be finished to accent the grain and to add protection for the exposed wood surfaces. In its finished appearance, LVL resembles plywood or lumber on the wide face. Seven facilities produce LVL in Canada.

Parallel strand lumber: Developed and made commercially available in 1990, parallel strand lumber (PSL) is made from the same veneers as LVL but the veneers are sawn into strands. The strands are coated in structural adhesives and formed into a large mat or billet and then pressed. The billet can be used as a mass timber panel for decking or wall applications or cut into smaller elements to create beams and posts similar to glulam. PSL is a dimensionally stable product with high load carrying capacity. PSL panels can be laminated with structural adhesives into larger components for use as beams and columns in larger and taller wood buildings. Similar to LSL, PSL is currently only manufactured by Weyerhaeuser in Canada.

For more details and technical information on mass timber products, visit the **NRCan Taxonomy of wood products**



Benefits of building with mass timber

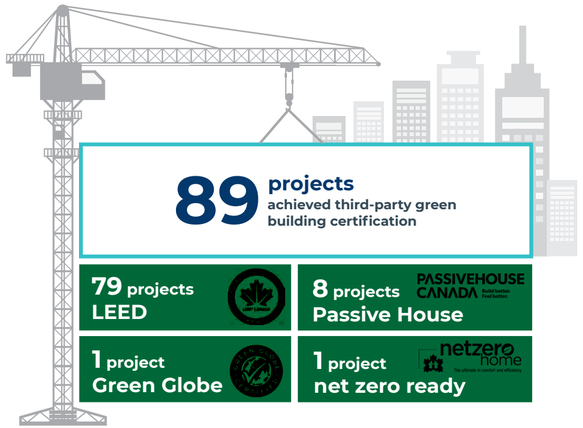
One of the greatest benefits of building with mass timber is wood's ability to sequester CO_2. As trees grow, they capture CO_2 from the atmosphere and store it in the wood. When trees are harvested for building materials, the carbon is captured for the life of the structure. In addition to storing carbon, wood products are associated with low levels of carbon emissions during manufacturing, thus reducing the overall carbon footprint of a building's construction. Combined with sustainable forest practices, mass timber could help to reduce the GHG impact of the construction sector, which represents approximately 39 percent of all emissions globally, according to the 2019 IEA Global Status report.

By some estimates, the average carbon content of a tree is close to 50 percent of its total volume. Construction-grade lumber typically holds about 1 tonne of CO_2 for each cubic metre of wood, while the average single-family home in Canada stores almost 30 tonnes of CO_2 within the wood products used for its construction.

The carbon captured by mass timber can be significant, especially in a tall wood building. For example, the 18-storey Brock Commons Tallwood House at the University of British Columbia (UBC) stores 1,753 tonnes of CO_2, while the total carbon benefit created by the tower's construction process is approximately 2,432 tonnes of CO_2 – equivalent to taking 511 cars off the road for a year.

Several carbon calculator tools have been developed to help the design and construction communities in evaluating the significant environmental advantages of building with wood, including the following:

- In 2002, the Athena Sustainable Materials Institute created the Impact Estimator for Buildings, a software program that can model over 1,200 structural and envelope assembly combinations to determine a life-cycle assessment for the whole building.
- The Canadian Wood Council developed an easily accessible on-line carbon calculator.
- In 2019, the Quebec government launched Gestimat, a web-based platform to compare the GHG emissions of two to six building options that use wood, steel and/or concrete.



Speed of assembly, design efficiency and flexibility are other advantages that have contributed to mass timber's popularity. Mass timber also aligns with increasing interest in circular economy solutions that seek to improve resource efficiency and reduce GHG emissions, thereby contributing to broader climate and environmental goals.

Infill projects and those in densely populated neighbourhoods greatly benefit from using mass timber building components, which are installed quickly and reduce the impacts of on-site construction. With precisely manufactured panels and prefabricated components produced off-site, construction teams are able to streamline the workflow to minimize waste, noise and required labour. While the environmental benefits of mass timber are considerable, the efficient construction process also enables structures to be built faster than ever. For example, in Abbotsford, British Columbia, the timber superstructure for StructureCraft's DLT manufacturing facility was erected in just one week, using prefabricated mass timber panels.

Because of their strength and dimensional stability, mass timber products are a practical alternative to conventional construction materials for many applications. Mass timber buildings also have superior resistance to earthquakes because they are lightweight and flexible.

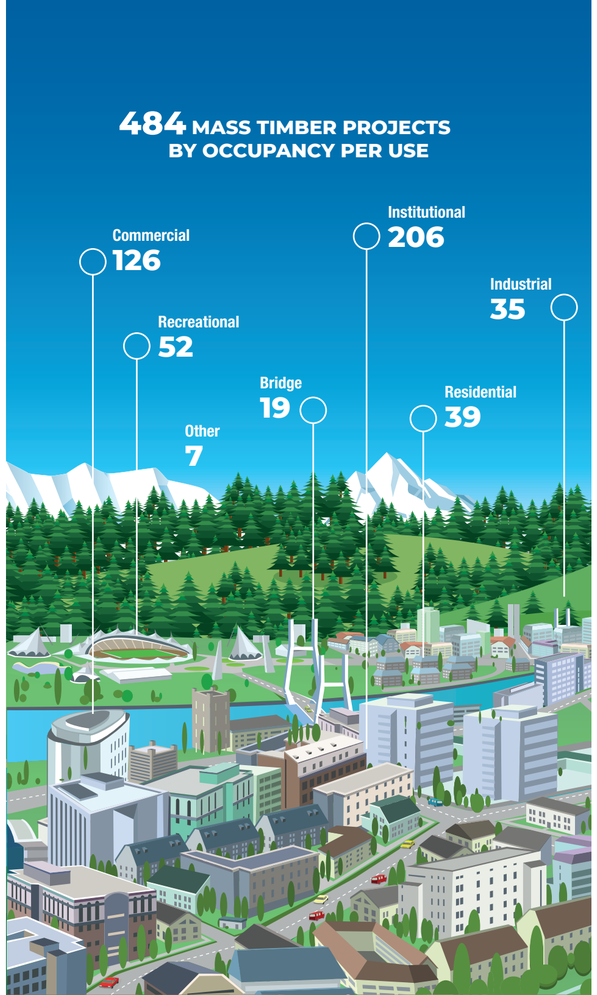
As well, wood's low thermal conductivity provides natural insulation that reduces heat loss; at the same time, the inherent fire resistance of wood ensures greater resilience in fires. This feature means that mass timber is capable of maintaining load-bearing capacity for longer than other materials for long fire exposures, allowing more time to evacuate a building and to extinguish the fire.

Moreover, wood buildings have an established record of long-term durability. From the ancient temples of China and Japan built in the first century to the numerous North American buildings built in the 1800s, wood construction has proven that it can stand the test of time.

The rigorous laws, regulations and policies enforcing sustainable forest management in Canada, as well as the abundance of our natural forests, ensure mass timber's long-term viability as a sustainable building solution. As well, the manufacturing process guarantees consistent results and facilitates the creation of modular components, which are being considered as a solution for affordable housing. This is an emerging evolution of mass timber construction that has the potential to transform many communities across Canada and throughout the world.

Being able to incorporate the beauty of exposed wood without compromising structural integrity compels many designers, builders and developers to use mass timber. Numerous studies have detailed wood's biophilic and health benefits, such as lowered stress levels, improved occupant wellness and increased productivity. Humanity's innate love of nature is stimulated by being surrounded by wood. As a non-toxic material with lasting aesthetic appeal, wood is a natural choice and is the reason that many owners charge a premium when renting office space with exposed wood to account for the highly desired biophilic benefits.

> "The significant environmental and sustainability benefits that mass timber introduces to general construction are well recognized and documented."
>
> **LUBOR TRUBKA**,
> MSc. Arch./Eng, FRAIC, Principal/Founder at Lubor Trubka Associates Architects



Mass timber applications

Mass timber is used for many types of structures, from hybrid (incorporating other materials, such as concrete and steel) to all-wood structures, which comprise a small proportion of the mass timber projects in Canada. There is a growing interest in hybrid mass timber construction because it capitalizes on the best attributes of each material to achieve optimal design and building performance.

Because mass timber is relatively light, a thin layer of concrete is sometimes added to mass timber floor systems because the additional weight minimizes vibration, which also reduces sound transmission.

To increase fire resistance, gypsum board and other materials are used to encapsulate mass timber. But in many cases, the wood can be exposed safely because of mass timber's inherent fire-resistance and charring process, which naturally slow the rate of burning.

When mass timber is exposed to the elements, it can weather naturally or maintain a polished finish, depending on the desired effect and the surface treatment that is applied. In addition to its structural and environmental benefits, mass timber is an attractive material that enhances interior and exterior aesthetics when it is visible.

Although many heavy timber structures up to nine storeys tall were built in the early 1900s, building codes in Canada only began to allow six-storey wood structures in 2009, starting in British Columbia. This change was followed by the NBCC and other provincial building codes in 2015.

The increase in mid-rise mass timber construction has been more gradual, with the majority of mass timber structures in the SMTC database being less than four storeys tall. For example, in 2018, more than 50 low-rise mass timber structures were completed, compared to seven mid-rise buildings.

As building codes have evolved, the use of mass timber has increased exponentially. The SMTC database shows that fewer than 10 mass timber projects were completed in 2007; by 2011, that number had more than tripled, and it continues to grow steadily. With "Wood First" policies in place for more than a decade, British Columbia and Quebec now have the most projects of all types, although public buildings dominate the list. Overall, more than 50 percent of the projects in the SMTC database are public structures, including schools, community centres and infrastructure such as bridges.

International collaboration and intensive research, including fire and structural testing, have led to anticipated code revisions that are expected to allow even more widespread use of mass timber. Awaited provisions in the 2020 NBCC reflect a greater understanding of mass timber's strength and fire resistance, enabling architects to incorporate the various materials with fewer limitations.

By also allowing 12-storey encapsulated mass timber buildings, the 2020 NBCC is another important step as Canada embraces its leadership role in the mass timber industry. This height limit will be surpassed by the upcoming 2021 IBC, which will allow mass timber buildings up to 18 storeys. Not surprisingly, many high-rise mass timber projects have been announced recently, some aiming to reach more than 30 storeys tall (see Projects in development on page 42).

While code requirements have had a large influence on mass timber projects, the development of more sophisticated design methods and materials also contributes to its growing popularity. As architects and builders implement new mass timber applications, they also open the door to further innovation. The rapidly increasing rate of mass timber construction in Canada is a direct response to the availability of resources, along with the advancement of materials and research. With the majority of domestic CLT, GLT and glulam manufactured in British Columbia and Quebec, there is a clear connection to the greater share of mass timber projects in these provinces. These forms of mass timber are also the most commonly used for all types of structures.

Origine, a 13-storey residential building in Quebec City.

Tall wood buildings

In recent years, many countries have announced a growing list of tall mass timber buildings, culminating in proposals for two 80-storey towers. These are the Oakwood Tower (by PLP Architecture) in London, England, and the River Beech Tower (by Perkins + Will) in Chicago, United States. In Japan, Sumitomo Forestry is planning to commemorate its 350th anniversary (in 2041) by building a 70-storey hybrid timber skyscraper in Tokyo.

In 2019, after Norway's Voll Arkitekter completed the world's tallest timber tower, the 18-storey Mjøstårnet (85.4 m), several European countries announced completion of tall mass timber buildings. In 2020, the 24-storey HoHo Vienna, in Austria, became the world's second tallest mass timber building, at 84 m.

These projects were preceded by the 18-storey Brock Commons Tallwood House (by Acton Ostry Architects) in Vancouver, British Columbia, which was the world's tallest hybrid timber tower when it was completed in 2017. This building solidified Canada's reputation as a leader in the development of tall wood structures, and the ongoing engagement of mass timber manufacturers, researchers and architects is ensuring that the legacy continues.

In 2017, the Canadian government provided $39.8 million to increase the use of wood as a green construction material in buildings and public infrastructure projects. This funding led to the creation of the Green Construction through Wood (GCWood) program. The GCWood program builds on the success of the Tall Wood Building Demonstration Initiative (TWBDI). The TWBDI funded two successful demonstration projects: the 13-storey Origine building in Quebec City and the 18-storey Brock Commons Tallwood House in Vancouver.

Over a dozen tall wood buildings in British Columbia, Ontario and Quebec are currently in the planning and construction phases. Projects in development (page 42) highlights a few of the tall mass timber buildings that are in various stages of planning, including a tower in Vancouver that aims to push past 30 storeys.

In late 2020, Dialog (a leading Canadian architecture and engineering firm) announced the development of a new hybrid timber floor system, also using concrete and steel, that is suitable for creating buildings that can reach 100 storeys and even taller. Innovations like these promise to transform what is possible with mass timber.

Low- and mid-rise construction

Close to 85 percent of the mass timber projects in Canada are one or two storeys tall, while another 10 percent have three to six storeys. The most common types in the low- to mid-rise category are offices, followed by community halls and residential buildings. This distribution shows that the non-residential construction market is driving significant growth in mass timber. Historically, non-residential construction has used fewer wood products and therefore represents a large opportunity for market share gains. The segment has seen early momentum with mass timber, with increasing interest in office, education and healthcare buildings.

Québec's Édifice Fondaction (by GHA and Tergos Architecture, built in 2010) was the first six-storey modern mass timber office building in Canada constructed with glulam and GLT. The project is LEED Silver certified. Because of wood's environmental benefits, almost 90 mass timber buildings in Canada qualify for third-party "green" certification, including several Passive House projects.

Passive House buildings consume up to **90** percent less **heating and cooling energy** than conventional buildings and are considered to be the most rigorous voluntary energy-based standard in the design and construction industry.

Federal funding for mass timber projects goes back to as early as 2009 when the Government of Canada supported the design and construction of several mass timber projects across Canada, including the BioEnergy and Demonstration Facility in British Columbia, the Tetra Building in Quebec and Confederation College in Ontario.

Along with its environmental benefits, mass timber is often chosen for its aesthetic qualities and ease of installation. When timelines and costs are critical, mass timber is a reliable choice. Many of the low- and mid-rise projects in Canada are also some of the most innovative, featuring exposed mass timber elements that emphasize this material's versatility and warmth.

The Wood Innovation Research Laboratory is a state-of-the-art wood science and engineering research facility.

Bridges and other infrastructure

Mass timber is a resilient, long-lasting material that adds natural beauty to utilitarian structures. More than 50 mass timber infrastructure projects have been built across Canada since 2007, including bridges, passenger stations and depots, airports, water treatment facilities and power plants. Federal funding was recently announced for the Chalk River Nuclear Laboratory in Ontario, which will feature several mass timber structures designed by HDR | CEI.

Mass timber bridges are one of the most common infrastructure typologies across Canada. The majority of the modern timber bridges (12) in the SMTC database are located in Quebec, continuing a long tradition of using wood to build bridges.

The Temiscamie River Bridge in Chibougamau, Quebec, is one of the first long-span glulam bridges in Canada (built in 2009), and was engineered by Nordic Structures. The company has engineered several other notable bridges in Quebec, including the Maicasagi Bridge (built in 2011) and the Mistissini Bridge (built in 2014).

In Nova Scotia, the Roger Bacon Bridge (by Wood Research and Development Canada) is the longest clear-span, three-lane timber bridge in Canada. It was built in 2019 on existing timber piles that are expected to last another 100 years. By replacing the old steel bridge with mass timber, two-thirds of its weight was reduced, and the new bridge now has an impressive 62.5-tonne carrying capacity.

Mass timber passenger stations and airport buildings comprise 20 projects in the SMTC database. These buildings include six locations in Vancouver along the SkyTrain Evergreen Extension (built in 2016), each featuring GLT roof panels supported by a steel frame.

In Montréal, three passenger depots for the city's $5.3-billion light rail REM line are currently under construction. These depots also have GLT panels over a steel frame (a design collaboration between Perkins + Will, Lemay and Bisson Fortin); completion is planned for 2021.

Recently completed in Ontario, the Vaughan Metropolitan Centre bus terminal (by Diamond Schmitt Architects) features an expansive, horseshoe-shaped glulam and GLT roof system. Water facilities, fire halls and other utilitarian structures are not only enhanced by wood's aesthetic qualities, but mass timber ensures a long-lasting, resilient building that maintains a carbon-friendly footprint.

Duchesnay Creek Bridge was built with mass timber in honour of Ontario's history of wood bridges.

Prefabricated systems

The advantages of prefabrication, including modular and panelized components, strongly influence mass timber's growing popularity. Large structural panels that are manufactured off-site help to reduce construction duration and on-site requirements (including labour and machinery), which also decrease overall costs and safety risks.

Pre-cut window and door openings speed up installation, and other customizations can be added using sophisticated, computer-aided machines (i.e., CNC) that are used in the manufacturing process. Designers can specify precise dimensions with reliable results, which reduces the amount of waste produced during construction. The protected environment of a factory also minimizes the effects of exposure to the elements. Mass timber buildings can be assembled quickly, often in a matter of a few weeks, which is especially helpful for infill projects and those in high-traffic urban areas or in areas with poor weather conditions.

As an added bonus, modular and panelized construction processes allow for easy disassembly and recycling at the end of a building's life, demonstrating mass timber's adaptability for the circular economy. Retrofits, additions and alterations to a building are also facilitated by panelized or modular systems, which can be added or removed more easily than by conventional construction methods.

Several international mass timber projects have implemented modular construction techniques, including The Hotel Jakarta Amsterdam in the Netherlands (by SeARCH, built in 2018), one of the first – and largest – energy-neutral hotels in Europe. The nine-storey, 200-room modular hotel was manufactured using mass timber in less than three months and assembled on site in only 13 days. Each modular room could fit on the back of a standard truck and came fully equipped with a balcony, bathroom and interior finishes.

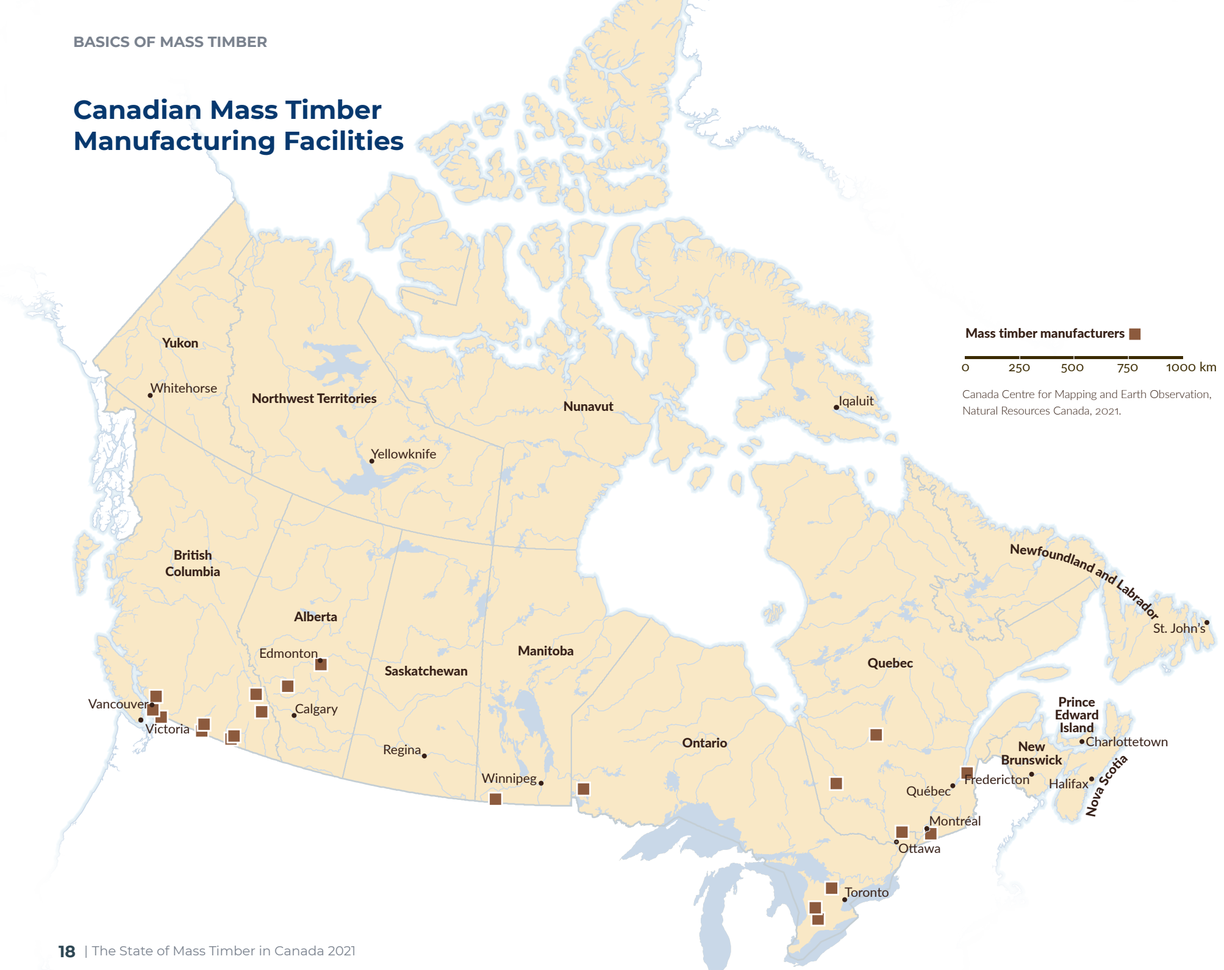
Most mass timber projects benefit from the efficiencies of prefabrication. Modular projects are not common in Canada because it is a relatively new method of assembly. However, British Columbia is looking at many affordable housing projects that use modular design as an option.

Jacobson Hall at Trinity Western University in British Columbia (by BR2 Engineering, built in 2018) is framed completely with wood and contains 90 modules, attached to a CLT elevator shaft. Each module took about 14 days to complete, and the first three floors of the building were assembled in only 11 days.

Several international companies are exploring modular mass timber systems as a solution for affordable housing, while Toronto recently initiated a Modular Housing Initiative to add 1,000 homes to the city. In Vancouver, the design firm Intelligent City is developing innovative mass timber urban housing systems with a modular, multi-storey platform that can be adapted for buildings up to 18 storeys tall.

Cross-laminated timber fabrication process.

Canadian Mass Timber Manufacturing Facilities



Canadian mass timber manufacturing sector

The forest sector is one of Canada's oldest and most important industries, contributing about $25.8 billion to Canada's economy in 2018. The mass timber industry relies on a robust forest sector, which follows sustainable practices to ensure that Canada's forests will regenerate at a rate much faster than they are harvested.

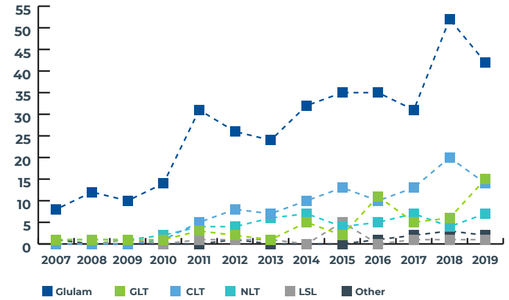
With some of the largest forests in the world, Canada has a unique advantage to supply and manufacture wood products while supporting a renewable resource that also reduces carbon emissions. A local wood supply allows Canada's various mass timber manufacturers to develop competitively priced products, which encourages the use of wood in applications for which it otherwise might not be considered. As the demand for mass timber has increased, Canadian manufacturers have expanded to meet the growing market, with more than 20 production facilities across the country.

An abundance of industry partners has fueled the development of Canada's mass timber industry, but the country's forests are one of the biggest contributors to its growth. From coast to coast, forestry – and a "culture of wood" – has always been an important part of Canada's national identity.

In the early 1800s, the Canadian lumber industry began on the East Coast with some of the earliest settlements, later expanding to the southern Great Lakes region. After the Canadian Pacific Railway was completed in the 1880s, the forestry trade blossomed in British Columbia; within several decades, the province was producing half of Canada's timber.

The Canadian mass timber market is currently developing, with new entrants to the market nearly every year. The glulam market is both the most competitive and most developed, with manufacturing capacity having existed in Canada for decades. After modern CLT was developed in Europe during the 1990s, the first manufacturing plant in Canada was established by Nordic Structures in 2007 and, in 2010, Structurlam started producing CLT in British Columbia. StructureCraft was the first to bring DLT to North America, in 2017. Many smaller producers manufacture NLT.

MATERIAL USE IN PROJECTS OVER TIME
(2007-2019)



CANADIAN MASS TIMBER MANUFACTURING FACILITIES BY PRODUCT

Now, British Columbia has the most mass timber facilities of any province, with nine locations; Quebec has five; Ontario has four; Alberta has two; and Manitoba has one. Proximity to forest resources is a significant factor, but as the popularity of mass timber has grown, so have the number of manufacturing facilities. A full list of manufacturers can be accessed via the SMTC interactive map.

Many of North America's most famous mass timber structures were engineered and/or supplied by Canadian mass timber manufacturers. Some companies, such as Art Massif, produce mass timber only for specific projects, while the majority are commodity suppliers. The 17 mass timber manufacturers in Canada are listed in the following section.

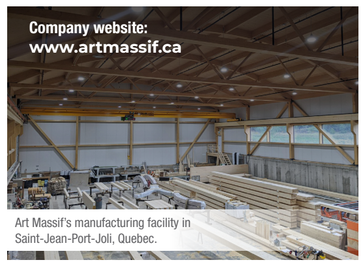
> "The Mass Timber industry is an opportunity for Canadians to be innovators, to add value to raw materials and resources, and to assume a leadership role in the emerging and global mass timber movement."
>
> **PATRICK CHOUINARD**
> Founder + New Business at Element5

Art Massif Wood Structure
(Saint-Jean-Port-Joli, Quebec)

Mass timber products: Glulam

Annual production capacity: 8,000 m³

Company summary:
Established in 2010, this company specializes in glulam construction for low- and mid-rise structures, with more than a dozen projects in Quebec. Art Massif Wood Structure recently invested $5 million into expanding and modernizing its manufacturing facilities. The company also developed a specialized glulam using a spruce core that can be covered by appearance-grade woods, to allow for a wider variety of high-end finishes.



Art Massif's manufacturing facility in Saint-Jean-Port-Joli, Quebec.

Brisco Manufacturing Ltd.
(East Kootenays, British Columbia)

Mass timber products: LVL

Annual production capacity: Not available

Company summary:
Brisco Manufacturing Ltd. produces LVL-based laminated columns, beams and panels. The company has been working with architects, engineers and general contractors to incorporate its new Brisco Fine Line™ products into a multitude of new exposed applications, not just traditional interior uses.

Company website:
briscoman.com

Element5
(St. Thomas, Ontario, Ripon, Quebec)

Mass timber products: Glulam, CLT

Annual production capacity: 60,000 m³

Company summary:
A relative newcomer that started producing CLT in 2017, this company recently built a $50-million manufacturing plant in Ontario, one of two plants making the widest CLT panels in Canada (3.5 m wide and up to 16 m long). Also, its first facility in Quebec was upgraded to have the capacity to produce 10,000 m³ per year of CLT and glulam. Element5 focuses on the design and manufacturing of advanced wall and floor systems made from CLT and glulam, targeting longer spans for commercial projects.

Company website:
elementfive.co

Forex Amos Inc.
(Amos, Quebec)

Mass timber products: LVL

Annual production capacity: 21,000 m³

Company summary:
Forex Amos Inc. began producing LVL in 2015. It produces four grades of LVL at various depths and at lengths of up to 60 ft.

Company website:
forexinc.ca

Fraserwood Industries
(Squamish, British Columbia)

Mass timber products: Glulam

Annual production capacity: 3,243 m³

Company summary:
Fraserwood Industries manufactures three types of glulam: GrainMatched™ glulam, EdgeMatched™ glulam and conventional glulam. The company also offers fabrication, digital design and engineering services.

Company website:
fraserwoodindustries.com

Goodfellow
(Delson, Quebec)

Mass timber products: Glulam

Annual production capacity: 7,000 m³

Company summary:
Goodlam is a division of Goodfellow Inc., specializing in the manufacture and fabrication of glulam and heavy timbers. First established in Louiseville, Quebec, in 1953, the Goodlam plant has moved to Delson, Quebec. The company also offers technical, machining and finishing services.

Company website:
www.goodfellowinc.com

Timber Systems Limited
(Markham, Ontario)

Mass timber products: NLT

Annual production capacity: 13,000 m³/year

Company summary:
Timber Systems, founded in 1980, manufactures Nail Laminated Timber, and also incorporates mass timber products such as glulam, CLT, and GLT into a wide array of project types. They offer a complete turnkey approach to timber construction, with in-house engineering, 3-D modelling, and project management.

Company website:
timsys.com

International Timberframes
(Golden, British Columbia)

Mass timber products: DLT

Annual production capacity: 2,000 m³

Company summary:
Founded in 2003, International Timberframes manufactures and installs two types of DLT: cross-laminated DLT and stacked DLT. It was the first company in British Columbia to manufacture and install DLT in a commercial application.

International Timberframes, located in Golden, BC, process of hand-hewing of mass timber.

Kalesnikoff Mass Timber Inc.
(Castlegar, British Columbia)

Mass timber products: Glulam, CLT, GLT

Annual production capacity: 50,000 m³

Company summary:
Established in 1939, Kalesnikoff Mass Timber Inc. is a multi-faceted forest products company with a sawmill and mass timber and value-added facilities. Its new mass timber manufacturing facility is vertically integrated and uses multiple species in its mass timber products.

Construction of the new Kalesnikoff mass timber manufacturing facility.

Louisiana-Pacific
(Golden, British Columbia)

Mass timber products: LVL

Annual production capacity: 135,921 m³

Company summary:
Louisiana-Pacific has been producing a variety of engineered wood products for over 40 years. In 1997 and 1999, the two laminated veneer lumber (LVL) lines – primarily utilizing Douglas fir – were added.

Company website:
lpcorp.com

Nordic Structures
(Chibougamau, Quebec)

Mass timber products: Glulam, CLT, GLT

Annual production capacity: 70,000 m³

Company summary:
Nordic Structures was among the first mass timber manufacturers in Canada, producing glulam, CLT and GLT. Its sister company, Chantiers Chibougamau, has manufactured forest products for more than 50 years in northern Quebec, harvesting black spruce from the boreal forest. Through research and development, Nordic Structures has developed a "transformation technology" called Enviro-Lam, which makes it possible to use wood fibres as small as 25 x 50 mm to produce large structural members.

Company website:
www.nordic.ca

StructureCraft
(Abbotsford, British Columbia)

Mass timber products: DLT

Annual production capacity: 30,000 m³

Company summary:
StructureCraft is an engineer-build firm specializing in timber structures. They collaborate with architects, owners, and general contractors from design through to construction to bring efficient, signature structures to life. StructureCraft is one of only two producers of DLT in North America and has the world's largest automated DLT manufacturing line. The firm also works extensively with other materials such as CLT, NLT, glulam and steel connections, cables and castings.

Company website:
structurecraft.com


Floor beam supporting mass timber panels with openings for plumbing, electrical cables and other connections.

Structurlam
(Penticton, British Columbia, Oliver, British Columbia)

Mass timber products: Glulam, CLT

Annual production capacity: 40,000 m³

Company summary:
Structurlam has manufactured complex structural timber components for almost 60 years, with a long history of producing glulam. The company began to manufacture CLT over 10 years ago. Structurlam's Brock Commons Tallwood House was the most celebrated project of the 2018 Wood Design Awards in British Columbia. The building set a record by winning in three categories: the Engineer Award, the Architect Award, and the Wood Innovation Award. The company also offers a range of mass timber design, engineering, 3D modelling, and production machining services.

Company website:
www.structurlam.com

Timmerman Timberworks
(New Lowell, Ontario)

Mass timber products: NLT

Annual production capacity: 102,000 m³

Company summary:
Timmerman Timberworks provides engineered wood products to commercial and residential markets. The company provides automated manufacturing of NLT, other mass timber products, and project management, design, engineering, build, and installation services.

Company website:
www.timmermantimberworks.com

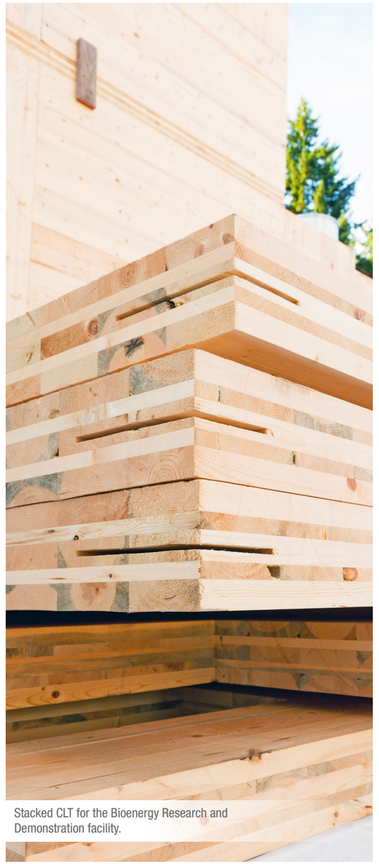
Western Archrib
(Edmonton, Alberta, Boissevain, Manitoba)

Mass timber products: Glulam, GLT

Annual production capacity: Not available

Company summary:
A leader in the design, manufacture and custom fabrication of glulam systems since 1951, this company's product line includes glulam beams and columns, and GLT panels made from several types of wood. Western Archrib also offers a range of engineering and technical support services.

Company website:
www.westernarchrib.com


Stacked CLT for the Bioenergy Research and Demonstration facility.

West Fraser Timber Co. Ltd.
(Rocky Mountain House, Alberta)

Mass timber products: LVL

Annual production capacity: 73,623 m³

Company summary:
A leading diversified wood products company, West Fraser Timber Co. Ltd. produces four grades of LVL at various depths and lengths. Its engineered LVL is manufactured from northern lodgepole pine.

Company website:
www.westfraser.com

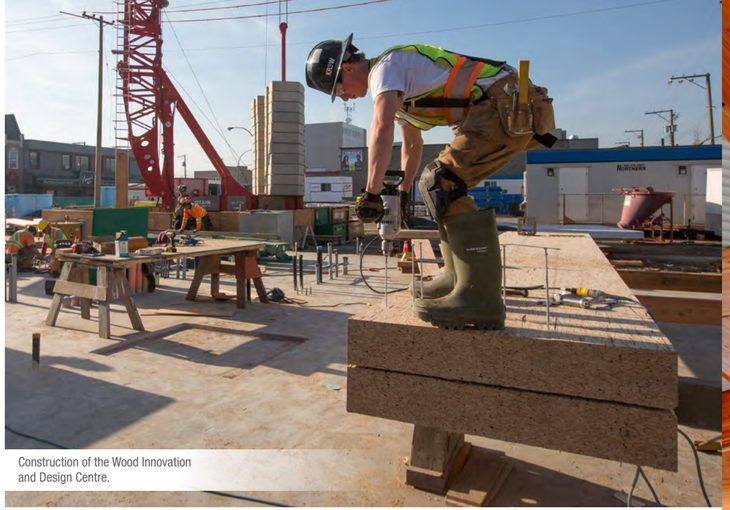
Weyerhaeuser
(Delta, British Columbia, Kenora, Ontario)

Mass timber products: LVL/LSL/PSL

Annual production capacity: 424,752 m³

Company summary:
As a long-term manufacturer of structural composite lumber (SCL) products and currently the only producer of LSL and PSL products in Canada, Weyerhaeuser is an industry leader in engineered wood products. This is exemplified in the significant quantity of SCL products that the company manufactures each year, comprising nearly 40 percent of Canada's overall mass timber production.

Company website:
www.weyerhaeuser.com



Construction of the Wood Innovation and Design Centre.

> "As the mass timber industry grows across Canada, there is the possibility that it can generate new economies that can empower and include many communities. Beyond the potential economic impact on communities, there is also the potential to unlock an authentic aesthetic expression for Canadian architecture."
>
> **CAROL PHILLIPS,**
> BES, B.Arch., FRAIC, LEED AP, Partner at Moriyama & Teshima Architects

The grove of trees flourishing in the atrium of Credit Valley Hospital helps patients with recovery.

MASS TIMBER CONSTRUCTION IN CANADA

Recent projects and industry growth

This chapter highlights a cross section of projects, the oldest built in 2007. With hundreds of projects in the database, selecting only one to represent each province or region offers a mere glimpse of the potential of mass timber. While the SMTC database includes buildings with a minimum floor space of 300 m^2 using mass timber as a key structural element, well over 1,000 buildings in Canada have used mass timber as a key design component. One example is the award-winning Calgary Central Library (by Snøhetta, with Dialog).

The mass timber industry's rapid development in Canada is reflected by the exponential growth of yearly projects, with over 50 completed in 2019; notably, half of those projects were in Quebec. A brief overview of each region's most significant projects and architects touches on some of the most important moments in 21st-century Canadian architecture – which increasingly features mass timber.

Government support has been instrumental in this industry's growth, and over $30 million in GCWood funding has been allocated for several upcoming mass timber projects. The first to be announced in 2019, The Arbour, is included in the section entitled Projects in development (page 42) By supporting tall wood projects in Canada, government funding is helping to advance the utilization of mass timber in a variety of applications where wood is typically underutilized.

The SMTC database represents the full range of building typologies. With leadership by provincial and federal agencies, public projects are choosing mass timber construction more frequently each year, with more than 50 mass timber schools and student residences across Canada to date. Over a quarter of the database projects are healthcare and community structures such as hospitals, libraries, museums and park facilities. The predominance of public projects can be attributed in large part to provincial "Wood First" policies.

Indigenous projects account for more than 30 structures in the SMTC database, many of which are Canada's most meaningful buildings, and so two examples are included in the following case studies.

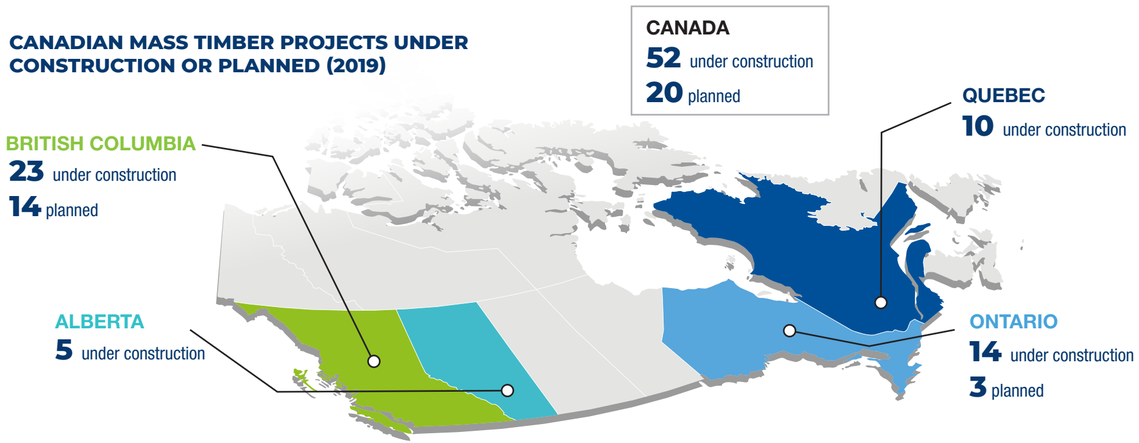
The representation of diversity in architecture involves a larger conversation, including the role of women. One of Canada's most famous architects who works with wood, Patricia Patkau, co-founded Patkau Architects. The Vancouver-based firm designed the Capilano Library (page 31) and many other award-winning projects, including the world-famous Audain Art Museum in Whistler, British Columbia.

With an abundance of forests, Canada's West Coast has a strong cultural connection to wood, which is reflected in the strength of its mass timber industry. Several Vancouver-based architects and engineers dominate the list of built mass timber projects in the SMTC database. The list includes HCMA Architecture + Design and KMBR Architects (12 projects each), followed closely by HDR | CEI (9 projects), and McFarland Marceau Architects (8 projects). Engineering the largest share of projects, Fast + Epp, Equilibrium Consulting Inc. and RJC Consulting Engineers worked on almost 100 structures (collectively) in the SMTC database.

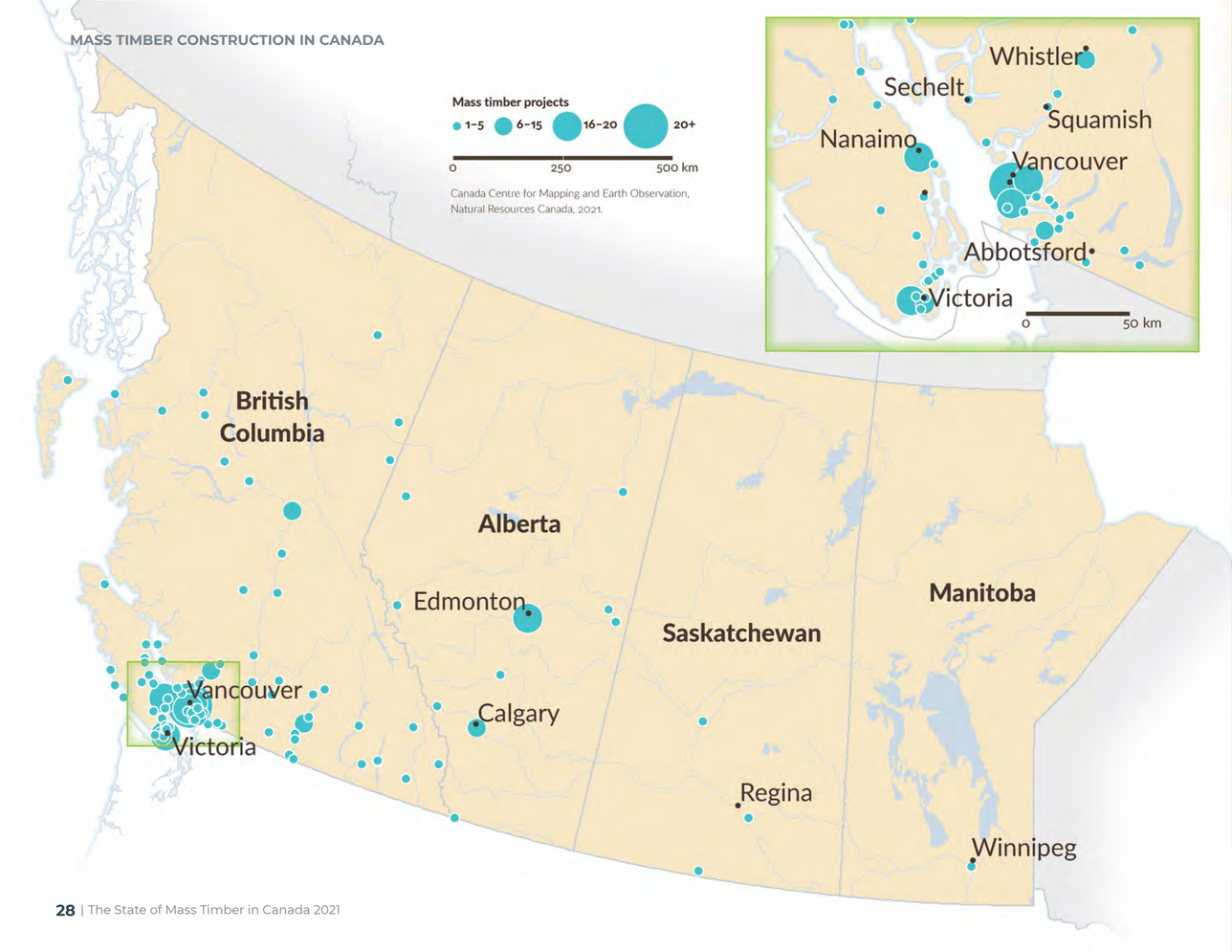
Together, as "Wood First" leaders, British Columbia and Quebec account for 84 percent of the gross floor area (1.5 million m^2) captured in the database. However, as building codes and industry development continue to evolve across Canada to encourage mass timber construction, it will be interesting to see how these trends change in future editions of this report.

> "It will be the success of humble and ordinary mass wood buildings that will be the foundation upon which tall wood buildings of the future will make spectacular contributions to sustainability in cities around the globe."
>
> **RUSSELL ACTON,**
> FRAIC, Partner/Co-Founder at Acton Ostry Architects

CANADIAN MASS TIMBER PROJECTS UNDER CONSTRUCTION OR PLANNED (2019)



Patkau Architects has designed many world-renowned structures that feature wood, including the Audain Art Museum.



Glulam posts supporting mass timber beams of the Wood Innovation and Design Centre

British Columbia and the Prairies

As the location for more than half of the projects in the SMTC database, British Columbia is a Canadian – and international – leader in the mass timber industry. In late 2009, the *Wood First Act* mandated that provincially funded projects in British Columbia should use wood as the primary construction material, and it allowed for six-storey wood construction.

This policy clearly influenced the adoption of wood and mass timber, especially in Alberta where the province adopted mid-rise wood frame construction back in 2015. In contrast to British Columbia, the Prairie provinces have built considerably fewer projects, although several of those have become award-winning examples of mass timber innovation. In 2020, Alberta was also the first province to allow wood buildings up to 12 storeys in all jurisdictions.

Several of the architects based in British Columbia are acclaimed for their work with wood, especially mass timber. Michael Green Architecture (MGA) was founded in 2012. One of the firm's most famous projects is the seven-storey T3 Minneapolis, which was the tallest wood building in North America when it was completed in 2016. A few years earlier (in 2014), MGA had built the tallest modern mass timber structure in the world, the six-storey (29.5 m) Wood Innovation and Design Centre in Prince George, British Columbia.

One of Canada's best-known female-led firms that champions Indigenous design and working with wood is Vancouver-based Urban Arts Architecture. The firm has won awards for several mass timber projects, including the Radium Springs Community Hall and Library (2018) – one of the first public buildings in British Columbia to use DLT.

In Alberta, Edmonton-based Manasc Isaac Architects is responsible for some of the province's most exciting mass timber projects, including the Red Deer College Student Residence, which clearly demonstrates a commitment to eco-friendly, biophilic design. As a regional advocate for mass timber, the award-winning firm started by designing high-performance buildings in the Canadian Arctic, and many of its projects have achieved LEED certification.

Tsleil-Waututh Administration and Health Centre, North Vancouver

BRITISH COLUMBIA CASE STUDY

The Tsleil-Waututh Administration and Health Centre reinforces traditions through the use of wood.

The Tsleil-Waututh Administration and Health Centre features wood prominently throughout the building.

BUILDER/CONSTRUCTION MANAGER:
Syncra Construction Management

ARCHITECT: **Lubor Trubka Associates Architects**

ENGINEER: **Fast + Epp**

WOOD SUPPLIER: **BC Passive House, Structurlam**

Mass timber:
Glulam posts and beams, CLT, NLT roof panels

Floor space (m^2):
2,881

Completion:
2019

This First Nations project is one of almost 90 buildings in the SMTC database with a primary structure that is all wood. The new seat of the Tsleil-Waututh Nation government was completed as the first phase of a campus-style village centre located on a mountainside site overlooking the Burrard Inlet near Vancouver, British Columbia.

Tsleil-Waututh means “People of the Inlet”; the symbiotic connection between this Indigenous culture and the sea is embodied in the wavy forms of the roof. The largest roof form is over a central, multipurpose gathering space that is the heart of community events and serves as a Council Chamber for government meetings.

The values of the community’s cultural heritage are embodied in the design solutions and were developed through an integrated collaborative design process with the entire Tsleil-Waututh community. The building is placed on a north-south axis and follows the course of a creek on the east side of the site, with views of both the forests and ocean. Cedar log columns and beams, symbolic of traditional structures, define the Government Chamber, which can be easily closed off for privacy or opened up to provide an addition to the main gathering space.

The interiors are created by exposing every structural building element without the need for additional artificial interior finishes. This required precision pre-manufacturing off-site and skillful concealment of the dense network of building services. An abundance of windows allows for plenty of natural light, minimizing the need for electrical lighting, while operable windows provide fresh air year-round in the temperate climate. Green roofs are planted with indigenous plant species to help regulate the indoor temperature, save energy and encourage biodiversity.

Capilano Branch Library, Edmonton

ALBERTA CASE STUDY

An impressive look at the 77-m continous folded wood roof from inside the Capilano Library.

An exterior view of the Capilano Library in Edmonton, Alberta

BUILDER/CONSTRUCTION MANAGER:
PCL Construction Management

ARCHITECT: **Patkau Architects with Group 2 Architecture**

ENGINEER: **Fast + Epp**

WOOD SUPPLIER: **Western Archrib**

Mass timber:
CLT roof

Floor space (m^2):
1,157

Completion:
2018

The Capilano branch of the Edmonton Public Library is a single-storey facility that serves over 165,000 visitors annually. On the outside, the dramatic, black aluminum-clad roofline is offset by a wood soffit that emphasizes the dynamic angles. Douglas fir CLT panels are used for the primary roof structure, supported by steel framing that was prefabricated and delivered in sections.

The continuous, angular CLT roof runs the 77-m length of the structure. It has three peaks that also help to define the interior spaces, including a community programming room and a Makerspace area with a 3D printer and sewing machine. The interior’s angular wooden ceiling is an appealing focal point and serves as a unifying element throughout the building. Ample glazing provides a connection to the outdoors, and wood slats diffuse the sunlight and create a grid of shadows that adds to the dynamism of the space. A 55-m-long window with seating overlooks a wooded ravine, which the city is restoring with tree plantings and native species.

The LEED Silver building was constructed in only 18 weeks and incorporates sustainable features such as LED light fixtures, a heat recovery system, low-flow water fixtures, bicycle storage, a change room and an electric vehicle charging station. Recycled content was included in the structural steel, steel studs, gypsum board and CLT. During construction, more than 95 percent of waste (approximately 98 tonnes) was diverted from the landfill. Along with winning a 2020 Prairie Wood Design Award, the library also won the prestigious 2020 AIA/ALA Library Award.

École Gravelbourg School, Gravelbourg

SASKATCHEWAN CASE STUDY

École Gravelbourg School has beautiful high ceilings and massive colourful windows that allow natural light to pour into the small town school.

The Gravelbourg School provides a dynamic and collaboration-focused learning space for students and educators.

BUILDER/CONSTRUCTION MANAGER: **Quorex Construction**
ARCHITECT: **P3 Architecture**
ENGINEER: **ISL Engineering**
WOOD SUPPLIER: **Structurlam**

Mass timber:
Glulam, NLT

Floor space (m^2):
1,300 (addition only)

Completion:
2016

This school underwent renovations and an addition to the high school to accommodate the inclusion of the elementary school. The project vision was developed with students, staff and the community using a collaborative design process. The dramatic update added 1,300 m^2, including classroom space, a new library and media centre, multipurpose areas, and offices.

A combination of coloured glass accents and exposed structural wood create an appealing entryway, with a continuation of the exposed wood and unexpected touches of colour throughout the airy, bright interior. The mass timber addition was completed in nine months.

A daycare facility is also connected to the school, thereby combining early learning, elementary and secondary education under one roof.

The design of the school is intended to harmonize with the nearby 19th century heritage buildings, which is a designated National Historic Site – an important feature in the small, multicultural town with fewer than 1,000 homes.

Some of the first settlers in the town were French and, even today, close to one-quarter of the community members identify French as their first language, and nearly 40 percent are bilingual. The town, which calls itself "a touch of Europe in the Prairies," also prides itself on four pillars: culture, heritage, spirituality and architecture.

Having won the 2017 Premier's Award of Excellence in Design – Award of Merit in Architecture, this school has earned its rightful place as a community beacon.

Winnipeg Humane Society, Winnipeg

MANITOBA CASE STUDY

Connectors used in the design of the Winnipeg Humane Society.

The Winnipeg Humane Society has a brick exterior and its interior is mass timber frame construction.

BUILDER/CONSTRUCTION MANAGER: **Bird Construction**
ARCHITECT: **SWATT | MIERS Architects with Number TEN Architectural Group**
ENGINEER: **Crosier, Kilgour & Partners**
WOOD SUPPLIER: **Western Archrib**

Mass timber:
Glulam roof

Floor space (m^2):
3,810

Completion:
2007

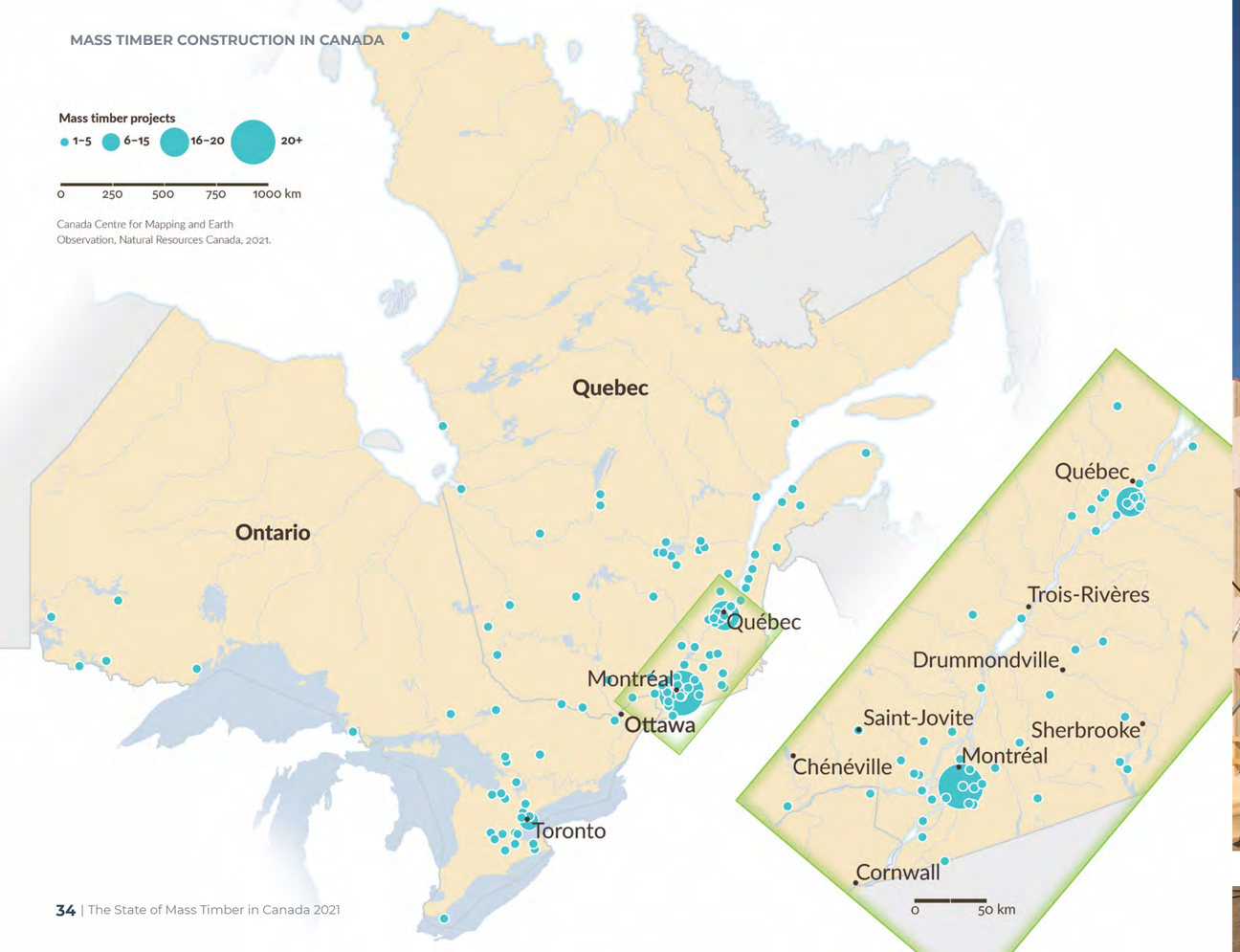
This innovative, environmentally sustainable building is the first LEED Silver animal shelter in Canada, built exclusively with local, natural and recycled materials.

Previously, the various community services were in different locations, so this project brought several departments together under one (glulam) roof, with the capacity to hold 10,000 animals per year. To achieve the building's environmental goals, it features waterless urinals, low-flow water fixtures and a 10,000-gallon underground storage tank that supplies rainwater for flushing toilets. It also has a geothermal system of heat pumps and groundwater wells to regulate central heating and cooling and other eco-friendly features. Overflow from the water storage tank goes into a retention pond designed to offset the burden on the city's storm sewer system.

The facility includes a full-service veterinary clinic capable of performing all types of medical procedures. With over 120 years of community service, the organization hosts many public functions. It has an education area that includes a multipurpose space for presentations, day camps and dog obedience classes.

Special attention to natural lighting and ventilation (essential for the animal holding areas) creates a pleasant, healthy atmosphere where volunteers and guests can enjoy their visits. The abundant use of wood adds warmth to the interiors.

Glulam beams and purlins top a hybrid structure that integrates steel, concrete and wood. Together, these elements create a welcoming environment that is worlds away from dreary shelters of the past. Offices and common spaces are enhanced by large windows with views of the natural landscape, which includes walking trails, prairie grass and trees.



Origine residential building during construction of the mass timber walls.

Ontario and Quebec

Collectively, Ontario and Quebec account for close to 200 mass timber projects in Canada. Because of their progressive wood policies, along with British Columbia, these three provinces contain almost 450 of Canada's mass timber projects, with that number increasing steadily.

With a robust forest sector in place, Quebec was the second province to institute a "Wood First" policy called the Wood Charter in 2013. The charter encouraged early adoption and innovation that continues to place the province among Canada's mass timber leaders. Close to 20 mass timber projects were built before 2012 in Quebec, including the UQAC Arena (case study page 37). This ground-breaking project was followed by the Laval University PEPS TELUS Stadium (by Hudon Julien Associés, ABCP and HCMA Architecture, 2011) and the Stade de soccer de Montréal (by Saucier + Perrotte and HCMA, 2015). These buildings feature glulam beams that span 67.6 m.

In 2019, Quebec completed 25 mass timber structures, a yearly record within Canada.

In 2012, the renovation and expansion of the Wayne Gretzky Sports Centre in Brantford (by CS&P Architects) was the only modern mass timber project in Ontario. By 2015, the award-winning Scarborough Civic Centre Library (by LGA Architectural Partners) was the third mass timber project in the province. 2017 was the first year that Ontario surpassed 10 mass timber projects. In the next several years, dozens of mass timber projects are scheduled for completion, including several of the country's most anticipated tall wood buildings.

> "Use of timber is directly aligned with the direction we see for the future of our practice and has given renewed purpose to our core values."
>
> **CAROL PHILLIPS,**
> BES, B.Arch., FRAIC, LEED AP, Partner at Moriyama & Teshima Architects

80 Atlantic Avenue, Toronto

ONTARIO CASE STUDY

Interior view of 80 Atlantic, Toronto's first new timber-frame commercial building to be built in a generation.

Exterior view of 80 Atlantic, a modern office building that offers high-design work environments and collaborative spaces.

BUILDER/CONSTRUCTION MANAGER: **Eastern Construction**

ARCHITECT: **Quadrangle Architects**

ENGINEER: **RJC Engineering**

WOOD SUPPLIER: **Nordic Structures (glulam), Timmerman Timberworks (NLT)**

Mass timber:
Glulam posts and beams, NLT floor and roof panels

Floor space (m^2):
8,825

Completion:
2020

Ontario's first mass timber commercial building in over 100 years was made possible by revisions to the province's building code in 2015, which made six-storey commercial wood buildings possible. The design is a modern take on the iconic, century-old brick and beam warehouse buildings that are being adapted for reuse as offices, condos and studio lofts in major cities everywhere.

Comprising four storeys of mass timber above a one-storey concrete podium, the new building completes a courtyard with the neighbouring structure to create a paired commercial development. Interiors were left raw for tenants to customize, while exposing long expanses of the spruce-pine-fir NLT floor and ceiling panels, and glulam beams and columns.

The floors are topped with plywood sheathing, an acoustic mat and concrete to reduce sound transmission. The large glulam beams for this project were actually manufactured in two parts and "stitched" together on site with screws. The architect estimates that using mass timber resulted in half the embodied carbon compared to the same building constructed in concrete.

A high-visibility glass curtain wall allows the interior to be viewed at night by passersby, while a specialized coating controls solar heat gain and glare in the daytime. A green roof also enhances the eco-friendly benefits of the design.

This structure clearly demonstrates the sustainable, aesthetically striking and cost-effective benefits of mass timber, while reducing carbon emissions by approximately half when compared to a similar building with conventional materials.

The building won a 2019 Wood Design & Building Award (Citation) and the Ontario Wood WORKS! Mass Timber Wood Design Award, along with two 2020 Real Estate Excellence Awards for Office Development of the Year and Green Development of the Year.

UQAC Arena, Saguenay

QUEBEC CASE STUDY

The UQAC Arena features a hybrid wood-steel truss system supporting a glulam deck.

The UQAC Arena's beautiful timber reduces the overall environmental footprint of the building.

BUILDER/CONSTRUCTION MANAGER: **Unibec**

ARCHITECT: **Lemay with Ardoises Architectes**

ENGINEER: **Conception Habitat 2000, ACE Engineering Consultants, Cégertec**

WOOD SUPPLIER: **Nordic Structures**

Mass timber:
Glulam trusses, GLT panels

Floor space (m^2):
4,600

Completion:
2009

This hybrid structure uses 283 m^3 of wood, accounting for approximately 70 percent of the construction materials.

Designed for the University of Quebec at Chicoutimi (UQAC), which enrolls more than 6,000 students each year, this sports building includes an ice rink, changing rooms, indoor stands for 250 people and outdoor stands for 1,000 people. Composite girders using glulam with steel tensioners are topped by a wooden roof deck, with large structural spans of 35 m. The angular beams create extra height above the public space, allowing for the addition of a press gallery and related rooms upstairs.

Because this region is susceptible to earthquakes, a thorough seismic design was carried out. In addition to providing excellent structural properties, the timber reduces the overall environmental footprint of the building, with a net reduction of 104 tonnes of carbon. A partial green roof system further enhances the structure's eco-friendly features.

This project won a 2013 Cecobois Award of Excellence.

Embedded steel elements unite mass timber elements through bolted connections.

Atlantic and northern regions

The SMTC database includes nine projects in the Atlantic and northern regions of Canada, all of which were built in 2017 or later. These regions have policy and code restrictions, but many are not close to a mass timber supplier or have a lower level of construction, which has influenced the adoption of mass timber.

The earliest project was the Paul Reynolds Community Centre (by Fougere Menchenton Architecture and CEI Architecture) in St. John's, Newfoundland and Labrador. It is a CLT and concrete and steel hybrid that uses 200 wood panels to form the roof structure.

With the exception of one building, all the mass timber structures in the Atlantic and northern regions are community centres, schools or infrastructure projects.

With four projects, Nova Scotia is the leader among the Atlantic and northern regions. A prime example is the Roger Bacon Bridge in Nappan, which is the longest clear-span, three-lane timber bridge in Canada. Completed in 2019, Nova Scotia's East Hants Aquatic Centre and Recreation Facility (by MJMA and TEAL Architects + Planners) features NLT panels on a steel frame.

The Atlantic case study features one of the country's most visited and quintessentially Canadian mass timber destinations: the Green Gables Visitor Centre in Prince Edward Island. The northern case study, the Salt River First Nation Multipurpose Facility, is the only mass timber structure in the Northwest Territories.

> "In the times of increased uncertainty for production and transportation of materials, it is becoming even more sustainable to focus on local industries. Mass timber is one of them. Proudly Canadian and truly renewable – this is a flag worth raising up high!"
>
> **VIVIAN MANASC**,
> MBA, LL.D. (Hon), AOE, FRAIC, LEED AP, Partner/Co-Founder at Manasc Isaac Architects

Green Gables Visitors Centre, Cavendish, Prince Edward Island

ATLANTIC REGION CASE STUDY

Meandering ramps move through the Lucy Maud Montgomery Exhibition space, with exposed mass timber frames above and a glazed end wall on the east side of the building.

Gable forms shape the farm-style buildings throughout, each supported by mass timber framing.

BUILDER/CONSTRUCTION MANAGER:
Williams Murphy & MacLeod (1993) Ltd.
ARCHITECT: **Root Architecture Inc.**
ENGINEER: **CBCL Limited**

Mass timber:
Glulam posts and beams, NLT roof panels

Floor space (m^2):
1,190

Completion:
2019

This 19th-century farm property, referenced in *Anne of Green Gables* as the heroine's childhood home, has become one of the most visited federal parks in Canada. A culturally important tribute to one of Canada's most famous authors, Lucy Maud Montgomery, the property has been owned and operated by Parks Canada since the 1930s. To accommodate the growing number of guests, a renovation and expansion was undertaken. In the second phase, the Green Gables Visitors Centre was built, along with the addition of a commercial kitchen and cafe.

Mass timber was a natural match for the traditional timber framing used for the original barn. The Exhibit Hall provides a dramatic view of the Green Gables House, while providing plenty of space for guests to browse the historical displays. Exposed wood is an important aesthetic feature, but it also reveals the glulam post-and-beam structure that comprises 85 percent of the columns, beams and trusses. Locally assembled NLT roof panels allow the interior to have an uncluttered appearance.

In keeping with a focus on using eco-friendly building materials, the centre was designed to LEED Gold standards, with 100 percent renewable energy through a combination of roof-mounted solar panels and Green Power purchasing. Natural daylighting and LED fixtures contribute to the energy-efficient design. This project was made possible through a Parks Canada investment that was part of a $3-billion fund to rehabilitate infrastructure assets within national historic sites, national parks and national marine conservation areas.

Salt River First Nation Multipurpose Facility, Fort Smith, N.W.T.

NORTHERN REGION CASE STUDY

The Salt River First Nation Multipurpose Facility is constructed with a heavy timber framing system of glulam panels, beams, and columns.

The Salt River First Nation Multipurpose Facility represents the shape of the First Nation's land.

BUILDER/CONSTRUCTION MANAGER:
Clark Builders/Turner Construction
ARCHITECT: **Manasc Isaac Architects**
ENGINEER: **Fast + Epp**
WOOD SUPPLIER: **Western Archrib**

Mass timber:
Glulam posts and beams, GLT panels

Floor space (m^2):
2,455

Completion:
2019

When this First Nation community decided to build a new multipurpose facility for its community government and administration offices, wood was a natural choice to maintain a sense of tradition.

Housing administrative offices, a courthouse, a 400-seat community hall, cultural and leasable space, along with a commercial kitchen capable of serving hundreds of guests, this diverse facility combines timeless heritage themes with modern design.

The Oxbow River, found on the original lands of the Salt River First Nation, inspired a wavy pattern that winds across the linoleum flooring, suggesting a river that flows through the building. The building's footprint also was designed to suggest the river's shape.

The new facility immediately became a valued community hub. As a result of the inclusion of wood, the carbon benefit of this facility is 662 tonnes of CO_2, equivalent to taking 140 cars off the road for one year.

Connection system for The Centre for Interactive Research on Sustainability.

Projects in development

In the SMTC database, well over 70 mass timber projects are either under construction or in the planning phases – and the numbers continue to grow, as more developers and builders discover the advantages of mass timber.

A wide range of upcoming projects include mid-rise and high-rise apartment buildings, office structures, schools and a variety of other public facilities, such as museums and community centres. Following are highlights among the many mass timber projects currently under development across Canada that can be tracked on the SMTC interactive map.

> Mass timber is transforming the way we design and construct our buildings. [...] From full 3D design models, to high-accuracy CNC machining, to speedy site installation of prefabricated components, mass timber has evolved and created a niche for itself like no other construction material.

DAVID MOSES,
PhD, PEng, PE, LEED AP, Principal at Moses Structural Engineers

Image of a mass timber elevator shaft.

LOW- and MID-RISE CONSTRUCTION

Simon Fraser University Student Union Building, Vancouver, British Columbia

- 5 storeys, 10,279 m^2; designed by Perkins + Will, in collaboration with Fast + Epp
- hybrid: glulam posts and beams with concrete and steel
- targeting LEED Gold certification
- almost complete

Waterton Lakes Visitor Centre, Waterton, Alberta

- 1 storey; designed by FWBA Architects
- hybrid: glulam posts-and-beams, steel framing, concrete shear walls
- almost complete

Kehewin Cree School, Bonnyville, Alberta

- 2 storeys, 3,000 m^2; designed by Manasc Isaac Architects
- hybrid: glulam posts and beams, GLT panels, concrete
- under construction

Honey Bee Research Centre, Guelph, Ontario

- 1 storey, 1,784 m^2; designed by Moriyama & Teshima Architects
- public spaces include classrooms, exhibition areas, a café and gift shop
- glulam “egg crate” roof and lattice structure
- under construction

Toronto and Region Conservation Authority Building, Vaughan, Ontario

- 4 storeys, 8,100 m^2; designed by ZAS Architects and Bucholz McEvoy Architects
- an all-wood, glulam post-and-beam structure with solar panels and a green roof; a net-zero, energy-efficient building designed to meet LEED Platinum standards
- under construction

Centennial College Expansion, Toronto, Ontario

- 5 storeys, 13,941 m^2; designed by Dialog with Smoke Architecture
- hybrid: CLT floor and roof panels on glulam posts and beams, light steel frame
- under construction

Anishinabek Discovery Centre, Sault Ste. Marie, Ontario

- 2 storeys, 1,868 m^2; designed by Two Row Architect
- state-of-the-art library, archives and gallery for Indigenous post-secondary studies
- hybrid: glulam posts and beams, light steel frame
- almost complete

Complexe sportif Aquagym de Dolbeau, Dolbeau, Quebec

- 1 storey, 1,812 m^2; designed by Ardoises
- hybrid: glulam beams and GLT panels, light steel frame
- almost complete

Esplanade Clark Pavilion, Montréal, Quebec

- 2 storeys, 1,255 m^2; designed by Les architectes fabg
- a concrete post-and-beam structure on the ground floor that supports CLT structure crowned by a green roof. The pavilion surrounds a public gathering space that transforms into an ice rink in the winter.
- under construction

View from the interior of the Fast + Epp mass timber office building.

TALL WOOD BUILDINGS

1766 and 1794 Frances Street, Vancouver, British Columbia

- 9 storeys, 7,848 m^2; designed by GBL Architects
- 84 units for Indigenous tenants; 35 percent of apartments are sized for large families
- hybrid mass timber structure with CLT floor, roof and envelope panels and steel structural columns
- Passive House building with green roof
- in planning

2150 Keith Drive, Nature's Path headquarters, Vancouver, British Columbia

- 10 storeys, 15,096 m^2; designed by Dialog
- exterior glulam-braced frame, CLT shear walls, CLT floor and roof panels over glulam beams and columns
- construction scheduled to begin in 2021

Corvette Landing, Victoria, British Columbia

- 12 storeys, 10,037 m^2; designed by LWPAC
- hybrid: modular 83-unit apartment building using CLT panels, light wood frame and steel studs; engineered by Intelligent City
- targeting Passive House certification
- in planning

QMUNITY Community Centre and Residential Tower, Vancouver, British Columbia

- 17 storeys, 11,463 m^2; designed by ZGF Architects
- hybrid: CLT on glulam posts and beams with light steel frame; one of the tallest mass timber buildings in the world
- providing support to LGBTQ persons, with 139 social housing units
- in planning

Canada Earth Tower, Vancouver, British Columbia

- 40 storeys, 31,494 m^2, designed by Perkins + Will, in collaboration with Fast + Epp and StructureCraft
- hybrid: CLT on glulam posts and beams, concrete podium; could become the tallest mass timber structure in the world
- At least 20 percent of residential space is designated as non-market housing, such as rentals.
- Every three-storey section of the south face will contain an outdoor garden accessible to residents.
- targeting Passive House certification
- in planning

77 Wade Avenue, Toronto, Ontario

- 8 storeys, 13,941 m^2; designed by Bogdan Newman Caranci
- hybrid: timber-concrete-steel composite using NLT, glulam posts, engineered by Structure Fusion
- one of Canada's tallest timber office buildings
- targeting LEED Gold certification
- nearly 80 percent of the wood to be exposed
- scheduled for completion in 2022

The Arbour at George Brown College, Toronto, Ontario

- 10 storeys, 16,250 m^2; designed by Moriyama & Teshima Architects, with Acton Ostry Architects
- CLT panels on glulam columns; engineered by Fast + Epp
- Ontario's first mass timber, low-carbon institutional building
- construction scheduled to begin in 2021

University of Toronto Tall Wood Academic Building, Toronto, Ontario

- 14 storeys, possibly becoming Ontario's tallest timber building; designed by Patkau Architects and MacLennan Jaunkalns Miller Architects (MJMA)
- hybrid: CLT on glulam posts and beams with concrete, glulam bracing, steel studs
- targeting LEED Gold certification
- in planning

A cross-section rendering of the 77 Wade Ave. tall wood building.

Exterior view rendering of the 77 Wade Ave. tall wood building in Toronto.

BRIDGES AND OTHER INFRASTRUCTURE

Sea to Sky Gondola Tree Walk, Squamish, British Columbia

- over 200-m-long glulam post and beam boardwalk rises to 23 m above the forest, with a timber viewing tower; designed by Aspect Structural Engineers
- under construction

Duchesnay Creek Bridge, North Bay, Ontario

- a 93-m-long concrete structure with glulam girders and arches; designed by Stantec, with LEA Consulting Ltd.
- The original timber truss bridge – a designated heritage structure built in 1937 – was closed for safety reasons.
- under construction

> "The advent of new products like cross-laminated timber, high-strength fiber reinforcements and 100-year-design-life pre-machined post-treated bridges means taller buildings and long spans for bridges carrying heavier loads."
>
> **DAN TINGLEY PH.D,**
> P.Eng. RPEQ Wood Research and Development

Duchesnay Creek Bridge features the use of glue-laminated timber in construction.

Interior of the Centre for Interactive Research on Sustainability building showcasing the mass timber elements.

CONCLUSION

Because advanced technologies and modern manufacturing methods have expanded the many ways that wood can be used, mass timber has emerged as one of the most exciting innovations in 21st-century architecture. For Canada, the opportunity to become a world leader in the mass timber industry is a natural fit. With 37 percent of the world's certified sustainable forests – which are harvested at less than one percent yearly, and replanted to ensure a constant supply – Canada is poised to continue leading the mass timber industry.

With increasing awareness of climate change and the impacts that various industries have on global emissions, Canada's forestry industry provides the key to sustainable construction. While the forests absorb carbon, when trees are harvested for building materials, the carbon is captured for the life of the structure. Because mass timber structures utilize large volumes of wood, the various materials provide a unique opportunity to transform the construction industry. It can transition from being one of the largest emissions producers to transforming not just buildings, but also the planet.

Within Canada, utilizing mass timber also supports a thriving bioeconomy that is built on the country's vast forestry resources.

The first CLT production lines in North America were established by Nordic Structures in Quebec and by Structurlam in British Columbia, more than a decade ago.

Since then, Canadian architects, engineers and manufacturers have developed innovative new applications for mass timber, demonstrating the potential for this material to transform the cities of the future. Michael Green, the Vancouver-based architect who designed several of North America's tallest mass timber structures, says in his 2013 TED Talk, "I've never seen anybody walk into one of my buildings and hug a steel or a concrete column, but I've actually seen that happen in a wood building. We're at the beginning of a revolution."

The mass timber industry is an international phenomenon that is rapidly developing, but it is also in its infancy. For example, while a recent United Nations Economic Commission for Europe report estimated the global CLT market to be around US$600 million in 2017, its value is projected to almost triple by 2024 (reaching US$1.6 billion).

Since 2010, the United States, Australia, New Zealand and Japan have established their first modern mass timber production facilities; some (such as Australia) have done so only within the past few years. Europe retains a leadership role, with Canada close behind.

The next decade promises many exciting developments, with the interest in mass timber continuing to build momentum, driven by its environmental benefits as a green building material that will help reduce GHG emissions associated with the construction industry.

Computer-aided design and manufacturing facilities that are capable of producing a wide variety of mass timber products are enabling Canadian architects and engineers to explore the full potential of this material, inspired by the vision of a more sustainable building industry.

Canadian building codes are also evolving to allow larger and taller mass timber buildings based on extensive research conducted in Canada and elsewhere. In addition to their many benefits, mass timber structures are inviting, appealing and healthy environments that everyone can enjoy.

For over a decade, the government has made significant investments through Canadian Forest Service programs such as GCWood, Forest Innovation Program, Investments in Forest Industry Transformation and the Expanding Market Opportunities Program.

These programs support mass timber research and development, and product and building demonstrations; they also support sector technology transfer while strengthening Canada's sustainable forest sector.

Likewise, organizations such as the National Research Council, FPInnovations and the Canadian Wood Council (CWC), along with academia, have helped to advance the research and development, demonstration and deployment of mass timber buildings with the goal of ensuring this industry's success.

Recent research supported by many of these initiatives has contributed to the adoption of mass timber, not only in North America, but worldwide. In Canada, continued support from provincial governments has stimulated rapid industry growth, with the understanding that mass timber construction not only creates beautiful buildings, but also bolsters the local economy, while reducing emissions.

Along with research, education is a key component of industry growth. With wood science centres in several of Canada's universities, it is no coincidence that more than 100 buildings in this report are educational projects, whether student housing or learning and recreational facilities. In recognition of the need for more wood education in Canada, the CWC's woodSMART initiative provides wood education tools and opportunities for future generations of architects, engineers and builders, to inspire them to build with mass timber.

The State of Mass Timber in Canada 2021 report and interactive map will be updated regularly. The exponential increase in mass timber projects is anticipated to continue, especially as the material's environmental and economic benefits are further understood.

Canada faces an immediate opportunity to utilize some of its greatest resources and talents to continue leading a worldwide movement towards a carbon-neutral construction industry.

> "Canadian governments and the forest industry have successfully introduced mass timber over the last 20 years, but now is the time for constructive action by researchers and teachers working with architects, engineers, and the construction industry to accelerate the commercial adaptation of mass timber building in Canada and globally."
>
> **ANNE KOVEN**,
> Mass Timber Institute

Acknowledgements

The Green Construction through Wood Program would like to thank the following organizations for their contributions to this report and accompanying interactive map, and for their ongoing efforts to support innovation and wider transformation of the mass timber industry and its greater acceptance in Canada.

- **Canadian Wood Council**
- **Dovetail Communications Inc.**
- **Forestry Innovation Investment Ltd.**
- **FPInnovations**
- **SCIUS Advisory Inc.**
- **WoodWorks!/Cecobois**

Contributions from numerous architects, builders, engineers and manufacturers are also recognized and appreciated.

Brentwood Skytrain Station