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.

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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
Mass Timber Projects in Canada*

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 (CO2), 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 Richmond Olympic Oval featuring a six-acre mass timber roof by StructureCraft.

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 464 structures, including bridges, towers, and agricultural buildings, and also captures 21 facilities across Canada that manufacture mass timber. The SMTC’s Interactive Map includes all these projects and manufacturers. Mass 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.

INTRODUCTION

Mass Timber Projects in Canada*

Structures: 464
Total gross floor area: 1,409,580 m², 16,730,581 sq. ft.
Completed: 227
Under construction: 52
Planned: 20

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

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The State of Mass Timber in Canada 2021

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.

Solid-sawn timber provides a greater degree of structural stability than light-frame construction, but its potential 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 (null-line timber) 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)-led Hoc Committee on Tall Wood Buildings recommended code proposals for the 2019 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.

These 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 disproven 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.
BASICS OF MASS TIMBER

Quebec published a guide for
The first edition of the International Building
The NBCC raised the limit on wood
Ontario amended the Ontario Building Code to allow wood
To reflect the rising popularity of mass
Washington and Oregon became the first American states to
FPInnovations published the first Canadian CLT
The first NBCC was introduced and
Revisions to the NBCC are
The ICC approved a set of proposals to allow tall wood buildings up to
Quebec introduced the Wood Charter
As part of its CleanBC plan, the provincial government
The NBCC made more than 800 technical changes,
British Columbia became the first province to allow mid-
The Shane Homes YMCA at Rocky Ridge (Calgary, Alberta), by GEC
The Canadian Commission on Building and Fire Codes
British Columbia became the first province to allow mass timber
Calgary became the first Canadian city to accept permit
The eight-storey
The nine-storey
The six-storey
The 18-storey
The 24-storey

The State of Mass Timber in Canada 2021 | The State of Mass Timber in Canada 2021
BASICS OF MASS TIMBER

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/or the way that they are joined 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 that 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 will be lighter and able to stand on softer ground.

Consequently, 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.

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.

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 roof, wall and floor applications. Panels are prefabricated using several layers of flat, wide timber laminated together and glued 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 promoted 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.

Glulam: Glue-laminated timber

Glulam provides many modern building materials because it was originally manufactured by hand. In Canada, GLT was used for large-scale floor panels in industrial post-and-beam buildings during the early 1900s. CLT is relatively dense because of its relative ease of fabrication and ease access to material. It requires no unique manufacturing capabilities and can be manufactured with any “off-the-shelf” dimensional lumber.

Modern CLT 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 CLT in Canada. Nearly 80 projects (12 percent) in the SMTC database utilize CLT.

NLT: Nail-laminated timber

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DLT: Dowel-laminated timber

Manufactured without glue or nails, DLT is the only mass timber product that has 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 acoustic applications.

Structures built 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 timber laminations run in one direction, parallel to the length of the member/panel. Most of the buildings included in the SMTC database (over 400 buildings or 60 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 can also be treated for outdoor use, and it easily conforms to curved shapes because of its high strength and stiffness. It is commonly used for flat-sawn roof structures and in timber bridges. Glulam is manufactured at 12 facilities in Canada.

**NUMBER OF PROJECTS BY MATERIAL USE**

<table>
<thead>
<tr>
<th>Material</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glulam</td>
<td>101</td>
</tr>
<tr>
<td>CLT</td>
<td>53</td>
</tr>
<tr>
<td>NLT</td>
<td>54</td>
</tr>
<tr>
<td>DLT, LVL, PSL</td>
<td>352</td>
</tr>
<tr>
<td>LSL</td>
<td>12</td>
</tr>
</tbody>
</table>

**CLT is commonly used in post-and-beam and mass timber structures, as well as wooden bridges.**
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. Buildings, a software program that can model over 1,200 structural and envelope assemblies to determine a life-cycle assessment for the whole building.

■ The Canadian Wood Council developed an easily accessible on-line carbon calculator.

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 CO2, while the total carbon benefit created by the tower’s construction process is approximately 2,432 tonnes of CO2 – 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 assemblies to determine a life-cycle assessment for the whole building.

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■ The Canadian Wood Council developed an easily accessible on-line carbon calculator.

One of the greatest benefits of building with mass timber is wood’s ability to sequester CO2. As trees grow, they capture CO2 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 fewer 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 CO2, for each cubic metre of wood, while the average single-family home in Canada stores about 30 tonnes of CO2 within the wood products used for its construction.

The State of Mass Timber in Canada 2021

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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 lightweight, 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, wood construction has proven that it can stand the test of time. 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 makes mass timber material in buildings to be fire-resistant, allowing more time to evacuate a building and to extinguish the fire.

Moreover, mass building materials are a practical alternative to conventional construction materials for many applications. 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 developers, builders, and architects to use mass timber. Numerous studies have detailed wood’s biophilic and health benefits, such as lowered stress levels, improved occupant well-being, and increased productivity. Humanity’s innate love of nature is stimulated by being surrounded by wood. As a non-toxic material with building 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.

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 makes 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.

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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. Awarded priorities in the 2023 CBC reflect a greater understanding of mass timber’s strength and fire resistance, enabling architects to incorporate the various materials with lower limitations.

By also allowing 12-storey encapsulated mass timber buildings, the 2023 CBC is another important step as Canada enters 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 16 stories, not surprisingly, many high-rise mass timber projects have been announced recently, some aiming to reach more than 30 stories 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, the rapidly increasing rate of mass timber buildings up to 18 stories. Not surprisingly, many high-rise mass timber projects have been announced recently, some aiming to reach more than 30 stories tall (see Projects in development on page 42).

Tall wood buildings

In recent years, many countries have announced a growing list of tall mass timber buildings, culminating in proposals for over 80-storey towers. These are the Oakland Tower (by PCL Architecture) in London, England, and the Rove Beach Tower (by Perkins + Will) in Chicago, United States. In Japan, Sekido Forestry is planning to commence its 350th anniversary in 2024 by building a 70-storey hybrid timber skyscraper in Tokyo. In 2019, after Nemawari’s Kōtō Architect completed the world’s tallest timber tower, the 16-storey Mjøstårnet (84 m), several European countries announced completion of tall mass timber buildings. In 2020, the 24-storey Hotel Wingsa in Austria, became the world’s second tallest mass timber building, at 84 m.

These projects were preceded by the 16-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 mass timber buildings. In 2020, the 24-storey Hotel Wingsa, in Austria, became the world’s second tallest mass timber building, at 84 m.

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) highlight a flow of the tall mass timber buildings that are in various stages of planning, including a tower that aims to reach past 50 storeys.

In late 2020, Dialog is 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 stories tall, while another 10 percent have three to six stories. 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.

Qualico’s EcoCity Foundation by Gough and Tong 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” certifications, including several Passive House projects.

Passive House buildings consume up to 90 percent less heating and cooling energy than conventional buildings and are among the first to achieve 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 Ballroom 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.
Mass timber is a resilient, long-lasting material that adds natural beauty to utilitarian structures. More than 10 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 mass timber structures designed by HDR | GHD.

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 Montreal, three passenger depots for the city’s 65.3-billion light rail REM line are currently under construction. These depots also have GLT panels over a steel frame (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.

Prefabricated systems
The advantages of prefabrication, including modular and panelized components, strongly influence mass timber designers. More than 70% of the building’s components are pre-assembled in the factory, 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. Prefabricated systems also facilitate 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 Joburg-Ambodikiso in the Netherlands (by GoMAK, built in 2018), one of the ST - tallest – and energy-neutral hotels in Europe. The nine-story, 300-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.

Several international companies are exploring modular mass timber systems as a solution for affordable housing, while Vancouver 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 16 stories tall.

Several companies have already developed prefabricated systems that can be adapted for buildings up to 16 stories tall.

Dutchesschned Bridge was built with mass timber in firm of California. It has 100 8-foot-long mass timber piles that are manufactured off-site 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. Prefabricated systems also facilitate by panelized or modular systems, which can be added or removed more easily than by conventional construction methods.

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Jacobson Hall at Trinity Western University in British Columbia (by BMR Engineering, built in 2016) is framed completely with wood and contains 90 modules, attached to a GLT elevator shaft. Each module took about 14 days to complete, and the first three floors of the building were assembled in only 11 days.

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Canadian mass timber manufacturing sector

The forest sector is one of Canada’s oldest and most important industries, contributing about $25.6 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.
New, British Columbia has the most mass timber facilities of any province, with nine locations. Québec has five, Ontario has four, Alberta has two, and Manitoba has one. Proximity to forest resources is a significant factor, but also 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.

**Art Massif Wood Structure**  
**(Saint-Jean-Port-Joli, Québec)**  
**Mass timber products:** Glulam  
**Annual production capacity:** 8,000 m³  
**Company summary:**  
Established in 2010, this company specializes in glulam and timber products into a multitude of new exposed applications, to allow raw materials and resources, and to assume a leadership role in the emerging and global mass timber movement.

**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.

**Element5**  
**(St. Thomas, Ontario, Ripon, Québec)**  
**Mass timber products:** Glulam  
**Annual production capacity:** 60,000 m³  
**Company summary:**  
A relative newcomer that started producing CLT in 2017, this company recently built a 200,000 sq ft. 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 15,000 m³ per year of CLT and glulam. Element5 focuses on the design and manufacture of advanced wall and floor systems made from CLT and glulam, targeting larger spans for commercial projects.

**Forex Amos Inc.**  
**(Amos, Québec)**  
**Mass timber products:** Glulam  
**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.

**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, design and digital engineering services.

**Goodfellow Industries**  
**(Deltion, British Columbia)**  
**Mass timber products:** Glulam  
**Annual production capacity:** 7,000 m³  
**Company summary:**  
Goodfellow is a division of Goodfellow Inc., specializing in the manufacture and fabrication of glulam and heavy timber products. First established in Louiseville, Québec, in 1953, the Goodfellow plant has moved to Deltion, Québec. The company also offers technical, marketing and finishing services.

**International Timberframes Ltd.**  
**(Golden, British Columbia)**  
**Mass timber products:** DLT  
**Annual production capacity:** 2,000 m³  
**Company summary:**  
Founded in 2013, International Timberframes Ltd. 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.

**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 DLT into a wide array of project types. They offer a complete turnkey approach to timber construction, with in-house engineering, 3-D modeling, and project management.
Kalesnikoff Mass Timber Inc. (Castlegar, British Columbia)
Mass timber products: LVL
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.
Company website: www.kalesnikoff.com

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

Structurlam (Peninsula, British Columbia, Oliver, British Columbia)
Mass timber products: Glulam, CLT
Annual production capacity: 40,000 m³
Company summary: Structurlam has manufactured complete 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: Not available
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
West Fraser Timber Co. Ltd.
(Rocky Mountain House, Alberta)

Mass timber products: LVL
Annual production capacity: 73,632 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, Kanata, 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

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 two 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 m² 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.

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 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 HMCW Architecture + Design and KMBER Architects (12 projects each), followed closely by HDR | LEI (11 projects), and McFarland Marceau Architects (10 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 m²) 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.

“...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)

CANADA

52 under construction
20 planned

BRITISH COLUMBIA

23 under construction
14 planned

ALBERTA

5 under construction

ONTARIO

14 under construction
3 planned

QUEBEC

10 under construction

Ritchie Architects has designed many world-renowned structures that feature wood, including the Audain Art Museum.
MATHEMATICAL CONSTRUCTION IN CANADA

The State of Mass Timber in Canada 2021

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 Prairies 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 Meroor 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.
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 electric 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.

**British Columbia Case Study**

**Tsleil-Waututh Administration and Health Centre, North Vancouver**

**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 (m²):** 2,881  
**Completion:** 2019

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 forms are accentuated 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 help to define the interior spaces, including a community programming room and a MakeSpace area, and a cantilevered section that adjoins a roof over a daylit space and adds a grid of shadow for light. A striking feature of the building is a 55-m-long window that provides an outdoor space.

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, and 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.

**Alberta Case Study**

**Capilano Branch Library, Edmonton**

**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 (m²):** 1,157  
**Completion:** 2018
**École Gravelbourg School, Gravelbourg**

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 m², 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.

**MANITOBAN CASE STUDY**

**Winnipeg Humane Society, Winnipeg**

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 purline, 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.
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 35). This groundbreaking project was followed by the Laval University PEPS TELUS Stadium (by Hudon Julien Associés, AQEP and HOMA Architects, 2011) and the Stade de soccer de Montréal (by Saucier + Perrotte and HOMA, 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, BEng, BlArch, FRAIC, LEED AP, Partner at Moriyama & Teshima Architects
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 stories 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.

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.

Ontario Case Study: 80 Atlantic Avenue, Toronto

Ontario Case Study

ONTARIO CASE STUDY
80 Atlantic Avenue, Toronto

Interior view of 80 Atlantic, Toronto’s first mass timber commercial building to be built in a generation.

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

Quebec Case Study: UQAC Arena, Saguenay

Quebec Case Study

UQAC Arena, Saguenay

This hybrid structure uses 263 m³ of wood, accounting for approximately 70 percent of the construction materials.

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

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

The UQAC Arena won a 2013 Cecobois Award of Excellence.
Mass timber construction in Canada

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

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.

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

ATLANTIC REGION CASE STUDY

Green Gables Visitors Centre, Cavendish, Prince Edward Island

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 (m²): 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.

NORTHERN REGION CASE STUDY

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

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 (m²): 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 wave 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 CO₂, equivalent to taking 140 cars off the road for one year.
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.

**LOW- and MID-RISE CONSTRUCTION**

**Simon Fraser University Student Union Building, Vancouver, British Columbia**
- 5 storeys, 10,279 m²; 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 m²; designed by Manasc Isaac Architects
- hybrid: glulam posts and beams, GLT panels, concrete
- under construction

**Honey Bee Research Centre, Guelph, Ontario**
- 1 storey, 1,704 m²; 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 m²; 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, 13,041 m²; designed by Daley with Siskin Architects
- hybrid: CLT floor and roof panels on glulam posts and beams, light steel frame
- under construction

**Anishinabek Discovery Centre, Sault Ste. Marie, Ontario**
- 1 storey, 1,908 m²; designed by Toen Reif Architects
- 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, 1,874 m²; designed by Arcopre
- hybrid: glulam beams and GLT panels, light steel frame
- almost complete

**Esplanade Clark Pavilion, Montréal, Quebec**
- 2 storeys, 1,976 m²; designed by IVE Architects
- 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

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.

**DAVE HESS, PhD, PEng, LEED AP, Principal at Moses Structural Engineers**

"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."
MASS TIMBER CONSTRUCTION IN CANADA

TALL WOOD BUILDINGS

1766 and 1794 Frances Street, Vancouver, British Columbia
- 9 storeys, 7,848 m²; 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 veneer 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 m²; 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
- In planning

Corvette Landing, Victoria, British Columbia
- 77 storeys, 11,400 m²; designed by MMB Architects
- 80 units for Indigenous tenants; 35 percent of apartments are sized for large families
- Hybrid mass timber structure with CLT floor, roof and veneer panels and steel structural columns
- Passive House building with green roof
- In planning

Canada Earth Tower, Vancouver, British Columbia
- 40 storeys, 31,494 m², designed by Perkins + Will, in collaboration with Fast + Epp and StructureCraft
- Hybrid CLT on glulam panels and beams, concrete podium; could become the tallest mass timber building in the world
- At least 20 percent of residential space is designated as non-residential, such as offices.
- Every third storey on the south face will contain an outdoor garden accessible to residents.
- Targeting LEED Gold certification
- In planning

QMUNITY Community Centre and Residential Tower, Vancouver, British Columbia
- 17 storeys, 9,108 m²; designed by ZGF Architects
- Hybrid CLT on glulam posts and beams with concrete podium, engineered by Intellitec Inc.
- Targeting Passive House certification
- In planning

Canada Earth Tower, Vancouver, British Columbia
- 16 storeys, 10,260 m²; designed by MMB Architects
- All units have large windows
- Under construction

The Arbour at George Brown College, Toronto, Ontario
- 10 storeys, 15,200 m²; designed by Margan and Teshima Architects, with Acton Ostry Architects
- Passive CLT panels on glulam columns, engineered by Fast + Epp
- Ontario’s first mass timber, low-carbon institutional building
- Construction scheduled to begin in 2021
- In planning

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

Sea to Sky Gondola Tree Walk, Squamish, British Columbia
- Over 200-m-long gable roof and beam toroidal arch 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 100-m-long concrete structure with glulam girders and arches designed by Stantec, with LDA Consulting Ltd.
- The original timber truss bridge was designed for a heritage structure in 1907 – was closed for safety reasons.
- Under evaluation

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.
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 five 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.

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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 worked 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. As an example of continued support from provincial governments has stimulated rapid industry growth, with the understanding that mass timber is not just a material that will help reduce GHG emissions associated with the construction industry.

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 wood eduMATE 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 adoption of mass timber building in Canada and globally.
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