Wood Design & Building®

Winter 2017-18 — Number 78

Six dollars

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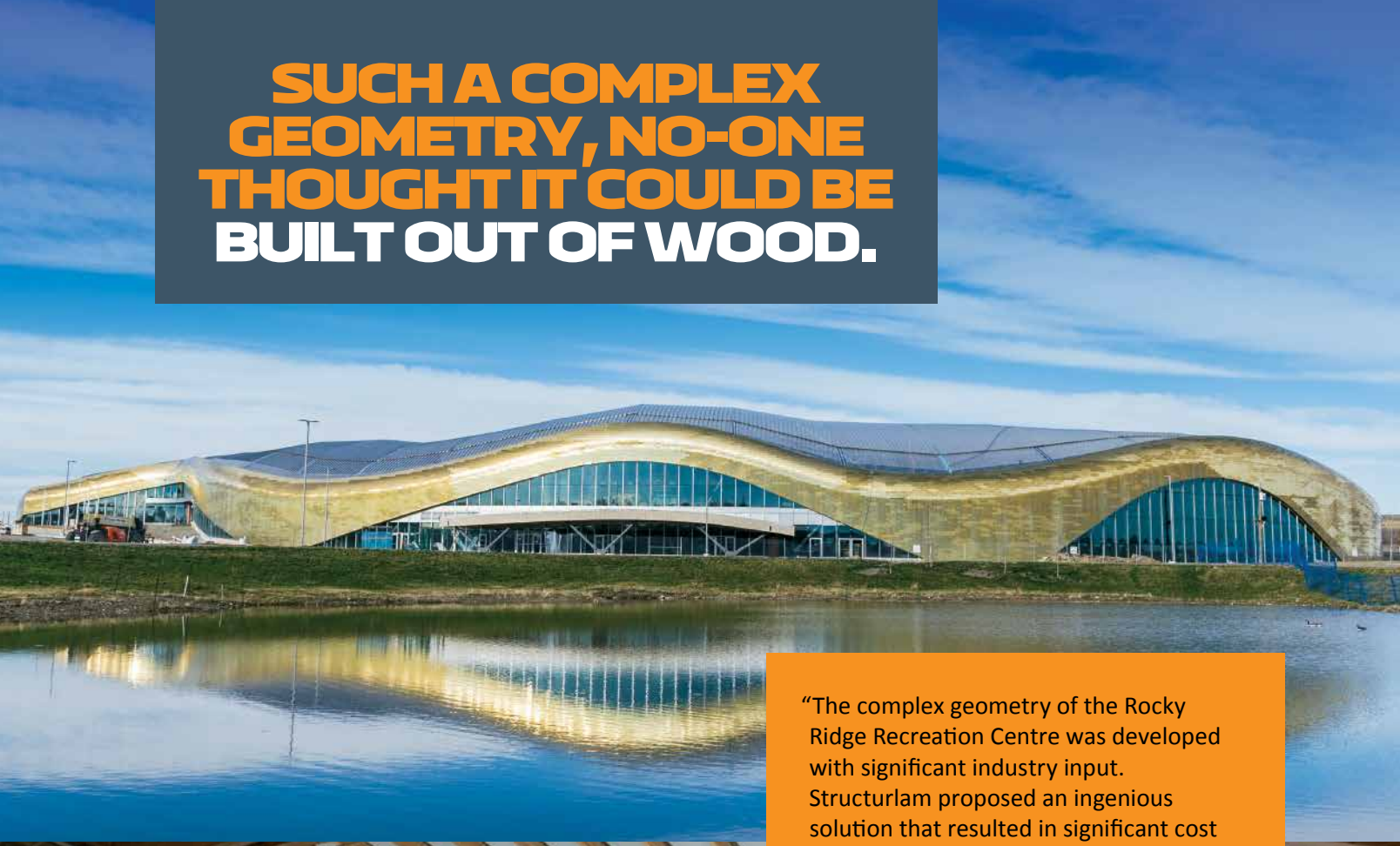
Software
User-friendly tools enable the most complex of designs

2017 Wood Design Awards
29 outstanding new projects

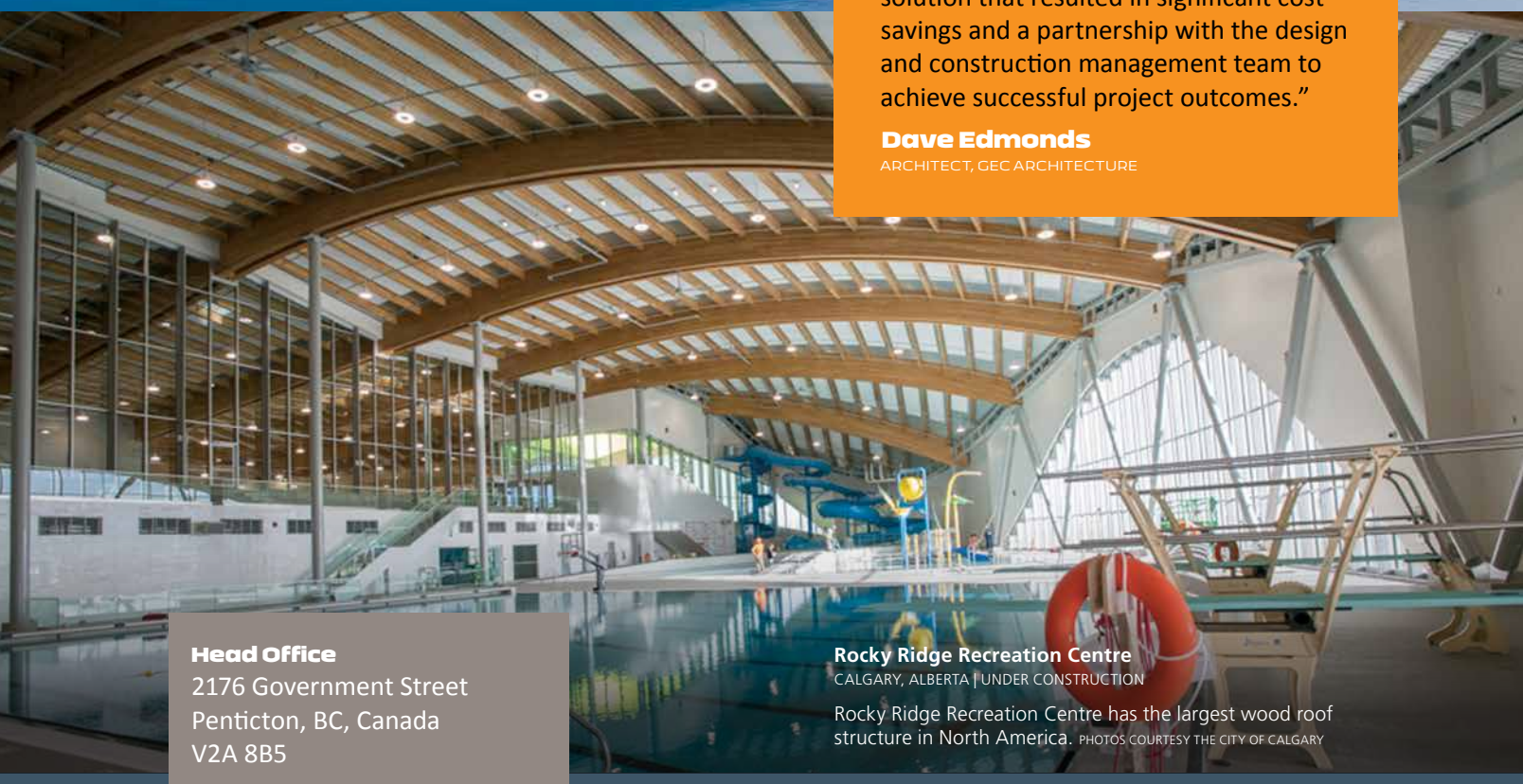
Timber in the Office
Happier, healthier, inspired employees

SUCH A COMPLEX GEOMETRY, NO-ONE THOUGHT IT COULD BE BUILT OUT OF WOOD.



"The complex geometry of the Rocky Ridge Recreation Centre was developed with significant industry input. Structurlam proposed an ingenious solution that resulted in significant cost savings and a partnership with the design and construction management team to achieve successful project outcomes."

Dave Edmonds
ARCHITECT, GEC ARCHITECTURE



Rocky Ridge Recreation Centre
CALGARY, ALBERTA | UNDER CONSTRUCTION

Rocky Ridge Recreation Centre has the largest wood roof structure in North America. PHOTOS COURTESY THE CITY OF CALGARY

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Above and **on the cover:**
NATIONAL ARTS CENTRE, OTTAWA, ON
PHOTO CREDIT: Double Space Photography

On the Cover

Departments

Features

A New Year

At *Wood Design & Building* magazine, we are proud of the fact our award-winning magazine is the only one in North America dedicated exclusively to articles about timber architecture and engineering. Our goal is to inspire you with creative solutions for wood design and construction.

The emphasis on sustainable solutions has never been greater and wood has a unique distinction as both a cost-effective and environmentally friendly building material that, especially given new technologies, can be used in more and more applications. In this issue, our two stories on software explore just that. On page 39, *Computational Design with Timber* details how the emergence of user-friendly software has been key to the rise of geometrically complex and freeform structures.

On page 44 Mike Phillips, from the Ontario Structural Wood Association, says that without today's sophisticated software, it would be nearly impossible to create the drawings necessary to manufacture trusses for some of the complex structures being created. With advances in wood science and wood products, the options for wood building solutions continue to expand and software is going to be a big part of the solution moving forward.

As our publication looks toward 2018, we will continue to explore these kinds of trends in wood design and construction.

This issue also features winners from our very own Wood Design Awards. From a museum to a bridge to a TED installation in Vancouver, this year's winners truly showcase a diversity of wood projects. (You'll have to get the *2017/2018 Wood Design Awards Winners* book next fall to see everyone!)

We hope you will join us for another year as we feature the top creative designs and solutions in the world of wood design and building.

Theresa Rogers
Executive Editor
trogers@dvtail.com

Wood Design & Building magazine invites you to submit your project for consideration and possible publication. We welcome contributed projects, bylined articles and letters to the editor, as well as comments or suggestions for improving our magazine. Please send your submissions to Theresa Rogers at trogers@dvtail.com.

inspiration BOARD

WHAT I'VE FALLEN FOR THIS MONTH...

SPONSORED BY SANSIN

ACCESSIBLE AND LUXURIOUS

I did much of my Christmas shopping at Toronto's Yorkdale Shopping Centre. The mall was decked to the nines and all of the recently added retail space was open. The expansion appeared like a jewel box, sparkling with chrome, glass, and luxury retailers. Yet, what I noticed most as I browsed was the amount of wood used on the new storefronts, especially by the mid-level retailers. Wood, I thought, is the little black dress of construction materials. You can dress it up or down, take it anywhere, and it's comfortable and versatile. Wood elevated the storefronts in this part of the mall and it made them accessible at the same time. Here are just a few examples I thought stood out:

www.yorkdale.com

MUJI

Mendocino

Birks

Lululemon

PHOTO CREDITS: Theresa Rogers

theBIG 95 TABBIES 2015 Award Winner

WOOD DESIGN & BUILDING®

www.wooddesignandbuilding.com

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Integrating Wood Within the Office Environment

Alexander McCleave

Offices are notoriously dull, bleak work environments. Often, employees wake up and travel to work only to arrive at a boring office space devoid of any sense of wonder or inspiration. This can have the unintended effect of stifling employees' creativity and creating discontent. Fortunately wood is making an entrance into the work environment. By creating a feeling of warmth and familiarity in an office space, employees are happier, more inspired, and enjoy coming to work. Wood connects us to the outdoors, is healthier than alternative materials, and creates a more beautiful and serene work environment. And if an office can't have a fully exposed wood structure, creating "moments" of architectural relief can be just as effective.

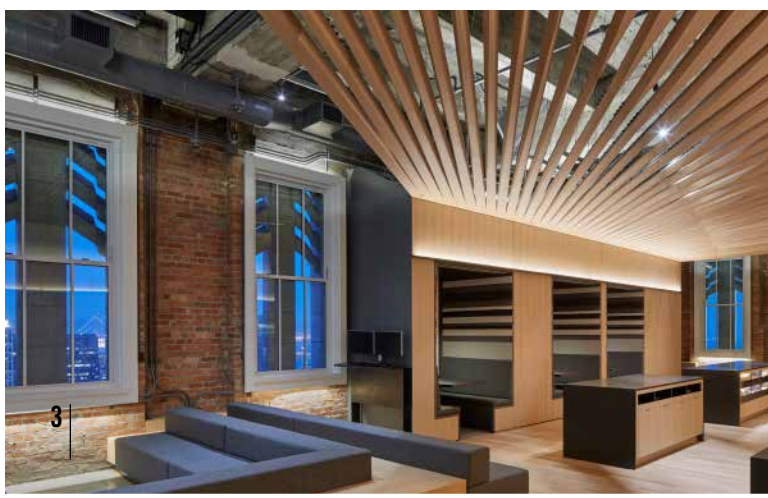
Global ad agency **Wieden + Kennedy** chose a tree theme for its Shanghai office and created a workspace inspired by branches growing out from a tree trunk. Vertical split joint boards connect, cross and naturally extend to different floors. They have a glossy oak veneer which adds a warmth and elegance to the office's otherwise industrial feel.

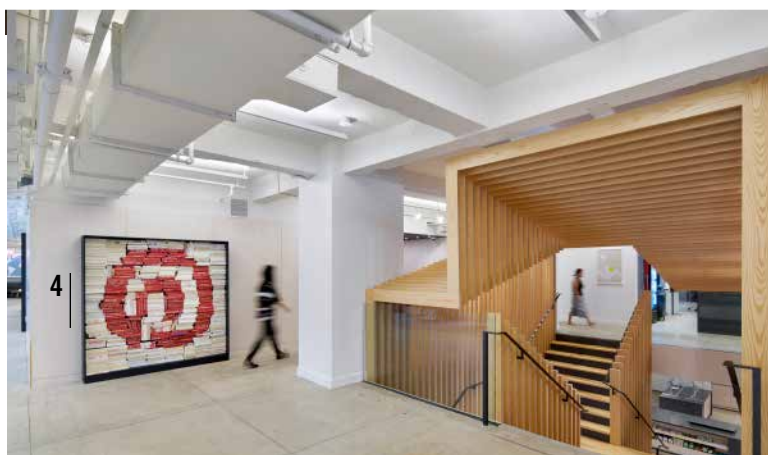
In Zurich, Switzerland, **Unilever Agile Offices** have created an inviting space inspired by a garden. In the Garden Room, employees can work in a peaceful, quiet and natural environment. The company says its employees feel positive about the wood and love the natural, relaxing and comfortable feel.

A main design element at **Bloomberg Tech Hub** is a porous wood liner that wraps the pantry space and splays in plan across the ceiling, wrapping down as paneling along one side and as the face of a series of window seat banquets on the other. The liner splits into a series of individually sculpted boards at the ceiling that recall the facade's chevron shapes and allow glimpses through to the raw concrete structure above.

At **Pinterest NY,** a central communication staircase crafted out of different wood panels immediately grabs your attention and links the two levels of the company. The scissor stair was positioned at the central bay of the workspace, forming a visual focal point and porous, inhabitable screen as employees enter the reception area from the elevator lobby at both levels.

These office spaces show how wood is able to create a natural, calming environment for employees while simultaneously creating intriguing works of art for all.





1. Wieden + Kennedy (2016)
   Architect: Dariel Studio
   Location: JingAn Shanghai, China
   PHOTO CREDIT: Dariel Studio

2. Unilever Agile Offices (2012)
   Architect: Evolution Design
   Location: Zurich, Switzerland
   PHOTO CREDIT: Peter Wurmli

3. Bloomberg Tech Hub (2015)
   Architect: IwamotoScott Architecture
   Location: San Francisco, CA
   PHOTO CREDIT: Bruce Damonte

4. Pinterest NY (2016)
   Architect: Spector Group
   Location: New York, NY
   PHOTO CREDIT: Jerry Mislewlcz

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Download the DLT Design Guide at www.StructureCraft.com

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mass timber | signature timber structures

Sansin Announces New One-Coat Flame Spread Protection for Interior Wood Substrates

The Sansin Corporation, manufacturer of environmentally friendly, high-performance wood protection, recently announced two new products. The first product is a one-coat "Class A" fire retardant coating for interior wood including SPF plywood, Oriented Strand Board, wood trusses, glulam, CLT, construction studs and many other assemblies where improved fire resistance is required. FireStop97 is a decorative, self-priming paint for wood substrates, available in white, pastel and light-colored wood tones. FireStop97 meets Class A flame spread ratings in just one coat and is fast drying, ultra-low VOC, durable and can be easily top-coated. The second product, FireStop99, is a low-VOC, two-coat application with excellent adhesion. FireStop99 comes in clear or custom tinted tones for interior wood surfaces. Both products intumesce (expand their film thickness) in the presence of heat or flame, creating a thick, charred, heat-insulating foam layer. This action prevents oxygen from reaching the combustible materials beneath. FireStop confirms to ASTM E84 and Canadian Standard CAN/ULC S-102-M88.

"Wood has inherent fire protective properties through natural charring, but Sansin's FireStop97 and FireStop99 provide heightened resistance," says Sjoerd Bos, Managing Director at Sansin. "Sansin developed these products to meet the growing needs of architects and developers designing and planning mass timber buildings with safety, resilience and beauty in mind." **www.sansin.com**

Updated Product Guide

APA – The Engineered Wood Association released an updated product guide for Oriented Strand Board (OSB). OSB is engineered for strength and designed for a variety of applications. It is also a proven performer for many residential and non-residential applications. Its high-performance capabilities make OSB ideal for diverse markets, including materials-handling applications, the structural insulated panel industry, do-it-yourself projects, wood I-joist products, and other applications such as furniture and trailer liners. The *Oriented Strand Board Product Guide*, Form W410, describes OSB's features, uses, quality assurance, and performance. This publication also explains the APA trademark, performance standards, and span ratings for panels used in both the United States and Canada. APA also released an updated ANSI standard, *ANSI 405-2018: Standard for Adhesives for Use in Structural Glued Laminated Timber* along with updated technical publications. **www.apawood.org**

Renovation for 2019 Canadian Grand Prix Includes Timber Roof

The Société du parc Jean-Drapeau (SPJD), a City of Montreal para-municipal organization whose mission is to manage, administrate, develop, and protect Parc Jean-Drapeau, unveiled the final concept for the Circuit Gilles-Villeneuve paddocks renovation project at a press conference in December. The project, which entails the construction of a new, modern multi-purpose building, will have a $48 million budget. Regarded as the largest tourist event in the country, the Canadian Grand Prix receives incomparable international exposure. The current structures have exceeded their serviceable lifespan and are in need of an upgrade. Formula One World Championship requirements have changed substantially since the first Grand Prix in 1978, particularly in terms of hosting the F1 teams and the technological needs related to the garages, control tower and media areas. The project will consolidate all of the services into one modern and accessible building on the cutting edge of technology. The objective of the project is to upgrade the equipment in the paddocks, while increasing the capacity of the loges above the garages to 5,000 people, up from the current capacity of 1,800. The building will be equipped, among other things, with a freight elevator which can be used to bring cars or heavy furniture to each of the levels of the building. It will also have a glassed-in elevator for spectators. Construction will begin immediately after the 2018 Grand Prix. The project will be completed in April, 2019. A public call for tender was issued for the project.
www.parcjeandrapeau.com

Combining Design with Social Science Can Help College Students Thrive

Can architecture help make college students more successful? An award-winning research project mixing architecture and social science disciplines is studying how the design of campus spaces can better support student retention as well as relationships between faculty and students – two critical measures of achievement. The study, conceived by Sara Grant, Partner at MBB (Murphy Burnham & Buttrick Architects), and environmental psychologist Evie Klein, is currently being piloted at Medgar Evers College in Brooklyn. Grant and Klein are looking to understand how spaces outside the classroom – like hallways, lobbies and commons – can best support Medgar Evers College's goals of increasing retention rates and better preparing a diverse and underserved student body to thrive beyond college. According to Grant and Klein, "How spaces outside college classrooms are designed and managed can play a critical role in creating communities of learning that are responsive and specific to the institution's culture." Using environmental psychology research techniques, architects and institutions can develop useful metrics to make decisions about designs of non-academic spaces that best contribute to post-college success.
www.mbbarch.com/news

Accoya Wood Achieves Declare Label From The International Living Future Institute

Accoya wood, a high-performance wood manufactured by Accsys Technologies, is now recognized under the International *Living Future Institute (ILFI)* Declare label. *Declare,* an ingredients label for building products, is a transparency tool to help architects and other specifiers make informed choices regarding sustainable and healthy material use in green buildings. *Accoya wood* has achieved the declaration status of "Red List Free," deeming its product ingredients are 100% disclosed to 100 ppm and do not contain any chemicals on the *Red List* thereby meeting the LEED v4 Material Ingredient credit, Option 1 reporting requirements. Accoya is made >99.5% from FSC certified Radiata pine, has a life span of more than 50 years, and is recyclable and biodegradable/compostable. Accoya is manufactured using Accsys Technologies' proprietary acetylation process. The modification process chemically alters the wood's free hydroxyls into stable acetyl groups. Acetyl groups are naturally present in all wood species, which means that nothing toxic is added. The altered cell structure of the wood makes it an unrecognizable food source for insects and prevents fungal decay.
www.accoya.com

Pioneering Women in American Architecture, Honored

A new website, "50 Pioneering Women of American Architecture", has been launched by the Beverly Willis Architecture Foundation, a group that seeks to elevate women in the architecture, engineering and construction (AEC) professions. The website presents historically significant women practitioners as selected by a jury of prominent architectural historians and based on criteria of the highest standards, according to Cynthia Phifer Kracauer, AIA, Executive Director of the foundation. The inspiring and educational website has been supported by the National Endowment for the Arts, developer Forest City, and dozens of architects and design firms. It started in 2012 with two women, Wanda Bubriski and Beverly Willis, who wanted to uncover the work that American women architects had done during the early decades of the 20th century. **https://pioneeringwomen.bwaf.org**

Mjøstårnet will be more than 262 feet tall. Photo Credit: Anti/Jens Haugen

Race for World's Tallest Timber Building Continues

Moelven Industrier ASA, a Scandinavian industrial group that supplies products and associated services to the building market worldwide, says it will build the world's tallest timber building. The company says "Mjøstårnet" will be more than 262 feet tall, 98 feet higher than what is today considered the world's tallest timber building. Mjøstårnet is named after its neighbor and Norway's largest lake, Mjøsa. The building will sit on the edge of the northeastern tip of the lake in the small town of Brumunddal, an hour-and-a-half north of Oslo. Spanning 18 floors, the building will include apartments, an indoor swimming pool, hotel, offices, restaurant and communal areas. Construction is scheduled to be completed in December 2018. Investor and contracting client, Arthur Buchardt says, "The assembly and construction of the Mjøstårnet is nothing short of world-class engineering, and will be managed without external scaffolding, despite the complexity of working at heights. We are primarily using cranes and supplementing with lifts as needed." Buchardt hopes that his ambitions to build the world's tallest wooden building may inspire others and demonstrate that it is possible to construct large, complex wooden buildings. **moelven.com/mjostarnet**

2017 WOOD DESIGN AWARDS

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www.hga.com

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Wood Design & Building magazine is delighted to announce the recipients of the 2017 Wood Design Awards. A jury consisting of Betsy Williamson of Williamson Williamson Architects Inc., Richard J. Bonnin of HGA, and Alan Organschi of Gray Organschi Architecture, have selected a stunning collection of winning projects from 142 submissions, 28 of which were international entries. The jurors gave a special award for Technical Innovation to Brock Commons, and a Public Art and Education award to Ways of Wood. Special awards were also granted by the Canadian Wood Council and the event sponsors, Real Cedar, SFI and Sansin. In partnership with the Canadian Wood Council, *Wood Design & Building* would like to thank everyone who participated in the 2017 Wood Design Awards program. A special thank you is also extended to our three esteemed jurors. Congratulations to the winners!

NORTH AMERICAN

HONOR

Audain Art Museum, Whistler, BC
Patkau Architects

Washington Fruit & Produce Company
Yakima, WA
Graham Baba Architects

Georgica Cove, East Hampton, NY
Bates Masi + Architects

MERIT

National Arts Centre Rejuvenation
Ottawa, ON
Diamond Schmitt Architects

The Owsley Brown II History Center
Louisville, KY
de Leon & Primmer Architecture Workshop

Discovery & Services Center
Iles-de-Boucherville National Park, QC
Smith Vigeant Architectes Inc.

Bloomberg Tech Hub, San Francisco, CA
IwamotoScott Architecture

Pause, Vancouver, BC
DBR/Design Build Research, Alsu Sadrieva

CITATION

Trois-Soeurs Bridge, Quebec, QC
ABCP architecture

Pinterest NY, New York City, NY
IwamotoScott Architecture

Orillia Waterfront Centre, Orillia, ON
Brook McIlroy Inc.

Lazaridis Hall, Waterloo, ON
Diamond Schmitt Architects

Story Pod, Newmarket, ON
Atelier Kastelic Buffey Inc.

INTERNATIONAL

HONOR

Elementary School Unterdorf Höchst
Vorarlberg, Austria
Dietrich | Untertrifaller Architectes

Haus B
Stuttgart, Germany
Yonder – Architektur und Design

Collège Jean Monnet Broons
Bretagne, France
Dietrich | Untertrifaller Architectes and
Colas Durand Architectes

Casa Curved
Basel, Switzerland
Daluz Gonzalez Architekten

MERIT

Valley Villa
Vilnius, Lithuania
Arches

Multi-functional Sports Hall Alice Milliat
Lyon, France
Untertrifaller Architectes and
Tekhnê Architectes

Wooden Ventilation Towers
Stockholm, Sweden
&Rundquist architects

CITATION

UC Architecture School Building
Santiago, Chile
Gonzalo Claro

Organic Farm
Tangshan, Hebei, China
ARCHSTUDIO

Special Jury Award – Technical Innovation

Brock Commons Tallwood House
Vancouver, BC
Acton Ostry Architects Inc.

Special Jury Award – Public Art and Education

Ways of Wood
Boston, MA
Daniel Ibañez (Margen-Lab)

Sansin – Sponsorship Award

Grange Park Playground
Toronto, ON
PFS Studio

Sustainable Forestry Initiative – Sponsorship Award

Solana
Whistler, BC
Murdoch & Company
Architecture + Planning Ltd.

Real Cedar – Sponsorship Award

Skyline House
Oakland, CA
Terry & Terry Architecture

Canadian Wood Council Awards

Tanguay – Trois-Rivières
Trois-Riviéres, QC
Coarchitecture

Courtyard House on a River
Greenwater, WA
Robert Hutchison Architecture

PHOTO CREDIT: James Dow

Audain Art Museum

Patkau Architects

The Audain Art Museum is a private museum in Whistler, BC. It houses Michael Audain's personal art collection, which traces a visual record of British Columbia from the late 18th century to the present. The design responds to these determinants by projecting a volume of sequential public spaces and galleries into a void within the surrounding forest. It is elevated a full story above the ground and crowned with a steep roof which defines a volume for administration and back-of-house support functions. The plan doubles as an integrated thermal strategy by using non-gallery zones as buffers between the demanding gallery environments and the exterior envelope. Building form and siting work synergistically with existing trees to embrace a reclaimed forest meadow. Directly across Blackcomb Way is Whistler Village. A bridge at street level draws the public from Blackcomb Way over the floodplain and through the trees onto a protected, sky-lit porch that overlooks the meadow. From there, visitors can either descend to the forest floor or enter the museum. Entering the museum, visitors gather in a lobby and event space that frames a wide view of the forest. Visitors then follow a glazed walkway overlooking the meadow. Permanent collection galleries precede access to the temporary exhibition galleries. The character of the building and interiors is deliberately restrained to provide a quiet, minimal backdrop to the art and the surrounding natural landscape. The simple form of the exterior is clad in an envelope of dark metal which recedes into the shadows of the surrounding forest. Where this envelope is opened, to provide access in the entry porch or view from the glazed walkway to the galleries, the dark metal is overlaid by a luminous wood casing. Public spaces in the interior, which are visible from the exterior, continue this warm materiality. Gallery interiors in both the permanent and temporary exhibition areas are closed white volumes with minimal detail.

PHOTO CREDIT: Kevin Scott

Washington Fruit & Produce Company

Graham Baba Architects

Surrounded by the world's most technologically advanced fruit packing warehouses, the 16,500-sq.ft. Washington Fruit & Produce Co. headquarters is an oasis in a stark landscape of concrete and low-lying brush. Tucked behind landforms and site walls, this courtyard-focused office complex provides a refuge from the noise and activity of the industrial processing yards nearby. Taking its design cue from an aging barn that the client had identified as a favorite, the concept seeks to capture the essence of an utilitarian agricultural aesthetic. A simple exposed structure that employs a limited material palette and natural patina, the design merges rural vernacular with an equally spare contemporary aesthetic. The L-shaped building is nestled into the landscape through the use of board-formed concrete site walls and earthen berms that wrap the perimeter to form a central, landscaped courtyard. Soil excavated for foundation work was repurposed for the perimeter berms, eliminating the need to remove it or add more. A notch through the berm provides access from the parking area to the formal courtyard and building entrance. Crossing the courtyard via a boardwalk, the visitor is embraced by a fully glazed facade, punctuated by a series of wood columns that march across the building in regular intervals. The boardwalk aligns with an off-set building entry, which is formed as a wood-wrapped passageway inserted into the glazed facade. The building recalls its agricultural roots by pulling the 18-foot-tall scissored glulam structural columns to the outside, revealing the physics of its construction and enabling the 175-foot interior volume to be column-free. Topped with 68-foot exposed truss girders, the interior reaches 20 feet at its peak. The repetitive nature of the structure ensured easy fabrication and assembly, saving costs and resources. Reclaimed barn wood siding and a weathering steel roof round out the exterior materials.

PHOTO CREDIT: Bates Masi + Architects

Georgica Cove

Bates Masi + Architects

A couple with property on a cove overlooking the ocean asked for a house that would be comfortable for just the two of them. However, with their love of entertaining, the house had to grow on busy weekends to accommodate their children, grandchildren, and guests. To instill the desired sense of comfort and peace, it was also important that the design blend with the pastoral setting and vernacular building traditions: predominantly shingle style homes and barns that are often built and added to over time. Historic precedent studies revealed that referencing New England connected farms in an innovative way could achieve both goals. One volume was often offset or rotated from the next to provide greater access to light, air, and privacy from the other functions. The spaces are arranged around a courtyard to create visual and physical connections between them but those connections can be broken by large sliding doors. Each structure has an independent mechanical system allowing it to be shut down when unoccupied. This allows the livability of the house to expand and contract whether the couple is alone; hosting dinner guests, or has a full house of overnight guests. As with connected farms, a limited palette of materials and details unifies the various spaces and responds to the local climate. The cedar shingles common to local buildings are scaled up to the size of boards to cover the roof and sidewalls. Cedar screens provide privacy and filter light. A limestone plinth filled with sand elevates the house above the floodplain while also creating drywells to accept storm water runoff. Oak floors and millwork throughout unify the spaces. The design repurposes the historic typology of the connected farm to suit the needs of the site and the family. By acknowledging the area's history and tradition of building, this home is an evolution of its cultural expression.

PHOTO CREDIT: Heinrich Landschaftsarchitektur

Elementary School Unterdorf Höchst

Dietrich | Untertrifaller Architectes

The recently completed Unterdorf elementary school in Höchst is a radical, uncompromising example of a modern school. In a plain, elongated, ground-level wooden building, four identical clusters are placed on the east side. The special education classes and the administration area are located on the west side, with a spacious hall connecting the area to the gym. The clusters comprise two central classrooms, an open group area and a quiet room as well as toilets and wardrobes around a central lounge. Each room is topped by an elevated, truncated pyramid through which daylight flows. A direct exit into a private garden and the outdoor classroom area provides outdoor space and enables short access routes. Large-area glazing provides the necessary transparency so that the teachers can always see their students. The entire school is of pure timber construction. The multi-layer, glued-together solid wood panel surfaces are unclad and the timber framework is visible in every room. Students benefit from the better learning environment and a pleasant, warm atmosphere in the building, which also saves on heating costs. The materials used are based on the fundamental principles of sustainability and ecological efficiency. The renewable, regional building material used dramatically reduced the "gray" energy factor. With 940 points, the school in Unterdorf has been awarded one of the highest values for a new building in Vorarlberg's "communal building records". This sets a new standard for schools in Austria and, hopefully, will stimulate further timber construction in Austria. It is hoped that authorities show flexibility and courage to innovative concepts and apply them to the very rigid school building guidelines and standardization practices.

PHOTO CREDIT: Brigida González

Haus B

Yonder – Architektur und Design

Before the turn of the century, the family moved into a 1950s era building located on a site with magnificent views of Stuttgart's basin-shaped valley. The architect's task was to renovate and rebuild the home, which had already undergone several renovations in its lifetime. In an effort to work sustainably, the new construction makes use of the existing house as much as possible. At the same time, the reconstruction more clearly organizes space, better frames the site's breathtaking views, and ensures that the four-level building is easily accessible despite being constructed on a site with an extreme slope. During the reconstruction, the upper building parts from the 1950s were removed and rebuilt in wood. This resulted in a lightweight and prefabricated attachment on top of the old masonry and concrete structure. Timber as main construction material creates a natural atmosphere, and, by using a renewable resource, reduces the buildings carbon footprint. The new rooftop and the interior ceilings are solid wood CLT construction. Lightweight walls consist of a wooden framework with a sustainable wood fibre insulation which minimizes thermal bridging of the assembly. The facade is clad with larch battens fixed to a diagonal substructure. A spacious and natural living atmosphere is created by the building's open interior. Architectural spaces merge into each other, highlighted by wooden built-ins. The new construction is topped by a panoramic roof terrace at the upper floor. Broad wooden windows within a mullion-transom facade afford unimpeded views over Stuttgart. Though loadbearing, the slender profiles made from laminated oak do not interrupt the outstanding lookout. Living in "green-space" above the rooftops of the city is experienced spatially through an ever-changing point of view.

PHOTO CREDIT: Frédéric Baron

Collège Jean Monnet Broons

Dietrich | Untertrifaller Architectes and Colas Durand Architectes

The Jean Monnet Secondary School lies north of Broons, a 3,000-resident town in Brittany, and is considered one of the most important educational facilities in the region. Situated in a semi-rural area, the college is sensitively integrated into the landscape. Built over the whole breadth of the site, it is bounded by a south-facing courtyard which is bordered by the low wing of the canteen. The teaching building, two floors in mixed concrete and wood above a concrete base, is compact and functional. The design reflects the concept of a modern school: light wood, robust exposed concrete, a fresh red color and lots of glass characterize the warm, open atmosphere of the interior. The natural and untreated materials also pay tribute to local building traditions. The clear and structured spatial organization facilitates an ideal workflow. The linear, horizontal emphasis of the block-shaped, wood-covered building structure contrasts with the verticality of the interiors, which plays with different heights, lighting designs, intersecting passages and multi-layered sightlines. The cafeteria section connects to the three-story school building at a right angle and has a green flat roof that softly transitions toward the lawn. All levels are connected visually and functionally. The ground floor of the school section houses the function spaces for all classes, such as event rooms, the library and administration. The 16 classrooms and nine specialized classes are on the two top floors and are exposed to daylight from at least two sides. The three-story auditorium, naturally illuminated through a set of skylights, is at the center of the building. The materials used have been chosen for their long life, so as to reduce maintenance costs. One of the facades of the concrete base is clad with a facing that integrates local granite, while the facades of the different floors are covered with an un-treated Douglas fir cladding.

PHOTO CREDITS: Alexandra Kreja

Casa Curved

Daluz Gonzalez Architekten

In an area of family homes close to Basel, the goal was to create a house with 6.5 rooms. The two main conditions were a short execution time and a strict budget. The house was to be built inside a plot that was already occupied by (and belonging to) the client's parents. The house had reduced dimension and was built along the north-south orientation. The architects wanted to maintain the beautiful garden that stretched along the north-south orientation of the house which meant doing some research to understand the inner workings of the property. They discovered the original home was constructed as a semicircular house in the 1980s by architect Max Schnetz. The new design had to be fluent with the spatial rotundity of the proximal, older house. The project began with the desire to create beautiful curves and it was decided the best way to achieve the idea was to base it on a curve that incorporated a "Swiss Box" design. By making minimal changes to the outside walls, the architects were able to accentuate the corners, giving the home an unexpected expressiveness and a curved feeling. The house, which was built in wood on a concrete basement, forms a connection between traditional Swiss construction while still emphasizing the bond between formal modernity and constructive tradition.

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Abbotsford Industrial Shop and Office

DLT manufacturer showcases wood's industrial style

Abbotsford, BC

To house the manufacturing operations of its new Dowel Laminated Timber (DLT) product, and to efficiently facilitate the realization of the creative timber designs they are known for, StructureCraft sought to design a new cost-effective, aesthetically attractive facility which would fairly reflect the philosophy of the company in both the choice of materials and the construction techniques. The building is a showcase for a new way to construct industrial buildings, using wood as the primary material.

The just-completed 51,500-sq.ft facility is located one hour east of Vancouver, on a perch of land with views to the lush Fraser Valley and mountains beyond, a location reminiscent of the central European "holzbau" industries it draws inspiration from. The building is all wood, including supports for the four large cranes facilitating production.

The main workshop is a 45,000-sq.ft. manufacturing and fabrication building – 324 feet long, split into two 60-ft. bays. The north bay services fabrication of the ongoing project-based work consisting of a great variety of beams, trusses, and panels; the south bay is dedicated to the new DLT line which houses the latest in European equipment, including the world's largest and fastest dowel-pressing machine.

Wrapped around the southeastern corner of the shop is a two-story expandable office structure, also in exposed timber, in which engineering, 3D BIM, and project management is carried out for projects spanning North America and Asia.

Design and Construction

For the shop component, the key design goal was efficiency, both in use of materials and speed of construction on-site. Thirty-foot-tall tilt-up timber structural wall panels resting on 2'-6" high concrete curb walls form the exterior of the building, with no need for additional crane columns. Insulation batts inside the plywood skinned LSL stud wall panels create an R60 insulated wall. Point loads from both roof and eccentric crane beam brackets are sustained using built-up studs within the wall cavity.

Also novel were the 63-ft. roof panels, made of slender Douglas fir glulam beams along both panel edges. The beams were ordered from the supplier with strategically placed steps in the top surface, creating inverted "belly-beams", deeper (for structural efficiency) in the center of the span, while also naturally creating slopes to drain. Douglas fir roof joists (2 x 12) were custom-notched to rest on the stepped beams so that the plywood-sheathed curve was completely smooth. With utilization of these panels in both north and south bays, the result is a slight "gull-wing" shaping of the roof, and a very economical design.

The 74 wall panels and 54 roof panels that make up the shop were prefabricated during the winter for a spring erection. The entire shop was erected in five days.

This industrial hall is a very large building. To free up space, the structure is without cross-bracing for its entire length. Its location in a high seismic zone demanded special attention to achieve this open design, namely careful detailing of the plywood shear walls and diaphragm, including heavy chord straps along the north and south edges of the roof.

The office component was also prefabricated. This area has exposed spruce glulam and NLT (Nail Laminated Timber) panels and unexposed stud and plywood wall panels that were brought together and analyzed first in 3D. This office was designed to showcase the DLT product that would be manufactured inside the new plant, but the floor and roof panels, as well as the feature wall panels, were nailed together because the DLT machine was not yet in place! These panels still demonstrate clearly some of the advantages of the DLT product, in that profiles were machined into the surface of the boards, giving it a quality that cannot be achieved using regular NLT. Further, the second floor and roof are formed of panels with machined recesses filled with fibrous material, hidden and very effective for noise absorption. NRC coefficients of up to 0.8 can be achieved using this technique. Already early in its use, the benefits are being clearly noticed; it is a very quiet office.

Unique in North America, but common for centuries in Europe, this building displays a very simple but effective cladding and rain screen system. Spaced horizontal Douglas fir 2 x 6 boards shaped to repel water are stood off from the membrane-clad plywood with vertical cleats, so that almost all the water is shed, and the wood members can breathe. In this way, the bare wood screen can be durable for many years. To speed up the cladding installation, prefabricated panels were created ahead of time, with "planned random" staggering of the joints. This allows the cladding system to be easily replaced as required in the future.

The new plant was designed to explore what could be possible using wood for a simple industrial building with a tight budget. That exploration, while not simple during the design phase, has created a prototype which proves that modern industrial buildings may be created cost-effectively, and attractively, using wood.

ARCHITECT
Keystone Architecture
Abbotsford, BC

STRUCTURAL ENGINEER
StructureCraft Builders
Delta, BC

GENERAL CONTRACTOR
StructureCraft Builders
Delta, BC

PHOTOGRAPHY
Moses Mehraban
Toronto, ON

Pond Residence

Reclaimed cypress exterior connects home to its environment

Northeastern United States

The homeowners desired a single-family residence that fit with the natural surroundings of their 4.3-acre woodland site in the northeastern corner of the U.S. and felt it was important to have a home that would not interfere with existing wildlife or discourage new habitats. They also wanted to live in a Net Zero building. To achieve this relationship with the land, the natural resiliency and durability of reclaimed cypress was an obvious choice for the exterior siding while interior surfaces are primarily clear Douglas fir to provide added warmth.

This five-bedroom home meets the busy couple's needs. Selecting a site that allowed an emotional connection to the land and wildlife was critical, so too was having a resilient, energy-efficient home for entertaining guests. The main rooms are on a single level and all door thresholds are low profile with exterior walks that meet ADA slope requirements.

The design attempts to make the land and home a single entity. The architect shaped the building to fit into the existing contours so the land would be minimally disturbed and any water running down from the northern hills would be collected in a pond. In doing so, the large pond acts as a focal point for the homeowners and now brings birds, fish, amphibians and aquatic insects to their daily experience. Douglas fir-framed glass sliding doors provide an intimate connection to the natural world on two sides of the house.

To maintain cost efficiencies, the project was tented during construction to make the construction timeline more efficient. Work did not have to start and stop for inclement weather conditions, during an especially difficult winter.

The exterior cypress was left unfinished to weather over time while the interior Douglas fir walls, ceilings, glulam and doors were finished with two coats of catalyzed lacquer. Floors are rift-sawn red oak and finished with waterborne satin polyurethane for durability.

The window casements are made of split species woods; unfinished redwood was used for the exterior, while Douglas fir, finished with clear lacquer, was used on the interior.

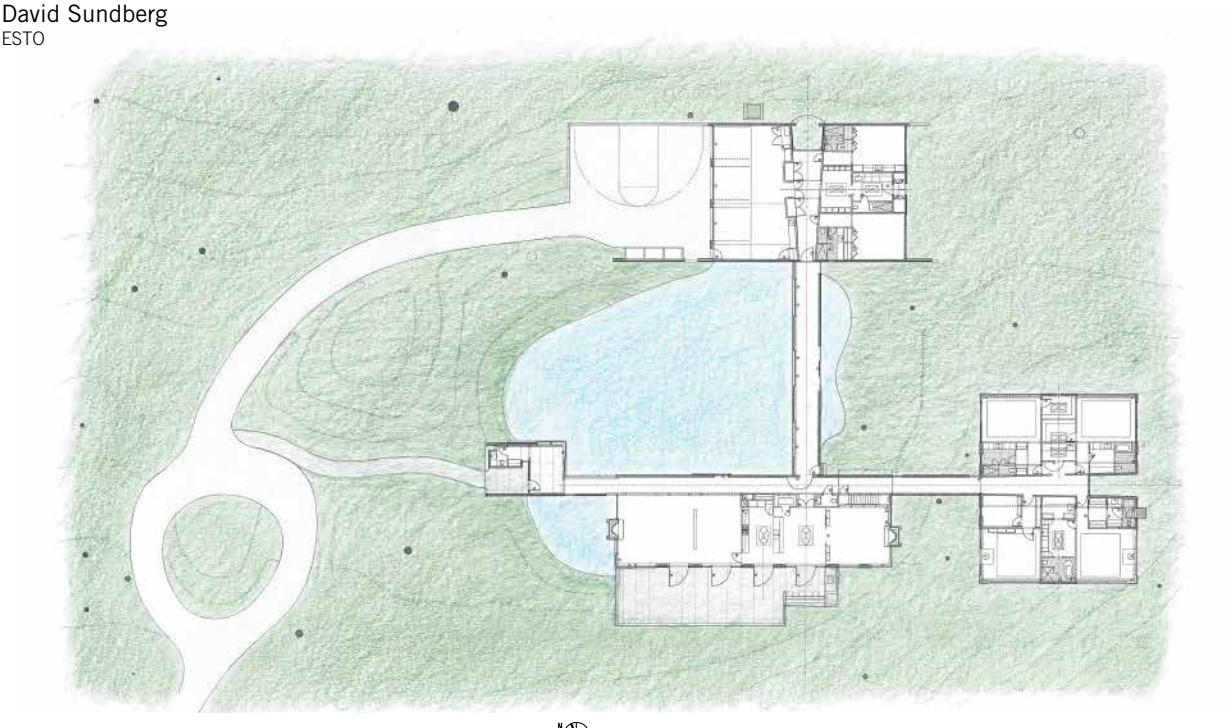
In order to achieve the Net Zero energy use, the building is fitted with a geothermal heating system which has 14 wells dug throughout the site. The heat pump and household loads are powered by 3,500 sq.ft. of photovoltaic panels on the rooftop, boosted by a six-panel radiant solar array that will meet 100 per cent of the home's electrical loads. Six rooftop solar flatplate collectors are also employed for hot water.

ARCHITECT
Cutler Anderson Architects
Bainbridge Island, WA

STRUCTURAL ENGINEER
Madden & Baughman Engineering, Inc.
Portland, OR

GENERAL CONTRACTOR
A. Pappajohn Company
Norwalk, CT

PHOTOGRAPHY
David Sundberg
ESTO



SITE PLAN

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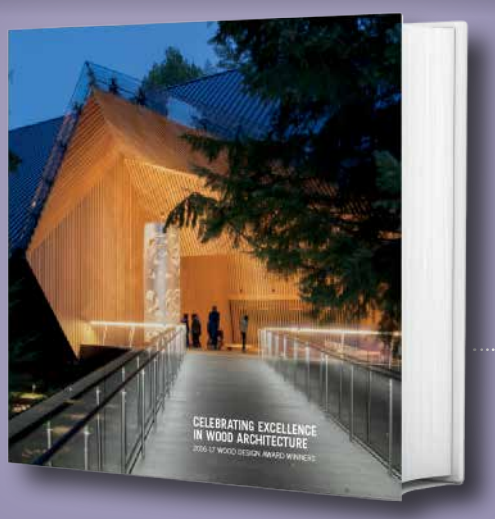

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Orillia
Waterfront
Centre
Port of Orillia
ICE

Orillia Waterfront Centre

Efficient glulam and CLT construction process accelerates project timeline

Orillia, ON


WASHROOMS

The Orillia Waterfront Centre is a significant community space on the shores of the picturesque Lake Couchiching in central Ontario. A popular amenity for the residents of Orillia, and a thoroughfare for visiting boaters, the building boasts a CLT, glulam, and glass lounge that provides expansive, scenic views along the water's edge.

The program of the $1.9-million, single-story features administration offices, washrooms and showers, and a large community space. The 5,106-sq.ft. building provides private services to boaters while also serving the general community as a venue for weddings, meetings and events. The principal room overlooking the marina can be divided into two, more intimately sized spaces, using large CLT pivot doors cut and assembled to reflect naval flag patterning.

The design-build project was a joint partnership between the architects, builders, engineers, and CLT fabricators. In a demonstration of the efficiency of building technologies, the glulam and CLT were erected in a single day, saving considerable time over traditional construction methods. CLT led to further efficiencies in construction as it is used in this case both as structure and as interior finish.

1. community lounge
2. reception
3. vending/catering
4. washroom
5. office
6. storage
7. service room
8. shower suites
9. utility
10. algae and gargage room
11. future skate change
12. laundry

GROUND FLOOR PLAN

The center establishes a sense of place on the waterfront. A key part of its success derives from its extensive use of wood in its public-facing areas, a familiar material whose warm tones invite use. It is a timeless material whose innate familiarity will help the pavilion age gracefully in the years ahead.

The Orillia Waterfront Centre serves as a beacon for the community and features a lightbox sitting atop the community lounge, drawing the public toward its warm wood interior. In the few summer months since its opening, the building has quickly become a well-loved destination point for the visitors and residents of Orillia.

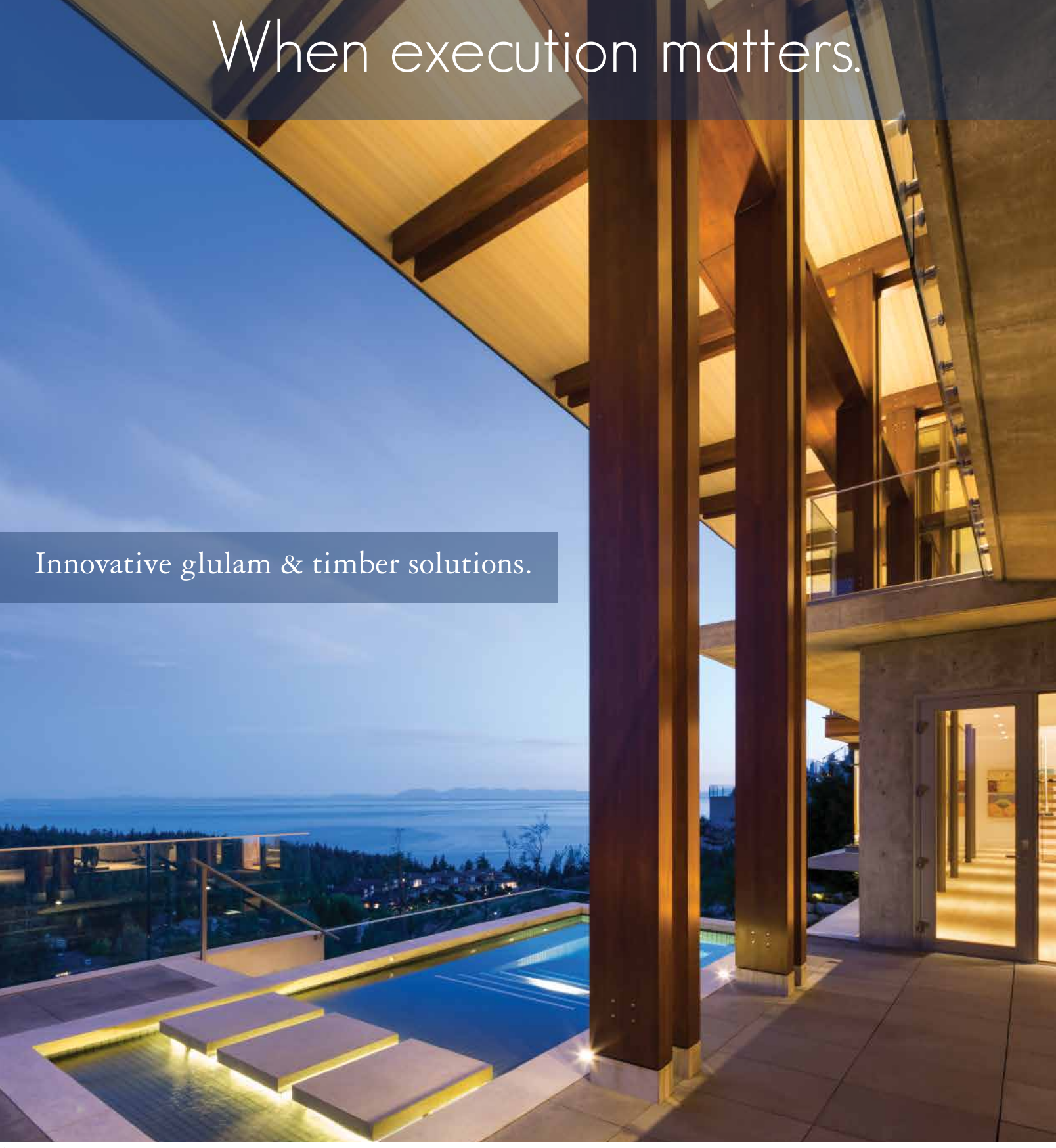
ARCHITECT
Brook McIlroy Inc.
Toronto, ON

STRUCTURAL ENGINEER
Steenhof Building Services
Orillia, ON

GENERAL CONTRACTOR
Bradanick Construction Services
Orillia, ON

TIMBER SUPPLIER
Element5 Co.
Toronto, ON

PHOTOGRAPHY
Tom Arban
Toronto, ON



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La Seine Musicale

Spruce glulam gridshell is like a jewel

Paris, France

La Seine Musicale is a multi-purpose musical facility located on Seguin Island, in Boulogne-Billancourt, a western suburb of Paris. The island is best-known for the old Renault manufacturing plant, the largest European automobile manufacturer of 20th century, which was closed in 1992.

The site is 0.2 miles long, on a pointed edge of Seguin Island. The Eiffel Tower happens to be almost as long and as wide as the site. Here, Japanese architect Shigeru Ban with French architect Jean de Gastines, designed a multi-purpose musical facility with a total floor area of 392,882 sq.ft. The program includes a multi-purpose concert hall with 4,000 seats, a classic auditorium concert hall with 1,150 seats, a music school, and shops. The client requested something "monumental" and "symbolic" so instead of making a typically shaped building, the architect conceived of a precious "jewel": the auditorium.

The auditorium is a vineyard style classic concert hall with seating that surrounds the stage. Its form is egg-like, and its surface is covered with mosaic tiles. The color of the tiles changes from emerald green to bronze red according to the lighting and the angle of vision. The mosaic tiles were inspired by the Japanese beetle, tamamushi, and specially produced for the project. The foyer around the auditorium is covered with glass and the gridshell structure is spruce glulam with beech connection joints. More than 1,700 unique timber elements comprise the double curved glulam structure.

The use of solar panels was a requirement. Instead of placing the panels on the top of the roof, the architects designed a triangle "sail" using the solar panels. The sail is placed around the auditorium and it moves according to the sunlight, just like an ordinary sail that moves according to the winds. Thanks to its movement, the sail is facing the sun all the time, which allows efficient power production while creating shade for the auditorium foyer.

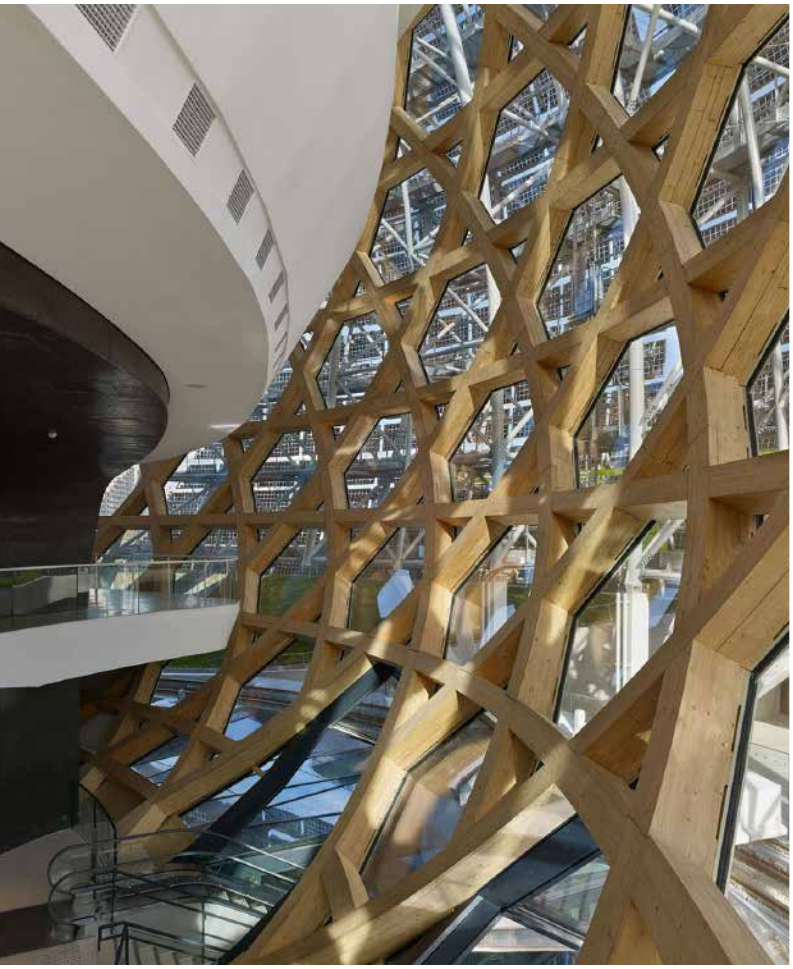
Inside the auditorium, the walls are covered with corrugated wooden strips. Several typographies were made by composing the same module differently, considering the acoustic reflection and absorption. The variety of patterns ensures the acoustic quality of the space through a homogeneous diffusion of sound waves.

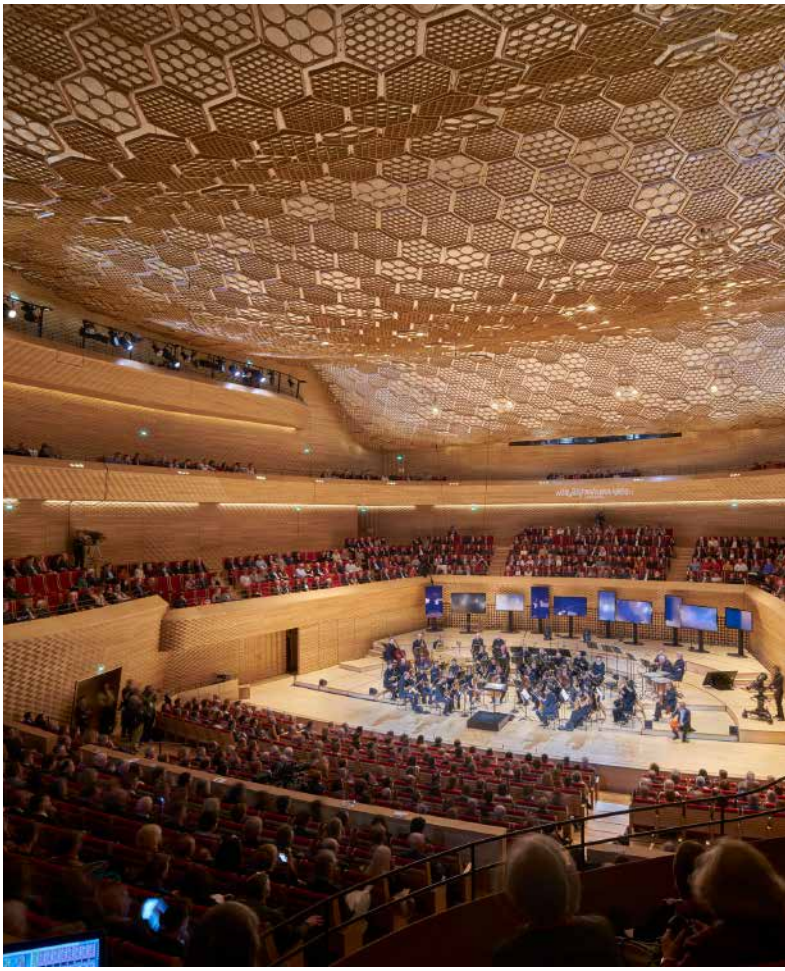
On the exterior, massive walls were designed using undressed/exposed concrete since the master plan required something more industrial like the former manufacturing plant. The jewel auditorium is a stark contrast with its wood structure.

The commercial axis which defines the island's master plan extends through the building. When there is no concert, glass shutters and bi-folding doors open up so that the public can use the Interior Street (rue Intérieure). Once inside, there are shops, a ticket office, restaurants, the foyer, and windows through which visitors can see inside the rehearsal rooms. The street leads to "Place Rodin", a sculptural terrace at the point of the island.

The greenbelt, the other axis defined inside the master plan, also extends into La Seine Musicale. The public is invited up the monumental exterior stairs to access to the rooftop garden.

It is the architect's desire to build public facilities such as museums and concert halls which are open to everyone, including those who may not be music or art devotees and La Seine Musicale is a wonderful example.





OWNER
Conseil Général des Hauts-de-Seine

ARCHITECTS
Shigeru Ban Architects + Jean de Gastines Architectes
Paris, France

STRUCTURAL ENGINEERS
Setec Travaux Publics & Industriels
Paris, France

Sblumer ZT GmbH
Graz, Austria

GENERAL CONTRACTOR
Bouygues Bâtiment IDF
Saint-Quentin-en-Yvelines, France

TIMBER SUPPLIER
Hess
Kleinheubach, Germany

PHOTOGRAPHY
Boegly + Grazia
Paris, France

PROJECT FACTS

Area
392,882 sq.ft.

Budget
1.7M Euros (approx. $2 million USD)

Opened
April 22, 2017

Leading Agencies Envision Long-Term Fire Safety on Construction Sites

Kenneth Bland, P.E.

In early October, leaders in construction fire prevention announced a new coalition initiative to address fire safety on construction sites. Coalition members agree there is a critical need for guidance and training to increase fire safety practices on the job site to prevent construction fires. Though less than 1 per cent of fires occur during the construction stage, those that do occur can result in injuries, significant financial losses, and may also require an intensive fire service response, straining municipal resources. Moreover, with the right systems and requirements in place, the majority of these fires are preventable, making it crucial to prioritize fire safety on construction sites.

The coalition approach is an essential strategy for addressing the complex, multi-faceted nature of this challenge. No one organization has the capacity to implement a total solution, but through the collaboration of many, the coalition can bring about positive change. Along with the American Wood Council, charter members of the coalition include Davidson Code Concepts, LLC, FireForceOne, the International Code Council, the National Fire Sprinkler Association, and the National Association of Homebuilders. Recently, the coalition also welcomed APA – the Engineered Wood Association, Chris Towski of the Cambridge Fire Department, The Hanover Company, and the National Association of State Fire Marshals to the group.

The genesis of this Coalition dates back to early 2016, when the American Wood Council formed a partnership with Ronny Coleman, former California State Fire Marshal and Principal of FireForce-One, and other interested parties. These organizations worked together to develop fire safety guidelines and resources, and to determine the best way to disseminate these tools to target audiences, including code officials, builders and fire services professionals. The primary result of this effort was the *Construction Fire Safety website*, which is now home to information on the *Construction Fire Safety Coalition* as well as resources geared toward those involved in the construction of large-area, multi-family housing.

The recent announcement of the coalition marks the second phase of construction fire safety efforts – to continue heightening awareness of job site fire prevention and codes and standards, and increase enforcement of fire safety requirements. The American Wood Council will serve primarily as the administrator of this coalition and manage all the resources provided by coalition members on the Construction Fire Safety website.

As a convening body, coalition members will engage in regular knowledge sharing, with quarterly calls to discuss industry events and address critical challenges. The coalition will share a quarterly email update, highlighting new partners, accessible partner publications and resources on the Fire Safety site, and industry news to keep professionals abreast of the most up to date information.

Coalition members will rely on science-backed research to collaboratively develop best practices, training and fire safety guidance for all stakeholders. This includes improving the accessibility and understanding of National Fire Protection Association (NFPA) Life Safety and Fire Codes, the International Building Code and the International Fire Code to ensure firefighters and occupants are safe, and buildings under construction remain unharmed by fire. Through training on topics such as meeting and exceeding codes on construction sites, the coalition also hopes to encourage a higher rate of enforcement by code officials. Future educational opportunities could involve a review of recent fires, lessons learned across the industry, as well as identified gaps and how to best address them.

Initiatives and resources developed by the coalition will benefit those who have a product or a direct role in fire prevention – code officials, fire services (firefighters, chiefs, protection engineers), developers, builders, and insurance underwriters. Resources on the *Construction Fire Safety website* can be accessed at no cost – since all audiences have a stake in prioritizing and ensuring safety of sites, workers, and the surrounding built environment and

community. The website has *fire safety manuals* and *prevention strategies* that keep fire department access top-of-mind in design. Stakeholders can access *checklists* and *best practices* to help meet safety requirements and inspection on job sites, and *guidance* on developing fire protection plans. It has also been suggested the coalition develop construction fire safety best practices for inclusion on construction drawings and plans. Coalition members are committed to continually identifying needed tools for professionals across the industry.

Long term, the coalition aims to achieve:

- Improved public and firefighter safety through reduced frequency and severity of construction site fires;
- Reduced frequency and severity of fires in projects involving construction, alteration, demolition or related activities, including site development and on-site material staging; and
- Reduced negative impacts on neighboring buildings, delays in building occupancy, water resources and the environment.

This effort is open to all across the construction, building, and fire safety professions who wish to help reduce the frequency and severity of construction fires. No matter where you stand in the industry or what building material you stand for, everyone plays an integral role in increasing safety on construction sites. Fires occur in both combustible and noncombustible buildings under construction, and when they do, they threaten lives, homes, community resources, and the surrounding built environment. By continuing to grow and evolve, the coalition can heighten awareness and increase construction fire safety.

There is no financial commitment associated with becoming a coalition member. Members will be asked to align on best construction site fire prevention practices and agree to promote awareness of the resources offered by the coalition. Coalition partners will offer available educational materials and programs to their audiences to help achieve these goals. To learn more, visit **www.constructionfiresafetypractices.com**.

Kenneth Bland, P.E., is the Vice President of Codes & Regulations at the American Wood Council (AWC), which represents the interests of the North American wood products industry that provides approximately 400,000 men and women in the United States with family-wage jobs. On behalf of the industry it represents, AWC is committed to ensuring a resilient, safe, and sustainable built environment. To achieve these objectives, AWC contributes to the development of sound public policies, codes, and regulations which allow for the appropriate and responsible manufacture and use of wood products.

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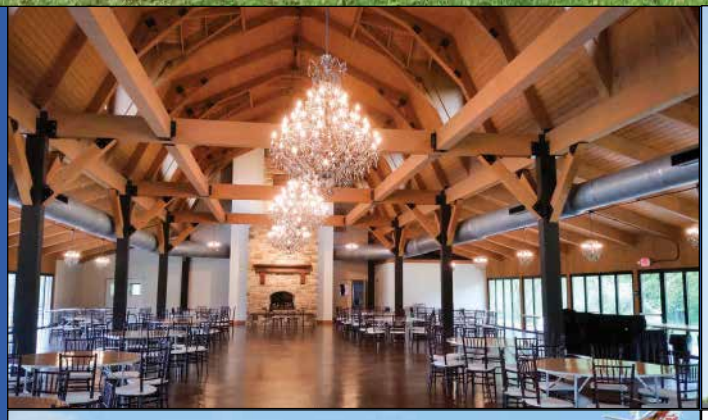

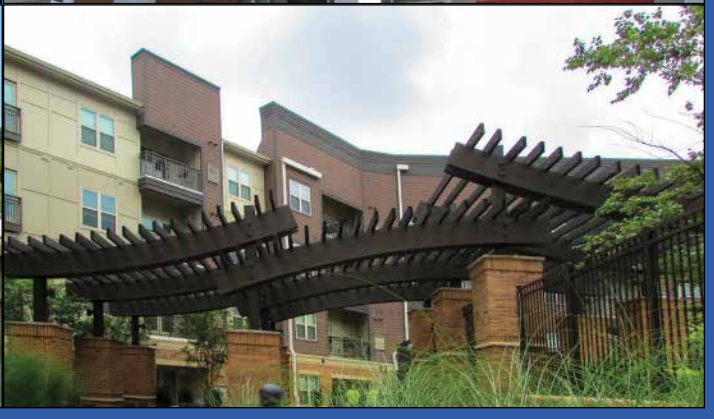

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Computational Design with Timber

Lucas Epp

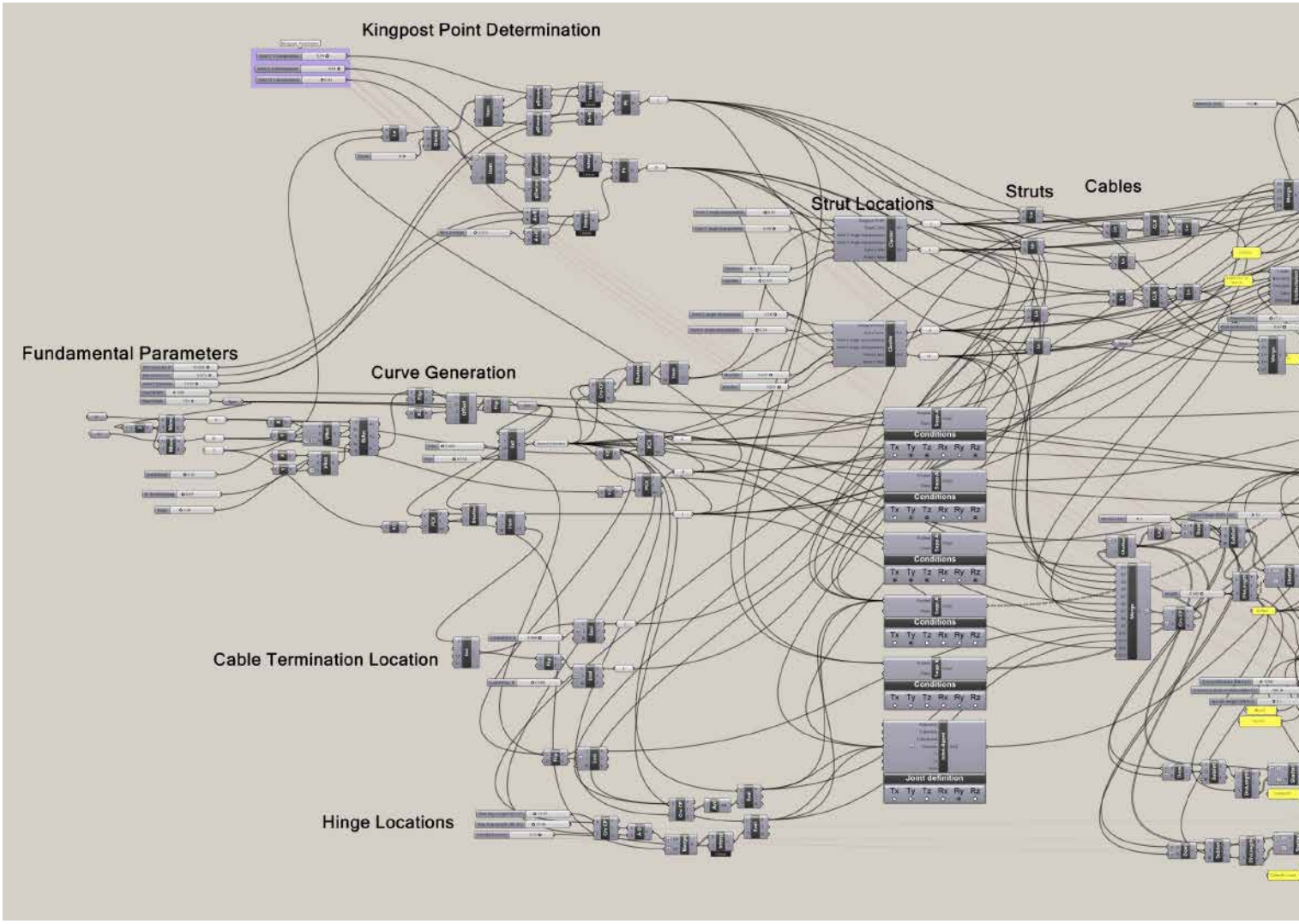
Over the last 10 years, the field of computational design has taken the building industry by storm. The meteoric rise of this new paradigm amongst designers can largely be attributed to the emergence of new user-friendly software tools. These tools enable the creation of parametric scripts by designers, without requiring computer programming skills. Use of computational design has now become *de rigueur* in leading architectural and engineering practices worldwide, particularly in geometrically complex or freeform structures.

These software tools encourage a design approach which defines the geometry of structures *parametrically* – the guiding geometrical principles of a design are exposed as *parameters* which can be changed at any point during the design. This enables rapid exploration of variations on a certain design or geometry.

Significant advances in software design over the last 10 years now allow real-time analysis to be performed as the geometric parameters are changed. As an example, this means that a designer, while changing the depth of the kingpost truss to the right, can watch in real-time as the structural forces change. This is a step change from traditional analysis methods which involve transferring geometry to a separate analysis software, and then running analyses often taking minutes or hours.

The design-performance feedback loop has thus been reduced from hours to seconds.

Dramatic curves on the 22,000-sq.ft. soffit at the New Calgary Library (Snohetta, Dialog)



Grasshopper Script which performs cost and structural optimization of a hybrid glulam and steel kingpost truss. The script defines parameters which can be changed such as truss depth, and then uses an Evolutionary Algorithm to search the parameter space and determine the lowest cost structure.

RECENT COMPUTATIONAL DESIGN

Depending on one's definition of computational design, it arguably started even before the first CAD software – Alan Sutherland's SKETCHPAD (1963). However in the architecture, engineering and construction (AEC) industry today, the term typically implies using computing to influence or enable the exploration of design space.

The possible applications of computational design are almost limitless; it is not limited to parametric geometrical investigation, and can be used for true generative design, where a computational algorithm generates the forms by following a set of rules.

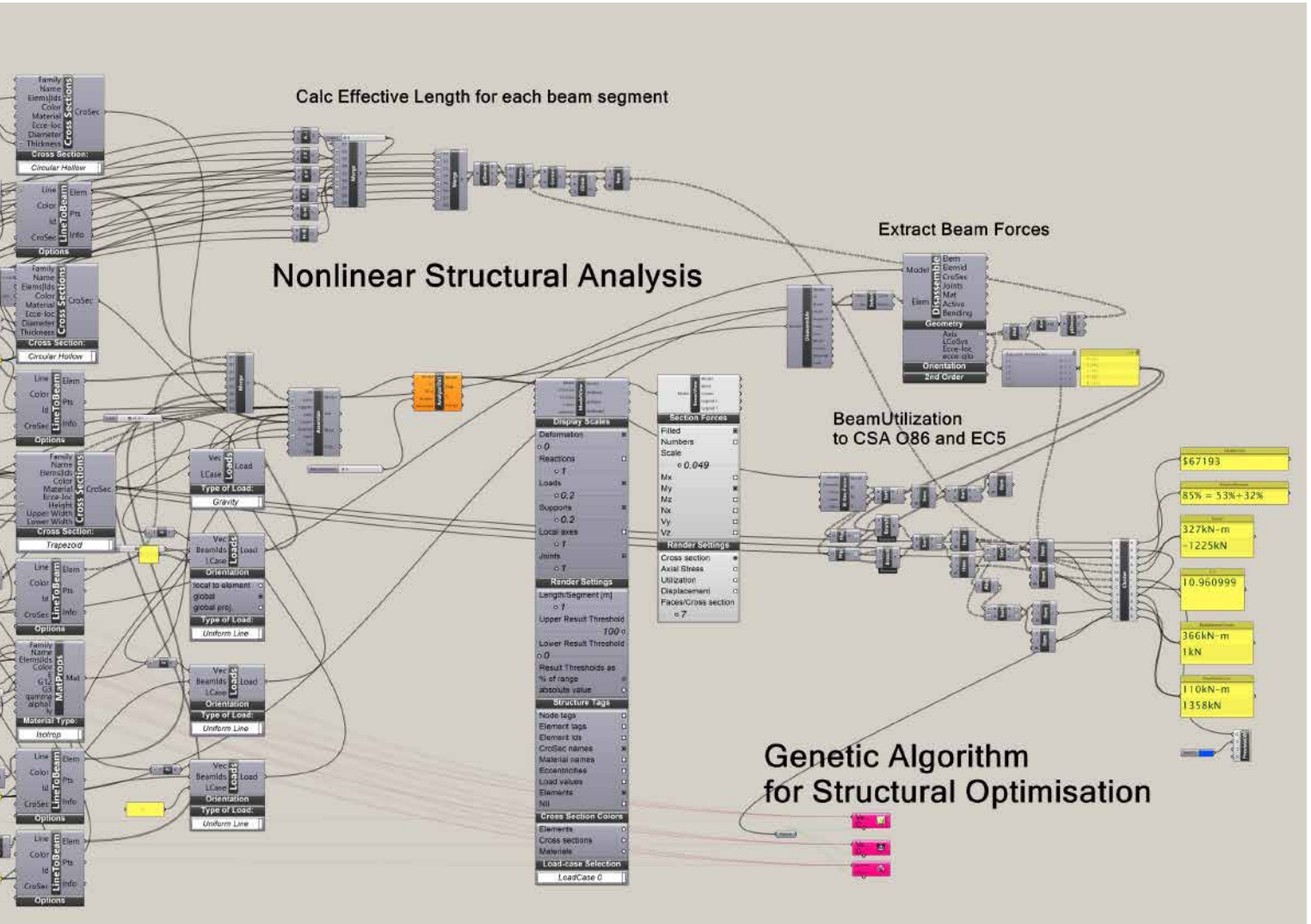
However, computational design in architecture and engineering has been primarily focused on the parametric definition of geometrical form, and the performance evaluation of such forms. The ability to quickly assess the performance characteristics of designs while varying design parameters can greatly aid design selection.

Early parametric CAD tools like Bentley's GenerativeComponents first started gaining popularity in 2005, particularly in London's architectural community. With the release of Grasshopper (a plug-in to Rhinoceros modelling software) in 2007, it quickly became the norm for parametric modelling and computational design in the AEC world. Other software tools like Autodesk's Dynamo have built on the success of Grasshopper.

These tools use a simple node-based interface, called visual programming – each node on the canvas shown above performs an operation, taking inputs on the left and giving outputs on the right. For example, a Line node would take as input 2 points, or a Structural Beam node would take as inputs a collection of Lines, a Cross Section, and a Material. The topology of the wires connecting the various nodes defines the algorithm logic, thus creating a script.

Inside computational software tools such as Grasshopper, robust user communities have contributed custom plug-ins enabling diverse types of computation and analyses, ranging from geometrical to mathematical to machine learning.

The performance characteristics of buildings which can be evaluated are extensive, including daylighting and building energy simulation, people movement,

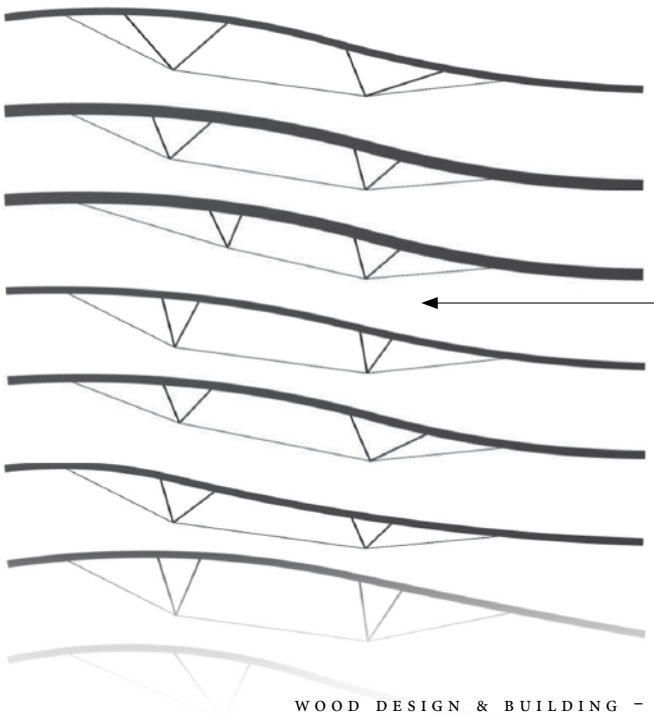


structural finite element analysis, CNC robotic simulation and toolpath generation, geometric analysis and optimization (e.g. for freeform facade panel planarity), form-finding (e.g. hanging chains a la Gaudi), and physics simulation including Computational Fluid Dynamics.

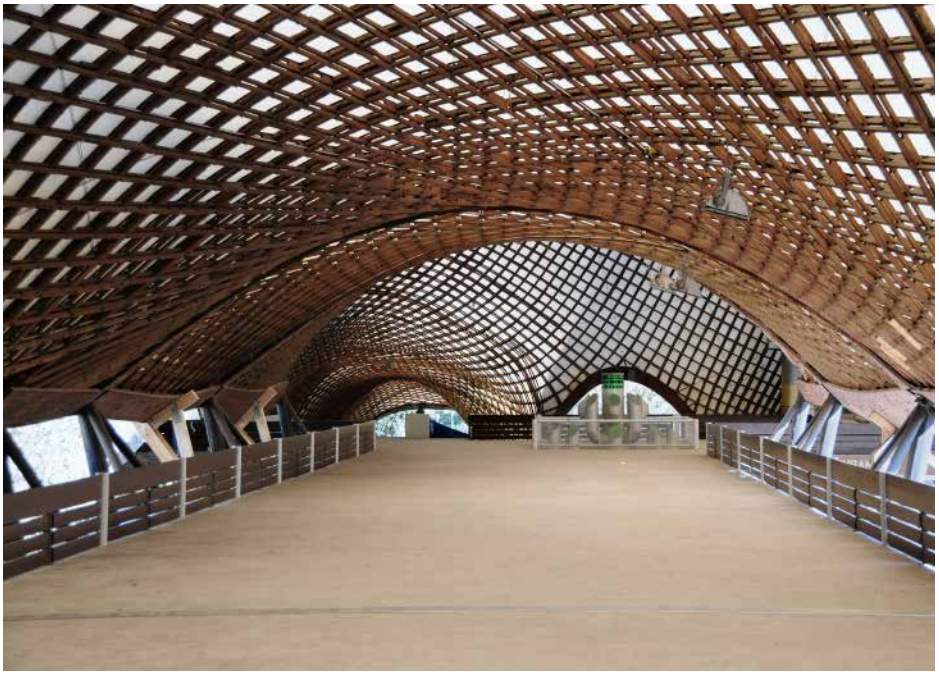
In the field of structural engineering, computational design is often used for optimizing the geometry or topology of a structure to achieve the most structurally efficient or lowest cost structure.

FREEFORM TIMBER

With timber as a natural material, there is a long history of designing and building complex or free-form shapes and structures of varying sizes. The flexibility and workability of the material makes it ideal for shaping and milling, but its natural



Various possible kingpost truss shapes



Mannheim Gridshell, Germany

defects and variability also present challenges in predictability.

Perhaps some of the earliest structures built using wood curved into shape are the indigenous dwellings constructed with bamboo, reed, and hardwoods in places like southern Iraq (Mudhif houses), Ethiopia (Dorze tribe houses), and Brazil (Oca houses).

In the 1960s, Frei Otto pioneered the use of timber for freeform gridshell structures, using the so-called bending active technique: a lattice of initially straight timber lathes is laid flat on the ground and then curved up into place on-site. After success with smaller structures at Expo' 67 Montreal, his crowning achievement was the Mannheim Multihalle (1975), an interconnected series of spaces created by a bidirectional double layer grid of 2" x 2" timber lathes, with clear spans up to 200 ft – a span-to-depth ratio thinner than that of an eggshell.

In the 1990s, Julius Natterer explored timber gridshells using elements which were initially curved in one direction and then allowed to torque about their long axis during installation, creating structures with larger structural depths and spans, culminating in the Expodach Hannover in 2000.

Both of these approaches, however, limit the geometrical form of the roof because the amount of curve or twist that can be placed in an initially straight timber element is limited. Another approach to creating truly freeform roof structures was explored with the Pompidou Metz (Shigeru Ban, 2010). Instead of using initially straight small cross-section lathes, much larger straight elements were used, with each piece three-dimensionally CNC-milled into the required twisted, curved shape to suit the geometry of the roof. Since this project, further advances in glue lamination have enabled the automated production of initially doubly curved Glulam elements, removing much of the wasted material created by CNC-milling an initially straight element. Several timber gridshells have been built worldwide using a similar strategy.

Apart from gridshells, continuous freeform cladding surfaces are increasingly interesting to contemporary architects. Much has been done with materials like glass reinforced concrete (GRC) and metal panels. More recently, timber as a material for large-scale freeform cladding has gained significant attention.

STRUCTURE

Inside Grasshopper, structural analysis of a structure with 20,000 elements can be calculated in <0.5 sec – effectively real-time. This allows for rapid exploration of different structural configurations. Using the example of the hybrid kingpost truss, over 100 analysis runs per second of this simple structure are possible using the script shown, allowing thousands of different configurations to be explored in a matter of minutes.

Model-based or metaheuristic optimization techniques such as evolutionary algorithms can then be used to iterate the selection of design parameters toward a structurally optimal solution.

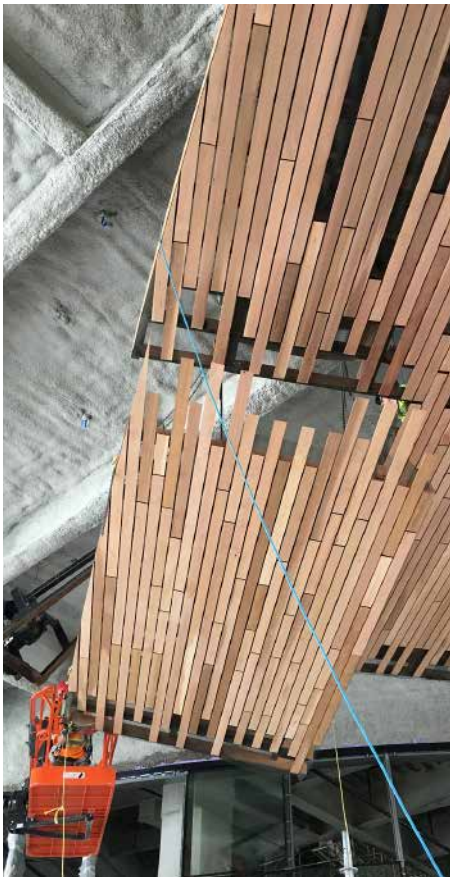
After the structural analysis has been run, the resulting structural forces can be used downstream to automatically size the elements and calculate material usage or cost. This gives the designer immediate feedback on important attributes of the structural configuration.

COMPLEX

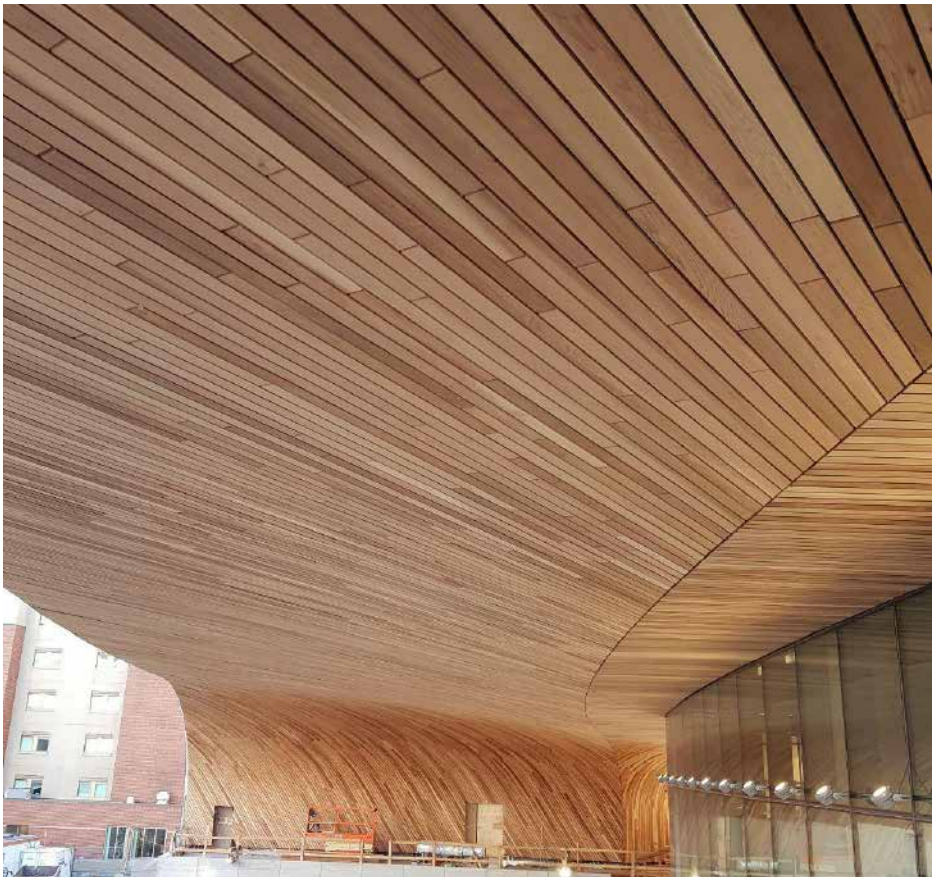
One useful aspect of computational design with timber is enabling structural analysis and automatic generation of fabrication information for geometrically complex projects.

The freeform soffit for Calgary's new public library forms a doubly curved underbelly and entrance to the building. The surface is created with Western red cedar battens; the battens are initially straight, and are bent and twisted as they are applied onto panels, following minimum energy curves known as geodesics across the surface. To apply these battens in place would have been impossible both from a labor and an accuracy standpoint. Prefabrication was a must.

To create the complex geometry, the soffit is built with prefabricated panels, with the battens attached to a ribbed structure of CNC'd backing elements. Over 20,000 unique pieces of CNC-profiled wood form the 300 panels in this structure. Each panel spans up to 25 feet, connecting to each other and curving down toward the ground, creating an



Installation of pre-fabricated panels.



Doubly curved soffit at the New Calgary Library created using a geodesic batten pattern.

entrance intended to attract the public into the building.

Computational design was critical in enabling the 3D geometry creation, structural analysis, CNC milling data, and fabrication drawings for this project. Custom algorithms were written to randomize the position of batten joints across the soffit, while respecting fabrication constraints such as the maximum overlap between panels. A parametric 3D modelling approach allowed rule sets for the prefabricated panels and battens to be established and then automatically produce 3D models and fabrication information for each of the 170 panels.

Computational design on this project enabled a vertically integrated approach, linking design, engineering, and fabrication information. As the overall geometry of the surface changed throughout the design, both structural analysis and generation of fabrication information was automatically updated.

SIMPLE

Naturally, computational design has found earliest adoption in complex projects. However, the principles of computation are not limited in scope to the complex.

For simpler structures such as mass timber, parametric design and analysis can be used for anything from helping determine optimal column grids or structural configurations to automating the creation of 4D models (construction of a structure through time), simulating CNC machine toolpaths, or to simply parsing and displaying data about the geometry or structure of a building in a graphic and interactive manner.

CONCLUSION

Use of software tools often associated with computational design enables projects with significant complexity, but is not limited to these. Using node-based visual programming, computational design approaches can be applied simply to many different problems.

Interest in using timber for structures both complex and simple is increasing. A focus on off-site and modular techniques in timber construction makes computational design well-suited to this field, and its use will continue to grow significantly in North America and abroad.

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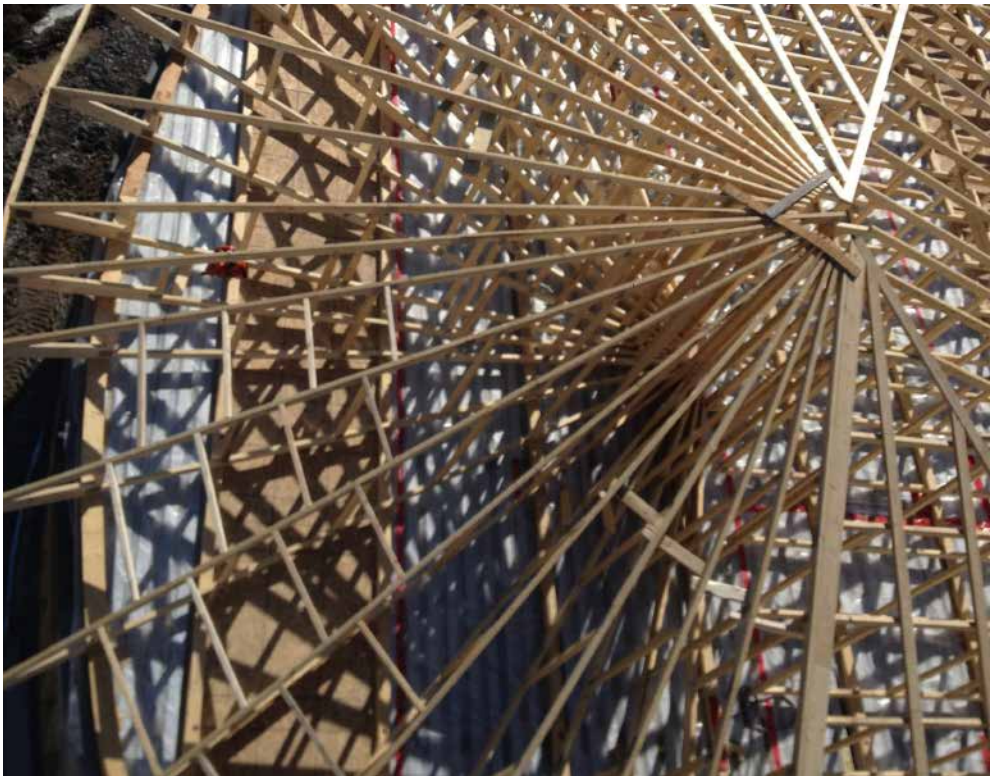
Software Design and Engineered Wood Trusses

Mike Phillips

Software plus a good designer produces great results.



This perfectly round commercial building demanded a perfectly circular roof. It was designed and manufactured by Peterborough Truss & Floor Ltd.

A few decades ago, you needed a drafting table, calculator and lots of time to design anything beyond a very standard roof. We won't even discuss the slide rule, used before calculators were common. Today, however, a good designer only needs one of the many excellent computer programs available to design the roof structure of any building.

With computer-aided design, the options are almost limitless. You want a grand entrance with a cathedral ceiling? No problem. Does your client's man cave – disguised as a garage – need more storage space, perhaps an attic truss? Easily done. What about a round commercial building that requires a perfectly circular roof? Of course! That can be done, too.

When we visited Bruce McHugh, GM and Vice President of Operations with Peterborough Truss & Floor, in his Peterborough, Ontario, manufacturing facility, he was happy to show us around. In the front, his computerized design office continues to grow; so much so that the boardroom is now full of designers. Out back in the plant, his equipment is going full tilt to keep up with demand. Like most Ontario-based truss plants, he has a long order book.

He showed me a gas station he had recently built. It is a simple commercial building that has a very complicated roof. Without software it would have been nearly impossible to create the drawings necessary to manufacture the trusses.

After the tour, McHugh, who is also the Vice President of the Ontario Structural Wood Association (OSWA), offered his thoughts on the structural wood industry in Canada. "It is finally advancing

David Jochim and Erik Pfautsch, both Senior Truss Designers with Peterborough Truss & Floor Ltd., discuss a design project.

and changing for the better. The software we use has quickly evolved from number crunching calculators into very powerful 3D modeling programs. The advancements are allowing our designers to integrate our engineered wood products into three-dimensional building plans using innovative and creative designs. We can still design trusses but we can also do so much more."

Most plate manufacturers also supply truss design software. MiTek is a dominant connector plate supplier in Canada along with Alpine Systems Corporation and Simpson Strong-Tie. And while they all sell truss plates and other connectors for wood construction, the key driver of their business is the software.

A good designer running the software is necessary and there is lots of training available. MiTek has more than 50 training modules for the beginner through to the seasoned pro. Truss fabrication design teams either have a professional engineer on the team or access to engineering advice. The team's experience will generally include some level of post-secondary training (either college or university) as well as job site construction and plant production experience. A well-rounded design team can create the design look wanted, with trusses that exceed building code requirements, at a competitive price.

The software provides integrated project management as well as truss, wall panel, and EWP design tools for an industry that demands quick, economic, high-quality results.

"We are continually improving our suite of software to produce powerful applications designed to grow your business success," says Jamie Boyd, Manager of Business Development & Technical Services at MiTek Canada Inc. and OSWA Board member. "MiTek software is designed with more than BIM modeling in mind. We offer the industry's most powerful software – from solutions for structural design to full production management, deck design, BOM estimating, and business management."

Naturally, the roof and truss design must be integrated into the rest of the online design. Again, software enables this integration by ensuring the total structure will "work" as one building unit. And with continued advances in wood science and the creation of new and better engineered wood products for beams, columns and panels, the options for wood building solutions continue to expand and evolve.

The Canadian truss industry has established quality and production standards for truss manufacturing. The Truss Plate Institute of Canada (TPIC) represents the industry on various building codes and standards committees.

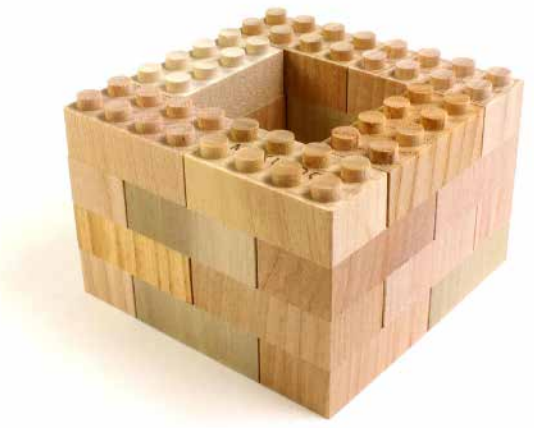
Brent Bunting, of Simpson Strong-Tie, represents OSWA on the TPIC. This group ensures that science remains the guiding principle to wood solutions.

"Building codes and design standards are constantly changing," he says. "The truss industry is at the forefront when it comes to changes in technology and methodologies that better serve the construction sector and ensure designs are robust, cost-effective and code-compliant."

Evidently, software will remain a huge part of the construction solution moving forward. Our task in the structural wood industry is to build, and with the aid of software, the opportunities are endless.

Mike Phillips has been the Executive Director of the Ontario Structural Wood Association (OSWA) since 2008. The association was originally called the Ontario Wood Truss Fabricators Association before it rebranded as OSWA in 2016. OSWA represents manufacturers, suppliers, engineers and designers in the Ontario structural wood industry. For more information, visit www.oswa.ca.

Wood WARE



MOKULOCK

New Tech Shinsei (NTS), an electronics company located in Japan, specializes in the assembly of electronic devices such as computers. Due to an economic depression several years ago, competition had become tougher than ever and the company was forced to explore new sources of revenue. With an abundance of timber on the market and a will to give back to their community, NTS created Mokulock wooden connecting toy bricks. They are available in six different species of wood including Japanese cherry, Japanese zelkova, Japanese bigleaf magnolia, birch, hornbeam, and maple. NTS says Mokulock bricks bring nature closer to their community and help inspire imaginations worldwide.

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