Wood Design & Building®

Spring/Summer 2019 — Number 82

MID-RISE INNOVATION

Ice Block 1
Honoring tradition

AquaBlu
Setting a new standard

Jacobson Hall
A modular first for Canada

Six dollars

Publications Mail agreement #40063877

contents

Above and **on the cover:** ICE BLOCK 1
PHOTOS: Bernard Andre

In honor of excellence

While we were producing this issue, I was also a juror for the second annual International Award for Wood Architecture, which brings together the editors of six international magazines that specialize in wood architecture: *Lignum* (Switzerland), *Mikado* (Germany), *PUU* (Finland), *Séquences Bois* (France), *Trä !* (Sweden) and, of course, *Wood Design & Building*. In early April, at the International Wood Construction Forum in France, the winner was announced (you can read about the community hall in Le Vaud, Switzerland, on p.8) – a much different building than last year's winner, the 18-storey Tallwood House at Brock Commons, on the University of British Columbia campus.

When comparing the two International Award winners side by side, the dramatic range of possibilities that wood offers is illustrated by contrasting scales and aesthetics, from what was the tallest mass timber building in the world (recently unseated by the 18-storey Mjøstårnet tower in Norway) to a sublime, angular structure nestled between a schoolyard and a church. What the two winners clearly have in common is their connection to community – and, education. As it turns out, several other International Award nominees were school buildings, so they are included in this issue's "Inspiration Board" along with a feature article (on p.26) about the Simone Veil Middle School in Lamballe, France – a mid-rise building that also won a Merit award in the 2018 *Wood Design & Building* Awards. Another notable education project, the five-storey Jacobson Hall residence at Trinity Western University is the tallest wood-framed modular building in Canada (featured on p.21).

Mid-rise buildings are especially important because they offer a scale that suits towns and cities of any size – and, they often accommodate residential housing along with mixed-use space. In essence, they can become the core of a community, much like our cover star, Ice Block 1 (p.12). As building codes evolve to allow greater flexibility in the use of wood for these structures, we are seeing a wider range of expression, whether the application is modular, hybrid or purely mass timber – we've included a variety of mid-rise projects in this issue, which in some cases are surprisingly innovative for what appears to be a "standard" building. Just like you can't judge a book by its cover, never judge a building by its facade.

Popi Bowman
Managing Editor

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 pbowman@dvtail.com.

inspiration BOARD

WHAT I'VE FALLEN FOR THIS MONTH...

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SUBLIME SCHOOLS

Several nominees for this year's International Award for Wood Architecture were educational facilities. Instead of drab places, these innovative, creative buildings invite their students to enjoy the environment around them, with ample light and the visible warmth of wood throughout their structures. Among the projects that were considered for the award, here are the beautiful schools that provided plenty of fuel for debate among the jurors as we considered who should win.

PHOTO: alt Architects, Ville-Pekka Ikola

Tuupala School in Kuhmo, Finland, is the first CLT school in the country; not coincidentally, the first CLT factory in Finland is also located in the same town. With a load-bearing spruce CLT structure and solid spruce cladding, the material palette is sparse and natural – the wood is treated with a colorless protective finish, to allow facades to turn grey gradually. Inside, birch plywood surfaces are abundant, while bright colors are used sparingly to complement the neutral tones.

PHOTO: Tracks Architecture, Guillaume Amat

La Ruche (Beehive) kindergarten in Perthes-en-Gâtinais, France, is largely constructed of biosourced materials, with 90 percent wood wool insulation and agglomerate wood panels, along with Siberian larch cladding. The interior prefabricated structure is spruce CLT, with glue-laminated Douglas fir elements for the covered yard structure. A series of pitched roofs allow for ample skylights, while large windows take advantage of the park setting.

PHOTO: KPMB Architects, Andrew Latreille

Wilson School of Design at Kwantlen University in Richmond, B.C., features a CNC-milled post-and-beam timber frame, wrapped by a glass curtain wall with varying degrees of reflectivity and transparency. The hybrid structure displays an integrated approach to using concrete and wood together – with both elements exposed throughout the interior. The wood finish brilliantly mimics the yellow coating of a lead pencil, evoking the mission of the building, which is to house students of design.

the BIG 95 | ABBIES 2015 Award Winner

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www.wooddesignandbuilding.com

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Canadian Boatmakers

Gabrielle Cole

Considering that Canada is graced by many bodies of water – comprising almost nine percent of the country's total area – it makes sense that travelling by canoe or kayak was the main method of transportation for the First Nations people and the original settlers. In recent times, finely crafted wooden boats are celebrated yearly at the Vancouver Wooden Boat Festival, which takes place towards the end of August on Granville Island. Running for more than 30 years, the festival features wooden boat displays and the opportunity to attend workshops and demos by some of the country's best boatmakers, of which there are many. We found four Canadian companies that pride themselves on excellent craftsmanship and refined quality, who are simply passionate about working with wood.

Orca Boats are designers and builders of hand-crafted wooden boats made from cedar strips, with accents of mahogany, maple and ash. Seven different types of kayaks are available, and customization is possible for both canoes and kayaks. Orca Boats has seen a lot of success, including being commissioned by the Vancouver International Airport to build custom canoes for display. The company is located near Vancouver, in one of the country's prime paddling destinations.

Located near North Bay in the small town of Powassan, Ontario, **Giesler Boats** produces 20 models of canoes and boats. The family-run business has existed for more than 70 years and spans over three generations. It is currently operated by the founder's four sons, two of his grandsons, and experienced boat builders who have been there for decades. Types of boats include rowboats, sportsman and canoes, all crafted with western cedar planks and copper nails.

Oyster Bay Boats (in Madeira Park, B.C., on the Sunshine Coast Highway) was started nearly 20 years ago by Rick Crook. Using locally cut and air-dried cedar, fir and maple, the company produces strongly built boats. The founder's personal favorite is the "Wee Lassie Canoe," which weighs just 30 pounds, first designed and created to increase convenience in his personal life. Eventually, Crook received many requests for canoes, and has since also started to build kayaks and rowboats, all made from cedar strips.

Tim Butson Wooden Boat Builder is a family company that prides itself on quality, craftsmanship and attention to detail. Several generations of Butson's ancestors were shipwrights in England; the family's Canadian boat business began in 1905 when his grandfather settled in Ontario. Butson founded his company in 1981 with his father, who was also a long-time boat builder, and they now offer restorations and custom-built wooden boats, at their "open door policy" shop in Bracebridge, Ontario.

1

2

3

4

1. Orca Boats
   Location: Coquitlam, B.C.
   PHOTO: Rod Tait

2. Giesler Boats
   Location: Powassan, Ontario
   PHOTO: Gerry Giesler

3. Oyster Bay Boats
   Location: Madeira Park, B.C.
   PHOTO: Richard Crook

4. Tim Butson Wooden Boat Builder
   Location: Bracebridge, Ontario
   PHOTO: Tim Butson

PHOTOS: Matthieu Gafsou

International Award for Wood Architecture

The winner of this year's International Award for Wood Architecture is a new community hall in Le Vaud, Switzerland, by Lausanne-based Localarchitecture, which was founded in 2002. The first iteration of the structure burned down shortly before it was due to open in summer 2016, so the architects used the reconstruction process as an opportunity to further refine their design – with dramatic results. Quite simply, the beauty of wood is captured in every angle of this building, especially inside.

With silver fir from local forests and a roof made of the metal sheeting commonly used by farms in the area, this striking structure impressed the jurors with its airy, timber-clad interiors and innovative geometries. The jagged roofline mimics the ridges of nearby mountains, while glazed triangular windows are slightly offset to enhance the visual impact of the building profile. The two gabled facades are the main load-bearing walls, with wooden joists providing structural stability. An abundance of windows along the north and south facades ensures plenty of daylight, along with views of the countryside. In both aesthetic and functional roles, wood enhances the success – and appeal – of this structure, which is now a cornerstone for this small community.
localarchitecture.ch/projects/le-vaud/

PHOTO: Perkins + Will

The Race to be Tallest

Perkins + Will was enlisted by Vancouver's Delta Land Development to design a mass timber high-rise that could reach 40 floors and become the world's tallest timber tower, if plans are approved. The Canada Earth Tower will feature approximately 200 apartments, and each three-floor section shares an outdoor garden. A horseshoe-shaped courtyard is surrounded by retail and restaurants, while the podium accommodates premium office space. The project aims to achieve the Passive House standard by incorporating photovoltaic panels, green roofs, passive cooling from natural ventilation, heat recovery systems and a triple-glazed glass facade. It's estimated that the Canada Earth Tower will use a third of the energy required for a conventional building of the same size, featuring a predominantly CLT structure with locally sourced timber. We'll be sure to report more news about this exciting development as it becomes available.

perkinswill.com

Global CLT Industry on Upswing

Zion Market Research estimates that the cross-laminated timber (CLT) industry could grow to reach US$1.6 billion in 2024, from US$603 million in 2017. According to its report, residential buildings held the largest market share in 2017, with approximately 50 percent of CLT projects; globally, Europe dominated the industry, with around 60 percent of the market share. Another source, Transparency Market Research, believes the industry growth will be significantly greater, to reach almost US$2.5 billion by 2026, but it also reports a higher value (US$713 million) in 2017.

Mass Timber on the Rise in Canada

Among many recent announcements that are excellent news for the wood building industry in Canada – including B.C.'s commitment to allow tall wood construction up to 12 storeys well in advance of the National Building Code updates – a number of new proposals caught our attention. Although far too many to list here, the highlights include three projects in Toronto by 3XN, including a new 10-storey office building that aims to be North America's tallest timber office tower. On the other side of the country, in Victoria, B.C., Mike Geric Construction and Aryze Development are planning to build a 12-storey condo project that could become one of the largest mass timber residential buildings in the province, adjacent to a traditional wood-frame, six-storey structure earmarked for affordable housing. Another 12-storey residential project a short drive from Victoria, Corvette Landing will be B.C.'s first Passive House, modular mass timber building, designed by Lang Wilson Practice in Architecture Culture (LWPAC).

3xn.com; gericconstruction.com; corvettelanding.com

PHOTO: Nikolaj Jakobsen/C.F. Møller

Sweden's Tallest Timber Building Opens to Residents

In the shadow of news that the Mjøstårnet high-rise was completed in Norway – achieving the "tallest timber tower in the world" title – an understated, 8.5-storey CLT apartment building in Västerås, Sweden, recently became the tallest timber building in the country. C.F. Møller Architects reports that the structure, which has four apartments on each floor, required only three days per floor to construct, with three craftsmen. Mechanical joints and screws were used so that the materials can be reused at the end of the building's life. "The total carbon-dioxide savings from use of solid wood instead of concrete are estimated at 550 tonnes of CO_2 over the building's life," says Rob Marsh, the firm's sustainability manager.

www.cfmoller.com

Ice Block 1

A modern interpretation of early 20th-century timber frame construction anchors a neighborhood while celebrating traditional industrial architecture

Sacramento, CA


west elm
SHOPS

Many development projects are stalled by unforeseen obstacles, and in this case, several years ago a three-alarm fire destroyed a former ice company warehouse that was slated for restoration. In its place, the developer wanted to honor the original structure's ambiance and history, while creating a modern hub that would enrich the neighborhood, a thriving arts and entertainment district. Construction began in mid-2016, and two years later, Ice Block 1 welcomed its first occupants. Called "a bustling village within a city" by the local media, this timber-framed mid-rise is the first of its kind for Northern California, and won this year's U.S. Woodworks award for Commercial Wood Design (Mid-Rise).

The four-storey, mixed-use office/retail building in the heart of Midtown Sacramento consists of a concrete podium topped with three storeys of mass timber framing on a 20x24-ft. grid, bolted together with raw steel connectors; the timber frame is articulated on the exterior with a grid of steel channels bolted to the facade that translate the interior beams and columns to the building face. A clear glass envelope integrates the building with its environment, allowing passersby to view the interior features while allowing occupants to enjoy the urban setting. Solid wall surfaces clad with galvanized corrugated siding act as bookends for the glass.

Inside, the glulam beams and purlins are left exposed, with Douglas fir decking. The third and fourth levels are constructed of concrete topping slab, Acousti-Mat and plywood sheathing over exposed tongue-and-groove Douglas fir planks. The designers cantilevered the glulam beams off the tops of the glulam columns, creating an offset connection and allowing the beam deflection to counteract gravity loads. This allowed for shallower beam depths and resulted in a stronger bay frame, giving the upper floors a brighter, open aesthetic.





The building is expansive, with an east and west wing connected on the upper levels, while the main level accommodates inviting outdoor terraces; in total, 131,980 sq.ft. (12,261 sq.m.) of office and retail space, along with 41,030 sq.ft. (3,812 sq.m.) of below-grade parking and a 14,450 sq.ft. (1,342 sq.m.) elevated outdoor deck with multiple access points – both stairs and ramps – to welcome pedestrians and cyclists.

In a nod to the area's industrial heritage, the exterior design features large structural steel braces and reflective aluminum fins and panels layered onto the facade grid, while outdoor podium spaces are shaded with traditional corrugated steel canopies suspended from the walls by exposed steel rod brackets.

A mix of restaurants and retail/commercial occupants, including West Elm and a craft brewery, means this popular destination is enjoyed by hundreds of people on a daily basis. As the architect intended, Ice Block 1 celebrates wood in the simplicity of its design.

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Heller Pacific
Sacramento, CA

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RMW architecture & interiors
Sacramento, CA

STRUCTURAL ENGINEER
Buehler Engineering
Sacramento, CA

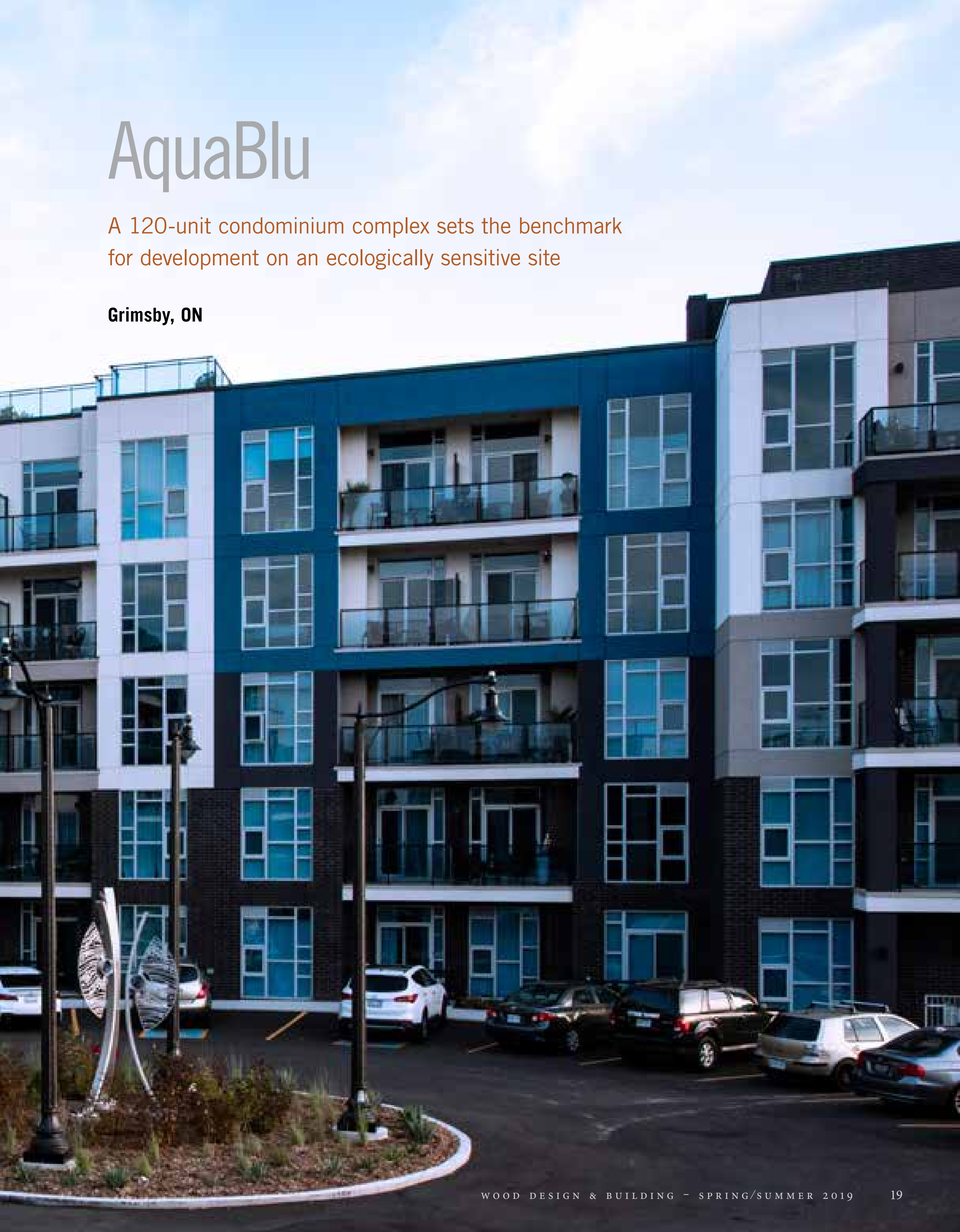
CONTRACTOR
Ascent Builders
Sacramento, CA

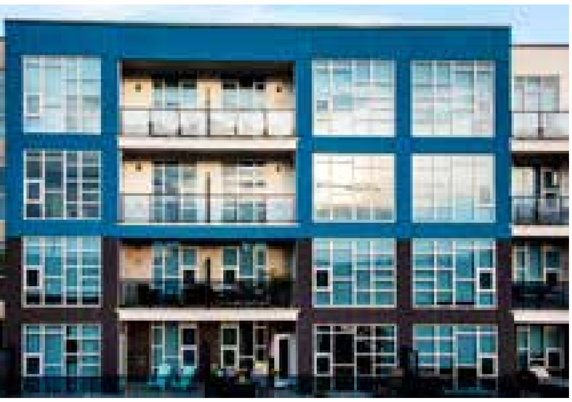
PHOTOGRAPHY
First spread: Bernard Andre
Second spread: top, Bernard Andre;
bottom, Tyler Gahagan
Last page: top, Bernard Andre; bottom, Chad Davies

AquaBlu

A 120-unit condominium complex sets the benchmark for development on an ecologically sensitive site

Grimsby, ON





With its lakefront location, small-town charm, unique character features and close proximity to major cities in Canada and the U.S., Grimsby is rapidly becoming a place where people want to live. The Niagara Region town is one of the fastest-growing municipalities in the country, with a growth rate greater than provincial and national averages – a rate that is forecast to continue over the next 10 years.

AquaBlu is among the first luxury waterfront condominium developments in this fast-growing town. Inspired by Miami's South Beach, the development's abundance of glass, contemporary detailing and lively aesthetics sets the new benchmark for future developments in the area.

AquaBlu is also one of the first buildings to be constructed to the new Ontario Building Code, allowing five- and six-storey wood construction. This opened up many opportunities for the design team, but also posed challenges. For instance, the building code requires that stair shafts and elevator cores be non-combustible; to accommodate this, masonry stair and elevator shafts were introduced into the wood construction. The behavior of these very different materials challenged the design team to develop project-specific details to ensure that the combination did not negatively impact the performance of the overall structure. Building components such as shrinkage-compensating ATS hold-down devices by Simpson Strong Tie – developed specifically for wood mid-rise construction – were used to ensure that the building performance would not be impacted by the initial shrinkage that is typical of wood-framed mid-rise buildings.

The main structure, including not only walls but also the floors and roof, was built from prefabricated wood panels assembled off-site. This solution not only helped to advance the construction schedule, but also allowed for strict quality control in the plant. To best manage this method of construction, specific instructions were developed to ensure that the structure was properly assembled, and that continuity was provided for major structural elements built from multiple panels, such as long shear walls and floor diaphragms.

Using wood as the primary structure helped to enhance the project in many ways. Along with supporting local trades, suppliers and businesses in the wood construction industry, it helped to reduce overall construction costs compared to other methods of construction, offered design versatility and flexibility, and allowed for a sustainable, low- carbon footprint. This last point was especially important considering the project's location, where residents embrace a lifestyle surrounded by waterfront, local wineries, small-town amenities and hiking trails.

As a new community landmark, AquaBlu is positioned perpendicular to the street, offering maximum views over Lake Ontario while reducing the impact of a large building along the streetscape. A pleasing pedestrian scale was achieved by stepping the building back at the north end, while still offering lake-facing terraces on the upper floors. Exterior finishes include a combination of materials such as glass, metal, masonry and EIFS in a color palette inspired by the surrounding landscape.

BUILDER
Homes by DeSantis
Hamilton, ON

ARCHITECT
KNYMH Inc.
Burlington, ON

STRUCTURAL ENGINEER
Leonard Kalishenko & Associates Ltd.
Toronto, ON

PHOTOGRAPHY
Phrankie Willson/KNYMH Inc.
Burlington, ON

Jacobson Hall at Trinity Western University

This wood-framed student residence is the first of its kind in Canada to use modular construction on a large scale

Langley, BC

Founded in 1962, Trinity Western University (TWU) is Canada's largest private Christian university, offering 45 undergraduate majors and 17 graduate and post-graduate programs to approximately 4,000 students. With rapidly increasing enrollment and existing on-campus housing for less than one-quarter of its student population, the school needed a solution to its student housing crisis – and quickly. It found the answer in modular construction, which offers a faster schedule, improved quality control, reduced site impact and a design that reflects the needs and lifestyle of future residents. As an added benefit, using wood for the building captures the carbon equivalent to removing 1,300 cars off the road for a year.

At five storeys, the 220-bed Jacobson Hall is the tallest wood-framed modular building in Canada. Even with the increased height of the modular structure, though, the builders were still able to design the building to meet seismic, wind, structural and other performance requirements. For example, designers tightened wall stud spacing on the bottom two floors and used select Douglas fir dimensional lumber, dried to a lower moisture content than typical, to minimize framing impacts from shrinking. For seismic requirements, Metric Modular installed Anchor Tiedown System (ATS) rods that ran from the concrete foundation up between the modules to tie the entire building to the foundation. The number and length of seismic straps was also increased, and the straps were installed with a heavier nailing pattern.

The foundation system was designed to keep the building at grade level and eliminate the need for multiple entrance stairs and accessibility ramps. Additionally, utilizing a factory-installed exterior cladding system required minor site finishing, which reduced the need for local trades to complete work on site – resulting in fewer risks associated with site work, and less disruption to campus life overall.

Services such as sprinkler systems and plumbing were pre-installed, as well as all fixtures, electrical and flooring. All furnishings and finishings were completed and installed in the factory prior to delivery, meaning the units contained beds, desks and even the mattresses, reducing the potential for move-in damage. Finally, the roofing membrane was factory installed, further minimizing site finishing and allowing for an accelerated construction timeline.

Jacobson Hall was framed completely with wood and contains 90 modules; all were 3.7 m. wide, but lengths varied from 9.8 to 18.9 m. Cross-laminated timber (CLT) was used to frame the elevator shaft; modules then connected to either side of the CLT structure. Each of the modules took about 14 days to complete, a process Metric says is approximately 50 percent faster than conventional construction.

Once each unit was assembled, it was shipped by truck to the campus and craned into place. Requiring five to 10 workers on site at any given time during craning, it took just 11 days to construct the first three floors. Metric started building the modules in their factory in mid-March and began delivering completed modules in late May; all modules were in place by mid-July, and students moved into their new residence hall in September 2018, just in time for the new school year.

"Using a modular design ticked off all the boxes on our list of needs, and then some," said Bob Nice, senior vice president of business administration and chief financial officer at TWU. "With a modular design we were able to meet an extremely tight deadline, reduce the construction site footprint on campus, stay within our budget constraints and give our students a safe, beautiful building with well thought-out layouts and features."

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Langley, BC

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STRUCTURAL ENGINEER
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CONTRACTOR
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PHOTOGRAPHY
Matt Borck
Langley, BC

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Simone Veil Middle School in Lamballe

Prefabricated CLT allows for ease and speed of construction, with practical elegance

Brittany, France

Lamballe is a charming, rural community with a long history of timber buildings; more than 30 half-timbered houses are found in the historic area, including an example from the 15th century that now operates as a popular art museum. One of the town's newest buildings is a secondary school that won a Merit award in this year's *Wood Design & Building* Awards, and was also a nominee for the 2019 International Award for Wood Architecture. The structure is a collaboration between the Austrian architects Dietrich | Untertrifaller (three-time *Wood Design & Building* Award winners in 2017) and local French firm Colas Durand.

This mid-rise educational facility accommodates more than 800 students throughout two volumes, totaling 29,528 sq.ft. (9,000 sq.m.). A long rectangular, wooden parallelepiped tops a curved glass and concrete base, facing southeast towards open countryside. The masonry plinth backs onto a hillside, while the curved front facade is fully glazed, with spruce columns. The concrete stair cores and base were specified for fire and seismic resistance, while upper-level floors and exterior walls are spruce cross-laminated timber (CLT), with exterior steel bracing crosses; structural precautions were taken due to the region's frequent, but usually minor, earthquakes. Floors are concrete-topped for acoustics and fire resistance.

Prefabrication allowed the building to be constructed in 18 months, with CNC milling direct from the designers. Timber for the secondary framing is locally sourced. The CLT structure makes it possible to incorporate many light, non-load-bearing walls, allowing for reconfiguration with minimal logistics, and also facilitating end-of-life management, in the form of recycling. Another benefit of using CLT for interior elements is eliminating the need for finishes such as paint or plaster.

In combination with concrete, wood is featured throughout the interior, including ceiling slats, horizontal cladding, windowsills, shelving, exposed beams and classroom furniture. A three-storey atrium topped by skylights connects the levels, while the glass-enclosed ground floor incorporates an entrance hall, classrooms, the cafeteria and a multiuse room. On the southeast and northwest facades, vertical and horizontal wood awnings regulate light in the classrooms.

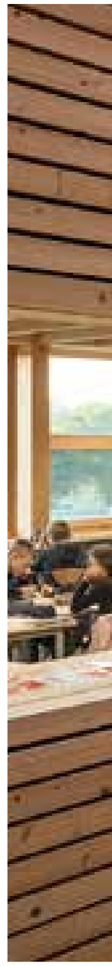
The choice of wood was one of the main criteria for achieving a High Quality Environmental (HQE) rating, the standard for green building in France. During judging for the *Wood Design & Building* Awards, the jurors praised the building's "clarity of design," which is both "understated and robust." The result is both functional and elegant, without compromise.

ARCHITECT
Dietrich | Untertrifaller, with Colas Durand

CONCRETE ENGINEER
Espace Ingénierie
Saint-Brieuc, France

WOOD ENGINEER
QSB
Lannion, France

PHOTOGRAPHY
Luc Boegly
Paris, France



80 Atlantic

Ontario Wood *WORKS!*

This is the third installment (of four) for our serial profile of 80 Atlantic Avenue in Toronto. Progress on the project has been steady, and now we're focusing on the building envelope as the structure gets enclosed. If you missed the first articles, you can find previous issues of the magazine in our online archive at WoodDesignandBuilding.com.

At the close of 2018, the building reached structural completion and assembly of the building envelope began. Three sides of the structure are being finished with prefabricated Ceramitex large-format tiles that will be installed with a mast climber platform. These facades, which include the east-side main entrance of the building that fronts on Atlantic Avenue, will have punched window openings with operable windows.

The large-format tile was chosen specifically to respond to the heritage context of the adjacent streets, with only the non-street-facing facade to be glazed. The tiles for the three street-oriented facades (one is a lane) are installed as the face of a rainscreen cladding system attached to adjustable girts, behind which is semi-rigid insulation. All insulation is in front of the AB/VB membrane, and the entire assembly is supported by structural steel studs.

The fourth, south-facing side of the building is a dramatic, high-visibility glass curtain wall that ties into the heavy timber superstructure with a custom anchor. The connection is similar to the kind that would be used for concrete, but it was redesigned specifically for the wood frame and was custom manufactured by Timmerman Timberworks.

Assembly of the building, including the south curtain wall, has gone very smoothly, thanks in large part to a valuable collaboration that used this project as a teaching tool. The entire project team participated in

A neighbor's view of the curtain wall installation.
PHOTOS: Quadrangle

a training exercise at the College of Carpenters and Allied Trades, where a full-scale mockup of one of 80 Atlantic's corner bays was completed. This hands-on trial run gave every player a clear understanding of the scale, scope of work and sequencing for the project.

The architect, structural engineer, fire engineer, code consultants, fabricators and installers were able to see first-hand how everything would fit together, and the design and installation teams benefited from the chance to work directly with the manufacturers. Assembly of the curtain wall afforded the team an opportunity to refine the installation technique and to work out how the fire-stopping would be applied.

The unitized curtain wall frames were factory assembled, having the glass four-sided structurally sealed. A 10mm outboard glass lite was used in order to achieve a flat look. The frame assembly is a typical Alumicor 2600 SM series with interlocking vertical male/female mullions and horizontal stack joints.

On site, the anchors were installed at each vertical mullion location. The anchors are HSS 8x3-in. sections that are lag screwed to the NLT floor slab. The unitized frames were then lifted into place, one by one, and the vertical mullions were connected to the anchors installed in the floor above – so the frames (with glass already installed) hang from above like a curtain. The adjacent frames connect together through the male/female mullion, so each vertical mullion is really two parts, and the frames above connect to the lower frames through the male/female stack joints.

The entire south facade was installed over the course of just a few weeks by Stouffville Glass. The high-performance, glazed wall floods the building with natural light and has operable windows for fresh air to enhance the comfort of the building's future occupants. Special consideration was given to the glass coatings to manage solar heat gain and control glare. From the exterior, under certain lighting conditions, the extensive glazing will allow passersby to see through the exterior facade to the dramatic and beautiful exposed timber structure inside.

Worker installs a glazed curtain wall panel on a full-scale mockup of one of the corner bays of the 80 Atlantic project at the Carpenters' Union training facility in Vaughan, Ontario.

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Quadrangle Architects Ltd.

DEVELOPER
Hullmark Developments Ltd.

ENGINEER
RJC Engineers

CONSTRUCTION MANAGER
Eastern Construction Co. Ltd.

NLT FABRICATOR
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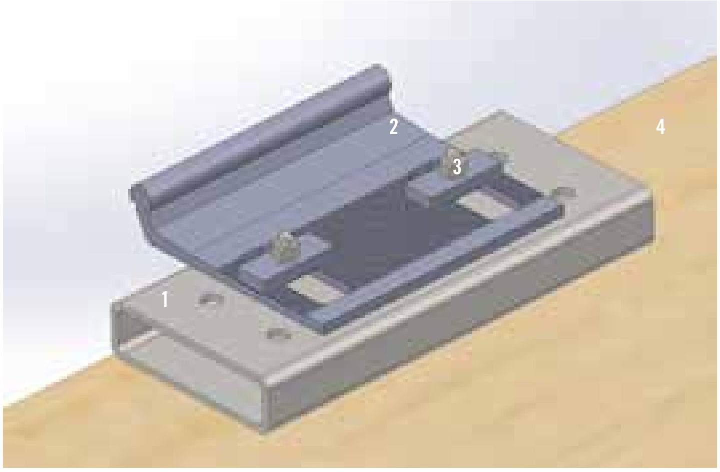
2. alumicor unitize anchor plate
3. Ø1/2" stud welded to HSS
4. NLT panel



Curtain Wall Attachment

PROJECT FACTS

Location
80 Atlantic Avenue (Liberty Village), Toronto, ON

Type
Office/Retail

Office Space
79,758 sq.ft.

Retail Space
7,719 sq.ft.

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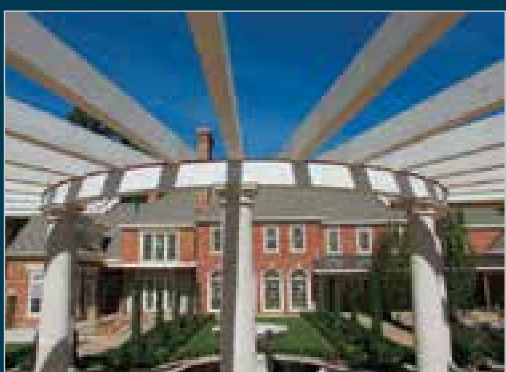

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PHOTO: Nicholas Bava/FORM Architecture Engineering

Moisture and Wood-Frame Buildings

Excerpts from the Canadian Wood Council "Building Performance Series No. 1"

Full version available at: cwc.ca/publication-type/fact-sheets/

Protection of buildings from moisture is an important design criterion, as important as protection from fire or structural collapse. Designers, builders and owners are gaining a deeper appreciation for the function of the building envelope (exterior walls and roof). This includes the performance of windows, doors, siding, sheathing membranes, air and vapor barriers, rainwater control layer and framing. The capabilities and characteristics of wood and other construction materials must be understood, and then articulated in the design of buildings, if proper and durable construction is to be assured.

Wood and water are typically very compatible. Wood is a hygroscopic material, which means it has the ability to release or absorb moisture to reach a moisture content that is at equilibrium with its surrounding environment. As part of this natural process, wood can safely absorb large quantities of water before reaching a moisture content level which is favorable to the growth of decay fungi. To ensure durable wood-frame buildings, the design of the structure and envelope should be based on an understanding of factors that influence the moisture content of wood and changes that occur due to variations in moisture content.

Understanding the moisture content of wood is crucial, as 1) varying moisture content leads to shrinking and swelling of wood members, and 2) high moisture content can lead to the growth of mould and decay fungi. ***Moisture content (MC)*** is a measure of how much water is in a piece of wood relative to the wood itself. MC is expressed as a percentage and calculated by dividing the weight of water in the wood by the weight of that wood if it were oven-dry.

Two important MC numbers to remember are:

1. *19 percent:* We tend to call a piece of wood "dry" if it has a MC of 19 percent or less. This type of lumber is grade marked as KD (typically shown as KD-HT) for kiln-dried, and means dry at the time of manufacture. (Note: Some lumber is also marked S-DRY for surfaced dry, or dry at the time of manufacture).
2. *28 percent:* This is the average fiber saturation point for wood where all the wood fibers are fully saturated. At moisture contents above the fiber saturation point, water begins to fill the cell cavity. Decay can generally only get started if the moisture content of the wood is above fiber saturation for a prolonged period of time. The fiber saturation point is also the limit for wood swelling.

Shrinkage and Swelling

Wood shrinks or swells as its moisture content changes, but only when water is taken up or given off from the cell walls. This only occurs when wood changes moisture content below the fiber saturation point. Wood used indoors will eventually stabilize at 8 to 14 percent moisture content; outdoors at 12 to 18 percent.

The amount of dimensional change is estimated at 1 percent of the width or thickness of lumber for every 5 percent change in moisture content. Shrinkage is to be expected in lumber across its width while longitudinal shrinkage is likely to be negligible, such as the vertical shrinkage of a wall stud. In a wood-frame structure, shrinkage occurs primarily in horizontal members such as wall plates and floor joists. In buildings designed to three to six storeys, the effects of cumulative shrinkage can affect the building envelope, such as the exterior cladding. Special consideration must be given to designs that allow for shrinkage. (Visit www.cwc.ca, select "design tools" and open the dimension calculator tool, or go to cecobois.com/en/calculators and open the lumber shrinkage calculator for determining the amount of shrinkage and swelling in wood.)

For example, when a wood-frame structure is combined with a brick veneer, a concrete block elevator shaft or stair tower, or a steel-frame building element, the cumulative effects of differential movement in a multi-storey building must be accounted for in the detailing and specifications.

Specification of dry lumber is an important step towards minimizing shrinkage. One advantage of using dry lumber is that most of the shrinkage has been achieved prior to purchase (wood does most of its shrinking as it drops from 28 to 19 percent). It will also lead to a more predictable in-service performance as the product will stay more or less at the same dimension it was upon installation.

Another way to avoid shrinkage and warp is to use composite wood products such as plywood, OSB, I-joists and structural composite lumber. These products are assembled from smaller pieces of wood glued together. Composite products have a mix of log orientations within a single piece, so one part constrains the movement of another. For example, plywood achieves this crossbanding form of self-constraint. In other products, movements are limited to very small areas and tend to average out in the whole piece, as with finger-jointed studs.

Control of moisture during construction is also important. Even when dry lumber is purchased and delivered to the jobsite, it can be wetted prior to or during construction. Procedures should be developed to:

- keep wood-based materials dry while in storage onsite,
- minimize wetting of installed materials, and promote drying of materials with venting, heating or dehumidification.

Wood materials that are exposed to wetting should be dried to 19 percent moisture content or less prior to enclosure within assemblies. On buildings that are exposed to significant wetting during construction, schedules should provide an allowance for proper drying to framing and sheathing materials. The weather barrier (i.e., the rainwater control layers), installed soon after assemblies are framed, can be used to minimize exposure to weather.

Decay

The primary durability hazard with wood is ***biodeterioration***. Wood in buildings is a potential food source for a variety of fungi, insects and marine borers. These wood-destroying organisms have the ability to break down the complex polymers that make up the wood structure. The wood-inhabiting fungi can be separated into moulds, stainers, soft-rot fungi and wood decay fungi. The moulds and stainers discolor wood; however, they do not damage the wood structurally. Soft-rot fungi and wood decay fungi can cause strength loss in wood, with the decay fungi responsible for deterioration problems in buildings.

Decay is the result of a series of events including a sequence of fungal colonization. The spores of these fungi are ubiquitous in the air for much of the year, but only lead to problems under certain conditions. Wood decay fungi require wood as their food source, an equable temperature, oxygen and water. Water is normally the only one of these factors we can easily manage. Wood decay fungi also have to compete with other organisms, such as moulds and stainers, to get a foothold in wood materials. It is easier to control decay fungi before decay has started, since these pre-conditions can inhibit growth rates at the start.

Decay and mould are terms that are often used interchangeably in the context of moisture-related wood damage. It is important to understand the distinction. Mould fungi can grow on wood (and many other materials), but they do not eat the structural components of the wood. Therefore, mould does not significantly damage the wood, and thus mould fungi are not wood-decay fungi. However, some types of moulds have been associated with human health problems, so the growth of mould in sufficient quantity and exposure to occupants is of potential concern regardless of physical damage to building products. Unfortunately, the relationship between mould and health is not yet fully understood. We live safely with some moulds in the air all the time, so clearly there are issues of thresholds, individual sensitivities and other variables that still need to be determined by health experts and building scientists.

Decay fungi, a higher order of fungi than moulds, break down basic structural materials of wood and cause strength loss, but are not associated with any human health problems.

Mould and decay do not necessarily occur together, nor are they indicators of each other. There tends to be a gradual transition from molds to decay fungi if moisture conditions continue to be wet.

Moisture Balance and Sources

Moisture flows within any building must be managed to prevent water accumulation or storage that may lead to premature deterioration of building products. Water will lead to deterioration by corrosion in steel products, by spalling and cracking in concrete products, and by fungi in wood products.

There are two general strategies to moisture control in the building envelope:

- limit the moisture load on the building
- design and construct the building to maximize its tolerance to moisture, to a level appropriate for the moisture load

The key design objective is to keep building envelopes dry, and to achieve moisture balance, where wetting and drying mechanisms are balanced to maintain moisture content levels at or below the tolerance level. The concept of "load" is well established in structural design, where dead loads, live loads, wind loads, seismic loads and thermal loads are fundamental to the design process. Similarly, moisture loads are placed on a building, and these loads must be accounted for and balanced in the building envelope design. The nature and magnitude of the loads will vary greatly depending upon the climatic situation, as well as occupancy of the building.

Moisture sources in and around buildings are abundant. Interior moisture sources include building occupants and their activities. Some studies have concluded that a family of four can generate 10 gallons of water vapor per day. Rainwater, especially wind driven, is the moisture source that impacts the performance of the envelope most.

The design of building envelope assemblies must be based on an evaluation of the probable exposure to moisture. For exterior walls, moisture load is primarily determined by:

- Macro-climate: regional climatic norms
- Micro-climate: site-specific factors such as siting, solar exposure, wind exposure and relationship to surrounding buildings, vegetation and terrain
- Building design: protective features such as overhangs and cornices

The levels of exposure can vary significantly on a single building, and the design of exterior wall assemblies can reflect these differences.

The Canada Mortgage and Housing Corporation published a nomograph (applicable to Vancouver, B.C.) to analyze exposures based on micro-climates and design factors. The principle criteria are overhang ratio and terrain (the primary influence on the microclimate of a given site). Analysis with a tool such as the nomograph allows the designer to further refine the criteria for wall type selection.

$$\text{Overhang Ratio} = \frac{\text{Overhang Width}}{\text{Wall Height}}$$

Overhang width equals the horizontal distance between the outer surface of the cladding and the outer surface of the overhang, while wall height equals the height above the lowest affected wood element (therefore, do not include concrete foundation walls).

A number of studies have concluded that the primary failure mechanism with respect to moisture is rainwater penetration through exterior walls. This has been particularly evident in several wet, humid coastal regions of North America, such as Wilmington, Seattle or Vancouver. Development of strategies for rain penetration control is the first priority in design for durability. Control of condensation caused by vapor penetration and groundwater are additional – though secondary – concerns. In both cases the strategy should meet the degree of the hazard or moisture load.

Rain Penetration Control

There are two general strategies for rain penetration control:

- minimize the amount of rainwater contacting the building surfaces and assemblies
- manage the rainwater deposited on or within assemblies

The dynamics of rainwater penetration are well established. Water penetration through a building assembly is possible only when three conditions occur simultaneously:

- an opening or hole is present in the assembly
- water is present near the opening
- a force occurs to move the water through the opening

This is true of all water penetration and has been expressed as a conceptual equation: *water + opening + force = water penetration*. The minimum size of opening which will allow water penetration varies in relation to the force driving the water. To control water penetration, it is necessary to understand the underlying driving forces that may be present. These can include gravity, surface tension, capillary suction, momentum (kinetic energy) and air pressure difference.

It follows that water penetration can be controlled by eliminating any of the three conditions necessary for penetration. Building design and detailing strategies can be developed that:

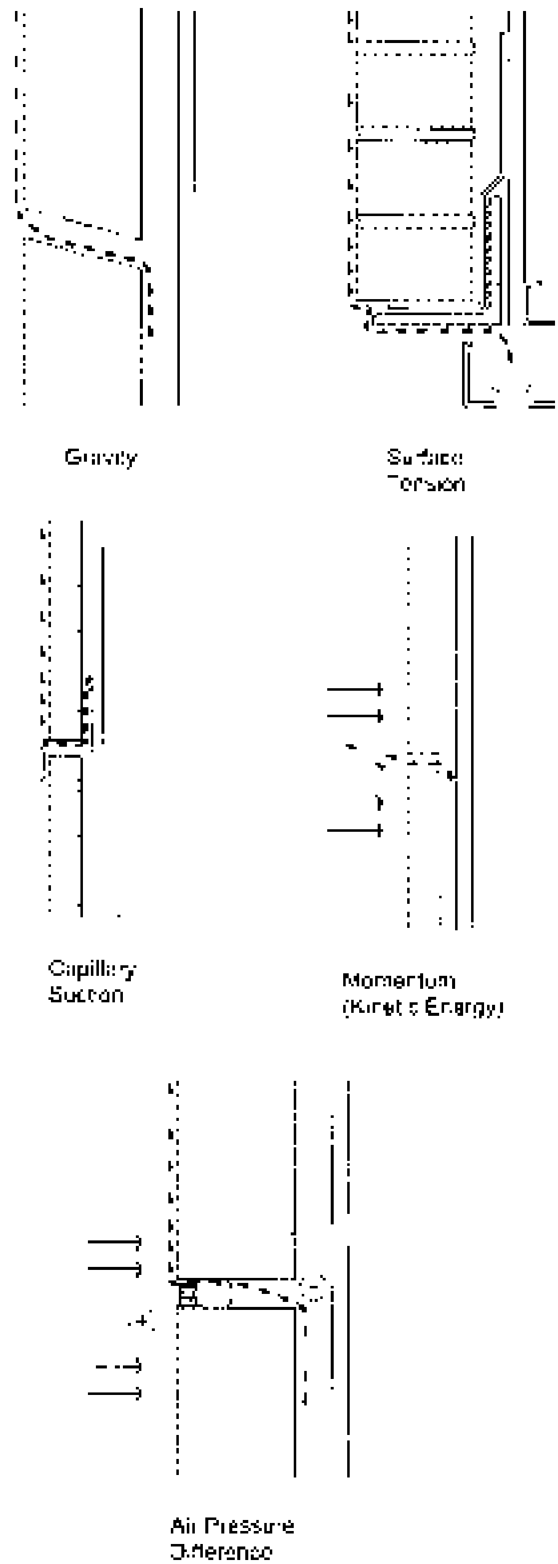
- reduce the number and size of openings in the assembly
- keep water away from any openings
- minimize or eliminate any forces that can move water through openings

The 4Ds

These general water management strategies have been further articulated into a set of design principles called *the 4Ds:* ***deflection, drainage, drying*** and ***durable materials.*** With respect to rain penetration control, deflection refers to design elements and details that deflect rain from the building minimizing rainwater loads on the building envelope. Drainage, drying and durable materials are principles that deal with the management of water once it has reached or penetrated the envelope.

These principles can be applied to design at two distinct scales. At the macroscale, there are ***design patterns*** that involve the manipulation of building and roof form, massing, siting, material expression and even issues of style. At

MAIN DRIVING FORCES FOR RAINWATER PENETRATION



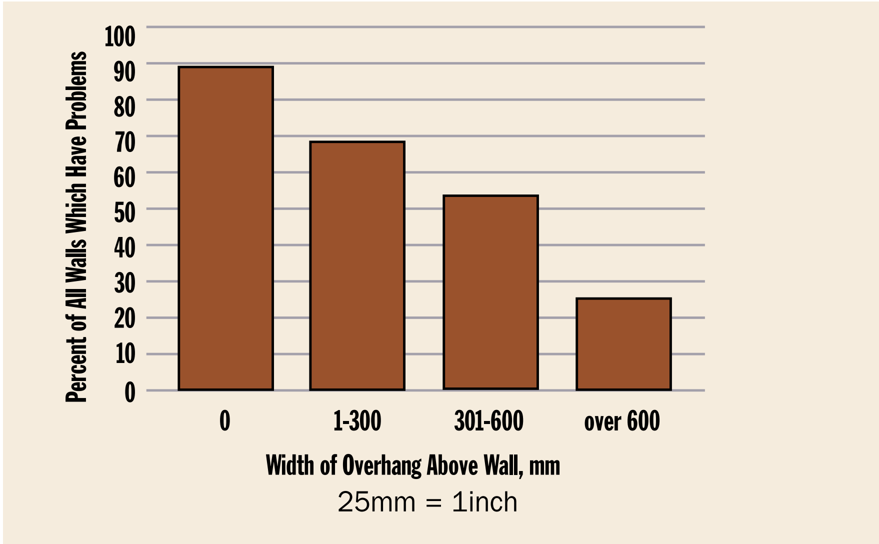
the microscale, there are ***detail patterns***, which determine whether water management works or does not work. Detail patterns involve the relationships between materials, installation sequencing, constructability and economy of means. Many of these patterns, developed empirically by trial and error, have been used by builders for centuries, whereas others have been developed more recently as a result of scientific research and testing.

The principles are also applied to ***material selection***. In most exposures, effective rainwater management is accommodated by multiple lines of defense. This is often referred to as ***redundancy***. The concept of redundancy involves recognizing the inherent limitations of the design and construction processes. Perfection is not easily achieved and errors in design and construction do occur. Where the degree of moisture hazard is high, these errors may have significant impacts on the envelope performance. Redundant systems provide for back-up protection, in the likely event errors are made.

The 4Ds can be understood as four separate lines of defense against rain penetration and the problems that can result.

Deflection

The deflection principle is evident in many building design patterns that have historically proven effective at reducing the amount of rainwater on exterior walls. These include: 1) placing the building so it is sheltered from prevailing winds, 2) providing sizable roof overhangs and water collection devices at the tops of exterior walls, and 3) providing architectural detailing that sheds rainwater. A pitched roof with sufficiently wide overhangs is the singular design element that can help ensure the long-term durability of wood-frame buildings. Deflection is applied at the smaller scale in detail patterns such as projecting sills, flashings and drip edges. Cladding and sealants are also considered to be part of the deflection line of defense. A water management strategy that relies only on deflection may be at risk in regions of North America where the hazard condition is high.



EFFECT OF OVERHANGS ON WALL PERFORMANCE
DRAWING: *Survey of Building Envelope Failures in the Coastal Climate of British Columbia*, Canada Mortgage and Housing Corporation

Drainage

Drainage is the next principle of rain penetration control, second only to deflection in terms of its capacity to manage rainwater. Building design patterns that incorporate the drainage principle include pitched roofs and sloped surfaces at horizontal elements. At the detail level, drainage is accomplished by collecting incidental moisture accumulation in the wall assembly and returning it to, or beyond, the exterior face of the cladding by means of gravity flow. In its simplest form, this is achieved by adding a drainage plane within the assembly, between the cladding and the sheathing. In wood-frame construction, the drainage plane typically consists of a moisture barrier (building paper, felt or housewrap), and most importantly, how they work in combination with window and door flashings. Drainage is generally the primary means of providing redundancy in a wall assembly.

A drainage cavity is a more elaborate feature that introduces an airspace between the cladding and the drainage plane/sheathing. The airspace serves as a capillary break to prevent water from excessively wetting the drainage plane. The airspace, particularly when it provides a pressure equalization function, also can be seen as another means of deflection, in that pressure-equalization neutralizes the primary driving force behind rain penetration (air pressure differential), and thereby reduces the amount of moisture being driven through the cladding into the drainage cavity.

Drying

Drying is the mechanism by which wall assemblies remove moisture accumulations by venting (air movement) and vapor diffusion. The drying potential of both the cladding and the wall sheathing/framing must be considered. Cavities introduced for drainage purposes also offer a means to dry the cladding material by back venting. Drying of sheathing and framing is often a separate matter and is greatly affected by the selection of moisture barrier and vapor barrier materials. Exterior wall assemblies must be designed to allow sufficient drying to either the exterior or the interior. The permeability of cladding, moisture barrier, vapor barrier and interior finish materials will greatly affect the overall drying potential of the wall.

Durable Materials

Durable materials must be selected for use at all locations where moisture tolerance is required. Where deflection, drainage and drying cannot effectively maintain the moisture content of wood components below 28 percent, the decay resistance of the wood must be enhanced. For wood framing components, this is achieved by pressure treatment with wood preservatives. The use of treated wood where sill plates are in contact with concrete foundations is a common detail pattern that follows this principle.

Building design patterns involving architectural expression should be reconciled with long-term durability considerations. Weathering properties and maintenance requirements should be considered. For example, face brick applied to wood-frame walls must be rated for exposure, and masonry wall ties must be sufficiently corrosion-resistant. Wood siding and trim with direct exposure to weather should be either naturally decay-resistant or treated wood materials.

Exterior Walls

There are three basic exterior wall type options for wood-frame buildings, each based on a distinct conceptual strategy for rainwater management: face seal, concealed barrier and rainscreen. When designing exterior walls for a given building, there is a need to select an appropriate system and be consistent through the design and detailing phase, and to clearly communicate the details of the system to the construction team.

Face seal walls are designed to achieve water tightness and air tightness at the face of the cladding. Joints in the cladding and interfaces with other wall components are sealed to provide continuity. The exterior face of the cladding is the primary – and only – drainage path. There is no redundancy. The "face seal" must be constructed – and must be maintained – in perfect condition to effectively provide rain penetration control. However, such reliance on perfection is questionable at walls exposed to rainwater. As a rule, face seal walls should only be used where very limited amounts of water will reach the cladding surface, such as wall areas under deep overhangs or soffits or in regions where the degree of moisture hazard is not high.

Concealed barrier walls are designed with an acceptance that some water may pass beyond the face of the cladding. These walls incorporate a drainage plane within the wall assembly, as a second line of defense against rain penetration. The face of the cladding remains the primary drainage path, but secondary drainage is accomplished within the wall. An example of a concealed barrier wall is wood siding installed directly over an asphalt-saturated felt moisture barrier and plywood sheathing. The water-resistant felt constitutes the drainage plane. Vinyl siding and drainage EIFS (exterior insulated finish system) installed over a moisture barrier also should be considered concealed barrier walls, although drainage in these cladding systems is enhanced by provision of some airspace – however discontinuous – behind the cladding. A concealed barrier strategy is appropriate for use on many exterior walls and can be expected to perform well in areas of low to moderate exposure to rain and wind. Performance in high to severe exposure conditions, however, is not assured. In all cases, the integrity of the second line of defense is highly dependent on correct detailing by the designer and proper installation by the builder. To maximize performance and service life of the assembly in high exposure conditions, consideration should be given to the use of a rainscreen assembly.

Rainscreen walls take water management one step further by incorporating a drainage cavity (3/8-in. minimum width) into the assembly, between the back of the cladding and the building paper. The drainage cavity offers enhanced protection from water intrusion by acting as a capillary break, thereby keeping most water from making contact with the moisture barrier. The airspace also serves to ventilate the backside of the cladding, which facilitates drying of the cladding, and mitigates against potential moisture accumulation in the wall framing caused by reverse vapor drive. Examples of rainscreen walls include brick veneer (usually installed with a one or two-inch airspace) and stucco cladding installed over vertical strapping (typically pressure-treated 1x3s at 16-in. o.c. on center). Rainscreen walls are appropriate for use in all locations where high exposure to rain and wind is likely.

Pressure-equalized rainscreens represent an advancement of the basic rainscreen strategy. These walls incorporate compartmentalization and increased venting of the drainage cavity to improve performance. As wind blows on a wall face, air passes through vents into the cavity behind the cladding. If this air is contained appropriately by subdividing the drainage cavity with compartment seals, an equalization of pressure occurs across the cladding, thereby eliminating one of the key driving forces behind water penetration. This strategy is most commonly applied to brick veneer walls, though conceptually it is possible to enhance any rainscreen assembly with this technology. Pressure-equalized rainscreens are appropriate for use on all exposures and offer the highest performance potential with respect to water management.

Wood-frame buildings have an established record of long-term durability. With the correct application of building envelope design principles, all materials can perform well with regards to durability. The imperative for durable construction goes beyond creating healthy buildings, as we must build durably to minimize the environmental impacts of our society. In fact, wood buildings perform well against other materials when considered from a life-cycle cost perspective that factors things like greenhouse gas emissions, water pollution index, energy use, solid waste and ecological resource use. However, the environmental advantages of wood can only be achieved if the building is designed and constructed for long-term durability. With passion and eloquence, the architect James Cutler has spoken of "honoring the wood" through the building design and detailing process. This would include the concept of protecting wood from moisture, which is the essence of designing for durability.

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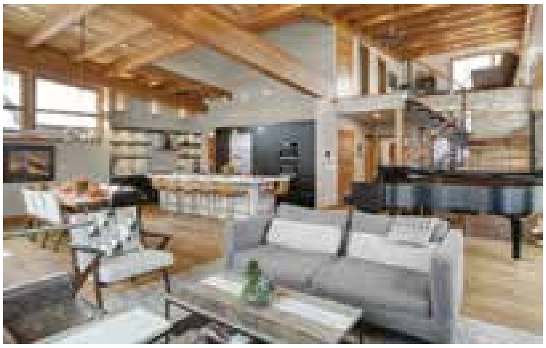
DESIGN AWARD 2019



RESIDENTIAL

WOOD DESIGN AWARD

TALL TIMBERS

Canmore, Alberta
Architect: russell and russell design studios
Structural Engineer: Valley Engineering
General Contractor: Mike Lakusta
Wood Supplier: International Timberframe
Photo Credit: CMC Photography and Measure Services

INTERIOR

WOOD DESIGN AWARD

TAYLOR INSTITUTE FOR TEACHING AND LEARNING

Calgary, Alberta
Architect: Gibbs Gage Architects with Diamond Schmitt Architects
Structural Engineer: Entuitive
General Contractor: Cana Group
Wood Supplier: Structurlam Mass Timber Corp.
Photo Credit: Ed White Photographics

COMMERCIAL

WOOD DESIGN AWARD

RAW: WASAGAMING

Riding Mountain National Park, Manitoba
Architect: AUX: Projects
Structural Engineer: Wolfrom Engineering Ltd.
Photo Credit: Simeon Rusnak Photography

RECREATIONAL

WOOD DESIGN AWARD

CAMP MANITOU OUTDOOR HOCKEY FACILITY

Headingley, Manitoba
Architect: 1x1 architecture inc.
Structural Engineer: Crosier Kilgour & Partners Ltd.
General Contractor: Concord Projects Ltd.
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- Eleanor Brough, Associate, Sarah Wigglesworth Architects (SWA), London, UK
- Lubor Trubka, Architect AIBC, FRAIC, Principal in Charge/Lead Design Architect, Lubor Trubka Associates Architects (LTA), Vancouver, BC
- Cory Zurell, Principal, Blackwell Structural Engineers, Toronto, ON

INSTITUTIONAL

WOOD DESIGN AWARD

SHANE HOMES YMCA AT ROCKY RIDGE

Calgary, Alberta
Architect: GEC Architecture
Structural Engineer: RJC Engineers
General Contractor: PCL Construction
Wood Supplier: Structurlam Mass Timber Corp.
Photo Credit: Adam Mork Architectural Photography

WOOD ADVOCATE

WOOD DESIGN AWARD

CALGARY MUNICIPAL LAND CORPORATION FOR THE SIMMONS BUILDING

Calgary, Alberta
Architect: McKinley Burkart Architects
Structural Engineer: RJC Engineers
General Contractor: Stuart Olson
Client: Calgary Municipal Land Corporation
Photo Credit: Roy Ooms Photography

JURY'S CHOICE

WOOD DESIGN AWARD

MONTREAL HOUSE

Calgary, Alberta
Architect: Sturgess Architecture
Structural Engineer: Enuitive
General Contractor: Karson Builders
Wood Supplier: Structurlam Mass Timber Corp., Bow Valley Exteriors
Photo Credit: Robert Lemermeyer Photography

INDUSTRY AWARD

WOOD DESIGN AWARD

ATCO HEADQUARTERS

Calgary, Alberta
Architect: Gibbs Gage Architects with Pickard Chilton
Structural Engineer: MMP Engineering
General Contractor: Cana Group
Wood Supplier: Western Archrib
Photo Credit: Jason Dziver Photography

For more information on Wood *WORKS!* Alberta initiatives visit www.wood-works.ca/alberta or contact bmurray@wood-works.ca

Wood-Fiber Insulation Panels Put to the Test

The Gibson, B.C. house is built to Passive House and LEED Platinum standards

The last nail driven into wood-fiber panel insulation in a home in British Columbia could mark a new standard for the Canadian home-building industry, while ushering in a new era of green, sustainable and high-performance building insulation for residential and commercial structures.

The non-profit forestry R&D company FPInnovations and 475 High Performance Building Supply have partnered to build three high-profile residential projects located in B.C., Saskatchewan and Ontario, to demonstrate the suitability of wood-fiber insulation panels. The panels are ecologically friendly and are expected to perform better than traditional rigid foam insulation. "Getting the homes built is a unique opportunity to demonstrate to the wood-products and building industries that these panels can join existing insulation products in the market while benefiting the environment and creating new jobs in the forest sector," says Jieying Wang, an FPInnovations building scientist who's monitoring the product's performance.

The B.C. home, completed in the summer of 2018, is the last of the trial's high-performance projects built to Passive House standards. Contractors used wood-fiber insulation panels imported from Europe, where they're a mainstay in home construction to insulate exterior walls, instead of rigid foam. The companies behind the initiative believe that wood-fiber insulation panels can be manufactured in Canada far less expensively than in Europe, with an R-factor rating equivalent to rigid foam panels.

"Dry process wood-fiber insulation panels are the future of building insulation in Canada because we have the natural resources and industry to produce them economically," says former FPInnovations lead scientist Bob Knudson, who spearheaded the project and recently retired. "We have excess fiber from saw mills for their production, and they offer superior performance and insulation, in addition to being environmentally safer than rigid foam insulation."

Superior Performance

FPInnovations designed tests to determine the fire safety, stability, durability and insulation rating of the panels. Wood-fiber insulation showed superior fire performance compared to the polymer foam insulation types that are currently used in North America, and the panels also showed superior moisture management in wall and roof systems compared to polymer foam insulation.

The panels are made of refined wood chips and shavings. The resulting fiber is dried, mixed with polyurethane adhesive and paraffin, formed into a continuous fiber mat, sized to desired thickness and cured. The resulting panels are then milled to the desired size and edge configuration. The manufacturing process allows for a homogeneous board from 20mm. up to 300mm. thick.

The partners found homeowners willing to have wood-fiber insulation panels installed in their homes by offering a discount in exchange for FPInnovations monitoring their performance through sensors installed in the buildings. The three residential building projects were also chosen for their locations in different Canadian climates. The B.C. house, located in Gibsons, is in

Attaching cladding to the exterior of the Gutex wood fibre insulation of the Radiance co-housing project. Note the solar panels mounted on the roofs of the project structures.

Radiance co-housing project in Saskatoon was built to meet Passive House standards in one of Canada's coldest regions.

mixed marine climate zone 4C. The Ontario build is a single-family residence near Collingwood in cold-humid climate zone 6A, while the Saskatoon, Saskatchewan, project is a nine-unit co-housing development in very cold climate zone 7.

"We believe these panels will lead to a transformation of the North American construction industry towards making durable, high-performance Passive House and zero-energy buildings more common," says Lucas Johnson, Western Regional Manager at 475 High Performance Building Supply. "We built three unique projects, each with distinct features, to demonstrate the versatility of wood-fiber insulation panels."

Customized Uses

The single-storey, prefabricated house in Gibsons, B.C., meets LEED Platinum standards and showcases wood as a structural composite material. The walls are constructed of 100-mm. thick, three-ply CLT with 100 mm. of rigid wood-fiber insulation fastened to the outside of the CLT. The wood-fiber insulation is covered with building wrap and exterior cladding. The green roof used 240 mm. wood-fiber panel insulation, and performance-monitoring instrumentation was installed onto the prefabricated wall and roof modules.

The build in Collingwood added a two-storey contemporary addition to a 150-year-old pioneer cedar-log house and used 80-mm. dry process wood-fiber insulation panels attached to outside 2x8-in. bearing stud walls, sheathed with half-inch plywood.

The co-housing project in Saskatoon consisted of a privately owned nine-unit townhouse development showcasing a low cost of living through low energy use. It relied on both 40-mm. panels and 240-mm. wood-fiber panels attached on the outside of 2x6-in. insulated bearing stud walls, sheathed with three-quarter OSB.

"Our low-cost construction method required a thick, rigid exterior insulation product, and wood-fiber insulation is one of the few products we found with negative embodied carbon," says Knudson. "The pressed-wood fibers trap carbon and sequester it for the life of the building."

The instrumentation installed in each building consists of point moisture measurement, relative humidity, and temperature sensors, as well as data logger units and a tactical intelligence gateway. Each home's performance is being monitored by FPInnovations for at least one year, and meaningful results are expected soon.

The future of wood-fiber panel insulation faces many challenges in becoming mainstream practice. Wood is thought of as a combustible product, yet the panels exceed fire-safety standards. In Canada, they're seen as a hard-to-believe-it's-true new product, yet they've been used for over 25 years across Europe, and their popularity is growing there. Knudson believes education is the key to building a Canadian market. "First, we had to build homes to show the industry that these panels are as good as rigid foam insulation," he explains. "We have the natural resources and the industry know-how to make these panels in Canada. They can truly transform the industry because they're environmentally friendly to make, reduce onsite labor and waste, and they're recyclable as well. When the data is analyzed, the results will demonstrate their effectiveness and reliability, and then I'm sure manufacturers will come forward."

Wooden Vases with a *Twist*

German architect and wood researcher Oliver David Krieg – an expert in computational design and digital fabrication, currently the Director of Technology at LWPAC in Vancouver – has released his first product design project, Aestus, which is a series of stratified vases that merge art and engineering. Industrial seven-axis robots carve the vases from hundreds of layers of beech plywood, to create a unique texture and shape that blends both modern and traditional aesthetics and design qualities. The series is made up of four vases that are functional and durable – a stainless steel inset marks the lip, and also works as a water repository and a setback platform at the bottom. The largest of the four is constructed with 540 layers of veneer and stands 110 cm. tall. Krieg founded his design company "to explore the complexity of natural materials and the elegant precision of digital manufacturing."

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