PROMOTING THE BUILDING ENVELOPE INDUSTRY ACROSS THE WEST

FALL/WINTER 2018

BC BEC

ELEMENTS

A BCBEC PUBLICATION

DIVERSE APPLICATIONS

Benefits and Best Practices in Mid-Rise Wood-Frame Construction

2018 BCBEC Conference and AGM

UNBC Wood Innovation Research Lab Record Setting in Energy Efficiency

EGBC & AIBC's Energy Modelling Guidelines Recently Published

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FEATURES

DEPARTMENTS

Shakir Rashid,
President,
BCBEC

Forging the Path Toward Better Buildings

Welcome to our eighth and fall issue of *BCBEC Elements* magazine! As President of the British Columbia Building Envelope Council (BCBEC), I would like to thank our Elements committee for another excellent issue of *BCBEC Elements* magazine, providing current and relevant information to all readers.

As we head into the final months of 2018, it's time to reflect on a busy and interesting year and look forward to some key dates upcoming in the next few months. This year we introduced the "Industry News" section in the magazine and we revamped our website. We have received some great feedback on those initiatives. Please do continue to send us feedback on our initiatives or suggestions on how BCBEC can support you in order to ensure that we are engaging in continuous improvement.

Every year, BCBEC hosts our annual conference and AGM to further our mandate of providing a platform for proponents of the building industry to discuss issues and exchange information on building envelope issues. This year the conference and AGM are at the JW Marriott Parq on October 26, 2018. The theme for the conference is "Stepping into the Future: Forging the Path Toward Better Buildings." We are fortunate to have speakers from organizations that are forging the path toward better building, including individuals from the municipal and provincial governments, leading consultants from the building envelope profession, experts on climate change and individuals that will discuss inspiring leadership traits. See page 19 for a profile of our excellent conference and AGM program.

This year, BCBEC board members had to work on amending the constitution and bylaws so as to bring them in line with the new *Societies Act.* The *Societies Act* came into effect November 28, 2016 and governs how societies, such as BCBEC, are created and run in B.C. The Act includes significant updates to allow for more flexibility in how societies operate, while still protecting the public interest. All societies in B.C. need to formalize the transitions before November 28, 2018. With guidance provided by the lawyers and approval by the board, BCBEC will be presenting the revised bylaws at the AGM for ratification by the membership.

I would like to thank our sponsors for the conference as well as the advertisers in the magazine; without your support, BCBEC would not be able to perform its mandate!

I look forward to the event in October. As we head into the holiday season, I would like to take this opportunity to wish everyone happy holidays and a healthy and exciting 2019!

Shakir Rashid, P. Eng.
BCBEC President

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AIRTIGHTNESS ACHIEVEMENT

UNBC Wood Innovation Research Lab record setting in energy efficiency

By Kelly Parker

The University of Northern British Columbia (UNBC) in Prince George is home to the new Wood Innovation Research Lab (WIRL), one of the most unique buildings in the world in that it is the most airtight. The building is the first of its type in North America to meet the internationally recognized energy efficiency standards to earn Passive House certification.

Certified Passive House buildings use up to 90 per cent less energy for heating and cooling, and up to 70 per cent less energy overall compared with standard buildings. What makes the WIRL's Passive House certification notable is its large volume-to-floor-area ratio and the cold climate of Prince George.

"We needed a structures lab that included a strong floor and a strong wall, and a bit more space," says David Claus, UNBC Assistant Director of Facilities Management, explaining how the project came about. The existing Wood Innovation and Design Centre contained an integrated engineering lab for the master's program for civil structural engineers who already have a degree, but would like to know more about sustainability and building with wood. To support that program they needed a lab, which had been incorporated into the original building, but was too small and lacked the strong floor/strong wall integrity that was required.

"(The faculty is) very much involved in teaching the Passive House standard," explains Claus, "and because the teaching of that is very involved, when we went to build the new lab, we asked, could we and should we build it to that Passive House standard, and actually demonstrate the sort of stuff that we're teaching? We came out of that meeting thinking that we could probably do it, and that we would give it a go."

Despite its 10 metre height, the research lab comprises just one storey, containing high-head lab space, classrooms and office space. The mass timber structure is constructed of glue-laminated (glulam) timber columns and beams on a concrete raft slab foundation. Prefab upright wood trusses 0.5 metres thick frame the wall panels. The floor was sheathed with sheet goods, and exposed roof and wall assemblies make up the interior for the lab portion of the building.

This part of northern B.C. experiences temperature differences of 60 degrees Celsius – minus 30 in the winter and plus 30 in the summer – which puts a lot of stress on any kind of building, and with passive buildings focused on energy efficiency, the challenge is even greater. Guido Wimmers, Program Chair and Associate Professor for Master of Engineering in Integrated Wood Design at UNBC, says, "If you build a large facility like this one with basically only one ground floor – although the building is 10 metres tall – you have a geometric disadvantage, because the building has the volume of three floors, but you only have one. In addition to the climate challenge, that meant the building had to be virtually three times as energy efficient as, for example, a typical office building in the same location. That brought us to the design of relatively thick walls."

Employing a wood superstructure was also essential in gaining thermal efficiency. "With the wall structure, we're concerned with the thermal bridging, so if you build your wall studs out of steel, it's almost impossible to avoid heat conduction, so you need wood studs in your walls to get the desired efficiency," explains Claus.

Some aspects of the build required trial and error, as with the work IDL Projects did with Winton Homes Ltd. to have the walls prefabbed into panels. One of the requirements for the project was that they didn't want to use spray foam insulation, so blown-in mineral wool insulation was used. IDL Project Manager Craig Cocker explains, "Originally the intent was going to be to build these panels without one side, and then use an adhesive and spray-glue this insulation into the panels. That type of insulation isn't used very much up here, so when we started spraying it, we quickly learned that it was a four-day drying cycle for each lift, and you were only supposed to spray in two-inch lifts, but the panels were 20 inches wide, so that was going to mean something like a one-month turnaround to do it that way, and it just wasn't going to work."

The team convened and determined that the solution was to stand the panels up first, and then spray in the insulation. They put a four-foot strip of sheathing on the exterior, sprayed insulation into it using lifts, and worked their way up. "We didn't want that insulation to settle," stresses Claus, "because that would have caused thermal bridging issues, so what they discovered was, if you tamp the insulation, it gets dense enough that it will take the pressure of all of the insulation on top of it, and it won't settle. However, if you tamp it all down, that pushes out the air that is part of the insulation factor."

The team consulted the manufacturer, which told them that their plan to increase the density to which they were planning on packing the insulation by about a third was fine, and significantly increased the R-Value, so the solution worked well in their favour. They also found that mounting the uninsulated panels was logistically difficult, and had to rework the entire construction schedule to accommodate the new approach, but as Claus says, "what we got at the end of the day was a better building."

Two significant features of the project that, on paper, are decidedly non-passive (passive-unfriendly?) are the bay door large enough for a semi-truck to enter, and – due to the fact that this is a wood innovation lab – a dust extraction unit. "The door was a relatively simple solution," emphasizes Wimmers, "and one manufacturer came to mind right away for that: a company in Germany that was producing extraordinary industrial doors. It wasn't the cheapest, but it worked well, and that was a relatively quick solution for that problem, and just required some optimization after the door was installed to really get the maximum airtightness efficiency out of it."

PHOTO CREDIT: UNBC.

"The other part of it – the dust extraction – was something that I hadn't had any experience with," Wimmers admits, "but that was just more or less logical thinking; how can we pull this off, and we were able to do that by working with the design team at Stantec to optimize the dampers and figure out the right sequence in executing it."

Relatively late in the process, the team came to realize that a cavernous industrial-use space like this one – especially one that is essentially a large wood shop – would be quite noisy. "If someone is working with a saw," notes Wimmers, "or any loud equipment in one corner of this very large facility, it's going to be very loud in the entire facility, so we analyzed and measured the room and came up with a cost-efficient and simple way to (improve the acoustics) by about 60 per cent using a baffling system constructed from reclaimed materials."

The level of airtightness achieved with this project is record setting – the most airtight industrial building in North America – and its performance will be monitored to measure the building's success as a passive structure. "We installed about 86 sensors and a few metres to monitor the building and its long-term performance, so we'll be getting reports within a year or two that will actually allow us to prove what the real efficiency and overall performance of the building is, and that's kind of unique because there are not a lot of projects out there that are truly monitored. And whatever the outcome is, we will publish the results, and we're very confident in the design," explains Wimmers.

"We had really good partners that were brought into this," says Claus. "Stantec did the design-build, and IDL was the construction contractor, and they were both committed to making this building work, and to working with us, which made it the building that it is. Stantec also sent a big part of their team to Passive House training right at the beginning, so that everybody who was involved in the project understood what needed to be achieved, and that was key to getting us there."

Now that it's up and running, the Wood Innovation Research Lab allows students and researchers the room to test state-of-the-art building systems (like their own lab), and to examine ways to integrate wood into the structural design of industrial buildings.

PEOPLE POWER:
Q&A with Pierre-Michel Busque

By Matthew Bradford

For Pierre-Michel Busque, designing better buildings has been a lifelong pursuit. From his early days at the Canada Mortgage and Housing Corporation (CMHC) to his leadership at Busque Engineering, the accomplished engineer has spent his career researching, designing and assessing building envelope systems for hundreds of residential, commercial and institutional buildings across the B.C. landscape.

Beyond the office, Busque has become a source of industry insights and education. He has authored numerous papers on building envelope performance issues, taught part-time at BCIT and presented at hundreds of building science seminars across North America. Today, he continues to champion industry collaboration and improvement as a program director with the Roof Consultants Institute.

Between his work and family, Busque rarely has a moment to spare. Nevertheless, he cleared his schedule to chat with *BCBEC Elements* about his career, achievements and industry perspectives.

BCBEC Elements: What sparked your interest in building science?

Pierre-Michel Busque: My high school girlfriend's father was a researcher at National Research Council Canada (NRC) and I kept hearing about air barriers, vapour barriers and condensation problems every time I visited her. Ultimately, that piqued my interest.

After getting my B.Sc in Civil Engineering from the University of Ottawa, I got hired as a projects officer at CMHC. I worked in their housing innovation division, where I managed research projects for a few years – a bulk of which were about air barriers and rainscreen technology.

After that I was hired to be a building envelope engineer at B.H. Levelton and Associates in B.C.'s lower mainland. I was hired by one of the managers, Marcus Dell, who really took me under his wing and showed me the difference between what seemed important in a research paper and what was actually important on site. I couldn't have asked for a better mentor; he was the right person at the right time in my life and I learned so much in that role.

I worked at Levelton until 2008, when I created Busque Engineering. And here I am!

BE: How have you seen the industry change throughout those years?

PMB: It's been a pleasure to watch it grow. The industry has come a long way from when I first started and the only rule was "the building shall not leak." Now, it's "the building shall not leak" along with, "the building shall be maintainable, cost-effective, attractive and thermally efficient" – which, of course, are all very important things.

For example, at CMHC, we worked on a super airtight house with an advanced air barrier system that was featured in *Popular Mechanics.* Our goal was to reach half of what the R2000 program demanded at the time and, in the end, we achieved one-fifth. That goes to show how far construction techniques and overall knowledge has advanced in 20 years because what was hard to achieve years ago can be done relatively easy today.

BE: How have you grown as a company?

PMB: The industry has changed dramatically over the last 10 years, and we've had to expand our scope of services to accommodate that evolution. Along the way, my strategy has been to grow organically and take the time needed to hire young engineers and bring them to a level of competence that I'm satisfied with. That's been a very rewarding experience for me.

BE: What have been some of the highlights for your business?

PMB: On a whole, it's been working with local builders in B.C.'s lower mainland, some of which I'm convinced are absolutely the best in the world at what they do. They model every aspect of a building in 3D to make sure it can be built and that everything will fit together perfectly, and many of their site supervisors are pretty much building envelope consultants.

As for memorable projects, there's a fantastic one every year. One I really enjoyed was fixing an 80-year-old church on Heather Street. We gave the Archdiocese of Vancouver the choice to build a super insulated interior wall that would require virtually no maintenance for the next 50-80 years. To finish this building and to have it look exactly the way it did before we started was very, very satisfying.

BE: What have you learned from spending your career in B.C.?

PMB: When I started my career as a young engineer in Vancouver, I saw city requirements as red tape and a necessary evil. Having worked in B.C. over these years and seeing how the city has taken the lead on setting benchmarks for energy efficiency, water penetration resistance and environmental stewardship, I've come to appreciate the vital role that legislative authorities play in our industry.

BE: Especially as the industry moves towards higher performance requirements in codes and standards...

PMB: Well, one of the biggest challenges these legislative authorities face is producing clearer and more concise regulations and standards that can be implemented by the engineering community without a lot of confusion. BCBEC is playing a big role in making that happen through its educational programs, collaborative discussions, and working with everyone to form a consensus around what we believe these regulations mean and how to meet them.

BE: As a past board member, how else do you see BCBEC impacting the industry?

PMB: I think this magazine is excellent, for one. Our luncheons are also a highlight. In the heat of the leaky condo crisis, they were where the industry got together to talk about its problems and share solutions. They were gigantic counseling sessions and they helped establish the standard from 1996 to now.

BE: What's next for you?

PMB: I am really excited about a window retrofit project that I will be working on at

Simon Fraser University with Urban Solutions Architecture. The 1970s vintage windows of the Water Tower Building are being replaced with energy-efficient dynamic glass, and the window frames will be thermally-decoupled from the precast concrete panels. The intent of the project is to reduce the cooling loads of the building in the summer.

Otherwise, I'm focused on building a team of competent professionals. I believe it takes a good 5-10 years to create a professional that is experienced enough to face any situation they're going to be challenged with. I want to build the best team I can so one day I can be the grumpy guy in the corner office.

DIVERSE APPLICATIONS

Benefits and Best Practices in Mid-Rise Wood-Frame Construction

By Jim Taggart

This article has been adapted from the recently released *Mid-Rise Best Practice Guide – Proven Construction Techniques for Five- and Six-Storey Wood-Frame Buildings.* Produced by Wood WORKS! BC with the support of BC Housing, the guide presents a diverse range of techniques and best practices for mid-rise wood-frame construction and is available here: http://wood-works.ca/bc/case-studies-videos/ and here: www.bchousing.org/research-centre/library/residential-design-construction/mid-rise-best-practice-guide&sortType=sortByDate

When the British Columbia Building Code (BCBC) was revised in 2009 to increase the allowed height of wood-frame residential buildings from four to six storeys,British Columbia joined many other international jurisdictions in recognizing the role wood construction could play in the creation of sustainable homes.

With more than 100 such buildings completed in British Columbia since 2009, there is clearly a firm market confidence in this new building style. This construction also helps many municipalities achieve their affordable and sustainable housing goals.

PHOTO CREDIT: RAEF GROHNE, COURTESY: INTEGRA ARCHITECTURE INC.
THE SHORE IS A FOUR-PHASE MARKET CONDOMINIUM PROJECT LOCATED ADJACENT TO MOSQUITO CREEK IN NORTH VANCOUVER.

The five projects featured here demonstrate the diverse application of wood-frame construction techniques to different geographic and market conditions: from small towns to dense urban centres, and affordable rental accommodation to high-end condominiums.

FEATURED PROJECTS

Sail

Completed in 2014, Sail is a two-phase market condominium project on the University of British Columbia's Vancouver campus. Phase 1 and 2 buildings include a total of 170 apartment units. The buildings are six storeys in height, constructed using traditional light wood framing and built on top of a two-storey underground parking garage of reinforced concrete construction.

Herons Landing and The Ardea

This two-phase project is located in the District of Saanich on southern Vancouver Island, with 104 affordable rental suites ranging in size from 340 sq. ft. studios to 920 sq. ft. three-bedroom units. Herons Landing has five residential storeys in wood frame on one commercial storey in concrete while The Ardea has four residential storeys in wood frame on two above-grade parking storeys in concrete.

Hillcrest Village

Located in the centre of Fort St. John in northeastern British Columbia, Hillcrest Village provides rental accommodation for families working in the region's various resource industries. With a total of 83 two- and three-bedroom suites, this two-phase wood-frame project includes L-shaped four- and six-storey buildings that together will frame a courtyard. Poor soil conditions prevented a slab-on-grade, so the foundation comprises a grid of parallel strand lumber (PSL) beams, supported on concrete pile caps.

The Shore

Completed in 2017, The Shore is a four-phase market condominium project located close to the centre of North Vancouver. The buildings are five- and six-storey wood-frame constructed on-grade, or on top of a basement parking garage of concrete construction. The complex is arranged around a central courtyard and has a total of 359 apartment units, ranging in size from 480 sq. ft. to 1,090 sq. ft.

SFU Downtown Residence

SFU Downtown Residence is located in the historic civic centre of downtown Vancouver. It was completed in 2016 and consists of four storeys of wood-frame construction, containing a total of 36 single-bedroom and 16 two-bedroom suites, above two storeys of concrete construction. The building extends to the property line on all four sides.

DESIGN FOR INCREASED DEAD AND LIVE LOADS

Compared to a four-storey building, the self-weight of a six-storey building, which accounts for much of the vertical load, increases by half, while wind and seismic forces are effectively doubled.

Lateral Loads

Increased lateral loads are addressed by increasing the number, length and capacity of shear walls. This often requires sheathing on both sides, making the routing of services difficult. Shear wall locations must therefore be considered at the schematic design stage, to ensure their performance is not compromised by plumbing or other service runs.

Shear walls in five- and six-storey construction must be precisely aligned from the top to the bottom of the building to avoid offsets in the load path. This requires identical (or nearly identical) wall configurations on every floor.

Lateral resistance must be provided in both directions. If the building has a central corridor, shear walls will be required in corridors and in the demising walls between suites. Apartments should be alternately left-handed and right-handed in plan to maximize the available wall length between entrance doors. At Hillcrest Village approximately 40 per cent of the corridor walls and all the demising walls are shear walls.

At Herons Landing and The Ardea, apartments are arranged around a central service core, with approximately equal numbers of units facing in each direction. This configuration meant that lateral resistance could be achieved using only the demising walls between suites as shear walls. With the exception of the SFU Downtown Residence, all the featured buildings use a lightweight cladding on the lower floors to reduce seismic loads.

Wood buildings have less mass of inertia to resist the uplift forces and lateral deflections caused by wind and seismic loads as they are lighter than concrete buildings. In mid-rise wood-frame buildings, resistance is provided by tie-down anchors, sectional threaded steel rods that run vertically through the walls of the building from the uppermost floor to the concrete podium or parking garage.

Rods are typically located at both ends of shear walls and installed in storey-height sections, connected with couplers and spring-loaded, applying compression even if shrinkage occurs in the structure. The base must be embedded in concrete (avoiding rebar) or anchored to engineered wood grade beams as at Hillcrest Village.

Shear walls and tie-down anchors control, rather than eliminate, lateral deflection, and so measures must be taken to connect adjacent building areas so that the anticipated movement can be accommodated. A gap must be left between adjacent structures, bridged by a flexible gasket anchored on either side by an aluminum profile. The required gap will depend on the anticipated deflection, which may be as little as 1.5 in. in a low seismic zone (e.g. Hillcrest Village) to 8 in. in a high seismic zone (e.g. Herons Landing and The Ardea).

Large deflections make it more difficult to integrate wood-frame structures with concrete or masonry elevator cores, or to use inflexible exterior cladding systems. However, where deflection can be controlled, these problems can be overcome.

At the SFU Downtown Residence, a full-brick masonry rain screen wall extends from the third-floor slab to the top of the building. The masonry was only possible because the narrow building is rigid, with a reinforced CMU shear wall along its west side that experiences minimal drift under lateral loads. Together with the closely spaced shear walls between the student rooms and rigid floor diaphragms, this creates an egg-crate structure that experiences little differential movement.

Dead Loads

Strategies for resisting increased dead loads include:

- Conventional studs can be nail-laminated together to form bearing posts.
- Higher strength material, such as Douglas fir, can be specified.
- Studs can be more closely spaced.
- Engineered wood posts can be used where greater strength is needed.

These strategies are generally necessary only on the lower floors. At Sail, for example, laminated Douglas fir studs were used on the first four floors, with spruce-pine-fir (SPF) above.

Increased energy conservation requirements have made 2x6 framing the standard for external walls and for internal walls on lower floors. Demising walls between suites either consist of staggered 2x4 studs between 2x6 sill and header plates, or two separate 2x4 walls (see Fire Safety and Noise Control on this page). The load-carrying capacity of these walls is equal to or greater than a standard 2x6 wall.

CONTROLLING SHRINKAGE AND DIFFERENTIAL MOVEMENT

The structure of wood is like a bunch of drinking straws, and liquid water is found in both the tubes of the straws (free moisture) and in the walls of the straws themselves (bound moisture). The release of free moisture does not cause shrinkage but that of bound moisture does.

When a tree is felled, bound moisture is likely at its saturation point, weighing about 28 per cent of the dry weight of the wood in which it is entrained. When wood members are enclosed in a conditioned building, the wood will release moisture until it achieves equilibrium with its surroundings. For British Columbia, this equilibrium moisture content (EMC) will vary between eight per cent and 12 per cent.

Shrinkage

The release of bound moisture results in shrinkage of approximately one per cent for every five per cent decrease in moisture content (MC) perpendicular-to-grain, and approximately 2.5 per cent of this value parallel-to-grain. In mid-rise buildings, shrinkage parallel-to-grain may be ignored.

However, for every 4 in. of material, shrinkage perpendicular-to-grain may be as much as 5/32 in. between the "green" MC and the in-service EMC. To avoid excessive shrinkage, dry wood should be used. Most architects specify a maximum MC of 15 per cent.

Most shrinkage will occur in the top plates and sill plates, and potentially in the floor joists, depending on how these are framed into the walls, and whether they are solid-sawn lumber or engineered wood I-joists. Wood I-joists are supplied at an MC close to the in-service EMC, and are the default floor system for mid-rise construction

However, at Hillcrest Village, the budget dictated the use of standard solid sawn joists. To minimize cost, the design team developed a detail that enabled them to use solid-sawn joists with a higher moisture content.

Floor panels were prefabricated on site using 2x10 lumber, then lowered into place by crane and bolted to laminated strand lumber (LSL) spacer beams. These LSL beams are the same depth as the floor joists. By using an engineered wood member in this location, the solid-sawn lumber material (is kept out of the vertical load path of the wall structure.

The negligible shrinkage in the LSL beams meant that the effect of shrinkage in the wood joists was confined to individual floors, rather than accumulating up the building.

Shrinkage values can be calculated based on the moisture content of the lumber specified. Through careful specification and detailing, shrinkage in mid-rise buildings can be kept to an acceptable minimum.

Differential Movement

Once it has reached its in-service EMC, wood is relatively stable, whereas concrete, steel and masonry continue to expand and contract with changes in temperature.

Differential movement is most likely to occur between wood floors and elevator shafts or firewalls constructed of concrete. Consequently, most design teams now use proprietary gypsum firewalls and nail-laminated timber (NLT) elevator shafts.

At Hillcrest Village, the NLT elevator shafts were "stick-built" on site. Each storey-height wall element was built on top of a 9.5 in.-deep PSL beam, exactly corresponding to the LSL beams to which the floor panels are attached. This detail ensured that any shrinkage would be consistent within each floor level.

FIRE SAFETY AND NOISE CONTROL

Building codes define the minimum standards for fire and life safety, thermal insulation, noise control and other aspects of performance.

Fire Safety

In addition to increased height, the 2009 code changes for residential wood buildings also applied several of the existing requirements for residential buildings of non-combustible construction over four storeys, including:

- Buildings more than four storeys must be fully sprinklered to the National Fire Protection Association (NFPA) 13 standard.
- Exterior cladding must be non-combustible – although fire-retardant-treated wood cladding is permitted. Trims and soffits may be of untreated wood.
- Wood used in other exterior applications, such as porches and canopies, must conform to the requirements for heavy timber construction.
- Wood surfaces within NLT elevator shafts must be sheathed in fire-rated plywood or gypsum wallboard.
- Stair shafts may be of light wood-frame construction protected by two layers of Type X drywall.

Except for the SFU Downtown Residence, where the only firewall is on the west property line, all the featured projects use proprietary firewall systems. These systems sandwich a gypsum fire barrier between two wood-frame walls which can continue to support the gypsum, should fire compromise the integrity of the wood-frame wall on the other side.

Noise Control

In terms of acoustic performance, the code is primarily concerned with the control of noise transmission between suites in multi-unit residential buildings. Excessive noise transmission is the most common source of complaints from residents in these buildings, whether tenants or condominium owners.

Sound is propagated either through the air (airborne sound), or through building elements (structure-borne sound). Noise reduction strategies for both types of sound begin with maximizing the mass of the building element between the source and the receiver. This may be achieved using concrete topping and/or a drywall ceiling in the case of floor/ceiling assemblies, or by using multiple layers of drywall on one or both sides of a demising wall between suites.

Beyond the considerations of mass, the strategies for controlling airborne and structure-borne sound diverge. To reduce airborne sound transmission, acoustic insulation can be placed within the ceiling or wall cavities. The labyrinthine internal structure of such insulation reflects sound energy at every turn, transforming noise into heat.

To reduce structure-borne sound, discontinuity is required along the direct path of travel (e.g. from one side of a wall or floor assembly to the other). For walls, this can be achieved using staggered 2x4 studs mounted between 2x6 sill and top plates or by constructing two separate 2x4 walls with a 1-in. gap between them. Further discontinuity can be achieved by fastening the drywall on resilient channels. For floor/ceiling assemblies, discontinuity can be achieved by installing a suspended drywall ceiling beneath the floor structure.

Attention must be paid to the continuity of these sound barriers to avoid flanking sound. Junctions between walls, floors and ceilings, and penetrations for pipes and ducts must be completely sealed.

If in-floor heating is being used, the concrete topping can provide both a medium for heat transfer and an acoustic barrier, as at Sail. By contrast at Hillcrest Village, no concrete topping was used, an acoustic mat was installed below the resilient floor finish, and the ceilings were constructed using two layers of drywall mounted on resilient channels attached to the underside of the joists.

BUILDING ENVELOPE CONSIDERATIONS

All the featured projects received building permits prior to the introduction of new insulation standards to the BCBC in December 2015. With the exception of Hillcrest Village, which is in a more extreme climate zone, the other projects achieved the required insulation levels for the walls using only cavity insulation. Most developers and contractors are familiar with this wall assembly, which has a proven performance and known cost.

Hillcrest Village provides an example of the split insulation system that may be required for buildings to meet the new energy conservation standards. In addition to mineral wool cavity insulation, the project includes 3 in. of semi-rigid mineral wool insulation installed on the outside of the plywood sheathing. This is covered with the air barrier, strapping and exterior cladding. The split system was preferred over full exterior insulation as it resulted in a thinner wall and provided more usable floor area within the allowable floor space ratio.

CONSTRUCTION PRACTICES

The 2009 code change brought with it several questions about construction practices: Would prefabrication be necessary to improve precision of construction? Would weather protection be necessary given the longer construction times for taller buildings? Would special fire protection measures be necessary during construction?

On-site and Off-site Prefabrication

While prefabrication is more common in six-storey construction than in four-storey construction, it is by no means universal. Of the featured projects, only Hillcrest Village employed off-site prefabrication, and this was for the walls only. The floors were prefabricated on-site as were the walls for Sail, Herons Landing and The Ardea. At the SFU Downtown Residence, all framing was done on site.

For The Shore, the owner, Adera, chose to prefabricate Phase 1 on site, and to stick-build Phase 2, to determine whether one method was demonstrably superior in terms of economy, speed and precision. There was no clear winner, and Adera now allows its framing subcontractors to use whichever approach they prefer.

That said, prefabrication can greatly reduce construction times as it allows framing to begin while concrete work is being done on site, as well as permitting just-in-time delivery of components to sites with limited access or storage space. This can translate into reduced soft costs for developers.

Weather and Moisture Protection

Longer construction times increase the risk of materials getting wet before the building is enclosed, so for mid-rise wood buildings it is important to minimize the exposure of materials to moisture during transportation, on-site storage and construction. It is common practice to monitor the MC of the framing lumber, and if necessary, this must be brought down to less than 19 per cent before the finishes are installed.

Fire Safety During Construction

While wood frame buildings are statistically just as safe as concrete ones when complete, they are more vulnerable to fire during construction. This realization has led to the creation of a construction safety protocol that is recognized by most developers and municipal fire authorities.

Developed by Adera for the Sail project, the protocol includes several recommendations relating to fire safety during construction, including:

- Running water should be available on site for firefighting at all times.
- Drywall should be installed from the ground floor up rather than the reverse, which has always been the standard practice.
- Hot trades, such as welding and torch-on roofing, should be carefully supervised, or eliminated altogether.
- In multi-phase projects where buildings are in close proximity, a dry sprinkler system should be installed in the eaves soffits of completed structures to prevent the spread of any fire that might start while the adjacent phase is under construction.

HOW IT WILL MOVE US INTO THE FUTURE

Originally understood as simply an environmental issue, the definition of sustainability now embraces social and economic concerns. As witnessed by the projects featured here, wood-frame construction has successfully scaled up in response to the need for denser, more compact communities, while continuing to offer efficiency and economy of construction.

Even as performance expectations increase, it is clear that wood-frame construction will continue to adapt to the changing circumstances. It is expected that the provisions of the NBC, which already permit wood structures to be used for mercantile occupancies on the ground and first floors of six-storey mixed-use buildings, will be adopted in British Columbia and elsewhere, making the current concrete podiums unnecessary.

We can continue to rely on wood-frame construction to deliver affordable and durable buildings, meeting the needs of communities for generations to come.

PROJECT CREDITS

Sail

Owner/Developer:
Adera Development Corporation
Architect: Rositch Hemphill Architects
Structural Engineer: Weiler Smith Bowers
General Contractor:
Adera Development Corporation

Hillcrest Village

Owner/Developer: Cape Construction
Architect: MGA | Michael Green Architecture
Structural Engineer:
Read Jones Christoffersen Ltd. (Vancouver)
General Contractor: Cape Construction

The Ardea & Herons Landing

Owner/Developer: EY Properties Ltd.
Architect: KPL James Architecture Inc.
Structural Engineer:
Read Jones Christoffersen Ltd. (Victoria)
General Contractor: Farmer Construction Ltd.

The Shore

Owner/Developer:
Adera Development Corporation
Architect: Integra Architecture
Structural Engineer: London Mah & Associates
General Contractor:
Adera Development Corporation

SFU Downtown Residence

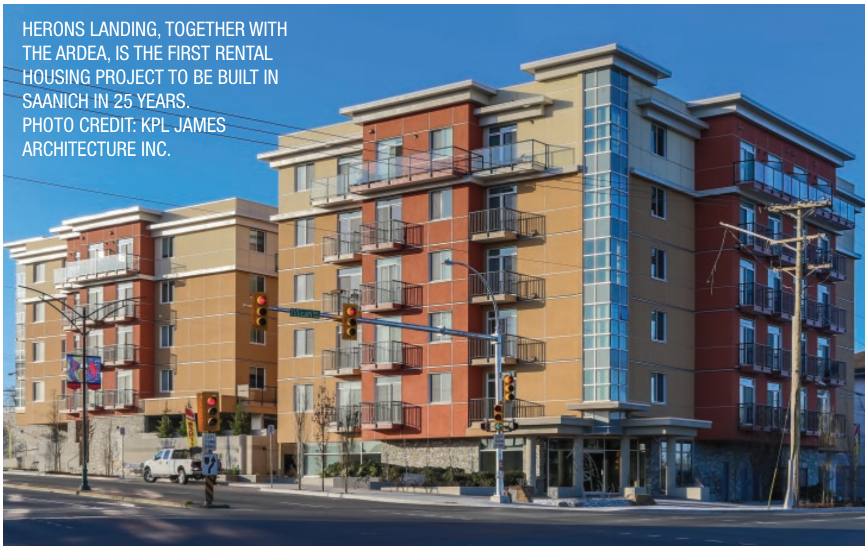
Owner/Developer: 308 Hastings Joint Venture
Architect: Raymond Letkeman Architects Inc.
Structural Engineer:
Bogdonov Pao Structural Engineers
General Contractor: Vanmar Constructors Inc.

Jim Taggart is a Vancouver-based writer and educator who has written and lectured on the use of wood in contemporary architecture for more than 20 years.

PROJECT HIGHLIGHTS: Q&A

Insights into working on mid-rise wood-frame buildings

By Richard Woodbury



HERONS LANDING, TOGETHER WITH THE ARDEA, IS THE FIRST RENTAL HOUSING PROJECT TO BE BUILT IN SAANICH IN 25 YEARS. PHOTO CREDIT: KPL JAMES ARCHITECTURE INC.

Below are interviews with an architect and property manager involved in projects featured in the *Mid-Rise Best Practice Guide,* highlighting construction challenges, the benefits of working with wood-frame structures, and more.

Dale Staples is a Principal with Integra Architecture, The Shore's architect. This wasn't his firm's first time working with six-storey wood-frame construction, as it had previously worked on a project in New Westminster, B.C.

BCBEC Elements spoke with Staples about The Shore. This interview has been edited and condensed.

BCBEC Elements: What were some of the challenges on the project?

Dale Staples: Some of the challenges were to create the maximum number of units, create a liveable community, tight site constraints and very complicated geometry. We had a high water table, so we had to do only a single level of parking just because of where we are relative to the sea level.

It was a tricky little site. It was one of these pieces in the city people had forgotten about and it's a nice contribution to the community because the creek that was there, people didn't have access to it. Now, there's this nice public walkway along the west side of the site, which is a benefit to the whole community.

BE: Can you tell me more about the site?

DS: It has some really odd boundaries. It has the creek on one side, a street on the south side and then it's bounded by two other lots; and then we had to create a new bridge across Mosquito Creek to get access to the site, and then we had a very large central courtyard, so it's a very urban space.

BE: Were there any challenges with using wood materials?

DS: No. This was our second six-storey wood-frame project, one of the larger ones. A lot of it was pretty conventional – two-by-four wall construction, the floor system is a TGI system, an engineered floor joist that's important to reduce shrinkage in the building when you're doing six-storey wood frames. They used kiln-dried lumber for the plates on the tops and bottoms of the walls. In the end, you end up with less shrinkage than a conventional four-storey frame building that wasn't framed with the same kinds of materials.

One of the buildings was done as a stick frame right on site, while the other one was done as a prefab and they had two different crews working on them just to see the timing of who could do it faster. It was interesting – you'd expect the prefab system would go ahead quicker, but they had a really good crew doing the stick frame portion, and it went up just as quickly.

E Y Properties Ltd. bills itself as focusing on land development and residential and commercial property management. The company has experience working with three- and four-storey wood-frame buildings, but a 2014 project in Saanich changed that.

Herons Landing and The Ardea are the first six-storey wood-frame buildings on Vancouver Island.

Angela Oakley, the Property Manager for E Y Properties Ltd., says you need to be precise when deciding what kind of wood to use on wood-frame projects. *BCBEC Elements* spoke with Oakley. This interview has been edited and condensed.

BCBEC Elements: What are some of the benefits of working with a wood-frame structure?

Angela Oakley: With a wood-frame structure it's a cheaper build, number one. We were able to prefabricate the floor as well and have them lift it in to save time on the building. The other benefits are with concrete, you do get shrinkage, so you get floor-plate movement, whereas in the wood frame, you don't get that as much because you're not dealing with the concrete.

BE: Were there any challenges in working with a six-storey wood-frame building rather than a three- or four-storey building?

AO: No. It was just interesting because we had RJC as our engineer and they were the ones that pioneered building a six-storey wood-frame building and getting the approvals for being able to do that. It was really interesting to see how the floor plates are all tied down together and how the tie-downs within the building constantly move for movement in the building. It was an interesting build.

BE: Do people have any misconceptions about working with wood?

AO: It depends on the quality and the grade of the wood you're going to buy because if you're dealing with really wet wood, you're going to get a lot more shrinkage, so you have to know your product.

PROFESSIONAL PRACTICE GUIDELINES – WHOLE BUILDING ENERGY MODELLING SERVICES

An overview of the guidelines released by the Architectural Institute of B.C. and Engineers and Geoscientists BC

By Harshan Radhakrishnan, P.Eng., Practice Advisor, Engineers and Geoscientists BC

The Joint Architectural Institute of B.C. and Engineers and Geoscientists BC *Professional Practice Guidelines – Whole Building Energy Modelling Services*, has been released by the two associations. They were developed with funding and support from BC Hydro, the City of Vancouver and BC Housing and are available for download at https://www.egbc.ca/getmedia/8f8f0579-ca25-4cfd-a92c-e3c75900d1b6/Energy-ModellingGuidelines_FINAL.pdf.aspx

WHY THESE GUIDELINES MATTER

With the roll-out of the BC Energy Step Code and the speed at which it is being adopted by local governments having jurisdiction in B.C., there will be a greater demand for energy modelling services on building projects. As of July 31, 2018, 30 communities have provided an intent to reference the BC Energy Step Code, out of which nine are already referencing the BC Energy Step Code in a policy, program or bylaw. These guidelines will be an important means by which engineers and architects can demonstrate that they have followed industry standard practice when delivering Building Energy Modelling services, not just for BC Energy Step Code projects, but on new and existing buildings of all types and sizes.

PURPOSE OF THESE GUIDELINES

The purpose of these guidelines is to standardize professional practice when architects and engineers are working on projects that utilize Whole Building Energy Modelling. The guidelines apply to architects and engineers who are providing, procuring, contributing to, and/or coordinating Building Energy Modelling services on new and existing buildings of all types and sizes, regardless of the requirements for professional design and review within building codes.

Example 1: The Living Building Challenge (LBC) is a performance standard that is achieved with the aid of energy modelling tools, and although there aren't any requirements related to LBC in the building codes, when registered professionals are engaged to either perform or supervise energy modelling to meet LBC requirements, these guidelines will apply.

Example 2: Although there may not be specified requirements for "registered professional" energy modellers to take responsibility for energy modelling within the building codes (which is true at least for Part 9 residential buildings), when registered professionals are engaged to either perform or supervise energy modelling, these guidelines will apply.

Note: These guidelines do not provide specific instructions or advice on how to conduct energy analysis and modelling. An example of a "how to" guideline would be Version 2.0 of the City of Vancouver's Energy Modelling Guidelines, which establishes the assumptions and calculations required to be used for Part 3 Energy Step Code projects (except projects pursuing Passive House Certification).

APPLICATIONS

Building Energy Modelling is done for a variety of applications:

1. Optimizing a building's energy use and energy use/cost forecasting,
2. Code compliance under the performance path, including designs conforming to both the base BC Building Code referenced standards and the BC Energy Step Code,
3. Meeting a certain rating system (e.g.: LEED Gold) or obtaining an incentive (e.g.: City of Campbell River, City of Kimberley), and
4. Energy modelling in existing buildings, and for facilities management.

Projects may have more than one modelling requirement, such as new buildings being modelled for code compliance that must also meet certification and rating programs. In all cases, professionals should consider all applicable building functions and systems necessary to appropriately model the building's energy consumption. All applications have obligations and responsibilities to which building professionals must adhere.

APPLICABILITY FOR BUILDING PROFESSIONALS

In new buildings and for most of the applications listed above, the focus of energy modelling is the whole building (or multiple buildings in certain cases). Hence the titles of these practice guidelines refer to it as "Whole Building Energy Modelling Services." Because of the whole building focus, all the members of the design team whose practices influence the building's energy use need to be engaged in the energy modelling process early in the design process. Therefore, the document provides guidance on the provision of Building Energy Modelling and analysis services such as the responsibilities of members of a design team providing Building Energy Modelling services including those responsible for the design of:

- Building enclosure (architects)
- Electrical systems (electrical engineer)
- Mechanical systems (mechanical engineer)

These guidelines apply not only to the architect or engineer who is responsible for the energy model, but to all architects and engineers (for example, sub-consultants such as building envelope engineers) who contribute to the energy modelling process. All contributors to the energy model must be knowledgeable of these guidelines and their associated responsibilities. For example, if a building enclosure engineer is sub-contracted to provide advice on the energy-efficiency of a building envelope, they must be aware of estimating the effective thermal resistivity of the enclosure, calculating thermal bridging impacts, strategies to increase building airtightness, etc. and work with the design team to understand how the design of the envelope contributes to achieving the whole building's energy performance. Building envelope engineers are often hired for advice relevant to environmental separation; for example water penetration design. The BE engineer hired for this purpose has to be aware of whether the thermal performance of the envelope is included in their scope of work.

QUALIFICATIONS

These guidelines address considerations that apply when hiring or evaluating the qualifications of those that perform the energy modelling. This includes qualifications for those performing the modelling and those supervising the energy modelling. The qualification specifics are in these guidelines, but in essence, the Qualified Modeller must have experience relevant to the certification or rating system – the application, for example. Depth of the experience must be appropriate to the complexity of the modelling work. They must be able to demonstrate their experience through documentation acceptable to their professional associations. Similar requirements apply to those who supervise energy modelling work.

KEY ROLES IN THE PROVISION OF ENERGY MODELLING SERVICES

Through these guidelines, three roles as they relate to provision of energy modelling services as a part of a project team have been established:

COORDINATOR

The architect or engineer responsible for coordinating the work that is represented by the energy model. For design projects, the Coordinator is the Coordinating Registered Professional (CRP), as defined in the Building Code when a CRP is required.

QUALIFIED MODELLER (QM)

Person responsible for Building Energy Modelling and analysis, who – through education, training and experience – is competent in simulation, science and systems that pertain to building energy performance. A Qualified Modeller may or may not be an architect or engineer.

ENERGY MODELLING SUPERVISOR (EMS)

An architect or engineer directly supervising a Qualified Modeller.

Note: The designation of roles referred to in these guidelines is independent of individuals. Therefore, where qualified, design team members can perform various roles such as being the EMS and Coordinator at the same time. For example, on existing buildings and facilities management modelling, the coordination role may be limited. On such projects, if qualified, the EMS or Qualified Modeller may take on the role of the Coordinator.

If the Qualified Modeller is an architect or engineer, the Coordinator can rely upon the Qualified Modeller to take responsibility for energy modelling work. If the Qualified Modeller is not an architect or engineer, an EMS must directly supervise and take responsibility for energy modelling.

PROFESSIONAL PRACTICE

Building Energy Modelling services may be rendered for a variety of applications through all stages of a building's life, starting with the pre-design stage for new construction, or the assessment of an existing building's operations. Through the coordination of the design team members through all applicable phases of a building project, the following requirements of professional practice need to be met:

1. **Appropriate use of the energy modelling tools:** Whole Building Energy Modelling tools must meet the requirements outlined in the code, standard, program or other requirements such as re-zoning conditions, applicable to the project.

2. **Energy statements on drawings:** The purpose of the energy statements on drawings is to identify, for the life of the building, the energy criteria and design used in a building's original design and subsequent energy-related alterations.

3. **Energy modelling report:** Building Energy Modelling information must be documented in the form of an energy modelling report, regardless of whether it is required by Owner/Client or AHJ. If modelling is being completed for compliance, or for a program with particular requirements as some energy modelling standards provide specific sets of rules and procedures that must be followed, the report must meet these requirements. In the absence of applicable standards with comprehensive reporting requirements, Energy Modelling Reports must include the minimum information provided in the Professional Practice section of these guidelines.

Examples where these requirements for professional practice apply:

- An energy study of building energy-related components to optimize energy performance and/or assess possible energy conservation measures (ECMs).
- Whole building energy simulation to demonstrate that the targets (Thermal Energy Demand Intensity, greenhouse gas emissions intensity, etc.) have been met.
- A measurement and verification (M&V) effort in existing buildings to verify energy performance and/or savings for ECMs identified during design.
- Achieving a certification/rating, such as BOMA BEST, Passive House, LEED and R2000.

ROLES AND RESPONSIBILITIES

Essentially, this section outlines the responsibilities of Owner/Client, Builder/Constructor, Coordinator, Qualified Modeller and the member of the design team, and requires the close coordination of these parties at appropriate stages in the design process (on new design projects, coordination starts right from the conceptual or schematic design phase). The roles and responsibilities for professionals associated with Building Energy Modelling projects vary depending on the type of service being provided. Therefore, the roles and responsibilities of the various stakeholders and the members of the design team have been provided to define:

- general role and responsibilities of each of these stakeholders;
- design team roles and responsibilities during the various stages of a project; and
- roles and responsibilities as they relate to the various applications.

QUALITY ASSURANCE

Outside of requirements within the codes, rating systems and other requirements, peer review of energy modelling work when done by or under the direct supervision of engineers or architects is not required by default. When a peer review is initiated, the section on quality assurance outlines what needs to be checked as a part of the peer review process and what ethical obligations exist on the part of the professionals conducting the review.

For projects in which engineers/architects provide Building Energy Modelling services, an architect or an engineer must act in the capacity of an EMS and directly supervise the Building Energy Modelling, if the Building Energy Modelling is done by a Qualified Modeller who is not an architect or engineer. The section outlines how the supervisor can demonstrate active involvement to make sure that energy modelling and associated results meet a reasonable standard of quality and veracity.

Finally, retaining complete and easily retrievable energy modelling reports and supporting documentation is critical to professional practice. It facilitates quality assurance, and allows for expedient review by other qualified professionals, if necessary. So, this section also provides information on how documentation and records must be archived and retained to demonstrate good professional practice.

WHERE TO GET MORE INFORMATION/TRAINING

Please visit the AIBC and EGBC events pages for future CPD events.

Additional opportunities and resources for building enclosure engineers:

- BCIT offers Energy Modelling for Building Professionals and a graduate diploma program in Building Energy Modelling.
- The Canadian Home Builders' Association of BC is offering a certification program for those wishing to become energy advisors on Part 9 buildings.
- Building enclosure professionals with an energy modelling background wishing to join International Building Performance Simulation Association's BC Chapter can register for no fees at www.bc.ibpsa.ca.
- Passive House resources are at: http://www.passivehousecanada.com/passive-house-resources/ and courses are at: https://passivehousecanada.silkstart.com/events
- BC Hydro's Building Envelope Thermal Bridging Guide: https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/power-smart/builders-developers/building-envelope-thermal-bridging-guide-1.1.pdf
- BC Housing's Illustrated Guide: Achieving Airtight Buildings: https://www.bchousing.org/publications/Illustrated-Guide-Achieving-Airtightness.pdf

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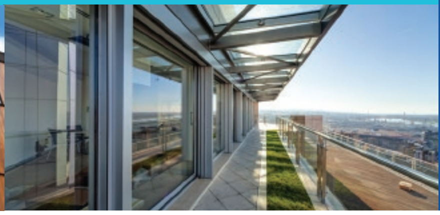

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Topics for this year's conference include:

- Discussion around the new BC Energy Step Code and upcoming BC Building Code changes as they relate to building envelope requirements
- New guidelines on TEDI and energy modelling
- Whole building airtightness testing
- Acoustic requirements, thermal comfort and radiant heating
- The impact of climate change on building design and adaptation

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BCBEC FOUNDATION AWARDS PROFILE: Jason Hirnschall

By Matthew Bradford

In 2016, Jason Hirnschall received a $1,500 scholarship from BCBEC's Education Foundation towards his education at the British Columbia Institute of Technology's (BCIT) Architectural and Building Engineering Technology program. Now a Building Science Consultant at Morrison Hershfield, Jason checked back in to discuss what brought him to the industry and his ongoing partnership with BCBEC.

BCBEC Elements: What drew you to the building science industry?

Jason Hirnschall: To be honest, I didn't even know what building science was before I started the program at BCIT. I was originally targeting work in an architectural practice but was exposed to courses in building science where I learned the field played toward some of my strengths. Eventually, those courses turned out to be among my strongest so I changed my focus.

I really enjoyed learning about the fundamental concepts of building physics and the durability and design challenges they present. Constructing a more durable building has the inherent connection to increasing its sustainability, and that aligns with my personal philosophy. The work is certainly diverse and challenging, with a good mix of time spent in the office and on-site. There's always something new to experience and for me it's turned out to be the right fit.

BE: What have been your most memorable projects/achievements to date?

JH: I participated in the field review of the Parq Vancouver urban resort and casino, which was an amazing learning experience. The complexity of the envelope and the challenges that needed to be overcome to tie everything together were unique. It's such a landmark project and it was great to have a part to play.

Even the smaller and seemingly simple projects offer up challenges that make them memorable when they don't go smoothly. These challenging situations can really test your technical knowledge and certainly help to grow your expertise. Sometimes, overcoming them can amount to a feeling of achievement!

BE: What role did BCBEC play in supporting your career?

JH: First off, receiving the [BCBEC Foundation] Award has been an absolute honour. At the time I received it, I was a mature student with a family and in the middle of changing my career. I worked very hard to manage everything, so receiving the acknowledgment and financial support from BCBEC has been extremely validating. It provided me with a great confidence boost when entering the workforce.

Also, I found the BCBEC website provided a great resource for understanding the different players in the industry and ways to connect with them and learn more about the industry. I have reached out this way and it helped me to make the decision to pursue building science as a career.

BE: Did you participate in any BCBEC events or programs?

JH: I attended the Annual General Meeting as a student and found it to be a beneficial experience that I would recommend to current students. I was also a presenter for a BCBEC luncheon where I covered my BCIT research project on shou sugi ban, a technique of charring wood for use as a cladding material. This was a tremendous experience for me and my co-presenters, and it provided an amazing opportunity to participate in knowledge sharing within the industry. To be so fresh out of school but still presenting relevant information to the industry – and be supported by BCBEC in doing so – was very rewarding.

BE: Do you see yourself giving back to the building science community down the road?

JH: Absolutely. I am a big believer in supporting the knowledge sharing within the industry and I look forward to the opportunity to present for BCBEC again in the future. I have also reached out to BCIT to act as an industry contact and have attended the students' building science research presentations to connect with them and answer their questions about what it's like to work in the building science field.

BE: What advice would you give to students entering the industry?

JH: Participate, ask questions, get to know people and listen to their experiences. If there's ever a time where the statement, "there are no dumb questions" is true, it's when you're a student. So don't be shy. There's a wealth of knowledge in our region; tap into it and learn more. There's so much more to building science than what's covered in school and there are great opportunities for diversity in your career.

CONVOY SUPPLY PRESIDENT COMPLETES ELITE IVEY PROGRAM

Surrey, British Columbia – Convoy Supply is pleased to announce that President and CEO Alma Garnett is among the 2018 graduates of QuantumShift, a unique leadership development program and network sponsored by Ivey Business School in London, Ontario; KPMG Enterprise; TD Commercial Bank; and *The Globe and Mail.*


ALMA GARNETT

Boosting entrepreneurial talent is critical for our country's future. Helping private businesses grow and improve their productivity is critical to building a robust economy and a strong future. Ivey and KPMG realize this and for the 15th year they invited a select group of entrepreneurs from across Canada to participate in QuantumShift, a rigorous weeklong program designed to provide tools to help business leaders accelerate the growth of their companies.

QuantumShift was developed for leaders of companies that are past the start-up stage and are ready to innovate. The program focuses on how to lead an enterprise through exponential growth; how to attract and retain the best employees; how to uncover obstacles that may be limiting growth; how to value a venture and use strategies for moving from business plan to financial proposition; and how to build a strong network of entrepreneurial peers to share best practices.

With this graduating class, Alma Garnett joins over 620 successful entrepreneurs who have completed the QuantumShift program. An established and reputable leader, Garnett has a reputation for embracing the entrepreneurial spirit in everything she does. She is passionate about helping to drive innovation and change in the North American construction industry.

In describing her weeklong experience, Ms. Garnett said, "The QuantumShift program is transformative in countless ways. The faculty at Ivey, the sponsors and the network of participants come together to truly explore the essence of leadership and the urgent need to develop organizational cohesion aimed at vibrant and sustainable growth in our businesses. The stretch for bold innovation is a hallmark of QuantumShift."

Established in 1972, Convoy Supply is a growing, independent, wholesale construction materials distributor with 44 locations spanning five provinces and four states. For more information on Convoy's products, services and history, visit www.convoy-supply.com.

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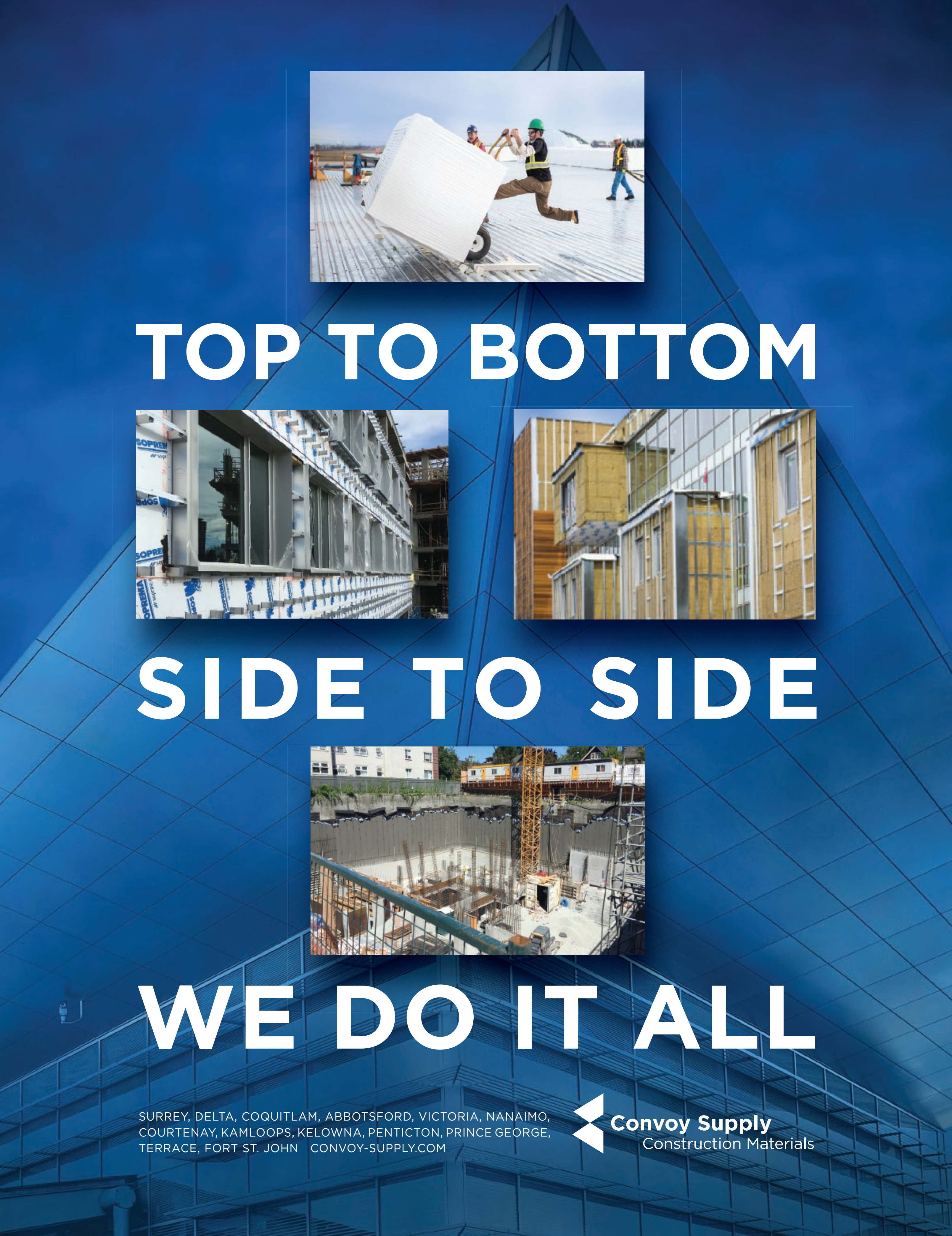
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