PROMOTING THE BUILDING ENVELOPE INDUSTRY ACROSS THE WEST

SPRING/SUMMER 2017

# BC BEC ELEMENTS

A BCBEC PUBLICATION

# STANDARD ISSUE

## B.C.'S MYRIAD BUILDING STANDARDS IN NEED OF THEIR OWN RENOVATIONS

## ALSO

**NRC Study**
Evaluating Alternative Solutions to Capillary Break Requirements

**People Power**
Q&A with industry research trailblazer Phalguni Mukhopadhyaya

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## FEATURES



## DEPARTMENTS



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Samer Daibess,
President,
BCBEC

# Welcome to our Spring/Summer Issue of *BCBEC Elements*

To our new readers, welcome to *BCBEC Elements*, the official, bi-annual publication of the British Columbia Building Envelope Council (BCBEC).

*BCBEC Elements* serves a substantial segment of the construction industry including: architects, engineers, government organizations, product manufacturers, contractors, construction associations and educators from across the country. Our readers are committed to promoting best practices and cutting edge building envelope solutions based on solid research.

While our editorial focus is on educational articles that discuss and inform on technical advances in the industry, our advertisers also contribute with valuable product information and support. As always, I wish to extend our appreciation to our advertising partners for their important continued financial support and endorsement.

On a personal note, I'm in my second term as president of BCBEC. I started in 2008 as a director. Throughout, it has been an honour and a privilege to serve our membership. Our current board of directors are a dedicated group, and they too are passionate about serving our membership. Together, we feel responsible to carry the industry torch our predecessors once carried.

I urge every one of us who has benefitted from B.C.'s building envelope boom to give back to the industry; share your expertise. This could be in the form of volunteering for organizations such as BCBEC, the Association of Professional Engineers and Geoscientists of BC (APEGBC), or the Applied Science Technologists & Technicians of BC (ASTTBC). It could also take the form of mentoring a young building science professional, taking the time to show them the ropes and welcome them to our industry. My message to the new, younger workforce of building science professionals: "dream big and good things will happen."

Event news: Amongst many initiatives, our hardworking Board and volunteers are staging our most prestigious event, the 15th Canadian Conference on Building Science and Technology (CCBST) in Vancouver next November. BCBEC hosts this three-day event, including the annual AGM, at the Hyatt Regency Hotel. I encourage you to join us. To register or to find out more, go online: www.ccbst2017.ca.

This edition of *BCBEC Elements* was led by Shakir Rashid, P.Eng., BCBEC's Vice President. Featured articles include: a discussion on evaluating alternative solutions to capillary break requirements, passive house commentary regarding B.C.'s myriad building standards, an interview with Phalguni Mukhopadhyaya of the University of Victoria, plus a profile on a recent recipient of the BCBEC Foundation awards.

I hope you enjoy this issue; thank you for joining us.

Samer (Sam) Daibess, P.Eng.
BCBEC President
Co-founder and Principal
LDR Engineering Group

## DO YOU WANT TO SEE YOUR ARTICLE PUBLISHED IN THIS MAGAZINE? DO YOU HAVE FEEDBACK OR A CRITIQUE ON PUBLISHED ARTICLES?

BCBEC invites contributions to our semi-annual publication, *BCBEC Elements*. BCBEC is a non-profit organization dedicated to providing a platform for proponents of the building and construction industry to discuss issues and exchange information on building science and building envelope issues. *BCBEC Elements* continues this mandate to foster an ongoing conversation for the growth and betterment of the building envelope industry.

BCBEC has partnered with MediaEdge Publishing Inc.to assist in the development and publication of the first publication dedicated to the Building Envelope Industry in Western Canada and the Northwestern United States. Within *BCBEC Elements*, you'll not only find pertinent information on fenestration, wall systems, roofing, below grade waterproofing, moisture control, air/vapour barriers and thermal barriers, but also the latest information on code changes, new technologies, techniques and spotlights on industry leaders and innovation.

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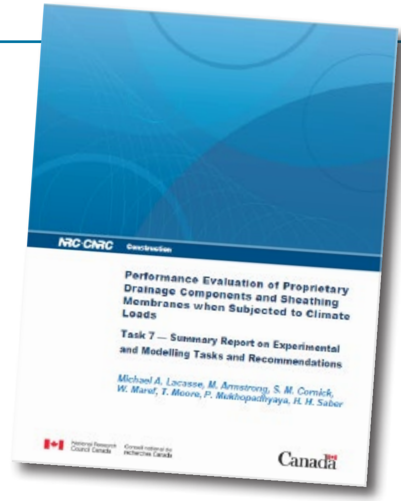
# Evaluating Alternative Solutions to Capillary Break Requirements




On Thursday, February 2, 2017, BCBEC and BC Housing presented *BUILDINGSMART with Safe and Durable Wall Assemblies,* a half-day workshop which showcased the latest research with practical solutions for building durable assemblies. Dr. Michael A. Lacasse, a building engineer and senior researcher at the Construction Portfolio of the National Research Council Canada (NRC), presented results on a number of research projects undertaken at the NRC.

The *Evaluation of proprietary drainage components and sheathing membranes* is a recently completed research project of particular interest to builders in the coastal climate of British Columbia. In these regions, the 2010 National Building Code of Canada (NBC; § 9.27 Cladding) requires a capillary break behind all Part 9 claddings. Currently, acceptable solutions to the NBC requirement for a capillary break include:

(a) A drained and vented air space not less than 10 mm deep behind the cladding;

(b) An open drainage material behind the cladding, not less than 10 mm thick and with a cross-sectional area that is not less than 80 per cent open;

(c) A cladding loosely fastened, with an open cross section (such as vinyl, aluminum siding);

(d) A masonry cavity wall or masonry veneer constructed according to § 9.20 (25 mm vented air space).

The multi-year project evaluated a number of proprietary systems and compared their performance to a reference wall assembly that meets the minimum code requirements. Two reference walls were evaluated (see Figure 1): one based on West Coast construction practices with a 10 mm clear cavity with stucco on paper-backed welded wire mesh, and the second based on East Coast practices which had stucco installed on an expanded galvanized metal lath installed over 19 mm strapping. Stucco cladding was chosen from allowable Part 9 claddings as the “worst case scenario” for water penetration. The reference wall configurations had the bottom of the drainage cavity open (i.e. vented).

FIGURE 1: VERTICAL SECTIONAL VIEWS OF WEST AND EAST COAST NBC-COMPLIANT SOLUTIONS FOR STUCCO INSTALLATION WITH CAPILLARY BREAK

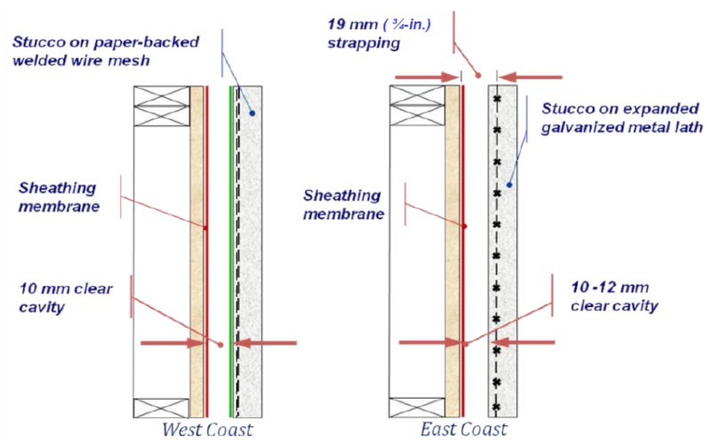



TABLE 1: CLIMATES OF DIFFERENT CANADIAN COASTAL LOCATIONS

| STATION | MI | Rainfall mm | Wind speed km/h | Heating Degree Days |
|---|---|---|---|---|
| Tofino, BC | 3.36 | 3257 | 10.6 | 3,120 |
| Port Hardy A., BC | 1.92 | 1808 | 11.4 | 3,440 |
| Abbotsford A., BC | 1.59 | 1508 | 8.8 | 2,832 |
| Vancouver, BC | 1.44 | 1155 | 11.8 | 2,818 |
| St. John’s, NL | 1.41 | 1191 | 23.3 | 4,755 |
| Halifax Int’l., NS | 1.49 | 1239 | 16.8 | 4,263 |
| Saint John A., NB | 1.27 | 1148 | 16.1 | 4,699 |

### CLIMATES CONSIDERED

The National Building Code requires capillary breaks in coastal areas that either have a Moisture Index (MI) above 0.9 in warmer climates (i.e. > 3400 heating degree-days) or with an MI above 1 for colder climates. The study considered three climate locations, two from British Columbia and one from Newfoundland:

- Tofino (Extreme coastal climate having MI = 3.4),
- Vancouver (West Coast climate – wet and mild; MI = 1.44), and;
- St. John's (East Coast climate – wet and cool; MI = 1.47).

For each of these three locations, three different years of climate data representing a typical wet (maximum), average (median), and dry (minimum) year were evaluated.

### METHODOLOGY

In this project, the hygrothermal performance of proposed alternative solutions for the capillary break was compared through laboratory evaluation and modelling activities using NRC's hygIRC-C numerical simulation model. The different drainage systems would be deemed an acceptable alternative solution provided they exhibited better or equal hygrothermal performance as compared to the NBC-compliant reference wall assembly. The performance criteria were based on the RHT index and the mould index.

**RHT Index:** Measurement of the risk of formation of mould on surfaces or wood rot of wood-based components given the relative humidity and temperature profile over a specified time period. The value of the index is the sum of the product of the relative humidity and temperature at specified values of relative humidity (e.g. 80, 92, 95, 97 per cent RH) and for temperatures of at least 5°C.

**Mould Index:** Rating system from 0 to 6, where 0 represents no mould growth and 6 indicates 100 per cent coverage of either heavy or tight mould growth. The start of the visual presence of mould on surfaces is given an index level value of 3.

RHT and mould indices are indicators of the risk to formation of mould based on temperature, relative humidity conditions and time; however, they do not predict the likelihood of occurrence. This would depend on several other factors that may affect the formation of mould.

Unless a client had specified installation with a "ventilated" cavity, the assemblies were vented (i.e. drainage cavity open at bottom of wall) as was done for the reference case. If the performance of a client wall assembly was found to be inadequate in comparison to the reference wall, other design options were evaluated in the simulations, including providing a "ventilated" cavity at the top of the wall drainage cavity, and "ventilated" at each two storeys or at each storey.

| Hygrothermal Properties |
|---|
| Density |
| Heat Capacity |
| Thermal Conductivity |
| Sorption Isotherm |
| Water Vapour Permeability |
| Water Absorption Coefficient |
| Air Permeability |

Several physical measurements on components were completed, which provided the basic seven hygrothermal properties of the wall system components that are inputs to NRC's hygrothermal model, hygIRC-C. The model was used to predict performance on the basis of the risk of moisture-related effects within wall assemblies subjected to different climatic conditions.

The hygIRC-C model simultaneously solved the highly nonlinear and coupled two-dimensional Heat, Air and Moisture (HAM) equations for both porous and non-porous wall components. The model has been extensively validated in a number of other projects for different building envelope systems and components (e.g. roofing, wall and fenestration systems). This project included two specific benchmarking exercises to verify assumptions specific to these wall assemblies, where experimental results were compared to modelling results.

As part of these benchmarking exercises, air flow experiments were conducted to evaluate the air flow occurring in the drainage cavity (see Figure 2). This permitted the characterization of air permeability of drainage components.

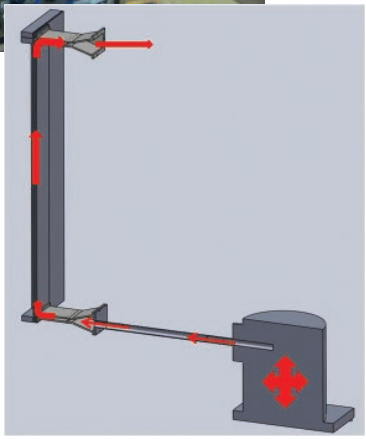


FIGURE 2: AIR FLOW EXPERIMENTS CONDUCTED TO CHARACTERIZE AIR PERMEABILITY OF DRAINAGE COMPONENTS.

## WALL ASSEMBLIES EVALUATED AND RESULTS

In Table 2 is a list of the different wall assemblies, whose hygrothermal performance was evaluated, together with some of their fabrication details, including a description of the drainage layer. Note that assemblies listed as Client J and Client K were funded by BC Housing and represent different construction practices used to meet the requirements for a capillary break given in the building code. Over half of the proprietary drainage systems tested matched or exceeded the performance of the reference wall, and four wall assemblies (A, D, G and I) did not provide adequate hygrothermal performance compared to the reference wall for at least some of the locations for which simulations were completed.

**R** – Reference wall; **V** – "Vented"; **VTD** – "Ventilated"; **BP** – Building paper conforming to CAN-CGSB 51.32; **SBPO** – Spun bonded polyolefin; **PP** – polypropylene; **HDPE** – high-density polyethylene; **PS** – polystyrene.

More information on all the different components of this project is provided in 10 research reports, published on the Air Barrier Association of America website at: www.airbarrier.org/library/index_e.php. The following is the title of each of these reports:

1. Task 1 – Wall Assembly Specifications
2. Task 2 – Building Component Hygrothermal Properties Characterization
3. Task 3 – Hygrothermal Model Benchmarking
4. Task 4 – Characterization of Air Flow Within Drainage Cavities and Drainage Components
5. Task 5 – Defining Exterior Climate Loads
6. Task 5 – Characterization of Water Entry, Retention and Drainage of Components
7. Task 6 – Hygrothermal Performance of NBC-Compliant Reference Walls for Selected Canadian Locations
8. Task 6 – Hygrothermal Performance of Client Wall Assemblies for Selected Canadian Locations
9. Task 6 – Hygrothermal Performance of Client Wall Assemblies: Results for wall components having Medium Resistant (MR) Mould Growth Sensitivity Class
10. Task 7 – Summary Report on Experimental and Modelling Tasks and Recommendations ■

TABLE 2: DESCRIPTION OF WALL ASSEMBLIES EVALUATED

| Assembly | Layer separating cladding from drainage layer | Drainage Layer | Sheathing membrane | Venting Strategy* |
|---|---|---|---|---|
| Reference (**R**) | None | Air space created by 19x38 mm wood strapping | 1 layer of **BP** | **V** at wall base every 3.5 storeys |
| Client A | **BP** ** | SBPO*** sheathing membrane | | **R** |
| Client B | **R** (none) | 10 mm air space created by 19 mm wood strapping: 76 mm water repellent insulation board | Fluid applied air barrier | **R** |
| Client C | **BP** | 10 mm open matrix nylon mesh matting bonded to PP† nonwoven sheathing membrane | | **R** |
| Client D | **BP** | Cross woven, micro-perforated polyolefin sheathing membrane with polyolefin coating | | **R** |
| Client E | PP† fabric (stucco screen) bonded to 11 mm HDPE‡ dimpled rain screen membrane | | **R** | Option 1: **R**<br>Option 2: $\mathbf{V}^{TD*}$ top & base every 2 storeys |
| Client F | **R** (none) | Nominal 25 mm Air space created by 20 ga. Z-ties | **R** | **R** |
| Client G | Non-woven PP† fabric (stucco screen) /bonder to 10 mm PP† 3-dimensional extruded mono-filament mesh | | **R** | **R** |
| Client H | **R** (none) | 52 mm porous PS†† insulation board | Fluid applied air barrier | **R** |
| Client I | **R** (none) | 3.8 mm corrugated 2 ply, corrugated asphalt impregnated drainage board (Grade D) § | **R** | $\mathbf{V}^{TD}$ top & base every storey |
| Client J | **BP** (Grade D)§ | Air space created by 9.5 mm (3/8 in.) plywood strapping | 2 layers of **BP** | **R** |
| Client K | **BP** (Grade D)§ | Air space created by 19 mm (3/4 in.) plywood strapping | 2 layers of **BP** | **R** |

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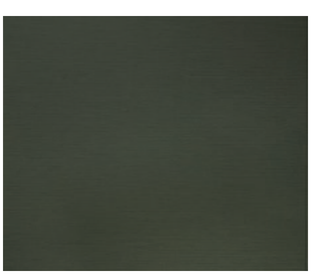
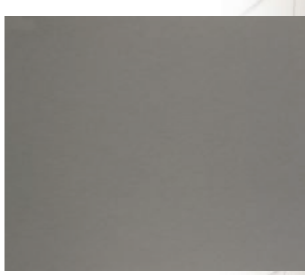


Zinc Quartz



Natural Zinc

Weathered Steel

NOTE: For more information about building with steel, please refer to the CSSBI publication on the structural integrity of steel building panels.

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# PEOPLE POWER:
## Q&A With Phalguni Mukhopadhyaya

By Matthew Bradford

Dr. Phalguni Mukhopadhyaya is a familiar face in the building science community. His research has sparked numerous building envelope advancements and his work at the University of Victoria is shaping the next generation of building science talents and technologies.

Mukhopadhyaya has built an impressive resume since completing his doctoral studies at the University of Sheffield's Civil Engineering department in the U.K. That resume includes years of experience as a civil engineer in India, a research engineer in the U.K., an EU research fellow in Germany, and a senior research officer with the National Research Council Canada (NRC). It also includes contributions to numerous universities and organizations, including Canada Wood (representing the Canadian forest industry), International Organization for Standardization (ISO), Underwriters' Laboratories of Canada (ULC) and the American Society for Testing Materials (ASTM).

Thanks to these efforts and more, Mukhopadhyaya has been recognized with a number of academic/industry-sponsored awards and accolades, including Construction Institute – American Society of Civil Engineers' (ASCE) Best Application Paper Award and prestigious editorships of three ASTM Special Technical Publications (STPs), among other achievements.

Today, Mukhopadhyaya continues his research as an associate professor of Civil Engineering at the University of Victoria. *BCBEC Elements* caught up with him between classes to learn more about his career and his current projects.

**BCBEC Elements: What is your industry focus and how has that guided your career?**

**Phalguni Mukhopadhyaya:** My area of specialization is moisture management and thermal insulation, particularly for building envelope constructions. The way I got into that is I started working for the National Research Council Canada (NRC) in Ottawa in 1999. At that time, the biggest issue bothering the construction industry was the leaky condo problem in British Columbia. NRC was leading a consortium of industry and other stakeholders to resolve that issue and I had the opportunity to meet with all these major construction industry stakeholders and help to develop moisture design guidelines that would not only address the leaky condo issue, but be applicable for all Canadian climates.

After finishing that initiative, I became more interested in thermal insulation because I realized that the energy efficiency of buildings would become a major issue in the coming decade or so. The industry was looking for high-performance thermal insulations, so I looked at insulations like aerogel and vacuum insulation panel (VIP), which were relatively unknown in the construction industry at that time.

There was also a rising interest in bio-based construction materials made from renewable sources. So, during my time with NRC, my team and I worked with various research organizations and industry stakeholders on bio-based foam insulations. I also did a few demonstration projects related to high performance thermal insulations in Ottawa; Ontario; and Whitehorse, Yukon, where we're still doing monitoring work today.

In 2015, I moved to British Columbia, and now I'm a professor at the University of Victoria where I continue to research energy-efficient buildings and more durable wood-frame constructions.

**BE: You also worked with Canada Wood?**

**PM:** Yes. After the B.C. leaky condo problem, and with the knowledge I gained from that issue, I worked with Canada Wood (representing the Canadian forest industry) in developing moisture design guidelines for China that would make wood-frame houses more durable and energy efficient. That's how I got into that aspect of the industry and it's something I continue to work on today.

**BE: What have been your proudest industry contributions to date?**

**PM:** There are a few things in my career that I believe have made true impacts in the industry. By working on that leaky condo problem, we developed a durability index that helped us analyze results and come up with design solutions. That durability index is something I was very proud to work on.

I'm also happy to have introduced the concept of vacuum insulation panels (VIPs) to Canada, as well as the concept of alternative core materials which can be used in VIP construction. I was the first researcher who published – along with my colleagues from NRC – the first technical paper on alternative core materials, which has since been picked up by a lot of people and helped bring down the cost of vacuum insulation panels significantly. For that, I was quite happy to be in the right place, in the right time, and with the right idea.

Lastly, I feel developing moisture design guidelines for China has had a profound effect in terms of increasing the export potential of wood from Canada to China.

**BE:** **What insights have you gained in your role as a professor?**

**PM:** I've only been a professor for just over two years, so my experience is certainly very limited. However, it's been a revelation to see how students look at the issues they're facing today. The industry has gone through a lot of change since I entered it. Back then we were more focused on solving the technical problems. Students today, though, are more conscious about the environmental and societal factors and integrating those considerations into construction.

That's a welcome change, and as teachers, we have a responsibility to support those aspirations. That's why when I was recruited to the university's Civil Engineering program, I contributed to the shift in vision for the department to reflect that environmental and societal focus. Now, it's known as the greenest Civil Engineering department, and that's something we're also proud of.

**BE:** **What are you working on now outside of the classroom?**

**PM:** As I mentioned, we did a few advanced thermal insulation demonstration projects in Yukon, and we are still monitoring them. The importance of the North is increasing day by day. For political and economic reasons, we have to be very quick to develop infrastructure up there, and that's what we're trying to do with our northern partners.

I am working with a B.C.-based industry partner, supported by the Natural Sciences and Engineering Research Council of Canada (NSERC) and B.C. Ministry of Energy and Mines, to develop low-cost high performance thermal insulations for building envelope applications.

**"PHALGUNI'S DEPTH OF KNOWLEDGE AND UNDERSTANDING OF PHYSICAL AND CHEMICAL PROCESSES IS INCREDIBLE. WHEN COUPLED WITH HIS VERY PERSONABLE NATURE, HIS CONTRIBUTION TO BUILDING SCIENCE KNOWLEDGE AND APPLICATIONS HAS BEEN TRULY SIGNIFICANT. I LEARN SOMETHING NEW EVERY TIME WE WORK TOGETHER."**

– DAVID KAYLL, PRINCIPAL, MORRISON HERSHFIELD AND PAST PRESIDENT, BCBEC

I'm also working on a project, supported by an industry partner and NSERC, which is looking at the durability of wood, and recently we signed a collaborative research project to review the performance of green buildings. There are green buildings that have been certified for the 5-10 years, so we'll be looking at their performance and finding out what has or has not worked. That will be great knowledge we can share to not only benefit ourselves but also the global community. ■

A RENDERING OF THE NANAIMO ABORIGINAL CENTRE HOUSING DEVELOPMENT, WHICH IS ADOPTING THE PASSIVE HOUSE STANDARD.

# STANDARD ISSUE

## B.C.'s myriad building standards in need of their own renovations

By James Peters

Rendering provided by DYS Architecture

Like much of the country, British Columbia's labyrinth of codes, standards and jurisdictional interpretations don't make things easy for builders, architects and tradespeople when it comes time to put hammer to nail. And during the planning stages for buildings of virtually any type, the morass of complicated, out-of-date and sometimes expensive-to-purchase standards slow down the process significantly – even bringing some construction projects to a halt.

At last glance, B.C.'s building code alone had hundreds of separate construction standards. Some may be inconsistent and require clarification, others may be out of date. Because of their inherent complexity, many industry players simply aren't familiar with or up-to-date on what's covered in the code – or other industry sources that provide standards as well.

### FOUR CATEGORIES

In most situations, building standards typically fall under four main categories: design, manufacturing, installation and performance. Each of these comes fully equipped with its own set of peccadillos: some standards cover only one of these categories, others cover several. For example, the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) is still considered the design bible for all things related to HVAC systems and technologies, as well as comfort, performance and, increasingly, building science issues. The ASHRAE handbook is a four-volume resource that updates one of its four tomes annually and is widely used by consulting engineers, mechanical contractors and government agencies – to name just a few. A few ASHRAE standards are referenced in Canadian codes.

But as architect Lucio Picciano, owner of DLP Architecture in Vancouver, points out, "One of the problems with ASHRAE's standards, especially for the layperson, is that you can't just look them up. It's a very expensive document and just to have one on hand is onerous. As architects we often rely on suppliers and consultants to interpret these standards for our clients and customers. So even though the expertise is there, much confusion and misunderstanding persists about which standards are the correct ones to apply on a particular job."

A sentiment echoed by Vancouver architect Richard Kadulski: "building standards are referenced in the codes and provide users with a third party benchmark. But many users, if not most, don't always have access to or fully appreciate what is covered by the standard. And that covers the spectrum – whether it's a standard that defines a level of performance, manufacturing or installation. Many users don't appreciate that there may be differences in how standards establish performance measures and other criteria within their scope or specialty."

He adds, "Most professionals may be familiar with at best a small number of standards – usually the few that might directly (relate to their expertise and the products they use)."

Picciano says, “Because our firm is relatively small and specialized, we get to work in several B.C. cities and municipalities and we see this every day. We do a lot of building envelope work on small-scale projects and have a good handle on how the different jurisdictions approach things. In the case of both building codes and Vancouver’s building bylaws, there have been some major changes. In the past there were never any performance standards when it came to energy efficiency in any building – so that’s now changed completely. And yet there is broad non-compliance with those standards, in my opinion. It’s almost pandemic. So we’re immersed in the frustrations.”

### PASSIVE AGGRESSIVE

In the last few decades, progressive architecture has seen a steady march toward designing and constructing buildings more energy efficiently with fewer environmental impacts and high degrees of comfort, particularly in B.C. Known as Passive House, this segment of the market continues to struggle with its more progressive standards versus much of the status quo.

The Passive House standard was developed in Europe, based on the work done in Canada in the late 1970s when the R-2000 new home program was launched. The focus at the time was on energy conservation – it set an energy consumption target for houses that was at least 50 per cent better than standard construction practices. One significant aspect was that it was prepared with the perspective of the building as a whole rather than simply a series of components. It was not just more insulation, but also whole building airtightness and testing, high efficiency mechanical systems as well as balanced ventilation with heat recovery.

The European Passive House Institute has evolved the performance standards so that they can be applied to any building size or type – not only to houses.

Mark Ashby, an architect in Nanaimo and Certified Passive House Designer (CPHD), says, “Because of this disparity, many of us in the passive building industry are creating our own standards, which tend to be more rigorous.” He adds, “A Passive House is simply an energy-efficient benchmark that is performance-based and sets hard limits on the amount of energy that can be used for heating and cooling as the total energy picture.”

Ashby also points out that many myths and misunderstandings continue to persist about Passive House standards. “Many people, including other architects, will tell you that passive buildings are unhealthy or stuffy because they have to be airtight. Not true. For one, these homes are required to have continuous mechanical ventilation, which is outlined in the current B.C. building code – a situation where the code and Passive House design are very much on the same page.”

Another pervasive passive building myth is that the homes are uncomfortable – again not the case. Under current passive building standards, designers have to consider thermal comfort. That criteria is spelled out under European ISO standards for humidity levels, so that air temperatures are not to be below 20C and not to exceed 25C. Temperature asymmetry is not permitted under passive building guidelines, so you actually end up with superior comfort.

As Ashby says, passive building standards are often quite different from other conventional standards in a few important respects.

## A PASSIVE HOUSE BUILDING CASE STUDY:

### Nanaimo Aboriginal Centre housing development

Crews have broken ground on the Nanaimo Aboriginal Centre housing project, which is adopting the Passive House standard. When complete, the 25-unit multi-family residence will offer affordable housing for youth, elders and families.

Funded by BC Housing, the complex is comprised of three blocks of ground-oriented suites situated around an open courtyard, “which enables all suites to have cross-ventilation and solar access,” according to Passive House Canada’s website. “The simplicity of the building systems reduces maintenance costs, and reduced energy consumption lowers the tenant’s monthly cost.”

Touting its many virtues, Ashby, who was the CPHD for the building, says, “I give a lot of credit to the design architects on this project, DYS Architecture from Vancouver, who did an excellent job of designing the building in a way that synthesizes the clients’ needs and cultural objectives with the structure’s energy efficiency objectives.”

He adds, “As is the case with most Passive House buildings, the energy efficiency requirements for this project relied on very accurate and detailed climate data, which includes info about solar resources and thus optimizing window criteria so that they’re providing beneficial heating in the winter. Just another example of how passive building standards are different than conventional codes.”

Owner: Nanaimo Aboriginal Centre
Project Manager: Walter Hoogland
Architect: DYS Architecture
CPHD: Mark Ashby Architecture
Construction Manager: Saywell Contracting
Mechanical: Design Air Systems
Electrical: Rocky Point Engineering
Structural: Herold Engineering
Landscape: Victoria Drakeford
Energy consultancy: RDH Building Science

For example, building performance is measured against a threshold of 15 kilowatt hours, per square metre, per year of energy – the standard for both space heating or cooling. “In addition,” Ashby says, “Passive buildings achieve energy efficiency through the passive performance of the building – so that building high quality envelopes is even more critical than with conventional structures. These standards are more rigorous than other energy-efficient standards, which tend to prioritize technical achievements such as energy-efficient heating and cooling systems or photovoltaics.”

“But the high performance standards required to qualify as a passive building aren’t necessarily in conflict with existing standards,” adds Kadulski. “Generally these standards and programs push the envelope beyond code requirements, which are the minimum that industry must meet. But building materials, systems and complete assemblies still must comply with code requirements.”

However, product standards developed by different organizations are not always directly comparable with others because the way they are prepared or what they measure differs. Some Passive House Institute standards differ from comparable CSA or ISO standards. The challenge for designers, specifiers and builders is to fully appreciate the differences.

#### LIGHT AT THE END OF THE TUNNEL?

Much like the law, the administration of construction standards appears to be a very large ship and changing course is no small matter. “There are jurisdictions in B.C. where the process has been streamlined and there is some progress on the horizon,” says Picciano. “The cities of Vancouver and North Vancouver, for example, are far more unified and consistent. In general, I think there’s been a lack of educating both the public and the staff working out of these jurisdictions, in terms of how building code changes should be implemented. There are some measures that will enforce some of the changes, such as B.C.’s *Building Act*, which will require a more consistent approach from all involved when it comes to implementing the standards across the province. I guess there’s always a learning curve, but many of the latest revisions came about more intensely, simply because it wasn’t just revising old codes but introducing much that is brand new in terms of energy efficiency and performance criteria.” ■


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# Should I be Concreting in Cold Weather?

By Jonathan Wong


When building with concrete in cold weather, guidelines in *ACI 306R-16* should be used to aid in the creation of durable concrete. ACI considers concreting in cold weather to be when the air temperature is below or is expected to fall below 4°C (40°F) before the concrete has gained adequate resistance to not be adversely affected by the cold weather, reaching the end of its protection period. A brief overview of the document is discussed below, outlining some considerations before deciding whether to continue concreting in cold weather or to wait for more favourable weather. The goal is to prevent damage to the concrete from early-age freezing and ensure the concrete gains the required strength through a combination of proper preparation, protection and mix design modifications.

### PREPARATION

Everyone involved with the handling of concrete, from the batching plant and delivery drivers to workers making preparations on-site, needs to be working together to produce concrete suitable for use in cold weather.

The batching plant needs to factor in aggregate conditions in the yard for the mixing temperature of the concrete. Considerations in delivery times are essential; substantial temperature loss during transportation can negatively affect the concrete. Site preparations (i.e. heating) to materials that come into contact with fresh concrete – such as formwork, reinforcement or large metallic embedment – and subgrade conditions need to be completed before concreting can begin. The site should have all the equipment ready to properly protect the concrete once it has been placed.

### PROTECTION

Protection of the concrete is critical to the concrete meeting compressive strength requirements. Concrete left unprotected can be considerably weaker due to issues such as bleed water freezing, an inability for the cement to hydrate, and thermal cracking. Once set, air-entrained concrete that has reached a minimum strength of 24.5 MPa is able to resist the effects of repeated freeze-thaw cycles. However, it is still best to protect the concrete until it has achieved the compressive strength of the mix design.

Insulation, heating systems and enclosures are used to protect the concrete until it develops enough strength to be exposed to the cold weather. Polystyrene foam sheets, urethane foam, insulation blankets and polyethylene sheets are used to insulate the concrete, allowing the heat produced from cement hydration or heating systems to keep the concrete at a minimum of 5°C to 13°C (40°F to 55°F), depending on section size. Corners and edges of the concrete are more susceptible to heat loss and need approximately three times the insulation. Do not, however, insulate more than required as chances of cracking from thermal shock and thermal shrinkage are increased by the higher internal temperature. The heating systems used should not dry out the surface of the concrete and should not expose the fresh concrete to excessive carbon dioxide emissions which will severely weaken the concrete surface. Enclosures are the most effective method to protect the concrete during cold weather; however, they are the most costly option and a combination of proper insulation and heating systems will typically suffice.

The period of protection required, roughly one to seven or more days, will depend on the type of loads the segment of concrete will incur and what environmental conditions it will be exposed to when the protection is removed. Generally, the greater the load and the more exposed to the concrete it is, the longer the concrete will need to be protected before it can be exposed to the cold weather. The process of removing the protection material also needs to be done gradually, as large temperature differentials in the concrete will increase the likelihood of cracking. During the protection period, the concrete should also be adequately cured. Water curing is not recommended when freezing temperatures are possible unless additional protection and precautions are taken. Curing compounds or impervious plastic sheets for concrete slabs should be used instead to prevent surface desiccation of the concrete.

### MIX DESIGN

Concrete with low water content and the lowest practical slump are ideal in cold weather concreting since it reduces the chances of excessive bleeding, leading to problems in finishing or freezing of the bleed water. Precautions need to be taken to protect the concrete if using accelerating admixtures, high early strength cement or extra cement to achieve sufficient strength. Large thermal gradients can occur from accelerating the rate of hydration as additional heat is produced, increasing the likelihood of cracking. It is also important to confirm the type of accelerator that will be used; chloride additives may not be tolerated and non-chloride accelerators should be used instead.

With all these considerations and more in *ACI 306R-16: Guide to Cold Weather Concreting*, is it economical and possible to abide by the guidelines and construct in cold weather? Or can the construction schedule wait or be delayed? Some thoughts before rushing into constructing in cold weather and ending up with concrete not meeting specifications. ■

*Jonathan Wong, B.Sc., is a Research Centre Technician at Kryton International.*

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## SEE YOU IN VANCOUVER!

# BCBEC FOUNDATION AWARDS PROFILE:

## Kelly Clark

By Matthew Bradford

In 2014, Kelly Clark was awarded a BCBEC Education Foundation scholarship of $1,500 towards her studies in the British Columbia Institute of Technology's (BCIT) Architectural and Building Technology program. Now, three years later, we caught up with Clark for an update on her career and a retrospective look at her involvement with BCBEC's student programs.

**BCBEC Elements: You graduated from BCIT's program in 2014. What then?**

**Kelly Clark:** After I graduated, I took the summer off to travel Eastern Europe. When I came back, I got a job at a building engineering firm that was then called Halsall Associates. I was doing property condition assessments, which is where we do high-level reviews of buildings and all their components like walls, windows, mechanical systems – everything. Part of my job was also capital planning, which is putting budgets together for a certain time frame for future repairs or renewals. Halsall was acquired by WSP just a couple months after I started, so now I work for WSP as a project manager.

**BE: What attracted you to the industry and, more specifically, your focus in building science?**

**KC:** Originally, I was interested in both sustainability and buildings, so when I was stuck in a job I didn't think was going anywhere, I started looking for ways to relate the two and found the BCIT program. I went into that because I thought it would be a good start. Right now, my job doesn't directly involve sustainability, but I really enjoy it and the company itself has sustainable values and teams that work on that specific aspect. Over the long term, I want to get back onto that path, but at the moment I like the work I'm doing with building engineering.

**BE: What role has BCBEC played in supporting your career?**

**KC:** Financially, the BCBEC Foundation Award was very helpful in getting my student loan paid off, which is a really big deal and something that a lot of people are struggling with these days. So that was greatly appreciated.

I also got a lot out of attending BCBEC's educational programs. When I was in school, BCBEC allowed students to attend their events for free and those gave me really good insights into the people of this industry and the types of things that happen in the real world. At school, you work on schematics and talk about theories, but the real world is always very different. It was just cool to be involved in the industry on that level and get the opportunity to learn more about building science. As for support for my career, I honestly think being part of the BCBEC network was 100 per cent responsible for getting me my first job. After I went to those events and met people in the industry, I was then able to go back to them later and use those connections to get a job.

**BE: What kind of events did you participate in with BCBEC as a student?**

**KC:** There were a lot, like monthly lunches where they have someone come in and present on a topic related to building science, or one-day conferences and the annual general meeting. They also sponsored a competition in our building science group. We picked our own topic, did a research project, and then BCBEC had experts come in to judge those projects and award small monetary prizes.

**BE: Do you see yourself giving back to that community down the road?**

**KC:** Absolutely. I would love to be in a position to help students in the same way one day. I know WSP takes on practicum students from BCIT as well, and that's really important because it's good to make them feel welcome in the industry. That attracts really good people, I think.

**BE: What advice would you give to students looking to get into the industry?**

**KC:** Get involved. Network. School is very important, but you need to get involved in the industry and make connections rather than focus solely on getting straight As. The point of technical school is to get a job, so take advantage of opportunities.

**BE: What's next for you?**

**KC:** I just started managing projects this January, which is a lot of fun and something I've never done before. It's also quite challenging, so over the next few years I want to lean into that and learn my role. As for my career, I really like teaching and educating. Thankfully, another role that will be open to me eventually is technical lead, which is specializing in the technical side of my specific area and training people. ■

## VANCOUVER LUNCHEON: CLT Firewall Penetration Performance

Wednesday, May 24, 2017, The Italian Cultural Centre
3075 Slocan Street, Vancouver, B.C., 12:00 p.m. - 2:00 p.m.

### About the Presenter:

**Conroy Lum, Research Leader,**
Advanced Building Systems, FPInnovations, Vancouver, B.C.

Conroy Lum is a structural engineer by training and oversees the work of the research groups on structural performance, durability, and sustainability in the Advanced Building Systems department of FPInnovations. His research contributions have been in the areas of developing methods for evaluating wood products and structural adhesives, and implementing such methods in standards to support product development and manufacturing.

### About the Topic: CLT Firewall Penetration Performance

The results and lessons learned from fire tests on Cross Laminated Timber (CLT) fire separations with closure (door) or service (pipe) penetrations will be presented. Building envelope design and construction considerations when a CLT firewall is used will also be discussed.

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