Self-Regulation • Seeking Feedback on Corporate Regulation • New Statement of Compliance for BC Pools

JOURNAL OF THE ASSOCIATION OF PROFESSIONAL ENGINEERS AND GEOSCIENTISTS OF BC

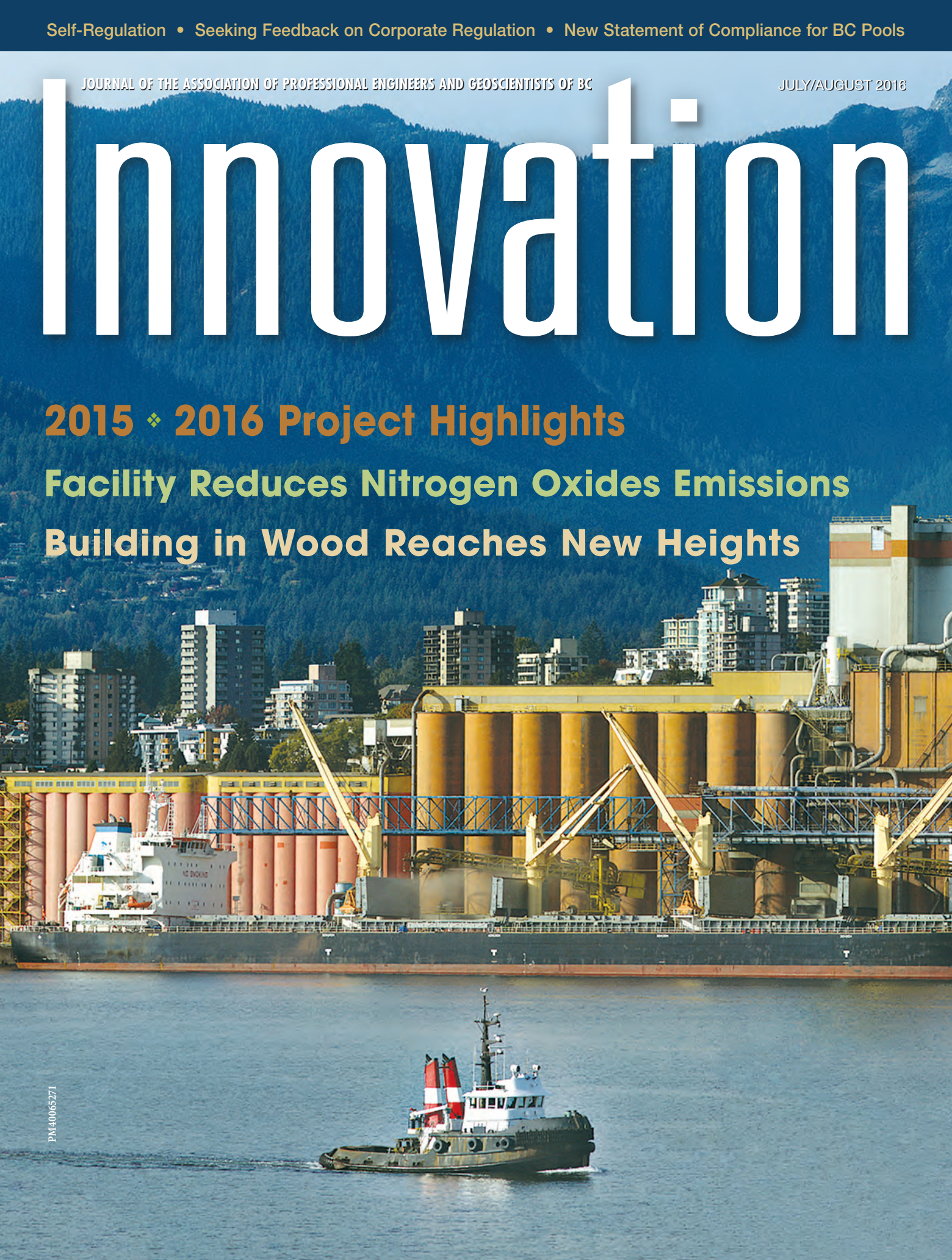
JULY/AUGUST 2016

Innovation

2015 ❖ 2016 Project Highlights

Facility Reduces Nitrogen Oxides Emissions

Building in Wood Reaches New Heights



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Abbotsford Senior Secondary: "A school to be proud of"

Known to locals as "Abby Senior," the new Abbotsford Senior Secondary School incorporates technology suggested by BC Hydro that has helped make it 33% more energy efficient than it might otherwise have been.

The old Abby Senior dated from 1952 and was "deteriorating rapidly," says Bob Mainman, Assistant Director of Facilities for School District No. 34 (Abbotsford). "It turned out that it was more economical to retain a few of the newer sections, two gyms and some classrooms, and build the rest new – and better. We had the opportunity to make the new school a school to be proud of, that the students would really like to come to every morning."

School District 34 also wanted the new Abby Secondary to be a model of how to build responsibly, sustainably and energy efficiently, even on a limited budget. With the help of an energy-modeling study funded by BC Hydro's New Construction Program, the District was able "to ask all of the 'what if" questions: what if we turn the building this way, what if we add triple glazing, what if we go to three storeys instead of two," says Rick Walker, in charge of energy management for the District.

The result is a building situated east-west to capture the most light and heat, with a stunning, three-storey, cast-in-place concrete, steel, glass and wood rotunda that provides natural "stack effect" ventilation. It also features increased roof and wall insulation, a heat recovery ventilator, and a wind and solar powered computer lab (if it's cloudy or calm, students pedal stationary bikes to generate electricity). The building's advanced, energy-efficient lighting systems – designed by Abbotsford's Jarvis Engineering Consultant's Ltd. – account for 33 per cent of the school's total electrical energy savings, but perhaps the most innovative energy conservation measure of all is an open loop ground source heat pump system that uses well water for year-round heating and cooling.

Making the new Abby Senior even more special: it was designed by Ryan Huston of Chilliwack's Craven Huston Powers Architects. Huston graduated from Abby Senior in 1975. 37 years later, he returned to design a beautiful new, sustainable school for generations to come.

Innovation

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ANDRITZ AUTOMATION's work on the Richardson Vancouver Grain Terminal expansion is featured in the 2015 ❖ 2016 Project Highlights, which showcases the work of APEGBC members during the last year.

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A full-scale mock-up of a two-storey section of UBC's new timber–hybrid high-rise student residence helped project engineers optimise final design details.

Professional Engineers and Geoscientists of BC

Self-Regulation Through Good Governance

Dr. Michael Wrinch, P.Eng., FEC
President

president@apeg.bc.ca

Self-regulation is a privilege and a responsibility. It is something that remains top of mind in my role as president of APEGBC. In the wake of the *Ordre des ingénieurs du Québec* and the Real Estate Council of BC (See page 10) recently losing self-regulation, it's worth reminding ourselves what it means for a profession to both self-regulate and to effectively govern to maintain that privilege.

APEGBC's objective is to protect the public interest through regulation of the practice of professional engineering and geoscience in the province. In a 2013 paper titled "Professional Self-Regulation and the Public Interest in Canada," Dr. Tracey L. Adams, sociology professor at Western University, states that advancing the public interest is achieved by:

1. Protecting the public from unqualified and incompetent practitioners, and
2. Developing mechanisms to ensure high quality of service is delivered.

Professional regulators achieve these ends through tools that include a code of ethics, minimum entrance requirements, practice reviews, practice guidelines, and a rigorous disciplinary system. These tools support the objective of protecting public interest. In addition, the public increasingly demands that professions continually demonstrate vigilance in protecting those interests.

What happens when professions forget their self-regulation purpose? We do not have to speculate, because several BC professions have lost the privilege of self-regulation in recent years. Teachers, private career colleges, and real estate are now regulated by government boards. As an example of what can contribute to loss of self-regulation, the independent advisory group charged with examining the BC real estate industry's regulatory framework reported "Each member of a self-regulating industry needs to be part of the compliance regime and report misconduct promptly," and "The independent advisory group found this culture is lacking in the real estate industry."

Losing the ability to self-regulate means a profession loses its ability to directly control its evolution, set standards, and maintain control over quality of service in the face of growing demands for greater consumer choice and increased economic efficiencies.

Governing APEGBC requires Council to make informed decisions for our members while also effectively communicating intent, so that mutual understanding and trust exist with the membership. Some choices Council makes are tough, but they are based on the best information available at the time, member consultation, and a test of "Is this in the public interest?"

Armed with the right information and communications tools, we can be effective as a Council. There are times when our decisions may conflict with the personal interests of some members, but ultimately we must protect the public interest by ensuring members perform to the highest standards of practice and ethics. We strive to strike a win–win balance between members' needs and the public interest.

To do this, we need to collaborate—with each other, with government, and with the public—and be forward thinking. By working together and being proactive, we can find and implement solutions that will serve public interest and the engineering and geoscience professions in BC long into the future.

JULY/AUGUST 2016 VOLUME 20 NUMBER 4

Innovation

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Submit letters up to 300 words to the editor, at innovation@apeg.bc.ca, by August 19 for the September/October edition. Letters are published as space is available. Opinions expressed are those of the authors, not necessarily of APEGBC.

Earthquake Preparedness at the Family Level

There is no question whatsoever that BC has some of the most competent academics, researchers and practitioners in the field of earthquake engineering and seismic design [Is BC Prepared for the Big One?, March/April 2016]. APEGBC engineers and geoscientists are recognized internationally for their skill and knowledge of seismicity, engineering seismology, and earthquake engineering design and analysis.

When it comes to earthquake preparedness, major resources are available in BC. One is the *Preparedness in a Day* workshop run by Emergency Management BC through its chapters and branches; for example, the North Shore Emergency Management Centre, in North Vancouver. I feel APEGBC members can help improve BC's earthquake preparedness at the individual and community level by attending such workshops with our families.

To help raise awareness and better retain the information shared, my family and I asked two other families to attend the May 7 North Vancouver workshop with us. Our families include four children between the ages of 11 and 20, and four parents—including a civil engineer and two geotechnical engineers with backgrounds in earthquake engineering. We organised our attendance long in advance and planned for it through a number of discussions.

The workshop will have lasting effect on us and our children, and our emergency preparations are now being fully implemented and maintained.

Despite our backgrounds, as parents we felt attending the workshop as families was the best way for us to leave a lasting impression on our children. They worked as a team to prepare themselves for the inevitable eventuality of the Big One—whether it happens in our lifetimes or not.

—Dr. Mahmoud Mahmoud, P.Eng., FEC
Vancouver, BC

In Memory of Dr. Neil Risebrough, P.Eng.

Anyone spending time with Neil Risebrough, P.Eng., soon realised he knew more about more topics than the average person. At the University of British Columbia, Neil was known as a great teacher and role model, a down-to-earth colleague and friend, and a reliable and experienced professional engineer.

Neil obtained his undergraduate and master's degrees in Applied Science (1960 and 1961) from the University of Toronto and his Ph.D. from UBC (1966). He remained in BC, raising his family, teaching in the UBC Faculty of

Engineering, and practicing engineering in his chosen field—metals and materials engineering—with Bacon Donaldson, which later became Canspec.

At UBC, Neil personally marked every exam taken by his students. He told them they had paid for their education, and he expected them to come to him after hours—even giving students his home phone number—if they needed help. Students in the Engineering Faculty awarded Neil the Gage Teaching Award in 1976 and made him an honorary president of the Engineering Undergraduate Society. As well, he received the Just Desserts award from the Alma Mater Society for his service to all students. Neil was respected as a teacher because he had more than academic knowledge. His work as a professional engineer allowed him to bring current examples of engineering into the classroom.

He specialised in failure analysis, and was often asked to provide expert witness in court. Neil's curiosity made him pursue the *why* and *how* of *what*. Along with academic subjects, he learned practical skills, such as plumbing, electrical wiring, and carpentry, and enjoyed long conversations with friends and family who had skilled trades knowledge. He read several newspapers a day for most of his life.

Neil Risebrough passed away from cancer in Richmond, BC, on January 10, 2016.

—Mary Risebrough
Richmond, BC

Three BC Members Made Geoscience Fellows

Geoscientists Canada has bestowed fellowships on three APEGBC members for service given to Canada's geoscience profession. The fellowships for Brendan Miller, P.Geo., FGC, Julie Orban, P.Geo., FGC, and Dr. Michael Wrinch, P.Eng., FEC, FGC (Hon.) (Shown, with 2015/2016 Geoscientists Canada President George Eynon, P.Geo., FGC), were announced in June at the 43rd annual meeting of Geoscientists Canada, in Calgary, Alberta.

The Geoscientists Canada Fellowship honours individuals who have given noteworthy service to the profession, through service to Geoscientists Canada, to one of the provincial and territorial regulatory bodies that are the constituent associations of Geoscientists Canada, or in another capacity.

Also at the meeting, Hendrik Falck, P.Geo. (NAPEG), FGC, took office as president of Geoscientists Canada for 2016/2017.

Geoscientists Canada is the national organisation of the nine provincial and territorial regulatory bodies that govern Canada's professional geoscientists and geoscientists-in-training.

Mission: ***Innovation***

As APEGBC's official publication, *Innovation* aims to publish information that is of interest and relevance to the professions, is balanced, objective and impartial, affects the conduct of members, and showcases innovative engineering and geoscience work of members. A secondary aim is to provide a forum for the exchange of views among APEGBC members through the publication of letters to the editor.

Regulatory Body for Quebec Engineers Placed under Trusteeship

Quebec's professional regulatory body for engineers, the *Ordre des Ingénieurs du Québec (OIQ)*, has had its powers of self-regulation revoked and has been placed under trusteeship of the provincial government.

Announced July 6, the move by Quebec's provincial government follows a recommendation from the *Office des Professions*, the authority that oversees the province's professional regulatory bodies. A press release issued by the Office states: "The Office believes that the effective delivery of activities of regulation of the profession and the financial stability of the OIQ are seriously affected, to the point of putting into question the capacity of the OIQ of carrying out its primary mission of public protection."

The OIQ has faced a number of internal challenges and financial difficulties in recent years. In 2014, two experts, Pierre Pilote and Dr. Yves Lamontage, were appointed by the *Office des Professions* to help the order address these issues and presented their recommendations in January 2015. In a report submitted in June 2016, the OIQ outlined how it intended to implement the recommendations. These were dismissed by Quebec's Justice Minister, Stéphanie Vallée, as "insufficient." She said that infighting and financial difficulties had made the OIQ unable to fulfill its primary responsibility of protecting the public.

Three administrators have been named by the government to work with the OIQ board to achieve a solution for governance of the order: professional engineer Michel Pigeon, lawyer Johanne Brodeur, and certified professional accountant François Renauld. The OIQ Board of Directors took office only recently.

A statement by the OIQ noted that it was "disappointed with this decision, which was made after a year of efforts and results in line with its mission of protecting the public. However, the OIQ respects it."

This development in Quebec, as well as the BC real estate industry's recent loss of self-regulation, has implications for professional regulatory bodies across the country.

"While OIQ operates in a different environment, issues of governance and public protection are resonant for APEGBC as the regulatory authority for engineering and geoscience in BC," said APEGBC President Dr. Michael Wrinch, P.Eng., FEC, FGC (Hon.). "Self-regulation is a privilege, not a right, and it is incumbent on us to remain vigilant and ensure we are acting to fully deliver on our duty to protect the public."

BC Real Estate Industry Loses Power to Self-Regulate

The BC government announced June 29 that it is ending self-regulation by the province's real estate industry, and is overhauling its governance, oversight and accountability.

"The point of regulation is to protect people," said Premier Christy Clark. "It is not a right. Self-regulation is very much a privilege. It's granted on behalf of the public by government to professions that say they can do the job and prove they can do the job."

Under the new framework, a dedicated superintendent of real estate will take over the Real Estate Council of British Columbia's regulation and rule-making authority to carry out the changes required to restore public confidence. Legislation is underway to provide the superintendent with the ability to enforce a comprehensive code of ethics and professional conduct for the industry, increase standards for licensees, and require record keeping and reporting that will help uncover industry practices that place consumers at risk.

The council itself will be revised to include a majority of public-interest, non-industry members.

The government's decision to end the industry's self-regulatory powers follows the release of a report by the independent advisory group charged this spring with examining the industry's regulatory framework. The report states, "Self-regulation is a privilege, not a right or entitlement. The profession or industry group must protect the public interest or risk losing that privilege, along with the confidence of government and the public." It provides 28 recommendations to improve real estate industry regulation and protect the public. The recommendations advise changes to requirements and processes that support public interest.

The government indicated that it accepts the recommendations

The loss of self-regulation by the province's real estate industry potentially has implications for all BC self-regulators. APEGBC will continue to follow this issue.

Access the report at apeg.bc.ca/BC-real-estate-reg-news.

Online Law and Ethics Seminar Goes Live this Summer

All applicants for registration as professional engineers, professional geoscientists or engineering and geoscience licensees in British Columbia must complete the Law and Ethics requirement.

APEGBC's new, online seminar will allow users to fulfill the Law and Ethics requirement for registration anywhere and at any time. Its 10 modules include videos, concise reading, case studies, knowledge tests, and activities for an engaging and accessible learning platform.

Until the online seminar is launched later this summer, applicants can meet the Law and Ethics requirement by purchasing and viewing the DVD version of the Law and Ethics seminar, from apeg.bc.ca/Resources/Online-Store/Products.

Share Your Feedback on Possible Regulation of Organisations

APEGBC is examining the issue of regulating engineering and geoscience organisations in BC, and seeks your feedback. The Advisory Task Force on Corporate Practice invites members to share their perspectives on regulating corporate practice in BC by submitting their feedback on an online form by August 28.

We are exploring this complex issue again to determine whether the association should pursue regulatory authority for corporate practice to enhance public protection. The issue is raised repeatedly by members and organisations that look to APEGBC to ensure practitioners and companies within various sectors meet the same quality assurance standards—particularly when major incidents involving engineering or geoscience occur in BC or elsewhere.

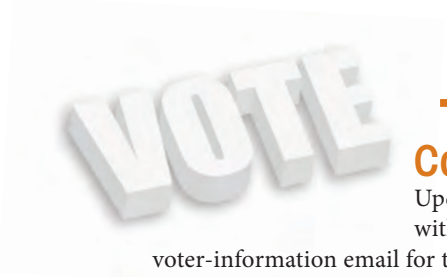
APEGBC seeks to fulfil its legislated duty of public protection, and this examination of corporate practice will help determine whether regulation of engineering and geoscience organisations would contribute to this goal in a meaningful way.

Council established an Advisory Task Force on Corporate Practice to guide the process of evaluation and member and stakeholder consultation. The task force comprises APEGBC members and industry representatives, including government, manufacturing, construction, the Association of Consulting Engineering Companies - BC (ACEC-BC), and others.

Feedback received by August 28 completes the first stage of consultation on the issue, and will be used to guide development and assessment of potential regulatory models for what corporate practice could look like in BC. The second stage of consultation, which begins this fall and includes a presentation at APEGBC's Annual Conference in Victoria, will focus on gathering more-detailed input on members' and stakeholders preferences for non-regulatory and regulatory options for corporate oversight.

After considering all input, the task force will make its recommendation to Council in 2017 whether to pursue regulatory authority over corporate practice in BC.

Find the survey at apeg.bc.ca/corporate-practice_Survey1. Questions, comments and requests for information can be directed to corporatepractice@apeg.bc.ca.



Cast Your Vote in the 2016 Council Election

Update your contact information with APEGBC to receive the voter-information email for this year's Council election. Voting will be conducted electronically, and members and licensees will be emailed candidate statements and voting instructions August 31. This information will also be available online, and paper ballots and hard copies of the candidate statements can be requested from the APEGBC office.

Voting opens August 31 and remains open until 12:00 PM NOON, PDT, Friday, October 7, 2016.

APEGBC members eligible to vote in Council elections include professional members (P.Eng. and P.Geo.) and engineering and geoscience licensees (Eng.L. and Geo.L.).

When logging into the APEGBC Member Portal to update your information, consider changing your password. Regular password changes help keep your information secure.

To update your information or change your password, log onto the member portal at apeg.bc.ca/update-info, or contact the APEGBC office at 604.430.8035 or toll-free 1.888.430.8035.

Submitting Motions at the Annual General Meeting

During APEGBC's 2016 annual general meeting on October 22, members can bring forward motions for Council's consideration. Motions may be proposed by registered professional members (P.Eng. or P.Geo.) or licensees (Eng.L. or Geo.L.).

APEGBC encourages members and licensees who wish to submit motions to do so by October 18. Advanced submission allows the association to address procedural issues with the proposed motions' movers before presentation at the AGM.

Members and licensees may also submit motions from the floor at the AGM. All motions must be received prior to the deadline approved by the assembly—usually 10:00 AM on the day of the AGM.

A motion's mover and seconder must both be present at the AGM to introduce their motion.

The AGM takes place Saturday (8:30 AM to 12:30 PM), October 22, 2016, at the Victoria Conference Centre, in Victoria, BC. At the meeting, APEGBC's president and CEO report on the association's activities of the past year, and the financial report is presented. Members will have opportunities to ask questions of Council about reported business and proposed motions.

For more information, visit apeg.bc.ca/agm.

Members Weigh in on Guidelines

In November, APEGBC asked members to participate in a survey on the association's guidelines. The first of its kind for APEGBC, the survey gathered baseline data from members relating to:

- awareness of APEGBC guidelines;
- awareness of professional obligations relating to the guidelines;
- guideline use; and
- guideline accessibility.

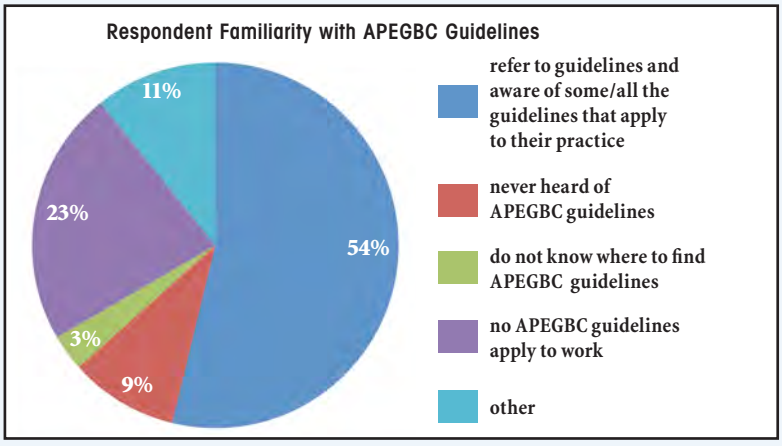
The survey was open for 29 days; 1,636 members responded.

The survey yielded valuable insights. Respondents identified content within the guidelines that they felt could benefit from greater clarity, made suggestions to improve ease of understanding for the guideline documents, and suggested future guidelines. Some members indicated they didn't want to see APEGBC create guidelines that already exist through federal or other provincial engineering regulators, or duplicate information that already exists within other municipal, provincial or federal standards, codes or bylaws. They also encouraged APEGBC to keep guideline documents concise for ease of use.

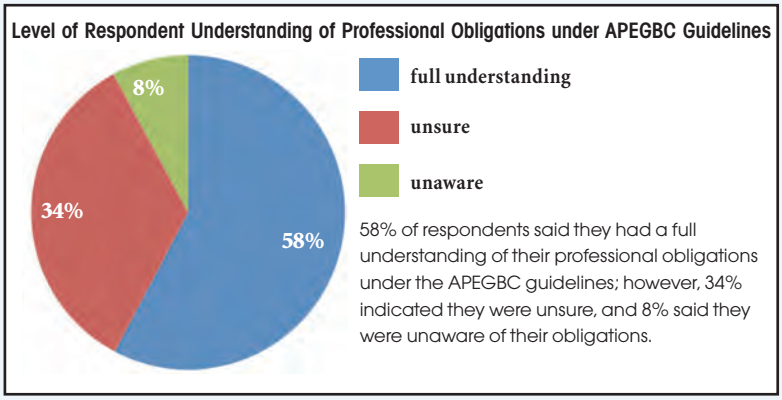
Next Steps

APEGBC staff are reviewing the survey's results and determining ways in which the findings can best inform the professional practice support provided to members. This may influence practice advice, guideline development, communication with members and educational opportunities. APEGBC is also exploring ways to address key findings around enhancing awareness of the guidelines and members' professional obligations, as well as improving members' access to the guidelines.

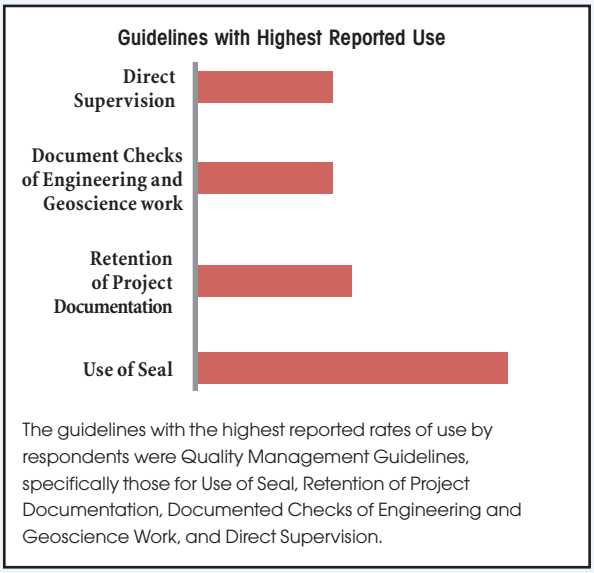
For survey results, visit apeg.bc.ca/news/guideline-survey-results. APEGBC guidelines can be found online at apeg.bc.ca/guidelines. For information about APEGBC guidelines, contact an engineering or geoscience practice advisor at practiceadvisor@apeg.bc.ca, 604.430.8035, or (toll-free) 1.888.430.8035.



LEFT: When asked to indicate their level of familiarity with the APEGBC guidelines, 54% of respondents said they refer to the guidelines and are aware of some or all of the guidelines that apply to their practice. The remaining 46% reported they do not refer to the guidelines in their work for various reasons.



58% of respondents said they had a full understanding of their professional obligations under the APEGBC guidelines; however, 34% indicated they were unsure, and 8% said they were unaware of their obligations.



The guidelines with the highest reported rates of use by respondents were Quality Management Guidelines, specifically those for Use of Seal, Retention of Project Documentation, Documented Checks of Engineering and Geoscience Work, and Direct Supervision.

New Guidelines to be Released this Summer

APEGBC typically produces new guidelines every year and updates its guidelines regularly to keep them relevant. This summer, look for new guidelines on Site Characterization Assessments for Dam Foundations in BC, Professional Responsibilities for the Design and Installation of Elevating Devices in New Buildings, and Expert Witness (SEE PAGE 51).

APEGBC's Council of elected members and government representatives meets throughout the year to conduct the business of association governance.

JUNE 17, 2016

Volunteer Guidelines Approved

A 2014 survey of APEGBC volunteers identified the need for a volunteer policy and procedure manual. As a part of the volunteer-orientation program currently being developed, a guideline document has been created to provide information on policies and procedures related to volunteers' involvement with APEGBC. This includes policies regarding harassment and violence, alcohol and drugs, confidentiality, and conflict of interest.

Council reviewed and approved the guidelines. Current and new volunteers will be asked to read and acknowledge acceptance of the policies and procedures, which will become a part of volunteer orientation. The guidelines will provide APEGBC volunteers with resources to support their involvement with the association, while supporting operations and good governance practices.

Discipline of Practice versus Discipline of Study Policy Updated

The Registration Committee has been examining the demonstration of engineering competencies as adequate proof that an academically qualified applicant whose discipline of practice is different than his or her discipline of study has the knowledge and competencies to practise.

Having piloted this approach since 2009, the Registration Committee requested that staff develop or revise policy to reflect this practice.

Council approved the resulting changes to the Policy on Applicants whose Discipline of Practice/Experience is Different than the Discipline of Academic Qualification.

Policy for Publication of Disciplinary Decisions Revised

Council approved revisions to the existing Policy on Publication of Disciplinary Decisions to allow APEGBC to publish the name of a member subject to discipline where some elements of the Notice of Inquiry have been proved or agreed to, instead of requiring that each individual element of the Notice of Inquiry be proved.

Human-induced Climate Change Position Paper Approved

APEGBC's Climate Change Advisory Group (CCAG) prepared a position paper on human-induced climate change.

Council approved the paper, pending final editorial and legal review before publication.

By establishing APEGBC's position on the causality of climate change, the association seeks to provide guidance for the provision of professional practice support to APEGBC professionals so they can meet their obligations under the *Engineers and Geoscientists Act* when carrying out professional activities related to climate change. An established position on this subject will also better enable APEGBC to provide input to various levels of government on the implications of climate action plans for engineering and geoscience practice in BC.

APPOINTMENTS

Building Codes Committee
Emilia Mazzonna, P.Eng.
Roz C. Nielsen, P.Eng.

Building Enclosure Committee
Robyn Edgar, P.Eng.
M.F. Sophie Mercier, P.Eng.
Christa E. Wilcock, P.Eng.
Michael J. Wilson, P.Eng.

Council Election Scrutineers
Paul Blanchard, P.Eng., FEC, FGC (Hon.)
Kathleen Kompauer, P.Eng., FEC, FGC (Hon.)
Dennis McJunkin, P.Eng., FEC, FGC (Hon.)

Discipline Committee
Thomas Leung, P.Eng., Struct. Eng., FEC
Oliver Bonham, P.Geo., FGC

Editorial Board
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Organizational Quality Management Committee
William Hughes, P.Eng.

Practice Review Committee
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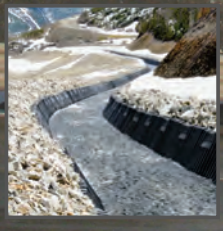


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Dr. Solomon Tesfamariam, P.Eng.

Past

The *National Building Code of Canada* places strict height limits on combustible wood-frame buildings in Canada. Over time, the code has changed to accommodate new research, materials and technologies that improve the structural and life-safety performance of wood-frame buildings and building systems. In 1990, it increased the maximum allowable height for residential (Group C) wood-frame buildings construction from three to four storeys and, in 1995, extended the increase to four storeys to include many office, retail and commercial buildings (groups D and E). The 2015 *National Building Code* and *National Fire Code* now permit construction of six-storey buildings using traditional combustible materials, with size and construction limitations for group C and D buildings.

However, concerns about fire, acoustics, building-envelope performance and other life-safety issues in tall buildings can be addressed by using other, alternative wood-construction techniques. Taller buildings have been and are being built in many places.

Present

In 2009, British Columbia led the way to allow light-frame wood construction for residential buildings of up to six storeys in its provincial building code. Quebec followed suit in 2014—and now allows wood buildings up to 12 storeys. Alberta and Ontario have also revised their building codes to allow six-storey wood buildings. In early 2015, about 150 mid-rise wood-building projects were being undertaken in BC. The six-storey limit is realistic for typical stick-frame construction using, for example, two-by-four-inch stud walls, joists and beams, as shown in recent shake table tests in the US and Japan.

The trend for increasing use of timber in residential and office buildings can be seen around the world. In 2010, Japan announced a law to promote the use of wood. One aim of the law was to facilitate timber-based structures in public low-rise buildings.

The global trend has also been to increase allowable wood-frame and timber–hybrid building heights. FPInnovations, a research and development agency that advances Canada's forest-sector competitiveness, has conducted research in Sweden, Norway and France into eight-storey wood-frame buildings that use cross-laminated timber technologies. In the UK, where a performance-based design approach to wood buildings applies in place of height restrictions, a nine-story wood-frame residential building was completed in 2008—the tallest such building at the time. Melbourne, Australia, has a 10-storey wood building, constructed in 2012. Jurisdictions in the US, including Seattle and Portland, are also building taller wood-frame–hybrid structures.

Future

A number of alternative solutions that permit increases from mid- to high-rise heights have been identified. For example, use of modern mass timber products such as glued laminated timber, cross-laminated timber and structural composite lumber has been identified as a viable approach to safely increase the height of wood buildings.

Timber-based hybrid buildings have also been identified as viable structural forms. Hybrid buildings combine steel, reinforced concrete, and wood into structural components and systems. The hybrid materials can be integrated at the component level, as hybrid slabs or diaphragms, hybrid beams, hybrid columns, hybrid diagonals, and hybrid shear walls, and at the building-system level, as hybrid shear wall systems, tube systems, or vertical mixed systems.

The University of British Columbia has been a leader in promoting wood-only and timber–hybrid buildings. A number of recently constructed buildings at the Vancouver and

A six-storey cross-laminated timber building (Left; Connection details, Right) tested at Japan's E-Defense shake-table facility.

Left: A University of British Columbia- and FPInnovations-designed timber–steel hybrid building.

Right: A shake-table test showed deformation and energy dissipation of the timber frame of a hybrid building were governed by the inelastic deformation of the connections.

Okanagan campuses, including the 18-storey student residence being built this year (See page 17), are examples. The university also leads in research into effective use of wood in mid- and high-rise buildings.

For example, at the university, we collaborated with FPInnovations to develop a hybrid structure that incorporates cross-laminated timber infill shear panels within steel moment resisting frames. The project included development and analytical validation of a number of tests, models and methods to measure the building's structural and life-safety performance. Tests assessed the connections between the wood-based panels and steel frames, and novel tube-type connections to eliminate damage in the timber, an iterative direct displacement-based design method, and a force-based design guideline for the building were developed. The results indicate how effective the proposed hybrid building would be, as well as improvements in its seismic performance.

Such research into structural and life-safety building performance and building systems—undertaken in BC and elsewhere—is key to laying sound foundations of evidence and information on which building code amendments and revisions are based. As alternative construction techniques, wood-based materials, and new technologies are developed and shown to perform to code standard, the ceilings on maximum allowable heights of wood-frame and timber–hybrid buildings will rise. ⊠

For the last six years, Dr. Tesfamariam, P.Eng., has led the development of timber-based hybrid structures at the School of Engineering, University of British Columbia, Okanagan. The work is supported through NEWBuildS—a multi-disciplinary NSERC strategic research network for engineered wood-based building systems—and Forestry Innovation Investment. His research interests include protecting civil infrastructure and structural systems from hazards.

Dr. Tesfamariam presents at APEGBC's 2016 Annual Conference, October 20–21, in Victoria, BC. His session will include research and modelling results for the hybrid building discussed here.

New Heights in Wood Construction

The UBC Brock Commons Student Residence Building

Duane Palibroda, P.Eng., Struct.Eng., Bernhard Gafner, P.Eng., Robert Jackson, EIT

Brock Commons is an 18-storey mass timber–hybrid student residence under construction at the University of British Columbia, in Vancouver, Canada. When completed in 2017, it will be the tallest mass timber–hybrid building in the world, at 53 metres high. Fast+Epp are the structural engineers, working in conjunction with Acton Ostry Architects and Architekten Hermann Kaufmann. Total project cost, including fees, permits, and so on, is $51.5 million.

The structure comprises 16 floors of five-ply cross-laminated timber (CLT) floor panels, a concrete transfer slab at Level 2, and a steel-framed roof. The CLT panels are point supported on glued laminated timber (glulam) columns at a 2.85-metre x 4.0-metre grid. Beams were eliminated from the design by using CLT's two-way spanning capabilities. Two full-height concrete cores, which provide lateral stability, complete the structure.

Project Background

The University of British Columbia has experienced increasing demand for student housing and has a sustainability commitment to a campus that acts as a "living laboratory" where innovation is encouraged, not only in academia, but also in building and infrastructure. Pairing this drive with the potential for external funding related to mass timber research, the project was born.

The key goals of the project were to create a safe, functional, sustainable, and cost-effective residence for students. Delivering a mass timber building with a construction cost that aligned with the unit cost of a comparable traditional concrete tower in Vancouver was an important goal to demonstrate the viability of wood as practical material for tall-building applications.

To facilitate this effort, UBC Properties Trust assembled an integrated design team. The construction manager was appointed, and the timber installer and concrete trades joined the team in a design-assist role, providing real-time feedback on the evolving structural design and offering valuable constructability advice.

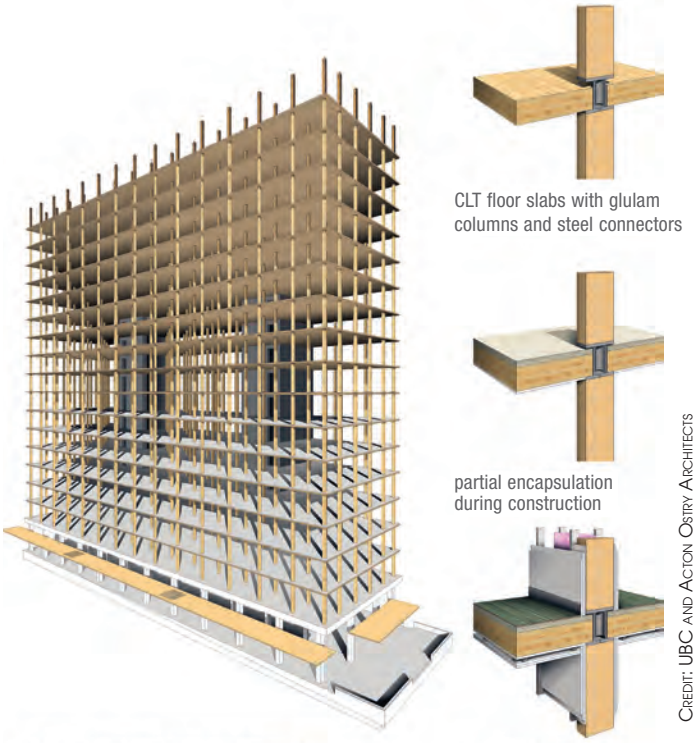
With the aggressive budget and timeline in mind, construction began in November 2015, 11 months after the design team was assembled.

Structural System

The design intent was to keep the structure simple and sensible—to develop a prefabricated "kit-of-parts" that could be installed quickly and easily, with minimal labour on site. Materials were used where they made sense.

Cross-laminated timber is often used as a one-way decking system, ignoring the two-way spanning capability afforded by its cross laminations. By using CLT to span in both directions, the design team was able to eliminate beams, significantly reducing the overall structural depth. This created a clean, flat, point-supported surface that allowed for unobstructed service distribution, as is commonly found in flat-plate concrete construction. Furthermore, by adjusting the column grid and architectural program to suit the maximum available panel size, the team was able to both minimise the overall number of panels—and therefore the number of crane picks—maximise structural efficiency, and reduce waste.

The primary lateral support for earthquake and wind loading is provided by two concrete cores. Although timber-based lateral force-resisting systems such as CLT walls and cores, timber-braced frames, or post-tensioned/self-centering systems were feasible design options for this project, the testing, time, and costs required to obtain regulatory approvals would have increased costs and delayed the completion date.



Design Challenges

With this level of innovation, several key design challenges needed to be resolved. These are discussed below.

Codes and Standards

The current *British Columbia Building Code* (BCBC 2012) limits the height of wood buildings to six storeys. As such, a special approvals process was required for this project. The design is based on a site specific regulation (SSR), administered by the BC Building Safety and Standards Branch and is applicable only to this project and site.

One specific requirement of the SSR was that the building be designed according to the not-yet-adopted *2015 National Building Code of Canada* rather than the prevailing BCBC 2012. The main impact of this requirement was an increase in the applicable seismic acceleration values, which are about 50 percent higher than those associated with the current code.

Due to the complexity of the project, two independent structural peer reviews were completed. The first independent review was timber focused, and was completed by Merz Kley Partner ZT GmbH, Dornbirn, Austria. The second review was

Organizational Quality Management

To successfully deliver innovative projects of this type, within the stringent design timeline, tight project controls are essential. Fast+Epp's Organizational Quality Management- (OQM-) certified quality-control procedures, which extend from project conception to completion, allowed engineers to stay organised and on-track throughout the design phase and into construction.

In the firm's experience, having tight quality-control procedures is particularly important for projects with aggressive schedules. APEGBC's OQM-certification process bolstered the firm's existing organizational management and checking procedures, creating lean, efficient, and easy-to-use tools.

Point-supported cross-laminated timber panel testing apparatus and failure

completed by Read Jones Christoffersen Consulting Engineers, Vancouver. In addition, Fast+Epp undertook an in-house structural review in accordance with its organisational quality management policies.

Prefabrication

Prefabrication is an essential consideration when designing large-scale wood structures. Well-planned erection and shop drawings are vital to ensuring smooth production and installation of timber elements. This results in fewer errors onsite, less remedial work, and a shorter overall construction schedule. All CLT and glulam elements were CNC (computer numerical control) machined with quality-control protocols to better ensure seamless erection of the timber superstructure.

To help achieve a high level of prefabrication for all design disciplines, CadMakers, a third-party consultant, modelled the building and helped coordinate design documents prior to and during construction. The three-dimensional model, created with CATIA software, includes fully detailed structural elements and connections, as well as mechanical/electrical systems and architectural fit-outs. The model allowed all CLT penetrations for mechanical and electrical sleeves to be fully coordinated during the design process and their conversion into fabrication files (CAD/CAM) needed for CNC machining.

Thorough quality-control measures were critical with this level of prefabrication, because more up-front information and documentation were required than with a typical project.

Point-supported Cross-laminated Timber

In addition to stiffness and bending requirements, rolling shear stresses at the supports are typically a controlling factor in two-way, point-supported CLT floor plates. A rolling shear failure is one in which the fibres "roll over" each other, due to shear forces that are perpendicular to wood grain. After designing the custom layup to suit the rolling shear and flexural demands, the design team completed 18 full-scale load tests on panels from three prospective CLT suppliers at the Vancouver FPInnovations laboratory to validate the analysis. Based on this testing, rolling shear capacities were found to be higher than published.

Column Shortening and Shrinkage

In tall wood buildings, axial column shortening needs to be considered during design. When properly accounted for, the shortening should not negatively affect the construction, use, or long-term performance of the building.

Several factors affect glulam column shortening:

- Dead load elastic axial shortening ($\Delta = PL/AE$)
- Live load elastic axial shortening ($\Delta = PL/AE$)
- Shrinkage parallel to grain
- Joint settlement
- Column length tolerances
- Wood creep

The main concerns regarding these shortening effects are the impact of the deformations on the vertical mechanical services, and the differential movement between the wood superstructure and the stiff concrete cores. The effects of these factors culminate at the roof level, where all columns below contribute to the shortening.

To mitigate some of these effects, a series of 1.6-millimetre-thick steel shim plates are being added during construction, on three strategic levels, at the column-to-column connections.

The 18-storey cores were constructed before installation of the building's timber and envelope began in June 2016.

Construction Tolerances and Sequencing

A carefully detailed structural system that accounts for construction tolerances can greatly reduce the risk of on-site issues causing delays and undue costs to the owner.

All material interfaces were identified and evaluated with regards to their material standard tolerance compatibilities. Where required, the design details and project specifications were adjusted to overcome discrepancies. Additionally, quality-control requirements were outlined in the specifications for all CLT and glulam elements.

In order to facilitate the use of one crane and provide sufficient time for manufacturing and shipping of the heavy timber elements, the construction team erected the concrete cores before the wood arrived onsite (Left).

When the timber-and-envelope stage began, the team began installing 22 large pre-fabricated envelope segments at each level, in parallel with the timber. This sequencing ensures weather protection at each floor, allowing building fit-outs to begin immediately.

Concept Mock-up

To validate the proposed design's constructability, the construction team constructed a full-scale mock-up of a portion of the building, 8 metres x 12 metres in plan and two storeys tall. The mock-up included several connection types to help determine and optimise the details used in the final design. In addition, the mock-up was used for development and evaluation of building-envelope systems considered for the project.

Conclusion

A mass timber building of this scale carries a unique set of engineering and management challenges, many of which can be mitigated through the use of innovative design strategies and strong quality-control protocols. To date, the project's cost has been competitive with that of concrete towers in the local marketplace—largely due to an integrated design team, real-time input from trades, and structural discipline. ⊠

***Duane Palibroda**, P.Eng, Struct.Eng., is Managing Principal at Fast+Epp Structural Engineers, and contributes more than 25 years of experience as project leader on key projects.*

***Bernhard Gafner**, P.Eng, is an Associate at Fast+Epp Structural Engineers. He is project manager and design lead on the UBC project.*

***Robert Jackson**, EIT, is a project engineer at Fast+Epp Structural Engineers and is heavily involved in the design and construction of UBC Brock Commons.*

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In 2015, Metro Vancouver completed a Nitrogen Oxides (NO_x) Reduction Project at the Metro Vancouver Waste-to-Energy Facility for a cost of $5.4 million. This project decreased NO_x emissions by more than half and included two main components. The first, which involved physical modifications to the combustion air system and combustion monitoring and controls, introduced a Low NO_x (LN™) process, a proprietary process developed by Covanta Energy to substantially reduce NO_x formation. The second main component involved upgrading the selective non-catalytic reduction (SNCR) system, which reduces NO_x by supplying additional ammonia to the furnace in a spray pattern that supports a more complete chemical reaction.

Clearing the Air

Project Reduces Waste-to-Energy Facility's Nitrogen Oxides Emissions

Chris Allan, P.Eng.


New tertiary air ports

Project Drivers

Metro Vancouver delivers regional services, policy and political leadership on behalf of 22 municipalities, one electoral area, and one treaty First Nation. One of the regional services provided is the disposal of municipal solid waste.

The waste-to-energy facility in Burnaby, BC, was commissioned in March 1988, and is an essential part of the region's solid waste disposal network, managing approximately 30 percent of the region's commercial and residential waste. The facility manages garbage in an environmentally safe manner and generates valuable, renewable energy sources: steam and electricity.

The facility cost approximately $70 million to construct over 2.5 years under a design/build/operate (DBO) contract. It is owned by Metro Vancouver and operated by Covanta Burnaby Renewable Energy, ULC. When the facility was constructed, Metro Vancouver publicly committed to continually working to improve the equipment's environmental performance through investigation of new technologies and improved methods of operation. Metro Vancouver's *Air Quality Management Plan* (2005) contains an objective to reduce NO_x levels in the region's airshed, including reducing point source emissions. The waste-to-energy facility was identified as a point source generating 0.8 percent of NO_x in the region.

In addition, in 2011, the British Columbia Ministry of Environment's new *Guideline for Emissions from Municipal Solid Waste Combustion* lowered the NO_x guidelines from 350 mg/m³ to 190 mg/m³. This value has since been adopted into a draft operational certificate for the waste-to-energy facility, which the Ministry of Environment has indicated it will finalise.

Why Target NO_x?

Nitrogen oxides, comprising primarily nitric oxide (NO) and nitrogen dioxide (NO_2), are formed during combustion in the presence of air. Nitrogen oxides are a precursor to ozone, secondary particulate matter, and acid rain. Ozone and particulate matter are the key air pollutants of concern in Metro Vancouver, with a broad range of health effects. Precursor reductions are key goals of Metro Vancouver's Integrated Air Quality and Greenhouse Gas Management Plan and the new multi-agency Regional Ground Level Ozone Strategy.

NO_x Reduction Project Components

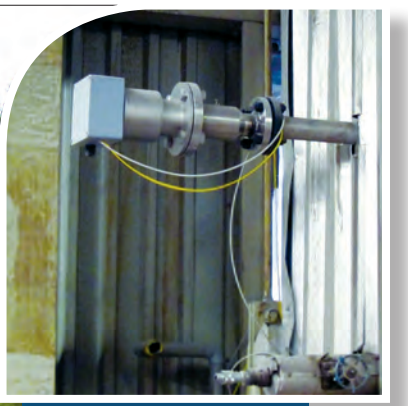
Combustion Air Modifications

Municipal waste combustors typically employ a moving grate with two major sources of combustion air. Primary, or underfire, air is supplied through plenums located under the grate, and is forced through the grate to dry and combust the waste. The quantity of primary air is adjusted to minimise excess air while maximising burnout of carbonaceous materials in the waste bed.

Secondary, or overfire, air is injected through nozzles located in the furnace waterwalls immediately above the grate, and provides turbulent mixing to complete the combustion process. Secondary air provides the majority of the excess air to the combustion process, which typically ranges from 60 to 100 percent in municipal waste combustors.

The LN™ process now included in the Metro Vancouver facility introduces a third source of combustion air: a portion of the secondary air stream is redirected to a series of tertiary nozzles that are installed in the furnace waterwalls at a higher elevation, but the total air flow within the system remains the same. The distribution of air between the primary, secondary and tertiary streams is controlled to yield optimal gas composition and temperature to minimise NO_x and to control combustion.

The design of the tertiary air nozzles and their positioning in the furnace are critical to the LN™ process performance. The tertiary air achieves complete coverage of the furnace cross-section to ensure good mixing with the combustion gases. It completes the combustion



Left: Addition of a second ammonia storage tank increases ammonia storage and supply.

Inset: Ammonia detector measures and controls ammonia slip.

process and yields uniform flue-gas temperature and velocity profiles, which improves the performance and reliability of downstream boiler equipment.

Integration with SNCR

At the waste-to-energy facility, the LN™ process was combined with an upgrade of the SNCR system to further reduce NO_x emissions and enhance the performance of the SNCR system. Upgrades to the SNCR system included increased ammonia storage, better mixing, and the ability to supply additional ammonia to the LN™ process.

Other System Enhancements

Combustion-Control System Modifications and Enhancements

Modifications to combustion controls were made to integrate the combustion system and LN™ system. The modifications included control logic changes, process observation and tuning, and operator training to maximise the potential gains from the system.

Boiler Protection

Because the LN™ process diverts a portion of secondary air to a new tertiary level higher up in the furnace, a larger zone within the furnace is subject to high temperatures and low oxygen. While this larger high-temperature zone reduces NO_x emissions, the system experiences more wear. This is mitigated at the Metro Vancouver facility by using back-cast tile mortar, which is more resistant to deterioration in the highest-temperature regions.

Performance Summary

Following start-up of the upgraded SNCR system in the fall of 2014, the NO_x Reduction Project was fully commissioned on April 1, 2015, and NO_x emission levels have been reduced to less than 135 mg/m³. This new operating level is more than 60 percent lower the current limit of 350 mg/m³, 29 percent below the limit of 190 mg/m³ in the draft operational certificate, and more than 50 percent lower than the 2013 average of 281 mg/m³. Prior to the NO_x Reduction Project, the facility was producing approximately 0.8 percent of the NO_x emissions in the region. Now it produces only 0.4 percent of those emissions. ⊠

Chris Allan, P.Eng., is a Lead Senior Engineer in Metro Vancouver's Solid Waste Services Department. He has worked in the waste-to-energy field for more than 15 years.

2015 ❖ 2016 Project Highlights

The 2015 ❖ 2016 Project Highlights showcase recent engineering and geoscience work by APEGBC members, in BC and elsewhere. *Innovation* thanks those who submitted project photographs and descriptions for consideration.

Audain Art Museum Stands Above the Floods

The Audain Art Museum houses an impressive collection of BC art. Because the 56,000-square-foot building sits on a forested site within the Fitzsimmons Creek floodway in Whistler, BC, the architectural design could not proceed until the debris flood hazard risk was determined to be acceptable.

Kerr Wood Leidal Associates was retained to assess the debris flood hazard and risk and to design flood-proofing measures for the site. The building is designed to withstand a 1-in-2,500-year debris flood event, and is elevated one storey above ground on a series of piers, with only about 10 percent of the footprint touching the ground. Debris floods would pass *under* the museum, thereby protecting the building, its precious collection, and visitors.

Consultants: Kerr Wood Leidal Associates Ltd. (flood protection); Thurber Engineering Ltd. (geohazard review); Equilibrium Consulting (structural); Creus Engineering Ltd. (civil); Spratt Emanuel Engineering Ltd. (building envelope); Integral Group (mechanical/electrical/LEED); LMDG Building Code Consultants Ltd. (building code)

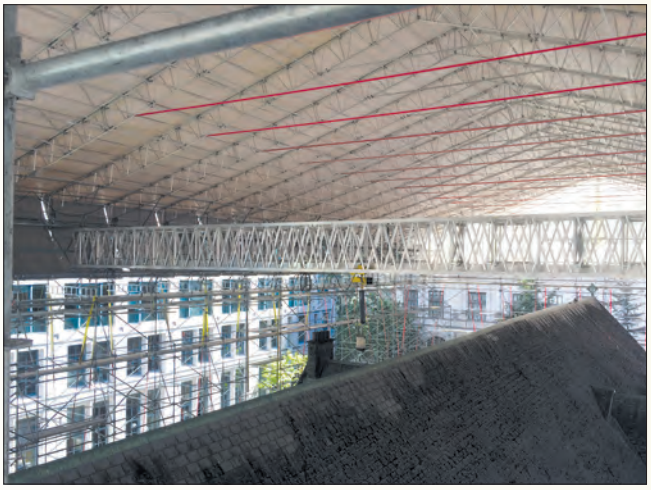
Rendering, Courtesy of Patkau Architects

Tomamu Cloudwalk Immerses Visitors in a Sea of Clouds

Hoshino Resorts is a Japanese-based international operator of *ryokan* (Japanese inns). In 2014, Hoshino Resorts was looking for a companion enhancement to their successful Unkai Terrace property. The structure they envisioned would provide visitors with the opportunity to experience an open-air walkway and immerse themselves in the spectacular cloud phenomenon known affectionately in Japan as *unkai*—the sea of clouds.

ISL Engineering and Land Services joined Macdonald & Lawrence Timber Framing to design an Alaskan yellow-cedar structure that invokes the vision and aesthetic of touching the clouds—the Tomamu Cloudwalk. The efficient and cost-effective design aligns with the sustainable ideals of the client, was built to withstand high wind, snow, and earthquake conditions, and creates an architectural piece that blends organically into the landscape.

APEGBC members, Cascade Engineering Group: Robin Zirnhelt, P. Eng.; Ryzuk Geotechnical: Shane Moore, P. Geo.



Re-roofing Vancouver's Christ Church Cathedral

Scott Construction team members have been involved with the renovation and restoration of Vancouver, BC's historic Christ Church Cathedral. In 1994, the Anglican parish launched a plan to renovate, restore, and strengthen the building. The plan's final phase involves replacing the roof with a standing seam zinc roof expected to last more than 100 years.

To protect the building's interior during construction, a temporary structure was built over the cathedral at nearly the cost of a 29,000-square-foot pre-engineered building. The structure incorporates a single girder gantry crane with a 28-metre clear span to transfer materials to the building's street side. The crane's Apollo beam has a measured deflection at the centre of 13.4 millimetres under a 125 percent load of 570 kilograms—less than 0.5 percent. This application is the first of its kind in North America.

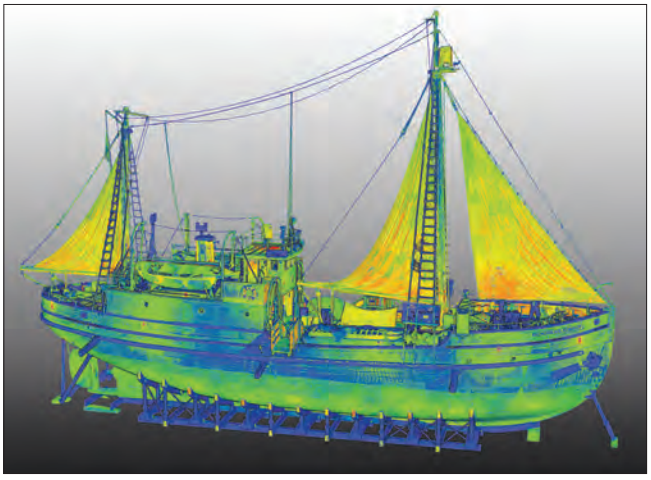
APEGBC members: Armin Khatoonabadi, P.Eng., Mathew Gore, EIT

Digital Preservation of the RCMP *St. Roch* National Historical Site

The RCMP schooner *St. Roch* was the first vessel to sail the Northwest Passage from west to east and to circumnavigate North America. Built in 1928 by North Vancouver's Burrard Drydock Co. Ltd., she served RCMP detachments in the Arctic until she was retired in 1954. In 1958, she was hauled onto dry land in Vancouver, where she became the core exhibit of the Vancouver Maritime Museum.

Partnering with the museum, Absolute Space Engineering used laser scanning technology to map the surface of the 32-metre-long vessel. The generated high-fidelity three-dimensional model, along with other digitised historical plans and documents, is now securely archived and disseminated by CyArk, a not-for-profit organisation that captures and shares detailed three-dimensional representations of the world's significant cultural heritage sites. Anyone with Internet access can virtually view the *St. Roch* and other historical sites around the world.

APEGBC member: George Liu, P.Eng.



Building Enclosure Protects Precious Art Collections

Downtown Los Angeles's The Broad is a new museum dedicated to postwar and contemporary art. The 120,000-square-foot building, designed by Diller Scofidio + Renfro in collaboration with Gensler, is designed as a veil and vault structure. The lacy building enclosure is the veil over gallery space that surrounds the central storage vault.

Simpson Gumpertz & Heger consulted on the building-enclosure design, and worked with the architects to select, coordinate, and detail water, air, vapor, and thermal (non-fire) barriers for the roof, opaque perimeter walls (excluding the curtain wall), and interaction with the garage. As part of the design review, the consultant also conducted computational condensation and thermal analyses on various conductive building-enclosure components to assess the effects of the interior climate control system.

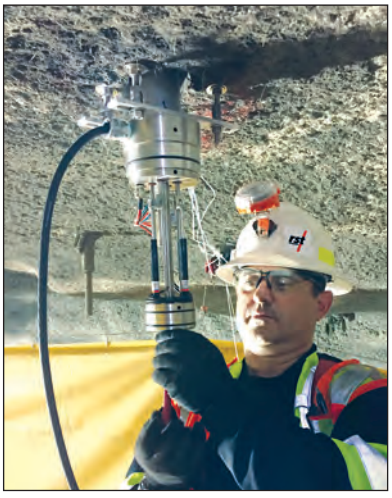
APEGBC member: Liyen Kan, P.Eng.

Assessing Fisheries Watersheds in the Omineca

On behalf of the BC Ministry of Forests, Lands and Natural Resource Operations, the sensitivity of five high-value fisheries watersheds, covering 230,000 hectares, in BC's Omineca Region was assessed. Three watersheds (Ahdatay, Klawli, and Rottacker) are located in the Nation River system, while two (Chowika and Davis) drain directly into Williston Lake.

A watershed and channel response-based approach was used to determine sensitivity to existing and future land use pressures. Professionals from several disciplines collaborated on the project, which included a comprehensive review of physical and biological watershed processes, supported by historical and current aerial imagery, GIS information, and available fisheries data. This science-based project lays a foundation in support of provincial fisheries-sensitive watershed designation, fisheries protection, and sustainable forest and watershed management.

APEGBC member, Polar Geoscience Ltd.: Lars Uunila, P.Geo.



Geotechnical Instrumentation Network at the John Hart Generating Station

RST Instruments Ltd. was engaged by the Aecon–SNC-Lavalin (ASL) Joint Venture to manufacture and install a geotechnical instrumentation network in the recently excavated crown of the new underground powerhouse at BC Hydro's John Hart Generating Station, Campbell River, BC. The network consists of 12 multi-point rock extensometers, 18 rock bolt load cells, data-loggers, and an RSTAR radio communication system. The instrumentation and data acquisition systems were designed to provide accurate real-time monitoring of movements and loading in the rock mass surrounding the powerhouse. Project work was coordinated between RST and ASL JV engineers and geoscientists.

Work is underway to install additional extensometers, vibrating wire piezometers, and load cells instrumentation in the powerhouse walls as the excavation advances downward.

APEGBC members, ASL Joint Venture: Keith Paul, P.Eng., Tony Dell, P.Eng.;
RST: Doug Baker, P.Geo., Alin Plesu, P.Geo.

Seafloor Gas Hydrates Surveyed

Ocean Floor Geophysics Inc. completed a high-resolution marine controlled-source electromagnetic (CSEM) survey of near-seafloor gas hydrates in Japanese waters, using the Scripps undersea electromagnetic source instrument (SUESI)/Vulcan system. The system is a deep-towed electromagnetic transmitter, with multiple towed receivers used to simultaneously map deep and shallow resistive structures for hydrocarbon exploration, near-seafloor gas hydrate deposits, and geohazards.

Tony Wass, P. Eng., was Party Chief for offshore operations, which comprised more than 670 line kilometres of high-resolution data collected in water depths of up to 1100 metres, the largest dataset of this type ever collected. Peter Kowalczyk, P.Geo., managed data collection and interpretation during the survey. A full three-dimensional inversion of the survey's data was also completed, in partnership with Mira Geosciences and Computational Geosciences Inc. (CGI) from the University of British Columbia.

2015•2016
Project Highlights

Load-out of Jack-up Oil Rig *Ensco 141,* United Arab Emirates

Grand Marine provides engineering and practical assistance to shipyards in British Columbia and overseas. In one of the company's latest projects, for Lamprell Engineering Limited, in Hamriyah, United Arab Emirates, assistance was given in the form of a complete engineering package of all aspects of the operation (the Method Statement) and the necessary hands-on practical assistance to execute all aspects of the marine operations.

This operation involved the load-out of the jack-up oil rig *Ensco 141* (7850Te) from land to a bottom-reaction semi-submersible barge, via self-propelled modular trailers. The barge and rig were towed (SHOWN DEPARTING) to a specific surveyed site four nautical miles into the Persian Gulf. The barge and rig were then ballasted down until the barge transom rested on the seafloor for stability, at which time the rig was floated off.

APEGBC member: Alfonso M. Sotres, P.Eng.

Inspection Program Facilitates Safety Inspection

Neptune Terminals is one of the largest multi-product bulk terminals in North America, located in North Vancouver, BC. The *Canada Shipping Act* requires annual equipment examinations and a load test to be completed once every five years on all ship loading and unloading equipment. During January 2016, experienced field engineering personnel from CWA's ASSET Reliability Division coordinated and witnessed the load tests on the Berth 1 East and West coal shiploaders and prepared the Transport Canada certification to ensure the ship loaders can continue to safely handle 12 million tonnes per year of steelmaking coal. The annual structural, mechanical and safety inspections were completed using CWA's wireless tablet inspection program to optimise the inspection crews' time on site during the maintenance shutdown window for the equipment.

APEGBC members: Devin Hagardt, P.Eng., Christina Robin, P.Eng., Harpreet Natt, P.Eng., Keith Arnstead, P.Eng.

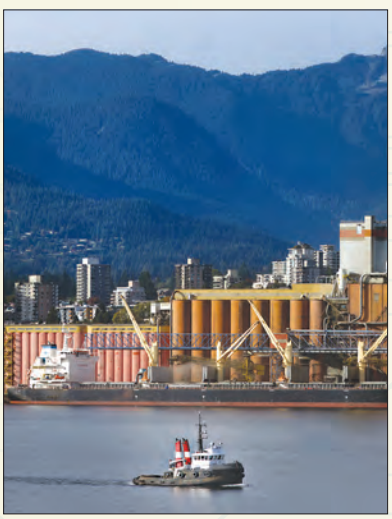
Controls and Automation of Terminal Expansion

The Richardson Vancouver Grain Terminal is one of the world's most efficient port terminals. It handles approximately three million metric tonnes (MMT) of grain and oilseeds per year and is a major exporter to countries along the Pacific Rim. The Annex 3 Expansion project increases the terminal's storage capacity by 80,000 MMT.

ANDRITZ AUTOMATION designed the controls and automation for the expansion, the system programmable logic controllers/human–machine interface (PLC/HMI) programming for the new equipment, and modifications for the existing facility. The expansion's controls provide significant enhancement over existing plant controls and include bin selection and automatic path setup, inventory control, and cross-contamination interlocks.

Control installation and commission were completed during continuous plant operations and required minimal shutdowns for tie-ins to existing equipment.

The enhanced automation and controls will significantly reduce the potential for human error that could contribute to spills and cross-contamination of products, and will also improve efficiency.



Rotortug® Infield Support Vessels for Floating Liquefied Natural Gas Facility

Robert Allan Ltd., Naval Architects, of Vancouver, designed the world's first purpose-built infield support vessels (ISVs) for Shell's Prelude floating liquid natural gas (LNG) facility off northwest Australia. The first of three of the Rotortug® vessels completed trials at ASL Shipyards, Singapore, for owners KT Maritime Services.

Propulsion of the highly manoeuvrable, powerful vessels features three azimuthing propulsion units. The tugs measure 41.95 metres x 16.00 metres and develop more than 100 tonnes bollard pull both ahead and astern.

The vessels' tasks include berthing LNG carriers, condensate-tanker tow-backs, pilot transfer, floating-hose handling, as well as contributing to security, emergency response, rescue, and evacuation requirements. Innovative design features include all pollutant liquids stored off the shell, an 800-millimetre-diameter vertically retractable towing fairlead, and a comprehensive LNG protection system.

APEGBC members, design team: Todd Barber, P. Eng., Robin Stapleton, P. Eng., Bart Stockdill, P.Eng.

Eagle Rock Aggregates' Aggregate Import Berth

Eagle Rock Aggregates commissioned an aggregate import berth at Long Beach, California, in July 2015. Seabulk Inc. provided enterprise performance management services for the facility.

The novel berth design for self-unloading bulk carriers comprises dual floating stiff-leg moorings that use a load path to shore foundations at a site where obstructions preclude conventional pile-supported structures. Advantages over conventional approaches include low capital cost, rapid implementation, no marine piling, low over-water coverage, easy adaptation to site settlement and sea-level change, and easy decommissioning. The project was completed and ready for use eight months after award of contracts, and in-water work was completed in two days with the use of prefabricated structural and floating components.

APEGBC members, Seabulk Inc.: Sid Sridhar, P.Eng.; Mark Mattila, P.Eng.; David Popoff, P.Eng.; Casper, Phillips & Associates: Richard Phillips, P.Eng.

Arctic Research Vessel *Sikuliaq*

Research vessel *Sikuliaq* is an icebreaker designed for oceanographic research in Alaskan waters, with the possibility of seasonal operations in the Canadian Beaufort Sea. It is owned by the US National Science Foundation and operated by the University of Alaska Fairbanks.

During the design, AKAC Inc. was the naval architect responsible for ensuring the vessel was capable of operating and conducting science missions in the Arctic ice. To meet its unique mission requirements, several unique design features were incorporated, including azimuth propulsion.

AKAC Inc. prepared an ice operations manual for the vessel and conducted hands-on field training to help ensure the vessel is used to its maximum potential. Evan Martin, P.Eng., was in charge of ice trials conducted to provide training to the crew, and to develop and verify operational procedures for conducting science operations in sea ice.

PHOTO: EVAN MARTIN, P. ENG.

Airside Operations Building Enhances Airport Safety

Vancouver International Airport's Airside Operations Building successfully opened in 2015, and now provides a consolidated home for all response services, airside operations, airfield maintenance, and fleet maintenance. Located in a centralised location, the new facility enhances overall airport safety by reducing the return to service times for equipment and shortening runway closures caused by winter conditions or foreign-object debris incidents. The buildings are post-disaster rated and demonstrate sustainable design with geothermal heating and cooling, LED lighting throughout, grid-tied wind turbines and solar photovoltaics, solar hot water, rainwater collection, and the use of local, renewable and recycled building materials. The project received incentives under BC Hydro's Power Smart New Construction Program.

Client: Vancouver Airport Authority; Consultant Team: Francl Architecture, Read Jones Christoffersen Ltd., Integral Group, MCW Consultants Ltd., Morrow Engineering Ltd., SNC Lavalin Inc., Genivar, Michel Labrie Architect Inc., Komm-Lynn Associates, LMDG Ltd., BKL Consultants Ltd., Blue Marble Architecture Inc.

PHOTO: ED WHITE

Baggage Backbone System at YVR

Vancouver International Airport (YVR) has the strategy to be the Asia–Pacific Gateway into North America. To achieve this, it needed to reduce transfer-baggage–connection times and to automate the flow of transfer bags. Vanderlande was selected by YVR to design and implement the system.

The new system, called a Backbone, connects the existing baggage infrastructure with high-speed conveyors. There is a total of 3.5 kilometres of tub-based conveyor systems (TUBTRAX), 3 kilometres of traditional belt conveyors, and a new control-room software system called VIBES. The project required extensive design and coordination efforts between several parties, including YVR, architects, building consultants, and Vanderlande.

The system can automatically transport oversized bags and reduces the amount of tug traffic on the apron, lowering carbon dioxide emissions. The system became operational in the summer of 2016.

Surrey Memorial Hospital's Support Service Connector Link

Currently under construction, the Support Service Connector Link at Surrey Memorial Hospital will connect the recently completed Critical Care Tower with food services, loading docks, and linen and material management, as well as increase efficiency of service delivery, and separate public and hospital services. The link is 3.6 metres wide, 5.5 metres deep and 72 metres long, and runs below grade between and under existing structures.

The project is being completed within a tight construction area with constricted access while keeping impacts to hospital operations to a minimum. Due to the narrow width of the excavation and the adjacent below-grade structures, the excavation is generally being completed using an internally braced shoring system that consists of pipe pile-reinforced shotcrete shoring walls with horizontal steel braces. Structural and geotechnical design also included extensive works to underpin and support the existing three-storey Rotunda Building columns, and foundations to facilitate link-tunnel construction beneath the building.

APEGBC members, Fraser Health Authority: Cynthia Pan, P.Eng.; Bush, Bohlman & Partners LLP: Mark Anderson, P.Eng., Struct.Eng.; Clint Low, P.Eng., Struct.Eng.; WSP: Steven Case, P.Eng., Andy Tashiro, P.Eng., Russ Riffell, P.Eng.; Rocky Point Engineering Ltd.: Mark Yeung, P.Eng.; PCL: Brian Riddoch, P.Eng., Bryce Dahlen, EIT

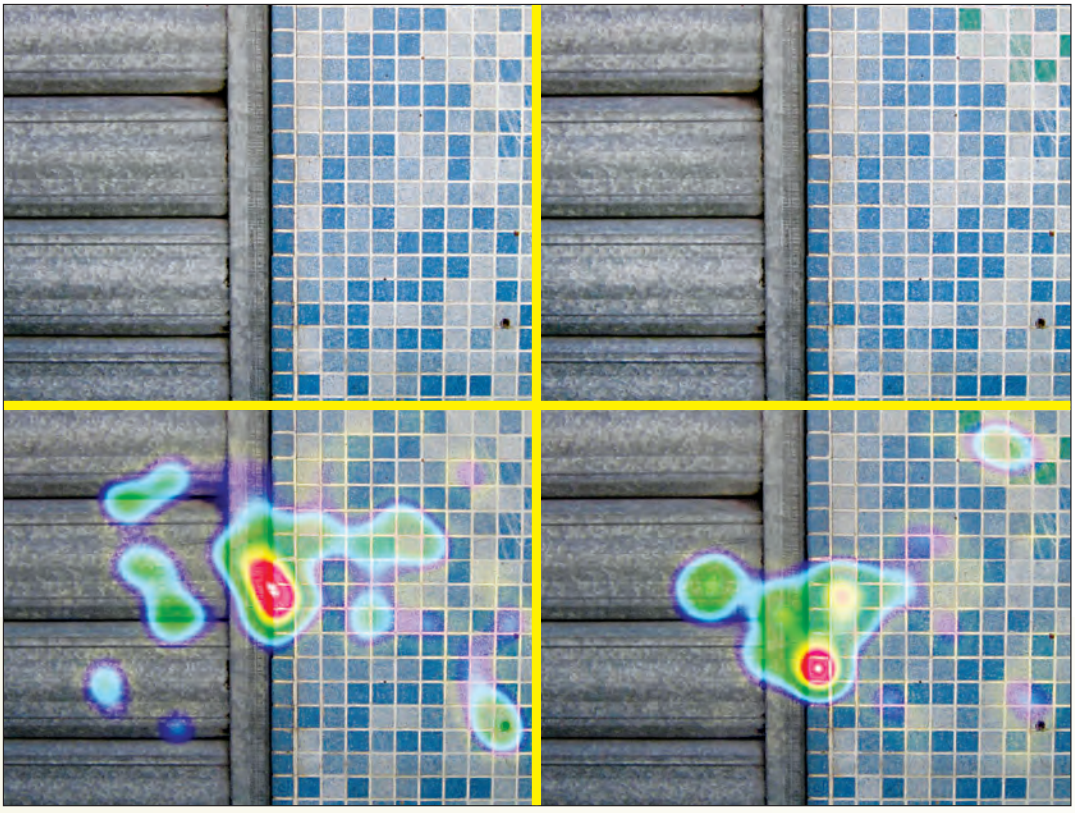
Spool Welding Robot Semi-Automates the Pipe Spool Manufacturing Process

Novarc Technologies's patent-pending Spool Welding Robot is a collaborative welding robot designed for 1G pipe welding. The robot increases arc-on time, reduces defects, and improves weld quality by combining operator's knowledge and mobility with the robot's repeatability to mechanise the pipe spool manufacturing process. The result leads to increased productivity and lower costs for pipe-fabrication shops.

The robot has a 4.5-metre reach, a minimum set up time of three minutes per weld, a 2.4-metre x 1.2-metre footprint, an ability to work with existing positioners, weld monitoring and quality assurance via camera, automatic distance control, and laser-assisted seam tracking. It also has a custom-made user-friendly pendant.

This collaborative robot combines operator's cognition and mobility with robotic repeatability to mechanise the pipe spool manufacturing process.

APEGBC members: Hassan Bateni, P.Eng., Abdolreza Abdollahi, P.Eng.; Soroush Karimzadeh, P.Eng.



Software Guides Viewers' Attention Within Images

Ever wonder if your audience sees what you want them to see in your slides or images? Researchers with the Simon Fraser University Multimedia Ergonomics team have developed image-processing software that introduces subtle changes in colour to guide viewers' attention towards or away from selected areas on an image.

The gaze-point heat map (Lower left) shows that viewers tend to look at the boundary between the two walls and the hole in the tile wall near the bottom right corner. Modifying the image (Top right) by subtly changing the colour in its top right corner redirects visual attention while preserving image aesthetics. The resulting gaze-point heat map (Bottom right) shows that viewers no longer focus on the hole in the tile wall, but instead on the area where the colour has been altered.

APEGBC member: Dr. Ivan V. Baji, P.Eng.

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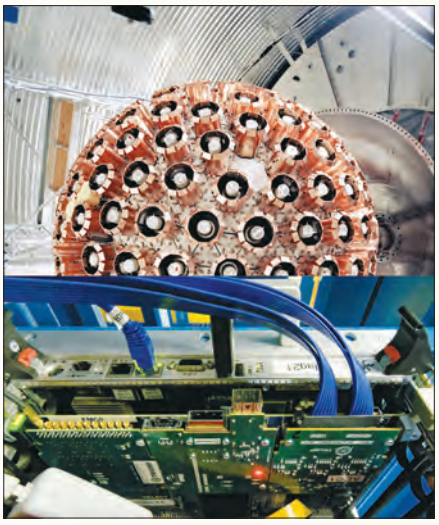


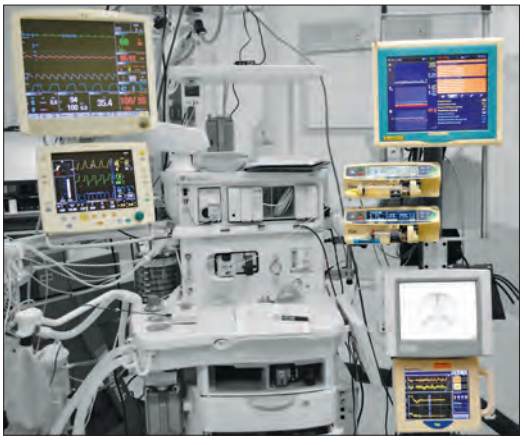
SNOLAB's DEAP-3600 Watches for Dark Matter

A pressing issue in physics today involves a hypothetical particle predicted to interact only rarely with ordinary matter. The hunt for dark matter requires scientists and engineers to develop innovative methods to study these elusive particles.

Two kilometres underground at SNOLAB, near Sudbury, Ontario, the DEAP-3600 detector features a suspended acrylic vessel filled with 3600 kilograms of liquid argon and is surrounded by photomultiplier tubes attached to acrylic light guides. If dark matter scatters an argon nucleus in DEAP-3600, the detector will sense the emitted light and allow researchers to probe the dark matter particle's properties.

TRIUMF is a leading contributor in DEAP-3600's construction, including the manufacture of 255 acrylic light guides. TRIUMF provided the electronics system for reading out over 300 single-photon sensitive photomultiplier tubes for deciding if a flash of light warrants recording and for handling various external systems characterising the detector.

Closed-Loop, Personalised Anaesthesia Administration Improves Patient Safety



With the goal of personalising anaesthetic drug dosing, the University of British Columbia Electrical and Computer Engineering in Medicine research group, led by Guy Dumont, P.Eng., and anaesthesiologist Dr. Mark Ansermino, developed *iControl*. The provably safe, certifiable, closed-loop system automatically adjusts in real time the administration rate of anaesthesia drugs based on feedback from a measure of the patient's brain activity.

Anesthaesiologists are responsible for giving sufficient drug to facilitate the surgical procedure, while maintaining the patient's vital functions. Currently, drug administration is controlled manually and guided by feedback from physiological measures. Inadequate dosing can compromise patient safety and negatively affect post-operative outcomes. Closed-loop feedback control will reduce variability in desired clinical effects, facilitate research to establish optimal care, and free anaesthesiologists to focus on higher-level tasks, such as responding to unexpected clinical changes. By introducing closed-loop control to personalise anaesthesia, *iControl* will improve patient safety in the operating room.

Connected Snow-Removal Camera Solution

Traditionally, snow removal firms have relied on weather reports to manage their operations. Weather reports typically cover a large geographic area, with snowfall in one neighborhood generally varying greatly with that in another. Businesses depend on ploughing services. With plough trucks arriving too early, too late, or too infrequently, this leads to unhappy customers and a loss of business. Houle Electric, in partnership with TELUS and Mobotix, developed a connected snow-removal camera solution to address these concerns.

A cloud-based algorithm processor uses the cameras' sensing technology to calculate temperature drops of greater than 2° Celsius within a 60-minute interval. Once detected, the camera takes a snapshot with a temperature/date/time text overlay and sends that information back to Global Roadway Maintenance for operational decision making. Hourly snapshots are also captured, eliminating need to manually keep records of when snow removal services were completed for each location.

VeloMetro Velomobile Sharing Network

VeloMetro has developed a novel three-wheeled, enclosed, pedal–electric-assist velomobile, called Veemo, for one-way sharing networks.The Veemo velomobile is regulated to 500-Watts-output power and a top speed of 32 kilometres per hour, keeping it within Canadian regulations for power-assisted cycles. Prototypes are being tested by VeloMetro engineers, but pilot fleets will be launching with the City of Vancouver and the University of British Columbia. People will be able to use a smartphone app to sign up, find, and reserve the nearest Veemo velomobile, and unlock it to start their trip.

APEGBC members, VeloMetro Mobility Inc.: Kody Baker, P.Eng., Jonathan Faille, EIT; Sean Boyd, EIT; Ben Cornwell-Mott, P.Eng.; Jeffrey To, EIT; Manny Lee, EIT; Andrea Latella-Duboyce, EIT

System Adds Flexibility to Craft Distillers' Production

Specific Mechanical Systems, of Victoria, BC, worked with master distiller Robert Cassell, Millstone Spirits Group, Philadelphia, to build a 910-Litre, pre-plumbed, skid-mounted distillation system for Victoria Distillers, Sidney, BC. The system permits the craft distiller to switch between products and produce unaged spirits while waiting for aged products to mature, and to expand production over time.

The system features a copper pot still with three interchangeable heads for production of spirits, including vodka, gin, whiskey, rum, and brandy. The all-in-one system combines mash, ferment, distillation and distillate-collection processes on one movable skid. It also includes an electronic control panel, pumps, two platforms, and an integrated davit lift for swapping out heads, and is fabricated from copper and 304 stainless steel. Distillers can expand the system with additional fermenters as needed.

APEGBC members: Brandon Fry, EIT, Michael Jackman, EIT, Patrick Keller, EIT, Reo Phillips, P.Eng.

Lasqueti Island Solar Photovoltaic–Diesel Offset Project

Hakai Energy and HES PV partnered to provide Lasqueti Island's school with a 41-kiloWatt solar photovoltaic–diesel reduction system. Because Lasqueti is not serviced by BC Hydro, residents typically use alternative forms of power. The island's school and out buildings were run entirely from a diesel generator until this year.

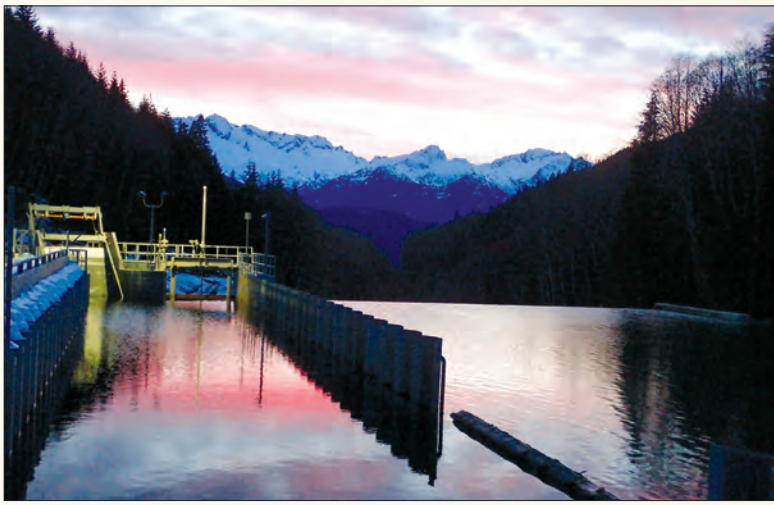
The project will reduce diesel fuel emissions by providing power to the school from the photovoltaic array and storage system. Similar systems could be deployed throughout BC's diesel communities, and would reduce greenhouse gas contributions. HES PV worked with Hakai Energy to design and deliver the project, but many environmentally minded island residents worked hard to convince the school district to add solar to the site.

APEGBC member, HES PV: Ed Knaggs, P.Eng.

Culliton Run-of-River Hydroelectric Project

The 15-megaWatt Culliton Hydroelectric Project is a run-of-river development located 20 kilometres north of Squamish, BC. Engineering design and project management was by Canadian Projects Limited, with TetraTech EBA (geotechnical) and Prime Engineering (electrical).

The project includes several distinctive design components: the headworks feature a three-stage sediment exclusion system to manage high-sediment load and extreme flow events using a steel sheet-pile sediment basin (RIGHT) and weir spillway structures. Other major project improvements resulted in significantly reduced earthworks and concrete volumes over the previous design, a singular safe access point from the busy Sea to Sky Highway, averted weather-related construction impacts, improved energy yield, and higher flood passage capability—at substantial cost savings. The project was constructed in just 16 months, with completion in December 2015, ahead of schedule.



Automation Upgrade at Atlantic Power Bio-Energy Facility

Atlantic Power Corporation is a co-generation power plant in Williams Lake, BC, that converts forest waste biomass to electrical power. Reliability challenges and risk from equipment obsolescence and associated power-supply uncertainty prompted the company to replace its legacy distributed control system (DCS). By working with Spartan Control, Atlantic Power reduced the upgrade's complexity and replaced the entire DCS in three phases within short-scheduled maintenance windows over a two-year span, with minimal disruption to power generation.

Repurposing of existing healthy equipment and upfront audits by site personnel reduced upgrade costs, yet ensured the new technology improved maintenance, reliability, and performance. The team also tested and accepted all implementation aspects prior to deployment to ensure rapid project completion. Overall, the plant realised a savings of $850,000 from the original cost estimate, is now able to easily expand the existing system by 20 percent, and has improved access to plant-process diagnostics to ensure availability and reliability of power delivery.

McLymont Creek Run-of-River Hydroelectric Project

The McLymont Creek Hydroelectric Project, located on a tributary of the Iskut River, is a 66-megaWatt run-of-river scheme owned by AltaGas Ltd.

Project components include an intake for diverting a maximum of 30 cubic metres per second of power water from the creek, a 2.8-kilometre-long conveyance tunnel, a powerhouse with three Francis turbines, a substation, and 9.5 kilometres of transmission line.

Gygax Engineering Associates (GEA) led the multi-disciplinary team that provided engineering design and construction-phase technical support for the project. GEA's team included Struthers Technical Solutions, Northwest Hydraulic Consultants, CM Rock Engineering, Wyllie & Norrish Rock Engineers, BGC Engineering, and Golder Associates. The innovative intake arrangement provides the required power flow diversion and flood and sediment passage, while accommodating site-access constraints. The tunnel has rock overburden of up to 780 metres.

The project was completed on budget. Power generation began October 2015, nine months ahead of schedule.

Heartland Biogas Facility

The Heartland Biogas Facility in northern Colorado is one of the largest of its kind in North America to process organic waste to produce renewable natural gas. Up to 30 semi-truckloads of food waste from restaurants, grocery stores and food manufacturers in the area are shipped to the facility every day. There, the waste is mixed with manure from a local dairy farm to form feedstock for anaerobic digesters to generate raw biogas.

Three Greenlane Biogas Totara+ systems, operating in parallel, upgrade as much as 127 cubic metres per minute (4,500 SCFM) of biogas daily to produce pipeline-grade renewable natural gas. The gas is supplied to Colorado's Sacramento Municipal Utility District through a 20-year gas purchase agreement.

Diversion of organic waste to the facility reduces both waste to landfills and greenhouse gas emissions.

APEGBC members: Abel Yasells Garcia, P.Eng.; Jean-Michel Logan, P.Eng.; William Taylor, P.Eng.

Mission Critical Emergency Power Upgrades in Vancouver

A mission-critical facility completed the first phase of a project to upgrade their existing emergency power system. The project involved constructing a new seismically rated, post-disaster, standby diesel generator plant, complete with a new medium-voltage emergency power distribution system, a fuel-oil supply system, and building infrastructure upgrades.

In addition to improving system reliability and redundancy, sustainability was a driving factor in the design, and each generator set was equipped with a diesel emissions reduction system that reduces pollutant levels, such as NO_X, by as much as 95 percent. Critical power loads remained fully supported throughout the project by following a detailed engineering design and a carefully managed methods-of-procedure process.

APEGBC members, H.H. Angus & Associates Ltd.: Philip Chow, P.Eng., P.E.; Peter Formosi, P.Eng.; Read Jones Christoffersen Ltd.: Dennis Gam, P.Eng.

Landslide Catchment and Deflection Barrier on Transmission Tower 3611

The Interior-to-Lower Mainland Project, energised in December 2015, is the latest component of BC Hydro's high-voltage transmission line network. The line enhances electricity supply between major generation sites within BC's Interior and the primary power-consumption area in the Lower Mainland, and crosses complex terrain.

Tetra Tech EBA, as part of the design–build team, was charged with ensuring planned tower locations remain safe and stable over the line's service life. One major challenge was Tower 3611, located in an area of known landslide hazard. Tetra Tech EBA, together with Trumer Schutzbauten Canada Ltd. and Ryzuk Geotechnical Engineering, designed a hybrid landslide catchment and deflection barrier to be installed upslope of the tower to prevent potentially large volumes of debris from impacting the tower. The 5-metre-high, 25-metre-long barrier is designed to resist loads up to 750 kiloNewtons per metre, and is the largest of its kind in Western Canada.

PHOTO: EVAN MARTIN, P.ENG.

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Richmond's Alexandra District Energy Utility Enters a New Phase

The Alexandra District Energy Utility (ADEU) is an ambient-temperature district energy system that delivers heating, cooling, and domestic hot water pre-heat services to connected buildings. In November 2015, the City of Richmond completed Phase 3 expansion of the system, increasing the overall energy centre footprint to add two 2,550-kiloWatt evaporative fluid coolers and three 1,500-kiloWatt condensing boilers with enough space for future expansion. A second geo-exchange field, with an estimated capacity of 1,000 kiloWatts of heating and 2,100 kiloWatts of cooling, was added to the system. The expansion also included installation of 575 trenched metres of 500-millimetre, non-insulated, high-density polyethylene (HDPE) DR17 distribution piping.

By using renewal energy, ADEU now reduces greenhouse gas emissions by as much as 800 tonnes annually.

APEGBC members: Robert Gonzalez, P.Eng; John Irving, P.Eng; Alen Postolka, P.Eng; Doru Lazar, P.Eng.

Searching for Groundwater at Kenya's Kakuma Refugee Camp

Staff from Advisian, a member of the WorleyParsons Group, travelled to Kakuma Refugee Camp in Kenya's Turkana Desert, to help identify potential groundwater resources, as part of a Geoscientists Without Borders and IsraAid initiative.

Kakuma is home to 185,000 refugees who are entirely dependent on groundwater, and about 120,000 semi-nomadic Turkana tribesmen. The UN High Commissioner for Refugees estimates each refugee accesses about 18 litres of water per day, for only a few hours each day at the site.

Staff used seismic refraction surveys to delineate top of rock, and electrical resistivity tomography to distinguish granular from fine-grained overburden, weathered from unweathered rock, and salt water from fresh, as well as to identify faults. Drilling targets are saturated granular overburden, faults, and weathered rock. Where possible, the geophysical interpretations were corroborated with existing borehole information. Water wells are now being drilled, using these geophysical targets.

APEGBC members, Advisian: Paul Bauman, P.Eng.; Chris Slater, P.Geo.

Port Mann Water Supply Tunnel

The Port Mann Water Supply Tunnel crosses the Fraser River between Coquitlam and Surrey, BC, and is a primary water supply link to municipalities south of the river. The $239-million project will replace a river crossing that is vulnerable to riverbed scour and earthquake loading.

The new water main is sized to accommodate regional growth, is located well below riverbed-scour depth, and is designed to remain functional after a 1-in-10,000-year return period earthquake. The tunnel was excavated between two 60-metre-deep vertical shafts on either side of the river, using a tunnel boring machine against earth pressures up to six bar (90 psi). The water main consists of a 2.1-metre-diameter, welded steel pipe constructed inside a 3.5-metre-diameter, concrete-lined tunnel. The project is scheduled to be completed and in service by the end of 2016.

Design Consultants: Ausenco Engineering Canada Inc., McMillen Jacobs Associates, Golder Associates; Construction Management: Hatch Infrastructure; General Contractor: McNally International Inc., Aecon Constructors Joint Venture

Small Space Retrofit of a Wastewater Treatment System

Creekside Custom Foods hired Keystone Environmental Ltd. to provide solutions to address fluctuating acidity, total oil and grease, and total suspended solids beyond Metro Vancouver permit limits.

Keystone Environmental Ltd. provided options to improve plant performance, identified short- and long-term system upgrades and modifications, and completed a design–build treatment system. Key design factors included handling high acidity from lactate in the sourdough baking process (pH = 3), spiking high alkalinity from wash chemicals, and high solids content, as well as limited space and a requirement to use existing infrastructure without demolition or sub-grade work.

The resulting three-dimensional layout showed horizontal and vertical extents where the proposed treatment equipment could be situated. The build occurred in the commercial bakery during 24/7 operations without affecting bakery operations. Safeguard Mechanical Ltd successfully installed and commissioned the system.

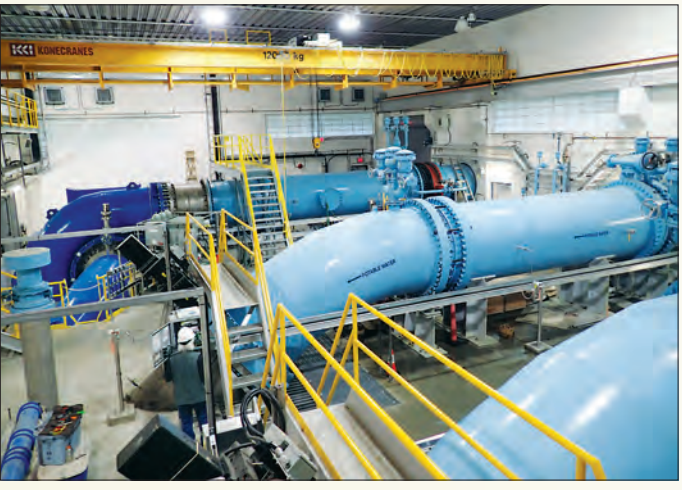
APEGBC members, Keystone Environmental Ltd. (primary consultant): Christina Chan, P.Eng., Alice Kruchten, EIT, Sarah Sanche, EIT; Primary Contractors: Greenline Management Ltd., Safeguard Mechanical Ltd.

Process Water Recycler Eliminates Need for Wet Sedimentation Ponds

Fines Recovery Solutions Inc. has developed an automated process to remove and handle the mud from dirty process water created by aggregate washing or construction operations. This system provides immediate recycling of 90 to 95 percent of the input water. The extracted mud is stabilised with a patented food-grade chemical to make it both easier to handle and resistant to reabsorption of water from rain or snow melt. The mud can be pumped or, after a brief consolidation period, trucked as a solid to a disposal site. The controller provides for local or remote control, alarming, and data tracking.

This process eliminates the need for wet sedimentation ponds, thus improving employee safety, reducing environmental risk from containment breaches, and freeing space for more profitable uses.

APEGBC member: Brian Weeks, P. Eng.



Capilano Break Head Tank and Energy Recovery Facility

The Capilano Break Head Tank and Energy Recovery Facility, located at the terminus of a seven-kilometre-long, gravity-driven tunnel from the Seymour–Capilano Filtration Plant, is a vital link in Metro Vancouver's Seymour–Capilano Water Filtration System that supplies treated potable water to the cities of Vancouver, North Vancouver, and Burnaby. Knight Piésold designed and commissioned the tank and facility to provide reliable water-supply continuity and dissipate excess pressure in clean drinking water from the filtration plant before it is delivered to residents and businesses. The facility includes one of North America's largest energy-recovery turbines in a municipal treated-potable water system. The turbine is expected to generate power to help offset consumption by the Capilano Pump Station, thereby reducing Metro Vancouver's total energy consumption by about 9,600 megaWatt hours each year.

Owner: Metro Vancouver; Design Engineer: Knight Piésold Ltd.; Subconsultants: CP Automation and Gygax Engineering Associates

Super-Oxygenation Technology to Support Water Treatment Processes

Northwest Hydraulic Consultants Ltd. is advancing a research project initiated at the University of British Columbia to evaluate potential superoxygenation as a viable method for increasing the efficiency of oxygen transfer in water treatment processes. The research furthers the university's efforts by pressurising a Speece Cone (developed by Dr. Richard Speece, at Vanderbilt University, Nashville, Tennessee) while adjusting oxygen inflow and ambient particulate concentration. Development of processes to mitigate against oxygen loss due to effervescences is also being considered.

Oxygen transfer efficiency can account for 60 percent of water and wastewater treatment energy requirements. The potential to reduce overall aeration facility footprint size and operational costs while increasing overall quality of water and wastewater treatment is significant.

APEGBC members: Ken Christison, P.Eng.; Dr. Don Mavinic, P.Eng.; Tyler Barber, EIT

Mara Lake Water Treatment Plant

Opus DaytonKnight was the prime consultant for the design, construction, and commissioning of the District of Sicamous' Mara Lake Water Treatment Plant. The new $7.9-million plant officially opened in February 2016, and provides water that now meets the BC Drinking Water Treatment Objectives for Surface Water Supplies. It allowed Sicamous to lift its three-year water-quality advisory.

The compact facility uses hollow-fibre membranes to treat up to 8 megaLitres/day from Mara Lake, and is expandable to 12 megaLitres/day. The custom board-form finished concrete, LED accent lights, and building angles maximise floor space while producing a visually attractive building at the town's entrance. An underground pump station and special sound treatments help the new building operate almost silently.

Lead consultant: Opus DaytonKnight; Sub-consultants: GTA Architecture Ltd., BENCH site design inc., WSP (Levelton), MHPM; Contractor: Maple Reinders.

Clean Water for Remote Northern Community

BI Pure Water Inc., Port Kells, BC, designed, manufactured, delivered and installed a package water-treatment system for the Government of Nunavut. The 20-metre-wide, 84-metre-long building was trucked to Hay River in four sections and barged up the MacKenzie River to site in Cambridge Bay, on Victoria Island, north of the Arctic Circle.

The highly insulated building contains a standby generator, electrical motor control centre, boilers, process piping, media filters, ultraviolet disinfection units, pumps, programmable logic control system, lighting, and ventilating equipment. Also designed and manufactured for this project are 570,000-litre and 60,000-litre water tanks, and 17 insulated underground valve vaults.

BI Pure Water engineers used "Design for Resilience" when conducting the detailed design to help ensure the infrastructure and system sustains operations during and after the impact of severe disturbances.

APEGBC members: Paul Anderson, P.Eng., FEC, Jim Tam, P.Eng., Guan Wong, P.Eng., Catherine Anderson, EIT, George Thorpe, P.Eng.

Kamloops Pump Station Upgrade

The Kamloops pump upgrade project's goal was to replace 63-year-old, multi-stage crude-oil pumps with new centrifugal pumps in a new building. Work started in late-2014, and was mostly completed by December 2015. Four parallel, across-the-line pumps were replaced with two new, single-stage series pumps driven by 5000-horsepower motors and variable-frequency drives. The project's design focus was to increase reliability at this critical station. The new pump station was built next to the existing station and was successfully commissioned within a 48-hour period.

APEGBC member, Greaves Project Solutions: Tom Greaves, P.Eng.; Golder Associates (environmental/geotechnical); Tetra Tech, Inc. (engineering)


Photo: Mitch Cheek

Stabilising the Valley Pit East Wall, Teck Highland Valley Copper Mine

Piteau Associates designed the Phase 8 expansion at the Teck Highland Valley Copper mine in south–central BC. The upper 255 metres of the east wall comprise a thick sequence of glacial overburden soils containing intervals of low-shear-strength clays and silts.

Two large (1.7- and 6-million-tonne) waste rock buttresses were required to maintain slope stability using slot cut and fill mining methods. A network of 70 active dewatering wells and 26 one-metre-diameter passive vertical drains was commissioned to control groundwater levels. Calibrated numerical models were used to forecast pore pressures and ground displacements to define slope-monitoring thresholds for safe operating conditions.

Completion of Phase 8 mining, to a final depth of 570 metres on the east wall, is scheduled for late-2016.

APEGBC members, Piteau Associates (designers): Nick Rose, P.Eng., and Andrew Holmes, P.Eng.; Teck Highland Valley Copper Mine: Sebastien Fortin, P.Eng.; Mathieu Veillette, P.Eng.

High-efficiency Evaporation System Supports Heavy Oil Recovery Process Development

A.H. Lundberg Systems Limited, Vancouver, BC, designed and supplied a new high-efficiency evaporation system to the Japan Canada Oil Sands Limited (JACOS) demonstration facility at the Hangingstone heavy oil recovery plant, near Fort McMurray, Alberta. The system includes a falling film evaporator driven by three mechanical vapour re-compressors (MVR) arranged in parallel.

The system was successfully started up and commissioned in July 2015. The installation purifies the blow down of the boilers providing steam to JACOS's steam-assisted gravity drainage heavy oil field. Because this facility is used for process-development purposes, the system was designed to operate with extensive capacity changes to the feed rate beyond the requirements or capabilities of a conventional MVR-driven evaporation system.

APEGBC members, A.H. Lundberg Systems Limited: Allan Jensen, P.Eng., Bruce Der, P.Eng., Greg Geub, P.Eng.

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Sinking Nevada's Leeville Turf No. 3 Ventilation Shaft Through an Aquifer

Amec Foster Wheeler served as engineering, procurement and construction contractor for increasing the ventilation capacity at the Newmont Mining Corporation underground gold mine by sinking a shaft and installing four large fans on the surface.

The shaft would pass through an aquifer, creating significant challenges. To control water during shaft sinking, the ground was frozen to about 550 metres in depth, the first such application in Nevada. The shaft freezing and sinking was subcontracted to Thyssen.

The cantilevered-beam design allowed early installation of plenum and fan ductwork. Amec Foster Wheeler further optimised the schedule by relocating the power houses to enable their early installation, and pre-assembling some major components in the vendors' facilities and onsite.

The project was completed under budget and on schedule.

APEGBC members, Amec Foster Wheeler: David Lee, P.Eng.; Allan C. Smith, P.Eng.; Aleksandar (Sasha) Golijanin, P.Eng.; Barlowe Lew, P.Eng.

Container Bulk Handling Optimisation

The Las Bambas project was under construction when MMG Limited purchased the property, near Cusco, Peru, at 4,100 metres above sea level. The plan was to develop a complete logistics system for containerised bulk handling of 1.5 megatonnes per year of copper concentrate.

Ausenco worked with MMG to design and implement the concentrate logistics, which comprised delivery from the mine site to a third-party export facility in Matarani. Based on findings from studies and simulation modelling, the Ausenco–MMG team created a system that allowed early export shipping prior to the completion of the new berth facilities. This unique containerised system reduces capital expenditure on truck fleet, minimises environmental risks related to spills, and reduces losses during handling, transfer, and transport.

APEGBC members, Ausenco team: Vlad Solodkin, P.Eng.; Bruce Larson, P.Eng.

Suspended Work Platform Expedites Project and Minimises Impact

Hatch has been working with Teck Metals Ltd. on an innovative approach to replace crane rails within the company's zinc electrolytic and melting plant in Trail, BC, without impacting production. The rail replacement process is being executed from a work platform suspended from the rail being replaced, which allows for safe and ergonomic access to the rail. A traditional approach requires scaffold access, which would affect production. The custom-built work platform provides workshop conditions at rail level, allowing greater work efficiency from 'production' type methodologies.

The rail replacement started in January 2016; completion is scheduled for July.

APEGBC members, Hatch: Chris Graves, P.Eng., Jason Kolba, P.Eng., Bryan Marchand, P.Eng.; Teck Metals: Michelle Fletcher, EIT, John Howe, P.Eng., Rashmi Bhadauria, P.Eng., Tom Stoddart, P.Eng.

New Acid Tower for Chile

NORAM Engineering & Constructors Ltd engineered an extensive upgrade of a sulphuric acid plant for a Chilean copper smelter. The 1,300-tonne/day double-absorption plant treats off-gas from Teniente and Peirce Smith converters. A new NORAM final acid tower, capable of increased gas throughput and a lower pressure drop, allows treatment of up to 150,000 Nm^3/h of metallurgical gases to capture essentially all sulphur trioxide gas and to produce commercial sulphuric acid of 98.5 percent purity. Environmental performance of the plant improved significantly, with a greater than 95 percent reduction in sulphur trioxide and acid mist emissions.

NORAM provided basic design, detailed engineering, site services, fabrication advisory services, and start-up assistance. Specialised equipment, including some tower internals and acid distributors, was custom manufactured in BC for shipment to site.

Extraordinary Load Move Across North–Central BC

Lee Peltz, P.Eng., Chris Grant, P.Eng, RPF, and Glenn Stanker, P.Eng., assisted Heavy Metal Heavy Haul Tall Totem Transport 1998 Ltd. in transporting two large rock trucks across north–central British Columbia.

The 7.3-metre-wide loads required all public roadways to be closed to traffic while the loads were moving. The route was divided into 12 segments, and the loads were stopped after each segment to clear any queued public traffic. The sequential closures worked well, even in Fort St. James, where side streets had to be closed to prevent traffic from entering the roadway while the loads were moving.

Four bridges required inspection and monitoring while the loads crossed. Chris Grant, P.Eng., RPF, traveled to Endako Mine and Fort St. James six times to weigh the vehicles and monitor the bridge crossings. In the process, he developed a new method for weighing axle loads for tridem axles.

Stabilisation of Eroded Cedar Creek Headwaters

The BC Lower Mainland's Cedar Creek headwaters were severely eroded following two recent significant rainfall events. During the events, creek substrates were breached, exposing highly erodible sands, which caused major slope failures and transported large amounts of sediment downstream near the sensitive aquatic habitat upstream of Burnaby Lake. This failure also put at risk an existing sanitary sewer west of the creek and caused substantial tree loss.

Urban Systems, along with Thurber Engineering and Hatfield Consultants, completed slope stabilisation by importing more than 15,000 tonnes of material, restoring the baseflow channel and slopes to the natural creek profile, and completing a significant planting and restoration program. To manage erosive storm flows, a high-flow bypass diversion and a custom energy-dissipation structure were installed to safely convey peak flows to a lower-energy reach of the creek.

APEGBC members, Urban Systems: Spencer Thompson, P.Eng., Simpson Hong, P.Eng.

Splatsin Community Centre Portrays Traditional Form

With an architectural design vision inspired by the traditional aboriginal Kekuli earthen structures of the past, the Splatsin Community Centre portrays traditional form following the age-old function of a community gathering place.

The 33,000-square-foot circular building houses a large open space for recreation and community gatherings, surrounded by a running track and spaces for commercial retail units, classrooms, and boardrooms. The structure's 36-metre clear-span roof-framing system, comprised of custom steel trusses, is supported by a tension-compression ring. An outer ring of reinforced concrete floors and walls supports a perimeter mezzanine level. The entryway features structural log columns and beams with cross-laminated timber decking.

Consultant: Stantec

Grandview Heights Aquatic Centre, Surrey, BC

This iconic LEED Silver-targeted aquatic facility features a 10-lane competition pool with dive platform and spectator seating, a leisure pool, lazy river, water slide, sauna, hot pools, and a fitness centre.

Using liquid chlorine, regenerative media filters, and ultraviolet reactors, AME Consulting Group Ltd. designed the pool system configuration to produce superior water quality while consuming less water, thereby reducing operating costs. Ultraviolet light destroys chloramines dissolved in the pool water, and chloramines in the air are exhausted from the pool gutter drain. High-level supply air washes the natatorium structure and windows. At low levels, it acts as displacement ventilation, providing effective make-up air for the pool's gutter exhaust system.

The structural design integrates air distribution. High-efficiency, heat-recovery chillers move heat recovered from the exhaust-air stream to areas requiring heat, and condensing boilers provide back-up heat.

APEGBC members: Rob Walter, Eng.L., AScT, Cassidy Taylor, P.Eng.

Photo: Harold J. Stewart, The AME Consulting Group Ltd.

World-Class Track and Field Facilities, Greater Vernon Athletics Park

Design and construction administration was provided for a fully landscaped sport complex with a FIFA two-star synthetic-turf soccer/football field, sand-based natural grass field, internationally rated synthetic-surface, dual-colour running track with shot-put sectors, javelin, discus and hammer cage, high jump, and pole vault. The field house contains public washrooms, team change rooms, and a classroom. Bleachers sit 400.

A thick layer of in situ expansive clay and the proposed facilities' tight footprint created challenges to achieving stringent tolerances that relate to differential movement on the finished track surface. The design called for the clays beneath the track and synthetic field to be replaced with non-frost-susceptible granular material. Where possible, the clay was re-used as fill beneath the turf field and within berms. Uncontrolled fill beneath existing high-pressure gas mains was another layout and design challenge.

APEGBC members, WSP: Jared Bunch, P.Eng. (civil); Williams Engineering: Michael Raiva, P.Eng. (mechanical), Paul O'Connor, EIT (electrical); Interior Testing Services: Peter Hanenburg, P.Eng. (geotechnical); Fletcher Paine & Associates: Robert Scherz, P.Eng. (geotechnical); DIALOG (architecture and sport architecture services)

Boundary Bay Dike Foreshore Upgrades

The Corporation of Delta retained SNC-Lavalin Inc. to upgrade two sections of the Boundary Bay dike. SNC-Lavalin provided design, cost estimates, construction and permitting documents, and all tendering and construction services.

Before construction, a nearby resident informed the team about a snake den on the dike. It is illegal to disturb hibernating snakes without permits from the BC Ministry of Environment. The company's snake handler worked with the ministry to develop a plan to move the snakes temporarily to the Burnaby Wildlife Rescue Society.

The day that construction started, a group of children with handmade posters protested the proposed disturbance of the snakes. Delta officials met with them to explain what was going to be done if snakes were found. More than 500 snakes were found in the area of the dike face. In the end, construction was completed on time and budget, and all snakes were returned to their den.

APEGBC members: Conrad Lehane, P.Eng., Grant Lamont, P.Eng., Sherry Lim, EIT

Courtenay Riverway Heritage Walk Improvements and Habitat Restoration

The Courtenay Riverway Heritage Walk is a multi-use path near the mouth of the Courtenay River, Vancouver Island. Wedler Engineering made improvements to the walk, which includes a length of three-metre paved path with opposing lanes.

In addition, a manmade slough was constructed, using retaining walls of soil-filled geotextile sacks, to restore fish and wildlife habitat. These also support the path, which is laid on a foundation of large, natural stones, along the existing natural river slough. The sacks provide a base for local flora to be planted directly into.

The man-made slough rises and lowers with the tides, and three large-diameter-arch culverts allow passage for wildlife. The improvements were finished with decorative concrete fencing, sodding, and replanted alders.

APEGBC members: Andrew Gower, P.Eng., Greg Merchant, EIT

Anaham Meadows Drainage Rehabilitation

Anaham Meadows has been an important agricultural area for BC's Tl'etinqox community for more than 100 years. Because of the region's dry climate, irrigation is necessary for crop and livestock production. In 1963, a series of drainage structures was built to facilitate seasonal flooding and draining of the meadows. The structures were difficult to operate and, over time, the system deteriorated to the point of being deemed inoperable.

Klohn Crippen Berger was engaged to restore the functionality of an aging irrigation system on a culturally significant site with unique environmental conditions. The primary objective of the project was to restore functionality using as many of the existing structures as possible. Successful project execution required disciplined management, multi-stakeholder engagement, technical innovation, and adaptability.

APEGBC members, Klohn Crippen Berger (primary consultant):
Andrew Muir, P.Eng., Robin Fitzgerald, P.Eng., Brian Borton, P.Eng.

Photo: Evan Martin, P.Eng.

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First Nation Construction Industry Education, Phase 1

The First Nation Construction Industry Education (FNCIE) Project is a multi-phase project that engages First Nation members of Tsilhqot'in communities to expand knowledge of career opportunities in the design and construction industry. This phase maximised First Nation employment in the design and construction of the Yunesit'in teachers' residences by providing training, mentoring by design professionals, and jobs. The design team also engaged school children in science, technology, engineering and math activities to build excitement in engineering careers. As well, a career fair was held to share industry opportunities with members. Future phases include an addition to the school gym and other regional building and infrastructure projects. Local, regional, provincial, and federal partners provide support.

APEGBC members, David Nairne + Associates Ltd. (primary consultant): Andrew Mill, P.Eng., Struct.Eng., Paul Miskimmin, P.Eng., Simon Duplus, P.Eng.

Nifty Lifting for Bridge Replacement

Edmonton, Alberta's new Walterdale Signature Bridge will comprise a pair of 206-metre steel arches across the North Saskatchewan River. Sixteen pairs of steel hanger cables will suspend the bridge deck from the arches. A pedestrian crossing will hang next to the deck.

Project general contractor ACCIONA Pacer Joint Venture contracted Allnorth as the Erection Engineer of Record.

The arch's midspan was first assembled on the riverbank, then skidded and barged into the river before being lifted 16 meters into place. A second heavy lift of about 2,000 tonnes brought the complete arch to its final configuration. Allnorth also designed the procedure for suspending the bridge deck and fine-tuning the hanger cables.

APEGBC members, Allnorth's Walterdale Bridge group: Dragan Majkic, P.Eng., Andy Chang, P.Eng., Nigel Brown, EIT, Koushan Sadeghi, P.Eng., Bogdan Alexeyenko, P.Eng.

Westhills YW/YMCA Langford Aquatic Centre

Westhills Land Corporation's YMCA/YWCA is the newest multi-use recreational facility to open in the Westhills community, in Langford, BC. This $30-million, 75,000-square-foot building provides residents with aquatic and fitness opportunities, and incorporates a new regional library, the Victoria Conservatory of Music, and a daycare.

Sustainable and energy-efficient design allowed substantive rebates to be offered by BC Hydro and FortisBC under their respective sustainability programs.

APEGBC members, On Point Project Engineers: Robert Walter, Eng.L., (mechanical); G. Wade Griffin, P.Eng. (structural); Matthew Pike, P.Eng., (civil); J. Roger Dupuis, P.Eng., (electrical); Clair Wakefield, P.Eng., (acoustics)

PHOTO: ED WHITE

New Life for TransLink's Oldest Station

Main Street Science World is the oldest and one of the busiest stations in TransLink's rapid transit system. Built in 1982 as a demonstration station for Expo '86, the station has been upgraded to increase accessibility, improve transfer experience for passengers arriving by bus, and increase capacity. An expanded east stationhouse with a new entrance, a west station entrance, escalators, stairs and elevator increase capacity and improve accessibility, and a new, open design improves lighting and security.

Applied Engineering Solutions Ltd. (AES) designed the station's electrical systems, ranging from power distribution and lighting to emergency systems. The scope also included design interface and coordination for the fire alarm and various system-wide train operating systems.

The station remained fully operational and passenger flow was maintained throughout demolition and construction.

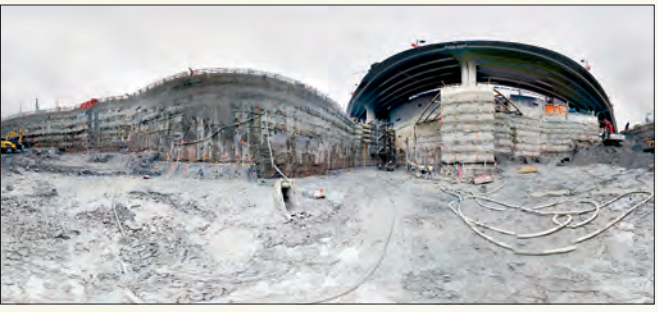
APEGBC member, AES (consultant, electrical): Ahmet Ulker; P.Eng., Narvir Patrola, P.Eng.

Rio Abajo Footbridge Restores Vital Community Access in Nicaragua

The Rio Abajo Footbridge over the Pueblo Nuevo River in Nicaragua was destroyed by Hurricane Mitch in 1998. Since then, the community has been impaired by the lack of a proper river crossing and has had limited access to markets, secondary schools, and health care services.

When Bridges to Prosperity, a non-profit organisation dedicated to reducing rural isolation by building footbridges over otherwise impassable rivers, learned of the challenges the residents experienced daily, they partnered with COWI North America (formerly Buckland & Taylor) and Kiewit Bridge & Marine District to construct a new footbridge. COWI North America's engineering team travelled to Nicaragua as part of the build team that completed the pedestrian suspension bridge superstructure in just eight construction days.

APEGBC members, COWI North America: Don Bergman, P.Eng.; Terrence Davies, P.Eng.



A Challenging Excavation and Shoring Project

GeoPacific Consultants Ltd. completed excavation and shoring design for Aquilini Development's south tower project at Rogers Arena, in Vancouver. Design began in 2013, and shoring construction by Matcon Canada Inc. began in early 2014. The presence of structures such as the Georgia Street Viaduct and the Rogers Arena building adjacent to the 15-metre-deep vertical cuts created unique challenges.

The support system for lateral earth pressure combined jet-grouted, anchored soldier piles for the poor upper-ground conditions and conventional anchored shotcrete wall within the competent glacial-till zone. Three viaduct piers, supported on concrete piles, existed next to the vertical cuts, but the contemplated excavation depth was below the pile tips. GeoPacific designed a micro-pile underpinning system to support the pier pile caps. A three-dimensional monitoring system combining highly sensitive tilt-meters and laser displacement meters was installed on each pier to monitor movement during shoring.

Below-grade construction works were completed in August 2015.

Heritage Building Acquires 21st-Century Systems

411 Dunsmuir is a 100-year-old heritage office building located in downtown Vancouver. OMICRON rehabilitated and expanded the building to provide a unique Class B office–mixed-use building with boutique floor plates.

The 45,000-square-foot project included a complete renovation and partial seismic upgrade of the existing Class B heritage building and a 14,000-square-foot, four-storey addition. A new transformer and secondary power distribution board were added to the existing indoor dual-radial high-voltage switch, and a new grounding grid was installed to upgrade building power distribution and provide capacity for future additions. A new roof-mounted air-handling unit provides the building's heating, cooling, and ventilation system. Variable air volume boxes with re-heat coils are provided on the supply air duct on each floor. A high-efficiency condensing boiler was installed in the building. The building is fully monitored and controlled by a building management system.

APEGBC members: Alex Riftin, P.Eng.; Calvin Schmitke, P.Eng., Struct.Eng.; Jack Zhang, P.Eng.; Bill Tucker, P.Eng.; Tim Loo, P.Eng

Vancouver House Excavation and Shoring

Excavation for the Vancouver House development began in May 2015. Encroachment for tie-back anchors at the southern end of the site was not provided, and engineers were faced with the task of supporting the 28-metre-deep vertical cut using internal braces. Braces had to be positioned to avoid critical vertical reinforcement zones in the proposed structure, which led to the asymmetric design.

Value engineering was used prior to construction on this project. The contractor worked with the geotechnical consultant to develop a cost-effective concept that met all the geotechnical requirements. This resulted in reduced construction schedule and overall project costs. The excavation successfully reached final grade in February 2016.

ICON West Construction Corporation (general contractor); APEGBC members, Southwest Contracting Ltd (excavation and shoring): Daniel Sims, EIT; Somerset Engineering (structural steel): Raymond Florendo, P.Eng.; GeoPacific Consultants Ltd. (geotechnical engineering): Matthew Kokan, P.Eng., Michael Indelak, P.Eng.

Energy-Efficient Steel Framing System Reduces Heat Transfer and Steel Use

Using new technology, thermal bridging heat transfer in steel framing is reduced by 80 to 90 percent. Another benefit is reduced steel use by up to 44 percent.

Vancouver-based Structa Wire Corp. has invented such a thermally efficient steel-stud framing system. The studs consist of two metal flanges, with a web of double truss wires that are resistance welded to the flanges. The tracks are also thermally improved. The Civil Engineering Department at the University of British Columbia modelled and tested the system's structural properties: the limiting height–strength tables for this system closely match conventional steel framing. The university's Mechanical Engineering Department performed thermal modelling. Hot box testing, at Oakridge Research National Laboratories, confirmed U values 55 percent lower than conventional framing. The system improves energy performance, reduces material use, and reduces sound transmission.

APEGBC members: William Spilchen, P.Eng., Dr. Tony Yang, P.Eng., Dr. Nima Atabaki, P.Eng., Matthew Bell, EIT.

Structural Challenges at UBC's Robert H. Lee Alumni Centre

Located in the heart of the University of British Columbia's campus, the Robert H. Lee Alumni Centre is a four-storey, 40,000-square-foot building made of concrete, steel and glass. Targeting LEED Gold certification, the second and third floors collect solar energy to help heat the building, while the interior features extensive use of local Douglas-fir wood.

The building's centrepiece is the atrium, with its free-spanning staircases clad in timber. Glotman•Simpson's challenge as structural engineering consultant was to produce a design that kept the stairs slim, light, and without intermediate support over the 15-metre span. The project team's solution was to hide steel trusses within the guardrails, with the stairs themselves spanning between the bottom chords of the trusses. This was modelled in E-TABS to check frequency to control vibration, and also in STAAD to establish the design forces.

APEGBC members, Glotman•Simpson Consulting Engineers: Mark (Anthony) ElAraj, P.Eng., Neil Wilson, P.Eng

Detail Erection and Electrical Engineering at Telus Garden

TELUS Garden is Vancouver's first LEED Platinum office tower. The predominantly concrete building features substantial and complex steel elements. KWH Constructors and Somerset Engineering were responsible for erecting and designing the connections.

Two structural steel elements required creative, detail erection engineering: the Office Bar, a four-storey cantilevered-truss office building, and the Canopy, a 73-metre steel archway at the property's base. Permanent and temporary connections were detailed using extensive field welding to ensure a clean, aesthetically pleasing look to the exposed steel.

The 22-storey tower includes energy-efficient and modern technologies to reduce energy consumption and optimise building performance. Under the Integral Group's design, heating and cooling are provided by a central plant, located in the basement, that uses waste heat from the nearby TELUS data centre as a source of heating energy via a network of hydronic piping that supports the building's mechanical system. A rooftop solar-photovoltaic array with 70-kiloWatt capacity generates 65,000 kW/hr/yr.

TELUS Garden is a smart building that delivers low-cost, efficient building services, such as lighting, thermal comfort, and air quality, with low environmental impact over the building's life cycle. Through strategic software design and converged network infrastructure and verification, TELUS Garden uses an integrated building automation system that includes analytics and graphics to optimise performance.

APEGBC members, Somerset Engineering: Philip Sullivan, P.Eng., Raymond Florendo, P.Eng., David Hollander, P.Eng.; Integral Group: Goran Ostojic, P.Eng., Jubin Jalili, P.Eng.

discipline and enforcement

Disciplinary Notice: Wayne H. Quong, P. Eng., Vancouver, BC

A Notice of Inquiry was issued to Mr. Quong regarding a report he signed and sealed for a hazard assessment for a commercial development in Salmon Arm, BC (the "Report").

In lieu of proceeding to a disciplinary inquiry, Mr. Quong agreed to a Consent Order dated April 21, 2016. In the Consent Order, Mr. Quong admitted that he demonstrated unprofessional conduct by affixing his professional seal to the Report without qualifying or limiting the extent of his responsibility. Mr. Quong admitted that he was not trained or experienced to conduct an appropriate review of the professional work related to river flooding, erosion hazard assessment, hydrology, and fluvial geomorphology contained within the Report.

As part of the Consent Order, Mr. Quong accepted and agreed:

1. That his membership in APEGBC is suspended for one month starting May 1, 2016; and
2. To pay $9,500 towards APEGBC's legal costs.

APEGBC members are reminded to adhere to APEGBC's *Quality Management Guideline for Use of the APEGBC Seal*, specifically section 3.4.3, which states:

> **3.4.3 Multiple discipline documents**
> 3.4.3.1 If more than one engineering and/or geoscience discipline is included in one document, as a minimum, the APEGBC professional for each discipline must seal the portion of document for that specific discipline, and qualify the extent of his or her responsibility. Where there is input from one or more APEGBC professional specialists, each specialist must also seal the document and qualify the extent of his or her responsibility. For example, in such a case, a structural engineer could qualify the seal with a statement such as, "For Structural Aspects Only".

The full text of the Consent Order agreed to by Mr. Quong can be found at apeg.bc.ca under Disciplinary Actions. The webpage contains information on APEGBC's complaint, investigation and discipline process. You can also contact us at 604.412.4869 or toll-free at 1.888.430.8035 ext. 4869, or by e-mail at complaints@apeg.bc.ca.

regulatory affairs

Use of Job Titles by EITs and GITs

When working in the fields of engineering and geoscience, it's important to represent yourself appropriately and accurately to the public. APEGBC regulates use of the terms "engineer" and "geoscientist" to protect the public and prevent misrepresentation of an individual's qualifications to engage in independent practice of professional engineering or professional geoscience. An APEGBC policy outlines the parameters of use by APEGBC engineers- and geoscientists-in-training.

The policy states that an individual who has status with APEGBC as an Engineer-in-Training (EIT) or Geoscientist-in-Training (GIT) is permitted to use a descriptive job title that includes the word "engineer," "geoscientist," or other restricted words associated with the practice of professional engineering or professional geoscience, provided the following conditions are met:

A. When using the job title, the individual is clearly identified as an EIT or GIT in the same communication;
B. The individual is working under the direct supervision of a registered professional engineer or professional geoscientist who takes professional responsibility for the EIT's or GIT's work;
C. The EIT or GIT works at a firm where there is a professional engineer or professional geoscientist on active staff; and,
D. The individual does not otherwise represent himself/herself or act in such a way that an average member of the public may likely be led to believe that the EIT or GIT is ready or entitled to engage in independent practice of professional engineering or professional geoscience.

The use of engineering or geoscience titles by an EIT or GIT who does not meet the above conditions would constitute a breach of section 22 of the *Engineers and Geoscientists Act*, which sets out prohibitions on unauthorized use of engineering and geoscience titles.

Examples of correct and incorrect use of job titles by EITs and GITs include:

Correct Use	Incorrect Use
Vincent Leung, GIT Exploration Geophysicist	Jeffrey Biggs Mechanical Engineer ***(Breaches Condition A)***
Abdul Aman, EIT Electrical Engineer	Ravi Prasad, GIT Chief Geoscientist ***(Breaches Condition D)***
Adam Rodan, GIT Geoscientist	Sonya Prasad, EIT Senior Structural Engineer ***(Breaches Condition D)***
Jesse Saunders Engineer-in-Training	

If you have questions about use of titles, contact Taymaz Rastin, Staff Lawyer, Regulatory Affairs, at trastin@apeg.bc.ca or 604.430.4978.

APEGBC and the BC Ministry of Health have developed a standardised statement of compliance for the construction and operation of pools in the province.

The British Columbia Pool Regulation Statement of Compliance eliminates regional differences required by provincial health authorities. Without standardised wording for the statement required under Section 6(2)(a)(i) of the *Pool Regulation*, some provincial health authorities had created their own forms, some of which go beyond the requirements of Section 6(2)(a)(i) and include wording that potentially:

- Voids the engineer's or architect's insurance policy; or
- Makes an engineer or architect liable for conditions pertaining to the operation of the pool and over which an engineer or architect has no control once the control of the construction pool has been passed to the pool owner.

The Ministry obtained the health authorities' agreement on the new form's wording and format. APEGBC Council endorsed the statement at its April 2016 meeting. The Architectural Institute of British Columbia is seeking endorsement from its Council.

The British Columbia Pool Regulation Statement of Compliance is available from apeg.bc.ca/Guidelines.

New APEGBC Professional Practice Guidelines

This summer, APEGBC is releasing a number of new APEGBC professional practice guidelines to assist members and licensees in their practice. The guidelines set out the expectations and standards of care in professional practice for specific areas.

Site Characterisation Assessments for Dam Foundations in BC

These guidelines were developed in response to the *Report on Mount Polley Tailings Storage Facility Breach*. They provide guidance on the due diligence to be followed when carrying out dam site characterization assessments on dam foundations in British Columbia, and set out a consistent and comprehensive standard of professional practice.

Written for qualified APEGBC professionals, statutory decision makers, regulators, First Nations, mining companies, the public at large, and other stakeholders involved or with an interest in the carrying out of site characterisation assessments for dam foundations in BC, the guidelines establish a common level of expectation regarding level of effort, due diligence and standard of care to be followed.

Professional Responsibilities for the Design and Installation of Elevating Devices in New Buildings

These guidelines provide APEGBC members and licensees with guidance on the responsibilities of professional stakeholders for the design, construction, installation and commissioning of elevating devices in buildings. The guidelines discuss the relevant codes and some commonly encountered issues related to integrating elevating device systems into the new building's systems, and provide guidance to APEGBC professionals who assist architects with the design and installation of elevating devices on new construction projects.

Expert Witness

In the course of their work, APEGBC professionals routinely provide opinions, based on their training, experience, knowledge and honest conviction, that could be characterised as "expert." In legal proceedings, however, the notions of expert and expert witness refer to an individual with specialised knowledge who helps the decision-maker understand the area of specialised knowledge. These guidelines provide guidance to APEGBC professionals who undertake the role of expert witness.

Revised Sustainability Guidelines

APEGBC's Sustainability Guidelines have been updated to better address climate change adaptation and mitigation. Revisions include references to: being guided by sound, peer-reviewed science; addressing climate-change adaptation and mitigation; considering projects' and materials' full lifecycle costs; and, adopting multi-disciplinary approaches to risk assessment and climate-change adaptation and mitigation.

Engineering and Geoscience Offshoring

Know Your Obligations When Sealing Work Done by Others

Engineering and geoscience work knows no boundaries. APEGBC professionals work on projects around the world, and engineers and geoscientists from elsewhere contribute to BC projects. In many cases, with today's communications technologies, practitioners can work on a project even when they are not physically present near it.

Combine this with companies trying to reduce costs and improve turnaround times on deliverables, and globalisation of engineering and geoscience services—often called offshoring—results.

However, unless done properly, offshoring may jeopardise public safety and contravene BC's *Engineers and Geoscience Act*. Members have responsibilities they must meet when collaborating on work with practitioners not licensed to practise in BC.

Offshoring refers to work obtained from sources outside the organisational unit requiring the services, including those located elsewhere in Canada or beyond. The work may be conducted by a non-BC office of the same organisation or through a third-party firm.

It works the other way, too—APEGBC professionals often provide offshored services for projects outside BC.

When involved in engineering and geoscience projects that include offshoring, members must ensure they meet their legal and ethical responsibilities. Generally, under the *Engineers and Geoscientists Act*, engineering and geoscience work for BC projects should be performed by registered APEGBC professionals. However, in some cases, APEGBC professionals may instead take responsibility for work done by those not registered here. In these cases, an APEGBC professional must *directly supervise* the individual and take responsibility for the work the individual contributes here.

Direct supervision entails being actively involved, including:

- considering appropriate experience levels when delegating professional tasks,
- providing adequate supervision of field reviews, and
- taking responsibility for the professional engineering or professional geoscience decisions.

APEGBC Professionals Sealing Documents after Minimal Prior Involvement

APEGBC professionals must meet several obligations before they apply their seal to a document they have had minimal involvement creating. The professional must:

1. confirm and document that the project includes a formal quality management system,
2. be aware of the formal training and experience of the individual who performed the work being signed off,
3. confirm that the individual developing the document is working within a practice area in which he or she has appropriate training and experience.

These steps are not required if the APEGBC professional has a long-standing professional relationship with the individual, or if they are both on the active staff of the same organisation and are involved in the delivery of similar products or services requiring the application of engineering or geoscience on a repeated basis.

Once the requirements are met, the APEGBC professional must carry out an appropriate review of the engineering or geoscience work before affixing the seal. The professional must be familiar with the engineering or geoscience document and have the training and experience to perform the work he or she is taking responsibility for—the professional sealing the document must be able to directly deal with and respond to questions related to the document or its implementation.

By sealing the document, the APEGBC professional is taking full professional responsibility for the work.

Equipment Manufactured and Designed Outside of Canada for Use in a BC Project

When APEGBC professionals specify equipment, products or components that require design and manufacture out of province for use on BC projects, they should begin by preparing and sealing performance specifications for each item. The specifications should also require the manufacturer or fabricator to certify that the equipment meets the performance specifications.

APEGBC does not require APEGBC professionals to seal equipment fabrication or vendor drawings. However, when APEGBC professionals receive the equipment, products or components from out of province, they may have obligations requiring application of their seal. For example, if Occupational Health and Safety legislation requires guards or safety switches, APEGBC professionals are responsible for checking and sealing that the equipment meets the requirements. APEGBC professionals must also confirm the equipment meets BC Safety Authority requirements. Where the equipment requires services such as structural supports, electricity, gas or water feeds, APEGBC professionals are responsible for designing and sealing documents showing those services.

Many BC projects use practitioners who are based outside of BC and, therefore, rely on BC-registered professionals to take responsibility for the work performed. It is imperative that APEGBC members understand their responsibilities and take appropriate steps to protect public safety.

For more information about the use of the APEGBC seal, direct supervision, and other quality management guidelines, visit apeg.bc.ca/Quality-Management-Guidelines or contact an APEGBC practice advisor at 604.430.8035. ⊠

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Members provided generous support to APEGBC's two charitable organizations this year. Donations made to the APEG Foundation from July 2015 to June 2016 enabled it to distribute scholarships to engineering and geoscience post-secondary students attending recognised educational institutions in BC. Donations to the Engineers and Geoscientists Benevolent Fund during the same period supported grant programs for members in exceptional financial need.

The generosity of the donors listed here plays a vital part in furthering the continued operation and programs of these important charities. On behalf of the foundation and benevolent fund, as well as members, thank you for your support.

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R. Shi, P.Geo.
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J.A. Touw, P.Geo.

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datebook

Sea to Sky Branch networking event and branch AGM
North Vancouver, BC • **JULY 28, 2016**
Information: apeg.bc.ca/Events/Events/2016/SS2JUL16

Sea to Sky Branch tour and introduction to the geology of the North Shore
West Vancouver, BC • **AUGUST 13, 2016**
Information: apeg.bc.ca/Events/Events/2016/SS1AUG16

Central Interior Branch annual golf tournament and BBQ
Prince George, BC • **AUGUST 13, 2016**
Information: apeg.bc.ca/Events/Events/2016/CI1AUG16

South Central Branch golf tournament and BBQ
Kamloops, BC • **SEPTEMBER 14, 2016**
Information, player registration: apeg.bc.ca/Events/Events/2016/SC1SEP16
Sponsor a hole
Information: apeg.bc.ca/Events/Events/2016/SC2SEP16

OQM Certification training sessions
(Various locations and dates)
Prince George, BC • **SEPTEMBER 16, 2016**
Information: apeg.bc.ca/Events/Events/2016/16SEPOQ1
Burnaby, BC • **SEPTEMBER 20, 2016**
Information: apeg.bc.ca/Events/Events/2016/16SEPOQ2
Vernon, BC • **SEPTEMBER 29, 2016**
Information: apeg.bc.ca/Events/Events/2016/16SEPOQ3
Victoria, BC • **OCTOBER 19, 2016**
Information: apeg.bc.ca/Events/Events/2016/16OCTOQ2
Kamloops, BC • **NOVEMBER 17, 2016**
Information: apeg.bc.ca/Events/Events/2016/16NOVOQ1

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APEGBC 2016 Annual Conference and Annual General Meeting

October 20–22, 2016; Victoria, BC

Join us to celebrate the accomplishments in BC's engineering and geoscience professions at APEGBC's 2016 Conference and Annual General Meeting. The event takes place in Victoria, BC, October 20–22, and consists of two days of professional development sessions, networking opportunities, an exhibitor tradeshow, followed by the 97th Annual General Meeting. Find information and register at apeg.bc.ca/ac16.

Power System Stability and Control

August 8–11, 2016; Vancouver, BC

This course provides an overview of power system stability and control problems. It includes basic concepts, physical aspects of the phenomena, methods of analysis, examples of incidents of system instability, challenges to the secure operation of present-day power systems, and a comprehensive approach to enhancing system security.

Advanced Project Management

August 25 & 26, 2016; Richmond, BC

This course is designed for project executives, directors, managers, and project managers who are involved directly or indirectly in managing projects. The course builds on the Fundamentals of Project Management background by analysing current industry practices and introducing value-improving practices to enhance the delivery of complex construction projects.

Static and Fatigue Design of Metal Welded Structures: A Practical Approach

August 29 & 30, 2016; Richmond, BC

Various methods of fatigue analysis of welded structures are discussed, along with appropriate choice of the stress parameter and necessary stress analysis method. The course focuses primarily on the application of the fatigue nominal stress method (S-N), the local strain-stress method.

New Product Development Workshop

September 8, 2016; Vancouver, BC

This workshop helps engineers understand how the product-development pieces fit together, and how to get the most from their efforts. The course reviews the product-development process, details the roles of each function, highlights critical dependencies, and discusses best practices. A planning exercise helps participants gain new insights and accelerate learning.

Hydrotechnical Design of Hydropower Facilities

September 12–14, 2016; Vancouver, BC

This course offers fundamentals of hydrotechnical design of hydropower facilities, with the following objectives: to recognise aspects of hydropower facilities requiring hydrotechnical design such as intake, penstock, power tunnels, gates, manifolds, etc.; to characterise hydrotechnical features, determine forces and design implications; to alert against common mistakes in hydrotechnical design for hydropower; and, to introduce simple computational aids, apply open-source software, and offer a collection of resources.

Working Effectively with Stakeholder Interests on Project Development

September 15, 2016; Vancouver, BC

Communities, Indigenous groups, regulators and investors increasingly seek competency in the social performance of project developers. These stakeholders are essential to project development success. This seminar will help technical practitioners understand and address these issues within the context of their organisations, based on a description of how social risks affect project success, and the intersections between the technical and social aspects of project development.

APEGBC Professional Guidelines: Human Rights and Diversity

September 16, 2016; Vancouver, BC

This seminar helps participants become familiar with the new APEGBC *Professional Practice Guidelines: Human Rights and Diversity* and gain understanding on how the guidelines and issues apply to professional practice. Topics covered include types of discrimination and diversity considerations, as well as the complaint procedure.

Navigating Complexity: Going Beyond Systems Thinking

September 20, 2016; Vancouver, BC

The session introduces complexity science and the Cynefin Framework. Also covered are how planning, strategy development, and project management demand a different perspective when facing complexity.

Coaches Corner: Five Keys for Great Coaching

September 21, 2016; Vancouver, BC

Participants will finish this course with a new understanding of the 'coach approach' for higher-quality conversations and will be able to put it into use immediately. The course includes two live coaching demonstrations.

Contract Administration and Contractual Issues for Engineering and Construction Projects

September 22, 2016; Kelowna, BC

This course covers legal and contractual issues related to the effective management and administration of construction projects. It focuses on the roles and responsibilities of the project managers to contractors and suppliers, provides project managers with a good understanding and the practical implications of the legal precedents, and improves the ability to make better decisions. Legal cases and disputes situations are reviewed and discussed.

System Safety and Cyber-Security Integration

September 23, 2016; Vancouver, BC

This full-day seminar covers fundamental elements of an integrated approach to managing safety and cyber-security risk for complex systems that provide critical services. In particular, the training focuses on how an established system- or software-safety process can be extended to take account of cyber-security threats.

Technical Writing: Solutions for Effective Written Communication

September 27, 2016; Vancouver, BC
November 23, 2016; Vancouver, BC

This seminar provides practical, applicable solutions and techniques for how to express thoughts succinctly in writing. Through a series of hands-on workshops, participants learn to write effective emails, technical memos, letters, reports, and other documents. This seminar helps both junior employees and seasoned professions improve their technical writing skills.

Building a Personal Brand and Selling Skills for Engineers and Geoscientists

September 29, 2016; Vancouver, BC

In this interactive, hands-on workshop, participants acquire the skills to present themselves and their firms in a professional, logical and non-manipulative manner, and secure profitable business based on their value propositions and by building strong relationships.

Geothermal Energy (Resource, Technology and Economy)

September 30, 2016; Burnaby, BC

This one-day course combines theory with practical guidance to improve and enhance participants' skills in geothermal system design and management. It also discusses laws and regulations related to geothermal resources, production, and energy sales.

Writing Effective Proposals and Reports

October 4, 2016; Vancouver, BC
November 29, 2016; Vancouver, BC

This seminar helps engineers and geoscientists develop the confidence and writing skills necessary to write effective proposals and reports. Through a series of hands-on workshops, participants learn the key elements of writing and submitting winning proposals and reports, and how to tailor content for both technical and non-technical audiences. In addition, they learn to determine what their internal and external clients are looking for and how a proposal or report will be evaluated or reviewed.

How to Achieve you Company Vision through Effective Performance Reviews

October 5, 2016; Vancouver, BC

This seminar shows participants how they can take their performance-appraisal form in one hand and their company vision in the other hand, to tightly link to two together to achieve a corporate strategy.

Call for Presenters

Are you an expert in your field who would like to contribute to the future of engineering and geoscience? APEGBC is actively seeking members to present on a variety of topics. For more information, please visit apeg.bc.ca/Events/Seminar.

For a complete listing of events or for more information, visit apeg.bc.ca/prodev/events or contact APEGBC Professional Development at 604.430.8035 or 1.888.430.8035.

Professional Engineers and Geoscientists of BC

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