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Engineer

November/December 2022

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An Engineer in the Kitchen

Jomar Manzano, P.Eng., on The Great Canadian Baking Show. P. 6



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PHOTO BY CARMEN CHEUNG, COURTESY CBC.



Comment

by Peter Saunders

When Schreyer Calls

It's certainly not every day that I receive a voicemail message from a former governor general of Canada, but such was the case on a Friday afternoon in October, just before the Thanksgiving long weekend. It was Ed Schreyer himself, for whom the top accolade among the Canadian Consulting Engineering Awards is named.

As it turned out, when we spoke a few days later, he was calling me from Manitoba—where he was premier from 1969 to 1977, before serving the nation as governor general from 1979 to 1984—for an update on the Schreyer Award and its purpose.

“The award named for Ed Schreyer is presented annually to the best technical entry among all of the submissions to the Canadian Consulting Engineering Awards program.”

Currently, as you probably well know, the Schreyer Award is presented annually to the best technical entry among all of the submissions to the awards program, as determined by our panel of 12 independent expert judges. It is one of five special awards and if no project is deemed worthy of this highest possible honour, it need not be given out at all, at the jury's discretion.

(Some recent winners of the Schreyer have included Trans-Canada Highway Avalanche Mitigation in 2021, the Samuel De Champlain Bridge Corridor in 2020 and Solving Small Community Drinking Water Challenges for the Tl'azt'en Nation in 2019. And you just saw the most recent showcased as the cover story for our September/October 2022 issue.)

Schreyer (the man, that is, not the

award) was phoning to learn more about the overall program and the special awards, as he is not himself a consulting engineer who would receive continual updates from us and our co-sponsors at ACEC-Canada. More to the point, he was reaching out to provide valuable input, which could play a role in changes to the program in the future.

At press time, those discussions have not yet gone any further than some initial brainstorming, but I am sharing this anecdote in this space and at this time because it's worth pointing out you don't need to be a premier, governor general or even a professional engineer yourself to contribute ideas for the future direction of this magazine, website, related media and national awards program. You just need to be interested enough to reach out to us.

Do you have any topics in mind that you'd like to suggest we cover in 2023 and beyond? Would you like to write a feature article or a column? Do you think we need to offer different special awards next time around and, if so, of what type? Did our recently inaugurated Top 10 Under 40 program help inspire you to suggest another new initiative for our platform? Would you like to work with us in any other capacity? Do you simply have some news you want to share with the engineering community?

We are here for all of the above ... and more! And the new year is just about to begin, so now is the perfect chance for you to email me (my address is below, as always) with your thoughts on what you'd like to see going forward. **CCE**

Peter Saunders • psaunders@ccemag.com



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An Engineer in the Kitchen

Senior structural engineer Jomar Manzano, of Toronto-based K.H. Davis Engineering Consultants, competed on *The Great Canadian Baking Show*. **By Peter Saunders**

As CBC TV viewers may have noticed, a consulting engineer was among the competitors on the fall 2022 season of *The Great Canadian Baking Show*. Jomar Manzano, P.Eng., PMP, is a senior structural engineer and project manager with Toronto-based K. H. Davis Engineering Consultants. He studied civil engineering at the Universities of Calgary and Manitoba before working for Tetra Tech in Winnipeg and then Associated Engineering (AE) and Entuitive in Toronto.

“I am a scientific person,” he says, “and both engineering and baking are very science-driven. As a kid, I wanted to put potions together and create something. Growing up at my mother’s knee, that’s what I did in cooking and baking, creating science I could eat!”

When he started university, Manzano dabbled in chemical engineering, but he was more inspired by architecture and, as he puts it, “switched to structural because my brain understands esthetics more than dynamics.”

Today, as part of a boutique firm, he not only works with architects on residential projects, but also wears multiple hats and handles many architectural portions of those projects, such as finishes, detailing and constructability.

“I like to see my designs come to life,” he says. “When I was working with larger consulting engineering firms on structures like bridges, water treatment facilities, towers and potash mines, because of the huge scope, I was only focusing on one portion of each project. In residential engineering, on the other hand, I am the point person for everything from beginning to end. I can walk down the street in most neighbourhoods in this city and say, ‘I did that myself!’ There’s a sense of pride in seeing a project come up from nothing.”

Manzano has also developed a sense of pride in his



Manzano’s first ‘showstopper’ was a halo-halo cake, taking inspiration from the colourful Filipino dessert.

PHOTO BY GEOFF GEORGE, COURTESY CBC.

“I like to see my designs come to life.”



PHOTO BY GEOFF GEORGE, COURTESY CBC.

with which he grew up. By way of example, in the season's first episode, he prepared a halo-halo cake, taking inspiration from the famous, colourful, icy desert.

Yet, he also found the experience of baking on the show was markedly different from engineering—and even from baking at home.

“There’s no amount of preparation you can undertake for baking live in a kitchen that’s not your own,” he says. “In engineering, all variables are accounted for and I have everything I need for any test I might face; but on the show, whether it’s the temperature or time constraints or receiving completely new information, I had to go by seat of my pants with no time to plan. The variables are constantly changing and are often against you, which is a nightmare for an engineer!”

Nevertheless, while Manzano did not win the season, the experience of being on *The Great Canadian Baking Show* was a highly positive one for him. Winning was never as important to him as the friendships he made with his fellow bakers.

“The show is really good at showing the diversity of Canada,” he says. “This season, more than half of the contestants were people of colour and more than half identified as queer. I hope my experience will help other queer, BIPOC folks feel seen and inspire them to follow their dreams.”

It was also positive for K. H. Davis.

“We don’t have a marketing department,” says Manzano, “but now when people Google my name, they see *The Great Canadian Baking Show* and they see that I’m part of the firm. So, the show was definitely an opportunity to increase our brand recognition.”

And in case anyone got the wrong impression: he has no plans to leave the firm to open a bakery.

“My mom asks why I don’t get into it, but engineering pays the big bucks,” he laughs. “I love baking and cooking as a hobby, but I don’t think anything has changed because of the show. It has just given me a better appreciation of everything I’m capable of.” **CCE**



SCREEN SHOT BY PETER SAUNDERS.

Manzano is a senior structural engineer and project manager with K. H. Davis, a boutique residential engineering firm.

Manzano has also developed a sense of pride in his baking over time. While watching *The Great Canadian Baking Show*, which he calls “our Olympics of baking in this country,” he started to see himself in the competitors’ shoes, feeling he could do the same thing they were.

So, he applied to be on the show last

year. As it happened, however, he got called back for an interview right when he was joining K. H. Davis and didn’t have time to follow up on the opportunity.

Fortunately, the show called him back again this year, when he was able to carve out more time for it.

“K.H. Davis is a small firm doing custom designs and when one of us is away, we really feel it,” he says, “but we were able to be nimble and I just directed my clients to our other engineers, so it wasn’t too difficult for me to be on the show.”

Once Manzano accepted the call, the show was a full-time affair for more than a month, starting with test bakes and a live, two-hour ‘bake-along’ to let the producers see what he could do.

“Then the cast of bakers was given our first set of briefs ahead of the shoot, to allow time to submit our recipes,” he explains. (A season of the show is shot in 16 days, spread out over a month.)

Describing his baking as nearly as detailed as his structural engineering, Manzano incorporates Filipino flavours

WaterPower Week Showcases Energy Transition Perspectives

Canada's net-zero goals will rely heavily on hydro. **By Peter Saunders**

Trade association WaterPower Canada (WPC) held its annual conference, Canadian WaterPower Week, from Sept. 21 to 23 at Toronto's Westin Harbour Castle. As part of the event, a series of presentations and discussion panels addressed issues related to the energy transition toward a future of net-zero emissions.

Following the first day's committee, board and council meetings and hydro pump storage concept training session, the second day opened with a plenary by Carolina Rinfret, WPC's new president and CEO, who introduced the conference's main theme: 'Powerful Synergies for Our Electric Future.'

Next, guest speaker Yvan Cliche—a fellow and senior energy researcher with the Centre d'études et de recherches internationales, Université de Montréal (CERIUM)—discussed the geopolitical upheaval caused by resource price fluctuation, with a focus on the internationalization of natural gas, a breakthrough for renewable energy sources and the need for critical minerals to support electrification.

Switzerland's Lombardi Engineering has teamed up in Canada with BBA.

The first panel of experts reached consensus on the importance of serious and strong policies to better co-ordinate provincial efforts to meet federal targets.

"Approvals will have to be turned on their head for the transition to happen by 2035," said Jennifer Williams, president and CEO of Newfoundland and Labrador Hydro.



"Federal policy helps push investment," added Josée Guibord, CEO of Evolugen, citing hydrogen and carbon capture and sequestration (CCS) as key transition technologies.

In concurrent breakout sessions, representatives of Ontario Power Generation (OPG) and Kiewit discussed Northern Ontario's Little Long Dam safety project, which aims to increase the discharge capacity of the Adam Creek spillway structure to ensure floodwater can bypass four Lower Mattagami River stations; while Hatch business development director Jonathan Atkinson and regional manager Martin Dodge provided an overview of their studies to assess electricity generation costs by

source and the scale of the role for hydropower refurbishments and redevelopments to play in a net-zero electricity supply.

A lunchtime plenary offered further perspectives on a net-zero grid from Chuck Farmer, vice-president (VP) of planning, conservation and resource adequacy for Ontario's Independent Electricity System Operator (IESO) and Marie-France Samaroden, VP of grid reliability operations for the Alberta Electric System Operator (AESO).

Later in the conference, a session about the growing role of Indigenous businesses in the electricity sector showcased the need for the corporate sector to partner with Indigenous communities in the collaborative development of new

projects and to provide work opportunities and training.

“Indigenous communities know the land better than we do,” said Mathieu Johnson, VP of strategy for Hydro-Quebec, before the session. “They are great partners.”

Concurrently, Seliam Sayah, head of the energy and water division of Switzerland’s Lombardi Engineering—which has teamed up in Canada with BBA—discussed his firm’s experience on pump storage projects.

BBA’s own power systems business director Nishant Gehani was part of the next panel, along with SNC-Lavalin director of grid solutions Tarek Abdel-Galil and others, which covered the theory and practice of net-zero energy systems. Meanwhile, a technical session addressed the replacement of two

100-year-old scroll cases for the Niagara River’s 10-unit Sir Adam Beck Generating Station.

At a gala dinner, astronaut Chris Hadfield, Canada’s first commander of the International Space Station (ISS), provided his own perspective about the fragility of the planet and the need for action to reduce the impact of climate change.

On the second day of the conference, a panel of human resources (HR) experts revealed Canada’s hydropower industry is currently only 26% female. To solve current staffing shortages, they said, the industry will need to attract more women, more young people and more out-of-country talent. This will call for work with academic institutions.

Breakout sessions discussed protecting aquatic resources with fish passages, outlined the poten-

tial benefits of alternative contract models, suggested how Canada can meet its carbon reduction objectives (based on analysis by SNC-Lavalin) and highlighted BC Hydro’s Site C environmental mitigation and compliance programs.

***“Federal policy helps push investment.”
– Joséé Guibord, Evolugen***

Finally, in the closing plenary, a panel discussed the importance of pursuing regional synergies and the role of new hydroelectric transmission infrastructure.

“The conference was a success,” said Carolina Rinfret. “Participants were happy to get together and network. Attendees really appreciated the subjects covered by the speakers and panelists.” **CCE**



Supporting innovative clean energy solutions

CSA Group standards and research help facilitate the safe deployment of small modular reactors (SMRs), addressing:

- Priority areas for standardization
- Updates of existing standards for SMR applications
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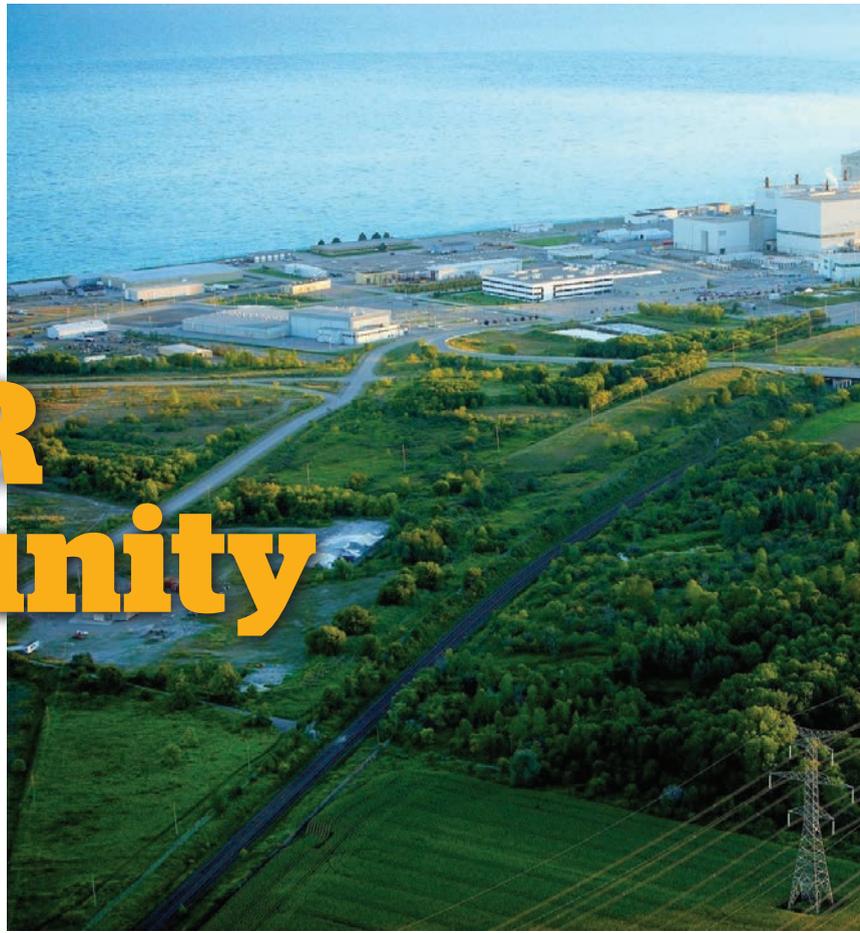
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The SMR Opportunity

Canada's decarbonization goals suggest a bright future for small modular reactors.

By Peter Saunders



With federal net-zero targets calling for deeper decarbonization of the power grid, momentum is building across Canada to increase capacity for emissions-free nuclear energy production. In addition to refurbishing existing facilities, which currently account for up to 15% of Canada's (and about 60% of Ontario's) generated electricity, another area seeing significant interest is the development of small modular reactors (SMRs), which could largely replace fossil fuel-powered generators for heavy industry, the oil and gas sector, communities and remote areas not connected to the main grid.

According to the Canadian Standards Association (CSA) Group, "more than 50 vendors in Canada and abroad are currently developing SMRS, leveraging

The appeal of these new nuclear fission reactors includes their simplified approach to safety, small size, portability and scalability.

OPG plans to build Canada's first SMR in Clarington, Ont.

proven nuclear power plant technologies, such as light water reactors, or introducing novel approaches." The appeal of these new nuclear fission reactors includes their simplified approach to safety, small size, portability and scalability.

Compared to the 6,400-MW capacity of the Bruce Nuclear Generating Station's eight Canada Deuterium Uranium (CANDU) pressurized heavy-water reactors in Tiverton, Ont., for example, a single SMR would produce between 5 and 300 MW.

Another goal is to improve affordability through factory-based plant construction. For this reason, groups of SMRs are already referred to as 'fleets.'

Building momentum

On Oct. 25, the Canada Infrastructure Bank (CIB) announced a commitment of \$970 million toward Canada's first SMR, which Ontario Power Generation (OPG) is developing and building next to its 3,500-MW Darlington Nuclear Generating Station in Clarington. The financing will cover the project's first phase, including project design, site preparation, equipment procurement, utility connections, digital strategy and related project management. It marks CIB's largest investment to date in clean power.

"There's a lot of momentum now," says Amy Gottschling, vice-president (VP) of science, technology and commercial oversight for Atomic Energy of Canada Ltd.

PHOTO COURTESY OPG.



deployment, building upon a 2021 feasibility study from their respective utilities.

There is also interest from Manitoba, particularly in the local government district of Pinawa, which hosts the AECL-owned and CNL-managed Whiteshell Laboratories nuclear research and development (R&D) site. Connected to Manitoba Hydro's grid, this site has been

the 1,500-person municipality's main employer—indeed, Pinawa was built specifically for its employees—but is now being decommissioned. So, there is an opportunity for a comprehensive SMR demonstration, which could lead to further deployments for off-grid communities and mining sites.

“This is what we call the middle stream,

(AECL), which owns the Chalk River Laboratories and the intellectual property (IP) for the CANDU reactors. “Following the direction of Natural Resources Canada (NRCAN) and the Small Modular Reactor Action Plan, with a pan-Canadian approach, we are supporting research, technology demonstrations, standards, programs, infrastructure developments and materials sciences through CNL. We are technology-agnostic.”

Gottschling, who worked for consulting engineering firm Kinectrics before joining AECL earlier this year, explains SMRs would complement large reactors and supplement the intermittent power generation of wind turbines and solar panels in smaller and remote communities.

“OPG, for example, understands the need for both large and small-scale projects,” she says.

For its part, AECL is working with vendors to help build the needed supply chains, corresponding to various provinces' degree of demand. Earlier this year, the governments of Alberta, Saskatchewan, Ontario and New Brunswick jointly released a strategic plan for SMR development and

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The size of SMRs promises benefits in terms of portability.

ation. Some of the solutions proposed include updates to existing standards, developing new national, regional and international standards and collaboration with other jurisdictions.”

Echoing AECL’s technology-agnostic approach, CSA has adapted most of its nuclear standards over the past decade to incorporate technology-neutral requirements and guidance, so as to allow for new designs, including SMRs.

Examples include CSA N286-12, Management system requirements for nuclear facilities; CSAN290.7:21, Cyber security for nuclear facilities (which was developed with input from SMR representatives, among other stakeholders, right from its initial publication in 2014); CSA N293S1:21, Supplement No. 1 to CSA N293-12, Fire protection for nuclear power plants, developed in 2020 to clarify application to SMRs; and CSA N294-19, Decommissioning of facilities containing nuclear substances.

“It is also recognized SMRs use new technologies and enhanced safety features that may not be addressed within the existing standards,” says Logan. “For this reason, the task force has worked to identify and prioritize other standards-related topics that would impact SMRs, including pressure boundary, steel-concrete composite construction, functional containment, emergency management and planning zones, in-service and periodic inspection, reliability and integrity management. For these topics, we are working with stakeholders to evaluate the applicability of existing standards, develop a more specific list of gaps and recommend the scope and urgency of potential updates to the impacted standards.”

Interest in SMR deployment across multiple jurisdictions, she explains, is also driving CSA to engage and collaborate with both Canadian and international stakeholders to harmonize requirements. OPG, by way of example, recently signed a memorandum of understanding (MoU) with ČEZ Group in

On Oct. 11, Ontario Power Generation signed a memorandum of understanding with the Czech Republic’s ČEZ to collaborate on advancing deployment of SMRs in their respective jurisdictions.

decarbonizing mining, oil, gas and other industrial operations in remote locations,” says Gottschling.

Setting new standards

With the development of SMRs comes the need for new standards. CSA started its nuclear program in the 1970s and has since developed more than 65 standards to support safe and reliable operations. The Canadian Nuclear Safety Commission (CNSC) references 90% of these, which address the full life cycle of nuclear power plants and related facilities, from design to decommissioning.

In 2015, CSA established a task force to track the development of SMRs and their needs for standardization.

“We are actively working with

sector stakeholders to identify and address SMR standards-related needs,” says Larisa Logan, CSA’s director of power generation and delivery.

Following up on this task force’s initial work, CSA published a research report in 2021, exploring the role of standards in facilitating SMR deployment.

“The report outlines various approaches, analyzes case studies from the aerospace and electric vehicle (EV) industries and includes a landscape scan of relevant co-operation and harmonization initiatives for SMRs, including those among regulators, industry and standards development organizations,” says Logan. “It concludes with recommendations and considerations on standards harmoniz-





the Czech Republic to advance deployment of SMRs. Under the MoU, they will share information to help reduce financial, technical and schedule risk to both parties for future projects.

Partnering with engineering firms

The need for nuclear-certified consulting engineering firms to take part in these ongoing developments is significant.

“CNL’s strategic vision for 2030, including but not just focusing on SMRs, needs strong partnerships to move fast, spanning government, academia and private industry,” Gottschling says. “We have Canada’s largest research campus and now is the opportunity for engineering companies to come forward.”

One such firm is SNC-Lavalin, steward of the CANDU design, originally developed more than 60 years ago and currently used across four continents. In the nuclear sector, SNC-Lavalin has overseen licensing, design, technology development, new builds, reactor life extensions, decommissioning and site remediation.

“I’ve been in nuclear for my entire career of more than 20 years and

these are exciting times right now,” says Julianne den Decker, senior VP (SVP) of nuclear project delivery for SNC-Lavalin, who joined Areva after studying civil engineering and architecture, then worked for CB&I and Aecon Group. “Climate change and energy security concerns will push an increase in electricity generation. The promise of SMRs bakes in efficiency, modularization and repeatability through the ‘fleet’ approach and project management will be very important in controlling costs.”

By way of example, SNC-Lavalin is working with Moltex Energy Canada in Saint John, N.B., which was selected by its province’s government and NB Power to develop an SMR for initial deployment next to the Point Lepreau Nuclear Generating Station in Maces Bay, N.B. Planning and preparatory work for this deployment are already well underway.

The two companies announced their strategic partnership in April, which was cemented in September when SNC-Lavalin nuclear president Joe St. Julian joined Moltex’s board of directors, alongside former OPG chief financial officer (CFO) John Mauti and former Westing-

SNC-Lavalin’s Canadian nuclear head office in Mississauga, Ont., features a CANDU reactor control room simulator.

90%

The Canadian Nuclear Safety Commission references 90% of CSA’s nuclear standards, which address the full life cycle of nuclear power plants and related facilities, from design to decommissioning.

house Electric president and CEO José Emeterio Gutiérrez. Another consulting engineering firm was already represented on the board by way of Xabier Ruiz, chief operating officer (COO) and former nuclear services director for Spain’s IDOM Engineering Consulting & Architecture, an early investor in Moltex.

“Moltex’s design will power itself using spent nuclear fuel,” den Decker explains, “which will help reduce the volume of spent fuel that needs to be stored.”

SNC-Lavalin is also poised to support other SMR vendors, which range from large original equipment manufacturers (OEMs) like GE Hitachi and Westinghouse to new start-ups, some of which are focused on older reactor design concepts that were never fully realized. As such work ramps up around the world, den Decker emphasizes the geopolitical factors in play.

“Canada was leading the way on SMR development three to four years ago, seeing real promise and developing a road map,” she says, “but now some parts of the world, even the U.S., are leapfrogging us with greater funding. In all countries, federal support is very important.” **CCE**

The Challenges of a Performance-based Building Code

Consulting engineers may face new criteria in design and construction. **By Avinash Gupta, P.Eng., Mohamed Mohamed, P.Eng., and Dominic Esposito, P.Eng.**

Efforts are in now progress to transition the National Building Code of Canada (NBC) from its primarily prescriptive requirements to a performance-based code with new criteria. This transition poses potential challenges for engineering professionals, particularly with regard to fire and life safety.

From prescriptive to objective-based

Where adopted, all requirements in the NBC must be complied with, either prescriptively or by other means that provide at least the minimum level of performance intended by the code. These requirements are called ‘acceptable solutions.’

The 1995 edition of NBC was replaced in 2005 by an objective-based code, *i.e.* stipulating overall objectives that were required to be met, with consideration of minimum

performance. This code included functional and intent statements to help users understand the reasoning behind the acceptable solutions.

The introduction of the objective-based code was a step toward a performance-based code to enable alternatives to prescribed requirements. Indeed, some of the acceptable solutions in the code are already performance-based, such as Division B: Part 5: Environmental Separation.

With a non-prescriptive approach, the proponent developing an alternative solution assumes responsibility for code compliance and demonstrating such to the authority having jurisdiction (AHJ).

Seeking flexibility

The performance-based building design concept is not new; in the 18th century, the Code of Hammurabi stated “a house should not collapse and kill anybody.”

The NBC’s current practice is

1982

The International Council for Research and Innovation in Building and Construction published ‘Working with the Performance Approach in Building,’ which explained “the performance approach is, first and foremost, the practice of thinking and working in terms of ends rather than means.”

intended to ensure its minimum prescriptive requirements are met in a proposed design, so no modeling or verification tools are needed. In contrast, a performance-based approach accommodates greater flexibility in design and material selection.

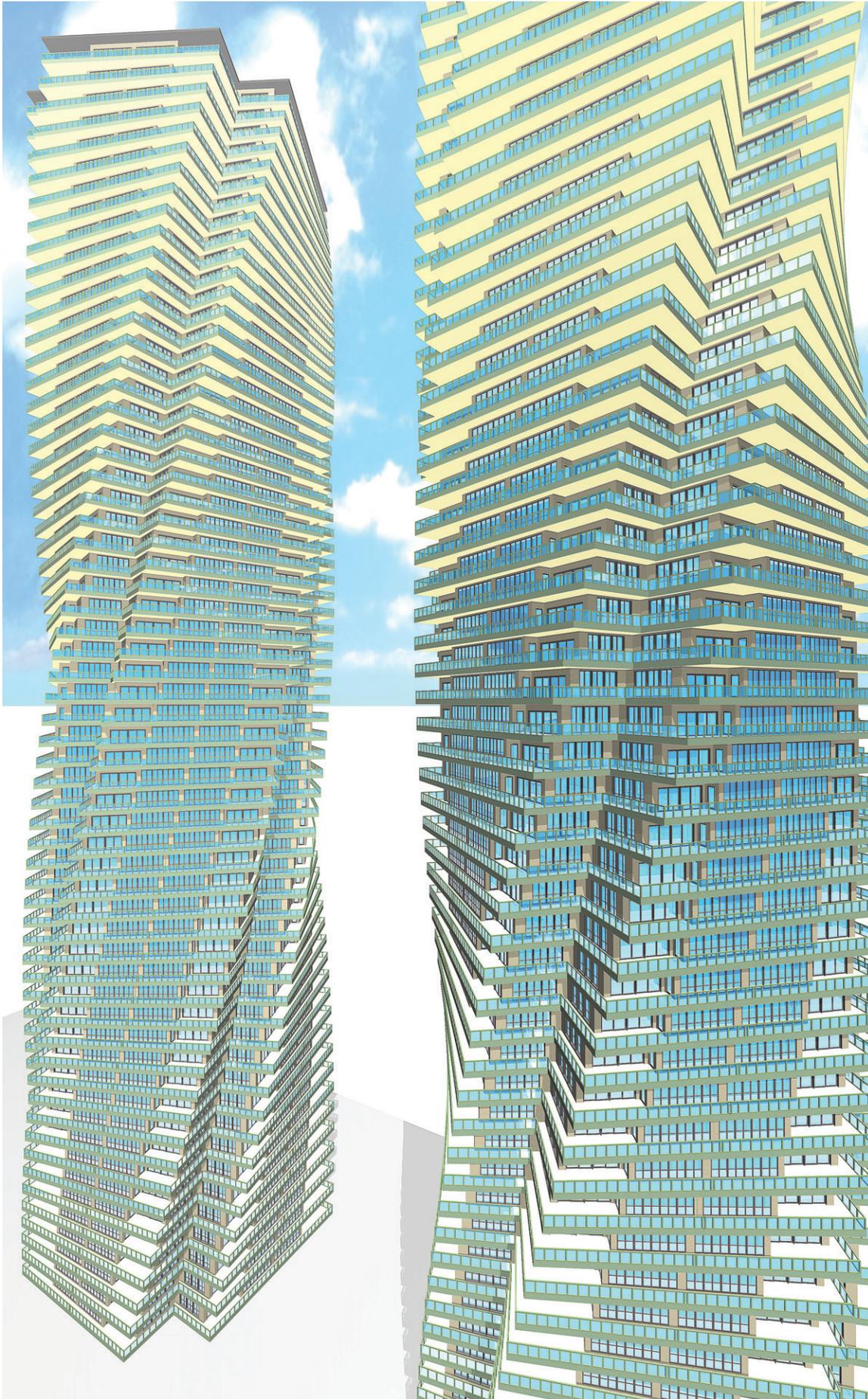
In 1982, the International Council for Research and Innovation in Building and Construction (CIB) published ‘Working with the Performance Approach in Building,’ which explained “the performance approach is, first and foremost, the practice of thinking and working in terms of ends rather than means. It is concerned with what a building or building product is required to do and not with prescribing how it is to be constructed.”

Performance-based design involves understanding the function of the proposed building and its components using resilient, meticulous and consistent scientific tools. All parts of a building must be subjected to scrutiny when developing a performance-based design.

While prescriptive requirements are embedded in the NBC and, thus, easier to deal with than performance-based requirements, they may not be the most desirable and economical solutions. Performance-based approaches may employ better, more innovative or cheaper solutions without compromising quality and safety.

That said, prescriptive specifica-

A performance-based approach accommodates greater flexibility in design and material selection.



The performance-based building code may be a better option for a high-rise design like this one, which is twisted by the progressive rotation of its floor plates and façade as it gains height, benefiting from a decrease in wind loads and greater energy efficiency as heat gain is reduced.

500

A 50-storey building is proposed with 500 occupants on the uppermost floor, which features an observatory and a nightclub.

The AHJ plays a pivotal role in assessing safety for a performance-based design.

tions will continue to play a significant role, as adequate knowledge for some performance features is not available. Specifications will often need to be expressed partly in performance terms and partly prescriptively.

Other motivations for retaining prescriptive requirements include the cost of a performance evaluation of a product in comparison to its price, a scarcity of professional resources, skilled labour and contractors or the absence of a local construction industry to build complex performance-based designs in remote parts of Canada.

Further, significant effort is required to design a performance-based building with adequate safety for occupants and property protection. The design should state the level of performance projected from experiments, calculations or modelling.

Preparer and reviewer qualifications

The qualifications, training and experience required for designers who develop performance-based buildings are not explicitly specified anywhere; there is no formal certification or educational training program. A registered and licensed professional engineer may create performance-based designs until provinces and territories determine such qualifications.

In the meantime, the AHJ

plays a pivotal role in assessing the methodology and levels of safety for developing a performance-based design. The qualification, training and experience of AHJs are key in approving performance-based designs.

Performance criteria

The Society of Fire Protection Engineers (SFPE) Handbook provides a framework of performance criteria for an agreeable level of risk to a building's occupants. One of these criteria, for example, is the safe evacuation of occupants before the environment becomes untenable in a fire emergency.

For a performance-based design, the team chooses fire safety criteria in consultation with the AHJ, based on the overall intended performance of an adopted code or standard. The fundamental prescriptive requirements will still constitute part of the design.

Application of performance-based design

The performance-based design approach provides flexibility, but does not and cannot replace the current model code. Consider the following example.

A 50-storey building is proposed with 500 occupants on the uppermost floor, which features an observatory and a nightclub. Located 150 to 160 m above grade, the most apparent concern is safe evacuation.

The NBC requires at least

two remotely located exits, adequately sized to serve the occupant load, clearly visible, identifiable and always accessible. The building's height and occupant load suggest compliance with NBC provisions would require many more—or wider—exit stairs from the uppermost floor to grade level. Complying with the code's acceptable solutions is not only a challenge, but may be impractical. So, a performance-based design is a better approach.

The building could be designed with refuge floors, where all occupants of the uppermost floor would be moved before they are evacuated. Another or complementary solution may be to specify high-speed elevators with additional fire and life safety features, although the risk of these elevators being out of order must be considered in the evacuation strategy. Available safe egress time (ASET) and required safe egress time (RSET) are essential to assess any fire scenario.

So, performance-based design might be practical for a structure that, due to its configuration, cannot technically meet existing prescriptive requirements. The designer must meet a predetermined set of performance criteria complementing the fundamental code provisions.

The main areas where performance-based design and procurement could be considered are service engineering, energy consumption, lighting, plumbing, air quality and heating, ventilation and air conditioning (HVAC).

Addressing concerns

An immediate concern is the role of the AHJ in reviewing

and approving a performance-based design proposal. Currently, most jurisdictions hire building officials who must pass all the code exams or are professional engineers, but may not be qualified to validate time-based egress analysis and/or smoke modelling, both of which are commonly required for managing a fire and life safety performance-based design.

Another significant challenge is how to predict performance. This will become feasible by developing educational modules for design professionals that show where, why and how the performance-based building concept is already being put into practice, with examples and explanatory notes. In the long term, a mandatory semester on performance-based design could be included in the curriculum for engineering schools.

In the meantime, it is of utmost importance to discuss a performance-based design for any project with the AHJ before committing, as many municipalities do not entertain alternative solutions. Reliable documentation must be negotiated and agreed upon between design professionals and regulators at a conspicuous location; such information will be essential to any forensic team investigating the reasons for a failure in the future. **CCE**

Avinash Gupta, PEng, is chief code compliance engineer and assistant fire marshal for the government of the Northwest Territories. Mohamed S. Mohamed, PEng, is East Canada manager for Jensen Hughes. Dominic Esposito, PEng, is a senior project consultant for Jensen Hughes. For more information, contact Gupta at avinashgupta.eng@gmail.com.

Post-pandemic LTC facilities

The University of Toronto (U of T) recently published 'Reimagining Long-Term Care Architecture in Post-Pandemic Ontario—and Beyond,' a study co-sponsored by consulting engineering firm Jacobs Canada and the Ontario Association of Architects (OAA). As the title suggests, the report explores how the built environment could better support long-term care (LTC) communities in the wake of COVID-19, which has had a disproportionate impact on people living and working in such facilities, exposing structural vulnerabilities.

The report outlines the need to update standards and design guidelines to enhance infection control, with best practices aligned with modern clinical approaches for LTC residents with physical and/or cognitive impairments. Efforts to ensure resident safety during the pandemic unintentionally increased isolation and reduced mobility.

One of the key figures behind the report is Jacobs vice-president (VP) and regional director of international relations Ansar Ahmed, P.Eng., who helped convene a roundtable in late 2020 that led to the report.

"When we think about vulnerable segments of society, such as the elderly, I believe an engineer's 'can-do' and 'must-do' approach, coupled with a collaborative mindset, is called for to deliver equitable and sustainable solutions to such challenges." - Ansar Ahmed

How was Jacobs involved in the development of the report?

Following the roundtable, Jacobs health-care principal and board-certified internist, geriatrician and health-care architect Dr. Diana Anderson and I were invited to provide testimony before the Ontario Long-



Ansar Ahmed.



Dr. Diana Anderson.

Term Care Commission. Dr. Anderson spoke to the importance of integrating a data-driven process to better understand the impacts of health-care design on patient outcomes, staff well-being and care delivery.

During that testimony, we were introduced to OAA and to Stephen Verderber, director of the U of T Centre for Design + Health Innovation. Jacobs and OAA decided to jointly fund research, led by Professor Verderber, focused on identifying case studies from around the globe that model design excellence

in LTC residences. The study went on to suggest 50 design considerations for professionals in this sector.

What were the key findings?

While the pandemic emphasized infection control challenges, the research findings demonstrated this aspect alone should not be the primary design driver. The report outlined the complex interplay between factors such as infrastructure, the incorporation of nature and wayfinding.

For this building type to succeed, design and operations need to align. Users need to be considered beyond their risk of infection spread, in quality-of-life and health outcome metrics, both of which are impacted greatly by the built environment.

The research also emphasized the need for further data collection and an evidence-based process in the engineering and architecture professions. We believe academic and industry partnerships undertaken for this study are the way forward in solving this complex problem.

What are the implications of these findings for consulting engineering firms?

Cross-collaboration across specialties must be emphasized. When we think about vulnerable segments of society, such as the elderly, I believe an engineer's 'can-do' and 'must-do' approach, coupled with a collaborative mindset, is called for to deliver equitable and sustainable solutions to such challenges.

There may be a tendency toward settling for approaches that are tried and tested, but problems faced by vulnerable communities scream out for the innovation, creativity and multi-dimensional solutions that have become the hallmark of the consulting engineering sector. **CCE**



Building Bridges to Last a Lifetime

Consulting engineers and other bridge experts gathered in Toronto in July to discuss the need to replace aging structures across the country. **By Peter Saunders**

In July, the Canadian Society for Civil Engineering (CSCE) organized the 11th International Conference on Short and Medium Span Bridges, dubbed 'SMSB 2022,' at the Sheraton Centre Toronto Hotel. Held every four years in various cities across Canada (including Quebec City in 2018 and Calgary in 2014), the conference provides a global forum on all aspects of short and medium span bridges, including forensic engineering, planning, design, construction and management.

This year's sponsors included many consulting engineering firms: Arup, Associated Engineering (AE),

CIMA+, Dillon Consulting, Entuitive, EXP, HDR, Lea Consulting, McIntosh Perry, Morrison Hershfield (MH) and WSP.

The event was co-chaired by WSP senior consultant Tony Wing, P.Eng., most of whose professional experience has involved managing, planning, designing and constructing bridges, tunnels and other transportation projects; and Toronto Metropolitan University (TMU) professor Khaled Sennah, P.Eng., whose areas of academic interest include bridge materials, dynamics, analysis, design, evaluation and rehabilitation. The honorary chair was WSP president and CEO

560

delegates registered and attended, says Tony Wing, and with volunteers and staff, more than 600 people were coming and going.

Marie-Claude Dumas.

"About 560 delegates registered and attended," says Wing, "and with volunteers and staff, more than 600 people were coming and going. Usually, we get around 500 people. There was big interest from around the world this year. At least 10 countries were represented."

Even more countries, topping 50, were represented during the pre-conference technical review of more than 400 submitted papers. Out of those, about 300 went on to be presented. This was accomplished by spreading concurrent sessions across seven rooms, with each session presenting five papers.

Two of the sessions that saw some of the conference's strongest attendance were devoted to new climate change provisions for CSA's Canadian Highway Bridge Design Code (CHBDC). This theme was also core to a keynote presentation by Don Kennedy, P.Eng., AE's vice-president (VP) of transportation structures.

"Climate change impacts the way we design bridges, from warmer and fluctuating temperatures to

"There was big interest from around the world this year."
- Tony Wing, WSP

flood events and fires, which can cause bridges to collapse,” says Wing. “The conference’s theme this year was ‘building bridges to last a lifetime’ and when you’re trying to do that, you need predictions of how the climate will change over the next 75 to 100 years.”

The conference’s timing was key in this respect, as CSA expects to release draft versions of the new CHBDC late this year or in early 2023, with full publication scheduled for 2024.

Another keynote speaker was Entuitive principal Stephen Brown, P.Eng., who discussed utilitarian and iconic bridges in and near the Greater Toronto Area (GTA), including downtown Toronto’s new Port Lands bridges (which attendees also visited on a technical tour), Markham’s Milne Dam bridge, St. Thomas’ Dalewood Bridge and the ongoing rehabilitation of Toronto’s Gardiner Expressway, which has required complex

engineering for rapid bridge replacement to minimize disruptions.

“Bridge replacement has been a focus of these conferences for quite a number of years, because governments have realized there’s a huge infrastructure deficit,” says Wing. “Accelerated bridge replacement is of particular interest in Canada. Some rapid replacements can be done over just one weekend, where the existing superstructure is lifted out and the new one—which has already been built—can then be lifted into place.”

He cites an example from one of WSP’s rapid bridge installations over Highway 417 in Ottawa.

“That was a three-span bridge with a total length well over 140 m,” he says. “These projects are typically done with single spans, not multiple spans, but they are growing in ingenuity all the time.”

While such topics dominated the conference agenda, there was also a trade show component that, with 35



exhibitors and 22 sponsors, was larger than expected for a niche-focused event.

“It was definitely a success for a bridge conference!” says Wing.

CSCE will organize the next conference to be held in Vancouver in 2026. The venue and dates have not yet been confirmed, but in the past, the conference has usually taken place around the third week in July. **CCE**

Some 300 papers were presented on new climate change provisions, bridge replacement, iconic bridges and more.



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By Rob Lauridsen-Hoegh

PBX Engineering Turns 25

The firm provides electrical engineering services throughout Canada and beyond.

A large, brushed aluminum plaque in the PBX Engineering boardroom in Vancouver shows the firm's history on a timeline, marking various milestones the consulting engineering practice achieved over its first 20 years.

Transportation dominated the earliest years. Projects in the late 1990s mostly focused on traffic signals, lighting and counterflow systems for highways, bridges and tunnels.

"Each project benefits from cross-functional experience." – Ian Steele, president, PBX Engineering

Over the next decade, a growing team built on these unique and foundational skills to expand into complex electrical systems for ports, terminals, water and wastewater infrastructure, even lighting up the Olympic rings that in 2010 graced the Vancouver harbour and the entrance to Vancouver International Airport.

Further along the timeline are awards, flagship projects and newly formed business units. By 2017, the last year displayed on the plaque, the scope and diversity of PBX had branched out to include significant, multi-faceted projects where electrical infrastructure, software and systems integration played pivotal roles.

Along the way were mergers and acquisitions (M&A) and even name changes as the

company grew from a four-man basement start-up to one of the West Coast's most respected electrical and systems engineering firms.

"It's our 25th anniversary this year and it's time for an updated timeline—maybe a bigger wall!" says Ian Steele, who joined PBX as a design engineer in 1997 and took over as president in 2014. "When this timeline was commissioned in 2017, we had about 4,000 projects under our belt. Today, we've topped 10,000, earned

numerous provincial, national and international awards and added our 90th team member. We have offices in Vancouver, Victoria, Kelowna and Squamish, B.C., Calgary and Edmonton."

The firm's leadership includes 10 principals: Steele, Alex Cosovanu, Andrew Townend, Brendan White, Cory Edgar, Julian Vasquez and Rob Grant led the firm after a rebranding in 2014; long-time colleagues David Black and Raj Atwal joined in 2021; and more recently, the firm welcomed Derek Uddenberg.

PBX serves public and private clients throughout North America with electrical infrastructure design and deployment services across six business units: automation, buildings, industrial, integrat-

ed security, municipal utilities and transportation.

The firm has provided engineering services for many high-profile projects of regional and provincial significance, including major linear and vertical construction, regional-level deployments and systems that support critical infrastructure.

"Many people know us for our work in transportation," Steele says. "We're proud of that recognition, but we're much more than that tip of the iceberg."

He explains the evolution of PBX has focused on diversification and measured, strategic growth, building up a breadth of unique expertise.

"Many of the design approaches used within one area of our practice will overlap with another," says Steele. "Internally, every project is a collaborative engagement. We leverage each other to solve complex problems. Each project, no matter the industry, benefits from cross-functional experience. This collaboration is a force multiplier."

This also allows the firm to provide a comprehensive suite of technical and project delivery services.

"We plan, we design, we lead construction, we test, we commission and everything in between that supports effective project delivery," Steele says. "Clients appreciate our services cover the full project life cycle."



Ian Steele joined the firm as a design engineer when it was founded in 1997. Today, he is its president.

He adds the firm's success is underpinned by its corporate culture.

"People like it here," says Steele. "We've focused on building a sense of community, a place where people can build long-term careers."

Many employees have been at PBX for 10 or more years. The firm has rolled out a new internal associate program for future leaders.

"It's all about sustainability," says Steele, "in terms of the business itself, but also in terms of the composition of our project portfolio. An important part of what drives our team is the impact our projects make. Electrical infrastructure supports initiatives that matter on a regional and national scale. We take pride in making a difference."

As part of this year's celebrations, PBX recently held a client social event where a new timeline plaque was indeed unveiled. And there's plenty of room on an adjacent wall to celebrate the next 25 years. **CCE**

Rob Lauridsen-Hoegh leads communications for PBX. For more information, visit www.pbxeng.com.



Literature review



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Setting standards for climate change resiliency

Dwayne Torrey is director of construction and infrastructure standards for CSA Group (formerly the Canadian Standards Association) in Toronto. With a degree in civil engineering, he began his career in consulting engineering before moving to CSA in 2004. In his current role, he oversees the strategic direction for more than 250 codes and standards that focus on safety and reliability of structures, construction materials, products, systems and mechanical equipment, working closely with industry and government to assess emerging trends and issues, such as climate change, circularity and modular construction.

How is the notion of climate change resiliency affecting CSA's standards?

It's definitely keeping us busy! Standards can be important tools for engineers, industry and government. As an organization, we've been doing a lot to tackle climate change resiliency from a number of fronts. We are assessing and updating our existing portfolio of standards and identifying areas where gaps exist.

One example of enhancing the existing portfolio is CSA S6:25, Canadian Highway Bridge Design Code. It has been around for 100 years, but the 2019 edition was the first to include considerations for how climate change influences the exposure and deterioration of bridges. Its technical committee has been very active since then, looking at how to further enhance bridges' serviceability and durability. We expect more updates relat-

ing to climate change resiliency in the 2025 edition.

Then there are the gap areas, where we never had standards before, but they are needed. Northern regions, for example, experience climate change effects worse than many other parts of the world. With this in mind, CSA has gathered experts to develop new standards for high winds, snow loads and foundations in permafrost.

Can CSA complement the National Building Code of Canada in this respect?

We develop many of the standards it references to support safe and reliable buildings. In the area of climate resiliency, a number of our standards are available for consideration. CSA S478, Durability of buildings, is referenced in the commentary as an option for architects, builders and owners.

What standards would you like consulting engineers to be more aware of?

We very recently published structural design standards for large-scale wastewater treatment plants (WWTPs). Previously, there were no comprehensive standards for designing these massive facilities. We brought climate change into the conversation, including rising sea levels and drought intensity.

We have also been working with stakeholders to determine how the electrical sector can adapt to climate change, with safety in mind for both overhead and underground installations. More enhancements are anticipated from our technical committees.

Another gap area is the impact of



“There are gaps where we never had standards before, but they are needed.”

flooding at the municipal level, an issue that wasn't as prominent 10 years ago. We've published a series of community water standards focusing on the flood-resilient design of new residential communities, with drainage systems based on regional-level considerations. Retention ponds and storm sewers aren't new ideas, but now they are being stan-

dardized in a way municipalities can implement.

What else is in the works?

Hotter, wilder weather will impact dams, so we are now working to develop guidelines for their adaptation. We are planning to finalize those in 18 to 24 months' time.

Circular construction is a concept that is rapidly accelerating. This shift from a focus on using raw materials only to the using of all outputs stemming from the use of raw materials means a shift in the way we plan, design, operate, manage, manufacture, distribute and handle 'post-life'. Our stakeholders see standards as an important tool to help facilitate this shift.

The best way to be aware of what is going on is to join the conversation, especially through participation in our technical committees. It's important we continue to pass down knowledge gathered from some of the best engineers in the country to the next generation. **CCE**



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