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- New NY (Tappan Zee) Bridge
- Sustainability in practice in Canada
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2014 | FALL/AUTOMNE

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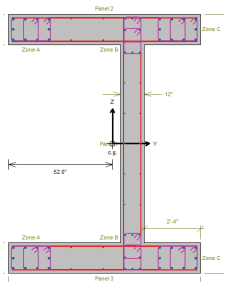

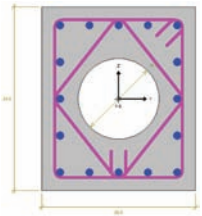

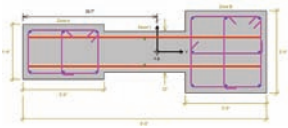

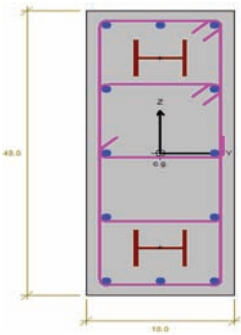

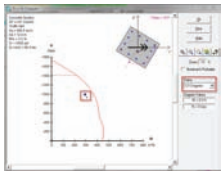

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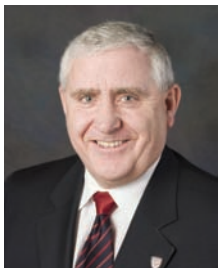

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"Building up Canada" Summit

Investment in infrastructure continues to be an important issue on the Canadian political landscape. The economic benefit of investing in Canada's infrastructure is now a well-established concept that is acknowledged at all levels of government. The question of investing in infrastructure is no longer why, but how and how much.

CSCE was invited by the Hon. Kathleen Wynne, Premier of Ontario, to attend a one-day infrastructure summit and participate in a discussion focused on driving public infrastructure, jobs and economic growth. The event was co-hosted by Premier Wynne and the Hon. Greg Selinger, Premier of Manitoba, and facilitated by Mr. André Juneau, the first deputy minister of Infrastructure Canada (2002). Premier Wynne chairs the Fiscal Arrangement Working Group – Infrastructure Sub-Group on behalf of the Council of the Federation comprising the provincial/territorial premiers and is preparing to bring the infrastructure investment issue to the table at the next Council meeting of the premiers.

It would be difficult to report on all the discussion at the summit but a few statements attributed to a number of expert panel participants help characterize the conversation. The following statements provide a perspective on the view of investing in infrastructure by industry leaders, senior politicians and stakeholders other than civil engineers. It is critically important that civil engineers hear and consider what is being said in order for us to contribute to the conversation.

"Cities are the engines of global economy." – Robert Hardt, president/CEO of Siemens Canada.

"Infrastructure is the key to developing stranded resources in the north and the approach must consider three important principles - respect, recognition and responsibility." – Hon. Bob McLeod, Premier of the Northwest Territories.

"We need to reduce the carbon footprint and consider the impacts of climate change in the development of infrastructure." – Hon. Kathleen Wynne, Premier of Ontario.

"There is capital available to fund infrastructure investment. Policy makers are keen to attract finance but frustrated that private investors do not share the keen interest. Private investors are frustrated that policy makers do not understand investors' needs. A paradox – infrastructure gap and available funding for infrastructure." – Irwin Mendelssohn, head of institutional investors for the World Economic Forum.

"Are we taking climate change seriously? We need to strengthen the business case for investing in the resilience of our infrastructure." – Jeff Lehman, mayor of the City of Barrie and chair of Ontario's Big City Mayor's Caucus.

The overall discussion focused on financing and investing in infrastructure and the changing environmental impacts on infrastructure. It is important that we hear our elected leaders acknowledge "…the significant amount of evidence available that addresses the links between infrastructure investment and economic prosperity." It reaffirms that infrastructure will

continue to be an important political agenda item for some time.

From CSCE's perspective, a message we will return to the senior levels of government is that infrastructure is about delivering a service. Hence, it is critically important that in considering investments in infrastructure we make sure we are investing in the right infrastructure based on sustainable delivery of services first. Once we have identified what we need to be investing in, then we need to make sure we are building it right, including considerations of durability for longevity and resiliency for adaptation to climate change. Civil engineers and CSCE have a role in the discussion on smart investments in infrastructure and the way forward requires leadership in sustainable infrastructure. ■

Reg Andres is vice-president of R.V. Anderson Associates Limited in Toronto.

Sommet « Faire progresser le Canada »

L'investissement dans les infrastructures continue d'être un enjeu important dans le paysage politique du Canada. L'avantage économique d'investir dans les infrastructures au Canada est à présent un concept bien établi qui est reconnu à tous les niveaux de gouvernement. La question d'investir en infrastructure n'est plus de savoir pourquoi, mais comment et pour combien.

La SCGC a été invitée par Mme Kathleen Wynne, première ministre de l'Ontario, à assister à un sommet sur les infrastructures d'une journée et à participer à une discussion concentrée sur la gestion des infrastructures publiques, sur les emplois et sur la croissance économique. L'événement a été co-présenté par la première ministre Wynne et par M. Greg Selinger, premier ministre du Manitoba, et guidé par M. André Juneau, premier sous-ministre d'Infrastructure Canada (2002). La première ministre Wynne dirige le Groupe de travail sur les transferts fédéraux – un sous-groupe sur l'infrastructure pour le compte du Conseil de la fédération qui est composé des premiers ministres provinciaux/territoriaux. De plus, elle se prépare à soulever la question de l'investissement dans les infrastructures lors de la prochaine réunion du Conseil des premiers ministres.

Il serait difficile de relater toutes les discussions qui ont eu lieu au Sommet, mais quelques citations des membres du comité d'experts aident à décrire la conversation. Les citations qui suivent fournissent une perspective des dirigeants de l'industrie, des grands hommes politiques et des partis concernés autres que les ingénieurs civils, au sujet de leur intention d'investir dans les infrastructures. Il est d'une importance capitale que les ingénieurs civils examinent et considèrent ce qui est dit afin que nous puissions contribuer à la conversation.

« Les villes sont les moteurs de l'économie mondiale. » – Robert Hardt, président/PDG de Siemens Canada.

« L'infrastructure est la clé du développement des ressources inexploitées dans le nord et cette approche doit prendre en considération trois principes importants : le respect, la reconnaissance et la responsabilité. » – M. Bob McLeod, premier ministre des Territoires du Nord-Ouest.

« Nous devons réduire l'empreinte carbone et prendre en considération les changements climatiques dans le développement des infrastructures. » – Mme Kathleen Wynne, première ministre de l'Ontario.

« Il y a un capital disponible pour financer les investissements dans les infrastructures. Les responsables des politiques ont la volonté d'attirer des ressources financières, mais ils sont déçus que les investisseurs privés ne partagent pas leur vif intérêt. Les investisseurs privés sont déçus que les responsables des politiques ne comprennent pas les besoins des investisseurs. Un paradoxe : le déficit de l'infrastructure et les fonds disponibles pour l'infrastructure. » – Irwin Mendelssohn, chef des investisseurs institutionnels pour le Forum économique mondial.

« Prenons-nous les changements climatiques au sérieux ? Nous devons renforcer l'analyse de rentabilisation pour investir dans la résistance de nos infrastructures. » – Jeff Lehman, maire de la ville de Barrie et président du Caucus des maires des grandes villes de l'Ontario.

L'ensemble de la discussion a principalement portée sur le financement et l'investissement dans les infrastructures et les conséquences des changements environnementaux sur les infrastructures. Il est important d'écouter nos élus reconnaître « … l'importante quantité de preuves accumulées qui portent sur les liens entre l'investissement dans les infrastructures et la prospérité économique. » Cela réaffirme le fait que les infrastructures continueront de constituer un élément important dans le programme politique pendant un certain temps.

Du point de vue de la SCGC et d'un message, nous retournerons aux paliers supérieurs de gouvernement en tenant compte que l'infrastructure se doit de fournir un service. En conséquence, au moment d'envisager des investissements dans les infrastructures, il est essentiel de nous assurer d'investir dans les bonnes infrastructures, d'abord basées sur l'offre de services durables. Une fois que nous aurons identifié ce dans quoi nous devons investir, nous devrons être certains que nous le construisons de la bonne façon en prenant compte des considérations de durabilité pour assurer la longévité et de la résilience pour s'adapter aux changements climatiques. Les ingénieurs civils et la SCGC ont un rôle à jouer dans le débat sur les investissements intelligents dans les infrastructures et sur la façon de procéder qui requiert du leadership en matière d'infrastructures durables. ■

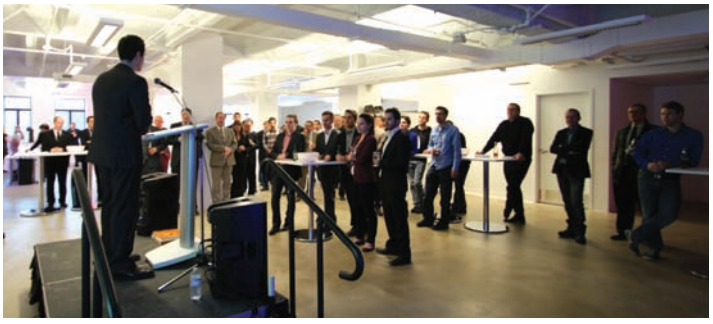
Reg Andres est le vice-président de R.V. Anderson Associates Limited à Toronto.

Quebec Region reinvigorated

Francis Labrecque, ing., MBA, PMP, LEED AP BD+C
Vice-president, Quebec Region, CSCE

The 2013-2014 year was filled with many notable events. The Montreal section, which had been inactive since 2009, has been revitalized thanks to the creation of a new executive committee composed of eight members, including the provisional chairman, Jean-Luc Martel. The official opening of the section was celebrated with a happy hour gathering this past March 18th. More than 75 professionals, teachers and students participated and showed great interest in taking part in future activities.

The 2013-2014 season wrapped up with a conference hosted by Rosa Galvez-Cloutier discussing the impacts of the tragedy at Lac-Mégantic.



More than 75 professionals participated in the launch celebration for the Montreal Chapter, overseen by the chapter president Jean-Luc Martel./ Plus de 75 professionnels ont participé à la cérémonie de lancement pour le chapitre de Montréal. Elle a été supervisée par le président du chapitre, Jean-Luc Martel.

The Montreal section has an objective to make itself more known during the 2014-2015 season by hosting several monthly activities for its members, including technical conferences, a career forum, a student competition and a closing event to round out the season.

A new president, Kim Lajoie, now leads the Quebec section. He was able to organize eight training activities as well as the famous annual lobster dinner which had more than 90 participants. The year ended with the presentation of the CSCE 2013 Award for Government Leadership in Sustainable Infrastructure to the city of Quebec for rehabilitation of the St. Charles River. Tony Bégin and Kate Puxley presented a painting by Puxley that represents the challenges of urban development and environment.

The Sherbrooke section is trying to get back on its feet after several difficult years in terms of recruiting members to form a new executive committee. The participation of Nathalie Roy, University of Sherbrooke, should revitalize the chapter.

Thanks to all the CSCE members of the province of Quebec for their involvement in the various committees and for the activities organized to promote our profession. ■

Région de Québec redynamisée

Francis Labrecque, ing., MBA, PMP, LEED AP BD+C, MSCGC
VP Région du Québec SCGC

L'année 2013-2014 a été remplie de plusieurs évènements marquants. La section de Montréal, qui était inactive depuis 2009, a été relancée par la formation d'un nouveau comité exécutif composé de 8 membres, dont le président par intérim Jean-Luc Martel. L'ouverture officielle de la section fut marquée par un 5 à 7 le 18 mars dernier

Official ceremony at the City Hall in Quebec City for the "Award for Governmental Leadership in Sustainable Infrastructure" for the rehabilitation of the Saint-Charles river./ La cérémonie officielle dans l'hôtel de ville de la ville de Québec pour le « Prix pour le leadership gouvernemental en matière d'infrastructures durables » pour la réhabilitation de la rivière Saint-Charles. From left to right/ De gauche à droite : Francis Labrecque (VP Quebec Region, CSCE/ VP de la région de Québec, SCGC), Mario Fafard (past-president of Quebec section, CSCE/ancien président de la section de Québec, SCGC), Kate Puxley (creator of the painting/peintre du tableau), Jonathan Julien (Quebec City/ville de Québec), Tony Begin (VP, CSCE/ VP, SCGC) and Daniel Lessard (Quebec City/ville de Québec).

auquel plus de 75 professionnels, professeurs et étudiants ont participé et démontré un grand intérêt à participer aux futures activités. La saison 2013-2014 s'est terminée avec une première conférence offerte par Mme Rosa Galvez-Cloutier portant sur les impacts du désastre du LacMégantic.

La section de Montréal s'est donnée pour objectif de se faire connaître davantage pour la saison 2014-2015 en organisant plusieurs activités mensuellement pour ses membres dont des conférences techniques, un forum carrière, une compétition étudiante et un évènement de clôture de la saison.

La section de Québec est maintenant dirigée par le nouveau président Kim Lajoie. Il a su mener à bien 8 activités de formation ainsi que le fameux souper annuel aux homards avec plus de 90 participants. La fin de l'année fut clôturée par la remise du « Prix pour le leadership en infrastructures durables de la SCGC 2013 » à la Ville de Québec pour l'ensemble des travaux d'assainissement de la rivière Saint-Charles. Le prix fut présenté par Tony Bégin et l'artiste Kate Puxley par la remise d'une toile représentant les défis rencontrés avec le développement urbain et l'environnement.

La section de Sherbrooke tente de se relever après plusieurs années difficiles au niveau du recrutement des membres dans le but de former un nouveau comité exécutif. La participation de Nathalie Roy de l'Université de Sherbrooke devrait redonner un nouveau souffle au chapitre.

Merci à tous les membres de la SCGC de la province de Québec pour leur implication dans les différents comités et les activités organisés afin de faire rayonner notre profession. ■

Young professionals in Quebec focus on career path

Québec City

For the seventh consecutive year, the CSCE Student Chapter of Université Laval, in collaboration with CSCE's Quebec section, has offered students a forum on the engineering profession. Various speakers came to talk about their careers. The purpose of the event is to introduce young professionals to the different career opportunities they will face in the future, in both the private and public sectors. The speakers shared their experiences with large projects, challenges they faced, their social involvement and networking. Once again, the event attracted about forty students who were able to discover various aspects of civil engineering. Next March, the forum will be repeated for the eighth year.

– Francis-Olivier Biron, ing. jr, AMCSCE

Montréal

Since the relaunch of the Montreal section last January, the young professionals committee has been working to create connections with the student chapters of various universities in the region. The purpose of the committee is to work in collaboration with the chapters to organize interesting events for young professionals. To this end, a meeting with the representatives of the student chapters is scheduled for September.

On March 18th, an event to launch the Montreal section took place. Five educational institutions from the Montreal region were represented among the participants.

For the 2014-2015 season, we are planning to hold a monthly event that will further integrate students and professionals in our activities. Among these will be two networking events for students: a career forum and a final-year study project competition. In addition, the young professionals committee is working on a project that seeks to increase the support provided to the Canadian National Concrete Canoe Competition and to establish a Canadian Steel Bridge Competition. ■

– Éric Lachance Tremblay, ing. jr, AMCSCE

If you are interested in getting involved or want more information about any of the events above, please get in touch.

Les jeunes professionnels à Québec se concentrent sur leur cheminement de carrière

Ville de Québec

Pour une septième année consécutive, la SCGC section étudiante de l'Université Laval en collaboration avec la SCGC, section Québec a offert aux étudiants un forum sur la profession d'ingénieur. Différents conférenciers sont venus parler de leur carrière respective. Le but de cette conférence est de présenter aux jeunes professionnels les différentes possibilités de cheminements de carrière auxquels ils auront à faire face dans l'avenir, tant dans les domaines privé que public. Les conférenciers ont partagés leur expérience acquise sur des projets d'envergure, les défis qu'ils ont dû surmonter, leur implication sociale et de réseautage dans leur profession. L'événement a attiré encore une fois une quarantaine d'étudiants qui ont pu découvrir certaines facettes du génie civil. L'activité sera répétée pour une huitième année en mars prochain.

– Francis-Olivier Biron, ing.jr, AMSCGC

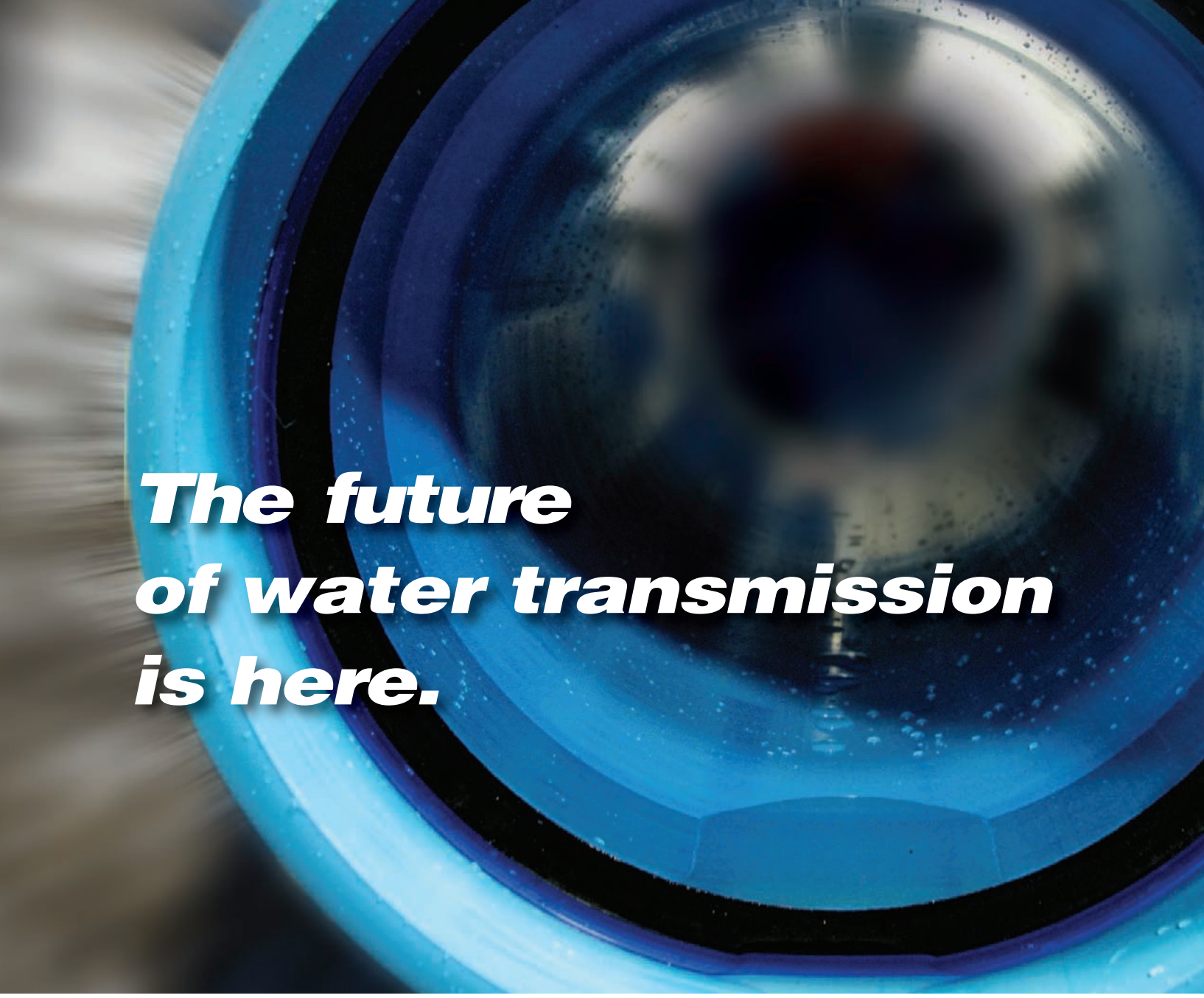
Montreal

Depuis la relance de la section Montréal en janvier dernier, le comité des jeunes professionnels travaille à tisser des liens avec les chapitres étudiants des différentes universités de la région. Le but du comité est de travailler en collaboration avec les chapitres afin d'organiser des événements intéressants pour les jeunes professionnels. À cet effet, une rencontre avec les représentants des chapitres étudiants est prévue en Septembre.

Le 18 mars dernier avait lieu l'événement de relance de la section Montréal. Parmi les participants à l'événement, 5 établissements d'enseignement de la région Montréalaise étaient représentés. Pour la saison 2014-2015, il est prévu d'organiser un événement mensuel qui permettra d'intégrer davantage les étudiants et les professionnels à nos activités. Entre autres, deux activités de réseautage seront organisées pour les étudiants : un forum-carrière et une compétition de projets de fin d'études. De plus, le comité des jeunes professionnels travaille sur un projet visant à augmenter le support apporté à la compétition canadienne de canoë de béton et à mettre sur pied une compétition canadienne de pont d'acier. ■

– Éric Lachance Tremblay, ing.jr, AMSCGC

Si vous souhaitez vous impliquer ou si vous voulez obtenir plus d'information sur l'un des événements mentionnés ci-dessus, veuillez communiquer avec nous.



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Student Chapter Affairs – Reflections and Looking Ahead

Charles-Darwin Annan, Ph.D., P.Eng., M.CSCE
Chair, CSCE Student Affairs

After an eventful year with many new initiatives, a new school year offers an opportunity to reflect on the past year, review some key lessons learned, and more importantly, look into the future.

First of all, all of our Student Chapters deserve congratulations for embracing the new programs and initiatives. For the very first time, the Student Affairs committee received and reviewed incredible annual reports of the year's activities from 24 Chapters. From exciting social events, professional talks and tour activities to smart fundraising techniques and an excellent 100% member recruitment success story, our students showed extraordinary leadership.

Congratulations to BCIT and Western for jointly winning the President's Award for Outstanding Student Chapter. Congratulations also go to Sherbrooke for winning the National Capstone Design Competition; to The University of Alberta for winning the Concrete Toboggan Race; to Cégep de Chicoutimi for winning the Troitsky Bridge Building Competition; to Université Laval for winning the National Concrete Canoe Competition; to Peter John Thompson of the University of Waterloo for winning the Hydrotechnical Engineering Award; and to Magdy Ibrahim from Concordia for winning the Best Student Paper Competition.

Last year, five new or inactive student chapters sprang to life. A few others became more dynamic. The National Student Chapter Leaders Workshop in Halifax was very stimulating and was an excellent networking opportunity for our Chapter leaders. This school year, Student Affairs will continue to connect with our Student Chapters. We will continue to make important resources available and to support participation of our undergraduate students in regional and national CSCE events.

The thing I most want for this new school year is to see new chapters emerge and emerging chapters become more established. ■

Dr. Charles-Darwin Annan is an assistant professor of civil engineering at Université Laval and can be reached at charles-darwin.annan@gci.ulaval.ca

Le chapitre des affaires étudiantes – Réflexions et vision d'avenir

Charles-Darwin Annan, Ph.D., Ing., M.SCGC
Président, Affaires étudiantes de la SCGC

Après une année mouvementée remplie de nouvelles initiatives, une nouvelle année scolaire offre l'occasion de réfléchir à l'année écoulée, de revenir sur certaines notions importantes, et plus important encore, de se tourner vers le futur.

Avant tout, tous nos chapitres étudiants méritent des félicitations pour avoir adhérés aux nouveaux programmes et aux nouvelles initiatives. Pour la toute première fois, le comité des affaires étudiantes a reçu et a révisé des comptes rendus annuels incroyables au sujet des activités de l'année, et ce, de la part d'un impressionnant total de 24 chapitres étudiants. Des formidables événements sociaux, en passant par les discussions professionnelles, les tournées d'activités, les techniques intelligentes pour ramasser de l'argent et la réussite de recrutement de 100 % des membres, nos étudiants ont montré un leadership extraordinaire.

Félicitations à BCIT et à Western pour avoir remportés conjointement le prix du président du meilleur chapitre étudiant. J'aimerais également féliciter l'Université de Sherbrooke pour avoir remportée le concours d'affiches Capstone pour étudiants ; l'Université de l'Alberta pour avoir gagnée la grande course de toboggan en béton ; le Cégep de Chicoutimi pour avoir remporté la compétition de construction de ponts Troitsky ; l'Université Laval pour avoir gagnée le concours national de canots en béton ; Peter John Thompson, de l'Université de Waterloo, pour avoir remporté le prix du génie hydrotechnique ; et Magdy Ibrahim, de Concordia, pour avoir remportée la compétition pour le meilleur article étudiant.

L'année dernière, cinq nouveaux ou inactifs chapitres étudiants ont vu le jour. Certains autres sont devenus plus actifs. L'atelier national des dirigeants des chapitres étudiants à Halifax a été très motivant et cela a été une excellente occasion de réseautage pour nos leaders des chapitres. Cette année, le comité des affaires étudiantes va continuer de tisser des liens avec nos chapitres étudiants. Nous continuerons de rendre les ressources importantes disponibles et de soutenir la participation de nos étudiants universitaires aux événements régionaux et nationaux de la SCGC.

La chose que je souhaite le plus pour cette nouvelle année scolaire est que de nouveaux chapitres étudiants voient le jour et que les chapitres étudiants émergents deviennent plus établis. Et vous ? ■

Charles-Darwin Annan est professeur adjoint en génie civil à l'Université de Laval et on peut le joindre à charles-darwin.annan@gci.ulaval.ca

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THE Great-West Life ASSURANCE COMPANY

The New NY (Tappan

Canadian engineers have helped design the main spans for a new U.S. bridge that will have a long service life.

By Don Bergman, P.Eng., and Anne-Marie Langlois, P.Eng.
BUCKLAND & TAYLOR

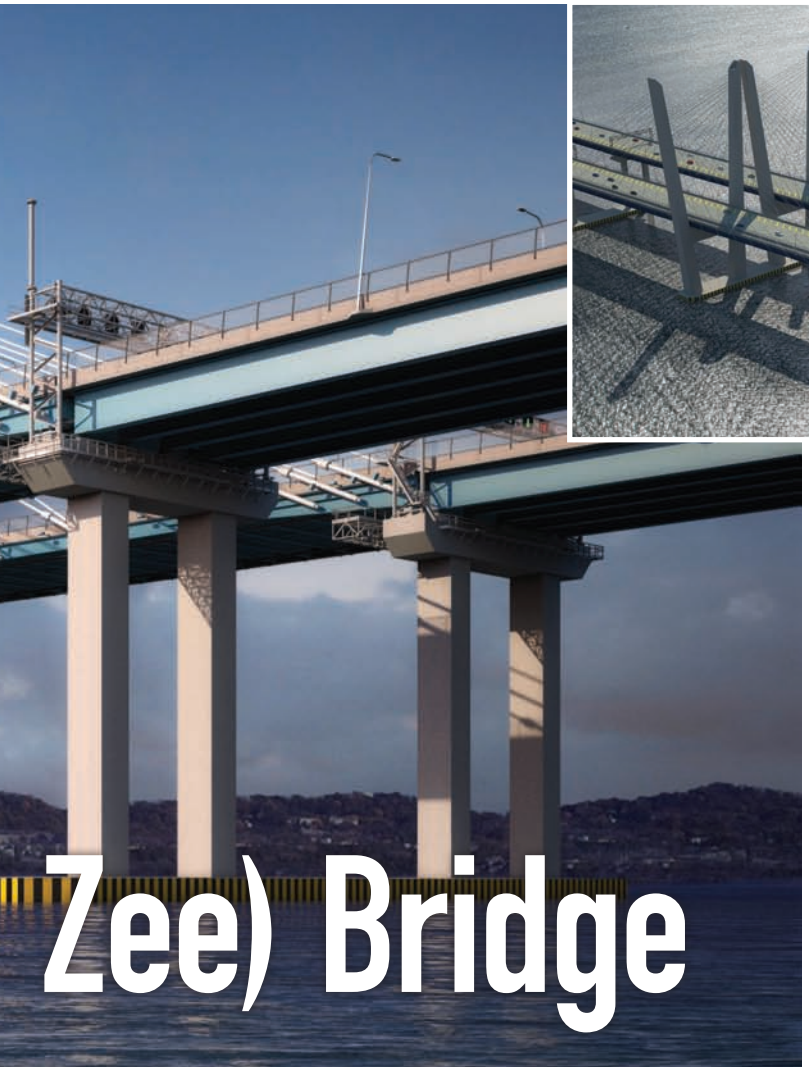
The New NY (Tappan Zee) Bridge project is a $3.9 billion effort to replace the nearly 60-year old functionally obsolete Governor Malcolm Wilson Tappan Zee Bridge. Spanning the Hudson River between Westchester and Rockland counties in New York, the bridge carries more traffic than it was designed for and suffers from ongoing high maintenance and rehabilitation costs.

The new crossing comprises twin parallel 4.98-km long structures with cable-stayed main spans. Buckland & Taylor, as part of the successful design-build team, designed the parallel replacement main span cable-stayed bridges.

Main span design

The iconic main span structure is the centrepiece of the new crossing. The main span structure comprises twin cable-stayed bridges, with 366-m main spans required to accommodate the navigation channel on the east side of the river, and 57-m side spans. Each deck will carry four traffic lanes and have wide inner and outer shoulders that provide operational redundancy and flexibility. The bridge is designed for the future addition of a cable-stayed rail transit deck between the roadway decks.

The main span decks are carried by a semi-fan parallel strand stay cable system anchored to unique outward leaning V-shaped reinforced concrete towers. The outwardly inclined legs of each tower will be connected by a single transverse beam beneath the bridge deck, helping improve aesthetics by accentuating slenderness. The future rail transit deck will be supported by a future cable anchorage unit and below-deck cross beam that will connect the inner legs of the two towers. The bridge is founded on 1.8-m diameter steel pipe piles driven through deep soft soils to bedrock at approximate depths of 61



The new bridge is almost 5 kilometres long, with a main span consisting of twin cable-stayed bridges of 366-metres.

Photo courtesy NYS Thruway Authority

Zee) Bridge

m to 76 m. The bridge foundations are designed to carry the future rail structure without modification.

Each composite deck superstructure, which is designed for constructability and durability, comprises stiffened steel edge girders and transverse floor beams. These support high performance precast concrete deck panels compositely connected to the steel with cast in-place infill joints. To minimize deck width and structure weight, the stay cables are eccentrically anchored outside of the edge girders.

New tools for long service life

Increased awareness and an understanding of bridge deterioration mechanisms is a vital factor in optimizing the lifecycle of a bridge. Existing North American structural design codes do not explicitly consider the durability and service life of reinforced concrete structures. Prescriptive requirements in these codes result in oversimplified "deemed to satisfy" rules that cannot quantify the service life of a structure in a given environment for given materials, nor do they reliably provide the long-term performance of structures in aggressive environments.

In order to achieve the required service life, a probabilistic approach to the concrete durability design was used. This approach is relatively new to North American major bridge projects and is similar to Load and Resistance Factor Design (LRFD) that has been used for strength and serviceability for many years. It provides reliability-based methods for explicitly determining the service life of the concrete elements. These new service life design tools have been implemented in "fib bulletin 34: Model Code for Service Life Design," which is part of the new ISO 16204:2012 "Durability — Service life design of concrete structures."

Similar to LRFD design, durability-related loads and resistances are assessed and quantified. For a bridge subject to chloride-induced reinforcement corrosion, a durability load is the chloride exposure level, and corresponding durability resistances are the chloride migration coefficient of concrete and cover thickness. Using this approach, durability requirements can be quantified and measured to verify that the required materials and properties are achieved. Concrete compressive strength is routinely measured as a means of verifying the structural performance. The same procedure is now being done successfully on the New NY (Tappan Zee) Bridge and other major structures for their durability requirements. ■

Don Bergman, P.Eng., is vice-president major projects and senior project director, and Anne-Marie Langlois, P.Eng., is a bridge engineer, both at Buckland & Taylor of Vancouver.

OWNER: New York State Thruway Authority
CLIENT: HDR Inc.
CONSTRUCTION CONSORTIUM: Tappan Zee Constructors, LLP (Fluor, Granite, American Bridge, Traylor Bros)
REPLACEMENT MAIN SPAN DESIGN: Buckland & Taylor, Vancouver (Don Bergman, P.Eng., Armin Schemmann, P.Eng., Chris Scollard, P.Eng.)
OTHER KEY PLAYERS: URS Corporation, GZA GeoEnvironmental, Inc.

Disposal of Mine Tailings in India

Engineering know-how from Canada is helping two mines in northern India to manage the environmental impact of their tailings.

By Fangqiu Gu, EIT, and Chris Lee, P.Eng.
GOLDER ASSOCIATES

This project came about when an Indian mining company was looking for ways to build better cost effectiveness and more sustainability into mining practices at two base metal mines.

The company was searching for an environmentally sound method for disposing of the sand-like "tailings," a waste product that is produced when a mine's mill grinds the ore. Tailings can contain heavy metals, chemicals and other toxic minerals that are not allowed to be released into the environment. Disposal of the tailings underground in a cemented, encapsulated form is beneficial from an environmental perspective.

The company also wanted to use the tailings as backfill to prevent the collapse of underground mine workings after parts of the ore body had been extracted. As well as restricting the amount of ore that could be recovered, leaving open voids underground could lead to serious impacts on the surface, including subsidence. Subsidence can cause changes to streams and lakes, and it also can damage roads, railways and buildings.

Paste backfill solution

The mining company looked for a way to resolve both problems by disposing of the tailings underground and away from surface storage ponds by having the tailings also act as "backfill" to support the worked-out sections of the mine and prevent their collapse.

This approach involved using paste technology to modify the tailings characteristics and behaviour. A dewatering system was designed for removing most of the water in the slurry containing the tailings; coagulating agents were added and the material was put through a filtration process. The filtered material was then combined with binders to form a high viscosity paste backfill. Paste backfill is a dewatered material that possesses a yield stress, has a measurable slump, bleeds little to no water, and exhibits plug flow characteristics. Once combined with a certain amount of binder and after a period of curing time, the paste tailings can achieve a significant structural strength for preventing failures and a collapse of the underground workings.

The Indian mining company first looked for a company based in India for a solution, but found the local consultants were unable to meet the requirements of the job.

Accordingly, the mining company then looked to Golder Associates, an engineering/environmental company with its roots in Canada, but with a strong international presence, including in India.

Photos courtesy Golder Associates

Paste plants like this one are proving to be good ways for mining companies to manage the environmental effects of the tailings produced by a mine.

Inset: A sample of cured cemented paste — the grey cylinder — is subjected to a stress test to determine its strength. The sample is shown at the time when the amount of pressure has caused it to start to fracture.

Golder used its experience in mining, including paste technology, to help develop a solution for the mines' needs.

Finding the correct recipe

The team from Golder included process, mining, mechanical, electrical, structural and instrumentation engineering professionals.

To make paste technology work given the site-specific characteristics, one of Golder's first considerations was the nature of the tailings from the two mines. The variabilities included the average solid specific gravity, pH, particle size distribution, the mineralogy and chemical composition of the tailings, and their water content. The test work that was performed allowed Golder to choose the correct process equipment and control systems.

Another consideration was the amount of tailings involved. One of the mines produces 2 million metric tons of tailings per year and this output is expected to increase by about half in the near future. The other mine, currently producing about 3 million tonnes of tailings per year, is expected to nearly double in output.

Golder's paste engineering and design team in Canada worked with Golder staff in India and the staff of the mining company to determine the correct paste recipe, binder content and viscosity to allow the paste to be transported by pipeline from the surface plant to the underground workings. The paste also had to achieve the required backfill strength for the mined out areas.

The team from Golder helped with the selection of a local engineering firm to perform the detailed design and construction of the paste plant. Golder carried out the overall basic engineering design and reviewed the detailed design work. They also provided construction and commissioning support, and operator training.

By August 2014 the projects were nearing their completion stages. They are expected to help the company meet the relevant environmental regulations in a way that is cost-effective and efficient from a production point of view.

Government entities in India, and the general public, want the economic benefits of mining, but are increasingly concerned about its potential for environmental, social and economic impacts. This project will help the mine owners effectively and efficiently mine their ore body while also managing the environmental impacts. ■

Fangqiu Gu, B. Eng. is a process EIT, and Chris Lee, P.Eng. is a principal, in the Paste Engineering & Design Group of Golder Associates in Sudbury, Ontario.

Operationalizing Sustainability in Civil Engineering Practice

By Edwin Tam, PhD, P.Eng
CHAIR, CSCE SUSTAINABLE DEVELOPMENT COMMITTEE

Do Canadian civil engineers understand what sustainability means in their profession? This was a fundamental question the Sustainable Development Committee (SDC) of the CSCE had to ask. The question comes not only from our professional responsibility and personal motivation, but also because in 2012, CSCE put forth its Vision 2020 in which its third mandate was to provide leadership in sustainable infrastructure. While as engineers we likely understand what infrastructure means, understanding what sustainability implies could be another matter entirely.

There are a number of guidelines and documents an engineer can turn to: many professional societies now have descriptions relating to sustainability in engineering practice. The CSCE in 2006 issued its own Guidelines for Sustainable Development. Arguably, many of us likely have an innate sense of what sustainability should entail, and its characteristics should include:

- Triple bottom-line thinking that considers social, economic, and environmental issues.
- Balanced leadership that can comprehensively examine multiple objectives and include participating stakeholders.
- Impact evaluations that consider long-term effects rather than just short-term gains or losses.

However, while these are plausible and often agreed upon elements, the challenge is to turn such open-ended concepts into actual actions: in other words, how can you operationalize sustainability? The SDC presented an updated discussion regarding sustainability at the recent CSCE 2014 annual conference in Halifax, and the committee proposed that practitioners consider several recommendations and examples, which are excerpted and abridged here.

Focus on operations and maintenance. The operations and maintenance (O&M) costs over many decades can amount to more than the initial capital cost. For example, on an annual basis, operating an innovative, effective, yet simpler wastewater lagoon can be 10% that of a conventional wastewater treatment plant. Moreover, O&M costs for a typical building far outweigh its initial construction costs. From an economic sustainability perspective, economic considerations such as these have been in civil engineering practice for some time. However, the same cannot be said for lifecycle assessments (LCA) that consider environmental impacts over a project's life, including its disposal or re-use. It is critical that engineering curriculums in university and professional development increase the emphasis on long-term O&M and LCA considerations.

Question regulations and standards. Every regulatory standard is based on "state-of-the-art" assumptions and interpretations. Question regulatory criteria when they indicate unaffordable lifecycle cost solutions (including externalities), and suggest more cost-effective and sustainable options that can still meet the intent of the criteria. For example, water quality trading can be much more cost-effective than building new treatment facilities.

Think small. Focus on the real "needs" rather than the "wants." The traditional single bottom-line engineering approach of focusing on "tried and true" or "proven" technologies can overlook new, emerging technologies or alternatives that may, in fact, satisfy the need, meet the objective and be more cost effective in the long term when indirect and external triple bottom-line costs (and benefits) are considered. Similarly, the desire to implement "state-of-the-art" technological solutions can lead to extravagant solutions being offered where a more conventional solution would be perfectly acceptable. For example, an individual well and septic installation in most places in Canada might cost $30,000 per house, whereas extending piped systems to those same houses can cost $150,000 per house or more.

Optimize first. Many new water treatment plants are designed and built to meet increased demand, despite the fact that much of the treated water or sewage capacity is lost through leakage and waste. Reducing wastage and loss in existing systems frees up capacity for the future, and minimizes the size and scope of any new facilities needed: why build to increase capacity by 30% when system losses remain at 40%? Meeting short-term peak demands is also a significant cost driver in civil infrastructure. Demand management and peak shaving strategies are usually more cost effective than upgrading. For example, a recent value engineering assessment of an $80 million trunk sewer in Calgary concluded that with a peak shaving storage facility costing $5 million to attenuate flows, the cost of the works could be reduced to $30 million.

Let the numbers speak for themselves.

Adopt simple, understandable evaluation criteria that assimilate triple bottom-line costs and benefits into a single number: $ per house serviced; $ per m^3 of water treated; $ per kg of phosphorus removed (from a river); $ per km of road length; and $ per m^2 of building area. These simple benefit-cost criteria are readily understood by decision-makers, while allowing for cross-sectional and longitudinal benchmarking and comparisons of sustainable engineering solutions. For example, the City of Ottawa once presented the residents of Carlsbad Springs a choice: 1) pay for extending the nearest trunk water main 7 km to provide conventional water service; or 2) accept a "trickle feed" system with each home having a storage tank in their basement to meet peaks, at 33% of the cost. They chose the "trickle feed" system. When people are given the choice, they will usually choose the most cost-effective option that meets their needs. Furthermore, cost effective alternatives can be sustainable in the truest sense: over the long term, the least resources are expended, and impacts are often minimized. However, communities are seldom given real choices when it comes to civil infrastructure.

Formulate clear, unbiased choices. Overly complicated decision making criteria is difficult for the public to understand, and makes it relatively easy to influence environmental assessments to favour preconceived solutions. Furthermore, it is important to seek out anomalies in alternative solutions. For example, five alternative solutions may be presented, and the one chosen has multiple advantages and only one disadvantage. But that one disadvantage might cost much more than any other solution considered. Conversely, building a new wastewater treatment plant, with one more advantage in the environmental assessment scoring matrix, could cost 10 times more than simply upgrading the existing lagoon system. Therefore, decision-making criteria should not only be fairly weighted through proper stakeholder consultation processes, but also minimized for bias.

Ultimately, the objective is to engineer for maximum sustainability through utilizing the least resources and to minimize or avoid lifecycle environmental and social impacts. In an era characterized by global consumption and material demands, we must instead focus on society's needs, rather than wants, when undertaking projects that could result in excessive resource utilization and pollution. ■

Dr. Tam is an Associate Professor, Civil and Environmental Engineering; Assistant Dean, Student Affairs, University of Windsor.

CSCE National Awards and Fellowships – Call for Nominations

Fellowships (FCSCE)

Members who have attained civil engineering excellence and who have contributed actively to CSCE and to the profession of civil engineering may be elected as Fellows by the CSCE Board of Directors. With the designation of Fellow, CSCE seeks to acknowledge annually academic and practicing members, currently active or retired. Fellowship nominations will be received up until September 30, 2014 for consideration this year.

Nomination forms and additional information on CSCE Fellowships can be found on the CSCE website http://csce.ca/committees/honours-and-fellowships/

Career awards

Nominations are invited at any time for the awards listed below. Those nominations received by November 15, 2014, will be considered for the 2015 awards to be presented at the CSCE Annual Conference in Regina, SK, in May 2015. Please submit nominations and supporting material electronically, clearly stating the award for which the nomination is made, by e-mail to the executive director, Doug Salloum, at doug.salloum@csce.ca.

Further details and Terms of Reference for all of the following awards are available on the CSCE website at csce.ca/committees/honours-and-fellowships/.

A.B. Sanderson Award

Recognizes outstanding contributions by a civil engineer to the development and practice of structural engineering in Canada.

Albert E. Berry Medal

Recognizes significant contributions by a civil engineer to the field of environmental engineering in Canada.

Camille A. Dagenais Award

Recognizes outstanding contributions by a civil engineer to the development and practice of hydrotechnical engineering in Canada.

E. Whitman Wright Award

Recognizes significant contributions by a civil engineer to the development of computer applications in civil engineering in Canada.

Horst Leipholz Medal

Recognizes outstanding contributions by a civil engineer to engineering mechanics re-

search and/or practice in Canada.

James A. Vance Award

Recognizes a CSCE member whose dedicated service, other than as president, has furthered the advancement of the CSCE and who has completed or recently completed service in one or more sequential positions at the national level.

Sandford Fleming Award

Recognizes outstanding contributions by a civil engineer to transportation engineering research and/or practice in Canada.

Walter Shanly Award

Recognizes outstanding contributions by a civil engineer to the development and practice of construction engineering in Canada.

W. Gordon Plewes Award

Recognizes particularly noteworthy contributions by an individual to the study and understanding of the history of civil engineering in Canada, or civil engineering achievements by Canadian engineers elsewhere. Normally, the recipient will be an individual, not necessarily an engineer, but in special circumstances the award can be given to an organization. ■

Appel aux Candidatures – Distinctions Honorifiques Nationales et Fellowships de la SCGC

Fellowships (FCSCE)

Les membres ayant atteint un niveau d'excellence dans le domaine du génie civil et ayant contribué activement à l'avancement de leur profession peuvent être élus au titre de « Fellow » par le conseil d'administration de la SCGC. Avec la nomination d'un fellow, la SCGC vise à reconnaître annuellement les membres appartenant au monde universitaire et les membres pratiquants, présentement actifs ou à la retraite.

Les candidatures de fellowship doivent être reçues avant le 30 septembre 2014 pour être prises en compte cette année.

Des formulaires de candidature et des informations supplémentaires sur les fellowships de la SCGC se trouvent sur le site Web de la SCGC http://csce.ca/fr/committees/honours-and-fellowships/

Prix carrière

Les membres sont invités à soumettre en tout temps, des candidatures pour les prix ci-dessous; les candidatures soumises d'ici le 15 novembre 2014 seront considérées pour les prix 2015 qui seront décernés au congrès annuel de la SCGC à Regina SK, en mai 2015. Veuillez soumettre les candidatures, en précisant le titre du prix, par courriel au Directeur Exécutive, Doug Salloum à doug.salloum@csce.ca.

De plus amples détails et paramètres pour l'ensemble des prix ci-dessous sont disponibles sur le site Web de la SCGC http://csce.ca/fr/committees/honours-and-fellowships/.

Le prix A.B. Sanderson

Est décerné aux ingénieurs civils qui se sont signalés par leur contribution exceptionnelle au développement et à la pratique du génie des structures au Canada.

La médaille Albert Berry

Est décernée à un ingénieur civil qui s'est distingué par son importante contribution au génie de l'environnement au Canada.

Le prix Camille A. Dagenais

Est décerné aux ingénieurs civils qui se sont signalés par leur contribution exceptionnelle au développement et à la pratique de 1'hydrotechnique au Canada.

Le prix E. Whitman Wright

Est décerné à un ingénieur civil qui s'est distingué par son importante contribution au développement des applications de 1'informatique au génie civil au Canada.

La médaille Horst Leipholz

Est décernée à un ingénieur civil qui s'est distingué par son importante contribution à la recherche et/ou a la pratique de la mécanique appliquée au Canada.

Le prix James A. Vance

Est décerné à un membre de la SCGC dont le dévouement a favorisé l'avancement de la Société et qui termine, ou achève, récemment un mandat au sein de la Société, sauf comme président.

Le prix Sandford Fleming

Est décerné à un ingénieur civil qui s'est distingué par son importante contribution à la recherche et/ou à la pratique du génie du transport au Canada.

Le prix Walter Shanly

Est décerné à un ingénieur civil qui s'est distingué par son importante contribution au développement et/où à la pratique du génie de la construction au Canada.

Le prix W. Gordon Plewes

Est décerné à une personne, pas nécessairement un ingénieur, qui s'est distinguée par sa contribution à l'étude de l'histoire du génie civil au Canada ou de l'histoire des réalisations canadiennes en matière de génie civil à travers le monde. Dans les circonstances exceptionnelles, le prix peut être décerné à une organisation. ■

Globalization and specialization augment need for professional development

Bhuwan Devkota, P. Eng, PMP, MBA, MSCE
CHAIR, CSCE, ENGINEERING PRACTICE COMMITTEE

Professional development is understood across most professions as a systematic acquisition of knowledge and new skills and enhancement of professional competence. The demonstration of continuing competency through continuous learning fulfills the increasing demand from the public for greater accountability.

The theme of this issue of CIVIL is global trends in professional development.

In the following technical section, the first article, "Global Trends in Professional Development for Practising Engineers," provides an overview of professional development and some insights on trends in various countries. The authors discuss regulation, licensure and professional development in Australia, Canada, Europe, India, the United Kingdom, and the United States.

A second article examines the importance of humanities and social sciences to the professional development of engineers. The author discusses the role of humanities and social sciences in a civil engineer's education and professional practice. He notes that professional engineers must make judgements that encompass human, societal and technical values.

The third article discusses six trends that affect the continuing professional development of civil engineers. These trends largely result from changes in the social, political and economic environments in which engineers provide services to public. The author notes an increasing emphasis on leadership skills, a proliferation of specialized credentials, and globalization among the trends relevant to Canadian engineers. ■

Bhuwan Devkota is a project manager with the Department of Public Works and Government Services Canada.

La mondialisation et la spécialisation augmentent le besoin du perfectionnement professionnel

Bhuwan Devkota, Ing., PMP, MBA, MSCE
PRÉSIDENT, SCGC, COMITÉ DE LA PRATIQUE DE L'INGÉNIERIE

Le perfectionnement professionnel est vu dans la plupart des professions comme étant une acquisition systématique de savoir, de nouvelles compétences et de l'amélioration des compétences professionnelles. La démonstration du maintien des compétences grâce à la formation continue répond à la demande croissante du public pour une plus grande responsabilisation.

Le thème du prochain numéro de CIVIL porte sur les tendances sur le plan du perfectionnement professionnel.

Dans la prochaine section technique, le premier article intitulé « Les tendances mondiales sur le plan du perfectionnement professionnel chez les ingénieurs praticiens » fournit une vue d'ensemble sur le perfectionnement professionnel ainsi que quelques aperçus des tendances dans différents pays. Les auteurs parlent de la règlementation, du permis d'exercice et du perfectionnement professionnel en Australie, au Canada, en Europe, en Inde, au Royaume-Uni et aux États-Unis.

Le second article se penche sur l'importance des sciences humaines et sociales au sein du développement professionnel des ingénieurs. L'auteur discute du rôle des sciences humaines et sociales à l'intérieur d'une formation en génie civil et dans la pratique professionnelle. Il note que les ingénieurs professionnels doivent porter des jugements qui comprennent des valeurs humaines, sociétales et techniques.

Le troisième article présente six tendances qui touchent le perfectionnement professionnel continu des ingénieurs civils. Ces tendances résultent grandement de changements dans les environnements sociaux, politiques et économiques dans lesquels les ingénieurs fournissent des services au public. L'auteur constate qu'on met davantage l'accent sur les compétences en leadership, sur la prolifération des titres de compétences spécialisées, et sur la mondialisation au sein des tendances utiles aux ingénieurs canadiens. ■

Bhuwan Devkota est un gestionnaire de projet au sein du ministère des Travaux publics et Services gouvernementaux Canada.

Global Trends in Professional Development for Practising Engineers

Bhuwan Devkota, MSc, P. Eng., PMP, MBA, MCSCE
CHAIR, CSCE ENGINEERING PRACTICE COMMITTEE; PROJECT MANAGER, DEPARTMENT OF PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Rishi Gupta, Ph. D., P. Eng., MCSCE
DEPUTY CHAIR, CSCE INTERNATIONAL AFFAIRS COMMITTEE; ASSISTANT PROFESSOR, CIVIL ENGINEERING PROGRAM, DEPARTMENT OF MECHANICAL ENGINEERING, UNIVERSITY OF VICTORIA

Aditi Gupta, MSc, MLIS
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The Canadian Oxford Dictionary defines "professional development" as "development in one's profession through seminars, courses, etc." (2004). In workplaces, professional development refers to acquisition of new skills and knowledge, both for personal and career development. Professional development encompasses different types of facilitated learning opportunities ranging from formal college degrees to short-term courses, seminars, distance learning programs and informal learning opportunities to keep up-to-date with knowledge and skills in respective fields of practice. It also encompasses conducting research or performing work related to normal research programs in institutions or locations other than one's regular workplace. Professional development generally takes place in a working environment and builds on knowledge and understanding acquired through formal education. However, professional development is not necessarily separate from education and the two processes may be integrated.

Professional development is understood across most professions as the systemic acquisition of knowledge and skills and the development of personal qualities, to maintain and enhance professional competence (Engineering Council 2014). Professional development contains both the acquisition of new skills to broaden competence and the enhancement of existing skills to keep abreast of evolving technologies. A wide variety of professionals – teachers, health care professionals, lawyers, accountants and engineers – engage in professional development activities. These professionals may participate in professional development activities because of an interest in lifelong learning, to maintain and improve professional competence, to enhance career progression, to keep abreast of new technology and practices or to comply with professional regulatory requirements.

Professional development is not a one-time activity; it is a continuous and on-going learning process in one's professional career. In the interests of protecting the health, safety and welfare of the public, it is essential for professionals to engage in lifelong learning (APEGA 2014). Similarly, APEGBC's sixth tenet in the code of ethics also focuses on life-long learning and promotes members to maintain their competence and advance the body of knowledge, and also encourages members to promote professional development (PD) for their associates (APEGBC 2014). The public is demanding greater accountability from professionals and the expectations from professionals to be well aware of the latest technological advancements is high. The licensing system for practice in engineering as an accredited professional service and general trends in professional development in various countries are discussed in this article.

Engineering as an accredited professional service

In most countries, engineering is an accredited profession and as a result, engineers are required by law to be licensed before they provide professional services or use the title "professional engineer." Many other accredited professions, such as accountancy, legal services and medicine, are also subject to accreditation or licensing requirements. In addition to having professional qualifications, licensing requirements contain other conditions such as completing practical training, passing examinations and meeting language, good character and reputation, citizenship or residency conditions (Engineers Australia 2003). The examinations prescribed by some licensing bodies may include technical exams and/or exams based on testing the knowledge of professional practice, law and ethics.

While several Organization for Economic Cooperation and Development (OECD) countries, including the United Kingdom, Denmark, Australia, Switzerland and Finland, have no or very limited legal restrictions on the provision of engineering services, the United States, Canada, Japan and Singapore operate restrictive licensing and regulatory procedures (Engineers Canada 2009). There have been increasing international recognitions of academic qualifications and practice competency and increasing negotiation of professional accreditation and reciprocity agreements. These developments are an

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important means for professional service providers to gain international experience and market access.

For accredited professionals, continuing professional development is one of the core values associated with the ethics of professionalism. This view is shared by engineers and engineering technology professionals, as well as by a significant majority of their employers (Engineers Canada 2009). In Canada, it is increasingly the norm for professional associations in all regulated and certified professions to have policies that require or expect their registered members to undertake a certain minimum amount of continuing professional development learning. In most Canadian provinces and territories, the engineering and geoscience regulatory organizations have prescribed specific types of mandatory or voluntary requirements for professional development activities (APEGA 2014, Adams 2012).

Throughout the OECD region, professional associations of engineers and technologists have increased attention on continued professional development (CPD) and often have established norms and requirements to meet these CPD requirements (Engineers Canada 2009). In both the United Kingdom and Japan, for example, professional associations have established both requirements and standards for continuing development for engineers (Engineers Canada 2009). In the United States, it is common for state registration boards to make continuing professional development a requirement for maintaining registered status. In Australia, evidence of participation in continuing professional development is required to maintain registration as a Chartered Professional Engineer or Chartered Professional Technologist (Angelino 2003).

In Canada, a majority of engineering and geoscience regulatory bodies have mandatory professional development policies and requirements. As of 2012, eight of the 12 professional engineering associations had mandatory CPD programs (Adams 2012). Association policies clearly have an impact on participation in professional development. Mandatory CPD is common in many regulated professions. In most Canadian provinces, the engineering and geoscience regulatory organizations have moved towards mandatory requirements (APEGA 2014).

Regulation and licensure in engineering

Regulation and licensure in engineering are established by various jurisdictions of the world to encourage public safety, well-being and other interests of the general public, and also to define the licensure and regulatory process. As with many other professions, the professional status and the actual practice of professional engineering are legally defined and protected by law. Where engineering is a regulated profession, there are specific procedures and requirements for obtaining a registration, charter or license to practice engineering. Some of these requirements in various countries around the world are described below.

Australia: The requisite qualification for the registration of professional engineers is a degree in engineering qualification accredited by the Institution of Engineers, Australia (Engineers Australia 2003).

Canada: Engineering is a regulated profession in all Canadian provinces and territories similar to medicine, dentistry and law (Engineers Canada 2013). The designation "professional engineer" or "P.Eng." can only be used by licensed engineers and the practice of engineering is protected by law and strictly enforced in all provinces and territories. The regulation and licensing of engineers are accomplished through a self-governing regulatory body that is given the authority to license and discipline professional engineers, as well as regulate the practice of engineering in respective provinces and territories.

Europe: The European Engineer is an international professional qualification for engineers used in 32 European countries. The title is granted after successful application to a national member of the European Federation of National Engineering Associations which includes representation from many European Union member countries (FEANI 2014). A person who has an engineering degree and usually an engineering professional qualification in one of the member countries is allowed to use the qualification in others, but this depends on local legislation in the respective country.

India: In India, engineers with a bachelor's or master's degree in engineering from a university are allowed to practice engineering. They must be registered with municipalities in order to submit public plans, designs or drawings for approval and record.

Nepal: In Nepal, engineers with an engineering degree from Nepal Engineering Council-accredited universities and institutions are allowed to practice as registered engineer.

Pakistan: In Pakistan, engineers with an engineering degree from Pakistan Engineering Council-accredited universities are allowed to practice as registered engineer.

United Kingdom: The Engineering Council is the regulatory body for practice of engineering in the United Kingdom. While certain engineering titles and qualifications in the UK are highly regulated, the practitioner does not need to be licensed to work as an engineer. The UK professional engineers registered by the Engineering Council are fully protected under the law by means of the Engineering Council's Royal Charter and by-laws.

United States: In the United States, the registration or licensure of professional engineers and engineering practice is governed by the individual states. Each registration or license is valid only in the state where it is granted. It is the state that regulates and controls engineering practice.

Trends in professional development

Professional development is a continuous process of learning and improvement. It plays

In 2004, Engineers Canada adopted a Guideline on Continuing Professional Development and Continuing Competence for Professional Engineers. In that document, Engineers Canada states that:
"Continuing Professional Development encompasses the planned acquisition of knowledge, experience and skills and the development of personal qualities necessary for the execution of professional and technical duties throughout an engineer's professional life. It encompasses both technical and non-technical skills. CPD is a vital tool for maintaining and developing the professional competence, innovation and creativity of an individual engineer."

a crucial role in achieving and maintaining engineering competence. A brief description of trends in professional development in various jurisdictions is presented below.

Australia: Regulation to continue professional development provides for a practitioner engineer to undertake continuing professional development as a requirement for continuing practice after initial registration or attainment of chartered status (Engineers Australia 2003).

Canada: As of 2012, eight of 12 professional engineering associations had mandatory continuing professional development requirement programs (Adams 2012, Engineers Canada 2012). At the end of 2011, almost 50% of practicing members in Canada were accountable to undertake a mandatory professional development learning program (Adams 2012).

Germany: There is neither a formal professional certification with a title of Professional Engineer nor an organized means for continuing professional development but each large enterprise has its own systems to maintain and to increase the competence of its engineers (Angelino 2003).

France: There is no professional certification and no organized continuing professional development, however, there is a law that obliges the enterprises to spend at least 1.5% of their payroll for continuing education of their personnel, not only engineers (Angelino 2003).

United Kingdom: The Engineering Council in the UK works to promote engineering and sets standards of education and professional development for the profession. Any one wishing to be registered with the UK Engineering Council must demonstrate competence and commitment through the professional review process (Engineering Council 2014). In practice, this means undertaking continuing professional development. The requirement is set out in the UK Standard for Professional Engineering Competence and the obligation is explained in the CPD Code for Registrants (Engineering Council 2014). The professional engineering institutions licensed by the Engineering Council advise and support their members on CPD in a number of ways, such as providing guidance, resources and monitoring programs (Engineering Council 2014).

United States: The American Society of Civil Engineers (ASCE) supports documented continuing professional development, including ethics training, as a condition for maintaining status as a licensed professional engineer. ASCE also supports uniformity of continuing professional development requirements among licensing jurisdictions (ASCE 2014).

Japan: In Japan, there is a recommended 50 hours/year of PD activities from professional engineers (Ryan 2011). The areas recommended for PD are: engineering ethics, science and technology, social issues, and engineering judgment. The Institution of Professional Engineers, Japan further states that it is desirable for professional engineers to accumulate 150 hours within three years (CPD 2014). The institution also states that this requirement for Asia-Pacific Economic Cooperation members is reduced to 250 hours over a five-year period.

Professional development trends in other accredited professions

Project Management Institute (PMI) is the world's leading professional membership as-

sociation for project, program and portfolio management professionals. These globally recognized credential holders need to adhere to PMI's Continuing Certification Requirements program. Every PMI accredited credential holder requires a specific amount of mandatory professional development units per three-year certification cycle (PMI 2014).

The Alberta Law Society requires that members of the bar consider and plan their continuing professional development and evidence this by retaining a copy of their annual plan, making the plan available to the Law Society on request. Members are also required to demonstrate their adherence to the plan through continuing professional development activities. Non-compliance with this requirement is subject to professional discipline (Engineers Canada 2009).

In Canada, most of the regulatory bodies for architects have prescribed mandatory requirements for continuing professional development. In some jurisdictions, mandatory continuing professional development also applies to architectural technologists.

Virtually every health profession prescribes continuing professional development requirements to maintain licensure.

Concluding remarks

Rapid technological development, internationalization of enterprises and globalization of the world economy have imposed pressure on nations to produce the best graduates, especially in science and technology, and economics (Angelino 2003). Continuing education has long been a central focus of the civil engineering community and a means through which practitioners can share information, stay informed of changes and advances in their fields, and advance the science of engineering (ASCE 2014). While many other countries around do not regulate the engineering practice and hence do not have any stipulations for CPD, countries like the U.K., U.S., Australia, and Canada, prescribe mandatory or voluntary CPD requirements. In Canada, as of 2012, eight out of 12 engineering associations prescribed mandatory CPD requirements. ■

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Humanities and Social Sciences: Important to the Professional Development of Civil Engineers

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As the work of civil engineers is a function of the economic, political, and social environment that affects infrastructure and development decisions, professional engineers require an ability to make intellectual judgements that encompass human, societal, and technical values. Societal concerns need to be reflected in the deliverables of civil engineering practice, which include infrastructure that are underpinnings of human civilization. An overview of professional development for civil engineers is provided in Burrell and Devkota (2012). The role of humanities and social sciences (H&SS) in a civil engineer's education and professional development is discussed in this article.

The need for humanities and social sciences in engineering

Increasingly during the past two decades, employers are seeking engineering professionals and graduates with proficiency in skills beyond technical ability. They want engineers and engineering managers with abilities to make decisions, communicate well, and collaborate productively with their colleagues in organized teams. Engineers are expected to be at the crossroads of technology and society, where they must communicate with social, legal, and other experts in advisory or consulting roles on matters such as public health and safety, environmental protection, resource utilization, and sustainability (Jaap and Woudstra 1997). Engineers operate in a dynamic global environment that challenges them with new demands and with the diverse, profound, and continual changes confronting humankind as it moves through the 21st century (Nguyen 1998). As the job environment is becoming more global, socially responsive, and competitive, the role of H&SS in engineering has been gaining importance (Ahuja 2014).

Engineers yearn for more respect from, and authority in, society (Bennet 2005). A widespread public perception exists that engineers are mere technocrats who can only occupy subordinate roles in society and political structures (Florman 1997). Identification of engineering with environmentally damaging technologies and with gender inequality has undermined the status of engineering in society (Conlon 2008). An undertone of professional discontent exists in Canada, the United States, and the United Kingdom, that the profession lacks societal esteem, and that lawyers, politicians, and societal leaders ignore or patronize civil engineers (Florman 1997). If engineering is to be practiced as a profession, then engineering science must be harmonized with human values and social organizations (Sarkar 2012). Professional activity supported on a balanced base of liberal learning supports ASCE's vision for the civil engineering profession (ASCE 2008).

Engineers lament that others in society would benefit from the solution-driven mindset of engineers, and certainly many social programs based on invalidated and often-incorrect social theories exist. Engineers do not control the political and social agenda, but with some H&SS they may be better able to influence some positive societal change. Too many technical professionals have only a peripheral role in the formulation and implementation of public policies as they have a poor understanding of the social, political, and economic issues that relate to the real needs of society (Sarkar 2012).

Humanities

The humanities are a domain of knowledge concerned with human culture and condition. Humanities allow us to learn about our inner selves, our fellow human beings, and about the cultures in which we live (Florman 1997). Engineers who ignore the humanities endanger themselves intellectually and emotionally, and risk becoming an underclass compared to persons who have committed to the study of liberal arts (Florman 1997). The humanities include the disciplines of literature, history, philosophy, and language and culture studies that use analytical, critical, or speculative methods.

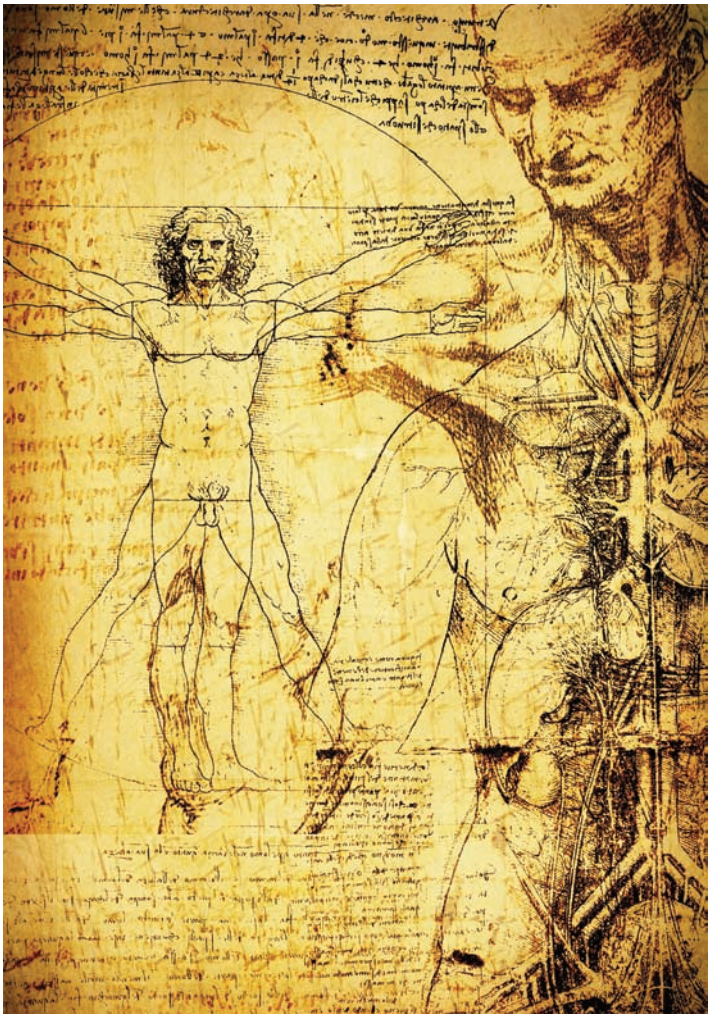
History: History focuses on the cause and effect of sequences of past events. History can provide insight and perspective with respect to current cultural practices and socio-political problems. Historians usually specialize in the study of the past of a period, region, economic sector, or social class. A broad understanding of history obtainable from an introductory course in world history can broaden an engineer's perspective concerning world events and study of the history of one's country can provide a background for good citizenry. Yet it is engineering history that reveals the interweaving of engineering and culture that often provides the

initial gateway for civil engineering students to the humanities.

Philosophy: Philosophy is the study of fundamental challenges of human reality, including existence, knowledge, values, and reason as it relates to basic beliefs, concepts, and attitudes. Areas of philosophical study include ethics, epistemology, logic, and metaphysics. It is widely accepted that professional ethics should be taught to engineering students (Sarkar 2012). Ethical considerations in engineering practice include consideration of issues of quality of life, equity and fairness, and environmental sustainability (Hargreaves 2014).

Literature: Literature is a privileged form of human activity because no other activity or discourse brings out, so fully or precisely, the variety, possibility or complexity of human life (Devika 2007). Literature provides insights that help when dealing with the crises in life. Reading fiction can allow for self-examination through comparison with the actions of the fictional characters. Literature, especially, in the form of the novel or tragedies, highlights how people cope with ethical dilemmas (Monk 1997).

Language and Cultural Studies: In a cross-cultural context, conflicts are generated from assumptions, expectations, and inaccurate perceptions that arise, sometimes unconsciously, from one's cultural background. For example, different societies exhibit collectivism and individualism as dominant and this has an effect on communication style and conflict resolution (Goh 2012). Knowledge of foreign languages, often a reflection of culture, can be an asset in acquiring and doing engineering projects in foreign lands. Canadian engineers should be effective in working in different languages and cultures if they are to succeed as global engineers (Chen and Fishbein 2009).



Other: Classics, religious studies, media studies, and art appreciation are other areas of humanities that may appeal to engineers (and profoundly affect an individual), but they have less obvious connection to the professional development of engineers. On the other hand, applied versions of humanities, such as writing (grammar and style), journalism, and communications, are marketable "soft skills" that engineering bodies endorse and employers reportedly seek.

Social Sciences

Social science is a domain of knowledge concerned with society and the relationships among individuals within a society. The study of social sciences helps engineers understand the context in which they work and how it enables or constrains the profession's capacity for social responsibility (Conlon 2008). Social scientists use social critique, symbolic interpretation, and/or the scientific method, often combining both quantitative and qualitative techniques. Social science includes the disciplines of anthropology, economics, political science, psychology, sociology and gender studies, which are reflected in learned discipline-specific social-science societies, journals, and academic departments.

Economics: Economics is the social science concerned with the processes that govern the production, distribution, and consumption of goods and services in an exchange economy. Bennett (2005) claims that engineering solutions are dependent upon market forces and market prices, and therefore states that engineers must learn economics, especially micro-economics which is about the determination of market value and the setting of prices. Sood et al (2012) considers courses in finance and economics as enabling effective participation in society. Courses in resource and environmental economics are also of value to the civil engineer.

Political science: Political science is the examination of political systems, behaviour, and culture. The formal study of political science combines writing skills with research methodologies to interpret empirical data and social theory. A general understanding of political theory might enable more engineers to be involved in the political process as perceptive voters and/or astute participants.

Other civil engineers might find interesting and useful courses in policy development, international relations, political economy or international development (the latter two being a combination of political science and economics).

Sociology: Sociology uses empirical investigation and critical analysis to develop knowledge about social actions, structure, and functions. Social policy and welfare based on the work of sociologists is fundamental to social work. Social theory suggests that the capacity to be socially responsible goes beyond the values (the ethics) of participants in that society. As social structure provides differential access to cultural and material resources, a basic understanding of sociology might enable civil engineers to assess their involvement in public policy and whether these interventions enable or constrain progress towards a just and sustainable world (Conlon 2008).

Other: Other social sciences include anthropology, psychology, linguistics, human and environmental geography, environmental studies, and gender studies. The individual engineer must weigh the value of the study of these subjects to one's career and life considering one's goals, ambitions, and interests.

Teaching H&SS to Engineers

The most essential generic attributes of an engineer include technical knowledge and skills (Nguyen 1998). Learning other areas of knowledge is secondary to the requirement to produce engineering graduates with technical competency, analytical capability and critical thinking skills. Yet most undergraduate civil engineering programs allow a few H&SS courses to be taken as electives. Incorporation of humanities and sciences in an engineering curriculum helps in developing communication, analytical and leadership skills, and in generating concern for society and the environment (Ahuja 2014).

A range of social, cultural, and pedagogical factors affect the incorporation of H&SS into engineering programs (Webb 2008). University departments competing for limited resources debate the degree of H&SS studies in engineering programs, control over the delivery of H&SS to engineering students (i.e. who specifies the courses and who teaches the courses), and the relevance and transferability of H&SS to engineering practice (Jesma and Woodstra 1997). The degree of H&SS studies in engineering programmes varies from 5 to 25%, depending upon the country, institution, and whether H&SS constitutes a minor in the degree program (Sarkar 2012, Jaap and Woodstra 1997, Webb 2008).

Some engineering programs incorporate specialized courses in the humanities and social sciences developed specifically for engineering students that provide for easier scheduling of complementary studies in time-constrained engineering programs and a comfortable environment for engineering students. Ross (2013) contends that learning liberal arts should never be comfortable nor taught in the same structured approach as an engineering class. Instead, he advocates taking regular H&SS courses thereby gaining an appreciation for both the subject matter and liberal arts students (Ross 2013).

Professional development

Taking a few introductory courses as part of an undergraduate program provides engineers with an inadequate knowledge of the humanities and social sciences. Therefore, civil engineers need to incorporate the study of H&SS as part of their ongoing professional development. Many opportunities exist for civil engineers to incorporate the study of H&SS as part of their continuing professional development. The opportunities exist in several differing formats and delivery methods, including classroom, distance education, and self-directed learning, so that engineers can study the humanities and social sciences in a formal or an informal manner.

The inclusion of H&SS in the professional development of a civil engineer depends upon the engineer's background, prior learning, interests, and experiences. Although most subjects in the humanities and social sciences may lead to self-awareness and personal growth, the relevance of humanities and social science subjects to engineering practice varies greatly. This makes a prescribed programme of study difficult to define and assess. Acceptable continuing professional development includes communication, business and interpersonal skills (the non-technical skills) and social implications of engineering (CCPE 2004). The engineer should consider whether the study of a specific H&SS subject provides for (a) improved analytical and communication skills that can be utilised in business and judicial/regulatory applications involving non-engineers, and (b) a broader perspective on the effects of engineering on society and the environment.

The amount of H&SS in professional development activities, based on common practices in undergraduate programs, should average (over a three-year period) 10% to 25% of total professional development hours. This excludes professional development in communications, management, and marketing. The majority of professional development, however, should be dedicated to technical review, upgrading, and advancement.

Concluding remarks

Professional engineers need to recognize that a narrow technical understanding of the world is insufficient in today's multifaceted, multicultural, and interconnected society. Practising engineers should appreciate the knowledge that graduates in liberal arts possess, and aim to acquire knowledge of H&SS themselves. Civil engineers require a basic understanding of societal relationships that would enable them to consider concepts of equity, fairness, social justice, environmental stewardship, and sustainability.

Employers and licensing bodies should recognize H&SS as an important component of the continuing professional development of civil engineers. H&SS should be accepted as partial fulfillment of corporate or regulatory requirements for professional development.

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Trends Affecting the Continuing Professional Development of Civil Engineers

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Continuing professional development (CPD) for civil engineers is a life-long process of obtaining skills, qualifications, and experience needed for professional competency and career advancement. Professional development may include a review of engineering principles and methodologies learnt during an university degree program; upgrading of knowledge concerning new instrumentation, modelling techniques, and design methodologies; expansion of engineering knowledge to other areas of practice; and broadening of knowledge of humanities, social sciences, business administration, and communications. Burrell and Devkota (2012) discuss the objectives, benefits, types, formats, and providers of professional development, as well as the responsibilities of civil engineers and their employers. CPD may increase personal confidence, build and maintain staff morale, and improve institutional effectiveness/corporate profitability. In this article, six trends affecting the CPD of civil engineers are discussed. These trends are mainly a result of changes in the social, political, and economic environment in which engineers work, and the growing challenges imposed by global change and limited natural resources.

1. Professional development is becoming obligatory or mandatory in many jurisdictions or within the place of employment. Engineers Canada's Board of Engineers endorsed in February 2012 a policy that Canadian engineering regulators require professional engineers to maintain competencies in the areas they practice by participating in quantifiable continuing professional development. The policy also calls for program reviews and consequences for non-compliance (Engineers Canada 2014).

In the United States, the American Society of Civil Engineers (ASCE) supports state-mandated continuing education (ASCE's Policy 425) and recommends uniformity of CPD requirements among licensing jurisdictions (ASCE 2009). In the U.K., Chartered Engineers are required to maintain and enhance competence by acquiring and recording CPD, with engineering institutions being encouraged to implement monitoring programs by 2017 (Engineering Council 2014). Engineers Australia requires documentation of a minimum of 150 hours of structured CPD over a three-year period, with audits at random or if the individual has been the subject of a complaint or works in a high risk area of practice (Engineers Australia 2009).

Employers support continuing professional development as an activity that maintains and improves their effectiveness or competitiveness, or both. Many firms, as part of employee appraisal and/or performance reviews, require staff engineers to meet a required number of professional development hours. Several employers invest time and money in innovative and cost-effective approaches to lifelong learning and investment in training programs is rising (Stewart 2014).

2. Specialized certification is becoming an important professional development goal. New forms of non-degree credentials with labour market value have emerged. Certification is an advanced qualification beyond licensure that demonstrates attainment of a body of knowledge within a specialty area of civil en-

gineering and a commitment to stay current on new technological innovations through continuing professional development requirements. These highly specialized credentials include LEED AP, Environ SP, MtgEng, and PMP. Several employers value certifications.

In 2004, ASCE created Civil Engineering Certification, Inc. (CEC) to provide a mechanism for professional post-licensure certification of specialties within civil engineering (ASCE 2014). Although some may question whether the collection of credentials is diminishing the value of the university degree and the P.Eng. designation, and enabling more non-engineers to do engineering-related work, it is nevertheless a reality.

3. The variety of types, forms, and delivery mechanisms of professional development is increasing.

CPD opportunities are no longer limited to face-to-face interactions such as classroom courses, short courses and workshops, conferences and symposia, and mentoring and reflective supervision. Where engineers are dispersed geographically, the use of video streaming, time-flexible interactive media, and internet meetings, as well as more use of global networks, are recommended for CPD training (Kerr 2010). International networking and social media platforms enable personal and professional development in ways never before possible thereby creating opportunities for learning, collaborations, and career advancement (Beck 2014). Long-term professional success can depend also on personal learning networks (such as CSCE's LinkedIn groups) typically encompassing a diverse set of relationships that provide information, understanding and context for personal and professional development questions (Beck 2014).

4. Knowledge of environmental management and sustainability is becoming an increasingly important required component of an engineer's ongoing professional development.

This trend may not be new but it is gaining in importance as humanity faces the challenges of increased urbanization, environmental degradation (e.g., deforestation

and desertification), species loss, water shortages, and climatic change. Many professional associations require engineers to develop an understanding of environmental issues and of the principles and goals of sustainable development. Byrne et al. (2010) lists several relevant policies, codes of ethics and guideline publications, noting that professional engineering bodies are envisaging an increased role for sustainability and sustainable development among the engineering community. Young (2014) lists some rating systems engineers use for different infrastructure types in different regions around the world.

5. There is an increasing emphasis on leadership.

Leadership is identified as an important skill that more engineers should possess (The Royal Academy of Engineering 2007; Bowman and Farr 2000; ASCE 2008). Engineers are well suited to assume leadership roles due to their attainment of strong analytical and rational decision-making skills, and the very nature of the profession (ASCE 2008). Leadership

is the ability to influence people to accomplish shared tasks within defined parameters while respecting individual talents and contributions. It involves strategic visioning and initiative taking with respect to the utilization of resources to accomplish a goal.

Engineering leadership is not synonymous with engineering management; some managers are poor leaders. An engineering manager relies on positions of control within an organizational structure to plan tasks and coordinate resources to achieve short-range objectives, whereas engineering leaders rely on trust and example to develop solutions adaptable to changing conditions and societal needs (Orton 2011).

6. Globalization is intensifying the need for professional development and compelling engineers to acquire greater awareness of other cultures and foreign engineering practices.

Globalization results in further interdependence of economic activities and assimilation or exposure to different cultures with both beneficial and detrimental effects on society. All engineers need to understand globalization and consider its effects in their professional

lives and business practices (Galloway 2004). A lot of effort is required to keep Canadian professionals competitive and current in the global markets (Gupta and Burrell 2010).

Globalization has three consequences on the professional development needs of professional engineers. First, international recruitment and outsourcing of engineering work to other countries will require many civil engineers, both as individuals and as members of engineering firms/institutions, to work harder at remaining competitive. Therefore, a concerted effort has to be made to ensure that the engineer has (and is credited with) sufficient professional development (especially technical upgrading and advancement) to be internationally competitive.

Second, civil engineers may be educated and/or practice engineering in countries other than their nation of birth and residence, and therefore engineers need to understand people from a different cultural background. Downey and Lucena (2005) discuss cross-cultural training based on a modular approach in which the emergence of engineering over time and from place to place is examined. Third, globalization of engineering consulting and industry creates a requirement to know how infrastructure planning, design, construction, and operation vary from country to country, and between developed and developing countries. Globalization thus puts increased onus on civil engineers to learn about the context of infrastructure development (societal and environmental), global infrastructure risks (natural, political, and financial), and project management (Galloway 2004).

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Welcome to new members

CSCE welcomes the following individuals who joined as new members in the last year:

Bienvenue aux nouveaux membres

La SCGC accueille les personnes suivantes qui sont devenues membres au cours de l'année :

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Ahmed Elkady	Montreal
Jonathan David James Eppell	Nova Scotia
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New edition: CSA-S-06 Canadian Highway Bridge Design Code

CSCE will be offering a one-day course on the new edition of the Canadian Highway Bridge Design Code. The course will be held throughout Canada starting in spring of 2015. Authors of the code will present and explain the major changes made to four main sections of the code: Section 4: Seismic Design, Section 5: Methods of Analysis, Section 6: Foundations and Geotechnical Systems and Section 12: Barriers and Highway Accessory.

The 11th edition of CSA-S6 Canadian Highway Bridge Design Code applies to the design, evaluation and structural rehabilitation design of fixed and movable highway bridges. The code establishes safety and reliability levels that are consistent across all jurisdictions in Canada. ■

Nouvelle édition: CSA-S-06 Code canadien sur le calcul des ponts routiers

À compter du printemps 2015, la SCGC présentera une formation d'une journée sur la nouvelle édition du Code canadien sur le calcul des ponts routiers. La formation sera offerte dans tout le Canada. Les auteurs du code présenteront les modifications importantes apportées à quatre principaux chapitres du code : Chapitre 4 : Conception parasismique; Chapitre 5 : Méthodes d'analyse; Chapitre 6 : Fondations et systèmes géotechniques et Chapitre 12 : Dispositifs de retenue et supports d'équipements routiers.

La 11e édition du CSA-S-06 Code canadien sur le calcul des ponts routiers couvre la conception, l'évaluation et la conception de réhabilitation de la structure des ponts routiers fixes et mobiles. Le code établit les niveaux de sécurité et de fiabilité conformes à toutes les juridictions du Canada. ■

CALL FOR CASE STUDIES

CIVIL magazine invites members and sponsors of CSCE/SCGC to submit case studies of infrastructure projects for publication.

Projects will be selected for publication based on various criteria, including their sustainability qualities.

Suggested projects include transportation (transit, bridges, etc.), water-wastewater infrastructure, power generation, industrial plants, etc. The project can be either in Canada or international and should have been completed in the last two years.

Submit an 800-word description plus photos to:
Bronwen Parsons, Associate Editor, CIVIL magazine. E-mail: bparsons@ccemag.com.
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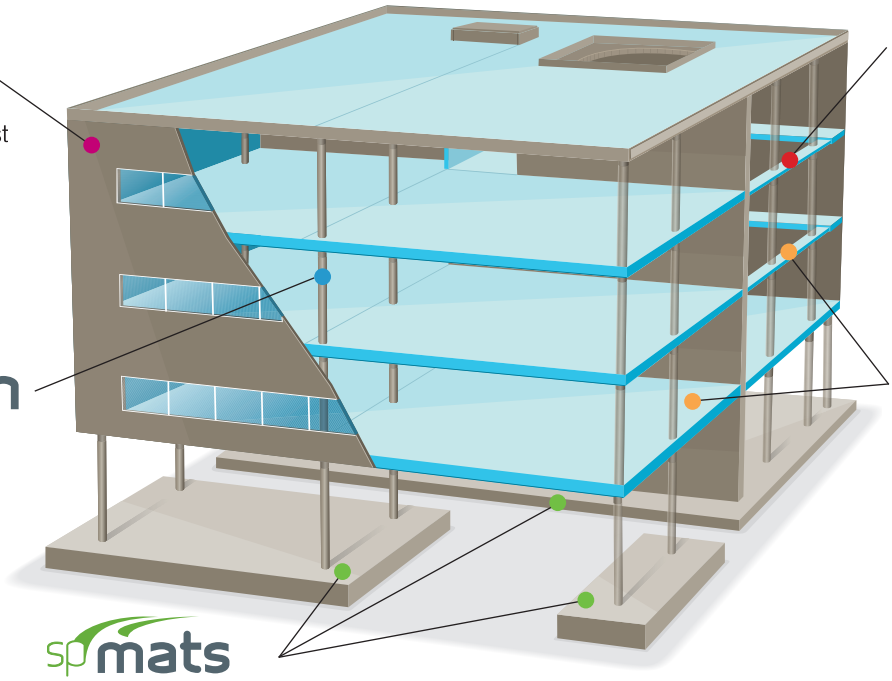

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