civil

CANADIAN CIVIL ENGINEER

L'INGÉNIEUR CIVIL CANADIEN

- Japan: Learning from the Tsunami
- Hong Kong: Seawater Flushing
- U.S.: Oakland Bay Bridge
- Alberta: Access Road to Fossil Site

2012 | FALL/AUTOMNE

Lessons from Abroad

Des leçons de l'étranger

Publications Mail Agreement #40069240

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ON THE COVER: The aftermath of the earthquake and tsunami which struck Japan in March 2011. A discussion of tsunami safety measures can be found on page 27, "Engineering lessons from the 2011 Japan tsunami."

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Annual Subscription Rates/Abonnement annuel
Canada & U.S./E.U. $35.00, Other countries/Autres pays $45.00; Single copy/Un numéro $7.50; Agency discount/Rabais au distributeurs 10%

PUBLICATION ISSN 9825-7515

RETURN ADDRESS/ADRESSE DE RETOUR :
The Canadian Society for Civil Engineering
La Société Canadienne de Génie Civil
4877 Sherbrooke St. W., Westmount, Quebec H3Z 1G9

Canadian Civil Engineer (CCE) is published five times per year by the Canadian Society for Civil Engineering (CSCE). L'ingénieur Civil Canadien (ICC) est publié cinq fois par année par la Société Canadienne de Génie Civil (SCGC).

CIVIL Magazine is produced by the publishers of Canadian Consulting Engineer Magazine, published by BIG Magazines LP, a division of Glacier BIG Holdings Ltd. Le magazine Civil est produit par l'editeur de la publication Canadian Consulting Engineer qui est publie par BIG Magazines LP, une division de Glacier BIG Holdings Ltd.

Business Information Group,
80 Valleybrook Drive, Toronto, Ontario M3B 2S9
Tel.: 416-442-5600; Fax: 416-510-5140

PUBLICATIONS MAIL AGREEMENT/POSTES CANADA ENREGISTREMENT #40069240

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Climate Change and Civil Engineering

Over the past two decades or more, much work has been done with respect to climate change. Even now, and perhaps more so than previously, climate change remains very high on various agendas throughout the world, with articles of one sort or another appearing in newspapers and elsewhere almost daily. Indeed, as of late, most of us can identify with unusual weather and a perceived change in our weather patterns. Certainly this is true here on the prairies of Canada, which I call home. But how does climate change and/or climate variability affect what we do in civil engineering? How do we respond?

Beginning in the early 1970s, and possibly even a bit earlier, scientists began to raise concerns that the world's climate was changing, with the main point of concern being an increase in the mean temperature. The temperature change was thought to result from a greenhouse effect principally associated with increases in human-induced carbon dioxide emissions. It was postulated that a temperature increase could result in melting of the polar ice caps, increasing mean sea levels, more frequent and more intense storm activity (hurricane, tornado, etc.) and significantly changed precipitation patterns that could be expressed as droughts in some areas and flooding in others.

From a civil engineering perspective, the most significant aspects of climate change are associated with the impacts of the change on societal infrastructure (e.g., buildings, drainage works) and natural systems such as rivers (e.g., water supply, flooding). Perhaps just as important are climate variability and extreme weather events, which present challenges in providing sufficient infrastructure resilience at acceptable cost. We must remind ourselves, however, that change and variability are intrinsic elements of the Earth's climate, which have thus been an integral part of civil engineering design for decades. Today, though, we are perhaps challenged even more than previously to address the climatic aspects of our designs.

Of course, from an IPCC perspective, civil engineers also need to be mindful of the carbon footprint of the works that are constructed and the means used to facilitate the construction. In this, due consideration is to be given to improved sourcing of construction materials, effecting efficiencies in material use and better management of wastes generated. The good news is that a move toward a reduced carbon footprint, regardless of one's views on climate change, is tantamount to good engineering practice.

Every three years for the past 30 years or so, the civil engineering societies in Canada (CSCE), the United States (ASCE) and Great Britain (ICE) meet at what is referred to as the Triennial Conference. The most recent conference took place in Washington earlier this year. The conference theme is selected by the host country and the event typically ends with the signing of a protocol agreement of some mutual interest to each of the three societies and the profession of civil engineering.

The last three protocols have in some manner dealt with sustainability, with the 2009 agreement specifically focused on civil engineering and climate change. The agreement sets out a number of priorities for addressing climate change and/or the impacts thereof, including those that involve mitigation and adaptation. In a mitigation context, there is need for the design of low-carbon infrastructure and increased efficiency of energy use, including consideration of the whole life cycle of a project. This could include, for example, such things as non-structural approaches to reduce traffic congestion. In short, as per the 2009 protocol agreement, "civil engineers must develop and implement tools, policies and practices for risk assessment and adaptation of existing and new civil infrastructure to climate change." At the very least, this would seem to be a reasonable direction for our profession to take. ■

J.A. (Jim) Kells, Ph.D., P.Eng., FCSCE is Professor and Head of the Dept. of Civil and Geological Engineering, University of Saskatchewan.

Le changement de climat et le génie civil

Au fil des deux dernières décennies, on a fait beaucoup en matière de changement climatique. Même en ce moment, et peut-être plus encore qu'auparavant, le changement climatique demeure une priorité à travers le monde, et des articles variés paraissent dans les journaux et même ailleurs, presque quotidiennement. En fait, la plupart d'entre nous perçoivent que la météo a quelque chose d'inhabituel et que les régimes climatiques se modifient. Cela est certainement vrai dans les Prairies, au Canada, que je considère comme mon coin de pays. Comment le changement climatique et/ou la variabilité du climat peuvent-ils affecter ce que nous faisons à titre d'ingénieurs civils ? Comment devons-nous réagir ?

À compter de 1970,et peut-être même un peu avant, les scientifiques ont commencé à exprimer leurs préoccupations quant au fait que le climat de notre monde changeait, et la principale préoccupation était alors le fait que la température moyenne augmentait. On croyait alors que le changement de température était le résultat d'un effet de serre relié surtout aux augmentations d'émissions de bioxyde de carbone provoquées par l'homme. On faisait l'hypothèse qu'une augmentation de la température pouvait provoquer la fonte des calottes polaires, augmenter le niveau moyen des mers, provoquer une intensification de la fréquence et de l'intensité des tempêtes (ouragans, tornades, etc.) et modifier de façon importante la configuration des précipitations, causant des sécheresses dans certains endroits et des inondations dans d'autres.

Pour le génie civil, les aspects les plus importants du changement climatique sont associés aux effets du changement sur les infrastructures de nos sociétés (ex. : les édifices, les travaux de drainage) et les systèmes naturels comme les rivières (ex. : l'approvisionnement en eau, les inondations). Encore plus importants sont la variabilité du climat et les phénomènes météorologiques exceptionnels qui présentent des défis lorsqu'il s'agit de fournir des infrastructures résistantes à des prix raisonnables. Nous devons être conscients, cependant, que le changement et la variabilité sont des éléments intrinsèques du climat de la terre, et qui ont donc fait partie des préoccupations de l'ingénieur civil depuis des décennies. Aujourd'hui, cependant, nous sommes peut-être mis au défi, plus que jamais auparavant, de nous préoccuper du climat dans nos travaux.

Évidemment, du point de vue du GIEC, l'ingénieur civil doit aussi se préoccuper de l'empreinte carbonique des ouvrages réalisés et des moyens utilisés pour faciliter la construction. En cela, il faut bien tenir compte de l'amélioration de l'approvisionnement en matériaux de construction, de la meilleure utilisation des matériaux et de meilleure gestion des déchets. La bonne nouvelle est le fait que la diminution de l'empreinte carbonique, peu importe ce que l'on pense du changement climatique, constitue une saine pratique du génie.

À chaque trois ans, depuis environ 30 ans, les sociétés de génie civil au Canada (SCGC), aux USA (ASCE) et en Angleterre (ICE) se rencontrent lors du congrès triennal. Le plus récent congrès a eu lieu cette année, à Washington. Le thème du congrès est choisi par le pays hôte et l'activité se termine généralement par la signature d'un protocole d'entente d'intérêt mutuel pour les trois sociétés et pour la profession.

Les trois derniers protocoles portaient en quelque sorte sur la durabilité, et l'entente de 2009 portait précisément sur le génie civil et le changement climatique. L'entente définissait certaines priorités dans le traitement du changement climatique et/ou de ses impacts, incluant tout ce qui concernait l'atténuation et l'adaptation. Dans une perspective d'atténuation, il y a lieu de concevoir des infrastructures à faible teneur en carbone et d'utiliser l'énergie de façon plus efficace, tout en tenant compte du cycle de vie complet d'un ouvrage. Ceci pourrait inclure, à titre d'exemple, des éléments comme une approche non-structurelle en matière d'élimination des embouteillages. Bref, selon les termes du protocole d'entente de 2009, « l'ingénieur civil doit élaborer et mettre en œuvre des outils, des politiques et des pratiques pour l'évaluation des risques et l'adaptation au changement climatique des infrastructures existantes et nouvelles ». Il s'agit là, à tout le moins, d'une orientation raisonnable que doit choisir notre profession. ■

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Brad Smid, P.Eng., MCSCE
VICE-PRESIDENT, WESTERN REGION
Brad Smid, ing., MSCGC
VICE-PRÉSIDENT, RÉGION DE L'OUEST

Western Regional Lecture Tour

The CSCE Western Region covers the geographic area of Alberta, British Columbia, and parts of Northwest Territories and the Yukon. The Region includes four active Sections (Edmonton, Calgary, Vancouver, and Vancouver Island), and is home to about one third of the CSCE's total membership.

Section volunteers, including the four section chairs and the regional vice-president, meet regularly to discuss ways to collaborate and add value to the programs that we deliver to CSCE members. One example of this sort of collaboration is regional lecture tours. These tours allow us to use our combined resources to bring in higher-profile speakers and lecture topics than the sections may be able to host on their own.

The second annual Western Regional Lecture Tour was held on February 28 and 29, 2012. Jerod Johnson of Reaveley Engineers + Associates from Salt Lake City, Utah, was the guest speaker for a series of outstanding lectures entitled Modern Solutions to Historic Problems: Utah State Capitol Seismic Retrofit Project. The lectures were hosted in all four sections of the region, and drew strong attendance and industry support.

This topic was chosen for its technical complexity, broad range of civil engineering discipline involvement, and as an example of a project that represents leadership in sustainable infrastructure. Proximity to a known and active seismic fault coupled with clear seismic deficiencies prompted the State of Utah to undertake a massive renovation of the 90-year-old Utah State Capitol building. The rehabilitation strategy for this award-winning project had two primary objectives: life safety and historic preservation.

We would like to thank the CSCE volunteers who worked hard on the logistics, publicity and fundraising for this event. We also thank our speaker, Jerod Johnson, for dedicating his time to visit all four sections in two days. Finally, we thank our sponsors for their contributions which allowed us to deliver a top-notch event and secure a bright future for additional regional lecture tours.

Sponsors for this event were:

- Gold – Stantec
- Silver – Dywidag, Graham, AMEC, Golder Associates, Ausen Sandwell
- Bronze – Cement Association of Canada ■

Brad Smid is program manager, North LRT Extension, LRT Design & Construction, for the City of Edmonton. He can be reached at brad.smid@edmonton.ca

La tournée régionale de conférences de l'Ouest

La région de l'Ouest de la SCGC couvre la zone géographique de l'Alberta et de la Colombie-Britannique, ainsi que certaines parties des T.-N.-O. et du Yukon. La région inclut quatre sections actives (Edmonton, Calgary, Vancouver et l'île de Vancouver) et compte environ le tiers des membres de la SCGC.

Les bénévoles des sections, y compris les présidents des quatre sections et le vice-président régional, se rencontrent périodiquement pour collaborer et enrichir les programmes offerts aux membres de la SCGC. Les tournées régionales de conférences sont un exemple de cette collaboration. Ces tournées nous permettent de nous servir de nos ressources collectives pour inviter des conférenciers de renom que les sections ne pourraient accueillir en restant seules.

A networking mixer was held prior to the lecture in Edmonton at the Art Gallery of Alberta. / Une rencontre a eu lieu avant la conférence donnée à Edmonton, au « Art Gallery of Alberta ».

Edmonton Section past-chair Andrew Neilson with speaker Jerod Johnson. / Andrew Neilson, ancien président de la Section d'Edmonton, avec le conférencier Jerod Johnson.

Photography: Pictures2Memories Photography


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La deuxième tournée régionale de conférences de la région Ouest a eu lieu les 28 et 29 février 2012. Jerod Johnson, de Reaveley Engineers + Associates, de Salt Lake City, Utah, était le conférencier invité et a prononcé une série de conférences remarquables sur le thème « Des solutions modernes pour des problèmes historiques : le projet d'adaptation aux dangers sismiques du Capitole de l'état de Utah ». La conférence a été donnée dans les quatre sections de la région et a suscité une forte présence et l'appui de l'industrie.

Le sujet avait été choisi en raison de sa complexité technique, du nombre de disciplines du génie civil impliquées, et parce qu'il représentait une forme de leadership en matière d'infrastructures durables. La proximité d'une faille sismique connue et active, ainsi que des défauts sismiques connus, ont convaincu l'Utah d'entreprendre un immense effort de rénovation de cet édifice vieux de 90 ans. La stratégie de restauration adoptée dans ce cas visait deux objectifs principaux : assurer la sécurité des gens et conserver l'aspect historique.

Nous remercions les bénévoles de la SCGC qui ont assuré la logistique, la publicité et le financement de cette activité. Nous remercions également notre conférencier, Jerod Johnson, qui a accepté de visiter nos quatre sections en deux jours. Enfin, nous remercions nos commanditaires pour leurs contributions qui ont permis d'organiser une activité de haut niveau, ce qui augure bien pour l'avenir des tournées régionales de conférences.

Les commanditaires de l'événement étaient :

- Or – Stantec
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- Bronze – l'Association du ciment du Canada ■

Brad Smid est directeur de programmes, North LRT Extension, LRT Design & Construction, pour la ville d'Edmonton. Son adresse courriel est brad.smid@edmonton.ca

Photography: Pictures2Memories Photography

Speaker Jerod Johnson of Reaveley Engineers + Associates chats with young professionals at the regional lecture tour networking mixer in Edmonton. / Le conférencier Jerod Johnson, de Reaveley Engineers + Associates, converse avec des jeunes professionnels lors d'une rencontre dans le cadre de la tournée régionale de conférences, à Edmonton.

Strategic Role of Students and Young Professionals

By Doug Salloum, BSc (Civil Eng.), MBA, PMP
CSCE EXECUTIVE DIRECTOR, EDITOR, CIVIL MAGAZINE
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We realize CSCE is competing for the attention and loyalty of younger members. If you are reading this article you are probably already a member of CSCE. And if you are a member under 35 you have probably been asked by friends or colleagues when discussing CSCE, "What's in it for me?"

The following article describes what CSCE is doing in one particular area: national competitions. Tell your friends.

National sanctioning of student competitions

In 2012 CSCE signed five-year sanctioning agreements with the organizers of three national student competitions: the Great Northern Concrete Toboggan Race, the Troitsky Popsicle Stick Bridge Competition and the Canadian National Concrete Canoe Competition. CSCE has committed $5,000/year to each of these competitions over the next five years. CSCE also committed to providing judges, promoting the events and providing plaques and/or trophies to the winning teams.

Travel to CSCE annual conference

CSCE wants to encourage undergrads to participate in the annual conference. To support this goal, the CSCE national office pays travel expenses and registration costs for two representatives of the winning teams in each of:

- Great Northern Concrete Toboggan Race
- Troitsky Popsicle Stick Bridge Competition
- National Concrete Canoe Competition
- President's Award for Best Chapter

Eight students travelled to Edmonton this year. While at the conference they met students from other schools, attended technical presentations and participated in organized and unorganized social events. On the last day of the conference each of the winning teams was recognized by the assembled conference delegates and the members of the winning teams were presented with plaques that will hang in a place of honour in their home civil departments.

National Capstone Competition

This is a new event. Most civil engineering students have a capstone project in their final undergrad year. Now the best of these will be selected by their departments to participate in a national competition.

One team from each Department will be invited to the CSCE annual conference to make a poster presentation. These presentations will be judged and a national winner will be announced at the conference.

The first of these capstone competitions will be organized to take place during the CSCE Annual Conference in Montreal, May 29-June 1, 2013.

Young Professional Award

Another new award will be initiated in 2012-

13. CSCE will recognize a practicing civil engineer under 35 years old. Details will be announced in the coming months.

Keep up to date

Details on all of these competitions will be provided and updated on the student section of the CSCE website, http://csce.ca/membership/student/

We want to hear from you as you begin your fall sessions. Contact your student chapter president and your faculty advisor. If you don't know how to find either of these individuals, contact the national office: email Patsy Kerr, membership officer, at membership@csce.ca.

I hope you have a great term. Have fun, learn as much as you can and get involved! ■

Le rôle stratégique des étudiants et des jeunes professionnels

Par Doug Salloum,
SCGC DIRECTEUR EXÉCUTIF,
RÉDACTEUR, CIVIL MAGAZINE

Nous sommes conscients du fait que la SCGC est en compétition pour obtenir l'attention et la loyauté des jeunes membres. Si vous lisez ces lignes, c'est que vous êtes probablement déjà membre de la SCGC. Et si vous êtes un membre âgé de moins de 35 ans, des amis ou des collègues ou des amis vous ont déjà posé la question, en parlant de la SCGC : « Qu'est-ce que ça m'apporterait ? »

L'article qui suit décrit ce que fait la SCGC dans un domaine précis : les concours nationaux. Parlez-en à vos amis.

Une sanction nationale pour les concours à l'intention des étudiants

En 2012, la SCGC a signé des ententes de reconnaissance de cinq ans avec les organisateurs de trois concours nationaux à l'intention des étudiants : le concours du toboggan en ciment (« Great Northern Concrete Toboggan Race »), le concours de ponts en bâtons de popsicles (« Troitsky Popsicle Stick Bridge Competition ») et le concours national de canoé en ciment (« Canadian National Concrete Canoe Competition »). La SCGC a un budget de 5,000$ par année pour chacun de ces concours pour les cinq prochaines années. La SCGC s'est aussi engagée à fournir des juges, à faire la promotion des concours et à fournir des plaques et/ou des trophées pour les équipes gagnantes.

L'assistance au congrès annuel de la SCGC

La SCGC tient à encourager les étudiants de 1er cycle à participer au congrès annuel. Pour atteindre cet objectif, la permanence de la SCGC paye les frais de transport et d'inscription pour deux représentants des équipes gagnantes dans les concours suivants :

- Le concours du toboggan en ciment (« Great Northern Concrete Toboggan Race)
- Le concours de ponts en bâtons de popsicles (« Troitsky Popsicle Stick Bridge Competition »)
- Le concours national du canoé en ciment (« National Concrete Canoe Competition »)
- Le prix du président offert à la meilleure section.

Huit étudiants se sont rendus à Edmonton cette année. Au congrès, ils ont rencontré des étudiants d'autres écoles, assisté à des exposés techniques, et participé à des activités sociales formelles et informelles. Au dernier jour du congrès, chaque équipe gagnante a reçu l'hommage des délégués réunis en assemblée, et les membres des équipes gagnantes ont reçu des plaques qui occuperont une place d'honneur dans leur département de génie civil.

Le concours national capstone

Il s'agit d'une nouvelle activité. La plupart des étudiants en génie civil doivent réaliser un projet lors de leur dernière année d'études de 1er cycle. La meilleure réalisation sera choisie par le département pour participer à ce concours national. Une équipe de chaque département sera invitée au congrès annuel de la SCGC pour faire un exposé. Ces exposés seront jugés et un gagnant national sera proclamé lors du congrès. Le premier concours de ce type sera organisé de façon à se dérouler pendant le congrès annuel de Montréal, du 29 mai au 1er juin 2013.

Le prix des jeunes professionnels

Un autre nouveau prix sera créé en 2012-2013. La SCGC rendra hommage à un praticien du génie civil âgé de moins de 35 ans. Les détails de ce concours seront annoncés au cours des prochains mois.

Informez-vous !

Les détails de tous ces concours seront fournis et mis à jour dans la section étudiante du site web de la SCGC, à l'adresse http://csce.ca/membership/student/

Nous tenons à avoir de vos nouvelles à l'heure où vous amorcez votre session d'automne. Adressez-vous au président de votre section étudiante et à votre conseiller de faculté. Si vous ne les connaissez pas et ne savez pas comment les rejoindre, adressez-vous à la permanence de la SCGC en rejoignant, par courriel, Patsy Kerr, responsable des services aux membres, à l'adresse membership@csce.ca.

Bonne session ! Amusez-vous bien et apprenez-en le plus possible ! Et participez ! ■

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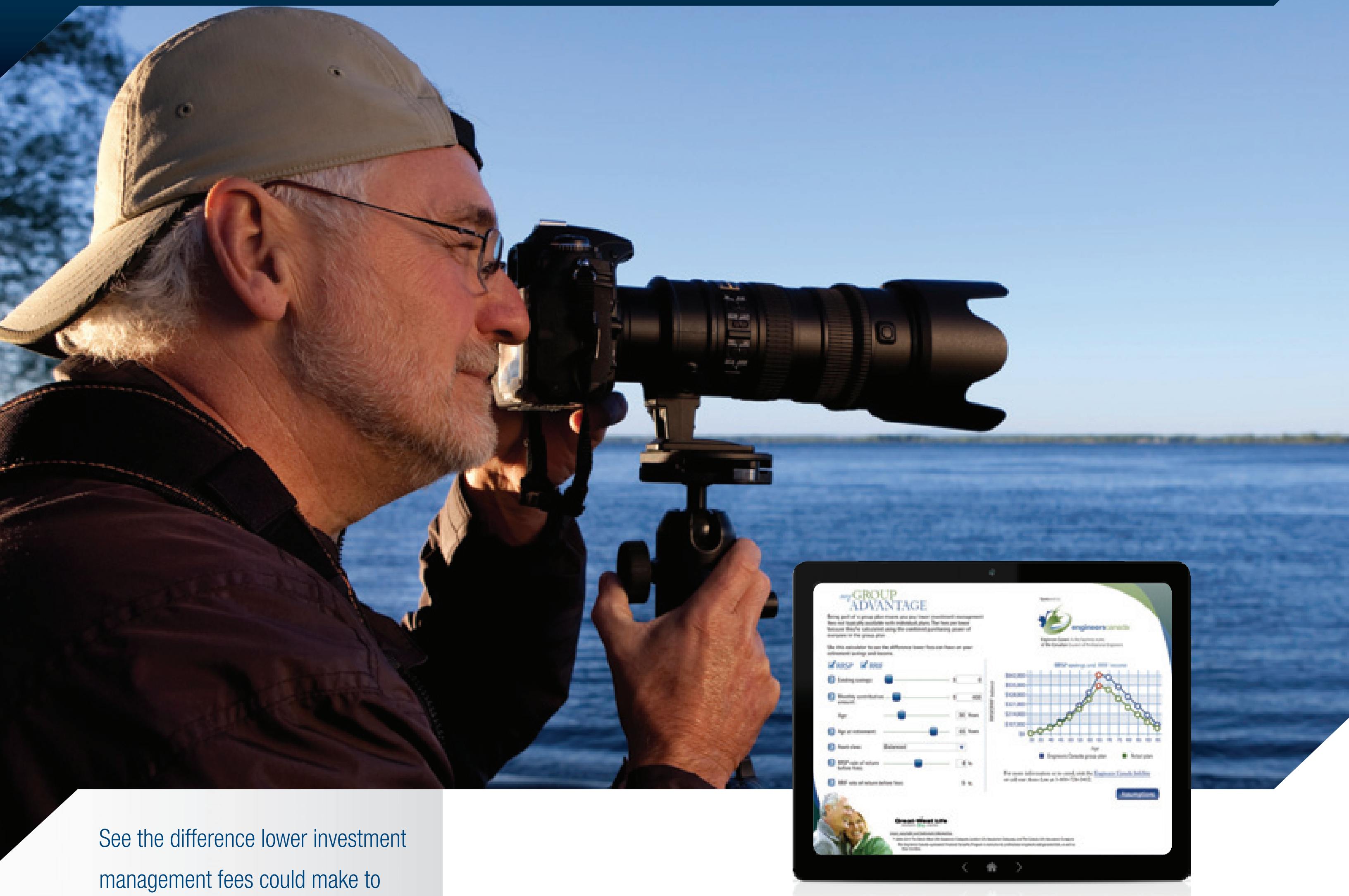

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The twin temporary truss bridges are in place until the OBG superstructure is connected to a suspension cable.

Oakland Bay Bridge Deck and Tower

By Kristin Greinacher, EIT
Klohn Crippen Berger

In 1989 an earthquake caused a span of the San Francisco Oakland Bay Bridge to collapse, triggering the State of California to replace the bridge between Yerba Buena Island and Oakland. The signature span for the replacement bridge will be the world's largest Self-Anchored Suspension Bridge (SAS) once completed in 2013. During construction of the $1.8-billion new bridge, the deck needed to be supported on temporary structures until the cable was installed and the deck weight transferred to the cable.

The contractor, American Bridge/Fluor Joint Venture, engaged Vancouver-based engineering firm Klohn Crippen Berger to provide structural and geotechnical designs for the massive temporary works required for construction of the SAS. These works included twin truss bridges supported on temporary towers. The temporary bridges were used to support and align the 28 orthotropic box girder (OBG) superstructure deck segments so that they could be welded and bolted together before being attached to the suspension cable.

Photos courtesy: California Department of Transportation

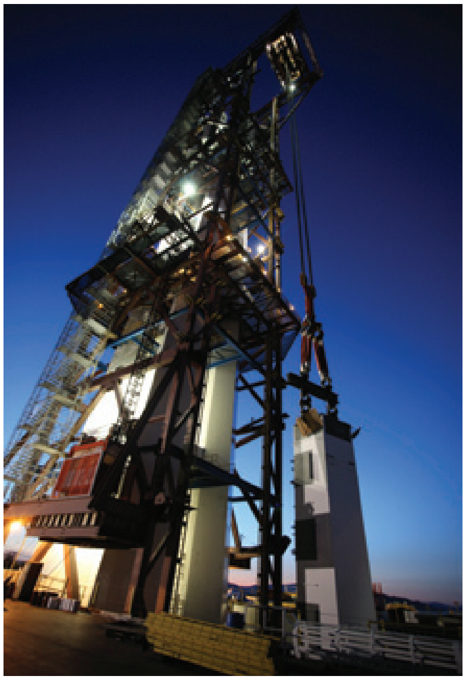
Steel trusses extend full length of bridge

The project bid documents included concept designs for individual towers braced laterally and longitudinally, providing discrete non-continuous support to the OBGs. During design, the arrangement was optimized by incorporating continuous trusses the full length of the bridge, which connect to the permanent bridge piers at both ends for longitudinal stability. The trusses eliminated the need for longitudinal bracing between the temporary towers, provided continuous access along the bridge, and facilitated much easier connections between the OBG segments.

The temporary bridge superstructure consists of twin 7-span, 600-m long trusses, with the east end cantilevered past the permanent pier. The trusses are 10 m wide and vary in depth from 6.5-12.5 m. Overland portions of the truss were erected in 13-35 m pieces weighing up to 65 tonnes, while over-water portions were erected using the project's high capacity marine crane. The largest truss lift was 125 m long and weighed approximately 1,000 tonnes.

The OBG segments carried by the truss are 6.3 m high, 27 m wide and up to 70 m long, weighing from 520-1,500 tonnes each. The

OBG segments were erected onto "cradles" designed to distribute reaction within the bottom of the box girder. The cradles and OBGs were then slid up to 220 m horizontally into their final position using Teflon lined bearing pads and stainless steel plates to minimize friction. Jacks located along the truss enabled up to 350 mm vertical adjustments to the OBG segments, allowing for precise positioning for connection. The entire system was designed to support the OBG, wind, accidental ship impact, and seismic loads through all stages of construction.



KCB designed the frame to assemble the main tower as well as other structures.

Temporary towers with seismic yielding mechanism

The large mass of OBGs supported 50 m above the bay gave rise to high seismic demands. In order to meet the stringent ductility requirements for the project, the six pairs of temporary towers supporting the truss were designed using tubular Eccentrically Braced Frames (EBFs) which incorporate a yielding mechanism that dissipates earthquake energy and limits the seismic loads in the structure. Traditional EBFs require lateral bracing at link points, meaning multiple horizontal diaphragms would be required at each link elevation. Tubular EBFs, developed by researchers at the State University of New York at Buffalo, were used for this project as they do not require lateral bracing. This was the first use of tubular EBFs in a major structure.

Placing the first of 19 cross-beams that connect the two orthotropic box girders. The temporary works required 25,000 tonnes of structural steel, more than the original Oakland Bay Bridge.

Conditions called for range of foundations

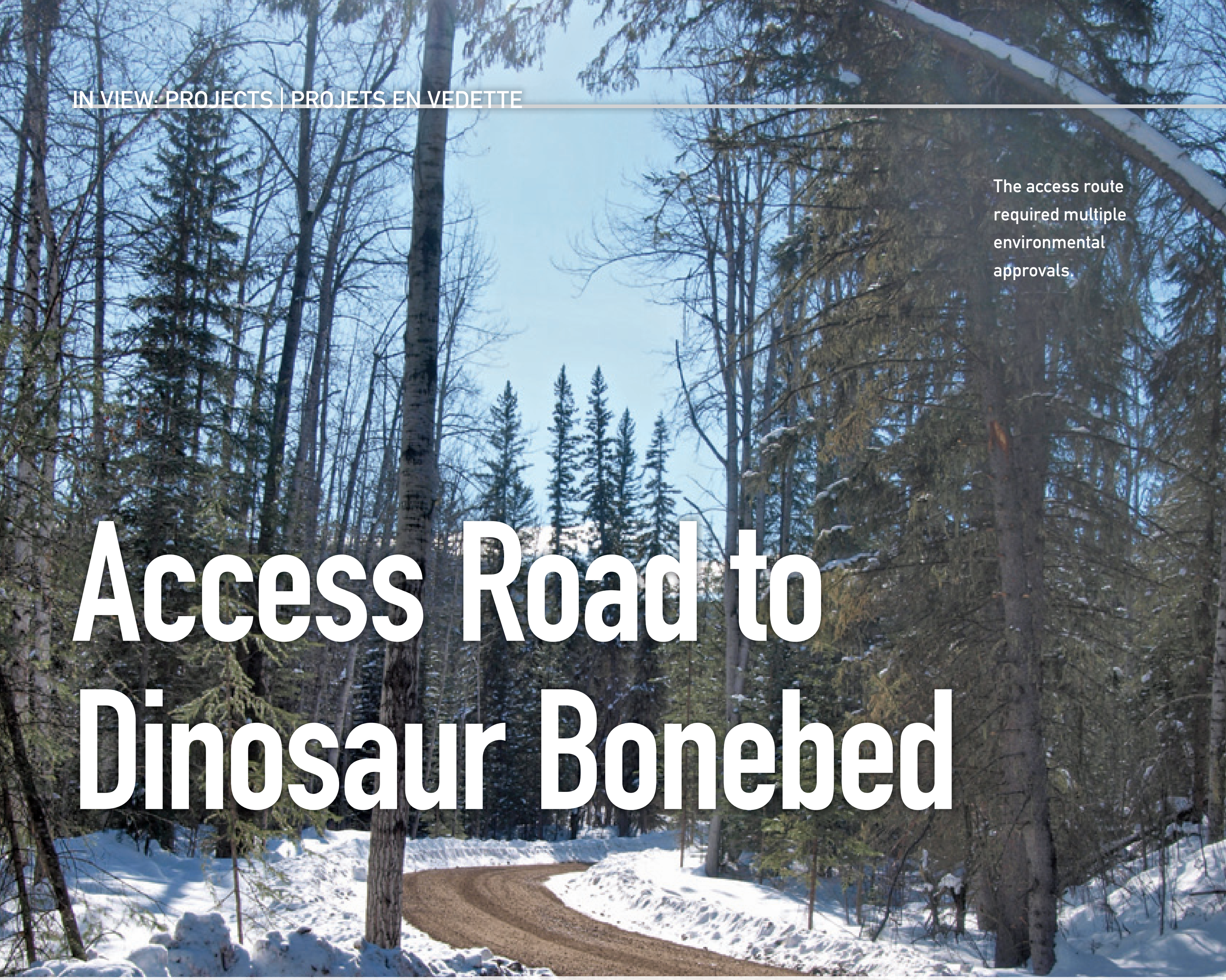
The foundation conditions vary from sedimentary bedrock outcrops with steep slopes at the west end, to deep, thick, relatively soft marine sediments overlying bedrock at the east end. In consideration of the varying foundation soil and rock conditions, the unequal spans and variable loadings, as well as cost-effectiveness, constructability, the schedule and protection of environmentally sensitive areas, a range of foundation solutions were adopted for the temporary towers.

The towers on steep sloping bedrock at the Yerba Buena Island are supported on vertical and horizontal micro-piles, while the towers on shallow bedrock are supported on large diameter rock socketed drilled shafts. The towers immediately adjacent to the permanent main tower are supported on large diameter steel pipe piles driven into the sound rock.

As there was no precedent in driving open-ended steel pipe piles into the Franciscan bedrock, unique challenges were faced during the design and construction; the uncertainties in drivability and pile capacity were addressed by a specified re-drive and test procedure. Two pairs of towers at the east end are supported on large diameter vertical and battered steel pipe piles driven either to depth in the bay mud or to refusal into bedrock. The set-up effect in bay mud was a key issue for these long piles. Extensive tension proof tests on micro-piles and dynamic testing on driven steel pipe piles were conducted to confirm the capacities.

Altogether, the temporary works have a value of approximately $350 million and use in excess of 25,000 tonnes of steel, more than the original Bay Bridge. Once the permanent structure is complete [due to open 2013] the temporary structures will be removed to reveal the SAS bridge, an iconic landmark for the Bay area. ■

NAME OF PROJECT: San Francisco Oakland Bay Bridge Replacement
OWNER: California Department of Transportation
PRIME CONTRACTOR, SAS CONSTRUCTION: American Bridge/Fluor Joint Venture
PRIME CONSULTANT, ERECTION ENGINEERING FOR SAS DECK & TOWER: Klohn Crippen Berger, Vancouver (Bruce Hamersley, P.Eng., David Dowdell, P.E., Thava Thavaraj, P.Eng.)



The access route required multiple environmental approvals.

Access Road to Dinosaur Bonebed

An access road to a 72 million-year-old archaeological site in Grande Prairie, Alberta, had to be carefully engineered to avoid damaging the discoveries.

By Focus Corporation

Since 1986 an archeological landmark in Grande Prairie, Alberta, has attracted palaeontologists from around the world who have trekked to the rugged site to unearth fossils.

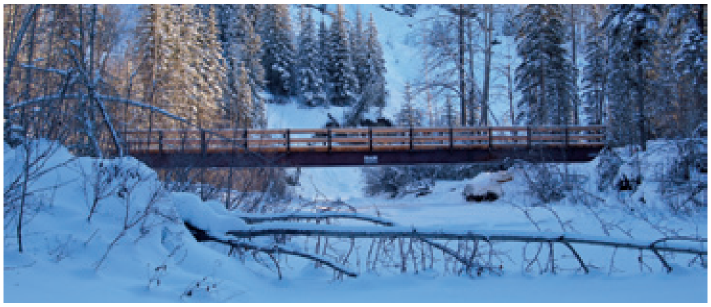
The area, known as the Pipestone Creek Dinosaur Bonebed, also has the potential to attract tourists and contribute to this northern community's economy. The Pipestone Creek Dinosaur Initiative has been working since 2003 to facilitate research and encourage tourism. While a multi-stage project will see the creation of a world-class museum, the first stage in developing the site was the construction of a road from Pipestone Creek Provincial Park, through the Pipestone Valley and across Pipestone Creek, allowing access to and from the bonebed.

Focus Corporation completed the design and construction of the access road, including two new bridges. The $1.5-million project was completed in 2011 as a partnership between the Pipestone Steering Committee and the County of Grande Prairie.

The project included a topographic survey, modeling and feasibility studies; functional and detailed design; bridge and road design; and construction of an 800-m access road through environmentally sensitive terrain. The work included a 30-m, 100-tonne bridge, and a 30-m pedestrian bridge crossing Pipestone Creek.

Hundreds of dinosaurs piled up

Bonebeds are areas where large numbers of fossilized bones, teeth and other skeletal parts of multiple individuals of one or more species



One of two bridges to the bonebed which lies in a steep valley. Construction had to be done quickly and during winter.

form a distinct layer within the rocks. The Pipestone Creek Dinosaur Bonebed is one of the world's most significant dinosaur bonebeds.

Discovered in 1972, the bonebed dates back 72-73 million years. It is unique in that it results from hundreds of dinosaurs meeting their demise in a river, which meant that their bodies were washed downstream and piled on top of each other in an ideal location for fossilization. Sand and silt quickly layered over the bodies and protected the bones from decomposition.

This remarkable site is at least as large as a football field and contains between 100 and 200 fossils per square metre, compared to most bonebeds, which have between 20 and 60 fossils per square metre. The Pipestone Creek bonebed has already yielded more than 3,500 bones, including those of 40 different animals and a previously undiscovered dinosaur.

Focus Corporation has been involved in this exciting landmark from the beginning of its development. Employees participated as consultants and engineers for several aspects of the project, including a storm basin study, topographic survey, legal survey, pedestrian bridge design and vehicular bridge design, as well as construction and tendering services and project management.

Built quickly and in extreme terrain

The access road project was complex. It had to be built in an area with extreme terrain, an environmentally sensitive body of water and numerous archaeological sites. It also had to be completed in a very short period of time, which necessitated construction during the winter.

The Pipestone River valley is 130 m deep with extremely steep slopes in an area with numerous archaeological sites that needed to be preserved — it seemed as if every day brought a new discovery. The challenge was to find an appropriate route that avoided the significant sites, could support heavy traffic loads up and down 1:1 slopes, and provided safe access to the 100-tonne bridge over the river. Focus engineers considered multiple construction methods and several possible routes before selecting the one that allowed construction of the most safe and environmentally conscious transportation route possible.

This project required numerous approvals from environmental organizations, including Alberta Environment, Department of Fisheries and Oceans, Sustainable Resource Development's Forestry Division, and Transport Canada. Furthermore, several assessment reports were required to qualify the project for federal, provincial and municipal funding.

The project's very tight schedule was dictated by the deadline for government funding from the Infrastructure Alberta Sustainability Fund. The project was awarded in August, leaving only three months to complete the design before construction began in November and had to be completed the following March, which meant construction had to be done during the winter.

The project was completed on time and met all environmental requirements.

Museum planned for the site

The creation of a safe, convenient and permanent access route to the site will prevent damage to the environmentally sensitive environment and archaeological treasures surrounding it.

The access road has also facilitated research and development efforts, which has positioned the Grande Prairie region as an international hub for the palaeontology community.

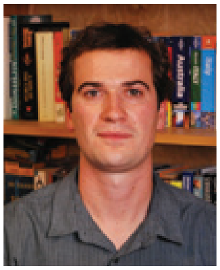
Efforts are also under way to capitalize on the Pipestone Creek Bonebed's tourism potential. Now that this major landmark is more accessible, there are plans to have it form part of a provincial Dinosaur Trail, which would include Dinosaur Provincial Park and the Royal Tyrell Museum in southern Alberta.

The next phase of the Pipestone Creek Bonebed Project is the Phillip J. Currie Dinosaur Museum, which is to be located on a 10-acre site north of the town of Wembley and will include a visitors' centre, research laboratories and extensive collections. ■

Hundreds of dinosaurs washed up at the site, which was discovered in 1972.

NAME OF PROJECT: Access Road to Pipestone Creek Dinosaur Bonebed, Grande Prairie, Alberta
OWNER-CLIENT: County of Grande Prairie
PRIME CONSULTANT, PROJECT MANAGEMENT, DETAILED ENGINEERING DESIGN: Focus Corporation, Calgary (Scott Roessler, P.Eng., Cameron Schmidt, CET, Po Sun, P.Eng.)

Sustainable Infrastructure and Asset Management Systems



By Nick Larson, P.Eng.
CHAIR, CSCE INFRASTRUCTURE RENEWAL COMMITTEE

In addition to becoming the new chair of the CSCE Infrastructure Renewal Committee, I have the additional privilege of becoming the editor of this section of CIVIL, where I will be conversing with my colleagues across the wide realm that is civil engineering to articulate what the lofty phrase "sustainable infrastructure" represents for us. I would like to encourage anyone who is interested to put down on paper their ideas, case studies or opinions relating to sustainable infrastructure and contact me to arrange publication in future editions of CIVIL. This article presents my perspective on the connection between asset management systems and sustainable infrastructure.

My initial experience with infrastructure (asset) management led me to define sustainable infrastructure from a purely economic perspective: being able to afford the costs associated with the construction and proper operation and maintenance of municipal infrastructure assets. However, I have recently begun a conversation to demonstrate that a properly designed asset management system is also the foundation of sustainable infrastructure from both an environmental and social perspective.

This is primarily accomplished by incorporating the notion of risk into the asset management system – the risk of a basement or creek being flooded with raw sewage, for example, has huge environmental and social consequences – and understanding and accepting a certain risk level for events such as this lies at the heart of sustainable infrastructure. A larger sewer system to accommodate higher peak flows will have higher average annual costs, but may result in less social or environmental impacts.

Measure the effect of decisions

So where is the sweet spot? The balance of economic, social and environmental issues – or the most sustainable solution – will vary from municipality to municipality. But any jurisdiction that has an asset management system in place to be able to measure these trade-offs, either qualitatively or quantitatively, will be in a much better position to make an informed decision on the most sustainable solution for their community. These systems do not have to be overly complex or expensive. Straightforward, simple asset management systems can enable significant advancements in assessing infrastructure investment decisions.

Quality of life could suffer if unnecessary resources are directed to infrastructure when they could be better used elsewhere in the community.

An example of connecting asset management systems to the notion of sustainable infrastructure that I have come across in smaller municipalities is the implementation of small decentralized wastewater treatment systems in lieu of large central wastewater treatment facilities. Asset management systems are able to demonstrate to decision makers that a $30-million treatment plant for a community of only a few thousand people is simply an unsustainable solution from all perspectives – economically because it is simply not affordable to the rate payers, environmentally because of the huge amount of resources that are required to build and maintain the plant, and socially because the quality of life in the community will have to suffer when resources are directed toward the plant when they could be used elsewhere in the community. The solution to the problem – excessive nutrients discharging into a sensitive receiving body in this case – can be solved with a number of innovative solutions that are a fraction of the cost and direct the community onto a more sustainable pathway.

Going against the status quo is not always easy. In this case, the regulators will need to be challenged to justify their policies that have mandated that the large plant be constructed. In the sustainability vernacular this is described as a "standards trap." Sometimes policies are established to solve one problem, but in the process they can cause others to appear. Asset management systems are the tool that will save this community from the unsustainable standards trap that is mandating the large facility.

Sound arguments based on facts

This is just one example of the role that asset management systems can and should play to inform the decisions that are made with respect to the sustainability of infrastructure assets. They can provide some tangible and demonstrable advantages or disadvantages

of different solutions to a problem. After all, measuring sustainability with generalities and good ideas is a good first step, but it can only take you so far – it is difficult to convince decision makers to adopt a more sustainable solution without a sound argument based on a factual analysis.

"Engineers inside municipalities and provinces need to play a more active role in encouraging a more holistic evaluation of alternative solutions at the initial planning phases, before making a final decision and retaining design services."

I believe that the adoption and advancement of asset management systems in municipalities should be encouraged by all parties as a tool that can be used to form the measuring stick for sustainable infrastructure. It is also my hope that in the near future our federal and provincial governments will begin to provide incentives for the development of asset management plans in all municipalities in Canada.

As civil engineers, we all have a role to play in our respective sectors of the profession to advance the notions of sustainability as it relates to the infrastructure that we plan, design, construct and maintain. Engineers inside municipalities and provinces need to play a more active role in encouraging a more holistic evaluation of alternative solutions at the initial planning phases, before making a final decision and retaining design services. Consultants need to advance the understanding of sustainability across their client base and encourage dialogue with the contractors who build infrastructure. Contractors need to embrace the benefits of sustainable designs and construction techniques to increase profits and advance innovation. Academics need to continue to push the boundary of technology and innovation to provide the tools, processes and methodologies that will make the Canadian civil engineering industry the envy of the world. It is this common discussion and understanding of what sustainability represents to our respective sectors that will ensure that Canadian infrastructure systems continue to provide the services that will make our society prosperous for generations to come. ■

Nick Larson is an associate and project manager at R.V. Anderson Associates Limited.

Lessons from Abroad

A couple of years ago, I was tasked to serve as the Deputy Chair of CSCE's International Affairs Committee and also as the guest editor of this issue with the theme "Lessons from Abroad." I was really excited to work with my international contacts to solicit articles. An attempt was made to obtain articles that covered a wide range of topics.

The first article in this issue is from Japan and presents the recent developments taking place in engineering education in Japan. This article is written by a team of professors from Kagoshima National College of Technology (KNCT), Kagoshima University, and an engineer from Canada, many of whom I met at an international symposium on education held in Kagoshima in 2009. It presents some of the initiatives undertaken by KNCT to make engineering education practical and to encourage students to work in a globalized environment.

The second article is authored by Vicki Chen from Hong Kong whom I had the pleasure of meeting during her recent visit to Vancouver when she was accompanied by a delegation of civil engineers from Hong Kong Institution of Engineers. This article presents the innovative and sustainable approach taken in Hong Kong to reduce the consumption of freshwater by using seawater for flushing.

The final article in this issue provides details of the lessons learned from the 2011 Tohoku tsunami in Japan, written by Dr. Shibayama and Dr. Nistor. Some of the preliminary details of Dr. Nistor's visit to Japan were presented by him during CSCE's National Lecture Tour last year. This paper provides greater details about the survey conducted after the 2011 tsunami and discusses the on-going debate in Japan about implementing hard or soft measures to prevent tsunami damage.

I thank all the authors for their timely contributions. ■

Rishi Gupta is faculty and program coordinator for the Department of Civil Engineering, School of Construction and the Environment, British Columbia Institute of Technology.

Rishi Gupta, Ph.D., P.Eng.
DEPUTY CHAIR, CSCE INTERNATIONAL AFFAIRS COMMITTEE

Rishi Gupta, Ph.D., ing.
VICE-PRÉSIDENT, COMITÉ DES AFFAIRES INTERNATIONALES DE LA SCGC

Des leçons de l'étranger

Il y a quelques années, j'ai été invité à servir à titre de vice-président du comité des affaires internationales de la SCGC et de rédacteur invité de la section « Leçons de l'étranger » de ce numéro. J'ai apprécié travailler avec mes collègues de l'étranger pour obtenir des articles. Nous avons tenté d'obtenir des articles portant sur une vaste gamme de sujets.

Le premier article de ce numéro vient du Japon et expose les derniers développements en matière de formation en génie civil au Japon. Cet article a été rédigé par une équipe de professeurs du KNCT de l'Université Kagoshima et un ingénieur du Canada. J'en ai rencontré plusieurs lors d'un symposium international sur l'éducation, tenu à Kagoshima en 2009. Il expose certaines initiatives entreprises par l'Institut de technologie de Kagoshima (KNCT) pour rendre la formation en génie plus pratique et pour inciter les étudiants à œuvrer dans un environnement global.

Le deuxième article est signé par Vicki Chen, de Hong Kong, que j'ai eu le plaisir de rencontrer lors d'une récente visite à Vancouver, alors qu'elle accompagnait une délégation d'ingénieurs de la Hong Kong Institution of Engineers. Cet article expose les démarches novatrices et durables prises à Hong Kong pour diminuer la consommation d'eau douce en utilisant l'eau de mer pour les chasses d'eau.

Le dernier article de ce numéro donne des détails sur les leçons du tsunami de 2011 et a été rédigé par les professeurs Shibayama et Nistor. Certains détails préliminaires de la visite du professeur Nistor au Japon ont été mentionnés par lui-même lors de la tournée nationale de conférences de la SCGC de l'an dernier. Cet article donne plus de détails sur l'enquête effectuée après le tsunami de 2011 et traite du débat actuel au Japon sur la mise en œuvre de mesures draconiennes ou plus douces en vue de prévenir les dommages attribuables à des tsunamis.

Je remercie tous les auteurs pour leur précieuse contribution. ■

Rishi Gupta est coordonnateur au département de génie civil de l'École de construction et de l'environnement de l'Institut de Technologie de Colombie-Britannique.

Initiatives Underway to Improve Engineering Education at Kagoshima Kosen in Japan

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Yasuyuki Shii, Ph.D.
ASSOCIATE PROFESSOR, KNCT, JAPAN
Masahito Yamauchi, Ph.D.
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ASSOCIATE PROFESSOR, KNCT, JAPAN
Masayoshi Yamada, Ph.D.
ASSOCIATE PROFESSOR, KNCT, JAPAN
Barbara Dabrowski, P. Eng.,
FELLOW, ENGINEERS CANADA

The purpose of this article is to introduce the system of National Colleges of Technology (*Kosen*) as unique institutions of higher education in Japan and describe recent improvements in engineering (including civil engineering) education at Kagoshima National College of Technology (Kagoshima *Kosen*; KNCT). The effects and the problems of these trials and improvements are discussed. Finally, some lessons learned from recent interaction between KNCT and some civil engineering academic institutions in Canada is also presented.

Unique educational system of National Colleges of Technology in Japan[1]

There are 51 National Colleges of Technology in Japan. The Japanese call them *Kosen*. *Kosen* were established in 1961, in response to a strong demand from the industrial sector for engineers who fostered and sustained the high Japanese economic growth at that time. They have some very unique features in the Japanese education system (see Figure 1).

They are institutions of higher education, the same as universities, but they offer students five years of engineering education, starting typically when the students turn 15 years old. Their curriculum emphasizes not only engineering theories but also scientific experiments, workshop training and practical manufacturing; as such, it differs from the university curriculum.

The students who want to work for industry can find work easily, because the job opening-to-application ratio for *Kosen* is very high. For example, in 2011 this ratio for KNCT students was 12 in spite of the current business depression in Japan.

At the Advanced Course level, the *Kosen* curriculum offers students a bachelor degree in Engineering. A noteworthy fact is that the advanced courses of *Kosen* are accredited by the Japan Accreditation Board for Engineering Education (JABEE). JABEE is equivalent to the Canadian Engineering Accreditation Board (CEAB) and maintains the international equivalency of engineering education programs provided by Japanese institutions of higher education under standardized criteria.

Problems concerning practical engineering education and the current trials at KNCT

Most of the teaching staff hired at the time when *Kosen* were founded had direct industry experience. However, the number of such teaching staff is gradually decreasing with the present popularization of higher academic credential education. In spite of the fundamental *Kosen* educational goal to foster practical engineers, KNCT currently has only a few professors with a professional designation of P. Eng., as compared to the many professors who have Ph. D. degrees.

Under these circumstances, KNCT is trying to improve the method of engineering education by improving their human resources. The most important component of this trial is to institutionalize co-education in cooperation with the Association of Professional Engineers. At the same time, KNCT is proactively seeking international education partners who will enable Japanese engineering students to gain international experience and to broaden their perspective.

Practical engineering education

KNCT has initiated a system of co-education with industry and has strengthened cooperation with various organizations in Kagoshima prefecture. Furthermore, it concluded a formal agreement for cooperative education with the Association of Professional Engineers in Kagoshima in 2007. In 2008, this KNCT initiative was adopted by the Ministry of Education in Japan as good practice for achieving high-quality and practical engineering education. Support was also expressed for engaging professional engineers to directly provide practical engineering education on engineering subjects concerning real systems found in industry and manufacturing.

In this initiative, the students learn from professional engineers about practical manufacturing topics, engineering ethics and other activities related to engineers' experiences from actual industry practice, before learning the fundamental theories of engineering (as seen in Figure 2(a)). Finally, they proceed to make various products, for example, robots, which are evaluated, not only by KNCT professors but also by the professional engineers participating in the trial (as seen in Figure 2(b)). Because of large scale and complex issues inherent in creating representative civil engineering structures or systems as part

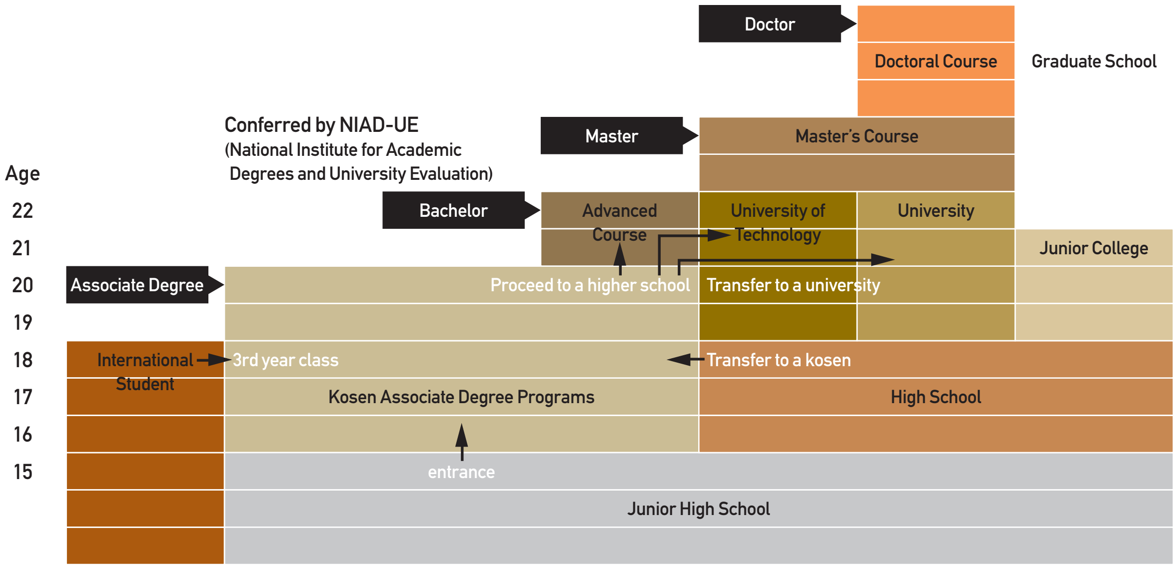


Figure 1: Japan's school system

of student's Graduation Research projects, students present these conceptually and the practical aspects are assessed by the professional engineers through discussions, opinions and advice. Students also benefit from the input of professional engineers' knowledge of laws pertaining to their research topic. This is very important for students, as it effectively supplements the academic theory taught by KNCT professors.

As mentioned above, each *Kosen* was established to foster technical, job-ready students who have practical engineering abilities and knowledge. *Kosen* may now be unable to play this role because of the lack of appropriate human resources instructing practical engineering subjects. This threat to the *Kosen* education system is significant and thus it is important to continue this KNCT initiative as it is getting good results with respect to fostering engineers who have the ability to learn not only engineering practice but also engineering ethics.

Based on a recent questionnaire survey of KNCT students and the participating professional engineers, further ongoing implementation of this initiative is deemed to be valuable and important. In addition, students have commented that they can apply new knowledge to their study or research and further develop their ideas taking industrial realities into account, learning engineering practice and being exposed to engineering ethics.

Recently, KNCT professors have been motivated to study regional problems in around Kagoshima and there is also a trend towards practical research activities, particularly in civil engineering. Examples are the effective utilization of volcanic ash[2] and managing "Shochu"[3] distillery waste. These problems are both local and practical and the students who assist in these studies learn very useful and practical knowledge both from their professors and from engaged professional engineers.

Fostering engineers who can deal with global concerns

KNCT also strives to forge international connections and has had visible success with its foreign partners. These partnerships provide KNCT students valuable exchange opportunities. The students who have had experiences at foreign institutions achieved a

Figure 2(a): Lecture by a professional engineer

Figure 2(b): Hands-on learning

significant broadening of their perspectives.

Although, several national, provincial and association-based programs are aimed at encouraging international partnership, co-op and exchange programs in Canada, the real success of creating international partnerships tends to be highly dependent on individual connections and collaboration efforts.

Due mainly to a narrow window of opportunity between the Japanese and the Canadian school calendars, a short pilot program was structured for three students in the KNCT Advanced Course program to attend courses in Vancouver during the months of September in 2008 and 2009. They audited civil engineering courses chosen at an appropriate pedagogical level to what they were studying in Japan and were offered English-language classes. KNCT faculty are eager to establish links with Canadian educators in congruent areas of interest, specifically at the undergraduate engineering level that has a focus on "practical" education.

It needs to be pointed out that there are some improvements needed with this initiative. Despite extensive collaboration activities and good will, barriers exist on both sides. Canadian partners have concerns that ongoing exchanges will create an imbalance by taking away an opportunity from Canadians and there is a lag on the Canadian side with respect to traction and insufficient capacity to match, and take advantage of, the invitation by Japanese partners. The possible inequity in funding, unmatched numbers of foreign students in Canada, and using Canadian public funds may also stymie partnerships.

KNCT would entertain a more formal exchange program where Canadian and Japanese students would travel (at their own expense) to the partner country for a semester of engineering study guided by faculty teams who would ensure an appropriate level of education was undertaken.

On the Japanese side, the students at KNCT have limited skill for communication in English or other foreign languages. Therefore, the reformation of the foreign languages curriculum must be achieved as soon as possible. Also, Japanese students have, to a limited extent, participated only in short visits abroad. So there must be much more work done in regard to making these visits more institutionally accepted, both for Japan and its foreign partners. The esteem in which engineers are held in Japan is a very interesting phenomenon and would provide a perspective for Canadian engineering students that is not prevalent in Canada, strengthen their global perspectives and be of value in their role as professional engineers of the future.

Finally, we would like to make a comment on the future prospect of the academic cooperation between the institutions of technology in Canada and *Kosen*. When some professors at KNCT visited Canada to learn about educational methods of practical engineering, they also learned that Canadian technical institutions recently have tendencies to incorporate the component of academic research into their curriculum as well as that of practical engineering education. Most *Kosen*, such as KNCT, are seeking effective educational methods to foster practical engineers. Canadian technical institutions have the human resources committed to practical engineering education and *Kosen* have those committed to academic research. Therefore, it might be said that there is a possibility that both institutions would be able to improve the educational activities, which each institution intends to realize, by using respective human resources from both systems of education: Japanese and Canadian. ■

1. This section including Figure 1 was described by referring to the web site of the Institute of National Colleges of Technology (http://www.kosen-k.go.jp/english/index.html).
2. The great amount of volcanic ash from Mt. Sakurajima, an active volcano in Kagoshima, has significant negative impacts on local human health, transportation systems and agriculture. Hence, its effective treatment or utilization is a priority for engineers in Kagoshima.
3. Shochu is a liquor made from sweet potato and one of the local specialties of Kagoshima prefecture.

UNIVERSITY OF VICTORIA
FACULTY POSITION IN CIVIL AND ENVIRONMENTAL ENGINEERING

The Faculty of Engineering, at the University of Victoria, invites applications for a tenure-track faculty position in Civil Engineering at the level of Assistant or Associate Professor. Applicants in all areas of Civil Engineering will be considered; however, applicants with research interests in design, assessment, repair and rehabilitation of civil engineering structures, use of innovative materials in repair and renewal, structural health monitoring, strengthening techniques and infrastructure in remote and northern communities, are particularly encouraged to apply. Candidates for the position must have a PhD in Civil Engineering, or a related field, together with demonstrated excellence in teaching, research, graduate student supervision, verbal and written communication, and collaboration with colleagues with engineering and non-engineering backgrounds. Candidates must be registered as a professional engineer or be eligible for and committed to registration. The successful applicant will be expected to teach at the undergraduate and graduate levels, supervise graduate students, establish an active research program, and participate in the academic affairs of the university. The successful applicant will have an opportunity to contribute to the development of an innovative new Civil and Environmental Engineering program that will emphasize sustainability and include program-wide implementation of problem based learning. The program will initially be part of the Mechanical Engineering Department.

The Department of Mechanical Engineering offers B.Eng., M.Eng., M.A.Sc. and Ph.D. degrees. The Department has 22 faculty members including three Canada Research Chairs and about 100 graduate students. The Department is known for its strong research programs in broad areas with superb research funding and a large number of research personnel and visiting researchers. With an excellent collegial atmosphere and active research, the Department attracts outstanding faculty and staff as well as first-rate graduate and undergraduate students. Further information on the Department can be found at http://www.uvic.ca/engineering/mechanical/.

The University of Victoria (http://www.uvic.ca/) is situated in the City of Victoria, the capital of British Columbia, at the southeast tip of Vancouver Island. Founded in 1963, the University is ranked as one of the leading universities in Canada with a reputation for excellence in research and teaching. Victoria is one of the most scenic locales in Canada with a pleasant climate year round.

Applications should include curriculum vitae, a statement of teaching and research objectives and interests, and the names, addresses, telephone number, and email addresses of at least four referees. Applications can be sent electronically by 31 October 2012 in PDF or MS Word formats to: meng_CEE@me.uvic.ca, addressed to:

University of Victoria

Professor Zuomin Dong, Chair
Department of Mechanical Engineering
University of Victoria
PO Box 1700
Victoria, BC, Canada V8W 2Y2

The University of Victoria is an equity employer and encourages applications from women, persons with disabilities, visible minorities, Aboriginal Peoples, people of all sexual orientations and genders, and others who may contribute to the further diversification of the university. All qualified candidates are encouraged to apply; however, in accordance with Canadian Immigration requirements, Canadians and permanent residents will be given priority.

The Success of the Seawater Flushing System in Hong Kong

Vicky Yao Chen
WATER AND URBAN DEVELOPMENT,
AECOM, HONG KONG

This article introduces and provides information on the seawater flushing system in Hong Kong. Hong Kong is a city near the sea with high population density and rapid economic development. The annual freshwater consumption in Hong Kong in 2010-2011 was 936 million cubic meters which served more than 7 million people (Water Supplies Department 2011). In order to reduce the demand on freshwater and to make the city more sustainable, a dual separate system was implemented for the water supply: freshwater for drinking and seawater for toilet flushing. Due to this practice, a huge amount of freshwater has been saved.

Now the government of Hong Kong Special Administrative Region has been planning for an extension of the use of seawater for toilet flushing for the remaining metropolitan areas, some rural areas and old places, whenever it is economically justified. The practice of such a successful city-scale seawater flushing system deserves to be brought to the attention of seaside cities around the world in order to promote sustainable use of water resources globally.

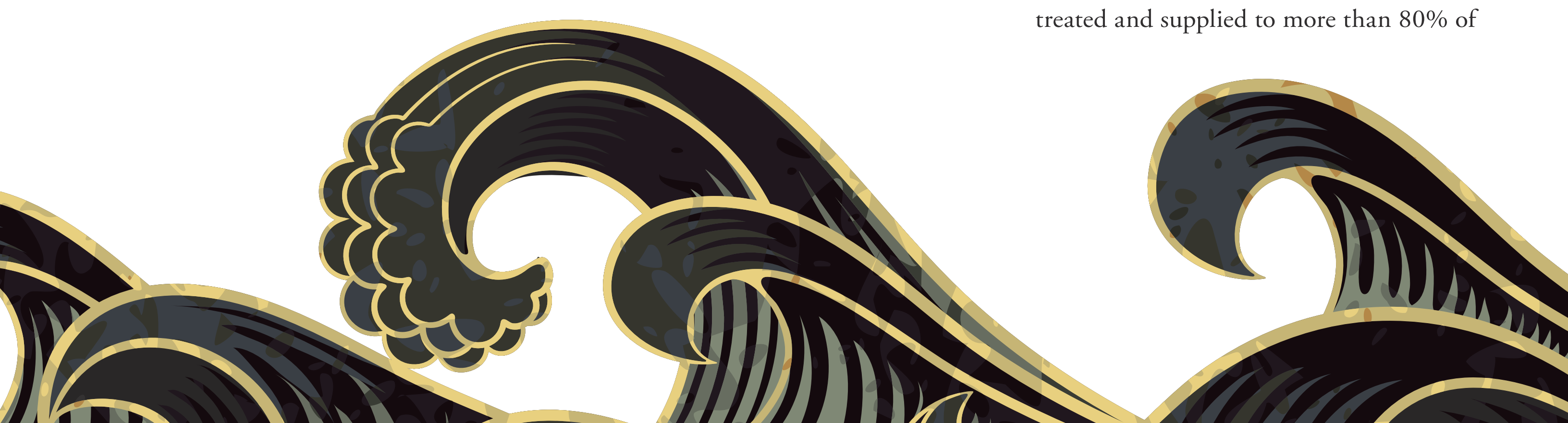
Introduction

Hong Kong is one of the special administrative regions of the People's Republic of China (PRC). The city is situated on the south coast of China and enclosed by the Pearl River Delta and South China Sea. It is renowned for its deep natural harbor, expansive skyline and for being the financial center of Asia. It is one of the most densely populated areas in the world, with a population of 7 million in a land mass of 1,104 km^2 (Census and Statistics Department 2012). With the large number of people in such a developed city with rapid economic development, a large water demand is inevitable. Although Hong Kong lies in the subtropics, rainfall can hardly meet the large water demand. In addition, Hong Kong has few natural lakes, rivers or substantial groundwater sources. Therefore, providing an adequate and stable water supply for such a high population density has always been a challenge.

Water Supplies in Hong Kong

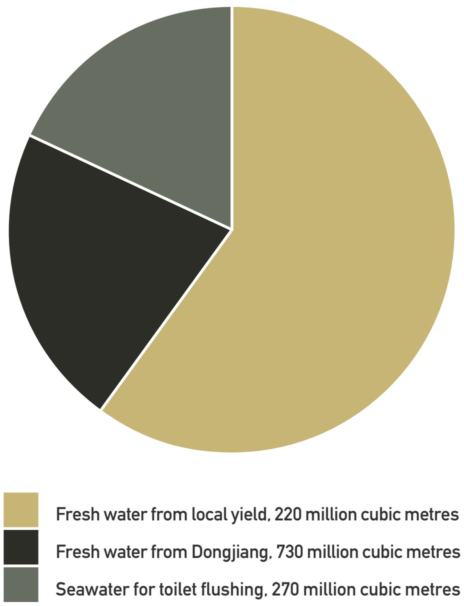
Initially the water supply in Hong Kong only came from local sources, including numerous small dams built in the valleys of the territory. Until 1964, water rationing was a constant reality for Hong Kong residents, occurring for more than 300 days per year (Water Supplies Department 2011). The worst crisis happened in June 1963 when only four hours of water was available every four days (Chau 1993). The situation eased when water from China was brought in. The Water Supplies Department (WSD), the government department that takes responsibility meeting the water demand and maintaining the water supply systems in Hong Kong, then adopted a number of methods to solve the problem caused by such natural limitations on water resources. Three main approaches were adopted: 1) construction of large reservoirs for water storage; 2) purchase of water from China; 3) use of seawater for flushing purposes. These approaches to some extent relieved the huge demand for water of a population that increased from 1.7 million in 1945 to about 6 million in 1992 (Chau 1993).

From then on, the raw water supplied for freshwater came from two principal channels: bought from Dongjiang River China and collected from domestic rainwater catchments. At present, water from the Dongjiang River accounts for 80% of the freshwater supply (Water Supplies Department 2011). The water supply is also supplemented with seawater for toilet flushing which is extracted by pumping stations located in coastal areas, treated and supplied to more than 80% of



the population. Figure 1 shows the amount and portion of different water resources for the total water supply in Hong Kong (Government of Hong Kong 2008).

Figure 1. The amount and portion of different water resources in Hong Kong.

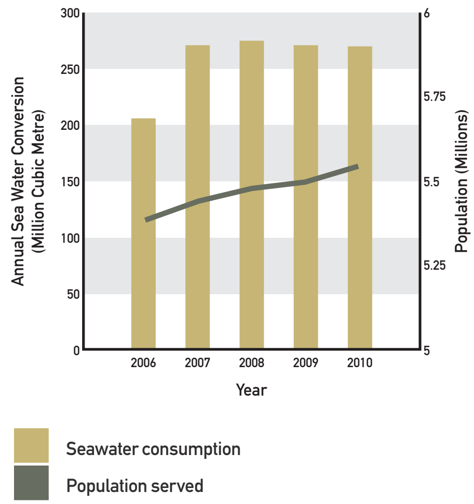


Using seawater for flushing

Developing seawater flushing system as a freshwater substitute was formally initiated in 1958 by WSD. In 1955, a pilot scheme of seawater flushing system was first used; while in 1957, seawater for toilet flushing was applied in all new houses and in selected districts (Water Supplies Department). In 1960, legislation was introduced to promote seawater flushing on a larger scale, followed by substantial investments in a separate network. However, due to the need to construct a separate plumbing network in each house and the need for the homeowner to pay for the seawater supply, the system was unpopular at that time. In order to further promote the practice, after 1972, seawater was provided for free and the costs of the system were recovered through the drinking water tariff. As a result, about 65% of Hong Kong's households used seawater for flushing in 1991. By 1999, this percentage had increased to 79% (Wikipedia).

Until now, more than 37 seawater pumping stations and a completely separate reticulation network of water mains, measuring more than 1,500 km in length, have been constructed (Civil Service Bureau 2005). The innovative system not only reduces the demand on freshwater from reservoirs or water treatment plants but also makes the city more sustainable. According to 2011 data (Water Supplies Department), every day an average of 740,470 m^3 of seawater was used for flushing purposes, conserving an equivalent amount of freshwater. Currently, the seawater flushing system covers most of the metropolitan areas and new towns, which is about 80% of Hong Kong's households. The consumption of seawater and the population served during the years 2006 to 2010 are shown in Figure 2 (Water Supplies Department 2011).

Figure 2. Annual seawater consumption and population served.



Hong Kong is the first place in the world to use seawater for flushing on such a large city scale. In 2001, the Chartered Institution of Water and Environmental Management of the United Kingdom awarded WSD of Hong Kong the prestigious Chris Binnie Award for Sustainable Water Management in recognition of its achievement for this project. Hong Kong is also the first non-European winner of the Chris Binnie Award (Civil Service Bureau 2005).

Seawater flushing system

There is a completely independent seawater supply system for toilet flushing from the freshwater supply system. The system is somewhat the same as the freshwater supply system in Hong Kong. It is mainly composed of seawater intake culverts, pumping stations, related water pipe networks and service reservoirs. Figure 3 illustrates a typical seawater supply system (Water Supplies Department). Before seawater enters into the pumping station, it is screened by strainers to remove

sizeable particles in order to facilitate the smooth transportation of seawater during the following process. It is then disinfected with chlorine or hypochlorite before being pumped to service reservoirs and for distribution. Normally, the residual chlorine concentration would be kept above 1 mg/L to avoid potential bacteria reproduction and prevent deposition of biological reproduction during the remaining transportation to the terminal receivers. In the past, bottled liquid chlorine was often used for disinfection because of its convenience and low cost. However, due to the related safety issue and limited storage space in some places, direct on-site generation of sodium hypochlorite chlorine for disinfection is now preferred. After disinfection, seawater is transported to pumping stations and supplied to reservoirs through rising mains. Although seawater is not treated to the same standard as freshwater, its standard still has to comply with the guidelines laid down by the department to prevent negative effect to the environmental sanitation (Water Supplies Department).

After seawater is discharged from toilets, it is combined with general wastewater from each house and then allowed to flow to the sewage treatment plant in a single sewage pipeline. That is to say, there are two separate water supply systems, one for freshwater and one for toilet flushing, but there is only one sewage discharge system. Therefore, the sewage salinity is relatively high in Hong Kong.

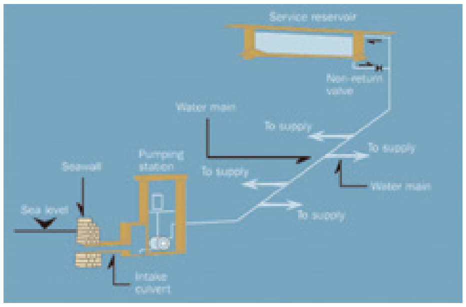


Figure 3. Typical seawater supply system in Hong Kong.

The high salinity of the sewage is not a significant consideration in the selection of sewage pipelines or the treatment of the sewage. Currently, considering corrosion, uPVC or vitrified clay is often selected as the material for small size sewage pipe; while concrete pipe with PVC lining is chosen for large size sewage pipe in Hong Kong. There is no special maintenance for the pipes. The treatment method for sewage in the wastewater treatment plant is the same as before: mainly chemical-enhanced primary treatment or secondary treatment with activated sludge. The results of such practice have not yet revealed any problems for the sewage pipes or the treatment capacity of the treatment plant. The system only shows a great advantage in saving freshwater resources.

Many cities across Canada are rich in water resources, however a sustainable water supply system like the seawater flushing system is worthwhile investigating. The City of Vancouver, for example, is aiming to reduce the per capita water consumption by 33% by 2020. Use of a seawater flushing system in some new towns or other locations would certainly help the city achieve its target.

Conclusion

Hong Kong has been successfully using seawater extensively for toilet flushing for more than four decades. The dual water supply system is seen as an effective way to conserve water. At present, seawater is already available for toilet flushing in metropolitan areas and most of the new towns, covering about 80% of the population. WSD in Hong Kong has been planning for an extension of the use of seawater for toilet flushing whenever it is economically justified. In such a way, substantial amounts of freshwater can be saved.

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Tsunami Power – Engineering Lessons from the 2011 Japan Tsunami

Figure 2: Evacuation building in Shizugawa.

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On March 11, 2011, a large earthquake of magnitude 9.0 took place, generating a tsunami that caused a severe damage to the east coast of Japan. As of June 20, 2012, 15,863 people lost their lives due to this event, while 2,492 are still unaccounted for. The total economic losses were in excess of $200 billion which makes this the costliest natural disaster in the history of humankind. To comprehensively record tsunami trace heights along the coastal region, the 2011 Tohoku Earthquake Tsunami Joint Survey Group was organized. As part of this group, the authors conducted field surveys in Iwate, Miyagi, Fukushima, Ibaraki and Chiba prefectures. Inundation heights were more than 15 to 20 m in Iwate and in the north part of Miyagi, 5 to 15 m along the coast of Sendai Bay and around 5 to 10 m in Ibaraki and Chiba. Buildings, including reinforced concrete structures, were washed away and ships were stranded inland. Coastal structures such as dikes and coastal forests also suffered extensive damage.

Tsunami rescue building in Shizugawa

Tsunami shelters and evacuation buildings are designed against the worst case scenario that was predicted or anticipated using available scientific and historic information. For the case of 2011 Tohoku tsunami, some of the designated shelters were below the expected tsunami inundation level. An example of this was observed in Shizugawa, where the tsunami reached the top of one of the evacuation buildings. During one of our field surveys, a local resident explained how he had to place his child in his arms so that he would not be soaked by the incoming wave, while he took refuge, as instructed, on the top of the four story building designated as an evacuation building.

This area also suffered severe damage due to the 1960 Chile tsunami; hence, some monuments were also built at elevations considered safe in order to teach and remind residents of the danger of tsunamis. However, even these monuments were destroyed by the most recent tsunami, highlighting the danger posed by these extreme events.

Because there were not enough tall buildings in this area, a four-story building near the shoreline was constructed to specifically act as a tsunami evacuation structure (Figure 1). For its designation as a tsunami rescue builidng, the "Tsunami Rescue Building Design Manual" (Japan Prime Minister's Office, 2005) was used, as it is one of the most recent documents for the design of tsunami-resistant structures in Japan. This building survived the event with almost no structural damage with the exception of some scour on the sides of the building (Figure 2). The tsunami heights in the area are shown in Figure 3. According to this resident's testimony, the ornament on the seaside edge of the rooftop was broken due to the tsunami and, according to this mark, the inundation height was 15.41 m.

The debate over soft or hard measures

In terms of the usage of hard and soft measures, the debate amongst experts in Japan is reaching consensus. Essentially, the idea that hard measures can protect against the loss of life has been discarded. The function of coastal structures would thus be to attempt

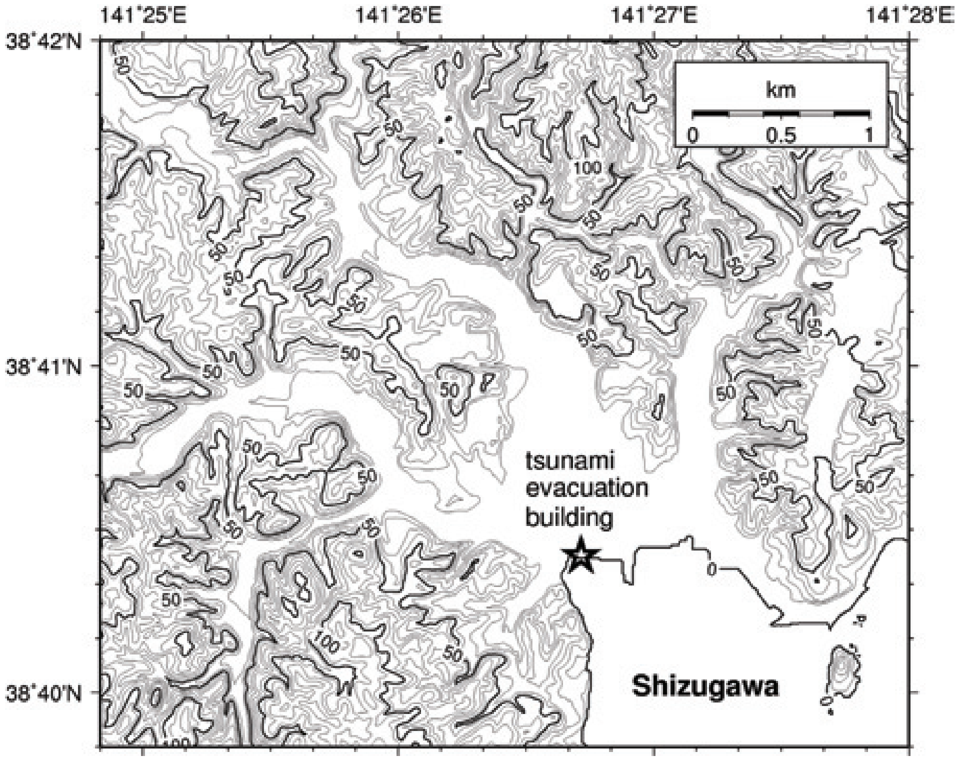

Figure 1: The location of the tsunami evacuation building in a contour map (10 m interval) of Shizugawa district, Minamisanriku Town. The contour map was generated based on Fundamental Geospatial Data from the Geophysical Information Authority of Japan.

to protect property or to help the evacuation process against the more frequent but low-level events (typically with a return period of several decades to 150 years).

On the other hand, soft measures, such as evacuation planning, would be used to protect lives, and would be designed with regard to more infrequent, higher-level events (with much longer return periods, for example, 1000 years).

The cost of using hard measures for tsunami protection is often significant, and the effectiveness is uncertain. For massive tsunamis, such as the March 2011 event, their effectiveness seems to have been relatively low. Future construction of hard measures should proceed after it has been established that they make sense from a cost-benefit point of view. This is especially important considering that they will be expected to prevent damage to property and coastal infrastructure and to help the evacuation process by reducing tsunami height.

Some of these considerations would be very relevant to Canada, particularly for the western coastal regions, which have been affected in the past by several tsunamis generated in the Pacific Ocean.

The authors are currently arguing for the classification of evacuation points in Japan into three separate categories:

- Category A: This top category would include higher terrain evacuation sites (such as hills) that are adjacent to the coast but continue to increase in elevation over a long distance. These would not be isolated low hills, but those that form part of larger geographical features and have a higher hinterland region. A good example would be Akanumayama in the Tarou area, already designated as an evacuation point.
- Category B: This would include robust buildings that have seven or more floors, or hills that are more than 20 m in height. This category would have the inherent risk of being isolated during the worst tsunami, but would likely be safe for most tsunami events.
- Category C: This would include robust buildings that are more than four floors high. This category, however, would have the risk of being overtopped during the worst tsunami events, as described earlier in the case of Shizugawa.

Thus, local residents would be trained to attempt to reach the highest category evacuation point (A), and only proceed to other locations in case better evacuation points cannot be reached. Currently, the authors are in dialogue with local government authorities of Kana-

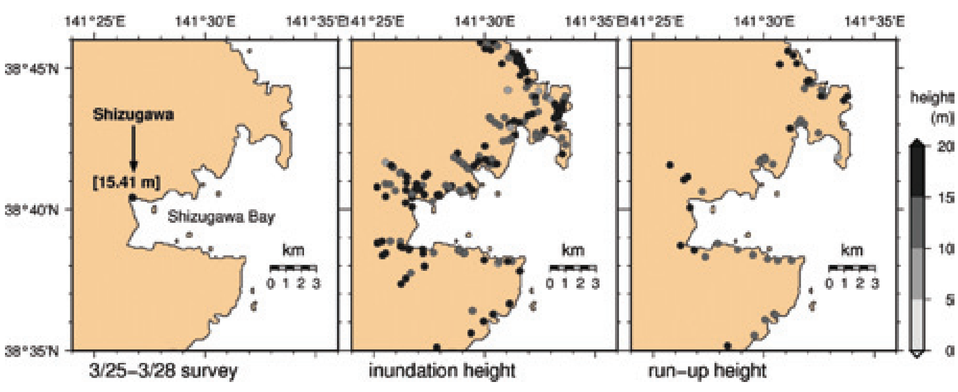

Figure 3: Regional distribution of tsunami trace heights. From left to right: results of our survey; distribution of inundation heights measured by the 2011 Tohoku Earthquake Tsunami Joint Survey Group [2011]; distribution of run-up heights measured by the 2011 Tohoku Earthquake Tsunami Joint Survey Group [2011].

gawa Prefecture and Yokohama City about the implementation of such a system. However, it has become apparent that in some areas, even Category C evacuation buildings simply do not exist (for example, in some dockland areas with a high concentration of low-elevation warehouses, which typically have a large workforce during the daytime but which are almost deserted at night). This represents a significant problem, and careful consideration must be given to how to deal with these areas.

Lessons for Canada

Since 80% of tsunamis in the world have occurred in the Pacific Ocean, the western coast of Canada is particularly susceptible to the threat of tsunami waves. Seismological features off the coast of British Columbia are similar to those in the Indian Ocean, which generated the December 2004 tsunami, and particularly to those off the coast of Chile that triggered the 2010 earthquake and tsunami and the ones in the offshore region of Tohoku which generated the massive 2011 Tohoku tsunami. Hence, the authors suggest several engineering lessons for Canada:

- Historical tsunamis provide valuable information with respect to the magnitude of possible future events. However, the experience of the 2011 Tohoku tsunami demonstrated that historical events have to be carefully investigated and assessed, and provisions for a probabilistic assessment of such events must be also made.
- Providing sound vertical evacuation structures must be considered for emergency evacuation plans for tsunami-prone coastal regions of western Canada, especially considering the short propagation times of tsunami waves generated in the Cascadia Subduction Zone.
- The best coastal protection structures and tsunami evacuation shelters are not sufficient for tsunami protection. Adequate evacuation and mitigation plans together with raising public awareness and continuous training are essential for minimizing the loss of life in such extreme events. ■

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CSCE National Honours and Awards – Call for Nominations

Nominations are invited at any time for the awards listed below; those nominations received by November 15, 2012 will be considered for 2013 awards to be presented at the CSCE Annual Conference in Montreal in June 2013.

Please submit nominations, clearly stating the award for which the nomination is made, by e-mail to: doug.salloum@csce.ca, or mail to: Doug Salloum, Executive Director, The Canadian Society for Civil Engineering, 4877 Sherbrooke St. W., Montreal, QC H3Z 1G9

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.

Excellence in Innovation in Civil Engineering Award

Recognizes excellence in innovation in civil engineering by an individual or a group of individuals practicing civil engineering in Canada, or a Canadian engineering firm, or a Canadian research organization. (Deadline for nominations is Jan. 15, 2013).

Young Professional Award

Awarded annually to a CSCE Member or Associate Member who has demonstrated outstanding accomplishments as a young professional engineer. Normally, nominees must be no older than 35 as of December 31 of the year that the award is presented, although this limit may be extended for nominees who have taken extended leaves from professional practice.

Horst Leipholz Medal

Recognizes outstanding contributions by a civil engineer to engineering mechanics research 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.

Award for Governmental Leadership in Sustainable Infrastructure

Recognizes those in the public sector who, through a project or program, are building for the future. Any municipal government or provincial or federal department that is planning, designing, building or delivering an infrastructure program or a project that significantly extends the life of these critical assets, makes better use of resources and reduces the environmental impact may apply. (Deadline for nominations is Feb. 15, 2013)

Appel – Distinctions Honorifiques Nationales SCGC

Les membres sont invités à soumettre en tout temps, des candidatures pour les prix ci-dessous; les candidatures soumises d'ici le 15 novembre 2012 seront considérées pour les prix 2013 qui seront décernés au congrès annuel de la SCGC à Montréal en juin 2013.

Veuillez soumettre les candidatures, en précisant le titre du prix, par courriel à: doug.salloum@csce.ca, ou en vous adressant à : Doug Salloum, directeur exécutif, La Société canadienne de génie civil, 4877 rue Sherbrooke ouest, Montréal, QC H3Z 1G9

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 Camiille 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 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.

Le prix E. Whitman Wright

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

Le prix d'excellence en innovation dans le domaine du génie civil

Souligne l'excellence dans le domaine du génie civil dont a fait preuve une personne ou un groupe de personnes pratiquant le génie civil au Canada, ou une société canadienne d'ingénierie ou un organisme canadien de recherche. (Delai de soumission de candidats : le 15 janvier 2013.)

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 du jeune professionnel

Attribué annuellement à un membre ou à un membre associé de la SCGC ayant accompli des réalisations exceptionnelles en tant que jeune ingénieur professionnel. Les candidats doivent être âgés de 35 ans ou moins au 1er décembre de l'année de l'attribution du prix. Toutefois, cette limite peut être prorogée pour les candidats qui ont pris des congés prolongés.

La médaille Horst Leipholz

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

Le prix pour le leadership gouvernemental en infrastructures durables

Reconnait des entités du secteur public qui, de par un projet ou un programme, construisent pour le future. Tout gouvernement municipal, provincial ou département fédéral qui planifie, conçoit, construit ou livre un programme ou un projet d'infrastructures qui prolonge d'une manière significative la vie de ces actifs, fait un bon usage des ressources et réduit l'impact sur l'environnement peut postuler. (Délai de soumission de candidats : 15 février 2013).

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.

Events	Dates	Locations
1. CALCUL DES PONTS ET PASSERELLES SELON CAN/CSA S6-06 (PRESENTED IN FRENCH)	October 8-11, 2012	Chicoutimi, Quebec, Montreal, Sherbrooke
This course covers the content of Section 17 – Aluminum Structures, of the Canadian Highway Bridge Design Code CAN/CSA-S6-06. Additional information, examples and calculation samples are also provided.		
2. CAN/CSA S6-06: ALUMINUM BRIDGES AND FOOTBRIDGES	November 27-29, 2012	Vancouver, Calgary, Edmonton
This course presents the content of Section 17 – Aluminum Structures, of the Canadian Highway Bridge Design Code CAN/CSA-S6-06 as well as additional information, examples and calculation samples.		
3. CSA-S806 DESIGN AND CONSTRUCTION OF BUILDING STRUCTURES WITH FIBRE-REINFORCED POLYMERS	February 5-8, 2013	Edmonton, Saskatoon Vancouver, Calgary,
Authors of the CSA-S806 analyze and explain the major revisions and additions contained in the new edition of this standard.		
4. CSA-S850 DESIGN AND ASSESSMENT OF BUILDINGS SUBJECTED TO BLAST LOADS	March 5-8, 2013	Vancouver, Calgary, Edmonton, Regina
This course presents this new standard which provides criteria for the analysis and design of new buildings and assessment of existing buildings to resist blast loading.		

These courses will be offered in other cities at a later date. Full details are available at www.csce.ca.

Formation Continue	Dates	Lieux
1. CALCUL DES PONTS ET PASSERELLES SELON CAN/CSA S6-06	8-12 octobre 2012	Chicoutimi, Québec, Montréal, Sherbrooke
Ce cours présente le contenu du nouveau Chapitre 17 – Ouvrages en aluminium, du Code canadien sur le calcul des ponts routiers CAN/CSA-S6-06. De nombreux compléments d'information, des exemples d'application et des exemples de calcul seront également fournis.		
2. CAN/CSA S6-06: ALUMINUM BRIDGES AND FOOTBRIDGES (PRÉSENTÉE EN ANGLAIS)	27-29 novembre 2012	Vancouver, Calgary, Edmonton
Présentation du contenu du Chapitre 17 – Ouvrages en aluminium, du Code canadien sur le calcul des ponts routiers CAN/CSA-S6-06 ainsi que des compléments d'information, des exemples d'application et des exemples de calcul.		
3. CSA-S806 DESIGN AND CONSTRUCTION OF BUILDING STRUCTURES WITH FIBRE-REINFORCED POLYMERS (PRÉSENTÉE EN ANGLAIS)	5-8 février 2013	Vancouver, Calgary, Edmonton, Saskatoon
Les auteurs du CSA-S806 analysent et expliquent les importantes révisions et ajouts contenus dans la nouvelle édition de cette norme.		
4. CSA-S850 DESIGN AND ASSESSMENT OF BUILDINGS SUBJECTED TO BLAST LOADS (PRÉSENTÉE EN ANGLAIS)	5-8 mars 2013	Vancouver, Calgary, Edmonton, Regina
Cette formation présente cette nouvelle norme qui fournit les critères d'analyse et de conception de bâtiments et d'évaluation de bâtiments existants pour résister aux explosions.		

Ces formations seront offertes dans d'autres villes, notamment au Québec, au printemps 2013. Veuillez consulter les détails à www.csce.ca.

By/Par Mahmoud Lardjane

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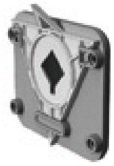
The Tempest LMF system features a vortex inlet design that allows a low flow rate to be set and eliminates the passage of odors and floatables and allows for debris and sediment to collect in the structure.

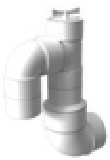
TEMPEST HF

The standard Tempest HF system allows a near constant discharge rate to be set and eliminates the passage of odors and floatables and allows for debris and sediment to collect in the structure.



TEMPEST MHF

The Tempest MHF is a standard orifice plate device designed to allow a specified flow volume through the outlet pipe at a specified head.



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