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civil

Coastal Hazards in Canada

Les dangers pour les côtes au Canada

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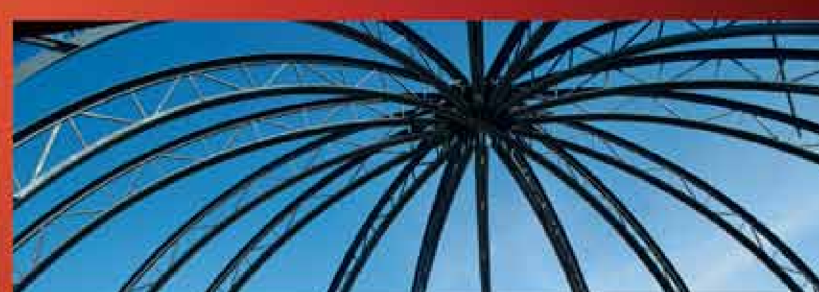

civil

features

page 8
Pollution in the Nearshore Regions of the Great Lakes

page 11
Tsunami Loading of Near-Shoreline Infrastructure

page 14
Storm Surges in Canada

page 18
Tsunami Risk and Vulnerability for Canada

columns

4 from the editors / mot des rédacteurs
6 presidential perspective / perspective présidentielle
21 the definition of infrastructure / la définition des infrastructures
22 history notes / notes historiques
24 international affairs / affaires internationales
26 csce national honours and awards call for nominations / appel—distinctions honorifiques nationales scgc
27 csce annual conference winnipeg 2010 winners student awards / winnipeg 2010 congrès annuel scgc gagnants prix étudiants
28 membership matters / question d'appartenance
31 spotlight on members / membres en vedette
32 engineering a sustainable world winnipeg 2010 / winnipeg 2010 solutions de génie pour un monde durable
34 lifelong learning / l'éducation permanente
34 coming events / calendrier des activités

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CSCE / SCGC
4920 de Maisonneuve W., Suite 201
Montréal, QC H3Z 1N1
Tel: 514-933-2634 Fax: 514-933-3504
E-mail: info@csce.ca
www.csce.ca

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Advertising / Publicité
Dovetail Communications Inc.
T: 905-886-6640
F: 905-886-6615
Janet Jeffery 905-886-6641 ext. 329
E: jjeffery@dvtail.com

All commentaries and questions about this publication should be forwarded to the Editor:
Pour vos commentaires ou de plus amples informations, contacte la rédactrice :
Louise Newman, louise@csce.ca 514-933-2634 ext. 23

Return Address / Adresse de retour :
The Canadian Society for Civil Engineering
La Société canadienne de génie civil
4920 de Maisonneuve W., Suite 201
Montréal, QC H3Z 1N1

FROM THE EDITORS / MOT DES RÉDACTEURS


LOUISE NEWMAN LOUISE@CSCE.CA

GUEST EDITOR: DR. IOAN NISTOR P.ENG., ASSOCIATE PROFESSOR, UNIVERSITY OF OTTAWA / ING., PROFESSEUR AGRÉGÉ, UNIVERSITÉ D'OTTAWA

COASTAL HAZARDS IN CANADA

Quickly glancing at the map of Canada, one can easily notice its extensive and intricate coastline, which, at 242,043 kilometres, is the longest in the world. Besides being bordered by three of the largest planetary oceans (Atlantic, Arctic and Pacific), Canada has innumerable freshwater lakes, which add significant length to its maritime coastlines. It is impressive that more than 72% of Canada's population lives in close proximity to a large body of fresh or sea water! A significant proportion of Canada's population (more then 22%) lives along the coastlines of the Great Lakes, which represent the world's largest body of fresh water.

The particular proximity of the oceans translates into an increased risk for coastal hazards for communities located in such areas. While coastal hazards can occur under various forms, Canada's potential coastal hazards include some of the most destructive ones: tsunamis, hurricanes and storm surges, as well coastal pollution due to accidental or systematic discharge of polluting agents. While some of these hazards may occur at infrequent or long intervals of time, their devastating impacts are significant and can heavily impact the coastal communities.

This issue briefly introduces and discusses some of these coastal hazards, which may affect both the maritime and inland Canadian coastlines. At the same time, some of the aspects related to the impact of the tsunami coastal inundation on infrastructure located in the vicinity of the coastline in tsunami-prone areas, such as along the western seaboard of British Columbia, are also presented. In spite of their rare occurrence, tsunami waves represent a significant threat for western North America given the major recorded tsunamis in the Pacific Ocean. Considering that major cities are located along this coastline, and the lessons learned following the December 2004 Indian Ocean Tsunami, it is imperative that engineers become aware of the possible devastating effects of such natural phenomena on infrastructure located in coastal areas.

continued on page 5

LES DANGERS POUR LES CÔTES AU CANADA

Un rapide coup d'œil sur la carte géographique du Canada suffit pour constater que nous avons beaucoup de rivages, et des rivages complexes : 242 043 kilomètres de rivages, en fait, ce qui représente un record! En plus d'avoir comme limites naturelles trois des plus grands océans de la planète (Atlantique, Arctique et Pacifique), le Canada possède un nombre incalculable de lacs d'eau douce, ce qui ajoute à la longueur totale de ses rives. Plus de 72 % de la population du Canada vit à proximité d'un vaste plan d'eau, qu'elle soit douce ou salée! Une importante fraction de la population du Canada (plus de 22 %) vit le long des rives des Grands Lacs, qui constituent le plus important réservoir d'eau douce au monde.

La proximité des océans signifie un risque accru de dangers côtiers pour ces communautés. Même si les dangers côtiers peuvent prendre diverses formes, les dangers côtiers propres au Canada sont parmi les plus destructeurs. Ce sont les inondations causées par les tsunamis, les orages et les ouragans, ainsi que la pollution des côtes attribuable à l'écoulement accidentel ou systémique de polluants. Bien que certains de ces dangers puissent se présenter à des intervalles longs ou peu fréquents, leurs effets dévastateurs sont importants et peuvent affecter lourdement les communautés riveraines.

Le présent numéro traite de certains de ces dangers côtiers susceptibles d'affecter les rives des océans et des lacs d'eau douce. On mentionne également certains aspects reliés à l'impact d'un tsunami sur les rives des communautés exposées, comme le long de la côte Ouest de la Colombie-Britannique. Malgré qu'il s'agisse d'un phénomène rare, les vagues de tsunami constituent une menace réelle dans l'Ouest de l'Amérique du Nord, compte tenu des importants tsunamis qui surviennent dans l'océan Pacifique. Comme d'importantes villes sont situées sur ces rivages, et à la suite des leçons servies par le tsunami dans l'océan Indien en décembre 2004, il est nécessaire que les ingénieurs

suite à la page 5

continued from page 4

We wish to extend our warm thanks to the engineers and scientists who contributed to this issue. The authors welcome and invite your comments and feedback. ■

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suite de la page 4

soient sensibilisés aux effets dévastateurs possibles de ces phénomènes naturels sur les infrastructures situées en régions côtières.

Nous remercions les ingénieurs et les scientifiques qui ont contribué à ce numéro et nous serons heureux de recevoir vos commentaires. ■

V.H. (VIC) PERRY FEC, FCSCE, MASC., P.ENG. / FEC, FSCGC, MASC., ING.

It is a great honour and privilege to be asked by one's peers to serve as president of such a great organization as the CSCE. With everyone's assistance, during my term as president, we will move the CSCE and our profession towards a higher level of involvement and recognition—a recognition that civil engineers, as keepers of the infrastructure, play an important role in society's quality of life.

During the past year as your SVP, I committed my time to travelling from St. John's, NL to Victoria, BC and meeting with as many CSCE members and non-members as possible. I wanted to find out why CSCE's membership has been flat for the past many years and how CSCE could become more relevant to a larger base of potential members, particularly younger members who are the future of our Society. The purpose of my travel was to ask four very important questions: (i) What is the business of civil engineers? (ii) What is the Critical Success Factor (CSF) for civil engineering in the 22nd century? (iii) What can CSCE do to address the CSF? and, (iv) What does the CSCE brand mean to you vis-à-vis Engineers Without Borders.

I received common responses to all questions, such as: (i) Civil Engineers plan, design, build and maintain infrastructure; (ii) The CSF is providing "Sustainable" Infrastructure; (iii) The brand is a bunch of old grey haired guys; and (iv) CSCE needs to take a leadership role through advocacy and by raising the profile of civil engineers.

We are facing interesting and challenging times as civil engineers.

Challenge I: Rapidly Increasing Demand—Each day more than a quarter of a million children are born, with a net effect of increasing the earth's population to 7 billion by 2020, even if birth rates continue to decline at current rates. That is the equivalent of adding the population of another China by 2020. The current population, as well as all those new children, deserves to have clean water, food and shelter—a standard of living we take for granted in North America. This standard of living or quality of life is only made possible through our infrastructure—the networks that allow the movement of goods and people. Increasing population requires expansion and/or improvements in the infrastructure.

Challenge II: Large North American Ecological Footprint—North Americans' ecological footprint, for example, is huge. If everyone on earth consumed as many resources and generated as much waste as we do, we'd need the equivalent of nearly five more planets in order to be sustainable! There is only one planet that is reasonably accessible today, so it is imperative that we use it wisely and sparingly, unlike we currently do. The 'big box' movement, which drives down prices and feeds consumerism, creates over consumption of large quantities of global resources. While lower prices help the less privileged, it also facilitates over consumption by enabling the purchase of 'wants' rather than 'needs'.

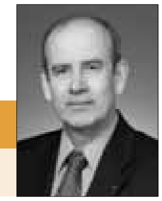
Challenge III: Rapid Deterioration of Existing Infrastructure—Our current infrastructure is deteriorating faster than we are repairing it. In North America today, there are more than 150,000 bridges that are structurally deficient or functionally obsolete and more than 3,000 new bridges are added each year. The American Society of Civil Engineers' 2009 Report for America's Infrastructure gave an overall D+ rating to America's infrastructure, with an estimated $2.2 trillion investment required to bring it to an acceptable level. In Canada the NRC in 1999 stated that 38% of our infrastructure is rated as poor or critical with respect to condition or meeting demand.

Challenge IV: Financing—Today, municipal, state, provincial and federal governments globally, with few exceptions, do not have the money to upgrade and expand the infrastructure to meet the current or future needs of society. Raising taxes or reallocating current tax dollars does not appear to be on the government's agenda nor is it the political will.

It is clear the "status quo" is unacceptable. We must change and sooner rather than latter. Civil Engineers have a critical role to play in meeting these challenges. CSCE has a role to play in assisting civil engineers to meet the challenges.

I believe that as civil engineers our business is infrastructure (soft & hard aspects) and that the most critical aspect of our business going forward is to ensure the infrastructure is sustainable and that CSCE's role should be to assist civil engineers in

continued on page 7



C'est un grand honneur et un grand privilège que d'être invité par ses pairs à présider un organisme aussi important que la SCGC. Avec l'aide de tous, au cours de mon mandat, nous conférerons à la SCGC et à la profession un plus grand niveau de participation et de reconnaissance, cette reconnaissance qui fait que les ingénieurs civils, à titre de gardiens des infrastructures, jouent un rôle important pour la qualité de la vie de la société.

À titre de premier vice-président, au cours de la dernière année, j'ai voyagé de St-John's à Victoria, rencontrant le plus de membres et de non-membres possible. Je voulais savoir pourquoi nos effectifs étaient restés au même niveau au cours des dernières années et comment la SCGC pourrait devenir plus pertinente pour attirer plus de membres, surtout de jeunes membres capables d'assurer l'avenir de notre société. Le but de mes déplacements était de vous poser quatre questions importantes : (i) Quel est le travail de l'ingénieur civil? (ii) Quel est le facteur critique de succès pour le génie civil au 22^{e} siècle? (iii) Que peut faire la SCGC pour tenir compte de ce facteur critique de succès, et (iv) Que signifie pour vous la marque SCGC par rapport à Ingénieurs sans frontières.

Toutes ces questions m'ont valu des réponses assez constantes, qui sont les suivantes : (i) L'ingénieur civil planifie, conçoit, construit et assure l'entretien des infrastructures; (ii) Le facteur critique de succès consiste à offrir des infrastructures « durables »; (iii) La marque SCGC évoque une bande de vieilles têtes grisonnantes; et (iv) La SCGC doit devenir un chef de file en faisant valoir les intérêts des ingénieurs et en assurant le rayonnement de la profession.

En tant qu'ingénieurs civils, nous avons des défis importants à relever.

Défi numéro I : une demande qui augmente rapidement—À chaque jour, plus d'un quart de million d'enfants naissent, ce qui portera la population mondiale à 7 milliards de personnes en 2020, même si le taux de natalité continue de diminuer au rythme actuel. Cette augmentation équivaut à ajouter, d'ici 2020, une population égale à celle de la Chine! La population actuelle, ainsi que tous ces enfants à venir, méritent de jouir d'un air pur, de nourriture et d'un toit adéquat, ce qui représente un niveau de vie que nous considérons comme normal en Amérique du Nord. Ce niveau de vie, cette qualité de vie, est rendue possible par nos infrastructures, ces réseaux qui permettent la circulation des biens et des personnes. La croissance des populations exige que les infrastructures soient développées et améliorées.

Défi numéro II : l'importante empreinte écologique de l'Amérique du Nord—L'empreinte écologique de l'Amérique du Nord est énorme. Si toute la population du monde consommait autant de ressources et créait autant de déchets que nous, il nous faudrait au moins l'équivalent de cinq autres planètes afin d'assurer notre durabilité! Comme il n'y a présentement qu'une seule planète qui soit raisonnablement accessible à l'être humain pour l'instant, il est essentiel que nous l'exploitions avec intelligence et parcimonie, et non comme nous le faisons présentement. Le mouvement des grandes surfaces, qui coupe les prix, crée aussi une surconsommation d'importantes quantités de ressources de la planète. Même si la chute des prix aide les moins privilégiés d'entre nous, elle facilite quand même la surconsommation en permettant aux gens d'acheter tout ce qu'ils veulent plutôt que ce dont ils ont besoin

Défi numéro III : la détérioration rapide des infrastructures existantes—Nos infrastructures actuelles se détériorent plus vite que nous pouvons les réparer. En Amérique du Nord, en ce moment, il y a plus de 150 000 ponts dont la structure est déficiente ou fonctionnellement désuète, et ce chiffre grossit de 3 000 ponts à chaque année. Dans un document publié en 2009 sur l'état des infrastructures des USA, l'American Society of Civil Engineers a évalué à D+ l'état général des infrastructures aux USA, ajoutant qu'il faudrait investir environ 2,2 milliards de dollars pour les ramener à un niveau acceptable. Au Canada, le CNR a affirmé, en 1999, que 38 % de nos infrastructures étaient dans un état mauvais ou critique, compte tenu de la demande.

Défi numéro IV : le financement—En ce moment, les gouvernements municipaux, provinciaux et fédéral ne disposent pas, à quelques exceptions près, de l'argent nécessaire pour améliorer et augmenter les infrastructures de façon à combler les besoins futurs de la société. La hausse des impôts ou la redistribution des recettes fiscales actuelles ne semble pas être une priorité des gouvernements.

Il est évident que le statu quo est inacceptable. Nous devons changer les choses, et le plus vite sera le mieux. Les ingénieurs civils ont un rôle capital à jouer pour relever ces défis. La SCGC a un rôle à jouer pour aider les ingénieurs civils à relever ces défis.

Je crois qu'à titre d'ingénieurs civils, notre boulot est centré sur les infrastructures, et le principal facteur critique de succès consiste à garantir que les infrastructures seront durables. Le rôle de la SCGC est donc d'aider l'ingénieur civil à devenir un chef de file dans le domaine. De là, le slogan « Leadership en matière d'infrastructures durables ». Je crois vraiment que cette perspective incitera les jeunes ingénieurs civils à se joindre à la SCGC.

Mon objectif à titre de président pour la prochaine année est de mettre en œuvre un plan qui permettra à la SCGC d'atteindre cet objectif de « *leadership en matière d'infrastructures durables* ».

La SCGC est un organisme de bénévoles, et nous comptons sur l'aide et la contribution de tous et chacun.

Je vous remercie de la confiance que vousm'accordez. ■

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continued from page 6

this task by taking a leadership role, hence "Leadership in Sustainable Infrastructure". I also believe that this vision will excite young engineers to join CSCE.

My objective as president over the next year is to put in place a road map to put CSCE on the road towards this vision—"*Leadership in Sustainable Infrastructure*".

CSCE is a volunteer organization and I will be asking for everyone's input and help.

Thank you again, for entrusting me with the role of president. ■

Pollution in the Nearshore Regions of the Great Lakes

Ram Yerubandi PhD
Research Scientist and Adjunct Professor
National Water Research Institute, Canada Centre for Inland Water, Environment Canada, Burlington, ON

Susan B. Watson PhD
Research Scientist
Environment Canada, Water Science and Technology, National Water Research Institute, Burlington, ON

INTRODUCTION

The Laurentian Great Lakes of North America (Superior, Michigan, Huron, Erie and Ontario) and their connecting channels form the largest fresh surface water system on earth. They hold approximately 20% of global fresh water, which provides drinking water to over 15 million Canadian and US consumers. In the last two centuries, the Great Lakes basin has experienced exponential increase in human settlement and basin development. The Lakes have undergone radical changes as a result of dredging, diversion and damming, erosion and the development of a major lake-wide ocean-linked shipping route. Climate change has modified ice cover, hydrological and thermal energy budgets. Considerable water pollution in the Great Lakes basin arises from point and non-point sources associated with agricultural, industrial and municipal activities. This has resulted in cultural eutrophication, algal blooms and increased levels of anthropogenic pollutants, toxins and pathogens (IJC, 1980). Because of this widespread deterioration, by the latter part of the last century an international remediation effort was initiated under the Canada-US Great Lakes Water Quality Agreement (GLWQA) (Plate 1). As part of this programme, the International Joint Commission (IJC) identified 42 areas of concern (AOCs). Remedial action plans (RAPs) were developed for each AOC to reduce impairments to acceptable target levels.

The Laurentian Great Lakes represent systems dominated by their coastal nature. The nearshore waters of the Great Lakes basin are exploited directly by humans for many uses; notably for drinking water, to disperse pollutants and wastewater, for industrial processes. Most pollutants that reach Great Lakes nearshore waters enter from the land via tributaries, shoreline discharges, or as surface runoff. Pollutant concentrations can be higher near tributary mouths and discharge sites until they are diluted with the nearshore waters and ultimately with the larger volumes of cleaner offshore water. Several physical factors combine to make the coastal systems complex and unique in their hydrodynamics, and the associated physical transport and dispersal processes of the coastal flow field are equally complex (Rao and Schwab, 2007). Physical transport processes are often the dominant factor in mediating geochemical and biological processes in this environment.

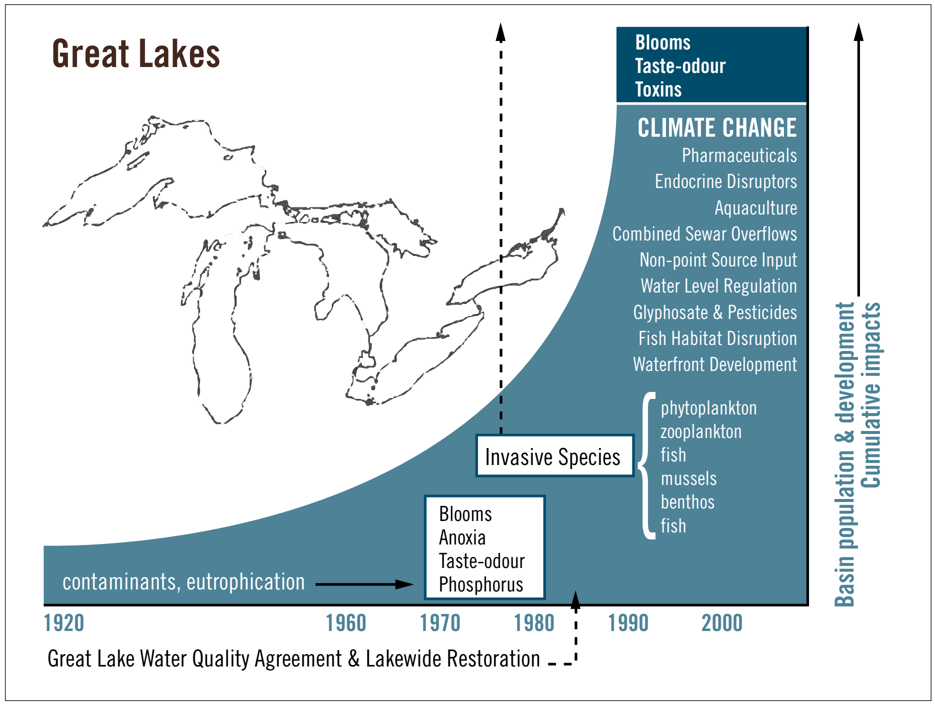

PLATE 1: Timeline of water quality concerns in the Great Lakes.

CONTAMINANT TRANSPORT FROM POINT SOURCES

The difficulty of predicting the discharges into coastal waters often lead to either over or under-estimation of their impacts. Domestic or industrial sewage is quite buoyant in the lake water column and forms a turbulent plume. Coastal currents exist over a wide range of length and time scales such as wave and wind-driven currents, and large-scale mean circulation. Although these spatial and temporal variations in coastal currents, especially their oscillatory behavior, can result in a highly dispersive environment, these complexities often lead to worst case assumptions which lead to overly conservative predictions. Often currents parallel to the coast or moving from open waters into coastal waters are significant sources of nutrients. We need long-term records of these currents and corresponding spatial and temporal patterns in temperature, contaminants, nutrients, and biota in order to relate these variations to the effects of climatic variability and coastal pollution sources. We also need better models of coastal waters to synthesize our knowledge and test mechanisms and process controls. In one such example, in the western end of Lake Ontario, urban communities of over 5 million residents rely on this waterbody almost exclusively for both water supply and wastewater disposal. Water intakes and wastewater discharges alike are typically installed alongshore from each other in a narrow band of the inshore area, extending, at most, a few kilometres offshore. Improvements in water purification and sewage treatment technology have, to some degree, offset the deleterious effects of increased development. However, current treatment technology seems to be nearing its practical design limit, while the demand for clean water and the need for suitable waste disposal facilities continue to rise at an ever-increasing rate. Excessive loadings of phosphorus, ammonia, and suspended solids from sewage treatment plants, bacterial contamination from Combined Sewer Overflows (CSO) and storm runoffs contribute to the problems of nearshore water clarity and poor water quality. Modeled predictions of the fate and transport of contaminants in Lake Ontario have been assessed by utilizing a combination of physical limnological data and different types of transport models. These studies showed that because of the variability of winds, the transient properties of coastal currents are often of greater importance in dispersing the material than the steady state for constant wind.

MICROBIAL POLLUTION IN THE NEARSHORE

Many Great Lakes beaches are used extensively for recreation from June through August. Over the past decade, many of these areas have become increasingly polluted with high bacterial levels and mats of decaying algae, rendering them unfit, and in some areas, unsafe, for recreational use. In response to the increasing concern with this issue, several studies are now evaluating the levels of microbial pollution at many beaches in the Great Lakes in the United States and Canada, and their links to sources such as storm water outfalls and tributary discharges. In Lake Ontario, a network of government-funded interdisciplinary source water protection studies are also undertaking an extensive evaluation of water quality and levels of waterborne pathogens such as *Cryptosporidium*, *Giardia*, campylobacter and enteric viruses at drinking water intakes and beaches.

INVASIVE SPECIES

Nearshore waters provide habitat for a growing number of non-indigenous species (NIS) introduced to the Great Lakes, which are dramatically affecting the ecology of these ecosystems with major socioeconomic impacts. In particular, the dreissenid mussels, introduced from ballast water in the 1980s, have rapidly colonized shorelines in extensive, dense beds. Dense mussel encrustation causes major fouling issues with shoreline and navigation structures, drinking and coolant water intakes. Aggressive

PLATE 2: Cyanobacteria bloom in Hamilton Harbour (source: City of Hamilton Public Health Services).

filter feeding by these organisms on plankton and other suspended materials from the water column produces major shifts in planktonic food web structure, redirects the inshore-offshore exchange of nutrients to the nearshore zones, and increases water transparency and the illuminated coastal lake-bottom area which supports plant and algal growth. The mussels also facilitate benthic growth by providing substrate for attachment. The resultant extensive nutrient-rich, illuminated inshore zones has likely contributed to the recent resurgence of *Cladophora* and other filamentous algae, and the proliferation of noxious mats of cyanobacteria such as *Lyngbya* along Lake Erie, Michigan and Ontario shorelines. Rotting algal mats clog intakes and wash up along shorelines and beaches, producing fetid odours and providing a natural substrate for the growth of bacteria (including *E. coli*).

HARMFUL ALGAL BLOOMS (HABS)

The attached algal/cyanobacterial proliferations noted above are among the many 'Harmful Algal Blooms ('HABs')' that occur across the Great Lakes. Not a new phenomenon, they are caused by both toxic and non-toxic blooms and are largely driven by excessive nutrient inputs from fertile and/or extensively developed watersheds. Severe HABs in the last century were mitigated by point source nutrient abatement beginning in the late '70s under the GLWQA, but recently have resurged as a major concern in many in offshore and nearshore areas. These events are generally associated with planktonic toxic cyanobacteria, but can involve a variety of species of both cyanobacteria and algae, and are particularly problematic in coastal areas. Impacts can include: risks to human and animal health via toxins, carcinogens, teratogens, or irritants in drinking water; other drinking water impairment (taste & odour, aesthetics); fouling of water intakes, fish nets and shoreline; bacterial growth in rotting mats (including potential pathogens, e.g., *E. coli*); beach closures (affecting recreation and tourism); tainting of fish, shellfish, and processed food (harming commercial and recreational fisheries and other food industries); food web integrity and structure, and environmental degradation such as anoxia. Sporadic outbreaks of high toxin levels have been reported in *Microcystis* blooms in nearshore areas (Watson et al., 2005, Hotto et al., 2007). Data collected by larger Ontario municipal water treatment plants show episodes of elevated toxin levels in raw water, which are adequately removed by the advanced treatment processes. However, a potential risk exists for smaller utilities and private users with more rudimentary removal technology. AOCs such as the Bay of Quinte, Hamilton Harbour and Rochester Embayment show periods of severe impairment of nearshore sites by windblown accumulations of toxic cyanobacteria (Plate 2), where the most common and resilient hepatotoxin microcystin (MC) can reach levels in excess of 300 µg MC L^{-1} (Watson et al., 2005). Outbreaks of intense earthy/musty taste and odour (T&O) in drinking and source water have also been occurring in the Great Lakes basin (Watson et al., 2007). These are largely caused by geosmin and 2-MIB, produced by some cyanobacteria and other non-algal taxa. Climate and large-scale water movement play a key role in these T&O events by transporting offshore pelagic T&O production by dispersed and patchy distributions of cyanobacteria (*Anabaena lemmermanii*) to nearshore water treatment plant intakes (Rao et al., 2003). The strength of the annual downwelling and associated T&O event varies among years with the duration and persistence of east winds (Watson et al., 2007). In the Northeast end of the lake (Kingston basin) and upper St. Lawrence River, prolonged late summer T&O is produced annually by both geosmin and MIB, derived from attached cyanobacterial communities. ■

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A HOUSE IN BANDA ACEH, INDONESIA, DESTROYED BY THE EARTHQUAKE AND TSUNAMI.

Dan Palermo PhD, P.Eng
Assistant Professor
Department of Civil Engineering,
University of Ottawa, Ottawa, ON

Ioan Nistor PhD, Ing.
Associate Professor
Department of Civil Engineering,
University of Ottawa, Ottawa, ON

Tsunami Loading of Near-Shoreline Infrastructure

INTRODUCTION

Tsunami-generated waves are extreme events. However, their impact on near-shoreline infrastructure, including structures, can be severe and their damaging effects can significantly affect coastal communities for extended periods of time following the event. The risks associated with tsunami hazard have increased due to the significant development of coastal regions, which are susceptible to tsunami flood waters. Structures are typically designed for gravity loads, wind loads, and earthquakes if located in seismic regions; however, tsunami-induced loading is generally not considered. Hence, it is important to understand the loading mechanisms induced by tsunami waves to assess the risks for Canadian coastlines, which could be affected by tsunami attack, and to design structures to be used as evacuation centres.

MECHANISMS OF TSUNAMI IMPACT

Historically, tsunamis have occurred along both the Atlantic and the Pacific coastlines of Canada. Studies have indicated that approximately 80% of tsunamis have occurred in the Pacific Ocean (Nistor and Murty, 2009), thus the western seaboard of Canada is at risk of being affected by tsunami. The intense seismic activity around the Pacific Ring of Fire combined with the capability of a tsunami to propagate over the entire ocean, make this region particularly vulnerable to such phenomena. It is believed that coastal communities on Vancouver Island, such as Tofino, are most susceptible to tsunami. However, the 1964 Alaska Earthquake and Tsunami caused significant damage to Port Alberni, located at head of the Ablerni Inlet; demonstrating tsunamis can travel through inlets with destructive force. Furthermore, it is believed that major cities on the west coast, such as Vancouver and Victoria, would be sheltered by Vancouver Island from the full effect of a tsunami generating in the Pacific Ocean. The 2004 Indian Ocean Tsunami, however, provides evidence of the propagation of tsunami waves as they diffract and refract around islands. For example, the west coast of Sri Lanka was severely affected by the tsunami, even though it was not directly in the path of the initial tsunami waves. Tsunamis have also occurred along the eastern seaboard of Canada, indicating that this region may also be affected, possibly by smaller tsunamis, in the future (Clague et al., 2003).

Tsunami waves undergo a significant transformation as they approach the coastline. While in the open ocean, tsunami waves are virtually unnoticeable and can only be detected using a complex array of submarine pressure transducers; their appearance, however, changes dramatically as they approach the coastline. As water depth decreases towards the shoreline, the rising ocean floor pushes up the tsunami waves resulting in a significant increase in wave height relative to the wave height experienced in deep ocean waters. Concurrently, wave celerity, the speed at which the tsunami wave propagates, decreases, since it is a function of the water depth. Depending on the submerged beach slope and characteristics of the near-shore bathymetry, as tsunami waves advance towards the shoreline, they may either break close to the shore and further flood the coastline in the form of a rapidly advancing hydraulic bore or, if the ocean bottom is steep, they flood the coast in the form of a rapidly rising tide that inundates the inland littoral area. The mechanism of tsunami advancement is different for each of these two cases. The tsunami-induced hydraulic bore has the form of a highly turbulent, rapidly advancing wall of foamy water, which is characterized by a highly non-linear hydrodynamic pattern with significant air entrainment. The bore moves as a result of the transfer of momentum to the still water ahead of it. The speed of the bore depends on the initial wave height as well as on the inland topography and the roughness elements (dunes, trees, houses, etc.) of the coast. The tsunami-induced bores can easily reach speeds of several meters per second and heights of several meters. In the case of the rapidly rising tide, the magnitude of the overall impact force has been reported to be slightly lower than that of the hydraulic bore.

TSUNAMI-INDUCED FORCES

Building codes, namely the 2005 National Building Code of Canada (NBCC, 2005), do not explicitly consider tsunami loading, as it is understood that inland structures can be protected by proper site planning and site selection. Furthermore, code developers consider tsunami to be a rare event with a long return period. Therefore, forces generated by tsunami are often neglected in structural design practice. Recent catastrophic events, however, (2004 Indian Ocean Tsunami; 2007 and 2009 Solomon Islands Tsunamis, and 2010 Chile Tsunami) have brought to light the destructive power of tsunami-induced hydraulic bores on near-shoreline infrastructure. Figure 1a illustrates damage to masonry infill walls and reinforced concrete columns in Pelluhue, Chile after the 27 February 2010 Tsunami, while Figure 1b is a photo of damage suffered by a reinforced concrete structure on the Island of Phuket, Thailand following the 26 December 2004 Indian Ocean Tsunami.

Nistor et al. (2009) and FEMA P646 (2008) provide a comprehensive review of the force components that are associated with tsunami-induced hydraulic bores. A brief description of each force component follows:

(1) Impulsive Force: The impulsive force is a short duration load generated by the initial impact of the leading edge of a tsunami bore. The calculation of the impulsive force is subject to substantial uncertainty.

(2) Hydrodynamic Force: The hydrodynamic force arises from the flow of the tsunami bore around a building or structural element. The force includes the effect of the flow velocity on all sides of the structure and is assumed to be uniform. The pressure, therefore, is constant through the depth of the flow.

A

B

FIGURE 1: Tsunami-related structural damage:
(a) Pelluhue, Chile; (b) Phuket, Thailand (Nistor et al. 2009).

(3) Hydrostatic Force: The hydrostatic force is generated by still or slow-moving water. The force is calculated based on a triangular pressure distribution. In the case of a hydraulic bore, the hydrostatic force is generally smaller in magnitude than the impulsive and hydrodynamic force components.

(4) Debris Impact and Damming Forces: Tsunami-induced bores traveling inland carry debris such as floating automobiles, and floating pieces of buildings, drifting wood, boats and ships. The damming force is the result of an accumulation of debris. The impact of floating debris can induce significant forces on a structural element, leading to damage or collapse.

(5) Buoyant and Uplift Forces: The buoyant force acts through the centre of mass of a submerged or partially submerged structure. Buoyancy has the effect of generating uplift forces, thus contributing to stability problems by reducing the resistance of a structure to sliding and overturning. The uplift forces can be further magnified by hydrodynamic forces if the rapidly rising water level is accompanied by a vertical flow velocity. This results in an additional vertical force.

(6) Gravity Forces: Drawdown of the tsunami-induced flooding can result in retention of water on flooring systems. This

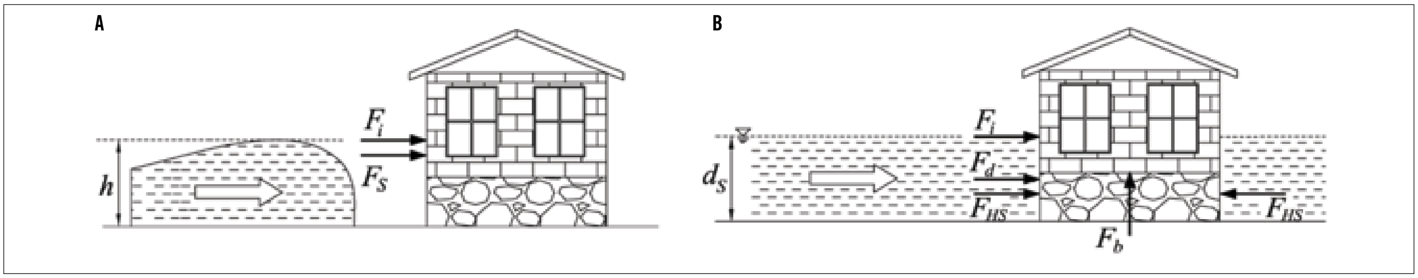

FIGURE 2: Tsunami Loading Combinations: (a) Initial Impact; (b) Post Impact (Nistor et al., 2009).

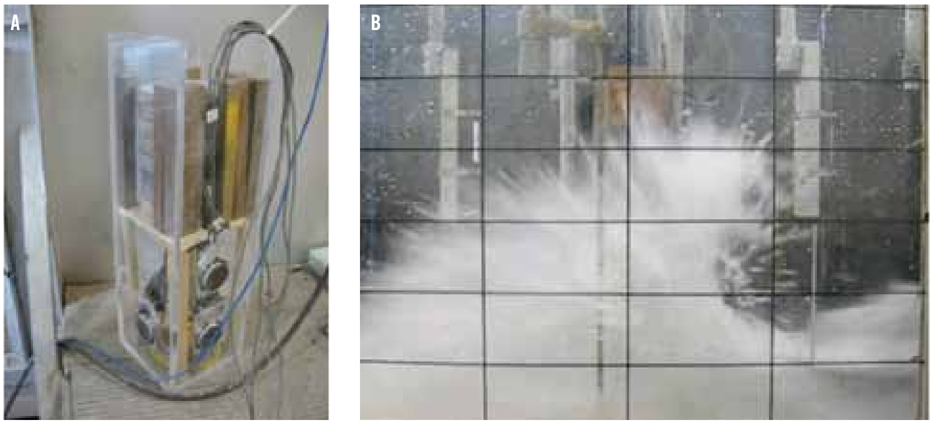

FIGURE 3: Experimental Program: (a) Rectangular Column; (b) Hydraulic Bore Impact on Rectangular Column.

phenomenon imposes additional gravity loading on the structure.

The force components generated by tsunami-induced hydraulic bores do not occur concurrently, thus, loading combinations are required to determine the maximum tsunami force, which could be incorporated in building codes and combined with other loads. Nistor et al. (2009) and FEMA P646 (2008) provide detailed discussion of various proposed loading combinations. Figure 2 provides two proposed loading combinations: Initial impact, which includes the combined effect of the impulsive, F_s, and debris impact, F_i , forces; and Post Impact, which includes debris impact, F_i, hydrodynamic, F_d, hydrostatic, F_{HS}, and buoyant, F_b, forces. The initial impact considers the first arrival of the leading edge of the tsunami bore, while the post impact results from the quasi-steady state flow of the bore following the initial impact. The tsunami design force is the maximum force determined from the two combinations.

CURRENT RESEARCH

The estimation of a tsunami design load is dependant on the height of the tsunami bore and the corresponding flow velocity. Current estimates of tsunami design forces can be excessive and often result in significantly higher forces than those based on earthquake ground motions. Meanwhile, recent tsunami events have demonstrated that severe damage is experienced by non-engineering structures, while damage to engineered structures is often confined to non-structural components. Thus, improved estimates of tsunami flow velocities corresponding to design tsunami heights are required to estimate tsunami design forces with confidence. The design tsunami load can then be incorporated in load cases adopting the philosophy of seismic loading, which is based on an extreme event, as proposed by Palermo et al. (2009) as a preliminary framework. Experimental research is currently ongoing to understand and assess the various force components and flow velocities associated with hydraulic bores (Nouri et al., 2010).

SUMMARY

Recent catastrophic tsunamis have emphasized the destructive power of tsunami-induced hydraulic bores as they propagate overland and impact near-shoreline infrastructure. As a result, research has initiated to improve our understanding of the forces associated with tsunamis and the interaction between tsunami-induced bores and infrastructure. The force components include: impulsive, hydrodynamic, hydrostatic, debris impact and damming, buoyant and uplift, and gravity. There is, however, uncertainty in both the estimation of the component forces, as well as the total tsunami load that should be considered. Future efforts, including experimental and analytical studies, are being directed toward a better understanding of the forces for the design and evaluation of infrastructure located in tsunami-prone areas. ■

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Storm Surges in Canada

Tad Murty PhD
Department of Civil Engineering, University of Ottawa, Ottawa, ON

Mahmoud Al-Riffai PhD Candidate
Department of Civil Engineering, University of Ottawa, Ottawa, ON

Ram Yerubandi PhD
National Water Research Institute, Canada Centre for Inland Waters, Environment Canada, Burlington, ON

INTRODUCTION

Storm surges occur on the coastlines of Canada, mainly from extra tropical cyclones (winter storms) and also from remnants of hurricanes travelling generally from the USA. Occasionally, meso-scale weather systems also can generate surges and seiches.

Storm surges have been observed in the following areas, which is not necessarily an exhaustive list: Atlantic and Pacific coasts, Gulf of St. Lawrence and St. Lawrence Estuary, Bay of Fundy, the Great Lakes, Lake Winnipeg, Hudson Bay, Beaufort Sea, Strait of Georgia, Juan de Fuca Strait and the Arctic Coast (Murty, 1984; Gönnert et al., 2001).

SURGES ON THE WEST COAST

During summer, surface winds off the coast of British Columbia are from the northwest, whereas during winter they are from the southeast. Due to the effect of geostrophic adjustment of wind-induced water currents, mean sea levels off the coast, thus, tend to be higher in winter than in summer. Sea levels also increase in the Strait of Georgia due to the outflow of the Fraser River, which is at a maximum in late spring. Nevertheless, winter remains to be the season of concern for storm surges due to high astronomical tides as well as for high mean levels from storms.

The case study of 14–19 December 1982 is described in Murty et al. (1995). The low pressure sea-level system (Figure 1) was traced moving towards the east along 40° N to longitude 140° W then climbing northeast just west of the north tip of Vancouver Island (50° N, 130° W) where it moved northwest parallel to the British Columbia coast. On 16 December 1982, at 0600 UTC, the lowest central pressure was 966 hPa, about 550 km (47° N, 132° W) west of the coast of Washington State. Figure 2 shows the observed surge heights reaching 0.9 m to 1.0 m at Victoria, Point Atkinson (just west of West Vancouver), Little River (north of Comox) and Seattle. Studies by Crawford et al. (2000) on the effects of winds, high tides and El Niño Southern Oscillation (ENSO) on erosion and coastal flooding indicated that such specific processes also contributed to the damage.

SURGES ON THE EAST COAST

Along the Atlantic coast, storm surges are often associated with vigorous north-eastwardly extra-tropical cyclones off the American seaboard. They can be characterized by very strong south-easterly to easterly surface pressure gradients over a large area whereas during the time of peak surge, the low pressure center is within two degree of latitude of Halifax. Although storm surges above 0.6 m are uncommon at Halifax, they occur on average twice per year (Parkers et al., 1997).

Table 1 lists the maximum positive and negative storm surge amplitudes in the Atlantic Coast, Gulf of St. Lawrence and the St. Lawrence Estuary, sorted generally by province.

SURGES ON THE GREAT LAKES

The Laurentian Great Lakes of North America have horizontal scales of hundreds of kilometers and depth scales of hundreds of meters. The human settlements around the Great Lakes are marked by structures designed to stabilize shorelines and protect properties from flooding and erosion. The Great Lakes coast consists of several commercial and small craft navigation ports and industrial and municipal structures. This coastal zone is affected by a wide range of natural hazards including storm induced surges and associated flooding. Some of the coastal areas of the Great Lakes are particularly vulnerable to bluff erosion associated with storm surges during high water levels.

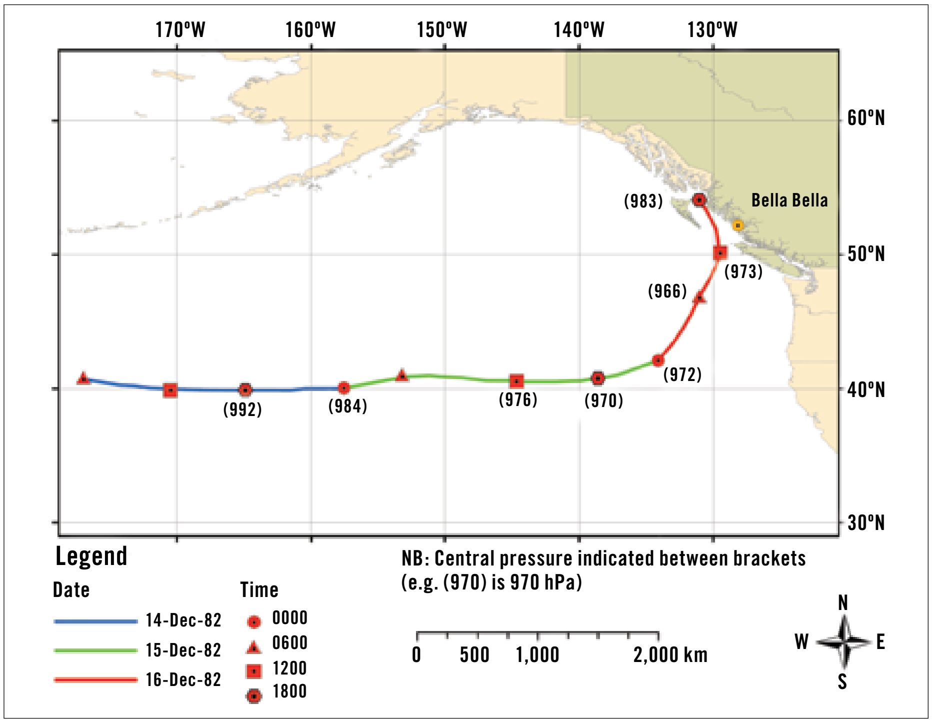


FIGURE 1: Cyclone track that generated a surge on BC coast (after Murty et al., 1995).

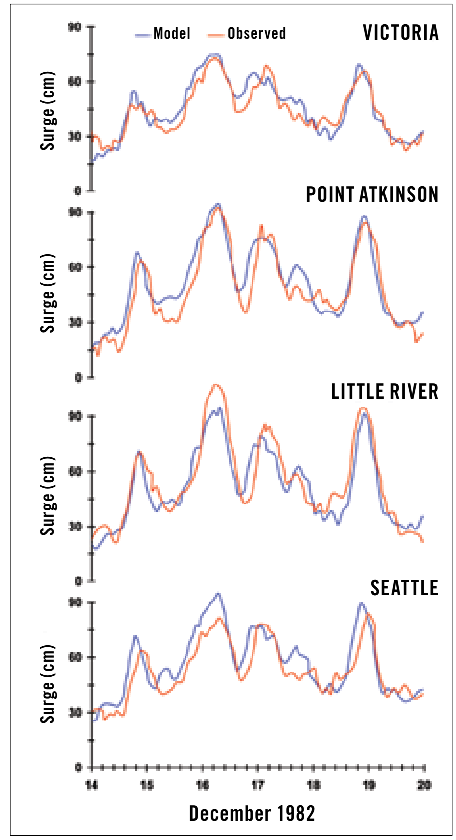


FIGURE 2: Observed and modelled surges at selected locations on North American Pacific coast (after Murty et al., 1995).

In terms of coastal dynamics, the Great Lakes behave much like many inland seas and exhibit physical processes characteristic of the coastal oceans. Because of shallow nature of these lakes, the wind action on coastal waters rapidly generates wind waves and water level fluctuations associated with strong currents. When a steady wind blows along the lake, the equilibrium condition of the water surface is a depression (set-down) along the upwind end, and increase of elevation (storm surge) along the downwind end of the lake. Storm surges in the Great Lakes have been described among others by Rao and Schwab (1976) and Murty et al. (1995). Storm surges on the Great Lakes range from 0.3 m to 2 m in height, with larger surges occurring during fall (Sept–Nov) storms. A typical storm surge is associated with a strong cyclonic disturbance traveling from southwest to northeast and centered on the Great Lakes.

In general the maximum surges occur at the eastern and western ends of Lake Erie and shallow basins of other Great Lakes, which are exposed to long distances of water surface across which storm winds blow. In one example, Hamblin (1987) described the surge of 6 April 1979, which had the largest recorded set-up between Buffalo and Toledo of 4.5 m. In one of the historical analysis of several storm surges in the Great Lakes, Murty et al. (1995) discussed about the wide spread destruction in terms of significant human and infrastructure losses caused by storm surges. Table 2 provides examples of storm surge potential along the Canadian and the U.S. shores of the Great Lakes.

Because of the frequent passage of storms through the Great Lakes region, the lakes are often subject to sustained strong winds. Surface seiche, which is the oscillatory response of the lake surface after wind cessation, can also have a significant impact on the nearshore circulation in some of the Great Lakes. Each lake has its own characteristic period of oscillation for the fundamental (unimodal) seiche and higher harmonics. The period of oscillation depends on the size of the lake and its mean depth. Lake Erie has the largest amplitudes of seiches (> 3 cm) and longest periods among all the Great Lakes. Platzman and Rao (1964) pioneered the prediction of seiches using a one-dimensional numerical model to Lake Erie. More recently two and three-dimensional models are developed to accurately depict the structure and amplitude of lake surface oscillations for all the lakes. ■

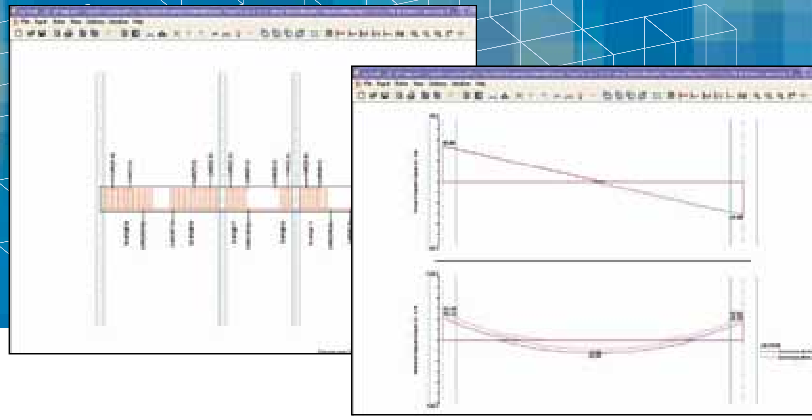
continued on page 21

TABLE 1: Extreme positive and negative storm surges in eastern Canada during 1965–1975 (Murty et al., 1995).

		Maximum Storm Surge (cm)	
Atlantic Province	Water Body	Positive Surge	Negative Surge
New Brunswick	Gulf of St. Lawrence	130	170
Nova Scotia	Gulf of St. Lawrence	110	130
Newfoundland	Gulf of St. Lawrence	110	120
Labrador	Labrador Sea	100	120
PEI	Gulf of St. Lawrence	130	140
Quebec	St. Lawrence Estuary	270	230

TABLE 2: Possible storm induced rise in water level (cm).

	Return Period (yrs)		
Station	10	50	100
Port Weller	38	83	115
Burlington	53	79	94
Kingston	46	60	66
Buffalo	180	231	254
Toledo	106	132	144



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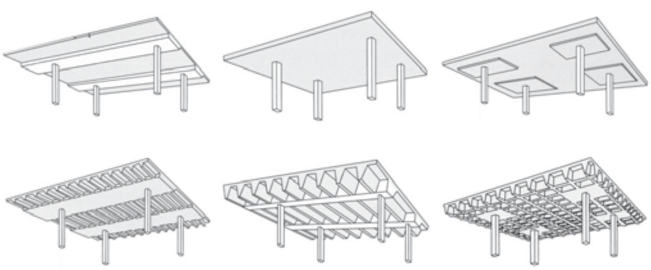

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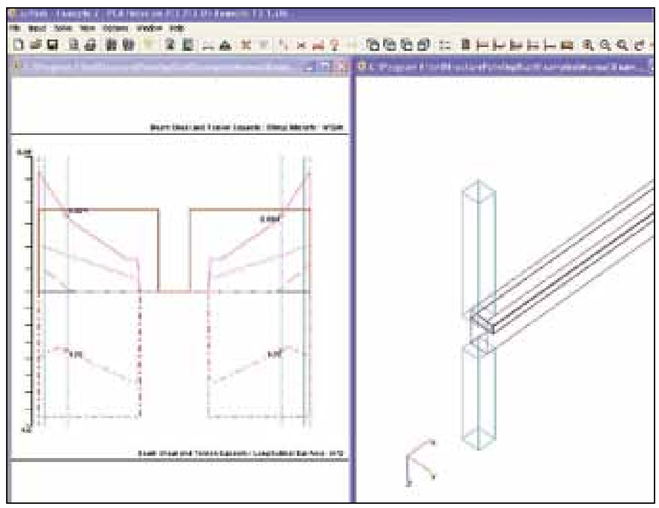

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Tad Murty PhD
Adjunct Professor
Department of Civil Engineering
University of Ottawa, Ottawa, ON

Mahmoud Al-Riffai PhD Candidate
Department of Civil Engineering
University of Ottawa, Ottawa, ON

Tsunami Risk and Vulnerability for Canada

INTRODUCTION

This short paper is a condensed version of *Natural Hazards* 28: 433–461, 2003: "Tsunami hazard and risk in Canada" by Clague, Munro and Murty.

Many tsunamis have struck the Canadian coasts, yet only few have caused significant damage. The exhaustive study by Jones (2000) on Canadian disasters mentions only one tsunami related catastrophe, which was triggered by the Grand Banks earthquake on November 18, 1929 where all except one inhabitant (28 lives) died on the Burin Peninsula of Newfoundland. Jones excludes from his records the tsunami caused by the explosion which occurred in the Halifax Harbour on December 6, 1917, although many drowned during this calamity (*Halifax Herald*, December 7, 1917).

The third tsunami that caused great destruction in Canada was in 1964 on the west coast of Vancouver Island, following a large earthquake in Alaska. Several other smaller tsunamis have occurred on both the Atlantic and Pacific coasts, and it is possible that much larger tsunamis than those in 1917, 1929 and 1964 could strike Canada. On the west coast of Canada even larger and more destructive tsunamis than the ones previously mentioned could be triggered due to a large earthquake at the Cascadia subduction zone which underlies the sea floor of the eastern North Pacific Ocean

(Atwater et al., 1996), a large landslide from the submerged flank of one of the volcanoes on the Hawaiian Islands (McMurtry et al., 1999), or simply due to a landslide anywhere along the populated reach of the B.C. coast. Devastation by a tsunami on the east coast of Canada is imminent should a large landslide at the Atlantic continental margin, or collapse of the flank of a volcano on the Canary Islands coast occur (Carracedo et al., 1999; Elsworth and Day, 1999; Ward and Day, 1999). Although such events may be rare, their occurrence would have devastating impacts on coastal communities where death and injury would be brought on to a vast number people.

PACIFIC COAST

Earthquakes beneath the Pacific Ocean may trigger tsunamis on the west coast of Canada which is located along the Pacific "Ring of Fire" (Figure 1; Lander et al., 1993; Lander, 1996; González, 1999). The largest tsunamis in B.C. result from great (magnitude 8 or larger) Earthquakes which occur at the Cascadia subjunction zone, where the oceanic Juan de Fuca plate moves under North America, and which have a magnitude 8 or larger, will tend to cause large tsunamis in B.C. (Clague et al., 1999). The coast of B.C. is also vulnerable to tsunamis which are triggered by even more distant Pacific earthquakes. It may be interesting to note that the great Alaska earthquake of March 28, 1964 (magnitude 9.2) generated the largest tsunami in the history of B.C. (Plafker, 1969; Lander, 1996). The earthquake off south-central Alaska triggered a series of waves which then propagated outward from the rupture area and had reached the outer coast of B.C. within a few hours. The catastrophe led to $10 million in damage (1964 Canadian dollars) to the Vancouver Island communities of Port Alberni, Hot Springs Cove, and Zeballos (Thomson, 1981).

Fortunately, most of the inhabitants on the Canadian west coast live around the Strait of Georgia, a low tsunami risk region. Nevertheless, there is greater risk posed to small communities on the western Vancouver Island (e.g., Tofino, Ucluelet, Port Alberni) (Clague et al., 1999) with a total population of 5,000, which is much smaller than the population of communities along the tsunami inundation zone on the Pacific coasts of Oregon and Washington.

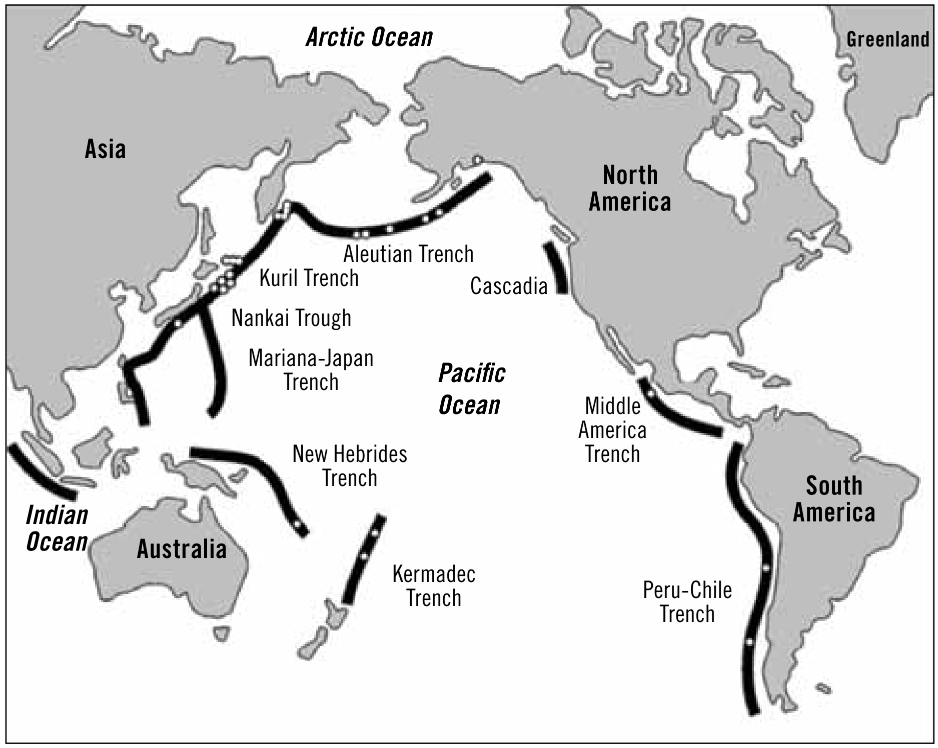

FIGURE 1: Subduction zones (black bands) shown in the Pacific Ocean where earthquakes have triggered large tsunamis. Circles locate the sources of tsunamis larger than 10 cm in height that were recorded at the Tofino tide gauge on the west coast of Vancouver Island between 1905 and 1981 (Clague, 2001, Figure 3).

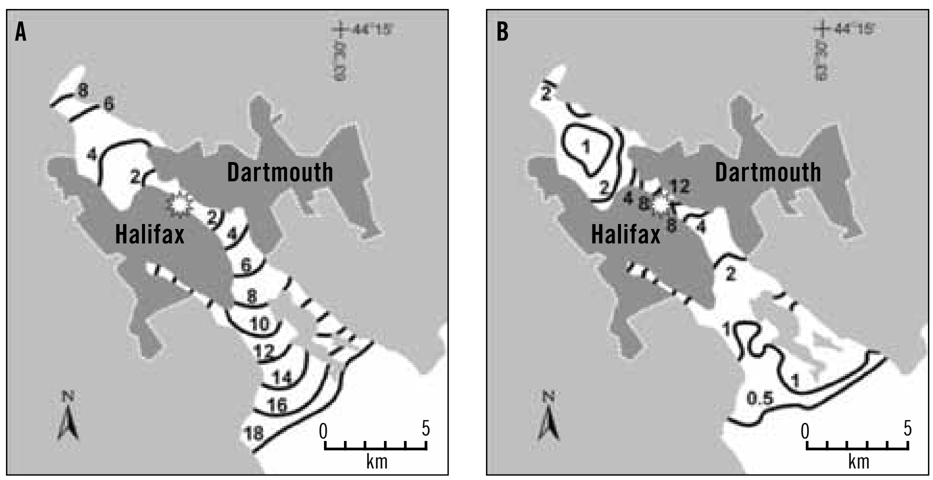

FIGURE 2: (a) Travel times, in minutes, and (b) maximum heights, in metres, of the tsunami of December 6, 1917 (data from Greenberg et al., 1994).

ATLANTIC COAST

The 1917 tsunami generated in the Halifax Harbour due to a massive chemical explosion on board a naval vessel was not a natural event (Figure 2). However, the 1929 tsunami caused by an earthquake-triggered landslide claimed more human lives in the history of natural tsunamis or for that matter earthquake, in Canada (Figure 3). Such an earthquake has a return period probably between a few hundred years to a thousand years and is unlikely to trigger a tsunami off Canada's east coast unless it causes a vertical displacement in a large area of the sea floor. A greater risk this earthquake could pose would be to cause a large tsunami indirectly triggered due to a submarine landslide, as occurred in 1929. Tsunamis generated by submarine landslides could also occur independently of an earthquake. However, there is no such record of such an event on the east coast. There is evidence of tsunamis occurring in the St. Lawrence Estuary by landslides not necessarily associated with

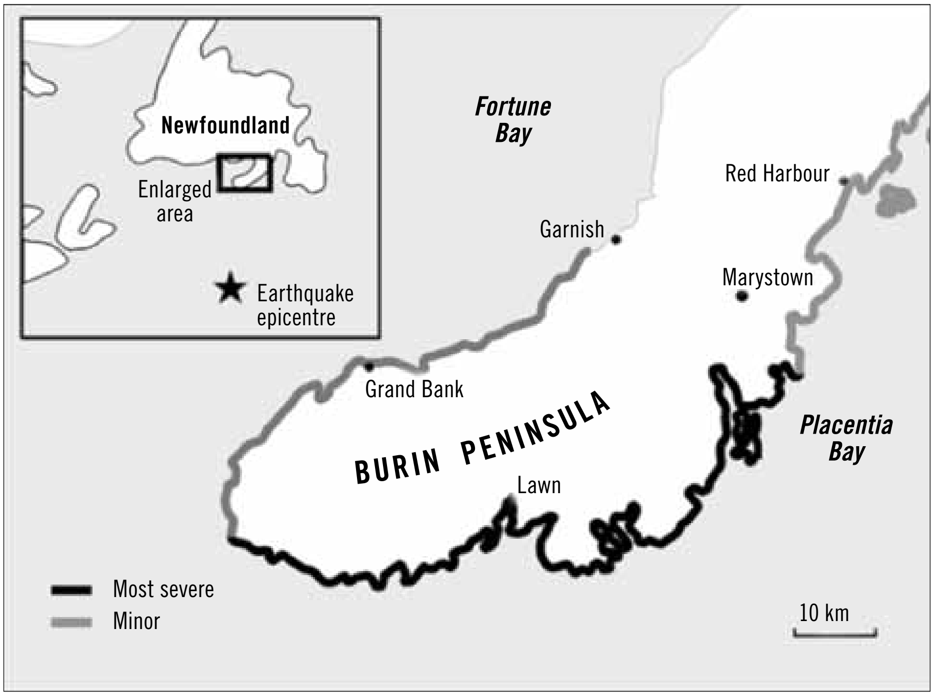

FIGURE 3: Extent of damage from the 1929 tsunami on Burin Peninsula, Newfoundland (Clague, 2001, Figure 9; modified from Whelan 1994).

earthquakes. Also, in 1975, in Kitimat Inlet in B.C., a moderate tsunami was generated by a landslide.

ARCTIC COAST AND INTERIOR WATERWAYS

Not much is known on tsunami hazards in Arctic Canada since no significant tsunamis have been reported in this region, nor is there any geological evidence historically. Even though both moderate and large earthquakes occur in some areas of the Arctic (e.g. Baffin Bay and Beaufort Sea), nevertheless the occurrence of a large tsunami anywhere in this region is unlikely due to the presence of large sea ice stretches.

Although landslides generating waves in lakes and rivers bordered by steep and unstable slopes (especially within actively growing deltas) can be rare, however, can be known to cause substantial damage and loss of life. In August 1905, the collapse of Pleistocene glaciolacustrine sediments into the Thompson River at Spences Bridge in south western B.C., triggered a wave 5–6 m high which propagated 1.5 km upstream, destroying 20 buildings and killing 15 persons (Evans, 2001). In western Quebec, three years later, a landslide on the Du Lièvre River generated a displacement wave that buried part of the village of Notre-Dame-de-la Salette, killing 27 people (Evans, 2001).

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continued from page 15

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THE DEFINITION OF INFRASTRUCTURE

As Civil Engineers, we define "*Civil Engineering*" as the planning, designing, constructing and operation/maintenance of "Infrastructure". This definition is consistent with most other learned civil engineering societies. As Civil Engineers, when we speak of infrastructure, we tend to focus on the hard assets and sometimes ignore the broader meaning of infrastructure.

However, the classical "Civil Engineering" definition of infrastructure is not shared by everyone. A broader based and more accepted definition of Infrastructure also includes services, social, environmental and political aspects.

1. **(noun) infrastructure, substructure**
   the basic structure or features of a system or organization
2. **(noun) infrastructure, base**
   the stock of basic facilities and capital equipment needed for the functioning of a country or area "the industrial base of Japan"

Infrastructure is the basic physical and organizational structures needed for the operation of a society or enterprise, or the services and *facilities* necessary for an economy to function. The term typically refers to the technical structures that support a society, such as roads, water supply, sewers, power grids, telecommunications,

continued on page 23

LA DÉFINITION DES INFRASTRUCTURES

En tant qu'ingénieur civil, nous définissons le « *génie civil* » comme étant la planification, le design, la construction et l'exploitation/entretien des « infrastructures ». Cette définition est conforme à celles qu'utilisent la plupart des autres sociétés savantes de génie civil. En tant qu'ingénieurs civils, lorsque nous parlons d'infrastructures, nous sommes parfois portés à ne penser qu'au biens durables, sans inclure les autres aspects qu'évoque le mot infrastructure.

Toutefois, ce n'est pas tout le monde qui fait sienne la définition classique du mot infrastructures. Une définition plus large et davantage acceptée inclut également les services, l'aspect social, l'aspect environnement et l'aspect politique.

Les infrastructures sont en fait les structures physiques et organisationnelles nécessaires au fonctionnement d'une société ou d'une entreprise, ou les équipements et services nécessaires au fonctionnement d'une économie. Le mot lui-même évoque les structures techniques qui soutiennent une société, comme les routes, les aqueducs, les égouts, les réseaux électriques, les télécommunications, etc. D'un point de vue fonctionnel, les infrastructures *facilitent* la production de biens et services; ainsi, les routes permettent le transport des matières premières jusqu'à l'usine et la distribution de produits finis

suite à la page 25

ALISTAIR MACKENZIE P.ENG., FCSCE, RYERSON UNIVERSITY

A Case Study In Engineering Restoration

As Canada's earliest transportation infrastructure developed from the extensive inland waterway systems of rivers and lakes used first by our native peoples and later developed by the fur traders of the Hudson's Bay and North West Companies, transportation by water has always been of interest to students of Canada's civil engineering history.

It was therefore pleasing for the writer to receive an invitation, together with Don Lawson of our sister society, the Canadian Society for Senior Engineers (CSSE), to participate in the 100th Anniversary Cruise of the Paddle Steam Ship "Trillium" in Toronto Harbour. The invitation was from the Canadian Institute of Marine Engineers and their Project Engineer Gordon Champion, and the event was held on June 18, 2010, exactly 100 years to the day from the launch of this vessel.

"Trillium", a steam powered side-wheel paddle vessel, was initially operated by the Toronto Ferry Company as a transportation link between the City of Toronto and the Toronto Islands. In 1926 the ferry system was taken over by the Toronto Transit Commission (TTC) and the ship joined a mixed transportation inventory of streetcars, buses and later subway cars. After 46 years of operation the vessel was withdrawn from service and for the next 18 years slowly deteriorated in a lagoon in the Toronto Islands.

Unwilling to let one of the City's transportation engineering icons suffer an ignominious end, members of the Toronto Historical Board and a number of historically aware engineers launched a strong campaign to have "Trillium" renovated. With donations from the City of Toronto and the Province of Ontario and with non-financial technical assistance by dedicated engineers, work was started in 1974 on a complicated refurbishment program that, despite the near derelict state of the vessel, was successfully completed two years later.

Since returning to service, "Trillium", now the only side-wheel paddle steamboat in regular use in North America, has operated special charter trips and limited weekend ferry service.

What is the relevance of this Marine/Mechanical Engineering story to CSCE?

The CSCE National History Committee "Guidelines" includes the following two paragraphs that relate to our Civil Engineering Heritage in a similar way to how the "Trillium" experience relates to other branches of the engineering profession:

2.5 *Encourage study and research into historic aspects of civil engineering in general and in related fields such as industrial archaeology, preservation technology and social and economic impacts.*

2.10 *Encourage the preservation of historic civil engineering structures and works and public access to the sites, by providing expert advice and non-financial assistance as may be helpful to the owners.*

The "Trillium" story shows how a group of dedicated people, including politicians and citizens in addition to engineers, can successfully accomplish the "rebirth" of a historic engineering project.

The National History Committee is willing to assist in any similar civil engineering venture and would be very pleased to hear from members across Canada of any such deserving case. ■

Une étude de cas en matière d'ingénierie de restauration

À titre de plus ancienne infrastructure de transport au Canada, créée à partir des réseaux internes de fleuves, de rivières et de lacs empruntés initialement par les Premières nations et ensuite par les coureurs de bois de la Compagnie de la baie d'Hudson et de la Compagnie du Nord-Ouest, le transport maritime a toujours attiré les personnes qui s'intéressaient à l'histoire du génie civil au Canada.

Ce fut un plaisir que d'être invité, en compagnie de Don Lawson, de la Société canadienne des ingénieurs aînés, à participer à la croisière du Centenaire du vapeur à aubes « Trillium », dans le port de Toronto. L'invitation provenait de l'Institut canadien de génie maritime et de son ingénieur de projet, Gordon Champion, et l'activité se déroulait le 18 juin 2010, exactement cent ans (à la journée près!) après le lancement du navire.

Le « Trillium » est un vapeur à aubes qui fut exploité par la « Toronto Ferry Company » pour assurer le lien entre la ville de Toronto et les îles de Toronto. En 1926, le service de traversier fut pris en charge par la « Toronto Transit Commission (TTC) » et le navire fut intégré à un ensemble de moyens de transport comprenant des tramways, des autobus, et, éventuellement, des rames de métro. Après 46 ans de service, le navire fut retiré de la circulation et passa les 18 années suivantes à se détériorer lentement, dans un étang, près des îles de Toronto.

Refusant de laisser l'un des symboles des services de transport de Toronto connaître une triste fin, des membres du « Toronto Historical Board » et quelques ingénieurs épris d'histoire ont lancé une campagne en faveur de la restauration du « Trillium ». Grâce à des dons de la ville de Toronto et du gouvernement provincial de l'Ontario et à une aide autre que financière d'ingénieurs dévoués, les travaux de restauration commencèrent en 1974 avec

un programme compliqué. Malgré l'état désastreux de l'épave, en deux ans, les travaux furent parachevés.

Le « Trillium » a alors repris du service, devenant le seul vapeur à aubes encore en service régulier en Amérique du Nord. Il effectue des croisières spéciales et assure un service limité en fin de semaine.

Quel est le lien entre cette histoire de génie maritime et la SCGC?

Les principes directeurs du comité national des affaires historiques de la SCGC comportent les deux paragraphes suivants, qui font le lien entre notre patrimoine de génie civil . De la même façon, l'épopée du « Trillium » intéresse les autres domaines du génie :

2.5 Encourager l'étude et la recherche des aspects historiques du génie civil en général et dans des domaines connexes comme l'archéologie industrielle, les techniques de conservation et les impacts économiques et sociaux.

2.10 Encourager la conservation des ouvrages de génie ainsi que l'accès du public à ces lieux en fournissant des conseils d'experts et toute aide non-financière susceptible de venir en aide aux propriétaires de tels lieux.

L'histoire du « Trillium illustre comment un groupe de personnes décidées, incluant des personnalités politiques et des citoyens, en plus des ingénieurs, peuvent procéder à la « renaissance» d'un ouvrage de génie historique.

Le comité national des affaires historiques est disposé à venir en aide à tout autre projet analogue et serait ravi si d'autres membres à travers le pays lui soumettaient de pareils projets. ■

THE DEFINITION OF INFRASTRUCTURE *continued from page 21*

and so forth. Viewed functionally, infrastructure facilitates the production of goods and services; for example, roads enable the transport of raw materials to a factory, and also for the distribution of finished products to markets. In some contexts, the term may also include basic social services such as schools and hospitals. In military parlance, the term refers to the buildings and permanent installations necessary for the support, redeployment, and operation of military forces.

ENGINEERING AND CONSTRUCTION

Engineers generally limit the use of the term *infrastructure* to describe fixed assets that are in the form of a large network. Recent efforts to devise more generic definitions of infrastructure have typically referred to the network aspects of most of the structures and to the accumulated value of investments in the networks as assets. One such effort defines infrastructure as the network of assets "where the system as a whole is intended to be maintained indefinitely at a specified standard of service by the continuing replacement and refurbishment of its components."

OTHER USES

In other applications, the term *infrastructure* may refer to information technology, informal and formal channels of communication, software development tools, political and social networks, or beliefs held by members of particular groups. Still underlying these more conceptual uses is the idea that infrastructure provides organizing structure and support for the system or organization it serves, whether it is a city, a nation, a corporation, or a collection of people with common interests. Examples: *IT infrastructure, research infrastructure, terrorist infrastructure, tourism infrastructure.*

As Civil Engineers, we need to expand our definition of infrastructure to include not only the hard assets, but the natural infrastructure, the political, social and environmental aspects of infrastructure. ■

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Credit: Parts of this article are from Wikipedia.

GORDON JIN P.ENG., FCSCE, CSCE PRESIDENT 2009–2010 / ING., FSCGC, PRÉSIDENT DE LA SCGC EN 2009–2010

REBECCA M. LAW PHARM. D., ASSOCIATE PROFESSOR, SCHOOL OF PHARMACY, MEMORIAL UNIVERSITY OF NEWFOUNDLAND / PH.D. PHARM. D., PROFESSEURE AGRÉGÉE, UNIVERSITÉ MEMORIAL DE TERRE-NEUVE

CSCE Presidential Visit to China and Hong Kong

In April 2010, Gordon Jin (CSCE President 2009–2010), Dr. Todd Chan (Chair, International Affairs Committee—IAC), and Prof. Jeanne Huang, Special Envoy to China, IAC, visited our sister engineering societies and Chinese governmental officials in China and Hong Kong. Brian Burrell (Chair—Career Development) joined them in Hong Kong. This is a brief summary.

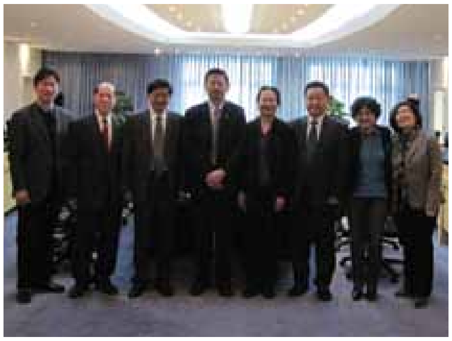
BEIJING

Chinese Hydraulic Engineering Society (CHES). CHES agreed to sign an updated CSCE/CHES General Technical Exchange Agreement. Other discussions included: joint international conferences and possible future projects; the Gansu Project (Shiyang River project in Gansu Province in NW China) currently undertaken by CSCE, CHES, and the Gansu Research Institute for Water Conservancy; and restarting the Youth Initiatives Program (YIP).

Ministry of Water Resources, P.R. China. Met with the Vice Minister of Water Resources and senior government officials. Discussed current water-related problems in China and how Canadian expertise may be useful. A priority is drought irrigation for southwest China. Discussed the 2009 CSCE/ASCE/ICE climate change protocol (to help mitigate issues of this nature) and possible joint projects with CSCE, especially related to infrastructure and storage facilities; also restarting the YIP—all funded by China.

China Civil Engineering Society (CCES). Discussions included: CCES concerns of sustainable development in China; the recent earthquake disaster; the CSCE endorsed sustainable development document; a proposed educational program in a Chinese university for Canadian engineering students; and the status of the joint CSCE/CCES/HKIE conference (ICWEM 2010, October 13–15, Shanghai).

China Highway & Transportation Society (CHTS). Discussions included joint collaboration e.g. a proposed CSCE/CHTS



MEETING WITH OFFICIALS OF THE CHINESE HYDRAULIC ENGINEERING SOCIETY IN BEIJING. / RENCONTRE AVEC LES DIRIGEANTS DE LA SOCIÉTÉ DE GÉNIE HYDRAULIQUE DE CHINE À BEIJING

project on the management and maintenance of Chinese highways in winter, and future CSCE/CHTS conferences. CHTS invited CSCE to send a bridge expert to lecture in their “Durability of Large-scale Bridge Engineering Technology Seminar” in Qingdao in September 2010.

ZHENGZHOU, HENAN PROVINCE

Met with the provincial CCES. Discussions included the close working relationship and administrative details between the national and the provincial CCES, membership issues, CCES local activities and functions, student recruitment, and financial support.

HONG KONG

Met Executives of the Hong Kong Institution of Engineers (HKIE). Extended the CSCE/HKIE Agreement by another five years. Discussed the upcoming CSCE/CCES/HKIE conference in Shanghai and potential cooperative programs. ***Met Executives of the CSCE Hong Kong Branch*** and discussed issues of concern to local members. ***Launched the first CSCE Student Chapter in Hong Kong.*** At the Hong Kong Institute of Vocational Education at Tsing Yi, G. Jin provided a lecture relating to global opportunities for young professionals in the construction sector, and a CSCE Presidential Address to the engineering students. ■

La visite du président de la SCGC en Chine et à Hong-Kong

En avril 2010, Gordon Jin (président de la SCGC pour 2009–2010), le professeur Todd Chan (président du comité des affaires internationales—CAI), et la professeure Jeanne Huang, envoyée spéciale en Chine du CAI, ont rendu visite à nos homologues de Chine et aux dirigeants de la Chine et de Hong-Kong. Brian Burrell (président du comité de perfectionnement) s’est joint à eux à Hong-Kong. Voici un bref résumé de la visite.

BEIJING

Société de génie hydraulique de Chine (SGHC). La SGHC a accepté de signer un texte mis à jour de l’accord général SCGC/SGHC sur les échanges techniques. D’autres discussions ont porté sur les sujets suivants : congrès internationaux conjoints et autres projets éventuels; le projet Gansu (projet sur la rivière Shiyang, dans la province de Gansu, dans le Nord-Ouest de la Chine) entrepris par la SCGC, la SGHC et l’Institut de recherche de Gansu pour la conservation de l’eau, et le redémarrage du Programme initiatives jeunesse.

Ministère des ressources en eau, Chine. Rencontre avec le vice-ministre des Ressources en eau et des dirigeants du gouvernement. Discussions sur les problèmes d’eau actuels de la Chine et sur la pertinence éventuelle des connaissances canadiennes. L’une des priorités est l’irrigation dans le Sud-Ouest de la Chine, aux prises avec une sécheresse. Discussions sur le protocole SCGC/ASCE/ICE de 2009 sur le changement climatique (aider à atténuer les problèmes de cette nature) et projets éventuels avec la SCGC en matière d’infrastructures et d’entreposage; redémarrage du Programme initiatives jeunesse, entièrement financé par la Chine.

Société de génie civil de Chine (SGCC). Discussions sur : les préoccupations de la SGCC en matière de développement durable en Chine; le plus récent séisme et

CSCE STUDENT MEMBERS AT THE HONG KONG INSTITUTE OF VOCATIONAL EDUCATION AT TSING YI. / MEMBRES ÉTUDIANTS DE LA SCGC À L'INSTITUT DE FORMATION PROFESSIONELLE DE HONG-KONG À TSING YI.

ses désastres; le document approuvé par la SCGC sur le développement durable; un projet de programme de formation dans une université chinoise pour des étudiants canadiens en génie; et l'état de la conférence conjointe SCGC/SGCC/HKIE (ICWEM 2010, du 13 au 15 octobre, à Shanghai).

La Société des autoroutes et des transports de Chine (SATC). Discussions sur les projets de collaboration, dont le projet sur la gestion et l'entretien des autoroutes de Chine en hiver, et les prochains congrès SCGC/SATC. La SATC a invité la SCGC à envoyer un expert en ponts pour donner un exposé dans le cadre de leur séminaire sur la durabilité de la technologie pour les grands ponts, à Qingdao, en septembre 2010.

ZHENGZHOU, PROVINCE DE HENAN

Rencontre avec la SGCC provinciale. Discussions sur les relations de travail étroites et les détails administratifs entre les instances nationales et provinciales de la SGCC, sur les questions relatives aux membres, aux activités locales, au recrutement des étudiants et à l'aide financière.

HONG-KONG

Rencontre avec les dirigeants de la « Hong-Kong Institution of Engineers (HKIE) ». Prolongation de l'entente SCGC/HKIE pour une autre période de cinq années. Discussions sur la prochaine conférence SCGC/SGCC/HKIE à Shanghai et sur d'éventuels programmes de coopération. ***Rencontre avec des dirigeants de la section de Hong-Kong de la SCGC*** et discussions sur les préoccupations des membres locaux. Lancement de la première section étudiante de la SCGC à Hong-Kong. À l'Institut de formation professionnelle de Hong-Kong, à Tsing Yi, G. Jin a prononcé un exposé sur les occasions mondiales offertes aux jeunes professionnels dans le domaine de la construction, et il a prononcé une conférence, à titre de président de la SCGC, devant les étudiants en génie. ■

LA DÉFINITION DES INFRASTRUCTURES

suite de la page 21

jusqu'aux marchés. Dans certains contextes, le mot peut aussi inclure les services sociaux de base comme les écoles et les hôpitaux. En langage militaire, le mot décrit les édifices et les installations militaires nécessaires au déploiement et aux opérations des forces armées.

INGÉNIERIE ET CONSTRUCTION

Les ingénieurs limitent généralement l'utilisation du mot *infrastructure* aux immobilisations corporelles prenant la forme d'un vaste réseau. De récentes tentatives en vue d'élaborer des définitions plus génériques soulignent davantage l'aspect « réseau » des infrastructures ainsi que la valeur accumulée des investissements. L'une de ces tentatives définit les infrastructures comme étant un réseau d'immobilisations dont l'ensemble a été conçu pour être entretenu indéfiniment selon des normes précises, grâce au remplacement constant et à la rénovation de ses composantes.

AUTRES UTILISATIONS

Dans d'autres applications, le mot *infrastructures* peut évoquer les technologies de l'information, les canaux informels et formels de communication, les outils d'élaboration de logiciels, les réseaux sociaux et politiques ou les croyances des membres de certains groupes. À l'origine de tous ces usages se retrouve l'idée que les infrastructures fournissent la structure organisationnelle et le support au système ou à l'organisation qu'elles desservent, qu'il s'agisse d'une ville, d'une nation, d'une entreprise ou d'une collectivité. Voici quelques exemples : *l'infrastructure des technologies de l'information, l'infrastructure de la recherche, l'infrastructure terroriste, l'infrastructure du tourisme.*

À titre d'ingénieurs civils, nous devons élargir notre définition des infrastructures de façon à inclure non seulement les biens durables mais aussi les infrastructures naturelles, ainsi que les aspects politiques, sociaux et environnementaux des infrastructures. ■

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, 2010 will be considered for 2011 awards to be presented at the CSCE Annual Conference in Ottawa, ON in June 2011. Please submit nominations, clearly stating the award for which the nomination is made, by e-mail to louise@csce.ca, or mail to: Ms. Louise Newman, The Canadian Society for Civil Engineering, 4920 de Maisonneuve Blvd. W., Suite 201, Montreal, QC H3Z 1N1

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

(deadline for nominations is Jan. 15, 2011)

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.

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.

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 2010 seront considérées pour les prix 2011 qui seront décernés au congrès annuel de la SCGC à Ottawa, ON en juin 2011. Veuillez soumettre les candidatures, en précisant le titre du prix, par courriel à louise@csce.ca, ou en vous adressant à : M^me^ Louise Newman, La Société canadienne de génie civil, 4920, boul. de Maisonneuve Ouest, bureau 201, Montréal, QC H3Z 1N1

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 E. WHITMAN WRIGHT

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

LE PRIX D'EXCELLENCE EN INNOVATION DANS LE DOMAINE DU GÉNIE CIVIL

(date limite est le 15 jan. 2011)

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.

LA MÉDAILLE HORST LEIPHOLZ

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

LE PRIX JAMES A. VANCE

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

LE PRIX SANDFORD FLEMING

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

LE PRIX WALTER SHANLY

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

LE PRIX W. GORDON PLEWES

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

CSCE ANNUAL CONFERENCE—WINNIPEG 2010—CONGRÈS ANNUEL SCGC

WINNERS STUDENT AWARDS—GAGNANTS PRIX ÉTUDIANTS

STUDENT PRESENTATION COMPETITION (UNDERGRADUATE STUDENTS) / PRÉSENTATIONS DES ÉTUDIANTS DE PREMIER CYCLE

1st / 1e Place

Alex Quoc Viet Hoang—*Multi-Phase Traffic Study: Wasaga Beach Mixed Development Project*—Ryerson University

STUDENT PRESENTATION COMPETITION (GRADUATE STUDENTS) / PRÉSENTATIONS DES ÉTUDIANTS DE 2E OU 3E CYCLE

1st / 1e Place

J.H. Skinner—(co-authors L.M. Lye and S.E. Bruneau)—*Climate Influences on the Annual Iceberg Flex off the Coast of Newfoundland*—Memorial University of Newfoundland

2nd / 2e Place

K.A. Truderung—(co-authors A. El-Ragaby and E. El-Salakawy)—*Shear Capacity of Dry-Cast Extruded Precast/Prestressed Hollow Core Slabs*—University of Manitoba

3rd / 3e Place

S. Soleimani—(co-authors B. Ormeci, O.B. Isgor and S. Papavinasam)— *Evaluation of Biofilm as a Protective Barrier for the Inhibition of Microbially Influenced Deterioration in Treatment Structures and Sewer Pipelines*—Carleton University

CSCE PRESIDENT'S AWARD FOR BEST STUDENT CHAPTER 2009–2010 PRIX DU PRÉSIDENT SCGC POUR LE MEILLEUR CHAPITRE ÉTUDIANT 2009–2010

University of Western Ontario

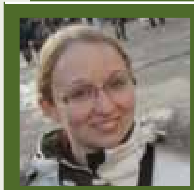
AECOM SUSTAINABLE ASSET MANAGEMENT COMPETITION

Undergraduate: Benjamin Jardine—*Investigation into Alternative Raw Material for Cement Production*—Carleton University

Graduate: A.I. Ali and M.S. Abdel-Monem—*Spreadsheet-Based System for Sustainable Asset Management*—University of Waterloo

2010 HYDROTECHNICAL STUDENT AWARD

The CSCE Hydrotechnical Committee is pleased to announce the winner of the 2010 award for the best water-related thesis by a master's student in Canada. The award is sponsored by Golder Associates Ltd. and is presented annually.



Award Winner Audrey Roy-Poirier

The 2010 winner of the award is Audrey Roy-Poirier of Queen's University, Department of Civil Engineering, for her thesis entitled: "Bioretention for Phosphorus Removal: Modelling Stormwater Quality Improvements" under the supervision of Dr. Yves Filion and Dr. Pascale Champagne.

LOUISE NEWMAN LOUISE@CSCE.CA

At the Society's Honours and Awards Banquet, held in conjunction with the 2010 Annual Conference, the CSCE recognized its members for their career achievements and for the excellence of their technical papers.

Twelve members were inducted as Fellows of the Society: Simaan AbouRizk, Mohamed Attalla, Jean-Maurice Chevarie, Lynne Cowe Falls, K.C. Er, Pierre Gignac, Mohamed Lachemi, Edward McBean, Edward R. Pentland, Harold Retzlaff, Shamim Sheikh, and David Whitmore.

Noran Abdel-Wahab, a Ph.D. candidate in structures at the University of Waterloo received the ***Dillon Consulting Scholarship***, which was established in 2006 and is awarded for academic excellence.

The recipient of the ***Donald Jamieson Fellowship*** for the 2010–2011 academic year is Sébastien Langlois, a Ph.D. candidate in the Department of Civil Engineering at the Université de Sherbrooke.

The ***Excellence in Innovation in Civil Engineering Award***, established in 2008 through the generosity of Canam Canada, was granted to the Association of Professional Engineers and Geoscientists of BC, the BC Ministry of Education, the Seismic Peer Review Committee, and the University of British Columbia—Dept. of Civil Engineering, Earthquake Engineering Facility for their innovation Guidelines for Performance-Based Seismic Assessments and Retrofits of Low-Rise British Columbia School Buildings.

The ***Sandford Fleming Award*** was established in 1999 in honour of Sir Sandford Fleming (1827–1915), Canada's foremost railway surveyor and railway engineer of the 19th century. For his outstanding contributions to the practice of transportation engineering in Canada, the award for 2010 was granted to Tarek Sayed, Professor of Civil Engineering at the University of British Columbia.

The ***W. Gordon Plewes Award*** for 2010 is granted to Teresa Charland of the Allen-Vanguard Corporation in Ottawa. The award was created in 1992 and is given to an individual who has made particularly noteworthy contributions to the study of the history of civil engineering in Canada.

The recipient of the ***E. Whitman Wright Award*** for 2010 is Jean Proulx, Professor of Civil Engineering at the Université de Sherbrooke. The Award was established in 1985 and is granted to a civil engineer who has contributed to the advancement of innovation and information technology in civil engineering.

The ***Camille A. Dagenais Award*** was established in 1981 in honour of Mr. Camille A. Dagenais, Past Chairman of the Board of SNC Group Inc., and President of the CSCE in 1972. For his outstanding contributions to the development and practice of hydrotechnical engineering in Canada, the recipient for 2010 is A.S. Ramamurthy, Professor of Civil Engineering at Concordia University in Montreal.

Established in 1977, the ***A.B. Sanderson Award*** recognizes outstanding contributions to the development and practice of structural engineering in Canada. The award for 2010 was granted to Robert Loov, now retired from the Department of Civil Engineering at the University of Calgary.

The ***James A. Vance Award*** was established in 1977 and is granted to a civil engineer and CSCE member whose dedicated service has furthered the advancement of the Society. For his outstanding contributions towards the advancement of the Society including as a Member of the Board of Directors, the National Management Committee and the Administration Coordinating Committee, the recipient for 2010 is Said M. Easa, Professor in the Department of Civil Engineering at Ryerson University in Toronto.

In 2006, the ***Donald R. Stanley Award*** was established in honour of the late Dr. Don Stanley, a leader in the transfer of research and technology into the practice of Environmental Engineering. The 2009 Donald R. Stanley Best Environmental Paper Award is granted to Chen He and Jiri Marsalek for their paper entitled "Hydraulic optimization of a combined sewer overflow (CSO) storage facility using numerical and

continued on page 30

AWARD RECIPIENTS—LES LAURÉATS

SAID EASA—PRIX JAMES A. VANCE AWARD

À l'occasion du banquet des lauréats qui s'est déroulé au congrès annuel 2010, la SCGC a rendu hommage à plusieurs de ses membres pour leurs réussites professionnelles ou pour la qualité de leurs communications techniques.

Douze membres de la SCGC ont été élus au titre de « Fellow ». Il s'agit de : Simaan AbouRizk, Mohamed Attalla, Jean-Maurice Chevarie, Lynne Cowe Falls, K.C. Er, Pierre Gignac, Mohamed Lachemi, Edward McBean, Edward R. Pentland, Harold Retzlaff, Shamim Sheikh, et David Whitmore.

Pour son excellence académique, la **bourse Dillon Consulting** a été octroyée à Noran Abdel-Wahab, étudiante de troisième cycle à l'Université de Waterloo.

Le récipiendaire de la **bourse Donald Jamieson** pour l'année académique 2010–2011 est Sébastien Langlois, candidat au doctorat à l'Université de Sherbrooke.

Le prix d'excellence en innovation dans le domaine du génie civil, établi en 2008 grâce à la générosité de Canam Canada, a été décerné cette année à l'Association of Professional Engineers and Geoscientists of BC, au ministère de l'Éducation de la Colombie-Britannique, au Seismic Peer Review Committee, ainsi qu'au Earthquake Engineering Research Facility du département de génie civil de l'Université de la Colombie-Britannique pour leur innovation nommée *Guidelines for Performance-Based Seismic Assessments and Retrofits of Low-Rise British Columbia School Buildings* (Lignes directrices pour l'évaluation et la réhabilitation sismiques des établissements scolaires de faible hauteur en Colombie-Britannique fondées sur la performance).

Créé en 1999 en l'honneur de Sir Sandford Fleming (1827–1915) principal arpenteur et ingénieur des chemins de fer du Canada au 19e siècle, le ***prix Sandford Fleming*** souligne une contribution exceptionnelle au développement et à la pratique du génie des transports au Canada. Le prix pour 2010 est décerné à Tarek Sayed, professeur de génie civil à l'Université de la Colombie-Britannique.

Le ***prix W. Gordon Plewes*** pour 2010 est décerné à Teresa Charland de la compagniee Allen-Vanguard Corporation à Ottawa. Le prix, créé en 1992, est décerné à une personne qui s'est distinguée par sa contribution à l'étude de l'histoire du génie civil au Canada.

Le récipiendaire du ***prix E. Whitman Wright*** pour 2010 est Jean Proulx, professeur de génie civil à l'Université de Sherbrooke. Créé en 1985, le prix est décerné à un ingénieur qui a contribué à l'avancement des technologies de l'information dans le domaine du génie civil.

Le ***prix Camille A. Dagenais*** a été créé en 1981 en hommage à M. Camille A. Dagenais, ancien président du conseil d'administration du Groupe SNC Inc., et président de la SCGC en 1972–1973. Pour sa contribution exceptionnelle au développement et à la pratique du génie hydrotechnique au Canada, le récipiendaire pour 2010 est A.S. Ramamurthy, professeur de génie civil à l'Université Concordia à Montréal.

Créé en 1977, le ***prix A.B. Sanderson*** rend hommage à l'auteur de contributions exceptionnelles au développement et à la pratique du génie des structures au Canada. Pour 2010, ce prix est décerné à Robert Loov, présentement à la retraite du département de génie civil à l'Université de Calgary.

Créé en 1977, le ***prix James A. Vance*** est décerné à un ingénieur civil membre de la SCGC qui s'est distingué par son dévouement pour l'avancement de la SCGC. Pour sa contribution exceptionnelle à la SCGC, en particulier comme membre du conseil d'administration, du comité national de gestion, et membre de la coordination de l'administration, le récipiendaire pour 2010 est Said Easa, professeur de génie civil à l'Université de Toronto.

Le ***prix Donald R. Stanley*** a été créé en 2006 en hommage à feu Don Stanley, un chef de file dans le transfert de recherche et de technologie dans la pratique du génie de l'environnement. Pour 2009, le prix Donald R. Stanley pour la meilleure

suite à la page 30

PRIX D'EXCELLENCE EN INNOVATION DANS LE DOMAINE DU GÉNIE CIVIL / EXCELLENCE IN INNOVATION IN CIVIL ENGINEERING AWARD: Tony Bégin (Canam Canada); George Akhras (CSCE Innovation and IT Committee); Doug Stewart (BC Ministry of Education); Liam Finn (U.B.C.); Peter R. Mitchell (APEGBC); John Sherstobitoff (Ausenco Sandwell); John Wallace (GENIVAR); Graham Taylor (TBG Seismic Consultants Ltd.)

HAMID TOPCHI-NEZHAD—MÉDAILLE CASIMIR GZOWSKI MEDAL

LOUISE NEWMAN LOUISE@CSCE.CA

continued from page 28

physical modeling", Canadian Journal of Civil Engineering, Volume 36, No. 2. The Honourable Mention is awarded to Joel Citulski, Khosrow Farahbakhsh and Fraser Kent for their paper "Optimization of phosphorous removal in secondary effluent using immersed ultrafiltration membranes with in-line coagulant pretreatment—implications for advanced water treatment and reuse applications", Canadian Journal of Civil Engineering, Volume 36, No. 7.

Established in 2009 in honour of the late Mr. Stephen G. Revay (1924–2004), President of the CSCE in 1989–1990, the ***Stephen G. Revay Award*** is granted for the best paper in the two-year period 2008–2009 in the areas of construction engineering, construction management, or project management. The award for 2009 was presented to Brenda McCabe, Catherine Loughlin, Ramona Munteanu, Sean Tucker, and Andrew Lam for their paper entitled "Individual safety and health outcomes in the construction industry", Canadian Journal of Civil Engineering, Volume 35, No. 12.

The ***Thomas C. Keefer Medal***, established in 1942, is presented annually for the best paper in areas such as hydrotechnical and environmental engineering. The medal for 2009 is awarded to G. Adriana Camino, David Z. Zhu, N. Rajaratnam, and Manas Shome for their paper entitled "Use of a stacked drop manhole for energy dissipation: a case study in Edmonton, Alberta", Canadian Journal of Civil Engineering, Volume 36, No. 6. The Honourable Mention is awarded to Ana Maria Ferreira da Silva for her paper "On the stable geometry of self-formed alluvial channels: theory and practical application", Canadian Journal of Civil Engineering, Volume 36, No. 10.

As superintendent of public works of the Province of Canada, Colonel Sir Casimir Stanislaus Gzowski (1813–1898) was responsible for improving waterways and canals and constructing roads, harbours and bridges. A founder of the CSCE in 1887, he served as president from 1889 to 1891. Established by Sir Casimir, the ***Casimir Gzowski Medal*** is awarded annually for the best paper on a civil engineering subject in the area of surveying, structural engineering and heavy construction. The 2009 medal was awarded to Hamid Toopchi-Nezhad, Michael J. Tait, and Robert G. Drysdale for their paper "Simplified analysis of a low-rise building seismically isolated with stable unbonded fiber reinforced elastomeric isolators", Canadian Journal of Civil Engineering, Volume 36, No. 7. ■

SÉBASTIEN LANGLOIS—BOURSE DONALD JAMIESON FELLOWSHIP

suite de la page 29

communication dans le domaine de l'environnement est attribué à Chen He et Jiri Marsalek pour leur communication "Hydraulic optimization of a combined sewer overflow (CSO) storage facility using numerical and physical modeling", publiée dans le numéro 2 (volume 36) de la Revue canadienne de génie civil. La mention honorable est décernée à Joel Citulski, Khosrow Farahbakhsh et Fraser Kent pour leur communication "Optimization of phosphorous removal in secondary effluent using immersed ultrafiltration membranes with in-line coagulant pretreatment—implications for advanced water treatment and reuse applications", publiée dans le numéro 7 (volume 36) de la Revue canadienne de génie civil.

Créé en 2007, le ***prix Stephen G. Revay*** rend hommage à feu Stephen G. Revay, Président de la SCGC en 1989–1990. Le prix est décerné pour la meilleure communication dans une période de deux ans dans le domaine du génie de la construction, gestion de la construction ou gestion de projets. Pour 2008–2009, le prix Stephen G. Revay est attribué à Brenda McCabe, Catherine Loughlin, Ramona Munteanu, Sean Tucker, et Andrew Lam pour leur communication "Individual safety and health outcomes in the construction industry", publiée dans la Revue canadienne de génie civil, numéro 12 (volume 35).

Créée en 1942, la ***médaille Thomas C. Keefer*** est décernée annuellement à l'auteur de la meilleure communication dans des domaines tels que l'hydrotechnique et le génie de l'environnement. Pour l'année 2009, la médaille est décernée à G. Adriana Camino, David Z. Zhu, N. Rajaratnam, et Manas Shome pour leur communication "Use of a stacked drop manhole for energy dissipation: a case study in Edmonton, Alberta", publiée dans le numéro 6 (volume 36) de la Revue canadienne de génie civil. La mention honorable est décernée à Ana Maria Ferreira da Silva pour sa communication "On the stable geometry of self-formed alluvial channels: theory and practical application", publiée dans le numéro 10 (volume 36) de la Revue canadienne de génie civil.

Surintendant des travaux publics pour la Province du Canada, le colonel Sir Casimir Stanislaus Gzowski (1813–1898) était responsable de l'amélioration des canaux et de la construction des routes, des ports et des ponts. Fondateur de la SCGC en 1887, il en fut le président de 1889 à 1891. Créée par Sir Casimir, la ***médaille Casimir Gzowski*** est décernée chaque année à l'auteur de la meilleure communication dans les domaines de l'arpentage, de la construction de charpentes et des grands travaux. Pour 2009, la médaille est décernée à Hamid Toopchi-Nezhad, Michael J. Tait, et Robert G. Drysdale pour leur communication "Simplified analysis of a low-rise building seismically isolated with stable unbonded fiber reinforced elastomeric isolators", publiée dans le numéro 7 (volume 36) de la Revue canadienne de génie civil. ■

NEWFOUNDLAND AND LABRADOR SECTION

Gordon Jin, FCSCE, P.Eng., CSCE President 2009–2010 is the recipient of the 2009–2010 Professional Engineers and Geoscientists Newfoundland and Labrador Award for Service. The Award for Service recognizes outstanding service and dedication to the Newfoundland engineering/geoscience professions through involvement in PEGNL or other Newfoundland or Canadian professional, consulting or technical associations and societies, and for their work in furthering the role of PEGNL and other associations and societies during the career of the professional engineer or professional geoscientist.

Susan Richter, FCSCE, P.Eng., is the recipient of the 2009–2010 Professional Engineers and Geoscientists Newfoundland and Labrador Award of Merit. The Award of Merit bestows distinction on outstanding engineers and geoscientists to recognize their exceptional achievements in either of engineering or geoscience. This the highest award presented by PEGNL.

EAST NEW BRUNSWICK AND PEI SECTION

Sherry Sparks, MCSCE, P.Eng., Vice-President of CSCE's Atlantic Region is the first recipient of the Engineers and Geoscientists of New Brunswick Support of Women in Engineer Award, which recognizes her volunteerism, professionalism and long-standing commitment to promoting civil engineering as a rewarding career for women.

WINNIPEG SECTION

Aftab Mufti, FCSCE, Ph.D., P.Eng. was appointed Member of the Order of Canada, C.M., for his contributions to and leadership in the field of civil engineering, notably for researching the use of advanced composite materials and fibre optic sensors in the construction and monitoring of bridges and other infrastructures.

CALGARY SECTION

Dr. Robert (Bob) Loov, P.Eng., FCSCE, FEIC, FCPCI, CSCE President 2000–2001 received the 2010 CSA Award of Merit in recognition of invaluable technical knowledge, persistence, diplomacy and highly effective leadership in standards for concrete design and construction. Dr. Loov is the first person to receive this award twice. He received it previously in 1992.

Dr. Loov was also named a Fellow of Engineers Canada. The "Engineers Canada Fellow" was awarded for 12 years of service on the Board of Examiners of the Association of Professional Engineers, Geologists, and Geophysicists of Alberta (APEGGA).

SECTION DE TERRE-NEUVE ET LABRADOR

Gordon Jin, FSCGC, ing., président de la SCGC pour 2009–2010, reçoit le prix décerné par l'organisme « Professional Engineers and Geoscientists Newfoundland and Labrador » pour services à la profession. Ce prix souligne les services exceptionnels et le dévouement manifesté à l'endroit de la profession par le biais de la participation à l'organisme PEGNL ou à tout autre association ou société de même nature à Terre-Neuve ou au Canada.

Susan Richter, FSCGC, ing., a reçu le prix du mérite pour 2009–2010 de l'organisme « Professional Engineers and Geoscientists Newfoundland and Labrador ». Ce prix souligne la réussite exceptionnelle d'un ingénieur dans son domaine. Il s'agit de la plus haute distinction accordée par « PEGNL ».

SECTION DE L'EST DU NOUVEAU-BRUNSWICK ET DE L'ÎLE-DU-PRINCE-ÉDOUARD

Sherry Sparks, MSCGC, ing., vice-présidente de la SCGC pour la région atlantique, est la première récipiendaire du prix attribué par l'Association des ingénieurs et des géoscientifiques du Nouveau-Brunswick pour l'appui envers les femmes qui choisissent une carrière dans le domaine du génie.

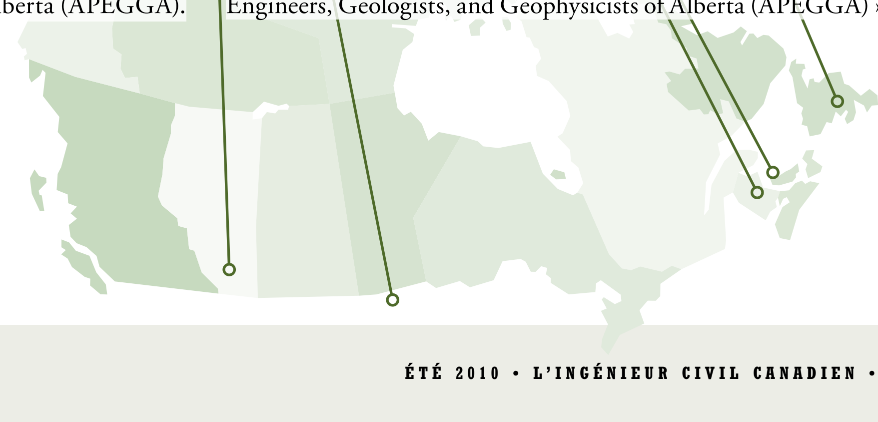
SECTION WINNIPEG

Aftab Mufti, FSCGC, Ph.D., a été nommé Membre de l'Ordre du Canada, C.M., pour sa contribution et son leadership dans le domaine de l'ingénierie, notamment pour ses recherches visant l'utilisation de matériaux composites de pointe et de capteurs à fibre optique dans la construction et le contrôle des ponts et autres travaux d'infrastructure.

SECTION DE CALGARY

Le professeur Robert (Bob) Loov, ing., FSCGC, FICI, FCPCI, président de la SCGC en 2000–2001, a reçu le prix du mérite de la CSA pour 2010 pour ses connaissances techniques, sa persistance, sa diplomatie et son leadership efficace dans l'élaboration des normes en matière de design et de construction en béton. Le professeur Loov est la première personne à recevoir ce prix deux fois. Il l'avait déjà reçu en 1992.

Le professeur Loov a également été nommé « fellow » de « Ingénieurs Canada ». Ce titre de « fellow » lui a été conféré en reconnaissance des 12 années pendant lesquelles il a été membre du bureau des examinateurs de la « Association of Professional Engineers, Geologists, and Geophysicists of Alberta (APEGGA) ».



THE HONOURABLE GREG SELINGER, PREMIER OF MANITOBA—COMMEMORATION CEREMONY OF THE RED RIVER FLOODWAY / L'HONORABLE GREG SELINGER, PREMIER MINISTRE DU MANITOBA—CÉRÉMONIE COMMÉMORATIVE DU CANAL DE DÉRIVATION DE LA RIVIÈRE ROUGE

DOUG MCNEIL, DEPUTY MINISTER, MANITOBA INFRASTRUCTURE & TRANSPORTATION / SOUS-MINISTRE, INFRASTRUCTURE ET TRANSPORTS MANITOBA

OPENING CEREMONY / CÉRÉMONIE D'OUVERTURE

INDUSTRIAL EXHIBITION / EXPOSITION COMMERCIALE—WORLD ROAD ASSOCIATION (PIARC) / ASSOCIATION MONDIALE DE LA ROUTE (AIPCR)

INDUSTRIAL EXHIBITION / EXPOSITION COMMERCIALE—ISIS CANADA

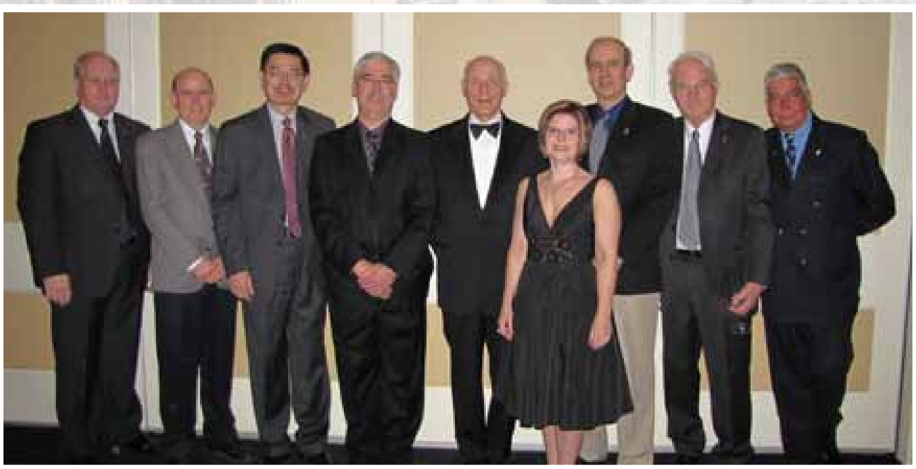
FRANK ALBO—KEYNOTE SPEAKER / CONFÉRENCIER

SOCIAL / SOIRÉE—FORT GIBRALTAR

GORDON JIN, OUTGOING PRESIDENT / PRÉSIDENT SORTANT—FORT GIBRALTAR

GORDON JIN PRESENTS CERTIFICATE OF APPRECIATION TO PETER RASMUSSEN / GORDON JIN PRÉSENTE LE CERTIFICAT D'APPRÉCIATION À PETER RASMUSSEN

VIC PERRY DELIVERS INAUGURAL ADDRESS AS PRESIDENT / VIC PERRY FAIT SON DISCOURS PRÉSIDENTIEL INAUGURAL



CSCE PRESIDENTS—PAST, PRESENT AND FUTURE / PRÉSIDENTS DE LA SCGC—ANCIENS, COURANT ET FUTURS: R. PICKLE, L. WAUGH, G. JIN, J. KELLS, R. LOOV, C.-L. BORBELY, V. PERRY, P. WRIGHT & M. HOSAIN

PETER RASMUSSEN & LINDA NEWTON—CLOSING CEREMONY / CÉRÉMONIE DE CLÔTURE

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2011 CSCE ANNUAL GENERAL MEETING & CONFERENCE

ENGINEERS—ADVOCATES FOR FUTURE POLICY

OTTAWA
JUNE 14–17, 2011

CONFERENCE ANNOUNCEMENT AND CALL FOR PAPERS

Annual General Conference

2nd International Engineering Mechanics and Materials Specialty Conference

3rd International/9th Construction Specialty Conference

20th Canadian Hydrotechnical Conference

SUBMISSION DEADLINES

October 15th, 2010: Deadline for short abstracts (250 words max.)

November 15th, 2010: Notification of acceptance

January 14th, 2011: Draft of full paper

March 14th, 2011: Receipt of final paper

SUBMISSION FORMAT

Two paper formats are available:
- Full-length papers (up to 10 pages)
- Extended abstracts for case studies (4 pages only)

Authors should specify the appropriate conference (general, specialty or hydrotechnical) on their submission. Papers will be accepted in either English or French. Student presentations should be identified as such.

For more instructions on how and where to submit abstracts, visit:

WWW.CSCE.CA/2011/ANNUAL

LIFELONG LEARNING / L'ÉDUCATION PERMANENTE

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National Lecture Tour

Host City Olympic Transportation Plan: A Sustainable Legacy for Vancouver
October/November 2010

The 2010 Olympic Winter Games was Vancouver's largest special event and transportation planning for the event was a complex challenge. The City of Vancouver developed a wide range of innovative strategies to create its Host City Olympic Transportation Plan.

CSCE's 2010–2011 National Lecture Tour will discuss how the Host City Olympic Transportation Plan was an unqualified success. The City demonstrated modern innovative transit with its Olympic Line—Vancouver's 2010 Streetcar, with a peak of 25,000 riders per day and more than 550,000 riders overall. The City converted over 4 kilometres of its Downtown streets into pedestrian corridors which supported walking as a mode of choice. The City also installed 1,200 secure bike parking stalls and provided free bike valet parking at all of the City venues and celebration sites.

The presentation will also include an overview of the City's Games-time transportation monitoring program where actual travel behaviour was observed using in-the-field data collection.

This National Lecture Tour will be presented by Dale Bracewell, M.A.Sc., P.Eng., of the City of Vancouver. Dale led the City of Vancouver's transportation planning and operations for the 2010 Olympic and Paralympic Winter Games. He has over twelve years of transportation engineering experience working for both municipal and provincial governments as well as the private sector. Dale regularly speaks at conferences and events and teaches a City Program course at Simon Fraser University.

Please visit www.csce.ca for venue and registration details.

La Tournée nationale 2010–2011 de la SCGC présentera en français le Plan de transport de la ville de Vancouver conçu et mis en place pour les jeux olympiques d'hiver 2010.

Les détails de cette présentation sont disponibles à www.csce.ca.

COMING EVENTS / CALENDRIER DES ACTIVITÉS

Domestic Venues

International Conference on Medium and Short Span Bridges (SMSB-8)
Niagara Falls, ON
August 3–6, 2010
http://www.csce.ca/2010/smsb/

TAC 2010 Annual Conference & Exhibition Adjusting to new realities
Halifax, NS
September 26–29, 2010
http://www.tac-act/english/annualconference/generalinfo/

4th International Conference on Durability & Sustainability of Fibre Reinforced Polymer (FRP) Composites for Construction—CDSCC 2011
Québec, QC
July 20–22, 2011
Web site: http://www.civil.usherbrooke.ca/cdcc2011

International Venues

2nd International Conference on Waste Engineering and Management (ICWEM 2010)
Shanghai, China
October 13–15, 2010
E-mail: icwem2010@163.com

Structural Engineers World Congress (SEWC)
Como, Italy
April 4–6, 2011
http://sewc-worldwide.org

6th International Structural Engineering and Construction Conference
Zurich, Switzerland
June 21–25, 2011
Web site: http://www.isec-society.org/ISEC_06/

MAJOR PARTNERS / ASSOCIÉS PRINCIPAUX

PARTNERS / ASSOCIÉS

AFFILIATES / AFFILIÉS

CSCE SECTIONS SCGC

Newfoundland
Contact: Gordon Jin, FCSCE
T: 709-737-8816 F: 709-737-2537
E-mail: gjin@mun.ca

Nova Scotia
Contact: To be determined

East New Brunswick and P.E.I. (Moncton)
Contact: Gérard Poitras, MSCGC
T: 506-858-4759
E-mail: gerard.poitras@umoncton.ca

West New Brunswick
Contact: Andy Small, MCSCE
T: 506-458-1000 F: 506-450-0829
E-mail: andy.small@amec.com

Montréal
Contact: Stéphane Marcouiller, MSCGC
T: 450-967-1260, ext. 3636 F: 450-639-8737
E-mail: stephane.marcouiller@tecsult.com

Sherbrooke
Contact: To be determined

Québec
Contact: Francis Labrecque, AMSCGC
T: 418-623-3373, ext. 192
F: 418-623-3321
Courriel: Francis.Labrecque@cima.ca

Capital Section (Ottawa-Gatineau)
Contact: Gary Holowach, MCSCE
T: 613-745-2213, ext. 110
E-mail: gholowach@dillon.ca

Toronto
Contact: Peter Langan, FCSCE
T: 416-497-8600, ext. 301 F: 416-497-0342
E-mail: plangan@rvanderson.com

Hamilton/Niagara
Contact: Mike Tait, MCSCE
T: 905-525-9140, ext. 26469 F: 905-525-9688
E-mail: taitm@mcmaster.ca

Northwestern Ontario
Contact: Gerry Buckrell, MCSCE
T: 807-623-3449 F: 807-623-5925
E-mail: gerry@enl-tbay.com

Durham/Northumberland
Contact: Amie Thérrien, ASCSCE
T: 905-882-1100 ext. 3024
E-mail: therriena@mmm.ca

London and District
Contact: Ernest Yanful, MCSCE
T: 519-661-4069 F: 519-661-3492
E-mail: eyanful@eng.uwo.ca

Manitoba
Contact: Dagmar Svecova, MCSCE
T: 204-474-9180 F: 204-474-7513
E-mail: svecovad@cc.umanitoba.ca

South Saskatchewan
Contact: Harold Retzlaff, MCSCE
T: 306-787-5642 F: 306-787-4910
E-mail: hretzlaff@highways.gov.sk.ca

Saskatoon
Contact: Ben Wagemakers, AMCSCE
T: 306-657-1465
F: 306-242-4876
E-mail: bwagemakers@pcl.com

Calgary
Contact: Dan Dankewich, MCSCE
E-mail: ddanke2@telus.net

Edmonton
Contact: Manas Shome, MCSCE
T: 780-733-4077
F: 780-496-9575
E-mail: manas.shome@worleyparsons.com

Vancouver
Contact: Jasmine Mihova
E-mail: j.mihova@civil.gmail.com

Vancouver Island
Contact: Kevin Baskin
E-mail: kevin.baskin@gov.bc.ca

CSCE Hong Kong Branch
Contact: Moe M.S. Cheung, FCSCE
T: (852) 2358-7152
E-mail: mscheung@ust.hk