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L'INGÉNIEUR CIVIL CANADIEN

2013 | SPRING/PRINTEMPS

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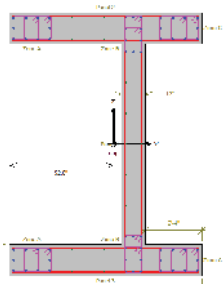

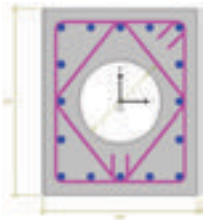

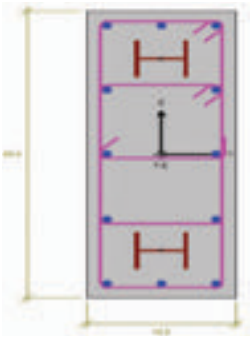

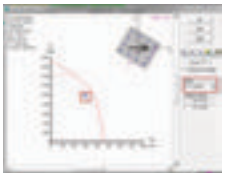

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L'INGÉNIEUR CIVIL CANADIEN

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A new paradigm for civil engineering education

The standard degree program in civil engineering in Canada is four years in duration. As part of the program of studies, most accredited schools across the country provide for various degrees of flexibility and specialization. Following an additional four years of suitable work experience, which generally means working under the supervision of a professional engineer, the civil engineer trainee is then able to obtain professional status. This model has generally worked well, but there are now pressures for change.

The need for change is being driven in several ways. First, we live in a world of increased complexity, which is necessarily accompanied by increased demand for technical content to be applied to the problems faced by the profession. Some of our complex issues include that associated with climate variability, infrastructure renewal and reduced resource availability. Second, at the same time, we are in a period when there is need for increased breadth of training, including that associated with social demands and other "soft" skills. These needs can include any or all of: a focus on sustainability, policy development, project management, asset management, leadership development, enhanced teamwork skills, effective communications, and economics and finance. Third, and this is the particularly compounding factor, programs in civil engineering now comprise reduced credit hours from what was delivered previously and, at the same time, there has been a tendency for increased program flexibility, which has the effect of reducing the breadth of coverage of the discipline.

In the United States, the American Society of Civil Engineers (ASCE) has been wrestling with the need for change for more than two decades. Their current focus is on the initiative referred to as Raise the Bar, in which they are strongly advocating for a master's degree or equivalent training beyond the baccalaureate degree for professional licensure. The initiative is intended to increase the knowledge and skills required by professional civil engineers to meet the challenges of the future more effectively. A similar model is being pursued in Europe. In the case of the United States, the situation is certainly somewhat more acute than in Canada insofar as the credit hours required for the baccalaureate degree are notably less. So, while we may agree on the need for "raising the bar," is the model being pursued by ASCE necessarily the right one?

An alternative model that could be considered is for civil engineering programs (and, indeed, engineering programs in general) to become non-direct entry. Currently, students entering engineering do so directly from high school. In many other professional colleges, such as medicine, law and pharmacy, students must take one or more pre-years of university training before they can apply to the professional program. Even in some four-year programs at the University of Saskatchewan, such as nursing and education, students are no longer permitted direct entry. I suggest that a one plus four model would be appropriate for engineering. In the first year, a

student would take courses in foundational subjects such as mathematics, sciences (e.g. physics, chemistry and biology, the latter not being a typical course for engineering but nonetheless quite appropriate in a present-day context) and humanities. Following that, once accepted, they would enter a four-year engineering program, perhaps with the first year being common and the remaining three being discipline specific (which is the typical model across Canada already). With this model, the ability to address the issues of program breadth and depth would be increased and, I suggest, the impact on program duration only slight given that the current time in program is nearly five years anyway. So, why not a one plus four civil engineering education paradigm to better meet the needs of tomorrow?

Un nouveau paradigme pour l'enseignement du génie civil

Le programme de diplôme en génie civil typique au Canada est d'une durée de quatre ans. Dans le cadre du programme d'études, la plupart des écoles accréditées à travers le pays fournissent divers degrés de polyvalence et de spécialisation. À la suite d'une autre période de quatre années d'expérience de travail pertinente, laquelle signifie généralement travailler sous la supervision d'un ingénieur professionnel, le stagiaire en génie civil est ensuite en mesure d'obtenir son statut professionnel. Ce modèle a généralement bien fonctionné, mais certaines pressions s'exercent maintenant pour le changer.

Cette nécessité est dictée de plusieurs sources. Tout d'abord, nous vivons dans un monde d'une complexité sans cesse croissante, qui s'accompagne nécessairement d'une demande accrue pour qu'un contenu technique soit appliqué aux problèmes auxquels la profession fait véritablement face. Certaines de ces questions complexes comprennent que de pair avec la volatilité du climat, suivent le renouvellement de l'infrastructure et une disponibilité réduite des ressources. En deuxième lieu, nous sommes parallèlement dans une période où un besoin d'accroissement de la portée de la formation se fait ressentir, ceci de pair avec des demandes sociales et autres compétences générales, le savoir-être. Ces besoins peuvent comprendre l'un ou l'autre ou l'entièreté de ce qui suit : une concentration sur la durabilité, le développement de politiques, la gestion de projets, la gestion de l'actif, le développement du leadership, des compétences de travail d'équipe accrues, des capacités de communication efficaces, ainsi que des compétences économiques et financières. En troisième lieu, et il s'agit là du facteur particulièrement confondant, les programmes de génie civil comprennent maintenant moins d'heures de crédits comparativement à ce qui était donné précédemment et, par le même fait, il existe une tendance vers une polyvalence accrue des programmes, ce qui a pour effet une réduction de la portée de ce qui est couvert par cette discipline.

Aux États-Unis, l'*American Society of Civil Engineers* (ASCE) se débat avec la nécessité d'un changement. L'accent se porte actuellement vers l'initiative à laquelle on réfère par les termes *Raise the Bar*, où un appel insistant est fait en faveur d'un diplôme de maîtrise ou d'une formation équivalente qui soit au-delà du diplôme de baccalauréat pour l'obtention de la licence professionnelle. L'initiative vise à accroître les connaissances et les compétences requises par les ingénieurs civils professionnels. Un modèle similaire est examiné de près en Europe. Dans le cas des États-Unis, la situation est certainement quelque peu plus évidente qu'au Canada dans la mesure où les heures de crédits requises pour un diplôme de baccalauréat sont remarquablement moindres. Ainsi donc, alors que nous puissions convenir de la nécessité de « relever la barre », le modèle que vise l'ASCE est-il nécessairement celui qui convient le mieux?

En alternative, un modèle qui pourrait être considéré est celui où l'accession aux programmes du génie civil (ainsi que, évidemment, les programmes de génie en général) ne soit désormais plus possible directement après les études secondaires. Présentement, certains étudiants accèdent au programme d'études de génie directement du niveau secondaire (lire *high school*). Dans plusieurs autres collèges professionnels, tels que la médicine, le droit et la pharmacie; les étudiants doivent compléter une ou plusieurs années préalables de formation universitaire avant de pouvoir faire une demande d'acceptation au programme professionnel. On constate même que dans certains programmes de quatre ans de l'Université de Saskatchewan, comme en sciences infirmières ou en enseignement, on ne permet plus aux étudiants l'entrée directe du secondaire. Je suggère qu'un modèle de « une plus quatre » soit approprié pour les études en génie. Au cours de la première année, un étudiant suivrait des cours dans des disciplines fondamentales telles que les mathématiques, les sciences (ex. : en physique, chimie et biologie, ce dernier n'étant pas un cours typique pour les études en génie, mais néanmoins passablement approprié dans le contexte actuel) et les sciences humaines. À la suite de ces cours, une fois acceptés, ils pourraient entreprendre le programme de quatre ans en génie, avec la première année pouvant faire partie d'un tronc commun et les trois autres étant dans une discipline particulière (ce qui est déjà un modèle typique en divers endroits à travers le Canada). En adoptant ce modèle, la capacité de traiter des questions de portée et de profondeur des programmes serait accrue et, je suggère, l'impact sur la durée du programme ne serait que minime considérant que la durée actuelle du programme est de près de cinq ans de toutes façons. Ainsi, pourquoi ne pas considérer le paradigme de « une plus quatre » années de formation en génie civil afin de mieux répondre aux besoins de demain? ■

Quebec Section Supports Current and Future Engineers

Mario Fafard,
PRESIDENT OF THE QUEBEC SECTION, CSCE

The Quebec Section of the Canadian Society for Civil Engineering has been in existence for many years now and it is still very active both with civil engineers working in the greater Québec-Chaudière-Appalaches area and civil engineering students and water/wastewater management students of Laval University. In order to promote the participation of local people, the Executive Committee is composed of several people from different backgrounds. This diversity of backgrounds allows a great outreach for communicating the activities of the CSCE, more specifically those of the Quebec Section of the CSCE, as well as a better anchoring of the CSCE within the community of engineers.

One of the leading activities of the Quebec Section is the organization of seminars addressing various subjects in order to meet the needs of the community of engineers of the area. There are usually seven to eight conferences per year. Some examples are: concrete and more sustainable building layouts, endurance tests on Goodco Z-Tech modular joints, geothermal science, thermography applied to bituminous coated material, life cycle analysis of buildings, ice pressure on dams, and a Canada-wide strategy for municipal sewage effluents. The conferences are organized at the end of the day within a friendly environment, promoting discussions between participants. Participation varies between 25 and 70 people. For those who wish, a certificate of participation is issued in order to qualify attendance to the *Ordre des ingénieurs du Québec*.

The support of future engineers remains a top priority for the section. Strong ties exists between the Quebec Section and the Student Chapter of Laval University. Besides the financial support the section provides to the student chapter, a careers forum is organized every year, allowing student members of the CSCE to meet with three or four civil engineers who come to share with these young people their experiences as well as their overall career path in civil engineering, all while giving them advice for the future. Working with the Student Chapter Executive, we are very involved in the recruitment of new student members by visiting classes from every level at the beginning of the school year to encourage these young people to join the CSCE.

This year, a special activity will be held within the framework of the Tracel (railway trestle) de Cap-Rouge centennial activities organized by the Société historique de Cap-Rouge (SHCR), with which the Quebec Section is associated. In addition to the student contest lead by the CSCE Quebec Section, Laval University and several partners from the private sector (see the CIVIL magazine, Winter 2012, pp. 8-9), the Quebec Section promoted the file presented by the SHCR to the Historical Committee of the CSCE in order to have this structure recognized as a civil engineering historical site.

The CSCE Quebec Section's yearly activities end in May with a traditional lobster dinner that draws about 150 participants. It is the ideal setting to strengthen the relationships between members of the CSCE, and also to thank all of the businesses and organizations that give their financial support to the Quebec Section. Without them, we could never put in place so many annual activities.

The members of the Quebec Section Executive are : Mario Fafard, president (Laval University) ; Kim Lajoie, vice-president (Cecobois), François-Jean Blouin, treasurer (LVM) ; and councilors Francis-Olivier Biron (student), Sylvain Carrier (Roche), Francis Labrecque (CIMA+), Éric Lévesque (Structal – Ponts), Suzanne St-Laurent (LVM), Jean-François Soucy (Department of Transportation), Éric Therrien (Génivar). ■

La section de Québec soutient ses ingénieurs et élèves-ingénieurs

Mario Fafard,
PRÉSIDENT DE LA SCGC, SECTION QUÉBEC

La Société canadienne de génie civil section Québec existe depuis de nombreuses années et demeure très active autant auprès des ingénieurs civils travaillant dans la grande région de Québec-Chaudière-Appalaches qu'auprès des étudiants en génie civil et ceux en génie des eaux de l'université Laval. Afin de favoriser la participation des gens du milieu, le comité exécutif est composé de plusieurs personnes issues de milieux différents tel que l'éducation et ingénieurs provenant de ministères, de bureaux de consultants et du milieu industriel et d'un représentant du chapitre étudiant de la SCGC de l'université Laval. Cette diversité de provenance permet une grande diffusion des activités de la SCGC, plus particulièrement celles de la SCGC Section Québec, et un meilleur ancrage de la SCGC au sein de la communauté des ingénieurs.

Une des activités phares de la section Québec est l'organisation de

séminaires qui portent sur divers sujets. Il y a habituellement, quatre conférences de septembre à décembre et entre trois et quatre de la période de janvier à mai. Le comité vise une série de conférences sur des sujets diversifiés afin de satisfaire les besoins de la communauté des ingénieurs de la région. À titre d'exemples, citons : le béton et l'aménagement d'édifices plus durables, essais de fatigue sur joints modulaires Goodco Z-Tech, la géothermie, la thermographie appliquée aux enrobés bitumineux, analyse du cycle de vie dans les bâtiments, poussée des glaces sur les barrages, stratégie pancanadienne sur la gestion des effluents d'eaux usées municipales, etc. Les conférences sont organisées en fin de journée dans un endroit convivial qui favorise les discussions entre les participants. Le nombre de participant varie de 25 à 70. Pour ceux qui le désirent, un certificat de participation est délivré afin de qualifier l'assistance à ces séminaires auprès de l'Ordre des ingénieurs du Québec.

Le soutien aux futurs ingénieurs demeure une grande priorité de la section. Un lien durable existe entre la section Québec et le chapitre étudiant de l'Université Laval. En plus de soutenir financièrement le chapitre étudiant, un Forum carrière est organisé à chaque année qui permet aux étudiants membres de la SCGC de rencontrer 3 ou 4 ingénieurs civils qui viennent partager avec ces jeunes, leurs expériences et le cheminement de leurs carrières en génie civil tout en leur donnant des conseils pour le futur. En concert avec l'exécutif du chapitre étudiant, nous nous impliquons fortement dans le recrutement des nouveaux membres étudiants en visitant en début d'année des classes de tous les niveaux pour inciter les jeunes à adhérer à la SCGC.

Cette année, une activité spéciale se tient dans le cadre des activités du centenaire du Tracel de Cap-Rouge (pont ferroviaire à chevalets) organisé par la Société historique de Cap-Rouge (SHCR) et auquel, la Section Québec est associée. En plus du concours étudiant (voir la revue l'Ingénieur civil canadien, Hiver 2012, pp. 8-9) piloté par la SCGC Section Québec, l'université Laval et plusieurs partenaires privées, la section Québec a soutenu le dossier présenté par la SHCR auprès du comité historique de la SCGC afin de faire reconnaître cette structure comme site historique du génie civil.

L'année des activités de la SCGC section Québec se termine en mai par le traditionnel souper aux homards auquel participent environ 150 personnes. C'est le moment idéal pour consolider nos liens entre membres de la SCGC mais aussi afin de remercier toutes les entreprises et organismes qui soutiennent financièrement la Section Québec. Sans eux, on ne pourrait pas mettre en place autant d'activités annuelles.

Les membres de l'exécutif de la Section Québec sont : Mario Fafard, président (université Laval) ; Kim Lajoie, vice-président (Cecobois), François-Jean Blouin, trésorier (LVM) ; conseillers : Francis-Olivier Biron (étudiant), Sylvain Carrier (Roche), Francis Labrecque (CIMA+), Éric Lévesque (Structal – Ponts), Suzanne St-Laurent (LVM), Jean-François Soucy (ministère des Transports), Éric Therrien (Génivar). ■

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Steel Day Tour

By Yuki Kishimoto, UBC CSCE Student Chapter Co-Chair

September 28, 2012, marked the third National Steel Day, during which a group of UBC civil engineering undergraduates and graduates had the exciting and rare opportunity to participate in guided tours of major steel fabrication facilities in Vancouver. Steel Day is a public annual event, organized by the Canadian Institute of Steel Construction to promote design, fabrication and construction using steel as a structural material. This year, UBC students toured George Third and Son (GTS) in Burnaby and AI Industries, both of whih are major names in the steel fabrication sector in Western Canada.

UBC students query the AI Industries spokesman about the steel fabrication process./Les étudiants de l'UBC s'informent auprès de l'expert de AI Industries sur le processus de fabrication de l'acier.

Transportation for the trip was sponsored by the UBC CSCE Student Chapter in collaboration with the Structural Engineers Association of British Columbia (SEABC), which enabled 12 undergraduate students and several students from the master's program to participate. Steel Day afforded UBC students excellent networking and learning opportunities, and sparked interest and understanding in the processes steel fabricators go through, from receiving raw material, to shipping high quality steel to the construction site.

This year, UBC students witnessed several exciting events: demonstrations of the use of information technology to increase production efficiency, a blacksmith in operation, the use of advanced machinery to produce steel products, seismic testing equipment, and large steel storage yards. The students were challenged to estimate total steel tonnage in the yard, and, as an exciting bonus for a few of our stressed-out engineering students, we had a chance to smash an old car with sledgehammers. Having enjoyed ourselves and forged

a strong connection between true industry operations and our steel design courses at UBC, the students left the facilities satisfied with having gained experience from a new perspective.

For more photos of the tours, visit http://ubccsce.ca/Gallery.php.

AI Industries expert explains how advanced machinery is used to streamline steel production./Un expert de AI Industries explique comment de la machinerie évoluée est utilisée afin de simplifier la production de l'acier.

Visite de la Journée de l'acier

Par Yuki Kishimoto, co-présidente du chapitre étudiant de la SCGC de l'UBC

Le 28 septembre 2012 marquait la troisième Journée nationale de l'acier, au cours de laquelle un groupe d'étudiants de premier et de deuxième cycle en génie civil de l'UBC avaient la rare et emballante occasion de participer à des visites guidées d'importantes installations de fabrication d'acier de Vancouver. La Journée de l'acier est un événement public annuel qui a lieu dans le but de promouvoir la conception, la fabrication et la construction en utilisant l'acier comme matériau structurel. Il est organisé par L'Institut canadien de la construction en acier. Cette année, les étudiants de l'UBC ont visité George Third and Son (GTS) à Burnaby et AI Industries, qui sont toutes deux des marques de renom dans l'industrie de la fabrication de l'acier de l'Ouest canadien.

Le transport pour l'excursion a été commandité par le chapitre étudiant de la SCGC de l'UBC en collaboration avec la *Structural Engineers Association of British Columbia* (SEABC), qui a permis à 12 étudiants de premier cycle et plusieurs étudiants du programme de maîtrise d'y participer. La Journée de l'acier a fourni aux étudiants de l'UBC d'excellentes occasions d'élargir leur réseau et d'apprendre, ceci en plus de stimuler l'intérêt et la compréhension des processus que les fabricants d'acier doivent suivre, de la réception des matières premières jusqu'à l'expédition d'acier de haute qualité vers les sites de construction.

Cette année, les étudiants de l'UBC ont été les témoins de plusieurs événements passionnants : des démonstrations d'utilisation de la technologie de l'information afin d'accroître l'efficacité de la production, un forgeron en action, l'utilisation de machinerie évoluée pour produire des produits en acier, de l'équipement d'essai sismique, et d'importants parcs de stockage d'acier. Les étudiants se sont vus donné le défi d'estimer le total de tonnage d'acier dans le parc, et, en prime stimulante pour quelques-uns de nos étudiants stressés en ingénierie, nous avons eu la joie d'écraser une vieille voiture à l'aide de marteaux de frappe. Nous ayant amusés et ayant forgé de solides connections entre les véritables activités d'exploitation de l'industrie et nos cours de conception de l'acier à l'UBC, les étudiants ont quitté les installations satisfaits d'avoir acquis cette expérience d'une nouvelle perspective.

Pour des photos supplémentaires des visites, veuillez aller à http://ubccsce.ca/Gallery.php. ■

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Simandou Iron Ore Railway

Canadian engineers helped to design a 670-kilometre heavy rail line to carry iron ore across the mountains of Guinea in West Africa.

By AECOM

Simandou, the largest integrated mine and infrastructure project ever developed in Africa, poses daunting engineering challenges. These include the building of a new 670-kilometre, heavy freight railway to transport iron ore shipments from Guinea's Simandou Mountain Range to the coastal city of Conakry, where a deep sea port is planned.

Developing Guinea's massive iron ore resources has the potential to transform the West Africa country into the world's third largest producer after Australia and Brazil. Rio Tinto, the project owner, along with Aluminum Corporation of China Limited, is working with the Government of Guinea and International Finance Corporation, the private sector lending arm of the World Bank, to ensure the project generates social and environmental opportunities in addition to economic ones.

Pit-to-port transportation

Before the first iron ore shipment is exported, a complete "pit-to-port solution," comprising a mine, railway, port and associated infrastructure, needs to be designed and constructed.

AECOM is providing engineering services for the project's rail and port components to Fluor, Simandou's EPCM (engineering, procurement, construction management) contractor. While the port is being delivered by AECOM's Australian operations, a Canadian team of AECOM engineers is leading the rail design group, which consists of more than 400 specialists based in 14 offices in Canada, the United States, Australia and Spain.

Simandou's rail component is one of AECOM's largest infrastructure projects to date. It consists of 670 kilometres of single track, heavy-haul railway, three tunnels (a combined 29 kilometres in length), approximately 39 bridges, 1,000 culverts, 13 passing sidings, rail yards, maintenance and employee facilities, as well as a control centre. The project is currently at the tendering stage and AECOM will be supporting this process throughout 2013.

Limited geotechnical data

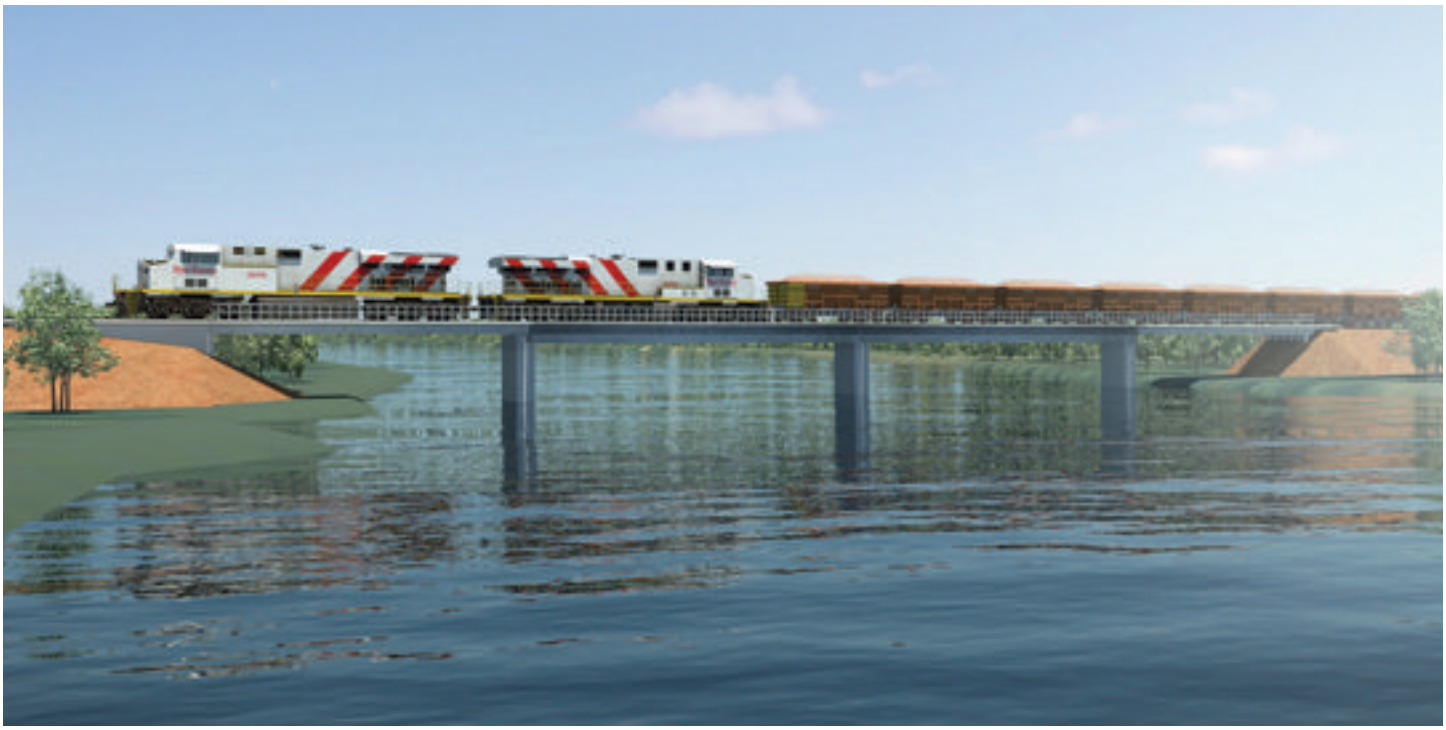
Connecting the mine to the port involves building a railway across the mountainous, forested Guinée Forestière region, one of the most remote areas in southeastern Guinea. The area's remoteness often meant working with limited geotechnical data to inform the track, bridge and tunnel design.

This challenge was an important factor, for example, in the design approach to the project's large number of bridges and major culverts. To accommodate sites where accurate data was unavailable, a range of design options for the bridge foundations were provided. Covering the most anticipated scenarios for site suitability, this approach limits the risk for delay during construction, as the most viable foundation can be determined on site.

Managing the project data was also a critical factor due to the number of different stakeholders involved and the international composition of the project team. AECOM's efforts included leading a collaborative pro-

Artist's Rendering. AECOM

The project includes approximately 29 kilometres of tunnels through the Simandou Range. AECOM proposed the drill-and-blast tunnel construction method as the most applicable method due to the locations.



Artist's Rendering, AECOM

The railway will include approximately 39 bridges and five roadway underpasses. An estimated 1,000 culverts will be installed as well.

cess to establish a framework to collect and share the project's spatial and CAD data globally. One solution involved developing a GIS-based iPad application that allowed data to be synchronized and disseminated on a continuous basis to all project stakeholders. AECOM also employed TILOS, a time location software program designed for planning and project controls that allows users access to track to real-time project data.

Saves 3,000 train running hours

Design of the railway's track and civil works focused on finding opportunities to reduce construction costs and improve system performance by optimizing the alignment. By following stringent design criteria for track radius, tangents, grading and earthwork formations, the travel time of trains was reduced by one hour per trip for the 670-kilometre journey.

This reduction is significant in relation to the railway's projected daily traffic. Based on an estimate of 10 trains running per day, each train consisting of approximately 240 wagons or more (up to 2.8 kilometres long), more than 3,000 hours will be saved per year to help lower fuel consumption rates and related carbon emissions.

Achieving performance efficiencies resulting from a smarter design was just one way AECOM supported the project's overall commitment to creating environmental and social outcomes. Another was the work to minimize the impact on local communities, and on areas with a biodiversity value.

This work first involved defining the social and environmental avoidance criteria that were required and then developing a GIS model that could feed the information into the rail line design decision process. The approach allowed for a more accurate and efficient examination of the impacts to adjacent villages and to the biodiversity sites in proximity to the route, enabling design changes to be made where possible.

Along with its social partnerships, which involve hundreds of millions of dollars worth of investment in public infrastructure projects and local education and training, Simandou aims to be a world-class mining operation modelled on sustainable development. The project's railway is only one part of this ambitious undertaking, but it has contributed to the vision of Simandou. ■

NAME OF PROJECT: Simandou Iron Ore Rail Project
OWNER: Rio Tinto
ENGINEERING, CONSTRUCTION, PROJECT MANAGEMENT: Fluor
PRELIMINARY ENGINEERING AND DETAILED DESIGN:
AECOM (Leslie Martin P.Eng., Scott Duggan, P.Eng., Liviu Huma, P.Eng.)

Photo: Sun Hung Kai Properties

Wastewater Treatment in Hong Kong

The Hong Kong government has been undertaking a series of "HATS" projects to expand the wastewater collection and treatment system around Victoria Harbour.

By Kelvin K. C. Cheung, PH.D.
MCSCE VICE-CHAIRMAN, CSCEHKB

Victoria Harbour is a natural landform harbour situated between Hong Kong Island and Kowloon Peninsula. The harbour is famous not only for its spectacular views, but also for its annual cross-harbour swimming race. However, the race was halted in 1978 due to deteriorated water quality. Sewage used to be discharged into the harbour after preliminary treatment (i.e. screening and de-gritting) almost untreated, which was not environmentally sustainable.

According to the information given by the Government of the Hong Kong Special Administrative Region (HKSAR), in the late 1980s the government initiated the development of the Harbour Area Treatment Scheme (HATS).

HATS is an overall sewage collection and treatment scheme for areas on both sides of Victoria Harbour to combat the water pollution caused by urban development. Given the large catchment area, construction of this world-class sewage infrastructure is being carried out in stages, namely, Stage 1 and Stage 2A.

HATS Stage 1 commenced in 1994 and was commissioned in 2001. This stage

comprised the construction of a centralized Chemically Enhanced Primary Treatment (CEPT) plant on Stonecutters Island. The new plant, which opened in 1997, adopts a space-saving double-tray sedimentation tank design to reduce its footprint. Occupying only 10.6 hectares of reclaimed land, it is one of the most compact/efficient plants of its kind in the world.

To cater to the technical requirements of HATS, Stage 1 included the construction of a 23.6-km long tunnel conveyance system deep underground and a comprehensive upgrading of the existing Preliminary Treatment Works (PTW), for collecting and delivering sewage from Kowloon Peninsula and the northeastern part of Hong Kong Island to the CEPT plant. About 75% of the sewage from HATS catchment is treated at the CEPT plant on Stonecutters Island and discharged through a submarine outfall, a 1.7-km long, 5-m diameter outfall tunnel and a 1.2-km long diffuser pipeline to the western harbour area (a part of Victoria Harbour).

HATS Stage 1 work has cost HK$8.2 billion and much more needs to be done to ensure the long term sustainable development of Victoria Harbour. As the remaining 25% of the harbour sewage has only received preliminary treatment, the government committed to further improving the water quality of the harbour by providing additional treatment to the sewage under HATS 2A.

In 2004, the government completed intensive studies on environmental impacts and engineering feasibility to decide the best way forward for the remaining stage of HATS.

The first phase (HATS Stage 2A) involves upgrading the existing Preliminary Treatment Works (PTW) around the northern and southwestern shore of Hong Kong Island and constructing a 21-km long deep tunnel system with depths varying from 70 m to 160 m below sea level. The tunnel will convey the sewage which has undergone preliminary treatment from the northern and southwestern part of Hong Kong Island to the CEPT plant. The plant will be expanded to provide centralized chemical treatment for all sewage from the whole of the HATS catchment, with provision of disinfection facilities. The target year for completion of this phase is 2014/15.

To facilitate the sustainable development of the harbour area in the long term, the second phase (HATS Stage 2B) will be constructed near the CEPT plant and will provide biological treatment to all the effluent, thus improving water quality further. A review is being carried out to determine the timetable for the implementation of HATS Stage 2B.

With the full commissioning of HATS Stage 1 in 2001, about 600 tonnes of sewage sludge are prevented from entering Victoria Harbour every day and the overall harbour water quality has substantially improved. In that regard, the cross-harbour swimming race, which was first held in 1906 and halted in 1978 due to deteriorated water quality, made its return on October 16, 2011, after a 33-year suspension. In the near future, this meaningful race will certainly be another of Hong Kong's most celebrated events. ■

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A BRIEF INTRODUCTION OF EACH STAGE OF HATS

HATS	Time Reference (Year)	Harbour Sewage Treated	Treatment Capacity (Mm^3/day)	Cost HK$ (Billion)	Projected Population Served (Million)
Stage 1 (Commissioned)	1994-2001	75%	1.7	8.2B	4.5M
2A	2009-2015	25%	Increased to 2.45*	17.2B	Increased to 5.7M

*Stage 1 and Stage 2A

PROPORTIONS OF DIFFERENT TREATMENT LEVELS OF COLLECTED SEWAGE IN HONG KONG

Preliminary/ Primary Treatment	Chemically Enhanced Primary Treatment (CEPT)	Secondary Treatment	Tertiary Treatment	Total
30%	53%	17%	<0.01%	100%

Photo: Rideau Canal, courtesy of National Capital Commission.

Evaluate Projects Through the Windows that Matter to Society

New tool helps planners, owners and communities think about sustainability at every stage of the project's life cycle.

By William J. Bertera, EXECUTIVE DIRECTOR, INSTITUTE FOR SUSTAINABLE INFRASTRUCTURE

It may once have been enough to simply build good civil infrastructure; to deliver quality projects on time and on budget. That day has passed. Evidence suggests that Planet Earth is going through another of its periodic warming spells. Whether, or to what extent, this change is caused or exacerbated by mankind is a determination for another forum. What is certain is that the engineering profession has a clear and pressing obligation to help us adapt to changing circumstances even as it attempts to redress them.

Civil infrastructure is the bulwark upon which all civilizations are based; it provides personal security, the basis for a sound public health program, and gives us the tools we need to create a quality of life that is both dignified and rewarding. In a world where national boundaries are increasingly diminished by the free flow of goods, capital and people, civil infrastructure is an essential component that rewards attention to infrastructure investment of all kinds.

At the same time, in an increasingly urbanized world with a growing population heavily concentrated in dense communities, civil infrastructure and its construction and maintenance reflect mankind's significant footprint on this earth. Regardless of how we look at it, civil infrastructure depends upon consumption of increasingly dear resources of all kinds and has the potential to impact upon, and even alter, fragile ecosystems and the atmosphere that sustains them and us as well.

In these circumstances infrastructure must be sustainable, i.e., it must not only responsibly meet the needs of our generation, but it must also be respectful of the options of future generations to preserve their choices. This is the significant challenge of our age.

Canadians have long established their capacity and willingness to implement important civil engineering projects in pursuit of the national interest, and have done so through both public and private sector means. The Transcontinental Railway, the Rideau Canal, the St. Lawrence Seaway, the Trans-Canada Highway, and most recently, major pipeline projects such as Gateway and Keystone make the point. Now we go a step further, a step towards an infrastructure initiative that both serves that national interest and is sustainable as well.

The engineering community in North America has a new tool to help develop sustainable infrastructure and to change the way we think about, discuss and prioritize investment in civil infrastructure – it is called Envision™. Envision is the result of a coming together of the engineering community in the United States and Canada in an unusual way. The American Public Works Association (APWA), the American Council of Engineering Companies (ACEC) and the American Society of Civil Engineers (ASCE), and their Canadian counterparts, have formed an organization called the Institute for Sustainable Infrastructure (ISI).

ISI has, in turn, partnered with the Zofnass Program for Sustainable Infrastructure at Harvard University to produce an infrastructure rating system to help planners, designers, developers, contractors and infrastructure owners develop projects and systems that include, and offer the opportunity for, increasing levels of sustainability in our infrastructure.

See projects through windows that matter to society

Envision is not a decision-making tool in and of itself. Instead, it helps and encourages decision-makers to think about sustainability at every stage of a piece of infrastructure's life cycle, beginning with the planning and design phase, through construction and continuing into operation and maintenance. Envision provides yet another piece of valuable information; one that includes sustainability considerations unlikely to be evident in the decision-making process otherwise.

Envision does so by looking at each infrastructure project though windows that matter

to society, windows that are reflected in the triple bottom line, which itself acknowledges that complex decisions about infrastructure are not just about good building, but about economics, the environment and social considerations as well, and about an acknowledgement that community understanding and support are essential ingredients in sustainable projects. Those windows include quality of life, leadership, resource allocation, the natural world and finally, climate and risk.

Importantly, Envision is a comprehensive rating tool that is applicable to all forms of infrastructure (other than buildings) and plays especially well to systems of infrastructure on a community level. It allows us to relate infrastructure projects of all sorts to our public spaces, to our environmental concerns and to community values. It is holistic and looks at our infrastructure through as many as 60 separate "credits" that ask us questions not only about whether we are doing the project right, but also about whether we are doing the right project.

These are goals and objectives very much in sync with principles recently endorsed by the Canadian Municipal Infrastructure Forum, which stressed the need for a long-term infrastructure plan that speaks not only to the triple bottom line, but to the importance of consideration of community values and decision-making authority in infrastructure management at all levels.

Envision is not prescriptive. It focuses upon outcomes and leaves to communities the ways in which they achieve those outcomes. It encourages holistic approaches to planning construction and operation, and allows for the introduction of community values and priorities to ensure projects that are both responsive and relevant to community resources and choices.

Envision is not intended for evaluating buildings, but it is intended for all other kinds of infrastructure, including those elements not usually considered civil infrastructure because they are owned by the private sector. Transmission lines, refineries and power plants are as much a part of our public infrastructure as are roads, bridges and airports from the perspective of their impact on the sustainability of whole communities, and Envision acknowledges that reality.

Envision is more than a single tool; it is a system of components designed to empower decision-makers. In addition to Envision itself, there is also an easy-to-use checklist, designed to enable public officials and private sector professionals alike to provide a quick, inexpensive way to evaluate small projects or to simply test the waters on larger endeavours. There is also a training program to instruct individuals in the use of Envision and then accredit their knowledge.

Go further: formal recognition of achievement

Importantly, while Envision is available in the public domain for unfettered use by units of government and the private sector alike, it is expected that there will be a significant market demand for formal recognition of the achievements won using the tool, and that both public sector infrastructure owners and operators as well as private sector developers will find real value to that public acclamation of achievement.

Consequently, ISI offers a formal recognition program, which, for a fee, verifies the assumptions and conclusions reached using the Envision scoring system, and documents the adherence of the applicant to the precepts of sustainability embodied in Envision. Awards associated with various level of achievement reflect increasing levels of effort and outcomes.

It is expected that achievements in sustainability encouraged through the use of Envision will help both public sector officials and private sector developers make the case with the general public and the investment community that sustainable infrastructure is a good and achievable public interest, one that has real benefits for the taxpayer and the consumer of those services. It is also expected that Envision will help communities prioritize infrastructure investment and accord it an important place on the menu of essential public needs.

It is instructive that the first project submitted for evaluation using the Envision Rating System is located in Alaska, with its implicit suggestion that Envision is a vehicle to sustainability not just for a nation, but for a continent. ■

Engineering Practice in Other Lands

Brian C. Burrell, P.Eng.,
CSCE VICE-PRESIDENT – TECHNICAL PROGRAMS

Few individuals obtain an engineering degree without planning to practice engineering. Yet engineering bodies in Canada have given a lot of attention to the five to seven years of formal engineering education rather than the numerous years of professional work that may follow. Although research and education are important, the engineering profession ultimately will be judged primarily by what engineers do in the workplace. It is important that political and business leaders maintain respect for the engineering profession, as this affects the employment prospects and remuneration of civil engineers and the role civil engineers may be given in decision-making concerning infrastructure and sustainability. Engineering bodies in Canada should not be complacent while the profession diminishes in public standing, and should learn from experiences elsewhere.

Best practices that have been working in some countries or regions could be applied elsewhere, subject to considerations of socio-economic context and applicable government policies and regulations.

In this issue of CIVIL are two articles providing differing insights on engineering practice in East Asia. In Hong Kong, the engineering profession benefits from high levels of public respect, resulting in good employment prospects and input to government decision-making. Few civil engineers in Hong Kong are underemployed. In mainland China, civil engineering practice is advancing rapidly, with major advances being made in research, education, and engineering practice. The workplace for civil engineers is also evolving, with more market-driven practices and less demand for civil engineering services from abroad.

Canadian civil engineers need to recognize that engineering knowledge, skills, and innovation are not limited to North America. Major civil engineering projects are being completed elsewhere in the world, to standards that equal or exceed those in North America. Opportunities exist outside our borders for civil engineers to work on some of the largest engineering projects in the world today, and this expertise will be exportable to other countries, such as Canada.

Brian Burrell is senior engineer with R.V. Anderson Associates Limited (Fredericton).

Pratique de l'ingénierie dans d'autres pays

Brian C. Burrell, P.Eng., FCSCE
VICE-PRÉSIDENT, PROGRAMMES TECHNIQUES, SCGC

Peu de personnes obtiennent un diplôme d'ingénieur sans avoir prévu d'exercer la profession d'ingénieur. Malgré tout, certains organismes d'ingénierie canadiens ont porté une attention particulière aux cinq à sept années de formation formelle en génie plutôt qu'aux nombreuses années de travail professionnel qui peuvent s'ensuivre. Bien que la recherche et la formation soient importantes, la profession d'ingénieur sera jugée selon ce que les ingénieurs font sur le marché du travail. Il est important que les leaders politiques et du monde des affaires maintiennent un respect pour la profession d'ingénieur, car cela touche les chances d'embauche et la rémunération des ingénieurs civils ainsi que le rôle que les ingénieurs civils auraient à jouer dans le processus de prise de décision concernant l'infrastructure et la durabilité. Les entités du génie au Canada ne devraient pas faire preuve de complaisance alors que la profession voit son prestige s'étioler aux yeux du public, et elles devraient apprendre des expériences d'ailleurs.

Les meilleures pratiques qui ont fonctionné dans certains pays ou certaines régions devraient être appliquées dans d'autres pays, celles-ci soumises aux considérations du contexte socio-économique et aux politiques ainsi qu'à la réglementation applicables.

Dans cette édition de CIVIL se trouvent deux articles qui présentent différents regards sur les pratiques de l'ingénierie dans l'Asie. À Hong Kong, la profession d'ingénieur bénéficie d'un respect très élevé de la part du public, ce qui entraîne de bonnes perspectives d'emploi et de participation à la prise de décision gouvernementale. Peu d'ingénieurs civils à Hong Kong sont sous-employés. Dans la Chine continentale, la pratique du génie civil progresse rapidement, où des avancées majeures sont réalisées dans la recherche, l'éducation et la pratique de l'ingénierie. Le marché du travail pour les ingénieurs civils est également en évolution, avec des méthodes qui sont plus ciblées sur le marché et où la demande pour les services de génie civil de l'extérieur fléchit.

Les ingénieurs civils canadiens doivent reconnaître que les connaissances, les compétences et l'innovation en ingénierie ne se limitent pas à l'Amérique du Nord. D'importants projets de génie civil sont exécutés ailleurs dans le monde, selon des normes qui sont équivalentes ou supérieures aux normes de l'Amérique du Nord. Les occasions existent ailleurs pour que des ingénieurs civils travaillent sur certains des plus importants projets d'ingénierie au monde d'aujourd'hui, et cette expertise sera exportable vers d'autres pays, comme le Canada.

Brian Burrell est ingénieur principal chez R.V. Anderson Associates, Fredericton.

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Opportunities and Challenges for Canadian Engineering Consulting Firms in China

Chen Dai, P.Eng., M.Eng., MCSCE
SENIOR ENVIRONMENTAL PLANNER/ SENIOR WATER RESOURCES ENGINEER, ASSOCIATE, AECOM, GUANGZHOU, CHINA

China is one of the most dynamic places in the world in terms of its economic growth. In 2010, China passed Japan in the second quarter to become the world's second-largest economy. During the past decade (2001 to 2010), the average GDP growth rate in China was about 10%. According to the Chinese 12th Five-Year Plan (2011- 2015), the average GDP growth rate target over the five years is 7% (Government of China, 2011).

To bolster the economy, China plans to invest large amounts of money on engineering projects and infrastructure. This might be seen as an opportunity for Canadian engineering consulting firms (CECFs) to do business in China.

In the Chinese 12th Five-Year Plan, the three key aspects of the Plan's industrial policy are: scientific development; construction of transportation and energy infrastructure; and development of seven "strategic emerging industries" including energy-saving technology, environmental protection, and new materials manufacture (Government of China, 2011). Based on the Plan, the major infrastructure projects include: transportation projects such as highway networks and bridges, new airports, a high-speed railway, and local railway projects including subway and light rail train in many cities; urban low-income housing; development of hydropower plants in southwest China and safe nuclear power generating plants; and water conservation projects.

Examples of the ongoing large-scale infrastructure projects in China include the South-to-North Water-Diversion Project and the Hong Kong-Shula-Macau Bridge Project. The water diversion project is the largest of its kind ever undertaken, with an estimated investment of RMB 486 billion. Three 1300-km canals will be constructed in the western, central and eastern parts of China to transfer water (44.8 billion m3 by 2050) from the upper, middle and lower reaches of the Yangtze River to the north, where water supply is not adequate (Water Technology, 2011). The Hong Kong-Zhuhai-Macau Bridge is a series of bridges and tunnels that will connect Hong Kong, Macau and Zhuhai, three major cities situated on the Pearl River Delta in southern China. The longest bridge section in the 50-km link will be 22.8 km long and include three cable-stayed spans between 280 m and 460 m in length (Transport and Housing Bureau, 2012). Construction formally began on December 15, 2009 and completion is scheduled for 2016.

Photo: Brian Burrell

China plans to invest significantly in engineering projects and infrastructure.

Sustainable infrastructure and sustainability

China has air pollution in several large cities and is the world's greatest emitter of carbon dioxide. The government is planning to invest heavily (> 3 trillion RMB) in environmental protection over the 2011-2015 period, including spending on innovative technology. The government also plans to invest RMB 4 trillion in water conservation projects over the next 10 years and RMB 1.5 trillion in renewable energy over the next five years.

Organization of the profession

Licensure: There are two major types of licensures in China's engineering design and consulting industry. One is the Engineering Design Qualification issued by the Ministry of Housing and Urban-Rural Development (previously known as the Ministry of Construction (MOC)). Another licensure is the Engineering Consulting Qualification issued by the National Development and Reform Commission (NDRC).

According to the Regulations Governing the Management of Qualifications for Construction Survey and Design Enterprises ("Decree 160") introduced by the MOC in 2007, the engineering design industry is divided into 21 fields based primarily on industry (MOC, 2007). The design qualification includes four grades (A, B, C and D) and four series: (a) Comprehensive Design Qualification (Grade A only) covers the entire 21 industrial fields, (b) Industrial Design Qualification covers all design types in a specific industry (e.g. a company holding agriculture and forestry qualification

can provide design services for these two industries), (c) Professional Design Qualification covers one or two design types in a specific industry (e.g. a company only holding an agriculture qualification can provide design services related to agriculture but not to forestry), and (d) Specialty Design Qualification for independent design related to a specific technology (MOC, 2007).

According to the Measures for the Qualification Accreditation of Engineering Consulting Entities promulgate by the NDRC (No. 29) in March 2005, engineering consulting entities under the Engineering Consulting Qualification can hold Grades A, B and C (NRDC, 2005). The professional qualification of engineering consulting entities are classified on the basis of 31 fields, including highways, railways, urban transit, water power, agriculture, hydrology and engineering geology, water conservancy projects, ecological construction and environmental projects, and municipal engineering (public utilities). The qualification of an engineering consulting entity shall specify the scope of engineering practice, which may include development planning, proposal preparation, feasibility study preparation, project appraisals, project design, project supervision and management.

Professional organizations: Currently, procedures for the appointment of engineering and technical personnel involves appraisal of the academic and technical competence of all kinds of engineers and technicians according to different specialities and their classification into junior, intermediate and senior levels, that is, technician and assistant engineer, engineer and senior engineer. Generally, university or college graduates of engineering and technological programs can be appointed as assistant engineers after practicing for one year in an engineering position. After four years, he or she can apply to be appraised for engineer status, and five years later, for senior engineer status. About five million persons are known to have engineering and technical posts through appraisal in China, including more than 3 million assistant engineers and technicians, 1.6 million engineers and 500,000 senior engineers.

TABLE 1. 10 LARGEST CANADIAN ENGINEERING FIRMS IN CHINA

Rank 2011	Firm Name & Location	Offices in Mainland China, Hong Kong and Macau
10	SNC-Lavalin International Inc.	Beijing and Shanghai
22	Hatch Group	Beijing and Shanghai
24	Golder Associates Corp.	Beijing, Guangzhou, Hong Kong and Shanghai
28	Stantec Inc.	No Office
55	EXP	No Office
74	Dessau Inc.	No Office
94	Morrison Hershfield	No Office
134	Delcan Corp.	Hong Kong
185	MMM Group Ltd.	No Office
Unknown	IBI Group	Beijing, Hong Kong and Shanghai

*Note: Ranking from ENR The Top 200 International Design Firms in 2011.

Local design institutes: In China, the major share of the engineering design and consulting market are taken by Local Design Institutes (LDIs). Before the 1990s, almost all LDIs were government-owned. During the last two decades, a process of full and partial privatization occurred so that LDIs could have greater operational flexibility to respond to market conditions, and new clients and trends. Although many LDIs were disconnected from government administration, some are still owned by the government, and generally most LDIs maintain close connections with China's government (Cultural Exchange China – Netherlands, 2010).

Doing business in China

Business culture: The Chinese business culture is very much different from the Western business practice. Cultural barriers might cause the failure of foreign consulting operations in China. Below are some tips on how to do business in China.

In China, a business relationship inevitably becomes a social relationship. Often, chatting about personal life outside of business is a great way to develop close friendships. The more you share your personal life, including family, hobbies, political views, the closer you are in your business relationship.

Exchanging gifts is a customary Chinese business practice. No matter the value, gifts are always appreciated and especially in the smaller cities or towns. Taking people out for meal is an alternative to gift giving.

Gei Mian Zi (giving face/due respect) is a very important concept in China. You must give the appropriate respect to another party according to rank and seniority. Seniority is very important to the Chinese, especially if you are dealing with a State-owned or government body. Always greet the most senior Chinese first. It is a form of respect that, if ignored, could ruin any chance of doing business with the other party. Also it is appropriate to address the other party by his or her designation.

Guanxi (connections/networks) is an important part of Chinese business culture. Guanxi symbolizes a combination of social friendship and professional partnership. Guanxi can not only assist transnational companies to obtain sources of information and resources, including business opportunities, government policies, and scarce necessities and profession-

als, but also be of great value to them in terms of building up corporate reputations, enlarging market share and even motivating employees.

Specialized skills: Working in China can be a great career experience. To be competitive in China, consulting engineering companies must offer skills that are in short supply and which therefore command a significant premium. These skills fall into four categories: high-level project management skills, highly specialized technical skills, advanced levels of practical experience, and familiarity with and access to transferable proprietary technologies.

Business development strategy for Canadian engineering firms

Canada ranks among the world's leading exporters of engineering services, recently ranking third after the United States and the United Kingdom (Engineers Canada and Canadian Council of Technicians and Technologists, 2009). Nonetheless, from 2002 to 2007, Canada's share of the international market (as measured by the business of the world's 225 largest engineering firms) averaged 3.4%.

Although Canada's share of China's engineering services market is unknown, CECFs have played a very important role in China. The most famous project in China done by CECFs is the Three Gorge Dam Project (TGDP). In 1986, funded by the Canadian International Development Agency (CIDA), a consortium of Canadian firms conducted a $15-million feasibility study of the TGDP. The consortium, known as CIPM Yangtze Joint Venture, included three private companies (Acres, SNC, and Lavalin), and two state-owned utilities (Hydro-Quebec and B.C. Hydro). The feasibility study included a detailed review of 30 years' worth of Chinese studies, an analysis of dam height alternatives and an evaluation of socioeconomic and environmental aspects - namely, resettlement, health and wildlife. The final reports, prepared by both the Chinese and the Canadian team, were submitted to the government in 1988.

Although the Chinese market looks attractive, it is still not easy for CECFs to expand and succeed in China. CECFs still face challenges like the barriers of design licences, cultural differences and local connections. CECFs need to decide on the appropriate mode of market expansion and develop strategies to develop business in China. Some suggestions are providing in the following paragraphs.

Having an office in China will help CECFs develop a good understanding of local bylaws and a better understanding of client requirements, and thus provide a superior product or service. For CECFs without an office in China, the most effective entry mode is to establish a wholly owned subsidiary in China.

Acquisition of an existing company might be a way to expand a business quickly in China. This provides immediate exposure to the Chinese market, and perhaps the necessary design and consulting licence from the existing company. Additionally you might have the existing company's Guanxi if you keep the existing management team. On the other hand, the acquisition entails more legal and regulatory requirements.

Another more effective market entry mode for CECFs is to set up a project joint-venture with an LDI. This involves two or more firms coming together in a flexible one-off business arrangement to undertake a project. To gain a competitive advantage, CECFs might provide superior technology and the LDI provide local knowledge and Guanxi. Guanxi is definitely important for CECFs in China, and it remains significant despite China's advanced opening-up and reform policies.

To be successful in China, CECFs need to use local talent as one way to effectively reduce their operational costs and to maintain a stable management team. The use of local talent reduces inefficiencies of operation and management caused by cultural differences. On the other hand, CECFs should avoid cultural conflicts in their management team that reduce managerial effectiveness and unity of purpose and direction within the firm.

The 10 largest Canadian engineering firms in China are listed in Table 1. CECF involvement in China is less than the involvement of American and European firms.

Concluding remarks

To maintain its rapid economic growth, China is continuing to invest huge amounts of money in engineering projects and infrastructure. This provides CECFs an opportunity to expand and succeed in China. However, CECFs will still be facing the challenges posed by design licensure, cultural differences, and local connections. To expand and succeed in China, CECFs need to develop an appropriate business development strategy to adapt to China's rapidly changing and complex market.

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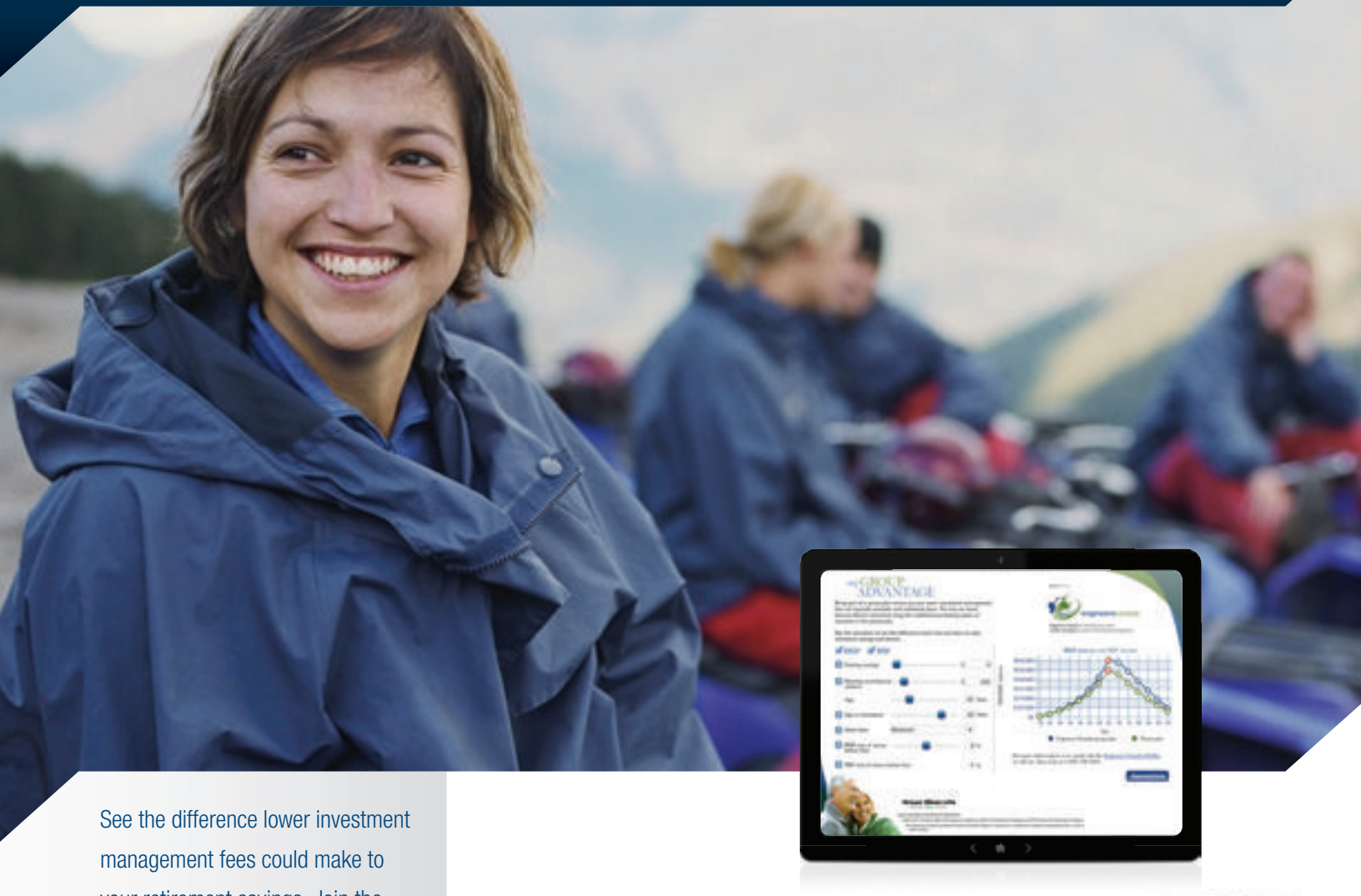

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Engineering Practice in Hong Kong

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Engineering practice in Hong Kong is characterized by high standards, high levels of public respect, and good employment prospects. As Hong Kong is one of the world's most vibrant and important business centres, civil engineers in Hong Kong are working in a dynamic environment where infrastructure is constantly being upgraded to match the needs of the international business and commercial sectors, and a growing and aging population. In brief, civil engineers are responsible for the design and construction of infrastructure that contributes to the preservation of the public health, safety and general welfare for the people in Hong Kong Special Administrative Region (HKSAR). This article presents a brief overview of how the profession is organized, some major issues facing the profession, and the strengths and weaknesses of civil-related disciplines in changing economic times.

The Hong Kong Institution of Engineers (HKIE)

The Engineering Society of Hong Kong was founded in 1947 with the aim of bringing together engineers of different disciplines for their common good. The Society flourished and as a result, the Hong Kong Institution of Engineers (the HKIE) was incorporated under the Laws of Hong Kong in 1975. Adapting to the needs of engineers in Hong Kong, the HKIE continues to develop and expand.

Most engineering companies in Hong Kong recognize corporate membership of the HKIE as the key qualification for employment of professional engineers. An important development in 1982 was the Hong Kong Government's decision to recognize corporate members of the HKIE for the civil service.

The HKIE is the body responsible for qualifying engineers in Hong Kong and is multi-disciplinary. Admission is usually into one of the 20 disciplines, which include building, building services, civil, environmental, geotechnical, materials, and structural.

The HKIE consists of the following classes of membership: corporate members (Fellow, Member) and other classes (associate member, graduate member, companion, affiliate and student member). Fellow is a senior corporate member who has achieved positions of responsibility to which he/she has brought superior knowledge and practice in an engineering discipline. A Member is a qualified professional engineer who has obtained an accredited/recognized degree or the equivalent in an acceptable engineering discipline, has received adequate training, has sufficient responsible experience, and has successfully completed the Institution's professional assessment or the equivalent.

"Ir" is a recognized abbreviation for "engineer" under HKIE Constitution Article 4, which stipulates that corporate members may adopt the courtesy prefix "engineer" in front of their names.

The HKIE has established close relationships with engineering institutions throughout the world. For reciprocal recognition of professional qualifications, the HKIE has signed agreements with engineering authorities in Australia, Canada, Ireland, mainland China, New Zealand and the United Kingdom. In addition, the HKIE has signed agreements of co-operation with other organizations in Europe, mainland China, North America and Southeast Asia. The HKIE is also an affiliate member of the World Federation of Engineering Organizations (WFEO) and a member of the Federation of Engineering Institutions of Asia and the Pacific (FEIAP).

The HKIE has three overseas chapters in Canada, United Kingdom, and Australia. The current chairperson of the Canadian chapter is Ir Brian Lee (blee@markham.ca) in Toronto.

The HKIE has one seat representing the Engineering Functional Constituency in the Legislative Council of Hong Kong SAR. Ir Dr. W. K. Lo, past president of HKIE, is the current representative of Engineering Functional Constituency in the Legislative Council. In addition, on the 1,200-member Election Committee (EC) for the election of the chief executive of the Hong Kong Special Administrative Region (HKSAR), there are 30 EC members from the engineering subsector elected by the corporate members of the Institution. In particular, corporate members and graduate members of the Information Technology Division of the HKIE are eligible to vote for the representatives in the Information Technology Functional Constituency in the Legislative Council and its Election Committee subsector. The views of the engineering profession are thereby well respected by both the HKSAR Government and the community.

Engineering mobility

In June 1995, the HKIE joined the Washington Accord as one of the signatories. Other signatories, including Australia, Canada, Chinese Taipei, Ireland, Japan, Korea, Malaysia, New Zealand, Russia, Singapore, South Africa, Turkey, the United Kingdom and the United States, recognize the engineering degrees accredited by the HKIE.

In 1999, Hong Kong became a founding member of the APEC Engineer Framework. A Registered Professional Engineer (RPE) in Hong Kong is eligible to register as a Hong Kong APEC Engineer. Both the APEC Engi-

neer Register in Hong Kong and the Engineers Mobility Forum International Register of Professional Engineers in Hong Kong were launched in April 2002. The Engineering Technologists Mobility Forum International Register of Engineering Technologists in Hong Kong was launched in February 2008.

In June 2001, the HKIE became a founding signatory to the Sydney Accord. Under this Accord, other signatories, including Australia, Canada, the United Kingdom and the United States, recognize higher diplomas and associate degrees accredited by the HKIE. On the multilateral recognition of engineers and technologists' qualifications, the HKIE is a founding member of the Engineers Mobility Forum and the Engineering Technologists Mobility Forum. The former provides a framework for the recognition of experienced professional engineers by responsible bodies in each of the signatory nations, while the latter is a framework that facilitates the multilateral recognition of technologists' qualifications.

In June 2009, the HKIE was admitted as a full signatory to the Seoul Accord. Computer science degrees accredited by the HKIE are recognized by other signatories, including Australia, Canada, Japan, Korea, the United Kingdom and the United States.

The HKIE and the Canadian Council of Professional Engineers (i.e. Engineers Canada) signed a Reciprocal Recognition Agreement in May 2004 for mutual recognition of corporate members of the HKIE and professional engineers (P.Eng.) in Canada. This agreement has facilitated the mobility of professional engineers between Hong Kong and Canada.

Education and continuing professional development (CPD)

Table 1 shows civil engineering (and civil-related disciplines) degree programs currently accredited by the HKIE as at September 24, 2012 (Washington Accord).

Continuing professional development (CPD) is an ongoing necessity in the ever-changing technological world in which we live. Practising professional engineers should aim to remain competent throughout their working careers so that they can properly carry out their various duties in relation to other engineering disciplines. To this end, engineers need to take opportunities to update their depth and breadth of knowledge and expertise, and to develop those personal qualities required to fulfil their roles in industry and in the community. The benefits of CPD are not easily quantifiable but nonetheless real. The HKIE CPD policy is based on the conviction that CPD is of value to its members, to the profession, to industry and to the community (HKIE website, 2012).

CPD covers matters of direct technical relevance as well as broader studies also of importance to HKIE members in the furtherance of their careers, such as communication, environmental matters, financial management, leadership skills, legal aspects, marketing, occupational safety and health, and professional ethics. The format of CPD activities can include, but is not limited to, participating in and organizing courses, lectures, seminars/symposia, conferences, presentations, workshops, industrial visits, e-learning and professional activities. The HKIE divisions, higher education institutions (Table 1), the engineering industry itself, and a variety of other organizations may provide CPD activities.

HKIE policy recognizes that HKIE should serve its members by acting as a CPD co-ordinator and facilitator (HKIE Website, 2012). The HKIE finds out what kinds of CPD are needed by its members, leads in the promotion of CPD, acts as a focal point in the collection and dissemination of CPD information, and organizes CPD activities such as lectures, seminars and workshops to meet the needs of its members and society (HKIE Website, 2012).

CPD applies to both corporate members and to engineers in the pre-corporate member stage. A minimum of 30 professional

TABLE 1. CIVIL ENGINEERING (AND CIVIL-RELATED) DEGREE PROGRAMS ACCREDITED BY THE HKIE

Education Institution	Degree
City University of Hong Kong Beijing and Shanghai	• B.Eng. (Honours) in Building Engineering (Construction Engineering and Management) • B.Eng. (Honours) in Building Engineering (Construction Engineering and Management) (Law Minor) • B.Eng. (Honours) in Building Engineering (Structural and Geotechnical Engineering)
The Hong Kong Polytechnic University	• B.Eng. (Honours) in Civil and Structural Engineering (Construction Engineering and Management) • B.Eng. (Honours) in Civil and Environmental Engineering • B.Eng. (Honours) in Civil Engineering
The Hong Kong University of Science and Technology	• B.Eng. (Honours) in Civil and Structural Engineering • B.Eng. (Honours) in Civil and Environmental Engineering
The University of Hong Kong	• B.Eng. (Honours) in Civil Engineering • B.Eng. (Honours) in Civil Engineering (Environmental Engineering) • B.Eng. (Honours) in Civil Engineering (Law)
Hong Kong Institute of Vocational Education (Tsing Yi)	• Offshore Programmes (offered by RMIT University in Australia) • B.Eng. in Civil Engineering • B.Eng. (Civil and Infrastructure)

Note: Information obtained from the HKIE website (2012).

TABLE 2 –STRENGTHS AND WEAKNESSES OF THE ENGINEERING AND CONSTRUCTION SECTOR

Strengths	Weaknesses
• Government has a strong financial position and plans for mega development • High status of the regulatory body HKIE– HKIE is a leading learned society and qualifying body with international recognition • Robust governance/licensing for people in the industry • Experienced and dedicated senior engineering/ construction professionals • Growing global business opportunities • Open door for global exchange for knowledge, technology and experience • Many local job opportunities	• Industry people have little concern for the interests of the industry • Low bid tendering practice affecting profitability and leading to untenable business practices • Major subcontracting due to cost shifting (maintain profit margin/not cost saving) and risk shifting • Human-resource problems – aging, shortages, unattractiveness, stressful/frustrating work environments

development hours per year are mandatory for corporate members. The HKIE specifies a minimum formal CPD requirement for those at the pre-corporate member stage and its policy is to encourage strongly CPD thereafter. The CPD record is taken into account when considering any application for Fellowship.

The state of the profession in Hong Kong

Number of practising engineers: In October 2012, there were more than 29,000 members in the HKIE of which about 14,000 were corporate members (1,000 are Fellows and 13,000 are Members). The corporate members are divided into 20 engineering disciplines. The civil division has the most corporate members in it (more than 5,400 members). It represents 0.1% of the population of Hong Kong (7 million people). Other disciplines falling within the civil sphere (as recognized by the CSCE) include the building division, the environment division, the materials division, and the structural division. Other major disciplines are the electrical, mechanical and building services divisions.

Supply versus demand: According to the Legislative Council meeting of HKSAR on May 23, 2012, the industry (engineering/construction) will continue to build as various construction projects/mega developments, including 10 major infrastructure projects commence (Hong Kong SAR Government, 2012). The demand for engineering/construction professionals is expected to increase. Generally, an adequate overall supply of human resources in the coming few years exists but shortages and aging in some trades are of concern. Between 2015 and 2020, a labour shortage of construction professionals and skilled tradespersons is projected in the construction industry. Therefore, the HKSAR Government maintains a close liaison with relevant authorities/industries/training institutes, regularly updates projections based on latest economic conditions, and considers changes/ adjustments to local development initiatives and training programs to respond to the predicted supply and demand.

The state of the profession, and employment in the construction industry, depends upon the economy. In Hong Kong, the local economy sustained high growth levels during the global financial tsunami affecting most countries between 2005 and 2010. In 2010, the professional services sector (which includes engineering and management) generated an economic contribution of HK$30.5 billion and provided 63,800 jobs (Census and Statistics Department, 2012).

Senior management of selected prominent establishments provided their views on short-term business performance (quarter-to-quarter changes) in a Hong Kong 2012 business tendency survey. Most felt that the business situation, volume of business, profits, and number of persons employed in the professional and business sector and in the construction sector would stay the same or improve (Census and Statistics Department, 2012).

Major issues

In a rapidly changing multi-faceted Hong Kong and in many parts of the world, growing demands/challenges from the general public and challenges concerning environmental and economic sustainability confront the engineering profession, as well as governments. To handle the situation, several issues must be addressed within the profession itself, within the construction industry, and then within the community and government.

Sustainable culture: Civil engineers have the knowledge to provide services in sustainable design and construction competently. To cope with public demands for greater sustainability and for greater information on the potential environmental impacts of proposed projects, engineers need to make sustainability and public information foremost considerations, and the construction industry must build up a sustainable culture involving changes in mindset and behaviour. The unique/genuine sustainable culture could be reflected upon the civil engineering and construction industries, in project life cycle, quality education, and professional development.

Professional status: Civil engineers (and civil-related disciplines) must work together to uphold professional status and to promote a positive public image of the profession. This involves helping the community understand engineering with programs aimed at school children and public/media involvement. Engineers must make politicians and the public aware that civil engineers are at the forefront of making Hong Kong a world-

class city by providing services that directly affect the quality of human life/livelihood, and by creating the infrastructure that supports the dynamic economy. The fundamental issue is reflected in the vision and mission statements of the CSCE Hong Kong Branch (CSCEHKB website, 2012).

Engineers must uphold and enhance not only the status of engineers but also the status of Hong Kong construction and skilled workers. The falling numbers of students taking civil engineering (and civil-related disciplines) subjects and training courses in construction trades is not a good sign and may be symbolic of a decline in the stature of construction-related activities.

Strengths and weaknesses of the construction sector: A general view of the civil engineering/ construction sector in Hong Kong is presented in Table 2. Other (often internal) factors may affect individuals, companies, or government differently.

Engineers' role in government policy: Engineers in Hong Kong need to ensure that the HKSAR Government continues to listen to engineering experts and use the advice of engineers rather than those in other occupations who lack the required expertise. The newly established Representative of Engineering Functional Constituency in the Legislative Council, Ir Dr. W. K. Lo said, "We must redouble our efforts to unite our profession, to protect our professional interests and to facilitate [participation] in the formulation of policies" (Lo, 2012). Engineers are a group of logical and rational people who are competent to provide realistic advice, viable solutions and sensible outcomes to a series of interlocking/ complex problems that the HKSAR Government is facing. Engineers indeed have a unique and challenging role in formulation of government policy.

Concluding remarks

Hong Kong city has an area of about 1100 km^2, nearly two times the city of Toronto (630 km^2). In 2010, Hong Kong's population was about 7.1 million, approximately three times that of Toronto (2.6 million). Like some other cities and countries, Hong Kong has been facing political instability, governance problems, and economic and social disparities, yet HKIE is still forward-looking, keeping its vision and mission, ensuring international relevance, upholding high professional conduct, and promoting the engineering profession with good employment prospects. With the momentum from various government-funded, large-scale infrastructure projects continuing to fuel the industry, the demand for engineering/ construction professionals is assured, and the economic outlook for civil engineering-related business is likely to remain robust in the foreseeable future.

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2. CSA-S850 DESIGN AND ASSESSMENT OF BUILDINGS SUBJECTED TO BLAST LOADS This course presents this new standard which provides criteria for the analysis and design of new buildings and assessment of existing buildings to resist blast loading. It will be offered in Quebec and the Maritimes at a later date. Full details are available at www.csce.ca. Formation présentée en anglais. Elle sera offerte au Quebec et dans les Maritimes ulterieurement. Tous les détails sont disponibles à www.csce.ca.	April 9-11 April 15-18	Winnipeg, Toronto, Ottawa, Vancouver, Calgary, Edmonton, Regina

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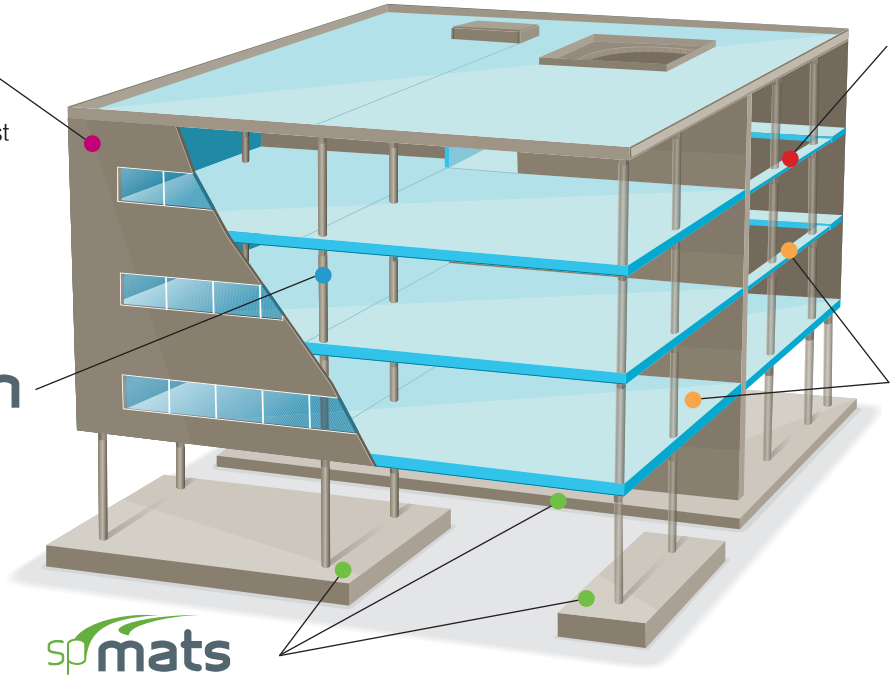

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