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CANADIAN CIVIL ENGINEER
L'INGÉNIEUR CIVIL CANADIEN

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- Post-tensioned Timber
- Building Tall in Light-Framed Wood
- In Memoriam: Dr. Todd Chan

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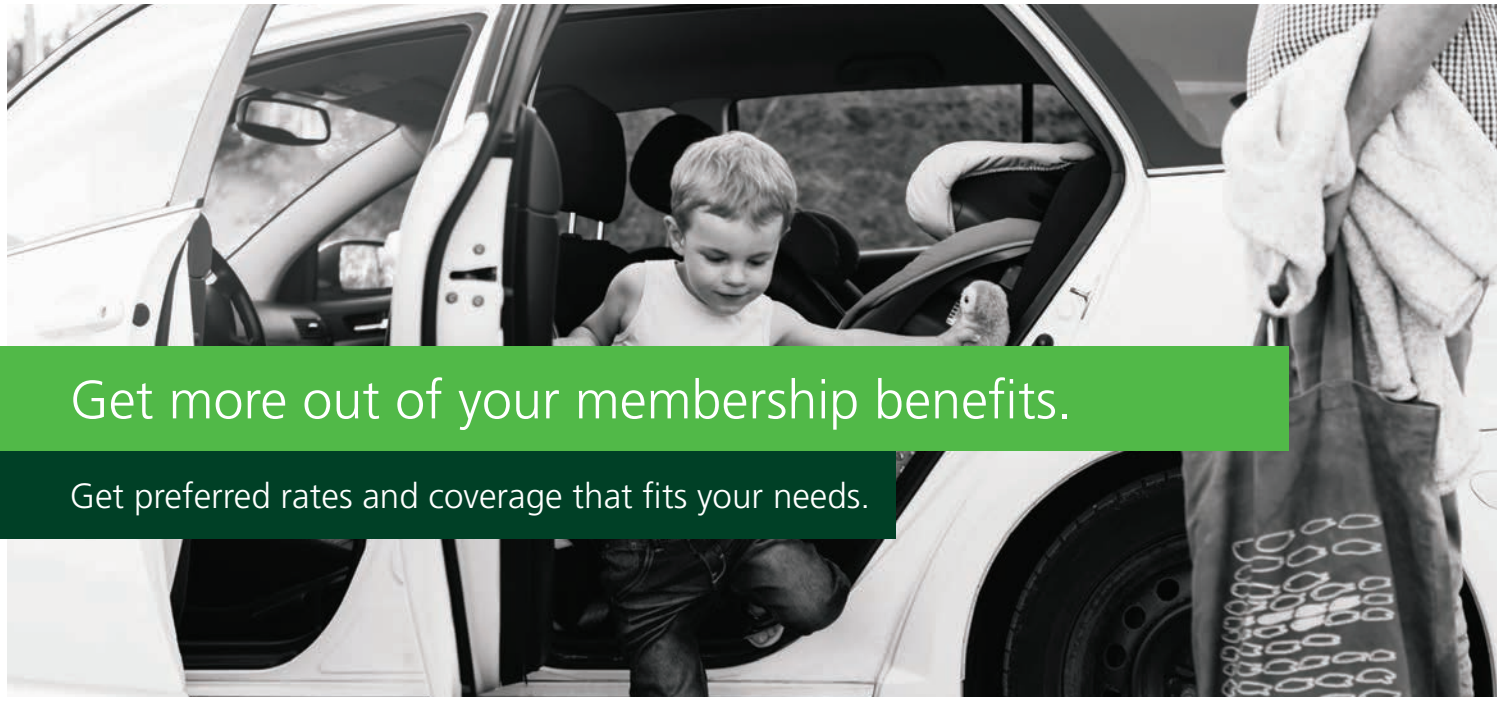

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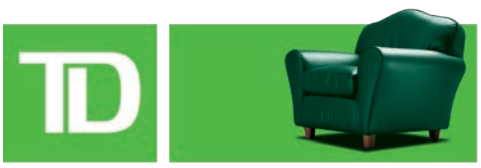

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On the cover: construction of the TallWood House at Brock Commons, UBC (photo: courtesy Seagate Structures)

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Susan Tighe, Ph.D., P.Eng.
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Gearing Up For Fall: Section Activities, Technical Excellence and Communication

It is hard to believe that fall is fast approaching. However, as the cooler weather approaches, it is also an exciting time for CSCE as the Sections and Regions gear up for their various activities. The technical divisions are also working hard on various publications and upcoming conferences.

The National Management Committee has been working to keep the strategic initiatives progressing. I am so impressed with the current activities going on within the society which is only made possible by the dedicated volunteers throughout the organization who work so hard to make CSCE the great organization it is today.

The leadership and expertise within the Canadian civil engineering community is truly world class. The CSCE, as a learned society is committed to highlighting this expertise and dedicated to promoting and raising the awareness of Canada's civil engineering community.

There are major needs for the development and implementation of innovative solutions to correct the infrastructure deficit. This need for novel and state-of-the-art tools to support leadership is paramount to ensure wise and efficient investments are being made. CSCE is working to provide leadership and assistance so that investments are timely, cost effective, environmentally friendly and sustainable.

It thus heavily depends on our communication strategy and support of our sections, which are located across Canada. If you are not actively involved in a CSCE section, then I challenge you to become involved.

Meetings are held across Canada in the respective sections and they provide a great opportunity for you to learn about what is happening in our profession. These meetings provide an excellent opportunity for CSCE members to network, learn and then communicate with others, especially the public on issues and topics that are relevant to civil engineers.

A fundamental goal and mandate of the CSCE is to communicate what we are doing to improve the quality of life of our community. The CSCE has numerous committees and technical divisions that are working in various fields of civil engineering to improve the life of Canadians.

These committees provide opportunities for members to contribute to the CSCE. In addition, it is an opportunity to enhance professional development and career objectives. You are encouraged to review the committees on the csce.ca website and contact the committee chair if you are considering getting involved.

As noted in my previous article, we also have a task force underway to re-examine roles and responsibilities with the ultimate goal of making the national office stronger and relevant for the changing needs of the organization.

If you are interested in providing some feedback, I encourage you to contact Past President,

Jim Gilliland who is leading this initiative. I anticipate that we will have some updates on this task force over the coming months.

Get involved and become an active member in CSCE. Whether that be at the section level or become an active participate on one of the committees or technical divisions, there are opportunities for personal and professional development.

This involvement helps promote the accomplishments of CSCE members and the relevance of the CSCE as a society. At CSCE Head Office, communication is a paramount goal. I believe those that are currently actively involved with the society would agree. It only takes a couple of hours and it will have a big impact on you, your community and your profession!

We look forward to hearing from you! Get involved, we want your feedback! CSCE is the place to be for civil engineering in Canada! ■

Susan Tighe, Ph.D., P.Eng. is Deputy Provost and Associate Vice-President Integrated Planning and Budgeting and the Norman McLeod Professor in Sustainable Pavement Engineering at the University of Waterloo.

Se préparer pour l'automne: activités des sections, excellence technique et communication

Il est difficile de croire que l'automne approche rapidement. Le temps frais annonce aussi des moments passionnants pour la SCGC. Les sections et les régions se préparent pour leurs diverses activités et les divisions techniques aussi travaillent fort sur les publications et les conférences à venir.

Le Comité national de gestion poursuit ses travaux sur des initiatives stratégiques. Je suis très impressionnée par les activités en cours au sein de la Société. Ceci n'est possible que grâce au dévouement des bénévoles qui s'impliquent dans toute l'organisation et qui oeuvrent à faire de la SCGC la grande organisation qu'elle est aujourd'hui.

Le leadership et l'expertise au sein de la communauté canadienne du génie civil sont vraiment de classe mondiale. En tant que société savante, la SCGC s'est engagée à mettre en évidence cette expertise et elle se consacre à la promotion de la communauté canadienne du génie civil ainsi qu'à un accroissement de la sensibilisation du public envers elle.

Il existe des besoins majeurs pour le développement et la mise en œuvre de solutions innovantes pour combler le déficit en infrastructures. Ce besoin d'outils novateurs et à la fine pointe pour appuyer le leadership est primordial pour assurer des investissements judicieux et efficaces. La SCGC travaille à fournir leadership et assistance afin que les investissements entrepris soient opportuns, rentables, respectueux de l'environnement et durables.

Cela dépend donc fortement de notre stratégie de communication et du soutien de nos sections de partout au Canada. Si vous n'êtes pas impliqués activement dans une section de la SCGC, alors je vous défie de vous impliquer.

Des réunions sont organisées dans tout le Canada dans les sections respectives et elles offrent une excellente occasion d'être au fait de ce qui se passe dans notre profession. Ces réunions présentent une occasion unique aux membres de la SCGC pour se connecter, apprendre et communiquer avec d'autres personnes, en particulier avec le public sur des questions et des sujets pertinents pour les ingénieurs civils.

Communiquer ce que nous faisons pour améliorer la qualité de vie de notre communauté est, pour la SCGC, à la fois un objectif et un mandat fondamental. La Société a de nombreux comités et divisions techniques qui travaillent dans les divers domaines du génie civil pour améliorer la vie des Canadiens.

Ces comités offrent aux membres la possibilité de contribuer à la SCGC. En outre, ils constituent des occasions de développement professionnel et d'avancement des objectifs de carrière. Je vous encourage à consulter les comités sur le site Web csce.ca et à communiquer avec le président du comité qui vous intéresse si vous envisagez de vous impliquer.

Comme je l'indiqué dans mon article précédent, nous avons également un groupe de travail en voie de création qui réexaminera les rôles et les responsabilités dans le but ultime de rendre le bureau national plus fort et plus pertinent pour les besoins changeants de l'organisation.

Si vous souhaitez fournir des commentaires, je vous encourage à contacter le président sortant, Jim Gilliland, qui dirige cette initiative. Des mises à jour sur ce groupe de travail seront disponibles au cours des prochains mois.

Impliquez-vous et devenez membre actif de la SCGC. Que ce soit au niveau de la section ou de l'un des comités ou de l'une des divisions techniques, vous trouverez là des possibilités de développement personnel et professionnel.

Cette implication contribue à promouvoir les réalisations des membres de la SCGC et la pertinence de la SCGC en tant que société. Au bureau national de la SCGC, la communication est un objectif de premier ordre. Je crois que ceux qui sont impliqués activement dans la société seraient d'accord. Cela ne prend qu'une couple d'heures et l'impact sur vous, sur votre communauté et sur votre profession sera important!

Nous avons hâte d'avoir de vos nouvelles! Impliquez-vous, nous voulons vos commentaires! La SCGC est le lieu idéal pour le génie civil au Canada! ■

Susan Tighe, Ph.D., P.Eng., est vice-rectrice et vice-présidente associée, Planification intégrée et budgétisation et professeure Norman McLeod en ingénierie des chaussées durables à l'Université de Waterloo

Quebec : A matter of region

Frédéric Brunet
QUEBEC REGIONAL VP, CSCE

Over the past few years, the Quebec Region has set itself the objectives of improving communication and collaboration between its various sections. In May 2017, the Region organized a workshop for the three sections and the six student chapters to discuss their common vision and objectives. These included:

1. Conduct biennial workshops to increase exchanges and strengthen relationships.
2. Set up a common website for the entire region to consolidate communications.
3. Hold an annual regional presentation based on the popular demand of our members.
4. Organize an annual visit to a major construction site for the various student chapters.
5. Jointly organize the CSCE 2019 Annual Conference.

During the last CSCE Board of Directors it was decided that the CSCE 2019 Annual Conference would be held again in Montreal. The Local Organizing Committee will be jointly chaired by François Leprince of the Quebec Section and Jean-Luc Martel of the Montreal Section. The goal of the committee is to have an active collaboration between the three local sections to organize this event and make it a regional success. It is planned that the portion of the conference profits that is allocated to the host section and the region will be fully managed at the regional level in order to pursue the common objectives outlined above.

Moreover, the Quebec region has a website that groups together the three sections (Montreal, Quebec and Sherbrooke): https://www.scgcquebec.ca/. In addition to modernizing and standardizing the region's image, this approach makes it possible to centralize information and to increase our partners' visibility. Also, the student chapters, which are also accessible via this website, have set up a communication hub via Facebook. This approach allows them to share the activities they have carried out and to communicate their recommendations. In short, the Quebec region is working to unite all its sections and student chapters in order to work together to improve member services, increase the visibility of partners and boost the experience of its volunteers. ■

If you have any suggestions or you are interested in learning more about our activities and events, please do not hesitate to contact me: vice-president-region@scgcquebec.ca.

Québec : une affaire de région

Frédéric Brunet
V-P. RÉGION DU QUÉBEC, SCGC

Depuis quelques années, la région du Québec s'est donnée pour objectifs d'améliorer la communication et la collaboration entre ses diverses sections. En mai 2017, la région du Québec a organisé un séminaire où les trois sections et quatre des six chapitres étudiants se sont rencontrés afin de discuter de leur vision et de leurs objectifs communs. Parmi ces objectifs :

1. Tenir des séminaires bisannuels afin d'accroître les échanges et consolider les relations.
2. Avoir un site web commun pour l'ensemble de la région dans le but de regrouper les communications.
3. Tenir une présentation annuelle régionale en fonction de la demande populaire de nos membres.
4. Organiser une visite annuelle d'un chantier de construction majeur pour les différents chapitres étudiants.
5. Organiser conjointement le congrès annuel 2019 de la SCGC.

Durant le dernier conseil d'administration de la SCGC, il a été voté que la tenue du congrès annuel 2019 de la SCGC se tiendrait à nouveau à Montréal. À cet effet, le comité d'organisation local sera présidé conjointement par François Leprince de la section de Québec et Jean-Luc Martel de la section de Montréal. L'objectif du comité est de mettre sur pied une collaboration active entre les trois sections locales pour l'organisation de cet événement et d'en faire un succès régional. Il est établi que l'ensemble des profits du Congrès seront récupérés par la région, lui permettant de poursuivre ses objectifs décrits ci-haut.

Par ailleurs, la région du Québec s'est dotée d'un site web qui regroupe les trois sections (Montréal, Québec et Sherbrooke) : https://www.scgcquebec.ca/. En plus de moderniser et d'uniformiser l'image, cette démarche permet de centraliser l'information et d'accroître la visibilité de nos partenaires. Par ailleurs, les chapitres étudiants, qui sont aussi accessibles via ce site web, ont adopté un pôle de communication via Facebook. Cette approche leur permet de partager les activités qu'ils ont réalisées et de transmettre leurs recommandations.

En somme, la région du Québec s'affaire à unir toutes ses sections et ses chapitres étudiants afin de travailler de pair dans le but de bonifier les services aux membres, d'augmenter la visibilité des partenaires et de dynamiser l'expérience de ses bénévoles. ■

Si vous avez des suggestions ou êtes intéressés à en savoir plus sur nos activités et nos événements, n'hésitez pas à me contacter: vice-president-region@scgcquebec.ca.

Student Chapters: Opportunities for Professional Development

Charles-Darwin Annan, Ph.D., P.Eng.
CHAIR, STUDENT AFFAIRS COMMITTEE, CSCE

Once again, a new school year is here and I would like to extend a heartfelt welcome to all civil engineering students across Canada. You have come from far and wide but with a common goal to succeed in your academic pursuits. The Canadian Society for Civil Engineering (CSCE) Student Affairs Committee wishes you well.

Academic success is indeed one key element in developing your future civil engineering career, but so are elements such as personal and professional development. Your CSCE Student Chapter is an excellent medium for you to develop or sharpen your personal and professional skills.

Participation in your chapter's activities gives you the opportunity to visit engineering works, help organize chapter events, run for a student leadership office, prepare written reports and make oral presentations to small and large audiences, participate in local, regional and national CSCE meetings and conferences, and interact with other civil engineering students from different universities and colleges. Essentially, we are here to help you prepare for entry into your noble profession.

The 2016/2017 academic year was hugely successful with increased

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Les chapitres étudiants de la SCGC: Des opportunités de développement professionnel

Par Charles-Darwin Annan, Ph.D., P.Eng.
PRÉSIDENT, COMITÉ DES AFFAIRES ÉTUDIANTES DE LA SCGC

À l'orée de la nouvelle année scolaire, je souhaite un accueil sincère à tous les étudiants en génie civil du Canada. Vous êtes venus de divers horizons, mais avec l'objectif commun de réussir votre parcours académique. Le Comité des affaires étudiantes de la Société canadienne de génie civil (SCGC) vous souhaite bonne chance. Le succès scolaire est en effet un élément clé dans le développement de votre future carrière dans le génie civil. D'autres éléments tels que le développement personnel et professionnel le sont tout autant. Votre chapitre étudiant de la SCGC vous offre un excellent moyen de développer ou d'affiner vos compétences personnelles et professionnelles.

La participation aux activités de votre chapitre vous donne l'opportunité de visiter des chantiers de travaux d'ingénierie, d'organiser des événements du chapitre, de postuler à un poste de direction, de préparer des rapports écrits et de faire des présentations orales devant de petites et de grandes audiences. Vous participerez à des réunions et conférences locales, régionales et nationales de la SCGC, vous interagirez avec d'autres étudiants en génie civil de différents collèges et universités. Notre rôle principal est de vous aider à préparer votre

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Why I Volunteer with a Committee

Nicholas C. Kaminski, P. Eng., PMP, MCSCE
CSCE YOUNG PROFESSIONALS COMMITTEE VP TREASURER AND VP COMMUNICATIONS

My involvement with the Young Professionals Committee began in January of 2016 when I assumed the executive roles of VP Treasurer and VP Communications. Presently, I also serve as Secretary of the South Saskatchewan Section of the CSCE in Regina. I joined the Young Professionals Committee to help foster the growth of our society and to contribute to a profession that has given so much to me in my career.

In joining the committee, I wanted to volunteer my time and contribute something meaningful to the society, and I can say it has been instrumental in my own personal career development. During my time with the committee, we have made numerous strides in expanding the reach and involvement of young professional members across the country, which makes me proud to represent our society.

The various benefits of participating with a national, regional or local committee includes enhanced networking with civil engineers varying in experience levels and sectors, gaining valuable volunteer experience and, most of all, contributing to one of the oldest engineering societies in the country.

Volunteering your time alongside peers, while progressing towards a common goal, is a rewarding experience. I encourage all young professionals to take the next step and join a committee or board with the CSCE as the benefits certainly outweigh the commitment. You can truly make a difference for the society and our profession while advancing your own career objectives.

We are always looking for additional members to bring experience and diversity to our National Committee as young professional representatives or to participate in executive roles. Assistance is always needed and we rely on the help of our volunteers to provide the many services the CSCE offers to its members. ■

The Young Professionals Committee is always open to answering any questions you may have and providing assistance whenever we can. Contact information for our members can be found on the CSCE's website. (kaminski.nick@icloud.com)

Jeunes professionnels: pourquoi je suis bénévole dans un comité

Nicholas C. Kaminski, P. Eng., PMP, MSCGC
V-P TRÉSORIER ET V-P COMMUNICATIONS, COMITÉ DES JEUNES PROFESSIONNELS DE LA SCGC

Ma participation au comité des jeunes professionnels a commencé en janvier de 2016 lorsque j'ai assumé les fonctions de vice-président trésorier et de vice-président des communications. À l'heure actuelle, je suis également secrétaire de la Section sud de la Saskatchewan de la SCGC à Regina. J'ai rejoint le Comité des jeunes professionnels pour aider à faire croître notre Société et pour contribuer à une profession qui m'a tant donné durant ma carrière.

En rejoignant le comité comme bénévole, je voulais faire une contribution significative à la Société et je peux dire que cela a joué un rôle déterminant dans le développement de ma carrière. Pendant mon implication au sein du comité, nous avons accompli de grands progrès pour élargir l'engagement de jeunes membres professionnels à travers le pays. Cela me rend fier de représenter notre société.

Les divers avantages d'une implication dans un comité national, régional ou local comprennent un plus grand réseautage avec des ingénieurs civils de niveaux et secteurs d'expérience variés, une expérience de bénévolat importante et, plus particulièrement, une contribution à l'une des plus anciennes sociétés d'ingénierie du pays.

Donner de son temps en compagnie de ses pairs pour agir dans un but commun est une expérience enrichissante. J'encourage tous les jeunes professionnels à rejoindre un comité ou un conseil de la SCGC car les avantages l'emportent certainement sur l'engagement. Vous pouvez vraiment faire une différence pour la Société et notre profession tout en faisant avancer vos objectifs de carrière.

Nous sommes toujours à la recherche de nouveaux membres pour apporter expérience et diversité à notre comité national en tant que jeunes représentants professionnels ou pour occuper des postes de direction. Nous avons toujours besoin d'assistance et nous comptons sur l'aide de nos bénévoles pour fournir les nombreux services qu'offre la SCGC à ses membres. ■

Le Comité des jeunes professionnels est toujours disponible pour répondre à toutes vos questions et pour vous apporter l'assistance qu'il est en mesure de vous apporter. Vous trouverez les coordonnées de nos membres sur le site Web de la SCGC. (kaminski.nick@icloud.com)

Continued from page 7

interaction among different CSCE student chapters. Participation in the 2017 Annual Student Chapter Leaders Workshop, held in Vancouver in June during the CSCE Annual Conference, increased by over 100% compared to the previous year. The National Civil Engineering CAPSTONE Design Competition also recorded an increase in participation. More than ever before, we are seeing our students' resolve to enrich themselves and build those lifelong and valuable professional networks.

This school year, I envision new opportunities and I encourage every student to take advantage of the FREE student membership. We will continue to provide support to our student chapters by offering programs to provide excellent networking opportunities. This is the time to get involved. ■

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

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entrée dans votre noble profession.

L'année universitaire 2016-2017 a connu un très grand succès avec une interaction accrue entre différents chapitres étudiants de la SCGC. La participation à l'Atelier annuel des leaders des chapitres étudiants de 2017, tenu lors du congrès annuel de la SCGC à Vancouver, a augmenté de plus de 100% par rapport à l'année précédente. Le Concours national de conception CAPSTONE de génie civil a également enregistré une participation plus forte. Plus que jamais, nous constatons la volonté de nos étudiants de s'enrichir et de construire ces réseaux professionnels de toute une vie et si précieux.

Pour cette année universitaire, je prévois de nouvelles opportunités et j'encourage tous les étudiants à profiter de l'adhésion étudiante GRATUITE. Nous continuerons à apporter notre soutien à nos chapitres étudiants en offrant des programmes permettant d'excellentes opportunités de réseautage. C'est le moment de vous impliquer. ■

Le Dr Charles-Darwin Annan est professeur agrégé de génie civil à l'Université Laval et peut être contacté à Charles-darwin.annan@gci.ulaval.ca

CSCE 2017 National Lecture Tour

Lac-Mégantic's Human and Environmental Disaster: the event, the impacts and the lessons to be learned (BC, AB, ON, SK, QC – October 2017 to February 2018)

Senator Professor Rosa Galvez, Ph.D., P.Eng., will describe what happened at Lac-Mégantic when a runaway train containing 74 rail cars of light crude oil derailed and caught fire. She will also outline the efforts made to remediate the impacts to this community and the environment.

Senator Professor Galvez is an expert in environmental impact and risk evaluation, contaminated site restoration and groundwater contaminant transport.

For details, please visit: https://csce.ca/lifelong-learning/national-lecture-tours.

CSCE's 10th International Conference on Short and Medium Span Bridges 2018

The 10th International Conference on Short and Medium Span Bridges, SMSB – X, will take place in Quebec City on July 30 – August 3, 2018.

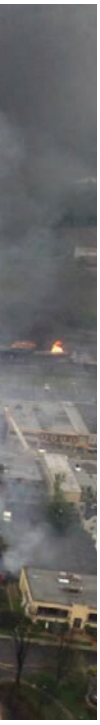
The SMSB Conference is organized under the auspices of the Canadian Society for Civil Engineering and is held every four years. This very successful conference has traditionally provided a worldwide state-of-the-art forum on all aspects of short and medium span bridges.

Abstracts will be accepted by November 27, 2017 and full papers must be received January 18, 2018.

For more information about the conference please visit: http://www.smsb-2018.ca/

La 10e Conférence internationale sur les ponts de petite et moyenne portée 2018 de la SCGC

La 10e Conférence internationale sur les ponts de petite et moyenne portée, SMSB – X, se tiendra à Québec, du 30 juillet au 3 août 2018. La conférence SMSB est organisée par la Société canadienne de génie civil et a lieu tous les quatre dans une ville du Canada. Cette conférence rencontre un très grand succès et a traditionnellement fourni un



La Tournée nationale de conférences 2017 de la SCGC

Le désastre humain et environmental du Lac-Mégantic: l'événement, les impacts et les leçons à tirer (B.-C., AB, ON, SK, QC – octobre 2017 à février 2018)

La sénatrice professeur Rosa Galvez, Ph.D., P.Eng., décrira ce qui s'est passé à Lac-Mégantic lorsqu'un train de 74 wagons de pétrole brut léger a déraillé et pris feu. Elle décrira également les efforts déployés pour corriger les répercussions sur cette communauté et l'environnement.

La sénatrice professeur Galvez est une experte en impacts sur l'environnement et l'évaluation des risques, la restauration des sites contaminés et le transport de contaminants des eaux souterraines.

La présentation sera faite en anglais.

Pour plus de détails, visitez: https://csce.ca/lifelong-learning/national-lecture-tours.

forum mondial sur l'état actuel des connaissances sur tous les aspects des ponts de petite et moyenne portée.

Les résumés seront acceptés au 27 novembre 2017 et les communications finales doivent être soumises au 18 janvier 2018.

Pour plus d'informations sur la conférence, veuillez visiter: http://www.smsb-2018.ca/.

The TallWood House at Brock Commons

Paul Fast, P.Eng, Struct.Eng., P.E., FIStructE
Robert Jackson, P.Eng.

REPRINTED WITH PERMISSION, STRUCTURE MAGAZINE, JUNE 2017

The tallest contemporary wood building in the world was completed this summer at the University of British Columbia (UBC) in Vancouver.[1] Brock Commons (Fig. 1) is an 18-story student residence that is a mass timber hybrid and measures a record 53 meters. Fast + Epp are the structural engineers, working in conjunction with Acton Ostry Architects and Hermann Kaufmann Architekten.

Project Background

UBC is experiencing an increase in demand for student housing and has a sustainability commitment to a campus that acts as a "Living Laboratory" where innovation is encouraged, not only in academia, but also in building and infrastructure. By pairing this drive with the potential for external funding related to mass timber research, the project was born.

The key goals of the project were to create a safe, functional, sustainable, and cost-effective residence for UBC students. Delivering a mass timber building with a construction cost that aligned with the unit cost of a comparable traditional concrete tower in Vancouver was an important goal, to demonstrate the viability of wood as a practical material for tall building applications.

To facilitate this effort, an integrated design team was assembled by the university. The construction manager was appointed and the timber installer and concrete trades joined the team in a design-assist role, providing real-time feedback on the evolving structural design and offering valuable constructability advice.

The structure is comprised of 17 stories of five-ply cross laminated timber (CLT) floor panels, a concrete transfer slab on the second floor, and a steel framed roof. The CLT panels are point supported on glulam columns on a 2.85m x 4.0m grid. Beams were eliminated from the design by utilizing CLT's two-way spanning capabilities. Two full height concrete cores provide the lateral stability for the structure.

Structural System

The design intent was to keep the structure simple and sensible: develop a prefabricated "kit-of-parts" that could be installed quickly and easily, with minimal labour on site.

CLT is often used as a one-way decking system, ignoring the two-way spanning capability afforded by its cross laminations. By utilizing CLT to span in both directions, the design team was able to eliminate beams, significantly reducing the overall structural depth (Fig. 2).

This created a clean, flat, point-supported surface, allowing for unobstructed service distribution, as is commonly found in flat-plate concrete construction. Further, by adjusting the column grid and architectural program to suit the maximum available panel size, the team was able to both minimize the overall number of panels and maximize the efficiency of the system.

The primary lateral support for earthquake and wind loading is provided by two concrete cores. Although timber-based lateral force-resisting systems such as CLT walls/cores, timber braced frames, or post-tensioned/self-centering systems were feasible design options for this project, the testing, time, and costs required to obtain regulatory approvals would have negatively impacted the client's budget and completion date.

Design Challenges

• *Codes and Standards*

The current British Columbia Building Code (BCBC 2012) limits the height of wood buildings to six stories. As such, a special approvals process was required for this project. The design is based on a Site Specific Regulation (SSR), administered by the Building Safety and Standards Branch of the BC Provincial Government and is applicable solely to

[1] *The Sakyamuni Pagoda of Fogong Temple built in China in 1056 stands 67.31 m (220.83 ft) and is the tallest wood building in the world.*

Seagate Structures

Figure 1: Timber erection – summer 2016. (Right) Figure 2: Point supported CLT system

Seagate Structures

this project and site.

Due to the complexity of the project, two independent structural peer reviews were completed. The first independent review was timber focused and was completed by Merz Kley Partner ZT GmbH in Dornbirn, Austria. The second was seismic focused, and was completed by Read Jones Christoffersen Consulting Engineers in Vancouver.

• *Prefabrication*

Prefabrication is an essential consideration when designing large-scale wood structures. Well-planned erection and shop drawings are vital to ensuring smooth production and installation of timber elements. This results in less errors on site, less remedial work, and a shorter overall construction schedule.

All CLT and glulam elements were CNC machined with quality control protocols to better ensure a seamless erection of the timber superstructure.

To help achieve a high level of prefabrication for all design disciplines, CadMakers, a third-party consultant, modelled the building and helped coordinate design documents pri-

Fast + Epp

Figure 3: Point supported CLT panel testing apparatus and failure.

Figure 4: Proof of concept mock-up.

or to and during construction.

This 3D model, created with CATIA software, includes fully-detailed structural elements and connections, as well as mechanical/electrical systems, architectural fit-outs, formwork panels, safety guards, etc. The model allowed all CLT penetrations for mechanical and electrical sleeves to be fully coordinated during the design process and their conversion into fabrication files (CAD/CAM) needed for CNC machining.

• *Point Supported CLT*

In addition to stiffness and bending requirements, rolling shear stresses at the column supports are typically a controlling factor in two-way, point-supported CLT floor plates. A rolling shear failure is one in which the fibers "roll over" each other, due to shear forces perpendicular to grain. After designing the custom lamination layup to suit the rolling shear and flexural demands, the design team completed 18 full-scale load tests on panels from three prospective CLT suppliers at the FPInnovations laboratory in Vancouver to validate the analysis.

There appeared to be some capability for the CLT to redistribute forces as internal shear cracks propagated through the panel before the critical failure mode occurred. Multiple types of shear/bending failures were observed near the supports (Fig. 3).

• *Column Shortening and Shrinkage*

In tall wood buildings, axial column shortening needs to be considered during design. When properly accounted for, the shortening should not negatively affect the construction, use, or long-term performance of the building.

Several factors affect glulam column shortening:

- Dead load elastic axial shortening (Δ = PL/AE)
- Live load elastic axial shortening (Δ = PL/AE)
- Shrinkage parallel to grain
- Joint settlement
- Column length tolerances
- Wood creep

The main concerns surrounding these shortening effects are the impact of the deformations on the vertical mechanical services, as well as the differential movement between the wood superstructure and the stiff concrete cores. The effects of these factors culminate at the roof level, where all columns below contribute to the shortening. To mitigate a portion of these effects, a series of 1/16-inch thick steel shim plates were added during construction, on three strategic levels, at the column-to-column connections.

• *Monitoring*

In an effort to better understand the unique behaviors of the building, the structure will be fitted with accelerometers, moisture meters, and vertical shortening string pots. Research teams at the University of British Columbia are undertaking this work as a part of the "Living Laboratory" initiative.

The data collected from the accelerometers and inclination gauges will help to verify the building's performance in a significant seismic event. The string pots will measure the floor-to-floor axial column shortening at strategic levels, which will provide more insight into axial column shortening in highly loaded glulam columns.

Lastly, moisture meters and data loggers will be installed in the CLT panels, collecting data from the manufacturing plant to the final installed condition. The meters will continue to measure moisture content throughout the service life of the building, which, in a few years' time will give a moisture content timeline from fabrication to moisture equilibrium.

Construction

• *Proof of Concept Mock-Up*

To validate the constructability of the proposed design, the construction team built a full-scale mock-up of a portion of the building, 8m x 12m in plan and two stories tall. The mock-up included several connection types to help determine and optimize the details used in the final design (Fig. 4). In addition, the mock-up was used for the development and evaluation of various building envelope systems considered for the project.

• *Construction Sequencing*

In order to facilitate the use of one crane and provide sufficient time for manufacturing and shipping of the heavy timber elements, the construction team erected the concrete cores to full height, and installed the L2 transfer slab throughout the winter of 2015/2016.

In June 2016, the timber and envelope installation began. This was completed in four phases. The first involved erecting all columns on one level, diagonally bracing them and using horizontal spreader bars at the column caps to set the grid (Fig. 5). The columns were installed by hand from bundles on the active deck, freeing up the crane for envelope panel installation.

The second phase was installation of the CLT panels, stitching adjacent panels as the active deck moved away from the cores (Fig. 6). The third phase was the installation of the steel drag plates at the concrete cores and perimeter angles to support the curtain wall system. The fourth was the installation of the envelope elements on the floor below the active deck (Fig. 7). Erection of the timber and envelope panels was completed in just nine weeks, with the four-step installation sequence repeating itself.

Conclusion

A mass timber building of this scale carries a unique set of engineering challenges, many of which can be mitigated through the use of innovative design strategies and strong quality control protocols. To date, the project has proven cost-competitive with concrete towers in the local marketplace, largely achieved by an integrated design team, real-time input from trades and structural discipline. This large scale prefabricated project is a testament to fresh thinking and holistic design. ■

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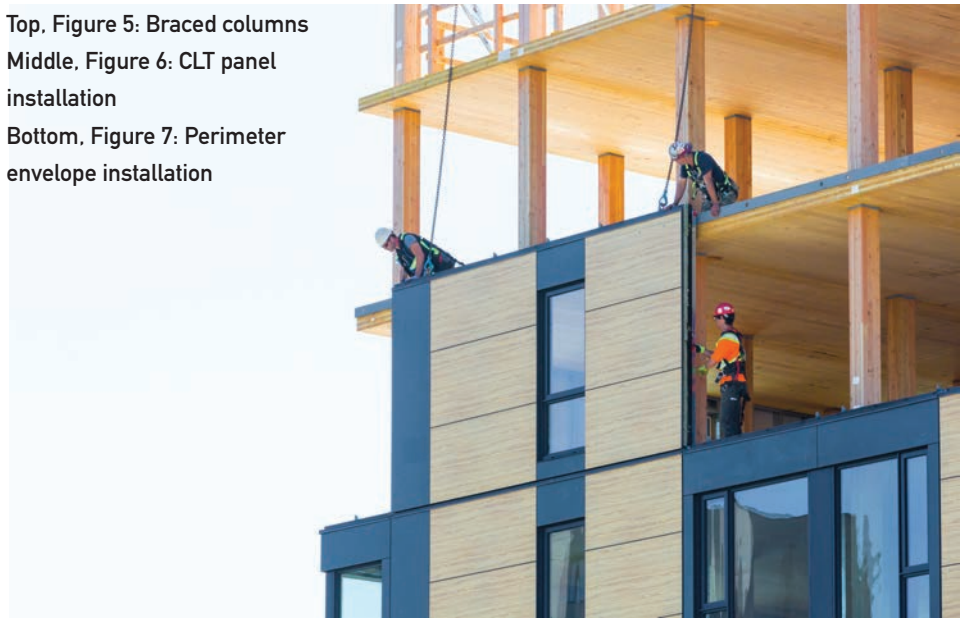
Seagate Structures

Seagate Structures



Steven Errico

Top, Figure 5: Braced columns
Middle, Figure 6: CLT panel installation
Bottom, Figure 7: Perimeter envelope installation

New Heights for Wood Buildings Worldwide

Mahdy A. Hamada, Ph.D., P.Eng., M.ASCE, MCSCE
TEAM LEAD/PROJECT MANAGER, STRIK BALDINELLI MONIZ LTD.
CSCE INDUSTRY LIAISON COMMITTEE

This issue of CIVIL Magazine has a theme around Wood Structures. In the past few years, a new trend of tall and mid-rise wood buildings emerged and resulted in a worldwide wave of interest, research and a tall buildings' height race.

Wood buildings are popping up everywhere all over the world, from North America all the way to New Zealand. The tall building industry is now interested in mass timber structures, while the mid-rise building industry is focusing more on light-framed wood construction.

Building tall in wood stems from our responsibility towards more sustainable and environmentally-friendly construction processes. Global warming is a sounding alarm nowadays; with greenhouse gas emissions considered one of the significant causes. Wood buildings have an important role in reducing these greenhouse gasses. In addition, wood buildings typically have less embodied energy, are responsible for lower air pollution, and have a lighter carbon footprint than other commonly used methods of construction.

The use of wood in construction raises the issue of potential impact on forests. However, several studies show that as long as there is a sustainable forest management plan, the sustainable wood buildings industry can go forever. Canada has one of the largest areas of original forest cover in the world and the usage of wood as a feasible and green alternative for construction is a must.

The performance of Wood buildings during past catastrophic events, such as earthquakes, paved the way for new design codes and manuals of practice towards allowing higher wood buildings. I hope you enjoy the technical papers presented in the current issue of CIVIL Magazine. ■

Nouvelles hauteurs pour les bâtiments de bois à travers le monde

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Ce numéro de la revue CIVIL a pour thème les structures de bois. Ces dernières années ont vu apparaître une nouvelle tendance de bâtiments de bois de grande et moyenne hauteur qui a entraîné de l'intérêt, des recherches ainsi qu'une course aux bâtiments de hauteur à l'échelle mondiale. Des bâtiments de bois apparaissent partout au monde, de l'Amérique du Nord à la Nouvelle-Zélande. L'industrie des bâtiments hauts s'intéresse maintenant aux structures en bois massif alors que celle des bâtiments de hauteur moyenne se concentre sur les ouvrages à charpente légère.

Bâtir en hauteur avec du bois résulte de notre responsabilité d'adopter des processus de construction plus durables et plus respectueux de l'environnement. Le réchauffement climatique a atteint un point critique et les émissions de gaz à effet de serre sont considérées comme l'une de ses causes importantes. Les bâtiments de bois jouent un rôle significatif dans la réduction de ces gaz à effet de serre. En outre, ils ont généralement moins d'énergie grise, créent moins de pollution de l'air et ont une empreinte carbone plus légère que les autres méthodes de construction couramment utilisées. L'utilisation du bois dans la construction soulève la question de son impact potentiel sur les forêts. Cependant, plusieurs études démontrent que, tant qu'il existe un plan de gestion durable des forêts, l'industrie des bâtiments de bois peut perdurer. Le Canada possède l'une des plus grandes zones de couverture forestière originale au monde et l'utilisation du bois comme alternative viable et verte pour la construction est un must. La performance des bâtiments de bois dans les catastrophes, telles que les tremblements de terre, a ouvert la voie à de nouveaux codes de conception et à des manuels de pratique permettant la construction de bâtiments en bois plus hauts. J'espère que vous apprécierez les documents techniques présentés dans ce numéro. ■

Post-tensioned Timber Structure: A Novel Solution for Multi-storied Buildings

Asif Iqbal and Marjan Popovski

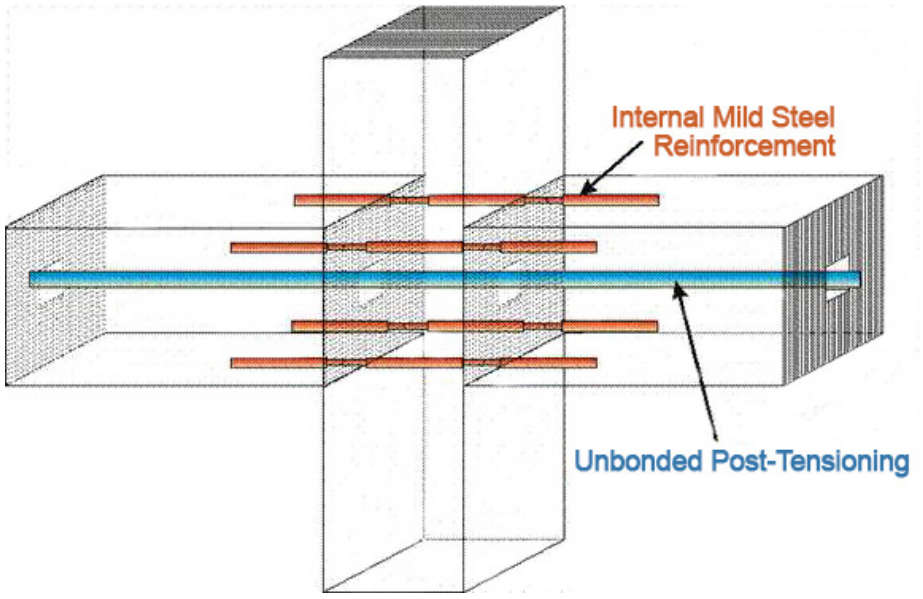
A new type of mass timber structural system has been developed in New Zealand over the last decade. Timber members made of engineered wood products are used in combination with post-tensioning cables to produce highly efficient structural components suitable for multi-story moment resisting frames or shear wall-based lateral load resisting systems.

Both systems are particularly useful in structures designed in high seismic regions. The post-tensioning also ensures self-centering of the components and the structural systems after a seismic event.

In addition to the post-tensioning, the systems can use energy dissipating devices within the connections that further enhance the ductility of the systems and make them good candidates for low damage structural applications.

Extensive experimental and numerical studies have been conducted to determine the performance of these systems, and design procedures have been developed for practical applications. In an effort to bring this system closer to North American designers, a summary of the evolution of the concept and the most important research projects and findings to date are presented here

In addition, a number of applications within and outside New Zealand are reviewed to demonstrate the applicability of the concept. Potential and recent initiatives for adoption of the technology in North America are also discussed.



Post-tensioned timber

The Concept

Around the middle of the last decade a research program was initiated in New Zealand on the application of post-tensioning in structural members and systems made of engineered wood products. In the case of moment-resisting frames, the addition of the post-tensioning forces increases the moment capacities of connections and gives the entire frame a self-centering property after removal of the lateral load.

Additional replaceable ductile elements can be used as energy dissipators during seismic loads. These dissipators not only absorb the seismic energy during an earthquake, but also protect the structural members from serious damage.

Engineered wood products have been found to be particularly suitable for this type of application because of their superior strength characteristics and volumetric stability compared to sawn timber.

The concept has been applied so far to different engineered wood products such as Laminated Veneer Lumber (LVL), Glue Laminated Timber (Glulam) and Cross Laminated Timber (CLT). One of the common energy dissipating connections consisted of axially loaded deformed bars, encased in steel tubes to prevent buckling.

A high level of deformation can be achieved by the 'fuse' with the possibility of replacement after yielding.

Research

As part of a comprehensive research investigation for the development of innovative seismic resisting systems for timber construction, a number of different hybrid solutions for frame and wall systems were successfully tested for implementation in multi-storey LVL buildings at the University of Canterbury, Christchurch, New Zealand.

Initially beam to column, column-to-foundation, or wall to foundation connections were tested with and without energy dissipation devices.

Figure 1: Arts and Media Centre of Nelson-Marlborough Institute of Technology, Nelson, NZ.

The research was extended to shear walls coupled with energy dissipating elements and interior beam column joints, which was followed up by tests on a two-storey building model (Buchanan et al. 2011).

These tests were followed by a feasibility study with applicability of the technology in multi-storied buildings. A six-storied timber building was designed and it was estimated to be comparable to concrete and steel in terms of cost and construction time (Smith et al. 2009).

The tests confirmed the behavior of the assemblies as well as feasibility of adopting the system in multi-storied building structures.

The two-storied model suffered little damage and was re-used as a practical structure providing office space after some modifications. Design procedures were developed based on the research findings and design guidelines were published for practitioners (Expan 2013).

In addition to systems for seismic loading, investigations were performed to the design of frames under gravity loading. The post-tensioned frames designed for gravity loads were also examined for lateral loads.

One of the critical aspects of moment frames is the stiffness of the beam-column connections. In-depth studies were performed to evaluate effects of joint flexibility and to determine the stiffness of the connections. Attempts were made to increase the stiffness with long screws acting as reinforcements.

A number of post-tensioned assemblies were instrumented and monitored for about a year to observe long-term performance of the members followed by an analytical study to quantify the parameters. A separate study reported long-term performances of hollow beams with straight and draped tendons. The results suggest that the post-tensioned systems are capable of satisfactory performance over the expected life span of buildings.

It should be mentioned that the post-tensioned concept is applicable not only to structures made of LVL but also to those with other types of engineered wood products. Experimental and analytical investigation of beam-column joints made of Glulam was performed. Post-tensioned core structures made of CLT panels were also tested.

Applications

The first building (Figure 1) built with this system is the Arts and Media Centre of Nelson-Marlborough Institute of Technology (NMIT) in Nelson, New Zealand with post-tensioned LVL shear wall panels and U-Shaped Flexural Steel Plates (UFPs) (Devereux et al 2011).

The post-tensioned structural frame system with wood has been used in some variations. One of them is in a podium structure for College of Creative Arts of Massey University in Wellington, New Zealand (Figure 2). The bottom two stories of the building are of concrete and the top three are made of wood. Innovative connection details were used in the column to overcome the weakness of LVL in perpendicular-to-the-grain direction; a wood-concrete composite system was used for floors (Cattanach and Davies 2012).

The Trimble Navigation building in Christchurch, New Zealand (Figure 3) is a prime example of application of the idea in different types of connections. The typical frames have post-tensioning with energy dissipating ele-

Figure 2: College of Creative Arts of Massey University in Wellington, NZ.

Figure 3: Trimble Navigation building, Christchurch, NZ.

ments at the beam-column joints. The walls and columns have energy dissipaters connected to the foundation. The post-tensioned walls also have UFPs between them for additional energy dissipation. The beam-column joints have energy dissipating elements at the connections (Brown et al. 2014).

The new Kaikoura District Council building in New Zealand has been designed to be the first in the world with post-tensioned CLT structure. CLT shear walls have been used alongside LVL beams and columns and wooded floors. A number of other structures are currently at different stages of design or construction.

Since the first application in the NMIT building the concept has been applied in a number of other structures in Europe and North America.

Following up on the work done on gravity frames in New Zealand, researchers at the Swiss Federal Institute of Technology in Zurich decided to design and construct the House of Natural Resources within the campus as a research facility for sustainable construction (ETH 2015).

Three structures are currently in the planning and design phase in North America. The proposed Cathedral Hill 2 project in Ottawa is a 14-storey commercial-cum-residential building to be built entirely of Glulam and CLT (Below and Sarti 2016). The shear walls

Three structures are currently in planning and the design phase in North America. The proposed Cathedral Hill 2 project in Ottawa is a 14-storey commercial-cum-residential building to be built entirely of Glulam and CLT.

Since the inception a decade ago there has been significant research on post-tensioned timber systems for seismic and non-seismic applications. Further work is continuing in Canada to adopt the technology in North America.

made of CLT will be post-tensioned and will also include energy dissipating connections. One of the two winners of the U.S. Tall Wood Building Competition is the Framework Project (Lever Architecture 2015), a 12-storey building planned for the Pearl district of Portland, Oregon. The building will use CLT as the primary material, with ductile connection details.

The Peavy Building at Oregon State University in Corvallis is in the design phase (Michael Green Architect 2016). This three-storey educational building with a height of 13.7m will use post-tensioned rocking CLT walls with UFPs as energy dissipating devices.

Since the inception a decade ago there has been significant research on post-tensioned timber systems for seismic and non-seismic applications. Further work is continuing in Canada to adopt the technology in North America. Preliminary results indicate the concept has good prospects and further investigations including experimental programs are currently under planning.

Ongoing and Future Developments

In order to facilitate the use of post-tensioning systems in North America, FPInnovations has recently acquired the Intellectual Property (IP) rights for the "Pres-Lam" system in Canada and the United States.

At this moment, FPInnovations with a number of collaborators is developing a comprehensive implementation strategy for the system. The strategy will include a research plan containing the aspects that need to be further addressed, an interaction plan with collaborators and other interested parties, a dissemination plan related to the existing and newly developed research and design information, and a road map for future code acceptance of the system.

A recent study suggested Seismic Performance Factors for application in North America. FPInnovations, along with practitioners from New Zealand, is also working with designers that are currently using the technology in the three buildings mentioned previously.

Conclusion

Although a significant amount of research was conducted in New Zealand to quantify the performance of the "Pres-Lam" system, there is still a need for research to help introduce the system in Canada and the U.S.

As a part of FPInnovations implementation strategy, a new research program has been launched recently in British Columbia to facilitate use of CLT in post-tensioned buildings at the University of Northern British Columbia in collaboration with FPInnovations.

The project focuses on new developments and testing of connection details for seismic applications leading towards development of guidelines for practical applications, by FPInnovations as the IP owner in conjunction with collaborative research by other research institutions. ■

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Building Tall in Light-Framed Wood

Michael Baldinelli, Mahdy A. Hamada and Graeme Baker

Light-framed wood construction has gained significant popularity over the past decade as a sustainable, cost-effective solution for low-rise multi-residential buildings. More recently, the push has been to extend the use of light-framed wood to mid-rise construction for increased density on urban infill projects.

In 2009, British Columbia amended its building code to allow six-story residential wood-framed buildings. In early 2014, the Province of Ontario passed legislation to permit wood-framed buildings up to six stories in the Ontario Building Code, effective January 1, 2015.

Templar Flats in Hamilton, the first six-story light-framed wood building built in Ontario.

Strik Baldinelli Moniz Ltd.

Figure 1: Templar Flats, Hamiton, ON

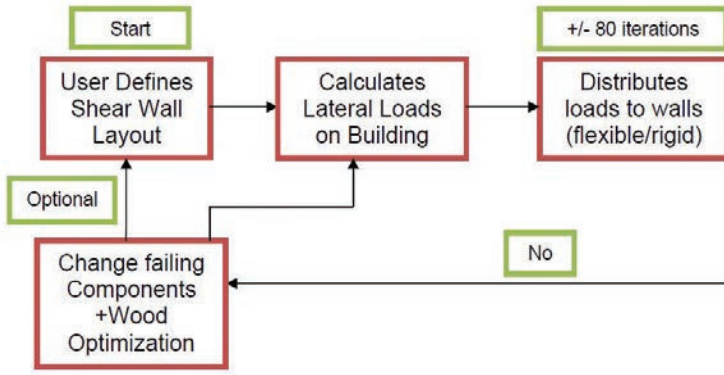

Figure 2: Flow chart of the analysis and design procedure developed by SBM.

Light-Framed Wood Buildings

Light-framed wood (LFW) buildings consist of wood diaphragms, wood shear walls, and wood roof trusses or flat roofs. The substructures consist of simple framing members of dimension lumber sheathed with nailed on wood-based panels such as Oriented Strand Board (OSB) and plywood. Those components are inter-connected through nails or metal connectors to perform as a three-dimensional structural system. Strik Baldinelli Moniz (SBM) designed the first six-story LFW building built in Ontario, shown in Figure 1.

Behavior under Lateral Loads

The current numerical simulation of light-weight wood framed structures available in the literature is limited to one or two-story buildings and is performed on an element-by-element basis. Forces on the structural components and lateral resisting structures are calculated by simplified analysis methods, neglecting the fact that LFW structures are three-dimensional systems including several interacting parts.

Another major challenge in predicting the response of LFW buildings to lateral loads results from the nonlinear nature of the structural response of these structures due to nails slippage. In addition, the structural response depends on the level of loading and the distribution of loads between the lateral resisting systems using assumptions of rigid and flexible diaphragms.

In general, the simplified calculation methods are conservative and lead to over-designed components. In addition, LFW structures are well known to have excellent ability to withstand short-term extreme loads due to its highly redundant structural form and effective energy absorption through the plastic yielding of the slender fasteners between components.

One-dimensional analysis approach was always considered for the analysis of these LFW buildings under lateral loads. Each light-framed shear wall is analyzed separately and designed, without considering the full three-dimensional response.

The lateral loads, at each floor, were distributed assuming flexible diaphragm distribution. Based on each wall design, the light-framed shear wall stiffness and lateral deflection can be calculated.

The one-dimensional approach is satisfactory for shorter simpler houses or small buildings, but not the best option for taller and more complex LFW buildings. A comprehensive three-dimensional modelling technique and software is required to analyze mid-rise wood buildings under lateral loads such as seismic and wind loads.

Three-Dimensional Analysis Approach

SX.N.WD is a sophisticated numerical tool developed by SBM to provide three-dimensional analysis and design for light-framed wood buildings. A simplified flow chart of the analysis and design procedure is shown in Figure 2.

Step 1; define the light-framed shear wall layout for each floor. Each shear wall is composed of wood studs, wood sheathing, nails, com-

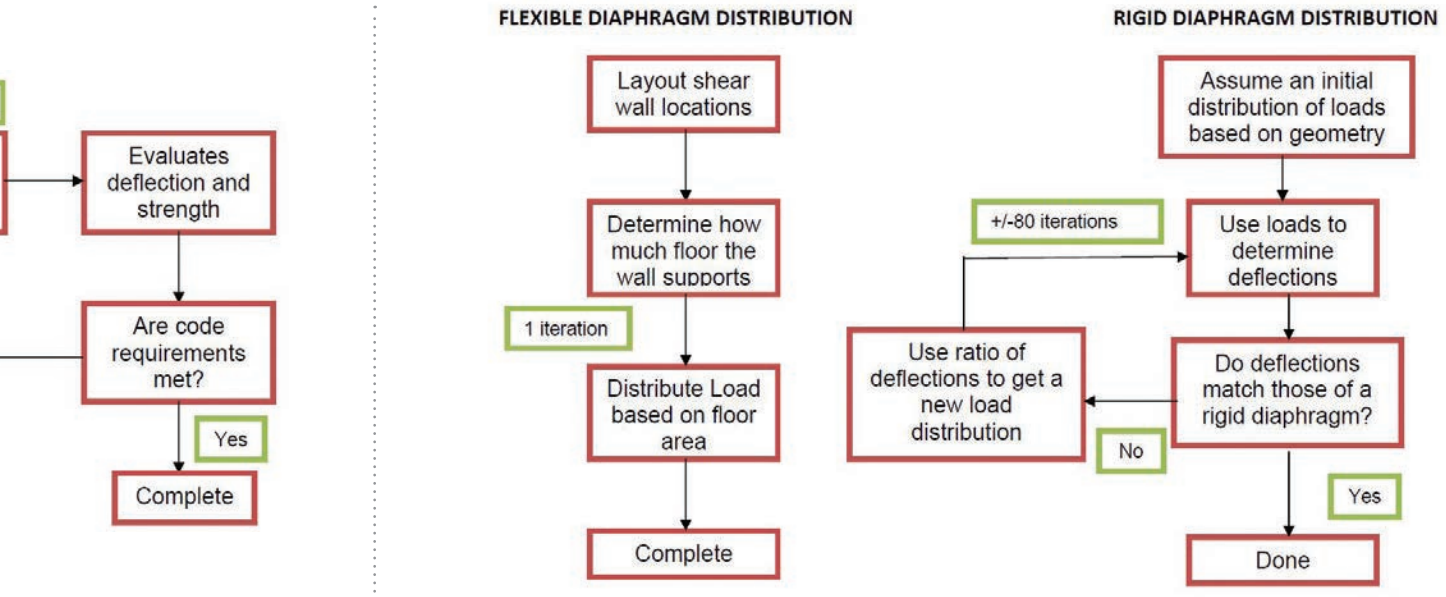

Figure 3: The flexible diaphragm distribution analysis is simple relative to rigid diaphragm distribution

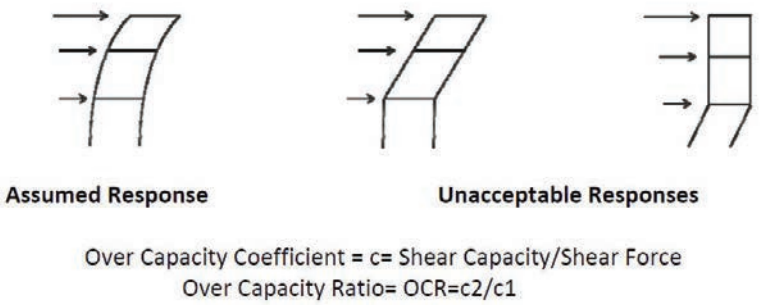

Figure 4: Overcapacity ratios are calculated by the SX.N.WD tool for all floors to avoid a weak storey failure

pression studs, and tension components such as hold downs or tie-rods. The initial layout is considered a starting point for the analysis.

Step 2; the tool calculates the seismic and wind loads on the building using code procedures. Wood buildings have reduced mass and high ductility which are of great benefit of significantly reducing the seismic forces applied. This makes a strong case for LFW to be used in the construction of mid-rise buildings.

Step 3; the current design recommendations by different code bodies states that both flexible and rigid diaphragm analyses are used to distribute the lateral loads applied on wood buildings. The flexible diaphragm distribution is simple and is based on tributary areas. However, the rigid diaphragm case requires iterations and nonlinear analysis as shown in Figure 3. The LFW shear wall stiffness is dependent on the load level and the response is nonlinear.

Step 4; once the lateral loads, due to wind and seismic, are distributed based on both flexible and rigid diaphragms concepts, the strength and deflection of each shear wall system is checked and design is finalized.

CSA O86 and OBC 2012 Code Check

In combination with strength and serviceability checks performed by SX.N.WD, the tool confirms all the CSA O86-14 and OBC 2012 codes' requirements. If any of the code checks fail, the tool iterates the design procedure until all code requirements are satisfied. The overcapacity ratios (OCR) are calculated for all floors to avoid a weak storey failure. The OCR values must be between 0.90 and 1.2, as shown in Figure 4. Accidental torsion and torsional sensitivity are assessed using SX.N.WD. and confirmed to be within code acceptable values.

Optimization Techniques

To optimize the building cost in conjunction with the design, SX-.N.WD selects from a database of wall assemblies (studs, sheathings, fasteners), posts, and tie-downs that are based on the least expensive option (ranked as such), if the option selected 'fails' then next wall assembly, post or hold down is selected, the program typically goes through 300-400 iterations to ensure the design passes all code re-

quirements. Once completed, the most cost efficient code compliant design is produced. The program has been implemented on five wood buildings and found savings of 10-15% versus traditional design methods that are based on one-dimensional or simplified approaches.

Case Studies

Detailed cases studies were conducted to determine the costs of LFW building versus counterparts such as concrete and steel buildings. The framing cost of LFW building can be in the range of $18 to $21/sf. Comparatively, concrete buildings costs on average $28/sf.

Substantial savings are found in the building's foundation due to the significant reduction in mass of LFW buildings. Six-story wood buildings had 10% more concrete in their foundations compared to four-story LFW buildings. The six-story concrete building solution had 70% more concrete in its foundation compared to the six-story wood building.

The true cost difference between wood and concrete buildings would not be 70%, as the concrete volumes do not take into account the forming and labour costs. Similar studies have been performed and a savings of 10 to 12% on overall building construction were observed when compared to traditional building materials, such as concrete and steel.

Future

Wood buildings typically have less embodied energy, are responsible for lower air pollution, and have a lighter carbon footprint than other commonly methods of construction. In addition, the spread of the user is heartened by having a simplified numerical tool that can analyze and design LFW buildings.

The current work done by SBM, in conjunction with the National Research Council (NRC) of Canada and The University of Western Ontario, is a step forward. It will assist the industry in developing sophisticated models for LFW buildings instead of analyzing these structures using hand calculations and approximate methods.

The expected benefit of the three-dimensional modelling over the traditional single-element design method is a more economical design solution that will improve the competitive position of wood as a structural material, and increase wood's market share in commercial construction. ■

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In Memoriam – Dr. Todd Chan

Dr. Todd (Hoi Tok) Chan, FCSCE, passed away early in August 2017 and CSCE lost one of its most loyal, distinguished and dedicated members.

Todd was an active member of CSCE for over 30 years and served the Society in various capacities, particularly in the international affairs and technical activities programs. He served as the chair of the International Activities Committee and was holding the position of Vice-President Global Partnerships before he passed away.

Todd completed his B. Sc. and M. Sc. degrees at Queen's University in Kingston and his Ph.D. at the University of Toronto, with expertise in the areas of ground water modeling and monitoring, solid waste management and environmental assessment and protection.

He had an illustrious career, serving in several senior technical positions at the Ontario Ministry of the Environment and Ontario Ministry of Transportation from 1964-1979. From 1979 to 1995 he served as a Senior Research Engineer at Ontario Hydro. In 1995 he embarked on an academic career and joined the Hong Kong Polytechnic University as a faculty member where he served until 2000. As a researcher he published many technical papers in archival journals and conference proceedings.

Todd's involvement with CSCE started in 1985 through his active participation in the Canada-China technical exchanges. He was a driving force behind maintaining these exchanges and he tirelessly promoted CSCE and Canadian engineering excellence, particularly in China.

CSCE recognized his service by honouring him as Fellow of the Society in 1994 and by awarding him the James A. Vance Award in 2005. Similarly, he received the China Civil Engineering Society (CCES) Award for his significant contributions to CCES international activities. In 2014 he was awarded the prestigious China Friendship Award, the highest award bestowed on foreign experts by the government of China.

Many friends and acquaintances of Todd will remember him not only for his professionalism and technical competence, but also for his kindness, warmth and graciousness. Despite his enormous experience and knowledge, he never spoke out of order or imposed his views on others. He was always ready to help and was not afraid to lead. He spoke wisely and offered helpful and constructive advice when appropriate.

He will be sorely missed by his many friends and colleagues in Canada, China, Hong Kong, and elsewhere, but he will be eternally remembered as a dear friend and gentle soul. Rest in peace Todd; we will miss you.

Ghani Razaqpur FCSCE, Jeanne Huang FCSCE, Edward McBean FCSCE, Ron Droste FCSCE, James Li MCSCE and Chris Twigge-Molecey, P.Eng.

Memoriam – Le Dr Todd Chan

Le Dr Todd (Hoc Tok) Chan, FSCGC, est décédé début août 2017, et la SCGC a perdu l'un de ses membres les plus loyaux, les plus distingués et les plus dévoués. Todd a été un membre actif de la SCGC depuis plus de trente ans et a servi la Société en diverses capacités, et plus particulièrement dans les affaires internationales et les programmes d'activités techniques. Avant son décès, il agissait en tant que vice-président des Partenariats mondiaux. Todd a obtenu son baccalauréat et sa maîtrise de l'Université Queen's à Kingston et son doctorat de l'Université de Toronto. Il s'est spécialisé dans les domaines de la modélisation et la surveillance des eaux souterraines ainsi que de la gestion des déchets solides et l'évaluation et la protection de l'environnement. Il eut une carrière illustre, ayant occupé plusieurs postes techniques séniors aux ministères de l'Environnement et des Transports de l'Ontario de 1964 à 1979. De 1979 à 1995, il fut ingénieur de recherche sénior à Ontario Hydro. En 1995, il s'est lancé dans une carrière académique à la Hong Kong Polytechnic University comme membre de la faculté jusqu'en 2000. En sa qualité de chercheur, il a publié plusieurs communications techniques dans des revues archivistiques et des comptes-rendus de conférences.

L'implication de Todd dans la SCGC a débuté en 1985 à travers sa participation active dans les échanges techniques Canada-Chine. Il fut une force vive dans le maintien de ces échanges, et il a fait la promotion de la SCGC et de l'excellence du génie civil canadien, en particulier en Chine. La SCGC a reconnu ses services en l'honorant comme Fellow de la Société en 1994 et en lui octroyant le Prix James A. Vance en 2005. Il a aussi reçu le Prix de la Société de génie civil de Chine (CCES) pour ses importantes contributions aux activités internationales de la CCES. En 2014, il a reçu le prestigieux Prix de l'amitié de la Chine, la plus haute distinction que le gouvernement chinois attribue à des experts étrangers.

De nombreux amis et connaissances de Todd se souviendront de lui non seulement pour son professionnalisme et ses compétences techniques, mais aussi pour sa gentillesse, sa chaleur et son élégance. Malgré sa vaste expérience et ses profondes connaissances, il n'a jamais tenu de propos déplacés ni imposé ses vues aux autres. Il était toujours disposé à aider et n'avait pas peur de diriger. Il parlait avec sagesse et offrait des conseils utiles et constructifs le cas échéant. Il manquera beaucoup à ses nombreux amis et collègues au Canada, en Chine, à Hong Kong et ailleurs, mais on se souviendra de lui éternellement comme un ami cher et doux. Repose en paix Todd, tu vas nous manquer.

Ghani Razaqpur FSCGC, Jeanne Huang FSCGC, Edward McBean FSCGC, Ron Droste FSCGC, James Li MSCGC et Chris Twigge-Molecey, P.Eng.

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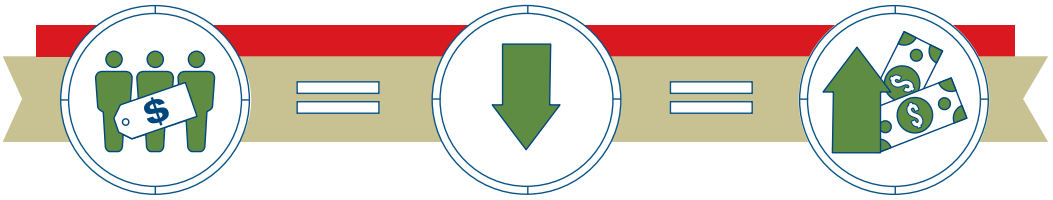

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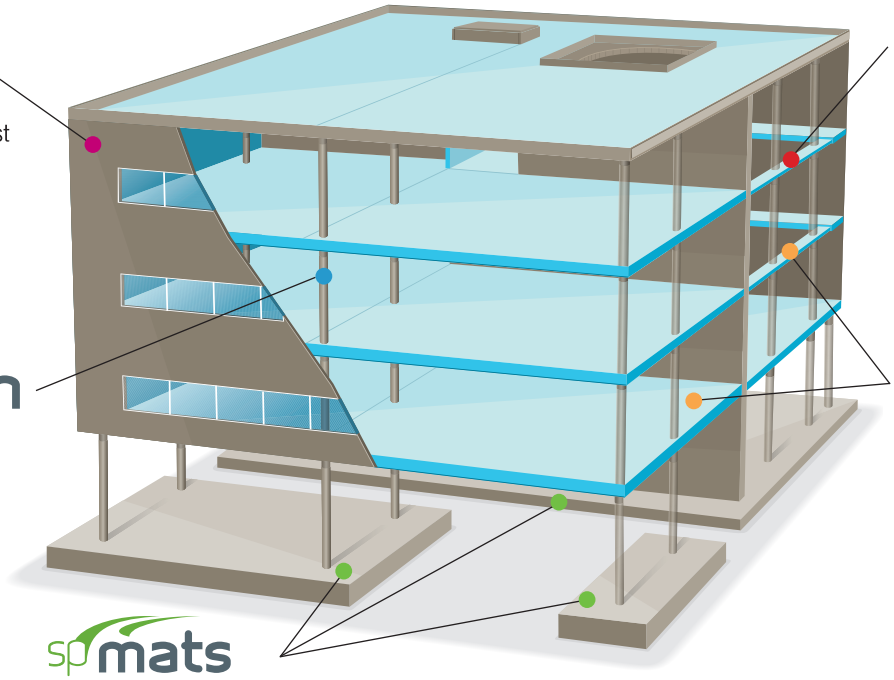

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