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## From the Editor's Desk

by Tuna Onur

Spring is here and excitement is in the air as the Canadian Conference on Earthquake Engineering (CCEE) in Quebec City is approaching and CAEE is having its Board elections. In this special issue, you will find a short introduction to the candidates running for various Director positions (full profiles and voting instructions will be posted on the CAEE web site).

Also in this issue, you will find a sneak preview of

### INSIDE THIS ISSUE

From the Editor's Desk	1
CAEE AGM and Board Elections!	1
Code Corner	4
BC Smart Infrastructure Monitoring System	6
Bridging the Faults	7
News	8
Upcoming Events	8

the new edition of Canadian Highway Bridge Design Code, CSA S6-19; information on BC Smart Infrastructure Monitoring System; and introduction to a new column by CAEE's Outreach Committee.

## CAEE AGM and Board Elections!

by Sharlie Huffman

CAEE's AGM will be held on June 18<sup>th</sup> at the CCEE in Quebec City. Details will be announced on the CAEE web site and at the CCEE. Board elections are also coming and the candidates for the CAEE President are:

**Sharlie Huffman** is the President of Huffman Engineering Ltd and she served as the Vice President of the CAEE last term.

**Lydell Wiebe** is an Associate Professor of Civil Engineering at McMaster University and he served as the Secretary of the CAEE last term.

Also open are Director positions and the candidates for these positions are:

**Martin Lawrence** is an Engineering Geologist at BC Hydro, and he has served as a Director since 2002.

**Don Kennedy** is the Vice President of Transportation Structures at Associated Engineering and he has served as a Director for over a decade.

**Voula Pantazopoulou** is a Professor of Civil Engineering at York University.

**Nathalie Roy** is an Associate Professor of Civil Engineering, at the Université de Sherbrooke.

**Sheri Molnar** is an Assistant Professor at the Earth Sciences Department, Western University.

**John Sherstobitoff** is a Principal at Ausenco and he served as a Director of the CAEE last term.

**Ghasan Doudak** is an Associate Professor of Structural Engineering at the University of Ottawa, and he served as the Treasurer of CAEE last term.

**Jeff Erochko** is an Associate Professor in Structural Engineering at Carleton University and he served as a Director of the CAEE last term.

**Luc Chiounard** is an Associate Professor of Civil Engineering at McGill University.

We provide a brief introduction to the candidates in the following pages. Full profiles and voting instructions will be posted on the CAEE website:

<http://caee.ca>

**CAEE Board Elections...** *Continued from Page 1*

**Sharlie Huffman:** Sharlie is the President of Huffman Engineering Ltd., and has 37 years experience in bridge design, construction, rehabilitation and structural health monitoring, including 34 years with the BC Ministry of Transportation & Infrastructure. She is a member of the Canadian Highway Bridge Design Code (CHBDC) Seismic Subcommittee. Sharlie is the current Vice President of the CAEE. She was on Canadian Earthquake Reconnaissance teams to China, Chile and Mexico.

"This is my second term on the Board of CAEE. I am currently the Vice President and Chair of Member Services. We are working on developing more on-line services for members and I would like to see that continue and expand. I would also like to see CAEE providing regular workshops, seminars and white papers. I look forward to increasing the relevance of the CAEE for the entire Canadian seismic community and to give it a greater international profile."

**Lydell Wiebe:** Lydell is an Associate Professor at the Department of Civil Engineering, McMaster University. He is the Vice Chair of Working Group 9 (Seismic Design) for CSA S16 (Design of Steel Structures), an Associate Editor of the Canadian Journal of Civil Engineering, and the current Secretary of the CAEE. His research seeks to develop economical ways to improve structural performance, with a focus on self-centering systems under earthquake loading.

"I joined the CAEE Board of Directors and served as Secretary since 2015, and I think the CAEE has come a long way over that time. I see a great opportunity for us to better connect Canada's earthquake engineering community through technical workshops, earthquake-related seminars, presentations on reconnaissance trips, and student chapter competitions. My vision for the CAEE is to provide a forum for all who work to reduce seismic risk in Canada to be united into a community where we all learn from one another."

**Martin Lawrence:** "I have been a CAEE member since 2002, and as a current Director, I am seeking re-election. I am a specialist engineering geologist at BC Hydro with nearly 20 years experience in seismic hazard studies for the retrofit of earth fill and concrete gravity dams. I had a leading role in updating BC Hydro's probabilistic seismic hazard assessment which followed the SSHAC Level 3 methodology (first and only application of its kind in Canada).

My vision for the future of CAEE is to continue to make it more engaged with and relevant to the membership and to ensure the timely dissemination of important information on the outcomes of research and engineering practice to the membership. As an engineering geologist, I believe CAEE will continue to benefit from the representation from the geotechnical/engineering geological community, and its cross-over with seismological and civil engineering disciplines."

**Don Kennedy:** Don has been a Director with the CAEE for over a decade. He has been involved in the seismic design of new and existing bridges, buildings and structures in Canada, New Zealand and North America for over 30 years. He was a member of the CAEE reconnaissance team after the Northridge earthquake in 1994. He is currently the Chair of the Seismic Design chapter of the Canadian Highway Bridge Design Code.

Over the years as a Director, Don has helped the CAEE grow in membership, and develop and fund conferences, research, training and other initiatives. He has also supported CAEE in retaining part-time administrative assistance to supplement the volunteer efforts. Beyond 2019, he would help CAEE to continue to deliver on its mandate for seismic conferences and training. He would also contribute to growing active membership and increasing training for engineers across Canada. He would work with colleagues in the geotechnical and seismological fields to broaden our reach.

**CAEE Board Elections...** *Continued from Page 2*

**Voula Pantazopoulou:** Voula is a Professor of Civil Engineering at York University, specializing in Earthquake Engineering and Structural Dynamics with emphasis on concrete structures, deterioration of structures due to corrosion, structural assessment and use of novel materials in structural retrofit, and seismic assessment of unreinforced masonry heritage structures. In recent years, she has focused on solutions for durable and resilient retrofits of seismically vulnerable infrastructure.

“I think that CAEE should enhance its relationship and collaboration with its European counterpart (EAEE). I believe earthquake engineering practice can contribute to better engineering approaches overall, and I see an educational role in this context for CAEE. I place in high priority the need to address seismic risk of structures. And I feel there is a need for targeted actions towards harmonization of standards and procedures for seismic design and assessment in Canada and globally.”

**Nathalie Roy:** “I am an Associate Professor in the Department of Civil Engineering at the Université de Sherbrooke. I am also the Assistant Vice–Dean for Equity, Diversity and Inclusion of the Faculty of Engineering. My main research fields are structural dynamics and earthquake engineering, and I have expertise in large–scale testing of structural elements. I am an active member of several research groups including *Centre d’études interuniversitaire des structures sous charges extrêmes*.

As a Director of the CAEE, I would work to enrich and diversify attendance to earthquake engineering conferences by expanding conference themes and addressing more explicitly the concerns of regions with low and moderate seismicity. I am the faculty advisor for a student group that has been working on high–impact civil engineering sustainability projects in developing countries. As a Director of the CAEE, I would like to prioritize structural and earthquake engineering knowledge–sharing with vulnerable international communities in terms of construction standards and practices.”

**Sheri Molnar:** Sheri is an Assistant Professor at the Department of Earth Sciences, Western University. Her research is focused on field and numerical methods for earthquake site characterization and seismic hazard mapping. She is the President of the EERI–BC Regional Chapter, and a member of the Task Group on Site Amplification of the NBC’s Standing Committee on Earthquake Design. She joined the CAEE reconnaissance team mission to Nepal following the 2015 Gorkha earthquakes.

“I am an active researcher in earthquake engineering and I believe the CAEE may benefit from including less–engineer–trained professionals such as myself, effective Newsletter communication with its members, and maintaining its earthquake reconnaissance team missions. I also believe that the CAEE is meant to consolidate all Canadian earthquake engineering professionals, and that their unification and/or ability to collaborate coast–to–coast would enable the CAEE to evolve.”

**John Sherstobitoff:** John is a structural engineer with over 35 years of experience relating to seismic analysis and design of infrastructure and buildings. He incorporated several ‘firsts’ in Canada: first use of viscous dampers; first base isolated building; first use of external buckling restrained bracing. John is currently chairing the National Building Code of Canada’s Standing Committee on Earthquake Design. He has visited numerous cities around the world following damaging earthquakes.

“My vision for the future of CAEE is multifold: increase membership and awareness of what CAEE is and does; re–energize the Research Committee, to inform membership about recent, current and upcoming earthquake related research in Canada; continue reconnaissance activities; liaise with organizations such as EERI; consider an expanded Newsletter; continue to host/co–host national and international conferences and seminars; encourage and support new engineers and geoscientists in academia and industry in the field of earthquake engineering, with targeted financial support.”

**CAEE Board Elections...** *Continued from Page 3*

**Ghasan Doudak:** I am an Associate Professor of Structural Engineering at the University of Ottawa. My area of expertise includes behaviour of structural systems under the effects of wind storms, ground shaking during earthquakes, and blasts. I serve as a member of NBC Standing Committee on Structural Design, and the Vice Chair of the CSA O86 Technical Committee on Engineering Design in Wood. I am currently the Treasurer of the CAEE.

“My vision for CAEE is to make it relevant to the members, especially younger engineers and students. I also foresee that in the next few years we will have a more cohesive structure and a better linkage between research, engineering practice and education. As part of my role as the Treasurer, I am hoping that the CAEE will flourish and will generate sufficient funding so that we can engage our members in more conferences, research activities, educational seminars, reconnaissance missions, etc.”

**Jeffrey Erochko:** Jeffrey is an Associate Professor of Structural Engineering at Carleton University. His research is focused on earthquake engineering in the context of steel and timber buildings, and historic timber and masonry buildings. Recently, he

co-lead the development of an experimental facility for research on Multi-Hazard Infrastructure Protection. He is currently a CAEE Director, the Chair of the Policy Committee, and the Board Liaison for Student Activities Committee.

“Over the past four years, I led the revision of the CAEE Bylaws, the development of two policies (Reconnaissance Policy and Copyright Policy), and creation of a student activities committee. Going forward, I support improved linkages between industry and academia, allowing researchers to better identify and address ‘gaps’ in knowledge. In addition, I think it should be a priority of CAEE to better integrate students, so that we can benefit from their energy and get them excited about career possibilities in earthquake engineering.”

**Luc Chiounard:** Luc is a specialist in the field of structural engineering. His research interests include spatial modelling of environmental data (earthquakes, hurricanes, icebergs); estimation of natural and man-made hazards; reliability analysis of engineering systems; and the inspection, evaluation and modelling of aging infrastructures, including optimal allocation of repair and maintenance funds.

## Code Corner

by Don Kennedy

The 2014 edition of the Canadian Highway Bridge Design Code (CHBDC), CSA S6-14, included performance-based design (PBD) provisions for the seismic design of new bridges. The method provided owners and designers with a framework to discuss post-seismic performance expectations for their bridges. To inform those discussions the CHBDC also provided performance objectives and damage states that tied performance to engineering measures. Three seismic hazard levels were specified: 10%, 5% and 2% probability of exceedance in 50 years. The force-based design (FBD) method was retained for many structures in Canada.

In late fall, the updated code and commentary are expected to be published (S6-19 and S6.1-19). S6-19 retained the PBD seismic design framework, and clarified or simplified some provisions of FBD and several important aspects of PBD. A significant re-organization of Section 4 (Seismic Design) and Section 6 (Foundations and Geotechnical Systems) shifted most seismic-related clauses of geotechnical and foundation design to Section 6 from Section 4.6. In addition, Section 6 expanded its coverage of the seismic design of shallow and deep foundations, walls, integral abutment bridges and approach embankments in the vicinity of bridges.

**Code Corner...** *Continued from Page 4*

Section 11 (Joints and Bearings) was substantially re-written, and aspects that affect seismic design were also co-ordinated with Section 4.

Within Section 4, several clarifications and simplifications were made, including:

- In Table 4.10, Seismic Performance Category, FBD is now accepted for lifeline bridges in lower seismic hazard zones than in S6-14.
- In Table 4.15, Minimum Performance Levels, PBD objectives are now specified for only two seismic hazard levels rather than three. Lifeline and Major route bridges require design to the 2% and 5% in 50-year hazard levels. Other bridges require design to the 10% and 2% hazard levels.
- In Table 4.16, Performance Criteria, strain and damage levels were refined. In particular, acceptable concrete strains at lower damage levels were relaxed to better match performance to test results. These updated strains have been in use in design since 2014 by the Province of BC. In this table, additional damage states were added; the term “restricted emergency traffic” was deleted while “emergency traffic” remains.
- The use of “expected” material properties was clarified for design in concrete and steel components. Members can be proportioned (designed) and detailed based on expected values, i.e. strengths greater than the minimum specified design strengths.
- Shear capacity of reinforced concrete columns in Clause 8.9.3 was increased using a simplified Modified Compression Field Theory approach. The intent is to match seismic testing, avoid over-conservatism that could make it difficult to achieve capacity-design requirements in ductile members, and maintain simplicity. Refined shear capacities from seismic testing, such as implemented by Caltrans or published by the UC San Diego, provide alternatives for design if approved by the owner.
- For existing bridges, significant new guidance is provided in both the code and the commentary. A new Table C4.11.1 – Performance Levels for Existing Bridges is included, which states that seismic retrofits, where implemented, would ideally target a seismic hazard level of 2% in 50 years for a collapse-prevention objective. Major-route and Other bridges are suggested to have collapse-prevention objective for a 5% in 50-year hazard. Owners and engineers together may alter or add to these objectives where warranted, and may also decide to implement upgrades in stages, to match overall bridge renewal and capital plans. Consideration of societal implications of the failure or loss of use of crossings for response, recovery and economic sustainability of the bridge and route should be an important element of bridge retrofit/renewal planning and implementation.

In April of 2019, the Seismic Committee on Engineering Design (SC-ED) of the National Building Code (NBC) of Canada voted on new refinements to seismic hazard. These will be published on the National Research Council (NRC) web page in parallel with updates to the NBC (2020). Once published, changes to seismic hazard will affect bridge designs as well. In most Provinces and Territories, that update will be implemented through new contractual requirements. In Ontario, the Province will review and issue a directive prior to adopting it formally. It is anticipated that this update will ‘roll up’ foundation factors directly into the hazard levels published for various site classifications, rather than providing a ‘firm ground’ uniform hazard spectra for a Class C reference site. In that event, owners and engineers would specify their site classification and obtain spectra for that site condition directly. F(T) factors, currently in Tables 4.2 through 4.9, would become redundant. Users could request spectra for Class A, B or C as appropriate, and use those spectra as targets to select and modify time histories for use in structural, geotechnical or soil structure interaction analyses.

# British Columbia Smart Infrastructure Monitoring System

by Yavuz Kaya

Southwest coast of British Columbia (BC), including Vancouver and the densely populated Lower Mainland, is located over the active Cascadia subduction zone that can produce large earthquakes of up to magnitude 9.0. Ongoing occurrence of earthquakes, which are large enough to cause damage to structures, is a strong reminder of the fact that the southwest coast of BC is a seismically active area. Other smaller, but still potentially damaging, earthquakes also occur in the overlapping continental crust and the subducting slab. Such seismic activity, as a result, presents hazard to the area and risk to the structures built in those areas.

The Ministry of Transportation and Infrastructure (MoTI) is responsible for 400 km of provincial disaster response routes in BC and maintains over 2,500 bridges in the highest seismic zones of BC. The MoTI has been installing earthquake sensors on bridges and tunnels in collaboration with the Earthquake Engineering Research Facility (EERF) at the University of British Columbia (UBC) since the late 1990s. The primary purpose of the system is to capture the ground motion input and its effect on structures in the event of an earthquake. In addition, the Geologic Survey of Canada (GSC) and the MoTI have jointly maintained a strong motion network (SMN) in BC since 2003 that currently involves approximately 160 strong motion Internet Accelerographs (IA). These instruments continuously compute a set of strong motion parameters, and report those values to a data centre whenever ground shaking exceeds predefined threshold levels. A shake-map is generated at the data centre for significant earthquakes using the strong motion parameters calculated by the triggered IAs. The shake-map is immediately published on a public website ([www.bcsims.ca](http://www.bcsims.ca)) where it can be viewed with various superimposed layers, such as bridges,

buildings or schools. This enables emergency responders and maintenance personnel to quickly assess the shaking intensity across the urban areas and at the location of critical infrastructure. It also allows these agencies to prioritize and maximize the effective use of their scarce resources available.

To help mitigate seismic risk on infrastructure, the MoTI and the UBC embarked on a program called the British Columbia Smart Infrastructure Monitoring System (BCSIMS), which integrates data from the instrumented structures and the SMN. The system organizes and processes real-time data in an efficient manner and delivers results and related reports to predefined recipients such as bridge inspectors at the MoTI. This instrumentation program provides immediate notification after an event and incorporates remote Structural Health Monitoring (SHM) system. The goals of the system are: (1) to provide a real-time seismic structural response system to enable rapid deployment and prioritized inspections of the MoTI's structures; (2) to develop and implement a structural health monitoring program to address the need for safe and cost-effective operation of structures in BC; and (3) to provide a real-time working platform ([www.bcsims.ca](http://www.bcsims.ca)) that can integrate many aspects of seismicity in BC.

The implementation of BCSIMS transforms the current practice of inspection and evaluation of structures after an earthquake to a more rational and effective one that makes effective use of state-of-the-art sensing technology with fast and efficient techniques for data analysis and interpretation. Therefore, the inspections can be focused and prioritized to maximize the effective use of the scarce resources.

## Bridging the Faults

by Paul Steneker

We are introducing this new column to the CAEE Newsletter to regularly report on the Outreach Committee's activities. In the Fall of 2018, the CAEE formed a network of students and young professionals across the country, whose goal is to organize various events and activities to help inform non-earthquake engineering participants of the importance of earthquake engineering related issues. Since its inception, this network has been working to generate exciting events for various target audiences. While the majority of these activities are only in the planning stages, many of the organizational work has already occurred at the local level of individual academic institutions, which served as testing grounds for the anticipated expansion.

A summary of some of the main activities is the topic of this month's column and is intended to serve as an introduction to the CAEE Outreach Activities Committee's work.

During the academic school year, the Outreach Committee plans to host a one-day design competition to build a model seismic force resisting building system for senior high school students. This competition aims to provide high school students interested in sciences with the opportunity to learn about the behaviour of their small scaled building models when undergoing scaled earthquake accelerations on a table-top shake table. The design parameters vary from the tight budgeting imposed by a material supplier, to the use of various types of available materials, to the economic gains provided by increased floor area, and the gains provided by limiting floor accelerations during scaled seismic events. Each team is ranked along these parameters and the highest performing team across the country is identified as the winner. The simultaneous events are initially scheduled for the month of April, beginning in 2020.

The formation of a guest speaking network is another new CAEE initiative in its early stages and seeks to link professionals in the industry with opportunities to share their experiences, particularly at the various universities across Canada. This network aims to take advantage of opportune moments where people with relevant experience, either from the industry or academic earthquake engineering background, might be in a position to visit a nearby university, providing a continuous stream of fresh topics to expose the students to. The CAEE Outreach Committee is currently seeking professionals with experience who would be interested in providing small portions of their time as the headline for such speaking events. The CAEE, in conjunction with the local institutions, is prepared to reimburse some travel expenses incurred while capitalizing on such opportunities.

Finally, the Outreach Committee has begun planning an annual seminar day for graduate students, and young researchers and professionals interested in the field of earthquake engineering. The goal is to meet once a year for networking and idea sharing. The first of such events is scheduled to occur during the upcoming CCEE conference, hosted in Quebec City in June.

The CAEE Outreach Committee currently has representatives from the following Canadian institutions: University of Toronto, McMaster University, Concordia University, École Polytechnique, University of Ottawa, and Université de Sherbrooke. We are seeking representation from other Canadian universities, particularly on the West Coast such as University of British Columbia or University of Victoria. Should you have any interest in participating in the CAEE Outreach Committee, please contact Paul Steneker by email at [stenekpr@mcmaster.ca](mailto:stenekpr@mcmaster.ca)

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**News**

### Correction and New CAEE Reconnaissance Report

Last Quarter we highlighted the upcoming CCEE Field Trip to the New Champlain Bridge in Montreal. The CCEE web site and this column referred to the new bridge as consisting of “multiple simply-supported spans with a cable-stayed central span”. The correct wording is “several continuous girder spans with a limited number of joints and a cable-stayed central span”. We thank our astute readers for the correction and apologize for the mistake.

CAEE recently released a report of the earthquake reconnaissance conducted by the CAEE team after the September 19<sup>th</sup>, 2017 Mw7.1 Puebla-Morales Earthquake in Mexico. The report can be accessed via the CAEE website:

[caee.ca/uploads/2017%20Central%20Mexico%20Earthquake%20CAEE%20Reconnaissance%20Report%202019.pdf](http://caee.ca/uploads/2017%20Central%20Mexico%20Earthquake%20CAEE%20Reconnaissance%20Report%202019.pdf)

## News and Upcoming Events

We would like to encourage you to share earthquake engineering related news and events that you would like to bring to the attention of your colleagues. Please send your news items, announcements, and other contributions by June 15 to [secretary@caee-acgp.ca](mailto:secretary@caee-acgp.ca) to get them published in the July Newsletter.

### Upcoming events

#### ICEES 2019: International Conference on Earthquake Engineering and Seismology

6-7 June 2019

San Francisco, CA

[waset.org/conference/2019/06/san-francisco/ICEES](http://waset.org/conference/2019/06/san-francisco/ICEES)

#### CSCE Annual Conference

12-15 June 2019

Laval, QC

[csce2019.ca/](http://csce2019.ca/)

#### 7 ICEGE 2019 – International Conference on Earthquake Geotechnical Engineering

16-20 June 2019

Rome, Italy

[www.7icege.com/](http://www.7icege.com/)

#### 12th CCEE – Canadian Conference on Earthquake Engineering

17-20 June 2019

Quebec City, QC

[www.ccee2019.org/](http://www.ccee2019.org/)

#### URM Seismic Resilience Forum

18-20 July 2019

Portland, OR

[aia-oregon.org/urm](http://aia-oregon.org/urm)

#### The Third International Bridge Seismic Workshop

1-4 October 2019

Seattle, WA

[www.iabee.org/iii-ibsw](http://www.iabee.org/iii-ibsw)