Canadian Association for Earthquake Engineering (CAEE)
L'Association Canadienne du Génie Parasismique (ACGP)

NEWSLETTER

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Promoting Creative Thinking

by Carlos Ventura

A number of years ago my good friend and colleague at UBC, Frank Navin wrote an interesting and inspirational article about creativity. The title of his article was "Engineering creativity – doctum ingenium." There are two sentences in his article that I have always remembered: "Creativity is the prerogative of humans. Human creativity uses what already exists and changes it in unpredictable ways that bring about a desired enlargement of human experience that goes beyond the usual choices." I have read Frank's article several times over the years because it reminds me of the need to bring to the classroom a balance between the traditional convergent "vertical" thinking, which is prevalent in engineering education, and creative "lateral" thinking. The need for this balance, not only in our educational system, but also in the way we do business, is due to the fact that professional and economic success in today's competitive global environment depends upon innovation and creativity. Society expects its engineers to add to the growth of our economy with their creative contributions. This clearly applies to our field of Earthquake Engineering and how our work impacts society.

Creativity is our prerogative to use what already exists, and allows us to make changes in unpredictable ways. Creativity is beyond ordinary thinking because we can expand our experience by going beyond the traditional choices available to us. We all experience great satisfaction when creativity helps us develop a new and unexpected solution to a particularly problem that does not have simple obvious answers. However, creativity, as opposed to innovation, is not as prevalent in engineering as it is in the arts. In his article, Frank wrote that the actual number of truly creative ideas that engineering researchers consider unique ranges from about one in 5 years to one in 10 years. The number of such ideas from practising engineers is thought to be one in 10 to 20 years. In contrast, the production of truly unique ideas by artists was roughly three to four per year.

What can the CAEE do to encourage creativity? Creativity and significant innovation must be encouraged, rewarded, and seen to be rewarded. But before potentially useful creative ideas can be generated, considerable effort must be expended to acquire the necessary knowledge. This knowledge is acquired by extensive reading, study of similar situations to find what needs improvement, discussions, and data accumulation from a variety of areas. The CAEE can be a great source to nurture and promote creative ideas because it is a society that exists to transmit knowledge. And I think that many long-term CAEE members could recognize this as part of the experience and knowledge that they have acquired through all these years.

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However, I think that we can do more about fostering creativity at the CAEE.

We could encourage the philosophy that no matter what was done in the past, there has to be a better way if one of us can find it. We can develop additional way to identify creative and innovation projects that will help us manage and reduce seismic risk, not only in Canada, but elsewhere. CAEE can also encourage creative and innovative thinking by inviting to our conferences and meetings individuals noted for their creative and innovative solutions to discuss methods to disseminate how such solutions come about. And we should encourage all our members to attend those sessions. We could also organize forums and discussions to develop a better understanding of the inherent risks of progress and our members should be encouraged to face the risks and gain the benefits.

I would like to hear your ideas and suggestions on how CAEE can promote creative thinking in our field of Earthquake Engineering
Please do not hesitate to call me or e-mail to me if you have any suggestions on how the CAEE can serve you better.

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Prof. Uzumeri… You Will Be Missed…

By Murat Saatcioglu

I am deeply saddened to inform you of the passing of S.M. Uzumeri, Emeritus Professor at the University of Toronto, on January 19, 2017. Born in 1930, he received his university education from the University of Toronto, where he subsequently served as a member of the academia until his retirement as a professor, while also having served as the Chair of the Department of Civil Engineering. Professor Uzumeri was among the pioneers of Earthquake Engineering in Canada. He contributed significantly to earthquake engineering research and building code development. His work on seismic resistant beam-column joints and column confinement is especially noteworthy. He played a significant role on the development of seismic provisions for the National Building Code of Canada and reinforced concrete design clauses for CSA Standard A23.3. Professor Uzumeri was among the founding members of the Canadian Association for Earthquake Engineering. His career, spanned almost half a century, was recognized in 2002 by the American Concrete Institute with a Symposium named after him.

He was a man of integrity, wisdom and foresight. He touched the lives of many of his students as a great mentor and educator. He will be deeply missed!

Code Corner

By Don Kennedy

In Volume 1 Issue 1 of this Newsletter we noted that CSA S6-14, Canadian Highway Bridge Design Code (CHBDC), was published in February 2015.

In this issue, we outline the framework for application of the CHBDC across Canada and introduce some of the important changes to Chapters 4 (Seismic) and Chapter 6 (Geotechnical) in the seismic design of bridges in Canada.

In future articles we will also discuss a number of important aspects affecting seismic design within other chapters, including structural, geotechnical, buried structures, concrete, steel, movable bridges, as well as analysis and design questions.

Legal and Practice Applicability

In Canada, the legal mandate for establishing design and construction requirements for highways, including highway bridges, lies with the provincial and territorial governments. S6-14 has been adopted by Provincial regulators across Canada. In Ontario the code was adopted in 2015 as amended by formal "exceptions" through regulation and legislation, similar to the formal adoption of the National Building Code as the BC Building code in British Columbia. The British Columbia Ministry of Transportation and Infrastructure (MoTI) has adopted S6-14 and published in December of 2016 a formal "Supplement" to the code on its website. This Supplement effectively amends many of the chapters within S6-14, including Chapter 4, Seismic Design. This is similar to the approach taken in Ontario. Together, S6-14 with this Supplement (BC) or exceptions (Ontario) comprise the state of bridge engineering practice, and / or the legal framework for bridge design for Provincial bridges in these two Provinces. In most Provinces and Territories the bridge code is adopted by government policy and as contractual requirements. All of the Provincial ministries of transportation regard the CHBDC as the state of practice, and consider any local exceptions with considerable care.

Provincial or Territorial professional associations may also publish practice guidelines to assist engineers in the application of codes, standards and expected practice. The Association of Professional Engineers and Geoscientists of British Columbia is in the process of developing a practice guideline for the seismic design of bridges in BC. This document will be reviewed by the Association, practicing engineers, technical specialists, representatives from municipalities and Agencies and the membership prior to publication.

Section 4: Seismic Design

- S6-14 adopted *performance-based design* (PBD) for many bridges in Canada. Force-based design is permitted for many bridges in lower seismic zones. Performance-based design encourages owners and designers to communicate on post-seismic expectations for damage and return to service, and opens up design to innovation using a wider range of seismic-resisting systems, including including isolation, added damping, or hybrid solutions. Seismic performance is demonstrated using damage measures, including strains, and return-to-service descriptions. In PBD, other measures, in particular "R" factors, do not have to be met but may remain useful in initial proportioning of ductile substructures. The BC MoTI 2016 Supplement has amended some of the damage measures, including sectional strains and deformations, to better achieve ductile sub-structures and to allow and mandate capacity design procedures to be used without undue cost.

- S6-14 uses updated seismic hazard based on the Geological Survey of Canada's fifth generation probabilistic seismic hazard models. The seismic hazard used for S6-14 is consistent with the 2015 National Building Code (NBC) of Canada.

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- Seismic hazard is provided for three different return periods: 475 years, 975 years and 2,475 years. Previously only a 475-year return period was explicitly required, with the commentary acknowledging that collapse prevention was implicitly expected for a larger (1,000 year) hazard level. Note, however, that the "Importance Factor", as high as 3.0, has been eliminated from the PBD approach and is 1.5 for a small subset of bridges designed using a force-based approach. While not code-mandated, the hazard for a 100-year return period remains available in part to allow for operational-level events for the design and operation of railway bridges within the AREMA standard.

- The uniform hazard spectral values are specified for firm ground sites (Class C). F factors either reduce these values for soft rock and rock sites, or increase them for softer soil sites. The F factors for Class A and B soils as published in S6-14 are superseded by those in S6-14 Update No. 1 published in April 2016. Shear wave velocities are used to differentiate soil types where possible.

- An extensive section on seismic isolation and damping has been added. Requirements for isolation bearings (e.g. testing) are included in Section 4, and where applicable, properties or testing relevant to seismic behaviour would govern over conflicting requirements within other chapters. . The use of seismic isolation in bridge engineering is encouraged since structural damage is less and the return to service for traffic, whether emergency traffic or to the public, may be more rapid and potentially more reliable or demonstrable following a large earthquake.

- More detailed requirements for steel lateral-load resisting systems are provided. Ductile steel systems for substructures or superstructures are now supplemented or covered in Section 4.

- Analyses and design approaches emphasize displacements rather the forces for ductile sub-structures, isolated or other structures. Elastic forces with a force-based design framework remain for some bridges.

- New provisions for damping modifications to spectral values are provided.

- Performance-based design has been added for the seismic retrofit and rehabilitation of existing bridges. For existing bridges, greater leeway is provided to Owners on hazard and performance than for new bridges.

Section 6: Foundations and Geotechnical Systems

- New reliability-based approach including a risk and consequence based framework to determine design factors. These improve both the static and seismic design of bridge foundations.

- Resistance factors are increased where site knowledge is greater. For seismic design, higher factors are adopted, which also better reflect a 'capacity design' approach for ductile substructures.

- The longer return period (2,475 years) for seismic hazard, previously mandated in the NBC, is now adopted in CSA S6-14. For some bridges this is likely to require additional considerations for liquefaction, lateral spreading or slope stability. Good communication and due consideration of site and route factors will be important to allow appropriate performance levels to be achieved, neither under- nor over-specifying either.

S6-14 is available for purchase at:
http://shop.csa.ca

The BC MoTI Supplement may be downloaded at:
http://www2.gov.bc.ca/gov/content/transportation/transportation-infrastructure/engineering-standards-guidelines/structural/standards-procedures/volume-1

The Ontario document listing exceptions is at:
http://www.ceo.on.ca/files/CHBDC 2014 Letter to CEO (attached).pdf

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News

CAEE Research Committee is Seeking Your Contribution

CAEE Research Committee is endeavoring to compile a catalogue of current Canadian Earthquake Engineering research activities. Results obtained from this survey will be available on the CAEE website. If you are interested to participate, please respond with the following information (dowlingj@ae.ca, (Yavuz.Kaya@gov.bc.ca):

1. A list of 3 to 6 keywords describing your current research activities
2. More information on your primary areas of research (~100 words)
3. Your current title (Prof, PhD candidate, etc.)
4. If you are a Professor, number of Masters and PhD students you currently have in total

News and Upcoming Events

Please send us your contributions of news items, announcements, and events you would like to share.

Upcoming events

CSCE Annual Conference and Annual General Meeting
31May - 3 June 2017
Vancouver, BC
csce2017.ca

3rd International Conference on Performance-based Design in Earthquake Geotechnical Engineering
16-19 July 2017
Vancouver, BC
www.pbdiiivancouver.com

39th IABSE Symposium - Engineering the Future
21-23 September 2017
Vancouver, BC
www.iabse.org/Vancouver2017

4th International Conference on Earthquake Engineering and Seismology
11-13 October 2017
Eskisehir, Turkey
www.tdmd.org.tr

SSA 2018 Annual Meeting
24-26 April 2018
San Juan, Puerto Rico
www.seismosoc.org/meetings/

16th European Conference on Earthquake Engineering
18-21 June 2018
Thessaloniki, Greece
www.16ecee.org

11th U.S. National Conference on Earthquake Engineering
25-29 June 2018
Los Angeles, California
11ncee.org