SEABC NEWSLETTER

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- SEABC's Newsletter is both edited and managed by The Communications Committee. newsletter@seabc.ca
- Submissions to the newsletter are encouraged and all members of the SEABC are asked to actively participate in contributing to our newsletter. Submissions letters to the Editor, questions and comments can be sent to: newsletter@seabc.ca
- SEABC editing staff reserve the right to include or exclude submitted material and in some cases edit submitted material to suit overall space requirements. If submittals are not to be edited, please advise editor at submission time.

Message from the President

February 2013

By Cameron Kemp, P.Eng.; SEABC President

Spring is just around the corner!

The days are getting a (little) longer, the temperatures are (slowly) climbing, the rain is getting (slightly) less oppressive and I'm seeing snowdrops and daffodils starting to come out of the ground. Time to shake off the winter blahs and get at it!

The SEABC has a very busy spring in store. Our Education Committee has an event per month from now until our summer recess. Please see the SEABC website for the upcoming seminars. Those of you that have attended our seminars in the past will appreciate the relevance of the seminar topics and the caliber of the presenters. We encourage you to continue your ongoing professional development and sign up for these upcoming sessions.

The SEABC Board is also strongly committed to promoting sustainability and has tasked our sub-committee on this subject to develop a new course on sustainability in the context of structural engineering. Look for this course to be presented later in the fall.

Our AGM this year is on Wednesday, May 29, 2013 which is a little later than normal, however we have scheduled it around the availability of our keynote speaker, Dr. Mike Cook, Senior Partner and Chairman of the prestigious structural engineering firm, Buro Happold from the UK. We have set ourselves the ambitious goal of attracting world-class keynote speakers to our AGM dinner meetings. Last year we were fortunate to have Mr. Bill Baker of SOM speak to us about the design and construction of the Burj Khalifa in Dubai. The years before we had Mr. Paul Fast of Fast and Epp and Mr. David Campbell of Geiger Engineers as our keynote speakers. We are confident that you will find Mr. Cook's presentation insightful and inspiring. Mr. Cook and his firm have completed many amazing structures. Check out their website at:- www.burohappold.com.

Please sign up early as we are expecting it to be a sellout event.

As part of our AGM we will be reconfirming our Board of Directors. If you would like your name to be considered for one of the available Board of Director seats please send an email with your qualifications and the reasons why you would like to be on the Board to the SEAB website. All applications will be carefully considered.

We have recently summarized our financial results for 2012 and established a draft budget for 2013 and I am very pleased to inform you that the SEABC remains very sound financially. We have a significant amount of cash on hand and the Board and our Committee Chairs have been doing a good job of balancing income with expenses. The details of our financial results will be presented at our AGM. This financial strength allows us to keep our membership dues to a minimum such that they should not be a deterrent to joining our Association.

On the subject of our membership, the latest figures I have received from our Registrar indicate that we have 1061 members, broken down as follows; 708 individual members, 25 associate members, 327 student members and 1 life member (our past President, David Davey). These are the highest membership numbers we have ever had! Over 1000 members is an impressive milestone for an Association that has only been in existence for five short years. I am particularly pleased to see the number of student members as they represent the future of this Association and the profession.

So…. rub the winter sleep out of your eyes, roll up your sleeves and get active in furthering the goal of making our Association the one by which others are measured!

Mike Cook, Chairman of Buro Happold will give the Keynote Address at the SEABC AGM

Education Committee

By Cam Smith, Director SEABC

Past Evening Seminar: 'Design and Construction of the New Port Mann Bridge'

2013's first seminar, titled 'Design and Construction of the New Port Mann Bridge' was presented by Ross Gilmour, P.Eng., Peter Kiewit Infrastructure Co., Project Manager responsible for the design and construction of the new Port Mann Bridge. The presentation included a discussion of the origins of design and the key elements of construction of the cable-stayed bridge. A change of pace from the usual venue in downtown Vancouver and in closer proximity to the project site, this event was held at the Executive Hotel & Conference Centre in Burnaby [see meeting report, Page 9, this issue].

Evening Seminar: 'Floor Design Spectra Guideline' (February 20, 2013 – UBC Robson Square)

The second seminar of 2013 was titled 'Floor Design Spectra Guideline' by Dr. Andreas Felber, Ph.D., P.Eng., Specialist Structural Engineer, Generation Engineering, BC Hydro. Floor design spectra are used to design structures and components or evaluate equipment located on or within larger structures. When multiple time history responses have been developed at various locations throughout a structure, floor design spectra allow practical response spectral design of building components and equipment. BC Hydro has recently developed a practice to formalize the process of calculating floor design spectra to provide a uniform approach for seismic upgrades and design of its facilities. Dr. Felber presented the methodology used to develop floor design spectra using recent examples for large structures as well as electrical and mechanical equipment. This event was free to SEABC members; registration details for upcoming events can be found on the SEABC website at:

www.seabc.ca/events.php

2013 Wine & Cheese / Opening Reception for the UBC Structural Teaching Laboratory (April 24, 2013 – UBC CEME Structures Lab)

This years' Wine & Cheese event is scheduled earlier than usual as it will also serve as the opening reception for the UBC Structural Teaching Laboratory, showcasing the new testing frame and providing an opportunity for UBC thank the various sponsors for their contributions. Details for this event will be announced shortly.

2013 SEABC Annual General Meeting (May 29, 2013 – Sutton Place Hotel)

The SEABC Annual General Meeting has been planned for May 29th with keynote speaker Michael Cook, Ph.D., Chairman and Senior Partner of Buro Happold, and Adjunct Professor at Imperial College, London. Dr. Cook has worked on a range of membrane and cable-net structures and has since led the design of numerous award-winning projects throughout the UK, USA, Germany and the Far East. Recent project work has included museums in London, Boston, Washington and Beijing, the Dallas Opera House, the Dresden Rail Terminus, and the Khan Shatyr – the tallest tensile structure in the world which will serve as a congress center in Kazakhstan. Details for the AGM will be announced shortly.

Video recording and archiving of seminars and events continues to be done to better serve the SEABC Membership who are unable to attend in person. This service is available through the SEABC website (via *Member Login*, under the *Seminar Downloads* link) where presentation literature from previous seminars is also made available.

As always, we appreciate feedback from members including comments on past events, suggestions for future topics, and proposals for presentations, so please do not hesitate to contact us at:-

education@seabc.ca.

IStructE News

By Bill Alcock, P.Eng. Struct.Eng. MIStructE.
Director SEABC

As the SEABC representative on IStructE Council, I was delighted to welcome Victoria Janssens to the International Interest Group and Council meetings as SEABC's Young Member delegate to IStructE. Victoria has kindly agreed to provide a summary of the new President's address which took place in the evening on January 11, 2013 in London.

International Interest Group Meeting (IIG)

The IIG has undertaken to study the requirements for structural engineering registration in the various countries represented on the IStructE Council. The ultimate goal of this process is to improve the portability of structural engineering registration from one jurisdiction to another, where possible. Presentations from the Australian, Singapore and South Africa delegates were received and are summarized below. Detailed information is available upon request from the writer.

Australia:

With the exception of the State of Queensland, there are currently no specific registration requirements to practice structural engineering in Australia. The practice of engineering is governed by an Act of Parliament which legislates the credentials required of engineers, but there is no governing body to check, register and discipline engineers.
In Queensland, however, registration has been required since 1934 and a registered engineer in Queensland is given the title of RPEG (Registered Professional Engineer – Queensland). A National Professional Engineers Registry (NPER) based on the Queensland licensing requirements has existed since 1994 however registration is not mandatory in order to practice.

Singapore:

Rigorous government registration requirements exist in Singapore for Civil (including Structural), Mechanical and Electrical engineers. All registration information is available on the government web-site but there are few openings available for foreign engineers to become registered. In order to obtain registration an engineer is required to write the FEE (fundamentals) and PPE (professional engineering) exams. CPD is mandatory (minimum 150 hours three year rolling). Engineers who do not maintain their CPD must make up the shortfall and appeal to the board for reinstatement.

South Africa:

The Engineering Profession Act of 2000 permits the Engineering Council of South Africa (ECSA) to consider and decide on applications for registration, prescribe the period of validity of registration and keep a register of registered persons.
The following table summarizes the qualification requirements for registration in South Africa associated with various international accords:

Category		**Tertiary Qualifications**	
ECSA	**EC (European equivalent)**	**Description**	**Academic Standard***
Professional Engineer	Chartered Engineer	Professional Engineering normally of four years duration	Accredited in terms of Washington Accord or equivalent
Professional Engineering Technologist	Incorporated Engineer	Engineering technology normally of three years duration	Accredited in terms of Sydney Accord or equivalent
Professional Engineering Technician	Engineering Technician	Technician engineering normally of two years duration	Accredited in terms of Dublin Accord or equivalent

*see: www.washingtonaccord.org/ for full details of these accords

Other items of interest from IStructE Council:

Past President John Nolan proposed that Regional Group Awards be automatically forwarded to the Board for inclusion as potential candidates for the annual IStructE Awards. John also recommended that Council

move towards a 50% pass rate on the Part 3 exams instead of the current level which about 33%.

Professor David Lilley made an impassioned speech on the role of the Structural Liaison Officer (SLO) at universities, stressing how important it is to encourage students to become members of IStructE. David has personally accomplished this at Charles Darwin University, by requiring that his students attend at least five evening technical meetings and by providing transportation and food for the students who attend the meeting. David's success rate with this technique has been remarkable. The free food seems to be the big draw for students! The Institution has a package of material available for interested SLO's. The role of SLO is something that perhaps SEABC should consider.

That's it for now!

Technical Committee

By Renato Camporese, , P.Eng., Struct.Eng., Director SEABC

The Task group investigating the Seismic Design of Basement Walls is currently the only active task group. Non-linear analysis is ongoing by graduate students at UBC under the direction of Dr. Mahdi Taibat. It is hoped that analysis will be complete by the summer for the committee's consideration and action.

APEGBC has now established an advisory committee to deal with temporary structures. The goal of the committee is to improve the structural engineering practice related to temporary buildings. The committee will meet bi-monthly and report directly to Council.

Draft documents regarding requirements for Fire Rating of Seismic Bracing and a Guardrail Design Guideline have been submitted to APEGBC for their review, endorsement and publication. The association has yet to respond to these proposed documents.

Vancouver Island Branch

By Martin Turek, P.Eng.

Hello SEABC Members,

I am excited to be involved in the SEABC Vancouver Island Branch for 2013. Tyler Thompson, Carl Wong, and myself, all with the Ministry of Transportation in Victoria, have joined up with the current organizer for this branch; Thor Tandy. Thor has done a great deal for the Island Branch and we are happy to join him to continue with activity here and to help to offer more to our Island membership. So far, for 2013, our goals include, but are not limited to:-

• Increasing exposure to SEABC and membership on Vancouver Island

• Hosting monthly (or so) live webinars on the Island which are being broadcast by the Vancouver Branch

• Planning local site tours and presentations.

So far we have had a test run of the webinar in January, and our second on February 20th. Thank you to the BC Ministry of Transportation and Infrastructure for allowing us to host the live webinars using their facilities. We expect to be able to host many more of them at the downtown Victoria location.

Please get a hold of us if you are living on or moving to the Island. We would be happy to add you to our distribution lists for our upcoming activities.

I look forward to the opportunity to participate in the great work that is done by SEABC, and to meet and work with the Island membership too!

Reinforced Concrete Design: A Practical Approach – 2nd Edition

By Svetlana Brzev and John Pao


The positive reception of the first edition of their textbook *Reinforced Concrete Design: A Practical Approach* motivated structural engineers and SEABC members Svetlana Brzev and John Pao to develop the second edition, which was released in January 2013 by Pearson Learning Solutions (940 pages). The authors have taken a practical approach to reinforced concrete design by combining the fundamental concepts of the underlying theory with the realities of Canadian design and construction practices.

Since 2005, the book has been adopted as a textbook at more than 20 universities and colleges across Canada, and the authors have received positive feedback from students, course instructors, and practicing engineers. The book has also been used by the students enrolled in the SEABC Certificate in Structural Engineering Program (Course C12 Practical Design of Reinforced Concrete 1).

Through fourteen chapters, the book covers the fundamentals of reinforced concrete design: design of beams and slabs for flexure, shear, and torsion; serviceability considerations; design of continuous floor systems; design of columns, walls, and foundations; and anchorage considerations.

The second edition features a new chapter on the design of two-way slabs, a challenging topic for engineering students and young engineers due to a multitude of possible design solutions resulting from redundant load paths in two-way slabs. The authors have made an effort to give a practical design perspective to this particular topic, and have focused on analysis and design approaches that are used in structural engineering practice. The topics include design of two-way slabs for flexure, shear, and deflection control. Topics such as Direct Design Method, Two- and Three-Dimensional Elastic Analysis procedures are covered in detail, and applied to regular and irregular slabs. Moment redistribution resulting from inelastic behaviour is also discussed. The chapter also covers key concepts of the Yield Line Method and offers a practical approach for estimating the ultimate load capacity in two-way slabs. The same design example is analyzed using these different methods in order to understand the pros and cons of each method.

A number of chapters have been revised to reflect the changes resulting from the 2005, 2007, and 2009 amendments of the CSA Standard A23.3-04 Design of Concrete Structures, and the National Building Code of Canada 2010. Several supplements are available to the readers by accessing the book web site, including the limited version of the new column design software BPA COLUMN, which generates column interaction diagrams for rectangular and circular columns with variable dimensions and reinforcement amount and arrangement. Additional supplements include spreadsheets related to foundation design and column load take down, and a few Power Point presentations showcasing reinforced concrete structures under construction and in finished form.

This book is a collaborative effort between an academic and a practising engineer and reflects their unique perspectives on the subject. Svetlana Brzev, Ph.D., P.Eng. is a faculty member in the Department of Civil Engineering at the British Columbia Institute of Technology, Burnaby, BC. Svetlana has over 25 years of combined teaching, research, and consulting experience related to structural design and rehabilitation of concrete and masonry structures, including buildings, municipal, and industrial facilities. John Pao, M.Eng., P.Eng., Struct.Eng., is the President of Bogdonov Pao Associates Ltd. of Vancouver, BC, a firm that practices in BC as well as California and throughout Western United States. John has over 30 years of consulting experience related to design of reinforced concrete buildings, including high-rise residential and office buildings, shopping centers, post-tensioned parking garages, institutional buildings and sports and recreation facilities.

Communications Committee

By David Harvey, P.Eng, Struct.Eng.
Director SEABC

We much appreciate those that contribute articles or photographs to the newsletter describing their activities or interests. Working to inform readers about our engineering designs or research helps raise our profession profile, and hopefully serves to inspire others. Contributions from structural engineers are invariable, interesting and we want to see more. Please keep sending in your submissions - we look forward to hearing from you. Kindly send information for publication to:-

newsletter@seabc.ca

– We'll try to include as many submissions as we can!

Inaugural Address of the President

By Victoria Janssens, EIT

Following my first day of Council meetings, it was my pleasure to attend the Inaugural Address of Y.K. Cheng: the President of the Institution for 2013 and the third President to be located outside of the UK. On the evening in question, Y.K. delivered his address - "Shaping our Future" – to a packed room comprising of many eminent structural engineers (including the Presidents father H.K. Cheng, the Institutions Gold Medallist in 2001).

Y.K. was born in Hong Kong and recalls being regularly exposed to the construction industry during his childhood. He went on to study civil engineering at Lehigh University, after which Y.K. worked at SOM Chicago for a number of years. In 1977, Y.K. returned to Hong Kong and has since worked with H.K. Cheng & Partners Limited. Y.K. is also a registered Class 1 structural engineer in China and is actively involved in public service (both in Hong Kong and China).

Following a whistle-stop tour of Y.K.'s professional background, he moved on to discuss the challenges facing our profession today. The President outlined the importance of considering the social, economic and environmental aspects of our work and emphasized the need to understand the risks associated with natural and man-made hazards. Y.K. also identified the increasing requirement for structural engineers to be familiar with a wide range of methodologies, codes and practices, as a result of globalisation of the profession.

Lastly, Y.K. gave an overview of the progress being made towards developing a truly international Institution. This is particularly relevant to engineers in British Columbia and it was promising to hear that this will be a key issue for the President during his year in office. The Institution is currently undertaking a full review of the routes to membership and of the CM Examination, with the goal of increasing their international appeal. Furthermore, comparability assessments of professional practice standards in various countries around the world are underway; these will assist the Institution in tailoring its approach as required on a country-by-country basis.

A full version of Y.K.'s address can be found on the Institutions website: www.istructe.org.

Bill, YK and Victoria

Port Mann Bridge

By David Harvey, P.Eng, Struct.Eng.

The new Port Mann Bridge was the presentation topic at the evening meeting on January 23. The spectacular new structure proved to be very popular, attracting a live audience of 75, who were treated to an equally spectacular presentation. The presentation was also webcast live to audiences in Victoria and Kelowna.

Our speaker, Ross Gilmour, P.Eng, former Sponsor and Project Manager for the Port Mann Highway 1 project, is Area Manager for Peter Kiewit Infrastructure. At $2.5 Billion the Port Mann Highway 1 project ranks as the largest transportation project in the history of BC. Ross' background includes construction of the Skytrain's Millennium Line, the Pitt River Bridge, and the Confederation Bridge, excellent credentials for managing a challenging project on this scale.

Crossing the Fraser River between Coquitlam and Surrey, the new Port Mann Bridge is the centerpiece of the new 40 km long Highway 1 widening project, the construction of which is being carried out by the a joint venture between Peter Kiewit Sons Co. and Flatiron Constructors Canada Limited. The 2 km long bridge crossing includes precast concrete segmental approach spans and an 850 m long main cable-stayed section, and will eventually carry a total of ten traffic lanes. The new Port Mann Bridge is officially the world's widest long-span bridge. The 65 m wide superstructure consists of two independent superstructures separated by a 10 m air gap, which contains the pylons. Last December, with the spans completed and the surfacing in place, the bridge was opened to six lanes of traffic and the original Port Mann Bridge, dating from 1964, was closed. Deconstruction of the original bridge will take place over the next 18 months and will cost at least $20 Million. Because the bridge footprints overlap at each end, removal of the original construction is necessary to allow completion of the new bridge.

Ross' two-hour plus presentation took us with a detailed account of the procurement, design and construction on the new Port Mann Bridge which is the Province's longest bridge structure. The construction of a project of this magnitude has many challenges, and Ross provided a detailed description of Kiewit's innovative approach, which includes several "world firsts". Particular points of interest included:-

- During the bid phase, the contractor commissioned a physical model to study the site hydraulic characteristics of the new bridge and the two adjacent foundations. The multi-million dollar cost of the model justified significant savings in foundation and channel scour protection.

- The design/build team quickly dismissed the option of twinning the original Port Mann Bridge. Challenges were identifying the extent of bridge upgrading required; quantifying and managing the operational risks; and arranging the work activities to suit the project schedule requirements for six- and ten-lane operation of the bridges.

- The contractor conducted a 54 MN static pile test, the largest externally-reacted test load on record for a bridge foundation pile. This test, coupled with a pile uplift test, enabled the foundation piles to be optimized, which resulted in an overall saving of approximately $30 Million.

- Pile driving for the north (offshore) pylon was carried out by a 700 ton barge-mounted crane, the largest piece of equipment in the Kiewit inventory. Importing this special equipment into Canadian waters required approval of the Canadian government – a time-consuming process which required agreement with the Canadian marine construction industry. Known as the "General", the massive crane can lift and stab the 70 m long, 1.8 m diameter by 38 mm wall-thickness steel pipe piles, and then drive them to refusal using a Menke 500 kJ hammer. The 63 piles for the north pylon foundation were driven in just 63 days, which helped rescue the north pylon's dragging

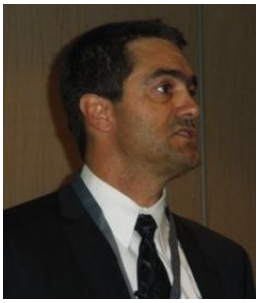
construction schedule, and fully justified bringing the "General" up to BC.

- The north pylon pile cap was prefabricated as a concrete shell in a dry dock, fitted out with temporary steel bracing, floated over the driven piling, and lowered into position onto the piles using water ballast. The precast shell was then dewatered and filled with rebar and concrete to complete construction of the massive elevated pile cap. Prefabricating the pile cap also contributed significantly to advancing the north tower's construction schedule.

- The bridge pylons, which rise some 110 m above the bridge deck and provide 42 m of navigation clearance, were constructed using slip-forming, a novel technique for building bridge towers. The contractor devoted considerable effort to developing a suitable concrete mix design. The selected concrete mix combined the necessary long-term strength and durability requirements with the short-term strength gain needed to support the slip-form platform as it slid up the pylon during construction. While the learning curve prevented the slip-forming technique from saving very much time compared with jump-forming on the south pylon, the north pylon's construction schedule greatly benefitted from slip-forming's impressive productivity.

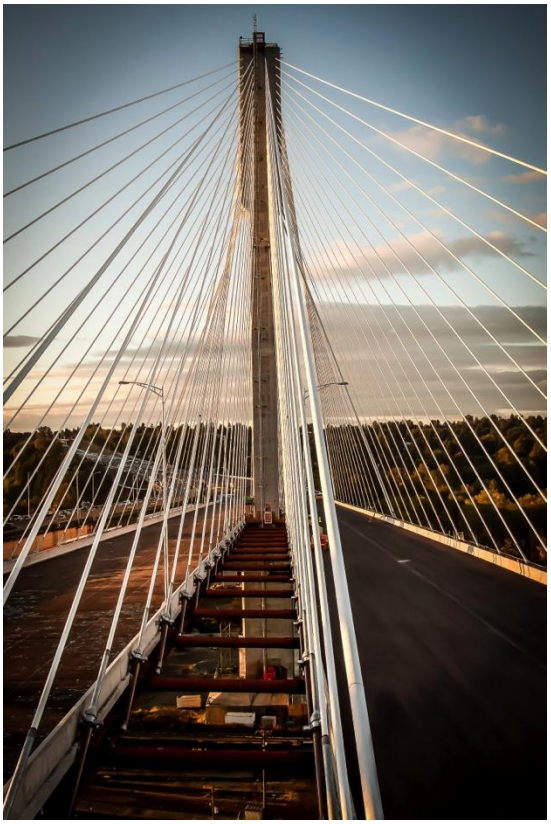
- The main bridge superstructure, supported by the 288 overhead stay cables, consists of a structural steel framework acting compositely with full-depth precast concrete panelized deck and connected by cast-in-place concrete stitch pours. This superstructure system could then be almost entirely constructed from overhead, which was a necessity when building above the rail yards beneath the south side span. Installation of the composite prefabricated superstructure was very productive and provided immediate construction access to newly installed deck sections. A total of 12,900 tonnes of structural steel was involved.

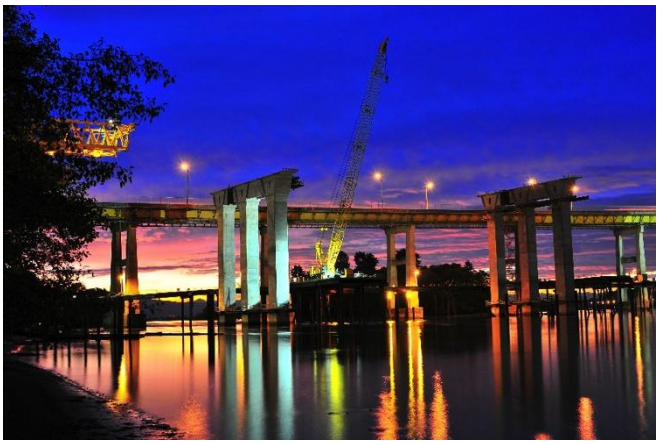
- The approach spans were built using nearly 1200 precast concrete match-cast segments weighing up to 90 tonnes. The segments were installed and supported using an impressive purpose-designed erection truss, which combined span-by-span and balanced cantilever duties. Only one end segment was lost during construction, which promptly recast and reinstalled, minimizing construction delays. Currently, segments in the bridge overlap areas are awaiting removal of portions of the original bridge.

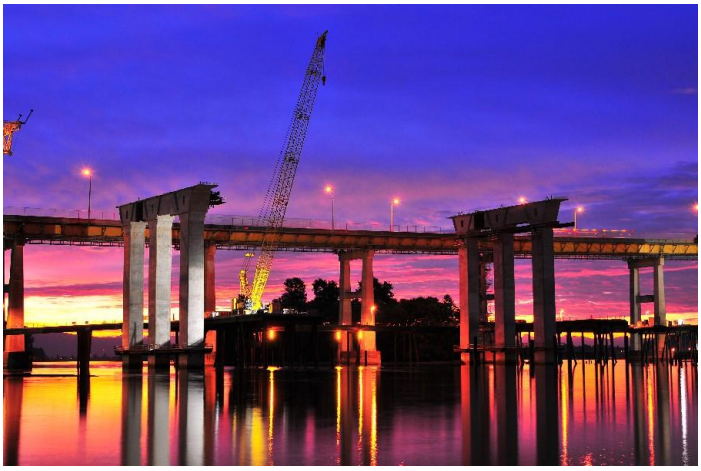


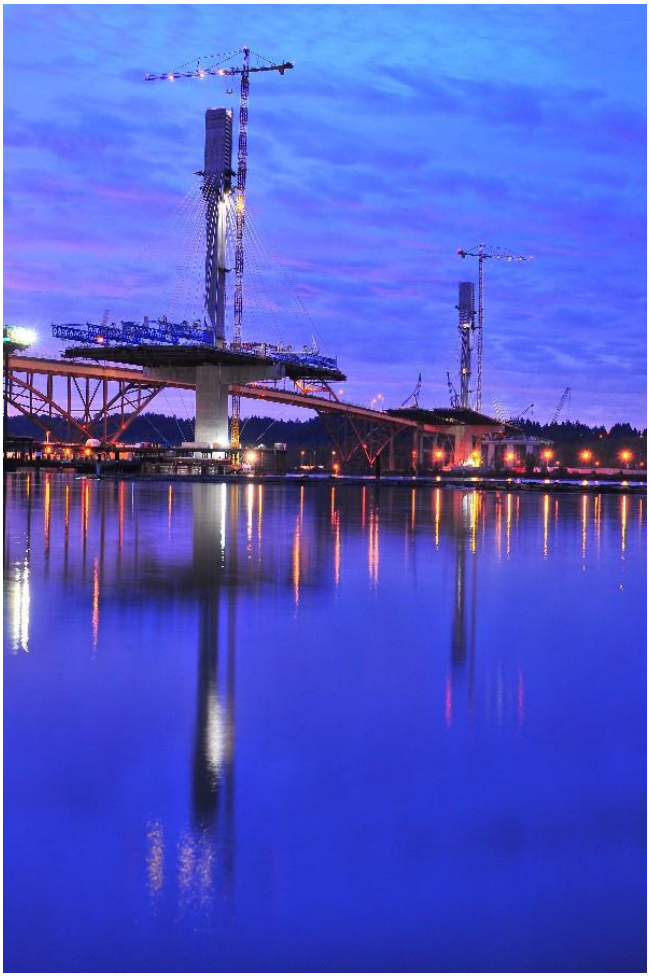
Ross' enthralling presentation held the audience's attention throughout and drew many searching questions, which he handled expertly. Those present, largely unfamiliar with construction on this scale, were given a great introduction to the art of building signature bridges under immense challenges and to the innovative techniques that can be employed. Ross' passion for the work he undertakes was very clear to the audience, who were most appreciative of his efforts, and of the extensive material he presented for our benefit.

A series of photos from the presentation follow which highlight the scale of the impressive new bridge and its construction progress.

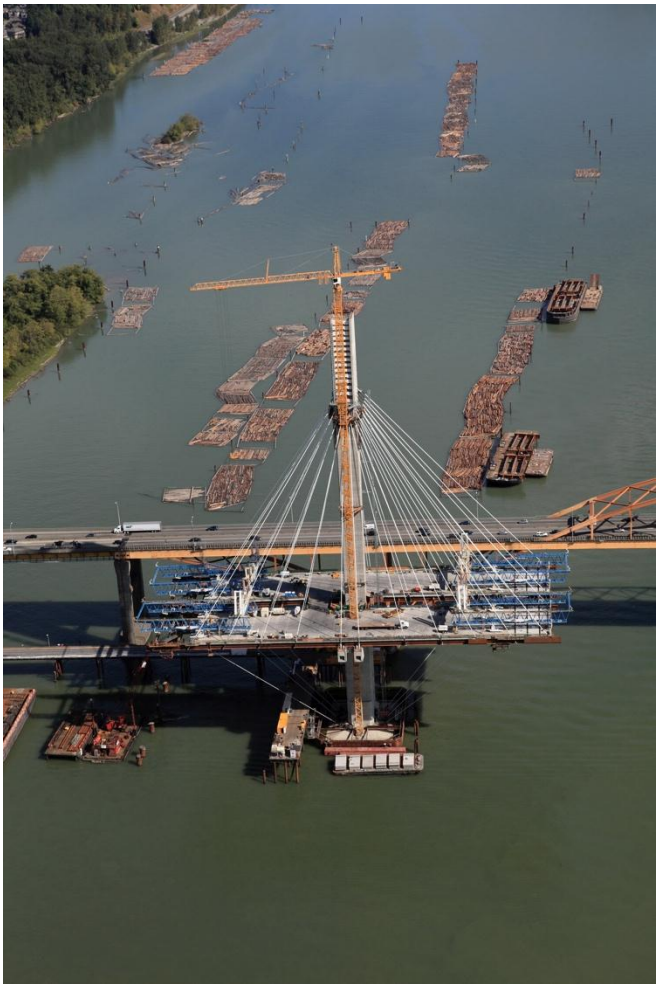


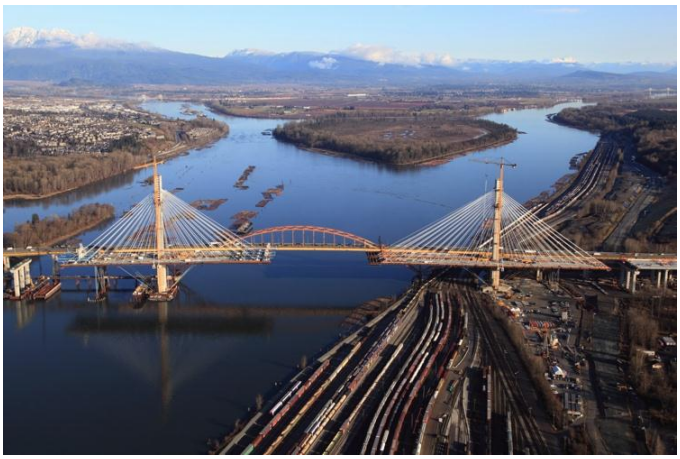


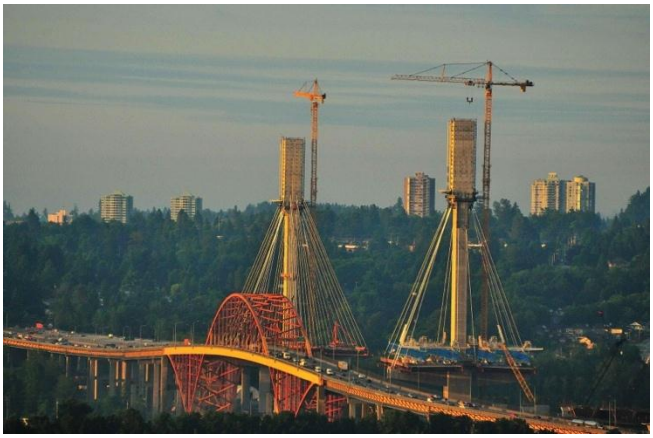




Photos above taken by Ryan Tabuchi







Interview with Paul Fast

By Bill Alcock P.Eng. Struct.Eng. MIStructE.

In our November SEABC Newsletter, we reported on the two major awards that the Vancouver firm of Fast + Epp received at the Institute of Structural Engineers Annual Awards night held in London, England, on November 2, 2012. The awards that Fast + Epp received were:

1. **Award for Community or Residential Structures** – awarded for the Van Dusen Gardens Botanical Visitor Centre

2. **Award for Education or Healthcare Structures – Commendation** for the UBC Centre for Interactive Research in Sustainability

SEABC Director Paul Fast

Bill: Paul, how did you become aware of the IStructE Annual Awards and selection process, and what prompted you to submit your designs for an award?

Paul: *We became aware of IStructE well over 10 years ago as a result of spending time in Europe and also having hired a Chartered Engineer (Duane Palibroda) with experience in London consultancies. We find the awards program most interesting because it is open to entries from the entire world and because it has a holistic judging criteria that acknowledges technical excellence and social and aesthetic values.*

Bill: Have you previously submitted other designs to the IStructE?

Paul: *Yes we have. Four other projects, most notably the Richmond Oval were successful, while a number of others were not.*

Bill: When did you find out that you had been shortlisted to receive an award?

Paul: *Typically the shortlisted entries are announced in August of each year following submission in May.*

Bill: You and your firm have deservedly developed a world-wide reputation for innovative design, particularly in timber structures. Did you make a conscious decision to pursue this line of work some time ago, or was it something that developed naturally from the type of work you were doing?

Paul: *At some point it just became apparent to us that timber has been an under-utilized material with untapped potential for adding aesthetic value and warmth to buildings. We are particularly enjoying exploring hybrid options such as wood-steel and wood-concrete that exploit the most beneficial properties of each material. We are also increasingly looking at structure to do double and triple duty such as serving an acoustic function, concealing services, acting as mechanical ducts in addition to its traditional role as supporting element.*

Bill: Your firm operates a subsidiary company that fabricates timber structures. Has the ability to manufacture your designs assisted in the development of new techniques for designing timber structures?

Paul: *Probably 95% of the designs prepared by our office are constructed by independent contractors,*

including steel fabricators that will assemble and erect hybrid structures. However, some of the panelized systems and more complex structures lend themselves more to a design-build delivery by our affiliated manufacturing company.

Bill: There seems to be a lot of interest in your capabilities in Europe. Is this something you are actively cultivating?

Paul: *Yes, we have established an office in Frankfurt, Germany and have been fortunate to receive some excellent press in European design publications for some of our projects. European architects have shown a lot of interest in our work; however, it is a steep hill to climb…*

Bill: How has your innovative timber engineering received a boost from the move towards sustainability?

Paul: *Definitely, there is no doubt that the design community and the world is viewing timber as a material with sustainability benefits.*

Bill: Your firm has pretty much attained the pinnacle of achievement in timber structures. Are there other engineering materials that you would like to work on developing in the future?

Paul: *Actually almost all the awards we have received have involved the use of both timber and steel in a hybrid manner. This year we will be submitting a couple of technically challenging and architecturally striking designs that exclusively use concrete and steel. We are also currently working on an iconic 52 storey mixed-use concrete tower.*

Other materials such as structural glass and plastics capture our interest. We have also started an IDEAS division and are currently developing an engineering/architecture app due to be released shortly.

Bill: Congratulations on receiving these major awards. I look forward to seeing you on the podium again at the 2013 IStructE Awards night!

Paul with his Fast & Epp Colleagues: Duane Palibroda; Paul Fast; Ian Boyle; Gerald Epp; and Julien Fagnan

Issues with Constructions Materials

By Adrian Gygax, P.Eng, Struct.Eng
Director SEABC

Recent years have seen a number of reports surface concerning counterfeit construction materials or suspect practices that our members need to be aware of. These have included structural bolts; rebar couplers; stud rails; and rebar details.

Another important issue that emerged is the phenomenon of “liquid metal embrittlement” that can be encountered when galvanizing welded or cold-worked steel fabrications.

If you have encountered anything along these lines please send me details. The information you provide will remain confidential; we will only the report facts to help guide your fellow structural engineers. You can reach me at: agygax@gea.ca

Thank you for sharing your “lessons learned” with others.

Awards for UBC Students

By Martin Bollo M.Eng., P.Eng., P.E., S.E., LEED® AP

Fourth year BCIT Civil Engineering student Stevan Gavrilovic was the recipient of the Structural Engineers Association of British Columbia Award in Structural Engineering at a ceremony held on Wednesday, November 14, 2012 at the Willingdon Conference Centre.

Along with two other awards for UBC students, these awards are offered to students entering their fourth year of studies in Civil Engineering who have demonstrated academic proficiency and an interest in structural engineering.

The awards are funded through proceeds from the SEABC Certificate in Structural Engineering Program. BCIT Faculty member Martin Bollo (pictured left and sporting a Movember moustache) presented the award to Stevan (pictured right).

Young Members Group

By Grant Fraser

In November 2012, the Young Members Group held an evening seminar on “Field Reviews in Engineering Practice”. On the evening a packed room listened attentively to two excellent presentations by Andy Metten P.Eng., Struct.Eng. (Partner at Bush Bohlman & Partners) and Peter Mitchell P.Eng. (Director of Professional Practice, Standards and Development at APEGBC).

Firstly Andy Metten discussed the how and why of field services, highlighting some of the pitfalls that may occur during site visits. Andy also presented tips for successful field reviews and discussed the benefits of seeing projects coming to fruition. Peter Mitchell then delivered a very informative presentation on appropriate professional practice related to carrying out field reviews. Due to the popularity of this subject matter, it was decided to record this event and upload this to the website as a resource for SEABC members. This recording is now available on (alongside the speakers’ power point presentations) through the seminar downloads page on the SEABC website.

Photos:- Andy Metten and Peter Mitchell

Organizational Quality Management

By David Harvey, P.Eng, Struct.Eng.

APEGBC launched its Organizational Quality Management (OQM) program in 2012 as a means of improving the efficiency of their quality auditing process. Currently this is carried out through practice reviews which have helped to improve practice standards for the past couple of decades. Practice reviews tend to focus on an individual's quality management program (QMP) which is required under Bylaw 14b. APEGBC members working in large organizations normally rely on the employer's QMP, which in many cases meets the regulatory requirements. Unfortunately, this can result in APEGBC inefficiently having to review applications of the same QMP on multiple occasions. In turn, having multiple staff members undergo practice reviews can add up to a significant cost of doing business for employers.

As a result, the OQM program allows organizations to have their QMP reviewed and endorsed by APEGBC. The big attraction is that the staff of companies that sign up for OQM, will be exempt from random practice reviews. This amounts to a "win-win" formula from both regulatory and commercial perspectives.

One aspect that will affect many structural engineering firms seeking to join the OQM program is APEGBC's "Use of the Seal" regulations. We published an article (Page 13) and appended Peter Mitchell's *Use of Professional Seal on Tender Documents* to the SEABC May 2012 Newsletter. Additional information is contained in the Association's Quality Management Guidelines:-

www.apeg.bc.ca/ppractice/documents

Essentially the regulatory requirement is that documents that may be relied upon by outside individuals or organizations must be sealed. Currently, this is a far from established practice in the industry; it is not uncommon to see issued-for-tender drawings lacking an engineer's seal. Therefore some adjustments in QMPs will become necessary for companies to become part of the OQM program.

Note that if an engineering seal is applied to a preliminary or incomplete drawing, APEGBC recommends that an appropriate qualifying note is added next to the seal. Please also note that we have been advised that sealing the drawing in no way changes the legal responsibility a company has for drawings it issues, or the regulatory obligations of the designer. Our recommendation is to aim for the benefits of having an accredited quality management program and adapt to any changes needed in the corporate practice of sealing drawings. Consider OQM as a marketing opportunity!

Nominate a Colleague

By David Harvey, P.Eng, Struct.Eng.

Do you have a deserving colleague that has contributed strongly to the profession and/or the community? Is that person serving as a role model and inspiring others? If so, consider nominating him/her for the 2013 President's Awards, recently announced by APEGBC – B.C.'s premier awards for professional engineers. To nominate an individual, you will need to prepare a letter of nomination, or support for a nomination, outlining that person's outstanding achievements.

The President's Awards include meritorious achievement; community service; professional service; the Young Professional Award; and the R.A. McLachlan Memorial Award – BC's top award for professional engineers. Nominations must be received by Friday April 12th 2013.

Full details of the awards and the submission requirements are available at:-

www.apeg.bc.ca/services/awards

For further information or assistance on any aspect of the APEGBC President's Awards, contact Laurel Buss at:-

lbuss@apeg.bc.ca

On the Web

By Stephen Pienaar, P.Eng; Director SEABC

I have personally found SEABC to be an amazing group to be part of. It has opened up a wealth of opportunities for professional development and networking. Residing in the Lower Mainland, it is easy for me to attend various events. Not quite so for our colleagues elsewhere in the Province, Canada and the world. But things are getting better all the time thanks to our website and some hardworking volunteers...

The Educations Committee, Corporate Committee and Young Members Group have done a brilliant job with hosting seminars. Video recording of several of the past year's seminars are available to members on the SEABC website. Members can log in at their leisure from anywhere in the world and watch any of the recordings in the archive. Going forward, the Educations Committee will be trying to record even more of their monthly evening seminars.

An exciting new development is the live webcasting of evening seminars to the SEABC branches in Victoria and Kelowna. The live webcasts enable the remote viewers to interact with the presenters. And being in a room with fellow members makes for it to be almost as good as actually being there: see the presentation in real-time, interact with the presenter and do some networking. While there have been a few technical glitches—call them teething problems—the live webcasts have had a positive reception. Kudos to the Educations Committee for their initiative and hard work!

Recent seminar recordings include:

- Young Members Group seminar in November:
  Conducting Field Reviews
  Presented on November 17 by Andy Metten P.Eng. Struct.Eng., Bush, Bohlman & Partners, and Peter Mitchell P.Eng., APEGBC
- October evening seminar:
  Energy-Efficient Buildings and Passive House
  Presented on October 17 by Robert Malczyk, P.Eng, Struct.Eng., Equilibrium Consulting Inc.
- Noel Natham Memorial Lecture in Structural Engineering:
  The Canterbury Earthquakes - Engineering Matters
  Presented on May 30 by Dr. David Hopkins, Consulting Engineer, Wellington, New Zealand

For these and other seminar recordings, please visit:-

www.seabc.ca/seminar-downloads

Staying up to date

The various SEABC committees are doing valuable work, and we are trying to reflect this by keeping the information on our website current. Please bookmark www.seabc.ca and check in regularly for upcoming events, seminars and courses.

Suggestions

Comments and suggestion for improving our online services are welcome. Please send your ideas to:-

webmaster@seabc.ca.

Sustainability Seminar Progresses

By Mark Porter, P.Eng., Struct.Eng. LEED AP

At the request of the Communications Committee, a sub-committee has been looking at putting together an in-depth seminar on applied sustainability for Structural Engineers. At the most recent board meeting approval was given for this steering committee to work with Diana Klein P.Eng in finalizing course content and speakers.

This course will tie in well with the release of the updated APEGBC guidelines. These over-arching guidelines were passed by Council in November 2011 and are due to come in to force in January 2014. Watch this space for further details.

The Structural Engineers Association of British Columbia is inviting members interested in standing as candidates for election to the Board of Directors for the 2013/2014 term. If you are a current voting member and would like to be a candidate, kindly provide us with a brief election statement (50 - 100 words) and a recent photograph.

We will be posting the list of candidates and their election statements on the SEABC website and notify members by email of the same. The SEABC bylaws require that we have a minimum of five Directors. However, we aim to have about ten to twelve Directors to ensure that we cover the spectrum of Structural Engineering. Unless elected by acclamation, election is by ballot.

Please submit election statements to the SEABC Communications Committee on or before Friday, March 29th at:-

election@seabc.ca

Should you wish to participate in one of the Association's programs or committees but not serve on the Board of Directors, please contact the Board at:-

feedback@seabc.ca.

Thank you for your interest in serving your Association, and for your continuing support of SEABC.

Administration Assistant

The Certificate in Structural Engineering Program is looking to recruit a part-time Administration Assistant to replace Fran Abbühl, who is retiring at the end of March. Brief description of duties include:

1. Attend and record monthly Executive Committee meetings
2. Administer committee functions including liaise with executive committee, students, instructors, venue staff, SEABC webmaster, and UBC Civil Dept.
3. Registering students to the courses
4. Maintain student records
5. Responding to queries

This is a part time position. The remuneration is $40 per hour, average number of hours of work, approximately 20 hours per month.
For enquiries contact Fran Abbühl at:

604.789.5801 or fran.abbuhl@seabc.ca

Recent Research at UBC

February 2013

By Carlos Ventura Ph.D, P.Eng

Steel Ring Connection for Tension-Only Brace Systems in Low Rise Buildings

A number of static cyclic and shake table tests are being conducted at the UBC Earthquake Engineering Research Facility (EERF) to determine the adequacy of steel ring connections (SRC) as a possible seismic upgrading technique to enhance the lateral ductility, energy-dissipation and damping of existing steel frames with tension-only braces. The project consists of two phases: Phase I was implemented to assess the cyclic behaviour of the frames upgraded with SRC; and Phase II is being implemented to determine the behaviour of the system under simulated ground shaking using the linear shake table at the EERF.

The proposed technique consists of an X-bracing system with a steel ring element at the mid-point of the brace. The lateral load on the frame is transferred to the steel ring element through the braces. The cyclic lateral displacement of the braced frame deforms the SRC. Excessive deformation causes the element to bend and when local plastic hinges are formed, energy is dissipated. A major advantage of this system is that it is a simple system to install, and very minimum modification of existing bracing systems is required. A typical single-storey frame equipped with the SRC system and the expected inelastic deformation mechanism due to lateral load is illustrated in Figure 1.

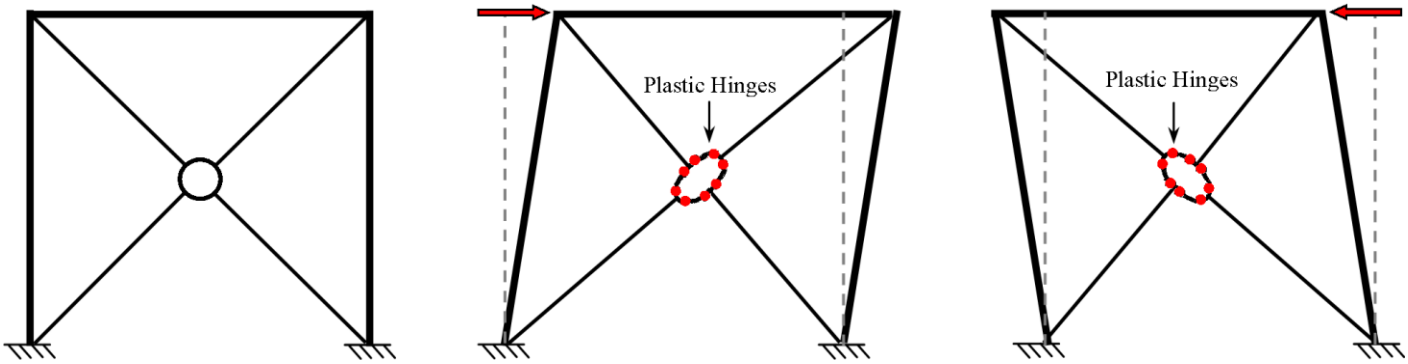


Figure 1: Concept of adding steel ring connection (SRC) to a typical single-storey braced frame and its deformation mechanism due to lateral load.

A schematic view of the SRC specimen and some connection details are illustrated in Figure 2.

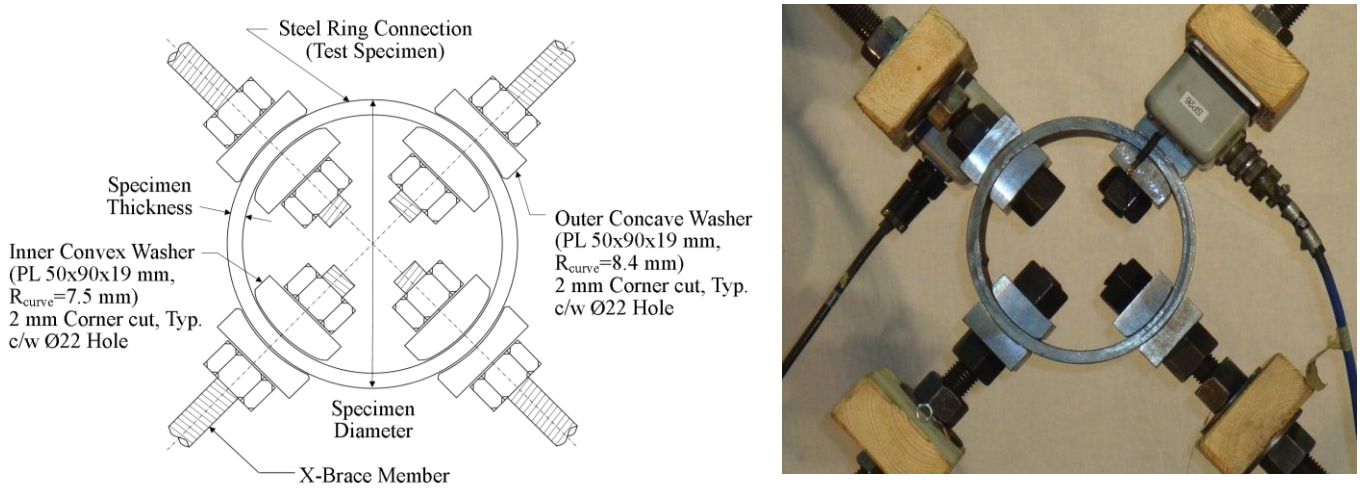


Figure 2: **Connection details of the SRC and view of a test specimen**

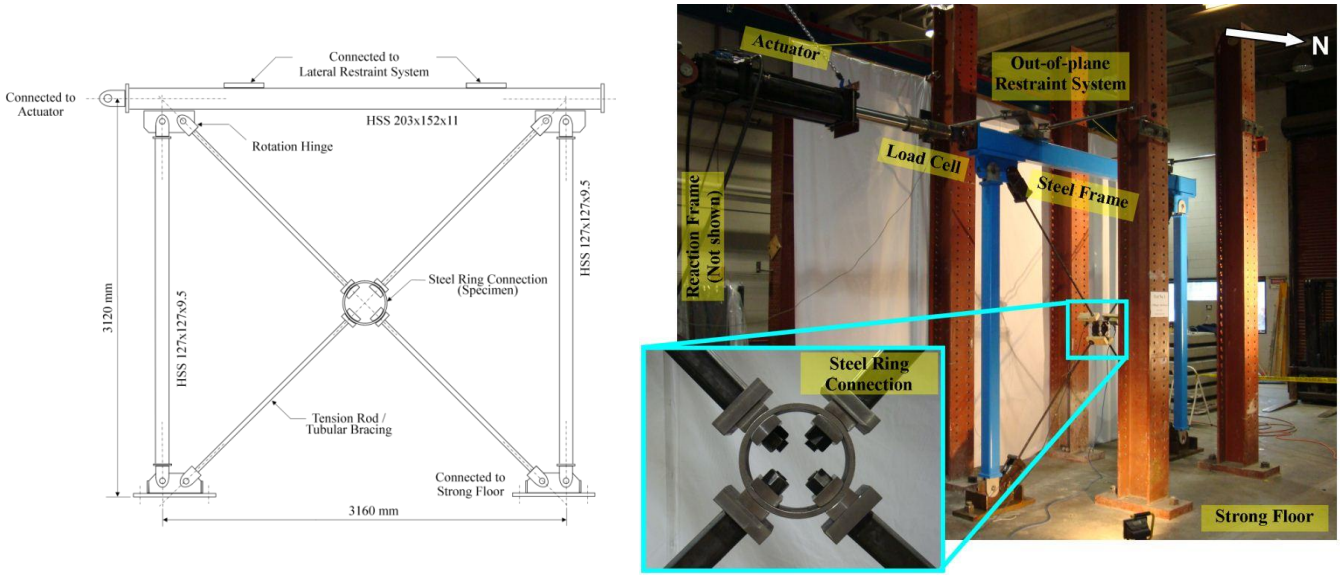
Testing Program

For Phase I of the project a test frame with various types of steel rings and different types of braces was subjected to cyclic loading. Details of the testing program for this phase are presented in Table 1.

Table 1: Testing Program and Description of specimens.

Test No.	Specimen ID	Ring Characteristics			Bracing Type	Specimen Description	Date of Test
		Diameter (mm)	Thickness (mm)	Wide (mm)			
1	Ring168x9.25	168	9.25	90	Tension rod	with washer – 100 mm off center	4, Feb., 2011
2	Ring168x9.25	168	9.25	90	Tubular	with washer – 100 mm off center	7, Feb., 2011
3	Ring168x9.25	168	9.25	90	Tension rod	with washer	11, Feb., 2011
4	Ring168x7	168	7	90	Tension rod	with washer	14, Feb., 2011
5	Ring168x7	168	7	90	Tension rod	without washer	15, Feb., 2011
6	Ring220x8.25	220	8.25	90	Tension rod	with washer	15, Feb., 2011
7	Ring274x8.75	274	8.75	90	Tension rod	with washer	15, Feb., 2011
8	Ring168x9.25	168	9.25	90	Tubular	with washer	21, Feb, 2011
9	Ring220x8.25	220	8.25	90	Tubular	with washer	22, Feb., 2011
10	Ring274x8.75	274	8.75	90	Tubular	with washer	23, Feb., 2011
11	Benchmark	No ring			Tension rod	No mid-joint connection	24, Feb., 2011
12	Benchmark	No ring			Tubular	Regular mid-joint connection	25, Feb., 2011

Figure 3 shows details of the testing frame and test setup for Phase 1 of the project.



(a) (b)

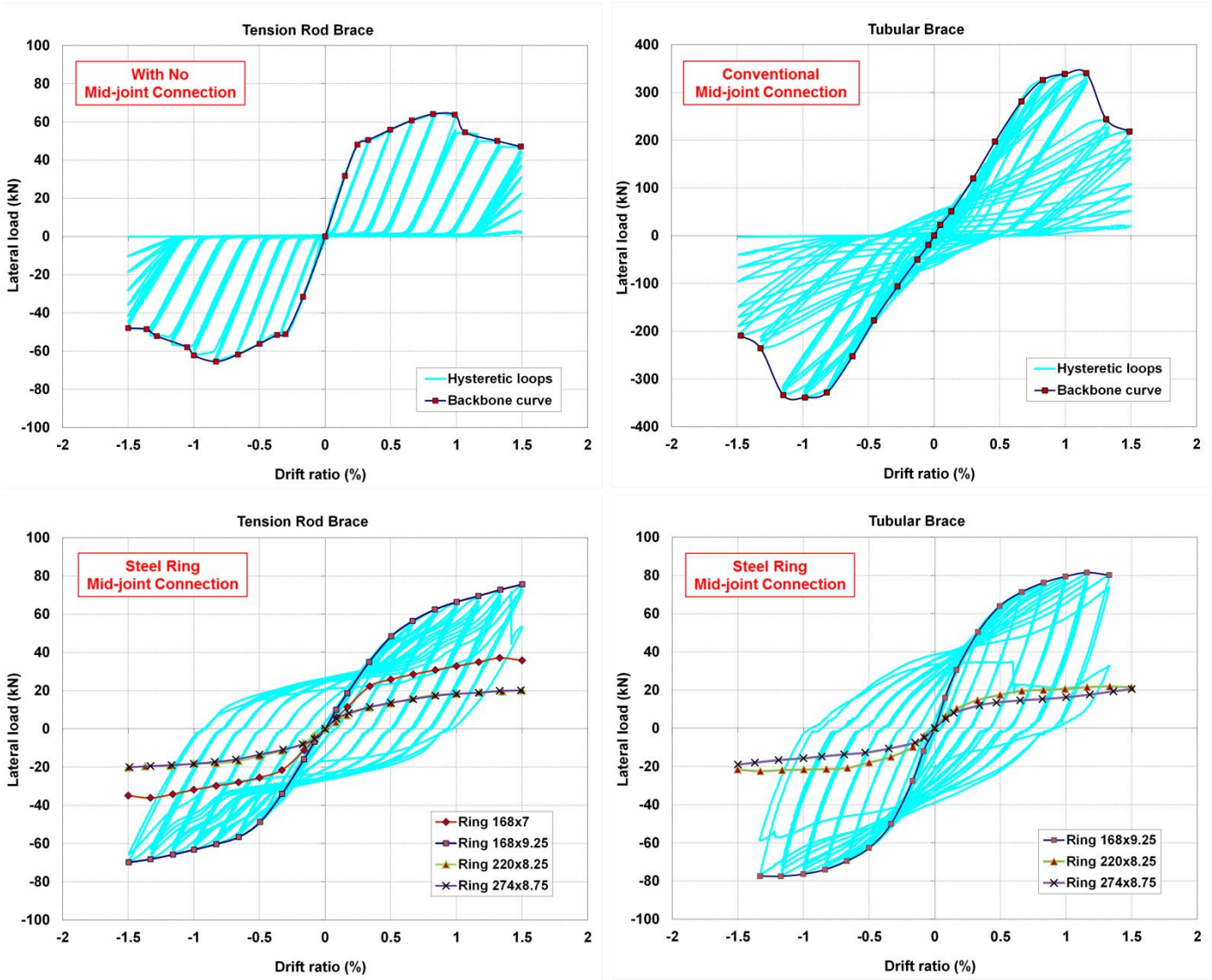
Figure 3: Test set-up: a) Test frame details; b) General view.

Four ring specimens were tested, as shown in Table 1. Two X-braced systems without SRC were used as benchmark specimens and represented a typical conventional braced frame: The tension rod braces were made of structural steel conforming to ASTM A307. The two rods were not connected at the mid-point of the brace. The tubular braces were made of structural steel conforming to CSA G40.21 Grade 350W, with regular mid-joint connection consisting of two splice plates (400x100x20) that were welded to the HSS segments.
It should be noted that the SRC concept has been designed only for tension system. For in-depth tubular tests much stronger rings should be used to match approximately the yielding load of the tubular brace. That would produce very different results and conclusions regarding the use of the SRC with tubular braces than the results and observations presented here. Phase 1 of the project included testing of tubular braces with and without SRC in order to get a preliminary idea of the performance of this proposed system.

Observations and test Results

The performance of various SRC elements and brace members of the upgraded frame was evaluated for storey drifts of up to 1.5%. The benchmark frames (braced frames with no ring) were subjected to the same loading condition in order to be able to compare results from different tests. Figure 4 shows a comparison of the hysteretic response and backbone curves of the benchmark frames and the upgraded frames with various SRCs. As expected, severe pinching associated with significant deterioration and rapid degradation in strength and stiffness was observed in the benchmark frames. The initial stiffness of the benchmark frames with tension rods and tubular braces was 7.1 and 14.8 kN/mm, respectively. The corresponding backbone curve was approximately linear up to 0.25% and 0.67% drift ratio, for tension rods and tubular braces, respectively. Beyond this drift, both the lateral strength and the stiffness were reduced shortly after peak load was reached due to severe buckling of the compression braces. The maximum value of lateral load carried by the braced frame with tension rods was 65.2 kN at a 1% drift level. Strength degradation occurred at this drift level and a reserved capacity up to approximately 80% of the peak load was measured, which reduced to zero with the repetitions of displacement cycles at 1.5% drift ratio. The maximum lateral strength of the braced frame with tubular sections was 347.2 kN at 1.17% drift, which was about 5 times that of the strength of the frame with tension rods. The strength was then decreased rapidly to 245.6 kN at a drift of 1.33% and 221.7 kN at a drift of 1.5 %. This value reduced to zero with repetitions of the cycles at 1.5 % drift.

The load–displacement behavior of the upgraded frames was characterized with full and stable hysteretic loops without any incidence of pinching up to the 1.5% drift. Significant post-yield hardening behavior was noted for the upgraded frames with no degradation of lateral strength, even up to a drift of 1.5%. The upgraded frames exhibited non-linear behavior at very low drift levels, as the widening of the hysteretic loops showed initiation of inelastic behavior of the specimens. The maximum lateral load carried by the upgraded frames with a 168x9.25 ring was 81.4 kN at a drift of 1.5%. The lateral strength of the upgraded frames heavily depended on the size of the ring. The strength was reduced with the increase in the diameter and the decrease in the ring thickness. The lateral strength was measured as 20 kN at 1.5% drift level for the 220x8.25 and 274x8.75 rings. The lateral load carried by upgraded frames with these specimens was nearly constant after the 0.5% story drift level. The lateral load on the upgraded frames at the smaller drift levels increased with the increase in the drift level.



(a) *(b)*

Figure 4: Hysteresis loops and backbone curves for the benchmark frames and the upgraded frames:

a) Tension rod braces; b) Tubular braces

Although the upgraded frames carried a smaller lateral load than the tubular benchmark frames, this was due to the capacity of the rings, which were designed to be used with tension rod bracing. However, more ductile behavior was achieved when SRC was used in the frames. Furthermore, both the upgraded frames with tension rods and tubular braces did not exhibit any strength-degrading behavior during the entire test. Except for the 168x9.25 ring, the upgraded frames did not reach failure at the 1.5% drift level, and these could have resisted several more cycles of loading. Stronger ring sections will be needed for seismically upgrading tubular braced frames.

Figure 5 compares the variation of lateral stiffness of the benchmark frames and upgraded frames with various SRCs for different drift levels. The initial lateral stiffness of the upgraded frames was lower than that of the benchmark frames, and, as expected, the lateral stiffness of both systems was reduced with the increase in drift levels. The rapid reduction in lateral stiffness of the benchmark frames was primarily due to the buckling of the braces. In contrast, the post-yield softening of the SRC was the main reason for the progressive reduction in lateral stiffness of the upgraded frames with the increased drift levels. As shown in Figure 5, the stiffness of the upgraded frames heavily depended on the size of the SRC and increased with the decrease in diameter of the ring.

Comparing the responses of the frames with tension rods upgraded with the 168x7 and 168x9.25 rings indicated that a higher stiffness was achieved with thicker rings. Also, a higher lateral stiffness was observed in the upgraded frames with tubular braces than the frames with tension rods when a similar size of SRC was used.

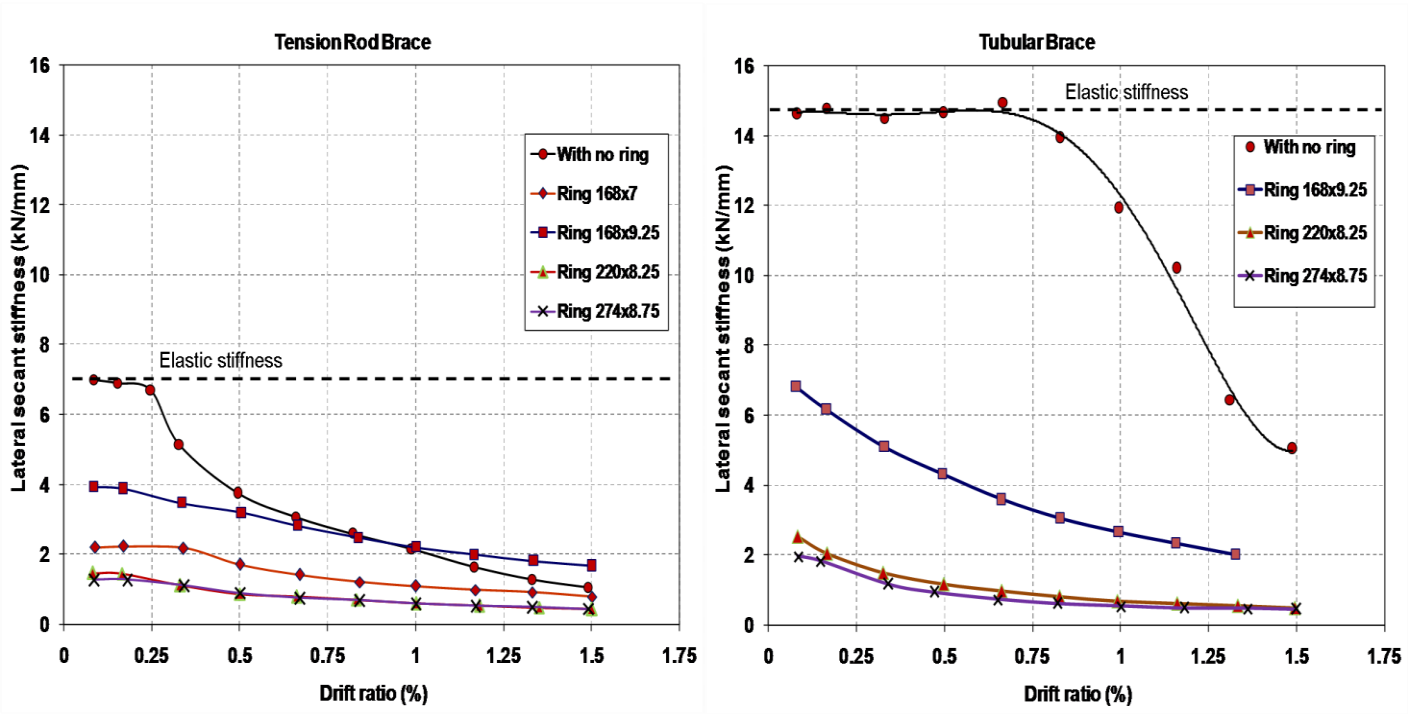


Figure 5: Lateral stiffness versus drift ratio in the test specimens.

Shake Table Tests

Phase II of the program started last November and will be completed in March. A total of 9 shake table tests will be conducted to complement the cyclic tests conducted in Phase I of the project. Three sizes of rings connected to tension rods will be tested for different types of earthquakes and different levels of shaking. Figure 6 shows an overview of the shake table setup.

Figure 6: Overview of shake table setup of SRC system

An example of the performance of the SRC system observed during two shake table tests is presented in Figure 7. The hysteresis plots show a very stable behaviour of the system, similar to that observed during the cyclic tests. The plots in this figure correspond to levels of shaking imposed on the system that are in excess of 1g of peak ground acceleration, so these can be considered as very extreme ground motions. Although the rings experienced severe plastic deformations, no failure of the system was observed. A detailed report with the results of the tests from Phase I and II will be released by the EERF in April of this year.

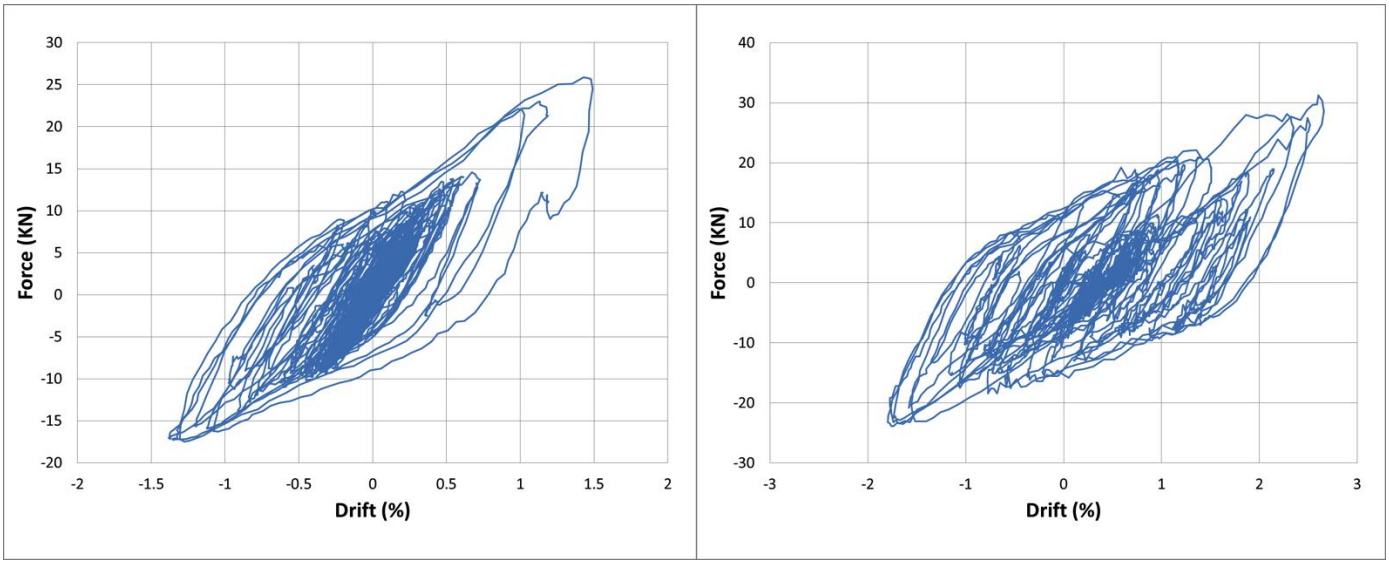


Figure 7: Hysteresis loops obtained from shake table test of SRC subjected to a) 1999 Chi-Chi, Taiwan earthquake at 2 times the recorded ground shaking (left); and b) VERTEQ IV synthetic earthquake record (right)

What have we learned so far?

Important observations from the work conducted so far, including lessons and experiences gained from the various tests performed and analyses of the data collected from each test include:

1. The results of cyclic tests showed that using the Steel Ring Connection system as a mid-joint connection of the X-braces performs well in terms of stability, load transfer and compatibility of the frame and the ring deformation. Fabrication and installation of the SRC is very simple and it is a convenient technique for upgrading braced frames. However, the system performance is sensitive to brace geometry and proper installation of the ring connectors.
2. The rings can sustain large inelastic deformations with slow progressive strength degradation. At large deformations, the shape of the ring changes to oval and plastic hinges are formed adjacent to the steel washers.
3. The tension rod braced frame with no ring has no stiffness and capacity in the descending branch of the hysteresis loop when the frame is unloaded or reloaded during the cyclic tests. The tubular braced frame with no ring maintains its load capacity during each cycle, but its strength reduces rapidly for drifts over 1.2%.
4. The hysteresis loops of the SRC specimens show a “fat shape” with stable cycles (in both Phases of the project), and this demonstrates that the proposed system is an effective energy dissipation device. No strength reduction and stiffness degradation is seen for drifts less than 1.5%.
5. Backbone curves show that SRC systems have more ductility than braced frames with no ring. The type of the brace has no effect on capacity and ductility of the SRC system but has a significant effect on the shape of the hysteresis loops for the braces with smaller rings. The capacity is increased for thicker rings. In contrast, the capacity is decreased when rings with larger diameter are used.
6. Adding the SRC system to the braced frames reduced lateral stiffness and the stiffness was reduced gradually as the drift ratio of the frame increased. The stiffness of the systems with the same SRC is higher in the tubular braces than the tension rod braces. Braced frames with no SRC remained in the elastic range for drifts up to 0.25% and 0.75% for tension rod and tubular braced frame, respectively.
7. Using the SRC with tension rod braces increased the amount of dissipated energy compared to that of the braced frame with no ring.

8. For the tubular braced systems, the stiffer SRC (Ring 168x9.25) dissipated the same amount of energy as that of the braced frame with no ring. The dissipated energy in the other SRC systems with tubular braces was lower than the benchmark frame. But it should be recognized that the rings tested were designed for use with tension-rod bracing; so stronger rings would be needed for upgrading tubular bracing systems.
9. The SRC systems with both types of braces exhibited higher equivalent effective damping than the braced frames without such a system. Effective damping increased in all the test specimens with the increase of the amplitude of the cycles.

Although it is recognized that additional testing is required to confirm the results obtained so far, it is clear from these tests that adding SRC system to a typical X-braced frame improves its performance and prevents undesirable buckling failure of the braces. We expect that a future phase of the project will be devoted to a detailed evaluation of the use of the SRC with tubular braces.

Acknowledgements

Funding for this project was provided by research grants awarded to Dr. Carlos Ventura, P.Eng., of UBC by the Steel Structures Education Foundation (SSEF), and the Natural Sciences and Engineering Research Council of Canada (NSERC). Mr. Peter VandeBurgt of L.E. Steel Fabricators Ltd. kindly donated the test frame and test specimens used for both phases of the project. The EERF at UBC provided support for this project in various forms.

Mr. Dejan Erdevicki, P.Eng., Struct. Eng., from Erdevicki Structural Engineering, was the motivator of the SRC concept, has acted as the external advisor to this project, and has contributed significantly to the success of the two phases of the project. A photo of Dejan inspecting the frame on the shake table is shown in Figure 8. Test setup and testing program were designed by Dr. Mehrtash Motamedi, P.Eng. under the supervision of Dr. Carlos Ventura. Dr. Motamedi, Mr. Felix Yao P.Eng., and doctoral student Seku Samory Catacoli Mosquera have coordinated the test activities. Several graduate and undergraduate students at UBC have assisted during the tests conducted in both phases of the project.

Figure 8: Dejan Erdevicki, designer of the SRC system, inspects the steel ring connections on the tension-rod braced frame prior to the shake table tests.

Ask Dr. Sylvie

CISC published Ask Dr. Sylvie articles in Advantage Steel up until Edition 34 available at: www.cisc-icca.ca/content/publications/publications.aspx

See also the list of CISC technical resources at:

www.cisc-icca.ca/content/technical/default.aspx

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Mark Your Calendars

Seminars

March 13 2013 – Pitt River Bridge from Beginning to Completion
Presenter: Craig Schaper, Associated Engineering
Coordinator: Saeed Niroumand
Venue: UBC Robson Square, Room C300
Time: 6pm-8pm

April 24 2013 – Wine and Cheese-Testing Frame Completion
Presenter: President of SEABC Cameron Kemp, Omicron
Coordinator: Tony Yang
Venue: UBC Point Grey Campus
Time: 6pm-8pm

June 5 2013 – Seismic Retrofit of Masonry Buildings – Half day seminar
Time: 1 p.m. to 5 p.m.
Venue: Marriott Pinnacle Hotel, Vancouver
Registration: Coming soon

Events

May 29 2013, 5.30pm-9pm – SEABC Annual General Meeting
Keynote Speaker: Mike Cook, Buro Happold
Coordinator: Andrew Seeton & Cam Smith
Venue: Sutton Place Hotel, Versailles Room A & B