Newsletter

Volume 27 • August 2014

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Association News

Final Words

Photo credit: Blumer

Message from the President

Cameron Kemp, P.Eng
SEABC President

Well, our summer is almost over. School will soon be restarting (we hope) and everyone will be back in the regular groove. I trust everyone found time to take a break and spend time with friends and family.

The Board will be meeting again on September 15 after a summer hiatus. Even though we have not met recently a number of initiatives and individual committees have continued to be busy through the summer months.

Firstly, I am pleased to announce that John Sherstobitoff has agreed to join our Board replacing one of our members that is stepping down.

Our Education Committee has a busy fall and winter program of courses and seminars lined up so stay tuned to our website and quarterly newsletters for the upcoming announcements of these events. This committee has also lined up four top-notch presenters for the structural stream at the APEGBC Annual Conference in Vancouver later in October.

We are also hosting a visit from the IStructE President (Nick Russell) and CEO (Martin Powell) from the UK in September. Later in September, a subgroup of the Board representing SEABC will be attending the Northwest Council meeting in Seattle. As part of the accompanying Northwest Conference, SEABC representative John Sherstobitoff will kick off the technical program with a talk on post-earthquake realignment of a Chilean building.

We are already thinking about our AGM next spring and are close to finalizing arrangements for our keynote speaker. In keeping with our recent history of finding world-class presentations to accompany our AGM, we believe we have another excellent keynote speaker lined up. Look out for the upcoming announcement.

Before its summer break, the Board approved a recommendation from our webmaster Stephen Pienaar, to give our website a major refresh to improve its appearance and functionality. This effort is underway and will be launched this fall – stay tuned for a new and improved website.

The SEABC, in conjunction with APEGBC, is participating in a comprehensive provincial initiative to increase BC's emergency preparedness, particularly with respect to earthquakes. We have set up a Disaster Response Committee within SEABC to participate in this initiative and to report back to the Board on their progress. This is a comprehensive and long-term initiative. We will keep you informed as to overall progress as this program develops.

A small subgroup of the Board has also been meeting to consider the challenge posed by our 2013 AGM keynote speaker, Glenn Bell's presentation *Developing our Next Generation of Structural Engineers*. The subgroup will formulate a framework to address this challenge and make a series of recommendations to the Board for their consideration. As this plan takes shape we will keep you informed.

As you can see, even though we did not meet through the summer, the Board and its various committees have remained busy with many exciting initiatives that will, we believe, strengthen our organization and bring even greater value to our members. To the extent that you are able, we encourage you to participate and take advantage of all that SEABC has to offer.

We are here to serve you.

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Survey of International Tall Wood Buildings

Steven Kuan, P.Eng.
Director, Wood First

A survey has recently been undertaken to look at lessons learned and experiences from ten built projects around the world that have demonstrated successful applications of mass timber and other technologies in tall wood buildings. Results of the survey indicate that there are a number of strong and common lessons learned across the projects, in addition to specific considerations for each. All of the projects were presented to the relevant authorities having jurisdiction in some form of an alternative solution.

The summary report of the *Survey of International Tall Wood Buildings* is now available for free download. The report presents common themes and trends intended to help stakeholders of North American tall wood building projects simplify their processes, increase their comfort and potentially lower their risk in design and construction of tall wood structures. For more information, please visit: www.rethinkwood.com.

UBC Earth Sciences Building
Architecture by Perkins+Will
Photo Credit Martin Tessler

Prefabricated panel installation at Holz 8
Architecture by Schankula Architekten
Photo Credit Huber & Sohn

SUMMARY REPORT:

SURVEY OF INTERNATIONAL TALL WOOD BUILDINGS

MAY 2014

Forestry Innovation Investment

BSLC

Committee Reports

Communications Committee

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

Director SEABC

The feedback we receive confirms our belief that you enjoy reading our popular Newsletter. We thank you for your support and promise to source as many interesting and readable articles as we can find for structural engineers to enjoy. Articles on projects, field trips, physical testing are particularly welcome, and research reports or news items are greatly appreciated. We greatly encourage photographs to illustrate your text submissions.

We therefore need you to contribute articles or photographs to the newsletter describing your activities or interests – a big thank you to those of our members who do so. Working to inform readers about our engineering designs or research helps raise our profession profile, and helps to inspire others. Contributions from structural engineers are invariably interesting, but we need more. Please send us your submissions - we look forward to hearing from you. Kindly send information for publication to:- newsletter@seabc.ca

– We'll include as many submissions as possible.

Northwest Conference

Many members will recall that SEABC is a member of both the Western and Northwest Structural Engineers Association Councils, which meet at their annual SEA conference. SEABC sends delegates to attend the Council meetings and a speaker to present at the technical sessions. John Sherstobitoff will present *Post-earthquake Jacking and Re-alignment of the "El Parque-Cuerpo 3" Building, Santiago, Chile* on behalf of SEABC, for the 2014 Northwest Conference at the Grand Hyatt, Seattle, WA (see the event flyer appended to this Newsletter). SEABC Members are welcome to attend. Note that the early bird registration cut-off date is August 29th.

Technical Committee

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. Although the paper prepared by Dr. Mahdi Taiebat based on the non-linear analysis performed by graduate students at UBC has been published by the Canadian Geotechnical Journal, Dr.Taiebat and a graduate student are continuing analytical work to explore a number of basement wall parameters. In particular, in order to be able to establish appropriate design recommendations, they will be examining other basement wall configurations, of varying floor heights and number of levels as well as the effects of varying soil conditions. A review by the task group is pending the results of the additional analysis.

Professors Perry Adebar, Robert Tremblay and Colin Rogers are embarking on a research project "Cost Effective Seismic Design Strategies for Low Rise Buildings with Steel Roof Deck Diaphragms." Although scheduled to start a year ago, the work has been delayed pending completion of work on a related project. The research is expected to take 4 years and SEABC has committed some funding to assist in this joint industry/university research project. The team will provide annual progress reporting to SEABC with a final formal presentation at the completion of the project.

Young Members Group

James Macauley

YMG Committee

Telus Garden Tour

On March 26, a group of about 20 SEABC YMG members visited the TELUS Garden Office Tower at the corner of Georgia and Seymour. The tour was led by Anthony El-Araj from Glotman Simpson Consulting Engineers and Mark Diack from Icon Pacific Construction, and explored the four-storey steel truss "sky garden" area and 24-storey post-tensioned concrete tower with 7.5-metre cantilevered balconies.

Designed by Henriquez Partners Architects, the building will eventually house the headquarters for Telus Communications. The tour was followed by a social gathering at the Kingston Hotel next door.

Being led through the concrete superstructure.

Telus Garden: Rendering of the finished building.

Touring the 4-storey high "sky garden" area.

On the Web

Stephen Pienaar, P.Eng.

Webmaster

Summer is a relatively quiet time on the SEABC website. Here is what's new:

- CSE Program:
  Registration for the September 2014 Term of the **Certificate in Structural Engineering** is now open.
  Lectures start: September 9
  www.seabc.ca/cse-current
- Recent seminar recordings:
  Professional Practice Lessons from the Christchurch Earthquake (February evening seminar).
  www.seabc.ca/videos
- Be involved:
  Curious about what is discussed at Board and Committee meetings? Read the **meeting minutes**.
  www.seabc.ca/minutes
- Be in the know:
  Join our **Twitter feed**: announcements for SEABC events and other interesting structural engineering snippets.
  www.twitter.com/seabc

Suggestions

We welcome your comments for improving the SEABC website and other online services. Please send your suggestions to webmaster@seabc.ca

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IStructE News

Bill Alcock, P.Eng. Struct.Eng. MIStructE.

Director SEABC

Vancouver Visit of IStructE President and CEO

IStructE President Nick Russell and CEO Martin Powell will be visiting Vancouver from Friday September 12 through Tuesday September 16, 2014, with their spouses. Items on their itinerary include signing an updated MoU with SEABC, meeting with APEGBC, attendance at a SEABC Directors meeting, a presentation to civil engineering students at UBC and a reception for local and regional members of IStructE.

We are very much looking forward to their visit and the opportunity to showcase Vancouver's natural beauty, structures and our very own SEABC.

Nick Russell and Martin Powell

As your SEABC representatives on IStructE Council, Victoria Janssens and I again attended meetings in London on July 24 and 25, 2014, including the International Interest Group, Young Members Group, and Council. We had two busy days in London, which covered a range of issues.

Unfortunately we regret that Victoria will no longer be representing SEABC at future IStructE meetings as she has accepted a new position in Hong Kong! We understand that she will be continuing to attend the Institution meetings as a Young Member from Hong Kong. It has been a pleasure attending the IStructE meetings in England with her and we wish her every success in Hong Kong.

International Interest Group

Presentations on Professional Registration requirements in India and Scotland were made by Hirac Sen and Angus Cormie respectively.

India

In India, there are currently 4 systems of schooling which can lead to professional qualification and India has also recently become a permanent signatory to the Washington Accord. India currently graduates over two million engineers from 589 universities and institutes of technology annually!

In India there is no Engineering Council, Engineers Act, or equivalent. Qualification to practice is largely controlled by local authorities. Structural engineers become "Empanelled Structural Engineers" (ESE's) after being reviewed and approved to practice by the local authority. Mobility to practice throughout the country is therefore highly restricted, because an ESE listing is required for each jurisdiction. There is also no compulsory CPD.

Scotland

The Scottish regulatory system for practicing structural engineering is quite similar to that in BC. (The Building Act of Scotland 2003 sets the standard of engineering.) To practice structural engineering, one must be a MIStructE or MICE, with a minimum of 5 years of post-charter experience. Application for registration as an SER (Registered Structural

Engineer) can be done on-line and requires assessment by two members of the Structural Review Board (SRB). The SRB assessors then put forward their recommendation to the SER Board. Angus reported that there is lots of paperwork required, CPD is mandatory and SER's are audited every 5 years or less.

Scotland also has a similar system to our Letters of Assurance / Schedules which they call "Warrants", for example, an approved Warrant is required by the municipality before work can commence on site, much like our Schedules A and B.

Hirac's and Angus's full presentations will be added to the IStructE website.

Council Meeting

Among the many items discussed, a couple of items that might of interest to SEABC members were presented at the IStructE Council meeting:

Structural Behavior Exam.

Darren Byrne reported that the Institution has developed an on-line "Structural Behavior Exam" designed to test new graduates fundamental knowledge of structural engineering. Each test would consist of 20 multiple choice questions selected from a database of 200 questions. Members of Council were subjected to a few of the questions and it was, needless to say, quite amusing. Employers take note: this test would be a great way to determine the basic knowledge of a prospective new hire. A sample exam is expected to be uploaded to the IStructE web site by mid-August this year and will be tested for 6 weeks. Feel free to give it a try!

Public Relations

The Institution is working hard to raise the profile of structural engineers, in general, with a public-facing campaign, including a web-based PR program. Included will be information on how to select a structural engineer. Council had the privilege of viewing an 8 minute video promoting both the architecture and structural engineering accomplishments of the 2012 London Olympics, which, despite various attempts to prevent it by the IOC, has been given approval for use.

The afternoon session on Friday July 25th focused on Continuing Professional Qualification (CPQ) as opposed to Continuing Professional Development (CPD). We should all be aware of CPQ, because it could very well become a global requirement.

CPQ, by its very name implies the need for further examinations. Council was divided into small groups of approximately 10 people per table to discuss the issues surrounding increasingly higher level of qualification. Needless to say, there were lots of differing opinions and these included:

- Concern that individual practices may become too specialized.
- What will the rules be? We need balance between generalist and specialist qualifications.
- Participation in specialization qualifications should be voluntary.
- Who will fund CPQ? There is strong commercial interest.
- CPQ should be revenue–neutral to the Institution – not a new revenue stream.
- Who is asking or it? The public? Clients?
- There is potential for individuals to be excluded from some work if they do not have higher qualification levels.
- Increased qualification levels should be focused on public safety concerns, not commercial control of engineering by specialists.
- If CPQ goes ahead, the Institution must be ahead of other organizations in providing it.
- Concern that a CPQ program that is initially voluntary will become mandatory.

CPQ Pro's:

- It benefits public safety
- With greater knowledge, there is reduced risk for engineers.
- Enhanced public standing for the Institution
- Commercial advantage over less qualified firms & individuals.

CPQ Con's:

- It may be seen as a revenue producer for the Institution and other regulators.

- Exclusivity will make practicing engineering more difficult for generalists.
- Mis-application of the need to use specialists by Authorities Having Jurisdiction.
- Undermining of Professional Liability Insurance for less qualified engineers.

For those of you who attended Glenn Bell's presentation at the AGM in March, all of the above is further food for thought.

Belated thanks to WoodWORKS! BC for their generous sponsorship at the SEABC AGM

Certificate in Structural Engineering Program

Shannon Remillong

CSE Program
Administrator

Working together with the Civil Department of the University of British Columbia (UBC), the Certificate in Structural Engineering Program (CSEP) was developed by a group of structural engineers in the city of Vancouver, British Columbia, January 2001. Initially courses were available only within the classroom setting, but are now also available via web cast.

Objectives

The Certificate in Structural Engineering program is intended to enhance the knowledge base of structural engineers by offering courses that fill the needs of the industry. The goal of the program is to provide additional knowledge and skills in structural engineering to permit the candidate to be more effective in an engineering firm.

The CSEP has developed a total of 31 courses, 17 Core Courses and 14 Elective Courses. Four courses are offered each term, with two terms per year beginning in September and January. Each term is 12 weeks long, with two hour classes per course per week. The CSE Program has approximately 130-150 students enrolled in one or more courses per term.

Current Term

September 2014 Term Course Registration is now open through the SEABC website. SEABC Members will receive a discounted rate for each course registered.

The following courses are being offered this September 2014:

- C1 Analytical Methods in Structural Engineering
- C4-2 Advanced Concepts in Earthquake Engineering & Seismicity
- E5-1 Seismic Design of Concrete Structures
- E7 Seismic Strengthening of Existing Structures

Registration Inquiries and Requests/Suggestions for next term: Please contact Shannon Remillong, Certificate Program Administrative Assistant, at email: courses@seabc.ca.

CSE Board of Directors

John Pao, P.Eng, Bogdonov Pao Associates Ltd. (Chair)
Shannon Remillong (Administrative Assistant)
Farshid Borjian, M.A.Sc., P.Eng., C.Eng., M.I.Struct.E., Struct.Eng.
Anthony El-Araj, P.Eng, PE, LEED AP, Glotman Simpson Consulting Engineers
Andreas Felber, Ph.D., P.Eng., BC Hydro
Darrel Gagnon, M.Sc., P. Eng., Buckland & Taylor
Chris Jacques, P. Eng., MIStructE, LEED AP, Read Jones Christoffersen Ltd
David Queen, P.Eng., BC Hydro
Bob Schubak, Ph.D., P.Eng., BC Hydro
Carlos Ventura, Ph.D., P.Eng., University of British Columbia

Reflections from North Island

Ralph Watts, P.Eng.

Good Judgement

Most engineers, particularly those who have been practising for a decade or more or had some of their structures tested, think they have pretty good judgement. But do we, and how would we know? Consider this scenario:

There are 100 engineers, all of whom design buildings.

All of them make some poor judgement calls that increase the real probability of failure to 10% on ten (10) of their structures for, say, the design snow load.

So there will be 1000 buildings each with a probability of failure of 10%. The rest of the buildings have very low probabilities of failure.

Now if the design snow storm comes along, how many of the engineers, on average, will have a failure of one of their buildings? For those who think 100, you need to review your statistics. Yes, on average, there will be 100 failures, the rest of the buildings, the low risk group, will likely have none. However, on average, the number of engineers with failures will only be 65, and of these, again on average, 39 will have 1 failure, 19 will have 2 and 7 will have 3 or more.

Similar results will happen if you assume each engineer has 100 substandard buildings each with a 1% probability of failure, in which case, on average, about 63 will have one or more failures and 37 will have none.

I think we would all agree that a real failure probability greater than one in a hundred is too high for one building let alone a sizable group of them. However, these examples show that despite the engineers being equally competent, about one third would have no failures and likely think they had good judgement, while others would likely be ridiculed and perhaps disciplined for poor judgement.

So back to the original question; do we know if we have good judgement? No. While failures are a sign of poor judgement or bad luck, a lack of failures even when your designs get tested could be nothing more than good luck.

Traffic Barrier Development for Industrial Road Bridges

John Deenihan Ph.D. EIT

Although CAN/CSA-S6-06, the Canadian Highway Bridge Design Code (CHBDC) is a primary reference for industrial road bridge design, the bridge barrier design and selection requirements do not directly relate to industrial roads applications. The term industrial roads can include forestry, mine, energy access routes and some public roads, characterized by low traffic volumes, narrower bridge widths, and generally lower vehicle speeds. Industrial roads are commonly used by professional vehicle operators. Due to the rugged natural terrain in British Columbia we have over 100,000 bridges on our rural and industrial roads.

Historically, industrial bridge curbs have been considered visual guide rails, providing delineation of the deck edge only. It is worth noting that it is not economically feasible to contain industrial trucks but the risk of barrier collision is significantly reduced for professionally-trained drivers who are familiar with low-volume industrial roads. Although there is a long history of successful utilization of timber curbs/guide rails and the recently adopted alternative W-beam and HSS rails, the BC Ministry of Forests, Lands and Natural Resource Operations (Ministry) does not provide specific guidelines on the design of these elements. Many jurisdictions in North America require the use of crash-tested bridge barriers, but none specifically address the containment of industrial traffic.

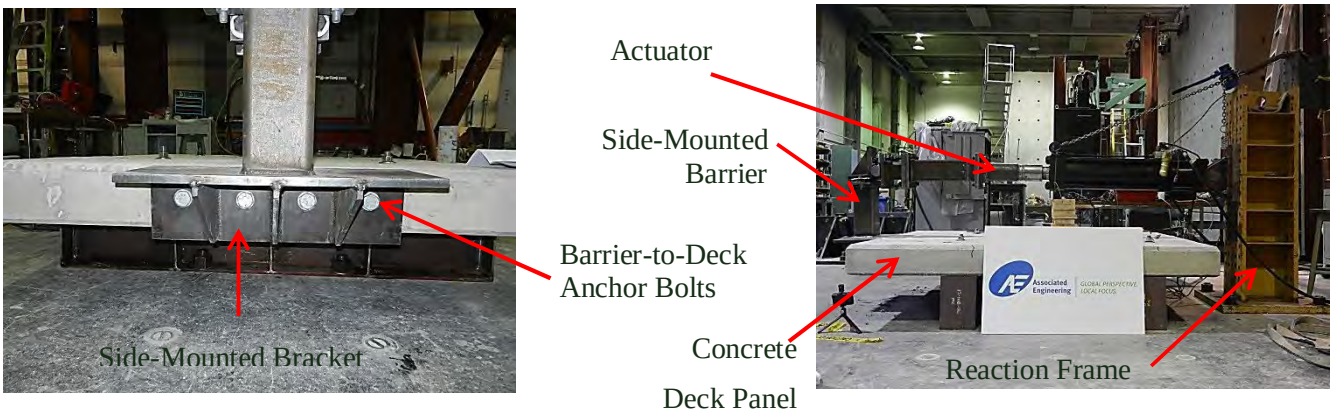


Figure 1: Typical Experimental Set-up

The Ministry does not adopt all CHBDC's barrier requirements, particularly the requirement for crash testing barriers. As a result, the vast majority of the bridge barriers on industrial road bridges do not meet the requirements of CHBDC S6-06. Recently, the Ministry began to develop a framework of barrier design guidelines and design parameters that would enable them to classify their bridge barrier inventory and provide coherent guidelines for designers choosing not to utilize the standard designs. The design parameters would also enable the Ministry to develop barrier performance levels and associated standard designs.

To establish these parameters the Ministry retained Associated Engineering to determine the capacity of their existing barrier designs and to develop standard side-mounted bridge barriers. We were tasked with evaluating the Ministry's existing inventory and developing new barrier configurations with enhanced capacity. We recognized that the Ministry's, then current, standard bridge barriers appear to be performing adequately and provide an acceptable level of containment and it was therefore preferable that we retain these systems. The University of British Columbia (UBC), under the supervision of Prof. Sigi Stiemer, conducted all the static lateral barrier testing. The barrier testing was conducted by applying an increasing lateral horizontal load at a known height to the barrier post/rail. The load was applied at a pseudo-static rate of application using an actuator. Barrier configurations were attached to 175 and 200mm thick precast concrete deck panels. Figure 1 presents the typical experimental set-up.

As the length of the actuator increases it bears against the barrier and reaction frame, thus generating a lateral force. The barrier rotates about the anchor bolts resulting in a compressive reaction applied to the concrete at the underside of the deck panel. The force couple generated from the actuator load and concrete reaction is resisted by the anchor bolts in tension. The anchor bolts are connected to the deck via threaded couplers which have a reinforcing bar threaded into the opposite end to provide the required anchorage.

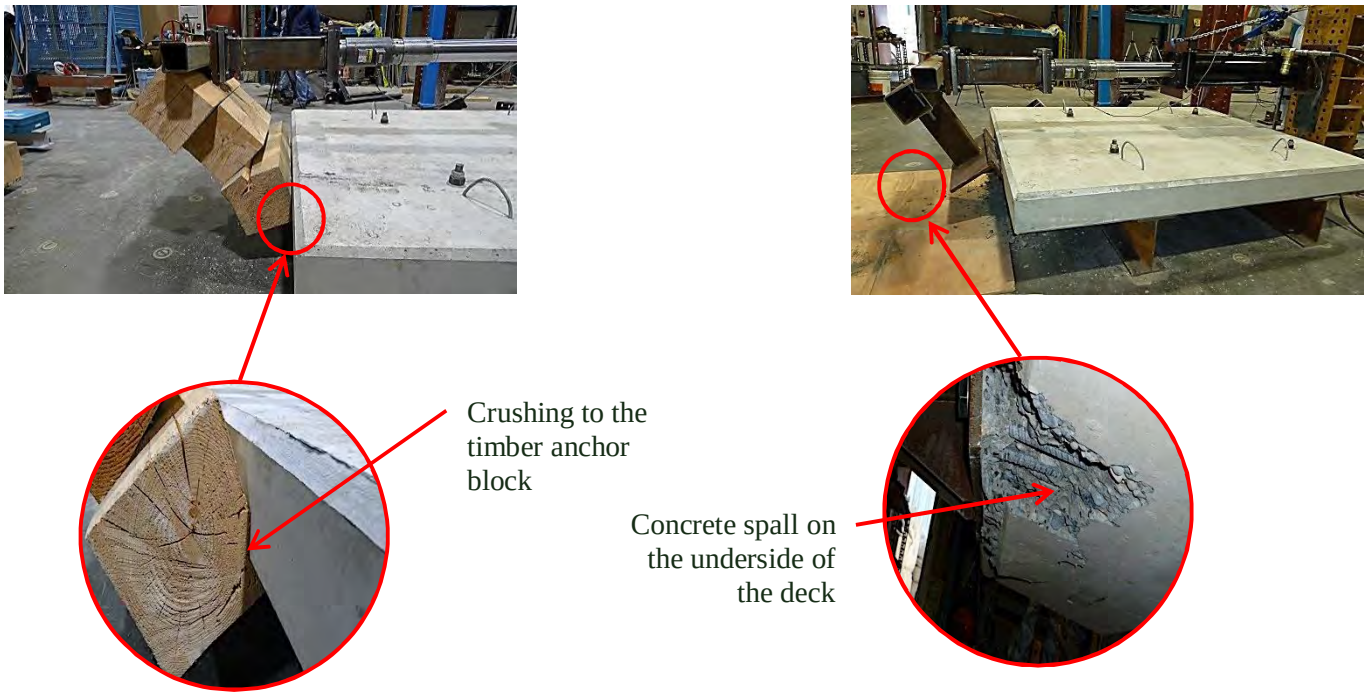


Figure 2: Typical Experimental Failure Mechanisms

The aim of the experimental investigation for the existing barrier configurations was to determine the maximum lateral resistance of the system and associated failure mechanisms. We tested the Ministry's standard Timber Curb and HSS Guide Rail configurations. Based on the findings we concluded that the timber curbs were capable of achieving a lateral load capacity of approximately 23 kN (applied at 425 mm above the deck), the HSS Guide Rail achieved a capacity of approximately 47 kN (applied at 485mm above the deck). The Timber Curb failed by crushing and splitting of the timber anchor block. The grade of the anchor bolts used for the HSS Guide Rail tests determined the failure mechanism, tension failure of the anchor bolts occurred when ASTM A307 bolts were used compared to compressive failure of the concrete at the deck edge when ASTM A325 bolts were utilized. Of

interest is that the tests conducted using A325 bolts achieved only a marginally higher capacity than the tests incorporating A307 bolts.

Based on the results we proposed the Anchorage Design Criteria presented in Table 1. At the time of this research CHBDC did not include design criteria for low-volume road bridge barriers, and therefore we used criteria from the AASHTO LRFD design code. Subsequently, the CHBDC 2013 Supplement to S6-06 introduced a TL-1 barrier (for low-volume road applications).

Table 1: Design Criteria (Factored Loads)

	Factored Design Criteria	Classification Level		
		CL-1 *	CL-2	CL-3
BC MFLNRO	Transverse Load (kN)	-	45	120
	Longitudinal Load (kN)	-	20	40
	Vertical Load (kN)	-	20	20
	Load Application Height (mm)	-	450	510
		-	TL-1	TL-2
AASHTO LRFD 2010	Transverse Load (kN)	-	60	120
	Longitudinal Load (kN)	-	20	40
	Vertical Load (kN)	-	20	20
	Load Application Height (mm)	-	460	510

* Existing timber curbs and W-beam guardrails

Based on the experimental capacities we classified the timber curb as a CL-1 barrier. It was clear that the Timber Curb provides low containment strength, but is highly ductility and performs adequately in the field. It was difficult to determine the capacity of the Timer Curb numerically and therefore we opted not to provide design loads for CL-1 barriers. Designers are permitted to only use the Ministry's Standard Drawings for CL-1 barriers. The HSS Guide Rail configuration did not meet AASHTO's transverse load requirements, thus we reduced our factored design criteria from 60 to 45 kN, permitting the HSS Guide Rail to be classified as a CL-2 barrier. We specified that only A307 bolts be used to connect the barrier to the deck panel because replacing a failed bolt is more economical than replacing or rehabilitating a failed concrete deck edge. We also created Standard Bridge Barrier Drawings for each classification level. The drawings have been adopted by the Ministry and enable designers to use the per-approved details without the requirement to re-design a barrier configuration.

Subsequently, the Ministry retained Associated Engineering to develop and test an enhanced capacity barrier capable of meeting the design requirements for a CL-3 barrier, as shown in Table 1. None of the Ministry's standard or tested barriers were capable of achieving the requirements for a CL-3 barrier. The results from the CL-2 tests indicated that the concrete in compression at the panel edge was the limiting strength factor, assuming adequate anchorage to the concrete deck was provided. It was apparent that the capacity requirements for a CL-3 barrier can easily be achieved using a top-mounted system, but to maintain the necessary operating width, that would require increasing the panel width to accommodate the top-mounted barrier.

Accordingly, we developed an improved anchorage assembly incorporating an embedded steel angle with vertical headed studs and horizontal Nelson Deformed Bars (NDB's) and stacked headed shear studs. The embedded angle and vertical shear studs improve the confinement of the concrete at the deck edge, while the horizontal NDB's and stacked studs transfer the tensile demands into the concrete panel. ASTM A325 anchor bolts were used to maximize the system capacity. Figure 3 presents the embedded reinforcing detail for the CL-3 bracket. The stacked studs were required to accommodate the shear connector blockouts that are required in precast concrete composite deck panels. These blockouts accommodate groups of headed shear studs, welded to the top flange of steel bridges girders, which provide the composite connection between the girders and deck panels. Shorter length NDB's would not provide adequate development length to fully develop the bars.

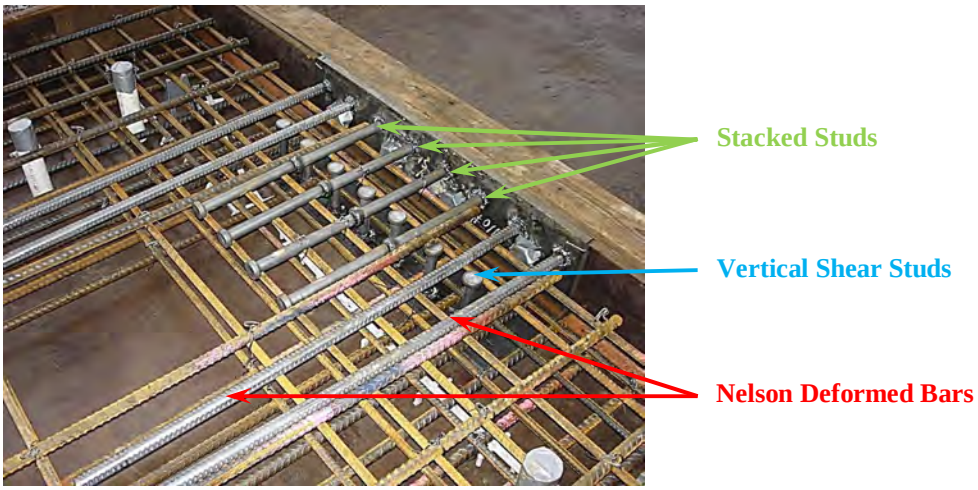


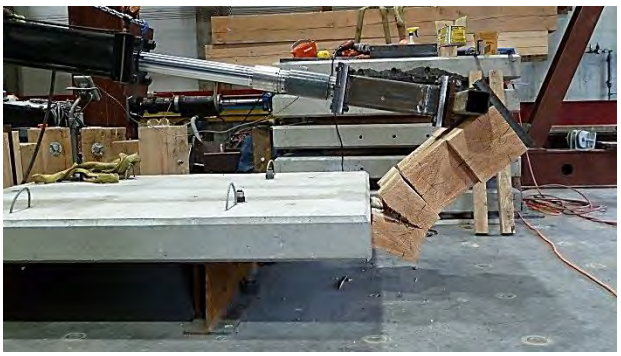
Figure 3: CL-3 Embedded Steel Anchor Detail

We tested the improved anchor detail in an identical manner to previous tests. Based on the results the detail achieved a lateral load capacity of approximately 163 kN (applied at 510 mm above the deck), which is almost 3.5 times greater than the previously tested CL-2 capacity. The CL-3 barrier connection failed due to yielding/pulling-out of the stacked headed studs and NDB's, and the loss of the top cover concrete. This was followed by compressive failure of the concrete on the underside of the panel and extensive rotation of the bracket. The connection provides sufficient over-strength (> 120 kN), to facilitate the design of a post and rail assembly that will yield prior to failure of the embedded bracket, thus capacity protecting the system.

Figure 4: Typical Experimental Failure Mechanisms

The experimental methodology adopted throughout this research has a number of potential applications, some of which are listed below:

- Static testing can be used as a cost effective assessment tool for the design of barriers to be subject to crash-testing.
- Static testing can be used to confirm an anchorage capacity that is difficult to justify numerically.
- Anchorage capacity justified by static testing can be compared with over-strength demands from post and rail systems to ensure a specific failure mechanism for the entire system.
- A successful static test would suggest that the barrier would likely meet the strength capacity requirements for a crash test.
- Static testing would provide no information on the dynamic performance of a barrier in containing a crash test vehicle.
- The embedded bracket detail can be modified to suit the installation of any steel post system, for applications in cast-in-place concrete decks the bracket spacing can be adjusted to suit a number of crash tested post-and-rail configurations.
- CHBDC S6-06 permits the design of the barrier anchorage without the requirement for crash-testing. Rehabilitation projects frequently require innovative barrier replacement schemes ,which are restricted by the existing structure. Static testing of a previously crash-tested barrier with a different anchorage detail is a cost –effective method of providing a crash-tested solution with a known anchorage capacity.



Typical CL-1 Timber Curb Barrier Testing

Typical CL-2 HSS Guide Rail Testing

CL-3 Specimen during Testing (Note: Loss of top cover concrete & confinement of embedded bracket)

CL-3 Specimen during Testing (Note: Area of deck panel engaged by embedded bracket)

Failed CL-3 Specimen (Note: Rotation of embedded bracket relative to orientation of deck reinforcement)

CL-3 Specimen – Post Failure

A Practical Guide to Wood-Frame Design: Lumber Properties

Joel A. Hampson,
MASc, P.Eng. LEED AP

The intent of this article is to help local designers address construction-site based issues related to timber design by providing some practical design approaches and helpful tips to smooth the transition between theories and contractors' realities.

The Canadian standard for timber (wood-frame) design is "O86-09: Engineering Design in Wood" by the Canadian Standards Association. The Standard is usually found in the grey pages of the "Wood Design Manual" by the Canadian Wood Council. The WDM is an excellent publication that interprets the specification and facilitates design with many tables and application examples. O86 and the WDM are fully metric (SI) publications, which based upon the (inch-) imperial units widely used in construction and for the majority of wood-framed components throughout Canada, necessitates unit conversions and other subtle approaches by the designer. The designer will often prefer to produce the construction documentation in imperial units for easy interpretation by the contractor; furthermore, the wood-frame designer will often find it more efficient to prepare calculations with imperial units.

Lumber is a fundamental component of timber construction and is ubiquitous in wood-frame projects as both structural and non-structural members. Table 1 lists the practical choice of lumber with its name as commonly used on site and also lists some imperial properties about the strong axis for quick design reference. The imperial dimensions are slightly smaller than the accepted name in inches; in fact, the name is referred to as the "nominal dimensions" as it comes from the rough-sawn lumber size before it is planed into the final dimensions at the mill.

Table 1. Lumber Section Properties

Name	Dimension		Area, in^2	Section modulus, in^3	Moment of Inertia, in^4	Unit weight, plf*	Aspect Ratio
	SI, mm	Imperial, in.					
2 X 4	38 X 89	1-1/2 X 3-1/2	5.25	3.06	5.36	1.1	2.33
2 X 6	38 X 140	1-1/2 X 5-1/2	8.25	7.56	20.8	1.7	3.67
2 X 8	38 X 184	1-1/2 X 7-1/4	10.9	13.1	47.6	2.3	4.83
2 X 10	38 X 235	1-1/2 X 9-1/4	13.9	21.4	98.9	2.9	6.17
2 X 12	38 X 286	1-1/2 X 11-1/4	16.9	31.6	178	3.6	7.50

* Unit weight per linear foot is based on D Fir-L and is given as 31 pcf (4800 N/m^3)[1]

[1] "Wood Design Manual" by the Canadian Wood Council, 2010, p. 653

At the heart of the lumber capacities is Table 5.3.1A (Specified strengths and modulus of elasticity for structural joist and plank, structural light framing, and stud grade categories of lumber, MPa)[2]. Lumber is divided into four categories of 'species' and three subcategories of 'grade'. Species categories are D Fir-L, Hem-Fir, Spruce-Pine-Fir & Northern. Each species' subcategories are SS, No. 1/No.2 & No. 3/Stud. The contractor will refer to the species categories as "Doug-Fir", "Hem-Fir" & "S-P-F". The last species—Northern—is a "catch-all" type of category of other lumber; it has its uses, but capacities are too low for a practical choice compared to what is available to the contractor.

Lumber is a nature-made material, which exhibits anisotropic mechanical properties; that is, the properties depend upon material axes orientation, loading angle & geometry and each lumber species has its own unique set of strengths properties. For example, Spruce-Pine-Fir has the highest flexural capacities (Bending-at-extreme-fibre strength), whilst D Fir-L has the highest shear capacities (Longitudinal-shear strength). Given the complexities of economies, it is generally impossible to predict the market price of lumber, which can often have a major impact on overall costs and structural efficiency, so it is practical to design for a "Wood" species that is comprised of a holistic set of strengths. This approach can provides the contractor with greater economic flexibility and can help avoid surprises for the structural engineer during a field review.

The contractor will generally purchase No. 1/No. 2 by default for reasons of availability and cost effectiveness. It is important to acknowledge that designs based upon the higher mechanical properties of the SS grade will be most likely to lack code conformity when the contractor supplies another grade on site. No. 3/Stud is the lowest grade of lumber and should be restricted to highly-redundant structural members such as studs and secondary structural elements. Thus No. 1/No. 2 is the practical choice to consider in design and—again—will help avoid surprises during field review. Table 2 shows the practical choice of strengths from D Fir-L, Hem-Fir & Spruce-Pine-Fir for No. 1/No. 2.

Table 2. Lumber Strengths

	Bending at extreme fibre, f_b	Longitudinal shear, f_v	Compression		Tension parallel to grain, f_t	Modulus of elasticity	
			Parallel to grain, f_c	Perpendicular to grain, f_{cp}		E	E_{05}
SI, MPa	10.0	1.5	11.5	4.6	5.5	9 500	6 500
Imperial, psi	1450	220	1670	670	800	$1.4X10^6$	$0.94X10^6$

[2] "O86-09: Engineering Design in Wood" by the Canadian Standards Association, 2010, p. 23

Joel Hampson

Joel A. Hampson, MASc, PEng, LEED AP, practices structural engineering in Vancouver, and Michael Roberts, PEng, helped him prepare this article. While the authors have tried to be as accurate as possible, they cannot be held responsible for the designs of others that might be based on the material presented in this article. The material cover in this article is intended for the use of professional personnel who are competent to evaluate the significance & limitations of its content & recommendations and who will accept the responsibility for its application. The authors and the sponsoring organizations disclaim any and all responsibility for the applications of the stated principles & values and for the accuracy of any of the material presented in the article.

Mark Your Calendar

Upcoming SEABC Seminars/Conferences

APEG Annual Conference and AGM

Date: Friday October 24

Presenters: Derek Ratzlaff, John Sherstobitoff, Tejas Goshalia, Andrew Metten, Mark Porter and Paul Fast.

Venue:Hyatt Regency, Vancouver

Time: 9.00-5.00pm

Registration: www.apeg.bc.ca/Annual-Conference

One Day Seminar by CSRN: Seismic Evaluation and Retrofit of Buildings

Dates: Friday September 19

Venue: Sheraton Wall Centre, Vancouver

Time: 8.30-5.00pm

Registration: www.seabc.ca/events.php

SEA Northwest Conference

Dates: Thursday September 18, Friday September 19

Venue: Grand Hyatt, Seattle

Technical Program: Thursday 1.00pm-4.30pm, Friday 8.00am-4.30pm

Registration:: www.seaw.org

See Flyer appended to the newsletter

Upcoming Industry Events

APEGBC: Evaluation and Management of Pavement Infrastructure Course

Date: September 15 and 16, 2014

Presenter: David Hein P.E. P.Eng

Venue: Richmond, BC

Time: 8.30-5.00pm Day 1, 9.00-5.00pm Day 2

Registration: apeg.bc.ca/Events

APEGBC: Seismic Analysis and Design of Steel and Reinforced Concrete Buildings

Date: September 17-19, 2014

Presenter: Dr. Ashraf El Damatty

Venue: Richmond BC

Time: 8.30-5.00pm Day 1, 9.00-5.00pm Days 2 and 3

Registration: apeg.bc.ca/Events

Final Words

Editorial Information

The SEABC Newsletter is published by the Structural Engineers Association of British Columbia. The current and past issues are available on the SEABC website at www.seabc.ca.

The Newsletter is edited and managed by the SEABC Communications Committee.

- Committee Chair: David Harvey
- Newsletter Editor: Catherine Porter
- Webmaster: Stephen Pienaar

Submissions are welcomed and all SEABC members are encouraged to actively contribute to the Newsletter. Submissions, letters to the Editor, questions and comments can be sent to: newsletter@seabc.ca.

The Committee reserves the right to include or exclude submitted material and in some cases edit submitted material to suit overall space requirements. If content is not to be edited, please advise so at submission time.

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Pre-paid rates per edition:

- $270 (quarter page), $360 (half page) or $450 (full page) plus GST. Rates include a banner advert on the Events page of the SEABC website.
- 50-word “Available for Employment” ads are free.

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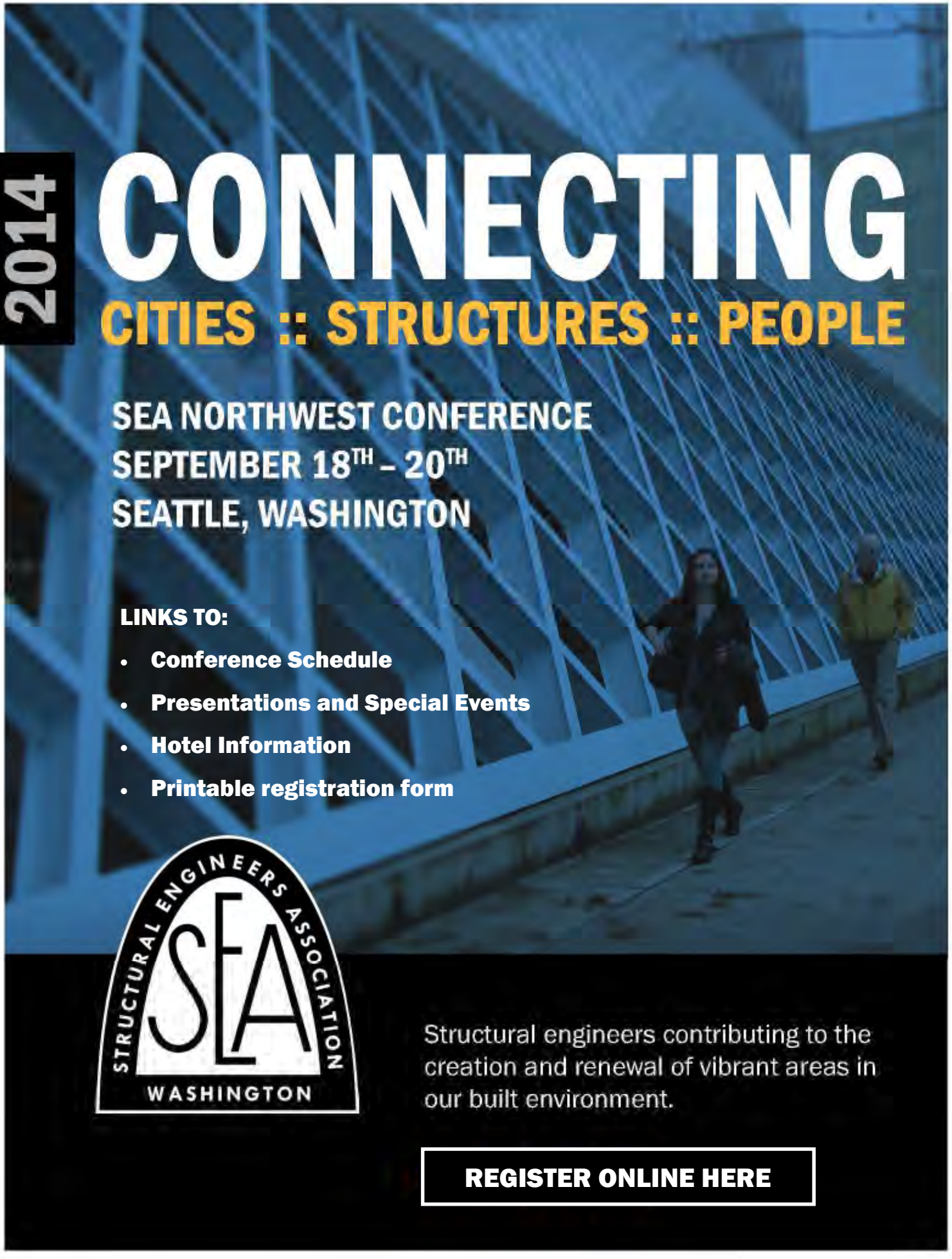
2014
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SCHEDULE OF EVENTS

Wednesday, September 17, 2014

The SEAW Hospitality Suite will be open for early registration.

Thursday, September 18, 2014

9:00 AM - 11:00 PM	NW Conference Board Breakfast Meeting
11:00 AM - 1:00 PM	Registration
11:00 AM - 6:00 PM	Vendor Exhibits
11:30 AM - 1:00 PM	Lunch (Families welcome) – with Speaker David B. Williams
1:00 PM - 4:30 PM	Technical Session I (with two 15-minute breaks)
4:30 PM - 5:30 PM	Structural Engineers Foundation (SEFW) Reception
6:00 PM - 7:00 PM	SEFW Event—Bridges to Prosperity, Avery Bang and Brooke Shore

Friday, September 19, 2014

8:00 AM - 11:30 AM	Technical Session II (with two 15-minute breaks)
8:00 AM - 5:00 PM	Vendor Exhibits
12:00 PM - 1:00 PM	Lunch with program: Toward a Sustainable Seattle
1:00 PM - 4:30 PM	Technical Session III (with two 15-minute breaks)
5:30 PM - 9:00 PM	Islander Dinner Cruise (Families welcome)

Saturday, September 20, 2014

9:00 AM - 12:00 PM	SEAW State Board Breakfast Meeting
9:00 AM - 11:00 AM	Free Walking Tour: Preserving and Protecting Historic Buildings in Seattle

TECHNICAL PROGRAM

Technical Session I

Thursday—September 18
1:00 PM to 4:30 PM

- Welcome and Introduction
- Post-Earthquake Jacking and Re-Alignment of the "El Parque-Cuerpo 3" Building, Santiago, Chile
  -John Sherstobitoff, Ausenco, SEABC
- The Historical Development of the Bearing Wall Skyscraper—The Pacific Northwest's Role
  -Tyler Sprague, University of Washington
- Cold-Formed Steel—History, Innovation, and Design
  -Jon-Paul Cardin, SCAFCO, SEAW Spokane

Technical Session II

Friday—September 19
8:00 AM to 11:30 AM

- Seismic Performance of Reinforced Masonry Shear Walls—from Research to Practice
  -Benson Shing, NW Concrete Masonry Association
- Overview of ASCE 7-10/7-16 Wind Provisions
  -Don Scott, PCS Structural Solutions, SEAW Southwest

Technical Session III

Friday—September 19
1:00 PM to 4:30 PM

- Introduction to ACI 562—Repair and Rehabilitation of Existing Concrete Structures
  -Chuck Larosche, WJE Associates
- Structural Engineering after a 2500-Year Earthquake: Lessons from Christchurch
  -Lara Simmons, LRS Engineering, SEAW Seattle
- Engineering for Resilience
  -David Bonowitz, SE

PRESENTATIONS AND SPECIAL EVENTS

Thursday, September 17, 2014

11:30 AM—1:00 PM **Opening Luncheon (Families Welcome)**

Master of Ceremonies—Peter Somers, SEAW Seattle Chapter Past President

Keynote Speaker—David B. Williams, Seattle-based freelance writer, will present "Reshaping Seattle's Topography." From the massive regrade of Denny Hill to the filling in of 2,400 acres of the Duwamish River's tideflats, Seattle has reshaped its topography more than most cities. Mr. Williams, author of the forthcoming book *Too High and Too Steep: Reshaping Seattle's Topography,* will tell the stories of these changes, including engineering feats and social impacts.

4:30 PM—8:00 PM **Structural Engineers Foundation of Washington Fall Forum** (Families Welcome)

4:30 PM—Reception:
Enjoy hors d'oeuvres and no-host bar while mingling with Conference attendees and other design professionals from the Seattle community.

6:00 PM—Presentation:
Bridges to Prosperity presented by Avery Bang, CEO, and Brooke Shore, Bridge Corps Fellow. The presentation will focus on B2P's mission to provide innovative designs using appropriate technology, education through community engagement, and inspiration for community leadership through international collaboration; and will include two case studies of footbridges built in the mountains of Nicaragua.

Friday, September 19, 2014

11:30 AM—1:00 PM **Luncheon**

Master of Ceremonies—Tom Corcoran, SEAW Seattle Chapter President

Program: Toward a Sustainable Seattle

The City of Seattle Comprehensive Plan, *Toward a Sustainable Seattle*, is a 20-year vision and roadmap for Seattle's future. The plan guides Seattle's decisions on where to build new jobs and houses, how to improve our transportation system, and where to make capital investments such as utilities, sidewalks, and libraries. The Comprehensive Plan is the framework for most of Seattle's big-picture decisions on how to grow while preserving and improving our neighborhoods. This session will provide insight on this long range vision for Seattle's growth and highlight how it defines the future work for structural engineers in both infrastructure and building design.

5:30 PM— 9:00 PM **Islander Dinner Cruise** (Families welcome)
Our private charter boat will show you Seattle's life on the water. See the tower cranes along the city's skyline, Lake Washington's next floating bridge, and the newly renovated Husky Stadium. Includes sit-down dinner and dessert, with a no-host bar. Departs from and returns to South Lake Union.

Saturday, September 20, 2014

9:00 AM—12:00 PM SEAW State Board Breakfast Meeting

9:00 AM—11:00 AM Walking Tour: Preserving and Protecting Historic Buildings in Seattle. Several SEAW engineers will lead a sidewalk tour of major seismic retrofits and other renovations in Seattle's historic Pioneer Square district. This free tour will start from the Hyatt lobby at 9:00 AM and last approximately two hours.

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SEA NW Conference Guest Room Rates
Available September 17-19, 2014

Standard King	$199.00
Deluxe Queen	$214.00
Triple Occupancy	$249.00
Quadruple Occupancy	$274.00

Please make room reservations by August 25, 2014
to ensure accommodations at the conference rate.

Reservations can be made online by visiting
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Please reference SEA Northwest Conference
for special rates.

For more information,
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http://grandseattle.hyatt.com

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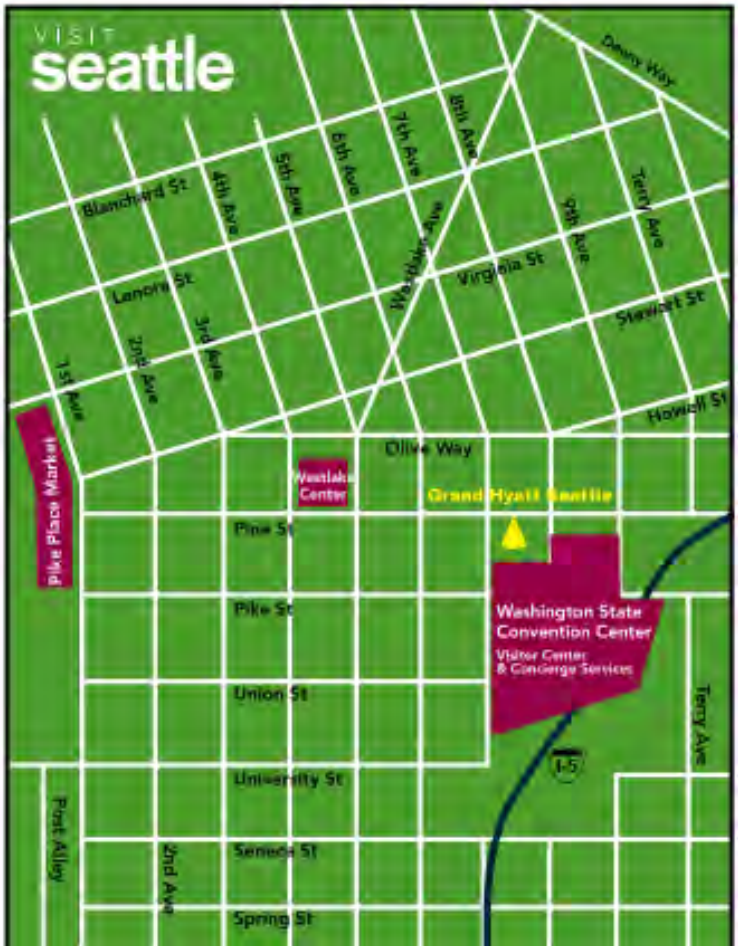

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2014 SEA NORTHWEST CONFERENCE

September 18 – 20, 2014

Grand Hyatt Seattle
721 Pine St, Seattle, Washington

PRINTABLE REGISTRATION FORM

REGISTRANT INFORMATION

Name _____

☐ Registrant ☐ Speaker ☐ Student*

Spouse / Guest* _____
Company / School _____
Mailing Address _____
_____
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SEA Chapter _____

REGISTRATION FEES

(Register by August 29 to avoid $50 surcharge)

		No.	Subtotal
Registrant	$375	_____	$_____
Student*	$50	_____	$_____
Transferable Registration(s)	$475	_____	$_____

(Conference ID & meal tickets can be shared among firm members. Please note primary contact and firm name at left)

Additional Fee after Aug. 29	$50	_____	$_____

Registration includes lunches and Thursday Reception and Forum. Please register separately for the Friday Islander Dinner Cruise.

MEALS & ACTIVITIES

Thursday, September 18th

Lunch (*With David B. Williams, author*):

Guest(s)	_____	$30	$_____
Children 4-12	_____	$15	$_____

Structural Engineers Foundation Reception and Forum with Avery Louise Bang and Brooke Shore – Bridges to Prosperity:

Guest(s)	_____	$25	$_____
Children 4-12	_____	$15	$_____

Friday, September 19th

Lunch (*Program: Toward a Sustainable Seattle*)

Guest(s)	_____	$30	$_____
Children 4-12	_____	$15	$_____

Islander Dinner Cruise

Total # Attending	_____	$55	$_____

TOTAL $_____

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Online:
https://resweb.passkey.com/go/StructuralEng2014

By phone: (206) 774-1234
Please reference SEA Northwest Conference for special rates.

* Guest and Student registrations do NOT include meals. Please add individual meals under the "Guest" category.

** Meals are free for Children under 4.

Cancellations prior to September 5th will be subject to a $25.00 handling charge, and $100 after September 5th.

For more information, please contact: Lynnell Brunswig at 206-682-6026 / seaw@seaw.org