Newsletter

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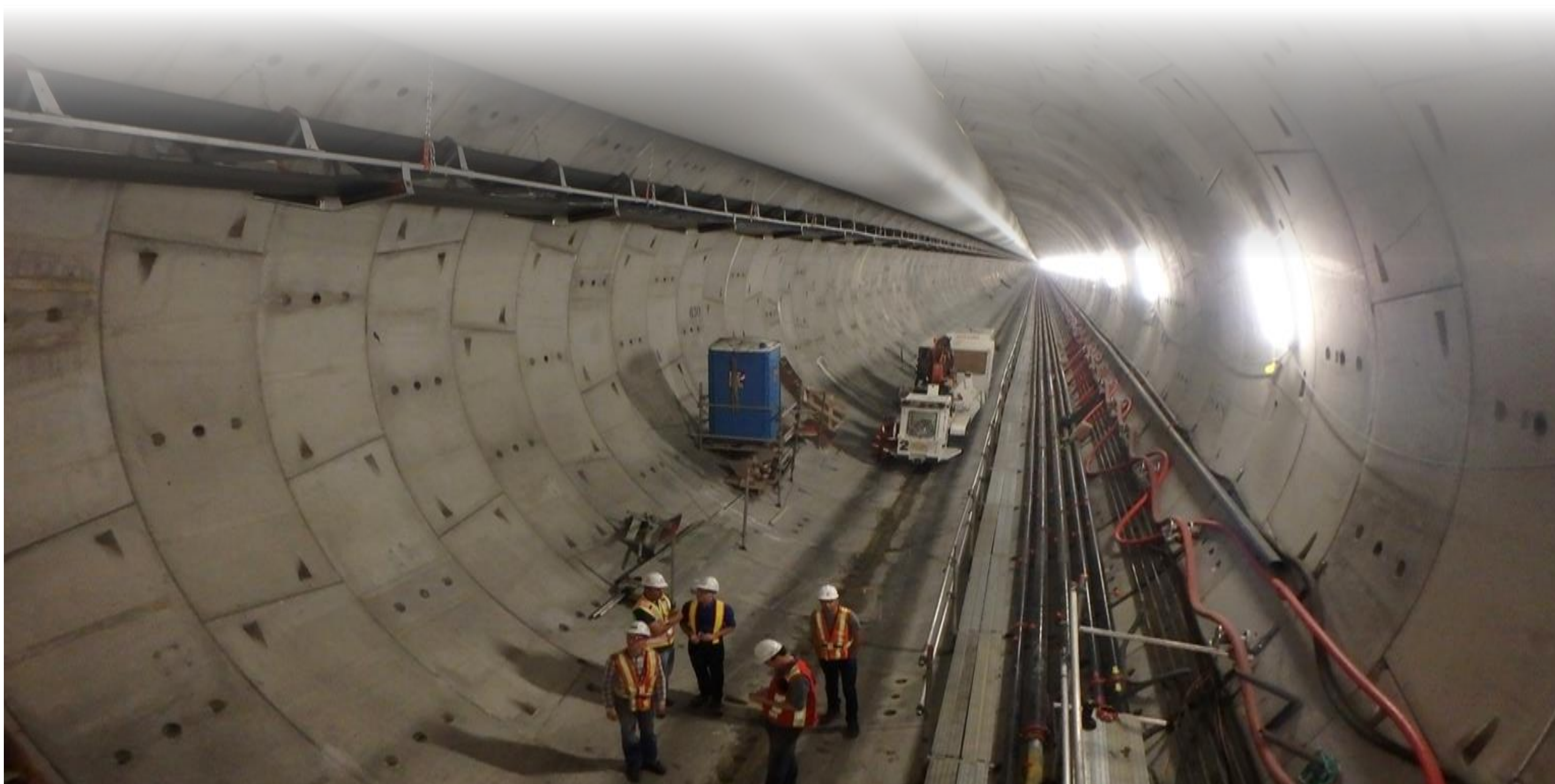


Message from the President

Cameron Kemp, P.Eng.

SEABC President

As I sit down to write this latest Presidents message we are in the waning days of an unbelievable summer. While the flowers and lawns may not agree with me we have had a spectacular stretch of warm sunny weather.

I hope all of you have had an opportunity through the summer to enjoy this weather with friends and family.

With fall just around the corner we will be restarting our SEABC activities following our summer hiatus. We have a new lineup of interesting and relevant courses and seminars scheduled for the fall and winter so look in the appropriate section of this newsletter or our website for updates on these courses.

We also hope to launch our new website this fall so stay tuned for a fresh new look with more functionality and ease of use.

We will also be announcing another world-class keynote speaker for our spring 2016 AGM this fall so stay tuned for that announcement. We have been fortunate to find another speaker of equal calibre to the ones we've had for the last three years.

Over the spring and summer there has been a lot of talk and press dedicated to major upcoming infrastructure projects-issues such as BC Hydro's Site C hydroelectric project, the Northern Gateway pipeline project, the LNG projects on the Central Coast, the George Massey Tunnel replacement project, the provincial earthquake preparedness initiative to name a few.

In some of what I have read there appears to be quite a bit of misinformation about some of these projects/issues; the pro/con impacts of these projects, their relative costs and benefits, their environmental impacts, etc. Some of what I have read or heard makes me cringe.

Based on this misinformation people take positions on these projects without knowing all the facts. As a learned organization involved in many of these projects I believe we have a responsibility to the public at large to provide as much factual information as we can particularly when the issues are complex and highly technical in nature.

The SEABC and APEGBC are vehicles to provide this information. I believe we should be more proactive in helping inform the public about these projects so that they are able to make informed determinations of their merits, costs, risks and potential benefits. As is usually the case there is a need to strike a balance between doing nothing and recklessly proceeding with projects before all the risks and rewards are fully known. Finding this right balance should be based on good scientific and engineering information not speculation, misinformation or fear mongering.

We've all heard the term NIMBY but recently I heard one that I hadn't heard before; BANANA (build absolutely nothing anywhere near anything). In a lot of cases this philosophy prevails in the minds of the general public or at least it gets reported that way in the media.

Our society needs many of these vital infrastructure projects to support its people and provide them with the basic infrastructure that allows them to live and work in safety and with a good quality of life. Doing nothing isn't an option.

Doing the right things which provide a clear benefit based on careful assessment of the merits and risks should be. We have a voice with important things to say on these projects/issues and we should use it more often and more proactively.

Let's give people the right information so that we as a society can make good decisions for our future.

North West Conference

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

Director SEABC

The annual meeting of delegates to the Northwest Conference of Structural Engineers Associations (NWCSEA), hosted this year by the Structural Engineers Association of Idaho (SEAI), took place in Boise, ID, on July 6 -17, 2015. The NWCSEA members include Oregon, Washington, Idaho, and British Columbia; Montana is now seeking to join the North West Conference and is planning to host the event in 2016.

Southern Idaho is an excellent location for outdoor activities and many conference delegates took full advantage of the opportunity while earning valuable professional development credits. The conference featured first-class social activities including a visit to the City's Adventure Park, a float down the Boise River, and taking in the history of Boise's colourful Basque community. The wrap-up dinner included Basque dancing and a spectacular fire dance. Some 80 delegates and exhibitors attended the conference, including me, representing SEABC.

The Conference kicked off with the Council meeting which discussed finances, membership, procedures, and future conference locations. BC may get to host the Northwest Conference in 2017. In parallel with the Council meeting was a Young Members forum. There were a good number of young attendees – attesting to Idaho's successful launch of its new Young Members Group which is modelled after BC's more established YMG. A further parallel session provided Board of Directors training for attendees with high aspirations.

The technical program of the conference provided information on a varied and interesting range of topics, including Idaho's signature building project, Jack's Urban Meeting Place, JUMP. The project description was followed by a site tour lead by design consultant, MKA. A panel discussion on mentoring young structural engineers followed in which I participated. Afterwards, several people told me that they found both the discussion and my comments valuable. The keynote dinner included addresses entitled Architectural History of Boise, and Designing Our Future Cities.

Next followed a construction tour of Main Street Station, and a talk on 'Building Your Business' by corporate consultant and coach, Cathy Light. MKA's John Hooper then took us through performance-based seismic design – the emerging trend in the design of medium and large buildings where value can be obtained. This was followed by the design of drift joints in building cladding, and a talk on 'Mid-Rise Heavy Timber Construction' which featured CLT design of the Wood Innovation and Design Centre building in Prince George. Next came an excellent session advising on 'How to Be an Expert Witness', with knowledgeable presentations by two lawyers and two engineers. The technical program wrapped up by a presentation on the international movement working on methods to make the design of buildings more efficient than the current process is achieving.

Of the over 2000 SEA members in the Pacific North West, almost one third are SEABC members. We, therefore, represent a significant proportion of structural engineers in our geographic region and are valued by the other SEAs. We should therefore be taking a more active role in the work of the NWSEA – hopefully we can showcase BC's structural engineering in 2017.

Committee Reports

Education Committee

Tejas V. Goshalia, P.Eng., P.E. S.E.

Committee Chair

Many factors beyond our everyday purview can affect the safety of our designs. At SEABC, we strive to bring forward discussions on recent topics and incidents that pose to influence to our profession. Hence Chris Roney, the Engineers Canada President Elect for 2016 and the official spokesperson of the Elliott Lake Inquiry Commission, was invited from Kingston-Ontario on June 1st at UBC Robson Square to articulate: what happened at the unfortunate collapse at the Elliott Lake Mall in 2012, why it failed, and what can we learn from it going forward. The evening seminar presentation was co-hosted and partially funded by APEGBC. Its invitations were extended at no cost to all. Other than SEABC members, it was also well attended by City Officials, Architects, some from the Insurance industry and members of other related trades and organizations.

All members are urged to visit SEABC's online video archives to see and hear the details of this very pivotal presentation. Below summary, highlights the key recommendations of the Inquiry Commission's (not necessarily in listed order):

- It importance to have formal, independent review and oversight of all work.
- Transparency and easy access to all records related to the structural integrity of a building should be made available by Professional Engineers and Architects so important facts do not get overlooked during subsequent works.
- Mandatory continued education is a must. It not only keeps us technically connected but also guides our moral compass towards ethical integrity.
- Self-commitment to the highest professional ethics is a must. Safety shall not be compromised by misplaced priorities. Professional misconduct must be made public known to future clients.
- There is a need for minimum prescribed structural maintenance standards for all buildings. Buildings should be inspected periodically, by qualified specialists or professional engineers. The structural adequacy compliance reports should be held in public registry for easy access.

While many of the above points are actively exercised and well ingrained in the BC structural engineering practice, the following message from Chris Roney must always be remembered:

" … the moral and ethical foundation of (our) vocation and profession – (are) to hold paramount the safety, health and welfare of the public".

Vancouver Island Branch

Thor Tandy, P.Eng, Struct.Eng, MIStructE

Branch Chair

Mission:

To provide a focal point for SEABC members on the Island to meet, discuss SEABC issues and to take benefit in the form of exchange items of technical interest.

2015 Branch Executive:

Branch Exec: Thor Tandy, Dan Weber, Dan Gao, Tyler Best, Roxanne Duigou (Camosun Rep)

Inter-Branch Liaison as best we can: Meagan Harvey, Lee Rowley, Ralph Watts

Branch Demographic:

- Members in the local Victoria, Gulf Islands area.
- A central Island group centred on the Nanaimo, Port Alberni area.
- A small North Island group.

Events:

Thanks to Dan Gao and Dan Weber, over the June/July period, we were treated to a visit to the site of the new Victoria bascule bridge. The visit was well attended by members, Camosun College engineering students and staff from CFB Engineering groups. The numbers dictated that the visit was separated into three separate days. It was timely to attend at this stage of construction and informative. Thanks to PCL for allowing it to happen.

We plan to develop other opportunities for similar site visits.

Proposed Events:

- Social event TBC.
- Executive Meeting Aug 17. With more members in the group plan to develop a calendar for remainder of year.

Contacts:

Victoria/Gulf Islands:	Executive
Central Island:	Lee Rowley
North Island:	Ralph Watts
Okanagan:	Meagan Harvey

Communications Committee

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

Director SEABC

The Communications Committee looks after our popular newsletter, and our website where most of our business is carried out. If you have an interest in publishing or website development, please let us know – we would love to hear from you!

SEABC members will now be reading the 31st issue of the newsletter. They may be forgiven for not noticing that they have been receiving new editions every quarter since SEABC started up in 2008. This consistent publishing takes commitment by the editorial team to provide content that is of interest to readers and relevant to today's practice of structural engineering.

To achieve this fine objective on a continuing basis, we need your help. What interests you will interest others. We need you to write articles and send us photographs that illustrate the topic of interest. If you cannot do it, kindly point out who can help. Please take the effort to send us the information we will need for our future newsletters to keep our members well informed.

Technical Committee

Kevin Riederer, M.A.Sc. P.Eng.,

Director SEABC

The Task Group investigating the Seismic Design of Basement Walls remains the only currently active task group. The task group is looking to have a report soon to present to SEABC Members.

Four other issues are currently under review by the technical committee:

- Clarification on P.Eng. requirements for Part 9 buildings when the design professional has designed only the gravity loads, lateral loads or both.
- Clarification on the requirement in BCBC clause 4.1.8.18.8(d) which prohibits the use of power-actuated fasteners and drop-in anchors for tension loads. Clarification on the requirement for a top rail at glass guards. The Guard Design Task Group is in the early stages of updating the SEABC Guard Design Guidelines.
- Updates to the SEABC Technical Paper "Fire Rating of Seismic Bracing"

SEABC encourages all interested members to participate in committees or task groups. Some of the existing standing committees are currently seeking a chairperson so please contact SEABC if you have a specific interest in these topics. If you have interests or concerns in other topics dealt with by one of the technical sub-committees or task groups please contact the chairperson of those groups.

Young Members Group

Anna Lemaire

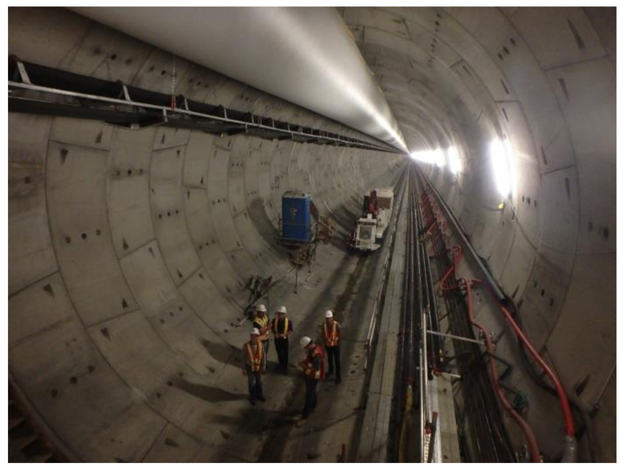
YMG Committee

On Wednesday, June 17, a group of 12 SEABC members went on a tour of the Evergreen Line tunnel boring operation, guided by the Technical Manager, Ardalan Hamidi, P.Eng. The bored tunnel of the Evergreen Line is currently under construction to link the south tunnel entrance located on the west side of Clarke Road near Kemsley Avenue in Coquitlam to the north tunnel entrance on the east side of Barnet Highway near View Street in Port Moody.

A Tunnel Boring Machine (TBM), 10-meter diameter and 11-meter long, was assembled in early 2014 and is currently excavating the tunnel at depths ranging between 17 and 50 meters, until the end of the summer. Tunnel liner is comprised of precast concrete liner ring segments installed by a ring inserter. The TBM is pushed forward and steered with the use of hydraulic jacks.

SEABC YMG Tour Group

Precast panels used for the tunnel liner



In the depths of the tunnel

Another view inside the tunnel

On the Web

Stephen Pienaar, P.Eng.

Webmaster

The SEABC volunteer committees are slowly coming out of a*estivation* with a couple of events, some confirmed and more are in the pipeline.

Current Events

New on the SEABC website:

- September 7:
  Closing date for the September 2015 Term of the Certificate in Structural Engineering. A few spots are still available for the course **C54 Bridge Seismic Analysis for Force-based & Performance-based Design** (new course) and **E1 Masonry Design of Buildings**.
- September 9:
  The Young Members Group is presenting **Hands-on Hilti training for designers**
  www.seabc.ca/hilti
- September 25:
  The SEABC Okanagan Chapter will present a seminar: **The Art and Zen of Guard Design – One Engineer's Reflections on the APEGBC Guideline: Designing Guards for Buildings**
  www.seabc.ca/artandzen
- Be first the first to 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's website and other online services. Please send your suggestions to webmaster@seabc.ca.

Upcoming CPD Ballot

The 2015 APEGBC election ballot launches on August 25th. Each eligible member will receive an email from the President which reiterates Council's support of the bylaw and the importance of voting. Following the launch, reminder emails will be sent to members who have not voted during the balloting period.

APEGBC has recently been promoting awareness of the CPD bylaw. Passing this long- overdue bylaw has been Council's priority for several years and continues to be. The BC Government strongly supports this initiative.

The CPD bylaw is to promote ongoing learning by the membership, and have the members report their CPD activity to APEGBC. Importantly, the reporting process is straightforward, and requires minimal effort.

APEGBC has created a CPD microsite: www.cpd.apeg.bc.ca Over the past seven weeks the site has been visited by a significant percentage of the membership indicating strong member engagement. Encouragingly, the level of user satisfaction reported is high.

As part of its promotional effort, APEGBC has reached out to the top 35 employers of its members and reports a positive response. The support of this group will be critical to the success of this bylaw.

Members have an obligation to vote on important issues. APEGBC needs a majority of members to indicate the future direction that Council should take.

SEABC Announcements

IABSE 2017 Symposium

Adam Lubell, PhD, P.Eng.

Read Jones Christoffersen Ltd

Symposium Co-Chair

Katrin Habel, Dr.sc.techn., P.Eng.

Associated Engineering (B.C.) Ltd

Symposium Co-Chair

SEABC will host the IABSE Symposium, a three-day technical conference that will be held at the Westin Bayshore from September 21 to 23, 2017. The Symposium will be preceded by a program of pre-conference workshops, tours of local structural engineering projects, and the Annual Meetings of the IABSE's technical committees and working groups. We are excited to welcome this high-quality international conference to Vancouver and we hope to present a program of great interest to SEABC members.

The local organizing committee is currently finalizing an exhibitor and sponsorship brochure, and we will start our fundraising initiatives this fall.

Please contact David Ellis, Chair of the Sponsorship Committee, if you are interested in finding out more about sponsorship and exhibition opportunities for the Symposium. ellis@ae.ca

This year's IABSE Symposium will be held in Geneva, Switzerland. Our Honorary Chair, Peter Taylor, and Co-Chairs Katrin Habel and Adam Lubell will be attending this event to learn from this year's event and to further the discussions on the planned Vancouver program. We will also start promoting the 2017 Symposium in Vancouver.

The Canadian Group of IABSE has also undergone some recent changes. Long-time Chair of the Canadian Group, Vic Anderson, has recently retired. SEABC Board Member Adrian Gygax has become the new Chair of this group, and we look forward to working with him as the Symposium approaches.

Please contact us with any comments, suggestions or questions regarding the IABSE Symposium and stay tuned for updates in the next SEABC Newsletter.

Katrin: kkhabel@iabse2017.org
Adam: alubell@iabse2017.org

APEGBC Council Election

The election of the new Council for the 2015/2016 session will take place in September – the results will be announced at Association of Professional Engineers and Geoscientists of BC's Annual General Meeting in Kelowna on October 17th. The only presidential candidate is electrical engineer, Mike Wrinch, who is the current Vice President; however, there are three candidates standing to become the next Vice President, only one of whom is a serving councillor.

But wait – a Council log-jam is approaching! There are a total of 13 candidates vying to become a councillor in the next session, of whom only two are currently-serving councillors, one being SEABC Director, David Harvey. David reports that he has greatly enjoyed his past two years on Council during which time much has been accomplished. David was particularly pleased to have been elected by Council to serve for the past year on the Executive Committee, which has a key role in the financial and strategic business of the APEGBC. He firmly believes that he has been able to ensure that structural engineering interests are considered when conducting Association business. It is happily evident in David's interaction with staff and Council that structural engineers are understood and well respected within our community.

David urges all structural engineers and their colleagues to take an interest in the election. It is most important that we elect a Council that will diligently carry out its responsibilities and ensure that APEGBC remains among the forefront of engineering regulators and continues to be a trusted advisor to government. He asks that you examine each candidate's credential and election statement closely before voting, and if you chose to vote for David, he will appreciate your support.

IStructE News

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

Director SEABC

Update on IStructE Council July 23 and 24, 2015

"The Future of the Profession - the challenge of change"

This year's Council "Away Days" took place at the Institution's new office on Bastwick Street in London with the theme being "The Future of the Profession-the challenge of change". Past President Nick Russell and Glenn Bell, both of whom are familiar to SEABC, led off the two Workshop Sessions with presentations, then Council was split up into four groups to participate in the two Workshops:

Workshop 1: The analysis - thinking beyond the Institution

5 years ago, Council viewed (a) sustainability; (b) BIM and c) Retrofit/adaptability as key development opportunities and challenges for the profession. Has the landscape changed or do these still remain real issues?

Generally it was felt that the concept of sustainability has become entrenched in our vocabulary, and increasingly in design, and that maintainability and structural component replacement are now emerging as important issues. BIM is now moving into the mainstream in design but there are issues associated with it. BIM should permit greater standardization and economy but has not yet reached that point, and checking is an issue. Retrofitting and adaptability of old structures continue to be an important part of structural engineering.

What are the biggest opportunities and threats for the profession?

Considerable discussion took place on this question, much of which focussed on the role of the structural engineer in society. It was felt the role of the structural engineer is declining in the view of our clients, and that architects and construction managers are taking increasingly more important positions on projects. Our role as inter-disciplinary coordinators has diminished. It was suggested that we need a clear value proposition for our client.

We could do a lot more to promote structural engineering to the public, for instance the Structural Awards Night could be televised. As with most engineers, we are too self-effacing, talking too much amongst ourselves and not enough to our clients and the public.

Workshop 2: The response – with particular emphasis on the Institution; its members; its "offering"

How should the Institution best respond to mitigate the threats and maximise the benefits?

Suggestions on moving forward varied from group to group but a few themes emerged:

- It was felt that promotion of and invitation to the Awards Night and Inaugural Address by members would be a good first step.
- Support less developed countries and provide them with the means of obtaining help on engineering issues.
- Encourage more general engineering studies at university so that students emerge with a greater understanding of the need for inter-discipline collaboration.
- Encourage creativity at university with greater emphasis on conceptual design and focus on the fundamentals of structural engineering.

A couple of groups even suggested the unthinkable: the potential merger of IStructE with another Institution or organization!!

International Interest Group

The IIG took some initial steps towards promotion of global collaboration in seismic and global warming engineering by encouraging members to complete a summary of the activities on these subjects within their region. This initiative has been temporarily put on a "slow burner" while the Institution evaluates a recent report on its future role in the field of seismic engineering.

Past President David Harvey

Lastly, many of you probably do not realize that one of our directors, David Harvey, was the President of this illustrious Institution from 2006 to 2007 and that his name is now enshrined on the wall in the Institution's new office. I have included a couple of photos of the list of Presidents for yours and David's benefit as I am sure he has not seen it. The list dates back to 1908. David, you have done us a great honour!

Design Procedure for Ductile Tension-Only Seismic Bracing with an Energy Dissipation Ring

Dejan Erdevicki,

Dipl.Ing, P.Eng.Struct. Eng. FIStructE

Principal Erdevicki Structural Engineering

Abstract

The paper presents a design solution for ductile 'tension-only' seismic bracing with an energy-dissipating ring. This type of bracing behaves very well under seismic loading – this behaviour has been demonstrated by experiments that reach very high post elastic drift limits. The presented procedure is a method created by the author and is based on information collected during research testing performed at the University of British Columbia. Testing was performed by a UBC research team led by Professor Carlos Ventura, in collaboration with Dejan Erdevicki from Erdevicki Structural Engineering.

The design procedure presented here describes the behaviour of the system, the relationship between energy, forces, drift limits and ring capacity. It also includes geometrical limitations and requirements for the ring element and bracing system, to ensure that the target drifts can be achieved. The procedure allows the user to calculate seismic forces and reduction factors based on an energy criterion and the chosen final drift for the structure. For longer-period structures, the equal displacement principle is discussed and considered. The procedure can be used for seismic capacity design and easily adjusted to suit applicable national codes.

Ring capacity tables and examples are included, and application of the bracing system to multi-storey buildings is discussed.

Ductile tension-only seismic bracing with energy-dissipating rings can be used for the design of new structures and for retrofitting existing ones. The system is relative simple, and if needed, allows easy replacement of the energy-dissipating ring following an earthquake.

Keywords: *Ductile Bracing, Energy Dissipating Ring, Design Procedure, Seismic Retrofit.*

1. Introduction

The tension–only bracing illustrated in Figure 1 is a simple and ductile bracing system that can be used as a seismic load-resisting structural element. The design procedure presented in this paper is a conservative method created by the author, based on the information collected during a series of tests on a full-scale braced frame carried out at the University of British Columbia. The testing program included quasi-static, cyclic and shake-table tests. Work on this research project started 2007 and most of the tests were performed from 2011 to 2013. The test program was performed at the UBC Earthquake Engineering Laboratory by a research team led by Professor Carlos Ventura, in collaboration with Dejan Erdevicki from Erdevicki Structural Engineering.

The test program was limited to 45 degree diagonals and one-story bracing. The author is confident that the procedure can be used also for multi-story bracing systems. The optimal angle for diagonals is 45^0. Until further test results are conducted, the author recommends restricting the angle of diagonal bracing α, to between 40^0 and 50^0.

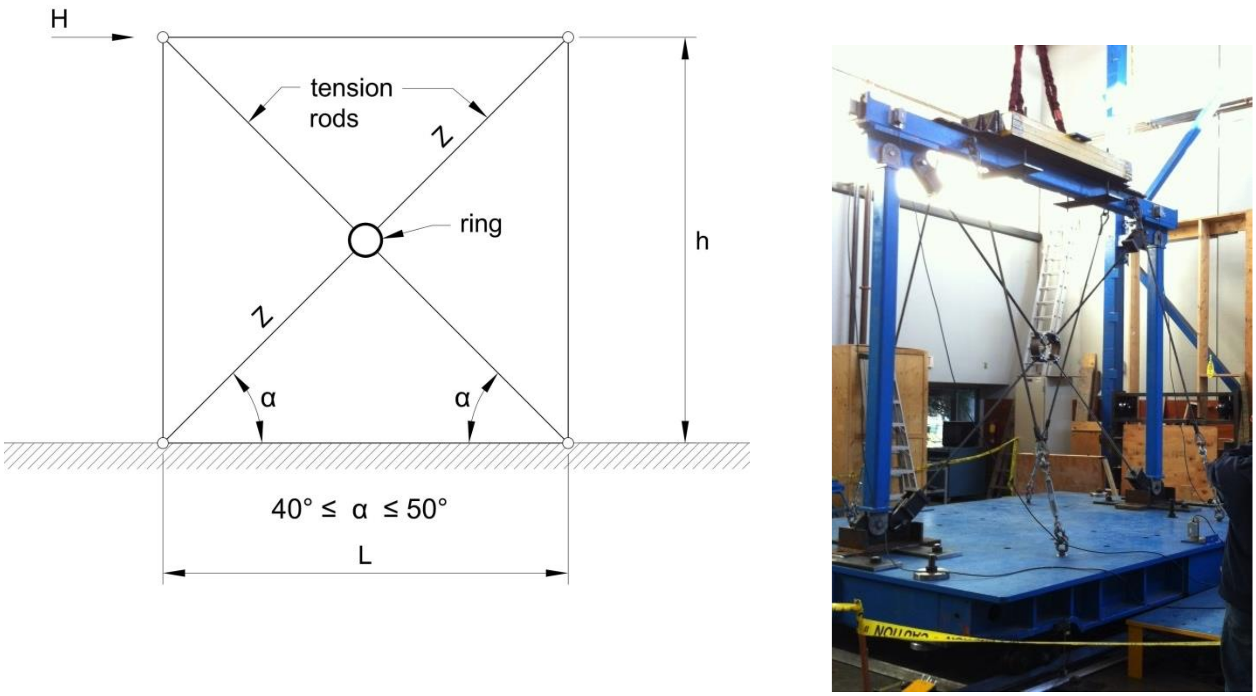


Figure 1

The system will dissipate energy by forming plastic hinges inside the central ring. Control of the number of hinging points and their locations is achieved using clamp plates. The design procedure presented in this paper is valid only if all the requirements for the ring and system design described below are fulfilled.

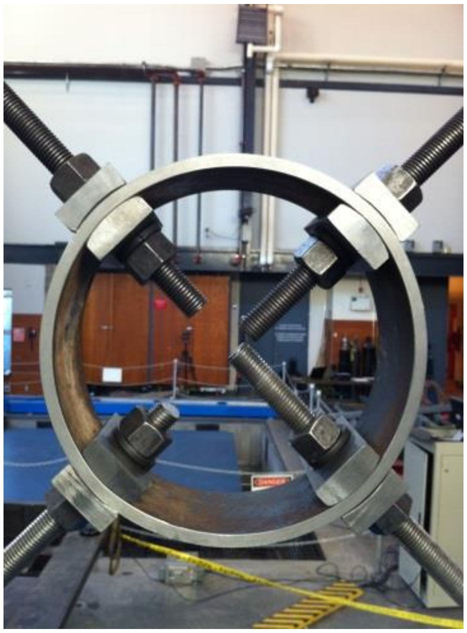
2. Notation

The following terminology is used:

A	*length of clamp plates, mm*
A_{eq}	*effective rod cross sectional area, mm²*
A_r	*rod cross sectional area, mm²*
B	*width of ring, mm*
C	*dimension between clamp plates, mm*
D_{eq}	*equivalent diameter of rod, mm*
D_i	*internal diameter of ring, mm*
D_o	*external diameter of ring, mm*
E	*modulus of elasticity of steel, MPa*
F_u	*tensile strength of ring material, MPa*
F_y	*yield strength of ring material, MPa*
H	*horizontal force, kN*

H_{el}	*elastic seismic horizontal force, kN*
H_{ov}	*overstrength horizontal force, kN*
H_y	*horizontal force causing yield, kN*
h	*height of braced frame, mm*
h_i	*height of i^{th} floor in multi-storey frame, mm*
K	*initial elastic stiffness of bracing, kN/mm*
K_r	*elastic stiffness of ring, N/mm*
L_d	*length of diagonal, mm*
M_f	*factored bending moment at a section, kNmm*
$M_{f\ wind}$	*factored bending moment for wind at a section, kNmm*
M_r	*seismic flexural resistance at a section, kNmm*
M_{rw}	*factored flexural resistance for wind at a section, kNmm*
R_0	*material factor as specified in the applicable design code*
R_d	*ductility factor as described in Section 6*
T_1	*first natural period of vibration, sec*
t_r	*thickness of ring, mm*
t_w	*clamp plate thickness, mm*
X, Y	*sections of peak ring flexure*
Z	*diagonal force, kN*
Z_{el}	*elastic seismic rod tension force, kN*
Z_f	*factored rod tension force, kN*
$Z_{f\ wind}$	*factored rod wind force, kN*
Z_r	*ring factored tension resistance, kN*
$Z_{r\ wind}$	*ring factored tension wind resistance, kN*
Z_y	*ring yield tension capacity, kN*
δ	*horizontal deformation corresponding to H*
δ_{el}	*elastic horizontal deformation*
δ_{max}	*maximum horizontal deformation*
δ_y	*horizontal deformation causing yield*
Φ	*hole diameter, mm*

3. Ring General Requirements



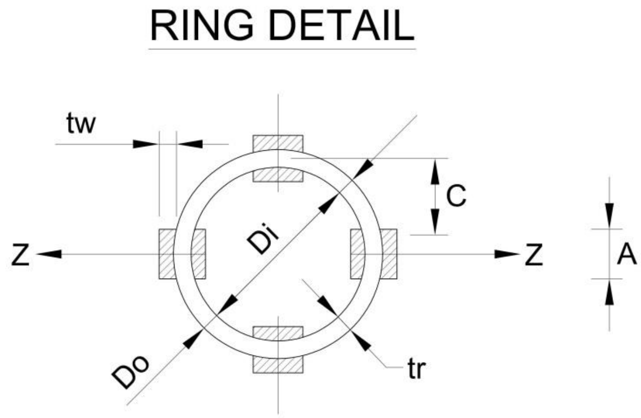


Figure 2

The ring and washers are generally as shown in Figure 2.

Based on current testing following geometric requirements are suggested:

- $D_i > 142 > h / 21$
- $t_r \geq 7$
- $B > 90 > 4 * \Phi$

The minimum tested inside ring diameter D_i was 149 mm for a frame height of 3160 mm ($h / D_i = 21.2$). Larger rings performed better as the post-elastic frame deformation for all quasi-static tests was limited to the same drift of 0.015 * h. For that reason it is suggested that $D_i > h / 21$ and $D_i > 142$ mm. All tested rings were 90 mm wide and had 22 mm holes ($B / \Phi = 4.1$). The suggested B / Φ ratio is to limit the ring net-section reduction.

When tested, rings without double clamp plates fractured at the hole locations, whereas rings with double clamp plates fractured at the edges of the clamp plates and performed much better in the tests. All tested clamp plates were 50 mm long, 19 mm thick and had 22 mm diameter holes. These clamp plates worked well for overstrength diagonal loading of about 110 kN.

Making the clamp plates too narrow or too thin will reduce the clamp plate capacity and would impair ring performance. The clamp plates should remain elastic in resisting overstrength loading and should be capable of distributing the load evenly across the width of the ring. In addition, the clamp plates should not be too long in order to maximize the post-elastic deformation capacity of the rings. The minimum D_i / A ratio tested was 2.98. The proposed D_i / A ratio are therefore $\geq$3.0.

The following geometric limits are proposed, but could be varied in the light of satisfactory test results:

- $A \leq D_i / 3$, ≥ 50, ≥ 2 * rod diameter, $\geq D_o / 6$
- $t_w > 19$, $> B / 5$, $> 0.4 * A$, $> 1.25 * t_r$
- Clamp plate radius to match inside and outside ring radius.
- Clamp plate corners to be chamfered 2-3 mm.
- Clamp plate material to be as strong, or stronger than the ring material.
- Ring and clamp plate holes are to be 2 mm larger than the rod diameter.

- Rod nuts and lock washers to be placed on the inside and outside of the ring.

Ring without Double Clamp Plates

Ring with Double Clamp Plates

4. Ring Capacity, Factored Loading and Overstrength Factor

The following simplified relationship between the rod tension force and ring moments can be used:

$M_f = 0.3 * Z_f * C$ or $Z_f = M_f / (0.3 * C)$

Where $C = (D_o - t_r) / 2 - A / 2 + 5$ mm

Numerical modeling of the ring and clamp plates would be another way to determine the maximum moment at Section X

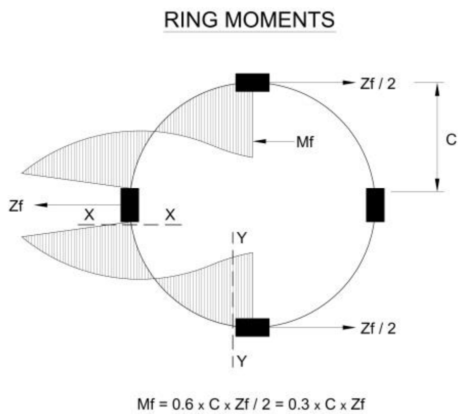


Figure 3

4.1 Non-Seismic Loading

For non-seismic loading, the ring bending resistance at Section X should be calculated based on the applicable steel design code, using the gross section $B * t_r$ without reduction for the hole. The suggested ULS stress limit is $0.9 * F_y$.

The capacity check at Section Y is not critical, as the section tension capacity is significantly larger than the corresponding moment capacity, and the initial moment at Section Y is only about 67% of the corresponding moment at Section X.

4.2 Seismic Loading Combinations

For seismic design, the following ring resistance can be used:

$M_r = M_y = 1 / 6 * F_y * B * t_r^2$ and $Z_r = Z_y = M_r / (0.3 * C) = 1/6 * F_y * B * t_r^2 / (0.3 * C)$

The seismic design requirement will be:

$M_r \geq M_f$ <u>or</u> $Z_r \geq Z_f$

M_f can be calculated using the design factored tension rod force $Z_f = Z_{el} / (R_d * R_0)$.

Z_{el} = elastic diagonal ULS seismic force corresponding to H_{el} calculated using the applicable building code.

$1.0 \leq R_o \leq 1.5$, $R_o = 1.5$ is recommended.

The overstrength ring capacity will exceed the tensile strength of the material, F_u and the ring will gain significant post-elastic capacity through shape change. Based on experimental results, the maximum ring overstrength could be between 2.0 and 2.5. The author suggests using an overstrength factor of 2.5 for design of all connections, tension rods, and affected structural bracing elements and foundations. The overstrength factor for rings larger than 210 mm could be reduced to 2.0.

4.3 Example and Capacity Table

Ring Factored Tension Resistance - Zr

Non Seismic loading Zr = 0.9*Zy

Seismic loading Zr = Zy

Zy = Yielding capacity

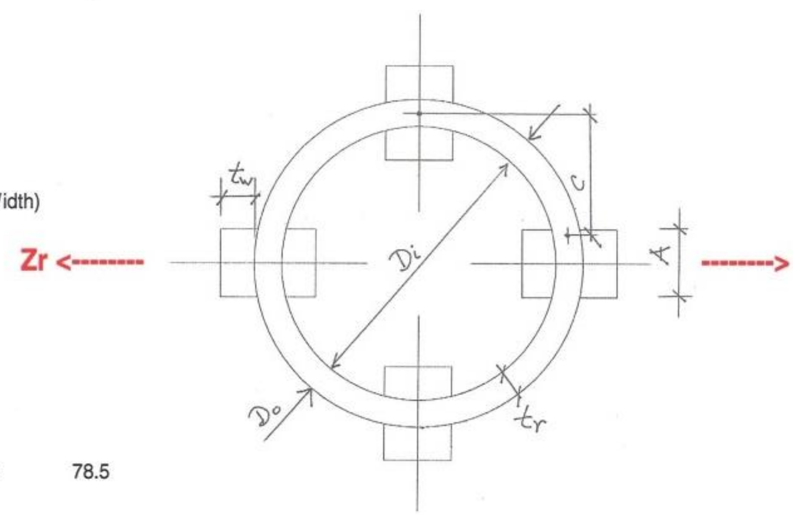
Fy (Mpa)= 350

B (mm) = 100 (Ring Width)

Do (mm) = 219

tr (mm) = 22

A (mm) = 50



C (mm) = (Do - T)/2 - A/2 + 5 = 78.5

Zr = 1/6*Fy*B*tr^2/0.3/C

Zr (kN) = 119.8868 Seismic Loading

0.9Zr(kN)= 107.8981 Non - Seismic Loading

Capacity Table

Ring	Do (mm)	tr (mm)	B (mm)	Fy (Mpa)	A (mm)	**Zr (kN)** - Seismic Capacity
168/8	168	8	100	350	50	**21**
168/9.5	168	9.5	100	350	50	**30**
168/11	168	11	100	350	50	**40**
168/13	168	12.7	100	350	50	**54.5**
219/8	219	8	100	350	50	**14.5**
219/9.5	219	9.5	100	350	50	**20.5**
219/11	219	11	100	350	50	**28**
219/13	219	12.7	100	350	50	**37.5**
219/16	219	16	100	350	50	**61**
219/22	219	22	100	350	50	**120**
219/25	219	25.4	100	350	50	**163**
273/8	273	8	100	350	60	**11.5**
273/9.5	273	9.5	100	350	60	**16.5**
273/11	273	11	100	350	60	**22**
273/13	273	12.7	100	350	60	**30**
273/16	273	16	100	350	60	**48**
273/22	273	22	100	350	60	**94**
273/25	273	25.4	100	350	60	**127**
324/11	324	11	100	350	60	**18**
324/13	324	12.7	100	350	60	**24**
324/16	324	16	100	350	60	**38.5**
324/22	324	22	100	350	60	**75**
324/25	324	25.4	100	350	60	**101**
356/13	356	12.7	100	350	75	**22.5**
356/16	356	16	100	350	75	**36**
356/22	356	22	100	350	75	**70**
356/25	356	25.4	100	350	75	**94.5**
406/13	406	12.7	100	350	75	**19**
406/16	406	16	100	350	75	**30.5**
406/22	406	22	100	350	75	**59**
406/25	406	25.4	100	350	75	**79.5**

Table T1

5. Bracing Stiffness

The initial elastic bracing stiffness K = H / δ.

The bracing stiffness is important in estimating the ductility factor Rd and should therefore be carefully determined. The bracing should be modeled with one diagonal only and should include the ring.

Alternatively, the ring stiffness K_r from Table T2 can be used to calculate the required effective diagonal cross sectional area A_{eq} and to model only the diagonal without the ring using A_{eq}.

$A_{eq} = A_r * L_d / (A_r * E / K_r + L_d - D_o)$

Example:

L_d = 4500 mm

A_r = 380 mm^2 (for 22 mm diameter rod)

Ring size: 324/25.4

K_r = 55 kN/mm (from Table T2) = 55 000 N/mm

E = 210 000 MPa

Required equivalent diagonal cross section:

A_{eq} = 380 * 4500 / (380 * 210000 / 55000 + 4500- 324)

A_{eq} = 303 mm^2

Or, equivalent rod diameter D_{eq} = 19.7 mm.

The bracing should be modeled with one diagonal rod using an equivalent rod diameter of 19.7 mm.

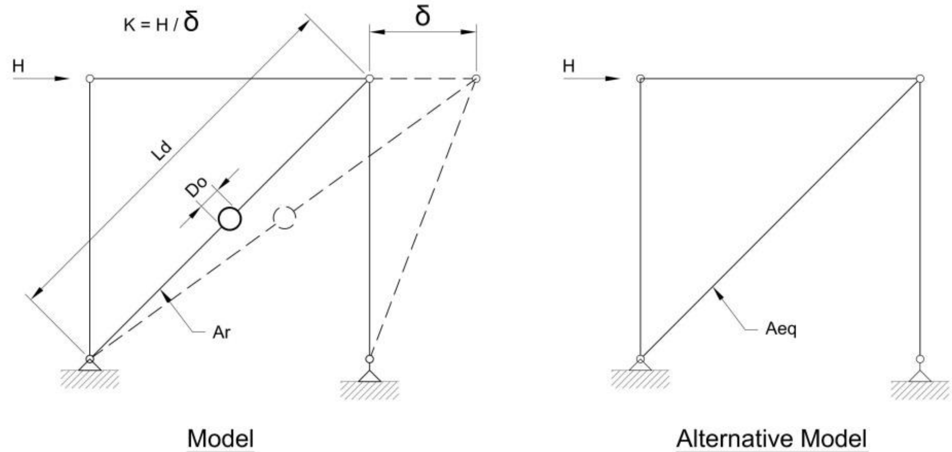


Figure 4

Ring Stiffness Table

Ring	Do (mm)	tr (mm)	B(mm)	**Kr (kN/mm)**
168/9.5	168	9.5	100	20
168/13	168	12.7	100	50
219/13	219	12.7	100	24
219/22	219	22	100	120
273/13	273	12.7	100	12
273/25	273	25.4	100	95
324/13	324	12.7	100	6.8
324/25	324	25.4	100	55

Table T2

The ring stiffness K_r for thicknesses not listed in Table T2 could be estimated using a ring of the same diameter and adjusting the stiffness using the t_r^3 ratio.

Example:

For the 219/16 ring, a thinner ring with the same diameter, 219/13 will be used. For the 219/13 ring, from Table T2, K_r = 24 kN/mm. Therefore, for the 273/16 ring, $K_r = 24 * 16^3 / 13^3 = 44.7$ kN/mm.

If the designer wishes to increase the bracing stiffness or capacity, it can be done by increasing the rod diameter, or by using multiple rods as shown in Figure 5, in which case the ring should satisfy the geometric requirements described in Section 3.

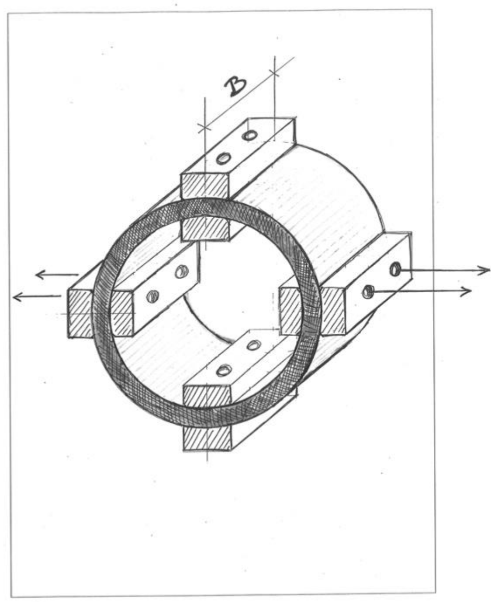


Figure 5

6. Energy and R_d

6.1 Systems with the First Period of Oscillation $T_1 < 0.5$(s)

-
- An energy criterion will be used to establish the ductility factor R_d as shown in Figure 6. Test results have verified that diagonal tension-only bracing with a central ring can reach a post-elastic drift limit of at least 1.5 %. In addition, it was also evident that the system overstrength factor is higher than the F_u / F_y ratio. The overstrength area ΔE1 is larger than the area ΔE2 for $\delta_y < 0.0075$ h, and is used to compensate for the ΔE2 area, and allow for simplification of the formula for E1 shown in Figure 6.

As a result: **$R_d = 2 * K * \delta_{max} / H_{el}$ (Eq 6.1)**

Substituting H_{el} / δ_{el} for K: **$R_d = 2 * \delta_{max} / \delta_{el}$ (Eq 6.2)**

H_{el} = The elastic seismic force calculated using the applicable building code

δ_{el} = elastic force displacement

$\delta_{max} = 0.015 * h$ = maximum displacement limit

Suggested Rd Limits:

$2.0 \leq Rd \leq 5.0$

It is important to note that the R_d factor can be increased using higher stiffness K, and will be reduced for a higher elastic force.

Example:

- H_{el}= 100 kN
- K = 5 kN/mm
- h = 3000 mm
- δ_{max} = 0.015 * 3000 = 45 mm
- R_d = 2 * 5 * 45 / 100 = 4.5
- Or using R_d = 2 * δ_{max} / δ_{el}
- δ_{el} = 20 mm
- R_d = 2 * 45 / 20 = 4.5

Therefore, if the system is properly modelled and the elastic seismic forces are applied, the factor R_d is the ratio between the maximum chosen displacement and the elastic displacement.

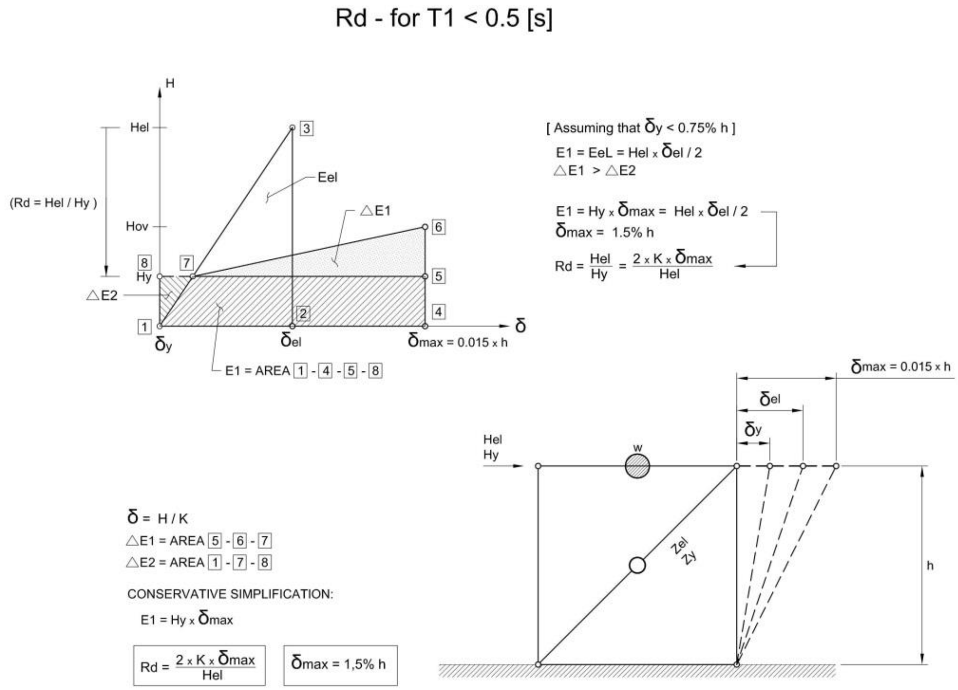


Figure 6

6.2 Systems with a First Period of Oscillation T_1 >0.5(s)

The generally accepted the equal displacement principle shown in Figure 7 can be used as an alternative to the previously described approach. Further testing will be required to verify that the equal displacement principle is adequate and to establish a realistic limit to the force reduction factor.

An important limitation of the system in this case is that the elastic force displacement δ_{el} must be <0.015 * h. If the designer decides to use the equal displacement approach, the author suggests limiting the force reduction factor R_d to 5.0.

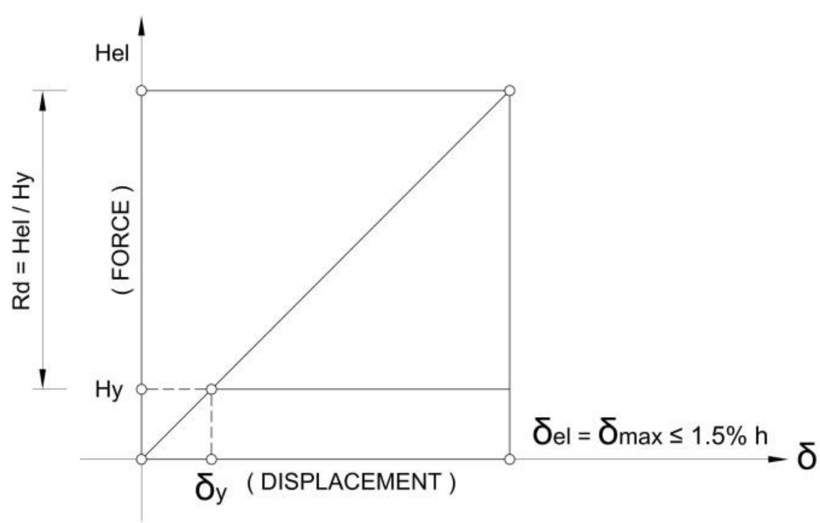


Figure 7

6.3 Multi-Storey Systems

The force reduction factor, R_d can be checked at each storey level using the elastic seismic shear force at that level and corresponding K and $\delta_{max} = 0.015 * h_i$ at that level. R_d can also be determined by calculating the elastic displacements at each level and using Equation 6.2. See Figure 8 for more details.

Ring ductility should be utilized at each floor level, and should be designed with respect to design seismic shear force at that level.

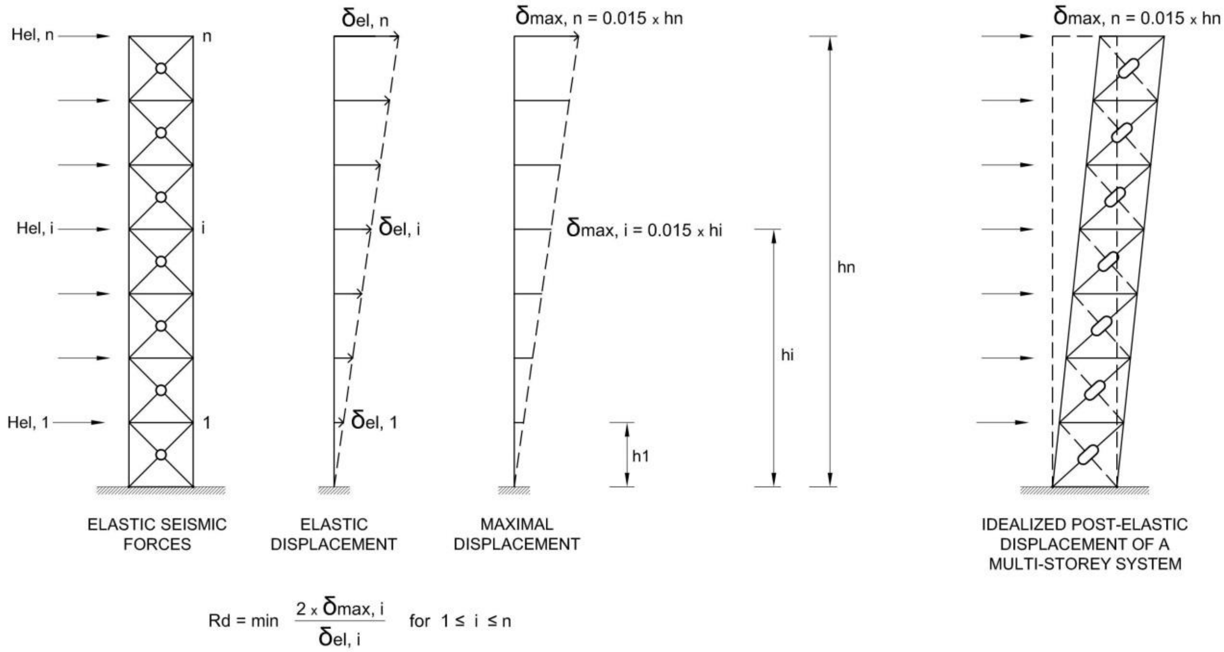


Figure 8

7. Design Procedure for Systems with $T_1 < 0.5$ s

- Design the ring and bracing for non-seismic loading.
- Calculate the first period T_1, and system stiffness, K.
- Calculate the elastic seismic force H_{el} based on the applicable design code.
- Calculate R_d as described in Section 6.
- Calculate the seismic design force $H_f = H_{el} / (R_d * R_0)$.
- Calculate the corresponding diagonal force Z_f.
- Design the ring as described in Section 4.
- Check the stiffness K based on the chosen ring size, and if K is lower than initially assumed, repeat the above procedure. If the chosen ring is stiffer than initially assumed, the system is safe in the case that it does not affect the force H_{el}. The designer can elect to refine the design or not.
- Design tension rods, connections and all affected bracing and foundation elements for overstrength forces $H_{ov} = 2.5 * H_y$ ($2.0 * H_y$ for rings > 210 diameter) but $H_{ov} < H_{el} / R_0$.

8. Design Procedure for Systems with T1>0.5 (s) using Equal Displacement Principle

- Design the ring and bracing for non-seismic loading.
- Calculate the first period T_1 and system Stiffness K.
- Calculate the elastic seismic force H_{el} based on the applicable design code.
- Assume $R_d = 5$.
- Calculate the seismic design force $H_f = H_{el} / (R_d * R_0)$.
- Calculate the corresponding diagonal force Z_f.
- Design the ring as described in Section 4.
- Check T_1 and K based on the chosen ring size.

  K must be larger than $K_{min} = H_{el} / \delta_{max}$.

  If T_1 is higher than initially calculated, the designer can elect to refine the design or not.

- Design the tension rods, connections and all affected bracing and foundation elements for overstrength forces $H_{ov} = 2.5 * H_y$ ($2.0 * H_y$ for rings > 210 diameter) but $H_{ov} < H_{el} / R_0$.

9. Installation

It is very important to install the ring exactly at the theoretical diagonal intersection point. A test performed on one braced frame with a ring 100 mm off-centre showed degradation of the hysteresis loops and pinching behaviour. Lock washers should be used. Slight pre-tensioning of the diagonal rods from the snug tight position is recommended. If higher capacity or stiffness is needed, wider rings with multiple diagonal rods as shown in Figure 5 can be used.

10. Conclusion

The procedure described in this paper allows designers to use a simple and ductile tension-only bracing system. The conservative design methodology described can be refined when the results from multi-storey braced frame tests are available. Larger diameter rings performed better in shake-table testing and can accommodate drift ratios greater than 1.5%.

Appendix A

Design Example:

- Ring Size: 219/22
- B = 100 mm
- F_y = 310 MPa
- A = 50 mm
- A_r = 506 mm^2

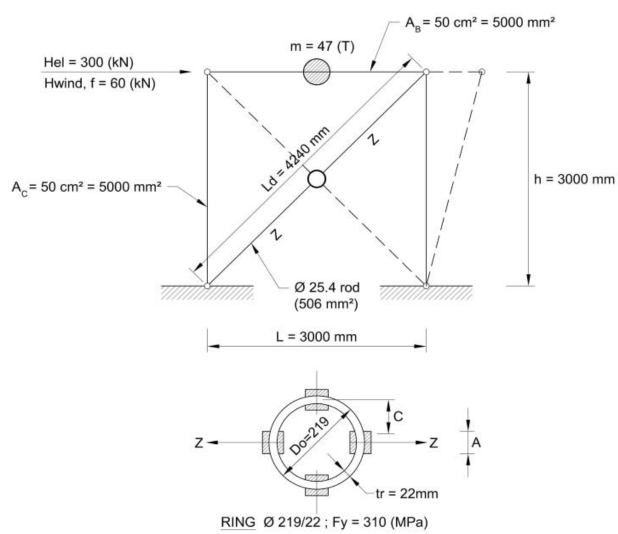


Figure 9

Wind Load Design

Factored diagonal wind load: $Z_{f\ wind}$ = 1.414 * 60 = 85 kN

Ring factored moment: $M_{f\ wind}$ = 0.3 * $Z_{f\ wind}$ * C

- C = (219 - 22) / 2- (50 / 2 + 5) = 78.5 mm
- $M_{f\ wind}$ = 0.3 * 85 * 78.5 = 2002 kNmm

Ring Wind Load Capacity:

- $M_{r\ wind}$ = 1/6 * 0.9 * 310 * 100 * 22^2 * 10^{-3} = 2 250 kNmm
- $M_{r\ wind}$ > $M_{f\ wind}$

or, using Z_r:

$Z_{r\ wind}$ = 1/6 * 0.9 * 310 * 100 * 22^2 / (0.3 * 78.5 * 1000)

$Z_{r\ wind}$ = 95.6 kN > Z_f = 85 kN

Or, using Z_r and Table T1:

- $Z_{r\ wind}$ = 310 / 350 * 0.9 * 120 kN = 95.6 kN > Z_f = 85 kN (OK)

Seismic Design

- R_0 = 1.50
- K_r = 120 kN/mm = 120 000 N/mm (from Table T2)
- Equivalent diagonal $A_{eq} = A_r * l_d / (A_r * E / K_r + l_d - D_o)$
- A_{eq} = 506 * 4240 / (506 * 210000 / 120000 + 4240- 219) = 437 mm^2

The bracing is modelled using A_{eq} and a stiffness, K = 10 kN/mm is determined. For a mass m = 47 tonnes, the first period T_1 = 0.43 < 0.5 (s).

- Based on the applicable code, the elastic seismic force, H_{el} = 300 kN and Z_{el} = 424 kN
- δ_{max} = 0.015 * 3000 = 45 mm
- $R_d = 2 * K * \delta_{max} / H_{el}$ = 2 * 10 * 45 / 300 = 3.0
- Seismic design force, $H_f = H_{el} / (R_d * Ro)$ = 300 / (3 * 1.5) = 67 kN
- Seismic design diagonal force, Z_f = 1.414 * 67 = 95 kN

Ring capacity for seismic loading:

- $M_r = M_y = 1/6 * F_y * B * T^2$ and $Z_r = Z_y = M_r / (0.3 * C)$
- $H_y = 0.707 * Z_y$
- M_r = 1/6 * 310 * 100 * 22^2 * 10^{-3} = 2500.67 kNmm
- $Z_r = Z_y$ = 2500.67 / (0.3 * 78.5) = 106 kN > Z_f = 95 kN (OK)

Ring Selected: 219/22

- $H_y = 0.707 * Z_y$ = 0.707 * 106 = 75 kN

Overstrength seismic force for design of the diagonal rods, columns and footings:

- $H_{ov} = 2.0 * H_y < H_{el} / 1.50$
- H_{ov} = 2.0 * 75 = 150 kN < 300 / 1.5 = 200 kN

References

(1) C.E.Ventura, M. Motamedi, D.Erdevicki, S.Samoru.

Tension-Only brace system for earthquake resistance of low rise buildings. EERF report for Steel Structure Education Foundation. December 2013.

(2) National Building Code of Canada 2012

(3) CSA Standard S16-09, Design of steel structures.

(4) Prof. Djuric, Stabilnost I dinamika konstrukcija, Beogradski univerzitet.1973

(5) C.E. Ventura. Steel Ring Connection for Tension – Only Brace Systems in Low Rise Buildings, SEABC Newsletter, February 2013.

A Busy Year

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

Director SEABC

Summer is almost over. School will be restarting shortly, and everyone will be back in their routine. Hopefully everyone found time to spend time with friends and family.

The Board will be meeting again on September 14th after a welcome summer break. Even though we have taken a summer break, work has continued at SEABC.

The 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 upcoming announcements of these events. The committee has also lined up four top-notch presenters for the structural stream at the APEGBC Annual Conference in Kelowna on October 17th. In July, I represented SEABC at the Northwest Council meeting in Boise, ID (see report, this issue). This event is always enjoyable, and SEABC is a key Council member.

We are already planning SEABC's 2016 AGM and are currently finalizing arrangements with our speaker. In keeping with our history of finding world-class presentations to accompany our AGM, we have another excellent keynote speaker lined up. Stay tuned for the upcoming announcement.

Before its summer break, the Board received an updated recommendation from our webmaster Stephen Pienaar, to improve the appearance and functionality of our website. This effort is now underway and will be launched this fall – look out for the new and improved website. We continue to participate in a comprehensive provincial initiative to increase BC's preparedness for emergencies, earthquakes in particular. Our Disaster Response Committee regularly reports to the Board on progress. We still hope to consider the challenge posed by our 2013 AGM keynote speaker, Glenn Bell's presentation *Developing our Next Generation of Structural Engineers*. A subgroup of Directors will look into tackling this challenge and make recommendations to the Board. We will keep you informed.

Even though the Board did not meet this summer, we have pursued initiatives intended to strengthen our organization and deliver better value to our members. However, we need volunteers to keep the momentum going – we encourage you to participate and take advantage of all that SEABC has to offer.

A Practical Guide to Wood-Frame Design


Joel A. Hampson, MASc, PEng, LEED AP


Scott Ash-Anderson, BSc, EIT

This is a correction issued for the latest article in the series about practical wood-frame design. The previous article addressed built-up lumber columns[1]. That article discussed the perpendicular-to-grain failure mode and noted the size factor for bearing, K_{Zcp}, to be unity. This is overly conservative as in the practical applications considered in these articles, the wall plates lay flat; thus, there is an allowance for this low-aspect ratio application[2]

$$K_{Zcp} = 1.15$$

The factored capacity tables from our previous article are re-stated in Table 1 & 2, and the capacities for the compressive resistance perpendicular are changed to account for this different size factor. Please see the previous article for a detailed derivation of the resistance values and their applicable limitations. (A very practical rule of thumb is 3-kip per each 2X4 and 5-kip per each 2X6.)

Table 1. 2X4 columns

Name	Breadth, in (mm)	Depth, in (mm)	Area, in^2	Column weight, lb	Factored compressive resistance, lb	
					Parallel to grain	Perpendicular to grain
1·2X4	1.5 (38)	3.5 (89)	5.3	9.0	3991	**3218**
2·2X4	3.0 (76)	3.5 (89)	11	18	7983	**6435**
3·2X4	4.5 (114)	3.5 (89)	16	27	11974	**9653**
4·2X4	6.0 (152)	3.5 (89)	21	36	15966	**12870**
5·2X4	7.5 (191)	3.5 (89)	26	47	19957	**16088**

[1] "A Practical Guide to Wood-Frame Design: Built-Up Lumber Columns" by J.A. Hampson & S. Ash-Anderson, SEABC Newsletter, May 2015, Volume 30,

[2] "O86-09: Engineering design in wood" by the Canadian Standards Association, 2010, Table 5.5.7.5

Table 2. 2X6 columns

Name	Breadth, in (mm)	Depth, in (mm)	Area, in^2	Column weight, lb	Factored compressive resistance, lb	
					Parallel to grain	Perpendicular to grain
1·2X6	1.5 (38)	5.5 (140)	8.3	14	10754	**5061**
2·2X6	3.0 (76)	5.5 (140)	17	28	21507	**10123**
3·2X6	4.5 (114)	5.5 (140)	25	43	32261	**15184**
4·2X6	6.0 (152)	5.5 (140)	33	57	43014	**20246**
5·2X6	7.5 (191)	5.5 (140)	39	67	53768	**25307**

Joel A. Hampson, MASc, PEng, LEED AP & Scott Ash-Anderson, BSc, EIT, practice structural engineer in Vancouver. 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 covered 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.

Figure 1: Built-Up Lumber Column in an Exterior Wall

Mark Your Calendar

Upcoming SEABC Course Offerings

September 2015 Term

The September 2015 Term will run on Tuesdays and Thursdays between September 8 and December 3

Courses will be held in the Alma Van Dusen Room at the Vancouver Public Library, 350 West Georgia Street, Vancouver.

C11 Timber Design of Light Residential and Commercial Buildings

Date: 12 Thursdays, September 10 to December 3, Mid-term Break: October 22

Time: 7:00pm-9:00pm

Course Outline: www.seabc.ca/cse

C54 Bridge Seismic Analysis for Force-based & Performance-based Design

Date: 12 Tuesdays, September 8 to December 1

Mid-term Break: October 20

Time: 4:15pm-6:15pm

Course Outline: www.seabc.ca/cse

E1 Masonry Design of Buildings

Date: 12 Thursdays, September 10 to December 3

Mid-term Break: October 22

Time: 4:00pm-6:00pm

Course Outline: www.seabc.ca/cse

E12 Design of Steel Structures for Seismic Resistance

Date: 12 Tuesdays, September 8 to December 1

Mid-term Break: October 20

Time: 6:45pm-8:45pm

Course Outline: www.seabc.ca/cse

Registration for courses: www.seabc.ca/registration

Upcoming Events

2015 SEAOC Convention Annual Golf Tournament

Date: Saturday September 12, 2015

Venue: China Creek, Newcastle Golf Club

Cost: $175/$150 for convention attendees

See Flyer attached

ATC & SEI Conference on Improving the Seismic Performance of Existing Buildings and Other Structures.

Date: December 10-12, 2015

Venue: San Francisco

Registration: www.atc-sei.org/registration

SEAOC Convention

Date: September 9-12, 2015

Venue: Bellevue, WA.

Registration: www.convention.seaoc.org

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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- Keynote Plenary: Cascadia Subduction zone
- Closing Keynote: One World Trade Center
- Cruise Around the World Dinner
- Excellence in Engineering Awards Lunch
- Young Member Roundtable
- Evening at Chihuly by CSI
- President's Cup
- Golf Tournament
- YMF Design Competition

We are pleased to announce that registration is now open. We encourage you to Register Early to receive the 2015 SEAOC Convention Best Value.

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Young Member Registration
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2015 SEAOC CONVENTION
Schedule of Technical Session Presentations

Thursday, September 10, 2015

TIME	Session A	TRACK 1	Session B	TRACK 2	Session C	TRACK 3	Session D	TRACK 4
8:00:00 AM 8:30:00 AM 9:00:00 AM	1A	***Opening Keynote Plenary Session*** **The M9 Project | Cascadia Megathrust Earthquake: Reducing Risk through Science, Engineering, and Planning** John Vidale, University of Washington, Department of Earth		Arthur Frankel, U.S. Geological Survey		Jeffrey Berman, University of Washington, Department of Civil		Michael Motley, University of Washington, Civil and
9:30:00 AM 10:00:00 AM		**Break/Trade Show: 1 Hour**						
10:30:00 AM	2A	Special Inspections for Wood Construction Michelle Kam-Biron, S.E.	2B	Global Practices in Earthquake Structural Engineering Kit Miyamoto, S.E.	2C	Performance-Based Design in the Cascadia Subduction Zone: The Case of Seattle Civic Square Abel Diaz, S.E.	2D	Structural Fire Engineering Darlene Rini, P.E.
11:00:00 AM	3A	Wood Shear Walls-Hardware Analysis for a Proper Connection Alfred D. Commins	3B	The 2014 South Napa Earthquake, One Year Later Mike Mahoney, Senior Geophysicist FEMA	3C	Three-Dimensional Settlement Evaluation for the Tallest Building on the West Coast Marty Hudson, Ph.D.	3D	MB360: A 5-Alarm Fire, Structural Evaluation, and Retrofit Marc A. Press, S.E.
11:30:00 AM	4A	Advancements in Force Transfer Around Openings for Wood Framed Shear Walls Karyn Beebe, P.E.	4B	Napa Church Earthquake Repair & Retrofit Jeff Weber, S.E.	4C	Case Studies on Improving Seismic Performance of URM Buildings in Seattle Dihong Shao, S.E.	4D	Rational Evaluation of Structural Response to Thermal Loads Neville Mathias, P.E., S.E.
12:00:00 PM 12:30:00 PM 1:00:00 PM		**SEAOC Annual Business Meeting Lunch: 1.5 Hours**						
1:30:00 PM	5A	T.R. Higgins Lecture Chia-Ming Uang, Ph.D.	5B	The Failure of the Tacoma Narrows Bridge in 1940 Charles Seim, P.E., F.ASCE	5C	Parametric Study on Effects of Mega-Thrust Mw9-Class Subduction Earthquakes and Aftershocks in Victoria, British Columbia, Canada Solomon Tesfamariam, Ph.D.	5D	Monotonic and Cyclic Testing of Components of Suspended Ceilings and Assessment of Capacities Amir Gilani, Ph.D., S.E.
2:00:00 PM	6A	T.R. Higgins Lecture Chia-Ming Uang, Ph.D.	6B	Tsunami Resilient Designs of Buildings for California Gary Chock, S.E., F.SEI, F.ASCE, D.CE	6C	Reliability of the ASCE41-13 Procedure for Non-Ductile Frames Based on Recorded Responses from Existing Buildings Ahmed Mantawy, Ph.D., P.E.	6D	Effective Use of Drift Joints in Exterior CFS Walls Kirsten Zeydel, S.E.
2:30:00 PM 3:00:00 PM		**Break/Trade Show Time: 1 Hour**						
3:30:00 PM	7A	Steel Castings in Structural Design – Case Studies Carlos de Oliveira, M.A.Sc., P.Eng.	7B	BIM (YMF) Larry Summerfield, S.E.	7C	US Resiliency Council - Rating Building Performance in Natural and Man-Made Hazards Ronald Mayes, S.E., Ph.D.	7D	Frequently Misunderstood Wind Provisions Emily Guglielmo, S.E.
4:00:00 PM	8A	Proposed Changes to Steel Column Evaluation Criteria for Existing Buildings Daniel Bech, S.E.	8B	ETABS Tips (YMF) Ali Sumer, Ph.D., S.E.	8C	Earthquake Performance Rating System David Pomerleau, S.E.	8D	ASCE 7-2016 Wind Load Provisions Don Scott, S.E., F.SEI
4:30:00 PM	9A	HSS Design with the Latest Codes and Material Specifications Kimberley Olson, S.E.	9B	Controlling Wind in Tall and Flexible Structures with Viscous Damping Devices Peter Lee, S.E.	9C	Downtime Model for a Spectrum of Building Sizes and Occupancies Considering the Earthquake Hazard David Yoo, E.I.T.	9D	Advancements in Wind Design - Wind Committee Status Report James Lai, S.E., F. SEAOC

Friday, September 11, 2015

TIME	Session A	TRACK 1		Session B	TRACK 2		Session C	TRACK 3		Session D	TRACK 4	
8:00:00 AM	10A	Evolving Design Issues with Tall Buildings using Peer Reviewed Approaches	Micheál O'Keeffe, S.E.	10B	Seismic Behavior of Reinforced Concrete Coupling Beams with Innovative Simplistic Detailing	Shih-Ho Chao, Ph.D., P.E.	10C	Integrating Sustainability with Structure	Keith Bauer, S.E.	10D	A New, Low-Cost Approach to Strengthening Wood-Frame Structures	David Lee, Ph.D.
8:30:00 AM	11A	The Resilience-based Design of the 181 Fremont Tower	Ibrahim Almufti, S.E.	11B	Creep of Sustainable Concrete and its Use in Concrete Filled Tubes	Katie Kuder, Ph.D.	11C	One Big Room: Facebook's New Campus (YMF)	Susan LaFore, S.E.	11D	The Berkeley Art Museum and Pacific Film Archive: Saving a Local Landmark With an Innovative Underpinning Solution	Timothy A. Nelson, S.E.
9:00:00 AM	12A	Lincoln Square Expansion: Performance Based Innovation, A Bellevue Signature Project	Cary Kopczynski, S.E.	12B	Behavior of Wall Boundary Elements with Different Confinement Details	Dawn Lehman, Ph.D.	12C	Differences in Embodied Carbon Assessments of Lateral Structural Systems	Megan Stringer, P.E.	12D	NIST - ASCE 41 Assessments of New Structural Steel Buildings Designed to ASCE 7	Steve McCabe, Ph.D., P.E.
9:30:00 AM		**Break/Trade Show Time: .5 Hour**										
10:00:00 AM	13A	Premiere on Pine: Performance Based Design Helps Create One of Seattle's Tallest Residential Towers	Joe Ferzli, S.E.	13B	Shake Table Testing of Precast Concrete Wall with End Columns (PreWEC)	Sri Sritharan, Ph.D.	13C	Fundamentals of Tuned Mass Dampers (TMDs) for seismic response reduction	Julio Miranda, Ph.D.	13D	Seismic Evaluation and Upgrade for Large Long-Span Manufacturing Facilities	Dihong Shao, S.E.
10:30:00 AM	14A	Coupling of Central Core and Perimeter Megabraces in 5th & Columbia Tower, Seattle	Bryce Tanner, S.E.	14B	The Shocking Secrets of Rocking Shear Walls	Benjamin Mohr, S.E.	14C	T-H Dynamic and Nonlinear Static Analysis for the Ferrocement Canopy of the New Athens Opera House	Gregory Penelis, Ph.D.	14D	Seismic Retrofit of a Precast Concrete Shear Wall Building Using FRP Materials and a Performance Based Design Criteria	David Pomerleau, S.E.
11:00:00 AM	15A	Seismic Design of Concrete Core-Wall Buildings	Joe Maffei, S.E., Ph.D.	15B	Prototyping Seismic Resilient CLT Lateral Systems: Results from NEES-CLT Planning Project	Shiling Pei, Ph.D.	15C	Bamboo Rebar: Use of Bamboo Reinforcement in CMU Walls	Caleb Dunne	15D	Development of Design Guidance and Example Applications for ASCE/SEI 41-13, Seismic Evaluation and Retrofit of Existing Buildings, the ATC-124 Project	Bret Lizundia, S.E.
11:30:00 AM 12:00:00 PM 12:30:00 PM		**Awards Lunch: 1.5 Hours**										
1:00:00 PM	16A	Performance Based Design of Wilshire Grand Tower	Kerem Gulec, P.E.	16B	All Timber Mid-Rise Construction - WIDC Project	Kris Spickler, P.E.	16C	Effective Communication: Concrete Tips for Improving Your Communication Skills	Annie Kao, P.E.	16D	Evaluating and Upgrading the Seismic Performance of Older Tall Buildings	Steve Mahin, Ph.D.
1:30:00 PM	17A	Performance Based Design of 111 Main	Peter Lee, S.E.	17B	Mass Timber High Rise Design Research	Matthew Timmers, S.E.	17C	California Structural Engineer Licensure: Past to the Future; SEs Lead or Follow	James Mwangi, Ph.D., S.E.	17D	Seismic Retrofit of a Historical Building Using Cored and Internal Grouted Reinforcing	Albert Chen, S.E.
2:00:00 PM	18A	ATC-58-II, Further Development of Next Generation Performance-Based Design Criteria	Ron Hamburger, S.E.	18B	Shear Connections with Self-Tapping-Screws for Cross-Laminated-Timber Panels	Afrin Hossain	18C	Women in Engineering *Panel Discussion*	Maryann Phipps, S.E.; Kate Stillwell, S.E.; Michelle Kam-Biron, S.E.; Kelly Cobeen, S.E.; Shalini Prochazka, S.E.; Ardel Jala, P.E.; Marjorie Lund, S.E.	18D	Design, Analysis and Testing of a Full-Scale Curtian Wall Retrofit for Blast Loads from a VBIED Threat	Joseph Valancius, S.E.
2:30:00 PM		**Break (reset room): .5 Hour**										
3:00:00 PM 3:30:00 PM 4:00:00 PM 4:30:00 PM	19A	***Closing Keynote Plenary Session*** **World Trade Center Freedom Tower** WSP (Structural Engineer)	Yoram Eilon, P.E., Senior Vice President, Building Services		Skidmore, Owings & Merrill, LLP (Architect)	Ken Lewis, Managing Partner		Tishman Construction (Construction Manager)	Allan Paull, P.E., Senior Vice President, Civil and Structural Engineering		Tishman Construction (Construction Manager)	Juan Estevez, P.E., Senior Project Manager

2015 SEAOC Convention
Annual Golf Tournament

China Creek @ Newcastle Golf Club

Saturday, September 12 • 7:30am – 2:30pm
Cost: $175/ $150 for convention attendees

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Sponsorship Opportunities Available:

- Hole Sponsor - $250 (18 Available)
- Longest Drive - $500 (1 Available)
- Closest to Pin - $500 (1 Available)
- 1st Place Gross Score - $250 (1 Available)
- 1st Place Net Score - $250 (1 Available)
- Fully Sponsored Foursome - $1,000 (4 Available)

For additional information contact
Soon-Min Kwon - skwon@miyamotointernational.com

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ATC&SEI

Dec. 10-12, 2015
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2nd Conference on Improving the Seismic Performance of Existing Buildings and Other Structures