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*Photo Credit: Andrea  
Sunderland*



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## Message from the President



David Harvey, P.Eng.  
SEABC President

### Forensic Structural Engineering II

We were treated to fascinating insights into the world of forensic engineering by our 2021 Pinnacle Lecturer, Don Kennedy. Forensics is an excellent way to learn about what can go wrong and how to avoid it. What is clear is that many things can go amiss, that failures typically involve a combination of unfavourable circumstances or errors, and/or a quality system was absent or not applied. Don took us through past events which illustrate this.

Subsequently, another tragic failure occurred – this time involving collapse of an elevated guideway structure in Mexico City. The accident has claimed 26 lives so far. Line 12 of the Mexico City Metro was opened in 2012 and has been plagued by problems ever since. It is well understood that most bridge failures occur either during construction (e.g., the Florida International University pedestrian bridge) or after many years of service as the result of inadequate maintenance (e.g., the Polcevera Viaduct in Genoa, Italy). The Line 12 failure occurred after about 8 years of operation, an unusual situation.

The structure that failed supports two metro tracks and consists of a series of simple spans measuring about 30 m in length. Each span comprises two welded-steel plate girders with precast concrete decking which appears to be acting compositely with the steelwork. The girder ends are dapped and supported by bearings at cross heads of the mono-column substructure. The joints in the precast deck panels appear to be performing poorly – there is widespread evidence of leakage and corrosion stains.

The failure has already raised questions concerning the structural integrity of the many other similar spans supporting Line 12. The tragedy is reportedly one of the worst in the Metro's 54-year history. The metro system is the second largest in North America,

carrying up to 4.6M people daily, and Line 12 is the newest section. So why has it fared so badly?

One pointer is that this portion of Line 12 is structural steel. Several of the other lines are below grade, while other 30 m span elevated guideway sections comprise prestressed concrete troughs. Also, Line 12 has been a controversial part of the system, costing well over budget and having suffered numerous problems. After two years in service, the line was closed for repairs for more than a year, and two years later the line was damaged by a 7.1 magnitude earthquake.

Reports claim this history speaks to lack of capacity and negligence in maintenance and supervision. The line was a pet project of the then City mayor who is now the country's foreign minister. Other disputed reports point to the Metro's recent operating budget being cut by millions of dollars. Bridge consultant Simon Bourne has suggested that an 'inherent defect' was to blame for the accident and pointed to a 'lack of construction supervision' having become commonplace. This aligns with a 2015 Mexican government report which cites 'hidden defects' and 'poor, hasty and incomplete certification'.

Images of the collapsed structure show that the failure occurred near midspan. The steel spans show evidence of mid-span tension flange butt welds. These are not necessarily a problem; however, the connections are clearly critical to the integrity of a fracture-critical, fatigue-sensitive structural system.

Was it a latent defect in a tension flange butt weld that triggered the failure? An investigation into the accident has already been promised, so with luck we'll find out the cause before long.



*Mexico City Tragedy – Rescue Underway*

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## SEABC Legacy Awards



Adrian Gygax P.Eng.  
Struct,Eng.

### SEABC Legacy Awards off to a successful start

As part of our annual Keynote Presentation, the Peter R. Taylor Grant for Structural Engineering Advancement and the Young Members Meritorious Achievement Award (YMMAA) were awarded for the first time. We had the pleasure of having Dr. Peter Taylor himself announce the Peter R Taylor Grant winner, a team from Ausenco led by John Sherstobitoff. The Legacy Award Committee Chair, past SEABC President Cameron Kemp had the honour of presenting the YMMAA to Adam Gerber at Aspect Structural Engineers.

Over the past decade, SEABC and its precursor organizations have amassed a considerable cash reserve, notably through our very successful technical seminars and most recently our hosting of the Annual Symposium of the International Association for Bridge and Structural Engineering (IABSE), which generated a sizeable surplus. Using this reserve, the SEABC Board of Directors established a legacy fund in 2020 that generates sufficient annual revenue to support the Peter R. Taylor Grant, the YMMAA as well as development of the Notable Structures Initiative.

### The Peter Ridgway Taylor Grant for Structural Engineering Advancement winning proposal – SFRS Example Database

The grant encourages SEABC members to advance and promote the field of structural engineering through an undertaking related to the field. Recognizing that “advancement” and “promotion” can take many forms, some of which can be quite serendipitous. The grant selection process is kept as free as possible of prescriptive criteria that would

unduly restrict the applicants’ imagination. However, the successful project undertaking must clearly demonstrate ingenuity, be of value to SEABC members, and underscore the contribution that structural engineering makes to society.

This year’s grant winner fully meets this criteria. The proposed project will catalogue examples of Seismic Force Resisting Systems (SFRS) that will help designers visualize the performance of structures that rely on them as well as assisting engineers in communicating expected seismic behaviour to building owners.

The outcome of the project will be a peer-reviewed white paper and a database on the SEABC website that compiles:

- Sketches, notes, details and photographs and one or two examples of each SFRS with  $R_d > 1$ , along with typical details. NBCC 2020 will define 49 different SFRS.
- Photographs of representative post-earthquake damage of each SFRS, at the allowable drift limits for importance factors of  $I_E = 1.0, 1.3$  and  $1.5$  for the code design level earthquake (2% in 50 years probability of exceedance).
- A description of specific locations in BC in a building where the expected damage will occur, and brief discussion about the damage state.
- A similar presentation to the above for non-SFRS portions of a new building for select material types with an emphasis on concrete (concrete columns and thin walls).

In a future phase, the team hopes to expand this work to cover behaviour for higher-probability earthquakes in four Canadian cities and expand the range of materials for non-SFRS systems.

The winning team comprises:

- John Sherstobitoff, P.Eng.
- Ari Wibowo, P.Eng.
- Kate Thibert, P.Eng.
- Amir Garekani, P.Eng.
- Behrad, Keshavarz, EIT
- Seadon Chui, EIT



The project will also receive additional funding from the insurance industry and BC Housing.

## The SEABC Young Member Meritorious Achievement Award Winner – Adam Gerber, P.Eng.

Meritorious achievement is usually recognized near the end of an engineer's career. These are fitting tributes to a person who has spent a lifetime enhancing our profession. However, some engineers demonstrate significant professional achievements early in their careers and recognizing these achievements at mid-career will serve to motivate others.

Any SEABC member under 35 years of age on 1 January of the year the award is given can be nominated by at least three current SEABC members.

The award reimburses the winner's airfare, conference or workshop fees, hotel and pay a \$75 per diem allowance, up to the award amount cap of \$3500.

This year's winner, Adam Gerber is a teacher, mentor, and an exceptional engineer. He is a problem solver, always thinking outside the box and not afraid to use sound judgement in tackling engineering challenges. He enthusiastically trains and mentors those starting out in the field. Finally, he is a consummate professional – extremely well respected by his peers and those he works with throughout the industry.

Prior to and throughout his Bachelor degree in Civil Engineering from the University of British Columbia, he gained experience in the design and construction of timber structures as a carpenter, foreman, estimator, and structural EIT. Adam returned to the University of British Columbia where he earned his Master's degree in Structural and Earthquake Engineering. His research focused on the development of timber-concrete composite technology and vibration performance of floors. His work in this area sought to identify high-performance and low-cost connection technology and compare their performance across several mass timber products. The test program, widely cited throughout the industry, was the largest of its kind and demonstrated the safety, viability, and opportunity for the further implementation of the

technology in Canada and around the world. Adam is also a certified Passive House Consultant and is Member of Code Committee CSA 086 – Task Group on Timber-Concrete Composites. He served as an Adjunct Professor at UBC in 2019 Design and behaviour of timber structures with a focus on cross laminated timber (CLT) walls and floors, timber-concrete composite (TCC) floors, light frame shear walls, diaphragms and framing systems

Adam joined Aspect Structural Engineers at its inception in 2016, and became a Principal in 2018.

A small selection of Adam's notable projects includes:

- Malahat Viewing Tower | Murdoch & Co. | Malahat, BC (*under construction*)
- St. Luke's United Church Redevelopment/Restoration | KPMB | Toronto, ON (*in design*)
- Block 31A & Parliament Building | SHoP Architects/Quadrangle | Toronto, ON (*in design*)
- Westbay Passive House | Battersby Howat | West Vancouver, BC
- Microsoft Silicon Valley Campus | WRNS Studio | Mountainview, CA
- National Arts Centre Rejuvenation | Diamond Schmitt Architects | Ottawa, ON
- Bow River Pedestrian Bridge | Banff, AB

We hope that this year's winners will inspire more SEABC members to come forward and submit a grant proposal and nominate an outstanding young member before next January's deadlines.

Details for both awards can be found on the SEABC website: [seabc.ca/legacy-awards](https://seabc.ca/legacy-awards)



*National Arts Centre*



*Microsoft Silicon Valley Campus*



*Malahat Viewing Tower*



*Bow River Pedestrian Bridge*



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# Simplifying Nailed Connection Design



Mark Budd, P.Eng.

Many of our analysis assumptions rely on providing sufficient details to accomplish the intended behaviour at a joint. In light-frame wood structures we often rely on nails to attach the members and transfer loads. CSA O86 provides design requirements for nailed wood connections in Clause 12.9. At first glance these code provisions can appear intimidating: three pages of definitions and conditions, seven equations with square-root terms, and multiple modifications based on member material. You may want to calculate the capacity only once before searching for a rapid, alternate calculation method.

The purpose of this article will be to decompose the calculation steps required for determining the factored lateral strength resistance of a nailed connection. This decomposition is meant to simplify the connection design, while also assisting anyone looking to create their own design tool (spreadsheet).

## Step 1: Plan and Gather Data

The first step in creating the design tool is planning. We need to input standard nail sizes, the connection member specifications, and the load factors that will be applied to the unit strength. From this information, we want the output to be the lateral resistance of the nailed connection. It is also helpful to know the mode of failure and geometry limitations that may apply. Keep these goals in mind as you create your design tool.

Create an area on the sheet where data tables can be located. Arrays (tables and lists) can be named and doing so helps keep the tool accurate. Define common nail size callouts along with the diameters and lengths that apply. These can be lifted from sources such as the Wood Design Manual, the National Design Specification (NDS) Appendix L, and

hardware manufacturer's catalogues. A design tool's data table should reflect your design preferences.

We will also consider each of the four member categories identified in Clause 12.9.4: standard lumber, structural panels (such as OSB and plywood sheathing), CLT, and steel. The embedment strength of the connection is based on the relative density values of the member and the diameter of the fastener. Relative density is provided in Table A.12.1 of CSA O86. In the case of steel side members, light-gauge material is often used. It is helpful to have a quick conversion table available to switch from gauge values to metric equivalents.

## Step 2: Arrange the Inputs

Use notation and drop-down menus to organize the standard data values. Functions such as INDEX, MATCH, and VLOOKUP can assist with the heavy lifting to retrieve data values based on the notation used. Metric values should be used for all CSA O86 calculations; however, imperial call-ups prove valuable for design and site communication. Any data used for calculation should be converted to the metric equivalent.

## Step 3: Confirm Geometry

Nailed connections rely on adequate penetration length to transfer the load. Limitations are presented in Clause 12.9.2. These limitations are based on the diameter of the nail and member thickness. Review these requirements and add a geometry check calculation near the input area. It is good practice to identify geometry problems before addressing the capacity.

## Step 4: Program the Equations

CSA O86 uses seven equations that are derived from the European Yield Model. The equations used for nails are presented in Clause 12.9.4.2 and follow a similar format to those used for bolts, dowels, and screws. It is interesting to note that the equations used are based on Johansen's yield theory work in the 40s and 50s. This yield theory work was originally applied to concrete slab design. Modern refinements have helped define the model to apply more directly to timber connection members.

The seven equations use member bearing strength as the dominant calculation factor. A modification

factor is applied for cases where the fastener rotates or develops plastic hinges. The least value results in the governing mode of failure and helps determine whether the joint detail can have ductile behaviour.

## Step 5: Present the Outputs

Once the unit lateral strength resistance is calculated for each equation, transfer the governing resistance and mode of failure to the output section on the sheet. This is helpful to have close to the input section, as it allows for quick review of the results during design. Apply the load factors for duration, service, arrangement, and material before finalizing the factored lateral strength resistance for the nailed connection.

## Step 6: Organize the Design Tool

It is important to recognize that, like many engineering concepts, this is but one process that may help you arrive at a valid solution. Review, adjust, and organize the design tool to match your preferences and workflow. Setup the design tools “flow” to allow for adequate checking and rapid capture of relevant results. Finally, name the file and attach a version number so that you can modify and update the sheet as new functionality is desired.

There are tools available online for the Clause 12 (or similar) calculations including: an online application provided by the American Wood Council (AWC), a beta-tool provided on Jabacus, and WoodWorks' own connection software for actual joint geometry.

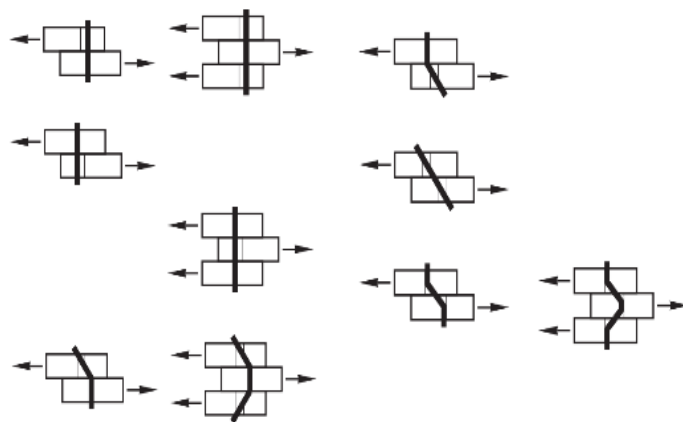


*Light-frame wood structures rely on nails to transfer loads*

These tools totally “nail it” in many functional regards, making them useful to calibrate and verify our own designs. Ultimately, we must all understand the intent of the code provisions before relying on pre-programmed time-saving tools.



*Figure 1. A nail retrieved from an existing shearwall*



*Figure 2. The failure modes are illustrated in Clause 12.9.4.2 (source: CSA O86-14 "Engineering design in wood")*

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# Committee Report

## On the Web



Stephen  
Pienaar, P.Eng.  
Webmaster

## Catch up on SEABC presentations

The SEABC Education Committee published a video recording of two recent presentations:

### 2021 Pinnacle Lecture

Don Kennedy, P. Eng. Vice President, Transportation Structures, Associated Engineering.

As structural and bridge engineers we strive to design safe, economic and sometimes innovative or elegant structures for a better-built environment. Especially when designing more challenging structures, our expertise and skills should be informed by the sometimes harsh lessons of past structural failures. But are these lessons merely mechanical in nature, or are human factors just as important? Too few of these failures are properly documented or shared among engineers, but recently some failures have been widely reported on in the media and within the engineering community. The 2021 Pinnacle Lecture provided an overview of these failures and issues, the engineering and human lessons, how we might apply these to our own engineering careers, whether working in design, management or risk management roles.

### Embodied Carbon for Structural Engineers

Joint Webinar was hosted in Vancouver on 20 January 2021. by SEABC and Carbon Leadership Forum (CLF) Michael Gryniuk, MSc, PE, LeMessurier Boston, MA, Lauren Wingo, MSc, PE, LEED GA, Arup Washington, DC and Dirk Kestner, MSE, PE, LEED AP BD+C, Walter P. Moore

Three speakers, all trained as structural engineers and involved in the Leadership Group of the SE 2050

Commitment program, discussed how crucial structural engineers are to reducing embodied carbon from our structures. They presented how the industry is taking steps to address embodied carbon through the SE 2050 Commitment and looked at different case studies and design strategies.

View these and many other video recordings:  
[seabc.ca/events-archive](https://seabc.ca/events-archive)

## Improve your firm's visibility

Let the SEABC website work for your firm:

- 1) **Directory of Structural Firms:** The Directory currently lists **100 firms** across the province. Member feedback confirms that listings are generating valuable leads. Listing in the Directory is free and available for firms that employ one or more SEABC members.  
[seabc.ca/directory](https://seabc.ca/directory)
- 2) **Photo of the Month:** The SEABC website receives around **5,000 unique visitors** every month. Your firm can get free exposure by featuring projects as the website's photo of the month.  
[seabc.ca/photo-of-the-month](https://seabc.ca/photo-of-the-month)
- 3) **Newsletter:** Take out a paid advert in the quarterly SEABC Newsletter. With a **circulation of over 1,000** (as of February 2021), the Newsletter is a great vehicle to get your message across to the B.C. structural engineering community.  
[seabc.ca/newsletter](https://seabc.ca/newsletter)

## A word of thanks

Appreciation goes to **Jeremy Atkinson** and **Mathew Fenton** for assisting me with website updates.

Sincerely,  
Stephen Pienaar, P.Eng  
SEABC Webmaster



## Young Members Group



Amr Farag, E.I.T. M.Eng

The SEABC YMG continues to be very active during the first part of 2021 hosting traditional events and reaching out to members to understand preferences for future activities. Highlights of the recent YMG activities are as follows:

### YMG Survey

The SEABC Young Members Group (YMG) conducted an email survey among its subscribers in mid-March to understand the members' preferences on event topics, format, and timing. The last survey of this kind was conducted several years ago, and this recent survey provided the YMG committee updated information to enhance the event planning process. A total of 35 valid responses were collected, which showed certain trends in the preferred event topics and timing. The YMG committee had discussed the findings and planned to propagate the changes into future events.

### 10<sup>th</sup> Annual Presentation Competition

The SEABC YMG hosted, with great success, the 10th Annual SEABC Young Engineers Presentation Competition on Tuesday, Feb. 23<sup>rd</sup> and Thursday Feb. 25<sup>th</sup>. With over 50 attendees each day, this year's event had the highest turnout in 10 years, also being the first year to be held virtually. The event this year was sponsored by Xradar (Platinum Sponsor) & Sika (Gold Sponsor).

In total, there was six fantastic presentations, including:

1. **Pouria Kourehpaz**, EIT, Ph.D. Candidate, University of British Columbia, *The New Samuel De Champlain Bridge, Montreal, QC: Design, Construction, and Challenges*
2. **Saif Aldabagh**, Research Assistant, University of British Columbia, *Simplified Predictive Expressions of Drift Limit States for Reinforced Concrete Circular Bridge Columns*
3. **Taikhum Vahanvaty**, Masters Student, University of British Columbia, *Estimating the Recovery Time of Damaged Buildings After an Earthquake*
4. **Ethan Wilkinson**, B.Eng, EIT, Associated Engineering, *Advantages of Base-Isolation on the Seismic Retrofit of Cambie Bridge*
5. **Brendan Fitzgerald**, M.Eng. EIT, Project Engineer, Aspect Structural Engineers, *Diaphragm Details for a Geometrically Challenging Mass Timber Roof in a High Seismic Region*
6. **Kishoare Tamanna**, MASc, EIT, Graduate Research Assistant, University of British Columbia, *Sustainable Structural Systems Incorporating Recycled Waste Materials*

After a collective decision, the judges ultimately declared Saif Aldabagh the winner! Saif's research highlighted the following: A critical component of the performance-based design is the quantification of damage states in terms of engineering demand parameters such as drift. Saif was awarded \$1000, the coveted SEABC YMG presentation competition trophy and an opportunity to present at the 2021 SEABC AGM.

Alongside the winner, the Presentation Competition also featured two People's Choice Awards winners, Ethan Wilkinson (B.Eng, EIT, Associated Engineering) and Brendan Fitzgerald (M.Eng. EIT, Project Engineer, Aspect Structural Engineers). Ethan and Brenden each received \$250.

This event would not have been possible without the exceptional judges: Deanna Perrin (P.Eng, BSc. RJC Engineers), Andy Metten (P.Eng, Struct.Eng, Partner, Bush Bohlman & Partners) and Anas Issa (PhD, EIT, University of British Columbia).

Being a virtual event and to encourage a greater audience, two door prize winners were selected for each day the event was hosted, each receiving \$100 gift card for Google Nest Hub. Thank you to all the attendees for listening, asking questions, and engaging in this year's event.

## P.Eng Registration Seminar: Path to Licensure for Engineers and the Competency Reporting System

On March 23, the SEABC Young Members Group hosted a virtual seminar session on the Path to Licensure for Engineers and the Competency Reporting System. Last held in 2018, this event has returned once again to provide information and assistance to young professionals and students on their journey to attain their P.Eng license.

The event featured two presentations by both Leila Lagroix from Engineers and Geoscientists BC and Kevin Riederer from RJC. Presentations highlighted key information on the P. Eng registration process, law and ethics, general application requirements, and the competency reporting system, including tips and tricks to writing effective competency examples. At the end of the presentation, a Q&A session was held, which provided quality time for participants to ask questions to the panelists for answers and advice.



*P.Eng Registration Virtual Seminar*

## Communications Committee



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

Director SEABC

My report on SEABC communications is that not much has changed. Our publication and website work continues which is key to SEABC operations. Fortunately, the pandemic has had little impact on communication work.

One thing I would like to say is a big thank you to SEABC members who have continued to be part of this great association. Without you, there would be little point in having SEABC. Thank you also to our stalwart contributors – many of whom have written articles for a decade or more. We rely heavily on your contributions for keeping our newsletter readers well informed and keeping SEABC relevant.

So please keep sending us interesting articles. There is much going on locally in structural engineering and the committee is looking to bring that to everyone's attention. If you have an interesting story to tell we want to hear about it from you.

Articles can be full- or half-page and should be illustrated. Short research papers are also acceptable. You can also send in photos with a descriptive paragraph. Contributions should be newsworthy and/or inform our readers on structural engineering. We also invite feedback, so let us know how we are doing.

Please send information for publication to:  
[newsletter@seabc.ca](mailto:newsletter@seabc.ca) – we look forward to hearing from you!



## Technical Committee



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

The Technical Committee has been fairly quiet during the pandemic. Members of the Task Group who developed the practice guideline for the “Structural Condition Assessments of Existing Buildings” will be giving a virtual presentation on the guideline hosted by EGBC in June. Visit the EGBC website for more information. [egbc.ca/](http://egbc.ca/)

Anyone with interest in participating on a Technical Subcommittee or task group is encouraged to contact SEABC. Any member with an issue or concern that they would like to have the Technical Committee consider is also encouraged to reach out to the committee.

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## Stay in touch with SEABC

SEABC has three email lists that members and supporters can subscribe to:

- SEABC Newsletter: Our quarterly newsletter (such as this one) emailed to you.
- SEABC seminars and industry events announcements: Announcement of upcoming SEABC evening seminars, workshop and other events that we think will be valuable to our structural engineer members.
- Young Members Group events announcements: Stay informed about events organised by the YMG: seminars, tours and networking.

We try to curate the content and frequency of emails to not clutter your inbox. To subscribe (or remove yourself) from any of these lists:

- Log in to your Member Dashboard at [seabc.ca/members](http://seabc.ca/members).

- Go to the Email Lists section

Another great way to get early notice of SEABC events, is to follow us on Twitter. Go to: [twitter.com/seabc](https://twitter.com/seabc).

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## Rehabilitation/Reuse of Structures



*Non-destructive testing can help determine the quality of the material for reuse.*



*Condition assessments can help determine the scope of remediation and upgrade on existing structures.*



# IStructE News



David Harvey, P.Eng.  
Struct.Eng

The lockdown measures in the UK are now being loosened as the country's vaccination number passed 34M doses. However, the Institution of Structural Engineers is still operating remotely, with all meetings and events being webcast. The February Council meeting was productive with a high attendance. This on-line meeting was held over two

days with break-out rooms for focused discussions. While the time frame was less than ideal in BC (overnight) at least there was no travel involved!

In March I attended an on-line meeting of past presidents which had a distinctly different character. Many of the former presidents are involved with high-level industry and government committees and are advising inquiries which was interesting to hear about. I am one of four past presidents serving on Council and so we are able to share strategic information with the others. Having not attended the meetings of past presidents since 2008, an on-line meeting provided a great opportunity to catch up with a very interesting group of people. This year, most of the former presidents attended, so I am hoping that future meetings can take place with on-line linkage to allow for more distanced participation.

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## Oldie but Goodie



Robert Bourdages, P.Eng.  
PE. SE. LEED AP

Scanning over my small book collection, I came across an old and tiny reference book entitled “International Correspondence Schools- The Civil Engineer’s Handbook”. Tiny indeed: 5.5” X 3.5” 1.0”, and published by the International Textbook Company in 1913 (411 pages), out of Scranton, PA.

The purpose of the book, as noted in the preface is “...to all who are interested a compact collection of principles, methods, formulas, and tables pertaining to the different branches of civil engineering.”

Notable subject matter includes mathematics, surveying, practical astronomy, railroads and trackwork, mechanics, strength of materials, masonry, reinforced concrete, foundations, hydraulics, sewerage, and roads.

So how was material strength defined and structural design approached at the beginning of last century? Here are some notable excerpts:

### Soft structural steel

Compression: 56,000 psi

Tension: 56,000 psi

Elastic limit: 30,000 psi

Shearing: 40,000 psi

Modulus of elasticity: 29,000,000 psi

### Timber (Douglas Fir) – Average Ultimate Limit

Extreme Fiber Stress: 5,000 psi

Modulus of Elasticity: 1,380,000 psi

Compression with grain: 4,400 psi

Shearing with grain: 500 psi

### Rivets

Shearing: 6,000 psi- 11,000 psi

Bearing: 12,000 psi- 22,000 psi

### Columns

“Structural members in compression whose ratio of slenderness exceeds 150 should preferably not be used. Sometimes, however, long columns cannot be avoided and when  $l/r$  exceeds the limits....Euler’s formula should be used.

### Combined Stresses

Bending with compression or tension:  $s = P/A + Mc/I$

### Reinforced Concrete

1. “A plane section of a beam remains plane after it has been subjected to bending.
2. For one and the same material, the unit stresses at different points of a beam subjected to bending are proportional to their distance from the neutral axis.
3. The unit stresses in steel and concrete at points equidistant from the neutral axis are proportional to their respective moduli of elasticity.
4. The concrete is assumed to take only compressional stresses, all the tensional stresses being carried by the steel.
5. The internal stresses in the section of a reinforced concrete beam subjected to bending form a couple consisting of the resultant of all compressional stresses taken by the concrete, on one hand, and the tensional stresses taken by the steel, on the other hand.”

The reinforced concrete beam design formulas are similar to the current literature for evaluating service load stresses in beams.

### Foundations

Safe loads on earth sub-foundations (tons/sf):

1. Hard pan and other indurated clays: 2-2.5
2. Ordinary Soils, comparatively dry: 1-1.5
3. Ordinary Soils, wet: 0.25-1
4. Swamp and bog material: 0.25-0.5

## Retaining Walls

“All the theories of the equilibrium and stability of retaining walls are based on assumptions that have not been conclusively proved. For this reason, empirical rules based on observations and experience are extensively employed in practice.”

## Beam Theory

The graphics and formulas for beam loading are shown for cantilevers, propped cantilevers, and simple span beam. The bending, shear, and deflection formulas are consistent with current practice.

Reading through the manual reminded me of how well developed the body of knowledge was over a century ago. From a structural engineering perspective, it appears that there was adequate information available to design and construct structures/elements with a reasonably high degree of consistency based on sound technical information.

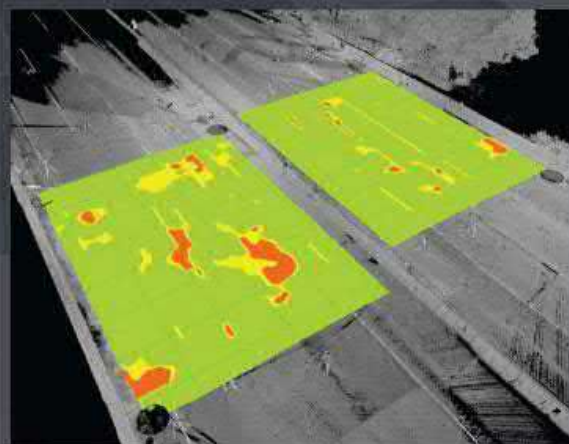
And finally, in the last 16 pages of the book, there are testimonials from people who were self-taught and improved their careers and salaries. Not unlike on-line learning.



## Non-invasive Rebar Corrosion Analysis

Monitor slab development. Detect early corrosion through to full delamination

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# Certificate in Structural Engineering Program



Shannon Remillong,  
CSE Program  
Co-ordinator

Registration for the **September 2021 term** will open mid-July 2021 through the SEABC website: [seabc.ca/certificate-program](http://seabc.ca/certificate-program). Early-bird rates and SEABC Member's discount, both a \$50 savings, will apply at registration. Classes will begin the week of September 7<sup>th</sup> and end the week of December 2<sup>nd</sup>.

## The following courses will be offered in September 2021:

- C12 Practical Design of Reinforced Concrete
- E13 Computer Software Application
- E16-1 Introduction to Cables and Cable Systems 1
- E15 Application of Dynamic Analysis for Seismic Design of Structures

Outlines for the four courses will be updated with relevant information by mid-June.

## Course delivery:

All courses will only be available ONLINE (in-person classes will resume when able).

Courses are once a week, 2 hours in the evening from 5:30-7:30pm.

Courses are 13 consecutive weeks.

## Important Dates:

- Early-bird Deadline: Friday, August 13.
- Registration Close: Monday, September 6.
- Withdrawal Deadline: September 20.

*Courses will fill up fast so make sure to register early and take advantage of the savings!*

This year at the SEABC Annual Meeting held in early March, the Certificate Program Executive Committee awarded the \$500.00 Mahmoud Rezai Scholarships to **six outstanding students** who have taken a minimum of 2 courses over 2 consecutive years, with the highest grade point average.

The students who have accomplished this goal between 2019 and 2020 are:

**Gregory Gislason** (Associated Engineering)

**Ali Lame** (Bush Bohlman & Partners)

**D. Mark Budd** (Cavvy Structural Engineering)

**Pulkit Mehta** (Latera Engineering)

**Chelsea Paton** (WSP)

**Sayed Hassan Mozneb** (13B Science)

***Congratulations everyone! Well done and we look forward to seeing you in September!***

The Executive Committee would also like to congratulate the following who have recently graduated from the SEABC Certificate Program, successfully completing 12 courses.

**Fernando Zarate**

**Elmer Balisacan**

## CSEP Stats:

- To Date we have 30+ Courses
- 3 Terms/Semesters per year
- Since last year, March 2020, enrollment numbers have increased well over 200 registrations per term.
- Record high: 232 Registrations for January 2021 term
- 2001-2021: 5788 enrolled in our courses over 20 years
- Webcast/online popularity is growing. Since January 2017, 50% of enrollments are choosing to attend class via live webcast/online.
- 2001-2021: 20 graduates of the Certificate in Structural Engineering Program
- CSEP has been offering courses since Jan 2001 (celebrating 20 years!)

## Webcast Students from Around the World (Approximately 1% of Enrollments)

- Australia
- Canada
- Chile
- China
- England
- Ireland
- Mexico
- New Zealand
- Qatar
- South Africa
- United Arab Emirates
- United States



## Current Canadian enrolments:

- 80% BC
- 7% AB
- 1% SK
- 1% MB
- 7% ON
- 1% QC
- 2% NB
- 1% NS



## Courses April 2021 Term:

- C4-2 Adv. Concepts in Earthquake Engineering & Seismicity
- C2 Effective Structural Modeling
- E23 Performance-based Design of Tall Buildings
- E25 Structural Health Monitoring

## Courses September 2021 Term:

- C12 Practical Design of Reinforced Concrete
- E13 Computer Software Application
- E16-1 Introduction to Cables and Cable Systems 1
- E15 Application of Dynamic Analysis for Seismic Design of Structures

Registration Inquiries and Requests/Suggestions:  
Contact: Shannon Remillong: [courses@seabc.ca](mailto:courses@seabc.ca)

## Breaking News

BC engineer and co-founder of Fast + Epp, Paul Fast has been chosen as IStructE's Gold Medallist for 2021. Paul has been recognized for his pioneering work developing wood and hybrid structures. Paul's Gold Medal address is scheduled for September in London.

Heartiest congratulations to Paul and his talented team!



*Paul Fast*

## CSA Award

Congratulations go to our 2021 Pinnacle Lecturer, Don Kennedy. Don has been awarded a 2021 Award of Merit by the CSA Group Standards Development Council. The Award of Merit is bestowed annually by CSA Group upon individual members for outstanding contributions and leadership in the development and advancement of voluntary standards.

As the chair of the Seismic Design Committee for the Canadian Highway Bridge Design Code, Don had been instrumental in introducing the performance-based design of bridges and has since been actively working to improve codification. The outcome has been to shift the code seismic design philosophy beyond simply life safety, to include performance objectives which assist emergency response and economic recovery. Don is particularly focusing on facilitating low-damage solutions which are discouraged by current code testing provisions.

Keep up the good work, Don!



*Don Kennedy*

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## Post-Disaster Building Assessment Guidelines for Communities



Andrew Seeton, P.Eng.  
SEABC Earthquake Resilience  
Committee

BC Housing is the Agency responsible to establish and lead the Building Damage Assessment Branch at the Provincial Emergency Coordination Centre during a catastrophic event. The scope of their role in this context includes all buildings in the province, not just BC Housing assets.

With this in mind, BC Housing has recently released "Post-Disaster Building Assessment Guidelines for Communities." The purpose of the document is to support local authorities (including municipalities, First Nations, and regional governments) in the development and operation of their own PDBA programs. The guidelines draw on the research that informed the British Columbia Post-Disaster Building Assessment Framework and Recommendations document, and provide direction and resources with regards to the following elements of PDBA programs:

- Bylaw and regulatory mechanisms for conducting PDBA
- Building assessment models and procedures
- Administrative and operational structures
- Strategies for pre- and post-PDBA operations
- Logistics, equipment, and communications
- Assessment teams
- Information and data management
- Training

The document provides insightful overview of the various components that feed into a successful PDBA

program and will be a foundational resource document from which communities can build their own programs in a unified and integrated manner.

SEABC members are encouraged to review the document to learn the context within which structural engineers may be able to assist in building damage assessments following a disaster such as earthquake or major flood event. The Province recognizes that the need for building assessors with structural engineering knowledge might exceed the availability of such assessors following a large event, and communities will need to depend on other skilled personnel to help rapidly assess non-complex buildings, some of whom will receive just-in-time training immediately following the event. In contrast, structural engineers would typically be deployed to assess more complex buildings and perform detailed engineering assessments to determine requirements for reoccupation, repairs, or demolition of buildings that are initially yellow- or red-tagged.

The guideline is a living document that will be updated over time in response to feedback from stakeholders. You are welcome to send your comments on the guideline to [ses@bchousing.org](mailto:ses@bchousing.org).

For more information, please visit:

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





## 2021 Pinnacle Lecture



David Harvey, P.Eng.  
SEABC President

This year's SEABC Pinnacle Lecture was delivered on-line to over 100 attendees on March 10, 2021. The Lecture was preceded by an announcement of the inaugural winners of the Peter Ridgway Taylor Grant for Structural Engineering Advancement and the SEABC Young Member Meritorious Achievement Award SEABC Legacy Awards by Adrian Gyax. This was followed by an update on the Certificate Program and announcement of the Mahmoud Rezai Memorial Award winners by program chair John Pao. The recipients had joined the on-line meeting and expressed their appreciation at being selected.

Don Kennedy then delivered the Pinnacle Lecture, entitled *Engineering and Human Factors in Forensic Analysis*, starting with the prominent failure during construction of the Florida International University Bridge.



*FIU Bridge on the Day of the Failure*

Rapid analysis of the concrete truss after collapse indicated very high interface shear stresses at the nodes but no particular attention to these on the preliminary drawings. This looked like an oversight by the designers, Figg Engineering, but at that time, it was not known if important details had been added at a later stage. Later investigations shown that that no real change had been made. When large cracks appeared indicating that a failure mechanism was present, Figg described the cracks as 'minor' and repairable. Admitting that the cracks were not

replicated by their analysis, it seems clear that Figg were on the wrong track and the lack of interface capacity was not apparent to them at the time. This is astonishing considering their vast track record of experience on signature bridges amassed by the firm over the past 30 years.

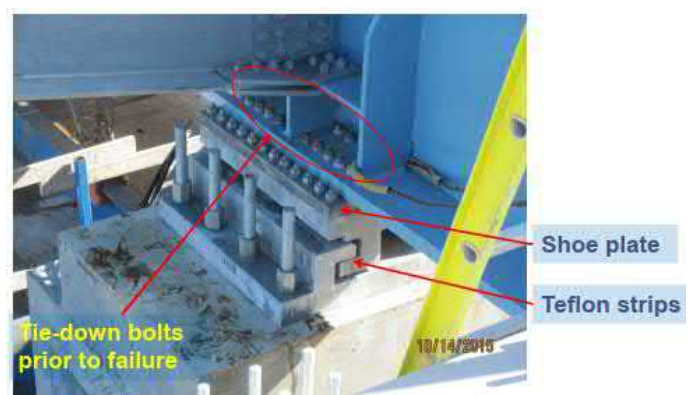


*Crack in FIU Bridge Node 11/12 Before Collapse*

Another key failing on the project was that the independent design review was too limited to be effective. The independent review consisted of global modelling rather than nodal detailing. The review was carried out by an analyst rather than an experienced designer and therefore added no value.

Don's in-depth analysis of this project summarized the failings and took us through many scenarios that could have averted the tragedy. He further explored human cognitive behaviour factors, dealing with risk and uncertainty, and lessons learned.

Don then moved on to the Nipigon River Bridge tie-down bearing failure, where fortunately, no injuries occurred. Here the bearing provided clearly lacked the articulation required by the design. Why was this so, and why was scant attention paid during project delivery to such a critical item?





*Original and Replacement Nipigon Tie-Down Bearings*

The failure calls into question the separation of the design teams from the construction process where critical continuity of knowledge is lost.

The 135W Minneapolis, Minnesota failure is atypical in that it occurred after decades of service life. In this case a nodal gusset plate in a continuous truss span had been under-designed but had sufficient capacity to avert failure. During deck rehabilitation work that preceded the failure, significant temporary construction loads had been added to the structure which caused the gusset plate to fail.

One key lesson from the 135W failure is that the bowed gusset plates at U10 indicated nodal displacements were taking place which precede failure. Despite being viewed by many parties, the significance of the bowed gusset plates was not perceived by anyone. Since the 135W failure, more attention is being paid to nodal gusset plates when inspecting and load rating truss bridges.



*135W Bowed U10 Gusset Plate*

The next failure Don mentioned was the Polcevera Viaduct, which collapsed after decades of service. Here the failure could well have been averted as deterioration on the concrete-encased cable stays had been reported. However, treatment under the maintenance program was insufficient to address the problem. Similar structures elsewhere had been closed or had had the cables replaced. Keeping this viaduct in service had tragic consequences.



*Polcevera Viaduct in 2010*

Although presentation time was short, interest remained high, and so borrowing an extra ten minutes, Don showed us spectacular, though happily non-tragic failures of the Arecibo Radio Antenna, the Albano Magra Bridge, and the Oroville Dam Spillway, all of which had interesting aspects to them. The bridge failure is unusual in that there is no clear trigger for the progressive collapse which occurred.



*Albano Magra Bridge – Post World War II*

On behalf of the attendees, David Harvey thanked Don for his interesting, thought-provoking lecture.



*Don Kennedy*

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## Mark Your Calendar

### Upcoming Seminars, Webinars and Events

#### Value By Design: Integrating Value Engineering and Sustainability for Construction Projects

**Date:** Thursday, June 10, 2021

**Time:** 8:45 AM-9:00 AM Pacific Time:

Registration/Login

9:00 AM-12:00 PM Pacific Time: Webinar

**Location:** Webinar

**For more info:** [egbc.ca/Events](http://egbc.ca/Events)

#### Geotechnical Earthquake Engineering

**Date:** Monday June 14, 2021 – Wednesday 16 June, 2021

**Time:** Login and Registration: 8:15 AM–8:30 AM Pacific Time

Online Course: 8:30 AM–4:30 PM Pacific Time

**Location:** Webinar, 18 seats available.

**For more info:** [egbc.ca/Events](http://egbc.ca/Events)

#### Responding to Microaggressions: Important Conversations

**Date:** Tuesday, June 22, 2021

**Time:** 11:45 AM–12:00 PM Pacific Time: Login  
12:00 PM–1:30 PM Pacific Time: Webinar

**Location:** Webinar

**For more info:** [egbc.ca/Events](http://egbc.ca/Events)

#### Business Development and Sales Skills for Engineers and Geoscientists - Kison Professional Selling Skills Program

**Date:** Friday, July 2, 2021- Thursday, September 30, 2021

**Time:** Registrants will be granted access to the program on Friday, July 2, 2021 at 10:00 AM Pacific Time to Thursday, September 30, 2021.

##### Monthly Webinars

Wednesday, July 21, 2021 from 10:00 AM–11:30 AM Pacific Time

Wednesday, August 18, 2021 from 10:00 AM–11:30 AM Pacific Time

Wednesday, September 15, 2021 from 10:00 AM–11:30 AM Pacific Time

**Location:** Webinar, 32 seats available

**For more info:** [egbc.ca/Events](http://egbc.ca/Events)

#### Interview Preparation: How to Effectively Convey Your Value

**Date:** Tuesday, July 6, 2021

**Time:** 11:45 AM–12:00 PM Pacific Time:  
Registration/Login

12:00 PM–1:00 PM Pacific Time: Webinar

**Location:** Webinar, 269 seats available

**For more info:** [egbc.ca/Events](http://egbc.ca/Events)



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# 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](http://www.seabc.ca).

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

- Committee Chair: David Harvey
- Newsletter Editor: Catherine Porter
- Editorial Assistant: Mark Budd
- 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](mailto: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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