CONNECTIONS

May 2020 Volume 20 Issue 6

Newsletter of the Structural Engineers Association of Oregon

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SEAO has a twitter account and can be followed at @SEAOregon.

Upcoming SEAO Meetings and Events:

Tuesday, May 5, 2020: Joint SEI/NCSEA/CASE Virtual Presentation

Location: On-line via Constant Contact
Time: 11:30 am to 1:00 pm
Cost: Free
PDH: 1 PDH Recommended
See Page 3 for more information.

Thursday, September 17—18, 2020: SEA NW Conference 2020

Location: The Westin Hotel, Seattle, WA
Save the dates.
Registration will open soon. Visit https://www.seaw.org/seanwconference for more information.

Wednesday, September 30, 2020: SEAO Excellence in Structural Engineer Awards Banquet

Save the date.
See pages 9, 11 and 12 for additional information and entry forms.
Deadline for submission is June 30, 2020.

Tuesday, November 3—6, 2020: NCSEA Structural Engineering Summit

Location: MGM Grand, Las Vegas, NV
Save the dates.
Registration will open soon.
Visit http://www.ncsea.com/events/annualconference/ for more information.

CONNECTIONS is a monthly publication of the Structural Engineers Association of Oregon, published to disseminate current news to our membership and others involved in the profession of structural engineering. The opinions expressed reflect those of the author and, except where noted, do not represent a position of SEAO.

Send membership inquiries to:

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PRESIDENT'S MESSAGE

By: Steve Trautwein, P.E., S.E.

Welcome to May, or week seven of COVID Shelter in Place. First and foremost, I hope that you are all safe and healthy and able to minimize your exposure to this deadly virus. These last two months have been truly life changing for us all, both personally and professionally. I expect that most of you are hunkered down and settled in to your home office and a new way of doing work. This new situation has brought difficulties ranging from inconveniences to tragedies. I hope that all of you are in the inconvenience range of that spectrum, and that we stay there throughout this experience. This situation also brings some silver linings. Myself, I have found a better work-life balance, spending more time with my family. There are renewed connections with old friends and family, and I have a new perspective on the fragility of life which has resulted in a heightened appreciation for what I have. I hope you all have found some of these silver linings as well.

One of the unfortunate effects of the Shelter in Place is the cancellation of all of our live meetings and seminars. While we were looking for options to conduct an online event for our April Membership Meeting, we were unsuccessful in pulling it together. Some SEAs around the country took advantage of NCSEA's offer of two free webinars and used those as their online meetings for April and/or May. SEAO chose to make those webinars available to all of our members to be viewed at their convenience. See the Free NCSEA Webinars notice in this Newsletter for more information. May's meeting will be a joint online meeting with SEI, and our next regular meeting will be in September. I am optimistic that things will have returned to normal by then, or at least the new normal, and we will be able to hold that as a live event.

The new normal. As we're heading into the third month of our Shelter in Place, there are signs that the COVID threat is decreasing, and there is much anticipation of lifting restrictions. Firms and individuals are trying to figure out what the new normal will be. I anticipate a greater portion of our engineering workforce working out of their homes than did before. While I have enjoyed the flexibility and benefits of working from home, I miss the face-to-face interactions and am looking forward to returning to the office. Some of us will decide they like working from home and want to make that a permanent change. Some may decide, hey, if I'm working remotely, why don't I do it from Banff or Mazatlán instead of rainy Oregon?

As supervisors and employers, having more remote workers will present a challenge, but one that I believe we should embrace and work together to make possible. Not everybody can do it, but some percentage of our workforce should be able to work remotely. As employees, recognize that there are pros and cons to your firm for allowing people to work remotely. Pros include higher morale due to work flexibility, location choice, and better work-life balance, and reduced facilities costs. Cons include possible reduction in efficiency, less effective collaboration, and travel costs for when the person does need to physically be there. If this is something you want to do, recognize the impact to your employer and to the team remaining in the office, and work together to minimize the impacts. Even before COVID, I saw this move to more remote workers as a coming trend, with our younger workforce placing higher value on work-life balance. COVID accelerates this. I think it's a good thing overall.

(Continued on Page 4)

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SEI/NCSEA/CASE JOINT VIRTUAL PRESENTATION
JOINT VISION FOR THE FUTURE OF STRUCTURAL ENGINEERING
TUESDAY, MAY 5, 2020

Presented By: Glenn Bell, SEI President

Description: In 2019 SEI, NCSEA, and CASE jointly prepared and adopted a Joint Vision for the Future of Structural Engineering, and the three organizations have been collaborating to pursue that vision. SEI President Glenn Bell will provide an update on various important and exciting initiatives underway including advancements in performance-based design, case studies recently processed from Confidential Reporting on Structural Safety – US, and the SE 2050 embodied carbon reduction initiative. Glenn will also lead a town-hall type discussion with participants on advancing the profession from local and national perspectives.

Speaker: Glenn Bell recently retired from Simpson Gumpertz and Heger after 45 years, 22 of which as CEO, to devote himself full time to professional service. He is 2019-2020 President of the Structural Engineering Institute of ASCE, Co-director of CROSS-US, Board Member of the Charles Pankow Foundation, External Assessment Panel Member for the Center for Risk Based Community Resilience Planning at Colorado State University, and Galletly-Dickson Visiting Scholar at the University of Bath in the UK.

Date: Tuesday, May 5, 2020

Sign-up: http://events.constantcontact.com/register/event?llr=uz6jdqkab&oeidk=a07eh1lnsa5cf657f61

Time: 11:30 am—1:00 pm

Cost: Free

PDH Credit: 1 PDH is recommended

Questions: Contact Jane Ellsworth at jane@seao.org

PRESIDENT'S MESSAGE (CONT. FROM PAGE 2)

BY: STEVE TRAUTWEIN, P.E., S.E.

The other aspect of returning to the office is safety. Restrictions may be lifted before you personally feel comfortable returning to a higher exposure environment. If you don't feel safe returning to work, or if you don't feel safe conducting a site visit, please listen to your gut. Use your PPE, don't take shortcuts, don't return to normal too fast.

Again, I hope we all make it through this unprecedented challenge feeling inconvenienced, even financially impacted, but not affected by personal tragedy. I hope the tragedies we experience come from the news, or word of a friend of a friend. Please stay safe. I look forward to seeing you again on the other side.

FREE NCSEA WEBINARS

With the Shelter in Place order, most if not all traditional continuing education opportunities have been cancelled or postponed. Knowing that Structural Engineers still need to maintain their training, NCSEA is offering SEAO members **two free recorded webinars** *(normally $250 each)* from their library.

- The first is by *Kim Olson, P.E.* **How the AISC 360-16 Chapter K Changes Affect HSS Design** covers the background for the changes to AISC 360-16 Chapter K, an overview of the updates, and illustrate that the differences are not as extreme as it appears at first glance. To access this webinar, please click here: https://vimeo.com/398607433 using the password: FREEWEBINAR
- The second is **Post-Tensioning Concepts, Repair, Modifications & Evaluation of Existing PT Structures** by *Nate Poen*. T his presentation will discuss the evolution of these changes, the problems they created, repair strategies and the long-term solutions provided by the new encapsulated post-tensioned systems that are used today. It can be accessed here: https://vimeo.com/398609811, also using the password: FREEWEBINAR

These webinars are also available here: www.ncsea.com/memberperks.

Both webinars award 1.5 hours of Diamond-Reviewed Continuing Education after passing a quiz. Once the webinars have been viewed, the participants may login to their accounts on NCSEA's Education Portal to take the quiz and receive their continuing education credit. Use the attendance code: 7b0RaKhy for **How the AISC 360-16 Chapter K Changes Affect HSS Design**, and 8RPo8a8N for is **Post-Tensioning Concepts, Repair, Modifications & Evaluation of Existing PT Structures**. If you have any questions, please email ncsea@ncsea.com

UPCOMING SEAO ELECTIONS

Elections for the SEAO Board of Directors are coming at the end of May. Typically, at our April Members Meeting, we will form a nominating committee to identify candidates. With our April meeting cancelled due to COVID, we will instead ask for volunteers, and the current Board will appoint a nominating committee from the pool of volunteers.

The nominating committee will be chaired by our Past President, Norm Farris. Note that as a nominating committee member, you are not eligible to stand for election, so if you want to help, but don't want to commit to a Board position, this is a great way to do so. If you are interested, please notify Jane Ellsworth by COB Friday, May 8, 2020.

If you are interested in running for a position, you can self-nominate. Open positions are President (although traditionally the current VP is our sole candidate for President), Vice President, Secretary, Treasurer (two-year position), and Director at Large (two-year position). If you are interested in running, please notify Norm Farris by Friday, May 22.

Elections will be held by electronic ballot at the end of May. The term of office is from September 2020 through September 2021. If you have any questions about the duties of the Board, please feel free to reach out to any of the current Board members or Jane Ellsworth. We look forward to having a new crop of enthusiastic Board members!

A BRIEF HISTORY OF PT

By: Rick Fine, SE PE

The following opinion is being provided by an individual member in the industry for information only, and these contents do not necessarily represent the opinions of SEAO; its members, board, or committees. This article shall be interpreted at the reader's discretion. For additional information, clarification, or details, the author of this article can be reached via email at rick@fineengineering.com.

Historically, mid-seventies to mid-eighties, unbonded post-tensioned concrete design was often done by post tensioning supply companies either as value engineering or deferred submittal. It was initially done with moment redistribution on slide rules, then hand calculators. The post-tensioning materials were proprietary systems and had differences in sheathing types, anchorage devices, and stressing equipment. Some were still using 'Stress-Relieved' strand and some were using 'Low-Lax' strand. All of this played into the "complexity" of unbonded prestressed concrete design.

For these reasons and others, many design engineers were not comfortable specifying one system, so they either designed a mild reinforced system with a value engineering option or used a deferred submittal process. By the mid-1980's the major suppliers had all gone to extruded sheathing of tendons, and the friction and loss coefficient assumptions had become uniform among the suppliers. Consulting engineers began to do more designs in-house. During this same period, computer software was developing. This made the number crunching less laborious and the designs more efficient since the designer could try alternate profiles/ tendon quantities a little more easily.

Also, at this time, it was common to specify the post-tensioning by showing the required tendon forces on the structural drawings. This force was the average force over the length of the tendon. As long as certain parameters were met, this was a reasonable technique. Especially considering that pretty much no one was doing any friction calculations other than assuming a "lump sum" loss that included seating loss, friction, and long-term losses. These calculations were tedious--even on a hand calculator let alone a slide rule.

> A quick primer for this assumption : jacking stress 80% Fpu = 216 ksi.
>
> After seating & friction loss @70% Fpu = 189 ksi & Long Term loss @14 ksi.
>
> Final effective force = 189 – 14 = 175 ksi or 26.8 kips per tendon. (As = 0.153 in^2)

This value was and is used throughout the PT industry when calculating the actual number of tendons required during shop drawing creation.

The ACI 318-11 code commentary (R18.6.1 states, "Lump sum values of prestress losses for pre-tensioned and post-tensioned members that were indicated before the 1983 commentary are considered obsolete." ACI 318 has recommended against using lump sum losses since the 1985 edition, although the current ACI 318-14 has revised those comments but gives references for techniques to calculate friction and long-term losses. I believe they expect engineers to take advantage of the modern software analysis capabilities. Here in lies the problem--a large number are not. Even though they are using the appropriate software, the 'lump sum' method is still used and 175 ksi is assumed all along the tendons. It has become standard practice to require the PT supplier to supply Friction/Loss calculations.

ACI 318-14 20.3.2.6.1 "Prestress losses shall be considered in the calculation of the effective tensile stress in the prestressed reinforcement, f_{se}, and shall include . . ."

This long-winded introduction finally brings me to my primary topic. Since the mid-1990's, the PT design software has become much more sophisticated (as well as the hardware) and can easily do the seating loss and friction calculations.

This has long been a pet peeve of mine for the following reasons.

Point 1: Industry non-secret one, ***ALL*** the tendon elongations are calculated based upon the assumed value of 189 ksi. (The assumed tendon stress prior to long term losses.) This is a non-secret because it is always on the first sheet of the PT shop drawings. Typically Δ= 0.081 inches per foot.

This is from $\Delta = \sigma L/AE$, where σ = 189 ksi, L=12 in., A = 0.153 in^2, E = 28,000 ksi (some use E=28,500).

Point 2: Industry non-secret two, ***ALL*** the tendon quantities on the shop drawings have been done based upon the magic number 26.8 kips per tendon. The friction calculations they submit are rarely used to calculate tendon quantities.

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A BRIEF HISTORY OF PT (CONT. FROM PAGE 5)

By: Rick Fine, SE PE

Point 3: The use of PT forces also contains ambiguities. Where along the tendon is this magic force supposed to be taken? Or is it the average force? (This is the value used historically.) If it is specified that it must be at ANY point along the tendon then, if one point falls below the specified value, additional tendons must be added. This may well overstress/overbalance spans closer to the stressing end. (The same ACI commentary section says, "…overestimation of prestress losses can be almost as detrimental as underestimation, since the former can result in excessive camber and horizontal movement.") In one case I am familiar with, the tendon was 2% low in only one span, adding the required tendons to meet the required force increased the effective force in the span adjacent to the stressing end to 18% above the specified force. This also indicates why the friction losses need to be considered during design.

Point 4: Another problem with force specifications is that the actual number of tendons is not explicit. What is the magic number? 26.8? 27.0? 26.6? In my years as head of a PT detailing department we always used 26.8 kips. But the problem is the round off. 273 kips is 10.19 tendons, 274 kips is 10.22 tendons. Our policy was that we would provide 10 tendons in the first case and 11 tendons in the second case. This may not seem like a big deal, but in a very competitive industry (believe me the PT supply industry is fiercely competitive), it can mean the difference between winning or losing a bid. Also, when you have multiple banded tendons on multiple floors, it can make a difference. This can be even more important for the distributed tendons where the force is highly variable and there are multiple levels; round off can be a significant quantity of tendons. So, is it reasonable to expect the PT estimator to figure all of this out during a take-off for a competitive bid? I was speaking to an estimator recently, and she said she had to get back to her "free engineering". Few of us like working for free.

Point 5: These calculations need to be done by the design engineer. The required number of tendons needs to be specified on the structural plans. The actual effective force has a direct effect on the nominal flexural capacity and tensile stresses in the concrete. Due to the friction losses, this force varies along the tendon. It also affects the balance loading which in turn reflects in the deflections of the member. In my view the design engineer hasn't completed his design unless these calculations have been completed. The shop drawing detailers are excellent interpreters of structural drawings, but they are not engineers. They don't know anything about the design loads, member deflections, or member stresses. They are only familiar with the code sections that directly affect the shop drawings. Why are they being asked to do part of the structural engineer's job?

Point 6: The other issue with the PT shop drawings is the requirement for a PE stamp. This is also directly related to the specification of forces. The definition of "Engineering" is met when the forces are used to calculate the number of tendons required. In the current design software, the tendons are laid out during the modeling. If these quantities are transferred to the design drawings, there is NO engineering required during the shop drawing creation. Thus NO PE stamp would be required, but I believe all jurisdictions currently still require stamping even when tendon quantities are specified.

In a more perfect world, all design engineers should specify tendon quantities. I believe PT designs would be easier to take-off for bidding, easier for the supplier to detail, and easier for the engineer to check the shop drawings, eliminating the need for PT suppliers to have a PE stamp on their shop drawings.

See pages 13—15 of this newsletter for PTI Technical Notes Issue 17, dated November 2013, providing additional information on specifying PT for buildings, provided by Rick Fine for your information and consideration. You can also visit PTI's website at https://www.post-tensioning.org/education/publications/faqstechnotes.aspx for additional free publications on PT design.

COVID-19 UPDATE

By: Steve Trautwein, P.E., S.E.

On April 2nd, I sent an email message to the membership addressing SEAO's informal position on the COVID-19 situation in Oregon. A copy of that message is included below. Shortly after that, both SEAOC and NCSEA issued formal position statements. I wanted to share these with you to provide a perspective of what is happening around the country.

The Shelter in Place executive order issued by California's Governor provided more language regarding construction, and also placed higher restrictions on travel, so SEAOC's position statement addressed this issue more directly. Specifically, their stated position is that Structural Engineers "provide essential services in maintaining critical infrastructure; provide professional services required to support legally-mandated construction activities; and are mandated by licensure and ethics to safeguard life, health, property and public welfare." SEAOC's position statement: https://cdn.ymaws.com/www.seaoc.org/resource/resmgr/files/seaoc_position_on_covid-19.pdf

NCSEA issued a similar statement: "Structural Engineers provide essential services in support of permitted ongoing construction activities, maintenance of buildings and infrastructure, and design of projects deemed to be critical. Structural engineers are bound by licensure laws, ethics, building codes, and other regulations to protect the safety of the public, regardless of the circumstances. Structural engineers and their firms should consider how to provide these essential services while complying fully with all applicable safety regulations and other legal mandates." NCSEA's position statement: http://www.ncsea.com/topics/covid19/

Reprint of April 2, 2020 email, SEAO's Response to COVID-19:

These last few weeks have seen the COVID-19 pandemic escalate exponentially in Oregon, the US, and the world. While our highest concerns lie with the health and safety of our families, it's impossible to not recognize the impacts on the Structural Engineering community. In particular, we face unprecedented challenges as the vast majority of us learn to work from home. Firms and individuals are experiencing productivity losses, schedule impacts, potential increased exposure to liability, and uncertainty with respect to how to support construction observation efforts. While SEAO is explicitly not offering legal advice, we do want to provide some guidance to the Structural community as together we navigate these uncharted waters.

Oregon's Executive Order 20 12 and Site Observations

Oregon's Shelter in Place order does not specifically address construction. It does include verbiage like "…to the maximum extent possible, (it is essential that) individuals stay at home…" (paragraph 1) and "…all businesses…shall facilitate telework and work-at-home…to the maximum extent possible" (paragraph 9). The closest we get to addressing construction efforts is in paragraph 10, "When telework and work-from-home are not available, businesses must designate an employee or officer to establish, implement, and enforce social distancing policies…". Such policies also must address how the business will maintain social distancing protocols for business-critical visitors. One way to interpret this would be to treat the Structural Engineer making a site visit as a "business-critical visitor", who then falls under the social distancing policies that are required to be established by the contractor and/or owner. Based on published guidelines from AGC (see below) and reports of others, it appears that appointing Social Distancing Officers and developing these protocols may become the common practice in at least parts of Oregon and the US.

Standard of Care

Much of what we do as Structural Engineers is evaluated in comparison to the nebulous "applicable standard of care", which is often defined with language like "the standard of skill and care generally exercised by other similarly licensed Structural Engineers in the same or similar locale acting under the same or similar circumstances and conditions around the same time." With COVID-19, we're in uncharted territory--we have not yet established what we do in these new circumstances and conditions. There are many thoughts on how to approach this. Is it prudent to continue to make site visits to support construction, as long as physical-distancing guidelines are met? Do you have legal grounds to refuse to make site visits if you feel unsafe? Is it responsible to conduct your site observation remotely, with a contractor showing you field conditions via video? As a community, we're still wrestling with these questions. The answers we come up with as an industry may shape the new standard of care as it evolves to incorporate life in a COVID environment.

Legal Matters

SEAO has connected with attorney Lee Wagner of the law firm Stewart Sokol & Larkin about some of the issues that the engineering community should consider during the COVID-19 pandemic. Lee has graciously provided the attached letter, "Risk Management for Engineering Firms in a COVID-19 Environment". He provides some excellent tips to

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COVID-19 UPDATE (CONT. FROM PAGE 7)

BY: STEVE TRAUTWEIN, P.E., S.E.

help mitigate risks you may be facing in these challenging times. I encourage you to read his letter and reach out to your own legal counsel if you have further questions.

Other Resources

The Oregon chapter of the Associated General Contractors (AGC) have issued some specific guidelines to their members. See their general COVID page here: https://www.agc-oregon.org/industry-priorities/covid-safety-health/ and their specific recommendations for the construction industry in Oregon here: https://www.agc-oregon.org/wp-content/uploads/2020/03/COVID-19-Executive-Order-No-20-12.pdf. The Oregon Home Builders Association (HBA) has published their guidelines here: https://oregonhba.com/wp-content/uploads/2020/03/COVID-19-Job-Site-Practices_final-1.pdf. The Oregon American Institute of Architects has summarized a list of resources here: https://www.aiaoregon.org/covid-19. Finally, the professional liability insurance company Berkley Design Professionals has published a useful article, "Mitigating Claims from COVID-19 Affected Services," which can be found here: https://files.constantcontact.com/7f1ae45c001/639f12bd-f759-4219-8b70-9f842a7f261d.pdf.

Going Forward

These are indeed challenging times for us both personally and professionally. As the Pandemic continues and the situation evolves, we will continue to monitor the situation and provide updates as appropriate. We also invite you to share your own experiences and findings with our community, either by emailing me at steve.trautwein@jacobs.com, or writing a letter to editor for the Connections Newsletter at jomarie@equilibriumllc.com. Be safe out there, look after your family and co-workers, and as my wife likes to say, "Be Corona-Careful!"

Best Regards,

Steve Trautwein, PE, SE
President, Structural Engineers Association of Oregon

Disclaimer

The information above is for general informational purposes only and should not be construed as legal advice in any form. Please consult with your attorney for legal advice for your specific situation.

NEW MEMBERS

Welcome to our new Members!

February
Kolby Sniff, Corbin Consulting
Jennifer Link-Raschko, US Gypsum
Neil Antonini, Antonini Sales

March
Noa Yates, Holmes Structures
Rainier Mackay, Holmes Structures
Leandro Pimenta, Holmes Structures
Alexander Daddow, Simpson Strong-Tie
Ghassem Khosrownia, USACE
Craig Hamilton, Zinkpower

WELCOME TO SEAO!

SEI STRUCTURES CONGRESS 2021 CALLS FOR ABSTRACTS & SESSIONS

SEI invites abstracts and sessions on topics of interest to structural engineers at every level of their career. Emphasis is on presentations that support advancing the structural engineering profession including leadership development, innovation and novel project solutions, emerging technologies, resilience, sustainability, functional recovery, Global Climate Change, and innovative research with practical applications. Implementation of these topics to the full life-cycle of structures including design, analysis, fabrications, construction, testing and maintenance welcomed.

SUBMISSION DUE DATE: JUNE 3, 2020, 11 P.M. ET

For more information, visit the SEI webpage at https://www.structurescongress.org/program/call-proposals?utm_campaign=2020.03.11%2520Structures%2520Congress%25202021%2520CFP%2520CORRECTION&utm_medium=email&utm_source=Eloqua

2020 SEAO AWARDS

SAVE THE DATE
This year's Excellence in Structural Engineering Awards will take place at the September dinner meeting on September 30, 2020. Projects will be judged on innovative design, engineering achievement, and creativity.

Awards will be presented in the following categories:

- New Buildings Under $20 Million
- New Buildings Over $20 Million
- Renovation/Retrofit
- Special Use Structures

We have raised the threshold for the construction cost of projects to better reflect the current market for construction and the intent of the awards for project size.

Applications are available on the SEAO website and also on pages 11 and 12 of this newsletter. Start thinking about what projects you may want to submit. It is not required that the project be in Oregon—only that it is submitted by an SEAO member. Submissions are due by June 30, 2020.

Want to get involved? The Awards Committee is looking for new members. Email Brynn Adkins at badkins@tmrippey.com.

SEAO/OACI GOLF TOURNAMENT

The 2020 golf tournament has been cancelled, but will return in the summer of 2021.

WEBSITE UPDATE

SEAO's new website is up and running. It is more user-friendly and up-to-date.

One new feature is each member's ability to track their PDHs and upload PDH certificates to their personal profiles (even for non-SEAO PDHs).

Check it out at seao.org.

ASK A QUESTION, GET AN ANSWER

Do you have a code question you would like to ask the Wind Committee or Snow Committee? SEAO is pleased to announce a simple way for Q&A's with technical committees. Email questions to jane@seao.org, and SEAO will direct your question to the appropriate committee chair for a response. Questions and their answers will be made anonymous and available to the membership on the website www.seao.org.

Committees include: Seismic, Wind, Snow, Code, Vintage Building, and Special Inspections.

SE REFRESHER & EXAM REVIEW COURSE
On-Line & On-Demand

NCSEA's SE Review Course is completely on-demand. Review course materials and watch the recordings when it is convenient for you for an entire year. Plus, attendees have access to virtual classroom to ask the instructors questions whenever they arise. The NCEES PE Structural Exam Prep Course allows you to study at your own pace but with instant access to the material and instructors. All lectures are up-to-date on the most current codes.

The Virtual Classroom provides you an on-line chat room for course discussion with all the instructors and the students. In addition, students can email instructors directly with questions.

The Course includes:

- 30 Hours of Instruction (8 Vertical Sessions + 10 Lateral Sessions)
- Exam Preparation Tips
- Problem-Solving Skills to Pass the Exam
- Handouts & Quizzes
- The Virtual Classroom
- Exam Study Guide

Cost for NCSEA/SEAO Members: $495
Non-Members: $695
Group rates: See http://www.ncsea.com/education/sereview/

EMPLOYMENT OPPORTUNITIES

HOLMES STRUCTURES

Project Engineers
San Francisco and Los Angeles, CA &
Portland, OR

We're an energetic group of creative and savvy structural engineers. We believe a welcoming workplace fostering collaboration and initiative brings out your best.

Holmes Structures is a California structural engineering firm, with offices in San Francisco, Los Angeles, and Portland. We are always looking for great talent. So if you are a person who pushes the boundaries — in your achievements, interests, and abilities — then we want you as part of our energetic and collaborative teams.

Interested in joining us? Reach out! Send your resume and cover letter to hr@holmesstructures.com.

Harper Houf Peterson Righellis (HHPR)

Structural Engineer
Portland, OR

HHPR is seeking an experienced Structural Engineer with 5 or more years of structural design experience for our Portland, Oregon office. This candidate will be highly attentive to detail and have excellent communication and organizational skills. We value and respect the creativity and input of our employees and have the honor of being recognized both in Oregon and nationally as a "Best Firm to Work For". If you are interested in working locally in a team environment, can respond effectively to multiple deadlines, and are eager to produce great work, visit our website at www.hhpr.com for additional information.

HHPR offers a competitive compensation, excellent benefits, including 401(K) Retirement plan, health and dental paid by HHPR for the employee and dependents, disability, life insurance, vacation, and sick benefits with an opportunity for company stock ownership.

Please send your resumes and cover letter to employment@hhpr.com.

MD STRUCTURAL ENGINEERING, INC.

Structural Engineer
Vancouver, WA

Our office provides designs for a wide range of projects: multi-family, large single family residential, office/retail, curtain wall systems, and earth retaining structures. MDS prides itself on customer service and providing cost effective and elegant solutions for all projects. We are currently seeking an enthusiastic professional engineer who is passionate about structural engineering and continued growth in the field. Position requirements:

- PE licensure in OR or WA with aspirations of attaining SE licensure
- Practical experience designing projects using wood, steel, concrete, and other construction materials in combination with current building codes
- An understanding and practical design experience with both gravity and lateral loads systems in all structures
- communication and customer service skills
- Experience in AutoCAD
- Experience designing aluminum storefront and curtain wall systems.

Send resumes to barbara@mdstructural.com.

STRUCTURAL ENGINEERS ASSOCIATION OF OREGON
9220 SW Barbur Blvd, #119, PMB #336, Portland, OR 97219
503.753.3075
www.seao.org E-mail: jane@seao.org

2020 Excellence in Structural Engineering Awards

The Structural Engineers Association of Oregon (SEAO) Excellence in Structural Engineering Awards was created to acknowledge outstanding projects and structural engineering advancement by members. The **sixth** annual SEAO Awards will be recognized as a part of the **Wednesday, September 30, 2020** dinner meeting and awards ceremony.

Eligibility Requirements:

1. Project must have completed construction during the calendar year of 2**019 or 2020**.
2. At least one member of the design team, research team, or a principal of the firm responsible for entry must be a member of SEAO.
3. Entries may be of any size, type, and location **in the world**.
4. Projects may be submitted into one category only.
5. Each company may submit up to two projects per category (8 projects total).

SEAO Judging Criteria:

Projects will be judged by a panel of invited judges from multiple fields related to design and construction based on the following criteria:

1. Creativity of structural design
2. Complexity of design criteria
3. Ingenuity of design for efficient use of materials and construction
4. Fulfillment of client's / owner's needs or expectations
5. Suitability of the structure for its environment

Entry Instructions:

All entries must include the following:

1. Completed entry form on following page, including signature. Please enter all information as they would appear on an award.
2. Project Summary:
   a. A written summary of the project emphasizing any outstanding accomplishments achieved and hurdles overcome during the course of the project's duration.
   b. Two pages of text maximum, (10.5 point font minimum, 1.5 line spacing), plus one optional additional page for photos and figures at the end of the summary. Architectural renderings will not be considered and should not be included with the summary. Figures showing structural analysis or structural drafting models and details (Revit, AutoCAD, etc.) are allowed.
   c. Summary must not include names of participating firms or project team members to allow for impartial judging. Any included names will be removed prior to judging.
   d. Do not include any confidential or sensitive information.
3. Provide up to 15 photos (per project entry). If entry is mailed, provide a separate CD/Flash drive with all photos and figures. If entry is emailed, provide a separate Zip file attachment of .jpg images. Renderings will **not** be considered.
4. $1**25** Entry Fee (per entry). Please make checks payable to SEAO and mail check as noted at bottom of entry form.
5. Multiple entries may be mailed together (and paid by single check). Refer to entry form for mailing address. If entries are emailed, send each entry in a separate email to the email address provided at the bottom of the entry form.
6. All entries shall become the sole property of SEAO. SEAO reserves the right to use or publish some or all entry material in publications. By entering, the Entrant grants a royalty-free license to SEAO to use any copyrighted material submitted. Such right includes publication of photographs and names of award recipients without compensation to Entrants.
7. **Submissions must be post-marked or emailed by June 30, 2020.**

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2020 Excellence in Structural Engineering Award Entry Form

Project Information:

Project Name: _____

This project is to be judged under the following category (select **one**):

- ☐ New Buildings Under $20M
- ☐ New Buildings Over $20M
- ☐ Renovation / Retrofit
- ☐ Special Use Structures

**Note: The SEAO Awards Committee reserves the right to transfer projects into a different category as it sees fit*

Project Location: City: _____ State: _____

Total Construction Budget: _____ Completion Date: _____

Entering Firm: (contact must be a current member of SEAO)

Please complete all sections of the form below. This information may be used for publicity purposes.

Firm Name: _____

Address: _____

City: _____ State: _____ Zip: _____

SEAO Contact Name: _____

Contact Email: _____ Phone: _____

By signing below, I accept responsibility for any issues regarding project confidentiality agreements.

→ **Signature:** _____

Involved Entities:

Owner/Developer: _____

General Contractor: _____

Architectural Firm: _____

Geotechnical Firm: _____

Civil Firm: _____

MEP Firm: _____

Other: _____ Role: _____

Submission Checklist:

- ☐ Entry Form
- ☐ Project Summary (see entry instructions)
- ☐ CD/flash drive for mailed entries or separate email attachment w/up to 15 photos/images
- ☐ Check for $125 per entry made payable to SEAO

Mail all materials to:
SEAO Awards
Structural Engineers Association of Oregon
9220 SW Barbur Blvd, #119, PMB #336
Portland, OR 97219
Or Email all materials (10 MB maximum per email) to:
seao.excellence.awards@gmail.com

Submissions Must Be Post-Marked or Emailed By June 30, 2020

pti Technical Notes

From the PTI DC-70 Special Topics Committee *Issue 17 • November 2013*

Specifying Post-Tensioning Requirements for Buildings: Force or Number of Tendons?

By DC-70, The Special Topics Committee of the Post-Tensioning Institute

At some point in the design of every post-tensioned concrete member, the licensed design professional (LDP) must determine the prestressing forces required in the member to satisfy code requirements. This prestressing force is calculated after all initial and long-term losses have been accounted for and is commonly referred to as the Final Effective Force (FEF). The FEF and the tendon profile are the two most important design parameters in post-tensioned members. The FEF and the tendon profile determine the flexural stresses under service loads. Using appropriate code equations and unbonded tendons, the prestressing force at nominal strength is a function of the FEF. There are several ways to assure that the FEF in the structure is achieved, depending on the size and strength of the prestressing steel installed.

Over the years, various prestressing steels have been used, including seven-wire strand with several different diameters, stress-relieved and low-relaxation, with strengths of 250 and 270 ksi (1723 and 1862 MPa); 1/4 in. (6 mm) diameter wires with a strength of 240 ksi (1655 MPa); and high-strength bars with varying strengths and diameters. Each type of steel can have unique friction and long-term loss properties. Today, the prestressing steel used in most buildings in the United States is 1/2 in. (13 mm) diameter, 270 ksi (1862 MPa), low-relaxation, seven-wire strand conforming to ASTM A416/A416M.

When stressed from one end only, friction along the tendon reduces the force applied by the jack to a smaller force at the fixed end. For normal-length tendons, once the jack is released and the wedges are seated, the force in the tendon reduces at the stressing end, increases to the stress acting at the wedge seating influence distance, and then decreases further to the fixed end. This assumes a bilinear force distribution from the stressing to the fixed end. For short tendons, where the wedge seating influence distance is greater than the distance between anchorages, the force at the stressing end is reduced when the jack is released and the wedges are seated and then increases to the force at the fixed end. In a tendon stressed from both ends, the lowest tendon force normally occurs near the middle of the tendon length. It has been commonly assumed that, with time, this force eventually redistributes over the length of the tendon, resulting in a constant "average" force along the entire tendon length. Most post-tensioned buildings in the United States have been designed with this "constant force" assumption. Whether the redistribution actually occurs has been debated and the possible resulting ramifications have been studied.[1]

This document will highlight the three most common methods used by LDPs to specify the FEF requirements in contract documents. These methods are:

1. Specifying the minimum required FEF after all friction and long term losses have occurred (usually expressed in terms of kips or kips per foot).
2. Specifying the number of tendons of a particular size ***and*** strength and the FEF per tendon assumed in the design.
3. Specifying ***only*** the number of tendons of a particular size and strength with no mention of effective force per tendon.

While all three methods are used, they involve significant differences in responsibility assumed by LDPs and post-tensioning (PT) suppliers. LDPs and PT suppliers should be aware of and clearly understand these different options. The benefits and limitations of each method are discussed below.

METHOD 1: SPECIFY FEF

In this method, the LDP specified in the contract documents only the minimum required FEF, the tendon profile assumed in the design, the location of any closure strips assumed in the design, and whether the design was based on a constant-force method or a variable-force method.* The selection of number and size of tendons required to furnish the required FEF with the specified profile is assigned to the PT supplier. The PT supplier, using the unique known material properties of their selected post-tensioning system, along with the contractor's preferred sequence of construction and construction joint locations, determines the number of tendons required to satisfy the design—that is, to furnish the required FEF shown on the contract documents. This involves the calculation, ***by the PT supplier,*** of all friction losses, initial losses, long-term losses, the FEF in each tendon, and the total number of tendons required to satisfy the design.

All of this is shown by the PT supplier on the PT instal-

*If no information about constant or variable force design methods appears in the contract documents, it is standard practice to assume that the design was based on the more commonly used constant force method.

lation drawings and calculations, which are usually submitted to the LDP for review. Generally, the total required FEF specified in contract documents in a particular member or length of slab is not an exact multiple of the calculated FEF per tendon. Rounding, either up or down, is then required on the part of the PT supplier. The LDP should establish rules for such rounding, and include them in the contract documents. A general discussion on rounding, including some general guidance, is included at the end of this document.

In this method, the ***PT supplier***, not the LDP, has the responsibility for accurately calculating losses in accordance with the standard of care for post-tensioning loss calculations.

Advantages of the FEF method (Method 1) are:

- It does not exclude any size or type of tendon;
- It places the responsibility for calculating losses in the hands of the PT supplier, who is most familiar with loss calculations in general, and for its own system in particular;
- It allows the Contractor and PT supplier to work out construction joint locations and sequence of construction without changing the design. Providing the number of tendons to meet the minimum FEF is required regardless of construction joint locations; and
- It offers the best assurance that the design is satisfied—that is, that the required FEF is actually provided.

A disadvantage of the FEF method (Method 1) is:

- If clear rules for rounding (including if it is permissible) are not established, either on the contract documents or by local standard practice, disputes can arise between the LDP and the PT supplier. A rational rounding protocol is presented later in this paper.

METHOD 2: SPECIFY NUMBER OF TENDONS AND MINIMUM FEF PER TENDON

In this method, the LDP specifies the number, material properties, and size of tendons required, and also specifies the minimum FEF per tendon on which the number and size was based. The LDP also requires that the PT supplier verify, by calculation, that the minimum FEF can be achieved with the construction joint locations and pour sequence selected by the Contractor and PT supplier. If the PT supplier cannot satisfy the LDP's specified minimum FEF per tendon, the PT supplier must then provide more than the minimum number of tendons specified in the contract documents.

This method is closely related to the FEF method (Method 1), since the LDP is indirectly specifying the minimum total FEF required as the product of the number of tendons and the minimum FEF assumed per tendon. In spite of the fact that the LDP specifies the number of tendons, the PT supplier is still responsible for loss calculations to verify the specified minimum FEF per tendon.

Advantages of Method 2 include:

- The LDP has more control over the post-tensioning materials than in Method 1 because both number of tendons and a minimum FEF per tendon are specified; and
- Easier correlation between structural and installation drawings than in Method 1.

Disadvantages of Method 2 could include:

- Responsibility for losses is unclear, as they are implicitly specified by the LDP (by the number of tendons) but calculated by the PT supplier to verify the minimum FEF per tendon; and
- Changes in construction joint location and/or pour strips may require the LDP and PT supplier to change the number of tendons and issue revised contract documents and installation drawings.

METHOD 3: SPECIFY NUMBER OF TENDONS ONLY

In this method, the LDP specifies only the number and size of tendons required in each member, as well as specifying the location of all construction joint(s) and closure strip(s) assumed in the design. No mention is made, on the contract documents, of any type of force or stress in the prestressing steel. To specify the number of tendons on the drawings, the LDP must first assume prestressing steel properties and calculate, estimate, assume, or otherwise determine all losses, and therefore the LDP assumes responsibility for the accuracy of those losses. The PT supplier satisfies the contract documents merely by furnishing the number and size of tendons specified. In this method, the PT supplier has no responsibility for prestressing losses.

The advantages of Method 3 include:

- It is easier for the PT supplier to interpret the drawings.
- It is easier to correlate between structural and installation drawings.
- "Rounding" disputes are avoided.

The disadvantages of Method 3 include:

- A single set of loss properties must be assumed, and it could exclude, or at least discourage, the use of otherwise acceptable tendon types and sizes; and
- Changes in location of construction joint(s) and/or closure strip(s) may require the LDP to change the number of tendons and issue revisions to the contract documents.

ROUNDING WHEN CONVERTING FEF TO NUMBER OF TENDONS

Some engineers feel that rounding down is **never** permissible when determining the required number of tendons. They argue that a minimum specified force (FEF) means just that: nothing less than the minimum force is acceptable. Others feel that there should be some tolerance on the minimum specified force. Rules for rounding should be stated in contract documents to avoid disputes when minimum forces are specified (as in Methods 1 and 2 discussed previously). One rational rounding protocol is presented in the following as an example. It involves the following terms:

$\boldsymbol{FEF_{spec}}$ = total FEF specified in a structural unit, which is taken to be a beam, a slab-band, or a width equal to half

the span for pan-joists, one-way slabs, and two-way slabs with distributed tendons.

$\boldsymbol{FEF_{tendon}}$ = specified or calculated minimum FEF per tendon

N_{reqd} = number of tendons required

$$\boldsymbol{N_{reqd}} = \frac{FEF_{spec}}{FEF_{tendon}}$$

If the decimal portion of $\boldsymbol{N_{reqd}}$ is less than a certain percentage of $\boldsymbol{N_{reqd}}$ (2% is often used for the limiting percentage), the number of tendons is rounded down. If the calculated percentage is equal to or greater than the limiting percentage, the number of tendons is rounded up. The larger the group of tendons evaluated (say, a band of 25 tendons or 14 tendons in a beam), the less effect rounding will have on the FEF specification.

For example, using 2% as the limiting criterion, assume the specified FEF for a beam is 440 kips and the calculated minimum FEF per tendon is 27.0 kips. $\boldsymbol{N_{reqd}}$ = 440/27 = 16.3 tendons, (Decimal portion/$\boldsymbol{N_{reqd}}$ = 0.3/16.3) × 100 = 1.8% < 2%), therefore round down and use 16 tendons.

SUMMARY AND CONCLUSION

The Post-Tensioning Institute (PTI) does not endorse the use of any one of these three methods, or the practice of rounding when converting from FEF to number of tendons. In PTI's view, these selections should be made by the LDP, who should be knowledgeable in these matters. To avoid conflict and confusion, PTI strongly recommends that both the LDP and the PT supplier understand the ramifications of these decisions and the divisions of responsibilities associated with each method.

REFERENCES

1. Bondy, K. B., "Variable Prestress Force in Unbonded Post-Tensioned Members," *Concrete International,* V. 14, No. 1, Jan. 1992, pp. 27-33.

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