CONTENTS

September 2019						
S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

October 2019						
S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

November 2019						
S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

December 2019						
S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

January 2020						
S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

February 2020						
S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29

September 2020						
S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

- **Sept 20th,2019 : 39th Structural Engineering Conference**
- **Oct 17th ,2019 : AWS Presentation**
- **Nov 7th ,2019 : Lunch Seminar**
- **Jan 23rd ,2020 : Lunch Seminar**
- **Sept 18th, 2020 : 40th Structural Engineering Conference**

PRESIDENT'S MESSAGE,

SEAON Members,

Welcome to this 2nd edition of the new SEAON Newsletter! Many thanks to Dr. Amgad Girgis for heading up the Newsletter and Awards Committee.

Some of the old-timers may remember that SEAON previously had a newsletter (delivered via US Mail, no less) and the Board made it a priority to reestablish this publication, as it is the most effective way to communicate the actions of the Board to the Membership. It's also a great way to showcase what the Nebraska Structural Engineering community is accomplishing, and to keep the Membership informed regarding legislative action affecting our profession.

I would like to direct your attention to the articles showing how active our Young Member Group has become. From site visits to pool parties to national recognition by NCSEA, they've really got things going! If you (or someone working for you) want to get involved with this group, send me an email and I can get you connected with Linsey Brown, Kate Fickle, or Tyler Schmitt. These three are the dynamic leaders of the YMG. Linsey will be representing the YMG at the NCSEA Summit in Anaheim, CA in November, and will receive an award recognizing the outstanding work she, Kate, and Tyler have done in leading the SEAON YMG. We're very proud of you three!

Finally, please consider getting involved in one of the many SEAON committees. It's really not that much work, and you get to meet some pretty great people. Check out our (new!!) website at SEAON.org to see what committees are available. Whether you like web design, legislative work, planning events, or whatever, we have a committee for you!

So enjoy this edition of the SEAON Newsletter!

Best wishes,

Ken Kilzer
SEAON President
kkilzer@olsson.com

EDITOR'S MESSAGE,

It is my pleasure to launch the second edition of SEAoN Newsletter. My goal for this newsletter is to keep Nebraska Structural Engineers updated with SEAoN activities and highlight hot topics in the structural engineering field. I sincerely hope that you find this edition useful and informative.

This issue gives a briefing on the Young member's group activities. We have a report on the 39th Annual Structural Conference. For the award program, we have an outstanding project entry that features some of the challenges and how the engineers overcame those challenges.

The paper in this issue was written on ultra-high-performance concrete, a material that has compression and tension strength that far exceeds conventional material and is expected to change the structural engineering application practice once implemented. Additionally, we have the August report on the Professional Engineering Council activities.

As you enjoy the topics in this edition, I invite you to consider contributing to future editions, especially by participating in the award program or writing an article for the paper section.

Best Regards,

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YOUNG MEMBER'S GROUP

The Structural Engineers Association of Nebraska (SEAoN) has taken the steps to create a younger member group (YMG). Last summer, Ken Kilzer was elected president and wanted to restructure the organization to improve relations, and collaboration. The restructure mainly included the addition of new committees with the addition of a younger member group.

The formation of the YMG group started in the summer of 2018 which quickly jumped to 27 members and 14 companies being represented within the first month of forming. From the formation, we decided to host a Kick-Off event which included a tour of the Countryside Church which was under construction and followed the event with a meet-and-greet happy hour afterwards. The event comprised of 15 members in attendance, which was more than half of the currently formed group.

In conjunction with the word of mouth from the attendees, which increased the group to 41 members within a month after the Kick-Off event, the YMG chairs decided to go to the local university campuses and talk with current structural engineering students. Four classes were targeted which were comprised of students at the Freshman level up to Master level students. The talks with the student classes added 44 new student members. Shortly after talking with the classes, a social event was held after the SEAoN Annual Structural Conference. The social event had approximately 25 members attend.

The last event of the year was a "Lessons Learned" presentation by March Holland, Chief Engineer for Paxton & Vierling Steel Company. During which he talked about things that he has seen that has worked well, things that he would recommend modifying, and things that he has seen that have not worked well. At the beginning of 2019, the three YMG chairs sat down and planned out the upcoming year. Multiple styles of events were considered which included: building tours, presentations of professional development hours, software presentations, social events, and a plant tour. The goal of the meeting was to budget for the year, try and provide multiple styles of events and to have enough to keep the group active.

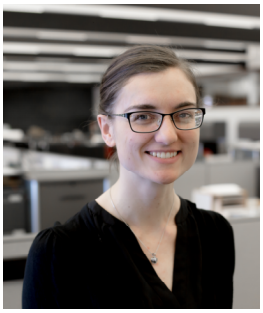
To date, the YMG has hosted four events which included an industrial engineering focused event at the Omaha Public Power District campus, a bridge focused presentation of the Union Pacific Railroad Bridge over the Mississippi River, a building focused tour of the new VA – Omaha Clinic followed by a social event, and another building tour of the new Children's Hospital in Omaha, NE. Three additional events are scheduled to be held during the remaining part of the year which includes social events and a concrete plant tour. Members have indicated building tours as very beneficial, as seeing structures in person gives an appreciation for the scale of structures while viewing the complexity of projects designed by others. Also, for many members, site visits are infrequently provided through work.
The current list of members within the YMG stands at 44 student members, 31 Engineering Interns, and 26 professionally licensed engineers representing 18 companies and one university.

If you are interested in joining the YMG, sign-up at https://kfickle.wufoo.com/forms/m19743hb0c8q09v/

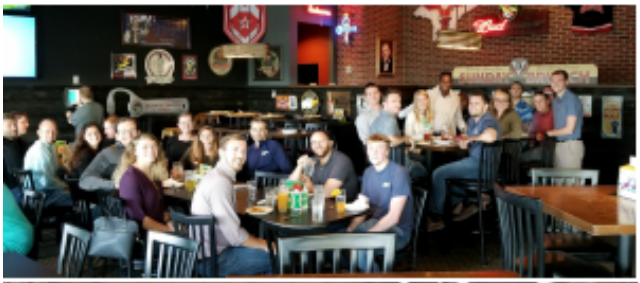
Co-Chairs

Linsey Brown (Olsson)
lbrown@olsson.com

Kate Fickle (Leo A Daly)
KEFickle@leoadaly.com



Tyler Schmidt (InfraStructure)
tschmidt@is-ecg.com



SEAON Young Members Group Year in Review

JULY 2018
Tour of Countryside Community Church by Kelley Clouse (TD2) & Happy Hour at Stokes

SEPTEMBER
Social after Structural Conference at Dudley's Pizza

DECEMBER
Presentation by Mark Holland "If I Know Now What I Didn't Know Then" [Bolts, Welds, and Connection Topics to Think About]

FEBRUARY 2019
OPPD North Omaha Station Tour & Presentation by Adam Christensen "Industrial Structural Engineering"

MARCH
Presentation on Clinton Bridge Project by Kyle Kauzlarich (HDR) & Design Team

MAY
Tour of VA Omaha Clinic by Ryan Curtis (Leo A Daly) & Happy Hour at LeadBelly

JULY
Tour of Children's Hospital Addition

39th ANNUAL STRUCTURAL CONFERENCE REPORT

The 39th Annual Structural Conference was held at the Scott Conference Center on September 20th. In attendance were 17 Students, 131 Members, 137 Non-Members/Late Registrants, 8 Committee Members, 7 Speakers and 3 Sponsors for a total attendance of 303.

The speakers were:

- Duane Miller of Lincoln Electric who presented his 'Lessons I've Learned Over the Past 40 Years'
- Mark Bartlett of Woodworks spoke on his topic 'Exploring Tall Wood: New Code Provisions for Tall Timber Structures'
- Russ Peterson of Ensoltech spoke on the NCMA Direct Design Software he developed.
- Steven Henderson Esq. of Stites & Harbison PLLC presented 'Professional Ethics for Structural Engineers'.
- Rick Gruye of Simpson Strong-Tie spoke on 'Strengthening Concrete Members using Fabric Reinforced Cementitious Matrix (FRCM)'
- Matthew Jarrett of Wiss Janney Elstner presented on 'Repairing the Liberty Bridge Buckled Truss Member'
- And last, but not least, Scott Campbell of NRMCA spoke on 'Insulated Concrete Forms'

We believe that this was a very successful conference and we look forward to the 40th Conference on September 18, 2020.

Rich Kotan,
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PROJECT AWARD PROGRAM

Structural Engineers are encouraged to submit one page describing their nominated project, including name, location, stake holders, and how any structural challenges were overcome. Maximum four pictures need to be sent with the one page. The projects will be studied by the committee and published in the upcoming newsletter.

UNMC Fred and Pamela Buffett Cancer Center

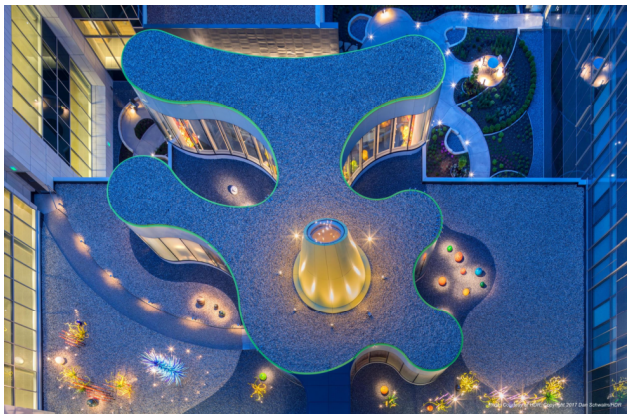
A collaboration of the University of Nebraska Medical Center (UNMC) and the Nebraska Medical Center (NMC), the Fred & Pamela Buffett Cancer Center consists of two major components: a cancer research tower and an inpatient care and surgery tower. Research, clinical care and education are integrated on the north-south axis, and cancer care, combined with other health services, on the east-west axis. Additionally, the building accommodates a pair of fueling capable heliports placed on the roof, each large enough to support a large military helicopter. The facility also needed to be designed to be LEED certifiable.

Structural System Overview:

Concrete has been the structural material of choice for UNMC and NMC for years, and the $284 million, 680,000 square foot Fred & Pamela Buffett Cancer Center is no exception. The entire structure utilizes over 39,000 cubic yards of structural concrete as its primary structural system.

Technical Summary:

· Ten-story lab building and eight-story inpatient care and surgery building.
· Strict vibration limits in the research spaces.
· Skip-joist and girder systems are used to resist gravity loads.
· Moment frames in both directions are used to resist lateral loads.
· Drilled piers make up the building foundations.
· Typical concrete strength is 4,000 psi, with the columns utilizing concrete from 4,000 psi to 6,000 psi strengths. Although there were numerous challenges during the structural design of this project, both large and small, we will focus on only a few of them.



Schedule

Like most major construction projects built today, compressing the design and construction schedule dictated early design bid packages. For the cancer center, a foundation and concrete frame package were issued months prior to issuing any architectural drawings. This meant that construction was well underway before the architectural, mechanical, and electrical designs were complete. To meet the aggressive schedule, the design team sat together as a special project team within HDR's offices. This allowed for closer coordination and quicker sharing of information. In addition, all of the design disciplines modeled their work in Revit, so that the project could be coordinated in three dimensions. The Revit models were also regularly shared with Kiewit Building Group (KBG), so KBG could track the progress of the design, update its construction schedules, and adjust its cost estimates. KBG also exported the Revit model into Navisworks for the sub-contractors to use for coordinating their work.

Flooring

The Buffett Cancer Center has 90,000 square feet of concrete slabs that incorporate Aridus rapid-drying concrete. Aridus is a proprietary concrete mix design sold by Ready Mix Concrete that optimizes the concrete mix to reduce the amount of water required. This is the first large-scale use of Aridus concrete in Nebraska. Its use eliminated the vapor transmission issues that lead to flooring adhesion issues and allowed for the construction schedule to be accelerated.

Linear Accelerator Vaults

The cancer center includes four linear accelerator vaults, which require massive concrete to shield the spaces outside the linear accelerator vaults from the high-dose radiation used for cancer treatments inside the vault. The density and thickness of the concrete vault walls and roof are critical in providing the required radiation shielding. At the cancer center, the thickness of the vault roof slabs were limited due to the building's floor-to-floor height. In addition, it was desirable to make the vault walls narrower to provide for a better architectural floor plan. To provide thinner vault walls and roof, 1,900 cubic yards of higher density concrete was used in combination with lead blocks in order to achieve the required radiation shielding. To increase the concrete density, 390 pounds per cubic yard of Rad Ban aggregate were added to the concrete mix. Rad Ban aggregate is a product that has not been widely used in Nebraska. This combination allowed for the vaults to fit within the building's floor-to-floor height.

Sanctuary Space

The healing garden and sanctuary space, which quickly became one of the facility's most widely praised spaces, was not part of the original building design. During construction, a donor came forward with both the funding and the sponsorship for renowned artist Dale Chihuly to create a rooftop healing garden and sanctuary space. The floor/roof that was to become the sanctuary and healing garden had not yet been poured. Additional reinforcing could be placed in the slabs for the new loading; however, the columns and, more importantly, the corbels supporting the framing at a building expansion joint were already poured and could not easily be strengthened. The capacity of these existing support elements limited the load that could be added. Further complicating the addition of the sanctuary space was its organic shape. The sanctuary is a curving, free formed shape with none of the exterior walls aligning with columns or beams below. Although concrete would normally be used for something with such a free-form shape, due to the limited capacity of the concrete structure below, the solution was to frame the sanctuary in steel.The roof is framed with metal roof deck on wide flange steel beams supported by three concrete columns located in the interior, and around the perimeter of the space, HSS columns double as mullions for the exterior glass walls. By using the mullions as a load bearing element, the roof loads are more uniformly distributed over the concrete slab below. The columns are intumescently painted, and left exposed. Their spacing matches the width of the exterior wall glass panels.

The end result is a stunning piece of art, architecture, and structure that has received national recognition from the American Institute of Steel Construction as one of eight projects in their list of 2018's, "What's Cool in Steel."

Overall Results

The Fred & Pamela Buffett Cancer Center was completed on time and within budget. Perhaps more importantly, the cancer center achieved the highest designation possible from the National Cancer Institute—as a Comprehensive Cancer Center, one of only 41 in the U.S.

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ULTRA-HIGH PERFORMANCE CONCRETE (UHPC), THE FUTURE IS NOW

INTRODUCTION

Ultra-High Performance Concrete (UHPC) was first introduced as Reactive Powder Concrete (RPC) in the early 1990's by employees of the French contractor Bouygues. When introduced, it came in two classes, Class 200 MPa (29 ksi) and 800 MPa (116 ksi). In the U.S., several state departments of transportation have expressed interest in introducing UHPC in their bridge projects, supported by FHWA research as well as research done by their local universities. Most notably Virginia has produced I-beams with UHPC and Iowa has built two bridges with UHPC beams and one with a UHPC deck. A significant interest has recently been directed at using UHPC in longitudinal joints between precast concrete beams. Over 200 bridges throughout the US have used UHPC in the deck joints.

Lafarge Cement Company markets a trade named pre-bagged UHPC product called “Ductal” which was formulated in the foundation of the RPC invented by Bouygues. However, its high cost has discouraged owners from implementing its use in applications beyond the initial demonstration projects, most of which had been subsidized by government technology implementation programs, and in joints which use limited quantities.

Recently, the Precast/Prestressed Concrete Institute (PCI) has commissioned the Omaha firm e.construct to lead a comprehensive UHPC implementation project. The company is joined by WJE of Chicago and three universities, UNL, North Carolina State University and Ohio State University along with six major precast concrete companies including Coreslab Structures (Omaha). The team started its work in November of 2018 and is expected to conclude it in late 2021. A primary goal is to train precasters to develop and produce their own mixes at a much lower cost than prebagged materials. The project is expected to produce two sets of guidelines that will eventually become PCI standards: Materials Guide and Structural Design Guide. Fully worked out examples of 250 ft long precast pretensioned concrete bridge beams and 60 ft long building floor slabs and beams will be provided. These products will be shown to be cost competitive with conventional concrete while they offer a multitude of benefits including approximately 50% weight reduction and 300% increase in service life.

WHAT IS ULTRA-HIGH PERFORMANCE CONCRETE?

There is no universally accepted definition. Compressive strength ranges from 17 ksi to 22 ksi. The PCI project defines compressive strength at prestress release as 10 ksi and at service as 18 ksi. The most significant property for structural design is the tensile strength and tensile ductility, which are much higher in UHPC due to the presence of steel fibers than in conventional concrete. In the PCI project, it is recommended that the ASTM C1609 flexural strength be above 1.5 ksi at first cracking and above 2 ksi at peak value with a significant deflection (ductility) beyond cracking, see Figure 1. This high strength allows for much higher shear resistance and the possibility of total elimination of stirrups.

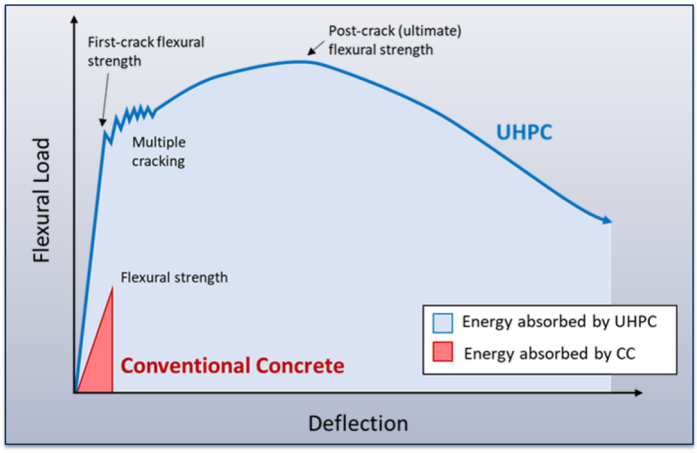

Figure 1- Excellent tensile strength and toughness of UHPC

The ingredients of a UHPC mix vary. In general, the mix consists, per cubic yard, of about 1900 pounds of "powder" and about 1700 pounds of fine sand with maximum grain size of 0.03 inch. The powder consisted of about 60% Portland cement, 10% silica fume and 30% ground slag, fly ash, or metakaolin. The materials are proportioned to produce the highest particle packing density. This, along with a very low water/binder ratio of about 0.20, is the primary source of compressive strength. The material is highly flowable with the aid of special admixtures that are added in pounds (or gallons) rather than the typical ounces in conventional mixes. The cause of the high tensile strength and ductility is the addition of special steel fibers in the amount of about 2 percent by volume, about 263 pounds per cubic yard. The fibers are cut from very fine 360 ksi brass coated steel wire. Figure 2 shows an example of the individual materials being used in UHPC.

Figure 2- Components of Ultra-High Performance Concrete (UHPC)

UHPC HAS BECOME COST COMPETITIVE ON FIRST-COST BASIS

Pre-bagged UHPC selling for over $2000 per cubic yard is not cost-competitive with conventional concrete for full size structural members. The six precasters involved in the PCI project, have been able to produce acceptable mixes at $650-850 pcy. If they sell the structural members at $1500 pcy, they would have a margin of about $750 for fabrication, overhead and profit, which is the total amount they charge now on a national average for conventional precast prestressed members. Considering that one can save 50% of the volume of concrete due to use of UHPC, it is thus possible to sell the UHPC products at a competitive price. This analysis does not include the additional benefits of longer life, less shipping costs, reduced foundations, etc., not to mention the considerable savings of CO2 emission and reduction in global warming potential.

STRUCTURAL DESIGN CONSIDERATIONS

In the U.S., structural design criteria for UHPC have not been fully developed. However, enough knowledge exists to conservatively perform design until refinements are published. For a beam element, service load flexural design can be performed using linear elastic theory with the relevant material properties and with prestress loss assumed to be 10% and 20% at initial and final conditions, and with tensile stress limit assumed equal to 50% of the flexural strength of UHPC. Prestressing is still the primary tension resistance element. A major beneficiary of UHPC is shear resistance. It is conservative to assume that the fibers contribute about 750 psi of shear strength resistance. Considering that concrete resistance, v_c, is on the order of 100 to 400 psi, and conventional rebar resistance is capped at about 800 psi, it is easy to see that no stirrups would be necessary.

EXAMPLE APPLICATIONS

The following paragraphs describe several concepts being pursued for development of UHPC precast/prestressed products.

(a) **Piles:** Figure 3 shows a standard Florida Department of Transportation (FDOT) pile that is 24 inches square and prestressed with 20- ½ inch diameter special strands and an equivalent UHPC pile. The conversion is made by blocking out the corners and creating an internal stay-in-place cardboard tube. The result is over 50% reduction in weight, while the flexural capacity remains essentially the same and the axial capacity is significantly increased. Note that the spirals normally required for conventional concrete may be found to be unnecessary due to the presence of high tensile strength fibers. Pile driving may prove to be less risky due to the material toughness and ability to absorb energy.

Figure 3- Comparison of conventional concrete pile with UHPC pile of the same flexural capacity. Note, UHPC has higher compressive capacity and better resistance to pile driving effects

(b) **Decked Bridge I-Beams:** Figure 4 shows a conventional bridge system, using the popular NU (Nebraska University) girder. Eight-foot-deep beams spaced 9 feet apart with a composite cast-in-place deck can span up to 180 feet. A UHPC decked I-beam system with the same total superstructure depth and spacing would have a possible maximum span of 265 feet, while using a fraction of the total concrete volume. In addition, our research has clearly shown that it is possible to eliminate all shear reinforcement, thus greatly simplifying production.

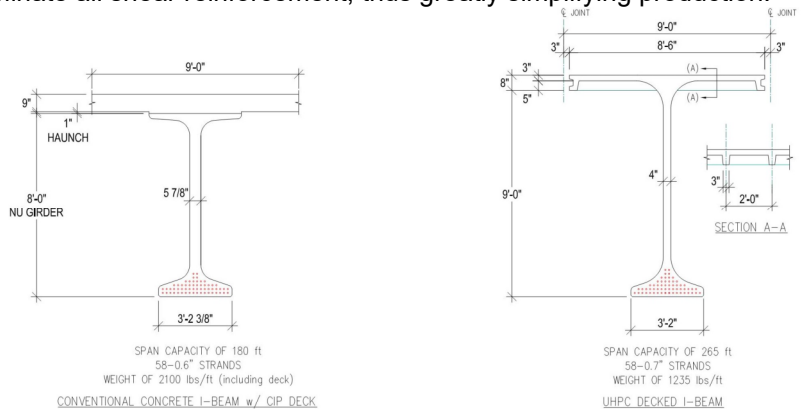

Figure 4- Conventional concrete vs. UHPC bridge I-beam. It is possible to increase span capacity while reducing the unit weight. Also, shear reinforcement can be eliminated

Other products being developed in the PCI Project include an innovative voided slab for multistory residential and office buildings, allowing for 60 ft clear span with only 22 in. total depth and with provision for placement of all utilities in the slab voids. Also, inverted tee beams with ledges as thin as 3 in., rather than the standard 8-12 in. depth are being developed and full scale tested. It can be shown that 120 ft tall pole can be made with a tube thickness of 2.5 in. and a diameter of 30 in. at the butt to 12 in. at the tip. Finally, the research has shown that the savings is not just limited to long spans or to flexural members. The range of applications is very broad and is only limited by the imagination of the structural engineer.

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SEAoN – Professional Engineering Council Report August 9, 2019

By Jeff Stevens, PE – PEC Committee Chair

Review of the concluded 2019 Legislative Session

The session saw the adoption of the 2018 IBC as the State Building Code (LB348) and the adoption of a new State Energy Code (LB 405). Radon resistant, new construction requirements (LB 130) were also adopted.

Several bills related to property tax reform were monitored due to the consideration of the sales tax exemptions on various services being rescinded.

On-going issues:

De-coupling. The NE PE&A Board appears to be gearing up for an effort to allow PE and SE candidates to sit for the PE or SE exam prior to gaining the required work experience; the candidates would complete the necessary work experiences and provide professional references prior to the Board awarding the PE or SE title.

In a recent survey, SEAoN found a nearly equal split among our members to either support or oppose de-coupling. My understanding is that NeSPE is similarly divided. While neither organization (or the PEC) may be able to reach a consensus, we will continue to inform our members of relevant information learned through the PEC.

Sales tax exemptions. Engineers and many other professionals do not pay sales tax on our services. The removal of sales tax exemptions is one of the many items proposed during the property tax reform debate, and this debate is likely to continue for the foreseeable future as there seems to be very little chance for consensus.

Separate SE licensure and (partial) Practice Act. Separate SE licensure issues were our primary motivation for joining the PEC. Our participation in the PEC has provided some insight into the political landscape that will be beneficial to SEAoN promoting the strengthening of our current SE title act. We need to review and update our approach based on what we have learned, some recent rules changes, and the potential of de-coupling.

If you are interested in additional information regarding the PEC, please contact me:

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You can find SEAoN on Facebook and Linkedin:

https://www.facebook.com/SEAONebraska/

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From the Publication Committee Chair

SEAoN is seeking topics of interest for the Newsletter invited article. If you have a general or technical engineering topic that you would like to see an article on, please send it to the below e-mail.

If you have expertise in an area of interest and would like to write an article, please send your bio and a paragraph describing your proposal to the below e-mail.

Contact e-mail: amgad.girgis@econstruct.us