KICKOFF PRESENTATION

Lessons in Creativity: Jack Christiansen's Innovative and Efficient Structural Designs (1.0 PDH)

Brief Presentation Description

The Pacific Northwest has a long, innovative history of structural engineering. The mid-century engineer Jack Christiansen utilized a creative and collaborative mindset to become an international leader in thin-shell concrete structures – forms unrivaled in their material efficiency and formal expression. Christiansen's projects and design process offers many relevant lessons for today's design engineers.

Bullet Point Learning Objectives

- History can be a source of inspiration
- Creative collaboration with architects and contractors leads to productive outcomes
- Being innovative requires leadership

Abstract

This presentation will present the remarkable creativity, efficiency and innovation embodied in Jack Christiansen's landmark structural designs. Though well-known for his long-span thin-shell concrete structures - like the Seattle Kingdome - Christiansen designed a wide range of structures throughout his career. These structures ranged from timber bridges to steel truss roofs and precast concrete vaults. The variety of these structures demonstrate Christiansen's persistent approach to structural design - one that included consideration of architecture, construction and material efficiency, all the while finding elegance and opportunity through the constraints of each project. A signature structural engineer of the Pacific Northwest, Jack Christiansen's work provides important design lessons that have continued relevance today.

Tyler Sprague, P.E., Ph.D, LEED AP
Associate Professor, University of Washington

Tyler S. Sprague is structural engineer, historian, and an Associate Professor in the Department of Architecture, with an adjunct appointment in Civil and Environmental Engineering, at the University of Washington. He earned engineering degrees from the University of California, Berkeley and the University of Washington, and worked professionally as a structural engineer, before completing his Ph.D. in architectural history in the College of Built Environments at the UW. His research investigates the intersection of architecture and structural engineering, through a variety of methods, throughout history.

His book, *Sculpture on a Grand Scale: The Thin Shell Modernism of Jack Christiansen*, was published by the UW Press in 2019. His current research explores the rich history and structural possibilities of timber construction.

Engineering for Elephants: A Structural Safari (1.0 PDH)

Brief Presentation Description

There is not much guidance in building codes when it comes to designing structures to withstand forces imparted by a 14,000 pound elephant. The Oregon Zoo Elephant Lands project demanded creative solutions to unique challenges, and a performance-based design approach that considered the safety and welfare of elephants, keepers, and zoo visitors alike.

Bullet Point Learning Objectives

- Structural Engineering is a creative profession
- No matter how much experience you have, there is always something you can learn
- Even an elephant can teach you something about Engineering

Abstract

Equilibrium Engineers served as Structural Engineer of Record on Elephant Lands at the Oregon Zoo, a project involving the re-purposing of 6.5 acres of the zoo property and complete replacement of the existing elephant habitat. The project included 60,000 square feet of new buildings consisting of an elephant management building, indoor viewing building, life support facility, rest room facility, and interpretive kiosks. As part of the project, the Zoo Train had to be re-routed, requiring a new elevated structural steel loop trestle. The project also included the first permitted use of CLT in a structure in Oregon. Between the elephants, train, CLT and numerous site constraints, Equilibrium Engineers had to navigate and solve many problems that they had never encountered before, making this project a significant achievement for our small firm and reminding us that structural engineering is truly a creative profession.

Ed Quesenberry, S.E.
Founding Principal, Equilibrium Engineers LLC

Ed Quesenberry, S.E. is the Founding Principal of Equilibrium Engineers LLC in Lake Oswego, Oregon. Ed has been a consulting Structural Engineer for over 30 years and since 2011 he has had the opportunity to serve as Structural Engineer of Record on several zoo projects in Oregon and California. He holds a degree in Architectural Engineering from Cal Poly, San Luis Obispo, is Past President of both SEAO and NCSEA.

Exhibitor Presentation - Core Brace – Premium Sponsor

BRBF State of the Art: Global Stability, Fatigue and Resiliency (0.5 PDH)

Brief Presentation Description

The state-of-the art topics in BRB design will be presented including the new global stability requirements of AISC 341-22, the application of BRB fatigue models, and the most up-to-date resiliency modelling techniques for BRBF. Attendees will learn how these topics will help design safer, more resilient structures which can be quickly checked for safety after earthquakes.

Bullet Point Learning Objectives

- Provide an understanding of the new BRBF global stability requirements of AISC 341-22 and how they are applied.
- Understand the development of BRB fatigue models and how they are used to determine the remaining life of BRBs after a seismic event.
- Learn about BRB-specific resiliency modelling parameters and how they can help engineers more accurately model the expected performance of BRBF structures in seismic events.

Abstract

The state-of-the-art in the design of Buckling-Restrained Braced Frames (BRBF) will be presented in three specific areas: First, the new BRBF global stability requirements of AISC 341-22 will be discussed. This failure mode is the subject of considerable research and presents a likely vulnerability in BRBF structures if not accounted for properly. Next, newly developed BRB fatigue models will be presented which enable the calculation of the remaining life of BRBs after a seismic event. These models result from research conducted involving the full-scale tests of 24 BRB subjected to cyclic and simulated earthquake loadings. Application of these models will be provided. Finally, resiliency modeling of BRBF structures will be presented. This modelling is used to predict the ability of structures to return to use after an event - specifically addressing residual drift, repair cost, and repair time objectives.
Recent BRB-specific resiliency models have been developed addressing these objectives and providing improvements over the generalized parameters found in FEMA P-58. Examples of the use of these parameters will be presented.

Brent Saxey, S.E.
Technical Director, CoreBrace (Premier Sponsor)

Brandt Saxey, SE, LEED AP, is the Technical Director for CoreBrace where he is responsible for the Research and Development of Buckling-Restrained-Braces. He is a member of the AISC 341 TC-9 Seismic Systems Committee, TC-6 Connection Design Committee, M3 Seismic Manual Committee, and the ASCE-41 Seismic Evaluation & Retrofit Committee.

Design of Slender Transparent Structures Using Glass (1.0 PDH)

Brief Presentation Description

This presentation will investigate what it means to be "structural" and consider how circumstances and consequence contribute to the overall risk when considering the balance between cost-efficiency and safety. It will also describe the development of analysis techniques for slender composite structures and the guides available for confident design of glass structures.

Bullet Point Learning Objectives

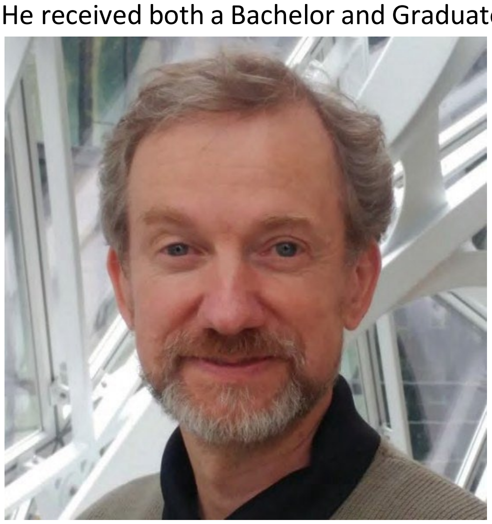
- Determination of risk beyond the probability of failure of an element
- Composite design with laminated glass
- Stability of slender beams with elastic restraint
- Design of glass structures and glass structural elements

Abstract

Glass is unique amongst building materials as being both transparent and brittle. Unlike the other common brittle materials, such as concrete and masonry, cracking of any kind is regarded as a failure. Due to the technology initially available, breakage and fall out were considered to be a necessary risk for the transparency glass offers. The same assumption of sudden failure also precluded glass from structural applications. As technology has advanced, so has the potential for robustness through redundancy and retention. Specialist designers have successfully constructed many glass structures.

Richard Green, PE, CPEng (Aust,) IntPE APEC
Engineer Founding Principal, Green Facades

Richard is a facade designer and engineer with 33+ years of experience as a global expert in the area of facades and structural glass. His experience encompasses all stages of a building enclosure's life-cycle. He received both a Bachelor and Graduate Diploma in Structural Engineering from Monash University in



Australia, specializing in light-weight structures, and has formal training in corrosion technology.

Richard's specialty is the design and analysis of complex façade structures. He has been involved with a number of world leading and award-winning projects covering a wide range of building types. He has worked on cultural facilities on six continents and such iconic buildings as the Stavros Niarchos Foundation Cultural Center by Renzo Piano in Athens, Greece; the restoration of the Sydney Opera House; the Amazon Spheres with NBBJ; and the refurbishment of the Seattle Space Needle with Olson Kundig.

As champion of making safe structural glass design readily available, Richard was the founding Technical Chair of the ASTM committee for Structural Use of Glass. He has also had an advisory role for CEN-TS 19100 and Eurocode 11 Design of Glass Structures and was previously a member of the technical committee developing Australian Standard AS 1288 Glass in Buildings. Richard also represents the United States on the International Organization for Standardization ISO (TC160) as an 'Expert' for matters regarding strength and use of architectural glass.

Totem Lake Connector Bridge (0.5 PDH)

Brief Presentation Description

The Totem Lake Connector is a signature bicycle and pedestrian bridge for the City of Kirkland, WA. The bridge is 800 ft long with undulating vierendeel truss spans crossing the roadways. The bridge is slated for opening in July 2023.

Bullet Point Learning Objectives

- Develop bridge concepts in an environmentally sensitive area with high seismicity
- Creating a signature pedestrian bridge that is functional and cost-sensible
- Developing a bridge that is constructible with fabrication and erection friendly details

Abstract

The Totem Lake Connector is a bicycle and pedestrian bridge that will connect two ends of the Cross Kirkland Corridor Trail, which is currently severed by one of Kirkland’s most complicated and busy intersections, with major utilities to navigate. The new bridge will serve as a regional landmark and a gateway to the rapidly developing Totem Lake area. The project was awarded for construction at the end of 2020, with completion expected in spring 2023.The final design is aesthetically pleasing, while implementing many efficient details to simplify fabrication and construction. The arched Vierendeel trusses are composed of pipes for the arch with tie-chord and hanger members, and are detailed to be fabricated in segments that maximize shipping sizes. The team identified a staging area adjacent to the structure where the segments for each span can be assembled to allow them to be set in place over the roadways with overnight closures.

Matt Baughman, P.E., S.E.
Associate Project Director, COWI

Matt Baughman is an Associate Project Director in the Seattle office of COWI with seventeen years of experience in bridge projects. He is currently serving as a buildable unit design manager for the roadway work of the Fargo-Moorhead Stormwater Diversion Channel project. Matt is also providing engineering support during construction as Engineer of Record for COWI’s eight bridges on the WSDOT I-405 Renton to Bellevue Design-Build project and the City of Kirkland Totem Lake Connector bridge.

Exhibitor Presentation – The Steel Tube Institute

Unordinary Tubular Connections (0.5 PDH)

Brief Presentation Description

Girts and moments and torsion, oh my! These aren't your momma's standard connections. This presentation will focus on the atypical HSS connections – the connections that are not covered in the Manual.

Bullet Point Learning Objectives

- Discuss atypical HSS connections: HSS girts, HSS beams
- Review unique HSS truss configurations: Multiplanar HSS trusses, HSS web to WF chord
- Highlight new and innovative design tools: Research, CIDECT, AISC 360-22 Specification

Abstract

Versatility is just one of the many advantages of HSS. As a result, the Steel Tube Institute fields hundreds of questions each year regarding unique HSS connections. This presentation will address some of the topics that have been raised that are not currently covered in "standard" resources such as the Steel Manual or Design Guide 24.

Cathleen Jacinto, P.E., S.E.
Structural Engineer, FORSE Engineering – Technical Consultant to the Steel Tube Institute

Cathleen has over 20 years of experience in the design industry as a structural engineer. She collaborated on a variety of building design projects while at Thorton Tomasetti and T.Y.Lin International in Chicago, Illinois, from small to large-scale project types in healthcare, aviation, commercial, infrastructural, cultural, and steel connection design. At FORSE Consulting Cathleen assists other structural engineers with designs on a variety of projects, and contributes to FORSE's seminars and publications. One topic Cathleen highlights is structural steel HSS Design, as a technical consultant to the Steel Tube Institute. She currently contributes as a Board Member to the Structural Engineers Association of Illinois and serves on committees with AISC, ASTM, and AWS. She has a Professional Masters Degree in Structural Engineering from the Illinois Institute of Technology and a Bachelor of Science in Civil Engineering form the University of Illinois Urbana-Champaign. Cathleen is a licensed Structural Engineer (SE) and Professional Engineer (PE) in the State of Illinois.

Innovation in Your Engineering Practice and How It Intersects with Insurance, Claims and Litigation (1.0 PDH)

Brief Presentation Description

Are you considering a project that will require you to produce innovative systems, procedures or processes that are untested? This discussion is oriented to help you consider whether you really want to do the project and then, if so, how do you proceed in a manner that minimizes your risk of claims and litigation arising.

Bullet Point Learning Objectives

Goals of this presentation:

(1) Identify need for innovation
(2) Develop internal guidelines to identify options
(3) Research similar innovations and their outcomes
(4) Consider Risk/Reward of the innovation
(5) Incorporate proper contractual protections for projects
(6) Work through potential impacts of Project/Innovation with Broker and Attorney

Abstract

Engineers innovating in their practices have the potential to make great advances for their trade and the public. They do so, however, at a higher risk of claims and litigation than if they were just painting inside the lines. This discussion will combine the expertise of one of the top A&E Professional Liability Brokers in the country partnered with a leading Professional Liability attorney to discuss the additional risks associated with innovation on projects and how to take reasonable steps to manage those risks to avoid claims and litigation, as well as steps to take to mitigate the risk of a claim or litigation if problems begin to pop up on the project.

Stan Pease, CRM, CIC, CCLA – President, Shipley & Pease Insurance
Lindsey M. Pflugrath, Hon. AIA, Attorney at Cairncross & Hempelmann PS

Stan Pease started his career in the Insurance Claims Industry, where he spent 15 years, and was heavily involved in developing claims servicing programs for specific industries and managing a large regional claims office for a national Insurer. This claims experience translates to a hands-on understanding of how insurance policies work to provide needed protection when a claim arises from professional services, and how insurance coverage, claims and the courts intersect. Stan has been a partner and officer in two major regional insurance brokerages spanning over 25 years where he started specializing in A&E Professional Liability Insurance in 1994. Stan purchased Shipley & Associates in 2013 and has built the company into one of the largest independently owned brokerages specializing in Professional Liability Insurance and Risk Management for Architects and Engineers in the Western US.

Lindsey M. Pflugrath, Hon. AIA, Attorney, a shareholder at Cairncross & Hempelmann PS, Seattle, WA . Lindsey's work has earned her several distinguished titles and roles in organizations including AIA, the Seattle Architecture Foundation, and the Urban Land Institute. Lindsey has devoted her career to understanding the legal risks her clients face in the construction industry. Her clients include developers, owners, owner's representatives, contractors, international multidisciplinary design firms, and local engineering and architecture firms. She takes great pride in offering an integrated suite of services to her clients, providing advice on risk management, contract negotiation and conflict resolution, as well as defending her clients from claims. Lindsey's practice spans Alaska, Washington, Oregon and Arizona and she considers it an honor to counsel her clients as they change the way people live, work and travel in the Pacific Northwest.

Lindsey is experienced in a wide variety of construction and real estate development, including single-family residential, multi-family residential, high-rise, commercial buildouts, public projects and infrastructure. She is involved in the full life cycle of her clients' projects from inception through completion and beyond. She provides advice on project delivery, drafts and negotiates design and construction contracts, assists with negotiating and securing subordination and assignments, and works with project teams to address challenges and opportunities as they arise during the course of construction.

Lindsey's approach to risk management is informed by her litigation experience. She has represented owners and construction professionals in all manner of civil litigation at both the federal and state court levels, including claims for design or construction defects, cost overruns or schedule overruns, liens, and claims of personal injury or wrongful death.

Lindsey is deeply engaged with organizations in the field of construction, and she holds numerous leadership positions as well as being recognized as an honorary American Institute of Architects (AIA) member. She is a respected leader in her field and a frequent presenter to industry organizations and professionals on a range of construction law topics.

Lindsey is licensed to practice in AK, WA, OR and AZ.

Exhibitor Presentation – Nucor

Behind the Curtain: Steel Design Tips from the Mill (0.5 PDH)

Brief Presentation Description

As structural engineers, we rarely connect directly with the steel mills producing the products we specify. This presentation will cover some of the topics specific to steel that will lead to increased efficiency in design.

Bullet Point Learning Objectives

At the conclusion of this presentation, the attendee will be able to:

- Use rolling schedules and price sheets to make informed and educated decisions during the design of steel members.
- Identify what is needed to properly specify deck, including the appropriate yield strength and attachment methods.
- Discern what grades of steel materials are prevalent in the market even if they aren't the "standard" specification.

Abstract

Let's pull back the steel curtain and take a deep dive into steel construction from the perspective of a few structural engineers who now work for steel producers. Their experience working from a different perspective in the supply chain offers some lessons learned that may result in additional efficiencies for inclusion in your steel framed projects. This presentation will cover a potpourri of topics. From understanding the supply chain for various products to price tiers and rolling schedules, and 19 gage deck to #3 rebar – these tips and tricks are good to know to make your designs even more effective and efficient from the material perspective.

Kim Olson, P.E.
Structural Manager, Construction Solutions, Nucor

Kim Olson, PE is a licensed structural engineer. She is currently a manager in Nucor's Construction Solutions Group where she leads their National Accounts and technical strategies. Prior to joining Nucor, she was an HSS Consulting Engineer for the Steel Tube Institute. At FORSE Consulting and Martin/Martin, Inc. she managed and designed a variety of structures. Kim is a member of several AISC, AWS and ASTM technical committees, and a Director for SEAC (Colorado).

Creating a Culture of Belonging thorough DEI Practices (1.0 PDH)

Brief Presentation Description

Listening and participating in this panel discussion can help provide the tools a company needs to grow a more diverse and inclusive workplace. The recommendations and ideas you learn from the discussion can be shared with firm leadership, impacting employee relationships and workplace practices. One of the best ways to evaluate and inform company culture is through a DEI lens. We welcome all to join this discussion to learn how you may contribute to the advancement of DEI in our industry.

Bullet Point Learning Objectives

- Develop tools to use at your company to grow a more diverse and inclusive workplace
- Evaluate and inform company culture through a DEI lens
- Share ideas with the leadership of your firm
- Impact employee relationships and workplace practices at a firm level
- Contribute to the advancement of DEI efforts in the Structural Engineering Industry.

Abstract

Every organization should strive to create a strong workplace culture. Regardless of a company's size, having a healthy culture leads to a staff that is highly motivated, productive, and loyal. While company leaders should work to establish an effective culture, it is up to the staff to ensure company values are diligently upheld on a day-to-day basis.

DEI is about empowering colleagues and maximizing our ability to include each other and work together. Being open to unique perspectives, delivering and receiving thoughtful feedback, and creating space for vulnerability, are just some of the DEI values that can enhance a company culture. There are several firms and organizations within the structural engineering profession that are embracing DEI practices. Please join us for a presentation and panel discussion that will explore these practices and other ways that DEI can improve company culture.

Listening and participating in this panel discussion can help provide the tools a company needs to grow a more diverse and inclusive workplace. The recommendations and ideas you learn from the discussion can be shared with firm leadership, impacting employee relationships and workplace practices. One of the best ways to evaluate and inform company culture is through a DEI lens. We welcome all to join this discussion to learn how you may contribute to the advancement of DEI in our industry.

Presenters:

Laura Lindeman, P.E. (Moderator) **–** Structural Project Manager, Coughlin Porter Lundeen
Lisette Terry, P.E. – Associate, Degenkolb Engineers
Marcus Freeman, P.E. – Senior Design Engineer – MKA
Kellie Filips – Project Engineer - PCS Structural Solutions
George Theo, MS - Associate Principle, Director of Human Resources, Coughlin Porter Lundeen

Laura Lindeman is a Structural Project Manager at Coughlin Porter Lundeen (CPL). She began her career as an intern at CPL and has now been with the company full time for 8 years. She has extensive

experience in the Class A office, life science and campus development markets. Her strong communication skills allow her to simplify complex structural issues as they relate to any project with peers and clients alike. She has a passion for sustainable design and her advocacy efforts include leadership of the firm's Sustainability Task Group and involvement with the Carbon Leadership Forum Seattle Hub. She is also an active volunteer supporting STEM education and understanding and breaking down the barriers to equity in structural engineering.

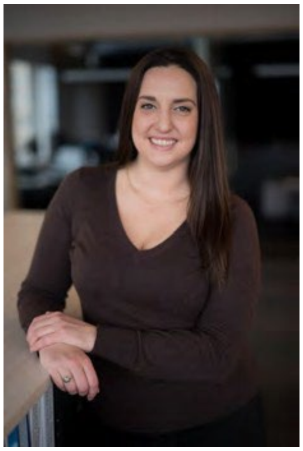
Lisette Terry: Over the course of her 17-year structural engineering career, Lisette Terry, has contributed to the success of a variety of projects, from modest single-family residential repairs to the sizable Panama Canal Third Set of Locks. She designed the Water Saving Basin structures that efficiently

reduce the water usage as each ship passes through the Third Set of Locks. Lisette began her career in the design of high-rise steel framed buildings before pivoting to marine projects which included the design of the Mud Mountain Dam Fish Passage Release Site on the White River, Washington. Following her marine work involvement, Lisette pivoted once again to Forensic Engineering. She works diligently to grow her Forensics team while managing quick-paced damage reconstruction and damage investigation projects. At the age of 15-years-old Lisette recognized her passion for science, math, engineering, and buildings and became determined to make Civil Engineering her career. Throughout the years, Lisette has found a deep passion in advancing the diversity, equity, and inclusion efforts in the Structural Engineering industry. She intends to make lasting waves as she continues to blaze the trail for a more diverse group of future Structural Engineers. The SEAW Diversity and Inclusion committee that she Chartered in 2020 and continues to Chair has established a new annual SEAW DEI scholarship intended to reach a diverse population of Structural Engineering students within Washington State Community Colleges.

Marcus Freeman has a diverse project history including, airports, convention centers, and residential high-rise buildings across the United States. He received both his Bachelor's and Master's degree in

Civil/Structural Engineering from Virginia Tech and has over 7 years of experience with Magnusson Klemencic Associates in Seattle, WA. Marcus is active member in MKA's Earthquake Design Technical Specialty Team with an emphasis on the use of passive energy devices and in building design. He has also served as president of SEAW's YMG (2016-2018) and is currently serving as chair of the Structural Engineering Engagement and Equity Committee (SE3).

Kellie Filips has spent the past decade working in and around the structural engineering field, from new



high rise concrete design to finding repair and reconstruction solutions to extend the performance and services life of existing structures. While Kellie enjoys the nuts and bolts of engineering, she has a passion for outreach as well, especially promoting STEM to young students. “I am passionate about promoting STEM to young girls and kids who have not been exposed to engineering/STEM. I was lucky enough to have a family legacy of engineering, which showed me what engineering looked like at a young age, but not everyone has that opportunity. I want young kids to see the practical, hands-on nature of engineering and to be able to see themselves as engineers.” Kellie is a member of the SEAW Outreach committee, founder of PCS’s woman’s group and a former high school basketball coach.

George Theo is the Director of Human Resources at Coughlin Porter Lundeen. Prior to joining CPL, he was the Associate Vice Chancellor and Dean of Students at the University of Washington Bothell. His current and past experiences have provided him with the ability to engage and interact with staff. His

ability to create positive environments and inclusive comminutes through engaging staff and developing mutual understandings. He has the ability to bring people together around a common purpose, sharing knowledge, and leveraging everyone’s’ unique strengths and experiences to make a collective impact. His unique background allows him to effectively respond to transformation within the industry and workforce.

Using Applied Research for Update of Seismic Evaluation and Retrofit Methods (1.0 PDH)

Brief Presentation Description

The paper for this presentation is under consideration by the ASCE/SEI Standards Committee on Seismic Evaluation and Retrofit. This paper presents an overview of many of the significant changes proposed to the ASCE/SEI 41 committee as a result of the ATC 140 project, with detailed discussion on selected provisions.

Bullet Point Learning Objectives

- Preview of major changes for seismic retrofit coming in ASCE 41-23
- State of the art nonlinear analysis provisions for existing structures
- Updates to concrete shear wall and URM Building specifications

Abstract

Seismic retrofit of existing buildings has significant societal, financial, and environmental impacts. In order to minimize these impacts, accurate evaluation methodologies are required to ensure that only the buildings requiring retrofit are identified and that the retrofit scope is highly efficient. The current standard, ASCE/SEI 41-17, is based on methodologies initially developed in 1997. A 2008 workshop of leading practitioners and researchers convened by NEHRP concluded that the procedures are perceived to be overly conservative, and existing performance-based seismic design methods are not accepted by practitioners as providing a uniform level of confidence. FEMA funded the ATC-140 project series to identify and recommend technical and procedural improvements to ASCE/SEI 41-17. The project team conducted focused studies on linear analysis, nonlinear analysis, building foundations, concrete structural walls, and unreinforced masonry buildings, as well as the Tier 1 and 2 deficiency-based procedures. The project team developed change proposals which were passed along for ASCE/SEI 41 consideration.

Terry Lundeen, P.E., S.E.
Principal, Coughlin Porter Lundeen

Terry Lundeen is a founding partner at Coughlin Porter Lundeen, a Seattle based structural and civil engineering firm. Terry has a broad background in the structural design of buildings in various sectors

including commercial office, multi-family residential, healthcare, life sciences, and higher education. He has a specific professional interest in renovation, adaptive re-use, historic preservation, and seismic upgrade. As such, he has been a member of the ASCE Seismic Retrofit Standards Committee since its inception and has participated in the development of ASCE 31, ASCE 41, and their predecessor guidelines. He is currently chairman of the ASCE 41 Analysis Subcommittee and a member of the ASCE 41 Steering Committee. Finally, he is Project Technical Director of the FEMA funded ATC-140 project - “Update Seismic Retrofit Design Guidance.”

Exhibitor Presentation – DuraFuse Frames

Innovations that Improve Functional Recovery of Steel Moment Frames (0.5 PDH)

Brief Presentation Description

Designing steel moment frame structures for the life-safety provisions of current standards may result in significant repairs and potentially building demolitions following a major earthquake. A newly prequalified connection in AISC 358-22, DuraFuse Frames, improves performance, reduces up-front costs, and provides enhanced functional recovery. The connection mechanics and advantages of using a replaceable fuse for seismic performance and resilience are presented.

Bullet Point Learning Objectives

- Connection mechanics and design methods for a newly prequalified, resilient moment connection are described.
- The impact on functional recovery of using moment frames with replaceable fuses is quantified.
- Case study examples including initial cost and functional recovery impacts of designing for Risk Category IV are presented.

Abstract

Steel special moment frames (SMFs) are popular in high-seismic areas because they accommodate various floorplans, and provide unobstructed views. Because SMFs are designed using a high R-factor, significant inelastic behavior is expected during major earthquakes. Several studies have indicated poor functional recovery from code-minimum SMFs due to residual drifts and beam repair or replacement costs. Improving SMF functional recovery can occur by designing to stricter drift limits, improving post-yield stiffness, and/or enhancing repairability. Designing for Risk Category IV increases total building costs by 6-16%, so it is desirable to explore other alternatives. An extensive study was conducted to find the most effective options. Eighteen SMF buildings with different heights, risk categories, and connections were analyzed. Drift results from nonlinear response history analyses were used in a FEMA P-58 analysis to quantify functional recovery. The presentation will discuss the results from the study and describe innovative SMF design techniques that dramatically improve functional recovery without increasing up-front costs.

Justin Marshall, PhD, P.E.
President, DuraFuse Frames

Justin Marshall is the President of DuraFuse Frames. He earned his B.S. and M.S. in Civil Engineering from BYU and his PhD from Virginia Tech. His design career includes positions in New York and the Western United States. His 13 years at Auburn University included teaching structural engineering courses and doing research on seismic and wind engineering. He has been involved in several post-disaster reconnaissance efforts and has served on the Seismic Subcommittee for ASCE 7-16, 7-22 and 7-28.

Seismic Isolation of the Terminal Core Roof at the Portland International Airport (1.0 PHD)

Brief Presentation Description

The Terminal Core Redevelopment is a 1.6 billion USD project to expand and seismically upgrade the existing main terminal at the Portland International Airport in Portland, Oregon. At the center of the project is the seismic isolation of a new 300,000 square foot roof which is being constructed over the existing main terminal while the airport is fully functioning. This presentation will discuss the extensive analysis and testing performed for the seismically isolated roof structure.

Bullet Point Learning Objectives

- How to address simultaneous uncertainties in soil and isolator properties within the nonlinear response history analysis method
- What types of full-scale tests are required to be performed by ASCE 7 for seismic isolators
- Construction and erection techniques to ensure occupant safety when building over a functioning airport

Abstract

The Terminal Core Redevelopment is a 1.6 billion USD project to expand and seismically upgrade the existing main terminal at the Portland International Airport in Portland, Oregon. At the center of the project is the seismic isolation of a new 300,000 square foot roof which is being constructed over the existing main terminal while the airport is fully functioning. Sixty-eight double-concave friction pendulum seismic isolators are placed at the top of each “tine” of 50ft tall Y-Columns which penetrate through the existing main terminal at approximately 100 ft o.c. Nonlinear response history analyses using a suite of eleven earthquake acceleration records considered upper- and lower-bound seismic isolation properties in combination with upper- and lower-bound soil properties for the MCE_R. Additional nonlinear response history analyses using a suite of seven records were performed for a deterministic earthquake on the Cascadia Subduction Zone. Full-scale prototype and production testing of the seismic isolators was performed at the EUCENTRE in Pavia, Italy and SISMALAB in Crispiano, Italy.

Reid Zimmerman, P.E., S.E.
Technical Director, KPFF

Reid has focused his career on advanced structural systems, performance-based seismic design, and emerging techniques for earthquake engineering. He brings creative thinking and state-of-the-art design to his projects by staying at the forefront of innovative structural technologies (e.g., seismic isolation, energy dissipation and rocking systems) through national code committee participation, research and development with universities, and publication in journal

Exhibitor Presentation – IDEA StatiCa US LLC

Steel Connection Design Using Finite Element Analysis (0.5 PDH)

Brief Presentation Description

Projects are getting more and more complex with less time to design. One area that has not advanced is steel connection design. This session will discuss how finite element analysis can provide safer designs and save time.

Bullet Point Learning Objectives

- Discuss current methods of steel connection design.
- Introduce the use of finite element analysis for steel connections.
- Describe how IDEA StatiCa can be used to provide efficient designs.
- Discuss how IDEA StatiCa works with other software.

Abstract

This session with cover steel connection design using finite element analysis. When a structural element being designed becomes less simplified, the room for error can grow exponentially leading into potential failures. To avoid this, finite element analysis allows us the ability to cut time and cost on the design of connections. Additionally, the ability to customize connections to meet the needs of the fabricator and erectors, while highlighting extreme connections, conveys not only the ease of design but as well the trustworthiness that comes with finite element modeling.

Dave Eckrote, P.E.
Director, IDEA StatiCa US LLC

Dave is the Director of IDEA StatiCa US. In 2021, Dave started the US office for IDEA StatiCa and is based outside Philadelphia. He has worked in the structural engineering industry for nearly 30 years in various capacities from construction inspection to design to structural engineering software. He is a licensed Professional Engineer in Pennsylvania and has a BS of Architectural Engineering (Structural Concentration) and a BS of Civil Engineering from Drexel University. Dave is a Past President of SEA of PA and Past Chair of the Northeast Coalition of SEAs.

The Lateral System Design of the Artise: Bellevue's First Building with Fluid Viscous Dampers (1.0 PDH)

Brief Presentation Description

The Artise is Bellevue's first building with fluid viscous dampers and super braces that skip floors. Traditionally, each level of a building is directly connected to the main lateral system. The Artise uses an internal subsystem to transmit forces from diaphragms not connected using small moment frames up and down to the brace points. The fluid viscous dampers that run parallel with the braced frames reduced local and overall drifts, and allowed for a higher occupancy category.

Bullet Point Learning Objectives

- Learn about the Artise's use of fluid viscous dampers, the first implemented in Bellevue, and how that saved structural system construction costs by reducing drift.
- Learn how the client gained value with the Artise's efficient lateral system which transfers forces to the basement walls and the unique superbrace and sub system design.
- Learn about soil structure interaction modeling for The Artise

Abstract

DCI Engineers was behind the performance based structural design of The Artise, a 25-story office tower in Bellevue's central business district. The lateral system is a super braced frame system using buckling restrained braces that are alternately connected at every other floor and every third floor; utilizing moment frames in between the brace connection points; and fluid viscous dampers in parallel with the braced frames - the first of its kind implemented in Bellevue. The lateral system stops at Level 1 and completely transfers lateral forces to the basement walls, which allows all basement levels to be open, unobstructed space.

The lateral system design saved the project team from excavating an entire below-grade floor. The building's super brace system allowed a completely unobstructed floor plate and worked in concert with the architectural vision to create consistent brace connection point patterns around all four sides of the building. The design allowed for a floor plate which enhanced resiliency and economy of space, resulting in a lower steel weight per square foot, adding value to the overall development.

Scott Erickson, P.E., S.E.
Principal, DCI Engineers

Scott is a Principal Structural Engineer with more than 25 years of experience designing high-rise buildings. He has developed efficient systems for various clients and developers in the commercial office, multi-family residential, and mixed-use markets. He was the first in the country to design a concrete shear wall building high-rise in a seismic area using high strength Grade 80 longitudinal reinforcing. He is driven by an innovative spirit and curiosity to explore new building technologies.

Exhibitor Presentation – Taylor Devices

A Simplified Approach to the Design of New Moment Frame Structures with Viscous Dampers (0.5 PDH)

Brief Presentation Description

This presentation will provide an overview of the validation process, the design procedure and present results from a comparative study between different structural systems, including the TDMF.

Bullet Point Learning Objectives

- Awareness of the impacts of dampers on building seismic performance
- Gain an understanding of the system properties and limitations of use for the TDMF system
- Understand, broadly, the design procedure for the TDMF system

Abstract

This presentation will focus on a new prescriptive method for the design of steel moment frame buildings with supplemental damping provided by fluid viscous dampers – the Taylor Damped Moment FrameTM (TDMFTM). The prescriptive method was developed and validated through the AC 494 and FEMA P-695 procedures to obtain approval as an alternative lateral force resisting system through ICC. The result is a novel approach to damper design for new structures, making the use of dampers more approachable to a wider engineering community than previously available. The TDMF procedure uses Modal Response Spectrum Analysis (MRSA) instead of Nonlinear Response History Analysis (NLRHA) as the basis for evaluation. Additionally, the procedure decouples the design of the moment frame from the damper frame, reducing design iterations. This makes the use of FVDs in new buildings easier to evaluate at schematic level design and significantly reduces the effort for full design.

Dampers, in and of themselves, provide an innovative solution to many complex structural problems – both for new and retrofit applications. Efforts to increase the approachability of damper design adds another critical tool in the toolbox for many engineers who would otherwise have not explored dampers due to barriers of unfamiliarity, intimidation, analysis efforts required through NLRHA and schedule concerns. This novel approach to damper design seeks to remove those barriers.

Nathan Canney, PhD
Director of Structural Engineering, Taylor Devices

Dr. Nathan Canney is the Director of Structural Engineering at Taylor Devices. He joined Taylor in 2020 after working as a structural engineer at CYS Structural Engineers in Sacramento, CA and, before that, MKA in Seattle, WA. Nathan has Bachelor's degrees in Civil Engineering and Applied Mathematics from Seattle University, a Master's degree in Structural Engineering from Stanford University and a PhD from the University of Colorado Boulder. After completing his PhD in 2013, Nathan taught structural engineering for four years at Seattle University before returning to consulting work in 2017. For fun, Nathan plays as an amateur contractor and woodworker, joyfully spending countless hours on home projects and renovations.

A Comparison of Project Approaches in Mass Timber (1.0 PDH)

Brief Presentation Description

Adam will explain how three landmark projects on the west coast are putting the new tall-wood building types to use. He will highlight a Type IV-C workforce housing project in Seattle, a Type IV-B affordable housing project in Portland, and Type IV-A market rate housing in Oakland, showing that Mass Timber can pencil for housing of all types with the right project priorities.

Bullet Point Learning Objectives

- The audience will learn how mass timber is a viable and sustainable construction material
- They will learn now non-structural constraints drove the structural decision making process
- They will learn about speed of construction can be used as the tool of offset for what appears to be a more expensive material

Abstract

The three new mass timber building types in the IBC 2021 code – type IV-A, -B, and -C – have created a new code-approved tool in the toolbox for engineers, architects, and developers. Allowing up to 18 stories with mass timber allows it to compete with concrete and steel buildings, which is proving to be very advantageous. Mass timber buildings have grown in popularity because of their beautiful aesthetic carbon sequestration, but economy of scale of these taller buildings allows a smart design team to capitalize on speed of construction. However it also presents a new level of challenges for structural engineers to tackle, including increased fire rating of members and connections (neither of which are fully defined in the code), ductile detailing requirements in diaphragm design, and the need for holistic system selection to fully realize the mass timber advantages.

Adam Jongeward, P.E., S.E.
Associate Principal, DCI Engineers Portland

Adam Jongeward has been on the forefront of mass timber development in the Pacific Northwest from its onset. From before CLT was popular to the first Construction Type IV-C to Type IV-A , Adam has led the growth of this innovative material.

Designing with Complex Geometries (1.0 PDH)

Brief Presentation Description

Complex geometries require complex structural solutions. However, finding a solution that is affordable and constructible is the difference between making the architect's vision a reality or not. This session will identify tools that can be used to work with complex geometries, as well as showing examples of how complex geometry problems were solved/simplified and brought to life.

Bullet Point Learning Objectives

- Describe methods for extracting structurally relevant geometry from an architect’s 3d Model
- Describe methods for transferring geometry to analyss software and performing structural analysis
- Describe methods for extracting relevant analytical results and displaying these on the geometry model

Abstract

Designing structures with complex geometry presents several challenges to the structural engineer, which span all phases of the design process. While complex geometry projects tend to be unique and require unique structural solutions, there are some tools and techniques which have proven useful time and time again. This presentation will draw from MKA’s experience on several recent projects. Covered topics include software options for geometry and parametric design, working with an architect’s parametric model, methods for developing an analysis model from a geometry model, and techniques for providing on-the-fly design feedback to architects. Using the Amazon Spheres as a case study, further discussion covers rationalizing an architect’s proposed geometry to account for practical limits of fabrication and construction, the design of members which do not follow code-standard configurations, and producing documents which clearly communicate design requirements to the detailer, fabricator and contractor.

The techniques discussed in this presentation were applied to the design of complex projects out of necessity, being the only way to complete these projects. However, we’ve found that the “new tools in the toolbox” that are discussed in this presentation have offered productivity and accuracy improvements on more conventional projects as well.

Robert Baxter, S.E.
Principal, MKA

Robert is a Principal at MKA, a key member of MKA's Sports and Cultural Specialist Groups, and leader of MKA's Advanced Geometry Technical Specialist Team. He has designed facilities for the NFL, NBA, MLS, and several top universities, with structures ranging from small kinetic art installations to 72,000 seat stadiums. Robert focuses on practical methods for realizing architecturally complex structures, with an emphasis on design processes, model interoperability, and fabrication techniques.