# *International Bridge Conference®*

*2025 Technical Program*

**IBC 25-01: Demolition 101: An Introductory Guide to the Bridge Removal Process**

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Throughout the years, Collins Engineers, Inc. has been involved with numerous complex controlled bridge demolition projects. This paper will serve to provide the international bridge engineering community with a practical guide to bridge demolition, conveying common techniques and lessons learned. The process of developing a typical demolition procedure including selecting the appropriate methods of demolition, consideration and analysis of critical limit states specific to demolition, and common challenges faced (along with their solutions) will be discussed. These discussions will be supported using case studies which will highlight the crucial and recurring concepts involving bridge demolition. The paper will also provide a list of frequently utilized reference material for further study and discuss best practices for client communication, providing a comprehensive guide to safe and efficient bridge demolition projects.

**IBC 25-02: Demolition of the I64 Truss over the Kanawha River using Strand Jacking and Balanced Cantilever Demolition**

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The Nitro River Bridge consisted of a 3-span through truss (375’, 562.5’, 375’) including a 250’ pin and hanger drop-in section in span 2. The CL Truss to CL Truss width dimension was 70’-6” and carried both EB and WB traffic. In general, demolition was accomplished by slabbing the bridge, removing stringers, strand jacking the 250’ drop-in section down onto barges, and cutting/picking pieces of the remaining truss while supported by falsework towers. Another unique aspect of the demolition was demolishing a 320’ section of truss over the pier by utilizing a ‘balanced cantilever’ approach which involved designing pier brackets to keep the structure stable while removing truss sections from the cantilever ends. All of these steps required analysis of the truss and falsework to ensure adequate strength and stability, as well as consideration for barge and crane stability. Staged analysis was utilized to estimate the existing truss forces, and preloading applied to minimize the existing member forces prior to cutting steel members. This paper will discuss the truss demolition, including the strand jacking and balanced cantilever components.

**IBC 25-03: Buck O’Neil Bridge Demolition**

Steve Eads Jr., P.E., Genesis Structures, Kansas City, MO; Zach Bardot, Genesis Structures, Kansas City, MO; Kevin Deye, Massman Construction Co, Overland Park, KS

The Buck O’Neil Bridge over the Missouri River in Kansas City consisted of multiple bridge types. The main river unit consisted of three signature tied arch spans that were removed using explosives. The northern end of the northern arch was positioned above a levee wall that was to remain undamaged. A falsework tower was constructed to support the arch structure to remain and the arch was strengthened to resist demands experienced during the explosive event.

**IBC 25-04: NDT-inspection and Initial Residual Service Life Assessment of the Lysefjord Suspension bridge with more than 2000 Main Cable Wire Breaks**

Tobias Friis, Ramboll, Copenhagen S, Denmark

Setting a new benchmark in bridge maintenance, this study delves into the structural health of the Lysefjord Bridge, a suspension bridge spanning 446 meters across Lysefjord in Rogaland, Norway. Featuring a construction with each main cable comprising six parallel laid prefabricated full locked coil cables, the bridge has seen over 2000 wire fractures in just 25 years of service, prompting a rigorous evaluation of its integrity and future viability.

Conducted by Ramboll in 2023 and 2024, this research unfolds in two pivotal segments. Initially, a special inspection combined state-of-the-art non-destructive testing techniques—Magnetic Rope Testing and Guided Wave Ultrasound Testing—with traditional visual assessments to thoroughly evaluate the external and internal condition of the bridge's cables. This phase not only assessed the current state of wire breaks but also reviewed historical inspection data to trace the evolution of these fractures from the bridge's inception to the present, aiming to predict future deterioration patterns. The work describes how the uncertainty arising from a lack of agreement between visual inspections and NDT-inspections is assessed to estimate a likely number of total wire fractures of around 2500.

Subsequently, the project tackled the challenging task of estimating the bridge's residual service life. This comprehensive evaluation employed a variety of engineering approaches, from metallurgical analysis to probabilistic assessments and simulations, underpinned by advanced bridge and cable models. The result is a nuanced understanding of the bridge’s residual lifetime, culminating in strategic recommendations for maintaining its structural health and safety.

**IBC 25-05: Constructing the Benjamin Franklin Bridge's Dehumidification System**

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The Benjamin Franklin Bridge opened to traffic on July 1, 1926, and was the longest suspension bridge in the world with a main span of 1,750 ft. until the opening of the Ambassador Bridge in 1929. The bridge carries Interstate 676/US Route 30 over the Delaware River, connecting the cities of Philadelphia, Pennsylvania and Camden, New Jersey and is owned and operated by the Delaware River Port Authority (DRPA), a bi-state agency.

Following a main cable internal inspection in 2016, the DRPA decided to install a cable dehumidification system on the bridge to prevent corrosion from occurring in the high-strength steel cable wires. In late 2019, a five-part $195 million rehabilitation project began where Part 1 included main cable and anchorage dehumidification, cable band bolt replacement, and acoustic monitoring installation. Parts 2-5 consisted of steel repairs, painting, decorative lighting, and walkway widening/rehabilitation.

Cable dehumidification is a complex blend of structural, mechanical, electrical and controls engineering. It involves the injection of dry air into the cable microenvironment to remove water and sustain relative humidity below a critical threshold where corrosion practically ceases. To date, the Benjamin Franklin Bridge is the fifth bridge in the U.S. and first known previously oiled cable to have had a cable dehumidification system installed.

The project is anticipated to reach substantial completion on schedule in early 2025. The paper will present the project work including best practices to guide bridge owners who are considering the installation of cable dehumidification systems.

**IBC 25-06: A Case Study on the Replacement of OSPD Deck Panels on an Existing Suspension Bridge**

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The A. Murray MacKay Suspension Bridge opened to traffic in 1970 and carries four lanes of traffic over the Halifax Harbour between Dartmouth and Halifax. The suspended structure of the bridge is approximately 740 meters in length and deck system comprises longitudinal stiffening trusses, transverse floor trusses and an orthotropic steel plate deck (OSPD). The OSPD consists of approximately 231 panels which are spliced together with hundreds of thousands of bolts. Each OSPD panel is approximately 9.6 m long and 5.5 m wide.

Recently, the OSPD panels have been shown to be susceptible to fatigue and some panels have experienced fatigue cracking. To address these fatigue concerns, the owner mandated that spare replacement panels be designed and fabricated. Though the exact dimensions of the existing panels vary along the bridge, the panels were designed and detailed the OSPD replacement panels as modular such that they could be used to replace the majority of the existing panels on the bridge. Additionally, HHB decided to move forward with the replacement of two panels on the bridge. Each panel replacement was completed successfully in single weekend bridge closures to mitigate the effect on local commuters.

In this paper, the replacement of two existing OSPD replacement panels is presented including the overall panel design approach, the development of the erection procedures and the structural analysis of the bridge during erection.

**IBC 25-07: Leveraging ABC Techniques for Weekend Bridge Replacements: A Case Study in Traffic Management and Efficiency**

Joseph Tierney, P.E., GFT, Boston, MA

Replacing critical transportation infrastructure in high-traffic corridors poses significant challenges due to potential economic and social impacts. This summary highlights a successful accelerated bridge construction (ABC) project that replaced two bridges carrying 135,810 vehicles daily across two weekends, ensuring uninterrupted traffic flow by alternating closures between the two bridges.

Key techniques included relocating overhead electrical lines, using a zipper barrier for a median crossover, and deploying precast elements such as abutment caps, moment slabs, and bridge units. The team also performed wingwall rehabilitation and concrete closure pours to enhance durability.

Strategic planning and collaboration were essential to success. A comprehensive risk assessment helped anticipate challenges, while detailed construction schedules and traffic management plans minimized disruptions. Public outreach efforts kept residents informed, including flyers, stakeholder coordination, virtual meetings, and real-time messaging boards.

Each weekend closure (8:00 PM Friday to 4:00 AM Monday) allowed one bridge to close while the other managed two-way traffic. This ensured the safe removal and installation of new bridge components, including waterproofing and paving. The four weeks between closures were used for tasks like installing cast-in-place barriers and preparing for the next phase.

The project leveraged innovative solutions, such as the zipper barrier system for traffic control, to enhance safety and efficiency. Early collaboration, stakeholder engagement, and ABC methodologies proved critical in minimizing disruptions and meeting tight deadlines.

This case study provides valuable insights for transportation agencies. It demonstrates that ABC techniques can successfully address urban infrastructure challenges while maintaining traffic flow and reducing construction timelines.

**IBC 25-08: Accelerated bridge construction including helical pile for a railroad truss replacement in an urban environment**

Allen Smith, P.E., S.E., Crawford, Murphy and Tilly, Saint Louis, MO; Jared Wigger, P.E., Crawford, Murphy and Tilly, st louis, MO

TRRA's "Broadway Truss Replacement Design Build" located in downtown St. Louis presented many challenges. The existing MacArthur Bridge is over 120 years old, located in an urban environment, and on a highly traveled rail corridor. The existing railroad span was a 150' double track, through truss over three lanes of a busy street. While one track was supported fully by two railroad truss lines, the other track was supported by both a railroad truss, and an abandoned highway truss. Condition and geometry constrictions necessitated the span replacement. The design-build team was tasked with replacing the bridge spans while maintaining single track service with minimal double track outages.
This paper will explore the difficulties and solutions associated with replacing this open-deck truss span with a ballast deck girder span in a constrained, urban work setting. The complex framing of the bridge required creative solutions for the removal and demolition. SPMTs were used to remove existing trusses and move in the new spans. Temporary girders were used to support the existing center span. Lastly, a contractor innovation was the use of freight containers to support the new girder span assembly.
Helical piles were used as a unique low overhead foundation solution. This is the first known use of these piles to support a rail bridge. Lessons learned in using a foundation with limited existing design standards will be presented. Other topics to be explored will be the issues associated with connecting the new, heavier structure to the existing bridge.

**IBC 25-09: Sonoma Marin Area Rail Transit – Precast Bridge 16.86 over San Rafael Creek (San Rafael, CA)**

Brian Olp, P.E., S.E., STV, Denver, CO

Sonoma Marin Area Rail Transit (SMART) is a commuter rail line between San Rafael, CA and Santa Rosa, CA. As part of a proposed two-mile southern expansion from San Rafael to Larkspur, the rail line crosses San Rafael Creek just south of San Rafael Downtown Station and 2nd street. Two single track, single span structures were proposed to carry the railroad over the creek. STV (Designer) and Stacy-Witbeck/Herzog JV (Design Builder) worked with the agency to develop a unique design solution for these rail structures to solve the site constructability, geometric, and environmental issues.
A concrete trough bridge section consisting of precast, prestresssed elements connected by post-tensioning was developed which achieved the required low structure depth. This design section simulated a cast-in-place section but utilized high quality precast elements.
To meet the aggressive schedule, the proposed precast element solution avoided the need for cast-in-place concrete and any falsework required within the channel, which was restricted due to the environmental permit.
The brackish water at this tidal inlet location created a very corrosive site condition for all the bridge elements. This was mitigated by use of epoxy coated rebar, increased concrete cover and special corrosive resistant concrete mixes to achieve the desired 100-year design life.
The contractor leveraged the precast bridge concept to stay out the channel and accelerate the construction schedule during the limited build window. The construction utilized special temporary support brackets on the precast girders along with timber struts to build the structure, which required no traditional falsework.

**IBC 25-10: Repairs to the Historic Tombigee River Hwy 182 Bridge**

Joe Knapp, P.E., Genesis Structures, Kansas City, MO; Randy Boudreaux, Neel-Schaffer, Jackson, MS; Steven Bowen, P.E., Malouf Construction, Greenville, MS

The historic Tombigbee River Bridge in Columbus, Mississippi, has encountered numerous challenges throughout its nearly 100-year history. In February 2020, a runaway barge struck the eastern river pier, displacing it by nearly 12 inches and jeopardizing the two supported truss spans. Neel-Schaffer Engineering and Malouf Construction collaborated to devise an innovative method to temporarily support the precariously positioned bridge spans, enabling the removal of the damaged pier and the construction of a new one. The new permanent piers were constructed directly upstream and downstream of the existing pier, designed to accommodate an overhead gantry system to support the two spans. Once the spans were supported by the gantry system, the existing pier was demolished. A precast footing and riser were then floated into position between the gantry legs and onto the new piers. This paper and presentation will delve into the unique history of the Tombigbee Bridge, previous repairs conducted by the same engineering and construction team, and the design and execution of the latest repairs.

**IBC 25-11: Increasing Interstate Vertical Clearances in an Urban Environment**

Scott Fisher, Virginia DOT, Colonial Heights, VA; Eric Thornton, P.E., CCM, Virginia DOT, Colonial Heights, VA

The Richmond Bridge Rehabilitation Bundle includes five VDOT owned bridges over I-95 in the City of Richmond: 1st Street Bridge, 4th Street Bridge, 5th Street Bridge, 7th Street Bridge, and Broad Street Bridge. These five bridges were designated as structurally deficient.

The original structures had been plagued with vehicle strikes as the vertical clearance on all five structures was sub-standard (averaging ~14'-5"). The scope of the project was to increase the vertical clearance to a minimum of 15'-0", close the joints, and rehabilitate the substructures. The Design-Builder was able to use innovative techniques and increase the vertical clearance on all bridges a minimum of nearly 16'-0" and in some cases up to 17'-4".

This was an extremely challenging project due to the heavy traffic flow in the I-95 corridor, multiple major utilities that needed to be suspended (and kept in service) over the interstate during the phased demolition and construction of the superstructure, and the urban constraints that would not physically permit extensive roadway bridge-approach work.

Four of the bridges were able to be reconstructed using conventional phased bridge replacement techniques (while suspending the existing electrical conduits). The Broad Street Bridge was reconstructed with Accelerated Bridge Construction techniques over the course of 4 weekends. ABC techniques were chosen to minimize the disruption to the City of Richmond's busiest roadway and minimize impacts to the Virginia Commonwealth University (VCU) hospital/emergency room.

**IBC 25-12: Crawford Avenue Bridge Rehabilitation - They don't make them like they used to and that's okay.**

Matt Pierce, P.E., Benesch, Cranberry Township, PA; Jason Lewis, P.E., Benesch, Cranberry Township, PA; Dominec Caruso, P.E., Pennsylvania DOT, Uniontown, PA

The Crawford Avenue Bridge carries PA 711 over the Youghiogheny River and CSX railroad, and is a focal point for residents, commerce, and recreational users within downtown Connellsville, PA. Constructed in 1959, the existing six-span steel superstructure used conventional pin and hanger details at four locations supported by rocker bearings on lightly reinforced concrete gravity substructures. The project scope of work included a superstructure replacement to eliminate the pin and hangers, a reduction of the existing seven deck joints, bearing replacements, and improved multimodal function for vehicles, pedestrians, and cyclists. Design challenges included: deck typical section and barrier type selection for multimodal use with stakeholder involvement; unbalanced span arrangement for continuous steel beam design resulting in uplift conditions, non-standard bearing designs, and unusual deck pour sequencing; and strut-and-tie modeling of deep concrete pier caps. Design solutions included using several unusual non-standard details such as the Rutgers Barrier, installing a deadman system to provide fixity at an abutment, and using sliding plate elastomeric bearings to accommodate both a 490' expansion length and uplift. Construction proved equally challenging with river flooding at near record levels, locating and avoiding existing reinforcement, steel erection and fit up given difficult vertical geometry, temporary utility support, barrier construction, and discovering historic bridge anchorages. This presentation will review the challenges, solutions, and lessons learned to improve the Crawford Avenue Bridge while demonstrating that they don't make them like they used to and that's okay!

**IBC 25-13: Chesapeake Bay Bridge Deck Replacement Using Accelerated Bridge Construction**

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The Maryland Transportation Authority (MDTA), as part of a continuous effort to preserve the condition and working order of the William Preston Lane, Jr. Memorial (Chesapeake Bay) Bridge, has engaged in Phase 1 of a multi-phased deck rehabilitation program at the four-mile long two-lane Eastbound Bay Bridge, which was opened to traffic in 1952 with prior deck rehabilitation works in 1973 and 1986. A Construction Manager at Risk (CMAR) project delivery method was selected by MDTA to include the Contracting Team in this complex project from design through construction completion. The scope of work includes removal of existing concrete deck and floor system as 30-foot units, called panels; installation of new prefabricated deck panels comprised of Exodermic™ deck, composite stringers and floorbeams; strengthening of selected truss members and gusset plates; new bearing installations; and utility relocations. The new prefabricated deck panels are four feet wider than the existing deck and include MASH TL-4 barriers. Specially designed link-slabs make the deck continuous between new prefabricated deck panels. Working with consultant designers and the Contractor to utilize available nighttime lane closure windows, a method to replace deck panels overnight was implemented. The Contractor's means and methods include the use of marine construction and large barge mounted cranes to prepare before lanes are closed to traffic, allowing efficient use of available windows. This approach prioritized reduction of impacts to the traveling public while maximizing efficiency of construction progress, all while working from the water on deck elevations ranging from 90 to 180 feet.

**IBC 25-14: Underwater Concrete Repairs on the Eastbound William Preston Lane, Jr. Memorial (Chesapeake Bay) Bridge**

Ruel Sabellano, D.Eng., P.E., M.ASCE, Maryland Transportation Authority, Baltimore, MD; Scott Nugent, Marine Solutions Incorporated, Rosedale, MD; Gregory Desing, Pennoni, Virginia Beach, VA

The Maryland Transportation Authority (MDTA) utilizes a comprehensive underwater inspections every four years on bridges with substructures in water. Following underwater inspections at the Eastbound William Preston Lane, Jr. Memorial (Chesapeake Bay) Bridge, areas of exposed steel reinforcing and concrete spalling were reported on two isolated locations. Due to the specialized nature of the underwater concrete repairs, including working at depths up to 75 feet below water level, MDTA utilized two AE firms with specialized engineering and commercial diving capabilities. Marine Solutions performed underwater concrete repairs and Pennoni performed underwater construction inspection of the repairs. The approach to performing these challenging underwater repairs involved locating and assessing the current conditions warranting repair, cleaning the areas by 4k psi water pressure to remove marine growth and loose concrete, installation of steel stay in place forms attached by concrete anchors along edges, sealing of form edges and pumping of grout. Grout was pumped from the lowest ports to the highest ports, ensuring the forms are completely filled with grout, all while continuously monitoring for leaks. Utilizing separate diving equipment to perform construction inspection, Pennoni verified each step of the construction process before moving forward. Monitoring and maintaining proper slump and water mix ratio of the grout was a critical factor to ensure proper water displacement.

**IBC 25-15: Suicide Deterrents Save Lives**

David Konz, F.SEI, P.E., S.E., AtkinsRéalis, Tampa, FL; Hilda Hilferding, AtkinsRéalis, Tampa, FL

Research revealed nearly 50% of attempts are within 10 minutes from when the person began thinking of suicide. Studies indicate suicide rates decline when lethal means are less available and nearly 90% of those intercepted will never attempt suicide again. Many bridge operators are facing a critical safety problem, and industry collaboration is the solution.

The Bob Graham Sunshine Skyway Bridge in St. Petersburg, Florida has a 1,200-ft main span with 175-ft vertical clearance and complex aerodynamics. In the five-year period 2016-2020, the bridge was ranked the fourth highest for suicides in the USA.

A critical safety project investigated 22 bridges globally with deterrents in place to provide an unbiased summation of current solutions. A customized decision matrix was used to rank options based on predefined parameters. The top alternatives were recommended for further study, including full-scale mock-ups to evaluate visibility, climb-ability, strength, and durability. The final design aimed to create a physical deterrent that would stop or delay individuals and allow authorities time to intercept.

Many challenges for this project are relevant to other structures globally. The 1.5mm stainless steel netting is difficult to climb and is durable in the coastal, chloride-rich environment. Hurricane Milton in October 2024 proved the system is resilient to extreme events. Ice accretion models were used to address northern climate solutions that must consider increased surface area. Snooper truck clearances ensure inspections activities can continue unimpeded.

Since constructed, only 1 suicide has been confirmed and hundreds of attempts were prevented. THIS PROJECT SAVES LIVES!

**IBC 25-16: LRFR Load Rating of Horizontally Curved Composite Steel Tub-Girder Bridges: An Illustrations**

Paul Biju-Duval, Finite Element Analysis Ltd., London, United Kingdom; Philip Icke, Finite Element Analysis Ltd., Kingston United Kingdom; Paul Lyons, Finite Element Analysis Ltd., Kingston, United Kingdom

Load rating is the process by which the live load capacity of bridges is determined. This paper presents a software-agnostic, detailed workflow on how the latest load and resistance factor rating (LRFR) methodology can be implemented for horizontally curved composite steel tub-girder bridges (also referred to as steel box girder bridges) using refined analysis methods, as required by the Manual for Bridge Evaluation. While these shell-based methods were long deemed time-consuming, the automation of the curved geometry finite element modelling as well as the user-friendly extraction of moments and shears under a variety of traffic load models now enable engineers to more accurately predict the bridge safety, which in turn reduces the risk of costly and unnecessary traffic restrictions and bridge strengthening or repairs.

**IBC 25-17: Greater Cleveland Regional Transit Authority Waterfront Line Bridge Rehabilitation**

Howard Swanson, P.E., S.E., H&H, Atlanta, GA; Charlie Graning, PCL Construction Inc, Tampa, FL

Transit services are provided in Cleveland, Ohio by the Greater Cleveland Regional Transit Authority (GCRTA). The Waterfront Line provides service from downtown to the Lakefront. The Waterfront Line Bridge is a 5-span segmental concrete box bridge that is 645 feet long. It crosses over Front Avenue and Norfolk Southern Railroad. Significant concrete cracks in the bridge were found and rail operations were halted. The bridge has significant curvature and had rail expansion problems on the approaches. H&H was selected to inspect the structure and design repairs to allow the bridge to be placed back in service. The presentation focuses on the construction activities associated with the rehabilitation.

**IBC 25-18: Portage Bay – A segmental bridge built in an active landslide**

Bradford Shaffer, P.E., S.E., AECOM, Seattle, WA; Keith Lee, P.E., AECOM, Sacramento, CA; Bryce Binney, P.E., AECOM, Denver, CO; Drew Miller, P.E., AECOM, Tampa, Florida; Rasha Jasim, P.E., AECOM, Seattle, WA

The Portage Bay bridges are nearly twin viaducts set to replace the existing seismically vulnerable Portage Bay Bridge. The two structures each are built at 5 piers by semi-balanced cantilever cast-in-place segmental construction, for a total of 12 spans and a bifurcated off-ramp structure on the south bridge. The bridges are stipulated to be reviewed and approved architecturally by the Seattle Design Commission for the aesthetics in a high profile location on Portage Bay, right adjacent to the University of Washington Alaska Airlines Husky Football Stadium. The bridges are stipulated as seismic Recovery Level Bridges per WSDOT, similar to AASHTO's Critical Bridge definition. Both bridge have their first 3 piers placed directly in an active landslide, which requires additional protection of the piers from the landslide flow. The bridges are part of a total project involving 3 interurban trail bridges connecting the regional trails, of which are carried on the south Portage Bay Bridge. A lid structure adorns the western approach of the bridges with spectacular views of Lake Washinton, the Cascade Mountains and the Olympic Mountains.

**IBC 25-19: ESCR Tied Arch Pedestrian Bridges**

Silvio Garcia, H&H, New York, NY; Kevin Lee, H&H, New York, NY; Eric Ilijevich, New York City Department of Design and Construction

Ongoing climate change has resulted in rising sea levels and more severe coastal storms. The East Side Coastal Resiliency (ESCR) project seeks to improve the overall climate resiliency of local properties, businesses, schools, and critical infrastructure and to protect local residents from the threats of future storm surges and flooding. Part of a larger plan for a comprehensive coastal protection system around the entirety of lower Manhattan, the project entails the construction of an integrated flood protection system consisting of raised parkland, floodwalls, floodgates, and storm drainage infrastructure improvements.

H&H played a leading role in the design of two new steel tied arch pedestrian bridges, the 209 feet long Delancey Street Bridge and 151 feet long E10th Street Bridge, over the FDR Drive and their associated accessible approach structures which connect the new raised parkland along the waterfront to the existing upland residential communities. Our comprehensive professional engineering services encompassed conceptual, preliminary, and final design and construction support for the bridge replacements, which were constructed using Accelerated Bridge Construction (ABC) techniques using self-propelled modular transporters.

The project posed a unique engineering challenge and setting for bridge design and construction as the need for the new bridges stemmed directly from an environmental context. The two bridges were envisioned to be signature structures that complemented the overall aesthetic of the surrounding neighborhood and parkland, reflecting the architect's vision of lightness and modernity in the bridge geometry and profile while achieving a harmonious blend of functionality and elegance.

**IBC 25-20: Schuylkill River Trail Cable-Stayed Pedestrian Bridge**

Trevor Kirkpatrick, AECOM, Tampa, FL; Joel Cummings, AECOM, Philadelphia, PA; Keith Lee, AECOM, Sacramento, CA; Nick Green, AECOM, Tampa, FL, United States; Bob Anderson, AECOM, Tampa, FL

The Schuylkill River waterfront in Philadelphia south of the Fairmount Water Works, once an industrial hub, had fallen into neglect by the mid-20th century. In 1992, the non-profit Schuylkill River Development Council (now The Schuylkill River Development Corporation (SRDC)) began fundraising for a riverfront trail and park. The City of Philadelphia, SRDC, federal, state, and private partners, have invested over $94 million, leading to significant improvements in the built environment and neighborhood revitalization along the completed sections of trail and greenway. The latest addition is a half-mile trail featuring a stunning 600-foot cable-stayed bridge with a graceful "S-curve" horizontal alignment. The twin towers, rising 139 feet above the deck, each anchor 28 wire rope cables. These cables hold up curved, precast, post-tensioned concrete U-beams and a 25-foot-wide bridge deck with circular overlooks at each tower, offering magnificent views of the river and city skyline. The deck is hinged at mid-span to mitigate post-tensioning losses. Tuned mass dampers were installed inside the U-beam to minimize vibrations and improve pedestrian comfort. Each tower is founded on nine 6-foot diameter drilled shafts to resist gravity, vessel collision and ice loads. Above the deck, the towers taper in two directions, adding dimensional interest. The cables are arranged in a unique basketweave pattern and use elegant pin-and-clevis anchors for a streamlined look. Aesthetic lighting and pedestrian benches enhance the user experience. The design focuses on conventional construction methods and minimizing future maintenance while providing an architecturally sensitive solution that reflects the spirit of Philadelphia.

**IBC 25-21: Integrated Construction Methods of Cable-Stay Pedestrian Bridges**

Matthew Cardamone, PKF Mark III Inc., Newtown, PA; Stephen Carullo, PKF-Mark III

The Schuylkill River waterfront in Philadelphia has been revitalized with the construction of the Christian Crescent Main Span, an iconic 3-span concrete cable-stayed pedestrian bridge with a 600-foot "S-curve" alignment. PKF's segment of the trail spans nearly 3,000 linear feet, providing an off-road connection between Fairmount Water Works and Bartram's Garden, two National Historic Landmarks. The bridge's structure rests on caisson foundations composed of 18 six-foot diameter shafts, each permanently cased two feet into bedrock with variable-length rock sockets. The scale of the foundations is impressive; the area encompassed by the footings can nearly fit within a high school basketball court, and each cap weighs over 2.6 million pounds. Additionally, the tower pylons, which required custom formwork and innovative cambering to counteract deflection over time, achieving vertical alignment approximately 27 years post-construction. The temporary supports for the precast U-beams involved 400,000 pounds of temporary steel towers and falsework, featuring over 5,000 linear feet of welds and 2,324 bolts, all of which were removed once cable installation was complete. Unique construction challenges included the transportation and precise placement of 130-ton precast, post-tensioned U-beams, during specific tides, by barge crane, as well as the detailed installation of basket-weave pattern cables that enhance both structure and aesthetics. This project exemplifies the integration of structural resilience, design precision, and long-term durability.

**IBC 25-22: A New Iconic Bridge for Brisbane**

Thomas Cooper, WSP, Melbourne, Victoria  Australia; Andrew Gallagher, WSP, Brisbane, Queensland  Australia

The Kangaroo Point Bridge is a 458-metre long, cable stayed bridge to be situated over the Brisbane River in Brisbane, Australia. It is the first of eight "green" bridges proposed by the Brisbane City Council to promote pedestrian, cycle, and e-transport across the city, connecting the built-up inner-city suburb of Kangaroo Point and the Central Business District

Crossing the Brisbane River as it winds through the central business district (CBD), the bridge will connect to two very active areas of the city, the densely residential Kangaroo Point and the centre of the CBD at the Brisbane Botanical Gardens. With a composite steel box superstructure and nearly 100-m tall steel box tower, the 183-metre asymmetric cable-stayed main span, paired with the narrow width required for a pedestrian bridge, is one of the longest of its kind internationally.

The structure's dynamic response for wind and pedestrian (footfall) comfort criteria has been considered through wind studies, wind tunnel testing, and advanced structural analysis. This project has been delivered with a parametric digital model (300LOD), where the bridge geometry is controlled by parametric scripts.

Pedestrians are separated from cyclists and e-transport users by ample width and line marking along the bridge's 6-meter-wide deck. The pedestrian path is shaded by a canopy supported on tapered steel posts, which cantilever at intervals from the northern edge beam. The bridge is also home to a restaurant raised above the deck near the entrance on the Botanic Garden side of the river.

**IBC 25-23: Historic Route 66 Bridgeport Bridge Rehabilitation**

David Neuhauser, P.E., STV, Inc., Oklahoma City, OK; Jose Joseph, P.E., STV, Frisco, TX

The William H. Murray “Pony” Bridge, known as the Bridgeport Bridge, is a 90-year-old structure that functions as a slice of America history. Beloved by Route 66 and bridge enthusiasts alike, the iconic Bridgeport Bridge in Oklahoma boasts 38 unique 100-foot pony truss spans that attract tourists from around the world. After years of use coupled with changing traffic patterns, the aging bridge was rated structurally deficient, threatening potential closures to traffic and heavier vehicles.
The Oklahoma Department of Transportation (ODOT) selected STV to serve as lead designer for the bridge’s long-anticipated revitalization. STV also provided reconnaissance data collection, stakeholder coordination, and an Alternatives Analysis Report study during the project’s planning stage.
Tasked with preserving the bridge’s iconic features, STV’s design team developed the first highway bridge in Oklahoma to use full-depth precast concrete deck panels and Ultra-High Performance Concrete (UHPC) joints. The widened bridge can now safely carry more vehicles across the South Canadian River, while the new parking lot and viewing area at the end of the bridge make it easier for tourists to experience this Route 66 destination.

**IBC 25-24: Rehabilitation of the Historic Monument Place Bridge**

Matthew Bunner, HDR, Pittsburgh, PA; Anthony Ream, HDR, Pittsburgh, PA; Ahmed Mongi, HDR, Charleston, WV

The Monument Place Bridge, constructed in 1817 near Wheeling, was a part of the original National Road and is the oldest bridge in West Virginia and among the oldest bridges still in service in the country. The bridge is a unique and rare example of a three-span stone arch that features the elliptical style of arch geometry. The structure was updated in 1931 when the original barrier walls were removed and replaced with overhanging concrete sidewalks and balustraded parapets. In 1958, a concrete shotcrete was applied over the stone, giving it the appearance of a concrete arch bridge.

Over the years, the original masonry along with the updated portions of the bridge had deteriorated significantly. This project involved the investigation and evaluation of the condition of the bridge, including analysis. Various rehabilitation options were evaluated, and final design of the selected scheme was performed. The project team dealt with many complexities including lack of design information, obscured portions of the structure, coordination with FHWA and the SHPO due to the historic nature of the bridge, adjacent properties and utilities, and preserving the appearance while upgrading the bridge, which remains on a well-traveled portion of US Route 40.

Tools such as LiDAR survey, pilot contracts for removal of portions of the shotcrete, geotechnical and material testing, masonry arch analysis, and photo documentation were utilized. This presentation will present both design and construction phases of the project, which will be complete before IBC 2025.

**IBC 25-25: Adaptive Reuse of the Historic Mount Carbon Bowstring Truss**

Brian Teles, P.E., GFT, Audubon, PA

PennDOT discovered a rare bowstring truss in Mt. Carbon, Schuylkill County, prompting a project supported by numerous stakeholders to provide new life for this unique truss. The project involved the relocation, restoration, and adaptive re-use of an 1878 NRHP eligible truss which has had four owners and three locations. The truss is part of a new trail for the Schuylkill River Greenway Association over Mill Creek in St. Clair, PA.

This truss was perfect to use as a pedestrian bridge for the Adaptive Reuse program for relocating historic trusses to extend trail networks. It is on a publicly accessible trail, and is in a highly visible location near SR 61 and a shopping center. It tied into the center’s industrial theme and presented an opportunity to publicly showcase the County’s history.

Not only was restoring a bridge originally a challenge but moving it from one location with limited access and fitting it into its new location took careful planning. Construction consisted of lifting the bridge in its entirety and moving to a staging area to be disassembled. It was shipped to an Ohio blacksmith who used new hot driven rivets to restore the truss. At the new location, new abutments were constructed, and the staging area was prepared for reassembly. With an even tighter window, the contractor had to truly thread the needle to place the bridge onto the new abutments.

The project is an excellent example of preserving historical structures via adaptive re-use on multi-modal transportation infrastructure.

**IBC 25-26: Pier Replacement with Temporary Crash Wall**

Gregory Stolowski, P.E., WSP USA, Lawrenceville, NJ; Anand Patel, WSP USA, Lawrenceville, NJ; Alexandra Beyer, P.E., WSP USA, Lawrenceville, NJ

The rehabilitation of the historic 3.5-mile Pulaski Skyway, connecting Jersey City to Newark, NJ, presented a unique challenge: replacing Pier 20 and its bearings on Spans 19 and 20. Limited space around the pier, including Conrail tracks and low headroom, demanded innovative solutions. This project implemented a multi-functional crash wall system. It served as temporary support for the superstructure during Pier 20 replacement, withstanding extreme loads from both construction and potential collisions. Importantly, the design also transitioned seamlessly to become a permanent crash wall after construction, protecting the bridge from future impacts. Micropiles were used due to limited workspace and low vertical clearance. This presentation will detail the design considerations for the crash wall's dual functionality, the construction methods addressing site constraints, and the crucial coordination with Conrail, surrounding utilities, and the New Jersey Department of Transportation (NJDOT).

**IBC 25-27: Yellowstone River Bridge Replacement – Unique Solutions in a Unique Environment**

Bob Sward, P.E., Structural Technologies, LLC, Fort Worth, TX; Sean McAuley, P.E., JACOBS, Denver, CO

The Yellowstone River Bridge Replacement project utilized a number of unique details, construction methods and technologies to build a long span, high level crossing over the Yellowstone River in Yellowstone National Park. The new bridge stands 175' above the river and spans geothermal and hydrothermal hazards in a remote area of the country with limited construction access and seasons. The bridge features segmentally constructed precast columns to maximize the summer construction season along with lead-rubber bearings for improved seismic performance. The lead-rubber isolation bearings allowed the team to balance the stiffness of the structure and provide a primary response to seismic demands which should limit total damage to the structure in earthquakes. The columns also featured detailing for improved seismic ductility, featuring grouted energy dissipating reinforcement within the bottom column segments and microcrystalline-wax filler in the PT tendons to allow distribution of strains and prevent tendon rupture at joint openings. The steel girder structure was designed and constructed to lay lightly on the land and minimize both visual and physical impacts to the surrounding landscape.

**IBC 25-28: CTA Harlem Transit Station Bus Bridge Replacement - Multi Discipline, Design, Construction & Innovation**

Irsilia Colletti, P.E., S.E., HNTB, Chicago, IL; Tony Shkurti, Ph.D., P.E., S.E., HNTB, Chicago, IL; David Budzik, HNTB, Chicago, IL

The CTA Blue Line Harlem Station Bus Bridge Rehabilitation replaces the existing three-span steel superstructure with an improved two-span continuous steel girder design which will reduce the number of expansion joints on the bridge from three to zero, maintain the limited existing clearances to the interstate highway below, and utilize the existing substructure units and foundations. The length of one span was increased by 150% to replace two spans on the existing bridge while maintaining the same structural depth due to clearance and vertical profile restrictions. The innovations that facilitated the design include conversion of the existing stem wall abutments to semi-integral, an integral steel pier cap fabricated as one transportable unit that are supported by three steel W columns with a portion of the girders up to splices on either side of the cap and geophysical testing which justified an increase of the capacity of the pier foundation. The integral pier cap also features a large web opening beyond the scope of AISC design guidance, which led to the design of an innovative web opening reinforcement detail using nonlinear FEA buckling analyses.

**IBC 25-29: Reprofiling of An Existing Cable Stayed Bridge - US 17/SR 404 SPUR BRIDGE**

Meng Sun, P.E., S.E., Parsons Transportation Group, Denver, CO; Robert Orsa, Parsons Transportation Group, Denver, CO; Greg Shafer, Parsons Transportation Group, Baltimore, MD; Kira Hamilton, Parsons Transportation Group, Denver, CO; Gernot Komar, Denver, CO

The US 17/SR 404 Spur Bridge (Talmadge Memorial Bridge), a pivotal cable-stayed structure connecting Savannah and Hutchinson Island, is undergoing a significant $189-million maintenance and upgrade project. Originally completed in 1991, the bridge currently features a 1,100-ft main span carrying State Route 404 and US 17, with a 185-ft clearance over the Savannah River, which restricts the Port of Savannah's ability to accommodate the largest modern container ships. The proposed solution is to raise the bridge profile by shortening the stay cable so that the bridge air draft reaches 206 ft.

Cable geometry is one of the critical design items for the bridge reprofiling. The cable length, cable angle, permanent angle deviation, cable shortening, and cable stressing length have been evaluated from the surveyed bridge profile to the final raised profile. Construction staging models have been developed to analyze the detailed cable stressing and bearing jacking sequence and steps with consideration of temporary loading on the bridge. Fifteen main cycles with over 500 steps were evaluated to account for local and global effects in the overall structure. The bridge capacity has been evaluated for service and strength limit state during the profile raise. The final bridge geometry has been cambered to compensate the long-term time dependent effect of aged concrete under the new loading.

**IBC 25-30: The Mast: Designing a Signature Cable Stayed Pedestrian Bridge**

Hunter Ruthrauff, TYLin, San Diego, CA; Bobby Sokolowski, P.E., TYLin, San Diego, CA

Inspired by the naval history of Erie, PA, the Holland Avenue Pedestrian Bridge is a cable stayed structure that crosses over the Bayfront Parkway connecting the core of downtown to the waterfront. The structure features a "mast-like" steel pylon and an asymmetric stay arrangement that is reminiscent of sails commonly seen in ships of Erie's past. The project is also highly focused on landscape integration as seen in its northern approach where the pathway snakes up to the bridge elevation with planters and trees interspersed throughout. The project also focuses on social space activation around key structures such as a halo bench around the base of the pylon and an overlook region at the apex of the northern approach.
This presentation will walk viewers through the origins of concept development including the type selection process that studied a variety of alternatives that ultimately led to the emergence of the alternative that is currently in construction. The presentation will also focus on the parametric design workflows from an architectural sense along with the interoperable programs used for structural analysis and the rebar model that was critical in identifying conflicts during construction documentation. The presentation will cap off with a review of the current state of construction and the challenges and solutions that have arisen during that process.

**IBC 25-31: Inspection of Modern Stay Cable Systems**

Mark Saliba, P.E., Freysinet Inc., Sterling, VA

Modern Stay Cable Systems, used almost exclusively in the US over the last 25 years, and for longer periods in regions outside the US. Modern Stay Cable Systems consist of parallel 7-wire strands, individually protected against corrosion, installed inside pipes; without filling the void space with the pipe. Systems installed for the prior 25 years generally consist of parallel wires or 7-wire strands installed inside pipes, and once tensioned to final loads the pipes were injected with cementitious grout for corrosion protection.
Advantages provided with Modern Stay Cable Systems include the ability to perform complete and thorough inspections from end to end. Modern Stay Systems also offer the ability repair, remove and/or replace individual stands, various system components and if needed, complete detensioning, removal and replacement of an entire stay cable. A most attractive feature is all these activities can be performed with the bridge in-service, and many performed with minimal impact on traffic.
Case studies of inspection programs will present the scope of recommended inspection tasks, including frequencies, corrective actions, means and methods and explain routine and special inspections. Typical findings will be presented as will the value of well documented asset inspection data to understand the findings year-over-year, allow for re-allocation of inspection efforts, frequencies, etc.
Implementation of a comprehensive inspection and maintenance program removes the risk of a relatively minor issues (caused during construction or early in-service) being undetected and left unattended, developing into very significant issues requiring expensive repairs/replacements and severe traffic impacts in the future.

**IBC 25-32: A Bridge Widening at an MSE Retaining Wall Conflict**

Cory Shipman, P.E., HDR, Dallas, TX; Jeffrey Svatora, HDR, St. Louis Park, MN; Stanley Oghumu, HDR, Dallas, TX

Mechanically Stabilized Earth Retaining Walls (MSE) are commonly used to wrap around a bridge abutment. However, this can present challenges to future designers when widening the bridge. The existing MSE straps conflict with proposed deep foundations and construction operations can cause distress in existing wall panels. HDR encountered this design scenario when widening twin bridges on the Sam Rayburn Tollway over Hebron Parkway in Carrollton, Texas. HDR met with the North Texas Tollway Authority to discuss potential solutions and, after considering several solutions, decided to support the proposed widening in front of the existing MSE Retaining Wall. To support the interior widening of the bridge, a new support bent was designed and constructed immediately in front of the MSE wall. This resulted in new girders cantilevering approximately 5 feet over the support bent and MSE wall embankment. The existing beams remained simply supported at the existing abutment behind the MSE wall. This difference in geometry caused a differential deflection issue between the cantilever ends of the proposed beams and the existing beam ends supported on bearings. With the application of loads at midspan, the ends of the proposed girders tend to deflect upwards, relative to the existing simply supported beams. As a result, high stresses in the deck are generated. These stresses are further amplified due to the relatively narrow beam spacing of 5.5 feet. A refined analysis was performed for this problem utilizing a 3D plate and eccentric beam model in LARSA with a 2D influence surface.

**IBC 25-33: Fatigue Assessment of Long Span Steel Bridges**

Neerajkumar Desai, Associated Engineering Consultants, Mumbai, Maharashtra  India; Jayashree Desai, Associated Engineering Consultants, Andheri West, Maharashtra  India

The process of progressive localized permanent structural change occurring in a material subjected to conditions which produce fluctuating stresses and strain at some point or points and which may culminate in cracks or complete fracture after a sufficient number of fluctuations is known as Fatigue phenomena.
This paper describes the considerations involved in the design and fatigue assessment of various types of steel bridges for different types of loading i.e highway, metro rail and broad gauge railway through case studies of projects executed recently. The primary focus is in the domain of Railway bridges wherein a large volume of traffic and high cyclical loadings are experienced over the service life. The paper draws upon experience gained in design of long span trusses ranging from 47.0m to 103 m covering different types of connections and classification of welds as per EURO and IRS/BIS norms.
It is observed that several attachments such as batten plates, diaphragm plates in tension chords and lacings in tension diagonals and several other such secondary attachments to primary load carrying members have the effect of reducing the fatigue category.
The robustness and economy of the design depends not only upon selection of optimal section sizes but also the type of weld detail class and welding methodology adopted so also the ease with which the fabrication can be done. The practical difficulties associated with the fabrication of long span trusses with welded/bolted connections needs extensive planning in design office to give an economical and robust design.

**IBC 25-34: Refined Load Rating of a Bridge with Unique Reinforced Concrete Arch and Stringer-Floorbeam Spans**

Lung-Yang Lai, Ph.D., P.E., S.E., Specialty Engineering, Inc., Bristol, PA; Garry Calotta, P.E., Pennsylvania DOT, Allentown, PA; Andrzej Trela, P.E., Pennsylvania DOT, Allentown, PA; Brian LoCicero, P.E., Specialty Engineering, Inc., Bristol, PA

The American Parkway Bridge in Allentown, Pennsylvania was originally constructed in 1956。 The bridge consists of cast-in-place reinforced concrete and steel approach spans, and the main span is a reinforced concrete open-spandrel arch structure。 The bridge was widened in 1987。 The widened portions of the superstructures in the concrete approach spans and arch span were constructed with pre-cast concrete members。 In 2015, some members in the concrete approach spans and the arch span were strengthened with CFRP due to cracking and spalling on many stringers and cross beams。
A load rating was conducted using the Load Factor Design (LFD) methods along with an in-depth inspection。 Load rating of the cast-in-place concrete structure required combining three-staged analyses considering staged-construction。 Three-dimensional analyses were used to compute axial forces and moments in the arch ribs and columns。 Axial force and Moment (P-M) capacity curves based on strain compatibility were developed for the load ratings of arch ribs and columns。 The concrete stringers and floorbeams in the concrete spans support two-way slabs, in contrast to one-way slabs in typical bridge structures。 Two-dimensional analyses showed that live load distributions are different from the AASHTO live load distribution factors。 From the 3-Dimensional analyses, torsional forces were observed in some concrete stringers and floorbeams。 The torsional effects were not observed with typical line girder analyses and could be the reason for the observed cracking。 The effects of CFRP strengthening were also studied。 It was determined that some strengthening may not be as effective as expected。

**IBC 25-35: Construction of the Hawk Falls Deck Arch**

Josh Crain, Genesis Structures, Kansas City, MO; Jarred Musser, Trumbull Corporation, Pittsburgh, PA; Nick Graczyk, Trumbull Corporation, Pittsburgh, PA; Dave Rogowski, Genesis Structures, Kansas City, MO

This paper examines the construction challenges faced during the erection of the 480-foot Hawk Falls Deck Arch Bridge, which spans Mud Run in Penn Forest and Kidder Townships, Carbon County. As a true arch bridge, construction methods necessitated careful consideration of geometry control to ensure successful closure. The decision-making process surrounding the use of falsework towers versus tie-back systems is explored in detail, highlighting the trade-offs in terms of stability, cost, and construction efficiency.

The paper highlights the unique challenges and complexities posed by the three variable camber arches, which required careful consideration for fit-up during erection. The paper delves into the logistical considerations of employing two 1,200-ton Liebherr LR 11000 crawler cranes for setting arch segments at radii of up to 420ft. Through this case study, the paper aims to contribute to the broader discourse on arch bridge construction, providing valuable lessons for future projects facing similar challenges spanning complex terrains.

**IBC 25-36: Design and Construction of an Airplane Carrying Bridge for MidAmerica Airport**

Tony Shkurti, HNTB Corporation, Woodridge, IL; Allen Smith, Crawford Murphy and Tilly; Peter Busch, HNTB, Chicago, IL

MidAmerica St Louis Airport is a public use airport with a joint use agreement with Scott Air Force Base. It is because of this agreement that Boeing chose to expand their operations and build a production facility for their Unmanned Aerial Refueler (aka refueling drone). The ideal location for the production facility required a new taxiway and taxiway bridge that spanned over a small flood prone creek. The hydraulic analysis of the floodplain led us to a four span bridge with length of 419'. FAA design criteria for Taxiway Safety Area on bridges led us to a bridge width of 179'.
After a detailed bridge type study where several superstructure types were investigated, the team proposed a closely spaced prestressed concrete bridge which was determined to be cost effective a more maintenance free.
The engineers were then tasked with designing a bridge that would meet the customary structural standards of bridges, while meeting the FAA requirements for taxiways pavements. While a highway bridge must bear the weight of a semi-truck with the maximum load of 80,000 pounds, the Taxiway Lima bridge was designed to carry potential aircraft well over 580,000 pounds with an additional 30% impact factor and 25% future loading.
The paper will discuss the decision made in the type-study and the results of a design (including seismic) for a massive weight using a blend of codes.

**IBC 25-37: Launched Construction of Simple-Span Structures for the Laredo-to-Nuevo Laredo Railroad Bridge over Rio Grande River**

Ben Pendergrass, Ph.D., P.E., Genesis Structures, Kansas City, MO; Matt Struemph, OCCI, Fulton, MO; Aaron Bedsworth, OCCI, Fulton, MO

This paper details the construction of six plate girder spans of a railroad bridge over the Rio Grande River, connecting Laredo, Texas to Nuevo Laredo, Mexico. The spans were erected directly north of the project site on temporary falsework. One-by-one, the spans were transported onto a temporary trestle bridge positioned to the east of the final alignment using SPMTs. Each span was then transversely slid into the final alignment orientation using a hydraulic sliding system and slide beams. The spans were then sequentially launched longitudinally south along the alignment using a strand jacking system, temporary launch bents, and a roller system. Once a span was launched beyond the transverse sliding area, the following span was then transversely slid into alignment and longitudinally pinned to the previous span. The pinned spans were then progressively launched in series until reaching their final position. The pinning of the spans allowed for longitudinal launching of the simple-span structures over a total of 800-ft. Vertical jacking was then utilized to position each span onto the permanent bearings. Final placement of the spans on their bearings was successfully completed in August of 2024.

**IBC 25-38: McClugage Bridge Tied Arch Span Construction and Float-In**

John Boschert, P.E., S.E., Genesis Structures, Kansas City, MO; Patrick Ryan, American Bridge Company, Peoria, IL; Steve Eads Jr., P.E., Genesis Structures, Kansas City, MO; Josh Crain, P.E., S.E., Genesis Structures, Kansas City, MO

The McClugage Bridge carries US Highway 150 over the Illinois River between Peoria and East Peoria, Illinois. The historic eastbound structure was constructed in 1939 and has reached the end of its service life. The replacement McClugage Bridge project is highlighted by a 650' tied-arch span over the Illinois River.

The construction of the tied-arch span was planned strategically to allow for simultaneous construction activities on the arch unit and the adjacent composite steel girder units. The tied-arch span was erected adjacent to the permanent bridge on temporary falsework structures and then transported to the permanent location through a complex float-in operation on deck barges.

The layout and design of the temporary falsework structures was done to facilitate interface with the barge float-in system and included heavy pipe-pile supports, temporary telescopic arch struts and utilized historic specialty jacking falsework towers previously owned by the Contractor. The float-in operation was performed in December 2023 and successfully moved the steel arch span from the temporary erection position to the permanent position.

This paper and presentation will focus on the construction planning and engineering that were performed by the project team to construct this landmark project, including the following:
•Coordination and planning for the complex erection operations
•Design of the temporary works required to facilitate erection of the system
•Engineering for the span float-in using deck barges and specialty jacking towers

### IBC 25-39: Planning and execution of bridge deck closures on the world's longest precast segmental span

Quentin Marzari, P.E., S.E., Arup, San Francisco, CA; Jonathan Aylwin, Arup, London United Kingdom; Chris Ursery, Arup, Corpus Christi, TX; Manuel Contreras Pietri, CFC USA, Miami Beach, FL; Allan Brayley, Flatiron, Broomfield, CO

The main spans of the US181 New Harbor Bridge expected to be built in Q1 2025 will replace the 66-year-old crossing over Corpus Christi, TX shipping channel. With a length of 3,289’, a central span of 1,661’, and a width under 149’, once complete, it will be one of the longest cable-stayed bridge in the USA, the longest precast segmental span and widest delta frame bridge in the world.

The construction engineering of such a structure called for special attention, particularly when considering the geometry control of the bridge and the site-specific wind hazard.
It culminated with the planning of the bridge deck closures.

There are four different closures on the bridge. Three are located on the back span side: temporary pier, intermediate pier, and transition pier closures. The last one is at the main span, connecting the two cantilevers together.
Each of these came with its own set of goals and constraints. With a relatively stiff superstructure, forcing alignment is generally inefficient, or comes at the expense of unintended locked-in loads. Hence, identifying the amount of tolerance in the various connecting elements was key.

Extensive coordination was required between the bridge EOR, contractor and the temporary works designer to ensure the sequencing of operations was agreed, and the interaction between the bridge and the temporary works was appropriately captured.

### IBC 25-40: Transforming a Decommissioned Marine Corps Elevated Causeway System (ELCAS) for Versatile Construction Access Solutions

Houston Brown, P.E., Pennoni, Newark, DE; Ralph Farabaugh, R.E. Pierson Construction Co., Pilesgrove, NJ; Mike Postorivo, R.E. Pierson Construction Co., Pilesgrove, NJ; Christos Aloupis, Pennoni, Philadelphia, PA

Delaware River and Bay Authority (DRBA) and RE Pierson Construction (REP) are constructing a $90 Million Ship Collision Protection System to protect the Delaware Memorial Bridge, critical infrastructure for commerce and traveling public. Due to the lack of a sufficiently capable dock for crane operations to transport equipment and materials from shore to the site, the contractor elected to install a temporary pier. For this purpose, they employed an Elevated Causeway System (ELCAS), which was acquired from the Marine Corps following its decommissioning.

The ELCAS was originally created to provide logistical support for the Marine Corps and Joint Expeditionary Forces in challenging cargo transfer areas. It's a modular system with standard ISO shipping container fittings, designed for rapid assembly using a "top down" method. The system, featuring airtight structural steel pontoons, includes a runway configuration and various pierhead arrangements, with 24-inch steel pipe piles for support, designed for specific loading needs.

To meet temporary works project specifications, Pennoni performed a detailed analysis throughout all construction stages, adhering to the AASHTO Guide Design Specifications for Bridge Temporary Works. Previous designs were reviewed to identify the critical checks, particularly for pile extraction where mud retention could overstress the pontoon system. To mitigate this, pipe piles were capped to prevent mud accumulation. Key design elements, including the connection plate assembly between pontoons and pile connection to pontoons, were evaluated. The ELCAS system was demonstrated to have adequate reserve capacity and has successfully supported a Manitowoc 777 crane in construction activities.

### IBC 25-41: Reconnecting communities: How capping the I-35 will change Austin, Texas for generations to come

Kasian Warenycia, P.E., Arup, New York, NY; Luke Tarasuik, Arup, New York, NY; James Conway, Arup, Austin, TX; Joseph Shiveley, Arup, Austin, TX

In recent years, the US has seen a significant trend toward innovative infrastructure renewal projects driven by the need to address aging infrastructure, the availability of federal investment through the Bipartisan Infrastructure Law, the adaptation of cities to meet the challenges of climate change, and the effort to address equity and justice in infrastructure planning. Many cities across the US are investigating the feasibility or have constructed similar capping projects such as the Gateway Arch National in St. Louis, Brooklyn-Queens Expressway in New York, Presidio Parkway in San Francisco, and ReThink Indianapolis I-65/I-70. Arup has been working with the City of Austin to develop the feasibility and concept design for a series of highway caps over I-35 as it passes through Downtown Austin. The planned upgrade will place the road below grade, creating the opportunity to cap over the highway and help reconnect the communities that have been historically divided by this complex infrastructure. The capping of the I-35 will provide up to 30 acres of space for new parkland and buildings above the highway. The cap structures, which consist of prestressed concrete I girders, are designed to take amenities including up to 2-story buildings with occupied roofs and up to 50ft tall shade trees in landscaped zones. The cap structures will be designed to take the heaviest loading throughout the programed zones to allow for changes to amenity space over the structures’ design life and adapting to the needs of future generations of Austin residents.

**IBC 25-42: The Brent Spence Bridge Corridor Project – A New Ohio River Crossing and Approach Structures**

AJ Cardini, P.E., AECOM, Boston, MA; Kyle McLemore, P.E., S.E., AECOM, Tampa, FL; Mark Wimer, AECOM, Akron, OH; Randy Thomas, Jacobs, Milwaukee, WI

The $3.6 billion Brent Spence Bridge Corridor Project will transform eight miles of interstate I-75/71 in Cincinnati, Ohio, and Covington, Kentucky. The project will reduce congestion, improve traffic flow and safety, and maintain a key regional and national transportation corridor. Lead designer AECOM and subconsultant Jacobs with contractor partners Walsh/Kokosing began work on this Progressive Design-Build project in 2023 under the direction of the Bi-State Management team (BSMT) comprised of ODOT and KYTC.

The existing Brent Spence Bridge, a double-decker truss built in the 1960's, will be rehabilitated and will remain to carry local traffic. A new bridge, called the Brent Spence Companion Bridge (BSCB), which will carry 10 lanes of I-75/71 over the Ohio River, will be built immediately to the west of the existing bridge. Due to site width constraints, a double-decker bridge with 5 lanes per level was required. The development and selection process for the preferred alternative of this major span crossing will be discussed.

The Kentucky side structural work includes double-decker bridge approaches to both the existing Brent Spence Bridge and the new BSCB; as well as bridges at several interchanges. There are 22 total bridges, with length totaling approximately 7,000'. The Ohio side structural work also comprises double-decker bridge approaches to both the existing Brent Spence Bridge and the new BSCB, a complete reconfiguration and reconstruction of the multi-level I-75/I-71/US50 interchange, and grade separations through the Cincinnati downtown core, with 43 total bridges. Both sides approach spans will feature numerous steel triple-I-girder straddles.

**IBC 25-43: Modernizing Lawrence to Bryn Mawr with Segmental Box Girders for the Chicago Transit Authority**

Emily Hereford, P.E., Stantec, New York, NY; Ben Soule, Systra – International Bridge Technologies, San Diego, CA; Joe Kelvington, Stantec, Raleigh, NC; Kevin Buch, P.E., Walsh Construction, Chicago, IL; Jay Lee, Stantec, Denver, CO

The Red and Purple Modernization (RPM) Phase One Project is the largest capital improvement in Chicago Transit Authority (CTA) history. It aims to replace, reconstruct, and modernize 10 miles of elevated track and support structures along Chicago's busiest transit corridor, enhancing train speeds and capacity with a 100-year service life. A major portion of the project includes a 1.4-mile viaduct identified as the Lawrence to Bryn Mawr Modernization (LBMM).

Final LBMM design and construction advanced from an alternative technical concept (ATC) proposal to utilize precast post-tensioned segmental box girder spans to lower construction costs, reduce build time and foundation construction, and minimize maintenance. Design required complex 4-D analyses, including rail-structure as well as vehicular-structure interaction, and accommodated top-down construction.

The ATC permitted maintenance of CTA transit operations throughout construction through staged construction within an extremely narrow urban corridor. Modified top-down construction which employed a specialized launching gantry system supported on permanent bridge piers made staged construction possible.

Single column piers which make up the majority of LBMM substructures are designed to support box beam spans as well as temporary construction loads from the launching gantry system. Drilled shafts placed in clay soils support these piers. LBMM design also features removal of existing tracks and track embankments confined between parallel retaining walls. Removal of embankments and walls opens the space underneath the structure for community use and/or future development.

This presentation will focus on the unique challenges met by designers and the contractor as they executed construction of this complex project.

**IBC 25-44: The wind design of the longest cable-stayed bridge in North America, the Gordie Howe International Bridge**

Pierre-Olivier Dallaire, ing., P.Eng., RWDI, Guelph, ON Canada; Zachary Taylor, RWDI, Guelph, ON Canada; Stoyan Stoyanoff, RWDI, Guelph, ON, Canada; Mark Istvan, RWDI, Guelph, ON, Canada; Barry Chung, AECOM, Tampa, FL

In 2025, the Gordie Howe International Bridge will be opened to traffic and will become the longest cabled-stayed bridge in North America. This impressive structure will serve as a vital economic link between Canada and the United States. With a main span of 853 m, the bridge is an important engineering achievement that required in-depth technical understanding of multiple aspects such as its wind performance and resiliency to the local climate. One aspect that also makes this structure quite unique is the traffic that one can expect since it is an international crossing.

Based on the extensive wind design work that was performed for this bridge, three main topics will be covered in this presentation:

•Optimizing the deck cross-section selection with considerations to aerodynamic stability, presence of heavy traffic, fencing, risk of icing, structural design, and acoustic performance.
•Understanding the wind-induced buffeting response of the bridge for various wind events and its impact on the detailed design of lock-up devices (LUDs) for wind action.
•Evaluate the performance of the stay dampers against wind-induced vibrations and quantify the demands for structural design.

These various studies should be considered as unique and were deployed to assist in the detailed evaluation of this bridge and represent an important advancement for the field of wind engineering. Innovative simulation approaches, design findings and conclusions will be presented and discussed.

**IBC 25-45: Design and Construction of 3-Tower 4-Span Cable-stayed Mississippi River Bridge**

Martin Furrer, P.E., S.E., Parsons, Chicago, IL; Greg Hasbrouck, Parsons, Chicago, IL; Vincent Gastoni, Parsons, Minneapolis, MN; Mitch Johnson, Ames Corporation, Burnsville, MN; Stacy McMillan, Missouri DOT, Jefferson City, MO

Missouri and Illinois DOTs looked to replace the Mississippi river crossing at Chester, a narrow truss at end of its useful life, using a best-value design-build procurement method.
Major site challenges:
• very large vessel allision loads for any pier located within navigable waters,
• Coast Guard requires 800 ft main with 500 ft auxiliary or single 1050 ft navigational channel,
• high seismic demands (proximity to New Madrid Fault) and large variations in depth to rock across the river,
• Illinois bank is occupied by state route and wide Union Pacific railroad mainline ROW,
• site is located near airport limiting structure height,
• significant river level fluctuations, impacting ability to build bridge in about 2 years.
Challenges are met by a four-span, three-tower cable-stayed bridge solution with two 885 ft main spans. A reinforced concrete deck of full depth modular panels with an overlay is supported by transverse steel floor beams and longitudinal steel edge girders. Stay-cables connect to exterior of edge girders at 45 ft intervals and anchored in towers with steel anchor boxes. The three towers are founded on either driven pipe piles or drilled shafts and consist of two free-standing, vertical legs each.
The presentation will discuss innovative solutions deployed to maximize technical score and minimize construction duration and cost, including post-tensioning-free deck, maximized tower rebar preassembly, bearing restraint solutions employed to best respond to the seismic demands, and the corrosion protection enhancements included to ensure a low-maintenance, 100-plus year service life for the crossing.

**IBC 25-46: Rebuilding the Lynchpin of American Commerce - the new I-70 Rocheport Bridge**

Greg Hasbrouck, Parsons, Chicago, IL

Interstate 70 is an artery of commerce serving the heart of national and regional distribution and commodity flows connecting Missouri’s largest cities. Each year, approximately 100 million tons of freight, worth more than $154 billion, is carried across I-70 in Missouri. Carrying 12.5 million vehicles per year, including over 3.6 million freight trucks travelling across the United States, the I-70 Bridge over the Missouri River at Rocheport has been called the “lynchpin of America.”

Built in 1960, the current crossing is a single through truss with steel plate girder approaches that carries two lanes of traffic in each direction and is functionally obsolete and structurally deficient. On July 1, 2021, the Missouri Highway Transportation Commission awarded a team comprised of Lunda Construction and Parsons a $220 million design-build project to replace the bridge. The project expands an existing 2.65 mile stretch of the I-70 corridor from four lanes to six lanes, provides new twin 3,120-foot-long bridges with a 490-foot navigation span across the Missouri River.

Using twin bridges was a key factor in alleviating MoDOT’s concerns about traffic delays during construction and minimizing the environmental footprint, as well as providing redundancy of structures and an overall best value. Upon completion, each bridge will be three lanes with room for future expansion. Each bridge consists of a 5-span steel plate girder unit and two 5-span PPCB approach units with approach spans founded on large-diameter pile bents and river piers on a single line of large-diameter drilled shaft socketed into rock.

**IBC 25-47: I-35 Haunched Slab Bridge Raises**

Natalie McCombs, P.E., S.E., HNTB Corporation, Kansas City, MO; Joe Sturgeon, P.E., HNTB Corporation, Kansas City, MO; Justin Frasier, Wildcat Companies, Topeka, KS; John Jackson, P.E., Fulcrum Construction Solutions, Oklahoma City, OK

The Oklahoma Department of Transportation was interested in increasing the vertical clearance under several bridges along the I-35 corridor in northern Oklahoma. The plans to raise the 4-span haunched slab bridges provided a detailed option for competitive bidding while allowing the contractor's means and methods to be implemented. The bridge type has an impact on how the bridge will be raised. A typical beam bridge has bearings that allow rotation during construction and operating conditions. With these bridges being haunched slab bridges, raising these bridges had different risks and behavior. The presentation will cover the process from design approach and special considerations to the construction implementation and innovations. Lessons learned will be discussed along the way.

**IBC 25-48: Tying Two Nonredundant Steel Two-Girder Bridges Together with Floorbeams to Create a Single Bridge**

John Sloan, AECOM, Raleigh, NC; Tim Sherrill, North Carolina DOT, Raleigh, NC; Ed Zhou, AECOM, Germantown, MD; Mark Guzda, AECOM, Mechanicsburg, PA

The I-26 Green River Bridges were built in 1968, and they consisted of parallel nonredundant steel tension member 2-girder steel structures with a main unit having spans of 260’-330’-260’. This project consisted of a strengthening and rehabilitation of the bridges that included adding cover plates, adding stiffeners, replacing the existing lightweight concrete decks with a new single lightweight concrete deck, adding shear studs to the girder and stringer top flanges to make them composite, tying the two bridges together with floorbeams to make them a single structure, and widening the deck. The project team has provided a feasibility study, final design, design phase load testing, and construction phase services that include the instrumentation and monitoring of the structure. All steel rehabilitation and strengthening work is complete, two phases of deck pours are complete, and the final phase of the deck replacement work is anticipated to be complete in the spring of 2025.

**IBC 25-49: James River Bridge - Main and Auxiliary Wire Rope Replacement**

Austin Holub, P.E., PCL Construction, Inc., Tampa, FL

The James River Bridge is a vertical lift bridge carrying US Route 17 over the James River between Isle of Wight and Newport News, VA. The bridge is owned by the Virginia Department of Transportation. The movable span of the vertical lift bridge is 415 feet long, weighs approximately 3,360,000 lbs, and is lifted by 80, 2-1/8 inch wire ropes.

The main counterweight ropes are original to the bridge at over 41 years old, surpassing their predicted lifespan. VDOT selected the option of two, 100-hour outages during which 40 ropes (one tower) would be replaced per outage.

To expedite the replacement of the wire ropes, VDOT chose to procure the ropes, take-ups, and associated hardware prior to advertising the construction portion of the project. While the ropes, take-ups, and hardware were being fabricated, VDOT awarded PCL the contract to perform the replacement. From the onset of the project, PCL actively collaborated with VDOT and HDR to develop plans to execute the replacement of ropes within the allowable time constraints.

The process for replacing the ropes utilized four, 400-ton and two, 50-ton hydraulic jacks for lifting the movable span, while air winches were utilized for removing and installing the new ropes over the sheaves. The outages occurred in January and February of 2024. While challenges were expected to occur, the project team successfully constructed the project due to the proactive steps taken by PCL, HDR, and VDOT during the planning and preparation phases.

**IBC 25-50: The US 50-Blue Mesa Bridge Emergency Repair**

Nathan Schaeffer, P.E., Michael Baker International, Moon Township, PA; Alex Gioseffi, P.E., Kiewit, Woodcliff Lake, NJ; Keely Matson, P.E., Michael Baker International, Lakewood, CO; Richard Schoedel, P.E., Michael Baker International, Moon Township, PA; Jacob O'Brien, P.E., Colorado DOT, Denver, CO

In April 2024, while conducting the Federal Highway Administration (FHWA) required non-destructive evaluation of Non-Redundant Steel Tension Member (NSTM) bridges, the Colorado DOT discovered two partial fractures at the shop butt welds along the bottom tension flange of the US-50 Blue Mesa Reservoir Bridge near Gunnison, Colorado. The Colorado Department of Transportation (CDOT) took immediate action in closing the structure to prevent bridge failure; however, the closure of the bridge resulted in a lengthy six-hour detour for local motorists. Emergency work with CMGC industry partners Kiewit Infrastructure Company and Michael Baker International began immediately to identify and implement solutions to repair or replace the critical bridge, as well as a second crossing of the reservoir of nearly identical construction. Thorough non-destructive testing began and ultimately revealed numerous indications throughout many of the structure's 118 tension butt welds. Widespread transverse hydrogen cracking of the girders' web-to-flange welds was also discovered. These defects led to the eventual decision to implement global plating of the bottom tension flanges to prevent collapse if any of the defects were to result in a fracture. A novel approach to deter the propagation of cracking through the web was also implemented, acting in conjunction with the flange plating to provide a fully redundant system. Significant weight was added to the bridge necessitating the use of A514 (100 ksi) for plating steel and thin ¾" polyester polymer concrete overlay to keep the weight within manageable limits.

**IBC 25-51: Retrofitting for Longevity: Modification of In-Service Steel Box Girders to Facilitate Bridge Inspection and Maintenance**

Y. Edward Zhou, AECOM, Germantown, MD; Brett McElwain, AECOM, Hunt Valley, MD; Eric Johnson, Pennoni, Mechanicsburg, PA; Ruel Sabellano, D.Eng., P.E., M.ASCE, Maryland Transportation Authority, Baltimore, MD; Hua Sheng He, Maryland Transportation Authority, Baltimore, MD

The MDTA owns 19 steel box girder bridges constructed in the 1970's with no access provided to the spaces beyond the ends of continuous-span units at both abutments and certain piers for each bridge. Over time, some girder ends have experienced significant corrosion-induced section losses in the areas surrounding bridge expansion joints. To facilitate bridge management activities in these areas including inspection, painting, repairs, and various maintenance actions, it is highly desirable or necessary to add access holes in the box girder end diaphragms. However, the end diaphragm above box girder bearings is a primary structural element and is highly loaded in shear between the bearing and box girder webs. This paper discusses: 1) an analysis procedure for determining the access hole layout and dimensions to maintain box girder integrity while meeting bridge management needs; 2) checking against pertinent AASHTO bridge design requirements; 3) the construction process of a recently completed pilot project on two curved bridges of 13 spans and 7 spans, and 4) issues encountered and lessons learned from construction after successful completion. The analysis procedure employed 3D finite element modeling to assess changes of buckling capacity due to added holes and maximum stresses surrounding the new holes. Successful completion of the pilot program required well-executed coordination among the owner, design team, and contractor for efforts including field visits to confirm as-built and deteriorated conditions, several iterations of structural analysis, and contract documents.

**IBC 25-52: Heat Straightening Practices**

Ronnie Medlock, High Steel Structures, LLC, Lancaster, PA; David McQuaid, P.E., DLMcQuaid and Associates, Upper St. Clair, PA

Heat straightening is an effective tool for straightening steel bridge members, particularly in remediation of bridge hits. This paper will describe heat straightening practice, including

- limits on what can and cannot be heat straightened from a practical point of view;
- basic heat straightening steps;
- using heat in conjunction with pressure;
- concerns about the blue brittle range of steel
- temperature limits based on the iron-carbon phase diagram
- temperature measurement;
- considerations for cold bending; and
- resources available for engineers.

Examples of bridge straightening will be featured.

This abstract is anticipated to align with a heat straightening demonstration during the IBC.

**IBC 25-53: Recommendations for Numerical Modeling for Rail Structure Interaction Analysis**

John Lobo, HDR, Denver, CO; Ying Tan, Ph.D., HDR

Rail-structure interaction analysis (RSI) is very important for the design of transit bridges and viaducts carrying continuous welded rail. The rail and its supporting structures are subject to different temperature loads and usually have different freedom of movement. The bridge and rail system are connected and this creates complex, non-linear interaction between the two systems. RSI analysis is prescribed by most transit agencies in North America, especially in case of long elevated guideway or bridges with curvature and for elevated guideway with direct fixation (non-ballasted) track. There are few guidelines on numerical modeling of the system and the basis of the small number of recommendations is not clear. There is a no consensus in the USA regarding which parameters will control analysis or how these parameters should be defined in the analytical models. This study evaluates the impact of four necessary and key model inputs, viz. bridge curvature, spring behavior, rail fastener spacing and fastener restraint force. The impacts of these parameters are studied through parametric analysis, keeping all other factors constant and examining the effects on axial rail stress, rail break gap, substructure forces and superstructure stresses. This study provides guidance to transit structure designers to determine the best method for modeling their structure in a rational manner.

**IBC 25-54: Railroad Bridge Live Load Impact Versus Train Speed: Field Test Evaluation**

David Jacobs, Ph.D., P.E., University of Hartford, West Hartford, CT; Suvash Dhakal, Connecticut DOT, Newington, CT

The rating section of the American Railway Engineering and Maintenance of Way Association’s Manual for Railway Engineering gives a formula for a curvilinear reduction in the design impact factor for rating purposes based on train speed below 60 mph (96.6 km/h). A novel study to measure the actual change in dynamic impact force from modern passenger equipment as a function of train speed was conducted by measuring the deflections, strains and accelerations of several truss and floor system members from live loads on the structure; a 118-year-old through truss bridge. Data were recorded from two different types of electric passenger trains with speeds ranging from approximately 5 to 40 mph (8.1 to 64.4 km/h). Our test results indicate that the impact reduction relationship relative to speed for the type of vehicles used in our study, is significantly less than from that called for by the Manual’s impact reduction formula. This result could have significant ramifications for extending the service life of existing, very old railroad bridges, where the predominant live load is passenger equipment, such as on the Northeast Rail Corridor between Washington, D.C. and Boston, Mass.

**IBC 25-55: Park Avenue Viaduct Replacement – Analysis and Design, Pushing the Envelopes of Accelerated Construction**

Firooz Panah, P.E., DBIA, AECOM, Boston, MA; Latif Ebrahimnejad, AECOM, Boston, MA; Ebad Honarvar, AECOM, New York, NY; Chris Cucco, AECOM, Boston, MA; Pradeep Maurya, AECOM, Boston, MA

Located in New York, Park Avenue Viaduct is an extremely active line carrying four tracks of Metro North Rail (MNR) trains from Grand Central to points North through Harlem. MTA C&D embarked on replacing this aging structure using Design-Build (D-B) delivery method. A team consisting of Halmar International as contractor and AECOM as design consultant was selected in December 2022 to deliver this project.
While the viaduct is very long, Phase 1 focuses on the replacement of 32 spans, each 65’ long, two tracks at a time. The 120-year-old viaduct consists of three through steel girders framed into steel columns. The D-B team can replace two tracks during the weekends only, while the other two are active.
To accomplish this, the D-B team used an integrated system of Prefabricated Bridge Units (PBUs) consisting of steel plate girders and full depth precast concrete deck. For the method of construction, Halmar decided to use two 200-tons mobile portal gantries for the demolition of the existing bridge and the installation of the proposed PBU’s.
The foundations and piers were constructed under the exiting viaduct. Four spans of the superstructure were replaced during the weekends. To save time, the rail plinths, track fasteners, and third rail were installed in advance before erection of the PBUs. The paper will also discuss analytical methods notably track-structure interaction, as well as unique details developed to stabilize the existing viaduct in the longitudinal and transverse directions during all stages of the construction.

**IBC 25-56: Design and Construction of a Steel Gussetless Truss Bridge for Railroad Application**

Juan Alfonso, P.E., HNTB, Parsippany, NJ; Xin Li, P.E., HNTB Corporation, Parsippany, NJ; Ayman Bataineh, P.E., HNTB Corporation, Parsippany, New Jersey; Gregory Romano, P.E., HNTB Corporation, Parsippany, NJ

The existing NJ Transit Structure 2.18 is a two-span, open deck girder bridge carrying a single curved track over West Side Avenue in Jersey City, NJ. The low clearance beneath the existing superstructure and pier arrangement requires replacing the bridge to accommodate the proposed NJDOT New Road alignment and profile. The replacement bridge alignment is to the inside of the existing track, which minimizes track outages and enhances safety during construction. However, the longer span of the replacement bridge and horizontally curved track layout necessitated a reevaluation of traditional railroad bridge designs. Through discussions with project stakeholders, a 160-foot-long single-span steel gussetless truss was selected as the preferred replacement alternative.

The innovative gussetless truss system features prefabricated built-up truss joints comprising a web plate welded to curved, cold-bent flange plates. The gussetless design eliminates the traditional gusset plate connection, which is prone to deterioration and is hard to inspect. The truss top/bottom chords and diagonals consist of fabricated I-sections similar to plate girders. Diagonals are connected to gussetless joints using double-shear field-spliced bolted connections.

The bottom chord, which also functions as a beam in strong-axis bending, enables elimination of stringers by using intermediate floorbeams between truss joints. Additionally, the gussetless joint is a moment-resisting connection, enhancing the structural system redundancy compared to traditional truss constructions, particularly when combined with the orientation of truss bottom chords in strong axis bending. As a result of the innovations, the bridge superstructure becomes easier to construct, inspect, and maintain.

**IBC 25-57: HLMR Disk Bearings Applications of on Light Rail Structures**

Ronald Watson, R. J. Watson, Inc., East Amherst, NY; Jay Conklin, R. J. Watson, Inc., Alden, NY; Zachary Searer, R. J. Watson, Inc., Alden, NY

High Load Multirotational (HLMR) Disk Bearings have long been used on Highway Bridges dating back 50 Years now with an outstanding performance record on all types of structures. One of the common applications is on light rail bridges in North America. One interesting User study is on the Washington Metropolitan Area Transit Authority (WMATA) System where they have used HLMR Disk Bearings on the new Silver Line Concrete Bridges and have also used disk bearings to retrofit steel plate girder bridges on the Orange Line replacing failed bronze spherical and steel rocker bearings.
This paper will focus on the WMATA applications and other users of disk bearings on different types of light rail bridges. Design and Testing requirements will also be looked at with a goal of educating engineers on the potential for this innovative and reliable device.

**IBC 25-58: Truss Panels Replacement and Structural Monitoring, Pulaski Skyway Span 47**

Vincent Liang, GPI, Bridgewater, NJ; Han-kil Lee, GPI, Bridgewater, NJ; Lenny Lembersky, GPI, Bridgewater, NJ

The New Jersey Department of Transportation (NJDOT) commissioned Greenman-Pedersen, Inc. (GPI) to design the rehabilitation of Spans 45 to 61 of the 93-year-old Pulaski Skyway. These deck truss spans, ranging from 175 to 300 feet long, feature truss expansion mechanisms and joints at alternating spans. Due to severe corrosion, truss panels adjacent to these joints require replacement. GPI proposed an innovative solution: using shoring towers on micropile foundations to temporarily support the truss and floorbeams while replacing affected chords, all while maintaining traffic flow. The rehabilitation process utilizes a sophisticated jacking procedure designed to reverse dead load stresses and isolate a portion of the truss from live loads using a floorbeam support system. A prototype contract for Span 47 was recommended to validate the design concept, reconstruction sequence, and jacking procedure through structural monitoring before extending the rehabilitation to the remaining spans.

GPI conducted non-linear staged construction structural analysis using CSiBridge to determine jacking loads and calculate structural responses. These results were verified during construction through extensive real-time monitoring of stresses and displacements at each stage of jacking and replacement. Additionally, destructive testing of removed corroded elements was performed to assess and validate estimated pack-rust buildup and section loss.

This paper focuses on the specified construction sequence and the truss's response during dead load reversal jacking, chord cutting and replacement, and final jack down, as revealed by structural monitoring results.

**IBC 25-59: In-site testing data analysis of Kinmen bridge**

ChinKuo Huang, China Engineering Consultant, Inc., Taipei City, Taiwan; Fsin-Chu Tsai, China Engineering Consultant, Inc., Taipei City Taiwan; Li-Ting Chung, China Engineering Consultant, Inc., Taipei City, Taiwan

The Kinmen Bridge is located in Kinmen County, connecting Kinmen Island and Lieyu Island at both ends. The bridge is 4.77 kilometers long, with a main bridge section of a 6-span and 5-tower cable-stay bridge, measuring 1050 meters in length, two side span of 125 meters, and four main spans of 200 meters each. Due to its location in a severe marine corrosion environment, the maintenance and upkeep conditions of the Kinmen Bridge are quite strict. In order to ensure the safety of pedestrians and the benefits of sightseeing, a bridge monitoring system is gradually established during the bridge construction period. And after the establishment of the monitoring system, ambient vibration tests, cable modal detection tests, load tests, etc. are carried out to collect data on the completion status of the bridge, and the test data is analyzed and organized as a reference for subsequent tracking, management, and maintenance.

**IBC 25-60: Extending Service Life to 200 Years: Insights from 30 Years of Optimizing Corrosion Sensor Use at the Great Belt Link**

Peter Møller, Rambøll Danmark A/S, København S, Denmark; Kim Obel Nielsen, Rambøll Danmark A/S, København S Denmark; Anders Bøwig Brøndum, Rambøll Danmark A/S, København S, Denmark; Svend Gjerding, Sund & Bælt Holding A/S, Copenhagen V, Denmark

The Great Belt Link, originally designed for a 100-year service life, has benefited from 25 years of corrosion monitoring, providing key insights to extend its durability to 200 years. This study emphasizes the critical role of corrosion control in the splash zone, where traditional methods like chloride testing fall short. Real-time corrosion sensors, installed between the waterline and +2.5 meters, revealed complex corrosion dynamics caused by macro-cell formation, reduced oxygen access, and environmental factors such as wind and tidal forces.
Key findings demonstrated that early installation of galvanic anodes in submerged sections effectively delayed corrosion initiation, with greater benefits when installed proactively. Although underwater installation costs were moderate, splash zone installations were more complex; however, the resulting reductions in future repair costs justified these expenses. The use of cathodic protection, combined with Linear Polarization Resistance (LPR) and advanced non-destructive testing (NDT) techniques, allowed for accurate real-time corrosion assessments, reducing the need for invasive testing and enabling strategic, cost-effective maintenance.
The Great Belt Link's proactive corrosion management strategy addresses challenges common to large bridges worldwide, where exposure to seawater, temperature fluctuations, and constant moisture cycles accelerate corrosion. The innovative monitoring approach at Great Belt is essential for areas like the splash zone, notorious for high corrosion rates and complex deterioration mechanisms. This strategy sets a new standard for corrosion control, ensuring that critical infrastructure can meet increased service life requirements with minimal environmental impact and maintenance demands.

**IBC 25-61: Bearing Rehabilitation and Replacement on the Great Belt Link West Bridge**

Andrew Smyth, Rambøll Danmark A/S, Copenhagen S, Denmark; Claus Pedersen, Rambøll Danmark A/S, Copenhagen S Denmark; Jens Fogh Svensson, Rambøll Danmark A/S, Copenhagen S, Denmark; David Lang, Rambøll Danmark A/S, Copenhagen S, Denmark; Niclas Grønkjær Rasmussen, Rambøll Danmark A/S, Copenhagen S, Denmark

The Great Belt Fixed Link is an 18 km rail and road corridor featuring a tunnel, a suspension bridge, and the 6.6 km multi-span concrete box-girder Storebælt West Bridge. As the only railway connection between Zealand and Funen, it is essential for linking Denmark with Sweden and central Europe. The West Bridge relies on 276 structural bearings supporting its two box girders, one for road and one for rail. Given the bearings' shorter service life relative to the bridge's expected 200 years, a comprehensive bearing renovation and replacement program has been initiated.

The program employs a digital-enabled maintenance strategy that combines in-depth inspections with structural health monitoring for a thorough evaluation of bearing conditions. This approach provides a holistic framework to plan and phase the replacement and renovation of bearings, ensuring minimal disruption to bridge traffic and sustained structural health.
Several technical challenges define this program, especially working in harsh marine

**IBC 25-62: Steel Bridge Design Resources for Efficient Conceptual Design Decisions**

Brandon Chavel, National Steel Bridge Alliance, Chicago, IL; Jeff Carlson, P.E., National Steel Bridge Alliance, Chicago, IL

The National Steel Bridge Alliance has a suite of resources that can help bridge designers and owners make effective and speedy decisions in the preliminary design phase that will result in an efficient steel bridge. When used in combination, these resources can allow engineers to compare various span arrangements, girder spacings, and girder sizes in a matter of hours. These resources include the Steel Span to Weight Curves, the new Steel Girder Bridge Design Standards, LRFD Simon, and NSBA Splice.

The Steel Span to Weight Curves are the quickest way to determine the weight of steel per square foot of bridge deck for plate girder bridges, and are ideal for comparing various span arrangements and girder spacings. The new steel girder bridge design standards include one, two, three, and four-span bridges, with span lengths ranging from 150 ft to 300 ft, along with various girder spacings. The standards include flange and web plate sizes, stiffeners, cross-frame sizes, shear studs, and deck designs. LRFD Simon is a line-girder analysis and design program for steel I-shaped plate girders and allows users to quickly produce complete steel superstructure designs in accordance with the AASHTO LRFD Bridge Design Specifications. NSBA Splice allows a designer to quickly analyze various bolted field splice connections to determine the most efficient bolt quantity and configuration.

Through actual bridge examples, designers will better understand how they can use these free resources during the TS&L stage of a project to make quick but important design decisions.

**IBC 25-63: Cast Steel Connections in Steel Bridges**

Jennifer Pazdon, MSE, P.E., Cast Connex Corporation, London, Canada; Carlos de Oliveira, Cast Connex Corporation, Toronto, ON Canada

Extant case studies of cast steel structural connections in existing vehicular, rail, and pedestrian bridges will be examined to elucidate the advantages over conventional connection fabrication including structural performance (e.g. fatigue life increase), overall economy achieved through reduction in labor effort and complexity of fabrication and erection, accelerated construction, reduced lifecycle cost from enhanced longevity of coating systems and ease of inspection.
In the US, the use of project-specific engineered steel castings in the design and construction of steel bridges lags behind other economies. Opportunities and challenges for increased adoption of project-specific engineered cast steel components in the US bridge market will be discussed including examination of a proposed framework of responsibility for component engineering design and casting manufacturing and resolution of discord in applicable codes and standards.
An overview of ongoing and anticipated future work of AASHTO/NSBA Task Group 17: Steel Castings to create resources to address identified challenges will be provided.

**IBC 25-64: Horizontally Curved Steel I-Girder Bridge Cross-Frame Design Evaluation and Guideline Synthesis**

Syed Muhammad Oan Naqvi, University of Texas Rio Grande Valley, Edinburg, TX; Siang Zhou, University of Texas Rio Grande Valley, Edinburg, TX; Bikesh Sedhain, KC Engineering and Land Surveying, P.C., New York, NY

Cross-frames are important load-carrying members for horizontally curved steel I-girder bridges, inducing complex lateral bending behavior for construction and in-service loading conditions; however, they are often designed using standardized dimensions and layouts. This research synthesizes prior studies in the past two decades and current U.S. state transportation agency specifications to provide a holistic review of the state-of-the-art cross-frame design practices for horizontally curved steel I-girder bridges. Cross-frames are required to be designed as primary load-carrying members for horizontally curved steel I-girder bridges. Intermediate cross-frames are generally arranged radially to resist overall torsion of the bridge system, while cross-frames are often omitted in the vicinity of skewed bearing lines to assist uplift alleviation; the main difference among state specifications is regarding arrangements near supports. To advance cross-frame design for horizontally curved steel I-girder bridges for more optimized load distribution, numerical parametric studies are conducted to evaluate the effects of different cross-frame type and arrangement (such as alignment angle and spacing) on structural responses of these bridges, including girder flange lateral bending stress, girder movement (displacement and rotation), web out-of-plane buckling, and cross-frame stress. Bridges from the database of state transportation agencies and prior research are simulated in the parametric studies. Optimized cross-frame designs are proposed for single-span horizontally curved steel I-girder bridges (with or without support skew) to achieve a decrease in girder and cross-frame stress and a reduction in the amount of material usage for cross-frames, while maintaining stability requirements for the bridge system with complex geometry.

**IBC 25-65: I-65 over Kentucky St. and Brook St. – System Redundancy of Three-Grider Integral Steel Straddle Bents**

Joshua Carter, P.E., AECOM, Louisville, KY; Charles Boltz, AECOM, Indianapolis, IN

The I-65 Bridge over Kentucky St. and Brook St. is a key component of the I-65 Central Corridor Project, which aims to replace or rehabilitate up to 18 bridges along the I-65 corridor in Louisville, Kentucky. The existing bridge is a multi-span steel structure featuring four Non-redundant Steel Tension Members (NSTM), in the form of steel cross girders, situated in a dense urban environment with low vertical clearance.

In collaboration with the designer, the Kentucky Transportation Cabinet (KYTC), and the contractor, a new three-girder steel straddle bent was selected to replace the existing NSTM cross girders with a redundant structure that meets the site's geometric constraints. Although these straddle bents are typically employed in a stacked configuration—recognized by the Federal Highway Administration (FHWA) as load-path redundant—site-specific restrictions necessitated the use of an integral version of the straddle bent.

To ensure that the straddle bent qualifies as a System Redundant Member, a redundancy analysis was performed in accordance with AASHTO guidelines for the Analysis and Identification of Fracture Critical and System Redundant Members. This paper will detail the redundancy analysis and the benefits that the Kentucky Transportation Cabinet will derive from the improved structural integrity.

**IBC 25-66: CIP Segmental Design of the Beaver River Bridge**

Matthew Adams, H&H, Tallahassee, FL; Alexander Collins, H&H, Tallahasee, FL; Robert Elliott, CDR Maguire Engineering, Warrendale, PA

The new Beaver River Bridges replace a single steel deck truss bridge on the Pennsylvania Turnpike, just north of Pittsburgh. The new bridges are parallel cast-in-place, balanced cantilever segmental structures, each 1645' long. The boxes are typically 73'-4.5" wide, but the Eastbound structure flares to 89'-7" in Span 1. The structures cross the river in 5 spans, with a 240' - 3 @ 385 '- 250' arrangement, and carry the turnpike over not only the Beaver River, but also over CSX and Norfolk Southern rail lines, as well as a local road. The piers vary from approximately 80' to 188' tall. They each have twin-wall columns for rotational stability and longitudinal flexibility. This presentation will discuss the designer's approach to the bridge project, including both superstructure and substructure design, as the design of the substructure was particularly intricate. The superstructure is cast monolithic with the piers in all cases. All piers are founded on 60" diameter drilled shafts, with 54" rock sockets. The geotechnical design required all drilled shaft forces be resisted by side friction, with no bearing assumption at the shaft tips. Pier 4, the shortest pier, carries a significant amount of the force from longitudinal loading, and is the critical element for the design. The twin-walls that crack under full temperature drop and full creep and shrinkage were iteratively studied using transformed properties to develop cracked moments of inertia used when those forces occur.

**IBC 25-67: Multiple 52-hour Bridge Closures Eliminated with Strategic Workplanning**

Zachary McKinley, E.I., PCL Construction, Inc., Tampa, FL

The Benjamin Harrison Memorial Bridge, a vertical lift drawbridge over the James River near Richmond, Virginia, facilitates a crucial river crossing for 7,000 vehicles daily and permits ocean-going vessels to navigate upriver to the Port of Richmond, supporting local industries. Consequently, the bridge is regulated by federal regulation and must open on demand for vessels. Originally constructed in 1966 and reconstructed in 1977 following a bridge strike, the bridge was still operating with its original centering device supports and span lock. In recent years, however, the span locks had become increasingly unreliable, and the machinery frame supporting the span lock and centering device had suffered significant section loss. In 2023, the Virginia Department of Transportation (VDOT) planned a comprehensive overhaul of the span lock machinery and electrical tie-ins on both the north and south piers. The project was executed through a traditional design-bid-build process and was scheduled to involve two 52-hour full bridge closures, during which the span would be held in the fully raised position to avoid a maritime outage. This necessitated a 1-hour detour for the traveling public. During initial work planning, PCL determined it was feasible to eliminate the detour by implementing a 30-minute notification requirement for bridge openings and utilizing traffic flagging operations. This paper will explore the challenges surmounted during project planning to ensure the continuous operability of this vital infrastructure, with special emphasis on meticulous workplans, value engineering proposals, coordination for long-lead items, and measures to ensure safety and quality throughout throughout the project.

**IBC 25-68: CSX Chickasaw Creek Swing Bridge Rehabilitation and Automation**

Ryan Sullivan, PCL Civil Constructors, Tampa, FL; Taylor Miller, PCL Civil Constructors, Tampa, FL

Located in Mobile, Alabama, and spanning the mouth of the Chickasaw Creek, CSX Transportation's Chickasaw Creek Bridge is a nearly 100-year-old through truss swing bridge. The bridge experiences the highest combined rail and marine traffic in CSX's Gulf Coast Region. PCL Construction was engaged to perform upgrades as part of CSX's ongoing program to implement bridge control systems and remote operations centers that allow CSX bridge operators to control multiple movable bridges from a centralized control center. PCL has a successful history of working with CSX, completing over fifteen movable bridge automation projects and three separate remote-control centers. The project scope for the Chickasaw Creek Bridge project included replacing the bridge's electrical system, including the submarine cable, installing a new remote-control system, improving structural access, making structural steel repairs, and replacing all mechanical operating systems from hydraulic driven to electromechanically driven.

Chickasaw Creek, which feeds into the Mobile River, is vital for marine transportation, requiring five-seven bridge openings a day for marine traffic. Chickasaw Creek Bridge is also crucial for rail transportation, with a minimum of five trains crossing a day. The bridge is also located close to a rail yard, further increasing rail traffic and HDR Engineering were contracted with the understanding that the bridge and Chickasaw Creek waterway would remain fully operational throughout the construction. This required extensive preconstruction planning and effective design to ensure uninterrupted rail traffic and 24-hour operation of the bridge.

**IBC 25-69: Design of the Belden Bly Bascule Bridge**

William Goulet, P.E., S.E., STV Incorporated, Boston, MA

The Belden Bly Bridge, a heel-trunnion bascule bridge with an overhead counterweight, connects Lynn and Saugus, Massachusetts. Owned by MassDOT, the bridge will soon open to traffic following the operational testing phase. It accommodates two lanes of traffic in each direction, with bike lanes and sidewalks on each side. The bascule span is 77 feet long by 78 feet wide and crosses a 50-foot-wide channel that serves a fishing and pleasure craft community on the Saugus River, located upstream from the bridge. The project also includes approach spans on either side, retaining walls, and intersection improvements at the southern end of the project. The bridge profile was raised as much as possible to address local flooding issues.

The wide span and low water clearance posed significant design challenges, leading to the decision to place the machinery room above the roadway. As the bridge operates, the counterweight and movable span fold around the machinery room utilizing a four-link arrangement. This made it difficult to position the counterweight's center of gravity without interfering with the machinery room. Throughout the design process, careful attention was given to maintaining overall balance and to avoid conflicts between bridge components through the full range of movement and put an emphasis on component detailing. Additionally, the width of the span was a controlling factor for the design of the machinery tower as deflections had to be minimized to maintain machinery alignment.

**IBC 25-70: Renfrew Bridge - Glasgow's First Double Swing**

Amanda Ruyack, P.E., H&H, New York, NY; Barry Keung, H&H, New York, NY

This paper presents the design and construction of a new movable bridge in Glasgow, Scotland. The 184-meter double-leaf cable-stayed swing bridge features an asymmetric or "bobtail" arrangement with 65-meter forward spans and 27-meter back spans, actuated by a slewing bearing with a planetary gearbox arrangement. While the motion is simple, the mechanism to both operate and support the span in all conditions requires consideration of various load types, deformations, and thermal changes. In addition to being a complex indeterminate structure, the long span length presents many additional and unique challenges that were addressed by a focus on efficiency in both design and construction.

**IBC 25-71: Unique Design and Construction of the Zaza River Bridge in Cuba**

Jorge Suarez, P.E., F.ASCE, STV, Inc., Pittsburgh, PA

The Zaza River Bridge in Las Villa, Cuba was built in 1959. This purpose of this project was to replace the existing steel truss bridge which was demolished by explosives by the revolutionary army lead by Fidel Castro to cut off a major supplies route to the Capital city of Havana. After coming into power, Castro needed the bridge to be replaced and proposed an international design-build competition for a replacement bridge. The winning proposal (designed by a 33-year-old engineer) would become the world's first precast, prestressed (post-tensioned) concrete highway bridge erected without falsework by the progressive cantilever method. The main span was 300 feet.

This paper will present the bridge history and details, unique substructure and superstructure elements using post-tensioning bars. There was also a limitation on bridge element weight due to availability of crawler cranes to a maximum of 19 tons. AASHTO H20-16 loading was design criteria. Speed of construction was one of the most important factors in the bridge selection process.

The project only took 6 months to complete from date of award with unskilled labor, a 12-day worker's strike and 20 days of inclement weather.

**IBC 25-72: Abingdon Road Bridge Redefined**

Ted Januszka, P.E., Pennoni, Newark, DE; Nafiz Alqasem, P.E., Maryland Transportation Authority, Nottingham, MD

As part of the Maryland Transportation Authority's (MDTA) $1.1 billion initiative to alleviate congestion and enhance mobility along the I-95 corridor, MDTA is reconstructing I-95 in Baltimore and Harford Counties, Maryland. Within this framework, Pennoni was engaged to design the replacement of the Abingdon Road Bridge, which spans I-95. Unlike other overpasses in the corridor, the Abingdon Road Bridge required phased construction to maintain continuous traffic flow along Abingdon Road throughout the project, rather than utilizing detours.
To meet this challenge, Pennoni employed advanced 3D Bridge Information Modeling (BIM) using OpenBridge Modeler, creating detailed models of both the existing and proposed structures. The new design features a two-span, haunched steel multi-girder bridge extending 280 feet. Integrating BIM with digital terrain models from adjacent projects enabled precise bridge sizing, optimization of vertical profiles, and a comprehensive assessment of alignment and grading impacts on the developing I-95 Northbound section. This modeling ensured sufficient vertical clearance over I-95 and facilitated the identification of potential conflicts or "clash detections" during construction staging.
The use of 3D BIM enhanced the constructability of the multi-phased design and effectively eliminated impacts to aerial and subsurface utilities, safeguarding critical infrastructure. Additionally, BIM fostered seamless communication with MDTA and Section 200 consultant teams, streamlining project coordination and accelerating design completion. Construction began in 2021 and was successfully completed in 2023. This project underscores the value of BIM in executing complex infrastructure projects with minimal disruption to the surrounding community.

**IBC 25-73: PennDOT's FIRST Digitally Delivered Bridge Project**

Joshua Mies, EIT, Pennoni, Plains, PA; Robert Naugle, P.E., Pennoni, Plains, PA

Pennoni's SR 3006 Section 250 (Milwaukee Road) over Gardener Creek project was selected to be PennDOT's first Bridge Authoring Digital Delivery Pilot Project and became the first bridge in the state to be constructed entirely from a digital deliverable. All project information pertaining to the bridge structure, pavement structure and earthwork was provided in a digital format, 3D and 2D, with no structure plans or roadway cross sections. Pennoni was responsible for the preliminary engineering, final design, and construction consultation for the replacement of the existing 32' long, single-span steel girder bridge with a steel grid deck carrying SR 3006 (Milwaukee Road) over Gardener Creek. The replacement structure is a 52' long single-span, prestressed reinforced concrete spread box beam bridge on integral abutments. A 3D model, utilizing the OpenBridge Modeler software, was developed and refined to a level of detail that all information typically included in a plan set was provided through 3D views, attributes, annotated model-developed views and additional 2D details. Information was conveyed using saved views which automatically take the viewer to the desired information without the need to manipulate the model. This 3D model served as the contract document for bidding and construction.

Pennoni continued involvement throughout construction providing guidance and training on the model deliverables with the contractor. The structure was opened to traffic in June 2024, one month ahead of schedule.

**IBC 25-74: Analytical Approach to the Erection Geometry of the Msikaba River Bridge**

Heinrich van Wijk, P.E., AECOM, Seattle, WA; David Middleton, CMEJV, Lusikisiki, Eastern Cape  South Africa; Kandiah Kuhendran, AECOM, Croydon, Surrey, United Kingdom; Gary Fairbairn, AECOM, Glasgow, United Kingdom

The Msikaba River Bridge, poised to be Africa's longest cable-stayed bridge, spans 580 meters over a 200-meter-deep gorge in South Africa's Eastern Cape Province. It forms part of the National N2 highway, reducing travel time between East London and Durban while enhancing transportation safety and reducing costs. The bridge's deck consists of two identical 290-meter halves supported by 127-meter-high pylons and 17 pairs of cables, anchored 130 meters behind each pylon. AECOM, appointed by the Concor - Mota-Engil Joint Venture, provided erection engineering services to ensure safe and precise construction of the bridge deck.
This paper explores the erection engineering methodology, focusing on the calculation of cable installation forces to maintain the deck and pylon geometry within the specified tolerances. The process involves employing finite element models in Midas Civil and SOFiSTiK for calibration and verification. The challenges of modeling complex construction stages, handling time-dependent effects, and implementing precise load management are addressed. Cable force calculation strategies, including displacement and force optimization, are investigated, and practical applications are discussed to ensure accurate control over the structure's geometry throughout its erection.

**IBC 25-75: The New AASHTO Risk-targeted Design Ground Motions**

Thomas Murphy, Ph.D., P.E., S.E., Modjeski and Masters, Inc., Mechanicsburg, PA; Lee Marsh, WSP, Tacoma, WA; Ian Buckle, University of Nevada Reno, Reno, NV; Andrew Adams, Modjeski and Masters, Inc., Mechanicsburg, PA

The seismic design ground motions used in the AASHTO LRFD Guide Specifications for Seismic Design and the upcoming 10th edition of the LRFD Bridge Design Specifications have moved from a Uniform Hazard basis to Risk-targeted ground motions.  Used in the building industry, Risk-targeted ground motions include consideration of the variation in the nature of seismic hazard across the nation.  This paper will discuss the development of the Risk-targeted ground motions as adopted by AASHTO, the reasons behind their adoption, and how the change will impact the design of new bridges.  The development of the target risk value, the assumed fragility curve, and how these affect the resulting design values will be addressed.

**IBC 25-76: Design and Construction of Raging River Bridge**

Hasan Nikopour Deilami Ph.D., P.E., S.E., P.Eng., PMP, Stantec, Issaquah, WA

The new $15M Raging River Bridge design and construction was a complex task on the larger I-90, SR 18 I/C to Deep Creek Design/Build project. Stantec, Inc. is the prime consultant and structural Engineer of Record supporting Aecon as the contractor. The goal of the project is to improve traffic operations and safety and reduce congestion along the WSDOT SR 18 mainline. In its existing condition, SR 18 has only one continuous lane in each direction, with no median barrier. This condition led to high crash rates, often with serious injuries and fatalities. The new 3-span, continuous pre-stressed girder bridge is 334' in length and is located just 10' west of the existing Raging River Bridge. There is 54' of clearance above the fast-moving Raging River channel. The two-column bent shafts are socketed 75'into competent glacial till. The bridge is situated 44' below electrical overhead lines carrying up to 500kV, providing primary power to several Washington population centers. The Raging River Bridge is one of the first bridges which is designed per WSDOT's new scour policy for stream and bridge protection. Long term performance of the Raging River Bridge will deepen the engineering community's understanding on best practices to build sustainable bridges in highly seismic areas and under concurrent severe stream/scour effects.

**IBC 25-77: Aerodynamic performance of cable-supported bridges during retrofit operations**

Pierre-Olivier Dallaire, ing., P.Eng., RWDI, Guelph, ON  Canada; Guy Larose, RWDI, Guelph, ON  Canada; Erik Marble, P.Eng., RWDI, Guelph, ON, Canada; Zachary Taylor, RWDI, Guelph, ON, Canada

Several existing suspension bridges are going through important retrofit programs in an effort to extend their service life and to preserve their main cables. These retrofit programs include seismic upgrades, replacement of selected truss structural members, painting operations, addition of suicide deterrent fences and installation of cable dehumidification. Therefore, temporary works, platforms and encapsulation/tarping of the deck are often deployed to complete the structural upgrades while minimizing environmental impacts. These temporary structures are known to influence the sensitivity of the structure to wind-induced vibrations. One notable recent example is the observed vertical deck motions induced by vortex-induced oscillations on the Verrazano Narrows bridge in 2020 caused by the tarp installed around the deck. This event provided convincing evidence that this risk is real and cannot be overlooked by bridge designers.

Because of the transient nature of the structure during this work, a strategy combining experimental methods and numerical predictions was developed to evaluate bridge aerodynamic stability, the wind loads and to provide guidelines for construction schemes. In particular, limits of encapsulation can be defined to allow these retrofit works to be carried out without negatively affecting the perception of bridge users or the reliability of the structure performance. This strategy can also leverage forecasting capabilities to optimize the exposure time of the bridge under temporary works.
This presentation will draw experience, findings and conclusions from various bridge retrofit projects including the Golden Gate Bridge, the Forth Road Crossing, the Verrazano Narrows Bridge, the Robert F. KennedyBridge and the Kessock Bridge.

**IBC 25-78: Seismic Analysis and Design of a Curved Overpass in Guayaquil, Ecuador**

Pedro P. Rojas, Ph.D., ESPOL Polytechnic University, GUAYAQUIL, GUAYAS  Ecuador; JOSÉ Barros, Ph.D., Catholic University of Santiago de Guayaquil, GUAYAQUIL, GUAYAS  Ecuador; JOSEPH HERNÁNDEZ, MPM., Consultora-PRA Pedro Rojas & Asociados S.A., GUAYAQUIL, GUAYAS, Ecuador

Guayaquil is one of the most important cities of Ecuador. It has several private and concessioned ports located at the south of the city.  Some of the private ports are container ports and the main access road to them is narrow.  This usually causes traffic jams during the ports rush hours.  To solve this situation, a curved overpass was designed.  This paper discusses the studies performed for the analysis and design of the curved overpass.  The first part of the paper provides a brief review of the geometry and the materials considered for the overpass.  The second part of the paper describes the field works executed at the beginning of the studies.  The structural criteria and the three-dimensional elastic model developed for the analysis and design of the substructure and superstructure components of the overpass are described.  It is concluded that the designed curved overpass satisfies the code requirements related to strength, stiffness, and ductility.

**IBC 25-79: Predicting Girder Deflections for Phased Construction and Widening**

Dusten Olds, P.E., HDR, Omaha, NE; Tom Eberhardt, P.E., HDR, Columbus, OH

With the combination of our country's aging bridge inventory, and more and more bridges needing rehabilitated or replaced while minimizing impact to the traveling public, phased construction and existing bridge widenings have become a popular option for bridge owners.  This paper and presentation will focus on design considerations, with a heavy focus on predicting non-composite dead load deflections for these types of bridge construction, beginning with a discussion of all-at-once construction as a baseline.  This will include a detailed discussion of appropriately predicting girder deflections with a real-world example steel girder bridge, including the limitations of a line girder analysis and how to mitigate those limitations.  Non-composite dead load deflection comparisons between different analysis types ranging from line girder to more refined analysis models will be quantified and presented through this real-world example.  Several consequences of inaccurately predicted deflections will be discussed. Additional design and detailing decisions should be considered with phased construction and widenings.  These types of construction will be compared to the all-at-once construction to help design engineers avoid the pitfalls that can come with phased construction and widenings and provide an insight of how load application and system behavior can differ during analysis versus what happens in the field during construction.  This paper will largely focus on appropriately predicting the girder deflections, it will also provide some additional discussion of other considerations for each construction type including traffic control, drainage, closure pours including where live is placed during the closure pour, and detailing considerations.

**IBC 25-80: Incremental Launching of 256m Steel Box Girder Bridge on QEW highway over Credit River in Ontario**

Hyunwoo Kim, P.Eng., AECOM, Pickering, ON  Canada; Jovan Vukotic, P.Eng., AECOM, Thornhill, ON  Canada; Firooz Panah, P.E., AECOM, Boston, MA; Damien Keogh, P.Eng., AECOM, Mississauga, ON, Canada

This paper discusses the design and construction of a twinned steel box girder bridge alongside 120 years old heritage concrete open-spandrel arch bridge, spanning an environmentally sensitive Credit River on major QEW highway in Ontario. No piers were allowed in water. The steel box girders 254 m long were incrementally launched over 3 spans without the need for intermediate supports in the river and construction within the river. Four steel boxes are used to support 26.7 m wide bridge deck. Girders were assembled and launched from the east riverbank without impacting riverbed or aquatic life, in full compliance with environmental regulations. Key design elements included optimizing the girder's load distribution, ensuring structural stability during launching, and addressing construction forces induced by incremental movement. The paper will also cover analytical efforts and the design of the foundations, piers, and deck. Also, a brief explanation of the process leading to the selection of the steel box girders for the superstructure. Advanced simulations and planning were used to coordinate the construction and ensure minimal disruption to traffic on the existing bridge. High esthetic appearance of modern bridge is achieved complementing the adjacent graceful and historic arch structure.

**IBC 25-81: Two Landmark Cable Stayed Bridges for Active Transport in Perth**

Wolfram Schwarz, WSP, Perth, WA  Australia; Gerhard du Plessis, private, Caulfield North, VIC  Australia; Risto Kiviluoma, WSP, Helsinki, Finland

The Causeway Pedestrian and Cyclist Bridges Project in Australia delivers a landmark active transport connection across the Swan River in Perth, Western Australia.
Consisting of two cable stayed bridges, the constructed option limited the number of river piers to just three, acknowledging the spiritual and cultural importance of the Swan River (Derbal Yerrigan) to Perth's first nations peoples.
Point Fraser Bridge comprises a single 52 m high pylon representing a boomerang. The bridge is asymmetric with a 48 m side span and a 99.7 m main span supported by cables attached to the inner side of continuously curved bridge deck.
McCallum Park Bridge comprises two 46 m high pylons representing digging sticks. The bridge is symmetric with 60 m side spans and a 155 m center span supported by cables attached to the inner side of the S-shaped bridge deck.
The basis of design included an ambitious requirement of a minimum 6.0 m wide deck with single sided cable attachment points to allow for a 2.5 m wide pedestrian path and a 3.5 m cyclist path. The superstructures and pylons of the bridges are manufactured from 400 grade weathering steel. The comfort criteria for footfall excitation on the project was defined for high density pedestrian traffic and joggers to be able to host annual marathon events.
This paper discusses the construction staging, cable force finding, camber prediction and geometry control as well as the footfall and wind dynamics of the lightweight steel structures.

**IBC 25-82: Design and Construction of Macau Bridge**

Sidong Li, TYLin, Chongqing, Liangjiang New Area  China; Yu Deng, TYLin  China; Ya ping Lai, TYLin, China; Xiao hu Chen, TYLin, China

The Macau Bridge is the fourth maritime connection between Macau and Taipa, effectively linking reclamation areas A and E in Macau's new urban district to the artificial island at the Hong Kong-Zhuhai-Macau Bridge port. Spanning 3,085 meters, the bridge accommodates two-way traffic across eight lanes, including dedicated motorcycle lanes in the center. This bridge comprises two main spans, each 280 meters long, crossing the Outer Harbour Channel and Macau Waterway. To address strict requirements such as navigational clearance and aviation restrictions, a steel truss bridge design was adopted. Innovatively, the steel trusses are positioned within the central roadway rather than alongside the main girder and are angled inward by eight degrees. These trusses are connected by crossbeams at the top, forming a novel steel truss-box girder composite structure. This design concentrates structural forces within the core areas of the steel box girder and truss, enhancing the overall structural efficiency. Compared to traditional steel truss bridges, the Macau Bridge offers improved lateral stability, an appealing aesthetic, optimized material usage, and significant economic benefits. This paper discusses the key design considerations, construction methods, load capacity testing and the effect of the bridge upon completion. The innovative structural solutions implemented in the Macau Bridge demonstrate advanced engineering practices and provide valuable insights for future bridge projects.

**IBC 25-83: The new Pattullo Bridge in Vancouver, B.C.**

Martin Romberg, P.E., Leonhardt, Andrä und Partner, Stuttgart,   Germany; Peter Walser, Leonhardt, Andrä und Partner, Stuttgart; Victor Alvado, Leonhardt, Andrä und Partner, Stuttgart

The Pattullo Bridge, a crucial connector over the Fraser River in British Columbia since its opening in 1937, exhibits significant structural deterioration, necessitating the construction of a new bridge. This paper outlines the design and construction features of the new Pattullo Bridge, emphasizing its seismic isolation system utilizing Lead Rubber Bearings and the corresponding calculation methods. Spanning a total length of 1235 meters, the bridge consists of a cable-stayed main section measuring 770 meters and two approach viaducts with length of 770 meters and 465 meters. The cable-stayed section includes a 332-meter main span, complemented by compensating spans of 162 meters and 84 meters, and offers a maritime clearance of 47 meters. A single 167-meter high double H-shaped pylon, constructed from reinforced concrete with post-tensioned cross-beams, supports the cable-stayed span. The composite deck features a steel grillage made of high-strength weathering steel beams, topped with full-depth precast concrete panels connected by in-situ concrete joints. The construction employs a free-cantilever method for the cable-stayed span and the initial compensation span, while the remainder utilizes temporary supports. This innovative design not only addresses current capacity and safety concerns but also ensures resilience against seismic events, marking a significant advancement in bridge engineering in the region.

**IBC 25-84: The New Storstrøm Bridge - erection methods, ship impacts and train runability**

Peter Curran, C.Eng., Ramboll, London, United Kingdom; Luca Cargnino, M.Sc., Struc. Eng, Ramboll, Copenhagen Denmark; Martin Svendsen, Ramboll, Copenhagen, Denmark

The existing Storstrøm Bridge is an historic combined rail and road bridge, opened in 1937 and was then the longest road bridge in Europe. Significant maintenance activities on rehabilitation of the existing bridge have taken place over the last 30 years. The condition of the existing structure and the ongoing maintenance demands are such that replacement is now economically advantageous. This is further motivated by the limitation of just one railway track on the existing bridge, which is insufficient to support the development of the strategic railway corridor between Copenhagen and Hamburg.

The new replacement Storstrøm Bridge will be Denmark's third largest after the Øresund Bridge and the Great Belt Bridge. It will be approximately 4 km long and have electrified double rail tracks accommodating speeds up to 200 km/h and a two-lane road. The bridge is presently under construction and is expected to be opened to road traffic in 2025 and rail traffic in 2027.

The paper describes the design approach adopted for the project, which was driven by the chosen erection methods. This has involved pre-casting all elements piece large in purpose-built fabrication sheds, offshore transporting and heavy lifting. The Storstrømmen channel waters are prone to high naval activity and this, combined with relatively flexible foundations and the high dynamic sensitivity of the girder due to train runability requirements, makes ship impact scenarios critical to the design. This paper outlines the ship impact and the train runability analyses.

**IBC 25-85: Reconstruction of False Chord Truss Members on the Eastbound William Preston Lane, Jr. Memorial (Chesapeake Bay) Bridge**

Jonathan Morey, P.E., WSP USA, Edgewood, MD; Ruel Sabellano, D.Eng., P.E., M.ASCE, Maryland Transportation Authority, Baltimore, MD

The Maryland Transportation Authority (MDTA) utilizes a comprehensive inspection program to evaluate the condition of its bridges, and program system preservation and priority repair works to maintain safe structures in good working condition. Within the Cantilever Deck Truss Spans of the Eastbound William Preston Lane, Jr. Memorial (Chesapeake Bay) Bridge, deterioration was reported at the riveted build up ends of select false chord members, which are connected through pins to truss gusset plates, allowing thermal and live load movements of the truss. To remedy the reported deterioration in this challenging location, which is intended to allow movement of the truss chord between the inside faces of the gusset plates through a long slotted pin hole, MDTA and WSP determined that removal and replacement of the existing false chord ends were the most appropriate solution. Temporary support systems held the deadload weight of the member, which receives nominal loads from the truss system, allowing for the end 5 to 7 feet of the truss member to be removed. A new bolted built-up truss member, with countersunk rivets on the outside face, was constructed to match the location of the original long slotted pin hole. New pins were installed once the false chord member end was reconstructed, connecting the false chord and gusset plates and restoring the intended function of the false chord member to the original design intent.

**IBC 25-SS01: Evaluating the Potential for Digital Delivery in Bridge Inspections**

Joshua Sadlock, P.E., GFT, Harrisburg, PA; Matthew Greenholt, P.E., GFT

This presentation explores the potential for digital delivery methods—such as reality capture, digital twins, and 3D modeling—to enhance the bridge inspection process. By drawing parallels to their established use in design, we will demonstrate how these technologies can improve the accuracy, clarity, and consistency of inspection reports. The integration of digital tools also offers opportunities to streamline maintenance planning, particularly for large and complex structures. Our goal is to highlight practical applications that could modernize and elevate current inspection practices.

**IBC 25-SS02: Joint Sealing for Short Span Bridge Decks**

Kevin Ernst, R. J. Watson, Inc., , ; Zack Searer

The primary function of a bridge joint is to accommodate movements of the superstructure caused by thermal forces. The purpose of the bridge joint seal is to protect the bridge substructure, including the bearings, by preventing rain, snow, ice, dirt, and chlorides from falling through the joint onto them. This presentation will discuss the history of small movement joint seals and present several case studies.

**IBC 25-SS03: Parametric Steel Bridge Design**

Matthew Volz, P.E., S.E., HDR, St. Louis Park, MN; Jonathan Kestelman, HDR, St. Louis Park, MN

Curved and skewed steel bridges are complex structures that require 3D finite element analysis to accurately analyze the behavior. HDR has developed powerful parametric tools and workflows improving interoperability to enhance HDR's design capabilities. These tools allowed HDR to address design changes with seamless updates to analytical models and facilitated the coordination between different teams and software. Allowing for modifications and updates to the models enabled the ability to generate multiple bridge geometries allowing for rapid generation of steel bridge data sets with varying skew, curvature, span length, deck width, etc. Recognizing that bridge geometry can quickly be modified, we further enhanced the workflow by creating input files that can generate multiple models at one go. This presentation will highlight how these tools are being used to facilitate complex steel bridge modeling as well as improving interoperability and data exchange between typically proprietary programs. This presentation will also discuss the steps HDR is taking to train physics-based machine learning models to support steel bridge design, including refinement to dead and live load distribution factors in line girder analysis, for example.

**IBC 25-SS05: Advancing Bridge Digital Models beyond Design**

Allen Melley, P.E., Pennsylvania DOT, , ; Joe Brenner, P.E., Michael Baker International

Bridge owners across the nation are moving forward with BIM and Digital Delivery and establishing pilot projects and programs to evaluate the impacts to workflows. Those most affected are the stakeholders involved beyond the design phase. In place of the typical 2D plan set a model is accessible on a screen, and the information is available in a structured digital format. Though this enables a more efficient process of directly sharing design data in construction and asset management, there are barriers for this adoption and effective use beyond the benefits of design phase use cases. Recent experience has shown that the success of BIM and Digital Delivery beyond design typically relies on two criteria: 1) the capacity of personnel without CADD backgrounds to consume the data and 2) the ability of different software tools to share data accurately and consistently.
This presentation explores both the "people" aspect of these barriers by sharing lessons learned from field applications of multiple BIM and digital delivery pilot projects, as well as the data interoperability facet by sharing PennDOT's pilot of open data standards to deliver model-based deliverables and collect digital as-built models for bridge projects. Bridge is taking the lead nationally and internationally for transportation in the development of Industry Foundation Classes (IFC) standards. PennDOT is looking to capitalize on this while continuing to build on existing processes and standards from the Digital Delivery Directive (3D2025) initiative to the next level including extending field and asset management use cases. PennDOT's aim is to apply the use of an open data standard that will assist them and other State DOTs to free themselves from proprietary technologies that make it difficult to exchange information between design and construction teams. Ultimately, the goal is to improve interoperability of digital data enabling extended use in design, construction, inspection, maintenance, and asset management aiding the development of digital twins. Join Joe and Allen as the lessons learned from previous bridge digital delivery projects are discussed and the steps to the application of an open data standards are initiated as part of this ADCMS Program-enabled project.

**IBC 25-SS06: Pennsylvania Turnpike 3D Bridge Modeling: Lessons Learned & Future Goals**

Ryan Rago, P.E., Pennsylvania Turnpike Commission, Middletown, PA; Dan Rogers, P.E., RETTEW Associates drogers@rettew.com

From January 2021 through June 2025, the Pennsylvania Turnpike Commission worked in coordination with RETTEW Associates, Inc. on the Commission's pilot 3D bridge modeling project. From preliminary engineering, to the opening of the 2-span prestressed spread box beam bridge to traffic in November 2024, to the as-built delivery in June 2025, the Commission and RETTEW addressed challenges associated with this new delivery type. Lessons learned along the way provided the Commission and RETTEW a means to improve future 3D bridge modeling projects, with new procedures already in place and initiatives established to provide for continued development.

**IBC 25-SS07: Utah's Experience with the Delivery of Digital Bridge Projects**

Cheryl Hersh Simmons, SE, Utah DOT, Salt Lake City, UT

This presentation outlines the path Utah DOT has taken with respect to the digital delivery of select bridge projects. It will focus on recent project experience to explore benefits, challenges, and lessons learned in design and construction.

**IBC 25-SS08: Emerging Technologies in Bridge Evaluation and Inspection: Case Studies on Practical Applications**

Gil Rosado, P.E., WSP USA, , ; Marcelino Aguirre, P.E., WSP USA, Orlando, FL

This presentation will feature two case studies showcasing the practical application of drone technologies in bridge evaluation. The first demonstrates the collection of actionable deterioration data on concrete bridge decks using drone-based imaging and AI analysis. The second highlights the use of high-definition photogrammetry and LiDAR to capture detailed as-built conditions of a steel truss bridge. We will provide a technical overview of the methodologies employed, discuss current capabilities and limitations, and offer insights into the evolving trajectory of drone-based inspection tools within the context of structural asset management.

**IBC 25-SS09: SR 0318 Over SR 0376 Emergency Bridge Replacement Project – Accelerated Design and Construction**

Richard Schoedel, P.E., Michael Baker International, , ; Keith Yoder, P.E., Michael Baker International

Over-height vehicles and bridges with substandard clearance can result in serious collisions that endanger lives and disrupt traffic. When the SR 318 bridge in Mercer County, PA was struck by the boom of a truck traveling eastbound on I-376 the morning of December 7, 2023, it sustained substantial damage which forced the bridge to be immediately closed. SR 318 carried approximately 3,000 vehicles a day and was the primary point of access to the interstate for a nearby national trucking terminal. For the safety of traffic traveling under the bridge, the interstate was closed and the damaged portion of the bridge was removed in less than 36 hours after the crash.
Rather than replace the bridge in its current position, PennDOT elected to replace the existing 4-span bridge with a new 2-span steel structure and raise the SR 318 profile over two feet to gain the necessary vertical clearance and prevent future strikes. The project included reconstruction of 200' of roadway to accommodate the profile raise, reconstructing three I-376 ramps, and reconstructing a nearby Park-N-Ride entrance. Both shoulders of SR 318 were widened to achieve the required sight distances at these intersections. To accomplish this in an expedited manner, the design had to avoid any impacts to right of way, minimize utility impacts, avoid nearby environmentally sensitive features and employ streamlined design procedures. The design and construction of the replacement took under 11 months to complete.

**IBC 25-SS10: SR 74 (Queen Street) over I-83, Vehicular Impact Emergency Repairs**

Stephen Beaver, P.E., WSP USA, Exton, PA; Mario Morina, WSP USA

SR 0074 (Queen Street) over Interstate 83 located in York County, PA is a 168'-0" long, 3-span continuous steel I-girder bridge constructed in 1959. On February 25, 2022 the fascia beam in the main span was impacted by a truck hauling a backhoe going northbound on I-83. This impact required the fascia to be temporarily supported by a prefabricated steel truss located on the deck / sidewalk while emergency repair plans were prepared. On August 24, 2022 near completion of the repair plans, the bridge was impacted by a dump truck going northbound on I-83. These two bridge hits together resulted in the full replacement of the fascia beam and first interior beam over the full length of the bridge, as well as heat straightening and steel repairs to several other beams. Because the bridge was located over an interstate highway (I-83), full road closures of I-83 could only be performed on weekends and overnight. This limitation required coordination between PennDOT, WSP and the contractor to develop emergency repair plans which could be executed by the contractor.

**IBC 25-SS11: Rapid Steel Solutions for Bridge Emergencies**

Ronnie Medlock, P.E., High Steel Structures, ,

Emergency situations require rapid steel solutions to return bridges to service as quickly as possible. As frequently demonstrated, fabricators can deliver bridges in months or even weeks. In this presentation, example projects will illustrate how fast steel can be provided and what keys things are needed to achieve these extraordinary results.

**IBC 25-SS12: Investigation of the Fern Hollow Bridge Collapse**

Andy R. Adams, P.E., Modjeski & Masters, Mechanicsburg, PA; Frank A. Artmont, Ph.D., Mechanicsburg, PA

On the morning of January 28, 2022, the Fern Hollow Bridge in Pittsburgh, PA collapsed under light traffic conditions, injuring 10 people. The bridge was a steel rigid-frame bridge (also known as a K-frame bridge), consisting of two main steel girders and four steel frame legs supporting the superstructure, and originally opened in 1973. Modjeski and Masters, Inc. (M&M) was engaged by the Pennsylvania Department of Transportation to assist in determining the cause of the collapse. A site visit was conducted the day of the collapse and included the examination and documentation of all major components of the bridge that were accessible. Subsequent analytical studies were conducted to determine the capacity of the bridge, the loads that were present at the time of the collapse, and the collapse sequence. This presentation will cover the investigation into the cause of the collapse, including the site visit, analytical investigations, and the determination of the likely failure mode. Based on the investigation results, it is likely that the collapse initiated with the failure of a transverse tension component within one of the frame legs, highlighting the need to ensure an understanding of structural behavior when evaluating unique details.

**IBC 25-SS13: Ductility: Another View**

Duane Miller, Lincoln Electric, ,

You have probably heard the adage "Steel is an inherently ductile material." Yet, we also know that on occasion, this "inherently ductile" material fails in a brittle manner. For seismic applications, engineers rely on ductile behavior to resist earthquake loading. Fabrication by welding inherently relies on ductility in order to accommodate the shrinking forces imposed on steel during fabrication. In this presentation, the fundamental mechanisms that enable ductile steel to perform in a ductile manner are presented. The theoretical discussion is combined with practical concepts that will change your approach to design and detailing of bridge members.

**IBC 25-SS14: Fatigue, Fracture, and Redundancy in Steel Bridges in 2025**

Robert Connor, Ph.D., Purdue University, Lafayette,

Fatigue and fracture issues in modern steel bridges have effectively been eliminated following decades of research and adoption thereof into the AASHTO Bridge Specifications. However, the statement "the Devil is in the Details" could not be truer when it comes to these two limit states. As a result, it is good to review some basic principles and detailing practices that are essential for long-term performance of steel bridges. Further, the concepts associated with redundancy, in particular, the now retired term "Fracture Critical Member (FCM), have also drastically changed (for the better) based research over the past decade. Engineers now have multiple reliable ways to address redundancy in bridges both currently in service and those in design. This presentation will present a high-level discussion of these topics that is geared towards the practicing engineering community.

**IBC 25-SS15: Panel Discussion with Duane Miller and Rob Connor**

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