INTERNATIONAL BRIDGE CONFERENCE®

2021 Conference Program Guide

JUNE 7-11, 2021

THE VIRTUAL, ON-LINE IBC

IBC 2021 - Welcome from the Chair

For 38 years ESWP's International Bridge Conference has offered the most comprehensive technical bridge program in the world, and this year is no exception.

For me, the legacy of this annual conference has always been the unparalleled sharing of ideas, knowledge and insight with people around the world for the sole purpose of improving the movement of people and products – quite a feat to maintain for over three decades. Amazingly, it's accomplished by a group of dedicated people who make up the IBC Executive Committee – all busy with family, work and play - but who come together in what little spare time they have with a belief in, and a dedication to, an industry that benefits everyone. Functioning in the background is the steadfast ESWP crew of David Teorsky, Kristina Emmerson, and Mike Gaetano repeatedly ensuring notifications are posted, deadlines are met and technology is in place to facilitate the conference.

And so, our legacy of learning continues this year with technical sessions that range from rail to road, interstate parks to BIM, proprietary products to foundation investigations, all complimented by workshops and virtual tours. Our trusted exhibitors have stayed the course with us these last two "virtual" years and are providing innovative ways for you to connect with them. They are at the ready with their online booths – please be sure to stop in and visit.

We are honored to have the Delaware Department of Transportation as our featured agency. In addition to its beautiful beaches and historic landmarks, this "First State", offers a robust transportation organization with a mission of providing a safe, reliable and convenient experience for all travelers utilizing all modes of transportation. I look forward to hearing about their program and projects.

Our Keynote Session is filled with individuals associated with organizations, agencies and universities who have their eye on future challenges that lay ahead for all of us. Pushing us forward to embrace new perspectives, principles and technology.

Finally, as we begin to move forward from this horrible pandemic and push the “re-start” button on our own lives, my hope is a renewed start for the transportation industry as well. One where our leaders and the public are educated about the important work we do and need to do, one that welcomes new ideas, one where financial priorities support much needed projects and most important of all, one where safety is the bottom line. And I’m confident the IBC will be there - continuing to support us all learning together.

I wish you all a heartfelt welcome to ESWP’s 38th International Bridge Conference – enjoy the Conference!

Jane-Ann Patton

General Chair IBC 2021

Jane-Ann Patton, P.E., is currently HW Lochner’s Pittsburgh Office Manager.

IBC
SCHEDULE-AT-A-GLANCE

2021 Technical Sessions

Technical Sessions have always been the heart of the IBC, where attendees can watch, listen and learn about the various topics scheduled for presentation. Conference attendees may choose from presentations in any of the concurrent technical sessions, as new presentations are scheduled every 30 minutes. Pre-registration is not required. Presentations of technical papers are denoted with “IBC 21-xx”. Presentations in the Special Sessions are denoted with “IBC 21 SSxx”. The following list of sessions are presented in alphabetical order by session title; a chronological listing follows. All times are Eastern.

Technical Sessions by date

IBC Workshops

IBC Workshops are focused sessions of extended length on specific topics and are presented by co-sponsors, partners and other leading industry groups. All workshops are included with your registration fee. Workshops are denoted with a "W-x"

IBC
VIRTUAL BRIDGE TOURS

It's the next best thing to being there! Since we can't go to the bridge, we will bring the bridge to YOU! This year, we are presenting not one, but four virtual tours of outstanding bridge projects! Each day during "Bridge Week" (exc. Friday) we are presenting a virtual tour for you to visit and learn about these projects. Each tour lasts approx. 30 minutes You can join the virtual tour by clicking on the session link at the scheduled times.

1. Monday, June 7; 4:00 PM - Newburgh-Beacon Bridge Re-Decking Project
2. Tuesday, June 8; 4:00 PM - Grist Mill Bridge
3. Wednesday, June 9; 10:00 AM - Benjamin Franklin Bridge
4. Thursday, June 10; 10:00 AM - Pennsylvania Turnpike Commission's Southern Beltway

IBC
POSTER SESSION

The 2021 IBC featues a Poster Session where you can continue your learning experience! Click in the "Documents" menu found in your eBag.

1. Synthetic Support Pennants for Structures; Mark Pieter Frolich, Phillystran Inc.
2. NJ Route 29 Tunnell - Fire Durability; Melissa Mertes, WSP
3. Initial Field Response and Modeling of Two Skewed Stell I-Girder Bridges; Siang Zhou, Larry A. Fahnestock, and James M. LaFave, Univeristy of Illinois
4. Alternative Accelrated Erection asnd Demolition Solutions, Mark Saliba, P.E., Freyssinet
5. Big River Crossing - Repurposing a portion of the Harahan Railroad Bridge; Brian Pelto, Ohio Gratings, Inc.

IBC
AWARDS 2021

Each year, the IBC Awards Committee presents several Medals and Awards of Distinction to world-wide, worthy contributions from the engineering community. This year is no exception - enjoy the year's award winners at our annual Awards Ceremony, on Tuesday, June 8 at 8:00 AM (ET). Congratulations to all of the 2021 Award winning projects, as follows:

George S. Richardson Medal: Recognizing a single recent outstanding achievement in bridge engineering

Awarded to the Shanghai-Suzhou-Nantong Yangtze River Rail-cum-Road Bridge, Nantong, China

Gustav Lindenthal Medal: Recognizing an outstanding structure that is also aesthetically and environmentally pleasing

Awarded to the Pingtang Bridge, Pingtang County, Guizhou, China

Eugene C. Figg Jr. Medal: Recognizing a single recent outstanding achievement which is considered an icon to the community for which it was designed

Awarded to the Dublin Link, Dublin, OH

Arthur G. Hayden Medal: Recognizing a single recent outstanding achievement in bridge engineering demonstrating vision and innovation in non-traditional structures

Awarded to the BMX Bowls Bridge, Houston, TX

Abba G. Lichtenstein Medal: Recognizing a recent outstanding achievement in bridge engineering demonstrating artistic merit and innovation in the restoration of bridges of historic significance

Awarded to the Historic Winona Bridge over the Mississippi River, Winona, MN

Award of Merit for Railroad: Recognizing a recent outstanding achievement in railroad engineering and construction

Awarded to the Cuijiaying Hanjiang River Bridge of Wuhan–Shiyan High-speed Railway, Hubei Province, China

IBC
EXECUTIVE COMMITTEE

The IBC is planned through the volunteer efforts of these top industry professionals who make up the IBC Executive Committee. The Engineers' Society of Western Pennsylvania (ESWP) extends a sincere thank you to the entire Executive Committee (listed below in alphabetical order) for their efforts in planning this year's conference. A very special thanks goes to the General Chair, Jane-Ann Patton, P.E., for her leadership in planning this years conference.

Elfatih Ahmed, Ph.D., P.E.
A&A Consultants, Inc.

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AECOM

Enrico T. Bruschi, P.E.
Jacobs

Matthew A. Bunner, P.E.
HDR Engineering, Inc.

Brandon Chavel, Ph.D., P.E.
National Steel Bridge Alliance

Michael Cuddy, P.E.
TranSystems

William Detwiler, P.E.
T.Y. Lin International

John C. Dietrick, P.E., S.E.
Michael Baker International

Kevin Duris, P.E.
Trumbull Corporation

Raymond A. Hartle, P.E.
GAI Consultants, Inc.

Donald W. Herbert, P.E.
Pennsylvania DOT (Retired)

Tyson Hicks
Joseph B. Fay Company

Liji Huang, Ph.D.
CCCC Highway Consultants Co., Ltd. (HPDI)

Margaret A. Jackson, P.E.
Pennsylvania DOT

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Pennsylvania DOT

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Jonathan McHugh, P.E.
Gannett Fleming, Inc.

Jane-Ann Patton, P.E., Conference Chair
LOCHNER

Francesco M. Russo, Ph.D., P.E.
Michael Baker International

Louis J. Ruzzi, P.E.
WSP USA

Stephen G. Shanley, P.E.
County of Allegheny, DPW

Rachel Stiffler
Vector Corrosion Technologies

James L. Stump, P.E.
Pennsylvania Turnpike Commission

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Maryland Transportation Authority

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County of Allegheny, DPW

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Consultant

Gerald J. Pitzer, P.E.
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Virginia DOT

Lisle E. Williams, P.E., PLS
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Ronald D. Medlock, P.E.
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W. Jay Rohleder, Jr., P.E. S.E.
FIGG

JOIN US AT THE 2022 IBC!

Join us in 2022 for the International Bridge Conference®, July 17–20, 2022 as we return to Pittsburgh, PA at the David L. Lawrence Convention Center. If you are interested in presenting a paper or workshop at the 2022 conference, watch for our "Call for Papers / Workshops" open immediately after the 2021 IBC. Also, promote your firm through the many different sponsorship and exhibit opportunities that are available - don't miss out and make your reservation early to take full advantage of all promotions! Visit www.eswp.com/bridge for more details.

URBAN CAP SPECIAL SESSION

Time: 8:00 - 10:00 AM

Session Chair: Gary Runco, P.E., Virginia Department of Transportation, Fairfax, VA

IBC 21-SS02: Creating a Park over an Interstate: History, Owner's Perspective, and a Bridge to Renewal in the City of Pittsburgh

Time: 8:00 AM

Zachary Workman, P.E., City of Pittsburgh, Pittsburgh, PA; Dan McDowell, RLA, LaQuatra Bonci Associates, Pittsburgh, PA

The I-579 "Cap" Urban Connector Project is a new, urban, 3-acre green space that will reconnect Pittsburgh's historic Hill District with the city's downtown business and cultural center. The tree-lined park will function as a "cap" over I-579, rebuilding the connections to a neighborhood that was disenfranchised by the construction of a cross-town urban interstate 50 years ago. The Hill District was the cultural center of Pittsburgh's thriving African American community through the 1960s, when portions were razed to construct the I-579 Crosstown Boulevard and Civic Arena. The site was primed for redevelopment with removal of the Civic Arena in 2011. The 2013 Lower Hill District Preliminary Land Development Plan (PLDP) proposed a public green space by creating a structural roof over the I-579 corridor, filling in the gap between two existing vehicular bridges to allow for a continuous surface over the interstate. The project was Awarded a $19 million federal grant through the Transportation Investment Generating Economic Recovery (TIGER) program. The City of Pittsburgh is the ultimate owner of the completed cap structure and park. This development is key to restoring a strong pedestrian connection for the Hill District to downtown. Improved connectivity is intended to provide greater economic opportunities through phased development of the former Civic Arena site, in accordance with the PLDP.

IBC 21-SS03: Community Outreach & Landscape Design

Time: 8:30 AM

Dan McDowell, RLA, LaQuatra Bonci Associates, Pittsburgh, PA

The I-579 Cap Park is a three acre site over I-579 in downtown Pittsburgh. The park will function as a "cap" over I-579, providing a walkable link to Pittsburgh's historic Hill District, a neighborhood that lost its direct access to downtown Pittsburgh over 50 years ago as a result of urban interstate construction. Three local artists from the Hill District and one national artist from the Baltimore area joined the design team to help enhance the overall site design and integrate art in the landscape design. The art elements express the history of the Hill District and African- American culture. The majority of the site and art elements are custom. These were developed through *a robust public involvement process, to identify desired features and part amenities. With major changes in grade, one design focus was to make as much of the site accessible as possible. Due to the funding sources and their limits, the park will be built in phases with the core framework being built first. Other future programming elements, such as the interactive water feature, café and restrooms pavilions, and performance stage, will be built by private funds. Flexibility needed to be built into the fabric of the park to meet the ever-changing recreational desires by the community it serves. Green infrastructure plays a significant role as well with storm water being managed through event lawn soils and terraced raingardens.*

IBC 21-SS01: Creating a Park over an Interstate: Design of Pittsburgh's Urban Cap Project

Time: 9:00 AM

Nick Burdette, P.E. and Roger Eaton, P.E., HDR, Pittsburgh, PA

The I-579 "Cap" Urban Connector Project is *a new, urban, 3-acre green space that will reconnect Pittsburgh's historic Hill District with the city's downtown business and cultural center. The tree-lined park will function as a "cap" over I-579, providing a walkable link to a neighborhood that lost its direct access to downtown Pittsburgh over 50 years ago as a result of urban interstate construction. Awarded a $19 million federal grant through the Transportation Investment Generating Economic Recovery (TIGER) program, the $29.3 million pedestrian park will be constructed on top of a bridge-like structure. This adjacent box beam structure is composed of 3 separate structures, designed to fit in the extremely congested urban site and connect to existing adjacent bridges. 126 unique beams were required to span the interstate in the skewed space between existing bridges. This unique structure required project-specific load considerations, including provision for park events and stage loading. Structural design required unique micropile foundations to avoid increasing loads on the existing interstate retaining walls, as well as slender piers constructed in narrow gore areas just inches from existing wall foundations. Extensive redundant waterproofing systems were utilized to ensure the moisture in up to five feet of park soil did not contact the buried structure below. Lightweight geofoam block was utilized to reduce the dead load in some of the longest spans. As part of the project, the existing bridge deck sidewalk cantilevers and barriers were removed and reconstructed to tie seamlessly into the new park surface.*

IBC 21-SS04: Creating a Park over an Interstate: Construction of a 3-acre Green Space in Downtown Pittsburgh

Time: 9:30 AM

Kyle Smith, P.E., HDR, Pittsburgh, PA; Dan McDowell, LaQuatra Bonci Associates; Zachary Workman, P.E., City of Pittsburgh, Pittsburgh, PA

The project is the design and construction of a new urban park in Pittsburgh Pennsylvania. The new park will span over a depressed section of Interstate I-579 (Crosstown Boulevard). The park surface will be constructed on top of a new bridge structure the spans over the interstate highway below. The new structure will fill in a gap between two existing vehicular bridges to allow for a continuous surface over the interstate. The new bridge will consist of a combination of 2-Span and 3-Span structures due to the flare of the interstate and the superstructure will be composed of composite adjacent prestressed concrete box beams. Construction of this adjacent box beam structure in the heart of downtown Pittsburgh included many challenges. The congested urban site included large existing retaining walls adjacent to the depressed interstate as well as dozens of utilities, existing sign structures that required relocation, and narrow gore areas where slender new pier foundations were constructed just inches from existing wall foundations. Delivery and erection of 126 unique adjacent box beams during brief interstate closures presented special challenges as the "roof" of this cap structure was closed off by beam placement. Unique products and materials including redundant waterproofing systems, fiber-reinforced protection slabs, and lightweight geofoam block added construction challenges for this mixed use land bridge. Challenges and lessons learned from key portions of construction will be discussed. The project is currently in construction and scheduled to be completed in late summer of 2021.

BIM SPECIAL SESSION

Time: 8:00 - 10:00 AM

Session Chair: Ronnie Medlock, P.E., High Steel Structures, Lancaster, PA

This session describes how state DOTs are moving to data-based workflows, including examples of how 3D models are being used for bridge design, construction, and asset management.

IBC 21-SS05: Building Information Modeling (BIM) for Bridges and Structures

Time: 8:00 AM

Ahmad Abu-Hawash, Iowa DOT, Ames, IO

Building Information Modeling for bridges and structures is a national initiative for managing transportation assets. This presentation will discuss the ongoing efforts by state DOTs and AASHTO for the adoption of BIM as a life cycle management strategy. Also, the benefits of BIM in design, fabrication, construction, and asset management will be discussed.

IBC 21-SS06: PennDOT Central Office-PennDOT's Planless 2025 program

Time: 8:30 AM

Allen Melley, Pennsylvania DOT, Harrisburg, PA

This presentation will provide an update on PennDOT's Digital Delivery Directive 2025. In this presentation audience members will be given an overview of PennDOT's strategic plan for advancing digital delivery, discuss how bridges are addressed in the plan, and provide some examples of how this will affect delivery of PennDOT bridge projects.

IBC 21-SS07: NYSDOT 3 D Bridge Modeling Effort

Time: 9:00 AM

Brenda Crudele, P.E., New York State DOT, Albany, NY

Traditionally 2D plan sheets have been the only format legally allowed for contractual work for NYSDOT projects. Model Based Contracting is an innovative approach where contractual work can legally be specified with electronic data, allowing for a digital information exchange between design and construction. Currently, NYSDOT is in the final phases of construction for its first pilot project and has just finished design of its second pilot project. The process developed and the Pilot Projects and will be discussed.

IBC 21-SS08: After BIM: Use of Digital Twins in Bridge Projects

Time: 9:30 AM

Alexander Mabrich, P.E., MSc, MBA, PMP, Bentley Systems, Fort Lauderdale, FL; JP Gauthier and Burak Boyaci, P.E., Bentley Systems, Sunrise, FL

As Building information modeling (BIM), a technology being used in the bridge construction industry, owners are realizing than the information stored in the 3D model needs to interact with the various stakeholders of the project. A true BIM model for bridge structures improve design quality with a better representation of the design intent of the engineer rather than creating 2D drawings, constructability, and collaboration.

However, a bridge project is not an isolated one. It includes multiple disciplines that need to collaborate in real time as their feedback could be crucial in the constructability of the bridge: utility conflicts, soil conditions, roadway geometry, overhead structures, traffic flows, environmental factors, social impact. The purpose of this paper is to present the advantages of using Digital Twins to provide the missing element of human interaction with the BIM models. A Digital Twin, that starts with a 3D model, rich with information, and gets updated constantly depending on the phase of the project: design, construction and operation.

RAILROAD SPECIAL SESSION

Time 10:00 AM- 12:00 PM

Session Chair: John Dietrick, P.E., S.E., Michael Baker International, Cleveland, OH

IBC 21-SS09: New Kensington Bridge Railroad Coordination

Time: 10:00 AM

Thomas Markosky, P.E., CBSI, The Markosky Engineering Group, Inc., Ligonier, PA

The New Kensington Bridge is a 14 span through truss structure over the Allegheny River and Norfolk Southern in Allegheny County, PA. The project is a bridge preservation which includes steel repairs, painting, and other repairs. The presentation will discuss coordination with Norfolk Southern which was started early in preliminary engineering to obtain concurrence on temporary clearance restrictions, to address contractor access, and to initiate the ROW process for temporary construction easements.

IBC 21-SS10: SEPTA's Right-of-Entry System: Safety, Coordination, and Planning on the Railroad

Time: 10:30 AM

David T. Montvydas, SEPTA, Philadelphia, PA

Interagency coordination between SEPTA and other railroads, other agencies, and private property owners is a daily occurrence. Our goal is to get each agency or property owner what they want (inspection, maintenance, and construction) while SEPTA preserves the highest levels of safety, service, and our ability to maintain the system. We achieve this through constant communication, clear guidelines, and combining efforts among differing agencies to get the most work completed in the shortest, most efficient time frames. This is done through our Right-of-Entry System.

CONSTRUCTION SPECIAL SESSION

Time: 10:00 AM - 12:00 Noon

Session Chair: Kevin Duris, P.E., Trumbull Corp., Pittsburgh, PA

IBC 21-SS13: Replacement of Bridge 3-507 on US113

Time: 10:00 AM

Jason Hastings, Delaware DOT, Dover, DE; Jonathan Karam, Delaware DOT, Dover, DE; Alan Young, Mumford and Miller, Dover, DE

The replacement of Bridge 3-507 on US113 in Millsboro, Delaware, required accelerated construction techniques to complete the replacement in 9 days due to the impacts of traffic on local residents and businesses. The project was a huge success due to the coordination efforts both in design, between owner/designer and local officials, and in construction, between owner/designer and the contractor. This presentation will hit on these efforts that led to the success of the project.

IBC 21-SS14: The use of Polyester Polymer Concrete on the Pennsylvania Rapid Bridge Replacement Project

Time: 10:30 AM

Ed Dice, Plenary Group; Jason Fuller, HDR; Kevin Crist, The Walsh Group

Polyester Polymer Concrete (PPC) is an innovative technique used on 357 box beam bridge structures included on the Rapid Bridge Replacement Project. The use of PPC on bridge decks was incorporated into the project as an Alternate Technical Concept due to the reduction in long-term maintenance costs. PPC's impermeability reduces costs from corrosion inducted damages, durability eliminates the costs of intermediate overlays and the longevity of skid resistance reduces long-term costs. PPC has an expected useful life of 30 years or more and prolongs the life expectancy of the bridge by preventing moisture and corrosive substances from penetrating the deck.

IBC 21-SS15: Pennsylvania Turnpike Commission Bridge SB-257 Deck Crack Repairs

Time: 11:00 AM

Dale Rosinski, P.E., CDR Maguire, Inc.; Allan Schuck, EIT, CDR Maguire, Inc.; Scott Rolley, P.E., WSP USA; Ray Reed, Mekis Construction

The Pennsylvania Turnpike Commission's Southern Beltway Project consists of all new construction of 13-miles of limited access toll road and 27 bridges in Washington and Allegheny Counties. This presentation provides insight from the perspective of the owner (PTC), designer (WSP), and subcontractor (Mekis Construction) through their partnered efforts to develop a practical and economical solution to address transverse deck cracking.

W-01: Los Angeles World Airports Automated People Mover – Elevated Guideway

Time: 10:00 AM - 12:00 Noon

Chester Werts, P.E., S.E., P.Eng., Greg Knutson, and Anthony Messmer, HDR

The $1.95B Automated People Mover (APM) is a 2.25-mile elevated guideway train system and the centerpiece of Los Angeles International Airport's (LAX) Landside Access Modernization Program (LAMP). Project scope includes the design and construction of a guideway structure, five passenger stations, and a Maintenance and Storage Facility. An overview of the project, seismic analyses, hybrid CIP segmental box girders, and modeling/design techniques used to mitigate vehicle roll-over during seismic events will be discussed.

KEYNOTE SESSION

Time: 1:00 - 3:00 PM

Session Chair: Jane-Ann Patton, P.E., IBC Chair, LOCHNER, Pittsburgh, PA

The Keynote Session is the official start to the 2021 IBC! Conference Chair Jane-Ann Patton hosts the session. Following welcoming remarks, we are pleased to announce the following presenters:

Carmen Swanwick, P.E., S.E., Utah DOT

Carmen Swanwick is the Utah Department of Transportation (UDOT) Region 2 Deputy Director. Carmen served as the Department's Chief Structural Engineer for almost ten years and has over 15 years of experience as a consultant in structural engineering within the transportation industry. She received both her Bachelors and Masters degrees from the University of Utah in Civil/Structural Engineering. Carmen is the AASHTO Committee on Bridges and Structures Chair and for the last six years served as the AASHTO Committee on Bridges and Structures (COBS) T-4 Committee on Construction Chair. Carmen participates in numerous National Cooperative Highway Research Program (NCHRP) projects and Transportation Research Board (TRB) Committees. Carmen has been involved in several Department initiatives through the years including the Accelerated Bridge Construction (ABC) program, development of the Unmanned Aerial Systems (UAS) program and recently the Digital Delivery effort with an emphasis on Building Information Modeling (BIM) for bridges and structures.

Derek Soden, P.E., S.E., FHWA

Derek is the Structural Engineering Team Leader in the Federal Highway Administration's Office of Bridges and Structures and is FHWA's Principle Structural Engineer. In this role, Derek is responsible for planning and managing national level programs targeted at improving the state of practice of structural engineering as applied to planning, selection of type, size and location, design, construction, and evaluation of highway bridges and structures. He leads a staff of highly qualified engineers that provide technical leadership and guidance to State DOTs, industry, and other FHWA offices in Headquarters, Research, Development and Technology, the Resource Center, Federal Lands Highway Divisions, and the Federal-Aid Divisions.

From 2012 to 2020, Derek was a Senior Structural Engineer with the FHWA Resource Center, where he provided technical assistance and training in the areas of bridge design, construction, and inspection. Prior to that, from 2009 to 2012, Derek was the Assistant Division Bridge Engineer for FHWA's Florida and Puerto Rico Divisions. Before joining FHWA, from 1998 to 2009, Derek was a bridge design engineer for the Alaska Department of Transportation and Public Facilities where he developed designs for new bridges and bridge repair, rehabilitation, and seismic retrofit projects throughout the state. Derek received his B.S. in Civil Engineering in 1997 from the University of Alaska in Fairbanks (where he was born and raised) and his M.S. in Structural Engineering in 1998 from the University of California, Berkeley.

Nicole Majeski, Delaware DOT

Nicole Majeski was sworn in as the 11th Secretary of the Delaware Department of Transportation on January 13, 2021. As Secretary, she leads an organization responsible for 90% of the state's transportation network, including the Division of Motor Vehicles and the Delaware Transit Corporation. Oversees the development and implementation of a six-year capital program of over $4 billion and ensures compliance with U.S. Department of Transportation. In addition, she works with the state's counties, municipalities and towns to coordinate land use planning and transportation infrastructure needs throughout the state. With an annual budget of nearly $1 billion and a dedicated workforce of over 2,500 employees, Nicole oversees one of the largest departments in state government.

As Secretary, Nicole represents Delaware as a member of the Eastern Transportation Coalition, the Northeast Corridor Commission, the American Association of State Highway and Transportation Officials and the Northeast Association of State Transportation Officials.

Prior to becoming Secretary, Nicole served as Deputy Secretary of DelDOT where she assisted in overseeing daily operations, managed policy and legislative initiatives, constituent relations, employee development and the audit section.

Before joining the state, Nicole worked for New Castle County Government for seven years, serving as chief of staff to then County Executive Chris Coons. She is a graduate of the University of Delaware and a Council of State Government Toll Fellow. Nicole and her husband Ari Messinger have two sons and reside in Middletown.

William Williams, P.E. Texas A&M Transportation Institute

Mr. Williams is an Associate Research Engineer at the Texas A&M Transportation Institute. Mr. Williams has over 30 years of structural engineering and design experience. He is an expert in the design, testing, detailing, and construction of bridge rails, and other types of roadside barriers for all different test levels. He has barrier design and testing experience in the United States as well as several countries abroad. He has served as principal investigator (PI) on numerous bridge railing retrofit projects in the United States and abroad. He recently served as PI on the 24.8 mile long southbound causeway bridge over Lake Pontchartrain near New Orleans, Louisiana. He has served as principal investigator or co-principal investigator on over 300 bridge railing and other roadside barrier projects for Texas A&M Transportation Institute. Many of these projects pertain to retrofit applications to meet the requirements of MASH Specifications. Mr. Williams has *designed and detailed numerous bridge railings systems for state agencies, private firms, international highway and private agencies. Mr. Williams has made numerous presentations at national and international meetings that pertain to the design and testing of roadside barrier systems.*

Mr. Williams has been principal investigator on the analyses and design of new crashworthy bridge railing systems for several historic truss bridges in the State of Texas. These projects required analyses of the complete truss bridges to determine if the bridge truss members and adequately resist the impact loading from errant vehicles impacting the railing attached to the truss members.

In addition, Mr. Williams has designed and detailed numerous perimeter security barrier systems for several private firms, municipal agencies, and the Federal government. Mr. Williams has designed and detailed approximately 25 barrier systems for the Department of State. Mr. Williams is an expert in the design and full-scale testing of perimeter security systems with respect to the ASTM 2656 specifications M30 to M50 test levels. In addition, Mr. Williams is an expert in the design and testing of fence systems with respect to the ASTM F2781-15 forced entry specification. Mr. Williams has designed numerous fence systems here in the United States.

He is an expert using such engineering software packages such as AutoCAD, Solidworks, STAAD PRO, RISA-3D, MathCAD, and numerous other structural analyses and design software packages. Mr. Williams specializes in reinforced concrete and structural steel design and detailing. In addition, Mr. Williams is an expert in structural analyses design and detailing of residential, commercial, industrial and petrochemical structures of all types. Mr. Williams has served as co-principal investigator for a project to determine the impact force imparted to bridge piers from large 80,000 lbs. trucks. Mr. Williams has investigated several large truck crashes involving large trucks impacting bridge piers in the United States.

Prior to joining TTI, Mr. Williams has spent most of his career in private consulting on structural and civil projects. He has worked on residential, commercial, industrial, municipal, state and federal projects. He has twelve years design and field experience in geotechnical, civil, hydraulic, and structural engineering design and construction. His assignments have included design and construction of commercial buildings, stormwater drainage system, asphalt roadways, structural steel and concrete bridges, and various structural projects for the petrochemical industry. He has held titles of Field Engineer, Field Surveyor, Structural Engineer, and Lead Civil/Structural Engineer. Mr. Williams was lead civil structural engineer for the large U.S 77/83 Interchange MPRR/Palm Drive Overpass in Cameron County, Brownsville, Texas. This project involved the design of pier foundations, bent caps, bridge girders (steel and concrete), bridge decks, and abutments for the interchange. Approximately 300 drawings were issued for construction for this project.

PROPRIETARY SESSION

Time: 3:00 - 6:00 PM

Session Chair: Rachel Stiffler, Vector Corrosion Technologies, Canonsburg, PA

The proprietary session will discuss several new technologies and innovations!

The session begins discussing pultruded FRP decking showing several hollow sections together forming one integral custom element. Next topic shows the intricacies involved in creating high load multirotational bearings used on the expansion project at LaGuardia Airport.

New technology about rope access for hard-to-reach areas using UAV inspection, 3D reality capture and AI for defect detection is to follow. The use of cathodic protection systems to extend the life of the 85 yr old Arlington Memorial bridge is next.

Ultra high performance fiber reinforced concrete for Unique rehabilitation of bridge structures follows. The final topic is testing of key components on the Chacao suspension bridge in Chile.

IBC 21-01: Innovative Bridge Rehabilitation using Pultruded FRP Decking

Time: 3:00 PM

Ali Mohammed and Michael Kemp, Wagners CFT, Toowoomba, QLD, Australia; Rohan McElroy, i3 consulting pty ltd, Brisbane, QLD, Australia; Brett Jennings, Wallbridge Gilbert Aztec, Adelaide, SA, Australia

The growing concern of maintaining road bridges operational in harsh marine environments urged the necessity to develop durable alternatives to be used in such applications. Glass fibre reinforced polymer (GFRP) composite bridge decks become a very attractive option for bridge repairs due to their superior characteristics compared to traditional materials in terms of strength, weight and durability. Besides, GFRP bridge decks are quick to install and cause minimal disturbance to the daily traffic at the time of construction as a result of being light-weight materials. Recently, a novel GFRP bridge deck has been developed by bonding several pultruded hollow sections acting compositely and forming one element at custom length and width. Extensive experimental and numerical analysis have been undertaken on the fabricated bridge deck which demonstrated the structural integrity of the developed product. As a result of these investigations, the novel bridge deck has been utilized in several repair projects as an alternative for the deteriorated decking of the existed road bridges. The most recent one is the Birkenhead bridge project in Adelaide, South Australia where the novel FRB bridge deck has been chosen for its advantages during both, the installation and in- service stage.

IBC 21-02: High Load Multirotational Bearings for the Laguardia Airport Modernization Project

Time: 3:30 PM

Ron Watson and Jay Conklin, R. J. Watson, Inc., Alden, NY

The Laguardia Airport in New York City, operated by the Port Authority of New York and New Jersey, is one of the busiest airports in the country. In 2016 the first of two massive projects totaling $8 Billion began which was headed up by the joint venture of Skanska-Walsh. This project consists of a new Terminal B and an 850,000 sq-ft headhouse. In addition, the roadway system feeding in and out of the terminal is being rebuilt with over 540 disk bearings being utilized on the ramps and structures comprising this complex. The second project is being headed up by Delta Airlines who is acting as the general contractor in replacing Terminals C and D. Again, a complex roadway is being constructed in front of the terminal which will include over 800 disk bearings of all types. These bearings are designed for high horizontal loads and rotations, uplift conditions and seismic isolation. This paper will highlight some of the challenges of the design, manufacture, testing and installation of these devices for this unique project with an emphasis on the versatility of this type of bearing system for complex bridges.

IBC 21-03: Lessons Learned from Using UAVs for Bridge Inspection on the Latah High Bridge in Spokane, WA

Time: 4:00 PM

Nathan Schuett, PRENAV, Belmont, CA; Andy Fickett, Fickett Structural Solutions, Middleton, WI

UAVs generate lots of buzz but are not widely adopted for bridge inspection due to challenges in close-up flight and data management. Today, UAVs are primarily deployed as a fancy set of binoculars, for spot checks of difficult to access areas. PRENAV is developing technology to change the way UAVs are used in bridge inspection, by capturing detailed 3D models (or point clouds) of structures via photogrammetry, and then overlaying photos and artificial intelligence for defect detection through a web-based portal. This streamlines the inspection process, automatically flagging and quantifying damage such as cracking, spalling, and more. During a rope access inspection of the Latah High Bridge in Spokane, WA, Fickett Structural Solutions decided to partner with PRENAV to pair UAV technology with rope access inspection. This presentation will discuss lessons learned, what worked well, what didn’t work, and opportunities for future development.

IBC 21-04: Cathodic Protection of Arlington Memorial Bridge with Two-Stage Anodes

Time: 4:30 PM

Natallia Shanahan and Shayan Yazdani, Vector Corrosion Services, Tampa, FL; Wayne Dodds, AECOM, Chesterfield, United Kingdom

Arlington Memorial Bridge is a reinforced concrete spandrel arch bridge that connects Washington, DC and Virginia across the Potomac River. This landmark historic bridge was opened in 1932 and after 85 years in service started showing signs of deterioration, including reinforcement corrosion. The National Park Service, the bridge owner, selected AECOM/Kiewit as the design-build team to provide a rehabilitation plan to extend the service life of the bridge by 75 years. The rehabilitation consisted of deck replacement and substructure repairs involving the installation of targeted cathodic protection (CP) systems in the arch cross-walls, floors, and under arches to mitigate and prevent corrosion.

The implemented cathodic protection system consisted of both galvanic and two-stage anodes to mitigate corrosion. Galvanic anodes were installed in the patch repairs to prevent the ring anode affect and ensure a high-quality and durable concrete repair. The two-stage anodes were installed in areas of concrete that were actively corroding but the concrete had not yet delaminated. The two-stage anodes deliver an initial charge to the reinforcement similar to an ICCP system to polarize the steel (Stage 1), after which they provide a maintenance amount of galvanic current sufficient to prevent corrosion (Stage2). Continuous monitoring of the two-stage anode performance showed their effectiveness in polarizing the steel and preventing corrosion activity. The Arlington Memorial Bridge rehabilitation shows that cathodic protection can be efficiently installed into a structure to provide a very effective and durable rehabilitation.

IBC 21-06: Chacao Bridge: Testing of Key Bridge Components to Ensure Effective Life-Cycle Performance

Time: 5:00 PM

Carlos Mendez-Galindo, Ph.D., mageba Latin America, Queretaro, QRO Mexico; Amit Kutumbale and Gianni Moor, mageba LLC, New York, NY

The Chacao Bridge is a 2.75km-long bridge being built by Ministry of Public Works (MOP) of Chile. Upon completion, it is claimed to become the longest suspension bridge in South America. Linking the Island of Chiloé with mainland Chile through the Chacao Channel. The proper long-term performance of critical structural components such as bearings, expansion joints, dampers and seismic isolators is vitally important in maximizing the long-term performance of this special structure. It thus plays a significant role in minimizing its life-cycle costs, not only in terms of direct and indirect financial costs resulting from

repair and replacement work, but also with respect to the disruption caused to the structure's users during the work.

A good way of ensuring that these key components will perform well throughout a long service life is to conduct laboratory testing prior to use, in accordance with national or international standards. As well as providing confidence in long-term performance, such testing can also provide useful information for use in planning and design work. Testing can be project-specific, requiring components that will actually be installed to be tested, or can take the form of type-testing in accordance with a specific standard, which once completed on a particular specimen may be valid for other specimens of similar design. While this kind of extensive testing may save some initial expense, the advantages of verifying good performance by such means can far outweigh the costs.

W-02: New Frederick Douglass Memorial Bridge Construction Update

Time: 3:00 PM - 4:00 PM

Dennis Howland II, P.E., District DOT, Washington, DC

The Frederick Douglass Memorial Bridge in Washington, DC is a unique three-span, springing arch, cable supported deck bridge that will serve as the gateway to the monumental core from visitors traveling from the south and east. Although it's not an interstate highway, it is a part of the National Highway System due to its strategic location and importance in the US economy, defense, and mobility to and from the abutting interstate highway. Our presentation will provide an update of the current construction progress, and a discussion about the associated community based activities underway focused on building "more than a bridge."

W-03: The Importance of a Detailed Specification for Bridge Painting

Time: 4:30 - 5:30 PM

Tony Serdenes, Gannett Fleming, Inc., Baltimore, MD; Mark Hudson, The Sherwin-Williams Co., Protective & Marine Coatings Division

This workshop will provide best practices when developing a bridge painting specification. It will focus on steps in designing a specification that will cover surface preparation, coating application, environmental requirements, and special provisions to cover areas of a structure that may need to receive special attention due to access/inaccessible areas. The goal of this workshop is to educate designers and owners on what steps to take when developing a paint specification.

DESIGN, PART 1 SESSION

Time: 9:00 AM - 12:30 PM

Session Chair: Brian Kozy, Ph.D., P.E., Michael Baker International, Linthicum, MD

Design is about conceiving of a solution that addresses all requirements for the lowest possible cost. This session covers topics and projects that provide insights into new and improved ways to achieve this in bridge engineering applications. Presentations in this session cover topics such as seismic design, special performance requirements, complex and innovative projects, and loads from truck platoons.

IBC 21-07: Seismic Design of the Gerald Desmond Bridge

Time: 9:00 AM

Javier Campos and Josh Matteis, Arup, Los Angeles, CA; Matt Carter, Arup, New York, NY

The Gerald Desmond Bridge Replacement is a 2000-foot cable stayed bridge with two 550-foot tall mono-pole towers. The Main Span Bridge cross-section consists of a steel box edge girders composite with a light-weight concrete deck, and steel floor beam system spanning approximately 160-foot between girders. The approach structures consist of single and multi-cell prestressed concrete box girders, built using a movable scaffolding system (MSS) due to its high elevation above ground. Being California's largest and first signature cable stay bridge at its time of construction, this paper focuses on the seismic design methodology and innovations in an active seismic region to achieve a 100-year design life. Some of the work conducted includes the development of non- linear time history analysis, understanding how viscous fluid dampers affect the seismic performance and dissipate energy, modeling soil structure interaction to capture the effects of liquefiable soil, as well as the combined effect between the cable stayed bridge and the concrete approaches. Other considerations include seismic events during construction and meeting a functional performance per project criteria.

IBC 21-08: Bridge Resiliency and Post-Earthquake Functionality Requirements

Time: 9:30 AM

Bijan Khaleghi, Ph.D., P.E., S.E., Washington State DOT, Tumwater, WA

The current seismic design practice requires normal bridges to meet the Safety Evaluation Earthquake (SEE) and Functional Evaluation Earthquake (FEE) for Essential and Critical bridges. Expected Post-earthquake Service Levels are categorized as: 1) No Service – Bridge is closed for repair or replacement, 2) Limited Service –Bridge is open for emergency vehicle traffic with reduced number of lanes for normal traffic is available within three months of the earthquake; and 3) Full Service – Full access to normal traffic is available almost immediately after the earthquake.

I n recent years the ultra-high performance concrete (UHPC) has been tested for bridge columns to improve to improve the performance of the connection within the plastic hinging regions. UHPC with its superior properties of higher compressive strength and modulus, and very low permeability, can provide improvements over conventionally build bridge columns. This paper focuses on the seismic performance precast bridge columns meeting the two level seismic hazard evaluations SEE and FEE requirement using a combination of UHPC for column plastic hinging regions in combination with super-elastic materials (shape memory alloy) or self-centering capability (unbonded center prestressing) to achieve seismic resiliency during earthquake and full or partial operation immediately after the earthquake.

IBC 21-09: Planning and Design of the I-294 Mile Long Bridge

Time: 10:00 AM

Lance Peterman, Jr., P.E., S.E., HDR, Rosemont, IL; Robert Hong, H.W. Lochner, Chicago, IL; Mohamad Faraj, P.E., P.M.E., Illinois State Toll Highway Authority, Downers Grove, IL

The Mile Long Bridge carries the Tri-State Tollway, I-294, over the Canadian National Railroad, the Illinois and Michigan Canal, the Chicago Sanitary and Ship Canal, the Metropolitan Water Reclamation District, the Des Plaines River, the Burlington Northern Santa Fe (BNSF) Willow Springs Intermodal Facility, Santa Fe Drive, and the 75th Street interchange in suburban Chicago Illinois. The new dual structures are comprised of seven units made up of 27 spans with a total length of 4,828 feet. The original bridge was built in 1957 with two lanes in each direction. The dual bridges were widened multiple times to meet increasing traffic demands over the years. The bridges are now being reconstructed and widened to carry five lanes in each direction as part of the Illinois Tollway's $4 billion Move Illinois capital program. Besides the nearly one-mile length, the other unique aspect of this project is the wide variety of surrounding features and facilities. The project challenges included maintaining vehicular and rail traffic during reconstruction with limited access and available right-of-way, while minimizing impacts to the waterways, rail corridors, road facilities, utilities and commercial activities beneath the structure. The solution for the proposed bridge type and layout was influenced by the limited construction methods and the locations where piers could be placed. The new bridges feature two long span steel units and five long span precast wide flange units. This bridge will utilize the longest prestressed concrete spans (187 feet) and longest steel spans (410 feet) on the entire Tollway system.

IBC 21-10: Influence of Material Toughness on Fracture Reliability in Steel Bridges

Time: 10:30 AM

Frank Artmont and Thomas Murphy, Modjeski and Masters, Mechanicsburg, PA

The fracture limit state of the AASHTO LRFD Bridge Design Specifications is addressed by requiring minimum impact toughness values for base material and mitigating potential fracture initiators through proper structural detailing. This fracture control approach has been successful in minimizing the number of fractures in steel bridges designed since its inception; however, it is not a calibrated limit state and the structural reliability against sudden brittle fracture has not been previously established. Accordingly, the objective of this study was to quantify the relationship between material toughness and fracture reliability in steel bridge members, considering the probabilistic distribution of fracture toughness and applied stress for a variety of structural steels and assumed crack sizes. The master curve approach is used to account for the probabilistic distribution of fracture toughness, and reliabilities are determined using Monte Carlo simulation and the Hasofer-Lind approach. The results indicate that the fracture reliability for modern bridge steels is consistent with the reliability of AASHTO strength limit states, and that certain steels currently available on the market can provide enough reliability against fracture to essentially eliminate sudden brittle fracture as a limit state of concern. This finding holds the potential for a new way of approaching the design of fracture critical members.

IBC 21-11: Design & Construction of the GCRTA Blue Green Line Bridges

Time: 11:00 AM

Christopher Cummings, P.E., DBIA, Edward Baznik, P.E., and Kimberly Guice, P.E., Michael Baker International, Cleveland, OH

Michael Baker was contracted as the lead designer for the Kokosing Design-Build Team on the Opportunity Corridor, Phase 3, project. Stretching from East 93rd Street to I-490, the new five-lane urban boulevard will improve the roadway network within a historically underserved area in the City of Cleveland. The project will enhance access to Cleveland's cultural hub, healthcare and educational facilities. The crossing of Opportunity Corridor over the GCRTA Blue-Green rail lines was one of the more challenging from a design and construction perspective. This presentation will focus on the pre-bid evaluation and layout, post-bid design and construction of the three-span, curved and skewed eastbound and westbound structures carrying the new boulevard over the active rail transit line. The design approach to the 3D finite element modeling and superstructure steel detailing will be discussed. Additionally, the design development and construction of a Concrete Filled Steel Tube (CFST) pier design will be communicated. The change to the CFST design was made post-bid after a conflict with an existing combined sewer was determined.

IBC 21-12: Horizontally Curved Steel Bridge Girder with Rectangular Tube Top Flange

Time: 11:30 AM

Geoffrey Stryker, STV Incorporated, Philadelphia, PA; Henry Berman, P.E., Pennsylvania DOT, King of Prussia, PA; Justin Eberhart, STV Incorporated, Harrisburg, PA; Tom Macioce, P.E., Pennsylvania DOT, Harrisburg, PA

STV recently completed the design of a horizontally curved steel bridge which utilized a rectangular tube for its top flange. The bridge is a 148- foot single span bridge over CONRAIL railroad tracks and below multiple overhead electric lines. The structure utilized five steel plate girders with a HSS 20x12x5/8" top flange, a 65" deep web, and a 2 ¾" x 24" bottom plate. The average curve radius is 535.5-feet. A tubular top flange was chosen due to its torsionally stiffness, which removes the need for temporary falsework to support the girder during erection. Project is currently under construction and being fabricated this winter. Presentation will include a discussion on previous tubular flange girders in PA, as well as fabrication information including shop drawings and fabrication photos.

IBC 21-13: Safe Platooning Headways on Girder Bridges

Time: 12:00 PM

Joshua Steelman, Bowen Yang, and Daniel Linzell, University of Nebraska-Lincoln, Lincoln, NE; Jay Puckett, University of Nebraska-Lincoln, Omaha, NE

Truck platooning – digitally linking two or more trucks to travel in a closely spaced convoy – is an emerging technology with the potential to save fuel and reduce labor. This paper describes a framework for determining how much a platoon permit load might be increased above Federal Bridge Formula B legal limits, given strict control over the load characteristics and operational tactics. In the near future, platoons are expected to be advanced not only with respect to traffic operations but also in their ability to weigh and report axle weight and spacing, functioning as mobile- WIM (mWIM). ConsequeTRB Reviewed, the live load statistics (bias and CoV) differ from code assumptions, and are perhaps controllable, which poses significant opportunity with respect to operational strategies. A parametric study considered different girder spacings, span lengths, numbers of spans, types of structures, truck configurations, numbers of trucks, and adjacent lane loading scenarios. The Strength I limit state was evaluated for steel and prestressed concrete I-girder bridges optimally designed by LRFD and LFD. Reliability indices were calculated for each load case based on the Monte Carlo Simulation Method. Summary headway guidance was developed and is presented herein to illustrate potential safe operational strategies with varying truck weights and platoon live load effect uncertainties.

REHABILITATION, PART 1 SESSION

Time: 9:00 AM - 12:30 PM

Session Chair: M. Patrick Kane, P.E., GPI - Greenman-Pedersen, Inc., Pittsburgh, PA

This session has a variety of rehabilitation presentations including a repair for an impact damaged steel girder, rehabilitation and replacement of 26 bridges on Interstate 70, bridge digital twin application to protect from overweight damages, an open spandrel historic arch preservation, an ASR Affected Bridge, replacement of a bridge over the C&O Canal in historic Georgetown, FEM analysis of an overpass with link slabs and modified bearings, and a long-term solution to mitigate pile corrosion.

IBC 21-14: Partial Steel Girder Replacement Due to Repeated Impact Damage and Use of Instrumentation to Monitor Effectiveness of Repair

Time: 9:00 AM

Laura Magoon and Christopher Kijak, RK&K, Baltimore, MD; David Barrett, Modjeski and Masters, Inc, Mechanicsburg, PA; Tekeste Amare, P.E., Maryland Transportation Authority, Baltimore, MD

Quarantine Road is a 4-span steel girder bridge with a 2-span continuous unit over I-695 whose exterior girder has been subjected to repeated impact damage from over-height vehicles. The original repair included heat-straightening; however, during design the girder suffered a third impact at the same location and it was apparent the girder would be vulnerable to future damage. Therefore, the design team provided an alternate plan which would remove and replace the damaged section of the girder bottom flange and web with a shallower section of the same design capacity to provide additional clearance. To minimize the traffic impact on I-695 during construction, the girder was supported from the deck by a temporary twin beam (W44x335) and tie rod support system. Gages and sensors were placed on the tie rods to monitor the load transfer process during construction (field data remains outstanding). The repair was designed to be a closed system. In addition, strain gages were installed on the damaged and adjacent girders to determine the dead and live load induced stresses at various stages of construction. This data demonstrates the repair is effective with the live load properly distributed; however, there is some permanent redistribution of the dead load to the adjacent girders. For future work, the use of instrumentation should be integrated as part of the construction process to ensure the full (and maintained) unloading of the damaged girder occurs so the repaired section, once loaded, is fully engaged for both live load and dead load.

IBC 21-15: Rehabilitation and Replacement of 26 Bridges along I-70

Time: 9:30 AM

Michael Perry, P.E., Stantec, Lexington, KY; Matthew Bunner, P.E., HDR, Pittsburgh, PA; Ahmed Mongi, P.E., West Virginia Department of Highways

This project involved the rehabilitation or replacement of 26 bridges along I-70 near Wheeling, WV, the WVDOH's largest letting ever at $214M. This paper will focus on the rehabilitation of 24 bridges along a complicated and busy interstate corridor that includes a tunnel, a major river crossing, and complex interchanges. The bridges include the Fort Henry Bridge, a tied arch over the Ohio River, multiple complex ramp structures, and mainline interstate bridges. The design of the project was completed on an extremely expedited schedule of 7 months. After an unsuccessful D/B procurement, the WVDOH decided to modify to a Design Bid Build procurement to allow the project to move forward on the previously established schedule. Careful coordination between bridge teams and MOT were required to perform the repairs in concert during multiple phases of construction and sequential closure of each direction of I-70. Rehabbed elements focused on creating minimized long-term maintenance with cost effectiveness. Joints and pin/hanger locations were eliminated creating revised continuity conditions. Ultra high performance concrete link slabs, bridged over previous interior joints. Other repairs included FHWA mandated cross slope correction, abutment conversions to semi-integral, bearing reconfigurations, steel strengthening, full coating systems and others. Substructure repairs included a tiered approach based on severity. With years of heavy chloride use and failing joints, the many concrete substructures had substantial deterioration. Repairs included passive cathodic protection on reinforcing. Discussion will include the many challenging repairs performed and coordinated between multiple firms, WVDOH, and ODOT on a very expedient timetable.

IBC 21-16: Bridge Digital Twin: A Paradigm Shift in Digital Preservation of Bridges against Overweight Damages

Time: 10:00 AM

Aaron Costin, Ph.D. and Alireza Adibfar, Ph.D., University of Florida, Gainesville, FL

Preservation of bridges has always been a concern for bridge engineers, operation managers, and transportation departments' officials. Bridges are designed to be able to carry a certain amount of loading over their expected service life. Passage of overweight vehicles will impose excessive stress and fatigue on bridges, specifically aged or structurally vulnerable ones. Therefore, there is a need for the integration of available technologies to improve data utilization. Intelligent Transportation Systems (ITS), specifically Weigh in Motion (WIM) systems, provide valuable real-time data about the live load over the ground transportation network and could be further developed to preserve bridges. However, the data are being stored in standalone databases and are not widely accessible for all the bridge engineers. This paper examines the fusion of Bride Information Modeling (BrIM) as a data integration platform with the WIM system to form the bridge digital twin, enhance data utilization, and improve post-processing. For simulating the process, a mock-up bridge was built, an Arduino microcomputer and sensor set was used to simulate the WIM system, data were imported into the computer using scripting, analyzed, and stored in a database. The validation process demonstrated that the data could be integrated into the BrIM model as a digital twin and are capable of being processed along with other associated data such as Structural Health Monitoring (SHM) data. The findings of this study help academic practitioners develop the data utilization algorithms and industry practitioners to improve the quality and efficiency of the bridge management system.

IBC 21-17: Preservation of an Open Spandrel Historic Arch Bridge and an ASR Affected Bridge in North Carolina

Time: 10:30 AM

John Sloan, AECOM, Raleigh, NC; Kevin Fischer, P.E., North Carolina DOT, Raleigh, NC

The Swift Island Bridge is a historic open spandrel concrete arch bridge constructed in 1927 near Charlotte, North Carolina, that is eligible for listing on the historic register. AECOM completed a design for the North Carolina Department of Transportation to replace the superstructure and widen the bridge from 20’-0” to 36’-0” so the structure can carry two lanes of westbound traffic with shoulders. The arches and piers were preserved and rehabilitated for a projected 75-year service life, while maintaining the historical and architectural character of the entire structure. Pedestals, haunches, and architectural details were preserved or replaced in kind, and the structure received a coating to maintain a uniform appearance among original concrete, new concrete, and repair materials. The project consisted of a feasibility study with 2D modeling of the existing and proposed structures, inspection, corrosion evaluation, service life analysis, historic architecture evaluation, 4D finite element modeling, final design, and construction phase services. An adjacent eastbound bridge was constructed in the 1970s that exhibited defects in the piers due to alkali-silica reactivity (ASR). In addition to the arch bridge rehabilitation and widening, AECOM completed an evaluation and rehabilitation of the eastbound bridge to mitigate the ASR that included 3D imaging of the piers using an unmanned aerial system to accurately map defects. A material evaluation, corrosion study, and field inspection were completed, and epoxy jacketing was employed as an ASR mitigation strategy. Additional rehabilitation items included polyester polymer concrete overlay, painting of steel girders, concrete repairs, and bearing replacement.

IBC 21-18: Innovative Design Applications: 31st Street NW Bridge over C&O Canal, Washington, DC

Time: 11:00 AM

Bradford Shaffer, Jason Bortz, Thomas Trapnell, and Elliott Mandel, AECOM, Arlington, VA; Mark Clabaugh, District DOT, Washington, DC

Replacement of 31st Street NW Bridge over the C&O Canal in Historic Georgetown had a multitude of unique constraints and stakeholder expectations as well as unknown challenges that were discovered during construction. This single span steel girder bridge on integral abutments was the 3rd bridge to span this location over the last 150 years. The existing structure was supported by abutments founded on the historic canal walls of the C&O Canal, and a cast iron pier. Due to the age of the existing structure and canal, as-built information was minimal and an assessment determined the pier was no longer structurally viable; however, the substructure units were determined to be historically significant and required to be maintained in their current location. Preserving the historic elements required a single span structure, with the new abutments placed behind the canal walls and the rehabilitated pier serving as an architectural element only. While designing a single 51' span steel girder bridge is not typically challenging, the structural depth was severely restricted to 26" to maintain both the vertical clearance required below for safe passage of the tourist barge below and the vertical profile of the roadway. 31st Street is also a major utility corridor which required that 49 utility lines be maintained in place, most with uninterrupted service, as part of the bridge replacement. Findings during construction led to value engineering using micropiles for the foundations as well as revising the deck to lightweight concrete to accommodate changes in construction staging and schedule.

IBC 21-19: Finite Element Analysis and Long-term Monitoring of a Highway Overpass Bridge with Newly Constructed Link Slabs and Modified Bearings

Time: 11:30 AM

Yifan Zhu, Kuangyuan Hou, Chung C. Fu, and Naiyi Li, The Bridge Engineering Software and Technology (BEST) Center, University of Maryland, College Park, MD; Ruel Sabellano, P.E., M. ASCE, Maryland Transportation Authority, Baltimore, MD

Joint failure, which causes leakage in bridge decks as well as deterioration in girders and substructures, is one of the most common concerns in highway bridges. Therefore, link slabs have been considered as a solution to eliminating these joints. The link slab system in this study is designed for an overpass bridge in the state of Maryland to improve its durability and reduce maintenance costs. Traditional link slab system design requires the replacement of current bearings with elastomeric bearings to minimize the thermal

stress generated in the superstructure. Theoretically, this modification will increase the longitudinal movement of the deck while releasing the stress caused by thermal expansion or contraction. Besides link slabs with different materials, this project proposes a more economical method by modifying sliding plates of the end bearings to match the designed boundary conditions while avoiding the high cost of jacking and replacement. This paper will deliver some background information and demonstrates the finite element analysis of the overpass highway bridge with link slabs under thermal loading. Finite element models of various alternatives were numerically studied for the best performed and most economical solution. Finally, the long-term monitoring system for the pilot bridge is introduced. As part of the system, displacement sensors were installed on the girder of the bridge during construction. Results from finite element analyses are validated by the measurement data and the influence of thermal effects on the upgraded bridge, as well as the effectiveness of the modified bearings, will also be studied.

IBC 21-20: *Saving the Bridge – The Long Term Solution to Mitigate Aggressive Pile Corrosion*

Time: 12:00 PM

Donald Green, P.E., Michael Baker International, Inc., Moon Township, PA; Jason Lahm, P.E., Wisconsin DOT, Green Bay, WI; Daniel Hawk, P.E., Michael Baker International, Inc., Madison, WI

Corrosion of driven HP14x73 steel pile foundations resulted in pile buckling after 33 years of service at the I-43 bridge over the Fox River in Green Bay, Wisconsin. Foundation failure resulted in an abrupt 2-foot drop in the bridge deck elevation at Pier 22. An emergency response saved the bridge piers and deck with reopening of the bridge to traffic within 105 days of the incident. Drilled shafts with reinforced concrete footings were post-tensioned to the existing bridge piers to provide alternate support to carry the entire pier load. The top of existing piers were retrofitted to save the existing bridge deck. Fiberglass reinforced polymer mortar casing was used to enhance corrosion protection of the drilled shaft foundations. In 2014, a corrosion monitoring program was put in place to monitor ongoing section loss due to corrosion at 16 Tier 2 bridge piers and provide a reliable prediction of remaining service life. This monitoring program was used to improve prediction of future section loss of pile foundations, determine remaining service life at primary bridge piers of interest, "right-size" mitigation, and improve reliability of budget forecasting for bridge rehabilitation. A combination of ER probe and half-cell electrode instrumentation was installed in conjunction with steel coupons to implement the monitoring program. The instrumentation continues to be used to supplement section loss measurements at steel coupons. WisDOT can use the measured corrosion rates to enact proactive mitigation measures to extend the service life of the bridge.

W-04: Designing Cross-frames & Diaphragms for Steel Bridges

Time: 9:00 AM - 1:00 PM

Brandon Chavel, Ph.D., P.E., National Steel Bridge Alliance, Rocky River, OH; Devin Altman, PE, AISC/NSBA, Corvallis, OR; Ronnie Medlock, P.E., High Steel Structures, LLC, Lancaster, PA

This workshop will provide guidance regarding steel girder bridge cross-frame layouts, type, members, connections as well as loads, analysis, and design. Presentations will walk through design decisions for cross- frames in bridges that are straight with low skew, straight and heavily skewed, horizontally curved, and horizontally curved with skewed supports. For each, there will be a focus on efficient cross-frame and framing plan layout decisions, analysis considerations, stability requirements, design loads, member design, and connection design.

W-05: Bridge Manaagement Systems to Meet FHWA and TAMP Requirements

Time: 9:00 - 10:00 AM

David Juntunen, The Kercher Group, Lansing, MI

FHWA's minimum requirements for a Bridge Management System (23 CFR 515.17) include collecting, processing, storing, and updating inventory and condition data, forecasting deterioration, determining benefit-cost over the lifecycle of the assets, identifying short- and long-term budget needs, and recommending programs and implementation schedules. This presentation will show how agencies have met these requirements and share lessons learned in building a bridge management system to meet the minimum standards and be supportive of their Transportation Asset Management Plans (TAMP).

ABC, PART 1 SESSION

Time: 2:00 - 5:00 PM

Session Chair: Louis J. Ruzzi, P.E., WSP USA, Pittsburgh, PA

In this session the attendee will see: Design and Construction of Pre-Fab bridges(superstructure/deck modules, Pier caps and pier columns) , utilizing an SPMT to move an off-site bridge to a barge, float out of the existing truss and floating in of a new structure, time line videos, replacement of portions of an arch bridge using pre fab units, a Lateral Slide, cutting time off your construction schedule and Jointless bridges in seismic regions

IBC 21-21: Design and Construction of Prefabricated Bridge Elements for the Replacement of Bridges 1-676 and 1-677

Time: 2:00 PM

Nicholas Dean, P.E., M.C.E. and Scott Walls, P.E., M.C.E., Delaware DOT, Dover, DE

This paper presents the design and implementation of the various prefabricated bridge elements utilized for the replacement of Bridges 1-676 and 1-677 on SR 141. The proposed replacement for each of these bridges consists of three spans of a little over 80'-0" that carry SR 141 over I- 95 and I-295. In order to minimize bridge construction time, prefabricated superstructure modules and precast pier columns and pier caps were used. UHPC was used to transversely connect the superstructure units. This project demonstrates Delaware's first application of prefabricated superstructure modules and precast pier columns and pier caps. This paper illustrates the pros, cons and lessons learned from using ABC techniques for the replacement of Bridges 1-676 and 1-677. It will also discuss the collaborative efforts between the design staff, the construction engineers, and the contractor to overcome obstacles and deliver a quality product within the project schedule. The first phase of construction for Bridges 1-676 and 1-677 was completed in October 2020. The second phase of construction is now underway and is expected to be complete November 2021.

IBC 21-22: Design and Construction of the Fulton Bridges

Time: 2:30 PM

Matthew Bunner, P.E., HDR, Pittsburgh, PA; Michael Perry, P.E., Stantec, Lexington, KY; Ahmed Mongi, P.E., West Virginia Department of Highways

This project involved the rehabilitation or replacement of 26 bridges along I-70 near Wheeling WV, as part of what was, at the time, the WVDOH's largest letting ever. This paper will focus on the accelerated replacement of long dual mainline bridges, the Fulton Bridges over Wheeling Creek. Initially, a detailed life-cycle cost analysis was performed to compare various renovation strategies for these bridges, with complete replacement being the most cost-effective option. Stakeholder input resulted in a traffic control scheme that included complete closure of one side of the interstate at a time as opposed to phased construction. Due to the skew of the creek below, the span arrangements of the bridges were different with both being 5 span steel plate girder structures with total lengths over 1200' and a maximum span of 340'. To limit the complete closure time of I-70 to less than 9 months, foundations and portions of the new substructure were constructed underneath the existing bridges, and pier cap reinforcement cages were fabricated off-site and installed immediately after demolition of the existing bridges. Bridge foundations included drilled shafts, micropiles and spread footings, and piers were considered mass concrete. This paper will also describe a geotechnical (slope stability) issue that was identified during final design, and how it necessitated adding another continuous span to the bridge several months before final plans were due, exacerbating an already tight design phase. How portions of the design computations and plan development were modified for the span addition will be discussed.

IBC 21-23: Replacement of the BNSF Truss 66.4 – A Multi-Level Approach to Accelerated Bridge Construction - Fabrication to Roll-On to Float-In

Time: 3:00 PM

Joe Knapp, Genesis Structures, Kansas City, MO; Kyle Izatt, Advanced American Construction, Portland, OR; Alan Bloomquist, BNSF Railway, Kansas City, KS

The Burlington Northern Santa-Fe (BNSF) Railroad Bridge No. 66-4, is located along the Northern bank of the Columbia River Gorge between Portland and Hood Mountain Oregon. As part of BNSF's continued rail improvements throughout the Pacific Northwest, the circa 1900's 153 ft thru pin style truss bridge over the conflux of the Little White Salmon River was replaced with a new 336 ft ballasted thru truss bridge. This presentation will focus on the unique construction methods utilized to minimize the environmental impact to the river and the surrounding wildlife and go into depth regarding the accelerated bridge construction techniques used during the project, most notably the truss fabrication and complete truss assembly by the Fabricator at their fabrication facility, the transfer (SPMT) of the truss from land onto a barge for transport, repositioning the truss on the travel barge for float in and ultimately the float in and setting of the truss onto its new bearings. The presentation will also highlight the coordination and planning required between multiple entities including the owner, engineer of record, the U.S. Army Corps of Engineers and Bonneville Power Administration.

IBC 21-24: Longfellow Bridge Rapid Construction

Time: 3:30 PM

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

The historic Longfellow Bridge spans the Charles River connecting Boston and Cambridge. Stretching more than 1,900 feet, it carries Route 3 and the Massachusetts Bay Transportation Authority's (MBTA) Red Line subway over the river. The Longfellow Bridge consists of 11 steel arch spans supported on ten granite block masonry piers and two massive abutments. There were also two approach stringer spans that were combined to a single span as part of the rehabilitation project. The rehabilitation of the arch spans included replacing all steel framing, including diaphragms, bracing, columns, floorbeams, and stringers, along with the concrete deck. Construction phasing utilized temporary shoofly track alignments in two phases to access the framing that provided support to the MBTA reservation, located between the east and westbound roadways. The Charles/MGH Station, located at the east end of the bridge, prevented two spans and two piers from being reconstructed as part of the normal construction phasing since full access was not provided due to the track curvature required as part of the shoofly alignments. The design team and contractor worked to develop a rapid construction concept to allow the replacement of approximately 100 feet of track supporting structure during each weekend shutdown. The design utilized precast bridge units and temporary shoring supports off of the arch ribs to allow for the construction of the final structure to occur within the allotted shut-down windows. The replacement of Spans 1 and 2 and Piers 1 and 2 was performed during five weekend shutdowns.

IBC 21-25: De Roche Creek Lateral Bridge Slide – Easing Traffic Disruption & Improving Safety

Time: 4:00 PM

Fred Harper, P.E., Michael Baker International, Little Rock, AR; Rick Ellis, P.E., Arkansas DOT, Little Rock, AR

The Arkansas Department of Transportation (ARDOT) has completed the replacement of two aging bridges over De Roche Creek on I-30 in Southwest Arkansas near the city of Arkadelphia. ARDOT partnered with Michael Baker International to provide bridge and roadway design and plans for this innovative endeavor, which serves as Arkansas' first highway bridge replacement project to use the Accelerated Bridge Construction method known as a Lateral Slide. I-30 is a heavily trafficked interstate route that connects Little Rock, AR to Dallas, TX, so using ABC to replace the structures was the ideal solution to reduce lane closure time and improve safety. Michael Baker conducted an initial Bridge Construction Staging Study to compare various lateral slide replacement options, and ultimately recommended an approach that uses two separate lateral slide operations. The new 170' long steel plate girder superstructures were erected on temporary falsework outside of the existing parallel bridges, while crews constructed the permanent semi-integral straddle bent substructure underneath the existing bridges, which utilize 72" diameter drilled shafts. Once completed, two separate bridge-slide operations were performed to move each of the new bridges into their permanent positions using post-tensioning jacks and a PTFE & stainless steel slide track. This option limited traffic disruption to two short-term periods, roughly eight days each, during which traffic was reduced to a single lane in each direction. The single span arrangement served to simplify the slide process, and also helped to reduce the environmental impact on De Roche Creek, a tributary of the Ouachita River.

IBC 21-26: Jointless Accelerated Bridge Construction in Seismic Regions

Time: 4:30 PM

Bijan Khaleghi, Washington State DOT, Tumwater, WA

Jointless bridges are constructed to work integrally with continuous superstructures and abutments. Movements due to creep, shrinkage and temperature changes are accommodated by using flexible bearings or foundation and through incorporating relief joints at the ends of the approach slabs. In addition to reduced maintenance costs, other advantages of jointless bridges include improved structural integrity, reliability and redundancy, improved long-term serviceability, improved riding surface, reduced initial cost, and improved aesthetics. In recent times, jointless bridges have been built in seismically sensitive areas. Prefabricated jointless bridges consisting of pretensioned girders post- tensioned spliced girders, trapezoidal open box girders, and other types of superstructure members are often used for accelerated bridge construction. Connections in precast concrete substructures are typically made at the beam-column and column-foundation interfaces to facilitate fabrication and transportation. However, for structures in seismic regions, those interfaces represent locations of high moments and shears and large inelastic cyclic strain reversals. D eveloping connections that can accommodate inelastic cyclic deformations and are readily constructible is the primary challenge for ABC in seismic regions. The AASHTO LRFD Specifications do not explicitly address the jointless precast, pretensioned or post-tensioned elements. This paper will attempt to capture the state-of-practice of jointless continuous bridges in seismic regions. The seismic design and detailing, accomplished research, construction practices of jointless bridges, and implementation of a precast concrete bridge bent system that is intended to meet those challenges are presented.

FEATURED AGENCY SESSION

Time: 2:00 – 5:00 PM

Overview of DelDOT's Bridges and Structures Program

Jason Hastings, MCE, P.E. – Chief of Bridges & Structures

This presentation will provide a basic overview of the bridge program of the Delaware DOT (DelDOT) and offer a high level look and some of the most interesting features of the organization.

DelDOT's Bridge Management Program

Jason Arndt, P.E. – Bridge Management Engineer

This presentation will provide a brief overview of DelDOT's Bridge Management Program. Much of the presentation will focus on Delaware's more recent bridge performance history and various measures that were implemented to successfully improve bridge condition performance measures over the past decade. The presentation will also briefly touch on the recent development of bridge deterioration modeling and its use in forecasting budget needs for meeting future performance targets as part of DelDOT's bridge asset management efforts, a key focus of all DOTs today.

Design vs. Construction

Craig Stevens, P.E. – Bridge Design Engineer; Kevin Lindell, P.E. – Bridge Construction Engineer

This presentation will feature a battle to determine once and for all who is right: design or construction.

DelDOT Bridge Community Outreach

Paul Huhn, Gus Toussaint – Project Engineers

DelDOT Participation in Bridges to Prosperity

Scott Walls, MCE, P.E. – Project Manager

These two presentations will focus on two initiatives to give back to the local and global community. The first initiative is STEM Outreach. DelDOT's Bridge Section presents to schools throughout the State of Delaware to help get kids engaged in STEM topics, bridge engineering in particular. This effort led to the development of an annual bridge design competition for middle and high school students. On a global level, DelDOT's Bridge Section supported Bridges to Prosperity to help build bridges in third world countries. The second of these presentations will cover this initiative as well.

DelDOT's ABC and UHPC Initiatives

Nicholas Dean, MCE, P.E. – Project Manager

This presentation will cover the development of DelDOT's Accelerated Bridge Construction (ABC) Program and the use of Ultra High Performance Concrete (UHPC). Emphasis will be on lessons learned by DelDOT as more projects utilize ABC techniques and UHPC. The presentation will also showcase past, present, and future projects throughout Delaware that are utilizing ABC and/or UHPC.

W-06: Bridge Load Rating and Posting: Understanding vehicular loadings

Time: 2:00 – 4:00 PM

Lubin Gao, FHWA, Washington, DC

Maximum vehicular loadings are set by Federal and State statutes and regulations. However, actual loadings are affected by many factors. Understanding vehicular loadings on bridges is critical. The objective of this workshop is to provide awareness to bridge engineers and make them better understand vehicular loadings for bridge rating, posting and permitting. We will discuss Interstate and state legal loads and overweight permit loads. We'll also discuss WIM technology and use of WIM data.

W-07: Machine-Learning Based Mobile App for Determining Corrosion Presence Using Images

Time: 4:00 – 5:00 PM

Alp Caner, BridgeWiz International Engineering and Consultant, CANKAYA, ANKARA

The app aims to create a set of tools for the inspectors that can identify the presence of corrosion in concrete bridge elements from both still images and video streams acquired by just a mobile device (and its camera). This device can be attached to a drone that can travel to regions that are deemed unreachable otherwise. These tools intend to resolve a multitude of shortcomings encountered by inspectors during standard inspection procedures.

DESIGN, PART 2 SESSION

Time: 9:00 AM - 12:00 Noon

Session Chair: Brandon Chavel, Ph.D., P.E., National Steel Bridge Alliance, Rocky River, OH

This session will address leading-edge topics that are important to all bridge engineers as we continuously implement innovative practices. These topics include use of BIM in the delivery of bridge projects, important changes related to the installation and design of high-strength bolts, innovative approaches for component replacements on highly traveled bridges, guidelines for bridges that may be susceptible to fire exposure, as well as MASH crash testing of new bridge barriers.

IBC 21-27: BIM for Bridges and Structures Case Study: Outcomes and Lessons Learned from the Steel Bridge Industry

Time: 9:00 AM

Aaron Costin, Ph.D., University of Florida, Gainesville, FL; Hanjin Hu, Michael Baker International, Moon Township, PA; Ronald D. Medlock, P.E., High Steel Structures LLC, Lancaster, PA

The recent push to adopt building information modeling (BIM) for bridges and structures in the transportation industry has encountered major barriers due to the lack of standardization. Unlike the building industry that has the U.S. National BIM (NBIMS) standard as a formal open platform standard and guide for the development of interoperable BIM software, the transportation industry does not currently have a similar open platform standard to enable the creation of interoperable BIM software to serve the needs of transportation stakeholders. The purpose of this paper is to present the findings of the research for one of the first use cases and development of data exchange requirements and model view definitions in adopting the open platform National BIM standard applied to Bridges and Structures for the U.S. transportation industry. A subcommittee of the Association of State Highway and Transportation Officials (AASHTO) and the National Steel Bridge Alliance (NSBA) Steel Bridge Collaboration was formed to conduct a pilot study in the creation of information delivery manuals (IDM) for steel bridges. This study serves as pilot for the development of future IDMs in the transportation industry. As a result, the current "IDM for Steel Bridge Detailing and Fabrication" serves as the starting point of the TPF-5(372) BIM for Bridges and Structures development of the Design to Fabrication Model View Definition (MVD). Finally, this study provides the outcomes and recommendations needed to expedite the development of IDMs for other use cases in the bridge and transportation industry.

IBC 21-28: Using Innovative Design to Meet the Needs of Stakeholders

Time: 9:30 AM

George Tawfik, STV, New York, NY

The Alexander Hamilton Bridge Interchange serves as the nexus for two of the busiest highways in the region and carries more than 120,000 vehicles a day. Working as part of a design-build team, the entrant served as the lead designer for three overpass ramps and roadway approaches that were improved and modernized as part of a complete overhaul of the interchange's more than 20 ramps. The $138.8 million project called for the replacement of substructures, steel rocker bearings, bridge decks, concrete pier columns and pier caps, along with the rehabilitation of abutments and improvements to drainage systems, signage, painting and lighting. In its request for proposal (RFP), the New York State Department of Transportation (NYSDOT) proposed replacing the ramps span-by-span during successive weekend road closures over a 26-month schedule. However, the entrant proposed an alternative plan that was accepted and provided multiple benefits to the client and community. After reviewing the RFP and community input, the entrant concluded that the original plan would disrupt traffic and the surrounding South Bronx neighborhood and could potentially result in financial penalties for the construction team if work was not completed in the prescribed time. The entrant proposed using fascia girders that ran along the exterior of the ramps. This extended the width of the ramps by two feet on each side and provided enough room to stage construction and keep traffic moving through the area. Moreover, the additional width was gained without increasing the footprint of the bridge piers.

IBC 21-29: Instrumentation Results of New MASH Crash Tested Barriers for William P. Lane, Jr. Bridge

Time: 10:00 AM

Travis Hopper, P.E., Scott Eshenaur, and Maria Lopez, Modjeski and Masters, Mechanicsburg, PA

Two new bridge barriers were crash tested in accordance with AASHTO MASH guidelines for future use on the William P. Lane Bridge over the Chesapeake Bay: 1) a combination barrier consisting of a reinforced concrete parapet with a top steel rail evaluated for Test Level 4 (TL-4), and

2) a combination barrier consisting of a steel parapet with a top steel rail evaluated for TL-4 and TL-5 Test Levels. For the first test configuration, the reinforced concrete barrier was attached to a representative overhang deck slab using anchor bolts. In the vicinity of the vehicle impact points, load cells were installed to measure forces in anchor bolts, and strain gauges were attached to reinforcing bars to resolve measured strain data into

forces through the overhang deck slab. In the second test configuration, the steel barrier was supported by evenly spaced representative floorbeams using a bolted base plate connection. Linear potentiometers were installed to measure lateral dynamic deflection of the barrier near the vehicle impact region. Strain gauges were attached to elements of the barrier at support locations adjacent to the vehicle impact point in order to evaluate force transfer through the barrier system into the base plate connections. This paper presents the analysis results of the force, strain, and displacement data measured in the barrier and deck structural components during crash load testing.

IBC 21-30: Using 3D Models to Improve Bridge Design and Deliver Better Projects

Time: 10:30 AM

Michael Alestra, P.E., Pennoni Associates Inc., Neward, DE; Scott Walls, P.E., M.C.E., Delaware DOT, Dover, DE

Pennoni is providing comprehensive design services to the Delaware Department of Transportation for the replacement of Bridge 1-447 Taylor's Bridge Road (SR-9) over Blackbird Creek in New Castle County. The replacement structure is a 4 span, 440-ft long bridge consisting of a precast, prestressed bulb-tee beam superstructure supported by reinforced concrete piers and semi-integral abutments that will pass the 50-year design storm and the effects of 3-ft of sea level rise, which will require raising the profile grade of Taylors Bridge Road at the bridge and along the approach roadways. This project highlights using a 3D model of the bridge and roadway as a valuable design tool. 3D BIM models were developed of the existing structure, proposed structure, and proposed roadway and grading. These models were used in coordination with digital survey terrain models to size the bridge in preliminary design and to optimize the roadway profile to evaluate and monitor impacts of alignment and grading changes to existing right-of way, wetland areas, and utilities. The bridge models are being used directly for bridge plan development, quantities, and reinforcement detailing and scheduling.

IBC 21-31: Important Changes in the 2020 RCSC Specification for Structural Joints Using High-Strength Bolts

Time: 11:00 AM

Jeff Greene, LeJeune Bolt Company, Burnsville, MN

The 2020 edition of the Research Council on Structural Connections (RCSC) Specification for Structural Joints Using High-Strength Bolts has many significant changes that may affect future bridge design, engineering, and construction. While there are more than twenty five major changes to the specification this paper will focus on the following six topics that have the most significant impact on bolted connections.

1. The addition of the Combined Method as the fifth approved method of installation.

2. Addition of Group 144, ASTM F3148 and adoption of Group 120, 144, and 150 as bolt strength categories.
3. Revised pre-installation verification testing and pretension values for Group 120 bolts over 1-inch diameter.
4. Updated guidance when considering short bolt use in shear connections.
5. Expanded view of "Alternate Design".
6. Expanded and consolidated list of topics for the EOR to consider.

The RCSC specification is relied upon to provide necessary guidance when determining the suitability, strength, and behavior of structural connections as well as instruction for proper bolt testing, installation, and inspection. These bolting related topics are a must know for anyone currently practicing in a steel construction field.

IBC 21-32: Analysis of Steel Composite Bridges Exposed to LRT Fire – A Performance-Based Design

Time: 11:30 AM

Aguiade Drak El Sebai, P.E. and Aurelie Noubissie, ing., AECOM, Montreal, QC Canada; Firooz Panah, P.E., AECOM, Boston, MA; Patrick Oatway, P.Eng., AECOM, Richmond Hill, ON, Canada

The current North American building and steel design codes provide guidelines on analyzing steel structures for fire. However, the North American bridge design codes offer no guidance on applying the fire loading on bridges, a load case that can arise under steel composite bridges spanning railway tracks; in this case spanning REM, LRT system in Montreal. Cementitious fire protection and intumescent paint meet the NFPA fire protection criteria and are commonly applied to steel structures inside building envelopes, but this option is not optimal for bridges given their extreme exposure condition, inspection requirements, and their aesthetic criteria. NFPA based fire protection measures are expensive and given the low probability of fire, a risk-based analysis is necessary to determine the best course of action. In the case of the two subject REM bridges, the goal was to prevent collapse but accept repairable damage to the superstructure for a fire with a specified intensity and duration. This study is intended to propose guidelines on analyzing steel composite bridges by applying a performance-based design. Two steel composite bridges have been analyzed for 40 minutes train fire exposure from underneath. The first structure is a 24m long simple span supported on drilled shafts with fixed-free bearing articulation. The second structure is 22m long simple span with a fixed-fixed bearing articulation. Results show that while the steel strength properties drop with increased temperature, the temperature gradient on steel has a positive impact on the bridge's curvature, interacting in the opposite direction of the dead load.

REHABILITATION, PART 2 SESSION

Time: 9:00 AM - 12:00 Noon

Session Chair: Elliott Mandel, P.E., AECOM, Arlington, VA

Presentations highlight developing bridge rehabilitation expertise featuring topics that will interest owners, analysts, designers and constructors. Included are: fire repairs, suspension bridge cable preservation, UHPC overlays and rocker link replacements, overheight truck damage inspection and repairs, and fatigue crack instrumentation and retrofit. Projects include: Brent Spence Bridge over the Ohio River (Kentucky, Ohio); Chesapeake Bay Bridge (Maryland); Delaware Memorial Bridge (Delaware and New Jersey); I-895 over Frankfurt Avenue (Maryland); and I-95/I-395 (Maryland).

IBC 21-33: Brent Spence Bridge Fire and Rehabilitation

Time: 9:00 AM

Jason Stith, Ph.D., P.E., S.E. and Aaron Stover, P.E., S.E., Michael Baker International, Louisville, KY; Josh Rogers, P.E., CBI, Kentucky Transportation Cabinet, Frankfort, KY; Frank Russo, Ph.D., P.E., Michael Baker International, Philadelphia, PA; Cory Wilson, Kentucky Transportation Cabinet, Covington, KY

On November 11, 2020, two trucks carrying flammable materials collided on the lower deck of the Brent Spence bridge. The Brent Spence bridge carries 1-75 and I-71 over the Ohio river into Cincinnati. The ensuing fire burned for two hours, damaging components of the bridge and disrupting traffic for several weeks. This paper will discuss the rapid response to assess the condition of the structure and the scope of repairs required to ensure safety of the traveling public. Among the issues that the owner had to contend with was uncertainty of the extents of damage, and heat of the fire relative to any potential damage to the steel and concrete structure. In situ NDT and laboratory testing were performed to determine if any of the steel had developed martensite which indicates potential hardening or embrittlement of the steel. Before the field team was able to access the structure due to the cleanup, the Project Team was already combing through as-builts, inspection reports, and original design drawings to determine load paths and critical details for the inspection team to focus on in the field. Once the repair punch list was determined in the field, the team developed repair plans using the existing as-builts to as the baseline for repair plans. Existing details were marked up to expedite the plan production. The presentation and paper will also summarize keys to quickly delivering construction ready repair plans and award of a competitive bid contract for construction within 5 days of the incident.

IBC 21-34: Transfer of Loading from Existing Main Cable to Supplemental Cables

Time: 9:30 AM

Jonathan Morey and William Conlon, WSP USA, Edgewood, MD; Abey Tamrat, MDTA, Dundalk, MD

The Maryland Transportation Authority (MDTA) owns and operates the Chesapeake Bay Bridge, a twin suspension bridge crossing that connects Annapolis to Maryland's eastern shore. The Eastbound (EB) and Westbound (WB) suspension bridges opened in 1952 and 1973, respectively. The Westbound span's main cables were constructed of Prefabricated Parallel Wire Strands (PPWS) with cable straps and a neoprene wrapping system. In 2009-2013, in-depth main cable investigations were performed and recommendations were made to extend the service-life of the suspension systems. In 2014-2015, main cable dehumidification systems were installed on both the Eastbound and Westbound Bridges, as the first preservation measure. The second major preservation recommendation for the Westbound Bridge was to install a supplemental cable system. The purpose of the project was to maintain serviceability of the main cables by strengthening the overall suspension system, replacement/rehabilitation of key suspension span components to restore functionality and restoring the original bridge profile. This paper will focus on the sequential transfer of loads from the existing main cable to the supplemental cable system. To achieve sequential load transfer, new suspender ropes were incrementally jacked to geometrically pull the new supplemental cable system into position. Initial steps of incremental jacking were performed at select new suspender rope locations, based on geometry. Following initial geometry jacking, additional locations were jacked incrementally to increase loads in the new supplemental cable. Final load transfer steps included jacking all ropes to desired loads, spreading load uniformly across the supplemental cable, and reducing load on existing main cables.

IBC 21-35: The First Ultra High Performance Concrete (UHPC) Bridge Deck Overlay on a Major Suspension Bridge in the United States

Time: 10:00 AM

Shekhar Scindia, Deleware River and Bay Authority, New Castle, DE; Abate Tewelde, Michael McDonagh, Jordy Padilla, and Andy Foden, WSP USA, Lawrence Township, NJ

The Delaware Memorial Bridge, composed of twin suspension bridges completed in 1951 and 1968, carries Interstate 295 and U.S. 40 across the Delaware River between Delaware and New Jersey. In 2018, the Delaware River and Bay Authority (DRBA) determined that the deck of the first structure was near the end of its service life. Through a 50-year lifecycle cost analysis, a partial-depth deck replacement overlay utilizing Ultra-High

Performance Concrete (UHPC) was identified as the preferred alternative to deck replacement and conventional overlays. The mechanical and durability properties of UHPC significantly exceed the properties of conventional concrete and overlay materials, such that UHPC can dramatically extend the service life of the existing deck with minimal traffic impacts compared to deck replacement. Being the first UHPC overlay on a suspension bridge, the DRBA decided to start with a pilot project constructed in 2020. The pilot project consisted of replacing the top 3.75 inches of the deck with UHPC on approximately 25,000 square feet of deck, incorporating overlays on the main suspension bridge as well as on the deck truss and steel girder approach structures. Construction of this project required flexibility from all team members due to the high traffic demands, the tight construction window, and the novel use of UHPC as a partial-depth deck replacement overlay. The completion of this pilot project set new milestones in the United States as the largest use of UHPC overlay on a project to date and with the largest continuous pour of UHPC overlay.

IBC 21-36: Rocker Link Replacement Quality Controls

Time: 10:30 AM

Jonathan Morey and William Conlon, WSP USA, Edgewood, MD; Abey Tamrat, MDTA, Dundalk, MD

The Maryland Transportation Authority (MDTA) owns and operates the Chesapeake Bay Bridge, a twin suspension bridge crossing that connect Annapolis to Maryland's eastern shore. Both the Eastbound (EB) and Westbound (WB) bridge suspension spans utilize pinned rocker link assemblies as support below the stiffening trusses ends at the towers. The end of service life of these elements was approaching due to wear from continual movements. Similar replacements were designed and implemented for both the EB and WB suspension spans. The designs incorporated jacking to re-establish original clearances at tower wind shear devices, while maintaining finger joint alignment, and also allowed for variations to control interfaces between existing and new components. Installation procedures and controls ensured that North and South Rocker Links at the same panel points provided identical length of rotation. In-line boring, used on the Westbound Bridge, allowed the overall pin assembly to make use of the large existing pin plates. Separate Top and Bottom Pin Stubs, at each Rocker Link, allowed the new Rocker Links to be installed in a piecemeal assembly, with the center piece fabrication finalized only after the required clearances were re-established and the final rocker link length determined. Line-boring of pin sleeves, located on stubs, removed the potential for weld distortion impacts on the pin/pin sleeve interface. The use of shims, and cut to length pin sleeves, resulted in Contractors achieving the specified clearance between new elements, while allowing for variation in fit-up to existing pin plates.

IBC 21-37: Emergency Repair of I-895 over Frankfurst Ave. by Cut Out and Replace

Time: 11:00 AM

Marcus Gursky, P.E., Whitney Bailey Cox & Magnani, LLC, Baltimore, MD; Tekeste Amare, P.E., Maryland Transportation Authority, Baltimore, MD; Michael Alestra, P.E., Pennoni Associates Inc., Newark, DE

The I-895 Bridge over Frankfurst Avenue, in Baltimore, MD, owned and operated by Maryland Transportation Authority (MDTA) was struck by an over height truck damaging the east exterior beam spanning northbound Frankfurst Avenue. The web of the exterior beam sustained a 1'-8" high x 6" wide hole including a 3-inch sweep and its bottom flange was rotated 2-inches at the point of impact. Other damages included stress cracking around the puncture, bent diaphragm connection plates, broken utility framing, and diaphragm connection plate weld cracking.

Immediately after impact the NBIS emergency response inspection team was on site evaluating the damage by conducting hands-on inspection, taking measurements of the damage and conducting non-destructive evaluation. Laser scanning survey was unitized to map the entire damaged beam with a precision of +/- 1/8-inch in any direction providing the designer with a complete picture of the damage including web warping that could not easily be measured by hand. Repair plans included installation of a topside jacking beam, removal of the damaged section of beam, a built-up section to replace the removed section, heat straightening measures, and a sequence of construction that minimized traffic disruption and provided for a fast and efficient construction. The hangers from the jacking beam supported the deck and removed any sag due to the damaged beam and supported the removal and replacement sections. Plasma cutting was used to remove the damaged section and the new section was welded to the top flange and bolted splices joined the web and bottom flanges.

IBC 21-38: Evaluation, Instrumentation & Retrofit of the Distortion-Induced Fatigue Cracking in the I-95/I-395 Steel Box Girder Bridges

Time: 11:30 AM

Christopher Smith, P.E., and David Barrett, Modjeski and Masters, Inc., Mechanicsburg, PA; Tekeste Amare, P.E., Maryland Transportation Authority, Baltimore, MD; Laura Magoon, RK&K, Baltimore, MD

A portion of I-95 and I-395 through Baltimore, Maryland, consists of a series of bridges and ramps utilizing steel box girder superstructures; these bridges were constructed in the 1970's. Routine inspections of the box girders revealed numerous cracks within the webs at cross-frame connection plates. Typically, the connection plates extend to the girder flange; however, they are not positively connected which was typical at the time of fabrication. The distance from the connection plate-to-web weld to the flange is referred to the “web gap”. Under loading this web gap experiences repetitive deformation. An instrumentation plan was implemented to investigate the root cause of the cracking which utilized strain gages and string potentiometers. The data under random traffic was analyzed to determine the number of cycles within each stress range. The number of cycles were then used to estimate the stress range occurring in the web gap. The deformations and associated stresses from the instrumentation data were used to confirm that distortion-induced fatigue of the web gap was the cause of the cracking. The remaining fatigue life was calculated and it was concluded that retrofits should be installed at the cross-frame connection plates to extend the service life of the bridges. Several types of bolted and welded retrofits were evaluated to determine the most effective retrofit that would reduce deformation and associated stresses in the web gap such that infinite life or a finite fatigue life in excess of the remaining service life of the bridges could be achieved.

W-08: Accelerated and Innovative Bridge Construction in Seismic Regions

Time: 8:00 AM - 12:00 Noon

Bijan Khaleghi, Ph.D., P.E., S.E., Washington State DOT, Olympia, WA

This workshop focuses on the performance of bridges built using ABC technologies in seismic regions, with emphasis on post-earthquake functionality and serviceability. This workshop exhibits ABC technologies with self-centering concrete columns and piers in seismic regions. Recent innovations in bridge design and construction meeting the post-earthquake functionality and serviceability requirements are presented. This workshop provides an opportunity for exchange of the state-of-the-art information in research and implementation of ABC in seismic regions with resiliency considerations.

W-09: Diversity Workshop

Time: 8:00 - 10:00 AM

Jennifer Howe, Trumbull Corporation; Tanya Adams, WSP USA; Rep. Eric Morrison, State of Delaware; Shanté Hastings, Delaware DOT; Meghann O’Connor (Moderator), Lochner

This workshop will involve a panel discussion with representatives from a state DOT, state legislator, a bridge contractor and a consulting firm. The questions being answered will involve how each organization handles Diversity, Equity and Inclusion (DEI) within the transportation industry and state government . They will share any initiatives, training ,employee surveys/focus groups to better adopt DEI practices

ABC, PART 2 SESSION

Time: 2:00 - 5:00 PM

Session Chair: Michael Cuddy, P.E., TranSystems, Philadelphia, PA

Accelerated Bridge Construction (ABC) continues to be a driving force in the industry as owners try to limit user impacts and increase safety for motorists and construction workers. Engineers are continuing to develop new ideas and strategies to improve upon ABC techniques. This session will explore design and construction innovations which range from complex modeling and BIM techniques; slide-in techniques; SPMT demolition concepts; use of pre-fabricated bridge units; and finally the use of grout-filled sleeve couplers to rapidly splice pre-stressed-precast concrete piles.

IBC 21-39: Steel Bridge Design Innovations for the New US27/S25/Okeechobee Rd. and SR826/Palmetto Expressway Interchange

Time: 2:00 PM

Patrick Noble, P.E., S.E., FINLEY Engineering Group, Tallahassee, FL

This presentation will cover several design innovations incorporated into this complex new interchange improvement project. This project consists of three new structural steel ramps spanning over the existing interchange and canals. The design features include steel straddle bents supporting two ramp structures that incorporate the latest thermal gradient design loading based on current FDOT research initiatives. A complete 3D model was created to determine the complex flow of forces and thermal movements that lead to the final solution of incorporating flexible guided bearings. The integrated CADD/Analysis model created using BrIM greatly enhanced the project development and streamlined the design process to allow generation of multiple bridge units for several ramps and was particularly useful during design optimization phases. Working with 3D models also creates several challenges in understanding the output and turning large volumes of this data into design values while allowing for quality control. This presentation will provide some of the techniques used to manage this process and gain the efficiency while keeping the accuracy of a complex analysis model.

Steel Design Engineering:

- Steel Box Girder Interchange Design
- Steel Straddle Bent Design
- Structural Steel Thermal Gradient
- 3D steel bridge modeling

Bridge Integration Modeling (BrIM) and Construction Sequence Visualizations:

- Construction Manual

- Temporary Works
- Design Verifications, Construction Loadings and Critical Sequences
- Visualization of Construction Sequences
- Equipment & Temporary Support Integration Lessons Learned

IBC 21-40: Idaho Bridge Slides 2.0

Time: 2:30 PM

Brian Byrne, Lochner, East Hartford, CT

Boise is one of the fastest growing cities in the United States, and I-84 is the heaviest volume road in the State. Idaho Transportation Department (ITD) needed to replace two mainline bridges carrying I-84, but were concerned about the increased risk of vehicles accidents using conventional staged construction techniques to do so. Building on the success of the first slide in bridge construction project, ITD was ready to use a similar technique for the interstate. The two bridges have spans of 112 feet and were built with integral straddle abutments and approach slabs. ITD wanted the consultant engineering to fully design and detail the falsework and slide concept so that the bidding was open to more contractors. The slide methodology did not use any proprietary systems so as to keep costs as low as possible. Pile caps were constructed in the quadrants while two lanes of traffic were maintained on I-84, and the new structures were built to the outsides. During the summer of 2020, a cross-over arrangement allowed one bridge at a time to be demolished, precast elements set and the bridges were slid into place. Building upon slide-in-bridge construction techniques used elsewhere, the detailing and process for these two slides and the first slide in McCall, use an approach that is distinct to Idaho.

IBC 21-41: SPMT Demolition of the West River Bridge

Time: 3:00 PM

Michael Oliver, STV Incorporated, Hartford, CT

The West River Bridge in West Haven, CT at one point in time before its replacement held the title as being the highest priority structurally difficient bridge in Connecticut. 150,000 vehicles per day crossed the bridge before its replacement. In an effort to minimize impacts to the traveling public the team pulled off the first SPMT (Self Propelled Modular Transporters) bridge demolition operation in the State of Connecticut. Twin SPMT trucks fitted with a pair of 1,000,000 pound capacity strand jack gantries were utilized to demolish the existing bridge in 10 nights, one pick per night. As part of this operation the construction engineer and the engineer of record were tasked with analyzing the new bridge for the super load. Traffic of one lane in each direction was also utilized. This operation saved 60 days on the construction schedule!

IBC 21-42: Accelerated Bridge Construction Techniques for the Rehabilitation of the Anacostia Freeway Bridges over Nicholson Street, SE, Washington D.C.

Time: 3:30 PM

Ruel Manuel, Chandrakanth Mallina , and Joshua Muller, PRIME AE Group, Inc., Baltimore, MD

The District Department of Transportation elected to rehabilitate three bridges on the Anacostia Freeway (Mainline Northbound/Southbound, and two ramp bridges) over Nicholson Street, SE. With over 135,000 vehicles that travel over the bridges every day, and the project site located in the heart of some of the District's most visited outdoor recreation spaces, any work on the mainline and ramps had to account for potential impacts well beyond the design of the structures themselves. The constraints of high traffic volumes, compact site constraints, and requirement to maintain traffic, led to the application of accelerated methods. Accelerated bridge construction (ABC) techniques were investigated from the initial Concept Study for the replacement or rehabilitation of the structures. The goals of the project included addressing the deficient superstructure and increase the vertical under clearance for one of the structures. Due to the importance of the mainline bridge, two lanes of traffic (in each direction) were required to be maintained at all times. The challenge to maintain traffic and accelerate construction, required the development of a four-stage sequence of construction. The ABC solution and sequence utilized was required to be compatible with the maintenance of traffic alternative developed and the available work areas. Using these primary design constraints several different ABC techniques and details were evaluated. The selected solution included superstructure replacement utilizing Prefabricated Bridge Units (PBUs) and substructure rehabilitation work compatible with the sequence of construction, ready to receive the new PBUs. The ramp bridges were replaced in a weekend closure.

IBC 21-43: River Road, Bridge over Raritan Valley RR, Emergency Bridge Replacement

Time: 4:00 PM

Steve Esposito, P.E., PMP, WSP USA, Newark, NJ; Krishna Tripathi, New Jersey DOT, Trenton, NJ; Alexander Kluka, WSP USA, Lawrenceville, NJ

With the structural elements in serious physical condition and truck traffic not adhering to the 4-ton load posting, NJDOT closed the River Road Bridge over Raritan Valley Railroad on Wednesday June 5th, 2019. WSP was tasked with designing a totally new structure on an extremely expedited schedule. Due to the sudden closure, restoring the roadway to full working order as early as possible was critical to residents and a strict requirement of NJDOT; a commitment was made by the NJDOT to restore traffic flow by the Summer of 2020. The replacement of the River Road Bridge had its challenges, including an extremely accelerated schedule, overhead power lines, an active railroad restricting access, a vocal and engaged public community, and even COVID-19 impacts – but each obstacle was addressed through clear communication and active involvement from all parties. The most challenging aspect of the bridge replacement was the aggressive project schedule. Precast elements were specified where a benefit to the schedule could be realized including walls, foundations, and sleeper slabs. Shallow depth prestressed concrete adjacent box beams were specified with a compressive strength of 8.5 ksi to span more than 80' while accommodating a future track expansion and minimizing impacts to the approaches. Semi-integral abutments, galvanized reinforcement, and dual coating steel components were designed to increase the service life and reduce maintenance costs of the structure. The design efforts allowed the team to meet the aggressive schedule and open the single-span structure just one year after the original bridge was closed.

IBC 21-44: Alternative System and Materials for Splicing Prestressed-Precast Concrete Pile

Time: 4:30 PM

Seyed Saman Khedmatgozar Dolati and Armin Mehrabi, Florida international University, Miami, FL

Application of deep foundation such as piles is a common method to establish bridge foundation in which there is a top layer of week soils. Among various types of piles and installation methods, driving prestressed-precast concrete piles (PPCP) is a durable and economic option in comparison with others. Also, since it employs pile segments prefabricated in precast plants and delivered to the site for installation, it conforms to the principles of Accelerated Bridge Construction (ABC), and provides a rapid alternative to other types. However, often because of limitation on shipping, transportation, and driving headroom, the length of PPCP segments delivered to the bridge site has to be reduced. Also, unpredictable soil condition may require longer piles than that anticipated. Therefore, splicing of pile segments has to be performed at the site to achieve longer lengths. A study carried out as part of research activities at Accelerated Bridge Construction University Transportation Center at Florida International University has reviewed various types of available pile splices and attempted to build upon the experiences gathered for ABC connections to introduce an alternative configuration for splicing PPCP segments. Accordingly, two types of mechanical connection configurations were introduced each using specific type of grout-filled mechanical couplers. The connections were designed to provide PPCPs with a time-effective, economical, and labor-friendly way of splicing. Because many of PPCPs are driven in the marine environment, the application of corrosion resistant material at the splice system is also incorporated. The paper summarizes these investigations.

ALTERNATE DELIVERY SESSION

Time: 2:00 - 5:00 PM

Session Chair: M. Patrick Kane, P.E., GPI - Greenman-Pedersen, Inc., Pittsburgh, PA

This Session will provide technical presentations on a variety of Alternate Delivery methods, including Public Private Partnerships, Alternative Technical Concept (ATC) and Aesthetic Project Technical Enhancement (APTE), Design-Build, Integrated Project Delivery, and Accelerated Design. Projects discussed in the Session include Samuel De Champlain Bridge, I-395/SR 836/I-95 Project in Florida, Kingston Third Crossing, Moravia Road Ramp to I-95 Southbound and the new Harry W. Nice / Thomas "Mac" Middleton Bridge.

IBC 21-45: Public-Private Partnership (P3) Procurement Method and Design-Build Delivery for the Samuel De Champlain Bridge

Time: 2:00 PM

Guy Mailhot, Eng. M.Eng., FSCE, FEIC, Infrastructure Canada, Montreal, Quebec Canada; Marwan Nader, Ph.D., P.E., Eng., T.Y. Lin International, San Francisco, California; Jeff Rogerson, Flat Iron, Richmond, BC, Canada

Opened to traffic on July 1, 2019, the new Samuel De Champlain Bridge represents one of the largest infrastructure projects in North America.

The rapidly deteriorating condition of the existing Champlain Bridge in Montreal led the Government of Canada to accelerate its replacement and ultimately awarded a $3.98 billion CDN contract to the Signature on the Saint Lawrence Group, in 2015, to deliver a new replacement crossing. The project was fast-tracked with a schedule of only 48-months from design to bridge opening. The 3.4-km lifeline bridge comprises of three independent structures: the 529-meter-long, asymmetric cable-stayed bridge that features a single, 169-meter-high tower and stay cables in an aesthetic harp arrangement; the 762-meter-long East Approach; and the 2,044-meter-long West Approach. The superstructure design includes two four-lane corridors for vehicular traffic, a transit corridor for a light-rail transit system, and a multi-use path for pedestrians and bicyclists. The Owner used a public-private partnership (P3) procurement model and the project was delivered using Design-Build delivery method. The first of four papers submitted to the symposium under the Special Session "Procurement Models and Delivery Methods of Mega Bridge Projects," this paper explains in detail the procurement process from the Owner's perspective and its profound contribution to the success of the new Samuel De Champlain Bridge.

IBC 21-46: Alternative Technical Concept (ATC) and Aesthetic Project Technical Enhancement (APTE) of the I-395/SR 836/I-95 Project in Florida

Time: 2:30 PM

William Detwiler, P.E., T.Y. Lin International, Coral Gables, FL

The $802 million-dollar I-395/SR836/I-95 Design Build Project is a partnership between Florida Department of Transportation (FDOT) and Miami- Dade Expressway Authority (MDX.) The I-395 Corridor includes 1.4-miles of bridge reconstruction from the I-95 Interchange to the MacArthur Causeway. The SR 836 Corridor consists of 3.5-miles of bridge reconstruction and new structures. I-95 is limited to 3-miles of roadway reconstruction. FDOT and the Owners Representative project team (OR Team) began conceptual development in 2011 and concluded with advertisement in February 2016. Four-teams expressed interest in the project, three were short-listed to continue through the design development period. Throughout the year long process, FDOT and the OR Team met with the design-build teams on several occasions to evaluate the proposed ATC's and APTE's. The project was eventually awarded in the Spring of 2018 with construction Notice-to-Proceed in the Fall of 2018.

The Request for Proposal (RFP) identified a total of 29 new bridges of segmental box girder, precast concrete Florida I-Beams (FIB's), welded steel plate girder and a unique cable stay signature bridge in downtown Miami over Biscayne Boulevard and 10 existing bridges to be widened. The 3.5-mile SR 836 mainline structure was proposed to be widened. The complexity of the project is highlighted by the Maintenance-of-Traffic needed during the anticipated 5-year construction duration. The winning team provided several new concepts including eliminating the 3.5-mile widening and building a second level viaduct over SR 836 Mainline and unique 6-leg arch structure which will be constructed in 2-phases.

IBC 21-47: A Novel Method of Project Delivery for the Kingston Third Crossing

Time: 3:00 PM

Zachary McGain, International Bridge Technologies; Mark Van Buren, City of Kingston, Canada; James Scheer, Peter Kiewit and Sons, Canada; Biljana Rajlic, Hatch, Canada

The Kingston Third Crossing is a long-awaited bridge project providing a new link across the Cataraqui river at the entrance to the Rideau Canal in Kingston Ontario. The Project, discussed for over 40 years has undergone a rigorous development process over an extended period. The Integrated Project Delivery approach was selected by the Owner in order to allow their knowledge, gained over the course of several years of project development, to be fully utilized and participate with the design and construction teams to maximize value for the community.

The bridge itself is three-quarters of a mile long with a feature navigation span near the east shore, marking the entry to the Rideau canal for boaters as well as accommodating competition and return lanes for the Kingston Rowing club. The site, as part of the Rideau canal, is a UNESCO world heritage site, and the shorelines have other sites in close proximity with First Nations and early settlement heritage. The business case put forward for funding approval highlighted the need to improve connectivity within the Kingston region, promote active transportation, and reduce travel time and associated greenhouse gas emissions. The novel procurement method which includes a multiparty project agreement, encourages collaboration and a focus on bringing value to the project (as opposed to only cost savings). A unique set of project delivery tools designed to work with the Integrated Project Delivery (IPD) model promote collaboration and assist in maintaining focus on value and ensuring buy-in by all parties.

IBC 21-48: Emergency Reconstruction of the Moravia Road Ramp to I-95 Southbound

Time: 3:30 PM

Scott Reynolds, P.E. and Donald Marinelli, P.E., Hardesty & Hanover, LLC, Annapolis, MD; Tekeste Amare, P.E., Maryland Transportation Authority, Baltimore, MD

This paper and presentation will highlight the emergency response to the fire damage to the Moravia Road ramp to I-95 Southbound in Baltimore, MD. A fire started and consumed several parked vehicles under the bridge, near a pier. Hardesty & Hanover (H&H) was contacted by the Maryland Transportation Authority (MDTA) to investigate the incident. The ramp was immediately closed to traffic. Over the next few weeks, H&H and the MDTA work continuously to develop a scheme to temporarily support the structure to allow traffic to reopen. Concurrently, the team worked on developing the final repair plans for bidding, using an A+B procurement (a first for MDTA). The contract documents were developed using a phased construction method that included temporary shoring, girder replacement, substructure concrete repairs, and a partial deck replacement.

IBC 21-49: Part I: Strategies in the Procurement, Design and Construction of the New Harry W. Nice / Thomas "Mac" Middleton Bridge

Time: 4:00 PM

Kenneth Butler, P.E., AECOM, Glen Allen, VA; Brian Wolfe, P.E., Maryland Transportation Authority, Nottingham, MD; Will Pines, PE, PMP, Maryland Transportation Authority, Baltimore, MD; Stephen Skippen, DBIA, Skanksa-Corman-McLean Joint Venture, Newburg, MD

The Maryland Transportation Authority (MDTA) is responsible for constructing, managing, operating and improving the State's eight toll facilities, comprised of two turnpikes, two tunnels and four signature bridges, including the Harry W. Nice / Thomas "Mac" Middleton Bridge (Nice- Middleton Bridge). The Nice-Middleton Bridge project is a $463 million design-build project to replace an existing signature bridge over the Potomac River between Maryland and Virginia. The project is one of MDTA's largest transportation initiatives to date. MDTA elected to use the design-build delivery method to take advantage of the benefits of significant time savings and design innovation. Project goals consider cost, schedule, safety, durability, and mobility, while project objectives include providing geometric compatibility with the approach roadway; providing sufficient capacity to carry vehicular traffic in design year 2040; improving traffic safety on the approaches and the bridge; and providing the ability to maintain two-way traffic flow during wide loads, incident, poor weather conditions and during bridge maintenance and rehabilitation work. MDTA procured the project using a Competitive Sealed Proposal process, which included qualifications-based Reduced Candidate List, technical and price proposals, one-on-one meetings, and consideration of Alternative Technical Concepts. Skanska-Corman-McLean Joint Venture (SCM JV) in major partnership with AECOM was selected to design and construct the project. The project was awarded in early 2020, design is substantially complete, and construction is underway. The paper will present the procurement, design and construction strategies used to deliver a major project that cost-effectively addresses the project goals.

IBC 21-50: Part II: Strategies in the Cost-Effective Design of the New Harry W. Nice / Thomas "Mac" Middleton Bridge

Time: 4:30 PM

Stephen Matty, P.E., AECOM, Hunt Valley, MD; Nathan Porter, P.E., AECOM, Glen Allen, VA

The Harry W. Nice / Thomas "Mac" Middleton Bridge project replaces an existing 1.9-mile, two-lane bridge over the Potomac River with a new 61- foot-wide, four-lane bridge to increase traffic capacity, improve safety and facilitate access for emergency response, maintenance and wide-load vehicles. The main spans of the existing bridge feature approach-span deck trusses leading up to an arch through-deck truss over the main channel. The new bridge was designed to cost effectively balance the number of spans against the number and heights of the supporting piers and foundations, while enhancing aesthetics. The design leveraged a combination of prestressed concrete girders in the low- and high-level approach spans with long-span, haunched steel girders over the main channel. The substructure and foundations vary from pile bents to concrete columns and caps on waterline footings to reduce impacts to the river bottom. The deep foundations are 36 and 66-inch prestressed concrete piles driven up to an estimated depth of 190 feet. The design approach provides a simple and repetitive design, which increases construction efficiency and reduces costs, while promoting quality and durability. The design provides a 100-year service life, by leveraging strategies such as minimizing the number of deck joints; using drainage details that reduce exposure to salt-laden water; using custom-designed high-performance concrete mixes; and selectively using corrosion resistant reinforcing steel. The design reduces life cycle costs through state-of-the-art design details and durable materials, while providing a structure that is easily accessible for future inspections and maintenance.

W-10: Accelerated Construction with Steel Sheet Pile Bridge Abutment

Time: 1:00 - 5:00 PM

Errynne Bell, Nucor Skyline, Rock Hill, SC; Richard Schoedel, P.E., Gang Zuo, P.E., Ph.D., and Aaron B. Colorito, P.E., C.B.S.I., Michael Baker International, Moon Township, PA

Steel sheet pile bridge abutments offer a unique solution for bridge construction that is cost-efficient, rapidly deployed, strong, and durable. This workshop will provide a thorough overview of the design methodology, from concept to completion. In this overview, we bring together the basics of AASHTO bridge design, and fill in the gaps to provide complete design guidance on all aspects of sheet pile bridge abutment design. Each workshop participation will receive a copy of the Steel Sheet Pile Bridge Abutment Manual, courtesy of Nucor Skyline.

W-11: Constructability, Durability and Sustainability of Concrete for Extended Service Life Projects

Time: 1:00 - 5:00 PM

Jose Pacheco, Ph.D., P.Eng. and Jan Vosahlik, Ph.D., CTL Group, Skokie, IL

Service life requirements for concrete bridges of 75 years or greater are becoming the norm in Public Private Partnerships (P3) and Design-Build projects. This type of project requires effective communication between the Contractor, Engineer of Record, Consultants and Suppliers. Achieving the specified service life involves all the stakeholders from design, material selection and qualification, and execution stages of the project. The workshop will cover various approaches used for selecting the optimal concrete materials for enhanced constructability, durability and sustainability of different concrete classes such as bridge deck, mass concrete, and others.

CONSTRUCTION SESSION

9:00 AM - 12:00 PM

Session Chair: William (Bill) Detwiler, P.E., T.Y. Lin International, Coral Gables, FL

IBC 21-51: Construction and Constructability of the I-74 Mississippi River Arches

Time: 9:00 AM

Erich Heymann and Timothy Davis, McNary Bergeron and Associates, Tampa, FL; David Klaseus, Lucid Engineers, PC, Wayzata, MN; Brian Giese, Lunda Construction Co., Waukesha, WI

The I-74 Bridge is a twin basket-handle varying depth steel arch that connects Bettendorf, Iowa and Moline, Illinois. The arch spans 800 feet across the Mississippi River and the top of arch sits nearly 250 feet above water. The arch structure is erected in place using temporary stays systems that are tied back to 225 foot plus tall shoring towers. This project offered unique challenges in construction engineering and constructability with items such as the stay towers, stays systems, trusses, concrete anchorages, bearings and bearing installation, mass concrete, temporary arch bracing, rigging, jacking and alignment tools, wind instability, as well as all aspects of geometry control. One of the unique challenges of this structure is that the arch is designed with a fixed base that is field milled for geometry control. Other challenges include extremely tight erection tolerances, the required ability to adjust ribs at field splices, minimal permanent bracing, magnitude of forces, and the necessity to "spring" the arch prior to installation of the keystone. Installation of the keystone requires multiple tools, some with capacities in excess of 1,100 kips, to work in unison with the stay systems. The estimated completion date of arch erection is Summer 2021.

IBC 21-52: From Breaking Ground to Ribbon Cutting - Constructing the Frederick Douglass Memorial Bridge

Time: 9:30 AM

JJ Reilly, McNary Bergeron & Associates, Old Saybrook, CT; Jake Presken, Walsh Construction Group

Over the last three years, a unique multi-arch bridge has been rising out of the Anacostia River in Washington D.C. This presentation walks through the Frederick Douglass Memorial Bridge project from the perspective of the Erection Engineer and the Contractor. Each phase of construction offered its own set of challenges which played into the erection schemes and construction methods. Foundation construction included water line footings, utility coordination, and complex reinforcing. The unbraced steel arches required external aeroelastic stability measures and robust geometry control due to the complex arch shapes. The final phase, deck erection, balanced the sensitivity of the structural system with deck geometry tolerances, all the while limiting the post-tensioned concrete substructure demands. Project-specific constructability details are highlighted for this unique structure as well as general constructability points for future projects.

IBC 21-53: 7 Mile Bridge Innovative High Capacity Friction Collars

Time: 10:00 AM

George Patton and Rafal Wuttrich, Hardesty & Hanover, LLC, Tampa, FL

The iconic 7 Mile Bridge on US 1 in the Florida Keys has been subject to the marine environment and numerous severe storms over a nearly 40- year service life. These conditions have resulted in corrosive deterioration and physical damage requiring major concrete repairs. Unsound concrete put the expansion bearings at risk of destabilization. To make repairs, it was necessary to lift and support the superstructure with a combined dead and live load of 1.4 million pounds. As the only available route, it was critical to maintain traffic during the work. An innovative engineering solution was required to address numerous technical challenges including heavy jacking load, unique bridge geometry that limited support options, and requirement to minimize loading that could further damage the bridge. The contractor and construction engineer identified the advantages of high-capacity friction collars clamped to the cylindrical pier columns. Initially, FDOT was apprehensive to support such a critical bridge using friction only, but after hearing the proposed comprehensive approach for design, construction, heavy-lifting, load testing and monitoring, FDOT was convinced that the plan was sound. This paper discusses development, design and implementation of the high-capacity steel friction collar system used to successfully perform the work including design criteria, non-linear finite-element analysis, construction and heavy-lifting procedures, measurements, inspections, load testing and monitoring used.

IBC 21-54: Advancing Rail System - The Assembly Line for Building the Rodanthe Jug-Handle Bridge

Time: 10:30 AM

JJ Reilly, McNary Bergeron & Associates, Old Saybrook, CT; Josh Apsitis, Superior Construction

The Rodanthe "Jug-Handle" Bridge is a new 2.4-mile long structure part of State Route NC-12 in the Outer Banks. NC-12 is the main emergency evacuation route for the Outer Banks region, so the new structure will provide a much more reliable and resilient route of travel compared to the current surface roads. It provides a permanent bypass to portions of the barrier islands that are prone to severe erosion, flooding, and breaches between the Pamlico Sound and Atlantic Ocean. The site access and right-of-way restrictions were very narrow due to existing property rights and environmental concerns. This posed a major challenge for building the bridge since the shallow water depth in the Sound meant conventional barge mounted cranes weren't feasible. An "Advancing Rail System" was designed to straddle the permanent bridge footprint to solve the right-of-way and access issues. It was used in a leap-frog fashion with all construction activities occurring within the 1600-foot trestle area similar to an assembly line. To meet the aggressive schedule, two rail systems were used on the project, one on the north heading and another on the south. This presentation will provide an in- depth look at the rail system. This will include initial concepting, design, major components and equipment, obstacles in the field, schedule, cost, and lessons learn/ed.

IBC 21-55: The Graceful Beauty of the Parabolic Box Girder in Bridge Construction & other Structures

Time: 11:00 AM

Robert Cisneros, High Steel Structures LLC, Lancaster, PA

This presentation recounts an engineer's periodic encounters with various parabolic curves in structural elements, and how this aesthetic form can augment the structural efficiency of a structural element, be it a champagne bridge pier, haunched girder (concrete or steel), trapezoidal box (tub) girder, truss, arch, suspension bridge, tower, parking garage or rural highway curve. Where non-linear geometries once added complexity and prohibitive cost to routine projects, today's technologies allow engineers to actually enhance structural performance and strength-to-weight ratios with parabolic and similar curves. After a brief re-acquaintance with the basic mathematics of y = x (where n~2) the audience will enjoy a whirlwind tour of aesthetically curved structures utilizing parabolae. The case study will illustrate how the engineer may quickly check & stabilize critical sections on a variable depth structural element, rely upon internal & system structural redundancy, and perform rapid field engineering checks such as crane layouts to safely lift an eccentric load even in challenging jobsite terrain.

IBC 21-56: Construction Engineering using Bridge Integrated Modeling on the 3rd Avenue Bridge Rehabilitation Project

Time: 11:30 AM

Ivan Liu, P.E., FINLEY Engineering Group, Tallahassee, FL

This presentation will cover the BrIM innovations that have been applied on the construction engineering phase of the 3rd Avenue Bridge rehabilitation project in Minneapolis, MN. The project consists of 7 existing arch spans to be rehabilitated where only the existing arch ribs and barrel arches will be repaired and new spandrel columns, cap beams, and deck slab will be cast. The unique aspect of the construction is the complex demolition and reconstruction sequence on the existing structure. Construction water access was not prohibited during construction which lead to a multi-phase construction sequence due to deck access for the numerous construction equipment traveling along the bridge. In addition, a strict schedule is required to be met on the project to meet with the owner's requirements for shutdown. This highly involved construction sequence with the complex geometry of the existing structure lead to the create of a full 3D integrated model of the bridge project. This 3D BrIM model was used to design and develop the visualization of construction sequence and the variety of temporary falsework supports and construction items required. The BrIM model provides the engineer and contractor an overview of what potential issues and clashes that may occur during construction for demo/casting activities.

REHABILITATION, PART 3 SESSION

Time: 9:00 AM - 12:00 PM

Session Chair: Jonathan McHugh, P.E., Gannett Fleming, Inc., Pittsburgh, PA

The 2021 Rehabilitation 3 Session showcases several different examples of cutting-edge bridge rehabilitation projects from around the United States. Sessions feature interesting yet diverse topics such as ultra-high performance concrete deck overlays, steel girder in-span hinge connections, MASH barrier study and evaluation, historic truss bridge rehabilitations, and HOV/toll bridge conversion. Come join us for an assortment of present day rehabilitation design and evaluation challenges and solutions.

IBC 21-57: Design and Construction of Four UHPC Bridge Deck Overlays for NJDOT

Time: 9:00 AM

Steve Esposito, P.E., PMP, WSP USA, Newark, NJ; Jordy Padilla, Michael McDonagh, and Kirollos Gadalla, WSP USA, Lawrence Township, NJ; Mike Kasbekar, New Jersey DOT, Ewing Township, NJ

The New Jersey Department of Transportation (NJDOT) initiated a research project to install and evaluate the performance of Ultra-High Performance Concrete (UHPC) for use as an overlay on a variety of bridges in New Jersey. During design, the Department identified bridges to be investigated for feasibility of the project. A review of chloride concentration levels, traffic impacts and structural defects was conducted accordingly. Through these investigations, four bridges were selected for construction to maximize the benefits of UHPC. The research program was established to extend the life of the bridge decks by eliminating the chlorides within the top surface of the deck with physical concrete removal while taking advantage of the enhanced properties of the UHPC overly to prevent further chloride intrusion. The advantages of UHPC include its superior bond strength with the deck surface, high abrasion resistance, enhanced durability, rapid cure time, and ability to mitigate chloride penetration. The work procedures involved the removal of the existing wearing surfaces and 0.5-inch of the top surface of the concrete decks through hydrodemolition to develop a suitable surface for the overlay. Unique constructability techniques were adapted during design and implemented effectively in construction to place UHPC using staged construction. In addition, several existing headers were removed and replaced with full- depth UHPC, increasing the durability and performance of the joints. The effectiveness of UHPC will be further reviewed with future testing and evaluation, and the success of the program will play a crucial role on the future of UHPC Overlays.

IBC 21-58: Evaluation and Load Rating of a Steel Girder In-Span Hinge Connection

Time: 9:30 AM

Sofia Puerto, Ph.D., P.E., Daniel Baxter, P.E., and Shayla Olson, P.E., Michael Baker International, Minneapolis, MN

Continuous steel plate girder bridges often use intermediate expansion joints located at in-span hinges to divide the superstructure into individual units with shorter expansion lengths. One common type of in-span hinge is often termed a "shiplap joint". This type of joint is located away from piers near the moment inflection point of the span maximizing girder efficiency. It consists of a cantilevered portion of the superstructure supporting a suspended portion of the superstructure on bearings placed on dapped portions of the steel plate girders. Few references are available for the evaluation and load rating of shiplap in-span hinges used in streel girder bridges. In this study, the strength and stability of a typical shiplap hinge connection is evaluated using two methodologies: a 3D finite element model including a detailed mesh of the connection and a proposed simplified methodology based on design equations. Load ratings of the connections obtained based on these methodologies are compared. The proposed approach allows for a conservative assessment of the hinge without the need of a detailed finite element model of the hinge.

IBC 21-59: Study of Vehicular Impact on Reinforced Concrete Bridge Parapet for Design

Time: 10:00 AM

Bao Chuong, P.E., Connecticut DOT, Newington, CT; Ramesh Malla, Ph.D., F. ASCE, F. EMI, University of Connecticut, Storrs, CT The most commonly used design method for reinforced concrete bridge parapets has been the approach presented in current edition of

AASHTO LRFD Bridge Design Specifications. However, this approach, which was developed based on the Yield Line Theory and NCHRP Report 350, has been found to possess many limitations. In 2009, the Manual for

Assessing Safety Hardware (MASH) has replaced NCHRP Report 350 to be the new standard for evaluating safety hardware devices. In 2019, an agreement was made between AASHTO and FHWA to implement MASH to all new permanent installation of bridge rails on the National Highway System. Therefore, there is an immediate need to refine and update the AASHTO method to reliably incorporate the MASH requirements. T his paper presents an evaluation of the AASHTO design equations using both Dynamic Finite Element Method (FEM) and an analytical analysis based on Theory of Plates. In the Dynamic FEM method, three-dimensional numerical models of the parapet section are created and analyzed with ANSYS computer program. In the analytical approach, MATLAB was used to compute the stresses throughout a plate having equivalent properties of a reinforced concrete parapet. Stress values at numerous locations on the plate were determined to locate areas of highest stress concentration, where yielding of rebars can occur. The ultimate goal of this project is to use highly accurate analysis methods to refine the yield-line-based AASHTO method and reliably implement new MASH safety requirements.

IBC 21-60: Rehabilitation of the Rockville Truss

Time: 10:30 AM

Brian Byrne, Lochner, East Hartford, CT

The Rockville Bridge, constructed in 1924 by the National Park Service to connect Zion and Grand Canyon National Parks, is the only remaining vehicular Parker Through Truss in the State of Utah and the structure is listed in the National Historic Register and a defining feature of the Town of Rockville. The 220 foot long bridge is the only good crossing for several residences and ranches south of the river. The bridge was posted for 14 Tons, too low for emergency and trash removal vehicles, and so this project had been commissioned to upgrade the bridge to meet a 25 Ton rating. This bridge is a defining and an adored element of the town, and the story of its citizens to save and upgrade this bridge, rather than replace it, is very compelling. In order to increase capacity sufficiently, a timber glulam deck was used and four of the diagonals replaced in kind. Additionally, steel stringers were swapped out and the floor beams strengthened. In this manner, the historic appearance is not only maintained, but enhanced with the timber deck, while upgrading the structure to meet the current needs of the citizens. The presentation will focus initially on the load rating and decision making process on how to increase the capacity of the existing historic truss while working within a small town budget.

IBC 21-61: Repurposed Bridge Rehabilitation: Converting HOV Lanes to Toll Lanes 395 Express Lanes

Time: 11:00 AM

Roberto Vilanova, Hiren Prajapati, and Elliott Mandel, AECOM, Arlington, VA

The 395 Express Lanes Extension Project is a Virginia Department of Transportation P3 D/B Megaproject that exhibits how modifications to existing infrastructure can transform travel to and from the nation's Capital. The conversion of two existing HOV lanes into three reversible, tolled Express Lanes along an 8-mile corridor required the rehabilitation of 31 bridges, which all had unique structural deficiencies. This project demonstrates the many challenges that were overcome in order for bridge work to be completed safely and effectively while maintaining traffic flow along a major arterial route to Washington, DC. Structural rehabilitation and modification of the bridges involved a wide range of design elements, from deck repairs, overlays and parapet/overhang replacement to widening, pier protection, mounted sound barriers and link-slab joint closures. The work was performed under complex MOT conditions. Bridge-specific detailed analysis was performed to ensure that placement of heavy machinery would not compromise the reduced deck thickness during milling and hydro-demolition operations. Careful design consideration was placed at points of interaction between the new and existing structures to prevent concrete cracking due to shrinkage and thermal differentials. To ensure that the revised structural elements would act as a composite structure, the existing structures were analyzed to verify they met current design criteria. With the increase of population surrounding metropolitan cities, the 395 Express Lanes Extension Project serves as an example of how DOTs and other agencies can repurpose existing bridges to accommodate future travel needs that provide improved transportation options to the traveling public.

IBC 21-62: Sellersville Truss Rehabilitation: A Bridge Worth Saving

Time: 11:30 AM

Brian Watson, HDR, Mechanicsburg, PA; Alex Craft, Loftus Construction, Inc., Cinnaminson, NJ; Henry Berman, Pennsylvania DOT, King of Prussia, PA

This project is the rehabilitation of a single span Pratt pony truss located in southeastern Pennsylvania. The truss is technologically significant for its early use of equally dimensioned H-sections rather than built up vertical and diagonal members. It is individually eligible for the National Register of Historic Places (NRHP) and is a contributing element to the NRHP-eligible Sellersville Historic District. Constructed in 1927, by 2013 the bridge had deteriorated substantially. The load posting had progressively dropped, threatening its ability to safely serve the community. Due to the extent of the deterioration

and rehabilitation constructability concerns the bridge was recommended for replacement. However, the State Historic Preservation Office (SHPO) and the local community supported saving the bridge as a gateway to the Borough's historic district. PennDOT agreed with community wishes and designed the project to rehabilitate rather than replace the bridge. Construction began in June 2019. Despite the challenges of complex repair details, the addition of unforeseen repairs, and a six-week COVID shutdown the contractor completed the project ahead of schedule. The bridge re-opened on October 31, 2020.

W-12: Ultra-High Performance Concrete (UHPC) for Bridge Preservation and Repair (Part 1): Introduction, Promising Applications, Practical Concepts

Time: 9:00 AM - 1:00 PM

Zachary Haber, Federal Highway Administration, McLean, VA

The use of ultra-high performance concrete (UHPC) in bridge design and construction has undergone significant growth over the past five years. Yet, this technology is still being underutilized by state and local transportation agencies. Preservation and repair (P&R) of bridge infrastructure, an ongoing challenge for many of these agencies, is a new application of UHPC that can make a significant impact. UHPC-based bridge P&R solutions offer enhanced durability and resiliency, rapid construction, and enhanced life-cycle cost performance. This workshop will present bridge engineering stakeholders with a suite of UHPC-based P&R solutions. The suite of solutions will consist of approximately six to eight concepts. Each concept will target a different bridge P&R need; examples include UHPC overlays for bridge decks, deteriorated bridge girder repair, and expansion joint repair/replacement. The workshop will cover:

- Introduction to UHPC: constituents, material properties, mixing and placing, and curing.
- History of UHPC in Bridge Engineering: first deployment and demonstration projects, prefabricated bridge element connections, development of design specifications.
- Construction, Inspection, and Testing: formwork, site preparation, inspection and monitoring of construction activities, QA/QC, on-site testing, and compression testing.
- Maintenance, repair, and strengthening solutions with UHPC: bridge deck overlays, beam end repair, link slabs, rail bridge strengthening, column jacketing, impact damage repair, and connection repair.

This proposed workshop will provide technical assistance to bridge maintenance and repair professionals interested in using UHPC in applications that range from relatively low- to moderate-risk P&R applications.

INSPECTION/ANALYSIS SESSION

Time: 2:00 - 5:30 PM

Session Chair: Jennifer C. Laning, P.E., Pennoni, Baltimore, MD

Inspection and Analysis session will include a variety of papers on inspection and analysis, involving new and innovative methods. We will hear about use of UAS for inspection and emergency response in Kentucky and Pennsylvania and the incorporation of BIM visualization to support bridge inspectors in Germany. Additional papers will discuss load testing, analysis and monitoring for structures in Maryland, South Carolina, Colorado, and nationwide for the US Army. Inspection and analysis play a critical role in the life cycle of bridges. This session will give perspective on some new and exciting applications.

IBC 21-63: Kentucky Transportation Cabinet - UAS for Bridge Inspection and Major Bridge Emergency Response

Time: 2:00 PM

Tracy Nowaczyk, P.E., Kentucky Transportation Cabinet, Frankfort, KY; Joseph Campbell, Federal Highway Administration, St. Paul, MN; Katherine Caldwell, KYTC Bridge Preservation

In 2019, The Kentucky Transportation Cabinet (KYTC) Kentucky began implementation of an unmanned aerial system (UAS) assisted bridge inspection program. The program was part of the response to increasing concern with the impacts of decreasing bridge inspection staff paired with aging bridge structures. The KYTC sought to build a single proof of concept UAS program. The goals of the program included: development of a UAS selection criteria, creation of a bridge inspection manual, establishment of training needs, and creation of necessary policies and guidelines. Some of the criteria of interest for the UAS selection included: Flight operations without GPS, ease of flight operations and training, ability to use live video image through large screen format (large monitor or goggles). The KYTC sought to consider budget while implementing a program for the 12 regional bridge inspection teams with high end consumer UAS. Through these simple goals and UAS selection criteria the KYTC has been able to give statewide inspectors the ability to supplement routine bridge inspections and respond to emergency events quickly, including the fire on the Brent Spence Bridge (I-75 over the Ohio River). The program offers an opportunity to identify potential issues on bridge structures earlier, and at a relatively low cost, while also increasing safety and efficiency for personnel. Future growth of the program includes expanding beyond traditional camera equipped drones to include more specialized equipment for bridge preservation as needs develop.

IBC 21-64: UAS Recommendations for PennDOT Bridge Inspections

Time: 2:30 PM

Alicia McConnell, Michael Baker International, Chicago, IL; John Zuleger, Michael Baker International, Louisville, KY; Rich Runyen, Pennsylvania DOT, Harrisburg, PA

PennDOT has recognized Unmanned Aircraft Systems (UAS) technology as another tool to enhance bridge inspection and mitigate impacts of routine bridge inspections to the public. UAS have emerged as a leading technology with the potential to provide easier access to bridge elements while alleviating some traffic and safety issues. These impacts include bridge closures, lane restrictions, and the transport and use of bridge inspection vehicles. PennDOT evaluated several UAS platforms, including a portion of Michael Baker International's fleet, for bridge inspection use and will present these findings to the UAS Task Force, who is developing a UAS program for PennDOT to address several different sectors of transportation. For the Bridge Inspection program, PennDOT and Michael Baker developed a phased approach and performed testing on six airframes suitable to bridge inspections. The testing phases included evaluating the selected UAS on routine structure elements, then complex bridges, and lastly in a nighttime emergency response scenario.

IBC 21-65: Supporting Bridge Inspectors with Interactive Mixed Reality Visualizations of BIM Process and Geometry Data

Time: 3:00 PM

Urs Riedlinger, Fraunhofer Institute for Applied Information Technology FIT, Sankt Augustin, Germany; Sonja Neumann, Bundesanstalt für Straßenwesen – Federal Highway Research Institute, Bergisch Gladbach, Germany; Marcos Hill, LIST Digital GmbH & Co. KG, Essen, Germany; Florian Klein, HHVISION | HOERSCH & HENNRICH Architekten GbR, Köln, Germany; Martin Mertens, Bochum University of Applied Sciences, Bochum, Germany

We present how bridge inspections can be enhanced through Mixed Reality (MR) using Building Information Modeling (BIM) data. Therefore, we identify the key processes relevant for an MR-supported bridge inspection, starting by preparation in the office, followed by the execution on-site and completed by the follow-up steps back in the office. Furthermore, we state how we plan to put this digital support into practice. We believe that our insights might help to advance the management of infrastructures – a challenging collaborative task with the overall goal to provide maximal safety using "minimally invasive" techniques, e.g. keeping traffic obstructions as small as possible. Therefore, the early detection of damages and their classification plays an important role to be able to take measures on time. In our conclusion, we discuss how the presented approaches integrate with the technical and the organizational framework and future developments within the field of bridge inspections, as well as directions for further research. We argue that a digitally supported bridge inspection is only feasible if all participants involved in the process are adequately supported, considering their working environment and meeting their requirements. These criteria are applicable, especially when introducing new tools, workflows, or further developments using innovative technologies.

IBC 21-66: Proof Load Testing of Prestressed Concrete Adjacent-Beam Bridges

Time: 3:30 PM

Mark Guzda, AECOM, Hunt Valley, MD; Ed Zhou, AECOM, Germantown, MD

Analytical methods commonly used for estimating the load carrying capacity of prestressed concrete (PSC) beam bridges with exposed and broken prestressing strands are often overly conservative, resulting in insufficient bridge load ratings, as low as near zero in some cases. These insufficient load ratings are controlled by the calculated capacities for the PSC beams which require assumptions for addressing the actual condition of deteriorated pre-stressing strands. Near zero load ratings typically require immediate actions by bridge owners which may include bridge closure, rehabilitation, and/or re-evaluation using refined methods. Proof load testing is the most reliable solution for establishing a lower-bound safe load carrying capacity when conventional analytical methods cannot provide an accurate capacity. This paper discusses the re-evaluation multiple PSC beam bridges with insufficient bridge load ratings from conventional calculations using the refined method of proof load testing per the AASHTO Manual for Bridge Evaluation. Case studies are presented for bridges of different age, geometry, deterioration and rehabilitation. Field measured strains and deflections of the PSC beams for incrementally increasing loads are assessed for linear-elastic response. In one case study, live load strains in prestressing steel were measured for two beams having significant losses to their strand patterns. The paper details the proof load test procedure and the results from the case studies emphasizing the benefits of proof load testing over conventional analytical methods.

IBC 21-67: An LRFR Approach for Classifying Military Vehicles for U.S. Army-Owned Bridges that Require Engineering Judgement

Time: 4:00 PM

Monica McCluskey, P.E., and Joshua Miller, PRIME AE Group, Baltimore, MD

As part of their 2020 biennial inspection program, the U.S Army is conducting a load rating effort for its bridges located at military installations throughout the United

States. To date, 201 structures at 26 Army bases are being evaluated for both vehicular and military vehicles. 72 of these structures are concrete bridges with unknown reinforcement which cannot be rated using traditional methods due to insufficient information and must therefore be evaluated using Engineering Judgement. AASHTO's Manual for Bridge Evaluation provides some guidance for these structures when the live loads are civilian vehicles. For Army-owned bridges, however, an Allowable Military Load Classification must also be determined i.e. a class of military wheeled and tracked vehicles that can safely cross the bridge. An evaluation procedure called Load Correlation is used to determine the proper Military Load Classification for a particular bridge. The current procedure, however, is based on the Allowable Stress Method. To allow the use of LRFR, a new Load Correlation equation and methodology using LRFR principles was developed. The methodology, however, is not just numeric but also requires the load rater to incorporate what one knows about the bridge into the load rating process. For older bridges with design vehicles less than an HS-20, and low ADT bridges, the correlation concept was also used to determine if a posting was required for state legal and emergency vehicles since these vehicles are not considered "normal traffic". Several examples will be provided to illustrate the procedure.

IBC 21-68: Validation of Fiber Reinforced Concrete Performance in Laboratory and Field for Bridge Rehabilitation

Time: 4:30 PM

Kuang-Yuan Hou, Yifan Zhu, Chung C. Fu, and Naiyi Li, The Bridge Engineering Software & Technology Center, Department of Civil and Environmental Engineering, University of Maryland, College Park, MD

Fiber-reinforced concrete is increasingly used in the bridge field recently. Compared with regular concrete, higher strength or performance is emphasized to enhance vulnerable bridge elements' durability. Reported here is a pilot bridge rehabilitation project from the Maryland Transportation Authority (MDTA) to upgrades a steel bridge overpassing I-95. Fiber-reinforced concretes, including the Engineered Cementitious Composite (ECC) and the Ultra-High-Performance Concrete (UHPC), are proposed as candidate materials for link slab connections to replace traditional steel joints of the existing bridge. Because ECC and UHPC link slabs are new materials for bridge rehabilitation in Maryland, their performances are crucial for the MDTA to adopt this rehabilitation strategy on similar bridges. To evaluate ECC and UHPC link slabs' performances, the crack formation is a fundamental indicator for fiber-reinforced concrete conditions. Continuous fine cracks are expected for fiber-reinforced concrete rather than a single visible crack during service. Special-made strain gauges are used to detect the deformation and monitor crack formations of cracks. For field installation, embedded strain gauges were developed and tested in the laboratory before field construction. Then, embedded strain gauges were placed at specific locations and elevations of link slabs during concrete pouring for long-term monitoring. In an one-year monitoring, crack formations of ECC and UHPC were detected by the embedded strain gauges, and the link slabs' performances were also validated based on their long-term monitoring data.

IBC 21-69: Remote Radar Monitoring for Bridge Load Testing and Stay Cable Forces

Time: 5:00 PM

Larry Olson and Patrick Miller, Olson Engineering, Inc., Wheat Ridge, CO

Case study results will be presented in which static and dynamic deflections of a typical highway bridge was measured with a non-contacting interferometric radar system (IBIS-S). The bridge was monitored during both normal traffic loading and known weight, slow rolling load testing. The Interferometric radar system (IBIS-S) can simultaneously measure the displacement and vibration responses of multiple locations of a structure for distances up to 0.5 kilometer. The IBIS-S system has a maximum accuracy of 0.01 mm (0.0004 inch) and a maximum sampling frequency of 200 Hz (Nyquist frequency of 100 Hz). The system is tripod mounted and can be rapidly deployed, allowing load testing in a matter of hours. The results from the IBIS-S displacement monitoring measurements compared very well with potentiometer displacement results on an FHWA International Bridge Study project on NJ Route 23 over NJ Route 202 in Wayne Township, NJ. Stay cable forces are determined with the IBIS-S system from the resonant frequencies associated with stay cables under tension from ambient vibration sources such as wind/traffic or physical excitation. The technical advantages of the radar technology versus laser lidar and conventional accelerometer/ strain gage measurements include remote measurements up to 500 m for 0 Hz (static) to 40 Hz vibration frequencies with simultaneous measurements of displacements/vibrations of multiple stay cables at a time, and measurements are independent of weather conditions. Comparisons between the IBIS-S results and an accelerometer on a large cable-stayed bridge agreed very will in terms of natural frequencies and corresponding forces.

W-13: Redundancy of Bridges Constructed with ABC Technologies

Time: 1:30 - 5:30 PM

Bijan Khaleghi, Washington State DOT, Olympia, WA

This workshop focuses on the bridge redundancy and identifies the breaches in the current practice on different aspects of redundancy that could improve the bridge structural resiliency in the damaged state and enables it to perform its design function. This workshop identifies rational approaches for assessing redundancy in bridges built using the accelerated bridge construction technologies.

This workshop provides an opportunity for assessing the current state-of-practice in redundancy of bridges constructed with ABC Technologies.

W-14: Railway Bridges: A Comprehensive Overview of Analysis and Design Requirements

Time: 1:30 - 5:30 PM

Ebadollah Honarvar, Stantec, New York, NY

Given the absence of a unified design code, this workshop presents a practical framework to effectively design and analyze bridges to embrace modern heavy, light, and high-speed rail transit systems. The requirements are explored and customized for a wide variety of bridge categories, including regular, complex, and long-span bridges. Instructions to develop project-specific design criteria, determine track requirements, identify structural and rail expansion joint systems, and conduct nonlinear seismic and track-structure interaction analyses are presented.

W-15: Protective Coatings 101

Time: 2:00 - 5:00 PM

Charles Brown, P.C.S., GPI, Columbia, MD

The workshop will provide an overview of an industrial protective coatings project, including design considerations, material selection, surface preparation guides, ambient conditions, and basic quality control techniques. What participants will attain out of this course is a basic understanding of how protective coatings are specified and applied to meet the goals of a project. We will discuss Corrosion, Good Design, Good Paint, Good Specifications, Good Contractors, Good Inspection and Good Maintenance. We will review and present typical inspection instruments used on a paint project, surface preparation guides, how to read a product data sheet and how to measure ambient conditions.

RR/MOVABLE SESSION

Time: 9:00 - 11:30 AM

Session Chair: Francesco M. Russo, Ph.D., P.E., Michael Baker International, Philadelphia, PA

Whether your interest is in the design of new movable bridges, the planning and development of iconic movable bridge replacement structures, or the critical work of rehabilitating and assessing existing complex movable bridges, this session is sure to provide the education and information you need.

IBC 21-70: Rope Tensioning, Span Balancing, Gear Indexing, and Seating Corrections of 3 Vertical Lift Bridges

Time: 9:00 AM

Robert Algazi and Rama Krishnagiri, WSP USA, Lawrenceville, NJ; Michael Abrahams, WSP USA, New York, NY; Georgio Mavrakis and Gerald Oliveto, New Jersey DOT, Ewing, NJ

Route 1&9T over the Passaic River, Route 1&9T over the Hackensack River, and Route. 7 over the Passaic River are tower drive vertical lift bridges maintained by New Jersey Department of Transportation (NJDOT). These bridges have been in service for 80 years, 66 years, and 17 years respectively and the wire ropes are original to the bridges. In-depth inspections and tension measurements revealed that some of the ropes in each group were out of tolerance. Dynamic strain gage testing indicated a generally span-heavy condition but the imbalance was not well distributed. At one of the bridges there were seating issues resulting in a floating bearing at one corner, and at a second bridge an unusually large system friction was noted. Heavy truck traffic at two of the bridges and the lack seating was concerning. To address these issues, wire rope tensioning, span balancing, gear indexing, and seating corrections for full seating under dead loads are being performed. Transverse and longitudinal balancing including interim and final balancing is being confirmed via dynamic strain gage testing. Gear indexing and seating corrections, in conjunction with tensioning and balancing are expected to correct the known issues. A close coordination between the designer, owner, and contractor is aiding the fast-track work.

IBC 21-71: Structure Health Monitoring and Dynamic Response of Two More than Century Old Truss Railroad Bridges

Time: 9:30 AM

Celso de Oliveira, Sachin Tripathi, and Ramesh Malla, Ph.D., F. ASCE, F. EMI, University of Connecticut, Storrs, CT

Since most of the New England railway bridges were design and built more than a century ago, it is imperative to determine their current dynamic characteristics due to the actual loading and vehicle type to ensure the bridge and passenger safety. This paper presents the dynamic study of the two old railroad bridges located in Connecticut, Devon (Figure 1) and Cos Cob (Figure 2) bridges. The accelerometers and a laser vibrometer were used to collect the structural response for both controlled loading and train under operation scenario. The modal analysis was conducted to obtain the natural frequencies and modal shapes of one of the spans in both bridges. For the analysis purpose, one of the spans next to the abutment was modeled in Finite element package (Figure 3). The Finite Element Model (FEM) was subsequently updated and was used to estimate the dynamic parameters such as natural frequencies, working frequencies of different trains at a different speed, mode shapes, and damping ratio. The output from the field test was employed to update FEM using the Modal Assurance Criterion. With the updated FEM, several simulations were done to understand the effects of vehicle speed and axle loads.

IBC 21-72: All Eyes on the Icon: Navigating the Type Selection Process of the I Street Lift Bridge

Time: 10:00 AM

Noel Shamble, T.Y. Lin International, Los Gatos, CA

The first bridge for downtown Sacramento in nearly 100 years, the I Street Bridge Replacement Project has drawn the eyes of the entire state capitol region. When presented with building a new bridge which will include a significant 300ft lifting main span, there emerged a strong civic desire to make a once-in-a-generation mark on the cityscape. This intensified the architectural challenge of blending the structural, mechanical, human, and environmental needs of the project into a global icon while still maintaining a "neighborhood" feel for local users. Shared between two cities, this high-profile project attracted input from thousands of citizens, numerous city officials, two mayors, industry leaders, and even a US Congresswoman. Yet, the bridge selection process was smoothly carried out on schedule with clarity and purpose. Now in final design, and slated to open in 2026, this paper will focus on the year-long type selection process, which culminated in February 2020 with the selection of a contemporary basket-handle network-arch lift bridge. After a brief history of the project and site context, the paper will focus on the architectural design process. Starting with winning the international architectural competition, the discussion will primarily focus on the evolution of the design process over a series of public meetings, before unveiling the final selection. The presentation will showcase the numerous design concepts that were studied, plus elaborate on how the decision-making framework allowed input from the community, key stakeholders, and civic leaders to be effectively interpreted and implemented by the project team.

PEDESTRIAN SESSION

Time: 9:00 - 10:30 AM

Session Chair: Stephen G. Shanley, P.E., Allegheny County, Department of Public Works, Pittsburgh, PA

This pedestrian bridge session will expose you to three unique pedestrian bridge projects. These projects will explore aesthetics, community involvement and construction challenges that were overcome to design and build these signature structures. This session will start with the Lilac Pedestrian Bridge that replaced a historic bridge with a new structure that recreated the aesthetics of the previous Pratt truss. The Kahasiniskak Pedestrian Bridge which was designed with two variable height box girders combined with inclined guiderails and the UCSD Mesa Housing Pedestrian & Bicycling Bridge which crosses an environmentally sensitive areas and was designed with spliced precast prestressed concrete girders.

IBC 21-74: Design & Construction of the Lilac Pedestrian Bridge

Time: 9:00 AM

Robert Durfee, DuBois & King, Inc., Laconia, NH; Cameron Bellisle, DuBois & King, Inc., Bedford, NH

The Lilac Pedestrian Bridge replaced the historic Lilac Bridge spanning over the Merrimack River. The existing 1909 Pratt through truss bridge was demolished and replaced with a new multiple span prefabricated steel truss superstructure (481 foot total span length) on rehabilitated abutments and piers. The riveted steel truss bridge was closed to vehicles in 1976 and later to pedestrians in 1992 due to safety concerns. The worsening conditions later warranted restriction of boat traffic below for fear of imminent failure of the structure under its own weight. Time was of the essence to replace the declining bridge as it carried an active sewer line (servicing a large portion of town, including the I-93 rest stops).

Collapse of the structure could have severed the sewer line, polluting the Merrimack River. An aggressive design and construction schedule was executed for the project. The design requirements for the new prefabricated truss superstructure incorporated multiple conditions so as to mimic the existing historic bridge but scaled down as a new pedestrian bridge. The constraints to be met by the fabricator include the truss type and style among other features like a veiled utility cavity below the deck. The new utilities (sewer, water and telecommunications) were attached below so as to not detract from the historic spectacle of the new bridge. During construction, the existing utilities, pedestrian traffic, and boat navigation on the river had to be maintained while the existing bridge superstructure was demolished (blasted) and the new superstructure moved into place.

IBC 21-75: The Kâhasinîskâk Pedestrian Bridge in Edmonton: Parametric design for user comfort

Time: 9:30 AM

Pierre-Louis Cons, P.Eng., Omar Moussa, P.Eng., and Arup Canada Inc., Sebastien Cote, P.Eng., Montréal, QC Canada

The new Kâhasinîskâk footbridge is part of the Valley Line Southeast light rail in Edmonton, a new 13-km line that connects Mill Woods to Downtown. The TransEd Partners consortium comprises EllisDon, Bechtel, Bombardier and Fengate, and was selected by the City of Edmonton to carry out this $1.8 billion project. The 64-meter footbridge spans over the rail corridor and Connors Road and improves mobility along to the North Saskatchewan River. The remarkable slenderness was a challenge for the strict vibration requirements. In order to achieve them, a complex steel structure was developed using parametric design and modelling tools such as Rhino, Grasshopper, Dynamo, Revit. The through bridge is designed to maximize stiffness at critical points and reduce weight at mid-span using two-variable height steel girders. To reach a 100-year lifespan, the enclosed girders are sealed and drained internally to prevent any accumulation of water ingress, exposed surfaces are drained and include dripping details to avoid staining of the abutments, the use of weathering steel helped reducing the maintenance. Special detailing also allowed for rapid construction of the orthotropic deck using bolted connections, while respecting the requirements of having no visible splice, for aesthetic reasons. In the same way, the bridge is following the Architecturally Exposed Structural Steel (AESS) requirements (Category 3, feature elements), which defines connection and steel finishes from a user perspective. At the end the complex geometrically double-curved girders, combined with the inclined and variable-height guardrails, create a unique visual effect and offer an exceptional view of downtown.

IBC 21-76: Use of Spliced Girders for Long-Spans Crossing Environmentally Sensitive Areas

Time: 10:00 AM

Sami Megally and Keith Gazaway, Kleinfelder, San Diego, CA

Crossing environmentally-sensitive areas can be challenging, especially when these crossings require long-span bridges. An example of such a challenging project is the Mesa Housing Pedestrian and Bicycle Bridge at the University of California San Diego (UCSD). The bridge connects the Mesa student housing to the rest of the UCSD campus, and it required crossing an environmentally sensitive canyon. A three-span configuration was selected for the crossing. No permanent or temporary supports are allowed within the environmentally sensitive area (ESA), which resulted in a 190-foot-long middle span. Due to this relatively long span length and limitations on girder weight for shipping and handling, the precast girders need to be spliced within the middle span that crosses the canyon. Unlike conventional spliced girder bridges, temporary falsework supports at splice locations in the middle span are not allowed because they fall within the ESA. Thus, each line of girders in this bridge consists of three segments: two segments over the bent/end spans, and one middle drop-in segment. Construction challenges included required use of high-capacity cranes with long boom reach. The complex construction sequence required detailed construction stage analysis and consideration of time-dependent properties of concrete and prestressing steel. The bridge has aesthetics features that made the analysis, design, and construction even more challenging. This includes significant curvatures in edge of deck and metal railings that have varying inclination along the length of the bridge. The bridge also has architectural treatment on the columns, abutments, retaining walls, and Lithocrete finish on the deck slab.

FOUNDATION SESSION

Time: 11:00 AM - 12:30 PM

Session Chair: Margaret A. Jackson, P.E., Pennsylvania Dept. of Transportation, Montoursville, PA

Foundations are essential building blocks for any resilient and stable structure. This foundation session will present three papers including:

- The innovative methods that were used for an emergency sinkhole repair on SR 422 in Lebanon County, Pennsylvania.
- The remediation for the excessive embankment settlement of the US 68 5-span, continuous prestressed girder bridge over the Lawrence Creek in Maysville, Kentucky.
- Concepts on how to better close the gap of uncertainty of estimating foundation member resistance due to spatial variability of geotechnical measurements and “method error”.

IBC 21-77: An Innovative and Robust Sinkhole Repair for PennDOT

Time: 11:00 AM

Thomas Leckrone, P.E., C.B.S.I., P.M.P., Ray Stauffer, P.E., Glenn Seibert, P.E., and Frank Namatka, P.E., Gannett Fleming, Inc., Camp Hill, PA

On July 2, 2019, the Pennsylvania Department of Transportation, District 8-0 (PennDOT) and Gannett Fleming formed a rapid design team to remediate a large sinkhole that closed SR 422, a main thoroughfare carrying 16,000 vehicles per day through Lebanon County. Following a collaborative strategy session on July 3, 2019, the project team developed an emergency response plan of bridging the sinkhole-prone area with a 2-foot-thick, 280-foot-long x 38-foot-wide concrete roadway slab supported with 84 steel micropiles in a 10-foot x 15-foot grid. Varying in length because of the variability of limestone depths and the presence of voids, these micropiles were drilled into competent bedrock as deep as 180 feet. To ensure safety in the event of future sinkholes, redundancy was achieved by designing the slab so that one pile could be missing at any location with the slab spanning that distance. Micropile installation, with depths ranging from 17 feet to 180 feet, was completed in 6 weeks. Inspection ports were installed in the roadway slab so that future ground movements below the slab can be monitored. Using leading-edge technology, including geographic information systems (GIS), PennDOT worked with Gannett Fleming to develop a subsurface 3-D GIS model of the proposed site activities to communicate anticipated drilling depth, then used it to show micropile status during construction. The entire project, from design to opening SR 422 to traffic, was completed in 4.5 months

IBC 21-78: Substantial Downdrag Requires a Micro Solution

Time: 11:30 AM

Craig Klusman, AECOM, Louisville, KY; Blake Jones, KYTC, Flemingsburg, KY; Joseph Hauber, Geotechnology, Erlanger, KY

The US68 Bridge over Lawrence Creek in Mason County Kentucky is a five span prestressed concrete I-girder bridge, 757 feet in length. Bridge inspectors began noticing problems on the bridge since just after its opening in the late 1990's. Both abutments have moved inward, resulting in an elimination of the gap between the backwall and ends of the prestressed concrete girders. The elastomeric bearings are showing excessive deformations, and the abutment backwalls and bridge seats exhibit heavy cracking. Significant settlement of the approach fill (upwards of 100 feet thick) has also occurred over the years. Both battered and vertical piles were driven through the approach fill embankments to support the abutments. The Kentucky Transportation Cabinet retained AECOM and Geotechnology to investigate the problem and to determine the appropriate course of action. This presentation will discuss the findings of a geotechnical exploration, slope stability analyses, settlement analyses, batter pile foundation analyses, bridge monitoring, structural investigation, and the evaluation of repair alternatives.

IBC 21-79: Design-oriented Geostatistical Calculation of Pile and Shaft Axial Capacities

Time: 12:00 PM

Michael Davidson Ph.D., P.E. and Michael McVay, University of Florida, Gainesville, FL; Michael Faraone, TerraSmart, Fort Myers, FL; Rodrigo Herrera, Florida DOT, Tallahassee, FL

Measured soil and rock properties typically exhibit spatial variability across a given bridge site. Uncertainty arises due to intrinsic spatial variability, and also, when empirical methods are utilized to correlate and integrate site geotechnical data. Quantifying these two distinct sources of uncertainty when computing pile and shaft axial capacities can help bring about: 1) foundation designs that reflect variability specific to a site;

2) identification of distinct geological zones within a site; and, (3) economical allocation of construction materials. Presented in this paper is the means in which statistical methods can be leveraged by practicing geotechnical engineers to compute pile and shaft axial resistance, variability, and uncertainty. Design-oriented procedures that are discussed operate on a collection of borings/corings pertinent to a site of interest, and permit both spatial variability analysis and method error estimation. In this way, design-relevant quantities such as through-depth resistance profiles, associated resistance factors, identification of geological zones, and suggestions for load testing can be produced. Foundation design data generated in this manner are shown for an illustrative case to overcome significant simplifications typical of current practice, where phenomena such as spatial variability are either ignored or indirectly accounted for via significantly more conservative (and more costly) configurations.

W-16: Ultra-High Performance Concrete (UHPC) for Bridge Preservation and Repair (Part 2): Expert Panel Discussion

Time: 9:00 AM - 1:00 PM

Zachary Haber, Federal Highway Administration, McLean, VA

The objective of this workshop session is to bring together bridge owners, consultants, contractors, and design in a forum that promoted discussion of recent projects, lessons learned, and challenges related to the use of UHPC for bridge preservation and repair. The session will be interactive, which is a significant benefit to attendees.

W-17: Balance Cantilever Bridges using a BIM Methodology

Time: 9:00 - 10:00 AM

Alexander Mabrich, Bentley Systems, Sunrise, FL

Expose the bridge professional to the latest techniques on BIM modeling and design for segmental bridges using the balance cantilever construction method.

W-18: Design and Construction of Steel Sheet Piling Structures

Time: 1100 AM - 12:00 PM

Richard Morales, LB Foster, Cumming, GA

The technical workshop will provide a general overview of various innovative solutions using Steel Sheet Piling for Deep Foundations, Case studies will include innovative solutions provided by collaboration with engineers and design-build contractors on projects such as 1) Pennsylvania Turnpike MSE SSP Wall, 2) NY Long Island Marine Development utilizing Open Cell, 3) Orange County (CA) Levee Capacity Increase utilizing silent "Push In Methodology" for SSP in a Congested Residential Neighborhood and 4) Cellular Steel SSP used for Expansion of the Panama Canal.

IBC Exhibitors

The Virtual Exhibit Hall is another important element of the IBC! Thanks to all of our returning and new exhibitors for making the exhibit hall a great, interactive way to continue the learning (and networking) experience of the IBC. Many exhibitors offer videos to watch, documents to download, websites to link to, and people to chat with at their booth! Plus, we now offer the ability to connect with exhibitors through the Video Chat feature. Be sure to earn some points by participating in the many features of the IBC Exhibit Hall.

AI Engineers
www.aiengineers.com

American Segmental Bridge Institute
www.asbi-assoc.org

CTS Cement Manufacturing Corporation
www.ctscement.com

Delaware DOT
www.deldot.gov

Euclid Chemical
www.euclidchemical.com

GPI
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GWY Inc.
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Michael Baker International
www.mbakerintl.com

MIDAS
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National Steel Bridge Alliance (NSBA)
www.aisc.org/nsba

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