The Albertus L. Meyers Bridge (aka 8th Street Bridge), is a historic gateway located on the south side of Allentown, Pennsylvania. Constructed in 1913 and designed originally to carry trolley cars and horse drawn wagons. The bridge consists of 17 spans; 8 approach spans and 9 main spans. The nine main spans are comprised of dual mildly reinforced concrete open spandrel arches, with span lengths of 135 feet each with a bridge deck that is over 100 feet above the valley below. The bridge was listed in the National Register of Historic Places in 1988 based on the innovative construction techniques of the time and the architectural significance of the bridge.

Even though the bridge has had many rehabilitations over its life, this paper will focus on the latest rehabilitation completed in 2016 which served to make it capable of supporting modern legal loadings, increasing its usable roadway width, repairing almost 100 years of deterioration due to drainage problems, increasing safety and restoring it to its original position as an icon on the Allentown skyline. The paper will also include information from the design phase through the construction phase and how modern construction techniques can be used to provide similar aesthetics as the historic structure.

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Abstract:
This paper provides the results of an Unmanned Aerial Vehicle (UAV)-based fracture critical bridge inspection. Fracture critical bridges are characterized by the potential for catastrophic collapse, through a brittle fracture of a single member. Fracture critical bridges require a detailed inspection when compared to simpler bridges mostly due to the difficult nature of identifying fatigue cracks and often require expensive underbridge inspection units for access purposes. A UAV, equipped with a protective cage, high definition visual cameras, LED flashlights and altitude sensors, was flown to regions of known fatigue cracking to assess feasibility of finding these cracks in a real life scenario. A comparison between human and UAV inspections provided mixed results. The human inspectors were able to see more defects than the UAVs. The ability of a UAV to replace a human for a fracture critical inspection hinges upon how close the UAV can get to the cracks, which affects the image quality, and the skill of the pilot. However, with better sensing techniques it may be possible to provide a sufficient inspection. The most important conclusions of this study are that UAV-based bridge inspection have the potential to be safer, less time-consuming, more flexible and less expensive due to traffic control and under bridge inspection unit issues, however improvements must be made to provide adequate fracture critical inspection.

Title:
Fracture Critical Bridge Inspection Using UAVs

Abstract:
This paper provides the results of an Unmanned Aerial Vehicle (UAV)-based fracture critical bridge inspection. Fracture critical bridges are characterized by the potential for catastrophic collapse, through a brittle fracture of a single member. Fracture critical bridges require a detailed inspection when compared to simpler bridges mostly due to the difficult nature of identifying fatigue cracks and often require expensive underbridge inspection units for access purposes. A UAV, equipped with a protective cage, high definition visual cameras, LED flashlights and altitude sensors, was flown to regions of known fatigue cracking to assess feasibility of finding these cracks in a real life scenario. A comparison between human and UAV inspections provided mixed results. The human inspectors were able to see more defects than the UAVs. The ability of a UAV to replace a human for a fracture critical inspection hinges upon how close the UAV can get to the cracks, which affects the image quality, and the skill of the pilot. However, with better sensing techniques it may be possible to provide a sufficient inspection. The most important conclusions of this study are that UAV-based bridge inspection have the potential to be safer, less time-consuming, more flexible and less expensive due to traffic control and under bridge inspection unit issues, however improvements must be made to provide adequate fracture critical inspection.
Abstract:

Liberty Bridge is a multi-span, deck truss bridge located in Pittsburgh, PA. The bridge was undergoing a major rehabilitation project to replace the deck as well as several secondary members. In addition, several primary chords were being strengthened. During the rehabilitation, an accidental fire occurred on the containment platform. The bridge was immediately closed to traffic while the damage was investigated. It was found that a primary bottom chord located directly above the fire buckled locally, causing the connecting truss node to shift nearly 2” from its original position. Movement of the node occurred both longitudinally along the damaged member length and laterally. Due to concerns of global load redistribution and instability, the bridge was closed indefinitely to live load traffic. A jacking system was designed to restore the bridge to its original geometry, to relieve the damaged member of forces, and to be used as a bypass of the damaged chord to re-open the bridge to traffic while the final repairs were made. The system consisted of brackets for the jacks, bracing members, and HP sections to span the damaged portion of the chord. The lateral bracing had to accommodate lateral movement during jacking to properly restore the truss to its original geometry. Additionally, the design of the jacking system had to allow for the final repair of the bottom chord while simultaneously allowing the bridge to be re-opened to live load traffic.

Title: Liberty Bridge Emergency Jacking Frame Design for Repair of Fire-Damaged Member

IBC attendees will learn details about the unique circumstances regarding an emergency repair of a damaged bottom chord of a nearly 500’ span truss bridge. Challenges of a repair of this type include coordinating with many parties and navigating details of a bridge designed nearly 100 years ago.

Abstract:

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Notes:

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The new Sakonnet River Bridge was constructed just south of the existing steel bridge in Portsmouth/Tiverton, Rhode Island. Prior to construction, displacements as great as several inches were estimated at several of the existing bridge bents as a result of foundation installation. RIDOT and its consultants considered the estimated settlement at and between individual bents and possible scenarios should the existing bridge not be able to accommodate the movement. Paramount was the safety of the public travelling the existing bridge; second, the need to maintain flow of traffic; and third, prevention of lengthy and costly construction delays. Given the potential risks, RIDOT made a bold decision to design a jacking system that was installed at several bents by the successful Bridge Replacement Contractor as one of the first required contract items. A network of instrumentation consisting of deformation monitoring points and strain gages were also installed on the existing bridge’s steel members and data was transmitted real-time for near-instant evaluation.

During adjacent foundation construction of the new bridge, strain and movement of the bents were monitored continuously. Several bents settled, and when the strain or movement neared action limits, jacking was implemented. Since the jacks were already installed, the bents were easily raised to pre-existing elevations in a short period of time without interrupting traffic on the existing bridge. The foresight to install the jacking system and to continuously monitor the bridge helped to prevent what could have been a bridge shutdown and major construction stoppage.

The jacking system prevented major shutdowns of Rt 24 and terrible press. The system was installed as a precaution in the event it might be needed. It was needed and it performed very well.
The Fore River Bridge, a Massachusetts landmark built in 1936, is a critical element of the state’s local highway system that by 2002 had deteriorated beyond the point of restoration. The Massachusetts Department of Transportation (MassDOT) needed a new permanent vertical-lift bridge to carry 32,000 vehicles per day to reduce commuting time between the cities of Quincy and Weymouth and procured a new bridge using the Design Build method. As a member of the successful Design Build team, Haley & Aldrich will address in this paper some design and construction highlights related to the foundations of the new Fore River Bridge including:

• How prior site experience, extensive local geological knowledge, and skilled geotechnical staff familiar with deep, high capacity drilled shaft design and construction contributed to the project’s success.
• How on-time, as-needed geotechnical drilled shaft design recommendations met applicable federal and state design requirements yet allowed for innovation and flexibility.
• How the project obtained the state’s water agency approval early in the design phase by performing a 3-D analysis of the foundation system to demonstrate negligible applied stresses on an existing deep rock water tunnel. This key approval streamlined the design phase and eliminated any potential schedule impacts due to this concern.
• How the Design Build team resolved foundation installation issues through a unified approach.

We hope to make it a fun and interesting presentation.
Abstract:
It takes significant time, money, labor, and equipment to run a bridge inspection program. Furthermore, the data and information resulting from these efforts should be of a high and consistent quality. This work examines the application of the Lean philosophy, originating from manufacturing, as a means to improve efficiency and quality of bridge inspections. Lean aims to maximize time on activities that add value to the final output and significantly reduce losses identified as waste.

The data collected in order to apply Lean philosophy to bridge inspection includes a time log of all activities occurring during the inspection of 15 bridges. Bridge inspection activities were defined as: review of previous documents in preparation for inspection; mobilization of equipment and personnel to the site; inspection time including the time spent on visual assessment, measurement, note taking, and photographs for each bridge element; demobilization, and reporting. The bridges included reinforced concrete slab bridges, pre-stressed concrete box girder bridges, steel girder bridges, culverts and timber beam bridges. Additionally, various professionals including four different inspection team leaders and seven bridge inspectors have been shadowed.

Bridge inspection activities are classified based on their value to the end product by identifying value-added and non-value added works. Findings from this research suggest that reporting typically consumes more than twice as much time as inspection. Different types of challenges present in bridge inspection have been observed and these constraints will be considered in developing final recommendations to improve bridge inspection efficiency and quality.

Title: Application of Lean Philosophy in Bridge Inspection

Participants will learn the general principles of Lean philosophy and how it can help improve bridge inspection outputs and processes. Data will be presented that reveals the inspection activities for which the greatest gains in efficiency can be made. Suggestions for achieving bridge inspection efficiency will be discussed.

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Abstract:
The new Champlain Bridge is approximately 3.4 km long and stretches across the St. Lawrence River. When completed in 2018, it will replace the existing crossing. It consists of 2044.4 m long west approach, a 528.8 m long cable stayed section over the Saint Lawrence Seaway and 761.6 m long east approach. On the west and east approaches, the bridge spans typically 80.4 m and 84.4 m respectively, with some variation near the bridge abutments. The superstructure will be supported on aesthetically pleasing unique sub-structures.

This paper will focus on elements of the global analysis of the approach steel spans and their substructures including the steel pier caps, precast post-tensioned pier segments and their foundations on the west and east approaches. Through the use of 3D global models, critical design loads were derived and then used for site specific local frame. The substructure analysis includes a typical steel pier cap consisting of two inverted steel delta frames field bolted after erection on two slanted precast concrete pier legs. Finite Element Analysis using shell elements was necessary to model the steel pier cap and understand the distribution of stresses within the structure.

Notes:
Global Analysis and Design of the approach structures of the New Champlain Bridge in Montreal is a very complex Design Build project that is under construction currently

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This paper examines the technical, practical, and strategic aspects of the adoption of the NTIS as experienced by the MDTA and AECOM. Challenges faced by both parties during the 2017 Biennial Inspection Cycle are addressed.

For several years, the MDTA has inspected their tunnels with the same level of care as their bridges. Defects and repairs were quantified and prioritized based on safety, operational, maintenance, and capital improvement needs. The NTIS provides a significant improvement in the overall approach to tunnel inspections. The processes described in the NTIS aids owners to make the efficient use of resources. The MDTA was well positioned for the transition: Their establishment of discrete component categories early on translates to the reporting requirements of the NTIS.

AECOM’s experience with the MDTA’s established inspection program and tunnels served as the starting point for organizing the prodigious amount of inspections data previously collected. National Tunnel Elements were identified and Agency Defined Elements were created to provide an NTIS complaint and owner-friendly means to track and monitor the condition of their assets at an appropriate level of detail. The inspection process focused on the elements with the greatest impacts on safety and reliability. Inspection findings coupled with condition state quantities provide the MDTA with greater means to make informed decisions on the repair and maintenance of the tunnels for both short term operational needs and as part of their long-term strategic plans to maintain the tunnels in a state of good repair into the foreseeable future.

Notes: The implementation of the NTIS brings the operation, maintenance, inspection, and evaluation of tunnels up to the level of our nation’s bridges and in line with the requirements of MAP-21. The impact of the implementation and adoption of these standards w
COWI acted as the Owner’s Bridge Engineering throughout the complete deck replacement of the Macdonald Bridge in Halifax, Nova Scotia, Canada. The Owner, Halifax Harbour Bridges, contracted American Bridge Canada Company to fabricate 46 new deck segments and ship and erect them during weekend closures. Traffic was uninterrupted during daytime hours, thus reducing the project’s impact on the travelling public. The deck was also raised from its initial position to allow larger ships to pass beneath, a task rarely carried out on long suspension bridges. This presentation will highlight the engineering challenges encountered throughout the construction process and the unique role (of both Owner’s Engineer and Construction Sequencing Engineer working directly with the Contractor) that COWI experienced.
Abstract:
The new US 52 Mississippi River Bridge is currently under construction linking the communities of Savanna, Illinois and Sabula, Iowa. The replacement bridge consists of 12 spans totaling 2454 ft from a causeway in the middle of the Mississippi River on the Iowa side to the high bluffs of the Mississippi Palisades in Illinois. A 546 ft main span steel tied arch over the navigation channel flanked by steel girder approach spans has been designed by Parsons Corporation in coordination with the Illinois DOT with construction to be complete by December 2017.

Waterline footings have become an increasingly popular choice for large river pier foundations, especially on design-build projects, to alleviate issues with the construction of deep and costly cofferdams. The varying geotechnical conditions and rock elevations across the river bed and relatively deep river pool led to the selection of waterline footings supported by large diameter drilled shafts for the five piers in the main navigation pool of the new US 52 Mississippi River Bridge, a traditional design-bid-build project, and the first use of waterline footings by the Illinois DOT.

This paper will present the unique design and construction aspects that led to the selection of waterline footings and the challenges in specifying requirements for this unique construction method in a design-bid-build environment while allowing the contractor flexibility to optimize the solution for their means and methods. Finally, the construction method chosen by the contractor and the construction experience from the field will be discussed.

Project Information

Name: US 52 / IL 64 over the Mississippi River
Location: Savanna, IL
Opening Date: 12/1/2017

Technical Merit of Presentation

The paper discusses the unique and increasingly more popular waterline footing construction method for foundations in deep river pools where traditional cofferdams have increased risk and cost implications to projects. The US 52 project is used as a case study for implementation of waterline footings in the traditional design-bid-build environment.

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Abstract:
The $120 million NYSDOT Region 11 Kew Gardens Interchange safety and operational improvement program is part of a complex interchange with four major highways and several at-grade roadways handling a combined AADT of over 500,000 vehicles per day. The existing ramp from Eastbound Union Turnpike and Eastbound Jackie Robinson Parkway to the Northbound Van Wyck Expressway (Ramp KB) is being replaced as part of the proposed improvement and structural upgrades.

The high traffic demand and tight urban conditions required unique partial staging of the replacement structure to minimize traffic disturbances at this busy interchange within the confines of existing roadways, major utilities and existing structures. The subject structure was designed as a reverse curve steel girder system, fully continuous between its abutments at a length of approximately 660' over 7 spans. It was designed to be a joint-less superstructure as opposed to the use of typical deck joints that would be used on a multi-span structure. At a length of approximately 660 feet, this 7-span (67'-90'-128'-83'-91'-99'-111') continuous steel girder bridge has tight reverse curvature of 273' and 984', along with a vertical profile crest curve and varying roadway superelevation with a flared deck width.

Unlike typical stage construction, only 2 spans were staged which introduced unique deformations in the steel girders which needed to be accounted for to ensure proper fit-up during construction. Finite element modeling of the structure was used to determine the full range of staging deflections during partial stage construction of this continuous reverse curve structure.

Notes:
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Internal curing of concrete using expanded shale, clay or slate lightweight aggregate has been recognized for many years. However, recently a new approach has been taken in which prewetted lightweight aggregate is introduced in a conventional concrete mixture, replacing an equal volume of conventional sand. The water absorbed in the aggregate is released into the concrete from within, providing the internal curing effect that results in more complete reaction of cementitious materials and improved material properties including reduced shrinkage, reduced early age cracking, and reduced permeability. Analysis has shown that these benefits lead to an increased expected service life for internally cured concrete in structural concrete, such as bridge decks, and for concrete pavements.

A number of agencies have tested this approach and have found it to have merit. Therefore, it is important for bridge engineers to understand the concept of internal curing and to be ready to apply it intelligently to projects.

With a focus on bridge decks, the following topics will be discussed: properties of lightweight aggregate that make it effective for internal curing; how to proportion internally cured concrete mixtures; the effect of internal curing on concrete material properties such as increased compressive and tensile strength and reduced permeability, shrinkage, cracking potential, modulus of elasticity and coefficient of thermal expansion; several bridge deck projects where internal curing has been used; resources on internal curing; and issues that should be considered when implementing internal curing.

The topic applies to increased service life for bridge structures, but I did not find any topic that directly addressed that - so I used "Bridge Maintenance" as the secondary topic.
The High Speed Railway link Madrid - Extremadura crosses over River Almonte with a great arch viaduct of high-performance concrete. With a 384 m long main span, this arch bridge sets a new world record as the longest span on a single concrete arch bridge used for high speed trains. Almonte’s span is considerable even compared with non-railway concrete arch bridges.

Spanish bridge designer Arenas & Asociados is responsible for its design, and has been involved in its construction as Site Supervisor. The bridge, property of Spanish Rail Administrator Adif, is being constructed by Spanish and Portuguese contractors FCC - Conduril, and is due for completion in late 2016.

The arch has been erected by cantilever method construction with the aid of temporary cable-stays from two temporary steel towers (using form travellers specially designed for this bridge). The deck is constructed using an overhead movable scaffolding system.

This paper explains the exceptional techniques and structural analysis outside the usual engineering work that have been developed to reach its design and construction. These studies include the selection of the antifunicular arch axis taking into account construction process and train loads, geometric and material nonlinear analysis, dynamic analysis and aerelastic behaviour. It also summarizes the site control activities and special operations undertaken during the structure’s erection, as its monitoring system or its geometrical control.

The presentation will show important technical developments and will be supported by an extensive photographic material collected over more than 5 years of construction control.

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Abstract:
The Indiana backspan steel grillage of the East End Crossing cable-stayed bridge was assembled and launched into permanent position from a hillside on the Indiana shore. The launch occurred in three major stages over the course of several months last fall and winter. The 3,600 kip assembled superstructure was pushed 775 feet over an adjacent roadway and river to land on the permanent tower. The 122-foot wide, 722-foot total assembled length of superstructure (including launch nose and tail), was pushed into position at a rate of approximately 9 foot per hour, experiencing a maximum deflection of close to five feet. The design and detailing of temporary works and temporary supports in the Ohio River were used to guide and anchor the steel throughout the course of the launch. Extensive structural checks at each stage of launching were performed to ensure stability and resistance of the permanent members to temporary launch stresses. Lateral stability, wind effects, and grillage twist for the wide, asymmetric, super-elevated cross section were checked. Project Team representatives, including the launching engineer of record, the Contractor, and an Owner’s representative will describe design details and structural checks performed, along with sharing the intricacies of the actual implementation (equipment used, changes made, and challenges encountered).

Notes:
If other East End Crossing presentations are accepted, we request back-to-back presentations.

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During inspection of this 322 span 3.8 mile steel framed elevated viaduct, stringer-end cope cracks, stringer web cracks and stringer to floor-beam connection angle cracks have been found on a regular basis. In order to understand the behavior of the structural system and determine remaining fatigue life, the WSP/URS Joint Venture performed analytical and experimental studies of the stringer to steel bent connections on the viaduct for NYSDOT. This paper summarizes the analytical study and its findings.

Three-dimensional finite element models, including a global viaduct model and a detailed connection model, were developed. The detailed connection model includes connection angles, bolts/rivets, partial concrete deck, stringers and columns. Interactions between viaduct decks and steel components and between angles and column web are considered. The global model includes four representative spans of the viaduct. To validate the modeling approach, a diagnostic load testing on one typical span of the viaduct was conducted with dump trucks, and strains in selected steel elements were measured. The model analysis results of the rotational stiffness values for stringer–bent connections were compared and calibrated by the testing results. The rotational stiffness values were then applied to the global model to estimate the load distribution in the viaduct. Comparisons were made between analytical and experimental results for stresses in the connection components and member forces in the stringers. It is shown that the models can predict the structural responses well, and the analysis results can be used to estimate the remaining fatigue lives of the connection components.
Abstract:
On May 10, 2013, Notice to Proceed was given to the joint venture of Skanska-Koch/Kiewit for a contract to raise the roadway of the existing Bayonne Bridge by 65 feet within the arch planes of the bridge and provide for the future navigational clearance of 215 feet. The project will rehabilitate and strengthen the original Othmar Ammann design, which was an arch bridge world record at 1,652 feet between reaction pins and was opened to traffic in November of 1931. The construction project is part of the Bayonne Bridge Navigation Clearance Program. As part of the work, new approach structures are being built on existing alignment using precast segmental concrete box girders, erected in balance cantilever with self-launching overhead gantries.

The presentation will feature a brief review of the program's history relative to the conceptual type selection. It will also feature project innovations, such as the erection scheme for the new arch floor, temporary bracing schemes for new portals, strengthening of the existing arch, and challenges associated with eccentric loading on the tall approach piers. A summary of the new approach spans constructed of precast segmental concrete box girders, and the precast concrete piers and pier caps will also be presented.

As of this conference, the milestone for opening the full 215' clearance is quickly approaching. This presentation will provide an update of the construction of both the main span arch and the concrete segmental approaches. Activities will include arch strengthening, new transition tower construction, and phased approach structure construction.

Notes:
Co-Author's
Redevelopment of former power and water treatment plants in the Seaholm District of Austin, Texas was to include a state of the art public library and open air plaza. A unique and innovative bridge structure was needed to connect the newly redeveloped district with the rest of downtown Austin. A steel frame network arch structure was designed and constructed to accommodate vehicle and pedestrian traffic. Cantilevered sidewalks extend away from the vehicle lanes for seamless flow of pedestrian movement and for visual appeal. The bridge structure also carries a significant number of utilities to service the redevelopment. The goal of the bridge was to create an iconic design element that was light and sleek, and integrated with the adjacent works. Extensive public involvement and architectural considerations helped shape the form and specific design elements of the structure.

Note the opening date is approximate.

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The primary function of cross-frames in straight steel I-girder bridges is connecting girders to obtain a stable structural system. During steel erection and deck pour, cross-frames work as lateral supports that stabilize the I-girders and prevent them from lateral-torsional buckling. Similarly, cross-frames enforce compatibility of vertical and lateral displacements between girders during deck placement, facilitating the structure’s geometry control. When the bridge is composite, cross-frames brace the girder bottom flanges in the negative moment region, preventing stability failures. In addition, in bridges with skewed supports, cross-frames provide a transverse load path, where internal forces are developed and transferred to girders. These collateral and undesired forces may affect the performance of the overall structure both during construction and in service. In particular, large levels of flange lateral bending stresses, the need for robust connections between cross-frames and girders, and the appearance of regions prone to fatigue failures are the effects of skew and the associated cross-frame forces. This paper presents analyses conducted in straight I-girder bridges with skewed supports considering different cross-frame distributions on the bridge layout, and different cross-frames configurations. Studies of the behavior of various types of cross-frames and their bracing properties are presented to demonstrate that current design practices may be modified to improve the overall performance of skewed straight steel I-girder bridges. The analyses show that the proper selection of a cross-frame type and distribution on the bridge layout may result in considerable reductions of the undesired skew effects, without affecting the functions of these components.
According to the 2015 National Bridge Inventory, the USA road system has 1,649 masonry bridges. A half of them in service were built about 100 years ago and 886 of them are structurally deficient or functionally obsolete. The details of the railroad bridges are not readily publicized but even a greater number of railroad masonry bridges are believed to be in service in the United States experiencing the similar deficiency.

Due to its rarity, most bridge owners do not seem to understand how to effectively inspect and analyze this type of bridge. Proper field data collection throughout educated inspection is extremely important in evaluating the load carrying capacity of an aged masonry arch bridge. This paper will take a deteriorated two-span masonry arch bridge as an example to demonstrate what to inspect, how to collect field data and how to analyze a masonry arch bridge.

The Water Street masonry arch bridge in Kentucky was inspected to collect field information using various methods such as ground penetrating radar, sounding with mallets, core hole sampling, and Schmidt Hammer tests. The primary load carrying blocks were qualitatively categorized in four different conditions. Based on the masonry strength values obtained from the field findings, the arch bridge was modeled in commonly available structural analysis software. This paper will present detailed analysis procedures utilizing a simplified method that Dr. Kim had developed for a number of highway and railroad bridge owners. A brief discussion on remedial procedures will also be presented in this paper.
Accelerated bridge construction (ABC) techniques were used to replace the 54-foot long, single-span superstructure of the U.S. Route 30 bridge over Bessemer Avenue in Pittsburgh, Pennsylvania, originally constructed in 1930. The superstructure was removed and replaced over the course of 57 hours, allowing the bridge to be closed to traffic for only one weekend as opposed to several weeks using conventional construction methods. Six prefabricated bridge element (PBE) "modules", each consisting of two steel beams with a pre-constructed concrete deck on top, were used to comprise the new superstructure. The modules were connected together on-site using an ultra-high performance concrete (UHPC) in the longitudinal joints between the modules. The UHPC mix used was an accelerated mix capable of obtaining 14,000 psi compressive strength (the strength needed to carry live load traffic) after only 12 hours of heat-treated curing. UHPC was used for this application due to its ability to gain strength quickly and provide simple, strong, durable connections between the prefabricated modules. The existing structure was modeled in 3D as part of the extensive planning phase to ensure proper fit for the new superstructure.
The American Society of Civil Engineers (ASCE) estimates that it would cost over $76 billion to repair or replace the structurally deficient bridges in the United States. Many of these bridges are over 50 years old with steel superstructures that are deteriorating due to heavy corrosion. The locations commonly impacted by corrosion damage are girder ends over bridge bearings due to leaking expansion joints. The girder’s bearing capacity may be significantly reduced due to the reduction in plate thicknesses.

Conventional methods used to repair corrosion damaged girder ends are costly and time consuming. To address this issue, the feasibility and structural efficiency of a new repair method using Ultra-High Performance Concrete (UHPC) was investigated. By encasing the corroded part of the girder end with UHPC, a new load path is created allowing forces to be transferred to the UHPC panel via shear studs welded to the undamaged portion of the web plate. The repair may be implemented in situ thus eliminating the need for jacking of the superstructure, lead paint removal, and lane closures, which accounts for the majority of costs in a conventional repair. The versatility of the repair accommodates bridge girders with different geometries and corrosion levels. The UHPC repair is a viable alternative to improve the state of the nation’s bridge infrastructure. The promise of this repair was noted by the American Association of State Highway and Transportation Officials (AASHTO) as a “Sweet Sixteen” High Value Research Project and is planned for implementation in the near future.

This presents a viable technique for rapid, cost-effective, and structurally efficient repair of corroded girder ends. The diversity of this method presents an alternative design to help overcome financial, logistical, and physical constraints. This design enables the repair of more bridges with minimal cost, specifically bridges with complex geometries.
Abstract:
The Port Authority of New York & New Jersey's Bayonne Bridge crosses the entrance to the ports of Newark and Elizabeth in New Jersey. The longest steel truss arch span in the world when it opened in 1931, the bridge was designed by Othmar Ammann. In order to maintain the economic vitality of the ports, the original 150-ft navigational clearance needed to be raised to 215 ft for mega container ships passing through the newly opened Panama Canal. The new navigational clearance will be attained in early in 2017.

For construction, the four traffic lanes were reduced to two and shifted west. Thus, staged construction to build two lanes at the higher elevation could be achieved while maintaining traffic at the lower elevation during peak hours. The new approaches comprise two-column precast post-tensioned piers with two trapezoidal concrete hollow box roadway girders with wings. Superstructure construction uses the balanced cantilever method. One set of pier T-columns is stubbed up through the closed east half of the existing roadway to build one-half of the roadway at higher elevation adjacent to existing traffic. Once this roadway is completed and traffic is moved, the lower roadway in the arch span will be removed. The existing lower approaches will then be demolished, the second matching pier T-columns will be erected, and the second roadway box structure will be constructed. Significant construction challenges include noise abatement and erection of the approach structures with private homes and businesses within 30 ft of the bridge footprint.

Technical Merit of Presentation
Understanding a mega-project that includes acceleration of construction, complex environmental issues, noise abatement, working in close proximity (within 30 ft) of existing homes, businesses, schools, cemeteries, and houses of worship have all made this project a great learning laboratory on how each issue was broken down and solved.

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The Port Authority of New York & New Jersey's Bayonne Bridge crosses the entrance to the ports of Newark and Elizabeth in New Jersey. The longest steel truss arch span in the world when it opened in 1931, the bridge was designed by Othmar Ammann. In order to maintain the economic vitality of the ports, the original 150-ft navigational clearance needed to be raised to 215 ft for mega container ships passing through the newly opened Panama Canal. The new navigational clearance will be attained in early in 2017.

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Notes:
This project, one of the major bridge projects in the NY metropolitan area, is currently under construction and is expected to be completed in 2019.

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Accelerated bridge construction (ABC) techniques were used to replace the concrete bridge deck of the Franklin Avenue bridge, a 5-span, 1011-foot long historic spandrel concrete arch bridge over the Mississippi River, originally constructed in 1923. The bridge deck was completely reconstructed in just 4 months using prefabricated bridge elements (PBE). 366 precast concrete deck panels were fabricated off-site and connected together on-site using ultra-high performance concrete (UHPC). UHPC was used for this application due to its ability to gain strength quickly (14,000 psi in 4 days) and provide simple, strong, durable connections between the prefabricated panels. This bridge, located in Hennepin County, Minneapolis, was the first project to use UHPC in the state of Minnesota.
The East End Crossing is a cable-stayed bridge near Louisville, Kentucky linking Prospect, Kentucky to Utica, Indiana as part of the Ohio River Bridges Project. The two-tower, three span structure is composed of a 1,200-foot mainspan, flanked by two 540-foot backspans. The backspans were both erected on temporary works, allowing superstructure erection to be performed independent of construction of the two diamond-shaped, 300-foot tall convex towers. The Kentucky backspan was built on falsework, the Indiana backspan was launched into position, and the mainspan was erected by cantilever from the towers. In order to meet a tight project schedule, the Project Team optimized deck erection cycles during mainspan construction, introducing additional temporary works in the mainspan to remove operations from the critical path. The typical erection cycle consisted of steel grillage erection and multiple stages of concrete deck panel erection and stressing of stays. Due to the tight schedule, multiple backspan and mainspan operations were checked and allowed to occur concurrently, optimizing the stay installation and deck erection. The Engineer of Record, the Contractor, and an Owners representative will describe what activities were planned to occur concurrently, what checks were performed, how construction crews were staged, and how daily collaboration among all groups resulted in erection of the mainspan and all cable stays in less than four months.

If other East End Crossing presentations are accepted, request back-to-back presentations

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Title: East End Crossing: Optimizing Mainspan Erection Cycles

PrimaryTopic: Construction Engineering  
SecondaryTopic: Cable Stayed Bridges

Project Information  
Name: Ohio River Bridges East End Crossing  
Location: Louisville, Kentucky  
Opening Date? 12/17/2016

Abstract:

Integrating many complex types of construction (towers, falsework, launching and mainspan) provided several disparate challenges that required coordination among multiple entities. Representatives from the Project Team will describe the value of the extensive planning, engineering, and coordination needed for a shared success for possible future use by IBC attendees.

Notes: If other East End Crossing presentations are accepted, request back-to-back presentations

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PrimaryTopic: Construction Engineering  
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This project was focused on development and deployment of a system for monitoring vertical displacement in bridge decks and bridge spans. The system uses high precision wireless inclinometer sensors to monitor inclinations at various points of a bridge deck. The inclination data is fed into a mathematical model which calculates vertical displacement. As a specific goal, this project was intended to monitor change in vertical displacement and curvature of a bridge deck during the deck replacement process. Wireless inclination/temperature sensors were developed and thoroughly tested in laboratory environment. Mathematical curvature calculation methods were used to convert inclination data into vertical displacement. Wireless precision inclination/temperature sensors were deployed on a bridge close to Pocomoke City in Maryland, which underwent deck replacement from January until August 2015. The sensor revealed that, temperature change could lead to changes in inclination of bridge girders. The changes in inclination would lead into temperature induced vertical displacement of a bridge deck. As a result, comparing change in displacement of bridge deck before and after deck replacement is not meaningful unless temperature effects are characterized. The study also revealed shortcoming of surveying, being used to find change in curvature of a bridge, because unless two surveys for a bridge deck are taken place at the same time, their results cannot be directly compared. The method based on wireless inclinometer sensors characterizes the effect of temperature and therefore, it separates contribution of temperature from the change in the displacement caused by deck replacement.