Pittsburgh ENGINEER

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Quarterly Publication of the Engineers' Society of Western Pennsylvania

AASHTO

Alternate Delivery Methods

Bridges

Pittsburgh
ENGINEER
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In this issue...

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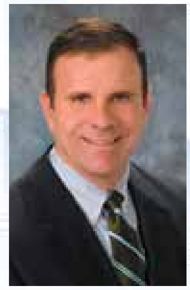
Guest Editor Column

Thomas G. Leech, P.E., S.E.



George M. Horas, P.E.

Chances are that you have one of the most important technological advances of this century in your pocket at this very moment. There's also a good chance that you have used it in the past 5 minutes to check an email, send a text message, make a call or check the results of last night's game. I am talking about your smart phone. It has altered life in general and has created new opportunities and challenges. Alternative delivery has had the same effect on the execution of public works across our Nation. Design/Build, Public Private Partnerships, Integrated Project Delivery, Construction Management at Risk and Construction Management/General Contractor are all becoming more popular as agencies continue to develop new approaches to deliver projects.

Alternative project delivery has roots in the systems that were developed in Europe in the early 1980's. Transportation applications began in the US in the late 1980's with unsolicited P3's on public projects in Virginia. Design/Build initiatives became more popular in the 1990's as more and more States started utilizing them. Today, the Design Build Institute of America estimates that over 40% of all non-residential construction in the US is performed through Alternative Delivery Methods. In fact, most States have now passed legislation enabling alternative delivery to be utilized on public works projects. It's hard to pick up ENR without reading about a P3 or Design/Build project.

"Much as technology advances have indelibly altered our way of life, alternative delivery is evolving and forcing the design and construction community to adapt"

As the Engineers' Society of Western Pennsylvania prepares for the 31st Annual International Bridge Conference®, we reflect upon how alternative delivery is changing the way in which projects are executed. Much as technology advances have indelibly altered our way of life, alternative delivery is evolving and forcing the design and construction community to adapt. This Special Edition of the Pittsburgh Engineer highlights projects that have utilized alternative delivery. As you read through the articles and view the pictures, it is hoped that you will form an appreciation of the challenges that new methods of project delivery have created and how techniques to overcome them are evolving. Much like technology, it is a continuum that will continue to require innovation. In addition to the articles, this Special Edition features the results of a photo contest where you will be treated to a sampling of some very special images of the bridges on US Public Lands.

As we welcome the American Association of State and Highway Transportation Officials and focus on their bridge program, note that they are on the front lines of alternative delivery. Be sure to check in with them as you tour their exhibit and take in the details of the ways in which our industry is changing.

IBC Chair's Message

By Calvin G. Boring, Jr.

As this year's General Chairman, I would like to extend a warm welcome to all of our attendees at the 31st Annual International Bridge Conference (IBC) in Pittsburgh, Pennsylvania on June 8 through 12, 2014. The Executive Committee of the IBC and the Engineers' Society of Western Pennsylvania (ESWP) have worked diligently this past year to develop an outstanding conference program. Our goal is to provide a broad spectrum of bridge engineering to cover all aspects of the practice. The Technical Program includes 84 technical papers, two seminars and eight workshops. The technical session topics include Design, Construction, Evaluation/Analysis/Inspection, Rehabilitation and Preservation, Accelerated Bridge Construction with special sessions that feature Rail, Long Spans, Foundations, Pedestrian Bridges and the new New York Bridge replacing The Tappan Zee Bridge. The IBC Executive Committee is providing one of the best venues for the presentation and demonstration of new and innovative bridge industry concepts, practices and products each year. We hope you will find this conference to be educational, informative, practical and innovative.

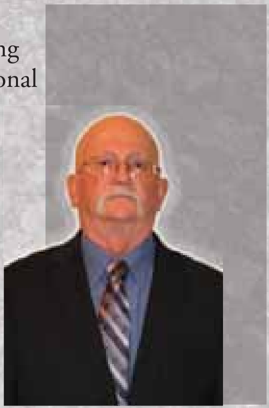
We are honored to have AASHTO at the 31st Annual IBC as our Featured Agency. AASHTO's Featured Agency Session is scheduled for Monday afternoon. We encourage all attendees attend and to visit AASHTO's display in the center of the exhibit hall. Please also take time to interact with all the exhibitors and thank them for their support. They have been an integral part of our success over the years.

The conference begins Monday morning, June 9, at the Keynote Session which will feature nationally renowned leaders addressing current topics affecting the Bridge Industry. These speakers are: Executives from this years' Featured Agency AASHTO, Federal Highway Administration, Lane Industries, Inc., Flour and the Pennsylvania Department of Transportation.

The John A. Roebling Medal will be presented to Mr. Malcolm T. Kerley at the Awards Dinner on Tuesday evening in the convention center. Also announced will be the winners of five Bridge Excellence Awards:

- George S. Richardson Medal for Single Recent outstanding achievement.
- Gustav Lindenthal Medal for innovation, aesthetics and harmony with the environment.
- Eugene C. Figg Medal for innovation and providing an icon to the community.
- Arthur G. Hayden Medal for innovation in special use bridges.
- Abba G. Lichtenstein Metal for innovation in restoration and rehabilitation.

The 2014 IBC runs through Thursday. Our workshops are split between Wednesday and Thursday, with the seminars on Thursday. Attendees will be able to attend more paper presentations and still take advantage of the workshops and seminars. Attendees can receive continuing education credits that satisfy the Professional Engineering licensure requirements for many states in the U.S., including New York and Florida.



Calvin G. Boring, Jr.

ESWP is the primary sponsor for the IBC. The conference is assembled through volunteer efforts of the IBC Executive Committee, which is composed of 36 individuals representing bridge owners, designers, constructors, manufactures, suppliers and educators. The IBC Executive Committee along with the ESWP staff have spent many hours developing an outstanding program. Please join me by saying "Thank You" for their undertaking. Without their tireless effort our conference would not be possible.

In closing, I ask on behalf of the IBC Executive Committee, that each attendee share your feedback regarding schedule and site enhancements. We also welcome you to highlight beneficial improvements or suggest improvements.

About the author...

Calvin Boring, Jr. is a Senior Estimator and Project Manager, Brayman Construction Corporation

AASHTO – The Last Hundred Years…

On Dec. 12, 1914, state highway officials met in Washington, D.C., at the Raleigh Hotel at 10 a.m. to establish a national organization that would allow for the discussion of legislative, economic, and technical subjects and would draft a legislative proposal for federal cooperation in road construction. On that day, the American Association of State Highway Officials (AASHO) was organized. Follow one hundred years of progress in highway and bridge policy and technical achievement.

1914 — AASHO... a national organization was established

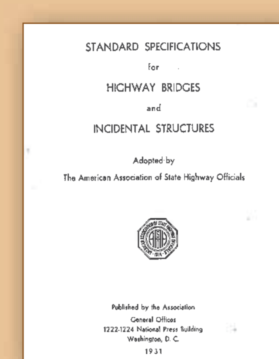
1916 — Federal Aid Road Bill of 1916

1918 — Joint Highway Congress sponsored by AASHO

1921 — Committee on Bridges and Structures formed

1926 — First Unpublished Bridge Specification developed

1931 — First Nationally Published Bridge Specification


STANDARD SPECIFICATIONS

for

HIGHWAY BRIDGES

and

INCIDENTAL STRUCTURES

Adopted by

The American Association of State Highway Officials

Published by the Association

General Offices

1222-1224 National Press Building

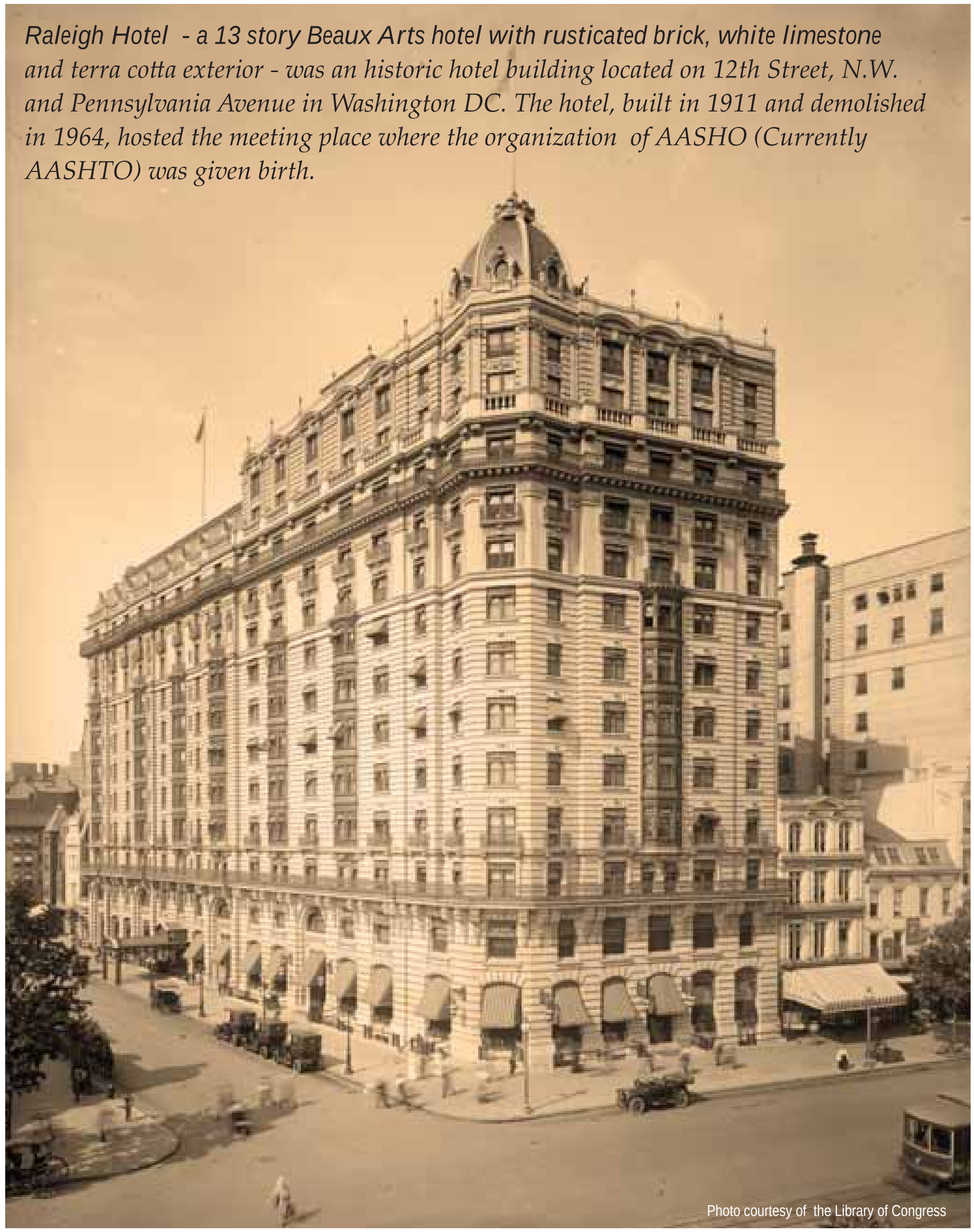
Washington, D. C.

1931

1935 — MUTCD first published

1944 — HS20-S16-44 Live Loading adopted

1956 — Federal Aid Highway Act of 1956



Raleigh Hotel - a 13 story Beaux Arts hotel with rusticated brick, white limestone and terra cotta exterior - was an historic hotel building located on 12th Street, N.W. and Pennsylvania Avenue in Washington DC. The hotel, built in 1911 and demolished in 1964, hosted the meeting place where the organization of AASHO (Currently AASHTO) was given birth.

Photo courtesy of the Library of Congress

- 1958 — AASHO Road Test inaugurated at Ottawa, Illinois
- 1962 — Established NCHRP
- 1965 — Established AMRL
- 1973 — Renamed: AASHTO
- 1986 — Inception of AASHTOWare
- 1993 — TRACE program launched
- 1994 — HL-93 Live Loading adopted and LRFD Specifications first published
- 1998 — Guide for CoRe first published
- 2001 — New web site launched: "...the window to the world..."
- 2014 — AASHTO 100 Year Anniversary

AASHTO – the First Hundred Years

By Thomas G. Leech

When we think of AASHTO, we may think of many things. First and foremost we think of a Standards setting body. We also may think of a body whose name changed in 1973. We may think of the (Bridge) Standard Specifications. We may think of the Green Book. We may think of the AASHTO Materials Reference Laboratory (AMRL) Standards. We may think of the LRFD Bridge Design Specifications, and we may certainly think of many Guide Specifications. But has this always been the case?

On Dec. 12, 1914, Henry G. Shirley, chief engineer of the Maryland State Roads Commission, and other state highway officials met in Washington, D.C., at the Raleigh Hotel at 10 a.m. to establish a national organization that would allow for the discussion of legislative, economic, and technical subjects and would draft a legislative proposal for federal cooperation in road construction. On that day, the American Association of State Highway Officials (AASHO) was organized.

Q1: In what year and month was AASHO founded?

Q2: AASHTO is and has always been a standards setting body? T or F

Q3: The compilation of national bridge design specifications began in what year?

Q4: In what year did AASHO publish the first bridge design specification?

> *"The degree of a country's civilization may, in a measure, be gauged by its highways."*
>
> *...U.S. Rep. Dorsey W. Shackleford, Sept. 29, 1913*

The transportation issues of that day (in 1914) were far different from the transportation issues of today. In major cities public transportation typically included walking and the streetcar – with roadways and bridges designed primarily to support these transportation modes. Away from the urban centers - In the county - the often heard slogan was "Get the farmer out of the mud". There was a national need to deliver mail service and to improve "post" roads; but few states would accept federal money for such a purpose. However, in many areas of the country, the dynamic was changing. The Allegheny County (Pennsylvania) Road Department, which was created in 1895, primarily built, in the era preceding the First World War, macadam roads consisting of 8" granite base with 2" coating of light stone covered with tar. In sparingly few places, Allegheny County began to build roads with asphaltic concrete, brick or block stone paving. The Commonwealth of Pennsylvania created an Automobile Division which began to issue driving licenses in 1905 in order to appropriate funds for road construction. And Henry Ford introduced his landmark Model T in 1908, making automobiles available and affordable to the masses for the first time. As the call for better roads grew in the early days of the 20th century, incredibly many members of Congress still believed that the Constitution prohibited a federal role.

It is against this backdrop that a group of visionaries in 1914 wrestled with complexities of competing legislative, economic, and technical concerns of the day. With a vision of a national system of highways, the new leaders of AASHO coalesced into an effective instrument. These visionaries would help draft legislative proposals for federal cooperation in road construction and would go on to establish policies and committees to advance the science of road (and bridge) construction.

The founders of AASHO, who attended the organizational meeting in the Raleigh Hotel on Dec. 12, 1914, included: Logan Waller Page, director of the Office of Public Roads(OPR); A.D. Williams, W.Va.; Sidney Suggs, Okla.; George A. Ricker, N.Y.; Charles M. Kerr, La.; T. Warren Allen, OPR; James H. MacDonald, Conn.; Sen. John Craft, Ala.; W.D. Sohier, Mass.; S. Percy Hooker, N.H.; J.E. Pennypacker, OPR; S.E. Bradt, III, R.C. Terrell, Ky.; W.E. Keller, Ala.; George P. Coleman, Va.; E.A. Stevens, N.J.; Paul D. Sargent, Maine; James R. Marker, Ohio, Lamar Cobb, Ariz.; Henry G. Shirley, Md.; Joseph Hyde Pratt, N.C.; and P.St.J Wilson, assistant director of OPR.

Q5: What does the "H" in H20 stand for?

Q6: In what year did AASHO change its name to AASHTO?

Could the initial fathers of AASHO foresee interstate highways stretching from coast to coast? Could the initial fathers, in 1914, foresee a paradigm shift from the transportation of goods from rail to truck. Could the initial fathers envision the average daily traffic in our metropolitan areas? Perhaps not exactly.

What did they see? How have they envisioned the future? Travel through 100 years of history and see the notable influences and advances fostered by the American Association of State Highway and Transportation officials.

1914: AASHO – a national organization was formed. In the opening session, the founders briefly left the Raleigh Hotel and visited to the White House where they met President Woodrow Wilson, an avid motorist and strong advocate of good roads. The first order of business was to prepare an AASHO plan for federal cooperation in funding road construction which was to be submitted to Congress.

1916: Federal Aid Road Act was passed. The legislation was based on a draft bill prepared by AASHO which among other things set forth to " … promote the improvement of Rural Post Roads, Military Roads, and Roads used for interstate commerce …" The landmark legislation dropped references to military roads, forbid the of funds for toll roads but provided a comprehensive national funding plan to construct, reconstruct, or improve roads with the understanding that the individual states would agree to maintain "in practically as good a condition as when it was first built".

1918: Joint Highway Congress was conducted in Chicago, on December 11 to 12, 1918 with theme dedicated to shaping a postwar highway program. AASHO, which favored federal aid for highways, was a primary sponsor of the congress.

1921: The Committee on Bridges and Structures was formed. It primary task was to develop national standard specifications for bridge construction and design.

1926: The Committee on Bridges and Structures developed its first working draft specifications. Copies were mimeographed and informally shared with interested parties. In the same year AASHO adopted the United States Numbered Highways System giving east-west routes even route numbers and north-south routes odd route numbers.

1931: The first bridge design and construction specification was published. The document was entitled the Standard Specifications for Bridges and Incidental Structures. These first bridge design specifications contained no more than 68 pages of design requirements (which can be compared to the more than 1660 pages of design requirements in the current LRFD Bridge Design Specifications). The largest class of highway loadings identified as H20 ("H" for hypothetical) was conceived a continuous train of two axle 20 ton and 15 ton vehicles positioned in 9'-0' travel lanes. Considering the main transportation vehicle of the day, the largest class of live loadings was 60 ton electrified rail cars occupying 10'-0" lanes.

1935: AASHO, working in tandem with the National Conference on Street and Highway Safety, developed a single standard for all highway settings, urban and rural. The result was the Manual for Uniform Traffic Control Devices for Streets and Highways (MUTCD), which when published initially in 1935, established road standards for both signs and pavement markings.

1944: With the Fourth Edition of the Standard Specifications for Highway Bridges, AASHO quantified the HS20-S16-44 Loading which was to be the primary standard live loading configuration for the next 50 years of Highway Bridge Design. The Fourth Edition maintained the 60 tom electric railway load first identified in the First Edition.

1956: The Federal-Aid Highway Act of 1956, which President Dwight D. Eisenhower signed into law on June 29, 1956. AASHO provided strong support of the creation of the Interstate Highway System, with association officials spending considerable time before Congress testifying on behalf of that proposed program.

1958: On October 15, 1958, the AASHO Road Test at Ottawa, Illinois, was officially inaugurated. This two-year effort, which was sponsored by AASHO and administered by the Highway Research Board of the National Academy of Sciences, conducted the most comprehensive studies to date evaluating the performance of highway pavements when subjected to repeated passages of vehicles of various weights and sizes.

1962: On October 10, 1962, AASHO entered into an agreement with the U.S. Bureau of Public Roads and the National Academy of Sciences to establish the National Cooperative Highway Research Program (NCHRP) as national program of highway research. The NCHRP is financed by a combination of pooled state funds and federal aid and has been instrumental in shaping best practices in highway and bridge construction and maintenance since its inception.

1965: On October 1, 1965, the AASHO Materials Reference Laboratory (AMRL) was established as a Research Associate Program at the National Bureau of Standards (now known as the National Institute of Standards and Technology) as a key step in the standardization of construction materials nationwide. AMRL initially focused on soil, aggregate, and bituminous materials, but its programs have since grown to provide laboratory assessments for metals, plastic pipe, and spray-applied fire-resistive materials.

1973: The Eleventh Edition of the Standard Specifications for High Bridges introduced Load Factor (LFD) Design. In the same year AASHO was rechristened AASHTO (Association of State Highway and Transportation Officials) to reflect the shift from serving as a highway-only organization to becoming an association that addresses all modes of transportation.

1986: With a new emphasis for asset management of the bridge inventory, AASHTO acquired the software of the Florida-based Info Tech's Bid Analysis and Software System (BAMS) to make it a proprietary computer software product for the benefit of participating member departments. Through many modification and improvements, the software is now known as AASHTOWare.

1993: With an initial focus on Civil Engineering education, the Transportation and Civil Engineering (TRAC) Program was launched as an AASHTO program seeking to introduce careers in transportation and civil engineering to high school students who participated in hands-on activities designed for use in math and science educational classes.

1998: Recognizing the need for a preferred standard for collecting bridge condition information,, the Guide to CoRe (Commonly Recognized Bridge Elements) was developed (by AASHOT and FHWA) as a basis for data collection, performance measurement, resource allocation, and management decision support.

1994: The First Edition of the LRFD Bridge Design Specifications was published. This was the compilation of work initiated in 1986 by the Committee on Bridges and Structures with a mandate to review foreign design specification and consider alternative design philosophies. With this a reliability based design specification was developed as well as a new definition of live loading, term HL-93.

2001: In a major effort to better serve its member departments and others with respect to wide-ranging services and needs, AASHTO formally rolled out a new website with the domain name: www.transportation.org.

2014: AASHTO turns 100 years old on December 12 (at 10:00 AM).

Answers to Quiz:
Q1: December 12, 1914;
Q2: False;
Q3: 1921; Q4: 1931;
Q5: hypothetical;
Q6: 1973.

So in 2014, celebrate with AASHTO, an organization that humbly began with discussion of legislative, economic, and technical subjects and then slowly and forcefully developed into a national leader of highway and bridge: design, construction and preservation policies.

About the author...

Thomas G. Leech, P.E., S.E., of Gannett Fleming Inc., is an Executive Committee Member of IBC and currently the IBC's Award's Chairman.

Constructing Virginia's Infrastructure One Public-Private Partnership at a Time

I-495 Express Lanes

By Robert E. Alger Jr.; with contributions by Bob Portley and Ginny Finley

According to the Federal Highway Administration's Office of Innovative Program Delivery, there is currently enabling legislation for the use of Public-Private Partnerships (P3) during the procurement of transportation projects across 33 States and Puerto Rico. While this fact alone would appear to indicate the usage of P3s is spreading across the nation, a deeper look will show that the actual use of this innovative "new" tool ranges from States where enabling legislation is no more than an empty promise to its citizens, to States that have boldly embraced the concept and have been able to deliver critical infrastructure improvements, thus catalyzing both regional growth and development. The Commonwealth of Virginia is one of the later.

Before exploring the details of several projects in Virginia, it would be appropriate to better define what a P3 is. In a report to Congress, the United States Department of Transportation begins a lengthy definition of a Public-Private Partnership as "a contractual agreement formed between public and private sector partners, which allows more private sector participation than is traditional…". While this may seem like an unnecessarily vague definition, it is in fact a quite succinct way of summarizing the incredibly broad range of models encompassed in this delivery method. To stick with the common "tool in the toolbox" analogy, the P3 concept is akin to a ratchet with each socket representing the procurement model for a single project.

One of the first projects in the modern era of P3s was the Dulles Greenway Toll Road, made possible by the Virginia Highway Corporation Act of 1988. As a subcontractor, The Lane Construction Corporation was responsible for constructing 6 miles of the road that included 13 bridge structures, and three large cast-in-place box culverts. Not only did this project set the stage for many subsequent and current P3s, the resulting economic development benefited the region immensely, and as of the last census, Loudoun County, Virginia had become one of the fastest growing counties in the United States.

Following the completion of the Dulles Greenway and passage of the Public-Private Transportation Act of 1995 (PPTA), Virginia rolled into the new millennium with several new procurements, including one of the largest P3 projects to date --the nearly $2-billion I-495 Express Lanes. With the Washington Metro Area ranked as one of the worst regions for traffic congestion in the United States, the concept of expanding the Beltway was not new. After exploring traditional delivery models early in the planning process, VDOT decided to reevaluate their strategy having encountered public opposition and prohibitive costs in those initial concepts.

I-95 Garrisonville

Then in 2002, Fluor submitted an innovative proposal for the project that provided a funding source, reduced the impact on the community and environment, reduced ROW requirements, transferred risk to the private sector, and brought in a level of operational expertise. In 2004, Transurban joined the team and with the support of VDOT all contracts had been executed by December 2007. Utilizing funding from Federal, State and Private sources, the Fluor-Lane joint venture was able to construct 14 miles of new roadway, 58 new bridges and overpasses and 12 key interchanges. Despite the challenges of working on an interstate with such a high volume of traffic, the team was able to achieve the milestone of five million safe work hours without a lost-time incident and still deliver the project a month ahead of schedule.

When discussing the "Public" component of a Public-Private Partnership, the default assumption is that this is referring to just the owner; however, a critical element to the success of this project was going beyond the team's interactions with VDOT and conducting an extensive public outreach program. During earlier years when the project was being considered for traditional delivery, public opposition became overwhelming when the high cost plan to take 300 homes was realized. With the innovation brought through a P3 delivery and VDOT's receptiveness to an alternative approach, not only was the cost significantly reduced and the project largely constrained to its original right of way, but access points were also increased and the taking of only five houses was required.

Innovation is one thing although getting the word out to appease public concerns is quite another. To accomplish this task the team identified and met with key stakeholder groups including elected officials, community groups, home owners associations, chambers of commerce and large businesses. Design public hearings and numerous large-scale public information sessions were conducted and a stakeholder database was established for regular information blasts via mail and e-mail. All of these approaches contributed to the ultimate success of the project.

Conversely, when the "Private" component of a P3 is mentioned the default assumption is that the benefits will be exclusively for the members of the consortium that are leading the financing and design-build elements. This however could not be further from the truth and significant participation was realized by a number of subcontractors and suppliers. In addition, the project has the distinction of involving the largest DBE & SWaM participation in Commonwealth history, with approximately half a billion dollars of work contracted to such firms.

Beyond the well documented improvements to regional mobility, a 2009 study by George Mason University estimated that almost 32,000 jobs were created in the Washington metro area alone as a result of the project, and that for every $1 in direct spending on construction, the economy of Virginia saw a $2.25 benefit. While the effects of the project will surely be observed for years to come, the early indications are that the successful completion of this endeavor was not only a major win for VDOT, but for all citizens of the Commonwealth.

Following the completion of the I-495 project in 2012, VDOT has contracted once again with the Transurban and Fluor-Lane team to finance and construct another P3 megaproject, the I-95 Express Lanes. Upon completion, 29 miles of Express Lane capacity will have been added to the corridor and direct connectivity will be enabled between the 95 Express Lanes, 495 Express Lanes, I-66 HOV and Dulles Toll Road HOV. Construction on the roadway began in late 2012 and substantial completion is expected to occur later in 2014 with over two million safe work hours currently recorded without a lost-time incident.

One of the key elements to the success of this project was the fast track design begun by design leads HNTB and HDR in March of 2012, which allowed for measurable construction to commence that August, in just over four months. Much like its 495 predecessor, the I-95 Express Lanes is expected to provide significant benefits to the local and regional communities beyond improved traffic flow, increased access, and elimination of bottlenecks. By partnering with the private sector it is expected that the Commonwealth of Virginia will leverage just under $1-billion in transportation improvements into $2-billion in economic activity and support nearly 8,000 jobs.

I-495 and Route 7 in Tysons Corner

After two decades of expeditiously delivering quality infrastructure to its citizens via an increasingly robust P3 program, and with almost a dozen projects actively being considered by its Office of Transportation Public-Private Partnerships, Virginia shows no signs of slowing down. Furthermore, it is also worth noting that some of the good ideas may have drifted across the Potomac, beginning with the formation of a bipartisan Congressional P3 Caucus last August and the recently appointed Special Panel on Public Private Partnerships in the House T&I Committee.

Dulles Greenway Under Construction

While the use of P3s may not be spreading across the nation as quickly as many would like, the benefits being realized by the early adopters of this tool will ensure that it is here to stay.

About the authors...

Robert E. Alger Jr.; with contributions by Bob Portley and Ginny Finley

Founded in 1890, The Lane Construction Corporation is one of America's leading construction companies, specializing in heavy civil construction services and products in the transportation, infrastructure and energy industries.

A SUMMARY OF CURRENT ALTERNATE PROJECT DELIVERY METHODS

Project delivery methods have evolved to deal with the many ways in which contracting parties may allocate their risk, from the traditional stipulated price/ general contract to the development of alternative financing and procurement methods including P3 models. Each delivery method has its advantages and disadvantages, and it is the role of the owner to provide a contracting mechanism that provides economic incentive and appropriately shares construction risks.

The information in the table is based on Colorado DOT Special Publication which is derived from FHWA's Special Experimental Projects No. 14 - Alternative Contracting (formerly Innovative Contracting). Since 1990, the FHWA has allowed the State DOTs to evaluate non-traditional contracting techniques.

METHOD	PROJECT DELIVERY SYSTEM IN WHICH....	SOME ADVANTAGES
Indefinite Delivery /Indefinite Quantity (ID/IQ)	The contractor bids per unit of specific work with a guaranteed minimum amount of work.	Needs can be responded to in a "just-in-time" and "as-needed" manner, work needs and outcomes are not subject to interpretation or negotiations.
Agency-CM	The owner contracts with a construction manager to perform preconstruction and CM services.	Opportunity to start construction before the design is complete (fast-tracking).
Construction Manager @ Risk (CM/GC)	The owner contracts with a construction manager based on qualifications, experience, fees for management services, and target construction price, to manage and construct a project.	Opportunity to establish selection criteria to match objectives of the project, owner retains control of the final design process, early contractor involvement results in a better understanding of the contract, better risk allocation, Guaranteed Maximum Price (GMP). *Examples include: Phoenix SkyTrain & Birdsboro Bridge over the Schuylkill River (see the accompanying articles).*
Design-Build	One single entity performs the design and construction of a project.	Better risk allocation, clear project goals, reduced delivery time, better project feedback, single source of responsibility, integration of design and construction, GMP identified. *Examples include NJ Hudson Bergen Light Rail Viaduct, Allentown, PA City Link Bridges (see the accompanying article).*
Modified Design Build	The owner completes a substantial portion of the design, and a single entity completes the remaining portion of the design and builds the project.	Ability to innovate, single source of responsibility, less owner resources required, better project coordination, improved risk management, reduced project delivery time, cost savings
Design Sequencing	The project is divided into several design packages, and the project is bid for construction before design completion.	Rapid encumbrance of funds, faster project delivery. *Examples include Sound Transit, East Link Extension Project, I-90 Homer M. Hadley Memorial Bridge (see the accompanying article).*
Design-Build-Operate	One single entity performs the design and construction of a project, and operates the project for a specified period of time under one single contract.	Integrates design, construction and operations under one single contract, operational issues are considered during design, faster project delivery, better life-cycle costs.
Design-Build-Maintain	One single entity performs the design and construction of a project, and maintains the project for a specified period of time.	Integrates design, construction and mainte-nance under one single contract, maintenance issues are considered during design, faster project delivery, better life-cycle costs.
Public Private Partnership (PPP)	Private entity or developer takes a part in financing a construction project in return for monetary compensation	Expedited completion, improved quality and system performance from the use of innovative materials and management techniques, substitution of private resources and personnel for public resources, access to new sources of private capital, mutual rewards. *Examples include (VA) Dulles Greenway Toll Road, I-495 Express Lanes, & I-95 Express Lanes - (see the accompanying article).*

Web references: www.coloradodot.info/business/designsupport/innovative-contracting-and-design-build/icac/DEFINITIONS.pdf

www.fhwa.dot.gov/programadmin/contracts/sep_a.cfm#s1

TAKING A CUE FROM NASA

AEROSPACE CONTRACTING APPROACH TO UNPRECEDENTED RAIL BRIDGE DESIGN RESULTS IN A NOVEL DESIGN AND ON-TIME DELIVERY

By Thomas Cooper, P.E., P.Eng. and John Sleavin, P.E.

Starting in 1996, Sound Transit, the transit agency for the Central Puget Sound region in Washington, began development on a regional high capacity transit project including light rail service, commuter rail, express bus routes and capital investments in transit facilities. This long-term vision has grown into a system that currently carries over 100,000 passengers in a typical weekday. More recently, in 2008 voters authorized the expansion of this system to provide additions to the express bus and commuter rail services, along with 36 miles of new linked light rail service through the North, East and South Corridors. As part of the light-rail extension program known as the East Link Extension project, Sound Transit proposes to extend their tracks across the I-90 Homer M. Hadley Memorial Bridge, the widest and fifth-longest floating bridge in the world.

Having no known precedent in civil engineering practice, the placement of light rail across the floating bridge presents unique challenges, including the design of a novel track bridge system to accommodate multi-dimensional movements at the existing expansion joints where transition spans are connected to approach and floating spans. While distinct joints have been developed for passenger rail systems that cross cable support structures and deal with multi-dimensional movements, for example the Tsing Ma Bridge in Hong Kong, we are not aware

of any other bridge carrying passenger rail that has had to accommodate the wide range and magnitude of movements required on this bridge.

Given the importance of the existing floating bridge to the regional transportation network, the stringent requirements to ensure passenger rail comfort, and the complex design of the track bridge, a robust program was needed to evaluate concepts, prepare detailed designs, conduct physical testing, and procure a system to carry light-rail vehicles from the fixed structures to the floating structure while meeting the necessary specifications for rider comfort and structural behavior. A key to the success of this program was the innovative contracting method used to conceive, develop and test this complex track bridge system.

ALTERNATIVE DELIVERY

Sound Transit modeled its alternative delivery method on the contracts used by NASA's space program in order to create a turnkey research, development, and demonstration project that provided access to the full resources of an integrated project team, including experienced structural, civil, and track engineers, as well as fabricators and constructors. Three main phases were identified, each with customized team member roles best suited for this unique, complex, and technically challenging assignment.

In the first phase of the contract, the chosen consultant/contractor team was to develop at least one new concept, evaluate the concept, run computer models to confirm its viability and prepare detailed design of the selected system. The consultant was offered incentives in the form of increased design fees for developing a track bridge system that could accommodate a higher operating train speed and use a shorter project development schedule than that defined in the initial contract requirements. For the second phase, which involved testing, the design fee would start at a higher than usual level and decrease based on the amount of time and design hours required to prove out the concept through component and full-scale prototype testing. In phase three of the contract, the track bridges will be constructed and installed on the bridge through an amendment to the original turnkey contract.

In November 2010, Sound Transit selected a team led by Parsons Brinckerhoff (consulting engineers) and Balfour Beatty (contractor) to undertake this project. The Request for Proposals required the winning team to provide a prototype design, fabrication and testing, and test track design and construction, as well as ultimately designing, furnishing, installing, testing, and, possibly, maintaining the permanent track bridge systems on the bridge. While the procurement followed a qualifications-based approach, the scoring considered the team's ability to undertake the entire project and each individual's performance records with Sound Transit in being able to deliver tough technical assignments. Though organized and contracted as a design/build contract, Sound Transit preferred the project to be run by the designer, not the contractor. Exceeding the minimum performance specifications with modest increases in construction cost was more valued than meeting the minimum performance requirements at a minimum construction cost.

Sound Transit thought this type of project environment would be better led by engineers.

THE CESuRa SOLUTION

The floating portions of the Hadley Memorial Bridge are constantly moving because of many factors, particularly seasonal changes in lake level and temperature, wind and wave action, and roadway vehicle loading. The light-rail vehicle loading and speed also will also affect bridge movement. The bridge and vehicle movements vary in magnitude and frequency and are sometimes dependent on the time of year or, in the case of the transit vehicles, human control. In addition, the bridge could move because of bridge maintenance, an extreme weather event, or other infrequent events, including the unlikely failure of the Chittenden Locks—which control the water level of Lake Washington—and resulting severe loss of lake level elevation.

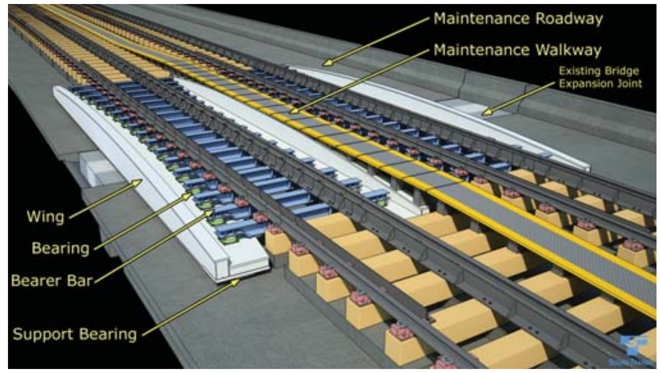
To accommodate these movements and resolve competing design requirements, a feasible track bridge system was conceived, developed, analyzed, evaluated and tested. The Curved Element SUpported RAil (CESuRa) concept, which was selected, works by means of the interaction of curved track supports in two planes that adjust automatically to movements in the transition spans of the bridge. The innovative CESuRa concept accommodates longitudinal movement, pitch, roll, and yaw, resulting in a uniform profile under all bridge movement combinations.

The CESuRa concept is based on five principles:

1. A hinge provided between two planes.
2. A curve of fixed shape on each of two secondary planes supported by the main planes and hinged with an axis along the longitudinal direction of the main planes.
3. Actuation of the secondary planes by the main planes.
4. A surface that continues from one main plane through the smooth curve and on to the second main plane.
5. Sliding rail joints to allow for longitudinal movement.

The refined CESuRa system acts like a pin-ended beam that spans the hinge point between the transition and fixed span or the transition and floating span. There are three main elements of the system, including two longitudinal box girders, referred to as wings. Additionally, there are transverse bearer bars that serve a purpose similar to that of ties in a conventional track but are supported on the wings by uni-directional friction pendulum bearings that allow rotation and limited translation. Lastly, there are the running and guard rails, which rest on, and are secured to, the bearer bars.

Both the structural elements of the track bridge and the rails



themselves experience substantially lower stresses with the CESuRa concept than the stress levels in previous design options that had been considered during the concept development. These differences in performance could potentially improve Sound Transit operations, life-cycle costs, and system reliability.

ENGINEERING APPROACH

As part of this multiple-year, multiple-phase project, concept development and engineering was conducted step-by-step, enabling the design team to verify its theoretical calculations and track bridge performance parameters by means of modeling and physical testing. A myriad of technical and commercial challenges and risks have been managed through structured risk-management analysis, extensive computer modeling and analysis, component testing, and full-scale prototype testing. Concurrently, the project design has been refined based on the results of finite element analysis modeling and physical testing.

COMPONENT AND PROTOTYPE TESTING

Full-scale component testing took place at the University of Washington Structural Research Laboratory. The goal was to verify that the wings, bearer bars, bearings and rails would undergo the required movements in the manner anticipated in the design, in advance of full-scale prototype testing. This testing also provided an opportunity to record lessons about fabrication and assembly of components, particularly with respect to tolerances, and to provide test data for validating the finite element modeling of key components.

Full-scale in-track testing of a prototype track bridge was desired to validate the computer analysis results, confirm that the design meets the performance criteria contained in the technical requirements for the track bridge system and the basis of design report, and meet the recommendations of the Joint Transportation Committee of the Washington State Legislature. To meet this requirement, the team developed a test program and worked with the Transportation Technology Center, Inc. (TTCI) to conduct full-scale prototype testing of two track bridges at the U.S. Federal Railroad Administration's 52 sq mi Transportation Technology Center, near Pueblo, Colorado. Construction of the test track began in February 2013. Vehicle testing started in August 2013 and concluded in mid-October

Vehicle testing started in August 2013 and concluded in mid-October 2013.

Prototype testing successfully verified that the Federal Highway Administration and Sound Transit safety and rider comfort criteria requirements were met, analyzed the reliability of components and the system as a whole, provided an understanding of wearing sequences and vulnerabilities and improved fabrication, assembly, and installation techniques. Concerns and other issues that arose during development of the prototype design were also addressed in the testing program. Finally, the testing program verified that all design requirements were met and identified areas for design refinement.

INSTALLATION

Pending Sound Transit Board approval, the final phase of the rail crossing will include fabrication of the track bridges and their installation on the Hadley Memorial Bridge. As part of this phase of the program, the Parsons Brinckerhoff team will have six new track bridges fabricated, while the two that were used for testing will be refurbished and painted for installation on the bridge. The eight track bridges will be installed by the Parsons Brinckerhoff team as part of the overall East Link Extension project.

Design of the $2.8 billion, 14 mile long, East Link Extension project is in progress. The track bridges will provide an essential link within an otherwise technically challenging project, which is set to begin construction in 2016. Construction and system testing are expected to take approximately six years, with the East Link expected to start revenue service in 2023.

About the authors...

Thomas Cooper, P.E., P.Eng., is a Senior Engineering Manager with Parsons Brinckerhoff, working in its Denver office. He has been the lead structural designer for the Track Bridge project since the project started.

John Sleavin, P.E. is the Deputy Director of the East Link Project for Sound Transit. He is the Project Manager for Sound Transit on the Track Bridge project.

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More than 80 firms are represented in the Corporate Member program of the Engineers' Society of Western Pennsylvania (ESWP). Memberships are available at 3 levels: Gold, Silver and Bronze. Gold members are entitled to 14 memberships that can be exchanged by employees; Silver, 9; and Bronze, 5 — annual dues are $2400, $1700, and $1000 respectively. In addition, ESWP Corporate Member Firms may add 2 additional individuals in our Under-35 age category at no additional cost. More information can be found at eswp.com. Please contact the ESWP Office (412-261-0710) for additional details.

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WYATT INCORPORATED Interior Construction

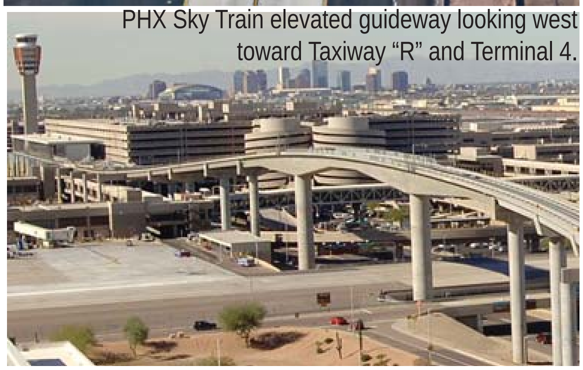
Zell Engineers

British Airways 747 crossing beneath the Taxiway "R" bridge

Courtesy of Phoenix Aviation Department

Jet passes beneath the Taxiway R bridge with the PHX Sky Train overhead

Courtesy of Visions in Photography



PHX Sky Train elevated guideway looking west toward Taxiway "R" and Terminal 4.

Courtesy of Visions in Photography

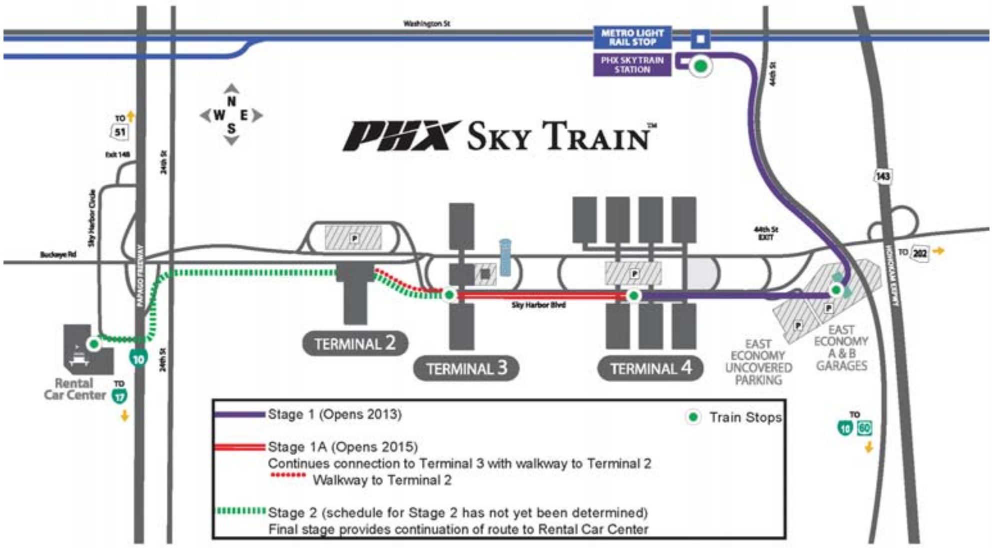
World's First Taxiway Crossing Delivered Using CM At-Risk

By David A. Burrows, P.E.

Phoenix Sky Harbor International Airport opened the first stage of their automated transit system, PHX Sky Train®, on April 8, 2013. Local media reported that on July 15, 2013, nearly two months ahead of projections, one million passengers had boarded the Sky Train and experienced the five minute ride from the 44th Street Station through the East Economy Lot Station, over Taxiway "R" (more than 100 feet above Sky Harbor Blvd.), ending at Terminal 4.

Since the development of its newest terminal in the late 1980's, Sky Harbor has contemplated building a transit system to deal with traffic congestion due to increasing passenger demand and aging ground transportation infrastructure. Without the Sky Train, projections show that quality of service and future Airport growth would be crippled by gridlock on the Airport's roadways. The Sky Train provides a dedicated, streamlined, safe, convenient, and more sustainable transportation link between airport terminals, parking lots, rental car center and regional light-rail transit facilities and reduces congestion around the airport terminals. This is no small feat given that Sky Harbor is one of the ten busiest airports in the country.

Planning efforts resulted in a five mile long corridor and three stages of construction to spread overall funding requirements. Stage 1 consists of approximately 2 miles of guideway, of which over 1.5 miles is elevated, to connect three stations: a Metro light-rail stop; a major airport parking facility; and Terminal 4, the largest airport terminal. Stage 1A, which is under construction, builds a new station at Terminal 3, approximately ¾ mile of guideway and a walkway to connect the Stage 1 facilities and Terminal 2. Both Stage 1 and 1A have used the Construction Manager At-Risk (CMAR) construction delivery method. The final stage is in conceptual design and will provide future connections to the rental car center (see map on Page 18).



Courtesy of the City of Phoenix Aviation Department

PHX Sky Train Route Map

The World's First

One of the biggest challenges in Stage 1 was the crossing of Taxiway Romeo (Taxiway "R"), the first time in the world that a transit system has crossed over an active taxiway. Moreover, the taxiway itself crosses over Sky Harbor Boulevard, thereby putting planes, trains, and automobiles all within close proximity.

On Oct. 10, 2010 a celebration to mark the re-opening of Taxiway R was held by the City of Phoenix with members of the City's Aviation Department, designers, contractors and media watching as the first two planes taxied under the new bridge. Nowhere in the world had this been done before, a bridge carrying trains over an active taxiway, even more remarkable, a taxiway that handles planes as large as Boeing 747's. Delivered a week ahead of schedule and approximately 35 percent below the initial budget, there was reason to celebrate. To make this crossing a reality, creative problem solving by both design and construction teams was necessary.

Planning To Build In an Operating Airport

Sky Train infrastructure design required careful consideration of construction impacts on airport operations and facilities as construction requirements drove many key design decisions. An integrated design and construction approach was used to help ensure that the project was built on-time and on-budget. At the 30% design level, a Construction Manager at Risk (CMAR) contractor was brought onto the team. The use of CMAR allowed early confirmation of construction schedule and budget, value engineering integrated into design, constructability issues and operational impacts mitigated during the design phase, and design tailored to the contractor's preferred construction approach.

A fast-track delivery of construction documents was necessary to minimize overall project schedule and risk associated with inflation and fluctuating material costs. In order to accomplish this, design and construction schedules overlapped by 2 years in an overall construction schedule of 3.5 years and to allow design to stay just ahead of construction, 31 separate design packages were issued. Building Information Modeling (BIM) was used by all design disciplines for vertical structures and shared with the contractor to avoid conflicts and quickly resolve those that did occur.

Taxiway Crossing Design Constraints

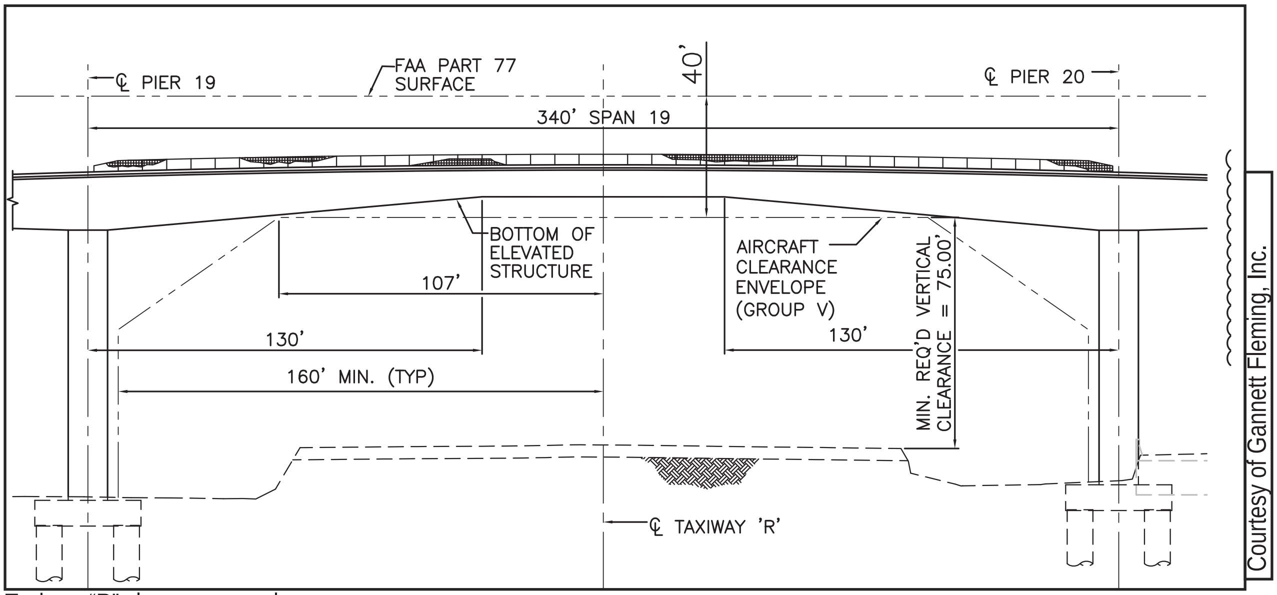
An area 340 feet in length and 75 feet in height above Taxiway R was needed to provide the clearance required for Group V Aircraft (Boeing 747's). Additionally, to stay below the Part 77 surface established by the Federal Aviation Administration for safe aircraft operations, the height of the bridge was limited. Thus, a narrow vertical band of approximately 40 feet remained within which the bridge could be built. Taking into account the vertical curve and bridge barrier, the vertical band reduced further to just over 30 feet. In addition to the challenging geometry was the schedule constraint for constructing the bridge. Because the construction required the taxiway to be closed, a limited shutdown period of six months was possible due to airport operations. The timing of the shutdown was an additional factor to be managed. Due to seasonal traffic volumes, the closure had to occur between Spring Break and Thanksgiving. If this window was missed, it would delay construction of the bridge, which would delay the entire project. Obviously, it was critical to choose the correct structure and get the design and construction right the first time.

Selection and Design

Eight alternatives were evaluated and ranked based on impacts to the taxiway, long-term maintenance, cost, aesthetics and special considerations specific to each structure type. Evident from a drive on metro-Phoenix's freeway system, concrete box girders are a popular choice, which require little maintenance, only routine inspection and in many cases, a lower life-cycle cost. Aesthetically, the box girder was the most streamlined and least obtrusive choice, fitting nicely with surrounding concrete structures and adjacent guideway. Thus, a cast-in-place box girder bridge was chosen.

Concern arose regarding the cost of falsework supporting a superstructure 90 feet above grade during construction. In order to minimize disruption to the taxiway, end spans (which did not require a taxiway shutdown) would be constructed first. To reduce falsework cost, the CM-at-risk contractor recommended that the designers determine a way to re-use the end spans' falsework for main span construction. Design based on this concept was completed in July, 2009.

The contract to build the bridge was awarded in September,



Taxiway "R" clearance envelope

2009. With the demand for construction impacted by the recession, the bridge contractor found an abundant supply of falsework material and proposed supporting all three spans simultaneously until post-tensioning was complete. Therefore, the elements added to accommodate the reuse of falsework were no longer necessary. A redesign of the bridge, which eliminated supplemental post-tensioning and closure pours, was completed in three weeks; a quick turnaround to keep construction on schedule.

Construction Phase Challenges

Tight construction clearances were common and unavoidable during construction. While the taxiway remained open, construction began with pier foundations. Due to the close proximity of traffic on Sky Harbor Blvd and a bridge over a nearby local street, the foundation for the eastern main pier proved particularly difficult to construct. This was overcome by installing the drilled shafts from existing grade rather than excavating first and drilling from the bottom of footing grade as conventionally done. A trench filled with slurry was placed to form the perimeter of the pile cap to allow for the 10 feet deep cap excavation without impacting the adjacent area.

Another challenge encountered while building the superstructure was in forming the deepest sections of the webs near the main piers. Because the webs tapered in thickness, working space for forming and stripping became extremely limited (as seen in the photo). Once the floor and webs of the girders for the end spans were constructed, the taxiway was shut down in April 2010 to begin the construction of the main span. The deck was poured continuously over all three spans and post-tensioning of the bridge occurred in early September 2010.

Arguably the biggest challenge to construction was the tight and unmovable schedule. It required tremendous planning efforts that included several hour-by-hour internal schedules for weekend and critical activities such as falsework lowering. Executing necessary restrictions on Sky Harbor Blvd. and surrounding roadways, required countless emails and hours of phone calls to communicate between contractors, airport operations, airlines, vendors, and the travelling public. Crews worked through most holidays and weekends, and out of 307 available shifts, the contractor worked 272 shifts or nearly 90 percent of the total time available.

Taxiway Reopening

As mentioned previously, on Oct. 10, 2010, Taxiway R was re-opened, about two and-a-half years later the first stage of the PHX Sky Train opened on April 8, 2013. Installation of the train's running surface and propulsion systems took place throughout 2011 and rigorous testing of the train system took place in 2012 through early 2013. A major milestone was reached on June 29, 2012 when the automated, electrically-powered train took its first test ride across the bridge while aircraft passed underneath.

Final accounting of the bridge construction cost totaled approximately \$6.7 million, an impressive \$3.8 million in savings from the preliminary estimate. Thanks to successful planning, design and construction, the millions of passengers that cross over the taxiway each year get to enjoy expansive views of Phoenix Sky Harbor International Airport, the city and surrounding desert landscape, as well as the experience of riding a train over planes, crossing above automobiles.

About the author...

David A. Burrows, P.E., PMP, LEED AP, was the lead structural engineer for the design of the Taxiway R crossing. He works for Gannett Fleming as a project manager and structures department manager in Fairfax, Virginia. Gannett Fleming served as the fixed facilities design consultant for the PHX Sky Train, which has won numerous awards including: the 2013 ACEC Arizona's 33rd Annual Engineering Excellence Awards competition Judges Choice Award and Clifford C. Sawyer Achievement Award, and ENR Southwest's 2012 Best Project in Transportation and Safety Categories.

Birdsboro Bridge Project
Berks County, PA

By Timothy Benner, P.E.

Along the banks of the Schuylkill River near the southern end of Berks County, Pennsylvania lies Birdsboro. The small Borough with a population of 5,100 is named after its founder, William Bird. Bird obtained warrants for the land that would later become Birdsboro starting as early as 1737 and established forges and mills along the creeks. His son, Marcus Bird, later established Hopewell Furnace about 3 miles south of the Borough, which became the largest producer of iron in America during the Revolutionary war.

One of the more significant natural resources within the project limits is the Schuylkill River, which is designated as a State Scenic River by the Pennsylvania Department of Conservation and Natural Resources (DCNR). In January of 2014 the Schuylkill River was named the State River of the Year, an award administered by the Pennsylvania Organization of Rivers and Watersheds (POWR) with funding from DCNR. The Schuylkill River is a popular recreational destination for boaters and anglers. The Schuylkill River is also a designated Water Trail by the Pennsylvania Fish & Boat Commission and has been designated a National Recreational Trail. A annual week long sojourn is held along the length of the Schuylkill River, including the Birdsboro project site.

The main road through Birdsboro is PA345, which carries approximately 10,000 vehicles per day and connects the Borough with PA422 and PA724. The bridge on PA345 is the only Schuylkill River crossing in the Borough and for several miles upstream and downstream. The existing bridge is a 1,097

Existing Birdsboro Bridge (left)

foot, nine span open spandrel concrete arch bridge built in 1927. It traverses the Schuylkill River as well as three tracks of Norfolk Southern Railroad. In addition to the main structure, a concrete T-beam bridge carrying Bridge Street is framed into the bridge at one of the supports. After decades of service the bridge was posted at 15 tons due to advanced deterioration and was programmed for replacement. The posting significantly impacted local industry forcing deliveries and shipments to re-route around the bridge.

Detouring traffic to replace the existing structure was not feasible due to the impacts to local stakeholders. The shortest detour route around this river crossing is approximately 15 miles. Staged construction was also problematic given the type and condition of the existing bridge. To that end, PennDOT developed preliminary plans for the realignment of PA345 to the north to allow traffic to be maintained on the existing bridge for the duration of construction. The plan called for the construction of two new bridges, one over the Schuylkill River and one over Norfolk Southern Railroad, with roadway constructed on a fill section between the two. The former Bridge Street would be constructed at grade as well. After conceptual plan development and environmental clearance, PennDOT let the project using the

New Birdsboro Bridge over Norfolk Southern Railroad

Design/Build format. In December of 2010, the project was awarded to J.D. Eckman, Inc. with McTish, Kunkel & Associates as Engineer. Engineering services for the Design/Build project included all final design including the design of the two main structures, roadway, right-of-way plans and acquisition, utility relocation coordination, erosion & sediment pollution control plans, aids to navigation plans, highway lighting plans, traffic control plans and ADA curb ramp plans. Permitting for the project was also included in the Design/Build portion of the project. Required permits included waterway obstruction permits from Pennsylvania Department of Environmental Protection (PaDEP) and the United States Army Corps of Engineers (USACE) as well as an Individual NPDES permit from PaDEP.

The development of final design plans began immediately after the contract was awarded. Critical activities such as right-of-way acquisition, utility coordination, and permitting were identified as schedule drivers and advanced as quickly as possible. With the Design/Build project format, the Contractor and Engineer were able to quickly address potential problems collaboratively as they surfaced.

As with most roadway relocations in urban areas, significant utility coordination was required to facilitate relocations in conjunction with construction sequencing. Six separate utility owners, both above and below ground, were present in the project area and required relocation. Relocations included 15 utility poles, 615 feet of 12" DIP water line, 845 feet of 8" DIP water line, 145 feet of 6" water line, 1,100 feet of 12" gas main, 430 feet of 6" gas main, and 225 feet of 2" gas line.

Subsurface Utility Engineering (SUE) was employed to identify the horizontal and vertical location of underground utilities and determine if they would be affected by construction of the roadway, including the installation of an entirely new stormwater drainage system. 28 test holes were conducted and location/designation information was incorporated into the CADD based mapping and project plans. Utilizing this information, detailed coordination was undertaken to plan for utility locations and avoid new construction as well as other utilities. The design/build project format allowed for a more fluid coordination process including quick analysis of 'what-if' scenarios and adjustments to design where possible to accommodate new utility locations.

The partial acquisition of eighteen properties was also required to construct the project. Construction was not permitted to begin until all right-of-way had been cleared. Right-of-way acquisition plans were developed, appraisals prepared, and negotiations with the owners were conducted. Additionally, one parcel in particular required deed research through the past 125 years to establish legal ownership. Final plans were also coordinated with an on-going commercial development located in the area of the relocated roadway near the end of the river bridge. As with the utility relocations, the design/build project format allowed for a more fluid coordination process.

New Birdsboro Bridge Schuylkill Crossing (right)

A final Hydrologic & Hydraulic report was prepared for the river bridge and incorporated into the permit applications. The Schuylkill River is within a FEMA detailed study area and a significant amount of analysis was undertaken to ensure the new structure would not affect flood elevations. All phases of construction were analyzed and permitted. During construction of the river bridge, adjustments were made to the temporary causeways to facilitate construction. Permit modifications were developed and field meetings held with the permitting agencies to ensure adherence to permit requirements. In addition, waste areas were permitted for demolition materials. Infiltration features such as rain gardens, bio-slopes, and vegetative lined channels were introduced to reduce surface runoff and improve post construction water quality. Tree and shrub plantings were also installed in the new fill sections constructed along the riparian corridor.

While developing the permit packages, the project team was informed of the possible presence of a state listed threatened species, the red-bellied turtle. Red-bellied turtles are known to inhabit the Schuylkill River. A habitat assessment was performed and it was determined that suitable habitat existed at the project site. Avoidance measures including isolating the work area from the river with silt fence and requiring the presence of a qualified biologist during dewatering and bridge demolition activities were incorporated into the project.

PA345 was constructed on a new alignment so that the existing structure could remain in service for the duration of the construction. Temporary traffic signals were utilized at two intersections to maintain the flow of traffic through the project area. Permanent coordinated traffic signals, with emergency pre-emption, are being constructed at the two PA724/PA345 intersections in the Borough. The roadway section between the two new structures was constructed on fill and the Bridge Street bridge was removed and replaced with a new access road built on a fill section between the two new structures. The embankment constructed between the two new structures required a quarantine period prior to driving piling at the abutments in order to eliminate downdrag forces from settlement.

The new structure over the Schuylkill River carries two lanes plus shoulders and a sidewalk. The 536 foot four span bridge was designed using 33x87.25 prestressed concrete Pennsylvania Bulb-Tee beams. Hammerhead piers with spread footings founded on the bedrock beneath the river bed, and stub abutments founded on HP12x74 steel piling were designed. Pier column and cap forming was standardized for reuse at each pier. Pedestrian railing and structure lighting was also included.

The new structure over Norfolk Southern Railroad also carries two lanes plus shoulders and a sidewalk. The 154 foot single span bridge was designed using the same 33x87.25 prestressed concrete Pennsylvania Bulb-Tee beams used in the river bridge and provides 23 feet of vertical clearance over the tracks. Similar to the river bridge, HP12x74 steel piling was used in the foundations. As with most new bridges in Pennsylvania, expansion joints were moved off structure to the end of the approach slabs. Both new structures were design to accommodate a duct bank for communications lines plus a future water line.

Construction of the new structure over railroad, as well as the acquisition of right-of-way and temporary construction easements from Norfolk Southern Railroad required coordination through the Pennsylvania Public Utilities Commission (PUC). A temporary at-grade crossing was installed and maintained during construction for access.

The Birdsboro Bridge Project presented many challenges to the project team, many of which had to be addressed prior to mobilizing the first piece of equipment to the site. The Design/Build project format allowed the contractor and engineer to collaborate and tackle those challenges and provide the owner with the most cost-effective project. Construction of the structures and realignment is schedule to be completed in 2014 with demolition of the existing bridge in 2015.

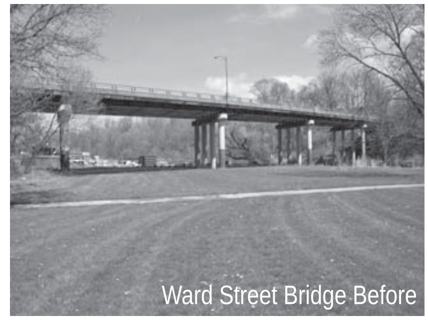
About the author...

McTish, Kunkel & Associates is a full service consulting engineering firm serving both public and private clients. Founded in 1976, they have offices located in Allentown, Pittsburgh, and Montoursville. MKA has an extensive resume of design/build and alternate designs for bridge projects across the Commonwealth. Timothy Benner has been with the firm for 17 years and is currently serving as their Transportation Division Manager.

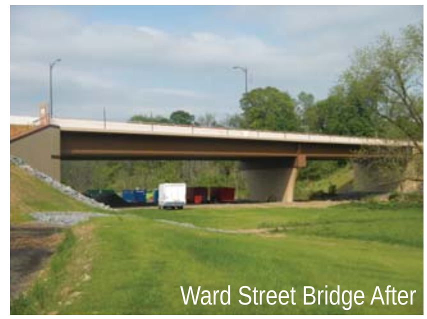
BEFORE & AFTER

Design/Build Facilitates the Re-Establishment of a City Link


15th Street Bridge Before


Ward Street Bridge Before


15th Street Bridge After


Ward Street Bridge After

By Gregory Kuklinski

The 15th and Ward Street Bridges are located in the City of Allentown, Lehigh County, Pennsylvania in Pennsylvania Department of Transportation District 5-0. Both bridges were originally constructed in 1954. The 15th Street Bridge crosses Martin Luther King Jr. Boulevard at which point there is 125' section of roadway. The name of the corridor then changes to Ward Street where the 2nd bridge crosses the Little Lehigh Creek and an abandoned rail bed slated for recreational use at some time in the future. The original 15th Street Bridge was a 69'-11" single span post-tensioned concrete bridge carrying two lanes of traffic. It was Pennsylvania's oldest example of a post-tensioned concrete beam bridge. The original Ward Street Bridge was a 401'-0" five span steel I-beam bridge with an open grate steel deck.

With an Average Daily Traffic volume of 15,000 vehicles, this heavily traveled stretch of roadway is a main thoroughfare connecting the north and south sides of the City. The Ward Street Bridge was closed to northbound traffic in 2010 and the southbound lanes were posted at 10 Tons because of advanced deterioration. This closure created mobility issues in the City and commerce disruption. The City of Allentown decided that a Design/Build method of procurement would result in the re-establishment of this important City link in a minimum amount of time and allow the maximum amount of industry flexibility in the delivery system.

In January, 2011, the project was awarded to the contractor J.D. Eckman, Inc. of Atglen, PA. Alfred Benesch & Company in Allentown, PA and American Geotechnical and Environmental Services, Inc. made up the design components of the Design/Build Team. The Design/Build Team was able to work within the provisions of the contract and put the power of this procurement method to work by advancing alternate approaches for two major elements of the conceptual design package.

The 15th Street Bridge spans an 8'x 6' concrete box culvert that conveys the City's stormwater flow to the Little Lehigh Creek. In order to reduce the impacts to the box culvert, the conceptual cast-in-place concrete abutments were changed to Mechanically Stabilized Earth walls with steel H-piles straddling the box culvert. The Steel H-piles and concrete cap were designed to span the culvert to reduce impacts so that the stormwater system could stay in-service during construction. This approach also minimized the potential for damage. The Ward Street Bridge was conceptually designed as a three span bridge. The Design/Build Team's alternate proposal changed the structure to a two span bridge by utilizing 9000 psi concrete which permitted lengthening the prestressed bulb-tee beams. The higher strength concrete, the reduction of weight by eliminating the raised sidewalk on the bridge and using foam in the valleys of the stay-in-place forms allowed the two span configuration.

There were environmental constraints imposed on the project due to the setting surrounding the Little Lehigh Creek. The Creek is listed in the PA Code as a High-Quality, stocked wild trout stream. This posed a restriction on in-stream activities from March 1 to June 15 and October 1 to December 31. The City also has an intake for their water treatment facility just downstream of the project location. Because of this, turbidity levels had to be monitored on a regular basis. In addition, exceptional value wetlands and a 150' riparian buffer requirement were project elements that had to be considered in the Design/Build Team's approach. Final permitting was a part of the Design/Build Team's responsibilities.

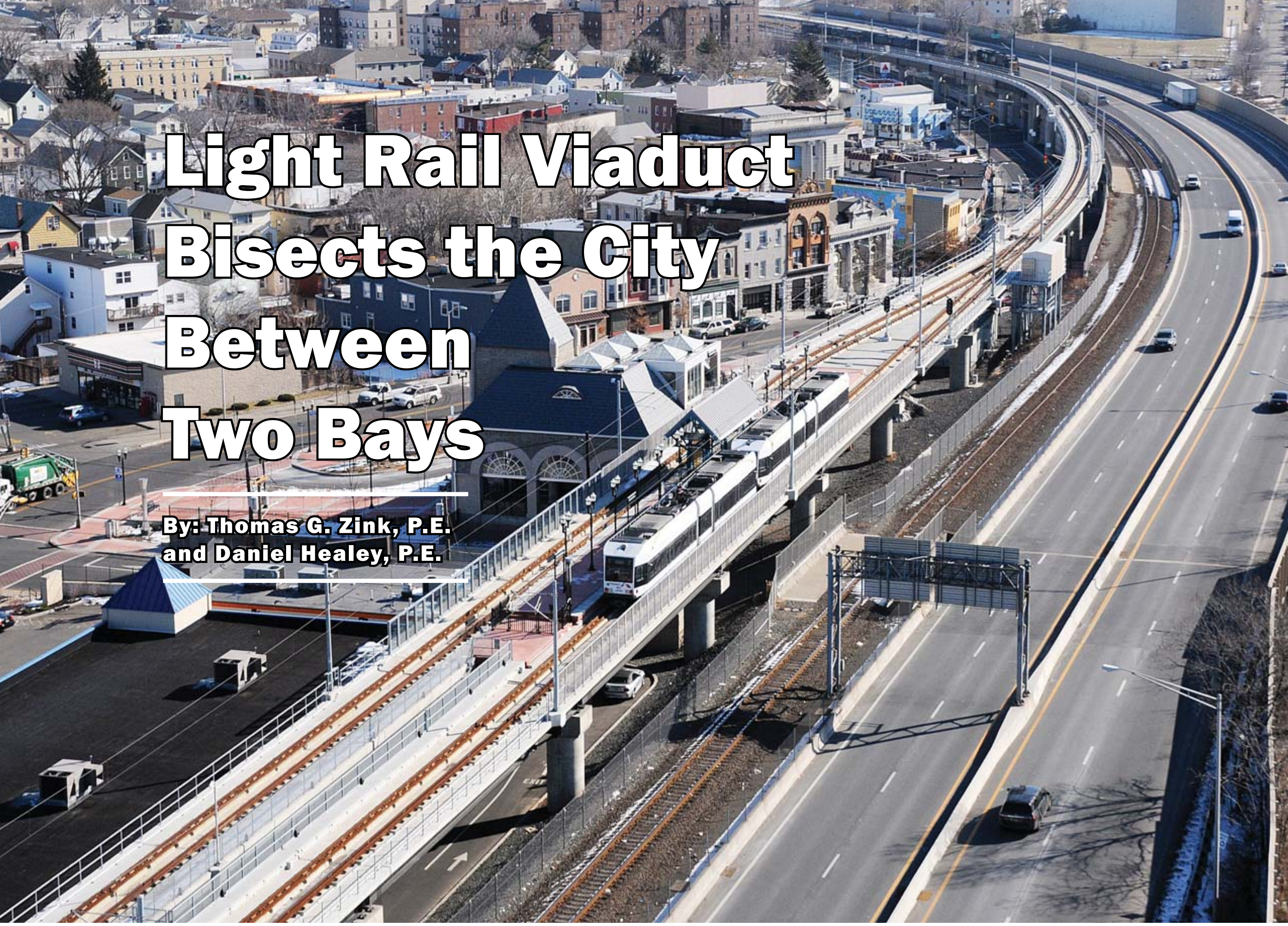
The Design/Build delivery method utilized on this project allowed the industry to leverage its' expertise while delivering a safe and efficient transportation network to the City.

About the author...

Gregory Kuklinski, PE is a Project Manager at Alfred Benesch & Company in Allentown, PA.

Light Rail Viaduct Bisects the City Between Two Bays

By: Thomas G. Zink, P.E. and Daniel Healey, P.E.



View of the new 8th Street Station showing the station building, loading platform, and 21-span viaduct.

Considered one of the most successful Private-Public Partnership projects in the United States, NJ TRANSIT's Hudson-Bergen Light Rail Transit System (HBLRTS) is a key component to New Jersey/New York's regional intermodal network. With stations located along its alignment through the cities of Hoboken, Jersey City, and Bayonne, New Jersey, the system accommodates approximately 47,000 passengers a day and provides mobility for commuters with intermodal connections to the PATH and ferry services into the New York City, as well as other bus and rail services.

In 2008, NJ TRANSIT (NJT) initiated what would become a $100M program aimed at extending the HBLRTS from the existing southern terminus at 22nd Street in Bayonne to a new station located further south at 8th Street in Bayonne. As part of this plan, NJT chose to utilize Design-Build contracting to procure the engineering design and construction. The contract, which required a one-mile extension of track as well as a new station building, was awarded to George Harms Construction Co., Inc. of Howell, NJ and their designated Engineer/Architect of Record design firm, Gannett Fleming, Inc.

The design and construction of this project presented many challenges, including managing the impact of the infrastructure placement and construction activities on the general public, vehicular and pedestrian traffic, area businesses, and residential areas. The project team embraced creative planning, design, and construction techniques to make the extension a reality. In an area full of businesses, existing neighborhoods, and heavily traveled city streets, the project process demanded a collaborative approach involving numerous stakeholders.

One of the most significant challenges on this project was the development of designs that fit within the confines of a very congested site. The new 8th Street Station and passenger platform (at the southern terminus) is situated within a tight area constrained by existing buildings, Conrail right-of way, New Jersey Department of Transportation infrastructure, and city roadways. During design development, the team was challenged with shoehorning the station building design and construction to fit into a small existing property lot. Due to the numerous physical constraints along the proposed alignment, approximately 40% of the system extension was supported on structure. This resulted in the need for a 21-span viaduct with an aerial loading platform at the southern end. The new station building is therefore a two-story structure that provides both staircases and elevators for access to the station platform. By

Northern section of viaduct as seen from Avenue E, facing North.

building up instead of out, the team was able to adequately address the lack of space for the new facility.

From a structural engineering standpoint, the viaduct was challenging to design as it required three very unique sections to meet the project demands. The northern section consists of four (4) three-span continuous superstructure units supporting a single track on a horizontally curved alignment. A turnout and track switch was required on the second section of the viaduct to allow the single track from the north to split into two separate parallel tracks to the south. This transition occurs on a three-span continuous unit that varies significantly in width from one end of the unit to the other. The two tracks then continue to the third section of the viaduct, whereby each track is supported by its own six span superstructure. The two tracks flank a loading platform in the vicinity of the station building. The split track configuration allows one train to load while another approaches the station, significantly improving operations at the southern end of the line.

Façade of station building with viaduct and loading platform in background.

Continuously welded rails were directly fixed to the structure using rail clips and concrete plinths cast into the deck. This added to the complexity of the design with respect to structure-rail interaction, particularly with respect to the forces generated by differential thermal movements and potential rail-break conditions. This situation was exacerbated by the fact that the rail line terminated on the structure in the vicinity of the station platform, resulting in the need for rail anchorage devices in the southernmost span. Similar anchorage devices were also required to each side of the track switch where the single track split into two separate sidings.

With the exception of the turnout section, each trackway is supported by two welded steel plate girders made composite with a cast-in-place concrete deck. A similar two-girder section was used for the loading platform as well. The steel framing supporting the turnout section required a splayed girder con-

Viaduct turnout section in the approach to the loading platform, facing South.

figuration, allowing it to transition from a two-girder section at the north end to a four-girder section at the south end. Transverse girders were provided to support the ends of interior girders that terminated away from the substructure units. Although contributing to the complexity of the framing in this section, the structural continuity was required to help distribute the high lateral forces transmitted to the structure by the rail anchorages that were required to each side of the turnout switch.

High volatility in steel pricing also added to the complexity of the superstructure design. As a design build project, the contract was awarded based on material pricing available at the time of the bid. However, the completion of the superstructure design was dependent on complex modeling and track alignments that were yet to be finalized. To help mitigate such risks, the various sections of the viaduct were prioritized and partial submissions made as designs reached both 60% a 90% levels of completion. The Contractor utilized the interim plans to keep his suppliers informed, and was able to lock in prices when the team gained confidence that the quantities would not be significantly affected by the completion of the design effort. The process of partial submissions was then extended to all aspects of design, including foundations, substructures, bearings, and deck designs and formed the backbone of the communications amongst the team to keep the project on schedule.

Due to high foundation load demands and relatively shallow depth to rock, most of the foundation elements supporting the viaduct piers were 6-foot diameter drilled shafts socketed 5 to 8 feet into hard, diabase bedrock using 5.5-foot diameter rock sockets. A single column was provided above grade at each shaft location. For most piers, a hammerhead pier cap was provided to support the two girder superstructure. However, since column locations were constrained by existing physical features, several pier caps had to be placed in non-concentric configurations. The resulting off-set pier caps led to unique loading conditions at each pier location, further complicating the design and presenting a schedule risk to the team.

In addition to the viaduct, the new station building presented another set of interesting and significant challenges to this project. First was the city's desire for the new station to replicate the characteristics of a historic station that was previously located on the site. This required a combination of research and significant stakeholder interaction. In addition, the new 8th Street Station features three art installations created by regional artists who were commissioned through NJT's Transit Arts Program. The largest piece of artwork adorns the entire open station entrance. The mural captures the essence of Bayonne, depicting local storefronts, residential homes, architecture, scenes from the waterfront, and the Bayonne Bridge. Integrating the mural created the need for additional coordination and planning. For instance, the mural was painted on-site on the only full wall within the station building. This required design coordination to make certain that non-vital building equipment was not

The mural in the station building depicts historic scenes and structures of the City of Bayonne.

mounted anywhere on this wall. Construction coordination was also critical to enable a crew of three to five artists working on scaffolding to paint the mural concurrently with the required activities and construction of the contractors' and subcontractors' forces, all working in the limited interior building space.

Despite the numerous design and construction challenges, the George Harms Construction/ Gannett Fleming project team successfully collaborated to complete the project on schedule, and the first train rolled into the new station in a ceremony that took place in January of 2011. The project has been very well received by the public, and is considered a successful project by NJ TRANSIT. The project was also honored with a 2012 Distinguished Award as presented by the American Council of Engineering Companies of New Jersey (ACEC/NJ).

First train approaching the station on Opening Day.

Originally inhabited by Native Americans, the city presently known as Bayonne was claimed by the Netherlands' Henry Hudson who explored the Hudson River in the New World. According to Royden Page Whitcomb's 1904 book, First History of Bayonne, New Jersey, the name Bayonne is speculated to have originated with Bayonne, France from which the Huguenots settled for a year before the founding of New Amsterdam (present day New York City). Others contend that the city was named Bayonne strictly for purposes of real estate speculation, as it is located on the shores of several bodies of water, being surrounded on three sides by the Upper New York Bay to the east, Newark Bay to the west, and Kill van Kull to the south.

About the authors...

Thomas G. Zink, P.E. is a Vice President of Gannett Fleming Inc. He serves as the firms National Bridge Practice Manager as well as the Manager of the Transportation Division of Gannett Fleming's Mount Laurel, New Jersey office. Mr. Zink holds B.S. degrees in both Civil and Architectural Engineering from Drexel University.

Daniel Healey, P.E. is Vice President of George Harms Construction Co., Inc. He manages the engineering staff at the firm, leads the estimating department, and also serves as Project Manager for the company design/build projects. Mr. Healey holds a Civil Engineering degree from Virginia Polytechnic Institute and State University and is a licensed engineering in the State of NJ.

2014IBCPhotoContest

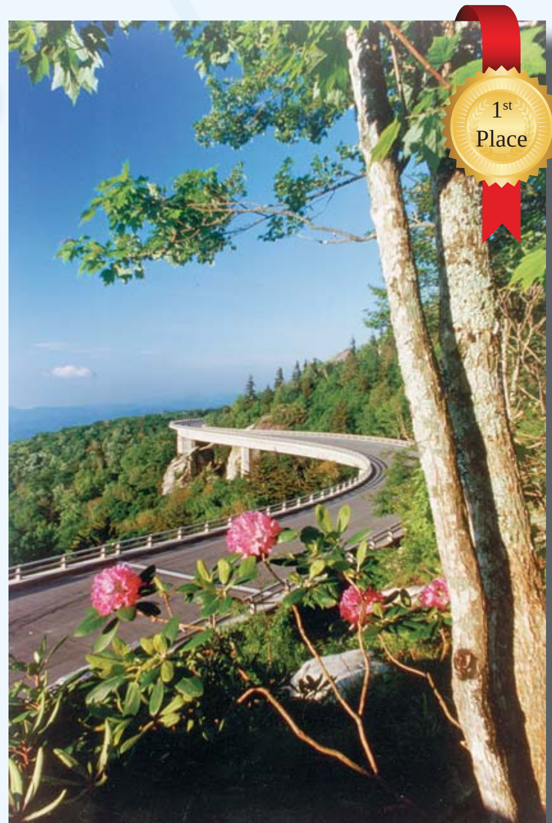
Back by popular demand, the International Bridge Conference has hosted its third annual Photographic Contest. This year we have chosen to feature the bridges of our "Federal Lands" – that includes our national parks, national parkways and other federal land locations. We have looked for both spectacular scenery and spectacular bridges in some off the beaten path surroundings. Have you ever traveled the Blue Ridge Parkway in the Appalachian Mountains? Have you ever traveled to Rocky Mountain National Park, Arches Naional Park, Yellowstone National Park, or the Grand Canyon? – If not, travel with IBC - and see some beautiful bridges in spectacular natural settings along the way. Enjoy! – IBC Executive Committee.

Linn Cove Viaduct
Blue Ridge Parkway
Grandfather Mountain, NC

Photographer:
FIGG Engineering Group
June 1996

Judges Comments:
"a beautiful natural setting with a delicate structure"

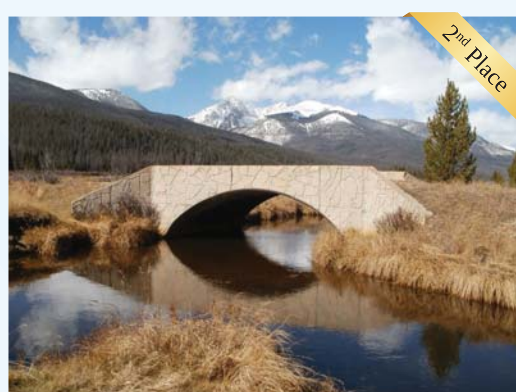
The Blue Ridge Parkway passes to the south side of Grandfather Mountain, the highest peak on the eastern escarpment of the Blue Ridge Mountain. The mountain boasts 16 distinct ecological communities and has experienced some of the highest surface winds ever recorded with unverified speeds estimated at 200 mph (320 kph).



Gubbins-Johnson Access Road over Baker Creek
Rocky Mountain National Park

Photographer:
Daniel Kent, Jr., October 2012

Judges Comments:
"pastoral reflected image in the splendor of the Rockies"



At more than 12,000 feet (3,700 m) above sea level and spanning the Continental Divide, Rocky Mountain National Park features majestic mountain views, mountain lakes, a variety of wildlife, varied climates and environments - from wooded forests to mountain tundra.

2014 IBC Photo Contest

Natchez Trace Parkway Bridge
Williamson County, TN

Photographer:
FIGG Engineering Group
October 1996

Judges Comments: "beautifully expressive classical lines - yet modern in every sense of the word"

US-191 over Colorado River (gateway to Arches National Park, Canyonlands National Park & Dead Horse Point State Park)
Moab, UT

Photographer:
FIGG Engineering Group
December 2010

Judges Comments: "Impressive desert hues in the canyon and reflected in the structure"

Black Bridge
Grand Canyon National Park, AZ

Photographer:
Matt Leech, July 2012

Judges Comments: "delicate and graceful structure in the depths of the canyon"

"The glories and the beauties of form, color, and sound unite in the Grand Canyon - forms unrivaled even by the mountains, colors that vie with sunsets, and sounds that span the diapason from tempest to tinkling raindrop, from cataract to bubbling fountain." John Wesley Powell

2014 IBC Photo Contest

Silver Bridge
Grand Canyon National Park
AZ

Photographer:
Matt Leech
July 2012

Judges Comments:
"slender long span structure in a dramatic setting"

Yellowstone National Park

Photographer:
Jason Hahn
June 2013

Judges Comments:
"a beautiful natural setting ... with a delicate structure"

Blue Ridge Parkway over North Carolina Route 80

Photographer:
Dan Kent, Jr.
June 2013

Judges Comments: "iconic structure with classical lines ..."

2014 ibc Awards Program

By Lisle Williams, P.E.

Roebling Medalist: *"...a leader... an innovator...a practitioner..."*

Richardson Medalist: *"this bridge truly represents the spirit of the Richardson Award for outstanding engineering and construction achievement ... a key transportation link between two states and the St. Louis metropolitan area"*

Lichtenstein Medalist: *"early 20th century history preserved with 21st century innovation"*

Hayden Medalist: *"an interesting blend of native culture and a modern pedestrian overpass ... striking and fitting within a rugged landscape"*

Lindenthal Medalist: *"the design- build team delivered an aesthetically pleasing toll bridge facility in a very short timeframe while incorporating innovative design and material concepts and overcoming the considerable environmental and regulatory constraints at the site"*

Figg Medalist: *"when you want a photograph of a dramatic, innovative bridge Icon, all you will have to do is look at the Dragon Bridge in South Vietnam"*

These are some of the many comments of the International Bridge Conference Award's Committee as they viewed, voted and selected this year's winners.

The International Bridge Conference® in conjunction with Roads and Bridges Magazine, bridge design & engineering Magazine and the Bayer Corporation, annually awards six medals to recognize individuals and projects of distinction. The medals are named in honor of the distinguished engineers who have significantly impacted the bridge engineering profession worldwide.

Interest in the IBC awards program is quite robust nationwide and internationally. This year the Awards Committee reviewed more than forty nominations for the various bridge metal categories alone, half of which were projects nominated beyond the borders of the United States. After lengthy deliberations, the following individuals and projects were deemed worthy of this year's awards.

John A. Roebling Medal

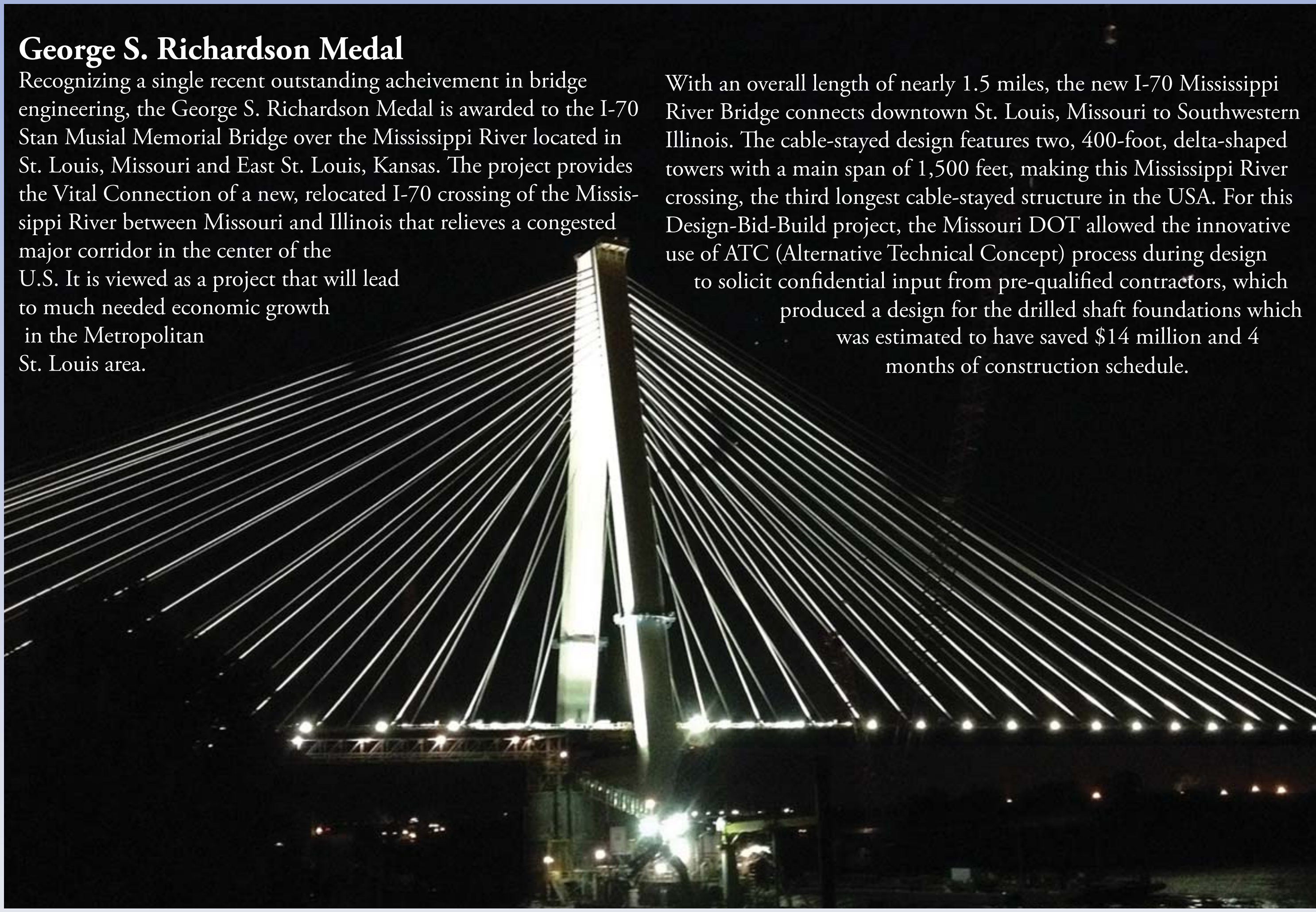
Recognizing an individual for lifetime achievement in bridge engineering, the 2014 John A. Roebling Medal is presented to Mr. Malcolm T. Kerley. Mr. Kerley, as current President of NXL Construction Services, Inc. and recently retired Chief Engineer for the Virginia Department of Transportation has faithfully served the transportation industry for over 40 years. A native of Virginia, Mr. Kerley received his undergraduate and graduate degrees from the University of Virginia after service in the U.S. Army Corps of Engineers he began a long carrier with the Virginia Department of Transportation attaining the position of chief engineer until his retirement from VDOT in 2012. For many years, Mr. Kerley provided direction, guidance and management to the Virginia Department of Transportation's Engineering Program with oversight responsibilities of six divisions including: Innovative Project Delivery Division, Location & Design Division, Materials Division, Right of Way and Utilities Division, Scheduling and Contract Division and Structure and Bridge Division. Mr. Kerley led the strategic planning, development and implementation of innovative agency-wide plans, programs and policies related to the development and delivery of engineering procedures and processes. He continues to participate in bridge related topics at the national level as a member of the TRB Committee for the FHWA Long Term Bridge Performance Program, member - NCHRP Synthesis Project 20-5 Committee. He has recently served on the SHRP2 panel to develop an Implementation Plan for Project R19A - Bridges for Service Life beyond 100 Years: Innovative Systems, Subsystems, and Components and participated on the steering committee for the Florida International University ABC-UTC. In addition, Mr. Kerley represented VDOT at federal, state, and local levels concerning transportation programs and projects by participating as a member or chairman in the AASHTO Standing on Committee on Highways (SCOH) including SCOH 20-7 Committee and SCOH Technology Implementation Group (TIG), AASHTO Subcommittee on Bridges and Structures (SCOBS), PIARC Committee TC 4.4 Bridges and Related Structures (2004-2012), NCHRP Synthesis 33-02 (Prefabricated Bridge Elements and Systems to Limit Traffic Disruptions during Construction), NCHRP Project 12-57 (Extending Span Ranges of Precast, Prestressed Concrete Girder), TRB Committee AFF-20 (A2C02) Steel Bridges and TIG committee member on Rapid Bridge replacement.


Malcolm Kerley

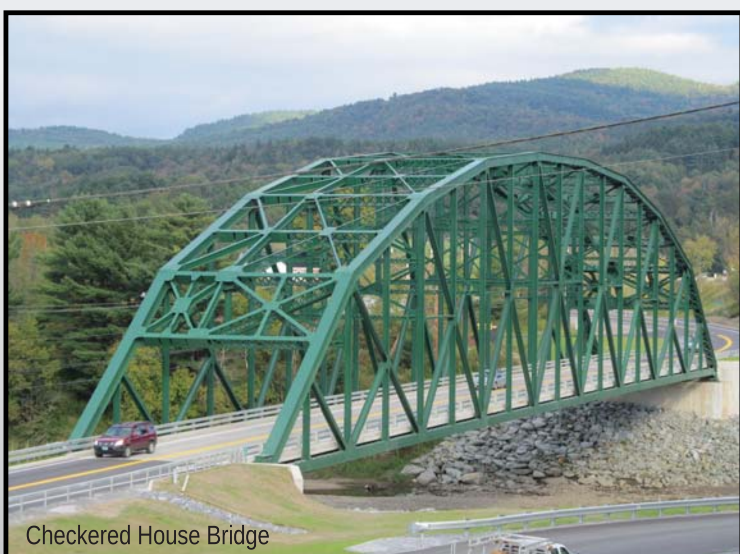
George S. Richardson Medal

Recognizing a single recent outstanding acheivement in bridge engineering, the George S. Richardson Medal is awarded to the I-70 Stan Musial Memorial Bridge over the Mississippi River located in St. Louis, Missouri and East St. Louis, Kansas. The project provides the Vital Connection of a new, relocated I-70 crossing of the Mississippi River between Missouri and Illinois that relieves a congested major corridor in the center of the U.S. It is viewed as a project that will lead to much needed economic growth in the Metropolitan St. Louis area.

With an overall length of nearly 1.5 miles, the new I-70 Mississippi River Bridge connects downtown St. Louis, Missouri to Southwestern Illinois. The cable-stayed design features two, 400-foot, delta-shaped towers with a main span of 1,500 feet, making this Mississippi River crossing, the third longest cable-stayed structure in the USA. For this Design-Bid-Build project, the Missouri DOT allowed the innovative use of ATC (Alternative Technical Concept) process during design to solicit confidential input from pre-qualified contractors, which produced a design for the drilled shaft foundations which was estimated to have saved $14 million and 4 months of construction schedule.



Abba G. Lichtenstein Medal



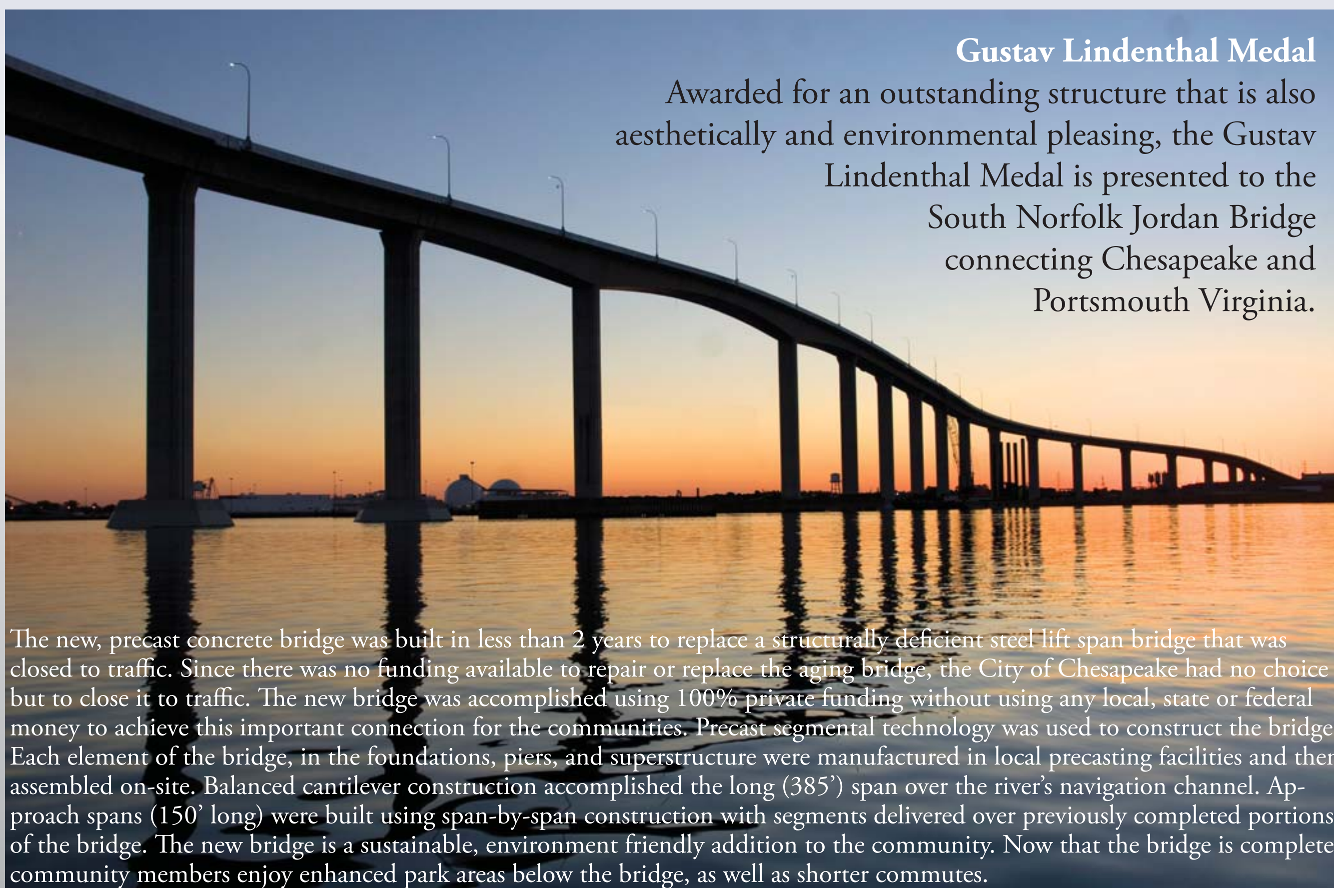
Checkered House Bridge

Recognizing a recent outstanding achievement in bridge engineering demonstrating artistic merit and innovation in the restoration and rehabilitation of bridges of historic or engineering significance, the Abba G. Lichtenstein Medal is awarded to the Checkered House Bridge in Richmond, Vermont. Built in 1929, the Checkered House Bridge, named after a nearby historic checkered brick pattern home, is a 350 ft.-long steel truss bridge that was placed on the National Register of Historic Places in 1990. The goal of the project was to widen the 350 foot span by twelve and one half feet. This rehabilitation and widening project had to satisfy Section 106 of the National Historic Preservation Act of 1996 and Section 4(f) of the U.S. Department of Transportation requirements. This project is only the second design-build project undertaken by the Vermont Agency of Transportation (VTrans) since design-build project delivery was authorized by the Vermont legislature. This was the first time that a steel truss bridge this size was widened. The moist challenging aspect of the project was the incremental side-launch method which proved to be a very practical application for a rehabilitation and widening project. To preserve as much of the bridge as possible, an incremental side-launch concept for a falsework and jacking system was developed that allowed the North truss to be moved while still receiving lateral support from the South truss system. The South truss was designed to support the entire existing truss bracing members with the aid of the unique falsework system that stabilized the eccentric self-weight, wind loading and jacking forces through the many phases of the North truss jacking operation.

Squamish Pedestrian Overpass

Arthur C. Hayden Medal

Recognizing a single recent outstanding achievement in bridge engineering demonstrating vision and innovation in special use bridges, the Arthur C. Hayden Medal is presented the Squamish Pedestrian Overpass in British Columbia, Canada. The overpass, an asymmetric single arch span, is a unique structure standing in harmony with its surroundings. The structure incorporates a variety of cultural symbolism and acts as a gateway to the community of Squamish, named after the indigenous peoples of the region. The bridge lies in the shadow of the 600 meter granite massif, known as the Stawamus Chief. The design of the overpass developed in collaboration with the Squamish Nation Chief, the Squamish Lil'wat Cultural Centre, and a local Squamish artist, closely follows the cultural symbols of the Squamish Nation. As an example, the tale of "slaying the serpent" that lived on Stawamus Chief is captured in artwork on the arch "thrust walls" and captured in the spear shaped hangers and struts. Similarly, the symbolic thunderbird is represented on the reverse side of the thrust walls, and can be seen heading north on the highway towards Mt. Garibaldi and Black Tusk – its perch. The significance of the artwork that is evident in all elements of the bridge is vital to a community that strives to preserve its rich history and traditions. Upon reaching the bridge from the west side, users are greeted by a pair of upturned paddles, a symbol of peace and respect. An observation deck is incorporated into the design to provide a rest area for users to pause and enjoy the expansive view before them of the sheer cliff, rock face of the Stawamus Chief.



Gustav Lindenthal Medal

Awarded for an outstanding structure that is also aesthetically and environmental pleasing, the Gustav Lindenthal Medal is presented to the South Norfolk Jordan Bridge connecting Chesapeake and Portsmouth Virginia.

The new, precast concrete bridge was built in less than 2 years to replace a structurally deficient steel lift span bridge that was closed to traffic. Since there was no funding available to repair or replace the aging bridge, the City of Chesapeake had no choice but to close it to traffic. The new bridge was accomplished using 100% private funding without using any local, state or federal money to achieve this important connection for the communities. Precast segmental technology was used to construct the bridge. Each element of the bridge, in the foundations, piers, and superstructure were manufactured in local precasting facilities and then assembled on-site. Balanced cantilever construction accomplished the long (385') span over the river's navigation channel. Approach spans (150' long) were built using span-by-span construction with segments delivered over previously completed portions of the bridge. The new bridge is a sustainable, environment friendly addition to the community. Now that the bridge is complete, community members enjoy enhanced park areas below the bridge, as well as shorter commutes.

Eugene C. Figg, Jr. Medal for Signature Bridges

Recognizing a single recent outstanding achievement for bridge engineering, which is considered an icon to the community for which it is designed, the Eugene C. Figg Medal for Signature Bridges is presented to the Dragon Bridge. Located in the central region of the country at the mouth of the Han River, Da Nang is one of Vietnam's principal port cities, serving as an important commercial and educational center, as well as a critical transportation hub. In order to facilitate long-term development and strengthen regional access, the Da Nang People's Committee (DNPC) initiated a program to construct a new bridge across the Han River, which would link the city with the developing eastern sectors. Envisioning an iconic structure to complement and enhance its surroundings, city leaders sponsored an international design competition. Rather than a high-deck bridge, which would have disrupted scenic views of the river and the city, a parkway-style bridge with an at-grade approach at the western end was proposed. The bridge's low profile resulted in a unique structural support - the "dragon" arch suspension system. The dragon is one of the most important symbols in Vietnamese culture, representing power and nobility. The bridge's arch suspension system is modeled after a dragon flying across the Han River. The bridge's pedestrian sidewalks are also influenced by the dragon theme, with the outer edge overlooking the Han River following the undulating pattern of a dragon's body. The bridge's center three spans employ a unique design that combines a hybrid steel box girder with a central rib steel-and-concrete arch. Above the bridge deck, the arch is composed of five steel tubes, carrying the bridge superstructure through a "spider frame" and suspenders placed at 8-meter intervals; these spider frames also provide the base structure for the dragon's scales. The bridge breathes fire and water at 10pm on weekends, and is illuminated at night by 15,000 LED lights.

The IBC Awards Committee includes Fred Graham, Jim Dwyer, Herb Mandel, Richard Connors, Myint Lwin, Rachael Stiffler, Ken Wright, Jay Rohleder, Matthew Bunner, John Dietrick, Helena Russell, Bill Wilson, Lisle Williams and Tom Leech (Committee Chairman).

About the author...

Lisle Williams, P.E. was named Emeritus Member of International Bridge Conference Executive Committee in 2010 and for many years has faithfully served on the IBC Awards Committee. Lisle dedicated a significant portion of his engineering career to the development of sustainable and viable highway and bridge transportation systems. – Editor

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