



*The 28th Annual*  
**International  
Bridge  
Conference®**  
*Bridges  
Without Borders*

**June 5-8, 2011  
David L. Lawrence  
Convention Center  
Pittsburgh, PA USA**

**CONFERENCE  
PROGRAM  
GUIDE**

Sponsored by:



*Engineers' Society  
of Western  
Pennsylvania*



**American Road &  
Transportation Builders  
Association**

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## WELCOME TO THE 28<sup>TH</sup> ANNUAL INTERNATIONAL BRIDGE CONFERENCE®

Please read the following general information to learn about many of the new features of the IBC! With our return to the David L. Lawrence Convention Center (DLLCC), we have the opportunity to offer many new and exciting elements to the Conference, and many new improvements from the 2010 IBC. As always, Conference personnel (found at the Registration Desk) and IBC Executive Committee Members (look for their ribbons!) can be an additional valuable source of information!

### REGISTRATION DESK

The Conference Registration Desk is located in HALL A of the DLLCC, on the riverside of the convention center. The hours of operation are:

- Sunday, June 5: 5:00 - 7:00 PM
- Monday, June 6: 7:00 AM - 7:00 PM
- Tuesday, June 7: 7:00 AM - 5:00 PM
- Wednesday, June 8: 7:00 AM - 1:30 PM

### REGISTRATION AND ADMISSION

Full Registration includes admission to the Keynote Session, Featured Agency Session, daily Technical Sessions, Workshops, IBC Exhibit Hall, Monday evening Exhibitors Party, and the Monday and Wednesday Exhibit Hall Buffet Luncheon. One-Day Registration includes the Technical Sessions, Workshops and IBC Exhibit Hall and corresponding exhibit function for that day only.

With so many new events included in the IBC, we hope to provide you with a better understanding of the various offerings for Conference attendees. You will still see the quality technical presentations as offered in all previous IBC's; these are referred to as "Technical Sessions", and include papers grouped into sessions of common subject matter. Again, we are offering several "Seminars" that are educational programs for continued training. We also offer for your consideration a number of "Workshops" presented by many of our co-sponsors, and other industry-leading groups on an even wider variety of bridge industry subject matter. Lastly, many of these same groups have coordinated their "Committee Meetings" during the dates of IBC; some of which are open to all conference registrants.

Remember: Seminars, Tours the IBC Awards Receptions, and Conference Proceedings require an additional registration fee. Please visit the Conference Registration Desk for details.

### BADGE IDENTIFICATION

Please wear your IBC name badge at all times during the conference; it is your passport to all Conference activities. ESWP has authorized Room Monitors on staff to deny access to anyone not wearing the appropriate badge. As a safety consideration, we do suggest that you remove your badge when leaving the Conference.

### MEETING INFORMATION

IBC functions are located in the DLLCC. Please check individual listings throughout this program for specific locations and times for all technical sessions, seminars and social functions. Events which require tickets will also identify the specific location for these functions. Any changes in the program schedule will be posted or announced at the Conference Registration Desk.

## CELL PHONES AND PAGERS

As a courtesy to the Speakers and fellow attendees, the IBC requests that all cell phones and pagers be turned off or switched to silent mode in all Presentation Rooms.

### ATTENDEE REGISTRATION LISTS

Conference registrations received prior to May 27 have been compiled in the "IBC PRE-REGISTRATION LIST - PART 1 of 2", and is available to all registered attendees in .PDF format, available to transfer to *YOUR FLASH DRIVE*. Please note, as we try to continually green the IBC, we are no longer printing Registration Lists for every attendee.

An addendum to the registration list, "PART 2 of 2," will be available Wednesday morning of the conference and reflects those attendees who registered after May 28 or on-site during the conference.

An electronic copy, produced in MS Excel, of the entire Attendee Registration List is available for purchase. The cost is \$25 for IBC Exhibitors, and \$95 for all others, the list will be e-mailed to you following the conference.

### MESSAGE BOARD

As a service to Conference registrants, a Message Board will be located in the Registration area of the DLLCC. The board will be available on June 6 - 8. Messages will be retained until the end of each day.

### IBC BRIDGE TOUR

**Tuesday, June 7; 1:00 - 5:00 P.M.**

Pittsburgh is the city of bridges, and the IBC is pleased to once again offer our tour of unique area bridges. A signed waiver and release and appropriate footwear will be required to enter the construction area. Proposed sites include the I-579 Crosstown Bridge, the Boston Bridge and the McArdle Roadway Viaduct. This guided tour departs from the Convention Center at 1:00 p.m. (An additional fee of \$40 is required; advance registration is required and seating is limited.) Please check the IBC registration Desk for availability and advance registration.

### IBC EXHIBIT HALL

One of the main attractions of the Conference is the IBC Exhibit Hall. As you stroll through more than 160 exhibits, you will be able to explore the latest technologies, products and services the bridge industry has to offer. We also present several "Mini-Theatre" presentations at various times throughout the conference, where you can learn even more about the products and services of many of the exhibitors. Additionally, don't forget to participate in our popular "Exhibit Hall Bingo" game for your chance to receive cash prizes, simply by visiting the exhibitors on your bingo card. All registered attendees will have a bingo card in their registration packet.

The IBC Exhibit Hall is located in HALL A of the DLLCC. You will be able to view the exhibits during the following hours:

- Monday: 12:00 NOON - 7:00 PM
- Tuesday: 8:00 AM - 5:00 PM
- Wednesday: 8:00 AM - 1:30 PM

The IBC will feature a Luncheon Buffet throughout the Exhibit Hall on Monday, June 6 and Wednesday, June 8 and is open (at no additional charge) to all registered attendees and registered spouses. Also, don't miss our popular Exhibitor Reception, on Monday

evening from 5:00-7:00 P.M. throughout the Exhibit Hall. All registered attendees will receive one ticket redeemable for a beverage at the reception, (Additional tickets can be purchased at the Conference Registration Desk.)

## HOST HOTEL INFORMATION

Enjoy the luxury and convenience of the IBC Headquarters Hotel, the Westin Convention Center Hotel. The Westin is Pittsburgh's newest and most elegant hotel. Linked to the DLLCC via Skybridge, or by an easy outdoor walk across Penn Avenue. Hotel reservations can be made by contacting the Westin Convention Center Hotel directly at 412-281-3700.

Westin Convention Center Hotel  
1000 Penn Avenue  
Pittsburgh, Pennsylvania 15222  
412-281-3700

## PRE-PRINTS AND IBC MERCHANDISE

Pre-prints for all technical presentations are available at the Pre-Print area located just inside of the Exhibit Hall near the Conference Registration Desk. Pre-prints can be purchased for just \$3.00 per copy.

Again this year: purchase a 1 GB flash drive that contains all available pre-prints in PDF format for only \$30.00

Also, you can find copies of previous years' IBC Proceedings (for \$55 per volume). The Pre-Print Booth will be open:

- Monday: 9:00 A.M. - 6:00 P.M.
- Tuesday: 8:30 A.M. - 5:00 P.M.
- Wednesday: 8:30 A.M. - 1:30 P.M.

## IBC GIFT ITEMS

Once again at this year's IBC, you will have the opportunity to purchase IBC Golf Shirts, T-shirts, and Hats. These items are high quality and feature the popular IBC logo. The Gift Item Table is located near the Pre-print desk on Concourse A, just inside of Hall A, where you can make your purchases throughout the Conference until Wednesday at 1:30 P.M. Please be sure to stop by and shop before Wednesday and check out our newest styles for the 2011 IBC!

## PROCEEDINGS

Proceedings are an optional order-only purchase and may be ordered in advance or on-site at the IBC for \$30.00. Following the conference, proceedings may be ordered for \$55.00. The official proceedings of the 28<sup>th</sup> Annual International Bridge Conference® will be available on CD in late Summer 2011 and mailed to you at that time.

## COFFEE STAND

Complimentary coffee breaks are available at various times throughout the Conference as noted in your Program Guide. Most breaks are presented in the Exhibit Hall. In addition, a coffee kiosk will offer beverages for purchase at various times during the conference. The Kiosk will be located outside of Hall A.

## PDH'S

### Earn Professional Development Hours (PDHs) by attending the IBC!

The Engineers' Society of Western Pennsylvania (ESWP), sponsor of the IBC, has been recognized as a Continuing Education Provider by the New York State Board of Professional Licensure and Florida Board of Professional Engineers, as well as many other state licensing boards. As such, your attendance at the IBC will qualify for continuing education credits.

To obtain verification of attendance at the IBC from the ESWP, you must request a PDH Confirmation Letter. Official confirmation from the IBC Offices regarding each attendee's eligibility for PDHs will be mailed after the Conference. Attendees who checked the "PDH Letter Requested" box on your Registration Form will automatically receive a Verification Letter that must be returned to ESWP. (PDH Letters can be requested at the Conference Registration Desk or by contacting the Engineers' Society of Western PA, sponsors of the IBC.)

NOTE - For fulfilling continuing education requirements with New York State, attendees are required to sign in-and-out of IBC technical sessions, workshops or seminars on the session registry. Registry forms are located at the entrance to any of these sessions. *Please note that ESWP is unable to verify your attendance in any session if you do not properly sign this registry!*

## PARKING

The Westin Convention Center Hotel does have its own parking facility, and valet parking is available for an additional cost of \$22 per day. Simply pull up to the front door of the hotel to utilize this service. Parking at the David L. Lawrence Convention Center is also available. Self parking lots are in the immediate vicinity. Maps are available on line at <http://www.pittsburghcc.com/cc/Directions/Parking.aspx>

## AMERICANS WITH DISABILITIES ACT

The International Bridge Conference and ESWP support the Americans with Disabilities Act (ADA), which prohibits discrimination against, and promotes public accessibility for those with disabilities. We ask those requiring specific equipment or services as an attendee to contact the ESWP Conference Department at 412-261-0710, ext. 11 and advise us of any such requirements in advance.

## LOOKING AHEAD!

Interested in presenting a paper, workshop, seminar or mini-theatre presentation at a future IBC? The IBC Call For Papers will open immediately following the 2011 Conference, and everyone is welcome to submit an idea for presentation. Visit [www.eswp.com/bridge](http://www.eswp.com/bridge) for more details.

## JOIN US AT THE 2012 IBC!

June 10-13, 2012, David L. Lawrence Convention Center, Pittsburgh, PA

## IBC EXECUTIVE COMMITTEE

The Engineers' Society of Western Pennsylvania wishes to extend it's thanks and gratitude to the following members for their dedication to the planning on the 2011 International Bridge Conference®. (\*denotes Honorary Member)

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**KEYNOTE SESSION**

**Time: 8:30 AM - 12:00 NOON**

**Room: Ball Room B**

**Chair: Thomas J. Vena, P.E., IBC Conference Chair, A&A Consultants, Inc., Pittsburgh, PA**

The 28th Annual International Bridge Conference® will kick off with the Keynote Session, featuring leaders of the bridge industry from around the world. This annual kick-off to the IBC will be led by Thomas J. Vena, P.E., Chair of the 2011 Conference. Scheduled topics and speakers include:

- "AASHTO/FHWA Update" Malcolm T. Kerley, P.E., AASHTO, Richmond, VA and M. Myint Lwin, P.E., S.E., Director, Office of Bridge Technology (HIBT), Federal Highway Administration, Washington, DC
- "The Future of High Speed Rail in North America" - Al Engel, Vice-President of Amtrak
- "America's Infrastructure Report Card" - Andrew Herrmann, P.E., ASCE President, Washington, DC
- "50 Years of Bridge Building" - Bob Luffy, former CEO, American Bridge, Pittsburgh, PA
- "Overview and Policy of KOREA Bridge" - Hyeong-Ryeol KIM, Ph.D., P.E., Director General, Road Policy Bureau, Ministry of Land, Transport and Maritime Affairs (MLTM), Republic of Korea

**KEYNOTE BIO BRIEFS:****MALCOLM KERLEY, P.E.****AASHTO, RICHMOND, VA**

Malcolm T. Kerley (Mal) is a 1971 graduate of the Virginia Military Institute and received his Masters Degree in Civil Engineering from the University of Virginia in 1973.

During his forty years with the Virginia Department of Transportation (VDOT), he worked in several areas of VDOT's Structure and Bridge Program mainly involved in the design and development of new structural plans. From 1992-2002, he served as State Structure and Bridge Engineer where he was responsible for the design, construction, inspection and maintenance of the Department's 20,000 structures. He was promoted in July 2002 to his present position where he is responsible for the engineering aspects of the Department, including overseeing the pre-construction design activities of four divisions within VDOT. A registered professional engineer in Virginia, Mal is actively involved in various committees within the transportation industry, represents Virginia on the AASHTO Standing Committee on Highways, and is Chair of the AASHTO Subcommittee on Bridges and Structures.

**M. MYINT LWIN, P.E., S.E.,****DIRECTOR, OFFICE OF BRIDGE TECHNOLOGY (HIBT),  
FEDERAL HIGHWAY ADMINISTRATION**

Myint Lwin is the Director of the Office of Bridge Technology with the Federal Highway Administration (FHWA). As Director of the Office of Bridge Technology, his responsibilities include: providing national guidance in the design and construction of major and unusual bridges and tunnels; developing national bridge program and

engineering policies; initiating system and process improvements to continually improve the quality and safety of bridges and structures; and providing technical and program direction for the Highway Bridge Replacement and Rehabilitation Program. Prior to his appointment in Washington, D.C., Mr. Lwin was the Structural Design Engineer at the FHWA Resource Center in San Francisco. Before joining FHWA in January 2000, he was the State Bridge and Structures Engineer, Office of Bridges and Structures, Washington State Department of Transportation. Mr. Lwin received his BSCE from the University of Rangoon, Burma, and his MSCE degree from the University of Washington, Seattle. He is a registered Professional Engineer in Civil and Structural Engineering.

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**ANDREW WILLIAM HERRMANN, P.E., S.E.C.B.,  
ASCE PRESIDENT, WASHINGTON, DC**

Andrew Herrman is a 1973 alumnus of Valparaiso University graduating with his Bachelors of Science in Civil Engineering. He received his Masters of Science in Civil Engineering at Polytechnic Institute of NEW York, NY. Andrew has worked at Hardesty & Hanover, LLP since the beginning of his career. He has held positions such as structural detailer, structural engineer, project engineer, associate engineer, partner, managing partner, and principal. He holds his Professional Engineer license in 29 states. Actively involved in ASCE for over 30 years, he is the President of the organization. He is the recipient of several ASCE awards including the President's Medal (2009), New Jersey Section "Excellence in Management Award" (2008), Lower Hudson Branch "John B. Jervis Award" (Engineer of the Year) (2008), and Metropolitan Section "Thomas C. Kavanagh Service Award" (2007). Outside of professional work and ASCE, he is actively involved in the community as well as participating in two The History Channel's documentaries. In his free time, he enjoys fishing, cross country skiing, enjoying time with his wife, Linda, two daughters, Christina and Leslie, as well as his grandchildren.

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**AL ENGEL,  
VICE PRESIDENT OF AMTRAK, WASHINGTON, DC**

Al Engel has more than 40 years of experience in the rail transportation business and over that time has been active in the study, advocacy and development of high-speed rail projects, including equipment procurement and infrastructure work on the Northeast Corridor in advance of the launch of Amtrak high-speed Acela Express service.

Prior to joining AECOM in 2009, Mr. Engel worked as a financial advisor with Morgan Stanley from 2006 to 2009. From 1991 to 2006, he was president and CEO of SYSTRA Consulting, a consulting firm affiliated with Societe Nationale des Chemins de Fer Francais (SNCF), the French national railway and Paris Metro specializing in rail transportation and public transit planning and engineering, including high-speed rail projects.

From 1985 to 1989, he served as president and CEO of LS Transit Systems, Inc., the company he launched which was later renamed SYSTRA Consulting. One of his several key consulting roles included the California High-Speed Rail Authority Implementation Plan.

From 1989 to 1990, he served as president and COO of Atlantic Track and Turnout Company, a steel product fabricator and distributor specializing in rail and track accessories. From 1978 to 1985 he headed the infrastructure engineering unit of Gibbs & Hill, the firm which serviced the Pennsylvania Railroad and later Amtrak on its electric traction engineering needs.

Mr. Engel spent the first decade of his professional life with General Electric holding various positions in the Locomotive Department including the management of the domestic electric locomotive business unit.

He currently serves on the American Public Transportation Association (APTA) board of directors and has served on several working committees of APTA and other industry associations. He was chairman of the High-Speed Rail Association from 1994 to 1995 and has won numerous awards for his leadership in public transportation advocacy.

Mr. Engel earned his Bachelor of Science degree in Electrical Engineering from Pennsylvania State University in 1968 and holds professional engineer licenses in New Jersey, New York, and Pennsylvania.

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**ROBERT J. LUFFY,  
FORMER CEO, AMERICAN BRIDGE, PITTSBURGH, PA**

Robert H. Luffy has made a significant and positive mark in the construction industry through his accomplishments within major civil engineering construction. During his 17 years as president and chief operating officer (CEO) of American Bridge, Luffy engineered a resurgence of the company followed by sustained growth and operating success.

During his tenure AB has constructed numerous internationally recognized bridge projects, including the reconstruction of the Williamsburg Bridge in New York City, the 25th of April Bridge in Lisbon, Portugal, the Lions Gate Bridge in Vancouver, British Columbia, the new Woodrow Wilson Bridge in Washington, DC, the currently in-process Self-Anchored-Suspension Span of the San Francisco Oakland Bay Bridge in California, among many others. He also began the successful foray into heavy marine construction that has seen the company become one of the largest in that field in the United States, completing major port and naval projects along the eastern and western seaboard, the Caribbean, and the inland waterway system.

Luffy received his Bachelor of Science degree in Civil Engineering in 1972 and a Masters of Business Administration degree in 1979, both from the University of Pittsburgh. He is a Registered Professional Engineer in the state of Pennsylvania.

Luffy is a member of the American Society of Civil Engineers, the American Society of Highway Engineers, the University Of Pittsburgh School of Engineering Visitors and the Construction Industry Round Table. He also remains active within the civic community of Pittsburgh, where he served as Chairman of the Pittsburgh Zoo for five years and well as a board member, and former chairman of the Boys and Girls Clubs of Western Pennsylvania. Having served as first lieutenant in the U.S. Army Special Forces in Vietnam, Luffy is actively involved in the Vietnam Veterans Leadership Program where he was named Veteran of the Year in 1990.

Now residing in the city of Pittsburgh, Pennsylvania, Robert plans to continue being actively involved in the engineering industry and enjoy his retirement years with his wife Debbie and their five children, Jake, Cole, Tyler, Sarah and Sam.

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**HYEONG-RYEOL KIM, PH. D, P.E.,  
DIRECTOR GENERAL FOR ROAD POLICY, MINISTRY OF LAND,  
TRANSPORT AND MARITIME AFFAIRS (MLTM)**

Hyeong-Ryeol KIM is the Director-General for Road Policy of the Ministry of Land, Transport and Maritime Affairs of the Republic of Korea. As Director-General for Road Policy, his responsibilities include establishment of road master plans, construction and

maintenance of expressway and national highway, construction of traffic congested roads in the metropolitan areas, execution of R&D in the road sector, planning and implementation of PPP projects in the road sector, maintenance of bridges and tunnels, establishment and implementation of intelligent transport system (ITS) plans.

He has been working at the Ministry of Land, Transport and Maritime Affairs since 1986 and served as Director of the Road Policy Division in 2009 and a spokesman in 2010.

He holds a Bachelor's degree and a Master's degree of Civil Engineering from Yonsei University and a Doctor's degree in Civil Engineering from University of Tokyo.

## FEATURED COUNTRY SESSION

**Time:** 1:30-5:00 PM

**Room:** Ball Room B

Learn more about the bridge program of the 2011 IBC Featured Country, the Republic of Korea, with sessions and speakers that include:

- The National Bridge Policy focused on Unified Remote Monitoring System and Seismic Retrofit Program — Ungjin NA, Director, Ph.D., P.E., ITS & Road Environmental Division, Ministry of Land, Transport and Maritime Affairs (MLTM), Republic of Korea
- Recent Major Bridges in Korea — Dong-Ho CHOI, Ph.D., Professor, Hanyang University, Rep. of Korea; Hyun-Moo KOH, Ph.D. Professor, Seoul National University, Rep. of Korea; Young Suk PARK, Ph.D. Professor, Myong Ji University, Rep. of Korea; Woo-jong KIM, Ph.D. DM Engineering, Co., Ltd., Rep. of Korea
- R&D Activities of Bridges in Korea — Youngseong Harry KOO, P.E, Director, Korea Institute of Construction & Transportation Technology Evaluation and Planning (KICTEP), Rep. of Korea; Byung-Suk KIM, Korea Institute of Construction Technology (KICT), Rep. of Korea
- Incheon Bridge, New link to Incheon International Airport — Duk Ki IM, P.E., General Manager, Samsung C&T Corporation, Rep. of Korea
- Mokpo Bridge: Design and Construction — Young-Jun Hong, General Manager, GS Engineering & Construction, Co., Ltd., Rep. of Korea
- Yeongduk 1st Bridge : Design and Construction of Cable-stayed Bridge — Seung-rok LEE, Ph.D., P.E., Vice President, POSCO Engineering & Construction, Co., Ltd., Rep. of Korea
- Introduction to Marine-Crossing Bridges : Jaber Causeway, Ulsan Harbor, and Geogum Bridge — Eu-Kyeong CHO, Ph.D, P.E., General Manager, Hyundai Engineering & Construction, Co., Ltd., Rep. of Korea
- Innovative and Aesthetic Challenges in Suspension Bridges — Jae-Hong KIM, P.E., General Manager, Daelim Industrial Co., Ltd., Rep. of Korea
- Gum-ga Extradosed Bridge — Dong-Keun KIM, P.E., Vice President, SK Engineering & Construction, Co., Ltd., Rep. of Korea
- Busan Geoje Fixed Link : Bridges and Immersed Tunnel — Sangkyoon JEONG, Ph.D., Manager, Daewoo Engineering & Construction, Co., Ltd., Korea

## CHAIRMAN'S WELCOME

I am pleased to welcome all of you to the 28th Annual International Bridge Conference® (IBC). The IBC Executive Committee has worked diligently to develop an outstanding conference program. Our goal was to provide a broad spectrum of bridge engineering that covers all aspects of the practice. The program contains topics in design, construction, inspection, testing, rehabilitation, preservation, replacement and much more. The conference also provides an environment of many opportunities for participants to share and learn from each other in all areas of bridge engineering. You will find this conference to be educational, informative, practical and innovative.



Thomas J. Vena, P.E.

The Engineers' Society of Western Pennsylvania (ESWP) is the primary sponsor for the IBC. The conference is assembled by the volunteer efforts of the IBC Executive Committee, which is composed of bridge owners, designers, constructors, manufacturers, suppliers and educators. The IBC Executive Committee, along with the ESWP staff, has spent many hours developing an outstanding program. Our objective is to always provide the attendee with the highest quality and practical value that is available.

We are honored to have The Republic of South Korea as our "featured country." This years featured country session will include a keynote lecture by the Director General for Road Policies of Korean Government, a state-of-the-art presentation on specific bridges in or near completion in 2011, and the special exhibition featuring the vibrant activities of Korean construction technology and industry.

The IBC Exhibit Hall is planned similarly to the 2010 Exhibit Hall with some upgrades to make your experience even better and more productive. We have enhanced networking opportunities for all the attendees; the Technical Sessions will be located in theatres within the Exhibit Hall itself, allowing plenty of time for exhibitors and conference attendees to interact between sessions, coffee breaks and lunchtimes. We encourage you to take the time to visit with them.

We will also offer Seminars, Workshops and Special Interest Sessions to keep you current with the latest technology advancements in the world of bridge engineering. We will again offer our annual Bus Tour on Tuesday afternoon, and will highlight current bridge construction projects in the Pittsburgh area.

For those of you attending the IBC for the first time, we trust that you will find the Conference a rewarding and exciting educational experience, as have many thousands before you.

For those who have attended the IBC previously, we hope to make this Conference truly profitable and memorable for you. We greatly appreciate your attendance and your contributions to the bridge profession; together we all make a difference. Thank you!

*Thomas J. Vena, P.E. is the General Chair of the 2011 International Bridge Conference®. Mr. Vena is the Vice President of Operations for A&A Consultants Inc.*



**PROPRIETARY SESSION**

**Time:** 1:30-5:00 P.M.  
**Room:** Theater 1  
**Chair:** Rachel Stiffler, Vector Corrosion Technologies, McMurray, PA

**11-01****1:30 PM****A NEW ORTHOTROPIC STEEL BRIDGE DECK FOR MULTIPLE LONGITUDINAL GIRDER BRIDGES**

Richard Vincent, Canam Group Inc. (Structal Bridge Division), Boucherville, QC Canada

An orthotropic bridge deck acting compositely with longitudinal steel girders is presented. The stiffened deck plate is prefabricated in wide and long panels and assembled with minimum field welding. The deck accommodates roadway crowns and curves. Designed for long life, a low weight and accelerated construction in mind, including shop applied wearing surfaces for immediate trafficking. Deck provides opportunities for rehabilitation of concrete decks and widening of existing bridges without altering abutments or piers.

**11-02****1:55 PM****NON-DESTRUCTIVE EVALUATION OF BRIDGE CABLES AND STRANDS USING THE MAGNETIC MAIN FLUX METHOD (MMFM)**

Masamichi Sugahara, Tokyo Rope MFG. CO., LTD, Chuo-ku, Tokyo, Japan

In recent years, lots of examples of corrosion in cables have been reported. We have developed a non-destructive evaluation technology (MMFM) that can be utilized to assess the condition of cables. MMFM is based on straightforward principle that when ferromagnetic material is magnetized, the magnitude of the resultant magnetic flux is directly proportional to cross section of ferromagnetic material. We report the principal methodology of MMFM, and the results of actual measurements by MMFM.

**11-03****2:20 PM****(ROAD DEVELOPMENT AGENCY (RDA) IN ZAMBIA, AFRICA BRIDGE INVENTORY PROGRAM)**

Jeremy Shaffer, Ph.D., InspectTech, Pittsburgh, PA; Rankin Engineering Consultants, Choji Road, Northmead, Lusaka, Zambia; Mike Schellhase, InspectTech, Pittsburgh, PA

**WORKSHOP 1: YOUR VISION...YOUR REALITY/INNOVATIVE FINANCING & THE PROJECT TEAM**

**Time:** 1:00 - 5:00 PM

**Room:** Room 328

**Presented by** H.W. Lochner, Inc.

The 2007 I-35 Mississippi River Bridge collapse in Minneapolis, Minnesota, was a shocking, thunderous roar heard throughout the United States. Since then State's have scrambled to maintain timely bridge inspections, close bridges that are rated deficient and adjust acceptable weight loads to accommodate existing conditions. With no funding in sight and a building back-log of projects, State's are fraught with uncertainty.

The back-log of projects within our State Department's of Transportation run the gambit; from simple bridge rehabilitations to new major interchanges encompassing context sensitive design to historic landmarks seen as gateways. Projects envisioned by

teams of design engineers, State representatives and communities.

Bringing this vision to reality will take innovative financing. Public Private Partnerships (P3's) are innovative financing, as each contract is different from the next. P3's are breaking ground in the United States. P3's have the ability to bring new technology to our infrastructure projects; technology that may not have been considered due to State budgets.

What makes a P3 successful? How do they compare to traditional and design-build delivery? What is the process and what are the options? What is working best and why? What are the roles of the Owner, Concessionaire and Design-Build Team? What does the future of P3's look like? This workshop will shed light on how successful P3's work, what the challenges are and lessons learned through the eyes of the owner, Concessionaire, Design-Builder and Engineer using multiple bridge/infrastructure projects.

Attendees will participate in an interactive workshop where they will hear and learn firsthand the value of Public Private Partnerships broken into - Planning for Success, An Owner's Perspective; Risk vs Reward, A Concessionaire's Perspective; Constructing the Project, A Design-Builder's Perspective.

**Presenters:** Shawn Tunstall, H.W. Lochner, Inc., Canonsburg, PA, Brian Byrne, H.W. Lochner, Inc., Rocky Hill, CT, Phillip Russell, H.W. Lochner, Inc., Austin, TX, Edward Ellard, MMM Group, Thornhill, Ontario, Juan Santamaria, ACS Infrastructure, Coral Gables, FL, Fred Kessler, Nossaman LLP, Los Angeles, CA, Matthew Girard, Flatiron Construction, Firestone, CO, Len Kozachuk, Infrastructure Ontario, Toronto, Ontario, Canada, Chris Gauer, MMM Group, Thornhill, Ontario

**WORKSHOP 2: FRP COMPOSITES HYBRID SYSTEMS ADVANCING SUSTAINABLE SOLUTIONS FOR BRIDGES**

**Time:** 1:00 - 5:00 PM

**Room:** 327

**Presented by** American Composites Manufacturers Association

For over 20 years, FRP composite products used in new bridge construction and rehabilitation has provided bridge engineers and owners with innovative and cost effective solutions. In new construction, features such as lightweight, corrosion resistance, and prefabrication has contributed to the goals of accelerated bridge construction by reducing assembly and installation time resulting in lower costs for deploying FRP composites technology. In rehabilitation, features such as speed and minimal disruption to the structure while in service have provided bridge owners with solutions for extending the service life of bridge structures. The technology continues to evolve with better products and solutions for many new applications.

The design and construction of products for bridges with long-term durability and low maintenance requirements is a significant challenge for bridge engineers and is an important component in the life cycle costs of bridges constructed in the U.S. The workshop will present case histories on FRP composites used in both new construction and repair where the bridge spans are longer and job sites are more challenging than any time in the past. The presentations will cover hybrid structural systems; deck retrofits for movable bridges, FRP rebar performance testing in concrete decks, and structural strengthening of bridge structures.

Attendees will also be given a technical overview of a recently published document by ASCE titled "Pre-Standard for Load & Resistance Factor Design (LRFD) of Pultruded

Fiber Reinforced Polymer (FRP) Structures." This Pre-standard was developed using principles of probability-based limit states design to provide uniform practice in the design of pultruded FRP structural systems and will help structural engineers design FRP composites for bridge deck systems.

Session attendees will learn about recent technology advancements on FRP composite products that are deployed to solve bridge construction problems that cannot be solved with traditional materials. The workshop will also provide information for engineers and owners with cost effective solutions.

**Presenters:** John Busel, American Composites Manufacturers Association, Tuckahoe, NY; Dan Richards, Ph.D., P.E., ZellComp, Inc., Durham, NC

## WORKSHOP 14: BRIDGE OWNERS FORUM

**Time:** 1:00 - 4:30 PM

**Room** 324

### Presented by High Steel Structures

In this forum bridge owners will describe their upcoming bridge programs. Attendees will get upcoming program details including

- Bridges programmed for letting during the next few years
- Major projects expected to be let within the next 3 to 10 years
- Upcoming projects of interest to large and medium sized contractors and fabricators
- Other details about funding that may be unique to each owner

In addition to presenting, Owner attendees will be able to assess the ongoing bridge construction and reconstruction programs in neighboring states in order to help ensure contractor capacity.

Attendees will learn about future owner bridge design needs, upcoming projects, upcoming letting information, and general bridge program information.

Forum participants include: Rebecca Nix, Utah DOT; Prasad Nallapaneni, Virginia DOT; Paul DelSignore, Amtrak; James L. Stump, Pennsylvania Turnpike Commission; Beverly Miller, Pennsylvania DOT

## DESIGN, PART 1 SESSION

**Time:** 8:30 AM-12:00 NOON

**Room:** Theatre 1, Hall A

**Chair:** Gerald J. Pitzer, P.E., Consultant, Pittsburgh, PA

11-29

8:30 AM

### MILTON MADISON BRIDGE: INNOVATIVE DESIGN BUILD PROCUREMENT TO ACCELERATE THE REPLACEMENT OF A VITAL RIVER CROSSING

**Aaron Stover, P.E., S.E., Michael Baker Jr., Inc., Louisville, KY**

Across the country, hundreds of river crossings and other major structures are nearing the end of their useful service life or are functionally obsolete. Engineers and owners are increasingly facing the need to find innovative ways to replace or rehabilitate these structures in an environment of dwindling funding resources. The process described in this presentation demonstrates for participants some strategies for accelerating project procurement and capitalizing on innovative ideas for accelerated reconstruction, including the re-use of existing substructures.

11-23

8:55 AM

### SOIL-STRUCTURE INTERACTION INVESTIGATIONS ON THE RE-USE OF EXISTING BRIDGE PIERS

**Joseph Romano, Michael Baker Corporation, Hamilton, NJ, Michael Z. Yang, Ph.D., P.E., Shafiu Azam, Yongxian Chen, Ph.D., P.E., Terrence J. Tiberio, P.E., Michael Baker Corporation, Moon Township, PA, Scott D. Zang, P.E., Michael Baker Corporation, Beaver, PA**

The paper introduces the 3D FE analysis model as well as the model validation process. Parametric studies to investigate the sensitivities of soil strength and stiffness on the optimization of the re-use of bridge piers were developed. Based on the analysis, a retrofit method was proposed for piers.

11-24

9:20 AM

### DESIGN AND CONSTRUCTION OF THE NORTH BANK BRIDGE

**David Greenwold, P.E., Ammann & Whitney, Boston, MA, Simon Fryer, Buro Happold Ltd, UK, Karl Haglund, Department of Conservation and Recreation, Boston, MA**

This paper reports on the design and construction of the North Bank Bridge in Boston and Cambridge, MA. The 700 foot long bridge was shaped to respond to the highly constrained site and community desires. The bridge features a dramatic tubular steel superstructure and fiber reinforced polymer decking. The detailed analysis included investigation of global buckling and pedestrian induced vibrations. The Contractor used sophisticated geometric analysis to simplify fabrication with no sacrifice in aesthetic benefit.

11-25

9:45 AM

### NEW BEAMS FOR THE "NEW BRIDGE" - INNOVATIVE BRIDGE DESIGN AND CONSTRUCTION - THE FIRST NEXT BEAM BRIDGE

**Steven Hodgdon, P.E., Vanasse Hangen Brustlin, Inc., Bedford, NH, Peter A. Krakoff, P.E., CPM Constructors; Jim D. Wentworth, P.E., Maine Department of Transportation**

New ideas, innovative project delivery, design and construction challenges are explored for this first of its kind bridge that stretches over 500 feet across the mouth of the York River in historic York, Maine. The York "New Bridge" is the first bridge to utilize the Northeast Extreme Tee (NEXT) Beam. Industry, owners, designers, fabricators, and contractors share their perspectives on these massive new beams from the northeast that aim to compete in the medium span bridge market and accelerate construction.

**COFFEE BREAK: 10:10 – 10:30 AM**

**11-26 10:30 AM**

### EXPANDING THE APPLICATION OF JOINTLESS BRIDGES TO LONGER BRIDGE LENGTHS

Ardalan Sherafati, Nima Ala and Atorod Azizinamini, University of Nebraska-Lincoln, Lincoln, NE

Integral-abutment jointless bridges are typically designed with flexible foundations which include one row of piles. Results of analysis, as expected, indicate that the stiffness of the piling system could be reduced by providing rotational capacity over the pile head. Since the major criterion limiting the application of jointless bridges is the capacity of the piles in lateral movement, the proposed detail can allow the application of jointless construction to longer bridge lengths.

**11-27 10:55 AM**

### FRAMEWORK FOR IMPROVING RESILIENCE OF BRIDGE DESIGN

Brandon Chavel, Ph.D., P.E., HDR Engineering, Inc., Chicago, IL, M. Myint Lwin, P.E., S.E., Federal Highway Administration, Washington, DC ; John Yadlosky, P.E., HDR Engineering, Inc., Pittsburgh, PA

Bridge failures can result in the disruption of commerce and services, significant repair costs, and most importantly the loss of human life. Performing a failure analysis during design, coupled with the review of past bridge failures, can help to avoid failures and the need to initiate investigations and perform forensic engineering after an event. The presentation will highlight fault tree methods and the application of lessons learned from past bridge failures.

**11-28 11:20 AM**

### DESIGN AND CONSTRUCTION OF THE MON-FAYETTE EXPRESSWAY BRIDGES - UNIONTOWN TO BROWNSVILLE, PA

Thomas Leech, P.E., S.E., Gannett Fleming, Inc., Pittsburgh, PA; Bernard J. Zielinski, P.E., Pennsylvania Turnpike Commission, Highspire, PA; William R. Piper, ALCM Inc., Mon/Fayette Expressway, California, Pa

The Pennsylvania Turnpike Commission has adopted several guiding principles for the design and construction of 37 bridges within the rugged terrain of the 17 mile segment of the Mon-Fayette Expressway from Uniontown to Brownsville, PA. This has resulted in the construction of many unique, aesthetic and signature structures including several high level viaducts, a special structure crossing the historic National Road (U.S. 40), and a major crossing over the navigable waters of the Monongahela River.

## DRILLED FOUNDATIONS (ADSC) SESSION

**Time: 8:30 AM - 12:00 NOON**

**Room: Theatre 3, Hall A**

**Chair: W. Jay Rohleder Jr., P.E. S.E., FIGG, West Chester, PA**

**11-17 8:30 AM**

### USING CMCS AS A CULVERT FOUNDATION: A CASE STUDY

Daniel Martt, P.G., Sebastian Lobo-Guerrero, P.E., Ph.D A.G.E.S., Inc., Canonsburg, PA

**11-18 8:55 AM**

### HIGH CAPACITY MICROPILES TO SUPPORT A 2,900-FT SPAN BRIDGE NEAR CARACAS, VENEZUELA

Jesus Gomez, Ph.D., P.E., D.GE., Carlos Englert, P.E., Schnabel Engineering, West Chester, PA

**11-19 9:20 AM**

### DESIGN AND CONSTRUCTION OF DRILLED SHAFTS FOR PITTSBURGH'S NORTH SHORE CONNECTOR

Daniel Uranowski, Brayman Construction Corp., Saxonburg, PA ; Daniel P. Messmer, P.E., D'Appolonia Engineering Division of Ground Technology, Inc.

**11-20 9:45 AM**

### DESIGN AND CONSTRUCTION OF LARGE DIAMETER DRILLED SHAFTS IN SOIL WITH SELF CONSOLIDATING CONCRETE (MULLICA RIVER BRIDGE PROJECT)

Charles Huynh, Case Foundation Company, Broomall, PA; Matt Lunemann, Parsons Brinckerhoff, Inc., Kwang S. Ro, Ph.D., P.E.

This paper describes the design and construction of fifteen 8 foot diameter drilled shafts to support a new bridge over the Mullica River in Port Republic, New Jersey. The design considered scour conditions. The design was confirmed utilizing an Osterberg Cell load test on a demonstration (non-production) drilled shaft. The authors compare the design to actual load test data and discuss reducing the shaft lengths due to favorable load test results. Construction considerations included quality control, the type of drill rig (due to logistics constraints) and use of polymer slurry, self-consolidating concrete, and mini-SID to verify bottom cleanliness after airlifting.

**COFFEE BREAK: 10:10 – 10:30 AM**

**11-21 10:30 AM**

### EMERGENCY MICROPILE RETROFIT FOR I-94 BRIDGE OVER RIVERSIDE DRIVE

Dan Thome, P.E., Nicholson Construction Company, Kalamazoo, MI; Michael J. Thelen, PE, M.ASCE, Soil and Materials Engineers, Inc. (SME)

Design/build emergency retrofit was performed by Nicholson using micropiles through the existing pier footings. Movement monitoring included Soldata's Cyclops real-time and continuous surveying system. The Cyclops allowed the emergency retrofit to proceed while providing understanding of movement trends from the existing bridge structure and eventually verified that the bridge pier loads were gradually transferred to newly installed micropiles. Presentation will highlight design and construction procedures utilized for emergency response of the micropile solution implemented.

11-22

10:55 AM

### **MICROPILE CONSTRUCTION FOR THE WILLIS AVENUE BRIDGE REPLACEMENT – GEOLOGIC CHALLENGES MEETS URBAN CONSTRUCTION LOGISTICS**

Terence Holman, Ph.D., P.E., Moretrench American Corporation, Rockaway, NJ; Thomas J. Tuozzolo, P.E., Moretrench American Corp.; Kyle Davis, Moretrench American Corp.; Joseph A. Pastore, P.E., Hayward Baker, Inc.

The joint venture team of Moretrench American Corporation and Hayward Baker, Inc. (the JV) completed construction of high capacity rock-socketed micropile foundations for the replacement of the Willis Avenue Bridge crossing from upper Manhattan Borough to Bronx Borough in New York City. The installation of the micropiles was complicated by three main factors: limited access and headroom, staged construction/phasing, and very difficult subsurface conditions resulting from straddling across a major geologic contact.

### **REHABILITATION SESSION**

Time: 8:30 AM - 12:00 NOON

Room: Theatre 4, Hall A

Chair: Lisle E. Williams, P.E., PLS, Consultant, Coraopolis, PA

11-04

8:30 AM

### **EXTENDING THE LIFE OF THE I-80 BRIDGE OVER THE MISSISSIPPI RIVER**

David Petermeier, P.E., S.E., Modjeski and Masters, Inc., Edwardsville, IL; John Kulicki, Ph.D., P.E., S.E., Thomas Murphy, Ph.D., P.E., S.E., David Barrett, P.E., Philip Ritchie, Ph.D., P.E., and Scott Eshenaur, P.E., Modjeski and Masters, Inc., Mechanicsburg, PA

Cracks were found in the cantilever floorbeam brackets of a steel stringer-floorbeam-girder bridge constructed in the 1960's carrying Interstate 80 across the Mississippi near LeClaire, Iowa. Over 150 strain gages and numerous displacement gages in conjunction with finite element analysis were used to investigate the cracking. Results indicated as little as 0.005 inches rocking of the floorbeam flange on the stiffeners created the problem. Rehabilitation plans were developed which included field welding and UIT treatments.

11-05

8:55 AM

### **REPLACEMENT & RELOCATION OF KELLER'S COVERED BRIDGE**

David Hoglund and Daniel A. Rogers, P.E. RETTEW Associates, Inc., Lancaster, PA

The Keller's Covered Bridge is a single-lane, single-span 57-foot-long Burr-arch wooden truss listed on the National Register of Historic Places. RETTEW spent eleven years coordinating the relocation of the covered bridge to a new location and designing a modern bridge at the existing location. The agreement to relocate the historic bridge to a new location where it would continue to carry vehicular traffic on a public roadway was the first of its kind in Pennsylvania.

11-06

9:20 AM

### **THE NEXT 100 YEARS: COST EFFECTIVE DESIGN AND REHABILITATION OF MASONRY ARCH BRIDGES**

Michael Cuddy, P.E., TranSystems, Langhorne, PA; Henry Berman, P.E. and Peter Berg, PennDOT Engineering District 6-0, King of Prussia, PA; Narayana Velaga, P.E., HNTB Corporation, Philadelphia, PA

Faced with an increasing number of structural failures to its masonry arch bridge population, PennDOT District 6-0 developed a rehabilitation program that provided for streamlined project design delivery, cost effective repairs and the preservation of historic and aesthetic values. Rehabilitation plans for 20 masonry arch bridges have been completed and awarded for construction using this streamlined process. The paper will focus on the steps taken to improve efficiency and the cost effective repair measures utilized.

11-07

9:45 AM

### **REHABILITATION OF THE JACKS RUN ARCH BRIDGE**

Gary Gardner, Jr., P.E., and Daniel W. Wills, P.E. ms consultants, inc., Coraopolis, PA; Michael J. Dillon, P.E., Allegheny County Department of Public Works Pittsburgh, PA

The \$8.9M rehabilitation of the Jacks Run Bridge, featuring a 320 foot arch, includes replacement of the deck, spandrel columns, floorbeams, and jack arches. The project was carried out with sensitivity to historic and community impacts. New elements restored the bridge's historic character. Utilizing temporary spans, pedestrian traffic across the bridge was maintained throughout construction. Other aspects include the use of two types of galvanic anodes and construction methods for deck replacement.

### **COFFEE BREAK:**

10:10 – 10:30 AM

11-08

10:30 AM

### **INVESTIGATIONS AND COUNTERMEASURES OF TYPHOON-INDUCED MULTI-HAZARD ON IMPACTING ON HIGHWAY BRIDGES**

Helsin Wang, The Institute of Bridge Engineering, China Engineering Consultants, Inc., Taipei, Taiwan; Chung-Yue Wang, Professor, Ph.D., Director

Typhoon Morakot severely damaged approximate 200 highway bridges in Taiwan in August, 2009. The induced multiple natural hazards, such as flood, landslide, debris flow, drifting wood, and barrier lakes, caused embankment erosion, discharge loss, overflow accompanying with debris, vibratory stream bending, etc. around bridges. Both traditional and innovative techniques are introduced to investigate different types of bridge failure. The cause analysis provides crucial information to take proper counter-measures on engineering and policy for future reconstruction.

11-09

10:55 AM

### **REHABILITATION OF NORTHBOUND 14TH STREET BRIDGE OVER THE POTOMAC RIVER IN WASHINGTON DC**

Wagdy Wassef, P.E., Ph.D., Modjeski and Masters, Inc., Mechanicsburg, PA, Nick Theofanis, Dan Irwin, and Martin Smith, Modjeski and Masters, Inc., Harrisburg, PA; Konjit Eskender, District of Columbia Department of Transportation

The northbound 14th Street Bridge in Washington DC carries northbound I-395 across the Potomac River. Several of the concrete river piers of the bridge exhibited vertical cracking. The piers are being rehabilitated using a post-tensioned concrete encasement. Dewatering the area around the piers required an innovative construction method to allow the construction of the cofferdam despite the low underclearance. In addition, the non-operable movable span and problem areas of the fixed spans are being rehabilitated.

**LONG SPAN BRIDGES, PART 1 SESSION****Time:** 8:30 AM - 12:00 NOON**Room:** Theatre 2, Hall A**Chair:** Richard Connors, P.E., Bureau Veritas North America, Inc., Pittsburgh, PA**11-10****8:30 AM****DESIGN AND CONSTRUCTION OF THREE EXTRADOSED BRIDGES IN LA PAZ (BOLIVIA)****Juan A. Sobrino, Ph.D., PEDELTA, Coral Gables, FL**

The construction of a beltway allowing traffic decongestion in La Paz, Bolivia, has just been completed. The new elevated road crosses three parallel valleys with signature bridges. These three consecutive bridges have similar features and as a result are called the Triplets. All three-span structures are extradosed concrete bridges with maximum span of 372 feet. The presentation includes the design criteria using American and European Codes and the main features of the erection process.

**11-11****8:55 AM****TIED ARCH BRIDGE WITH TWIN, FREE-STANDING STEEL RIBS OVER MISSISSIPPI RIVER, HASTINGS, MN****Vincent Gastoni, P.E., Martin Furrer, Greg Hasbrouck, and Shaoyun Sun, Parsons, Chicago, IL**

The new Mississippi River crossing at Hastings, MN consists of a 545 foot main span tied arch with free-standing ribs. This bridge was selected as part of a design-build "best value" competition, to create a community icon for this scenic recreation area. The free-standing arch ribs are steel boxes, with no upper wind bracing, and are supplied with post-tensioned concrete ties; this offers not only aesthetic appeal, but a cost-effective solution in this context. When completed, the bridge will represent a record span for this type of structure in North America.

In addition to the unique structure type, the project is mandated to meet rigorous structural redundancy requirements specified by the Minnesota Department of Transportation and to provide a 100-year design life. The redundancy requirements significantly exceed typical considerations for arch and hanger redundancy, and include requirements for floor beam loss and the failure of other main structural elements, with restrictions for both service and strength limit states. To meet the corresponding design challenges, a unique floor system with both longitudinal and transverse main girders has been developed to provide sufficient alternate load paths. Also, detailed computer models with response time history analyses are being used to validate the structural redundancy under various fracture scenarios. To meet the 100-year design life, stainless deck reinforcement and other innovative material usage and details are employed.

**11-12****9:20 AM****THE PRACTICE OF THREE BUNDLES CABLE-STAYED BRIDGE WITH DOUBLE COMPOSITED WARREN TRUSS GIRDER****Chang Kyu Park, Ph.D., Hyundai Engineering & Construction Co., Ltd., Jongno-Gu, Seoul Korea, In-Ho Jang, Ph.D., Jun-Soo Ha, P.E., Geun-Young Kim, P.E., Kwan-Woo Park, P.E.**

The 2nd Geo-Geum Bridge is a part of the fixed connection of the Geo Geum Island to the South Korean Peninsula. The bridge is a 2-lane national highway bridge with a total length of 2,028 m composed of a 912 m long approach bridge and a 1,116

m (= 120 + 198 + 480 + 198 + 120m) long main bridge. The girder is a 6.0 m double composite warren truss, and the stay cables are laid out as 3 bundles in one central plane.

**11-13****9:45 AM****WANDO BRIDGE IN KOREA - FABRICATION AND CONSTRUCTION****Won-Jin Yu, Ph.D., Chang-Ho Chun, Hyun-Seok Choi, Jae-Beom Shim, Samsung C&T Corporation, Chunnam, South Korea**

The Wando bridge is an asymmetric cable stayed bridge located in Wando island, Korea. The bridge is composed of 75m steel tower, 500m steel girder and 32 cables. Pre-assembled large blocks - one tower and nine girders, have been erected rapidly using 750 t crane and 4000 t floating crane. To minimize the working time of floating crane, variety of ideas and thoughtful engineering were applied to erection and joint connection.

**COFFEE BREAK:****10:10 - 10:30 AM****11-14****10:30 AM****A BRIDGE IN HARMONY WITH NATURE - US 191 COLORADO RIVER BRIDGE IN MOAB, UTAH****Steve Fultz, P.E., S.E., FIGG Bridge Engineers, Inc., Denver, CO; Fred Doehring, P.E., Utah Department of Transportation, Salt Lake City, Utah**

The new US 191 Colorado River Bridge in Moab, Utah was designed by FIGG for the Utah DOT. The sustainable, long-span bridge features twin concrete segmental structures built from above in balanced cantilever to protect the river and surrounding landscape. Context sensitive solutions developed through extensive community involvement resulted in a bridge that appears to be born of the earth with colors, textures and shapes that blend the bridge into nature. Opened to traffic in December 2010.

**11-15****10:55 AM****DETAILED DESIGN AND CONSTRUCTION OF ULSAN HARBOR SUSPENSION BRIDGE WITH 1,150M MAIN SPAN****Jung-Han Lee, Ph.D, P.E., Kyung-Ho Park, Ph.D, P.E., Jong-Hwa Park, Ph.D, P.E., Eu-Kyeong Cho, Ph.D, P.E., Yung-Mook Na, Ph.D, P.E., Hyundai Engineering & Construction Co., Ltd., Jongno-Gu, Seoul Korea**

The Ulsan Harbor Bridge is a single span suspension bridge which spans the harbor mouth of Ulsan in Korea. The bridge has 1,150m long main span with 303m and 355m long approach viaducts respectively. It was the 3rd longest one as a single span suspension bridge in the world when planned in 2007. The width between main cables is 23.5m with 4 traffic lanes. The tensile strength of main cables is 1,960 Mpa.

**11-16****11:20 AM****R&D FOR THE CONSTRUCTION OF LONG SPAN BRIDGES****Kyoung-Jae Lee, Ph.D., Inho Hwang, Ph.D., Jae-Hong Kim, P.E., Un Il Baek, P.E., Daelim, Seoul, South Korea**

Super Long Span Bridge R&D Center has established in Korea to develop and support the construction techniques of long span bridges. Daelim, a leading company in the bridge construction, has developed the equipment for the erection of main cables in suspension bridge and the geometric control systems for the construction stages. This paper presents the status of R&D of Daelim in the construction of long span bridge and its technical advance in this area.





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<ul style="list-style-type: none"> <li>• Structural Steel Fabrication</li> <li>• Non-Destructive Testing (MT, PT, UT, RT)</li> <li>• Coatings</li> <li>• AISC, ISO, ASNT Certification Services</li> </ul>	<ul style="list-style-type: none"> <li>• Precast/Prestressed Concrete</li> <li>• Mechanical/Electrical</li> <li>• Expert Witness Evaluations</li> </ul>	



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### SEMINAR: (TICKETS REQUIRED)

IBC Seminars are intensive, four-hour, single-topic focused sessions. An additional fee of \$175 is required for each seminar and advance registration is required, and a ticket will be provided to you at that time. Tickets are required to attend all seminars. Seating for each Seminar is limited, so please register early. Certificates of Completion are awarded upon completion.

### SUCCESSFUL DESIGN AND CONSTRUCTION MANAGEMENT OF THE HOOVER DAM BYPASS BRIDGE

Time: 8:00 AM–12:00 NOON

Seminar Leader: M. Myint Lwin, P.E., S.E. FHWA, Washington, DC

Goals: To provide (1) a forum for the Owner's, Designer's and Contractor's Management Teams to share the lessons learned in successfully completing the Hoover Dam Bypass Bridge and (2) an opportunity for attendees to discuss the success factors that are essential for managing highly challenging bridge design and construction projects successfully.

- 1: Planning and Managing for Success, Dave Zanetell, FHWA
- 2: Design of Permanent Works (criteria and constructability), David Goodyear
- 3: Construction Execution — (engineered construction), Ken Hirschmugl bayashi / PSM JV
- 4: Erection Engineering (3D modeling to facilitate construction), Mark Ketchum. OPAC Engineers
- 5: Integration and Proactive Risk Management, Dave Zanetell, FHWA
- 6: Open Discussion, M. Myint Lwin, P.E., S.E.

### WORKSHOP 3: NATIONAL BRIDGE INDUSTRY WORKSHOP: "NEW FOCUS, DEVELOPMENTS, AND OPPORTUNITIES"

Time: 8:00 AM - 12:00 NOON

Room: 330

Presented by ARTBA

The National Bridge Industry Workshop will bring leaders from FHWA, states and industry together in one room to discuss the future of the bridge program in key policy areas, including:

- A. Bridge Preservation
- B. Asset Management
- C. Contracts Administration
- D. Public — Private Partnerships
- E. Innovation

You do not want to miss this extremely informative session that will provide you with a look into the future of bridge policy and opportunity in the United States. Presenters: King Gee, Associate Administrator, Office of Infrastructure, FHWA; Butch Wlaschin, Director of the Office of Asset Management, FHWA; Gerald Yakowenko, Group Leader, Contracts Administration, FHWA; Anwar Ahmad, Bridge Preservation Engineer, FHWA; Chris Kane, P3 Collaborative

## WORKSHOP 4: STRUCTURAL HEALTH MONITORING OF BRIDGES - TECHNOLOGIES AND PRACTICES

**Time:** 8:00 AM - 12:00 NOON

**Room:** 329

**Presented by National Instruments**

Structural health monitoring (SHM) continues to gain wider adoption, driven by key instrumentation and IT technologies that have evolved to enable intelligent monitoring systems that are more reliable, effective, and economical. This workshop will provide an overview of the state-of-the-art and practice of structural health monitoring, with real-world example case studies of systems deployed and operating on bridges around the world. The session will also provide updates on new key technologies impacting SHM systems, including wireless sensing and fiber optic sensing.

The planned agenda for the workshop:

- Overview of Structural Health Monitoring — National Instruments
- Applicable Sensor Technology and Economics with Case Studies — Applied

**Geomechanics**

- Structural Health Monitoring of the Marbach Bridge - Advitam
- Structural Health Monitoring of the Seohae Grand Bridge — National Instruments
- Structural Health Monitoring for Large and Small Bridges: Project Review of a

Steel Truss Cantilever Bridge in Vancouver — Digitexx Data Systems

- Structural Health Monitoring of the Tacony-Palmyra Bridge — IIS/Drexel University
- Bridge Monitoring Systems with Fiber Optic Sensing — Chandler Monitoring

**Systems**

- Development of Low-Power Wireless Monitoring System for Fracture Critical Highway Bridges — University of Texas at Austin

Attendees will gain an understanding of the current practice of structural health monitoring, and have the opportunity to discuss the challenges and opportunities of applying SHM systems to improve the management and maintenance of bridge assets.

**Presenters:** David Potter, National Instruments, Austin, TX; Tom Weinmann, Applied Geomechanics, Buffalo Grove, IL; Benoit Kroely, Advitam, Sterling, VA; Digitexx Data Systems, Scottsdale, AZ; Matthew Yarnold, IIS/Drexel University, Philadelphia, PA; Keith Chandler, Chandler Monitoring Systems, Lawrenceville, GA; Todd Helwig, University of Texas, Austin, TX

## W-5: COATINGS WORKSHOP

**Time:** 8:00 AM - 12:00 NOON

**Room:** 328

**Presented by SSPC: The Society for Protective Coatings**

- 8:00-8:30AM Time is Money: Improving Shop and Field Painting Throughput by Reducing Finish Coat Handling Time - Handling and transportation of finish coated steel from the fabrication shop to the project site is impacted by the length of time that the finish coat must dry. Known as shop-field throughput, a reduction in the dry time required prior to handling (without compromising performance), as well as a minimization of handling damage can greatly reduce project costs. Additionally, faster dry times reduce the risk of dust and abrasive embedment into the finished product. This study compares the handling time of three generic types of high performance finish coats cured under normal and cold/damp conditions, applied as two and three-coat systems, using traditional standardized test procedures as well as novel testing procedures designed to simulate actual handling and environmental conditions in the shop or field.

**Presenter:** Kurt Best- Bayer, Pittsburgh, PA

- 8:30-9:30AM Suspended Scaffold Access in Power Plants, Bridges and Offshore - This presentation will focus on how suspended scaffolding can be used to provide access to bridges for inspection, maintenance and repair operations. Applications photos and case studies from Spider projects will be displayed. We will focus on proper planning, platform configuration options and worker safety considerations.

**Presenter:** Clint Ramberg- Spider, Tukwila, WA

- 9:30-10:00AM Performance Evaluation of One Coat Systems on New Steel Bridges - In an effort to address cost issue associated with shop application of conventional 3-coat systems, FHWA completed a study to investigate the performance of eight one-coat systems and two control coatings for corrosion protection of highway bridges. Based on prior performance, a three coat system and a two coat system were selected as the control coating systems. The performance of all coating systems was evaluated under accelerated lab and outdoor exposure conditions. Accelerated testing was performed in the lab for 6840 hrs. Natural weathering exposure was performed in the outdoor environment for 18 months and at a marine exposure site for 24 months. This paper will discuss final results of the study.

**Presenter:** Pradeep Kodumuri- SES Group & Associates, McLean, VA

- 10:00-11:00AM An In Depth Look at Standards Most Frequently Used by Industrial Painter-This presentation will explore all of the standards, used by industrial painters including a review of the basics and a focus on the more obscure requirements and ambiguities. The presentation will also address what constitutes an industry standard, the contractual implications of specifying using only a standard, and the impact of secondary and tertiary references in standards.

**Presenter:** Aimee Beggs & Heather Stiner — SSPC, Pittsburgh, PA

- 11:00-11:30AM Span PI-2 Climate Control Program- Holding a 210 Foot Span of a Highway at 60 Degrees While Pier Concrete is Completed - The construction of a major project such as a bridge can often provide significant challenges to say the least. These challenges are not always within the physical building or logistics of the bridge but often can be material related. One such challenge can be the curing of the materials on the project. To that end the industrial contractor knew that they would need temporary climate control to meet the tight specifications for concrete curing during a construction project for the new Pearl Harbor Memorial Bridge in New Haven, Conn.

Scheduled for completion by 2016, the Pearl Harbor Memorial is a 10-lane bridge that will be one of the first extradosed cable stayed bridges constructed in the U.S. An extradosed bridge is a hybrid design combining a concrete cable stressed girder bridge with a cable stayed bridge. The structure is the centerpiece of a \$2.2 billion mega-project to reconstruct and widen 7.2 miles of I-95 in Connecticut between West Haven and Branford.

**Presenter:** David Simkins- Polygon, Amesbury, MA

- 11:30AM-12:00PM Slip Coefficient and Tension Creep Testing Protocol for Coatings used in Bolted Connections- Appendix A of the Specification for Structural Steel Joints Using ASTM A325 or A490 Bolts published by the Research Council on Structural Connections describes the testing methods to determine the slip coefficient of coatings used in bolted connections. The presentation will describe the process associated with testing and certifying coatings targeted for use in slip-critical connections, including panel fabrication, surface preparation, coating application, selection of mating surfaces, testing for resistance to slip and tensioned creep, and data reporting including A, B and C classifications.

**Presenter:** Bill Corbett- KTA Tator Inc., Butler, PA

**LONG SPAN BRIDGES, PART 2 SESSION**

**Time:** 1:30 - 5:00 PM  
**Room:** Theatre 2, Hall A  
**Chair:** M. Myint Lwin, P.E., S.E., Federal Highway Administration, Washington, DC

**11-36 1:30 PM****DESIGN AND CONSTRUCTION OF HWAMYUNG BRIDGE**

Kwang-Soo Kim, Ph.D., Eun-Chul Lee, M.S., Chun-Soo Lee, B.S., Eui-Taek Yoon, M.S, P.E., Hyundai Engineering & Construction Company, Busan, South Korea; Jong-Il Jung, B.S, P.E., Dohwa Consulting Engineers Co., LTD.

The Hwamyung bridge was designed as concrete cable-stayed bridge crossing the Nakdong River in Busan. This bridge is the largest cast-in-place concrete cable-stayed bridge in Korea with center span of 270m and side span of 115m each. A typical segment is 27.8m wide by 6.8m long and 4.0m depth. It consists of a single cell box with inclined webs and transverse wall with tie tendons provided to transfer the stay-cables forces from the anchorage area.

**11-38 1:55 PM****DESIGN OF THE NEW MILLENNIUM CABLE-STAYED BRIDGE IN SOUTH KOREA**

Younghak Kwak, P.E., Young-Min Kim, Ph.D., Myeong-Su Choi, Ph.D., DAEWOO E&C, Seoul, South Korea; Woo-Jong Kim, P.E., Ph.D., DM Engineering, Seoul, South Korea; Kyung-Sik Cho, Ph.D., DM Engineering, Seoul, South Korea

The New Millennium Bridge project is developed in the south-western part of Korea. The cable stayed bridge in Lot1 is a FCM-anchored hybrid two-pylon cable stayed bridge with a main span of 510m. A distinct feature of the bridge is their high(195m) and low(135m) pylons with two bundle cables in the side span. The Link is directly exposed to the south-western Sea, and the site is characterized by strong wind during typhoon.

**11-39 2:20 PM****LONG CONCRETE SPANS AND TALL PIERS IN PENNSYLVANIA - TURNPIKE SECTION 51H OVER THE MONONGAHELA RIVER IN BROWNSVILLE**

Ken Heil, P.E., FIGG Bridge Engineers, Inc., Exton, PA; Eric Hayes, Walsh Construction Company, Denbo, PA

The new Monongahela River Bridge near Brownsville, Pennsylvania features long spans and 200-foot tall piers to create an elegant concrete segmental bridge. The 3,022 foot long bridge has seven spans, including a main span of 518 feet, built in balanced cantilever to cross the river, rail lines, and local roads. Walsh Construction and FIGG teamed to provide a Contractor Alternate design that resulted in a savings of \$8.6 million for the Pennsylvania Turnpike Commission.

**11-40 2:45 PM****THE DESIGN & CONSTRUCTION OF A CABLE-STAYED BRIDGE WITH ELLIPTIC PYLONS**

Dong-Ho Lee, Ph.D., Dong-Keun Kim, P.E., Hyun-Kioo Kim, P.E., Se-Hoon Choi, P.E., Jae-Geum Kim, P.E., Infrastructure Business Division, SK Engineering & Construction, Seoul, South Korea

In this paper, the elliptic pylon cable-stayed bridge in Korea is introduced. This bridge is a two-span cable-stayed steel plate deck bridge, which has 230m of a main span(2@115=230m). It is located in sector 4 of connecting road of the In-cheon Grand Bridge. The design parts will introduce the landscape design concept of the main bridge and the structural behaviour of cable-stayed bridge. The construction parts will introduce the pylon Roll-Up erection during construction.

**COFFEE BREAK: 3:10 - 3:30 PM****11-41 3:30 PM****CONSTRUCTION ENGINEERING OF CONCRETE CABLE STAYED BRIDGE CONSTRUCTED BY DAELIM**

Dae-Yong Park, Ph.D., Sung Ho Kim, Ph.D., Joo Taek Park, Kwang Min Lee, Jae Hong Kim, P.E., Daelim Industrial Co., Ltd., South Korea

The construction engineering of concrete cable-stayed bridge consists of four steps which are review phase, pre-execution phase, execution phase, and special analysis phase. In this paper main four steps of the construction engineering are described for the 2nd Dolsan concrete cable-stayed bridge of edge girder type constructed by DAELIM Corporation in Korea. IBC Attendees can indirectly experience the construction process and get the information for construction engineering in the concrete cable stayed bridge of edge girder type.

**11-42 3:55 PM****CABLE LOSS: CASE STUDY WITH DYNAMIC FACTORS IN EXCESS OF 2.0**

Greg Hasbrouck, Eddie He, Ph.D, P.E., S.E., Parsons, Chicago, IL

Time history response study of cable loss for design of the Christopher S. Bond Cable-Stayed Bridge in Kansas City resulted in valuable insights into the structure behavior. One notable phenomenon demonstrated by the study resulted in dynamic factors for structure elements subject to combined dynamic response in excess of the maximum of two recommended by the Post-Tensioning Institute Recommendations for Stay Cables.

**INNOVATIVE CONCEPTS SESSION**

**Time:** 1:30 - 5:00 PM  
**Room:** Theatre 3, Hall A  
**Chair:** Kenneth J. Wright, P.E., HDR Engineering, Inc., Pittsburgh, PA

**11-43 1:30 PM****DESIGN OF A PC BOX GIRDER BRIDGE WITH CORRUGATED STEEL WEBS IN MIANMAO EXPRESSWAY**

Weiguo Yan, Jiangsu Transportation Research Institute Co.,Ltd., Nanjing, Jiangsu China

Donghe 3# bridge, which is a curved continuous rigid frame bridge with high pier and long span in high earthquake intensity area, has been designed as a two-span PC box girder bridge with corrugated steel webs. The structural scheme is expected to reduce the dead load of girder and to shorten the construction period. In this paper, some new technical characteristics and proprieties of design methods for the bridge are discussed.

11-44

1:55 PM

**LOW-COST REHABILITATION WITH FRP STRIPS**

Mark Whittemore, P.E., Dubois and King Inc., Bedford, NH; Robert Durfee, P.E., SECB

This paper explains how mechanically fastened, fiber reinforced polymer (MF-FRP) strips provided the significant advantages of a low-cost, rapid construction, rehabilitation method for increasing the structural load carrying capacity of a concrete flat slab bridge, while minimizing impacts to the traveling public. Faced with a difficult decision about how to spend limited financial resources on the bridge, the MF-FRP rehabilitation scheme economically upgraded the bridge capacity from a 14 Ton weight limit to legal loads.

11-45

2:20 PM

**EMERGENCY BRIDGE REPLACEMENT: A DESIGN-BUILD SUCCESS STORY**

Jeremy Hedden and Mario J. Quagliata, P.E., Bergmann Associates, Inc., East Lansing, MI

The ordinary outward appearance of the 9 Mile Road Bridge over I-75 north of Detroit, MI belies the extraordinary story behind its demise and successful reconstruction. After a fuel tanker truck exploded under the bridge, the resulting heat collapsed the steel superstructure forcing MDOT to close I-75 and 9 Mile Road, both of which are heavily traveled corridors. MDOT quickly executed a design build contract to restore I-75 and 9 Mile Road while planning for future improvements.

11-46

2:45 PM

**NEW BRIDGES OVER OLD DOCKYARDS - INJECTING LIFE IN AN URBAN WATERFRONT DEVELOPMENT**

Ellen Maes, Waterwegen en Zeekanaal NV, Gent, Belgium; Agnieszka Zajac, Autonomous Municipal Ghent Development Authority, St. Jacobsnieuwstraat, Belgium; Dietmar Fiechtlinger, Dietmar Feichtinger Architectes, Paris, France; Wim Van de Voorde, Technum-Tractebel Engineering, Kortrijksesteenweg, Gent, Belgium

Feichtinger Architectes delivered an elegant design for three bridges over the Old Dockyards in Ghent. The central part of the steel bridges is lifted by the movable foundation piles underneath, thus creating the necessary space to allow vessels to pass. The technical innovation of the bridges lies in the fact that pedestrians are able to pass the bridge when it is moving. Designing these bridges proved to be challenging because of the necessary safety measures.

**COFFEE BREAK:**

3:10 – 3:30 PM

11-47

3:30 PM

**USE OF DUPLEX STAINLESS STEEL IN GIRDERS & CROSS FRAMES OF BRIDGE SUPERSTRUCTURE**

Ronald Spacht, Jr., P.E., URS Corporation, Harrisburg, PA; Dr. Stuart Chen, Ph.D., University at Buffalo, Buffalo, NY

This paper summarized an investigation of the design and cost considerations regarding the use of stainless steel in bridge design. Design standards used include; AASHTO LRFD Bridge Design Specifications, Fourth Edition 2007 and the latest edition of the AISC standard specification for steel. An initial construction cost and life cycle cost

comparison was performed on a two-span continuous horizontally curved girder bridge using both standard grade 345 carbon steel and Duplex 2205 stainless steel

11-48

3:55 PM

**DESIGN OF THE BRENT SPENCE BRIDGE REPLACEMENT**

Ruchu Hsu, P.E., Parsons Brinckerhoff, New York, NY; Matt Barber P.E., Lochner, Seattle, WA

This paper highlights the innovative design features of the final three alternatives for the replacement of the Brent Spence Bridge at Cincinnati, OH. The new crossing poses many design challenges, including the requirement to carry 20 design lanes (striped for twelve lanes + eight shoulders), which, combined with a width limitation, requires the new bridge to be double-decked. The alternatives to be described include: one tied-arch and two cable-stayed bridges, one double-tower and one single-tower.

11-49

4:20 PM

**BRIDGING BOOTHBAY WITH HCB**

John Hillman, P.E., S.E., HC Bridge Company, LLC, Wilmette, IL; Nathaniel Benoit, P.E., Maine Department of Transportation, Augusta, ME

The or HCB, is an award winning, emerging structural technology that utilizes concrete, steel and fiber reinforced plastics in an embodiment that exploits the inherent advantages of each of these materials. This paper will focus on the most recent application of HCB technology through a case study of the Knickerbocker Bridge in Boothbay, ME carrying Barbers Island Road over the Back River. This bridge exhibits a new level of application of composite bridge technology on a large scale.

**RESEARCH/EVALUATION SESSION**

Time: 1:30 - 5:00 PM

Room: Theatre 1, Hall A

Chair: Kent Harries, Ph.D., F.ACI, P.Eng., University of Pittsburgh, Pittsburgh, PA

**11-STUDENT PAPER**

1:30 PM

**A NOVEL VULNERABILITY INDEX FOR DESIGN OF RC BRIDGES SUBJECTED TO SEISMIC HAZARDS AND ENVIRONMENTAL STRESSORS**

Behrouz Shafei, Graduate Student Researcher, Department of Civil and Environmental Engineering, University of California, Irvine, CA

This paper proposes a novel vulnerability index as a reliable time-dependent measure of the seismic damageability of corroded bridges. While this index can be directly used for the structural design and performance assessment of bridges, it can be also considered as a critical parameter for the life-cycle cost analysis of bridges subjected to multiple natural hazards and environmental stressors.

11-51

1:55 PM

**EVALUATION OF SHEAR KEY CRACKING IN ADJACENT BOX BEAMS**

Maria Lopez de Murphy, Ph.D., Penn State University, University Park, PA; Jubum Kim, Ph.D., Penn State Harrisburg, Middletown, PA; William C. Koller, P.E., District 1-0 Bridge Engineer-PennDOT,

A collaborative project between PennDOT and the Pennsylvania State University

focused on possible causes of cracking in the longitudinal shear keys of adjacent box beams and suggested improvements in current bridge design, construction, and repair practices. The project consisted of numerical simulations and laboratory studies of the shear key elements. Results suggested that a full depth epoxy grouted shear key has the highest potential to reduce shear key grout failure.

**11-32** **2:20 PM**

### EFFECT OF TRANSVERSE STIFFENERS ON SHEAR STRENGTH OF INTERMEDIATE WEB PANELS

Sherif Safar Aly, Ph. D., American University in Cairo, New Cairo, Egypt

According to AISC specification, transverse stiffeners of web panels support axial compression force in the post-buckling stage. However, it was previously reported that transverse stiffeners were mainly loaded by bending. Therefore, transverse stiffeners inertia requirement stipulated by the AISC was revisited. The effect of flexural rigidity of one-sided intermediate transverse stiffeners on the ultimate shear strength of web panels was investigated by the finite element method. New recommendations for sizing transverse stiffeners of web panels were established.

**11-33** **2:45 PM**

### RELIABILITY-BASED DURABILITY DESIGN AND CONTROL OF CRACK WIDTH IN BUSAN-GEOJE FIXED LINK PROJECT OF KOREA

Sehoon Kim, Ph.D., Jechun Kim, Ph.D., and Bohyun Yang, DAEWOO E&C, Busan, South Korea;

This paper includes the details of reliability-based durability design against chloride diffusivity and the method of crack control by combining the analysis of hydration heat and stress with the calculation of crack width, which are applied in Busan-Geoje Fixed Link Project.

**COFFEE BREAK:** **3:10 – 3:30 PM**

**11-34** **3:30 PM**

### ANALYTICAL AND EXPERIMENTAL ASSESSMENT OF STEEL TRUSS BRIDGE GUSSET PLATE CONNECTIONS

Yavuz Montes, Georgia Institute of Technology, School of Civil and Environmental Engineering, Atlanta, GA; Yoon Duk Kim, Ph.D., Donald White, Ph.D., Roberto T. Leon, Ph.D., P.E., Georgia Institute of Technology, Atlanta, GA; Robert S. Zobel, Ph.D., P.E., Professional Service Industries (PSI), McLean, VA; Mark Iadicola, Ph.D., National Institute of Standards and Technology, Gaithersburg, MD; Justing M. Ocel, Ph.D., P.E., Federal Highway Administration, McLean, VA

This paper focuses on findings from comprehensive studies of steel truss bridge gusset plate behavior and proposes practical design and rating procedures. The studies include comparisons of analytical models to responses from large-scale experimental tests from discrete and innovative full field measurements. The paper shows that there is considerable consistency between the experimental data and analytical solutions.

**11-35** **3:55 PM**

### CRACKING ANALYSIS OF FLORIDA BARGE CANAL SPliced I-GIRDER BRIDGE

Dongzhou Huang, P.E., PBSJ, Valrico, FL; Scott Arnold, P.E., Florida Department of Transportation, Tampa, FL; Bo Hu, P.E., PBSJ, Tampa, FL

The Cross Florida Barge Canal Bridge is a three-span continuous spliced I-girder bridge and is currently under construction. Many cracks were developed at the ends of the girders after the prestressing strands were detensioned. The analytical results show that the maximum vertical tensile stress at the end zone due to the longitudinal prestressing strands is nearly 8% of the total prestressing force which is the main causes of the cracks.

#### SEMINAR: (TICKETS REQUIRED)

IBC Seminars are intensive, four-hour, single-topic focused sessions. An additional fee of \$175 is required for each seminar and advance registration is required, and a ticket will be provided to you at that time. Tickets are required to attend all seminars. Seating for each Seminar is limited, so please register early. Certificates of Completion are awarded upon completion.

#### FWHA/AASHTO TUNNEL SCAN SEMINAR

Time: 1–5:00 PM

Seminar Leader: Louis J. Ruzzi, P.E., PENN DOT District 11-0

Most highway facility components in the United States are governed by design, construction, maintenance, inspection, and operations codes and regulations of the American Association of State Highway and Transportation Officials (AASHTO) and the U.S. Federal Highway Administration (FHWA). However, to date highway tunnels in the U.S. do not have comparable national codes and regulations. This seminar covers the latest developments and emerging technologies in the field of roadway tunnel design, construction, maintenance, and inspection. Key topics, which include the AASHTO Subcommittee on Bridges and Structures Technical Committee on tunnels (T-20) overview, are listed below: ASHTO Technical Committee on Tunnels (T-20) Overview:

- Update on FHWA Rule Making for National Tunnel Inspection Standards
  - Tunnel, Operations, Maintenance, Inspection, and Evaluation (TOMIE) Manual
  - Research- LRFD Tunnel Design and Construction Specifications
  - 2009 Tunnel Domestic Scan, Final Report and Overview
  - Project Overview: North Shore Connector Tunnel in Pittsburgh
  - Much progress has been made this past year in the field of tunnel engineering, which includes a new AASHTO
  - Publication of a manual for Roadway Tunnels. An opportunity to interact with the presenters will be provided at the end of each topic presented.
1. AASHTO Technical Committee on Tunnels (T-20), Louis J. Ruzzi, P.E., PENNDOT and Kevin Thompson, Arora and Associates, P.C.
  2. Proposed Rule Making for National Tunnel Inspection Standards, Jesus Rohena
  3. Tunnel, Operations, Maintenance, Inspection, and Evaluation (TOMIE) Manual, Brian Leshko, HDR
  4. RFD Tunnel Design and Construction Specifications, NCHRP 12-89, Louis J. Ruzzi, P.E. & Kevin Thompson



5. 2009 Tunnel Domestic Scan, Final Report and Overview, Jesus Rohena & Kevin Thompson
6. North Shore Connector Tunnel in Pittsburgh, Mike Hebor, HDR

## WORKSHOP 6: FUNDAMENTALS OF BRIDGE BENEFIT AND LIFE CYCLE COST ANALYSIS (PERSONAL LAPTOP OPTIONAL)

**Time:** 1:00 - 5:00 PM

**Room:** 330

This workshop conveys fundamental concepts used in the economic analysis of highway bridge projects and proceeds to an explanation of economic analysis methods, especially life-cycle cost analysis and benefit-cost analysis. The workshop also reviews the use of traffic forecasts, risk analysis, and economic impact analysis in the economic analysis process. It concludes with an interactive training session on use of benefit-cost analysis tools. Participants wishing to explore the software to be displayed should bring their laptops and contact Nathaniel Coley at [ncoley@dot.gov](mailto:ncoley@dot.gov) to obtain the software for installation on personal laptops.

Participants should bring their personal laptop if interested in walking through the software presentation. Laptops should be equipped with wireless access and have extended life batteries. Wireless access can be purchased from the convention center.

**Presenters:** Nathaniel Coley, Federal Highway Administration, Washington, D.C.

## WORKSHOP 8: WORKZONE SAFETY WORKSHOP, PART 1

**Time:** 1:00 - 5:00 PM

**Room:** Theatre 4, Hall A

**Presented by** ARTBA

This event, sponsored by ARTBA's National Work Zone Safety Information Clearinghouse, is being held in conjunction with the International Bridge Conference.

The workshop is packed with timely information delivered by national experts in the safety field.

- 1 - 2:00 PM: Session Opening—Work Zone Clearinghouse Activities Update: This session will help you understand all the benefits you can obtain by using the resources of this phenomenal organization.

**Presenters:** Lisa McCluskey, American Road and Transportation Builders Association; Jerry Ullman and Hong Yu, Texas Transportation Institute

- 2:15 - 3:15 PM: Night Work and Vehicle Intrusions, Reoccurring Challenges in Work Zone Safety: When it comes to work zone safety, there are a lot of concerns, but contractors will tell you two are critical: night work and vehicle intrusions. If you represent an owner/agency, design firm, safety professional or contractor, come listen to what leading researchers have to say about these issues and how they are working to address these problems.

**Presenters:** Dave Fosbroke and Jennifer Lincoln, NIOSH; Dulcy Abraham, Purdue University (invited)

- 3:30 - 4:30 PM: Training Requirements in OSHA's Crane and Derrick Standard: While mandatory certification for crane operators is still several years away, other training provisions in the new OSHA standard are now effective, including standards for riggers, signal persons and others. Get up-to-date on OSHA's new standard by participating in this important session.

**Presenter:** Larry DeMark, Equipment Training Solutions

## WORKSHOP 9: NEXT BEAMS:PRESTRESSED CONCRETE BEAMS

**Time:** 1:00 - 5:00 PM

**Room:** 328

**Presented by** High Concrete Group

NEXT Beam is a new Bridge Beam that is an open double tee, accommodates inspection and utilities, is a single pour production process, and is well suited for ABC. The NEXT Beam is a cost effective and Contractor safety friendly prestressed concrete solution for 30'-90' span range. Durability, Economy and Accelerated Construction will be part of the Presentation.

**Presenters:** Doug Lorah, High Concrete Group & Mike Alterio, Alpha Structures

## IBC BRIDGE AWARDS RECEPTION

**TIME:** Tuesday, June 7; 5:00 - 7:00 PM

**ROOM:** Concourse C

**HOST:** Tom Leech, P.E., S.E., Gannett Fleming, Inc., Pittsburgh, PA

ESWP, in association with bridge design and engineering (bd&e) Magazine, Roads and Bridges Magazine, Bayer MaterialScience LLC, presents the 24<sup>th</sup> Annual IBC Bridge Awards Ceremony. Following Tuesday's sessions, unwind and network apart from the Conference with fellow attendees and celebrate the Award winners at our IBC Awards Reception. A separate registration is required with a fee of \$25 (\$40 without conference registration).

The International Bridge Conference® annually awards five medals and one student award 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. Honorees will be recognized as follows:

- **Michael J. Abrahams, P.E.**, New York, NY is awarded the John A. Roebling Medal, recognizing an individual for lifetime achievement in bridge engineering.
- **Stonecutters Bridge, Hong Kong, China** is awarded the George S. Richardson Medal, presented for a single, recent outstanding achievement in bridge engineering.
- **North Arm Fraser Crossing, British Columbia, Canada** is presented the Gustav Lindenthal Medal, awarded for an outstanding structure that is also aesthetically and environmental pleasing.
- **Mike O'Callaghan-Pat Tillman Memorial (Hoover Dam By-Pass) Bridge**, connecting Arizona and Nevada is presented the Eugene C. Figg, Jr. Medal, awarded 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.
- **Te Rewa Rewa Bridge in New Plymouth, New Zealand** is awarded the Arthur C. Hayden Medal, recognizing a single recent outstanding achievement in bridge engineering demonstrating vision and innovation in special use bridges.
- **FHWA Manual entitled: "Analysis and Design of Skewed and Curved Steel Bridges with LRFD Reference Manual"** is presented the Engineering Excellence Award, awarded to be special and beyond the traditional guidelines of the medal categories.
- **Behrouz Shafei, University of California at Irvine** is presented the James D. Cooper Student Award, awarded to undergraduate and graduate students who demonstrate an interest and passion for bridge engineering.

**DESIGN, PART 2 SESSION****Time:** 8:30 AM - 12:00 NOON**Room:** Theatre 1, Hall A**Chair:** Thomas G. Leech, P.E., S.E., Gannett Fleming, Inc., Pittsburgh, PA**11-50****8:30 AM****CALIBRATION OF AASHTO LRFD FOR FILLED GRID DECKS BASED ON HISTORICAL PERFORMANCE**

Chris Higgins, P.E., Ph.D., and O. Tugril Turan, Oregon State University, Corvallis, OR; Mark Kaczinski and Phil Gase, Bridge Grid Floor Manufacturing Association, North Baltimore, OH

The American Association of State Highway Officials Load and Resistance Factor Design Specifications provide design criteria for fully and partially filled grid decks and unfilled grid decks composite with reinforced concrete slabs. These deck systems are widely used in practice for both new construction and rehabilitation of existing bridges. The current AASHTO-LRFD equations were not calibrated against historically successful field performance of actual in-service bridge decks. This paper evaluates the current AASHTO-LRFD design specifications using 26 in-service decks. The deck designs were compared with the current AASHTO-LRFD design moments (for strength and fatigue) as well as deflection criteria, the previous AASHTO-LRFD design moments, and with AASHTO-LRFD concrete slab deck design tables. Design demands, fatigue stress ranges, and deflection limits were compared for each of the decks considered. Based on the results, design recommendations are provided.

**11-51****8:55 AM****PEDESTRIAN BRIDGES WITH HYBRID STAINLESS STEEL-GFRP STRUCTURE**

Juan Sobrino, Ph.D., PEDELTA, Coral Gables, FL

One of the most interesting issues in the development of bridge engineering is the use of new high-performance structural materials such as stainless steel and GFRP that provide excellent mechanical properties, magnificent durability and aesthetic possibilities. Three pedestrian bridges built in Spain with hybrid structure combining steel (or stainless-steel) and GFRP are presented: a 131 feet arch, a simply supported 92 feet truss and two similar 164 feet span trusses with variable depth.

**11-52****9:20 AM****BRIDGE LESSONS LEARNED FROM THE CHILE EARTHQUAKE IN 2010**

Phillip Yen, Ph.D., P.E., FHWA, McLean, VA ; Genda Chen, Ph.D., P.E, Missouri University of Science and Technology, Rolla, MO; Ian Buckle, University of Nevada at Reno, Tony Allen, Washington State Dept. of Transportation, Daniel Alzamora, Federal Highway Administration, Jeffrey Ger, Federal Highway Administration, Juan Arias, University of Nevada at Reno

In 2010 a devastating earthquake, measuring 8.8 on the Richter scale, struck off the coast of the Maule region of Chile affecting Chile's two biggest population cities: Concepcion and Santiago. A Transportation Infrastructure Reconnaissance Team (TIRT) was organized by the Federal Highway Administration, which performed a thorough post-earthquake investigation of highway infrastructure focusing on structural and geo-technical concerns on and around bridges, and retaining walls. This paper presents the

summary of the preliminary findings of the earthquake performance of the transportation infrastructure which the team visited during the reconnaissance.

**11-53****9:45 AM****I-40 MISSISSIPPI RIVER BRIDGE SEISMIC RETROFIT PROJECT**

Robert Schamber, P.E., TRC, Rancho Cordova, CA; Fred Stephenson, P.E., TRC, Memphis, TN

The I-40 Mississippi River Bridge is a steel-tied arch bridge located in Memphis, Tennessee. This bridge is a vital transportation, commerce and defense link carrying 60,000 vehicles daily. It is situated at the southeastern edge of the New Madrid Seismic Zone.

Considering the potential for a major earthquake, TDOT and AHTD gave priority status to seismically retrofit the bridge and its approaches. TRC is providing retrofit design and construction engineering for this \$265 million project.

**COFFEE BREAK:****10:10 – 10:30 AM****11-54****10:30 AM****SEISMIC VULNERABILITY AND RETROFIT DESIGN OF SLENDER BRIDGE PIER WALLS**

Majid Sarraf, Ph.D., P.E., PEng., Parsons, Irvine, CA;

I-10 Bridge over Warm Creek Channel in San Bernardino, CA, is one of many bridges with slender pier walls which was constructed in 1970. The bridge is also located in the vicinity of major faults and ground acceleration as high as 0.7 g. As little seismic criteria existed and considered at the time of the design for such pier walls, their seismic evaluation often reveals their deficiencies which includes: Inadequate longitudinal reinforcement for bending and lack of confinement, as well as inadequate shear strength. A traditional retrofit strategy allows for pinning of the wall and the in-plane shear failure in due large longitudinal moment and transverse shearing off the longitudinal bars. However, important seismic behavior and combined vulnerabilities could be missed. This involves stand alone-mode of the piers walls vibration out of their plane, particularly most critical when already under longitudinal failed rebar condition. Thus, slender pier walls would be subjected to secondary order effects which are particularly important and could cause collapse of the entire structure. This paper focuses on a new methodology for seismic evaluation and retrofit design considerations for slender piers particularly in high seismic regions. The modeling and analysis using SAP2000, the effect of fault rupture on an existing bridge will be presented along with the retrofit design to maintain hydraulic efficiency of the channel with minimum cost of retrofit construction. This paper describes very critical and new considerations in seismic evaluation and retrofit design of many slender pier walls in many bridges built over water ways and drainage canals, to avoid instability of piers and bridge collapse.

11-55

10:55 AM

**A SYNERGY FOR INCREASED SEISMIC PROTECTION OF BRIDGES**

Roy Imbsen, P.E., D. Engr., and Anoop Mokha, Ph.D., S.E., Earthquake Protection Systems, Mare Island, Vallejo, CA

The AASHTO Guide Specification for LRFD Seismic Bridge Design (2009) was developed for bridges, using a displacement based approach. The Guide Specification suggests three possible alternative Global Seismic Design Strategies to consider at the beginning of the design process, one of which is isolation. Seismic isolation design also uses a displacement based approach which provides a means to easily compare, for a given bridge, the level of performance and cost differences between a ductile design and an isolation design.

**ABC SESSION**

Time: 8:30 AM - 12:00 NOON

Room: Theatre 2, Hall A

Chair: Louis J Ruzzi, P.E., Pennsylvania Dept. of Transportation, Pittsburgh, PA

11-56

8:30 AM

**MOVING THE CAPILANO RIVER BRIDGE TO USE AS A CONSTRUCTION DETOUR**

Murray Johnson, P.Eng., Buckland & Taylor Ltd., North Vancouver, BC, Canada; David J. Queen, P.Eng., British Columbia Ministry of Transportation and Infrastructure, South Coast Region, Burnaby, B.C., Canada; Nick Sandhu, E.I.T., British Columbia Ministry of Transportation and Infrastructure, South Coast Region, Burnaby, B.C., Canada

To facilitate the construction of a new river crossing in a congested urban setting the original bridge was moved sideways for the detour. This allowed a staged construction approach to rapidly build during the environmental window and make the site available for construction of the new bridge. The conceptual and detailed design to slide the bridge was developed by the BC Ministry of Transportation & Infrastructure and Buckland & Taylor Ltd..

11-57

8:55 AM

**REHABILITATING NEW HAMPSHIRE'S INTERSTATE BRIDGES 60 HOURS AT A TIME**

Tom Kendrick, P.E., McFarland-Johnson, Inc., Concord, NH; Ronald L. Kleiner, Jr., P.E., New Hampshire Department of Transportation, Concord, NH

This Accelerated Bridge Construction project involved the superstructure replacement of a structurally deficient bridge in a high profile, urban location. After evaluating several conventional rehabilitation options, ABC methods were selected that allowed each half of the bridge superstructure (one interstate barrel) to be replaced in a single 60-hour weekend closure period. For this project, ABC saved project costs, shortened the construction duration, and greatly reduced impacts to the local community and the traveling

11-58

9:20 AM

**CONSTRUCTION OF CURVED TRUSS BRIDGE USING ILM AND INCLINED CLIMBING SYSTEM**

Sung Man Yang, P.E., Kyung-Ho Park, Ph.D., Hyundai Engineering & Construction Co. Ltd., Youn-Chul Shin, Hee-Hong Kim, P.E. and Sung-Ryong Park, Hyundai Engineering & Construction Co. Ltd., Jongno-Gu, Seoul, South Korea

Incremental Launching Method(ILM) is applied to construct the 1,520m curved double warren truss railway bridge without any intermediate supports. And, Inclined Climbing System is contrived to maximize operational efficiency, which realize one spanning bridge could be launched continuously in every 15 days. The Inclined Climbing System is designated as "Newly developed and advanced construction technique" by KICTEP, and awarded the golden prize on "Domestic Tournament on Innovative construction technology" by Korean Government in 1997.

11-59

9:45 AM

**ACCELERATED BRIDGE SUPERSTRUCTURE WIDENING & REPLACEMENT**

Khossrow Babaei, and Amir M. Fouladgar, P.E., The LPA Group, a unit of Michael Baker Corporation, Falls Church, VA; Claude S. Napier, Jr., P.E. FHWA Resource Center

The design and construction aspects of accelerated superstructure replacement and widening of the eastbound Route 15/29 bridge over Broad Run in Prince William County, Virginia are presented. The existing bridge is 130' concrete T beam structure comprised of 3 spans. The accelerated construction was accomplished in 3 stages, after the preparatory work for widening (including extending the piers and abutments) was completed under normal traffic. Construction for each stage began Friday night and finished Sunday evening, while the traffic was detoured and the bridge was closed. At each stage a span of the bridge was replaced with prefabricated segments comprised of steel beams and concrete deck. When opened to traffic Sunday evening, the installed span participated in carrying the normal traffic. The overall superstructure was replaced in 3 weekends. This innovative project was sponsored by the FHWA Highways for Life Program.

**COFFEE BREAK:**

10:10 – 10:30 AM

11-60

10:30 AM

**ACCELERATED BRIDGE CONSTRUCTION USING PRECAST SUPERSTRUCTURE COMPONENTS IN INCHEON BRIDGE PROJECT**

JongYoung Song, Ph.D., P.E., Samsung C&T Corporation, Yeongi-Gun, Chungnam South Korea;

The main span of the Approach Bridge is the longest 145m, precast PSC box-girder bridge in South Korea. Total 836 numbers of small segments ranging from 7.2m to 3m in depth was erected using balanced cantilever method by specially designed derrick crane for this project. Pier table of superstructure was designed as 20-meter long precast unit for rapid bridge construction and erected by 3000 tonnage capacity floating crane. At mid span precast key segments connecting the adjacent cantilevers was applied to shorten construction time. Also, precast end span segment with 11m length provided significant time saving by eliminating formwork system. These applications of precast components of superstructure provided rapid bridge construction by increasing work zone safety and reducing environmental impacts at sea crossing project. The success of large precast component highly depends on precise geometry

control associated with well planned construction monitoring. In this paper, the key aspects of construction engineering

**11-61****10:55 AM**

### **FOUR INFORMATIVE PLUS ENTERTAINING MOVIES ON DVD'S THAT EXPLAIN ACCELERATED BRIDGE CONSTRUCTION SOLUTIONS TO THE GENERAL**

PublicAlfred Mangus, P.E., and Craig Copelan, P.E. Professional Engineers in California Government, Sacramento, CA

Four award winning California Bridge case histories movies entertain but inform the general public about various Accelerated Bridge Construction techniques. PECG, Director David Brown and PBS Channel KVIE of Sacramento, California describe repairs to the fire damaged MacArthur Maze Bridge, San Francisco Oakland Bay Bridge and the I-5 Boat Section. These films educate the general public or can be a training tool for the bridge industry. Caricatures and cartoons make complex issues easier to understand.

**11-62****11:20 AM**

### **OVERNIGHT DECK REPLACEMENT OF THE I-190 GRAND ISLAND BRIDGE**

Mark Horschel, PE, Bergmann Associates, Rochester, NY; Christian Hulse, P.E. New York State Thruway Authority, Cheektowaga, NY

This presentation will describe how the cast-in-place, reinforced concrete deck on the 3,383 foot long South Grand Island Bridge was replaced with concrete-filled, steel grid panels in overnight operations to accommodate the high traffic volumes during the daytime.

## **INSTRUMENTATION/INSPECTION SESSION**

Time: 8:30 AM - 12:00 NOON

Room: Theatre 3, Hall A

Chair: Gary Runco, P.E., Borton-Lawson, Lancaster, PA

**11-63****8:30 AM**

### **INSPECTION AND EVALUATION OF NON-COMPOSITE ADJACENT PRESTRESSED CONCRETE BOX BEAM BRIDGES**

Leon Lai, P.E., S.E., Ph.D., Peter Kim, P.E. and Tony Jen, P.E., Specialty Engineering, Inc., Bristol, PA; Clay Naito, Ph.D., P.E., Lehigh University, Bethlehem, PA

This paper presents findings from recent inspections of non-composite prestressed concrete adjacent box beam bridges. The current PennDOT load rating procedure is compared to a new procedure, which is based on a non-destructive testing research recently completed at Lehigh University. This research proposed a refined correlation between strand deteriorations and facial conditions of deteriorated beams. The cause of diagonal cracks and the impact of these cracks on bridge strength are also reported.

**11-64****8:55 AM**

### **UNDERWATER INSPECTION AND ACOUSTIC IMAGING OF DEEP WATER ROCK ANCHORS AT BLUE MESA RESERVOIR, COLORADO**

David Reser, P.E., Infrastructure Engineers, Inc., Bridgeville, PA USA

The US 50 bridge over Blue Mesa Reservoir, Colorado, is one of the most challenging underwater inspection environments worldwide. Water depths are 200ft at high mountain elevation. Rock anchors installed in fractured bedrock are a critical part of the bridge foundation design. This presentation outlines the challenges faced by underwater inspectors to access and inspect the submerged rock anchors. Acoustic imaging techniques were used to supplement diving operations and help map rock anchor locations.

**11-65****9:20 AM**

### **NEW TOOLS FOR INSPECTION AND EVALUATION OF STEEL TRUSS BRIDGE GUSSET PLATES**

Christopher Higgins, Ph.D., P.E. and O. Tugrul Turan, Ph.D., Oregon State University, Corvallis, OR

**11-66****9:45 AM**

### **LRFR RATINGS ON EXISTING BRIDGE INVENTORIES – A CASE STUDY**

Daniel Whittemore, P.E., LEED AP, AI Engineers, Inc., Middletown, CT; Prasad Nallapaneni P.E., MBA, Virginia Department of Transportation, Richmond, VA

Through analyzing a large data set of existing, in service bridges throughout the state of Virginia, conclusions are drawn between the load rating results of various common bridge types and span lengths between the LFR and LRFR methods of load ratings. AASHTO Legal loads are used for live loading, and AASHTOWARE's Virts software is used in the analysis.

**COFFEE BREAK:****10:10 – 10:30 AM****11-67****10:30 AM**

### **MEASUREMENTS AND ANALYSES OF CABLE TENSILE FORCES IN CABLE-STAYED BRIDGES USING LASER VIBROMETER**

Jin Taek Jun, Cheol-Hwan Kim, P.E, Hyun Bae Kim, Dong Geun Ahn, Posco Engineering & Construction, Inc., Incheon, South Korea

The tensile force acting on the cable of long-span bridge is one of the most important factors since it reflects not only the structural stability of cables but also overall construction quality. In this study, a method using wireless laser vibrometer is developed to measure the tensile forces on cables in a distance. In addition, its unique post-analysis software is used to calculate the tensile forces in real-time and to reduce the construction time.

**11-68****10:55 AM**

### **ASSESSMENT OF PIER CAP RETROFIT PT BARS USING TAUT CABLE VIBRATION MEASUREMENT METHOD**

Y. Zhou, Ph.D., P.E., URS Corporation, Hunt Valley, MD; Brett Commander, P.E. Bridge Diagnostics Inc., Boulder, CO; Mark Guzda, P.E. and Peter Daloni URS Corporation, Hunt Valley, MD

The taut cable vibration measurement (TCVM) method was recently used in Maryland to assess tensions in hundreds of post-tensioning (P-T) bars installed over 20 years ago for retrofitting deficient hammerhead reinforced concrete pier caps. The method was

validated and calibrated using a hydraulic jack and load cells in the field. It was found that the TCVM method is able to estimate the existing tension force in the P-T bars with high accuracy.

### SEMINAR: (TICKETS REQUIRED)

IBC Seminars are intensive, four-hour, single-topic focused sessions. An additional fee of \$150 is required for each seminar and advance registration is required, and a ticket will be provided to you at that time. Tickets are required to attend all seminars. Seating for each Seminar is limited, so please register early. Certificates of Completion are awarded upon completion.

### GEOTHERMAL ENERGY PILE SYSTEMS

**Time: 8:00 AM–12:00 Noon**

**Presented By The Sustainability Committee Of The Deep Foundations Institute**

Geothermal energy piles are an innovative renewable energy technology designed to exploit the relatively constant temperature of the ground for efficient heating and cooling of structures. In this seminar, notable practitioners and researchers will discuss the design issues and operational considerations of geothermal energy piles and provide an overview of their basic processes, mechanisms and key research initiatives. Results from thermal conductivity tests performed on individual piles and pile groups will be presented along with U.S. and international case histories. The technology as applied to large commercial and government installations will be highlighted, including considerations of installation geometry and varying construction techniques. Research involving long-term monitoring of an instrumented building will be presented including a comparison of a conventional heating and cooling system with a heat pump system comprising energy foundations and borehole ground-source heat exchangers. Design challenges that must be overcome to promote wider usage of this technology will be discussed.

1. Design Considerations of Energy Piles, Guney Olgun, Virginia Tech
2. Thermal Conductivity Evaluation of a Pile Group Using Geothermal Energy Piles, Tracy Brettman, Berkel & Company Contractors
3. Ground-Source Geothermal Technology Applied to Large Commercial and Government Installations, Thomas Lapham & Tony Amis, Geothermal International
4. Efforts currently underway in Colorado related to Energy Foundations, John McCartney, Ph.D., P.E., University of Colorado at Boulder; Karen Henry Ph.D., P.E., United States Air Force Academy

### WORKSHOP 8: WORKZONE SAFETY WORKSHOP (PART 2)

**Time: 8:00 AM - 12:00 NOON**

**Room: Theatre 4, Hall A**

**Presented by ARTBA**

- 8 - 9:00 AM Why is OSHA Updating its Silica Standard? What are the hazards associated with crystalline silica? How are industry workers exposed? What is OSHA planning for its new standard on silica? Do we need a stricter standard or should we simply enforce the current version? This panel will explore the health effects of silica and express the pros and cons of a new OSHA standard.

**Presenter: Scott Schneider, Laborers' Health and Safety Fund of North America**

- 9:15 - 10:45 AM Roadway Safety+ The Latest Safety Training Tool for Roadway Construction: Roadway Safety+ is a comprehensive training tool covering a range of

safety topics in road, bridge and heavy construction. From animated Typical Applications from the MUTCD, to managing work zone speed, to tips for safe nighttime construction, this program has it all. (Attendees will receive a free Roadway Safety+ Training Program CD, which is the basis for this presentation.)

**Presenters: Scott Schneider, Laborers Health and Safety Fund of North America; Don Elisburg, National Asphalt Pavement Association; Emmett Russell, International Union of Operating Engineers; Omar Lopez, American Road and Transportation Builders Association; Jerry Ullman Texas Transportation Institute; Rod Wolford and Beth Larson, FOF Communications**

- 11 AM - 12:00 PM New Decision Tool— Determining When to Use Accelerated Bridge Construction: The industry is buzzing with innovative designs and techniques for accelerated bridge construction, but when should these techniques be considered and used? This session introduces a new tool developed by Oregon State University that walks you through the decision process and helps planners, designers and contractors understand when—and when not to accelerate.

**Presenter: Toni Doolen, Oregon State University**

### WORKSHOP 10: PRODUCTS AND OUTCOMES OF SHRP 2 FOR THE INTERNATIONAL BRIDGE COMMUNITY

**Time: 8:00 AM - 12:00 NOON**

**Room: 330**

**Presented by Transportation Research Board, SHRP 2, NAS**

The Second, Strategic Highway Research Program, SHRP 2 is a \$230 million focused research program that will change the highway transportation state of the art and practice for future decades. The overall program has a broad and diverse range of projects which touch all aspects of highway transportation including; long range planning, environmental considerations, highway renewal, system operations and many aspects of safety SHRP2 will yield over 100 hundred products and outcomes which are anticipated to have a broad appeal to both researchers as well as practitioners.

The SHRP 2 Renewal focus area has a total of ten (10) projects, representing approximately \$16.5 million, in application based research and development focused on critical topics for structures and bridges, such as, innovative bridge design and accelerated bridge construction, 100-year service life for bridge systems and components, and design guidance for 100 year service life bridges and structures. The pre-implementation and implementation phases of this strategic national program will be performed in close coordination and cooperation with the AASHTO Technology Implementation Group (TIG) and the AASHTO Subcommittee on Bridges and Structures (SCOB) as well as FHWA's bridge community. These coordinated efforts will result in both strengthening the research products and mainstreaming their acceptance by the international bridge/structures communities of practice. The subject workshop will consist of four; unique presentations provided by SHRP 2 staff and the principal investigators from several key SHRP 2 structures projects. Each presenter is internationally recognized for their respective experience, knowledge and contributions to the engineering and construction communities.

- Knowledge of the SHRP 2 Research program and the outcomes and products focused on the bridge and structures communities.
- Learn the latest details on accelerated bridge construction (ABC) with a special emphasis on mainstream acceptance, ABC structural detailing and seismic design details.



- Ability to discuss the SHRP 2 bridge research results and outcomes with SHRP 2 project experts and internationally recognized subject matter specialists.
- Learn the latest technical platform regarding the LRFD serviceability limit state guidance and directions and needs for future calibration and guidance refinements.
- Understand the philosophy and decision making protocols for the selection, design, and preservation of 100 year service life bridges and bridge components.

**Presenters:** Jerry DiMaggio, Transportation Research Board, SHRP 2, NAS, Washington. D.C.

## WORKSHOP 11 (PART 1): AUTOMATED REBAR DETAILING AND ADVANTAGES OF USING 3D MODELS

**Time:** 8:00 AM - 10:00 AM

**Room:** 328

**Presented by Bentley BrIM**

Today's bridge industry embraces automated software, providing designers with unique options for detailing diverse concrete structures and enhanced design capabilities using 3D modeling tools. For demonstration purposes, this presentation uses automated detailing solutions from Bentley to look beyond CADD to the innovative bridge technologies useful in generating quantity takeoffs to create and track automated bar lists, running 3D conflict checks for rebar, and dealing with other bridge construction challenges.

**Presenters:** Alexander Mabrich, PE, Msc, Bentley BrIM

## WORKSHOP 11 (PART 2): USING DIGITAL TERRAIN MODELING FOR BRIDGE LOCATION OPTIMIZATION

**Time:** 10:00 AM - 12:00 NOON

**Room:** 328

**Presented by Bentley BrIM**

Surveyors provide a wealth of data, such as electronic ground data and Digital Terrain Models (DTMs), to optimize the civil aspect of bridge projects, including the location, length, slopes, and skew angles for bridges. Discover how roadway software uses this data to streamline design workflows. In this presentation, Bentley's civil engineering solutions will be used to explore site grading options for configuring slopes for abutments and identifying final road elevations for bridge construction.

**Presenters:** Alexander Mabrich, PE, Msc, Bentley BrIM

## WORKSHOP 12: RECENT ADVANCES IN LIGHTWEIGHT AGGREGATE IN CONCRETE FOR BRIDGES (PART 1)

**Time:** 8:00 AM - 12:00 NOON

**Room:** 327

**Presented by the Expanded Shale, Clay and Slate Institute**

The objective of this workshop is to introduce designers and owners to the results of several major research projects that are revealing substantial durability and design benefits when lightweight aggregates are used in concrete for bridges. The limited number of presentations in the workshop will allow the presenters to go into much greater detail than is normally given in most technical sessions. The workshop is also intended to provide a forum for attendees to ask questions and for researchers to exchange information and ideas. The information presented will allow attendees to design and construct more durable transportation structures and more efficient bridge designs using lightweight

aggregate in concrete.

Evaluating the effects of "internal curing," which is achieved by replacing a portion of the aggregate in conventional concrete with prewetted lightweight fine aggregate, is the first topic of discussion. Two research teams will report on their work that demonstrates the benefits of internal curing, including reduced shrinkage and permeability. One research team has considered all manufactured lightweight aggregates in the US and has conducted a range of detailed investigations using several of the aggregates. The second team will present results of analytical modeling of high performance concrete, field testing of concrete slabs, and the impact of internal curing on the service life of bridges.

The effect of using internally cured concrete, "all" lightweight concrete and "sand" lightweight concrete on the cracking of bridge decks is the second topic of discussion. The research team will present results that demonstrate a significant reduction in the cracking tendency of concrete when lightweight aggregate is used. Lightweight aggregate from three sources was used in this research program. Other concrete material properties will also be discussed.

The structural testing of lightweight concrete for bridges is the final topic discussed in the workshop. The first report will be on a comprehensive research program that has investigated a range of structural tests on specified density concrete, including development of reinforcement and shear. Concrete made with lightweight aggregate from three suppliers was considered in this study. The second report will give results from monitoring and testing high-strength lightweight pretensioned concrete girders in a highway bridge. Issues considered include prestress losses, modulus of elasticity and camber.

**Presenters:** Jason Weiss, Purdue University; Daniel Cusson, National Research Council – Canada; Ben Byard, Auburn University; Gary Greene, PSI at FHWA's Turner-Fairbank Highway Research Center; Brett Holland, Georgia Institute of Technology

## WORKSHOP 13: A PRACTITIONER'S GUIDE TO CURRENT AND FUTURE STATUS OF BRIDGE PAINTING

**Time:** 8:00 AM - 12:00 NOON

**Room:** 326

**Presented by KTA-Tator**

This exciting Workshop will be of interest to General Contractors, Painting Subcontractors, Steel Fabricators, Erectors and Others involved in either Shop or Field Painting Operations. The current state of the practice will be discussed. In addition Mr. Kline will provide a sneak-peek and what lies ahead in the paint arena for bridges.

- Metalizing versus Galvanizing versus Zinc-Rich Paint will be discussed.
- The likely role of Nanotechnology in the future of Bridge Coatings.

A discussion and Q and A Session will follow the Presentation.

**Presenters:** Eric S. Kline, KTA-Tator, Inc.

**CONSTRUCTION SESSION**

**Time:** 1:30 - 4:00 PM  
**Room:** Room 330  
**Chair:** Donald W. Herbert, P.E., Pennsylvania Dept. of Transportation, Pittsburgh, PA

**11-74 1:30 PM****THE TAXIWAY R BRIDGE, TAKING THE SKY TRAIN OVER THE PLANES**

David Burrows, P.E. and Mark Stark, P.E., Gannett Fleming, Inc., Phoenix, AZ; David Hensley, P.E., City of Phoenix Aviation Department, Phoenix, AZ; Tim Muller, P.E., Austin Bridge & Road LP, Phoenix, AZ

At Phoenix Sky Harbor International Airport, one of the ten busiest airports in the world, cast-in-place, post-tensioned concrete was successfully used to provide superior value, meet an aggressive construction schedule, squeeze into a tight construction corridor, and clear span an aircraft taxiway. Gannett Fleming, the lead designer, Austin Bridge & Road the bridge contractor, and the City of Phoenix Aviation Department all worked together to accomplish the world's first transit system crossing over an active aircraft

**11-70 1:55 PM****DESIGN AND CONSTRUCTION OF THE FULTON ROAD PRECAST CONCRETE ARCH BRIDGE**

Daniel Baxter, P.E., S.E., Michael Baker Jr. Inc., Cleveland, OH; Presented by: John Dietrick, P.E., S.E.; Chris Cummings, P.E.; Michael Baker Jr., Inc., Cleveland, OH

This paper describes the design and construction of the Fulton Road Bridge. Located in Cleveland, Ohio, and spanning over the Cleveland MetroParks Zoo, two active railroad lines,

**11-71 2:20 PM****HUEY P. LONG BRIDGE TRUSS LIFT MONITORING**

Thomas Weinmann, Applied Geomechanics Inc., Buffalo Grove, IL

As an alternative to the stick-build truss widening specified for the Huey P. Long Bridge, the MTI Joint Venture proposed a pre-built truss erection alternative to reduce impact on public, rail and river traffic requiring the lifting of three sets of paired trusses over 500-ft long, weighing more than 2700 tons. A real-time, remote monitoring system was used during the transport, lift and setting operation to limit truss distortion during the lifting and skidding operation.

**11-72 2:45 PM****DESIGN AND CONSTRUCTION OF LARGE-SCALE GROUND ANCHORAGE SYSTEM WITH HIGH PERFORMANCE MATERIALS**

Zhi Fang, Ph.D., College of Civil Engineering, Hunan University, Changsha, Hunan China; Mingxian Chen, P.E., Department of Communication and Transportation of Hunan Province; Kuangyi Zhang, Ph.D. student, College of Civil Engineering, Hunan University; Guoping Chen, P.E., Administrative Bureau of Expressway of Hunan Province; Jianhua Hu, P.E., Design and Planning Institute of Communication of Hunan Province

A innovative ground anchorage, with 5000kN of pull-out resistant capacity and from advanced materials of CFRP and RPC was developed and put into practice successfully

in the special ground anchors of a long-span suspension bridge with a main span of 1176m, Aizai bridge, located at Hunan, China. Its constitution, design consideration, construction technique and behavior are introduced in detail based on its design and construction experience as well as field test results.

**11-73 3:10 PM****DESIGN, PRODUCTION AND ERECTION OF FULL-SPAN PRE-TENSIONED PRESTRESSED CONCRETE BOX-GIRDERS IN INCHEON BRIDGE VIADUCT**

Kyoung-Lae Park, Eng., P.E., Chung-Hee Lee, Min-Kwan Kim, and Jong-Ho Yang, Samsung C&T Corporation, Seoul, South Korea

The objective of this study is to represent the design and construction of prestressed concrete box-girders in Incheon Bridge Viaduct. The superstructure of the Viaduct were made by pre-tensioned prestressing method in a specially built casting factory, transported to the construction field at the sea, and erected by FSLM (Full Span Launching Method), using specially developed methods and equipment. In this paper, detailed analysis and design of PSC box-girders are introduced. Also, brief construction method and sequences are represented.

**11-75 3:35 PM****PILE INSTALLATION CLOSE TO ADJACENT BRIDGE STRUCTURE: A CASE HISTORY**

Aravinda Ramakrishna and Raymond Mankbadi, P.E., M. ASCE, Hardesty & Hanover, LLP, West Trenton, NJ; Kuang-yu Yang, P.E., M. ASCE, New Jersey Department of Transportation, Trenton, NJ

This paper presents a case history involving planning and construction of a pier foundation close to an existing foundation supporting bridge for the proposed Route 52 Causeway project. Details on construction planning and results of piles installation for the proposed structure are discussed. The theory of ground motion and vibration, and its applicability to develop foundation construction planning are also discusses. Finally, recommendations on planning and construction of piles close to adjacent

**RAIL SESSION**

**Time:** 1:30 - 3:45 PM  
**Room:** Room 328  
**Chair:** James Dwyer, Advanced Rail Management Corporation, Pittsburgh, PA

**11-76 1:30 PM****REPLACEMENT OF SEPTA BRIDGE 20.25 - R5 LANSDALE LINE**

Justin McCarthy, P.E. and Robert S. Bistline, P.E., HNTB Corporation, Harrisburg, PA; Joseph J. Guzzi, HNTB Corporation, Philadelphia, PA; Robert L. Lund, Jr., P.E., SEPTA, Philadelphia, PA

Bridge 20.25 is a twin, riveted two-girder open deck structure located on SEPTA's R5 Lansdale Regional Rail Line believed to have been rebuilt in the early 1900's. A welded two-girder weathering steel superstructure with new precast concrete bearing seats was designed in approximately three (3) weeks. Each bridge was removed and replaced with the new prefabricated structures over two (2) weekend outages during the fall of 2009 while maintaining single-track service during peak travel operations.

11-77

1:55 PM

**PADUCAH AND LOUISVILLE RAILROAD BRIDGE****John Harms S.E., P.E., Hanson Professional Services Inc., Springfield, IL USA**

An integral component of the U. S. Army Corps of Engineers' Kentucky Lock addition is the new Paducah and Louisville Railroad Bridge over the Tennessee River. This new bridge is part of the Corps' railroad relocation project required for the new 1,200-foot lock. Construction of the high-level 3,094-foot-long railroad bridge required extensive coordination, innovative design and logistical considerations to realign this mainline railroad over a major river crossing.

11-78

2:20 PM

**DESIGN AND CONSTRUCTION OF THE NORTH SHORE CONNECTOR AERIAL STRUCTURE****Christopher Vollmer, P.E., PMP, Gannett Fleming, Inc, Pittsburgh, PA; Keith A. Wargo, P.E., Port Authority of Allegheny County, Pittsburgh, PA**

The terminus of the Port Authority of Allegheny County's North Shore Connector project which is supported on a 14-span aerial structure adjacent to Heinz Field presented many unique challenges due to the specific project constraints and stakeholder requirements. Several factors which influenced the design and layout of the structure included: site constraints, an integrated train station and platform, a double cross-over, continuously welded rail, aesthetic commitments and requirements to provide free flowing pedestrian access.

11-79

2:45 PM

**STRUCTURAL MODELING AND DESIGN OF THE DENVER I-225 LRT CORRIDOR BRIDGE OVER I-225****Daniel Baxter, P.E., S.E., Michael Baker Jr. Inc., Cleveland, OH; David Nemovitz, P.E., Michael Baker Jr., Inc., Lakewood, CO**

This presentation describes the structural modeling and design for the proposed bridge carrying the FasTracks I-225 corridor over I-225 in Denver. This nine span, reverse-curvature bridge will carry two direct-fixation tracks with continuously welded rail (CWR). Due to curved geometry and direct-fixation force effects, a three-dimensional, non-linear, finite element model was developed to evaluate rail-structure interaction, including thermal force distributions and rail gap analysis. Variable fastener stiffness and effects of CWR terminations were also considered

11-80

3:10 PM

**METRIFICATION AND EVALUATION OF GUSSET PLATES ON THE ROUTE 100 VIADUCT****William Farrow, P.E., Gannett Fleming, New York, NY; Christopher Higgins, Ph.D., P.E. and O. Tugrul Turan, Ph.D., Oregon State University, Corvallis, OR; Chris Carnes, P.E., SEPTA, Philadelphia, PA**

A technique has been developed that deploys digital imaging technologies to quickly determine the as-built geometry of gusset plates in the field and was recently used by bridge inspection personnel on an in-service truss bridge on SEPTA's Route 100 Line in suburban Philadelphia. The plate geometric data acquired from the images was extracted for implementation in finite element analysis (FEA) as well as the Whitmore section method to quickly assess the gusset plate connections.

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MONDAY JUNE 6 EVENTS

8:30 AM - 12 NOON KEYNOTE SESSION  
BALL ROOM B

12:00-7:00 PM EXHIBIT HALL OPEN (LUNCHEON BUFFET AT NOON, AND NETWORKING RECEPTION AT 5:00)

1:00-5:00 PM INNOVATIVE FINANCING (W-1) ROOM 328 FRP COMPOSITES (W-2) ROOM 327 OWNER FORUM (W-14) ROOM 324

1:30 - 5:00 PM FEATURED COUNTRY BALL ROOM B PROPRIETARY SESSION THEATRE 1

TUESDAY JUNE 7 MORNING EVENTS

8:00 AM - 5:00 PM EXHIBIT HALL OPEN

8:00 AM - 12 NOON HOOVER DAM BYPASS SEMINAR NAT'L BRIDGE INDUSTRY (W-3) ROOM 330 STRUCTURAL HEALTH (W-4) ROOM 329 COATINGS (W-5) ROOM 328

8:30 AM - 12 NOON DESIGN, PART 1 THEATRE 1 DRILLED FOUNDATIONS THEATRE 3 REHABILITATION THEATRE 4 LONG SPAN, PART 1 THEATRE 2

10:00 - 10:30 AM NETWORKING COFFEE BREAK

TUESDAY JUNE 7 AFTERNOON EVENTS

1:00 - 5:00 PM LIFE CYCLE COST ANALYSIS (W-6) ROOM 330 WORKZONE SAFETY (W-8) THEATRE 4 NEXT BEAMS (W-9) ROOM 328

1:00 - 5:00 PM IBC BUS TOUR

1:00 - 5:00 PM FHWA/AASHTO TUNNEL SCAN SEMINAR

1:30 - 5:00 PM LONG SPAN THEATRE 2 INNOVATIVE CONCEPTS THEATRE 3 RESEARCH/EVALUATION THEATRE 1

3:00 - 3:30 PM NETWORKING COFFEE BREAK

2:30 - 3:30 PM POSTER SESSION Q&A

5:00 - 7:00 PM IBC AWARDS RECEPTION CONCOURSE C

WEDNESDAY JUNE 8 EVENTS					
8:00 AM - 12 NOON	GEOTHERMAL SEMINAR	WORKZONE SAFETY (W-8) THEATRE 4	SHRP 2 (W-10) ROOM 330	REBAR DETAILING (W-11) ROOM 328	LIGHTWEIGHT CONCRETE (W-12) ROOM 327
8:30 AM - 12 NOON	DESIGN, PART 2 THEATRE 1	ABC THEATRE 2	INSTRUMENTATION THEATRE 3	BRIDGE PAINTING @ 8:00AM (W-13) ROOM 326	
8:00 AM - 1:30 PM	EXHIBIT HALL OPEN (LUNCHEON BUFFET AT NOON)				
9:30 - 10:30 AM	POSTER SESSION Q&A				
10:00 - 10:30 AM	NETWORKING COFFEE BREAK				
10:00 - 12 NOON	DIGITAL MODELING (W-11 PART 2) ROOM 328				
1:00 - 5:00 PM	BRIDGE INSPECTION SEMINAR				
1:30 - 5:00 PM	CONSTRUCTION ROOM 330	RAIL SESSION ROOM 328	TRENDY TOPICS ROOM 329	LIGHTWEIGHT AGGREGATE (W-12) ROOM 327	

TRENDY TOPICS/SUSTAINABILITY SESSION

Time: 1:30 - 3:45 PM

Room: Room 329

Chair: Ronald D. Medlock, P.E., High Steel Structures, Inc., Lancaster,PA

11-81

1:30 PM

STATE OF SUSTAINABLE BRIDGE DESIGN PRACTICES IN THE UNITED STATES

Allison Halpern and Sigrid Adriaenssens, Princeton University, Princeton, NJ

This paper provides an overview of the measures private industry, academia, and the federal government are taking to develop sustainable bridge design practices in the United States, as well as a discussion of recommended changes to the governing bridge design standards to account for future sustainability concerns. Concluding remarks include suggestions for innovative ways to incorporate sustainable choices into vehicular and pedestrian bridge design, which are not currently being considered by the bridge design industry.

11-82

1:55 PM

SUSTAINABLE BRIDGE SOLUTIONS USING RECYCLED PLASTICS

Vijay Chandra, P.E., Parsons Brinckerhoff, Inc., Herndon, VA; Presenting Paper: John S. Kim, P.E., Ph.D., Parsons Brinckerhoff, Inc., Richmond, VA; Thomas J. Nosker, Ph.D., Rutgers University, Piscataway, NJ

The world's first vehicular bridges made of nearly 100% recycled plastics were opened at Fort Bragg, NC in 2009. The world's first railroad bridges made of the same material were opened at Fort Eustis, VA in 2010. This new innovative and sustainable construction material can provide a cost-effective solution to the currently aching infrastructures and an excellent solution to the environmental issues of plastic waste.

11-83

2:20 PM

TESTING OF A FIBER GLASS REINFORCED POLYMER HONEYCOMB BRIDGE IN HURON COUNTY OHIO

Douglas Nims, University of Toledo, Department of Civil Engineering, Toledo, OH; Ed Baznik, EIT, Michael Baker Jr., Inc., Cleveland, OH; H. John Snyder, P.E., W.E. Quicksall & Associates, New Philadelphia, OH; Mike Endredi, EIT, University of Toledo, Toledo, OH

A Fiber Reinforced Polymer Honeycomb bridge was installed in Huron County, Ohio in 2008. The bridge spans approximately 17 feet (5.2 meters) and is on a low traffic road. This case study describes the design, fabrication, and testing done in the laboratory, at commissioning testing and after two years of service. The design and material standards for polymer bridges are not fully developed. The work completed provides an understanding of the bridge's early life.

11-84

2:45 PM

HEALTH MONITORING OF PRECAST GFRP-REINFORCED BRIDGE DECK PANELS

Rebecca Nix, S.E., Utah Department of Transportation, Salt Lake City, UT; Chris P. Pantelides, Ph.D., S.E. and Jim Ries, Department of Civil and Environmental Engineering, University of Utah, Salt Lake City, Utah

The deck of the Beaver Creek Bridge was constructed in 2009 using precast concrete deck panels reinforced with glass fiber reinforced polymer (GFRP) bars. The paper



presents the monitoring of two panels during lifting, transportation, post-tensioning, and static and dynamic truck load tests. Results from the truck load tests include relative deflections between the bridge deck and girder diaphragms, as well as deflections and vertical accelerations of the prestressed girders.

### WORKSHOP 12: RECENT ADVANCES IN LIGHTWEIGHT AGGREGATE IN CONCRETE FOR BRIDGES (PART 2)

Time: 1:30 - 4:00 PM

Room: 327

Presented by the Expanded Shale, Clay and Slate Institute

A Continuation of Part 1 from Wednesday morning

### SEMINAR: (TICKETS REQUIRED)

IBC Seminars are intensive, four-hour, single-topic focused sessions. An additional fee of \$150 is required for each seminar and advance registration is required, and a ticket will be provided to you at that time. Tickets are required to attend all seminars. Seating for each Seminar is limited, so please register early. Certificates of Completion are awarded upon completion.

### BRIDGE INSPECTION AND BRIDGE MANAGEMENT

Time: 1:00 - 5:00 PM

Seminar Leader: Hal Rogers, Michael Baker Jr., Inc

This seminar will provide a better understanding of bridge management systems that use transition probabilities to predict future bridge needs. Its target audience is bridge owners and consultant inspection program managers who need this type of information to set agency budgets and performance goals to manage their bridges in a rational manner. Topics include:

- Introduction to transition probabilities,
- bridge modeling (Maintenance Repair and Rehabilitation vs. Improvement projects),
- changes to AASHTO's bridge element-level condition data, and
- new directions for bridge management.

The AASHTOWare Pontis BMS will be the center of Topic One, while the other topics will be discussed from a more general perspective.

1. Using Modeling Capabilities, Paul Thompson
2. Changes in Element Level Data for Bridge Management, Anwar Ahmad, FWHA
3. New Directions For Pontis Bridge Management, Jose Aldayuz, Hal Rogers, & Paul Thompson, Michael Baker Jr., Inc



KRUUNUSILLAT

## INTERNATIONAL BRIDGE DESIGN COMPETITION IN HELSINKI, FINLAND

Helsinki invites proposals for an iconic bridge

Vast waterfront areas of the Finnish capital Helsinki are being redeveloped from former industrial uses. Two of the main areas will be connected by a bridge for trams, cycling and pedestrians.

Located in the heart of the city, the new bridge will be an icon of Helsinki and form part of the city's legacy for future generations.

The bridge should pay respect to Helsinki's history and culture, harmonizing with the city's maritime landscape.

Helsinki invites teams of bridge designers and engineers to participate in a design competition, open from May 30th to August 3rd, 2011.

More at [www.kruunusillat.fi](http://www.kruunusillat.fi)



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## POSTER SESSION

**Time:** Tuesday, June 8: 9:00 AM - 5:00 PM,  
Wednesday, June 9th 8:30 AM - 1:30 PM  
**Room:** Exhibit Hall A

Make time to visit the IBC Poster Session on Tuesday or Wednesday during the conference. Poster Presenters will be present at their poster for 1 of 2 arranged time slots to entertain Q&A. Stop by either from Tuesday 2:30 - 3:30 PM or from Wednesday 9:30 - 10:30 AM to visit with the poster presenters!

### POS 11-1: INNOVATIVE UHPC PEDESTRIAN CABLE STAYED

**BRIDGE IN KOREA**, Changbin Joh, Korea Institute of Construction Technology (KICT)

### POS 11-2: DETAIL DESIGN OF 3-PYLON SUSPENSION BRIDGE

**WITH TWO MAIN-SPANS IN KOREA**, Do Gyun Kim, Daelim Industrial

### POS 11-3: CABLE SUPPORTED BRIDGES OF DAELIM INDUSTRIAL

**COMPANY**, Young Jae Seo, Daelim Industrial

### POS 11-4: HYBRID STRUCTURAL TESTING CENTER

, Nak-hoon Shim, Myongji University

### POS 11-5: DEVELOPMENT AND OPERATION OF CONSTRUCTION

**RESEARCH**, Jung Dae-Sung, KOCED CMI

### POS 11-6: SUPERSTRUCTURE CONSTRUCTION OF NAK-DONG

**RIVER BRIDGE**, Jaehyoung Park, Samsung C&T Corporation

### POS 11-7: DESIGN AND CONSTRUCTION SPECIFICATIONS OF

**MAIN AND CRESCENT BRIDGES IN PALM JEBEL ALI**, Jaehong Kim,

Samsung C&T Corporation

### POS 11-8: EVALUATION OF WAKE GALLOPING OF UNPARALLEL

**TWIN CABLES OF THE MOKPO CABLE-STAYED BRIDGE**, Sang-Hoon

Lee, GS Engineering & Construction

### POS 11-9: THE YEOSU BRIDGE IN KOREA

, Young-Jun Hong, GS

Engineering & Construction

### POS 11-10: THE SECOND NAMHAE BRIDGE IN KOREA

, Jung-Il Yoo, GS Engineering & Construction

### POS 11-11: DEVELOPMENT OF HIGHLY EFFICIENT

**CONSTRUCTION TECHNOLOGIES FOR SUPER LONG SPAN**

**BRIDGE**, Byung-Suk Kim, Korea Institute of Construction Technology (KICT)

### POS 11-12: AUTOMATED BARGE IMPACT MONITORING SYSTEM

**AT US41 NORTHBOUND BRIDGE OVER THE OHIO RIVER**,

Asadollah Bassam, CTLGroup

### POS 11-13 CONSTRUCTION STAGE ANALYSIS OF CABLE-STAYED

**BRIDGE**, Heena Kharat

### POS 11-14: SUPER LONG SPAN BRIDGE R&D CENTER

, Kyoung-Bong Han

### POS 11-15: EXPERIMENTAL TESTS OF CFT MEMBERS FOR

**PREFABRICATED BRIDGE**, Oh Hyun Chul, DAEWOO

## MINI THEATRES

The 28<sup>th</sup> Annual International Bridge Conference® is excited to offer Mini-Theaters located within our expanded exhibit hall! Mini-Theater presentations are unique in length, and content – presentations times are a half an hour in length during exhibit hall hours. Content is provided by companies already represented in the Exhibit Hall, and provides attendees a further opportunity to learn more their products and services. Check out our Mini-Theatre location near Aisle 300 in the Exhibit Hall!

### MINI THEATERS SCHEDULE

Monday, June 06, 2011 4:00 PM

Presented by: American Shotcrete Association

“Shotcrete Specifications for Quality In-Place Concrete”

This presentation will focus on the content and structure of a shotcrete specification which directly impact the quality of in-place concrete when placed via the shotcrete process. A questions and answer period will follow the presentation and printed specification guidance and example will be available.

Tuesday, June 07, 2011 9:00 AM

Presented by: Substructure Inc.

“High Resolution Seafloor and Structural Mapping”

Substructure Inc. will provide an educational presentation on the applications for high resolution multibeam surveying and mapping and the technologies involved. Discussed will be the challenges of multibeam surveying and how Substructure’s survey vessel Orion was custom-built to address those challenges.

Tuesday, June 07, 2011 3:00 PM

Presented by: American Shotcrete Association

“Infrastructure Repair Using Shotcrete”

The benefits and advantages of shotcrete in infrastructure repair will be discussed along with strategies and examples. The presentation will also offer attendees the opportunity to participate in a question and answer period.

Tuesday, June 07, 2011 4:00 PM

Presented by: American Shotcrete Association

“DOT Case Studies Using Shotcrete”

This presentation will focus on 3 case studies of State DOT projects that successfully employed the shotcrete process. The strategies used as well as the benefits that resulted from the use of the shotcrete process will be discussed for each case

## WELCOME TO THE IBC EXHIBIT HALL!

The 2011 IBC Exhibit Hall has moved to larger space in the David L. Lawrence Convention Center, in HALL A. We can now accommodate even more displays than ever before—heavy equipment, active displays and super-sized exhibits and our brand new Mini-Theatres, along with numerous enhancements for your enjoyment. With more space than ever to accommodate additional features, the IBC Exhibit Hall is the place to be for attendees and exhibitors! In addition to more than 150 Exhibits, the Featured Country display from the Republic of South Korea is prominently featured in the center of the Exhibit Hall. The Mini-Theatres provide Exhibitors with an opportunity to step out from their Exhibit booth and present additional information about their products & services—a separate schedule of presentations can be found alongside the listing of all other presentations.

The IBC Exhibit Hall is open:

- Monday: 12:00 Noon - 7:00 PM, featuring complimentary lunch from 12:00 Noon - 1:00 PM and evening "Get Acquainted" reception from 5 - 7:00 PM.
- Tuesday: 8:00 AM - 5:00 PM, concession lunch sales available
- Wednesday: 8:00 AM - 1:30 PM, featuring complimentary lunch from 12:00 Noon - 1:00 PM)

Coffee breaks, when scheduled, will be located throughout HALL A.

Thanks to all of our returning Exhibitors, and to our new Exhibitors, too! The following is a quick find numerical listing of all exhibitors. Following, an alphabetical listing with full contact information and company description can be found. This listing contains all Exhibitors as of May 31, 2011.

## Bridge Preservation Maintenance & Rehabilitation

- **T-48 Thin Overlay:**  
(3/8 - 1/2") Bonds Well to Steel and all Surfaces
- **T-48 Chip Seal:**  
Easy Application, Skid and Water-Resistant
- **T-70 & T-78 Crack Sealer:**  
Seals Cracks, Lower "life-cycle cost"
- **T-18 Overlay:** Light weight, Waterproof, Fast-Setting (under 1 hour)
- **T-17 Patch:** Rapid-Setting, Permanent

## 2011 IBC EXHIBITORS, BY BOOTH NUMBER

- 301 United Fiberglass of America Inc.
- 303 WorkZone Safety Clearing House/ARTBA
- 305 American Road and Transportation Builders Association
- 307 Sci-Tek Consultants, Inc.
- 309 Hydro-Technologies, Inc.
- 313 All Access Rigging Co.
- 317 Hardesty & Hanover, LLP
- 323 Terex Hydra Platforms
- 325 ADSC
- 327 SIMCO Technologies Inc.
- 335 Layne GeoConstruction
- 339 Fatigue Technology
- 343 Substructure Inc.
- 347 & 446 Hill & Smith Inc.
- 400 Klaas Coating (NA) LLC
- 401 Salit Specialty Rebar
- 402 Applied Foundation Testing
- 403 Moog USA, Inc.
- 404 Fabreeka International Inc.
- 405 Missouri Department of Transportation
- 406 Sapa Aluminum Bridge Decking
- 407 Gerdau - ZBAR Division
- 408 Silicone Specialties, Inc. (SSI)
- 409 Dynamic Isolation Systems
- 412 HiVisPriceSaver.com
- 413 Hardwire LLC
- 416 Applied Geomechanics, Inc.
- 417 Palmer Engineering
- 422 Bridge Grid Flooring Manufacturers Association (BGFMA)
- 423 Applied Bolting Technology
- 424 Techstar-Inc.
- 425 Armtec
- 426 & 428 Wacker Neuson Corporation
- 427 American Arminox, Inc.
- 429 Bentley Systems, Incorporated
- 430 Ecological Fabrication Technologies
- 431 Arup
- 432 Harbor Technologies LLC
- 433 Thomas Industrial Coatings
- 434 Neel Company, The
- 435 Splice Sleeve North America, Inc.
- 438 Modjeski and Masters Inc.
- 439 Wire rope Works, Inc.
- 442 Earthquake Protection Systems, Inc.
- 443 Campbell Scientific, Inc.
- 500 R.J. Watson, Inc.
- 501 Reinforced Earth Company, The
- 502 & 504 Computers & Structures, Inc.
- 503 Advitam, Inc.
- 505 Scougal Rubber Corporation
- 506 Kentucky Transportation Center



507 Loadtest, Inc.  
 508 Transpo Industries Inc.  
 509 EarthCam, Inc.  
 512 & 516 Acrow Corporation of America  
 513 CTLGroup  
 517 Wheeling Corrugating Company  
 522 McClain & Co., Inc.  
 524 LARSA Inc.  
 526 Sofis Company, Inc.  
 528 AECOM Technical Services, Inc.  
 530 Chase Construction Products  
 532 Clearspan Construction Products  
 534 Seismic Energy Products, L.P.  
 538 Carolina Stalite Company  
 539 ATLSS Research Center - Lehigh University  
 542 PlasmaFab  
 543 Advanced Infrastructure Technologies  
 547 Harcon Corporation  
 600 CONTECH Construction Products Inc.  
 601 Termarust Technologies  
 602 Coastal Precast Systems  
 603 Roads & Bridges Magazine  
 604 Freyssinet, Inc.  
 605 Bureau Veritas  
 606 NDT Corporation  
 607 American Shotcrete Association  
 608 Highway Care  
 609 G.A. & F.C. Wagman, Inc.  
 612 ChemCo Systems  
 613 Trinity Highway Products, LLC  
 616 FIGG  
 617 D.S. Brown Company, The  
 638 LUSAS  
 639 Vector Corrosion Technologies  
 642 Surtreat Holding LLC  
 646 Pickering, Corts & Summerson, Inc.  
 647 DYWIDAG Systems International USA, Inc.  
 700 SIKA Corporation  
 701 Clodfelter Bridge & Structures Int'l, Inc. (CBSI)  
 701 The Dyson Corp  
 702 & 704 American Composites Manufacturers Association (ACMA)  
 705 D'Appolonia Engineering  
 706 Monotube Pile Corporation  
 707 Dynamic Surface Applications, Ltd (DSA)  
 708 Strand7 PTY Ltd  
 709 MDX Software  
 712 InspectTech Systems, Inc.  
 713 Pennoni Associates Inc.  
 716 Hilman Rollers  
 717 Central Atlantic Bridge Associates  
 723 L.R. Kimball  
 725 Houston Structures  
 727 Williams Form Engineering

729 National Steel Bridge Alliance  
 731 Pieresearch  
 733 HRV Conformance Verification Associates, Inc.  
 735 MIDASoft, Inc.  
 738 Eriksson Technologies, Inc.  
 739 National Academy of Science  
 742 Rampart Hydro Services  
 743 Safway Services, LLC  
 746 Greenman-Pedersen, Inc./Instrument Sales, Inc. a GPI Company  
 801 WireCo World Group  
 803 Euclid Chemical Company, The  
 804 AZZ Galvanizing Services, Inc.  
 807 Foundation Technologies Inc.  
 808 Bridon International  
 809 BendTec, Inc.  
 812 DOTQS  
 813 Deep Foundations Institute  
 816 Viathor, Inc.  
 817 Silica Fume Association  
 822 Hayward Baker Inc.  
 823 Polyset Company  
 824 ZweigWhite  
 825 Power Team, An SPX Brand  
 826 American Bridge Manufacturing  
 827 Corpro Companies, Inc.  
 828 Plaxis  
 830 Kwik Bond Polymers  
 831 DeAngelo Brothers Inc.  
 832 Sealite USA  
 833 Interstate Road Management  
 834 MC Ironworks  
 835 Mabey Bridge & Shore, Inc.  
 838 Short Span Steel Bridge Alliance  
 839 Skyline Steel, LLC  
 843 Phoenix National Laboratories, Inc.  
 847 Geocomp Corporation  
 900 TUV Rheinland Industrial Solutions  
 902 Langan Engineering & Environmental Services  
 904 E.T. Techtonics Inc.  
 906 TransCon Supply / Strongwell  
 908 FRP Bridge Drain Pipe  
 912 Brayman Construction Corporation  
 916 G.W.Y., Inc.  
 922 Michael Baker Jr., Inc.  
 924 Quikrete Companies, The  
 926 A.D. Marble & Company  
 928 Bridge design & engineering magazine  
 930 ICE - International Construction Equipment  
 932 Tokyo Rope Mfg. Co. Ltd.  
 934 Erdman Anthony  
 938 Professional Engineers in California Government  
 942 Conduit Constructors/ Bridge Line  
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 Contact: Eugene Sobecki  
 Fax: 973-244-0085  
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Acrow is an industry leader in the design and manufacture of prefabricated modular steel bridges. Acrow's principal business is the engineering, manufacturing, and supply of Acrow Panel Bridges. We have been in business for over 50 years. Acrow is based in North America with representation in 35 countries.

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 Contact: Antonio Marinucci, PhD, PE  
 Phone: 214-343-2091  
 Fax: 214-343-2384  
 E-mail: [tmarinucci@adsc-iafd.com](mailto:tmarinucci@adsc-iafd.com)  
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 Contact: Barry Raeburn  
 E-mail: [barry@aitbridges.com](mailto:barry@aitbridges.com)  
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Website: [www.acmanet.org](http://www.acmanet.org)

ACMA is the world's largest composites trade association and hosts the largest composites conference in North America - COMPOSITES. The ACMA Transportation Structures Council serves to inform and educate practitioners on FRP composites used in civil engineering / construction applications. Manufacturers products on display include structural profiles, bridge decks, pedestrian bridges, rebar, piling, and concrete repair/strengthening systems. Visit [www.acmanet.org/dac/tsc.cfm](http://www.acmanet.org/dac/tsc.cfm).

### AMERICAN ROAD AND TRANSPORTATION BUILDERS ASSOCIATION

Booth #: 305

Contact: Jim Colleton

Phone: 202-289-4434

Fax: 202-289-4435

Website: [www.artba.org](http://www.artba.org)

We are a federation whose primary goal is to aggressively grow and protect transportation infrastructure investment to meet the public and business demand for safe and efficient travel. In support of this mission, ARTBA also provides programs and services designed to give its 5,000+ public and private sector members a global competitive edge.

### AMERICAN SHOTCRETE ASSOCIATION

Booth #: 607

Contact: Chris Darnell

Fax: 248-848-3740

E-mail: [Info@Shotcrete.org](mailto:Info@Shotcrete.org)

Website: [www.Shotcrete.org](http://www.Shotcrete.org)

ASA is a non-profit organization of contractors, suppliers, manufacturers, designers, engineers, owners, and others with a common interest in promoting and educating the concrete industry on the versatility, quality and economic advantages of the use of shotcrete.

### APPLIED BOLTING TECHNOLOGY

Booth #: 423

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E-mail: [chrisc@appliedbolting.com](mailto:chrisc@appliedbolting.com)

Website: [www.appliedbolting.com](http://www.appliedbolting.com)

Applied Bolting Technology manufactures Squirter Direct Tension Indicating (DTI) washers. These washers are used to install bolts to the right TENSION, regardless of the bolt's torque resistance. Tens of millions of Squirter DTIs have revolutionized the bolt-up process in structural steel projects around the world, making bolt installation and inspection easy and accurate.

### APPLIED FOUNDATION TESTING

Booth #: 402

Contact: Tracy Bedingfield

Phone: 904-284-1337

Fax: 904-284-1339

Website: [www.testpile.com](http://www.testpile.com)

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### APPLIED GEOMECHANICS, INC.

Booth #: 416

Contact: Tom Weinmann

Phone: 847-850-5051

Fax: 847-850-5021

Website: [www.geomechanics.com](http://www.geomechanics.com)

Applied Geomechanics specializes in providing integrated monitoring solutions associated with existing infrastructure, as well as new construction. From tiltmeters to GPS and Fiber Optics, our innovative and comprehensive instrumentation monitoring programs are cost effective tools to reduce both the risk and the cost of construction

### ARMTEC

Booth #: 425

Contact: Eric Humphries

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Fax: 860-760-6658

E-mail: [eric.humphries@armtec.com](mailto:eric.humphries@armtec.com)

Website: [www.armtec.com](http://www.armtec.com)

Armtec noise barriers are complete wall systems designed for absorptive noise abatement in residential and industrial applications. Made of proprietary composite concrete materials, our products are among the most technologically advanced and effective noise barriers on the market. Armtec is also a supplier of transparent barriers that can enhance scenic views along roadways, improve commercial visibility, reduce the apparent height of a noise wall, and increase the amount of sunlight in neighbouring yards.

### ARUP

Booth #: 431

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E-mail: [jarney.barbas@arup.com](mailto:jarney.barbas@arup.com)

Website: [www.arup.com](http://www.arup.com)

Working on bridges for nearly 40 years, Arup offer a complete service for all aspects of the design and construction of bridges. We respond to challenges by bringing together traditionally separate disciplines and specialists into a single multi-professional practice. Arup have access to an unusual range of skills and unique experience helping us achieve successful solutions that meets our clients' needs and aspirations.

**ATLSS RESEARCH CENTER - LEHIGH UNIVERSITY**

Booth #: 539

Contact: Chad Kusko

Phone: 610-758-5299

Fax: 610-758-5902

Website: [www.atlss.lehigh.edu](http://www.atlss.lehigh.edu)

The Center for Advanced Technology for Large Structural Systems (ATLSS) was established in 1986, and is Lehigh's internationally respected center for engineering research and education addressing the civil and marine infrastructure for Pennsylvania and the nation. This mission includes Pennsylvania's bridge and highway structures, and the contributions of research, education and technology transfer to enhancing their design and performance. ATLSS has extensive experience in laboratory and field instrumentation, testing, and fatigue and strength evaluation of bridges.

**AZZ GALVANIZING SERVICES, INC.**

Booth #: 804

Contact: Kevin Irving

Phone: 815-693-4242

Fax: 815-723-5008

E-mail: [kevinirving@azzgalv.com](mailto:kevinirving@azzgalv.com)Website: [www.azz.com](http://www.azz.com)

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**BENDTEC, INC.**

Booth #: 809

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E-mail: [wendy@bendtec.com](mailto:wendy@bendtec.com)Website: [www.bendtec.com](http://www.bendtec.com)

BendTec, Inc is a LEADER in the bending, fabrication, design, and engineering of large and small piping & structural steel for structural & architectural applications. BendTec is AISC certified in compliance with Simple Steel and Major Steel Bridges, Fracture Critical Endorsement & Sophisticated Paint Coating Endorsement.

**BENTLEY SYSTEMS, INCORPORATED**

Booth #: 429

Contact: Barbara Day

Phone: 919-851-8559

Fax: 919-851-8533

Website: [www.bentley.com/Bridge](http://www.bentley.com/Bridge)

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**BRAYMAN CONSTRUCTION CORPORATION**

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E-mail: [d\\_uranowski@brayman.com](mailto:d_uranowski@brayman.com)Website: [www.braymanconstruction.com](http://www.braymanconstruction.com)

Brayman is a full service provider of General Contracting and Specialty Geotechnical design/build solutions throughout the entire eastern United States. Capabilities include - bridges and complex structures, steel erection, lock and dam construction/repair, marine construction, demolition, excavation/drainage, specialty geotechnical solutions - micropiles, caissons, driven/drilled piles, sheet piling, augercast piles, rock/soil nailing, ground anchors/tiebacks, grouting, underpinning and more.

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Booth #: 928

Contact: Lisa Bentley

Phone: 44-207-973-4698

Fax: 44-207-233-5057

Website: [www.bridgeweb.com](http://www.bridgeweb.com)

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Booth #: 422

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E-mail: [bgfma@bgfma.org](mailto:bgfma@bgfma.org)Website: [www.bgfma.org](http://www.bgfma.org)

BGFMA... this next generation Bridge Grid Flooring Manufacturers Association industry group features an expanded professional organization focused on the reliable development and application of bridge grid flooring and Exodermic™ decking. The role of the association is to promote the use of grid reinforced concrete bridge decks through data collection, research/development and education.

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**CAMPBELL SCIENTIFIC, INC.**

Booth #: 443

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Website: [www.campbellsci.com](http://www.campbellsci.com)

Campbell Scientific, Inc. manufactures data acquisition systems for bridge monitoring and testing. Proven on many of the world's premier bridges, our rugged, stand-alone, DC powered instrumentation features multiple telemetry options, low power use, non-volatile data storage, rainfall histograms, real-time FFTs, and rugged reliability even in harsh, remote environments.

**CAROLINA STALITE COMPANY**

Booth #: 538

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E-mail: [info@caba-bridges.org](mailto:info@caba-bridges.org)Website: [www.caba-bridges.org](http://www.caba-bridges.org)

The Central Atlantic Bridge Associates (CABA) represents PCI Certified prestressed concrete bridge beam producers in the Central Atlantic region — Pennsylvania, Virginia, Maryland, Delaware, and New Jersey. It promotes the use, application, and technical development of prestressed concrete for the transportation markets.

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Fax: 781-332-0702

E-mail: [dzuberer@chasecorp.com](mailto:dzuberer@chasecorp.com)Website: [www.chaseconstructionproducts.com](http://www.chaseconstructionproducts.com)

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E-mail: [matt@clearspanbridgedeck.com](mailto:matt@clearspanbridgedeck.com)Website: [www.clearspanbridgedeck.com](http://www.clearspanbridgedeck.com)

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Booth #: 701

Contact: Jerry V. Clodfelter

Phone: 713-675-1180

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Website: [www.cbsiusa.com](http://www.cbsiusa.com)

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Fax: 757-545-6296

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Booth #: 617

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Booth #: 705

Contact: Dave Leitze

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Website: [www.dappolonia.com](http://www.dappolonia.com)

D'Appolonia provides civil, geotechnical and environmental engineering analysis and design services for infrastructure and transportation systems. The firm's areas of specialization include foundations, earth retention and excavation support structures, slope stabilization, ground improvement, subsidence mitigation, dewatering, instrumentation, geophysical reconnaissance and Value Engineering.

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One of the strengths of DFI is the broad spectrum of its membership. All disciplines participate on an equal footing, be they contractors, engineers, owners, academicians, equipment manufacturers and distributors or materials manufacturers and suppliers. All types of foundation systems are represented, whether installed by driving, drilling or other means. This diversity provides a wealth of knowledge and an opportunity to learn from one another.

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Booth #: 904  
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 Fax: 215-592-7620  
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 Website: www.ettechtonics.com

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Booth #: 442

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Booth #: 430

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Booth #: 934

Contact: Bernie Zimmovan

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E-mail: zimmovanb@erdmananthony.com

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Erdman Anthony has provided bridge engineering for more than 50 years to major transportation agencies throughout the eastern United States. We offer a full range of services, including structural design, highway design, H&H design, and railroad coordination. Overall, our core businesses include transportation, civil, facilities, geospatial, and construction services.

**ERIKSSON TECHNOLOGIES, INC.**

Booth #: 738

Contact: Roy Eriksson

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Eriksson Technologies provides consulting engineering services and develops and markets engineering design software. Engineering services are primarily rendered to precast/prestressed concrete fabricators that serve the transportation market. Our full range of services include detailing, shop drawing preparation, stressing bed design and retrofit, product design and re-design, lifting and handling, damage assessment, and repair. Engineering software includes applications for pretensioned bridge girder, spliced bridge girder, and precast and cast-in-place culvert design.

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Booth #: 803

Contact: John Weisbarth

Phone: 800-321-7628

Fax: 216-481-7072

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Booth #: 404

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Booth #: 339

Contact: Robbie Boyd

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Fatigue Technology (FTI) is the pioneer and world leader of cold expansion technology. FTI's solutions increase the fatigue life of holes in metal structures and have been used by the aerospace industry for the past 40 years. Cold expansion arrests the growth of small cracks in holes. Using this technology to install a bushing into a drill stop hole improves the fatigue life of the hole by 10 to 12 times.

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Booth #: 616

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Booth #: 807

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Booth #: 908

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Phone: 978-635-0012

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E-mail: [jdimaggio@nas.edu](mailto:jdimaggio@nas.edu)Website: [www.TRB.org/SHRP2](http://www.TRB.org/SHRP2)

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### NATIONAL STEEL BRIDGE ALLIANCE

Booth #: 729

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Website: [www.steelbridges.org](http://www.steelbridges.org)

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 Phone: 877-853-9227  
 E-mail: m.rush@e-zbar.com  
 Website: www.e-zbar.com  
 Providers of E-ZBar rebar spacers

**PLAXIS**

Booth #: 828  
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 Phone: +31(0)152517720  
 E-mail: reception@plaxis.nl  
 Website: www.plaxis.nl

Plaxis is the name of our company as well as our brand name. Under this brand name we supply a range of software tools, courses, seminars and expert services all targeted at the world of geotechnics, geo-engineering and civil engineering.

Our software is based on the finite element method and intended for 2-Dimensional and 3-Dimensional analysis of deformation and stability of soil structures, as well as groundwater and heat flow, in geo-engineering applications such as excavations, foundations, embankments and tunnels.

Our courses and seminars focus on knowledge transfer rather than on learning how to use Plaxis software. With our Expert Services we help customers with complicated modelling issues and expert advice.

**POLYSET COMPANY**

Booth #: 823  
 Contact: Benny Zlotnick  
 Phone: 518-664-6000  
 Fax: 518-664-6001  
 E-mail: b.zlotnick@polyset.com  
 Website: www.polyset.com

Polyset has been a leading manufacturer of expansion joint products and systems for bridges and commercial structures for over 25 years. We also have a line of Zero VOC HRZC coatings featuring Ply-Zinc, a high temperature, chemical resistant sprayable cathodic coating.

**POWER TEAM, AN SPX BRAND**

Booth #: 825  
 Contact: John Corona  
 Phone: 610-247-4314  
 Fax: 815-873-3391  
 E-mail: john.corona@spx.com  
 Website: www.powerteam.com

POWER TEAM is a world leader in hydraulic special service tools and equipment for global construction markets. We manufacture precision quality high-pressure hydraulic products including pumps, jacking cylinders/rams, post tension jacks, and valves. Products are sold through a worldwide network of stocking industrial distributors.

**PROFESSIONAL ENGINEERS IN CALIFORNIA GOVERNMENT**

Booth #: 938  
 Contact: Chelsea Mithcell  
 Phone: 916-446-0400  
 Fax: 916-446-0489  
 E-mail: cmerrill@pecg.org  
 Website: www.pecg.org

PECG provides representation in employment and professional matters for 13,000 state-employed engineers, architects, engineering geologists, land surveyors, and related professionals. PECG members design and inspect California's highways and bridges, ensure schools and hospitals are seismically safe, and protect our air, water, and beaches for today and generations to come.

**QUIKRETE COMPANIES, THE**

Booth #: 924  
 Contact: Dennis Bittner  
 Fax: 404-841-0289  
 E-mail: dbittner@quikrete.com  
 Website: www.quikrete.com

The QUIKRETE® Companies are the largest manufacturers of packaged concrete in the United States and an innovative leader in the heavy highway industry. With more than 88 manufacturing facilities in the United States, Canada, Puerto Rico and South America, The QUIKRETE Companies have unsurpassed product distribution and depth.

**R.J. WATSON, INC.**

Booth #: 500  
 Contact: Jeremy Konst  
 Phone: 716-691-3301  
 Fax: 716-691-3305  
 Website: www.rjwatson.com

R.J. Watson, Inc. specializes in the design manufacture and testing of high load multirotational bearings, seismic isolation devices, joint sealing systems, waterproofing membranes and high strength fiber composite materials used to strengthen and rehabilitate structural members such as columns, beams, walls, piles, girders and slabs. In addition, R.J. Watson is now involved in the design and supply of FRP bridge deck and girder systems.

**RAMPART HYDRO SERVICES**

Booth #: 742  
 Contact: Jeff Parks  
 Fax: 412-262-6188  
 E-mail: sales@rampart-hydro.com  
 Website: www.rampart-hydro.com

Rampart is the world leader in ultra-high pressure (UHP) Hydrodemolition and HydroCleaning. Ultra high pressure Hydrodemolition uses less water; is environmentally friendly; provides a superior bond; and is fast and cost effective. Rampart has used Hydrodemolition on bridge surfaces and substructures, dams, tunnels, and parking garages. Rampart now offers complete vacuum cleanup of the water and debris creating Dry Hydrodemolition. We look forward to helping you with your demanding projects.

**REINFORCED EARTH COMPANY, THE**

Booth #: 501

Contact: Michele A. Curry

Fax: 703-821-1815

E-mail: [info@reinforcedearth.com](mailto:info@reinforcedearth.com)Website: [www.reinforcedearth.com](http://www.reinforcedearth.com)

The Reinforced Earth Company is a world leader in the design and supply of proprietary retaining wall system and earth-related technologies. Recognized as the supplier to some of our nation's largest highway construction projects, working as a subcontractor/material supplier on Department of Transportation and privately owned projects, we perform all duties associated with our jobs from sales, marketing, engineering, design, supply and construction assistance.

**ROADS & BRIDGES MAGAZINE**

Booth #: 603

Contact: Rick Schwer

Fax: 847-390-0408

E-mail: [rschwer@sgcmail.com](mailto:rschwer@sgcmail.com)Website: [www.roadsbridges.com](http://www.roadsbridges.com)

As the leading monthly trade publication for the transportation construction market, Roads & Bridges Magazine reaches over 60,000 engineers, contractors, DOT and other public officials (local, county, state & federal). Our readers design, build and maintain the roads, highways, bridges, and viaducts across the US and Canada.

**SAFWAY SERVICES, LLC**

Booth #: 743

Contact: Jerry Dolly

Phone: 518-381-6000

Fax: 518-381-4613

Website: [www.safway.com](http://www.safway.com)

The QuikDeck™ Platform System can provide the solution to reduce labor costs and enhance access for bridge construction, rehabilitation and maintenance. QuikDeck™ can significantly reduce man-hours and overall project costs. Safety is our number one goal. All QuikDeck™ components are designed to meet or exceed OSHA safety regulations.

**SALIT SPECIALTY REBAR**

Booth #: 401

Phone: 716-299-1990

Fax: 716-299-1993

E-mail: [kcornell@stainlessrebar.com](mailto:kcornell@stainlessrebar.com)Website: [www.stainlessrebar.com](http://www.stainlessrebar.com)

Salit Specialty Rebar (SSR) is North America's stainless rebar specialist. At SSR we offer shipping across North America, fabricated rebar, dedicated equipment, on time delivery, cut to length, and shrink wrapped to avoid contamination. SSR offers all sizes in both metric and Imperial from our vast inventory.

**SAPA ALUMINUM BRIDGE DECKING**

Booth #: 406

Contact: Greg Osberg

E-mail: [gregory.osberg@sapagroup.com](mailto:gregory.osberg@sapagroup.com)Website: [www.sapagroup.com/us/Company-sites/Sapa-Industrial-](http://www.sapagroup.com/us/Company-sites/Sapa-Industrial-Extrusions---)

Extrusions---

Sapa offers the advantages of aluminum isotropic bridge deck technology proven over 43 years of experience. Our advanced bridge deck products allow for accelerated construction (including preassembled "Deployment Ready designs"), facilitate rehabilitation versus replacement and reduce life cycle costs. Engineers and bridge owners can complete more projects, in less time and at lower cost!

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Booth #: 307

Contact: Felicia Thomas

Fax: 412-371-4462

E-mail: [fthomas@scitekanswers.com](mailto:fthomas@scitekanswers.com)Website: [www.scitekenvironmental.com](http://www.scitekenvironmental.com)

Sci-Tek, one of the largest minority owned companies in the Pittsburgh region, offers a broad range of experience and deep expertise in civil, environmental, and geotechnical engineering. Private and public clients are located throughout the Mid-Atlantic and Northeastern United States. Sci-Tek provides the following solutions for the transportation industry: Hydraulic/Hydrologic Modeling and Analysis, Lighting Design, Environmental Consulting, Water Resources Engineering, and Railroad Crossing Designs and Approvals.

**SCOUGAL RUBBER CORPORATION**

Booth #: 505

Contact: Rob Anderson

Phone: 206-783-2650

Fax: 206-764-4984

Website: [www.scougalrubber.com](http://www.scougalrubber.com)

Manufacturer of Steel Reinforced and Plain Elastomeric Bearings, PTFE Slide Bearings, Vibration Isolators as well as Cable Dampers and Sealing Boots. In business since 1916 Scougal Rubber has been a supplier to the bridge industry for over 40 years.

**SEALITE USA**

Booth #: 832

Contact: Mark Novo

Phone: 603-737-1311

Fax: 603-737-1320

E-Mail: [m.novo@sealiteusa.com](mailto:m.novo@sealiteusa.com)Website: [www.sealite.com](http://www.sealite.com)

Sealite USA is a supplier of solar powered bridge navigation lighting as well as buoys and navigation aids for all types of bridge construction projects and obstruction lighting.

**SEISMIC ENERGY PRODUCTS, L.P.****Booth #:** 534**Contact:** Steve Bowman**Phone:** 903-675-8571**Fax:** 903-677-3993**E-mail:** [steve.bowman@sepbearings.com](mailto:steve.bowman@sepbearings.com)**Website:** [www.sepbearings.com](http://www.sepbearings.com)

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**SHORT SPAN STEEL BRIDGE ALLIANCE****Booth #:** 838**Contact:** Dan Snyder**Fax:** 202-452-1039**E-mail:** [dsnyder@steel.org](mailto:dsnyder@steel.org)**Website:** [www.shortspansteelbridges.org](http://www.shortspansteelbridges.org)

The Short Span Steel Bridge Alliance is a group of bridge and culvert industry leaders, including manufacturers, fabricators and representatives of related associations and government organizations who have joined together to increase awareness of the unique benefits, cost-competitiveness and safety facts related to the use of short span steel bridges in installations up to 140 feet in length.

**SIKA CORPORATION****Booth #:** 700**Contact:** David White, PE**Phone:** 201-933-8800 x 6678**Fax:** 01-507-7107**Website:** [www.sikaconstruction.com](http://www.sikaconstruction.com)

Sika Corporation, Lyndhurst NJ, is a technology leader celebrating 100 years of experience in concrete materials and restoration technology. Sika's innovative product line includes concrete admixtures, sealants, adhesives, corrosion inhibitors, specialty mortars, epoxy resins, structural strengthening systems, grouts, anchoring adhesives, overlays, and protective coatings.

**SILICA FUME ASSOCIATION****Booth #:** 817**Phone:** 412-299-7229**Fax:** 412-299-7238**E-mail:** [Tony@silicafume.org](mailto:Tony@silicafume.org)**Website:** [www.silicafume.org](http://www.silicafume.org)

The Silica Fume Association, through a cooperative agreement with the FHWA, provides high-performance concrete technology transfer to transportation departments and the design community.

**SILICONE SPECIALTIES, INC. (SSI)****Booth #:** 408**Phone:** 918-587-5567**Fax:** 918-586-4912**E-mail:** [scott.fowler@ssicm.com](mailto:scott.fowler@ssicm.com)**Website:** [www.ssicm.com](http://www.ssicm.com)

Serving the Companies that have been building America Since 1969. SSI offers Contractors and Owners innovative products for new and remedial construction. In today's

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**SIMCO TECHNOLOGIES INC.****Booth #:** 327**Contact:** Dennis Burns**Fax:** 418-656-6083**E-mail:** [dburns@simcotechnologies.com](mailto:dburns@simcotechnologies.com)**Website:** [www.simcotechnologies.com](http://www.simcotechnologies.com)

SIMCO Technologies offers integrated solutions for the optimum design and maintenance of concrete infrastructure. STADIUM®, its leading-edge service-life predictive software, reliably predicts concrete degradation kinetics and time to initiate reinforcing steel corrosion. SIMCO Technologies solutions serve all those vested in developing safe, sustainable, and cost-effective concrete structures.

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Sofis Company, Inc. has been a General Contractor for 50 years. We are DOT prequalified. We have earned a reputation for knowledge and respectability specializing in Bridge Repair, Inspection and Support Services. Supplying top of the line Snoopers, Cable Rigging, Traffic Control and all related services; with an exemplary safety record.

**SPLICE SLEEVE NORTH AMERICA, INC.****Booth #:** 435**Contact:** Stan Kunoki**Phone:** 949-861-8393**Fax:** 949-861-8419**Website:** [www.splicesleeve.com](http://www.splicesleeve.com)

Splice Sleeve North America markets the NMB Splice-Sleeve System, a grouted coupler for rebar used primarily to connect precast concrete elements like bridge piers and abutments, sound walls and retaining walls. Couplers exceed the requirements of ACI-318 and AASHTO for type 2 performance. Also rated 18-KSI in NCHRP 10-35, a 5 Million cycle fatigue test.



**STRAND7 PTY LTD**

Booth #: 708

Contact: Anne Delvaux

Fax:

E-mail: [anne@beaufort-analysis.com](mailto:anne@beaufort-analysis.com)Website: [www.strand7.com](http://www.strand7.com)

Beaufort Analysis, Inc. (BAI) is the distributor of the Strand7® Finite Element Analysis System in the United States. Strand7 is a general purpose finite element analysis program developed by Strand7 Pty Ltd, Sydney, Australia and is used throughout the world for the analysis of ship structures, aircraft, road and rail vehicles and a wide range of industrial products as well as for the analysis of buildings and bridges

**SUBSTRUCTURE INC.**

Booth #: 343

Phone: 604-439-1039

Fax: 603-431-1032

E-mail: [info@substructure.com](mailto:info@substructure.com)Website: [www.substructure.com](http://www.substructure.com)

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**SURTREAT HOLDING LLC**

Booth #: 642

Contact: Tony Fiasco

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E-mail: [tfiasco@surtreat.com](mailto:tfiasco@surtreat.com)Website: [www/surtreat.com](http://www.surtreat.com)

Surtreat is the supplier of the most advanced technology and high-tech materials for concrete restoration and protection in the world. We eliminate unnecessary concrete removal and rebar replacement by chemically changing the cement phase of concrete and inhibiting corrosion, saving millions of dollars in maintenance costs and eliminating costly downtime.

**TECHSTAR-INC.**

Booth #: 424

Contact: Warren Brown

Phone: 419-424-0888

Fax: 419-424-5959

E-mail: [Warren@techstar-inc.com](mailto:Warren@techstar-inc.com)Website: [www.techstar-inc.com](http://www.techstar-inc.com)

D. S. TechStar, Inc. designs, manufactures and sells a variety of engineered products for bridges. Over the past twenty years, TechStar has supplied modular expansion joints, pot bearings, disc bearings, shock transmission units and parallel wire cable to bridges around the world. With manufacturing bases in several continents, TechStar can supply the bridge community with quality products meeting any design specification.

**TEREX HYDRA PLATFORMS**

Booth #: 323

Contact: Christer Bradley

Fax: 803-366-0603

E-mail: [christer.bradley@terex.com](mailto:christer.bradley@terex.com)Website: [www.terexrb.com](http://www.terexrb.com)

Terex Hydra Platforms self erecting, self propelled, under bridge aerial access platforms used for bridge inspections and repairs. Key Features:

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- 180 degree platform rotation
- Emergency Stops
- Hydrostatic Drive
- Operator activated Communication system

**TERMARUST TECHNOLOGIES**

Booth #: 601

Contact: Wayne Senick

Phone: 888-279-5497

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E-mail: [wsenick@termarust.com](mailto:wsenick@termarust.com)Website: [www.termarust.com](http://www.termarust.com)

Termarust Technologies manufactures cost effective, high performance anti-corrosive coatings for steel/metal structures. The Termarust® (HR CSA) High Ratio Co-Polymerized Calcium Sulfonate system stops the corrosion process specifically in crevice corroded and pack rust joints and connections and is ideal for flexible steel structures like bridges, towers, cables, high mast light poles, etc.

**THOMAS INDUSTRIAL COATINGS**

Booth #: 433

Contact: Ross Boyd

Phone: 636-475-3500

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E-Mail: [rboyd@thomasindcoatings.com](mailto:rboyd@thomasindcoatings.com)**TOKYO ROPE MFG. CO. LTD.**

Booth #: 932

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Tokyo Rope is a leading wire and cable manufacturer for various applications/markets. MMFM is a cutting edge technology of NDE for its superior accuracy. CFCC is Carbon Fiber Composite Cable which offers its superior characteristics: Strength, Lightweight, High Corrosion Resistance and Flexibility, etc.

**TRANSCON SUPPLY / STRONGWELL****Booth #:** 906**Contact:** Larry Thomas/Dan Smith**Phone:** 866-419-9747/517-339-2632**E-mail:** larry.thomas@conmatgroup.com/ DSmith@strongwell.com**Website:** www.transconsupply.com/ www.strongwell.com

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At TransCon, the entire team is involved in the bidding and estimation process. This extensive knowledge of each project enables the sales and management team to provide materials and services that meet or exceed project-specific standards and specifications.

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Strongwell has been pultruding fiber reinforced polymer composite structural products since 1956. Today, with more than 66 pultrusion machines and 647,000 square feet of manufacturing space in three plant locations, Strongwell has unequalled capacity, versatility and flexibility to meet the needs of its customers and allied partners. All Strongwell pultruded products are made in the USA. The company is financially strong, total quality oriented, technically advanced, and customer focused. Strongwell's customers include Fortune 500 industrial and commercial firms, major architectural and engineering firms, leading contractors and distributors, and many other companies - both large and small - in a variety of markets.

**TRANSPO INDUSTRIES INC.****Booth #:** 508**Contact:** John B. Karlson**Fax:** 914-636-1282**E-mail:** info@transpo.com**Website:** www.transpo.com

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**TRINITY HIGHWAY PRODUCTS, LLC****Booth #:** 613**Contact:** Gwendolyn Samuels**Phone:** 330-539-7305**Fax:** 330-545-3718**Website:** www.highwayguardrail.com

Trinity Highway Products, LLC is the leading manufacturer of highway guardrail, highway guardrail end treatments, temporary and permanent crash cushions, truck-mounted attenuators and cable barrier. Trinity is the market leader in booth innovation and safety standards.

**TUV RHEINLAND INDUSTRIAL SOLUTIONS****Booth #:** 900**Contact:** Mike Forbes**Fax:** 616-891-3565**E-mail:** mforbes@ndtg.net**Website:** www.nondestructivetesting.com

Non Destructive Testing Services provides bridge fabrication inspections for steel and concrete prestressed bridges, NDT inspections on existing bridges, and bridge paint inspections. NDTs has developed and performs a complete sign structure inspection program. NDTs's mechanical laboratory provides weld procedure qualifications, bridge bearing pad testing, and numerous other testing services.

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Vector Corrosion Technologies provides award winning products and services for concrete corrosion protection. Our innovative solutions include: chloride extraction, ICCP, and an array of galvanic protection systems (embedded galvanic anodes, galvanic jackets and activated arc spray zinc metallizing). Vector also provides corrosion evaluation and mitigation of post-tension corrosion.

**VIATHOR, INC.****Booth #:** 816**Contact:** Clark Verkler**Phone:** 916-987-0246**Fax:** 916-987-0248**Website:** www.viathor.com

Viathor, Inc. is dedicated to the development of top quality, user friendly, bridge design and analysis software. VBent, is a fully interactive substructure design tool for pier caps, columns and footings in integral (monolithic) and non-integral piers. Recent enhancements include flexure and shear reinforcement design, prestressed bent caps, and integral outriggers and drop caps. VBent can read PAPIER input files, and has been approved and accepted for use by PennDOT. VBridge is a superstructure design program for reinforced, or cast-in-place post-tensioned, concrete bridges. VBridge can compute live load for any bridge configuration and support type (integral and non-integral piers). VBridge analyzes 3D bridge models, and creates VBent input files by sharing geometry and load information.

**WACKER NEUSON CORPORATION**

Booth #: 426 &amp; 428

Contact: Austin Hoffmann

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E-mail: [austin.hoffmann@wackerneuson.com](mailto:austin.hoffmann@wackerneuson.com)Website: [www.wackerneuson.com](http://www.wackerneuson.com)

Wacker Neuson is a global manufacturer of light and compact equipment with a comprehensive product portfolio. Wacker Neuson is the partner of choice among professional equipment users in construction, utility, municipal, industrial, landscape, agricultural, restoration and homeowner markets.

**WHEELING CORRUGATING COMPANY**

Booth #: 517

Contact: Mike Benson

Phone: 304-234-2326

Fax: 304-234-2378

Website: [www.wheelingcorrugating.com](http://www.wheelingcorrugating.com)

Wheeling Corrugating Company specializes in permanent metal bridge deck forms. Form depths range from 2 inches through 4.5 inches accommodating girder spacings up to 15'-0"

**WILLIAMS FORM ENGINEERING**

Booth #: 727

Contact: Ryan Williams

Phone: 616-866-0815

Fax: 616-822-1890

Website: [www.williamsform.com](http://www.williamsform.com)

Williams Form Engineering Corporation has been offering high capacity Ground Anchors, Concrete Anchors, Post Tensioning Systems, and Concrete Forming Hardware to the construction industry for over 80 years.

**WIRECO WORLD GROUP**

Booth #: 801

Contact: Richard Humiston

Phone: 816-270-4825

Fax: 816-270-4707

Website: [www.MacWhyte.com](http://www.MacWhyte.com)

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Booth #: 439

Contact: Bill Austin

Fax: 570-327-4274

E-mail: [w.austin@wireropeworks.com](mailto:w.austin@wireropeworks.com)Website: [www.wireropeworks.com](http://www.wireropeworks.com)

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**WORKZONE SAFETY CLEARING HOUSE/ARTBA**

Booth #: 303

Contact: Lisa McCluskey

Fax: 202-289-4435

E-mail: [lmclluskey@artba.org](mailto:lmclluskey@artba.org)Website: [www.workzonesafety.org](http://www.workzonesafety.org)

The National Work Zone Safety Information Clearinghouse is dedicated to providing the transportation construction industry and the general public with comprehensive information to improve motorist, worker and pedestrian safety in roadway work zones.

**ZWEIGWHITE**

Booth #: 824

Contact: Kevin Carmody

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E-mail: [kcarmody@zweigwhite.com](mailto:kcarmody@zweigwhite.com)Website: [www.zweigwhite.com](http://www.zweigwhite.com)

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