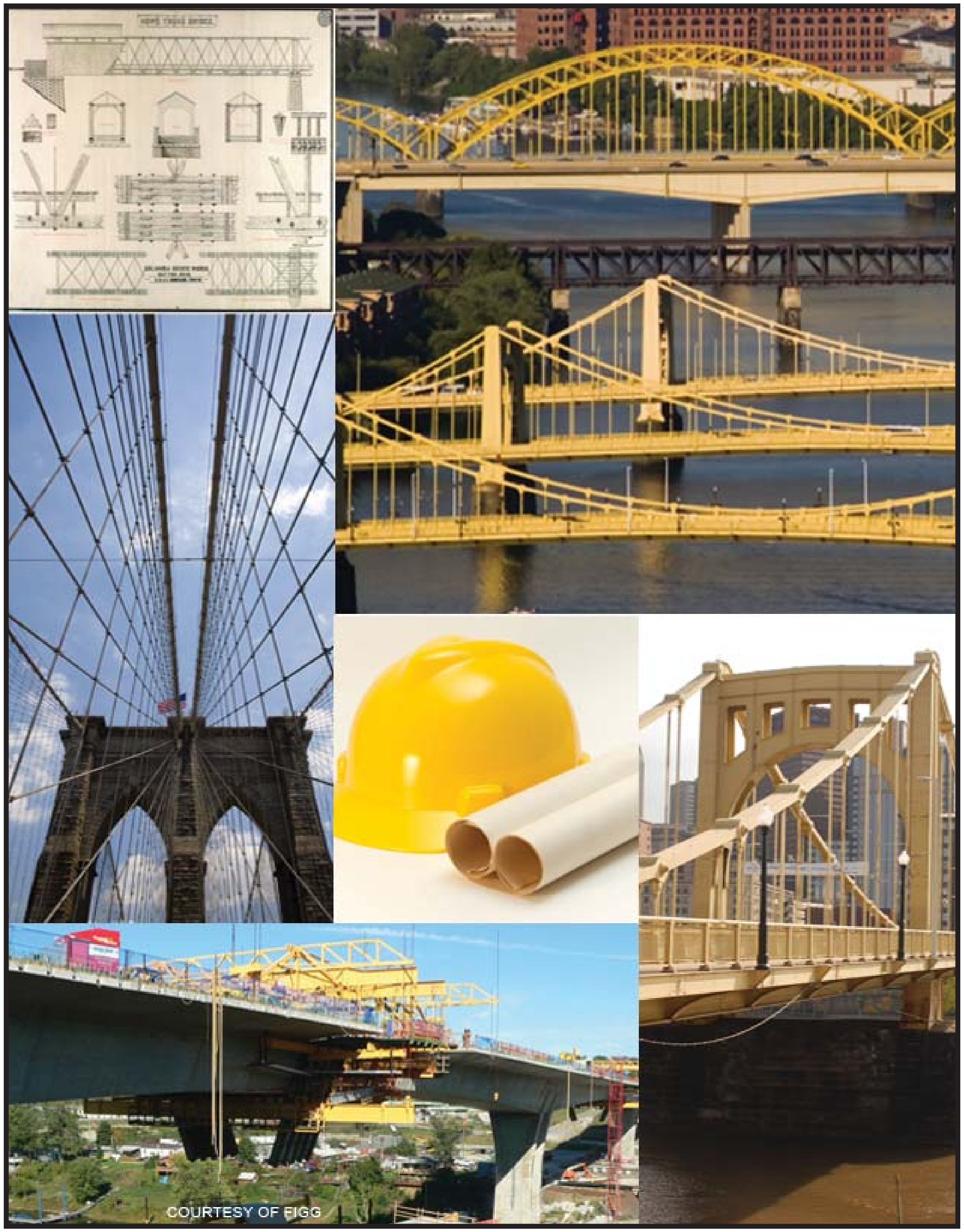
Meeting Bridge Challenges in Challenging Times



THE INTERNATIONAL BRIDGE CONFERENCE®

June 14-17, 2009
David L. Lawrence
Convention Center
Pittsburgh, PA U.S.A.

26th Annual INTERNATIONAL BRIDGE CONFERENCE

2009 Featured Agency:

Pennsylvania
Department of
Transportation

pennsylvania
DEPARTMENT OF TRANSPORTATION

World of Bridges in the City of Bridges

THE INTERNATIONAL BRIDGE CONFERENCE®

Table of Contents

Good Information

1. Check the IBC web site for important updates and continuous developments at www.eswp.com/bridge
2. On-line registration is now open! Early bird registration discounts are available thru May 22
3. Make your hotel reservations early!
4. Look for other General Information on Page 2 of this brochure.

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 Florida Board of Professional Engineers, as well as many other state licensing boards. As such, your attendance at the IBC may 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. If you require a Confirmation Letter, please check mark the "PDH Letter Requested" box on the Registration Form. Please note that some sessions will require you to register individually

Schedule at a Glance

	8am	9am	10am	11am	Noon	1pm	2pm	3pm	4pm	5pm
Monday, June 15										
	Keynote Session					Featured Agency				1st Timers Reception
	Spouse's Breakfast			IBC Bridge Awards Luncheon		W-1: Lightweight Concrete for Bridge				
						W-2: Maximizing Foundation Design using Full Scale Load Testing				
					IBC Exhibit Hall Open! (Hours: 12noon– 7pm, includes Lunch and Evening Reception)					
Tuesday, June 16										
	Design Part 1 Session					Construction Session				
	Design-Build Session					Context Sensitive Design Session				
	Bridge Evaluation Session					Long Span Bridges Session				
	Confined Soil Walls Seminar									
	Highway Tunnel Inspection Seminar									
			Railroad Bridge Session			IBC Bridge & Bus Tour				
	W-3: Bridge Aesthetics					W-7: Seismic ABC				
	W-4: FHWA ABC					W-8: Bridge Owner Program Forum				
	W-13: SSPC Coatings (rescheduled from Wednesday)					W-9: Drilled Foundation & Anchored Earth Retention				
	W-5: Management Practices					W-10: High Tech Underwater Inspection				
	W-6: Detailing for Bridges					W-11: State Highway Agency Forum				
				IBC Exhibit Hall Open! (Hours: 11am – 5pm)						
Wednesday, June 17										
	Bridge Monitoring Session					Bridge Management Session				
	Design Part 2 Session					ABC Session				
	Rehabilitation, Part 1 Session					Rehabilitation, Part 2 Session				
	Gusset Plate Seminar									
	W-12: FHWA Long Term Bridge Performance Program									
	W-14: Western PA Transportation Research Forum									
	W-15: FRP Composites: Rapid Construction									
	W-16: Construction Best Practices for Engineers									
		W-17: PennDOT Maintenance Topics								
	IBC Exhibit Hall Open! (Hours: 8am--1:30pm, includes Lunch)									

Chairman's Welcome

Welcome to the 2009 International Bridge Conference®. This year's conference will be held June 14-17, 2009 at Pittsburgh's David L. Lawrence Convention Center. Despite the tough economic times, the Executive Committee (listed below on Page 3) of the International Bridge Conference® and the Engineers' Society of Western Pennsylvania (ESWP) have been working hard to improve on its very successful 25th Anniversary conference. A special thanks to our Co-Sponsors (listed below on Page 3) and Financial Sponsors who help to promote and support the Conference. We have listened to you, our customers, and made changes to the conference based on the feedback from our post- conference survey. We are proud to announce the changes to the exhibit area, the new workshops, training offerings and demonstrations. Also, we continue to reach out to our contracting partners to make this conference one in which they can share their valuable experiences with bridge designers for the good of the transportation industry. We hope that these changes along with our traditional program meet your needs on both an individual and company level.

Our program for this year includes:

- Keynote Session: Our Keynote Session will include nationally known leaders including:
    - U.S. Congressman Representative James L. Oberstar, Chairman of the Committee on Transportation and Infrastructure (invited),
    - M. Myint Lwin, P.E., Director of Office of Bridge Technology, FHWA,
    - Pennsylvania DOT Secretary and AASHTO President Allen D. Biehler, P.E.,
    - Malcolm T. Kerley, P.E., Virginia DOT's Chief Engineer and Chairman of the AASHTO Subcommittee on Bridges and Structures,
    - Daniel L. Dorgan, Minnesota DOT Director, Office of Bridges and Structures.
- Technical Program: The Technical Program continues to build on its success from last year by offering over 100 technical presentations. The sessions topics include:
    - Design
    - Design/Build
    - Bridge Evaluation
    - Construction
    - Context Sensitive Design
    - Long Span Bridges
    - Bridge Monitoring
    - Bridge Rehabilitation
    - Bridge Management
    - Accelerated Bridge Construction

You can find all of the information on the IBC Technical sessions, including a full abstract of each paper on pages 6-17. Sessions are listed in order by date.

- Pennsylvania Department of Transportation: As the featured agency for this year, the IBC Executive Committee sought to invite a DOT that has been a leader on numerous transportation issues over the years. This year is no different for PennDOT, as they have embarked on one the most aggressive bridge programs in the country with their Accelerated Bridge Program (ABP). In addition to the ABP, the Department will have a number of speakers on a variety of bridge topics including bridge problems/solutions, bridge fabrication QA/QC, 100 year life for bridges, historic bridges and bridge inspection to name a few.
- Exhibit Hall: We are expecting over 175 exhibitors this year as we have moved the Trade Show into Hall B of the David L. Lawrence Convention Center which offers refreshing natural daylight. We also plan to add more areas to demonstrate equipment like inspection cranes; man lifts, diving inspection boats, etc. Attendees are welcomed to take advantage of the industry's knowledge of products, equipment and design experience by visiting this area. We welcome all the exhibitors who have participated in the past and the many new exhibitors for this year.

This year, the IBC will offer more than 15 workshops on a variety of topics. A full schedule of these workshops can be found on Pages 18-21 of this brochure.

We will again offer Workshops, Papers and Exhibits that will be special interest to members of the Contractor Industry. Three workshops in particular are "must see" events for Contractors.

Also, new for this years is a "Welcome New Attendee" reception meant especially for our first time registrants, on Monday afternoon.

Please visit the IBC website (www.eswp.com/bridge) for continual updates to the Programs, Schedule and Exhibits. More information is available, as well as on-line registration.

Thank you considering IBC in your training and travel plans for this year. The Executive Committee for IBC and ESWP is continuing to strive to make IBC the "World of Bridges in the City of Bridges" and your *one-stop-shop* for the bridge industry.

I hope to see you in June!

Louis J. Ruzzi, P.E.
2009 International Bridge Conference® General Chair
District Bridge Engineer
Pennsylvania Department of Transportation-District 11-0

General Information

Registration

Full Registration includes admission to the Keynote Session, Featured Agency Session, daily Technical Sessions, Workshops, IBC Exhibit Hall, Exhibitors Party, and the Monday and Wednesday Exhibit Hall Buffet Luncheon. The Bridge Awards Luncheon (Monday) is included, however seating is strictly limited to the first 300 requests; you must select the luncheon on the registration form to receive a ticket. One-Day Registration includes the Technical Sessions, Special Interest Sessions, 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.

Educational Seminars, Tours and Conference Proceedings require an additional registration fee. Please see the Registration Form.

You can register by using the Registration Form on Page 15. Your registration, along with payment, must be received by the Engineers' Society of Western Pennsylvania by Friday, June 12, 2009; following that date you must register on-site. On-line registration is also available at www.eswp.com/bridge

All refund requests must be received in writing. No refunds after June 12. If you don't cancel and don't attend, you will be charged the full registration fee.

Accommodations

A special block of rooms has been reserved at the Westin Convention Center Hotel, host hotel of the IBC. After May 21, 2009 they will accept reservations on a "space available" basis and the special Conference rate of $169 (plus tax) may not apply. For additional assistance, please contact the IBC offices. The Westin Hotel invites their guests to enjoy the complimentary use of their hotel shuttle that will take you to any destination within a 2 mile radius of the hotel. Additional room blocks have been made available for overflow housing–please refer to the IBC website for details.

Westin Convention Center Hotel

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 David L. Lawrence Convention Center via Skybridge, or by an easy outdoor walk across Penn Avenue, the Westin is conveniently located to the IBC Headquarters. Hotel reservations can be made by contacting the Westin Convention Center Hotel directly at 412-281-3700. On-line reservations can be made at http://www.starwoodmeeting.com/StarGroupsWeb/booking/reservation?id=0812092550&key=755C2

Flying

Travelers arriving by plane can enjoy the first-class service and impeccable facilities of the Pittsburgh International Airport, voted Best U.S Airport by Conde Nast Traveler, located approximately 18 miles from downtown. Shuttle service can be arranged at the Transportation Services Desk near the baggage claim area and operates from 7 am to 11:40 pm daily with departures every 30 minutes. The cost is $19 one-way and $36 round-trip per adult. Rental cars and limousines are available. Taxi service can be obtained by calling Checker Cab at 412-321-8100 or Yellow Cab at 412-321-8100. More information is available at www.flypittsburgh.com.

Airport Flyer 28x

For $2.60 each way (exact change required) the Port Authority provides public transportation daily from 5:30 am to 12:00 am from the airport to downtown Pittsburgh and departs every 20 minutes. The 28X can be boarded at the Lower Level Ground Transportation bus stop (near baggage claim at Door #6.) For additional information please call 412-442-2000 or visit their web site www.portauthority.org.

Driving

For attendees driving to Pittsburgh, directions are available at the Convention Center web site: http://www.pittsburghcc.com/cc/Directions/Default.aspx

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.

Spouse & Guest Program

While you are attending one of the technical functions of the conference, your spouse will be able to enjoy one of the many attractions of the Pittsburgh area. This new feature of the conference will begin with a "Get Acquainted" Continental Breakfast on Monday June 15 at 8:30am, with a Guest Speaker from the VisitPittsburgh - Pittsburgh's Convention & Visitors Bureau. Further, each day of the conference will feature an optional tour open to all conference attendees and their spouses & guests. Activities being planned for the 2009 Spouses program include a unique and informative tour of Pittsburgh aboard "Just Ducky" tours (Monday, 6/15), a day at the Heinz History Center (Tuesday, 6/16) and a private group tour of PNC Park, home of the Pittsburgh Pirates MLB baseball club (Wednesday 6/17). Please mark your selections on the Conference registration form. If you have questions about the events planned for the Spouses program, please contact Conor McGarvey at the IBC Offices. Registration for the Spouse's Program is $75 and includes a ticket to the Get Acquainted Breakfast, and admittance to 2 Exhibit Hall buffet lunches and for the Monday evening Exhibit hall reception. Registrations for the daily tour events are priced individually, and subject to minimum attendance.

"First-timers Reception"

All "first-time" attendees to the International Bridge Conference® are welcomed (and encouraged!) to attend the "First-timers Reception" on Monday June 15, at 5:00pm. This is a great way for the IBC Executive Committee to acclimate new attendees to the IBC and provide additional information about all of the events and happenings at the Conference. If you are a "first timer" to the IBC, please consider joining us for this mixer, to learn more about the IBC!

Pittsburgh — The City of Bridges

Located at the confluence of three sparkling rivers and banked on all sides by green hills, Pittsburgh has earned its reputation as one of America's "most livable" cities. Long a center for the production of steel, iron and glass, Pittsburgh's economy is now driven by technology, medicine, finance and tourism.

Nights come alive in the Cultural District, home to five theaters within walking distance of hotels and the convention center. The Cultural District also affords a selection of up-scale and mid-range dining, from French to Italian, Tex Mex to Thai.

In the Strip District, the clubs are hot, the food is spicy, and dance floors pulse to the sounds of rock, blues, jazz and swing. Award-winning brew pubs serve up the finest lagers and ales, while classic Pittsburgh fare is featured at nearby diners. By day, the Strip is alive with street vendors and shoppers buying the freshest breads, pastries, cheeses, coffees and ethnic specialties.

Just across the river on Pittsburgh's North Shore, you'll find PNC Park, the home of the Pittsburgh Pirates. This 38,000 seat classic baseball stadium has been called the perfect blend of location, history, design, comfort and baseball" by ESPN. The Pittsburgh Pirates will take on the Detroit Tigers over the weekend prior to the IBC dates; Friday, June 12 and Saturday June 13 at 7:05pm, and Sunday, June 14 at 1:35pm. Single game tickets are available at www.pittsburghpirates.com, or by calling 1-800-Buy-BUCS.

Questions?

Please direct any questions to Mr. Conor McGarvey at the International Bridge Conference®, c/o Engineers' Society of Western Pennsylvania, 337 Fourth Avenue, Pittsburgh, Pennsylvania 15222, USA. Phone: 412-261-0710, Fax: 412-261-1606 or e-mail: c.mcgarvey@eswp.com.

General Information

2009 IBC Executive Committee

Technical Program Chair
Jeffrey J. Campbell, P.E.
Michael Baker Jr., Inc.

Attendance Chair
Thomas J. Vena, P.E.
County of Allegheny, DPW

Bridge Awards Co-Chair, Featured Agency Chair
Carl Angeloff, P.E.
Bayer MaterialScience, LLC

Bridge Awards Co-Chair, Magazine Chair
Thomas G. Leech, P.E., S.E.
Gannett Fleming, Inc.

Budget Chair
Victor E. Bertolina, P.E.
SAI Consulting Engineers, Inc.

Construction Co-Chair
Michael J. Alterio
Alpha Structures, Inc.

Construction Co-Chair
Ronald D. Medlock, P.E.
High Steel Structures, Inc.

Co-Meetings Co-Chair, Keynote Program Chair
Eric S. Kline
KTA-Tator, Inc.

Co-Meetings Co-Chair
Mary Lou Ralls, P.E.
Ralls Newman, LLC

Co-Sponsors Chair
Lisle E. Williams, P.E., PLS

Education Chair
Kent A. Harries, PhD, FACI, P.Eng.
University of Pittsburgh

Exhibits Chair
Enrico T. Bruschi, P.E.
AECOM

General Chairman
Louis J. Ruzzi, P.E.
Pennsylvania Dept. of Transportation

Marketing Chair
Kenneth J. Wright, P.E.
HDR Engineering, Inc.

Rules Chair, Seminars Chair
Richard Connors, P.E., PMP
Municipality of Murrysville, PA

Spouse Program Chair
Gerald J. Pitzer, P.E.
GAI Consultants, Inc.

Tours Chair
Donald Killmeyer, Jr., P.E.
ms consultants, inc.

Training Chair
Gary Runco, P.E.
Metal Foundations LLC

IBC COMMITTEE
Al M. Ahmed, P.E.
A&A Consultants, Inc.

Jose Aldayuz, P.E.
AASHTO

Calvin Boring
Trumbull Corporation

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

James Dwyer
STV, Inc.

James H. Garrett, Jr., Ph.D.
Carnegie Mellon University

Donald W. Herbert, P.E.
Pennsylvania Dept. of Transportation

M. Myint Lwin, P.E., S.E.
Federal Highway Administration

Thomas P. Macioce, P.E.
Pennsylvania Dept. of Transportation

Herbert M. Mandel, P.E.
GAI Consultants, Inc.

Matthew P. McTish, P.E.
McTish, Kunkel & Associates

Dennis R. Mertz, Ph.D.
University of Delaware

William J. Rohleder Jr., P.E., S.E.
Figg Bridge Engineers, Inc.

Helena Russell
bridge design and engineering

2009 IBC Co-Sponsoring Organizations

American Association of State Highway and Transportation Officials (AASHTO)
www.transportation.org

American Public Works Association (APWA)
www.apwa.net

American Road & Transportation Builders Association (ARTBA)
www.artba.org

American Society of Highway Engineers (ASHE)
www.highwayengineers.org

Associated Pennsylvania Constructors (APC)
www.paconstructors.org

Association of Diving Contractors International (ADCI)
www.adc-int.org

Pennsylvania Department of Transportation (PENNDOT)
www.dot.state.pa.us

Precast/Prestressed Concrete Institute (PCI)
www.pci.org

Transportation Research Board (TRB)
www.trb.org

Prestressed Concrete Association of Pennsylvania (PCAP)
www.pcap.org

Federal Highway Administration (FHWA)
www.fhwa.dot.gov

Society for Protective Coatings (SSPC)
www.sspc.org

Carnegie Mellon University – Department of Civil Engineering
www.ce.cmu.edu

University of Pittsburgh – Department of Civil and Environmental Engineering
www.engr.pitt.edu/civil

Keynote & Plenary Sessions

Keynote Session

Monday, June 15; 8:30am–12:00pm
Session Chair: **Louis J. Ruzzi, P.E.**, *District Bridge Engineer, Pennsylvania Department of Transportation-District 11-0, Bridgeville, PA*

The Honorable James L. Oberstar
Congressman Minnesota 8th District (Invited)

Jim Oberstar was born Sept. 10, 1934, to a working-class family on Minnesota's Iron Range. His father, Louis, was an iron miner, first in the Godfrey Underground Mine and later in the open pits. His mother, Mary, worked in the Arrow Shirt Factory in Chisholm to supplement the family income while she raised Jim and his two brothers.

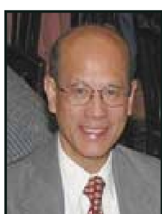
In 1963 Jim began working for Representative John Blatnick, who represented Jim's home town of Chisholm in Congress. He started as a clerk in the Subcommittee on Rivers and Harbors and eventually worked his way up to become Blatnick's chief of staff and the administrator of the Committee on Public Works, which is known today as the House Committee on Transportation and Infrastructure. He was elected to Congress in 1974 and immediately secured a seat on the transportation committee and started building his reputation as one of the nation's leading experts on transportation issues. Chairing key subcommittees on oversight and aviation, Jim spearheaded major reforms in transportation safety, especially in the aviation sector.

Jim has also been a strong advocate for creating a diverse intermodal transportation system that incorporates new state of the art technologies. His work has been recognized groups like the American Society of Civil Engineers which has named him as an honorary member.

He was elected chairman of the Transportation and Infrastructure Committee when Democrats took back the majority 2006, becoming the first Member of Congress who has served as both the administrator and the chairman of a full congressional committee. In the first two years of under Jim's leadership, the committee had 93 bills in its jurisdiction reach passage by the full House of Representatives and go on to become law.

On August 1, 2007, the I-35W bridge collapsed in Minneapolis. Within hours Jim had authored a bill to rebuild the bridge. Forty-eight hours later, the legislation had cleared both the House and Senate and had been signed into law, and $255 million of assistance was on its way to Minnesota.

Jim in now looking to the future. The Transportation Committee is currently working on the next surface transportation bill to maintain and expand the nation's vast transportation system. As drivers cope with rising gas costs and congestion, Jim will work to ensure that we invest in our country's vital infrastructure while at the same time tackling energy challenges head-on.



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.

The Honorable Allen D. Biehler, P.E.
Secretary, Pennsylvania Department of Transportation, Harrisburg, PA

Nominated by Gov. Edward G. Rendell, Allen D. Biehler, P.E., was confirmed by the State Senate as Pennsylvania's Transportation Secretary in February 2003.

Secretary Biehler is responsible for an organization of about 12,000 employees with an annual budget in excess of $5 billion. PennDOT owns and operates the nation's fifth largest state-owned highway system and administers one of the nation's largest grant programs for mass transit, rail freight and aviation. PennDOT also processes 30 million driver and vehicle customer service transactions each year, and operates the 12 Pennsylvania Welcome Centers which greeted over three-million visitors in 2002.

Before taking the lead at PennDOT, Secretary Biehler amassed 34 years experience in transportation engineering, planning, construction administration and public transportation management.

Malcolm T. Kerley, P.E.
Chief Engineer, Virginia Department of Transportation, AASHTO

Mal Kerley, Chief Engineer for the Virginia Department of Transportation (VDOT), is a member of the AASHTO Standing Committee on Highways and has served as Chair of the AASHTO Highway Subcommittee on Bridges and Structures (SCOBS) since 2002. In July 2002, he was named Chief Engineer at VDOT, accountable for the quality, cost and timeliness of all engineering plans associated with the design of, and right-of-way acquisition for, VDOT transportation projects. He had served as Administrator of VDOT's Structure & Bridge Division from 1992 to 2002, responsible for planning, design, construction, maintenance and inspection of more than 20,000 bridges and overpasses. He began his career with VDOT in 1971. He has a civil engineering degree from the Virginia Military Institute (BSCE, 1971) and Master's degree from the University of Virginia (MECE, 1973).

Daniel L. Dorgan
State Bridge Engineer, Minnesota Department of Transportation–Bridge Office

Dan Dorgan is the State Bridge Engineer for the Minnesota Department of Transportation and has over 30 years experience in bridge design and management. He began his career with the Minnesota DOT in 1975 and has held various positions as a bridge designer, administrator for bridge consultant contracts, and manager in the Metropolitan District of Minnesota DOT. In addition to a Bachelors of Civil Engineering, he also holds a Masters Degree in Business Administration from the University of Minnesota.

Featured Agency Session

Monday, June 15; 1:30–5:00pm
Session Chair: Tom Macioce, P.E., Chief Bridge Engineer, Pennsylvania Department of Transportation, Harrisburg, PA

Learn more about the bridge program of the Pennsylvania Department of Transportation, with sessions and speakers that include:

- Bridge Problems and Solutions - Craig Beissel, P.E.
- Research on NDE P/S Beams - Dr. Clay Naito, Ph.D., Lehigh University
- Bridge Fabrication & QA/QC - Bob Horwhat, P.E. & Joe Bracken III, P.E.
- Historic Bridges in Pennsylvania - Kara Russell
- Accelerated Bridge Program - Hal Rogers, P.E.
- The Evolution of Bridge Inspection - Lance Savant, P.E.
- Pennsylvania Bridge Risk Assessment Strategy - Tom Macioce, P.E. & Tony McCloskey, P.E.
- 100 Year Bridge Summit - Kristin Langer, P.E.

Railroad Bridges Plenary Session

Tuesday, June 16; 10:30am–12:00pm
Session Chair: **James D. Dwyer**, *STV, Inc., Pittsburgh, PA*

The IBC Committee, recognizing the importance of the North American railroads to both our economy and security, will conduct a special plenary session devoted to presentations on railroad bridges.

Discussion will consist of current practices related to railroad bridges, rules and regulations applicable to rail bridges, research and specification requirements, bridge management and inspection programs and funding. Speakers include:

Steve A. Millsap, P.E.
Assistant Vice President–Structures - BNSF Railway

John F. Unsworth, P.Eng.
Manager, Structures Planning and Design - Canadian Pacific Railway

Gordon A. Davids, P.E.
Chief Engineer - Structures Federal Railroad Administration, Office of Safety

IBC Bridge Awards Luncheon

Monday, June 15; 11:30am–1:00pm

ESWP, in association with bridge design and engineering (bd&e) Magazine, Roads and Bridges Magazine, Bayer MaterialScience LLC, and the International Bridge Conference®, invites you to join us at the 22nd Annual IBC Bridge Awards Luncheon, sponsored by Sherwin Williams. This event is limited to the first 300 people at this complimentary event. 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. The student award is named in honor of a former IBC General Chairman, champion of the student award's program and friend to the bridge community at large. Honorees will be recognized in the following categories:

- John A. Roebling Medal – For lifetime achievement in bridge engineering. Major achievements may include design, construction, research or educational endeavors.
- George S. Richardson Medal – For a single, recent, outstanding achievement in bridge engineering. Fields of endeavor may include design, construction, research or education.
- Gustav Lindenthal Medal – For a single, recent, outstanding achievement in bridge engineering demonstrating, as appropriate, technical and material innovation, aesthetic merit, harmony with the environment or successful community participation.
- Eugene C. Figg Jr., Medal – For a single, recent outstanding achievement in bridge engineering that, through vision and innovation, provides an icon to the community for which it was designed.
- Arthur G. Hayden Medal – For a single recent outstanding achievement in bridge engineering demonstrating innovation in special use bridges such as pedestrian, people-mover, or non-traditional structures.
- James D. Cooper Student Award – A student paper competition open to college and university engineering students in the United States and worldwide.

You must select the "Awards Luncheon" option on the Registration form (and be registered to attend the Conference on Monday) to receive a ticket. Requests are honored on a first-come, first-served basis.

John A. Roebling Medal

The John A. Roebling Medal recognizes an individual for lifetime achievement in bridge engineering. We are pleased to recognize Harold R. Sandberg as, P.E., S.E. the 2009 recipient. As the first employee and Chairman Emeritus of Alfred Benesch & Company, Mr. Sandberg is well known in the engineering community. His many contributions to the industry have garnered numerous prestigious awards. As an honorary member of ACI he was given the Henry Crown Award in 2005 and the Alfred E. Lindau Award in 2006. As a strong advocate of redundancy, he presented papers at meetings of the IBC. In 1982 he testified before the House Congressional Sub-Committee regarding failures in public structures. At 89, Mr. Sandberg continues to be active in several professional committees.

George S. Richardson Medal

The George S. Richardson Medal, presented for a single, recent outstanding achievement in bridge engineering, is presented to recognize the I35W Bridge over the Mississippi Bridge in Minneapolis, Minnesota. After the Aug. 1, 2007 collapse, the new segmental girder structure was designed, constructed, and opened to traffic at 5:00am on Sept. 18, 2008. The award celebrates the accomplishments of the government, contractors and consultants who were focused on delivering a complex project within extremely tight time constraints.

Gustav Lindenthal Medal

The Gustav Lindentahl Medal, awarded for an outstanding structure that is also aesthetically and environmentally pleasing, will be presented to recognize the Woodrow Wilson Bridge, south of Washington D.C. linking Virginia and Maryland. The fixed span and bascule bridge features an aesthetic appearance and integrated state of the art environmental measures to preserve underwater vegetation and protect fish during foundation installation.

Eugene C. Figg Jr. Medal

The Eugene C. Figg Jr. Medal for Signature Bridges, recognizing a single recent outstanding achievement in bridge engineering, which is considered an icon to the community for which it is designed, will be presented to recognize the Sanhao Bridge over the Hunhe River in the Northeastern city of Shenyang, China. This artistic bridge expresses a new structural form that will give identity and distinction to the connecting communities.

Arthur G. Hayden Medal

The Arthur G. Hayden Medal, recognizing a single recent outstanding achievement in bridge engineering demonstrating vision and innovation in special use bridges, will be presented to recognize Seattle's Museum of Flight Pedestrian Bridge. This bridge, sculptured to represent the wisps of an airplane's contrails, provides a visually interesting invitation to the Museum of Flight.

James C. Cooper Student Award

The James D. Cooper Student Award recognizes undergraduate and graduate students who demonstrate an interest and passion for bridge engineering. The award is presented to winners of a student competition for technical writing and engineering insight. The 2009 award will be presented to Michael Loy of Oregon Episcopal High School for his paper entitled Developing a Novel pH Buffer Methodology to Inhibit Concrete Corrosion. The awards committee judged this paper to be superior all other undergraduate student and graduate student entrees, quite an accomplishment for a high school senior.

TUESDAY, JUNE 16–MORNING SESSIONS

DESIGN, PART 1 8:00-10:30 AM

Session Chair: Gerald Pitzer, P.E., GAI Consultants, Inc., Homestead, PA

09-01: Digitally optimized structural design and manufacturing inspire novel footbridge typologies.

Sigrid Adriaenssens, Laurent Ney, Eric Bodarwe, and Vincent Dister, CEE, Princeton University, Princeton, NJ

The Centner pedestrian bridge at Verviers, Belgium is the first design and artifact that successfully exploits the possibilities of linking equivalent steel plate stiffness method to digital steel plate cutting techniques. Structurally, this new bridge is designed as a statically determinate beam placed on the foundations of the original derelict trussed bridge. The new structure has a U-profile in cross-section. The webs serving as handrail, are assembled of 10 different type of steel plates with a laser cut aperture pattern the aperture pattern and the steel plate thickness have been structurally optimized to deal with the maximum occurring shear forces. The analytical verification method consists of replacing the laser cut steel plate with a full steel plate with equivalent stiffness and applying the usual EuroCode3 design rules for slender webs. The longitudinal bridge profile reduces in height towards the supports in accordance with the maximum bending moment, taken by the two top and one bottom flange. The bridge is modeled and analyzed in a finite element (FE) model and verified and detailed.

For construction purposes, the numeric FE model is translated into a digital graphic model that serves as input for the steel laser cutter. Once the aperture pattern is cut in the steel plates, all plates are welded together and finishes applied in the contractor's workshop. The bridge is transported as one piece and installed overnight on site Due to little manual labor involved, the joining simplicity of the structural elements and the ease of installation, this innovative and elegant looking pedestrian bridge turns out to be a more economic solution than an identical copy of the initial trussed bridge.

09-02: Avenues Walk Flyover - Severe Curvature on a Single Span Bridge

Samuel Spear, GAI Consultants, Homestead, Pa

At 218' long and having a centerline radius of 300', the Avenues Walk Flyover is one of the longest and most highly curved single span girder bridge structures in the world. The $13 million flyover provides access to a valuable commercial development site in Jacksonville, Florida by spanning the Florida East Coast railroad. The lack of available approach roadway area resulted in a very aggressive roadway and bridge alignment. The structure is scheduled to open to traffic in November, 2008. This paper will focus on unique design features, comparative computer modeling, and product delivery methods. Accomplishing this combination of span and curvature required unique design elements to optimize capacity and ensure stability. Elements that will be addressed in the paper include varying end skews, non-uniform girder spacing, non-uniform girder web depth, lower lateral bracing in the outermost girder bay, uplift resistant bearings, a cast in place concrete counterweight, and a deck pour staged to improve construction stability. In order to provide verification of bridge behavior during erection and under traffic, the design incorporated grid analysis, 3D element modeling and finite element analysis in a comparative way. Using these different types of analysis allowed the designers to both focus on the big picture, and to look at local response in detail. The effects of lower lateral bracing and counterweight location on uplift will be examined. The project was successfully awarded and delivered on time and on budget through employment of design competition and design-build methodologies. Impacts of the project award and delivery process on the design will be discussed.

09-03: Design of a Four-Span Steel Bridge With Challenging Site Conditions, Numerous Geometric Constraints, Geotechnical Concerns, and Three Abutments

James Andrews, P.E., Pennsylvania DOT, Indiana, PA, Ahmad K. Ahmadi, P.E., Ph.D., and Keith Michael, P.E., SAI Consulting Engineers, Inc., Pittsburgh, PA

This paper will discuss the design of a four-span continuous multi-girder bridge on 8% grade, built between a rock cliff face on one side and a steep slope on the other side. The bridge crosses a railroad at a very sharp skew with limited vertical and horizontal clearances. The bridge is on a curved alignment and has a "T-Span" framing into it to support a local road that intersects with the main road on the bridge. A conventional 2-D analysis was performed for the initial design and camber of the "kinked" girders, and a 3-D model was developed to verify the results.

"One sided" cantilever pier caps supported by drilled shafts support a five-span, prestressed concrete box beam bridge that supports a portion of the approach roadway to the bridge where the roadway overhangs the steep hillside. A retaining wall was placed behind the pier columns, cast integral with the pier columns, and anchored into the hillside to provide additional support.

Acid mine drainage, open mine voids, and a layer of coal beneath the bridge substructures presented geotechnical design challenges for the design of drilled shaft caisson piers. In order to avoid significant shoring and tie backs, Abutment 3 was constructed with tangent caissons. The bridge is constructed and will be open to traffic in late October 2008.

09-04: Dynamic Amplifications in Bridge Pier Design Forces Under Barge-Bridge Collision Loading

Michael Davidson, University of Florida, Gainesville, FL; Gary Consolazio, University of Florida, Gainesville, FL

Bridges spanning navigable waterways in the U.S. are currently designed using the AASHTO static force approach to determine bridge pier structural demand due to vessel collision. However, findings from recent full scale experimental impact tests have revealed that significant mass-related inertial forces can develop in impacted piers due to the effect of the overlying superstructure. Based in part on these findings, a dynamic (time history) analysis technique has been developed that utilizes vessel force deformation relationships and predicts both impact-load time-histories and member design forces. Additionally, new vessel force deformation curves have been developed for use in determining the impact forces associated with barge collision events. In the present paper, dynamic analysis is combined with the newly developed vessel crush curves to investigate bridge dynamic amplification phenomena during barge collisions. Pier component design forces are quantified using dynamic analyses and compared to results obtained using the AASHTO static analysis procedure. Such comparisons are presented for 17 bridges located throughout Florida. Amplification effects are found to be significant and widespread, suggesting that dynamic phenomena should be included in bridge design provisions.

09-05: Maple-Oregon Double Leaf Rolling Lift Bascule Bridge

Todd Ude, Teng & Associates, Inc., Chicago, IL; Ken Smorynski, Teng & Associates, Inc., Chicago, IL

The city of Sturgeon Bay in Door County, Wisconsin has developed along both sides of the narrow bay. Wisconsin DOT has recently completed a second bridge crossing in the downtown, improving traffic safety and capacity between the halves of the city. The new Maple-Oregon bridge accommodates marine traffic with a double-leaf rolling-lift bascule span. Each leaf rolls back on a horizontal track as it rotates to the open position. Each leaf is 115' from center of roll to midspan for a 230' span in the closed position, making it the largest bascule span in the state. The design features steel bascule girders and framing and a solid lightweight cast-in-place concrete deck. Each leaf is balanced via concrete counterweight, and operated by two electric 60 horsepower AC variable speed motors with flux vector drives. The bridge operates on demand, and for much of the year, multiple lifts per hour can be expected. This paper will provide an overview of the design and describe some of the solutions adopted for details specific to rolling lift bascules. Cost data are provided and the structure is put into context by comparison to other rolling leaf bridges.

DESIGN-BUILD 8:00-10:30 AM

Session Chair: William Rohleder Jr. P.E. S.E., Figg Bridge Engineers, West Chester, PA

09-06: I-35W: Soaring over the Mississippi River in Eleven Months

Alan Phipps, P.E., S.E., FIGG, Tallahassee, FL; Kevin Western, P.E., Minnesota Department of Transportation, Oakdale, MN

The I-35W Bridge is a modern concrete bridge for the future, designed and built in 11 months while incorporating a progressive design of new technology and materials. The owner, Minnesota Department of Transportation, created a vision for quality, safety and innovation that was achieved under budget on this 10-lane Interstate. Completed in 339 days (more than three months ahead of schedule), this design/build bridge over the Mississippi River features elegant design, sustainable eco-friendly materials, "smart bridge" technology, first use of LEDs for major highway lighting, concrete with nanotechnology that cleans the air (gateway element) and is transit and suspended pedestrian bridge ready. The 504' main span across the Mississippi River required 120 precast concrete segments for construction of the four adjacent box girders. Erection of the main span began on May 25, 2008 and was completed just 47 days later, on July 10, 2008. Delivery of the bridge in the accomplished timeframe required close coordination among the design/build team members, a commitment to attaining all of the project goals without compromise and the willingness to accept measured risk when planning the project.

09-07: The Christopher S. Bond Cable-Stayed Bridge

Patrick Cassity, Parsons, Chicago, IL

The $232 million kcICON Design-Build Project includes the design and construction of a landmark bridge over the Missouri River and reconstruction of over four miles of Interstate-29/35 in Kansas City, Missouri. The new bridge is almost 138 feet wide and approximately 1,700 feet long including approach spans. The suspended portion of the bridge consists of a composite steel and concrete, asymmetrical cable-stayed system with a main span of 550 feet and a side span of 451.5 feet. The creation of a gateway experience for motorists traveling on this bridge is a fundamental part of creating an icon for the Kansas City community. The striking, diamond-shaped pylon rises over 300 feet off the water and creates a natural gateway between the communities of North Kansas City and Kansas City.

The horizontal line of the bridge across the water is enhanced by a kinetic lighting solution. The lighting system includes necklace lights consisting of light-emitting diode panels mounted to the outer surface of the edge girder. These color-changing light-emitting diode panels are controlled by a lighting control system that allows for the display of infinite numbers of lighting shows across the length of the bridge, from simple one-color panels to complex, color-changing events. The colors and lighting events can be coordinated with seasonal changes and with special events taking place in the community.

09-08: Design of the Indian River Inlet Cable Stayed Bridge

Kenneth Butler, AECOM, Glen Allen, VA; Douglass Robb, DelDOT, Rehoboth Beach, DE

This presentation will describe the bridge design aspects for the Indian River Inlet Bridge Replacement design-build project in Delaware. The new bridge will carry the SR1 Coastal Highway across the Indian River Inlet. The roadway includes four lanes of traffic with shoulders, a 12 ft sidewalk and a sand bypass system. The main span unit consists of a concrete cable-stayed bridge with a 950 ft main span and 400 ft back spans. The superstructure components include edge girders, floor beams and a concrete slab. It is supported by two vertical planes of stay cables anchored in the edge girders. The stay cables are anchored in two vertical reinforced concrete pylons with steel beams connecting two opposite stay anchorages to resist longitudinal tensions across the pylon section. The floor beams and edge girders are post-tensioned, as well as the top slab in the longitudinal direction in the vicinity of the transition piers and center portion of the main span. The foundations for the main span unit consist of 36 inch x 36 inch prestressed piles. The deck is fixed for longitudinal movements at the North pylon and free to move at the South pylon. The deck is guided laterally at both pylons. Expansion joints are located at the transition piers and abutments. The cable-stayed spans are built on falsework over land and in cantilever with a traveling form for the portion of the main span located over the Inlet.

09-09: Designing Downslope Bridges along the Sea-to-Sky Highway for the 2010 Olympics

Schaun Valdovinos, Hatch Mott MacDonald, Vancouver, BC, Canada

This presentation will discuss the widening of British Columbia's picturesque Sea-to-Sky Highway in preparation for the 2010 Winter Olympics. The foundations of the new highway bridges were quite challenging and respond to the steep, unpredictable mountain terrain using various innovative solutions. The design-build contract was well suited to this type of work, allowing design to occur parallel to site excavation. This enabled the design to evolve as necessary to any obstacles encountered without requiring massive rework.

Several bridges will be showcased in this presentation, with the first using prestressed concrete I-girders to span steep down-slope terrain. Using ample amounts of annotated photographs, special features of the bridge will be explained including the use of an angled column at the first pier location to avoid bearing on fractured rock at the crest of a high cliff.

The second bridge to be discussed consists of 6m long precast concrete deck panels that span transversely between a steel edge beam and a median wall. This bridge archetype was developed specifically for the job to extend the roadway over short down-slope gullies and cliffs. Road gravels are applied atop the finished deck to effectively extend the at-grade travel lanes seamlessly onto the deck. The details of this bridge will be supplemented with appealing photographs of the site and of construction.

Several other multi-span bridges will be highlighted using aerial photos along with illustrations. The $500M upgrade is nearing completion and has created some very interesting bridge structures along this stretch of steep, mountainous terrain.

09-10: Design/Build Collaboration: Contractor, Engineer & Steel Fabricator

Daniel A. Rogers, PE, RETTEW Associates, Inc, Lancaster, PA; Tom Wandzilak, High Steel Structures, Inc., Lancaster, PA

The Pennsylvania Turnpike Commission awarded the contract for the construction of the Kriebel Road Bridge over the Turnpike to the team of Loftus Construction, Inc. and RETTEW. The design/build team avoided constructing a costly median pier by proposing a 148′-6″ simple span composite steel plate girder bridge and met the tight 12 month project schedule for completion of design and construction.

The design/build team met with High Steel Structures Inc. in the preliminary stages of design. This coordination resulted in key decisions on plate sizes, diaphragm members, types of connections and stiffener locations which then benefited the project schedule, the cost of the project and the efficiency of the design.

Through the early coordination with High Steel, the team recognized the plate sizes as critical to the fabrication schedule; therefore, RETTEW was able to expedite design and submissions to keep the project on schedule. Loftus, High Steel and RETTEW coordinated efforts on the erection procedures and successfully completed erection of all 5 girders in the required 4-hour erection schedule. The success of the erection schedule was largely dependent on decisions that were made early in the project, such as eliminating the field splice and pairing the girders on the ground prior to lifting.

RETTEW and High Steel coordinated drafting efforts throughout the project, resulting in a more efficient design and fabrication schedule. High Steel generated shop drawings from preliminary RETTEW design sketches and those shop drawings were then shared with RETTEW to use for final plans and to coordinate detailing.

BRIDGE EVALUATION 8:00-10:30 AM

Session Chair: Jeffrey Campbell, P.E., Michael Baker, Jr., Inc., Moon Township, PA

09-11: Emergency Gusset Plate Repair under Live Load

Michael Malloy, GussetFix LLC, Avon, OH

Shortly after the I-35 bridge collapse, the Ohio Department of Transportation took a closer look at their truss bridges. The results of these inspections led to the emergency repair of two major bridges, the Main Ave bridge (SR-2 over the Cuyahoga River) and the Innerbelt bridge (I-90 over the Cuyahoga River).

Due to the importance of these structures, and the difficulty in providing temporary supports, a technique was used to add material to more than 40 Gusset plates and to replace two truss chords without disconnecting the existing connections. This allowed the bridges to be repaired under traffic.

This patent pending technique utilizes a specialized ASTM A490 bolt, properly designated as ASTM A354-BD. These special order bolts were ordered with extra long threads to allow for two nuts to be utilized on each bolt. The procedure removes and replaces one rivet at a time with a specialized bolt and one nut. The bolt is fully torqued, then the next rivet is removed and the procedure is repeated until each designated rivet is replaced. Once all the rivets are replaced, a fill plate with holes large enough to go over the first nut is placed over the specialized bolts. Then the new material, with standard bolt holes, is placed over the bolts and a second nut is added to each bolt and fully torqued. The presentation will go into detail about the repair method, discuss test results, and show a brief video of the installation.

09-12: The Smith Street Bridge: Rehabilitation of a Cantilever Deck Truss

David Thurnherr, P.E. and C. Michael Cooper, Bergmann Associates, Rochester, NY; Thomas Hack, City of Rochester, NY

Originally designed by the Phoenix Bridge Company and constructed in 1931, the Smith Street Bridge (a.k.a. Bausch Memorial Bridge) carries approximately 26,000 vehicles daily in four travel lanes, two cantilevered sidewalks and a median/turn lane 913 feet across the Genesee River Gorge in Rochester, NY. The structure consists of three main spans of three parallel deck trusses (a 240-foot suspended main span, flanked by 180-foot anchor and 90-foot cantilever spans) over the Genesee River and two simple spans of three parallel plate girders (66-foot spans each) at the east approach. The structure has undergone numerous rehabilitations in its lifetime, including a deck replacement, painting, and steel repairs in the 1970's, a pin-and-hanger replacement in the 1990's, and now the current project which includes painting and repair of structural steel members, repair and overlay or replacement of the concrete deck and sidewalks, bridge railing replacement, removal of abandoned utilities, minor repairs to the existing substructure, aesthetic and lighting enhancements and minor approach highway reconstruction.

Inspection and design began in 2005 and construction began in 2007. The project has presented several unique challenges, including difficult erection procedures for structural steel repairs and increased scrutiny subsequent to the I-35W disaster (the Smith Street Bridge is one of 49 bridges in New York State that were identified as being of similar design to the I-35W Bridge). However, cooperation amongst the owner, engineer, and contracting team has facilitated quick resolution of all issues, and the project is on schedule for successful completion in fall of 2009.

09-13: McKinley Bridge Reconstruction

Anne Zweibel, Hardesty & Hanover, LLP, Okemos, MI; Tiffany Brase, Illinois DOT, Collinsville, IL

The McKinley Bridge, originally an 87-span, 5,798-ft structure spanning the Mississippi River between St. Louis, MO and Venice, IL, was built in 1910. Deterioration of the 4,233 ft of approach spans necessitated the complete demolition and reconstruction of the approach spans to seismic standards, as well as rehabilitation of the three approximately 520-ft through-truss main spans. The completed, award-winning project, now 34 spans and 5,733 ft long, was opened to vehicular traffic on December 17, 2007.Originally carrying two railroad tracks and two vehicular lanes, the McKinley Bridge has carried only vehicular traffic since 1977. The bridge is eligible for the National Register of Historic Places and is notable for the three through-trusses that comprise the river spans.

Shortly after the reconstruction project was bid, the Great Rivers Greenway Association of St. Louis joined with IDOT to fund the addition of a bicycle/pedestrian lane to the bridge, an important link in a 77-mile bike route system. A fast-track design revision was begun, and revised plans were prepared so that steel could be ordered and construction could proceed with minimal impact to the original schedule.

Design challenges included a site contaminated with hazardous and radioactive wastes; the mandate to retain the historic appearance of the main river spans while replacing the cantilevered outboard roadways; limited right-of-way; issues pertaining to the erection of 185-ft to 215-ft curved approach spans; and the last-minute addition of the bicycle/pedestrian lane. Design challenges and solutions will be discussed and illustrated with construction photos.

09-14: Rehabilitation of the Ramsdell Road Bridge

Matthew Low and Edward Weingartner, Hoyle, Tanner & Associates, Inc., Manchester, NH

The Ramsdell Road Bridge in Henniker, New Hampshire was constructed in 1937 as a Works Progress Administration project during the second phase of the New Deal. The bridge is a historic Warren Through-Truss of riveted construction with a reinforced concrete deck and outboard cantilevered sidewalk. Rehabilitation design of the bridge began with the intent of restoring the structure and maintaining its historic fabric and integrity, while increasing the live load capacity from the original H15 design load to an HS20 design load. Utilization of an innovative bare exodermic deck with lightweight aggregate concrete and replacement of key structural members were required to increase the live load capacity. The floor system and bottom chords were replaced in their entirety. Replacement of two (2) rocker bearings and partial replacement of three (3) main built-up end diagonal members was also required. Existing green lead paint was removed and replaced with a new three (3) component system in grey, to match the original color.

The bridge is located in a United States Army Corps flood storage area, meaning that at any time, water in the Contoocook River could rise by approximately 16 feet to store water during large rain events, bringing the water level up to the portal bracing elevation.

Now complete, this $1.5M construction project is an example of how historic preservation and modern transportation needs can simultaneously be met. This paper will highlight the design and construction phases of this project.

09-15: Three-Dimensional Analysis and Load Rating of the Cleveland Innerbelt Deck Truss Bridge

Daniel Baxter, Michael Baker Jr. Inc., Cleveland, OH; Jeff Broadwater, Michael Baker Jr. Inc., Cleveland, OH

The Cleveland Innerbelt Bridge is a 2,721 ft nine-span curved variable-depth deck truss that carries Interstate 90 across the Cuyahoga River valley near downtown Cleveland. Opened on August 15th, 1959, the eight lane bridge, supported by two main truss lines, is the widest ever built in the state of Ohio and also one of the most heavily travelled, with daily traffic volumes of over 100,000 vehicles. Ongoing deterioration of the structure has prompted the Ohio Department of Transportation to undertake a detailed load rating of the bridge.

This paper will discuss the structural analysis and design methods that were utilized to load rate the structure. A three-dimensional model was created to analyze the bridge to capture the effects of structure curvature and wide main truss spacing, and to determine accurate load distribution. The modeling of the complete bridge in three-dimensions using finite element analysis software will be described, with particular attention given to the joint analysis procedures used to determine the degree of joint fixity utilized in the model, and the effects of joint fixity on analysis results. The interpretation and application of code requirements relating to primary and secondary moments in truss members and member effective length will be highlighted. A comparison will be provided between structural analysis results and strains obtained from recent static load tests of the actual structure.

09-16: Developing a Novel pH Buffer Methodology to Inhibit Corrosion of Steel Reinforcement in Concrete

Michael Loy, Student Paper Award Winner, Portland, OR

Concrete deterioration costs over $100 billion dollars per year in the United States in repair, replacement and environmental impact. The major cause of deterioration is corrosion of steel rebar in concrete occurring when concrete pH is reduced by high acidic attack or when chloride ions penetrate concrete, destroying the natural, protective "passivation" layer which surrounds rebar. Previous mitigation strategies have focused on creation of additional passivation layers or sealants and coatings to inhibit corrosion.

This study developed a pH buffer methodology to maintain high concrete pH thereby protecting the passivation layer. Sodium borate and sodium carbonate based-buffers, both highly alkaline and non-chloride, were mixed into concrete by replacing mix water with 25%, 50% and 100% concentrations of each buffer, then compared against a non-buffered control. Samples were placed in a 100% CO2 chamber to accelerate acidic corrosion and immersed in a 2M sodium chloride solution to accelerate chloride corrosion.

Effects of pH buffers on compressive strength, pH levels, half-cell corrosion potential, flowability and air content were studied. Buffers maintained high pH and reduced probability of corrosion. The 50% sodium borate concentration was most effective exceeding the control in compressive strength, maintaining consistently high pH, testing second-best in low probability of acidic and chloride corrosion with moderate flowability. Results of this study supported an efficient, cost effective, non-toxic buffer methodology to extend concrete service life, improve durability and promote a sustainable environment.

TUESDAY, JUNE 16–AFTERNOON SESSIONS

CONSTRUCTION 1:30-5:00 PM

Session Chair: Calvin Boring, Trumbull Corporation, Greensburg, PA

09-17: Post Tsunami Bridge Reconstruction in Indonesia

Robert Magliola, Parsons, Downers Grove, IL

The December 26, 2004 Indian Ocean tsunami devastated the northwest coast of the island of Sumatra in Indonesia. More than 230,000 persons lost their lives and 90 bridges were damaged and destroyed along the Banda Aceh to Meulaboh Road. The author, working for Parsons, was the lead structural bridge engineer for the bridge design and reconstruction project let by the US Agency for International Development (USAID). This paper tells of the post disaster response. The actual performance of various classes of bridge structures under tsunami loading is presented. The variety of emergency bridge structures employed and their durability over an extended duration is described. Also examined are the replacement bridge types now being constructed. The paper describes how replacement bridge types: steel truss, spliced precast I-beam and cast-in-place box culverts, were selected based on local construction means and methods, material availability, site accessibility and economy. The paper tells how these bridges are being constructed in remote locations with little aid of heavy equipment. It tells of how the AASHTO bridge code was adapted to meet the requirements of the much higher vehicle loads permitted in Indonesia, and comparison is made between the AASHTO bridge code and the Indonesian Bina Marga bridge code. This paper also addresses the programmatic design process used to design the replacement structures in 10 months with little upfront geotechnical or geometric information.

09-18: Improved Link for Safety and Security: Replacement of Florida Avenue Bridge, New Orleans, LA

Kirti Pancholi, P.E., U.S. Coast Guard, Washington, D.C.

The replacement of the Florida Avenue Bridge was a unique combined Highway and Railroad Bridge Project under the Truman-Hobbs Act. The paper describes the recent days engineering marvel and the management of the bridge project of this size at the cost not seen these days. The use of engineering was challenged every step of design and construction. The bridge at the junction of Mississippi River Gulf Outlet, Inner Harbor Navigation Canal and Industrial Canal, the strategic location, was relocated a hundred and fifty feet south of the old Florida Avenue Bridge. The additional benefit was the increased safety and security in the area. The old Bascule Bridge at this strategic location afforded very restrictive, only one hundred feet, navigation clearance. Its removal now provides far better security. The three times larger horizontal clearance now provides safer navigation for about 18 million tons of crude oil, coal and metallic ore. The partnership between U. S. Coast Guard, the New Orleans Port, Norfolk Southern Railroad Company, the Belt Railroad Company, the Consultant, and the Contractor in resolving challenges like eliminating one of the two railroad tracks on the bridge, removal of existing bascule having practically no clearance from Mean High Water and the effects of Hurricane Katrina just before the completion of construction is a good guide for the other current and future Highway/Railroad moveable bridge projects.

09-19: Innovative Widening Truss Erection of the Huey P. Long Bridge

John Brestin, HNTB Corporation, Kansas City, MO; Keith Jacobson, Massman Construction Company, Kansas City, MO

The Huey P. Long Bridge, crosses the Mississippi River in New Orleans, Louisiana. Built in 1935, it is an 1840-foot three-span continuous cantilever truss bridge with an adjacent 530-foot simple span through truss which carries rail and vehicular traffic. The proposed widening of the bridge will be complete by early 2012. This paper will focus on the erection of the main river unit widening trusses as well as address the analysis and behavior of the temporary stability frame used to the brace the trusses during the lifts.

This stretch of the Mississippi River is a heavily traveled shipping channel, so one of the primary goals was to minimize the risk of ship impact to falsework in the river. This gave rise to an innovative method to erect the primary trusses span by span requiring no falsework in the river.

The span by span erection method, utilizes temporary stabilizing frames that span between the bottom chords of the proposed widening trusses and have stabilizing towers to brace the compression chord of the truss while lifting. The whole system of trusses and stabilizing frames is lifted at the four corners by strand jacks supported on the top of the widened pier trusses. During the lift, the trusses are positioned outside of the pier trusses to allow them to be lifted to their final height. Once the trusses are lifted 150 vertical feet, the stabilizing frames telescope inward and pull the widening trusses transversely and are then lowered slightly onto their permanent bearings.

09-20: Wind Loads on Steel Box Girders during Construction Using Computational Fluid Dynamic Analysis

Glenn Myers, PBS&J, Fort Lauderdale, FL; Ali Ghalib, PBS&J, Atlanta, GA

Constructability requirements for structural steel bridges are defined in the AASHTO Guide Specifications for Horizontally Curved Steel Girder Highway Bridges and the AASHTO LRFD Bridge Design Specifications. These requirements are intended to define conditions encountered during construction that may cause instability or inelastic deformation of the steel structure and to provide guidance on acceptable methods to alleviate these conditions. Analysis for constructability must consider Component and Construction Dead Loads, Construction Live Loads and Wind Loads. The component and construction loads are easily to determine for the constructability analysis and assumptions are typically noted in the Contract Plans. Wind loads need to be carefully considered for the different climatologic and topographic factors, and exposure conditions that occur during construction.

The critical wind exposure condition in the constructability analysis is on the exposed partially erected girders during the various construction stages and also on the completed skeletal frame prior to the addition of forms and concrete deck. Drag coefficients to be utilized in the development of wind pressures under these conditions are not readily available. Computational Fluid Dynamic (CFD) modeling was performed to develop horizontal drag and vertical lift coefficients for the constructability analysis, which are significantly larger than those used for the completed bridge as stipulated in the design specifications. The purpose of this paper is to present the analysis of the wind loading on the skeletal frame and to report the criteria utilized in the development of the constructability plans for the Interstate 4 / Lee Roy Selmon Expressway Interchange.

09-21: Design and Construction Aspects of Post-tensioned Concrete Incremental Launching Bridge

Teddy Theryo, PB Americas, Inc., Tampa, FL; Paul Towell, PB Americas, Inc., Minneapolis MN

The first modern prestressed concrete incrementally launched bridge was constructed in Europe in the early 1960's. This construction method is very competitive for straight, continuous medium span ranges, although horizontally curved bridges with constant radii can also be constructed. Since then, many post-tensioned incrementally launched bridges have been built around the world, except in the North America. The basic idea of incremental launching is to build a short stationary casting form at one end of the abutment. A short segment is cast, and then a launching nose is attached followed by casting another segment behind the first segment. The segments and launching nose are pushed forward. New segments are cast and pushed forward until the bridge is completed.

The authors will focus on the essential design and construction aspects for this type of bridge construction instead of focusing on a particular bridge launch. This paper will serve as more of an educational paper detailing the construction method and design aspects of incrementally launched bridges.

Construction method topics will include the launching nose, jacks, temporary supports, sliding bearings, friction bearings and side guides. Design topics will include the advantages and disadvantages, tendon layout, cross-section, loading, construction staging, serviceability limit state, ultimate limit state and detailing.

09-22: I-76 Allegheny River Bridge: Pennsylvania's First Long Span Cast-in-Place Concrete Segmental Bridge

Garrett Hoffman, P.E., FIGG, Exton, PA; Gary Graham, P.E., Pennsylvania Turnpike Commission, Harrisburg, PA

The new I-76 Allegheny River Bridge for the Pennsylvania Turnpike Commission is under construction near Pittsburgh, Pennsylvania. Walsh Construction is building Pennsylvania's first long span concrete segmental bridge, which were designed by FIGG. The twin 2,350′ structures are being constructed over local roads, active rail lines, the river and 14-Mile Island, an environmentally-sensitive state park. The 532′ main span crosses the main channel of the Allegheny River. The bridge is being constructed on an adjacent alignment just south of the existing bridge with cast-in-place balanced cantilever construction utilizing form travelers. The eastbound structure is being constructed first, with spans of 285′/380′/380′/444′/532′/329′. The westbound structure will be built subsequently and all traffic moved to the new bridges. Work includes completion reconstruction of the toll plaza, expansion of acceleration and deceleration lanes to improve over all safety and smaller bridges for local traffic and golf cart traffic that cross the Turnpike mainline. Notice to proceed was provided to Walsh on May 17, 2007. The three-year construction schedule is timed to reach completion in 2010, work with schedules for major golf tournaments at the adjacent Oakmont Country Club in 2007 and 2010.

09-23: Construction of the Pomeroy Mason Cable Stayed Bridge

Jorge Suarez, Michael Baker Jr., Inc, Moon Township, PA ; Don Tillis, Ohio Department of Transportation, Marietta, OH

The Pomeroy Mason Bridge is a concrete cast-in-place cable stayed bridge structure, which replaces an existing through steel truss structure on U.S. Route 33 over the Ohio River in Miegs County, Ohio. This new signature bridge will provide for a link between two cities: Pomeroy, Ohio and Mason, West Virginia. Baker is providing Ohio DOT District 10 with Construction Support Services which include: construction inspection and documentation, cable-stayed bridge expertise, problem solving during construction, falsework design, schedule monitoring, submittal reviews, and project closeout. This paper and presentation will discuss the many challenges successfully overcome through the teamwork of ODOT, the contractor, and the construction managers, including two floods, a significant slope stability issue, complicated falsework, unique form traveler design and fabrication, and rock slope remediation. Partnering techniques and good communications between all the construction team participants allowed them to mitigate and expedite practical solutions to these and many other daily challenges. Most importantly, the project is being completed with no lost time injuries on site and an overall excellent safety record.

The cable-stayed portion of the bridge is a total of 1,163 feet long. The main span is 675 feet with two 244 feet back spans. The roadway is 56′-0″ curb to curb and consists of post-tensioned concrete with edge girders with floor beam and slab system. The "A" shaped bridge towers are founded on deep foundations consisting of drilled shafts socketed into rock. The paper summaries the construction of the bridge from substructure drilled shafts to superstructure segment closure.

CONTEXT SENSITIVE DESIGN 1:30-5:00 PM

Session Chair: Thomas Leech, P.E., S.E., Gannett Fleming, Inc., Pittsburgh, PA

09-24: Boulevard of the Allies Bridge over Forbes Avenue

Cheryl Moon-Sirianni, PennDOT District 11, Bridgeville, PA; Robert Pintar, Wilbur Smith Associates, Pittsburgh, PA

PennDOT, District 11-0 designed the reconstruction of the intersection of the Boulevard of the Allies with Forbes Avenue and Fifth Avenue in the Oakland neighborhood of the City of Pittsburgh. The Oakland area is world renowned as a center for art, cultural, educational, and health care institutions. The project included replacing mainspan bridge and ramp structures; improving traffic operations; and addressing safety issues. The District teamed with the Oakland Task Force to develop context sensitive designs. This collaboration helped to transform the design of a transportation project into the design of a landmark structure that can be woven into the Oakland community fabric. Several design charettes were conducted by the design team to solicit input from the local institutions and stakeholders. The results were the inclusion of various enhancements not in the original design, including sidewalks, additional aesthetic elements, enhanced landscaping, smaller-scale lighting, and more.

The District prepared the original design using the design-bid-build procurement method. Bids were advertised and received, but the low bid was higher than expected. The District decided that the responsible course of action was to repackage the project with structures as design-build items and the remainder of the work as design-bid-build items. The best value form of design-build was utilized with a stipend to the responsive, yet unsuccessful bidding teams. The design-build, best value procurement method provided numerous opportunities for direct interaction with the design-build teams, thereby allowing for even more refinement of the design-build requirements. The winning design-build team's bid was lower than the original bid.

09-25: Towards Green Bridges

Scott Snelling, Hardesty & Hanover LLP, New York, NY

The goal of green design includes reducing greenhouse gas emissions, pollution emissions, waste, and the use of non-renewable resources to sustainable levels. The recently published Transportation Research Board Special Report 290 concluded that climate change "will have significant impacts on transportation, affecting the way US transportation professionals plan, design, construct, operate, and maintain infrastructure" and "is not just a problem for the future." There is no existing standard for the green design of bridges or transportation infrastructure. Bridge professionals need not wait for this void to be filled. Green design strategies are well established and can be applied to projects immediately.

The LEED Green Building Rating System was created for commercial buildings, but includes many provisions that can be applied to bridge projects.

The paper will focus on the top ten actions that bridge professionals can take to design and construct green bridges:

1.) Accommodate alternative transportation.
2.) Use recycled materials and industrial by-products.
3.) Minimize maintenance costs.
4.) Divert construction waste from landfills.
5.) Perform a Life Cycle Cost Analysis.
6.) Perform a Life Cycle Assessment to compare the carbon footprint, pollution, embodied energy, and economic activity associated with each proposed design alternative.
7.) Use construction equipment that meets modern emissions standards.
8.) Use regionally extracted and manufactured materials.
9.) Use grid-source green electricity.
10.) Innovate.

09-26: Design and Performance of Riveted Bridge Connections

William Vermes, Euthenics, Middleburg Heights, OH

From the late 1800s to 1960, riveted construction was the predominant connection method of both steel bridge fabrication and erection. Now, nearly a half-century since the end of the accepted use of rivets, many American engineers, unfamiliar with riveted design, look at rivets with suspicion and as an inferior connection. However, review of past riveted construction practices, recent research and current field observations of riveted steel bridges shows that riveted connections are in fact an enduring and legitimate means of steel bridge construction.

Rivets have long been considered as bearing connections prone to slipping. However, tests performed in the 1920s through the 1950s demonstrated that tension produced within the rivets as they cooled and thus contracted actually provided a clamping force to the steel plies. Additionally, tests also showed that rivet slippage did not occur at stresses under 15 ksi, well above allowable shear and bearing stress values, and that any slip generally was only in the range of 0.03 to 0.05 inches. Overall, riveted connections have performed with few examples cracking occurring at from rivets holes.

Within current AASHTO and AREMA guidelines, riveted connections are considered as a Category D fatigue detail. Recent investigations suggest that riveted connections may be more appropriately considered as a Category C fatigue detail.

Structural riveting is not quite a lost art yet. Michigan, Ohio and Indiana have several groups of ironworkers and blacksmiths who are relearning the methods and the touch of structural bridge riveting, and have successfully applied riveting to the rehabilitation of several historic truss bridges.

09-27: Replacement of Historic Tied Through Arch Bridge

Quentin D. Rissler, P.E., and Daniel Rogers, RETTEW Associates, Inc., Lancaster, PA

The existing 58′ simple span tied through arch bridge over Big Chickies Creek in Lancaster County, Pennsylvania was designed in 1916 by prominent Lancaster County engineer Frank H. Shaw. The tied arch design by Shaw slightly modified the patented rainbow arch design of engineer James H. Marsh by adding diagonal truss chords. The bridge, which was one of only 2 left of its kind in Lancaster County (only 14 of Marsh's arch bridges remain in the country) had extensive concrete deterioration that necessitated replacement. The County of Lancaster contracted with RETTEW to design the replacement structure with specific instructions to develop a context sensitive design that reflected the distinctive architectural and historical features of the National Register eligible bridge. RETTEW also addressed issues with the waterway opening, sight distances and safety requirements on the bridge.

The replacement bridge was designed with precast concrete tied through arches and a cast-in-place concrete deck. The bridge was lengthened to a 70′ span for hydraulic improvements. For improved safety, the bridge was widened to two lanes and a standard PA Type 10M bridge barrier was added for barrier protection.

RETTEW coordinated efforts with contractors and precast fabricators from the preliminary design stage through fabrication to address concerns with construction, fabrication and transportation of the arches. RETTEW employed innovative design techniques by combining the use of standard PennDOT BRADD software to design the substructure while using STAAD structural modeling and analysis software and spreadsheets to design the arch and deck.

09-28: Urban Planning and the Design of Bridges: a Case Study

Thomas Piotrowski, H2L2 Architects/Planners, New York, NY; Bruce Chamberlin, H2L2 Architects/Planners, Philadelphia, PA

In 2000 H2L2 was commissioned to provide design services for the phased redevelopment of 5 miles of Interstate 490 in Rochester New York. This segment, located west of the City connected the City with inner ring neighborhoods and the airport. The scope included development and implementation of a comprehensive plan for the renovation of the corridor. The major elements were the renovation of the existing highway overpasses and a new signature bridge over the Genesee River. The project area was evaluated from several perspectives. The corridor is a major gateway into the City and the motorist's experience was important. The project area was visible from a number of significant view corridors in the City. The redesigned overpasses and the new replacement bridge were designed to enhance these experiences and views as well as opportunities to significantly improve the aesthetics of the impacted areas and the City.

Interstate 490 traverses rural and suburban landscapes as it makes its way to downtown Rochester. The most dramatic moment is when the City comes into view and the highway crosses the Genesee River. The design approach was to treat the renovated overpasses as a series of identical, linked bridges with architectural treatments and materials similar to the new span over the Genesee. The overpass closest to downtown and the river was to be replaced with a steel arched bridge designed to frame the skyline and introduce the form of the new river span.

The new river crossing is a 6 lane steel arched bridge with splayed hanger cables. It was envisioned as a significant element in the city skyline from vantage points south of the city. Its arched form is reminiscent of other river crossings, many comprised of smaller arched spans with masonry piers. Monumental masonry pylons frame the east and west portals to the bridge while marking the waterway and pedestrian walkways below.

09-29: Total Integration of Architecture, Engineering and Construction Realities

Michael Fitzpatrick, TY Lin International, San Francisco, CA; Jim Grube, Hennepin County, Medina, MN

The new Lowry Avenue Bridge will replace the existing steel truss structure over the Mississippi River north of downtown Minneapolis. Although the performance of the 50 year old and structurally deficient existing bridge was declining, plan for a replacement bridge required the backing of the community.

In order to gain stakeholder concurrence on the design the owner, Hennepin County, assisted by SRF Consulting Group and T.Y.Lin International, created a rigorous Public Involvement Plan. The local communities had been vocal about the aesthetics of the replacement structure and requesting to retain some of the character of the existing structure.

The Public Involvement program included a Technical Advisory Committee (TAC) and Public Advisory Committee (PAC) to review and recommend design options. Throughout the process, large public meetings were held in various community centers around the project site. The meetings were often attended by elected local officials, city council members, State Senators, and the local media.

During type selection, five alternates were evaluated using a weighted matrix selection. The basket handle arch with distinctive water piers was clearly the bridge which recalled the volumetric experience of the truss.

At the onset, TYLI established a total integration of 3D models with the 2D construction drawings. The architecturally driven form of the arch and piers were tested for constructability and redundancy during the first design iteration.

This presentation will demonstrate the process of fully integrating 3D modeling and 2D construction documents that preserve architectural intent and accommodate real world construction limitations.

09-30: Cable Stayed Bridges in City Centres

Pekka Pulkkinen, Company WSP Finland Ltd, Oulu, Finland; Erik Eriksson, WSP Finland Ltd, Oulu, Finland

Cable Stayed Bridges in City Centres: In Finland two cable stayed bridges will be built in the city centres of Helsinki and Tampere. The bridges are under construction. Both of them are results of bridge competition arranged by the cities. Demanding architectural and environmental requirements were set in the competition. Special value was given to compatibility of the bridge to centre buildings and city landscape. Scale of bridge compared to adjacent buildings was critical issue in both cases. Illumination of structures was considered to be very important.

In both cases the pylons are inclined in order to create a new structural object between vertical buildings.

Crusell Bridge will be built in the Helsinki City: It will be a gate to new residential area which will be built on the old dock area. It will have lanes for cars, pedestrians and trams. The total length of the bridge is 150 metres. The inclined steel towers will have stainless steel cladding in order to have high quality for corrosion protection and finish. The bridge have several interesting structural concepts, such as transversally composite deck cross section although deck is longitudinally concrete. Edge beams and towers are made of steel. The illumination of towers will be installed only on inner sides of towers, which gives an interesting night view for pedestrians.

Laukko Bridge will be built in the Tampere City, just beside the famous Ratina Stadium. It is a pedestrian bridge which connects the stadium and the city centre. The single steel tower is inclined in both axis. The tower is located on inner side of the superstructure. There is no supports in the water. Laterally the concrete deck is in curvature. The main span is 100 metres in length. The main structural components will be illuminated.

Design work in both bridges have been carried out using latest 3D modeling software. During the tender phase contractors were able to view model via internet. During construction the contractors will utilize the model in surveying and control.

LONG SPAN BRIDGES 1:30-5:00 PM

Session Chair: Carl Angeloff, P.E., Bayer MaterialScience, LLC, Pittsburgh, PA

09-31: Construction of the Kanawha River Bridge: A Record Segmental Span

Santiago Rodriguez, T.Y. Lin International, Alexandria, VA; Ahmed N.K. Mongi, West Virginia DOT - Division of Highways, Charleston, WV

A new long span segmental box girder bridge crossing the Kanawha River is currently under construction as part of the widening of Interstate 64 between the cities of Dunbar and South Charleston in Kanawha County, West Virginia. The T. Y. Lin International's designers, working with the West Virginia Department of Transportation, Division of Highways, were confronted with the challenge of creating a low-cost, aesthetically pleasing structure that would alleviate traffic congestion for commuters in the Charleston area. The new bridge spans the entire waterway supported by piers located at the water's edge on either side, thus avoiding interference with barge traffic. The eight-span Kanawha River Bridge has a 760-foot main span; the longest concrete box girder span in the United States, which is scheduled to be closed in early 2009. The structure has a total length of 2,975 feet, including 460 and 540-foot side spans and five additional approach spans ranging from 144 to 295 ft. The 66.8-foot wide superstructure accommodates four traffic lanes plus shoulders, on a single cell box girder.

This paper describes the project procurement using alternative bidding for steel and concrete designs, the design modifications proposed by the Contractor for construction, and the bridge construction process using balanced cantilever construction with cast-in-place segments. The segmental superstructure consists of seven cantilevers with a total of 167 segments built with two pairs of form travelers that avoid the need for falsework during construction.

09-32: Crossing the Han River

Radu Dragan, Ammann & Whitney, New York, NY

After winning an international design competition for a new bridge crossing the Han River in Da Nang, Vietnam, AW was retained to complete a feasibility study and engineering design for this new bridge.At the bridge location the river is approximately 600m wide, occupying a prominent place in the center of the city. The design aimed at producing a unique, signature quality structure, visually and aesthetically reminiscent of the Vietnamese culture.

The selected option consists of a five span Main Bridge, of which the center three are tied arches integral with their corresponding piers. The piers are shaped to suggest a continuity of the arches, in an effort to give the impression of a Dragon intersected by the bridge deck.

The Main Bridge is 592m long; with a center span of 200m, flanked by two interior spans of 128m, a 64m span on the west end and a 72m span on the east plus an elevated approach structure. The bridge cross section carries six lanes of traffic, divided by a 6m wide center median, shoulders and sidewalks for a total width of 36m to 37.5m (the variable width is the result of a wavy bridge fascia imposed by aesthetic requirements).

The superstructure is supported by a single-rib arch, centrally located within the roadway median, continuous over the three interior spans. The arch rib consists of five large diameter steel tubes, partially filled with concrete, connected to each other by spider frames at each suspender location (8m spacing).

09-33: Performance Based Design of Long-Span Cable Stayed Bridge Towers

Alp Caner, METU, Ankara, Turkey; Cenan Ozkaya, Yuksel Project, Ankara, Turkey

Over the last twenty years, there is a considerable increase in design and construction of cable-stayed bridges. The seismic requirements of the standard bridge specifications do not typically apply to the analysis and design of long-span cable stayed bridges. The focus of this study can be divided into two phases as (1) to investigate the common characteristics of existing long-span cable stayed bridges by developing a database and (2) to determine the seismic performance of a typical cable-stayed bridge with most common characteristics determined from the statistical database evaluation. In this research, variations in cable and tower forces will be documented based on a force and displacement based design approach.

09-34: Study on Flutter Control Measures of Long Span Bridge with Truss Girder Based on CFD Model

Gao LIU, China Highway Planning and Design Institute Consultants CO., Ltd., Beijing, P.R China; Tiancheng LIU, Bridge Technology Research Center, China Highway Planning and Design Institute Consultants CO., Ltd., Beijing, P.R. China

The conception of aerodynamic control measure for long span bridge is to change the flows around girder so as to influence the aerodynamic forces acting on girder through modifying girder's geometry shape and adding small attachments. So far, wind tunnel test is the most popular method to verify flutter stability of long span bridge. Moreover, computational fluid dynamic (CFD) models and computer capacity have been developed to a stage where assessment of aerodynamic stability of practical bridge is possible. In this paper, an effective CFD model is established to simulate the flow around truss girder based on Navier-Stockes equations considering three-dimensional effects, and the sensitive analysis on parameters is conducted by comparing with benchmark of wind tunnel test. Furthermore, with a series of numerical simulations, the investigations of flutter control effects of central slotting, winglets and their combinations are carried out, including the relationships of flutter stability performances and the widths of central slotting as well as the locations and arrangements of winglets. Moreover, their flutter control mechanisms are analyzed from microcosmic points of view involving vortexes motion and pressure distribution. Finally, the combination of novel winglets with central slotting is proposed for Baling River Bridge as the result of above investigations, which is a suspension bridge having a main span of 1088m with steel stiffening truss girder located on the mountainous region of China. It is proved that the central slotting and winglets are especially convenient and effective to restrain the flutter of long span bridges.

09-35: Study on Structural System of Sutong Bridge

Xigang Zhang, Minshan Pei and Liji Huang, CCCC Highway Consultants Co., Ltd, Beijing, China;

Sutong Bridge, whose layout is (100+100+300) +1088 + (300+100+100)m marks the largest span of cable-stayed bridges in the world. The complex natural condition at the bridge site and the strict requirements for resistance of wind and seismic action make it crucial to choose a favorable structural system to assure the function and safety of the bridge. The comparison among several optional structural systems for Sutong bridge is illustrated. After detail analysis is carried out for viscous damper and hydraulic buffer, super liquid viscous damper with additional lock-ups is designed for the first application in bridge engineering. The parameters for the damper is analyzed and studied and the dampers are installed successfully after required damper tests.

09-36: A New Landmark Bridge to Da Nang City, Vietnam

Esko Jarvenpaa, and Atte Mikkonen, WSP Finaland Ltd, Oulu, Finland; Esko Leppaluoto, WSP Finaland Ltd, Helsinki, Finland

Da Nang is a city of one million inhabitants in central Vietnam and one of the fastest developing areas in Vietnam. The City announced an international design competition concerning the bridge design last year (2007). The financing of the bridge come from the city of Danang. The name of the bridge is the Nguyen Van Troi-Tran Thi Ly Bridge

The winning proposal will result a new landmark for the city. There will be a 6-lane cable-stayed concrete bridge with backward inclined tower in the middle lane of the bridge. The bridge will be 730 metres long and the tip of the tower, will be at around 140 metres above the surface of the river. The length of the main span is 230m and the effective with of the bridge is 33,5m, suspended with stay-cables in the middle line of the bridge. The configuration of the back span cables form a spiral geometry resulting a fascinating view for spectators especially during the evenings. The top of the tower will get a viewing space for visitors.

The winning design and the environmental plan associated with it were especially praised for their technical and visual success. The construction work is set to began at the end of 2008 and the bridge will be ready for commissioning in 2011, with an estimated cost of $100M USD.

09-37: Structural Hardening for Cable Elements of Cable Supported Bridges

Nathan Sauer, P.E., VSL, Hanover, MD

The necessity of ensuring transportation structures are protected from threats on all levels is an ongoing concern for all those involved in the construction, operation and maintenance of these structures. Cable-supported bridges can be particularly vulnerable to a variety of threats, but with the proper analysis of these threats and the execution of a thorough planning process, these structures can be effectively protected. This presentation will examine the details involved with each step of this process. These steps include objectively evaluating vulnerable elements against generally defined threats; defining the specific threat the hardening solution will be required to defeat through a discussion of the various types of threats; how to select the best alternative for structural hardening based on specific evaluation criteria such as price, performance, aesthetics, and integration into the existing structure; as well as performance testing, and plan, specification and quality assurance development.

WEDNESDAY, JUNE 17–MORNING SESSIONS

BRIDGE MONITORING 8:00-12:30 PM

Session Chair: James Garrett, Ph.D., Carnegie Mellon University, Pittsburgh, PA

09-38: Monitoring System Behavior during Earthquake

Vincent Morisseau, Advitam, Velizy, France; Benoit Kroely, Advitam, Velizy, France

European concession contracts commonly last over periods ranging from 20 to 70 years. Preventive inspections and structural maintenance represents significant challenges which occur over such periods. In the case of Gefyra, Operation Company of the Charilaos Trikoupis Bridge, also called Rion-Antirion Bridge, the concession period is 35 years. Therefore, Gefyra decided to work with Advitam to build methodologies and system to optimize structural inspection & the maintenance process. This includes a structural health monitoring system which provides real time monitoring of the bridge and automatic alarm management. The monitoring system is designed to monitor all critical elements of the bridge in order to detect abnormal behavior. It provides in particular automatic traffic management in case of earthquakes and high winds, which are common events in this part of the Gulf of Corinth.

The setup of the system in case of earthquake has been carefully designed. Based on multiple thresholds, the system is able to recognize that an event is an earthquake and not normal behavior. The system will then auto-adapt itself and increase its acquisition rate to capture additional information.

On July 2008, a 7.3 earthquake occurred just a few miles away from the bridge, and the system recorded numerous data from the sensors. This paper will share the design and setup of the system on the bridge. Then it will present the results accumulated by the system over the past 4 years.

09-39: Fracture Critical Alaska Bridge Inspections Using Rope Access Techniques

Brian Leshko, HDR Engineering, Inc., Pittsburgh, PA

For the Alaska Department of Transportation and Public Facilities (AKDOT&PF), under Task Order 4 to Term Agreement - Fracture Critical and Special Bridge Inspections, HDR performed hands-on inspection of each fracture critical member, fatigue prone detail and other identified items on 36 transfer bridges, located throughout the State of Alaska. HDR developed interior and exterior access plans that enabled inspection of the bridges at "an arm's length distance" commensurate with the requirements for fracture critical inspections. Access and inspection plans were developed with a priority placed on the safety of inspectors while minimizing impacts to the traveling public.

Rope access is the application of specialized rope techniques to place an inspector in hard-to-reach locations in the vertical environment. For this task order, the major benefit of rope access was that the bridges remained open throughout the inspection since no traffic control was required to provide a work zone. Rope access is a work system using ropes and specialized hardware as the primary means of supporting an inspector. Rope access inspectors descend, ascend and traverse ropes to access the structure to perform the hands-on inspection. Rope access inspectors use a back-up fall protection system in the unlikely failure of their primary means of support.

This paper describes the planning, coordination, logistics and overall process of conducting rope access and confined space entry field inspections of dual fracture critical steel box girder bridges located throughout the South Central, Southeastern and Inside Passage regions of Alaska.

09-40: Multi-Level Bridge Deck Evaluation Using Combined NDT Methods

Kenneth Maser, Infrasense, Arlington, MA

The work described in this paper draws upon the results of a condition survey program carried out on 88 overlaid bridge decks in Wisconsin's southwest region over a two-year period. The purpose of this program was to identify decks that required rehabilitation, and to quantify the scope of the rehab work. Each deck was initially surveyed using Infrared Thermography (IR), Ground Penetrating Radar (GPR), and an underside visual examination. A Level 1 evaluation was performed on each deck using this data to estimate the overall deterioration quantities. Based on the Level 1 results, decks with significant deterioration quantities (typically >10%) were designated for a Level 2 evaluation, which included detailed mapping of delaminated and debonded conditions, coring, and determining quantities for Type 1, Type 2, and full depth repair. The Level 2 evaluation served as the basis for programming future deck rehabilitation. The paper shows how the results of the IR and GPR methods were integrated to exploit the strengths and minimize the limitations of each method, so that the combination yielded more information than was available using each method separately. The core data was used to verify the results of the NDT methods, and the core results agreed with the Level 2 mapped conditions 85% of the time. The paper describes the equipment used, the field data collected, the analysis methods employed, and the integration of results obtained from the different types of surveys.

09-41: A Holistic Approach to Structural Health Monitoring

Donald Shaw, Osmos USA, White Oak, PA; James Garrett, Ph.D., Carnegie Mellon University, Pittsburgh, PA, Fernando Cerda and Jacobo Bielak, Civil and Environmental Engineering, Carnegie Mellon University, Pittsburgh, PA

Structural Health Monitoring (SHM) has been increasingly discussed for a decade. Largely because of limitations in available monitoring devices, the vast majority of that discussion has followed the traditional reductionist philosophy that to understand the whole it is necessary to understand each part. This paper discusses a new approach that uses fewer sensors designed to evaluate structures by monitoring the performance resulting from component interactions. The current economic condition in the United States for infrastructure rehabilitation and replacement demands improved methods for prioritizing where limited funds are appropriately spent. Preserving societal infrastructure functionality warrants a more performance-oriented SHM approach than the component-deterioration oriented approach currently used for management of bridge systems.

While today's analytical tools are powerful, they cannot accurately determine highly local and detailed conditions, such as exact stress states of existing structures. Unknowns, such as residual stresses from construction and long exposure to loads and the environment place limitations on a strict analytical approach. Further, periodic inspections with usually conservative and subjective evaluations do not offer the reliability demanded to make rational decisions.

This paper makes a case for a holistic methodology that is rooted in such successful approaches as heath care and condition-based maintenance strategies for mechanical equipment. In these approaches, the focus has been on triggering maintenance activities based on monitored performance signatures indicating whether or not a significant system change has occurred. Such "quantification" signature patterns allow the engineer to determine if and where subsequent activities are appropriate.

09-42: Fracture Damage Assessment and Monitoring - Cable Stayed Bridge Superstructure Tie Down Anchorages

Adrian Ciolko, CTLGroup, Skokie, IL; Joshua Derechin, Michael Baker Jr. Inc., Charleston, WV

CTLGroup and Michael Baker Jr. engineers assisted the West Virginia DOT in evaluating and monitoring the causes and consequences of Abutment No. 2 Tie Down anchorage fractures at the Veterans Memorial Cable Stayed Bridge across the Ohio River. Cracks had been discovered in several of the 20, 2 1/2-inch diameter threaded anchor bolts encompassing the 2 anchorage arrays during periodic bridge inspections. This cracking prompted the need for progressively frequent emergency-basis bolt repairs. The structural evaluation and monitoring program served as the basis for development of design criteria for the subsequent construction of permanent tie down anchorage structural repairs. The structural evaluation program incorporated:

• Determination of distribution of the dead load, live load and temperature load stress in the anchor bolts using the frequency of bending vibration method.

• Monitoring of strain fluctuation in all 20 bolts and the cable stayed superstructure linkage, using an automated wireless structural health monitoring system, adapting strain sensors. An algorithm was developed for the data acquisition and communication system, that immediately alerted WVDOT and Baker of rapid strain and load changes in the anchor bolts, signaling bolt fracture in service.

• Fracture analysis of broken bolts using metallographic analysis techniques was performed. The goal of this effort is to determine fracture origins and potential material-related causes for the observed failures. The fracture surfaces were examined to determine fracture origin(s) and mode of crack propagation (e.g., fatigue or overload). Heat treatment history, chemistry, hardness and other properties were studied.

Tie down anchorage structural repairs are scheduled to commence in November, 2008 and be completed by the Spring, 2009.

09-43: Monitoring the 352 Meter Long Monaco Floating Pier

Hovhanessian Gilles and Benoit Kroely, Advitam, Velizy, France

Again limits have been pushed further with the realization of the key element of the extension of the Condamine port at Monaco, a 352 m long and 163 000 tons semi-floating pier. The highly pre-stressed reinforcement concrete structure with a design life of 100 years is attached to the main land abutment with a very complex and 770 tons steel ball-joint system while the other end of the pier it is secured with two sets of fixed anchor chains to the seabed.

This exceptional project is a mix of building techniques, mechanical engineering, and offshore works: it includes several world records and, particularly, the spectacular connection of the ball joint system.

All these design breaking records are possible thanks to the evolutions in civil design & construction methods. In this context another evolution is of great help to allow confirming that the structures are behaving like expected by the calculation models: the monitoring tools. New technologies for the monitoring of structures are powerful tools to better understand the behaviour and make sure that structure remains in good health over time.

In this paper we will review the structural health monitoring system that is installed for this extraordinary structure.

09-44: Load Testing of Bridges at Logan International Airport

Evan Lowell, Transystems Corporation, Natick, MA

Analytical load ratings were calculated for several bridges at Boston-Logan International Airport. These calculations determined that several members rated below the required capacity for legal load types and special airport vehicles. TranSystems Corporation performed load testing of selected representative bridge members to determine if the actual load rating capacity of these members was greater than that determined through the conventional analysis methods used in the load rating. The load testing consisted of the following tasks: Review of existing load rating calculations (which had been performed by others); Development of a load test procedure; Determination of target loads, and selection of incrementally increasing test loads to meet these targets; Calculation of analytical strain and deflection values under the test loads;

Performance of the load testing over a span of 4 consecutive nights through a combination of partial and full roadway closures; Comparison of the analytical strain and deflection values with the actual field measured strain and deflection values; and, Development of load rating recommendations based on these comparisons.

The member types included: reinforced concrete slab; reinforced, asymmetric, cast-in-place concrete girder; precast, prestressed concrete double tee beam; reinforced, cast-in-place concrete girder. The field measured strain and deflections were measured through a combination of strain gages, strain transducers and linear potentiometers installed on the selected members. The load testing results provided for an increase in load rating capacity for four of the six member types.

09-45: Overview of 40 Bridge Structural Health Monitoring Projects

Daniele Inaudi, SMARTEC SA, Manno, TI, Switzerland; Rene Deblois, Roctest Ltd., Saint-Lambert, QC, Canada

In the last 15 years, Structural Health Monitoring has become a useful and increasingly widely used tool for the construction, management and lifetime extension of bridges and other civil structures. This paper is an overview of more than 40 bridge monitoring projects carried out over the last 15 years in 13 different countries and using advanced sensing systems including fiber optics, GPS and corrosion sensing. In particular we concentrate on the analysis of the different types of bridges that were monitored, their situation (new construction, existing structure, refurbishment) and the main purpose of the installed monitoring system. Two main categories emerge from this analysis: new bridges with innovative aspects or particular relevance and existing bridges with known deficiencies.

We analyze the most typical sensor architectures used to monitor those bridges, giving statistics on the number and type of installed sensors, their survival rate and the duration of the monitoring project. For some projects, the monitoring concentrated on a specific event in the life of the bridge, for example its construction or refurbishment. Other projects aimed to long-term monitoring and are still running, in some cases after almost 10 years.

We summarize the main findings of each project and show concrete examples of actionable information that could be gained thanks to monitoring.

Finally, as an example of a Structural Health Monitoring project, we will briefly present the Monitoring system of the new I35W St. Anthony Falls Bridge in Minneapolis.

09-46: Integrated Monitoring System of Bridges

Cristian-Comisu, Faculty of Civil Engineering, Iasi, Romania

The main scope of the research is to develop an integrated monitoring system for durability assessment of existing and new concrete bridges. The system must interface and integrate the actual practice mainly based on visual inspections and combines the response of a number of different reliable sensors, installed on the structure to monitor the progress of damage, with enhanced realistic deterioration models. The system and the sensors were developed to cover the parameters for the most important deterioration mechanisms: corrosion of reinforcement in bridges, carbonation of concrete, freeze-thaw cycles, alkali-silica reaction and mechanical damage, as well as the changes in the structures behavior and safety: static deformation, strains; crack widths and vibrations (frequencies, amplitudes, accelerations and vibration modes). The progress of the various types of damage mechanisms can be predicted by monitoring the key physical and chemical parameters of the materials (such as temperature, humidity and pH for the concrete, measured on the surface of the structure and as a profile through the concrete thickness, and/rate of corrosion of reinforcement), and key mechanical parameters (such as strains, deflections, vibrations). As the sensors have to be permanently installed on the structure, they must present special characteristics of durability, easiness of installation and substitution, apart from being obviously low cost.

DESIGN, PART 2 — 8:00-12:30 PM

Session Chair: Kenneth J. Wright, P.E., HDR Engineering, Inc., Pittsburgh, PA

09-47: Cable-Stayed Bridge across the Odra River, Czech Republic

Jiri Strasky, Jiri Strasky, Ph.D., P.E., Consulting Engineer, Greenbrae, CA

In March 2008 a new cable-stayed bridge that was designed by the author's affiliated office in the Czech Republic was completed. Near a city of Ostrava a freeway D47 crosses the Odra River and Antosovice Lake on a twin bridge of the total length of 589 m. The main span of the length of 105 m that crosses the Odra River is suspended on a single pylon situated in the bridge axis. The deck of each structure is formed by a continuous two cell box girders without traditional overhangs. In the suspended spans the girders are mutually connected by a continuous deck slab and by single precast struts erected between the girders. The transverse connection of the girders is relatively simple and creates a clear truss structural system. The shear forces from the central webs are transferred by post-tensioned inclined webs into the stay cable's anchor blocks. The transverse bending of the structure is resisted by a tension capacity of the transversally prestressed deck and by a compression capacity of the struts.

The main span is suspended on a 47m high single pylon. The single pylon is formed by the steel core that is composite with a concrete cover. Inside of its top part the stay cables are anchored; the bottom part is filled with concrete. The stays have a semi-radial arrangement and are of VSL SSI 2000 system.

The deck of both bridges was progressively cast span-by-span in a formwork suspended on the Overhead Movable Scaffolding System. Therefore temporary piers in the suspended spans had to be built. When the spans adjacent to the pylon were cast, the pylon's steel core was erected and concrete fill and cover were progressively cast. Simultaneously, the concrete struts between the girders were erected and top slab between the girders was cast and transversally post-tensioned. After that, the stay cables were installed and tensioned. Then the temporary piers were removed.

The structural solution was developed on the basis of very detailed static and dynamic analyses. The static function and quality of the workmanship were checked by static and dynamic loading tests.

The bridge was designed by Strasky, Husty and Partners, Brno, Czech Republic. The bridge was built by SKANSKA DS, Division 77 Mosty, Brno, Czech Republic.

The paper will describe the architectural and structural solution, discuss the results of the static and dynamic analysis and describe the process of the construction.

09-48: Innovative Use of PC/PS Concrete for Light Rail Grade Separation

Thomas Barnard and Ahmad Abdel-Karim, DMJM Harris, Sacramento, CA

The subject project provides a separation of grades between the Sacramento Regional Transit light rail (LRT) tracks and South Watt Avenue, near its intersection with Folsom Boulevard in Sacramento, CA. Grade separation of the entire intersection of South Watt Avenue and Folsom Boulevard is the long term solution for modal conflicts at this location; however, it was determined that in the near term, the greatest congestion relief would be derived from a Watt/LRT grade separation.

Like most present day grade separations, the subject project must be constructed under traffic. In this case, the modes include vehicular (with a heavy truck component), light rail passenger service and heavy freight rail components, as well as pedestrian and bicycle users.

Use of precast/prestressed concrete girders for rail structures is not unusual; however, it is when the structural scheme is a through girder configuration. The structure type selection was driven by the site geometric constraints, with the most significant challenges being;

- Conforming to the LRT track grade restrictions into/out of the Manlove Station,
- Providing minimum vertical and horizontal clearances during and after construction
- Maintaining a safe operating environment for all modes during construction

The selected structure is a five span hybrid, consisting of cast-in-place reinforced concrete substructure supporting a post-tensioned, precast/prestressed concrete through girder or "trough" type superstructure, with a total structure length of 535 feet. Using this structure type minimizes construction time and therefore the impacts to the various modes of traffic converging within the project limits.

09-49: Design Development and Construction of I-5 Gatway Pedestrian Bridge

Gary Rayor, OBEC Consulting Engineers, Eugene, OR; Jiri Strasky, Consulting Engineer, Greenbrea, CA

As a part of a major highway interchange improvement project at Beltline Highway and Interstate 5 in Eugene, Oregon, an innovative cable-stayed pedestrian bridge was constructed primarily of precast concrete structural elements. The cable-stayed pedestrian bridge uses segmental precast concrete deck panels, precast concrete main tower, and precast concrete MSE wall approaches. The precast concrete structural elements are combined to allow rapid construction over the busy interstate freeway, provide extremely good stability at all stages of construction, and eliminate forming for the composite cast-in-place topping slab. This innovative use of precast concrete structural elements, especially the deck panels, has also successfully been used by the authors in stress-ribbon, through arch, and suspension bridge types, as well as the cable-stayed bridge presented in this paper. The background and development of the general bridge concepts used in previous projects serve to improve the understanding of the design of the I-5 Gateway Pedestrian Bridge and show the versatility of the use of innovative precast concrete deck construction methodology

09-50: Utah's First Concrete Segmental Bridge - Over the Colorado River

Steve Fultz, P.E., FIGG, Denver, CO; Richard Miller, P.E., Utah DOT, Salt Lake City, UT

World renowned Moab Utah is the gateway to Arches National Park, Canyonlands National Park, Dead Horse State Park, and the Sand Flats Recreation Area. US-191 connects Southeastern Utah and provides the main access through this pristine area. UDOT is replacing the functionally obsolete US-191 Bridge over the Colorado River just north of Moab near the entrance to Arches. Minimizing construction and long term impacts to this unique environment, traffic, and heavy recreational use were key components of the successful bridge solution. With this goal, and in step with UDOT's accelerated bridge construction focus, the solution is a post-tensioned three-span cast-in-place concrete segmental bridge with only one pier in the river. Twin 37'10" wide structures, each 1022-feet long, will be built from above with form travelers to minimize impacts to the river and sensitive environmental / recreational areas below. With a main span of 438-feet and side spans of 292-feet, Utah's first segmental concrete bridge ensures minimal impact to the cherished environment and continual recreational use. A specialized FIGG Bridge Design Charette enhanced the Public Involvement process and facilitated development and determination of aesthetic treatments and features in line with the community's vision. The bridge will be textured to mimic surrounding rock formations, and will be uniquely stained to blend into the surroundings, minimizing its existence in the landscape. Final design will be complete by the end of 2008, with construction anticipated to begin in early 2009.

09-51: Road Bridge over the River Sil - Unique Design Simulations

Peter Barrett, CAE Associates, Middlebury, CT; Jorge Perez Armino, A.T.P. Ingeniere, S.L., Leon, Province of Leon, Spain

The "Road bridge over the river Sil" is a conventional composite road bridge coupled with an arc suspension design. The hybrid design introduced unique design challenges caused by the load interaction between the conventional bridge and the arc section. A detailed nonlinear analysis approach was selected to provide accurate force and moment calculations on all members throughout the construction process and bridge life. The nonlinear incremental construction analysis procedure calculates displacements, forces and stresses in all members of the bridge in real time. The methodology accounts for time dependent changes in concrete modulus of the deck and its load path interaction with the steel frame and arc bridge to assure that no members were over stressed during construction. Also included in the design analyses were the post construction loads on the bridge.

Short-term shrinkage and long-term effects of creep were evaluated analytically using nonlinear material modeling. These models provide an accurate representation of the true stress and deflection state in the hybrid bridge that is only achieved using a time-marching simulation of the load path dependent features. Redistribution of internal forces are explicitly computed and time-dependent stresses and strains in both the concrete, steel deck and cables are also calculated. The time marching analysis also determines strains, stresses, curvatures and deflections at critical times during the life of the structure.

This paper addresses the functionality of modeling this unique hybrid bridge design using commercially software for sophisticated analyses easily performed on desktop computers.

09-52: Impact of Construction Methods on Curved Post-Tensioned Concrete Box Girder Bridges

Bo Hu, PBS&J, Tampa, FL; Dongzhou Huang, PBS&J, Tampa, FL

Post-tensioned curved concrete box girder bridges provide a versatile solution for highway projects with economic, geometrical and aesthetic constraints. The balanced cantilever construction is the most adopted construction method for this type of bridge. Although construction sequence and system transfer effects in straight bridges are well known by engineers, most previous investigators had not studied the effects of balanced cantilever construction methods on structural responses of curved concrete box girder bridges. AASHTO Specifications do not provide guidelines for curved segmental concrete bridges in regards to this issue. Furthermore, there are no clear guidelines on the post-tensioning tendon layout for curved segmental concrete bridges with the balanced cantilever construction method for achieving an optimized prestressed state. The purpose of this paper is to investigate the structural behavior of post-tensioned curved concrete box girder bridges erected with the balanced cantilever construction method, as well as the post-tensioning design method for accomplishing a reasonable force condition under design loads. First, 3-D finite element models that consider construction sequence are established with variable design parameters, such as span length and curvature radius. The dead load, live load, post-tensioning, and time-dependent effects are then studied in comparison to the results of straight bridges erected with the balanced cantilever method. Based on the effects of the construction method for normal stress, shear stress, and the bearing reactions at different curvatures, new criteria for neglecting curvature effects are proposed. Finally, different post-tensioning layouts are examined and several optimized post-tensioning layouts for curved units are recommended. The research results are instructive and could be used in bridge design.

09-53: Effect of Skew Angles on a Simply-supported Curved Steel Plate Girder Bridge

Jimin Huang, HDR Engineering Inc., Tampa, FL

The SR 417 Bridge is a new ramp structure located at Seminole County, Florida. The single-span bridge has a span length of approximately 200 feet along a sharp curve with a radius of 500 feet. Steel plate girders are used for the superstructure. The substructure consists of pile-supported end bents wrapped around with Mechanically Stabilized Earth (MSE) walls. The bridge crosses the roadway below at a 70o skew with a minimum horizontal clearance of 10 feet from the edge of the roadway to the nearest MSE wall face. The design of the bridge is challenging since it has a long simple span, a sharply curved alignment, and horizontal clearance restraints. Appropriate bridge skew angles at each end bent need to be selected to minimize maintenance issues, for ease of bridge construction, and to achieve a cost-effective solution. With a parametric study, this paper investigates the effects of different bridge skew angles on the load demands of the bridge including bearing re! actions, shear, vertical and transverse bending moments, and their impact on the designs of steel plate girders and the substructures. Five different skew angles were evaluated, including 0o, 15o, 30o, 45o, and 60o, at both ends of the bridge. In addition, this paper compares constructability and estimated costs of different skew alternatives. Because the bridge is along a sharp curve, bearing uplift was identified as a structural design issue as well as a bridge maintenance issue. Measures to reduce bearing uplift are discussed, including selecting favorable bridge skew angles, adjusting cross-frame spacing, changing bearing configurations, and using concrete end diaphragm. Based on the results of this study, the recommended solution for the bridge has a 45o skew at the beginning of the bridge and 0o skew at the end of the bridge. The findings of this paper will help bridge engineers to select appropriate skew angles for the design of simply-supported steel plate-girder bridges with sharply curved alignments.

09-54: Design of Rail Transit Bridges Using the AASHTO LRFD Code

Jeffrey Wetmore, AECOM Transportation, St. Paul, MN

Conversion of Washington Avenue Bridge to accommodate the Central Corridor light rail transit between St. Paul, and Minneapolis, Minnesota provided the impetus for examining rail transit bridge design criteria. The proliferation of federally funded New Starts projects means that many agencies must develop design criteria for transit projects. Recognized guidance for U.S. bridge design includes both the American Railway Engineering and Maintenance Association (AREMA) Manual for Railway Engineering and the American Association of State Highway and Transportation Officials (AASHTO) LRFD Specifications for Bridge Design (and the earlier Standard Specifications for Highway Bridges). These sources do not include design criteria for rail transit bridges. Designers often use the AREMA Manual for guidance, potentially because the steel rails on a transit system make transit bridges appear more similar to freight railroad bridges than to highway bridges. The Transit Cooperative Research Program, Report 57, Track Design Handbook for Light Rail Transit, reaches a different conclusion and states that the AASHTO code is probably more applicable for the design of LRT aerial structures than the AREMA Manual (page 7-1). Benefits of using the AASHTO code for the design of rail transit structures include attaining a more uniform level of reliability (and cost effectiveness). Design issues to consider include the characteristics of the light rail vehicles, with their accurately known and stable configurations. These characteristics reduce the probability of exceedance for transit vehicles when the same load factors are applied to transit vehicles and highway vehicles.

09-55: The Evolution of Pre-Cast Segmental Bridge Construction in the State of Florida

Timothy Barry, P.E., Reynolds Smith and Hills Construction Services, Inc, Rockledge, FL

Over the past six years, the Florida Department of Transportation (FDOT) has made sweeping changes in the design and construction practices of pre-cast segmental bridges. These changes became necessary upon the discovery that a number of the segmental structures in service in the State of Florida were experiencing major durability and structural deficiencies. These changes involve improvements in the design guidelines, material requirements, specifications, and construction practices. Also, they require the implementation of new technologies still in the development process. Since 2002 these new requirements have been gradually phased into new segmental bridge projects and the industry is feeling the effects, both positive and negative, of these changes.

Many of the changes enacted by the FDOT have brought significant cost and time impacts to specific projects during the early stages. However, initial results show that the overall goal of improving quality is being achieved. Florida has long been a nationwide leader in segmental bridge construction and its policies are often emulated outside the state. As a result Florida hopes to provide guidance to others nationwide in improving the industry as a whole.

There have been many struggles and many lessons learned thus far in the process of enacting these new policies. However, there is no doubt that as a result of these changes, a better, more viable product is being produced than was ten years ago. The successful implementation of these new procedures and new technologies are a positive step in the continuing evolution of the segmental bridge industry.

BRIDGE REHABILITATION 1 8:00-12:30 PM

Session Chair: Richard Connors, P.E., PMP, Municipality of Murrysville, Murrysville, PA

09-56: Birmingham Bridge Rocker Bearing Failure & Retrofit

Louis J. Ruzzi, P.E., PENNDOT-District 11-0, Bridgeville, PA; Patrick Gaynor HDR, Bridgeville, PA

The Authors will discuss the rocker bearing failure and PENNDOT's response to the failure including the first response actions, forensics investigation and subsequent repairs/retrofit and lessons learned. The talk will include the initial discovery of the problem and closure of the bridge on February 8, 2008 and the efforts required to stabilize the bridge during the first weekend. This includes the close coordination communication between PENNDOT's Design, Maintenance, Construction Staff, Central Office and our Partners (Consultants and Contractors.)

We will explain the most likely cause of the rocker bearing failure and how this information was used to examine the repair/retrofit options. In addition, the actual repairs/retrofits will be discussed.

Finally, we will discuss lessons learned on policy changes as a result of this failure. It is important to share this information with other states so they can take preventative action to avoid a similar situation.

09-57: Design of Stay Cable Replacement for the Luling Bridge

Armin Mehrabi, Bridge Engineering Solutions, PC, Lewiston, NY

The Louisiana Department of Transportation and Development has decided to replace all stay cables of the Luling Bridge to address their deficiencies. The extent of damages to cables, decision making process, and design requirements and concepts were discussed in an earlier paper (IBC08-89). Since then, a comprehensive design for cable replacement has been developed and soon the construction work will begin. This paper summarizes the completed analysis and design work.

The cable replacement design, the first occasion in North America, is heavily influenced by the geometric restrictions, cost, and requirement for minimum interruption to the bridge traffic. The design had to accommodate an extraordinary construction sequence. The operation is limited to one side of the bridge at a time, providing for no lane closures during peak hours. he use of temporary cables minimizes stress variation in the structure. A highline cable, proposed for lifting and installation, reduces the need for construction space. Most of the operation is conveniently concentrated at the deck level where the temporary cable anchors and stressing ends are positioned. The newly designed cable system is a parallel strand system consisting of seven-wire strands, individually waxed and sheathed, all encased in a PE sheathing. This allows individual strand installation, tensioning, inspection and replacement. A 3-D FE model of the superstructure was used to generate member action envelopes under loading combinations. This led to limitation of construction loading, determination of stressing patterns and geometry control variables at various construction stages, and the need for strengthening to avoid overstressing.

09-58: Chesapeake City Canal Bridge Back to Its Fatigue Safe State

Ahmad Faqiri, Pennoni Associates, Inc., Wilmington, DE

A comprehensive approach consisting of testing, analysis, design, and construction consultation was the key to an effective bridge repair that made the floorbeam connection angles of the Arch Span of the Chesapeake City Canal Bridge fatigue safe indefinitely. The Bridge is a two-lane steel structure carrying U.S. Route 213 over the Chesapeake and Delaware Canal. Owned and maintained by the U.S. Army Corps of Engineers the bridge is nearly a mile long, with its main tied-arch structure spanning 540 feet.

In recent years, hairline cracks in the top fillet region of the floorbeam connection angles in the main span became unmanageable. Modifications such as drilling holes at the end of the crack tips and other pre-emptive measures were taken to arrest the cracks to no avail.

A three phase analysis of the cracks on the floorbeam tie-girder connection angles of the Bridge tied-arch span was conducted. The analysis included structural instrumentation and load testing, global modeling of the tied-arch span, a finite element local model of the floorbeam connection angles, and fatigue analysis to determine the remaining life for the existing angles. These models were also used to develop a design for retrofitting the connection to alleviate the fatigue stress conditions.

Based on the analysis and retrofit recommendations, the bridge rehabilitation and fatigue retrofit consisted of the removal and replacement of the bridge deck expansion joints, replacement of stringer bearings, and replacement of the top portion of the floorbeam tie-girder connection angles.

09-59: Optimization of Isolation Bearing Parameters for Effective Mitigation of Seismic Risk for Bridges

Murat Dicleli and Memduh Karalar, Middle East Technical University, Ankara, Turkey

Seismic isolation of bridges is a design methodology that is based on limiting the magnitude of the seismic forces transferred to the substructures. The performance of seismic isolated bridges (SIBs) is measured by the maximum isolator force and displacement (MIF and MID). The MIF represents the magnitude of the seismic force transferred to the substructures. Thus, it has a remarkable effect on the design of the substructures. The MID is generally used to determine the isolator size as well as the width and type of the expansion joints. In some cases, the widths of the substructures may be governed by the MID. Accordingly, for a given ground motion, smaller isolator force and displacement will produce a more economical bridge design under seismic effects. Seismic isolators used in bridge applications may be classified into two groups as rubber-based and sliding-based. The force-displacement hysteresis of these isolators is generally idealized as bilinear for design purposes. The characteristic strength, Qd and the post-elastic stiffness, kd, are the main isolator parameters that affect the behavior of a SIB for a given ground motion with specific frequency characteristics and intensity. Thus, the optimal selection of these isolator parameters based on minimizing the MID and MIF will result in an economical design of the SIB. Accordingly, the objective of this research study is to formulate closed form equations as functions of the isolator, bridge and ground motion properties to calculate the optimum Qd and kd of the isolator to minimize the MID and MIF. Using the developed equations it will be possible to select the proper isolator properties that will result in an economical SIB design.

To achieve the above stated objective, .first, sensitivity analyses are conducted to investigate the effects of several bridge, isolator and ground motion parameters, on the optimum values of Qd and kd. From these sensitivity analyses, the parameters that affect the optimum values of Qd and kd are identified. Next, for each one of the identified parameters, nonlinear time history (NLTH) analyses of typical SIBs are conducted to determine the optimum values of Qd and kd for an assumed range of values of the parameter under consideration. Next, the available data is plotted as a function of some dimensionless parameters. Nonlinear regression analyses of the plotted data are then conducted to obtain closed form equations for the optimum values of Qd and kd, to minimize the MID and MIF. The obtained closed form equations are then verified using a suite of ground motion data different than that used for the development of the same equations. It is observed that the optimal Qd is proportional to peak ground acceleration of the ground motion and bridge mass and inversely proportional to the peak ground acceleration to peak ground velocity (Ap/Vp) ratio of the ground motion. It is also found that the optimal kd is proportional to peak ground acceleration of the ground motion and bridge mass, inversely proportional to Qd and is a polynomial function of the Ap/Vp ratio of the ground motion.

09-60: Externally Bonded FRP Composites for the Rehabilitation of Reinforced Concrete T-beam Structures

Jeffrey R. Levan, P.E., Pennsylvania DOT, Montoursville, PA; An Chen, Ph.D. and Julio Davalos, Ph.D., West Virginia University, Department of Civil and Environmental Engineering, Morgantown, WV

This paper presents a synthesis of findings from an ongoing PennDOT District 3 project to utilize externally bonded FRP composites for the rehabilitation of reinforced concrete T-beam bridges Identifying a method for selecting candidate bridges for suitability of repair is based on current NCHRP studies. Three levels of repair are identified, Level 1 (contract), Level 2 (contract/Department force), and Level 3 (Department force). From this methodology, a candidate bridge was selected for a contract repair project. Field and laboratory testing of existing bridge materials is described. Pre-repair tests include ultrasonic pulse velocity and rebound hammer on beam concrete, compressive strength tests on deck concrete cores, carbonation tests for both beam and deck concrete, SEM-EDX analyses for beam and deck concrete, and tension tests of the extracted beam-reinforcing steel. Structural analysis was based on AASHTO specifications. Finite element modeling was performed to determine existing capacity and the FE model was calibrated by testing of the bridge using applied truck loads. Initial FRP design was based on strengthening to replace a known area of corroded reinforcement. The FRP repair system was designed based on current ACI 440.2R-02 design guidelines. Repair work was completed in the summer of 2008, with post-construction load testing and supporting full-scale lab studies scheduled for the fall of 2008 and spring 2009. Results from the rehabilitated bridge and supporting testing will be used to develop draft PennDOT design standards and construction specifications and to apply "lessons learned" to the design and constructability of future tee-beam rehabilitation projects.

09-61: Rehabilitation Challenges of the Route 35 Bridge Over Manasquan River

Thomas Fisher and Rama Krishnagiri, PB Americas, Inc., Princeton, NJ

The NJ Route 35 Bridge over Manasquan River serves over 35,000 vehicles/day, and the volume swells to over 50,000 during summer on this major link to two shore resorts. The 1080-foot, nine-span double-leaf bascule viaduct, carries four lanes. This 60-year-old structure was rehabilitated to provide 25 years more of useful life. With the surrounding residential and commercial development, a new structure was decades away and cost prohibitive due to major environmental and Right-of -Way impacts. The $32-million project was substantially complete in August 2008.

The aging deck, deteriorated lead-based paint, and deteriorated steel in the approach and movable spans were in dire need of replacement or strengthening. Due to the two very busy shore resorts, an extensive community involvement process was coordinated between the owner, stakeholders, businesses, designers and public during the design and construction. There were significant timing restrictions imposed by the NJDEP due to endangered species and andromonous fish in the waterway. The major concerns of the motoring public, businesses and marina owners, coupled with timing restrictions, and the mandate to maintain the existing four lanes throughout construction posed a tremendous challenge in choosing appropriate design, construction materials and methods; setting, sequencing and meeting the construction schedule economically. Additionally, the bascule span could be closed only during winter months, with openings limited to Sundays. Thus bascule span work was further complicated. To avoid painting during the winter months, the bascule steel was metallized in-situ. Standardizing deck replacement utilizing pre-fabricated panels for repetitive fabrication and easy installation proved very effective. Over 60,000 SF of Exodermic deck was used for deck replacement. Bearing and steel repairs, painting, substructure and fender repairs within a given stage were carefully sequenced for the approach and bascule spans, within the timing restrictions. The owner and designers extensive coordination was reflected in the contract documents and resulted in an economically constructed project. The low bid was close to the engineering estimate, and is on target as the project is nearing completion.

09-62: Exodermic Deck Repairs on the Kingston-Rhinecliff Bridge

William Moreau, New York State Bridge Authority, Highland, NY

The reinforced concrete deck of the Kingston-Rhinecliff Bridge (KRB) was replaced with modular exodermic deck panels during a three year project between 2000 and 2002. The KRB is an 5200 foot long deck truss with approach spans of 1400 feet on each end. In 2003 cracking of the exodermic deck was identified on the approach girder spans. Strain gauging and computer modeling identified shortcomings in the design and a retrofit to the deck was designed and implemented. This paper will explain the mistakes made during the design and detailing of the exodermic deck for this application as well as identify the solution adopted.

09-63: Managing Fatigue Cracks In Steel Tub-Girder Webs at Interior, Cross-Bracing Connections

Henry Fix, AECOM, Horsham, PA ; Michael Chajes, University of Delaware, Newark, DE

The Newport Viaduct, in Newport, Delaware is a twin, 19-span viaduct, which is over 2000 feet long, consisting of different simple-span and continuous-span units. The cross-section is a variety of 2, 3 and 4 steel tub-girder configurations. The bridge is 30 years old and has a current ADT of over 67,000 vpd.

During a recent routine safety inspection, over 700 fatigue cracks were discovered throughout the length of the viaduct. The cracks in the webs appeared at connection plates to the webs for the interior cross-bracing. An engineering study was performed to investigate the crack-forming mechanism and to determine what future action should be done with the intentions of returning the structure to a normal 24-month inspection cycle. The engineering study investigated the possibility of repairing the cracks, retrofitting the cross-bracing detail and/or determining a critical flaw length for future inspection monitoring. Core samples of the web material were taken for microscopic inspection of the cracks and Charpy V-notch testing. The bridge was instrumented and monitored to get an understanding of the crack forming mechanism. Finite element models were developed to correlate the field measurements with theoretical models. The finite element models were used to develop the appropriate actions for the future management of the bridge.

This paper will present the findings from the inspection, the testing and engineering study for the cracks in the box girders. This paper will also explain the crack management program that was developed for the Delaware DOT for the future management of the bridge.

09-64: Applying Suspension Bridge Suspender Rope Replacement Techniques to the Suspenders of a Through Arch Bridge (Northway Twin Arch Bridges over the Mohawk River, Albany, NY)

Blaise Blabac. PE, Modjeski and Masters, Inc., Poughkeepsie, NY

The contractor for this project, Piasecki Steel Construction, proposed an alternate method for the replacement of the 168 suspenders for these twin through-arch bridges which utilized a proven technique previously applied to suspension bridges. This concept, developed in collaboration with Modjeski and Masters, saved the bridge owner (New York State DOT) a total of approximately $5 million by eliminating the complex jacking system and traffic control requirements shown on the Contract Plans. One of the most significant benefits of the contractor's method was that it allowed the work to be performed under full traffic. The method shown on the Contract Plans required closing the bridge during certain phases of the work - a complex maintenance and protection of traffic plan that involved rerouting traffic on an interstate carrying an average of 110,000 vehicles per day. In addition, the contractor's proposed jacking system had several distinct structural advantages over the method shown on the Contract Plans: 1) there was no change in load path, and 2) it incorporated a redundant system designed to carry the full 100-ton reaction of the suspended floorbeam once the existing suspender was removed. Modjeski and Masters assisted Piasecki Steel by proving the feasibility of the concept to the NYSDOT and by providing detailed design calculations and working drawings of the jacking system used to replace the suspenders. This paper illustrates the key components of the suspender replacement method employed by the contractor and compares them to the method detailed on the Contract Plans.

WEDNESDAY, JUNE 17–AFTERNOON SESSIONS

BRIDGE MANAGEMENT/EVALUATION 1:30-3:45 PM

Session Chair: Donald W. Herbert, P.E., Pennsylvania DOT, Uniontown, PA

09-65: Bridge Information Modeling (BIM) and Advanced Measuring Methods Case Laser Scanning In Renovation Design

Antti Karjalainen, WSP Finland Ltd, Oulu, Finland; Kirsi Hanninen, WSP Finland Ltd, Helsinki, Finland

New 3-D CAD design tools and 3-D measurement methods have been developed and tested in the several real bridge construction projects in Finland during 2004-2008.

Design programs based on 3-D modeling will change bridge design process. Laser scanning technology in construction has developed fast. Surveying data from laser scanning is possible to transfer directly to bridge design. This methodology seems to be very useful in rehabilitation projects, where existing structures will remain as part of final structure. When scanning data has been transferred to 3-D program as basic data, design based on real and accurate information can easily been done.

A research project was carried out with the aim to find out the possibilities to measure and to control the 3-D geometry of bridges by laser scanning in 2008. An old timber truss bridge (Bridge over river Pyhajoki in Finland) which needed repairing was selected as the target. There was only one general drawing of the bridge available as source information. Measurement with the traditional methods would in practice have been almost impossible, or at least extremely hard to realize.

The aim of this study was 1) to produce a point cloud of the bridge and 2) to create a 3-D model of the bridge from thereof and 3) to find out best practices for the further treatment of 3D-data for re-construction project.

In field experiments a reference point system was constructed first. It facilitated the accurate handling of the needed coordinate transformations. After that the initial surfaces of the old bridge were scanned. As a result laser scanning provided a point cloud data which was cleaned and modelled as reference surfaces with a certain program. With these reference surfaces an information model was created and drawings were done for the basis of the construction planning with 3D CAD software. At the end of the project the success of the modeling was checked by comparing the information model created to the point cloud created by laser scanning. The 3D laser scanning is providing accurate source information to bridge design too. In bridge rehabilitation projects 3D laser scanning is highly applicable.

09-66: Cost Effectiveness of Stainless Steel-Clad Reinforcing Bars and Other Corrosion Mitigation Strategies in Bridge Decks

John Lawler and Paul Krauss, Wiss, Janney, Elstner Assoc., Northbrook, IL

Chloride-induced corrosion of traditional carbon steel reinforcing bars (black bars) is a primary cause of deterioration of concrete structures, especially bridge decks. A service life model has been applied to predict the performance of corrosion mitigation alternatives, including the use of micro-composite alloy reinforcing steel, epoxy-coated reinforcing steel, solid stainless reinforcing steel, stainless clad reinforcing steel, and high performance concrete (HPC), in a bridge deck setting. In recognition of the uncertainty in the extreme long-term performance of highly corrosion-resistant materials, a range of chloride thresholds, bounded by values reported in the literature or observed by the authors, have been considered for each bar type. The deck service life model was prepared based on a set of severe, yet realistic, exposure conditions. The service life modeling was conducted to provide a rational basis for performing a life cycle cost (LCC) analysis. The costs associated with the initial construction of the deck and repair and maintenance scenarios developed based on predicted performance were estimated and used to calculate the annualized cost, i.e. the total cost discounted over each year in the life of the bridge, for each case. While recognizing that deck and repair service life, initial concrete and reinforcing bar cost, rehabilitation cost and schedule, and discount rates will affect the LCC analysis, based the best estimates of these values, the stainless-clad reinforcing steel has the lowest annualized cost of all the alternatives considered.

09-67: Load Rating Bridge Substructure Units

Robert W. Bondi and Richard M. Schoedel, Michael Baker Jr., Inc., Moon Township, PA

The adequacy of bridge substructures is usually based on information from as-built plans, design calculations and inspection results. This information should be checked to verify that substructures have at least the capacity of the lowest rated superstructure member. If this information is not available, substructure adequacy is left up to the engineer's judgment. For massive wall piers and abutments this is acceptable. Multi-column bents and piers and other similar substructures should be load rated if they show signs of distress such as structural cracking, excessive concrete spalling, excessive reinforcing steel corrosion, reinforcing bars not engaged by concrete, are classified as structurally deficient due to primary flexural or shear reinforcement, show signs of movement, or exhibit other distress. The inspector should record the extent and depth of spalling, loss of reinforcing steel cross-sectional area, loss of concrete cross-section, and distressed locations. The inspector should also calculate the remaining cross-sectional area of the concrete component and the reinforcing steel.

Load ratings should then be performed based on operating levels for reinforced concrete members as stated in the current AASHTO Standard Specifications for Highway Bridges, Section 8, or AASHTO LRFD Bridge Design Specifications, Section 5, or by the strut and tie approach. One should not exceed the limitations contained in the 1973 AASHTO Specifications for shear analysis. The strut and tie method generally uses lower effective concrete strengths and lower resistance factors than traditional analysis methods and therefore, will not necessarily predict higher member capacities in all cases. However, the strut-and-tie model may be beneficial where deficient shear reinforcement is compensated by the reserve capacity in the flexural reinforcement or vice versa and in cases with concentrated loads close to supports.

09-68: Comparison of Coating System Service Life Based on Type of Primer, Number of Coats, and Surface Preparation Method

Jayson Helsel, KTA-Tator, Inc., Pittsburgh, PA

This paper provides an objective review of the service life of high performance industrial coating systems considering the type of primer, number of coats and method of surface preparation. The differences in primer type addresses coating systems with zinc rich versus non-zinc rich coatings. The number of coats in a coating system focuses on the performance of two versus three coat systems. Additionally, the review looks at how the method of surface preparation affects longevity of the coating system. The surface preparation comparisons are power tool cleaning for coating system rehabilitation versus abrasive blast cleaning for coating system replacement. Included in the review are comparisons of installation and life cycle costs based on a suggested maintenance painting sequence. The review will focus on field coating application.

09-69: Proposed National Tunnel Inspection Standards

Jesus Rohena, FHWA, Washington, DC

There are approximately more than 300 highway tunnels in the USA. The majority of these tunnels are more than 50 years old. Recent events in some tunnels like the CA/T in Boston, MA and also the Hanging lakes in CO have made tunnel inspections a priority for tunnel owners. After the fatal incident in Boston, the National Transportation Safety Board, recommended to FHWA to develop a National Tunnel Inspection Standards. This paper will present the status of ongoing FHWA activities to address the NTSB recommendation.

09-70: Data fusion of bridge inspection data using learning algorithm

Amin Hammad and Behzad M. Darbani, Concordia Institute for Information Systems Engineering, Concordia University, Montreal, QC, Canada

Bridge operators are always concerned with whether their bridges are in good conditions and if there is any safety threat for bridge users. In order to answer these questions, and evaluate the bridge condition, bridges are inspected periodically using visual inspection or Nondestructive Testing (NDT) methods. Interpreting inspection data from different sources combined with bridge properties, and inferring a condition rating is not an easy job. Each inspection method measures one physical or chemical property of the bridge and we should find a way to combine these measurements in a comprehensive way. Effective management of our bridges requires collecting large amount of data from visual inspection and NDT. However, the real value of these data depends on the information that can be extracted from the data.

This paper presents a method on how to deal with inspection data, when various visual, destructive and nondestructive inspection methods are used to inspect bridges. A learning algorithm is used to fuse inspection data and link them to other bridge properties including traffic volumes, bridge type and age. The algorithm probabilistically evaluates bridge condition ratings based on available data. The proposed method is applied on set of real inspection data from Alberta Transportation, Canada to automatically evaluate bridges.

ACCELERATED BRIDGE CONSTRUCTION 1:30-3:45 PM

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

09-71: A Precast Bridge System for Rapid Construction Applications

Bruce Campbell, Parsons, Southfield, MI; Martin Furrer, Parsons, Chicago, IL

The Federal Highway Administration is promoting the use of rapid bridge construction technologies to get in, get out and stay out. These non-traditional construction techniques are being used more frequently to limit the impacts to users of the transportation systems and improve durability. The State of Michigan is interested in a rational approach to the development of such technologies and their application to the state wide bridge program.

In the first application of the rapid bridge construction technology in the State of Michigan a bridge replacement was chosen for a 245 foot four span, three-lane grade crossing over US-131. The replacement bridge consists of precast abutments, precast multi-column piers and caps, precast prestressed I-beams and a precast post-tensioned deck. The precast deck is full-depth, longitudinally post-tensioned to achieve continuity, and utilizes a waterproof membrane and HMA overlay. The bridge was completed and opened to traffic September 12, 2008. The paper will present the detailing of the design for rapid bridge construction technologies to meet the unique needs of the state and the capabilities of local fabricators. The paper will also examine construction lessons learned in the field and their application to future designs.

09-72: Road Over I-84: Piecing it Together

Michael Arens, Michael Baker Jr., Inc., Salt Lake City, UT

The Riverdale Road over I-84 Bridge in Riverdale, UT required replacement in conjunction with roadway widening and upgrading the interchange from a diamond to a SPUI. Riverdale Road is a high density retail area. In order to reduce the construction impact to the area, the Utah Department of Transportation (UDOT) implemented Accelerated Bridge Construction (ABC). Several innovative solutions were implemented including multiple prefabricated elements and non-composite concrete deck panels.

The new SPUI bridge was constructed in phases using almost all pre-fabricated elements. H-piles were driven for the pile foundations, and cast-in-place footings were cast on the piles. Precast blocks were stacked and post-tensioned together for the abutments. Precast columns and bent caps were placed and post-tensioned for the bent. Steel plate girders were installed on the two spans. Pre-cast end diaphragms were installed on the girder ends and then precast non-composite deck panels were installed on the girders. Precast approach slabs were installed as the last link.

The non-composite precast deck panels were placed on neoprene foam strips on the outside of the top flanges of the girders. There were no shear studs connecting the panels to the girders. This feature greatly accelerated the installation of the deck panels since shear studs did not have to be installed and grout pockets did not have to be filled. The panels were connected with grout closure pours and then longitudinally post-tensioned. Grout was then pumped into the haunch area between the foam strips to provide full bearing of the deck onto the girder.

09-73: Design/Build of Bridge for Interstate Storage & Pipeline

William Castle, W.J. Castle, P.E. & Associates, P.C., Hainesport, NJ

When a new NJ Transit Rail System was constructed, access to Interstate Storage and Pipeline Corporation, a major jet fuel supplier to McGuire Air Force Base was eliminated. Interstate retained the services of The Castle Group to design and construct a pre-fabricated bridge for the new access road. Working with N.J. Transit, U.S. Army Corp, NJDEP, U.S. Coast Guard and local agencies, The Castle Group was able to develop, design and construct this Project efficiently and within budget. All engineering, permit acquisition, & construction management was performed by in-house personnel, which minimized costs and reduced overall construction time. Efforts were made to ensure that all work performed was limited to designated areas and not intruding into the adjacent railroad tracks or wetland areas.

The bridge was prefabricated in two 8' wide sections and designed for HS-25 loading. Each abutment foundation was constructed of a steel cap beam supported by Chance Helical Piles attached with specialized brackets designed by The Castle Group. These Chance Pilings were used due to the presence of underground gas lines, overhead power lines, fiber optics, and N.J. Transit restrictions.

The bridge sections were set into place and assembled within two hours while the metal deck pans, reinforcing steel, and concrete deck were placed in one working day. The entire construction portion of the project was completed within sixty days for a total cost of $270,000.00.

Our Company was awarded the Special Recognition Award by NJDOT-NJQI for this project as well as Outstanding Project Award by DVASE.

09-74: Accelerated Bridge Construction Approach Keeps Tappan Zee Bridge Open

Mohammad Shams and Kenneth Standig, HDR, New York, NY

The 53-year-old Tappan Zee Bridge is a 3-mile long crossing of the Hudson River, located 13 miles north of New York City. The bridge consists of a central 2400-ft through truss, 5000 ft of deck trusses on either side of the central spans and an 8300-ft long causeway at the west extent of the bridge. It has 3 northbound lanes, 3 southbound lanes, and a reversible center lane for rush hour traffic. Over 140,000 vehicles cross the bridge every day, compared to 18,000 vehicles daily in 1955. Under the current $147 million project, the concrete deck of the outer four lanes of the bridge will be replaced for a length of about 2.5 miles. The design approach calls for replacing the concrete deck and its supporting stringers, with a prefabricated superstructure system. This approach was selected to ensure that a section of bridge deck could be removed and replaced and open to traffic within a short period. Because of the heavy traffic volumes, multiple lane closures are only permitted overnight. The contractor is required to open all lanes at the end of each night shift, in time for the morning rush hour, and is subject to penalties of $1000 per minute for missing the deadline. The contractor has successfully replaced over 1.5 miles of the bridge deck. The completion of deck replacement is scheduled for the end of 2008. This major rehabilitation project will ensure the continuity of a critical transportation connection in the NYC metropolitan area.

09-75: Move the Bridge with Post-Tensioning Devices

Jimin Huang, HDR Engineering Inc., Tampa, FL

Large construction equipment, such as big cranes, launching trusses, and Self-Propelled Modular Transports (SPMT) have been used to move structural components or entire superstructures from offsite locations to their final positions. However, this equipment is generally very expensive and sometimes difficult to find and operate. This paper investigates the use of simple and easy-to-use post-tensioning devices to move bridge superstructures in certain situations. With post-tensioning strands or bars attached to the structure components, bridge superstructures can be "lifted", "pushed" or "pulled" into their final positions. Such a moving system needs to be designed to effectively move the structure and have the capability to adjust its position if required. Structural components to be moved also need to be designed to handle any changes in internal forces during the movements. This construction approach has been successfully used for the NE 8th Bridge construction in Bellevue, Washington, and the construction of approach spans for the Belleair Beach Causeway Bridge, Belleair Beach, Florida. The NE 8th Bridge is a two-span steel plate girder bridge with a total length of 328 feet and a width of 120 feet. To keep all traffic lanes open during the bridge replacement, half of the new structure was built on a temporary substructure and moved over a distance of 65 feet in the transverse direction to its final position Post-tensioning bars were used to pull the superstructure supported on top of the abutments and piers. The approach of the Belleair Beach Causeway Bridge consists of 9 spans of a solid post-tensioned slab with a total length of 660 feet and a width of 81 feet. Each slab segment was cast behind the abutment with a single segment length of approximately 37.5 feet and incrementally launched in the longitudinal direction from the abutment toward the center of the bridge using two external post-tensioning cables. Compared to large construction equipment, post-tensioning devices are relatively inexpensive and easy to operate in the field. The concepts and details presented in this paper can be used for similar projects in the future to lower construction costs, accelerate bridge construction, and improve construction safety.

BRIDGE REHABILITATION 2 — 1:30-3:45 PM

Session Chair: Matthew P. McTish, P.E., McTish , Kunkel & Associates, Allentown, PA

09-76: Structural Analysis of the Pulp Mill Covered Bridge

Sean James, P.E., and Josif Bicja, Hoyle, Tanner & Associates, Inc., Manchester, NH

The Pulp Mill Covered Bridge is one of six remaining double-barrel covered bridges in the country and design is ongoing for its rehabilitation. It is located over Otter Creek between Middlebury and Weybridge, Vermont with half of the structure owned by each Town. It was originally built circa 1850 as a 180 foot single clear span timber superstructure utilizing double-barrel burr arch-trusses. Shortly after it was built, it began to have extensive sagging and structural problems. In 1860 secondary laminated arches with iron rod hangers were added to strengthen the trusses. With these modifications, the covered bridge was changed to be a multiple kingpost burr arch-tuss type covered bridge. These modifications, as well as other changes made since, have caused many structural issues in the bridge that must be resolved.

The focus of this paper will be the analysis and rehabilitative design for this unique covered bridge. A 3-D computer model of the bridge was utilized for the structural analysis, which took into consideration the complicated load sharing interaction of the bridge's four arches and three trusses based on their unique geometrical rigidities and stiffness. Member stresses from dead, wind, snow load and a notional truck train live load model - representing a group of vehicles routinely permitted on highways - were found and compared against current design standards. The structural needs, once determined, were then balanced with historical concerns and also with the current need to increase the live load carrying capacity of this historic covered bridge.

09-77:Emergency Pier Repairs to the Kinney Truss Railroad Bridge, Colchester, NY

Michael Marks, EIC Group LLC, Fairfield, NJ

The Kinney Truss Bridge, owned by the NY Department of Environmental Conservation and Second Bruno Corporation carries an access road across the Beaver Kill in Colchester, Delaware County, NY. Constructed in 1890 for the Ontario and Western Railroad, the two span bridge has an overall length of 310 feet with Baltimore Truss superstructures supported by stone abutments and a river pier.

The 2005 inspection report noted severe pier undermining and leaning. The bridge was declared unsafe and closed to traffic.

In June 2006, an underwater inspection revealed 75% of the footing was undermined and movement was occurring. Subsequent flooding caused the pier to shift 2 resulting in the bearings dropping 1.5. Collapse was imminent.

EIC Group LLC recommended an immediate staged repair consisting of filling the 6 deep scour hole with concrete, cap replacement and encapsulation of the pier stones. Temporary supports were installed and concrete cast into the wide cracks to stabilize the structure. The bridge was jacked and the pier repaired.

Working together with the Army Corp and DEC, permits were obtained within a week and Ritacco/Sparwick Construction was hired to perform the repairs. Within days of mobilization in September, the pier moved two more inches and there was concern that total collapse was possibly only hours away. However, movement halted after the initial concrete pour was done. Repairs had to be completed before the winter since the pier would not withstand the river ice.

The project utilized over 600 CY of concrete and was completed in October 2006.

09-78: Carnegie Interchange Rock Buttress Remediation

Daniel Martt, Al Hajdarwish, Gene Lipovich, A.G.E.S., Inc.; Canonsburg, PA; William Adams, Pennsylvania Dept. of Transportation, Bridgeville, PA

During the initial construction in 1968 of Interstate 79 at the proposed Carnegie Interchange west of Pittsburgh, the piers for the overpass bridges were constructed and the embankment was approximately 2/3 completed when it was discovered that the piers on the north side of Robinson Run had moved laterally 6 to 8 inches, although remaining essentially plumb. A subsequent study by others recommended remediation using tie backs or a rock buttress. A rock buttress was placed in front of the embankment and construction of the roadway was completed.

During Phase II design studies for the I-79 Rehabilitation Project in 2002, the site was re-evaluated in light of the reconstruction of the mainline structures. Studies conducted by A.G.E.S., Inc. for PennDOT identified problems with both long-term slope stability and temporary stability during the bridge rehabilitation. The remediation had to take into consideration pier loadings from existing bridges, as well as construction on uneven rock buttress surfaces above a stream under the existing overhead structures.

The remediation included ninety-nine rock anchors approximately 100 to 120 feet long extended into hard siltstone/sandstone bedrock with design loads of 160 to 260 kips over a 400 feet width of slope. The design took into consideration the constructability of installing bearing pads on the uneven rock buttress surfaces.

09-79: Rehabilitation of the 31st Street Bridge

Donald Marburger and Sean Hart, P.E., Baker Engineers, Moon Township, PA; Jeffrey Clatty, Pennsylvania Department of Transportation, Bridgeville, PA

The 31st Street Bridge is a 28-span steel structure comprised of 25 two-girder, floorbeam, stringer spans and 3 arch spans. The arch spans are two two-hinged arches that span 241 feet and the center 3-hinged arch that spans 385 feet. The bridge spans over the main and back channels of the Allegheny River, Herr's Island, three railroads, and Smallman Street. It connects the Lawrenceville section of the city to the North Side spanning between Penn Avenue and PA Route 28. The structural design was performed by Baker Engineers and Tri-State Design and Development, Inc. The general contractor for the construction was Trumbull Corporation. The total cost of the project was approximately $28 million. The bridge was built in 1928. The topic of this paper is the 2006-2007 rehabilitation.

The 31st Street Bridge rehabilitation consisted of total deck replacement and expansion dam replacement, replacement of high profile rocker bearings due to seismic considerations, nearly 2,000,000 pounds of major steel repairs and strengthening, and aesthetic features such as period light poles and re-use and re-configuration of the existing iron pedestrian handrailing.

This paper will discuss the main rehabilitation items and will focus on unique elements such as the plating of the steel arches, context sensitive design issues such as the re-use of the existing iron pedestrian railings, new aluminum pedestrian railings to mimic the re-configured existing iron railings, use of the Cal-trans type roadway barrier, and replacement of 4 spans and one steel bent.

09-80: Rehabilitation of Route 50 Drawbridge Ocean City, MD

Patrick O'Neill and Scott Reynolds, Hardesty & Hanover, LLP, Annapolis, MD

The Ocean City Drawbridge on Route 50, experiences approximately 4000 openings a year and carries an ADT of 24,000. The original structure was built in the 1940's with the movable span consisting of a dual leaf bascule bridge comprised of a girder, floorbeam, stringer system with an open grid steel deck supported by purlins. The 2005 inspection determined the purlins to be in critical condition. Maryland State Highway Administration commissioned Hardesty & Hanover to design a replacement of the grid deck and purlin systems as well as significant mechanical rehabilitation and replacement. Within existing on-call contracts an owner affected design-build team consisting of Hardesty & Hanover and Covington Machine and Welding was formed allowing for constructability concerns to be addressed as the design progressed. This integral relationship with the contractor during design led to significant alterations to scope and staging of the project, resulting in the minimum impact upon vehicular and marine traffic while providing a significant increase in the design life of the bridge. A complete closure of Route 50 allowed the complete replacement of the grid deck system and numerous couplings, bearings, and gears to be accomplished within a two month period. H&H provided construction support services throughout the field work and performed strain gauging analysis to provide final balancing. This paper presents how an integral relationship between the designer and contractor can render an effective solution to critical defects in a short period of time with minimal impact to the public.

IBC Seminars are intensive, four-hour, single-topic focused sessions. Each seminar requires an additional fee of $125. Please see the special section on the Conference Registration Form. Seating for each Seminar is limited, so please register early. Professional Development Hours (PDHs) are provided upon request and verification.

STATE OF THE ART CONFINED SOIL WALLS AND ABUTMENT, AND VARIATIONS OF SOIL NAILING TECHNOLOGIES

Tuesday, June 16; 8:30am–12:00noon

Moderator: Michael Adams, *Senior Researcher, FHWA Turner Fairbank Highway Research Center, McLean, Virginia;* Robert Barrett, *TerraTask, LLC; Colby Barrett,*

Part One – History and Introduction (One hour)

The first half workshop presents a summary of 40 years of geotechnical research in retaining walls, bridge abutments, open bottom box culverts, reinforced soils, landslides and rockfall. This research was performed by Colorado DOT, the US Forest Service, the Federal Highway Administration and several agencies and universities. Expenditures on this research effort exceeded 25 million dollars and the major conclusion presented here is that smaller, lighter inclusions in granular soil produce stronger composite behavior than do heavier, stiffer elements on wider spacing. Full scale demonstrations show that variations in spacing of the inclusions approaches exponential factors in some cases.

Several new tools, methods and techniques will be presented that are not as yet in standard practice. Earthquake Wings (a new and better way to build abutments in seismic regions) will be presented. Scour prevention methods will be introduced. The presentation concludes with recent constructions with the Soil Nail Launcher, including Launched Nails, Launched Micropiles and Launched Scour Micropiles. Super Nail concepts will also be discussed.

Part Two – Design Methods for Geosynthetically Confined Soil Walls, Abutments, Piers, Box Culverts, Soil Nails and Micropiles. (Two Hours)

This session presents analytical methods for designing state of the art composites. Examples of field constructions and including cost estimating will be presented. This session will also discuss the reasons for failures in MSE constructions.

At the end of the seminar, the participants will be able to:

- Gain awareness of geotechnical research into composite soil behavior
- Utilize analytical methods for designing various structures and foundation types using geosynthetically confined soil
- Increase their knowledge base of state-of-the-art construction methods and techniques

HIGHWAY TUNNEL INSPECTION, MAINTENANCE AND OPERATION SEMINAR

Tuesday, June 16; 8:30am–12:00noon

Moderator: Jesus Rohena, *FHWA*

This seminar will focus on the sharing of the best practices for inspection, maintenance, and operation of Highway Tunnels. Topics to be covered include:

- Design, Construction, Inspection, Maintenance and Operation
- Fire Safety Modeling – Consultant
- Highway Tunnel Inspection, Maintenance and Operation - PennDOT
- Structural, Mechanical, Electrical
- Ventilation
- Appurtenances

At the end of the seminar the participants will be able to:

- Understand the principles of good practices in inspection, maintenance and operation
- Establish contacts and reference sources
- Develop sound and effective programs for tunnels

Target Audience: Federal, state and local highway agency engineers, and consultants in materials, design, construction, inspection, maintenance and operation of tunnels.

LOAD RATING OF GUSSET PLATES OF CONNECTIONS OF STEEL TRUSS BRIDGES

Wednesday, June 17; 8:30am–12noon

Moderator: M. Myint Lwin, P.E., S.E. *FHWA*

This seminar will focus on two goals:

- To provide bridge engineers with the fundamental knowledge to use the recent FHWA guidance to load rate gusset plates in accordance with the AASHTO LRFR and LFR methods
- Lessons learned by State and Consultant Bridge Engineers in addressing the impact of the evaluation requirements for existing truss bridges.

Topics includes:

- NTSB Recommendations, FHWA Technical Advisories and FHWA Guidance on Load Rating of Gusset Plates of Steel Truss Bridges using LRFR and LFR –
- New York DOT's Perspective in Using LRFR in the Load Rating of Gusset Plates -
- PennDOT's Perspective in Using LFR in the Load Rating of Gusset Plates -
- Using Finite Element Analysis in Load Rating of Gusset Plates -
- Application of Software in the Load Rating of Gusset Plates -
- Open Discussion

At the end of the seminar, the participants will be able to:

- Understand the background behind the FHWA Guidance and the detailed steps involved in load rating by the LRFR and LFR methods
- Gain a good knowledge on how load ratings are done by State and Consultant Bridge Engineers
- Develop sound and effective programs for insuring structural adequacy of bolted and riveted gusset connections in steel truss bridges in compliance with NBIS.

Target Audience: Federal, state and local highway agency engineers, managers and their consultants in design, construction, inspection and load rating of steel truss bridges.

2009 IBC BRIDGE TOUR

Tuesday, June 16; 1–5:00pm

Pittsburgh is the city of bridges, and the IBC is pleased to once again offer our tour of unique area bridges. The tour this year includes stops at the Rankin Bridge over the Monongahela River and the new bridge being built to carry the Pennsylvania Turnpike over the Allegheny River in Harmar (a signed waiver and release will be required to enter the construction area). These two structures will be under construction in 2009. Time permitting, the tour may finish with a ride on the Monongahela Incline to Mount Washington for a breathtaking view of the City. This guided tour departs from the Convention Center at 1:00pm.

An additional fee of $40 is required.

MONDAY, JUNE 15–AFTERNOON WORKSHOPS

(W-1) LIGHTWEIGHT CONCRETE FOR BRIDGES

Monday, June 15; 1:00–5:00pm

Presented by: Expanded Shale Clay and Slate Institute (ESCSI)

The objective of this workshop will be to introduce designers and owners to the properties and applications of lightweight concrete (LWC) for bridges. Construction applications where LWC has been used include new long-span bridges, seismic and/or poor foundations, and accelerated construction projects with precast concrete elements. Design and construction issues and the enhanced durability of LWC would be emphasized from a practical perspective. Internal curing which can be achieved when prewetted lightweight aggregate replaces normal-weight aggregate in concrete mixtures would also be discussed.

How attendees could benefit:

The outcome of the workshop will be that attendees will have information and examples of applications that will allow them to confidently implement the benefits of using LWC in bridges.

(W-2) MAXIMIZING BRIDGE FOUNDATION DESIGN USING FULL SCALE LOAD TESTING

Monday, June 15; 1:00–5:00pm

Presented by: Loadtest, Inc.

The workshop will guide attendees through the fundamental characteristics of modern geotechnical engineering design and analysis. Recognized industry leaders in deep foundation testing will share detailed techniques for improving the design of deep foundations with reference to the applicability of codes and specifications.

Real world construction experience and knowledge will illuminate the importance of construction techniques for improving deep foundation performance with particular reference to the relationship to end-bearing and shear will also be presented.

The importance of time and creep characteristics when assessing deep foundation test results. Again, the workshop with utilize applications based on both research and development in the construction industry and will provide useful insights for practicing engineers and contractors.

Applying full scale testing at the pre-design stage of bridge foundation design. How this valuable information is incorporated into LRFD and the costs associated with this strategy will be discussed.

These issues and topics will have broad appeal to any geotechnical, structural or bridge engineer involved in specifying, analyzing, designing or constructing deep foundations. Any engineer or student pursuing a post-graduate program would also benefit from the Program.

How attendees could benefit:

- Learn practical methods to economize bridge foundation design
- Understand how many of the largest bridges in the world utilize full scale testing to save time and money
- Engage with industry leaders that have conducted over 2,000 full scale load tests worldwide
- Understanding how to mitigate risk when designing bridge foundations.

TUESDAY, JUNE 16–MORNING WORKSHOPS

(W-3) BRIDGE AESTHETICS–PRACTICAL IDEAS FOR SHORT AND MEDIUM SPAN BRIDGES

Tuesday, June 16; 8:00am–12:00pm

Presented by: TRB General Structures Committee (AFF10)

This workshop will be presented by members of TRB's AFF10(2) Subcommittee on Bridge Aesthetics. The objective will be to educate members of the bridge community about the approach to aesthetic bridge design that is presented in the recently completed draft, first edition of TRB's "Bridge Aesthetics Sourcebook - Practical Ideas for Short and Medium Span Bridges".

There will be a series of presentations based on the Sourcebook content. Special emphasis will be provided on Design Guidelines and Bridge Lighting. A guided tour of the Subcommittee's companion web site will show what resources are available to designers. There will also be presentations about how Historic Considerations should be taken into account and how Bridge Context can affect both the design of a bridge and the use of the space in which it is located.

The workshop will then provide participants with a practical bridge design exercise that will allow them to actually employ the ideas and design concepts presented earlier in the workshop.

How attendees could benefit:

Workshop attendees will gain a practical knowledge of how to approach aesthetic bridge design for short and medium span bridges. They will also be presented with thought provoking ideas about bridge aesthetics and context and gain an understanding of issues that are of concern throughout the practice of bridge design. The panel of presenters will be on hand to answer questions related to aesthetic bridge design and bridge context.

(W-4) FHWA ACCELERATED BRIDGE CONSTRUCTION WORKSHOP

Tuesday 8:00am–12:00pm

Presented by: Federal Highway Administration (FHWA)

The highway community has been moving toward a new way of doing business as construction has intensified in recent years in an attempt to confront a two-fold problem. First, our highway infrastructure is aging. Much of it was built in the 1950s and 1960s and is in need of rehabilitation or replacement. Second, although highway capacity has increased little during the last two decades, traffic demand has grown tremendously, causing high levels of congestion. Large construction projects designed to improve worn-out and outdated roads and bridges compound traffic problems during lengthy construction periods. Today's motorists want high quality, longer-lasting highways and bridges, but they want any construction-related activity completed as quickly as possible.

The workshop objective will be to present concepts of Accelerated Bridge Construction (ABC) technology and provide solutions to the above mentioned issues using ABC technology.

How attendees could benefit:

This workshop will provide information on the state of the art practices of Accelerated Bridge Construction Technology, including information on how, by using innovative prefabricated bridge technologies and innovative equipment and contracting strategies rather than conventional techniques, we can achieve our goals of rapid onsite construction with minimized traffic disruption, improved safety and constructability, and improved durability, and at competitive construction costs and ahead of schedule.

(W-13) SOCIETY FOR PROTECTIVE COATINGS (SSPC) COATINGS SESSION

Tuesday, June 16; 8:00am–12:00pm

Presented by Society for Protective Coatings (SSPC)

This workshop will present:

- High Build Aliphatic Moisture Cure Urethanes, the Next Generation
- A Tolerant Solvent-Free Epoxy System Applied Over Hydroblasting: The Way To Enjoy Cost Effective Protective Performance And Environmental Friendliness In Steel Bridge Painting
- OSHA: What's On the Horizon
- Corrosion Engineering Initiative
- Environmentally Friendly Graffiti Resistant Coatings – Waterborne Polyurethane Coatings for Bridge Structures That Actually Work
- Federal Infrastructure Spending Stimulated Recovery in Lake County, Ohio

SSPC will have the above presentations in the morning followed by lunch, then an afternoon tour of Pittsburgh's Heinz Field, home of the Pittsburgh Steelers.

(W-5) BRIDGE MANAGEMENT WORKSHOP–SHARING BRIDGE MANAGEMENT PRACTICES: A PRESENTATION & PANEL DISCUSSION

Tuesday, June 16; 8:30am–12:00pm

Presented by: Wade Casey – FHWA & AASHTO Member States

Federal, state, and local governments are under increasing pressure to balance their budgets and, at the same time, respond to public demands for quality services. Along with the need to invest in America's future, this leaves transportation agencies with the task of trying to manage current transportation systems as cost-effectively as possible to meet evolving, as well as backlog needs. The use of existing or new transportation management systems provides a framework for cost effective decision making that emphasizes enhanced service at reduced public and private life-cycle cost. The primary outcome of transportation management systems is improved system performance and safety while collecting, analyzing, and integrating the data necessary to calculate, forecast, and display selected performance indicators, and identify critical performance gaps to make investment decisions and tradeoffs. The Bridge Management Workshop will engage state department of transportation (DOT) bridge management practitioners from selected states across the country under the theme of "Sharing Bridge Management Strategies." Bridge management is essential in order to maximize scarce resources and maximize service life and a bridge management system is an effective tool in allocating limited resources to bridge related activities. How various states use the information from a bridge management system in the decision making process will be discussed.

(W-6) DETAILING FOR BRIDGES

Tuesday, June 16; 8:30am–12:00pm

Presented by: John McCaskie, Association of General Contractors (AGC)

Participate! Bridge Contractors Talking to Bridge Contractors, <u>and</u> to Owners and Designers (so that we better understand). Topics to be presented will include:

- Rehabilitation
- Demolition
- Contractor Liabilities
- New Frontiers
- and, bring your own topic!

As market needs change, contractors venture differing kinds of work related to bridge construction, maintenance and rehabilitation Share with others your problems and concerns and how you handle them. Come to realize that we all share the same challenges and it is not necessarily a lonely battle.

TUESDAY, JUNE 16–AFTERNOON WORKSHOPS

(W-7) SEISMIC ACCELERATED BRIDGE CONSTRUCTION

Tuesday, June 16; 1:00–5:00pm

Presented by: TRB Structures Section

The intent of this workshop is to introduce attendees to the application of Accelerated Bridge Construction (ABC) methods in regions of moderate to high seismicity.

The ever-increasing demands placed on transportation networks across the nation, coupled with an aging infrastructure, has led to the need to rapidly replace, widen, and build new highway infrastructure including bridges. The Federal Highway Administration has been actively promoting the advantages of ABC including reductions in traffic disruptions and traveler delays, improved work zone safety, and reduced on-site environmental impacts. However, ABC methods utilized elsewhere may not be suitable in regions of moderate to high seismicity. In particular, connection details tying together prefabricated elements must be capable of resisting seismic loads and must ensure ductile response of bridge systems.

In this workshop, case studies of construction projects, seismic ABC connection details in use or under development, research results, and criteria for selecting the use of ABC methods in regions of moderate to high seismicity will be presented.

This workshop is co-sponsored by the Transportation Research Board General Structures Committee (AFF10) and the Seismic Design and Performance of Bridges Committee (AFF50).

How attendees could benefit:

Attendees will gain an improved understanding of the issues associated with the use of ABC methods in regions of moderate to high seismicity, and can apply this information to current or future projects under development.

(W-8) BRIDGE OWNER PROGRAM FORUM

Tuesday, June 16; 1:30–5:00pm

Presented by: Ronnie Medlock, High-Steel Structures

At the Bridge Owner Construction Forum, invited Owners from across the region will describe their upcoming bridge programs.

Important details program details will be provided, including:

- Latest information about response to a stimulus package (actual or anticipated, depending upon the state of the package)
- Bridges programmed for letting during the next few years
- Major projects scheduled for letting in the next 3 to 10 years
- Upcoming projects of interest to the large and medium sized contractors and fabricators
- Other details about the funding situation that is 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. Scheduled to present: Barry Benton, Delaware DOT; Robert J. Healy, Maryland State Highway Administration; Hal Rogers, Pennsylvania DOT; James L. Stump, Pennsylvania Turnpike Commission; TBD, Utah Department of Transportation; Ronaldo T. (Nick) Nicholson, Virginia DOT

How attendees could benefit:

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

(W-9) FOUNDATION DRILLING WORKSHOP

Tuesday, June 16; 1:30–5:00pm

Presented by: The International Association of Foundation Drilling (ADSC)

This workshop will provide the latest design, specification, construction, and confirmation testing practices being implemented in the highway industry. Topics of interest will be presented by leading experts in the design and construction of drilled foundations and anchored earth retention. We will also provide examples of completed projects and how innovative design and construction methods were utilized to solve challenging project requirements, while also achieving high standards of quality control.

How attendees could benefit:

Attendees will learn current practice for design of drilled foundations and earth retention systems, and will see examples of successfully constructed projects incorporating state of the art equipment and construction methods. Special attention will be placed on providing innovative solutions to challenging foundation applications.

(W-10) HIGH TECH UNDERWATER BRIDGE INSPECTION TECHNIQUES

Tuesday, June 16; 1:30–5:00pm

Presented by: Marion Hill Associates, Inc. (MHA)

High-tech scanning equipment has expanded the capabilities of underwater inspection of bridge piers beyond conventional diving techniques and standard methods. Sonar (acoustic) imaging provides details of structural components and scour around a pier in very poor to zero underwater visibility. The equipment has built-in measuring capabilities that permits accurate delineation of a scour area and calculates the volume of material that may be needed to correct a potentially hazardous deficiency and is used in conjunction with a trained hard-hat diver equipped with an underwater color recording DVD camera mounted on his or her's helmet allows for a very detailed and through inspection of a bridge pier. There is also an added degree of diver safety because their image shows up on the monitor in relationship to the bridge pier and underwater hazards to be avoided.

MHA plans to provide a demonstration of our specialized equipment including our M/V LIFTBOAT that lifts completely out of the water providing a very stable command center for MHA hard-hat divers and sophisticated sector scanning sonar. Sonar and underwater color camera images will be transmitted to the patio of the Convention Center. This will provide an ideal vantage point for audience participants to view the command center next to a railroad bridge pier sending back detailed images of a diver doing an inspection being guided to specific locations using sector scanning sonar. The audience can ask specific questions and have the divers respond to inquiries.

(W-11) STATE HIGHWAY AGENCY FORUM: STATE OF THE PRACTICE; BRIDGE LOAD RATING AND POSTING

Tuesday, June 16; 1:30–5:00pm

Presented by: Thomas Saad, FHWA

FHWA & AASHTO Member States Panel Discussion and Roundtable

A select group of State Highway Agencies will provide current and recommended practices for bridge load evaluation to ensure bridge safety, to post highway bridges for state legal loads, and to provide oversight to allow for the safe operation of the increasing requests for annual and special permits for overweight vehicles.

Due to the recent adoption of the AASHTO Manual for Bridge Evaluation which provides provisions for implementing Load and Resistance Factor Rating (LRFR), and the transition by State DOTs to full implementation of the LRFD Specifications, many State DOTs are modernizing their bridge evaluation programs to take advantage of the benefits of LRFR for rating new and existing highway bridges. These States are also taking a closer look at their current practices to ensure quality of their inventory of existing Load Factor and/or Allowable Stress Ratings.

To ensure the highest level of safety for the public traveling on our nation's highway bridges, it is vital for State DOTs to have comprehensive practices in place to perform load evaluations of design, legal and permit vehicles and to provide the most accurate load capacity information from which to manage the vehicular traffic on each bridge. It is vital for bridge engineers to understand the best practices for load rating and to apply them accurately to properly inform owners how to post and permit for the ever increasing numbers of heavy loads on the highway network.

WEDNESDAY, JUNE 17–MORNING WORKSHOPS

(W-12) THE FHWA LONG TERM BRIDGE PERFORMANCE PROGRAM

Wednesday, June 17; 8:00am–4:30pm
Presented by: FHWA - Highway R&D Services

The objectives of this workshop are: to describe the FHWA's Long Term Bridge Performance Program (LTBPP) and present the scope of the program activities to members of the bridge community; to seek input from workshop attendees on potential improvements to the program; and to encourage development of complementary R&D programs by public transportation agencies, university researchers and the inspection/NDE industry.

The LTBPP is an ambitious 20-year research effort to study the long term performance of highway bridges. The objectives of the LTBPP are to collect, document, and make available high-quality quantitative performance data on a representative sample of bridges nationwide. The availability of the collected data is expected to result in greater knowledge of bridge performance and degradation.

Specifically, it is anticipated that the LTBPP will provide a better understanding of bridge deterioration focusing on its numerous causes including corrosion, fatigue, environment and loads. The program will also collect information regarding the effectiveness of current maintenance and improvement strategies, and on the operational performance of bridges, focusing on congestion, delay and accidents.

The LTBPP is expected to provide information and data that will engender substantial improvements in bridge inspection programs, nondestructive testing technology, bridge design practices, bridge materials, bridge maintenance, preservation & rehabilitation practices and bridge management policies and practices at the local, state and federal levels.

How attendees could benefit:

The attendees will learn the scope, scale and details of the 20-year LTBPP. All aspects of the program will be presented including bridge performance issues, data priorities, bridge sampling techniques, pilot study, and inspection/monitoring protocols. They will be apprised of opportunities for parallel and/or complementary research and development projects.

(W-13) SOCIETY FOR PROTECTIVE COATINGS (SSPC) COATINGS SESSION

Rescheduled to Tuesday, June 16; 8:00am-12:00pm

(W-14) WESTERN PENNSYLVANIA TRANSPORTATION RESEARCH FORUM

Wednesday June 17; 8:00am–12:00pm
Presented by: Dr. Kent A. Harries and Dr. Melissa Bilec, The University of Pittsburgh Department of Civil and Environmental Engineering

The forum highlights both research-in-progress and recently completed bridge and transportation research funded by PennDOT and NCHRP. The forum is focused on technology transfer and is of interest to DOT engineers, consultants and practitioners. Forum attendees will receive a CD consisting of the presented papers. The forum is open to all IBC attendees.

(W-15) FRP COMPOSITES FOR BRIDGES: SETTING NEW STANDARDS IN RAPID CONSTRUCTION & REPAIR

Wednesday, June 17; 8:30–11:30am
Presented by: American Composites Manufacturers Association (ACMA)

FRP composite technology for use in bridge engineering offers solutions that range from routine repairs to innovative designs for complex installations. This workshop will explore new repair techniques that significantly improve existing transportation structures; ground-breaking bridge applications made possible by using FRP composites; and implementation of recent codes and standards by AASHTO and ACI that make specifying FRP composites easier. The objective of this course is to equip the bridge design engineer with a tool kit of FRP composite design possibilities that can offer cost-effective solutions for decks and structural rehabilitation in bridges.

Key features of composites multiple strengths and wide-ranging design possibilities will be illustrated using current installations as a benchmark to future applications. We will also discuss specifying composites when preparing a bid contract, including initial cost considerations and how to capture lower overall costs due to benefits inherent to FRP composites, such as easier transportation, rapid installation, and life cycle cost advantages over traditional materials. New designs, including superstructures, decks, and repairs on bridge structures, will be also highlighted.

This workshop will be equally beneficial for those professionals who are just exploring the use of FRP composites in bridge applications for the first time and those with more composites experience that are interested in specification, design or repair of transportation structures.

How attendees could benefit:

Session attendees will learn how to design and specify composites with recently approved codes and standards from ACI and AASHTO. In addition, new products and installation techniques will be demonstrated using case histories of field applications that focus on accelerated construction and longer life cycles.

(W-16) BRIDGE CONSTRUCTION BEST PRACTICES FOR ENGINEERS

Wednesday, June 17; 8:30am–12:00pm
Presented by: Michael D. Flowers, American Bridge/Fluor Enterprises, JV; Walter J. Gatti, Tensor Engineering; Brian Fenters, Rampart Hydrodemolition Services

Part 1: An update on the construction of the New San Francisco-Oakland Bay Self Anchored Suspension Bridge, including an overview of the complex design of the bridge, i.e., the self anchored design and how that drives any number of unique construction challenges and approaches. Also included; a status report on where the project stands in the overall construction process and a look ahead to the expected progress in the next year. The project bid in March 2006 and is scheduled to complete in 2013.

Part 2: Presentation concerning standardization of Design drawing information, the use of 3D models to approval fabrication drawings and animation of complex assemblies.

Part 3: A demonstration of how states throughout the U.S .are using hydrodemolition for their bridge rehabilitation projects and how they can learn from each others' methods. One of the items we would like to highlight, since PennDOT is the Featured State, is that they have recently begun using hydrodemolition for rehabilitation projects other than for LMC overlays, i.e. barrier retrofit and box beam deck replacement. Further, we will examine typical issues related to the hydrodemolition process that engineers typically inquire about; speed of process, water runoff, water treatment, and cleanup of the spoils.

How attendees could benefit:

- Better understanding of the process
- Develop a comfort level to try other DOT's methods
- Equip engineers with additional rehabilitation tools
- Potential for DOT's to try a case study using different types of surface preps

(W-17) PENNDOT BRIDGE MAINTENANCE TOPICS

Wednesday, June 17; 10:00am–12:00pm
Presented by: PennDOT

- Louis J. Ruzzi, P.E., District 11-0, Bridge Preservation Philosophy
- Jason Zang, P.E., District 11-0,Bridge Maintenance Contract History/Project Examples
- William Koller, P.E., District 1-0, Bridge Preservation Work in District 1-0
- Matt Pierce, P.E., AECOM, SR 79 35M-Bridge Preservation Project/Roadway Reconstruction in District 11-0

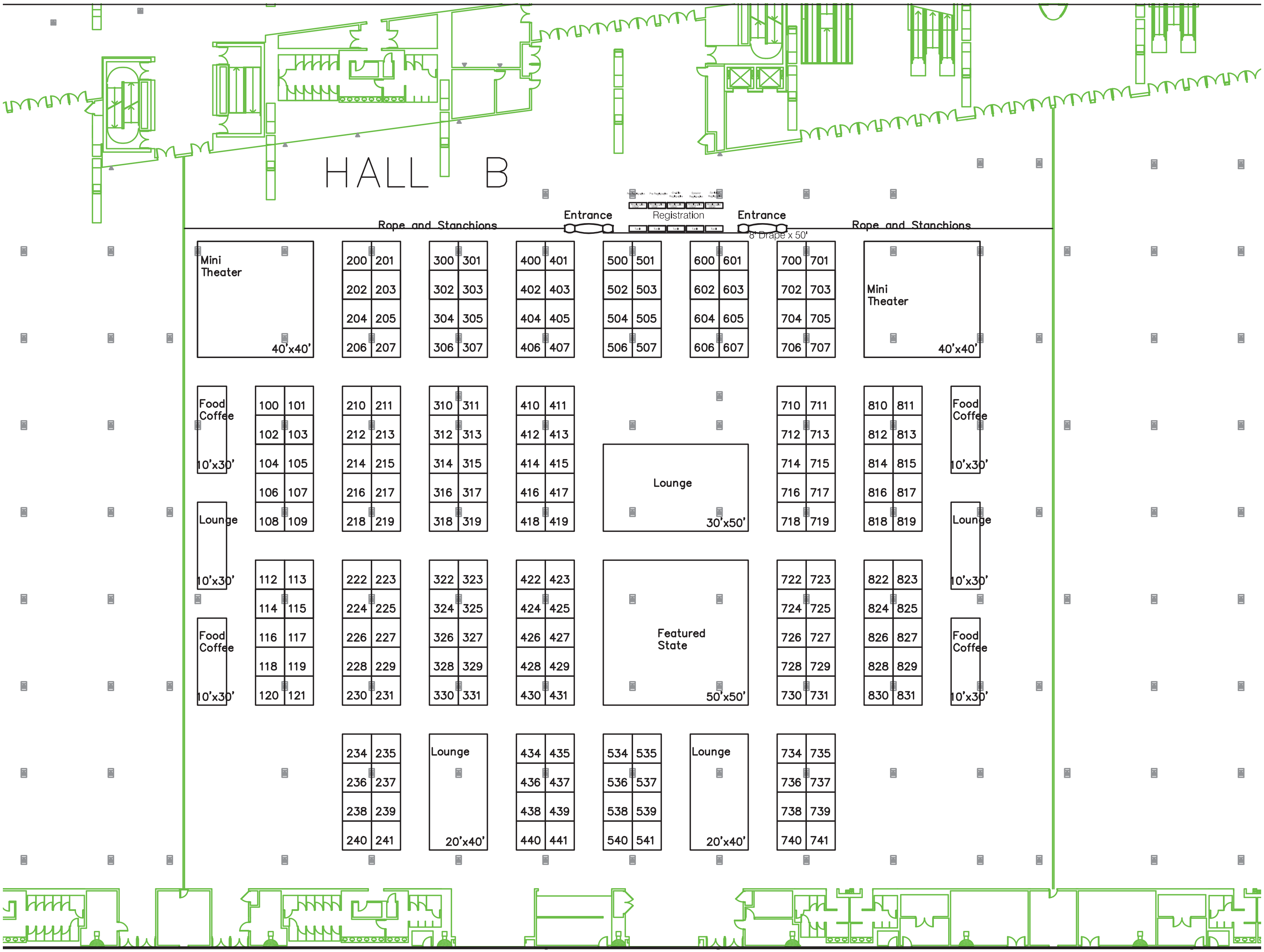
2009 IBC Exhibit Hall

The 2009 IBC Exhibit Hall has moved to larger space (Exhibit Hall B) in the David L. Lawrence Convention Center, to accommodate even more displays than ever before–heavy equipment, active displays and super-sized exhibits and our brand new Mini-Theatres. With more space than ever to accommodate additional features, the IBC Exhibit Hall will be the place to be. In addition to more than 150 Exhibits, the Featured Agency, PennDOT, will be prominently featured, along with numerous enhancements for your enjoyment. The Mini-Theatres will provide Exhibitors with an opportunity to step out from your Exhibit booth and present additional information about your products & services. Mini-Theatres will be located in the expanded Exhibit Hall–reservations must be made in advance; an additional fee applies. Specific times and other details, including an up-to-the-minute listing of Exhibitors can be found on the IBC home page, at www.eswp.com/bridge/index.htm. It is not too late to reserve a booth or reserve your time slot in our Mini Theatres in the 2009 IBC Exhibit Hall, but space is limited, *so do not delay!* Here are a sampling of the firms already committed to the 2009 IBC (as of 5/1/09):

2009 IBC Exhibitors; listed alphabetically with booth number
(As Of: May 1, 2009)

A.D. Marble & Company .... Booth: 304
Acrow Corporation of America .... Booths: 311/313
Advitam, Inc. .... Booth: 325
AECOM .... Booth: 427
AI Engineers Inc. .... Booth: 305
American Arminox, Inc. .... Booth: 404
American Association of State Highway & Transportation Officials (AASHTO) .... Booth: 102
American Bridge Manufacturing .... Booth: 504
American Composites Manufacturers Association .... Booths: 702/704
American Shotcrete Association .... Booth: 114
Amscot Structural Products .... Booth: 327
Applied Foundation Testing .... Booth: 104
Applied Geomechanics, Inc. .... Booth: 234
Architectural Polymers .... Booth: 715
Automatic Power, Inc. .... Booth: 426
Barnhart Crane & Rigging .... Booth: 812
Barrier Systems Inc. .... Booth: 431
BASF Construction Chemicals, LLC .... Booth: 723
Beaufort / Strand7 PTY Ltd .... Booth: 507
BendTec, Inc. .... Booth: 810
Bentley Systems .... Booths: 703/705
Bigge Crane and Rigging Co. .... Booth: 717
Boschung America, LLC .... Booth: 202
Boulderscape Inc. .... Booth: 316
Brayman Construction Corporation .... Booth: 109
Bridge design & engineering magazine .... Booth: 607
Bridge Grid Flooring Manufacturers Association (BGFMA) . Booth: 710
Bridon International .... Booth: 112
Bureau Veritas .... Booth: 106
Burgess & Niple, Inc. .... Booth: 503
CAE Associates Inc .... Booth: 213
Campbell Scientific, Inc. .... Booth: 315
Cargill - SafeLane .... Booth: 813
Carolina Stalite Company .... Booth: 423
Chase Construction Products .... Booth: 212
ChemCo Systems .... Booth: 502
Clodfelter Bridge & Structures Int'l, Inc. (CBSI) .... Booths: 500/501
Computers & Structures, Inc. .... Booths: 403/405
CONTECH Construction Products Inc. .... Booth: 600
Corrpro Companies, Inc. .... Booth: 407
Crafco, Inc. .... Booth: 825
CTLGroup .... Booth: 726
Cyro / Evonik Industries .... Booth: 120
D.S. Brown Company, The .... Booth: 411
D'Appolonia .... Booth: 307
DeAngelo Brothers, Inc. .... Booth: 740
Deery American Corporation .... Booth: 100
DGI Menard .... Booth: 414
Dynamic Surface Applications, Ltd (DSA) .... Booth: 537
E.T. Techtonics Inc. .... Booth: 814
Earthquake Protection Systems, Inc. .... Booth: 817
Enerpac .... Booth: 735
Epoxy Interest Group of CRSI .... Booth: 400
Eriksson Technologies, Inc. .... Booth: 301
Euclid Chemical Company, The .... Booth: 818
Figg Engineering Group .... Booth: 734
Freyssinet, Inc. .... Booth: 418
Fyfe Company LLC .... Booth: 302
Fynite Solutions & Clark Testing Group .... Booth: 402
G.W.Y., Inc. .... Booth: 811
Greenman-Pedersen, Inc./Instrument Sales, Inc. a GPI Company .... Booth: 700
Greenstone Inc. of Delaware .... Booth: 205
Harcon Corporation .... Booth: 534
Hardesty & Hanover, LLP .... Booth: 701
Hayward Baker Inc. .... Booth: 231
High Steel Structures, Inc. .... Booth: 206
Hill & Smith Inc. .... Booths: 215/217
Hilman Rollers .... Booth: 413
HNTB Corporation .... Booth: 827
Houston Structures .... Booth: 207
HRV Conformance Verification Associates, Inc. .... Booth: 505
Hydro-Technologies, Inc. .... Booth: 222
InspectTech .... Booth: 535
Insulfoam LLC .... Booth: 330
Jancy Engineering, Inc. .... Booth: 424
KTA-Tator, Inc. .... Booth: 718
LARSA Inc. .... Booth: 714
Lehigh University - ATLSS Research Center .... Booth: 428
Loadtest, Inc. .... Booth: 711
LUSAS .... Booth: 210
Maguire Group Inc. .... Booth: 725
Marion Hill Associates, Inc. .... Booth: 713
MATECH Corp .... Booth: 328
McClain & Co., Inc. .... Booth: 722
MDX Software .... Booths: 506/507
Michael Baker Jr., Inc. .... Booth: 419
Michelman - Cancelliere Iron Works .... Booth: 736
MISTRAS Group, Inc. .... Booth: 322
Monotube Pile Corporation .... Booth: 605
National Steel Bridge Alliance .... Booth: 415
NDT Corporation .... Booth: 312
Non-Destructive Testing Services .... Booth: 724
North American Galvanizing Co. .... Booth: 324
NX Infrastructure .... Booth: 219
OSMOS-USA .... Booth: 602
Palmer Engineering .... Booth: 417
Pennoni Associates Inc. .... Booth: 211
Pickering, Corts & Summerson, Inc. .... Booth: 604
Pieresearch .... Booth: 822
Polyset Company .... Booth: 816
Portland Cement Association .... Booth: 728
Power Team .... Booth: 306
Prestressed Concrete Association of Pennsylvania .... Booth: 716
Pro-Bel Group of Companies .... Booth: 235
Proto Manufacturing, Inc. .... Booth: 819
Q.B. Associates, Inc. .... Booth: 317
Quikrete Companies, The .... Booth: 116
R.J. Watson, Inc. .... Booth: 401
Rampart Hydro Services .... Booth: 425
Reinforced Earth Company, The .... Booth: 416
Richard Goettle, Inc. .... Booth: 830
Roads & Bridges Magazine .... Booth: 314
Roctest, LTD .... Booth: 730
Salit Specialty Rebar .... Booth: 541
Scougal Rubber, Corp. .... Booth: 203
Seismic Energy Products, L.P. .... Booth: 712
Sensr .... Booth: 303
Sherwin-Williams .... Booth: 310
Shotblast, Inc. .... Booth: 741
SIKA Corporation .... Booth: 603
Silica Fume Association .... Booth: 434
Simulia .... Booth: 204
Sisgeo Srl .... Booth: 118
Skala, Inc. .... Booth: 113
Snap-Tite .... Booth: 230
Sofis Company, Inc. .... Booth: 601
Sound Fighter Systems, LLC .... Booth: 331
Specialty Diving, Inc. .... Booth: 436
Splice Sleeve North America, Inc. .... Booth: 719
SSI/Dow Corning .... Booth: 218
Stagnito Media .... Booth: 326
Stirling Lloyd Products, Inc. .... Booth: 706
Structal Bridges .... Booth: 437
Structural Integrity Systems, LLC .... Booth: 412
T - Wall Retaining Wall System .... Booth: 101
T.Y. Lin International .... Booth: 815
TEREX .... Booths: 103/105
Termarust Technologies .... Booth: 707
Thyssenkrupp Safway, Inc. .... Booths: 318/319
TNO DIANA North America .... Booth: 108
Transpo Industries Inc. .... Booth: 406
TRC .... Booth: 323
Trinity Highway Products, LLC .... Booth: 121
U.S. Bridge International .... Booth: 225
Unibridge USA, Inc. .... Booths: 200/201
Universal Manufacturing Corp. .... Booth: 429
Vector Corrosion Technologies .... Booth: 440
Viathor, Inc. .... Booth: 430
W.J. Castle Associates .... Booth: 831
Westfall Company, Inc. .... Booth: 606
Wheeling Corrugating Company .... Booth: 410
Williams Form Engineering .... Booth: 223
WireCo World Group .... Booth: 300
Wirerope Works, Inc. .... Booth: 435
WSP Sells .... Booth: 823
ZMPC / Busch Industries .... Booth: 731

Exhibits



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Lounge 20'x40'
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2009 IBC Registration Form

On-Line Registration Available at eswp.com/ibc

ATTENDEE INFORMATION

ATTENDEE NAME (FIRST, LAST) ________

NICKNAME AS IT SHOULD APPEAR ON BADGE ________

COMPANY / FIRM ________

STREET ADDRESS ________

CITY ________ STATE ________ POSTAL CODE ________

COUNTRY, if other than U.S.A. ________

PHONE ________

FAX ________

E-MAIL ________

INDUSTRY TYPE:

- ❑ CONSULTANT
- ❑ GOVERNMENT
- ❑ CONTRACTOR
- ❑ ACADEMIC
- ❑ MANUFACTURER
- ❑ OTHER:________________________

REGISTRATION CATEGORIES

PLEASE CHECK APPROPRIATE BOXES

	Postmarked Before May 22	Postmarked After May 22
❑ FULL REGISTRATION	$475	$525
❑ TWO-DAY REGISTRATION (❑ Mon/Tues ❑ Tues/Wed)	$375	$425
❑ ONE DAY REGISTRATION (❑ Mon ❑ Tues ❑ Wed)	$200	$225
❑ STUDENT (FULL TIME) REGISTRATION	$30	$40
❑ GOVERNMENT RATE (FULL REG.)	$375	$425

❑ BRIDGE AWARDS LUNCH; NO FEE, LIMITED TO FIRST 300 PEOPLE

ADDITIONAL REGISTRATION CATEGORIES

❑ PDH LETTER REQUESTED

❑ IBC SEMINAR (EACH) .... $125 .... $125

- ❑ Confined Soil Walls
- ❑ Highway Tunnel Inspection
- ❑ Load Rating of Gusset Plates

❑ OFFICIAL PROCEEDINGS ON CD (*SUMMER '09*) $30

❑ BUS TOUR OF PITTSBURGH BRIDGES (TUES.) $40

❑ SPOUSE (PLEASE PROVIDE SPOUSE NAME) $75

- ❑ Just Ducky Tour (Monday) $50
- ❑ Heinz History Tour (Tuesday) $50
- ❑ PNC Park Tour (Wednesday) $50

TOTAL DUE .... $______________

METHOD OF PAYMENT

❑ CHECK (MADE PAYABLE TO I.B.C.) ❑ VISA/MC ❑ AMERICAN EXPRESS ❑ ESWP ACCOUNT #________

AUTHORIZED SIGNATURE ________

ACCOUNT NUMBER ________ EXPIRATION DATE ________ CVV ________

*Due to fraud protection measures, credit card payments must include the correct billing address for payment processing. If the credit card used for this purchase is different from the address listed above, please provide billing address on the line below.

CREDIT CARD BILLING ADDRESS ________

Cancellation Policy: All refund request must be received in writing. No refund requests will be honored after May 29, 2009. If you do not cancel, and do not attend the IBC, you will be responsible for your full registration fees. Substitute attendees are welcome. All refunds are subject to a $25 administration processing fee. Some IBC events are subject to minimum participation; should you register for an event that is cancelled, you will be refunded your fee.

You may submit your registration in 3 manners:
1. Mail this form to I.B.C., c/o The Engineers' Society of Western PA, 337 Fourth Avenue, Pittsburgh, PA 15222
2. On-Line Registration Form available at www.eswp.com/bridge
3. Fax this form to: 412-261-1606

Questions? Phone the IBC at 412-261-0710, or e-mail us at c.mcgarvey@eswp.com

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