Accelerating Infrastructure Innovations

# FOCUS

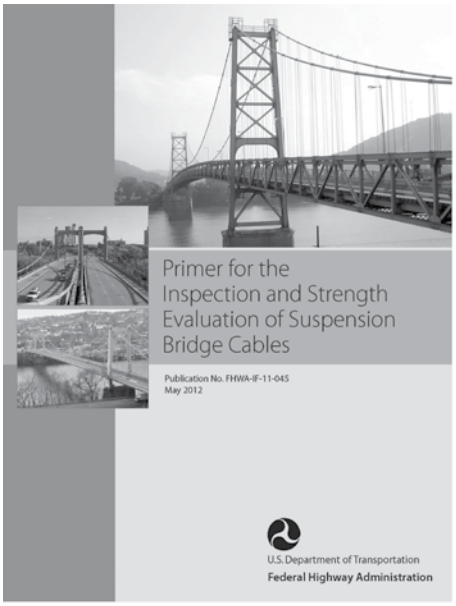
July 2012

INSIDE



## Extending the Service Life of Suspension Bridge Cables: FHWA Releases New Inspection Primer

Many suspension bridges across the country are iconic design structures, but they are also essential transportation links for both communities and commerce, representing a significant investment in the Nation's infrastructure. "As these key structures age, it is vital to ensure that they have adequate load-carrying capacity and to maintain and extend their service life," said Myint Lwin, Director of the Federal Highway Administration's (FHWA) Office of Bridge Technology.




FHWA's new *Primer for the Inspection and Strength Evaluation of Suspension Bridge Cables* (Pub. No. FHWA-IF-11-045) offers an initial resource for agencies planning and performing inspections, metallurgical testing, and strength evaluations. The Primer is designed to supplement the 2004 National Cooperative Highway Research Program Report 534, *Guidelines for Inspection and*

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U.S. Department of Transportation
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**Suspension Bridge Cables,**
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*Strength Evaluation of Suspension Bridge Parallel Wire Cables*, and the 1996 FHWA report, *Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges* (Pub. No. FHWA-PD-96-001).

The Primer provides an overview of cable bridge components, methods for protecting bridge cables, and causes of cable deterioration. Suspension bridge cable wires primarily deteriorate due to corrosion. Several factors affect a cable's susceptibility to corrosion, including environmental conditions, the amount of water penetration, installation practices, and the vulnerability of the wires to corrosion attack. Conditions inside the cable that can affect the individual wires include acid rain; carbonate or bicarbonate, nitrate, and alkaline chemistry; seawater or salt spray; and cathodic action when certain metals are placed in contact with the wires.

Inspection guidelines and laboratory testing methods are highlighted, including the levels of inspection and inspection intervals. The three levels of cable inspection are periodic routine visual inspections of the cable exterior, biennial hands-on inspections of nonredundant fracture-critical members, and thorough internal inspections beginning when the cable has been in service for 30 years. Laboratory strength testing is also essential for evaluating cable capacity. This testing process encompasses preparing specimens, conducting tensile tests, obtaining data for stress versus strain curves, examining suspect wires, and finding preexisting cracks.

An overview is provided on evaluating field and laboratory data. Topics include mapping and estimating wire deterioration, wire strength properties, and the redevelopment of force in broken wires. Also covered is how to estimate cable strength. Factors that contribute to the estimated strength include the tensile strength of the wires, distribution of the tensile strength, broken or cracked wires in the cable, and the redevelopment force in broken wires.

As noted in the Primer, the American Association of State Highway and Transportation Officials Load and Resistance Factor Rating (LRFR) method is not yet applicable to the rating of suspension bridge cables. LRFR calibrations have not been performed to date for long-span bridges, such as suspension bridges. In addition, the current LRFR calibration is designed for bridges with dead load to live load ratios that are generally not higher than about 2 to 1. In long-span bridges, the dead loads may be higher than the live loads by a factor of 5 or higher.

Guidance is also featured on inspection documentation and reporting, including necessary information for maintenance personnel, biennial, and internal cable inspection reports. The appendices include an example of a strength evaluation, flowcharts illustrating inspection and strength evaluation procedures, and sample inspection and strength evaluation forms.

To download the Primer, visit www.fhwa.dot.gov/bridge/pubs/if11045.pdf. For more information on the inspection and evaluation of suspension bridge cables, contact Myint Lwin at FHWA, 202-366-4589 (email: myint.lwin@dot.gov). *

# Infrastructure Innovation Webinars

*These free Webinars provide a quick introduction to the latest infrastructure innovations and technologies.*

**Rigidified Fiber-Reinforced Polymer (FRP) Tubular Arches and Hybrid Composite Beams**
July 19, 2012, 2:30–4 p.m.
(eastern daylight time)

The Webinar will discuss two market-ready FRP composite technologies for bridges that could yield significant economic benefits. Rigidified FRP tubular arches (RFTA) are well suited to a variety of sites, including environmentally sensitive areas and locations where it is difficult or damaging to bring in heavy equipment and machinery. Using RFTAs can also result in low life-cycle and maintenance costs.

Hybrid composite beams (HCB) weigh considerably less than conventional bridge components and can be erected using smaller, lighter pieces of construction equipment. HCBs optimize the performance characteristics of concrete, steel, and FRP composites during beam fabrication and show promise for providing a long service life with corrosion resistance.

Webinar presentations will include testing verification of structural properties, short-and long-term benefits of using the two technologies, implementation challenges, and case histories.

Registration information is available at www.fhwa.dot.gov/hfl/commtool.cfm. The Webinar is hosted by the National Highway Institute (NHI), in conjunction with the Federal Highway Administration's (FHWA) Highways for LIFE program. For more information, contact Julie Zirlin at FHWA, 202-366-9105 (email: julie.zirlin@dot.gov).

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# States Step into a Virtual World at FHWA Geotechnical Expo

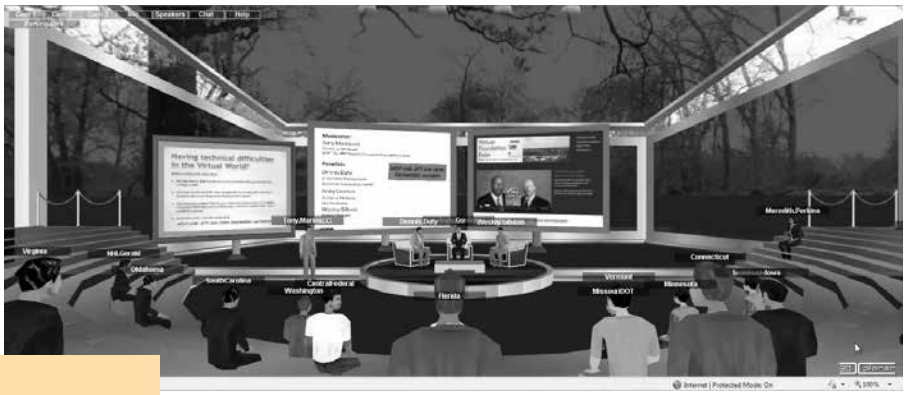
For participants of the March 2012 Virtual Foundation Expo sponsored by the Federal Highway Administration (FHWA), it was a conference like no other.

Approximately 150 participants from 22 State departments of transportation (DOT) could view and listen to presentations on drilled deep foundation technology, talk to presenters, and interact with other participants, all without leaving their offices.

"Through this virtual event we were able to create a unique and successful education and networking experience for DOT engineers," said Silas Nichols of FHWA.

In FHWA's first use of a virtual world, the free online Expo was held in conjunction with the 2012 International Association of Foundation Drilling conference in San Antonio, Texas. Organized by the FHWA Office of Bridge Technology and National Highway Institute (NHI), the 2-day Expo featured panel discussions on such topics as quality in deep foundations, use of slurry in drilled foundations, and techniques for large-diameter and small-diameter hole excavation.

"It was important for us in the design of the Virtual Expo to focus it around our virtual participants and tailor it to their needs," said Meredith Perkins at NHI. "We wanted to make sure that our participants were not passively watching events taking place at the conference, but instead were actively involved in a format that was appropriate to the virtual world delivery method."



All participants in the March 2012 Virtual Foundation Expo selected an avatar to represent them in the virtual world.

> "The Virtual Expo gave FHWA a new way to bring together geotechnical engineers and industry representatives who otherwise might not be able to participate in the conference."

The second day of the Expo featured live presentations streamed from the conference. Topics covered included load and resistance factor design issues, anchored earth retention systems, and micropile systems. Also highlighted was the full-scale load testing and base grouting of drilled shafts in Missouri. After their session, presenters would join the Virtual Expo for an exclusive question and answer period with participants. All participants selected an avatar to represent them in the virtual world, so that they could ask questions and communicate with other participants. During the Expo, videos were also available showing demonstrations of geotechnical equipment, as well as interviews with equipment vendors.

"The Virtual Expo gave FHWA a new way to bring together geotechnical engineers and industry representatives who otherwise might not be able to participate in the conference, due to travel restrictions and budget limitations," said Louisa Ward of NHI. "The Expo was a great success, and we are now exploring other uses for this virtual technology."

Participants were enthusiastic about the opportunities provided by the new technology. "Relative to a Webinar, this platform not only creates more of a conference atmosphere, but makes it easier and promotes both individual and group interactions and discussions," noted Dhaneshwar Harnanan of the Arizona DOT.

For many agencies, several staff members were able to participate in the Expo, increasing the value and the knowledge gained. "Multiple folks in our department were able to attend and engage at a conference we would otherwise have no chance to attend," said Michael McDonnell of the Connecticut DOT.

To view videos and recordings from the Expo, visit http://vimeopro.com/adsc/virtualfoundationexpo. For more information on the Virtual Foundation Expo, contact Silas Nichols at FHWA, 202-366-1554 (email: silas.nichols@dot.gov). To learn more about FHWA's geotechnical engineering resources, visit www.fhwa.dot.gov/engineering/geotech/index.cfm. *

# Intelligent Compaction: The Road from Evaluation to Implementation

Implementation of intelligent compaction (IC) for paving projects in the United States continues to advance following a Federal Highway Administration (FHWA) initiative that evaluated and demonstrated the technology across the country.

In 2011, FHWA completed a 3-year transportation pooled fund study, "Accelerated Implementation of Intelligent Compaction Technology for Embankment Subgrade Soils, Aggregate Base, and Asphalt Pavement Materials" (Project No. TPF-5(128)). As part of this initiative, 16 IC demonstrations were conducted in 13 States.

Following the study, FHWA held IC Regional Workshops in 2011 and 2012 in Atlanta, Georgia; Salt Lake City, Utah; and Minneapolis, Minnesota. These workshops were supported by the National Asphalt Pavement Association and Asphalt Institute, as well as roller manufacturers and suppliers. FHWA's goals for the workshops were to:

- Familiarize attendees with the fundamentals of IC.
- Demonstrate the route to successful IC implementation.
- Help participants become technology champions for IC in their organizations or companies.

The workshops collectively were attended by more than 200 State and local government engineers from 35 States and representatives from academia, contracting firms, and equipment manufacturers. International representatives from three continents also attended. Discussion highlights included use of generic IC specifications for both soil and asphalt materials and the implementation of a new IC data management program, Veda. "These interactive workshops also identified barriers and potential solutions for implementing IC," said Lee Gallivan of FHWA.


An intelligent compaction (IC) roller is used to place a hot-mix asphalt lift on U.S. 219 in Springville, NY.

"Intelligent compaction roller technology is the next big development in the construction of long-lasting asphalt pavements that will benefit not only industry and agencies but the public as well."

IC technology consists of an advanced dynamic evaluation device (accelerometer) positioned on or in roller drums to measure the response of the underlying materials to the compaction forces being applied by the drum. The accelerometer readings are then analyzed by an onboard computer that takes the readings and evaluates the compaction levels and uniformity of the materials.

The rollers are also equipped with global positioning system (GPS) technology that establishes the roller drum locations and displays data on the operation and measurements of the rollers in real time. A color-coded display assists the roller operator in achieving the needed coverage over the full pavement area in both daytime and nighttime conditions.

The technology is available on both single-drum rollers for soil and aggregate base materials and double-drum rollers for asphalt pavement materials. Some manufacturers also provide an onboard printer for on-the-spot reporting or summaries of the compaction operations, as well as wireless capabilities to remotely monitor the roller operations. For asphalt paving, onboard surface temperature measuring devices are included to assist operators in determining the optimum time for compaction.

Benefits of using the IC technology include:

FHWA held workshops around the country to demonstrate the IC technology, including in Minneapolis, MN.


A thin lift of hot-mix asphalt is compacted with an IC roller on U.S. 52 in West Lafayette, IN.

1. *Improved quality of compaction operations.* For asphalt pavement materials, compaction of the materials at the optimum time and temperature is critical. For soil materials, the IC rolling capabilities allow operators to identify nonuniform or weak areas for resolution before they become a problem.
2. *Reduced agency maintenance costs.* Increased quality control during construction results in longer-lasting pavements, reducing agency costs.
3. *Environmental sustainability.* The improved rolling operations result in reduced carbon dioxide emissions.
4. *Savings for contractors.* By achieving 100 percent coverage at the required levels with no over- or under-rolling, IC technology maximizes roller productivity, ensures operations are done right the first time, and minimizes contractor pay reductions for not meeting agency requirements.
5. *Safer operations.* IC reduces the number of personnel needed to evaluate construction operations, minimizing exposure to work zone traffic.

"Including IC in the quality control of construction operations should be a no-brainer because of how it benefits the contractors as well as the agencies," said Newt Bingham of the Alaska Department of Transportation and Public Facilities.

IC technology also provides operators easy-to-read graphical information on where they have been and need to go to achieve 100 percent compaction coverage of the paving materials, instead of the limited conventional spot testing that may not be representative of the total operation. By using IC technology for both soil and asphalt pavement operations, the Minnesota Department of Transportation is aiming to reduce the frequency of its project acceptance verification testing by two-thirds.

"The last major advancement related to compaction and roller equipment occurred nearly 50 years ago with the development of the double-drum vibrator rollers. Intelligent compaction roller technology is the next big development in the construction of long-lasting asphalt pavements that will benefit not only industry and agencies but the public as well," said Chris Connolly of Bomag Americas, Inc.

To view the IC generic specifications, two Technical Briefs released by FHWA, and other information on IC, visit www.fhwa.dot.gov/pavement or www.intelligentcompaction.com. The specifications were updated following the IC workshops to better reflect project-level coordination issues. Additional details on the IC process can be found in the April 2008, April 2010, and July 2011 issues of *Focus*.

For more information on using IC technology, contact Lee Gallivan at FHWA, 317-226-7493 (email: victor.gallivan@dot.gov), or George Chang at the Transtec Group, 512-451-6233 (email: gkchang@thetranstecgroup.com). ✻

# A Quick Introduction to Change Orders and Claims

Take the training you need at a time that's convenient for you with free online courses developed by the Transportation Curriculum Coordination Council (TCCC). The courses are offered through the Federal Highway Administration's (FHWA) National Highway Institute (NHI).

New courses include Change Orders, Claims, and Dispute Resolutions (Course No. FHWA-NHI-134110). Lesson 1 of the free 1-hour training offers an overview of change orders for transportation construction contracts. Topics covered include what constitutes a change in a contract, definitions for the different kinds of changes, regulations that affect changes, and FHWA's role in the change order process. Lesson 2 discusses claims that can result from change orders and the process for resolving disputes over claims, including defining claims and determining a claim's validity. Also discussed are strategies for avoiding disputes.


To learn more about TCCC training courses, visit www.tccc.gov.

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FHWA's free online training offers an overview of change orders for transportation construction contracts.

The training is designed for technicians and administrators who are responsible for change orders, claims, and the resolution of claims.

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Launched in 2000, the TCCC is a partnership that includes representatives from FHWA, NHI, regional State training and certification groups, several American Association of State Highway and Transportation Officials subcommittees, and industry associations. More than 70 online training courses developed by the TCCC are available from NHI. All TCCC courses are reviewed every 2 years and updated if needed. If there is a change in a specification or method used in a course, that course is updated as soon as possible.

New TCCC courses under development include training on earthwork excavation, rock stabilization, and compaction inspection.

For more information on the course content, contact Julie Trunk at FHWA, 202-366-4639 (email: julie.trunk@dot.gov). To take the Change Orders course, visit www.nhi.fhwa.dot.gov. Details on other online TCCC training opportunities can be found at www.nhi.fhwa.dot.gov/training/course_search.aspx (click on "View All Available Web-Based Training Courses"). For more information on the TCCC, visit www.tccc.gov. Updates on new TCCC courses will be posted as information becomes available. *

# Highway Technology Calendar

*The following events provide opportunities to learn more about products and technologies for accelerating infrastructure innovations.*

**National Pavement Preservation Conference**
August 27–30, 2012, Nashville, TN

The conference will feature best practices in pavement preservation and information on new materials, equipment, and technologies. Participants can also observe demonstration projects showcasing preservation techniques for both asphalt and concrete pavements used across the country. Conference sponsors include the American Association of State Highway and Transportation Officials (AASHTO), Federal Highway Administration (FHWA), Foundation for Pavement Preservation, National Center for Pavement Preservation, and the National Association of County Engineers.

*Contact:* To learn more, visit www.nationalpavement2012.org.

**2012 National Hydraulic Engineering Conference**
August 28–31, 2012, Nashville, TN

The theme of the 2012 conference is "Flow Near, Under, and Over Roads: Optimizing Highway Hydraulics." Presentations will highlight solutions to hydraulics challenges highway agencies face, including scour, stream stability, water quality, climate change, and modeling. Featured topics include coastal engineering, stormwater quality, erosion and sediment control, flooding case studies, bridge and culvert hydraulics, and changes in watersheds. The conference is sponsored by FHWA, AASHTO, the Tennessee Department of Transportation, Transportation Research Board (TRB), and the U.S. Army Corps of Engineers Cold Regions Research Laboratory.

*Contact:* Cynthia Nurmi at FHWA, 404-562-3908 (email: cynthia.nurmi@dot.gov), or visit www.fhwa.dot.gov/engineering/hydraulics/conferences/120412.cfm.

**International Conference on Long-Life Concrete Pavements**
September 18–21, 2012, Seattle, WA

Organized by FHWA, in partnership with the National Concrete Pavement Technology Center, the conference will address concrete pavement design, construction, and materials technologies that result in long-life, sustainable concrete pavement. A mini-symposium on concrete paving durability will be held on the final day of the conference.

*Contact:* Shiraz Tayabji at Fugro Consultants, Inc., 410-302-0831 (email: stayabji@aol.com), or Sam Tyson at FHWA, 202-366-1326 (email: sam.tyson@dot.gov). Conference information is also available at www.fhwa.dot.gov/pavement/concrete/2012conf.cfm.

**TRB 92nd Annual Meeting**
January 13–17, 2013, Washington, DC

More than 11,000 transportation professionals from around the world will gather to share perspectives on current developments in transportation research, policy, and practice. The spotlight theme for 2013 is "Deploying Transportation Research—Doing Things Smarter, Better, Faster."

*Contact:* For information, visit the TRB Web site at www.trb.org (click on "Annual Meeting"). Questions about the meeting can be emailed to trbmeetings@nas.edu.

**2013 Design-Build in Transportation Conference**
March 18–20, 2013, Orlando, FL

Join transportation leaders in discussing lessons learned in the use of the design-build project delivery method for transportation projects. Discussions will cover choosing the right delivery method, contracting approaches, innovative financing solutions, risk allocation, and performance contracting.

*Contact:* Jerry Yakowenko at FHWA, 202-366-1562 (email: gerald.yakowenko@dot.gov), or visit www.dbtranspo.com.

**Second National Covered Bridge Conference**
June 5–8, 2013, Dayton, OH

The FHWA National Historic Covered Bridge Preservation Program is sponsoring the conference in partnership with the National Park Service and U.S. Forest Service. Themes include research and rehabilitation projects, best practices for rehabilitation, and continuing threats and challenges to covered bridges, including damage caused by Hurricane Irene and Tropical Storm Lee in 2011. Participants will have the opportunity to tour several historic covered bridges.

*Contact:* Everett Matias at FHWA, 202-366-6712 (email: everett.matias@dot.gov), or visit www.woodcenter.org. *

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## Infrastructure Innovation Webinars,

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### Precast Bent System for Use in High Seismic Regions

September 20, 2012, 2:30–4 p.m. (eastern daylight time)

The precast bent or pier system can be used in high seismic regions to connect prefabricated bridge elements and systems. The system uses precast column and cap beam (crossbeam) elements that are joined into an integral unit using newly developed connection details. FHWA's Highways for LIFE program recently completed a demonstration project for the new system.

The Webinar will provide a brief overview of the bent system concept, as well as information on the demonstration project. Also featured are a detailed description of the seismic design process for the system, design examples, and descriptions of the construction details used with the system.

This session is the second of a two-part series on the precast bent system. To view the first Webinar, which was presented on August 18, 2011, visit www.fhwa.dot.gov/hfl/innovations/webinars.cfm. Registration information for this Webinar will be available in September 2012 at www.fhwa.dot.gov/hfl/commtool.cfm. The Webinar is hosted by NHI, in conjunction with the FHWA Highways for LIFE program. For more information, contact Julie Zirlin at FHWA, 202-366-9105 (email: julie.zirlin@dot.gov). ✻