Accelerating Infrastructure Innovations

# FOCUS

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## INSIDE



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U.S. Department of Transportation

Federal Highway Administration

# A Strategic Approach to Bridge Management

## *Improving the Performance of Bridges in Idaho, Michigan, and Virginia*

In Idaho, Michigan, and Virginia, a commitment to using asset management practices for bridges and culverts has improved the condition and performance of structures statewide and resulted in a more strategic and systematic approach to transportation decisionmaking.

"Emphasizing the use of a bridge management system to assist bridge owners in performing the right activity to the right bridge at the right time, and at the right cost, is paramount to preserving our highway bridges and our overall transportation infrastructure," said Wade F. Casey of the Federal Highway Administration (FHWA).

A new case study released by FHWA, *Bridge Management Practices in Idaho, Michigan, and Virginia* (Pub. No. FHWA-IF-12-029), examines how these three states have succeeded in embracing bridge management.

"The case study supports FHWA's goal of promoting the use and understanding of bridge management systems," said Shyan-Yung Pan of FHWA.

The practices employed by each State include four primary features:

- Measurement of performance of bridges and culverts with targets for performance. Performance is measured using National Bridge Inventory (NBI) condition ratings.
- Work programs that respond to performance measurements and targets.
- Reports to stakeholders on the performance of bridges and culverts.
- Commitment to preservation of existing assets.

The Idaho Transportation Department (ITD) uses a data-driven approach to bridge management. Project selection and prioritization begins by evaluating bridge management system data on structure conditions and work needs. This approach also uses the expert guidance of ITD staff in both central and district offices, who schedule projects based on their knowledge of local needs coupled with assessments of the projects' contribu-

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## Bridge Management,

continued from page 1

© ITD

The Perrine Bridge in Twin Falls, ID.

© MDOT

A bridge inspection is conducted by the Michigan Department of Transportation.

tions to statewide mobility. Funding is divided between operation, preservation, and restoration.

The performance of bridges and culverts is measured as the percentage of the deck area on State-owned structures that is in good condition. From 2006 to 2011, the number of structures in good condition increased from 67 percent to 74 percent. This data and other ITD performance measures are reported on an online dashboard available at http://itd.idaho.gov/dashboard/default.htm.

ITD uses the Pontis® bridge management software to store inventory data, condition data, and inspectors' recommendations for work on bridges and culverts. Pontis is available through the American Association of State Highway and Transportation Officials AASHTOWare® products. For more information, visit www.aashtoware.org.The ITD database includes data for both State-owned and locally-owned bridges. ITD also uses the BridgeWatch® program for real-time monitoring of 250 scour-vulnerable bridges. For more information about BridgeWatch, visit www.usengineeringsolutions.com/solutions/bridgewatch.

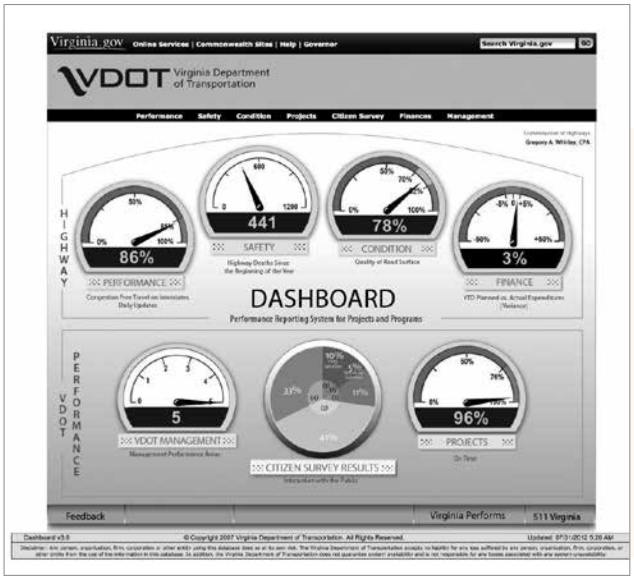
Additional data systems being developed by ITD to manage its transportation assets and operations include financial planning, pavement management, maintenance management, fleet and equipment, mobility management, and safety management.

The Michigan Department of Transportation (MDOT) implemented a strategic plan more than a decade ago to improve deficient bridges and preserve good bridges. MDOT maintains 4,400 State-owned bridges and culverts with more than 4.5 million sq m (49 million sq ft) of deck area. The strategic plan allowed MDOT to transition from "worst first" planning to a balance of preventive maintenance, rehabilitation, and replacement work. The agency allocated funding for preventive maintenance and the rehabilitation of bridges in good and fair condition, as well as the replacement of bridges in poor condition. Since adopting this strategy, the number of structurally deficient bridges has been reduced by more than half.

To carry out the bridge management program, MDOT's Bridge Operations Section works with engineers in the agency's regional offices to develop work programs, monitor conditions, and evaluate the success of bridge and culvert projects. The staff in the Bridge Operations Section also collects and evaluates data on structure conditions and computes performance measures. Data systems used include Pontis and two applications developed by MDOT, a Transportation Management System that holds inventory and condition data for most transportation assets and a Bridge Condition Forecasting System that models deterioration and evaluates the outcomes of proposed bridge programs.

Performance of bridges and culverts is measured using NBI general condition ratings. These measures are reported to Michigan's State Transportation Commission, other State government agencies, and the public.

Structures in good condition are scheduled for preventive maintenance, while structures in fair condition are selected for rehabilitation and those in poor condition are scheduled for replacement. MDOT publishes decision matrices that identify repair options in response to deck conditions and the expected duration achieved by each repair. For Michigan's 31 "Big Bridges," MDOT develops 50-year plans that show the anticipated




© VDOT

Visit the Virginia Department of Transportation's performance measures dashboard at http://dashboard.virginiadot.org/default.aspx.

## State Contacts

**ITD**—Matthew M. Farrar, Bridge Engineer, 208-334-8538 (email: matt.farrar@itd.idaho.gov), or Kathleen Slinger, Bridge Asset Management Engineer, 208-334-8407 (email: kathleen.slinger@itd.idaho.gov).

**MDOT**—David Juntunen, Bridge Operations Engineer, 517-335-2993 (email: juntunend@michigan.gov).

**VDOT**—Kendal R. Walus, State Structure and Bridge Engineer, 804-786-4575 (email: kendal.walus@vdot.virginia.gov).

years and costs of preventive maintenance and rehabilitation. These "Big Bridges" include moveable bridges, unique bridges, and ones with deck area in excess of 9,290 sq m (100,000 sq ft). MDOT also prioritizes projects for scour-vulnerable structures using assessment methods developed by the National Cooperative Highway Research Program.

The Virginia Department of Transportation (VDOT) is responsible for nearly 13,000 bridges and 8,000 culverts. State law requires the use of asset management processes and periodic reporting on the condition of transportation assets. VDOT has work programs for bridges and culverts that carry out projects for rehabilitation, restoration, and preventive maintenance, along with service maintenance projects such as deck washing. These separate but simultaneous programs ensure that preventive maintenance and restoration work goes forward, even though there are pending needs for the replacement of deficient structures. VDOT also implements 6-year improvement plans for structures.

The agency uses Pontis in many of its bridge management tasks, including bridge inspection, inspection quality control, identifying work candidates, reporting on structure conditions, and maintaining all bridge and culvert inventory data. Pontis also supports budgeting tasks, such as statewide budgeting for in-service structures, allocation of funds to the various VDOT districts, and computation of investment needs for structures.

VDOT is developing a bridge programming tool, the Optimizer, that uses outputs from Pontis to form work plans for structures. The Optimizer will provide realistic scoping for bridge projects and propose projects that meet VDOT's criteria.

VDOT's annual reports present numerous performance measures for structures. These include totals for bridges that are structurally deficient, functionally obsolete, and deficient (the combined total of structurally deficient and functionally obsolete structures), as well as the number of structurally deficient structures that have been restored or have deteriorated. Also reported are the number of weight-posted structures and information on the State's bridge health index and the age of structures. Measures for structurally deficient and functionally obsolete structures are posted on VDOT's online dashboard at http://dashboard.virginiadot.org/default.aspx. The statewide goal is a structural deficiency total of no more than 8 percent of bridges and culverts. In 2011 this total equaled 8.2 percent. VDOT also issues biennial reports on the investments needed to maintain and improve its assets.

To download a copy of the case study, visit www.fhwa.dot.gov/asset/hif12029/hif12029.pdf. For more information on bridge management, contact Shyan-Yung Pan at FHWA, 202-366-1567 (email: shyan.pan@dot.gov), or Wade F. Casey at FHWA, 202-366-4606 (email: wade.casey@dot.gov). To learn more about bridge management practices in Idaho, Michigan, and Virginia, see the list of contacts above. ✻

# A Visual Guide to Identifying ASR in Concrete Structures and Pavements

Information transportation agencies need to identify alkali-silica reaction (ASR) in concrete structures and pavements can be found in the Federal Highway Administration's (FHWA) new *Alkali-Silica Reactivity Field Identification Handbook* (Pub. No. FHWA-HIF-12-022).

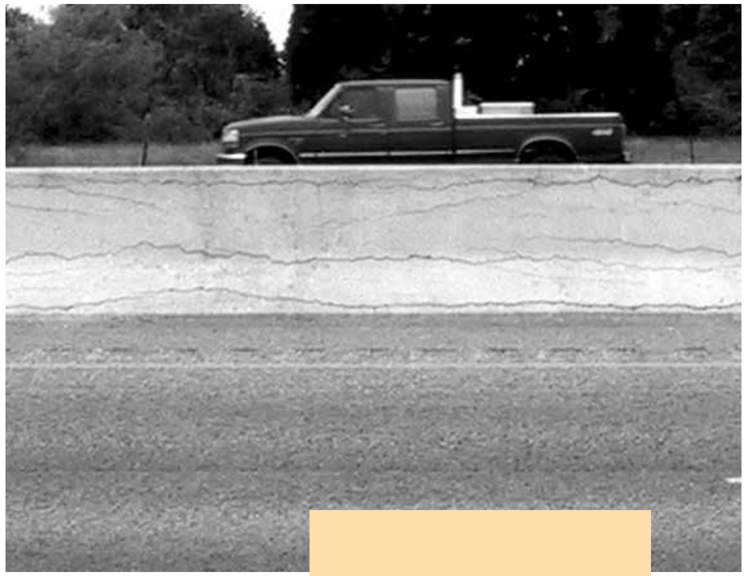
"The guide provides a quick visual reference to assist users in detecting and distinguishing ASR in the field from other types of damage," said Gina Ahlstrom of FHWA.

ASR occurs when silica in some aggregates and alkalis in concrete combine with water to form a gel-like substance. As the gel absorbs water and expands, it can cause the concrete to crack. Over time, the cracks enable other forms of distress to occur, such as freeze-thaw damage or corrosion. This can lead to premature deterioration and loss of service life for concrete pavements and structures.

Another type of alkali-aggregate reaction is alkali-carbonate reaction (ACR), which involves certain types of dolomitic rocks. This reaction can also result in the expansion and cracking of concrete elements. As cases of ACR are more limited, however, the handbook concentrates on identifying ASR.

The handbook graphically illustrates the sequence of how ASR occurs. Field symptoms of ASR are then described, including cracking, expansion, localized crushing of concrete, extrusion of joint material, surface pop-outs, and surface discoloration and gel, which may be alkali-silica gel or lime leaching from the cracked concrete. Photos provide a visual reference for identifying symptoms.

Users of the handbook will find information and photos on the effect of exposure conditions, including moisture and temperature. Concrete that is exposed directly to moisture, for example, is likely to exhibit more severe symptoms of ASR than concrete that is less exposed.



**This concrete highway barrier is affected by alkali-silica reaction (ASR).**

"The guide provides a quick visual reference to assist users in detecting and distinguishing ASR in the field from other types of damage."

Also discussed is how ASR can occur simultaneously with other deterioration processes or may make the concrete more vulnerable to these processes after ASR damage has occurred. Examples include steel corrosion and freeze-thaw deterioration. The handbook highlights non-ASR-related distress and notes that all forms of deterioration should be considered when performing a condition survey.

A brief overview is provided on managing pavements and structures affected by ASR. A confirmed diagnosis as to the presence and extent of ASR requires laboratory testing and petrographic examination of concrete cores. By combining the results of the laboratory investigation and the symptoms from the site investigation, agencies can determine the likely contribution of ASR to the observed damage. More information on managing affected structures is available in the 2010 FHWA *Report on the Diagnosis, Prognosis, and Mitigation of Alkali-Silica Reaction in Transportation Structures* (Pub. No. FHWA-HIF-09-004). The report is available at www.fhwa.dot.gov/pavement/concrete/pubs/hif09004/asr00.cfm. FHWA expects to release a new document, *Alkali-Silica Reactivity Surveying and Tracking Guidelines,* by fall 2012.

The handbook's three appendices feature collections of photographs illustrating ASR in bridge structures, concrete pavements, and other transportation structures such as highway barriers, light poles, and curbs.

To download a copy of the handbook, visit www.fhwa.dot.gov/pavement/concrete/asr/field.cfm. For current information on ASR, visit FHWA's online ASR Reference Center at www.fhwa.dot.gov/pavement/concrete/asr.cfm. Launched under FHWA's ASR Development and Deployment Program in 2009, the center contains more than 300 specifications, guidance documents, test methods, and other references on ASR. Updates on ASR can also be found in FHWA's free quarterly technical update, *Reactive Solutions*. The update is available at www.fhwa.dot.gov/pavement/concrete/reactive/index.cfm. To subscribe, send an email to asrnewsletter@transtec.us.

For more information on the handbook or the ASR Development and Deployment Program, contact Gina Ahlstrom at FHWA, 202-366-4612 (email: gina.ahlstrom@dot.gov).

### FHWA ASR Research

FHWA's Office of Infrastructure Research and Development launched three ongoing ASR research projects in 2008. The first study, "Advancing the Fundamental Understanding of Alkali Silica Reaction Mechanism and Developing Reliable Accelerated Laboratory Test Method," has two objectives: 1) Developing prescriptive concrete mixture designs that are resistant to ASR and provide 75 years of service life with minimal maintenance, and 2) Developing an accurate and reliable accelerated laboratory test method that can be used in lieu of the ASTM C 1293 method, which can take 1–2 years.

The second study aims to "Develop Nondestructive Field Test Methods to Quantify ASR and Also Develop Cost-Effective Rehabilitation Methods." This study will develop or modify suitable equipment to detect the presence of ASR in existing concrete infrastructure and predict the progression of ASR for the remaining service life of the structure. Methods are also being developed to rehabilitate concrete infrastructure affected by ASR so that it can achieve the designed service life. The third study, "Accelerated Determination of Alkali-Silica Reaction Susceptibility During Concrete Prism Testing Through Nonlinear Resonance Ultrasonic Spectroscopy," is developing a reliable rapid nondestructive technique for evaluating concrete mixtures for ASR that can be used instead of waiting up to 1–2 years for the ASTM C 1293 results.

For more information on the ASR research studies, contact Paul Virmani at FHWA, 202-493-3052 (email: paul.virmani@dot.gov).

## Infrastructure Innovation Webinars

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

**Federal Highway Administration (FHWA) Load and Resistance Factor Rating (LRFR) Implementation Webinar Series**

*Application of Load Testing in Bridge Load Rating*

September 20, 2012, 1–4 p.m. (eastern daylight time)

December 6, 2012, 1–4 p.m. (eastern standard time)

The Webinars will provide participants with information on using the load testing technique to evaluate the live load carrying capacity of bridges. Among the highlights will be resources available and lessons learned. Topics for the September session include application of load testing techniques in bridge load rating, such as diagnostic static load testing, and ambient vibration dynamic load testing for bridge evaluation. The December session will focus on experiences in North Carolina and Rhode Island, as well as load testing of bridges at Logan Airport in Boston, Massachusetts.

The target audience for the Webinars includes bridge and structures staff from local, regional, and State transportation agencies; FHWA staff; and consultants. Participants will have the opportunity to download Webinar presentations.

To register for the September Webinar, visit https://connectdot.connectsolutions.com/diagnostic/event/registration.html. Registration for the December Webinar is available at https://connectdot.connectsolutions.com/loadtest02/event/registration.html. For more information, contact Lubin Gao at FHWA, 202-366-4604 (email: lubin.gao@dot.gov).

# Construction Quality Assurance for Design-Build Projects


TECHBRIEF

Publication Number: FHWA-HRT-12-039
Date: April 2012

Construction Quality Assurance for Design-Build Highway Projects

INTRODUCTION

A majority of State transportation agencies are now using the design-build (DB) contracting method for at least some of their new projects, realizing benefits such as faster project completion, improved constructability, reduced costs, and fewer claims following project completion.

DB is an accelerated project delivery method in which the design and construction phases of a project are combined into one contract. This allows aspects of design and construction to take place at the same time and encourages innovation. The Federal Highway Administration (FHWA) selected DB to be one of the methods promoted by its Every Day Counts (EDC) initiative in 2010. For more information on EDC tools and resources available for implementing DB, visit www.fhwa.dot.gov/everydaycounts/projects/methods/db/dbresource.cfm.

Quality assurance (QA) plays a vital role in completing a successful DB project. As FHWA highlights in its new Tech Brief, *Construction Quality Assurance for Design-Build Highway Projects* (Pub. No. FHWA-HRT-12-039), defining roles, responsibilities, and necessary activities for QA is key to achieving effective quality management for a DB initiative.

The Tech Brief examines six core elements of a construction QA program:

1. Contractor quality control.
2. Agency acceptance.
3. Independent assurance.
4. Dispute resolution.
5. Personnel qualification.
6. Laboratory accreditation/qualification.

FHWA's Transportation Construction Quality Assurance Reference Manual defines quality control (QC) as "the system used by a contractor party to monitor, assess, and adjust their production or placement processes to ensure that the final product will meet the specified level of quality." *Construction Quality Assurance for Design-Build Highway Projects* looks at various aspects of QC systems, including the use of test data to determine project acceptance, organizational structure, documentation and records, and the use of consultants to perform QC.

As noted in the Tech Brief, "it is good practice to require the design-builder to provide a comprehensive quality management plan that outlines the overall quality system for both design and construction of the project."

The project acceptance process is also examined, including agency responsibilities; verification sampling and testing; validation of QC data; quality measures for acceptance, including statistical quality measures such as percent-within-limits and the acceptable quality level for work items; and inspection. Just as with traditional design-bid-build projects, the Tech Brief notes, "visual inspection is a key part of agency acceptance on DB projects."

Independent assurance (IA) is another key element in the acceptance process. An IA system is intended to confirm that the sampling and testing activities performed by the agency and design-builder are conducted by qualified personnel using proper procedures and properly calibrated and functioning equipment. The responsibility for IA lies with the transportation agency.

The Tech Brief offers guidance on dispute resolution, qualifications for personnel performing sampling and testing for QC, and qualifications for laboratories used to perform verification testing, QC testing that is included in the acceptance decision, and testing used for IA or dispute resolution. Another important topic covered is the need for DB contracts to describe the process for documentation and disposition of nonconforming work that does not meet the specified level of quality.

Transportation agencies can also find guidance on warranty provisions for DB contracts. The inspection procedure for determining warranty compliance should be clearly outlined and include provisions for notification, so that a representative of the design-builder can observe warranty inspections. A process for disputing warranty inspection findings should also be established.

To download the Tech Brief, visit www.fhwa.dot.gov/publications/research/infrastructure/12039/index.cfm. Printed copies are available by contacting the FHWA Product Distribution Center at 814-239-1160 (email: report.center@dot.gov). For more information on DB project delivery, contact Jerry Yakowenko at FHWA, 202-366-1562 (email: gerald.yakowenko@dot.gov), or visit www.fhwa.dot.gov/everydaycounts. To learn more about the FHWA Materials Quality Assurance Program, contact Michael Rafalowski at FHWA, 202-366-1571 (email: michael.rafalowski@dot.gov), or Dennis Dvorak at the FHWA Resource Center, 708-283-3542 (email: dennis.dvorak@dot.gov). ✻

# Highway Technology Calendar

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

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

Organized by the Federal Highway Administration (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:* 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.

**2012 Industrial Materials Conference**
November 28–29, 2012, Indianapolis, IN

The conference will feature best practices in the use of high-volume recycled materials in sustainable pavement systems. Conference sponsors include FHWA, the Industrial Resources Council, and the Indiana Department of Transportation.

*Contact:* Lee Gallivan at FHWA, 317-226-7493 (email: victor.gallivan@dot.gov), or visit www.industrialresourcescouncil.org/events/2012IMC.

**Transportation Research Board (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.

**Seventh National Seismic Conference on Bridges and Highways**
May 20–22, 2013, Oakland, CA

Conference sessions will focus on understanding and mitigating damage to the Nation's highway infrastructure from earthquakes and other natural hazards. Sponsors include FHWA; the California Department of Transportation; TRB; American Association of State Highway and Transportation Officials; University at Buffalo, The State University of New York; and the Multidisciplinary Center for Earthquake Engineering Research.

*Contact:* Phillip Yen at FHWA, 202-366-5604 (email: wen-huei.yen@dot.gov), or visit http://7nsc.info.

**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/2013-national-covered-bridge-conference.

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FOCUS

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Its primary mission is twofold: (1) to serve the providers of highway infrastructure with innovations and support to improve the quality, safety, and service of our roads and bridges; and (2) to help promote and market programs and projects of the various offices of FHWA's Office of Infrastructure.

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# Ideas in Action: National Online Dialogue on Improving Transportation Performance

From May 21 to June 22, 2012, the Federal Highway Administration (FHWA) engaged its stakeholders through a virtual town hall meeting that explored ways to improve transportation performance management.

During the National Online Dialogue (NOD) on Improving Transportation Performance, Federal, State, local, and tribal transportation professionals had the opportunity to share, vote, and comment on experiences and strategies for improving the safety, condition, and mobility of America's highways and connecting road networks. Nearly 400 stakeholders participated in the NOD.

Topics discussed included:

- Adequacy of arterial traffic volume data for performance management.
- Need for better trade-off analysis tools.
- Need for more peer-to-peer workshops.
- Availability of bicyclist and pedestrian data.
- Development of methods for establishing performance measures and setting targets.

On August 16, 2012, from 1:30 to 3:30 p.m. (eastern daylight time), FHWA will host a Webinar on "Ideas in Action: National Online Dialogue Results." The Webinar will summarize the NOD and share how FHWA is using selected idea submissions to shape its stakeholder engagement and communication activities. To register for the Webinar, visit www.nhi.fhwa.dot.gov/resources/webconference/web_conf_learner_reg.aspx?webconfid=24745. The archive of the NOD will be available at https://fhwaperformance.ideascale.com until September 1, 2012.

For more information on the Webinar, contact Michael Nesbitt at FHWA, 202-366-1179 (email: michael.nesbitt@dot.gov).