

FOCUS

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A Nationwide Checkup on Infrastructure Health

Is there a better way to assess the Nation's highway infrastructure health?

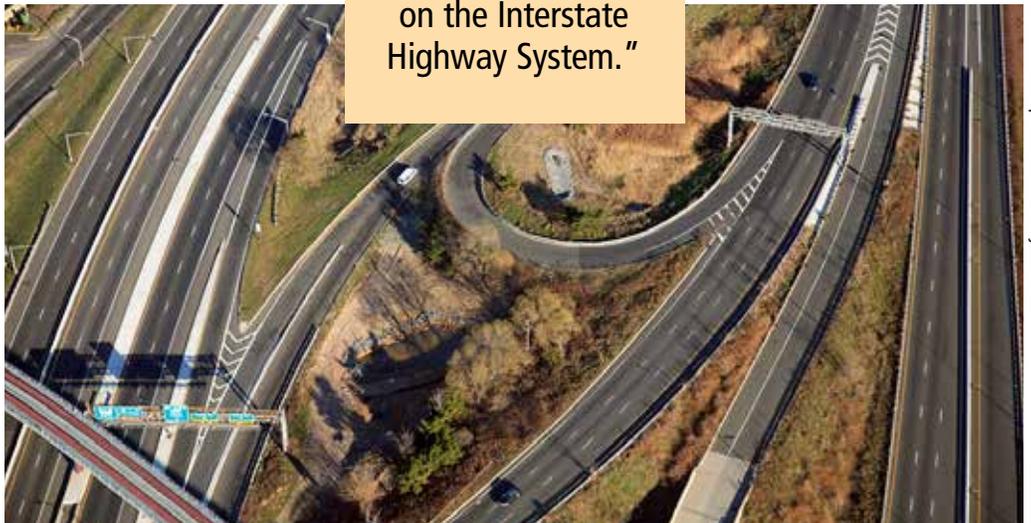
Results from a study on infrastructure health conducted by the Federal Highway Administration (FHWA), in coordination with the American Association of State Highway and Transportation Officials (AASHTO), are now available online in a series of four reports. "The study's goal was to define a consistent and reliable method to document infrastructure health, focusing on bridges and pavements on the Interstate Highway System," said Nastaran Saadatmand of FHWA.

A related goal was to develop tools to provide FHWA and State transportation agencies with key data that will produce better and more complete assessments of infrastructure health nationally.

Study researchers developed an approach for categorizing bridges and pavements in good, fair, or poor condition that could be used consistently across the country. For this study, definitions of good, fair, or poor relate solely to the condition of a bridge or pavement and do not consider other factors such as safety or capacity. Three separate tiers of per-

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"The study's goal was to define a consistent and reliable method to document infrastructure health, focusing on bridges and pavements on the Interstate Highway System."



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Improving FHWA's Ability to Assess Highway Infrastructure Health examines methods for consistently and reliably evaluating the health of the Nation's bridges and pavements.

www.fhwa.dot.gov/publications/focus/index.cfm



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The FHWA study developed an approach for categorizing bridges and pavements in good, fair, or poor condition that could be used consistently across the country.

formance measures that can be used to categorize bridges and pavements were then evaluated. These tiers were previously defined by AASHTO. Tier 1 measures are considered ready for use at the national level, while Tier 2 measures require further work before being ready for deployment. Tier 3 measures are generally still in the proposal stage.

Performance measures for bridges included Structural Deficiency (SD) ratings (Tier 1) and Structural Adequacy Based on National Bridge Inventory (NBI) ratings (Tier 2). A Tier 3 measure was not included for bridges. Performance measures for pavements included the International Roughness Index (IRI) in Tier 1 and Functional Adequacy Based on Highway Performance Monitoring System (HPMS) Distress Data in Tier 2. A Tier 3 measure for pavements assesses structural condition based on Tier 2 data and pavement deflection data.

These measures were evaluated on I-90 in Wisconsin, Minnesota, and South Dakota. The I-90 corridor runs for 1,406 km (874 mi), with average annual daily traffic ranging from approximately 5,000 vehicles to 90,000 vehicles. Evaluations were done using HPMS and NBI data, as

well as data collected by the FHWA project team and provided by the participating State highway agencies. State information included documentation of their systems, processes, and corridor inventory and pavement management system data.

The good, fair, and poor analysis for bridges proved to be a viable approach, with NBI data sufficient for the performance management assessment. However, a bridge's SD status was not as easily incorporated into the analysis. The study report notes that a measure of structural adequacy based on NBI ratings would be a viable supplement to SD status as a national measure of bridge condition, although "implementation would require developing a general consensus on its definition."

The good, fair, and poor approach is also feasible for pavements and implementable today using IRI as a Tier 1 measure. However, IRI does not fully represent the condition of a pavement, as it indicates little about the ability of the pavement structure to withstand traffic loadings. Implementation of the Tiers 2 and 3 pavement measures also proved to be feasible, although the study recommends data collection and processing improvements to advance the measures and achieve

a more accurate picture of pavement health, particularly given the limitations of IRI in assessing pavement condition.

As part of the study, a sample health report was prepared for the pilot corridor. This report uses several metrics to assess the overall health of a corridor, including the good/fair/poor measures, age, remaining service life for pavements, and traffic volumes. "The assessment would enable FHWA to examine corridor health across multiple States in a consistent manner," said Saadatmand. Also discussed is a prototype tool that would automate creation of infrastructure health reports.

To download the pilot study report, *Improving FHWA's Ability to Assess Highway Infrastructure Health* (Pub. No. FHWA-HIF-12-049), visit www.fhwa.dot.gov/asset/pubs/hif12049/hif12049.pdf. A report addendum examines discrepancies between pavement rutting observed during field data collection

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Improving FHWA's Ability to Assess Highway Infrastructure Health examines different types of performance measures for pavements and bridges. It should not be viewed as FHWA's proposal for the establishment of national pavement and bridge measures as required by MAP-21. FHWA will propose these national measures through the rulemaking process, which will include an opportunity for public comment before regulations are finalized.

AAR: Get the Facts

Get the facts on alkali-aggregate reactivity (AAR).

AAR in concrete structures and pavements can occur as both alkali-silica reaction (ASR) and alkali-carbonate reaction (ACR). The Federal Highway Administration's (FHWA) new *Alkali-Aggregate Reactivity Facts Book* (Pub. No. FHWA-HIF-13-019) discusses both types of reaction but concentrates on ASR, as cases of ACR are more limited.

"Developed as part of FHWA's effort to deliver training to States, the Facts Book is designed to serve as a reference document containing detailed information on AAR," 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. Problems caused by ASR were first identified in California in the 1930s, with ASR now recognized as a major cause of concrete deterioration worldwide.

The Facts Book offers background information on the chemical reactions that cause ASR, as well as discussion of the symptoms of ASR, test methods for detecting it, mitigation methods, and preventive measures, including avoiding reactive aggregates and controlling the concrete's alkali content. Also discussed are specifications that address ASR, including the American Association of State Highway and Transportation Officials (AASHTO) specification, AASHTO PP65-11, Standard Practice for Determining the Reactivity of Concrete Aggregates and Selecting Appropriate Measures

for Preventing Deleterious Expansion in New Concrete Construction.

Practitioners can also find guidance 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 observed in a site investigation, transportation agencies can determine the likely contribution of ASR to the observed damage.

ASR mitigation methods are described, including options that have been used most frequently and those whose effectiveness has been proven in the laboratory and the field, versus measures that remain more experimental. Mitigation measures generally cannot repair or restore an ASR-affected structure, but they can reduce future expansion of the structure or lessen the impact of future expansion. Among the most effective mitigation measures have been the application of coatings and sealers such as silane to reduce the internal relative humidity in the concrete and slow the progression of ASR.

Information can also be found on ACR. This reaction, which involves alkali hydroxides in the concrete and certain types of carbonate rocks present in some aggregates, can also result in the expansion and cracking of concrete elements. The Facts Book discusses the chemistry of the reaction, mechanisms of expansion, contributing factors, and differences between



Top: This concrete highway barrier is affected by ASR.

Bottom: The edge beam supporting this bridge railing has minor ASR-related cracking.

ACR and ASR. Generally measures that have been effective in reducing concrete expansion caused by ASR do not work for ACR. To prevent ACR from occurring, AASHTO specification PP65-11 includes procedures for detecting and avoiding the use of alkali-carbonate reactive rocks.

To download the *Alkali-Aggregate Reactivity Facts Book*, visit www.fhwa.dot.gov/pavement/pub_details.cfm?id=894. For more information on AAR, contact Gina Ahlstrom at FHWA, 202-366-4612 (email: gina.ahlstrom@dot.gov). Additional resources on ASR can be found at FHWA's online ASR Reference Center at www.fhwa.dot.gov/pavement/concrete/asr.cfm. The center contains more than 300 specifications, guidance documents, reports, test methods, and other references on ASR. *

The Future of Pavement Management

What does the future hold for pavement management?

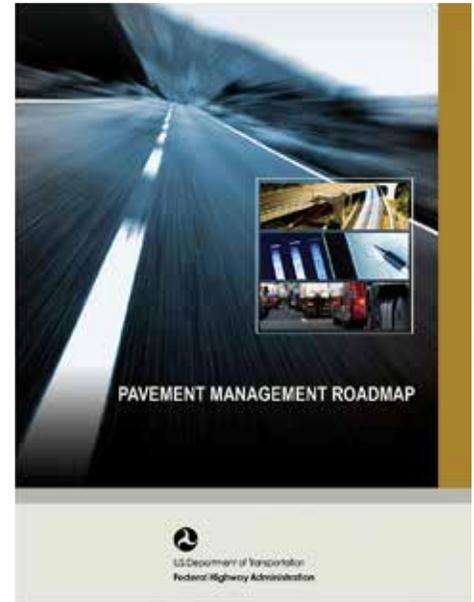
Research, development, and technology transfer initiatives across the country are expanding the role of pavement management, updating the use of existing tools and technologies, and introducing new tools for highway agencies. These initiatives support the goals of the Federal Highway Administration's (FHWA) *Pavement Management Roadmap* (Pub. No. FHWA-HIF-11-011).

Released in 2010, the *Roadmap* identified the steps needed to address current gaps in pavement management and establish research priorities. Twenty-three short-term needs (over 5 years) were identified and 24 long-term needs (over 5 to 10 years). FHWA developed the *Roadmap* in partnership with State and local highway agencies, Canadian government agencies, metropolitan planning organizations, members of academia, and private industry.

Supporting the *Roadmap's* goal to update current pavement management tools and showcase best practices, a new *Pavement Management Guide* was released by the American Association of State Highway and Transportation Officials (AASHTO) in 2012, replacing the previous 2001 version. Updates include an

increased emphasis on using preventive maintenance treatments as part of a pavement preservation program. The guide also features technology advances that have improved pavement data quality and integration. To purchase a copy of the updated guide, visit the AASHTO Bookstore at https://bookstore.transportation.org/collection_detail.aspx?ID=117. To view a video introduction to the guide, visit www.transportationtv.org/Pages/default.aspx?VideoId=286.

Projects that have also advanced the *Roadmap's* goals include a recently completed FHWA initiative designed to increase the benefits of pavement management data collection. A major component of a pavement management system (PMS) is the regular monitoring of pavement condition to evaluate how a pavement section is performing over time and determine when either preventive or rehabilitative action should be taken to preserve the section. The project examined the optimum frequency of pavement data collection, as well as recommended data items to include in an effective PMS. Also studied were evolving technologies and the potential to include new data items, such as network-level pavement deflection measurements using a rolling wheel deflectometer (RWD).



Researchers analyzed PMS data on pavement condition and distress from Colorado, Louisiana, Michigan, and Washington State, as well as data from Minnesota's MnROAD pavement test track and FHWA's Long-Term Pavement Performance program. The project report scheduled to be released by 2014 will feature best practices and guidelines for integrating design, material, and construction information within a PMS. Procedures to guide the timing and selection of pavement preservation and rehabilitation practices will also be included. "The guidelines can be easily tailored to the needs and objectives of any highway agency," said Nadarajah Sivaneswaran of FHWA. For more information on the project, visit <https://rip.trb.org/view.aspx?id=1230683>.

In Virginia, pavement management is being improved through a new structural index that can be used to include data on the pavement's structural condition as part of a network-level pavement evaluation. Developed by researchers at the Virginia



FHWA tested moving pavement deflection devices at Minnesota's MnROAD pavement testing facility in September 2013.



A new FHWA project is developing procedures to guide the timing and selection of pavement preservation and rehabilitation practices.

Tech Transportation Institute's Center for Sustainable Transportation Infrastructure, under contract to the Virginia Center for Transportation Innovation and Research (VCTIR), the Modified Structural Index (MSI) for asphalt pavements minimizes discrepancies between network-level predictions and project-level decisions. A modified version of the Texas Department of Transportation Structural Capacity Index, the MSI was developed for use by the Virginia Department of Transportation (VDOT).

VDOT currently maintains a database of historical condition and construction history, among other information, for the more than 201,162 lane-km (125,000 lane-mi) of roads throughout the State. In 2006, VDOT also began collecting distress data using digital images. The agency then uses a set of pavement management decision matrices to plan pavement treatments. These matrices are classified by Interstates, primary routes, secondary routes,

and unpaved roads, as well as by pavement type. Typically, functional pavement condition had primarily been considered in the evaluation, but this can result in recommended pavement treatments that are either under-designed or over-designed when considered at the project level.

"Using the new index to consider structural condition in addition to observable pavement condition will improve the selection of pavement sections for maintenance," said Brian Diefenderfer, Senior Research Scientist at VCTIR. "It will also improve the selection of pavement treatments."

A pilot implementation project on I-81 in Virginia demonstrated that the MSI can be used to support the pavement management decision process, including deterioration modeling and the development of structural performance measures. Phase II of the project, which will be completed in 2014, is developing a similar index for both composite and concrete

pavements. To download the 2013 project report, *Developing a Network-Level Structural Capacity Index for Structural Evaluation of Pavements*, visit www.virginiadot.org/vtrc/main/online_reports/pdf/13-r9.pdf. For more information, contact Brian Diefenderfer at VCTIR, 434-293-1944 (email: brian.diefenderfer@vdot.virginia.gov).

Research into new tools and technologies to improve pavement management also includes an FHWA project on "The State-of-the Technology of Moving Pavement Deflection Testing." Completed in 2011, this project studied pavement deflection testing devices such as the RWD and traffic speed deflectometer that can be operated while traveling at highway speeds, minimizing traffic disruptions and safety hazards. Data collected can be used to create a structural map of the highway network, so that problem areas can be targeted for more detailed inspection and rehabilitation. Three devices were identified as viable, with recommendations made for more comprehensive evaluation.

A follow-up FHWA project, "Pavement Structural Evaluation at the Network Level," is continuing to study the use of moving pavement deflection technology at highway speeds. Field evaluations of three devices were held in September 2013 at the MnROAD pavement testing facility. To learn more, contact Nadarajah Sivaneswaran at FHWA, 202-493-3147 (email: nadarajah.sivaneswaran@dot.gov).

More information on these and other *Pavement Management Roadmap* projects is available at www.fhwa.dot.gov/pavement/management/roadmap/activities.cfm. For additional information on the *Roadmap*, contact Nastaran Saadatmand at FHWA, 202-366-1337 (email: nastaran.saadatmand@dot.gov). *

LTTP InfoPave to Debut at TRB Annual Meeting

Get the latest news and developments from the Federal Highway Administration's (FHWA) Long-Term Pavement Performance (LTTP) program at two LTTP sessions scheduled for the Transportation Research Board (TRB) 93rd Annual Meeting in Washington, DC.

The LTTP State Coordinators' Meeting on January 12, 2014, will feature an introduction to LTTP InfoPave, a new program that allows users to more easily tap into the wealth of pavement data available from the LTTP initiative. Representatives from State transportation agencies and academia will share their experiences in testing the new Web-based system. The meeting will also discuss new LTTP warm-mix asphalt projects and the 2014 International Data Analysis Contest.

LTTP InfoPave will officially launch at the TRB Annual Meeting on January 13. At the "LTTP InfoPave Public Release" session, attendees will learn how to use the system to obtain data for analysis, as well as how the program simplifies the LTTP database.

For more information on the LTTP sessions, contact the LTTP Customer Support Service Center at 202-493-3035 (email: ltppinfo@dot.gov). *

Infrastructure Innovation Webinars

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

Alternative Contracting Methods: Deployment from EDC2 Summits Until Now—Where Are We?

October 17, 2013, 2:30–4 p.m. eastern daylight time (EDT)

The Webinar will offer the basics of alternative contracting methods for practitioners who missed the Federal Highway Administration's (FHWA) series of Every Day Counts 2 (EDC2) Summits. Specific methods highlighted will include alternate technical concepts, construction manager/general contractor, and design-build. Deployment efforts will also be spotlighted, including success in accelerating project delivery and minimizing unforeseen project delays and cost overruns. The session is designed for representatives from State and local agencies, transportation associations, and FHWA, as well as other contracting, design, and construction professionals.

To register, visit www.nhi.fhwa.dot.gov/resources/webconference/web_conf_learner_reg.aspx?webconfid=25396.

Bridges for Service Life Beyond 100 Years: Innovative Systems, Subsystems, and Components

October 29, 2013, 2–3:30 p.m. EDT

As part of the second Strategic Highway Research Program (SHRP2) Webinar Series, the Transportation Research Board will conduct this session exploring the Bridges for Service Life Beyond 100 Years project and resulting guide. The guide defines procedures for systematically designing new and existing bridges for service life and durability. Webinar topics will include the service life design approach, guidelines for applying the procedures at a program and project level, and a benefits assessment for the service life approach. The intended audience includes bridge engineers and owners at local, State, and Federal transportation agencies; representatives of the bridge design, preservation, and construction industry; and consultants.

For registration information, visit www.trb.org/StrategicHighwayResearchProgram2SHRP2/Blurbs/169470.aspx. *



To learn more about the SHRP2 Webinar series, visit www.trb.org/StrategicHighwayResearchProgram2SHRP2/SHRP2Webinars.aspx.

Highway Technology Calendar

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

Sixth Asphalt Shingle Recycling Forum

November 7–8, 2013, Denver, CO

The forum will highlight practical applications for shingles in pavements, modifications to American Association of State Highway and Transportation Officials (AASHTO) standards, and ongoing research efforts to advance the technology. Sessions will be of interest to State, local, and Federal government staff; contractors; suppliers; consultants; and members of academia. Sponsors include the Federal Highway Administration (FHWA).

Contact: Lee Gallivan at FHWA, 317-226-7493 (email: victor.gallivan@dot.gov), or William Turley at the Construction and Demolition Recycling Association, 630-585-7530 (email: turley@cdrecycling.org). Registration information is available at www.shinglerecycling.org/content/home.

Transportation Research Board (TRB) 93rd Annual Meeting

January 12–16, 2014, Washington, DC

Transportation professionals from around the world will gather to share perspectives on current developments in transportation research, policy, and practice. The conference will feature more than 4,000 presentations in nearly 750 sessions and workshops. The spotlight theme for 2014 is “Celebrating Our Legacy, Anticipating Our Future.”

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.

LTPP InfoPave Public Release Session

January 13, 2014, Washington, DC

FHWA’s Long-Term Pavement Performance (LTPP) program will introduce LTPP InfoPave at this TRB Annual Meeting session. The new Web-based system will allow users to more easily tap into pavement data available from the LTPP program. Participants will learn how to use the system to obtain data for analysis, as well as how the program simplifies the LTPP database.

Contact: LTPP Customer Support Service Center, 202-493-3035 (email: ltppinfo@dot.gov).

2014 Design-Build in Transportation Conference

March 19–21, 2014, San Jose, CA

Join transportation leaders in discussing lessons learned in the use of the design-build project delivery method for transportation projects. Topics will include choosing the right delivery method, contracting approaches, tools and techniques that enhance collaboration, innovative financing solutions, risk allocation, and performance contracting. All modes of transportation will be featured.

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

Tenth National Conference on Transportation Asset Management April 28–30, 2014, Miami, FL

The conference is designed for transportation agencies and metropolitan planning organizations in all stages of asset management implementation. Themes will include establishment and monitoring of asset management plans, performance measures for asset management, tools and technology to assist decisionmaking, and adaptation to extreme weather events and climate change, including using risk assessment and vulnerability analysis. Strategies for overcoming barriers to asset management implementation will also be discussed. Organized by TRB, the conference is also supported by FHWA and AASHTO.

Contact: Steve Gaj at FHWA, 202-366-1336 (email: stephen.gaj@dot.gov), or visit www.trb.org/conferences/AssetManagement2014.aspx. *

FOCUS

Focus (ISSN 1060-6637), which is published monthly by the U.S. Department of Transportation's Federal Highway Administration (FHWA), covers the implementation of innovative technologies in all areas of infrastructure.

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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versus data collected by the States. Available at www.fhwa.dot.gov/asset/pubs/hif13037.pdf, the addendum recommends practices for collecting consistent, high-quality pavement rutting data.

Following the pilot study, further research was done on developing a next generation pavement performance measure that provides an accurate and repeatable assessment of a roadway's functional condition. The measure will solely use HPMS data. During the study, the focus shifted from developing a single composite index of ride quality, cracking, and rutting to analyzing these distresses individually. To view the report, which offers recommendations for collecting,

processing, reviewing, and storing data on these distresses, visit www.fhwa.dot.gov/asset/pubs/hif13042.pdf.

FHWA and AASHTO presented the study results to senior-level State transportation agency representatives at a national meeting held October 13, 2011, in Detroit, Michigan. To view the national meeting report, which summarizes discussion about the recommended condition ratings and health reporting, visit www.fhwa.dot.gov/asset/health/workshopreport.pdf.

For more information on the Infrastructure Health study, contact Nastaran Saadatmand at FHWA, 202-366-1337 (email: nastaran.saadatmand@dot.gov). *