

# RESEARCH UPDATE

JULY 2012

## Bringing Innovations Home from TRB

Each January, the Transportation Research Board (TRB) Annual Meeting offers MDOT staff the invaluable opportunity to learn from the experiences of their peers from across the country and around the world. They return home ready to share and apply what they've learned to improve Michigan's transportation system.

The 2012 meeting drew 11,000 participants. More than 4,000 presentations at nearly 650 sessions and workshops showcased the latest transportation research. Fifteen MDOT staff attended, including practitioners and managers representing a variety of work areas and four regions.

The group returned with more than 20 key takeaways and specific action items to put their new knowledge to work throughout the department. MDOT Research Administration helped the group coordinate their activities to represent a diverse range of subject areas, targeting sessions on topics of high value to Michigan. They learned about the latest developments in areas such as accelerated bridge construction, mechanistic-empirical pavement design and active traffic management. (See the articles on pages 2, 4 and 5 for details.)

"The group worked hard to bring back a wealth of information that applies to many different focus areas in the department," says MDOT Engineer of Research Steve Bower. "The benefits extend long after the meeting ends due to the extensive networking opportunities resulting from TRB."

The information exchange goes both ways. Each year, MDOT staff share their considerable expertise at the TRB Annual Meeting as session moderators, presenters and committee members, and by submitting papers and supplying information for poster sessions.

At this year's meeting, MDOT Director Kirk T. Steudle, who has long been a strong proponent of highway safety and reducing crash-related injuries and fatalities, gave a presentation on changing safety culture within organizations. Steudle, who serves as the current president of the American Association of State Highway and Transportation Officials (AASHTO), described recent



Research Administration's Michael Townley attended poster presentations of research results. (Photo by Risdon Photography, courtesy of TRB.)

safety initiatives implemented in Michigan. These included targeted three-year efforts to add more cable median barrier and to install rumble strips in non-freeway locations. (See page 7 for more on the rumble strip effort.)

MDOT staff have leadership roles in other national research activities as well. Chief Operations Officer Greg Johnson serves on the AASHTO Standing Committee on Research (SCOR), while Bower represents the department on the SCOR Research Advisory Committee. Other MDOT staff also serve on AASHTO and TRB committees, subcommittees and project panels.

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### Find More Online

Presentations, video sessions, papers and other materials from the TRB Annual Meeting are available at <http://amonline.trb.org>.

MDOT employees can access full versions of these materials for free. Register for an account using your State of Michigan e-mail address.

# Bridges

## Reaping the Rewards of Accelerated Bridge Construction



One of MDOT's three accelerated bridge construction projects to date involved replacing a bridge in 2009 on Parkview Avenue over US-131.

As the nation's infrastructure ages, many of its bridges are in need of replacement or repair. But bridge projects can be very time-consuming and expensive, requiring detours that significantly disrupt traffic and economic activity. To minimize these impacts, engineers are looking to accelerated bridge construction (ABC), which involves the use of prefabricated components and other methods to dramatically reduce bridge construction time.

"Using ABC, a bridge project that might have taken months or years can be completed in a matter of weeks," says MDOT University Region Engineer Paul Ajegba. "We're really interested in ABC as an innovative way to deliver projects more quickly and economically."

ABC uses bridge components that are prefabricated off-site and then quickly put into place during construction, often with a self-propelled modular transporter, a platform vehicle that can be used to carry an entire bridge. ABC also may involve innovative design, planning and procurement methods to accelerate project schedules.

At this year's TRB meeting, MDOT staff heard firsthand about other states' experiences with ABC. In 2011, Iowa replaced a bridge on **US-6** in just two weeks' time instead of the several months it would have taken using traditional methods. Massachusetts replaced **14 bridges** on I-93 in 10 weeks

instead of four years. Later this year, New York will replace two bridges on I-84 over two weekends instead of two construction seasons, saving an estimated \$1.5 million.

By reducing construction time, ABC dramatically decreases traffic disruptions, increasing traveler and construction worker safety. It also helps reduce construction impacts on the environment.

MDOT has used ABC on three bridge projects to date, and will be expanding its use of the technique in

the next three years. The department has established a committee to facilitate implementing the technology and is developing guidelines for its use.

"MDOT is in the process of reviewing its entire network of bridge projects," explains Bridge Development Engineer Dave Juntunen. "Accelerated bridge construction will be considered as an option for all of them."

Related papers and presentations from the TRB meeting are available at <http://amonline.trb.org> (Sessions 170 and 775).

## Maximizing Girder Length for More Efficient Bridges

Bridge girders have traditionally been limited in length by challenges involved in fabricating and transporting them. Consequently, longer bridges typically involve a number of girders supported by intermediate piers. Since a single continuous span produces a more efficient structure with better stress distribution, engineers have developed a method for splicing together girders at the construction site.

Several TRB meeting presentations addressed the use of long-span, spliced and continuous prestressed girder bridges. Topics included methods for reducing cracking in prestressed girders; the design, fabrication and handling of long-span precast pretensioned girders; the use of Bulb-T girders, in which the top flange is significantly wider than the bulb-shaped bottom flange; and methods for splicing girders together.

"There is a lot of interest in how these technologies fit in with our bridge program," Juntunen says. "They could

be especially relevant when using prefabricated elements to further implement accelerated bridge construction."

Related materials from the TRB meeting are available at <http://amonline.trb.org> (Session 219).



*"There is a lot of interest in how these technologies fit in with our bridge program."*

—Dave Juntunen  
MDOT Bridge Development Engineer

# Bridges

## Strategies for Extending Bridge Service Lives

More than 25 TRB committees and task forces organize sessions, presentations and posters related to bridges and other structures for the TRB meeting. MDOT staff had the opportunity to attend several sessions related to extending bridge service lives. Topics included:

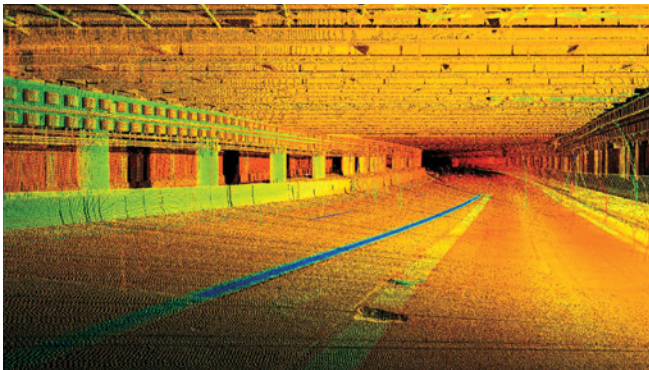
- **Carbon fiber repair:** Several sessions addressed the use of fiber-reinforced polymer, a strong, lightweight and corrosion-resistant material that can be used to strengthen and repair bridge components, including beams, columns and decks. MDOT is interested in a pile repair technique that involves wrapping piles in carbon fiber and filling voids with grout. Beginning in October, MDOT will explore this and other methods as part of a carbon fiber research project.
- **Epoxy overlay testing:** Researchers in several states outlined promising results related to the performance of thin-bonded epoxy overlays to seal bridge decks to help maximize their

service lives. These overlays prevent the infiltration of water and chlorides while providing a high-friction wearing surface. MDOT has used these overlays on about 300 projects and is actively monitoring their performance.

- **Long-Term Bridge Performance Program:** MDOT will be participating in this Federal Highway Administration (FHWA) program, which involves the periodic inspection of a representative sample of bridges nationwide over 20 years. The program will track bridge performance and develop recommendations for bridge materials that are more durable.
- **PONTIS development update:** One session detailed an update to PONTIS, the AASHTO software that MDOT uses to manage its bridge inventory. This application allows users to target maintenance efforts by tracking the condition of separate bridge components, from expansion joints to wearing surfaces and paint.

Papers and presentations from these sessions are available at <http://amonline.trb.org>. See Sessions 320 (carbon fiber repair), 365 (epoxy overlays), 804 (bridge performance program), and 776 (PONTIS update).

## Connecting to National Networks



MDOT shares experiences with other states to make the most of LiDAR laser scanning.

MDOT Design Services Manager Dan Belcher is responsible for implementing and supporting a wide range of engineering surveying technologies in Michigan. He has actively participated in two national networks that complement the aims of TRB.

One such group is the Highway Engineering Exchange Program, or HEEP, a national organization fostering software

and technology information sharing among highway practitioners. As MDOT continues to make greater use of LiDAR laser scanning systems to create planimetrics and digital terrain models, Belcher reports that HEEP is helping Michigan stay at the forefront of LiDAR implementation.

“LiDAR has been adapted for a range of tasks, such as asset management, bridge underclearance appraisal and survey-grade mapping,” Belcher says. “State DOTs are using it more and more as the software becomes less expensive and certain critical tasks become automated. I have learned a great deal about these kinds of developments through HEEP. It presents a forum that lets practitioners say, ‘Here’s how we did

it,’ and it provides hands-on solutions that I can take back and apply in Michigan.”

Another national group that Belcher has been involved with is AASHTO’s Technology Implementation Group, or TIG. Belcher was an active participant when TIG featured automated machine guidance—a very precise GPS-guided highway construction method—as one of its focus technologies.

“The members of our TIG committee helped establish national best practices and guidelines for automated machine guidance technology,” says Belcher. His involvement made a difference in Michigan, too, helping to spur two pilot projects in the state. The use of automated machine guidance technology has become firmly established in Michigan since then.

For more information about HEEP, visit <http://heepweb.org>, and for more about AASHTO TIG, see <http://tig.transportation.org>.

# Pavement

## Taking Informed Next Steps with Mechanistic-Empirical Pavement Design



MDOT is working to ensure that warm-mix asphalt—like all building materials—is properly characterized for mechanistic-empirical pavement design.

The TRB Annual Meeting kicks off every year with a series of Sunday workshops that allow attendees to experience topics in greater depth. This year one workshop was especially valuable for MDOT's pavement design group, which is in the process of implementing the AASHTO *Mechanistic-Empirical Pavement Design Guide* (MEPDG). The workshop brought together DOT representatives who described their experiences with DARWin-ME, the AASHTO pavement design software based on the principles of the MEPDG.

MDOT Pavement Design Engineer Mike Eacker, who is on special assignment to help implement MEPDG methodologies in Michigan, participated in the workshop. "The timing turned out to be very good, since MDOT just approved the purchase of a multi-user

server license of the software, and we are going to start using it this summer," Eacker says. "At the meeting, I had a chance to learn firsthand about the experiences of other DOTs that have already started using DARWin-ME. Hearing about some of the issues they have encountered, and in particular understanding what kinds of pavement designs to expect from the software, will help us a great deal when we start using it ourselves."

MDOT's transition to mechanistic-empirical (M-E) pavement design will continue to progress in stages for the next few years, and research and implementation efforts are ongoing. "TRB helped connect me with a network of experts to call upon as Michigan keeps moving forward," Eacker says. "I returned to Michigan with a long list of notes and tips for working with the DARWin-ME software, and my contacts at other DOTs continue to provide assistance and help address many of our questions."

Another popular topic was green pavement design. Eacker learned about other states' progress in using environmentally friendly techniques and incorporating them into the M-E design process.

"Whether it's low-energy warm-mix asphalt or crushed concrete reused as pavement base, every new material needs to be characterized correctly in the M-E design software," he says. "Like other states who discussed their progress at the conference, we need to conduct research to define warm-mix asphalt properties for use with M-E design."

Eacker concludes, "All in all, TRB was a great experience. I brought back an immense amount of knowledge and practical tools to assist with my immedi-

ate tasks related to MEPDG implementation in Michigan."

Presentations from the workshop are available at <http://amonline.trb.org/> (Session 111).



*"I was very fortunate to have the chance to attend the TRB meeting in 2012. While I focused on research that directly applied to my duties at MDOT, I also sat in on a few sessions that were of personal interest or were of value to MDOT in general. There's a wealth of information to access at the conference—it's really impossible for one person to make it to everything they're interested in."*

—Mike Eacker  
Pavement Design Engineer

# Mobility and Operations

## Managing Congestion, Improving Safety in Real Time

Everyone has experienced it at one time or another—a crash occurs at rush hour and brings traffic to a halt. The congestion worsens when a frustrated driver makes an ill-advised maneuver to avoid the backup and causes another incident.

Advances in active traffic management (ATM) have given state DOTs tools and strategies to reduce collisions that result from congested conditions. ATM systems continuously monitor traffic and roadway conditions and respond to incidents and congestion in real time by deploying a range of automated tools to encourage the safe, free flow of traffic.

The tools and strategies available to combat congestion as it occurs—and limit congestion-related crashes—provided the subject for the TRB session “Domestic Developments in Traffic Management.” The session highlighted successful ATM programs operated by Minnesota and Washington State DOTs as well as Virginia DOT’s plans to implement a combination of ATM strategies and treatments along a segment of I-66.



*I-96 in the Detroit metropolitan area is the site of a project studying the effectiveness of two ATM strategies: lane control and queue warning systems.*

The ATM techniques presented in the session included:

- **Shoulder lane management systems.** The hard shoulder is used as a travel lane during congested periods or to move traffic around an incident.
- **Lane/junction control (“smart lanes”).** Variable message signs and changes made in real time to pavement markings and signs to direct drivers to specific lanes based on traffic and roadway conditions.

- **Queue warning systems.** These systems alert drivers to backups and direct them to alternate lanes.

- **Variable speed limits.** Speed limit signs change in real time to alert drivers to slow their speeds as they approach congestion or crash sites.

MDOT is beginning its review of ATM strategies with a pilot project on I-96 in the Detroit metropolitan area. Working in cooperation with local agencies, MDOT is implementing lane control and queue warning systems as part of an overall incident management strategy. Changes to signs are made in real time as traffic conditions warrant to indicate closed lanes or to direct drivers to use alternate lanes. ATM tools like these complement other MDOT initiatives that promote a safer, smarter and greener transportation system.

Papers and presentations from the meeting session are available at <http://amonline.trb.org/> (Session 206).

## Taking the Guesswork Out of Maintenance Management

The TRB meeting provides a great opportunity to compare MDOT’s experiences and practices with those of other transportation agencies. Gregg Brunner, associate region engineer of operations in the Bay Region, attended the meeting for the first time in 2012 and found this to be true in the area of maintenance management.

Brunner is part of a statewide MDOT team evaluating maintenance management systems for potential implementation in Michigan. MDOT is just beginning to explore the use of these systems, and Brunner says the lessons learned at TRB will help guide future efforts. Brunner attended a session that

highlighted other agencies’ use of maintenance management systems for tracking assets, prioritizing work, creating work orders and reporting on work accomplished—all with an eye toward achieving the desired level of service.

“It was very worthwhile to see what others are doing, to learn new things and to see how MDOT compares,” Brunner says. “We added additional tools to our toolbox.”

Presentations from the TRB session “**Maintenance Outsourcing and Performance Management**” are available at <http://amonline.trb.org/> (Session 207).

# National Involvement

## National Recognition for MDOT Research

High-value research is in the spotlight each year when the AASHTO Research Advisory Committee (RAC) selects its “Sweet 16” from among more than 100 research projects submitted by state DOTs across the nation. The winning projects are showcased at RAC’s annual summer meeting.

MDOT’s research project “Recommendations for Meeting the Transportation Needs of Michigan’s Aging Population” is among this year’s Sweet 16. Research Administration staff will participate in a poster session during the RAC annual meeting in July to highlight the low-cost, high-impact measures researchers recommended to meet the requirements of the five “A’s” of senior-friendly transporta-



Signage changes to aid older drivers, reflected in the sign on the right, include lettering that decreases the nighttime halo effect, removal of underlining and enlargement of the first letter of the cardinal direction (east, west).

tion: available, accessible, affordable, adaptable and acceptable. MDOT is working with other Michigan agencies to implement and promote these measures to ensure that Michigan residents have access to the transportation ser-

vices they need to keep them safely mobile as they age.

MDOT is soliciting funding for a project to implement one of the recommended measures—an educational component that will provide resources needed by aging drivers. This implementation effort will encourage drivers to take a positive, proactive approach to preparing for their retirement from driving, in much the same way as they make financial preparations to retire from work.

For more information about this research project, see the *Research Spotlight* available at [www.michigan.gov/documents/mdot/MDOT\\_Research\\_Spotlight\\_Aging\\_Population\\_377503\\_7.pdf](http://www.michigan.gov/documents/mdot/MDOT_Research_Spotlight_Aging_Population_377503_7.pdf).

## Pursuing Non-Nuclear Test Methods

Like many state DOTs, MDOT uses portable nuclear density gauges to provide a quick, reliable measure of in-place soil compaction at construction sites. A rod containing a radioactive source is extended into the soil to a desired depth, where it emits gamma radiation. Detectors in the base of the gauge record the amount of radiation that passes through the soil, which provides a measure of soil density.

Because nuclear density gauges employ radioactive sources, they are subject to strict regulation by the U.S. Nuclear Regulatory Commission. These regulations for ownership of gauges cover their use, transportation, maintenance, training, storage and disposal. “MDOT is definitely interested in finding

alternative ways to measure density in the field that don’t involve the worker hazards and significant costs associated with managing nuclear density gauges,” says Richard Endres, engineer of MDOT’s Geotechnical Services Section. “Many other state DOTs are also looking carefully at the research for answers.”

Toward that end, a paper presented at this year’s TRB Annual Meeting provides comparative data on several non-nuclear devices based on research conducted by the U.S. Army Engineer Research and Development Center. The paper, “[Evaluation of Non-Nuclear Soil Moisture and Density Devices for Field Quality Control](#),” reports on the performance of 21 non-nuclear tests for soil compaction. The authors discuss a com-

bination of a commercially available soil density gauge and a field moisture content test as the best current alternative to the nuclear density gauge.

In another promising development, the National Cooperative Highway Research Program (NCHRP) Synthesis program has accepted a research topic suggested by MDOT for 2013: “Non-Nuclear Methods for Compaction Control,” [NCHRP Synthesis 20-05/Topic 44-10](#). “We’re pleased that NCHRP thought our proposal was a good one,” Endres says. “We really need a solid national synthesis of all the previous work that’s been done to compare the performance of non-nuclear devices to one another as well as to nuclear methods.”

# National Involvement

## TRB Commends MDOT Rumble Strip Paper

With a focus on reducing lane-departure crashes, in 2008 MDOT launched a three-year project to install almost 7,500 miles of shoulder and centerline rumble strips on existing pavements on two- and four-lane rural highways. When this ambitious installation project—the largest initiative of its kind—concluded in 2010, Wayne State University researchers began a research project (“Impact of Non-Freeway Rumble Strips—Phase I”) to evaluate the impact of the rumble strip installations.

The researchers presented papers at this year’s TRB meeting on three components of the rumble strip study:

- **Driver behavior.** Researchers found that centerline and shoulder rumble strips improved drivers’ tendencies to stay in their lanes and did not have a negative impact on passing maneuvers. This paper received the 2012 Best Paper Award from the TRB Commit-

tee on the Operational Effects of Geometrics.

- **Driver/bicycle interactions.** Field studies indicated that centerline rumble strips decreased the likelihood of motor vehicles riding onto or across the centerline. Drivers were more likely to contact or cross the centerline when bicyclists were nearer to the travel lane.
- **Pavement condition.** Researchers used the rate of crack propagation over a two-year period as a measurement of the rumble strips’ short-term impact on pavement condition. They found that the rumble strips did not significantly impact the rate of crack propagation.

The final report for this project will be available at [www.michigan.gov/mdot/0,4616,7-151-9622\\_11045\\_24249---,00.html](http://www.michigan.gov/mdot/0,4616,7-151-9622_11045_24249---,00.html) later this summer.



Cameras monitored passing maneuvers on long stretches of rural roadway.

## MDOT TRB Poster: Predicting Safety of Roadway Improvements

MDOT teamed up with the Wisconsin Department of Transportation and Opus International Consultants to present case studies on road safety audits at a 2012 TRB meeting poster session. The session illustrated how the AASHTO *Highway Safety Manual* (HSM) is helping MDOT and other agencies predict the number of crashes on roadways, prioritize improvement projects and evaluate the economic impacts of safety modifications.

AASHTO released the HSM in 2010, and MDOT is helping to pioneer its use. The HSM supports a scientific approach to quantifying safety by considering a range of facility characteristics and con-

ditions in assigning a safety value to a location. These include type of roadway segment or intersection, urban or rural designation, lane width, type of signal control, grading, and lighting. The HSM moves beyond traditional analysis methods, which are unable to capture the current safety performance of a roadway or predict future safety.

MDOT highlighted two projects on the TRB poster. At the intersection of M-37 and M-115 near Traverse City, MDOT used the HSM to compare the expected safety outcome of implementing four-way stop control versus a roundabout conversion. MDOT also used the HSM to evaluate and prioritize safety

improvements, such as roundabouts and signal upgrades, around the Frandor Mall in Lansing.

To enhance its accuracy, the HSM’s safety performance function must be locally calibrated and adjusted based on a project’s proposed and actual conditions and location. Transportation Engineer Dean Kanitz drew on robust crash and roadway data and the SafetyAnalyst software tool developed by FHWA and AASHTO to obtain calibration values for the two projects. “We produced calibration values that we could use to predict safety performance in terms of number of expected and excess crashes for a specific facility type,” Kanitz says.

The poster “HSM as a Decision Support Tool: Case Studies from Michigan and Wisconsin” is available at <http://amonline.trb.org> (Session 396).

# MDOT Staff Help Guide National Initiatives

TRB manages or sponsors multimillion-dollar cooperative research programs that address highways, transit, air, freight and hazardous materials. MDOT staff have the opportunity to help guide which research projects get selected and oversee individual projects by serving on project panels. The following individuals represent MDOT's interests on national research projects through TRB. Each panel member must be nominated and accepted in order to serve.

## MDOT Staff on TRB Cooperative Research Program Project Panels

Margaret Barondess	Peter Jansson	Patricia Schriener
Rebecca Curtis	Kimberly Johnson	James Schultz
Richard Endres	David Juntunen	Kristin Schuster (chair)
Susan Gorski	Kimberly Lariviere	Kirk Steudle (chair)
Jeffery Grossklaus	Eileen Phifer	William Tansil
Thomas Hanf	Alan Robords	Louis Taylor

More than 200 TRB standing committees and task forces are staffed by volunteer members from state DOTs, academia and the private sector. Members work to identify research needs, review papers for presentation at the TRB meeting, encourage implementation of research findings, and develop conferences and workshops. The staff members listed below represent MDOT in this capacity.

## MDOT Staff on TRB Committees and Task Forces

Nishantha Bandara	Karen Faussett	Balaram Singh
Steven Bower	Denise Jackson	Kirk Steudle
Timothy Croze	David Juntunen	Mark Van Port Fleet (chair)
Rebecca Curtis	James Schultz	Ronald Vibbert



MDOT Director Kirk T. Steudle spoke to the TRB Executive Committee during the 2012 TRB Annual Meeting. (Photo by Risdon Photography. Courtesy of TRB.)

## Research Administration

### MISSION:

*Promoting innovative research for economic benefit and improved quality of life*

### VALUES:

*Quality, teamwork, customer orientation, integrity, pride*

## The Research Administration Team

### Executive

Steve Bower, Engineer of Research  
Linda Feldpausch, Secretary

### Project Administration

Michael Townley, Project Administration Manager  
Sarah Esquivel, Research Project Analyst  
Portia VanPelt, Research Program Analyst  
Homer Sprague, Statistician

### Program Management

André Clover, Research Program Manager  
Mark Polsdofer, Research Program Specialist

### Statistical Services

Wen-Huo Kuo, Statistician

### Library Services

Alexandra Briseno, Librarian

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