

The Bridge

Linking Transportation Research and Practice



Vol. 23, No. 2

October 2009

Roundabout test-drive puts truckers behind the wheel before construction

Temporary mock-up is key to bringing the project to life

Given the opportunity to see and drive a temporary version of the roundabout before the real one was built, truckers gave engineers the thumbs-up.



Washington State DOT

By Dave Chesson, Washington State Department of Transportation. This article originally appeared in Washington State LTAP News, Issue 95. Reprinted with permission.

Sometimes, seeing is believing. When Washington State Department of Transportation (WSDOT) proposed a roundabout at the intersection of two state highways in Skagit County, some truck drivers were pessimistic. But given the opportunity to see and drive a temporary version of the roundabout before the real one was built, truckers gave engineers the thumbs-up.

In 2006, WSDOT embarked on a project to build a roundabout just east of Mount Vernon at the intersection of State Route 9 and State Route 536, in an area known as Big Rock. When it comes to new projects, sometimes WSDOT outreach, local

media attention, or even an open house, isn't enough to get a vote of confidence from the public. That's when communicators have to think outside the box to build customer confidence and help deliver the project on schedule. And that's what led to a joint effort between engineers and communicators to build a temporary full-scale, drivable roundabout before construction of the Big Rock roundabout.

New homes, more traffic

The area will soon see an increase in traffic, due largely to a nearby 800-home development that is under construction. Several options were discussed, but none could provide the safety benefits and increased capacity for the future like a roundabout. Quadrant Homes, the developer, would be responsible to design, build and pay for the project under the direction and supervision of WSDOT.

After several public meetings, including an open house in the fall of 2006, many local truck drivers were still not impressed with the roundabout idea. Many believed the roundabout would not be big enough for their big rigs. WSDOT needed a creative way to reach an important group of constituents that depended on the road for their livelihood.

See Roundabout test-drive on Page 4

In This Issue:

Roundabout test-drive	1
"Blacktop cookies" for patching potholes.	3
Asphalt pavement: a great material for recycling.	3
"LTAP Bucks" awarded	5
Top nine life-saving strategies	6
Keep your mind nimble with these five foods	7
Summaries of stop-controlled intersection research	8

Learning by doing

Most of us would agree that we learn and remember more by *doing* than by *hearing about* or *seeing*. That's why good teachers require lots of homework and why good training programs include plenty of interactive discussions or hands-on exercises. In very simple terms, learning involves the formation of connections between stimuli and responses. With this in mind, it makes sense that in a learning environment more stimuli is better than less. *Doing* stimulates more of our senses, generates more responses, and creates stronger connections.

The big story in this issue is about how the Washington State Department of Transportation (WSDOT) demonstrated the value of *doing* on a grand scale. After trying to convince motorists—with presentations, statistics and diagrams—that roundabouts are easy to navigate even with large vehicles, WSDOT created a full-sized mock-up of a roundabout, and then invited drivers of all types and sizes of vehicles to try it out. The drivers learned very quickly that roundabouts are easy to use.

When you finish that article, take a look at page three, where you'll learn how the City of Pittsfield, MA stores hot mix asphalt pavement in convenient 20-pound "cookies" for patching potholes. When they need a patch, they simply reheat a few cookies to soften the material and then press it into a pothole.

Also on page three, Dr. Zhanping You, professor of transportation and materials at Michigan Tech briefly explains the characteristics of hot mix asphalt that make it possible to cool and reheat many times without degrading the performance.

After that, flip to page six where you can read about nine strategies that the Federal Highway Administration (FHWA) urges agencies to consider when thinking about ways to make our roads safer. Interestingly, all nine have been used to some extent in Michigan through the MDOT Local Safety Initiative (LSI). You'll find more information about the LSI, including contact information, on page seven. I'll include more about the LSI in future issues of *The Bridge*. The program, which was established in 2004, has helped several local agencies identify innovative, low-cost ways to improve the safety of roads and intersections.

Finally, on the last page you'll find links to research reports about the FHWA's Low-Cost Safety Improvements Pooled Fund Study. The study evaluated four different strategies for traffic control at stop-controlled intersections.

The Bridge

The Bridge is published quarterly by Michigan's Local Technical Assistance Program at Michigan Technological University. Subscriptions are free and available by contacting the Center.

Michigan's Local Technical Assistance Program

Michigan Technological University
309 Dillman Hall
1400 Townsend Dr.
Houghton, MI 49931-1295

© Copyright 2009 Michigan Technological University. To obtain permission to reprint any articles or graphics from *The Bridge*, *The Fact Sheet*, or the *ORBP Newsletter*, please contact Michigan LTAP.

Director..... Terry McNinch
Assistant Director..... Tim Colling, P.E.
Research Engineer II/Civil Engineer John Kiefer, P.E.
Editor/Technical Writer John Rynanen
Technical Writer Ann Kitalong-Will
Senior Software Engineer..... Nick Koszykowski
Office Manager Christine Codere
Office Assistant..... Devin Seppala
Office Assistant..... Tammy Kus

Telephone 906-487-2102
Fax 906-487-3409
E-mail LTAP@mtu.edu
Michigan LTAP <http://www.MichiganLTAP.org>

4500 copies mailed this edition

Michigan Technological University is an equal opportunity educational institution/equal opportunity employer.

LTAP Steering Committee

The Local Technical Assistance Program (LTAP) is a nationwide effort financed by the Federal Highway Administration and individual state departments of transportation. It intends to bridge the gap between research and practice by translating the latest state-of-the-art technology in roads, bridges, and public transportation into terms understood by local and county highway or transportation personnel.

The LTAP Steering Committee makes recommendations on, and evaluations of, the activities of the Local Technical Assistance Program based on discussions at the Technology Transfer Interchange and Advisory Committee meeting. This meeting is held annually and is open to all rural and urban agencies, and individuals concerned with the transfer of transportation technology in Michigan.

Ronald Krauss 517-702-1822 FHWA

Area Engineer, FHWA

Bruce Kadzban 517-335-2229 MDOT

Local Agency Programs, MDOT

Ronald A. Young 517-736-8168 Michigan Counties

Engineer/Manager, Alcona County Road Commission

Sponsored by



U.S. Department of Transportation
Federal Highway Administration



Published in cooperation with



“Blacktop cookies” for patching potholes

This article was adapted from an article that originally appeared in the Fall 2008 issue of *Mass Interchange*, a quarterly newsletter published by the Baystate Roads Program.

Pittsfield, Massachusetts' Commissioner of Public Works Bruce Collingwood and his staff are always striving to increase efficiency, decrease liability and lower operating costs for road maintenance. This is especially true during tough economic times. To simplify the process of filling potholes, they have devised a recipe for making “blacktop cookies” that are easy to handle and stockpile for use during the winter season when potholes develop.

The recipe consists of hot-mix asphalt (HMA), spread liberally on the ground and formed into 25 lb wafers. The 350 degree material is allowed to cool overnight. It is then gathered together and stockpiled.

When pothole patching is necessary, the crew loads up to four tons of cookies into a trailer-mounted reclaiming hot box the night before. At 2:00 a.m. the following morning, a timer starts the diesel-powered machine, which begins to warm the “cookies” slowly. By 7:30 a.m., the reheated HMA is ready to use. Pulling the hot box behind a truck, the crew presses the loose, hot blacktop into potholes and then compacts it. The repairs usually last the entire winter.

Collingwood said pothole repairs using this method are much less expensive and less labor-intensive than repairs using cold patch material. “Cold patch doesn't stay in the potholes very well, which requires revisiting the same repair many times all winter long,” he said. “Overall, the hot asphalt is much easier to use and it's much less expensive.”

The Pittsfield DPW maintenance crew originally tried using an old hot box and asphalt heater that burned LP gas instead of diesel fuel. That machine overheated the material and burned off too much of the oils. “Our new machine has a super-insulated box, and it heats more uniformly. It really works well.” Collingwood said.



The City of Pittsfield's stockpile of cured blacktop cookies. Inset photo: Pittsfield maintenance crew filling potholes with reheated blacktop cookies.



City of Pittsfield's asphalt reclaiming hot box.

So far, the City of Pittsfield DPW has only made the cookies using new asphalt intended for that purpose, but the process would also work well with asphalt left over after a paving job.

Asphalt pavement: a great material for recycling

Zhanping You, P.E., Ph.D., associate professor of transportation engineering and materials at Michigan Technological University, appreciates the City of Pittsfield's innovative approach to “storing” hot mix asphalt (HMA) pavement.

“The City of Pittsfield is demonstrating a good and smart way to store their HMA for use later,” Dr. You said. “What they are doing is in the category of reclaimed asphalt pavement, or RAP, which involves reusing old asphalt pavement in a new pavement.”

Dr. You explained that as long as it is not overheated or allowed to oxidize too much, the physical properties of asphalt cement will remain

unchanged for a long period of time. “Asphalt pavement is a great material for recycling,” he said. “The main components – aggregate and asphalt cement binder – both lend themselves to reclamation and reuse.”

Dr. You has conducted a great deal of research in the areas of asphalt materials characterization and mix design as well as performance evaluation and rehabilitation of asphalt materials. One of his current research projects, which involves extracting asphalt cement from used roofing shingles, provides an extreme example of the material's usability. “We're extracting usable asphalt cement from roofing shingles that are 40 years old,” he said.

In addition to research involving extracting and reusing asphalt cement from pavements and roofing shingles, Dr. You is also conducting research that deals with other areas of asphalt pavement materials design. One such project involves evaluating the use of non-metal “E-waste” (plastic computer housing, for example) to improve the long-term performance of asphalt pavement.

For more information about Dr. You's research efforts, please visit his Web page: www.cee.mtu.edu/~zyou.



Roundabout test-drive from Page 1

This wasn't the first time WSDOT had been faced with this situation. A year earlier engineers in Whatcom County had proposed to build four roundabouts on the Guide Meridian and received a cool reception from the community. Drivers, truck drivers in particular, were skeptical that roundabouts could safely handle big rigs. So WSDOT built a temporary roundabout in a gravel lot and invited truck drivers, emergency responders, and farmers to test-drive the full scale roundabout. The support from the local trucking community was overwhelmingly positive after they had been given the chance to see and drive the roundabout.

Organizing a test drive

Taking a page out of the Whatcom County engineer's notebook, the decision was made to build a temporary roundabout for Big Rock drivers to give it a test drive. A team of traffic engineers, surveyors, maintenance personnel and communicators was assembled to implement the plan.

The first job was to find a location that would be big enough for the roundabout and suitable for a public gathering. It would require a flat parking lot, clear of light poles or islands, which could handle large semi-trucks, farm equipment, school buses and emergency services vehicles. It also would need to be close enough to the project to draw the intended audience of local drivers.

The Washington State Patrol agreed to allow WSDOT use of a parking lot at the Bow Hill Weigh Station on I-5, just north of Burlington. The roundabout team used an aerial photo of the parking lot and a scaled CAD drawing of the roundabout to verify that it would fit within the boundaries of the weigh station facility. The roundabout itself was approximately 140 feet wide, which is about half the length of a football field.

If you publicize it they will come

With the location secured, the communications team went to work to brief local officials and invite the community. They updated the project Web page, sent a press release to the media, posted fliers at numerous locations in the area, and called trucking companies, schools and emergency services to recruit participants.

Meanwhile the layout team began sizing up the CAD design file to the scaled aerial

Roundabouts are easy to drive

How WSDOT convinced drivers in five easy steps



Step 1. Create a visual mock-up of the completed roundabout. The mock-up helped planners explain the concept more easily to residents and local leaders.

Washington State DOT



Step 2. Pick a site for the test-drive. Engineers chose a nearby weigh station for the test-drive. To confirm the roundabout would fit, they superimposed it on an aerial photo of the facility.

Washington State DOT



Step 3. Create the roundabout at the site. Surveyors used chalk paint, sandbags, and cones to indicate road edges, pavement markings, curbs and islands in the roundabout design.

Washington State DOT



Step 4. Invite skeptical drivers to try it out. Truck and bus drivers, emergency responders, farmers and residents pulling RVs all tested (and approved) the roundabout.

Washington State DOT



Step 5. Build it. Roundabout construction began on June 4, 2007. It was open to traffic on July 27. The total cost of the test-drive was less than \$5000.

Quadrant Homes

photo with all of its various components. The roundabout had to be placed in the parking lot in a way that would allow drivers and viewers to participate safely, while allowing vehicles using the weigh station to also use and navigate the parking lot. Three different layouts were devised and reviewed by the team before the best fit was determined and chosen.

Set up and test

When the week of the event arrived, the design team, along with a WSDOT survey crew, went to the site to make the design a reality. Chalk paint was used to mark reference points at strategic locations. The survey crew used those points to begin marking the predetermined measurements on the ground. WSDOT's Mount Vernon maintenance crew helped set 400 sandbags at regular intervals to represent curb lines. Chalk lines and cones also were used to mark the center island and road edges. Within eight hours the team built the full-scale roundabout complete with visible lane markings and signs.

The next day, the roundabout was put to the test. Drivers with all sizes of vehicles drove the roundabout. Everything from a local resident in his RV towing a boat, to an oversized load pulling a 12.5-foot wide, 75-foot trailer, used the roundabout. Tanker trucks and rock haulers, with varying sizes of pup trailers, drove the course safely. Two local school districts brought out buses and drivers, and the local fire department checked it out with a fire truck. Over 25 semi-trucks used the roundabout and several residents showed up to watch. WSDOT traffic engineers rode with each participating driver to give them safety tips and to solicit comments on the design.

The local residents who showed up to watch, like most of the truck drivers, were more aware and open to the idea after watching the roundabout in use. The common response was that it was "bigger than I expected." All of the drivers who participated were able to navigate the roundabout within its boundaries. In less than three hours after completion of the test-drive, crews removed almost all traces of the roundabout. All that remained was the chalk paint that rain soon would erase.

Correcting misconceptions

Getting public support for roundabouts hasn't been easy in Washington or in other parts of the country. The public is often skeptical of ideas that are new to them, and many misconceptions still exist, partly due to older "traffic circles," which did not provide many of the improved design features that today's roundabouts have. But once roundabouts are installed, the majority of users quickly learn to appreciate them.

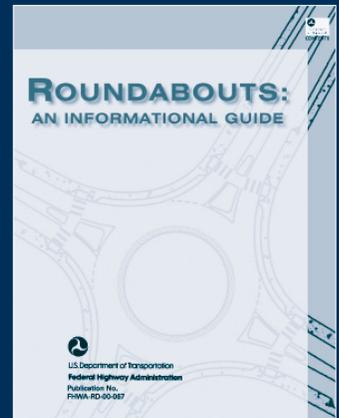
Roundabouts reduce collisions substantially, especially those involving injuries, improve traffic flow and reduce annual operating costs compared with signalized intersections. They also make intersections safer for pedestrians and bicyclists. The Insurance Institute for Highway Safety says that modern roundabouts reduce total crashes by 39 percent, injury crashes by 76 percent and fatal crashes by 90 percent.

Construction of the roundabout at Big Rock began on June 4, 2007 and was successfully completed and open to traffic on July 27, 2007. The cost of building the test-drive roundabout came in at under \$5,000.



Need more info about Roundabouts?

Read *Roundabouts: An Informational Guide*. The publication, available as a PDF download from the Federal Highway Administration's Turner Fairbanks Highway Research Center, is the definitive source of information related to the planning, operation, design, and configuration of modern roundabouts in the United States. Comprehensive coverage is provided for all travel modes that need to be considered in roadway design. The information contained in this guide is the culmination of extensive research into best practices from around the world, interpreted in the light of accepted U.S. design standards such as AASHTO's Green Book and the MUTCD.



Visit www.tfhrc.gov/safety/00068.htm to download.

"LTAP Bucks" awarded

Paula Diem (City of Saginaw), Paul Ivey (City of Saline), and Scott Eckstorm (Roscommon County Road Commission) won "LTAP Bucks" certificates recently through random drawings among people who responded to recent surveys. The certificates are worth \$100 each and can be used toward the cost of any LTAP sponsored workshop.

Tim Colling, P.E., assistant director of Michigan's LTAP at the Michigan Tech Transportation Institute in Houghton appreciates the value of feedback from workshop



"Understanding the needs of the agencies we serve helps us put together workshops and other activities that are relevant and useful for them."

Tim Colling, P.E. – Michigan's LTAP

participants, and he likes using LTAP Bucks certificates to encourage people to speak up. "Understanding the needs of the agencies we serve helps us put together workshops and other activities that are relevant and useful for them," Colling said. "LTAP Bucks provide a great incentive for people to speak up."

Paula Diem completed a follow up survey for the workshop, *Traffic Safety – From Finding the Problem to Fixing It*. Pat Ivey completed a follow up survey for the workshop, *What Elected Official's Need to Know About Traffic Safety*. Scott Eckstorm completed a needs survey for an upcoming series of hydraulics training workshops.

FHWA urges road agencies to consider top nine life-saving strategies

Federal Highway Administration

The FHWA Safety Program urges State and local roadway officials to consider implementation of nine safety countermeasures that show great potential to reduce highway fatalities and injuries. As State highway agencies develop plans to address the safety challenges identified in their strategic highway safety plans, they are urged to consider the benefits of investments in these proven roadway safety tools and techniques.

1. Road Safety Audits: A road safety audit (RSA) is a formal safety performance examination of an existing or future road or intersection. Audit teams are independent and multidisciplinary. The team reports on potential road safety issues and identifies opportunities to improve safety for all road users.

2. Rumble Strips and Rumble Stripes: Rumble strips are raised or grooved patterns on the roadway that provide both an audible warning (rumbling sound) and a physical vibration to alert drivers that they are leaving the driving lane. They may be installed on the roadway shoulder or on the center line of undivided highways. Rumble stripes are rumble strips that are placed at the center line or edge line.

3. Median Barriers: Median barriers are longitudinal barriers used to separate opposing traffic on a divided highway. They are designed to redirect vehicles striking either side of the barrier. Median barriers can significantly reduce the number of cross-median crashes and the overall severity of median-related crashes.

4. Safety Edge: The Safety Edge asphalt paving technique minimizes vertical drop-off safety hazards. A Safety Edge shape is created by fitting resurfacing equipment with a device that extrudes and compacts the shape of the pavement edge at a specific angle as the paver passes. This mitigates shoulder pavement edge drop-offs immediately during the construction



A road safety audit team watches traffic signal operations and road users at an intersection.



A cable barrier in the median prevented this tractor trailer from crossing the median and entering an opposing lane of traffic on a Michigan highway.



A roundabout, completed in July 2006 in Otsego County, Michigan, drastically reduced congestion and crashes at a busy rural intersection.



A channelized median provides a pedestrian refuge area to help students cross US-41 on the campus of Michigan Technological University in Houghton.

process and over the life of the pavement. Because the technique involves only a slight modification of paving equipment, it has a minimal impact on project cost. Improved compaction of the pavement near the edge is an additional benefit of the Safety Edge.

5. Roundabouts: A roundabout is a circular intersection where entering traffic yields to vehicles on the circulatory roadway. Roundabouts are designed to channel traffic at the entrance and provide collision deflection around a center island. Modern roundabouts are geometrically designed to reduce speeds and deflect collision forces, which substantially improves safety, while providing excellent operational performance at the intersection.

6. Left- and Right-Turn Lane at Stop-Controlled Intersections: Left-turn lanes are auxiliary lanes for storage or speed change of left-turning vehicles. Left-turn lanes reduce the likelihood of intersection crashes. They also make turning easier for drivers and improve the intersection's operational efficiency. Right-turn lanes provide a separation at intersection approaches between right-turning traffic and adjacent through-traffic. This reduces conflicts and improves intersection safety.

7. Yellow Change Intervals: Yellow signal lights that are not timed appropriately are a safety hazard. Yellow change intervals that are not consistent with normal operating speeds create a "dilemma zone" in which drivers can neither stop safely, nor reach the intersection before the signal turns red.

8. Medians and Pedestrian Refuge Areas in Urban and Suburban Areas: Medians reduce traffic conflicts and increase safety by providing a buffer area between opposing lanes of traffic. Medians can be open (pavement markings only), or channelized (raised medians or islands) to separate various road users. Pedestrian Refuge Areas—also known as crossing

islands, center islands, refuge islands, pedestrian islands, or median slow points—are raised islands placed in the street to separate crossing pedestrians from vehicles.

9. Walkways: Appropriately designed walkways increase safety for all road users. Types of walkways include:

- **Pedestrian Walkway** – A continuous way designated for pedestrians and separated from motor vehicle traffic by a space or barrier.
- **Shared Use Path** – A bikeway or pedestrian walkway physically separated from motor vehicle traffic by an open space or barrier, either within a highway right-of-way, or within an independent right-of-way. Shared use paths may also be used by pedestrians, skaters, wheelchair users, joggers, and other non-motorized users. Shared use paths also are referred to as “trails” or “multiple-use trails.”
- **Sidewalks** – Walkways that are paved and separated from the street, generally by curb and gutter.
- **Roadway Shoulder** – In rural or suburban areas where sidewalks and pathways are not feasible, gravel or paved highway shoulders provide a safer area for pedestrians to walk next to the roadway.



On the Web:

FHWA Safety Program
<http://safety.fhwa.dot.gov>

Road Safety Audits
<http://safety.fhwa.dot.gov/rsa>

Shoulder and Centerline Rumble Strips
www.trb.org/trbnet/projectdisplay.asp?projectid=458

Median Barriers
http://safety.fhwa.dot.gov/roadway_dept/policy_guide/road_hardware/

Safety Edge
http://safety.fhwa.dot.gov/roadway_dept/pavement/fhwasas07023/

Roundabouts
<http://www.tfrc.gov/safety/00068.htm>

Turn Lanes at Stop Controlled Intersections and Yellow Change Intervals
<http://www.transportation.org/sites/safetymanagement/docs/Desktop%20Reference%20Complete.pdf>

Medians, Pedestrian Refuge Areas, and Walkways
<http://www.walkinginfo.org/library/details.cfm?id=13>

For direct links to these resources and more, go to:

www.MichiganLTAP.org/pubs/Bridge



Bridging the Gap to **Better Health**

Keep your mind nimble with these five foods

by RealAge, Inc. Reprinted with permission.
© 1999-2009. All rights reserved.

Not a fan of crossword puzzles? Can't get the hang of sudoku? Don't worry. There's another way you can sharpen your brain: Revise your grocery list.

Dr. Mehmet Oz, RealAge expert and host of a new national TV show – The Dr. Oz Show – recommends adding five important foods to your supermarket tab to help spark a brain boost.

Key Nutritional Knockouts

Blueberries: Compounds in the bright berries may help shield against harmful processes tied to Alzheimer's disease and premature brain aging.



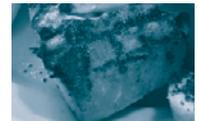
Eggs: This breakfast favorite is loaded with selenium – a mineral that could help make your brain years younger.



Mustard: What makes mustard so amazing? Turmeric. Getting just 17 milligrams of it a day (about a teaspoon of mustard) can help activate genes that control the cleanup of cellular waste in your brain.



Salmon: This pink fish is a great source of omega-3 fatty acids, including the type thought to have the most anti aging effects on the brain. A DHA supplement is another way to get your omega-3s.



Kale: Getting at least three servings a day of dark, leafy greens high in carotenoids and flavonoids can slow mental decline associated with aging.



RealAge[®]
www.RealAge.com

RealAge is a U.S. federally registered trademark of RealAge, Inc. Republication or redistribution of RealAge, Inc. content is expressly prohibited without the prior written consent of RealAge, Inc. RealAge, Inc. shall not be liable for any errors or delays in the content, or for any actions taken in reliance thereon. For an accurate calculation of your RealAge, visit www.RealAge.com.



Road safety assistance available through MDOT

The MDOT Local Safety Initiative (LSI), provides tools and services that help local road agencies improve the safety of their roads. The LSI is available to local agencies free of charge, on a first-come, first served basis.

Available services include:

- Analyze crash data to identify areas of interest
- Conduct field reviews based on safety analyses
- Suggest countermeasures and conduct follow-up

For more information, contact Tracie Leix, P.E., supervising engineer.

Email: LeixT@michigan.gov; Phone: 517-373-8950



**Local Technical Assistance Program
Michigan Technological University
309 Dillman Hall
1400 Townsend Drive
Houghton, MI 49931-1295
906-487-2102**

Non-Profit Organization
U.S. POSTAGE PAID
Permit No. 11
Houghton, Michigan
49931

Summaries of stop-controlled intersection research available from Turner-Fairbank Highway Research Center



The Federal Highway Administration (FHWA) organized 26 States to participate in the FHWA Low-Cost Safety Improvements Pooled Fund Study as part of its strategic highway safety plan support effort. The purpose of the study is to evaluate the safety effectiveness of several low-cost safety improvement strategies through scientifically rigorous crash-based studies. The study evaluated four different strategies for traffic control at stop-controlled intersections. Summaries of the results from each evaluation are now available as *Tech Brief* documents on the web. The title, publication number, and a web address for each *Tech Brief* document is included below.

Safety Evaluation of STOP AHEAD Pavement Markings

Publication #: FHWA-HRT-08-045

On the web: www.tfhrc.gov/safety/pubs/08045

Safety Evaluation of Center Two-Way Left-Turn Lanes on Two-Lane Roads

Publication #: FHWA-HRT-08-046

On the web: www.tfhrc.gov/safety/pubs/08046

Safety Evaluation of Increasing Retroreflectivity of STOP Signs

Publication #: FHWA-HRT-08-047

On the web: www.tfhrc.gov/safety/pubs/08047

Safety Evaluation of Flashing Beacons at Stop-Controlled Intersections

Publication #: FHWA-HRT-08-048

One the web: www.tfhrc.gov/safety/pubs/08048