On August 28th the Tennessee Transportation Assistance Program (TTAP) partnered with the Federal Highway Administration (FHWA) and the Tennessee Department of Transportation (TDOT) to host a Safety Edge Open House and Demonstration event. This event, held in Nashville, allowed more than 50 participants from city and county agencies, TDOT, FHWA, engineering consultants, and contractors to learn more about how the Safety Edge can help to reduce the hazards associated with pavement edge drop-offs.

Safety Edge Background

Nationally, 56 percent of fatal crashes involve roadway departures. In 2012, roadway departure contributed to 621 of Tennessee’s 1,014 traffic fatalities. Pavement drop-offs, or locations where the shoulder is lower than the edge of the adjacent pavement, play a significant role in many roadway departure crashes. Researchers studying crashes in Missouri during 2002-2004 reported that pavement edges may have been a contributing factor in as much as 24 percent of rural run-off-road crashes on paved roadways with unpaved shoulders. This type of crash was twice as likely to include a fatality when compared to all rural crashes on similar roads.1

Drivers leave the paved road for many reasons. When a driver drifts off the roadway and tries to steer back onto the pavement, a vertical pavement edge can create a “tire scrubbing” condition that may result in over-steering. If drivers over-steer to return to the roadway without reducing speed, they are prone to lose control of the vehicle. This loss of control is often described as “overcorrection” in crash reports and news stories. The resulting crashes tend to be more severe than other crash types. The vehicle may veer into the adjacent

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Fall is officially here, and winter is right around the corner. The leaves are falling from the trees and Mother Nature has sent us an early blast of Arctic air. With almost two weeks to go until Thanksgiving, much of Tennessee has already seen its first snowfall (with more on the way). It’s time to get those chores done to be ready for winter!

My thoughts in this column focus on technology transfer and implementation. Universities around the country, including my own, do a lot of research on behalf of highway agencies, mostly those at the federal and state level. The intent of this research is to address specific problems, with the ultimate objective of improving materials, designs, and processes related to roads and streets. Not every research project results in a product—it often takes a number of projects, each advancing the understanding of a problem—to do so. However, once a product results, it does no good if it isn’t deployed. That’s where technology transfer comes into play.

One difficulty in technology transfer is simply getting the message out to the practitioner. It may disappoint my academic peers, but not many highway agency managers or engineers read the scholarly journals in which we publish research findings. Research results need to be disseminated through trade journal articles, webinars, workshops, product demonstrations, and other means that directly target the potential end user. The Federal Highway Administration Resource Center actively promotes technologies resulting from research, and its web site, www.fhwa.dot.gov/resourcecenter/ should be in every roadway agency’s bookmarks. TTAP works closely with this center.

I’m an engineer myself, and I think it’s safe to say that, as a group, engineers tend to be conservative about adopting new ideas. We bind ourselves in standards, specifications, recommended practices, regulations, guidelines, etc. that provide a level of comfort and protection from risk. Face it—being a pioneer in any area entails some chance that things will go awry. We put both our reputation and our employer or client’s money on the line. Failures can be embarrassing and even job threatening. So, the thought goes, let someone else be the risk taker. That’s one barrier to technology transfer. If a research result doesn’t get incorporated into a specification, recommended practice, or guideline, it probably won’t get implemented.

Capacity is another issue that affects technology implementation. By capacity, I mean individuals or firms with knowledge, experience, and equipment to deploy the technology. For example, a simple innovation like the Safety Edge requires contractors to have pavers equipped with the
system. Without clients that demand the system, contractors are unlikely to modify their equipment. Highway agencies, on the other hand, are often reluctant to dictate that the contractor community change accepted practice. Breaking this chicken-and-egg situation requires a champion willing to advocate the new approach. Such a champion can encourage the broader community to adopt the new way.

That’s it for now. As always, if we can help, please don’t hesitate to call or email. TTAP looks forward to assisting you. Be safe!

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Safety Edge Demonstration, continued from page 1

lane, where it may collide with oncoming cars; overturn; or run off the opposite side of the roadway and strike a fixed object or overturn on a slope.

Inexperienced drivers are not the only victims of tire scrubbing. Smaller, lighter vehicles have a harder time climbing a steep pavement edge. At high speeds, the climb is particularly dangerous. According to in-service evaluations, a vertical or near vertical drop-off of 2.5 inches or greater has been shown to pose a significant risk.

The challenge in preventing these types of roadway departure crashes is that a drop-off is created during most paving projects. Even when the unpaved shoulder is re-graded to eliminate the drop-off, the edge often becomes exposed within a few months due to erosion or exposure to traffic. The pavement edge itself also may deteriorate.

The Safety Edge is an effective solution to reduce pavement edge-related crashes, by shaping the edge of the pavement to 30 degrees using a commercially available device (called a shoe) that can be attached to the paver. The asphalt is extruded under the shoe, resulting in a durable edge that resists edge raveling. Research has shown this 30-degree shape allows drivers to re-enter the roadway safely.

After paving with the Safety Edge, the adjacent material should be re-graded flush with the top of the pavement. This is considered the best practice, and provides the safest condition. The difference is that when the edge becomes exposed, this shape can be more safely traversed than a vertical edge. Research has shown that pavements built with the Safety Edge showed reductions of 5.7 percent of total crashes.

Safety Edge Open House and Demonstration

The event began with welcoming statements from Pam Kordenbrock, FHWA Tennessee Division Administrator, and Jessica Rich, FHWA TN Division Safety Engineer. Chris Wagner, Senior Pavement and Materials Engineer with the FHWA Resource Center, shared information on lane departure crashes and edge drop-offs, the Safety Edge concept and its effectiveness in mitigating lane departure events, and the Safety Edge construction process. Brian Hurst, Transportation Manager 2 in the TDOT Project Safety Office, discussed Tennessee’s efforts to reduce the occurrence of lane departure crashes, the role of the safety edge as a countermeasure against these crashes, and Tennessee’s Strategic Highway Safety Plan.

Mr. Wagner’s presentation addressed a wide range of Safety Edge-related topics. Included in his presentation was a case study of a real-world roadway departure crash that resulted in the death of three Georgia high school students. This was presented as an example of the type of crash that the Safety Edge is designed to prevent. Key messages from his presentation include:

- Roadway departure crashes are a significant problem on our nation’s roadways. These crashes result in an average of one fatality every 29 minutes, or 50 per day.

- The Safety Edge creates a 30-degree pavement edge profile that can be safely traversed by a wide variety of vehicles even with relatively high drop-offs.

- Several vendors offer commercial Safety Edge devices that can be added to existing paving equipment. Other agencies, including the North Carolina DOT, have developed in-house solutions that can be duplicated by other organizations. Commercial Safety Edge shoes range in cost from $700 to $3,000.

- Shoulder clipping should be performed prior to paving with the Safety Edge to achieve optimal results.

- Use of the Safety Edge results in minimal project cost increases. The National Center for Asphalt Technology at Auburn University estimates that the Safety Edge requires

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only 0.1 percent more pavement material than conventional paving processes.²

- The Safety Edge is not suitable for some pavements and roadways. Examples of unsuitable project characteristics include open-graded surface mixes, "mill and fill" operations where the shoulder is not repaved, roadways with curb and gutter, and locations where the shoulder drops off at an angle greater than 30 degrees.

- The Safety Edge can be utilized on thin overlays. Lift thickness does not correlate with edge depth.

- The Safety Edge results in a more durable pavement edge because the shoe increases density by up to 2%.³

- More than 40 states routinely evaluate the Safety Edge for use on paving projects.

Mr. Hurst’s presentation showed participants that roadway departure crashes, including those involving edge drop-offs, are a significant concern in Tennessee. In the period from 2008 to 2012, roadway departure crashes contributed to 63% of Tennessee’s traffic fatalities and 42% of the state’s serious injury crashes. The Safety Edge is now one of many infrastructure safety countermeasures that have been identified in the most recent update to the Tennessee Strategic Highway Safety Plan (SHSP). Mr. Hurst also shared that the Safety Edge is now a standard TDOT provision in all applicable new construction projects and on many resurfacing projects.

Following these presentations, participants traveled to the new Tennessee Traffic Incident Management (TIM) training facility at the Tennessee Highway Patrol Training Center. While on site the group was hosted by Tim Murphy, Paving Division Manager with LoJac, and Hossam Bahour, TDOT Project Supervisor. On the date of the visit, a LoJac paving crew was laying asphalt pavement on the new roadway sections that will allow traffic incident management first responders to new or refined traffic control and response coordination techniques in a controlled environment. The paver was equipped with a Carlson Safety Edge Endgate, allowing all participants to observe the equipment in action on a real-world paving project. During this time on the work site, the open house presenters and hosts were available to answer questions from participants.

Learn More about the Safety Edge

To see materials (including presentations, pictures, and videos) from Tennessee’s Safety Edge Open House and Demonstration, or to find links to learn more about the Safety Edge, please visit the TTAP website at http://ctr.utk.edu/ttap/index.html.

Safety Edge Shoe Available for Loan

If you would like to implement the Safety Edge on your own local roadway project, FHWA has made a paving shoe available for loan through TTAP. To learn more about this equipment or to request its use, please contact Matt Cate at 1-800-252-7623 or mcate@utk.edu.

The Tennessee Department of Safety and Homeland Security and the Tennessee Department of Transportation celebrated the opening of a first of its kind training facility on October 30. The Tennessee Traffic Incident Management Training Facility will be used to teach best practices for safe, quick clearance of major highway incidents.

The facility features a section of interstate-like roadway ranging from two to six lanes, guardrail, a two-way interchange, and cable and steel barrier rail, as well as a section of two-lane highway and a full four-way intersection. The facility will be used to simulate a variety of crashes, and allow emergency responders to train on safe and efficient clearance techniques.

“Public officials came together to plan and develop this facility dedicated specifically for traffic incident management,” TDOSHS Commissioner Bill Gibbons said. “As a result of this partnership, state troopers and other first responders, as well as the general public using our highways and those involved in traffic incidents, will benefit.”

“We know the longer roadways remain closed due to major traffic incidents, the danger of secondary crashes increases dramatically,” TDOT Commissioner John Schroer added. “Improving emergency response will decrease the risk of secondary crashes, overall congestion, and keep our highways safer for all motorists.”

The training site concept, which is the first of its kind in the nation, was introduced to TDOT by Tennessee Highway Patrol Colonel Tracy Trott. The training site is located on land adjacent to the THP Training Center off Stewarts Ferry Pike in Nashville. TDOT applied for and received federal Highway Safety Improvement Project funds, which will cover 90% of the $912,025.05 cost to build the facility.

“To say that we are excited and grateful for this training facility would be an understatement. We have had four state troopers killed in secondary traffic incidents since 2000. This new track will not only help law enforcement, but also enhance the skills of other first responders in the safe and quick clearances of highway incidents,” THP Colonel Tracy Trott said.

The Tennessee Traffic Incident Management Training Facility is dedicated to TDOT and THP first responders who have been killed in the line of duty.

To view a video of the TIM Training Facility ribbon cutting ceremony, visit the TDOT News YouTube channel at https://www.youtube.com/user/TDOTnews.
The Federal Highway Administration (FHWA) has just released a Manual providing information and selection criteria associated with safety improvements on High Risk Rural Roads (HRRR). It includes the following topics:

• Safety benefits;
• Cost-effectiveness comparison of safety treatments;
• Applicability of treatment deployment with respect to identified need;
• Initial and reoccurring maintenance costs associated with treatment installation; and
• Decision-making process for treatment selection.

With the large number of safety treatments available, it can be challenging for practitioners to select the most effective treatment to implement with limited funds. The manual is intended to assist an agency in understanding the effectiveness of safety improvements on HRRR to aid in the treatment selection process.

The manual is organized by safety treatment categories as listed in Figure 1.

At the beginning of each treatment category section, a treatment matrix provides an overview of benefits and costs associated with each safety improvement in the section. The matrix may be used to help narrow the list of potential treatments by sorting through criteria specific to the practitioner’s needs and available resources. For example, if practitioner would like to identify an intersection treatment with a maximum initial cost, the matrix can be used to narrow the treatments to only those falling within the maximum range. Figure 2 on page 7 shows an abbreviated version of the Horizontal Curve Treatment Matrix.

The manual also provides information to determine a range of treatment options based on the resources available to implement a treatment.

The following are some of the safety improvements for HRRR explored in the manual:

**Horizontal Curves:**
- Install curve warning signs;
- Install / upgrade curve warning signs with fluorescent;
- Double use of advanced warning signs for curves;
- Use of optical speed bars;
- Install chevron signs;
- Install arrow signs at horizontal curve locations;
- Install post-mounted delineators at horizontal curves;
- Install targeted longitudinal rumble strips on the outside of horizontal curves;
- Install icy curve warning system;
- Improve superelevation at horizontal curve locations;
- Remove compound horizontal curves;
- Modify horizontal / vertical geometry.

**Signalized Intersections:**
- Improve traffic signal visibility;
- Provide intersection lighting;
- Install pedestrian signal heads to existing signalized intersections;
- Provide flashing beacons at intersection approaches;
- Use raised medians to restrict turning movements;
- Install priority control system for emergency vehicles;
- Provide advanced dilemma zone detection for rural high speed signalized approaches;
- Implement J-turns along a signalized corridor;
- Install acceleration and deceleration lanes;
- Install right or left turn lane;
- Install offset or channelized left turn lane;
- Convert a traditional signalized intersection into a roundabout;

continued on page 7
- Reconstruct at-grade intersection to create an interchange.

**Unsignalized Intersections:**
- Relocate an existing stop bar on minor approach;
- Install stop ahead pavement markings;
- Install advanced intersection warning signs;
- Provide a stop bar on minor road approaches;
- Improve sight distance with sight triangle;
- Provide upcoming road names on advanced warning signs;
- Install retroreflective strips on sign posts;
- Upgrade to larger stop signs;
- Double use of stop signs;
- Improve sight distance and conspicuity at railroad grade crossings;
- Install a splitter island;
- Channelization of major and minor roads;
- Provide intersection lighting;
- Install dynamic advanced intersection warning signs;
- Upgrade existing railroad crossing hardware and warning systems;
- Implement lane narrowing through rumble strips and painted median at rural stop-controlled approaches;
- Provide flashing beacons at intersection approaches;
- Convert minor road stop control to all-way stop control;
- Convert a traditional stop-controlled intersection into a J-turn intersection;
- Use raised median to restrict turning movements;
- Install acceleration or deceleration lanes;
- Install railroad crossing hardware and warning systems where they currently do not exist;
- Convert a 4-leg intersection into two 3-leg intersections (offset T-intersections);
- Install bypass lane;
- Modify horizontal and/or vertical geometry;
- Improve horizontal intersection alignment or skew;
- Install traffic signals;
- Install right and left turn lane;
- Install offset or channelized left turn lane;
- Install a roundabout (from stop-controlled);
- Remove or separate an existing railroad grade crossing.

**Non-motorized User:**
- Provide crosswalks at targeted locations;
- Install pedestrian signal heads to existing signalized intersections;
- Construct wildlife fencing;
- Install rectangular rapid flash beacons;
- Build sidewalks;
- Construct adjacent shared-use paths;
- Construct shared-use paved shoulders for horse & buggy road users or bicyclists;
- Construct exclusive bicycle lanes;
- Install curb extensions;
- Install or modify culverts to accommodate wildlife crossing;
- Install pedestrian hybrid beacons or high intensity activated crosswalk (HAWK);
- Construct bicycle trail grade separation structures.

We are always looking for your comments, ideas and suggestions to help make the TTAP Program more useful to you. Please fill out and fax the form below to TTAP at (865) 974-3889 or mail to TTAP; Suite 309 Conference Center Building, Knoxville, TN 37996-4133.

1. Please send me more information on the following articles mentioned in this newsletter.
   ____________________________________________
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2. Please list any additional training workshops you would be interested in attending.
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3. Please list topics for videos you would like TTAP to obtain.
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4. Please list any other ideas or suggestions on how TTAP could assist you.
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