

Roadway Safety Professional Capacity Building Program



U.S. Department of Transportation
Federal Highway Administration

Through engaging peer workshops, the RSPCB Program matches agencies seeking solutions to roadway safety issues with trailblazers who have addressed similar challenges and emerged with a roadmap and noteworthy practices for approaching the issue.

Northeast Roadway Departure Safety Peer Exchange

An RPSCB Peer Exchange

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INTRODUCTION

This report summarizes the proceedings of the Pennsylvania Roadway Departure Safety Peer Exchange held in Harrisburg, Pennsylvania, sponsored by the Pennsylvania Department of Transportation (PennDOT) and the Federal Highway Administration (FHWA) Office of Safety's [Roadway Safety Professional Capacity Building Program](#).

From July 19 to 20, 2016 the Federal Highway Administration (FHWA) Office of Safety and PennDOT convened 22 representatives from six States: Connecticut, Maryland, New Jersey, Ohio, Pennsylvania, and West Virginia. A list of attendees is available in [Appendix A](#).

The purpose of this event was to share noteworthy practices on roadway departure safety countermeasures and strategies. Topics included high friction surface treatments (HFST), signage and pavement markings, rumble strips, and Safety Edge. The proceedings included a series of SWOT analyses of critical low-cost roadway departure countermeasures, presentations by lead adopters and facilitated roundtable discussions. At the conclusion of the peer exchange, participants met in groups of peers from their respective States to identify potential actions to implement lessons learned from the peer exchange. Please refer to [Appendix B](#) for the content and agenda of the peer exchange.

WELCOME

Richard Roman, PennDOT's Director of Operations and Maintenance, welcomed participants to the event. He described PennDOT's program and highlighted several challenges and initiatives, such as efforts to: improve winter traffic services; make traffic signals more efficient; improve work zone safety; and install HFST.

Dick Albin from the FHWA Resource Center set the ground rules for discussion and outlined FHWA roadway departure safety focus areas and resources. FHWA defines a roadway departure crash as a crash in which a vehicle crosses an edge line, a centerline or otherwise leaves the traveled way. Between 2012 and 2014 there

were an average of 18,586 fatal roadway departure crashes annually. FHWA analyzed these crashes to determine key focus areas. The following three focus areas account for 75 percent of roadway departure crashes:

- Rollover Crashes
- Opposing Directions Crashes
- Tree Crashes

PEER EXCHANGE PROCEEDINGS

Signing and Striping

Connecticut DOT

Joe Ouellette from Connecticut DOT (ConnDOT) described their local rural roads horizontal curve treatment program. ConnDOT appealed to local agencies for assistance in using High Risk Rural Road funds on horizontal curves. ConnDOT developed and sent forms to 118 local agencies eligible under the High Risk Rural Road (HRRR) special rule. The funds were limited to signage and pavement marking treatments. Sixty local agencies expressed interest.

The treatments will be implemented at no cost to the local agency. ConnDOT will install curve treatments through contract; local agencies will maintain the treatment.

ConnDOT used online mapping tools to help determine the curve geometry at nominated curves. They then reviewed the crash history and other curve attributes to determine eligibility and rank the curves based on a set of risk factors. After prioritizing curves statewide, ConnDOT met with the local agencies to consult with them about potential treatments. Following these discussions, a consultant hired by ConnDOT developed plan sheets to identify signing and marking treatments for each curve and worked with local officials to implement those designs.

In 2017 and 2018 ConnDOT plans to treat 2,000 curves on local roads. They have proposed an initiative to expand the program to horizontal curves on the state system as well.

Roundtable Discussion

Participants had a wide-ranging discussion about signs and markings. The following topics were discussed:

- **Fluorescent signing.** West Virginia uses fluorescent sheeting at high risk locations. Ohio uses fluorescent signs at school zones. Ohio, West Virginia and Pennsylvania also use reflective post sleeves. PennDOT has found it challenging to ensure fluorescent signs are replaced with matching material when they need to be replaced.
- **Optical Speed Bars.** Counties in New Jersey are experimenting with the use of optical speed bars as a traffic calming measure at curves. Pennsylvania and Maryland have also tried them.
- **Meeting Manual on Uniform Traffic Control Devices (MUTCD) Requirements.** State DOTs are undertaking various efforts to meet new MUTCD requirements. Pennsylvania routinely installs new signing as part of any road project; they have not reevaluated every curve. Ohio has been very proactive in evaluating curves and updating signs through a systematic program managed by the Traffic Department. New Jersey is also evaluating curves using ball banking and have found that some curves are 'oversigned.' Connecticut has a plan to bring horizontal curves on the State system up to new MUTCD standards.
- **Recessed Pavement Markings.** Connecticut recesses paving markings. They have found that they get good retroreflectivity and improved durability. Some states, such as West Virginia, use contrast paint, or

a black shadow around thermoplastic markings, to improve the visibility of markings. Some States, such as Maryland, are increasing the width of lane striping from 4 inches to 5 or 6 inches.

- **Raised Pavement Markings.** Several States are using raised pavement markings, although there is concerns about its durability. Some States have found that poor pavement conditions can result in failure for raised pavement markings.

Signing and Striping SWOT

Strengths	Weaknesses
Can be installed simply and quickly More affordable than other solutions Methods are easy to follow	Contracting can be a challenge Lack of data on effectiveness Maintenance costs Challenge meeting new standards
Opportunities	Threats
Use more durable markings Use new technologies (e.g., LEDs) Variety of material choices Evaluating durability of delineators Better use of HSIP funds	With lower maintenance budgets, some DOTs are considering restriping less often Need to meet new national standards Public opposition to oversigning Poor installation Lack of asset management data for replacing signs

Safety Edge

Ohio DOT

Michael McNeill from Ohio DOT described their Safety Edge Program. Safety Edge is designed to minimize the vertical drop off at the pavement edge by creating a 30 degree angle at the edge of the pavement. The purpose is to reduce run-off-road crashes by allowing vehicles easier reentry to the roadway. Safety Edge has also been shown to make the pavement edge more durable.

Ohio DOT implemented Safety Edge at 10 to 12 pilot locations in 2011. In 2012, Ohio DOT began implementing Safety Edge on 12,000 miles of state-owned rural undivided roadways as a matter of policy. Today, their goal is to increase implementation of Safety Edge on local roads.

Roundtable Discussion

FHWA’s Every Day Counts (EDC) initiative helped to advance the use of Safety Edge in Pennsylvania. Now it is deployed routinely (500+ locations). EDC helped to raise awareness among roadway safety stakeholders and to overcome contractor concerns.

Representatives from each State described their experiences with Safety Edge:

- **Ohio** has focused the application of Safety Edge on locations with ‘oversteers’ that lead to head-on collisions. Ohio initially encountered resistance from paving contractors, but now they use Safety Edge as a matter of policy.
- **Connecticut** implemented Safety Edge at a pilot location, but they encountered lateral displacement near the pavement edge.
- **New Jersey** has not implemented Safety Edge. Safety staff at NJDOT met with internal resistance to the use of Safety Edge. Other State DOT safety representatives shared that they have encountered internal resistance, particularly from staff in their paving department.

- **Maryland** completed a series of demonstration projects and developed a draft specification, but they do not yet implement Safety Edge as a matter of policy.
- **West Virginia** includes Safety Edge in their paving specification. They are interested in expanding the use of Safety Edge to concrete pavements.

Safety Edge SWOT

Strengths	Weaknesses
Fairly easy to implement Reduces roadway departure crashes Can make pavement edge more durable Data on benefits exist Works with most new paving equipment	Potentially additional costs Lack of understanding about proper application Misperceptions about how it affects pavement May affect drainage Need newer equipment
Opportunities	Threats
Conducting and promoting research Local Technical Assistance Program (LTAP) provides pavement shoe to counties Use EDC and State Transportation Innovation Councils (STIC) to make standard Educate people about Safety Edge Assign State DOT champion Update state specifications to make it standard	Dealing with driveways Poorly implemented pilot projects Resistance from industry Lack of ROW to implement

Rumble Strips

New Jersey DOT

Eric Oberle from New Jersey (NJDOT) and Caroline Trueman from FHWA’s New Jersey Division Office described the implementation of centerline rumble strips in New Jersey. Following successful pilots, NJDOT began to systematically install centerline rumble strips. NJDOT uses centerline rumble strips to reduce opposing direction crashes and left side fixed object crashes. They apply centerline rumble strips on State highways with two-way traffic separated by centerline traffic stripes with a minimum lane width of 10 feet. By policy, the rumble strips are a one-half inch in depth and sixteen inches transverse. Both passing and non-passing zones are treated.

Over the past two years, NJDOT has used Highway Safety Improvement Program (HSIP) funds to install centerline rumble strips on more than 760 miles of State highways. They have faced some challenges with noise complaints in some residential areas and by some who claim the noise may disrupt wildlife.

Roundtable Discussion

- **Rumble Strip Specifications.** State specifications on rumble strips vary. Some states use centerline rumble strips in passing zones; others do not. The specified length, width and depth of rumble strips varies from State to State.
- **Barriers to Implementation.** Many States have encountered resistance to edge line rumble strips from bicycle lobby groups. The bicycle community wants to ensure that there are sufficient gaps. Edge line rumble strips can also present issues for buses and, in Pennsylvania, for horse drawn carriages. In some cases, a lack of right of way can limit the use of rumble strips.

- **Maintenance.** One challenge State DOTs face is inventorying and managing safety features on roadways. Sometimes State DOTs will add safety features only to have them removed during the course of routine maintenance.

Rumble Strips SWOT Scramble

Strengths	Weaknesses
Low cost Some positive feedback from traveling public High return on investment Support from leadership	Residential opposition (noise) Fear that they will degrade pavement surface Limited shoulders Misperceptions about impact of centerline rumbles on seams Difficult to apply on concrete
Opportunities	Threats
Communicate benefits to public Improving technologies to address noise issues Fog sealing Mumble strips	Lack of political will Location selection Bicyclist opposition Opposition from paving industry

High Surface Friction Surfaces

Pennsylvania DOT

Jason Herschock and Gavin Grey from PennDOT gave a presentation on PennDOT’s use of HFST. HFST is a pavement treatment with a high friction coefficient that is applied to an existing pavement surface. PennDOT has applied HFST at 154 locations and plans to apply it at an additional 79 planned locations.

PennDOT’s evaluation of 15 initial pilot locations showed significant crash reductions at treatment locations. To select locations for the pilot, PennDOT conducted skid tests at locations with a higher than expected rate of wet road or roadway departure crashes. To assess the treatments, PennDOT reviewed 3-years of before and after crash data and determined the average cost of the treatments. Based on this analysis, they found that the benefit to cost ratio at these pilot locations was 20.5 to 1.

Roundtable Discussion

Participants discussed their experiences and approaches to HFST.

- **Application.** PennDOT installs HFST at stop-control intersections where sight distance is an issue and where people are running through stop signs. Other states have used it on downgrade stop conditions where additional stopping distance is needed.
- **Cost of HFST.** Prices on HFST can vary significantly. It is the binder not the aggregate that drives the cost of HFST. To save costs and ensure quality, it is better to bid the treatment directly rather than as part of a general contract. To get the best life out of a project, it is best to apply it on new pavement surfaces. HFST can also be used on exit ramps and bridges.
- **Durability.** PennDOT has found HFST treatments have an average lifecycle of 8 years and that the treatment often outlasts the life of the resurfacing. They have found that the treatments hold up well under plowing. Pennsylvania implements the treatment from the beginning to the end of the curve.
- **Motorcycle Safety.** Sweeping HFST to remove loose aggregate after its application is critical for motorcycle safety. HFST can be used to improve motorcycle safety at friction demand locations.

- **Communicating Benefits of HFST.** The primary objection to HFST is from contractors who do not understand how to apply it. Automated HFST application drastically reduces the risk associated with failure. Pennsylvania has worked with their State Transportation Innovation Council (STIC) and Local Technical Assistance Program (LTAP) to develop a demo video on HFST. They also developed a “MythBuster” fact sheet and have conducted significant peer to peer education. Ohio has used HFST at a few spot locations, but they are looking to expand the application to approximately 30 locations this year. They are working to communicate the benefits to their pavement staff, who see it as a “Cadillac solution.”

HFST SWOT Scramble

Strengths	Weaknesses
Can be implemented quickly Less expensive than geometric improvements Versatile Shown to be effective at reducing crashes Relatively durable Can be implemented where environmental issues constrain ROW use	Higher, more variable, costs than other pavement treatments Lack of experience installing Misperceptions regarding maintenance and durability Lack of data on curves
Opportunities	Threats
Develop standard specifications Develop better quality assurance capacity and procedures Combine contracts for broader application Evaluate different aggregates and epoxies Conduct trial and demos Develop promotional materials for stakeholders	Lack of industry capacity for implementation Lack of long-term data on durability Poor installation Poor location selection Poor quality control Misperception that it will damage plows

Other Countermeasures

FHWA representatives asked States to share their experiences or questions regarding other roadway departure crash countermeasures. Topics raised included:

- High tension cable median barriers;
- Energy absorbing utility poles;
- Practical performance-based design that prioritizes safety;
- Solar pavement markers;
- Assessment of behavioral factors; and
- Effects of automated driver-assist technologies.

KEY TAKEAWAYS

Each State presented the key takeaways from the day’s discussion they would like to explore in greater detail in the future.

Connecticut

- **Signing and striping** - Explore 360-degree post delineators and revisiting center line and edge line markings on local roads in urban areas.

- **Rumble Strips** – Reconsider policy on rumble strips in passing zones. Extend the use of edge line rumble strips with input from the bicycle community.
- **Safety Edge** - Need to train contractors about Safety Edge so that they understand its feasibility.
- **HFST** - Want to do more; interested in reviewing the resources provided by Pennsylvania.

Maryland

- **HFST** - Interested in expanding implementation of HFST. Meeting with leadership intend to discuss funding and contracting strategies and begin identifying candidate locations.
- **Safety Edge** - Reviewing the status of Safety Edge specifications.
- **Partnerships** - Interested in improving partnership with STIC.

New Jersey

- **HFST** - Interested in developing criteria and specifications for HFST for High Risk Rural Roads. Interested in using HFST videos to train staff.
- **Safety Edge** – Plan to provide more training to internal staff using training videos.
- **Partnerships** - Will reach out to County Engineers and STIC to discuss the results of this peer exchange.
- **Other** - Interested in resources on roadway departure issues at T-intersections.

Ohio

- **Rumble Strips** – Plan to meet with representatives from Michigan DOT to learn about their implementation of center line rumbles.
- **HFST** – Interested in moving forward as a systemic application of HFST.
- **Signs and markings** – Will install wider edge lines.
- **Safety Edge** – Intend to review what has been implemented in the field.
- **Other** - Interested in learning more about safety measures to address the safety of older road users.

Pennsylvania

- **Fixed objects and utility poles** – Interested in pursuing further discussions on applications of energy absorbing utility poles.
- **Rumble strips** - Intend to address opposition from bicyclists.
- **Safety Edge** – May develop specifications for the application of Safety Edge on concrete roadways.
- **Signing**– Interested in making it easier for locals to implement sign treatments on curves. Interested in identifying crash modification factors for fluorescent signs.
- **Automated vehicles** – Interested in understanding infrastructure requirements of emerging technologies.

Appendix A: Attendees

First Name	Last Name	Job Title	Organization	Business Phone	Business Email
Samantha	Biddle	Regional Planner	MD State Highway Administration	410-545-5560	sbiddle@sha.state.md.us
Phil	Bobitz	Transportation Engineer	FHWA Pennsylvania Division Office	717-221-4574	phillip.bobitz@dot.gov
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Breck	Jeffers	Transportation Engineer	Ohio DOT	614-387-0112	cory.hopwood@dot.state.oh.us
Brandi	Krofcheck	Operations and Safety Engineer	FHWA Maryland Division Office	410-779-7153	breck.jeffers@dot.gov
Michael	McNeill	ITS/Lighting Engineer	West Virginia DOT	304-558-9446	brandi.g.krofcheck@wv.gov
Eric	Oberle	Transportation Engineer	Ohio DOT	614-387-1265	michael.mcneill@dot.ohio.gov
Joe	Ouellette	Senior Engineer - Traffic	New Jersey DOT	609-530-2667	eric.oberle@dot.nj.gov
Shaneka	Owens	State Safety Engineer	Connecticut DOT	860-594-2721	joseph.ouellette@ct.gov
Glenn	Rowe	Safety Engineer	FHWA West Virginia Division Office	304-347-5473	shaneka.owens@dot.gov
Robert	Stuedler	Chief, Traffic Engineering & Permits	Pennsylvania DOT	717-334-3155	growe@pa.gov
William	Stroud	Transportation Engineer II	Maryland Department of Transportation	443-572-5039	rstedler@sha.state.md.us
Caroline	Trueman	Transportation Engineer	MD State Highway Administration	410-787-5821	wstroud@sha.state.md.us
Douglas	Whitaker	Safety Engineer	FHWA New Jersey Division Office	609-637-4234	caroline.trueman@dot.gov
Dick	Albin	Assistant County Engineer	County of Cumberland	856-453-2192	dougwh@co.cumberland.nj.us
Jennifer	Atkinson	Safety Engineer	FHWA Resource Center	303-550-8804	dick.albin@dot.gov
Joseph	Cheung	Senior Transportation Engineer	Leidos	417-362-9017	jennifer.e.atkinson@leidos.com
Aaron	Jette	Civil Engineer	FHWA Office of Safety	202-366-6994	joseph.cheung@dot.gov
Frank	Julian	Policy Analyst	U.S. DOT Volpe Center	617-494-2335	aaron.jette@dot.gov
Cathy	Satterfield	Safety Engineer	FHWA Resource Center	404-562-3689	frank.julian@dot.gov
		Safety Engineer	FHWA Office of Safety	708-283-3552	cathy.satterfield@dot.gov

Appendix B: Event Agenda

Day One

8:00 am **Welcome**

- Welcome to Pennsylvania – Richard Roman, Director for the Bureau of Maintenance and Operations, PennDOT
- Peer Exchange Format, Ground Rules, and Goals – Dick Albin, FHWA
- Self-Introductions – All Participants
- FHWA Roadway Departure Strategic Plan Presentation – Frank Julian

SWOT Analysis Scramble- Strengths, Weaknesses, Opportunities, Threats

- Purpose and Instructions – Cathy Satterfield, FHWA
- HFST Scramble Group 1 – *CT*, OH, WV Group 2 – *PA*, MD, NJ
- Signs and Lines Scramble Group 1 – *OH*, WV, PA Group 2 – *MD*, NJ, CT
- Rumble Strip Scramble Group 1 – *NJ*, CT, PA Group 2 – *WV*, OH, MD
- Safety Edge Scramble Group 1 – *MD*, CT, OH Group 2 – *PA*, NJ, WV

BREAK

SWOT Analysis Scramble (continued)

- Discussion of results

Mini-Presentation(s) on SIGNING AND STRIPING

- **Signing and Markings on Curves – Connecticut**

SIGNING AND STRIPING (not just curve-related) Roundtable

- Q&A on presentation
- Practices in other participating States and FHWA
- Countermeasures Options and Combinations
- MUTCD curve signing compliance
- Performance Specifications?

12:00-1:00 LUNCH

Mini-Presentation on Safety Edge

- **Ohio**

Round Table Discussions

- Q&A on presentation
- Practices in other participating States and FHWA
- Issues on implementation
- Current status
- Barriers to implementation

BREAK

Mini-Presentation on Rumble Strips

- **New Jersey**

RUMBLES Roundtable

- Q&A on presentation
- Practices in other participating States and FHWA
- Balancing Safety, Pavements, Bike Access, and Noise
- Center vs Shoulder/Edge Applications
- Options and Effectiveness

4:30 WRAP-UP DAY ONE

Day Two

8:00 **Recap of Day 1**

Mini-Presentation on HFST

- **Pennsylvania**

HFST Roundtable discussion

- Q&A on presentation
- Practices in other participating States and FHWA
- Locating Curves to Treat
- Public Involvement
- Specifications
- Construction Issues and Quality Control

BREAK

State Implementation Breakout Groups

Final Report Out and Wrap-Up

12:00 ADJOURN