

Roadway Departure Solutions

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PA
SAFETY
SYMPOSIUM
toward zero deaths

Roadway Departure Fatalities

Roadway Departure Crash – A crash in which a vehicle crosses an edge line, a centerline, or otherwise leaves the traveled way.

National Fatalities

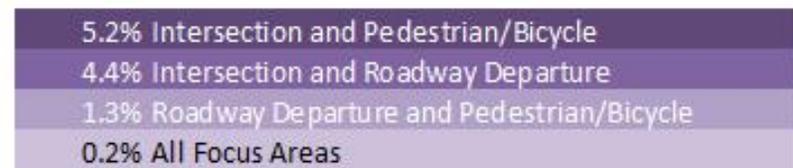
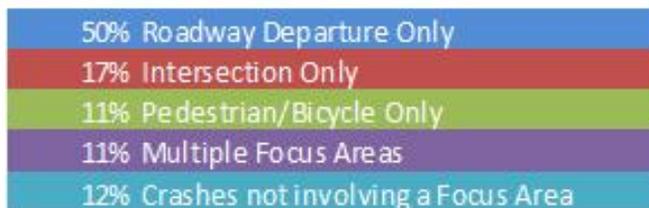
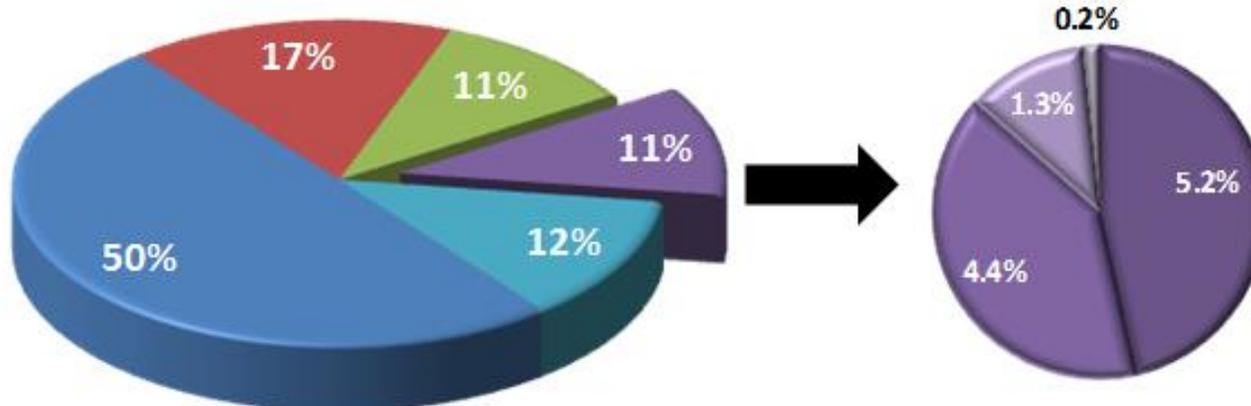
33,117 /Year

(FARS 2012-2014)

RwD Fatalities

18,355/Year

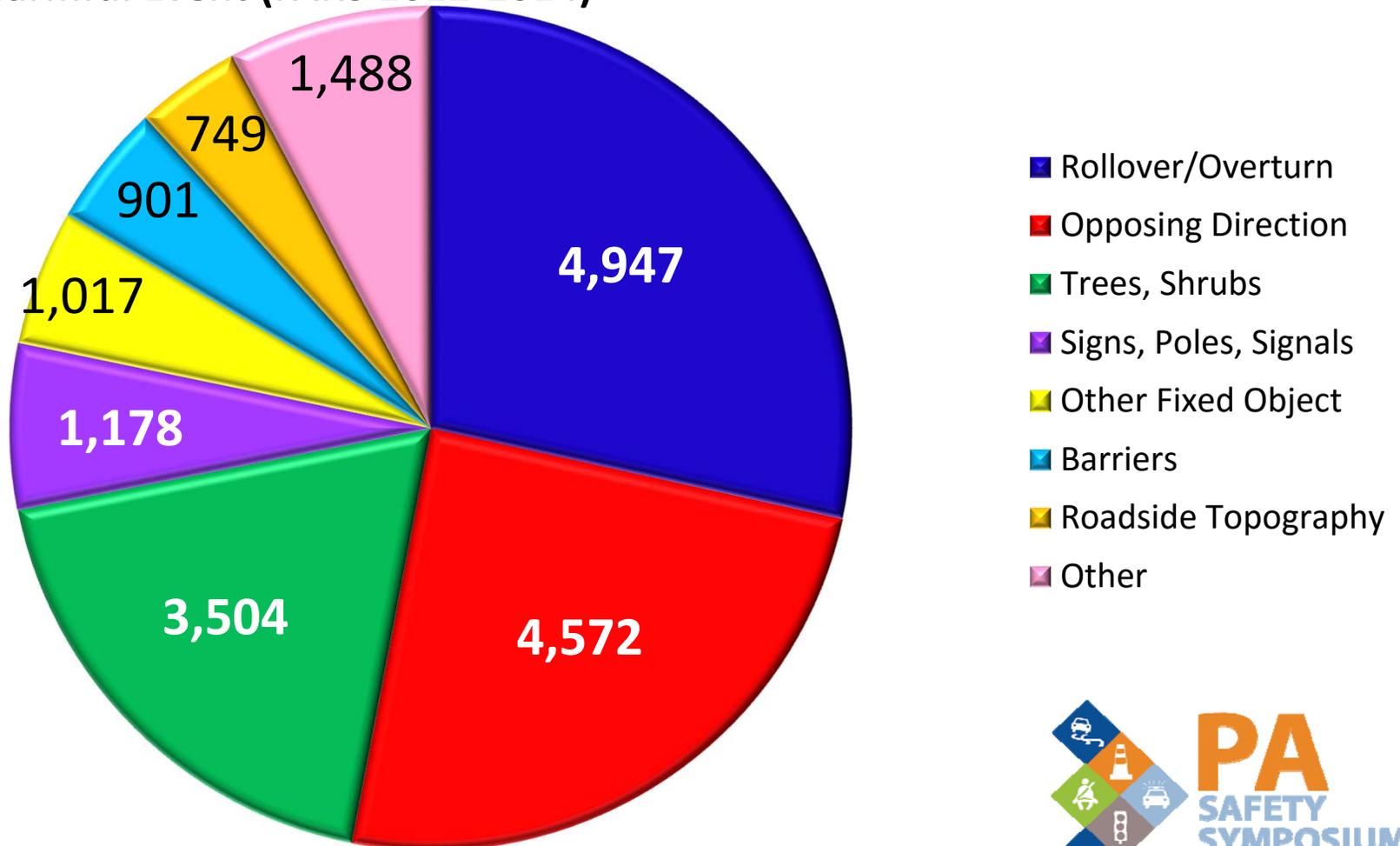
**56% of all
Fatalities**



FHWA Roadway Departure Strategic Plan

Average Annual Roadway Departure Fatalities

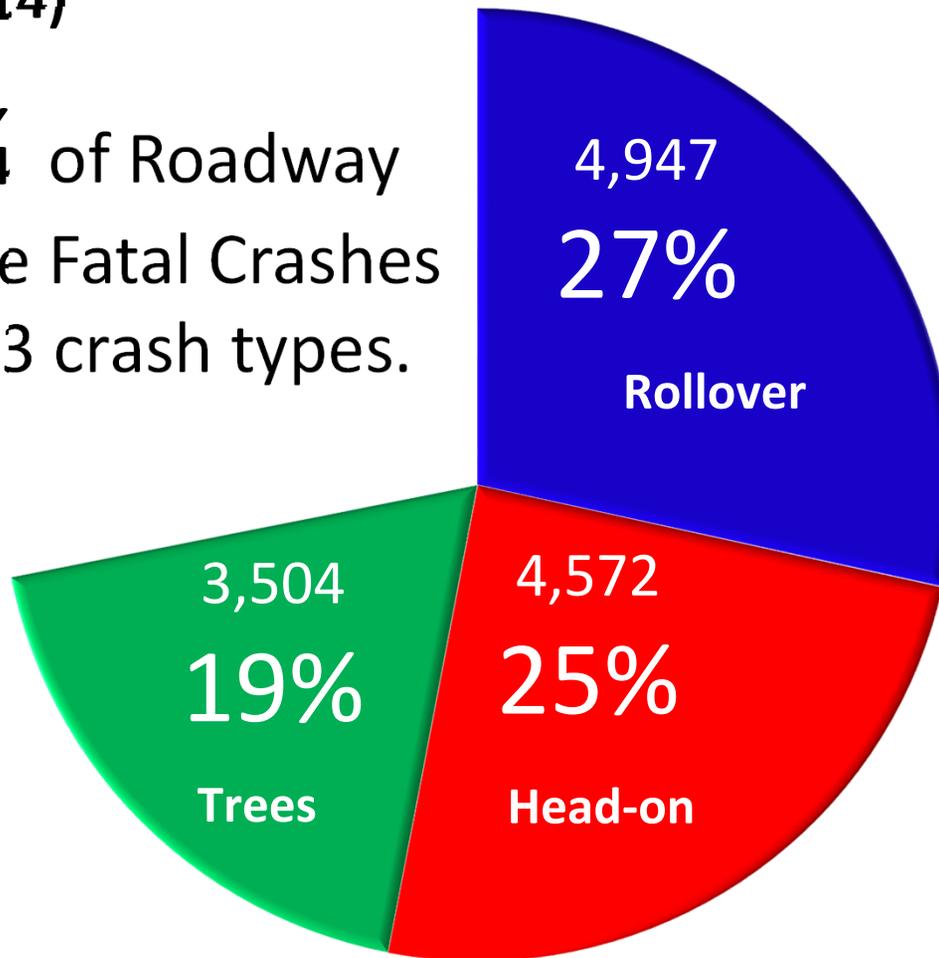
Most Harmful Event (FARS 2012-2014)



FHWA Roadway Departure Strategic Plan

Roadway Departure Fatalities by Most Harmful Event (FARS 2012-2014)

Nearly $\frac{3}{4}$ of Roadway Departure Fatal Crashes are from 3 crash types.

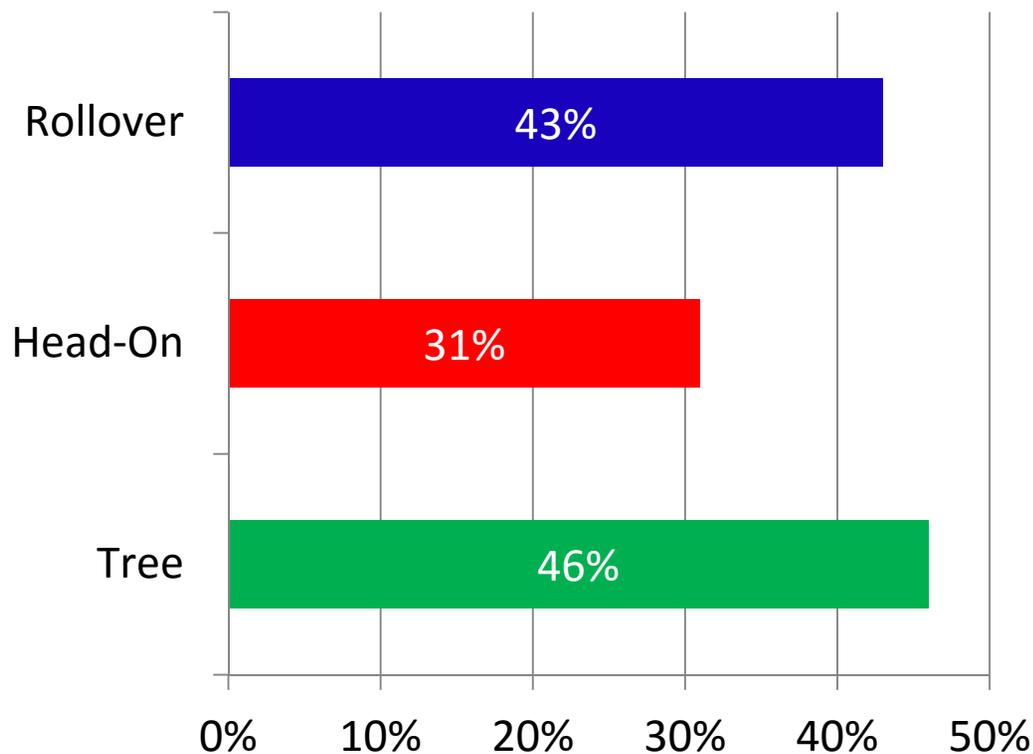


http://safety.fhwa.dot.gov/roadway_dept/docs/rwd_strategic_plan_version2013.pdf

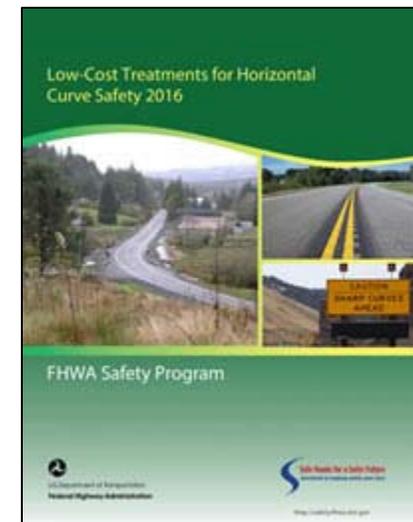


Curve Crashes for the Rwd Emphasis Areas

Curve related Rwd crashes



Low-Cost Treatments for Horizontal Curve Safety 2016

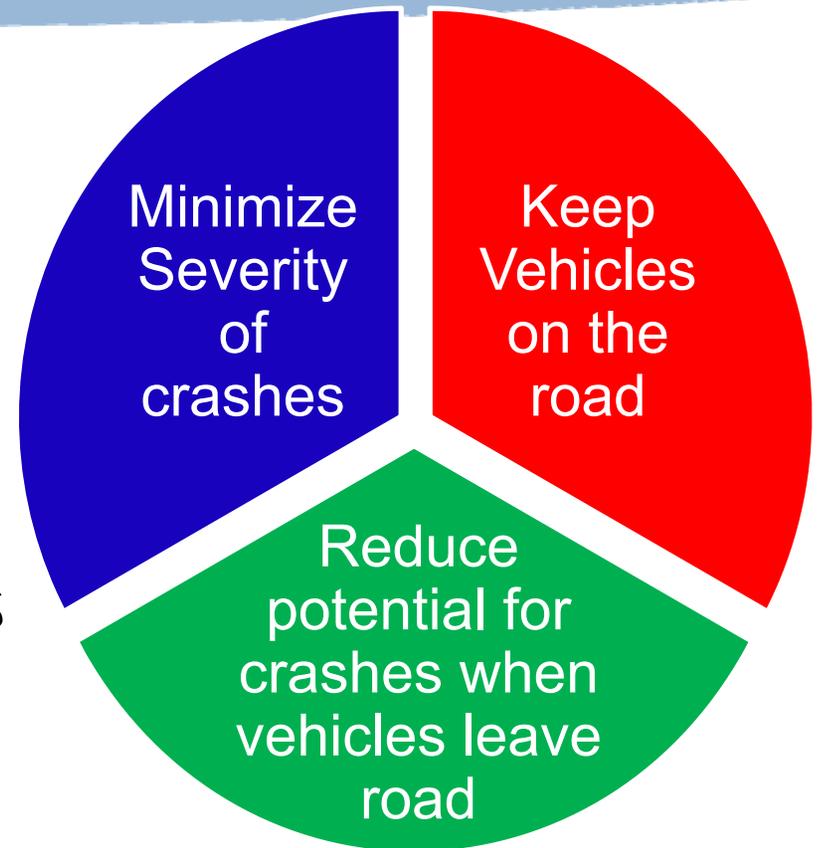


http://safety.fhwa.dot.gov/roadway_dept/horicurves/



Roadway Departure Objectives

- Keep vehicles on the roadway, in their appropriate directional lane.
- Reduce the potential for crashes when vehicles do leave the roadway or cross into opposing traffic lanes.
- Minimize the severity of crashes that do occur.



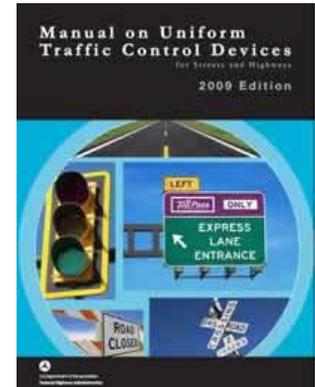
Strategies to keep vehicles on the roadway

- Improved curve delineation
- Friction treatments in curves and other spot locations
- Edge line, shoulder & centerline rumble strips.

Keep
Vehicles
on the
road

Improved curve delineation

- MUTCD (2009) requirements



Friction treatments in curves

- Every Day Counts initiative

Total Crashes

- Ramps CMF = 0.65
- Curves CMF = 0.76

Wet Road Crashes

- Ramps CMF = 0.14
- Curves CMF = 0.48



Edge line, shoulder & centerline rumbles



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FHWA Home / Safety / Roadway Department / Rumble Strips and Stripes

Rumble Strips and Rumble Stripes

Welcome to the Federal Highway Administration's (FHWA) Rumble Strips and Rumble Stripes website. This site contains information about longitudinal center line, edge line, and shoulder rumble strips and stripes.

What's New: The [Fact Sheet](#) for practitioners and the [Implementation Guide](#) for technical specialists on the issues related to accommodating bicyclists are now available. Additional [State DOT Rumble Strip Policies](#) and [Research](#) links have also been added.

 General Information	 Safety	 Design and Construction	 Accommodating All Users
 Mitigating Noise	 Pavement and Maintenance	 Policies, Guidance, and Research	 Frequently Asked Questions

Technical Advisories

Click here to see FHWA Guidance on: [Center line rumble strips](#) and [Shoulder and Edge Line Rumble Strips](#)

http://safety.fhwa.dot.gov/roadway_dept/pavement/rumble_strips/



Edge line, shoulder & centerline rumble strips



Shoulder Rumble Strip – Reduction in crash frequency from before to after rumble strip implementation for single-vehicle run-off-road fatal and injury crashes

	Percent reduction in crash frequency from before to after rumble strip implementation	Standard Error
Rural two-lane roads	38%	10%
Rural freeways	17%	7%



Center line Rumble Strip – Reduction in crash frequency from before to after rumble strip implementation for head-on and opposite direction sideswipe fatal and injury collisions

	Percent reduction in crash frequency from before to after rumble strip implementation	Standard Error
Rural two-lane roads	45%	6%
Urban two-lane roads	64%	27%

http://safety.fhwa.dot.gov/roadway_dept/pavement/rumble_strips/



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Strategies to reduce crashes when vehicles leave the roadway

- The Safety EdgeSM for all paving projects
- Maintained clear zones
- Traversable roadside slopes.

Reduce
potential for
crashes when
vehicles leave
road

Safety Edge SM



With Safety Edge



Without Safety Edge

	Drop-off	ROR	Head-on	F+I	Total
CMF	0.657	0.812	0.833	0.904	1.023
Std Error	0.065	0.044	0.080	0.036	0.040

<http://www.fhwa.dot.gov/innovation/everydaycounts/edc-1/safetyedge.cfm>

Maintained clear zones

- Clear Zone — The unobstructed, traversable area provided beyond the edge of the through traveled way for the recovery of errant vehicles
- AASHTO values based on research from the 1960's that found that 80% of vehicle stopped within 30' of the traveled way



Benefits of increasing the Clear Zone

Table 40 Percent reductions in specific types of obstacle accidents due to clearing/relocating obstacles farther from the roadway (93)

Increase in Obstacle Distance (I.O.D.), m (ft)	Trees (%)	Mailboxes, Culverts, & Signs (%)	Guardrails (%)	Fences/Gates (%)
0.9 (3)	22	14	36	20
1.5 (5)	34	23	53	30
2.4 (8)	49	34	70	44
3.1 (10)	57	40	78	52
4.0 (13)	66	N.F.	N.F.	N.F.
4.6 (15)	71	N.F.	N.F.	N.F.

Notes:

N.F. = generally not feasible to relocate obstacles to specified distances.

I.O.D = amount of increase in obstacle distance from roadway.

This table is appropriate for obstacle distances of 9.1 m (30 ft) or less and only on two-lane rural roadways.

NCHRP 440 – *Accident Mitigation Guide for Congested Rural Two-Lane Highways*



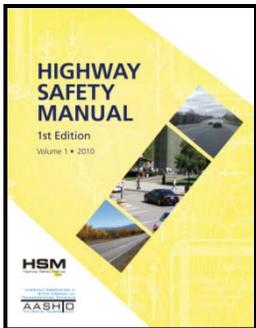
Traversable roadside slopes

- Slopes that are flatter than 3H:1V are traversable

Table 13-18. Potential Crash Effects on Total Crashes of Flattening Sideslopes (15)

Treatment	Setting (Road Type)	Traffic Volume	Crash Type (Severity)	CMF				
				Sideslope in Before Condition	Sideslope in After Condition			
					1V:4H	1V:5H	1V:6H	1V:7H
Flatten Sideslopes	Rural (Two-lane road)	Unspecified	All types (Unspecified)	1V:2H	0.94	0.91	0.88	0.85
				1V:3H	0.95	0.92	0.89	0.85
				1V:4H		0.97	0.93	0.89
				1V:5H			0.97	0.92
				1V:6H				0.95

Base Condition: Existing sideslope in *before* condition.



NOTE: Standard error of the CMF is unknown.



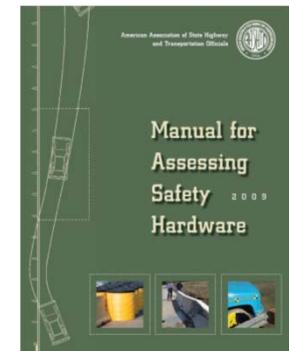
Strategies to minimize the severity of crashes

- Barriers to shield obstacles including:
 - Trees and shrubbery
 - Other fixed objects
 - Slopes
- Other Safety Hardware

Minimize
Severity
of
crashes

Barriers and Roadside Hardware

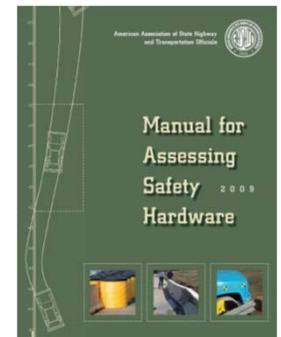
- Roadside hardware is crash tested to assess performance prior to installing in the field
- Current criteria is the AASHTO Manual for Assessing Safety Hardware (MASH)



MASH Implementation Plan

For contracts on the National Highway System with a letting date after the dates below, only safety hardware evaluated using the 2016 edition of MASH criteria will be allowed for new permanent installations and full replacements:

- W-beam barrier and cast-in-place concrete barrier: **December 31, 2017**
- W-beam terminals: **June 30, 2018**
- Cable barrier, cable barrier terminals, and crash cushions: **December 31, 2018**
- Bridge rails, transitions, all other longitudinal barriers (including portable barriers installed permanently), all other terminals, sign supports, and all other breakaway hardware: **December 31, 2019**



Pennsylvania Strategic Highway Safety Plan 2012 (2016 SHSP under development)

Vision

- *Pennsylvania works continuously toward zero deaths and injuries on our roads.*

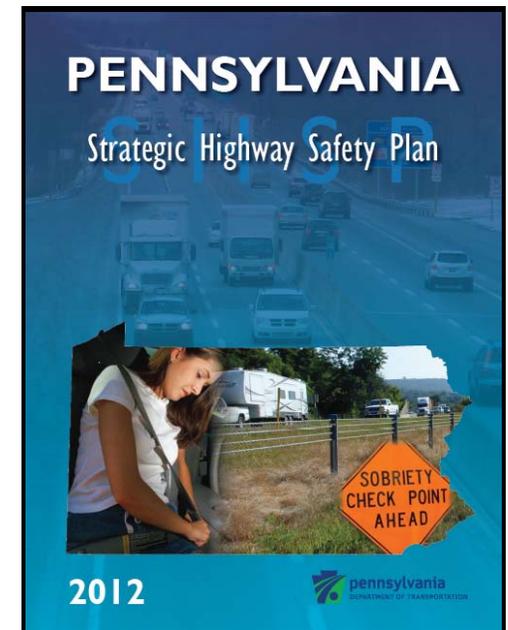
Mission

- *Improve highway safety by developing and implementing education, enforcement, engineering and emergency medical service strategies.*

Goal

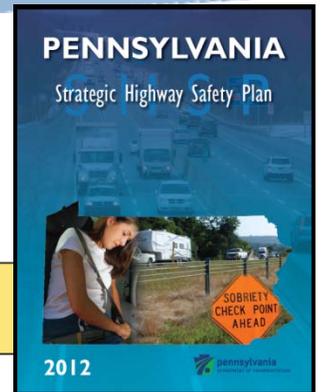
- *Reduce average fatalities and major injuries by 50 percent over the next two decades.*

<http://www.penndot.gov/TravelInPA/Safety/Pages/Strategic-Highway-Safety-Plan.aspx>



Pennsylvania Strategic Highway Safety Plan

Strategies for reducing Head -On and Cross Median Crashes



Top Strategies



Install centerline rumble strips.



Install median barriers (Cable for open medians at high crossover locations & Traffic barriers on four lane undivided roads).



Implement low-cost improvements at curves (examples include delineation, chevrons, advanced curve warning markings, etc.).



Widen lanes and/or shoulders on curves.



Install center 2-way left turn lanes on two-lane and four-lane roads.



Enhance agency crash data systems for head-on/crossover crashes by incorporating a cross median crash flag to the Pennsylvania Police Crash Report and updating the Cross Median Crash report annually.



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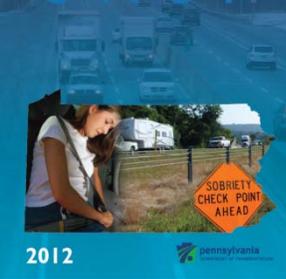
Pennsylvania Strategic Highway Safety Plan

Strategies for reducing Run-off-road crashes

Top Strategies

-  Continue rumble strip applications (edgeline or shoulder) in conjunction with paved shoulders four feet wide or greater. Widen shoulders to accommodate additional locations to install rumble strips.
-  Implement low-cost improvements at curves (examples include delineation, chevrons, advanced curve warning markings, etc.).
-  Eliminate shoulder drop-offs, starting with high severity (> 6) drop-offs. Expand the use of Safety Edge.
-  Improve recovery area/clear zone. Update or install guiderail where warranted.
-  Improve roadway design and geometric enhancements. Widen lanes and/or shoulders on curves and rural highways.
-  Develop FHWA Roadway Departure Implementation Plan for Pennsylvania.
-  Address locations identified as slippery pavement. Apply skid-resistant pavement/friction surfacing treatments.

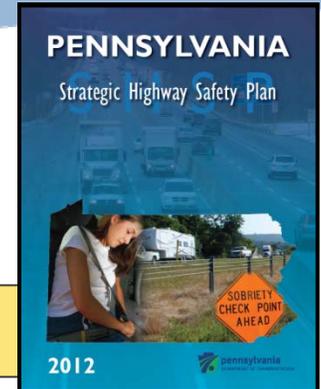
PENNSYLVANIA
Strategic Highway Safety Plan



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Pennsylvania Strategic Highway Safety Plan

Strategies for reducing Hit Fixed Object Crashes



Top Strategies

-  Remove frequently hit trees and other objects in hazardous roadside locations and high-crash corridors.
-  Remove/relocate frequently hit utility poles.
-  Enhance delineation of fixed objects (utility poles, trees, etc.).
-  Shield bridge end walls (examples include bridge transition guiderail).
-  Install additional guiderail (or appropriate barriers) to shield objects that can't be removed.
-  Modify roadside clear zone in the vicinity of hazardous fixed objects.



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Roadway Departure Implementation Plan

- In 2012, FHWA worked with PennDOT to develop an Implementation Plan for Rwd.
- With contract assistance, Pennsylvania data was analyzed and locations identified for potential application of Rwd countermeasures
- The plan, if fully implemented, was estimated to cost \$85M and would reduce an estimated 60 fatalities each year.



Roadway Departure Peer Exchange

- In July , 2016, PennDot hosted a Peer Exchange to discuss Roadway Departure strategies
- 6 states participated
 - Pennsylvania
 - Ohio
 - West Virginia
 - New Jersey
 - Maryland
 - Connecticut
- Noteworthy practices were discussed related to
 - high friction surface treatments
 - signing and striping
 - rumble strips
 - Safety Edge



Roadway Departure Peer Exchange

- Notable Take-aways for PennDOT
 - **Fixed objects and utility poles** – Interested in pursuing further discussions on applications of energy absorbing utility poles
 - **Rumble strips** - we would like to better address opposition from bicyclists
 - **Safety Edge** –we may develop specifications for the application of Safety Edge to concrete roadways
 - **Signing**– Interested in making it easier for locals to implement sign treatments on curves. We are also interested in identifying BCAs/CMFs for fluorescent signs.
 - **Automated vehicles** – interested in understanding infrastructure requirements of emerging technologies



Questions?

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