



Roadway Departure Focus State Initiative Roadside Safety Systems Inspection, Maintenance & Designers' Mentoring Program

Why worry about the roadside?

18,586 deaths per year in the USA

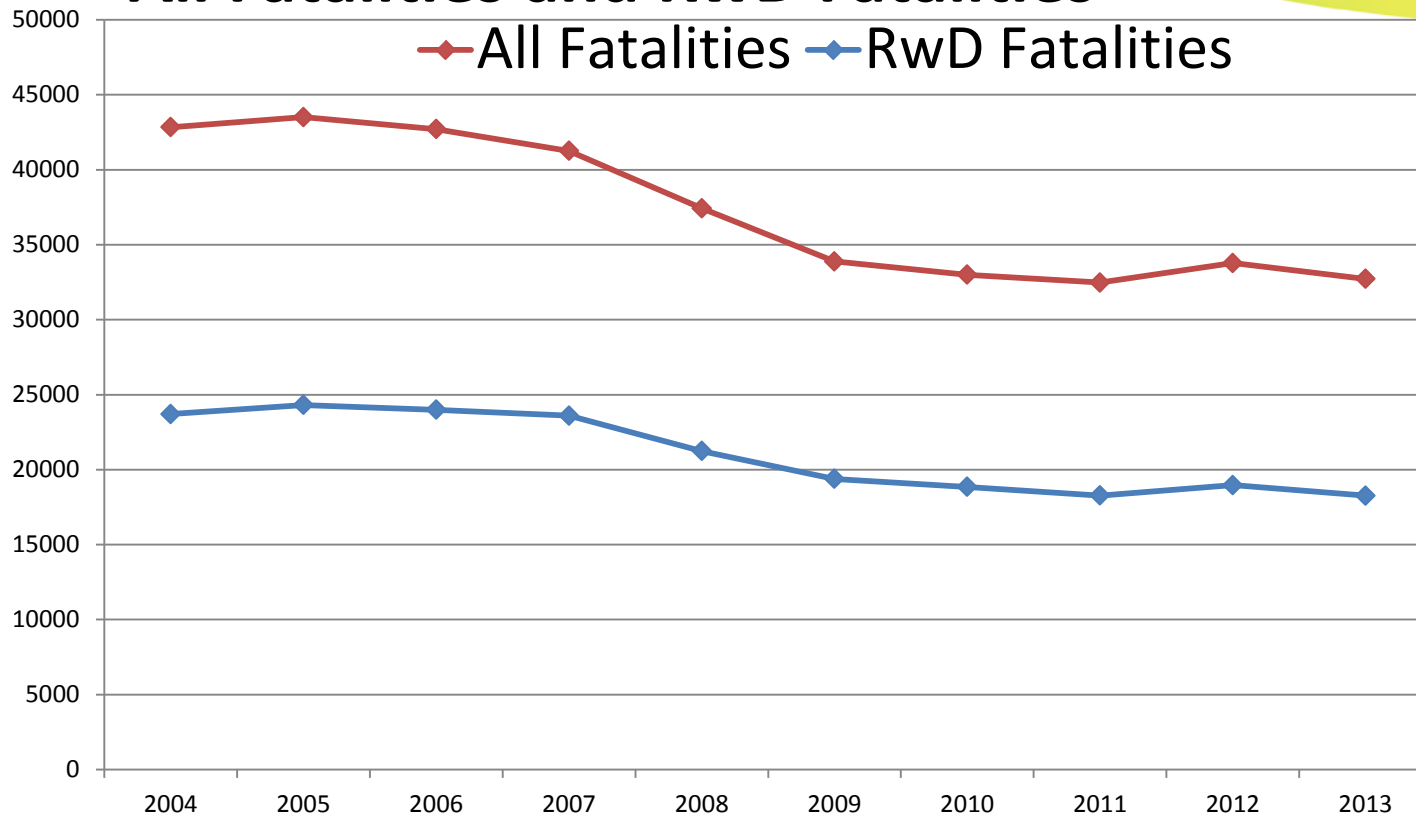


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<http://safety.fhwa.dot.gov>

Annual U.S. Fatalities and RwD Fatalities

All Fatalities and RwD Fatalities



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Federal Highway Administration

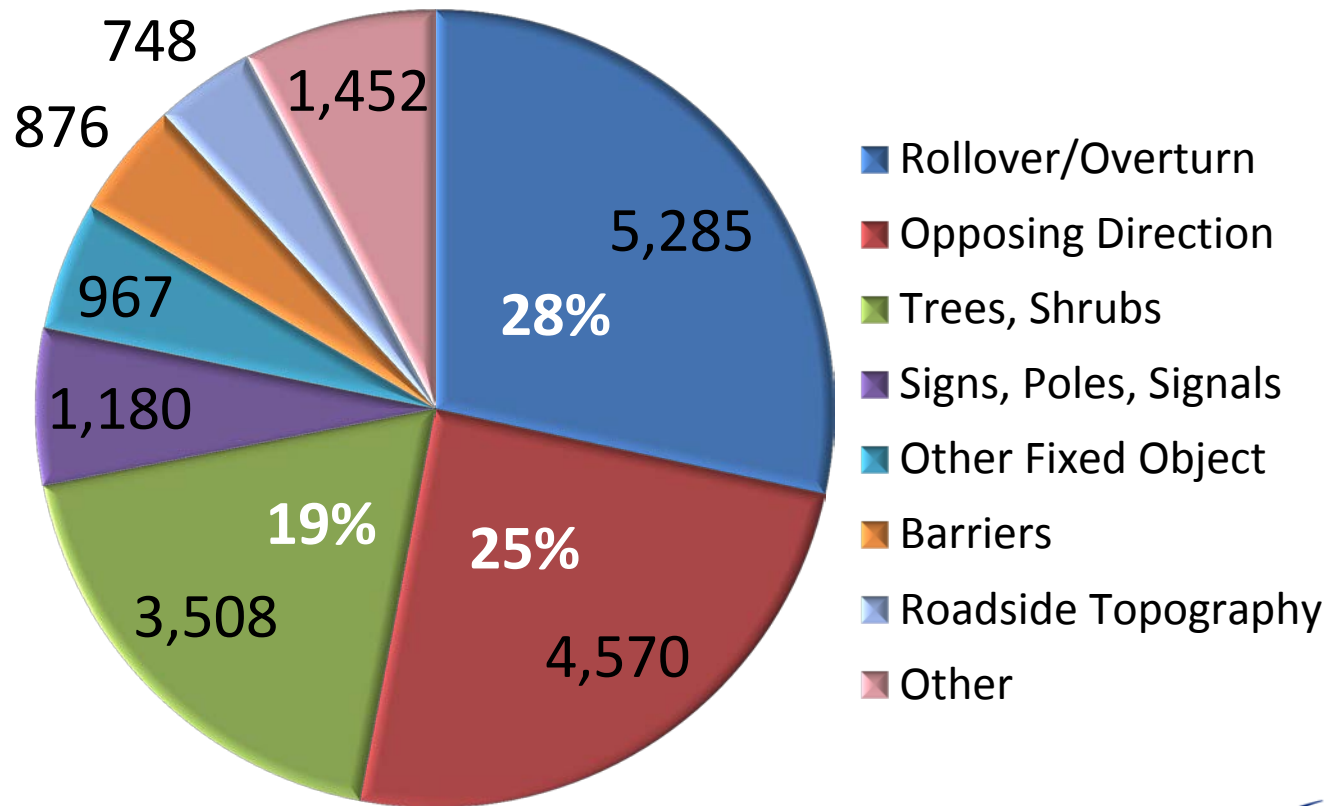


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Annual U.S. Fatalities and Rwd Fatalities

Rwd Fatalities by MHE (FARS 2010-2013)



Roadway Departure Strategic Plan

Goal:

Reduce national roadway departure fatalities by a minimum of 500 per year from the existing 17,000 per year to 8,500 per year by the year 2030.



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Roadway Departure Strategic Plan

Goal:

Reduce national roadway departure fatalities by a minimum of 500 per year from the existing 17,000 per year to 8,500 per year by the year 2030.

Fact: Roadside hardware installation & maintenance makes a difference.



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Generally Accepted Practice for Crash Testing Roadside Hardware – AASHTO MASH



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Generally Accepted Practice for Crash Testing Roadside Hardware – AASHTO MASH



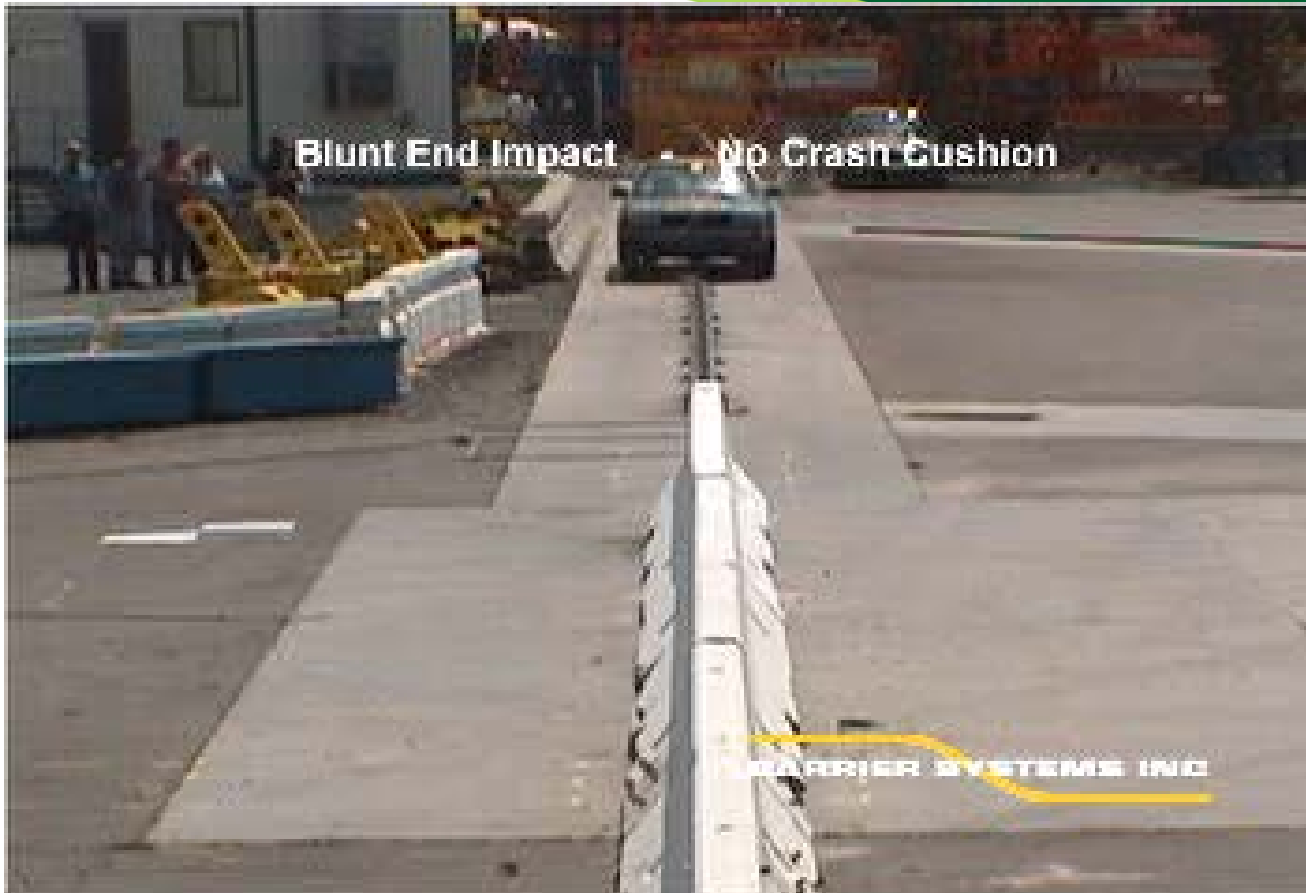
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Blunt Ends



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Generally Accepted Practice for Crash Testing Roadside Hardware – AASHTO MASH



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FHWA Memorandum: Roadside Safety Hardware dated May 26, 2015

 **Memorandum**

Subject: ACTION: Roadside Safety Hardware Date: MAY 26 2015

From: Tony Furst
Associate Administrator In Reply Refer To: IHSST

To: Division Administrators
Federal Lands Division Engineers
Safety Field

Purpose

The purpose of this memorandum is to bring to your attention two primary issues related to guardrail end terminals that will require you to take action. As you are aware, we have been closely examining the performance of guardrail end terminals. It's recognized that there are installation and maintenance challenges with these devices. As the construction season starts, and after the heavy winter, this is the appropriate time to pay particular attention to installation and maintenance issues. In this memo, FHWA emphasizes the need to have in place policies and procedures to evaluate the selection of roadside safety hardware relative to the roadway type, configuration and terrain; ensure its proper installation and maintenance; and periodically evaluate its in-service condition. In addition, we are aware there are some obsolete, non-crashworthy guardrail end terminals that still exist on the nation's highway system. We have raised awareness regarding these terminals through previous memoranda issued over a number of years. We strongly recommend that you encourage the removal of pre-NCHRP-350 guardrail end terminals.

Background

It is FHWA policy that roadside safety hardware installed on the National Highway System (NHS) should be in compliance with the crash testing and evaluation criteria contained in the Manual for Assessing Safety Hardware (MASH) or its predecessor the National Cooperative Highway Research Program (NCHRP) Report 350. Devices that are compliant with either of these two sets of criteria are currently considered crashworthy devices.

It is critical that devices be installed and maintained properly so they are in the best position to perform as designed and tested. Attached is a technical brief titled "Selection, Installation, and Maintenance of W-beam Guardrail End Terminals" which highlights general guidelines regarding the selection, installation, and maintenance of W-beam

- **policies and procedures** to evaluate the selection of roadside safety hardware relative to the roadway type, configuration and terrain;
- **proper installation & maintenance**; and periodically evaluate its in-service condition.



Existing conditions on U.S. Highways



Existing conditions on U.S. Highways



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Common Installation Issues



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Common Installation Issues



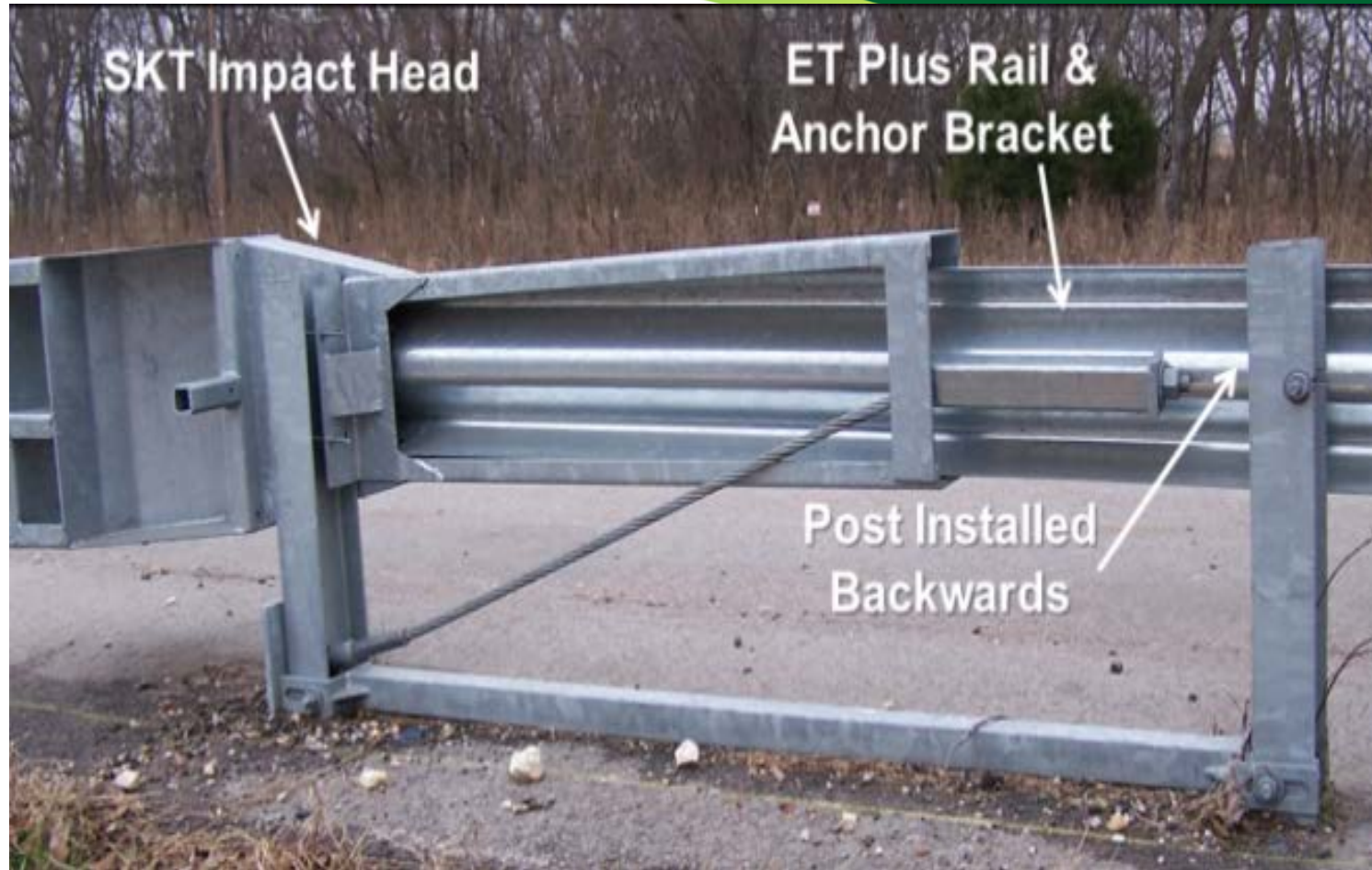
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Common Installation Issues



Blunt Ends



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Defining the Problem

Every 30 minutes



1 roadway departure fatality

On an average day



48 people die in
roadway departure crashes



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What tools do we currently have to help?



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FHWA Roadway Departure Strategic Plan

Objective 1:

Keep vehicles on the roadway, in their appropriate directional lane.

Strategies to achieve this objective include:

- Improved curve delineation;
- Advance Dynamic Speed Feedback signs for curves;
- Friction treatments in curves and other spot locations; and
- Center line, edge line and shoulder rumble strips.



FHWA Roadway Departure Strategic Plan

Objective 2:

Reduce the potential for crashes when vehicles do leave the roadway or cross into opposing traffic lanes.

Strategies to achieve this objective include:

- The Safety EdgeSM for all paving projects;
- Improved and maintained clear zones;
- Traversable roadside slopes; and
- Increased Separation between Opposing Lanes, particularly in curves.



FHWA Roadway Departure Strategic Plan

Objective 3:

Minimize the severity of crashes that do occur.

Strategies to achieve this objective include:

- Design, selection and placement of barriers to prevent rollovers;
- Design and placement of barriers in medians;
- Use of barriers to shield the roadside trees and other hazards; and,
- Improvement of other roadside safety hardware.



Inspection, Maintenance & Design Mentors' Program – Project Goals

Objectives 2 & 3:

To improve Roadway Departure safety through the following:

- Proper selection and design of barriers, terminals and crash cushions.
- Correct installation of these features.
- Maintenance and repair of damaged features.



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Roadway Departure
Technology Transfer



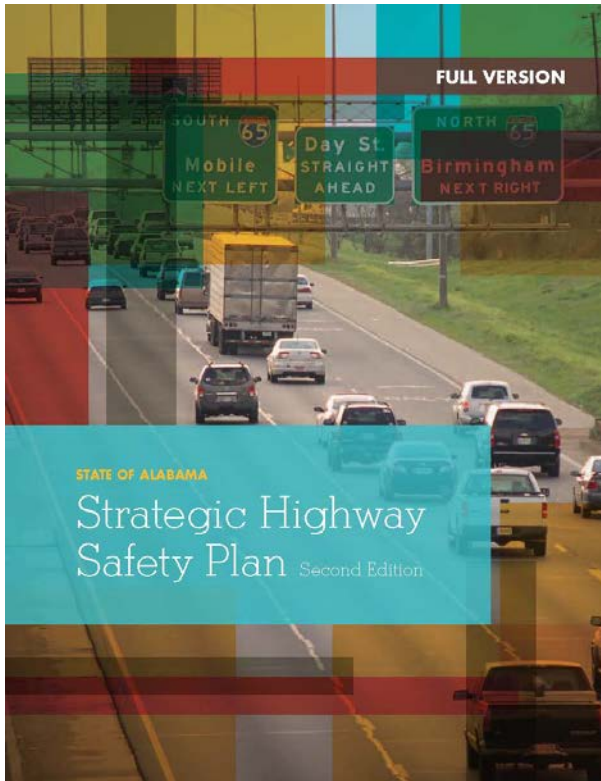
Roadside Safety System
Inspection/Maintenance
& Designer Mentor

Inspection, Maintenance & Design Mentors' Program

Why This Program?



Strategic Highway Safety Plan



State DOT Strategic Highway Safety Plan

- Roadway Departure Module that addresses countermeasures to reduce Roadway Departure Fatalities in the state



Inspection and Maintenance & Design Mentors' Program – Benefits

1. Provides the skills needed to design, install and maintain effective barrier systems.
2. Supports Strategic Highway Safety Plan (SHSP) by reducing the severity of run-off-road crashes.
3. Fosters a roadway departure safety culture in both highway designers and construction inspectors.
4. Provides the materials for the state to continue the training on a regular basis.



How does it Work?

- By offering the tools for the State DOTs to provide their personnel and contractors with the appropriate information needed to ensure optimal barrier installations.
- Using the team's expertise to review and/or assist in establishing state-of-the-art practices to enhance roadway departure safety.



What is Required?

- **State contact** – A committed leader that can coordinate and establish a team consisting of engineers, inspectors and maintenance personnel to review and comment on the materials and participate in conference calls.
- **FHWA Division Office representative** – To participate and be a member of the team.
- **State Legal Contact** – To review the liability issues involving the installation and repair of guardrails.



What is Required?

- **Training Facility** – To secure a training location to accommodate expected number of participants and manufacturers' exhibit space.
- **State Materials** – Crash data, State Standards, Specifications, Construction details, list of State approved systems and a list of state's barrier contractors.
- **Other** – State specific areas of concerns, problem areas, new areas, etc.

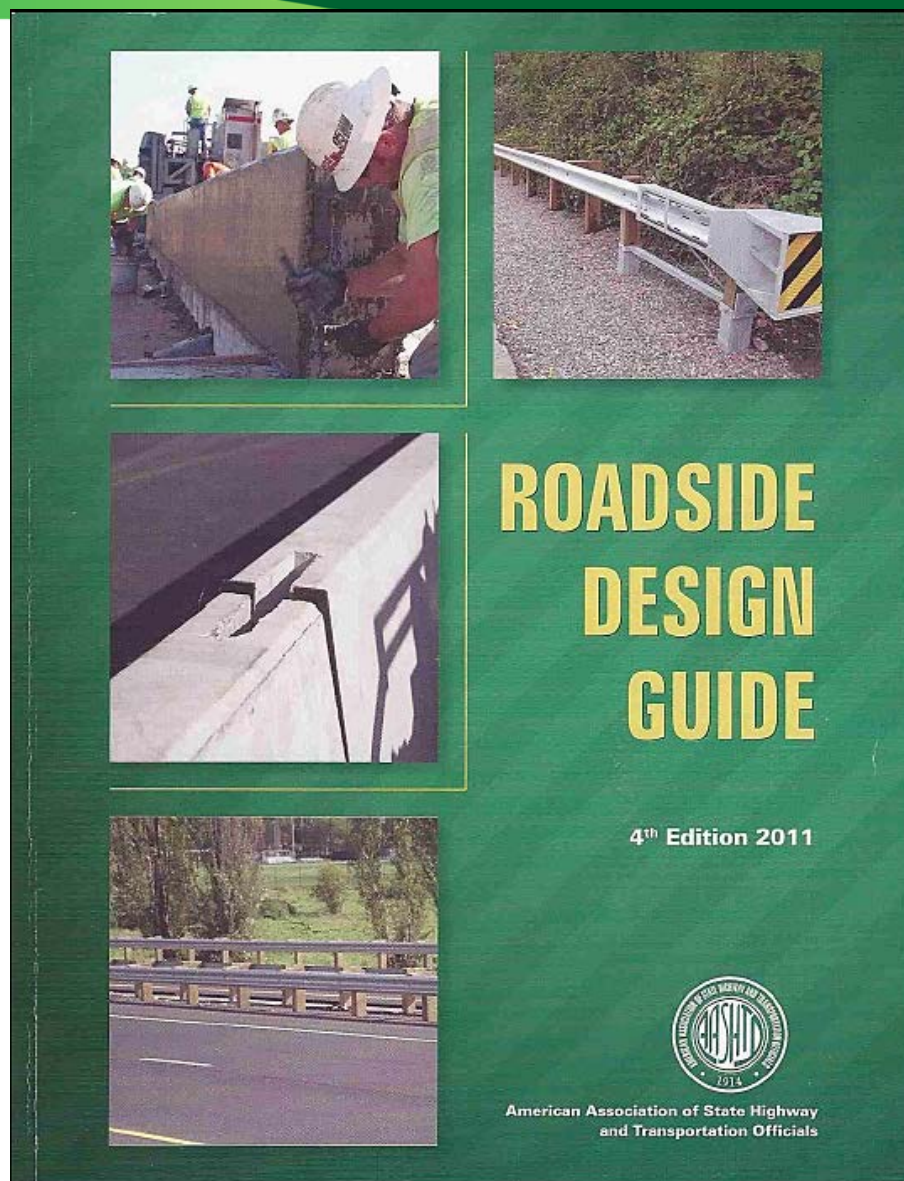


Project Deliverables?



Designer Training
Inspection and Maintenance
Training
Technical Briefs (5 topics)
Roadside Safety Pocket Guide
Resource Charts

Roadside Safety Systems Designer Training

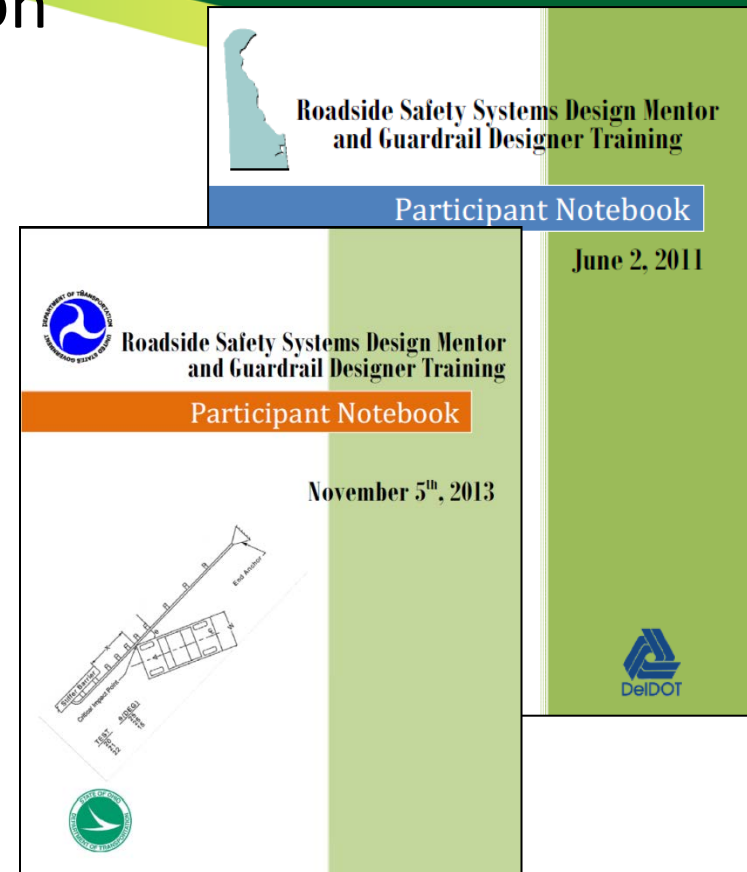


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Roadside Safety Systems Designer Training

- This is a one-day training session
- Target audience includes State and local government personnel and consultants having direct responsibilities for selecting and designing traffic barriers, including end terminals and transitions, and crash cushions

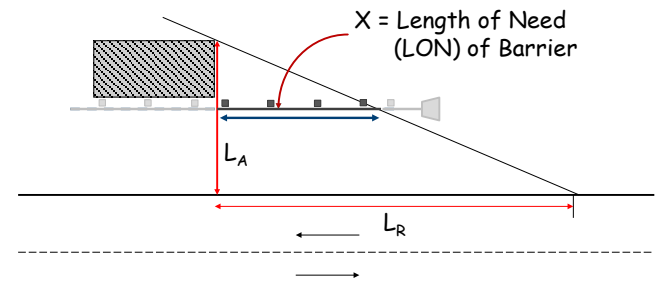


Roadside Safety Systems Designer Training

The course material consists of six sessions presented in PowerPoint, with photos and crash video clips and a workshop session. All references are **State specific** and utilize State standards, specifications and Design Manual.



Step 3: Intersect the Hypotenuse



Roadside Safety Systems Designer Training

Course Topics

- Session One – Defining the Problem, Describing Testing Requirements, and Pre-training Assessment.
- Session Two – Describing the Performance Characteristics of Common Barrier Systems.
- Session Three – Describing the Performance Characteristics of Common Terminals and Crash Cushions



Session 1

1-6



Course Topics (cont'd)

- Session Four – Examining Barrier Guidelines.
- Session Five – Design Considerations.
- Session Six – Workshop/Post-training Review/Course Evaluation.



Session 1

1-7



Roadside Safety System Inspection and Maintenance Training

- This is a two-day training session
- Target audience includes all levels of government, contractors, maintenance personnel, and inspectors having direct responsibilities for installing, maintaining, or inspecting traffic barriers, including end terminals and transitions, and crash cushions.



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FHWA Roadway Departure Technology
Roadside Safety Systems Installer Training

Participant Notebook

April 8th – 9th, 2013

Florida Roads

TDOT

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DelDOT

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Roadside Safety System Inspection and Maintenance Training – Day 1

The course material consisted of 7 sessions presented in PowerPoint, with photos and crash video clips. All references are **State specific** and utilize the State's standards, specifications & Design Manual w/objectives:

Objectives of Course

At the end of this 2-day training you will be able to:

- Identify when a traffic barrier is the best treatment to use at a specific site.
- Select a barrier that will adequately shield the identified hazard.
- Assess the topography of the site to ensure an optimal installation.
- Compare manufacturers' safety hardware products.

Objectives of Course (Cont'd)

At the end of this 2-day training you will be able to:

- Inspect completed work and correct potential shortcomings
- Maintain various guardrail and terminal systems

Roadside Safety System Inspection and Maintenance Training – Day 1

Course Topics

- Session One – Introduction
- Session Two – Testing Requirements and Performance Characteristics of Common Barrier Systems
- Session Three – Testing Requirements and Performance Characteristics of Common Terminals and Crash Cushions
- Session Four – Guardrail Design and Site-specific Installation Considerations



Session 1

1-7

Course Topics (cont'd)

- Session Five – Installation Considerations
- Session Six – Guardrail/Terminal Installation and Common Errors
- Session Seven – Maintenance of Systems



Session 1

1-8



Roadside Safety System Inspection and Maintenance Training – Day 2

The safety hardware manufacturers makes presentations on products used in the participating State, and participants are given hands-on familiarity with selected products on-site.



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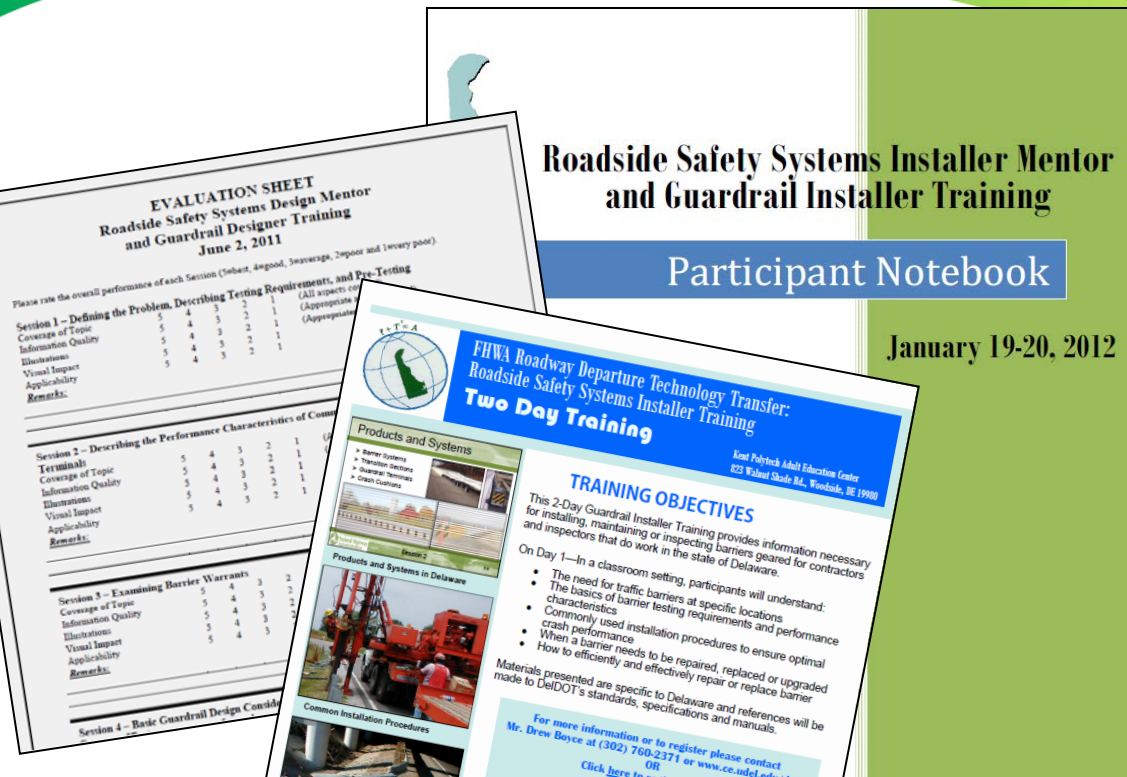
<http://safety.nwda.dot.gov>

State Input

- **What?** – are state problems/areas of concern that they would like the trainings to address.
- **Legal Issues** – how does state want to handle liability topics?
- **Products** – products on the state qualified approved list.
- **When?** – Training sessions usually held back-to-back.
- **Where?** – Facility needs adequate space for the indoor/outdoor displays.



State Training Tools



All materials used to present & facilitate the training will be packaged for the State.

Roadside Safety Systems Toolkit

Technical Briefs (5)

- Expand knowledge of the state-of-the-practice in Roadside Safety, for Design, Installation, and/or Maintenance.
- Provide summary information on topics selected by participating State to improve roadside safety.
- Can be used to fill existing gaps within existing state specifications.

Roadway Departure Technical Brief No. 3

Roadside Safety Systems Damage Assessment

Roadway Departure Technical Brief No. 4

Midwest Guardrail System (MGS)



CATEGORY: Design

ISSUE: Although standard strong-post W-beam remains one of the most widely used traffic barrier testing with today's high center of gravity vehicles has shown it to be near or at its performance roadside crashes. A new generic design, the Midwest Guardrail System (MGS) has been crash-tested at the discretion of State Departments of Transportation. The Louisiana DOTD plans to introduce the 27" high W-beam standard drawings and specifications, but most designers are not yet familiar with

ODOT
have
app
MGS
vari

Roadway Departure Technical Brief No. 3

Midwest Guardrail System (MGS)



CATEGORY: Design

ISSUE: Although standard strong-post W-beam remains one of the most widely used traffic barriers in the United States, recent testing with today's high center of gravity vehicles has shown it to be near or at its performance limits in high speed and angle roadside crashes. A new generic design, the Midwest Guardrail System (MGS) has been crash-tested and approved for use at the discretion of State Departments of Transportation. The Ohio DOT has recently introduced this design to replace its current 27 3/4" and 29" high Type 5 W-beam standard drawings and specifications, but some designers may not be familiar with this new barrier system.

OBJECTIVE: To provide additional information on the MGS system to ODOT design engineers and other personnel who may have responsibilities for installing, inspecting, or maintaining this design. As noted above, standard drawings for each of these applications have been developed by ODOT in conjunction with the introduction of the MGS guardrail.

METHODOLOGY: This Technical Brief will describe the MGS system characteristics and identify the types of locations for which variations of the design have been successfully crash-tested. For additional information please see the FHWA website at http://safety.fhwa.dot.gov/roadway_dept/policy_guidance/roadway_dept and also on AASHTO's Task Force 13 website at www.aashtotf13.org.



MASH TL-3 Test of MGS Transition to Thrie-beam



Roadway Departure Technical Brief No. 5

In-service Evaluation of Roadside Safety Features



can be installed on any public road in Florida, these features DOT's Qualified Products List (QPL). Even so, each barrier type, different crash performance, and varying degrees of required these variables is uniformly collected and analyzed statewide, it is used for use at specific locations and that some devices may not be

ing data on the performance and repair costs associated with roadside installation issues. This in-service performance data should be sent to the central office for review and analysis. vers where any serious crash involving roadside hardware has been terminal, or crash conditions require repair following an impact, type of feature impacted, suggested data items to record for each

each are cable barriers, W-beam guardrail, W-beam with rail, and roadside barrier or as a median barrier. The following data items

vehicle type and impact conditions (i.e., estimated speed and there is no police report, one may conclude the impact was minor



MASH TL-3 Test of MGS Transition to Thrie-beam



Technical Briefs (5)

- Briefs are categorized:
 - Design-related Topics
 - Maintenance-related Topics
 - Installation-related Topics
- Brief layout will contain:
 - Issue
 - Objectives
 - Methodology
 - Process



Existing Technical Briefs Developed

1. Pre-Installation Field Review Check List. (2)
2. Pre-Installation Field Review.
3. Guardrail Installation at Intersections, Side Roads, and Driveways.
4. Maintenance of Traffic Barrier Systems.
5. Roadside Safety System Damage Assessment
6. Roadside Safety System Damage Repair.
7. MGS Guardrail System.
8. Use of Guardrail with Curbs

Existing Technical Briefs Developed

9. In-service Evaluation of Roadside Safety Features
10. Selection and Grading of W-beam End Treatments (2).
11. Transitioning W-beam Guardrail to Existing Bridge Rails.
12. Maintenance of High Tension Cable Barrier
13. Damaged Roadside Hardware: Repair or Upgrade?
14. Drive-by Inspection of Safety Hardware

Roadside Safety Pocket Guide

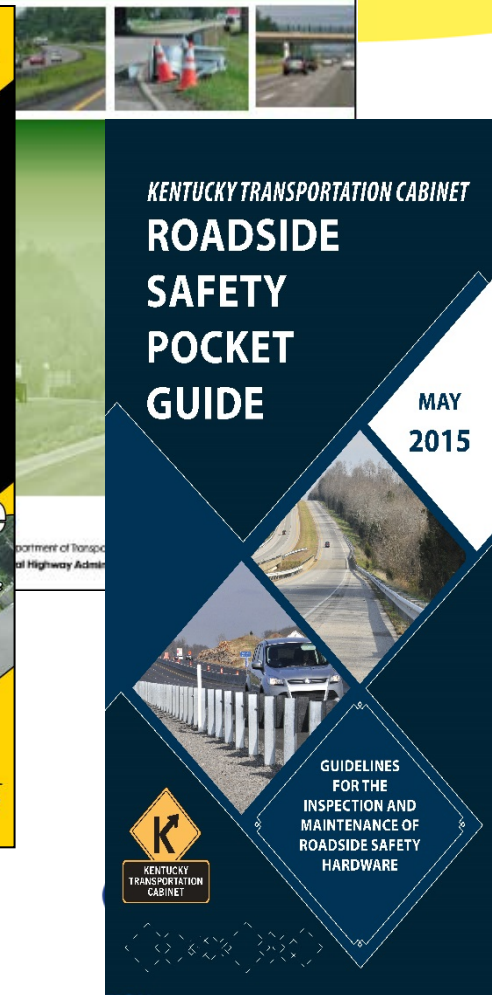
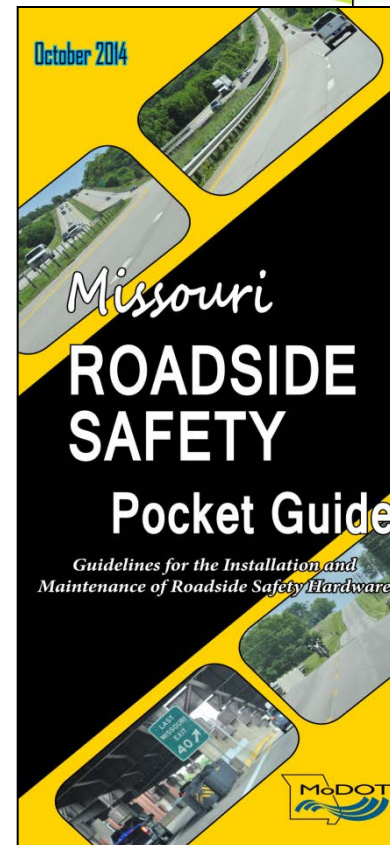
This is State specific guide and is designed to be used by field personnel involved in:

- selecting
- designing
- installing
- inspecting
- maintaining

roadside safety hardware.



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Content

Some of the areas covered in guide are:

- Guardrail Basics
- Clear Zone
- Types of Barrier
- Length of Need
- Types of Terminals and Crash Cushions
- Maintenance



Crash Cushion Attenuating Terminal (CAT-350)



Test Level: NCHRP 350 TL-3

How it works: During head-on impacts, the telescopes rearward, shearing out tabs between telescopes to decelerate the vehicle.

Locations: Median protection.

FLEAT Median Terminal (FLEAT-MT)



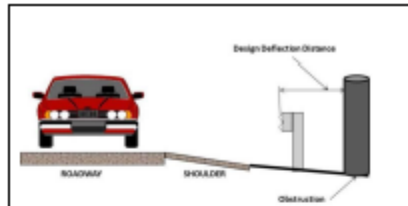
<http://www.roadsystems.com/fleat-mt.html>

Test Level: NCHRP 350 TL-3

How it works: During head-on impacts, the rail translates down the rail kinking the rail to decelerate the vehicle.

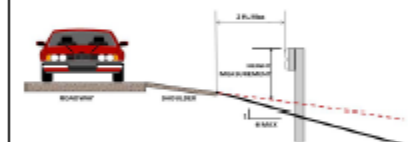
Locations: Median protection.

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Height Measurement

The minimum height of Strong-Steel Post W-Beam Guardrail is 27 1/8", measured as shown below or from the gutter line when set above a curb. If set behind a sidewalk barrier height should be set from the sidewalk elevation.



Barrier Placement on Slopes

Barrier, regardless of type, performs best when an impacting vehicle is stable when contact is first made. Since vehicles running off the road at high speeds tend to become airborne and are likely to override barrier placed on a slope, the following guidelines apply:

- Do not place W-beam guardrail on slopes steeper than 1V:6H.
- W-beam systems can be placed anywhere on 1V:10H or flatter slopes.
- MGS barrier can be installed on 1V:8H slopes but 1V:10H is preferred.

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Resource Charts

These charts have been developed as:

- National guidance.
- A resource or a quick guide for identifying and selecting various safety systems eligible for Federal reimbursement.
- Photos of existing in-service systems correctly installed.

http://safety.fhwa.dot.gov/roadway_dept/policy_guide/road_hardware/resource_charts/



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Resource Charts

Charts developed to date:

- Work Zone Barrier – Steel
- Cast-In-Place Concrete Barriers
- Aesthetic Barriers
- Roadside Post and Beam Rail Element
- Cable Barriers
- Roadside Terminals
- Median Terminals
- Crash Cushions









Resource Charts

Cable Barriers

August 23, 2012






* Systems can be installed on 1V:5H and 1V:4H slopes, but cable configuration and offsets from the roadway edge and from the ditch bottom must be in accordance with test results and manufacturers' recommendations.

NAME	MANUFACTURER	TEST LEVEL		POST TYPE	CABLE	DISTINGUISHING CHARACTERISTICS
		NCHRP 350	MASH			
Generic Weak-post Cable Guardrail (Low Tension)		Generic	3	I-Beam Post Flanged steel U-Channel Post Weakened rounded Timber Posts	3 cable configuration. Cables placed on one side of post; the side closer to the road - Roadside Application. Two cables are placed on one side of the post and the other cable is placed on the opposite side - Median Application.	Cables are attached with hook bolts. Uses a crashworthy generic terminals. Typical Post Spacing 4 ft to 16 ft.
Brifen Wire Rope Safety Fence (WRSF) http://www.brifenua.com		Brifen	3 and 4	Z Shaped Posts	3 and 4 cable configuration. Interweaving of cables between adjacent post.	Top cable is placed in a slot at the center of the post. Other 2 or 3 cables are weaved around post. Uses proprietary terminal. Posts can be driven or socketed. Typical Post spacing 10.5 ft to 21 ft.
Gloralter http://gloralters.com		Gloralter	3 and 4	C Channel Posts	3 and 4 cable configuration. Pre-stretched or Non-pre-stretched.	Cables are attached using a single steel hair pin. Posts are placed such that adjacent post are on opposite sides of the cable. Uses proprietary terminal. Posts can be driven or socketed. Typical Post spacing 10 ft to 30 ft.
Nucor Steel Marion Cable Barrier System http://nucorhighway.com/rsc-cable.html		Nucor Steel Marion	3 and 4	U Channel Posts	3 and 4 cable configuration. Pre-stretched or Non-pre-stretched.	Cables are attached using locking hook bolts or hook bolts and a strap. 2 of 4 cable are placed on one side of post and the other two are placed on the opposite side. Uses proprietary terminal. Posts can be driven or socketed. Typical Post spacing 6.6 ft. to 20 ft.
Safence http://www.gregorycorp.com/highway/safence.cfm		Gregory Highway Products	3 and 4	C-shaped Posts	3 and 4 cable configuration.	All cables are inserted in a slot at the center of the post and separated by plastic spacers. Uses proprietary terminal. Posts can be driven or socketed. Typical Post spacing 6.5 ft to 33.2 ft.
CASS http://www.highwayguardrail.com/products/cb.html		Trinity Highway Products, LLC	3 and 4	C-shaped and I-Beam Post (S3 & S4)	3 and 4 cable configuration. Pre-stretched or Non-pre-stretched configuration.	Cables are placed in a wave-shaped slot at the center of the post and separated by plastic spacers. Some versions also have cables that are supported on the flanges of the post. Uses proprietary terminal. Posts can be driven or socketed. Typical Post spacing 6.5 ft to 32.5 ft.

Resource Charts

Roadside Terminals





August 28, 2012

NAME	MANUFACTURER	PERFORMANCE CHARACTERISTICS		TEST LEVEL		FLARED	TANGENT	31-inch Height (optional)	DISTINGUISHING CHARACTERISTICS	LOCATIONS CAN BE USED
		Energy Absorbing	Non Energy Absorbing	NCHRP 350	MASH					
Vermont G1-d		Generic	X	2		X			No impact head. Shop-bent w-beam 5 ft flare. Concrete anchor block with steel rod connecting at post 3.	Driveway turnouts
Modified Eccentric Loader Terminal (MELT)		Generic	X	2		X			No impact head. Rail installed on parabolic curve. Strut between the steel tube foundation for the two end posts to act together to resist the cable loads. All wood posts.	Installed only where a reasonable runoff area exists behind and downstream of the terminal. End of W-beam rail with offset of 4'-0".
Buried-in-Backslope Terminal		Generic	X	3		X			No impact head. Height of W-beam rail should be held constant in relation to the roadway shoulder elevation until barrier crosses the ditch bottom. Rubrail should be added below the w-beam.	Cut sections of a roadway When the road transitions from a cut to a fill.
Eccentric Loader Terminal (ELT)		Generic	X	3		X			End consists of a fabricated steel weldment inside a section of corrugated steel pipe. Rail installed on parabolic curve. Strut between the steel tube foundation for the two end posts to act together to resist the cable loads. All wood posts.	Installed only where a reasonable runoff area exists behind and downstream of the terminal. End of W-beam rail with offset of 4'-0".
Slotted Rail Terminal (SRT-350) http://www.highwayguardrail.com/products/wt-rt350.html		Trinity Highway Products, LLC	X	3		X		X	No impact head. Longitudinal slots on W-beam rail element. Strut and cable anchor bracket between post 1 and 2 act together to resist the cable loads. Slot Guards on downstream end of slots. Steel and wood post options available. Parabolic flare on wood post. Straight line flare on all SYTP steel post version and HBA steel/wood post version.	Installed only where a reasonable runoff area exists behind and downstream of the terminal. End of W-beam rail with offset of 4'-0". Wood post option has 3'-0" to 4'-0" offset.

Resource Charts

Median Terminals

August 23, 2012





NAME	MANUFACTURER	PERFORMANCE CHARACTERISTICS		TEST LEVEL		33-inch Height (option)	DISTINGUISHING CHARACTERISTICS	HOW IT WORKS	LOCATIONS CAN BE USED
		Energy Absorbing	Non-Energy Absorbing	NCHRP 350	MASH				
Brakemaster 350 http://www.energyabsorption.com/products/products_brakemaster350_craib.asp		Energy Absorption Systems, Inc.	X		3		Steel posts are not embedded. Break Tension System at post #1. Short W-Beam rail sections that translate over each other.	During head-on impacts, the system telescopes rearward, using friction technology to decelerate the vehicle.	Low frequency impact areas. In the median with 1-way or 2-way traffic.
Crash Cushion Attenuating Terminal (CAT-350) http://www.highwayguardrail.com/products/cat350.html		Trinity Highway Products, LLC	X		3		Breakaway wood posts and a cable anchorage system. The beam elements are slotted W-beam rail sections. Nose is 10 gauge And first set of rails are 12 gauge and second set of rails are heavier 10 gauge.	During head-on impacts, the system telescopes rearward, shearing out tabs between the slots to decelerate the vehicle.	Low frequency impact areas. Attached directly to a W-Beam median barrier, or to a Thrie-Beam median barrier using the standard W-Beam to Thrie-Beam transition section.
TREND 350 Median http://www.highwayguardrail.com/products/tet.html		Trinity Highway Products, LLC	X		3	X	Square Impact Face. All steel driven posts. Breakaway steel posts at #1 and #2, standard steel guardrail posts #3 and beyond. Steel Strut between posts #1 and #2.	During head on impacts the system telescopes rearward, using between the system rails and the deformation of the rails to decelerate the vehicle.	Low Frequency impact areas. Attached directly to a W-Beam Median Barrier, or to a Thrie-Beam median barrier using the standard W-Beam to Thrie-Beam transition section.
FLEAT Median Terminal (FLEAT-MT) http://www.roadsystems.com/fleat-mt.html		Road Systems, Inc.	X		3	X	Two impact heads, two modified W-beam rails, standard W-beam rails, two breakaway cable anchor assemblies and weakened steel or wood posts. Uses many of the same components as the roadside FLEAT terminal.	During head-on impacts, the impact head translates down the rail kinking the rail to decelerate the vehicle.	Low frequency impact areas. Attached directly to a W-Beam median barrier, or to a Thrie-Beam median barrier using the standard W-Beam to Thrie-Beam transition section.



Resource Charts

Crash Cushions

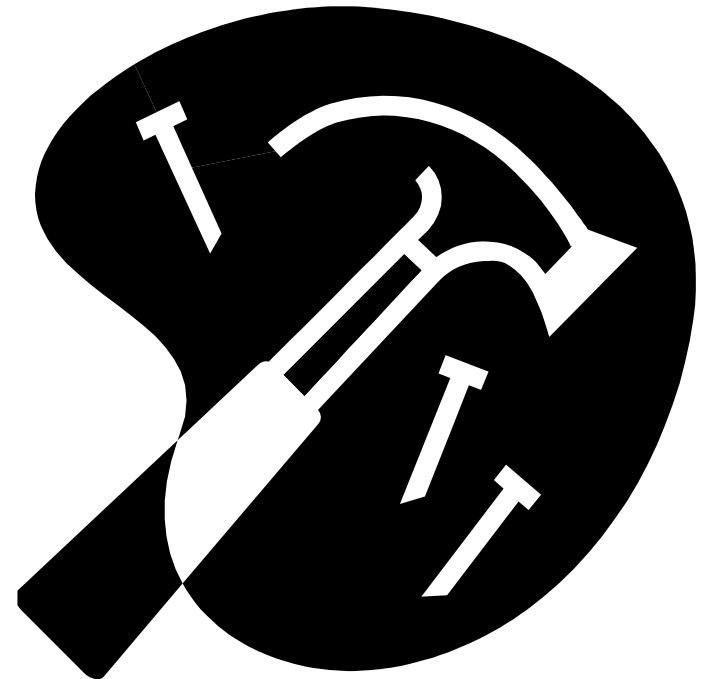
August 23, 2012

NAME	MANUFACTURER	PERFORMANCE CHARACTERISTICS			TEST LEVEL		DIMENSIONS			LOCATIONS		HOW IT WORKS	LOCATIONS CAN BE USED	MAINTENANCE CHARACTERISTICS (per AASHTO RDG)
		Non-Reflective, Gating	Reflective, Gating	Reflective, Non-gating	NCHRP 350	MASH	WIDTH (without transitions)	LENGTH	HEIGHT	PERMANENT	TEMPORARY			
BEAT-SSCC Single Sided Crash Cushion http://www.roadsystems.com/beat-sscc.html	 Road Systems, Inc.		X		TL3		24"	28'-0" standard but available in lengths of 32', 36', 40', 44'	28"	X		Mandrel section of the impact head bursts the tubing to absorb the impact energy. Attaches directly to rigid barriers, bridge rails and abutments.	Shoulder Protection Ground mounted or surface mounted post on a concrete pad.	Sacrificial
BEAT-BP Bridge Pier System http://www.roadsystems.com/beat-bp.html	 Road Systems, Inc.		X		TL3		Variable to adjust to pier widths	Variable to adjust to number of piers and pier spacing. I.e. 1 pier = 79', 2 pier = 103', 3 pier = 115', 4 pier = 151'	28"	X		Mandrel section of the impact head bursts the tubing to absorb the impact energy. System completely surrounds piers and has attenuator at both approach ends.	Median protection at bridge piers.	Sacrificial
Quadrend http://www.energyabsorption.com/products/products_quadrend150_end.asp	 Energy Absorption Systems		X		TL3		15"	20'-0"	32"	X		Quadbeam rail sections translate downstream while sand filled containers are crushed. Attaches directly to rigid barriers, bridge rails and abutments. Requires redirecting cable on backside of system to direct the rail sections away from traffic. Requires Paved Pad.	Shoulder protection at the end of rigid barriers	Sacrificial
X-TENuator http://www.barriersystemsinc.com/x-tenuator	 Barrier Systems, Inc.			X	TL3		21"	24'-9"	27.75"	X	X	Impact head has locking bar to lock cables into place. The friction between the cables and the impact head dissipates crash energy.	Median or shoulder Protection Gore Two-side Protection	Sacrificial

Resource Charts

Currently under development:

- Work Zone Barriers
- Median Post and Beam Rail Element



State Resources Tools



Electronic versions of the Technical Briefs, Pocket Guide, and Resource charts will be provided to the State for publishing.

Roadside Safety Systems Toolkit



Evaluations



- **90 Days Evaluation – All training attendees**
- **1 year Evaluation – Program Completion**
To determine what Missouri has done with the materials provided.



DOT Manager



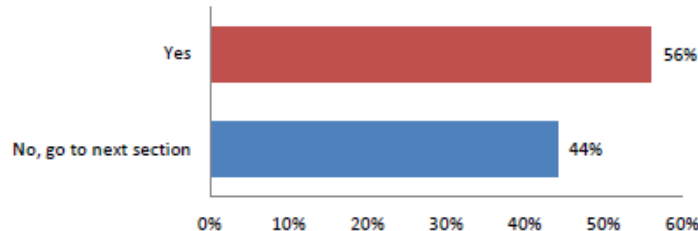
State Personnel



Evaluation Summary

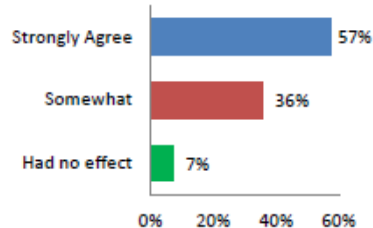
B. Roadside Safety Design Mentor and Designer Training

1. Did you attend this 1-day training?



50 total responses, 28 - attended training.

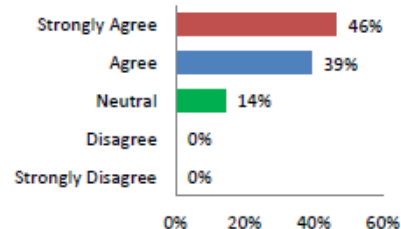
2. Did the training help meet your present work objective?



28 total responses.

16 - Strongly agree that the training help met their present work objective.

3. As a result of the training, has your understanding of the subject matter improved?



28 total responses.

13 - Strongly agree that the training help met their present work objective.

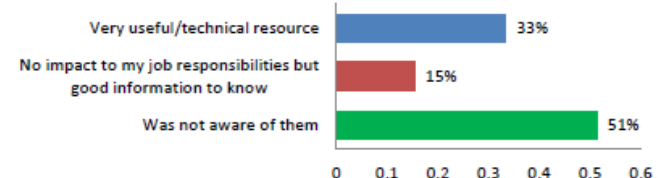
4. Additional Comments/Recommendations:

4 total responses, 14% of submissions.

- Excellent
- I liked watching the testing of guiderail. It was interesting to see how it held up under crash situations.
- This is extremely important to my field of 3R projects. One issue is the conundrum of a T intersection at a creek; what to do around a radius to protect drivers from the bridge and perpendicular creek. Radius guide rail treatment is the only current option yet hit head on presents a fixed object/ramping hazard. For which the FHWA presents no better solution. We need to collaborate and resolve.
- I think training should be done once a year as a refresher along with new updated data.

C. Roadway Departure Technical Briefs

1. FHWA developed technical briefs specific to your state for the Design, Maintenance and Inspections disciplines. What is your overall appraisal of the Technical Briefs?



39 total responses, 20 - responded that they were not aware of them.

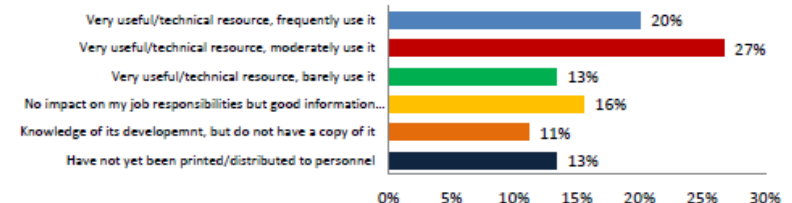
2. Additional Comments/Recommendations:

2 total responses, 5% of submissions.

- Good information
- The last memo – Roadside Design: Steel Strong Post W-Beam Guiderail – dated 5/17/10 is fine. However FHWA is ahead of PennDOT policy. Keep our options open. We work in a world of "Alterations" and very limited "New Construction"

D. Roadway Safety Pocket Guide

1. FHWA developed a Roadside Safety Pocket Guide for your state. What is your overall appraisal of the Roadside Safety Pocket Guide?



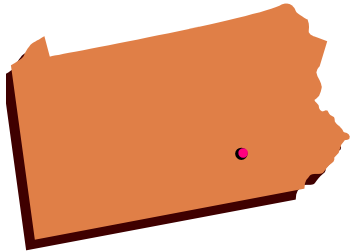
45 total responses, 12- responded that it is a very useful/technical resource and they use it moderately.

2. Additional Comments/Recommendations:

5 total responses, 11% of submissions.

- Great. Great. Great. I keep and use the Roadside Pocket Guide EVERY TIME I design a guide rail system. Good job for using English Units only. Leave metric for the chemist/micro-fields. 2 unit manuals are ineffective and show blurred vision. English system is intuitive. We are a binuminate nation. Keep politics out of Transportation. Thank you.
- I carry the Publication with me on every field review for guiderail and consider it to be 'essential'.
- I would like to have one of these Roadside Safety Pocket Guides.
- In addition to having it saved on my computer, I just printed it off last week
- Need a copy of the Roadside Guideline manual to prove to people what it

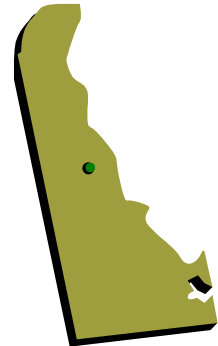
Where have we gone?



Pennsylvania (Nov. 2009—Nov. 2010)



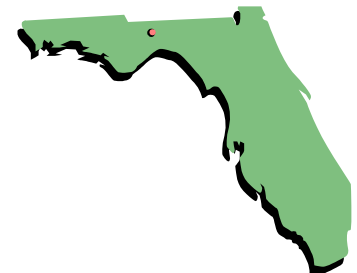
Delaware (Feb. 2011—Feb. 2012)



Louisiana (May 2012 – November 2012)



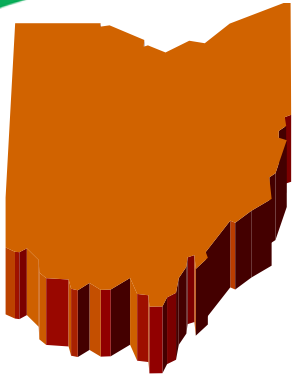
Florida (January 2013 - May 2013)



U.S. Department of Transportation
Federal Highway Administration



Where have we gone?



Ohio (June 2013—Dec. 2013)



Tennessee (Nov. 2013—April 2014)



Texas (Feb. 2014—Sept. 2014 est.)



Missouri (May 2014—Oct. 2014)



U.S. Department of Transportation
Federal Highway Administration

Where have we gone?



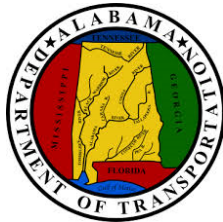
Georgia (October 2014—March 2015)



Kentucky (Nov. 2014—May 2015.)



Alabama (June 2015—November 2015)



U.S. Department of Transportation
Federal Highway Administration

Thank You!

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U.S. Department of Transportation
Federal Highway Administration

 **Safe Roads for a Safer Future**
Investment in roadway safety saves lives
<http://safety.fhwa.dot.gov>