U.S. Department of Transportation
Federal Highway Administration

SafetyEDGE
Your Angle for Reducing Roadway Departure Crashes

SAFETY EDGE

Module 1: Introduction of EDC Initiatives

Level of Audience: Engineers, Project Managers and Municipal Authorities

Instructor: Dr. Benjamín Colucci

Duration: 1.5 Hours

Acronyms

AAA	American Automobile Association
AASHTO	American Association of State Highways and Transportation Officials
DTOP	Department of Transportation and Public Works
DUI	Driving Under Influence
EDC	Every Day Counts
EIS	Environmental Impact Statements
FAQ's	Frequently Asked Questions
FARS	Fatality Analysis Reporting System
FHWA	Federal Highway Administration
NHTSA	National Highway Traffic Safety Administration
OGFC	Open Graded Friction Course
PCC	Portland Cement Concrete
PRHTA	Puerto Rico Highway and Transportation Authority
PRLTAP	Puerto Rico Local Technical Assistance Program
RAP	Reclaimed Asphalt Pavement
RC	Ramp Champ
RDG	Roadside Design Guide
ROR	Run Off the Road
SE	Safety Edge
SWM	Shoulder Wedge Maker
TRB	Transportation Research Board
WMA	Warm Mix Asphalt

Learning Outcomes

1. Define the Puerto Rico Transportation Technology Transfer Center.
2. Define the Every Day Counts Initiative.
3. Discuss the Every Day Counts Initiatives.

Puerto Rico Transportation Technology Transfer Center

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Your Angle for Reducing Roadway Departure Crashes

Centro de Transferencia de Tecnología en Transportación
1986-2011
Aniversario
Excelencia en el Adiestramiento y Capacitación de Oficiales en la Transportación, Municipales y Estatales.

Dr. Benjamín Colucci
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Director

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Associate Director

Draft Module

Our Center

- Established in1986
- Civil Engineering Department, University of Puerto Rico at Mayagüez
- Sponsors:
  - Local Technical Assistance Program (LTAP)
  - Department of Transportation and Public Works (DTOP)
  - Virgin Islands Department of Public Works

Present…

- 58 LTAP Centers in United States including Puerto Rico

Tribal Centers:

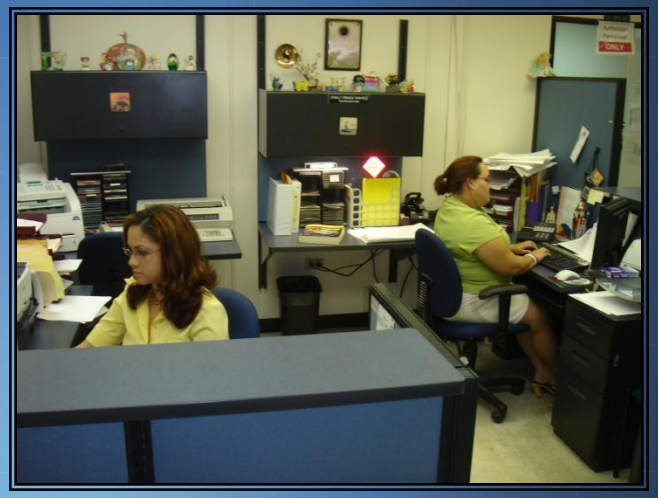
- East Mississippi
- Colorado
- California
- North Valleys
- Alaska
- Northwest
- Oklahoma

Objectives

- Provide technical assistance to municipalities and local transportation agencies.
- Provide information in the planning, design, construction, maintenance and operation of transportation facilities.

Resources

- Office Space - 1,200 feet ^{2}
- Personnel
  - Director, Benjamín Colucci
  - Associate Director, Alberto M. Figueroa
  - Training Manager, Gisela González
  - Administrative Coordinators
    - Ms. Grisel Villarrubia
    - Mrs. Irmalí Franco
  - Students

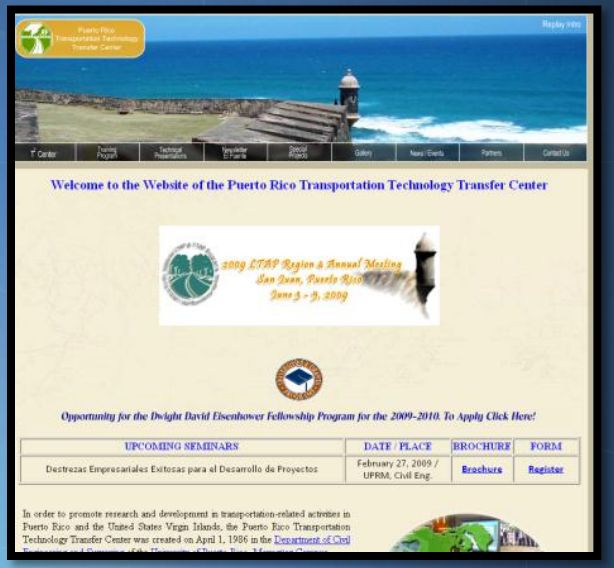


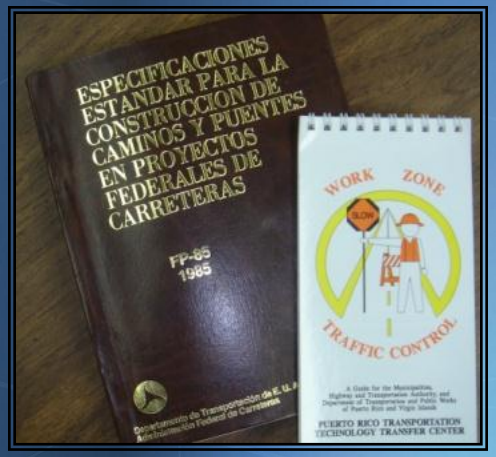
Resources

- Technical Support
  - University professors specialized in different areas
  - Private sector instructors
  - Instructors from other centers in United States
- Specialized Equipment
- Audiovisual Equipment
- Computer Software's

Activities

- Bilingual Newsletter - "*El Puente*"
- Technical Information Services
  - Technical Library/Audiovisual
- Computer Software's
- Postal Address/Electronic List
- Web site: http://www.uprm.edu/prt2
- Special Projects





Lessons Learned

- During the past 25 years, Puerto Rico Transportation Technology Transfer Center has learned the importance of:
  - Instructor & Topic
  - Audience Interest
  - Quality, not quantity
  - Consistency

Additional Information…

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E-mail: grisel.villarubia1@upr.edu

http://www.uprm.edu/prt2

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EDC INITIATIVES

Instructor: Eng. Alvin Gutiérrez

Historic Background of EDC Initiative

- The Every Day Counts Initiative (EDC) is designed to identify and deploy innovation aimed at

  - ✓ shortening project delivery,
  - ✓ enhancing the safety of our roadways, and
  - ✓ protecting the environment.

Nine (9) EDC Initiatives

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1. Warm-Mix Asphalt (WMA) ✓
2. Safety Edge ✓
3. Geosynthetic Reinforced Soil (GRS) ✓
4. Prefabricated Bridge Elements Systems (PBES) ✓
5. Adaptive Signal Control Technology (ASCT) ✓
6. Enhanced Technical Assistance on Stalled EISs
7. Flexibilities in ROW
8. Flexibilities in Utility Relocation
9. Design Build (D-B)

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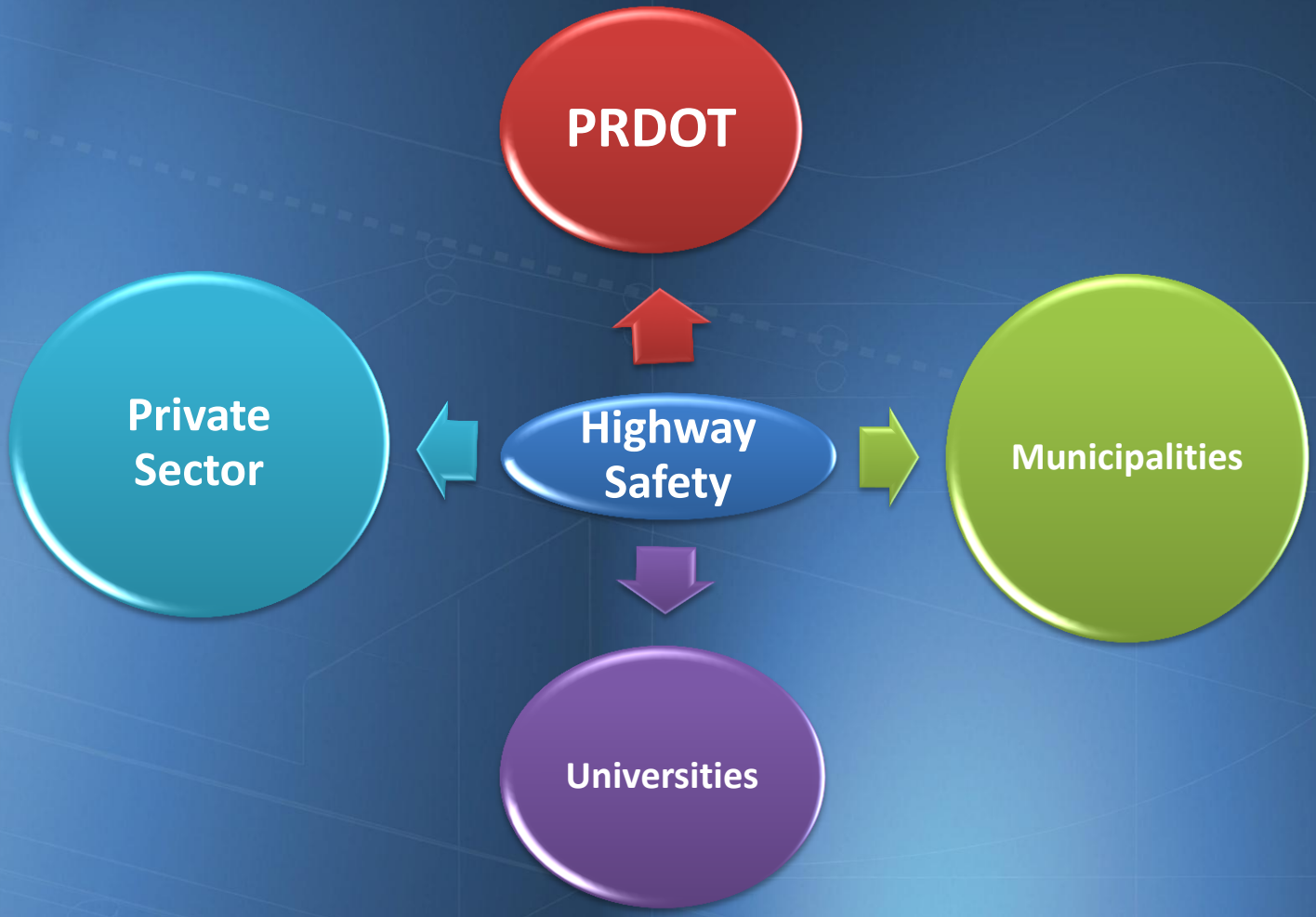
EDC SAFETY EDGE IN PUERTO RICO

Instructor: Eng. Ana Torres

Is Highway Safety important for everyone?



Every Day Counts: Safety Edge in Puerto Rico

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1. Literature Review
2. Field Tests
3. Safety Edge Specification
4. Implementation of Safety Edge

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WHAT IS SAFETY EDGE?

Instructor: Eng. Juan C. Rivera

Description of the Problem: Forgiving Roadside Concept

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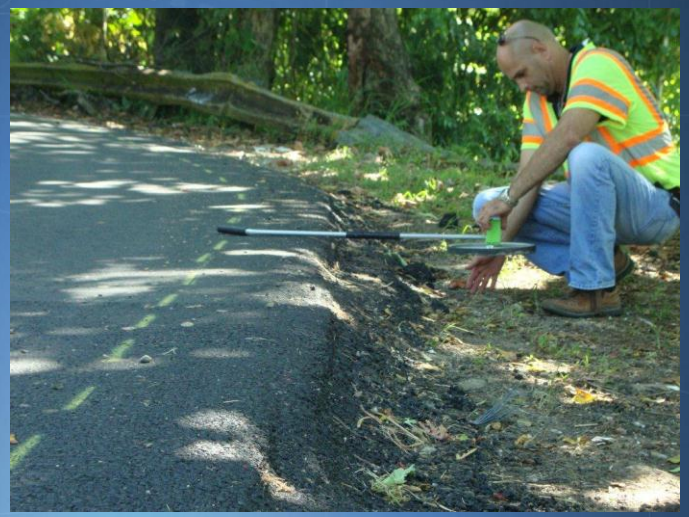
Your Angle for Reducing Roadway Departure Crashes

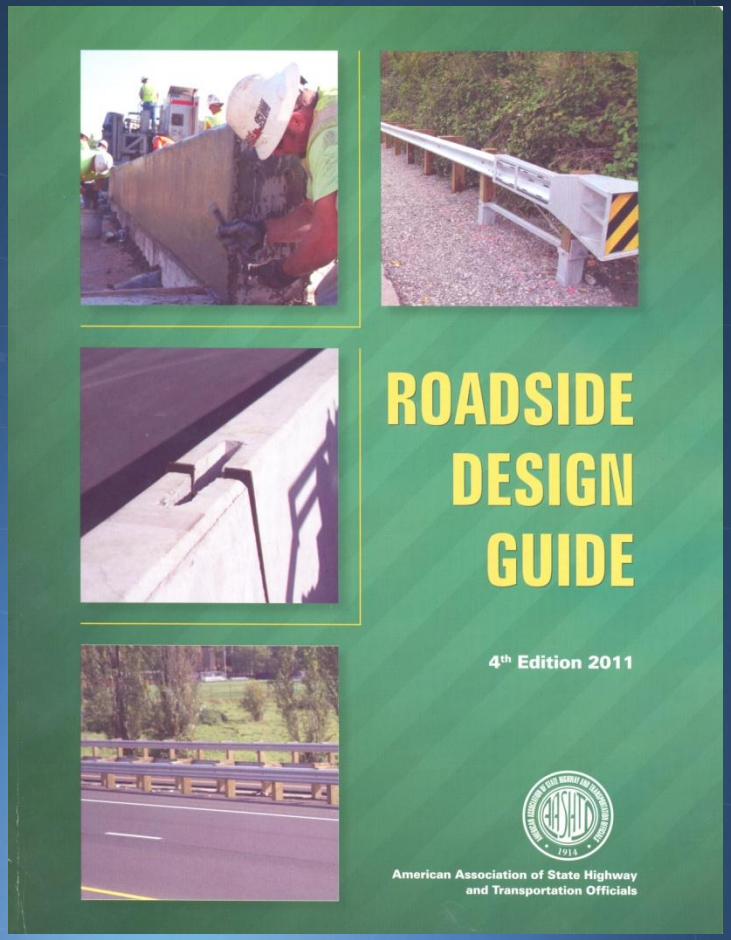
- Reasons by which a vehicle might leave the roadway and encroach on the roadside:
  - ✓ Driving under the influence of drugs or alcohol
  - ✓ Adverse roadway conditions (weather)
  - ✓ Vehicle component failure
  - ✓ Driver distractions
  - ✓ Crash avoidance
  - ✓ Excessive speed
  - ✓ Driver fatigue
  - ✓ Poor visibility



Adapted from: Roadside Design Guide, 4th Edition 2011

Roadside Design Guide

- Roadside Design Guide, 4th Edition 2011
- American Association for State Highway and Transportation Officials (AASHTO)
- Included concepts:
  - Clear Zone
  - Slopes
  - Safety Devices



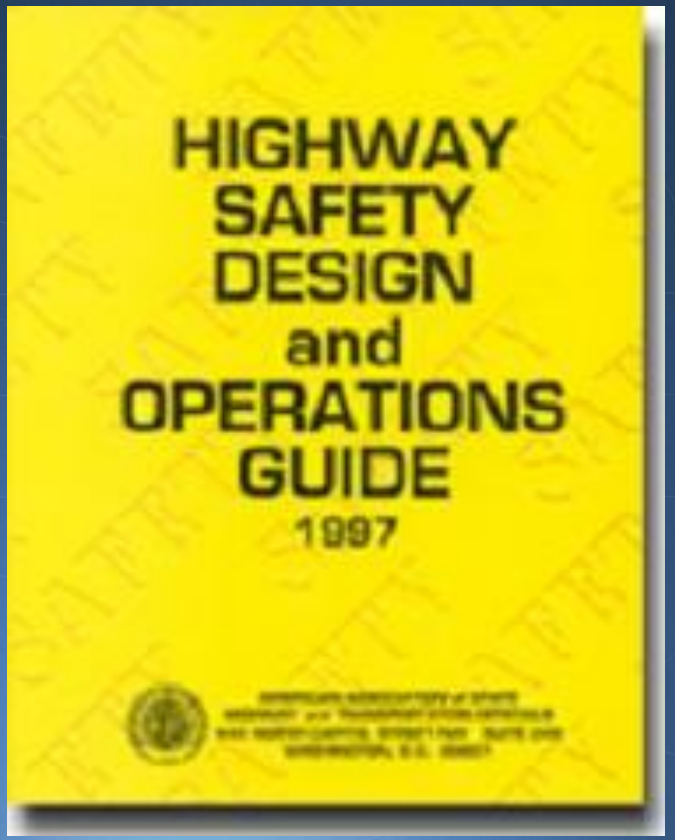
Description of the Problem: Clear Zone Concept

- Crashes before 1960's:
  - Vehicle Head-on
  - Adjacent Trees
- Crashes after 1960's:
  - Sign Supports
  - Ditches
  - Bridges
  - Piers

Adapted from: Roadside Design Guide, 4th Edition 2011

Description of the Problem: Clear-Zone Concept

"For adequate safety, it is desirable to provide an unencumbered roadside recovery area that is as wide as practical on a specific highway section. Studies have indicated that on high-speed highways, a width of 9 m [30 ft] or more from the edge of the through traveled way permits about 80 percent of the errant vehicles leaving the roadway to recover".



Adapted from: Roadside Design Guide, 4th Edition 2011

Description of the Problem: Clear-Zone Concept

- Suggested Clear-Zone Distances from the Edge of Through Traveled Lane

(Table 3-1, Roadside Design Guide, 4th Edition 2011)

U.S. Customary Units

Design Speed (mph)	Design ADT	Foreslopes			Backslopes		
		1V:6H or flatter	1V:5H to 1V:4H	1V:3H	1V:3H	1V:5H to 1V:4H	1V:6H or flatter
≤40	UNDER 750[c]	7–10	7–10	[b]	7–10	7–10	7–10
	750–1500	10–12	12–14	[b]	12–14	12–14	12–14
	1500–6000	12–14	14–16	[b]	14–16	14–16	14–16
	OVER 6000	14–16	16–18	[b]	16–18	16–18	16–18
45–50	UNDER 750[c]	10–12	12–14	[b]	8–10	8–10	10–12
	750–1500	14–16	16–20	[b]	10–12	12–14	14–16
	1500–6000	16–18	20–26	[b]	12–14	14–16	16–18
	OVER 6000	20–22	24–28	[b]	14–16	18–20	20–22
55	UNDER 750[c]	12–14	14–18	[b]	8–10	10–12	10–12
	750–1500	16–18	20–24	[b]	10–12	14–16	16–18
	1500–6000	20–22	24–30	[b]	14–16	16–18	20–22
	OVER 6000	22–24	26–32[a]	[b]	16–18	20–22	22–24
60	UNDER 750[c]	16–18	20–24	[b]	10–12	12–14	14–16
	750–1500	20–24	26–32[a]	[b]	12–14	16–18	20–22
	1500–6000	26–30	32–40[a]	[b]	14–18	18–22	24–26
	OVER 6000	30–32[a]	36–44[a]	[b]	20–22	24–26	26–28
65–70[d]	UNDER 750[c]	18–20	20–26	[b]	10–12	14–16	14–16
	750–1500	24–26	28–36[a]	[b]	12–16	18–20	20–22
	1500–6000	28–32[a]	34–42[a]	[b]	16–20	22–24	26–28
	OVER 6000	30–34[a]	38–46[a]	[b]	22–24	26–30	28–30

Data Source: Roadside Design Guide, 4th Edition 2011

NHTSA Crash Statistics

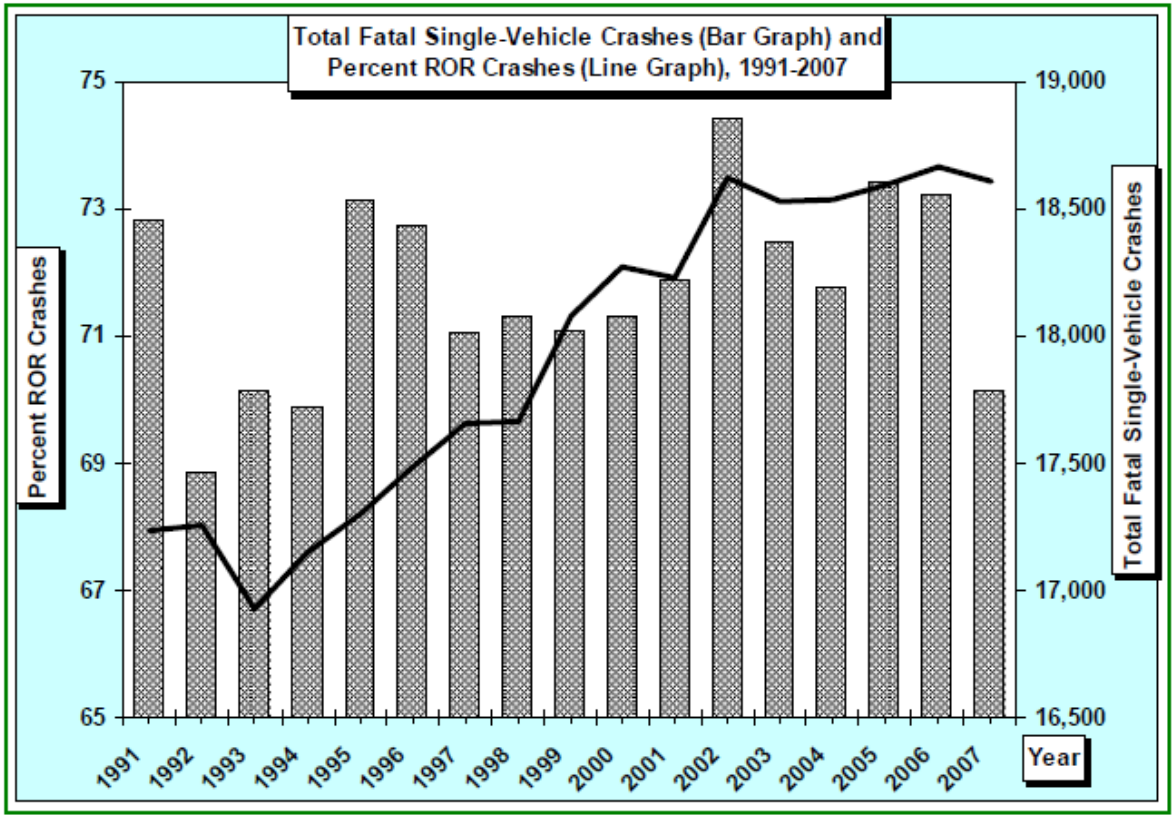


Figure 1. Total Passenger Vehicle Fatal Single-Vehicle Crashes (Bar Graph) and the Percent of ROR Crashes (Line Graph), 1991-2007 (FARS 1991-2007).

Data Source: http://www.nhtsa.gov/FARS

Quick Facts and Statistics

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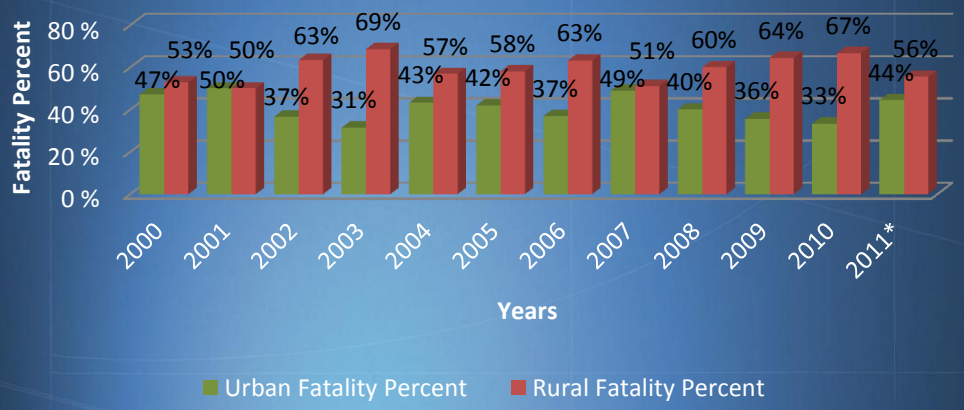
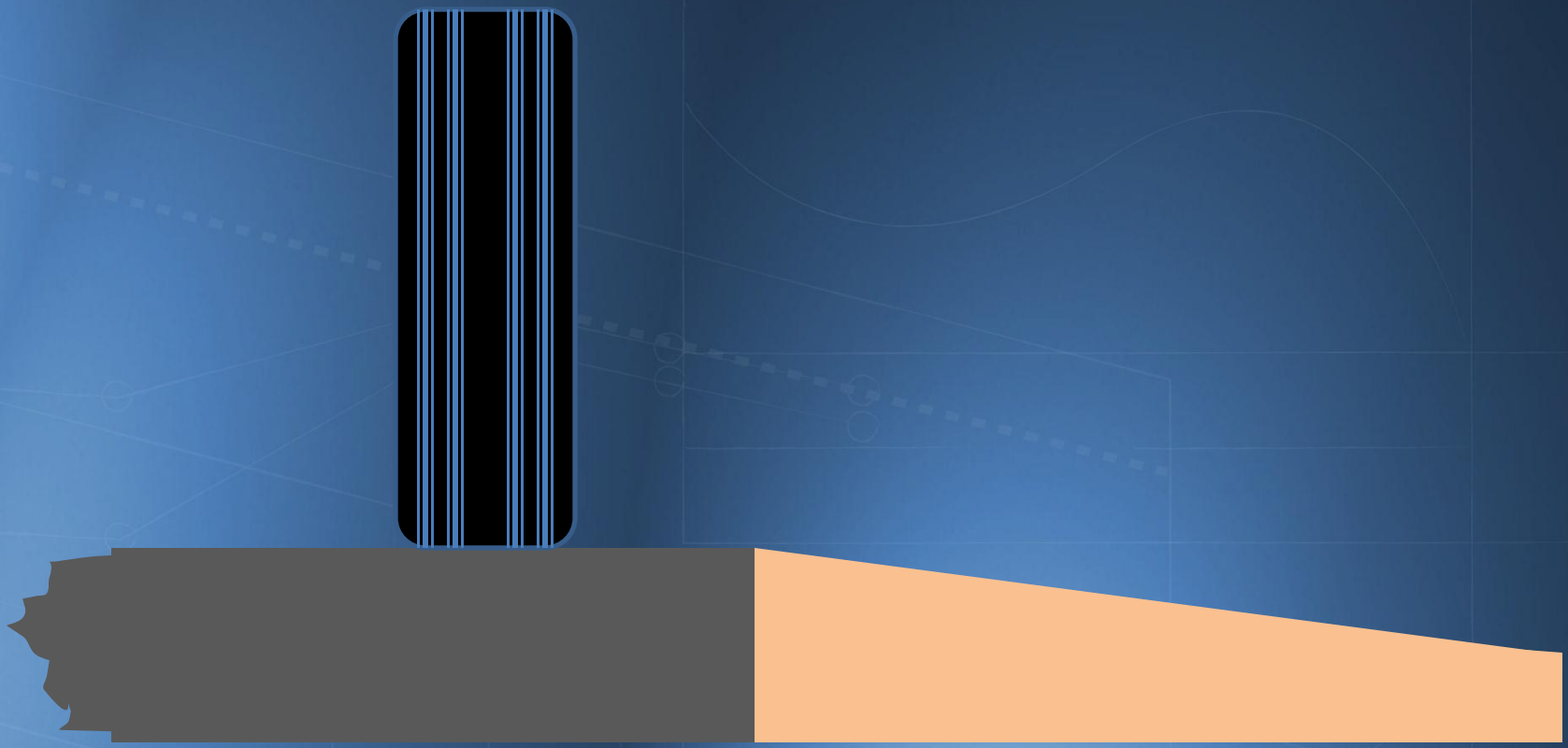
Fatalities "Off Roadway" in Puerto Rico

Urban vs. Rural "Off Roadway" Fatality Percent



Data Source: Comisión para la Seguridad en el Tránsito

Animation: Roadway Without Safety Edge



Pavement without Safety Edge

Pavement Edge Drop-off

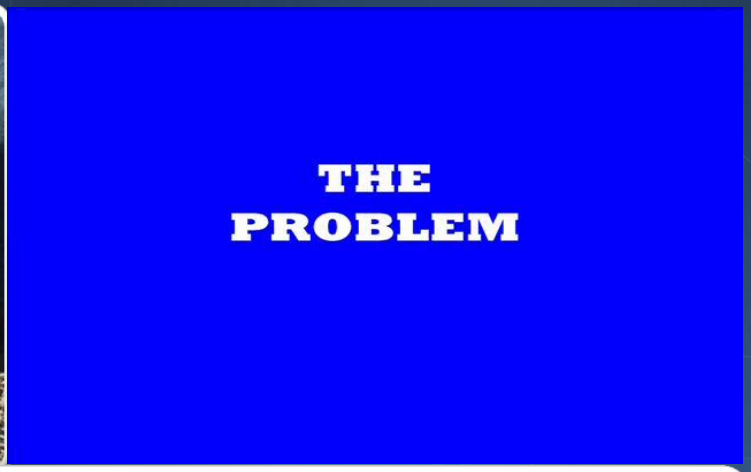
Unpaved Shoulder

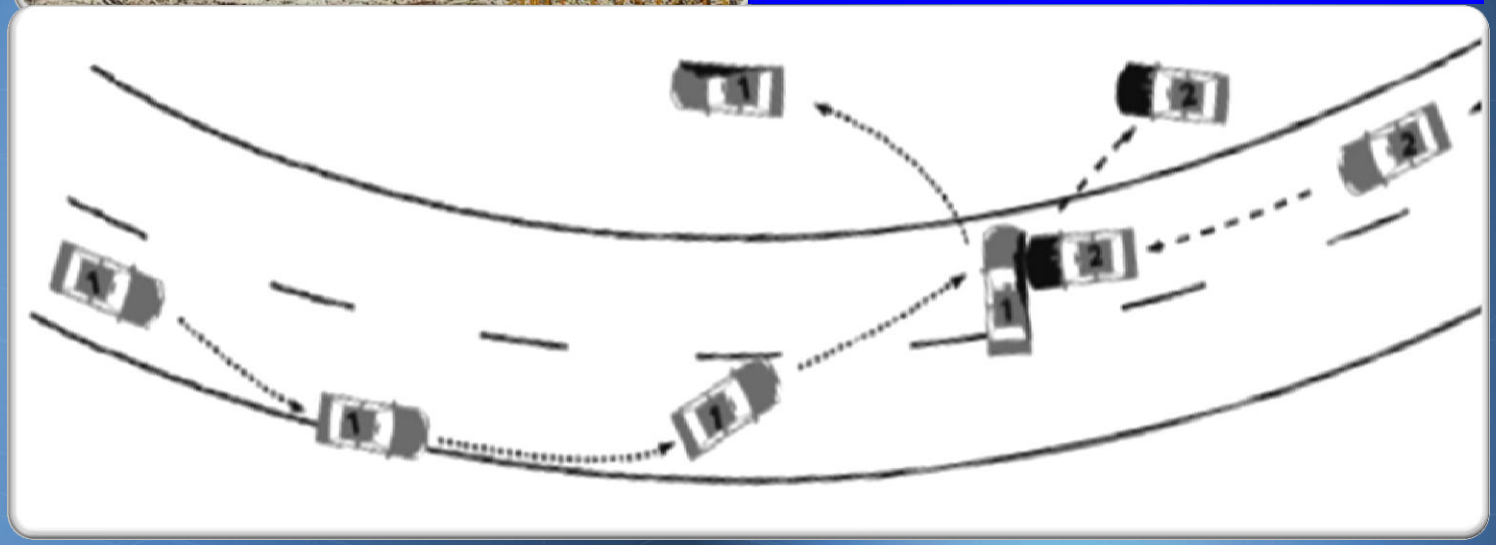
Pavement Edge Raveling

Pavement Edge Drop-off: 1 year after construction

Are Pavement Edge Drop-offs a problem?

Typical Drop-off Crash with Tire Scrubbing

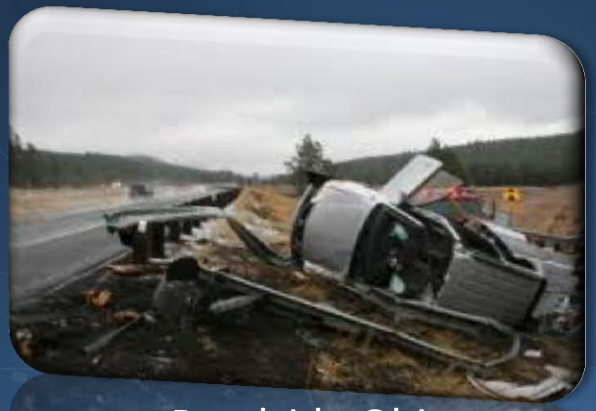




Crashes Caused by Edge Drop-offs:

Edge Drop-Off Crash Types

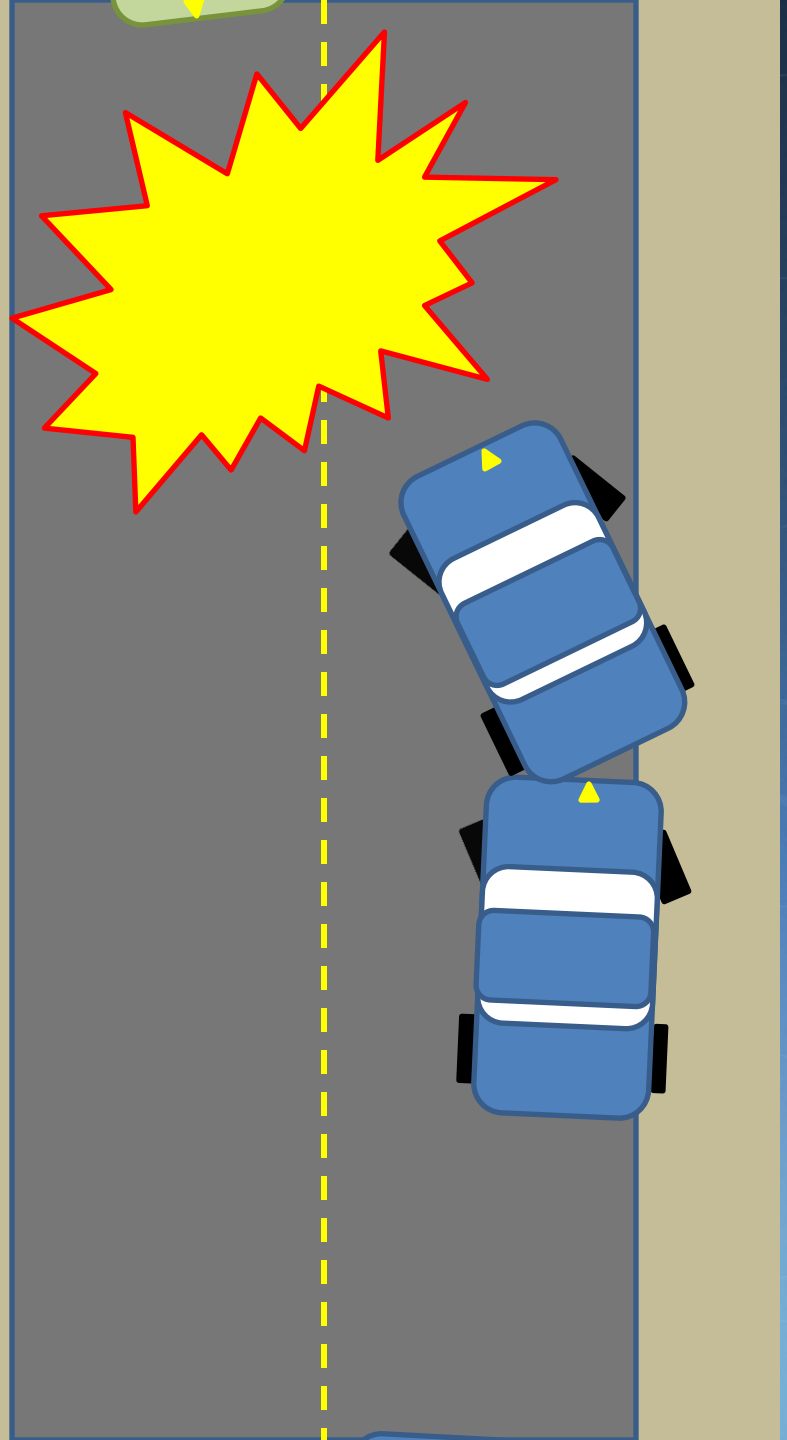
Rollover



Roadside Object

Opposing Sideswipe

Head-on



Driver crosses over into oncoming traffic

Driver Overcompensates Steering

Right tires leave edge of pavement

Locations at High-Risk for Drop-offs

1. Horizontal Curves
2. Near Roadside Mailboxes
3. Turnarounds/Unpaved Pull-Outs
4. Eroded Areas
5. Asphalt Pavement Overlays

Horizontal Curves

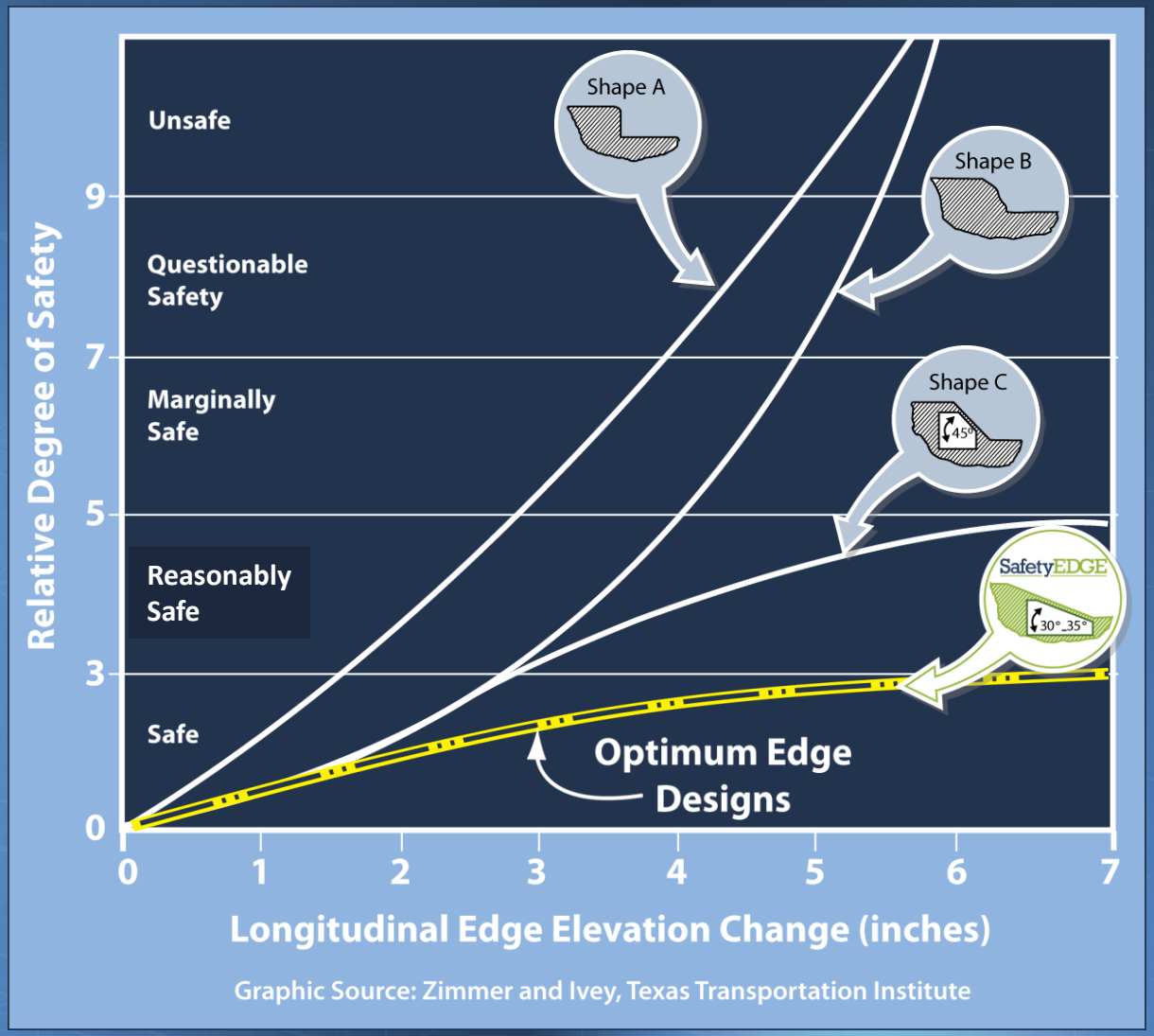
Mailboxes

Turnarounds/Unpaved Pull-Outs

Eroded Areas

Asphalt Overlay

Edge Shape Degree of Safety

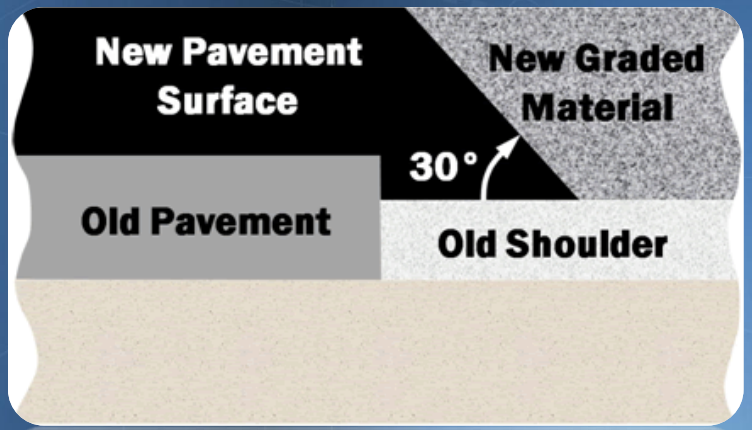


Adapted from: The Influence of Roadway Surface Discontinuities on Safety (TRB)

The Safety Edge:
The Practical Solution

Review: What is Safety Edge?

- Easy and inexpensive solution
- 30° pavement edge drop-off
- Improve durability of pavement
- Safer roadway edge



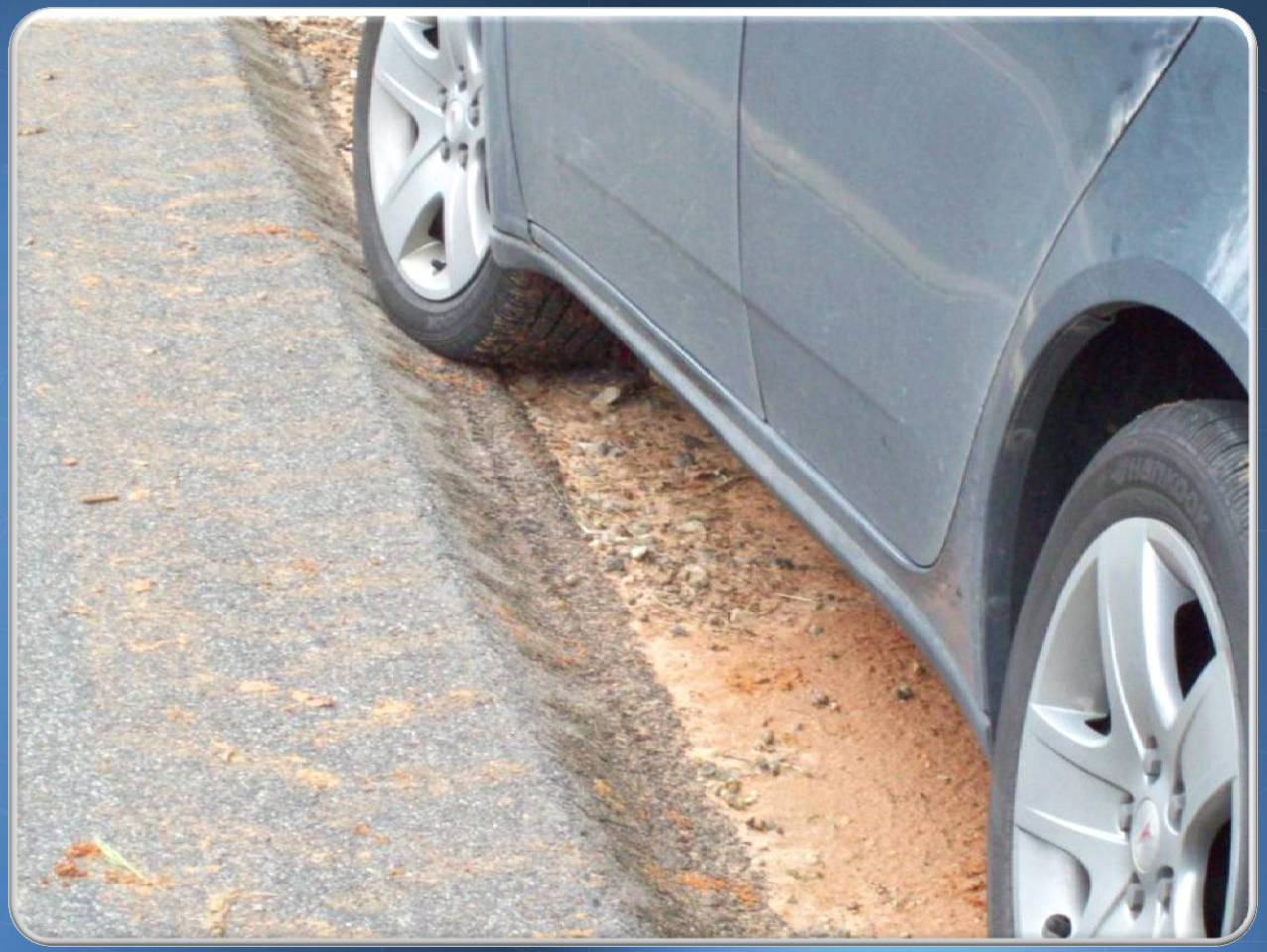
Draft Module

The Safety Edge Solution

30-Degree Angled Edge

Special Attachment: Safety Shoe

Safety Edge: After 6 years



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Questions?

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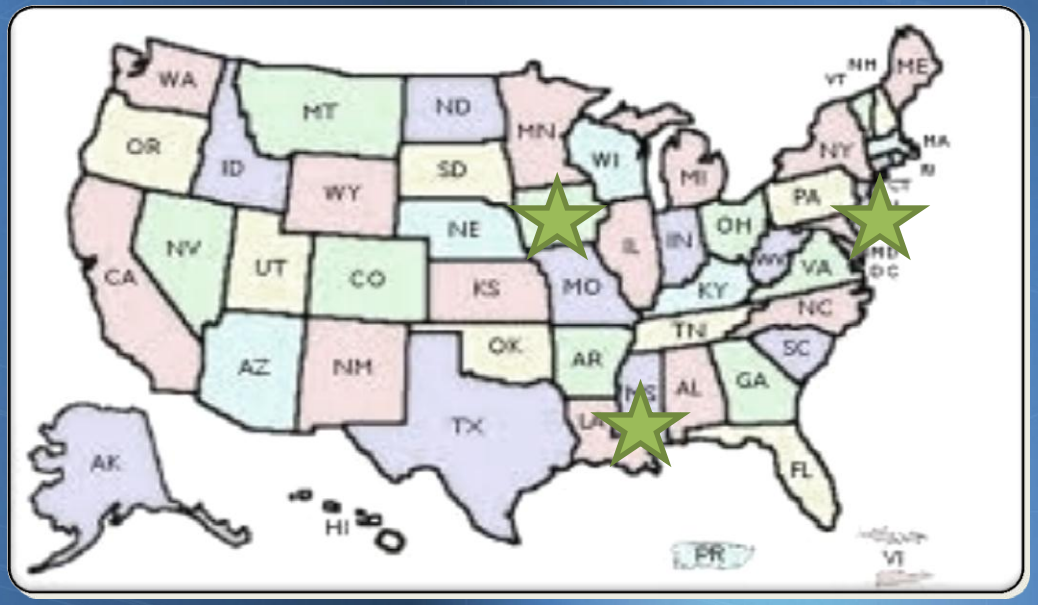
EDC SAFETY EDGE DEMONSTRATION PROJECT

Instructor: Eng. Juan C. Rivera

Demonstration Project: Locations

In the next sections, we will provide literature review of the following locations:

- Seaford, Delaware
- Jasper County, Iowa
- Columbus, Mississippi



Literature Review:
Delaware Demonstration Project

Title:

- Safety Edge Project Demonstration: Seaford, Delaware

Location:

- Along Old Furnace Road, Delaware

Authors:

- Harold Von Quintus
- Jagannath Mallela

Sponsoring Agency:

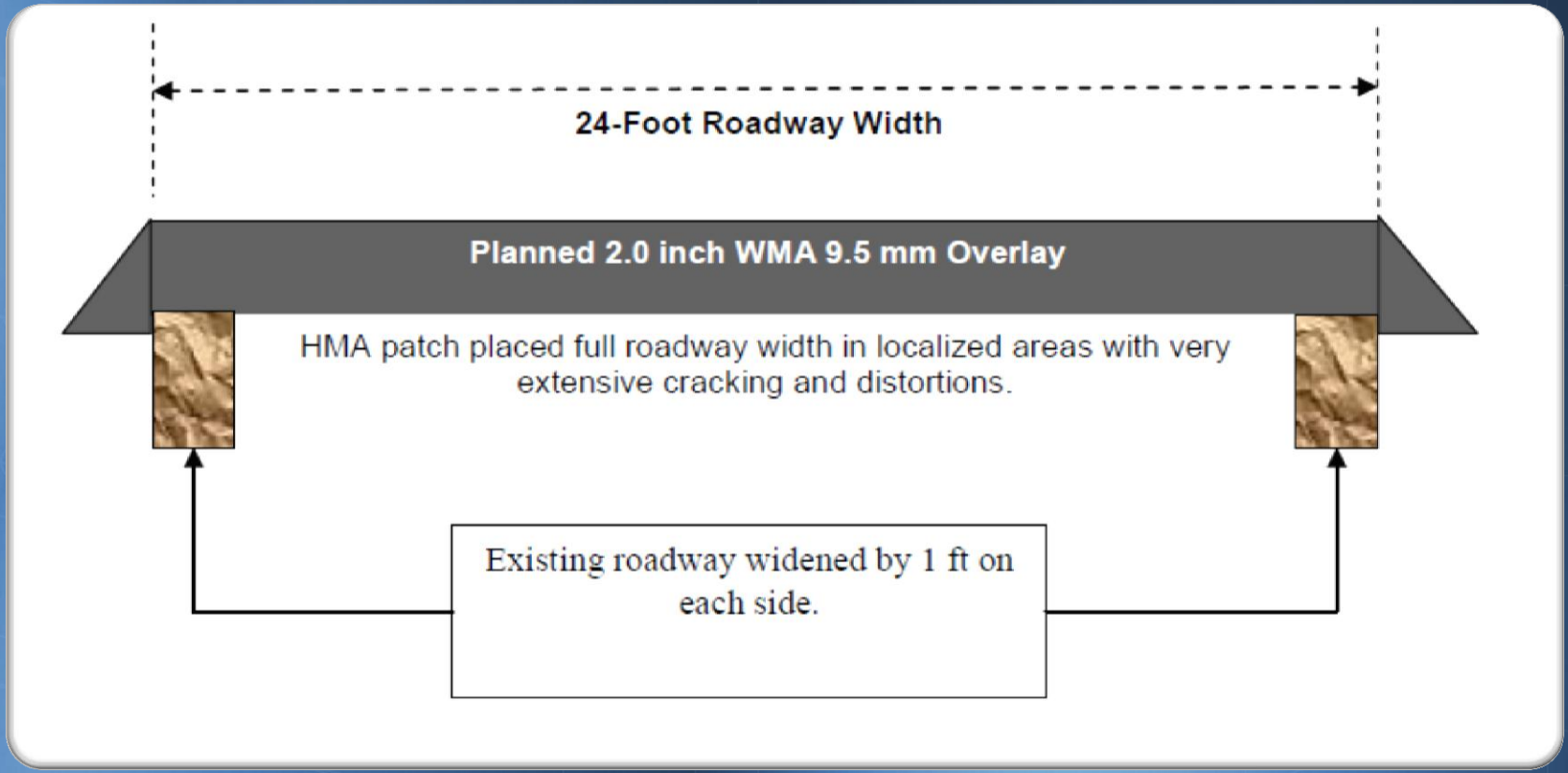
- Office of Infrastructure, Federal Highway Administration

Performing Organization:

- Applied Research Associates, Inc.

Adapted from: Safety Edge Demonstration Project, Seaford Delaware Field Report

Literature Review: Delaware Demonstration Project



Source: Safety Edge Demonstration Project, Seaford Delaware Field Report

Literature Review:
Delaware Demonstration Project

Overall Opinion of the SE:

- No detrimental impact on paving operations

Slope of the SE:

- Average Slopes: 37°-50°
- Construction personnel suggested (20°-25°) slope by to meet 30° requirement

Section/Area Designation		Slope of Safety Edge$_{SM}$	
		Mean, degrees	Coefficient of Variation, %
Prior to Rolling; mean of two areas		34.1	5.2
After Final Rolling			
1	Advant-Edger	45.4	10.8
2	Advant-Edger	50.0	11.4
3	TransTech Shoulder Wedge Maker	36.6	24.3

Adapted from: Safety Edge Demonstration Project, Seaford Delaware Field Report

Literature Review:
Delaware Demonstration Project

Placement:

a) TransTech: Shoulder Wedge Maker (SWM)

b) Advant-Edger: Ramp Champ (RC)

c) Warm Mix Asphalt (WMA)

a)

b)

c)

Adapted from: Safety Edge Demonstration Project, Seaford Delaware Field Report

Literature Review: Iowa Demonstration Project

Title:

- Safety Edge Project Demonstration: Jasper County, Iowa

Location:

- Route F62 in Sully

Authors:

- Paul Littleton
- Jagannath Mallela

Sponsoring Agency:

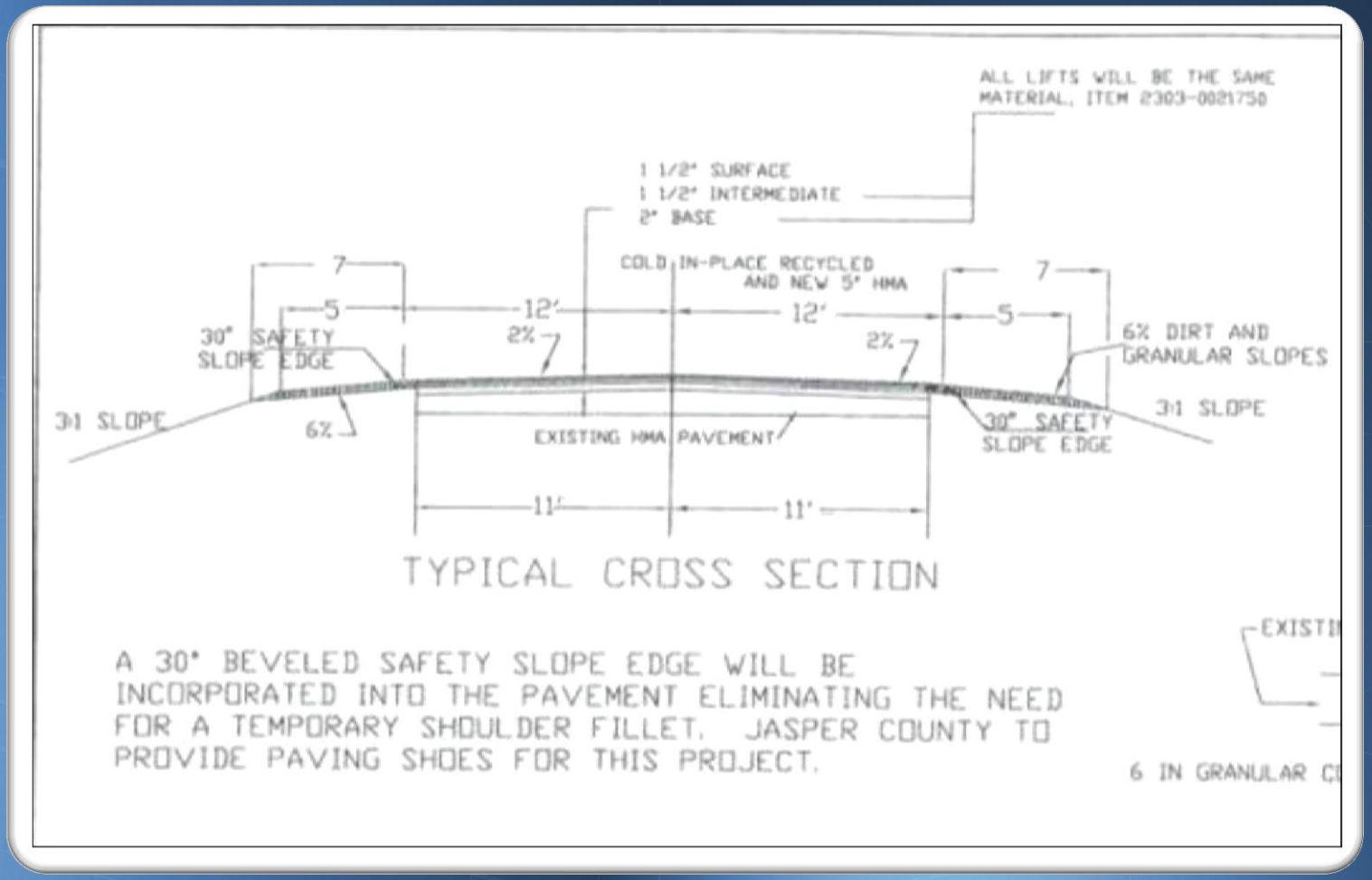
- Office of Infrastructure, Federal Highway Administration

Performing Organization:

- Applied Research Associates, Inc.

Adapted from: Safety Edge HMA Demonstration Project, Jasper County, Iowa Field Report

Literature Review: Iowa Demonstration Project



Adapted from: Safety Edge HMA Demonstration Project, Jasper County, Iowa Field Report

Literature Review: Iowa Demonstration Project

Overall Opinion of the SE:

- The paving operation was not noticeably slowed or otherwise inconvenienced by incorporating the Safety Edge
- However, the average slope of the completed Safety Edge was greater than the targeted 30°
- It would be beneficial to be able to decrease the angle of the device when using HMA mixtures for which the slope angle tends to increase when compacted.

Slope of the SE:

- Average Slopes: 38°

Adapted from: Safety Edge HMA Demonstration Project, Jasper County, Iowa Field Report

Literature Review: Iowa Demonstration Project

Adapted from: Safety Edge HMA Demonstration Project, Jasper County, Iowa Field Report

Literature Review: Mississippi Demonstration Project

Title:

- Safety Edge Project Demonstration: State Route 182 near Columbus, Mississippi

Location:

- State Route 182

Authors:

- Harold Von Quintus
- Jagannath Mallela

Sponsoring Agency:

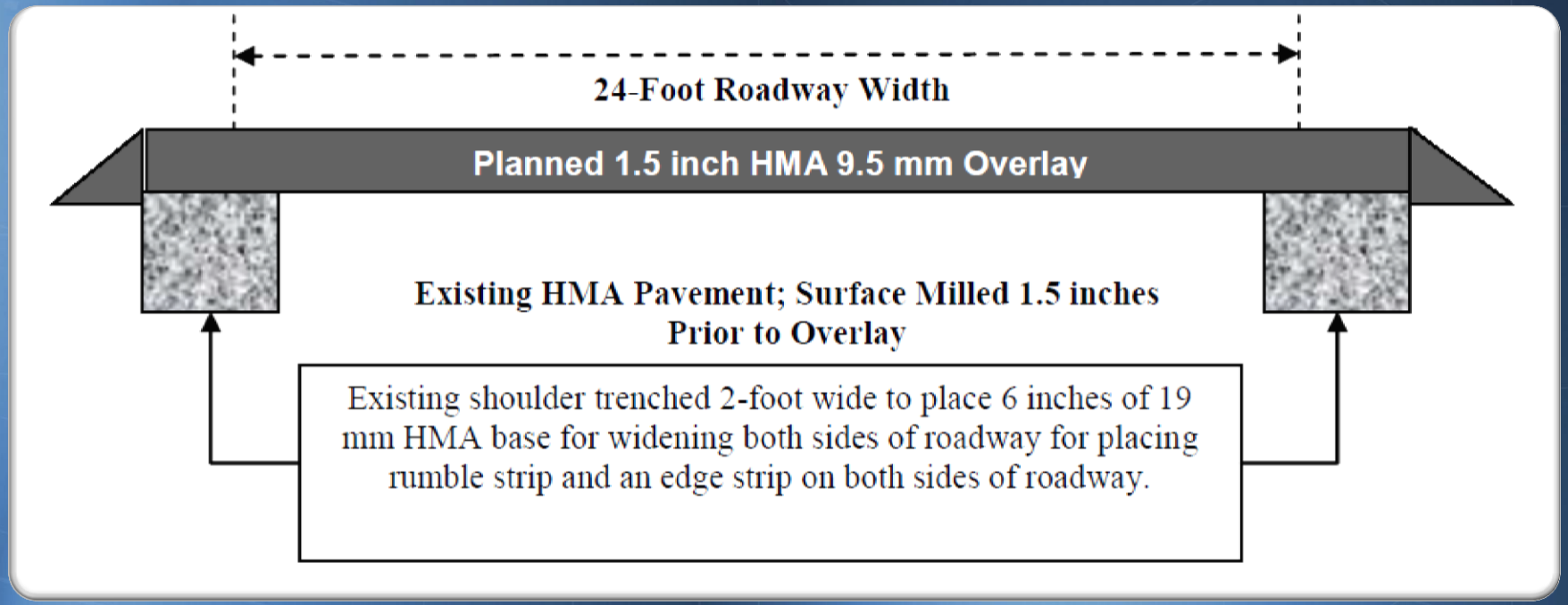
- Office of Infrastructure, Federal Highway Administration

Performing Organization:

- Applied Research Associates, Inc.

Adapted from: Safety Edge Demonstration Project State Route 182, Columbus, Mississippi Field Report

Literature Review: Mississippi Demonstration Project



Adapted from: Safety Edge Demonstration Project State Route 182, Columbus, Mississippi Field Report

Literature Review: Mississippi Demonstration Project

Overall Opinion of the SE:

- The slopes before and after rolling were found to be approximately equal (an average slope of 37.0 degrees after rolling compared to an average slope of 40.1 degrees prior to rolling).
- The density of the HMA mixture adjacent to the Safety Edge was found to be higher than along the unconfined edge in the areas placed without the Safety Edge a positive benefit from the Safety Edge device.

Slope of the SE:

- Average Slopes: 37°

Adapted from: Safety Edge Demonstration Project State Route 182, Columbus, Mississippi Field Report

Literature Review: Mississippi Demonstration Project

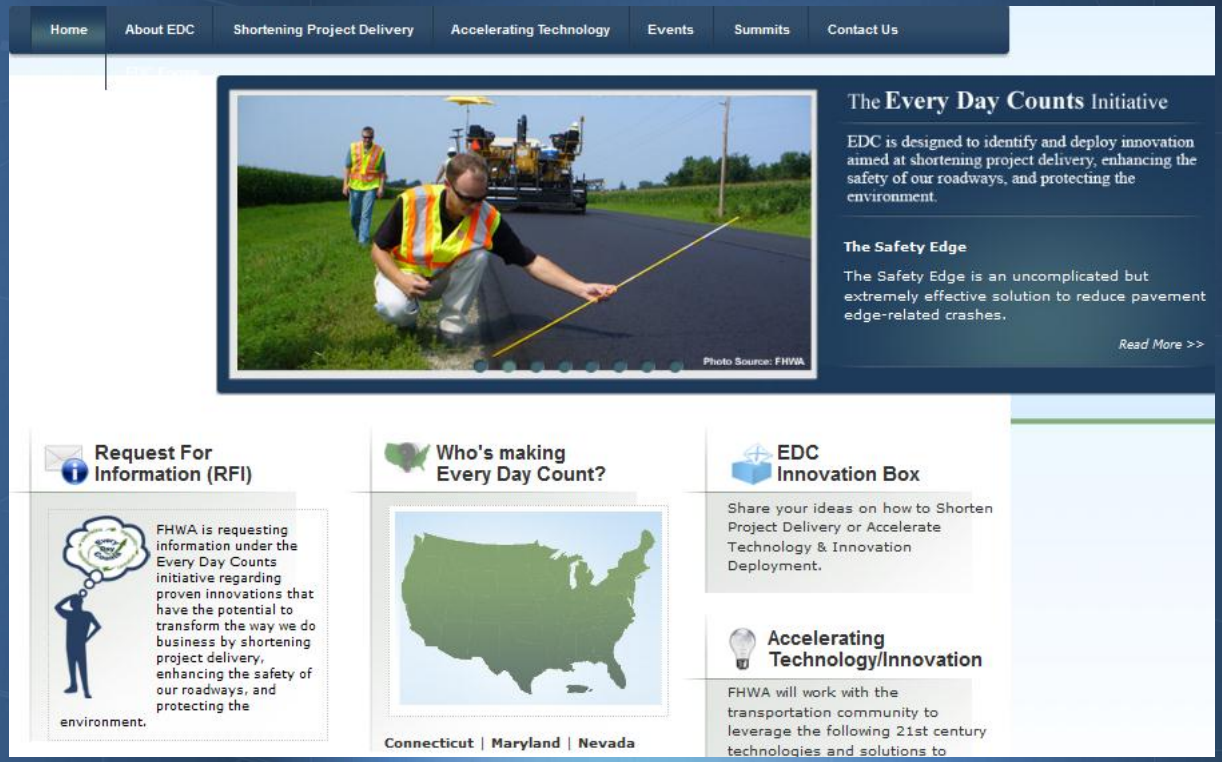
HMA Density Tests

Location of Cores

Adapted from: Safety Edge Demonstration Project State Route 182, Columbus, Mississippi Field Report

Introduction to EDC Initiatives Quiz

1. In total, there are ____ EDC Initiatives.
   a) 3
   b) 6
   c) 9

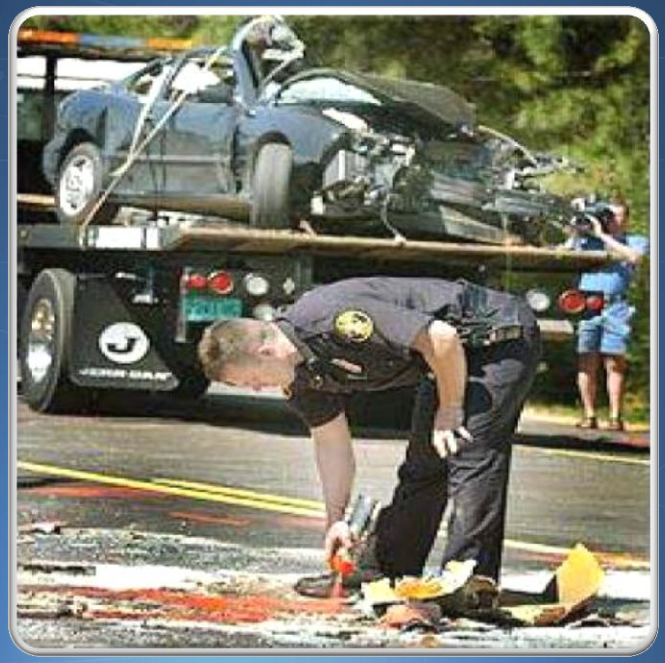


Introduction to EDC Initiatives Quiz

2. “Run off the road” deaths are exclusively caused by Driving Under Influence (DUI) conditions.

a) True

b) False



Review: Learning Outcomes

1. Define the Puerto Rico Transportation Technology Transfer Center.
2. Define the Every Day Counts Initiative.
3. Discuss the Every Day Counts Initiatives.

References

1. EDC Presentation: Moving Your State Partners to Adopt the Safety Edge
2. Puerto Rico Transportation Technology Transfer Center
3. Roadside Design Guide, 4th Edition 2011
4. Safety Edge, Demonstration Project: Seaford Delaware Field Report
5. Safety Edge, Demonstration Project State Route 182: Columbus, Mississippi Field Report
6. Safety Edge, HMA Demonstration Project: Jasper County, Iowa Field Report
7. Safety Impacts on Pavement Edge Drop-offs
8. The Safety Edge: Your Angle for Reducing Roadway Departure Crashes (FHWA DVD)
9. http://www.fhwa.dot.gov/everydaycounts/projects/
10. http://www.fhwa.dot.gov/everydaycounts/technology/

Acknowledgement

This module was made possible through the collaboration of Eng. Juan C. Rivera, Eng. Ana L. Torres, Eng. Alvin Gutiérrez, Eng. Freddie Salado, Dr. Benjamín Colucci, Ms. Melvies Rodríguez, Mss. Leilany Benejam and Mr. Josué Ortiz.

End of Module #1:
Introduction to EDC Initiatives