Roadside Barriers

Roadside Barriers

Course Outline:

Part 1 – Research Results

Part 2 - Roadway Departure Technology Transfer

Part 1
Research Results
W-beam Guardrail

In-Service Performance Evaluation of G4 (1S) Strong-Post W-beam Guardrail

Researchers:
Dr. Priyanka Alluri, *Research Associate*
Dr. Albert Gan, *Professor*
Dr. Kirolos Haleem, *Research Associate*
Florida International University

Research Project Manager:
John Mauthner, P.E., *Roadway Design Office*
Florida Department of Transportation

Project Objectives

Volume I: *W-beam Guardrail*

- Conduct an ISPE of median and roadside G4 (1S) Strong-post W-beam Guardrail Systems for both Limited Access and Non-limited Access Facilities in Florida.
- Develop a system for the collection and maintenance of guardrail inventory data.

Identification of Study Locations

In total, ***685.2*** miles of limited access facilities and ***341.5*** miles of non-limited access facilities were identified as G4 (1S) Strong-post W-beam Guardrail Systems. Additional locations with ***rub-rail*** were also identified in this study to determine their affect on guardrail performance.

Guardrail without rub-rail on the Florida Turnpike

Guardrail with rub-rail on I-95

Application Development by:

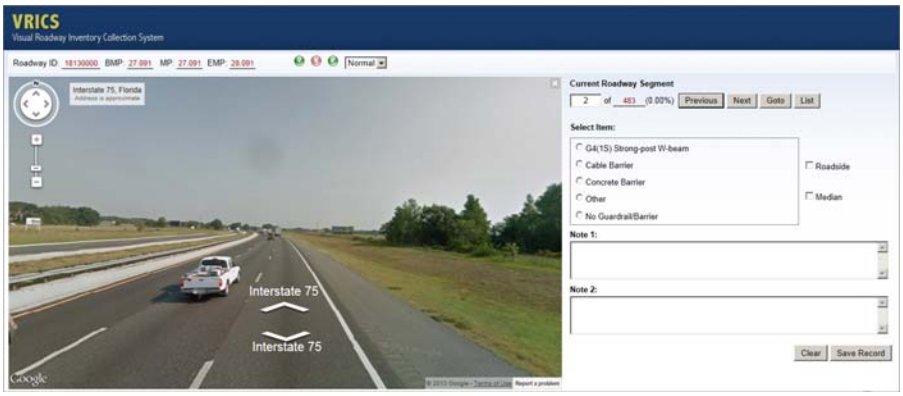
Dr. Kaiyu Liu of the Lehman Center for Transportation Research, Florida International University

http://131.94.122.209/VRICS/RdDataReview.aspx

Visual Roadway Inventory Collection System

Application Used:

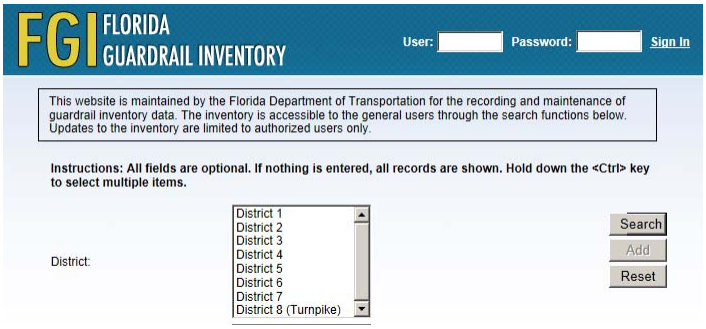
VRICS - Visual Roadway Inventory Collection System



FGI - Florida Guardrail Inventory System

The Florida Guardrail Inventory (FGI) System was developed by Dr. Liu for Maintenance Offices to Record and Maintain Guardrail Inventory Data on all State Road Facilities in Florida.

http://131.94.122.83/FGI/main.aspx



Review of Police Reports

- From 2006-2010, ***40,738*** crashes were identified and their police reports were reviewed using a web-based application.
- For guardrail-related crashes, we looked at:
  - ✓Crash Severity and Vehicle Type
  - ✓Location of guardrail that was hit (i.e., ***roadside or median***)
  - ✓Whether the vehicle crossed over the guardrail or not (***guardrail crossover crashes***)
  - ✓Whether the vehicle crossed over the median and went into the opposite direction of travel or not (***median crossover crashes***)
  - ✓Type of crossover: ***under-ride***, ***over-ride***, *or* ***penetration***

Limited Access Facilities

Limited Access Facilities

Crossover Crash Statistics by Guardrail Placement

Guardrail Placement	Guardrail Crossover Crashes	Guardrail Non-Crossover Crashes	Total Crashes	Percent of Guardrail Non-Crossover Crashes
Median	263	5545	5808	95.5%
Roadside	81	1387	1468	94.5%
Not Sure	0	14	14	100.0%
Total	**344**	**6946**	**7290**	**95.3%**

Study Data Trend Correlation:

Performance Difference in **%** of Non-Crossover Crashes

For Guardrail Placed in Medians versus Roadsides

Is Comparable @ **Δ = 1.0%**

Crossover Crash Statistics by Vehicle Type

Vehicle Type	Total Guardrail Crossover Crashes	Total Guardrail Non-Crossover Crashes	Total Crashes	Percent of Guardrail Non-Crossover Crashes
Car	133	5104	5237	**97.5%**
Light Truck	141	1528	1669	**91.6%**
Medium Truck	20	74	94	78.7%
Heavy Truck	41	135	176	76.7%
Motorcycle	2	23	25	92.0%
Other	5	31	36	86.1%
Unknown				
Total				

Study Data Trend Correlation:

Performance Difference in **%** of Non-Crossover Crashes

By Vehicle Type For Cars versus Pickups is

A Statistically Significant Difference @ Δ = 5.9%

Crossover Crash Statistics by Severity

Study Data Trend Correlation:

Fatal (K) Crash Rate of Guardrail

For Crossover to Non-Crossover = **10:1**

				Percent of Total Guardrail Non-Crossover Crashes (b)/6946	Total Crashes
Fatal (K)	34	**9.9%**	68	**1.0%**	102
Incapacitating (A)	73	**21.2%**	522	**7.5%**	595
Non-Incapacitating (B)	104	30.2%	1382	19.9%	1486
Possible (C)	56	16.3%	1713	24.7%	1769
PDO (O)					0
Unknown					3
Total					0

Study Data Trend Correlation:

Incapacitating (A) Crash Rate of Guardrail

For Crossover to Non-Crossover = **3:1**

Median Crossover Crash Statistics by Vehicle Type

Vehicle Type	Total Median Crossover Crashes	Total Median Non-Crossover Crashes	Total Crashes	Percent of Median Non-Crossover Crashes
Car	23	4134	4157	**99.4%**
Light Truck	35	1323	1358	**97.4%**
Medium Truck	4	67	71	94.4%
Heavy Truck	16	121	137	88.3%
Motorcycle	1	17	18	94.4%
Other	3			
Unknown	1			
Total	**83**			

Study Data Trend Correlation:

Difference in **%** of Median Non-Crossovers

By Vehicle Types

Cars Performed Better than Pickups by **2.0%**

Median Crossover Crash Statistics by Severity

Study Data Trend Correlation:

Fatal (K) Crash Rate of Median Guardrail

For Crossover to Non-Crossover = **7:1**

				Percent of Total Median Non-Crossover Crashes (b)/5725	Total Crashes
Fatal (K)	7	**8.4%**	70	**1.2%**	77
Incapacitating (A)	19	**22.9%**	484	**8.5%**	503
Non-Incapacitating (B)	30	36.1%	1172	20.5%	1202
Possible (C)					
PDO (O)					
Unknown					
Total					

Study Data Trend Correlation:

Incapacitating (A) Crash Rate of Median Guardrail

For Crossover to Non-Crossover = **3:1**

Guardrail Non-Crossover Crash Percentages at all Median Locations and at Locations with Rub-rail by Severity

Crash Severity	Percent of Guardrail Non-Crossover Crashes	
	All Median Guardrail Locations	Locations with Rub-rail
Fatal (K)	**74.0%**	**78.6%**
Incapacitating (A)	**89.1%**	**91.8%**
Non-Incapacitating (B)	92.8%	92.9%
Possible (C)	96.9%	96.7%
PDO (O)	97.8%	97.2%
Unknown		
Total		

Study Data Trend Correlation:

By Severity Type

Guardrail with Rub-rail Performed Better than Median Guardrail without Rubrail

Key Findings

- ***97.5%*** of cars were prevented from crossing the guardrail.
- ***91.6%*** of light trucks were prevented from crossing the guardrail.
- There is a *Statistically Significant Difference* in the Performance of Cars versus Light Trucks @ ***5.9%***.
- ***Crossovers were more severe compared to non-crossovers.***
- Among all crossover crashes, ***over-rides*** were most severe.
- Locations with ***rub-rail*** by Severity Type performed some-what better, however, this was based on limited data availability.
- Additional research is required to determine the affect ***Rub-rail*** has on the performance of ***W-beam Guardrail***.

Non-limited Access Facilities

Non-limited Access Facilities

Crossover Crash Statistics by Guardrail Placement

Guardrail Placement	Guardrail Crossover Crashes	Guardrail Non-Crossover Crashes	Total Guardrail-related Crashes	Percent of Guardrail Non-Crossover Crashes
Median	50	761	811	**93.8%**
Roadside	53	511	564	**90.6%**
Not Sure	0	9	9	100.0%
Total	**103**	**1281**	**1384**	**92.6%**

Study Data Trend Correlation:

Performance Difference in **%** of Non-Crossover Crashes For Guardrail Placed in Medians versus Roadsides Is Comparable to the Average @ **92.6%**

Crossover Crash Statistics by Vehicle Type

Vehicle Type	Guardrail Crossover Crashes	Guardrail Non-Crossover Crashes	Total Crashes	Percent of Guardrail Non-Crossover Crashes
Car	45	904	949	**95.3%**
Light Truck	40	291	331	**87.9%**
Medium Truck	2	10	12	83.3%
Heavy Truck	14	51	65	78.5%
Motorcycle	0	12	12	100.0%
Other	2	2	4	50.0%
Unknown				
Total				

Study Data Trend Correlation:

Performance Difference in **%** of Non-Crossover Crashes By Vehicle Type For Cars versus Pickups is **A Statistically Significant Difference @ Δ = 7.4%**

Crossover Crash Statistics by Severity

Study Data Trend Correlation:

Fatal (K) Crash Rate of Guardrail

For Crossover to Non-Crossover = **6:1**

	Guardrail Non-Crossover Crashes				
	(a)	(a)/103	(b)	Percent of Total Guardrail Non-Crossover Crashes (b)/1281	Total Crashes
Fatal (K)	10	**9.7%**	19	**1.5%**	29
Incapacitating (A)	17	**16.5%**	93	**7.3%**	110
Non-Incapacitating (B)	38	36.9%	246	19.2%	284
Possible (C)					
PDO (O)					
Unknown					
Total					

Study Data Trend Correlation:

Incapacitating (A) Crash Rate of Guardrail

For Crossover to Non-Crossover = **2:1**

Key Findings

- Median guardrail prevented ***93.8%*** of errant vehicles from crossing over the guardrail.
- Roadside guardrail prevented ***90.6%*** of errant vehicles from crossing over the guardrail.
- Overall, ***92.6%*** of guardrail-related crashes were prevented from crossing over the guardrail.
- ***95.3%*** of cars were prevented from crossing the guardrail.
- ***87.9%*** of light trucks were prevented from crossing the guardrail.
- There is a *Statistically Significant Difference* in the Performance of Cars versus Light Trucks @ ***7.4%***.
- ***Crossovers were more severe compared to non-crossovers.***

Safety Performance: Passenger Cars Versus Light Pickup Trucks

Facility Type	Guardrail Placement	Type of Non-Crossover	Passenger Car Statistics			Light Truck Statistics			Z Test Statistic	Performance of Passenger Cars Significantly Different from Light Trucks?
			Non-crossover Crashes (a)	Total Guardrail-related Crashes (b)	Percent of Non-crossover Crashes (a)/(b)	Non-crossover Crashes (c)	Total Guardrail-related Crashes (d)	Percent of Non-crossover Crashes (c)/(d)		
Freeway	All Guardrail (Roadside & Median)	Guardrail Non-crossover	5104	5237	97.5%	1528	1669	91.6%	10.77	Yes
	All Median Guardrails	Guardrail Non-crossover	4065	4157	97.8%	1240	1358	91.3%	10.83	Yes
		Median Non-crossover	4134	4157	99.4%	1323	1358	97.4%	6.35	Yes
	Median Guardrail with Rub-rail	Guardrail Non-crossover	630	636	99.1%	176	199	88.4%	7.14	Yes
		Median Non-crossover	634	636	99.7%	190	199	95.5%	--	--
Arterial	All Guardrails (Roadside and Median)	Guardrail Non-crossover	904	949	95.3%	291	331	87.9%	4.62	Yes

2013 Design Training Expo

Part 2
Roadway Departure Technology Transfer

2013 Design Training Expo

U.S. Department of Transportation Federal Highway Administration

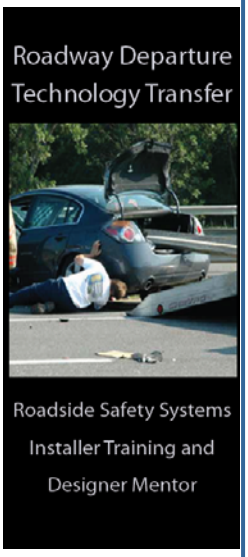
DRIVING DOWN FATALITIES

STATE OF FLORIDA • DEPARTMENT OF TRANSPORTATION

Goals of the Project

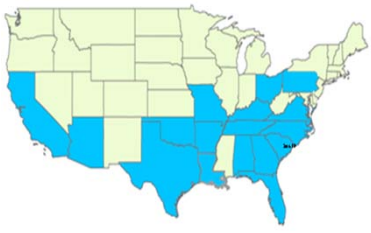
Improve Roadway Departure Safety by:

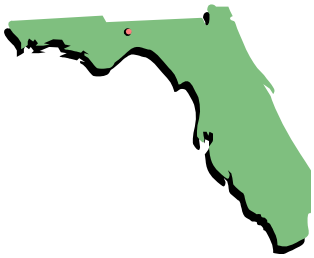
- Proper design and selection of safety features.
- Correct installation procedures.
- Maintaining safety features in a state of constant "readiness."



Why Florida?

- Florida is one of ***17*** FHWA *Roadway Departure* Focus States.
- In *2010*, over ***20.5*** percent of all traffic-related Fatalities were *Roadway Departure* related.



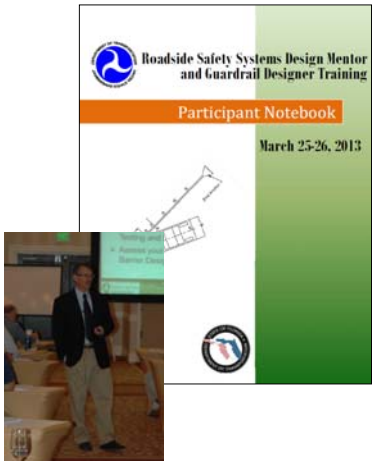


Project Deliverables

Guardrail Designer Training
Guardrail Installer Training
Technical Briefs (5 topics)
Roadside Safety Pocket Guide
FHWA Resource Charts

Guardrail Designer Training

- Two-day training session
- Target audience included Florida DOT and local transportation agency personnel, Florida Turnpike Enterprise, LTAP, NACE, Florida Association of County Superintendents and consultants with direct responsibilities for specifying and designing roadside barriers, including end terminal, transitions, and crash cushions



Guardrail Designer Training – Day 2 and Guardrail Installer Training – Day 1

Safety Hardware Manufacturers made presentations on products approved to be on our Qualified Products List, and participants were given hands-on familiarity with a variety of safety products.

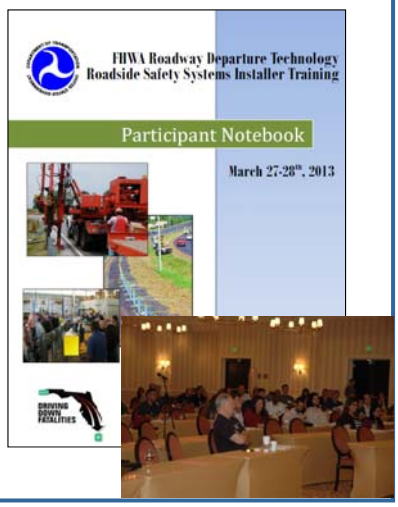
Temporary Barriers →

Crash Cushions →

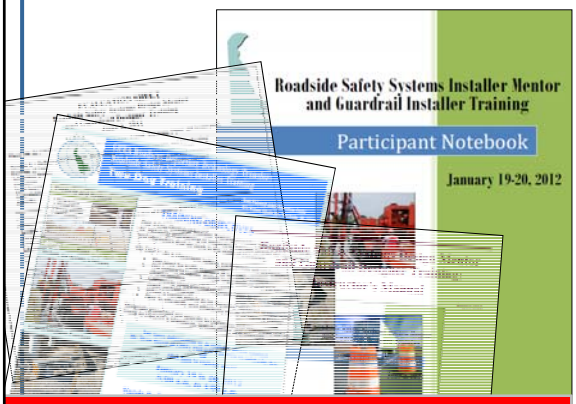
End Terminals →

Guardrail Installer Training

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



State Training Tools



Roadside Safety Systems Toolkit

All materials used to present and facilitate the training has been packaged for the State, so State personnel can conduct their own training on a regular basis.

Technical Briefs (5)

Purpose

- Expand knowledge of the state-of-the-practice in Roadside Safety.
- Provide background, key data and research, and priority recommended practices to improve roadside safety.

2013 Design Training Expo

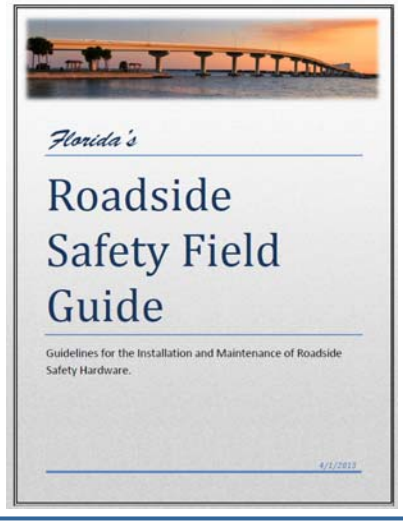
TECHNICAL BRIEFS

Florida's Technical Brief Topics:

- Pre-Installation Field Review Check List.
- Guardrail Installation at Intersections, Side Roads, and Driveways.
- Roadside Safety System Damage Assessment.
- The MGS Guardrail System.
- In-service Evaluation of Roadside Safety Features.

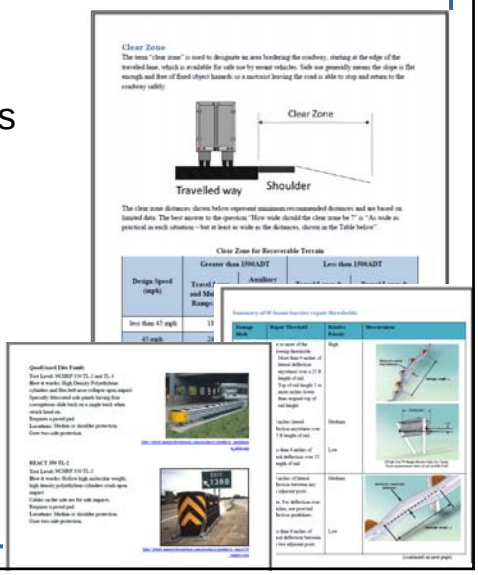
Roadside Safety Field Guide

This is a State specific guide and is designed to be used by all personnel involved in designing, selecting, installing, inspecting, and maintaining roadside safety hardware.



FIELD GUIDE EXAMPLE

- Part 1 – Guardrail Basics
- Part 2 – Special Cases
- Part 3 –End Terminals
- Part 4 – Maintenance



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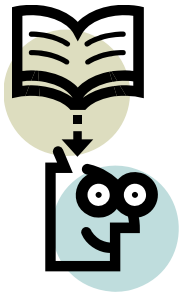
Thank You ...



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