

2012 KYTC FHWA ACEC PARTNERING CONFERENCE

4TH EDITION OF THE AASHTO
ROADSIDE DESIGN GUIDE



September 2012



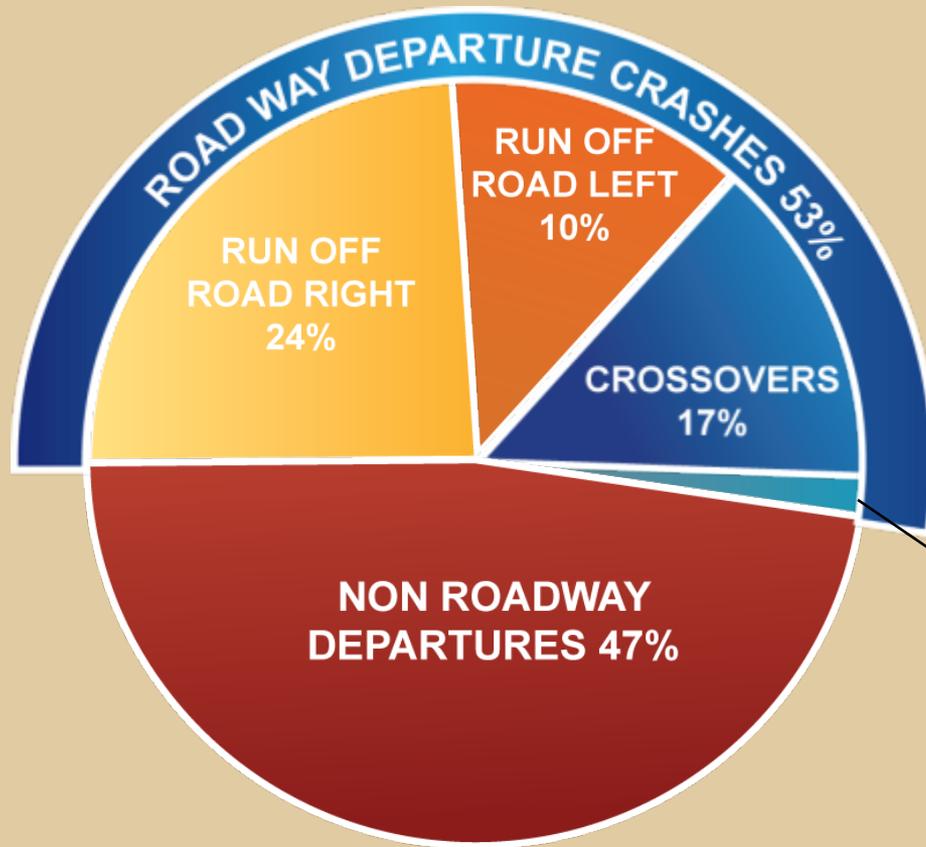
ROADSIDE DESIGN GUIDE

4th Edition 2011

AMERICAN ASSOCIATION OF
STATE HIGHWAY AND
TRANSPORTATION OFFICIALS
AASHTO
THE VOICE OF TRANSPORTATION

2008 National Fatal Crashes

34,017
U.S.
Fatal
Crashes

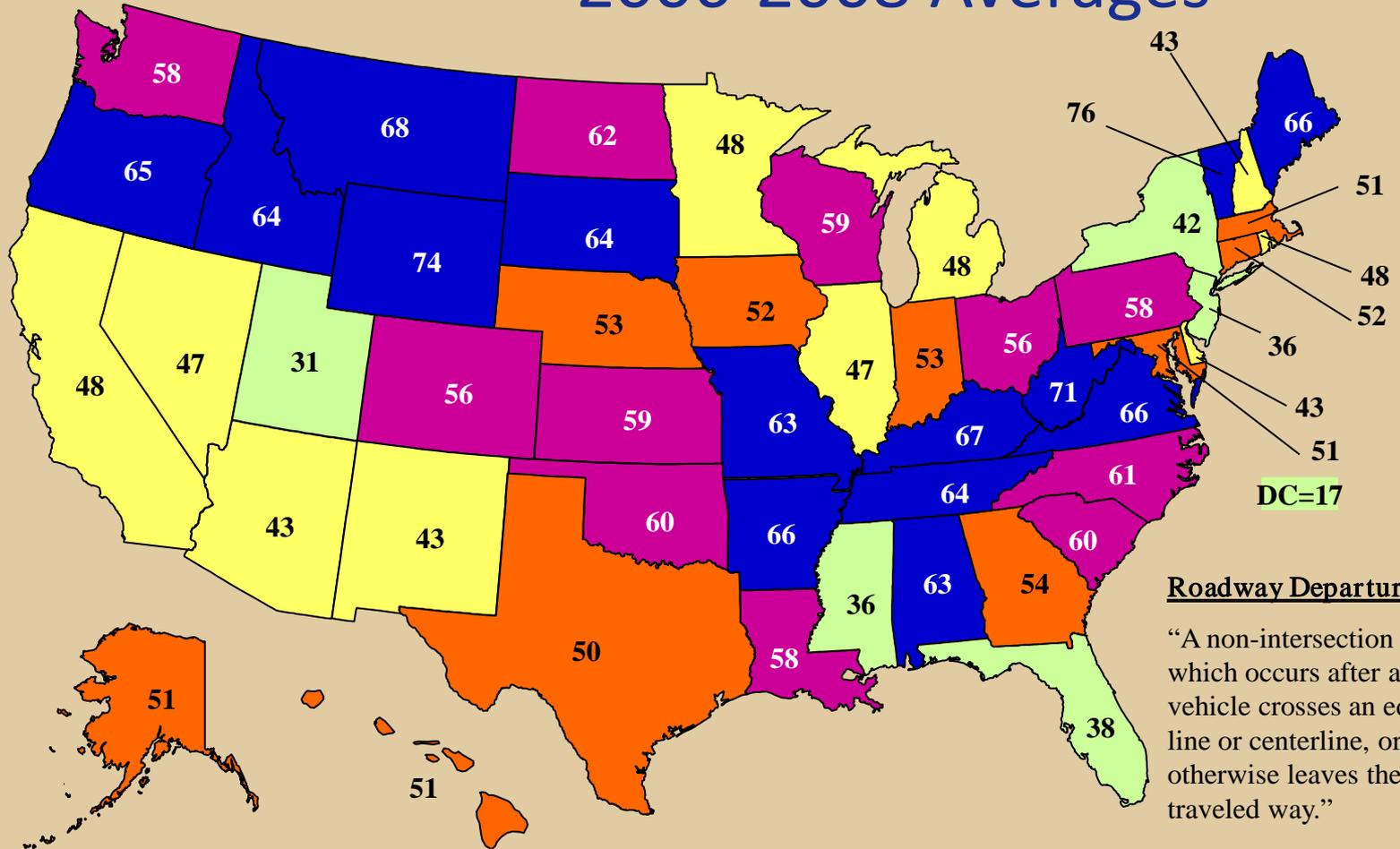


17,818
U.S.
Roadway
Departure
Crashes

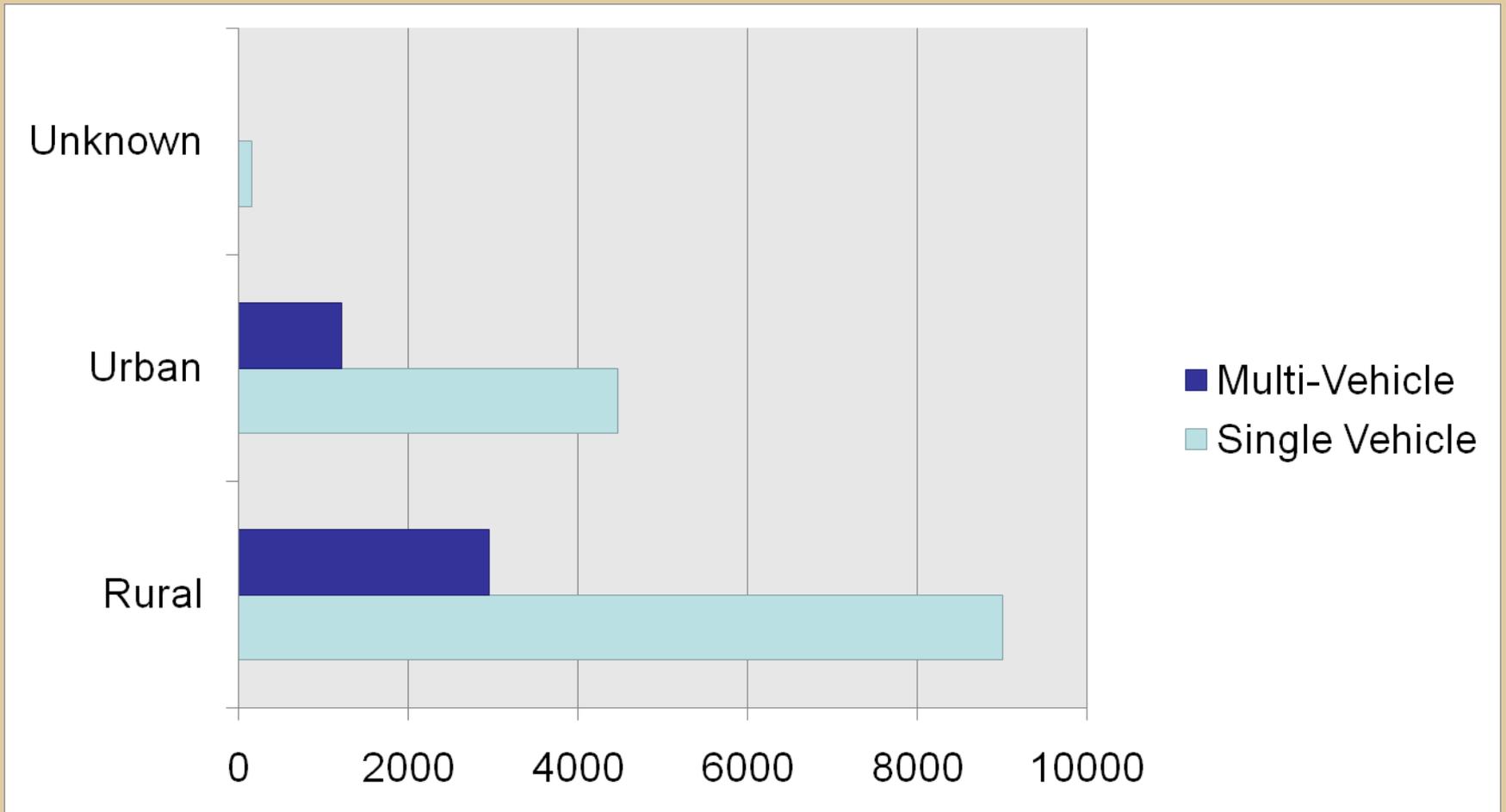
Roadway Departure Crash - A non-intersection crash in which a vehicle crosses an edge line, a centerline, or otherwise leaves the traveled way.

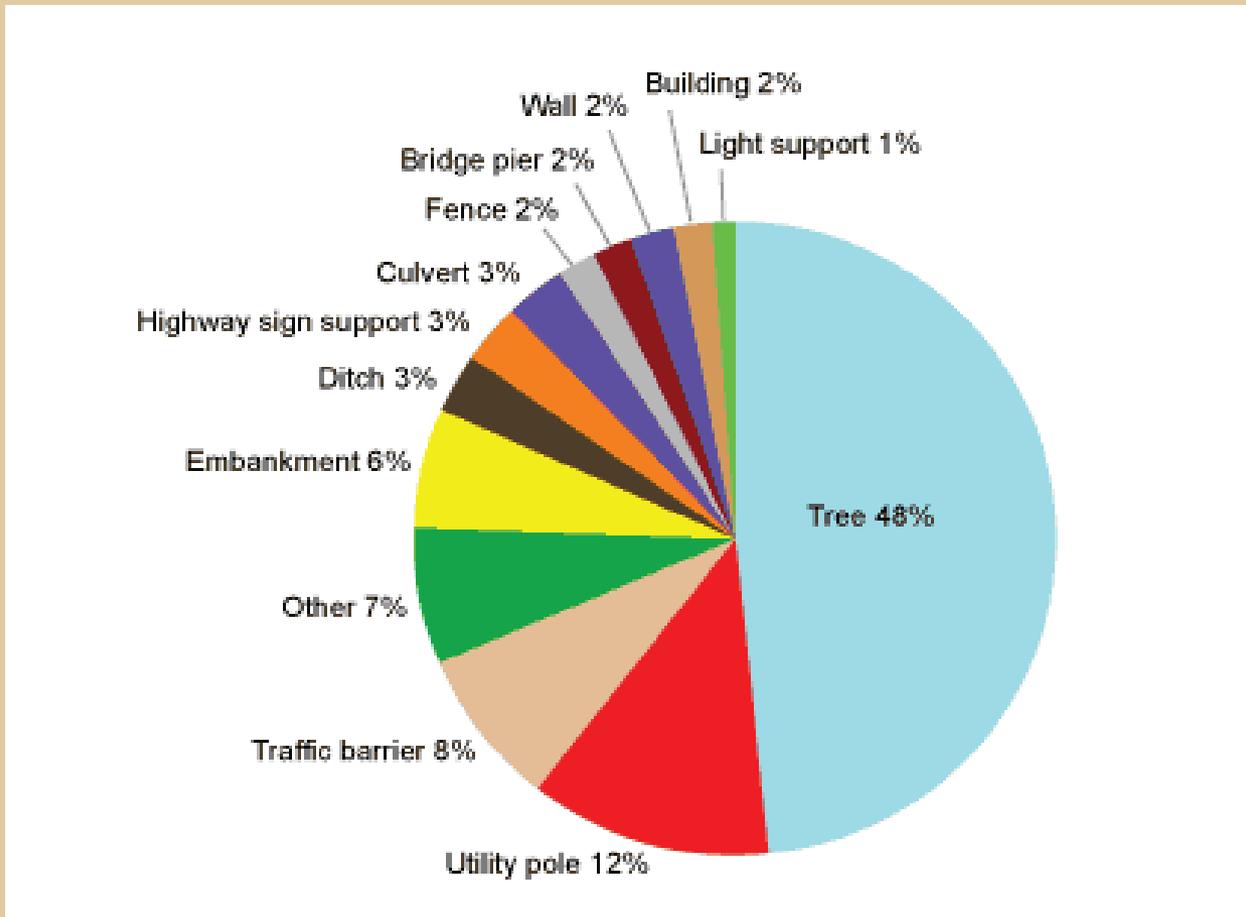
Percent of Rwd Fatal Crashes

- 2006-2008 Averages



2008 Rwd Fatal Crashes

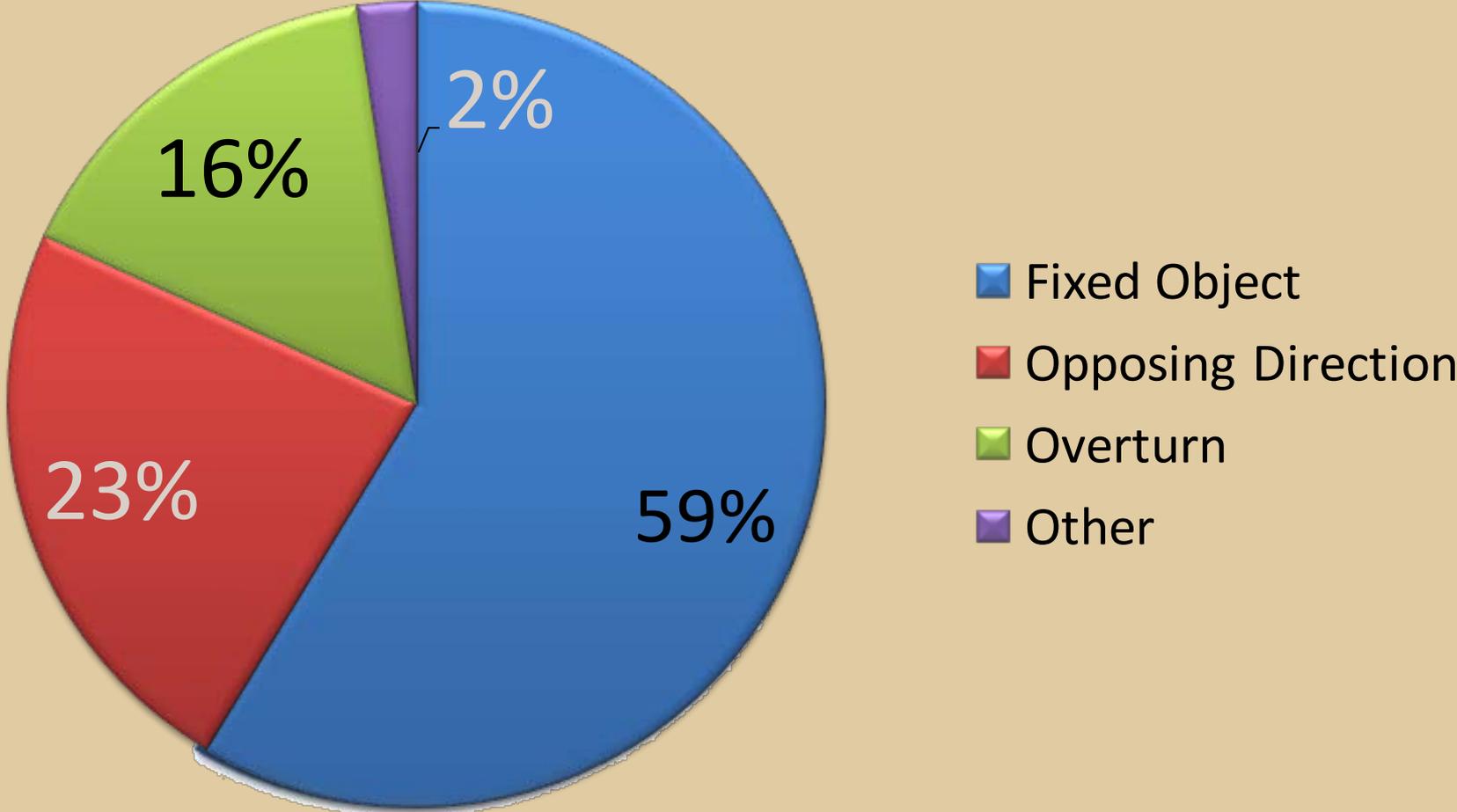




Percent distribution of fixed-object fatalities by object struck, 2008

RwD Crash Types

First Harmful Event in Fatal RwDs

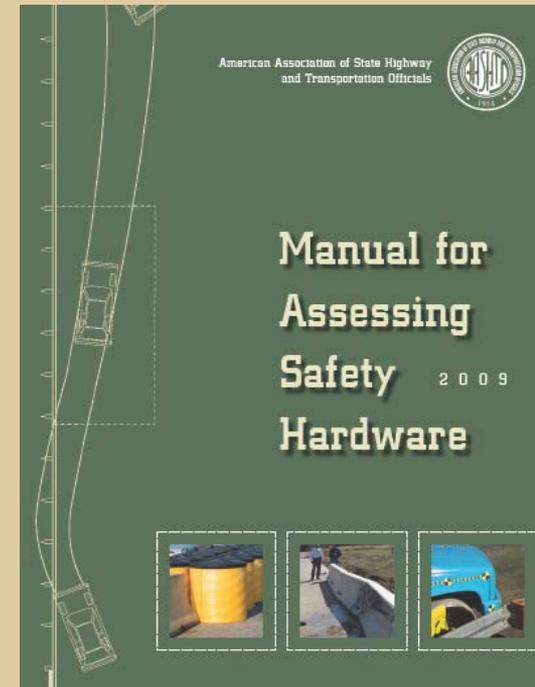


Source: FARS (Averaged over 2006-2008)

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RDG Update Objectives

- Statistics Updated
- Incorporated Research
- Incorporated AASHTO “MASH” document
- Referenced safety hardware websites for designer use.
- 4th Edition RDG published in 2011



New Crash Test Criteria

- Crash Test Criteria evolves with vehicle fleet and improvements in roadside hardware
- MASH replaces NCHRP Report 350 Criteria
 - Primary changes to vehicle mass, speed and angle of impact
 - Biggest Change is impact angle on end terminals and crash cushions
 - TL-4 Test has more energy

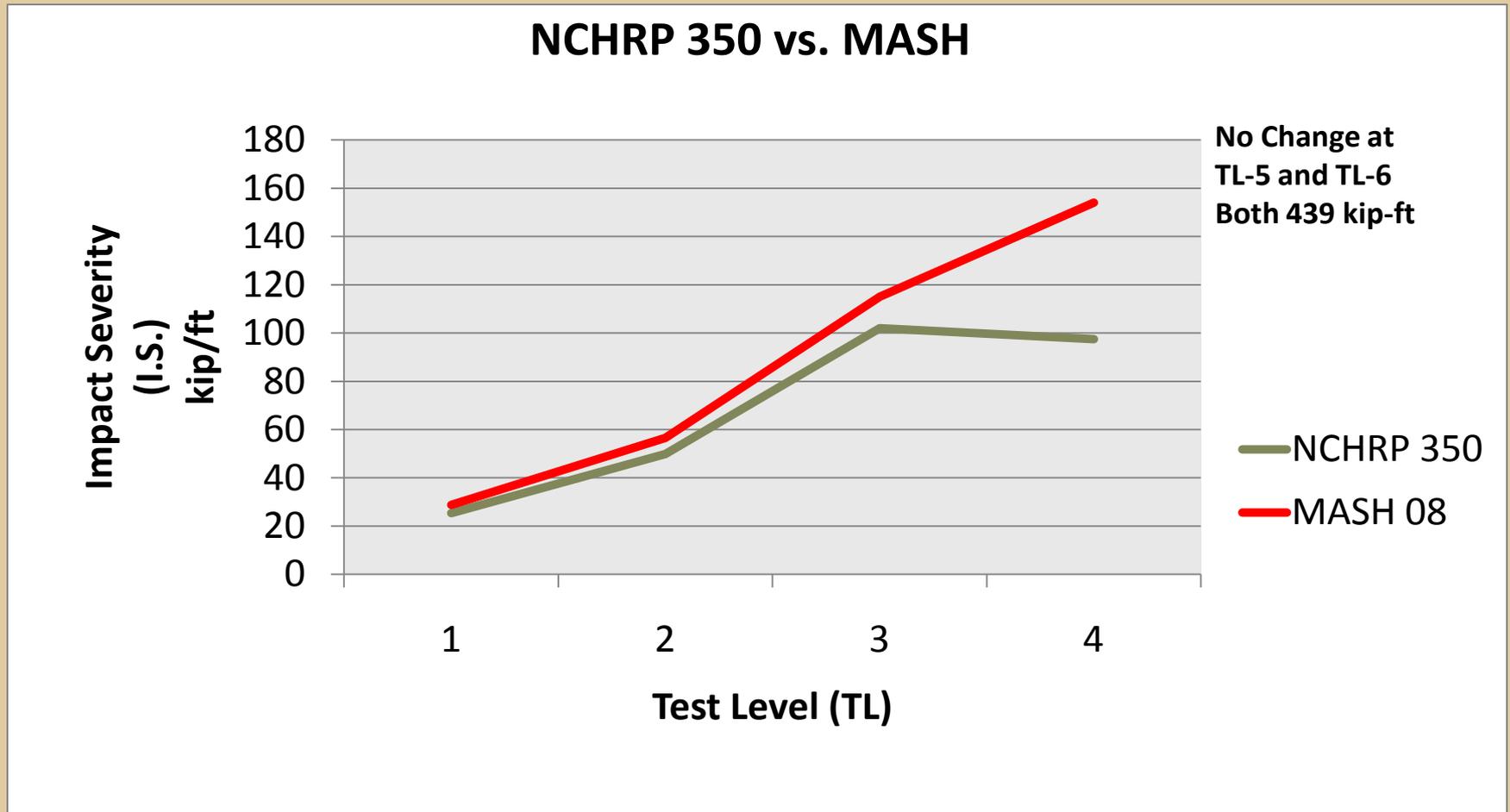
MASH Testing Concerns

- 32" Concrete Jersey Barrier, TL - 3 and TL - 4 Tests



MASH vs 350 Impact Severity

$$I.S.=1/2m(v*\sin\Theta)^2$$



350 vs MASH Test Level 4



RDG 2011 – Highlights of Changes

Chapter 1 – [An Introduction to Roadside Safety](#)

- Update roadside crash statistics and web site references for more detailed data
- Reference New Crash Test Procedures for MASH (2009) and Barrier Test Matrix
- Reference AASHTO/FHWA Joint Implementation Plan for Continued Use of Report 350 Accepted Hardware
- Reference FHWA Acceptance Letter Web Site and AASHTO TF-13 Web Site

Links to Task Force 13 Guide to Standardized Highway Barriers

- Appendices B & C deleted
- Link to details of barriers are available by links to TF 13

Table 5-3. Roadside Barriers and NCHRP Report 350 Approved Test Levels

System	Test Level	FHWA Acceptance Letter	System Designation	Reference Section
FLEXIBLE SYSTEMS				
W-Beam (Weak Post)	2	B-64	SGR02	5.4.1.3
Three-Strand Cable (Weak Post)	3	B-64	SGR01a and b	5.4.1.1
High-Tension Cable Barriers	3 and 4	Various	Various	5.4.1.2
Modified W-Beam (Weak Post)	3	B-64	SGR02	5.4.1.3
Ironwood Aesthetic Barrier	3	B-56, 56-A, and 56-B		5.4.1.4
SEMI-RIGID SYSTEMS				
Steel Post with Steel Blockout	2	B-64	SGR04a	5.4.1.6
Box Beam (Weak Post)	3	B-64	SGR03	5.4.1.5
Steel or Wood Post with Wood or Plastic Blockout	3	B-64	SGR04a and b	5.4.1.6
NU-GUARD by Nucor Marion	3	B-162		5.4.1.8
Trinity T-31 and Trinity Guardrail System	3	B-140		5.4.1.8
Gregory (GMS)	3	B-150		5.4.1.8
Midwest Guardrail System (MGS)	3	B-133		5.4.1.7
Blocked-out Thrie-Beam (Strong Post)	3	B-64	SGR09c SGR09a	5.4.1.9.1
Merritt Parkway Aesthetic Guardrail	3	B-38		5.4.1.10
Steel-Backed Timber Guardrail	2 and 3	B-64-D		5.4.1.11



News and Bulletins

- Our Fall meeting will be in Rapid City, SD. See the News and Bulletins page for more info.
- For Minutes from previous meetings, see the News and Bulletins page.

Task Force 13 Home

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[W-Beam Guardrail Repair Guide \(FHWA\)](#)

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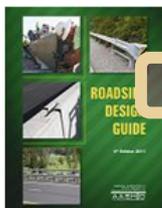
Task Force 13 develops, recommends, and promotes standards and specifications for bridge and road hardware used by highway and transportation agencies on the nation's roadways. Task Force 13 is a committee of concerned and experienced representatives from industry, academia, and state and federal transportation departments. Task Force 13 serves the Joint AASHTO-AGC-ARTBA Subcommittee on New Highway Materials and Technologies, whose mission is to develop guide specifications for new materials and technologies identified for use in highway construction projects. The present Joint Committee was established in 1972 uniting the American Association of State Highway and Transportation Officials (AASHTO) and Associated General Contractors of America (AGC) committee with the American Road and Transportation Builders Association (ARTBA). Task Force 13 is the longest standing of all existing subcommittee Task Forces.

Standards are documented agreements containing technical specifications and criteria to be used consistently as rules, guidelines, or definitions to ensure that material, products, processes and services are fit for their purpose. For example, the construction details of the guardrail barrier common on America's roadside are derived from a 1995 standard "A Guide to Standardized Highway Barrier Hardware." Adhering to this standard ultimately means that highway barriers will perform consistently from State to State to make roadsides safer for errant vehicles that leave the roadway. Standards thus contribute to making life simpler, and to increasing the safety, reliability and effectiveness of the goods and services we use.

Roadside Design Guide, 4th Edition

The Roadside Design Guide is an AASHTO publication that synthesizes current information and operating practices related to roadside safety presented both in metric and U.S. customary units. It focuses on safety treatments that can minimize the likelihood of serious injuries when a motorist leaves the roadway.

Chapters 3 through 9 of the Roadside Design Guide refer to many of the systems available in the online guides offered by Task Force 13. The links below DO NOT point to AASHTO's Roadside Design Guide, but rather to the specific types of systems referred to in those chapters. To obtain more information or to purchase a copy of the Roadside Design Guide, please click the following cover image below.



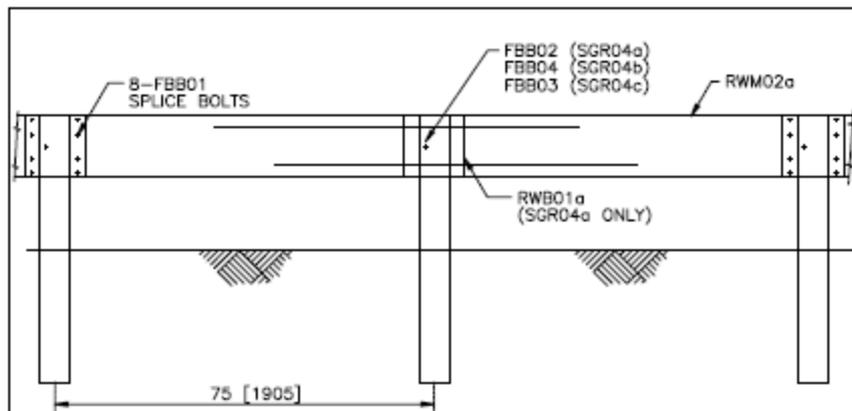
- Chapter 3: Roadside Topography and [Drainage Features](#)
- Chapter 4: Sign, Signal, and Luminaire Supports, Utility Poles, Trees and Similar Roadside Features ([Luminaire Supports](#))
- Chapter 5: [Roadside Barriers](#)
- Chapter 6: [Median Barriers](#)
- Chapter 7: Bridge Railings ([Bridge Rail Systems](#) or [Transition Systems](#))
- Chapter 8: [Barrier End Treatments](#) and [Crash Cushions](#) ([Barrier End Treatments](#) or [Crash Cushions](#))
- Chapter 9: [Traffic Barriers](#), [Traffic Control Devices](#), and Other Safety Features for Work Zones
 Additional Information can be found at [The National Work Zone Safety Information Clearinghouse](#)

For more information or to purchase a copy.

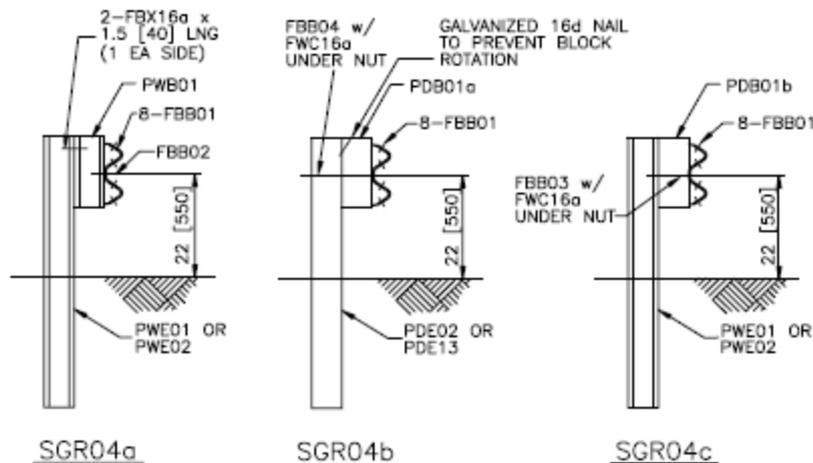
Publications of Task Force 13

For more information on each guide or to access the online version, click on the links below.





ELEVATION



1994

STRONG-POST W-BEAM GUARDRAIL

SGR04a-c

SHEET NO.	DATE:
1 of 4	6/30/05

INTENDED USE

Strong-post W-beam guardrails should be used in locations where a maximum dynamic deflection of 36 inches [900 mm] or less is acceptable. W-beam guardrails should be anchored and terminated using a suitable end treatment. SGR-04a (steel posts) with steel blockouts is a Test Level 2 barrier. SGR-04b (wood posts) with wood, steel or plastic blockouts is a Test Level 3 barrier; SGR-04c (steel posts) with wood or plastic blockouts is also a Test Level 3 barrier.

COMPONENTS

Unit length = 150 inches [3810 mm]

Designator	Component	System	Number
FBB01	Splice bolt and nut	a-c	8
FBB02	Guardrail-post bolt and nut	a	2
FBB03	Guardrail-post bolt and nut	c	2
FBB04	Guardrail-post bolt and nut	b	2
FBX16a	Post blockout bolt (1.5 inches [40 mm]) and nut	a	4
FWC16a	Round washer	b,c	2
PDB01a	Timber post blockout	b	2
PDB01b	Timber post blockout	c	2
PDE02	Timber post	b	2
or PDE13	Timber post	b	2
PWB01	Steel post blockout	a	2
PWE01	Steel post	a,b	2
or PWE02	Steel post	a,b	2
RWB01a	W-beam backup plate	a	1
RWM02a	W-beam rail	a-c	1

APPROVALS

FHWA Acceptance Letter [E-64](#), 2/14/00.

REFERENCES

M.E. Bronstad, J.E. Michie and J.D. Mayer, Jr., *Performance of Longitudinal Traffic Barriers*, National Cooperative Highway Research Program Report Number 289, Transportation Research Board, June, 1987.

C.E. Buth, W.L. Campise, L.I. Griffin, M.L. Love, and D.L. Sicking, *Performance Limits of Longitudinal Barriers*, Federal Highway Administration, Report No. FHWA-RD-86-153 (vol. 1), Washington, D.C., May 1986.

R.L. Stoughton, R.L. Stoker, E.F. Nordlin, *Dynamic Tests of Metal Beam Guardrail*, Transportation Research Record, Transportation Research Board, Washington, D.C., 1975.

STRONG-POST W-BEAM GUARDRAIL

SGR04a-c

SHEET NO.	DATE
2 of 4	6/30/05

RDG 2011 – Highlights of Changes

Chapter 2 – Economic Evaluation of Roadside Safety

- Reference to RSAP being updated under Project 22-27 and reference to TRB website for status (and download)
- Reference to AASHTO Highway Safety Manual (2010) Chapter 7 economic appraisal procedures
- Added Section 2.3 for In-Service Performance Evaluation

RDG 2011 – Highlights of Changes

Chapter 3 – Roadside Topography and Drainage Features

- “Clear-Zone” terminology coordinated with Green Book
- Clear-Zone for auxiliary lanes defined
- Curb discussion moved to Chapter 5
- Expanded examples for clear zone evaluation

Culvert Opening Protection



Chapter 4 of the RDG

- Sign, Signal, and Luminaire Supports, Utility Poles, Trees, and Similar Roadside Features
 - Breakaway Devices
 - Not all signs applicable
 - Sign Supports
 - Utility Poles
 - Trees
 - MASH - windshield penetration criteria for signs

Highlights of Changes 4th Ed. RDG

- Chapter 5 – Roadside Barriers
 - Reference to MASH and Implementation Plan
 - Brief discussion of motorcycles w/barriers
 - Task Force 13 / FHWA Acceptance Letters
 - New W-beam systems
 - MGS and Proprietary 31-inch systems

Highlights of Changes 4th Ed. RDG

- Chapter 5 – Continued
 - Zone of Intrusion concept
 - Revised discussion of guardrail behind curbs
 - Runout lengths reduced for barrier design
 - Guardrail posts in rock or mow strips
 - Upgrading existing systems revised
 - Plus or minus 3” is gone

Highlights of Changes 4th Ed. RDG

- Chapter 5 – Roadside Barriers
 - Guardrail height for new construction
 - TL-3 on NHS
 - 27.75" Min
 - 29" with +/- 1"
 - +/- 3" Gone G4(1S) & G4(2W)
 - 26.5" Low Tolerance for 3R on NHS

Background and Design Considerations

- Concerns with current W-beam design
 - Light truck and high cg rollover rates
 - Installation height sensitivity
 - Rail ruptures



Test No. 4798-7

1,963 kg/95.3 km/hr/24.0 deg

686 mm (27 in.) Height

Vehicle Rollover (Failure)

Dynamic Deflection = 28.1 in.



Test No. 471470-27

2,075 kg/101.4 km/hr/26.1 deg

686 mm (27 in.) Height

Vehicle Rollover (Failure)

Dynamic Deflection = 35.8 in.

Test No. MIW-1

2,007 kg/99.8 km/hr/25.8 deg

686 mm (27 in.) Height

Vehicle Rollover (Failure)

Dynamic Deflection = 39.4 in.



Test No. NEC-1

1,979 kg/103.2 km/hr/24.5 deg

706 mm (27.8 in.) Height w/ Curb

Rail Rupture & Vehicle Penetration (Failure)

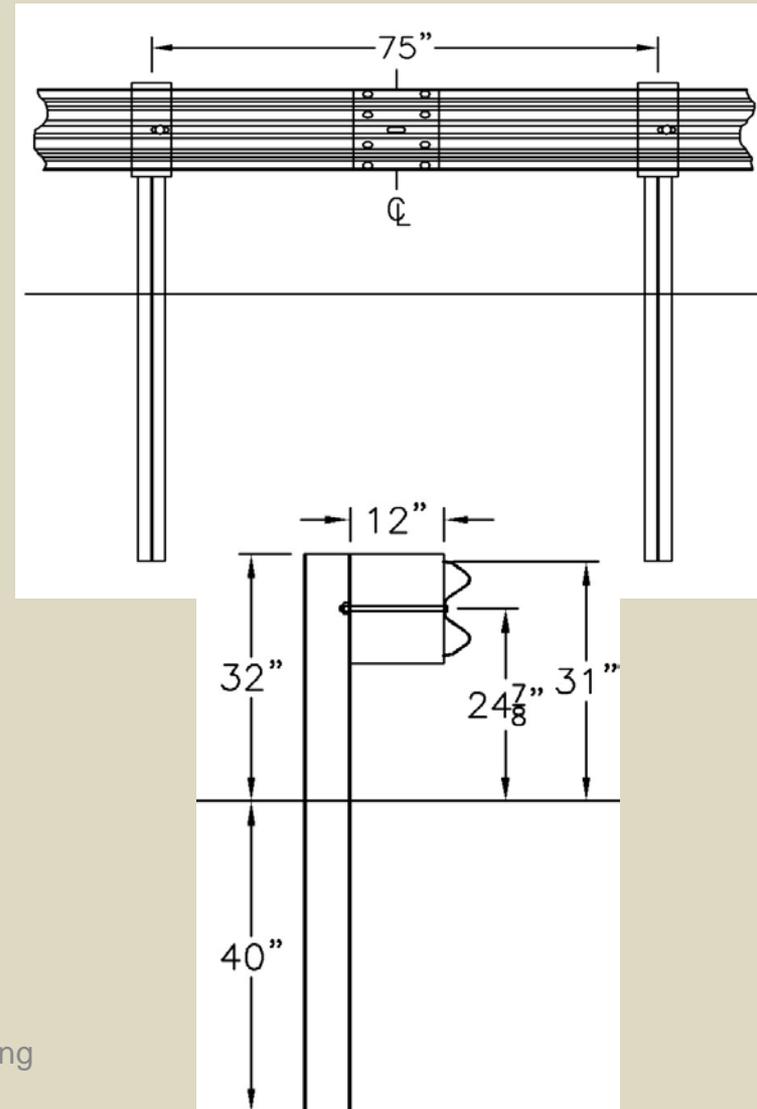


31" Guardrail

- Benefits
 - Improved Performance
 - High CG vehicles
 - Improved re-directive capacity
 - Improved height tolerance
 - Better performance in non-standard installations
 - Equal or reduced cost
- Four designs
 - Three proprietary and one non-proprietary

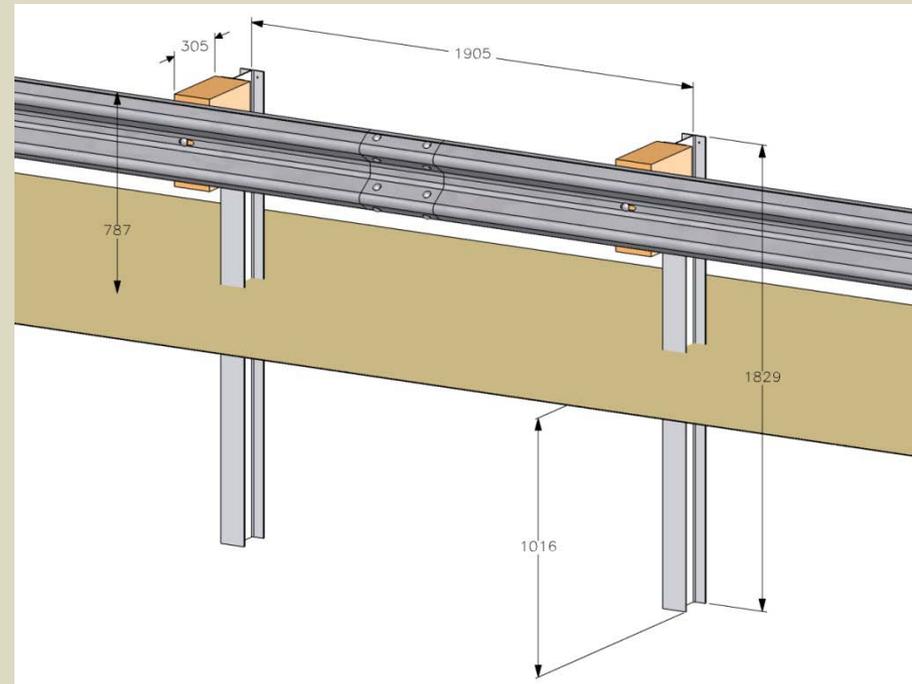
Midwest Guardrail System (MGS)

- Standard W-beam with minor changes
 - Mid-span splices
 - Increased mounting height
 - Increased blockout depth
 - Reduced post embedment



Midwest Guardrail System (MGS)

- Std., $\frac{1}{2}$ and $\frac{1}{4}$ post spacing
- Offset from curbs
- Long Span
- Steep Slopes
- Steep Flare Rates
- 8:1 Foreslopes
- Thrie to W-Beam Transition
- End Terminals
- 3:1 without blockouts



Typ. W-Beam

MGS



Gregory Mini Spacer (GMS) System

- Mini Spacer post-to-rail attachment
- Standard 6' long W6x9 or W6x8.5 posts
- Splices at mid-span or at post
- No spacer block



T-31 Guardrail System

- 6'-0" Steel Yielding Line Post (SYLP)
- Splices at mid-span
- Countersunk-head post bolt
- 6" backup plate
- No spacer block



NU-Guard 31

- 6'-6" RIB-BAK U-Channel post with slot
- 3 1/2" washer between post and rail
- Posts at splice
- No spacer block



Length of Need

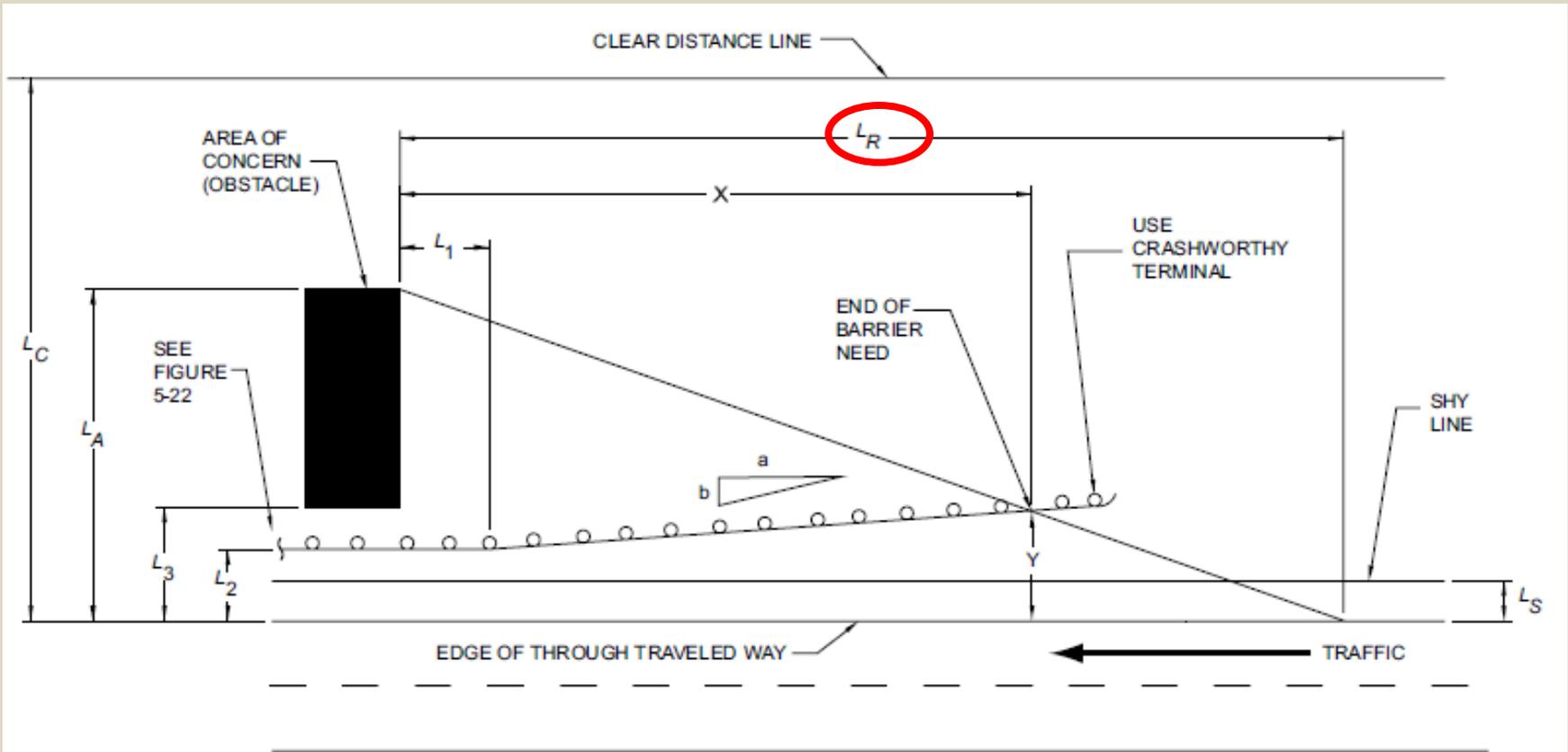


Figure 5-39. Approach Barrier Layout Variables

$$X = \frac{L_A + \left(\frac{b}{a}\right)(L_1) - L_2}{\left(\frac{b}{a}\right) + \left(\frac{L_A}{L_R}\right)}$$

NOT THIS SHORT

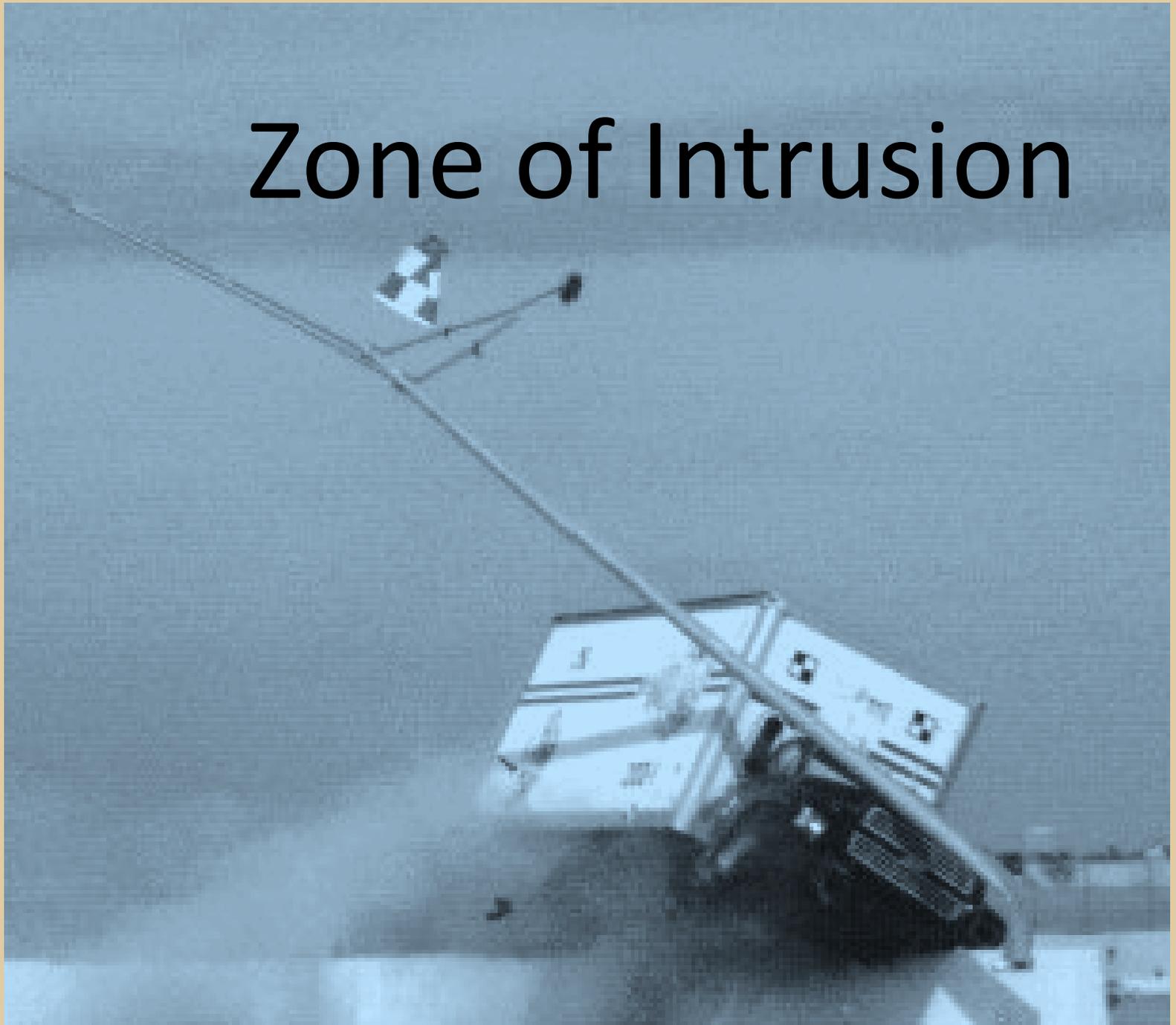


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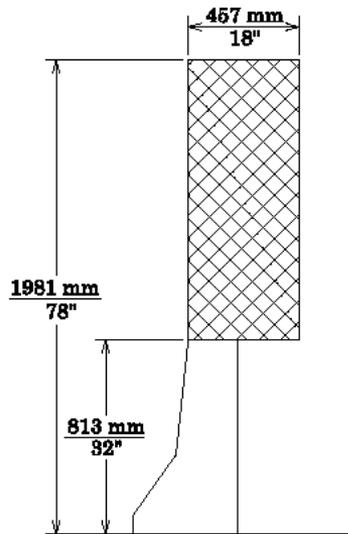
Runout Length, L_R

Design Speed (mph)	Runout Length (L_R) Given Traffic Volume (ADT) , feet			
	Over 10,000	5,000-10,000	1,000-5,000	Under 1,000
80	470	430	380	330
70	360	330	290	250
60	300	250	210	200
50	230	190	160	150
40	160	130	110	100
30	110	90	80	70

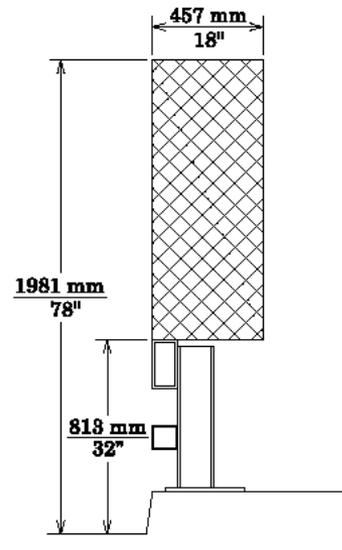
Zone of Intrusion



RDG Guidance

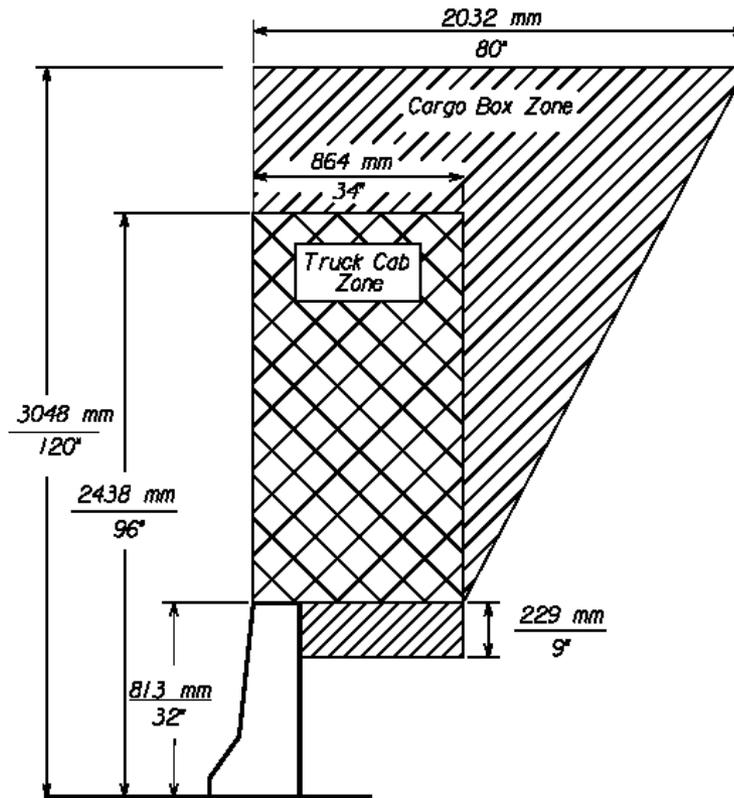


* Reviewed TL-3 sloped-faced concrete barrier heights fell in a range of 762 mm (30 in.) to 813 mm (32 in.)



** Reviewed TL-3 steel tubular barrier on curb (curb greater than 6") heights fell in a range of 813 mm (32 in.) to 864 mm (34 in.)

Zone of Intrusion



* Reviewed TL-4 barrier heights fell in a range of 737 mm (29 in.) to 1067 mm (42 in.)

Truck into CMB



Chapter 5 addresses the LFRD Bridge Pier Protection Guidelines

New Research (NCHRP 12-90) underway to develop risk based guidelines

- **AADT**
- **Route Classification**
- **Bridge Type**
- **Site Location**
- **Risk vs Benefit of Tall Barrier (higher TL)**
- **Length of barrier for vehicle larger than TL-3**

Pier Protection



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Pier Protection



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Impact into Bridge Column



RDG Chapter 6 - Median Barriers

2006 Changes

- New Guidelines for the use of median barrier
- High-tension cable barrier information added
- Added guidance on placement of cable barrier in the median

2011 Changes

- Incorporated guardrail height requirements per 2010 FHWA memo
- Included height tolerances for rigid and flexible barriers
- Added information on high-tension cable barrier on 4:1 slopes

Lessons learned



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Lessons learned



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Lessons learned

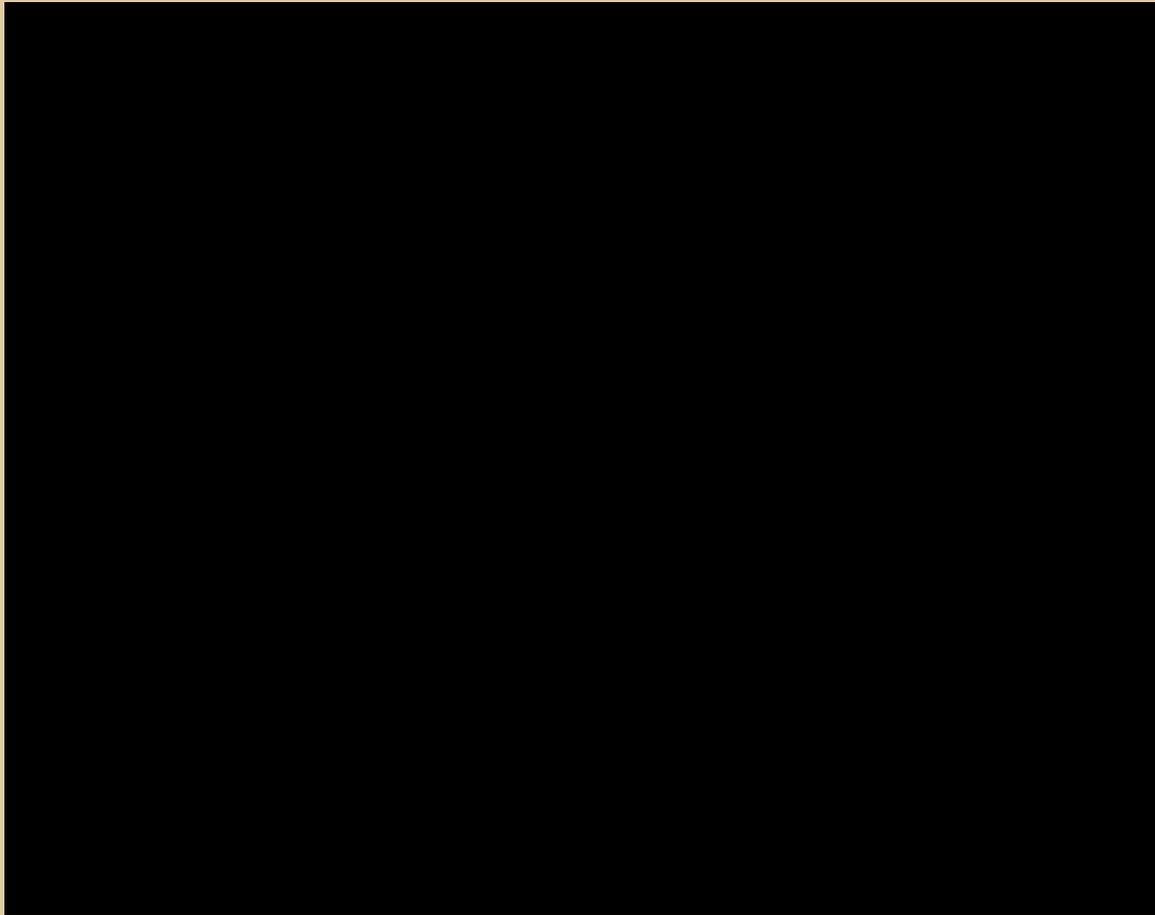


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Lessons learned



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Chapter 7 – Bridge Railings

- Discusses MASH and LRFD
- Incorporates “Protective Screening at Overpasses”
- References Task Force 13 Bridge Rail Guide

Chapter 8 – End Terminals and Crash Cushion

- Anchorages vs. terminals
- Discussion of MASH, NCHRP 350
- Introduction of the Work-Energy principle
- “Crash cushion” instead of “attenuator”

Chapter 8 – End Terminals and Crash Cushion

- Updated lists to show commonly-used and/or currently-marketed devices
- References to FHWA acceptance letters and Task Force 13 drawings
- Terminals and crash cushions further broken out by type

Chapter 8 – End Terminals and Crash Cushion

Terminals classified into:

- Cable barrier terminals
 - 3-strand, high-tension
- W-beam terminals
 - Tangent, flared, median, 31-inch
- Box-beam terminals

Chapter 8 – End Terminals and Crash Cushion

Crash cushions classified into:

- Sacrificial
- Reusable
- Low-maintenance and/or self-restoring
- Other (sand barrels and miscellaneous)

- Chapter 9 – Work Zone Devices
 - Generic and Proprietary PCB designs enumerated
 - Reduce deflection / pinned barriers
 - Water filled barriers v longitudinal channelizers

- Chapter 10 – Roadside Safety in Urban or Restricted Environments
 - Describes an urban enhanced lateral offset of 4 feet minimum, 6 feet desirable
 - Urban control zone concept: keep obstacles away from intersections, driveways, speed change lanes
 - Emphasizes 1.5 foot min lateral offset to obstructions is *not* a clear zone

- Chapter 11 - Mailboxes
 - Vandal proof mailboxes
 - Secure, locked mailboxes
 - Lightweight plastic designs



- Chapter 12 - **ROADSIDE SAFETY ON LOW-VOLUME ROADS AND STREETS**
 - New chapter to RDG
 - Low cost strategies: **SIGNING, MARKING, AND DELINEATION**
 - Clear zone
 - Roadside hardware

For additional information please contact:

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