FORENSIC ANALYSIS OF ROADWAY DEPARTURE CRASHES ON LVRs

Ron W. Eck, P.E.

Morgantown, WV

Overview

- Introduction and Background

- Summary of Database

- Identifying Contributing Factors in Crashes

- Lessons Learned

The Roadway Departure Problem

- In 2007, 59% of the 41,059 traffic fatalities involved lane departures

- Run-off-road crashes cause 1/3 of all traffic fatalities

- Two-thirds of these crashes occur in rural areas

Run-Off-Road Crashes

Involve vehicles that leave the traveled way and encroach onto the shoulder and beyond and hit one or more natural or artificial objects, such as trees, utility poles, embankments, guardrails, and drainage structures.

To reduce the number of ROR fatal crashes

- Keep vehicles from encroaching on roadside,
- Minimize the likelihood of crashing or overturning if the vehicle travels off the shoulder, and
- Reduce the severity of the crash.

However,

typical countermeasures (e.g., flattening curves, installing shoulder rumble strips, flattening sideslopes, object removal, and shielding hazards) are usually not feasible on low-volume roads.

Need

Better understanding of factors associated with single vehicle run-off-road crashes on rural low-volume roads.

Approaches

- Analyze crash data

- Forensic analysis of sample of LVR crashes

Crash Data

- Large sample size
- Summary reports may lack detail
- Usually not enough crashes to develop patterns
- Police reports have limitations

Forensic Analysis

- More detailed information about each crash permits better assessment of contributing factors
- Quantity of info is variable
- Small sample size
- Only severe crashes
- Time-consuming

Objectives

- Analyze sample of single-vehicle, run-off-road crashes on low-volume roads

- Compile data on roadway, vehicle and driver factors

- Identify any contributing factors

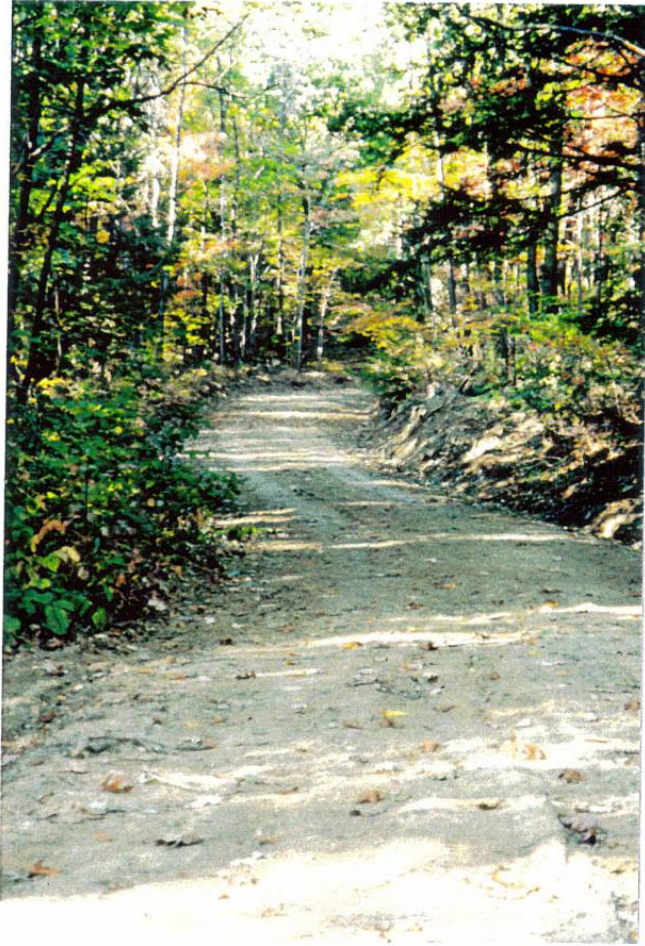- Suggest risk management lessons learned

Scope

- 35 single-vehicle ROR crashes on LVR in MD, OH, PA and WV

- Over approx. 15-year period

- Terrain, geology and climate of that area

- Involved a claim or potential claim against road agency

Scope (cont'd)

- Information available varied from case to case but in all cases included PAR and photos of site and vehicle

- Engineer visited 24 sites (69%)

- Where claims were filed, none went to trial

Roadways at Crash Sites

Surface Type

- Earth   1   (3%)
- Gravel   6   (17%)
- Bit. Surf. Trmnt.   18   (51%)
- Hot Mix Asphalt   9   (26%)
- PCC   1   (3%)
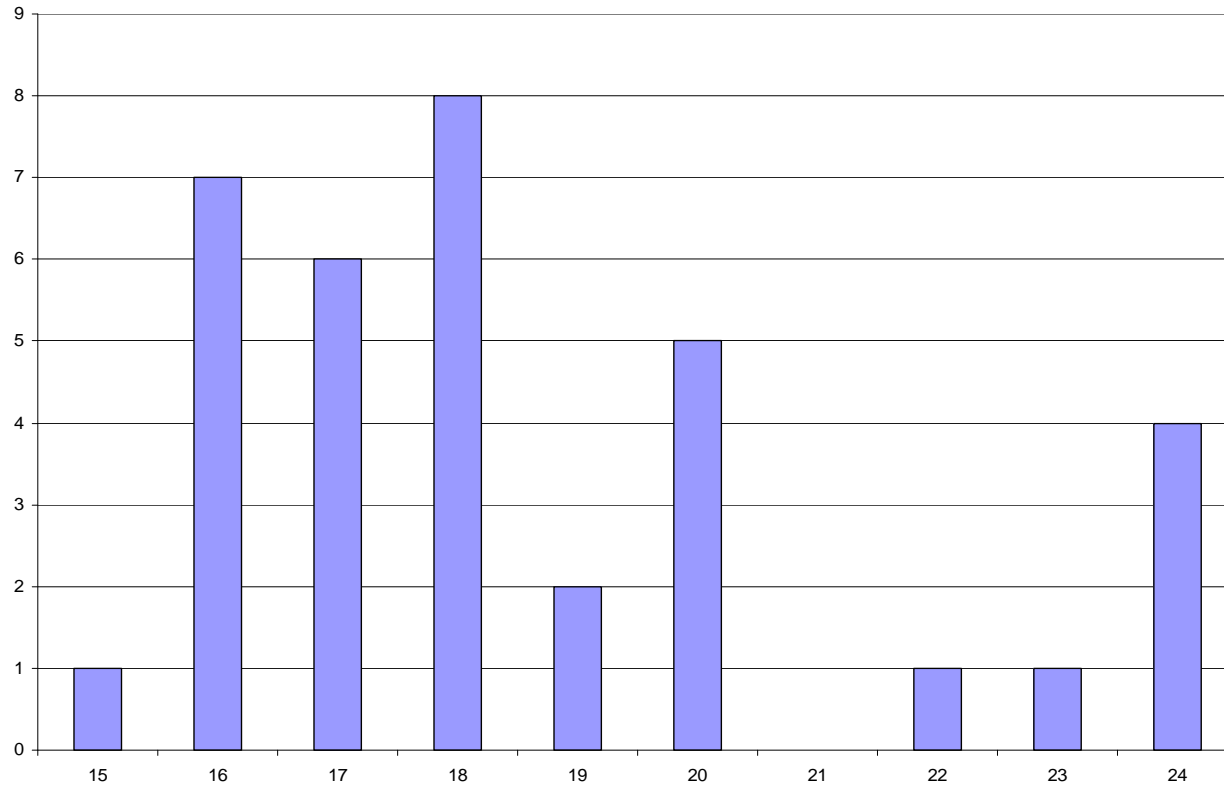
Roughness

Roughness or surface profile irregularity was mentioned in 3 of 35 crash reports (9%).

Roadway Width

80% of roads between 16 and 20 feet wide

Roadside Conditions

- Obstacle-Free   1   (3%)
- Trees   26   (74%)
- Slopes   23   (66%)
- Furniture   6   (17%)
- Water   3   (9%)
- Traffic Barrier   1   (3%)

Horizontal Alignment

Tangent   12   (34%)

Right Curve   10   (29%)

Left Curve   13   (37%)

Vertical Alignment

Upgrade   8   (22%)

Level   10   (29%)

Downgrade   17   (49%)

Alignment Combinations

Downgrade Curve L	6	(17%)
Downgrade Curve R	6	(17%)
Level Curve L	4	(11%)
Level Curve R	4	(11%)
Downgrade Tangent	5	(14%)
Upgrade Tangent	5	(14%)

Traffic Control Devices

Signing

- Warning signs present at 8 locations

- Relevant warning signs at 6 locations

- None of curves had chevrons

Markings

- None   32   (91%)

- DYCL   2   (6%)

- DYCL + Edgelines   1   (3%)

Crash Environment

Month of Year

July	9	(26%)
August	4	(11%)
September	4	(11%)
January	4	(11%)
March	4	(11%)

Light Condition

Daylight   23   (66%)

Darkness   12   (34%)

Travel Surface Condition

- Dry   22   (63%)

- Wet   9   (26%)

- Ice/Snow   4   (11%)

Driver Characteristics

Gender

- Male   26 (74%)

- Female 9 (26%)

Driver Age

<20	9	(26%)
20-29	11	(31%)
30-39	6	(17%)
40-49	5	(14%)
50-59	3	(9%)
60+	1	(3%)

Driver Familiarity

- Resided in county   31 (89%)

- Resided outside county   4 (11%)

Alcohol/Drugs

- None   28   (80%)

- DUI   7   (20%)

Vehicles

Vehicle Types

Pass. Car	29	(83%)
Motorcycle	4	(11%)
Single Unit Truck	1	(3%)
Other (tractor)	1	(3%)

Crash Characteristics

Severity

- Fatal   8   (23%)

- Serious Injury   27   (77%)

Nature of Crash

- Rollover   14
- Struck Tree   12
- Hit Embankment   8
- Struck Furniture   6

Abnormal Surface Condition Noted on Police Report

- Loose Stone   7   (20%)
- Isolated Ice   1   (3%)
- Bleeding   1   (3%)

Departed Road on . . .

Right   22   (63%)

Left   13   (37%)

Patterns Identified— Extreme Geometry

- Sharper horizontal curves on or near bottom of steeper downgrades

- Unusually long and steep curving downgrades

Top of Grade

Approaching Curve Near Bottom

Fatal Crash of Loaded Tanker

Pattern Identified—
Road Surface Condition

- Bit. Surface Treatments

  -- excessive stone

  -- bleeding

- Driveway/Side Road drainage across road

Pattern Identified—
Human Factors

- Younger drivers
  - Speeding
  - In-vehicle distractions?

- Expectancy violations

Lessons Learned--General

- Use of roadway information from forensic matters can be helpful in identifying contributing factors in LVR crashes

- Use a systems safety approach in investigating LVR crashes since roadway and vehicle factors often not considered.

Lessons Learned--Specific

- Warn drivers of extreme geometries and check the delineation

- Selective vegetation trimming to help drivers see extreme alignments

- Make sure proper procedures are followed in applying bituminous surface treatments

Lessons Learned (cont'd)

- Check driveways for compliance with design standards

  -- water draining onto or across roadways?

  -- mud being tracked onto roadway?

- Learn to look for expectancy violations

- Learn to "Read the Road"

Reading the Road

- Look for evidence that motorists are having difficulty negotiating a section of road. For example:

  -- abundance of locked wheel tire marks

  -- multiple gouges in pavement surface

  -- scars on trees and roadside objects

  -- frequent "knock-downs" of roadside objects
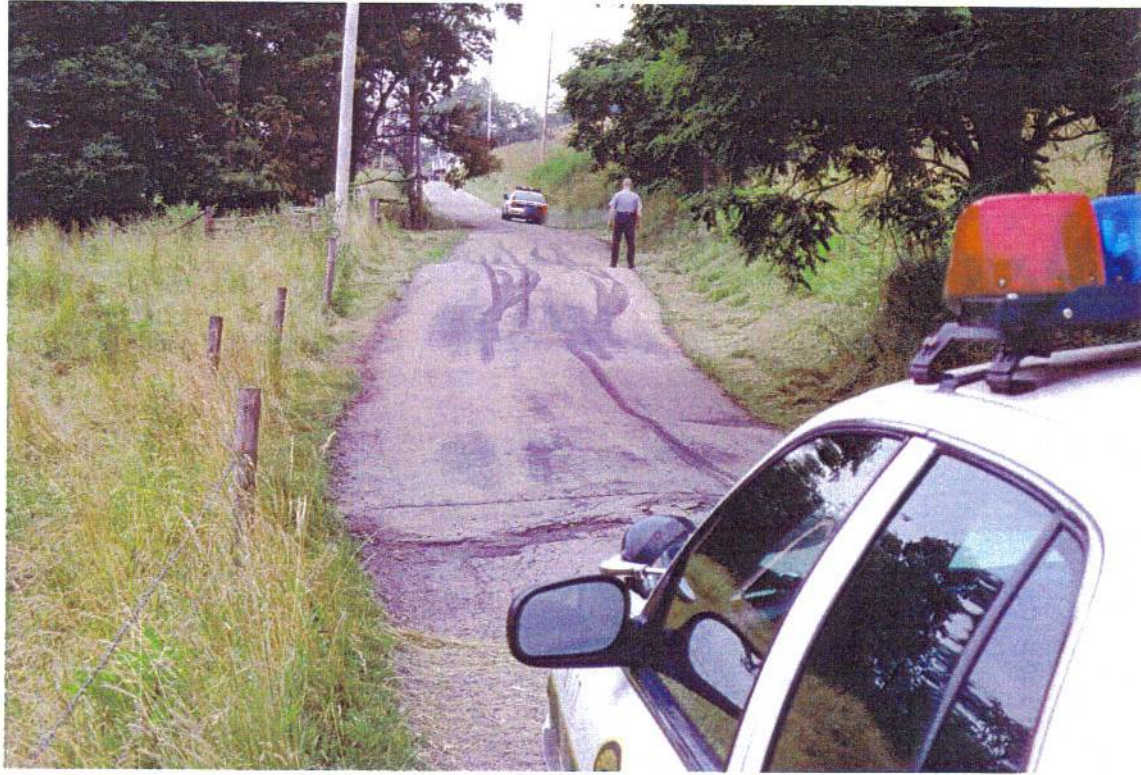
Questions/Comments?

Ron Eck

Ronald.Eck@mail.wvu.edu