Measuring the Impacts of Speed Reduction Technologies: A Dynamic Advanced Curve Warning System Evaluation

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Introduction

• March 2004 Oregon DOT installed an “Advanced Curve Warning System” in the Myrtle Creek curves on I-5
• Portland State University asked to conduct field evaluation

• Crash rate above average
  – 1.18 per MVMT vs. 0.22 per MVMT

• 33 reported crashes
  – 13 on the sharper southbound curve
  – 20 crashes occurred on the northbound curve

• 12 injury (3 severe)
• 70% of the crashes involved only one vehicle
• More truck crashes southbound
  – 11 overturning incidents
Other Similar Applications

- Truck Rollover
  - California (I-5 Sacramento River Canyon)
  - Texas (freeway off-ramp loops)
  - Maryland and Virginia (freeway off-ramp loops – with WIM, speed, height detection)

- Truck Downgrade Warnings
  - Colorado (I-70, Eisenhower Tunnel)
  - Oregon (I-84, Emigrant Hill, eastern Oregon)
Site Description

• Starting 0.5 mile from curve, 50 mph speed zone
  – Advisory speed of 45 mph

• 2002 ADT
  – 16,750 NB and 15,700 SB
  – 27 % trucks

\[ R_{SB} = 617 \text{ ft} \]
\[ R_{NB} = 649 \text{ ft} \]
\[ e = 10\% \]
Before Signing Conditions

- Dual overhead horizontal alignment advisory signs w/ beacons
- Ground mounted truck rollover warning
- Chevrons in NB direction
Advanced Curve Warning System

• Dynamic Message Signs (DMS) installed for both NB and SB
  – On existing sign bridges

• Radar unit for speed measurement
  – Pole-mounted near the sign bridges (height 20 ft)
  – Doppler technology to detect vehicle speeds and travel direction
  – Initially set for strongest (trucks)
  – After testing, switched to fastest target

• Total system cost $140,000
## DMS Messages

<table>
<thead>
<tr>
<th>Panel</th>
<th>Default Message</th>
<th>Warning Message</th>
<th>Excessive Speed Message</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>Speeds less than 50 mph</em></td>
<td><em>Speeds 50 to 70 mph</em></td>
<td><em>Speeds over 70 mph</em></td>
</tr>
<tr>
<td>1</td>
<td>CAUTION</td>
<td>SLOW DOWN</td>
<td>SLOW DOWN</td>
</tr>
<tr>
<td>2</td>
<td>SHARP CURVES AHEAD</td>
<td>YOUR SPEED IS XX MPH</td>
<td>YOUR SPEED IS OVER 70 MPH</td>
</tr>
</tbody>
</table>
Southbound
Northbound Pictures

Before

After

YOUR SPEED IS OVER 70 MPH
Measures of effectiveness

• Change in mean speed for passenger cars and commercial vehicles
• Change in the speed distribution for both passenger cars and trucks
• Public response to the sign
Speed Data Collection

- Sampling
  - 4 before days (W, F, Th, F)
  - 3 after days (F, F, Th)

Technique

- Obtained using an UltraLyte laser speed detection and ranging device (LIDAR)
- Speed measurements were taken separately for passenger vehicles (including light trucks and SUVs) and heavy trucks
Data Collection Location

- **Southbound** –
  - Data were collected from a vehicle parked in the ramp gore area

- **Northbound** –
  - Data were collected from behind the concrete barrier approximately 420 feet downstream from the sign bridge
Data Collection Summary

- 11 hours before, 17 hours after
Data Analysis

– All speed measurements cosine corrected
  • However, did not adjust for road geometry
– Separate analysis for commercial and passenger vehicles
– Speed data in 200 foot bins (distance from sign bridge)
  • Average
  • Standard deviation
  • 95th percent confidence interval
Comparison of Mean Zones - Southbound, Passenger Vehicles

Zone Location (feet from sign)

Sign Visible

Sign

Start of Curve

Before Mean

After Mean

Travel
Comparison of Mean Zones - Northbound, Passenger Vehicles

Zone Location (feet from sign)

Travel Direction

Sign Visible

Sign

Start of Curve

MPH

Before Mean

After Mean
Comparison of Mean Zones - Northbound, Commercial Vehicles

Zone Location (feet from sign)

MPH

Before Mean
After Mean

Sign Visible
Sign
Start of Curve

Travel

October 25, 2004

ITE/IMSA Meeting – Portland, OR
Speed Distribution

- Before
- After

<table>
<thead>
<tr>
<th>Speed Category</th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>35-&lt;40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40-&lt;45</td>
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<td>45-&lt;50</td>
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<tr>
<td>65-&lt;70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;70</td>
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</tr>
</tbody>
</table>

ITE/IMSA Meeting – Portland, OR

October 25, 2004
Intercept Survey Results

• At nearest rest area
  – NB (closest closed due to construction) 35 miles north
  – SB, 26 miles south

• Northbound & Southbound Combined, n = 67
  – 85% passenger vehicles
  – 90% noticed sign
  – 74% saw speed displayed
  – 81% useful information
  – 77% adequate location
  – 89% visibility adequate
Conclusions

• ACWS is effective at reducing the speeds of a majority of vehicles (3 mph SB and 2 mi NB)
• No suggestion for lowering upper speed for DMS messages
• Public response to the device was positive
Last thoughts

- Speed reductions were systematic
  - Something else influencing speed?
- Motorist see speed for fastest vehicle in platoon
  - Concern for driver mis-information?
  - Future analysis may study individual vehicle speed plots
- Future monitoring of crash records
  - Will speed reduction translate to crash reduction?
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