Roadway Design Factors and Drowsy Driving: Roadside Rest Areas & Rumble Strips

Peter T. Savolainen, Ph.D., P.E.
Associate Professor & Safety Engineer
Iowa State University
Institute for Transportation (InTrans)
Civil, Construction & Environmental Engineering

NTSB Public Forum on Drowsy Driving

October 21, 2014
Countermeasure 1: Roadside Rest Areas

Fatigue-related crashes = f(rest area spacing)
Average Number of Crashes by Distance from Rest Area

- For every mile upstream/downstream of the rest area:
  - Crashes increased by 1.8% on freeways
  - Crashes increased by 7.5% on two-lane highways
Countermeasure 2: Centerline & Shoulder Rumble Strips
Relevance to Drowsy Driving

- Rumble strips have been shown to reduce lane departure crashes, injuries, and fatalities.

- What behavioral changes have facilitated these crash reductions?

- Are there incremental effects of using shoulder rumble strips in conjunction with centerline rumble strips?
Field Study Locations

- 5 two-lane roadways with CLRS-only
  - ADT range: 1,500 – 5,300
  - 10 passing zones
  - 8 curves/adjacent tangents

- 5 two-lane roadways with CLRS and SRS
  - ADT range: 3,300 – 6,000
  - 8 passing zones
  - 4 curves/adjacent tangents
# Lane Positioning Results

## CLRS-Only

<table>
<thead>
<tr>
<th>Segment Type</th>
<th>CENTERED</th>
<th>Significant Difference?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tangent</td>
<td>Before: 36.3%</td>
<td>After: 48.4%</td>
</tr>
<tr>
<td>Left Curves</td>
<td>Before: 33.1%</td>
<td>After: 54.9%</td>
</tr>
<tr>
<td>Right Curves</td>
<td>Before: 24.7%</td>
<td>After: 45.3%</td>
</tr>
</tbody>
</table>

## CLRS & SRS

<table>
<thead>
<tr>
<th>Segment Type</th>
<th>CENTERED</th>
<th>Significant Difference?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tangent</td>
<td>Before: 34.9%</td>
<td>After: 68.7%</td>
</tr>
<tr>
<td>Left Curves</td>
<td>Before: 33.8%</td>
<td>After: 72.5%</td>
</tr>
<tr>
<td>Right Curves</td>
<td>Before: 34.6%</td>
<td>After: 67.5%</td>
</tr>
</tbody>
</table>

50,000 total
Before & After vehicular observations
## Encroachment Results

<table>
<thead>
<tr>
<th>Segment Type</th>
<th>EDGELINE Encroachment Rate</th>
<th>CENTERLINE Encroachment Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before</td>
<td>After</td>
</tr>
<tr>
<td><strong>Tangent</strong></td>
<td>10.5%</td>
<td>6.6%</td>
</tr>
<tr>
<td><strong>Left Curves</strong></td>
<td>13.2%</td>
<td>4.5%</td>
</tr>
<tr>
<td><strong>Right Curves</strong></td>
<td>11.6%</td>
<td>6.6%</td>
</tr>
</tbody>
</table>
Conclusions

- Roadside rest areas
  - Decrease “fatigue-related” crashes in the vicinity of rest areas up to a distance of 20 miles
  - Effects are more pronounced on two-lane highways

- Centerline rumble strips (CLRS)
  - Improve central lane positioning tendencies
  - Decrease centerline encroachments

- Shoulder rumble strips (in addition to CLRS)
  - Further improve lane-keeping
  - Decrease edgeline encroachments
Thank You!

Questions?

Peter T. Savolainen, Ph.D., P.E.
Associate Professor & Safety Engineer
Iowa State University
Institute for Transportation (InTrans)
Civil, Construction & Environmental Engineering
Phone: (515) 294-3381
pts@iastate.edu