High-Tension Cable Barrier Systems

Lifesaver’s Conference
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Outline

• Crossover Median Crashes
• Literature Review
• Crash Data
• Median Crashes

• Safety Benefits
• Costs
  – Installation
  – Maintenance
• Benefit-Cost Ratio
• Conclusion
Crossover Median Crashes

What are they?
Vehicle departs roadway on left shoulder, crosses median, and enters opposing lane of traffic

Why does it matter?
Crossover median crashes are often the most severe and more likely to result in fatalities and/or severe injuries.

Safety Countermeasure
Cable median barriers provide effective means to prevent crossover median crashes
Literature Review

Past Research

• NCHRP Reports

• State DOTs
  – Michigan DOT
  – Oregon DOT
  – Washington State DOT

Gene Snyder Freeway
Cable Median Barrier Locations*

Legend

Cable Surveys
- Cable Surveys

Vendor
- Brifen
- Gibraltar
- Trinity

[Map of Kentucky with cable barrier locations marked]
Crash Data

Study Area

• Identified seven segments in Kentucky within KY 841, Interstate 65, Interstate 75, and Interstate 275

• Rationale:
  – Represent high traffic volume areas for analysis
  – Available crash and cost data

• Time Period (Before & After):
  – 3 years (3 segments)
  – 5 years (4 segments)
Crash Data

KyOPS Query

• Pre-CMB
  – Directional Analysis Code: Median Crossover, Head-On, Opposite Direction Sideswipe, and Angle
  – Manner of Collision Code: Angle and Head-On

• Post-CMB
  – Same as above
  – 1st / 2nd / 3rd / 4th collision event with CMB
Crash Data

Pre-CMB Median Crossover Crashes

• 2004 – 2008:
  – 671 median crossover crashes along seven segments

• 2011 – 2015:
  – 6 median crossover crashes along seven segments

~10X
Median Crashes – Far Side

Interstate 64

Kentucky Route 4
Median Crashes – Near Side

Kentucky Route 841

Interstate 265
Safety Benefits

Methodology

• Highway Safety Manual, AASHTO
  – Used statistical methodologies (Empirical Bayes Theorem and Wilcoxon Test) to derive post-CMB installation “expected” crashes

• Determined reduction in target crashes from the “before” to the “after” periods

• Assigned monetary values to crash types
Safety Benefits

Lost Productivity

- Economic Costs – Wage Losses, Medical Expenses, Property Damage, and Employee Costs
- Comprehensive Costs – Quality of Life Losses, Other Economic Losses

<table>
<thead>
<tr>
<th>Collision Injury Type</th>
<th>Economic Cost Per Crash</th>
<th>Comprehensive Cost Per Crash</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatality (K)</td>
<td>$1,500,000</td>
<td>$9,900,000</td>
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<tr>
<td>Incapacitation Injury (A)</td>
<td>$88,500</td>
<td>$1,100,000</td>
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<tr>
<td>Non-Incapacitating Injury (B)</td>
<td>$25,600</td>
<td>$298,000</td>
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<tr>
<td>Possible Injury (C)</td>
<td>$21,000</td>
<td>$138,000</td>
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<tr>
<td>Property Damage Only (O)</td>
<td>$4,200</td>
<td>$8,400</td>
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</tbody>
</table>

National Safety Council 2014
## Safety Benefits

### Crash Reductions

- Determined expected crash reductions
- Translated those reductions to Economic and Comprehensive Benefits

<table>
<thead>
<tr>
<th>Segment ID</th>
<th>Crash Reduction 3-Year</th>
<th>Crash Reduction 5-Year</th>
<th>Economic Benefit 3-Year</th>
<th>Economic Benefit 5-Year</th>
<th>Comprehensive Benefit 3-Year</th>
<th>Comprehensive Benefit 5-Year</th>
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<tbody>
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<td>38</td>
<td>53</td>
<td>$12,458,680</td>
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<td>$84,688,560</td>
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<td>Total</td>
<td>236</td>
<td>417</td>
<td>$77,374,960</td>
<td>$136,717,620</td>
<td>$540,175,680</td>
<td>$954,462,960</td>
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</table>
Total Costs

Costs

• Installation: Reviewed contract proposal costs
• Maintenance: Collected and analyzed 3,957 cost invoices from KYTC CMB districts

<table>
<thead>
<tr>
<th>Segment Info</th>
<th>Initial Cost</th>
<th>3 Years</th>
<th>5 Years</th>
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<td>$1,233,401</td>
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<td>$806,265</td>
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<td>7</td>
<td>2009</td>
<td>$1,384,246</td>
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<td>2010</td>
<td>$108,454</td>
<td>$39,311</td>
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<td>2010</td>
<td>$1,323,144</td>
<td>$520,815</td>
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<tr>
<td>10</td>
<td>2010</td>
<td>$1,757,609</td>
<td>$411,460</td>
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Benefit-Cost Ratios

BCA Ratios

• Wilcoxon Test
  – Passed all tests
  – Statistically significant

• BCA Ratios > 1

<table>
<thead>
<tr>
<th>Segment</th>
<th>Economic B/C</th>
<th>Comprehensive B/C</th>
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<tbody>
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<tr>
<td>10</td>
<td>5.59</td>
<td>N/A</td>
</tr>
<tr>
<td>Total</td>
<td>7.92</td>
<td>22.15</td>
</tr>
</tbody>
</table>

Total Estimated Savings (3-Yr)

Economic = $67.6 mil    Comprehensive = $530.4 mil
Conclusion

• Safety: Proven effective roadside hardware countermeasure for reducing crossover median crashes

• Economic ROI: Substantial cost benefits from safer highways
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