Cable Median Barrier in Illinois

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REPORT ON
THE ADVISABILITY OF EXPANDING THE USE OF CABLE MEDIAN BARRIER IN ILLINOIS

Prepared for Illinois Legislature
July 2009
WHEREAS, Steel cable strung in highway medians is a low-cost safety device that is proving phenomenally effective at saving lives, perhaps more so than steel-beam or concrete barriers; and

WHEREAS, Steel-beam, concrete, and cable barriers all cut down on accidents in which cars cross over into oncoming traffic; cable, however, also cuts down on the number of rebound accidents in which a vehicle hits a barrier and bounces back into traffic; and cable performs better than other barriers when installed on the moderately sloping terrain common to many existing medians; and

WHEREAS, Because cable barriers are considerably cheaper, states can install them in medians where motorists had no protection before; cable costs about 30% less than steel and 50% less than concrete; and

WHEREAS, Several other states have installed cable barriers and have had dramatic drops in fatalities and injuries from crossover accidents; Missouri saw a 92% decrease, down to only 2 deaths, in 2006, after the state installed cable barriers along Interstate 70; therefore, be it

RESOLVED, BY THE HOUSE OF REPRESENTATIVES OF THE NINETY-FIFTH GENERAL ASSEMBLY OF THE STATE OF ILLINOIS, that we request that the Department of Transportation conduct a study on the advisability of expanding the use of cable barriers in Illinois and report its findings and recommendations to the General Assembly no later than July 1, 2009; and be it further

RESOLVED, That a suitable copy of this resolution be delivered to the Secretary of Transportation.

Adopted by the House of Representatives on May 14, 2008.
Format of report

Executive Summary

A cross-median crash occurs when a vehicle loses control on a multi-lane divided highway, crosses the median and collides with another vehicle traveling in the opposite direction. These crashes can be especially severe and deadly. The loss of life and tremendous suffering to the residents and families of Illinois and other users of Illinois highways is not acceptable.

To address this problem, the Illinois Department of Transportation Bureau of Safety Engineering (IDOT/BSE) conducted a study and prepared a policy to deploy cable median barrier in areas with the greatest potential to reduce severe cross-median crashes. Between 2005 and 2006, IDOT and the Illinois State Toll Highway Authority installed 210 miles of high-tension cable median barrier along Illinois Interstates. Although the number of years of “after installation” crash data is limited, preliminary analysis indicates that cable median barrier is reducing cross-median crashes. These positive results are consistent with what other states have been experiencing across the country.

This report offers the following primary conclusions:

- **Cable median barrier is reducing cross-median crashes in Illinois and saving lives. Its use should be expanded.**
- **IDOT is concerned about the increasing and ongoing costs to maintain and repair median barriers. Any funding proposals should take into account the annual maintenance costs of cable median barriers. Proper maintenance and repair are critical for the barrier to properly function over its service life.**
- **IDOT requires the use of four-strand, high-tension cable barrier, which has passed a higher level of crash testing in order to reduce the likelihood of breaches (vehicles going over or under the cables).**
- **As IDOT’s experience with cable barrier has grown, maintenance and construction challenges have become manageable. IDOT is working with other states to develop and crash test a new cable barrier that may further address these concerns.**
- **Based on a benefit-cost analysis, 328 miles of additional cable median barrier are recommended for further investigation of possible cable median barrier installation. This represents 19 percent of the Interstate miles that do not now have median barrier.**
- **Barrier on this 19 percent of the system would address 49 percent of fatal and 43 percent of serious injury cross-median crashes (2001-2008 data period).**
- **The locations tend to be near major urban areas, where higher traffic volumes and more frequent interchanges increase the likelihood of cross-median crashes.**
- **The potential locations identified by application of statewide criteria should be reviewed and adjusted by IDOT district staff. Local factors, input from law enforcement and emergency response personnel, identification of logical termini, evaluation of non-Interstate freeways, and information obtained during the more detailed design phase should all be taken into account.**

SECTION 2

Types of Median Barrier

The three primary types of median barrier used throughout the United States are cable barrier, steel plate beam guardrail, and concrete barrier. Each barrier type has advantages and disadvantages, and the most appropriate barrier to use at a given location depends on site-specific characteristics. Appendix E includes a DVD produced by the Federal Highway Administration that provides additional information and video of the various types of median barrier.

**Cable Barrier**

Cable barrier (Exhibit 2-1) has become the most common median barrier in non-urban areas. The barrier captures and redirects vehicles through the tension that is developed in the cables, which are periodically connected to large concrete anchors. When impacted, the posts are designed to bend over or break off. Cable barrier is the most flexible barrier when impacted. Because of the way it functions, vehicles tend to remain more stable and occupants experience lower forces during impact, as compared to other barrier types. These qualities make it a good choice from a safety standpoint.

A lower-tension, non-proprietary system with three cables has been used in the United States since the 1960s. Because of its low cost and good performance, it is still commonly used in some states. In the past 10 to 15 years, several proprietary systems have come on the market. These barriers have three or four cables, installed in much higher tension. Even though they are slightly more expensive, many states have adopted them exclusively for median applications.

Citing advantageous safety and maintenance characteristics as compared to the generic lower-tension system, one of these advantages is illustrated in Exhibit 2-2. High-tension cables remain near their design height after typical impacts and may continue to function even before the posts are replaced.

Because cable barrier is the most flexible barrier when impacted, deflection distance is a critical consideration. Deflection is the lateral distance that a barrier moves when impacted by a vehicle and is approximately 8 to 15 feet. This is a major concern at freeway interchange ramps, where impact forces are often higher than those at non-interchange locations. The impact force at an interchange is especially high due to the presence of overpasses, requiring careful design to ensure proper functionality.
Section 1: Introduction
Median
Interstate Cross Median Crashes
2001–2008

- 106 fatal crashes
  - 164 fatalities
  - avg: 20 per year

- 126 serious injury crashes
  - 277 people injured
  - avg: 34 per year
Section 2: Types of Median Barrier
cable median barrier
steel plate beam guardrail
concrete barrier
Pros and cons of each type

- Common applications
- Cost
- Deflection
- Safety performance
- Crash test performance
- Maintenance considerations
<table>
<thead>
<tr>
<th>Most Common Median Applications</th>
<th>Cable</th>
<th>Steel Plate Beam</th>
<th>Concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>$14 per linear foot. (barrier only)</td>
<td>$43 per linear foot. (barrier only)</td>
<td>$103 per linear foot. (barrier only)</td>
</tr>
<tr>
<td></td>
<td>Additional costs for shoulder/median improvements, traffic control, etc.</td>
<td>Additional costs for shoulder/median improvements, traffic control, etc.</td>
<td>Additional costs for enclosed drainage system, median pavement, etc.</td>
</tr>
<tr>
<td>Deflection</td>
<td>8-12 feet (often cannot be used in narrow medians)</td>
<td>2-3 feet</td>
<td>No deflection (can be used in narrow medians)</td>
</tr>
<tr>
<td>Safety Performance</td>
<td>Most flexible, forgiving impact. Because it is a weak-post system (posts bend over or break off), less likely to cause vehicular instabilities. High tension systems may remain functional after impacts, depending on severity/point of impact. Breach of the barrier (vehicles going under or over the cables) has been observed under some severe impact conditions.</td>
<td>Most common barrier used in the U.S. with strong safety record. More forgiving impact than concrete barrier. Because it is a strong-post system (posts deflect backward during impact), more likely to cause vehicular instabilities as compared to cable barrier. May remain functional after impacts, depending on severity/point of impact.</td>
<td>System remains fully functional after impacts. Because repair is normally not needed, exposure of maintenance personnel is minimized. Most rigid: - Exerts greater forces on vehicle occupants during impact. - More likely to cause vehicular climbing/rolling. - Most effective at containing very large trucks.</td>
</tr>
<tr>
<td>Crash Test Performance</td>
<td>Some systems have passed Test Level 4. These are now required in Illinois for new installations.</td>
<td>Test Level 3</td>
<td>32-inch concrete barrier has passed Test Level 4. 42-inch concrete barrier has passed Test Level 5.</td>
</tr>
<tr>
<td>Maintenance Considerations</td>
<td>Posts almost always replaced after impacts. Socketed post systems are an option to reduce maintenance. Cables can be re-used after impacts. Tension in cables should be periodically checked. Mowing/weed control necessary. Pavement along barrier is an option to reduce mowing. Least likely to cause snow drifting/build-up. Methods for adjusting height to accommodate pavement overlays are being investigated but the issue is currently unresolved.</td>
<td>Posts frequently replaced after impacts. Socketed post systems are not an option. Steel rail sections replaced after impacts. Mowing/weed control necessary. More likely to cause snow drifting/build-up as compared to cable barrier. Adjusting height to accommodate pavement overlays is relatively simple.</td>
<td>Normally needs no repair after impact. Reduces the need for mowing. May increase snow drifting/build-up. Height of the barrier is sufficient to accommodate pavement overlays.</td>
</tr>
</tbody>
</table>
Section 3: Experience with Cable Median Barrier in Illinois

- safety performance: preliminary
- barrier breaches
- cost in Illinois: initial and on-going
- maintenance and construction issues
- enforcement and emergency response
Cross-median crashes at locations where cable median barrier has been installed.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Cross-Median Crashes</th>
<th>Fatal Cross-Median Crashes</th>
<th>Cumulative CMB Installed (miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>10</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>6</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>11</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>13</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>16</td>
<td>5</td>
<td>108</td>
</tr>
<tr>
<td>2006</td>
<td>4</td>
<td>2</td>
<td>185</td>
</tr>
<tr>
<td>2007</td>
<td>4</td>
<td>2</td>
<td>210</td>
</tr>
<tr>
<td>2008</td>
<td>4</td>
<td>2</td>
<td>210</td>
</tr>
</tbody>
</table>

Preliminary safety performance
preliminary safety performance

- 287 impacts
  - 252 property damage
  - 24 minor or possible injuries
  - 10 serious injuries
  - 1 fatality
barrier breaches
Cost in Illinois

- Initial construction cost: $163,000 per mile
- Ongoing maintenance cost: $10,000 per mile per year
maintenance and construction issues

- construction
  - concrete anchors
  - height adjustment: overlays
  - space restrictions next to inside shoulder (pavement patching, etc.)

- maintenance
  - every impact typically needs repair
  - frozen or wedged posts
  - one injury: not traffic related
maintenance and construction issues
enforcement and emergency response
non-proprietary system under development
Experience in Other States

- **Missouri**
  - 600 miles installed
  - 50 soon to be constructed
  - 200 miles of low-tension

- **Minnesota**
  - 140 miles installed
  - 96 soon to be constructed
  - 79 miles planned, not funded

- **Washington**
  - 192 miles installed
  - 10 soon to be constructed
  - 42 miles of low-tension
Section 4: Method for Determining where Cable Median Barrier is Recommended
FARS data

- crashes coded as head-on or opposite direction sideswipe
- more difficult to screen crashes
Methodology

- Define highway characteristics where cross-median crashes are occurring.
- Proactive/systematic approach rather than purely black-spot focused.
<table>
<thead>
<tr>
<th>ADT Range</th>
<th>0-35</th>
<th>36-40</th>
<th>41-45</th>
<th>46-50</th>
<th>51-55</th>
<th>56-60</th>
<th>61-65</th>
<th>66-70</th>
<th>71-80</th>
<th>81-80</th>
<th>91-100</th>
<th>101+</th>
<th>Total</th>
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<tr>
<td>300,001+</td>
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<tr>
<td>200,001-300,000</td>
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<td>1.8</td>
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<tr>
<td>90,001-100,000</td>
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<td>0.0</td>
<td>9.6</td>
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<tr>
<td>60,001-70,000</td>
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<tr>
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<td>0.0</td>
<td>8.2</td>
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<tr>
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<td><strong>Total</strong></td>
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<td>1.3</td>
<td>1.2</td>
<td>1.3</td>
<td>0.7</td>
<td>0.8</td>
<td>0.4</td>
<td>4.1</td>
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**Footnotes:**
1. The values in the table represent the median width for each ADT range, with the values in parentheses showing the actual widths.
<table>
<thead>
<tr>
<th>Category</th>
<th>In Blue Line</th>
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<th>Out Blue Line</th>
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<tr>
<td></td>
<td>Frequency</td>
<td>Percent</td>
<td>Frequency</td>
<td>Percent</td>
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<tr>
<td>Miles</td>
<td>322</td>
<td>19%</td>
<td>1330</td>
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<td>Fatal Crashes</td>
<td>37</td>
<td>49%</td>
<td>39</td>
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<tr>
<td>A-Injury Crashes</td>
<td>43</td>
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<td>B-Injury Crashes</td>
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<td>56%</td>
<td>16</td>
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<tr>
<td><strong>Total Crashes</strong></td>
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<td><strong>46%</strong></td>
<td><strong>156</strong></td>
<td><strong>54%</strong></td>
<td><strong>289</strong></td>
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<td>PW Benefit</td>
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<td>$274,494,817</td>
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<td>$531,534,448</td>
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<td>PW Cost</td>
<td>$90,846,707</td>
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<td>$375,657,948</td>
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<td>$466,504,655</td>
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<td>Weighted Crash Density</td>
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<td>1.1</td>
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</table>
Cable Median Barrier Recommended

Evaluate Cost Effectiveness of Barrier for Areas with a Concentration of Cross-Median Crashes
- **Priority 1**
  B-C = 3.8

- **Priority 2**
  B-C = 2.4

- **Priority 3**
  B-C = 1.9
Section 5: Recommendations and Results
Recommendations

- 322 miles recommended for further investigation.
  - 19% of Interstate mileage with no median barrier
  - Would address 49% of fatal and 45% of serious injury crashes (2001-2008)
  - near major urban areas: higher traffic volumes, more frequent interchanges (61% classified Urban; 39% Rural)
Recommendations

- Locations should be reviewed and adjusted by IDOT district staff.
  - geometric factors, interchange spacing/frequency, other design information
  - logical termini
  - input from law enforcement/emergency response

- Locations with concentrations of CMC’s that did not meet statewide criteria should also be reviewed: black spot component
Cost

- Initial construction: $53 million
- Yearly maintenance: $3.3 million for 322 miles of potential locations only.
- Also emphasized existing shortfall in maintenance budget.
  - additional $1 million per year needed to maintain existing cable median barrier.
Evaluate Cost Effectiveness of Barrier for Areas with a Concentration of Cross-Median Crashes
- Priority 1: 123 miles (B-C: 3.8)
- Priority 2: 126 miles (B-C: 2.4)
- Priority 3: 73 miles (B-C: 1.9)
Will be available on IDOT’s website.

Comments/Questions