Cable Barriers: Texas Research

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Presentation Outline

- Cross-median crash problem
- Evolution of cable barrier in Texas
- Overview current research project
- Highlight key issues
- Wrap-up
Cable Barrier - Advantages

- Lower initial cost
- Effective vehicle containment
- Designed to facilitate quick and easy repairs
- Used with median cross slopes as steep as 4:1
- Low deceleration forces upon the vehicle and its occupants
- No drainage issues
Cable Barrier - Challenges

- Accommodate deflection distance
- Damage even with moderate impacts
- Require maintenance every impact
- May require periodic inspections
- Containment of trucks
- Barrier penetration
Cross-Median Crashes: Urban
Cross-Median Crashes: Rural

- I-35 Hewitt
  - 7 fatalities
- US75 Sherman
  - 10 fatalities

HOW THE ACCIDENT HAPPENED

About 4:29 p.m. on Sept. 20, 2004, Miroslaw Jozwiak was driving his 18-wheeler north on U.S. Highway 75 at 65 mph. What happened next:

1. The 18-wheeler went from the right lane to the passing lane. Then, without slowing, it began to veer to the left, through the grassy median and into southbound traffic.

2. The 50,000-pound rig slammed the front-left corner of Las Harinas Fund Expedition, in the passing lane. Manuel Espinoza's Ford F-150 pickup slammed into the side of the 53-foot trailer.

   The pickup was nearly torn apart, but remained in the roadway. Four occupants died, two were injured. The 18-wheeler crashed the SUV into the grass and flipped it over. Both vehicles caught fire. All five people in the SUV died. Mr. Jozwiak suffered minor injuries.

SOURCE: National Transportation Safety Board; Sherman Police Department

Motorcoach Median
Crossover and Collision
With Sport Utility Vehicle
Hewitt, Texas
February 14, 2003

Highway Accident Report
NTSB/MAR/05/02
PB2005106454
Translation 7727-5
Cross-Median Crashes: Stats

<table>
<thead>
<tr>
<th>Year</th>
<th>PDO</th>
<th>Injury (C)</th>
<th>Injury (B)</th>
<th>Injury (A)</th>
<th>Fatal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>273</td>
<td>324</td>
<td>266</td>
<td>199</td>
<td>130</td>
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<tr>
<td>1998</td>
<td>298</td>
<td>306</td>
<td>285</td>
<td>175</td>
<td>100</td>
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<tr>
<td>1999</td>
<td>295</td>
<td>302</td>
<td>229</td>
<td>170</td>
<td>121</td>
</tr>
</tbody>
</table>
Median Barrier Warrants

- Median width: 30 feet
Traditional Median Barriers

Single Slope

Jersey
Table 6-7. Benefit/Cost Ratios for Installing High-Tension Cable Barriers over Concrete Barriers: Favorability.

<table>
<thead>
<tr>
<th>Median Width (ft)</th>
<th>AADT (in 1000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>0.9</td>
</tr>
<tr>
<td>10</td>
<td>1.2</td>
</tr>
<tr>
<td>15</td>
<td>1.4</td>
</tr>
<tr>
<td>20</td>
<td>1.5</td>
</tr>
<tr>
<td>25</td>
<td>1.5</td>
</tr>
<tr>
<td>30</td>
<td>1.5</td>
</tr>
<tr>
<td>35</td>
<td>1.5</td>
</tr>
<tr>
<td>40</td>
<td>1.5</td>
</tr>
<tr>
<td>45</td>
<td>1.5</td>
</tr>
<tr>
<td>50</td>
<td>1.5</td>
</tr>
<tr>
<td>55</td>
<td>1.5</td>
</tr>
<tr>
<td>60</td>
<td>1.5</td>
</tr>
<tr>
<td>65</td>
<td>1.5</td>
</tr>
<tr>
<td>70</td>
<td>1.5</td>
</tr>
<tr>
<td>75</td>
<td>1.5</td>
</tr>
<tr>
<td>80</td>
<td>1.5</td>
</tr>
<tr>
<td>85</td>
<td>1.5</td>
</tr>
<tr>
<td>90</td>
<td>1.5</td>
</tr>
<tr>
<td>95</td>
<td>1.5</td>
</tr>
<tr>
<td>100</td>
<td>1.5</td>
</tr>
<tr>
<td>105</td>
<td>1.5</td>
</tr>
<tr>
<td>110</td>
<td>1.5</td>
</tr>
<tr>
<td>115</td>
<td>1.5</td>
</tr>
<tr>
<td>120</td>
<td>1.5</td>
</tr>
<tr>
<td>125</td>
<td>1.5</td>
</tr>
</tbody>
</table>

B/C > 1.5

*Based on a 4-lane, 65 mph (88 km/hr) posted speed limit scenario.
**Due to the deflection characteristic of cable barriers upon impact, installing on medians with a width less than 20 ft is usually not appropriate.
Cable Evolution in Texas

◇ Safety bond $$$ - 600 million
◇ $157 million for cable median barrier
  ◦ 94 projects
  ◦ 738 miles
◇ $30 million
  ◦ Both CTB and cable
  ◦ 85 miles
◇ 17 of 25 Districts
Cable Evolution in Texas

- Gibraltar
- Brifen
- Trinity
- NUCOR/GSI

Cost, availability and experience

Problem: An alternative to traditional concrete and metal beam barriers is needed because these structures can be expensive and difficult to install.

Median barriers can result in fatalities or severe injuries to occupants of the vehicles involved and the motorists in the opposing traffic lanes. State departments of transportation (DOTs) are interested in lowering median reassurance crashes through the use of median barriers. The concrete and metal barriers currently in use present these hazards, however, are difficult to maintain in sharp turns where their performance is often suboptimal. In addition, concrete and metal beam barriers are expensive, and state and local agencies often lack the resources to rapidly deploy these technologies to areas where vehicles frequently cross over the adjacent medians.

Putting it in Perspective:

- Spurred by data that demonstrate the significant impacts of crossover crashes:
  - Between 1990 and 1999, 3.2 percent of all interstate crashes in Illinois were crossover crashes, and these crashes resulted in 32.7 percent of all injury fatalities.
  - From 1990 to 2000, more than 750 people in South Carolina lost their lives in 67 separate intermediate crossover medians crashes.
  - North Carolina DOT has found median crossover crashes to be three times more deadly than other twenty crash types. Median barriers are expected to lead to an estimated 50 percent reductions in these types of collisions.

Solution: Promote the accelerated deployment of cable median barriers as an alternative to concrete and metal beam barriers, some states are turning to cable median barriers to save lives in these critical areas with high potential for crashes.

Although cable barriers have been used since the 1920s, we have not until lately had that many states using DOTs started using a modified cable in 1990 as a median barrier. Today, many states, including Alabama, Colorado, North Carolina, Ohio, Oklahoma, Oregon, South Carolina, Texas, and Washington State, are installing cable barriers in medians originally built without barriers. New data suggest that cable median barriers are not effective.
Cable Evolution in Texas

I-820 – Fort Worth

- Summer 2003
- 1 mile Brifen
5609 Research

- Cable in-service performance evaluation
  - Maintenance
  - Safety
- Comparison of cable vs. concrete
- 18-month project
  - Completion in February 2008
5609 Research

In-Service Evaluation of Cable Median Barrier Performance

Program Coordinator – A. Rory Meza (DES)

Project Director – Roy Parikh (FTW)

Project Advisors

- Jimmy Bodiford (FTW)
- Brian Crawford (ABL)
- Bobby Dye (DES)
- Darwin Myers (DAL)
- Grover Schretter (FTW)
- Lance Simmons (ATL)
5609 Research: GIS Analysis

Note: red line = cable barrier and black line = concrete barrier
Key Issues

◊ Design
  ■ Placement
  ■ Test level
  ■ Post type
  ■ Anchor

◊ Maintenance
  ■ Impacts
  ■ Repair

◊ Safety
Design: Placement

TxDOT Design Division memorandum dated June 21, 2006
Design: Placement

12'-0" minimum
(more when possible)

Cable Barrier

8' to 10' off
ditch bottom
or beyond

Travel Lane

Shdr

1V: 6H or flatter

Acceptable Cable Barrier Placement

1V: 4H Max.

TxDOT Design Division memorandum dated June 21, 2006
Design: Placement

◊ Shoulder
  ■ Higher frequency of impacts
  ■ Maintenance concerns

◊ Median

◊ Both sides

US75 - Collin County
Design: Placement

- Provision of emergency crossovers
  - Enforcement
  - Response time
- Utilize overpass locations
Design: Test Level

- NCHRP 350
  - TL-3
  - TL-4

- Primary consideration is truck percentage
Design: Post Type

Socketed

Mow Strip
Key Issue: Anchor Design

- Soil conditions
- Weather concerns

I-20 Kaufman County
Maintenance: Impacts
Maintenance: Impacts

I-20/ I-30 Parker County
TxDOT Fort Worth District
## Maintenance: Impacts

<table>
<thead>
<tr>
<th>Barrier</th>
<th># of Impacts</th>
<th>Avg. Posts</th>
<th>Avg. Men</th>
<th>Avg. Time (hrs)</th>
<th>Volume Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brifen 1</td>
<td>65</td>
<td>6.6</td>
<td>3.75</td>
<td>1.26</td>
<td>70 - 77K</td>
</tr>
<tr>
<td>Trinity 1</td>
<td>76</td>
<td>8.6</td>
<td>3.67</td>
<td>1.18</td>
<td>30 - 65K</td>
</tr>
<tr>
<td>NUCOR 2</td>
<td>6</td>
<td>9.5</td>
<td>3.17</td>
<td>1.83</td>
<td>24 - 28K</td>
</tr>
<tr>
<td>TOTALS 3</td>
<td>147</td>
<td>7.8</td>
<td>3.53</td>
<td>1.25</td>
<td>24 - 77K</td>
</tr>
</tbody>
</table>

1  Brifen & Trinity data for 57 week time period
2  NUCOR data for 27 week time period
3  25 mile section on I-20/I-30 in Parker County
Maintenance: Impacts

Road Condition

- Dry: 24%
- Wet: 35%
- Ice: 10%
- Unknown: 31%

Vehicle Type

- Car: 74%
- Truck/SUV: 14%
- Semi: 9%
- Unknown: 3%
Maintenance: $ Recovery

- High % “unknown” vehicles
- North Carolina
  - State police damage tags
  - Significant improvement

<table>
<thead>
<tr>
<th>Barrier Type</th>
<th>Hits</th>
<th>Total Property Damage</th>
<th>State Property Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable</td>
<td>1,592</td>
<td>$9,599,568</td>
<td>$955,763</td>
</tr>
<tr>
<td>Weak Post</td>
<td>567</td>
<td>$3,669,675</td>
<td>$419,775</td>
</tr>
<tr>
<td>W-Beam</td>
<td>1,266</td>
<td>$8,778,927</td>
<td>$488,260</td>
</tr>
<tr>
<td>Concrete*</td>
<td>67</td>
<td>$379,900</td>
<td>$3,250</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3,486</strong></td>
<td><strong>$22,428,070</strong></td>
<td><strong>$1,867,048</strong></td>
</tr>
</tbody>
</table>
Maintenance: Impacts
## Maintenance: Impacts

<table>
<thead>
<tr>
<th>District</th>
<th>San Antonio</th>
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</thead>
<tbody>
<tr>
<td>Roadway</td>
<td></td>
</tr>
<tr>
<td># of Miles</td>
<td>19</td>
</tr>
<tr>
<td>Barrier Type</td>
<td>NUCOR/GSI</td>
</tr>
<tr>
<td>Dates</td>
<td>August 2006 - April 2007</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td># of Impacts</td>
<td>83</td>
</tr>
<tr>
<td>Linear Damage (ft)</td>
<td>11,964</td>
</tr>
<tr>
<td># of Posts</td>
<td>690</td>
</tr>
</tbody>
</table>
Maintenance: Mileage

Total Miles of Different Types of Cable Barrier System Installed in Texas

- 177 (57%) CASS
- 79 (25%) Brefen
- 42 (13%) Nucor
- 15 (5%) Gibraltar
Maintenance: Repair

Level of Difficulty in Repairing the Cable Barrier System

- 6 (33%) Easy
- 3 (17%) Average Difficulty
- 1 (6%) Somewhat Difficult
- 1 (6%) Very Difficult
- 7 (38%) Very Difficult
- No Answer
Maintenance: Repair

Availability of Repair Parts

- Always Available: 5 (28%)
- Average Availability: 0 (0%)
- Somewhat Difficult: 4 (22%)
- Very Difficult: 0 (0%)
- No Answer: 9 (50%)
Maintenance: Repair

Average Time Spent on Repairs

- 8 (46%) > 3 Hours
- 3 (18%) > 2 Hours
- 1 (6%) > 1 Hour
- 2 (12%) > 1/2 Hour
- 3 (18%) 0 - 1/2 Hour
- 1 (6%) < 1/2 Hour

35
Number of Maintenance Sections with Penetration of Passenger Vehicles through the Cable Median Barrier System

- Yes: 4 (22%)
- No: 14 (78%)
Maintenance: Containment

Number of Maintenance Sections with Penetration of Trucks through the Cable Median Barrier System

- Yes: 13 (72%)
- No: 5 (28%)
Maintenance: Mow Strips

Number of Maintenance Sections with Mow Strips along the Cable Barrier System Installation

- Yes: 12 (67%)
- No: 6 (33%)
Safety: Fatal Crashes

One year before and after - 335 mi. of cable

<table>
<thead>
<tr>
<th>One-year Pre-Installation</th>
<th>One-year Post-Installation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cross-Median Fatal Crashes</td>
<td>Cross-Median Fatal Crashes</td>
</tr>
<tr>
<td>Cross-Median Fatalities</td>
<td>Cross-Median Fatalities</td>
</tr>
<tr>
<td>47</td>
<td>1</td>
</tr>
<tr>
<td>52</td>
<td>1</td>
</tr>
</tbody>
</table>
Wrap-up: Website

Homepage – www.medianbarrier.net

In-Service Evaluation of Cable Median Barrier Performance

When they occur, cross-median crashes are typically very violent in nature and have a high probability of multiple serious injuries and deaths. Many of these severe cross-median crashes can be prevented with adequate barrier protection. In order to maximize the amount of barrier put in place, TxDOT has started to install cable median barrier systems (sometimes referred to as wire rope or wire safety fence) in addition to traditional concrete barriers. Cost data has shown that cable barriers are approximately one-third the cost of concrete barriers per mile, making them a cost-effective option. There are generally seven NCHRP Test Level 3 cable barrier products installed in Texas: (1) Biffen wire rope safety fence, (2) Trinity Industries CASE™, (3) Nucor Steel Marion High Tenax Cable and (4) Gibraltar. Three NCHRP-350 Level 4 systems are also available for use in Texas.

This project will assess and document the in-service performance of the various cable barrier installations in Texas. The research will evaluate TxDOT’s experience with cable median barrier by analyzing its installation cost, maintenance costs, maintenance experiences, and crash history before and after implementation. The project will develop recommendations and guidelines to direct TxDOT staff for future cable median barrier installations.
Wrap-up: In-Service Assistance

Cable Barrier Maintenance/Repair Log Form Page

<table>
<thead>
<tr>
<th>Accident Information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1: DATE (MD/YN)</strong></td>
</tr>
<tr>
<td>Format: YYYY-MM-DD</td>
</tr>
<tr>
<td>(e.g., 2003-12-30</td>
</tr>
<tr>
<td>for Christmas day)</td>
</tr>
<tr>
<td><strong>2: LIGHT CONDITION</strong></td>
</tr>
<tr>
<td>Choose only one of the following</td>
</tr>
<tr>
<td>Please choose.</td>
</tr>
<tr>
<td><strong>3: TIME</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>3A: DISTRICT</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>3B: MAINTENANCE SECTION</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>4: ROAD CONDITION</strong></td>
</tr>
<tr>
<td>Choose only one of the following</td>
</tr>
<tr>
<td>Please choose.</td>
</tr>
<tr>
<td><strong>5: HIGHWAY</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>6: APPROX. REFERENCE MARKER</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>7: DIRECTION OF TRAVEL</strong></td>
</tr>
<tr>
<td>Choose only one of the following</td>
</tr>
<tr>
<td>Please choose.</td>
</tr>
<tr>
<td><strong>8: VEHICLE TYPE</strong></td>
</tr>
<tr>
<td>Choose only one of the following</td>
</tr>
<tr>
<td>Please choose.</td>
</tr>
<tr>
<td><strong>9: PROPERTY DAMAGE ONLY</strong></td>
</tr>
<tr>
<td>Choose only one of the following</td>
</tr>
<tr>
<td>Please choose.</td>
</tr>
</tbody>
</table>
Wrap-up: Conclusions

◊ Texas is aggressively installing cable median barriers
◊ Preliminary results are positive
◊ For more information:
  - Project 0-4254 median barrier guidelines report:
  - Contact me:
    - (817) 261-1661 or s-cooner@tamu.edu