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RESEARCH PROJECT TITLE

In-Service Performance Evaluation of
Median Cable Barriers in Iowa

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In-Service Performance Evaluation of Median Cable Barriers in Iowa

tech transfer summary

Median cable barriers are a safe, cost-effective option for preventing or reducing the severity of median crossover crashes.

Objective

This project aimed to determine the cost-effectiveness of the cable barrier systems in Iowa by comparing the crash cost savings due to reduced injury severity to the costs of installation, routine maintenance, and repairs.

Background

Median crossover crashes occur on divided roadways and involve an errant vehicle crossing the median and striking either a fixed roadside object or an oncoming vehicle in the opposing direction of travel. These crashes pose the highest risk of fatal and severe injuries among all Interstate collisions due to the high speeds of the vehicle(s) and the sharp angles of impact.

Median barriers are often used to reduce the opportunity for median-related collisions. Cable barriers have become especially popular due to their documented safety performance and lower installation costs compared to the more rigid concrete walls or steel-beam guardrails.

The Iowa Department of Transportation (DOT) began installing median cable barriers in 2003 and currently has approximately 330 miles of the countermeasure in place.



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Median cable barrier treatment along an Interstate in Iowa



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Median cable barrier treatments on I-29 in Iowa

Problem Statement

Anecdotal evidence, in-service performance reviews, and cost-effectiveness evaluations from other regions in the US have shown cable barriers to operate as desired. However, Iowa's unique topography, weather conditions, and other factors motivate the need for additional research.

Research Description

This project included an in-service evaluation of median cable barrier systems that have been installed in Iowa, an in-depth investigation of the safety impacts of the systems, and estimation of the cost-effectiveness of the systems based on the results of the analyses.

In-Service Data Collection

The roadway and traffic characteristics of Iowa's Interstate roadway network were provided by the Iowa DOT through its online geographic information management system (GIMS) portal, and researchers manually identified median cable barrier installations using up-to-date Google Earth imagery.

The researchers also collected median and shoulder widths and the offsets of cable barriers from roadway edges using Google Earth imagery and tools. They divided Iowa's Interstate network into 897 independent analysis segments, including 362 segments on which cable barriers were installed during the analysis period (2007 through 2015) and 535 control segments that did not have any median barriers installed during the study period.

The researchers obtained weather data through the National Weather Service Cooperative Observer Program.

Safety Analyses

Crash data were collected from the Iowa DOT's statewide crash database. Median-related (or run-off-road left) crashes during the nine-year analysis period were identified through two review processes: (1) using Iowa DOT-recommended crash code logic functions to collect the appropriate law enforcement crash reports based on field officer documentation and (2) a manual review of all crash narratives from crash reports collected on roadways with known cable barrier installations. From these reviews, the researchers identified 7,028 median-related crashes.

The researchers developed a series of severity-based statistical models to evaluate the safety effectiveness of cable median barriers on Iowa roadways, including a naïve before-after analysis and a cross-sectional analysis. In addition, an in-depth investigation was conducted of crashes that involved an existing median cable barrier and where at least one occupant suffered a fatal, serious, or minor injury.

Cost-Benefit Analyses

The Iowa DOT provided installation cost information for 14 cable barrier projects let between 2011 and 2015; the average installation cost per mile was \$80,803. Repair costs corresponding to 2,096 police-reported crashes from 2011 to 2015 were obtained from three districts; the average maintenance and repair cost was approximately \$1,393 per crash.

The installation, maintenance, and repair costs were analyzed together with the results of the safety analyses to determine the cost-effectiveness of Iowa's currently installed median cable barriers. A design life of 20 years, a discount rate of 4%, and a 1% annual increase in traffic volume were assumed, and crash costs estimated by the Iowa DOT were considered for the financial analysis.

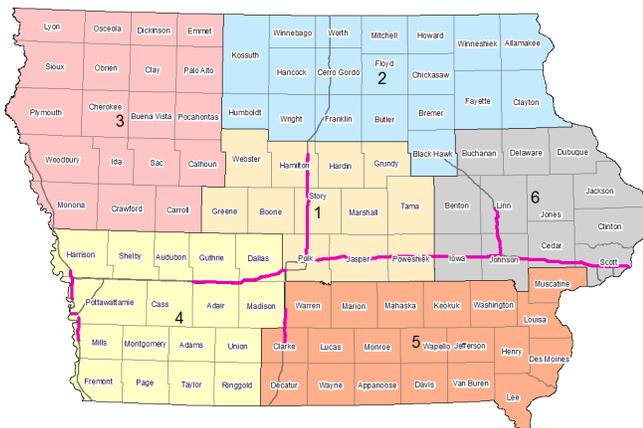
Expressway Analysis

To determine the potential applicability of cable median barriers on Iowa's expressways, 3,629 suitable expressway segments representing 1,140 miles of expressway were collected from the Iowa DOT GIMS database. A total of 1,175 target (run-off-road left) crashes were identified on these segments out of a total of 16,084 median-related crashes between 2011 and 2015.

As in the Interstate analysis, a crash prediction model was estimated for the identified target crashes, with the predicted number of crashes varying by different combinations of median width, traffic volume, and speed limit.

Key Findings

- The naïve before-after safety analysis showed that median cable barrier installations reduced fatal, incapacitating, and non-incapacitating injury crashes by 68.7%, 36.8%, and 23.9%, respectively. Conversely, possible injury and property damage only (PDO) crashes increased by 5.7% and 95.4%, respectively.
- The cross-sectional safety analysis similarly showed that fatal, incapacitating, and non-incapacitating injury crashes were reduced by 61.6%, 30.8%, and 25.8%, respectively. Possible injury and PDO crashes increased 11.2% and 108.3%, respectively.
- An increase in the average median width of a segment was correlated with a decrease in cross-median crash frequency, regardless of injury severity level. Similar trends were identified for both Interstate and expressway segments.
- Using Iowa DOT crash costs on a per-crash basis and assuming a 20-year design life, the cost-benefit analysis showed that median cable barriers have a benefit-cost ratio of 16.08.



Interstate median cable barrier installations by Iowa DOT district and county

Conclusions and Recommendations

- The reductions in injury severity are similar to the results of recent evaluations in other states. Similar trends were also observed with respect to the increases in possible injury and PDO crashes, which were likely due to nuisance strikes given the barriers' proximity to the traveled way.
- The reductions in fatal, incapacitating, and non-incapacitating injuries are significant, despite the increase in possible injury and PDO crashes. The increase in the frequency of low-severity crashes is acceptable in light of the reductions in crash severity.

- The cost-benefit analysis indicated that median cable barriers are a favorable investment for the assumed 20-year design life.
- Based on the results of the safety and cost-benefit analyses, it is recommended that median cable barriers continue to be installed to reduce the risk of median-related crashes.

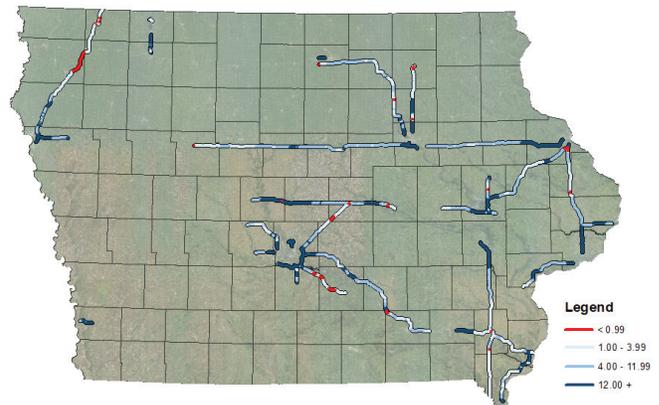
Implementation Readiness and Benefits

Iowa's median cable barrier installation program has provided an effective median treatment that reduces injury severity and represents a favorable investment of financial resources.

The final report for this project provides guidelines based on an aggregate composition of median width and annual average daily traffic (AADT) for prioritizing locations for future median cable barrier installations. Candidate locations for median cable barriers on Interstates and expressways were identified and assigned a priority level (high, medium, low, or not economically viable).



Candidate locations for median cable barrier installation on Interstates



Candidate locations for median cable barrier installation on expressways