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RESEARCH
SERVICES SECTION

TECHNICAL SUMMARY

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PROJECT COST:
$55,000

Statistical analysis revealed a number of locations where cable median barriers will improve safety.

Predicting the Cost-Effectiveness of Highway Median Barriers

What Was the Need?

Cross median crashes occur on divided highways when a vehicle leaves the road, crosses the median and collides with a vehicle in the opposing lanes. Between 2001 and 2005, cross median crashes and head-on crashes in Minnesota took more than 600 lives. The Minnesota Strategic Highway Safety Plan targets these crashes for reduction, and Mn/DOT has begun installing median barriers, primarily cable guardrail, in strategic locations around the state as a cross median crash countermeasure.

The results of this initiative are encouraging: Preliminary data indicates that no fatal cross median crashes have occurred on the treated highway sections since installation began in 2004. However, the cost to install the guardrail ($100,000 per mile) at all desirable locations exceeds available funds. Mn/DOT traffic engineers need methods for identifying sections at greatest risk for cross median crashes and predicting the benefits of installing barriers.

What Was Our Goal?

The objective of this study was to provide Mn/DOT with tools for identifying highway sections at high risk for cross median crashes and for estimating and comparing the costs and benefits of installing barriers on various sections.

What Did We Do?

Researchers created statistical models to estimate cross median crash frequency on different highway sections and identify possible high-risk locations. They also created a simulation model that Mn/DOT could use to predict and compare the cost-effectiveness of cable guardrail projects.

- **Statistical Models.** Researchers used Mn/DOT's computerized crash, roadway and traffic data from Mn/DOT's Highway Safety Information System to build a database for statistical analysis of cross median crashes occurring on urban and rural freeways from 2001 through 2005. Because these electronic records do not explicitly identify cross median crashes, researchers faced the prospect of manually reviewing hard copy accident reports to verify whether crashes in their database were cross median crashes.

  To negotiate this problem, researchers developed an analytical technique that used subsets of Mn/DOT's hard copy accident reports to determine which crash records in the database were likely to be cross median crashes. They selected these records for 2003 through 2005 and used them to prepare data files suitable for statistical analyses to identify highway sections at high risk for cross median crashes. Two statistical models were created for these analyses: one for freeways and one for rural expressways.

- **Simulation Model.** Researchers defined the cost-effectiveness of a proposed barrier project as the project cost divided by the estimated number of cross median crashes blocked by the barrier over a specified number of years. They developed a simulation model that could perform this calculation for a given highway section. The model is Excel-based with a spreadsheet for inputting data such as cross section specifications, average daily traffic count, barrier cost per mile and number of years the estimate should cover. Several data inputs are defaults. The heart of the model is an equation that works with the spreadsheet data to compute and display crash probabilities for the section and the total dollars that could be saved over the estimated period by preventing all cross median crashes.

continued

"This study provided tools to identify where most cross median crashes appear to occur and the cost benefit of installing barriers."

–David Engstrom,
State Traffic Safety Engineer, Mn/DOT Office of Traffic, Safety and Technology

"There were well-established statistical tools for screening locations for the risk of relatively frequent types of crashes, such as those occurring at urban and suburban intersections. Median-crossing crashes appeared to have fallen through the cracks."

–Gary Davis,
University of Minnesota Department of Civil Engineering

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Cost Effectiveness of Median Barrier Treatments						**version:**	1.4					
Gary A. Davis		University of Minnesota			2 opposing vehicles/lane							
											opposing traffic	
Cross Section Data:											mean	st.dev
G	d	mu		nsec=	7		ADT=	40000		v	65	5
-0.0417	10.0000	0.7500		edge=	5		Length=	1		tp	1.1	0.25
-0.1667	18.0000	0.4000		nlane_op=	2		Horizon=	10		a	0.65	0.1
0.0000	4.0000	0.4000								veh/l/mi=	12.82	12.82051
0.1667	18.0000	0.4000					ybar=	411.856			enter	compute
0.0417	10.0000	0.7500					vybar=	95.333				
0.0150	12.0000	0.7500					tpbar=	1.100				
-0.0150	12.0000	0.7500					aybar=	20.930	medwid=	60		
				Simulation Specs			MVMT=	14.600				
				delta=	0.02		enc/yr=	4.492				
				niter=	15000		mcmid=	6571	pmid=	0.438067	Exmid=	1.967946
				nsteps=	500		mccrash=	571	pcrash=	0.038067	Excrash=	0.171009
				close2=	4.50		mccross=	1707	pcross=	0.1138	Excross=	0.511229
				nveh=	2							
							$/mile=	100000				
							cost=	100000			**$/crash=**	29236.3

The simulation model uses an Excel spreadsheet to compute the costs and benefits of installing a median barrier based on cross section data, average daily traffic, and other user and default inputs. The example above predicts a benefit ($/crash) of more than $29,000 over 10 years for a hypothetical roadway segment.

What Did We Learn?

Researchers used the statistical models to investigate cross median crash risk at 1,443 Minnesota freeway and rural expressway sections. The models estimated cross median crash frequency on these sections for 2003 through 2005, and identified 181 freeway and 80 rural expressway sections where the crash number exceeded zero. The estimated crash number was one or greater for 31 sections and two or greater for four sections. These results were tabulated in the final report along with the estimated number of crashes per mile for each section and the probability that its crash rate exceeds the mean average for all sections in its group.

What's Next?

The software developed for the simulation model was delivered to Mn/DOT with user documentation, and training sessions were conducted for traffic engineers at the Central and District 3 offices. The Mn/DOT Office of Traffic, Safety and Technology intends to use the results of the study to help prioritize cross median crash countermeasures, primarily cable guardrail, for various highway sections, and will use the tabulated results of the statistical analyses to screen for sections that appear to be at risk for cross median crashes. The office also anticipates using the simulation model in the future: The model's spreadsheet requires the user to input cross section data, and that data is not yet readily available for the sections identified in the statistical analyses. Researchers believe that the results of the study will also prove useful to county and local engineers tasked with preventing cross median crashes.

This Technical Summary pertains to Report 2008-17, "Cross Median Crashes: Identification and Countermeasures," published June 2008. The full report can be accessed at http://www.lrrb.org/PDF/200817.pdf.