MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 17-339 (project 397) | December 2017

Evaluation and Mitigation of Vehicle Impact Hazards for Overpasses

the ISSUE

Crashes of heavy trucks with bridge columns are random events with a low probability of occurring. Few collision events have resulted in catastrophic partial or full collapse of bridges. This study was performed to develop risk and mitigation plan for South Dakota bridges under vehicular collision forces.

the RESEARCH

A risk assessment for truck collisions with bridge columns was performed and the vulnerability of bridge columns to catastrophic failure under lateral collision forces was evaluated to develop a risk analysis and mitigation strategy for critical bridges on the state's Interstate system and other highways. An experimental study was conducted on two 1/3-scale bent specimens to assess the effectiveness of a retrofit measure for vulnerable bridge bents. The retrofit consisted of a crash strut that spans between the bent columns and acts as a shear wall. A finite element dynamic analysis was performed to assess the suitability of the collision force specified in American Association of State Highway and Transportation Officials Load and Resistance Factor Design Bridge Design Specifications.

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Project Title

Evaluation and Mitigation of Vehicle Impact Hazard for Overpass Bridges in South Dakota

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the **FINDINGS**

The collision risk and the economic importance of a bridge were combined in a decision analysis method to rank the overpass bridges. The quartile distribution, based on collision risk and road user cost, resulted in a prioritization policy for implementing risk mitigation procedures. Laboratory testing of a 1/3-scale vulnerable two-circular column bent indicated structural failure at less than one-half of the design collision force and potential for unseating of the edge girder. A similar specimen, but with a crash strut retrofit, was capable of resisting 1.5 times the design collision force. Dynamic finite element analysis the 600-kip vehicle collision force specified by AASHTO is a reasonable estimate for the load demand induced by the collision with the bridge column of an 80,000 lb tractor-trailer travelling at 55 mph.

the **IMPACT**

The prioritization list generated in this study, coupled with other factors such as the remaining useful life of the bridge, bridge replacement schedule, availability of resources, and cost effectiveness of using the same retrofit method for a group of bents that share the same features, can be adopted by SDDOT for implementing protection or retrofit measures for vehicular collision forces.

A crash strut, similar to the one tested in this study, was shown to be an effective measure to retrofit column bent that are vulnerable to collapse under vehicular collision loads.

For more information on this project, download the entire report at http://www.ugpti.org/resources/reports/details.php?id=897

For more information or additional copies, visit the Web site at www.mountain-plains.org, call (701) 231-7767 or write to Mountain-Plains Consortium, Upper Great Plains Transportation Institute, North Dakota State University, Dept. 2880, PO Box 6050, Fargo, ND 58108-6050.