UTC Project Information	
Project Title	MPC-397 – Evaluation and Mitigation of Vehicle Impact Hazard for Overpass Bridges in South Dakota
University	South Dakota State University
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Funding Agencies	USDOT, Research and Innovative Technology Administration
Agency ID or Contract Number	DTRT12-G-UTC08
Project Cost	$170,000
Start and End Dates	January 1, 2012 – December 31, 2013
Project Duration	2 Years
Brief Description of Research Project	**Research Needs:** With the increase in heavy truck traffic resulting from the oil industry in the northern plains, the probability of a significant impact load on a bridge pier resulting from a truck collision will increase. Collision loads, intentional or accidental, could potentially cause partial or total collapse of highway bridges. Catastrophic failure of bridges may result

	in significant loss of life and adverse socio-economic impact. Bridges in the northern plains are especially vulnerable to impact loads since they were and are not designed for any significant lateral load levels such as earthquake or blast loads. Studies are needed to develop risk assessment and management strategies to reduce the risk of collision loads in Region 8 states to a level that is economically feasible. Although not commonly occurring, collision of heavy vehicles on to highway overpass bridge piers had happened in the past and paralyzed traffic on both the overpass and the highway below. The 2003 Nebraska bridge collapse accident on I-80 was caused by a truck collision and halted the traffic in that section for 3 days. This type of hazard can be categorized as an extreme event that has a low probability of happening, but carries very significant consequences, which justifies certain preventive measures if proven to be cost effective. The robustness of the overpass pier and the preventive measures to slow down the vehicle before collision are the keys to mitigate the impact of the accident. The cost for increasing the robustness of pier structure to the level compatible to impact loading may not be justifiable especially for existing structures. Thus it is assumed in this study that the most cost effective mitigation measure for this type of hazard is to effectively reduce the speed of the accident vehicle before the collision or to retrofit deficient bridge column to increase. This study will evaluate the impact resistance for typical bridge columns on South Dakota Interstate system and provide practical recommendations to reduce vehicle speed under the collapse threshold and to retrofit deficient bridge columns. **Research Objectives:** 1. Evaluate the risk of bridge collapse caused by vehicle collision impact for South Dakota highway system. 2. Based on impact resistance of existing bridge columns, propose practical mitigation measures to reduce the accident vehicle speed approaching the column in order to reduce the risk of bridge collapse due to vehicle impact. 3. Provide recommendations for the design of bridge columns in future bridges.
Describe Implementation of Research Outcomes (or why not implemented) Place Any Photos Here	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.
Impacts/Benefits of Implementation (actual, not anticipated)	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.
Web Links • Reports • Project Website	https://www.ugpti.org/resources/reports/details.php?id=897