Texas A&M Transportation Institute

Texas Department of Transportation

PROJECT SUMMARY REPORT

0-7121: Determine the Adequacy of Installation of Existing Roadside Barriers on High-Speed Roadways

Background

Posted speed limits on Texas roadways have increased in recent years. Texas now has many miles of roadways posted at speeds of 75 mph and above. Barrier systems (e.g., guard fence, median barriers, and bridge rails) are currently tested and evaluated at a design impact speed of 62 mph. The performance limits of existing barriers are not known. Some barrier systems may have little or no factor of safety for accommodating more severe impacts beyond their design condition.

The objectives of this project included determining appropriate impact conditions for roadways with posted speed limits of 75 mph and above, and exploring the capability of existing or modified barriers to accommodate these impact conditions.

What the Researchers Did

Researchers used data from the Crash Record Information System to conduct exploratory data analysis and cross-sectional data analysis. The effort was to determine how commonly used generic longitudinal barrier systems are performing on Texas roadways with high posted speeds relative to barriers installed on roadways with posted speeds of 70 mph and below.

The National Cooperative Highway Research Program 17-43 database, which includes reconstructed single-vehicle run-off-the-road crashes, was used to determine impact conditions for roadways with high posted speed limits. Linear regression analysis was performed to obtain an 85th percentile estimate for both impact speed and impact angle for high-speed roadways with posted speed limits of 75, 80, and 85 mph.

Finite element impact simulations were performed on selected concrete barriers using the estimated high-speed impact conditions for an 85-mph posted speed limit. Concrete barriers evaluated included a 42-inch-tall single slope concrete barrier (SSCB), 36-inch-tall single slope traffic rail (SSTR), 32-inch-tall F-shaped barrier, and 36-inch-tall vertical parapet (T222).

The impact performance of two guardrail systems was investigated using finite element modeling and simulation for high-speed conditions for a posted speed limit of 80 mph. These included a Midwest Guardrail System (MGS) with shortened blockouts and a roadside thrie-beam guardrail system (RTGS).

The structural adequacy of the selected concrete barriers was investigated by comparing the capacity of the barrier systems with design impact loads estimated for posted speed limits of

Research Performed by:
Texas A&M Transportation Institute

Research Supervisor:
Roger Bligh, TTI

Researchers:
Sonal Chamargore, TTI
Chiara Silvestri-Dobrovolny, TTI
Bahar Dadashova, TTI
Marcie Perez, TTI
Aniruddha Zalani, TTI
Sun Hee Park, TTI
William Williams, TTI
Judong Lee, TTI
Maysam Kiani, TTI

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80 mph and 85 mph. The structural analyses were performed following the methodology of Section 13 of the American Association of State Highway and Transportation Officials *LRFD Bridge Design Specifications*. The design loads for the high-speed impact conditions were determined by scaling the *Manual for Assessing Safety Hardware* (MASH) TL-3 design force based on the increase in impact severity between the two impact conditions.

What They Found

Researchers found that the impact conditions associated with a 75-mph posted speed limit were within current tolerance for MASH TL-3 impact speed and angle. Impact conditions estimated for roadways with an 80-mph posted speed limit included an impact speed of 66.4 mph and an impact angle of 25.6 degrees, and the impact conditions associated with an 85-mph posted speed limit involved an impact speed of 68.9 mph and an impact angle of 27.3 degrees.

The simulation results indicated that the occupant risk metrics and angular displacements for the concrete barrier systems increased for the high-speed impact conditions compared to MASH TL-3 impact conditions but were all within MASH thresholds. Both the MGS with shortened blockouts and RTGS also satisfied MASH evaluation criteria for impact conditions associated with a posted speed limit of 80 mph.

Researchers found that the existing concrete barrier designs have sufficient strength both on the interior and at the ends to resist impact forces associated with an 80-mph posted speed limit. When the designs were assessed for a posted speed limit of 85 mph, it was found that the barrier interiors had sufficient capacity, but the strength of the barrier ends was slightly below the estimated design impact loads.

What This Means

Researchers concluded that since the impact conditions associated with a 75-mph posted speed limit were within current tolerance for MASH TL-3 impact speed and angle, existing MASH-compliant barriers should be suitable for use on roadways with a posted speed limit of 75 mph.

Researchers concluded the SSCB, SSTR, T222, and F-shaped concrete barriers are likely to meet MASH evaluation criteria for the 1100C passenger car and 2270P pickup truck for the high-speed impact conditions associated with a posted speed limit of 85 mph. If existing concrete barrier systems are used on roadways with a posted speed limit of 85 mph, researchers recommend reducing the spacing of the vertical barrier reinforcement and anchorage bars at the ends of the barriers to increase the resistance.

Researchers consider both the MGS with shortened blockouts and RTGS to have a reasonable probability of complying with MASH for high-speed impact conditions estimated for a posted speed limit of 80 mph. Full-scale crash testing of these systems is recommended to verify impact performance at the high-speed impact conditions.

For More Information

Project Manager:
Darrin Jensen, TxDOT, (512) 783-5388

Research Supervisor:
Roger Bligh, TTI, (979) 317-2703

Project Monitoring Committee Members:
Ken Mora, Charles Airiohuodion, Taya Retterer, Tim Wright, Alberto Guevara, and Vincent Shovlin

Research and Technology Implementation Office
Texas Department of Transportation
125 E. 11th Street
Austin, TX 78701-2483

www.txdot.gov
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