

Tech Brief

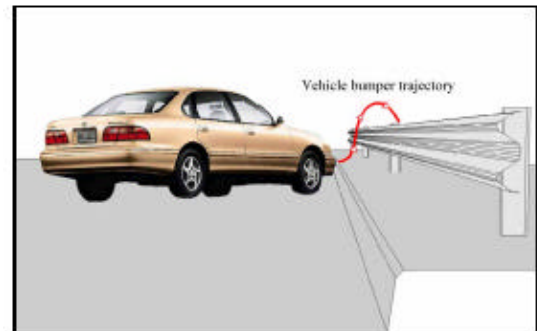
Vehicle Impact Simulation for Curb and Barrier Design: Volume 1- Impact Simulation Procedures

FHWA-NJ-1998-007-TB

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HERE'S THE PROBLEM

Vehicle impact simulation results are needed for producing design and evaluation trajectory data necessary for determining appropriate set-back distances for guide rails (railings) located near curbs.

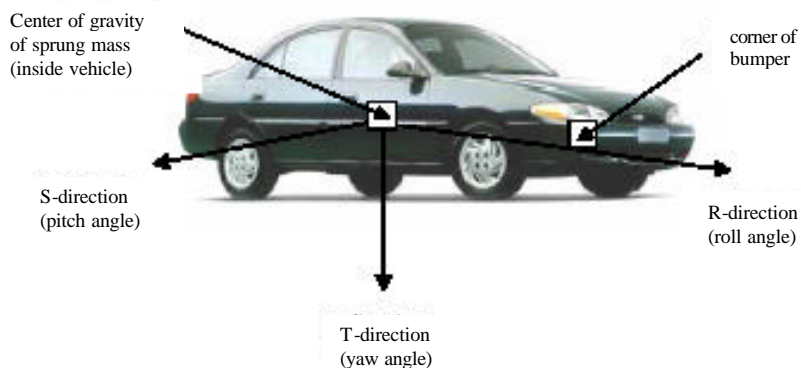


AND, HERE'S THE SOLUTION

To perform computer simulations of vehicle-curb and vehicle-berm impacts to characterize the behavior of a wide range of vehicle types after such impacts.

THESE ARE OBJECTIVES...

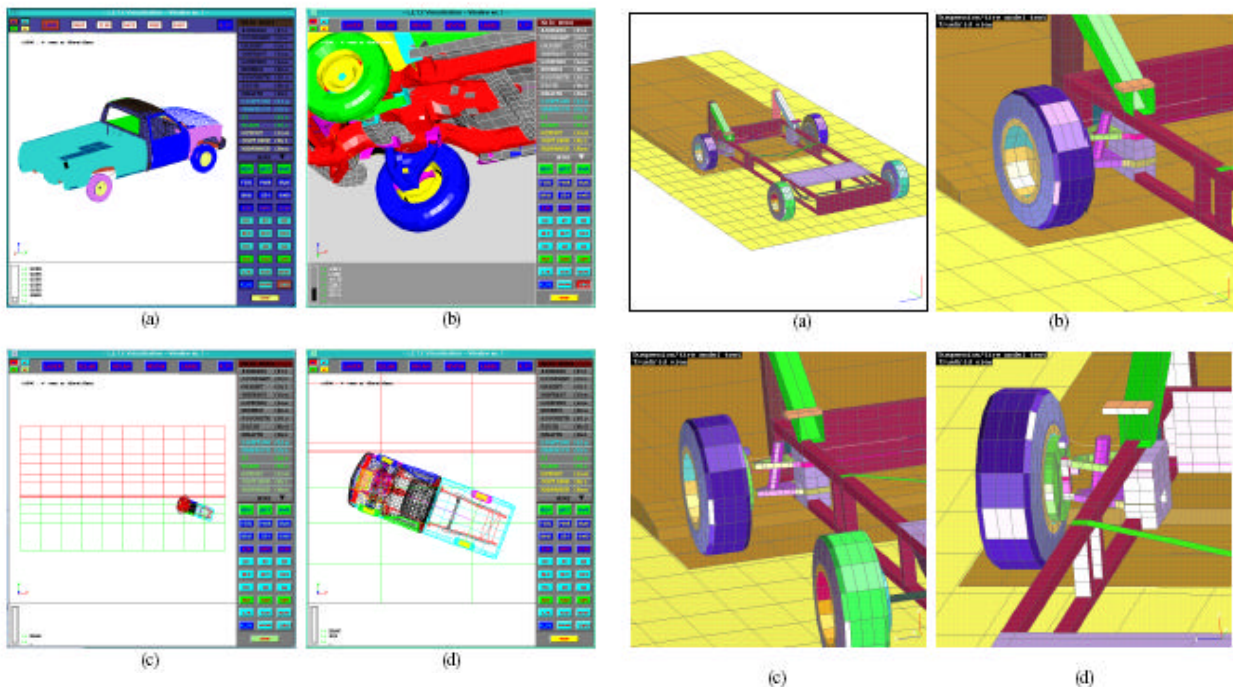
- The main objective of this project is to produce design and evaluation trajectory data to be used by New Jersey Department of Transportation Engineers.
- To use these simulation results to supplement existing curb-impact vehicle trajectory databases.



HERE IS WHAT WE DID...

This study was composed of five segments. It was initiated with an extensive literature review of numerous vehicle impact simulation techniques.

The second step was the generation of vehicle impact trajectory plots, which were based on highway vehicle object simulation model (HVOSM) modeling. HVOSM is a vehicle handling computer simulation model that implements moderately sophisticated vehicle, suspension, and tire models. These were generated for a wide variety of vehicle types, curb and berm types, impact speeds, and impact angles. Six vehicles were selected for this study: Ford Escort, Honda Civic, Chevrolet Cavalier, Plymouth Voyager, Chevrolet Pick-up, and a Jeep Wrangler. Trajectory plots and trajectory data were used to evaluate the appropriate set back distances for guide rails that are placed adjacent to curbs or berms. The goal here was to generate complete trajectory plots for a wide range of impact conditions using a specified set of curb and berm profiles, and using the set of vehicles selected. For each choice of curb and vehicle, a large number of impact angles and speeds were simulated using HVOSM, and then plotted into design parameters for vehicle encroachments on curbs.



Previous studies, in which HVOSM simulation results were accompanied by full-scale crash testing, were then reviewed to determine the validity and limitations of HVOSM for curb impact simulation. This was carried out in order to evaluate the accuracy of the HVOSM simulation results conducted here.

Next, the applicability of using the LS-DYNA3D FEA simulation code and publicly available finite element analysis (FEA) vehicle models for curb and berm impact was determined. The FEA method was found to be a state-of-the-art method for vehicle

impact analysis. The FEA simulation code LS-DYNA3D has gained widespread acceptance in roadside safety analysis due to its sophisticated handling of contact interactions during impacts. This method was used to compare results to the HVOSM method. The FEA testing proved to be an accurate means of simulating curb impacts as long as the vehicle model has the correct modeling features incorporated into it.

Finally, the advantages, disadvantages, features, and limitations of both HVOSM and FEA simulation techniques were identified and described.

CONCLUSIONS...

Based on the results of this study, it was determined that HVOSM simulation results generated herein are reasonably accurate, provided that the limitations of modeling methods employed are not violated. Moderate velocity impacts on shallow curbs and rigid berms can generally be simulated using HVOSM with confidence. Higher speed impact, impacts on large curbs, interaction of tires with berm soil, and interaction of the vehicle with guide rails cannot be accomplished using HVOSM, but can be accomplished by using FEA simulation methods.

WHAT IS THE NEXT STEP?

The next step in this case would be to continue validation research through the use of full scale crash testing for FEA vehicle models.

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<p>A final report is available online at http://www.state.nj.us/transportation/research/research.html</p> <p>If you would like a copy of the full report, please FAX the NJDOT, Bureau of Research, Technology Transfer Group at (609) 530-3722 or send an e-mail to Research.Bureau@dot.state.nj.us and ask for:</p> <p>Report Title: Vehicle Impact Simulation for Curb and Barrier Design: Volume 1- Impact Simulation Procedures NJDOT Research Report No: FHWA-NJ-1998-007</p>	