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Roadside Safety Pooled Fund

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Roadside Safety
Research Program
Pooled Fund Study

Crash Wall Design for Mechanically Stabilized Earth (MSE) Retaining Wall

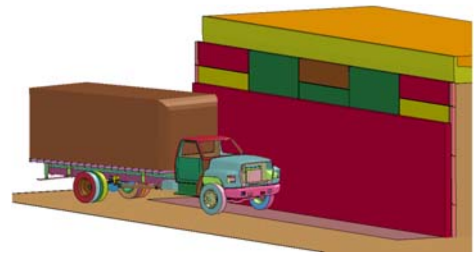
INTRODUCTION

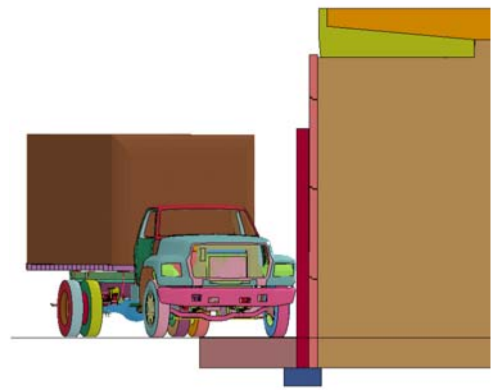
This study was undertaken to evaluate the effectiveness of a crash wall design to protect MSE wall panels from Single Unit Truck (SUT) impact. The 8-inch thick crash wall is shown to significantly reduce the damage to the MSE wall panels due to such impacts.

RESEARCH METHODOLOGY

In order to evaluate the crash wall design on the MSE wall, three MSE wall models were developed for three simulation cases. (1) a typical MSE wall structure, (2) the MSE wall structure with a crash wall, and (3) the MSE wall structure with a crash wall that is tied with anchors to the panels. These models have explicit representation of the backfill soil, the concrete wall panels, the moment slab, the barrier and coping, and the crash wall (for cases 2 and 3). Concrete steel reinforcement and soil steel strips were explicitly modeled including their connectivity to the surrounding continuum. Beam elements were used to represent rebar embedded in reinforced concrete parts (panels, barrier, moment slab, and crash wall). Shell elements were used to represent steel strips that are embedded in the backfill soil. Soil and concrete parts were modeled using solid elements.

The system was initialized to capture initial stress at the steady state condition. Namely, the initial stress in the backfill soil due to gravitational loading and the initial stress in the steel strips due to active earth pressure of the wall were applied. This initialized state was verified using weight calculations of the system and the maximum strip loads using an analytical expression provided in Section 11 in *AASHTO LRFD Bridge Design Specifications.*





FE Model of MSE Wall with Crash Wall

ANALYSIS

An SUT traveling at a speed of 56 mph and an angle of 15 degrees was used to represent the impact load. These impact parameters are representative of AASHTO *Manual for Assessing Safety Hardware* (*MASH*) TL-4 test condition. The existing SUT vehicle model was originally developed as an *NCHRP 350* 8000S test vehicle. The model was modified to reflect the new *MASH* 10000S vehicle specification for TL-4. The research team validated the modified SUT (10000S) model using the results of a *MASH* TL-4 full-scale crash test performed by TTI. The simulation results obtained with the modified SUT vehicle correlated reasonably well with the test results. Moreover, the validity of the simulation was quantified by

PARTICIPATING PARTNERS:

Alaska Department of Transportation & Public Facilities

California Department of Transportation

Louisiana Department of Transportation and Development

Minnesota Department of Transportation

Pennsylvania Department of Transportation

Tennessee Department of Transportation

Texas Department of Transportation

Washington State Department of Transportation

Federal Highway Administration

Texas Transportation Institute

CONTACT INFORMATION:

Dave Olson, Chair
Washington DOT
Policy, Standards and Safety Res.
P.O. Box 47372
Olympia, WA 98504-7372
(360) 705-7952
Olsonda@wsdot.wa.gov

D. Lance, Bullard, Jr., P.E.
Roadside Safety & Physical Security Division
Texas Transportation Institute
TAMU 3135
College Station, TX 77843-3135
(979) 845-6153
l-bullard@tamu.edu

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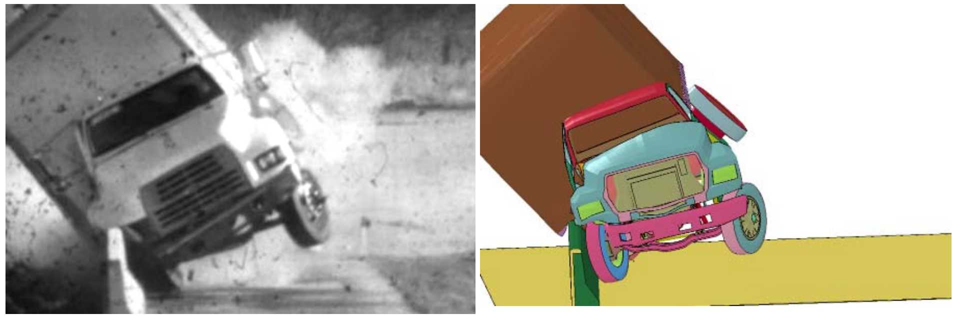
calculating comparison metrics between simulation and crash test signals.

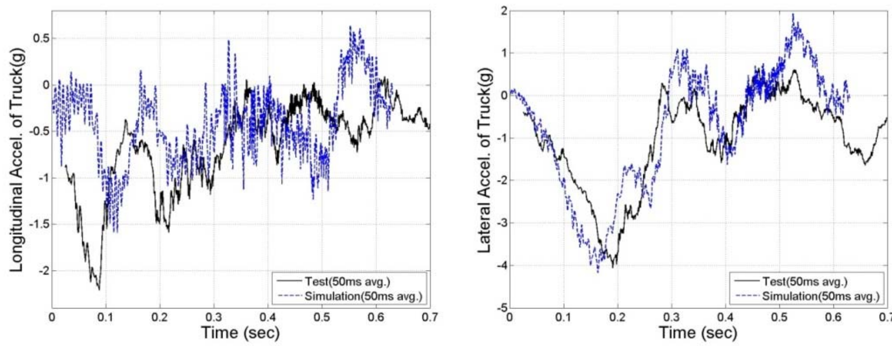
Using this 10000S vehicle model, three impact simulations were performed using the three different MSE wall models described earlier. The results of the analysis of the MSE wall impact showed that the wall panels incurred considerable damage from a direct impact. This indicates that the wall panels alone cannot resist a direct impact of such severity. However, when the 8-inch thick continuous crash wall was added in front of the panels, the panels exhibited only minor damage that likely would not require repair. Similar behavior was observed when the crash wall was anchored to the MSE wall.

When the wall panels are damaged by a direct impact, the required reconstruction work is complicated and costly because a significant section of the in-service MSE wall system would need to be rebuilt. Repair of any damage to an outer crash wall is much less complicated and expensive. Use of the crash wall would reduce repair time and cost and minimize disruption of traffic due to lane closures.

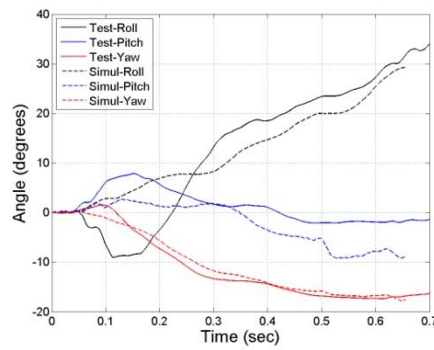


Test *Simulation*

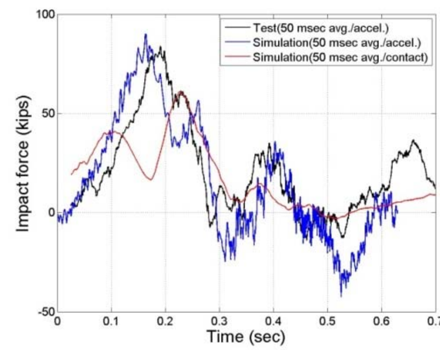
Vehicle Position and Orientation at a Given Time (0.489 sec)



Accelerometer Data

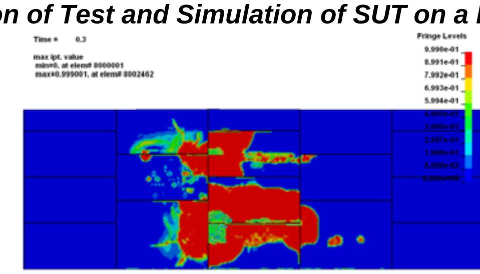


Angular Displacement

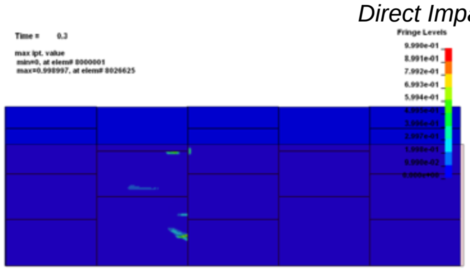


Impact Force

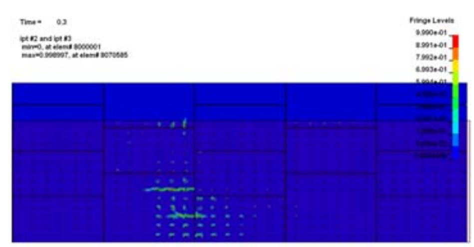
Comparison of Test and Simulation of SUT on a Rigid Barrier



Direct Impact Case



Crash Wall Impact Case



Crash Wall and Anchors Impact Case

Damage profile of the panel (impact side)

FOR MORE INFORMATION:

[Final Report on MSE Wall]

TTI Research Supervisor:
Akram Y. Abu-Odeh
abu-odeh@tamu.edu

Pooled Fund Technical Rep.
Mark Burkhead
Pennsylvania Department of Transportation
MarkBurkhead@state.pa.us

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