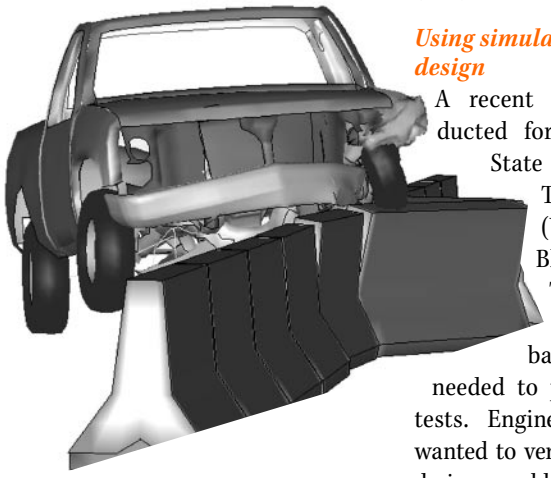
Cutting-Edge Crash Testing

Project shows predictive use of computer simulation



Design it. Build it. Test it.

A time-honored and logical process for producing roadside safety devices. Now computer simulation enables engineers to integrate design and testing phases, saving money and providing greater flexibility.

"We will see more and more projects that have an integrated simulation component to help guide the crash testing program and limit the cost of the project," predicts Roger Bligh, director of the Center for Transportation Computational Mechanics at Texas Transportation Institute (TTI).

Using simulation during design

A recent TTI project conducted for the Washington State Department of Transportation (WSDOT) prompted Bligh's comments. The state uses a portable concrete barrier design that needed to pass federal crash tests. Engineers in Washington wanted to verify that the barrier design would hold up to testing and subsequent roadside use, so they asked researchers at the center to conduct virtual crash tests. Researchers used the LS-DYNA computer simulation program to model vehicle impacts.

"Our simulation indicated that there was a high probability that the current design would not pass, and Washington officials elected to evaluate some design modifications and improvements through computer simulation. We were able to develop models and compare simulated crash tests of these alternatives for them. They then used the results to select what they felt was the best option," explains Bligh.

In recent years, computer simulation has frequently been incorporated into the design process to evaluate changes to improve a device following an unsuccessful crash test. The TTI project used simulation in a predictive manner prior to testing, as a part of the design and evaluation process, before time and money were spent on constructing and testing the actual physical device.

"We conducted several simulations on situations for which we didn't perform a physical crash test. Those extra simulations give us supplemental information on impacts and other considerations when we look at future design options," says Dick Albin, design policy standards and safety research engineer with WSDOT.

Predicting test results

The Federal Highway Administration requires all longitudinal roadside barriers to meet safety performance evaluation guidelines. For WSDOT to continue to use its portable Type 2 concrete barrier with pin-and-loop connection, the barrier needed to be evaluated in accordance with the guidelines set forth in National Cooperative Highway Research Program (NCHRP) Report 350.

Based on simulation results, engineers knew what to expect when the crash tests were run. While both the existing and modified designs passed, the barrier with the design improvements performed better. In the test of the original design, the barrier connection partially failed and the barrier sustained considerable damage. The improved pin-and-loop connection design maintained its integrity and the barrier sustained less damage with reduced barrier deflection.

"We were certainly pleased with the results. We had two goals for the simulations — to see if our current design had any flaws that would cause failure and to select an improved design before spending money to implement it," says Albin. "Because our current design passed the crash test, we now have time to refine any new designs before implementing them. The simulations give us feedback to use in the process of making a final design decision."

This project provides an example of simulation used as an additional evaluation and design tool to help guide the crash testing phase of a roadside safety product.

"The correlation we got between simulation and crash testing was very reasonable. It was all done in a predictive manner, rather than having previous crash tests to use as a validation of the models," notes Bligh. "This is an illustration of the type of work that will be done in roadside safety from now on."

The TTI project used simulation in a predictive manner prior to testing, As shown here, simulation was extremely accurate.

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Related report: *NCHRP Report 350 Test 3-11 of the Washington Type 2 Concrete Barrier, May 2001*