



THE GEORGE
WASHINGTON
UNIVERSITY
WASHINGTON DC



Roadside Hardware Safety Evaluation and Improvement using LS-DYNA

Daniel Young PE, Dr. Dhafer Marzougui, Dr. Nabih Bedewi
The George Washington University
FHWA/NHTSA National Crash Analysis Center

2003 FEMCI Workshop

Outline

- Need
- Vehicle Models
- Roadside Hardware Models
- Case Studies
- Modeling Uncertainties
- Conclusion

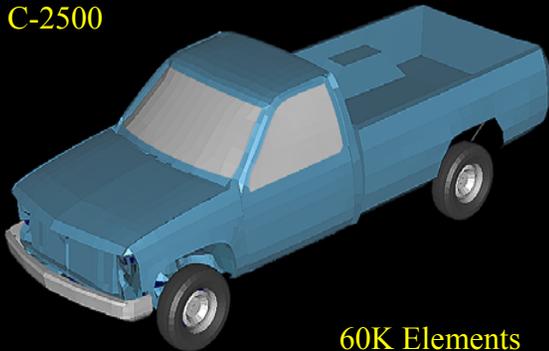
Need

- All roadside hardware is required to meet full scale crash test recommendations set forth by NCHRP Report 350.
- One of the most severe and commonly used tests requires a C2500 pickup truck to be safely redirected from a crash of 100 km/hr with 25° impact angle.
- Full scale crash testing is expensive at ~\$50k/per test and generally has a slower turnaround time with parametric studies.

Vehicle Models

- LS-DYNA vehicle models reverse engineered.
- Vehicle models freely available for download from our public finite element model archive @ <http://www.ncac.gwu.edu/archives/model/index.html>

C-2500



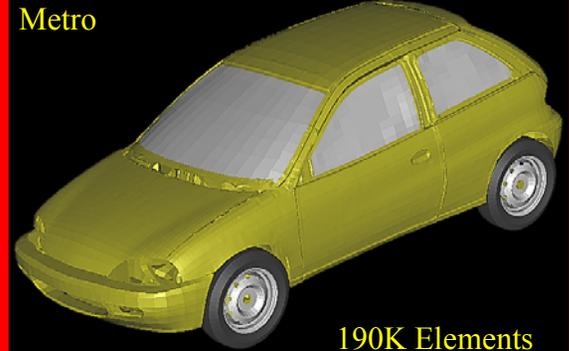
60K Elements

Neon



290K Elements

Metro



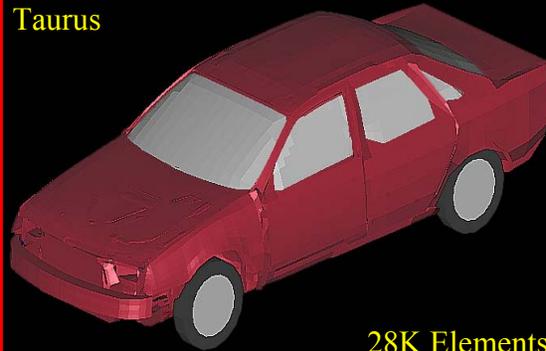
190K Elements

Caravan



330K Elements

Taurus



28K Elements

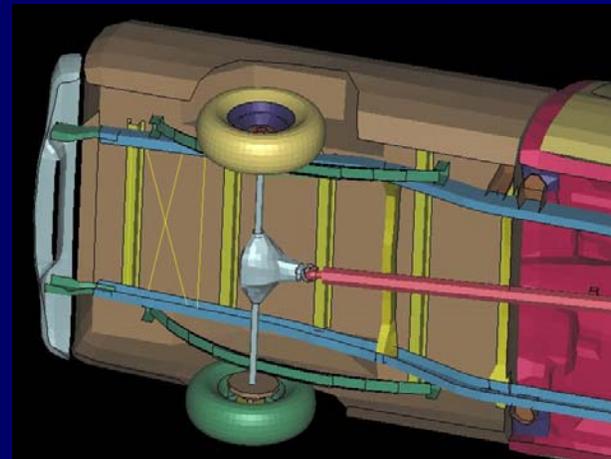
F-800



22K Elements

Vehicle Model Details

- Some models include engine, suspension, axles & steering components.
- Generally they do not include nonstructural cabin components, i.e. dashboard, seats and inside door molding.



C2500 LS-DYNA Model

Plate Transition Model

Between Permanent Concrete barrier and Portable Concrete Barrier

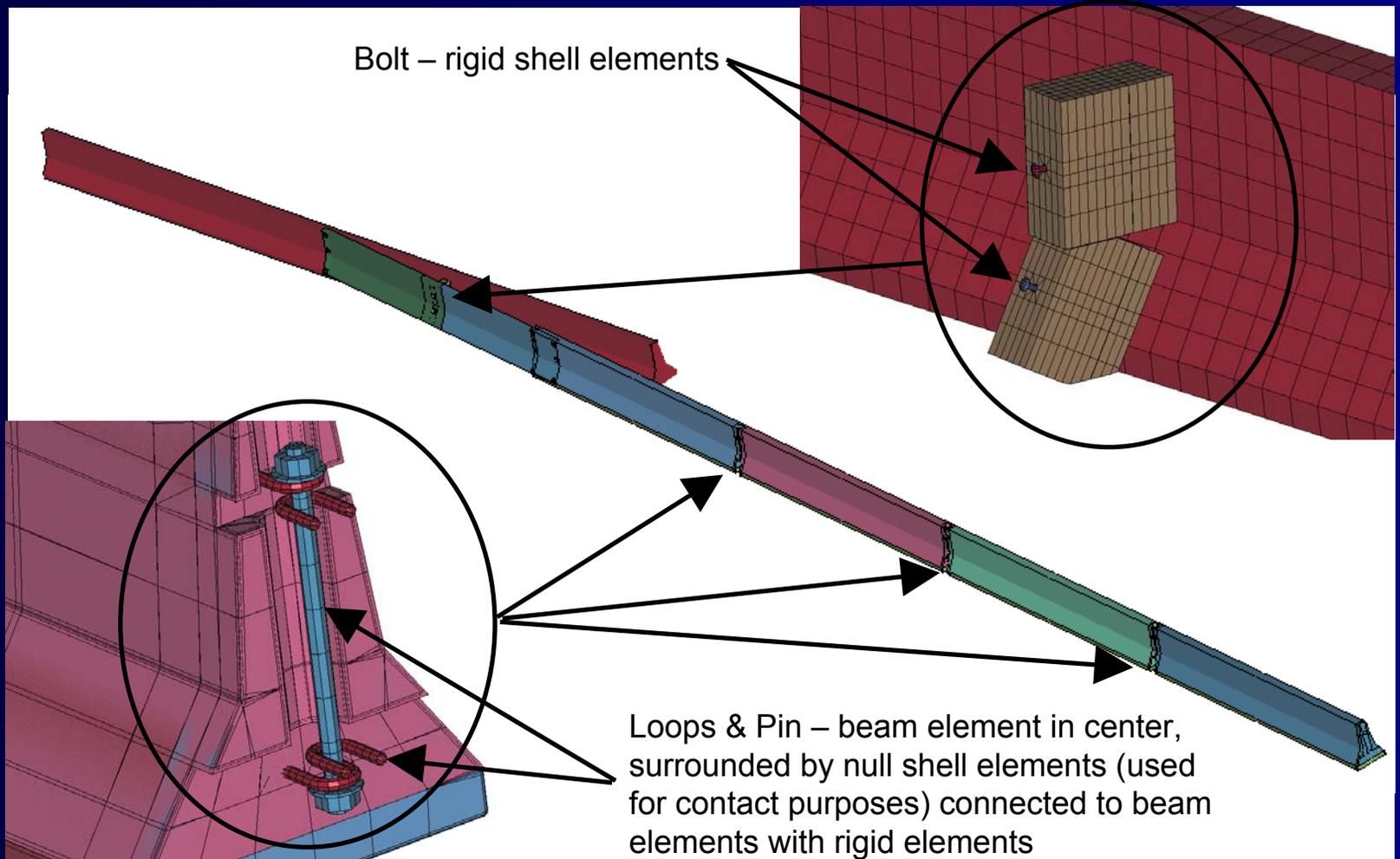
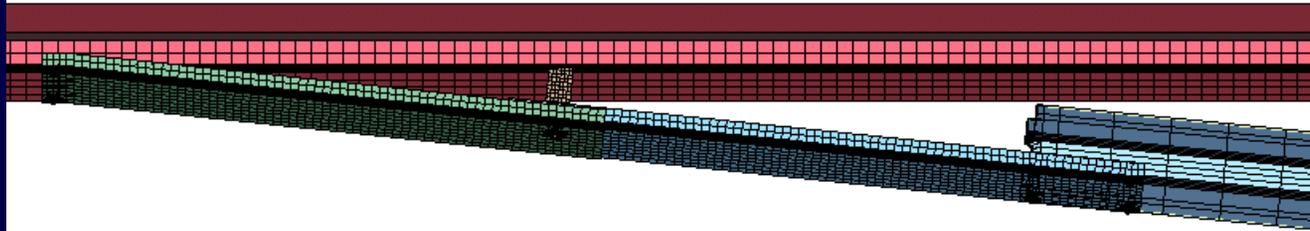


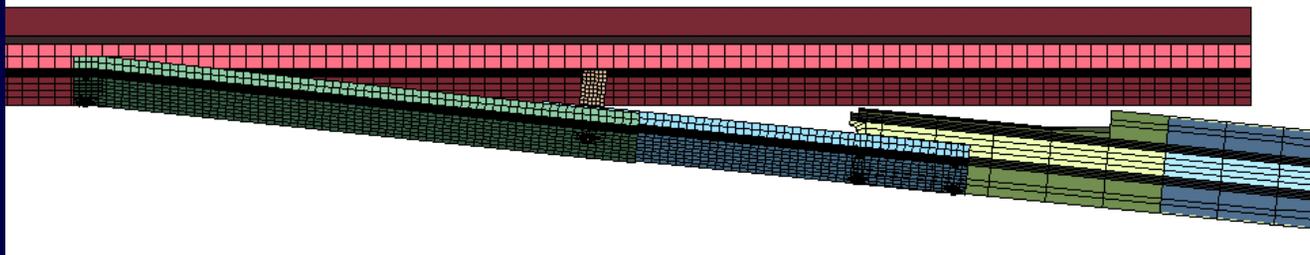
Plate Transition Model Case 1 & 2

Between Permanent Concrete barrier and Portable Concrete Barrier

Case 1

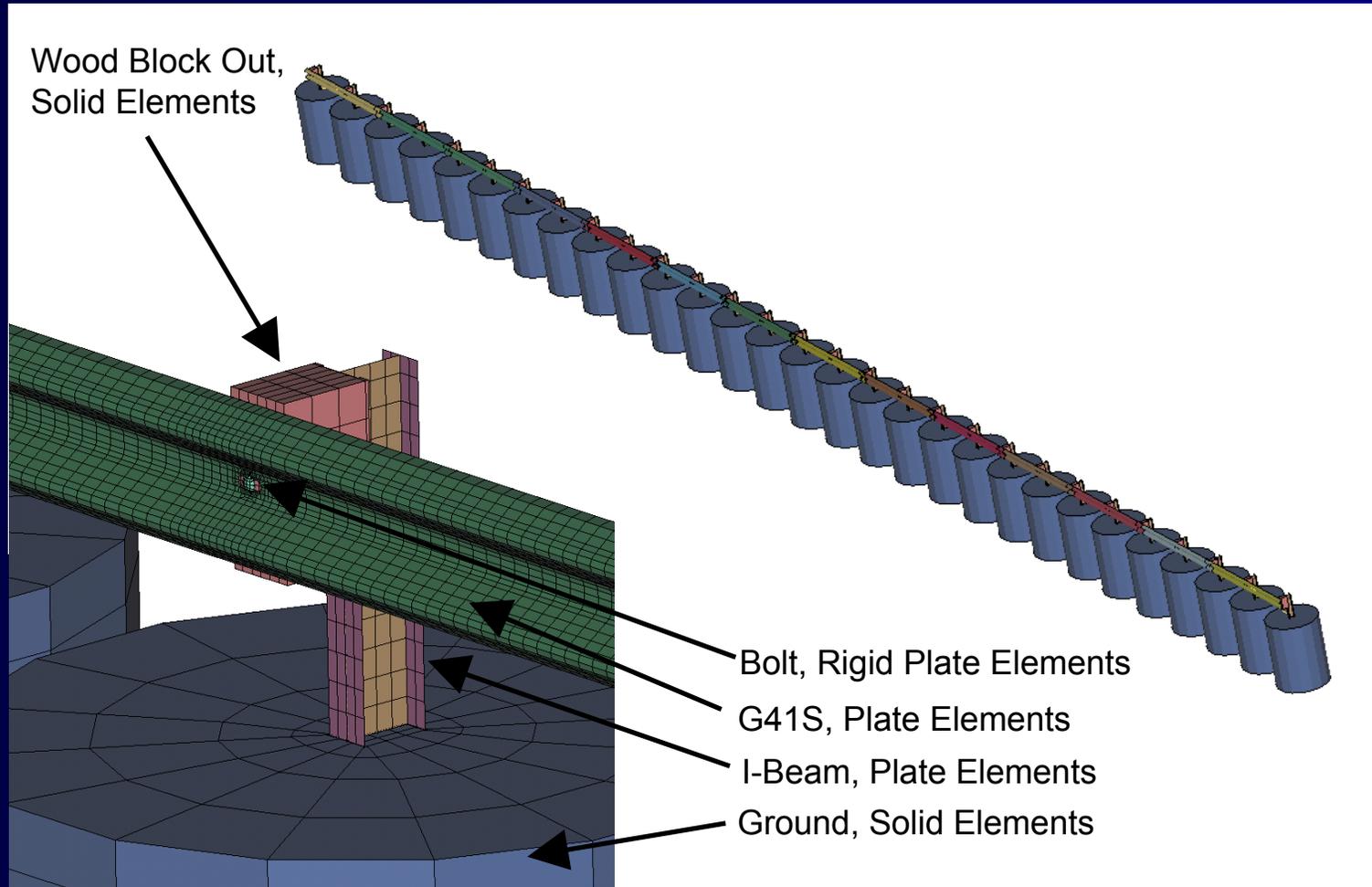


Case 2



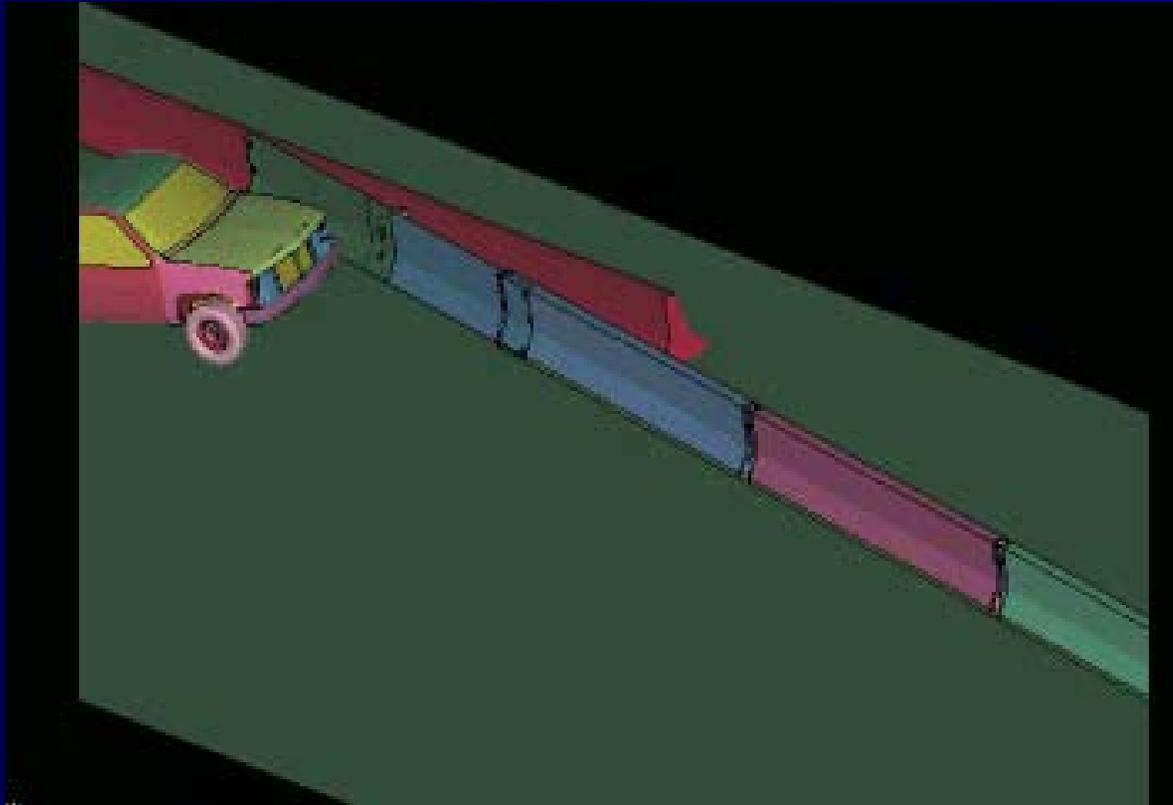
Case 2 has concrete removed (chiseled away) from portable concrete barrier to help close gap between the two barriers.

G41S – Guard Rail Model



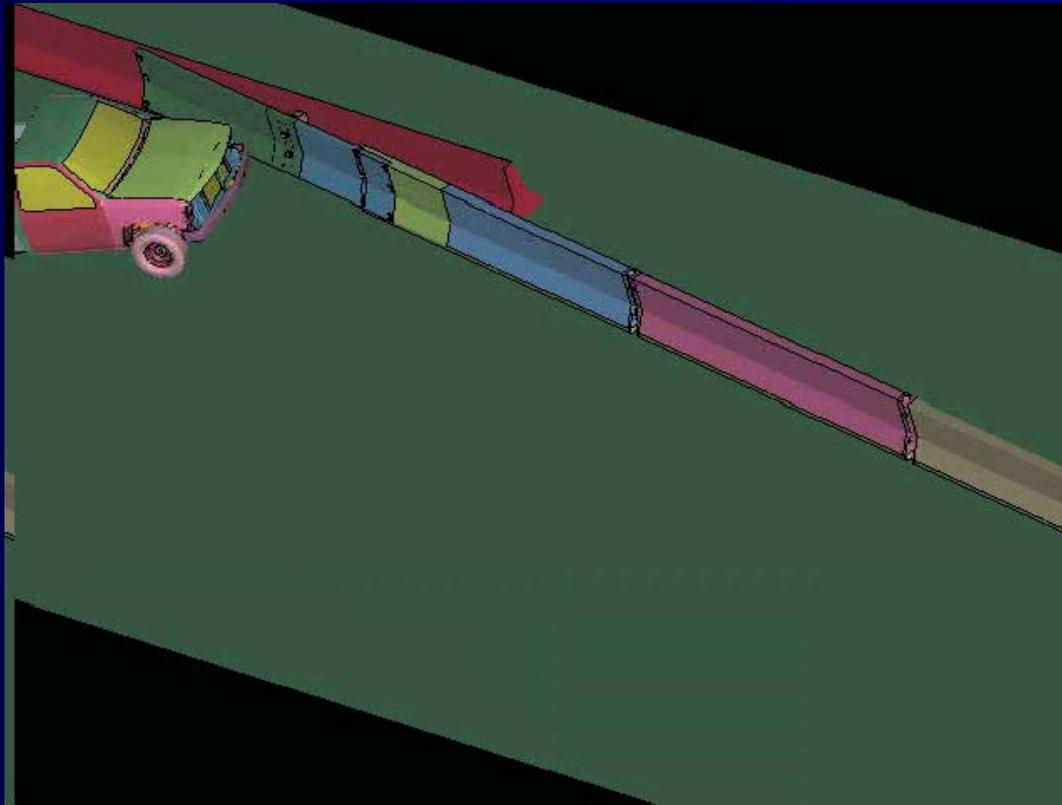
C2500 Pickup & Transition Plate

Case 1- Does Not Meet NCHRP Report 350

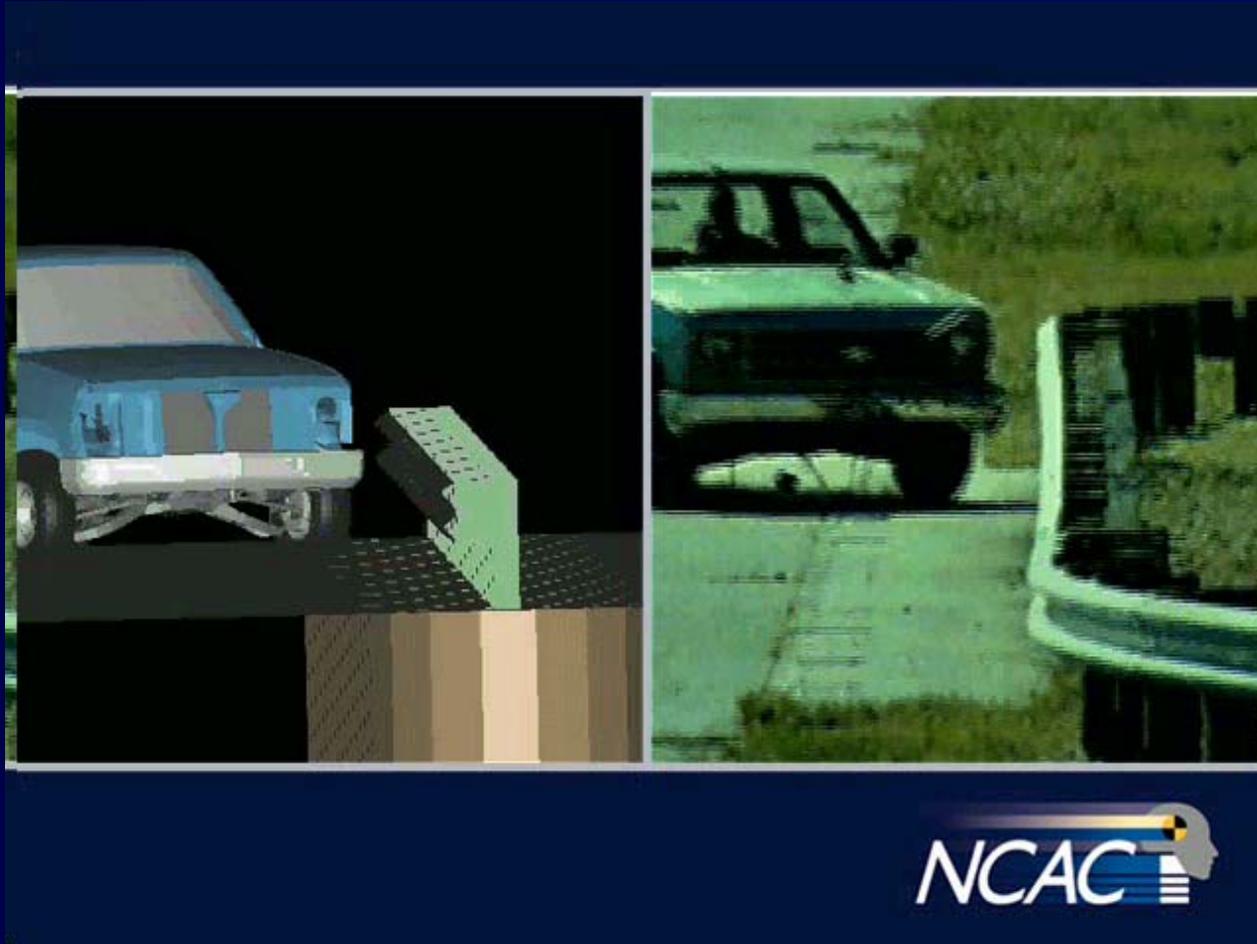


C2500 Pickup & Transition Plate

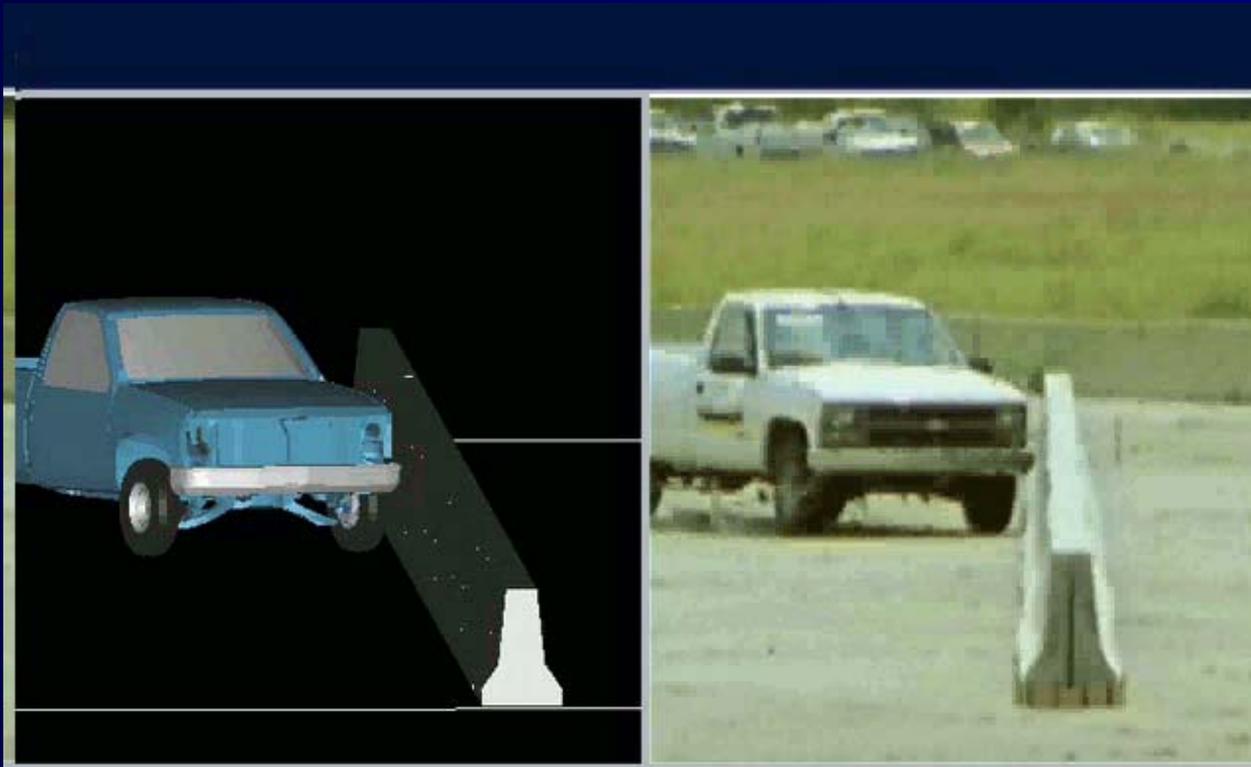
Case 2 – Improved Performance



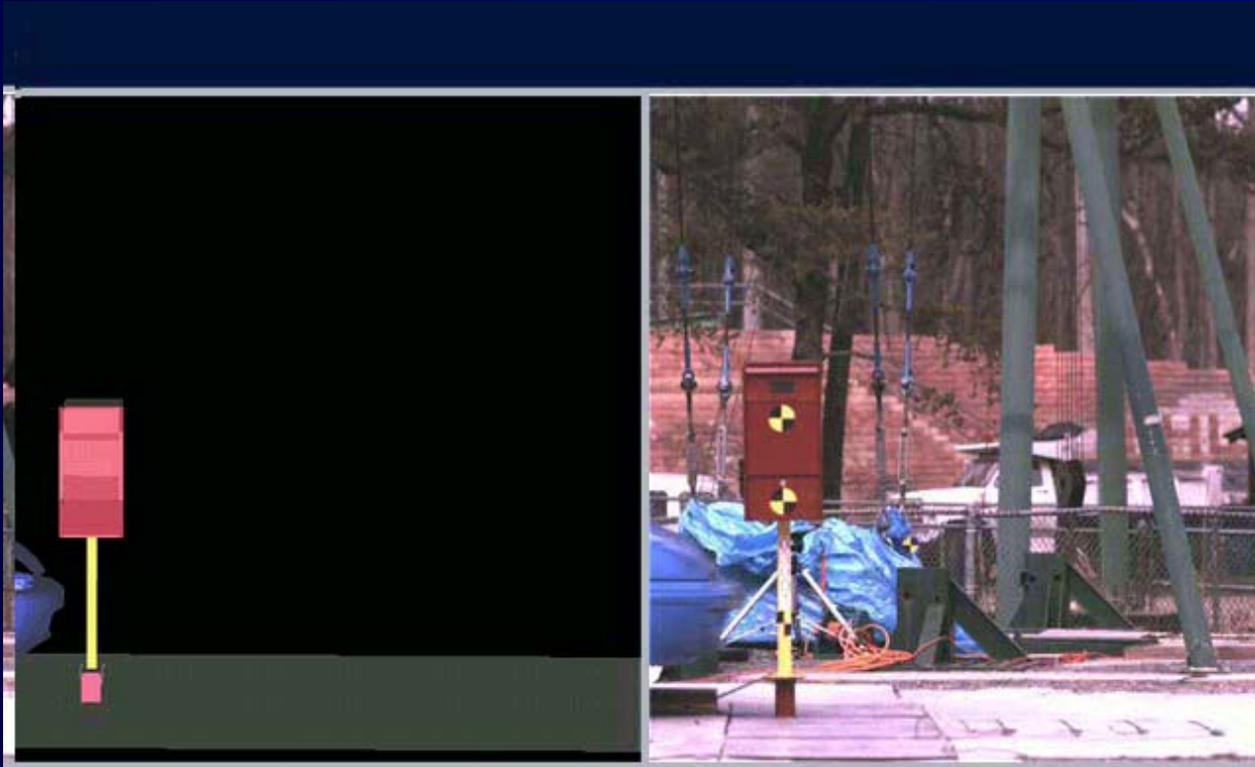
C2500 Pickup & G41S Guard Rail



C2500 Pickup & Portable Concrete Barriers (PCBs)



Geo Metro & Mail Box



Modeling Uncertainties

- Behavior of Contact Algorithm
 - Element Snagging
- Behavior of Friction
- Complexity of modeling failure
 - Tire Blowout
 - Glass Failure
 - Properties of Wood & Soil

Conclusion

- LS-DYNA modeling coupled with full scale testing is a cost and time effective way of developing new roadside hardware equipment.
- Models continue to become more and more accurate as computing power evolves.

Questions?

