New Side Impact Dummy Developments

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ABSTRACT

A reduction in vehicle side impact deaths continues to be a major focus at NHTSA. In 2002, 23% of crash deaths were attributed to side impact collisions, of which 60% resulted from injuries to the brain. Several significant safety-lead developments have occurred this year. The proposed FMVSS 214 NPRM, released on May 12th 2004, recommends the introduction of two new Anthropomorphic Test Devices (ATD's) in the FMVSS 214 side impact certification test, the ES-2re and SIDIIs FRG. The design and development of these ATD's was supported by the research and engineering team at FTSS, Plymouth, USA. A description of the ES-2re ATD design, the SIDIIs FRG ATD design and the LS-Dyna finite element models of these ATD's is presented.

Particularly noteworthy is the continued collaboration between FTSS Inc. and DYNAmore Gmbh for developing the ES-2re dummy model. The new model is based on the existing DYNAmore ES-2 finite element model and is supported by FTSS dummy engineering design and test data. FTSS and DYNAmore are working closely together to offer a high quality LS-Dyna dummy model support service and to address the future ATD model needs of the industry.

Future research into the application of WorldSID (50th Male occupant) for side impact regulation testing continues to be a focus at all vehicle crash research groups. This paper also reviews the latest developments of the FTSS WorldSID 50th percentile finite element model.

LS-Dyna Users Conference, Bamberg
October 14th & 15th, 2004

New Side Impact Dummy Developments

Bhavik Shah & Jennifer Tang, FTSS
Peter Schuster & Sebastian Stahlschmidt, DYNAmore

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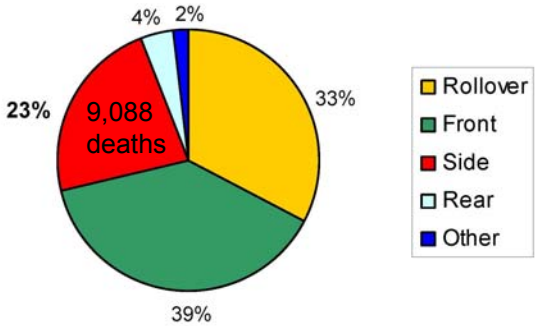
Introduction

Passenger Vehicle Occupant Fatalities

by type of crash



NHTSA estimates, in serious side-impact crashes involving at least one fatality, nearly 60 percent of those killed have suffered brain injuries.

N=32,335
Source: 2002 FARS & NHTSA

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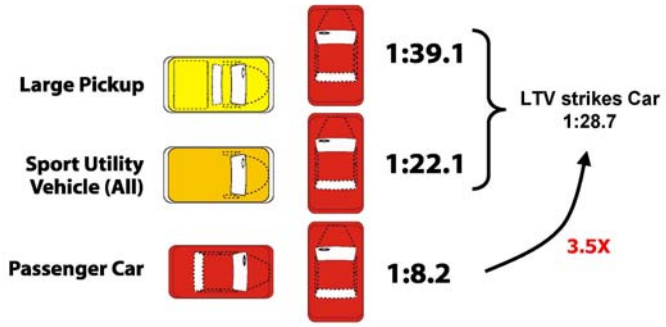
Introduction

Driver Fatality Ratios for Side-impact Crashes



3.5 times more likely to be killed by an LTV than a PC in a side-impact crash.

Source:
1995-2001 FAR & NHTSA

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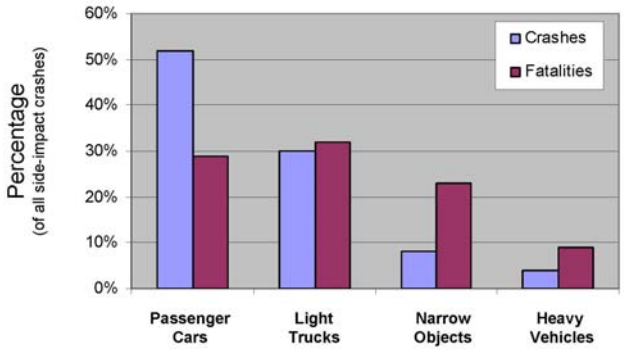
Introduction

Distribution of Side-impact Crashes
by What Hits You



Source: NHTSA

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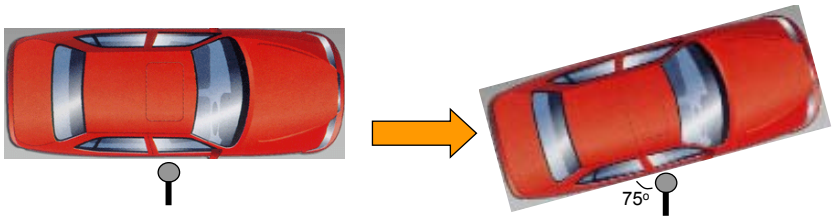
Introduction

- Significant industry trends considered by NHTSA
  - Increase in number of LTV on the road
  - Side airbag advancements need to offer protection to all size occupants
  - Side airbags result is more oblique loading into the occupant
  - Head injuries are the major cause of death
- NHTSA proposed a revision to FMVSS 214. The current regulation:
  - Uses DoT-SID, measures the thorax & pelvis injury only
  - Includes a single moving barrier test configuration
  - Considers the 50th percentile male occupant only (DoT-SID)
- NHTSA NPRM released on May 12th, 2004

NHTSA MVSS 214 NPRM

- Summary of the new MVSS 214 NHTSA proposal
  - Two barrier tests
    - Angled Pole Impact (New)
    - Barrier Impact (Same as before)
  - Two dummies instead of DoT-SID
    - SIDIIs FRG (Floating Rib Guide)
    - ES-2re (Rib extension)
  - Four impact tests will be required in total

MVSS 214 NPRM – New Pole Test



Current MVSS 201 Proposal for MVSS 214

- Test Configuration
  - Oblique test at 75° rather than 90°
  - Test velocity increased to 32 km/h (20 mph) from 29 km/h
- Dummy Selection
  - ES-2re 50th percentile
  - SIDIIs FRG 5th percentile

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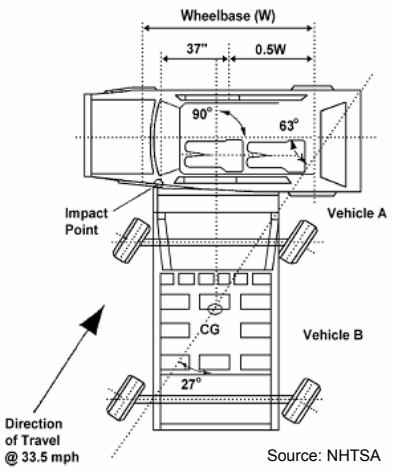
MVSS 214 NPRM – Barrier Test

- Test Configuration
  - No Change to barrier, speed and approach angle
- Dummy Selection
  - ES-2re 50th percentile
  - SIDIIs FRG 5th percentile
- Dummy Injury Criteria
  - Changed



Source: NHTSA

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MVSS 214 NPRM – Injury Criteria

- Proposed Dummies Injury Criteria

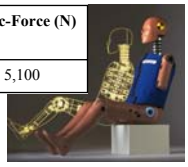
NHTSA Proposed Injury Criteria for ES-2re

Criterion	HIC_{36}	Rib-Def. (mm)	Lower Spine (g)	Abd.-Force (N)	Pubic-Force (N)
Proposed Limits	1,000	35-44*	82	2,400-2,800*	6,000

*A particular value within this proposed range would be selected.

NHTSA Proposed Injury Criteria for SIDIIs FRG

Criterion	HIC_{36}	Thorax Rib Def. (mm)	Lower Spine (g)	Abdomen Rib Def (mm)	Pubic-Force (N)
Proposed Limits	1,000	In Research	82	In Research	5,100



Source: NHTSA

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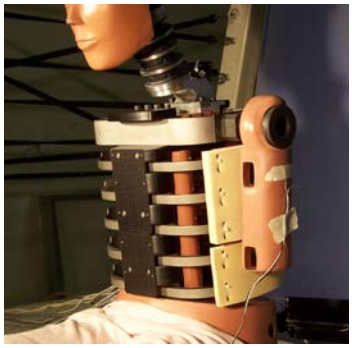
SID-IIs FRG Overview

- SID-IIs FRG – a floating rib guide system to constrain the vertical movement of the ribs.
- Invented by NHTSA/VRTC and FTSS to improve rib module durability under large thorax/abdomen compression.
- New rib guides added with front cover plate and return spring.
- Bump stops added, ribs cannot displace by > 68 mm.
- Spine box parts modified for correct mass distribution.
- Shoulder rib damping material redesigned.



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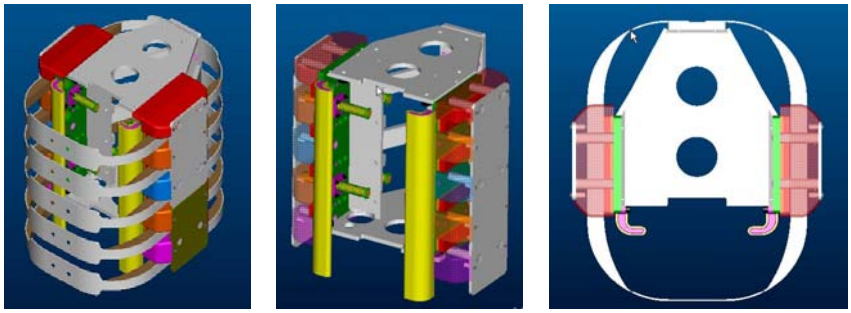
SID-IIs FRG – How does it work?



- Lateral compression of the rib pushes the front cover plate forward.
- Rib guides move together with the front cover plate.
- Rib guides constrain the vertical movement of the ribs.
- When ribs unload, the return spring brings the front plate and rib guides back to the original position.

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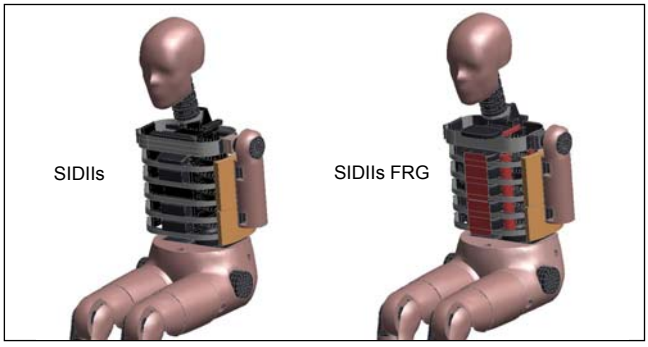
SIDIIs Vs SID-IIs FRG Biofidelity



- VRTC/NHTSA have studied the ISO TR9790 biofidelity rating for both SIDIIs and SIDIIs FRG.
- Initial results show that the biofidelity rating of both are very similar.

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SIDIIs FRG Validation

- Standard Lateral Pendulum Tests — Completed
- Non-standard Pendulum Tests — Work-in-progress
  - Lateral, armrest shaped impactor
  - Oblique impacts
    - Thorax
    - Abdomen
- VRTC Sled Tests — Awaiting test data

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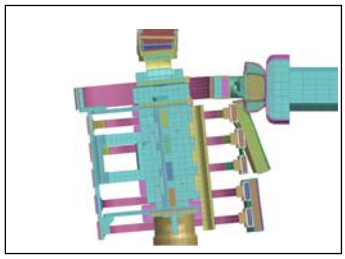
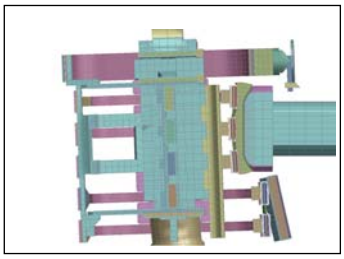
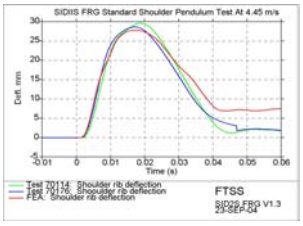
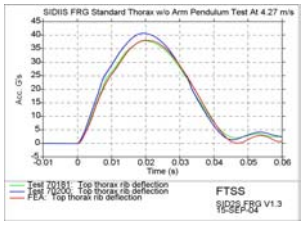
SIDIIs FRG Validation – Shoulder & Thorax









Test
Simulation

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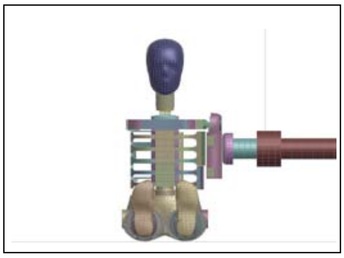
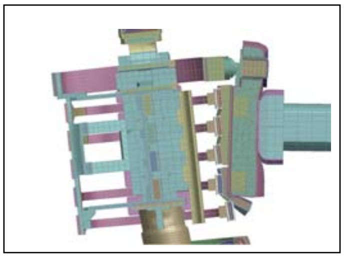
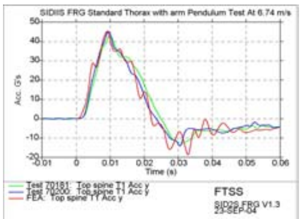
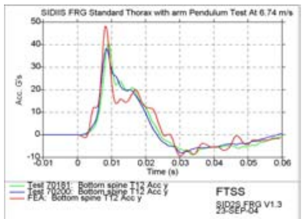
SIDIIs FRG Validation – Thorax with Arm









Test
Simulation

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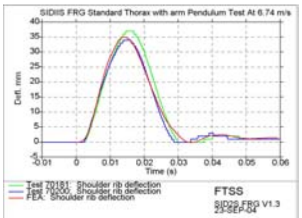
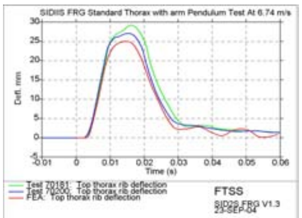
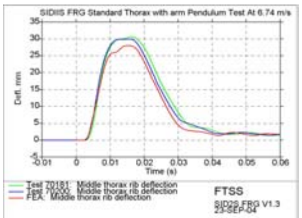
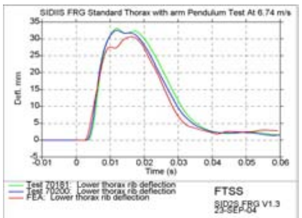
SIDIIs FRG Validation – Thorax with Arm









Test
Simulation

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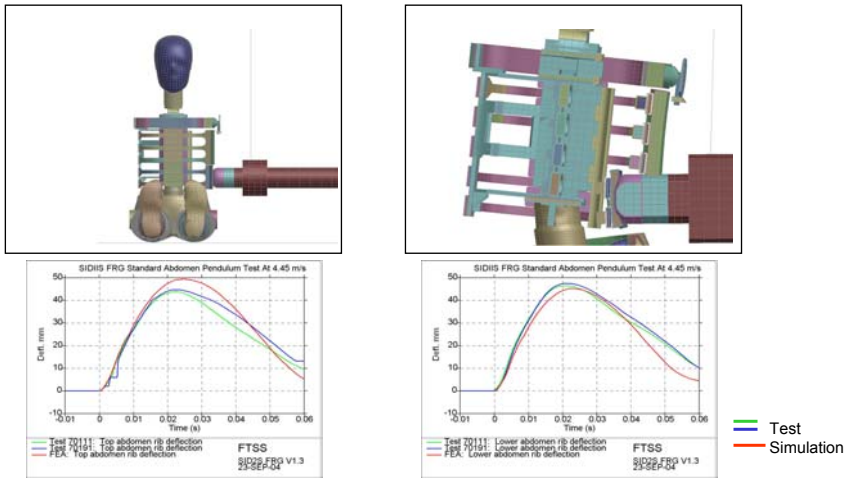
SIDIIs FRG Validation – Abdomen



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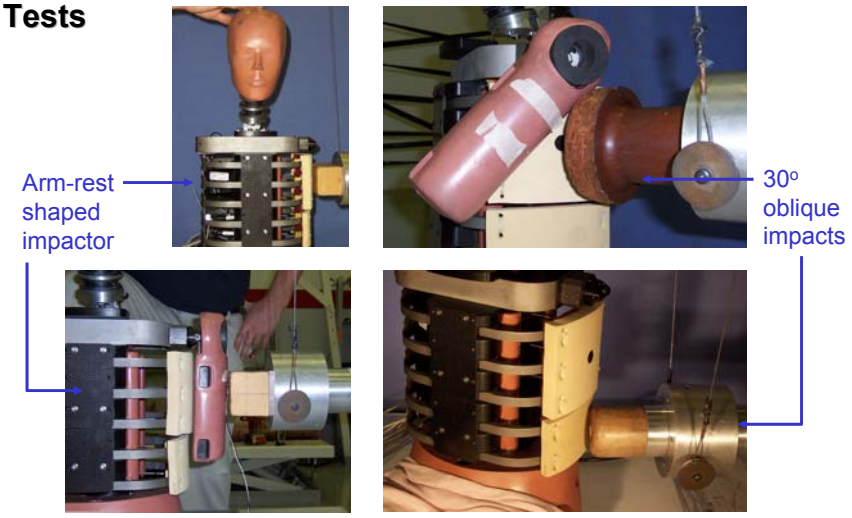
SIDIIs FRG Validation – Non-standard Tests



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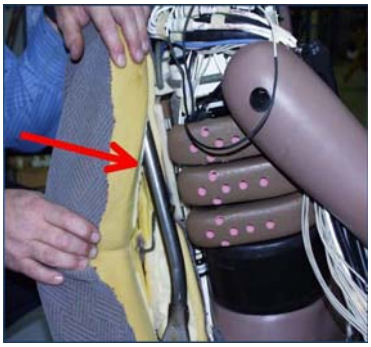
ES-2re Overview

- ES-2 advantages over DoT-SID are:
  - Can measure head injury
  - More sensitive than SID in the thorax and abdomen
- Main issue: Vehicle designs that transfer large loads into the back plate rather than ribs.
- In addition, side airbags transfer a significant load into the rear quarter of the rib cage.
- NHTSA chose a rib extension design over a back plate load criterion – hence ES-2re.



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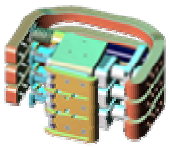
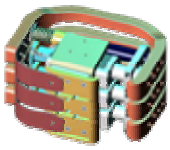
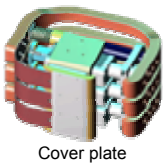
ES-2re Overview



New backplate & Roller bearings



Rib Extensions



Cover plate

- Rib extensions added between the existing ribs and the back plate. There is a new back plate.
- Rib extensions are supported on the back plate by roller bearings and can glide freely.
- A cover plate avoids 'snagging' with the jacket or seat.

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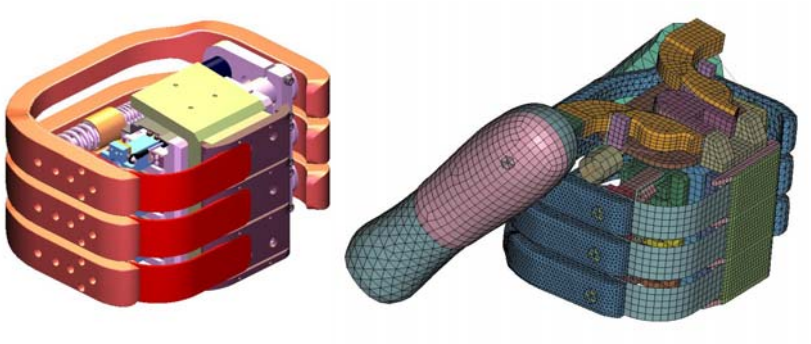
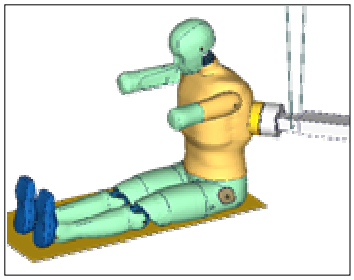
ES-2re Model Development

- Model has been developed by DYNAmore, in collaboration with FTSS.

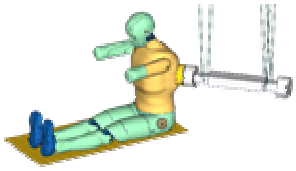


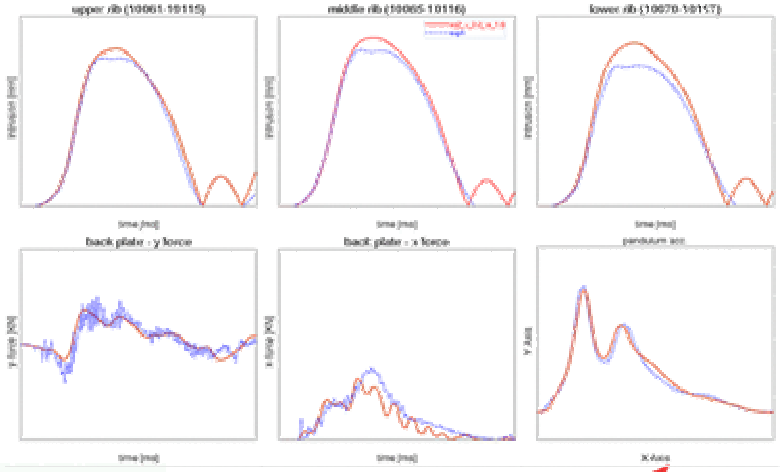
ES-2re Model Validation



- In addition to a lateral impact, FTSS carried out an oblique (45 degree) test on the ES-2re.
- FTSS design and test data was used by DYNAmore to develop the ES-2re model.

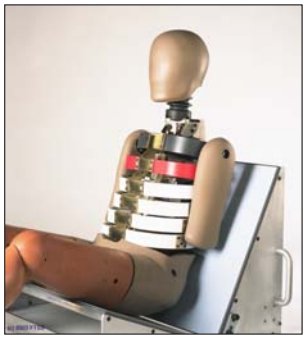
ES-2re Model Validation

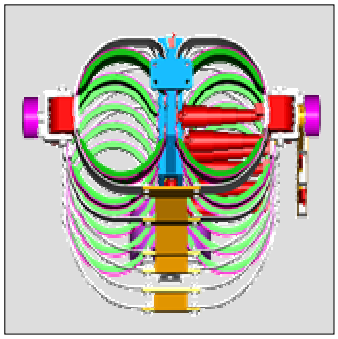




WorldSID-50th

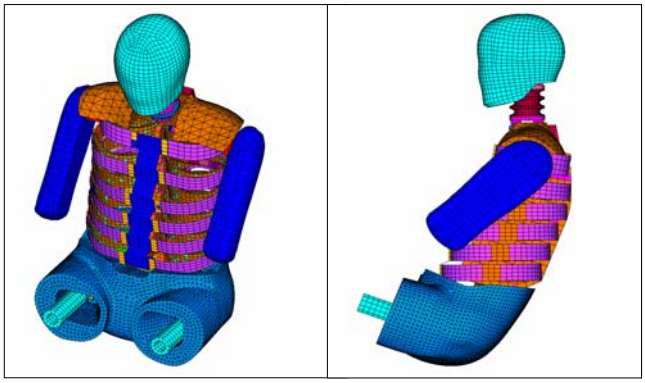
- NHTSA plans to carry out research into the advanced side impact WorldSID dummy during 2005-2006+





WorldSID-50th Model Description

- FTSS Meshed Model of Head to Lower Torso



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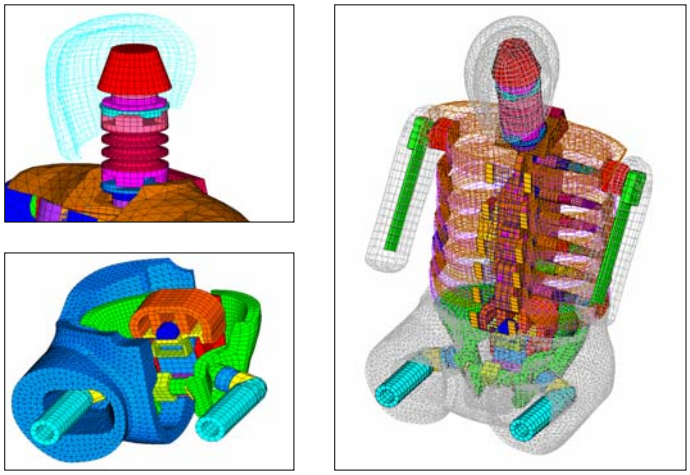
WorldSID-50th Model Description



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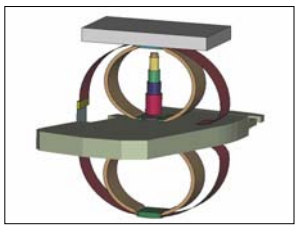
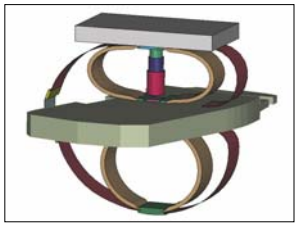
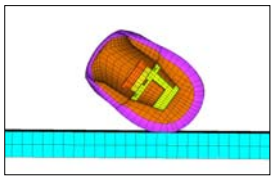
WorldSID-50th Model Validation

- FTSS are currently correlating to component and sub-assembly tests.
- Next stages are:
  - Pendulum Validation
  - Sled Validation
- Model release is scheduled for February 2005







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Thank you !

Dictionary Definition:

n. pl. **dum·mies**

An imitation of a real or original object, intended to be used as a practical substitute.

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