



FI-5-8

# Evaluation of Advance Compatibility Frontal Structures Using the Progressive Deformable Barrier

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# Overview

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- Introduction
- Vehicle selection
- Test Configuration
- Method of Test Evaluation
- Test results / Comparison
- Conclusion

# Introduction

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- Bilateral agreement between French DSCR and US NHTSA to enhance cooperation and increase the efficient use of resources to promote the development of improved vehicle safety programs and related regulations.
- Investigate whether barrier deformation using PDB, intrusion, and dummy injury measures can differentiate compatibility performances between vehicles.
  - Evaluates criteria of self protection and partner protection in the offset frontal crash test configuration with vehicles that have structures designed for good partner protection.
  - Compares current tests with prior research conducted under the cooperative agreement.
  - Compares the results to prior car-to-car crash tests and real world crash analysis.

# Prior Research

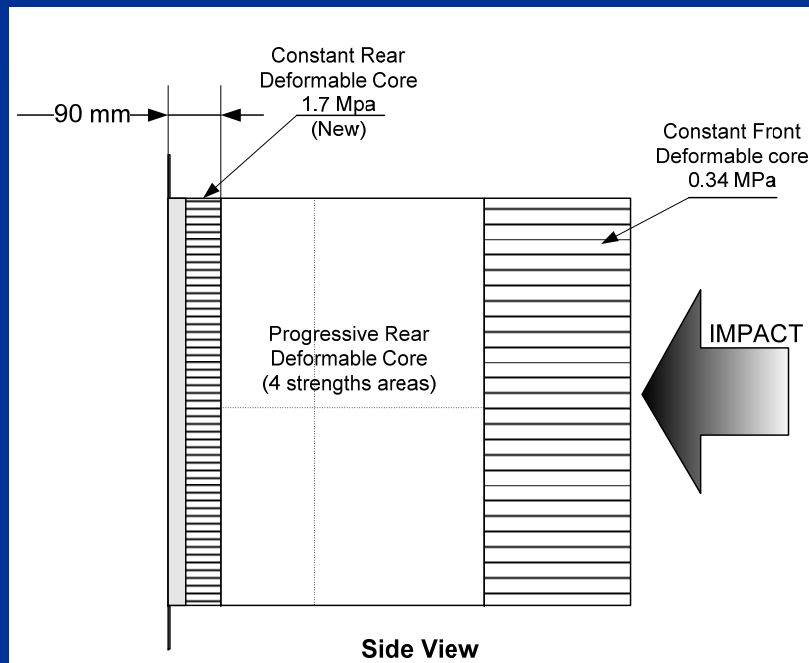
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- Prior effort between DSCR and NHTSA (ESV Paper No. 07-0303)
  - PDB Offset tests with a body-on-frame Chevrolet Silverado pickup truck and a unibody Chrysler Town & Country minivan
- U.S. NCAP Testing
  - Full width rigid barrier at 56 km/h
  - Frontal stiffness and force matching height data available for both Honda Odysseys
- U.S. Vehicle-to-Vehicle Tests
  - Honda Odysseys (with and w/o ACE) were crashed into a Ford Focus in a full frontal crash configuration

# Test Configuration

PDB-XT = PDB + 90mm in the back

- Offset PDB+
- 50 % overlap
- 60 km/h



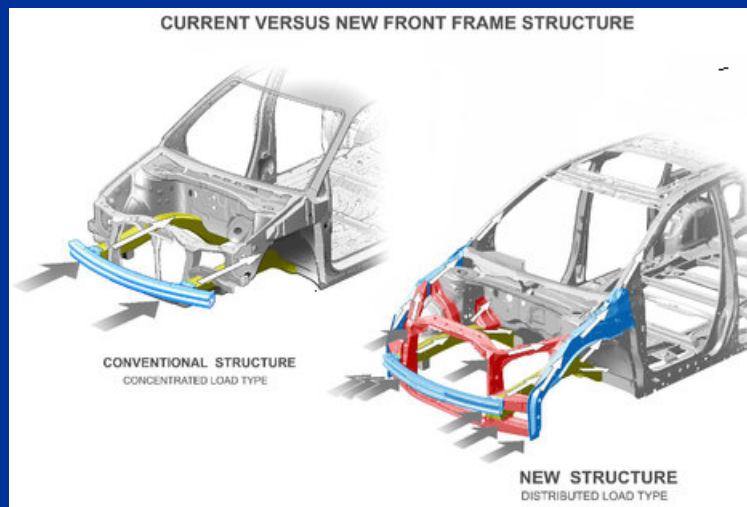
2 Belted 50th percentile males – Driver had Thor-Lx legs

# Vehicle Selection

- 2 Honda Odyssey minivans



- MY 2004 – w/o ACE
- MY 2005 – with ACE



- Body-in-white showing Honda ACE structure

# Method of Test evaluation

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- Test Severity Evaluation
  - Equivalent Energy Speed
- Self Protection (Vehicle based metrics)
  - Compartment intrusion
  - Dummy injury criteria
- Partner Protection (Barrier based metrics)
  - AHOD Average Height Of Deformation
  - ADOD Average Depth Of Deformation
  - Dmax Maximum Deformation

# Test Severity

## Odyssey with ACE



- PDB Energy Absorbed by the barrier: 104 kJ
- EES: 49.6 km/h

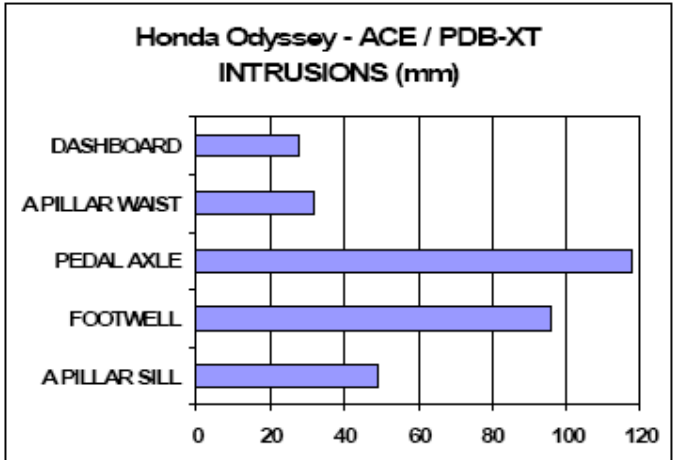
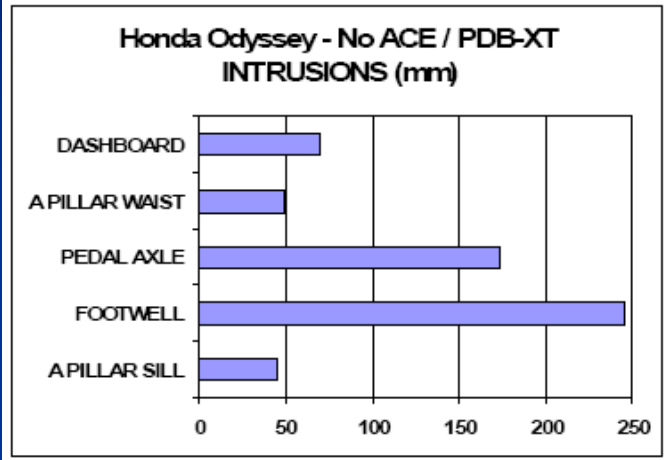
## Odyssey without ACE



- Energy Absorbed by the barrier: 97 kJ
- EES: 50.6 km/h



# Self Protection

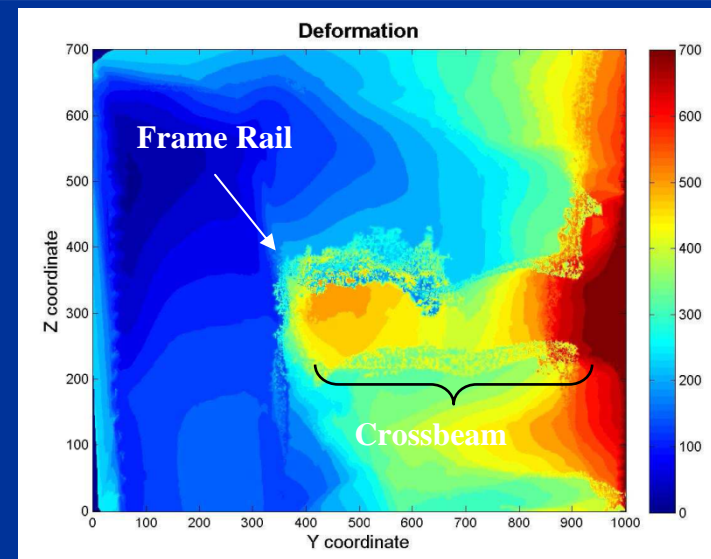
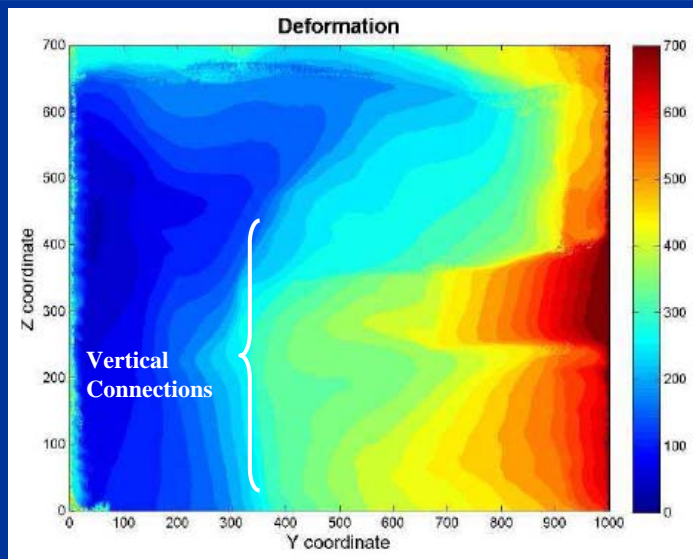
	Odyssey with ACE	Odyssey without ACE																																				
Intrusion	 <p>Honda Odyssey - ACE / PDB-XT INTRUSIONS (mm)</p>	 <p>Honda Odyssey - No ACE / PDB-XT INTRUSIONS (mm)</p>																																				
Injury Measures	<table border="1"> <thead> <tr> <th></th> <th>Driver</th> <th>Pass.</th> </tr> </thead> <tbody> <tr> <td>HIC36</td> <td>290</td> <td>284</td> </tr> <tr> <td>Chest Def</td> <td>26.6</td> <td>26.5</td> </tr> <tr> <td>Chest Gs</td> <td>39.2</td> <td>27.4</td> </tr> <tr> <td>Left Femur</td> <td>4.76</td> <td>2.03</td> </tr> <tr> <td>Right Femur</td> <td>1.21</td> <td>0.97</td> </tr> </tbody> </table>		Driver	Pass.	HIC36	290	284	Chest Def	26.6	26.5	Chest Gs	39.2	27.4	Left Femur	4.76	2.03	Right Femur	1.21	0.97	<table border="1"> <thead> <tr> <th></th> <th>Driver</th> <th>Pass.</th> </tr> </thead> <tbody> <tr> <td>HIC36</td> <td>283</td> <td>273</td> </tr> <tr> <td>Chest Def</td> <td>28.7</td> <td>33.4</td> </tr> <tr> <td>Chest Gs</td> <td>37.1</td> <td>28.7</td> </tr> <tr> <td>Left Femur</td> <td>1.61</td> <td>2.78</td> </tr> <tr> <td>Right Femur</td> <td>0.75</td> <td>1.36</td> </tr> </tbody> </table>		Driver	Pass.	HIC36	283	273	Chest Def	28.7	33.4	Chest Gs	37.1	28.7	Left Femur	1.61	2.78	Right Femur	0.75	1.36
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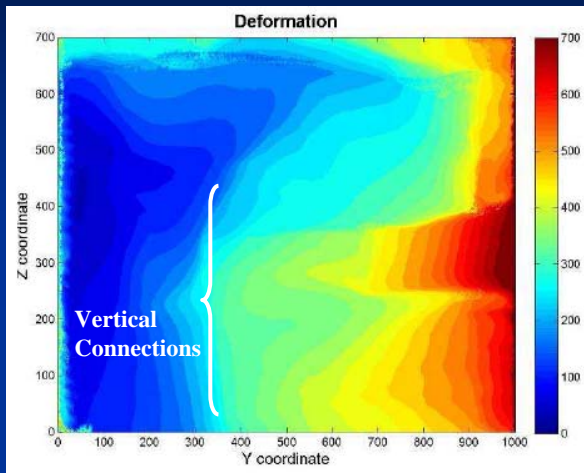
# Partner Protection: Front End Behavior 1 / 3

## Odyssey with ACE

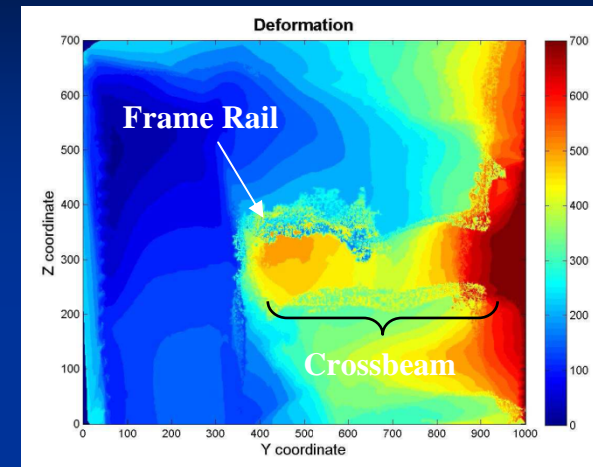


## Odyssey without ACE

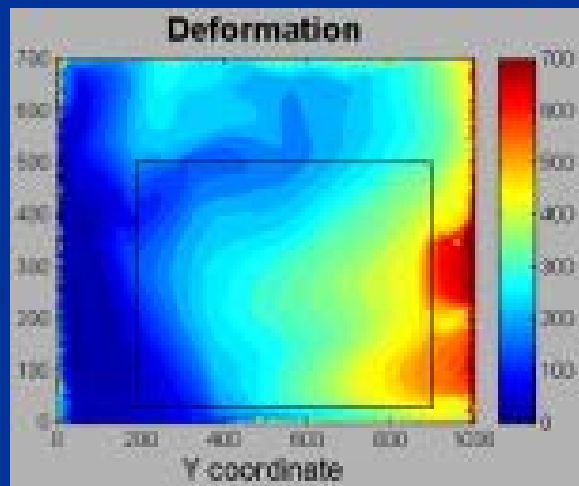




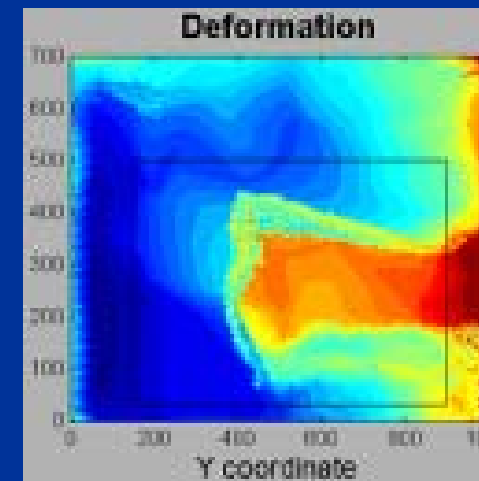
Odyssey with ACE



Odyssey without ACE



Town & Country Minivan



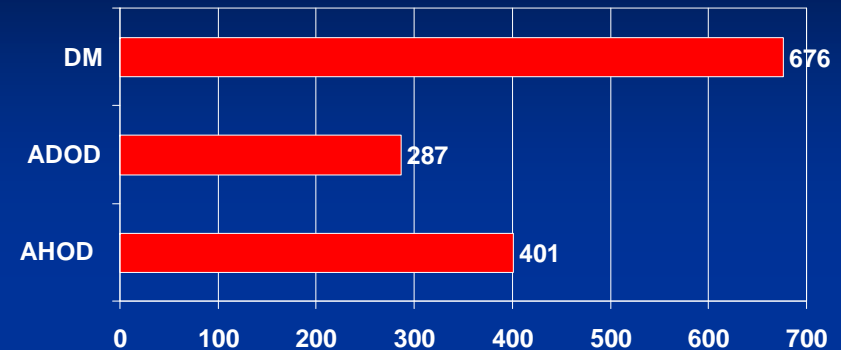
Chevrolet Silverado Pick-up Truck

# Partner Protection: Parameters

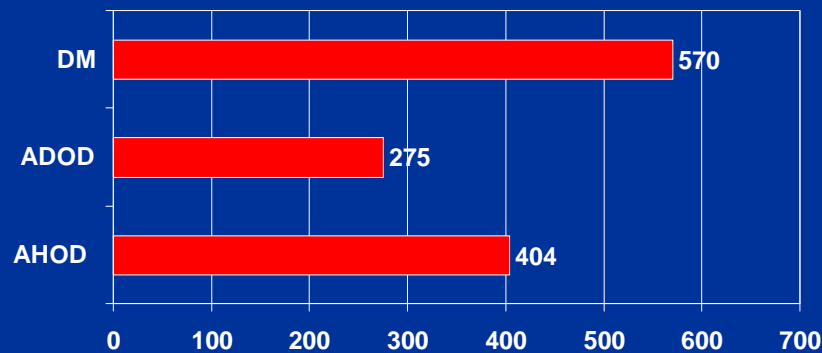
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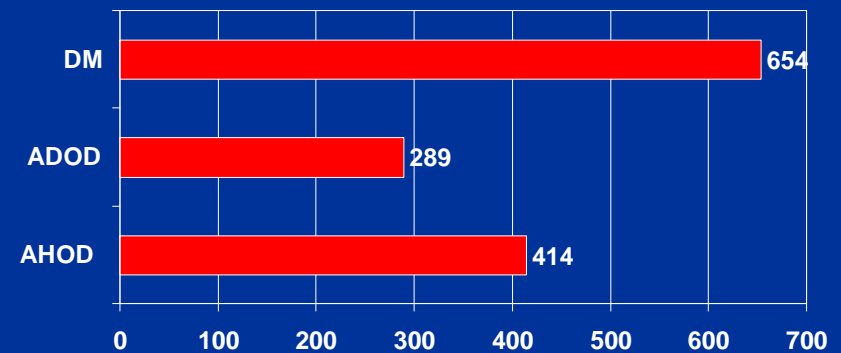
Odyssey with ACE



Odyssey without ACE



Town & Country  
Minivan



Chevrolet Silverado  
Pick-up Truck

# Vehicle-to-Vehicle Crashes: Stiffness

	KW400* N/mm	Accel. At CG in Focus (m <sup>2</sup> /s)	Accel. At CG in Striking Vehicle (m <sup>2</sup> /s)
2002 Ford Focus	934		
<b>Bullet Vehicles</b>			
2005 Chrysler Town & Country	1,137	90.5	47.6
2003 Honda Odyssey w/o ACE	1,448	108	32.1
2005 Honda Odyssey w/ACE	1,456	113.5	40.3
2003 Chevrolet Silverado	1,619	86.2	32.9

\* KW400 is the stiffness-related crush energy absorbed by a vehicle in the first 400 mm of crush (also called work stiffness).

# Vehicle-to-Vehicle Crashes: Performance



Bullet: Odyssey with ACE



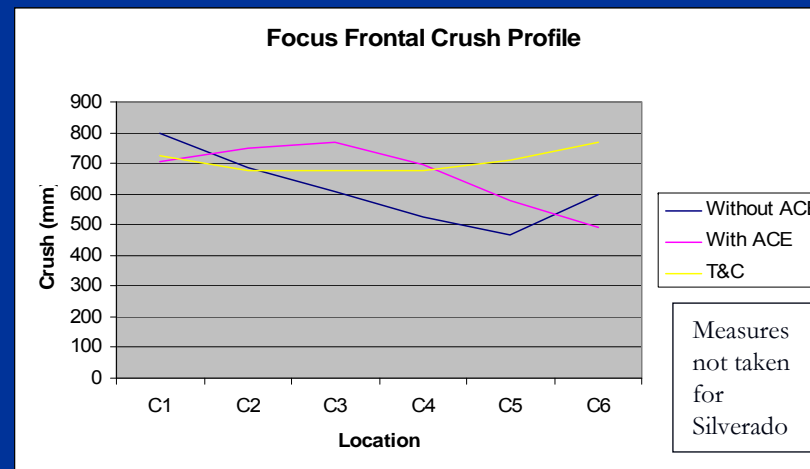
Bullet: Odyssey without ACE



Bullet: Town & Country Minivan



Bullet: Chevrolet Silverado P/U Truck



Target Vehicle is a 2002 Ford Focus

# Real World Performance of ACE



2005 Honda Odyssey (2,102 kg)



2006 Ford Escape (1,545 kg)

- NASS CDS Case No. 2007-04-0137
- Minor severity crash
- CDC code of 01FYEW02
- Principle direction of force: 20°
- Honda Odyssey
  - $\Delta V = 15$  km/h
  - Airbags deployed
  - Driver sustained minor injuries
- Ford Escape
  - Airbags did not deploy
  - Driver sustained minor injuries
- Intrusion in both vehicles likely insignificant (based on photos)

# Summary

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- Homogeneous deformation of the PDB suggests good horizontal and vertical engagement with a partner vehicle, as shown by the vehicle-to-vehicle tests.
- Analysis of compatibility metrics indicates stiffness alone may not indicate aggressivity.
- Further evaluation is needed to address both the stiffness of the vehicle as well as the homogeneity of that stiffness.



Full Analysis can be found in  
ESV Paper 09-0329

The End