

Lessons Learned: HGV-Car Testing



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Objective

Study potential for front underrun protection with new EU regulation changes

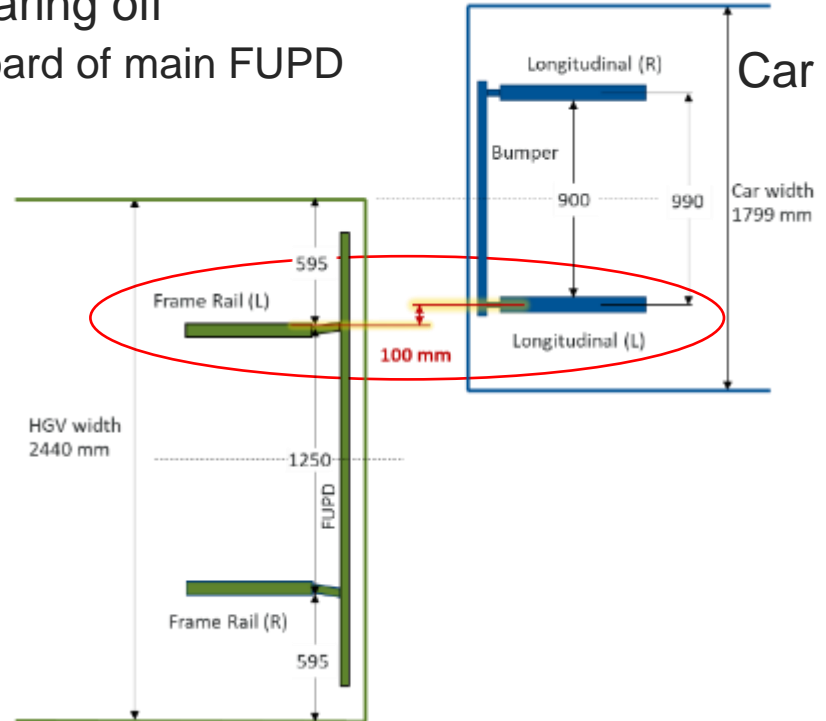
1. Modify truck front using compatibility design principles
2. Compare before-after test conditions with/without new front

Results: Test 1

- Most significant result was FUPD shearing off
 - Main structures of passenger car outboard of main FUPD supports



HGV

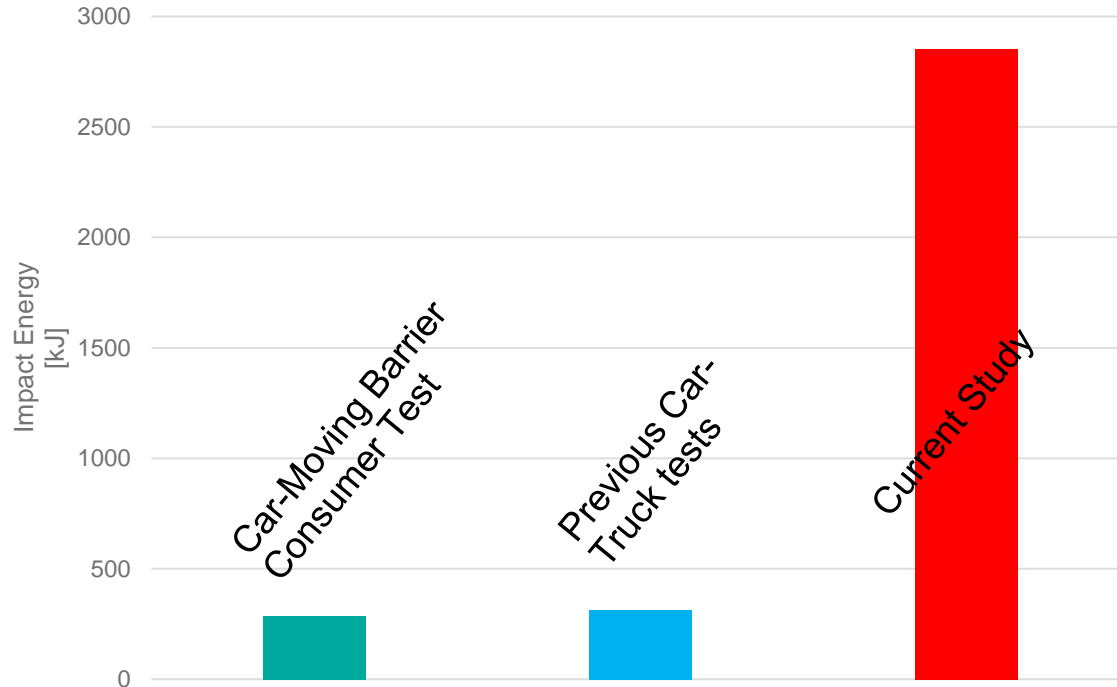


Car



Lower longitudinal
virtually undamaged

Why is this so severe for the car?



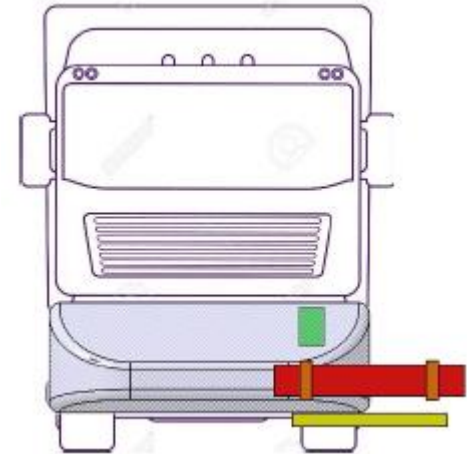
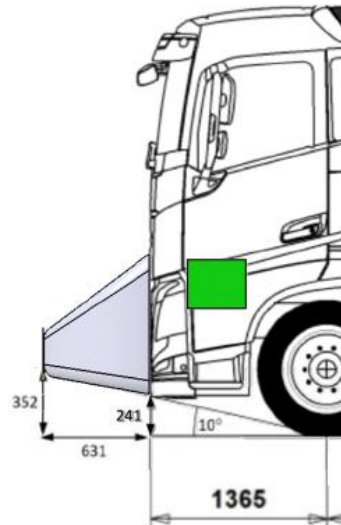
How can we improve the outcome?



1. Create interaction with car's front structures on truck
2. Dampen/control forces during crash without causing underride of car
3. If possible, keep car out of truck's path
4. Take advantage of new EU directive allowing modest extensions of the truck for safety and efficiency

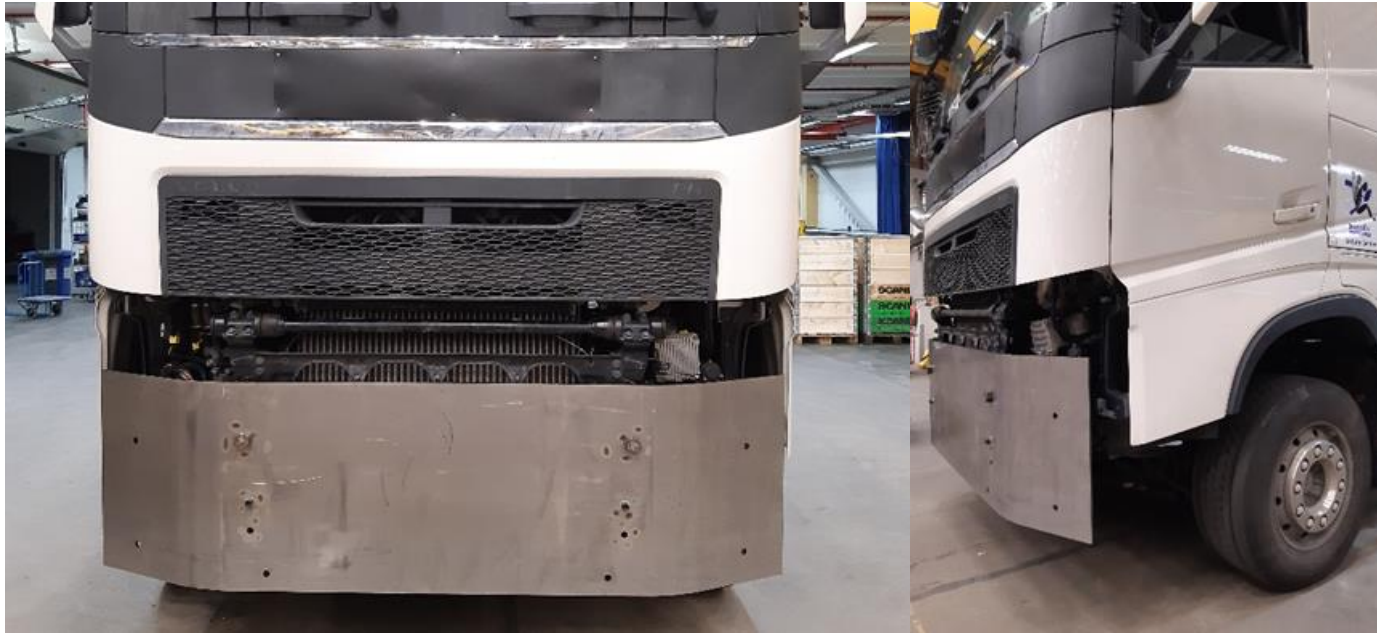
Prototype Design Constraints

- Study operational constraints for HGVs
- Identify geometric envelope (approach angle, turning circle, etc.)
- Establish interaction zone for car and truck structures
- Create design for a HGV front concept using available fast prototyping materials



Design not intended as a commercial solution

Step 1 – Create solid interaction surface





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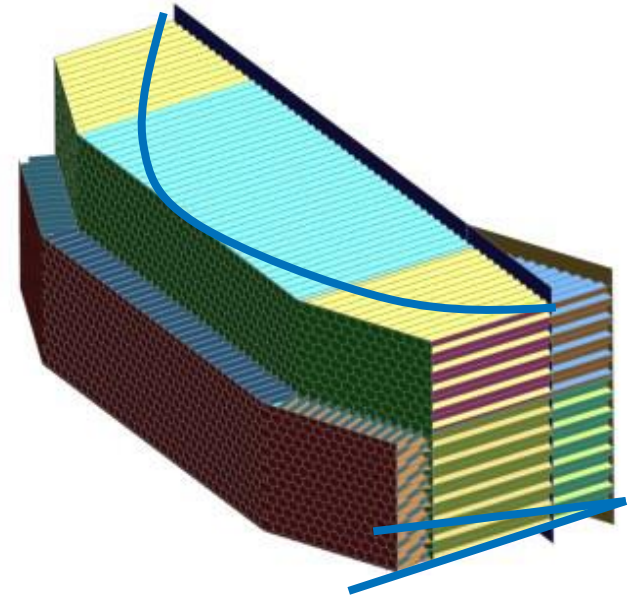
Step 2: Dampen Impact Forces



Step 3: Try to redirect truck

- Angled sides and thicker cladding to promote "glance off"

Final geometry restricted by manufacturing limitations for honeycomb barriers





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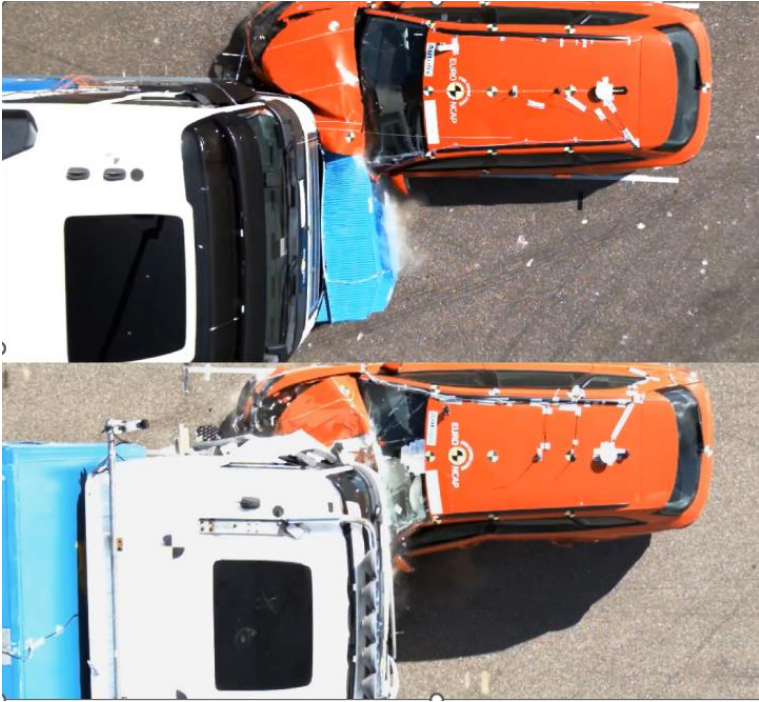


$$v_{car} \approx 0 \text{ km/h}$$

$$v_{truck} \approx 47 \text{ km/h}$$



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$$v_{car} \approx 0 \text{ km/h}$$
$$v_{trolley} \approx 0 \text{ km/h}$$



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Barrier and Backup Plate worked!



Test 1



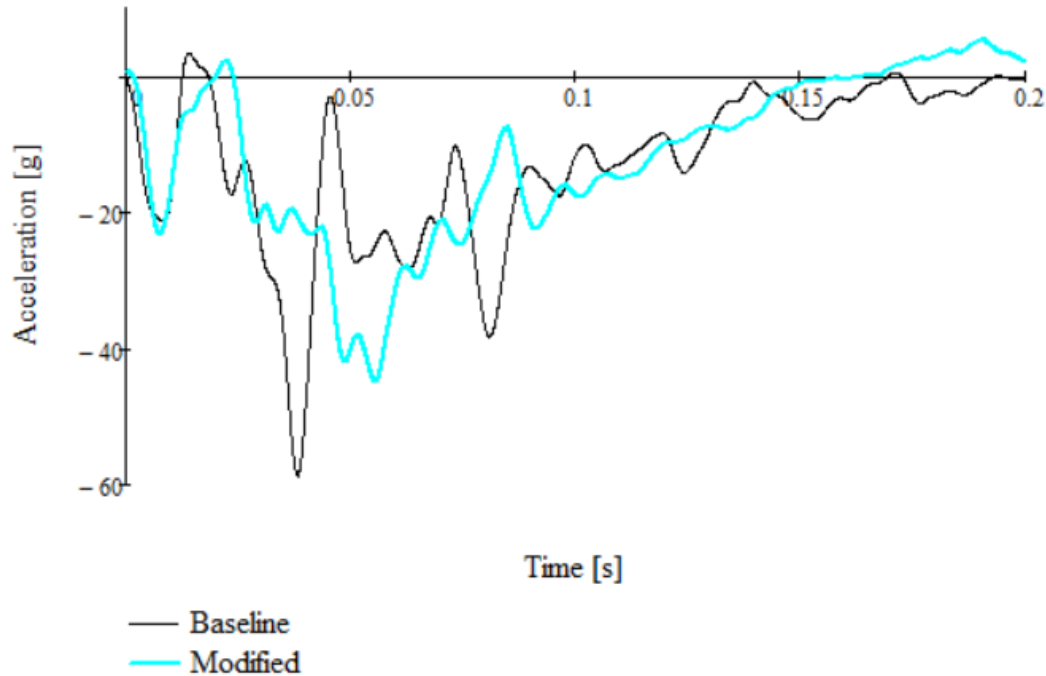
Test 2



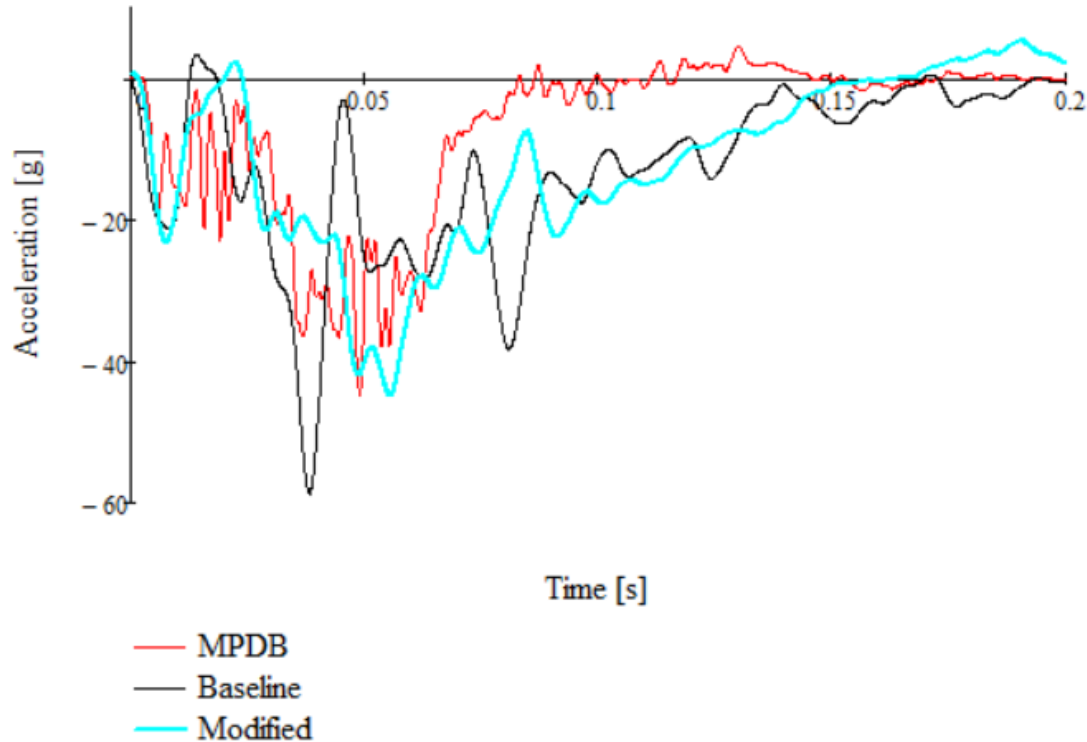
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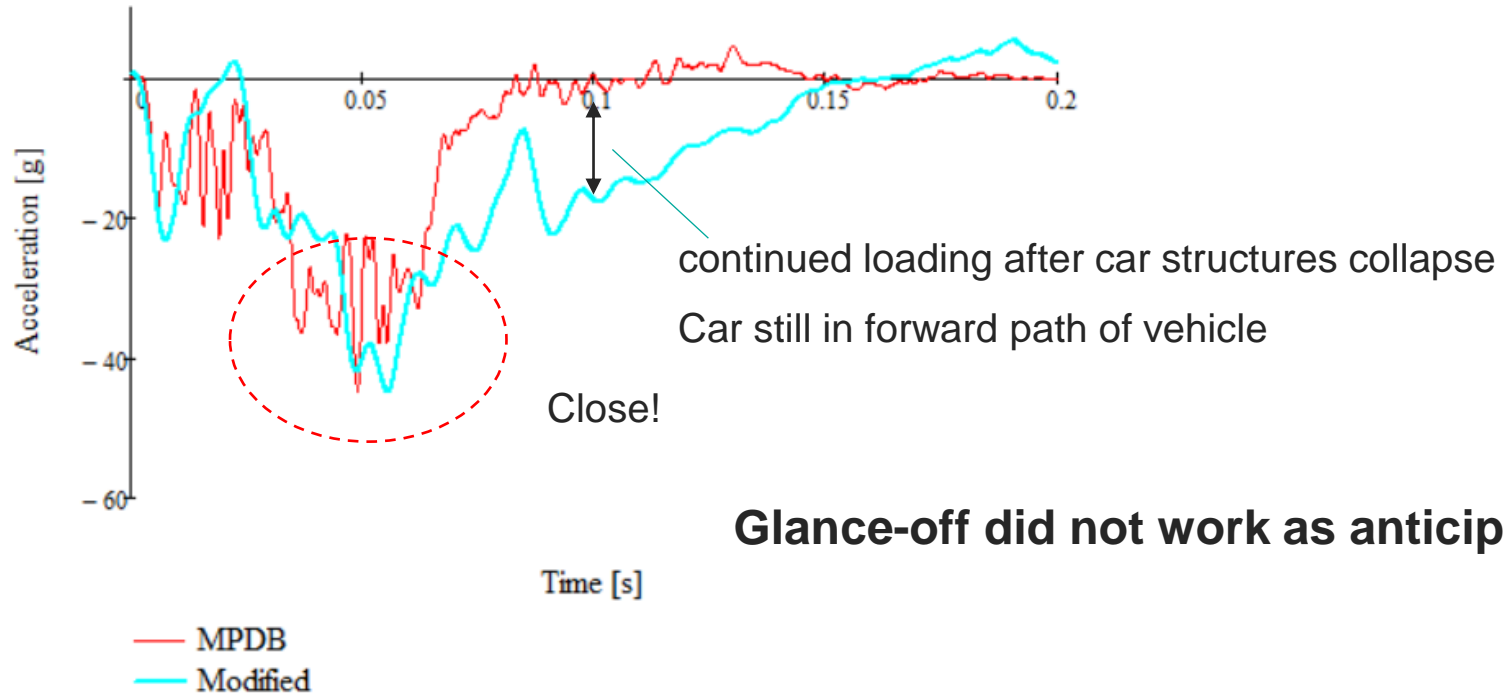
Accelerations Car- Truck Tests



Accelerations Car- Truck Tests + MPDB

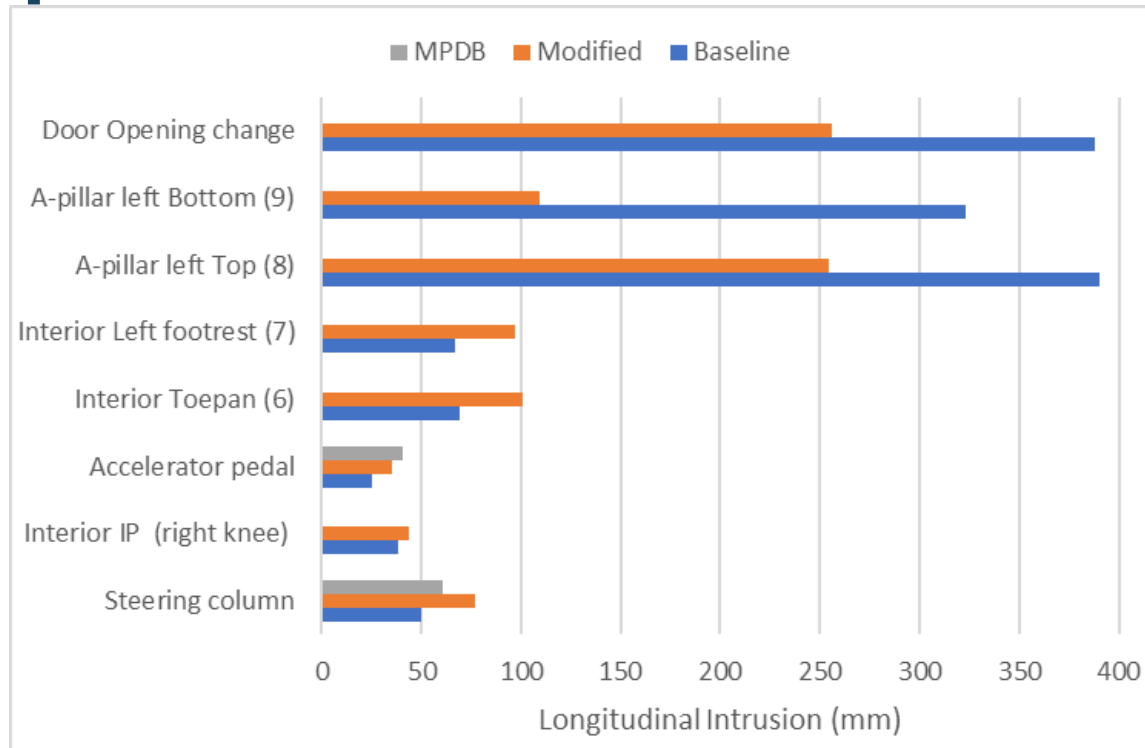


Accelerations Modified Truck Test + MPDB



Glance-off did not work as anticipated

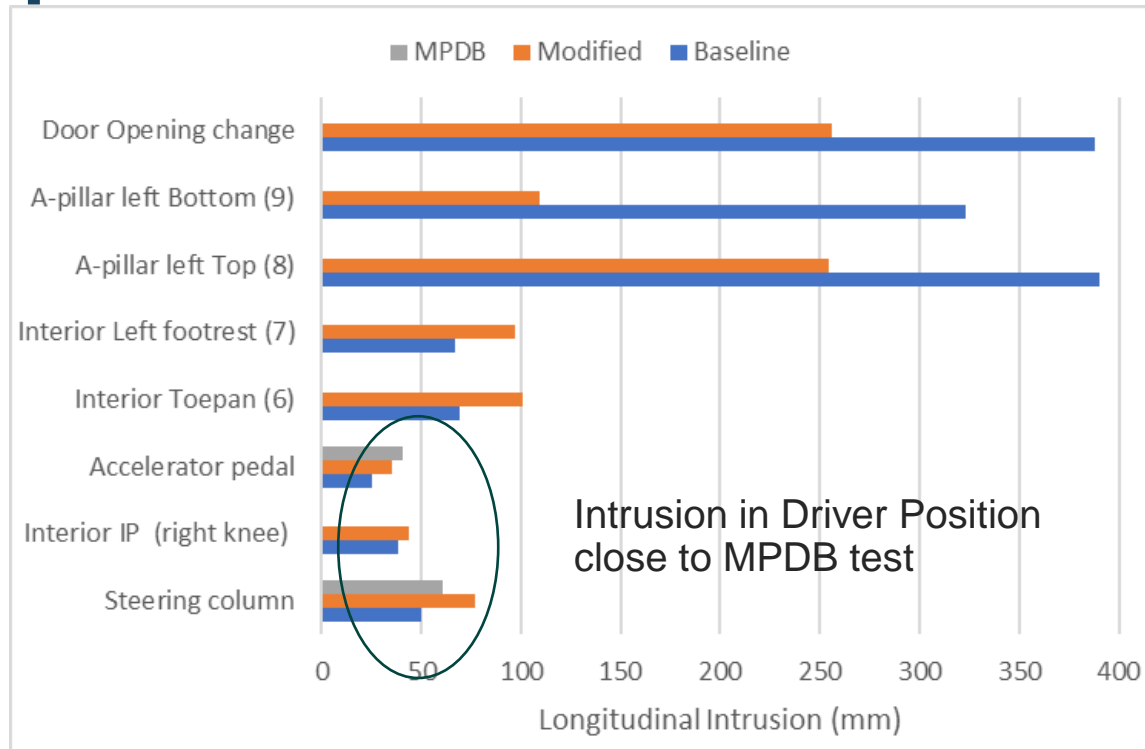
Intrusions to Passenger Compartment



Dramatic reduction in A-Pillar Deformation (ca 0 mm i MPDB)

Slight increase inboard due to improved interaction

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Design limits for car

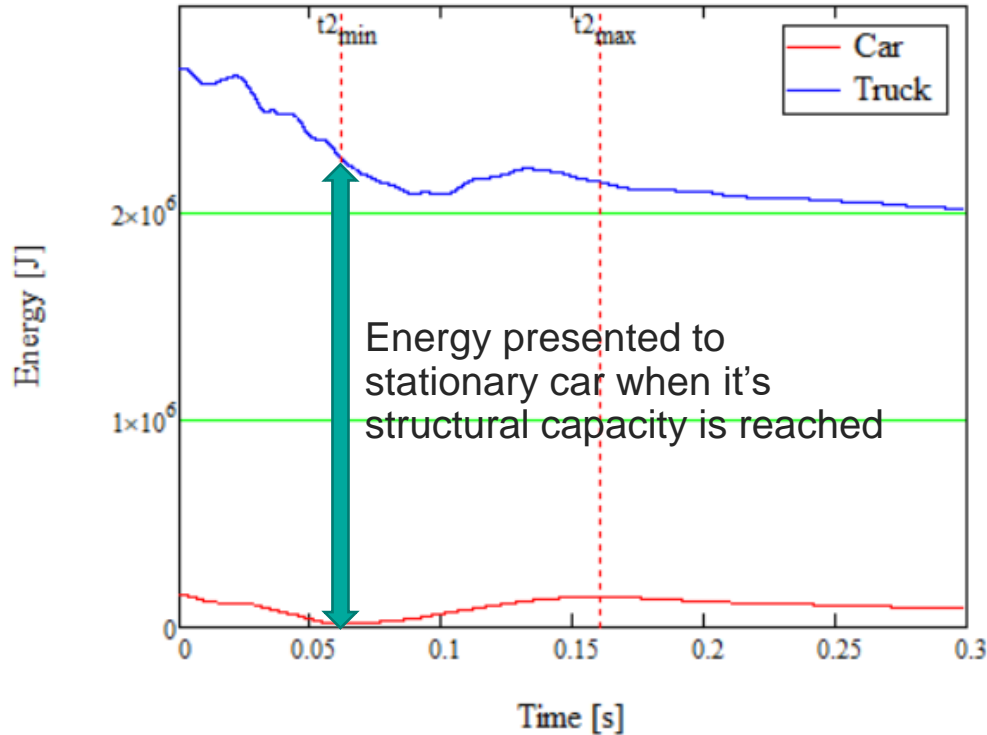


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What is the Design Challenge?



Car velocity = 0

Lessons learned

- Testing with moving HGV is an extremely violent event
- 100 km/h closing speed and 50% offset is extreme condition, beyond conventional vehicle designs
 - 5-10 times higher energy levels than conventional testing
- Structural support at the outer edges of trucks necessary to distribute loads and promote glance off
- Energy absorption and load distribution cannot solve the problem alone
 - Extreme energy levels!
 - Need Safe System Approach to use active safety systems and road infrastructure to limit the occurrence of these crashes and support passive safety design solutions