

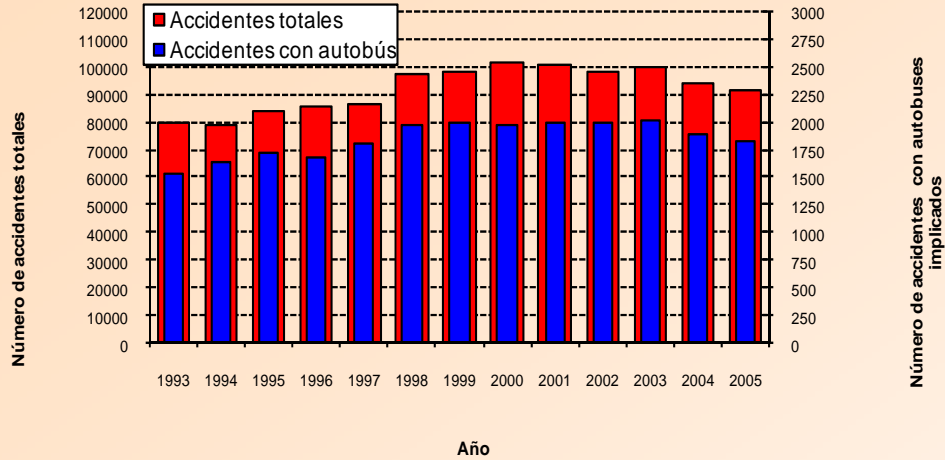
**Informal Document No. GRSP-44-26**  
**(44th session, 10-12 December 2008,**  
**agenda item 19(a))**

# **FRONTAL COLLISION BUSES AND COACHES. RESEARCH AND PROBLEMS**

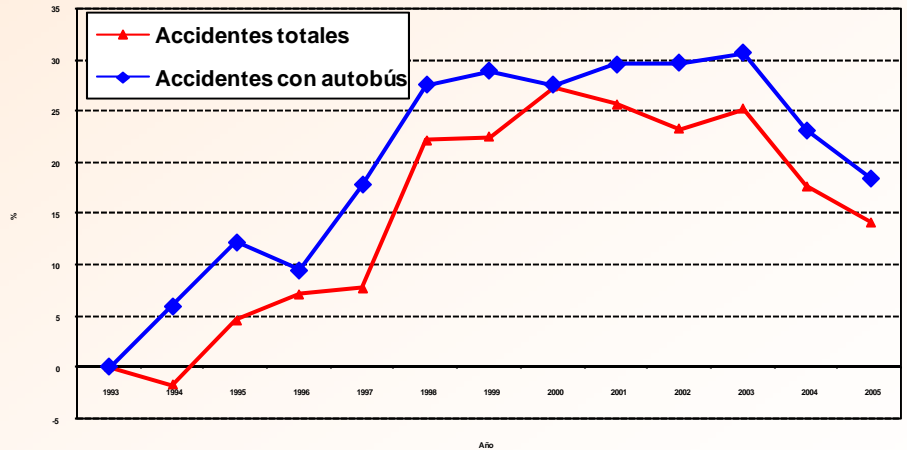
GRSP MEETING 10-12/XII/2008



# TRAFIC ACCIDENTS (SPAIN 1993-2005)



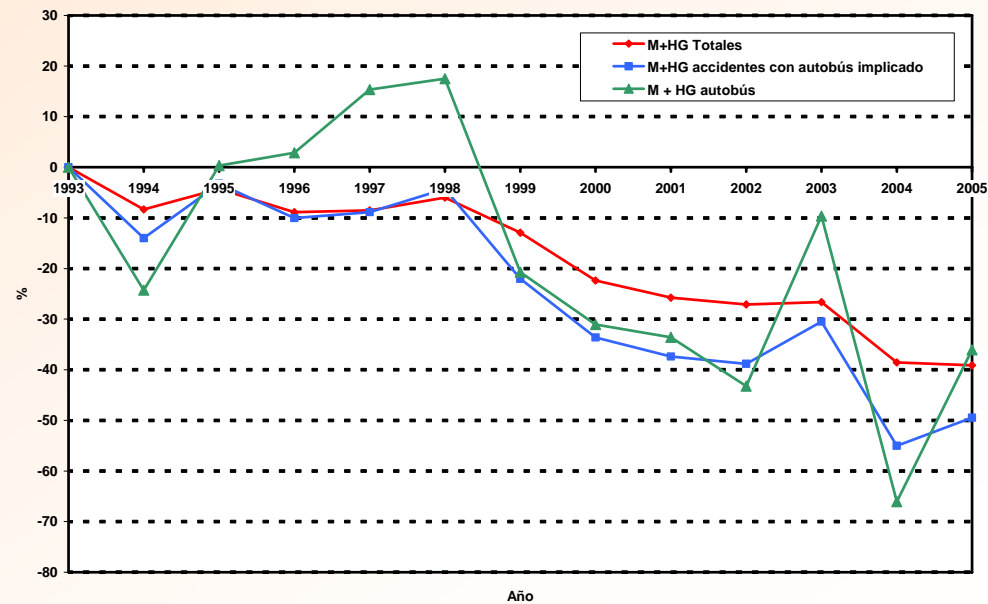
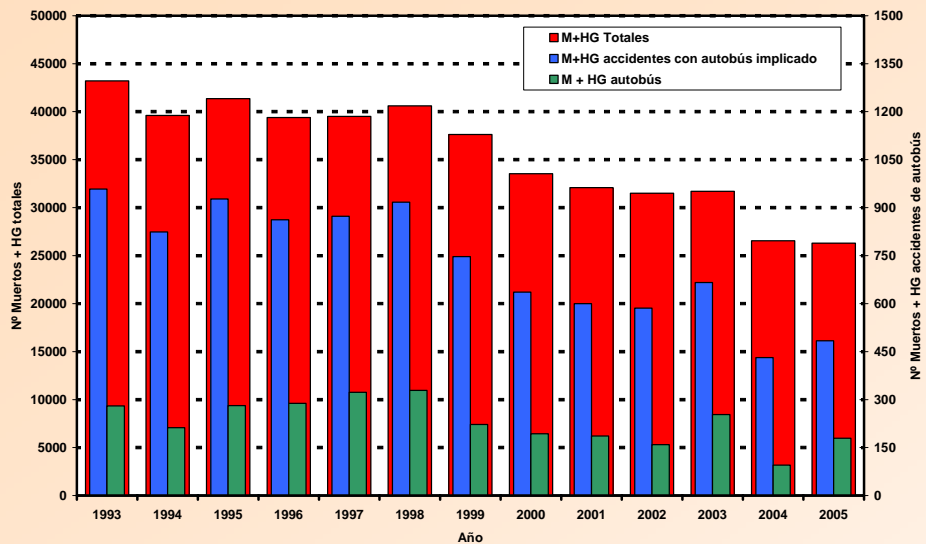
**APROX. 1800 ACC.**



Porcentajes referidos al año 1993



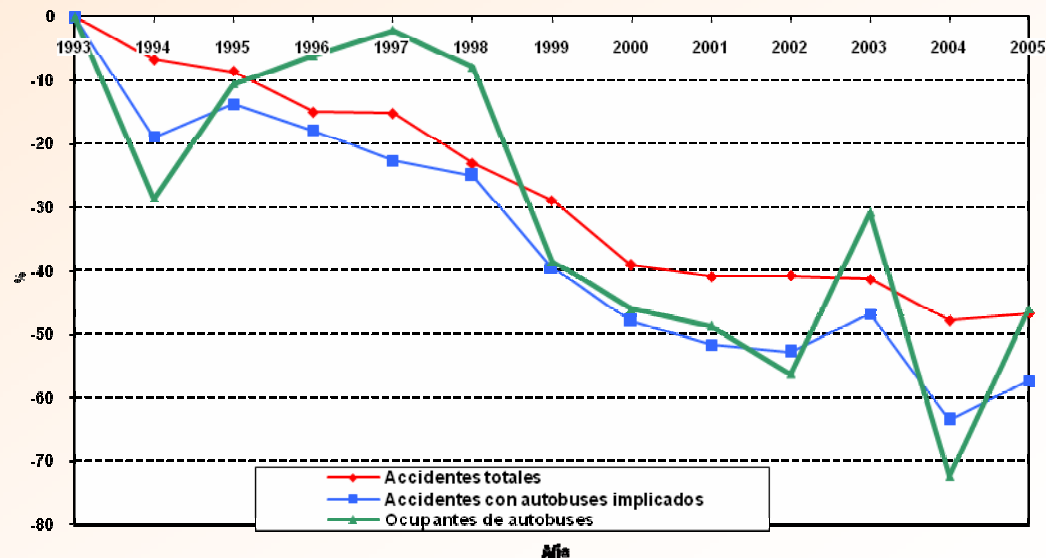
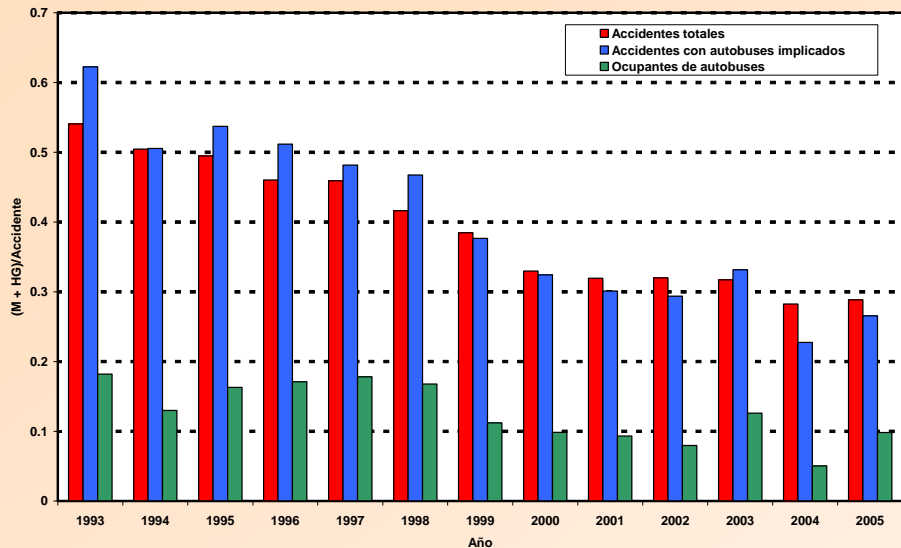
# VICTIMS (SPAIN-1993-2005)



Porcentajes referidos al año 1993



# VICTIMS/ACCIDENT (SPAIN-1993-2005)



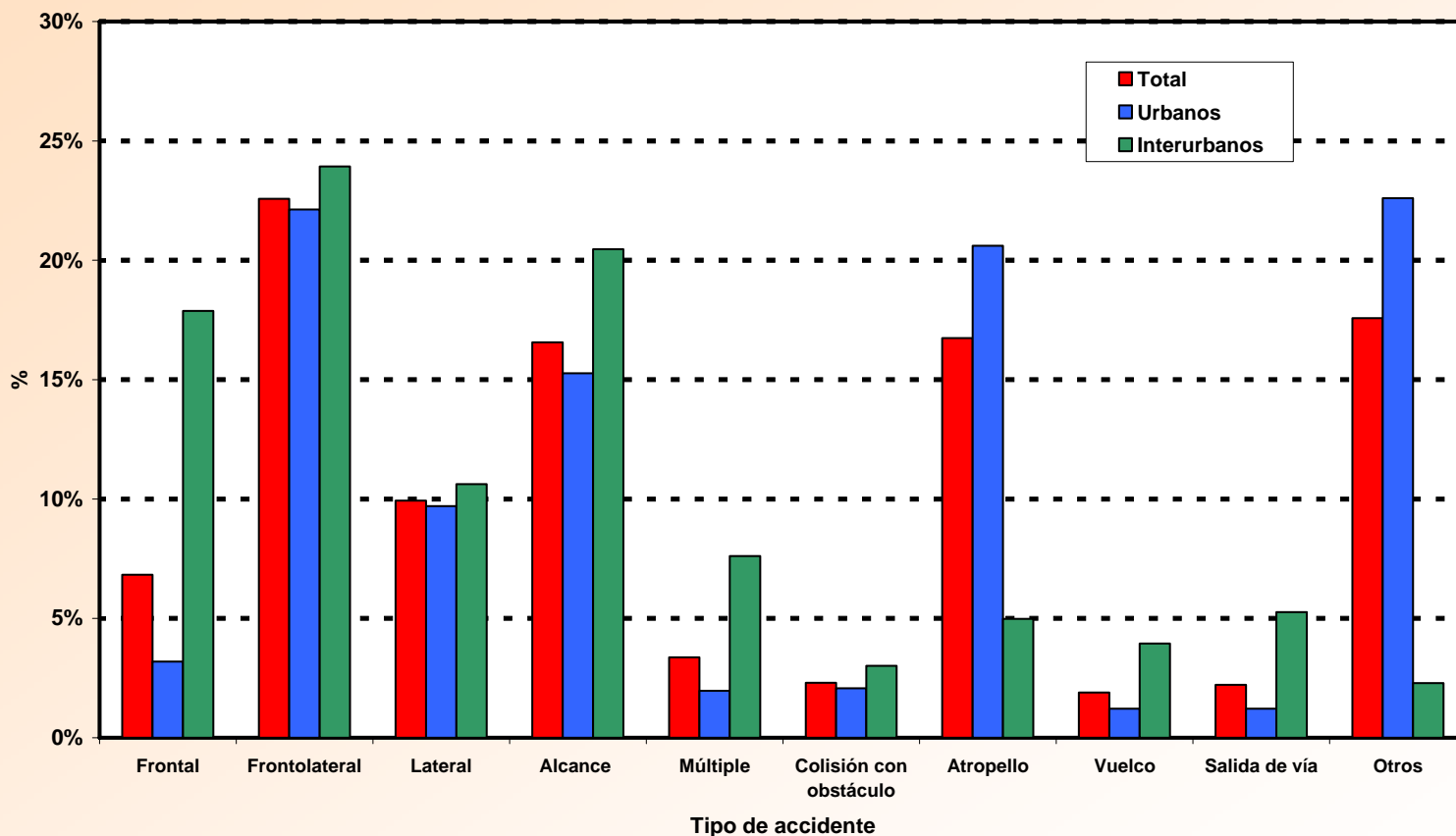
Porcentajes referidos al año 1993



# TYPE OF ACCIDENT (SPAIN-1993-2005)

## Accidents with Bus or Coach involved

Distribución de los accidentes con autobuses implicados (1993-2005)

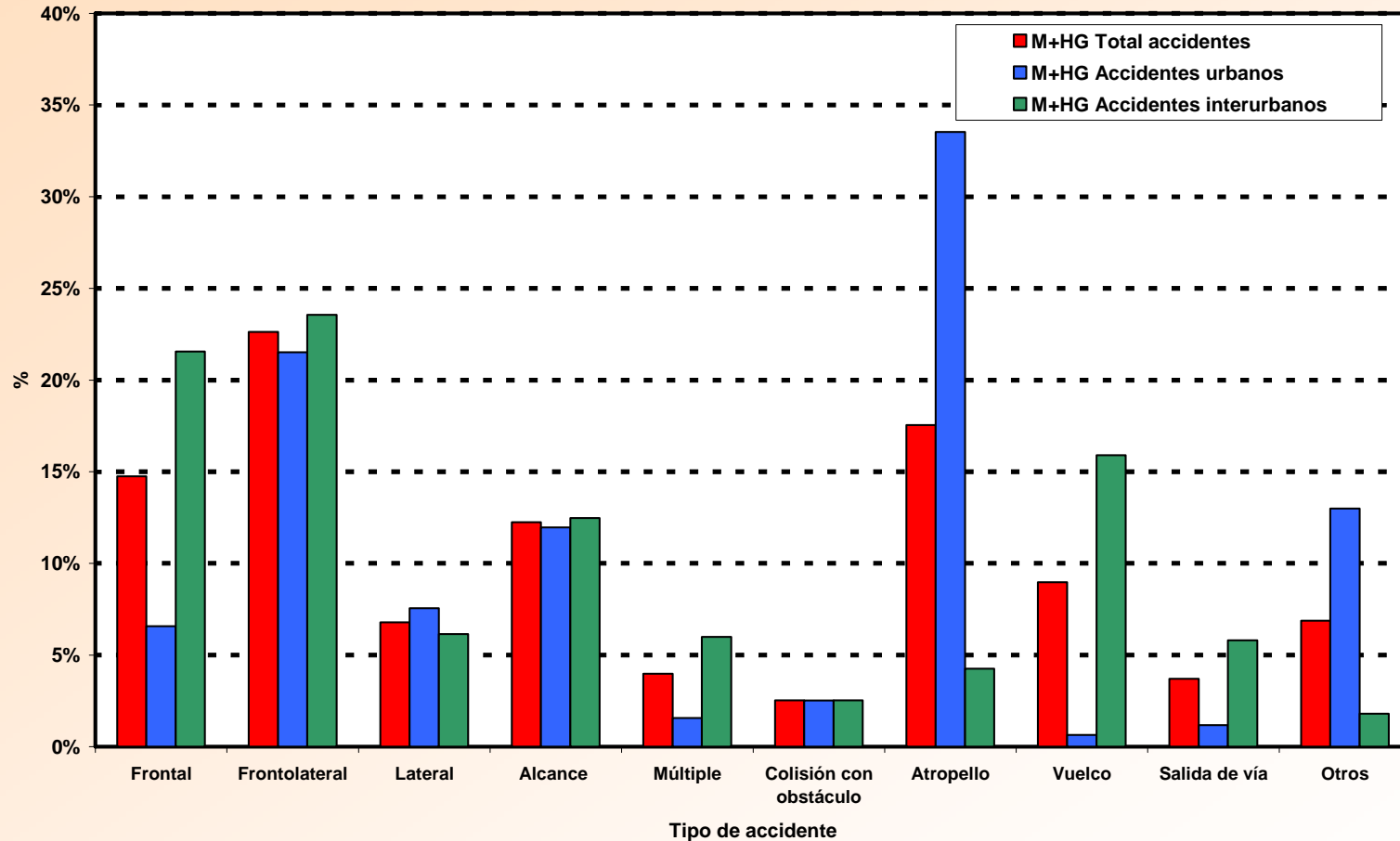


Datos promedio 1993-2005



# TYPE OF ACCIDENT (SPAIN 1993-2005)

## Víctims in accidents with Buses & Coaches



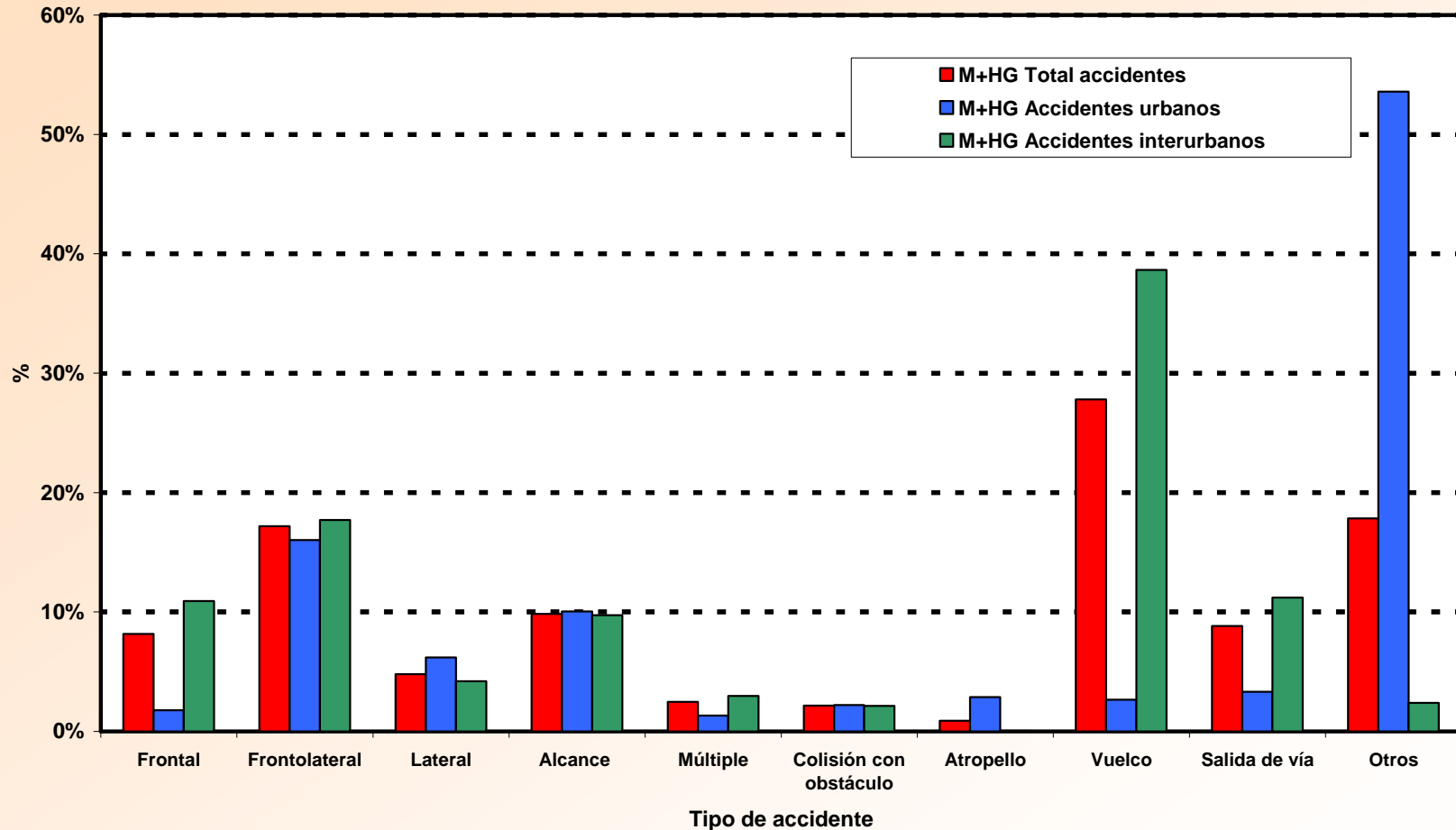
Datos promedio 1993-2005



# TYPE OF ACCIDENT (SPAIN 1993-2005)

## Víctims inside Buses & Coaches.

Ocupantes de autobuses

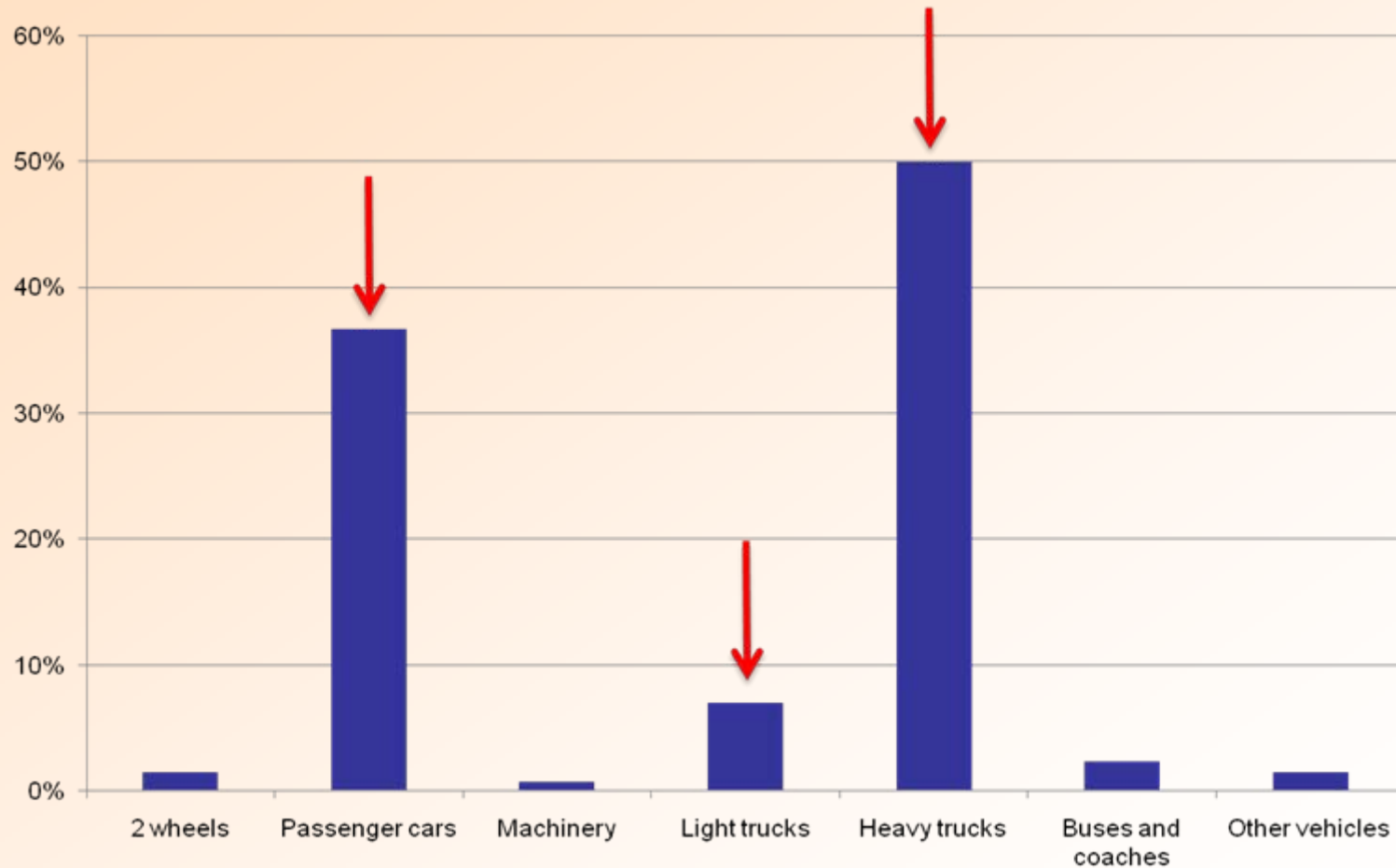


Datos promedio 1993-2005



# INTRODUCTION

**FREQUENCY OF RURAL ACCIDENTS DEPENDING ON THE OPPOSITE VEHICLE IN FRONTAL COLLISIONS:  
REAR END-HEAD ON. ACCIDENTS WITH DEAD AND SEVERELY INJURED PASSENGERS IN THE BUS (1993-2005)**





# FRONTAL PROBLEMS: INCOMPATIBILITY



## Collision with passengers car, vans and light trucks

Frontal – Rollover

### Description:

A car crashes semi-frontally with the bus while finishing a wrong overtake. Finally the coach left the road and rolled over 90 degrees, standing on its right side.

### Bus Deformations:

The right side of the bus damaged because of the rollover. The left front corner was badly damaged because of the impact with the car.



# FRONTAL PROBLEMS: INCOMPATIBILITY

## Collision with passengers car, vans and light trucks



Frontal (Bus) and Frontal (Car)

### Description:

The coach was driving by a dual carriage way, in a left curve. A car crashes frontally (40% offset) into the bus, at 130kph, and reaches coach fuel tank. Coach starts burning.





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# FRONTAL PROBLEMS: INCOMPATIBILITY



## Collision with heavy vehicles

Collision – Frontal (Bus) and Rear (Opponent)

### Description:

The coach was driving by a motorway, when crashed (60% offset) against the rear part of a truck, which was driving at 40kph.

### Bus Deformations:

The right front corner of the coach structure was badly damaged, because of the crash against the truck.



# FRONTAL PROBLEMS: INCOMPATIBILITY

## Collision with heavy vehicles

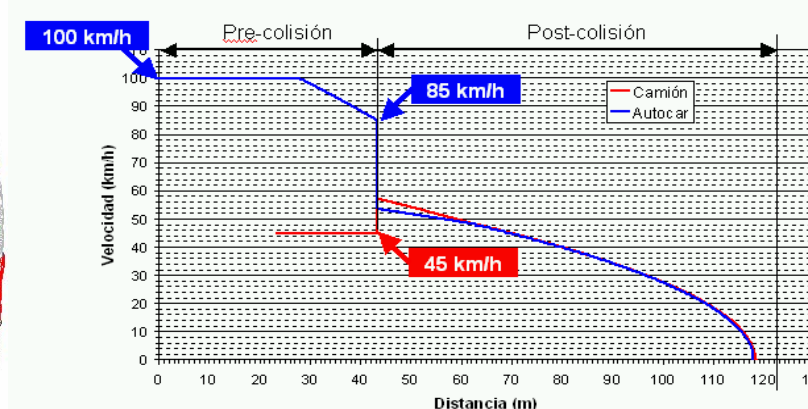
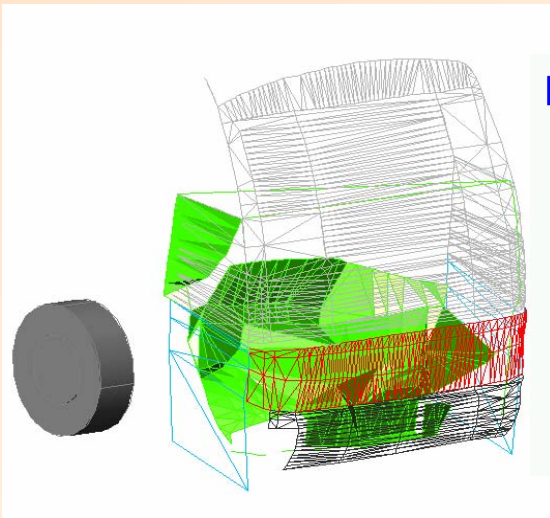


Collision – Frontal (Bus) and Rear (Opponent)

### Description:

The coach was driving by a motorway, when crashed (65% offset) against the rear part of a truck,

### Bus Deformations:



Height(m)	Intrusión (mm)
0.4	0
0.6	553
0.8	661
1	899
1.2	1164
1.4	1148
1.6	1089
1.8	872





# FRONTAL PROBLEMS: RESTRAIN SYSTEMS

## SEATS AND SAFETY BELTS ANCHORAGES



## PARTITIONS





# RETENCIÓN DE PASAJEROS

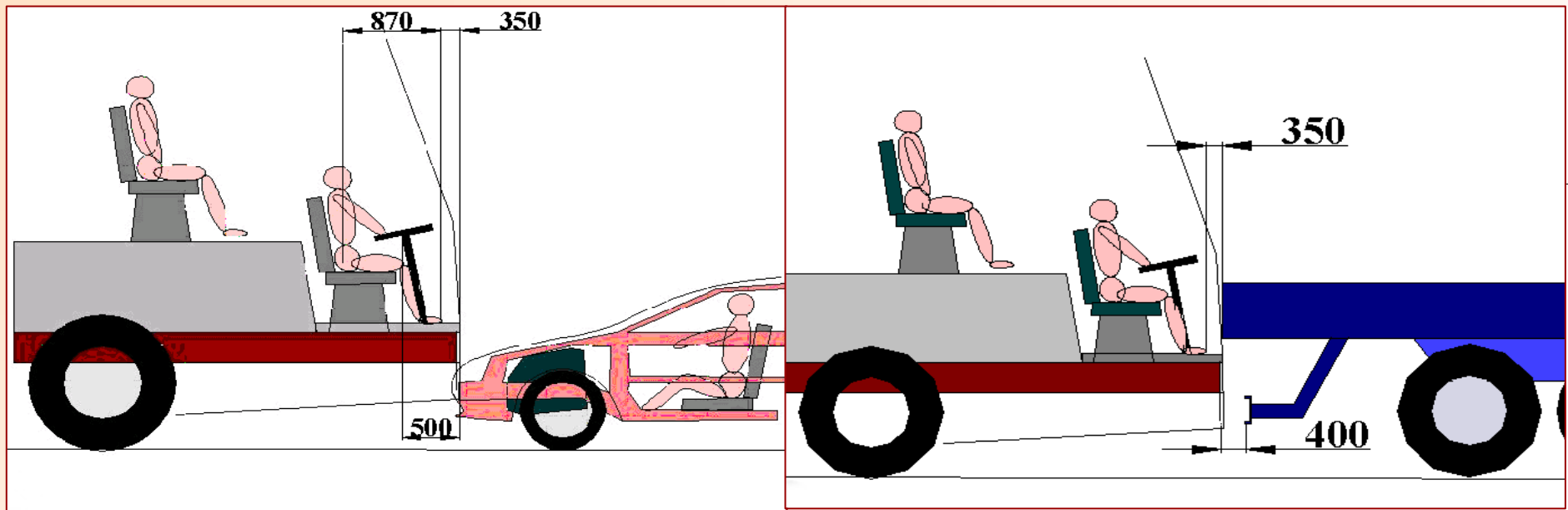


# MAIN PARAMETERS AFFECTING THE DRIVER'S SAFETY (INSIA research)

## ★ Height of the driver's floor. (Geometric Compatibility)

- Low driver's floor (around 800 mm)
- Normal driver's floor (around 975 mm)
- High driver's floor (around 1060 mm)

## ★ Distance to the front of the vehicle

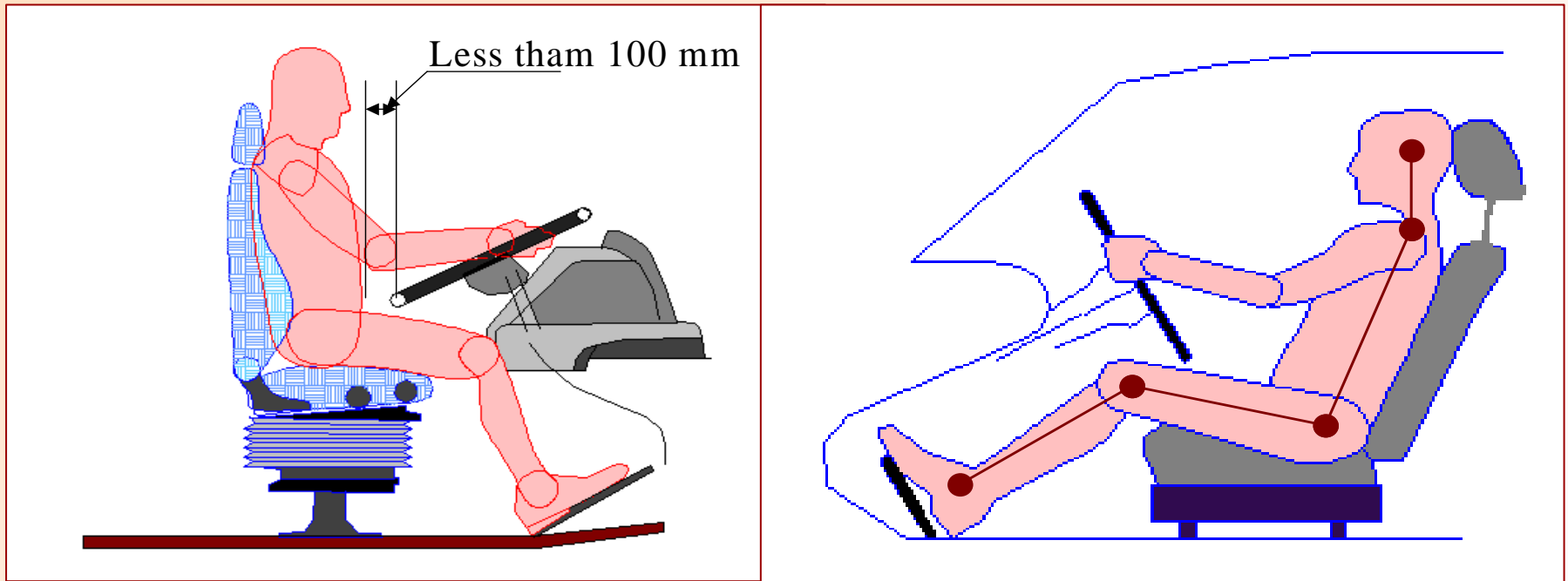




# MAIN PARAMETERS AFFECTING THE DRIVER'S SAFETY



## Free space around the driver



Different posture between coach and cars drivers



# DEFINITION OF A SURVIVAL SPACE FOR THE DRIVER

## e. From comfort and displacement allowed by safety belt



### Test:

- According Regulation 80
- 50% percentile dummy
- Coach's driver's seat

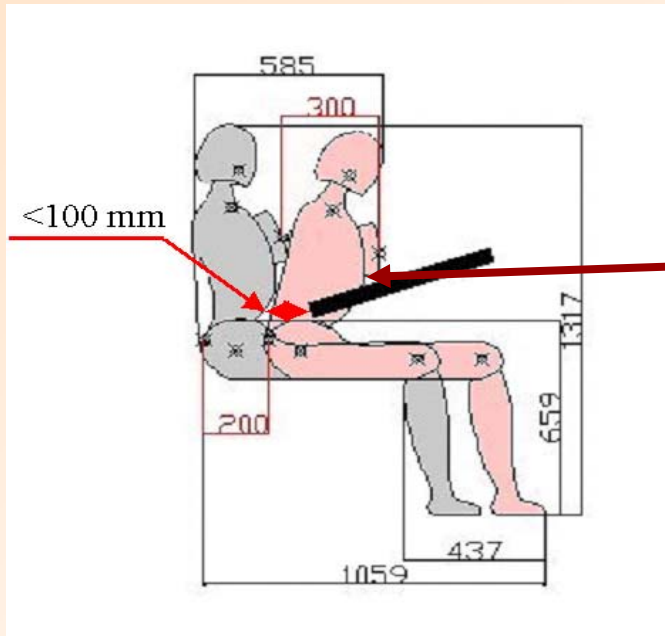


# DEFINITION OF A SURVIVAL SPACE FOR THE DRIVER

Minimum space around driver, to remain free of any intrusion in an accident

Four options could be considered:

- The driver restrained with 3-point belt never cross it (R16 or Directive 2000/3)



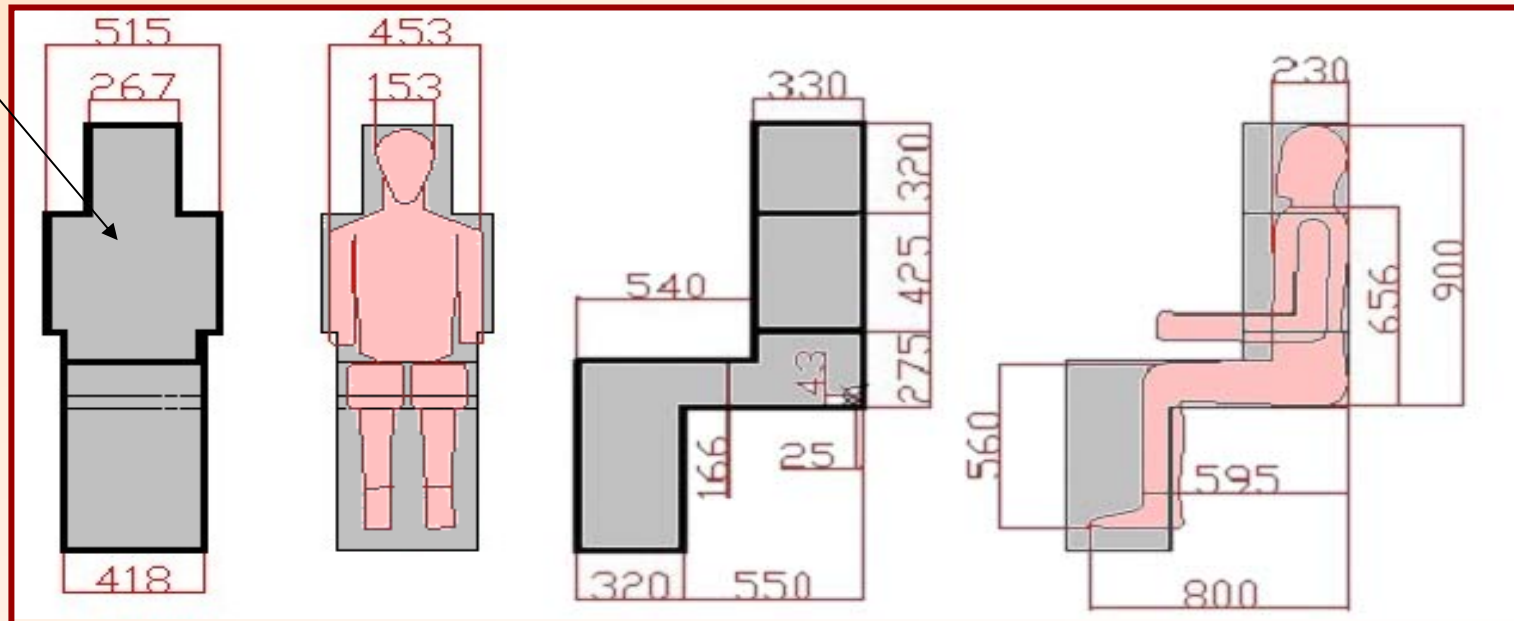
**INTRUSION: So, It should not be use to define survival space**

# DEFINITION OF A SURVIVAL SPACE FOR THE DRIVER

## b. The procedure in Regulation UN-ECE 29 (for trucks)

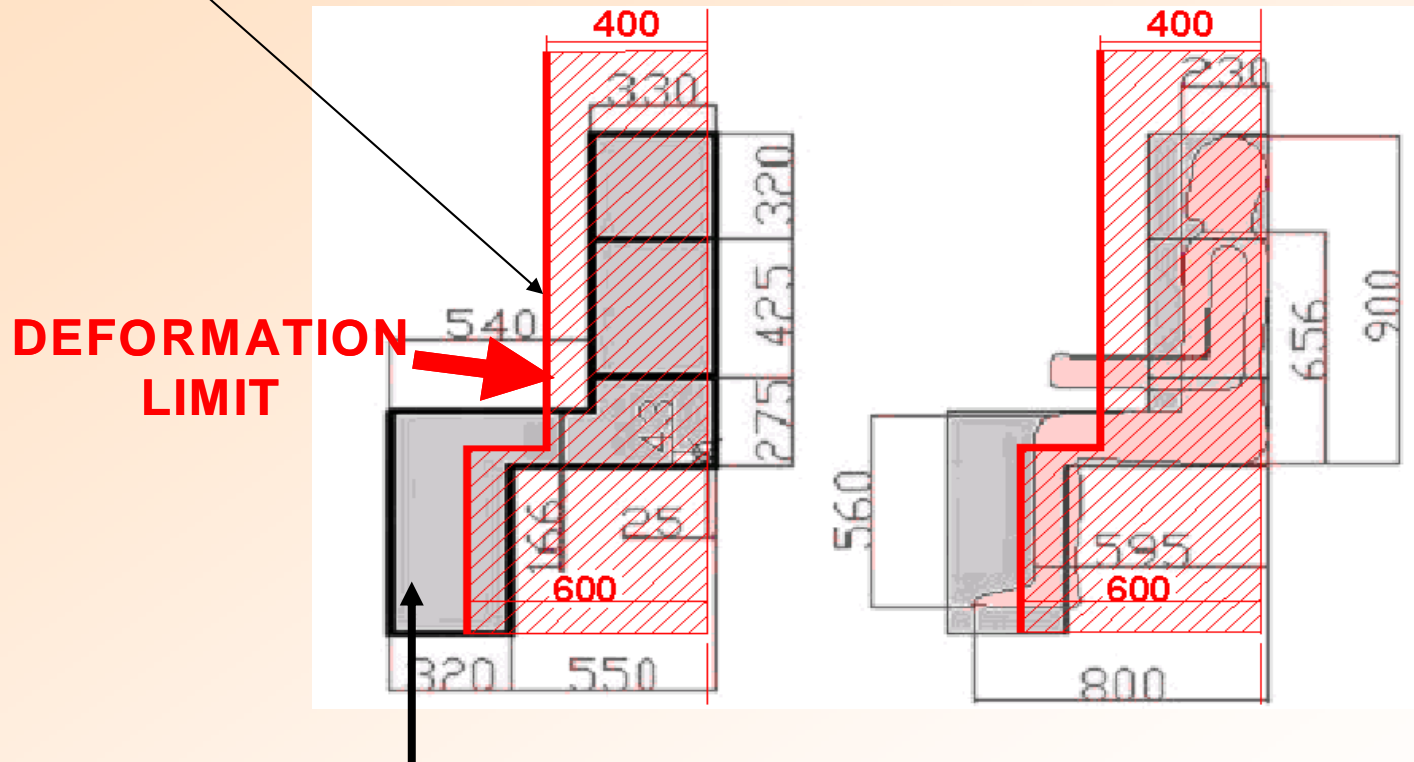
A dummy of the 50<sup>th</sup> percentile cannot be in contact with any rigid part or the cabin after the tests.

## c. The Spanish's standar UNE 115-204-87 which deals with rollover strength in utility vehicles. Volume free of intrusion



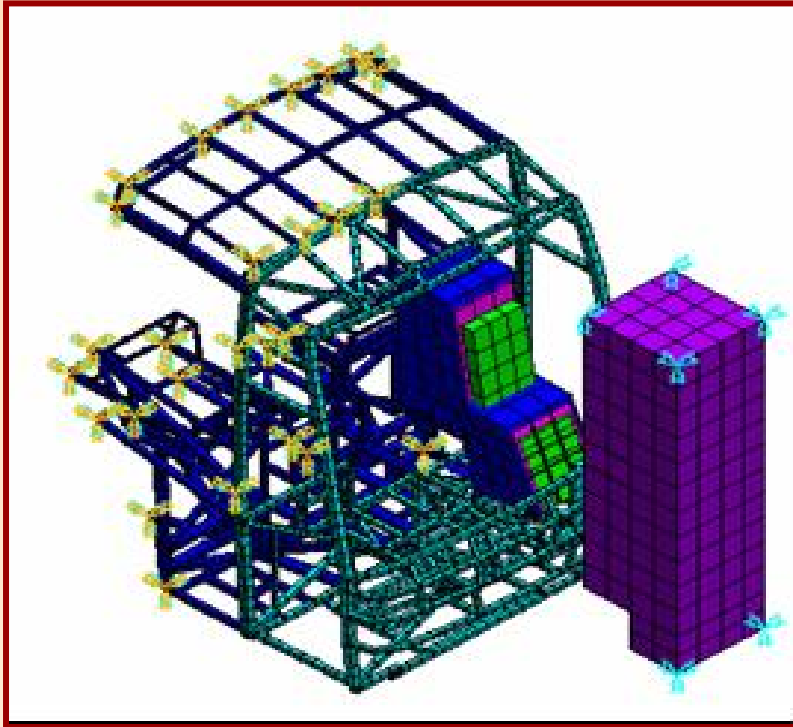
## DEFINITION OF A SURVIVAL SPACE FOR THE DRIVER

- d. ECBOS Work Document: Task 3.3.2 (TNO) propound a survival space after Swing-bod test (1500 kg) conform ECE/ R29 .



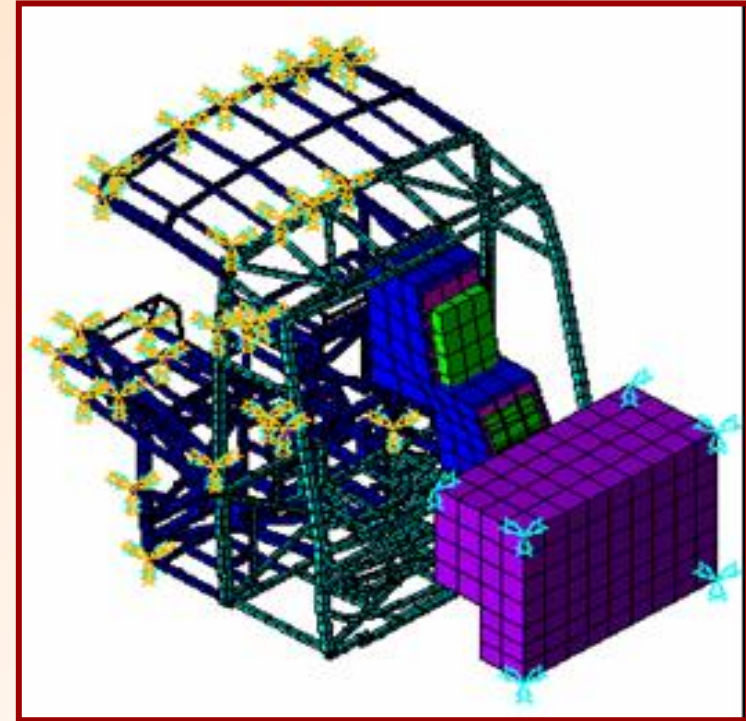
UNE survival space seems the better

# PROPOSALS: Collision with heavy vehicles



## SIM 1: FRONTAL LOW OVERLAP

- Speed 30 km/h
- Overlap 30%

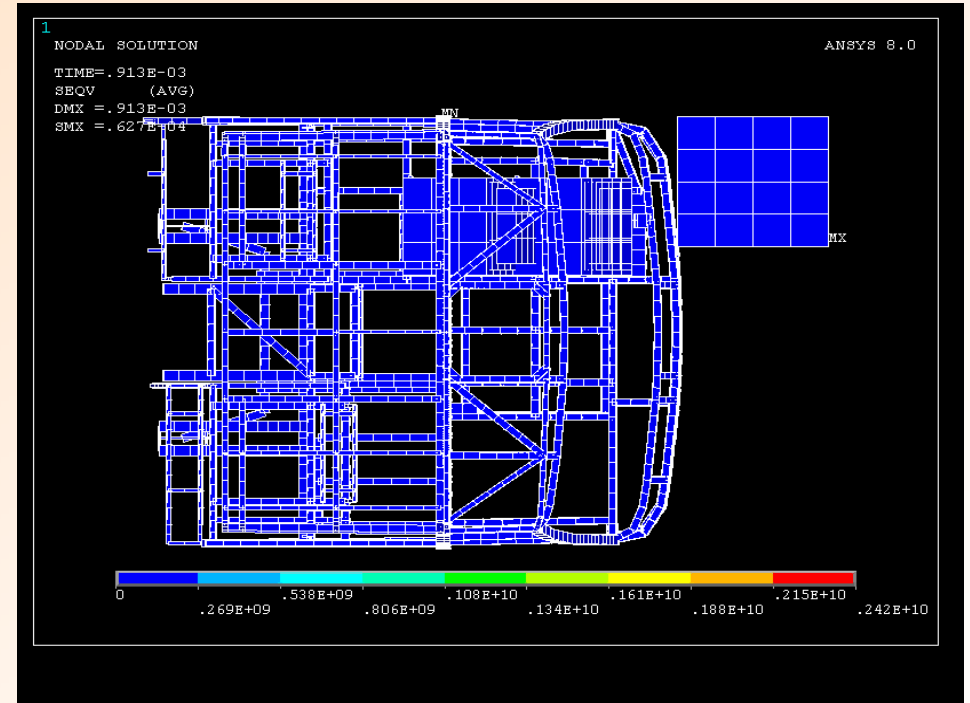
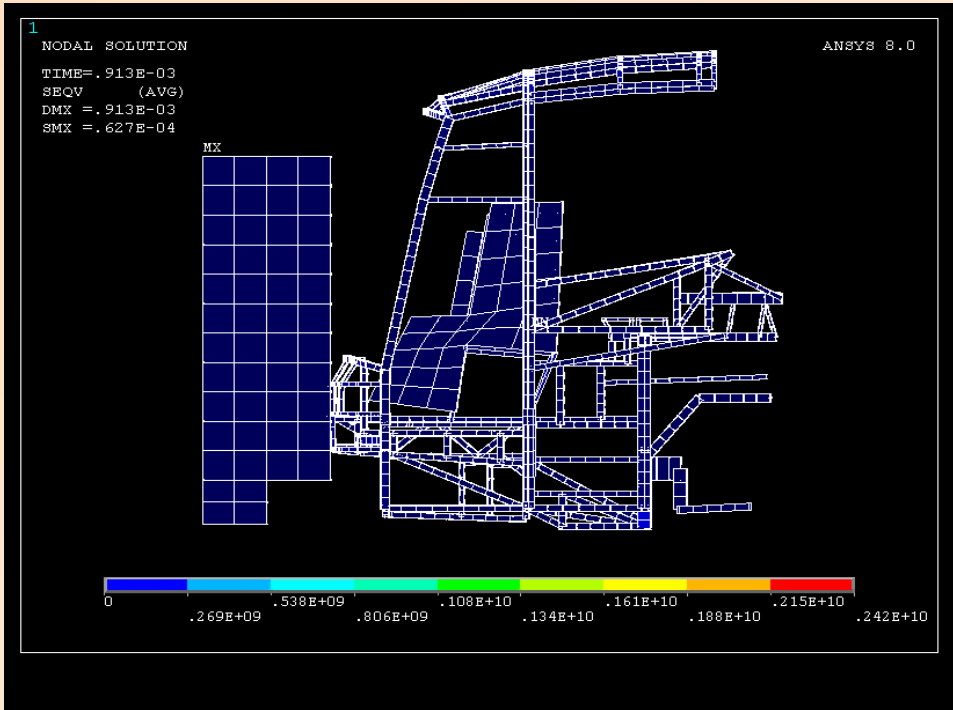


## SIM 2: REAR ON HIGH OVERLAP

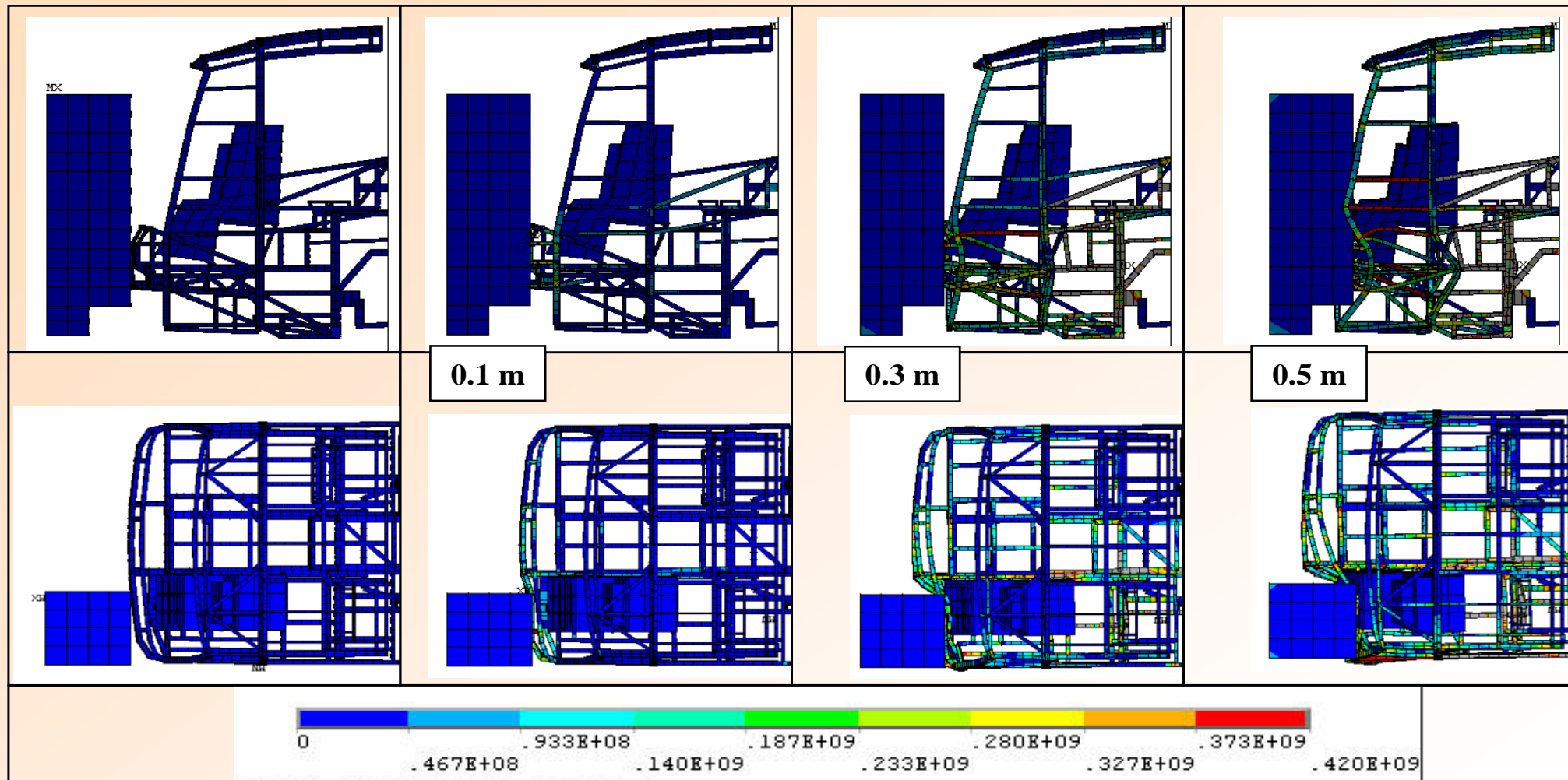
- Speed 30 km/h
- Overlap 70%



# PROPOSALS: Test frontal Collision with heavy vehicles

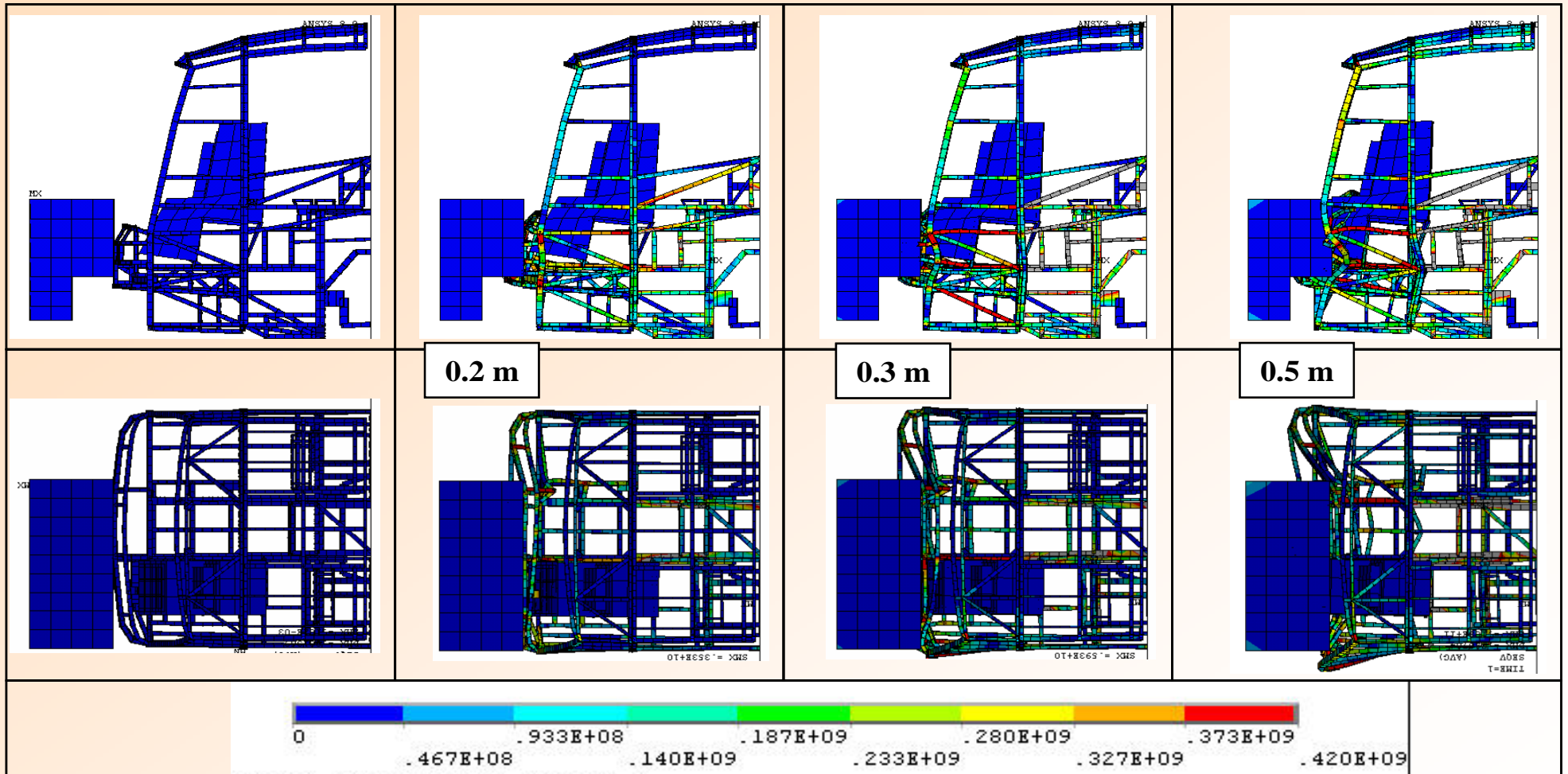


# PROPOSALS: Test Frontal Collision with heavy vehicles



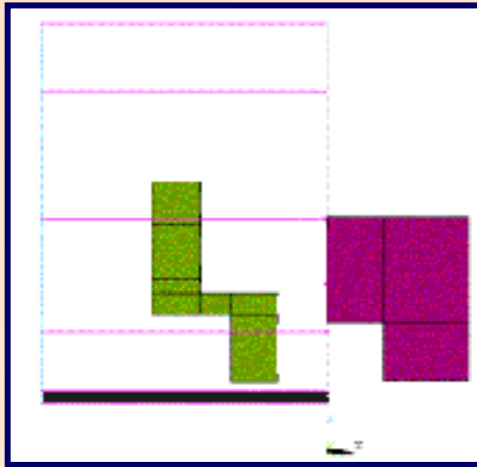


# PROPOSALS: Test Rear-on Collision with heavy vehicles

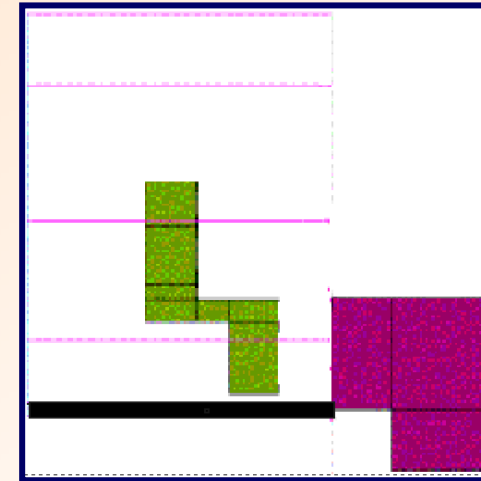


# PROPOSALS: Collision with heavy vehicles

A higher floor with FUP's enhances passive safety



height < 1100 mm



height > 1100 mm

Current designs are not strong enough to maintain the defined survival volume for driver/crew in the two simulations



# REPERCUSSIONS

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## R & D needed:

- Statistical data
- Definition of possible tests/simulations
- Biomechanical analysis
- ...

**Ad Hoc Expert Groups/ EEVC/European Projects / ...**

## MANUFACTURES:

- FUP: *Not difficult to adopt (little structural changes)*
- Seats-safety belts anchorages: *Not much more difficult than nowadays*
- Partitions: **New requirements**
- Structural strength: **New designs and/or new vehicle concept**



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# FRONTAL COLLISION BUSES AND COACHES. RESEARCH AND PROBLEMS

GRSP MEETING 10-12/XII/2008

