



**Norwegian Public Roads
Administration**

ROBUS  Road Barrier
Upgrade
of Standards

ROBUST Computational Mechanics

Results and Comparison

Workshop in Brussels 30.05.2006

**Kristin Johannessen
Force Technology**

Vehicle models

Light vehicle model:

- GeoMetro R0 – Original, downloaded from NCAC and improved by NPRA, SNRA, Force
- GeoMetro R1 – Included spinning wheels by POMI
- GeoMetro R2 – R1 + seats, seatbelts and gebod by NPRA/Force
- GeoMetro R3 – R1 + steering and suspensions by POMI
- GeoMetro R4 – R3 + seats, seatbelts and gebod by NPRA/Force
- Generic (Fiesta) – Developed by TRL

Bus Model (13t) – based on Scania and modified by NPRA, SNRA, Force

10t Heavy weight vehicle model – developed by POMI

Barriers

Barrier	Description of barrier	Vehicle model for impact
B5	Concrete barrier	GM_R1
B1	ESP - N2	GM_R2 and GM_R3
B2	Super-rail® plus - H3	GM_R3 and GM_R4
B3	VarioGuard - H2	10t lorry_R1
B3	VarioGuard - H2	Bus

All barriers delivered by Volkmann & Rossback GMBH & CO.KG, as Robust partner



Steel ESP N2 (Barrier B1)



Barrier delivered by Volkmann & Rossback GMBH & CO.KG,
as Robust partner (picture from TRL)

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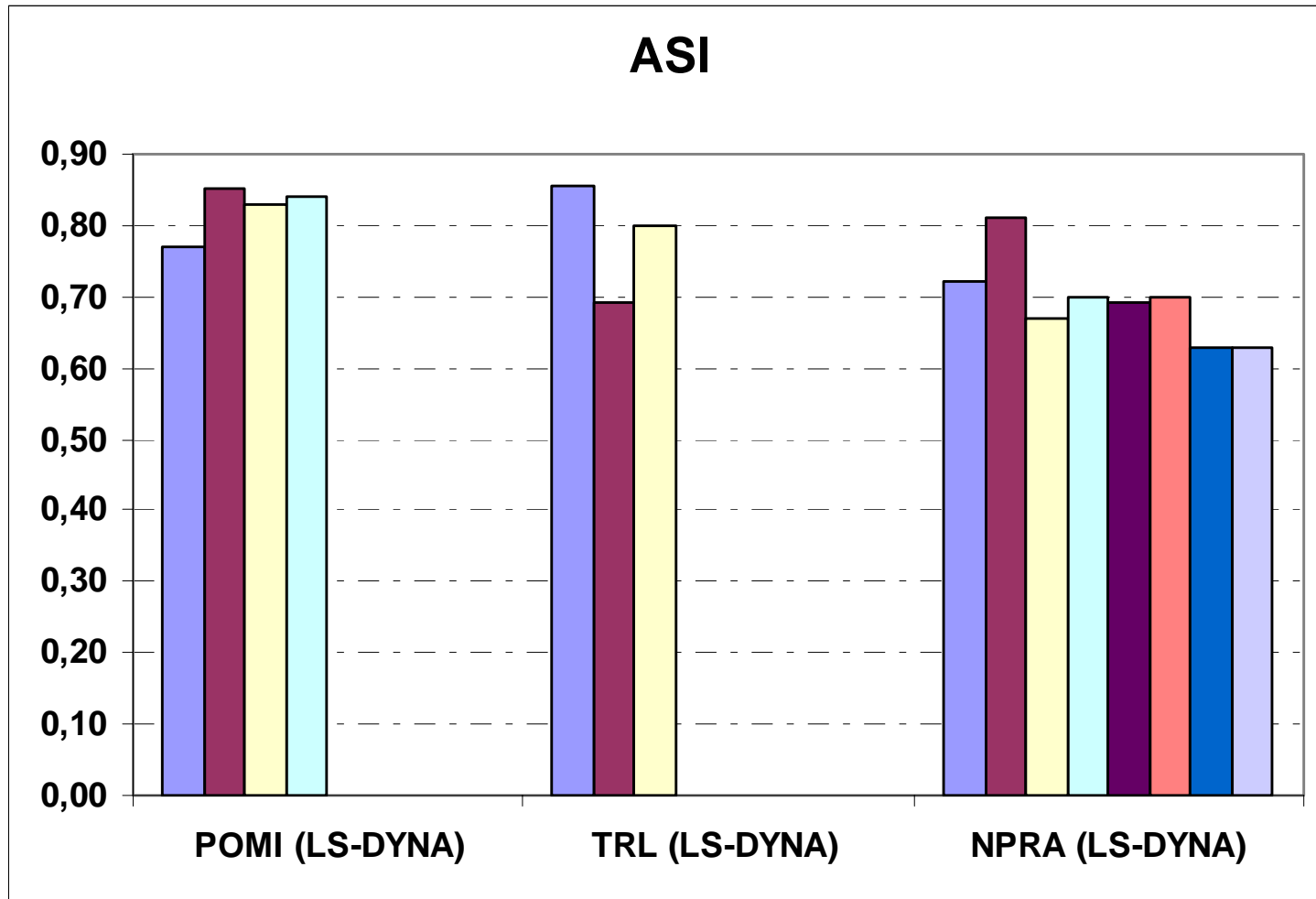
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ESP N2 – Input parameters

- Versions of GM
- Impact speed
- Vehicle test mass
- Barrier boundaries (foundation, ends)
- Material data
- Friction (wheel asphalt)



ESP N2 - Results



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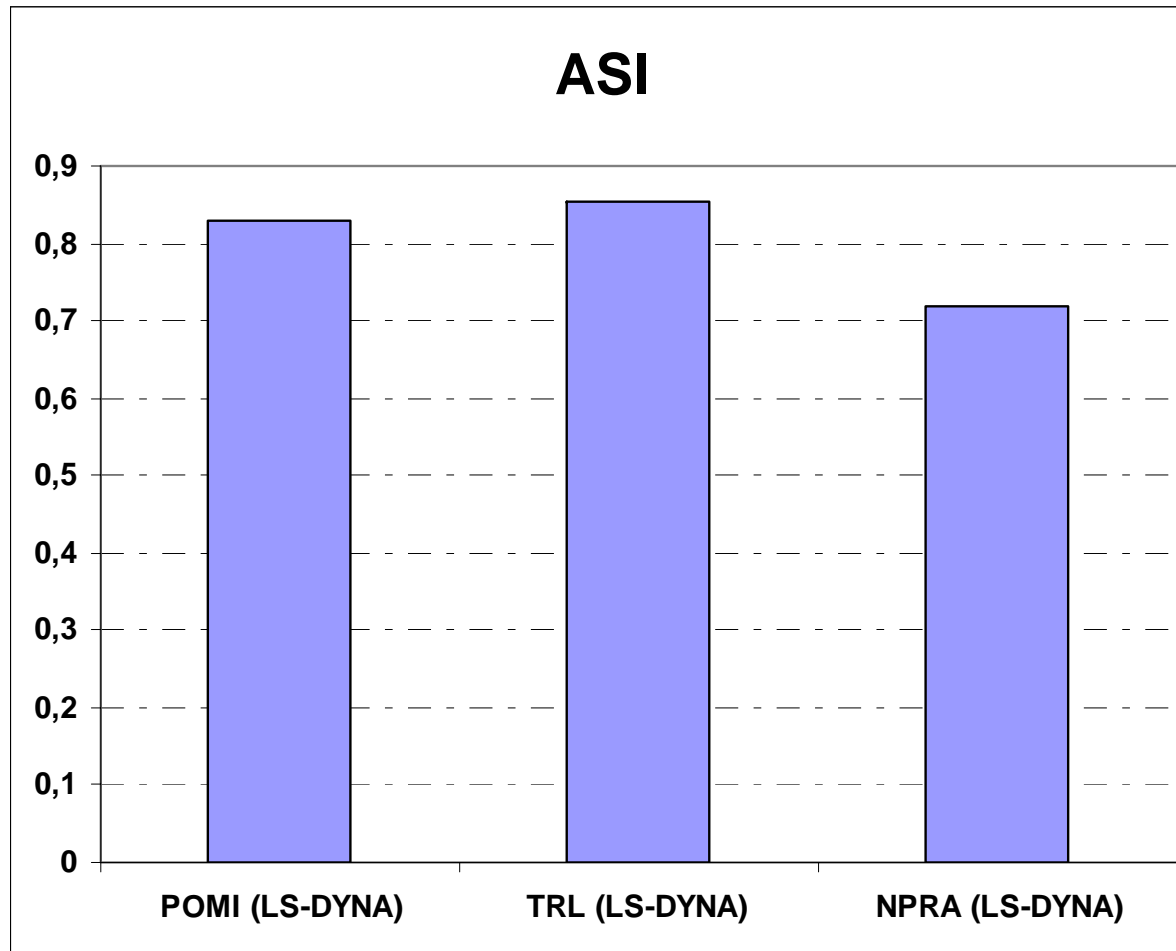


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ESP N2 - Results



ASI
Std. Dev: 0,07
Mean: 0,8

Comparable simulations; fixed at ground level -180mm

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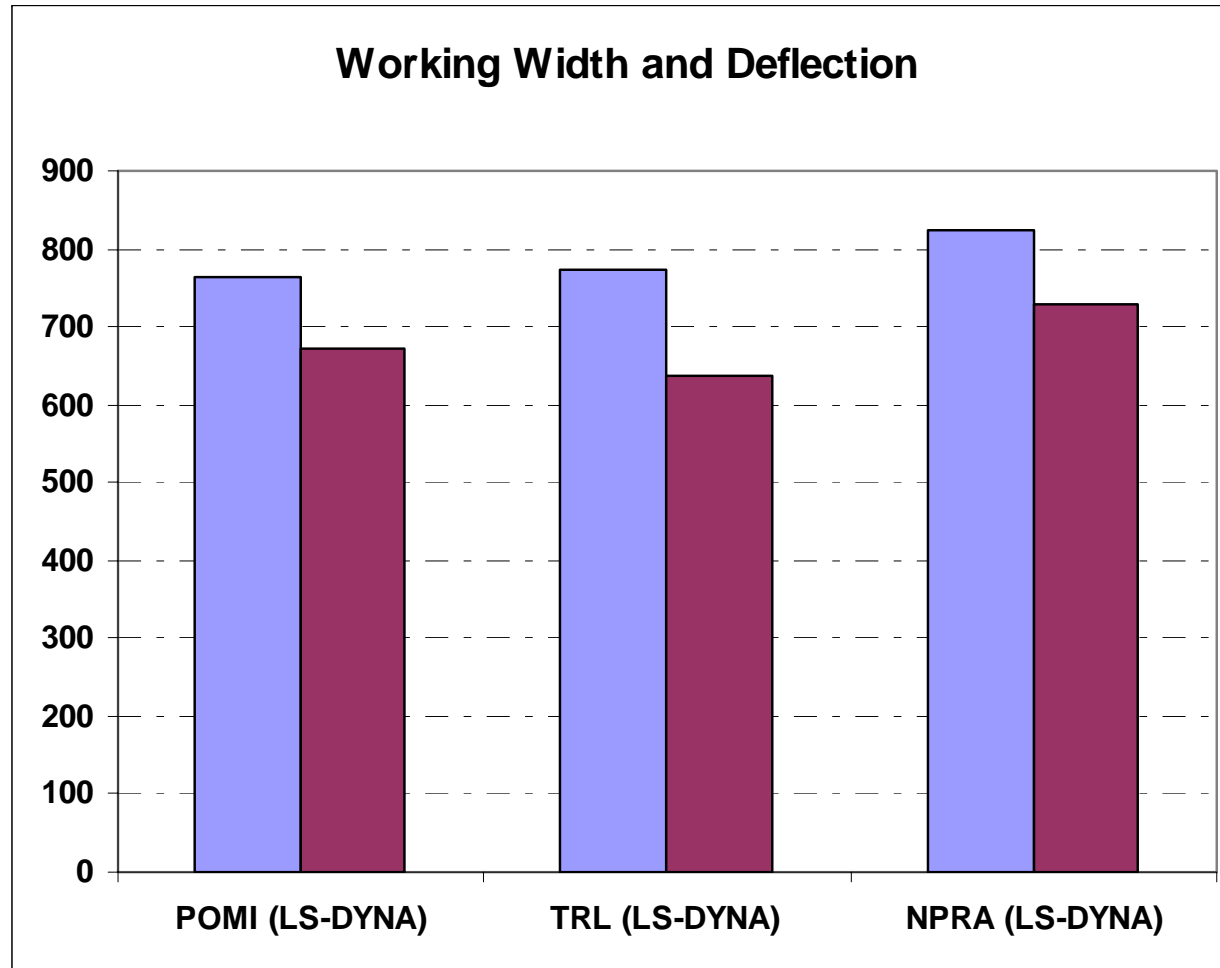
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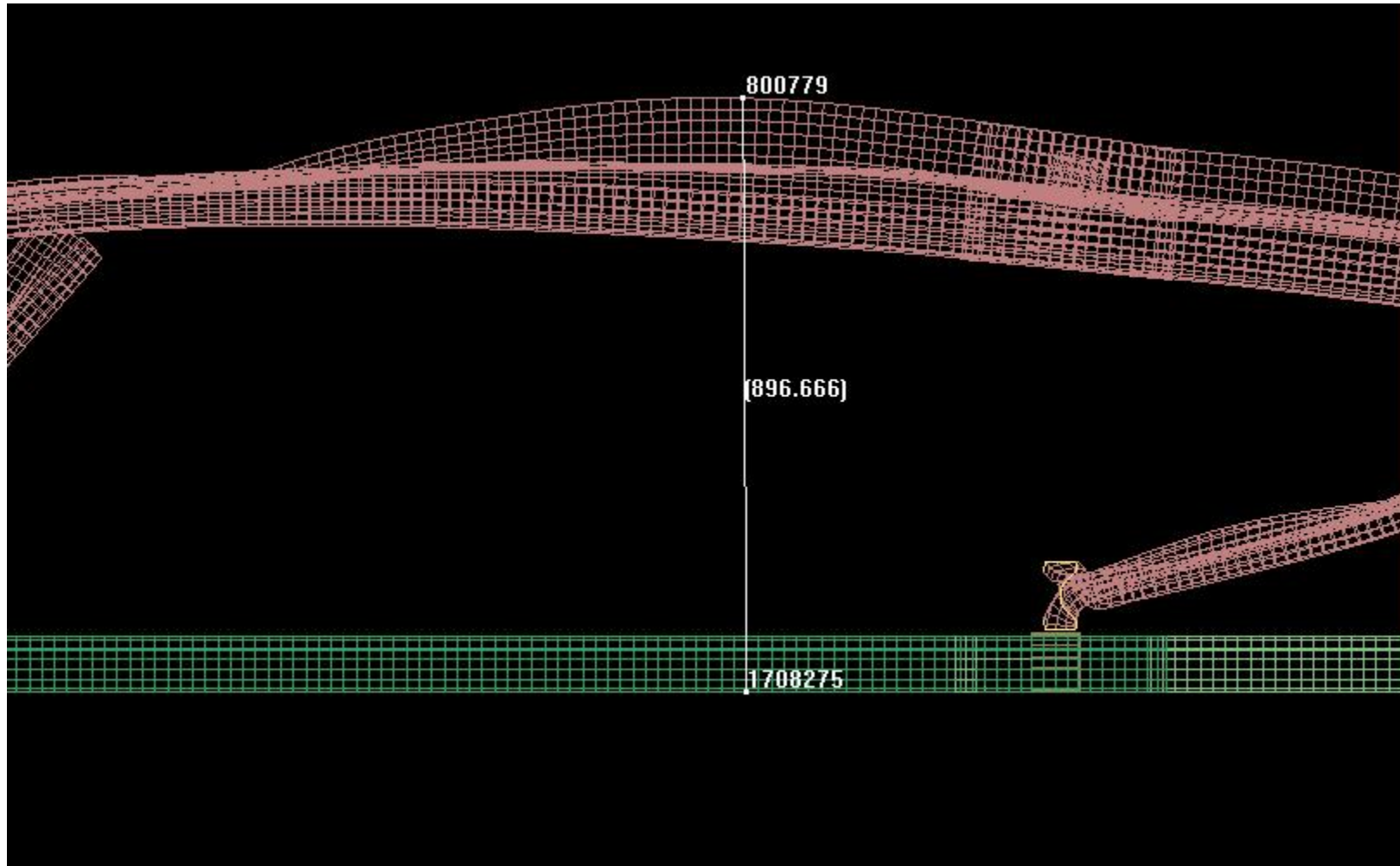
ESP N2 - Results

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Measurement of W

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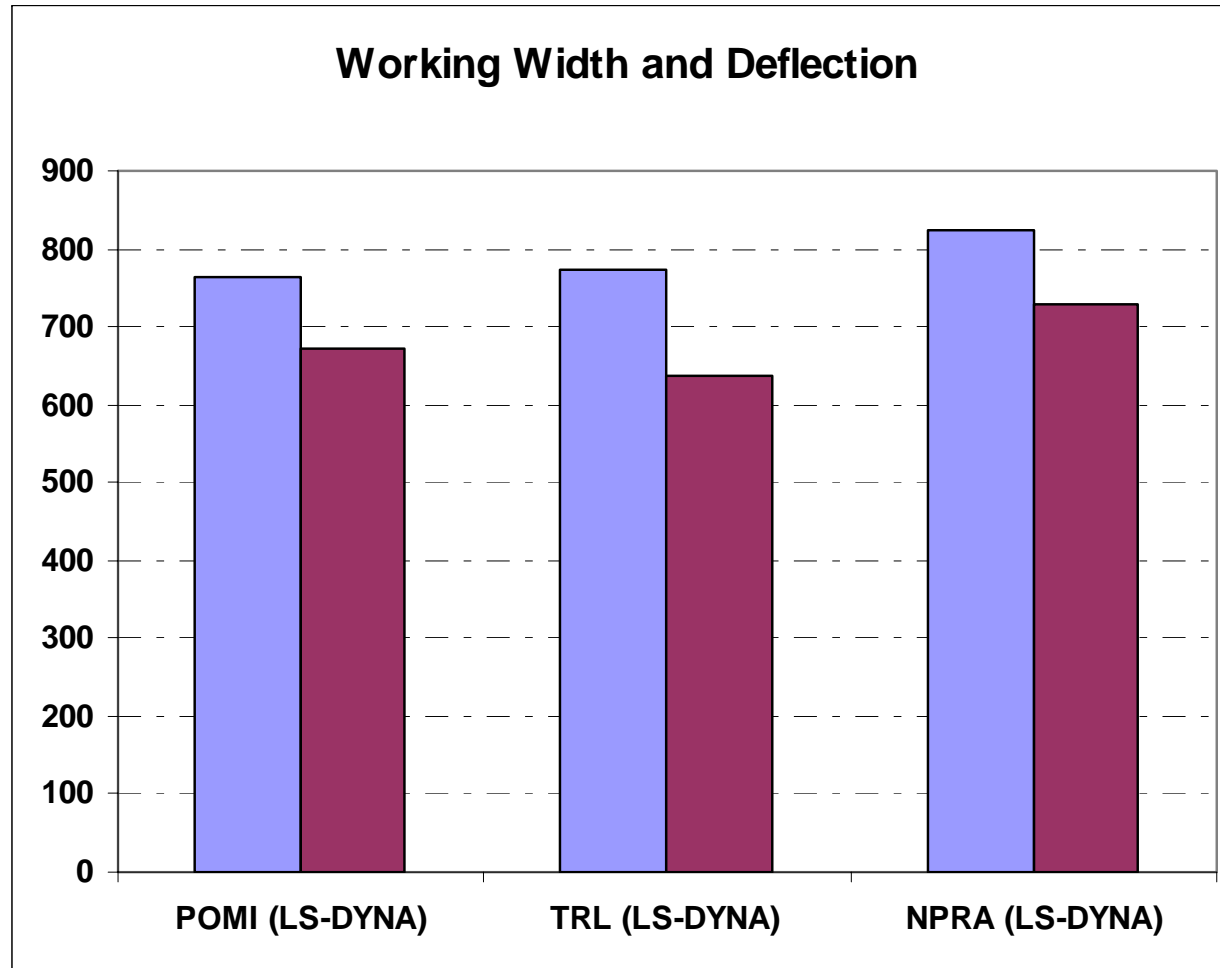
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ESP N2 - Results

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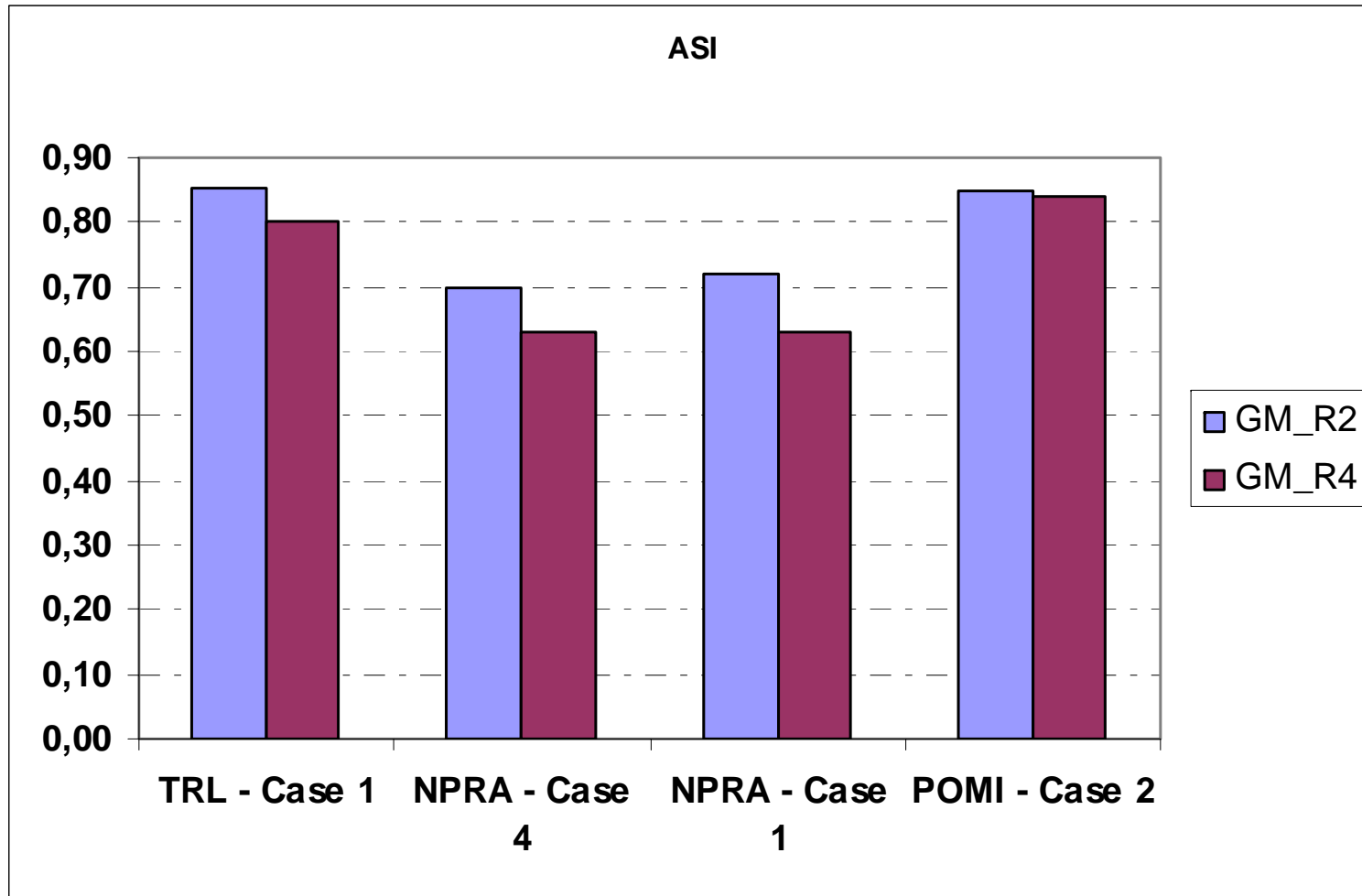
**W: Std. Dev: 33
Mean: 787**

**D: Std.dev: 69
Mean: 679**



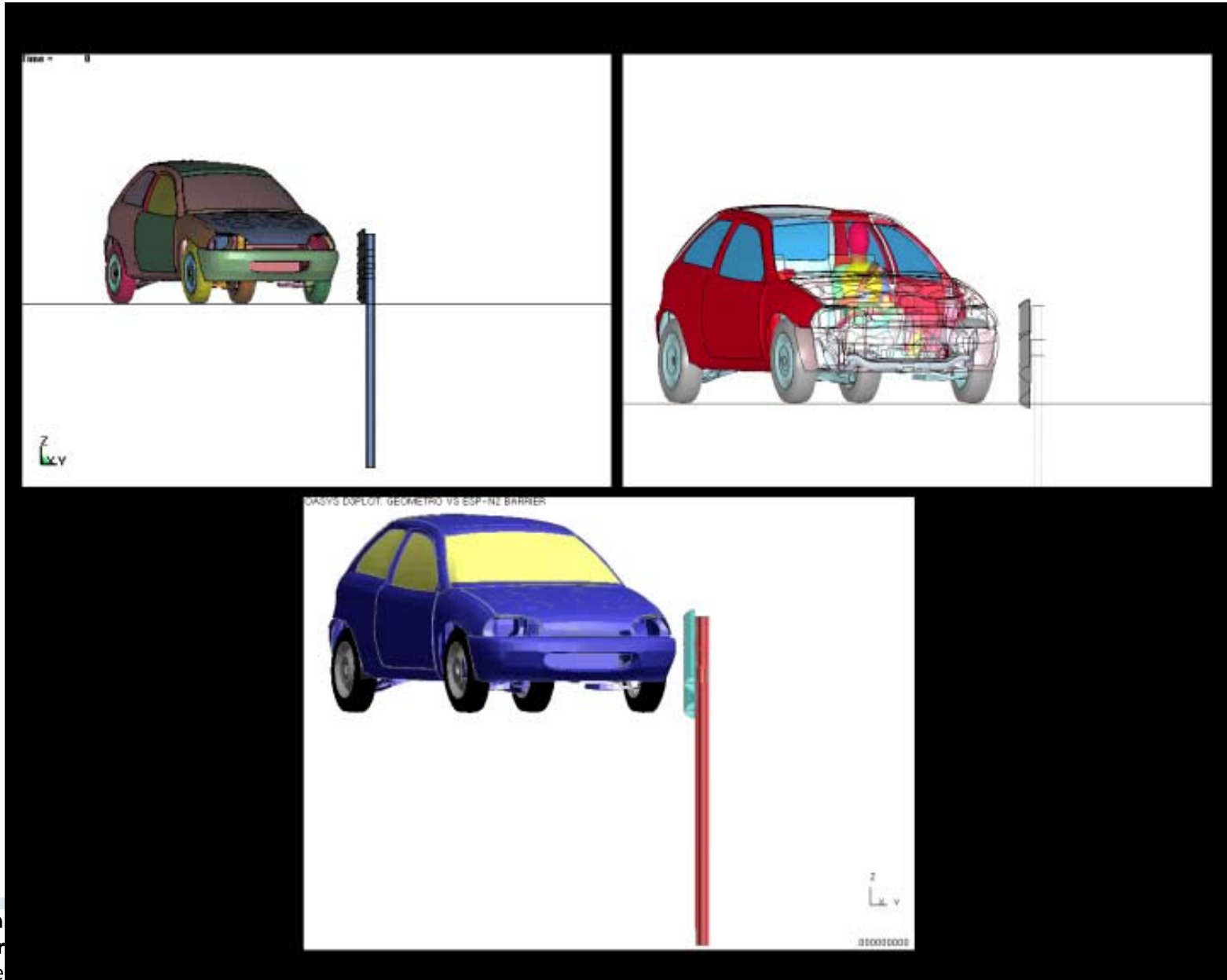
ESP N2 - Results

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ESP N2 - Results

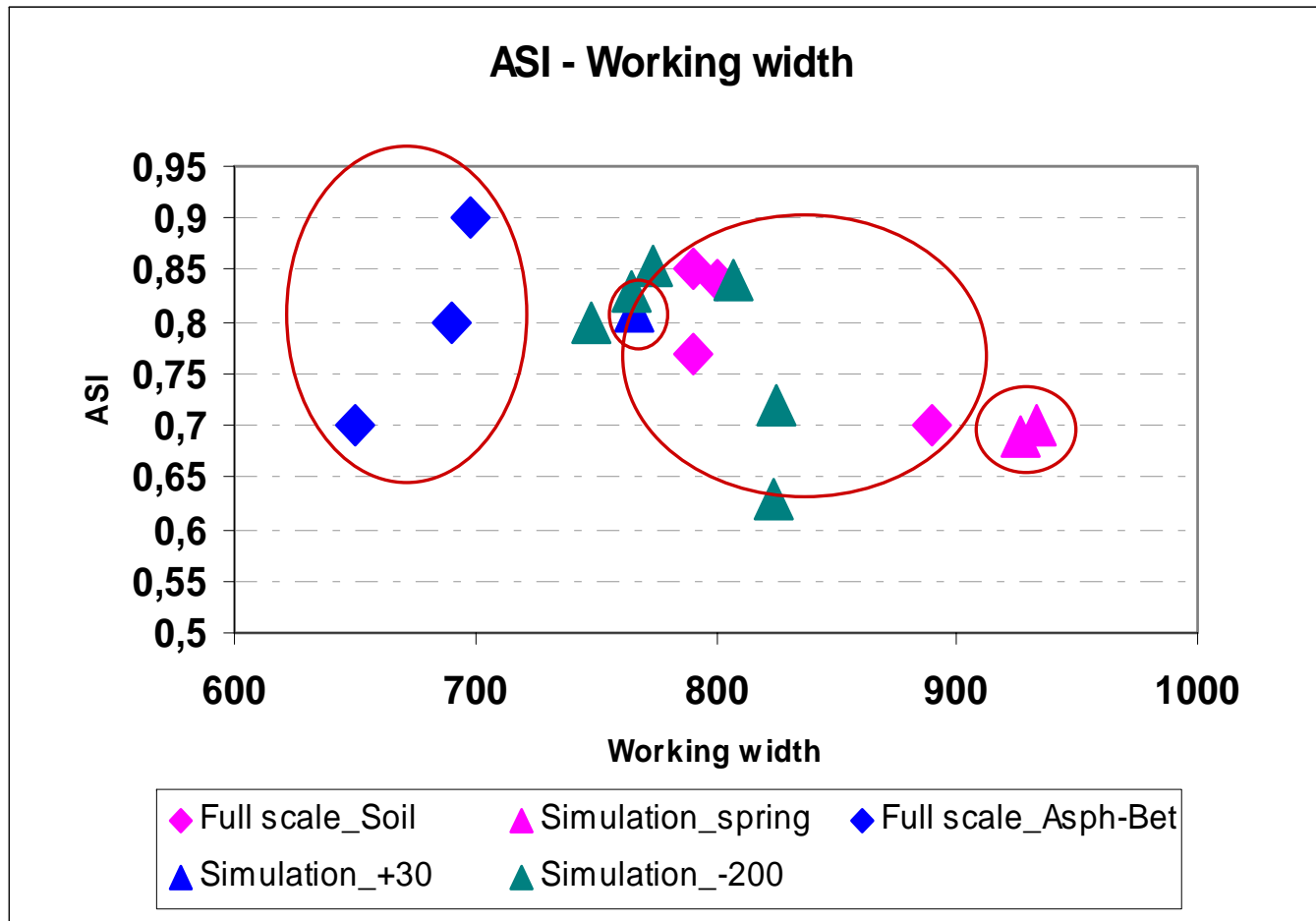
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ESP N2 – Comparison full-scale test



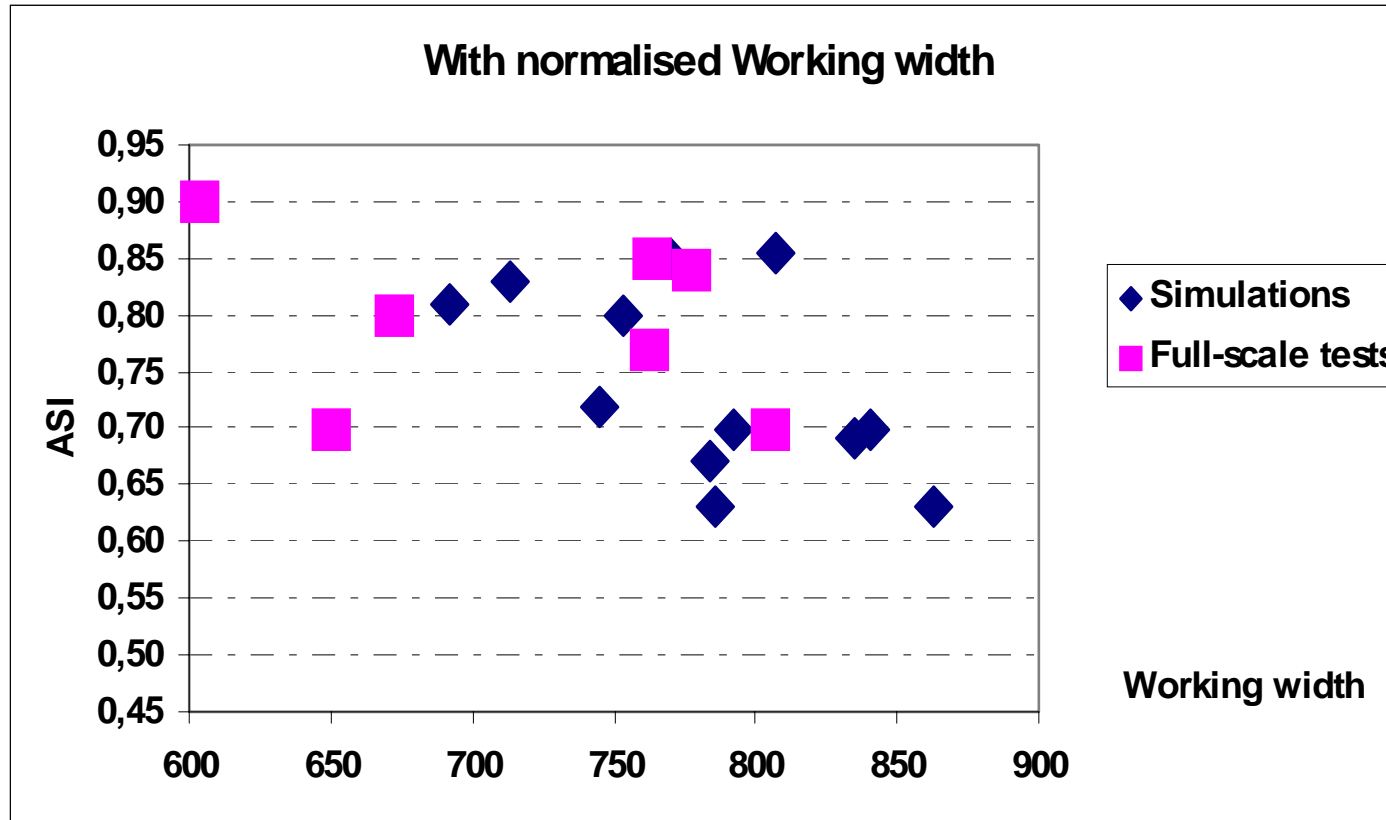
ASI:
Simulation
 Std. Dev: 0,08
 Mean: 0,75

Full scale test:
 Std.dev: 0,08
 Mean: 0,79

W:
Simulation
 Std. Dev: 63
 Mean: 834

Full scale test:
 Std.dev: 83
 Mean: 758

ESP N2 – Comparison full-scale test



**W-normalised:
Simulation**
Std. Dev: 50
Mean: 779

Full scale test:
Std.dev: 76
Mean: 730

W:
Simulation
Std. Dev: 63
Mean: 834

Full scale test:
Std.dev: 83
Mean: 758

Normalised according to prEN 1317-2:2005;
Impact energy related



Concrete (Barrier B5)

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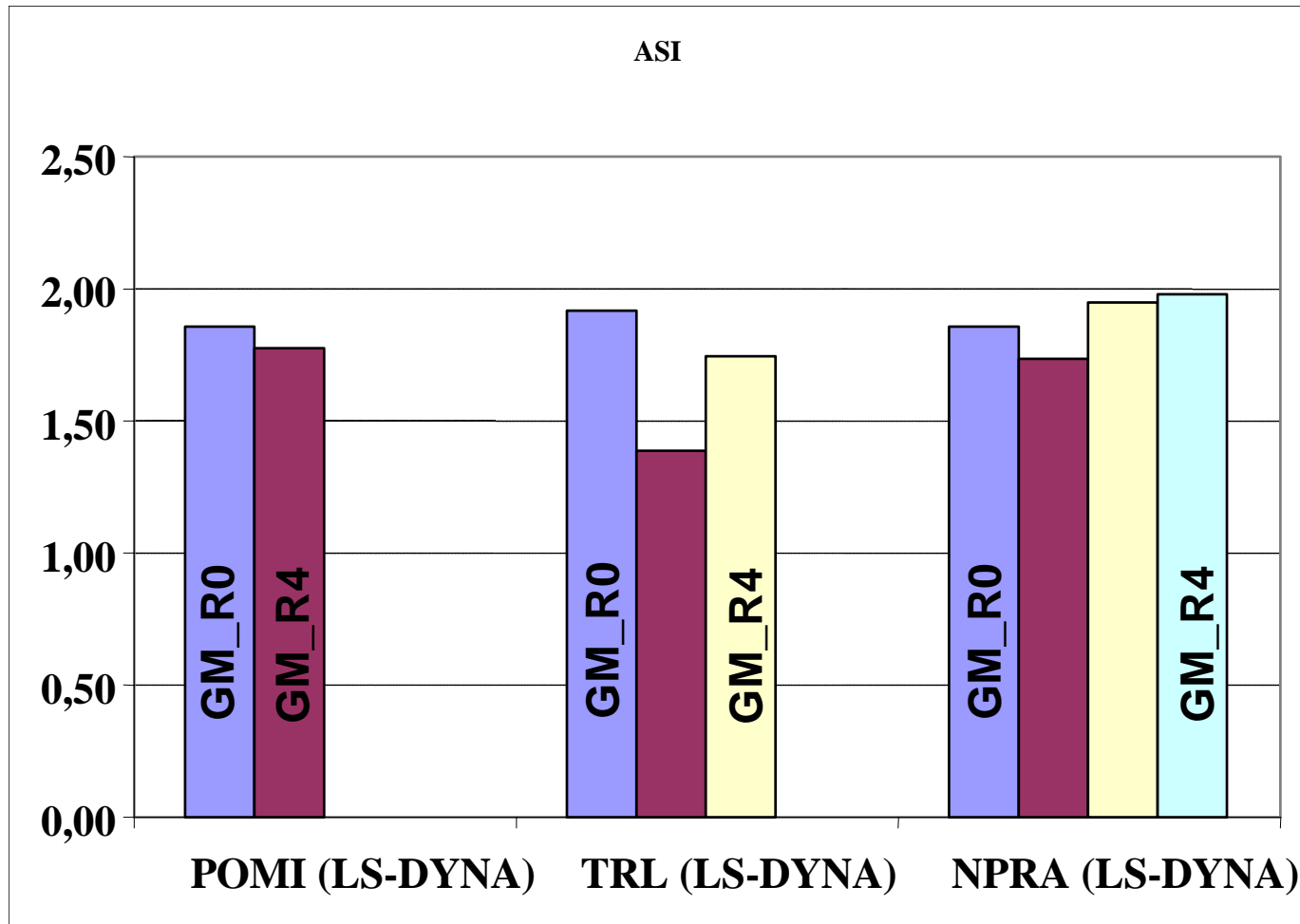
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Concrete - Input parameters

- Vehicle versions (GM_R2 vs. GM_R0)
- Vehicle test mass
- Friction barrier vs. vehicle



Concrete - results



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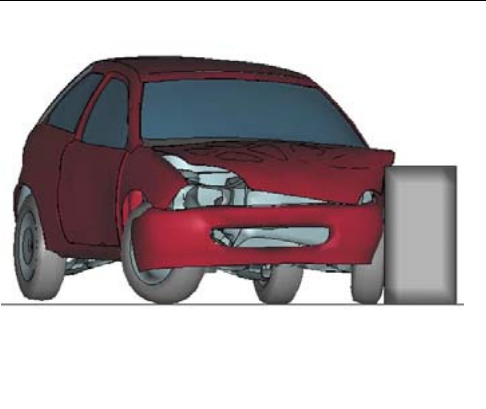
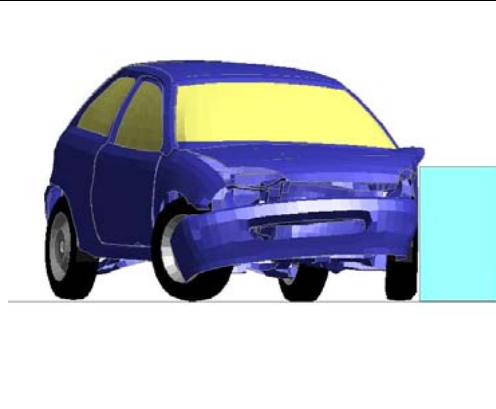
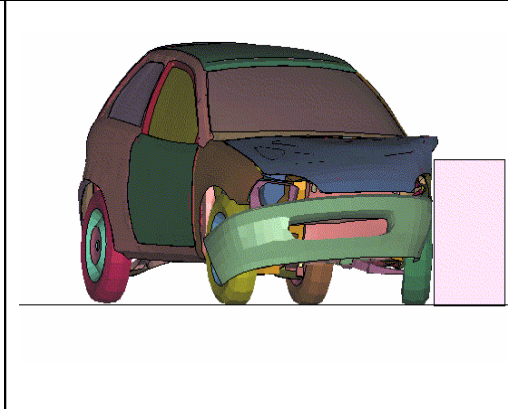
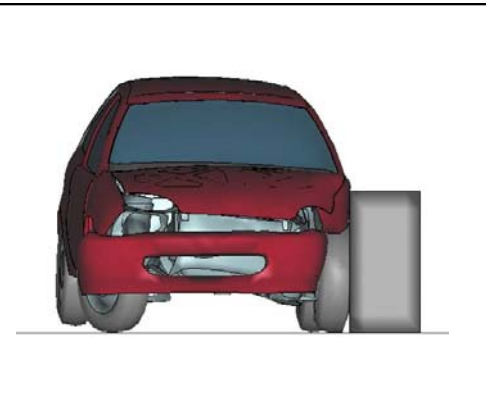
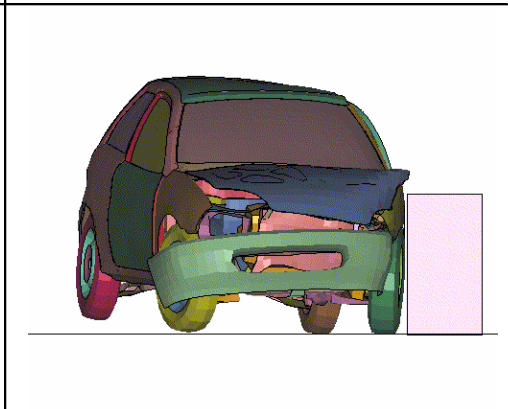


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Concrete - results

POMI – GM R4	TRL – GM R4	NPRA – GM R4
		
Time = 0,05 sec	Time = 0,08 sec	Time = 0,05 sec
		
Time = 0,10 sec	NA	Time = 0,10 sec

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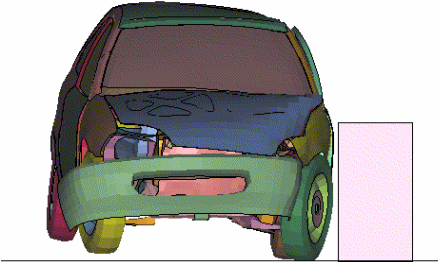
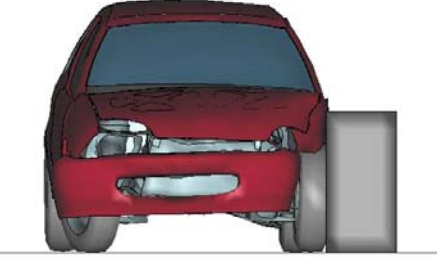

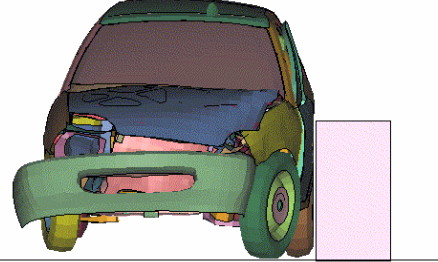
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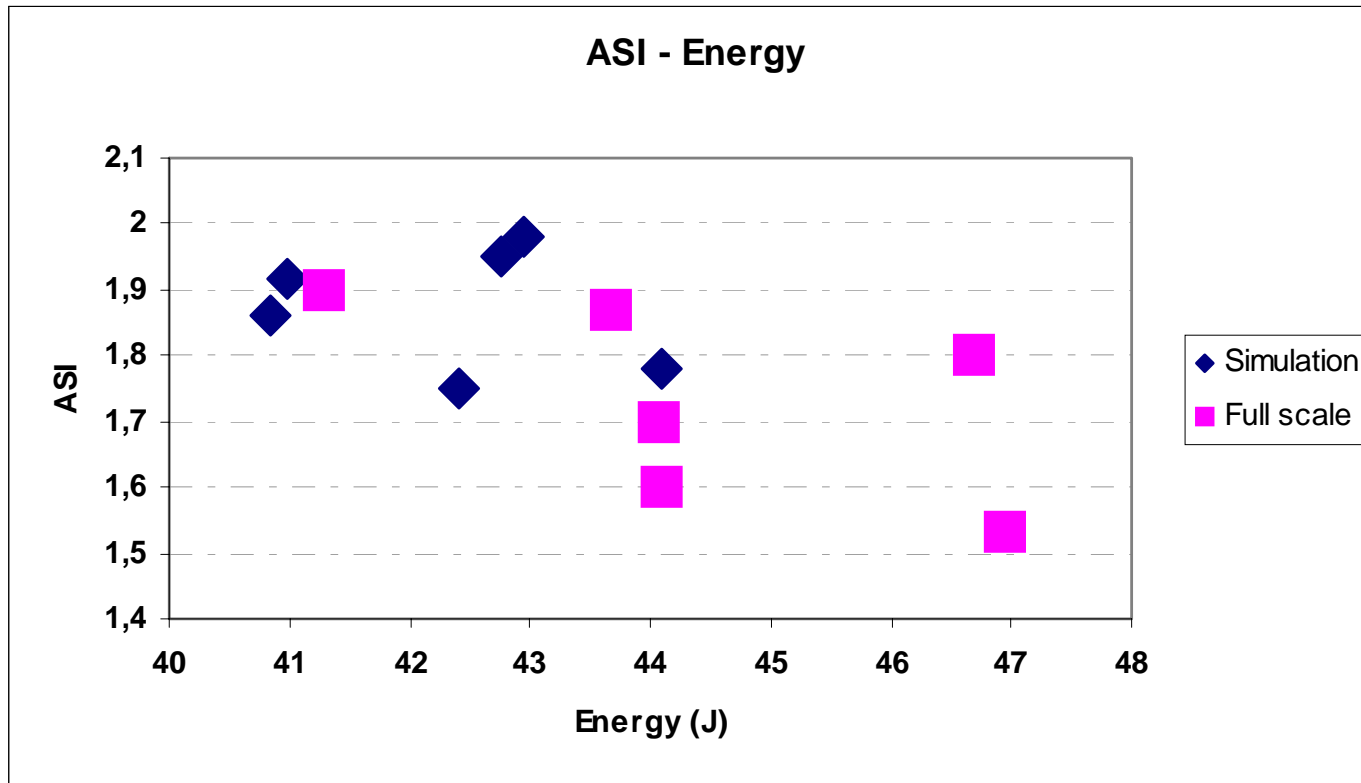
Concrete - results

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POMI – GM R4	TRL – GM R4	NPRA – GM R4
		
Time = 0,15 sec	Time = 0,16 sec	Time = 0,15 sec
		
Time = 0,20 sec	Time = 0,24 sec	Time = 0,20 sec



Concrete – comparison full-scale test



ASI
Simulation:
 Std. Dev: 0,09
 Mean: 1,87

Full-scale test:
 Std.dev: 0,15
 Mean: 1,73



SuperRail Steel H3 (Barrier B2)



Picture from TRL

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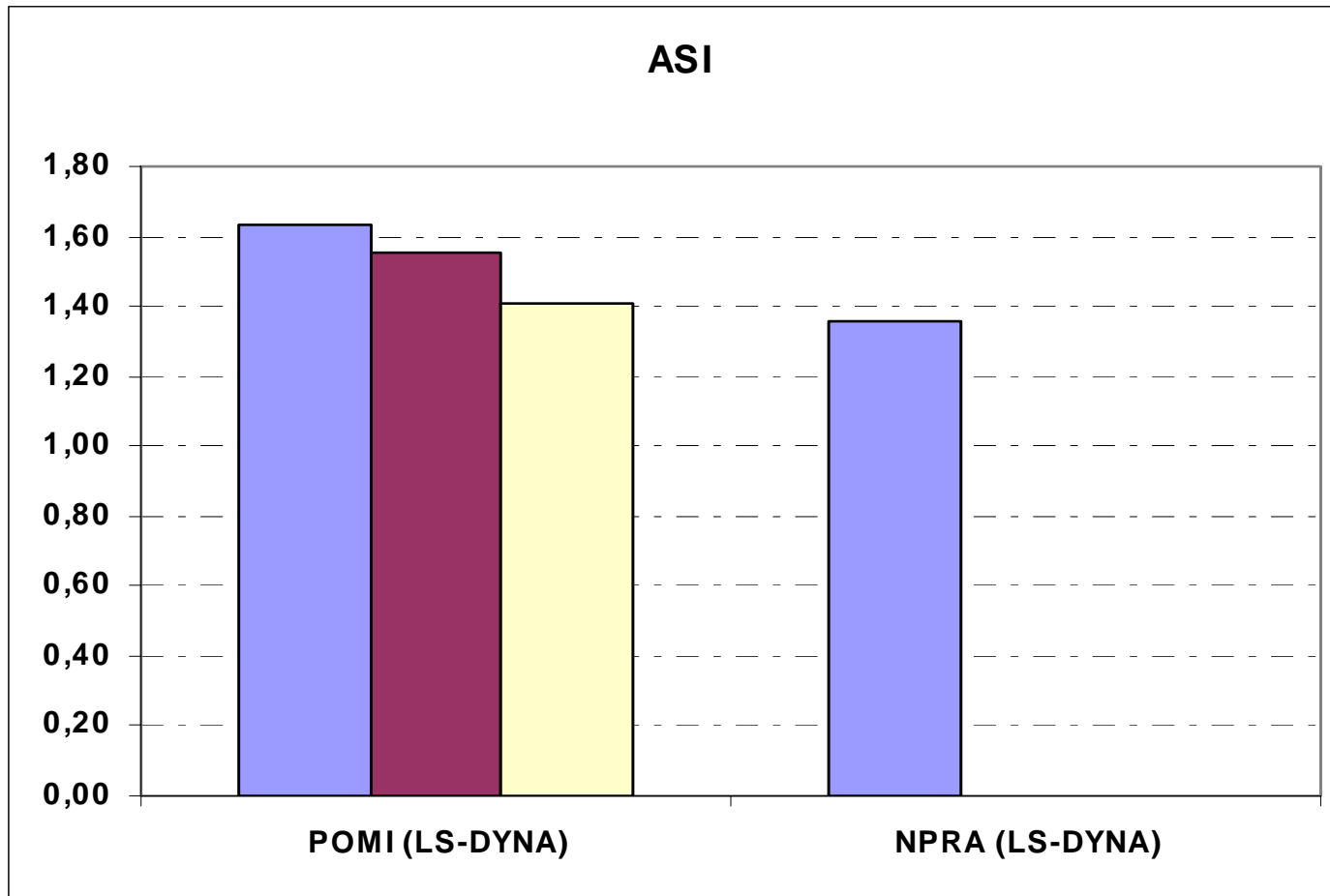
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SuperRail – Input parameters

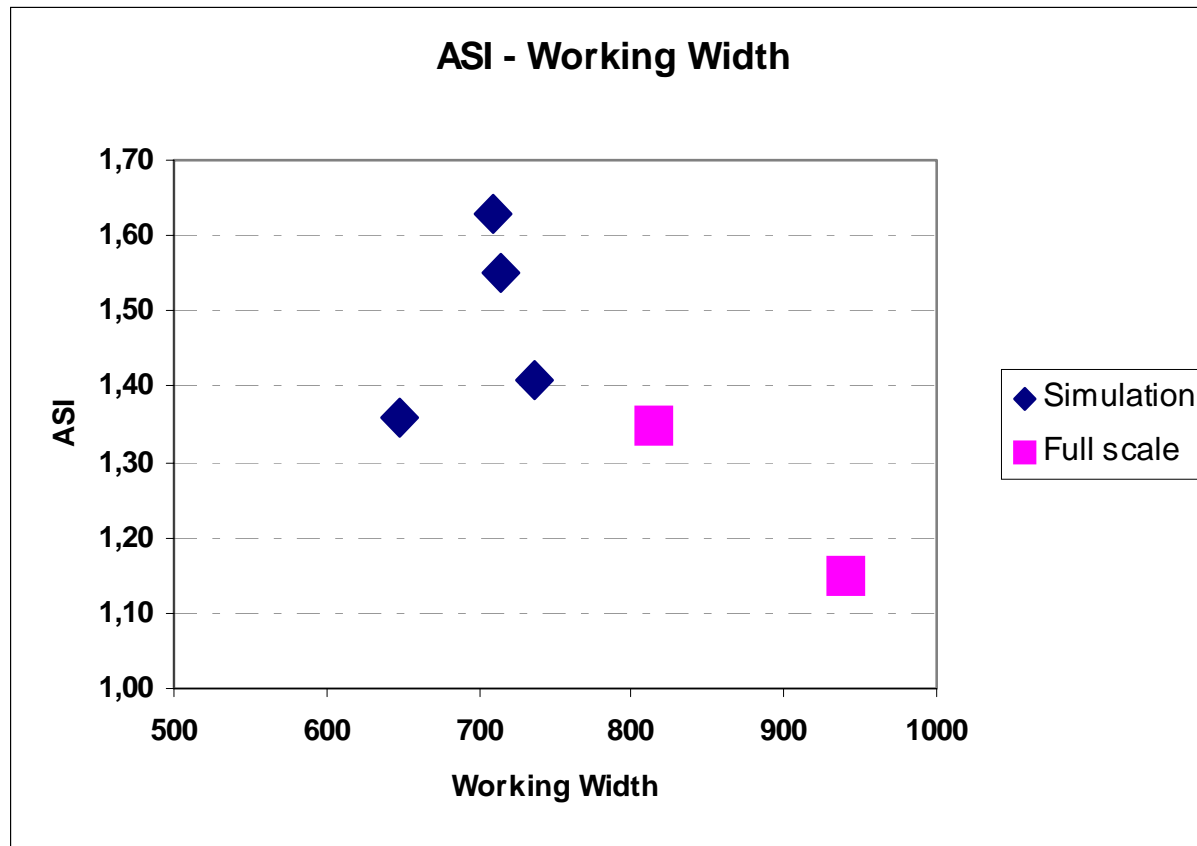
- Different version of GeoMetro used
- Fixation to ground different
- End boundaries different
- Slightly different material data



SuperRail - Results



SuperRail - comparison with full-scale test



ASI
Simulation:
Std. Dev: 0,12
Mean: 1,49

Full-scale test:
Std.dev: 0,14
Mean: 1,25



VarioGuard Steel H2 (Barrier B3)



Picture from www.volkmann-rossbach.com



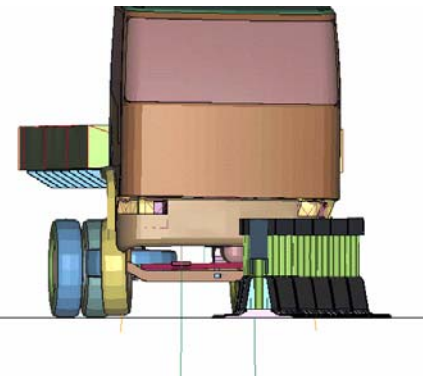
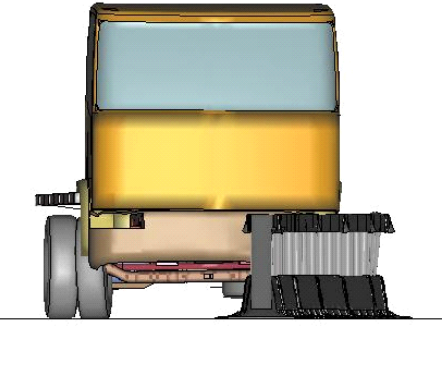
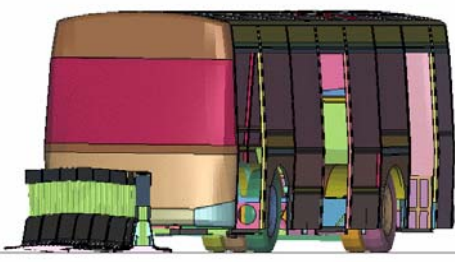
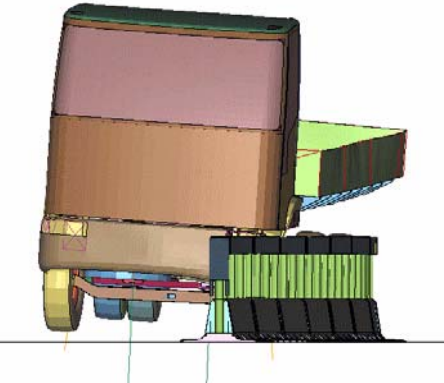
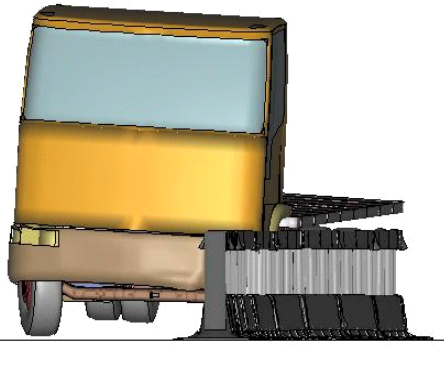
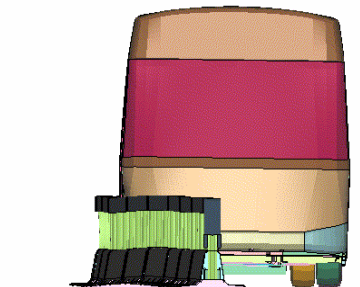
VarioGuard – input parameters

- Three different vehicles have been used:
 - 10t Lorry
 - 13t Bus
 - Small car (GeoMetro)



VarioGuard

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NPRA – 10t	POMI – 10t	NPRA – Bus
		
Time = 0,4 sec	Time = 0,45 sec	Time = 0,40 sec
		
Time = 0,80 sec	Time = 0,75 sec	Time = 0,80 sec

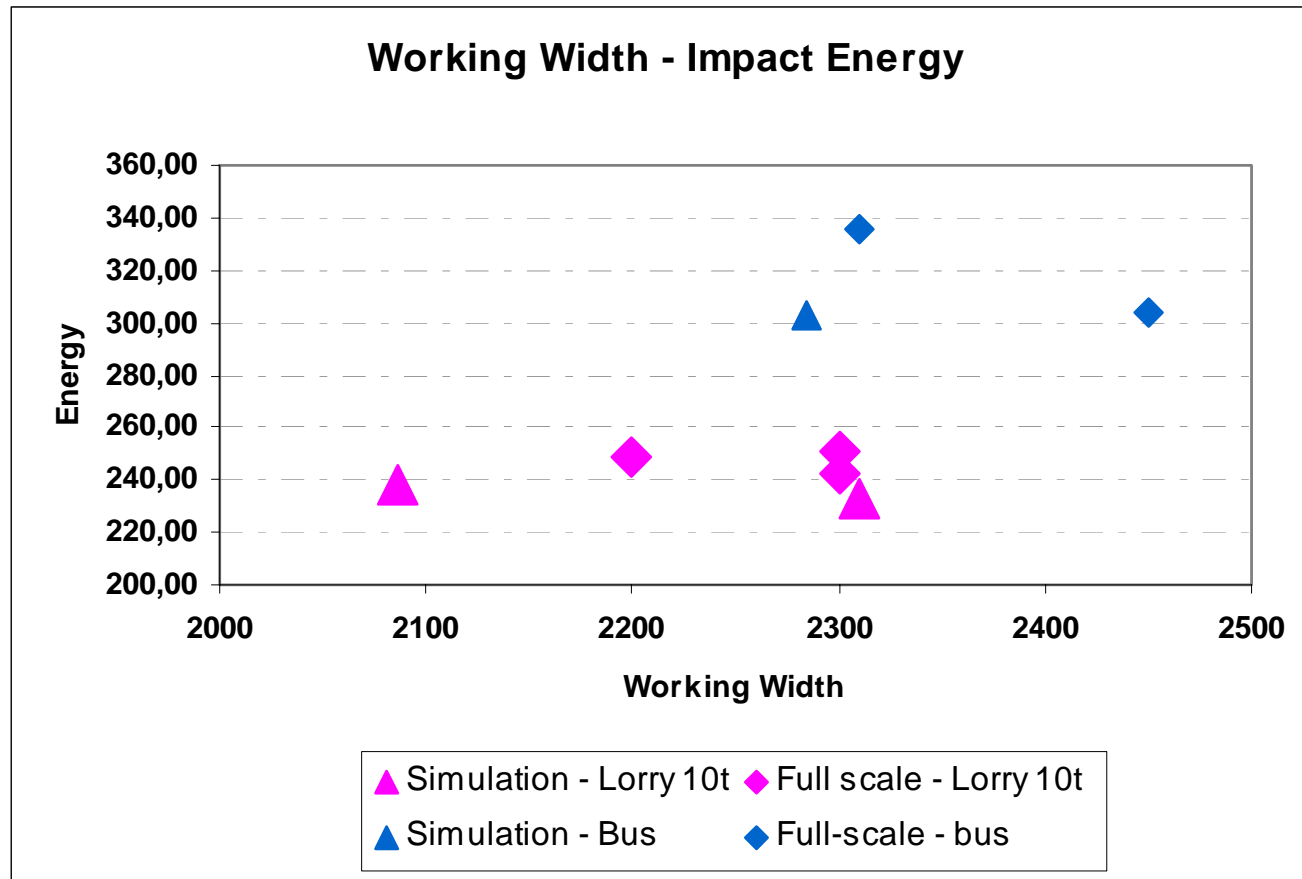


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VarioGuard – comparison with full-scale test



**W – 10t Lorry
Simulation:
Std. Dev: 158
Mean: 2198**

**Full-scale test:
Std.dev: 58
Mean: 2267**





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