The Technology of Highway Safety

LAY-BYS AND PROTECTION AGAINST LATERAL OBSTACLES SITUATION IN SLOVENIA

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LAY-BYS - END WALL PROTECTION

Lay-bys as you can see in most European tunnels – safe?

In Slovenia:

Yes - until 2010

No - after 2010

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Some basic facts:

Statistic data:

Total number of tunnels:	21
Tunnels with lay-bys:	6
Number of lay-bys:	24
Tunnels under construction:	1
Lay-bys under construction:	4
Speed limit in most tunnels:	100 km/h

Lay-bys elements in tunnels:

- lay-bys width: 3 meters
- lay-bys length: 40 meters / 48 meters or 55 meters

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Basic solution was rejected by authorities

Computer simulation:

Performed by University of Ljubljana, Faculty of Mechanical Engineering.

Performed according to EN 1317-3.

Three possible solutions were studied:

- short guard rail – length 4 m,
- long guard rail – length 8 m,
- modified crash cushion – length 4 m, width 2 m.

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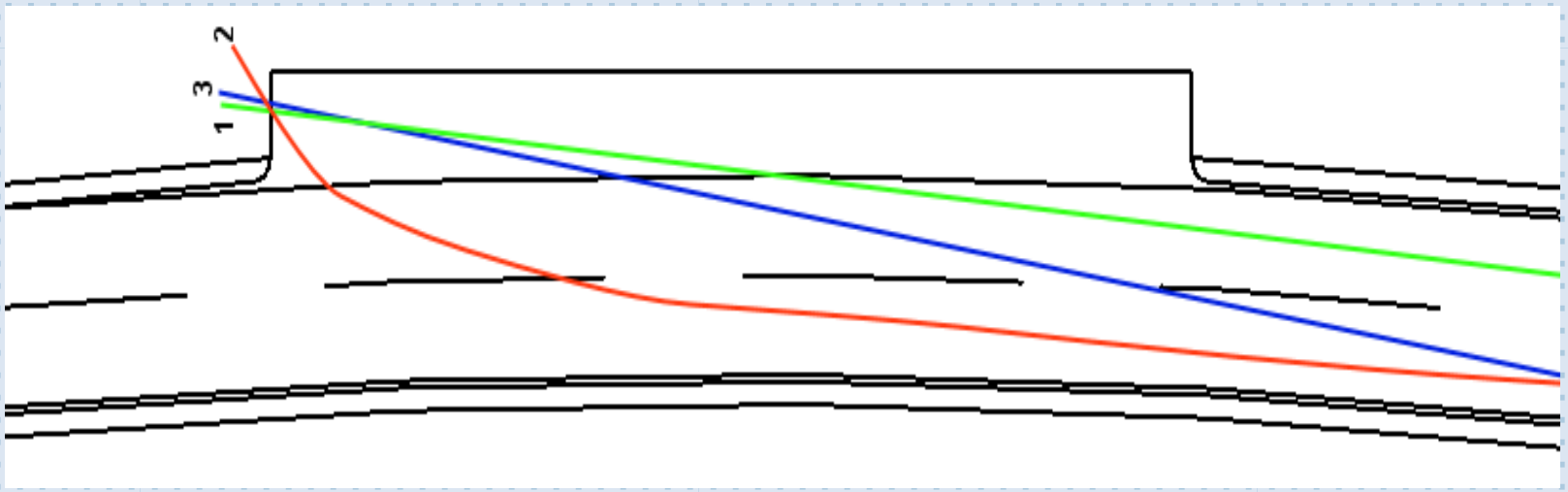
Since 2010 when crashes started to occur 13 people died.

Drivers were, except in one case, alone in the car.

Only in two cases suicide was confirmed.

Crash trajectories (established from video cameras).



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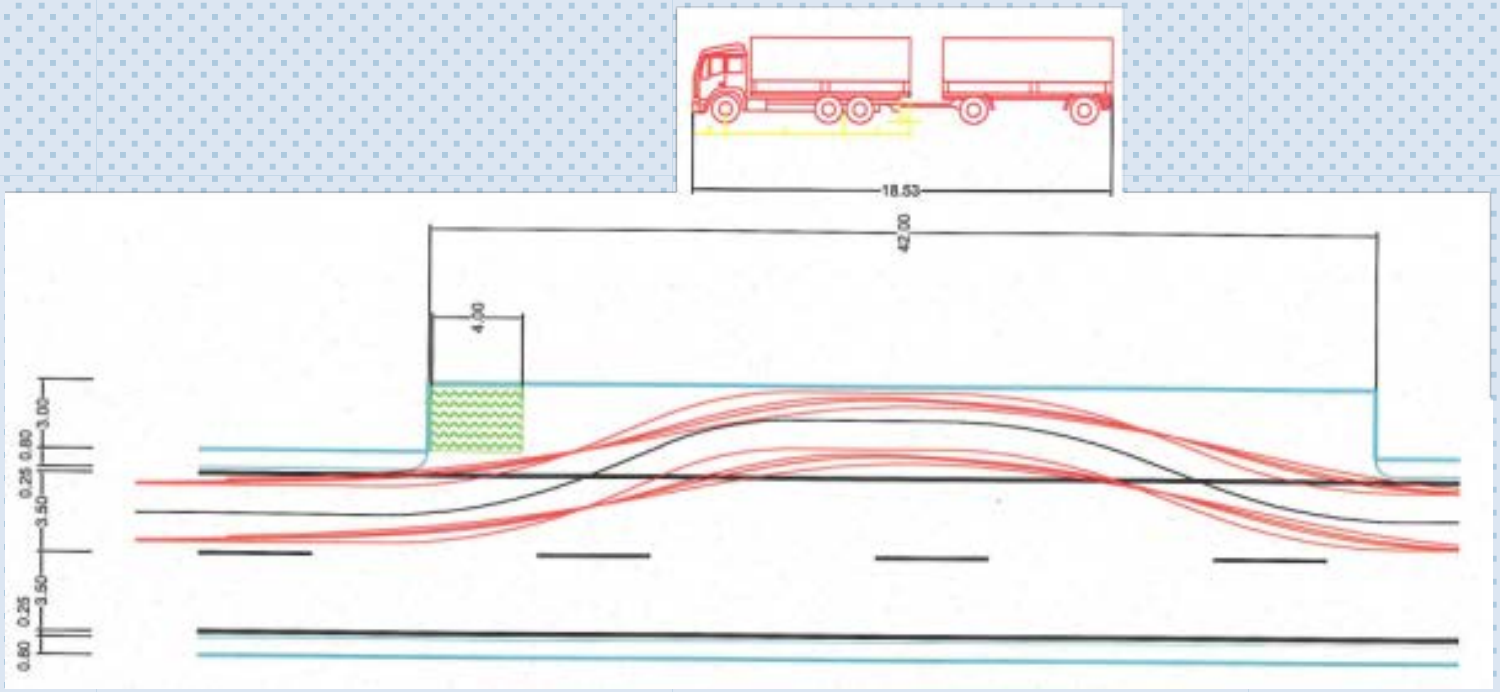
Available space:

Lay-by's length: 40 m

Minimal necessary length: 36 m

Available space to install necessary equipment: 4 m



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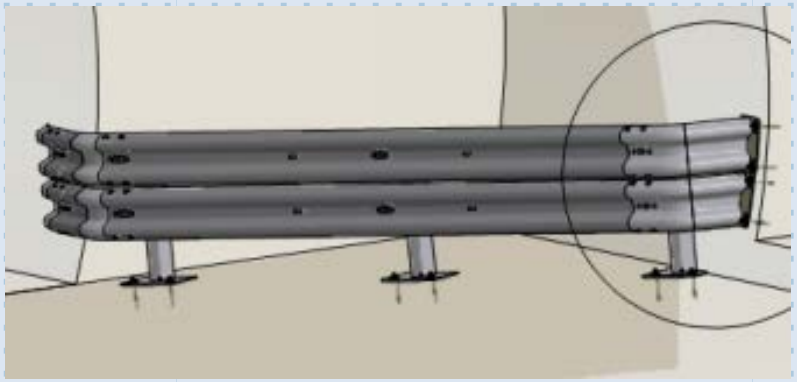
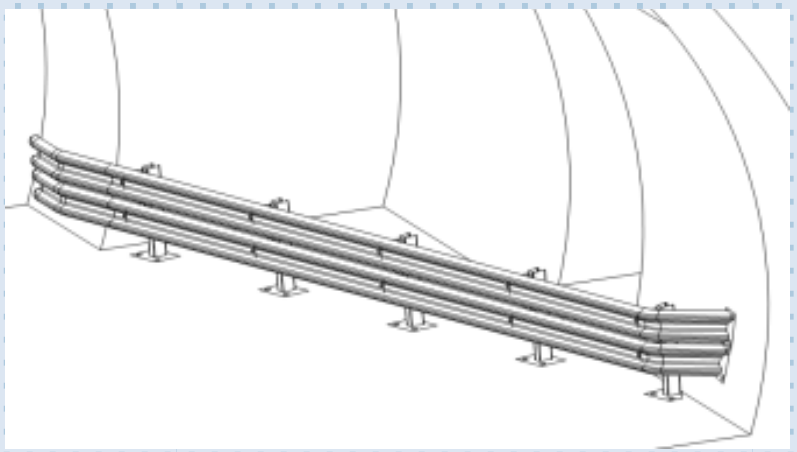
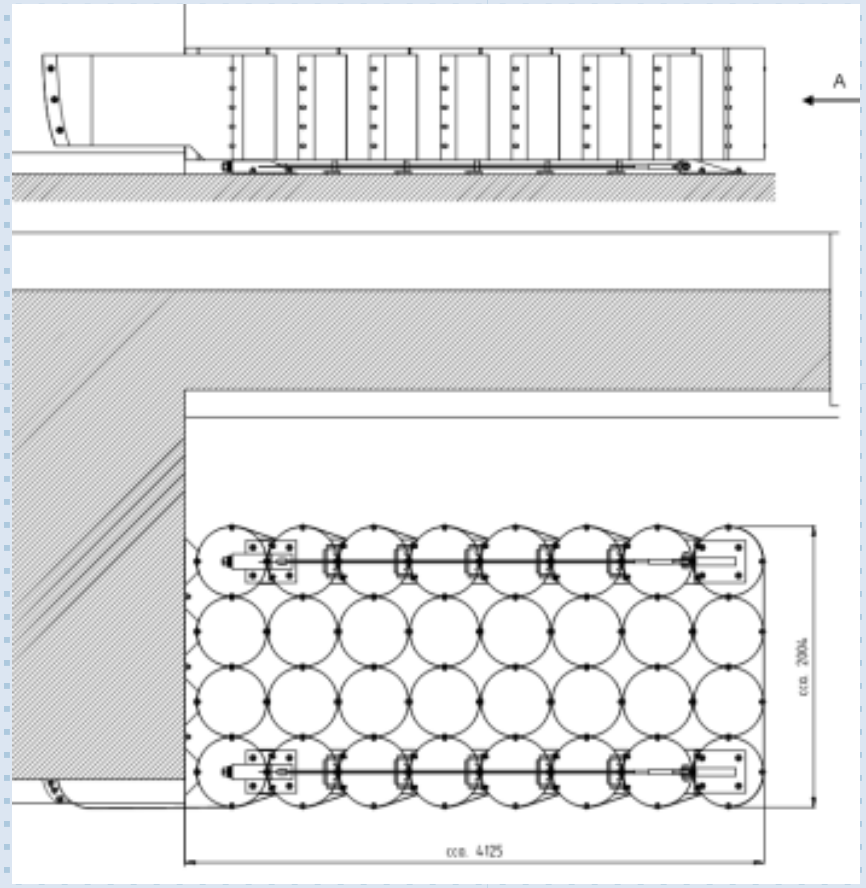
Simulated solutions:







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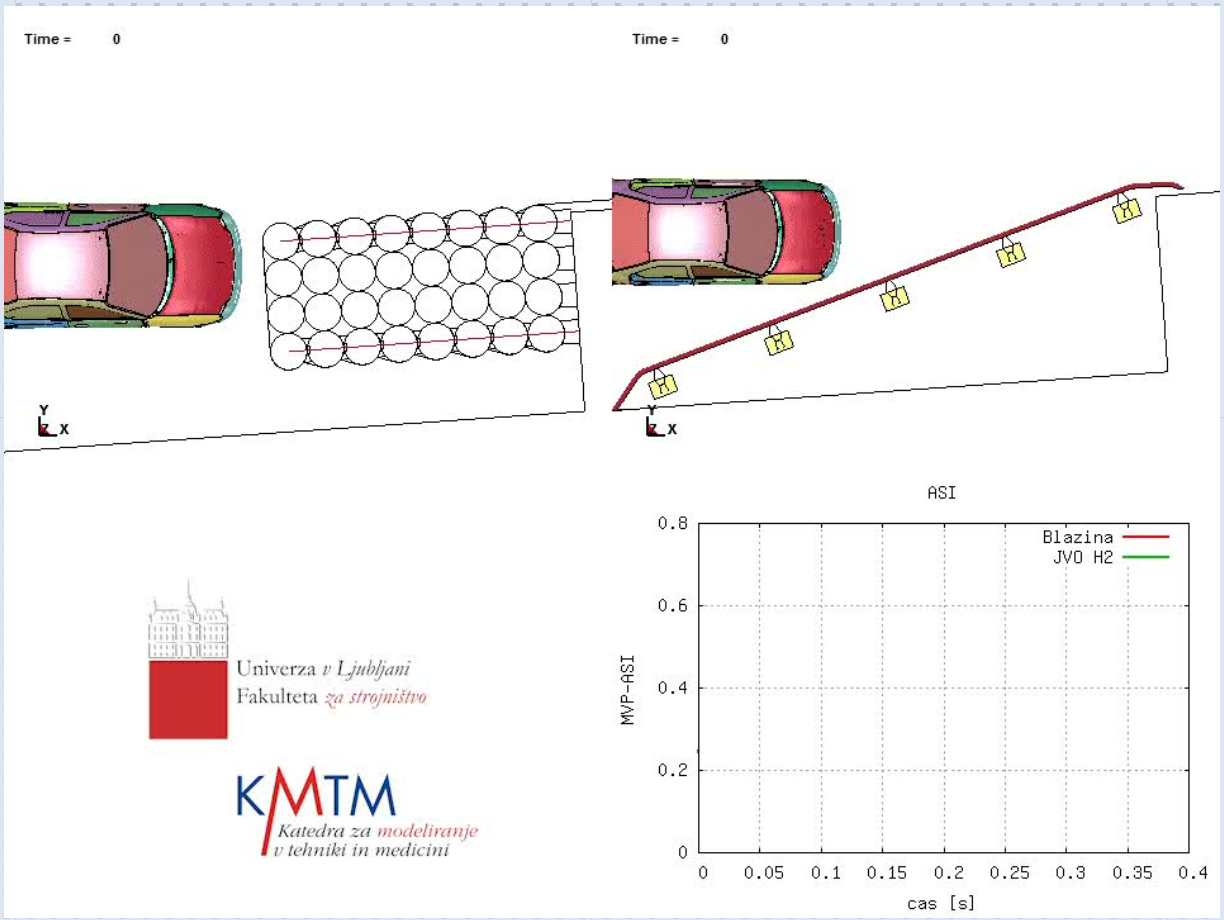
Simulated comparison of the two solutions



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Computer simulation results

	vozilo 900 kg, 80 km/h			vozilo 1300 kg, 100 km/h		
	JVO kratka	JVO podaljšana	blazina VECU-STOP	JVO kratka	JVO podaljšana	blazina VECU-STOP
MVP-ASI [/] NIVO A (ASI≤1,0) NIVO B (1,0≤ASI≤1,4)	1,57	1,11	1,25	2,20	1,57	1,03 (B)
THGU-THIV [km/h] Dovoljena meja THIV≤44 g	42,58	37,34	42,78	53,13	36,91	42,49
PGU-PHD [g] Dovoljena meja PHD≤20 g	30,42	16,23	15,78	58,28	34,80	18,18

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Conclusions

Computer simulation results show that for existing tunnels modified crash cushion is the optimum solution. But it has to successfully pass crash test and obtain CE certificate.

Number of necessary crash cushions (24) does not justifie the costs for crash tests.

Since there is no available product tested for 80 km/h or even for 100km/h that would optimally fit in to 4 m box like designed one, we had to use available tested products. We had limited success.

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Future activities

Enhance visibility

Larger signs

Slow down traffic

Section control

Modify lay-bys

Inclined walls

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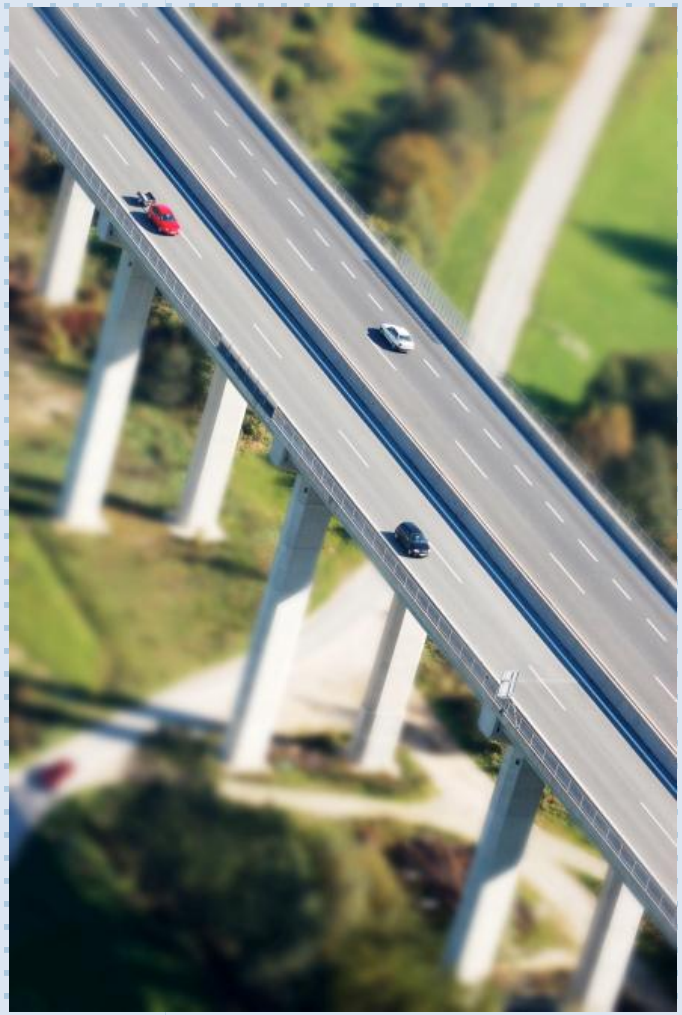

Thank you for your attention.

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