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# INJURY HAZARD IN COLLISIONS WITH ROADSIDE INFRASTRUCTURE

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Seminar

**GAMBIT**  
**2008**

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WIMED, EKKOM



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## Road restraint elements



**LATTIX**



**CASS**



**TRACC**



**EURO-ET**

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## Road restraint elements (poles)



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[203.Avi](#)

[203a.avi](#)



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## Three category of passive safety of sign supports

- high level absorption (HE)
- low level absorption (LE)
- non energy absorption (NE)

**Norm EN –PN 12767**

**Coefficient of energy absorbed by car in collision with object is called EES/EBS (Energy Equivalent Speed/Equivalent Barrier Speed).**

**$\Delta v$  of car is called „dose of poisson”, it is also measure of injury risk of passengers**

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## Category of energy absorption

Collision speed $v_i$ [km/h]	50	70	100
	Exit speed $v_e$ [km/h]		
<u>HE</u>	$V_e = 0$	$0 \leq v_e \leq 5$	$0 \leq v_e \leq 50$
<u>LE</u>	$0 < v_e \leq 5$	$5 < v_e \leq 30$	$50 < v_e \leq 70$
<u>NE</u>	$5 < v_e \leq 50$	$30 < v_e \leq 70$	$70 < v_e \leq 100$

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# Characteristic parameters of restraint systems

wg. EN-PN 12767 i 1317-1

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**ASI** – Acceleration Severity Index , nondimensional index of acceleration of car body; can be interpreted as the values below which passenger risk is very small. Limit of accelerations ( $a_x = 12 \text{ g}$ ,  $a_y = 9 \text{ g}$ ,  $a_z = 10 \text{ g}$ )

**ASI** = max [ASI(t)] Calculated value of ASI compare to corresponding level:  
0.6, 1.0, 1.2, 1.4

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**THIV** – Theoretical Head Impact Velocity (velocity in km/h), speed of theoretical „head” during contact with the vehicle inner surface. Velocity calculated according norm obtain gradually values: 3, 11, 27, 33, 44 km/h).

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**Safety level** – in scale 1 – 4 for passenger: tests for two speeds: 35 km/h and speed according declared value, tj. 50, 70, 100 km/h.

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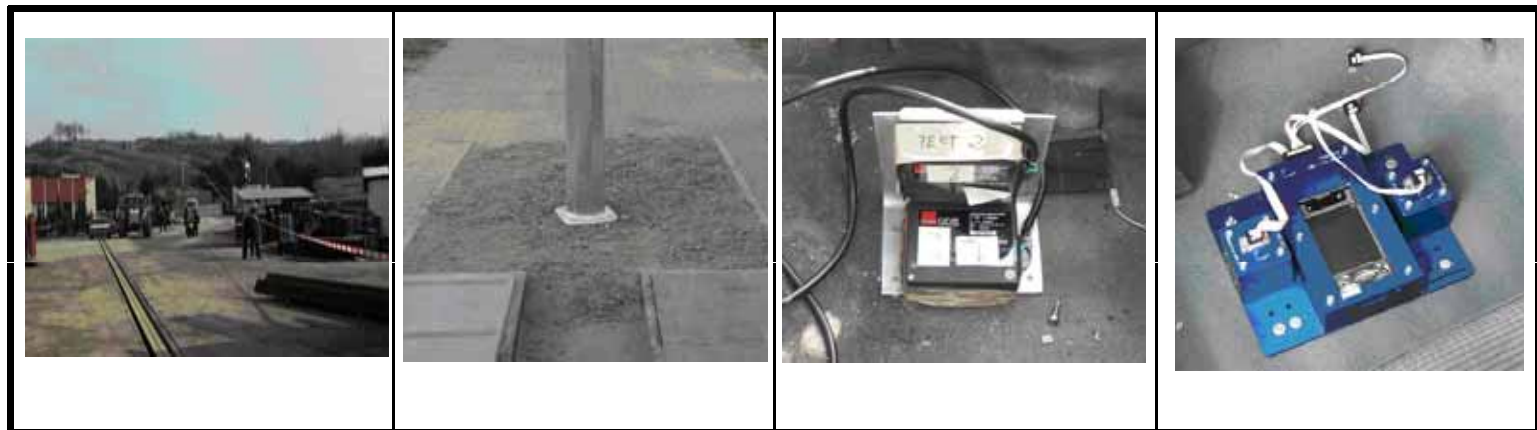
## Elements of roadside infrastructure – WIMED - investigation

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Different sorts of supports on X-307 profile base

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Collision track and instrumentation devices: UDS i DAQ

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# Results of investigations



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Obiekt	PSW X-307	latarnia stalowa	plaska 2x2 X-307 plaskownik	plaska 2x2 60 mm plaskownik
Samochód	Fiat Tipo	F125p	F125p	F125p
$V_p$ (km/h)	54,0	63,0	62,0	64,0
$V_e$ (km/h)	30,5	24,0	55,0	43,0
$\Delta V$ (km/h)	23,5	38,0	7,0	21,0
$a_x$ max	7 g	8 g	7 g	7 g
ASI	0,45	0,52	0,19	0,53
THIV (km/h)	21,9	27,5	8,2	21,7
kateg.	NE	NE	NE	NE
UWAGI				
				



X- 307 profile



pipe 60 mm

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# Risk of injury in collision with elements of restraint system

Risk it is a possibility that in a given time or given circumstances an undesirable effect will occur.

**Risk** = probability of effect x quantity of undesirable effects

**Final risk** = partially risk (1) + partially risk (2) +.....

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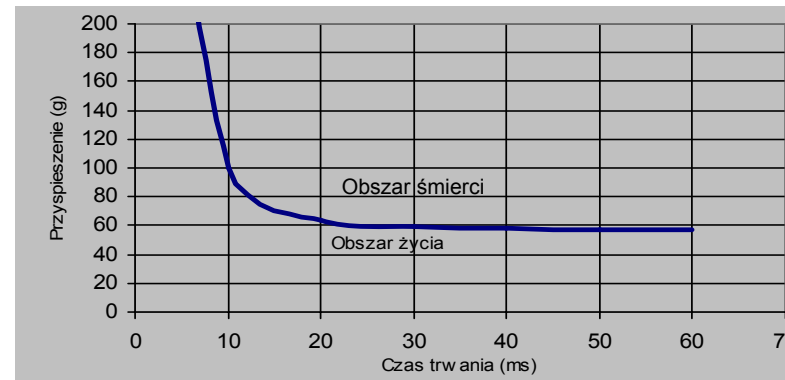
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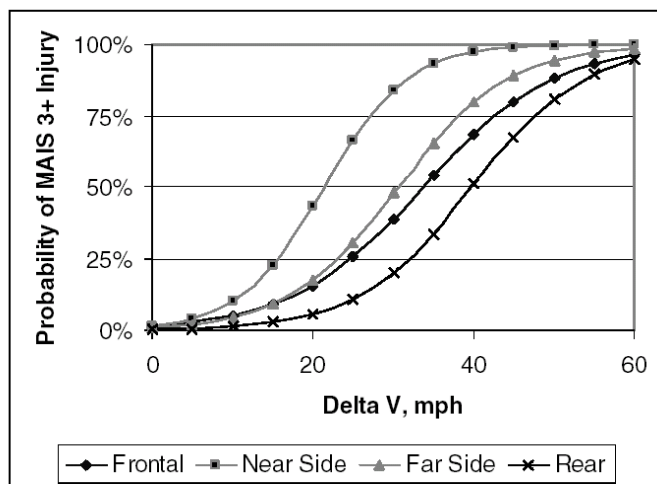
# Quantity of undesirable effects

**AIS (Abbreviation Injury Scale)** AAAM (Association for the Advancement of Automotive Medicine)

- AIS = 0** uninjured
- AIS = 1** minor
- AIS = 2** moderated
- AIS = 3** serious
- AIS = 4** severe
- AIS = 5** critical
- AIS = 6** maximal



(Wayne State Tolerance Curve for Head)



**Risk of injury bigger than 3 (MAIS 3+) at particular velocity change  $\Delta v$**

Ciężkość obrażeń	Względne koszty
MAIS 1	0.0038
MAIS 2	0.0468
MAIS 3	0.1655
MAIS 4	0.4182
MAIS 5	0.8791
MAIS 6 (śmierć)	1.0000

**Relative costs of injury in accident (1 person)**

**HARM=13,401 [ASI]<sup>1,54</sup>**

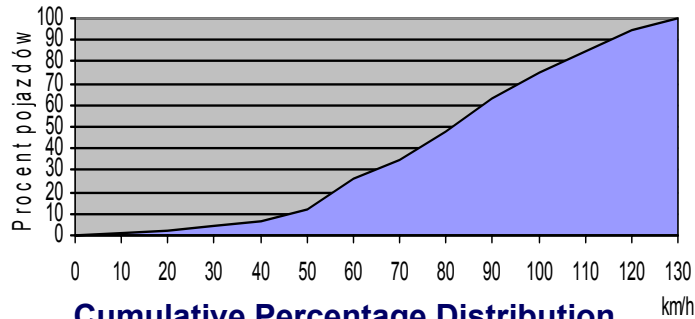
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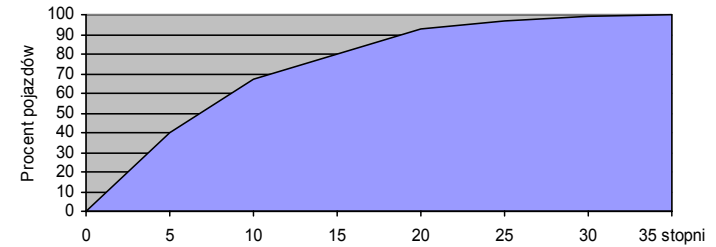
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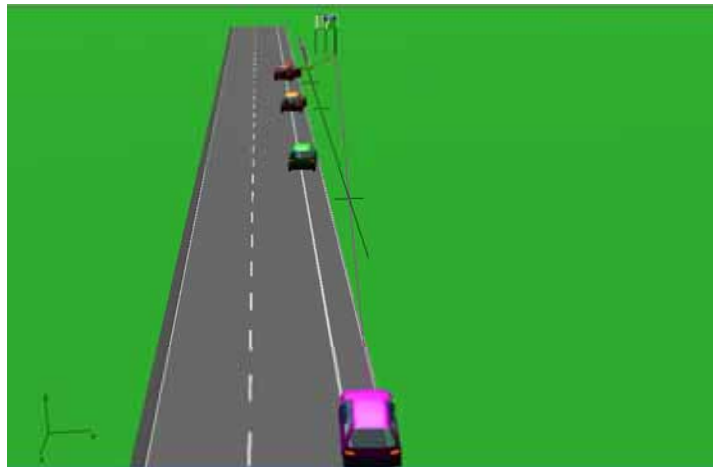
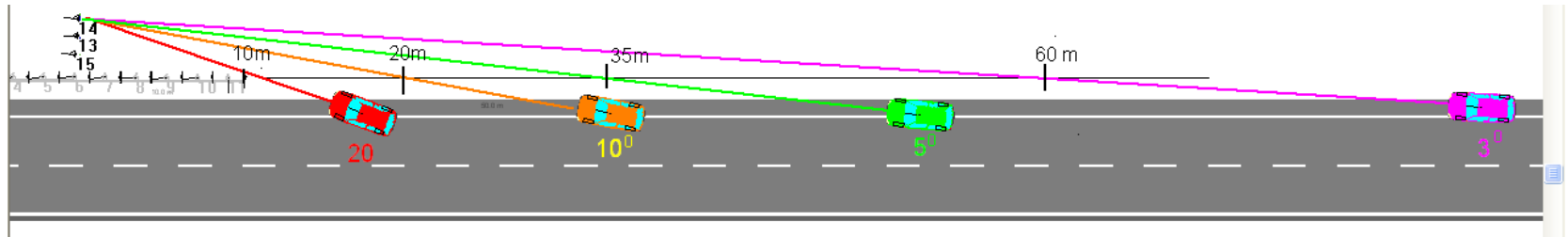
# Calculation of risk



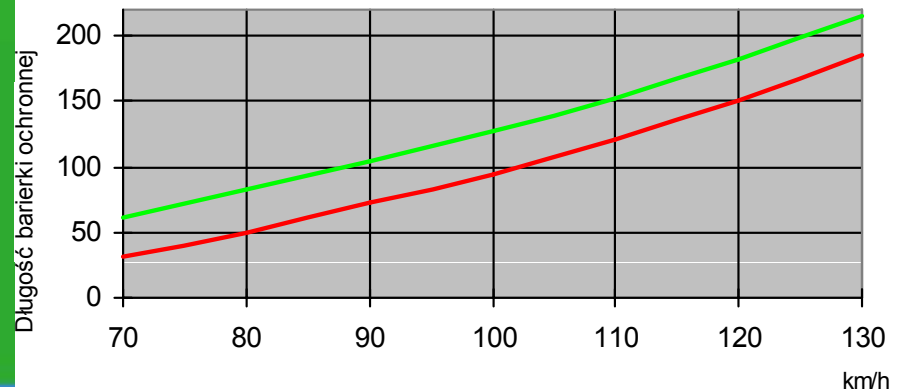
Cumulative Percentage Distribution of Exit Speeds (RISER).



Cumulative Percentage Distribution of Initial Exit Angle (RISER).



Minimal length of roadside barrier vs. speed



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## Example from roads



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# Comparison of risk of collision



I. Classical supports

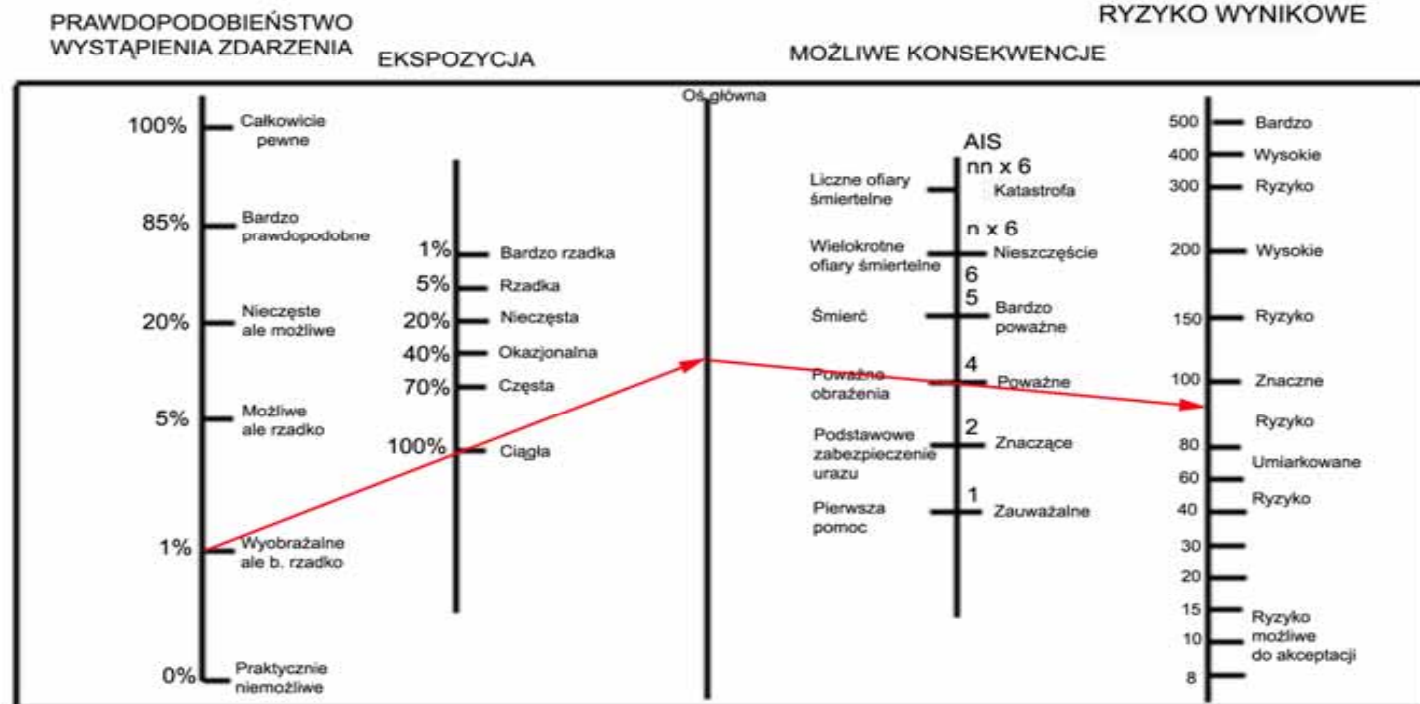


II. Classical supports + barrier



III. Safety supports

## KALKULATOR RYZYKA



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# Comparison of risk of collision



I. Classical supports



II. Classical supports + barrier



III. Safety supports

KALKULATOR RYZYKA

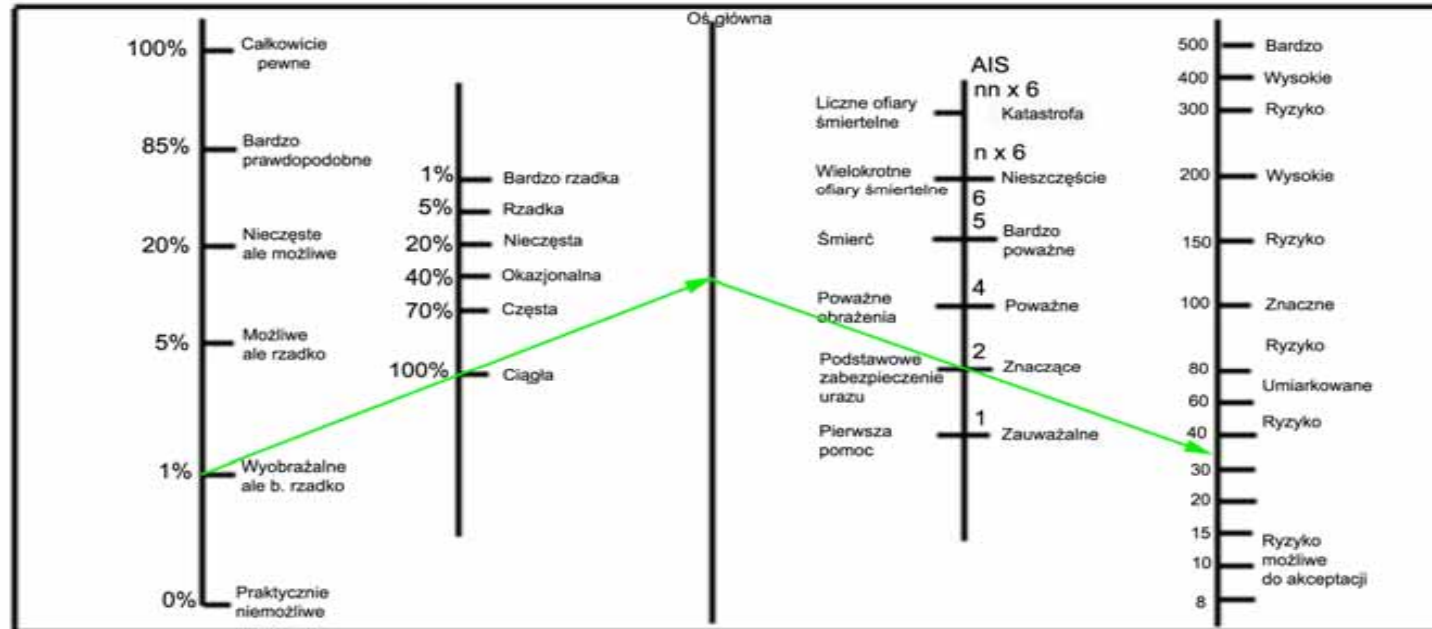


PRAWDOPODOBIEŃSTWO  
WYSTĄPIENIA ZDARZENIA

EKSPOZYCJA

MOŻLIWE KONSEKWENCJE

RYZYO WYNIKOWE



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# Comparison of risk of collision



I. Classical supports



II. Classical supports + barrier



III. Safety supports



I. Classical supports

90

III. Classical supports + barrier

35

II. Safety supports

40 - 42

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**Thank you for your attention**

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