

*Road safety Engineering  
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# *Road Restraint Systems EN1317 Application Tools*

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# Overview

Road safety context

EN1317 Application Tools

# Road safety context

## The problem on EU25 roads :

- 42,000 persons killed/year
- 1,213,300 persons injured/year



# Road safety context

## The problem on EU25 roads :

- Estimated social costs = €200bn/years = 2 % EU GDP












→ Europe asked to halve road fatalities < 2010 (white book)

# Road safety context

## The solutions :

- Are described in the well-known “Haddon Matrix”

<i>Haddon Matrix</i>	Driver	Car	Road
<b>Before</b>			
<b>During</b>			
<b>After</b>			



# Road safety context

## The driver :



- Inform and educate the drivers
- Strengthen radar controls, police presence, ...
- Education on reflexes in case of danger
- Decrease time to arrive on accident place
- Increase the emergency call possibilities

# Road safety context

## The car :



- Impose regular car inspections
- Inform the driver on the car's level of safety
- Increase energy absorption possibilities
- Impose use of seatbelts, airbags, ...
- Help cars communicate with emergency

# Road safety context

## The infrastructure :



- Make clear and visible signs
- Facilitate the driver choices
- Make safe road designs
- Provide the safest road restraint systems
- Make infrastructure interact with drivers
- Make speed the emergency calls easier

*Today's topic*

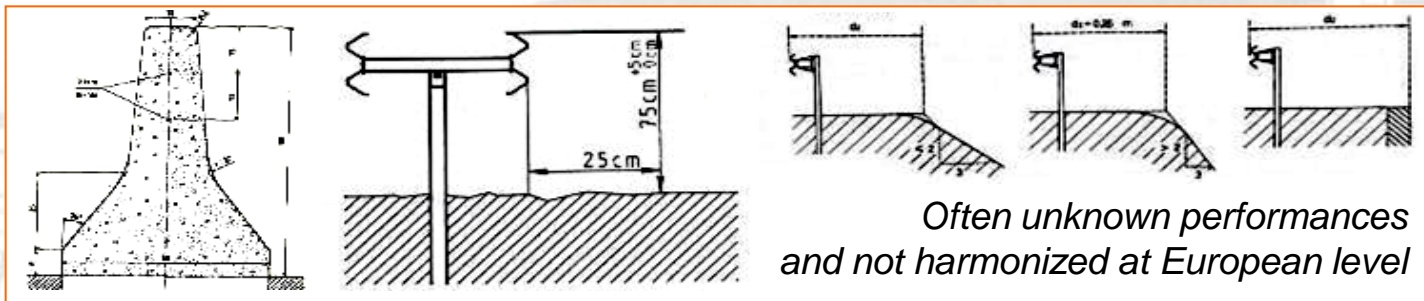
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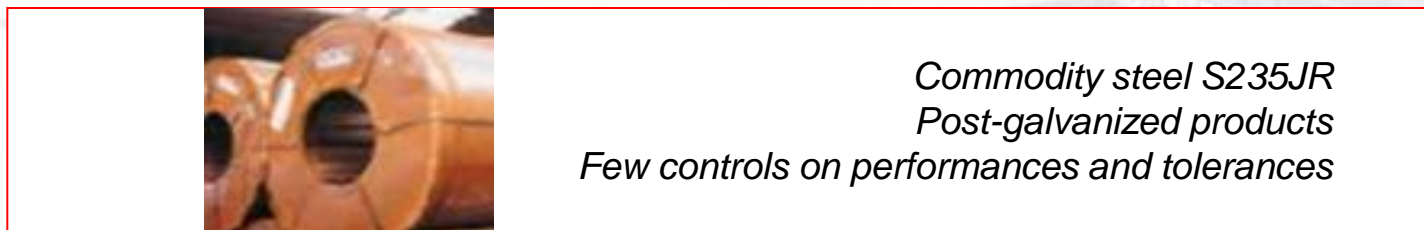
# Road safety context

## The infrastructure – situation before EN1317 :

- Imposition of the type of safety barriers to be used:



- Imposition of materials & designs:



**→ No possible innovation on design or material**

# Road safety context

## The infrastructure – situation before EN1317 :

– Conclusions :



→ Implementation of new Standard based on performance: EN1317

# Road safety context

## The infrastructure – situation with EN1317 :

Prescriptive standards ...

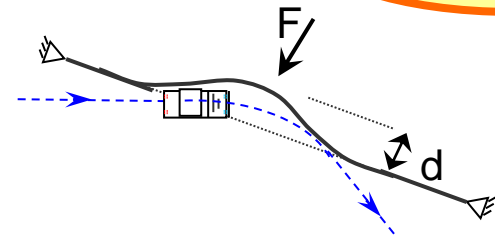


Performance standards

# Road safety context

## OLD infrastructure (before EN1317) :

	Hard shock ( $F \gg \gg$ )	Soft shock ( $F \ll \ll$ )
Low displacements ( $d \ll \ll$ )	<p><b>OLD RIGID SYSTEMS</b></p>	<p><u>Ideal</u> : <b>Technically difficult</b></p>
High displacements ( $d \gg \gg$ )	<p><u>Worse</u> : <b>All disadvantages</b></p>	<p><b>OLD DEFORMABLE SYSTEMS</b></p>



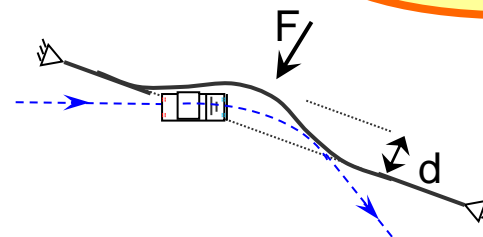
# Road safety context

## NEW infrastructure (with EN1317) :

	Hard shock ( $F \gg \gg$ )	Soft shock ( $F \ll \ll$ )
Low displacements ( $d \ll \ll$ )	<p>OLD RIGID SYSTEMS</p>	<p><u>Ideal</u> : Technically difficult</p>
High displacements ( $d \gg \gg$ )	<p><u>Worse</u> : All disadvantages</p>	<p>OLD DEFORMABLE SYSTEMS</p>

*Annotations:*

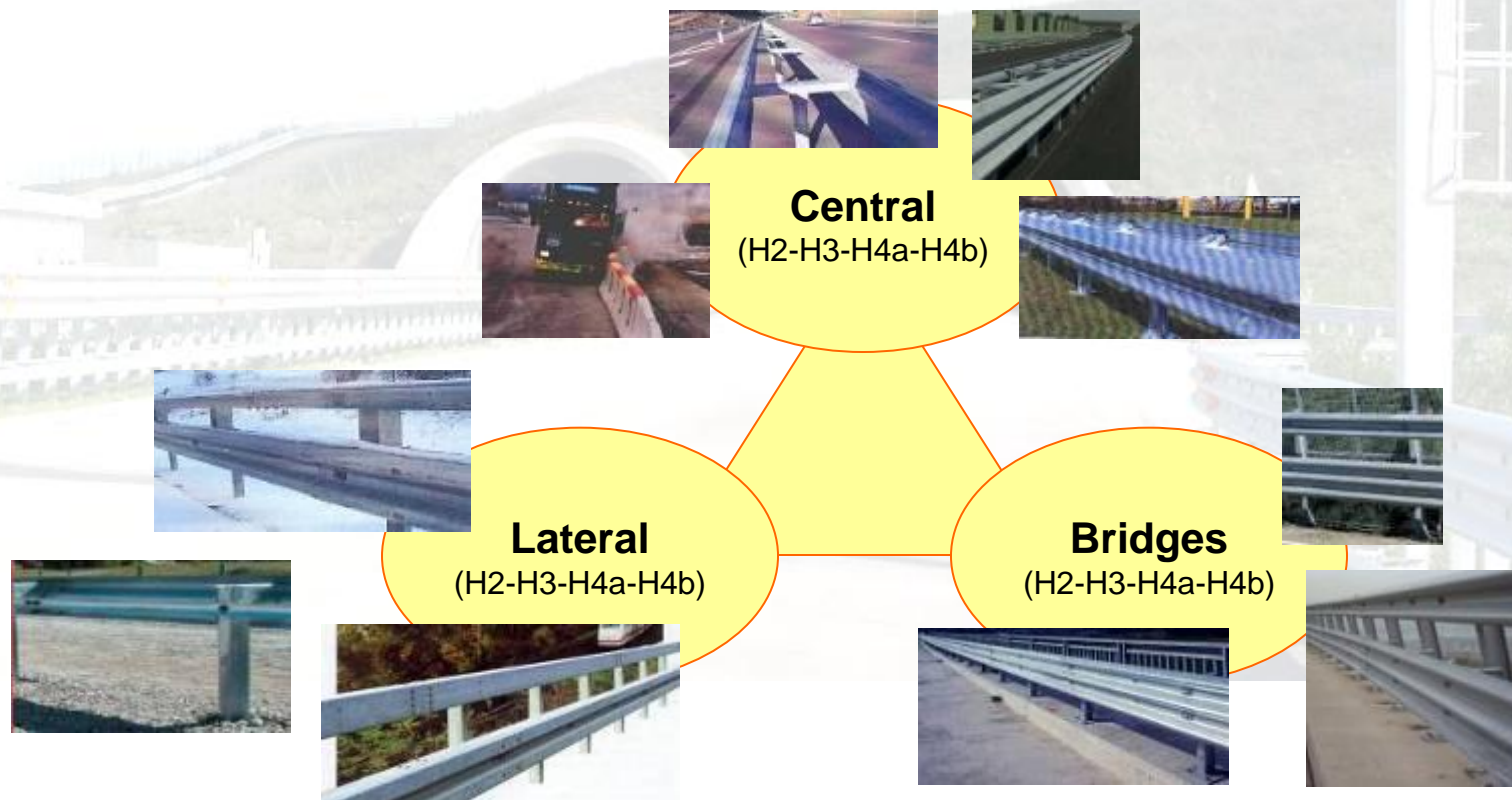
- Yellow oval: OLD RIGID SYSTEMS
- Yellow oval: OLD DEFORMABLE SYSTEMS
- Orange box:  $d \uparrow$  to soften the shock
- Green box: OPTIMUM
- Orange box:  $d \downarrow$  to increase resistance





# Road safety context

A lot of **NEW SAFER** products according to EN1317 :



# Road safety context



Common **bad image of steel** safety barriers:

B  
E  
F  
O  
R  
E  
  
E  
N  
1  
3  
1  
7



← Old steel solutions  
~ **N2, ASI A, W8**

*No heavy vehicles retained  
& huge reparation needed*

Common **bad image of concrete** safety barriers:



← Old concrete solutions  
~ **H2, ASI C, W1**

*Too high risks for the road users  
(severity & stability)*

# Road safety context



New steel safety barriers with less deformation keeping safety:

T  
O  
D  
A  
Y



← New steel solutions  
~ **H4, ASI A, W2\***

*Truck can be retained & 5 times less reparation*

New concrete barriers accepting some deformation for higher safety:



← New concrete solutions  
~ **H4, ASI B, W1\***

*Lower risks for road users*

\* W of the H4b system for an impact of a H2 level ( )to be compared to the previous W)



# Overview

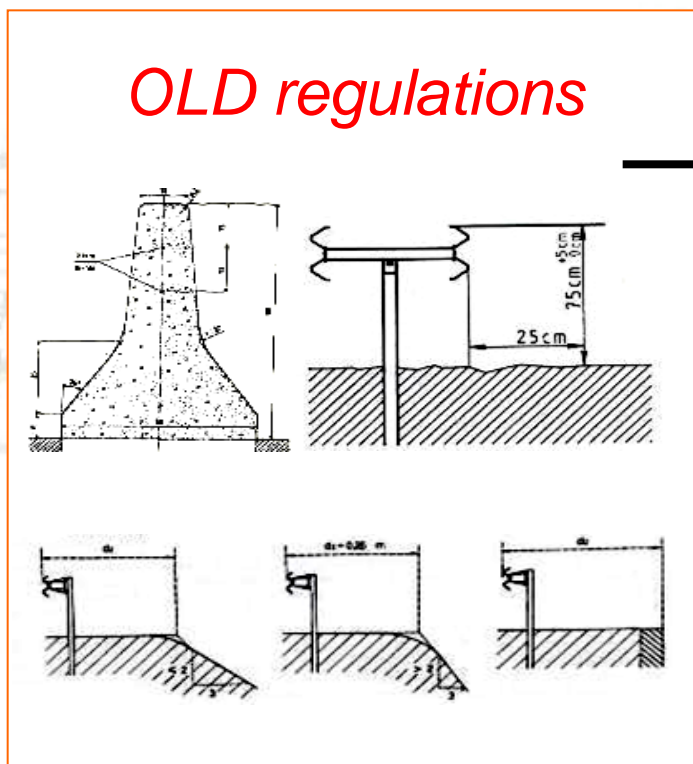
Road safety context

EN1317 Application Tools

# EN1317 Application Tools

Example : How EN1317 could influence National Regulations?

National regulations imposing material & design



**NEW regulations**

Road type	Traffic Type	Median Barriers	Roadside Barriers	Bridge barriers
Motorway (A) and main roads (B)	I	H2	H1	H2
	II			H3
	III			H3-H4
Secondary roads (C) and Urban freeways (D)	I		S5	H2
	II		S < S5	H2
	III		> S5	H3
Urban roads (E) and local roads (F)	I	N2	N1	H2
	II	H1	N2	H2
	III	H1	H1	H2

ASI A preferred to B  
ASI C forbidden

National regulations imposing safety levels of EN1317



# EN1317 Application Tools

1st criteria: CONTAINMENT LEVEL (heavy vehicles safety)

## RS Working Group activities



Belgium regulation:

Speed limit	Section	Danger zones
$v < 50$ km/h	N1	H2 or H4b
$50 < v < 90$ km/h	H1	H2 or H4b
$90 < v < 120$ km/h	H2	H4b



German regulation (main topics)

Danger's level	Speed (km/h)	Traffic (Cars)	Road exit	Daily (trucks)		
Very dangerous	> 50	/	Yes	>3000	H4b	
				<3000	H2	
			No	>3000	H2	
				<3000	H1	
Medium dangerous	> 100	/	/	>10000	H2	
				$3000 < n < 10000$	H1	
				<3000	N2	
				>10000	H2	
	$70 < v < 100$	>3000	/	/	$3000 < n < 10000$	H1
					<3000	N2
					>10000	H2
					$3000 < n < 10000$	H1
$50 < v < 70$	>3000	/	Yes	>10000	H2	
				$3000 < n < 10000$	H1	
				<3000	N2	
				<3000	N2	



French regulation

Speed limit	Side	Middle
$v < 90$ km/h	N1	N2
$v > 90$ km/h	N2	N2/H2



Italian regulation:

Road type	Traffic type	Middle barriers	Side barriers	D.Z.
Highways & high speed secondary roads	I	H2	H1	H2
	II	H3	H2	H3
	III	H3-H4	H2-H3	H3-H4
Low speed SR & high speed urban road	I	H1	N2	H2
	II	H2	H1	H2
	III	H2	H2	H3
Low speed urban roads and local roads	I	N2	N1	H2
	II	H1	N2	H2
	III	H1	H1	H2

European Union Road Federation (ERF)



# EN1317 Application Tools

Side Barrier

Central Barrier

Bridge Barrier



Austria

H2



H2



H3



Belgium

H2



H2



H4b



Denmark

H1



H2



H3



Finland

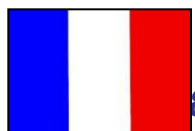
N2



N2



H2



France

N2



H1



N2



# EN1317 Application Tools

## Side Barrier

## Central Barrier

## Bridge Barrier



Germany

H2



H2



H4



Ireland

N2



H2



H2



Italy

H2



H3



H4b



Netherland

H2



H2



H2



Spain

H1



H2



H3



# EN1317 Application Tools

## Example 1 : Use of EN1317 in ITALY (~ 2005)

- *H safety barriers with ASI A only (safe for small AND heavy vehicles)*



## Example 2 : Use of EN1317 in BELGIUM (~ 2005)

- *EN1317 not yet used or with low performances requirements*





# EN1317 Application Tools

Things are moving since EN1317 application in Belgium



Figure 1 – New system (H4) replacing the old prescriptive one in Belgium (Black spot)



# EN1317 Application Tools

## Why differences of National Codes between countries?

- Difference of landscape
- Difference of road design
- Difference of road culture



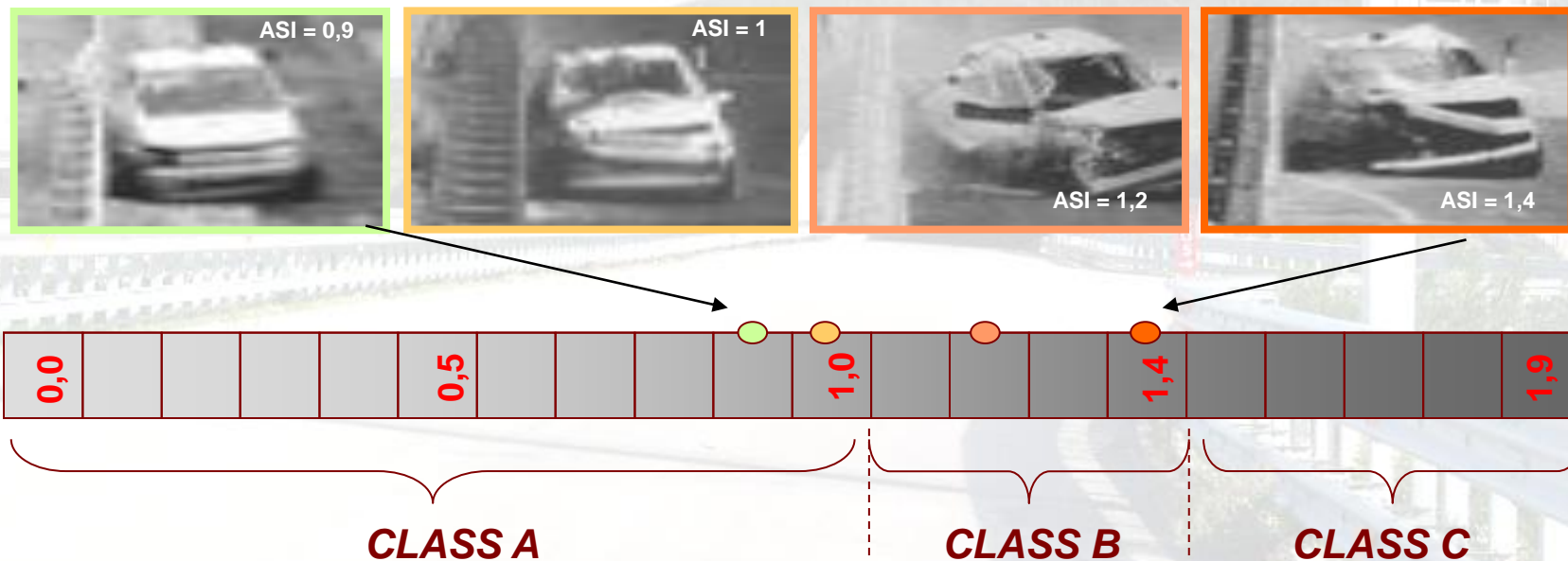
*Holland with large flat landscape*



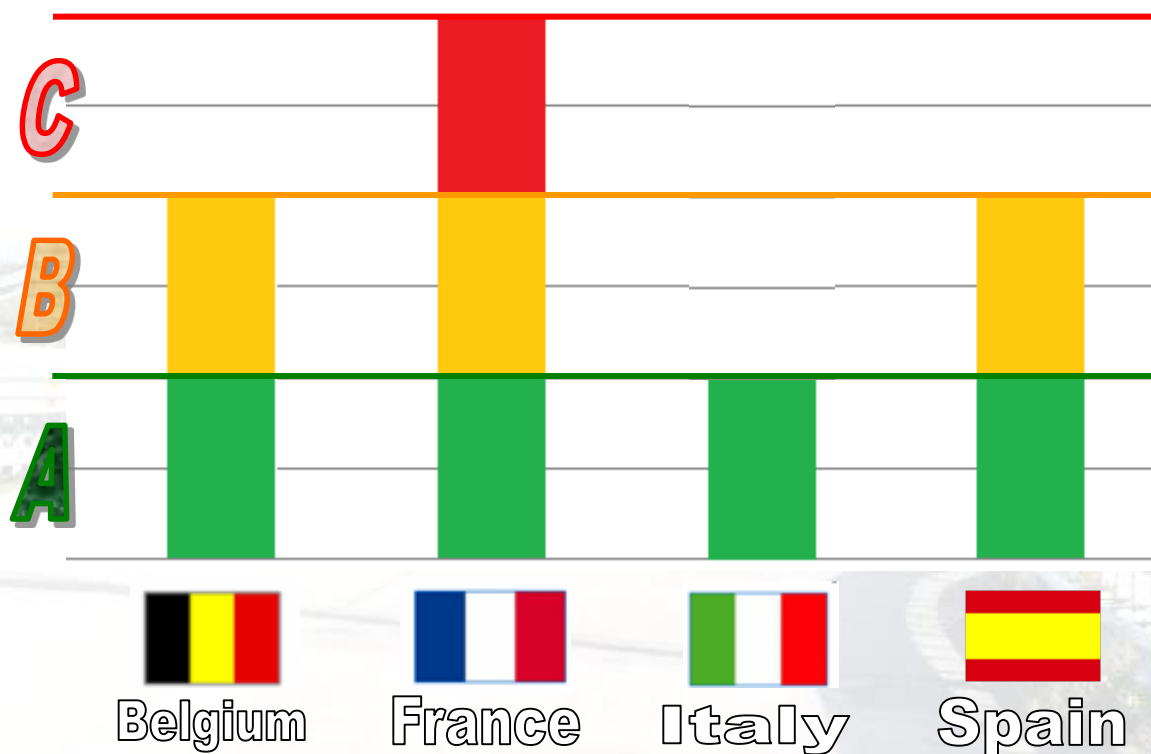
*Italy with hills and mountains*

# EN1317 Application Tools

2<sup>nd</sup> criteria: The ASI level (light vehicles safety)



# EN1317 Application Tools



→ **Generally: ASI A preferred to B, ASI C forbidden**

# EN1317 Application Tools

## National Regulations new role :

### THE THREE STEPS OF VRS TECHNICAL HARMONIZATION



**PERFORMANCE CLASSES:** Containment levels,  
Crash-Test methods and Acceptance criteria

EN 1317, parts 1, 2, 3  
and 4 (ENV)

➔ **Already EN (1990-2001)**  
**Currently under revision parts 1 & 2**



**PRODUCT CONFORMITY:** Factory Production  
Control and CE marking

EN 1317, part 5

➔ **Under Formal Vote -**  
**Publication within 2007**



**VRS DEPLOYMENT:** Recommendations and Criteria  
for VRS implementation, Roadside Safety Audits

NO EN

➔ **National Regulations**

**Standard EN1317**  
**= reference**

**Application Tool**  
**= helping tool**

**National regulations**



# EN1317 Application Tools

## The EN1317 Application Tools aim to :

- link EN1317 criteria to understandable physical concepts
- help increase safety by using EN1317 criteria
- avoid making mistakes by a wrong use of EN1317
- give safety advice when making new roads
- give safety advice when replacing old systems

## The EN1317 Application Tools don't aim to :

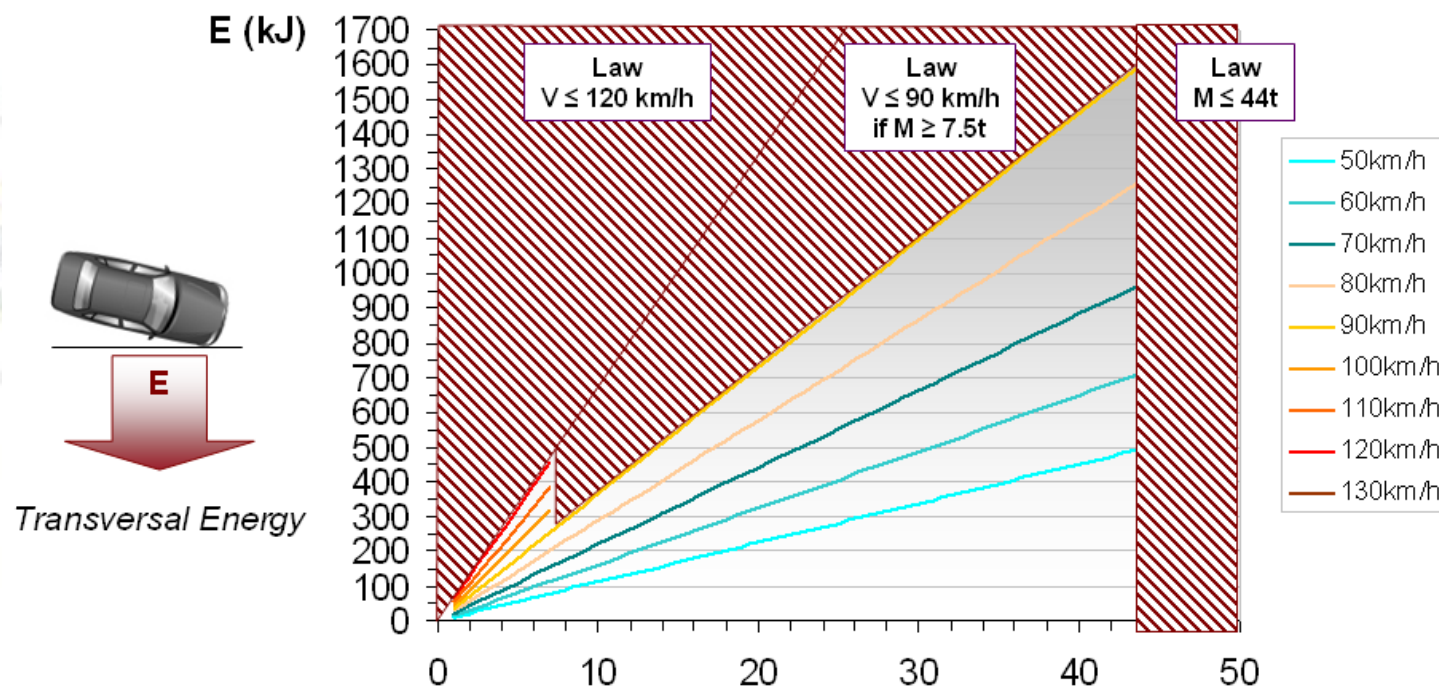
- choose the level of safety

**→ The final decision is for the Road Authorities.**

# EN1317 Application Tools

## The Application Tools : Example for containment level

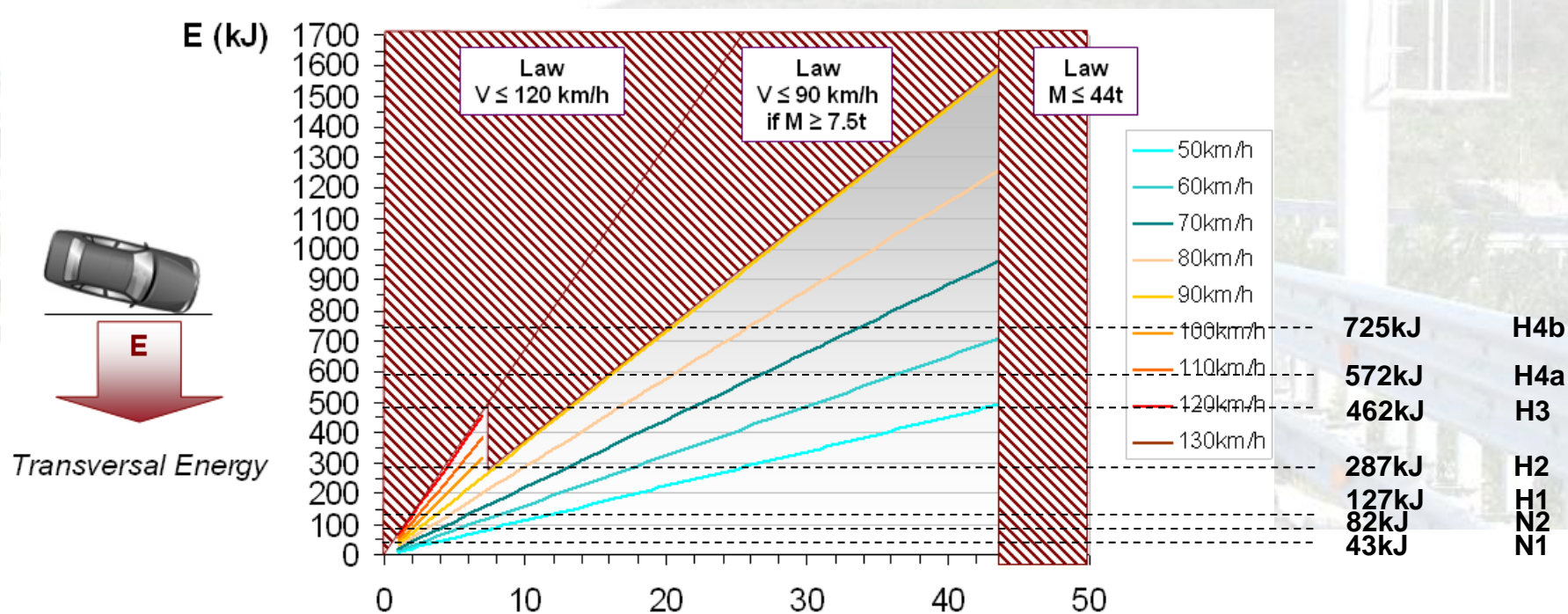
### *Table of the transversal energy*



# EN1317 Application Tools

## The Application Tools : Example for containment level

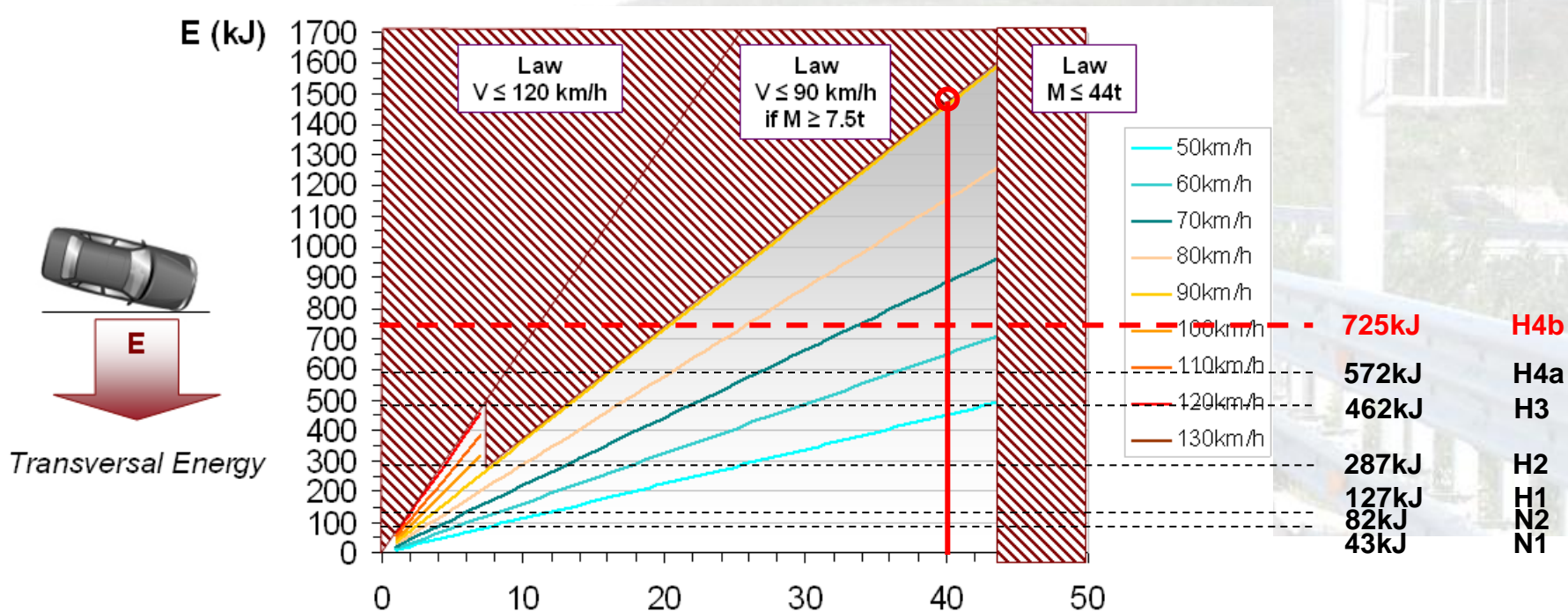
*Containment levels according to the table*



# EN1317 Application Tools

## The Application Tools : Example for containment level

If I want to stop a **40 tons truck** at **90 km/h** → **H4b**

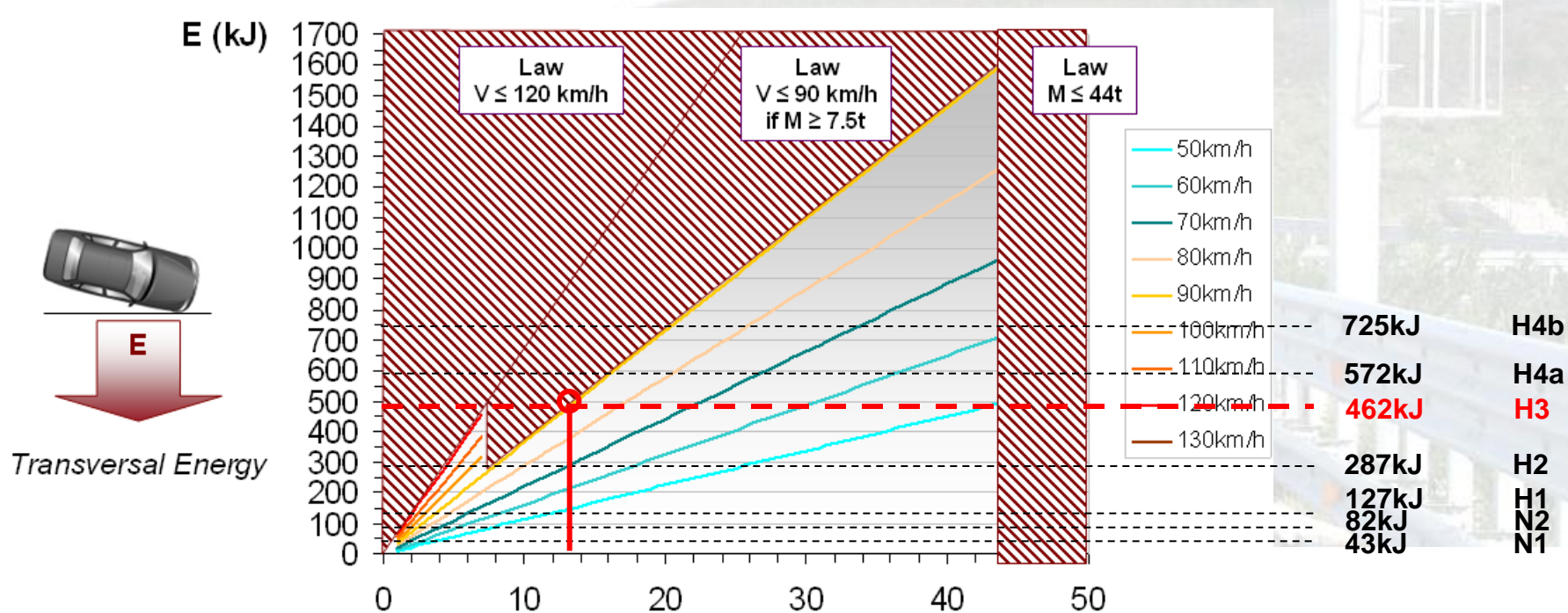




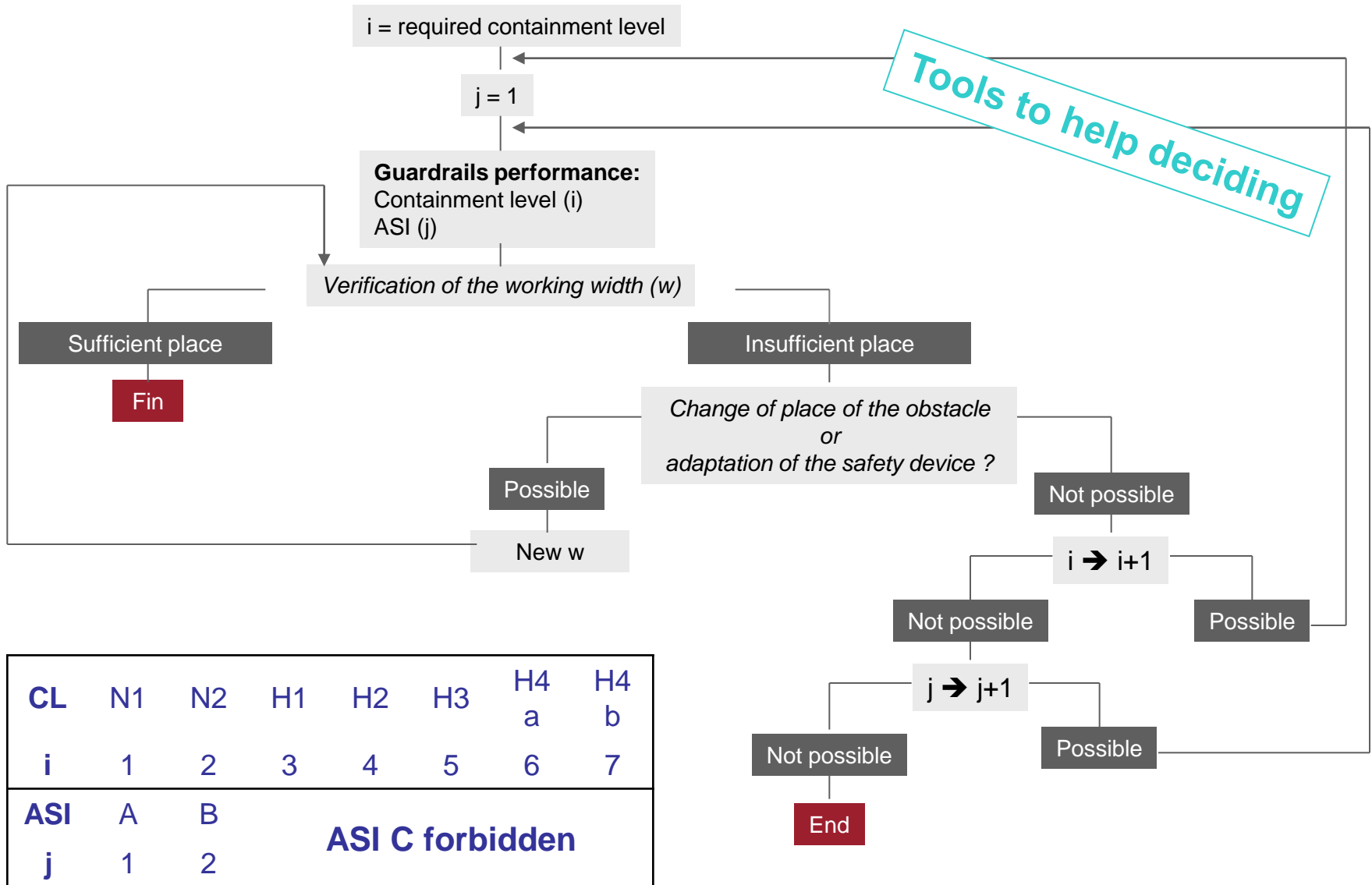
# EN1317 Application Tools

## The Application Tools : Example for containment level

If I want to stop a **13 tons bus at 90 km/h** → **H3**



# How to choose the ASI and the Working Width?



# EN1317 Application Tools

## The infrastructure – situation with EN1317 :

– EN1317 Road Restraint Systems are LCM

*(LCM = Low Cost Measures = High Benefit/Cost ratio)*



# EN1317 Application Tools

## The infrastructure – situation with EN1317 :

– EN1317 Road Restraint Systems are LCM

*(LCM = Low Cost Measures = High Benefit/Cost ratio)*







ArcelorMittal

*Thank you for your attention!*

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