Laboratoire d'essais Inrets Equipements de la Route

Evaluation of Road Restraint Systems by an Accredited Test House in the Context of European Standardisation

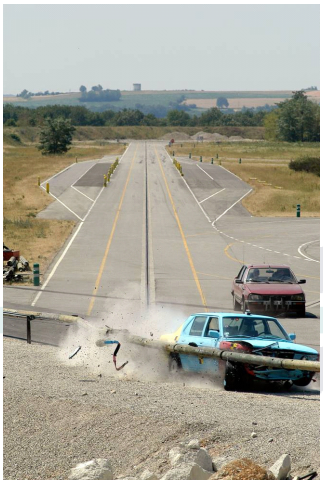
J.A. BLOCH

Building Tomorrow's Transport Infrastructure in South-East Europe

Belgrade
16 – 17 November 2005

Crash Testing of Roadside Barriers

www.lier.fr



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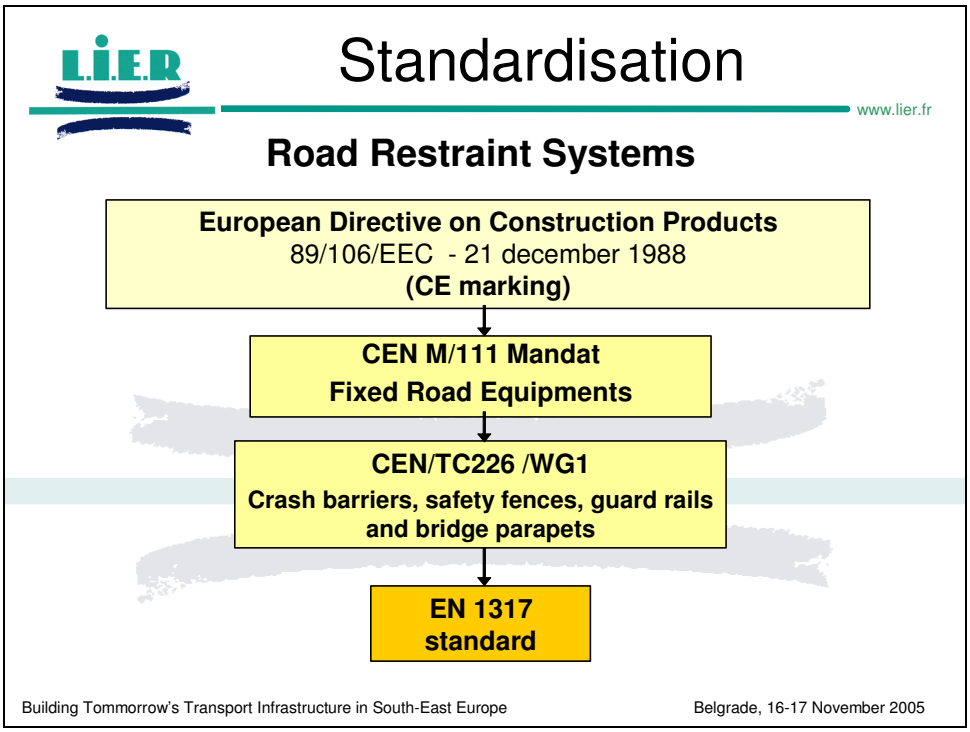
Standardisation
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Road Restraint Systems
European Directive on Construction Products
89/106/EEC - 21 december 1988
(CE marking)
CEN M/111 Mandat
Fixed Road Equipments
CEN/TC226 /WG1
Crash barriers, safety fences, guard rails and bridge parapets
EN 1317 standard
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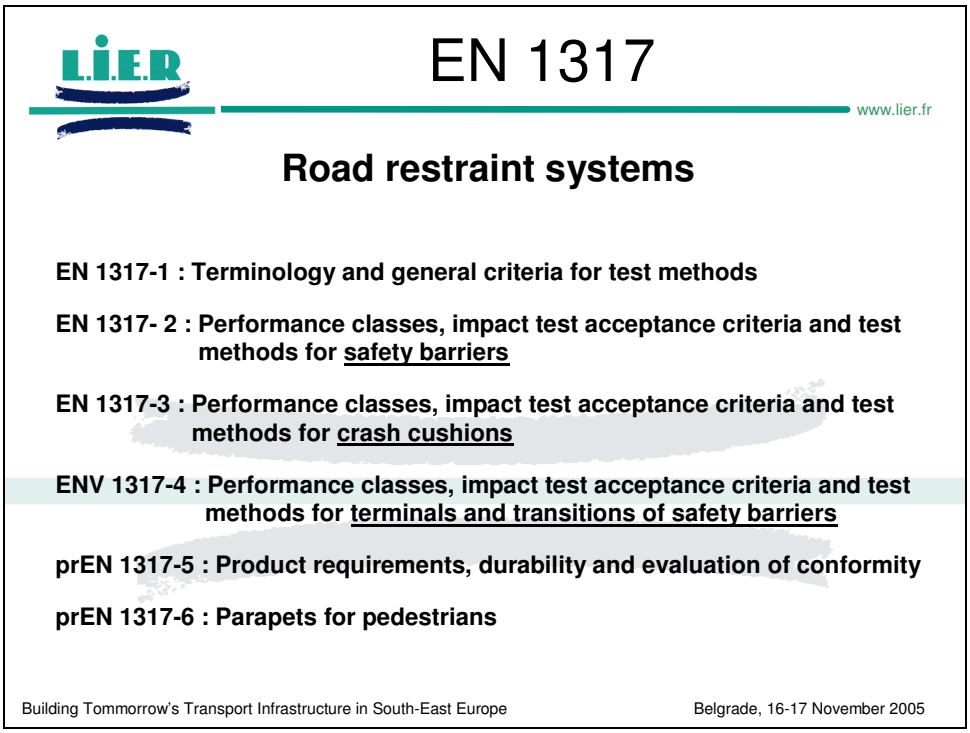
EN 1317
www.lier.fr
Road restraint systems
EN 1317-1 : Terminology and general criteria for test methods
EN 1317- 2 : Performance classes, impact test acceptance criteria and test methods for safety barriers
EN 1317-3 : Performance classes, impact test acceptance criteria and test methods for crash cushions
ENV 1317-4 : Performance classes, impact test acceptance criteria and test methods for terminals and transitions of safety barriers
prEN 1317-5 : Product requirements, durability and evaluation of conformity
prEN 1317-6 : Parapets for pedestrians
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Testing Laboratory

www.lier.fr

Definition (prEN 1317-5) :

A competent laboratory which measures, examines, tests, calibrates or otherwise determines the characteristics or performance of materials or products within the scope of this standard.

A laboratory accredited by a signatory of EA (European co-operation for Accreditation) or the appropriate statutory instrument, within the scope of this standard, in the territory where the test was executed may be presumed to be competent.

ISO/CEI 17025
General requirements for the competence of testing and calibration laboratories

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EN1317 – 1

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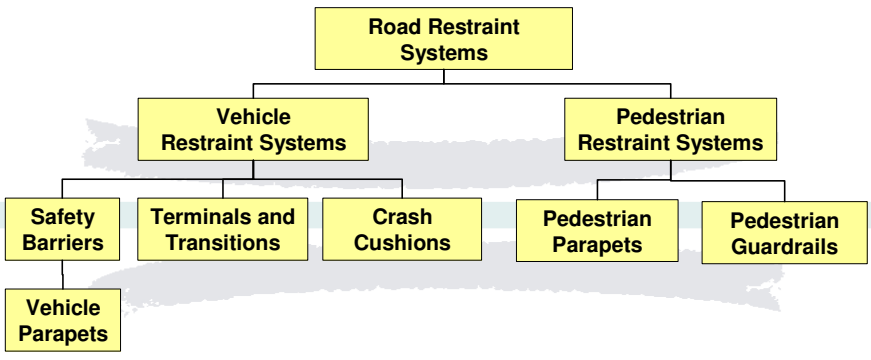
EN 1317- 1 : Terminology and general criteria for test methods



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EN1317 – 1

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Test Vehicles

Vehicle	Mass (kg)
passenger vehicle	900
passenger vehicle	1 300
passenger vehicle	1 300
passenger vehicle	1 500
passenger vehicle	1 500
rigid truck	10 000
rigid truck	10 000
bus	13 000
rigid truck	16 000
rigid truck	30 000
articulated truck	38 000

No specific vehicle model nor vehicle age is defined

Test houses are free to use the vehicles they want

⇩

Need for more precise requirements

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EN1317 – 1

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Severity Indices

ASI : Acceleration Severity Index

Maximum value of ASI (t) plot obtained from vehicle Centre of Gravity accelerations (x, y, z)

$$ASI(t) = [(a_x/12)^2 + (a_y/9)^2 + [(a_z/10)^2]^{1/2}$$

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EN1317 – 1

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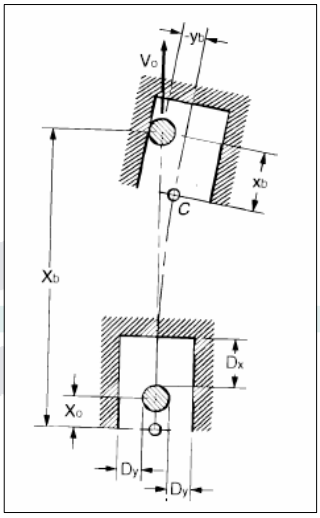
Severity Indices

THIV : Theoritical Head Impact Velocity (m/s)

Speed of a theoritical head when contact with a theoritical box

PHD : Post-impact Head Deceleration (g)

Maximum deceleration of this theoritical head after impact *(informative criteria)*



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EN1317 – 2 safety barriers

www.lier.fr

EN 1317- 2 : Performance classes, impact test acceptance criteria and test methods for safety barriers

Barriers intalled on stabilised soil, asphalt or concrete (bridge barriers)

Evaluation of :

1- the impact severity

2- the containment level and the deformation

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EN1317 – 2 safety barriers

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Containment levels

CONTAINMENT	LEVEL	TEST
low angle	T1	TB 21
	T2	TB 22
	T3	TB 41 + TB 21
normal	N1	TB 31
	N2	TB 32 + TB 11
high	H1	TB 42 + TB 11
	H2	TB 51 + TB 11
	H3	TB 61 + TB 11
very high	H4a	TB 71 + TB 11
	H4b	TB 81 + TB 11

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EN1317 – 2 safety barriers

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Test types

	Vehicle	Mass (kg)	Speed (km/h)	Angle (°)
TB 11	Car	900	100	20
TB 21	Car	1 300	80	8
TB 22	Car	1 300	80	15
TB 31	Car	1 500	80	20
TB 32	Car	1 500	110	20
TB 41	Rigid Truck	10 000	70	8
TB 42	Rigid Truck	10 000	70	15
TB 51	Bus	13 000	70	20
TB 61	Rigid Truck	16 000	80	20
TB 71	Rigid Truck	30 000	65	20
TB 81	Articulated Truck	38 000	65	20

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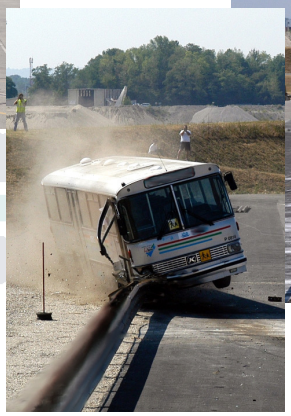
Example of Test types

TB32

TB81



TB51

EN1317 – 2 safety barriers

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Qualitative criteria :

- **no ejection of parts**
- **no vehicle rollover, containment of the vehicle**
- **VCDI (Vehicle Cockpit Deformation Index)**
- **exit trajectory must comply with the « CEN box »**

Quantitative analysis :

- **computed criteria :**
  - **ASI : Acceleration Severity Index**
  - **THIV : Theoritical Head Impact Velocity (m/s)**
  - **PHD : Post-impact Head Deceleration (g)**
- **working width of the barrier**

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EN1317 – 2 safety barriers

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Test analysis

Severity class	criteria		
A	ASI = 1,0	and	THIV = 33 km/h (PHD = 20 g)
B	ASI = 1,4		
C	*ASI = 1,9*		

Class C is under discussion

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EN1317 – 2 safety barriers

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Test analysis

Working width - W

Maximum dynamic deflection of the barrier

W classes	Valeur (m)
W1	W = 0,6
W2	W = 0,8
W3	W = 1,0
W4	W = 1,3
W5	W = 1,7
W6	W = 2,1
W7	W = 2,5
W8	W = 3,5

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EN1317 – 3 crash cushions

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EN 1317-3 : Performance classes, impact test acceptance criteria and test methods for crash cushions

Evaluation of :

1- the impact severity

2- the containment level and the deformation

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EN1317 – 3 crash cushions

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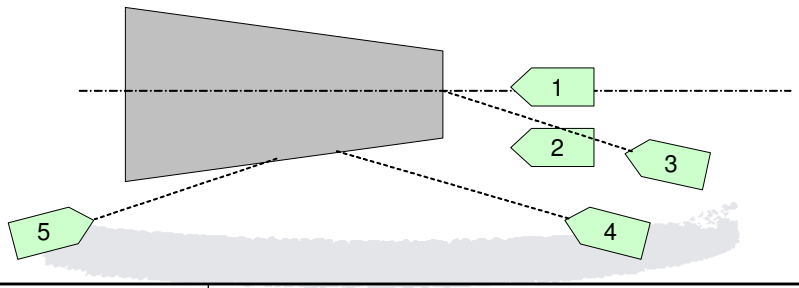
Test definition



vehicles	900 kg, 1300 kg, 1500 kg
angle	frontal : centred, 15°, offset ¼ vehicle lateral : 15°, 165°
speeds	50 km/h, 80 km/h, 100 km/h, 110 km/h

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EN1317 – 3 crash cushions

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Ex : Test TC 1.2.100 - R25 (1300 kg) / 100 km/h

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EN1317 – 3 crash cushions

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Test analysis

Qualitative analysis :

- **control of ejections**
- **control of vehicle trajectory**

Quantitative analysis :

- **computed criteria :**
  - **ASI : Acceleration Severity Index**
  - **THIV : Theoritical Head Impact Velocity (m/s)**
  - **PHD : Post-impact Head Deceleration (g)**
- **deflexion of crash cushion**

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EN1317 – 4 terminals and transitions

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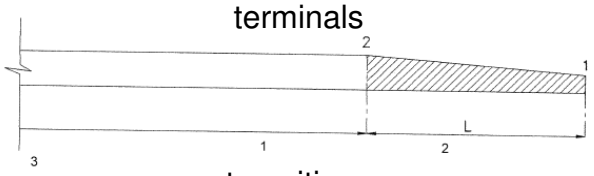
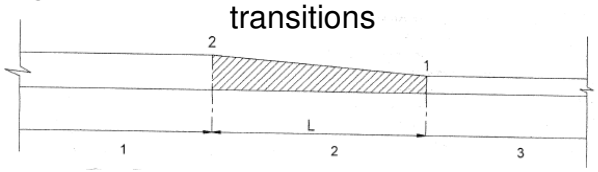
Terminals and transitions

ENV 1317-4 : Performance classes, impact test acceptance criteria and test methods for terminals and transitions of safety barriers

terminals



transitions



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EN1317 – 4 terminals and transitions

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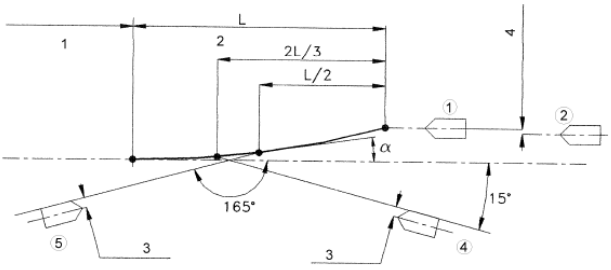
Terminals : 4 tests



Evaluation of :

1- the impact severity

2- the extremity deformation

3- the vehicle trajectory

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EN1317 – 4 terminals and transitions

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Terminals

the impact severity

Severity class	criteria		
A	**ASI = 1,0**	and	**THIV = 33 km/h pour essais 4 et 5** **THIV = 44 km/h pour essais 1 et 2** **+** **(PHD = 20 g)**
B	**ASI = 1,4**		

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EN1317 – 4 terminals and transitions

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Transitions

Test conditions :

Equivalent with EN1317-2 test conditions

(impact point depends on the length of the removable barrier)

Evaluation of :

1- the impact severity

2- the containment and the deformation level

Following EN1317-2 criteria

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Over and Above EN1317

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EN1317 defines severity and containment tests in typical conditions

BUT

What about the barrier performance in real use conditions:

- -Different soil conditions
- -Barriers in curves
- -Different vehicle types
- -Different vehicle speeds and angles
- -Different barrier lengths and extremity conditions

?

Proposal for a study on a rating test procedure

(cf EuroNCAP vs. vehicle passive safety standards)

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Motorcyclist Protection

www.lier.fr

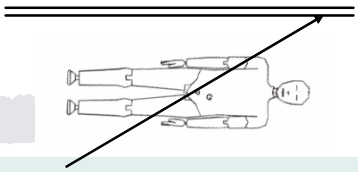
LIER test procedure

Hybrid II dummy with a Hybrid III head and neck

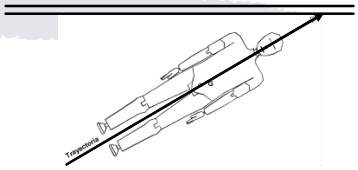
Speed : 60 km/h - Angle : 30°

2 tests configurations:

- dummy parrallel to the barrier



- 30° angled dummy position
(direct impact with the head)



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Motorcyclist Protection

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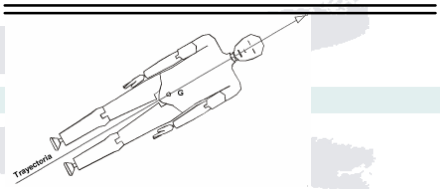
UNE-135900

Performance assessment of the roadside motorcyclist protective devices

- Localised protection vs. Continuous systems
- Hybrid III dummy
- One launching position :



- Impact speed : 60 km/h

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Motorcyclist Protection

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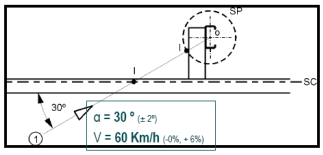
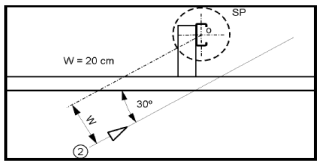
UNE-135900

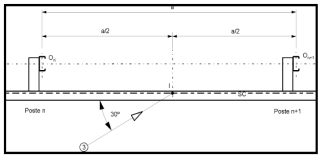
Trajectory 1 : post centered



Trajectory 2 : post offset



Trajectory 3 : bay centered



localised systems

continuous systems

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Motorcyclist Protection

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UNE-135900

2 severity classes depending on biomechanical criteria:

	Head	Neck					
level	HIC_{36}	Fx (N)	Fz traction (N)	Fz compression (N)	Mx (Nm)	My extension (Nm)	My flexion (Nm)
I	650	Diagram	Diagram	Diagram	134	42	190
II	1000	Diagram	Diagram	Diagram	134	57	190

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Research activities

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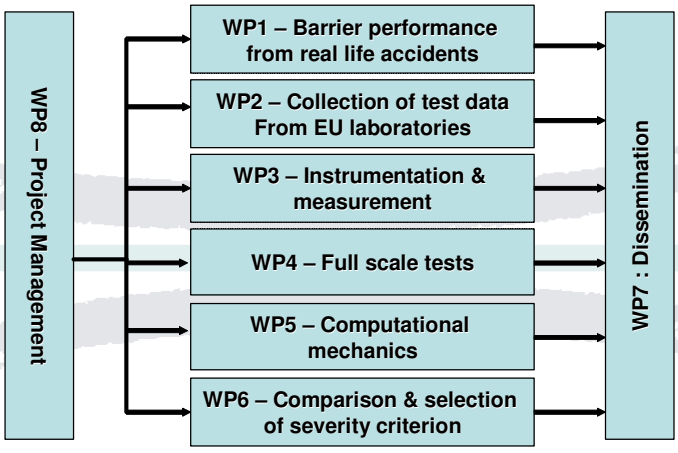
ROBUST european project
(Road Barrier Upgrade of Standards)



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Simulation

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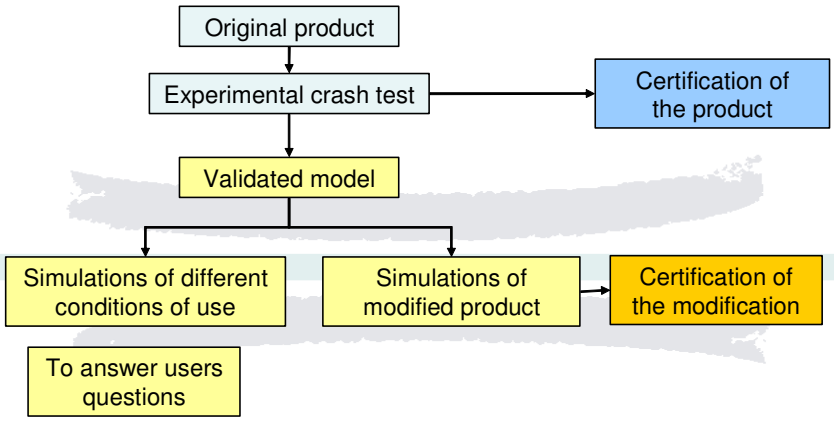
Typical use of computational mechanics:



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Simulation

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CM-E working group

(sub-group of CEN TC226/WG1/TG1)

- To investigate and develop the application of computational tools for use in the standardisation of road equipments (for modified products)
- To define model requirements for test vehicles and road equipment
- To define an objective validation procedure for simulations
- To define reporting procedures for simulations (data output, variables, etc)

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