Innovation and International Best Practice on Road Restraint Systems

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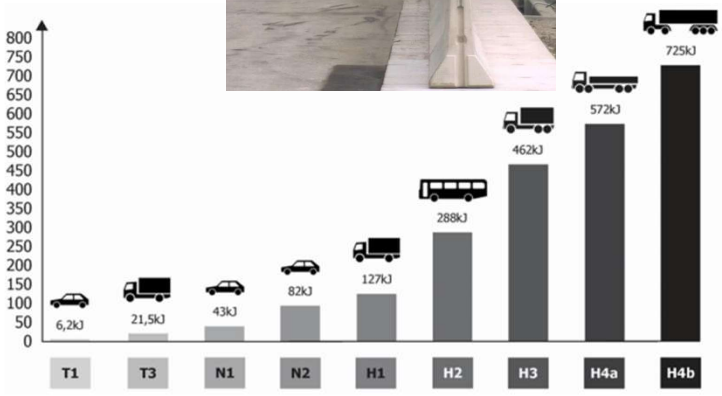
In the beginning …

Road restraint system design & development by individual national governments

- Set of National design specifications
- More or less R&D by each individual country
- Limited further development
- Restricted choice of barrier models

EN 1317: The European Standard

Common basis for determining product category agreed on by European national road authorities and industry



Performance based standard

1. **Common test method**
2. **Single certification**
3. **Access to multiple markets**

Encourages more product development by manufacturers

Increased use of computer simulation in support of physical crash testing

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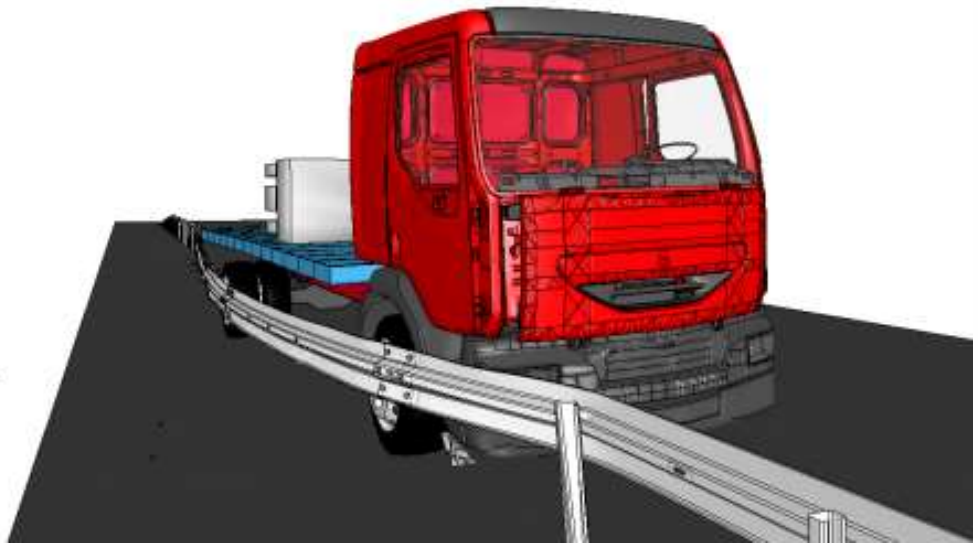
Performance based standard

Encourages more product development by manufacturers

Use of computer simulation in support of physical crash testing facilitates optimization & development.

In addition to certification crash tests:

- Development of modified products
- Proving of different installations
- Checking alternative impact configurations



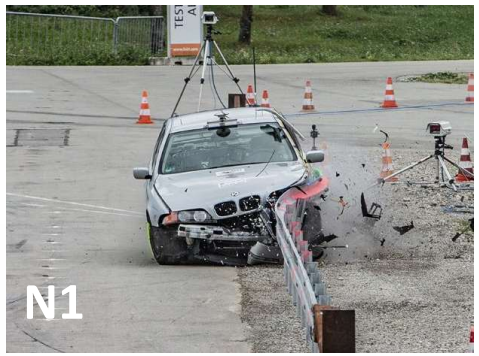
Certification always on basis of physical crash tests !

EN 1317-2 (Barriers)

Containment levels

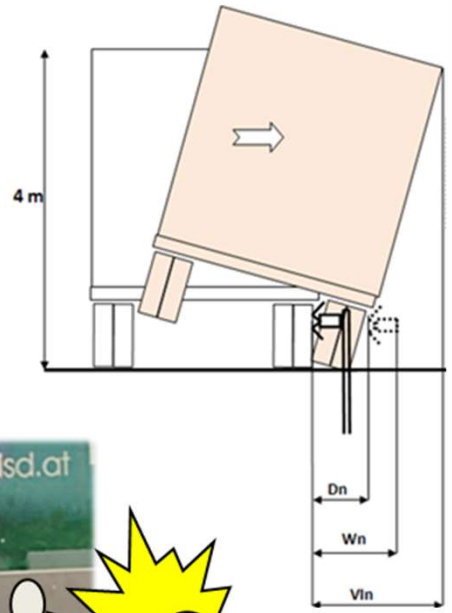
(barrier restraining capability):

T1-T3, N1-N2, H1-H4(L1-L4)



Containment test (Heavy vehicle):

- Vehicule contained? Stiffness / “Working Width”?
- Acceptable vehicle behaviour (e.g. no rollover)?
- **Working Width (W_N): W1 – W8**



Severity test (Occupant risk – small car):

- Passenger compartment intrusion
- Acceptable vehicle behaviour?
- **Severity level: A, B, C**

- **Benchmark for comparison of different products!**
- **Balance containment capacity - impact severity - operating space available**

Concrete Barriers for Every Application

- Each barrier type no longer restricted to particular applications
- Driven by market demand and higher safety levels – facilitated by a common, performance-based testing standard

Precast:

- Lightweight: low cost, easy handling
- Heavy: maximum restraint
- Thin: minimal footprint
- Rigid (anchored/embedded): high restraint - low operating space
- Flexible (free-standing/anchored): low impact severity – more operating space required

Cast-in-place:

- Various dimensions
- Improvements in durability

Case Study: Increasing Use & Availability of Special Products - Terminals

⚠ Untreated barrier end = hazard
e.g. spearing, snagging or hard impact

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- **Energy-absorbing terminals:** controlled vehicle deceleration

Energy absorption – EN 1317 test

Case Study: Increased Use & Availability of Special Products - Transitions

- Abrupt barrier change can lead to hazardous change in stiffness
- Connect ends of barriers to avoid weak zones at ends of installations
- Transition = mitigated risk of increased impact severity or system breakage due to ubrupt change of barrier
  - ➢ Numerous barrier combinations
  - ➢ European standards →Europe-wide solutions → fewer combinations needed

Case Study: Bridge Parapet Development

- National, generic bridge parapet: although effective in vehicle restraint, often:
  - high material usage,
  - complex manufacturing,
  - stiff post snagging risk,

Case Study: Bridge Parapet Development

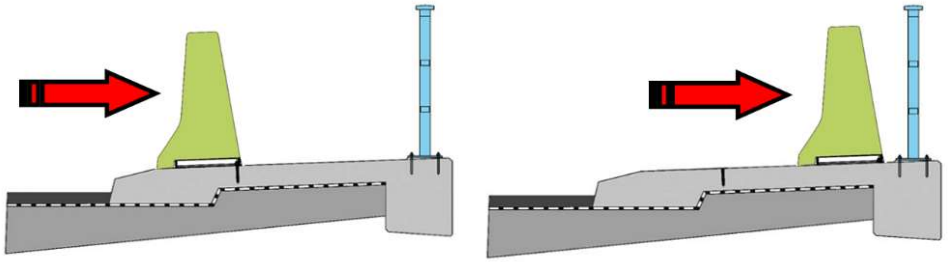
… often:

- Up to H2 containment only (13 tonne coach) – not designed to restrain heaviest trucks!
- frangible barrier anchorages to protect bridge deck structure

Case Study: Bridge Parapet Development

Innovation through EN 1317:

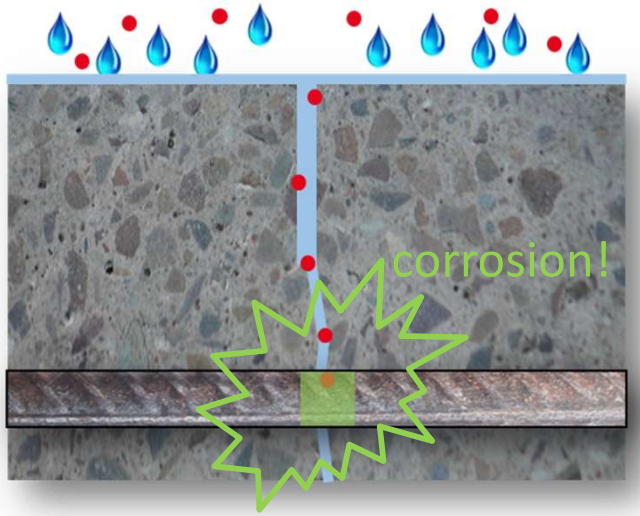
- Optimisation of design
- Concrete designs eliminate stiff post impact risk
- Highest containment levels - H4/L4 (38T truck)
- Unanchored – lower impact severity and no damage to bridge deck from transferred impact loads



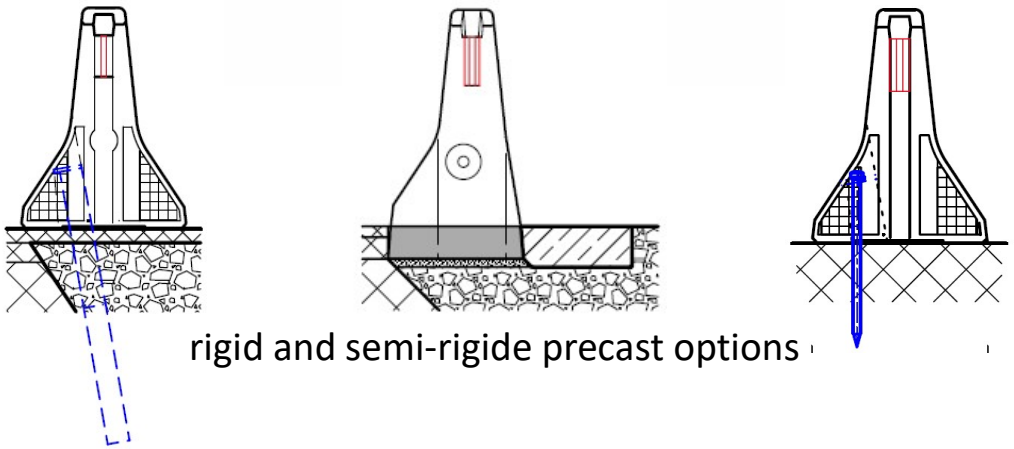
Case Study: Cast-in-Place Concrete Barriers

- Cast-in-place durability limited due to shrinkage cracks allowing corrosion of reinforcement.
- Quality control and durability requirements drive on-site quality checks and development of solutions to improve cast-in-place durability.
- Rigid precast barrier solutions are also now available for traditional cast-in-place applications.

Infiltration of water and chloride



Coated reinforcement strand



rigid and semi-rigide precast options

The Road Ahead

- Future further development of the European standard will push continued product development and maintain wide portfolio of products.

- Reduction of carbon footprint will be an important part of the next revision of EN 1317 and this will influence the future evolution of products.

To sum up …

European standard EN 1317 and the associated CE marking for road restraint systems have been driving innovation in Europe and around the world by encouraging development that could not been achieved by national governments alone.

The use of a common evaluation basis allows comparison of a wide variety of restraint systems leading to greater choice for each application. The constant market-driven development leads to a widening range of systems that are also available outside of the European Union wherever EN 1317 is recognised.