Energy Absorption
Is prescription constructive?

Safe Vehicles Structures Workshop
28 April 2004
The Belfry – UK Midlands

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Introduction

- No such thing as a train without crashworthiness
- Or Energy Absorbing capability
- All structures have an inherent level of crashworthiness
- How do we manage and design it into the structure
- Where does the definition of Energy Absorption end

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The Legislation

- Rail vehicle crashworthiness legislation is produced in order to save the lives or lessen the injuries of the occupants during the prescribed collision scenarios:
  - Train to train
  - Train to locomotive
  - Large obstacles level crossing
  - Small obstacles
- To reduce the deceleration during these scenarios it is necessary to absorb energy forward of the driver.
- The use of Energy Absorbing Units is key to this criterion.

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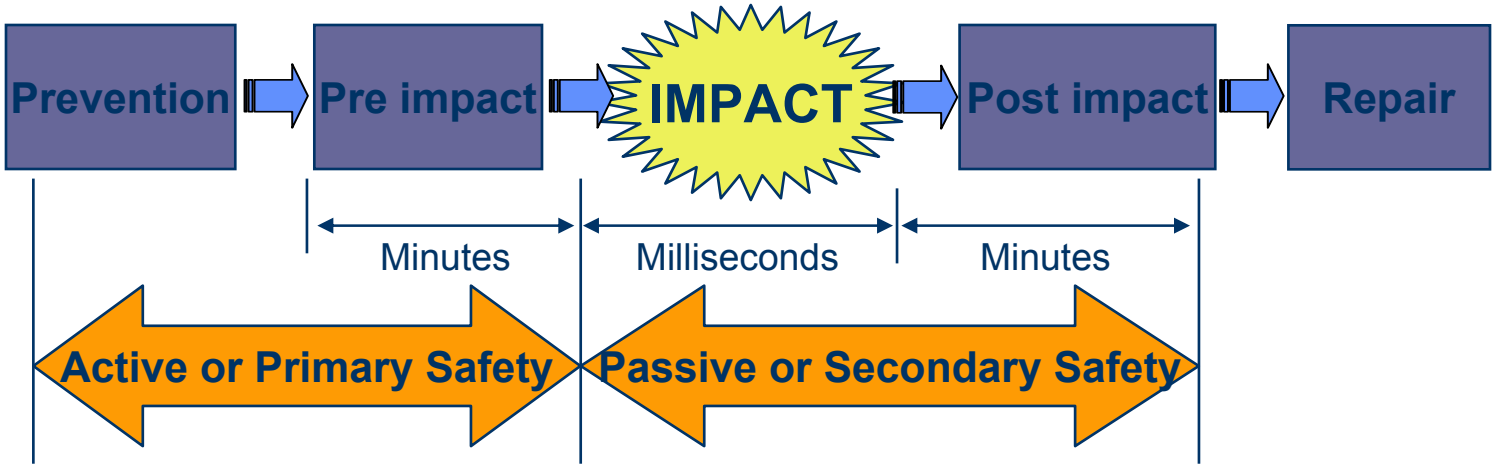
Active & Passive Safety



Active Safety:-

- Signalling
- Obstacle detection
- ERTMS

Passive Safety:-

- Restraint Systems
- Protection Systems
- Vehicle Interior Layout

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Laws of Motion

Velocity km/h	Velocity m/s	Velocity into Solid Wall m/s	Displacement @ 5g m	Total Absorber Length m (70/30 ratio)	Minimum Total Cab Length m (Absorber + Survival Space)
36.00	10.00	5.00	0.25	0.36	1.11
55.00	15.28	7.64	0.59	0.85	1.60
60.00	16.67	8.33	0.71	1.01	1.76
120.00	33.33	16.67	2.83	4.05	4.80

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Compression Ratio

- The calculation assumes a 70/30 ratio of length to absorb energy against fully compressed length

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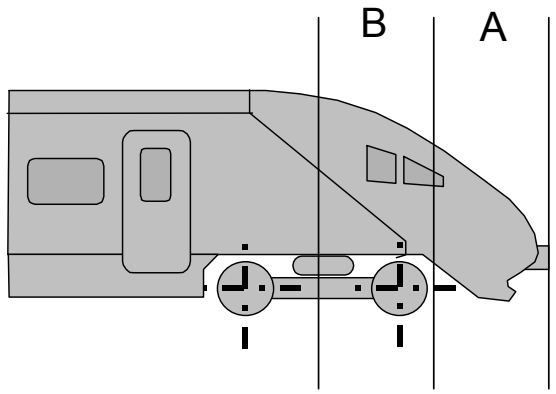
Cab Layout 1



- Split into two sections
- A is the energy absorbing section
- B is the 0.75m driver's survival zone

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Short-nosed vehicles

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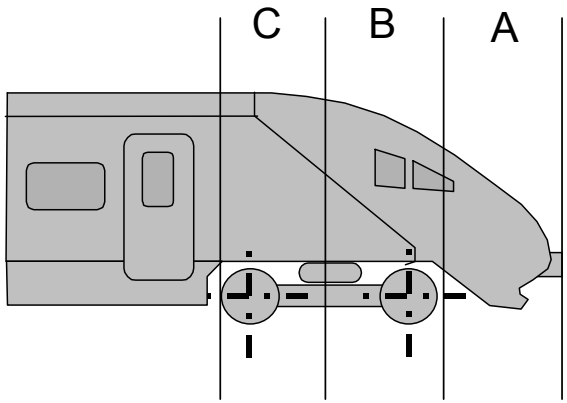
Cab Layout 2



- Split into three sections
- A is the energy absorbing section
- B is the 0.75m driver's survival zone
- C is the secondary energy absorbing zone

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Alternative Energy Absorption

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Conclusions

- Energy absorption can produce mean deceleration level of 5g in main occupant or passenger tubes
- Difficult for the driver's zone.
- Vehicle Crashworthiness legislation is defined to save the lives or lessen the injuries
- Vehicle structure validation should use occupant injury levels
- Passive safety systems could be deployed to protect in the impact phase
- Necessary to accept a higher deceleration rate in the Driver's area
- Provide an alternative means of energy absorption - air bag system
- Is 5g mean deceleration low enough to afford the occupants the necessary level of Passive Safety without significant redesign of vehicle interiors?

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