Lightweight Composite Rail Driver's Cab.

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Rail Vehicles Group Manager

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De-Light Project

- EU FP6 funded project
- Spacium Train: Bombardier.
- Suburban networks.
- Materials:
  - Steel substructure
  - Composite shell
- Designed to meet crashworthiness requirements of:
  - Bombardier.
  - EN 15227 *"Railway Applications – Crashworthiness Requirements for Railway Vehicle Bodies"* .

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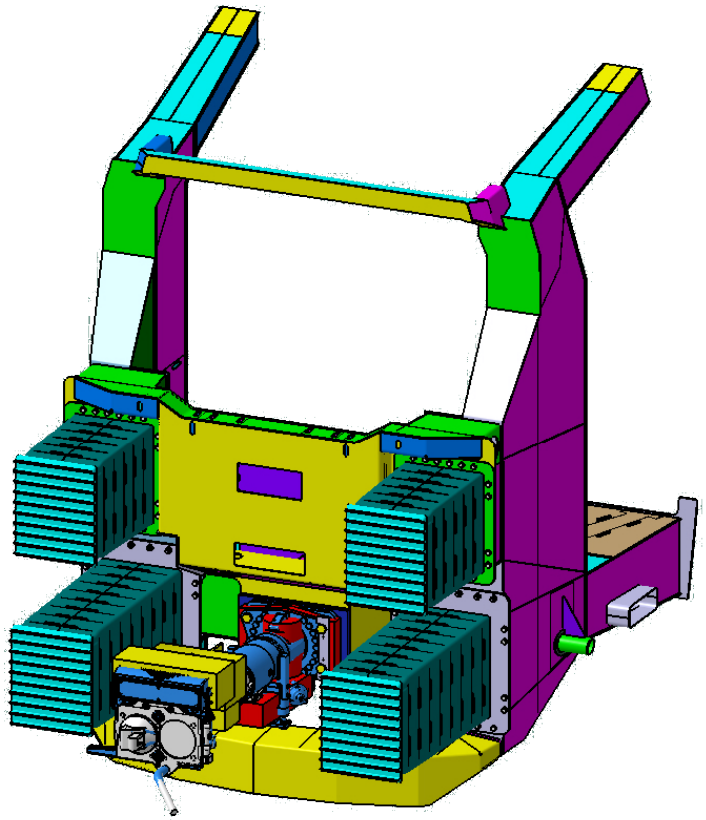
Current design philosophy

- Main cab structure:
  - Steel box construction.
  - Welded plates.

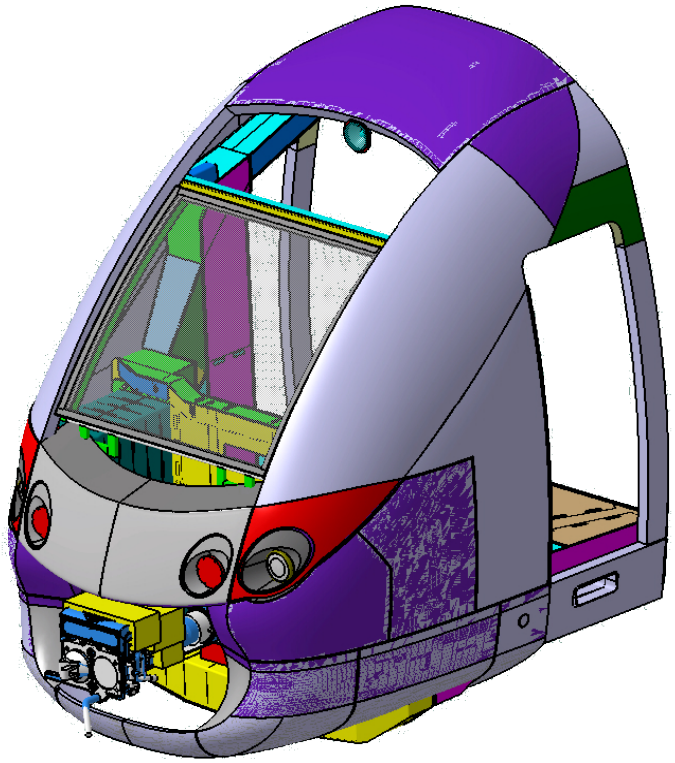


ISSUES

- Weight.
- Complex to assemble.
- Cost.

Current design philosophy

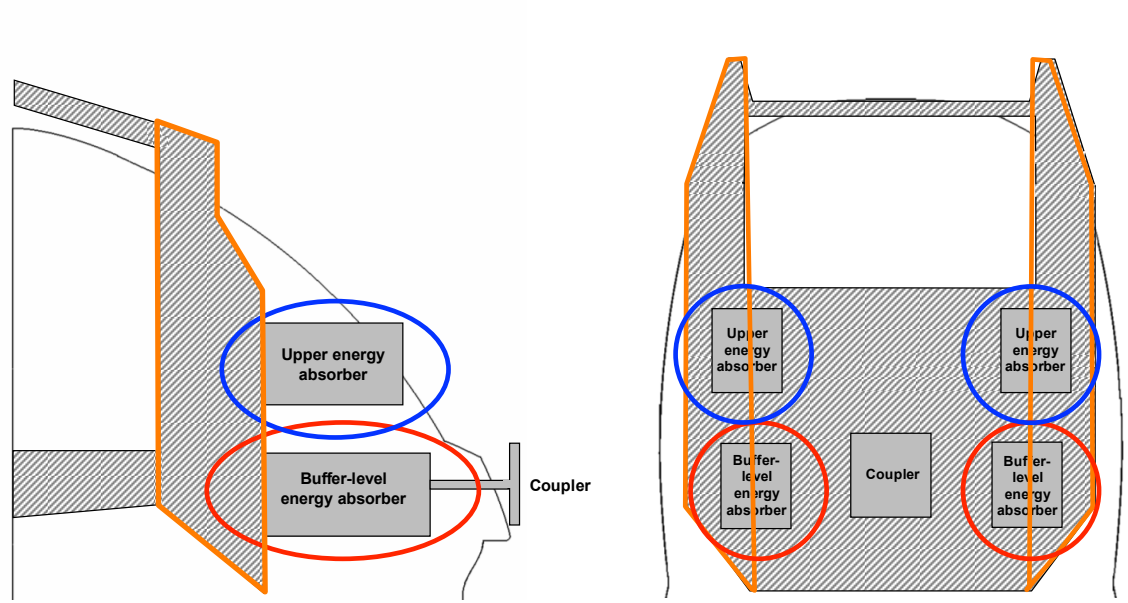
- Cab shell
  - Thin composite sheet.
  - Attached to steel sub-frame.



ISSUES

- Poor energy absorption.
- Substantial sub-structure adds weight.
- Ineffective use of space.

Standard Crashworthiness design



- Two sets of energy absorbers:
  - Lower at buffer level
  - Upper to react LDO crash scenario
- Loads reacted by substantial steel pillars.

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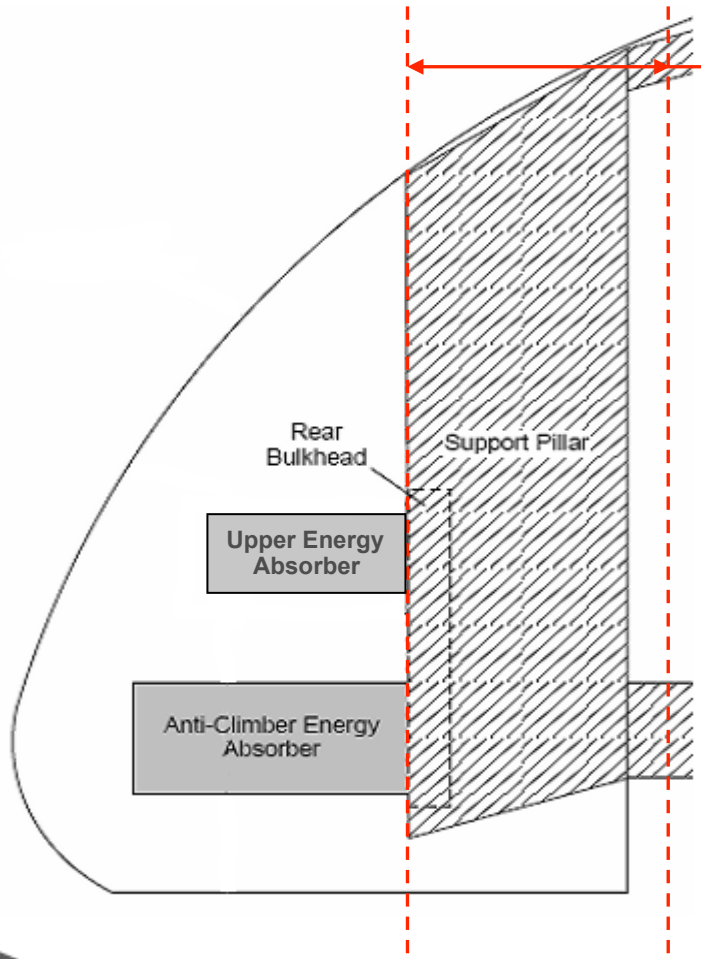
Cab Design Zones



- Reaction Zone
  - Non deformable structure
  - Load paths
- Secondary Crush Zone
- Primary Crush Zone

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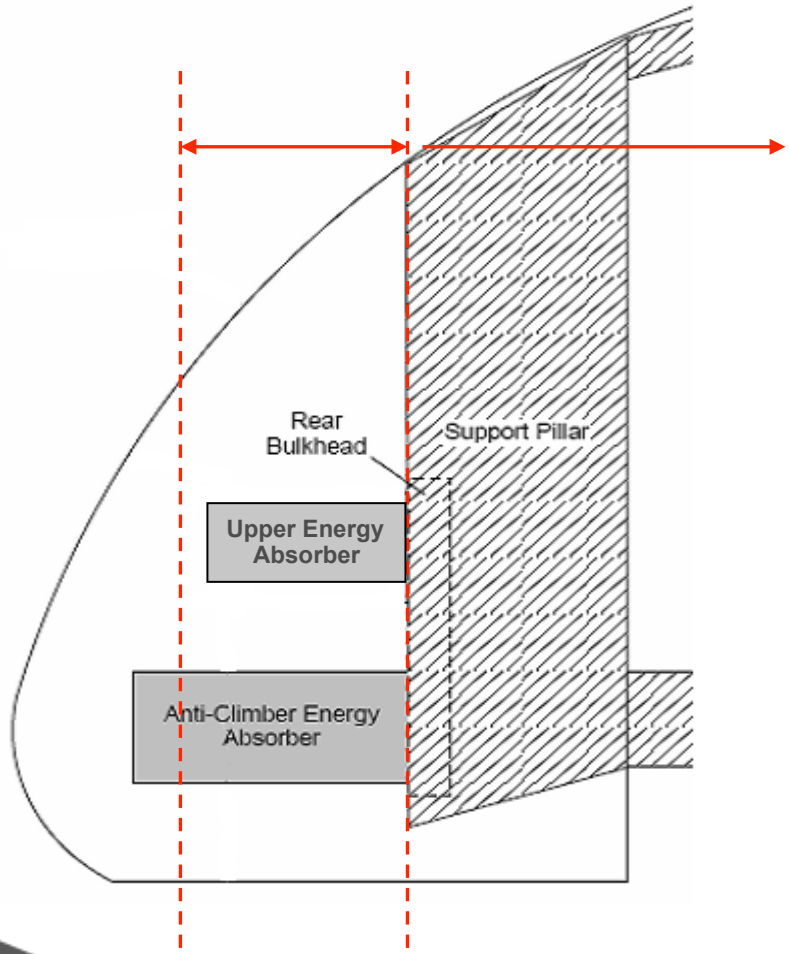
Cab Design Zones



- Reaction Zone
- Secondary Crush Zone
  - Houses the main energy absorbers
  - React majority of energy
- Primary Crush Zone

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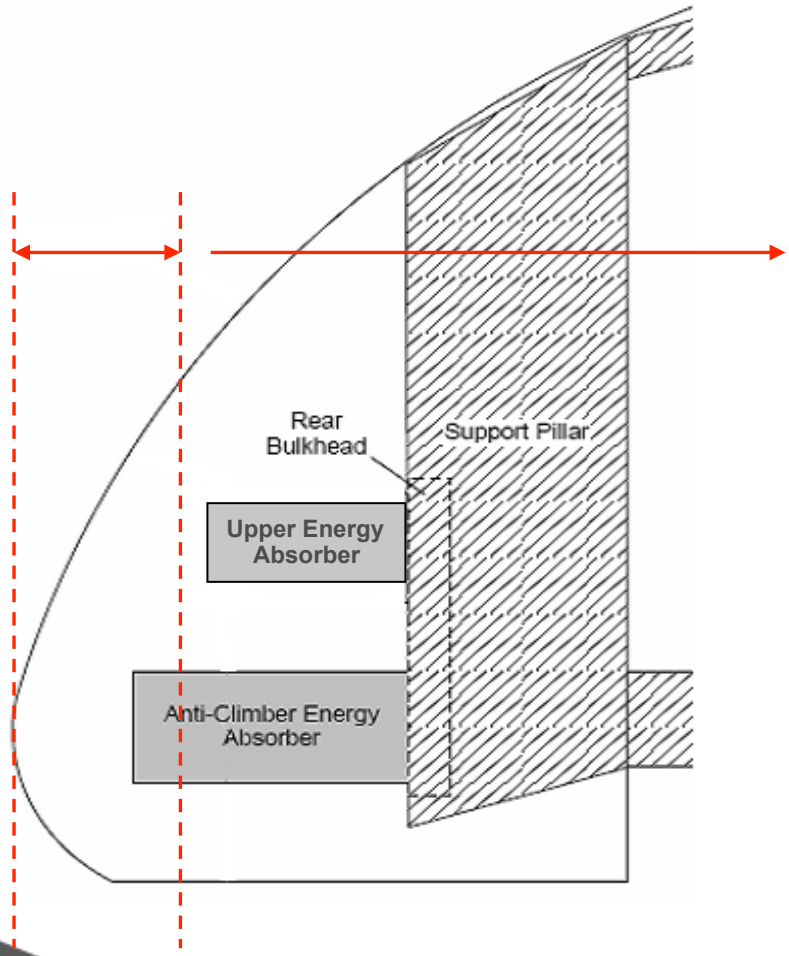
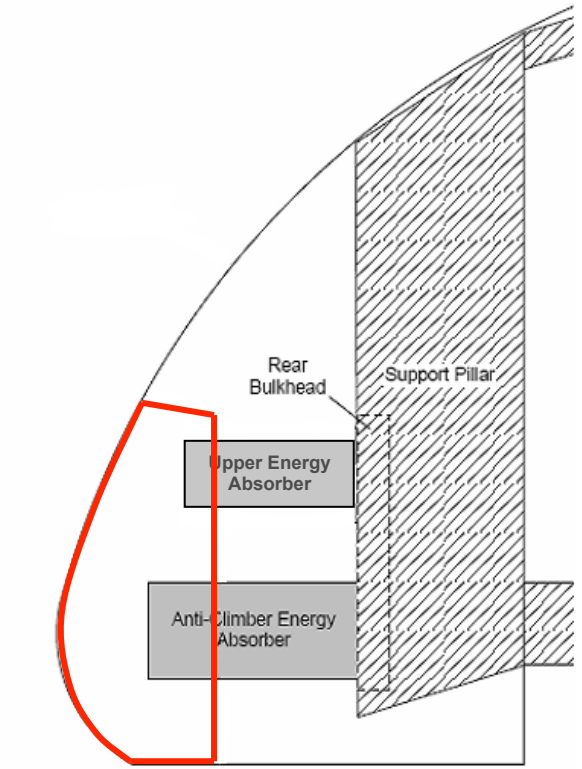
Cab Design Zones

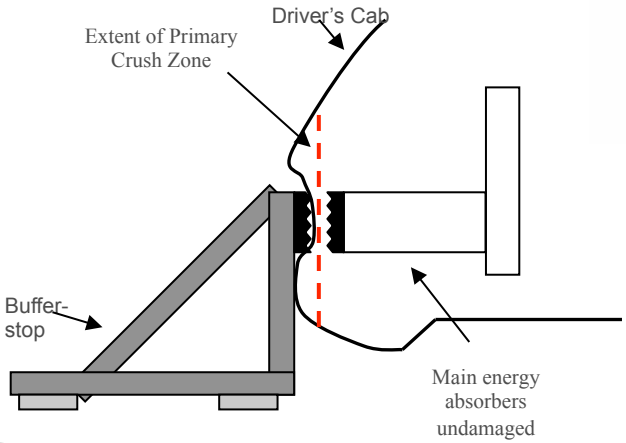


- Reaction Zone
- Secondary Crush Zone
- Primary Crush Zone
  - Reacts small impacts
  - Reduces size of main energy absorbers
  - Aligned with secondary crush zone

Primary Crush Zone

- Detachable nosecone
  - Located in primary crush zone.
  - React energies ≤ 0,2MJ.
  - Replaceable, interchangeable.
  - Composite sandwich structure.
  - Lightweight.





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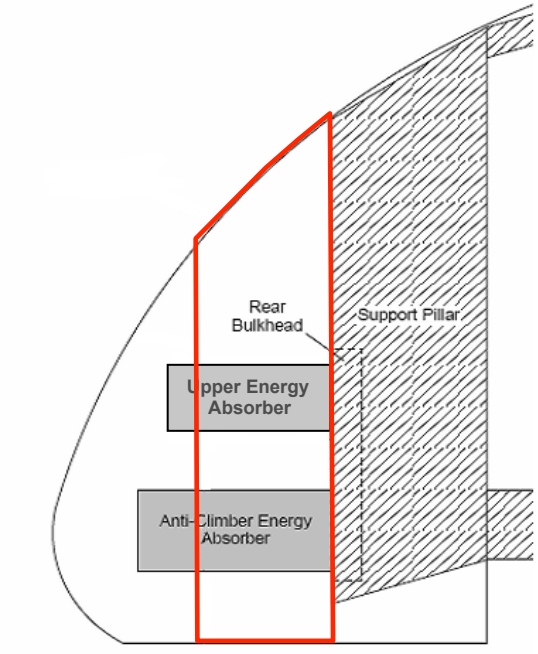
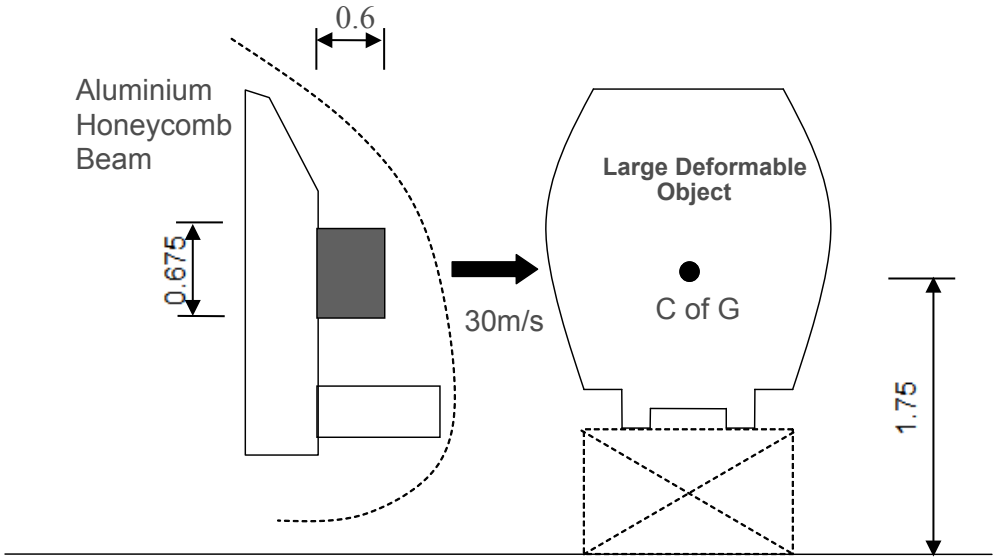
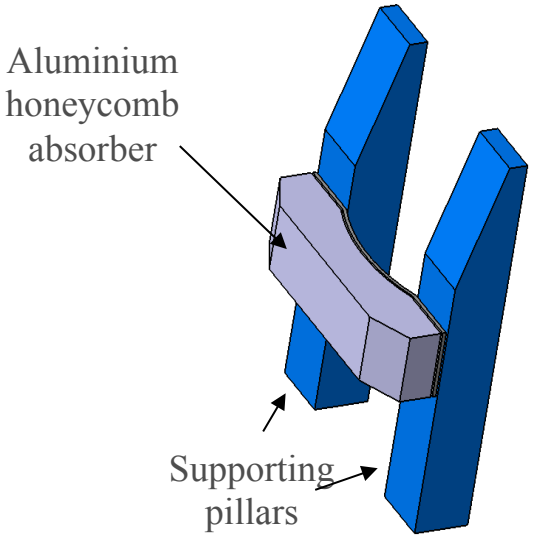
Secondary Crush Zone

- Main energy absorption module:
  - Upper absorber for Large Deformable Obstacle crash.
  - Lower absorbers for buffer-level impacts.



Upper Absorber Concept





- Aluminium honeycomb beam
- Fit within existing design.
- Designed to absorb LDO crash energies

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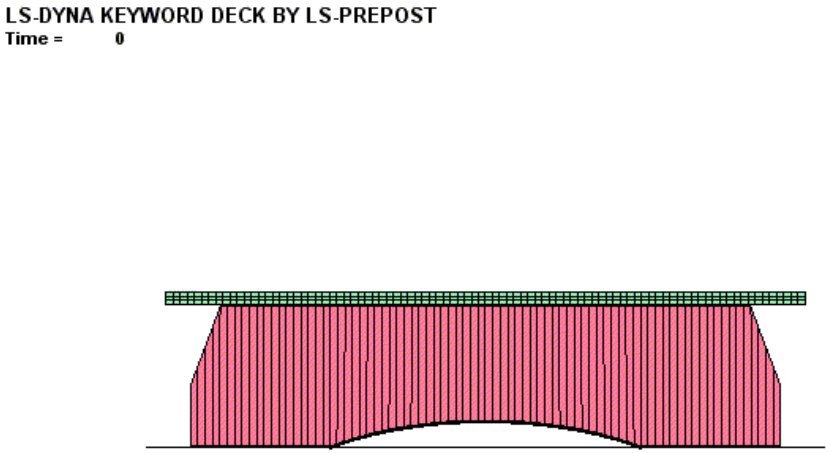
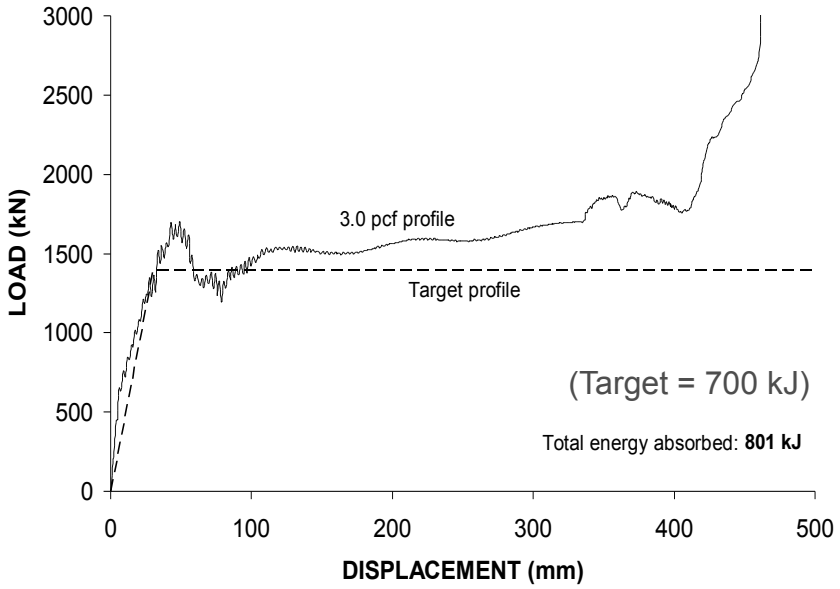
Dynamic Modelling of Upper Absorber





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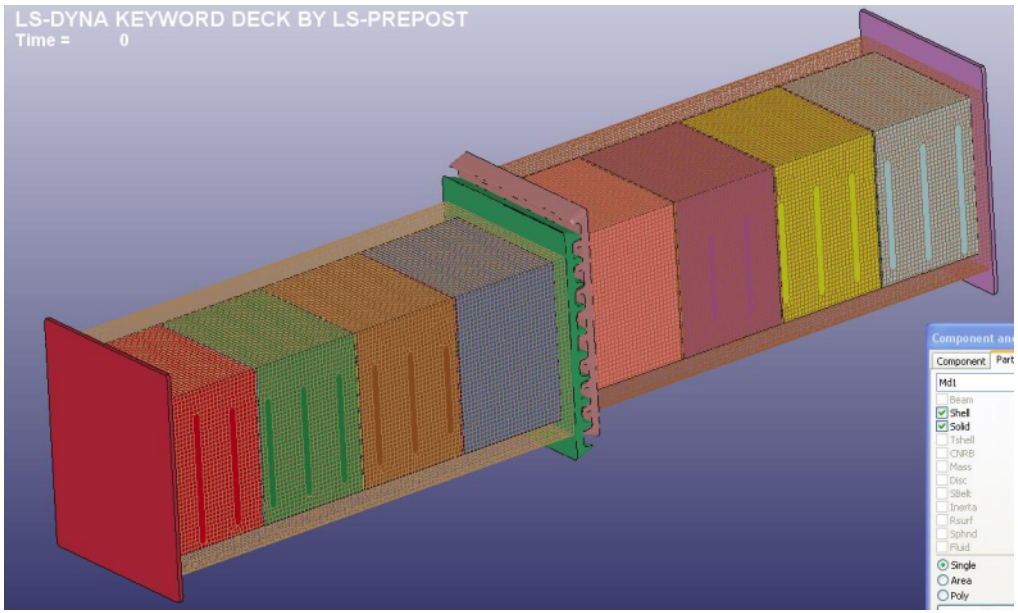
Lower Absorber Concept

- Large aluminium tube
- Blocks of aluminium honeycomb of varying density
  - Begin crushing at rear of absorber rather than the front
  - Honeycomb will self align when fully crushed.



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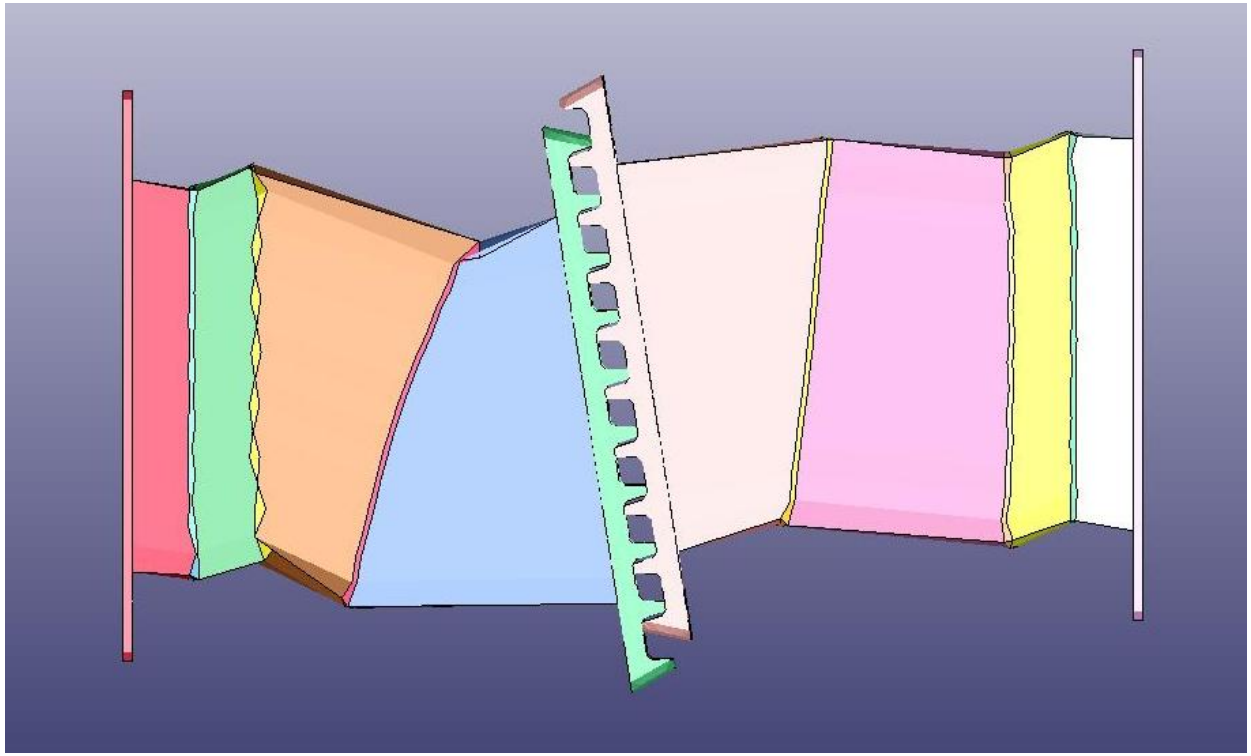
Lower Absorber Concept



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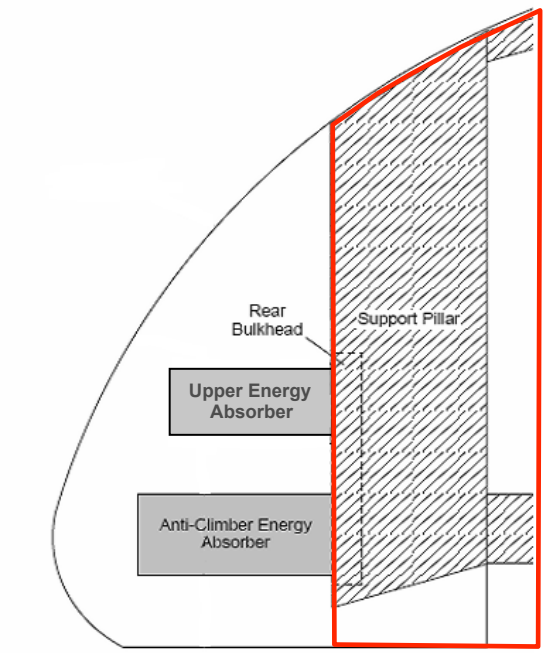
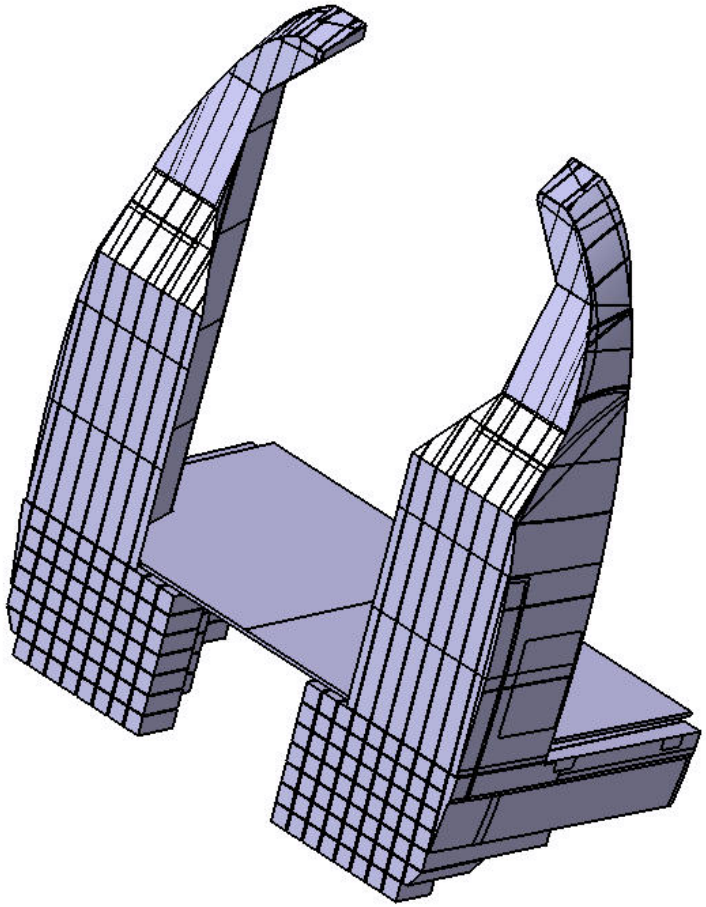
Reaction Zone

- React the energies from impact:
  - Provide support to absorbers.
  - Distribute load rearward.
  - Non-deformable.
- Blended composite pillars into structural cab shell.



Reaction Zone:

- Composite Pillars:
  - React loads from upper absorbers
- Composite reactors:
  - Withstand loads from lower absorbers.
  - Integrated with pillars



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Reaction Zone Testing

- Test specimens manufactured.
- Each specimen consists of 4 tubes and designed to withstand 200 kN.
- Tested under compression at Newcastle University.
- Loading rate of 1000 kN/min
- Average failure load = 542 kN

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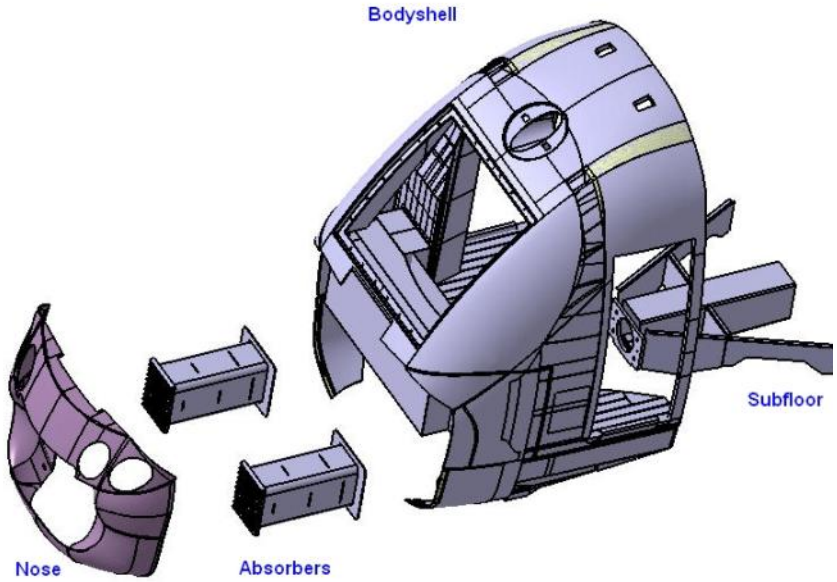
Complete Design



- Full scale prototype:
  - Showcased at INNOTRANS, Berlin.
  - Mass saving: 60%
  - Part-count saving: 40%
  - Cost saving: 50%

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Thank You!

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