Lightweight Modular Vehicle Platform - Manufacturing

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Lightweight Modular Vehicle Platform Project

AutoCRC Smarter Safer Cleaner

DEAKIN UNIVERSITY

SWINBURNE UNIVERSITY OF TECHNOLOGY

VPAC VICTORIAN PARTNERSHIP FOR ADVANCED COMPUTING

RMIT UNIVERSITY

ANU THE AUSTRALIAN NATIONAL UNIVERSITY

- Initiate and drive the development of a lightweight modular vehicle platform
- Propose an alternative vision for the automotive industry
- Visionary Project of the Cooperative Research Centre for Advanced Automotive Technology
- Five Australian Research Partners
- Conceptual design and feasibility assessment of vehicle body structure
- Technology development plan supported by ongoing research

Lightweight Modular Vehicle Platform Project

- The design must be simple, low-cost and configurable to suit a range of customers and markets
- Develop a lightweight, low cost base structure
- Meet all statutory requirements for safety, durability, crashworthiness etc.
- Modular to enable multiple variants on the same platform

Traditional Chassis Systems

- Unibody Design
- Material is primarily steel
- Stamping
- Welding

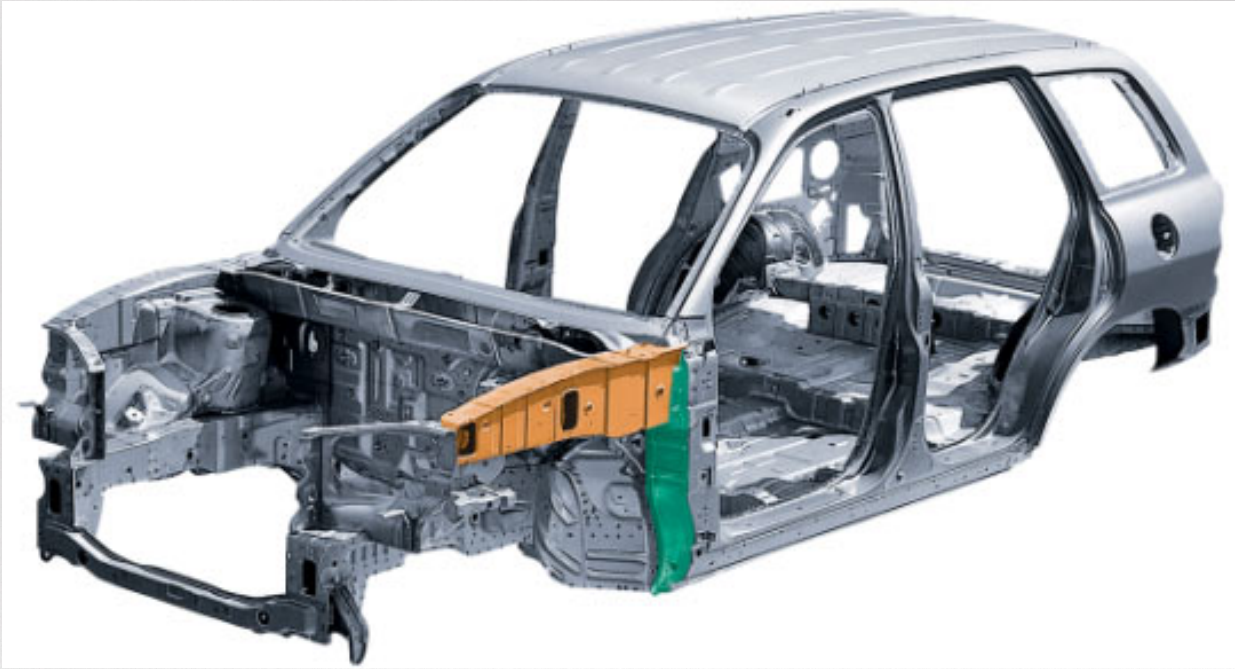


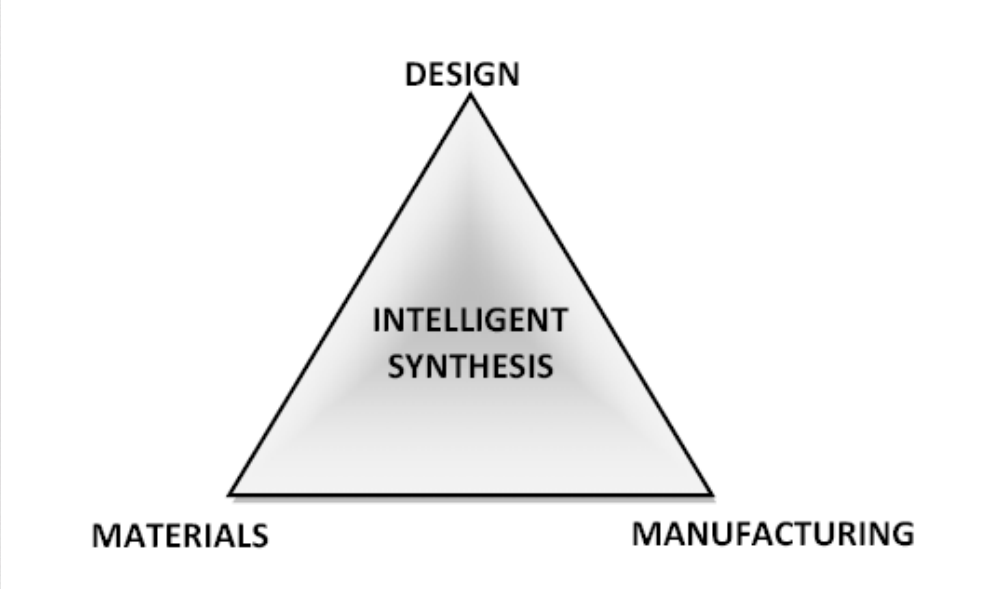
Image source: http://www.hyundainews.com/Media_Kits/2006_Models/Santa_Fe/Press_Release.asp

Concept Design

- Space Frame based
- Materials include Aluminium, Steel, High Strength Steel
- Constructed from closed sections, composite sandwiches, tubular sections, nodes

Manufacturing Aims

- Cost Effective
- Allow for more expensive materials
- Simple
- Flexible Tooling
- Minimal Infrastructure
- Scalable Production Volumes



Manufacturing Constraints

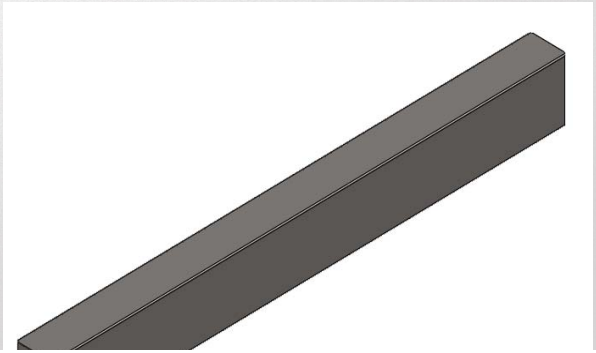
- Lightweight materials have different properties to traditional steel
- Can be more difficult to form
- More expensive
- Multiple materials are present in the body structure design
- Different processes for each material

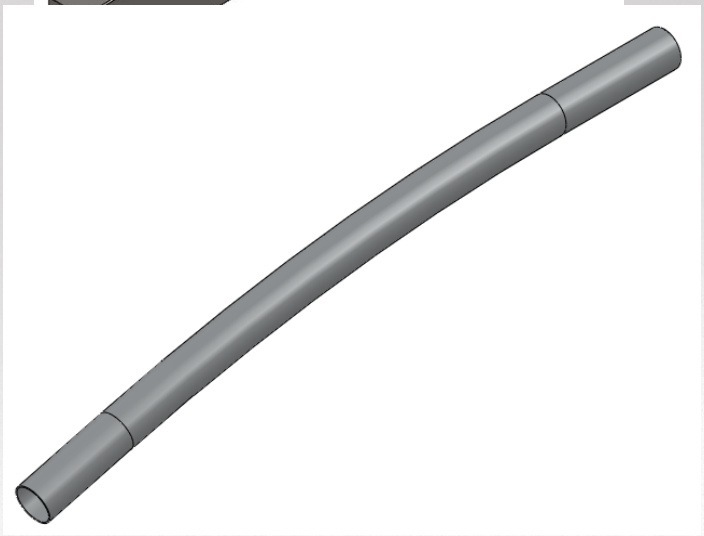
Assembly Constraints

- Joining dissimilar materials can be difficult
- Closed members are not easy to join
- Single sided joining is required
- Joining aluminium via liquid phase welding is difficult
- Disassembly considerations
- Adhesives require
  - Application
  - Thickness control
  - Flexible fixtures
  - Curing

Parts Manufacture

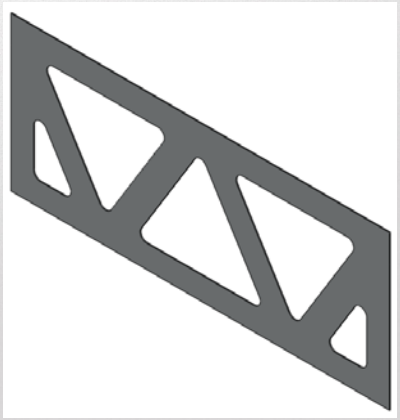
- Closed Section Members
  - Uncoiling and Straightening
  - Laser Cut to correct width
  - Roll Forming with Inline Laser Welding
  - Trimming
- Extruded Sections
  - Provided in lengths
  - Cut to length
  - Stretch Bender

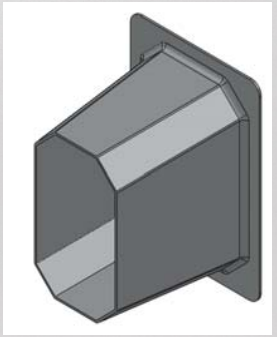


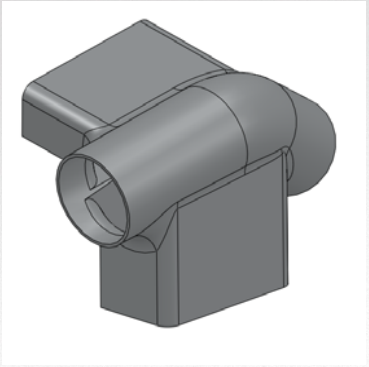


Parts Manufacture (cont…)

- Flat Panels
  - Uncoiling and Straightening
  - Laser Cutting
- Folded and Welded Parts
  - Uncoiling and Straightening
  - Laser Cut
  - Folding/Bending Machine
  - Welded
- Cast Parts
- Composite Panels



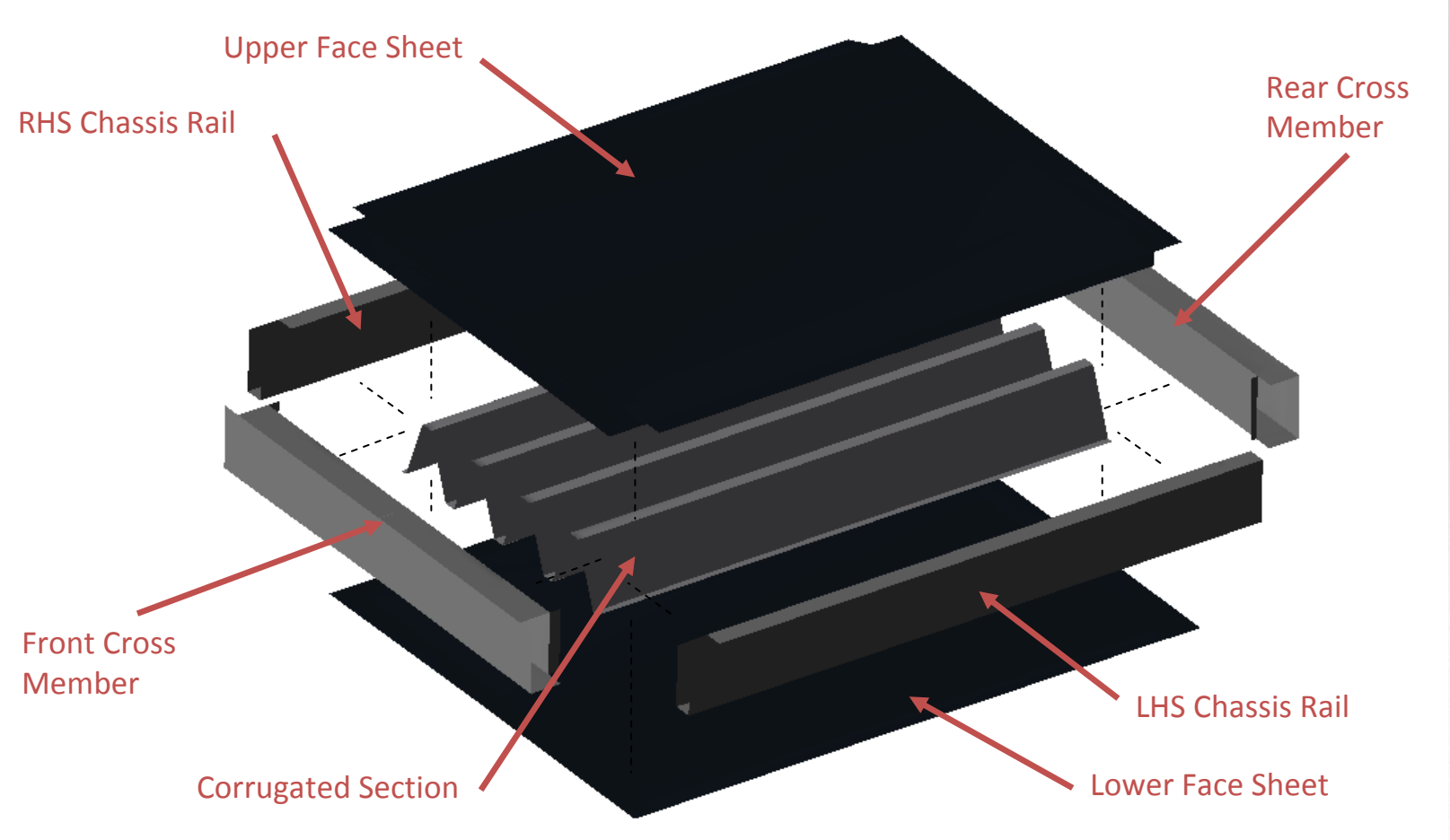




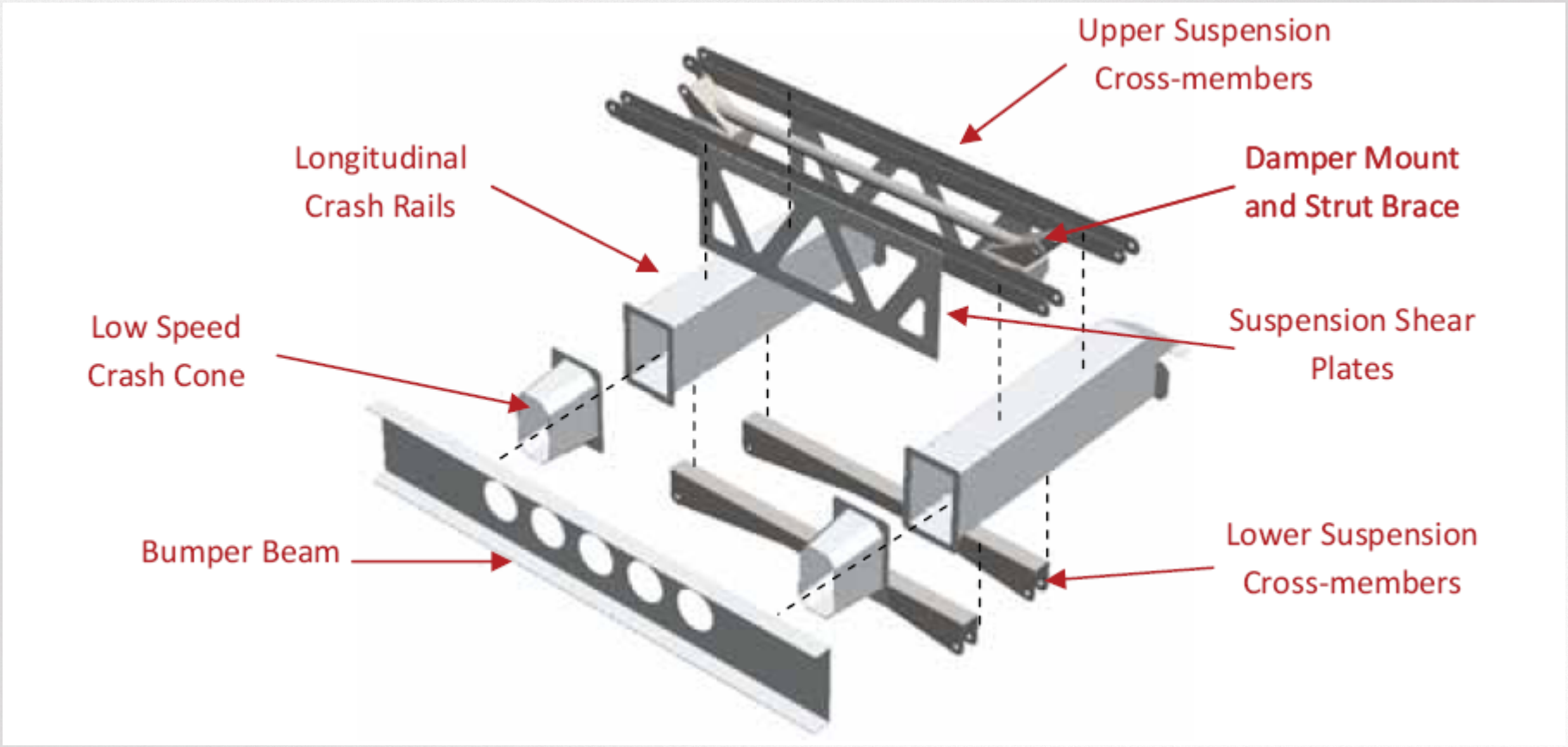
Infrastructure

- The required infrastructure includes
  - Uncoiler and Straightener
  - CNC Laser Cutter
  - Roll Former
  - Roll Former with Inline Laser Welder
  - Stretch Bender
  - CNC Laser Router
  - Welder
- This equipment can be used on multiple components with minimal tooling changes
- The equipment can also accommodate the different vehicle variants with minimal tool changes

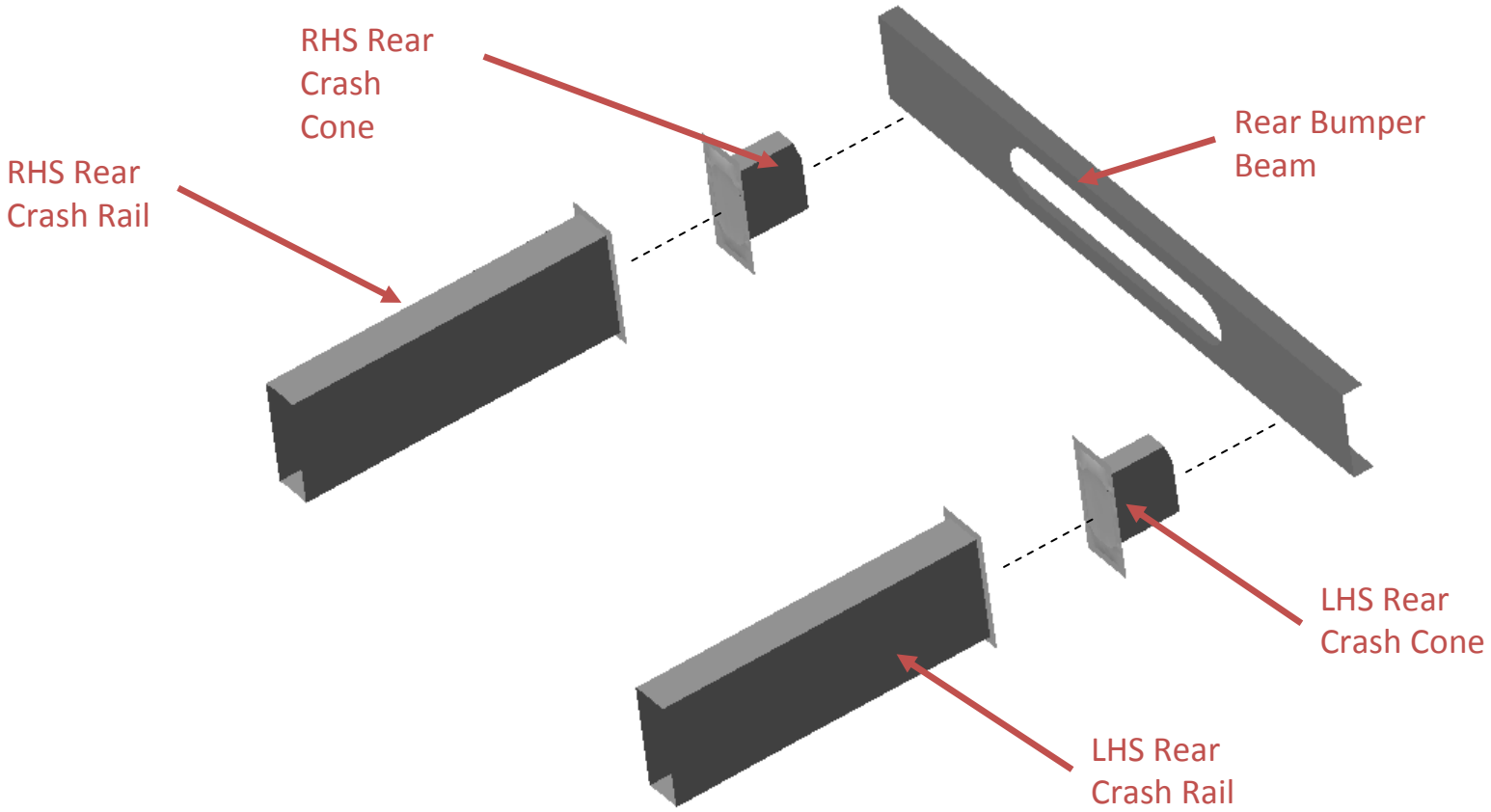
Deck Module


Upper Face Sheet
RHS Chassis Rail
Rear Cross Member
Front Cross Member
Corrugated Section
LHS Chassis Rail
Lower Face Sheet

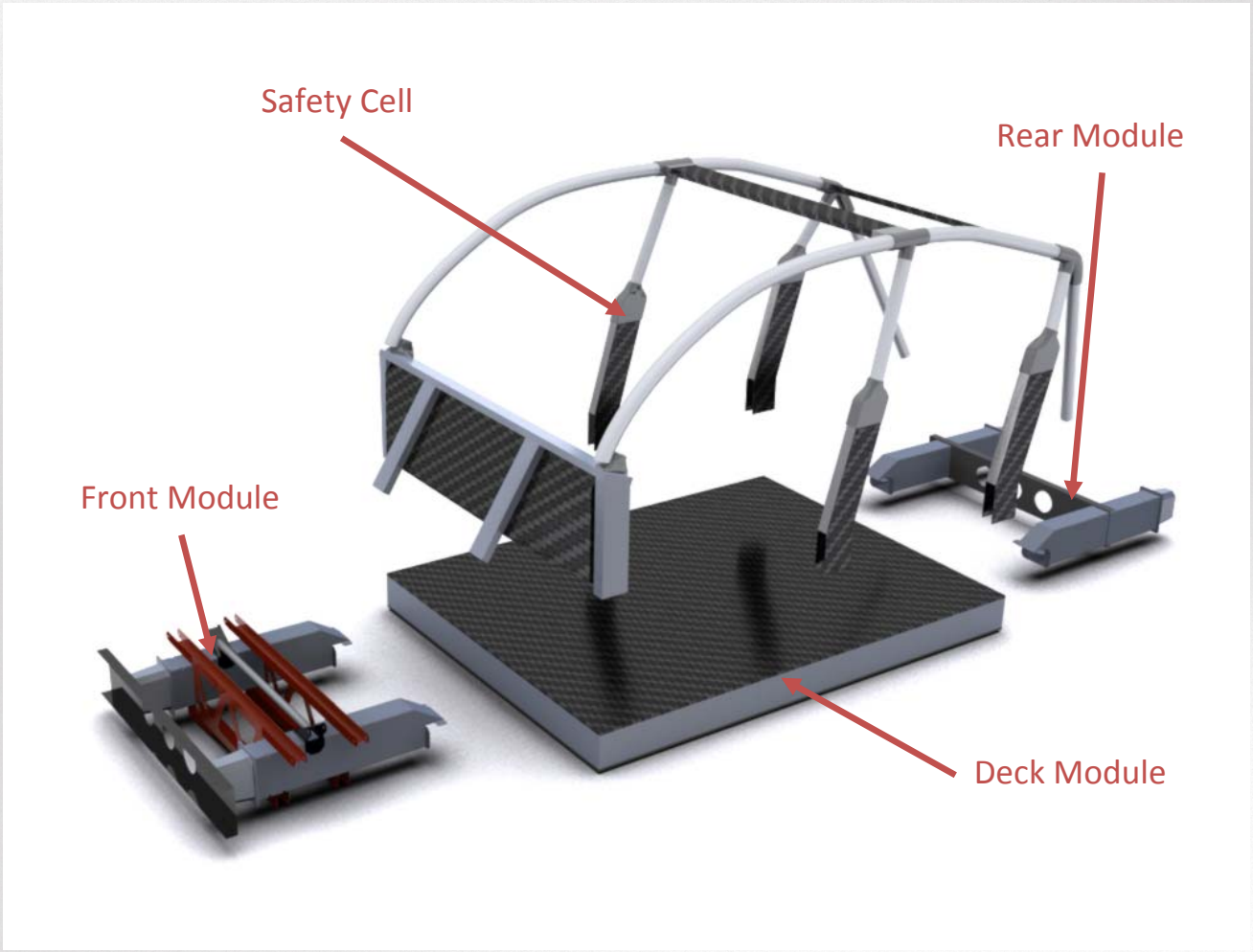
Front Module



Rear Module


RHS Rear Crash Cone
RHS Rear Crash Rail
Rear Bumper Beam
LHS Rear Crash Cone
LHS Rear Crash Rail

Body Structure

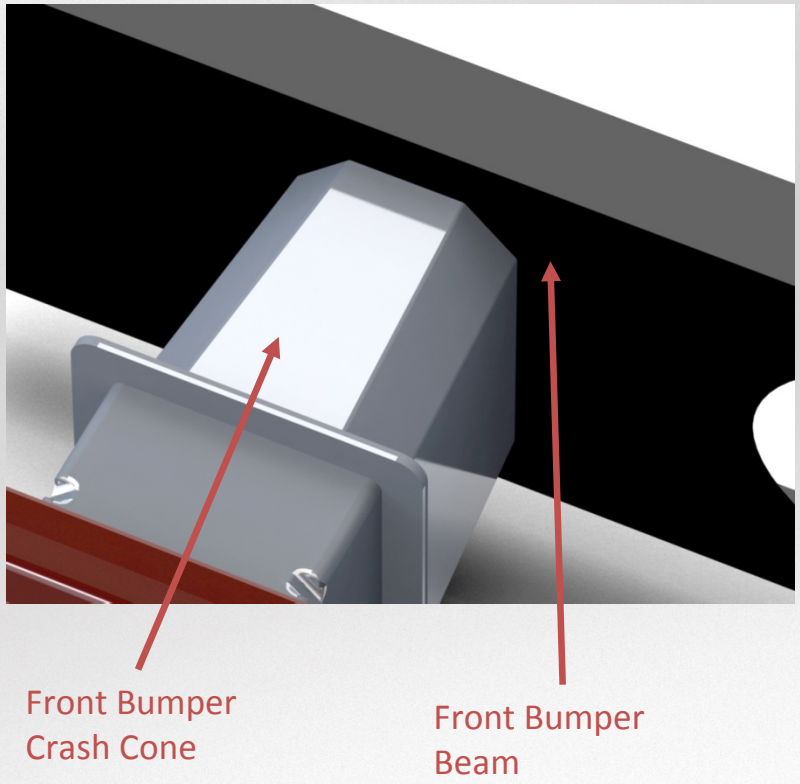


Joining

- Over 70 parts in the body structure
- Over 120 separate joints
- Roughly 20 “types” of joints
  - Closed Section End to Closed Section
  - Closed Section to Sandwich Panel
  - Tubular Sections to Nodes

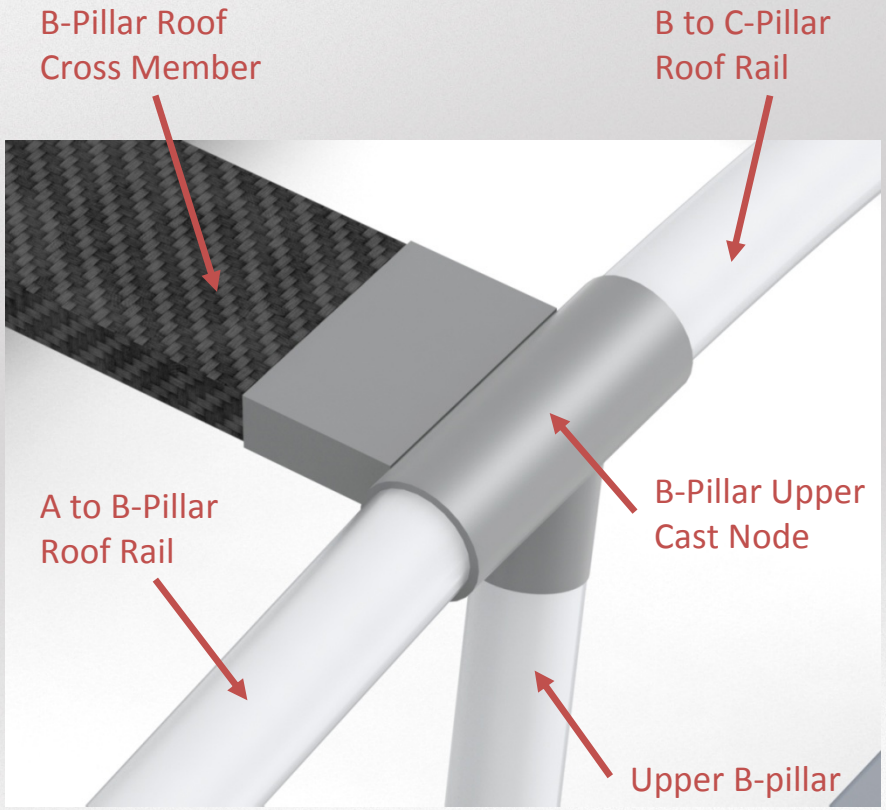
Joining Challenges

- Dissimilar materials are involved in a joint
- Closed Sections
- Sandwich Panel
- Perpendicular joints of dissimilar materials



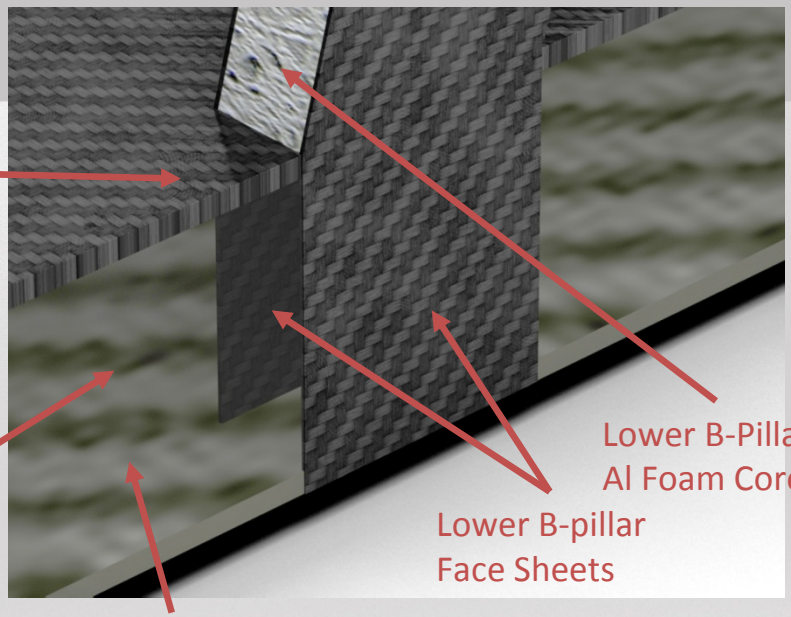
Joining Example

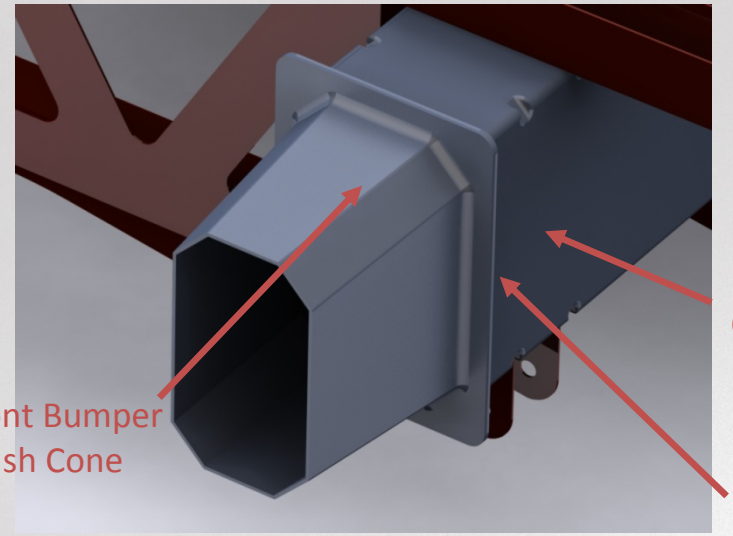
- B-Pillar Upper Cast node
  - Cast node
  - Cast Aluminium
- B-Pillar
  - Aluminium Alloy Tube
- B-Pillar Roof Cross Member
  - Roll Formed Aluminium Sheet
- A to B-Pillar Roof Rail
  - Aluminium Alloy Tube
- B to C-Pillar Roof Rail
  - Aluminium Alloy Tube
- Adhesives and Blind Rivet



Joining Solutions

- Simple Design
- Clever design of joints
- Adhesives
- Blind rivets





Conclusion

- LMVP represents a challenging project in terms of manufacturing and assembly
  - Desirability for low cost manufacturing
  - Lightweight materials
  - Dissimilar materials
  - Composite structures
  - Single-sided joints
- Challenges can be met
  - Flexible manufacturing and infrastructure
  - Cleverly designed joints
  - Use of advanced joining methods

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