



ASTON MARTIN



Yan Pugh-Jones
Frederick Walker

DB11



ASTON MARTIN

DB11 – Project Mission

Architecture

Manufacturing

Summary

DB11 – Project Mission Second Century Plan



DB11 – Project Mission VH Platform



DB9

Coupe



DB11 – Project Mission Next Generation Platform



DB11
2016

Coupe					

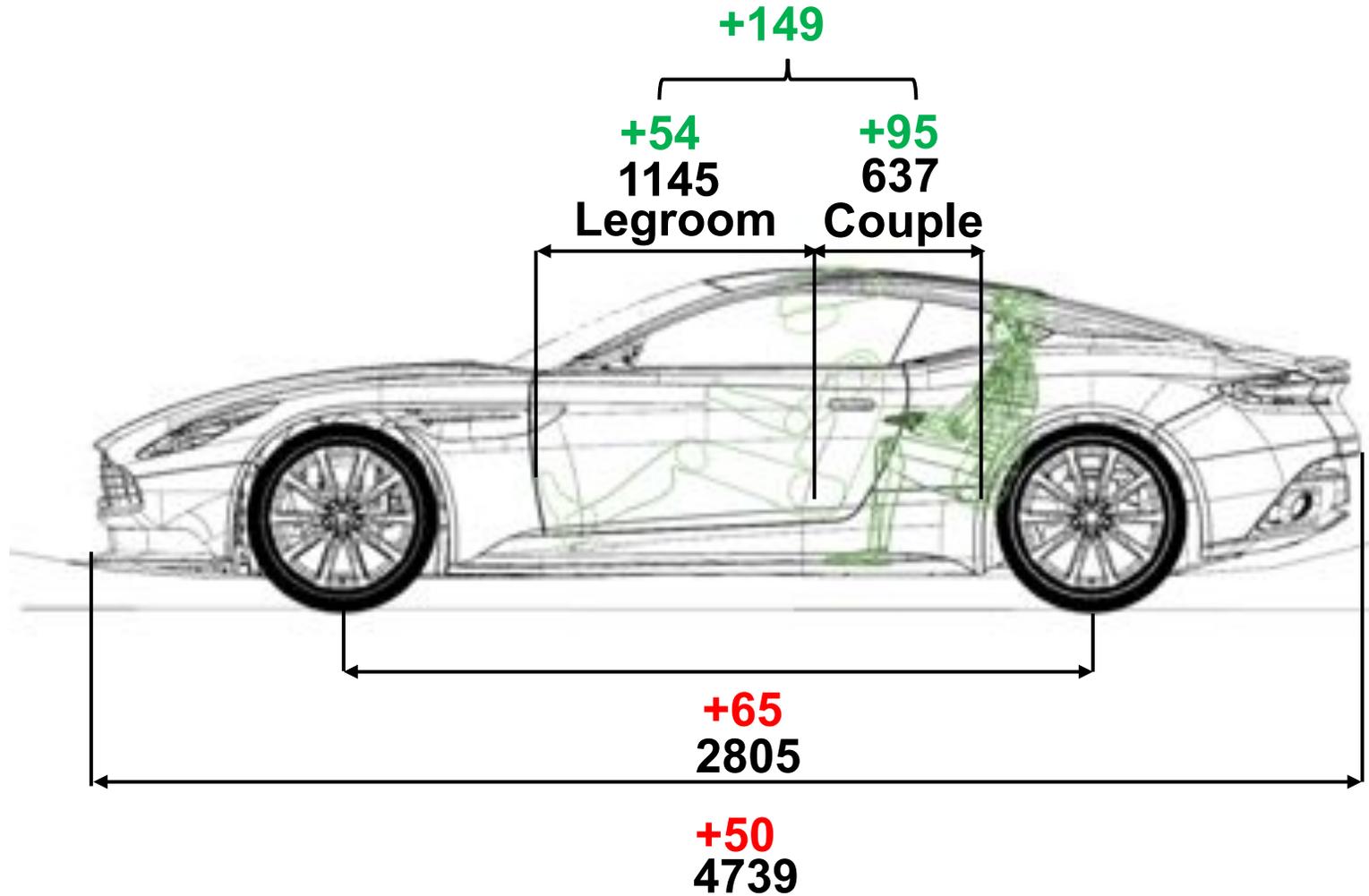
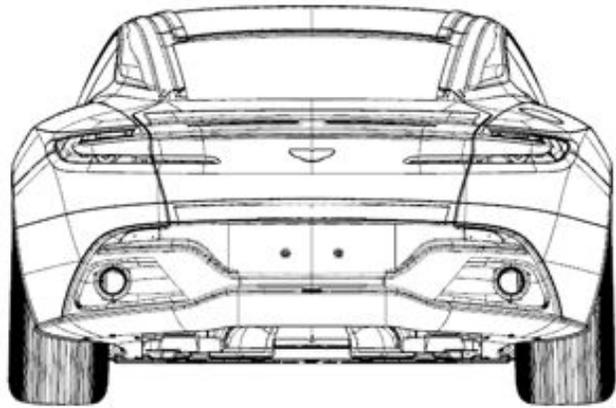
DB11 – Project Mission Next Generation Platform



**“The world’s most timeless and elegant sports grand
tourer”**

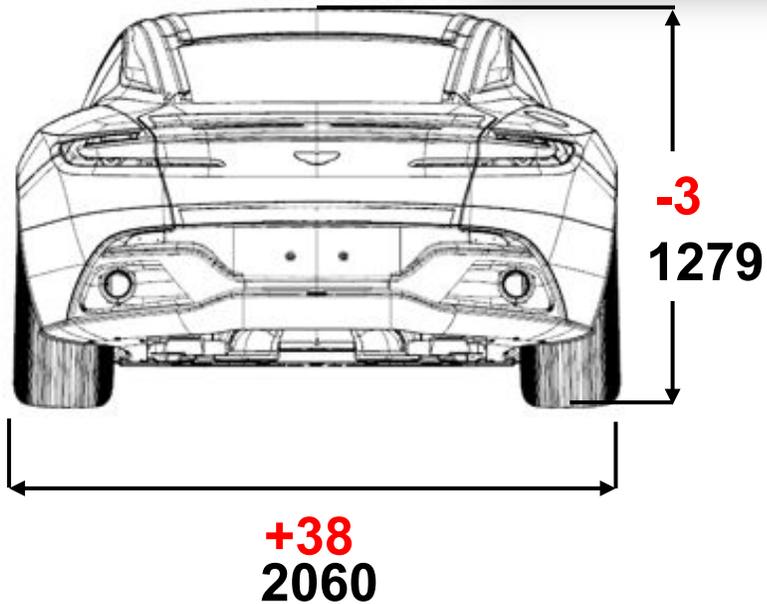
- The heart of Aston Martin: The fulcrum of our sports car range
- Supreme elegance and sports car precision, agility and effortless touring
ability
- Exceptional breadth of character: GT composure allied to sports car
excitement
- Forceful performance and everyday usability

DB11 – Project Mission Usability & Package

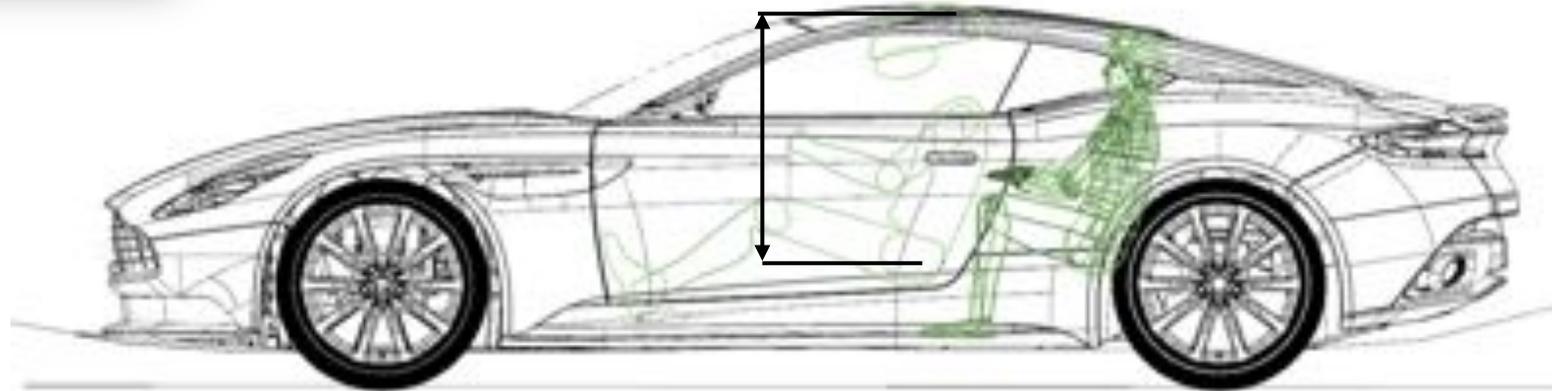


DB11 – Project Mission Usability & Package

+76l
260l
Boot volume



+9
982
Headroom



**DB9 Passenger Seat Isofix
Only**
2 Rear Seat Isofix Positions



DB11 – Project Mission Performance

	Performance DB11	Change from DB9
V12 Displacement:	5.2l	-13%
Power:	600bhp	+18%
CdA:	<0.650	-17%
0-62mph (100kph):	3.9s	-15%
0-100mph	<8.0s	-16%
Vmax:	>200mph	+10%
CO2g/(km * bhp):	<0.5g	-26%



DB11 – Project Mission Exterior Design



- Floating Arc cantrail
- Large highly sculpted front hinging aluminium clamshell
- Iconic and authentic Aston Martin Grille
- LED headlamps



DB11 – Project Mission Interior Design



- All new electrical architecture
- Electrically operated centre console
- First time application of knee airbag for Aston

Martin

Aston Martin DB11, GALM, Birmingham, 2017





ASTON MARTIN

DB11 – Project Mission

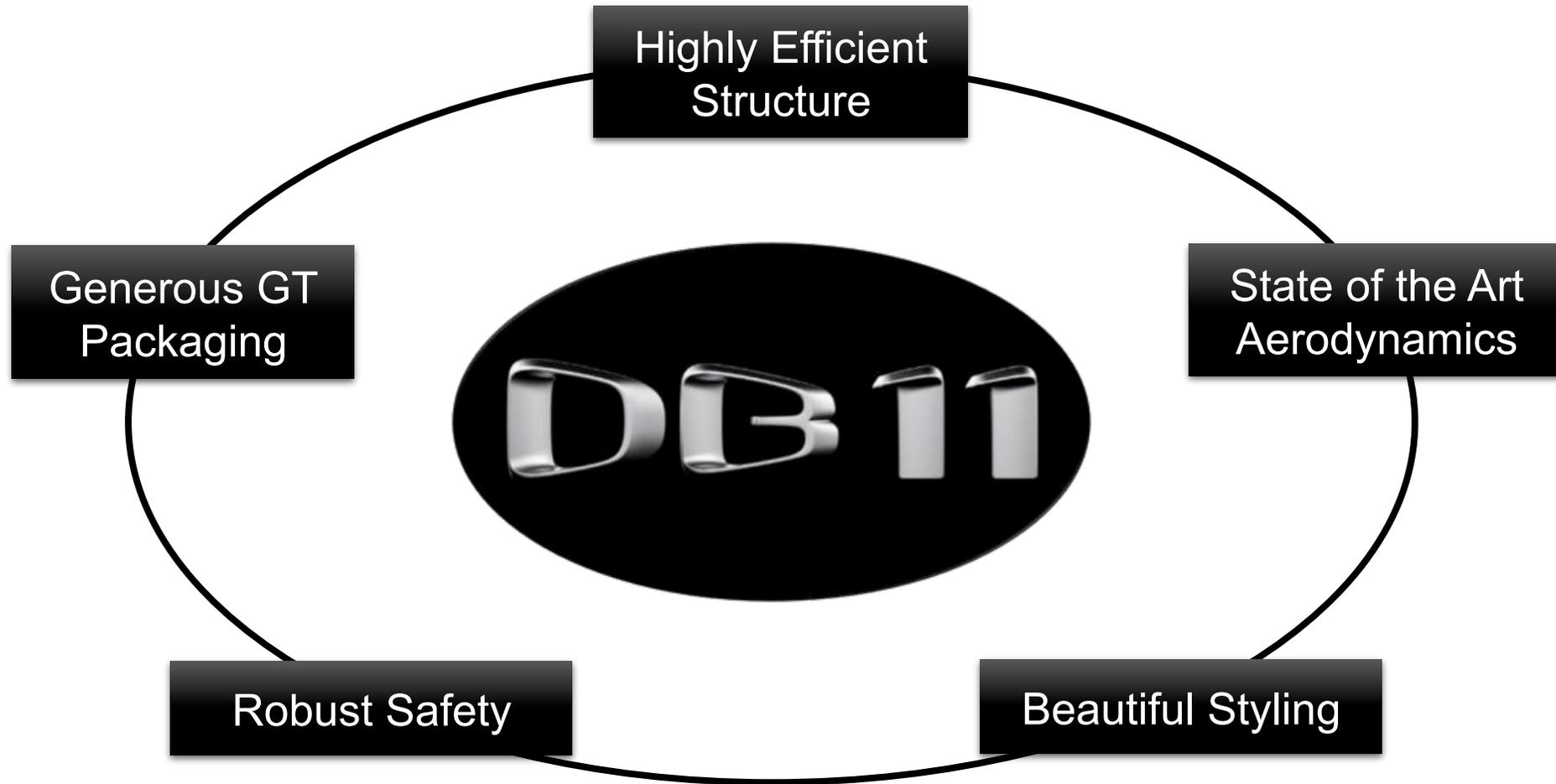
Architecture

Manufacturing

Summary

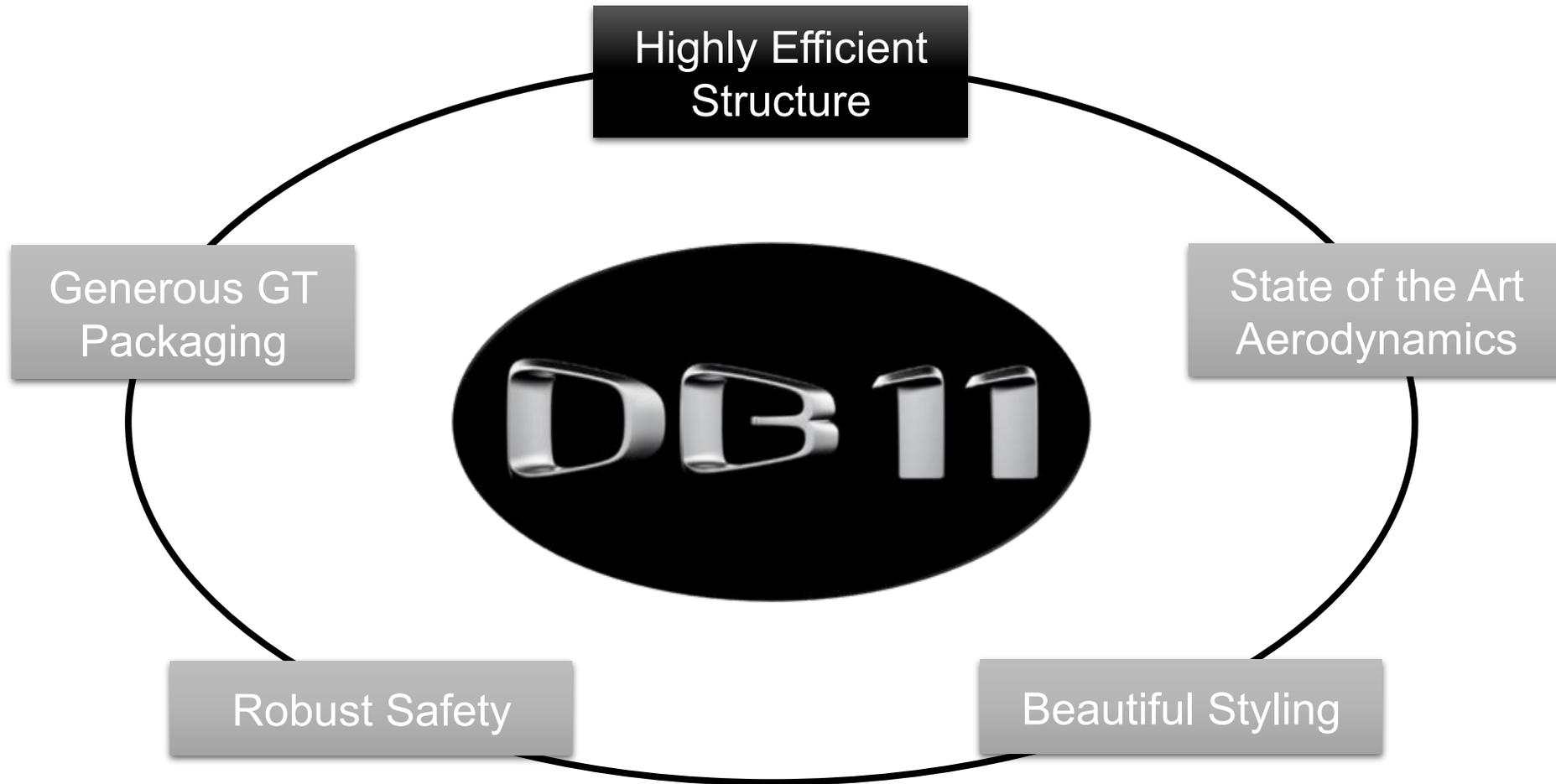
Architecture

Architectural Goals



Architecture

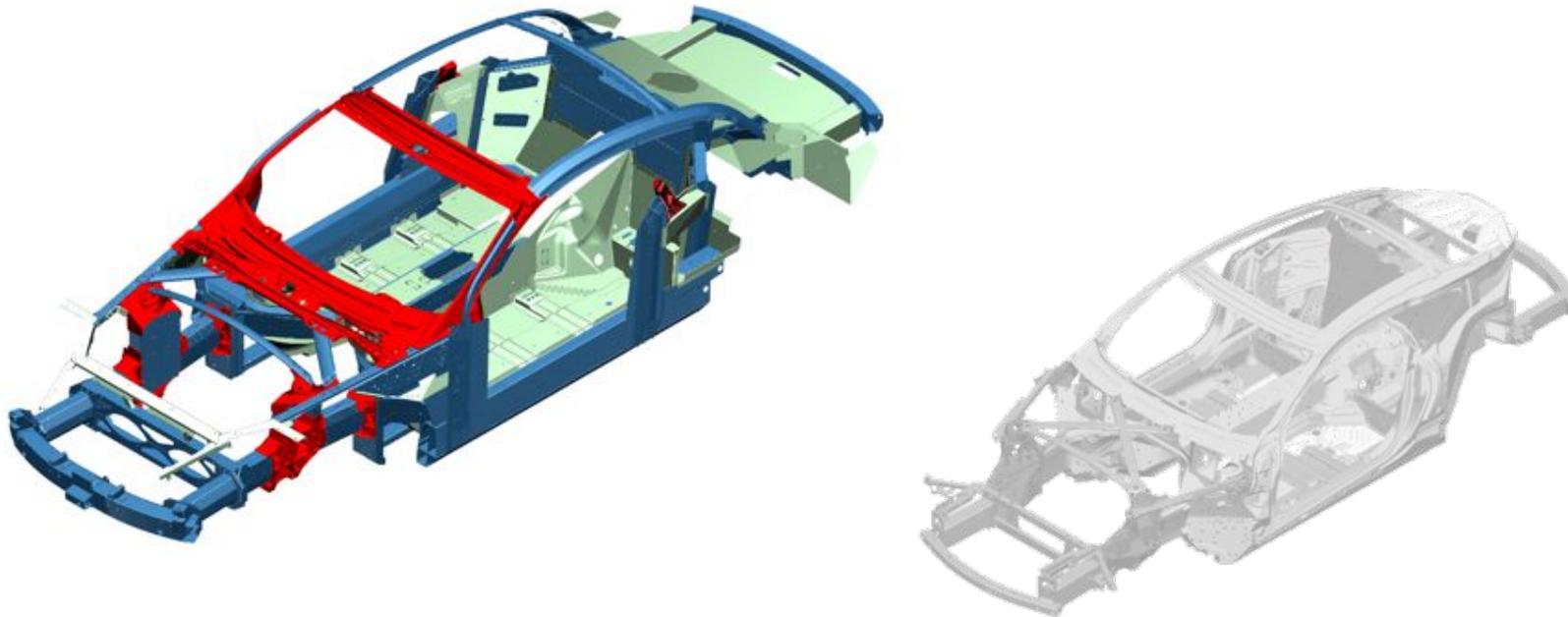
Architectural Goals



Architecture Material Mix – Underframe

DB9

- Aluminium Extrusion intensive whilst also utilising gravity die Castings and both simple and superplastically formed 5XXX Series Sheet



0%



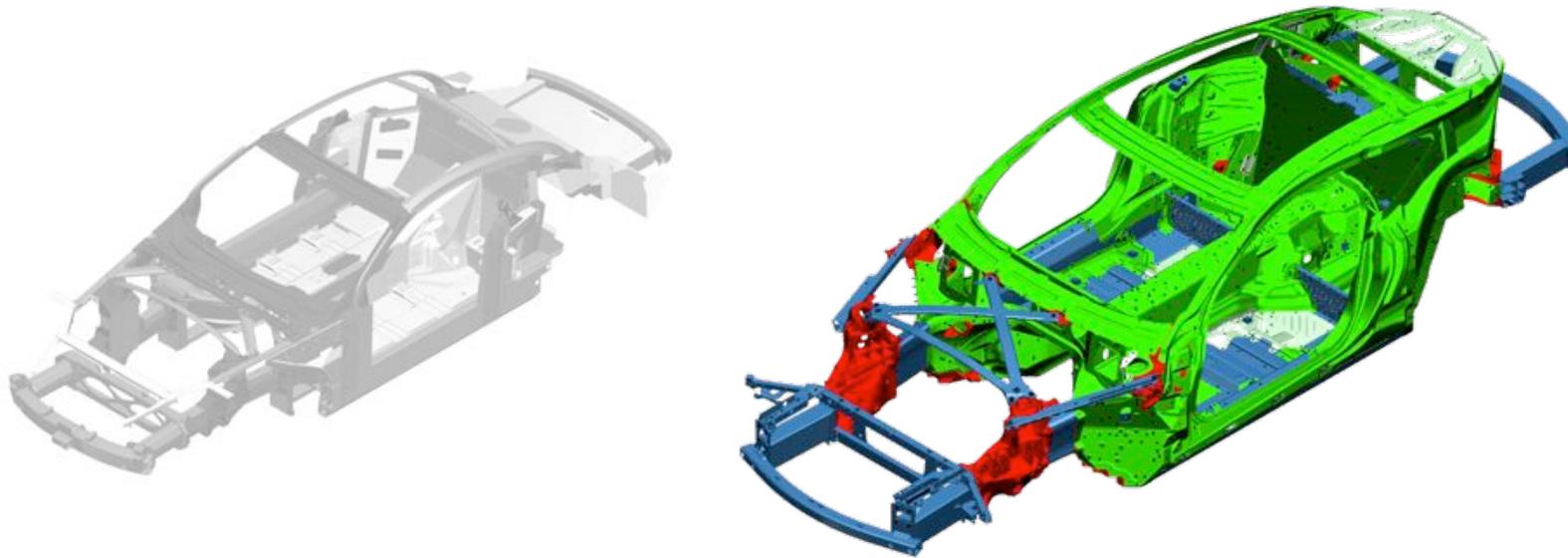
Material Mix by Mass

- Aluminium Sheet 5XXX Series
- Aluminium Sheet 6XXX Series
- Aluminium Die Castings
- Aluminium Extrusion Profiles

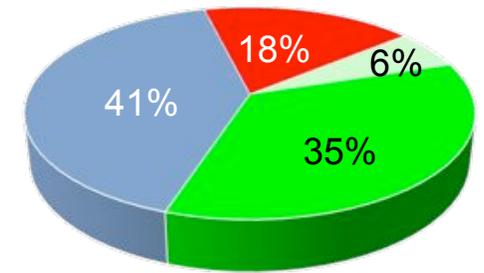
Architecture Material Mix – Underframe

DB11 Platform

- Over twice the amount of aluminium sheet metal used compared to DB9
- 6XXX series sheet for increased strength over 5XXX series
- Integration of a one piece structural bodyside



DB11 Underframe



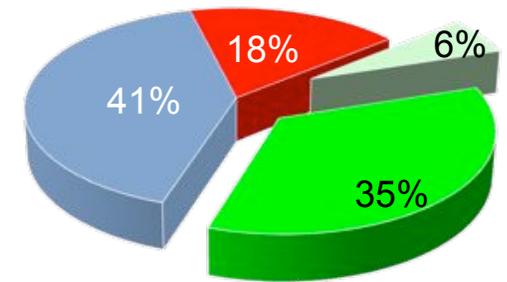
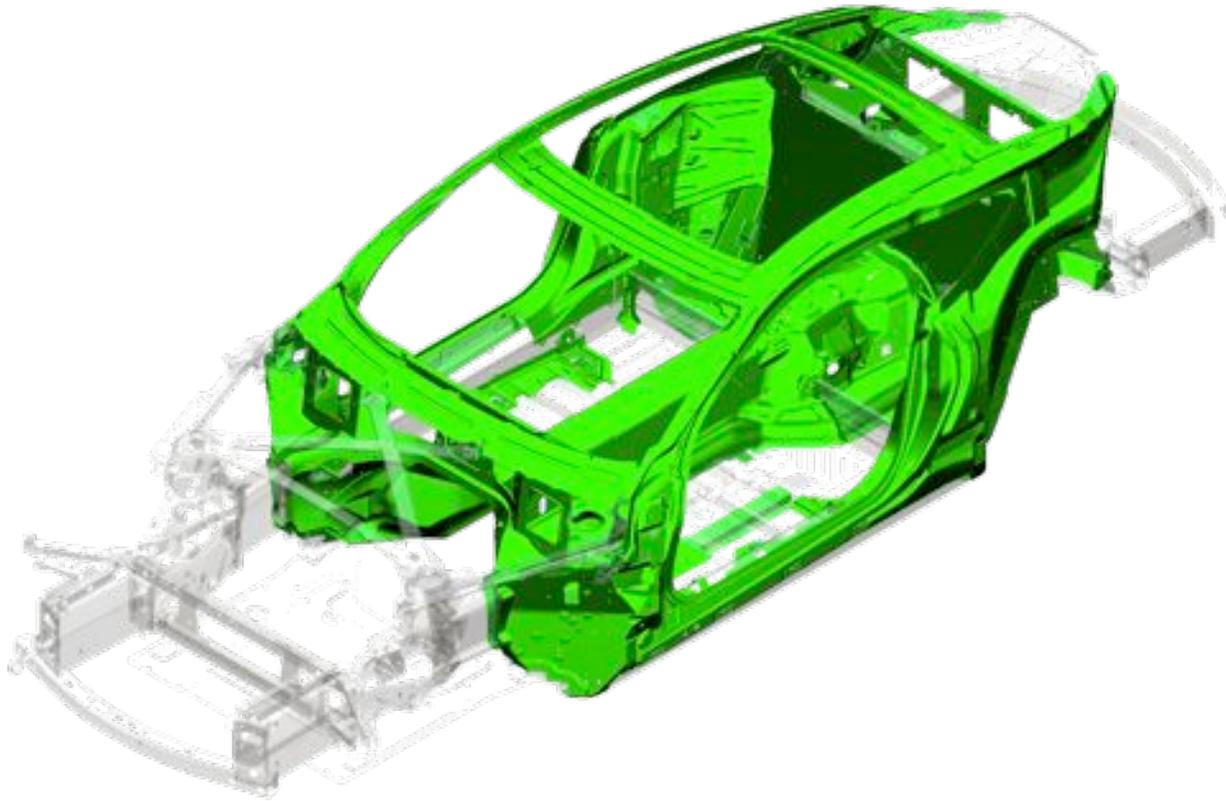
Material Mix by Mass

- Aluminium Sheet 5XXX Series
- Aluminium Sheet 6XXX Series
- Aluminium Die Castings
- Aluminium Extrusion Profiles

Architecture

Material Mix – Underframe

- Aluminium Sheet metal used in areas for package efficiency, organic development through CAE, robust body sealing and dimensional accuracy

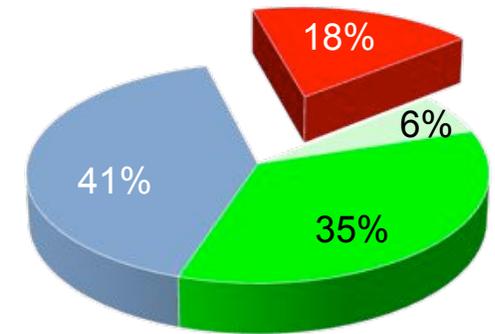
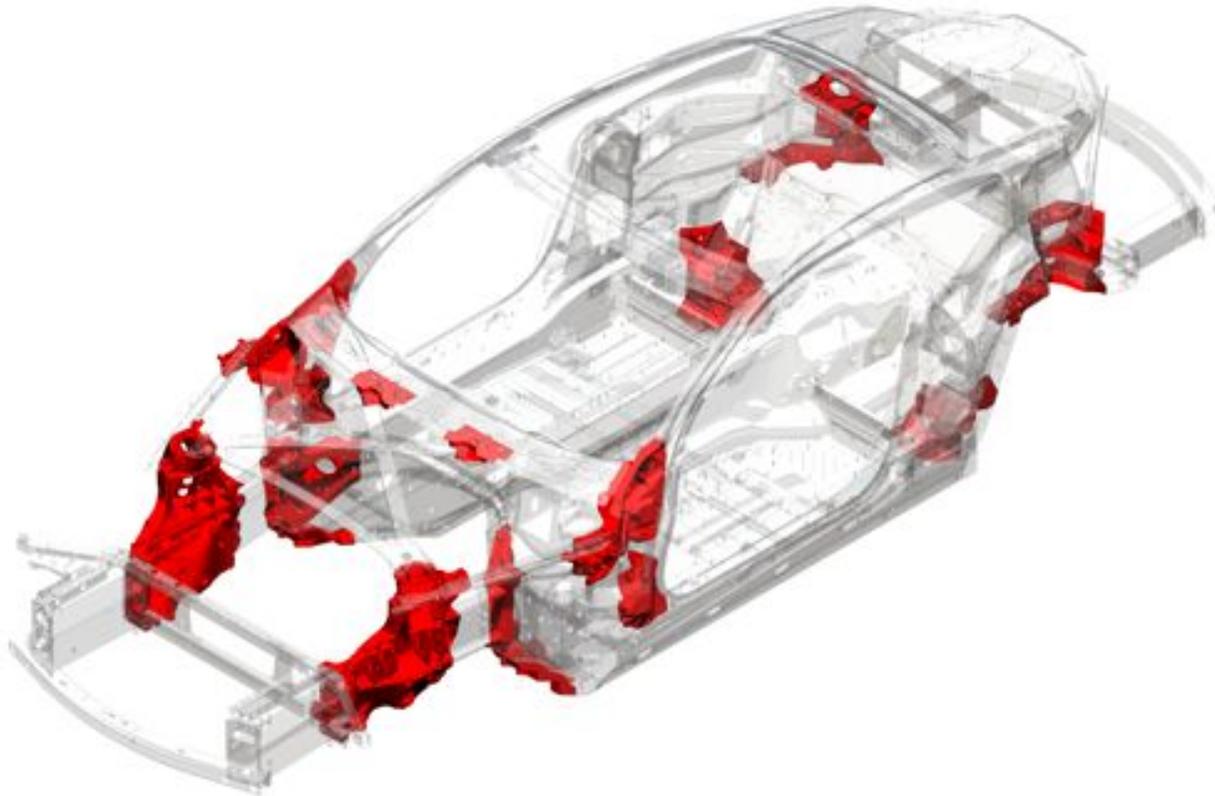


Material Mix by Mass

- Aluminium Sheet 5XXX Series
- Aluminium Sheet 6XXX Series
- Aluminium Die Castings
- Aluminium Extrusion Profiles

Architecture Material Mix – Underframe

- Aluminium gravity die castings for integration and complex nodal joints

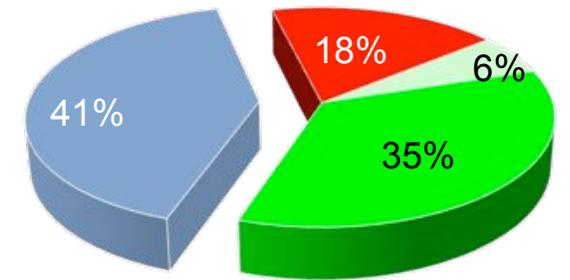
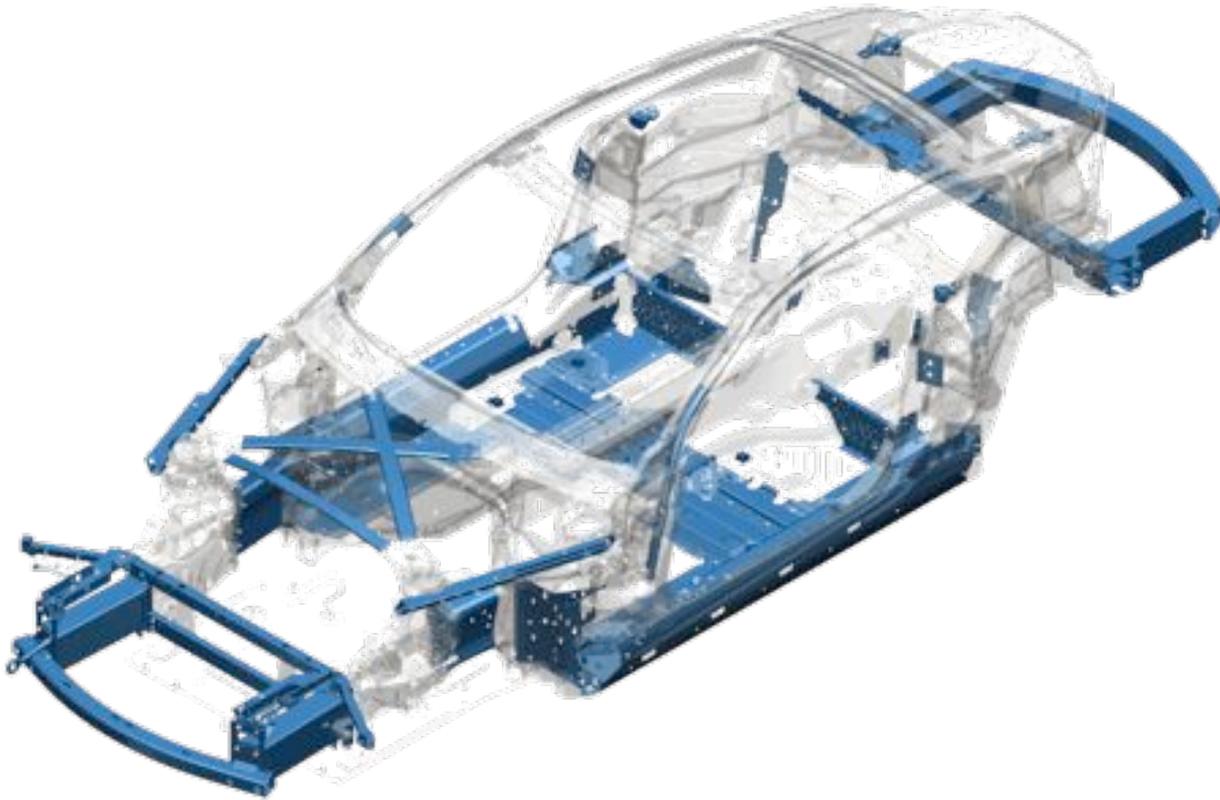


Material Mix by Mass

- Aluminium Sheet 5XXX Series
- Aluminium Sheet 6XXX Series
- Aluminium Die Castings
- Aluminium Extrusion Profiles

Architecture Material Mix – Underframe

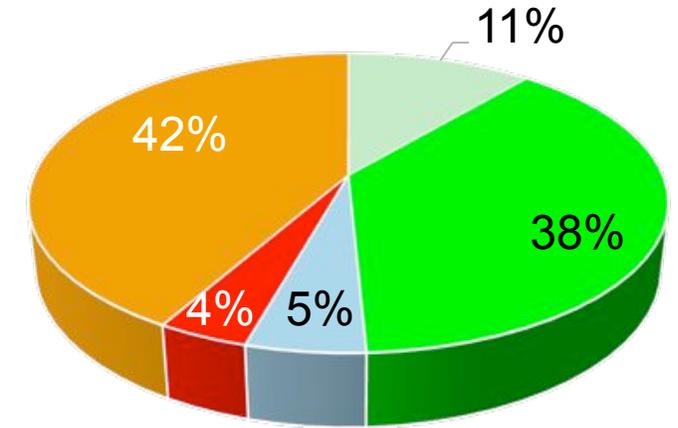
- Aluminium extrusion profiles for crash load paths and reinforcements



Material Mix by Mass

- Aluminium Sheet 5XXX Series
- Aluminium Sheet 6XXX Series
- Aluminium Die Castings
- Aluminium Extrusion Profiles

Architecture Material Mix – Body + Closures

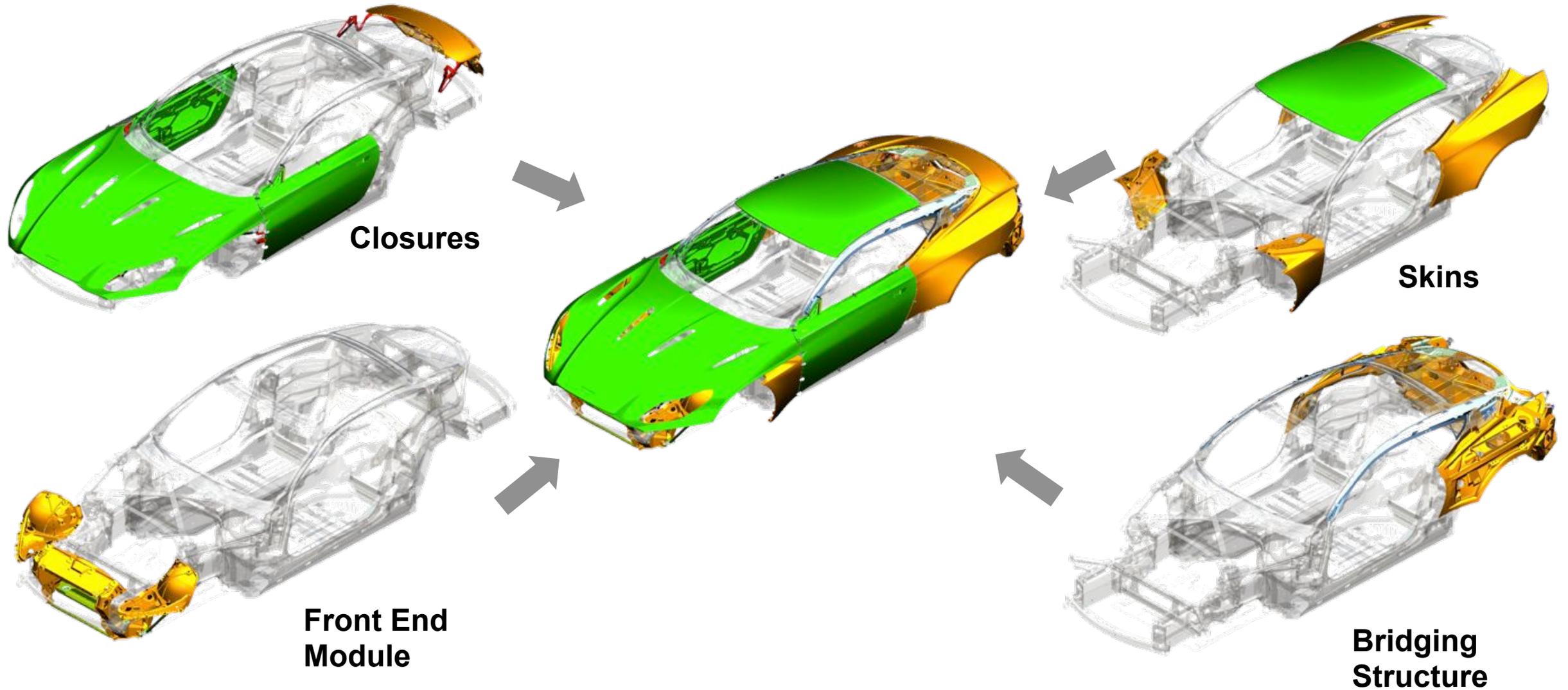


DB11 Body & Closures Material Mix

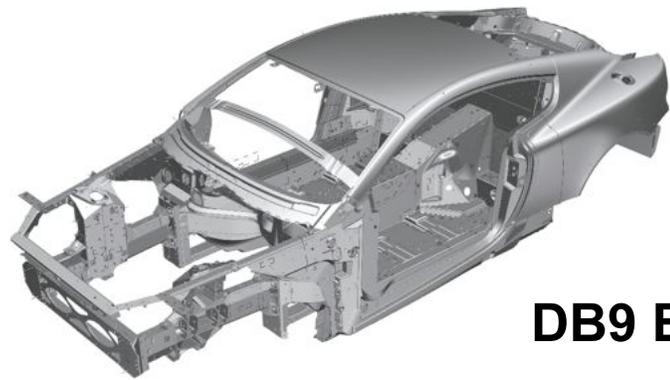
(Excluding Underframe)

- Aluminium Die Castings
- Aluminium Sheet 5XXX Series
- Aluminium Sheet 6XXX Series
- Mild Steel Sheet
- Sheet Moulding Compound (SMC)

Architecture Material Mix – Body + Closures



Architecture Mass Reduction

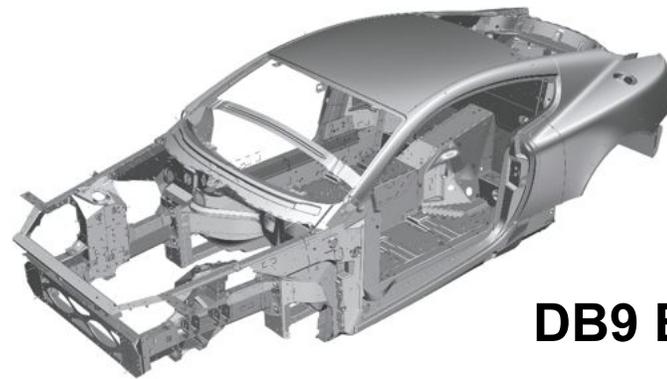


DB9 BIW

Architecture Mass Reduction

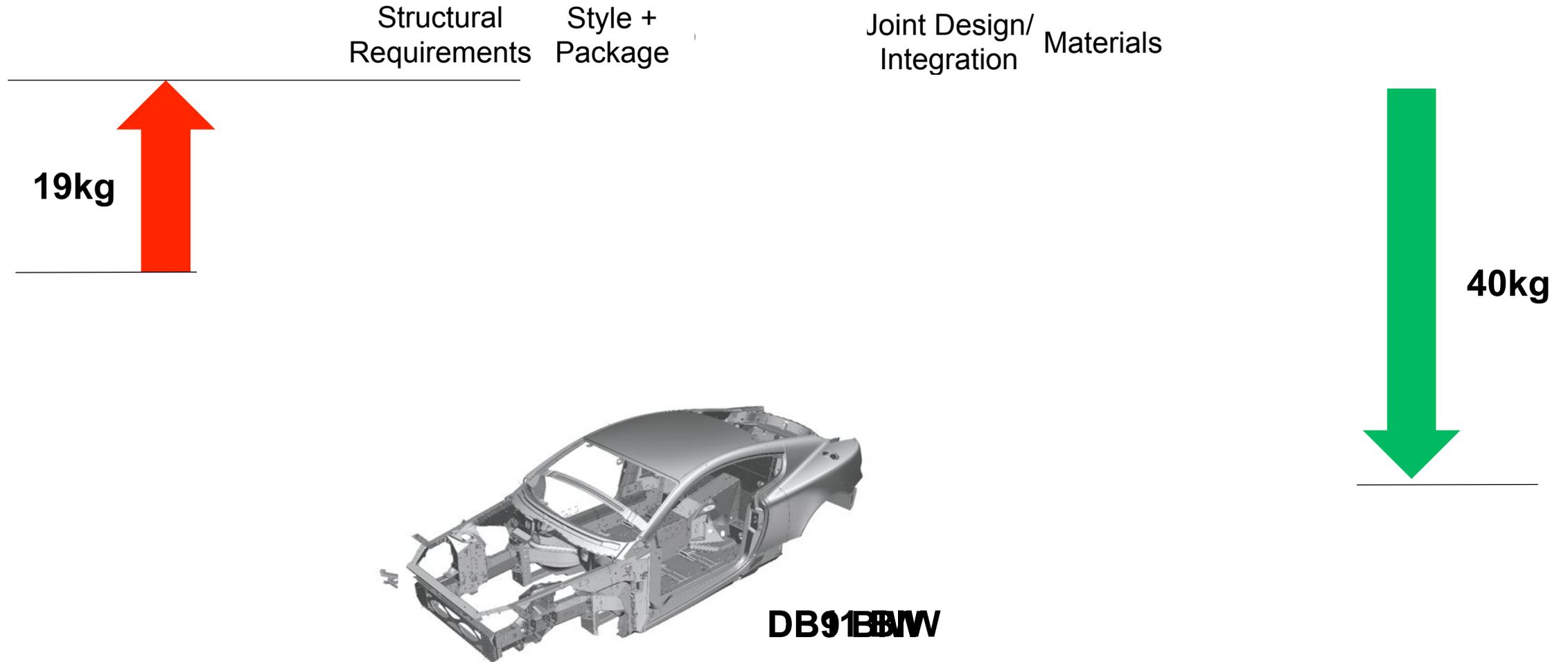
Structural
Requirements

19kg

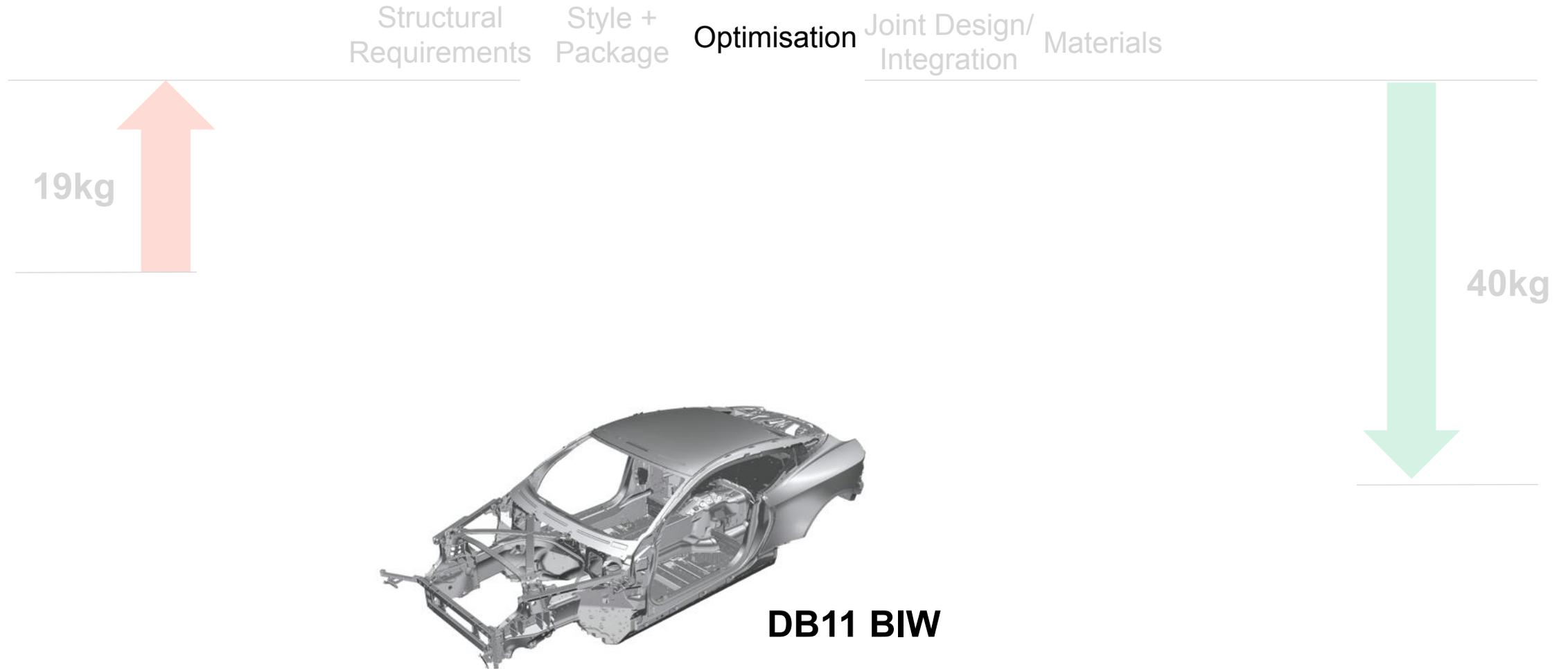


DB9 BIW

Architecture Mass Reduction



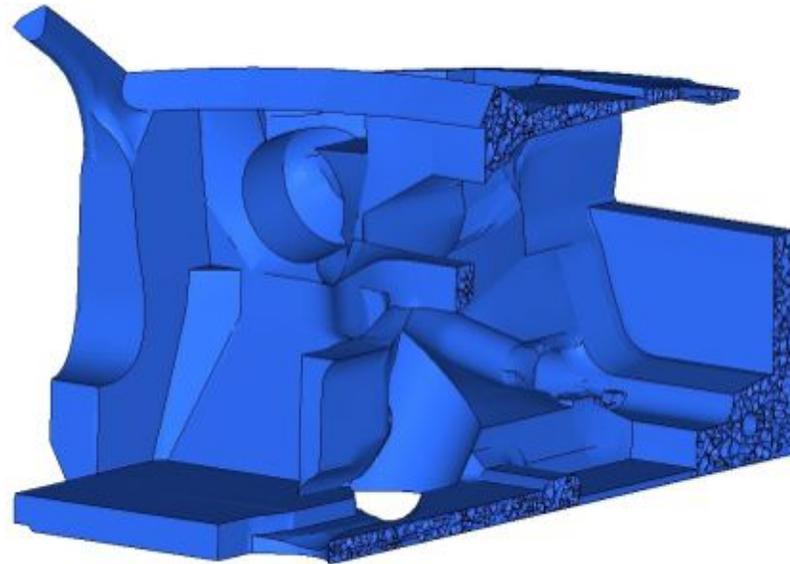
Architecture Mass Reduction



Architecture Mass Reduction – Optimisation

Topology Optimisation

Design Space Creation

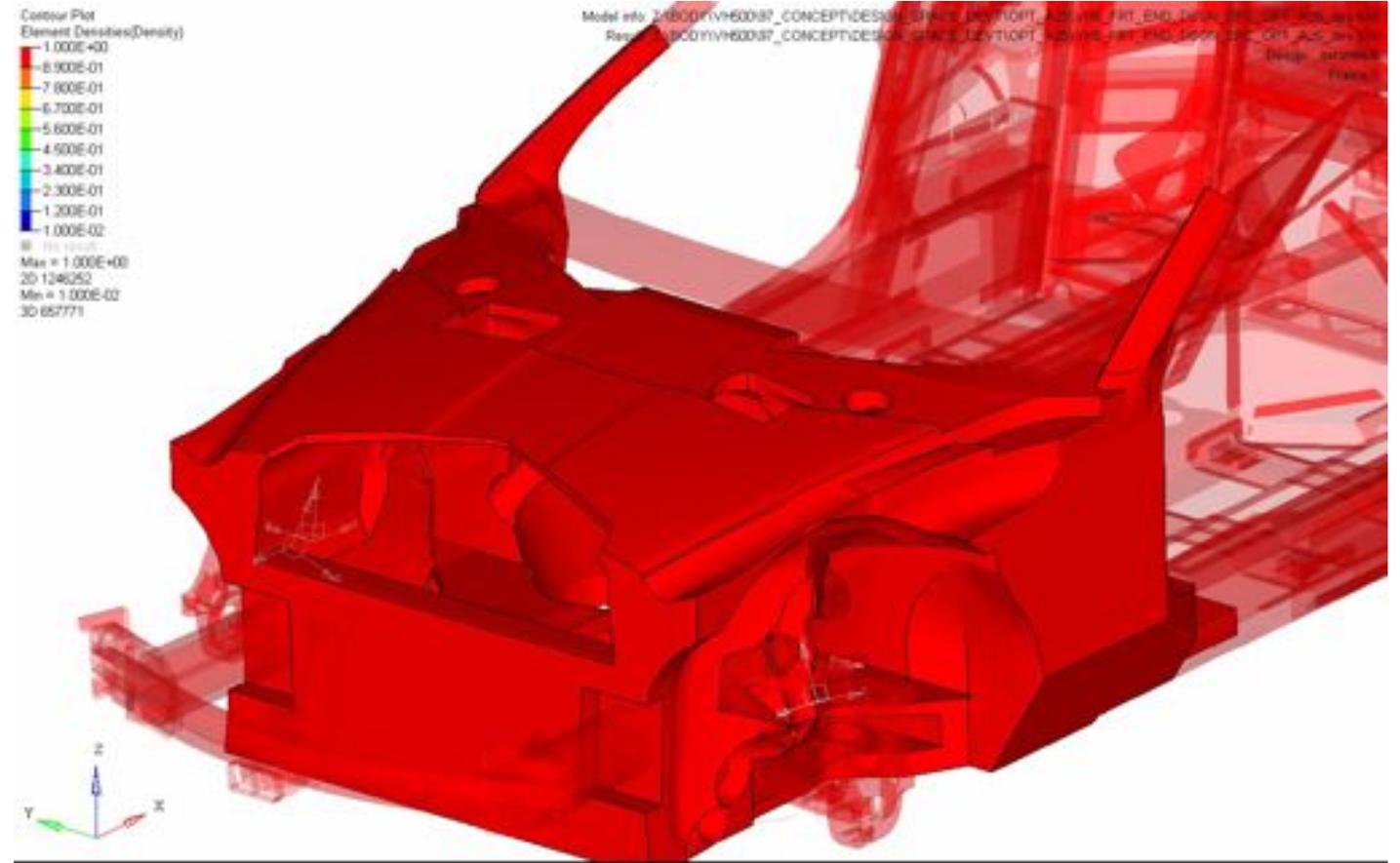
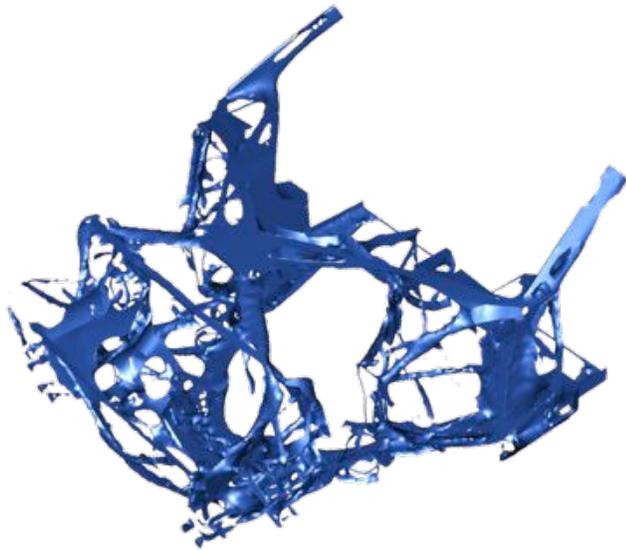


Architecture

Mass Reduction – Optimisation

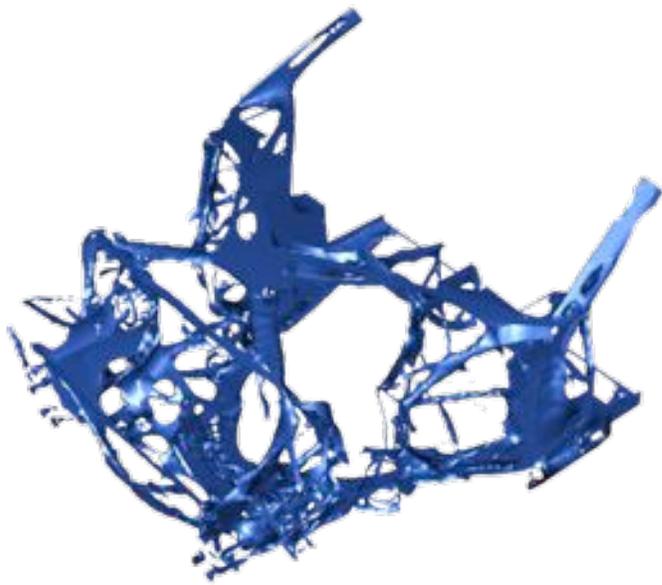
Topology Optimisation

- Topological optimisation to minimize mass using derived stiffness targets for multiple loadcases

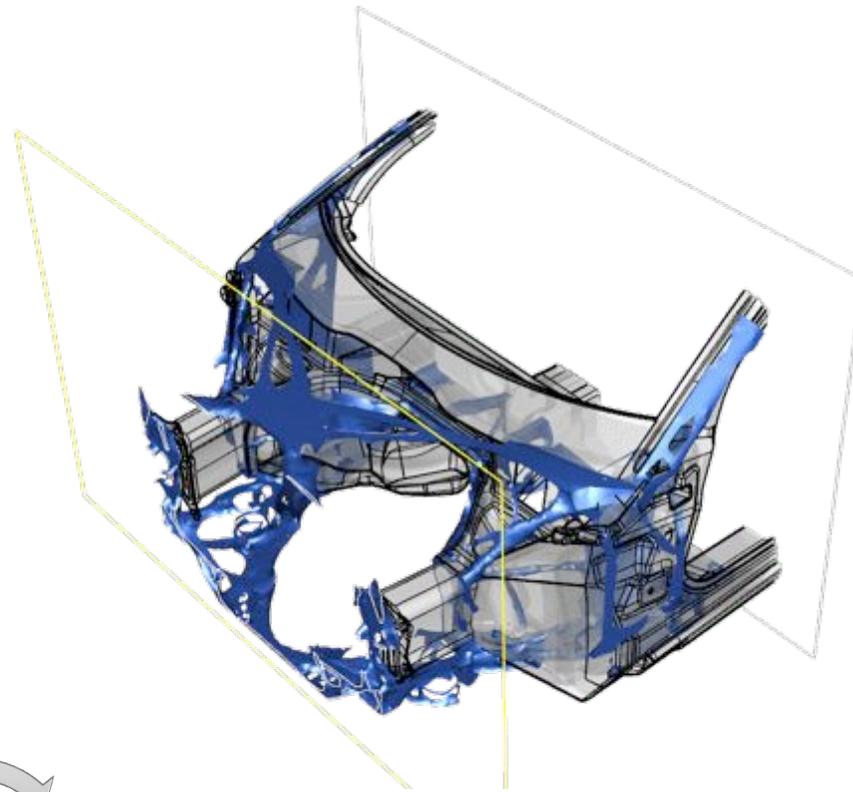
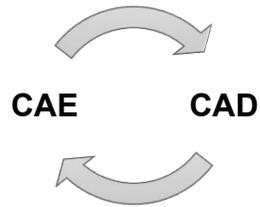


Architecture Mass Reduction – Optimisation

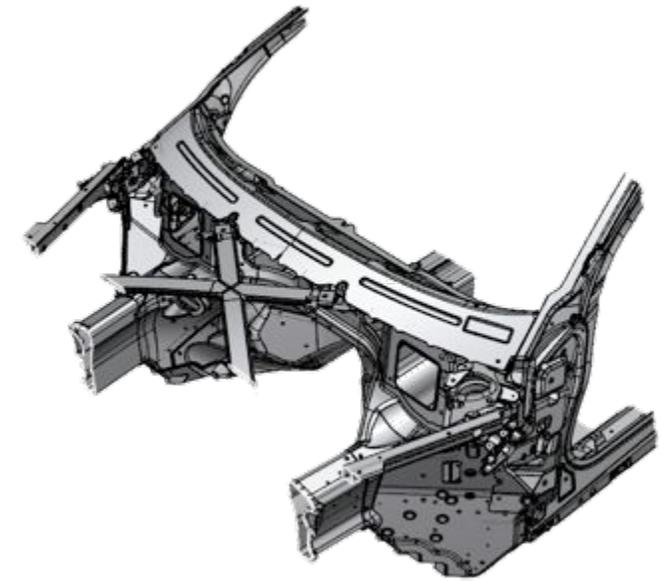
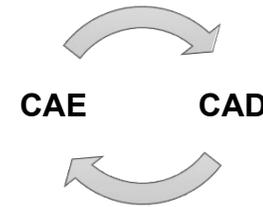
Topology Optimisation



Where material
is wanted



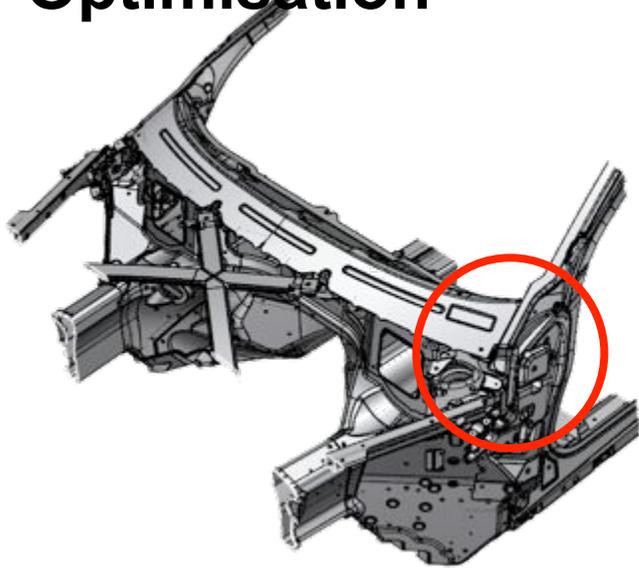
Initial concept to
deliver load
paths



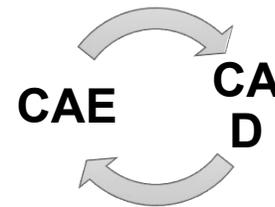
Final Production
Form

Architecture Mass Reduction – Optimisation

Casting Shape Optimisation



Design Space for
start of shape
optimisation



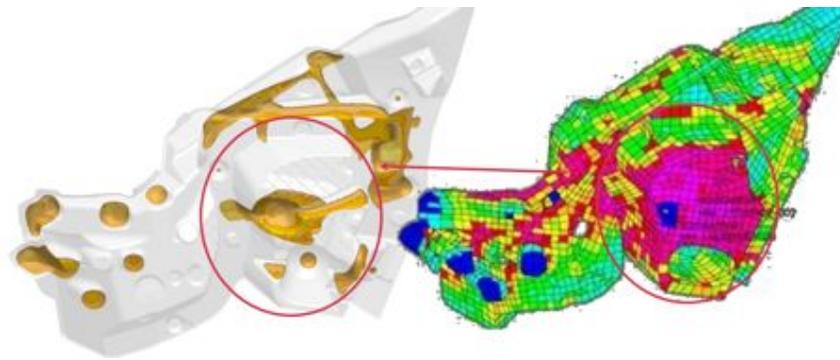
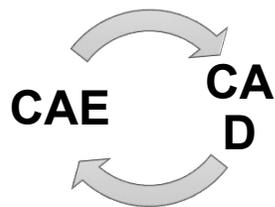
Casting Shape
optimisation from
CAE into CAD

Architecture Mass Reduction – Optimisation

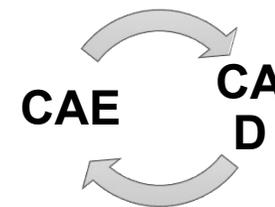
Casting Shape Optimisation



Starting model for
CAE
development



Casting
manufacturing
simulation
sympathetic to stress
map for wall thickness
optimisation



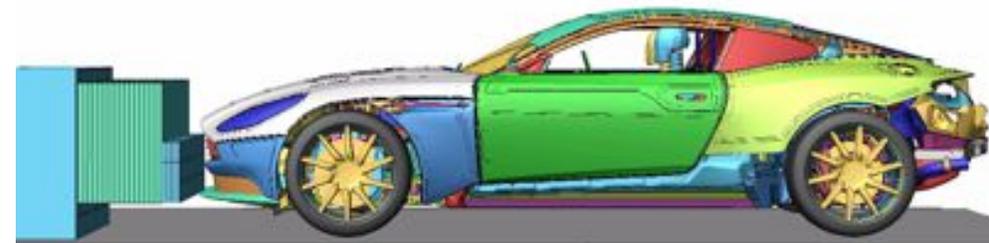
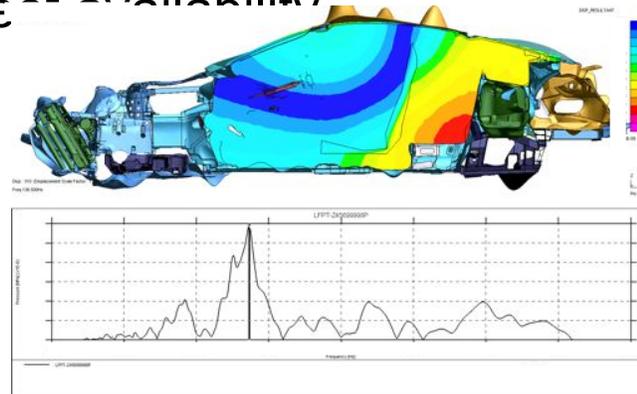
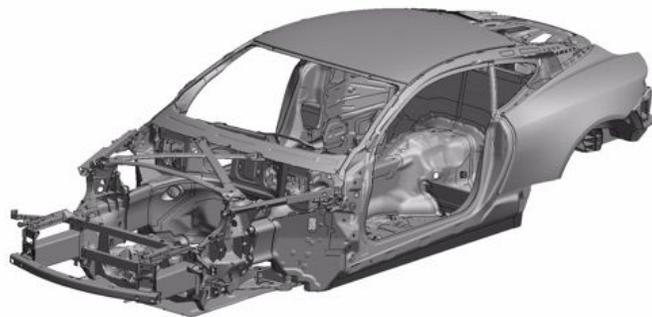
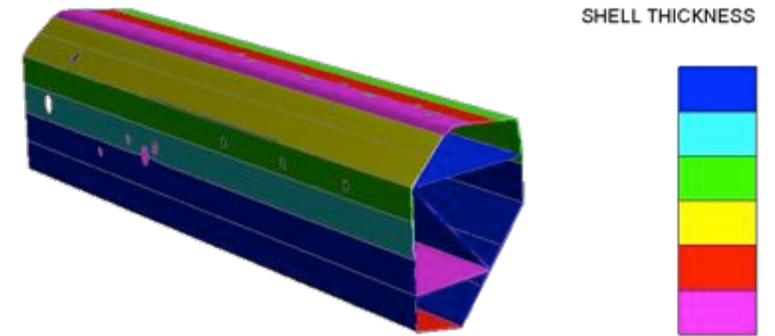
Final manufactured
form w/ optimised
mechanical properties
and wall thickness

Architecture

Mass Reduction – Optimisation

Gauge Optimisation

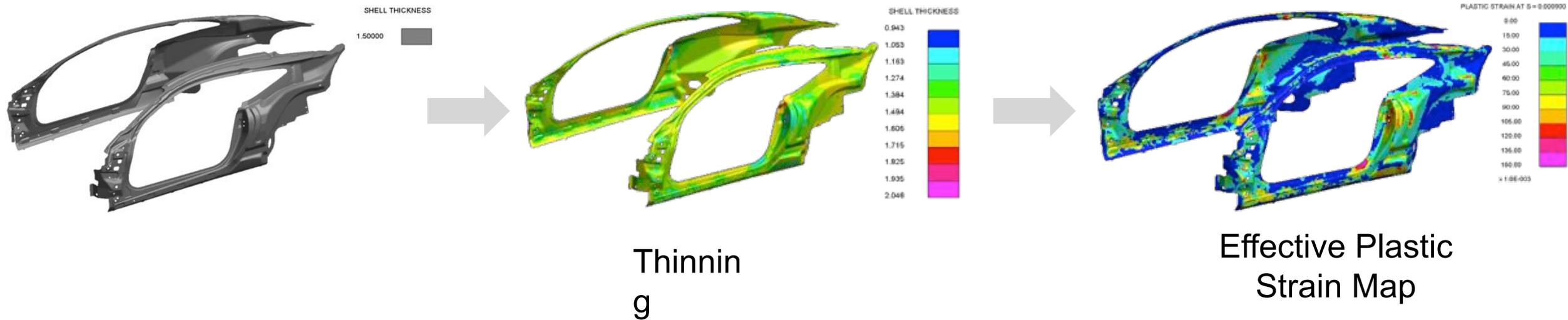
- Completed throughout design development to inform design and understand redundant material
- First applied using global statics and dynamics...
- ...then iteratively balanced with energy management requirements
- Applied with component manufacturing feasibility constraints and for commercial benefit of sheet availability



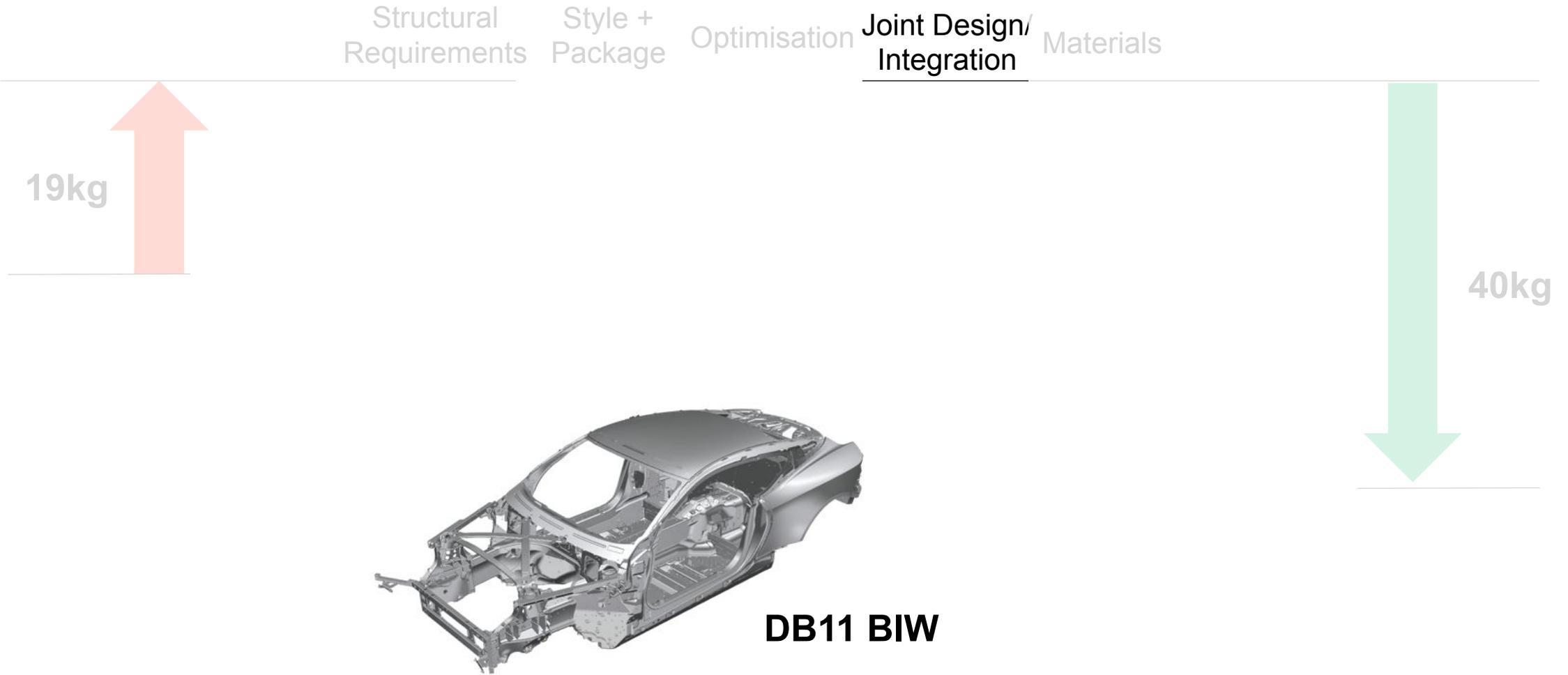
Architecture Mass Reduction – Optimisation

Stamping Simulation

- Finished part gauge prediction using forming simulation
- Finished Part strength and elongation mapping → further gauge optimisation



Architecture Mass Reduction

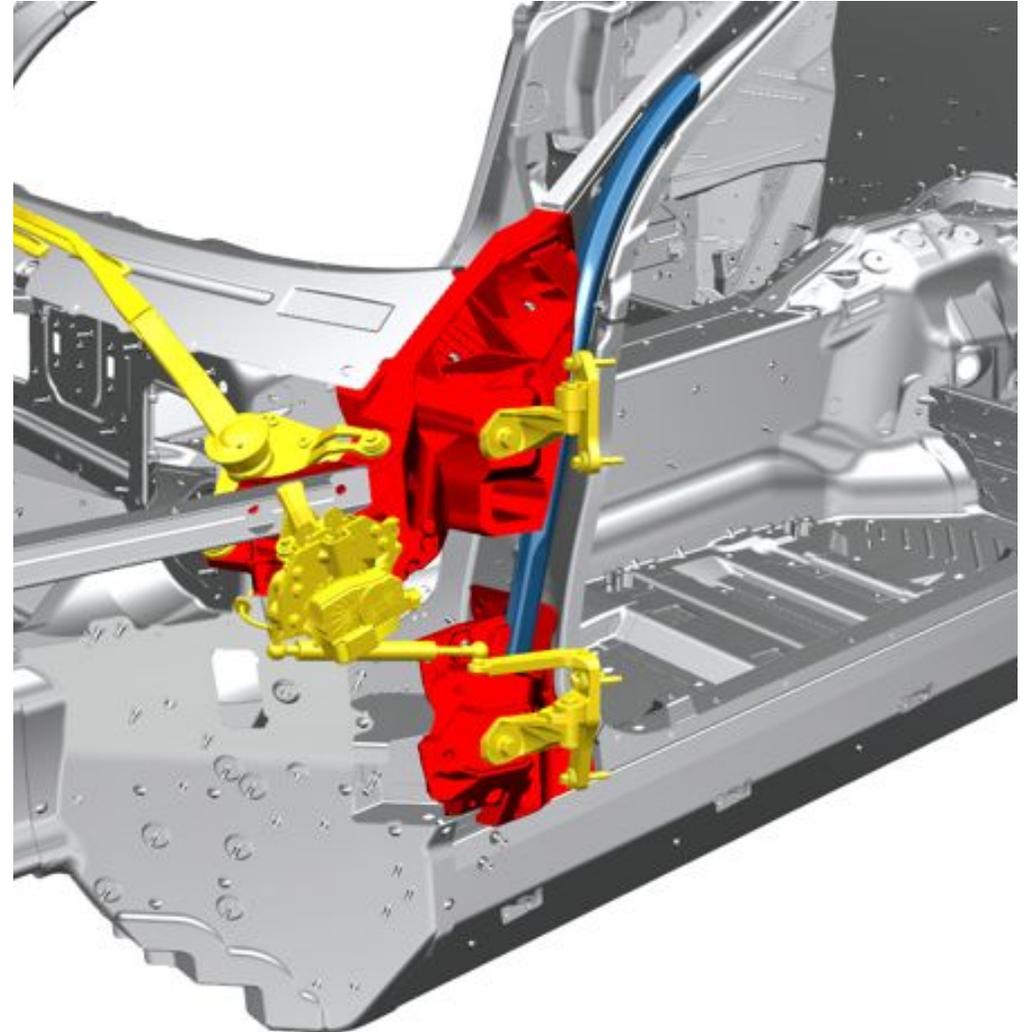


Architecture

Mass Reduction – Joint Design / Integration

Functional Integration – A Pillar Castings

- Door Hinges
- Bonnet Latches
- Door Gas Strut Body Mount
- Wipers
- Damper Top Longitudinal Reinforcement



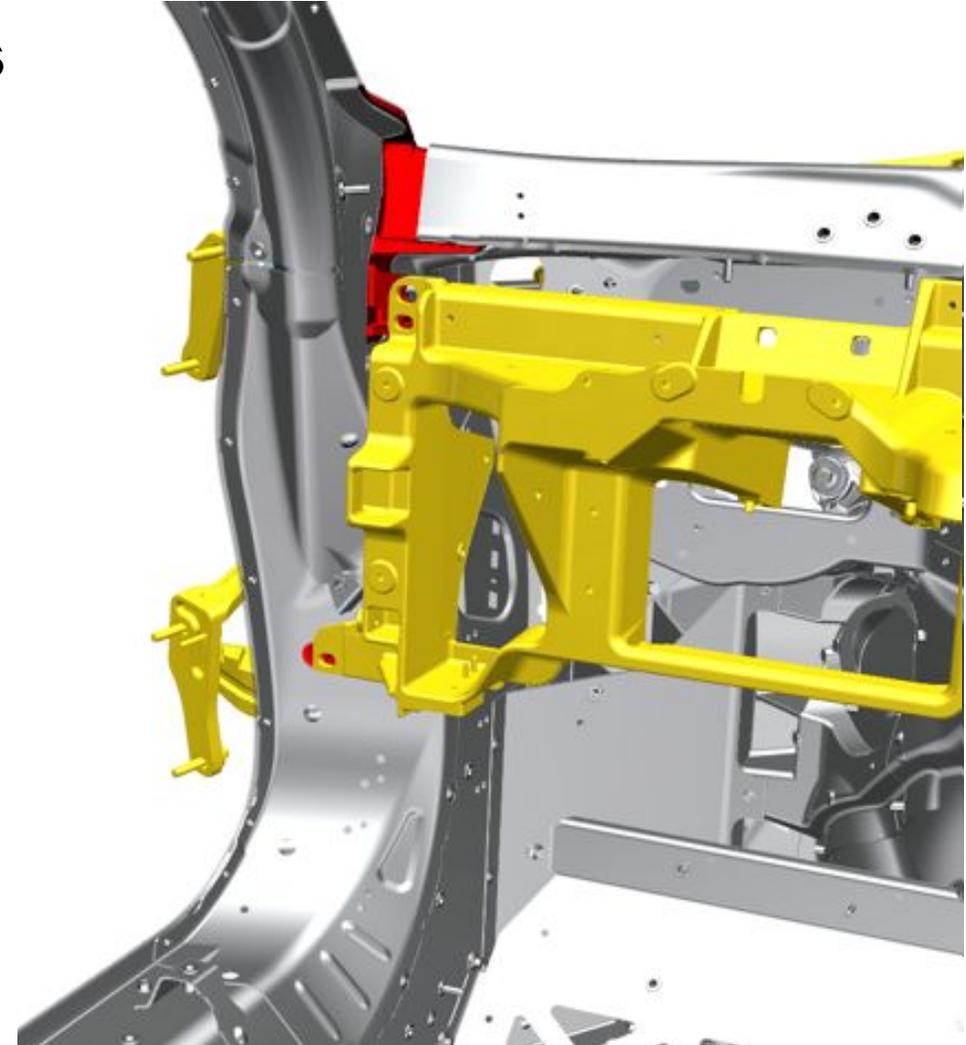
Architecture

Mass Reduction – Joint Design / Integration

Functional Integration – A Pillar Castings

- Door Hinges
- Bonnet Latches
- Door Gas Strut Body Mount
- Wipers
- Damper Top Longitudinal Reinforcement
- IP Cross Car Beam Mountings

6 Major Vehicle Systems Mounted to 1 Node



Architecture

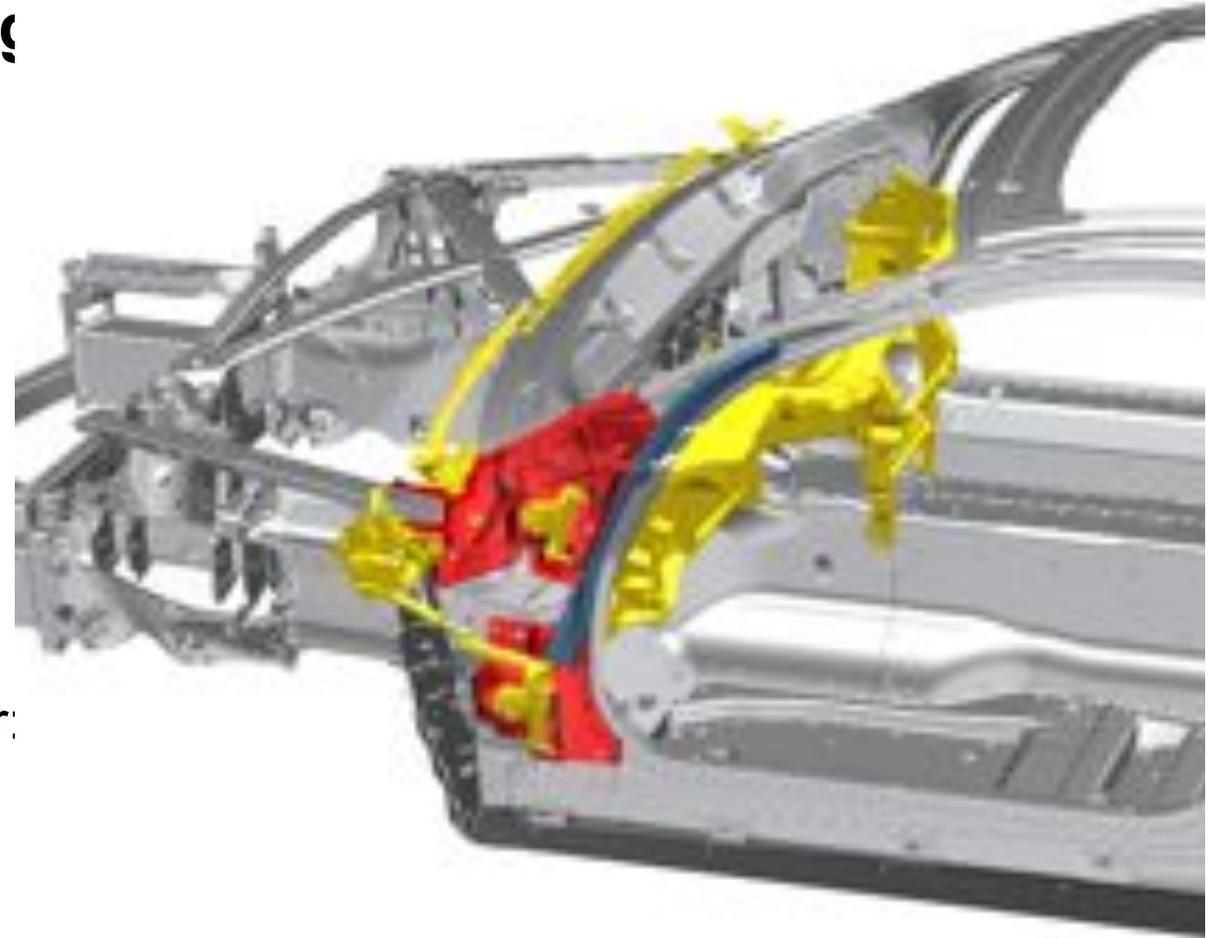
Mass Reduction – Joint Design / Integration

Functional Integration – A Pillar Casting

- Door Hinges
- Bonnet Latches
- Door Gas Strut Body Mount
- Wipers
- Damper Top Longitudinal Reinforcement
- IP Cross Car Beam Mountings

6 Major Vehicle Systems Mounted to 1 Node

- Node Also Forms Major Part of the Loadpaths for:
 - Roof Crush
 - Front Impact (e.g. 64ODB)
 - Side Impact (e.g. Fed side barrier)
 - Torsional & Bending Stiffness

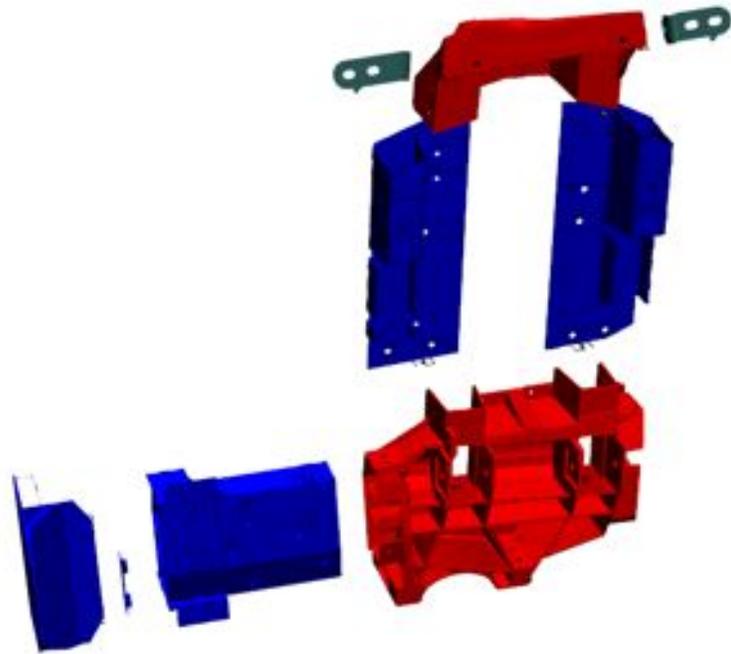


Architecture

Mass Reduction – Joint Design / Integration

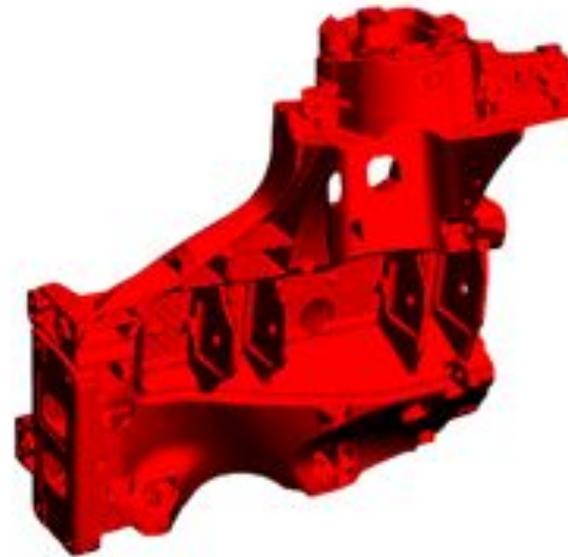
Functional Integration – Front Damper Mounting

- Sand Cored hollow die casting used to reduce part count and optimise package space to larger engine and for structural efficiency

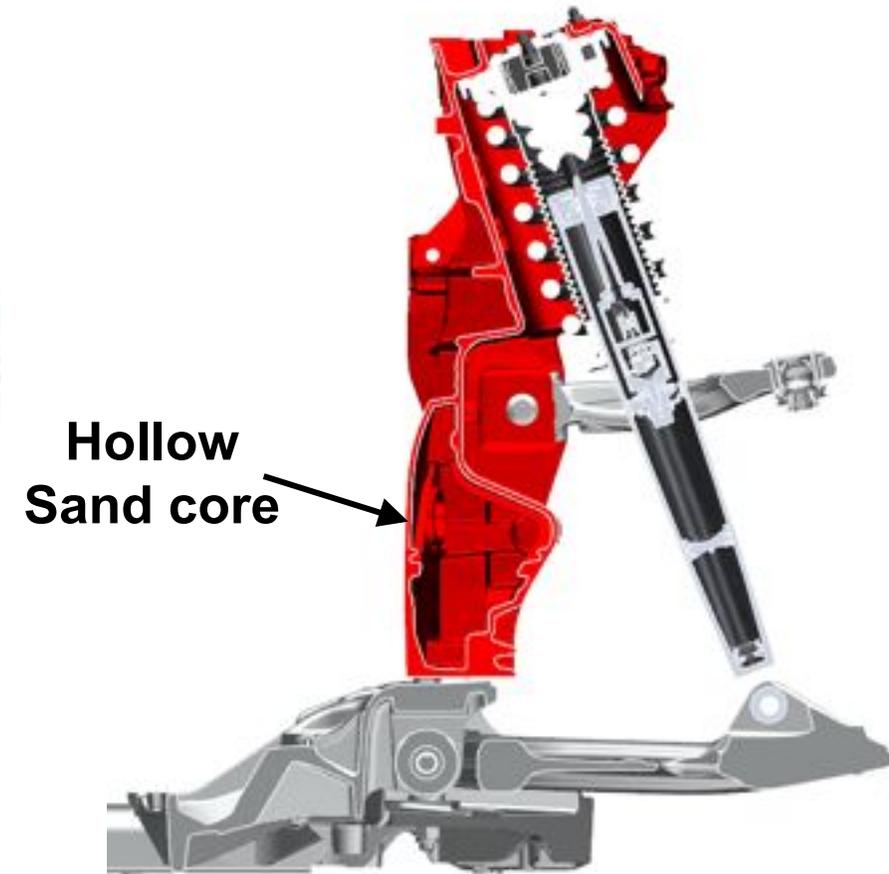


DB9

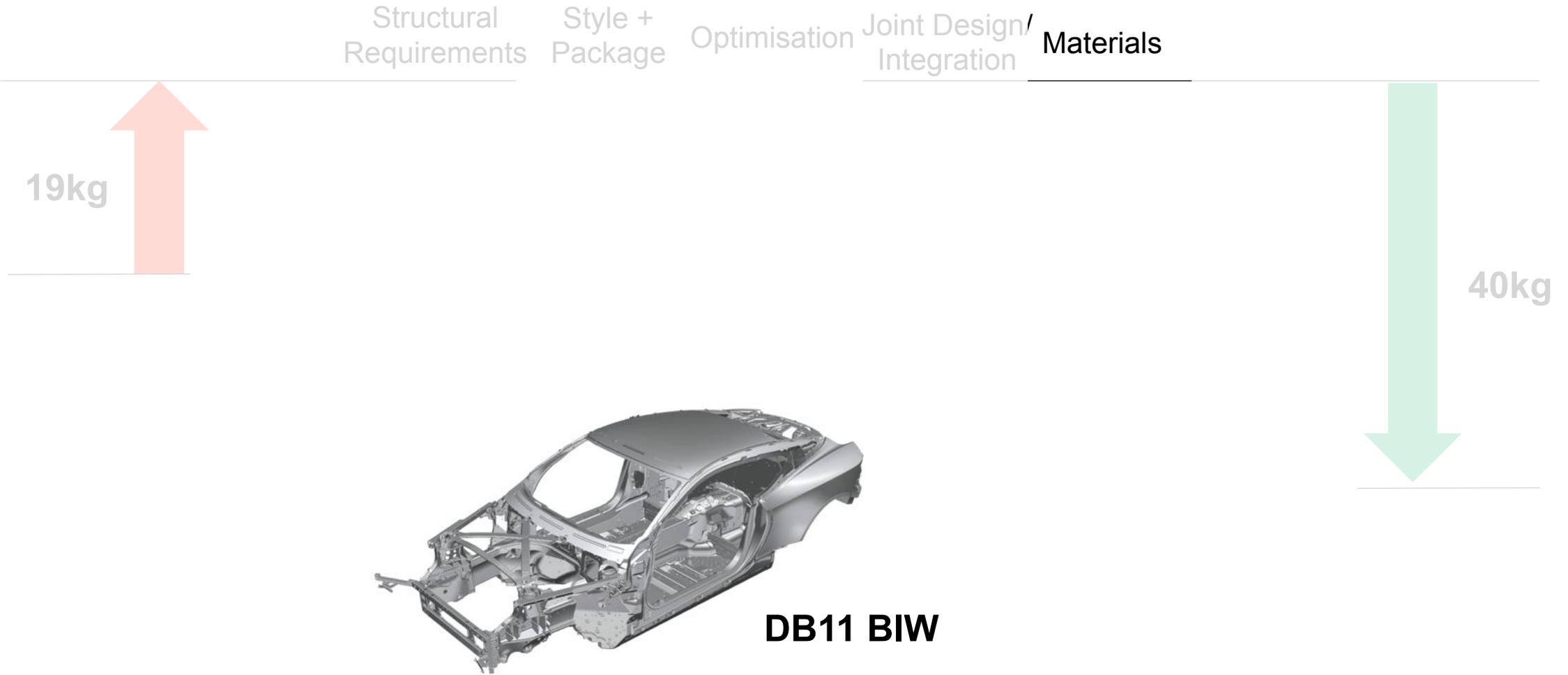
9 Parts
into 1



DB11



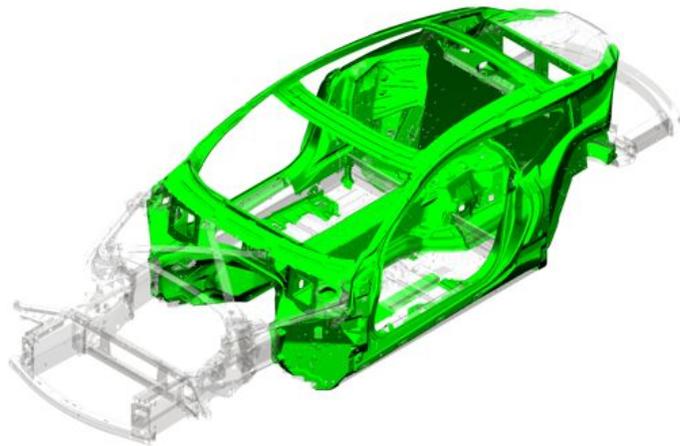
Architecture Mass Reduction



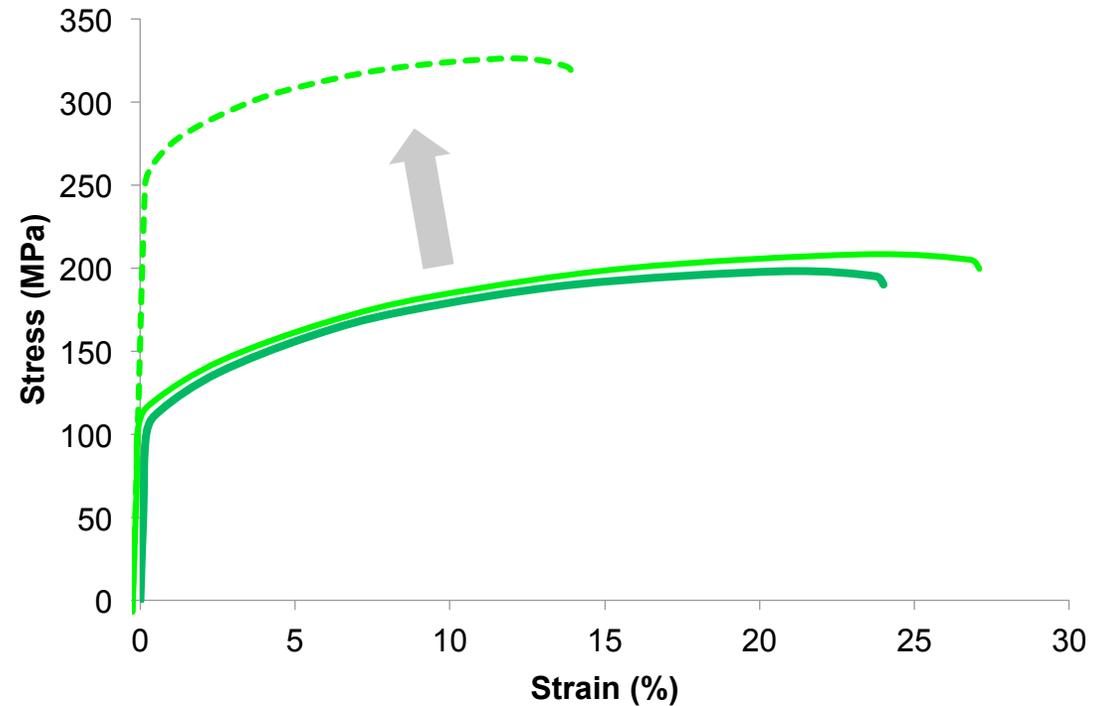
Architecture

Mass Reduction – Materials

- VH Platform used 5XXX for sheet metal
- 5XXX series has excellent formability but low strength in comparison to those available in heat treated 6XXX series
- Heat Treatment required to achieve best available strengths



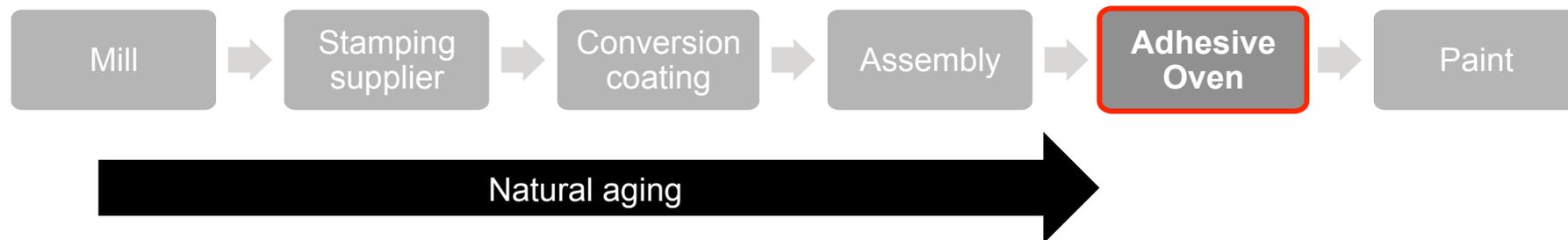
6XXX Sheet



Architecture

Mass Reduction – Materials

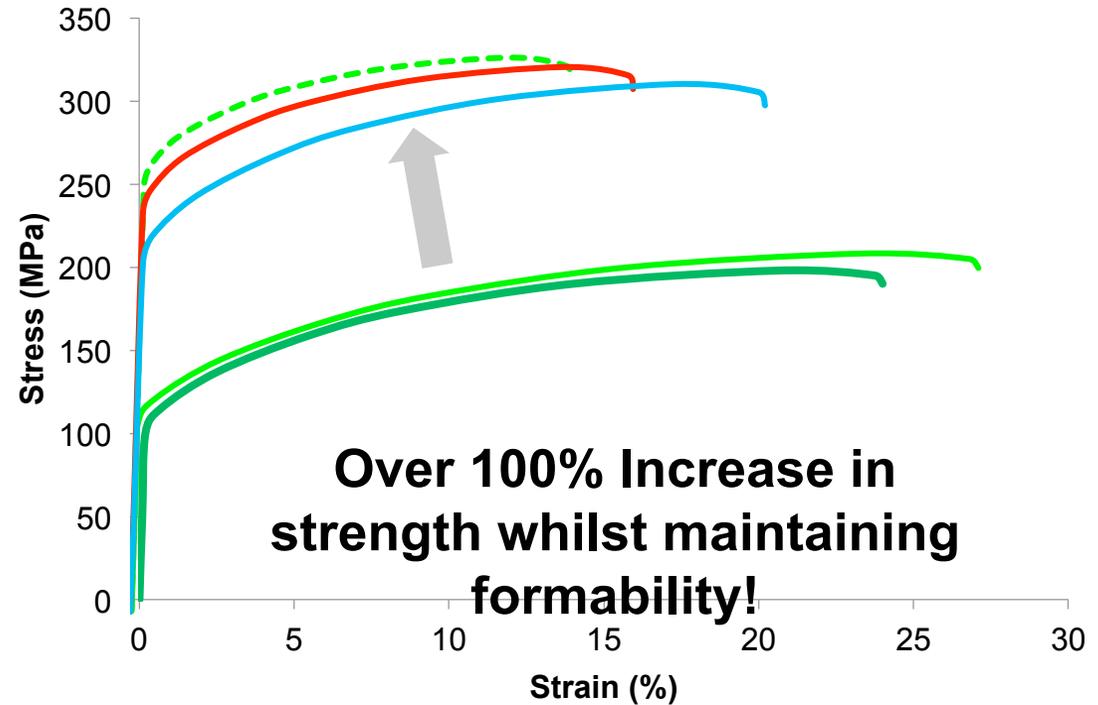
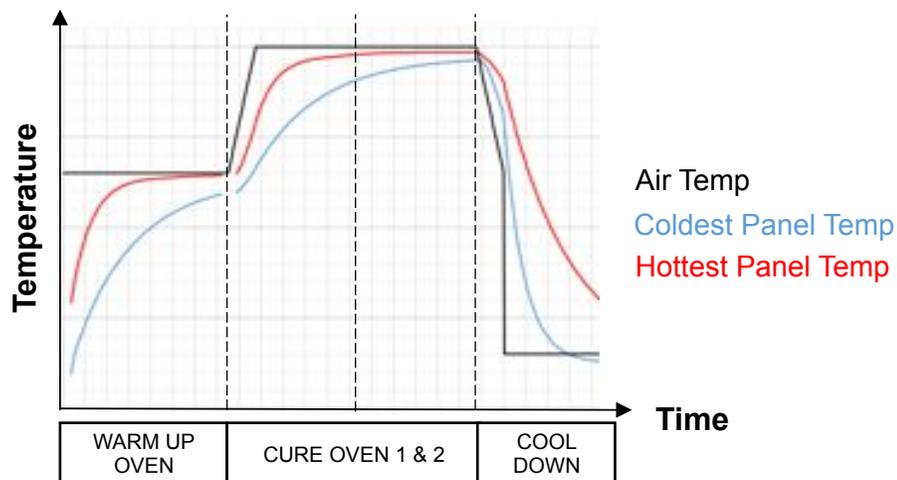
- High temperature oven used to cured adhesive
- DB11 exploits adhesive oven curing process to achieve in line alloy heat treatment at no extra cost
- AA6016 selected due to reduced sensitivity to natural aging in T4 condition (compared to other 6XXX) and commercial availability
- Dimensional issues of heat treatment removed by baking as a structural assembly



Architecture

Mass Reduction – Materials

- Metal heat treatment limited by adhesive cure requirements
- Oven temperature profile optimised for both adhesive performance and sheet heat treatment through simulation



Architecture

Ride & Handling – Full Body Stiffness

Outstanding
GT ride



Ride & Handling Targets



Body Structural
Efficiency Targets

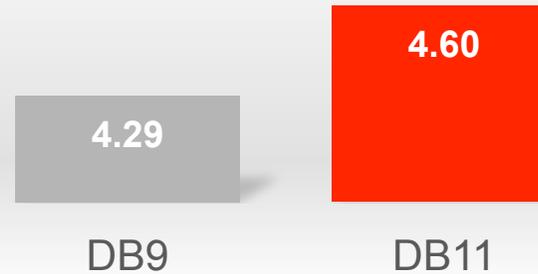
$$\text{Lightweight Index} = \frac{M \checkmark}{Kt \checkmark \times A \checkmark}$$

M = BIW Mass

Kt = Torsional Stiffness

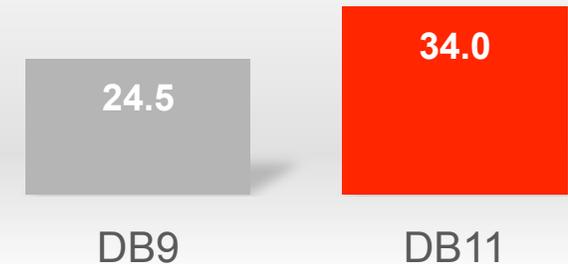
A = Track x Wheelbase

Projected Area (m²)



6% bigger... Wider Track,
Longer Wheelbase

Torsional Stiffness (kNm/°)



39% stiffer... Improvements
in bending and local
stiffness's combined with
robust modal alignment

Architecture

Ride & Handling – Full Body Stiffness

Outstanding
GT ride

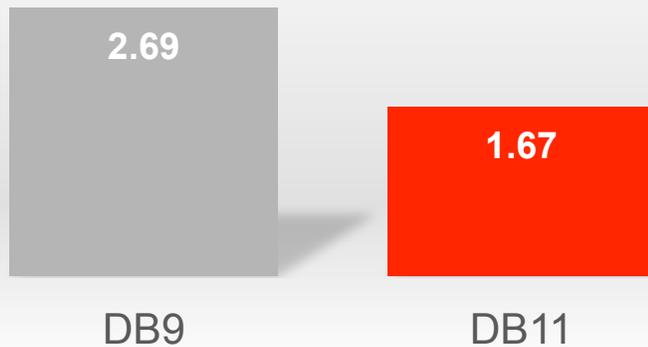


Ride & Handling Targets



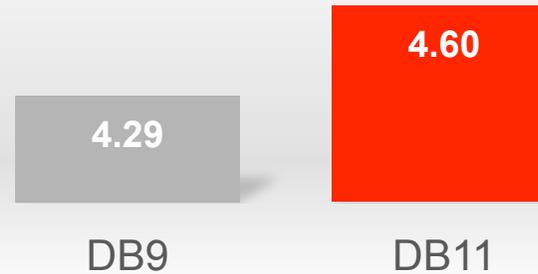
Body Structural
Efficiency Targets

Lightweight Index



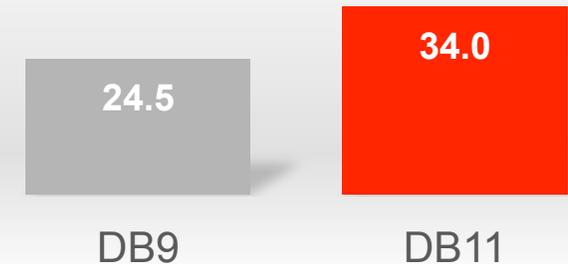
38% improvement...

Projected Area (m²)



6% bigger... Wider Track,
Longer Wheelbase

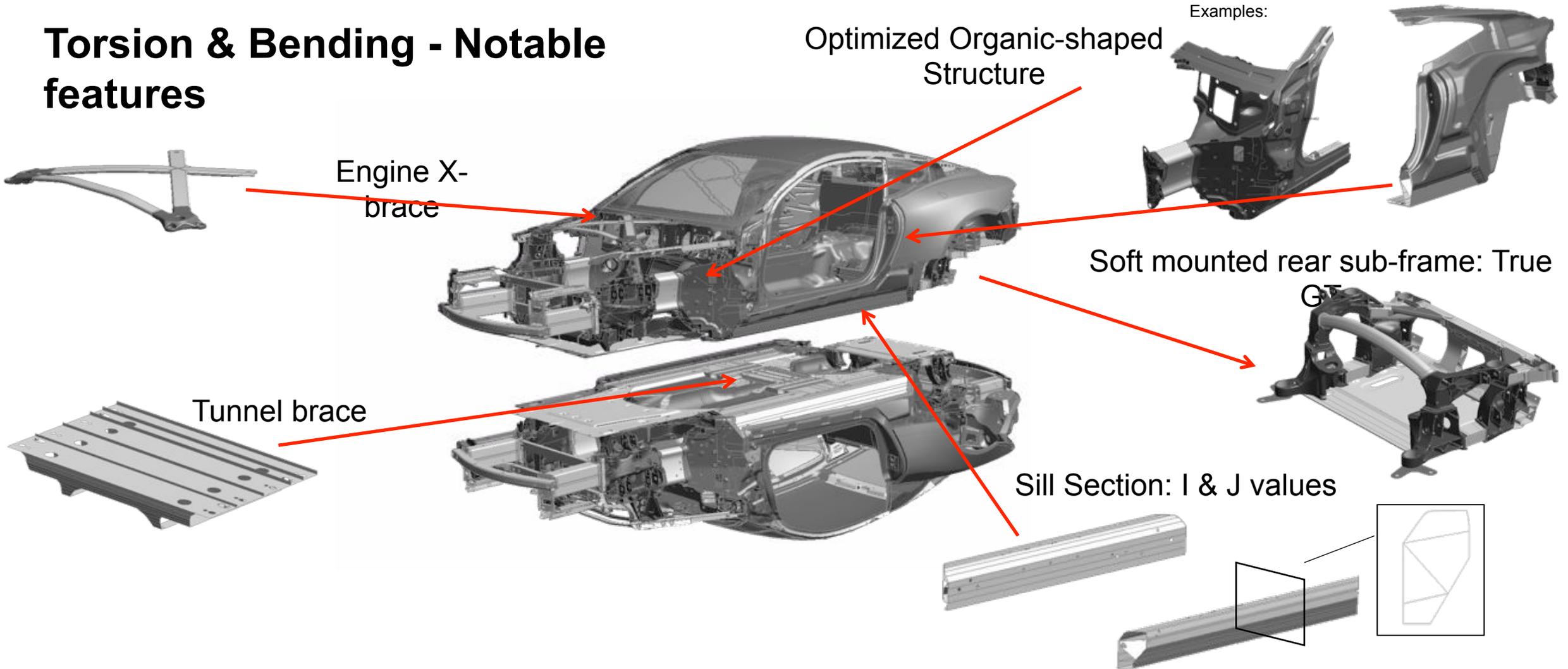
Torsional Stiffness (kNm/°)



39% stiffer... Improvements
in bending and local
stiffness's combined with
robust modal alignment

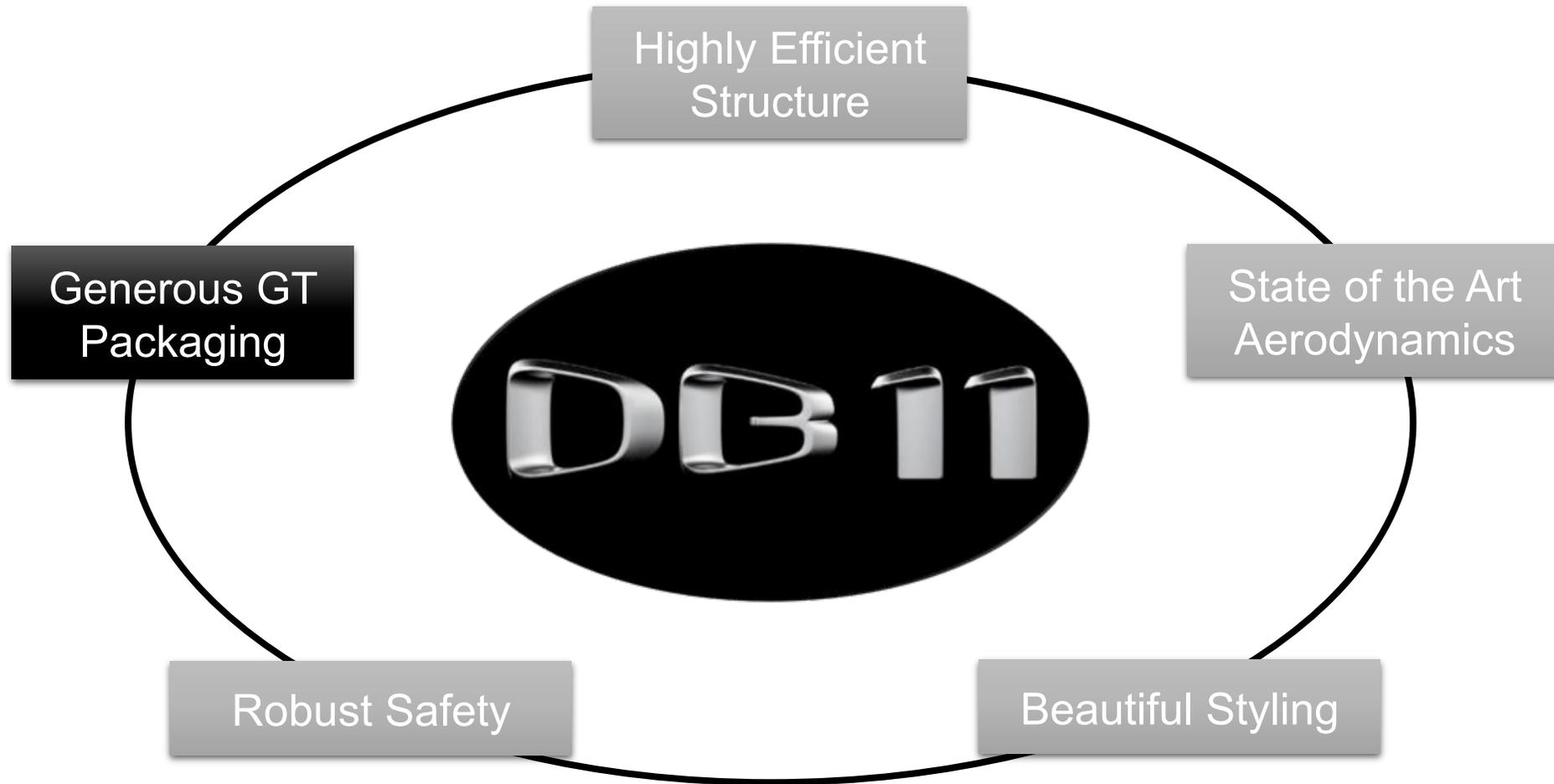
Architecture Ride & Handling – Full Body Stiffness

Torsion & Bending - Notable features



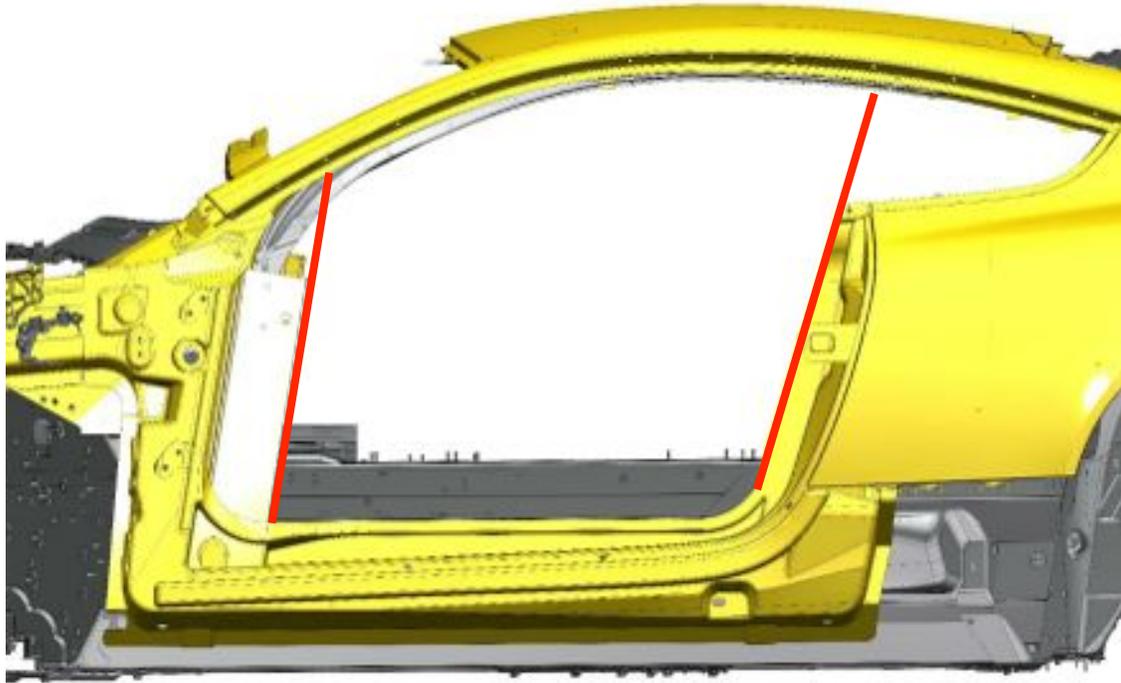
Architecture

Architectural Goals

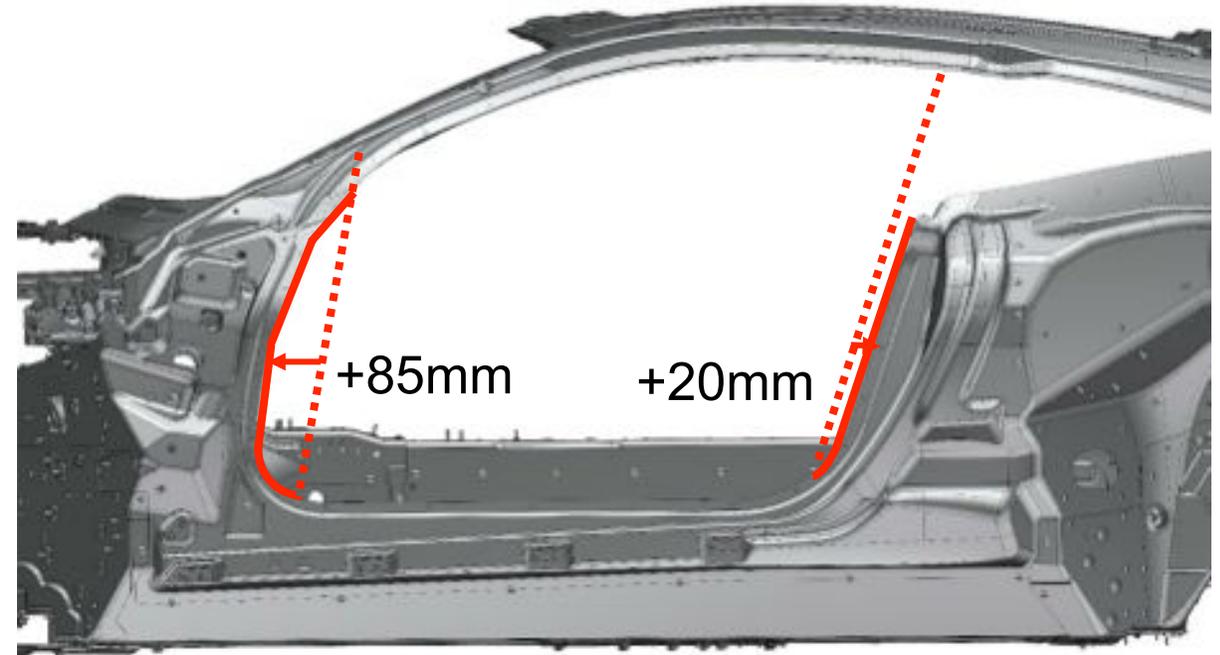


Architecture Packaging – Door Aperture

DB9



DB11



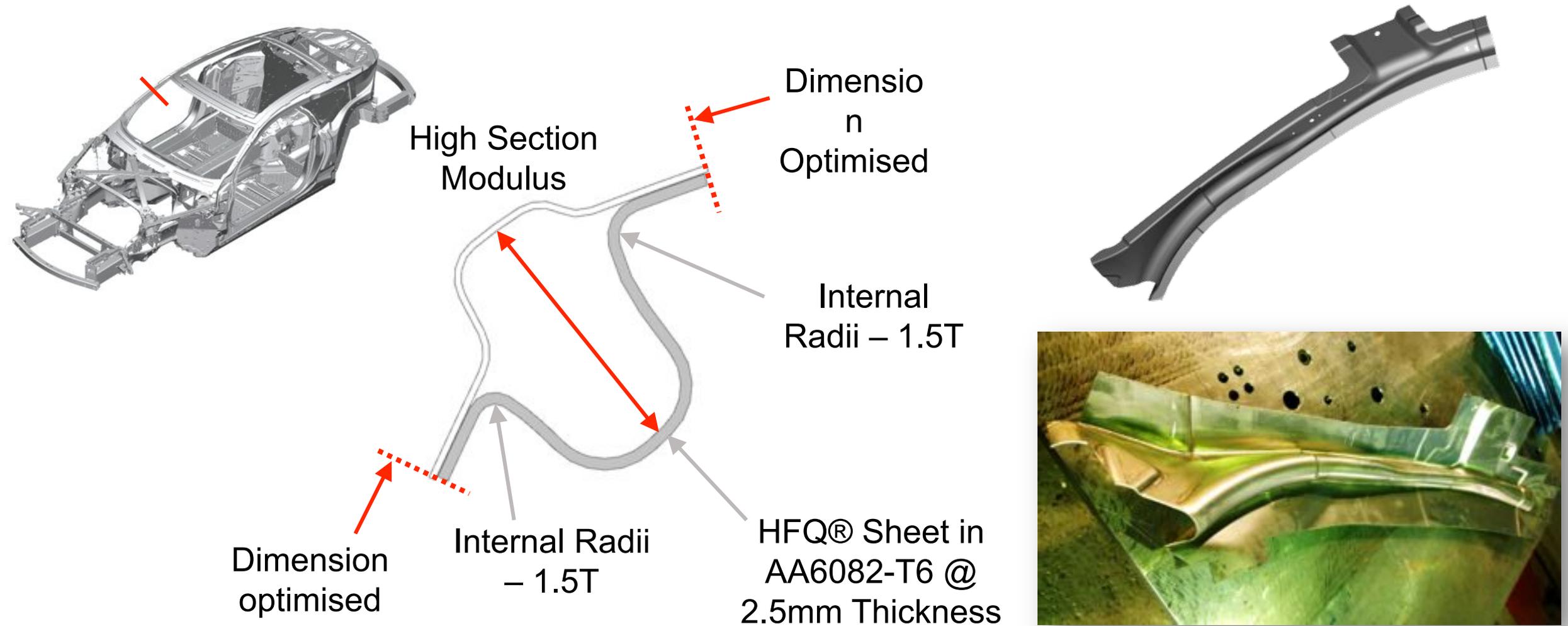
Increased use of sheet metal in DB11 versus extrusions in DB9 has allowed an overall increase in door aperture length of **105mm**, significantly aiding customer ingress and egress.

Architecture Packaging – A-Pillar Visibility (HFQ®)

- Reducing A pillar size with increased roof crush requirements and low rake roof line

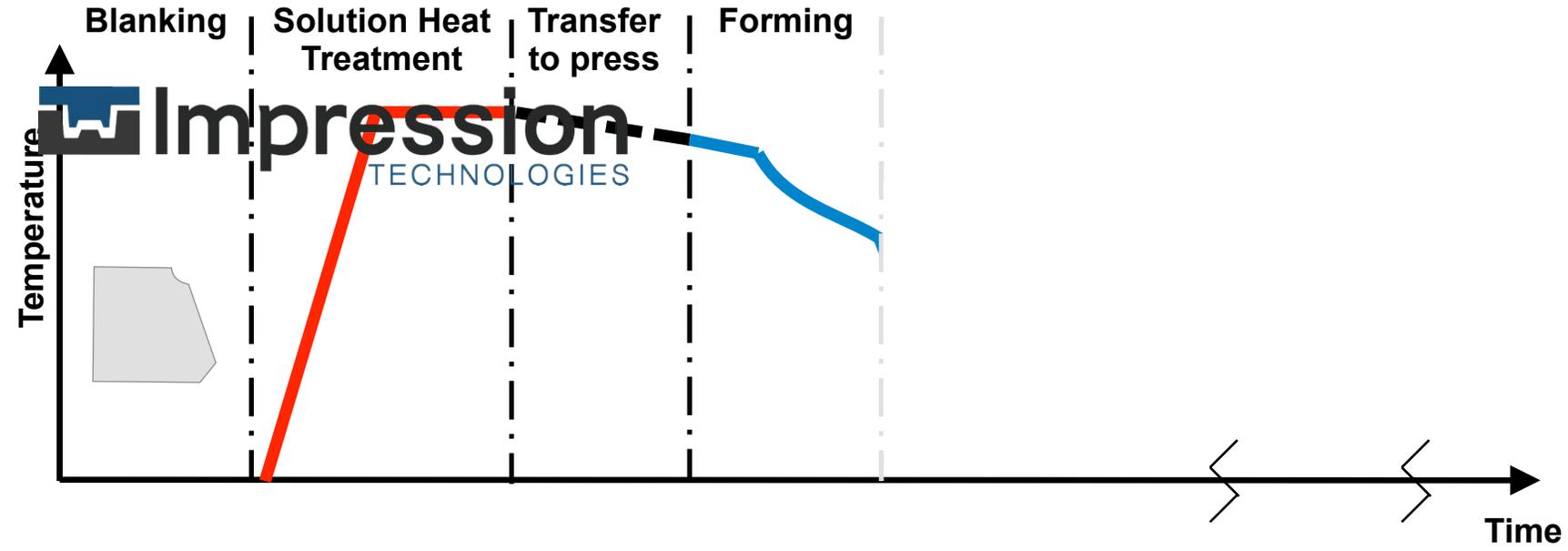


Architecture Packaging – A-Pillar Visibility (HFQ®)



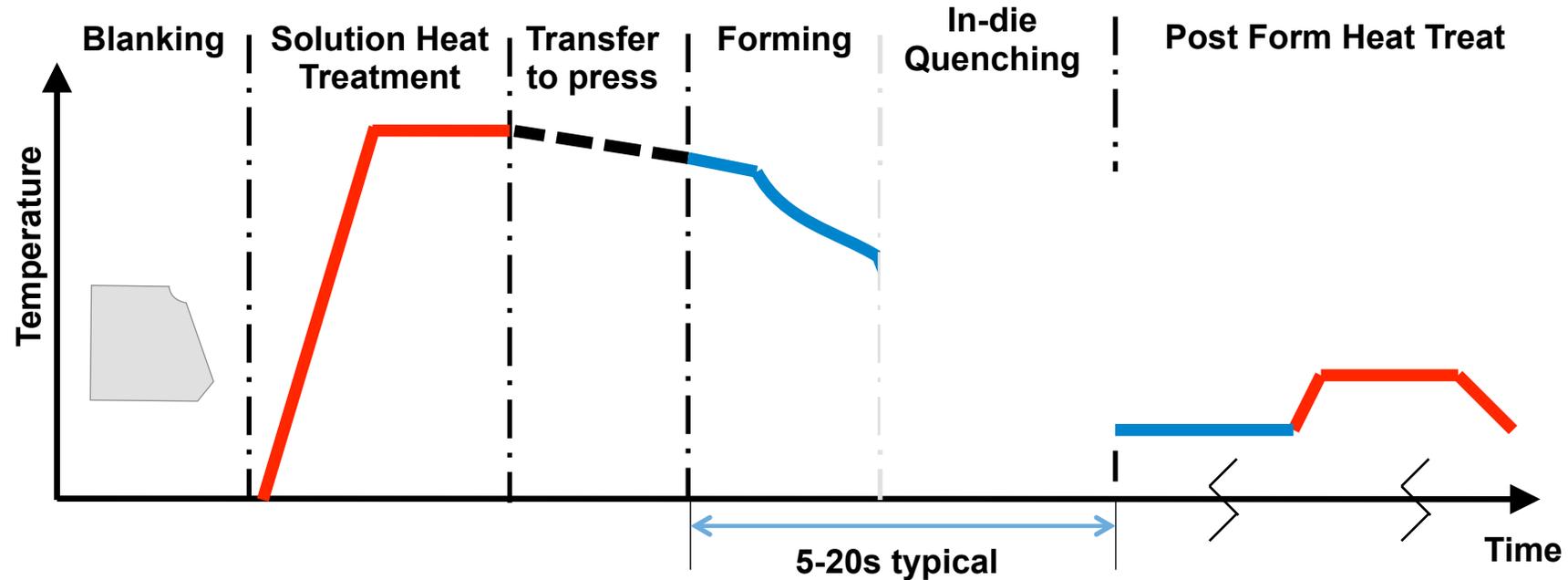
Architecture Packaging – A-Pillar Visibility (HFQ®)

- Technology licensed under Impression Technologies
- Components are rapidly formed at elevated temperatures at which ductility is high (e.g. 400-500°C) → High form



Architecture Packaging – A-Pillar Visibility (HFQ®)

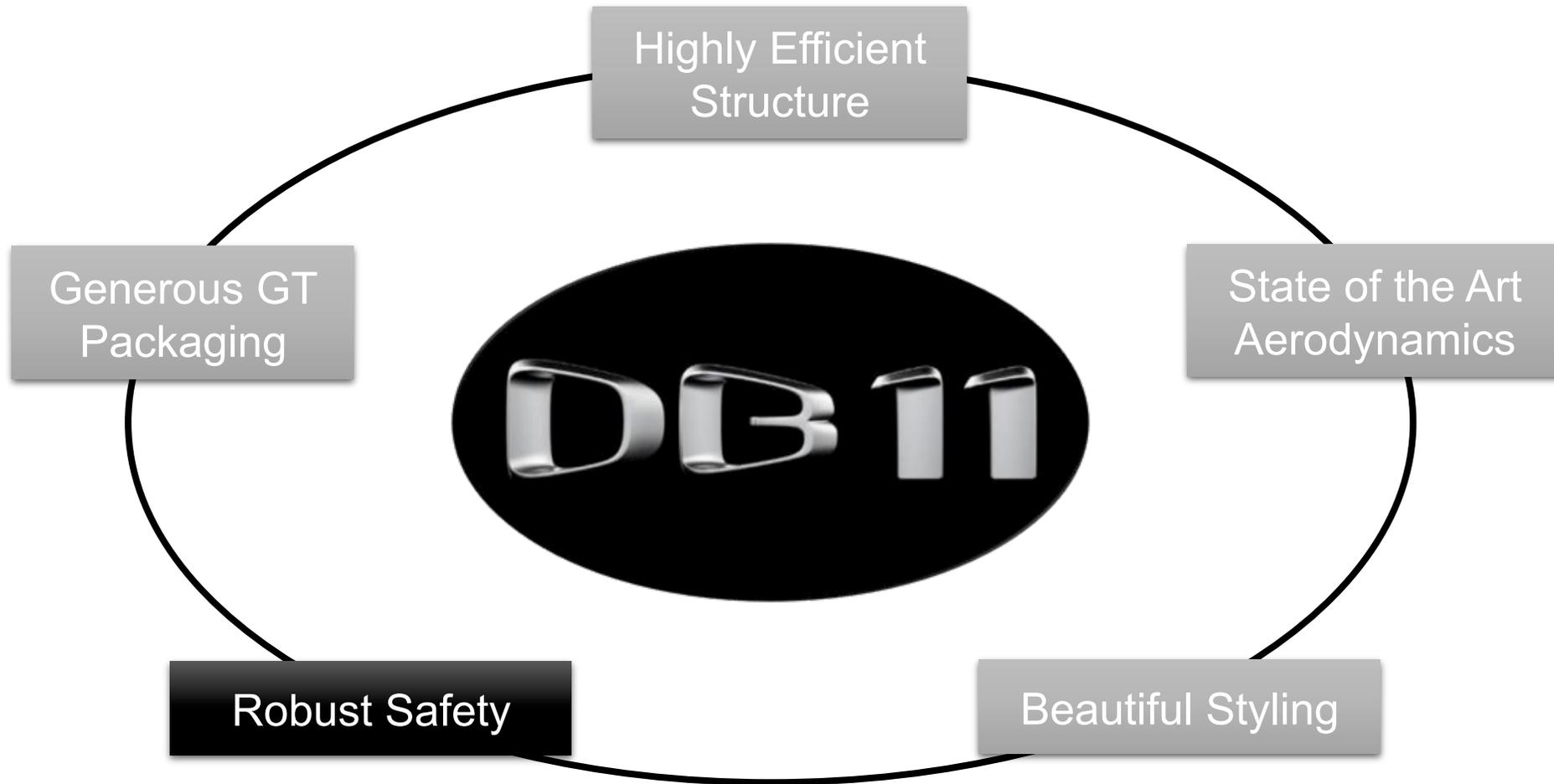
- Technology licensed under Impression Technologies
- Components are rapidly formed at elevated temperatures at which ductility is high (e.g. 400-500°C) → **High form**



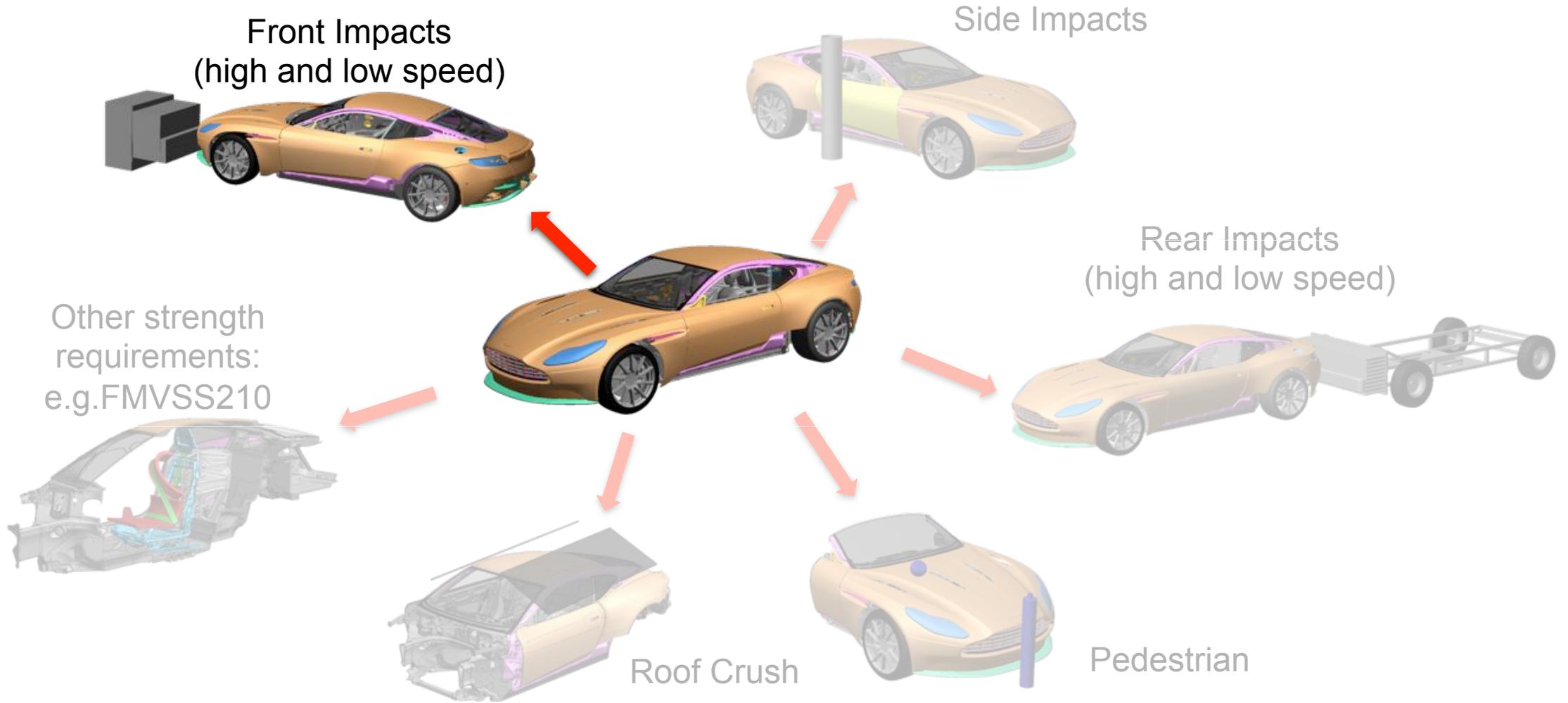
- In-die Quenching means that 6XXX series grades leave the press in the solution heat treated condition. Components are then artificially aged to T6 strengths → **High strength**
- Hot Formed Quenching™ with AA6082-T6 is typically ~20% higher yield strength than AA6016-AMH

Architecture

Architectural Goals



Architecture Robust Safety



Architecture

Robust Safety – Front

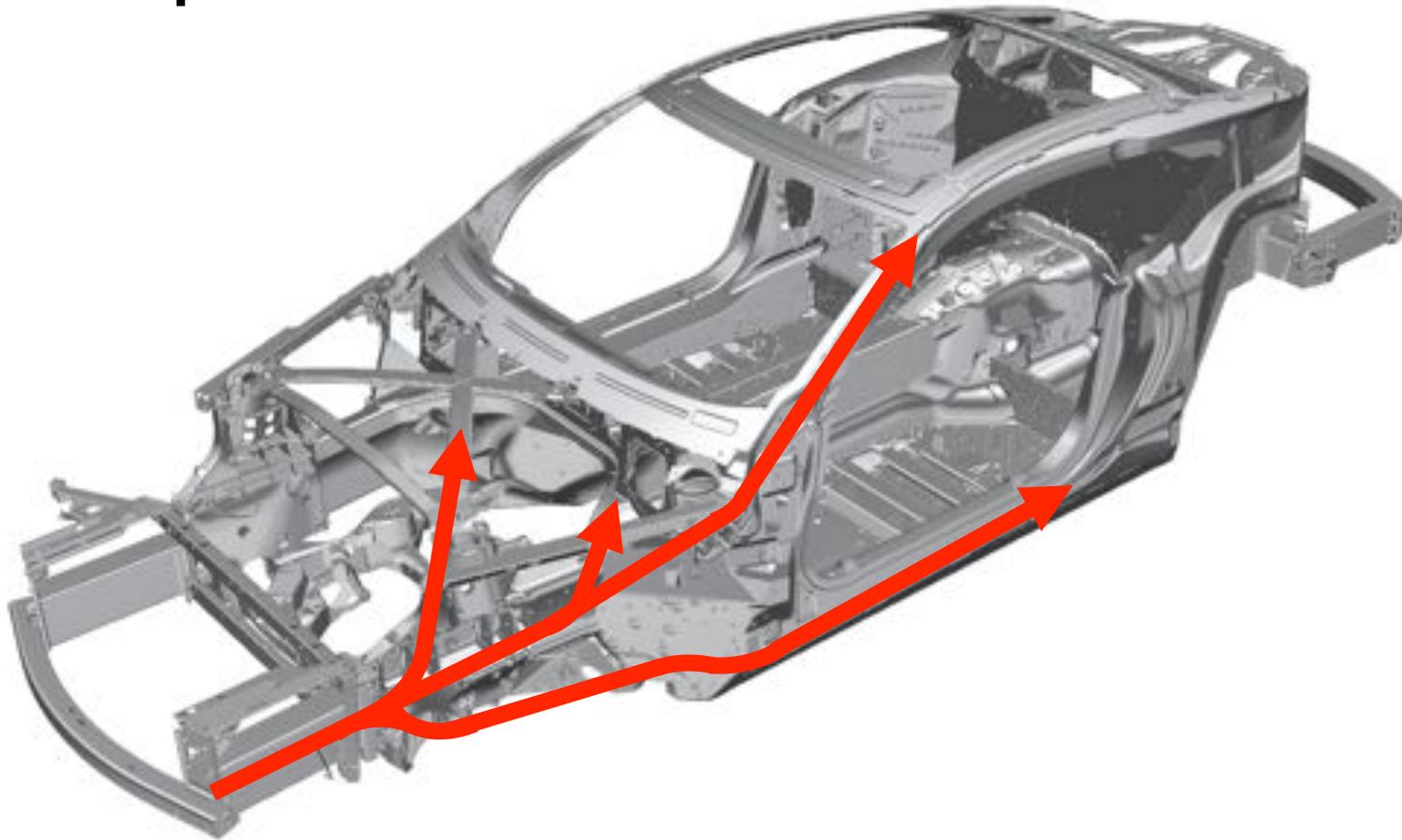
Demanding Style



Extremely tight front package:

- Large twin-turbo V12 engine
- Short front overhang (reduced 16mm versus DB9)

Front Crash Concept

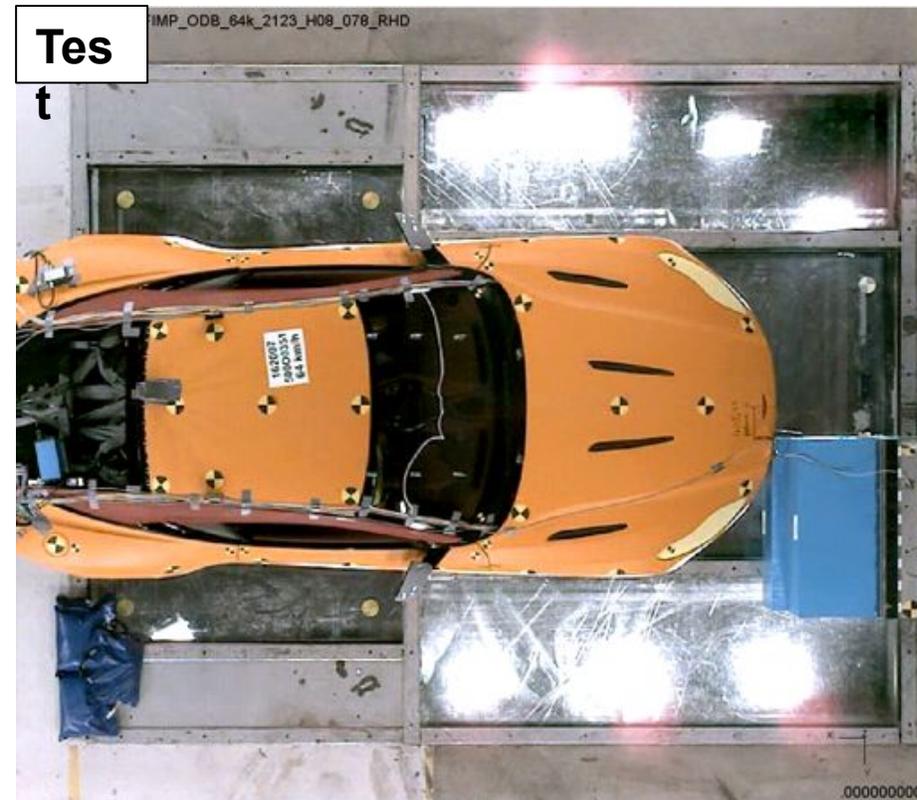
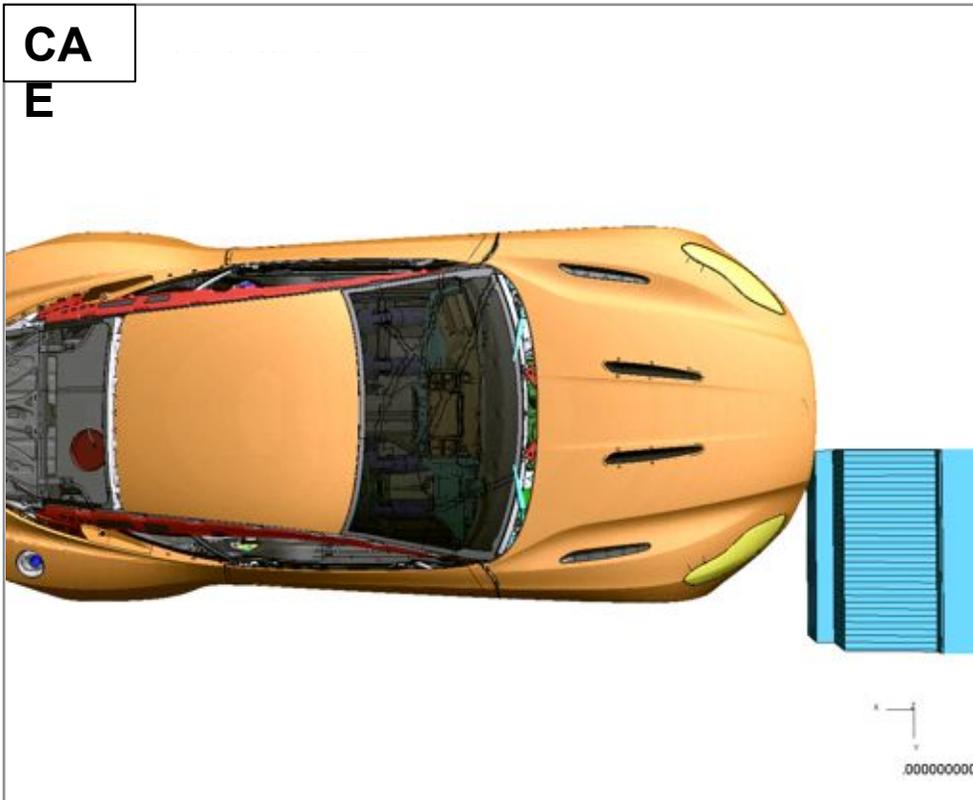


Architecture

Robust Safety – Front

Front Impact 64ODB

Exceeds regulatory standards: Frontal offset deformable barrier performed not at the regulatory 56kph but at EuroNCAP spec 64kph

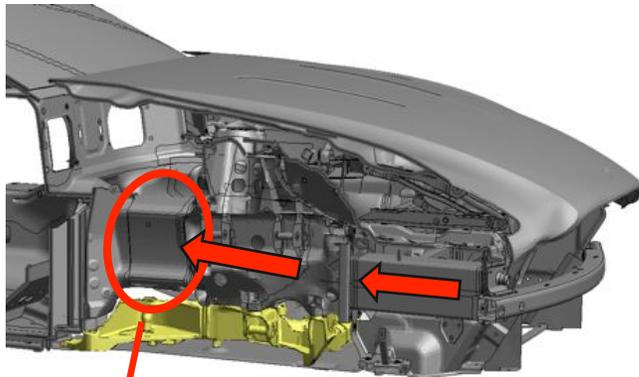


Architecture Robust Safety – Front

Front Impact 64ODB – Development

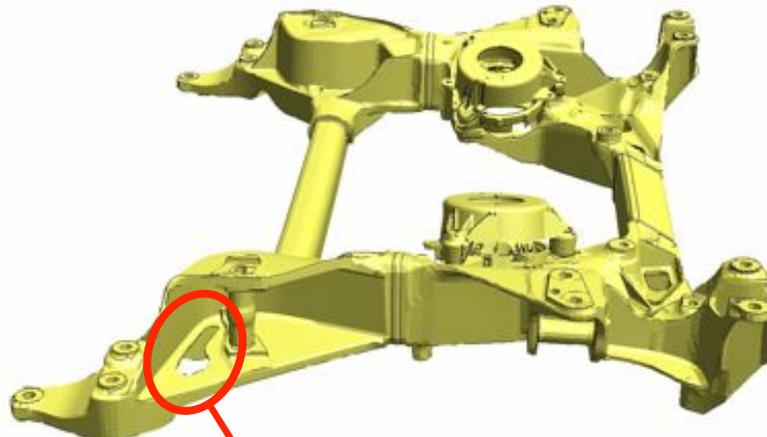
Meticulously engineered to deliver the uncompromised style featuring a small front overhang and extremely tight powertrain package

The challenge



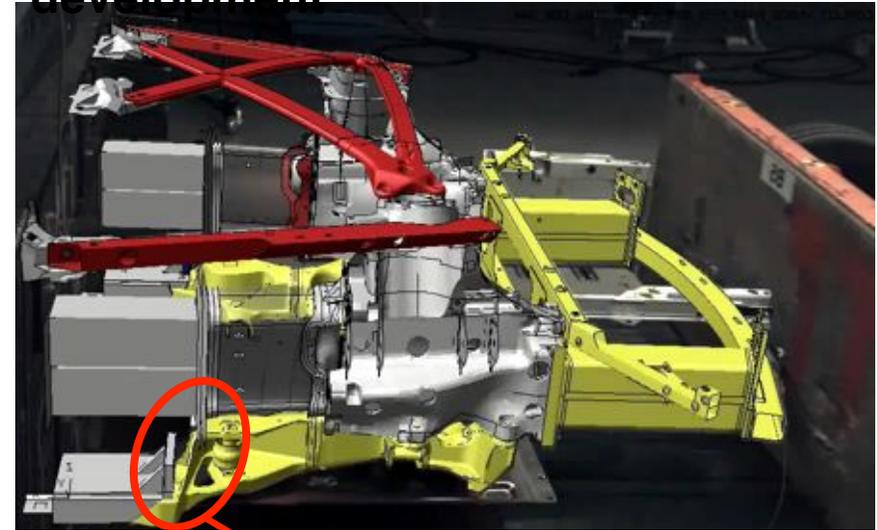
Enabling Secondary cans to crush (sequentially)

The concept



Front subframe structural fuse

The development

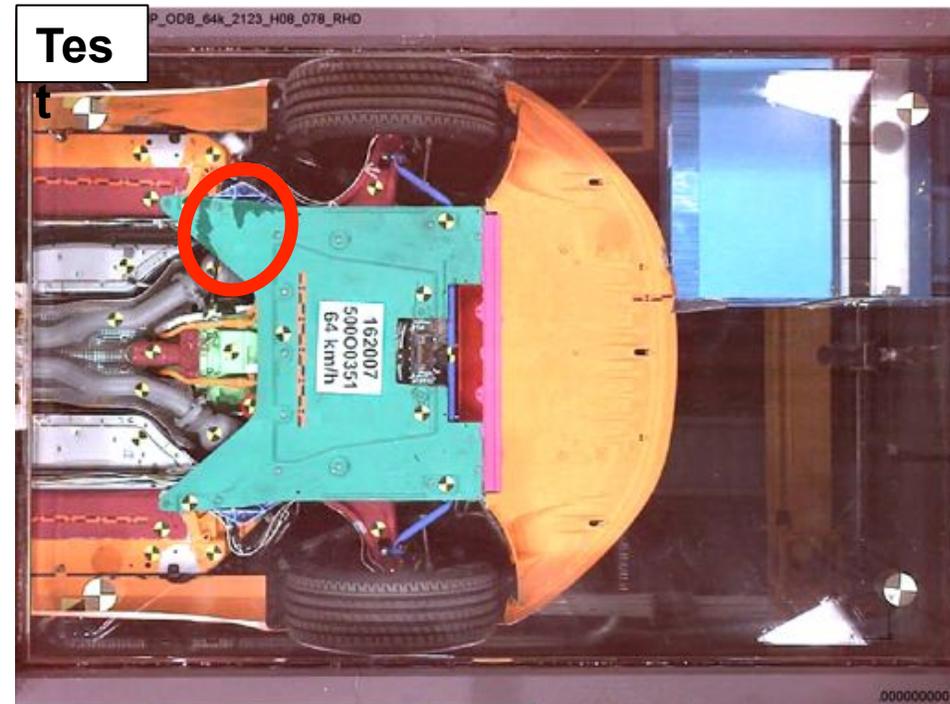
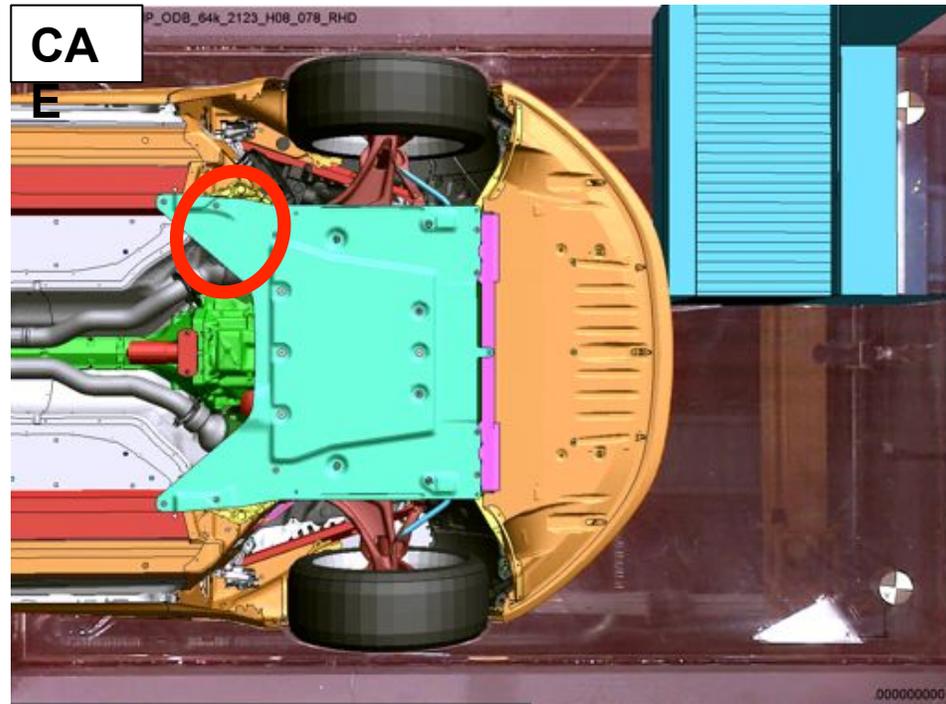


Sub-assembly validation by CAE / Test correlation

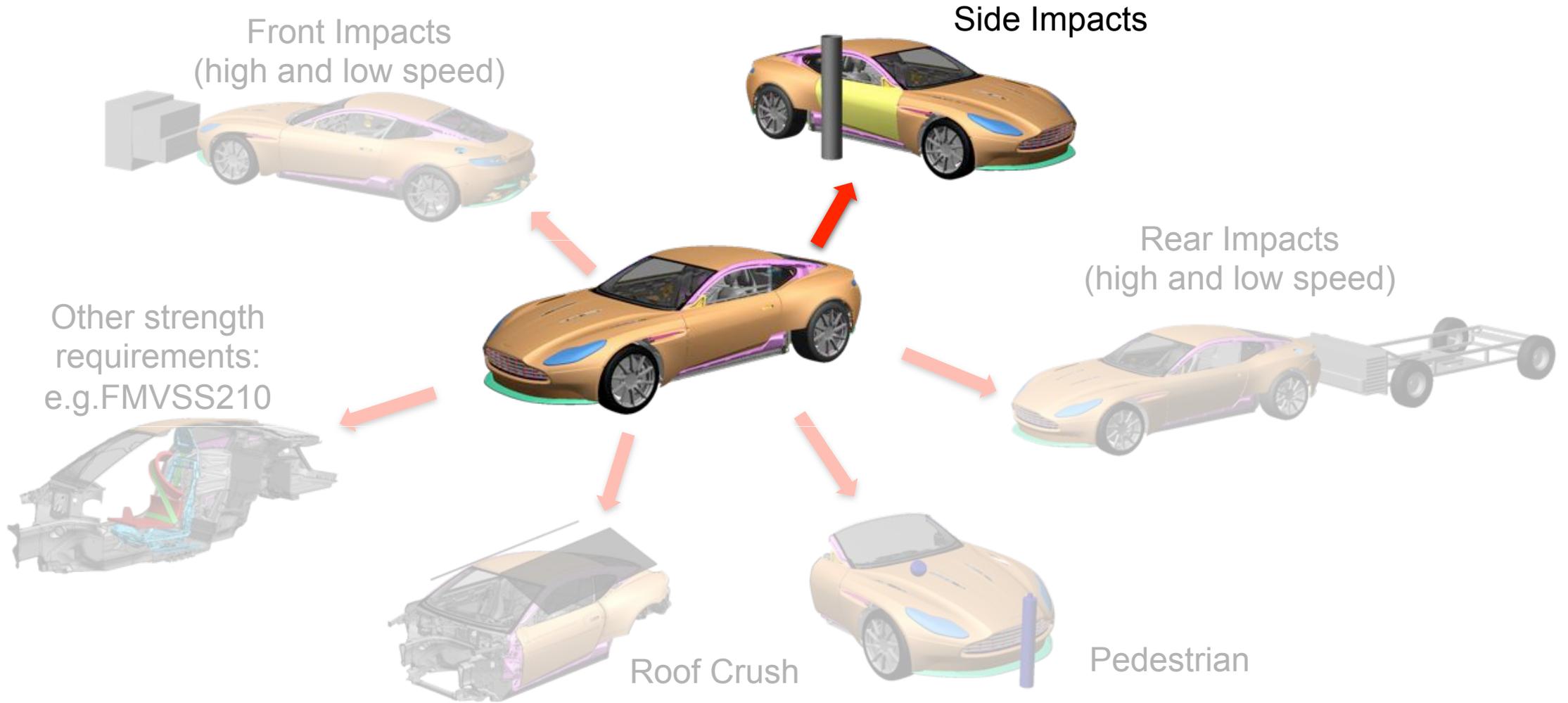
Architecture Robust Safety – Front

Front Impact 64ODB – Development

Robust safety delivered: Under-view demonstrates the effective operation of the design



Architecture Robust Safety



Architecture

Robust Safety – Side

Demanding Style

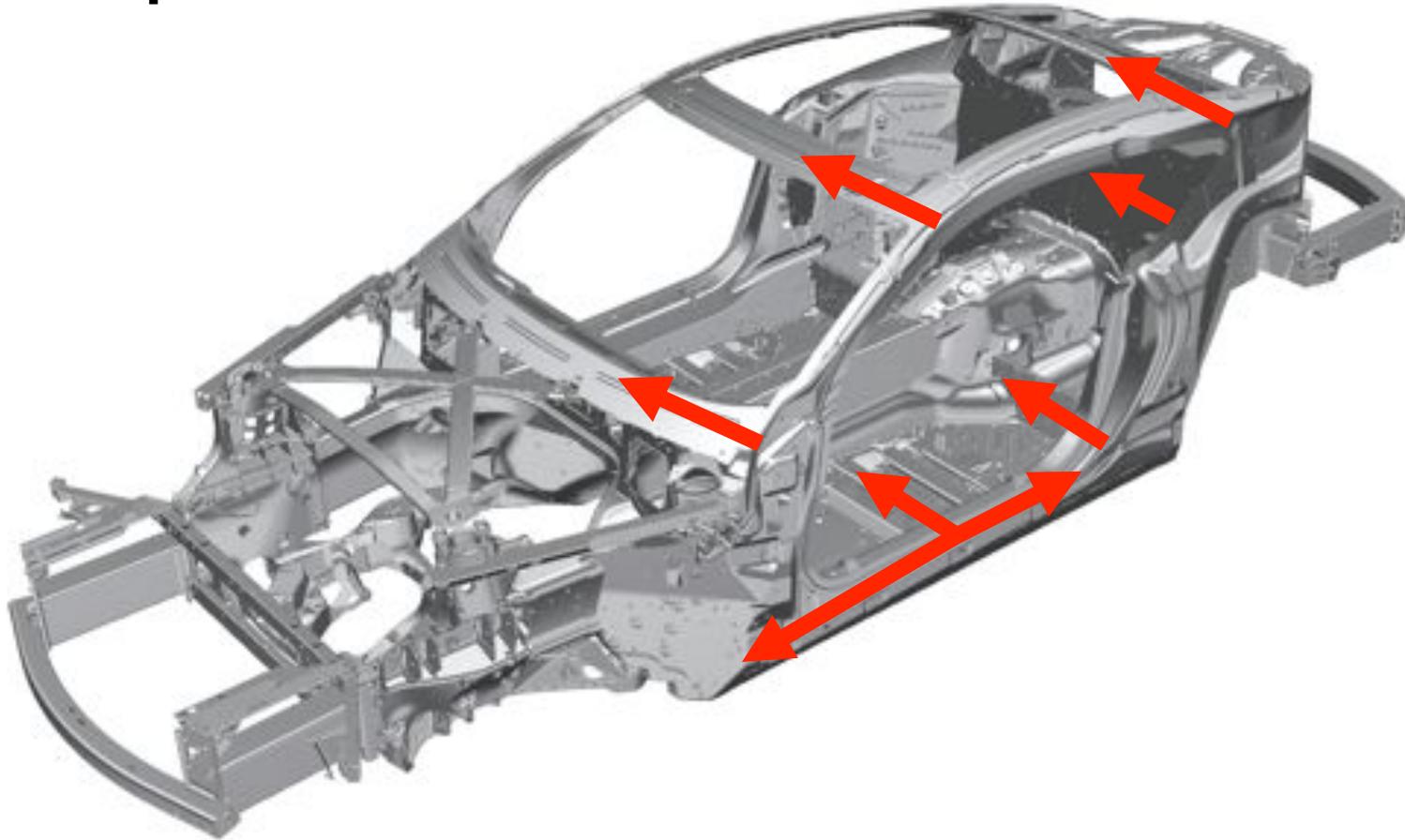


Heavily sculpted side profile:

- reduces visual weight of vehicle
- allows for striking feature line at bottom of door



Side Crash Concept

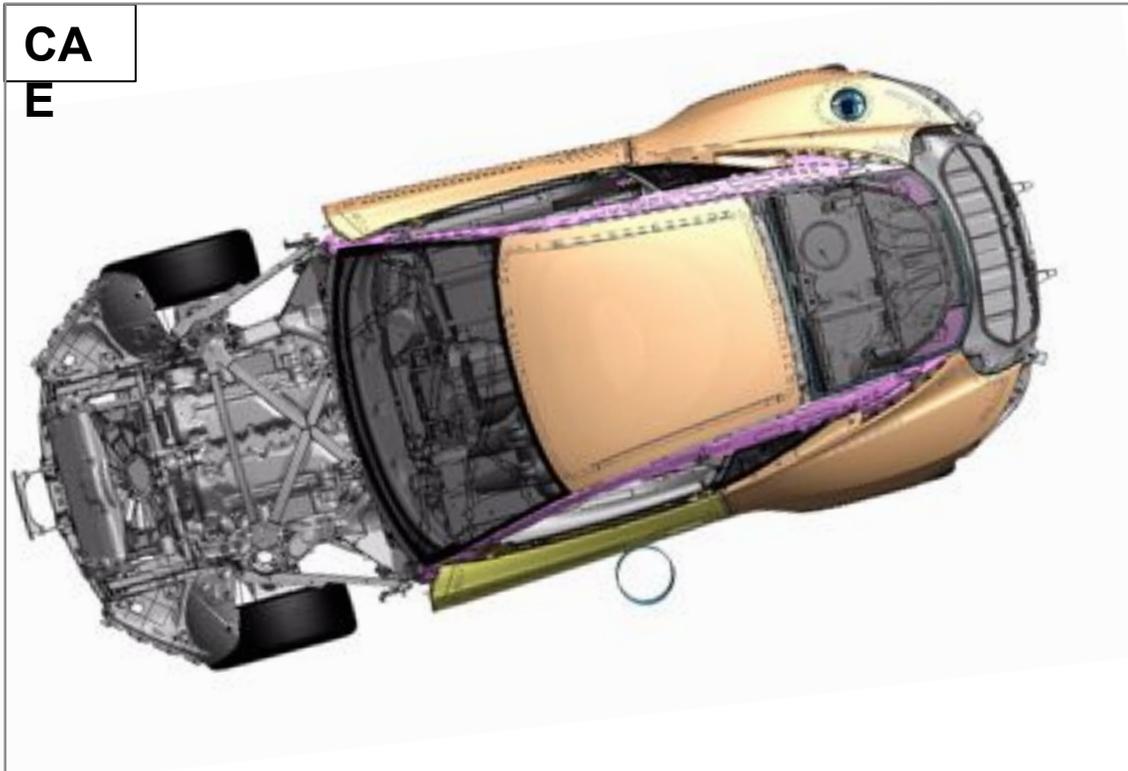


Architecture

Robust Safety – Side

Side Pole Impact

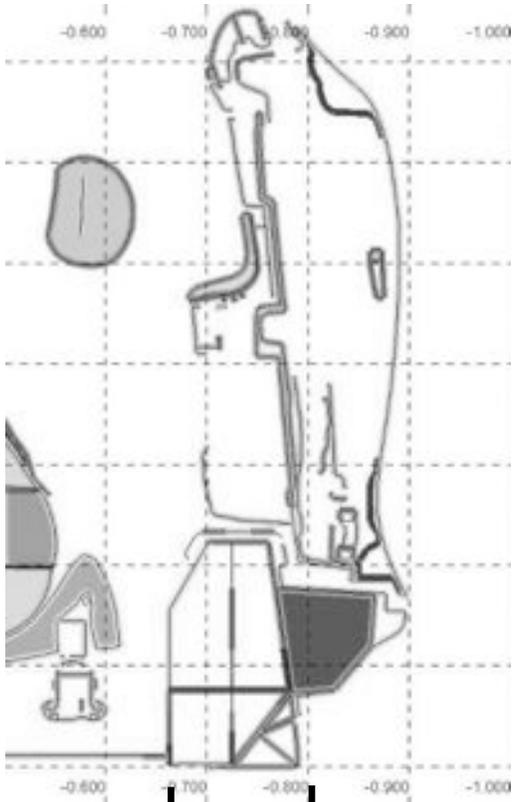
Side pole impact: Delivered with no compromise to the beautiful slim-waist body-style



Architecture

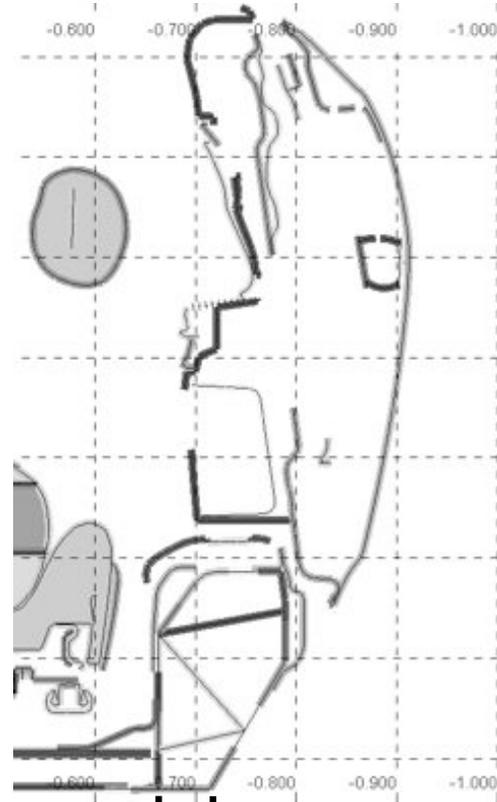
Robust Safety – Side

DB9



130mm

DB11



65mm

The challenge:

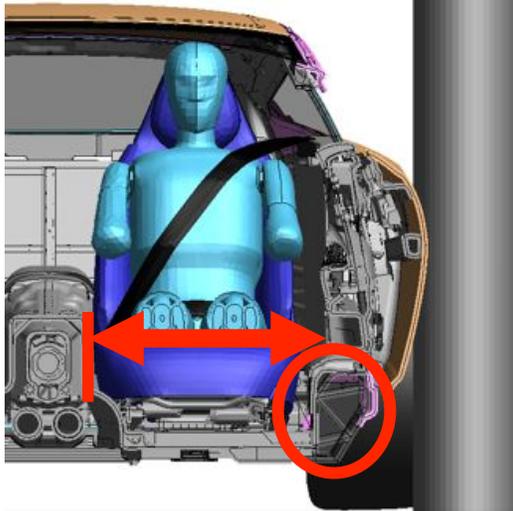
- Heavily sculpted side profile results in a limited section depth to sill in area overlapping cross car structure

Architecture Robust Safety – Side

Side Pole Impact – Development

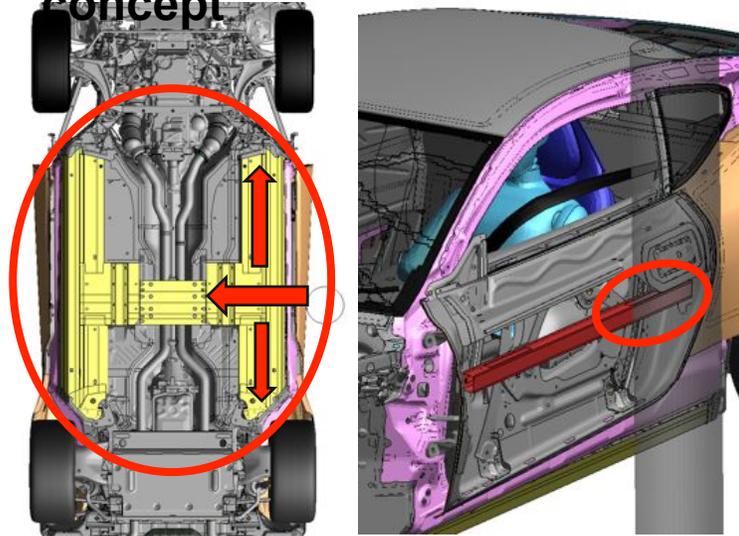
Meticulously engineered from component-level to whole-vehicle-level

The challenge



Occupant seated between:
High tunnel & low tapering sill

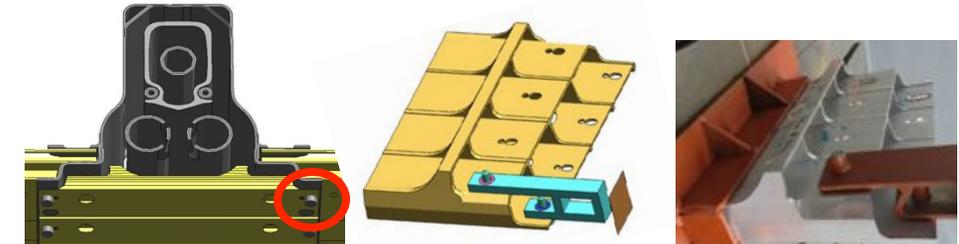
The concept



1. H-Frame underfloor loadpath
2. Slotted door beam

The development

Tunnel-brace key-hole feature

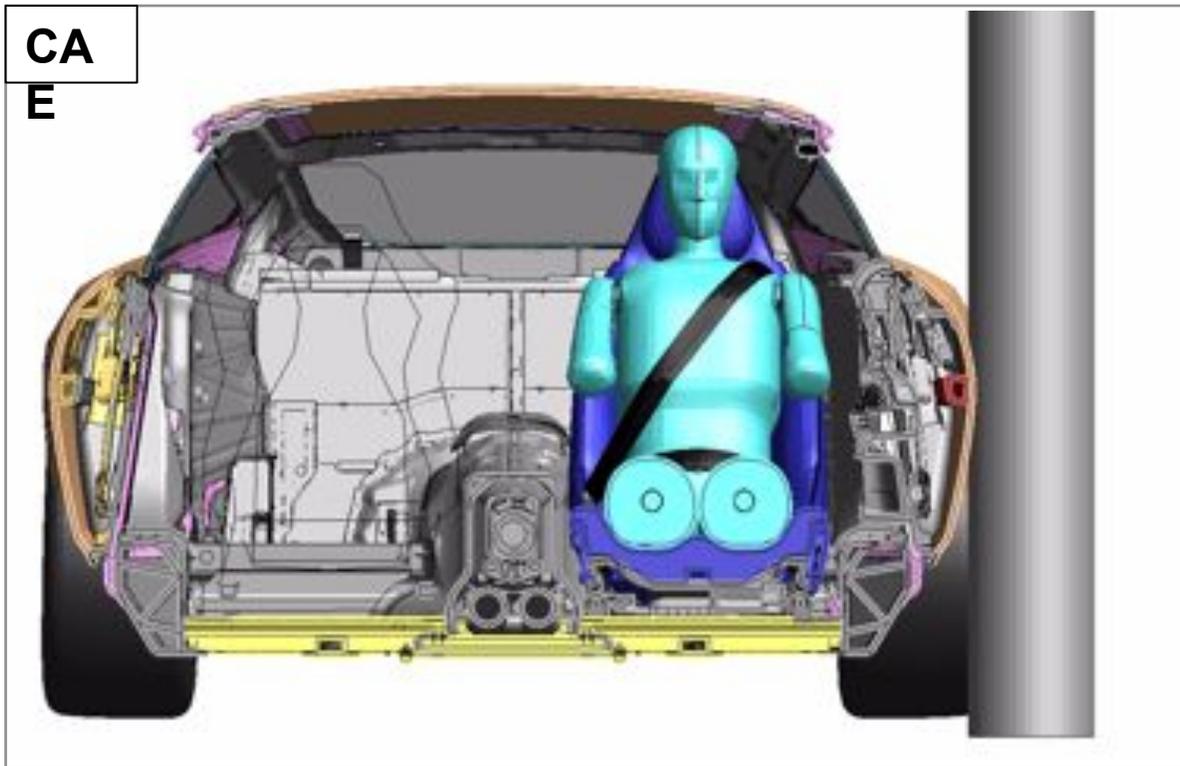


Door-beam slots

Component level
optimization by CAE &
Test

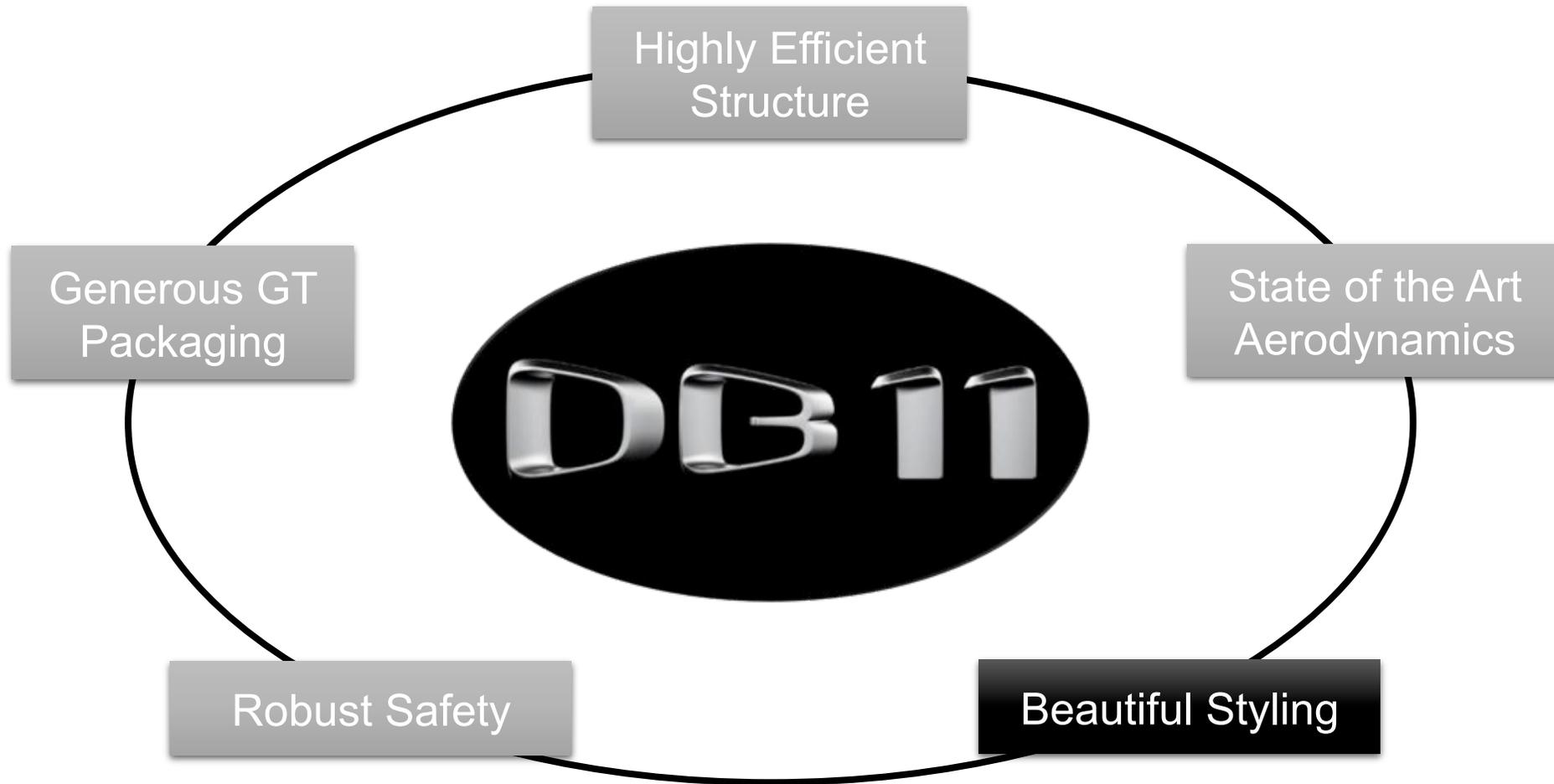
Side Pole Impact – Development

CAE X-section and Crash-test on-board view demonstrate the robust performance of the underfloor load-path



Architecture

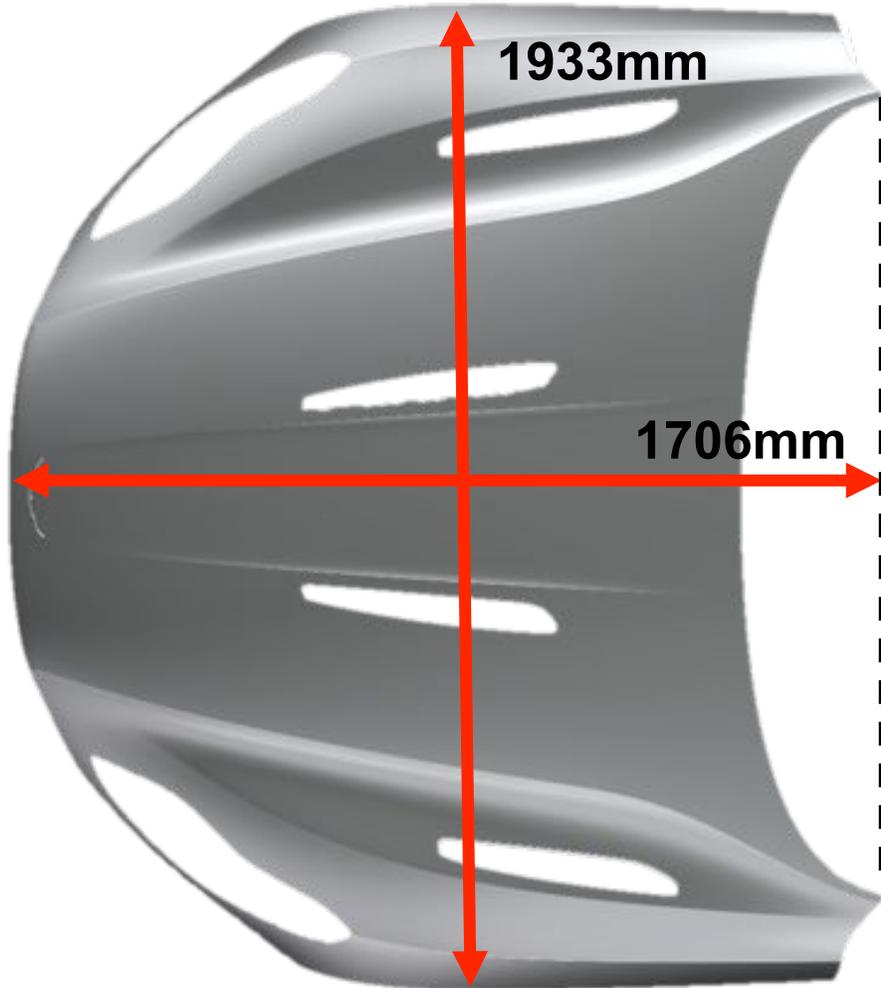
Architectural Goals



Architecture Beautiful Styling – Clamshell Bonnet



Architecture Beautiful Styling – Clamshell Bonnet



Outer: 1.1mm AC170
Inner: 1.0mm 5182
Single Draw Tool

Architecture Beautiful Styling – Clamshell Bonnet



Development Tool
24 feasibility simulations
3 draw bead recuts
40+ drawn shells

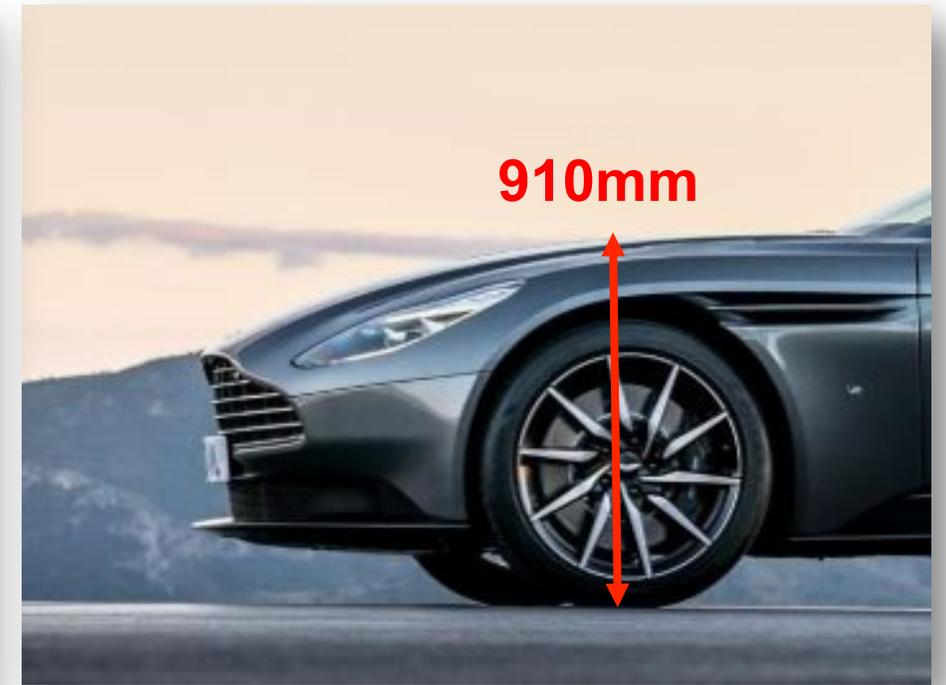
Architecture Beautiful Styling – Authentically Low Front End

Bonnet to leading edge of vehicle



Solid aluminium grille

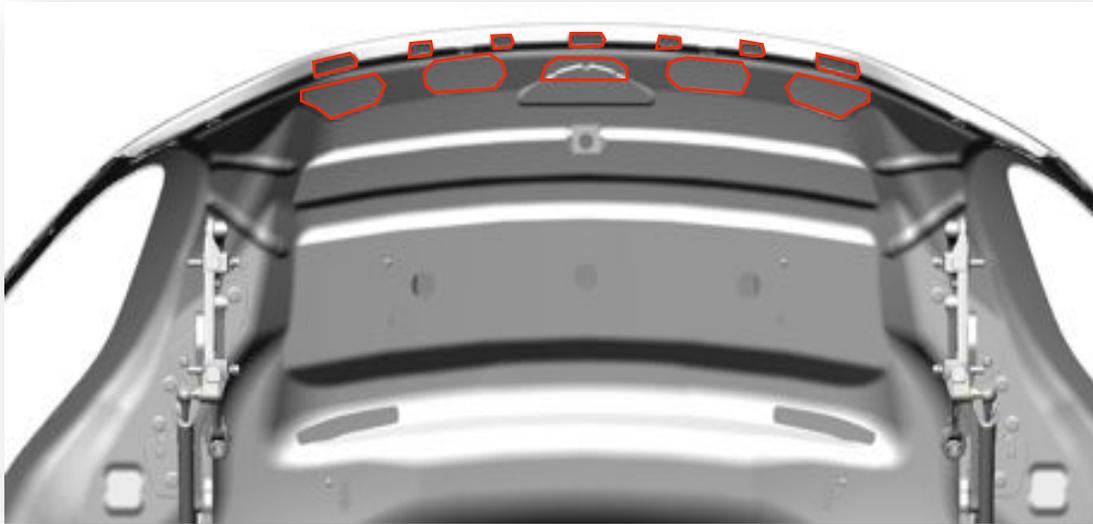
**Low bonnet line
despite large V12 engine**



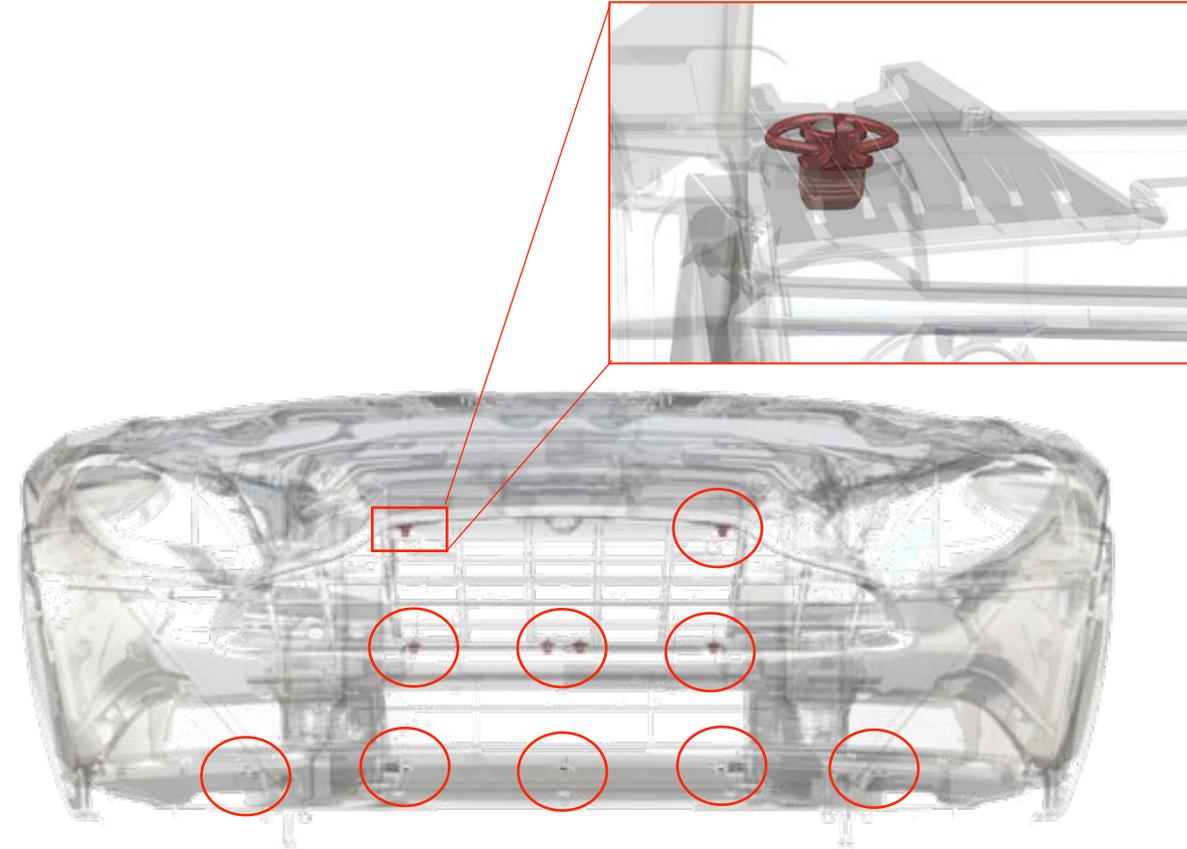
**Aggressive,
forward leaning
stance**

Architecture

Beautiful Styling – Authentically Low Front End



Carefully placed cut outs in leading edge of bonnet

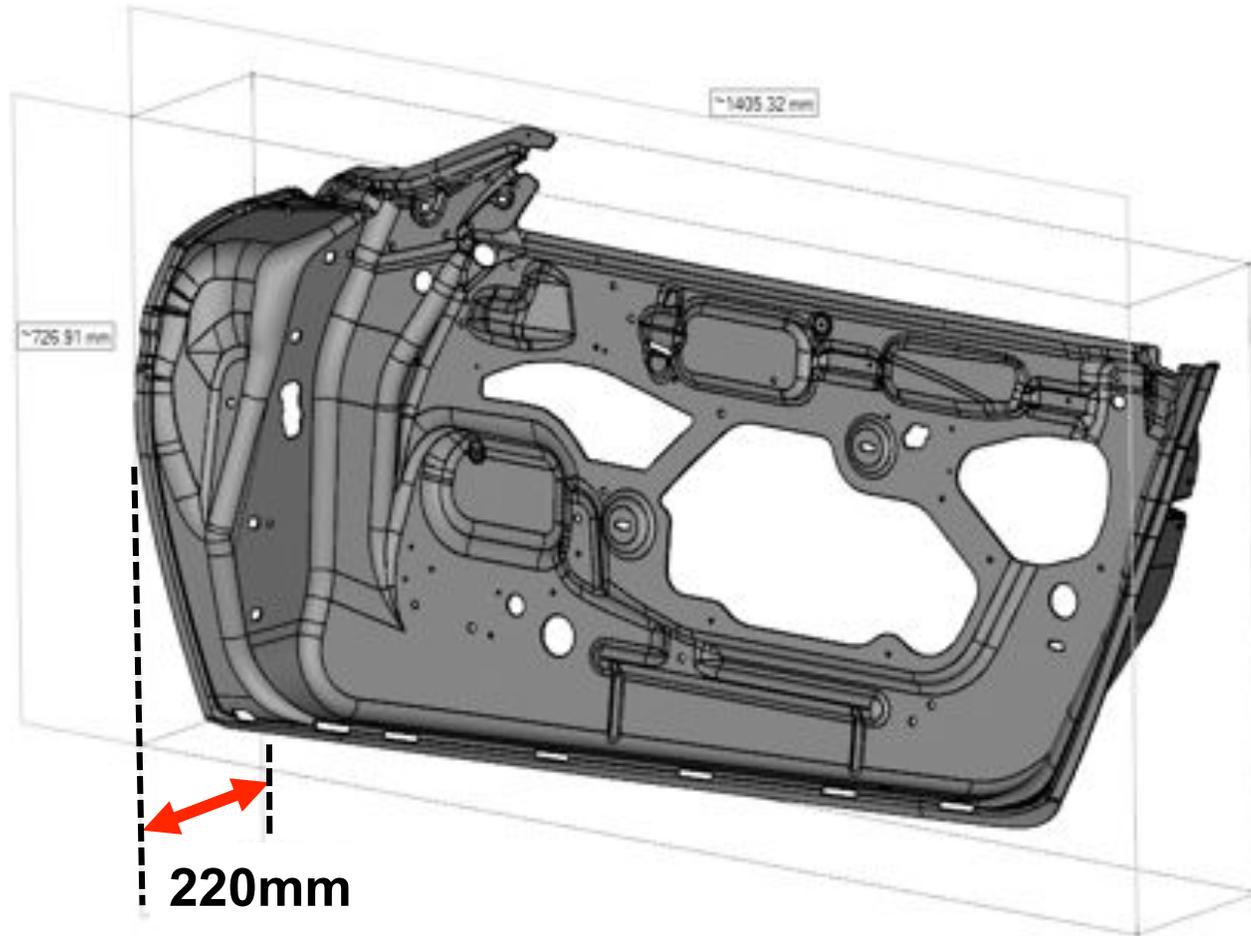


Tuned sprung break outs between grille and structure and splitter to undertray

Architecture Beautiful Styling – Side Profile



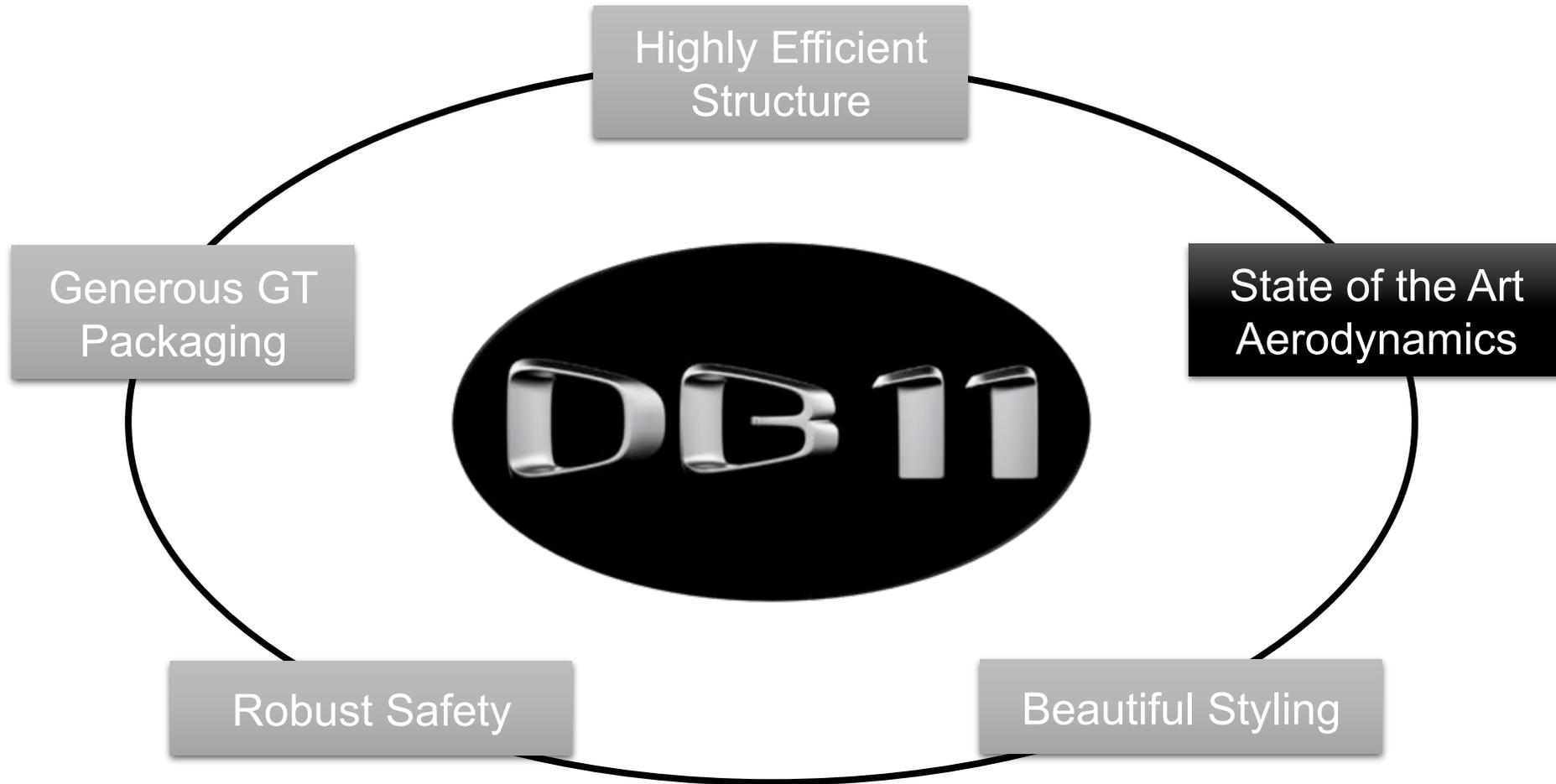
Architecture Beautiful Styling – Side Profile



- **AC200 aluminium using**
- **3 stage hydraulic cold forming process**
- **Draw, Re-draw, Restrike**

Architecture

Architectural Goals



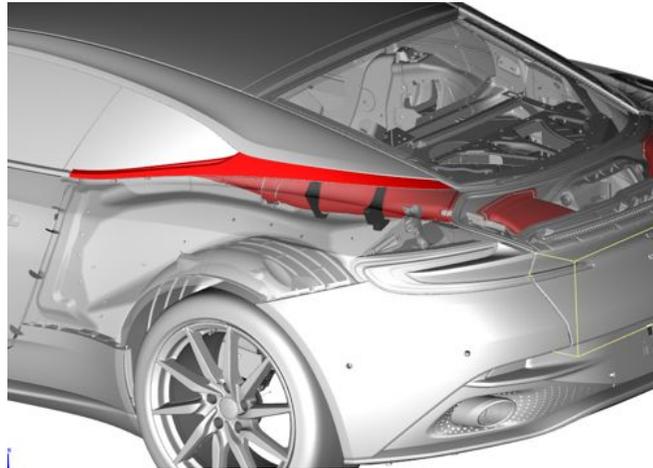
Architecture State of the Art Aerodynamics



Curlicue



Aeroduct™



Architecture State of the Art Aerodynamics

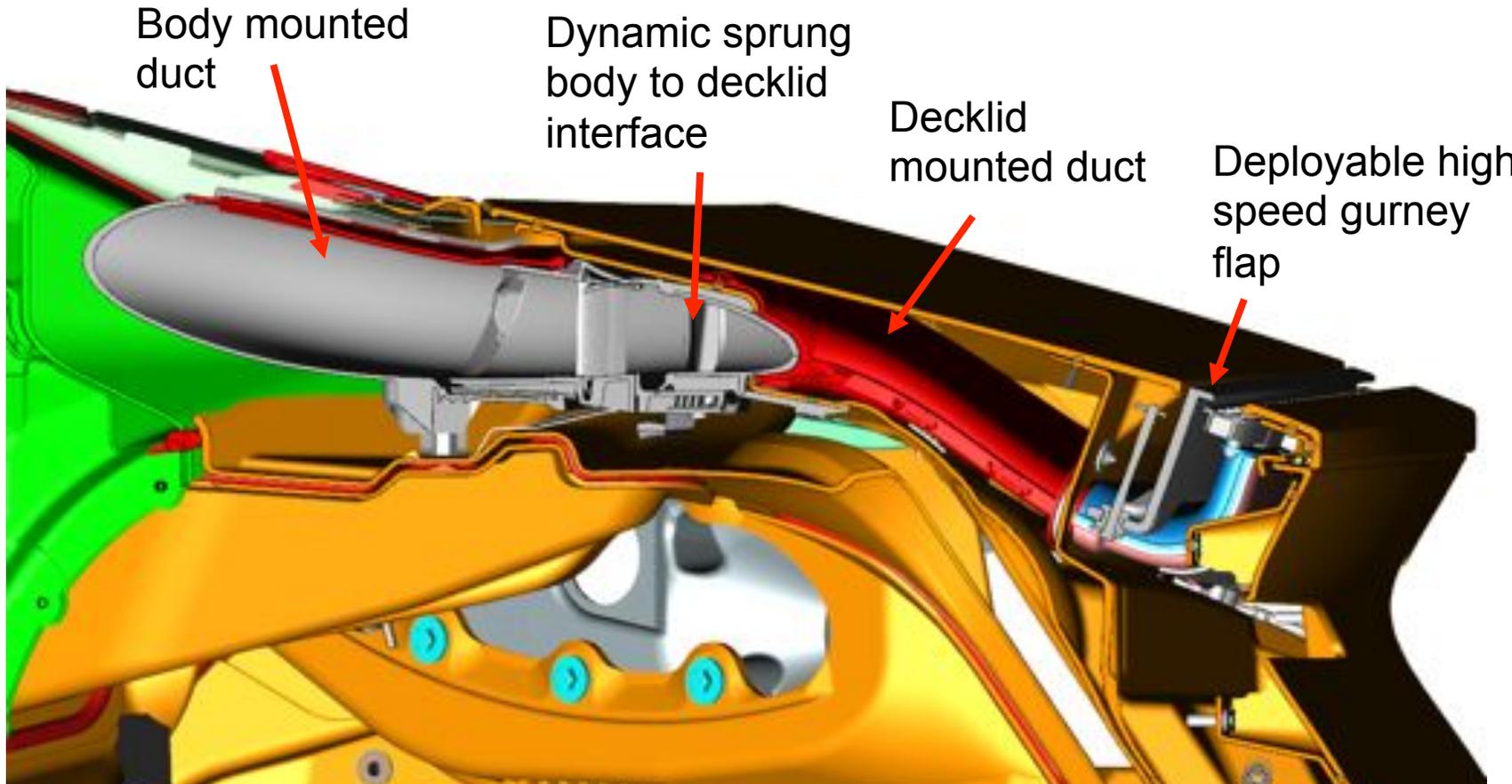


Curlicue



Architecture

State of the Art Aerodynamics – Aeroduct®





ASTON MARTIN

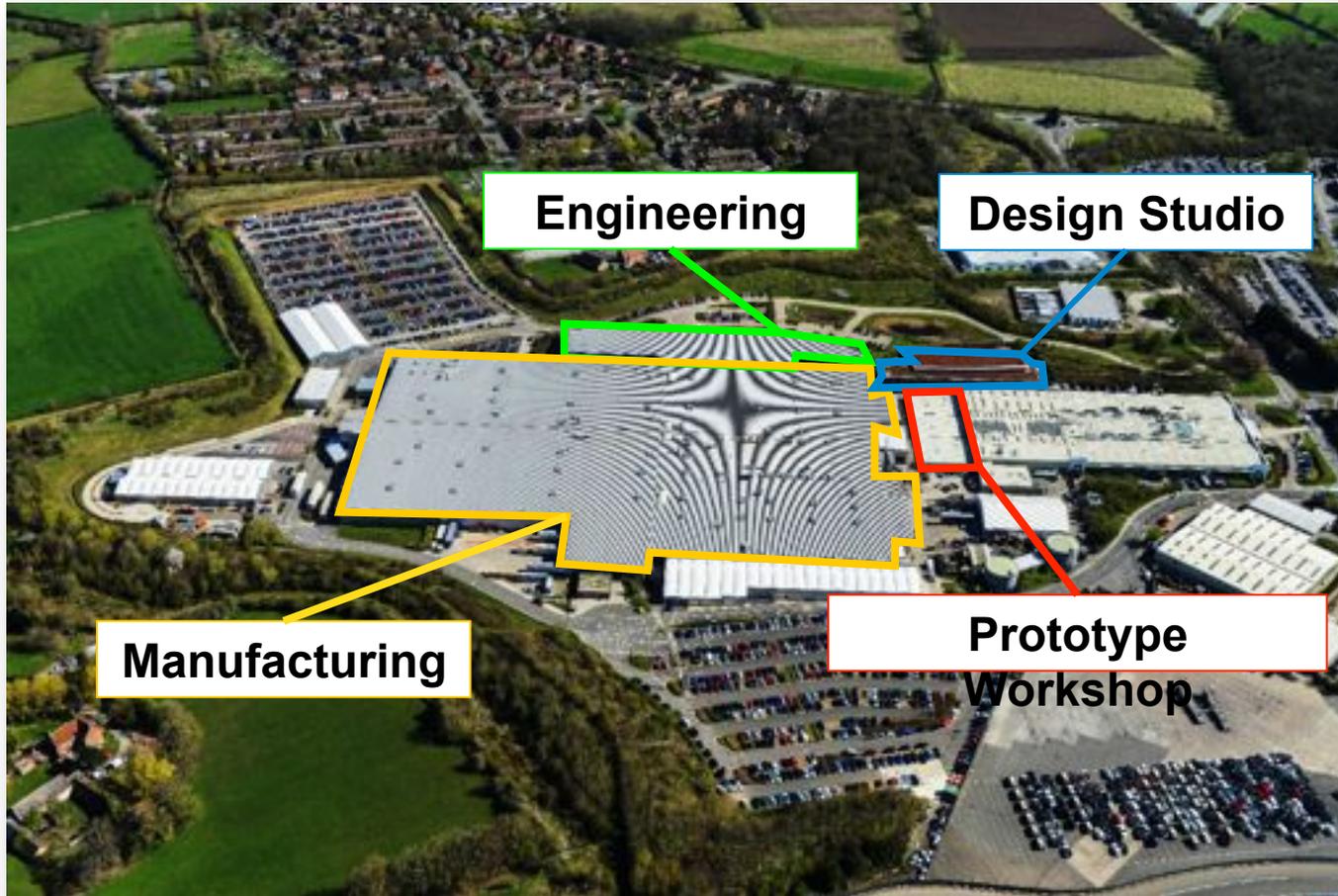
DB11 – Project Mission

Architecture

Manufacturing

Summary

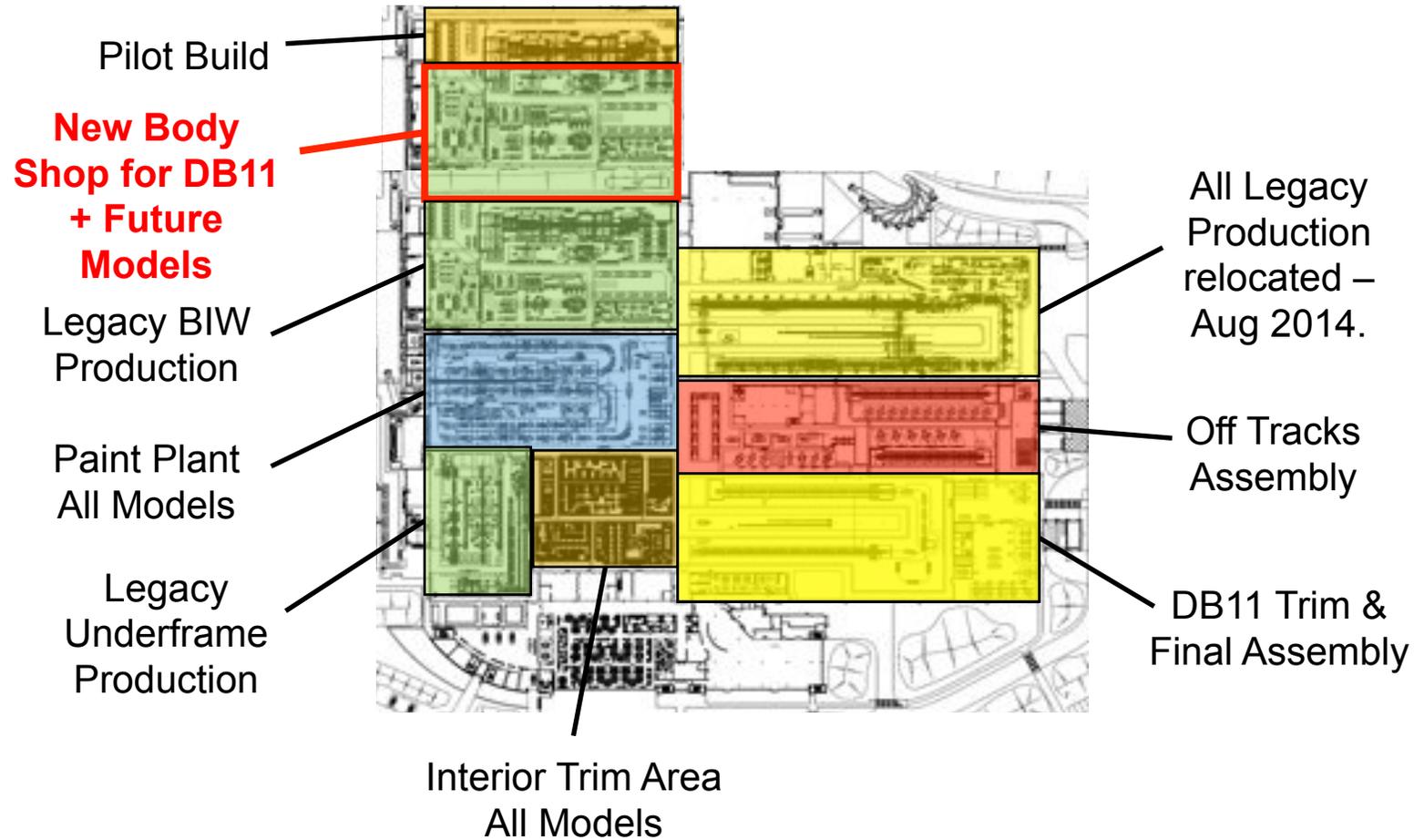
Manufacturing Location



DB11 was designed, engineered and is manufactured at our HQ in Gaydon - UK

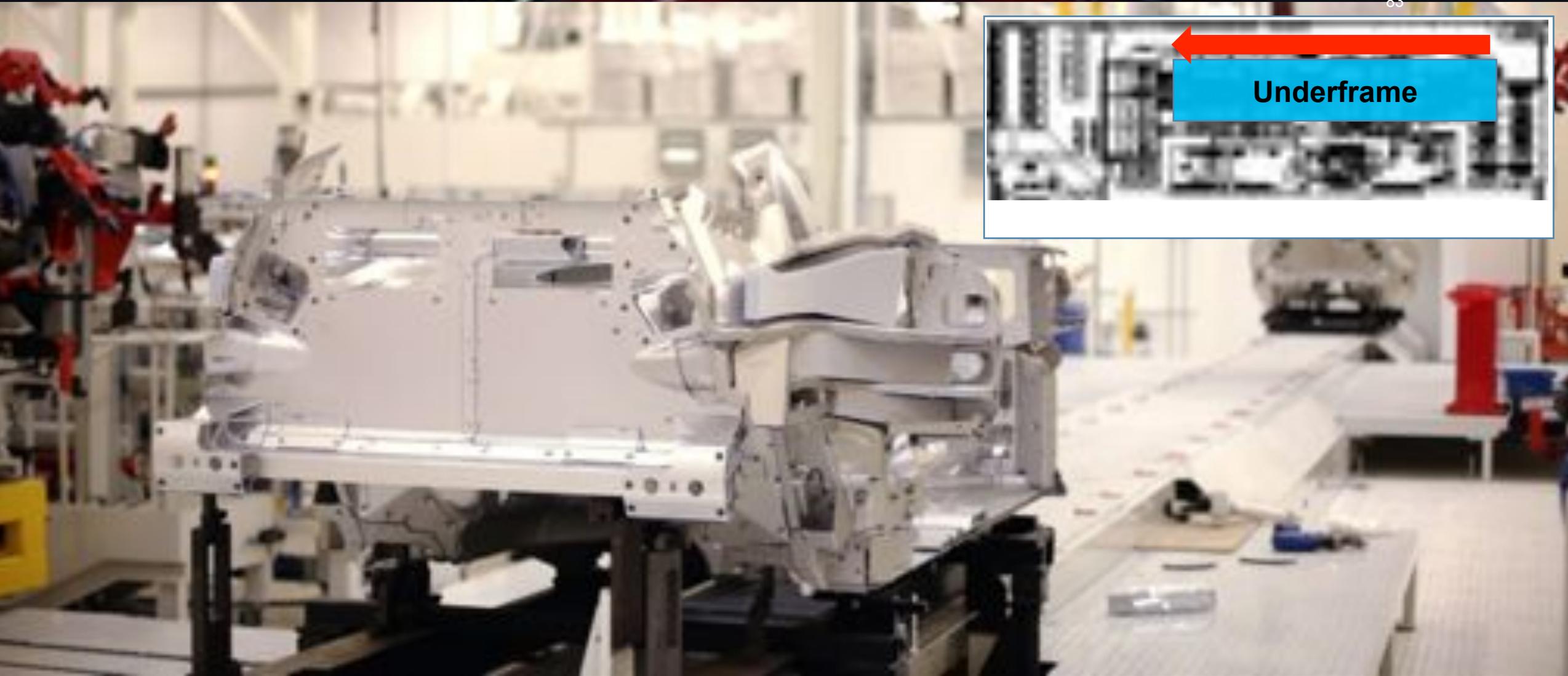
Total Plant Manufacturing Area:
38,000sqm

Manufacturing Manufacturing Layout

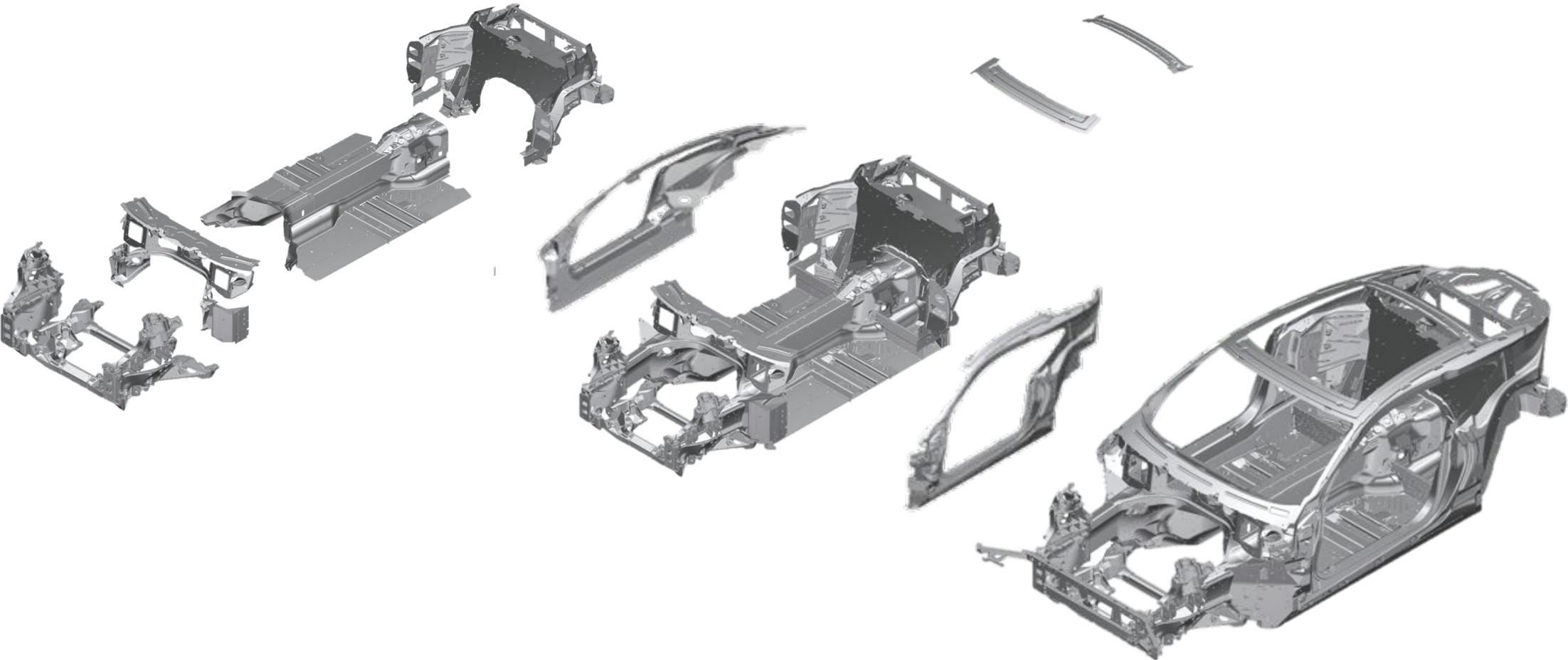


New Body Shop for DB11: 5,700sqm

Manufacturing Assembly Sequence - Underframe



Manufacturing Assembly Sequence - Underframe



Manufacturing Assembly Sequence – No Underframe Derivatisation

DB9

RHD



LHD



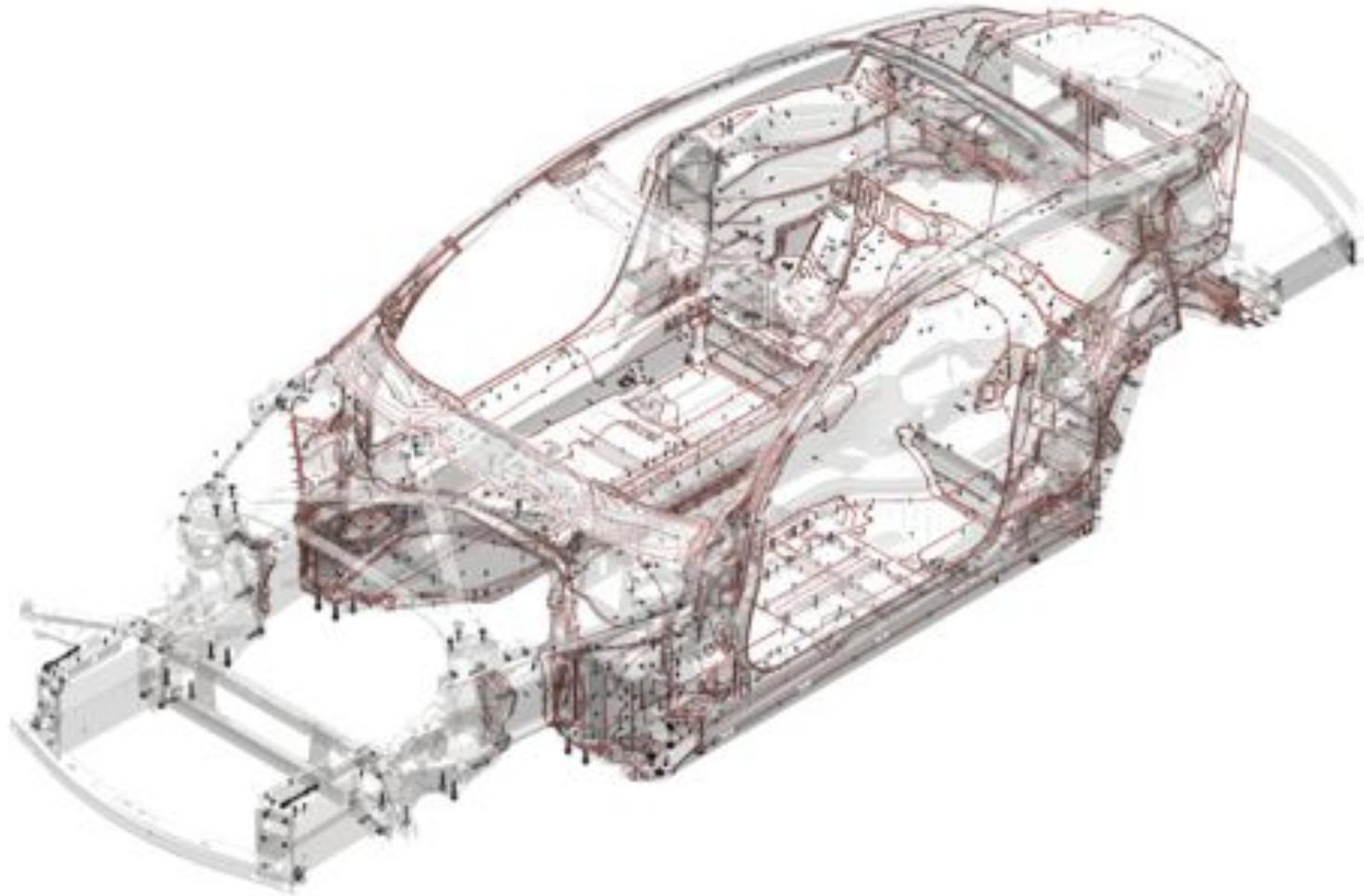
DB11



RHD & LHD

**Single derivative out of body shop for both
hands and all world markets.**

Manufacturing Underframe Joining Summary



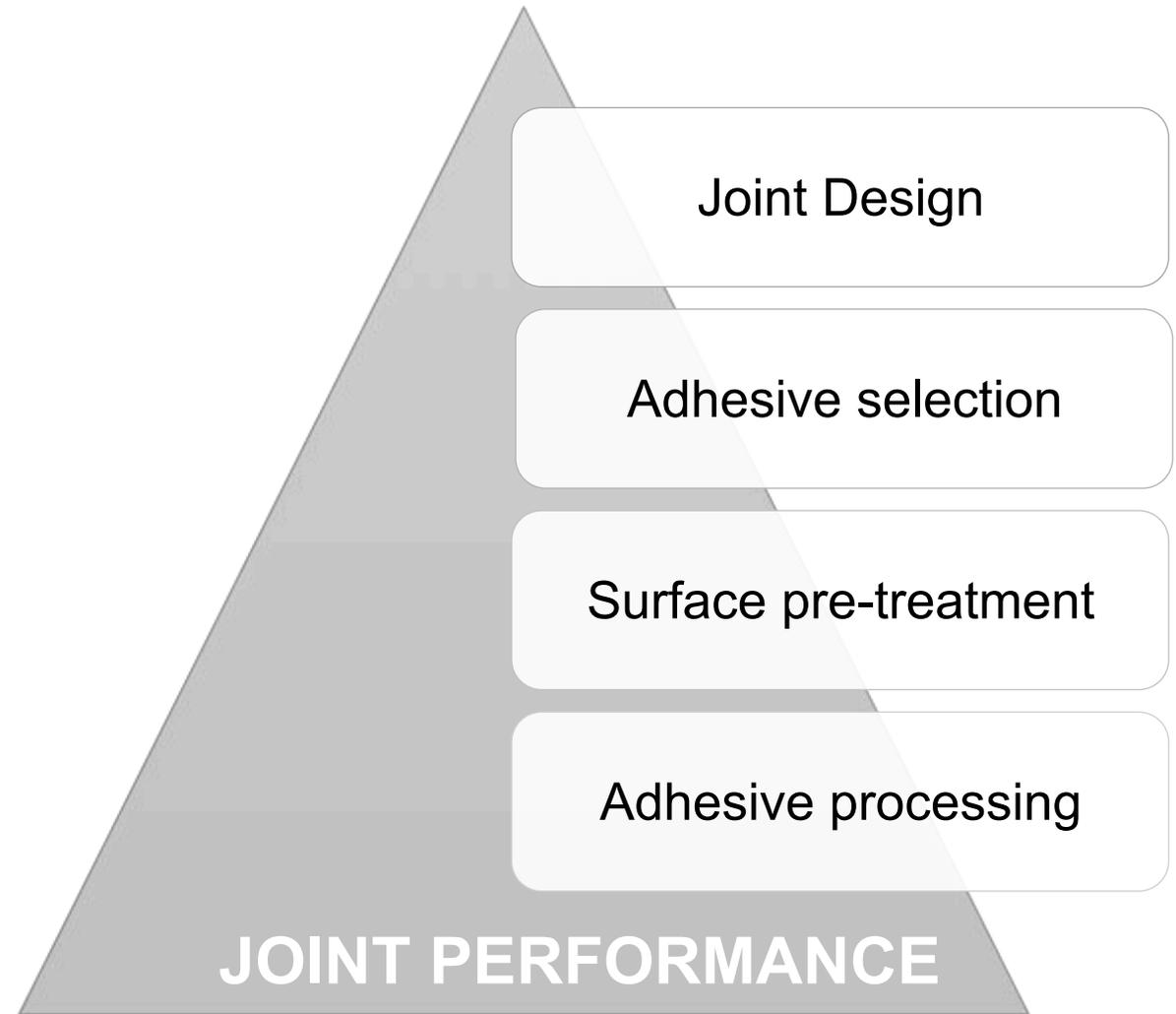
113m of hot cure
BETAMATE™ structural
adhesive

841 Structural Rivets

437 Self Pierce Rivets

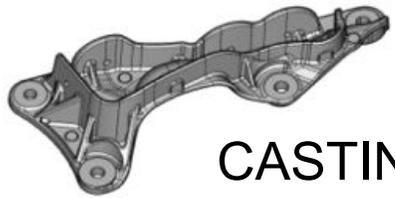
52 Drill Drive Screws

Architecture Joining Concept

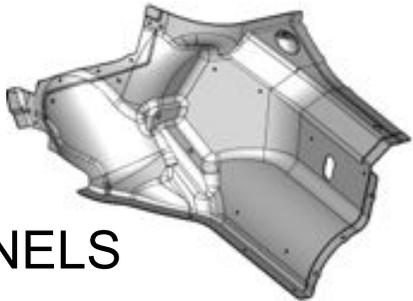


Architecture Joining Concept – Bill of Process to achieve Joint Performance

Supplied components



CASTINGS



PANELS



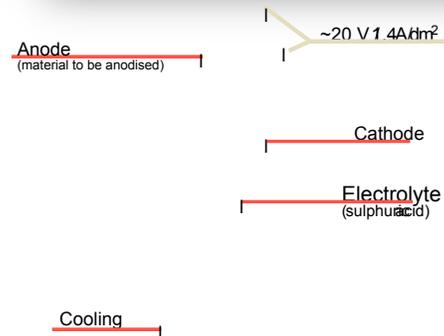
EXTRUSIONS



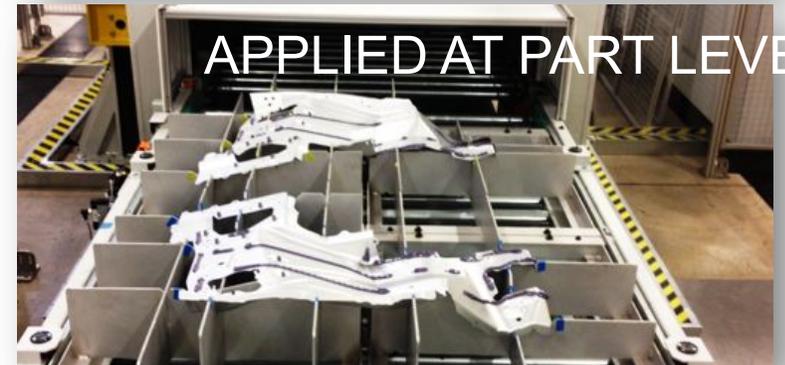
Conversion & Corrosion Coating



ANODISING



100% Robotic Adhesive Application

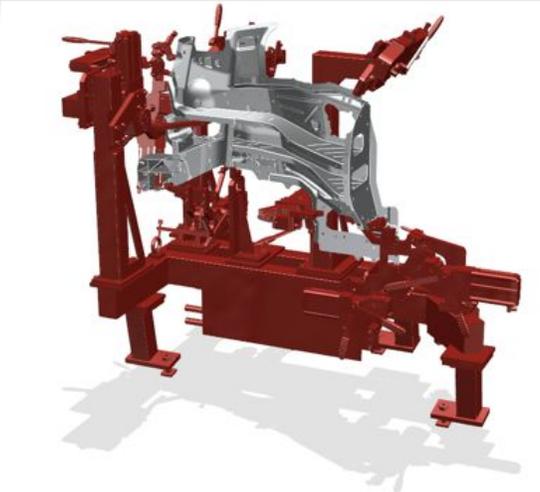


APPLIED AT PART LEVEL

Architecture

Joining Concept – Bill of Process to achieve Joint Performance

Create Joint



Mechanical Joint Closure

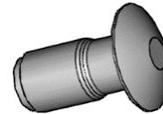


SPR

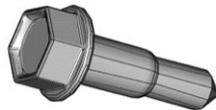
Double Sided →
*Part Fixture
Located / No
Holes Required*



Single Sided
with matching
holes → *Gun
Access / Part
Self Location*



STRUCTURAL
RIVET



DDS

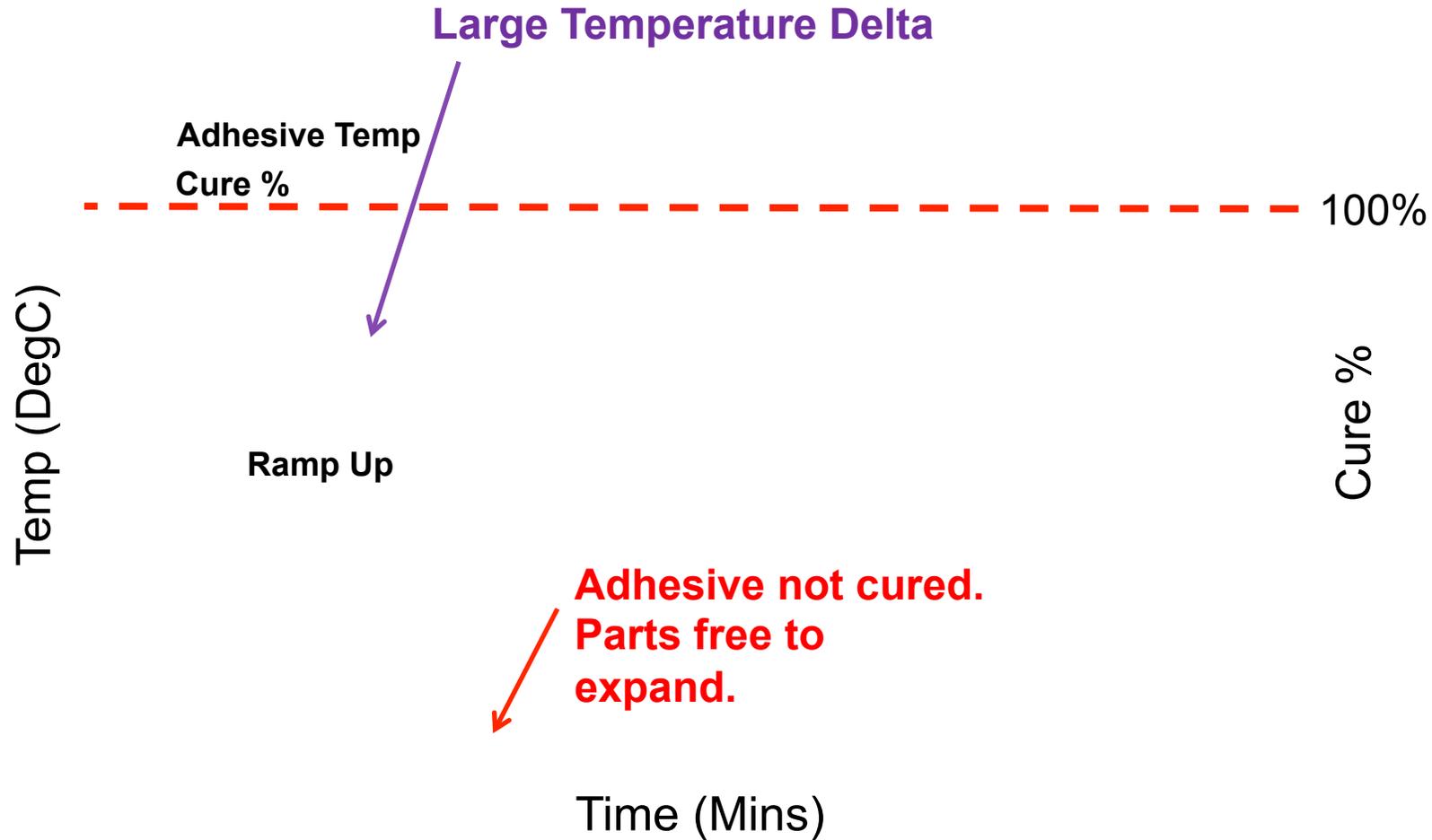
Single Sided with
Pilot → *Gun
Access / Joint
Size / Earth
Continuity*

Adhesive Cure



Architecture

Joining Concept – Bill of Process to achieve Joint Performance

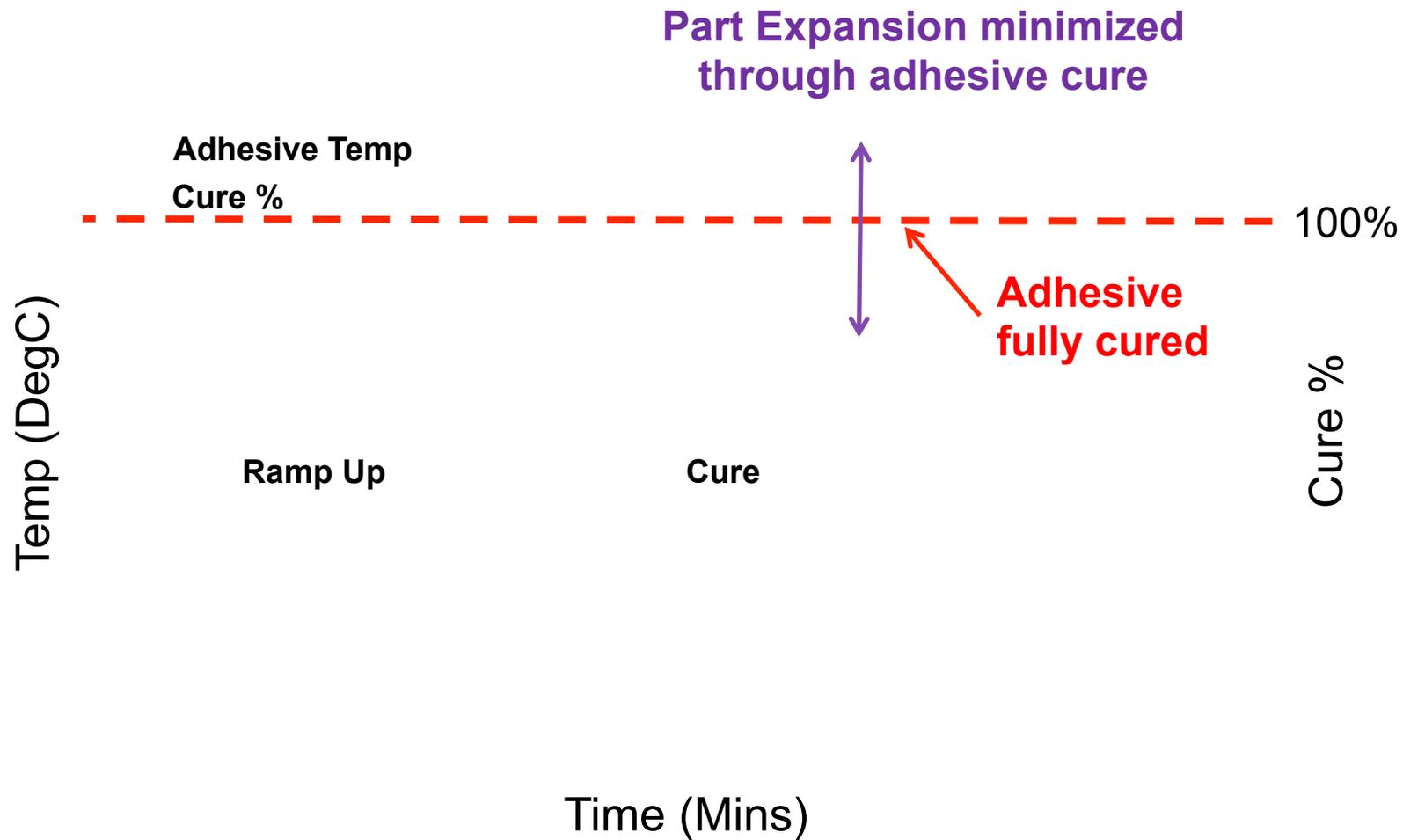


Adhesive Cure



Architecture

Joining Concept –Bill of Process to achieve Joint Performance

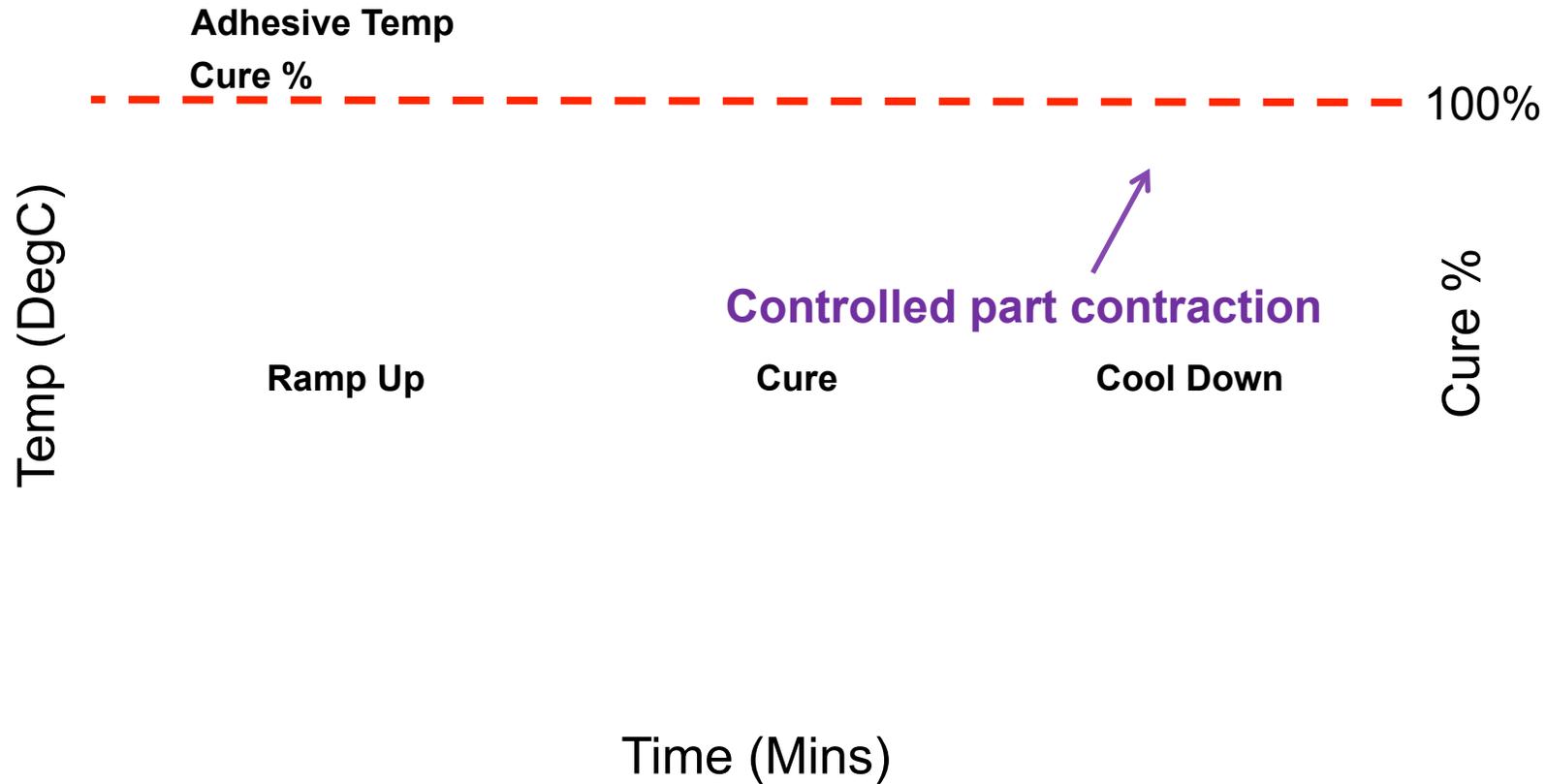


Adhesive Cure



Architecture

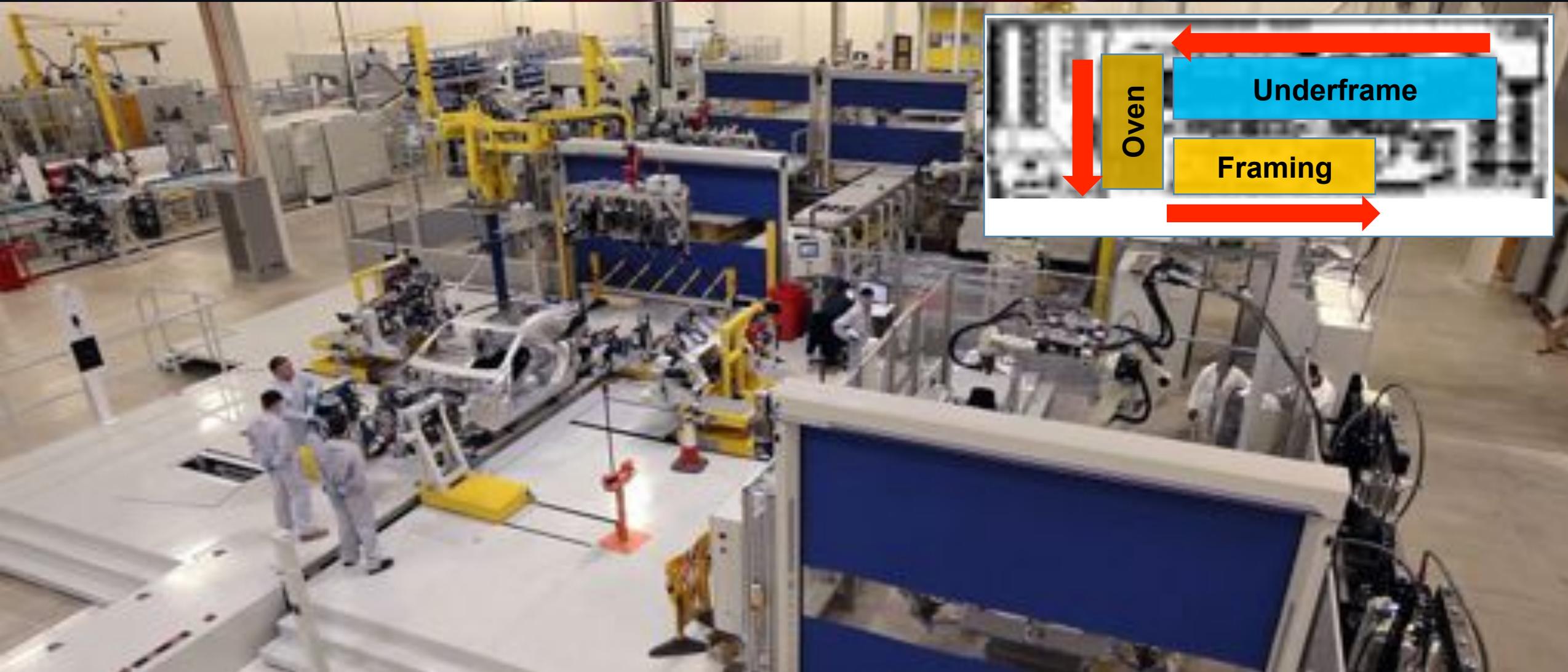
Joining Concept –Bill of Process to achieve Joint Performance



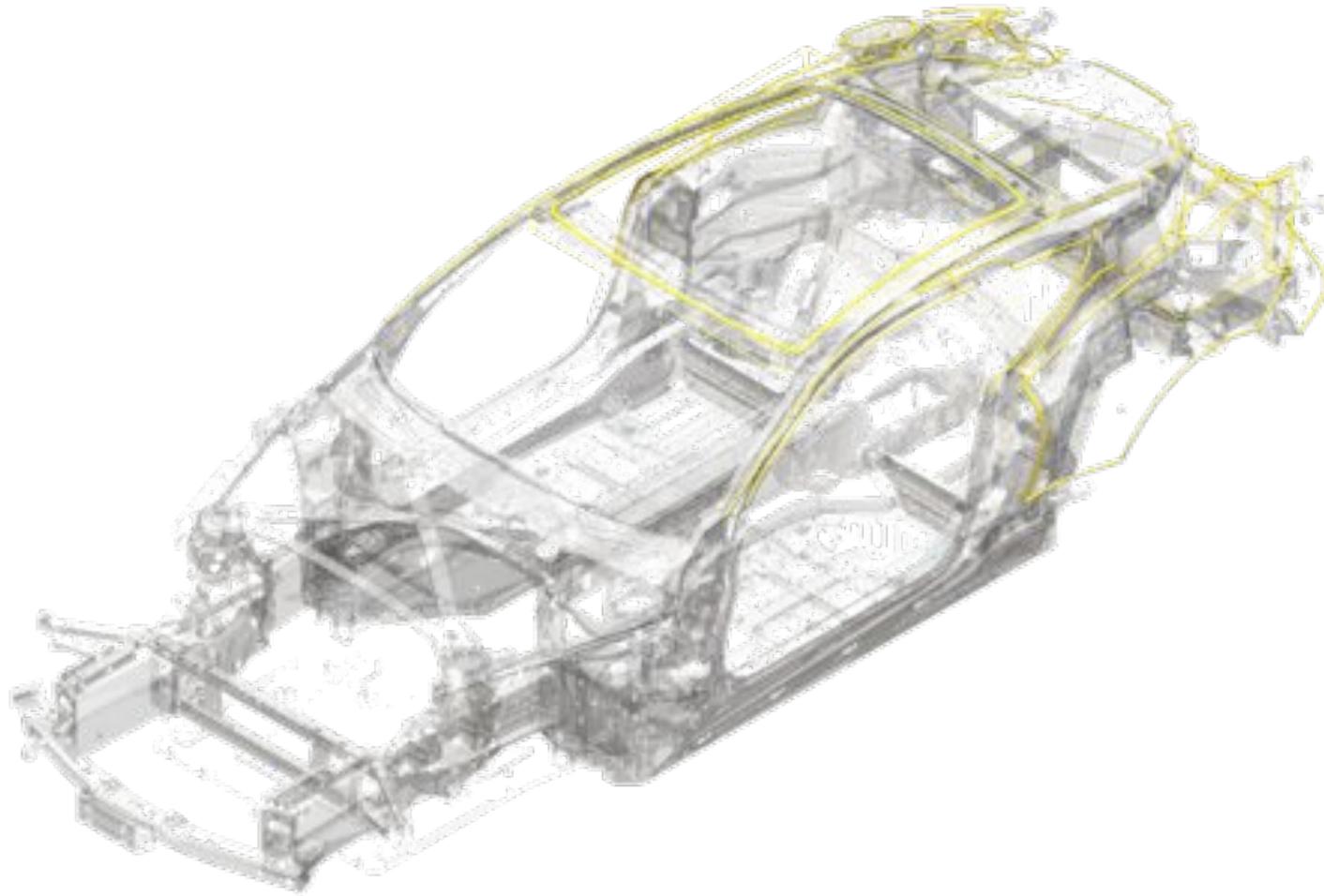
Adhesive Cure



Manufacturing Assembly Sequence – Framing



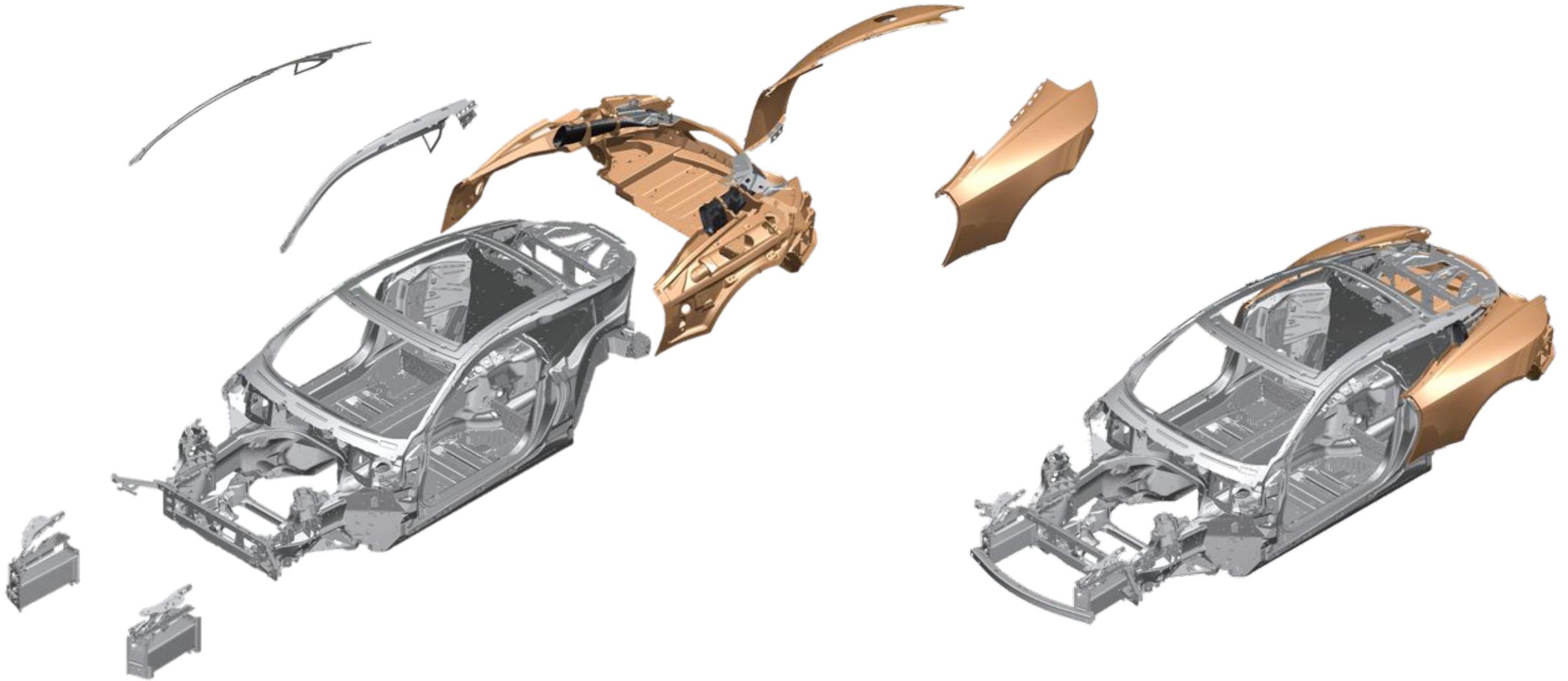
Manufacturing Framing Joining Summary



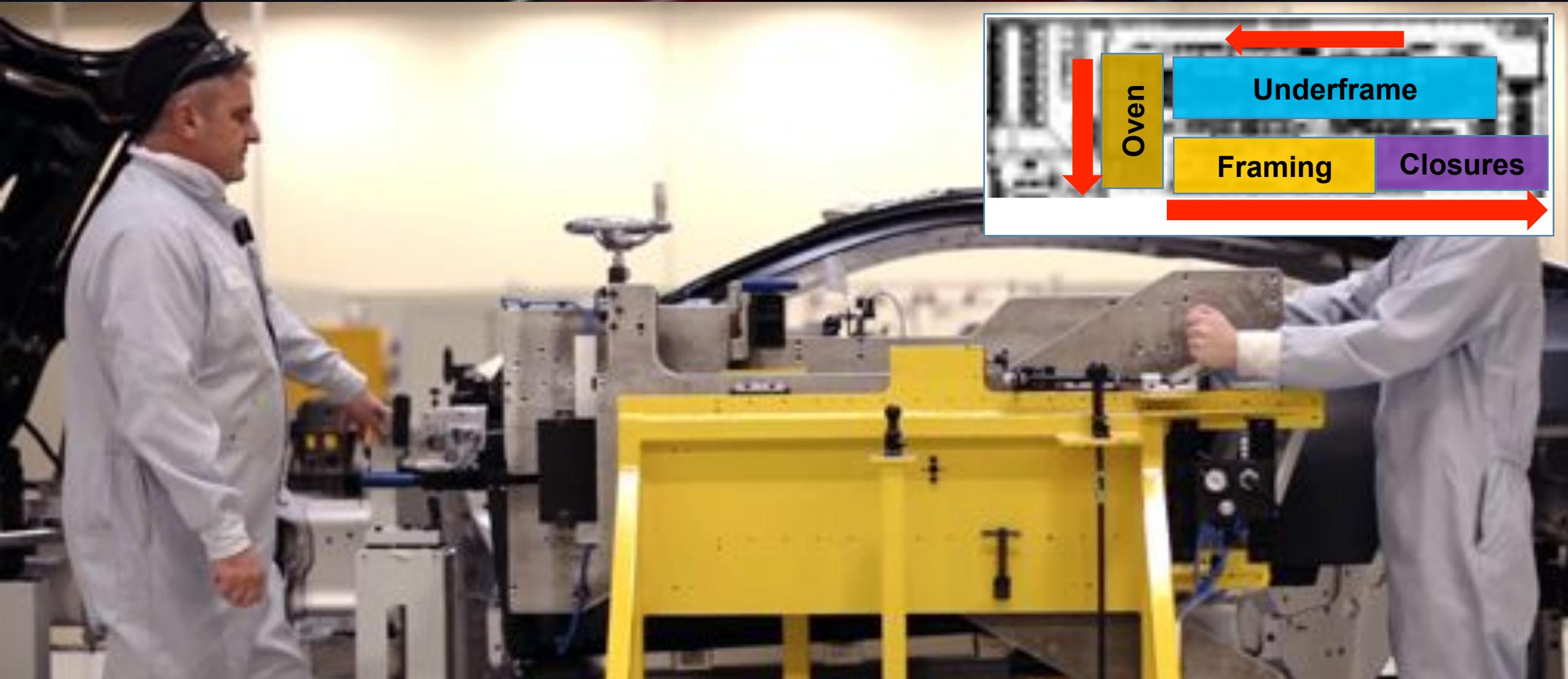
39m of cold cure BETAFORCE™
PU adhesive

Allows +/- tolerance
compensation through bond
squeeze out to enable position of
panels to be set independently of
underframe variability.

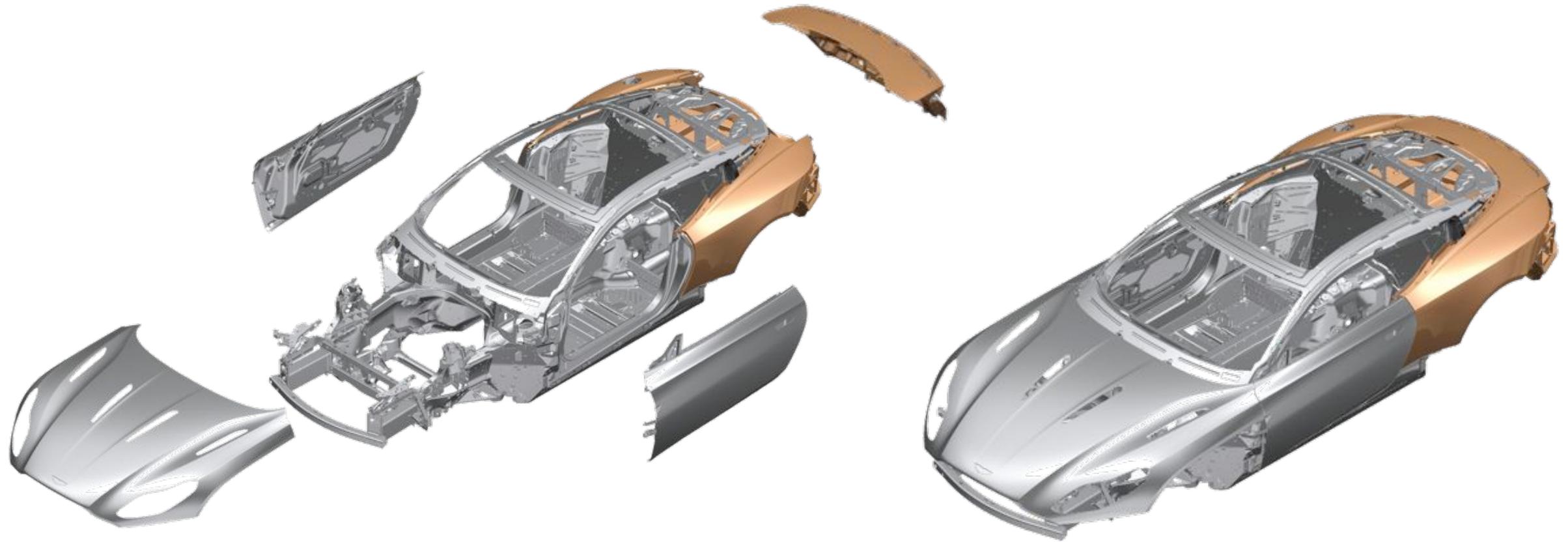
Manufacturing Assembly Sequence – Framing



Assembly Sequence – Closures



Manufacturing Assembly Sequence – Closures



Manufacturing Assembly Sequence

Paint Process

Process:

- Low temperature paint cycle (90°).
- Whole body including hang-ons and trim items painted together

Benefits:

- No body variation introduced through paint process
- Allows hand polishing to achieve mirror finish
- No colour mismatch





ASTON MARTIN

DB11 – Project Mission

Architecture

Manufacturing

Summary

Reviews

“The Aston Martin DB11 spearheads a completely new model range explosion by Aston. And it's brilliant” **Autocar** ★★★★★

“Even on this initial showing the new DB11 is clearly the best Aston Martin in decades” **Auto Express** ★★★★★

“The best drive of my career. As unique as it is beautiful... to call the DB11 brilliant is an understatement” **The National Post**

“There are no cracks to paper over with the DB11, no eccentricities to excuse. It's the best, most completely resolved new Aston Martin in the company's history.” **Motor Trend**





ASTON MARTIN



DB11