

GREAT DESIGNS IN **STEEL**

INTEGRATED BATTERY OCCUPANT PROTECTION BODY-IN-WHITE CONCEPT USING TAILORED BLANKS

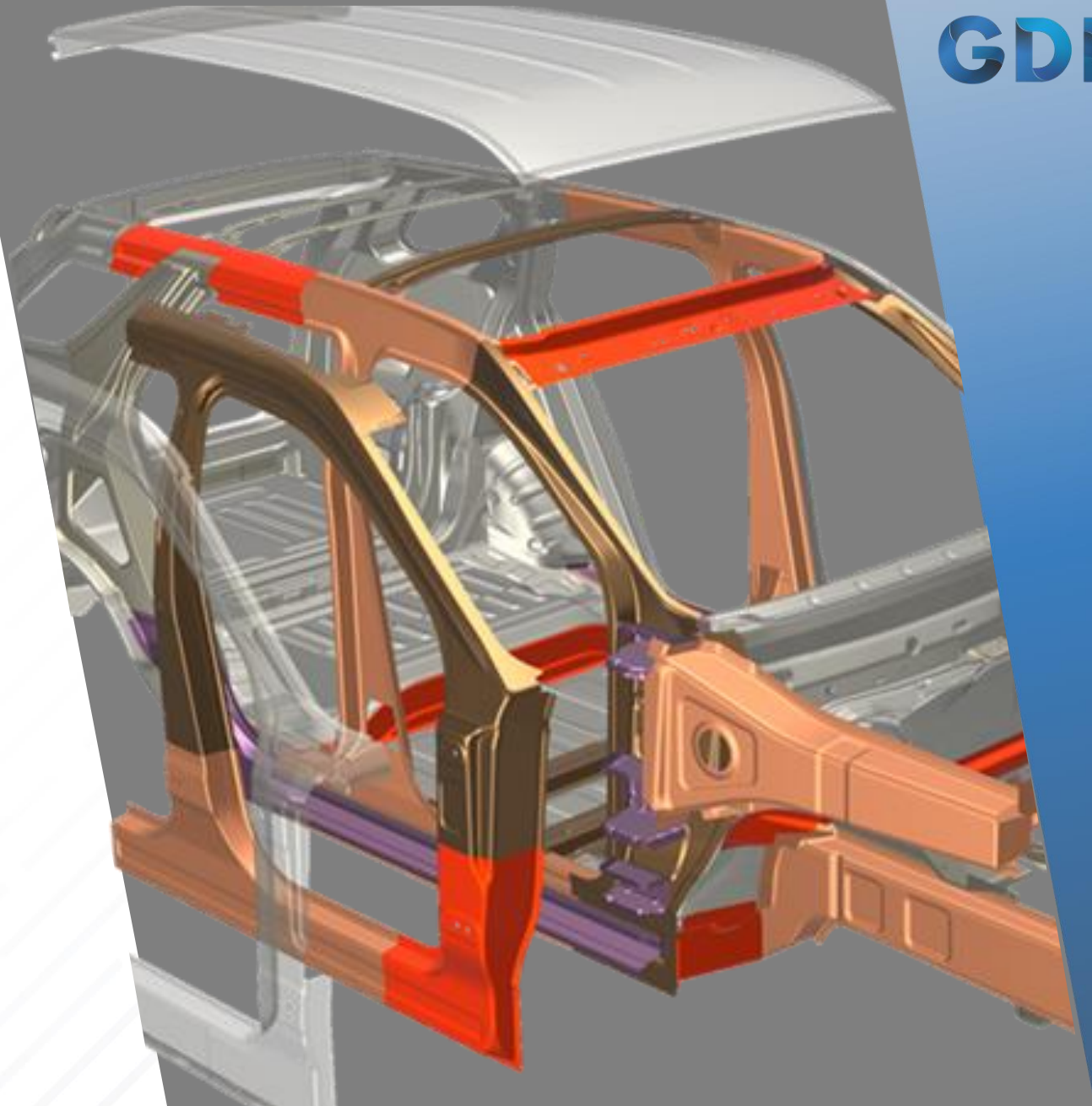
Gagan Tandon

Director, Product Development

ArcelorMittal Tailored Blanks Americas

AGENDA

- Customer Current Challenges
- AMTB BEV Solution Objectives
- ICE to BEV Journey to AMTB BEV
 - Key Architecture Changes
 - Occupant & Battery Protection System
 - Battery Ring – Novel Concept
 - Performance Comparison
 - BIW Weight Breakdown
- Summary



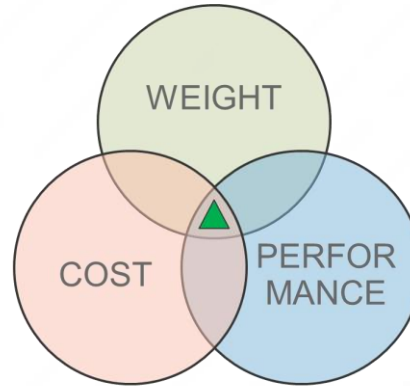
AMTB'S BATTERY RING CONCEPT

AN INNOVATIVE BATTERY AND PASSENGER SAFETY SOLUTION!

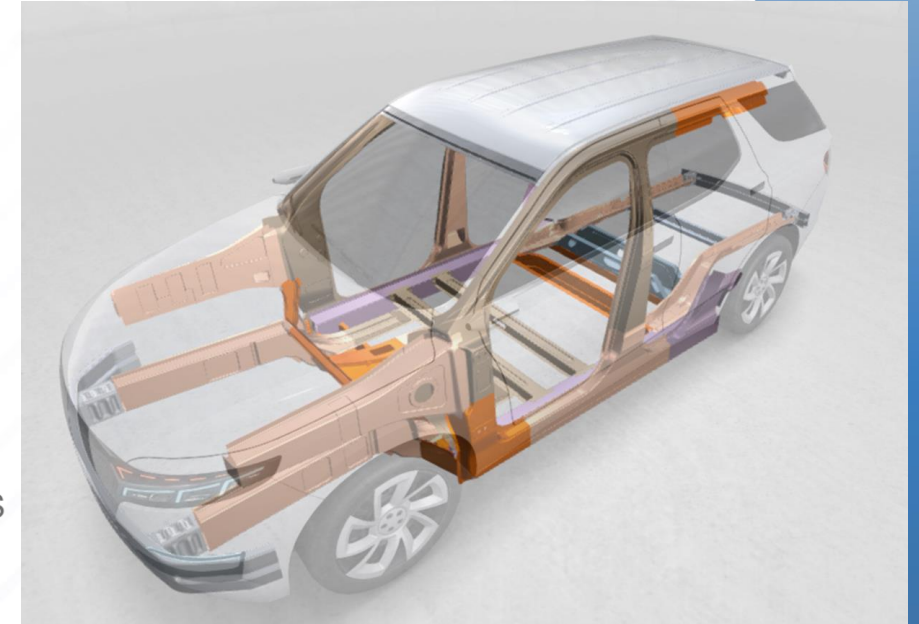
How can we help our customers overcome current challenges?

Challenges:

- Tougher crash regulations
- Reducing carbon footprint
- ICE to BEV platform conversion



▲ LASER WELDED BLANK SOLUTIONS



Decrease CO₂ emissions



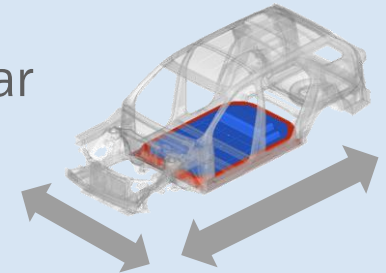
Meet new crash regulations



Invest in BEV Solutions



Create modular shared platforms



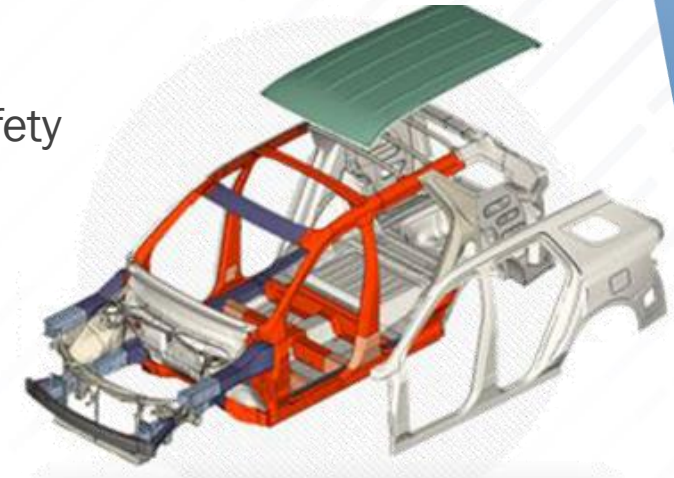
Laser welded blanks key enabler for meeting these challenges

AMTB'S BATTERY RING CONCEPT

AN INNOVATIVE BATTERY AND PASSENGER SAFETY SOLUTION!

Key Solution Development Objectives

- Meet multiple OEM design strategies
 - Dedicated BEV platforms vs integrated ICE and BEV powertrains
 - Regional vs global variants in future body platforms as worldwide safety standards not uniform
- AMTB BEV solution – A novel concept of integrated battery and occupant protection Body-in-White (BIW) concept
 - Integrated battery and passenger safety concept
 - Retain OEM assembly sequence
 - Integrated vehicle assembly
 - Part consolidation concepts
 - Maximize part commonality (~90% plus)
 - Cost and weight effective multi-powertrain BIW architecture



ArcelorMittal S-in Motion®

Steel intensive lightweight battery box with minimal weight impact leveraging strength of Laser Welded Blanks

AMTB'S BATTERY RING CONCEPT

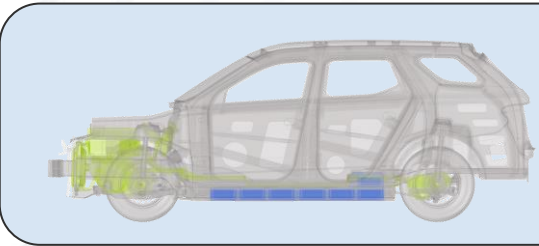
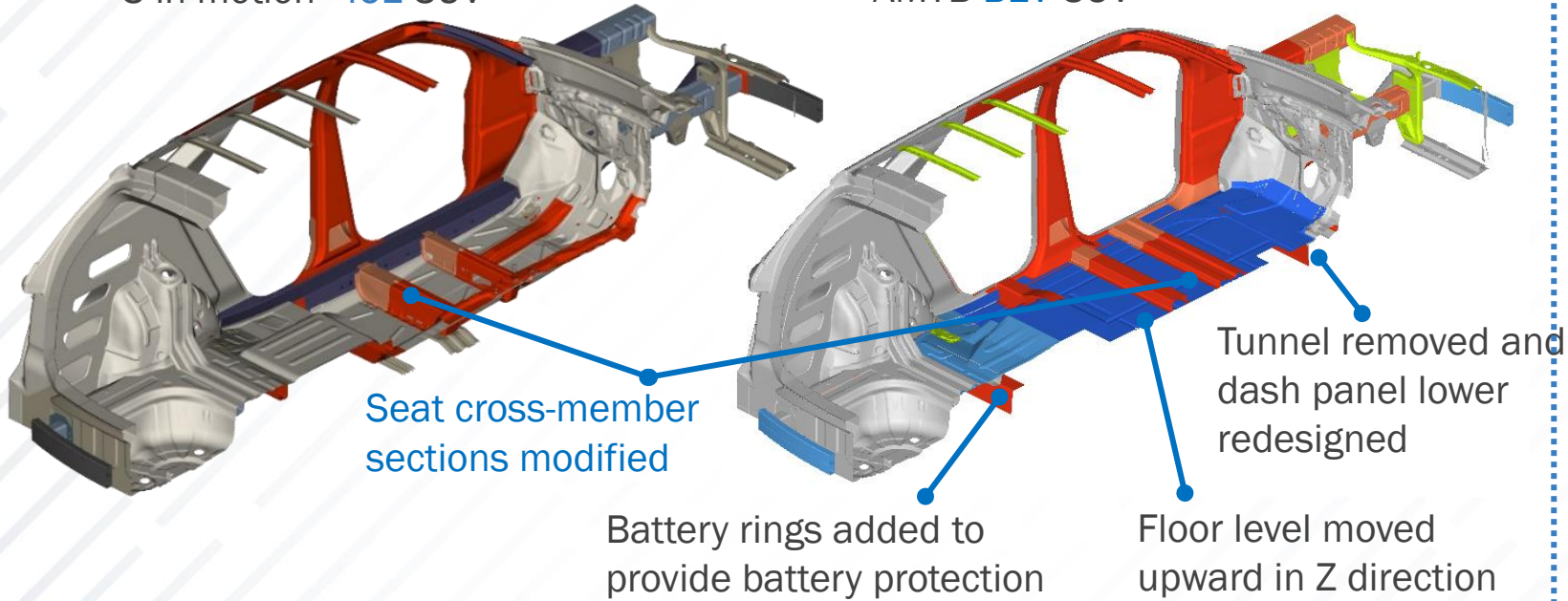
AN INNOVATIVE BATTERY AND PASSENGER SAFETY SOLUTION!

ICE to BEV: AMTB BEV Main architecture Modifications

Main architecture changes

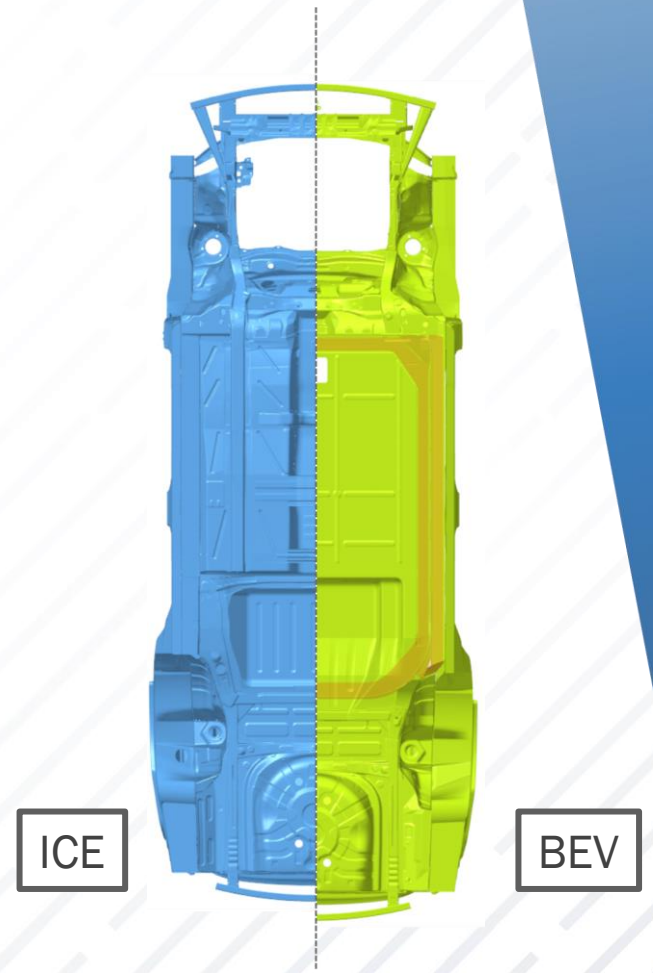
S-in motion® ICE SUV

AMTB BEV SUV



AMTB BEV

- 195" L x 77" W x 70" H
- Wheelbase – 117.3"
- Curb weight: 2282 kg



ICE

BEV

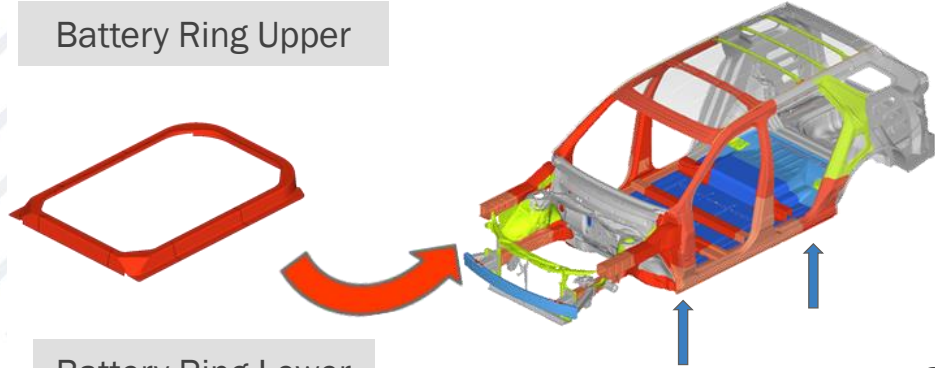
Both BIWs share a common platform with respect to assembly sequences

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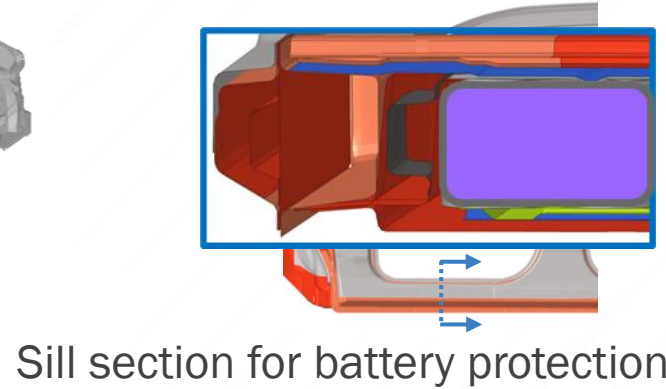
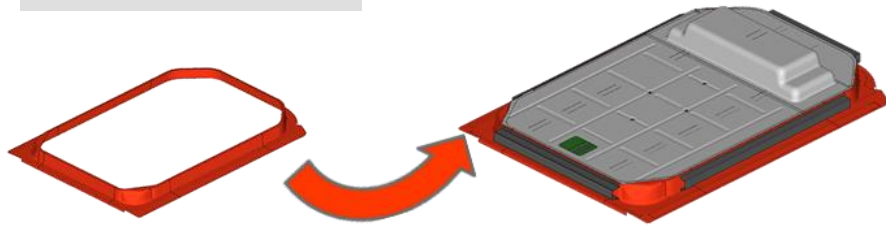
AN INNOVATIVE BATTERY AND PASSENGER SAFETY SOLUTION!

What is a Hot Stamped Battery Ring Concept ?

Battery Ring Upper

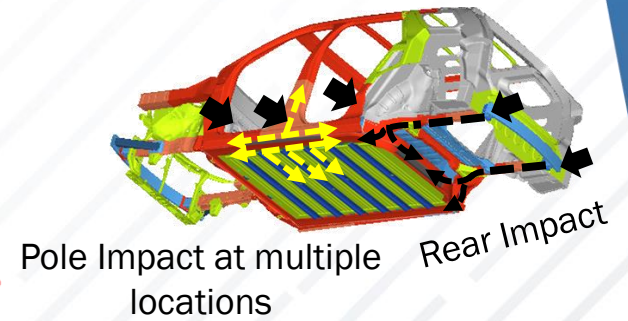
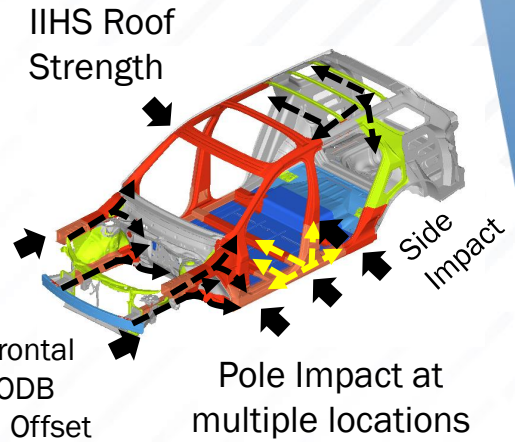
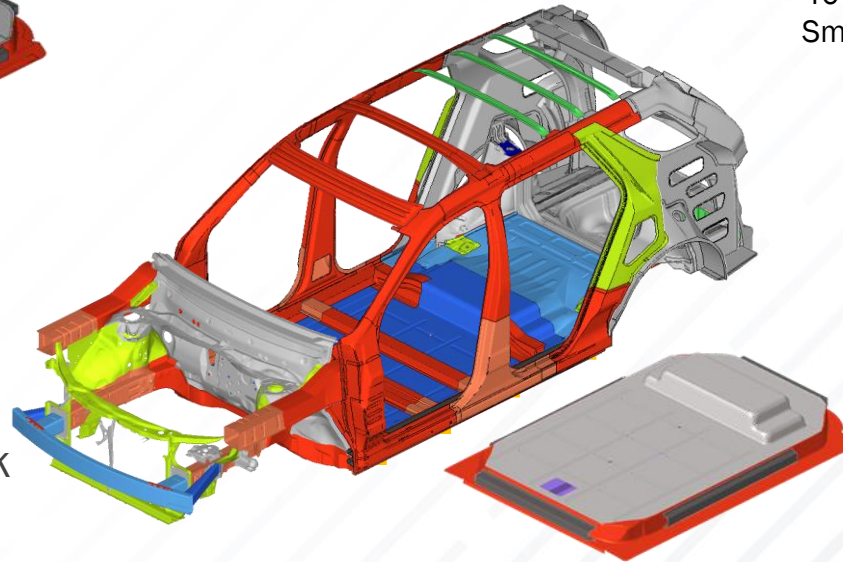


Battery Ring Lower



Sill section for battery protection

- Key structural reinforcement encompasses battery module to develop an optimized BIW to meet performance standards
- Lightweight - protects the battery pack maximizes battery module volume

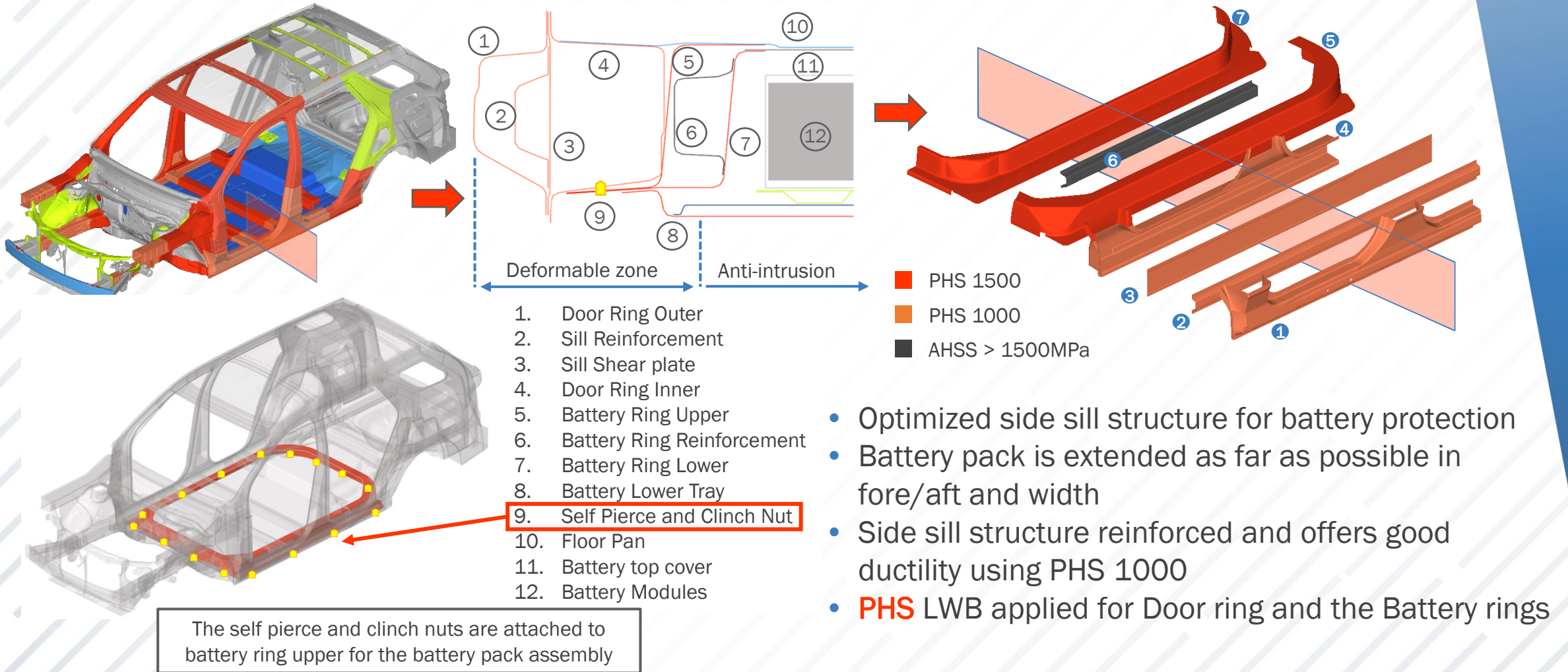


Battery Ring Concept with Door Rings = an integrated battery and occupant protection BIW concept

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Side Structure Exploded View Highlights

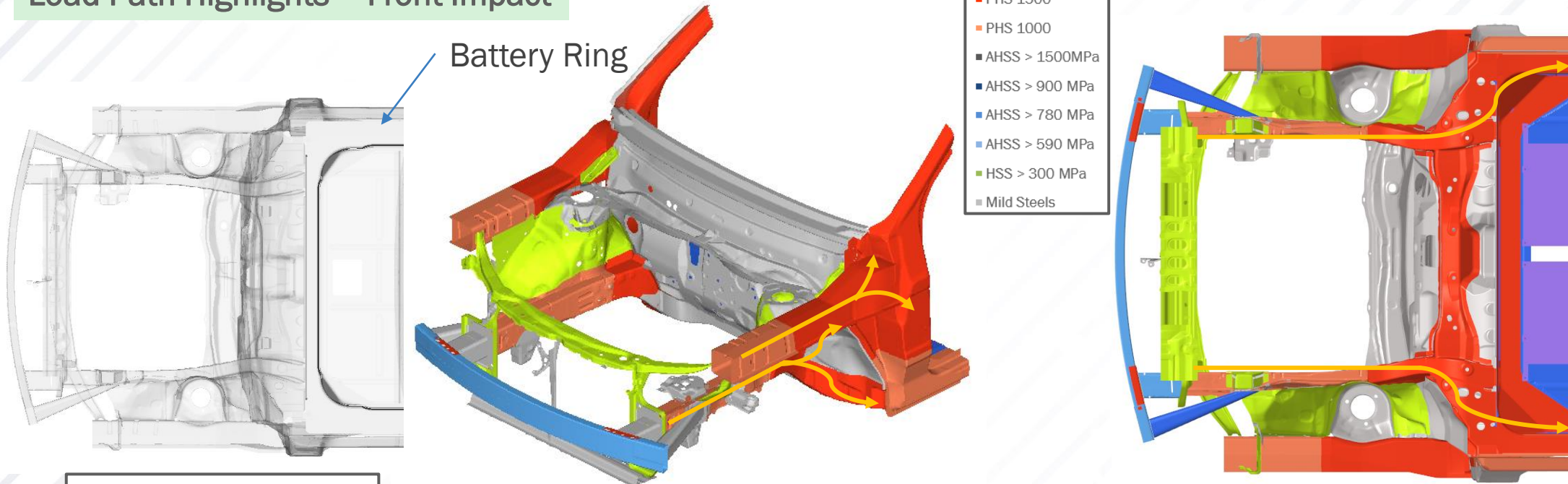


Battery Ring Concept with Door Rings = an integrated battery and occupant protection BIW concept

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Load Path Highlights – Front Impact



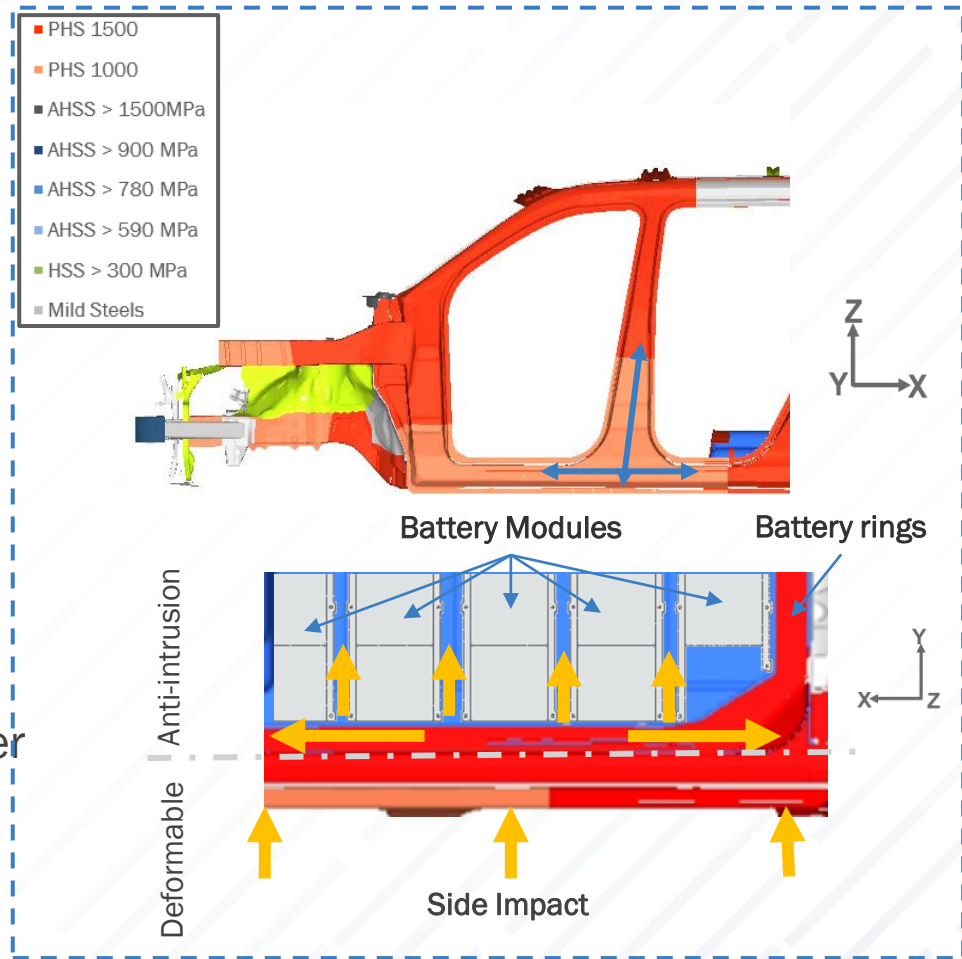
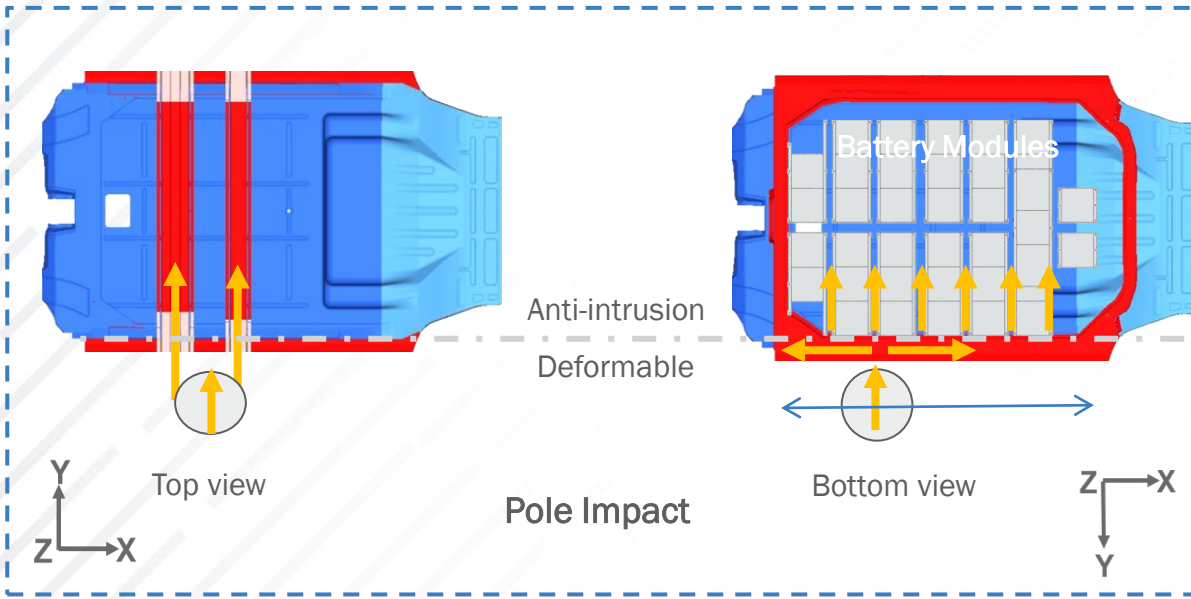
Animation: Plastic strains on Battery rings

- **PHS 1000** in tips of front rails and shotguns for energy absorption
- **PHS 1500** in Hinge pillars, A-pillars and Battery rings for anti-intrusion in cabin and battery space

AMTB'S BATTERY RING CONCEPT

AN INNOVATIVE BATTERY AND PASSENGER SAFETY SOLUTION!

Load Path Highlights – Side Impact



- PHS 1500
- PHS 1000
- AHSS > 1500MPa
- AHSS > 900 MPa
- AHSS > 780 MPa
- AHSS > 590 MPa
- HSS > 300 MPa
- Mild Steels

- PHS 1000 in tips of Floor cross members and B-Pillar lower
- PHS 1500 in Battery Rings and Floor cross members
- **Designed for pole impact anywhere along the side structure for expansive crash/safety requirements**

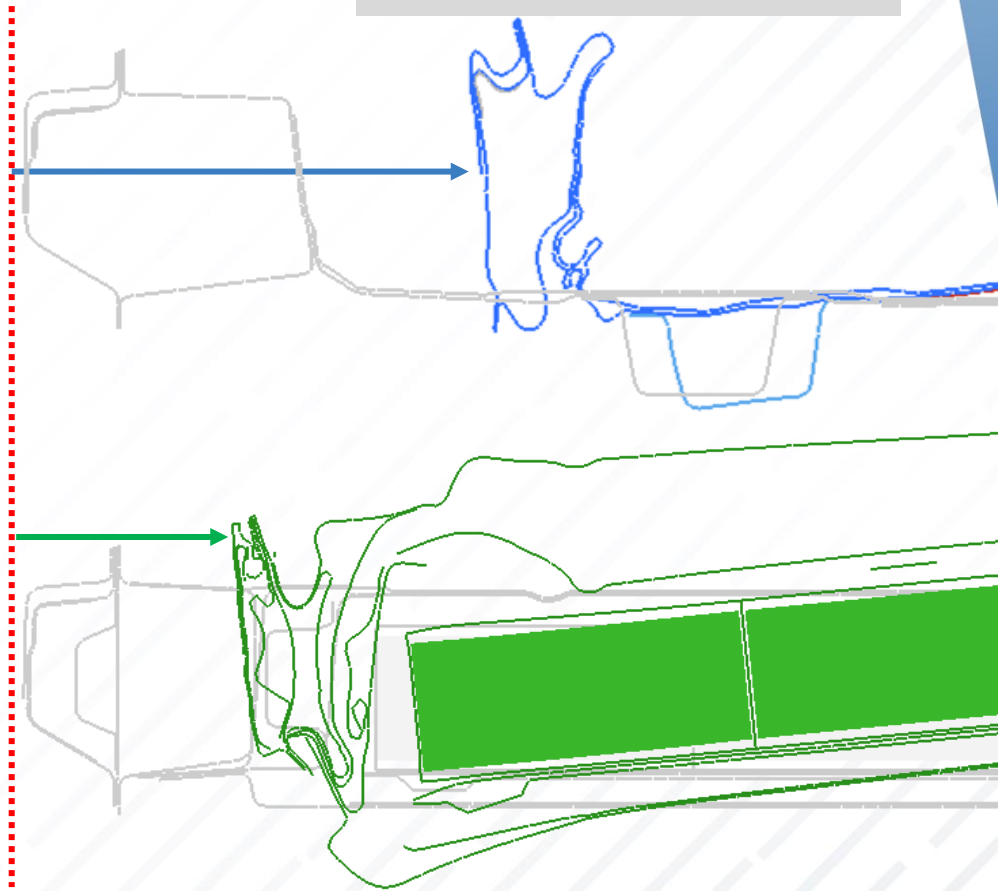
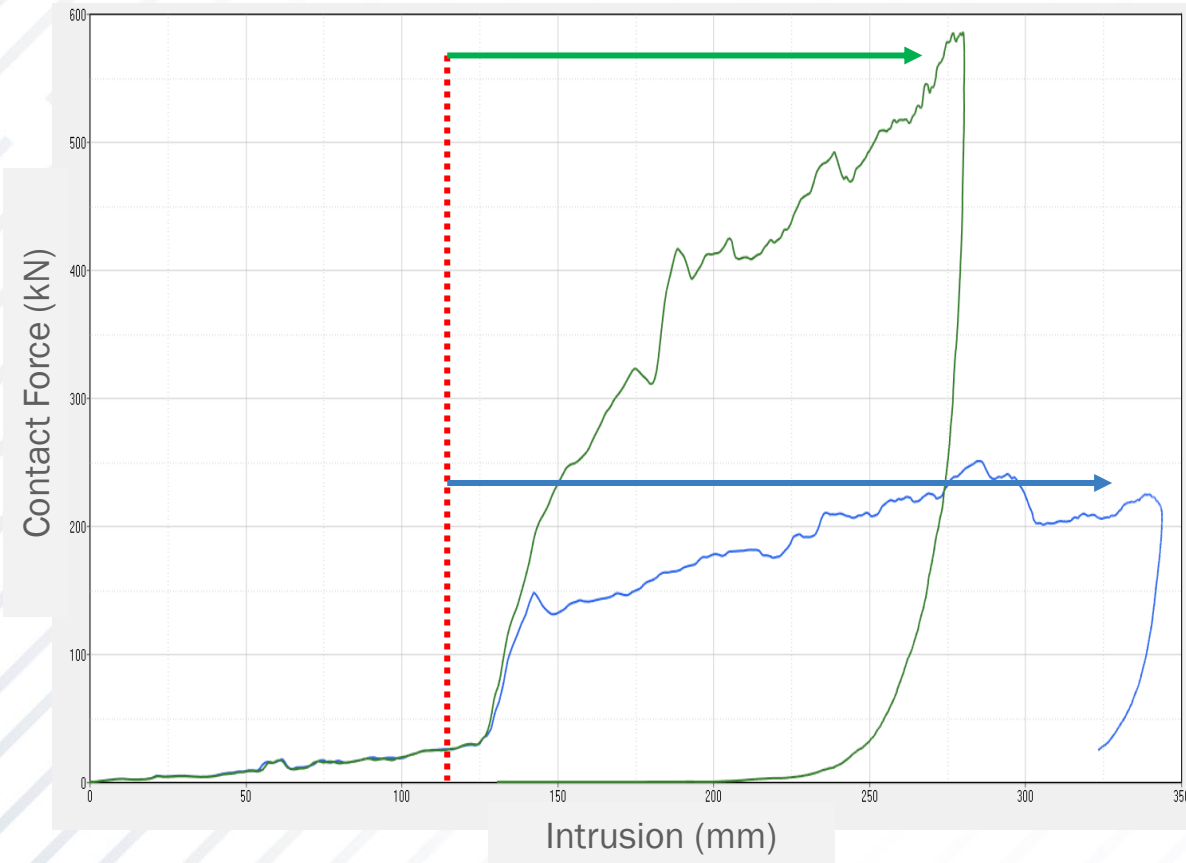
Battery Rings are integral part of side crash strategy and designed to withstand pole and side impact modes

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Pole Crash Comparison -ICE vs. BEV
Challenges

— S-in motion® ICE
— AMTB BEV



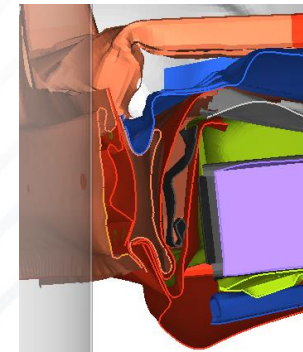
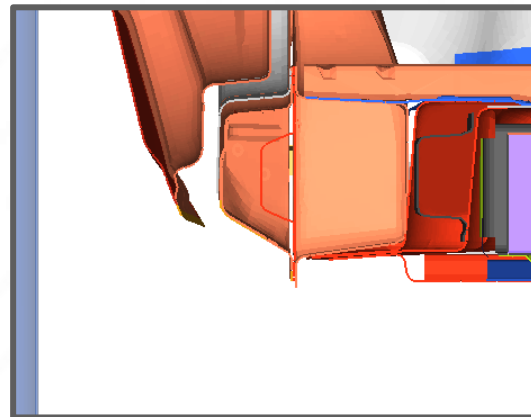
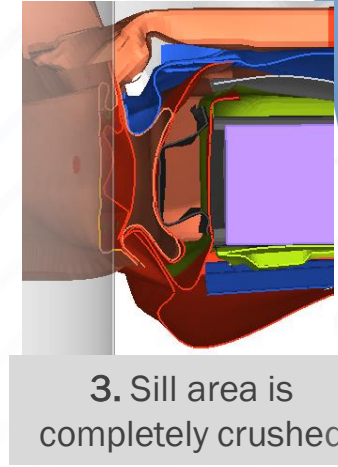
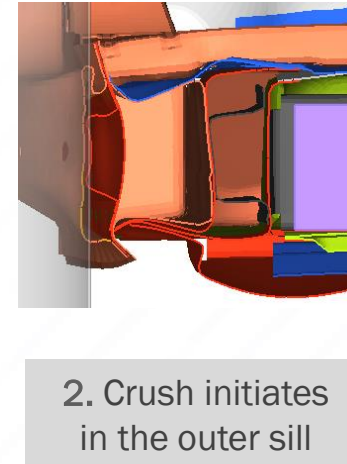
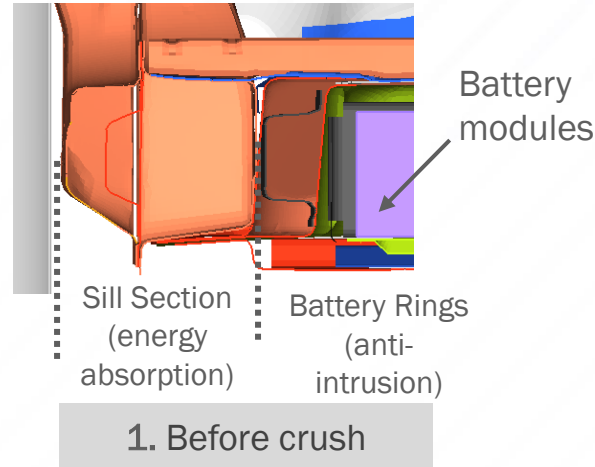
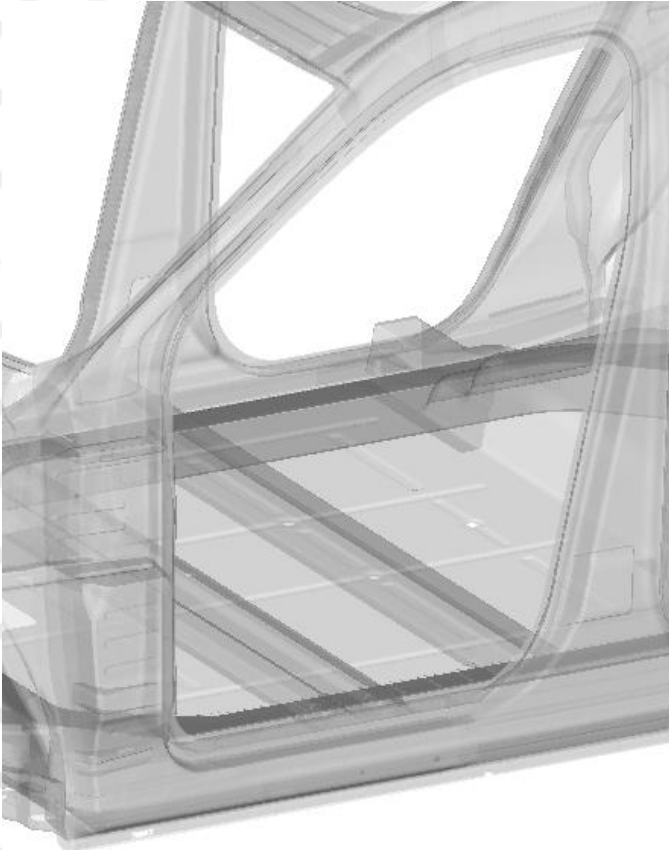
AMTB BEV: 40% higher kinetic energy, 20% lower cabin intrusions → 230% resultant contact force

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Energy absorption – 50th Pole crash

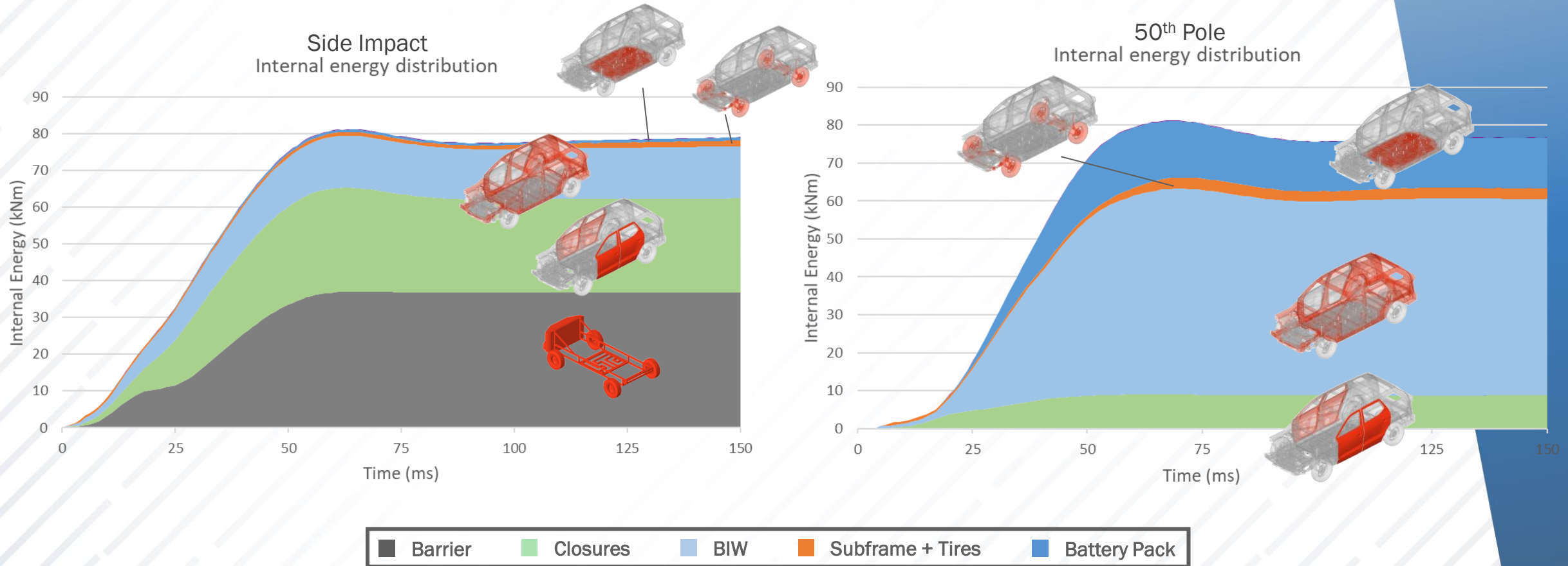
Animation: Plastic strains on Battery rings



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Internal energy breakdown – Side Impact & 50th Pole



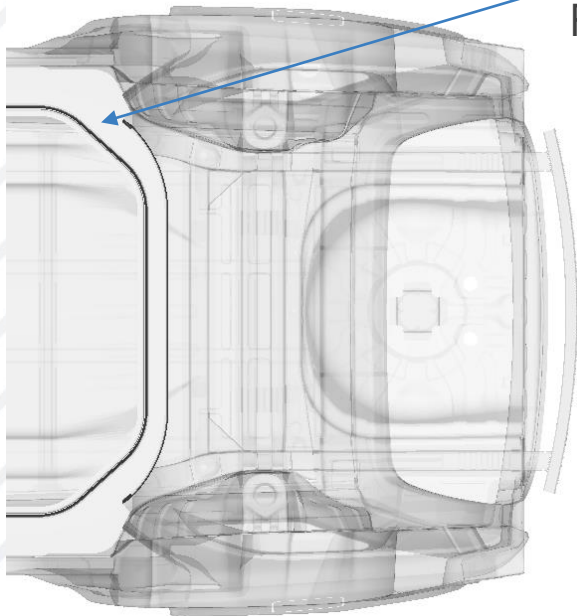
Battery Ring works well managing both anti-intrusion and energy absorption in the side load cases

AMTB'S BATTERY RING CONCEPT

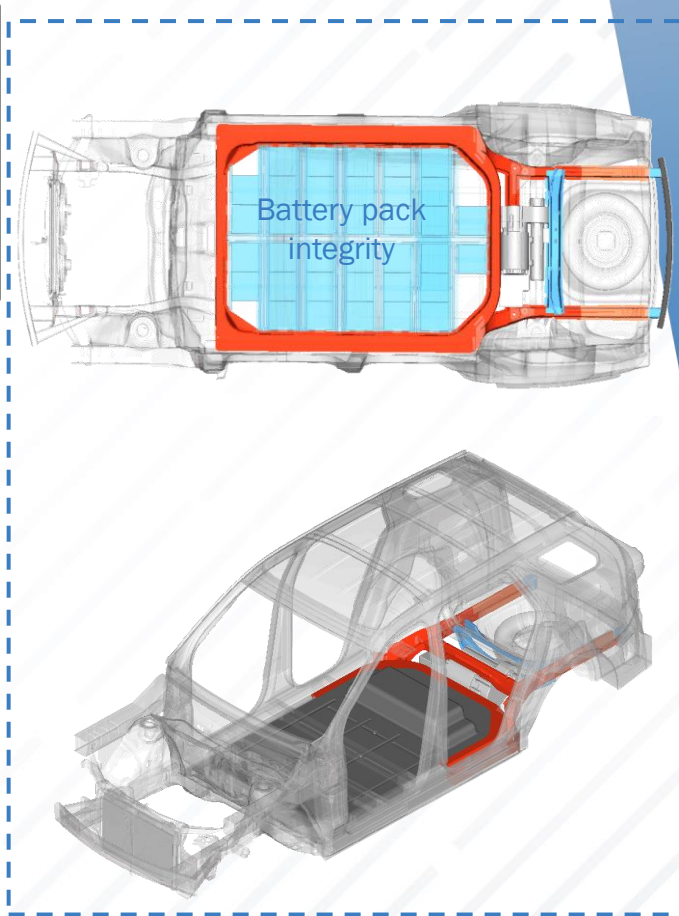
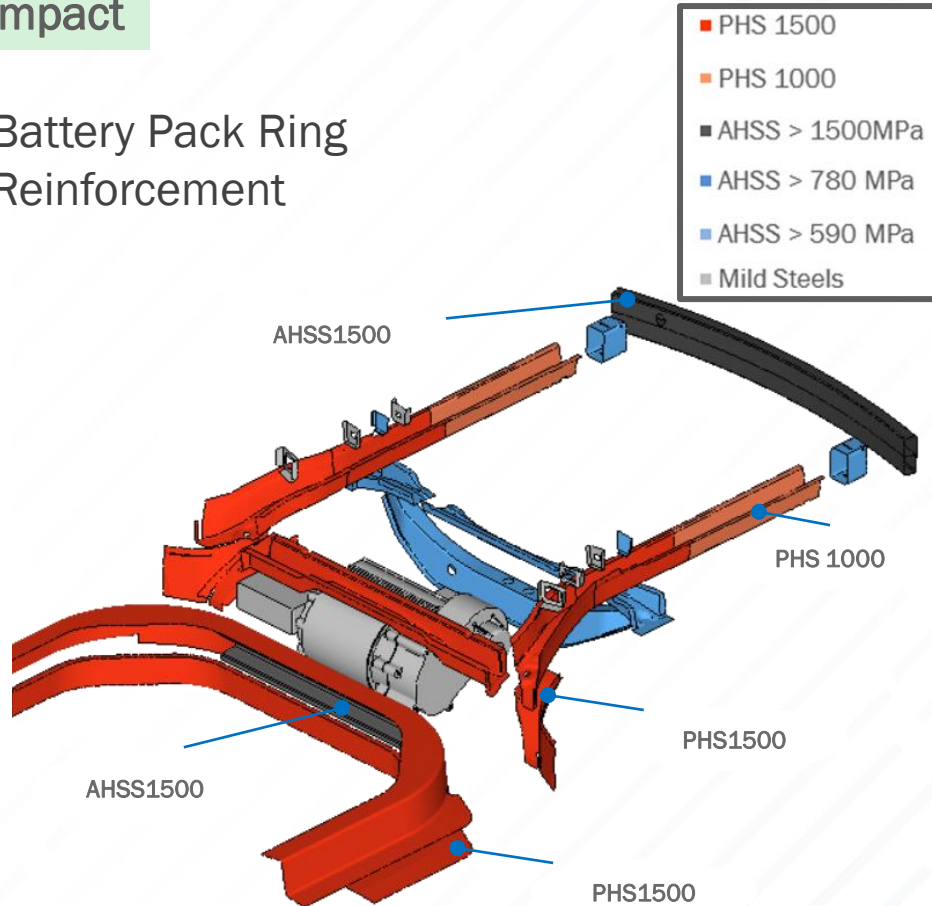
AN INNOVATIVE BATTERY AND PASSENGER SAFETY SOLUTION!

Load Path Highlights – Rear Impact

Animation: Plastic strains on Battery rings



Battery Pack Ring Reinforcement



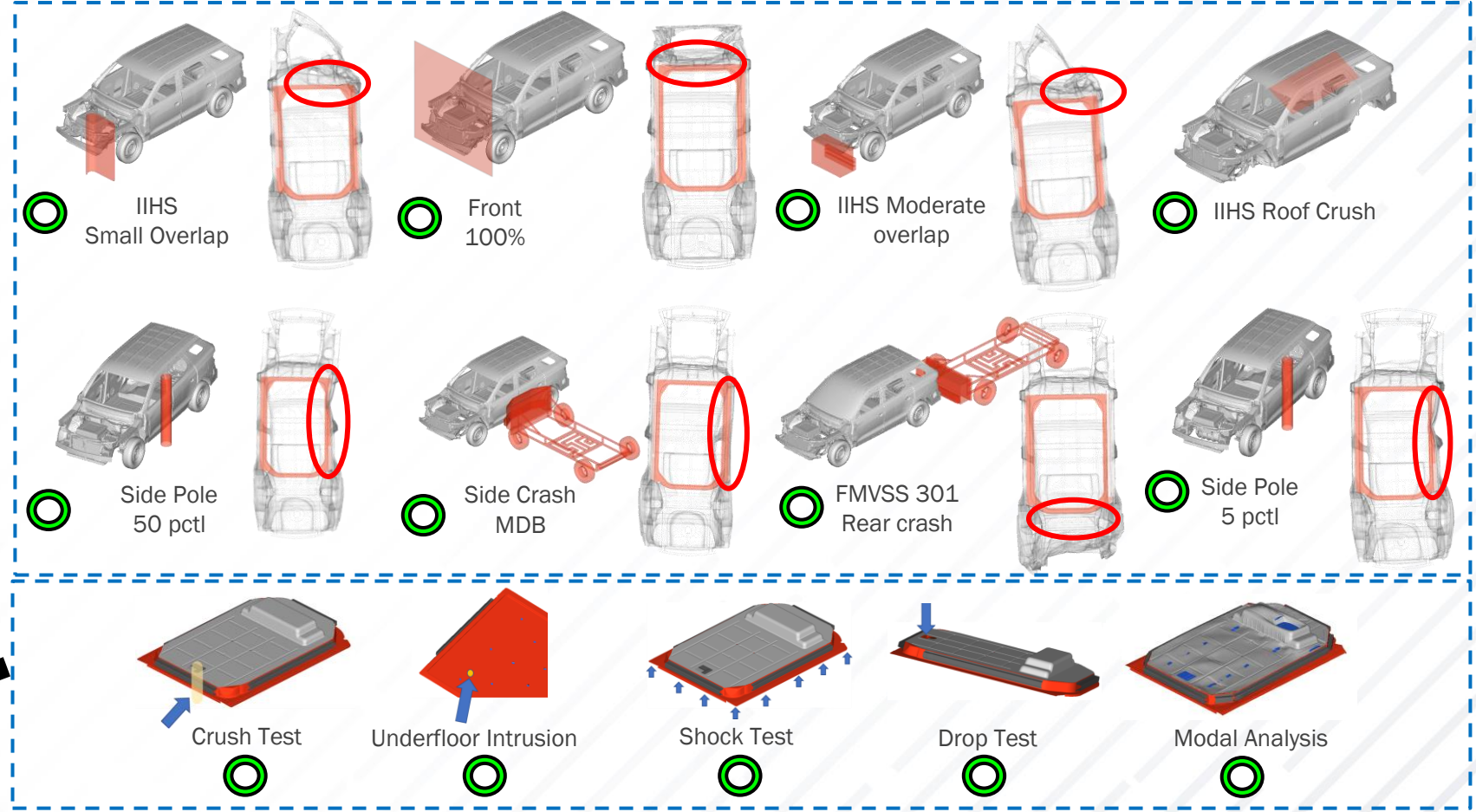
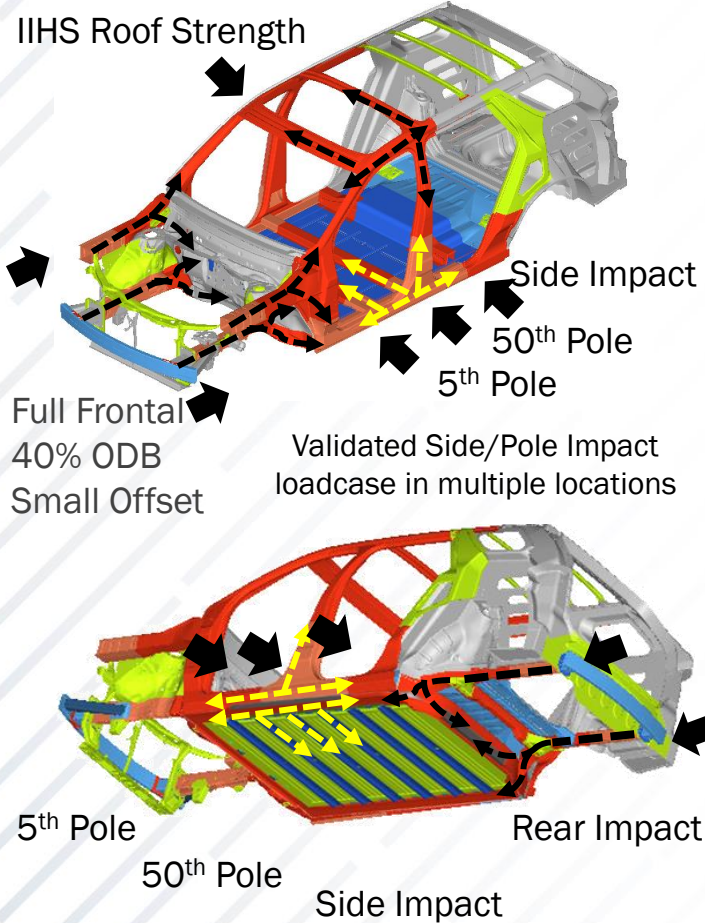
- Hot stamped Laser welded blank ring battery pack reinforcement application is ideal to manage e-motor crash inertia

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AN INNOVATIVE BATTERY AND PASSENGER SAFETY SOLUTION!

Analysis Summary

Meets Performance targets



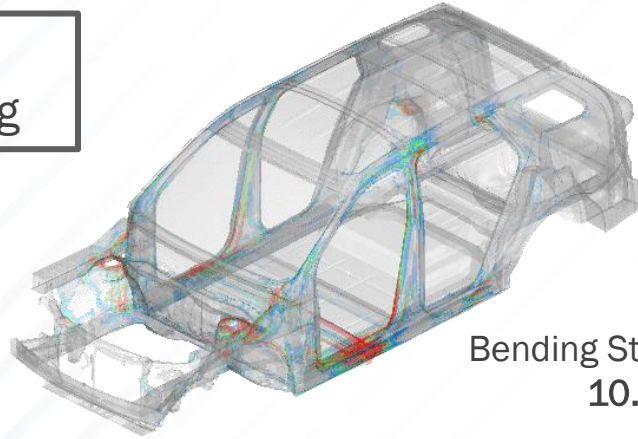
Hot Stamped Laser Welded Door Ring & Battery Rings are optimized for battery and occupant protection

AMTB'S BATTERY RING CONCEPT

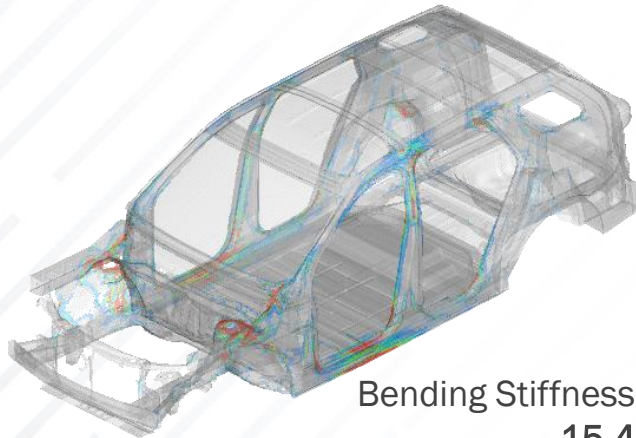
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Stiffness – Static bending and torsion

Static
Bending

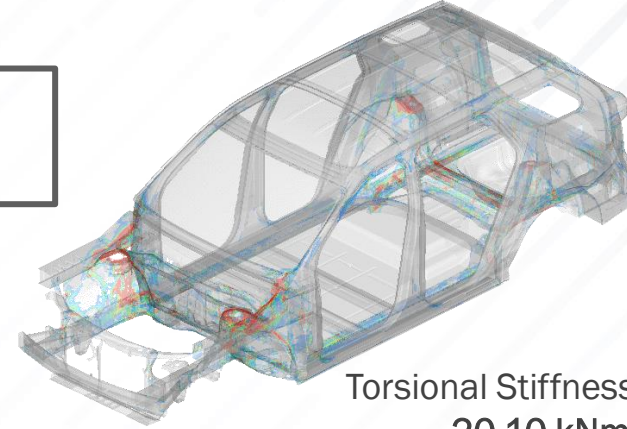


Bending Stiffness BIW only
10.59 kN/mm

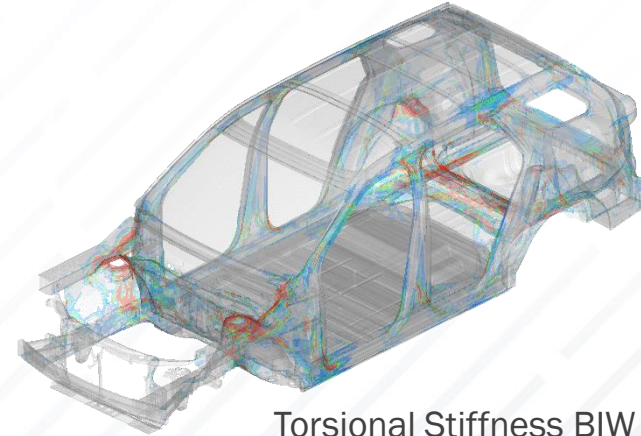


Bending Stiffness BIW + Battery pack
15.41 kN/mm

Static
Torsion



Torsional Stiffness BIW only
20.10 kNm/deg



Torsional Stiffness BIW + Battery pack
30.20 kNm/deg

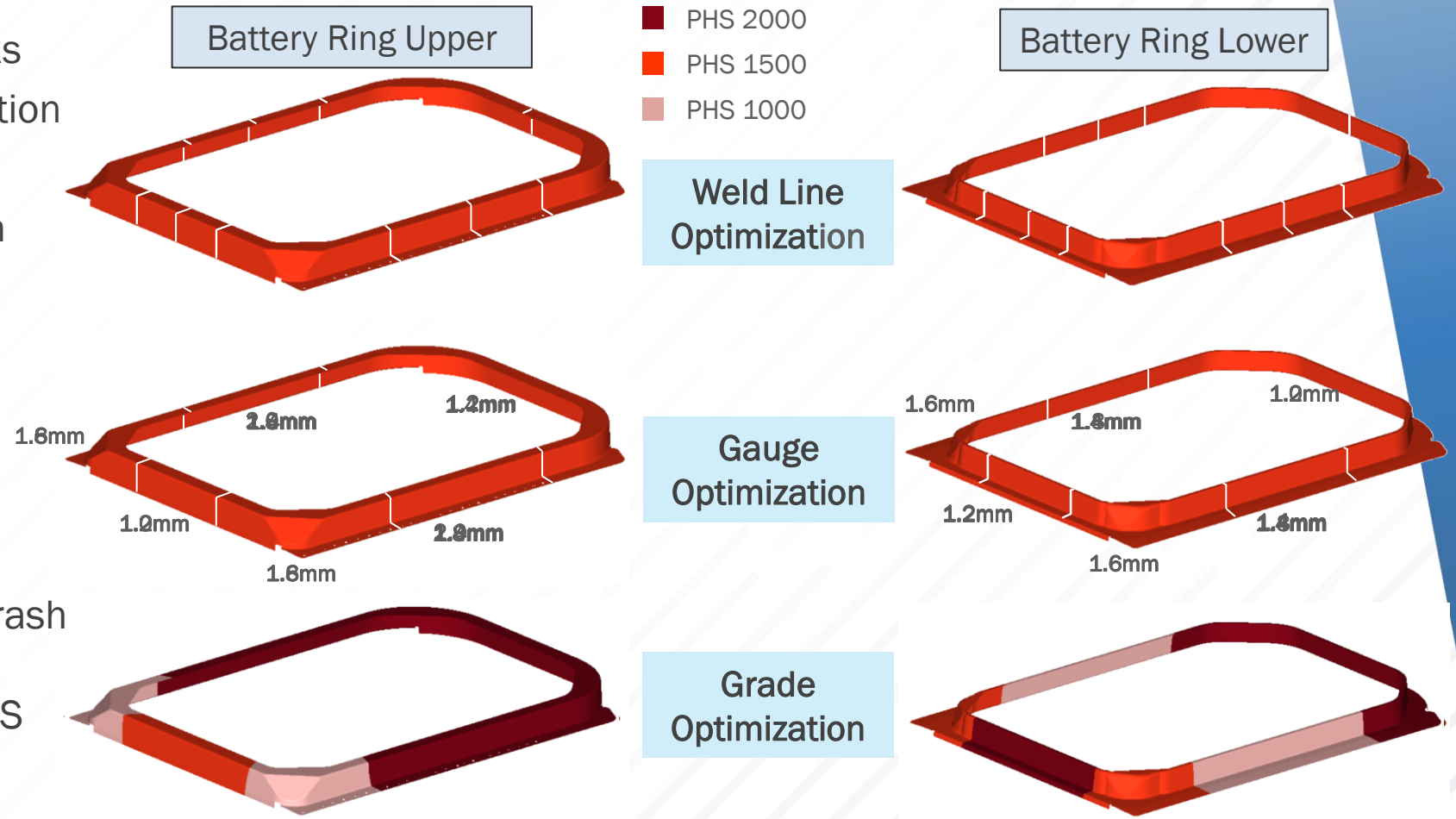
BIW and Battery structure is optimized for bending and torsional stiffness

AMTB'S BATTERY RING CONCEPT

AN INNOVATIVE BATTERY AND PASSENGER SAFETY SOLUTION!

Why Laser Welded Blanks? For Gauge and Grade Optimization

- Benefit of Laser Welded Blanks
 - Weld line location optimization
 - Gauge optimization
 - Material grade optimization
- Strength and elongation optimized
 - Based on performance
 - Higher strength for anti-intrusion can apply PHS 1500 and PHS 2000
 - Higher elongation and crash ductility for energy absorption can apply PHS 1000

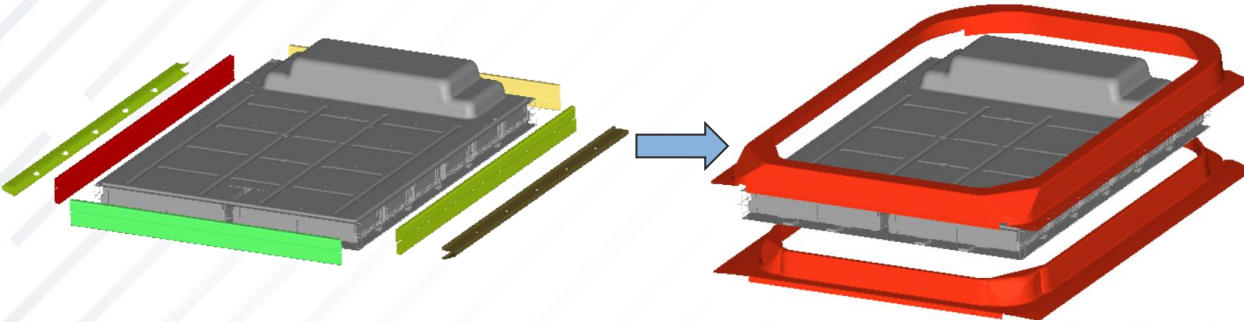


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Why Laser Welded Blanks? For Gauge and Grade Optimization

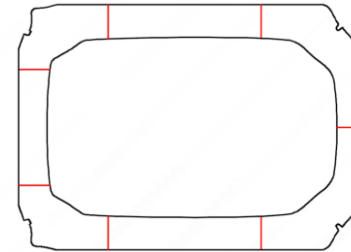
Part Consolidation → Cost Savings!



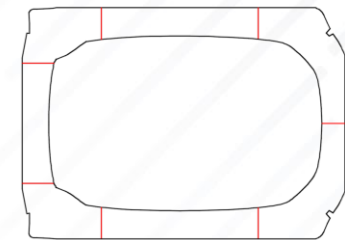
- Potential to consolidate 6-10 parts → 2 parts
- Reduced stamping die investment
 - Reduced assembly complexity → tighter tolerances
 - Hot stamped material (PHS 1500 & PHS 1000) facilitates designing complex shapes
 - Added cost reduction by avoiding the use of Aluminum extrusions or roll formed or steel stamped reinforcements (typically added in the sill area of side structure)

Scrap Reduction → Cost Savings!

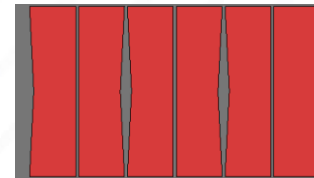
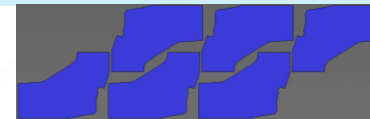
Battery Ring Upper



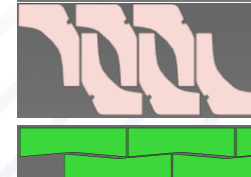
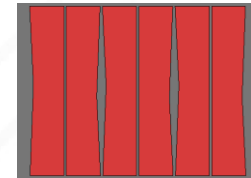
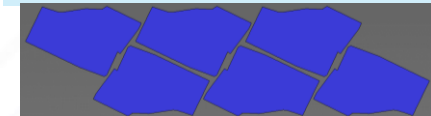
Battery Ring Lower



Material Utilization: 80%



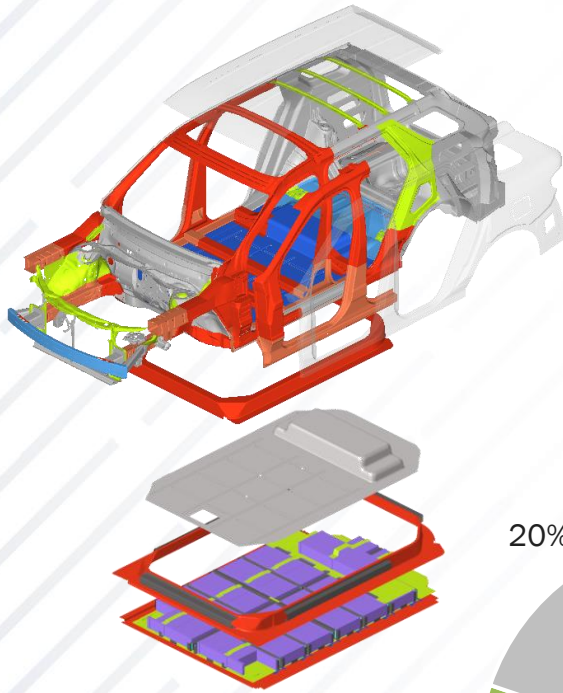
Material Utilization: 82%



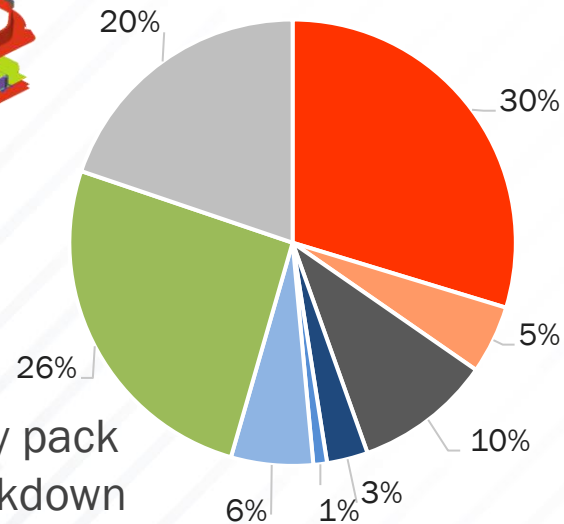
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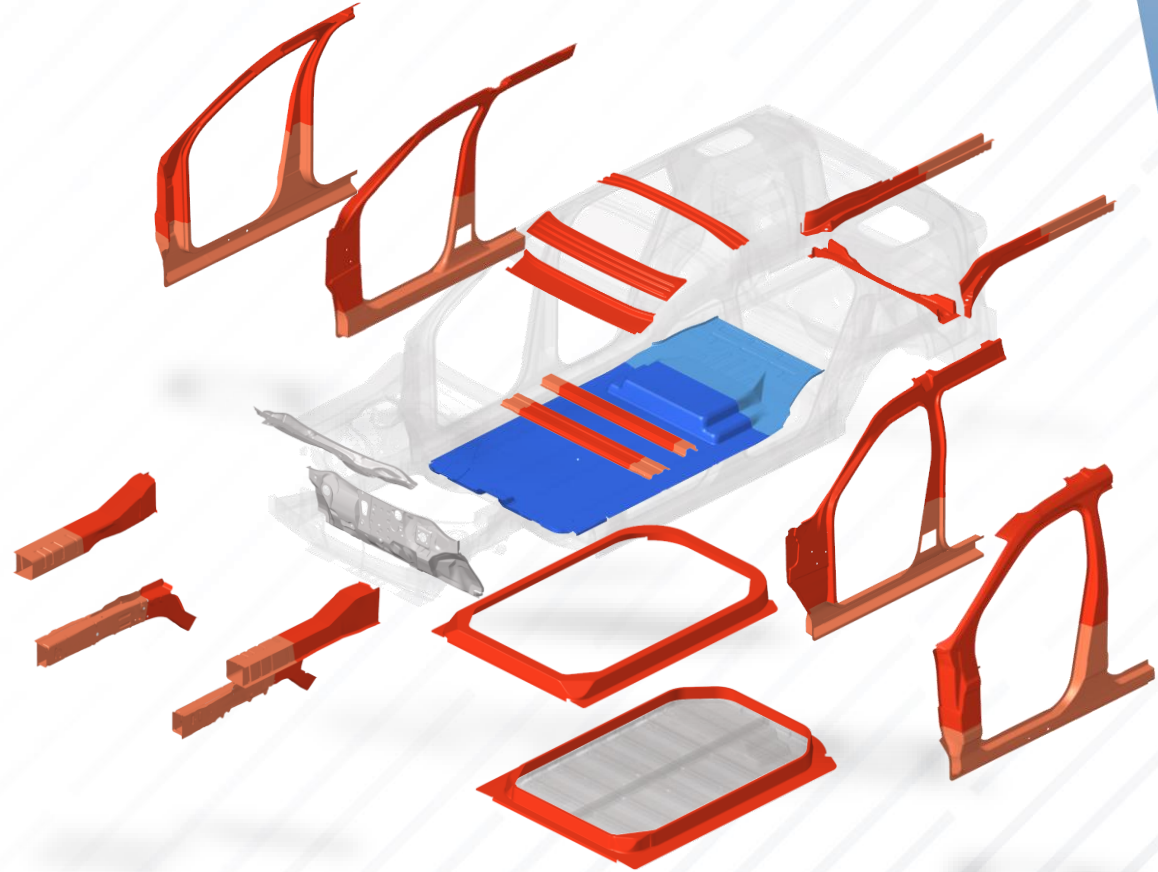
Laser welded blanks (LWBs): efficient Multi-powertrain solution for BEV



- PHS 1500
- PHS 1000
- AHSS > 1500MPa
- AHSS > 900 MPa
- AHSS > 780 MPa
- AHSS > 590 MPa
- HSS > 300 MPa
- Mild Steels



BIW + Battery pack material breakdown



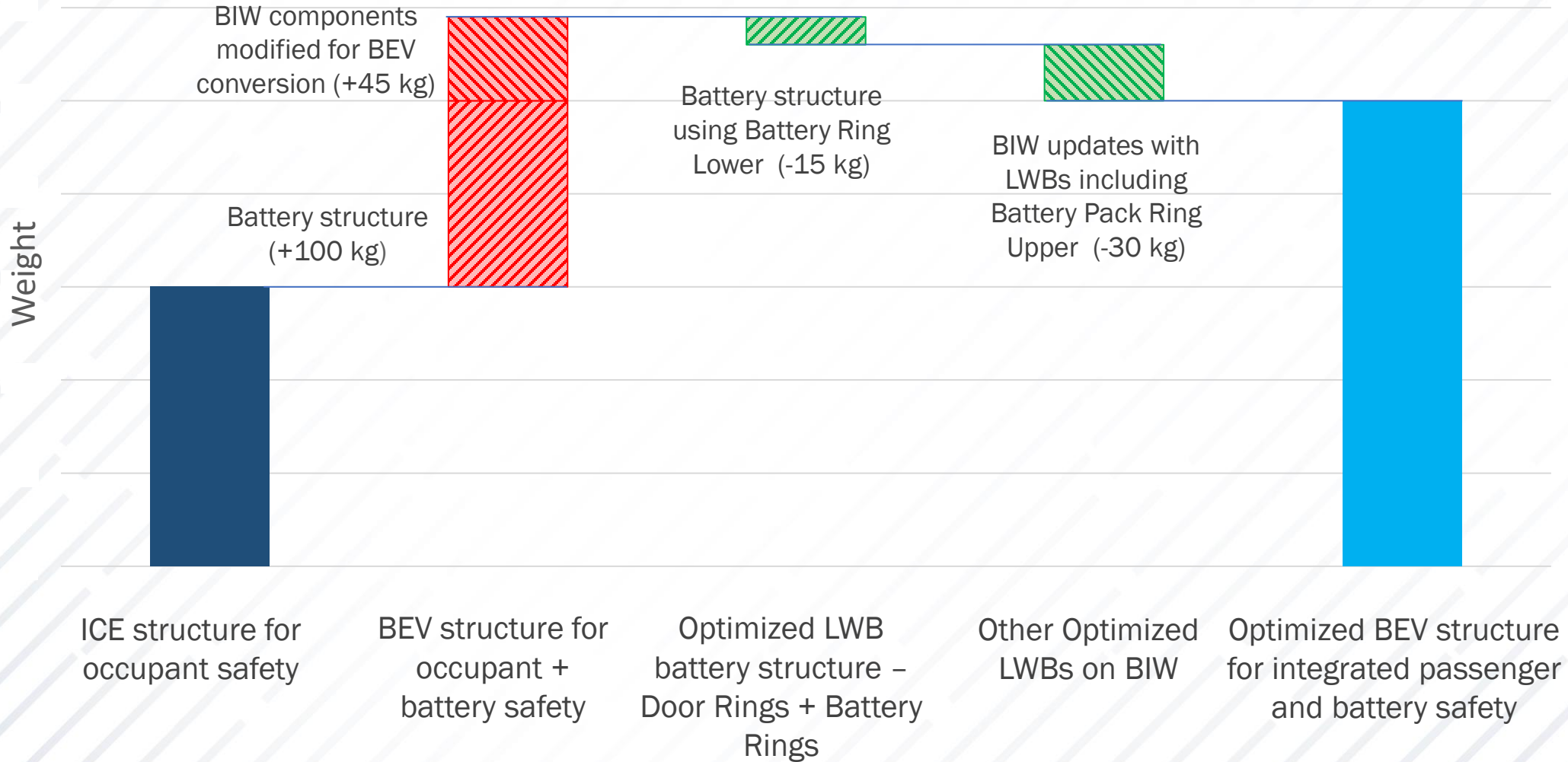
25 LWBs Possible consolidating 70-80 individual parts in assembly

LWB intensive concept is lighter, and designed for part integration and cost savings

AMTB'S BATTERY RING CONCEPT

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AMTB BEV Weight Optimization Breakdown



HS LWB Battery rings maximize the weight reduction while ensuring passenger and battery safety

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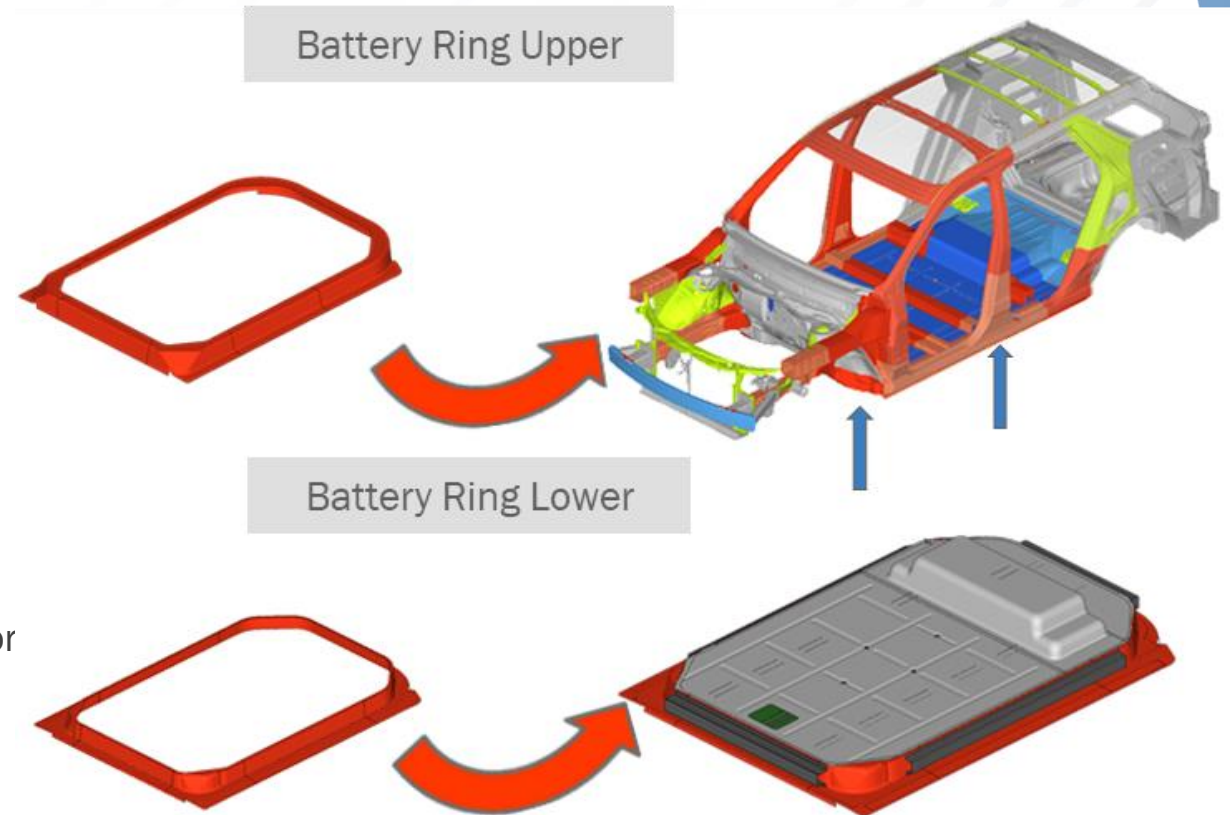
Hot Stamped Battery Pack Ring Concept

What is a Hot Stamped Battery Pack Ring Reinforcement?

- Novel concept uses Press Hardened Steel
- Key structural battery rings encompasses battery modules to develop an optimized BIW to meet performance standards
- Lightweight and protects the battery pack while maximizing battery module volume

Hot Stamped Battery Pack Ring Reinforcements

- Upper Structural reinforcement part of Body BIW
 - First layer for “Ring concept reinforcement”
 - Attaches via spot welds to inner side sills, front-rear underbody crossmember and floor tub (OEM design dependent)
- Lower Structural reinforcement part of Battery Pack
 - Second layer for “Ring concept reinforcement”
 - Bolted to Body BIW through upper & floor (OEM design dependent)

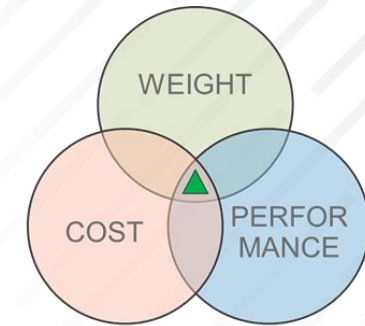


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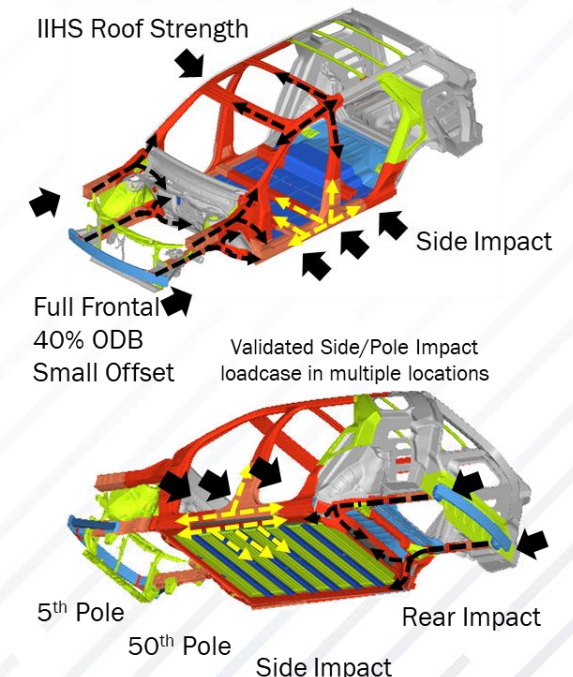
AN INNOVATIVE BATTERY AND PASSENGER SAFETY SOLUTION!

Summary

- AMTB's hot stamped laser welded blanks (HS LWB) technology
 - Allows our customers to optimize cost, weight and performance
- HS LWB Door Rings provide the optimal balance of weight, cost and performance
 - Multiple OEMs have applied the door ring solution to vehicles
 - AMTB has developed many cost optimization solutions for Door Rings
 - Co-engineering with our customers allows us to innovate and find new ways to cost optimize, maximize weight savings, improve material utilization
- Battery ring design results in **15 kg** weight reduction
- LWB technology - Part consolidation, high part commonality
 - Different BEV modular architectures also possible with common battery pack structure
- Battery Rings are active in the load path for both occupant safety and battery pack protection – an integrated innovative solution leading to lightweight designs



▲ LASER WELDED BLANK SOLUTIONS



Door Rings + Battery Rings are an innovative solution for optimized weight, cost and performance

AMTB'S BATTERY RING CONCEPT

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Thank You / For more information

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