

Lightweight Composite Design of EV Battery Enclosure to Enhance Safety & Productivity

Hanwha Advanced Materials

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Aerospace & Mechatronics



Chemicals & Materials



Solar Energy



Financial Services



Construction



Leisure & Lifestyle

Contents

Who we are

- Global Network & Automotive Applications

Our approach

- Recent Developments

Conclusion



Global Network

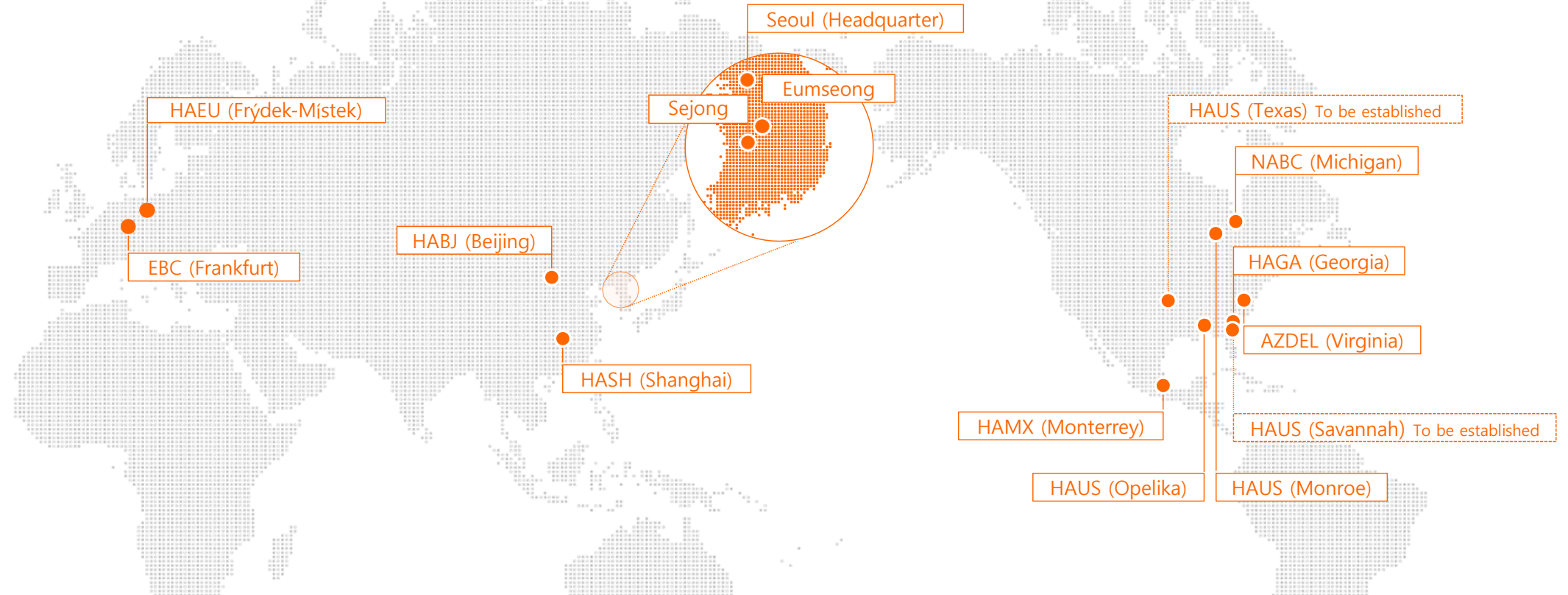
7th largest conglomerate in South Korea

80 Affiliates

469 Networks

Sales \$60.7B

Total asset : \$199B



Aerospace & Mechatronics



Chemicals & Materials



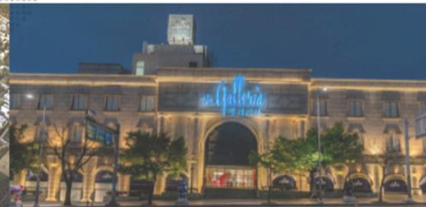
Solar Energy



Financial Services



Construction



Leisure & Lifestyle

Automotive Materials

GMT StrongLite

Glass Mat Reinforced Thermoplastic

No.1
Global Lightweight
Composite Materials

70%
Global Market Share

**Eco-friendly
materials**



LWRT SuperLite

Lightweight Reinforced Thermoplastic

No.1 Brand
Global LWRT Market

**Superior
Lightweightness**

**Eco-friendly
materials**



EPP BuffLite

Expanded Polypropylene

25,000t
Global Annual
Production

Recyclable

**Eco-friendly
materials**

TPO/TPU IntermLite

Thermoplastic Polyolefin
Thermoplastic Polyurethan

M/S No.1
Domestic PSM Market

Global Leader
Auto Interior Material

**Eco-friendly
materials**

SMC

Sheet Molding Compound

**Excellent
heat and fire
resistance**

**Excellent
chemical
resistance**

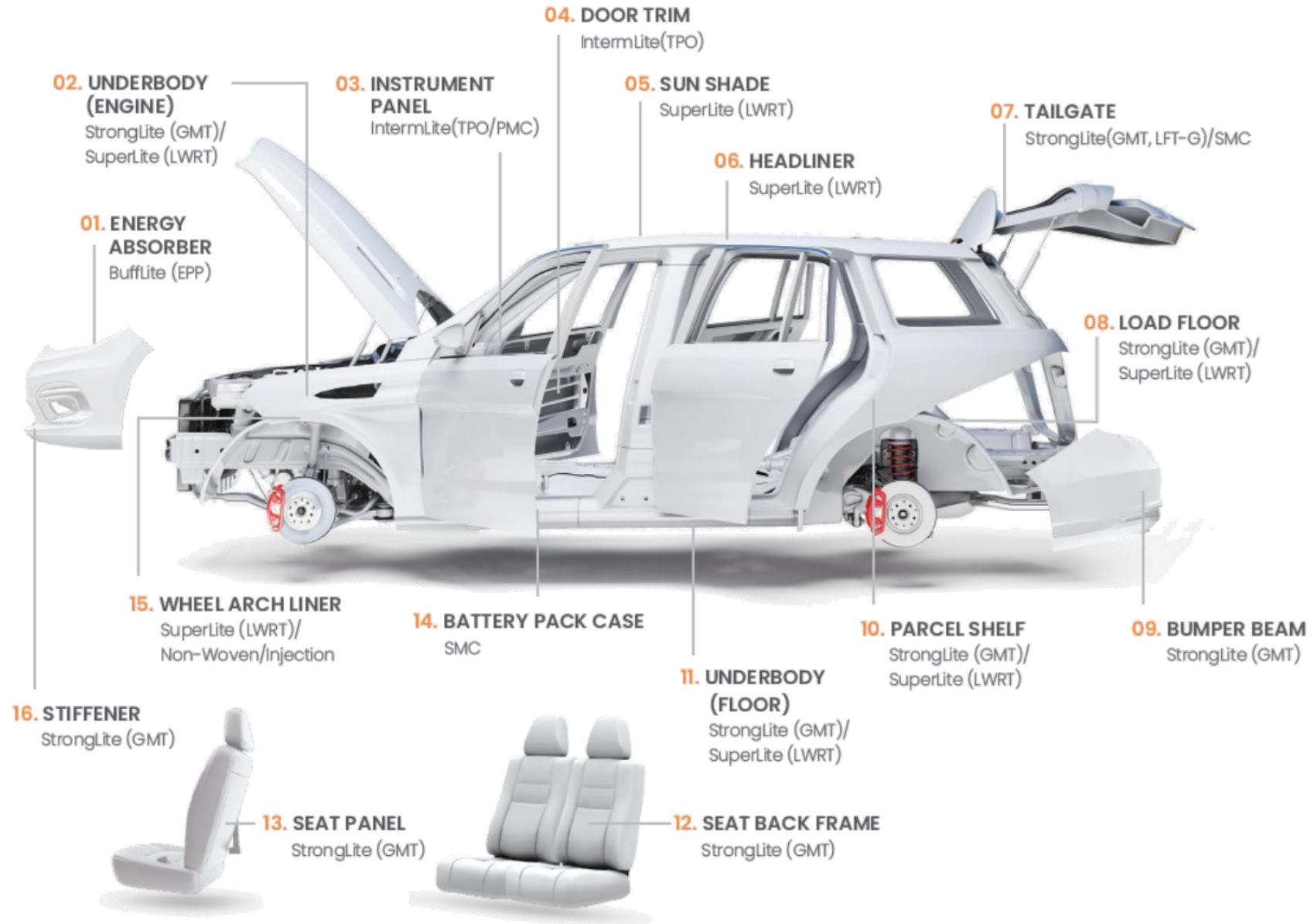
**Excellent
corrosion
resistance**

* CFRTTP

Continuous Fiber Reinforced Thermoplastic



Automotive Applications



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Motivation on EV Battery Enclosure



75%

of new car sales are EVs¹

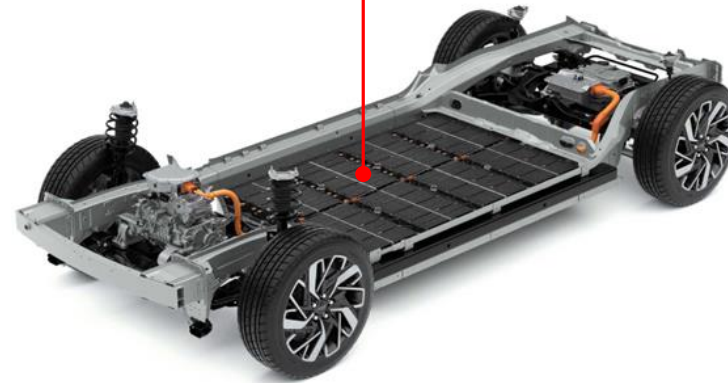


1 in 4

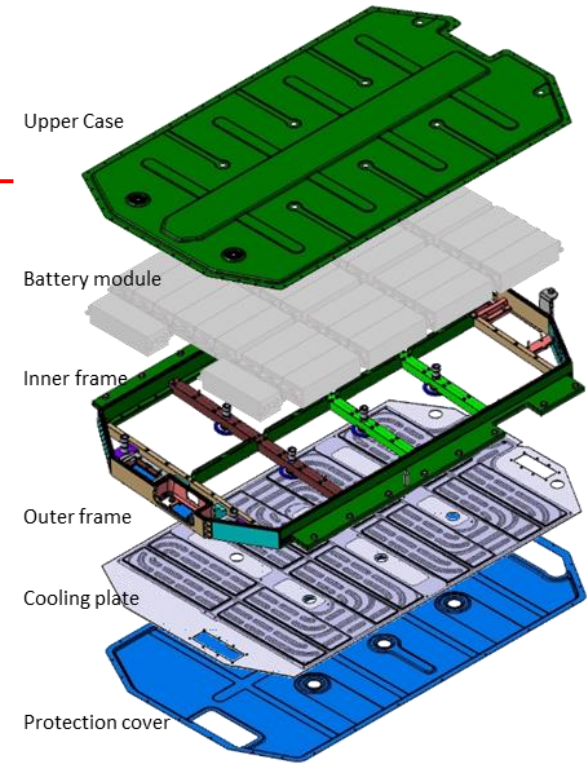
cars on the road is an EV

Market expectation

Source: McKinsey & Company

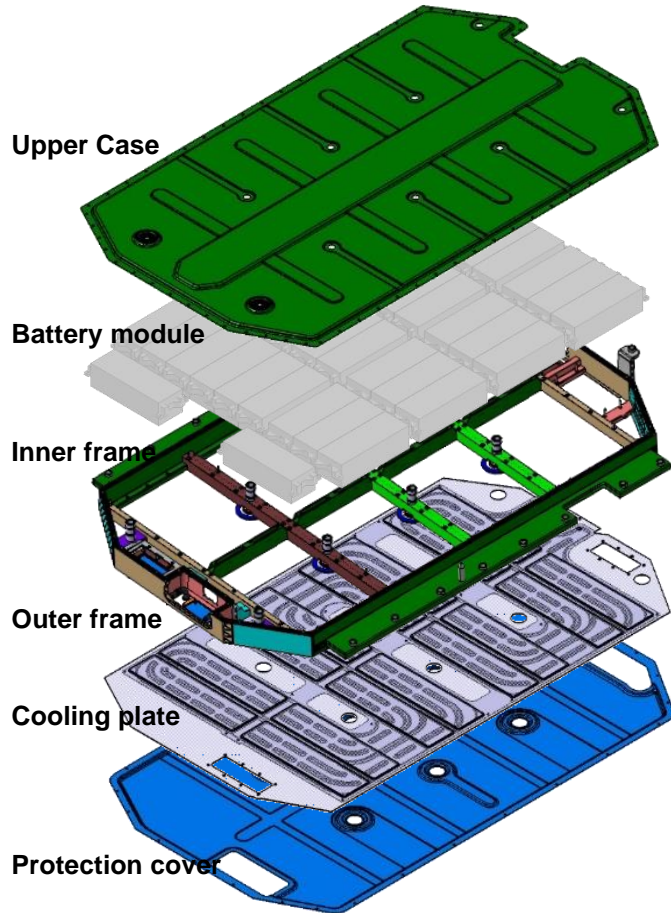


Designated platform



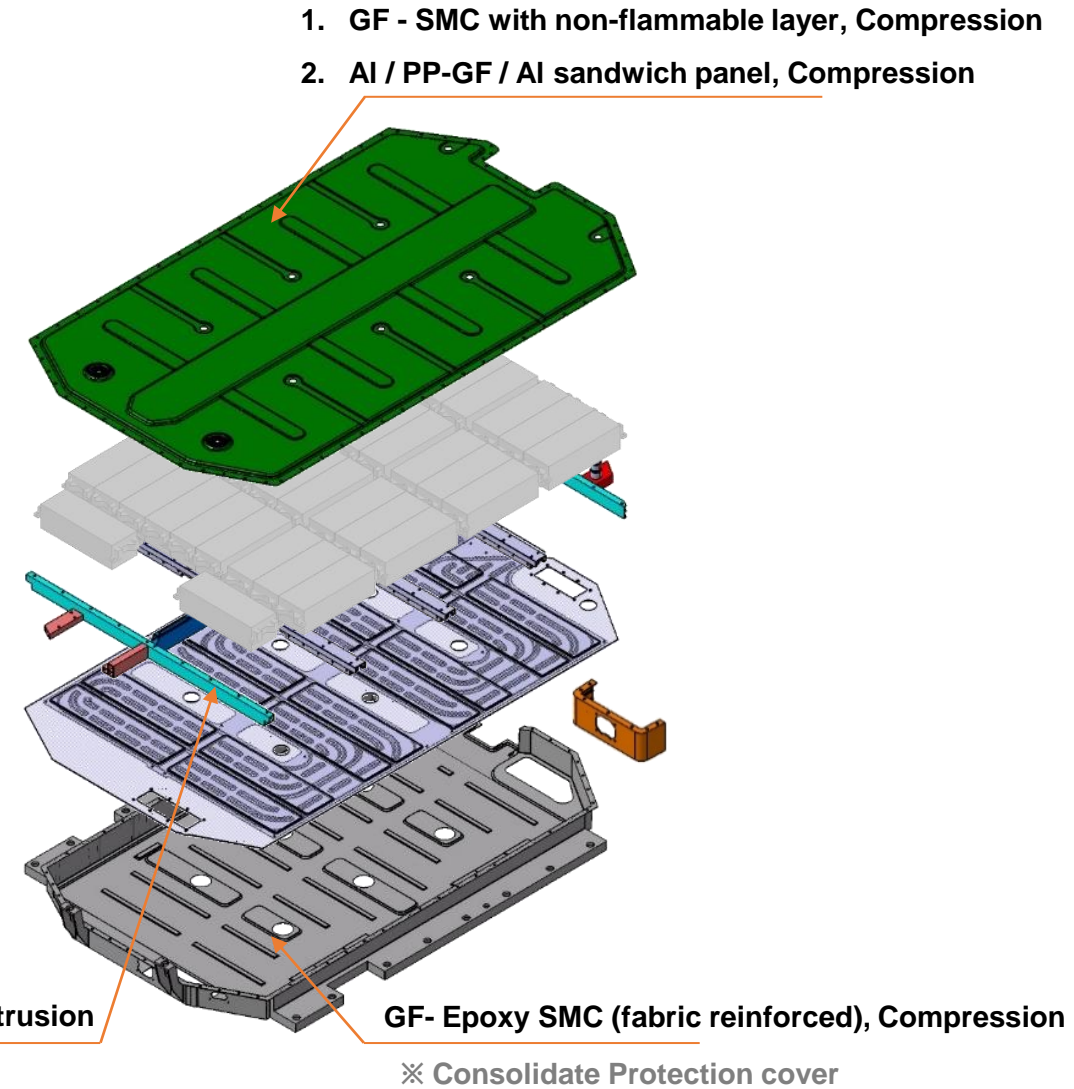
- Glass Fiber Reinforced Unsaturated Polyester (UPE)
- Sheet Molding Compound (SMC)
- Chopped Fiber Reinforcement
- Woven Fabric Reinforcement
- Hybrid among them

Composite concept on EV Battery Enclosure



Challenges

- Thermal runaway
- EMI Shield
- Structural Strength
- Lightweight
- Simple manufacturing



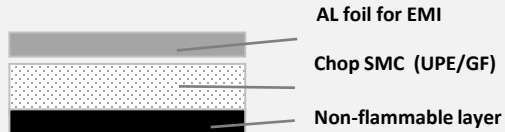
Concept Detail

Upper Case

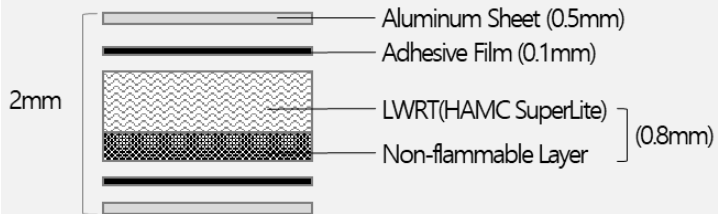
Current : Steel (0.6t)



▷ GF-SMC + Al foil



▷ Al / PP-GF / Al Sandwich



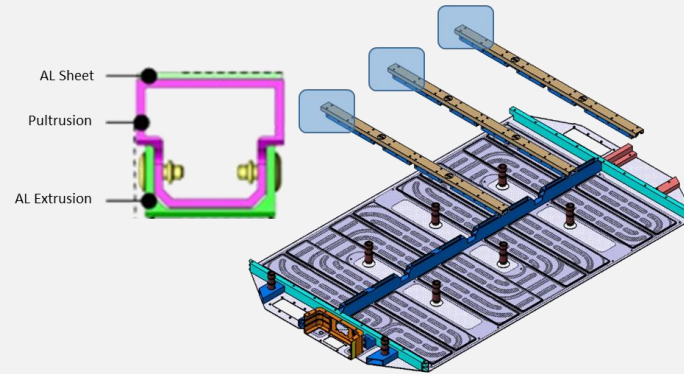
11.9 → 7.2 kg (- 39.5%)

Inner Frame

Current : Aluminum (2.0t)



▷ Epoxy Pultrusion



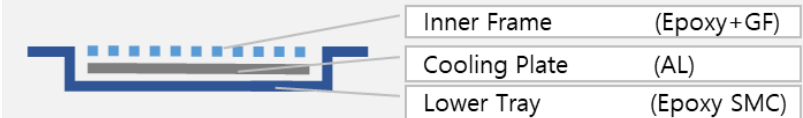
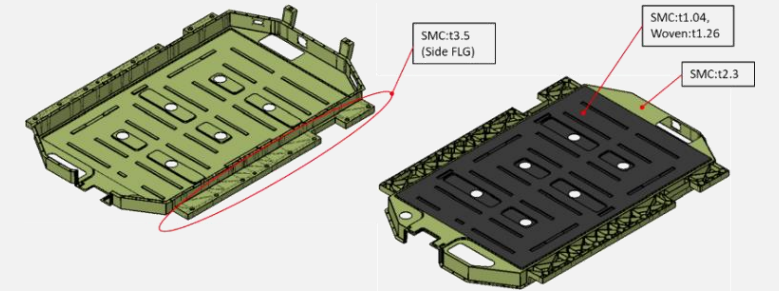
7.2 → 6.2 kg (- 13.9%)

Lower Tray

Current : Aluminum (3.0t) / Steel



▷ Epoxy SMC with Chopped and Woven GF



47.2 → 26 kg (- 44.9%)

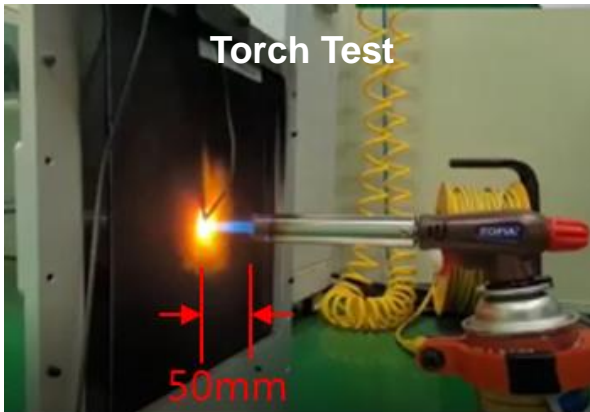
Upper Case

Main Target

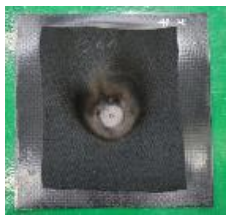
- Thermal runaway & EMI Shielding

Depends on part design, different approach

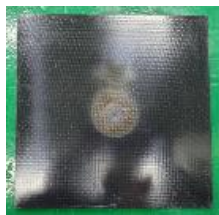
- Curved shape : SMC Base, Flat shape : Aluminum Sandwich shape



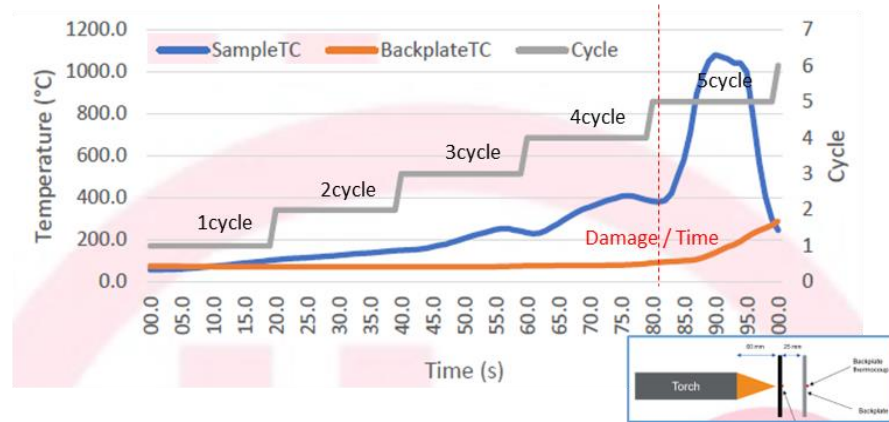
- 2.0t Woven SMC
- 200gsm Non-flammable layer



Front
Max.1086°C



Back
Max.149°C
Back
Max.149°C



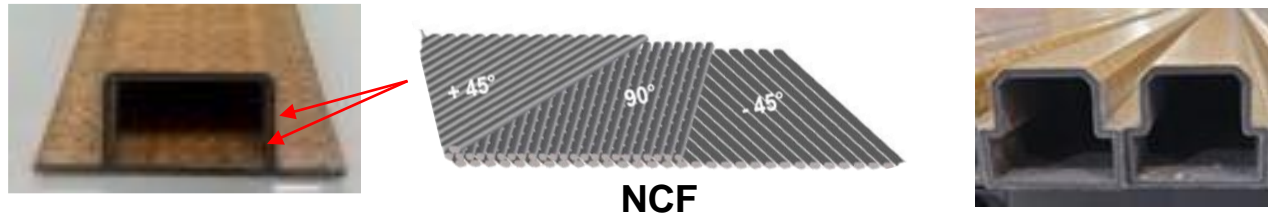
Al Sandwich Structure (2mm) test results

	#1	#2
Composition		
# of Cycle	3~4	4~5
Penetration Time[s]	60	76

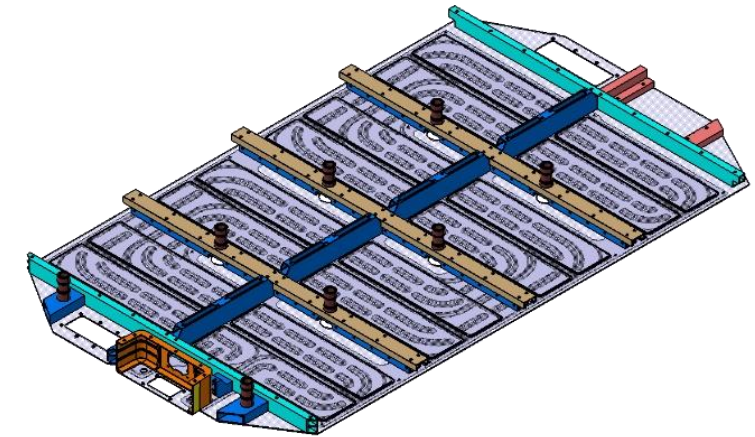
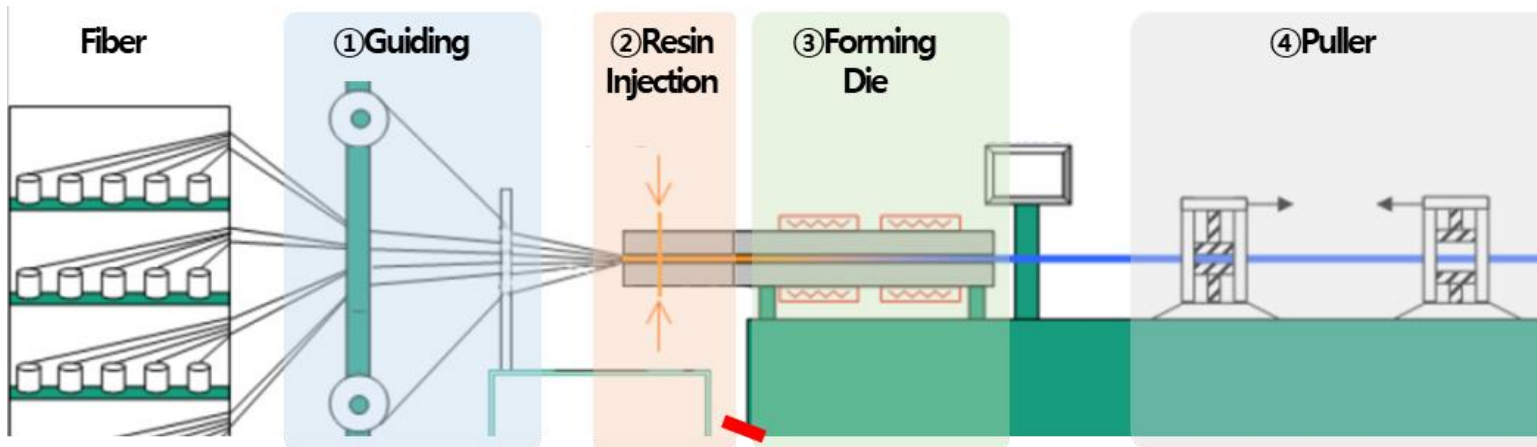
Inner Frame

Motivation

- Composite Seat Cross Member (up to 50% weight reduction compare with Steel)
- Tailored part property by material combination and design



Pultrusion Process



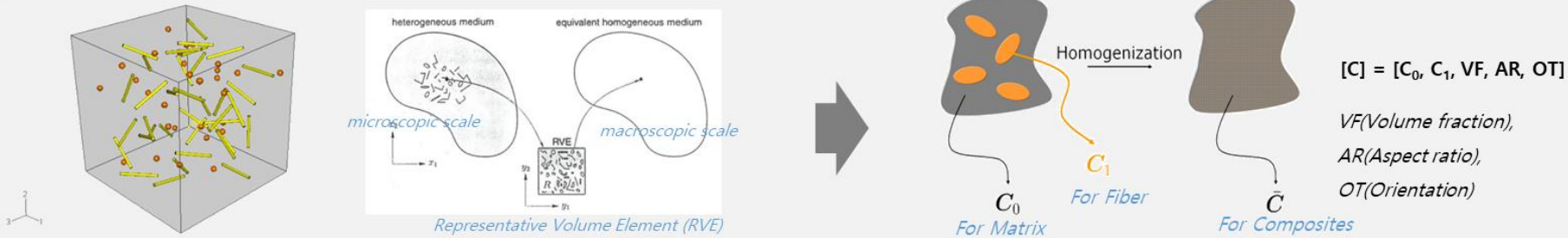
Lower Tray

Motivation

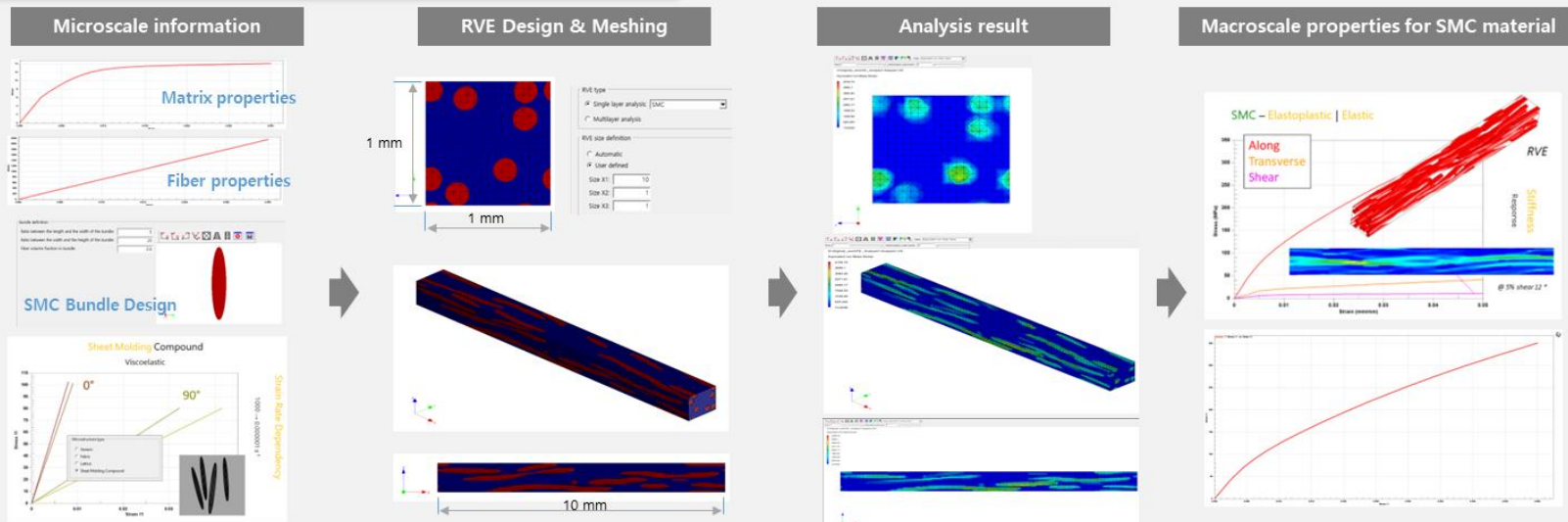
- Consolidate as much as possible for weight & manufacturing cost

Material Development

Basic Theory of Mean-Field Homogenization

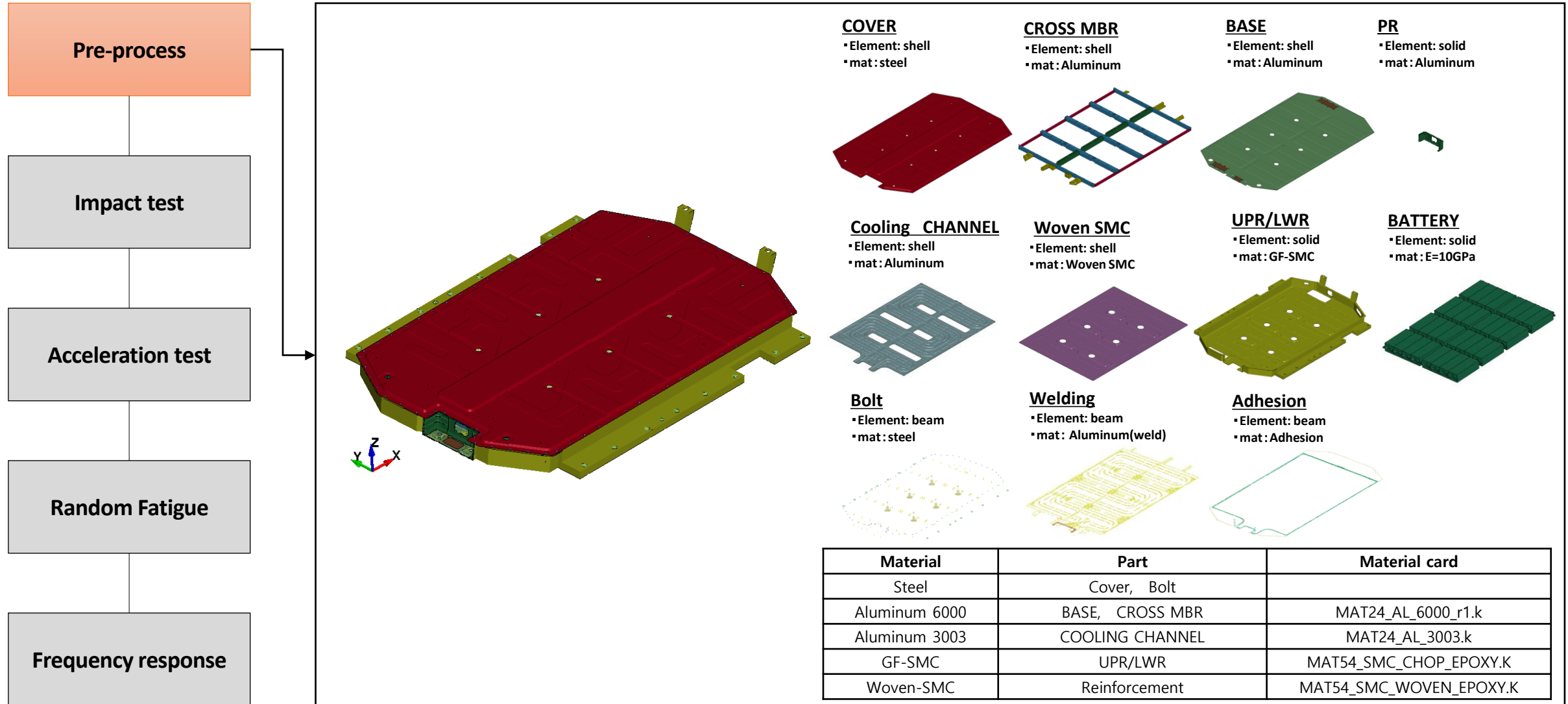


Multiscale Modeling and Analysis of SMC material



Composite concept validation - CAE

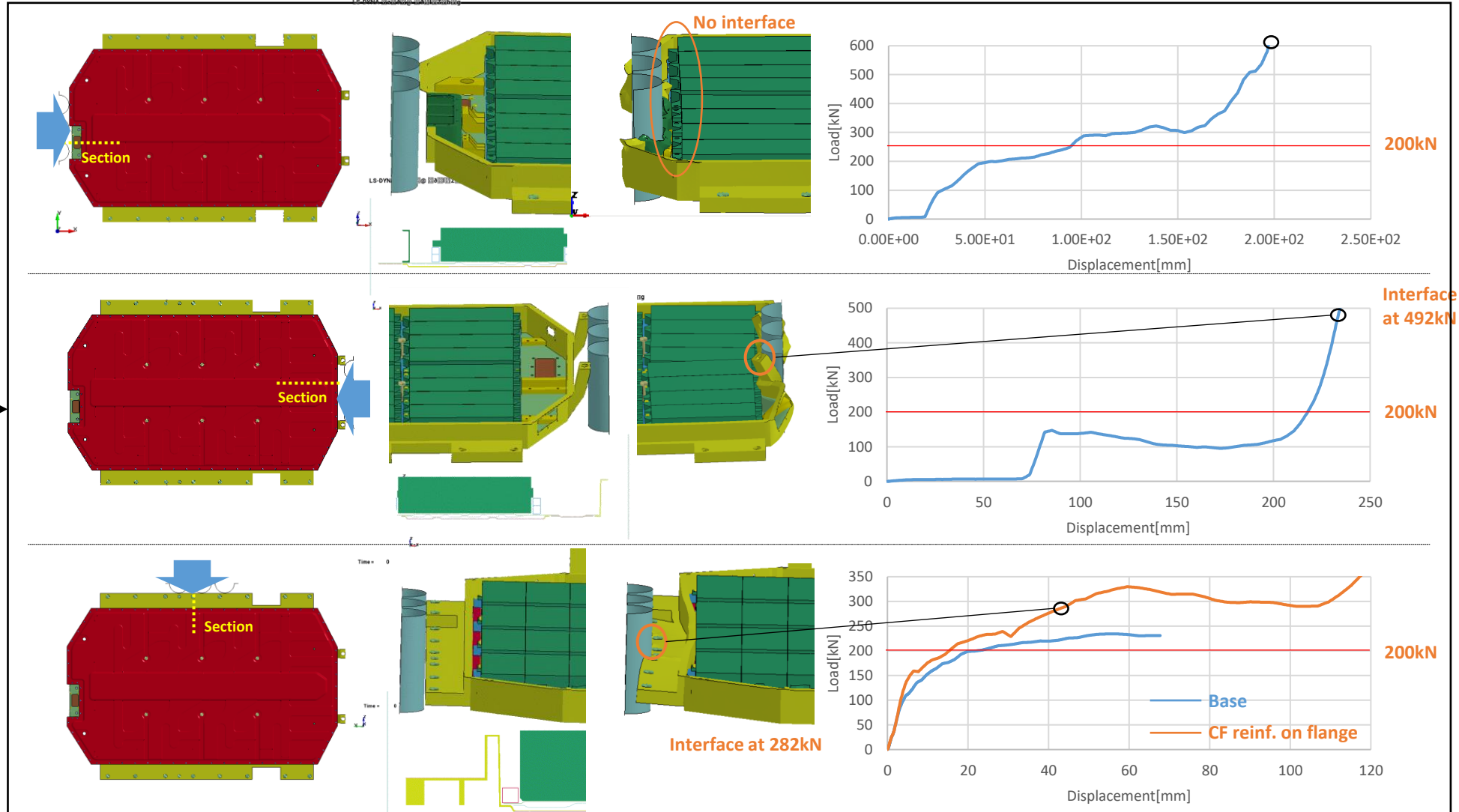
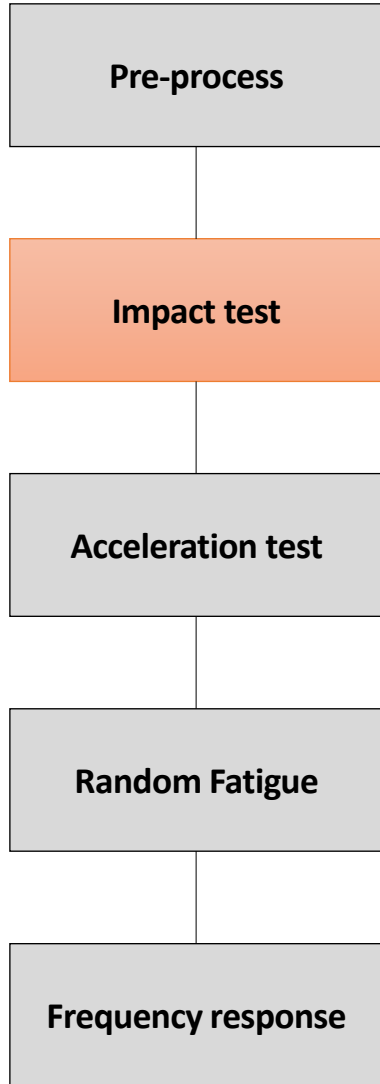
Analysis



Composite concept validation - CAE

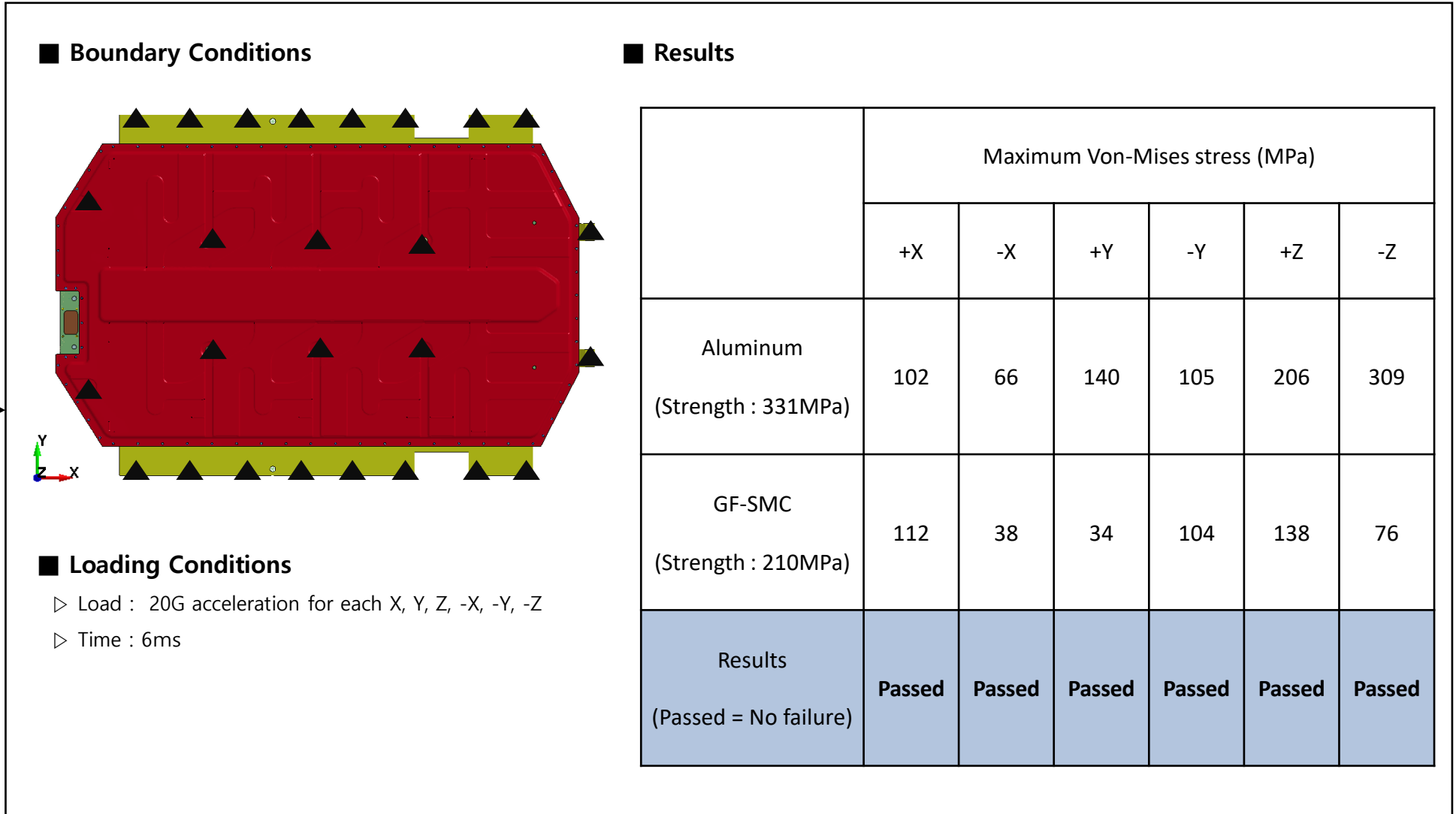
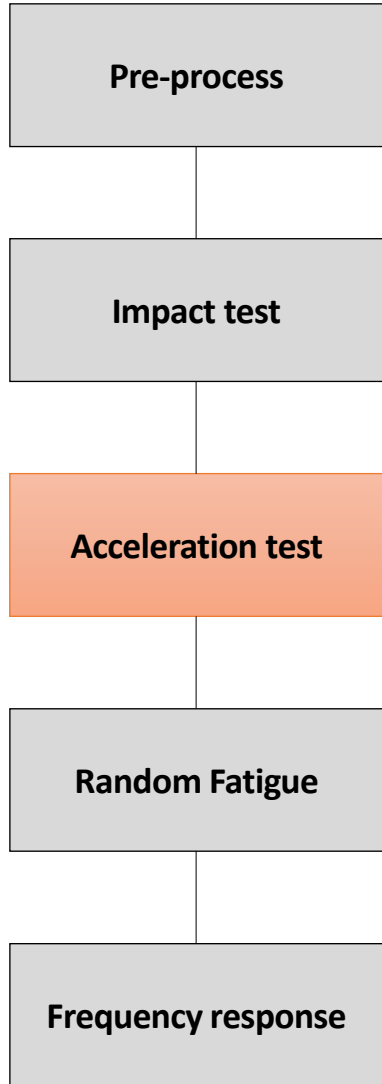
Analysis

Meet the requirements (reaction force of 200kN must be ensured before contacting the battery module)



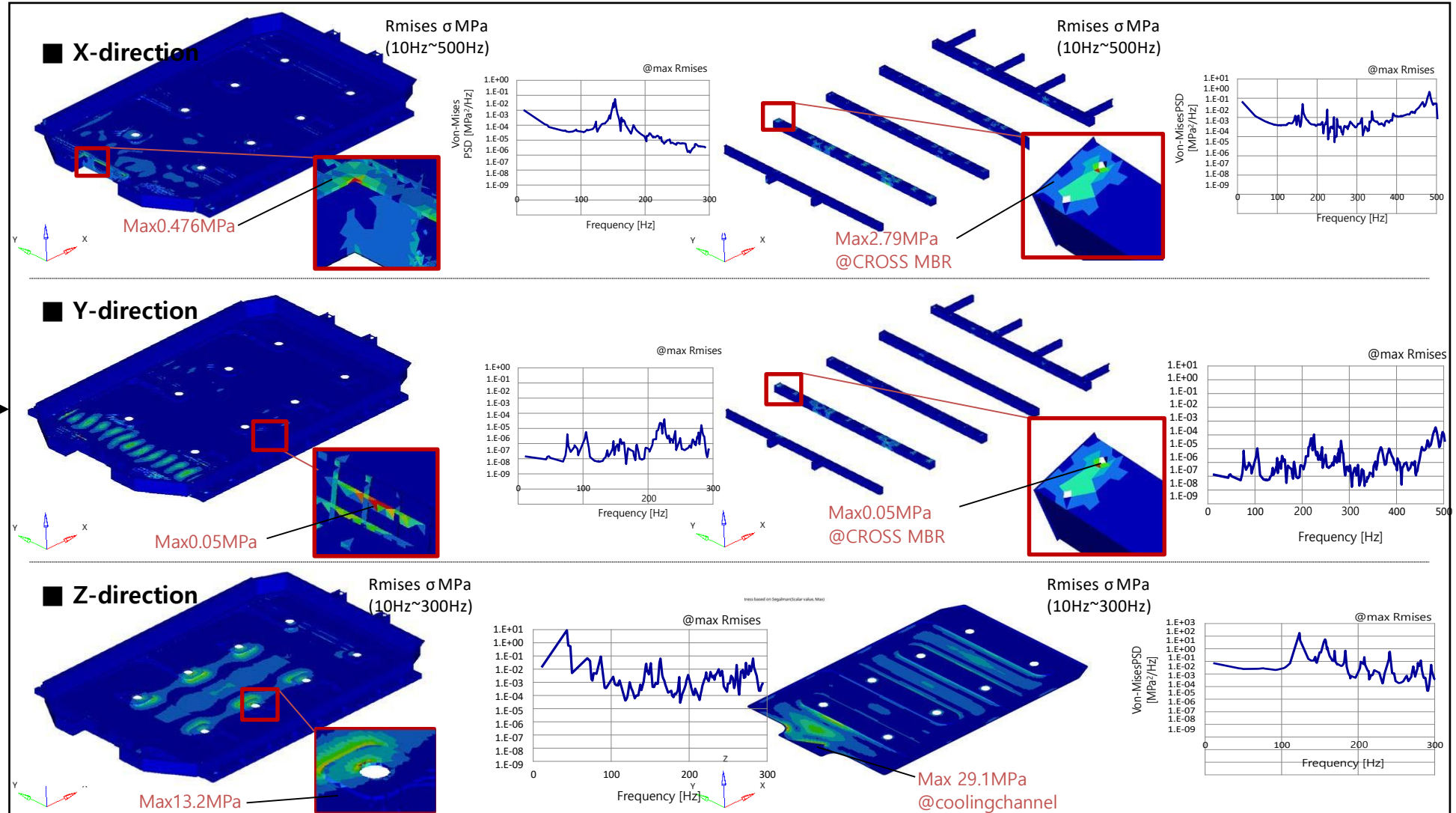
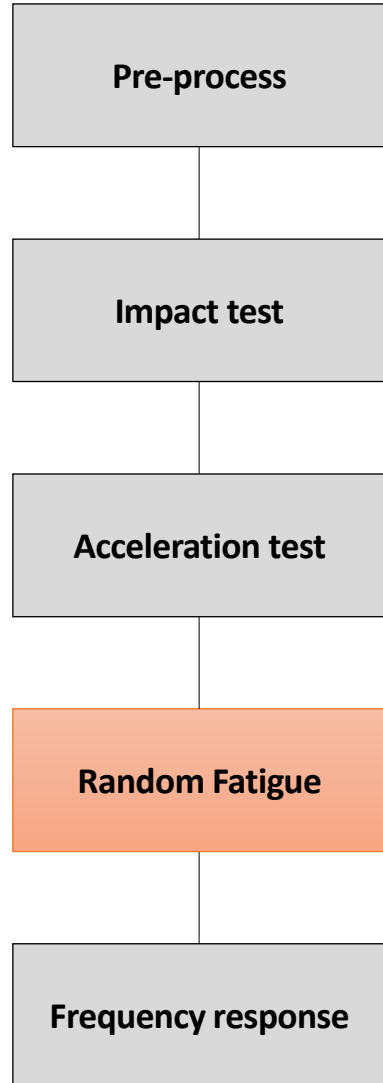
Composite concept validation - CAE

Analysis



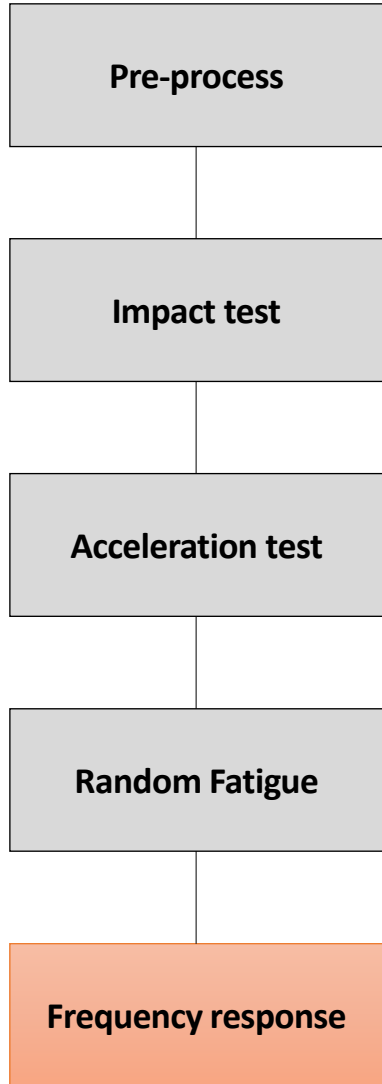
Composite concept validation - CAE

Analysis



Composite concept validation - CAE

Analysis

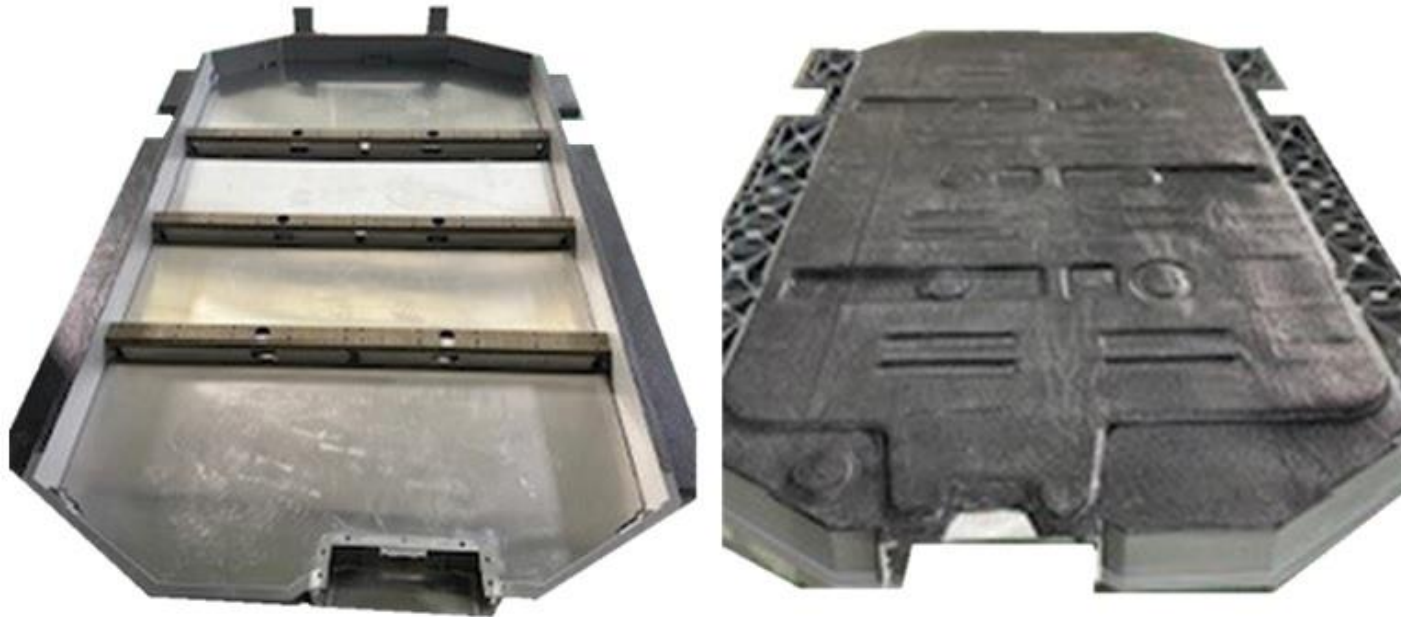
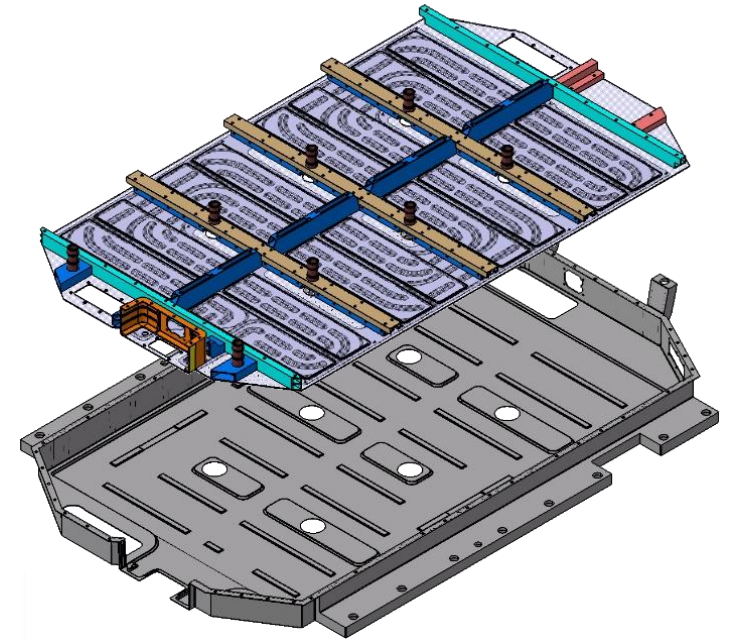


Dir	Acceleration Frequency	Max Acceleration (z direction)	
		Acceleration (mm/s ²)	Von-Mises (MPa)
X			
Y			
Z			

Prototype

Assembly

- ▷ Inner Frame (GF Pultrusion) : Rivet & bonding with AL extrusion part
- ▷ Cooling Block : FSW (Friction Stir Welding) with inner frame
- ▷ Lower Case : Bonding with cooling block (include inner frame)



Global Network & Business areas

Recent Developments

Conclusion



Conclusion

- **New Concept Battery Enclosure Structure is developed**
 - ~ 30% weight reduction was achieved and validated by CAE
 - Part performance validation is expected using prototype
- **Pultrusion concept can be applied many different applications**
 - Replace Aluminum diecasting
 - Several Chassis applications, especially EV
- **Further material & structural optimization is on-going**

Thank you !

