

Presentation on Light Weighting Technology

AutoDynamic Technologies & Solutions Pvt Ltd
“Delivering Ideas to Products”

Date: 22 Dec 2022

ABOUT

APPL GROUP

- USD 72 Million
- 370 employees
- IATF 16949 certified
- DUNS No: 650348753

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**APPL INDUSTRIES
LIMITED
&
OTHER GROUP
COMPANIES
(230 EMPLOYEES)**



- PP COMPOUNDS
- ENGINEERING PLASTICS
- SPECIALTY COMPOUNDS

**AUTODYNAMIC
TECHNOLOGIES &
SOLUTIONS PVT LTD
(USD 3.5 Million)
(83 Employees)
(DUNS No 87-140-7590)**



- **STRUCTURAL PLASTIC PARTS**
- **GLASS AND CARBON FILLED COMPONENTS**
- **AUTOMOTIVE**
- **INDUSTRIAL**
- **EXPORT PRODUCTS**

**APPL GLOBAL INFOTECH
PRIVATE LIMITED
(54 employees)**



- PRODUCT DESIGN
- PRODUCT DEVELOPMENT
- SIMULATION, CAE
- TOOL DESIGN



Integrity | Excellence | Customer Focus | Technology Edge | Responsibility

To bring unique, innovative products and solutions that are ahead of the times which satisfy a wide range of basic and implied needs in the Indian and Export market

Our Value Proposition – Material to Part

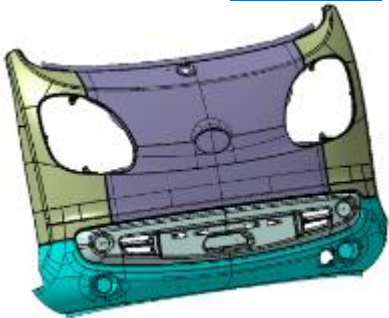


Engineering



Manufacturing & Supply

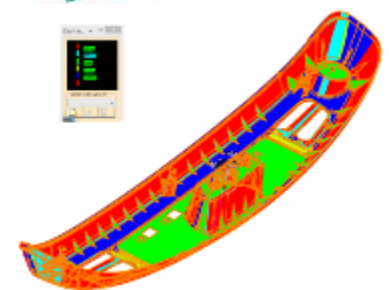
Design



Product Development Capability

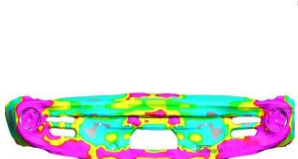
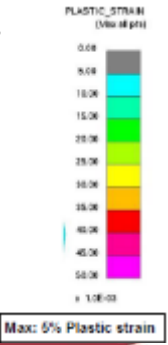
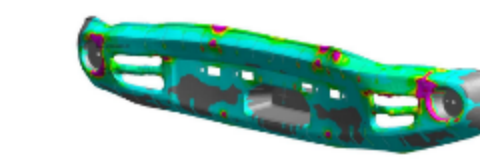
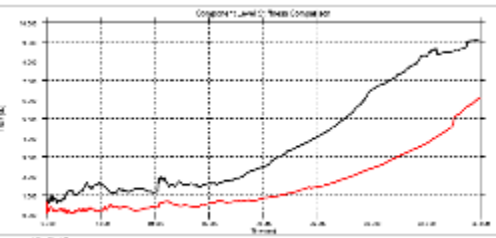
Prototype

Material Development / Selection



Simulation & Testing

Altair tools

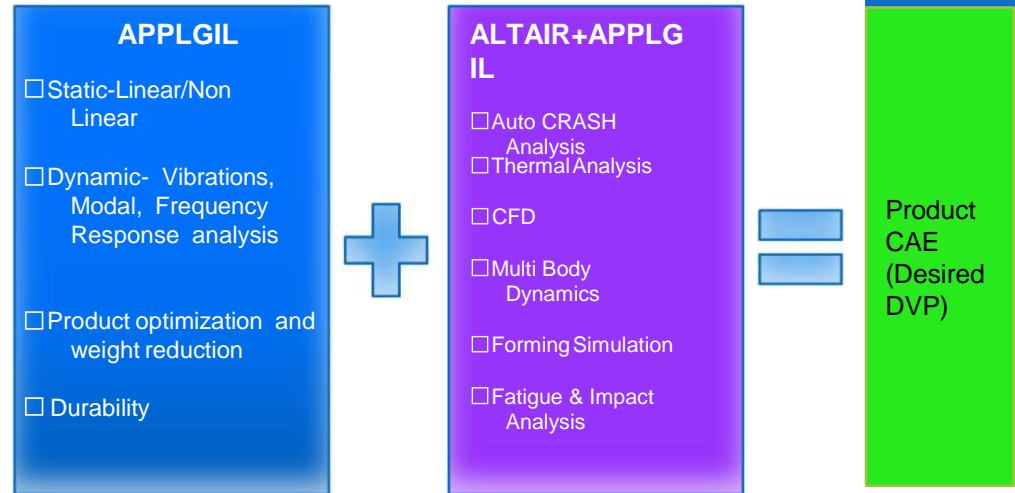


Our Design Capabilities

- ☐ Full Service supplier Projects
- ☐ Optimization and product performance improvement studies
- ☐ Value Analysis & Value Engineering
- ☐ Support to NA & European technical centres and captive units in India
- ☐ Support to India Automotive OEM and tier suppliers
- ☐ Support to Non automotive Customers around world

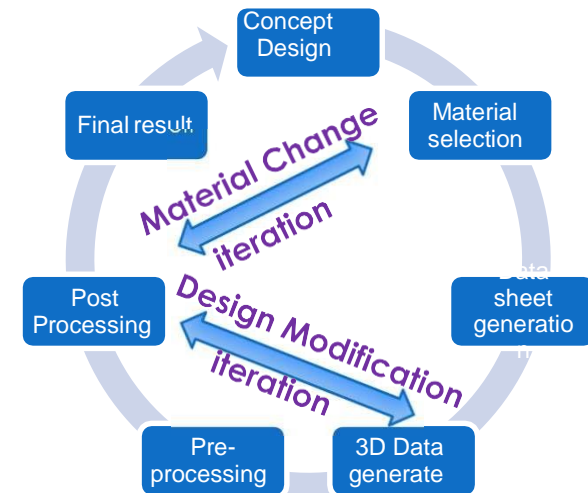
CAE Software (APPGIL)

CAE Capabilities



5

CAE Process

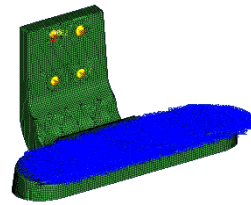
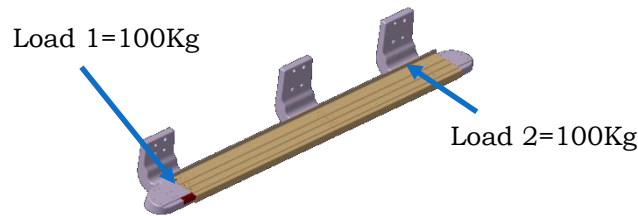


Case Study -Static Linear analysis

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Input DVP

1. Loading condition

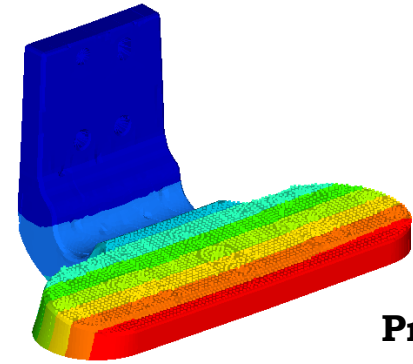


Mesh model



Contour Plot
Displacement(Mag)
Analysis system
12.563
11.167
9.772
8.376
6.980
5.584
4.188
2.792
1.396
0.000
No result
Max = 12.563
Grids 267007
Min = 0.000
Grids 247529

Displacement 12.56mm



Process

2. $\Delta < 15\text{mm}$, Linear static,
3. CAD Data in sheet metal
4. Regulation & Standards

- Meshing:-Hypermesh

Physical test



- Analysis:-Optistruct
- Material:-PP 30GF

Result

- Displacement 12.56mm



Physical Test

- Load case: Front 80Kg+ Rear 80Kg
- Cycles: 1Lakh+30000cycles

Test Result :

- Displacement ~13mm

Conclusion:

CAE Simulation values found to match to the physical test results



Deflection measurement on foot step front side:



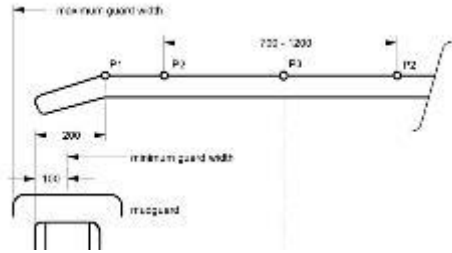
Load in Kg	Specification	Deflection in mm(D1)											Remark
		Initial	After 10,000 Cycles	After 20,000 cycles	After 30,000 Cycles	After 40,000 Cycles	After 50,000 Cycles	After 60,000 Cycles	After 70,000 Cycles	After 80,000 Cycles	After 90,000 Cycles	After 1,00,000 Cycles	
0	Specification not available for data generation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Data generation only
20		2.986	3.520	3.354	3.548	3.125	3.205	3.197	2.826	3.141	2.981	2.960	
40		6.322	6.090	6.254	6.375	5.980	5.959	6.210	5.670	6.031	5.915	5.948	
60		9.698	8.690	8.845	8.956	8.761	8.488	8.508	8.195	8.733	8.524	8.611	
80		13.260	1.602	11.688	11.721	11.250	11.278	11.301	11.298	11.345	11.323	11.351	
Set value (after load removed)		0.177	0.340	0.065	0.115	0.192	0.121	0.231	0.225	0.284	0.218	0.235	

Quasi-Static Impact Analysis of FUPD

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Input DVP

1. Loading condition- AIS- 069 (ARAI Standard)



2. Deflection < 400 mm, Quasi- static,
3. CAD Data in sheet metal

Physical Test



Load vs. deflection graph
Fig. 6 below shows the load vs. deflection curve during the static test of FUPD LH side. Total deflection at 80 kN was 30.71 mm.

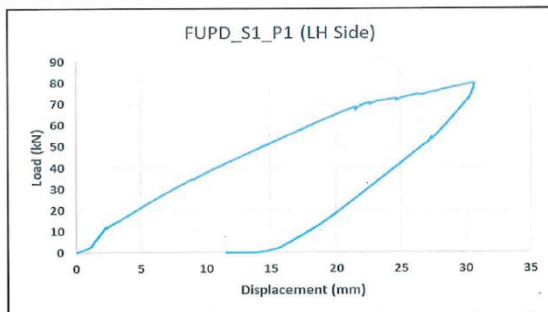


Fig. 6: Graph of load v/s deflection for point P1 (LH).



Loading Point P2 LH side

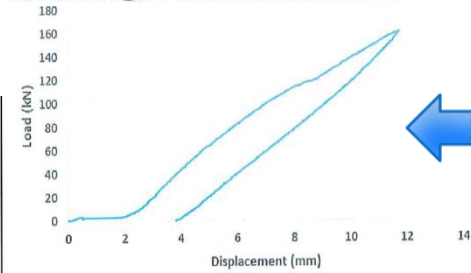
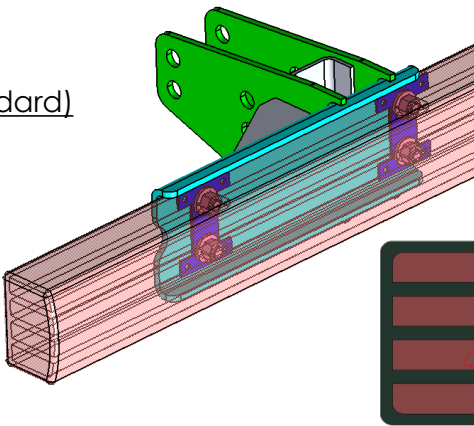


Fig. 7: Graph of load v/s deflection for point P2 (LH).

CAE Result



- Meshing:-Hypermesh
- Analysis:-Radioss
- Material:-Composite GF+Epoxy

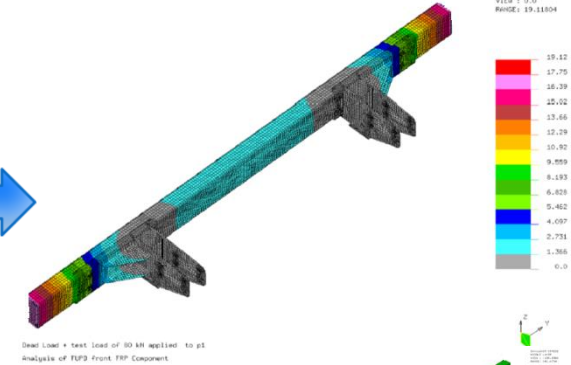


Figure 5a: Maximum deflection = 19.12 mm

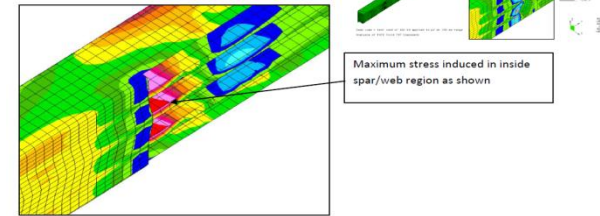


Figure 6b: Maximum layered stress sxx in FRP = 241.7 MPa < Pa (Allowable strength)_SAFE

Result

Load	Physical testing total deflection	Permanent set (mm)	Elastic set (Only FUPD)	FE Result (Only FUPD)
P1	30.71 mm	11	19.71 mm	19.12 mm
P2	16.38 mm	5	11.38 mm	10.95 mm
P2	11.67 mm	4	7.67 mm	3.16 mm

Conclusion:
CAE Simulation values found to match to the physical test results

Case Specific - Thermal analysis for EV battery cooling systems

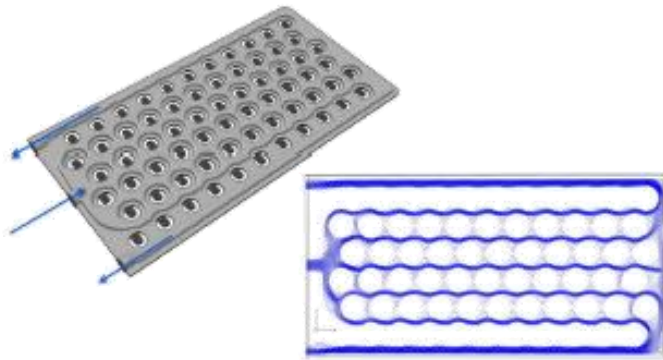
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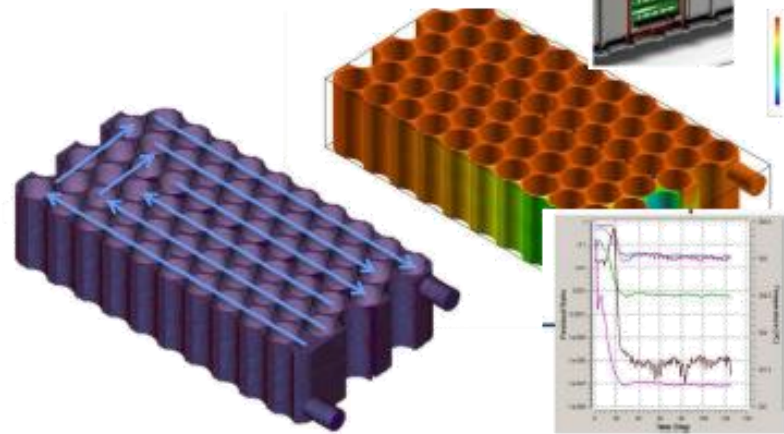


Thermal analysis for EV battery cooling systems

- Flow
- Thermal – Steady and Transient
- Design iterations



Evaluation for different cooling methods



Flow and heat transfer of liquid cooling within a battery pack module

We have technology tie up with Altair Engineering



Integrity | Excellence | Customer Focus | Technology Edge | Responsibility

Injection Molded Composites (IMC)

Technology & References

IMC Machine @ AutoD

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Continuous Glass Fiber being fed into the machine



IMC PRINCIPLE

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Get the Benefit together

Injection Molded Composite Process - Principle

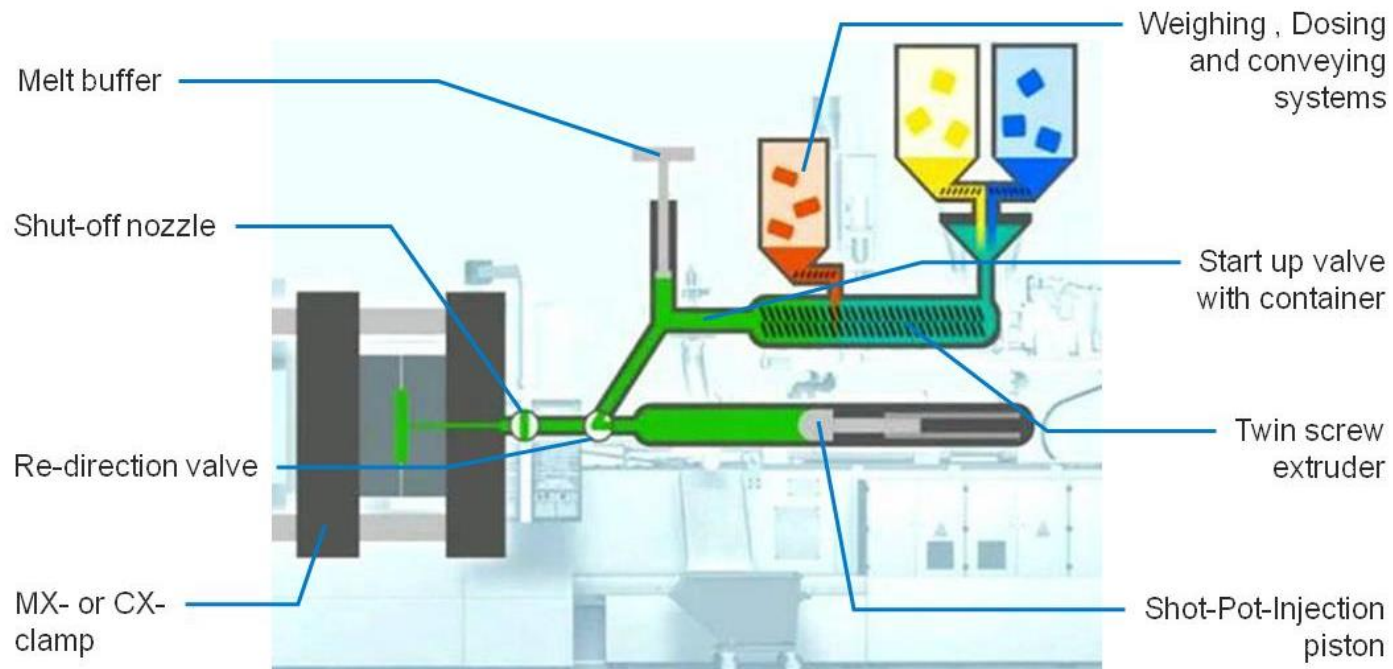
Injection Molding:

Single screw
Material processing
Discontinuous process

Extrusion:

Twin screw
Material compounding
Continuous process

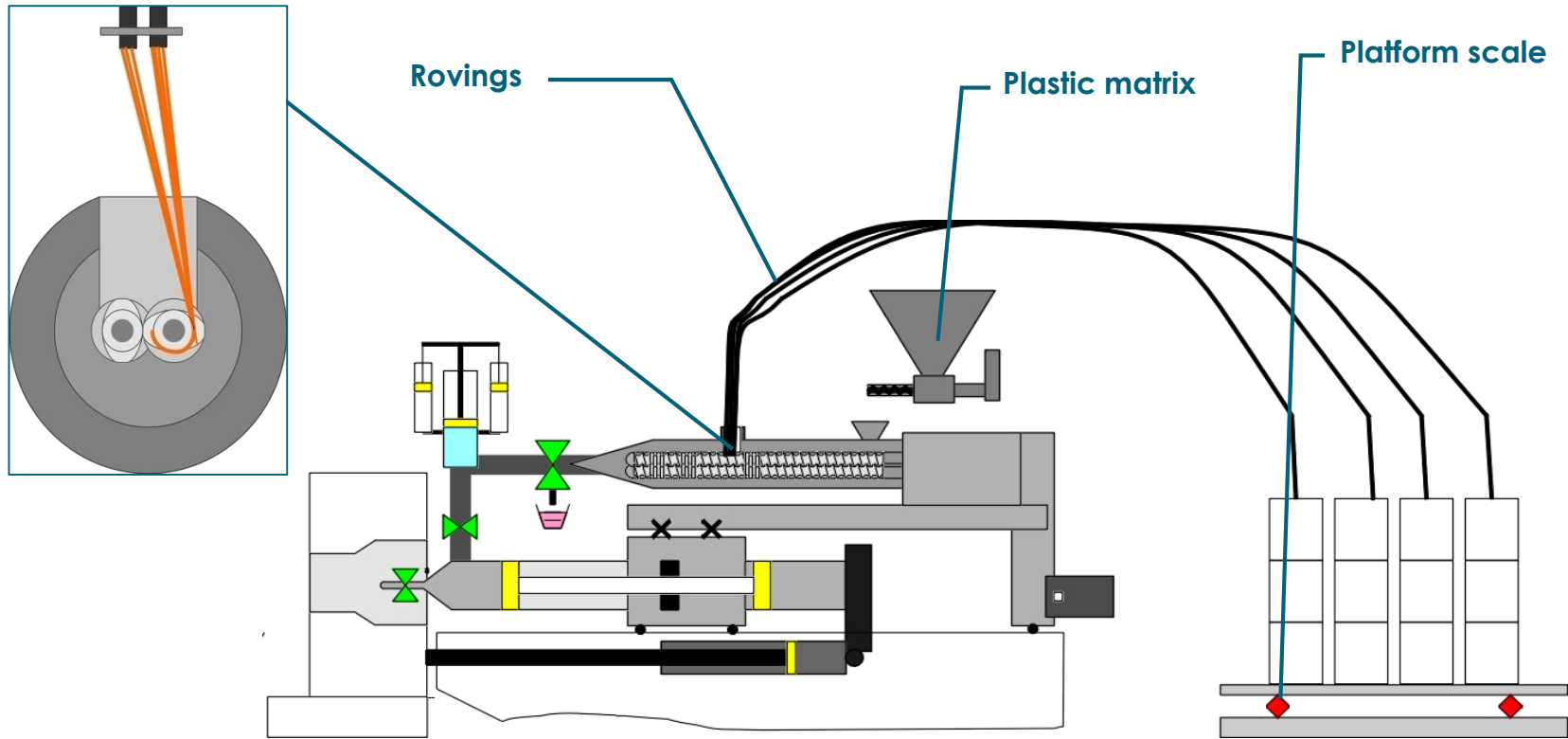
Continuous and discontinuous – Two in One



IMC PRINCIPLE

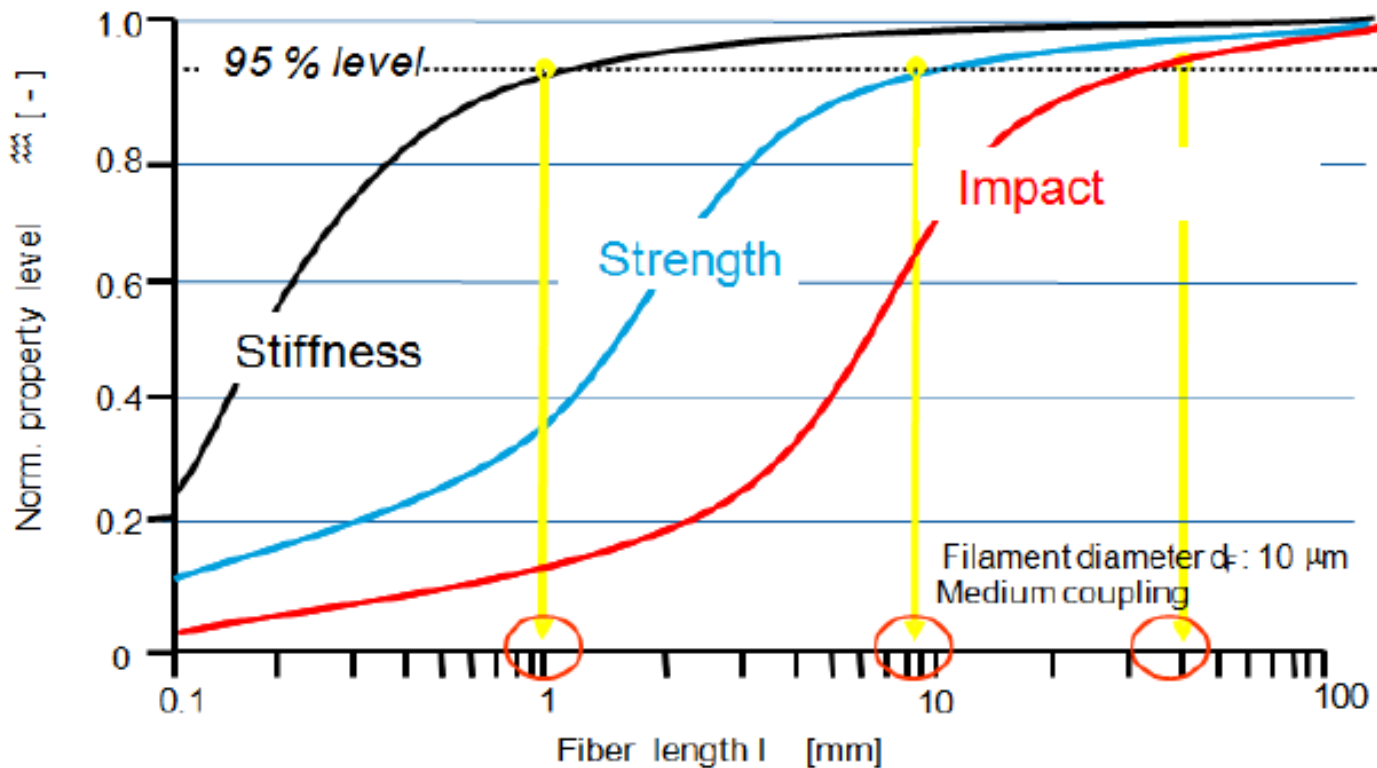
12

What makes an IMC suitable for long glass fiber applications?
IMC with platform scale



Influence of fiber length on mechanical properties

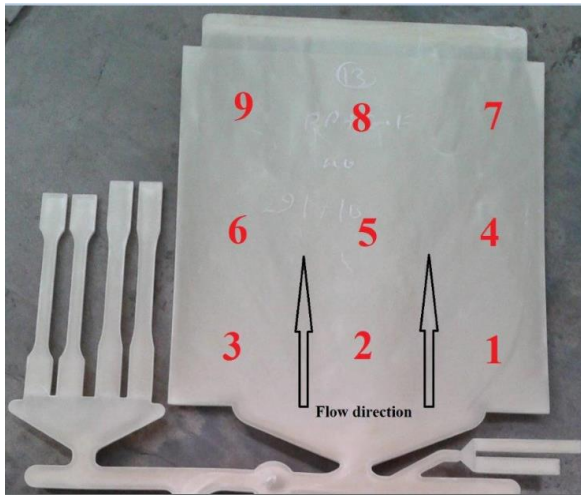
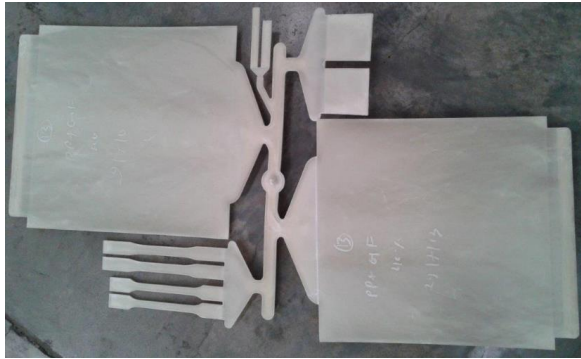
Long glass fiber – PP/GF (qualitative)



Source: FH Rosenheim, Prof. Schemme, based on Thomason & Vlugs

Proprietary Test Specimen Mold

14

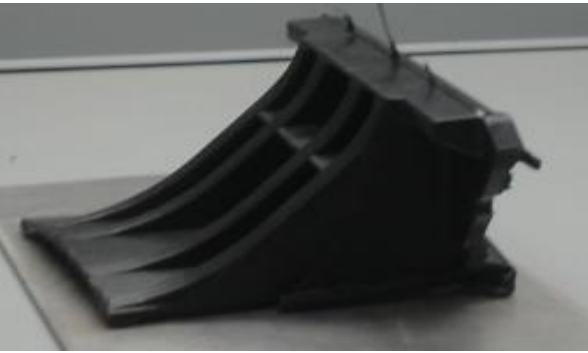


Filler Contain Results for the plate molded with 40 % Glass filled PP

1	2	3	4	5	6	7	8	9	Avg.
39.90	41.50	40.54	39.5	40.65	40.12	38.31	41.11	40.37	40.22
40.47	40.36	40.56	39.4	40.91	41.69	41.00	40.43	40.38	40.57

ACTUAL FIBER LENGTH

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Note - Testing done on part level, test specimens cut from the actual molded part.

Part thickness was in the range of 2.5 to 2.7 mm.

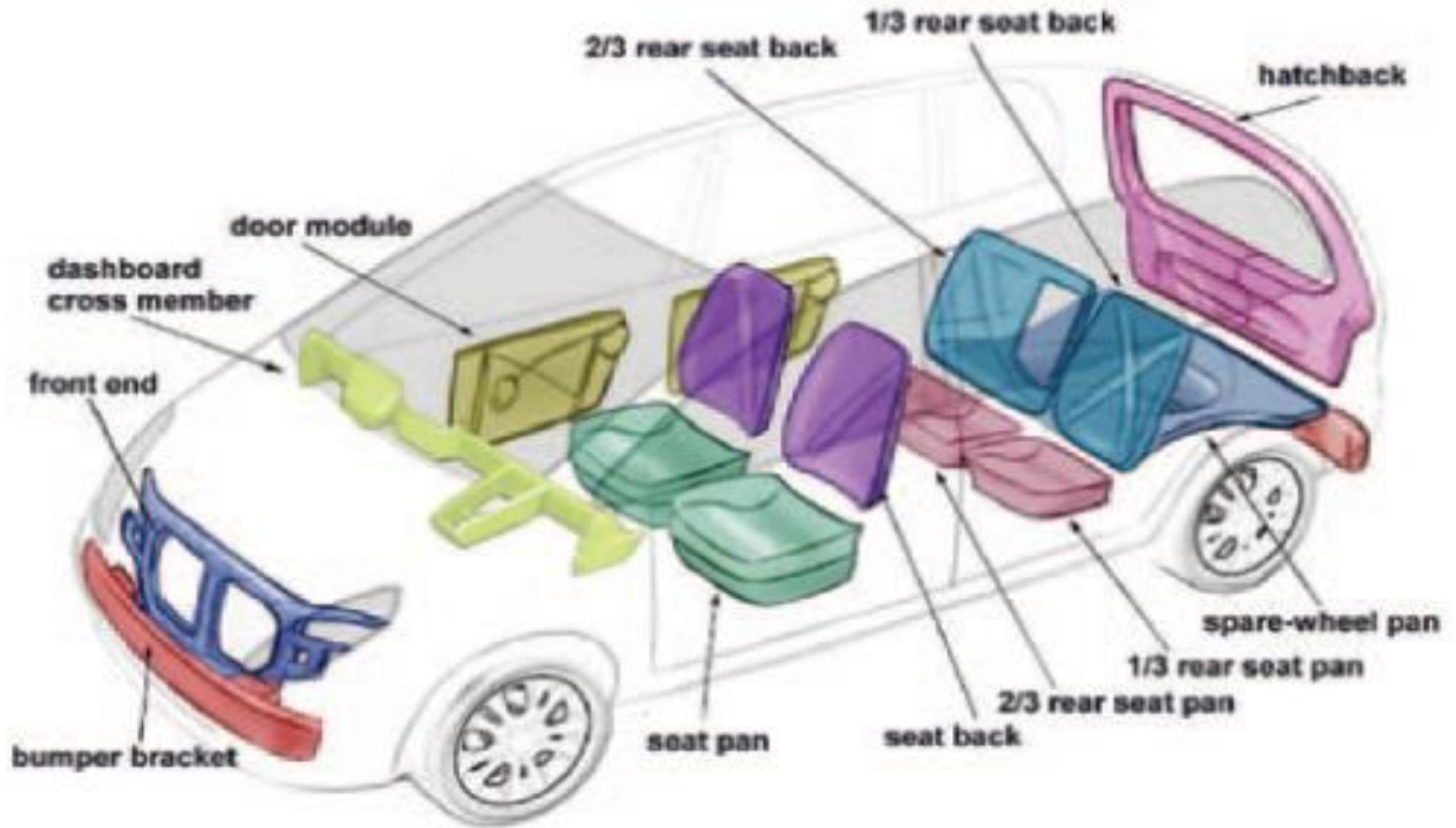
Fiber length - GF Injection molding = < 0.5 mm

- LFT / LGF Injection Molding = < 1mm

- IMC = minimum 5mm & even more than 30mm in MANY areas

Potential Parts

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STRUCTURAL COMPONENTS

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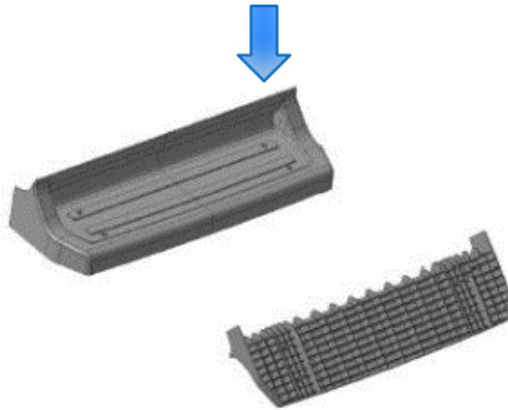
Light Weighting

Case Studies using IMC Technology

Reference Case Study

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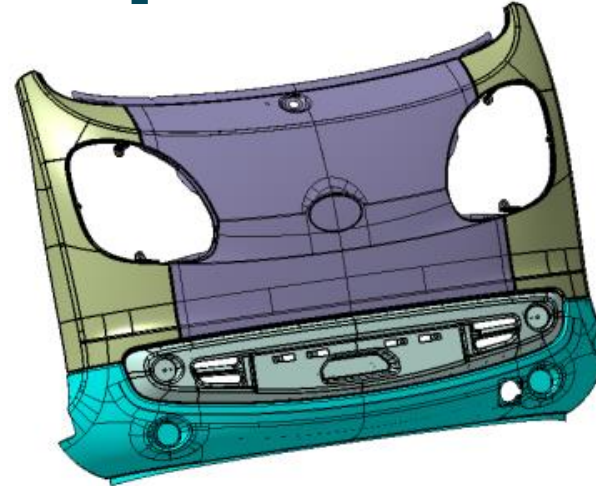
Rear Foot Step



Weight:	2.25 kg (30% Saving)
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- Part Integration
- Less Inventory
- Lower cost

Bumper Beam _ LCV

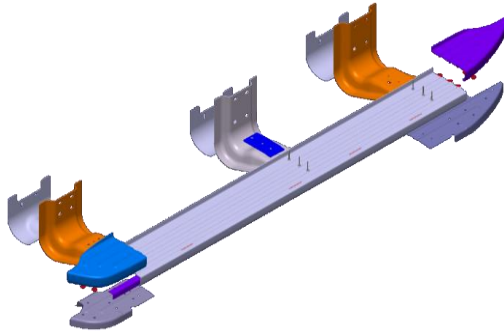


Weight:	1.05 kg (52% Saving)
---------	----------------------

- Eliminated Powder Coating
- Lower Cost
- Meets Crash Intrusion Requirements

Reference case Study

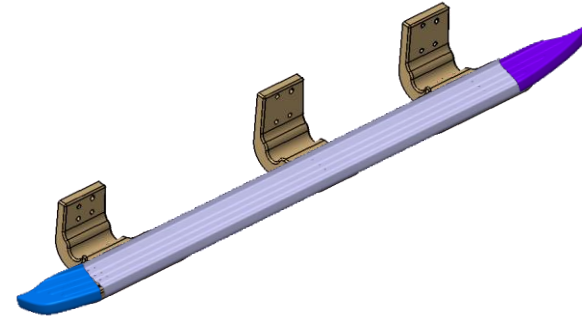
20



Fabrication – Metal

Weight:	9.445 kg each
---------	---------------

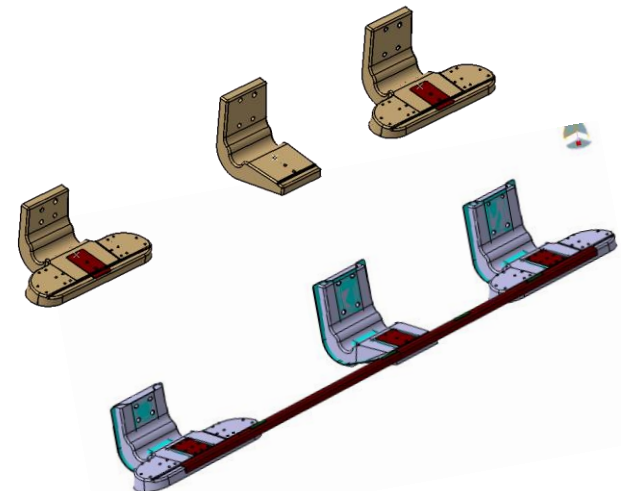
- Eliminate –
 - 03 - FRONT BRKT SIDE FOOT STEP RH
 - 04 - REAR BRKT SIDE FOOT STEP RH
 - 06 - REINF CENTRE SIDE FOOT STEP
 - 07 - BRACKET REINFORCEMENT SIDE FOOT STEP
 - 08 - MIDDLE BRKT SIDE FOOT STEP RH
 - 09 - BRKT RNFRCMNT FRT MID FT STEP
- No Change in Mounting location on Vehicle
- Existing Metal end cap brackets modify to accommodate IMC molded bracket.
- No Change in existing PLASTIC END CAPS, ALUMINUM PART and STIFFENER SIDE FOOT STEP (05)

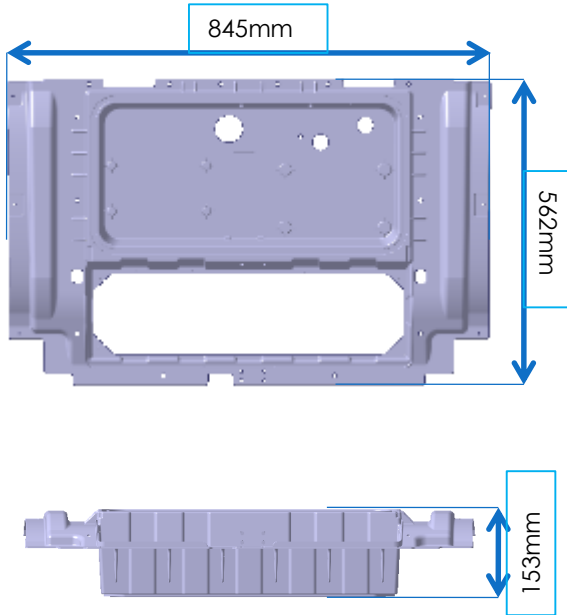


IMC - Long Glass Fibre

Weight:	6.149 kg each
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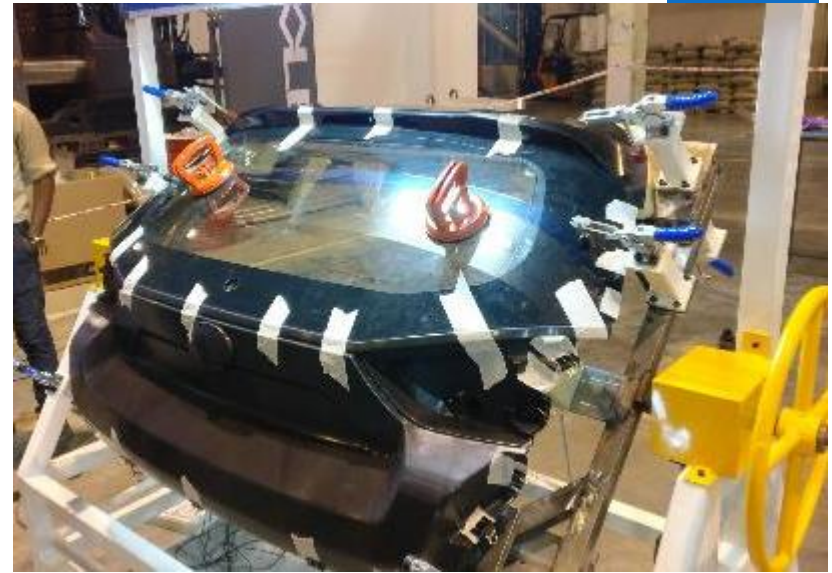
Weight Saving : 34.89 %





Tailgate Assembly – Indian OEM

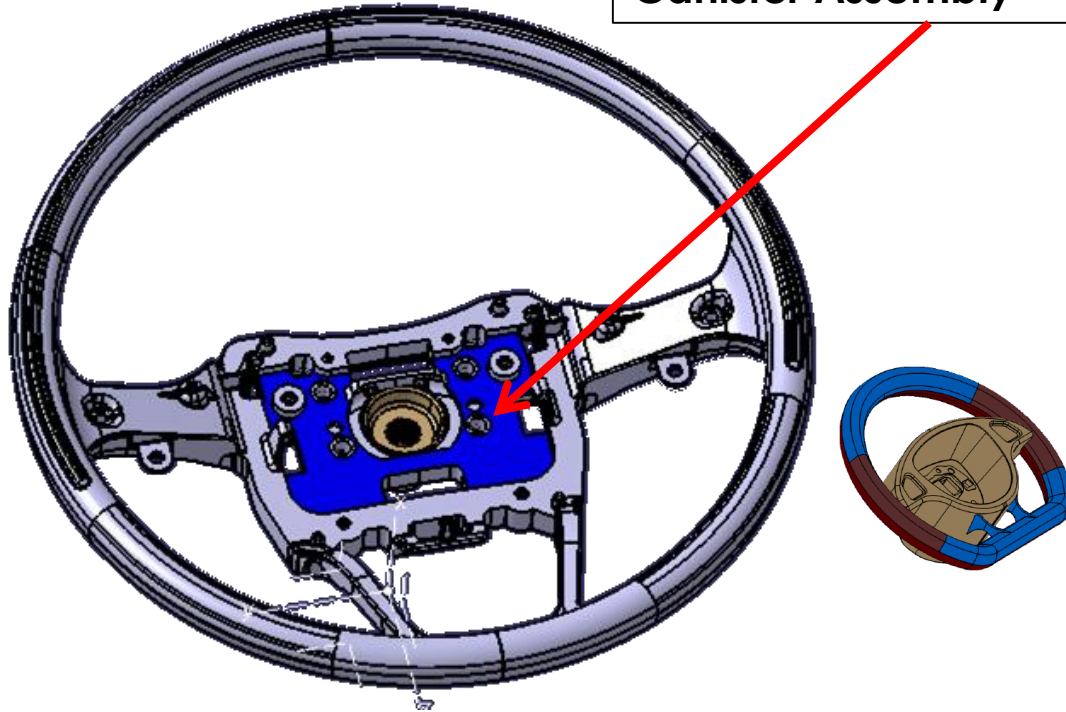
22



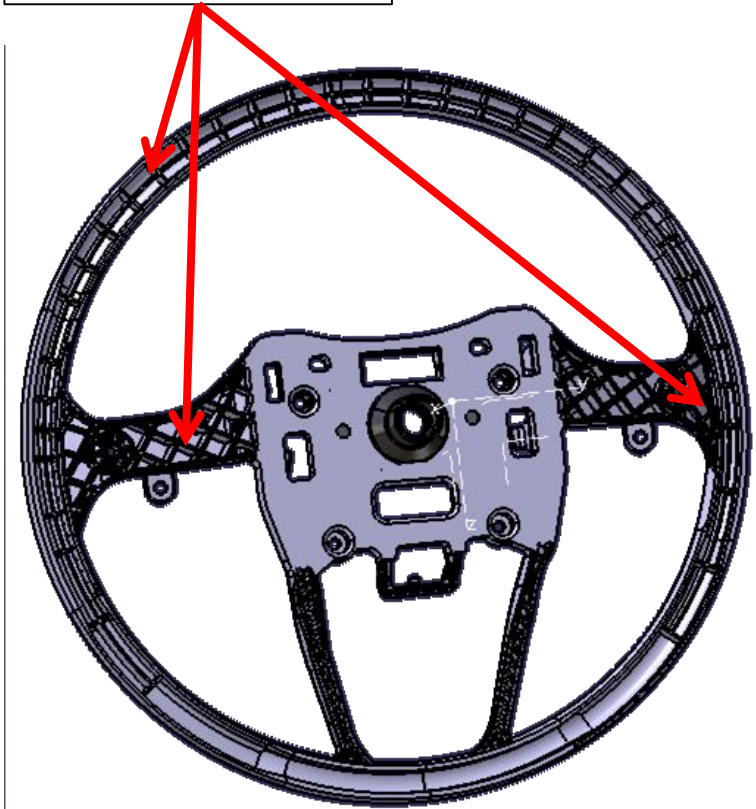
Material : PPCGF 30%
Weight of Plastic Part : ~8.2 kg
Weight Reduction : 30%



Provision for Switch Bezel &
Canister Assembly



Ribbing structure

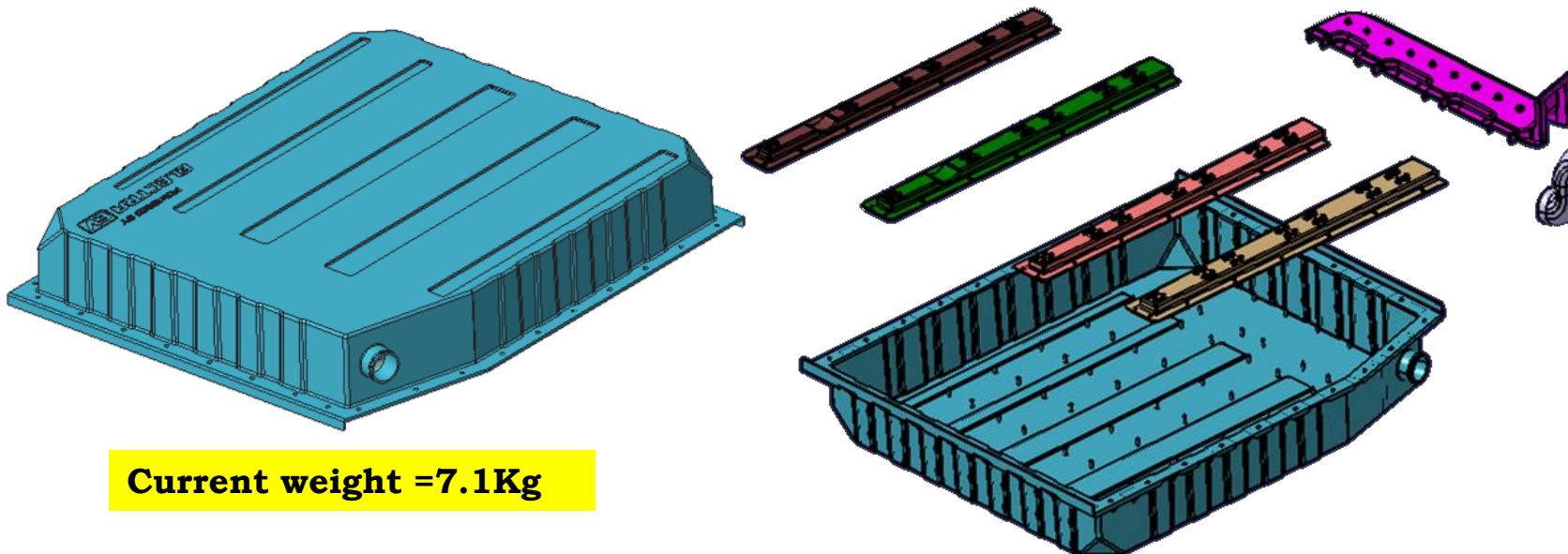


Material: PA 6 – 40% LFT
Weight reduction: 40% - 48 %

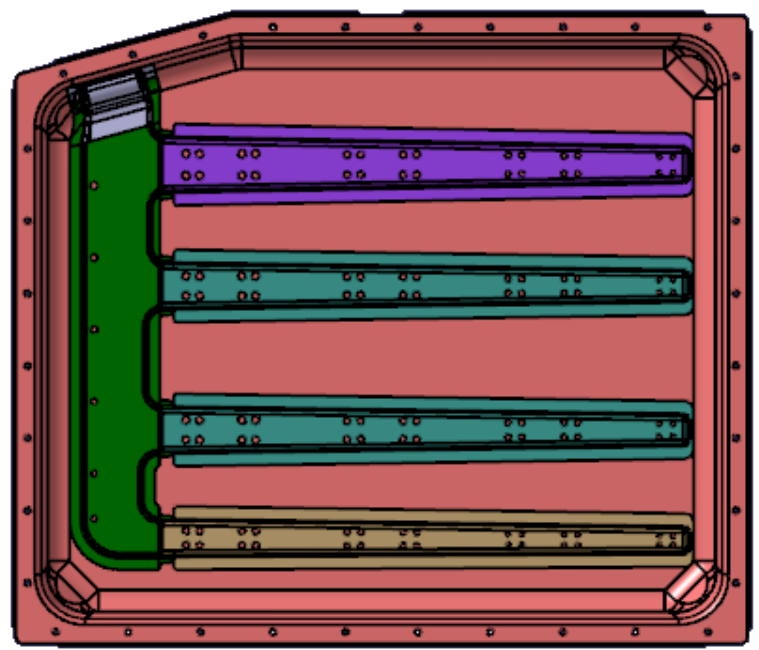
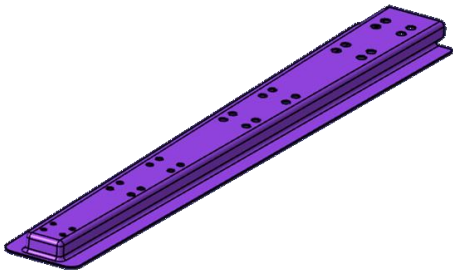
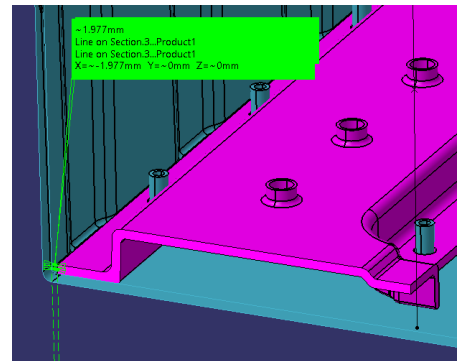
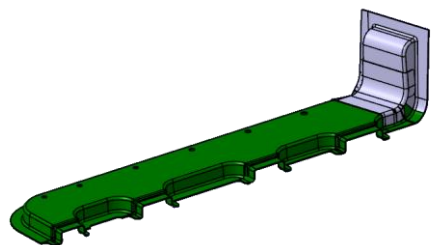
- String Ribbing for better strength & durability
- Ability of PU Over molding
- Back cover (Optional)

EV Battery Top Cover

24

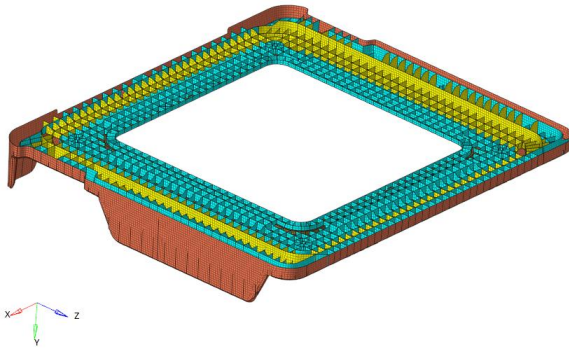


Current weight =7.1Kg

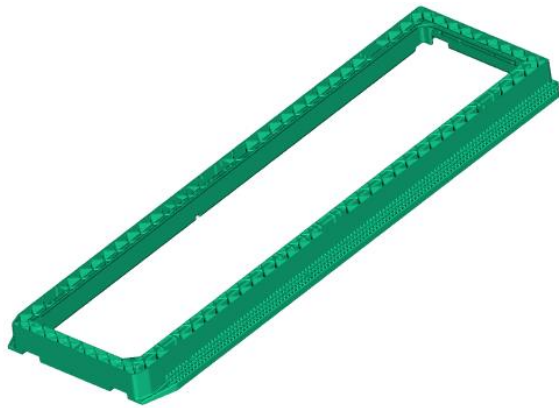


Hospital Bed & Food Carrier

25



Weight: 5.90 kg (28% Saving)



Weight: 3.85 kg (37% Saving)



EV Components

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Product 1- Composite Load Body

19



Sheet Metal Container
Size = (8'6" x 6') ft
Weight = 550 kg



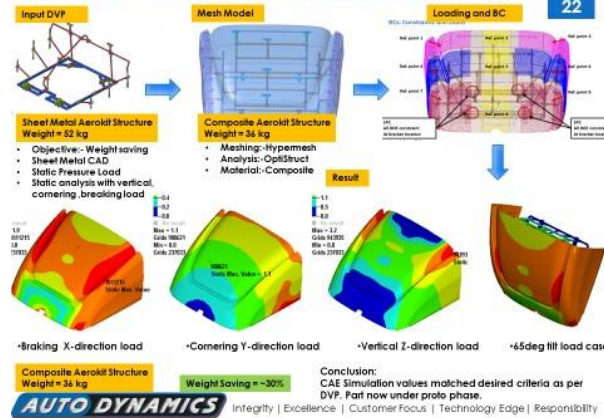
Composite Load Body
Size = (8'6" x 6') ft
Weight = 227 kg

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Case Study 4 - Wind Deflector –Aerokit (Under Prototype phase)

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Product 3 - Composite RUPD

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Sheet Metal RUPD
Beam Weight = 18.5 kg



Composite RUPD
Beam Weight = 13.5 kg



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Product 2- Composite Battery Carrier

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Sheet Metal Battery Carrier
Weight = 24 kg



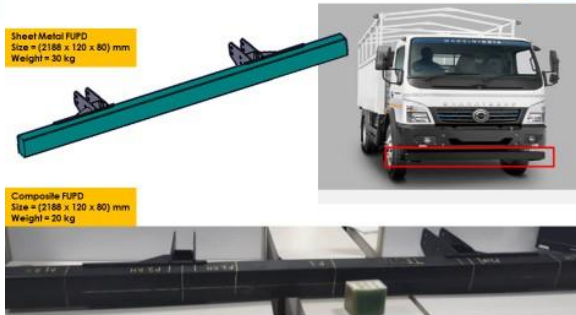
Composite Battery Carrier
with Lockable Cover
Weight = 12.5 kg

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Product 5 - Composite FUPD

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Product 6 - Composite Battery Top Cover

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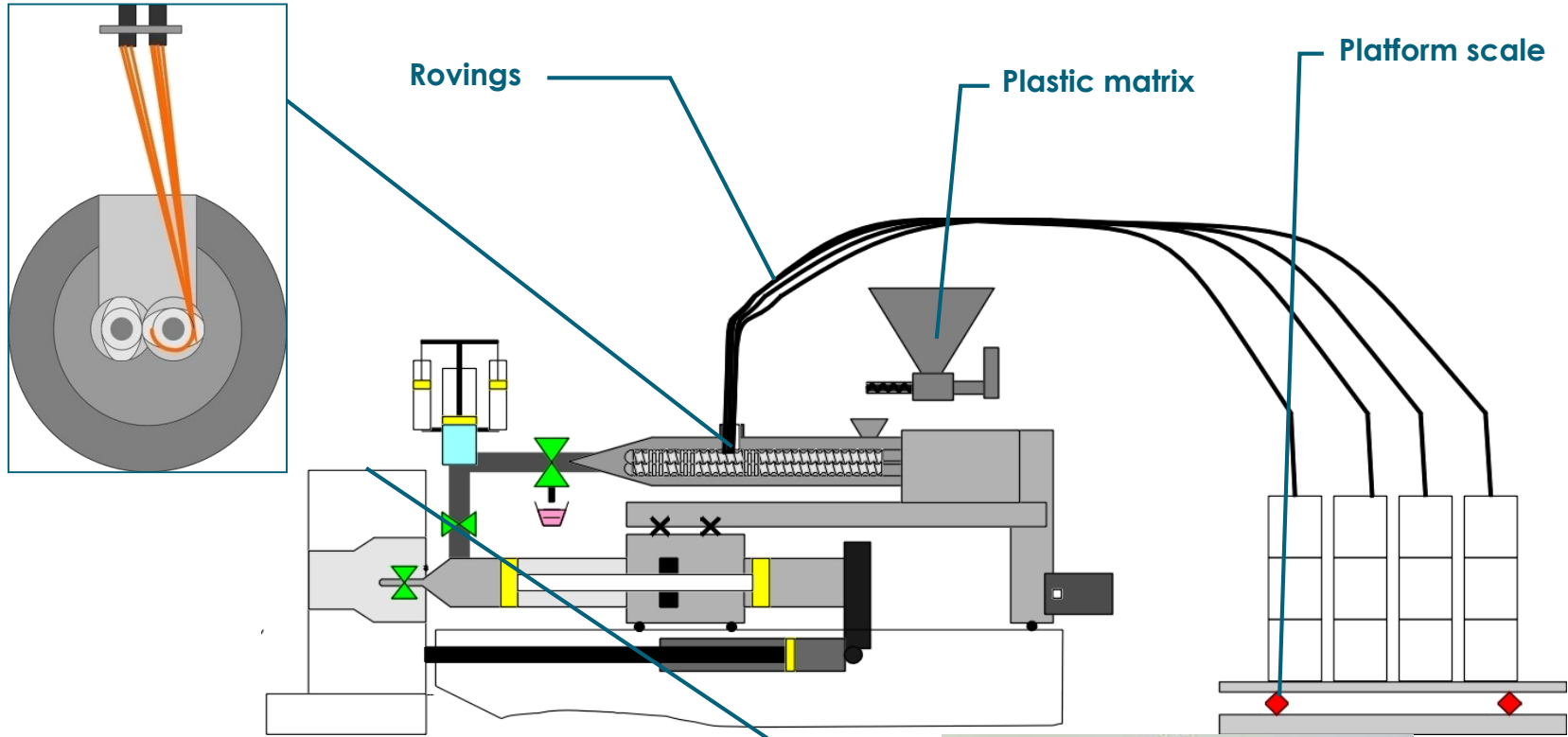
Glass / Carbon / Aramid
Fabric

Enhancing IMC Capability

Technology
&
References

Enhancing IMC Capability

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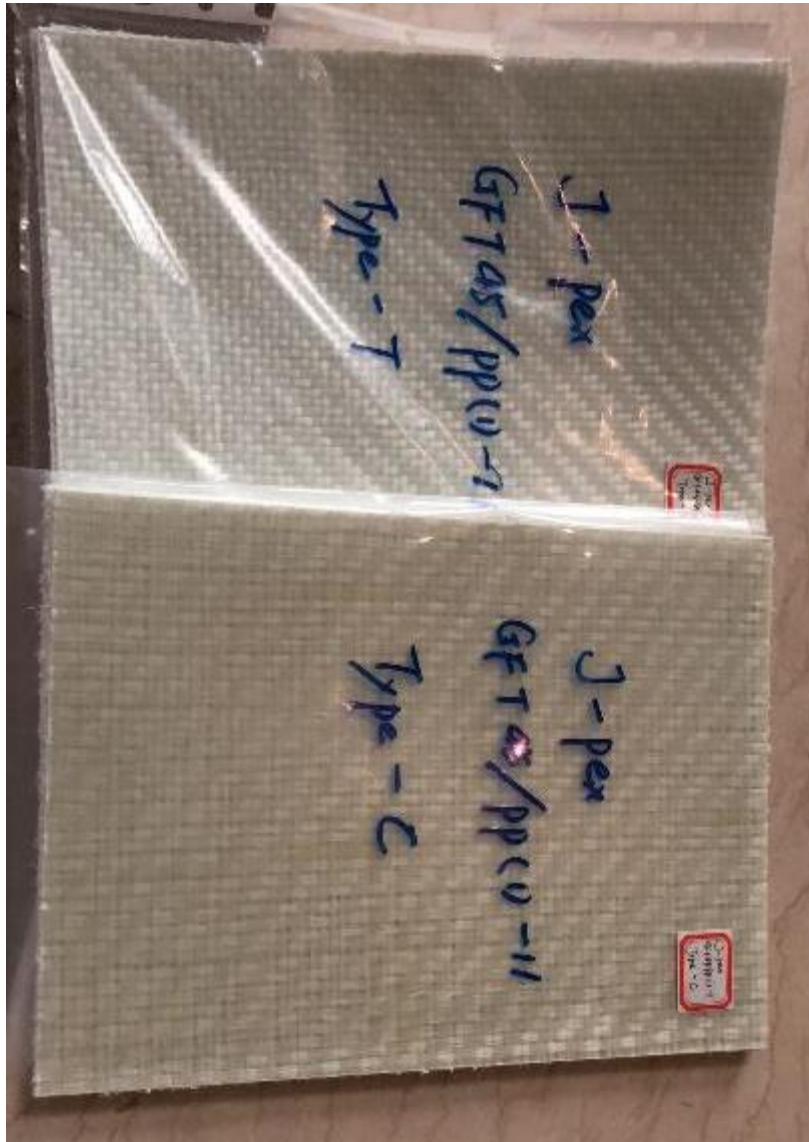
1. Fiber cloth infiltrate
2. Mould pressing
3. Fiber sheet
4. Fiber sheet cutting
5. Semi-finished product
6. Semi-finished product pick-up

Fabric Heater



Enhancing IMC Capability

29

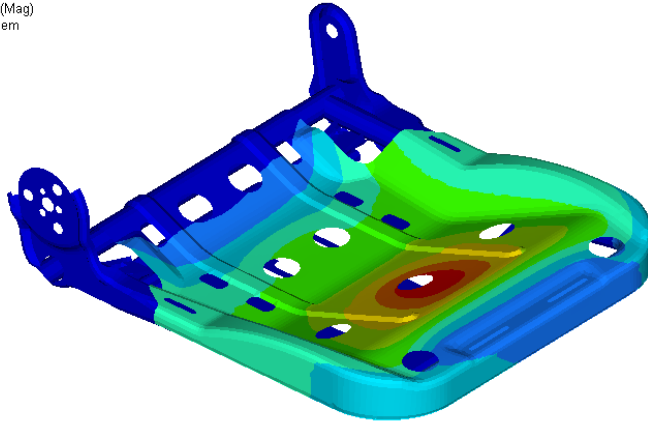


Items	unit	According to Standar	Value
Polymer	-	-	PP
Fiber	-	-	E-glass
Fiber content	vol.%	ISO 1172	45
Density	g/cm ³	ISO 1183-1	1.69
Thickness per layer	mm	-	0.5
Tensile strength	MPa	ISO 527-4	370
Tensile modulus	GPa	ISO 527-4	17
Flexural strength	MPa	ISO 14125	350
Flexural modulus	GPa	ISO 14125	16
Charpy notched impact strength	kJ/m ²	ISO 179	118

Finalised Material Option

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Contour Plot
Displacement(Mag)
Analysis system
-3.045
-2.707
-2.368
-2.030
-1.692
-1.353
-1.015
-0.677
-0.338
-0.000
■ No result
Max = 3.045
Grids 1103
Min = 0.000
Grids 1490



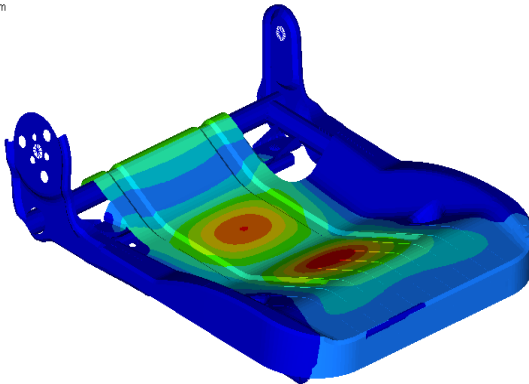
Weight: 3.218 kg
Thickness: 0.9 mm

Current design : Steel

Displacement: 3.045 mm

Proposed design: PP CGF 30 %

Contour Plot
Displacement(Mag)
Analysis system
-3.959
-3.519
-3.079
-2.639
-2.199
-1.759
-1.320
-0.880
-0.440
-0.000
■ No result
Max = 3.959
Grids 8177
Min = 0.000
Grids 11837

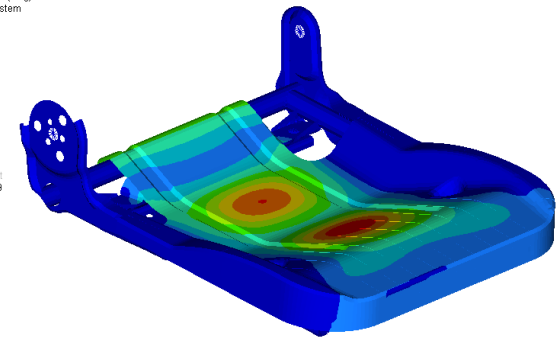


Displacement: 1.24 mm

Weight: 1.125 kg
Thickness: 3 mm

Proposed design: PA 6 CGF 30%

Contour Plot
Displacement(Mag)
Analysis system
-3.959
-3.519
-3.079
-2.639
-2.199
-1.759
-1.320
-0.880
-0.440
-0.000
■ No result
Max = 3.959
Grids 8177
Min = 0.000
Grids 11837



Displacement: 0.95 mm

Molding in IMC with Glass Laminate

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Manufacturing Capability

Our Manufacturing Capabilities

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Molding capability available at our Hinjewadi Location:

☐ **2300 T Injection Molding Machine** (1Nos).

Key features :

1. Twin Screw to ensure homogenization, glass/Carbon fibers with Polyolefins, Polyamide.
2. High buffer zone capacity for higher shot size
3. 2300 Tons clamping force for larger parts
4. OHIM (On-Line Injection Hot-press Molding) facility
5. Capability to produce Carbon Fiber reinforced parts.

☐ **1000 T Injection Molding Machine** (1No)

☐ **700 T Injection Molding Machine** (1No)

☐ **450 T Injection Molding Machine** (2Nos)

☐ **Ultrasonic welding machine.**

☐ **Assembly line with poka-yoke.**



Production Facility

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1000 T IMC Machine



Ultrasonic Welding Machine



2300 T IMC Machine



Assembly Line



Our Quality Testing Capabilities

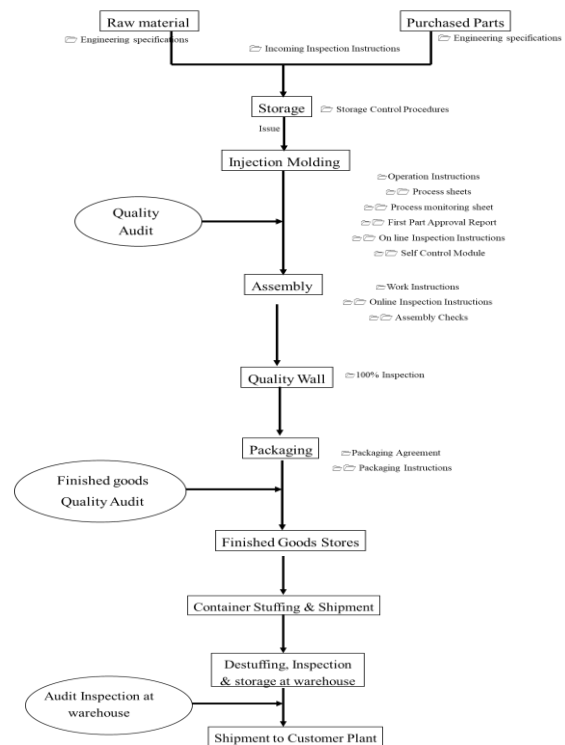
We have our **NABL Accredited Lab** with in-house facilities of Research & Technology Centre at Hinjewadi, Pune

Specialized testing outsourced & monitored by ARAI, Auto-Cluster etc.
RTC labs under certification of TS 16949 and NABL

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Quality Flow Chart



Supplier Awards

36



Zero Defect Supplier - BEL



Best Emerging Supplier - IAC

Our Certification and Awards:

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IATF Certification 16949 : 2016 Automotive Management System



NABL Certification

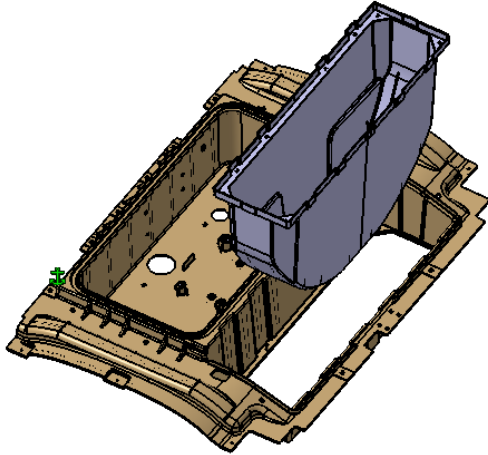


Assembly Operations

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ATSPL have capability of assembly operations. We are supplying to :

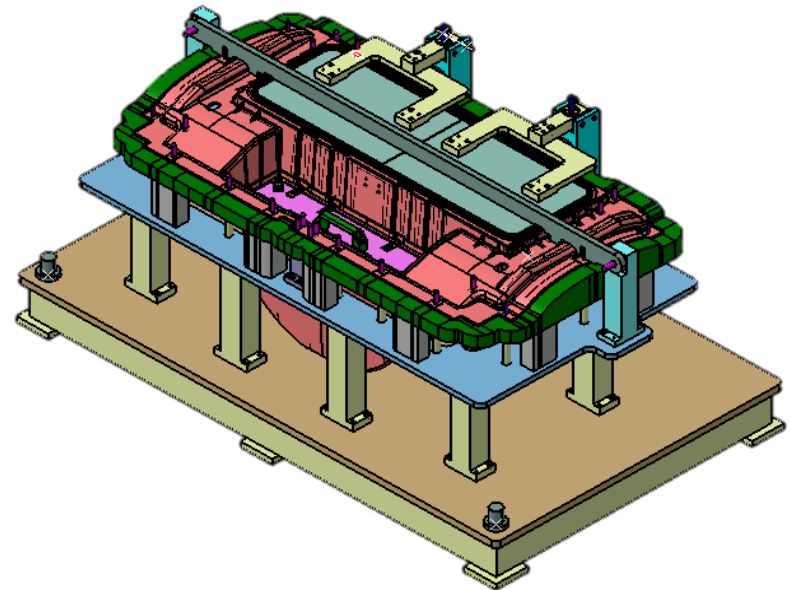
- Mahindra electric ER project
- Mail box- US export project



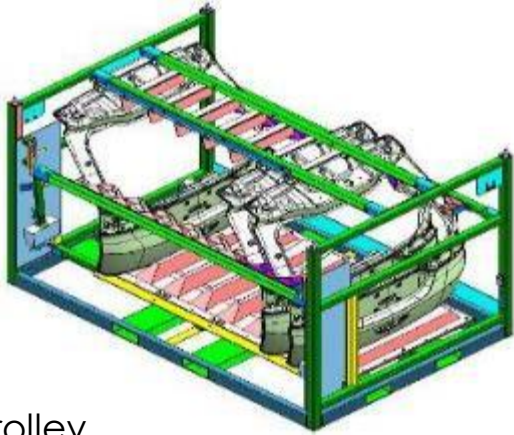
Quality Checking Gauges

39

ATSPL have capability of checking & validation of parts & other quality operations.



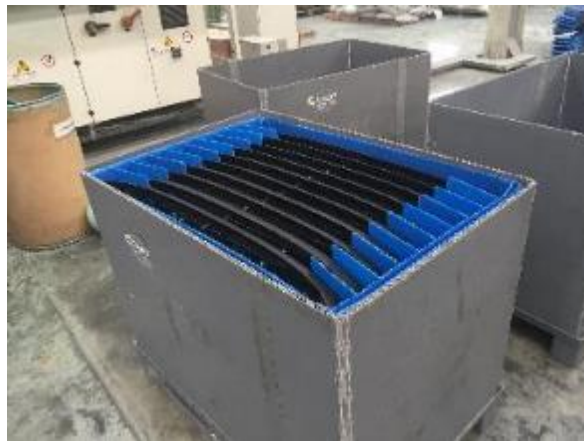
ATSPL have good SCM capability across India over 7 locations.
We have good exposure with exports as well



Trolley



Trolley



Filled with Parts .Each Part secured



Weight reduction of 30% to 50% - Impact due to

➤ **Specific gravity difference between metal & plastics.**

Cost reduction of 10% to 20% - Impact due to

➤ **Process cost** - Combination of 2 process of extrusion & injection molding to 1 process of IMC.

➤ **Raw Material Cost** - Elimination of RM cooling, drying, packing, transport and then re-melting granules in injection molding to make parts. Can select RM ingredients and compound & injection in 1 shot.

➤ **Quality improvement** – Better Retention of Polymer properties by reducing one melting cycle

Thank You