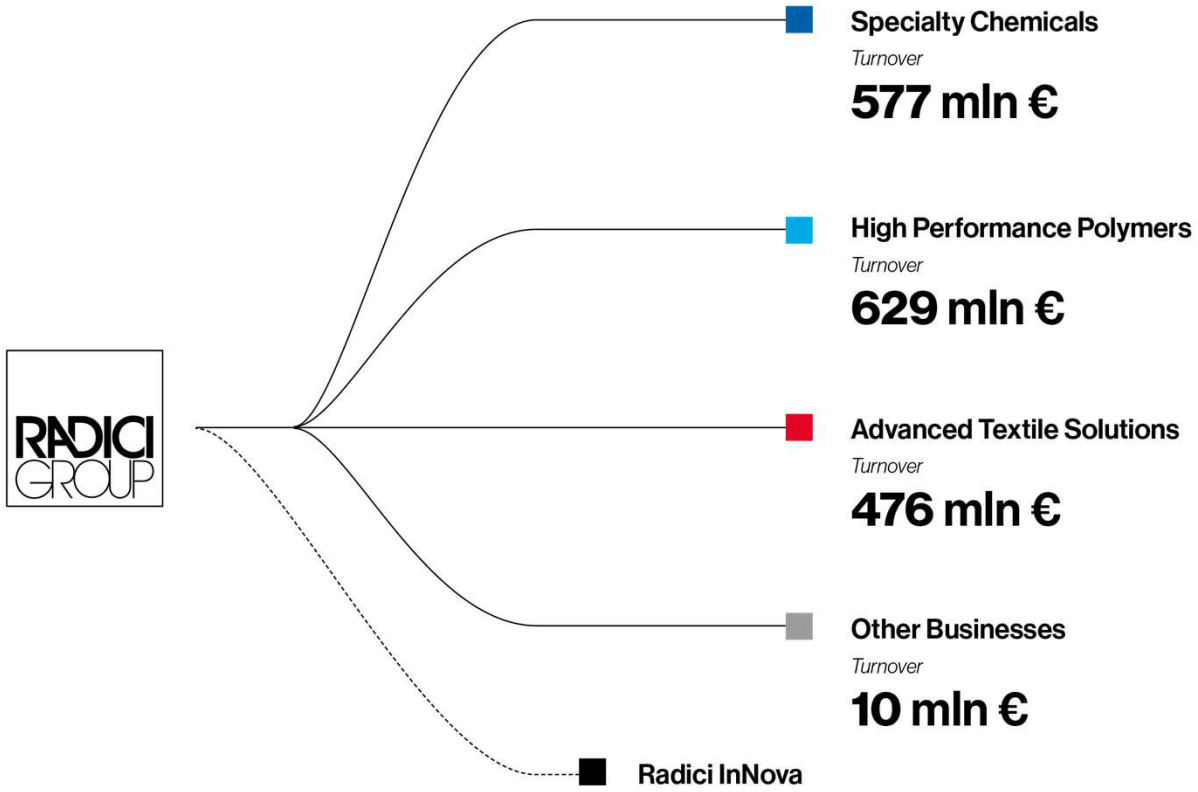
mid Moulding Innovation Day 2025

Structural components of an electric self-balancing wheelchair (metal replacement) and a redesign problem solved by Moldex3D

RADICI Group
Andrea Canegrati

Moldex3D

Business area turnover



High Performance Polymers

Genny Zero: the project

Key features

> **Concept:** Self-balancing, fully electric wheelchair for sustainable and inclusive urban micromobility.

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> **Design:** Combines accessibility, functionality and aestethics, maximizing comfort and users' experience.

Genny Zero: Radici contribution

Material solutions

> ***Structural components***

❖ **Frame**: **RADILON S RV300W**, 30% GF PA6.

High stiffnes, good mechanical resistance, excellent heat resistance and aging properties retention.

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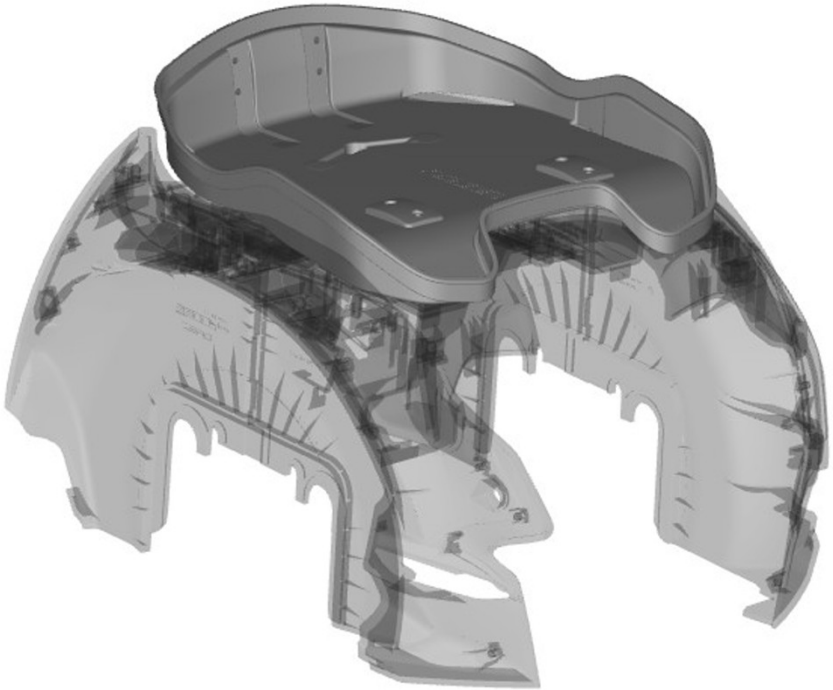

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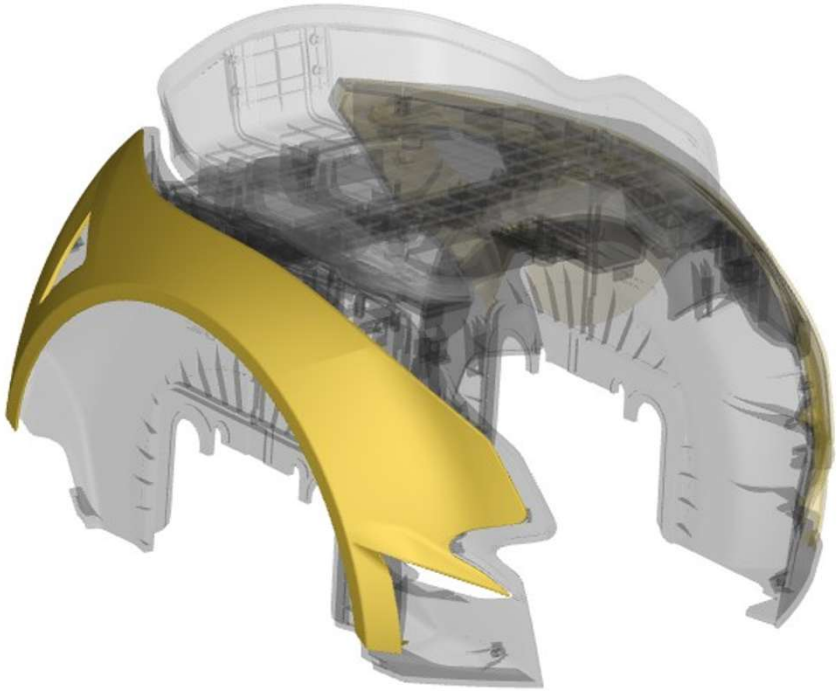
Toughned, high impact resistance and improved flexibility. Enhanced surface aspect.



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Support design with know-how and CAE tools

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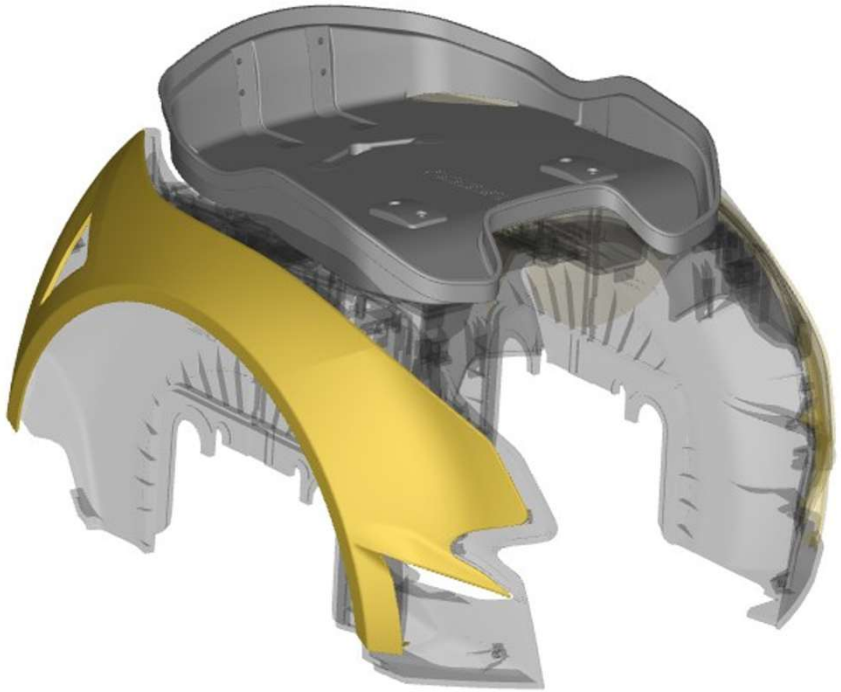

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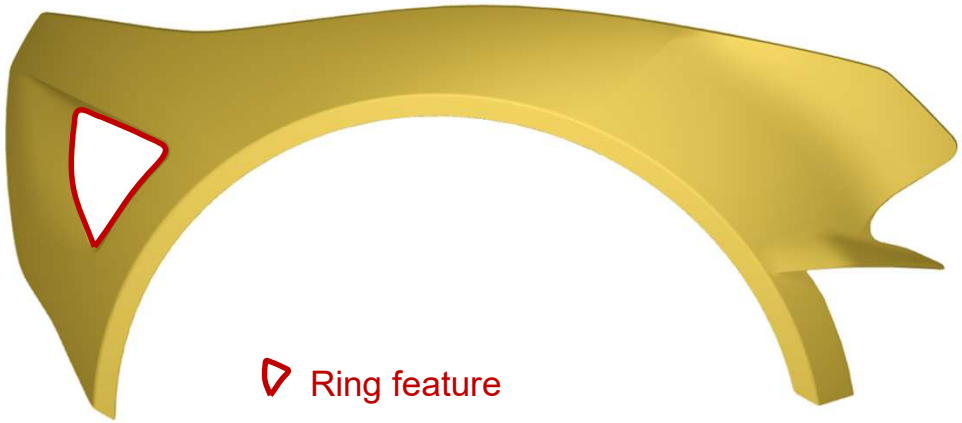
Key features and customer's requirements

> **Flawless appearance:** hide weld lines from filling of a geometry with a ring-like feature



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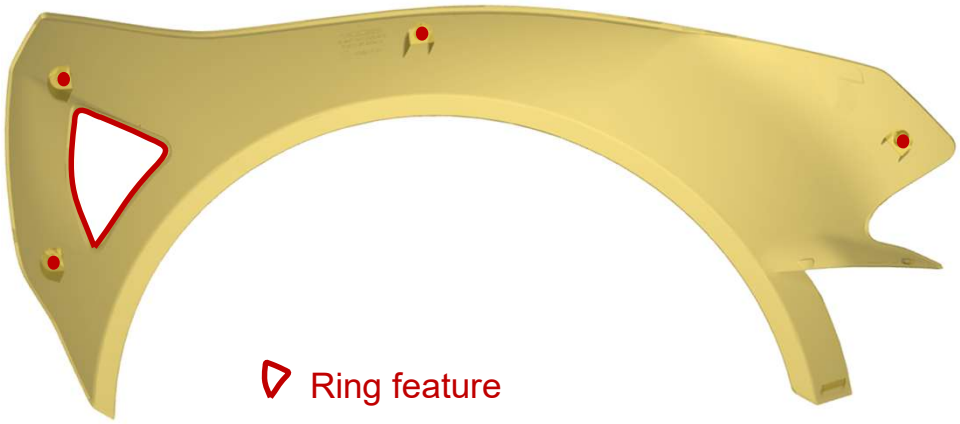
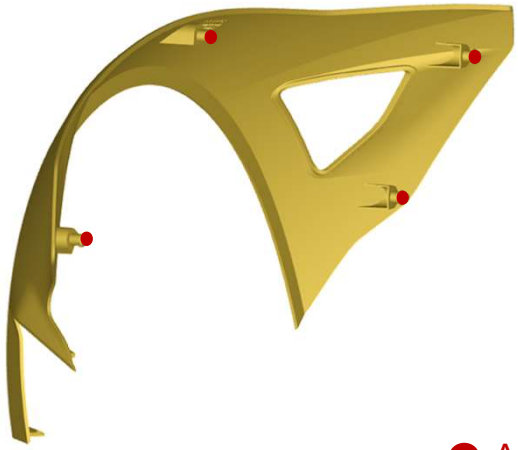


Ring feature



Anchor points

Genny Zero: Fairings

Key features and customer's requirements

> **Flawless appearance:** hide weld lines from filling of a geometry with a ring-like feature

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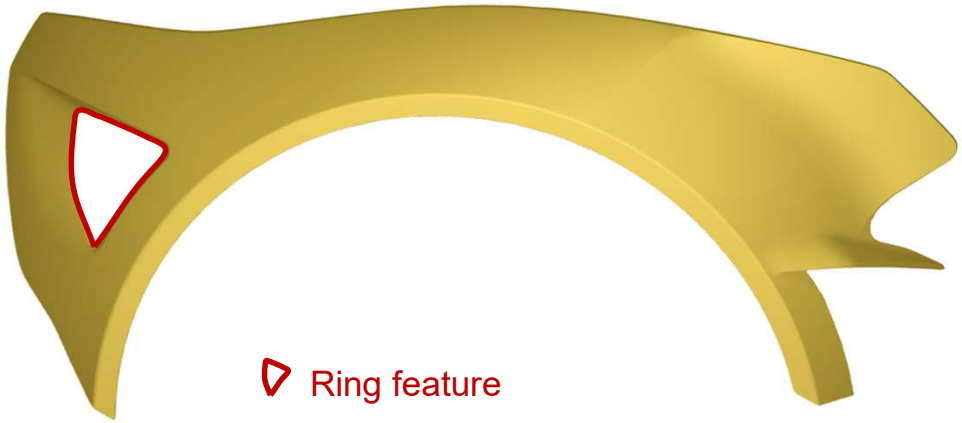
> **Mass coloured:** Neat grade, ensuring top-notch surface finishing

> **Natural coloured:** to be taylor-painted on customer's will. Dry of the paint in oven. 8% glass fibre added to improve dimensional stability at high temperature



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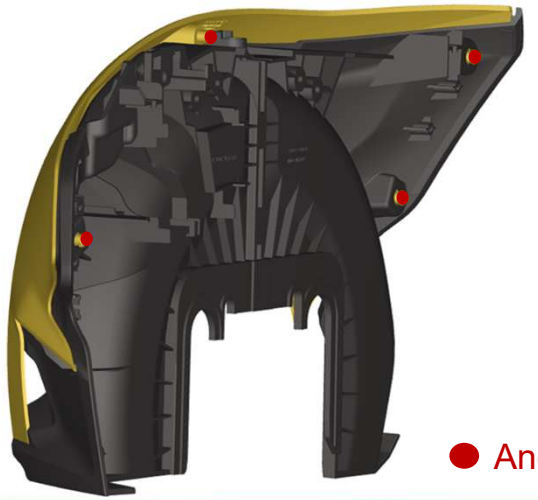

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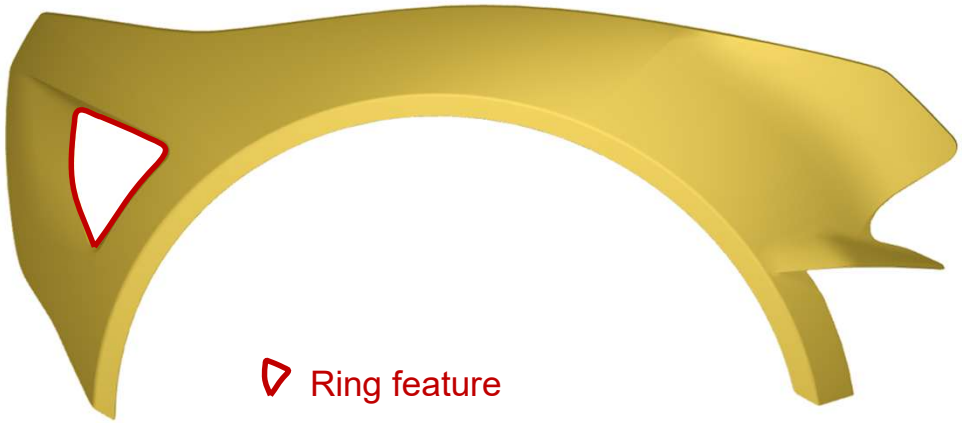
Challenge: Single mold processes 2 Materials



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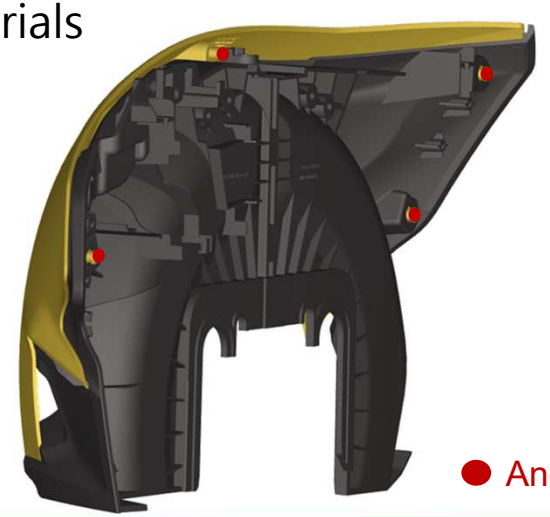
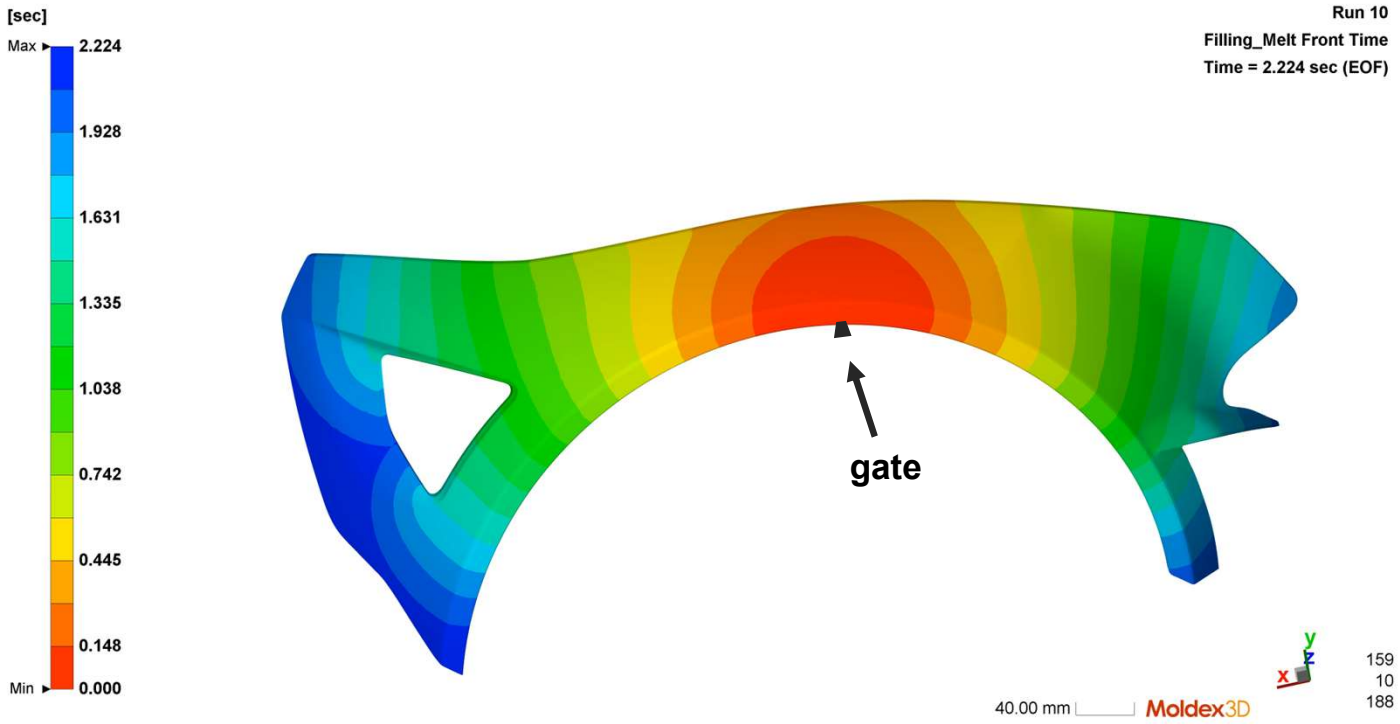


Anchor points

Fairings – Process Simulation

1st option: Single, mid-span gate

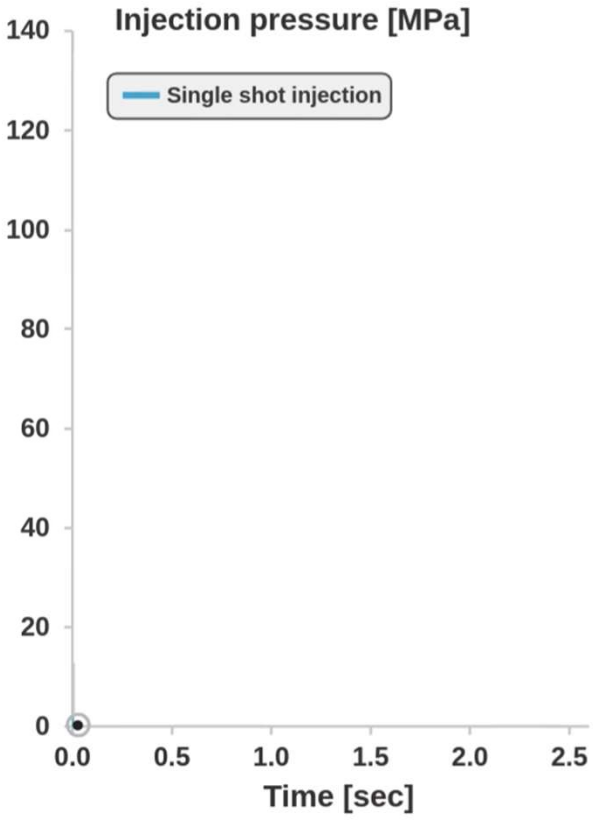
> **Filling**: Melt front advancement

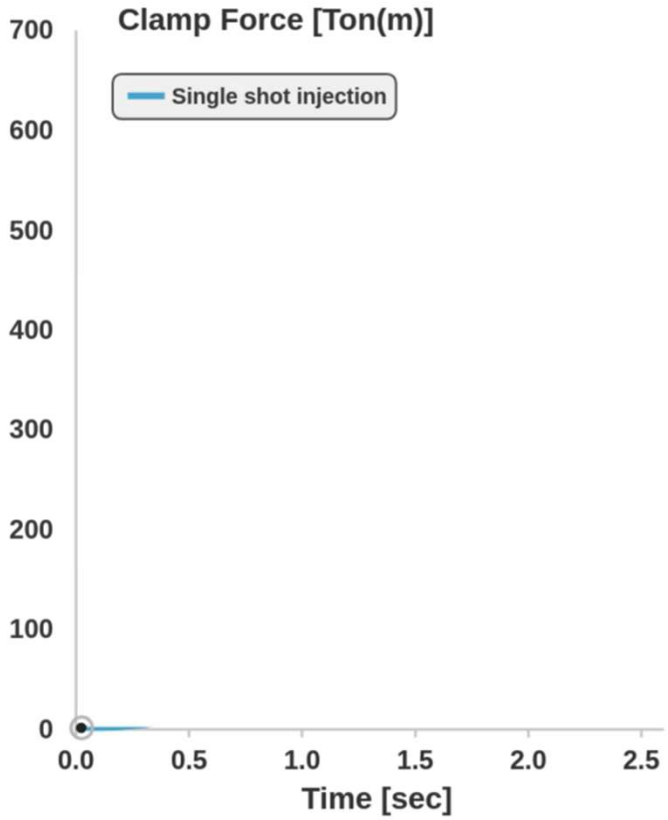


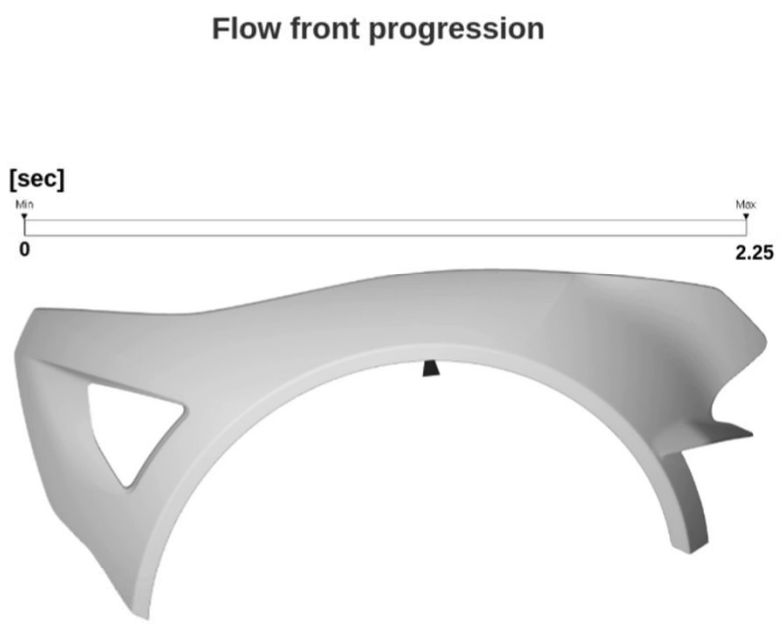
- Smooth filling
- Weld line spot exposed
- High injection pressure
- High clamping force

Fairings – Process Simulation

1st option: Single, mid-span gate







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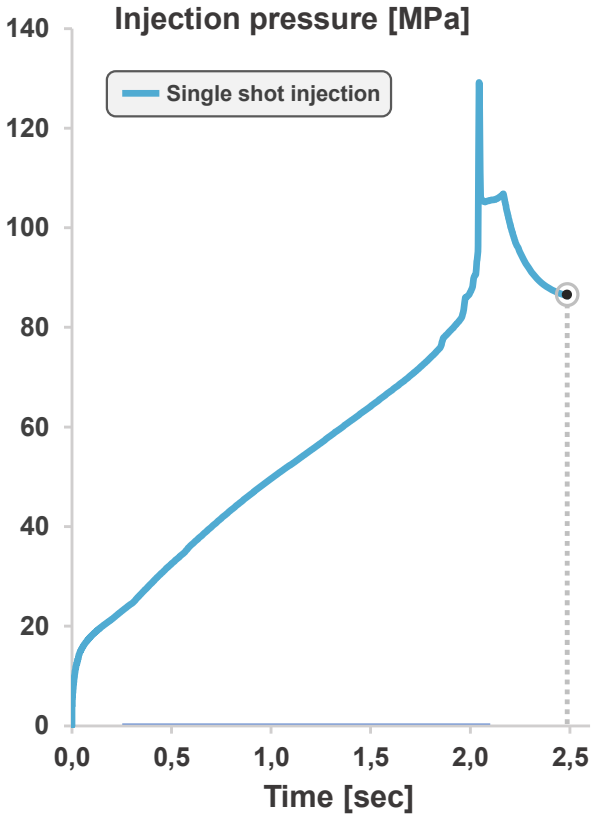
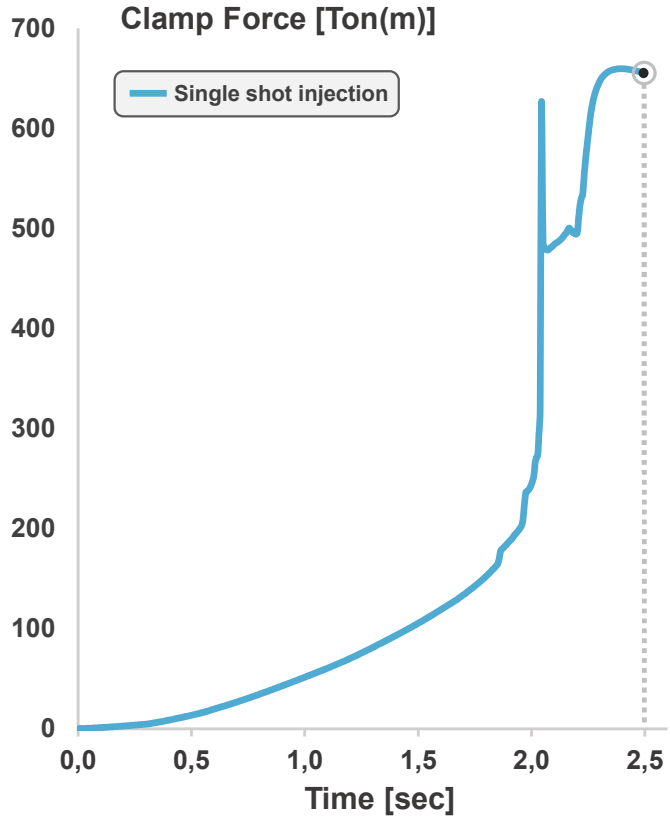
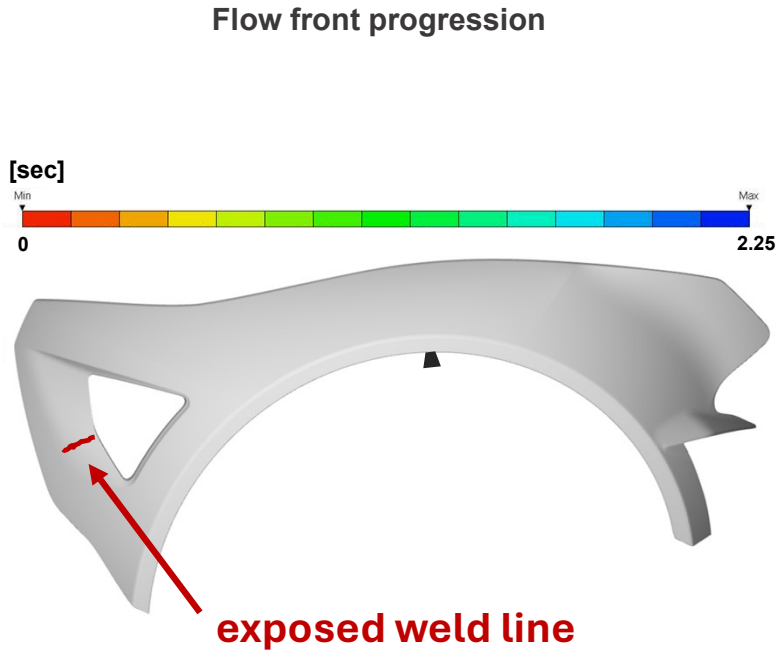


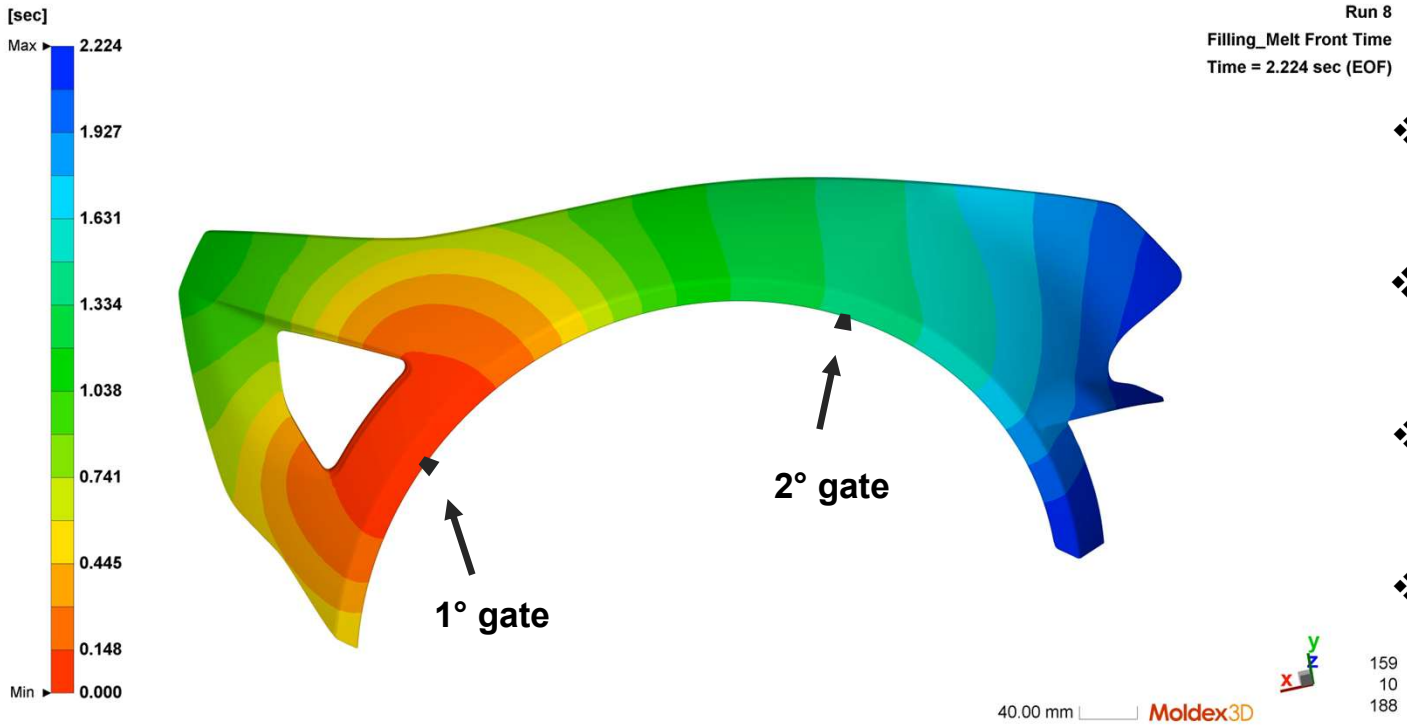




Fairings – Process Simulation

2nd option: Double gate, sequential injection

> **Filling**: Melt front advancement



- Smooth filling
- Weld line spot hidden
- Moderate injection pressure
- Handleable clamping force

Fairings – Process Simulation

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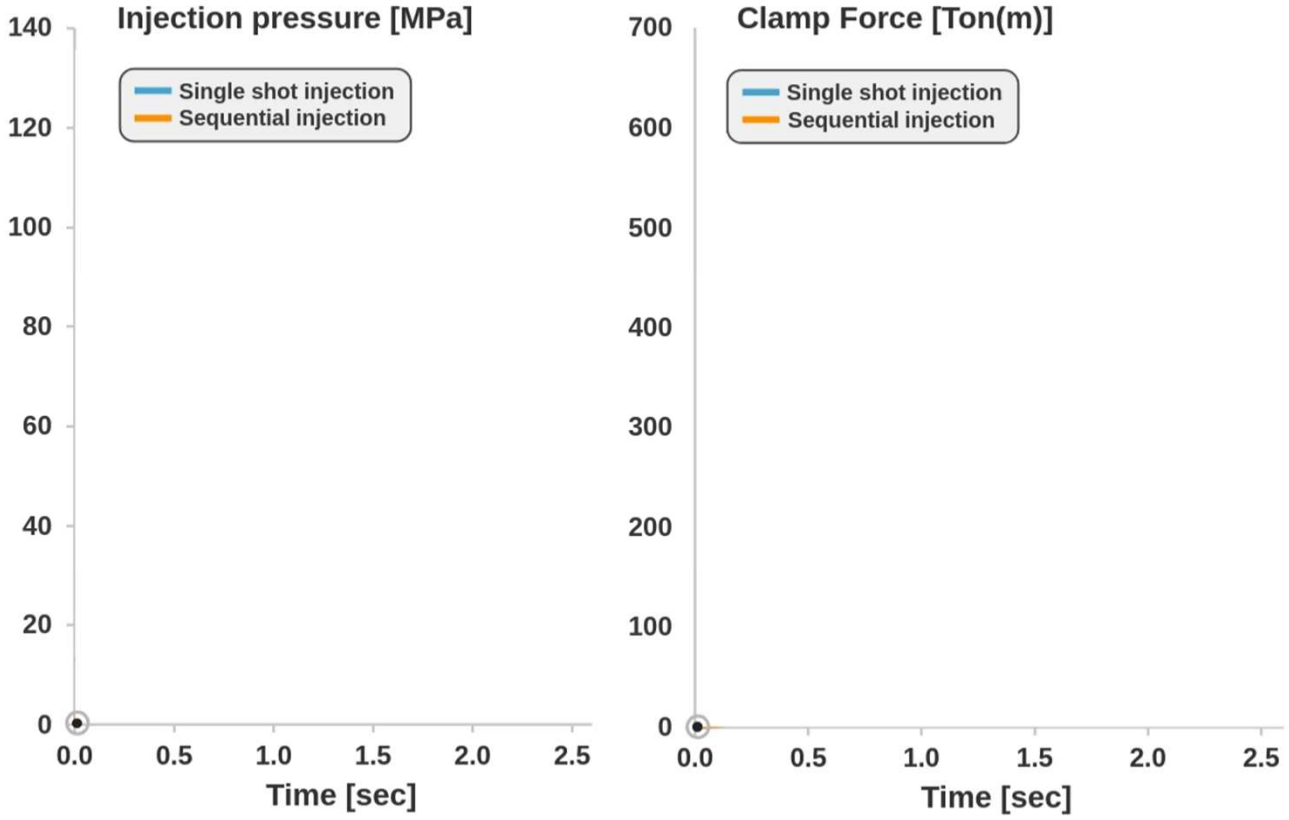

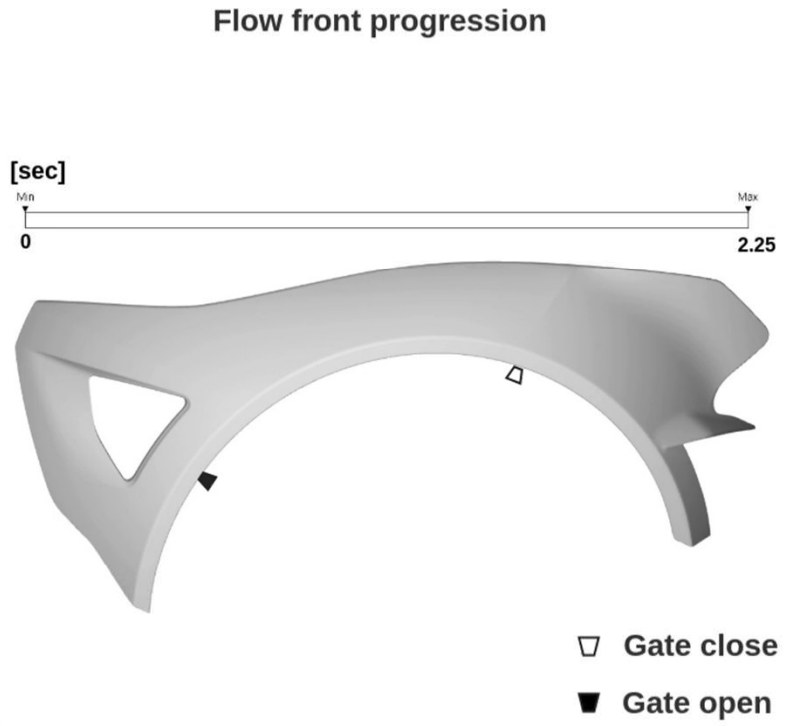

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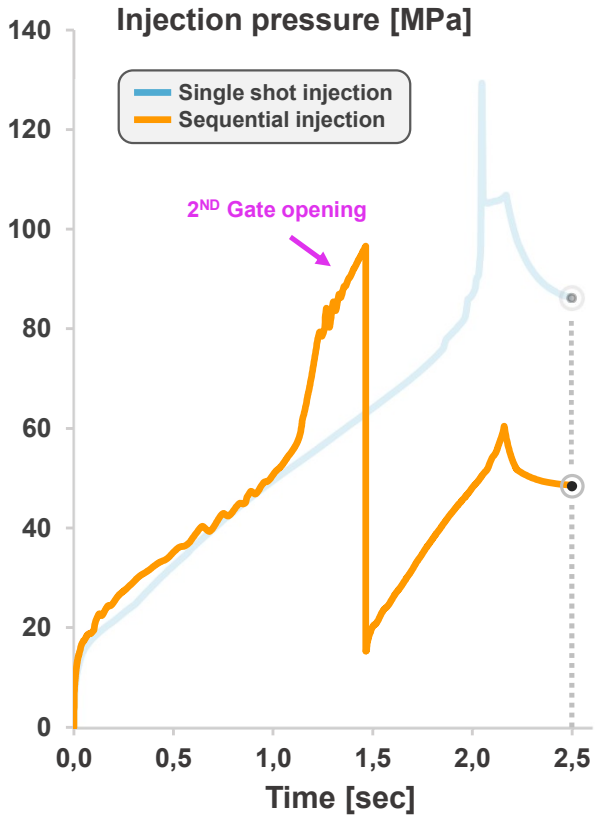
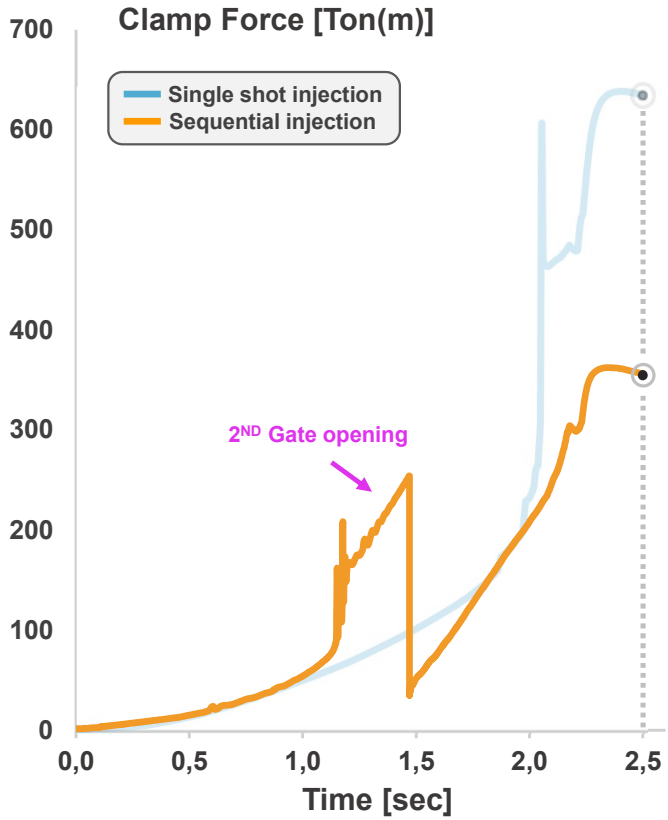
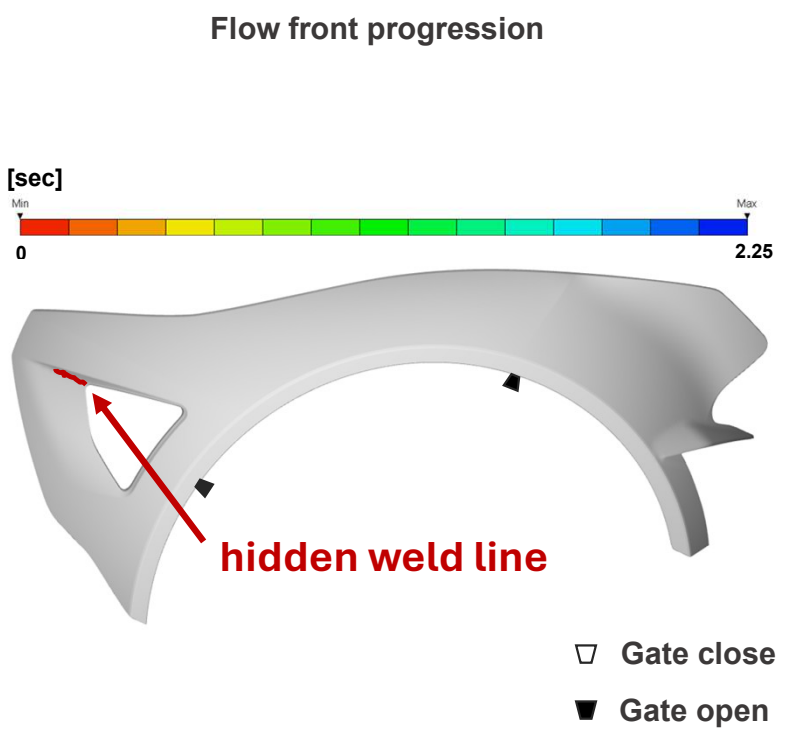


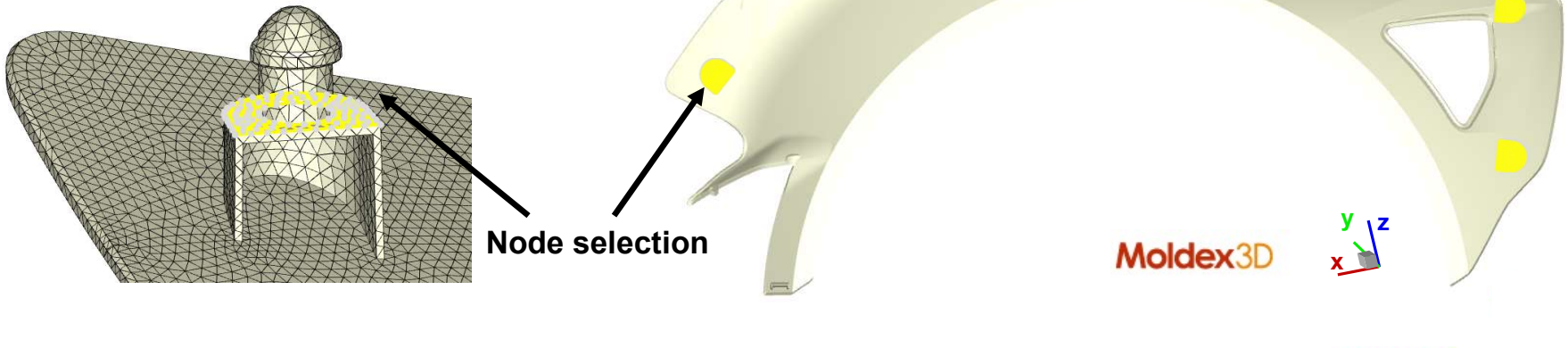




Fairings – Warpage simulation

Local Best-Fit approach

Local Best-Fit approach delivers warpage results to local best match the deformations of the selected nodes against their original values.



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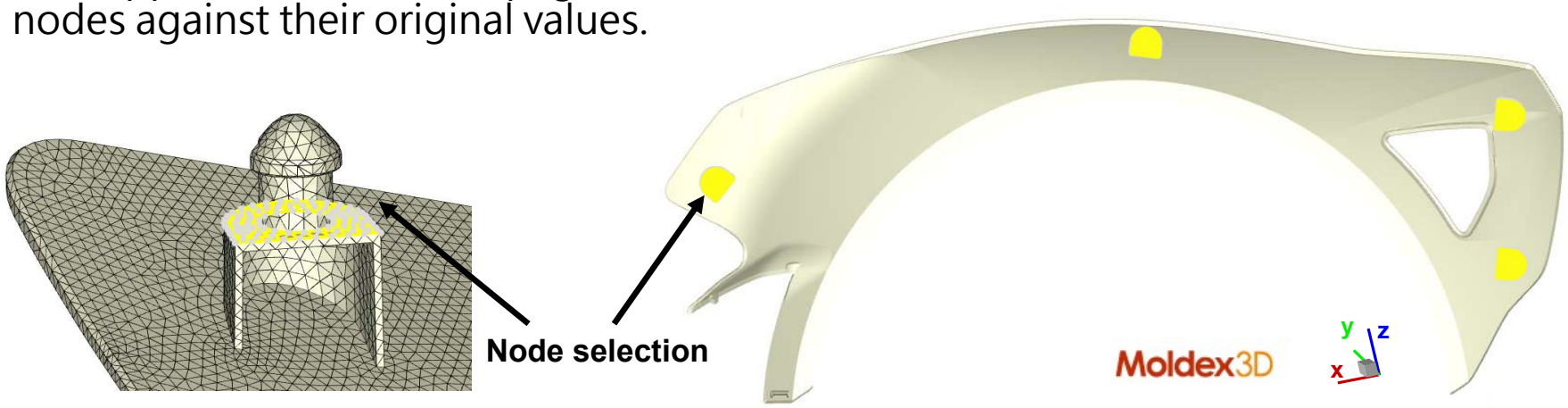


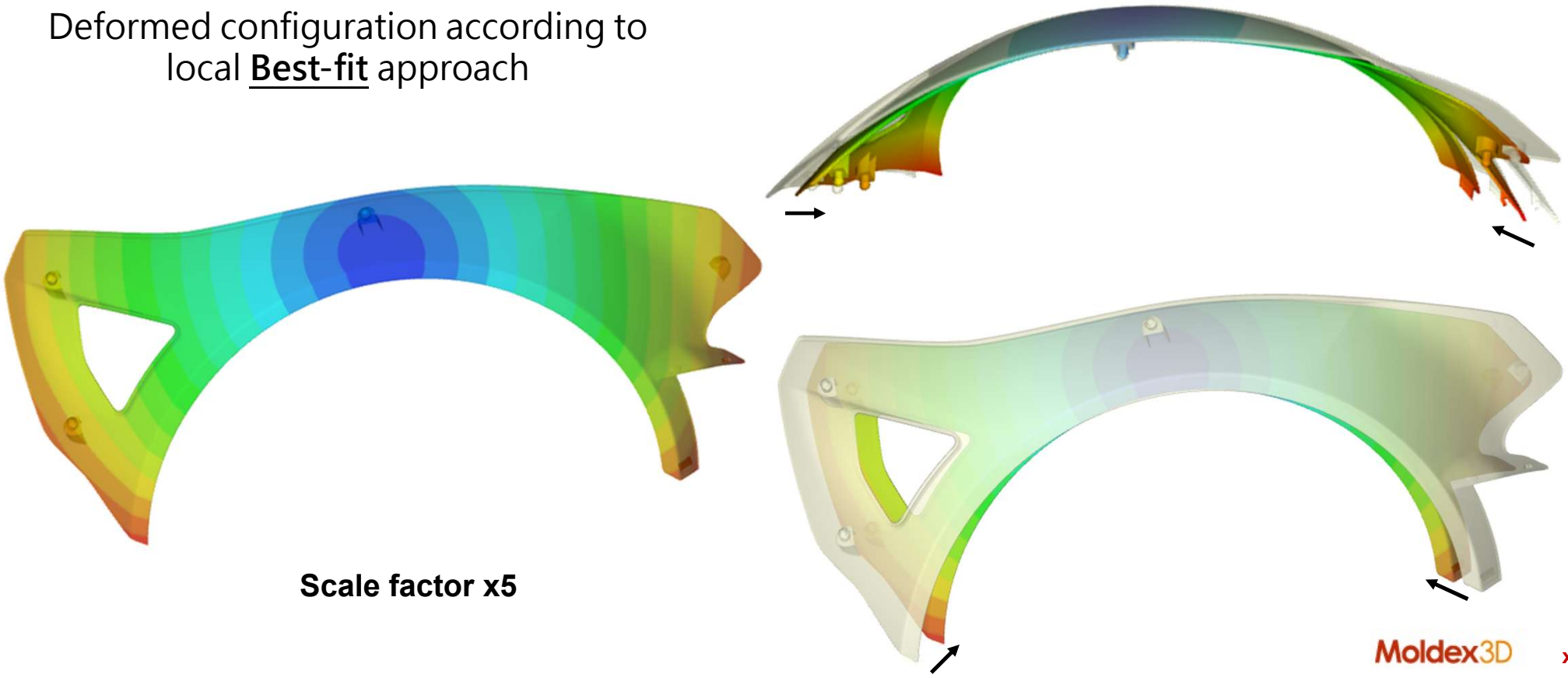
The offset of the fastening point in the warped configuration against the original is evaluated, allowing:

- potential issues during the fairing-to-frame assembly, caused by excessive offsets, to be anticipated already in the simulation phase.
- the rendering of the shape the fairing will retain once assembled on the frame

Fairings – Warpage simulation

Sequential injection – Local Best-Fit – Neat Grade

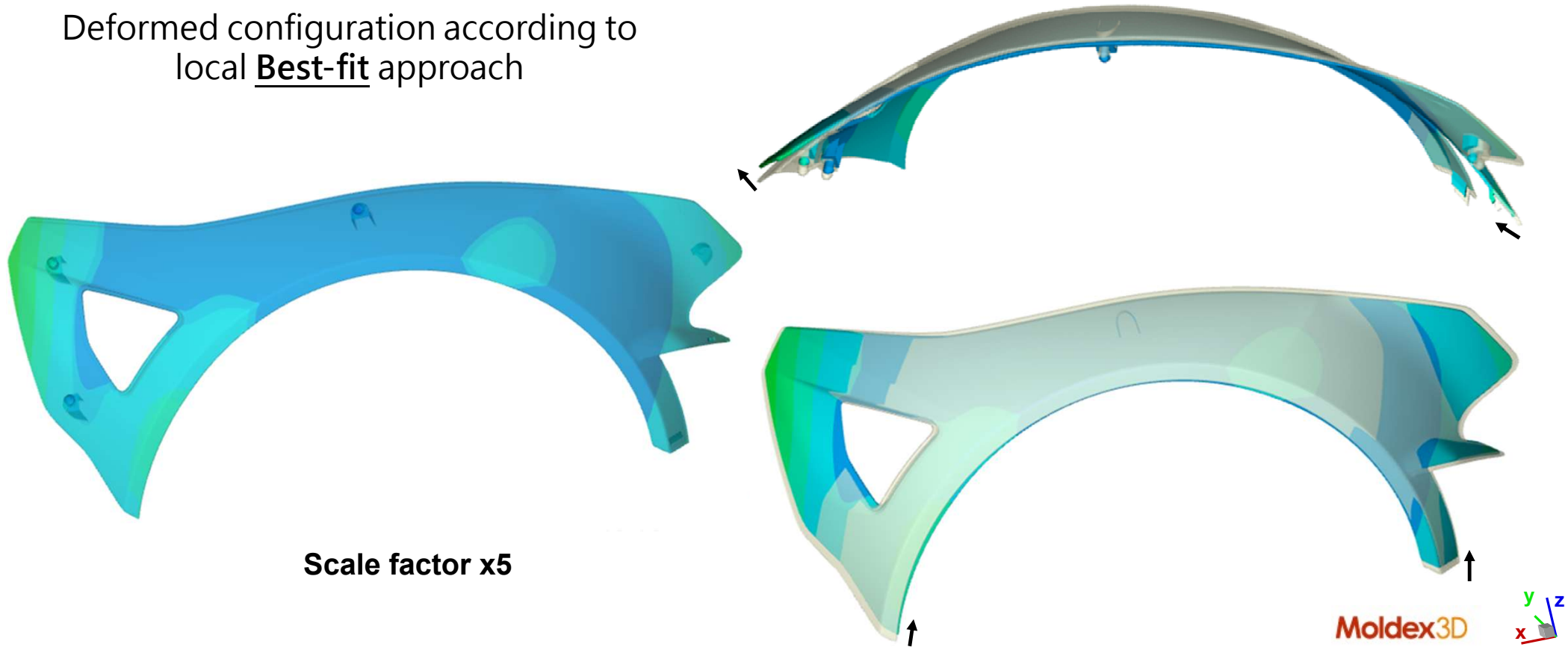
Deformed configuration according to local **Best-fit** approach



Fairings – Warpage simulation

Sequential injection – Local Best-Fit – 8%GF Grade

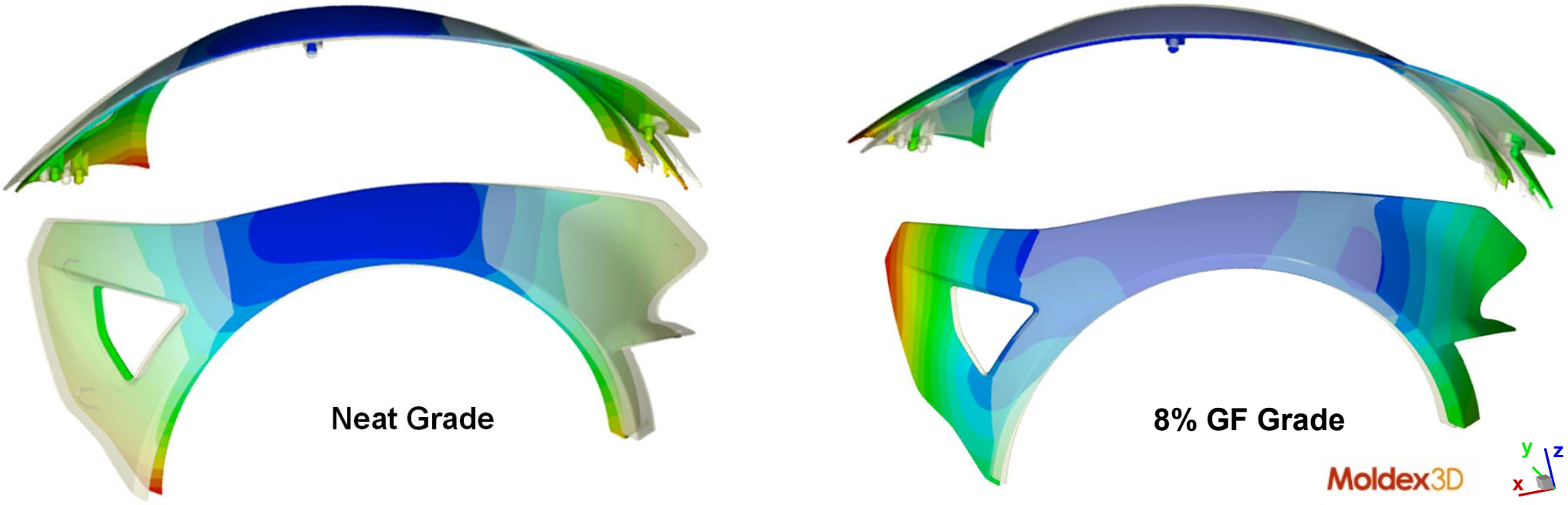
Deformed configuration according to local **Best-fit** approach



Fairings – Warpage simulation

Sequential injection – Local Best-Fit – Comparison

A single, suitable, isotropic mold compensation value was sapplied.



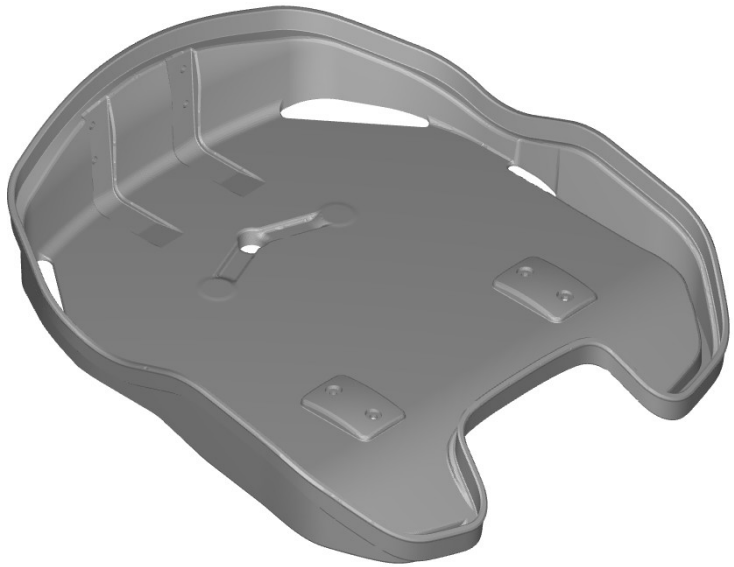
The predicted deformed configurations, for the two materials, considering mold compensation, are similar. On the basis of the simulated results the mold design was carried out.

Genny Zero: Seat

Key features and customer's requirements

Target: Replace Aluminium with engineering polymer.

> Why?



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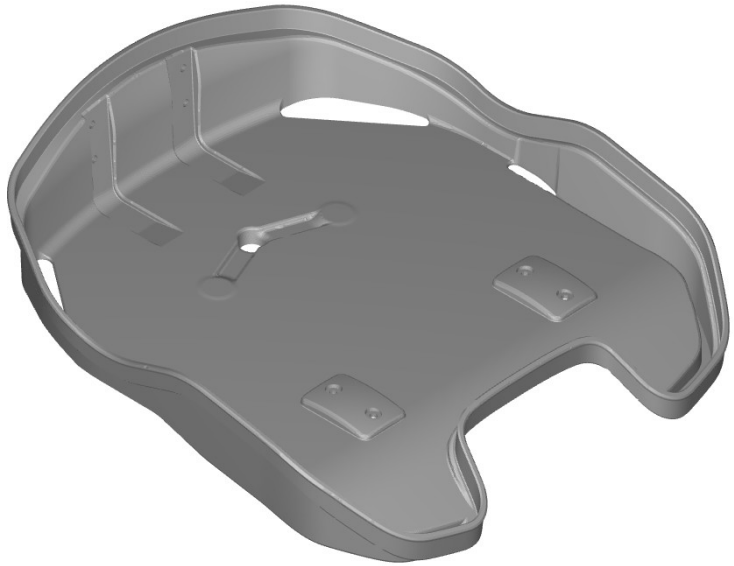

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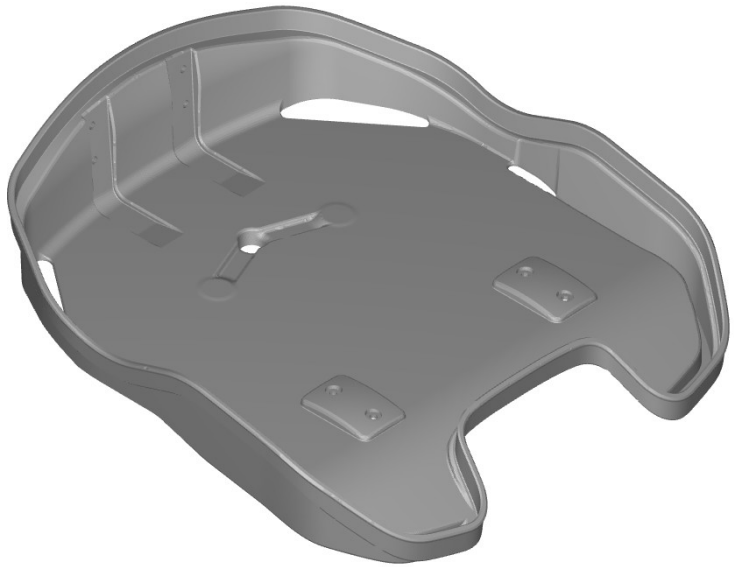

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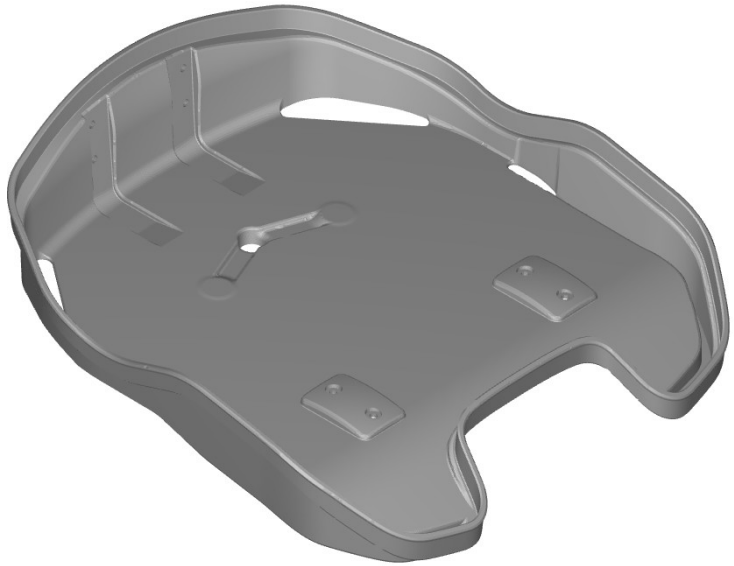

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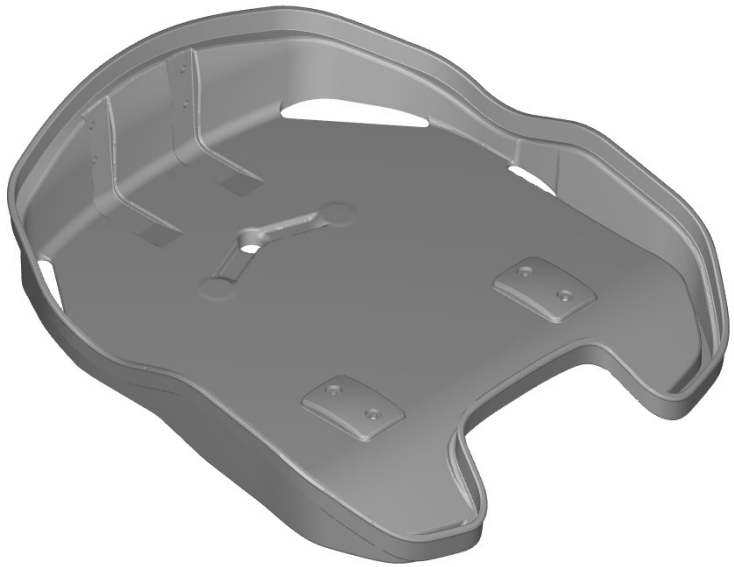
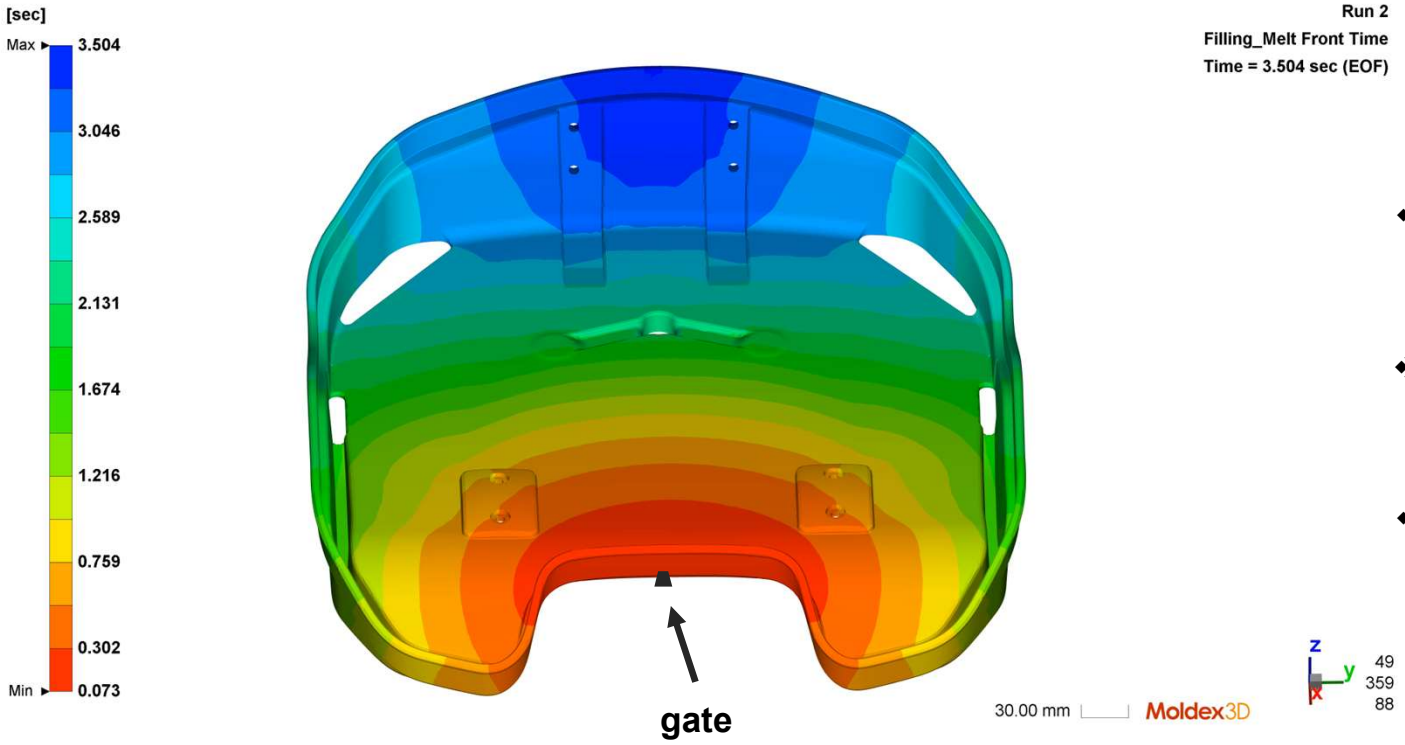


Challenge: select gate location providing maximum fibre alignment with expected load, prediction of fibre orientation distribution.

Seat – Process Simulation

Head injection gate

> **Filling**: Melt front advancement



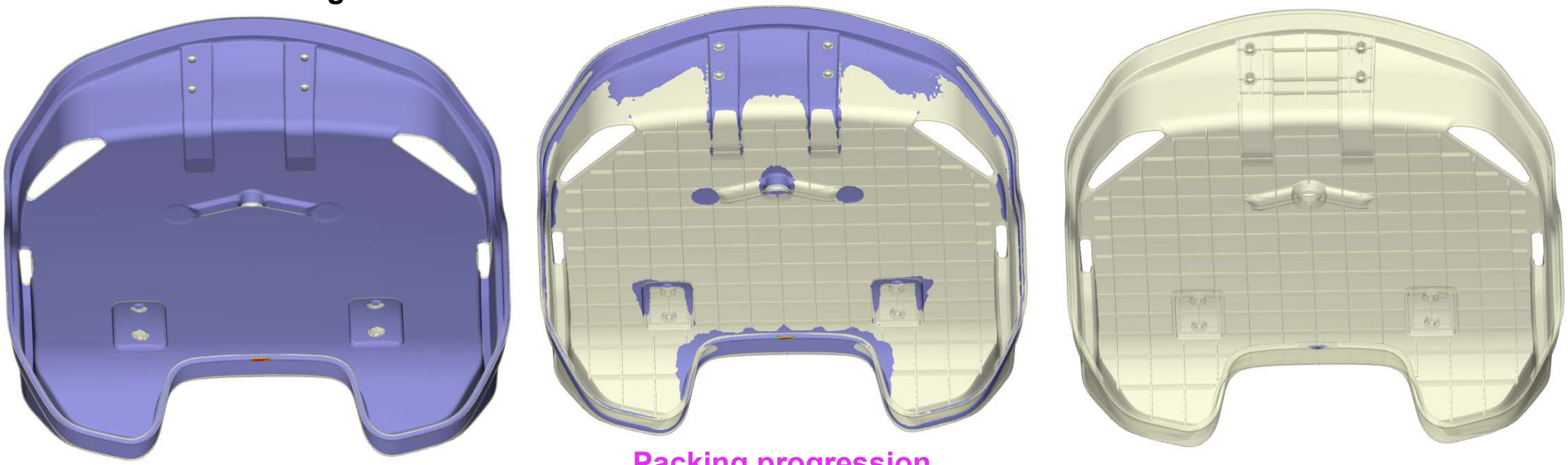
- Smooth filling
- Strategic gate positioning
- Moderate injection pressure

Seat – Packing Simulation

Molten core

High packing quality ensures material consolidation, resulting in best performance under load.

End of filling



End of packing

Packing progression

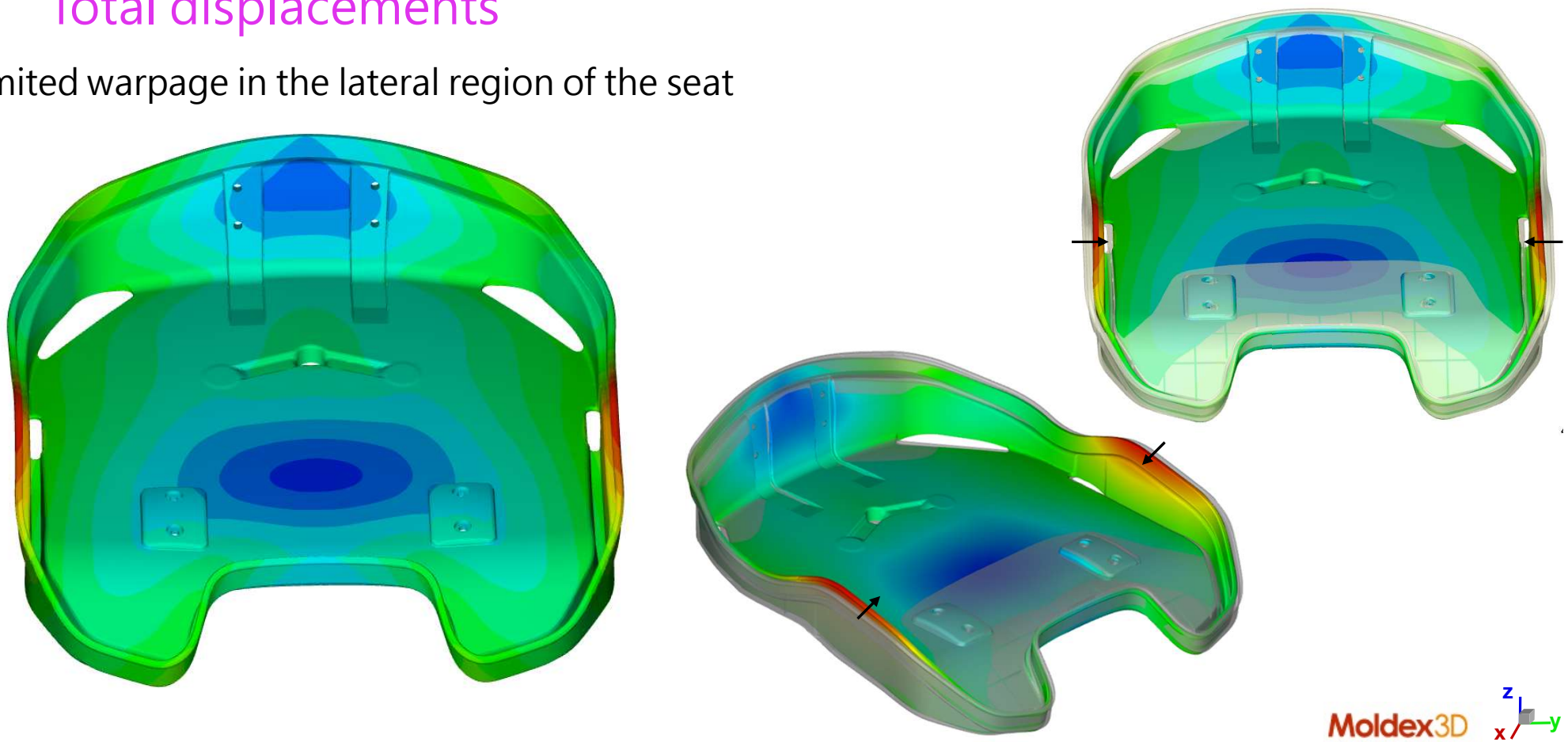
Prediction of material solidifaction and consolidation

Moldex3D

Seat – Warpage Simulation

Total displacements

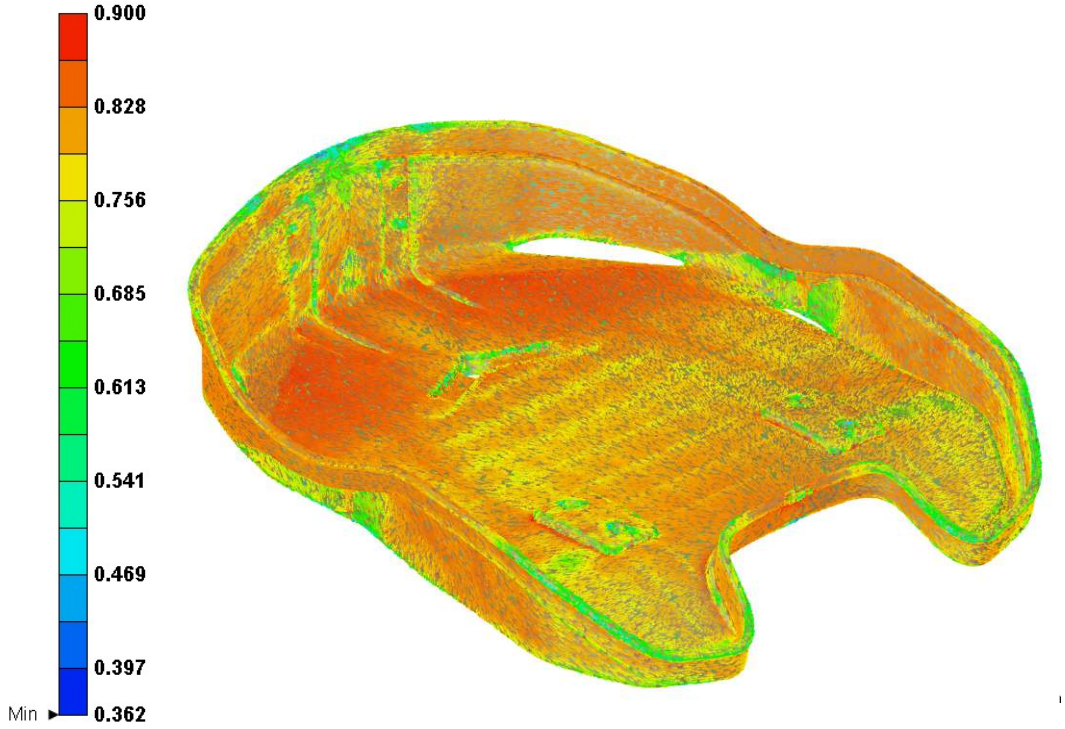
Limited warpage in the lateral region of the seat



Seat – Fibre orientation

1st eigenvector

The simulated fibre orientation is preferientally aligned with the expected critical stresses



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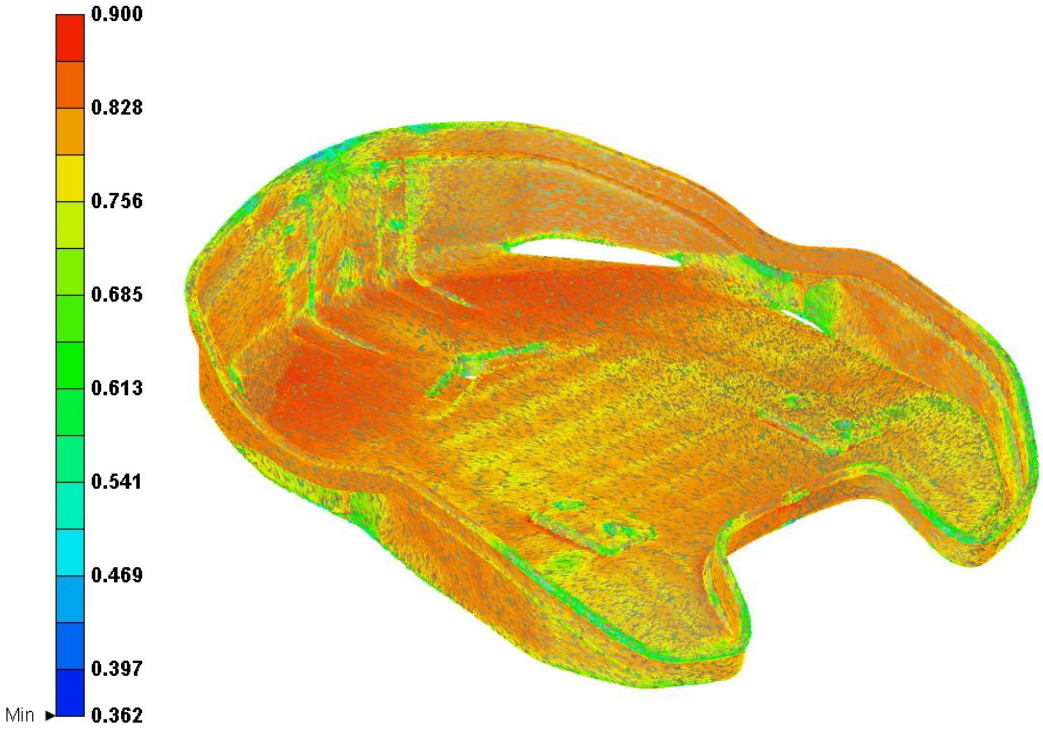
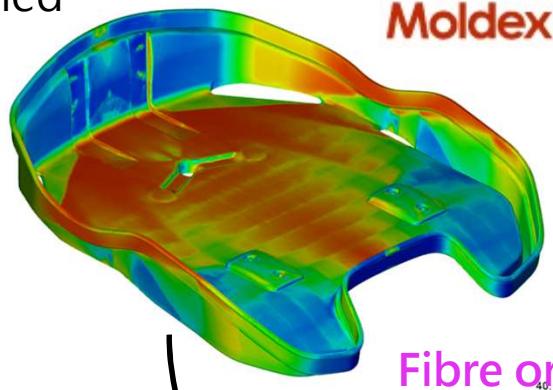
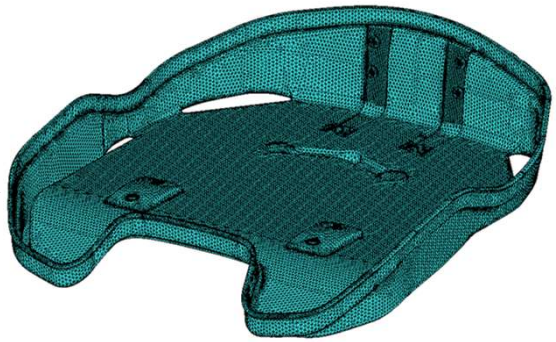


Moldex3D **Manufacturing simulation**



Fibre orientation mapping



Structural analysis

Moldex3D

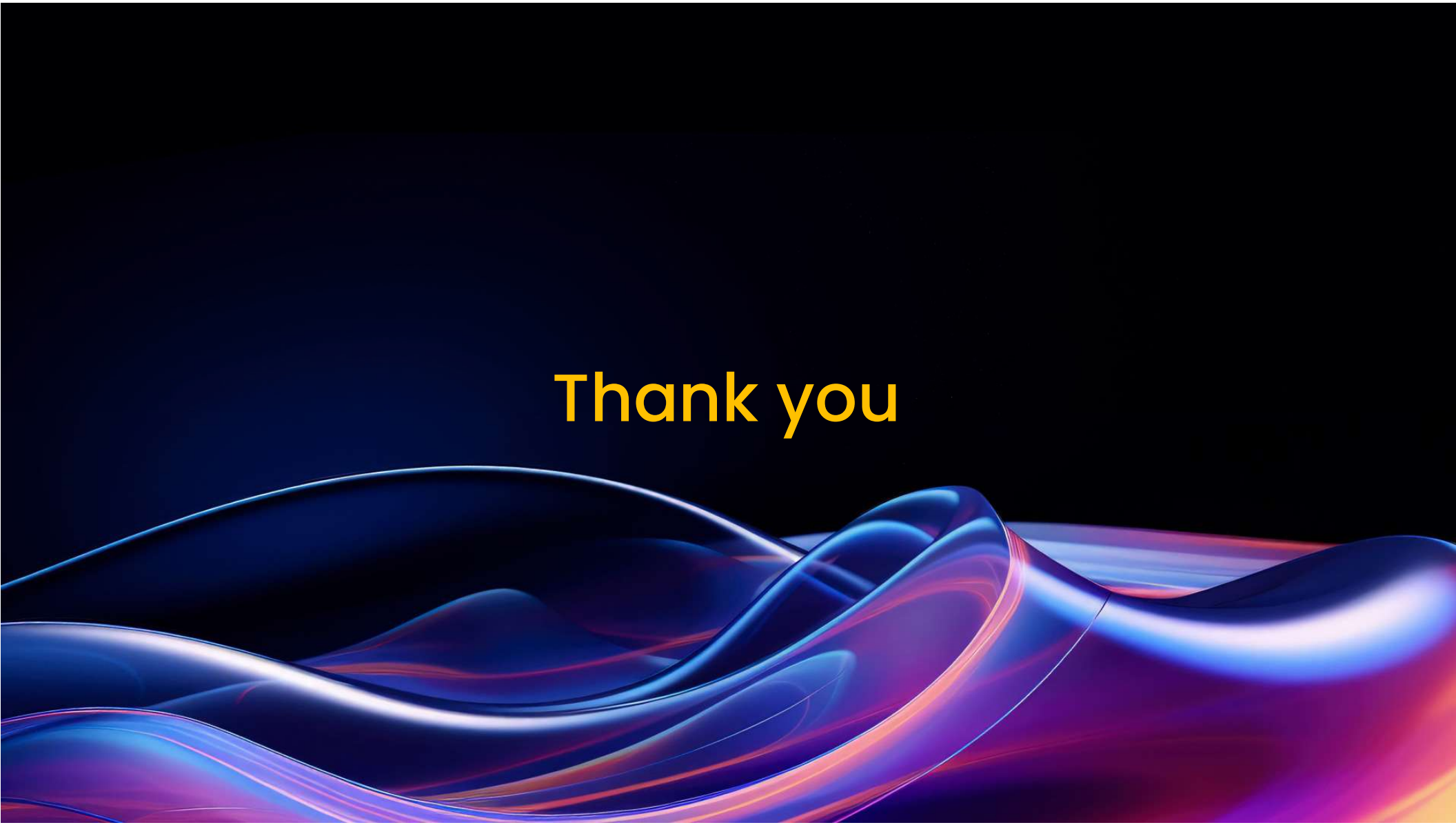
Takeways

> The design of the fairings and of the seat of an electric, self-balancing wheelchair was supported by process simulations.

> To meet customer's requirements on final components, potential process related issues should be foreseen in the design stage.

> An advanced process simulation helped us to:

- ❖ Identify and manage the locations of un-aestethic features
- ❖ Tune process parameters according to the customer's technological limits
- ❖ Anticipate possible fairing-to-frame assembly issues, due to excessive offsets between anchor points (Fairing-Frame)
- ❖ Evaluate fibre orientation distribution to be transferred to structural simulation


Thank you

. Presentazione azienda
. Problema
. Ipotesi di Soluzione

mid Moulding Innovation Day 2025