Warpage minimization of structural component with glass fiber reinforced polymer by using HRS's FlexFlow technology: a practical case

HRS FLOW HOTRUNNER TECHNOLOGY | *Passion for expertise*

CONNECT! – Frankfurt/Main 3° May 2017

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Introduction

Company Structure

INglass

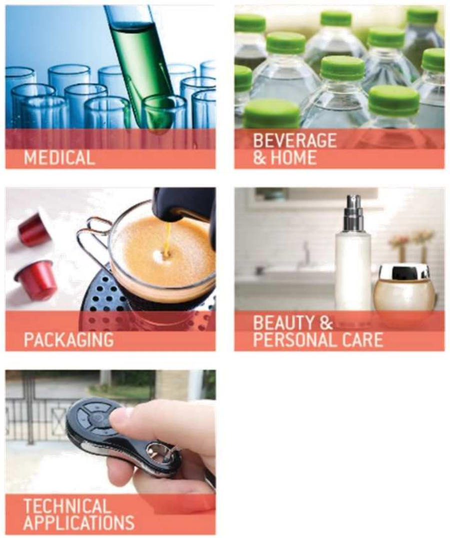
HRS

ERMO

AUTOMOTIVE

NON AUTOMOTIVE

MULTITECH
Business Unit



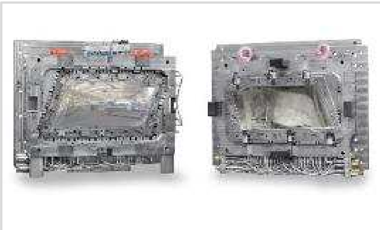
LIGHTING
Business Unit

TEC-PAC
Business Unit

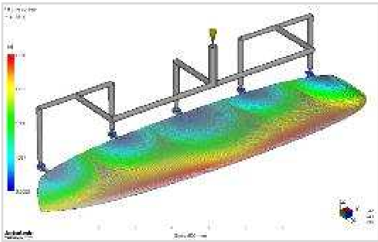
HRSflow advanced Development support

Innovations
FLEXflow electric servo-driven valve gate system

Application experience and solutions
Color change, Mucell, LFG, in mould labelling...



Tooling & Hot runner concepts and solutions
Angled nozzle, Stack molds, SLM (Selective Laser Melting), ERMO in-house tool shop experience



Moldflow
Gating, fill&pack, warpage, Moldflow specialist, HRSflow silver cerificate

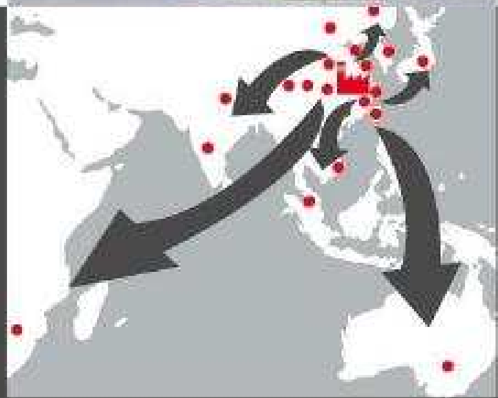
High Knowledge of injection process
20 injection machines available worldwide

Passion for expertise

Our worldwide production plants

Italy - San Polo di Piave
50km north of Venice

China – Hangzhou
175km south west of Shanghai



USA- Michigan – Grand Rapids
250km west of Detroit

3 PRODUCTION PLANTS / 52 SALES/SERVICE BRANCHES AND OFFICES

CAE Team

- ✓ 15 Rheological analysis specialists
- ✓ 4 Senior Engineer Autodesk Professional Level Certified
- ✓ 5 CAE centers on different jet lag
- ✓ Top Autodesk Moldflow and Moldex 3D licenses

Our experts are in the major production centers:

- Italy (EMEA)
- China/India (APEC)
- Canada/USA (NAFTA)
- Brazil (MERCOSUR)

OUR EXPERTISE: SKILLED TEAM

Know-how:
- Mold design
- Hot runners design
- Injection molding process
- Polymers know-how

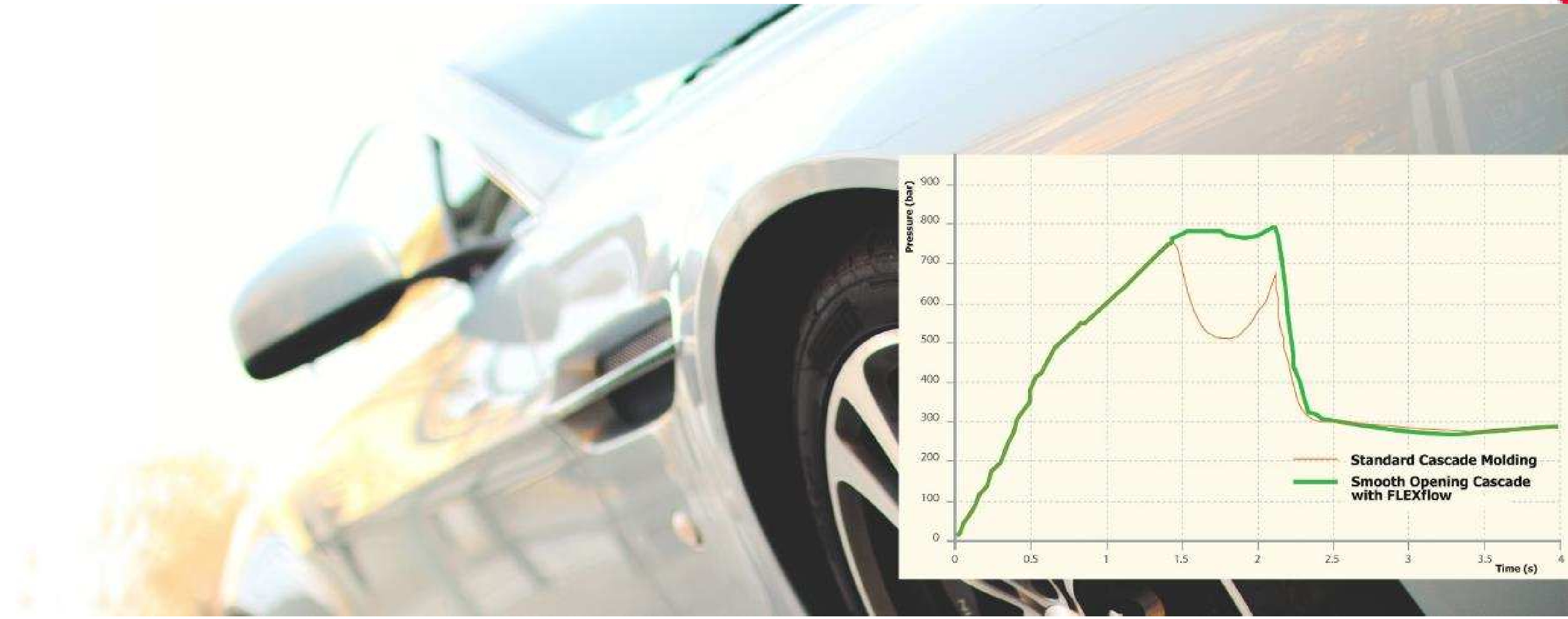
Process Simulation:
- Cooling
- Filling
- Packing
- Fiber Orientation
- Warpage
- Co-injection
- Injection-compression
- Overmolding
- Gas Injection
- Insert Molding

✓ Reduced cycle time
✓ Warpage control
✓ Excellent aesthetical quality
✓ Optimal tonnage for the molding machine
✓ Molding process stability

A good result starts from a correct definition from the beginning

FlexFlow

FLEXflow – The servo-driven valve gate system

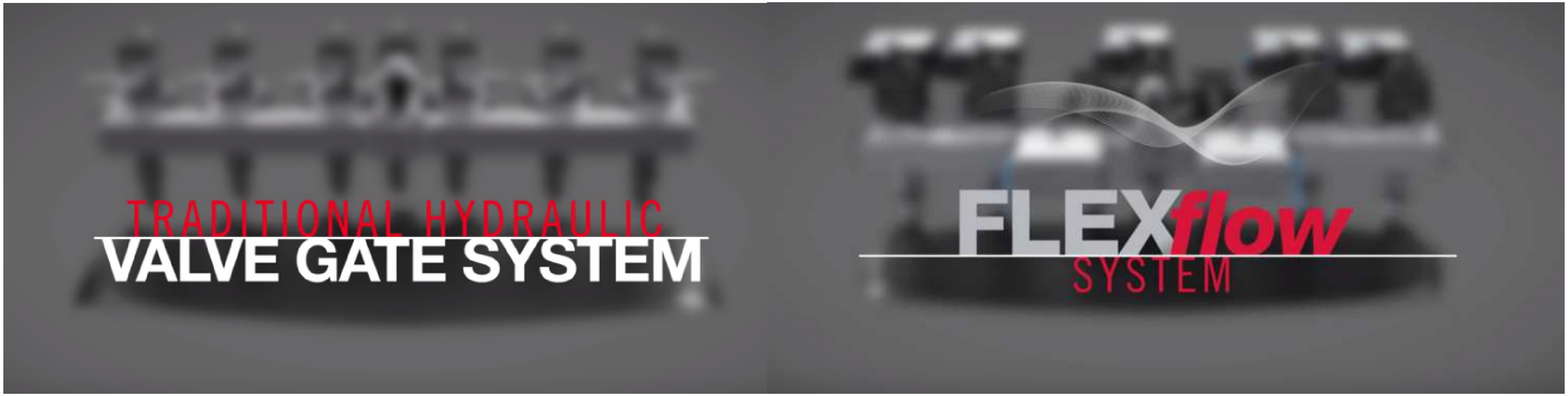


What? The FLEXflow is an innovative **electric servo-driven valve gate system**

Output? obtain accurate, easy and flexible **pressure and flow rate control** during the injection process

How? through an independent adjustment of each valve pin during opening and closing phases, with a precise control of **position, stroke, velocity and acceleration**.

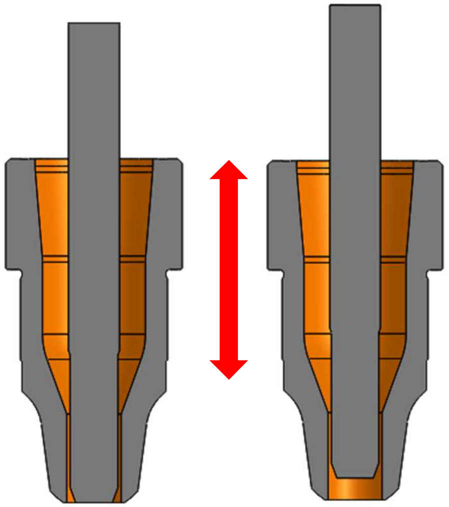
Comparison Between Traditional Hydraulic system and FLEXflow system

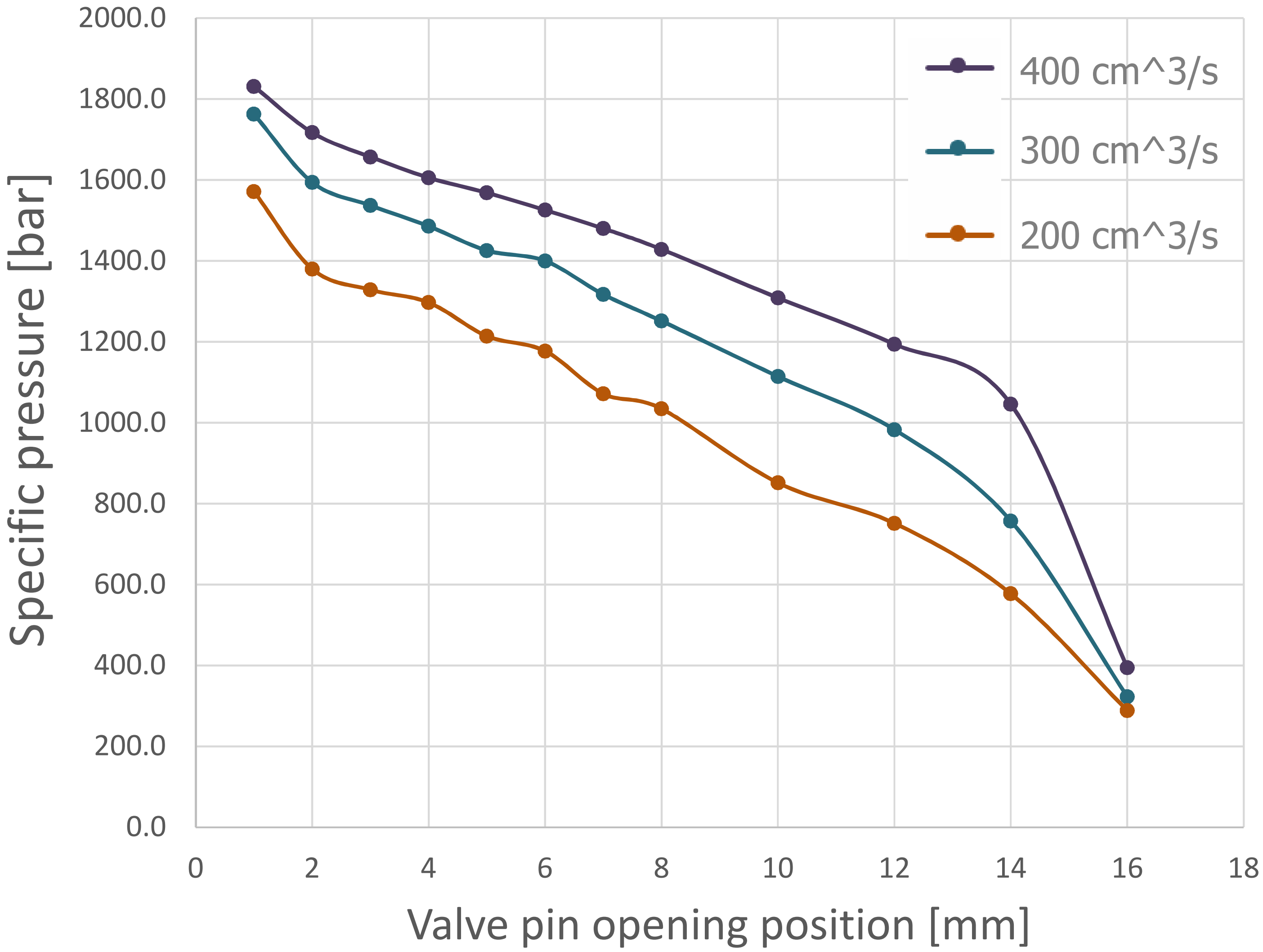


The 3-D video about the comparison you will find here:

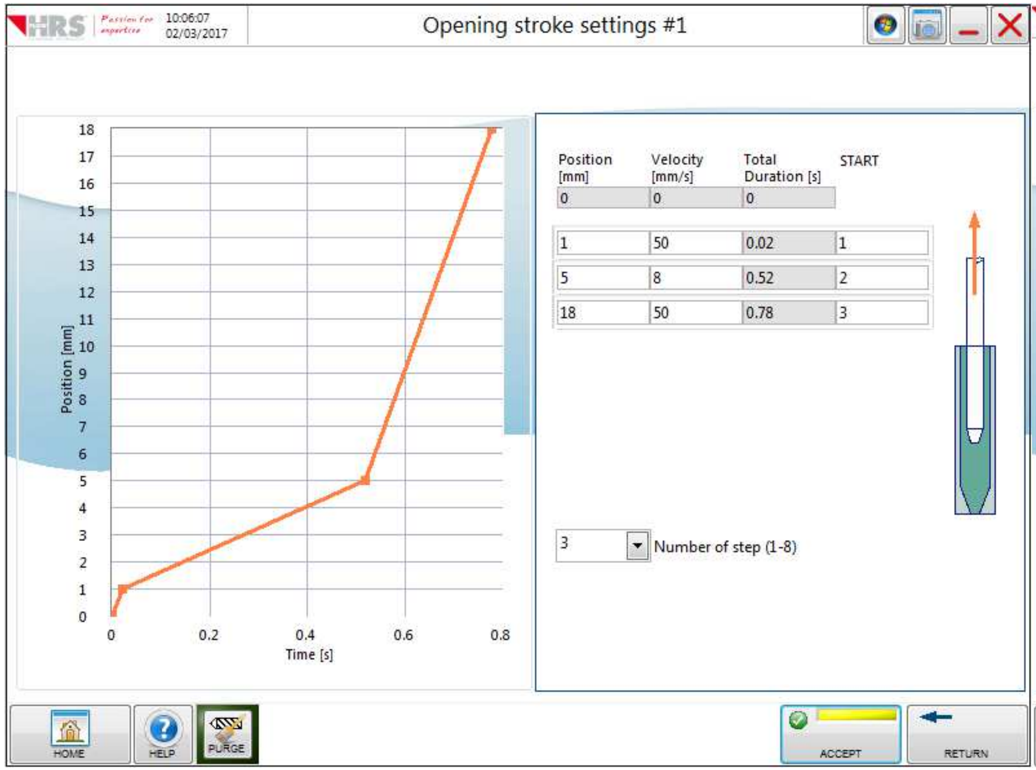
https://www.youtube.com/watch?v=W1rxcO95d_A

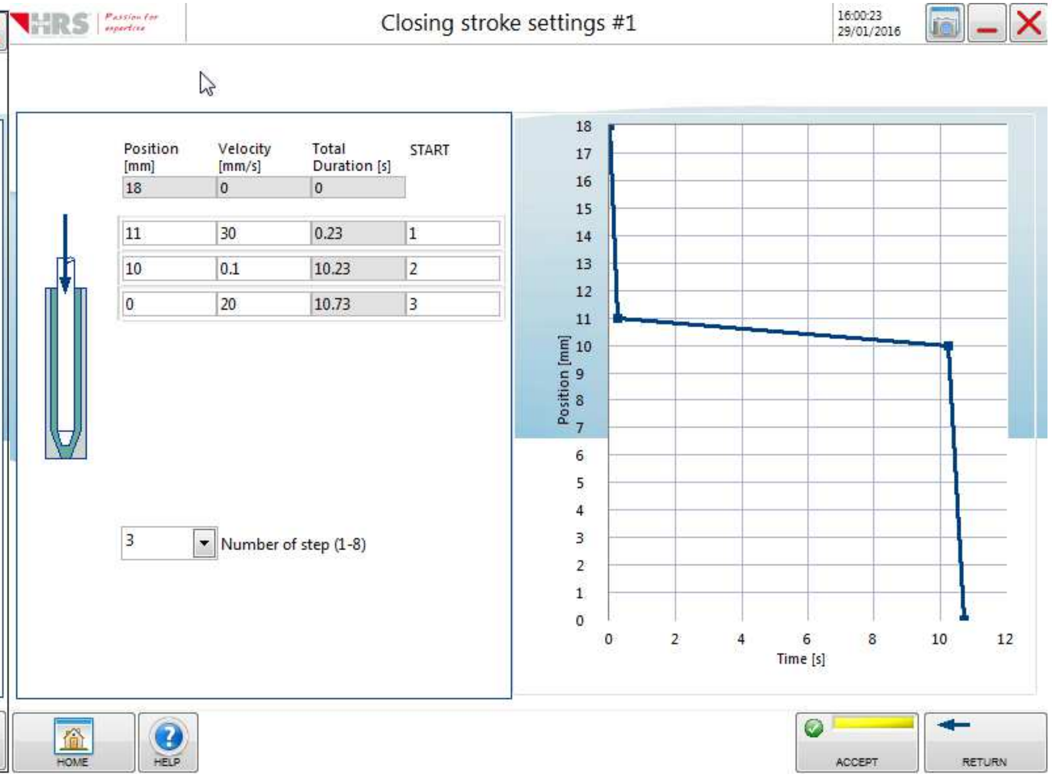
Tip optimized for fine pressure regulation





FLEXflow - Controller user interface: Page “Settings”



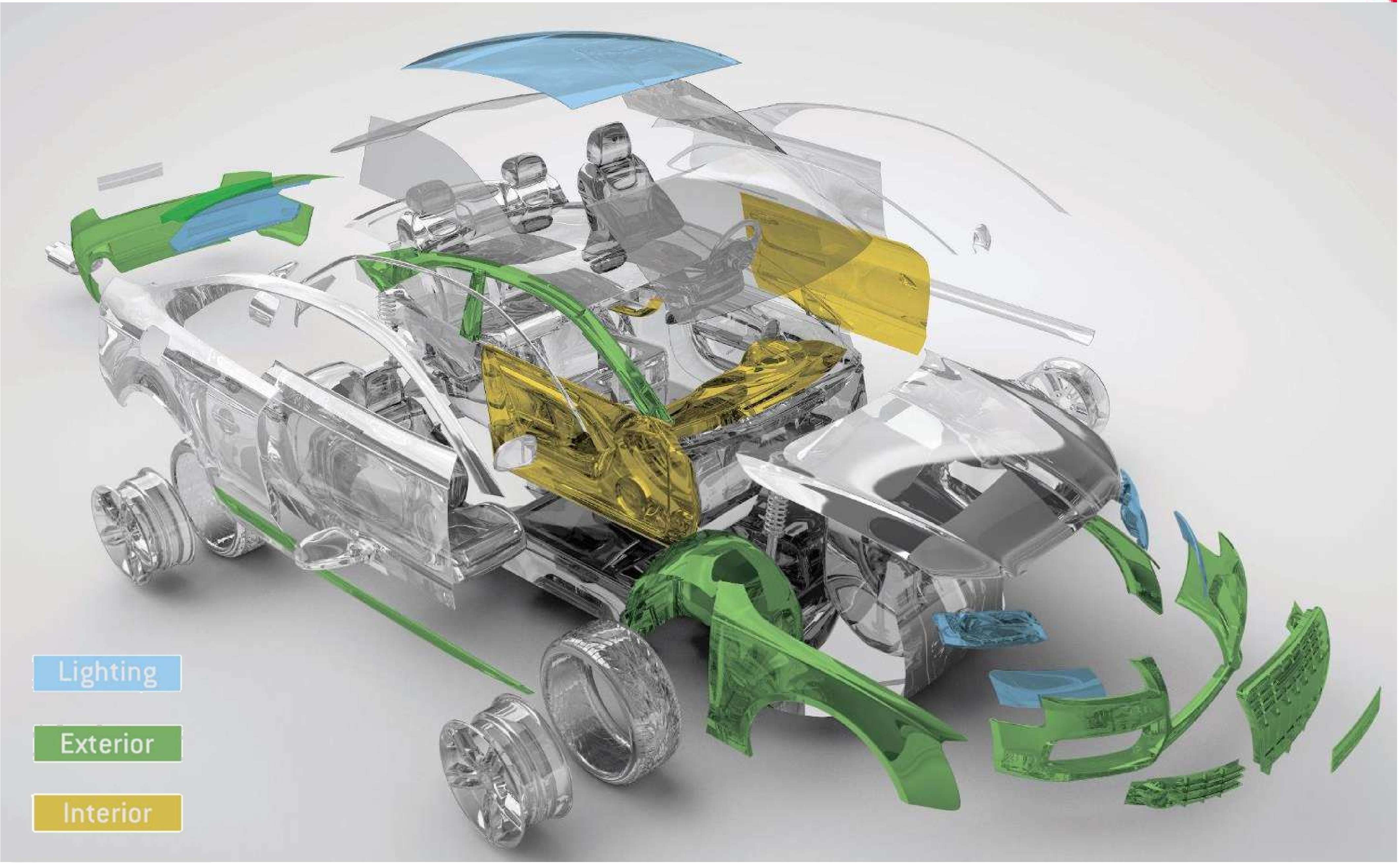


Opening and closing settings - Max 8 steps can be setted

Sequence parameters based on **time** or **screw position** or **pressure value** in the cavity

Possiblity to handle up to 2 different injection units on the same IMM.

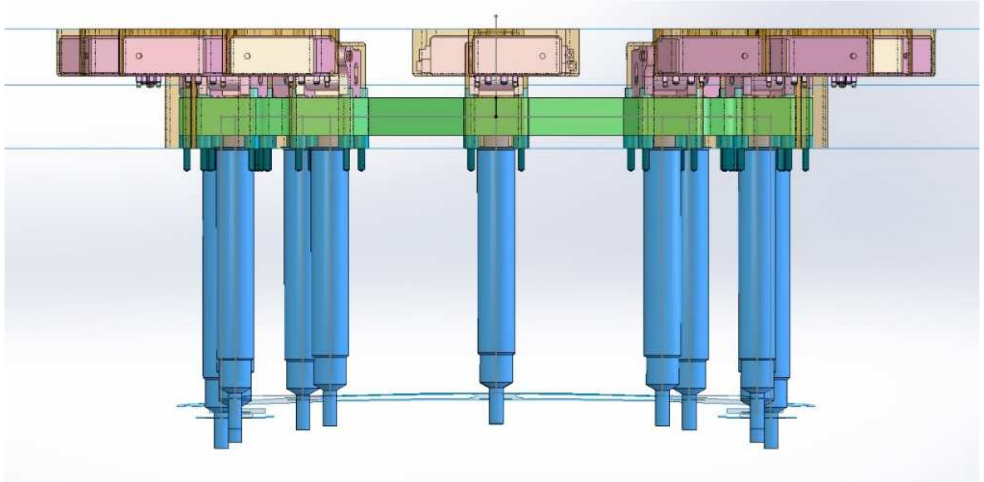
FLEXflow - applications for sequential injection

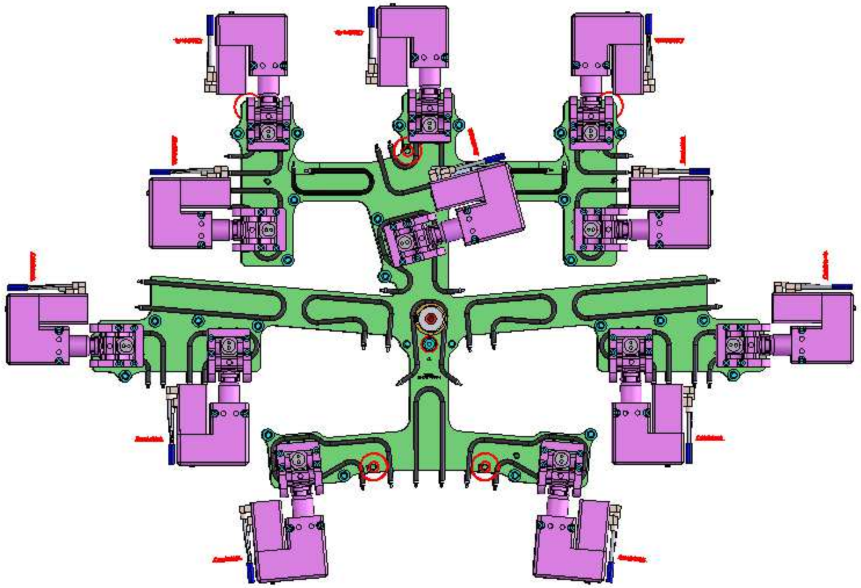


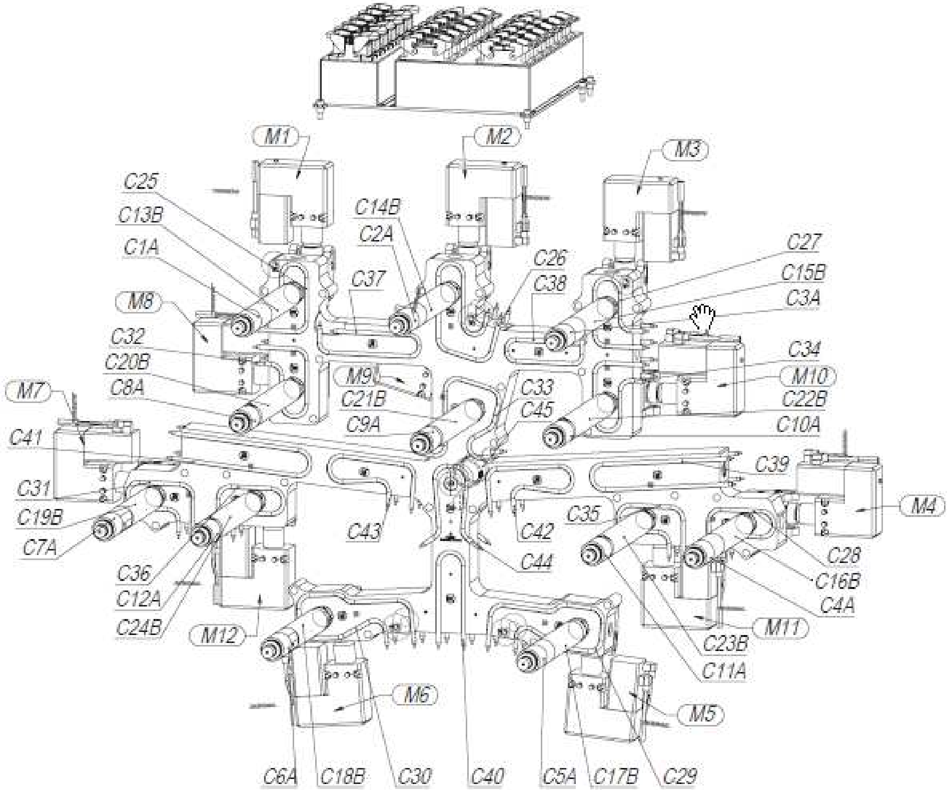
Roof Frame

FLEXflow for a roof frame

System Layout







Part weight: 2150g

Part size: 1120mm x 830mm

Material: SMA + 30% GF

Hot Runner: 12 sequential conical valve gate

Series : Aa series

Simulation Model

Part dimension: 1120 mm x 830 mm

Average thickness: 3 mm

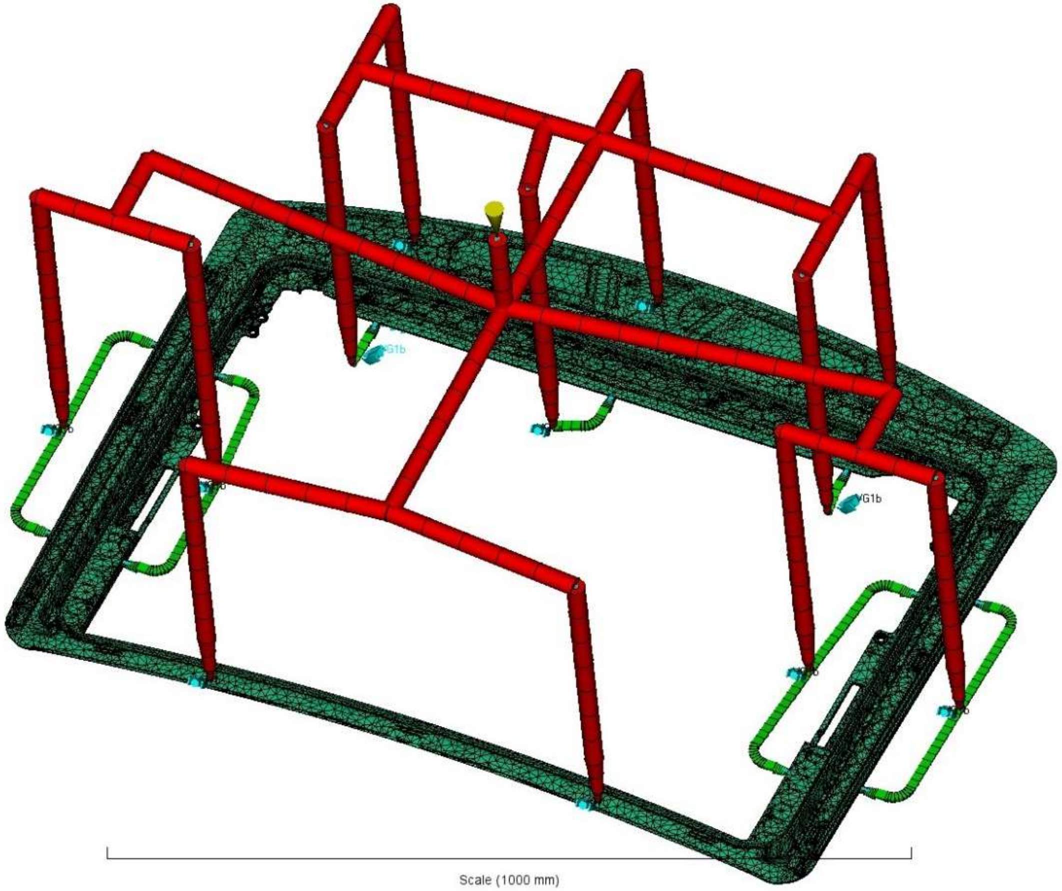
Dual Domain Mesh with 150K elements

Runners modeled as Beam

Material Xiran SG260: Moldflow tested

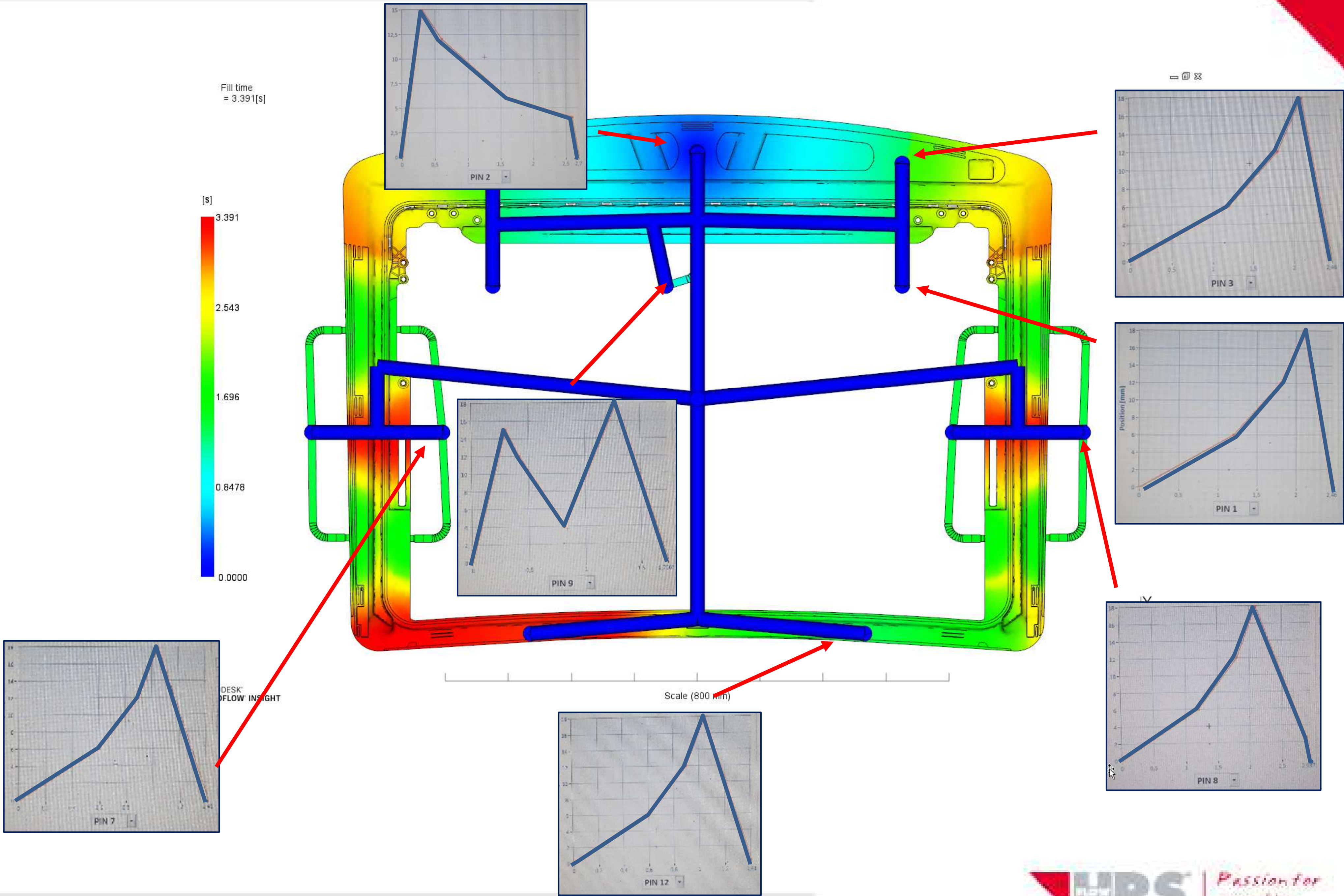
FlexFlow settings applied on tips

Due to high part stiffness and material properties cooling simulations has been proved not to impact the overall deflection so has been not reported here.

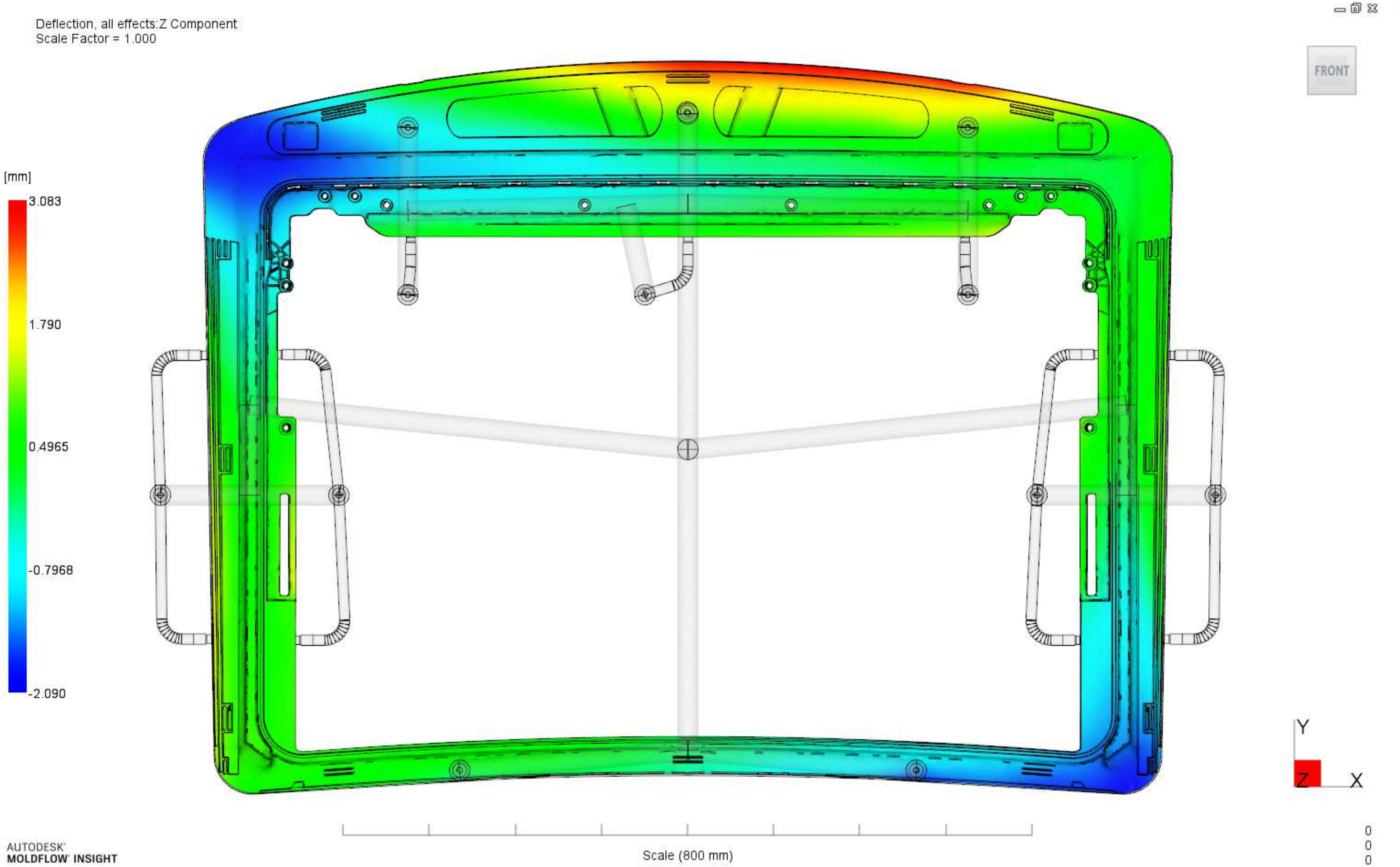


Passion for expertise

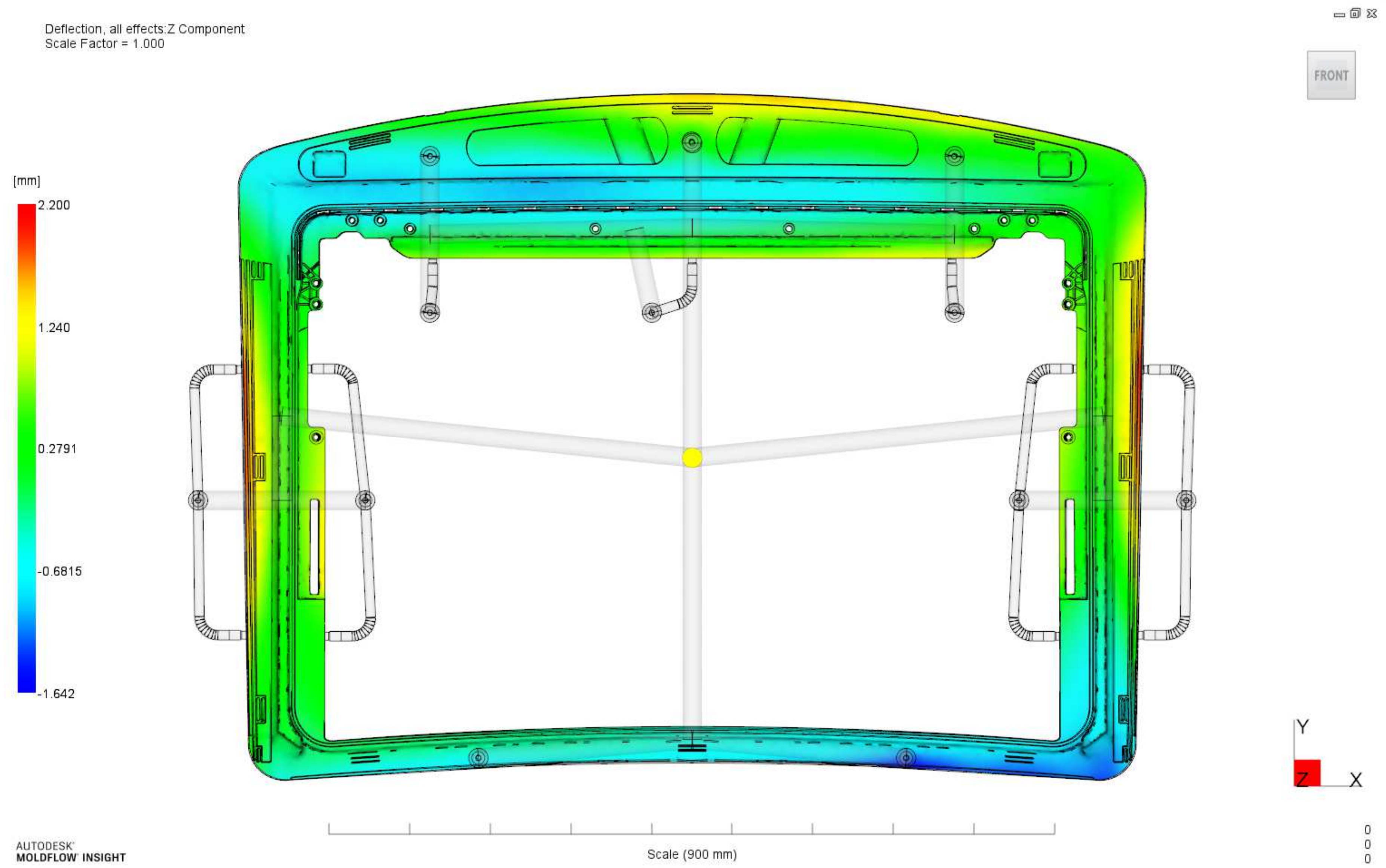
Simulation Results



Deflection traditional



Deflection FlexFlow



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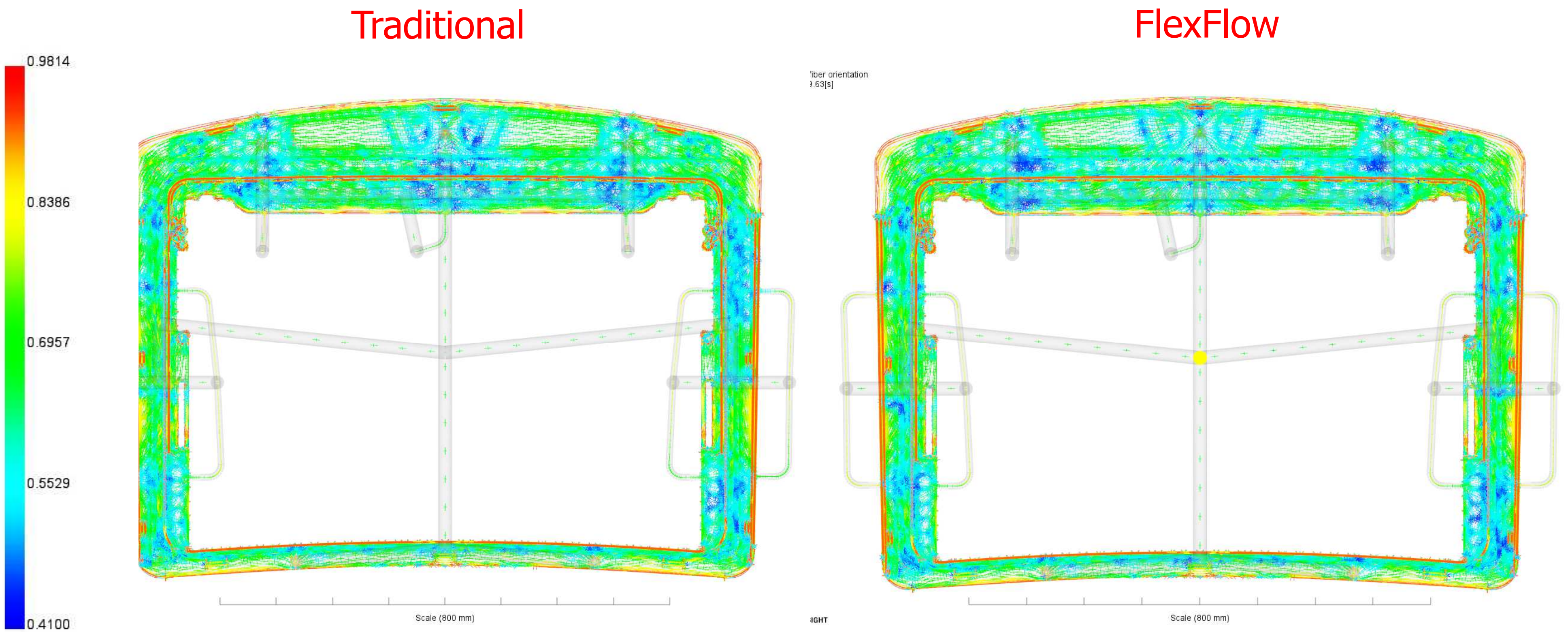
Fiber Orientation

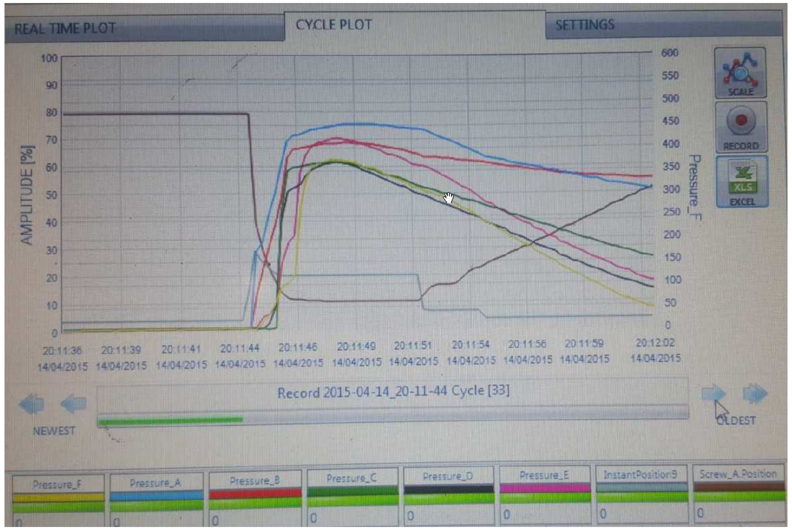


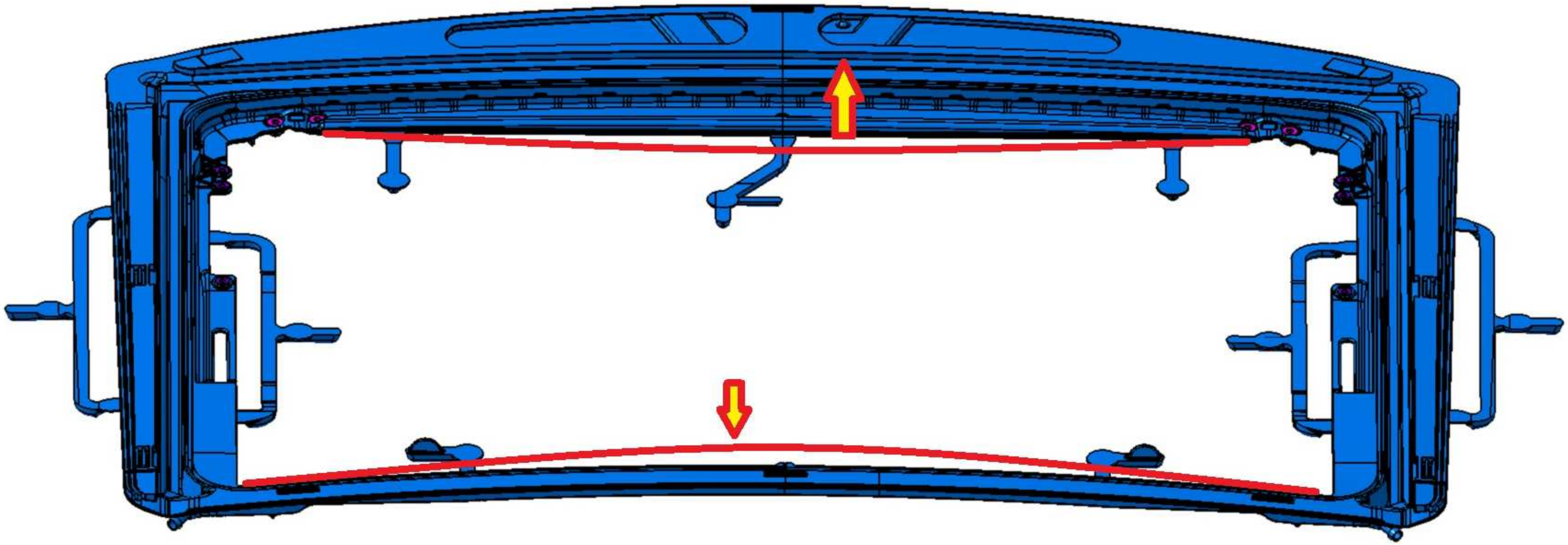
The effect of FlexFlow is visible on glass fiber orientation which is partially different in same areas leading to smaller warpage

Deflection comparision

Deflection traditional

Due to glass fibers orientation and uneven inner pressure profile, the warpage on the frame was significantly out of tolerance.

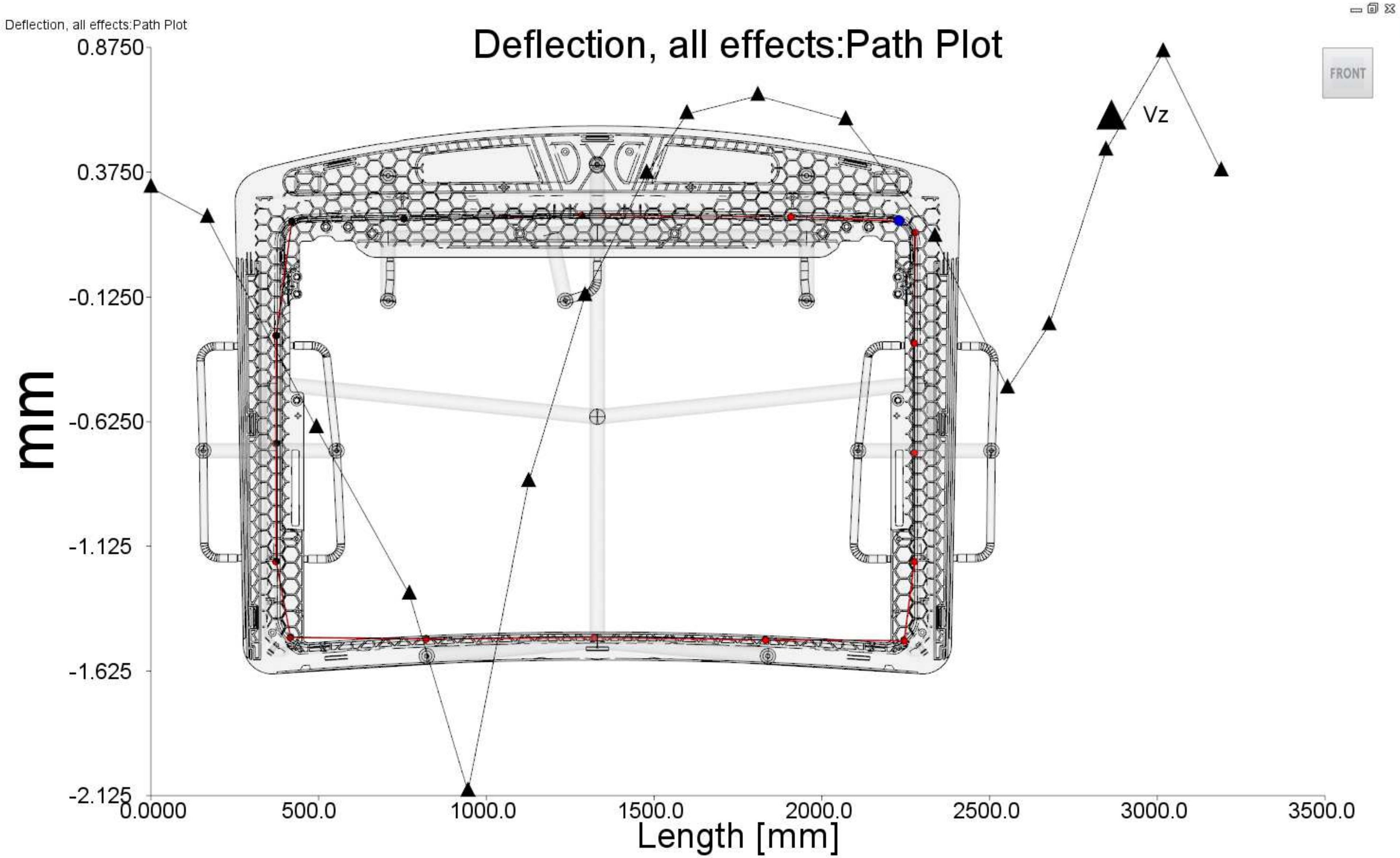




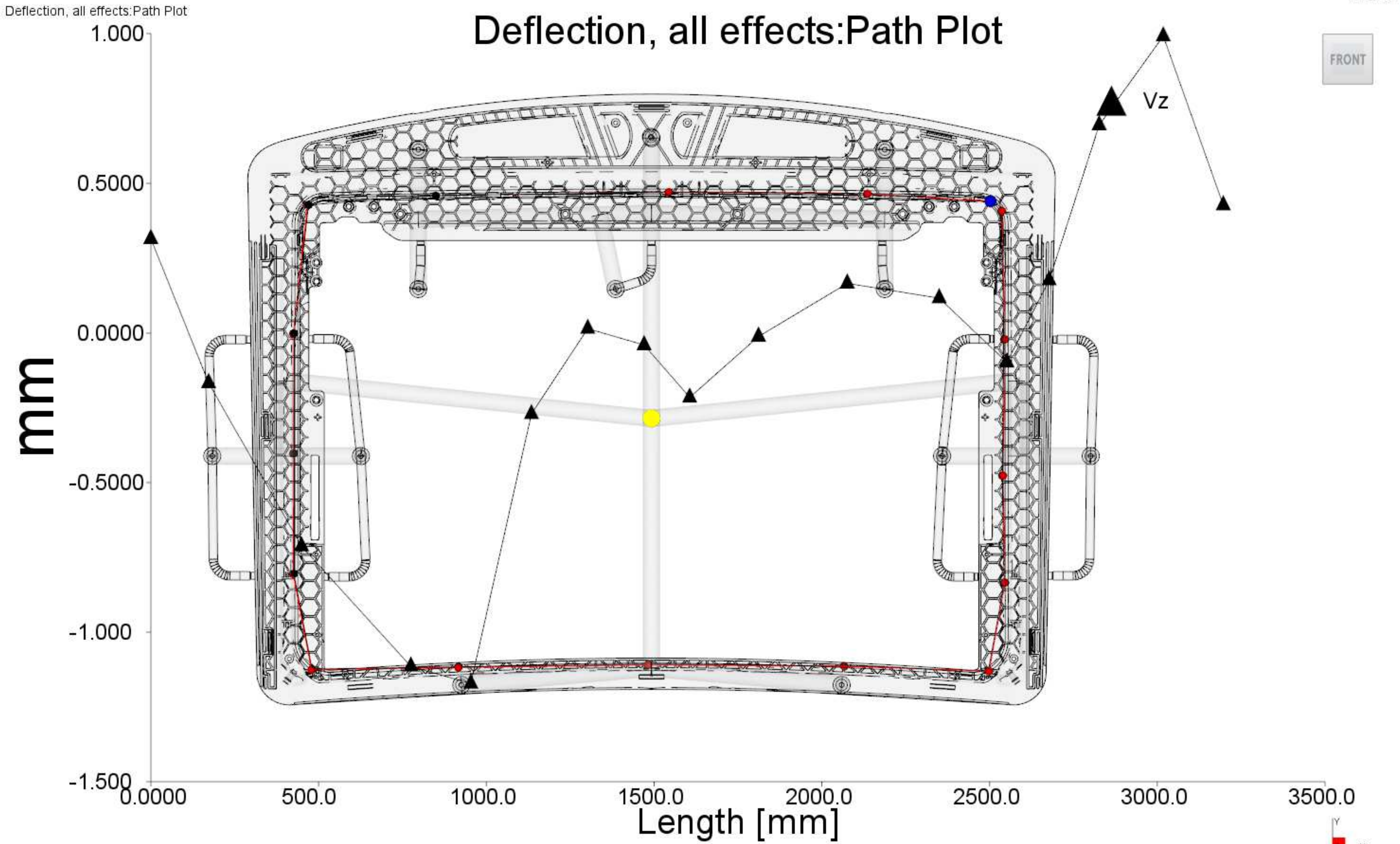
by courtesy of

with special thanks to

Deflection traditional



Deflection FlexFlow



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Conclusion

Conclusion

Two different simulation have been run considering the same process settings of trials using both a traditional approach (valve pin open close always at maximum velocity and stroke) and FlexFlow capalibity (with custom set of strokes and velocity for each valve pin).

The second obtained by simulations have been compared with real measurement of molded samples.

The comparison is not matching 100% as deflection value and direction is not the same but clearly show that the tendency in deflection reduction with FlexFlow is real.

Next steps will include a few optimization of model:

- Introduction of initial fiber lenght distribution
- Modification of fiber model
- Tool deflection consideration
- Thermal modelling of gates

Q&A