

mid Moulding
Innovation
Day 2024

FlexFlow strategy for Tandem Injection Molding

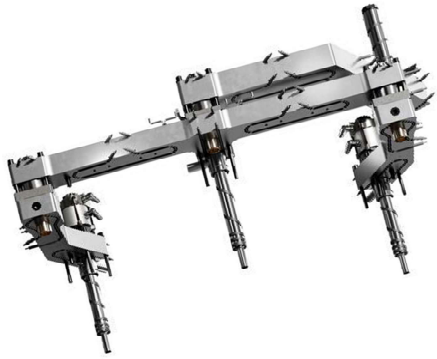
Oerlikon HRS Flow
Luisa Barbisan

Moldex3D



FlexFlow strategy for Tandem Injection Molding

Division Flow Control - Oerlikon HRSflow



Division Flow Control Oerlikon HRSflow

Polymer Processing Solutions Division

A key enabler for a sustainable polymer processing industry with a focus on manmade fiber plant engineering and flow control equipment solutions.

oerlikon



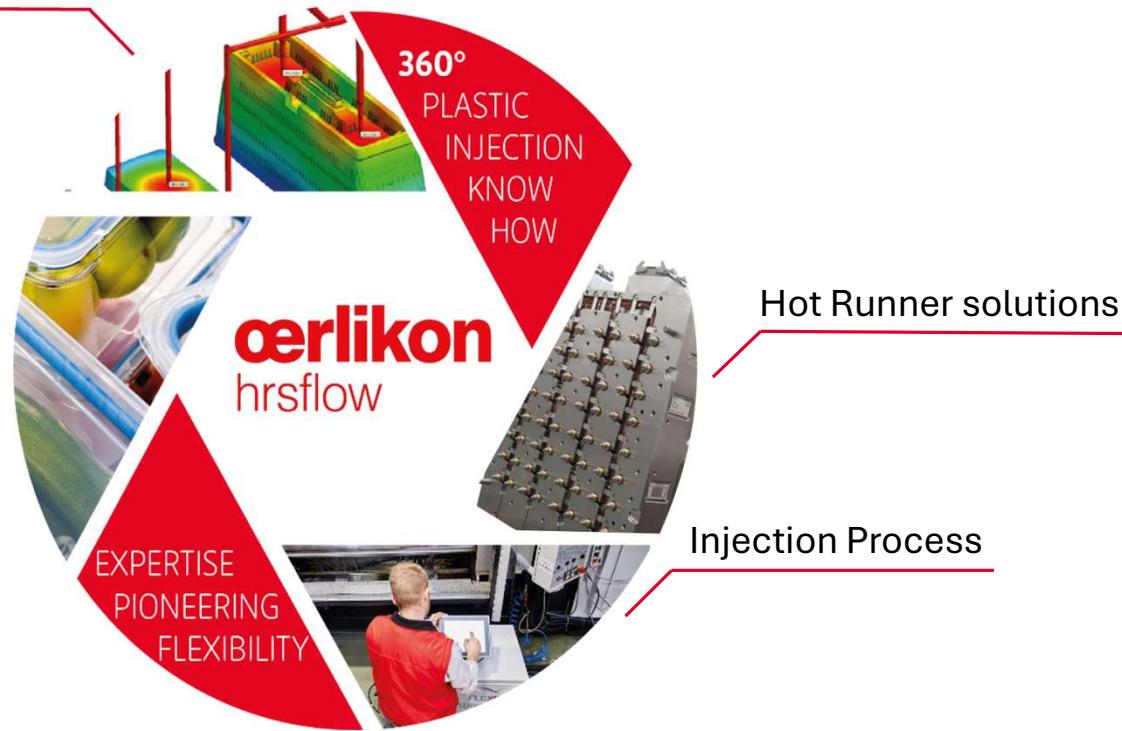
Division Flow Control - Oerlikon HRSflow

Oerlikon HRSflow Know How

360°
PLASTIC INJECTION
KNOW HOW

Applications experience

CAE Simulations



EXPERTISE
PIONEERING
FLEXIBILITY

360°
PLASTIC
INJECTION
KNOW
HOW

Hot Runner solutions

Injection Process

oerlikon
hrsflow

Division Flow Control - Oerlikon HRSflow

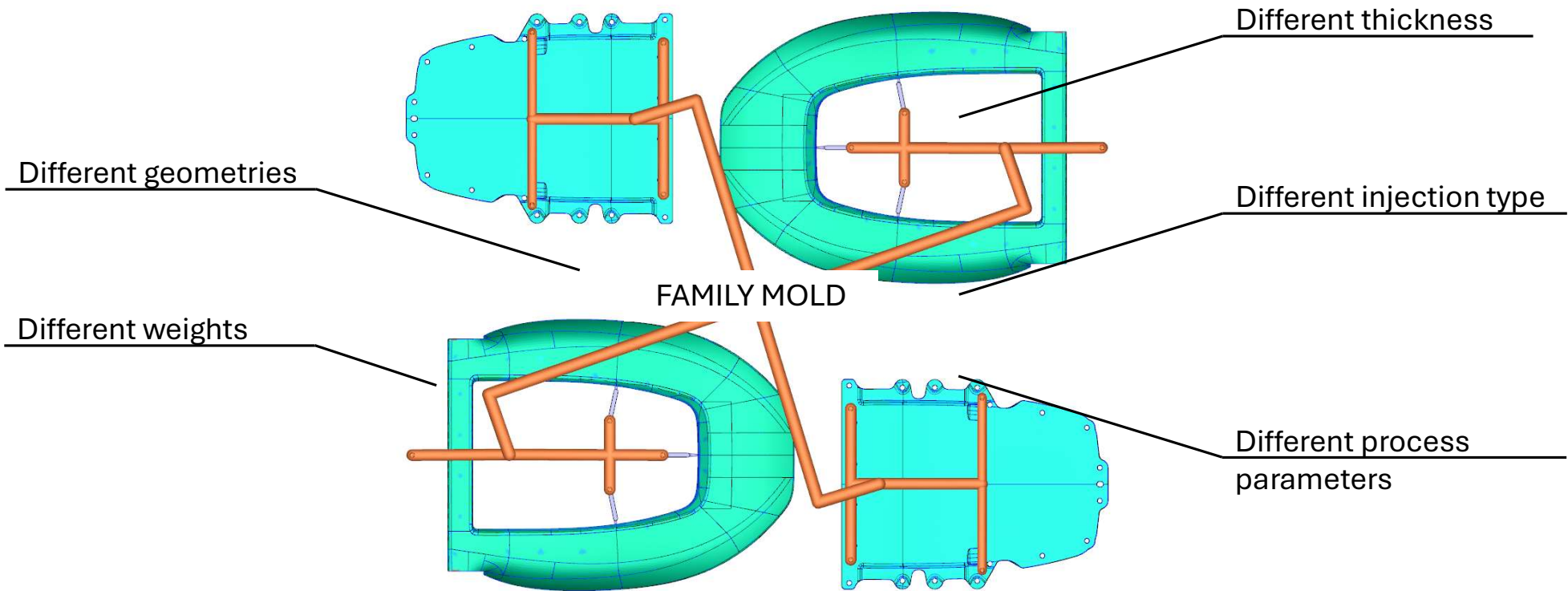
Our Worldwide presence



- 3 production plants (Europe, America, Asia)
- 1035 employees worldwide
- 52 branches worldwide
- 5 CAE calculation pools

FLEXflow Strategy for a Tandem Injection Molding

Target: optimize family mold process



FLEXflow – Flow Control Solution



- **What** → servo-driven valve gate system with an advanced control unit to set and monitor the valve pin position.



FLEXflow – Flow Control Solution



- **What** → servo-driven valve gate system with an advanced control unit to set and monitor the valve pin position.
- **Goal** → obtain accurate pressure and flow rate control. Eliminate hesitations, pressure lines, flashes..

FLEXflow – Flow Control Solution



- **What** → servo-driven valve gate system with an advanced control unit to set and monitor the valve pin position.
- **Goal** → obtain accurate pressure and flow rate control. Eliminate hesitations, pressure lines, flashes..
- **How** → independent adjustment of each valve pin with precise control of stroke and force during opening and closing



FLEXflow – Flow Control Solution



- **What** → servo-driven valve gate system with an advanced control unit to set and monitor the valve pin position.
- **Goal** → obtain accurate pressure and flow rate control. Eliminate hesitations, pressure lines, flashes..
- **How** → independent adjustment of each valve pin with precise control of stroke and force during opening and closing
- **Results** → control weld lines positions
→ control pressure drop on sequential system
→ reduce hesitations and accelerations
→ reduce pressure lines
→ balance family mold,
→ control pressure distribution on tandem injection molding...



Case study

Project:

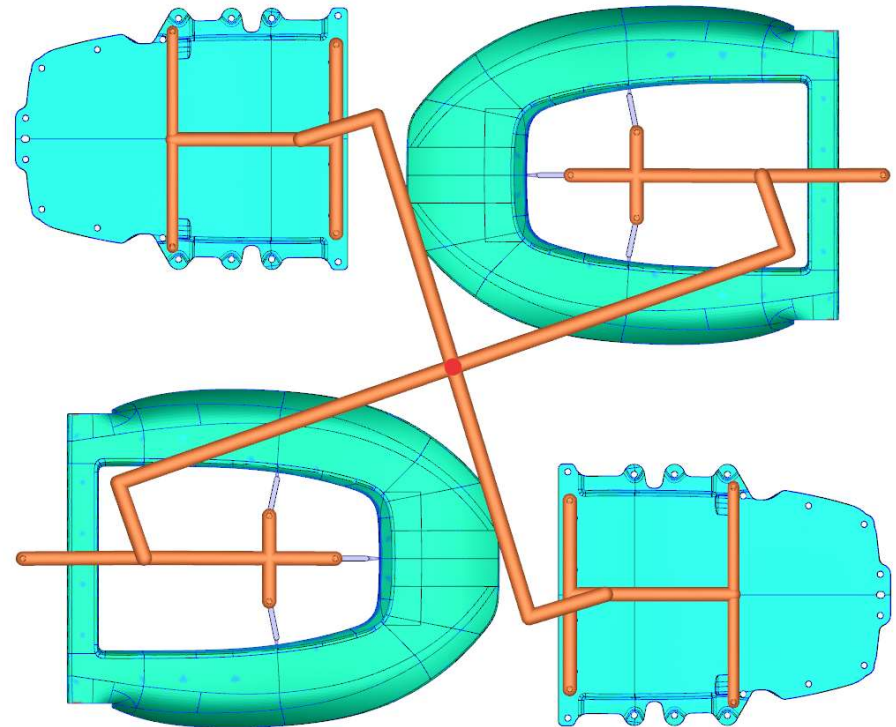
- 4 cavities (2+2).
- Different thickness between cavities.
- Different geometries.
- 16 injection points (8 drops on cold runners, 8 drop on the part).

Customer constraints:

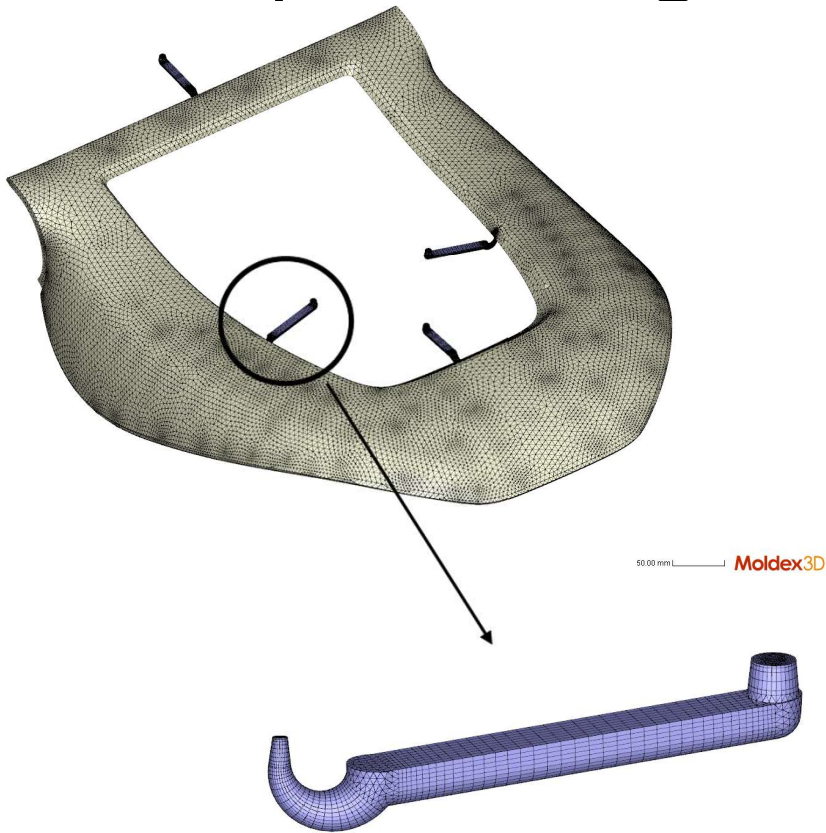
- Injection sequence.
- Process parameters (melt temperature, mold temperature, packing pressure).
- Clamp force limit 1800 tons.

Target:

- Demonstrate the FLEXflow efficacy for tandem injection.
- Optimize the process finding the best solution.

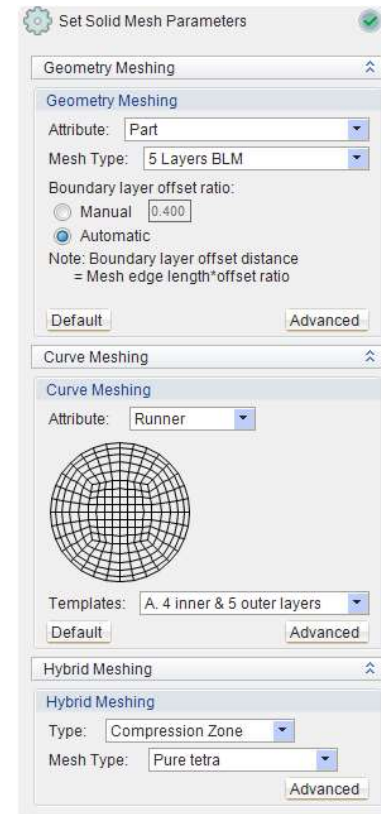
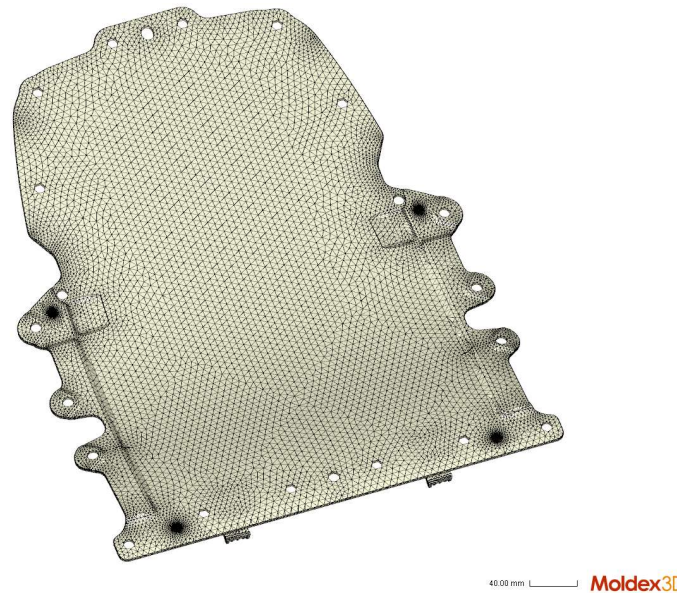


Preprocessing – mesh



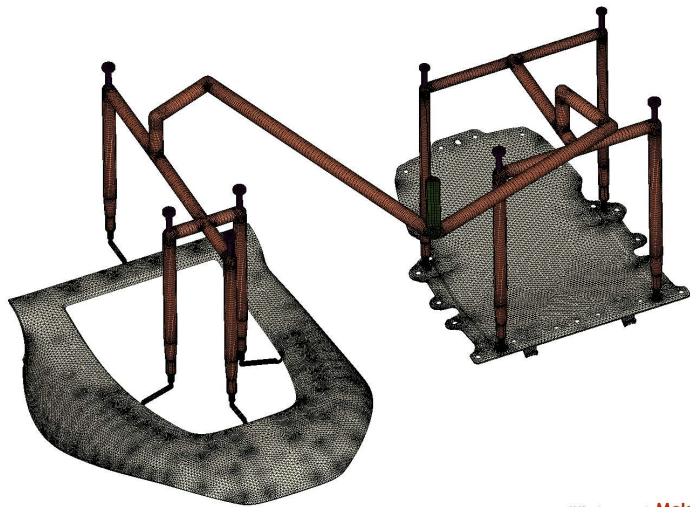
Cavities Mesh:

- Part : 5 Layers BLM.
- Cold runner: starting from curves as per customer indications.





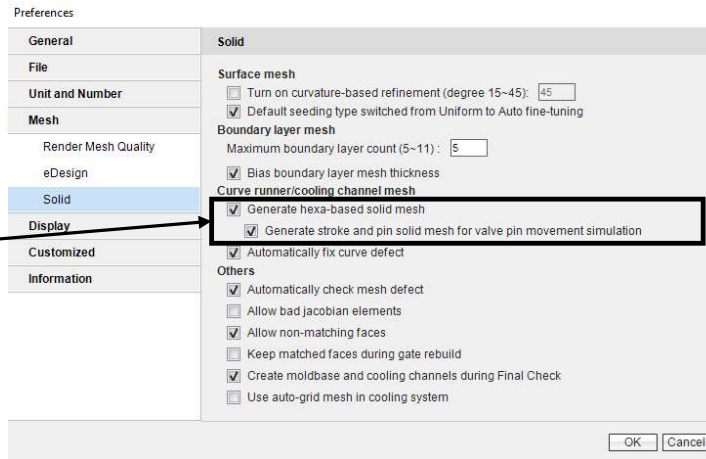
Preprocessing – mesh



90.00 mm | Moldex3D

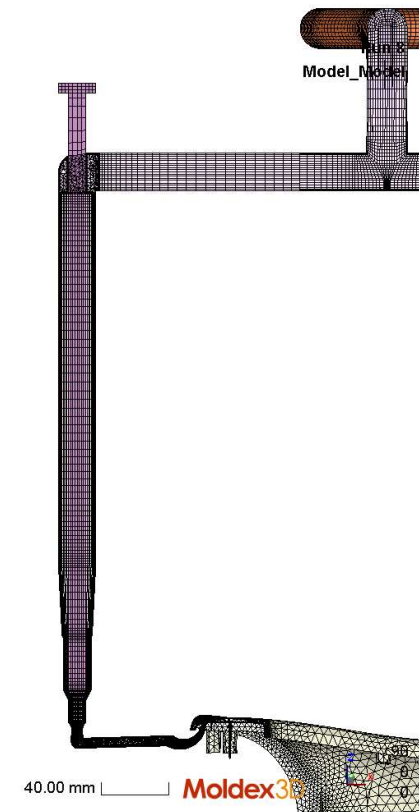
To admit valve gate control during opening and closing:

Enable option "Generate stroke and pin solid mesh for valve pin movement simulation".



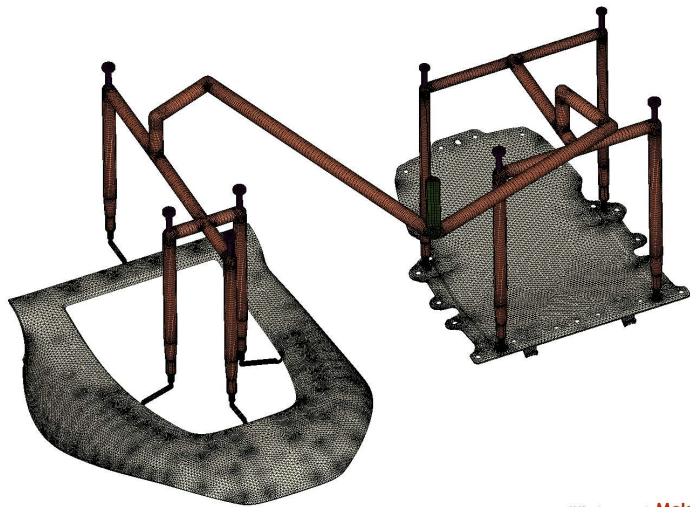
System Mesh:

- HRS Hot runner system: 16 drops, conical valve gate, FLEXflow.





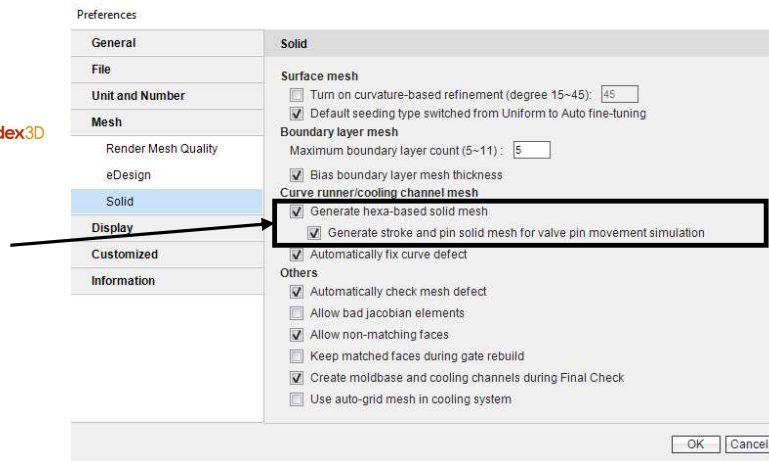
Preprocessing – mesh



40.00 mm | Moldex3D

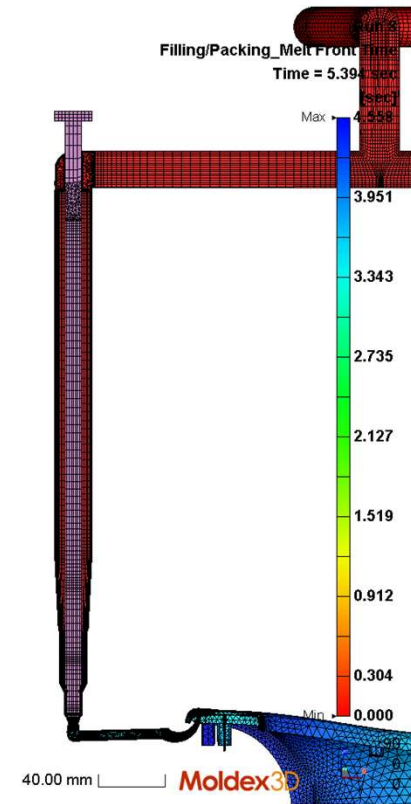
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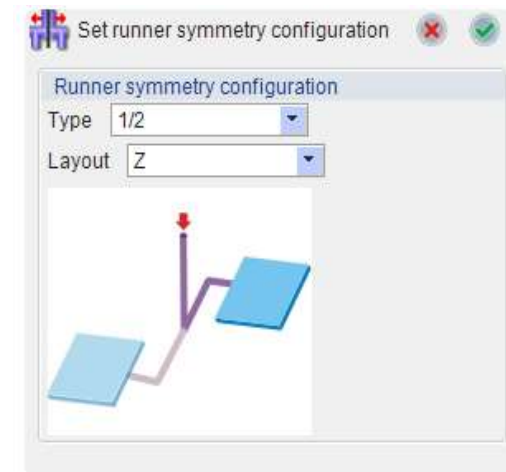
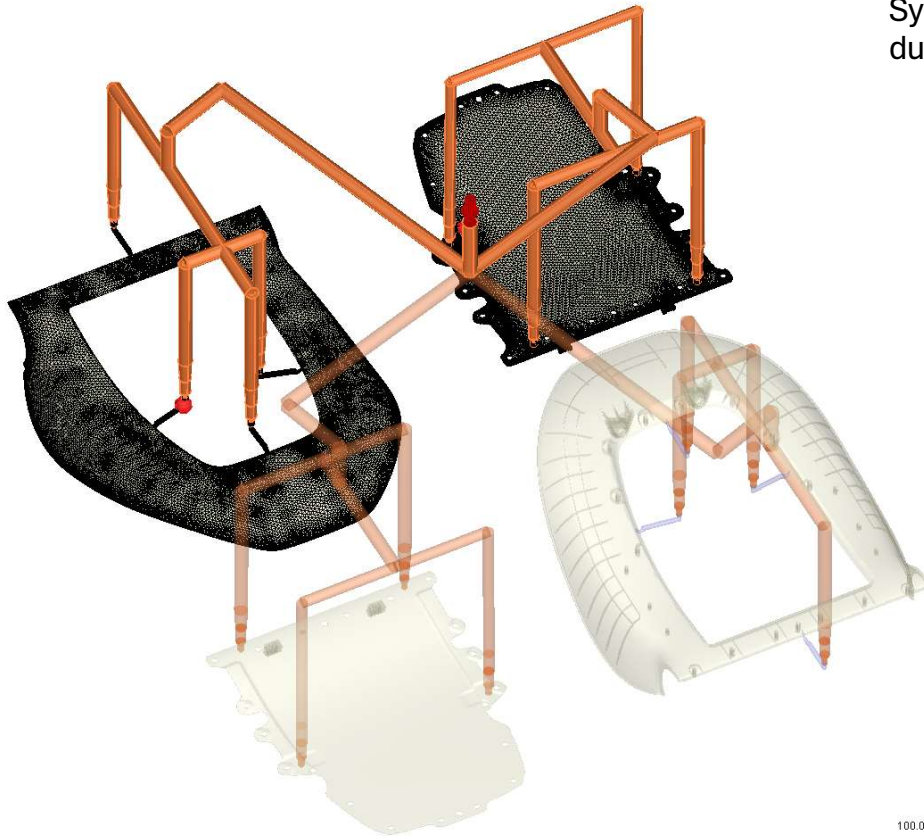
System Mesh:

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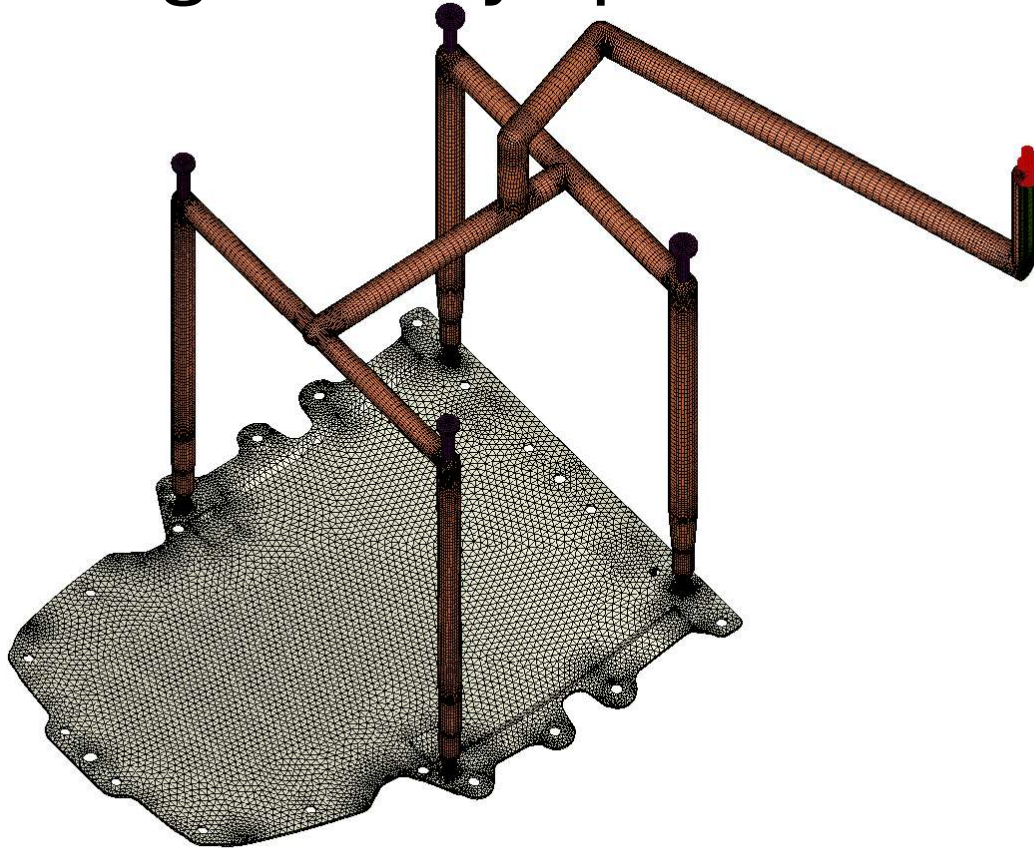


Preprocessing – mesh

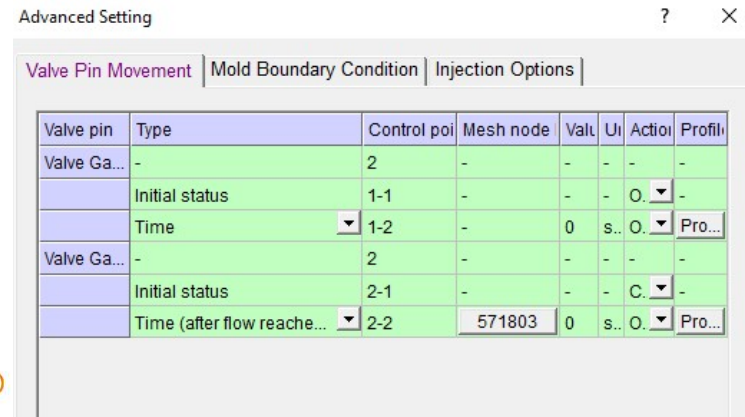
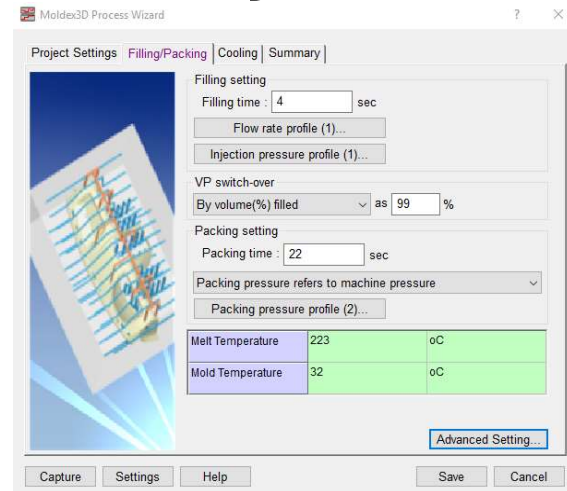
Symmetry has been used to reduce model size and analysis duration.



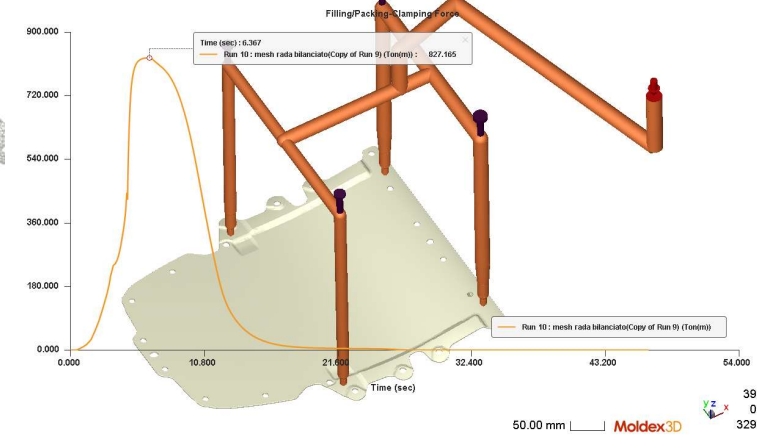
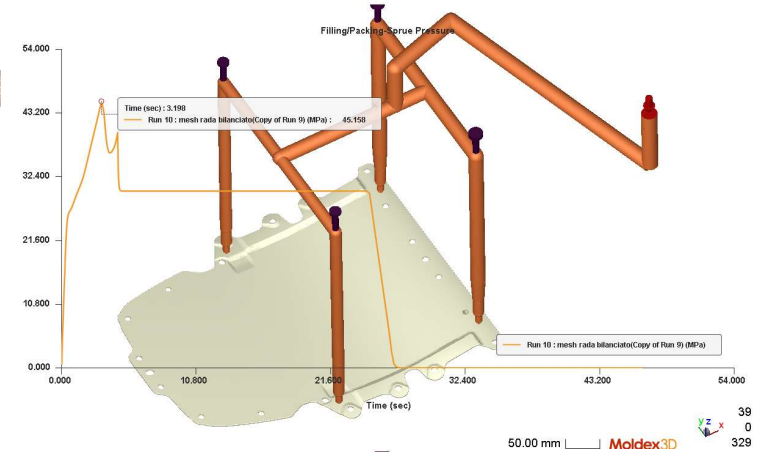
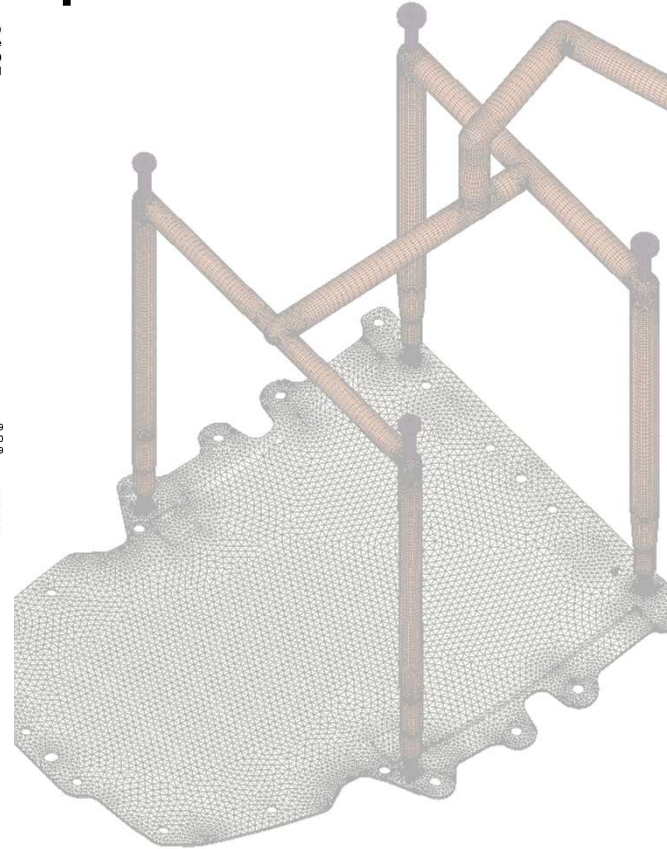
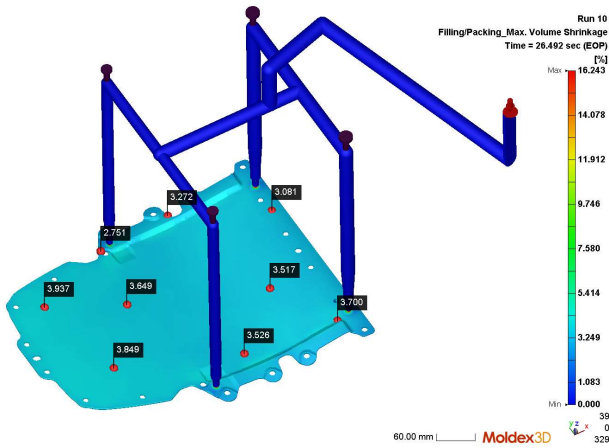
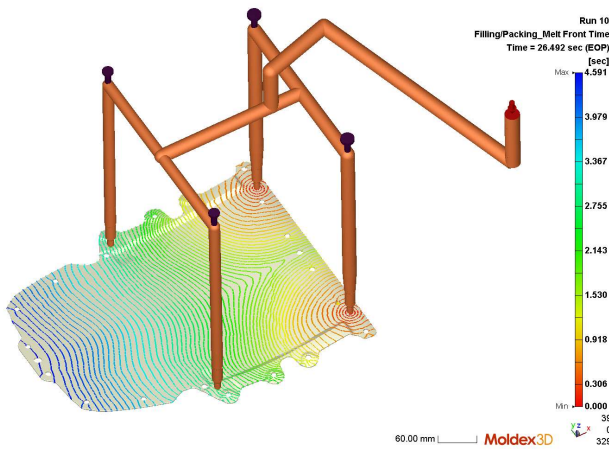
Single cavity optimization : first cavity



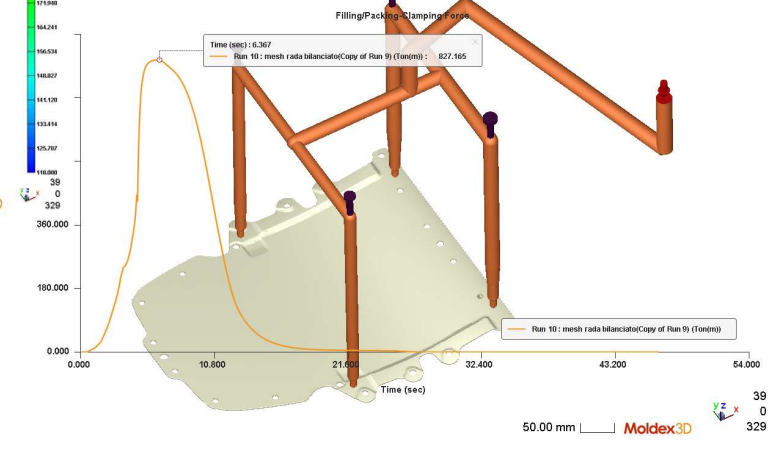
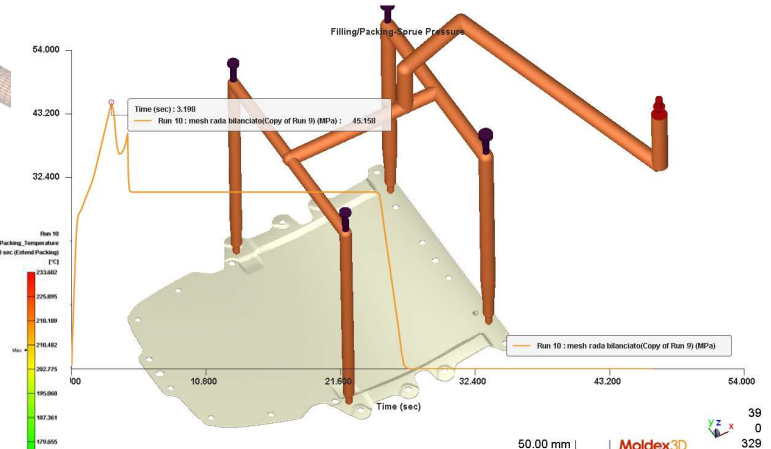
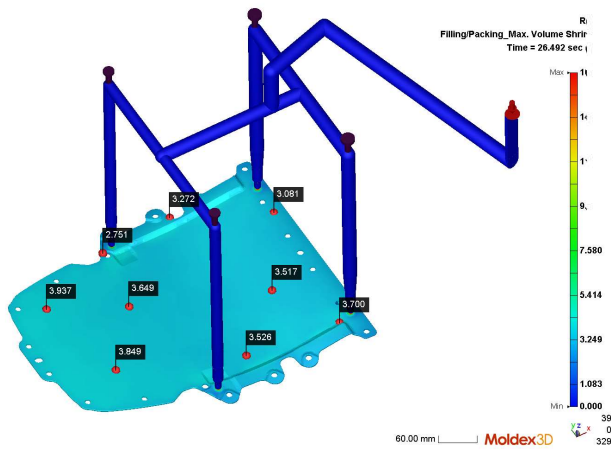
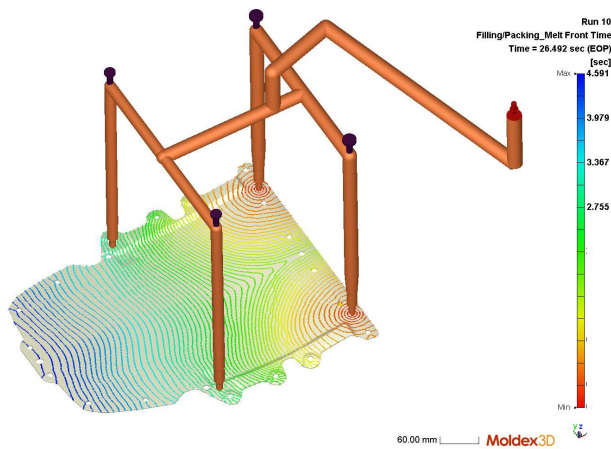
60.00 mm Moldex3D



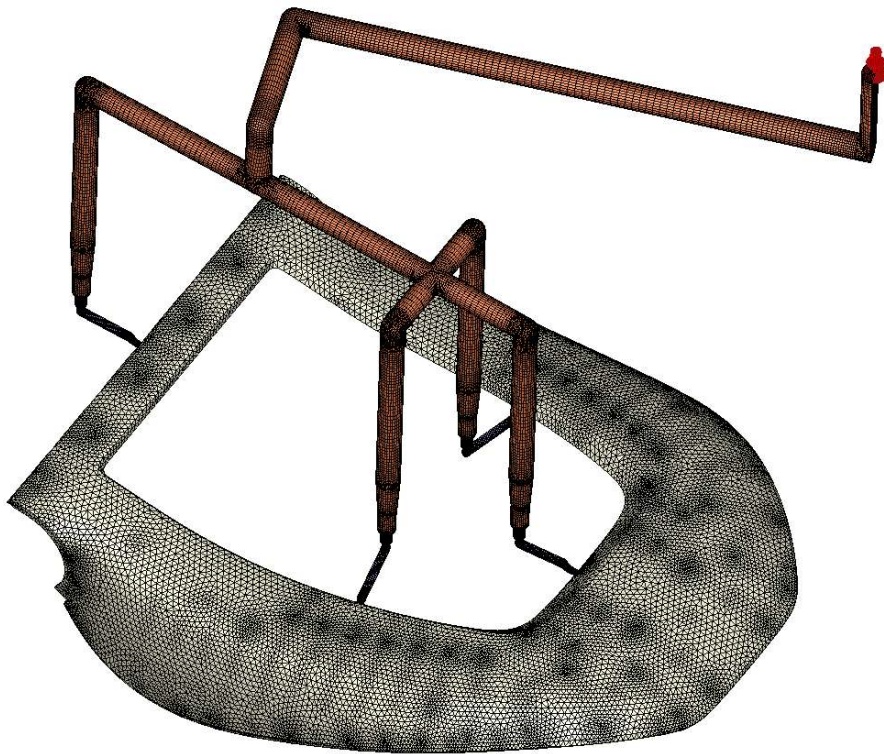
Single cavity optimization: first cavity



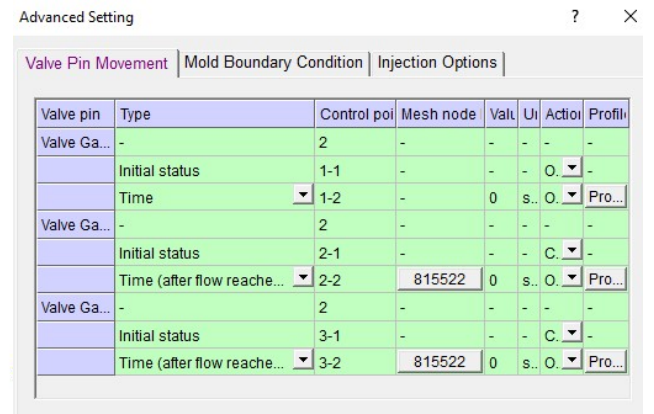
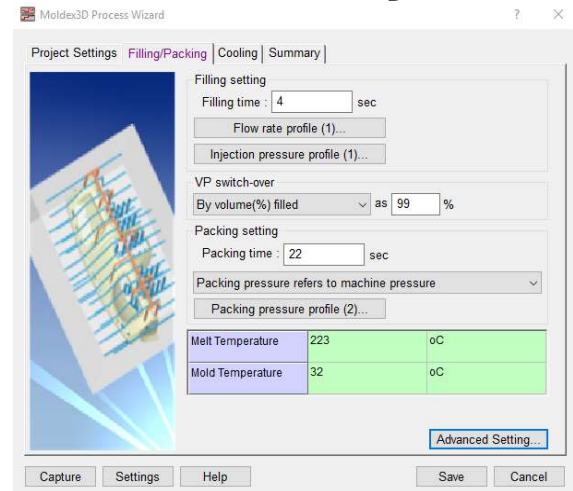
Single cavity optimization: first cavity



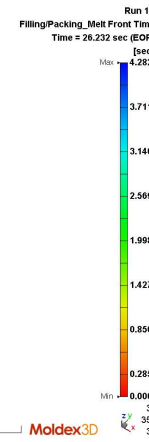
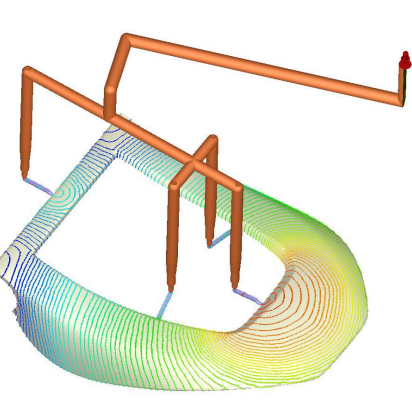
Single cavity optimization : second cavity



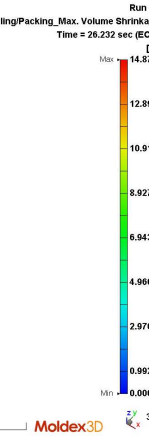
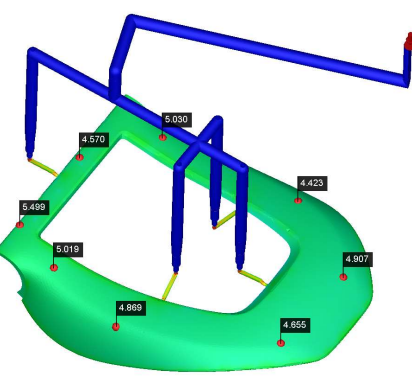
70.00 mm Moldex3D



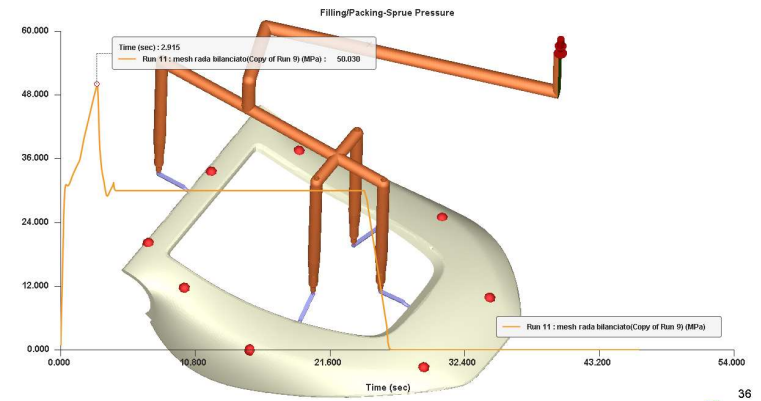
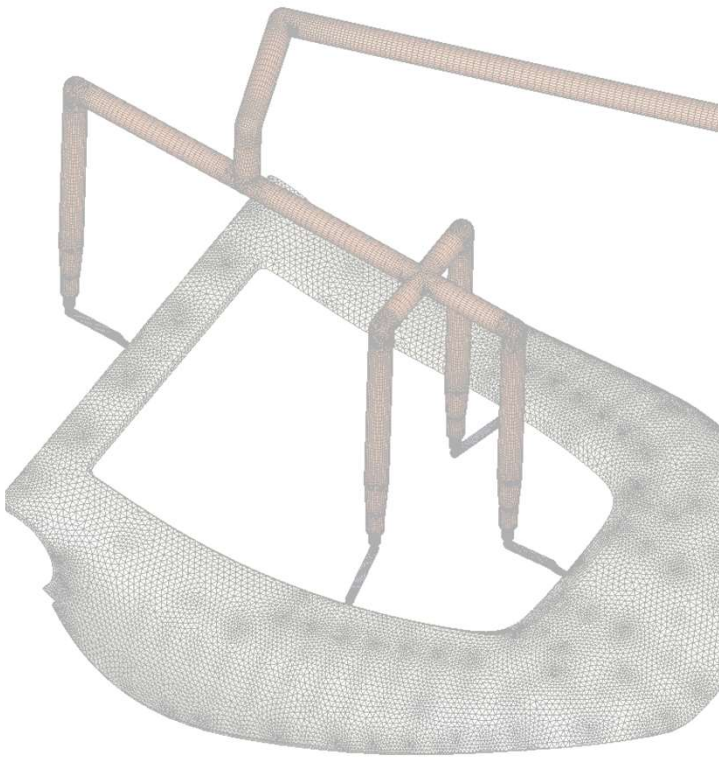
Single cavity optimization: second cavity



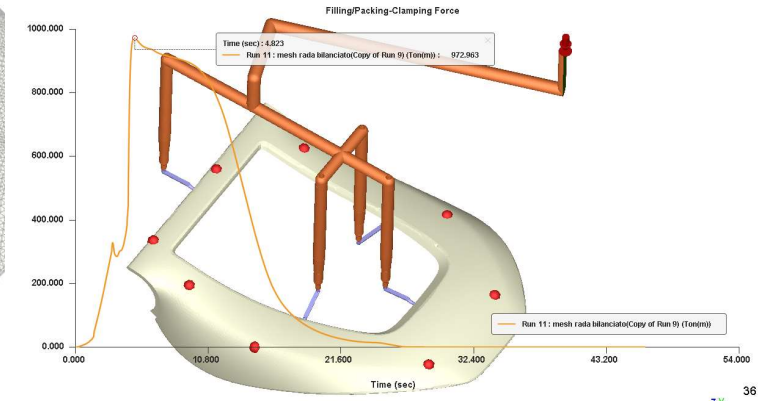
70.00 mm | Moldex3D



70.00 mm | Moldex3D

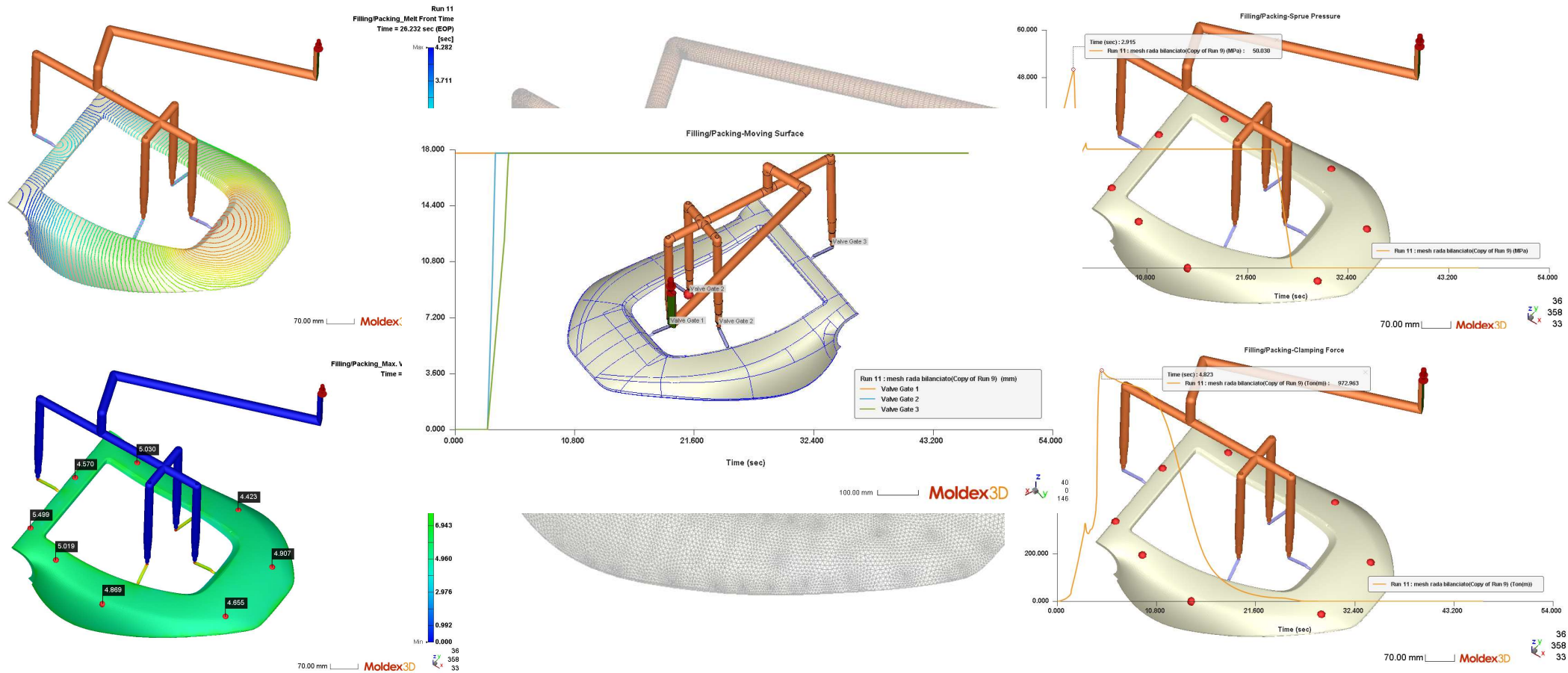


70.00 mm | Moldex3D

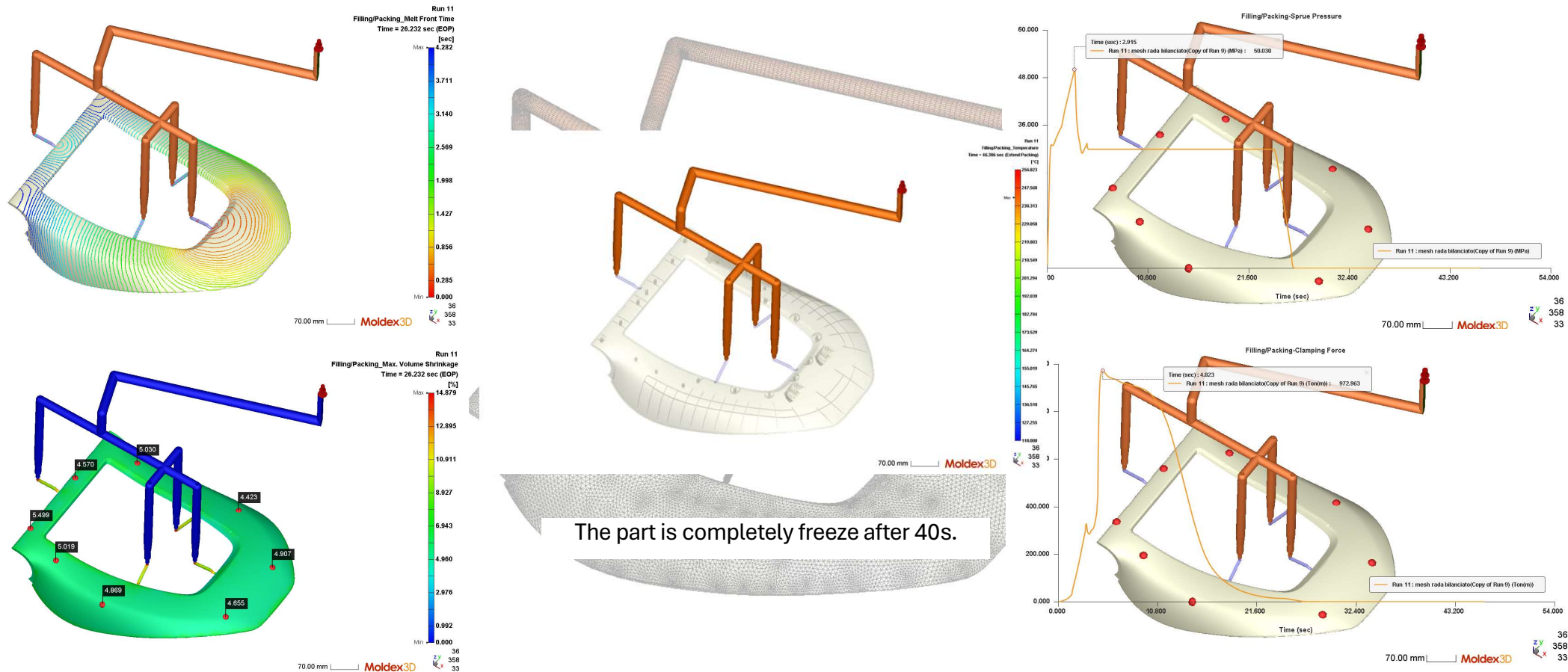


70.00 mm | Moldex3D

Single cavity optimization: second cavity

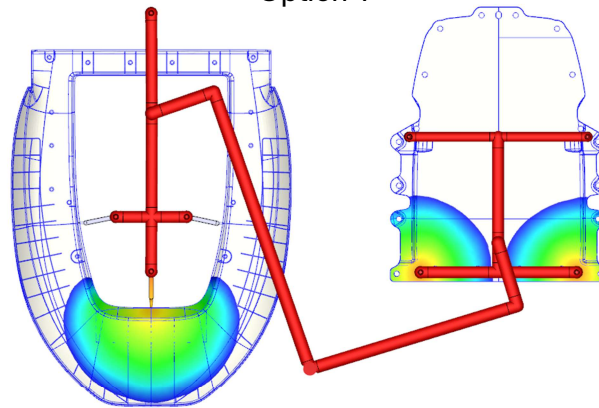


Single cavity optimization: second cavity

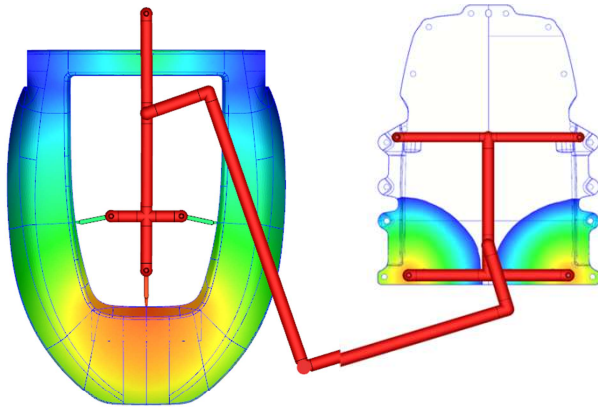


Different injection strategies

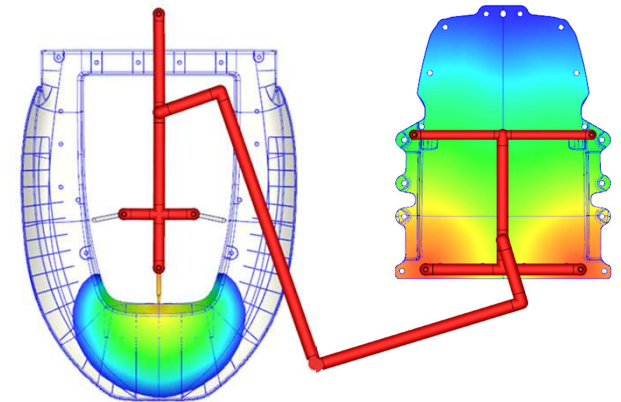
Balanced injection
Option 1



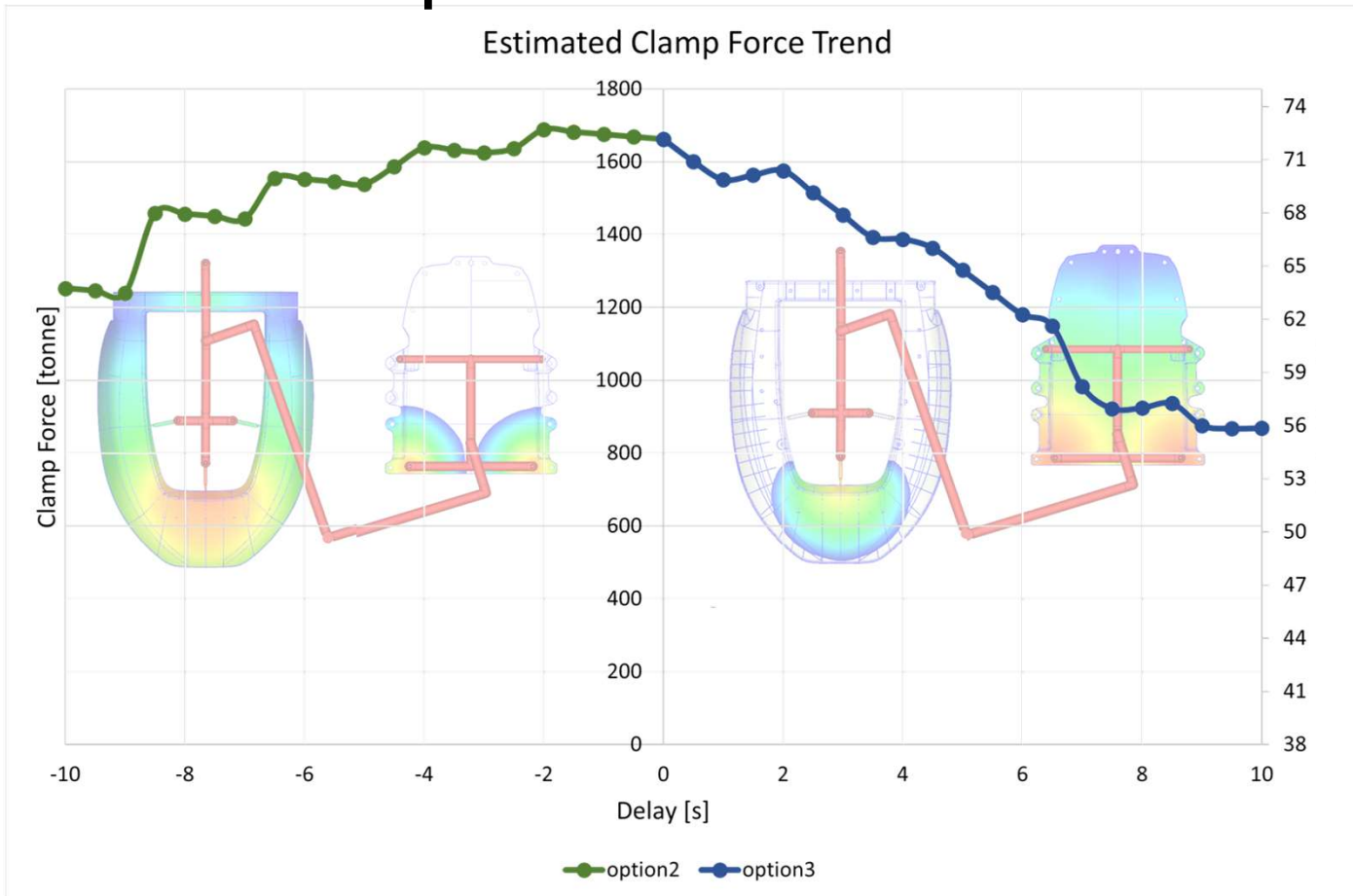
Tandem injection: delaying smallest cavity.
Option 2



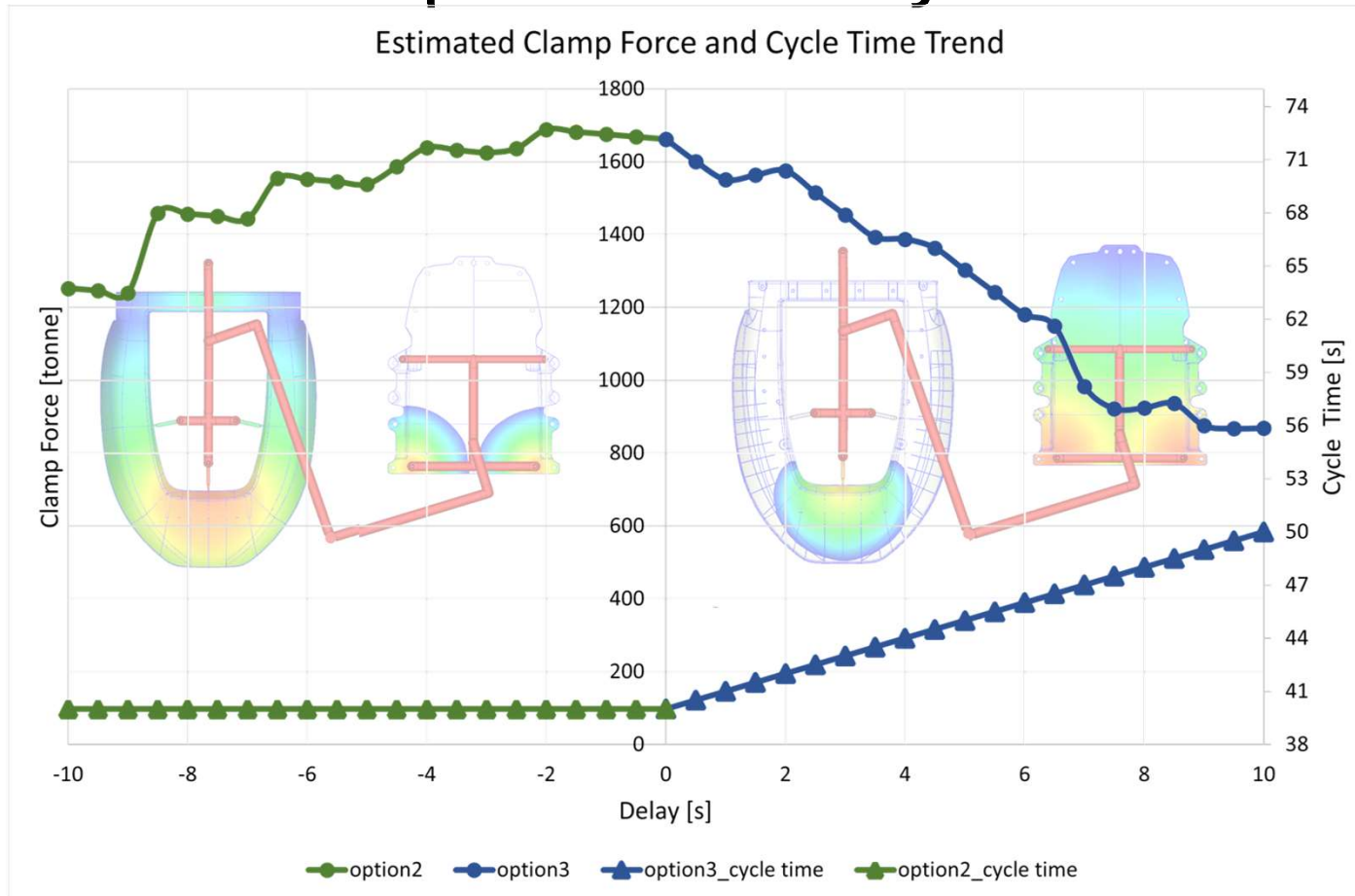
Tandem injection: delaying biggest cavity.
Option 3



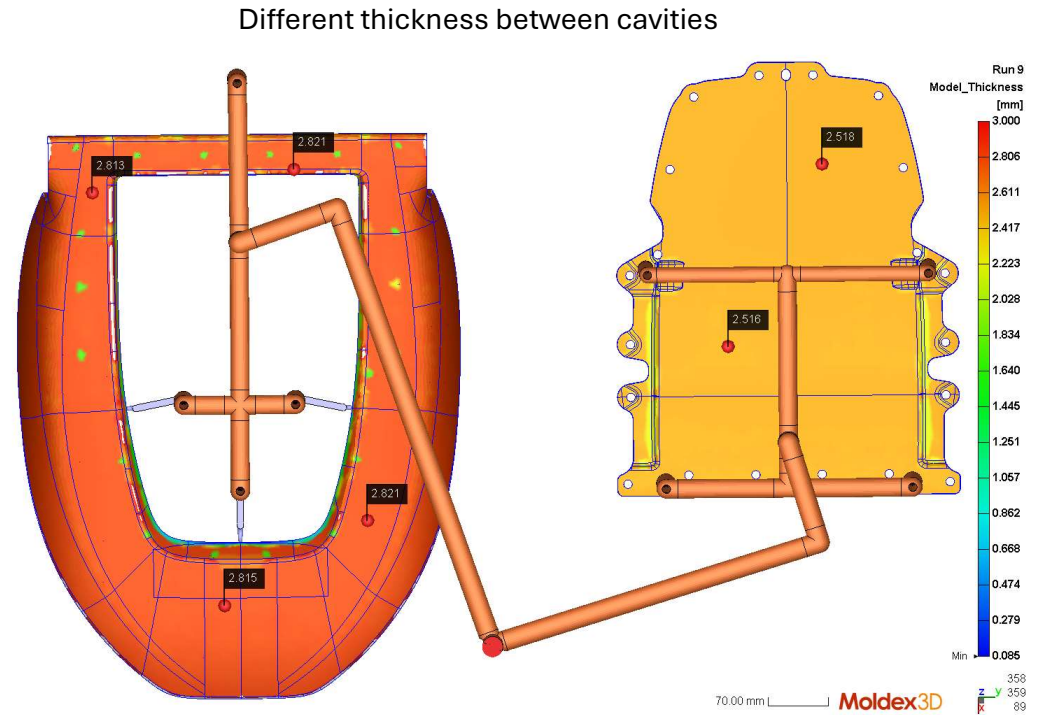
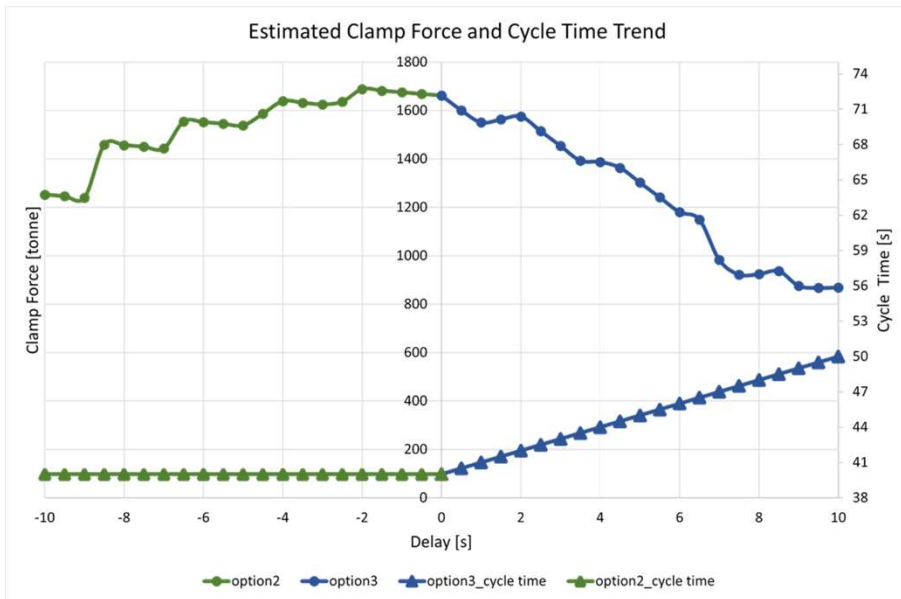
Estimated clamp force trend



Estimated clamp force and cycle time trend

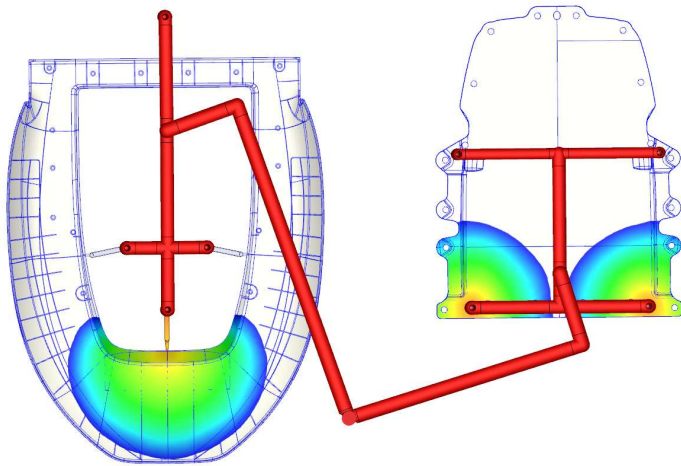


Estimated clamp force and cycle time trend

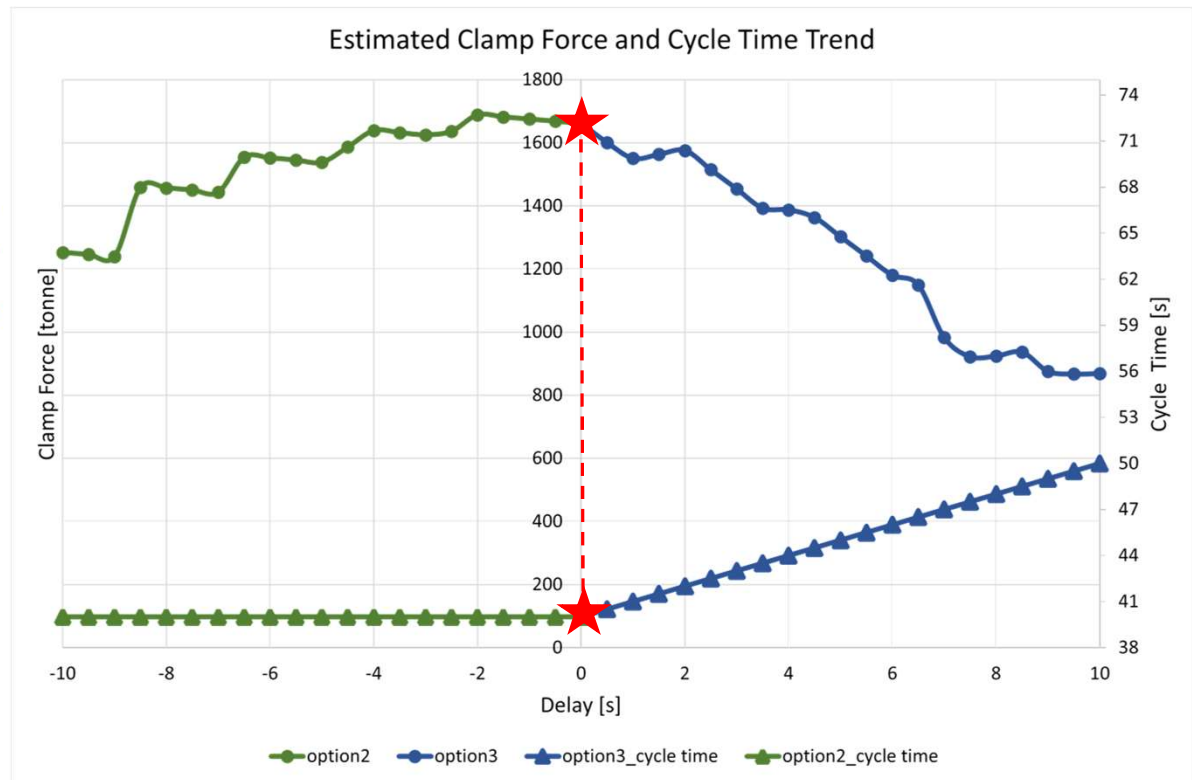


The cycle time trend is different between the two options due to the difference in thickness between the two cavities.

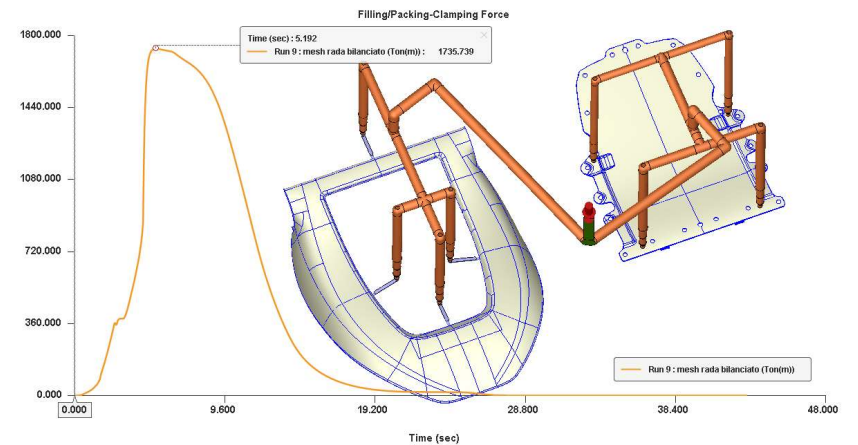
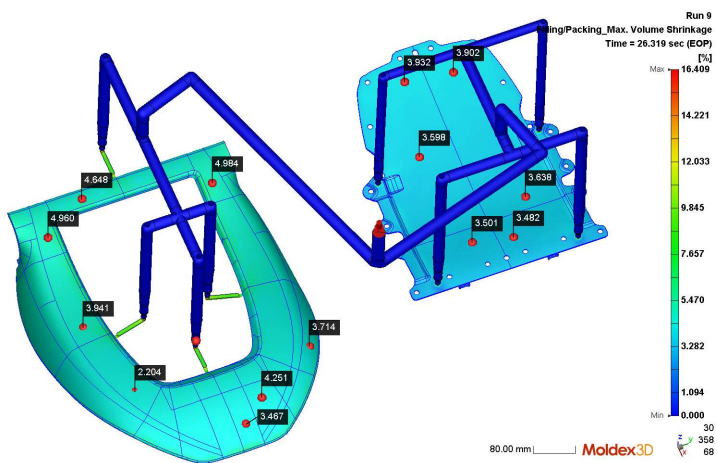
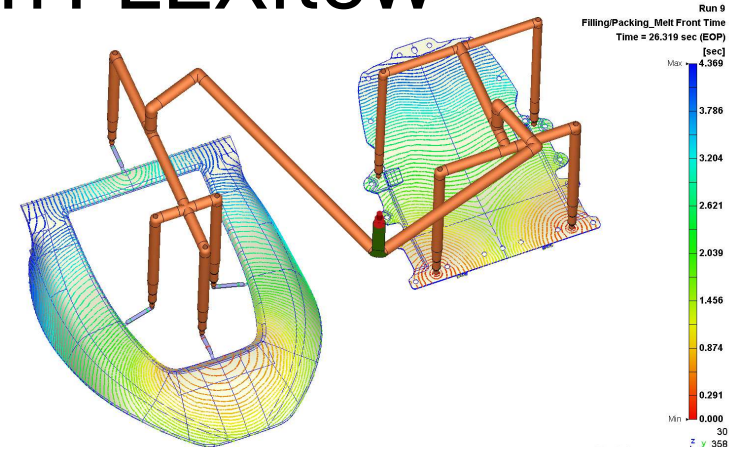
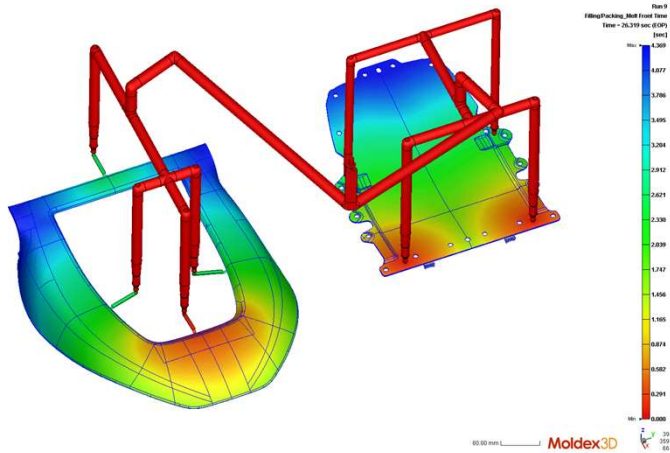
Option 1: Balanced filling with FLEXflow



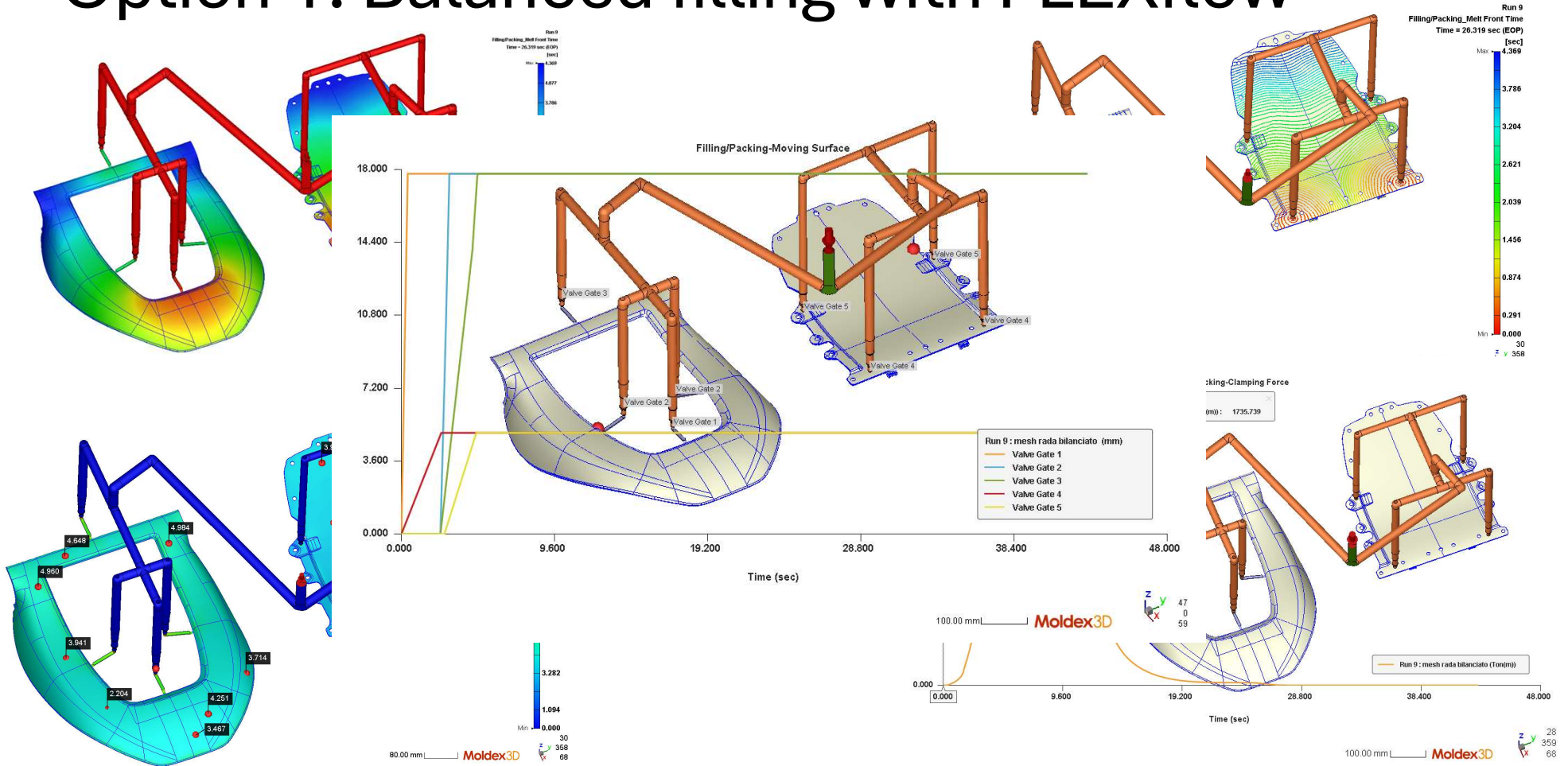
- Balance filling: first nozzles on both cavities open at start of injection
- Different FLEXflow settings on nozzles guarantee a balanced filling without hesitations.
- Shorted cycle time
- Clamp force near the limit



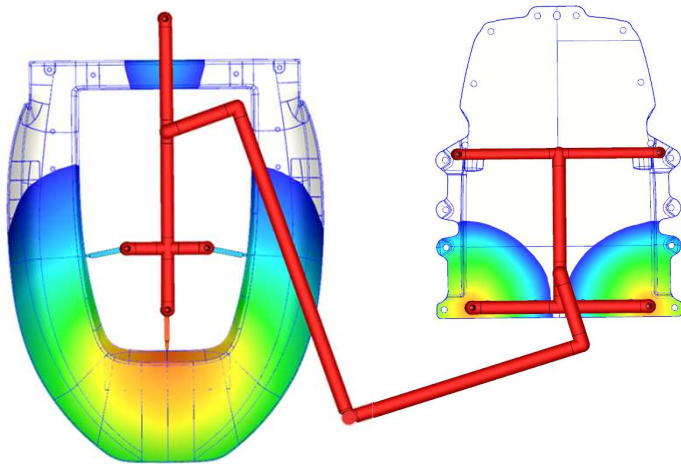
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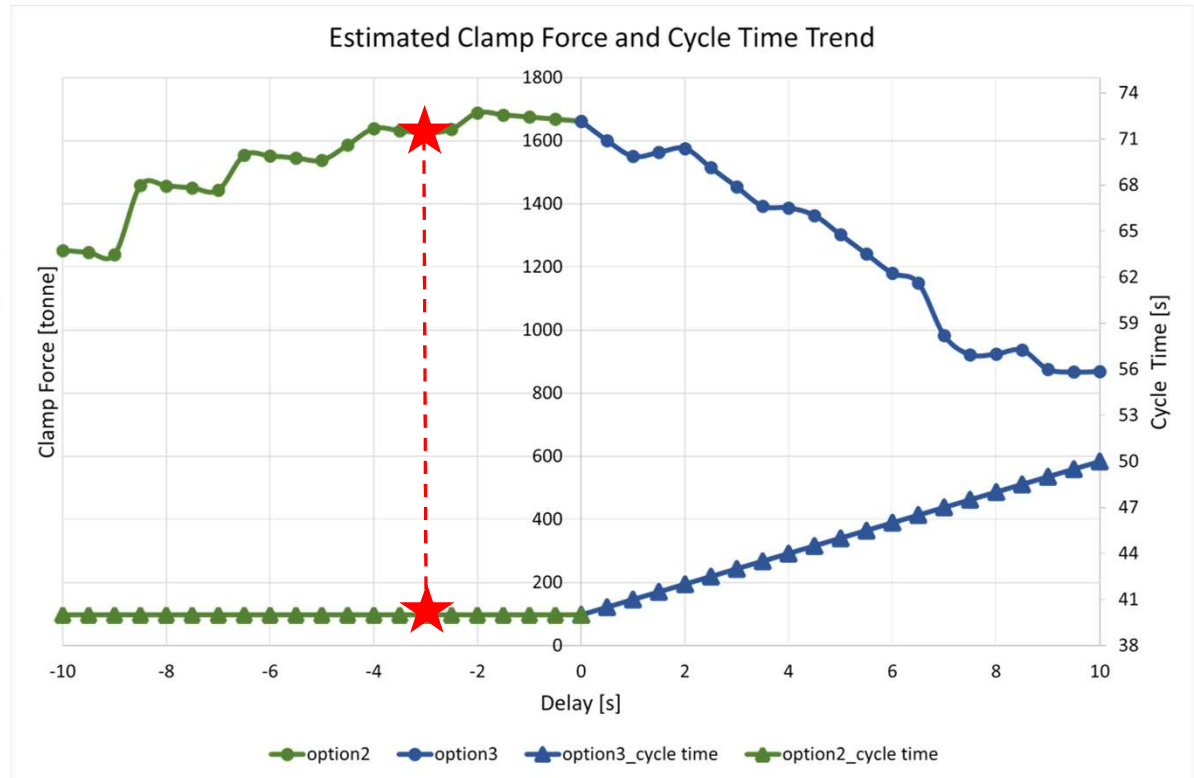
Option 1: Balanced filling with FLEXflow



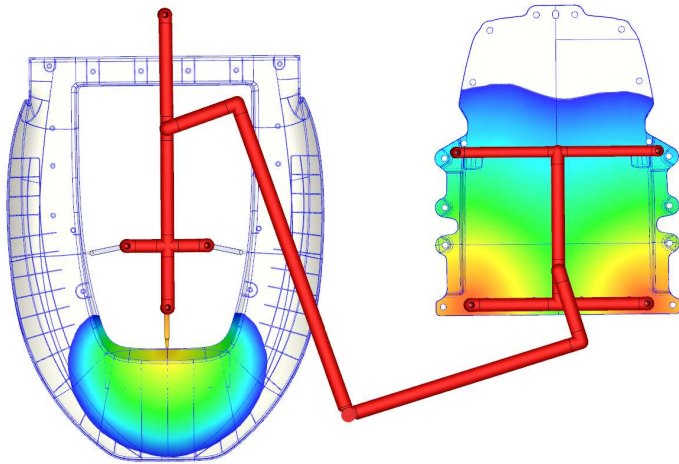
Option 2: Open first cavity with a delay



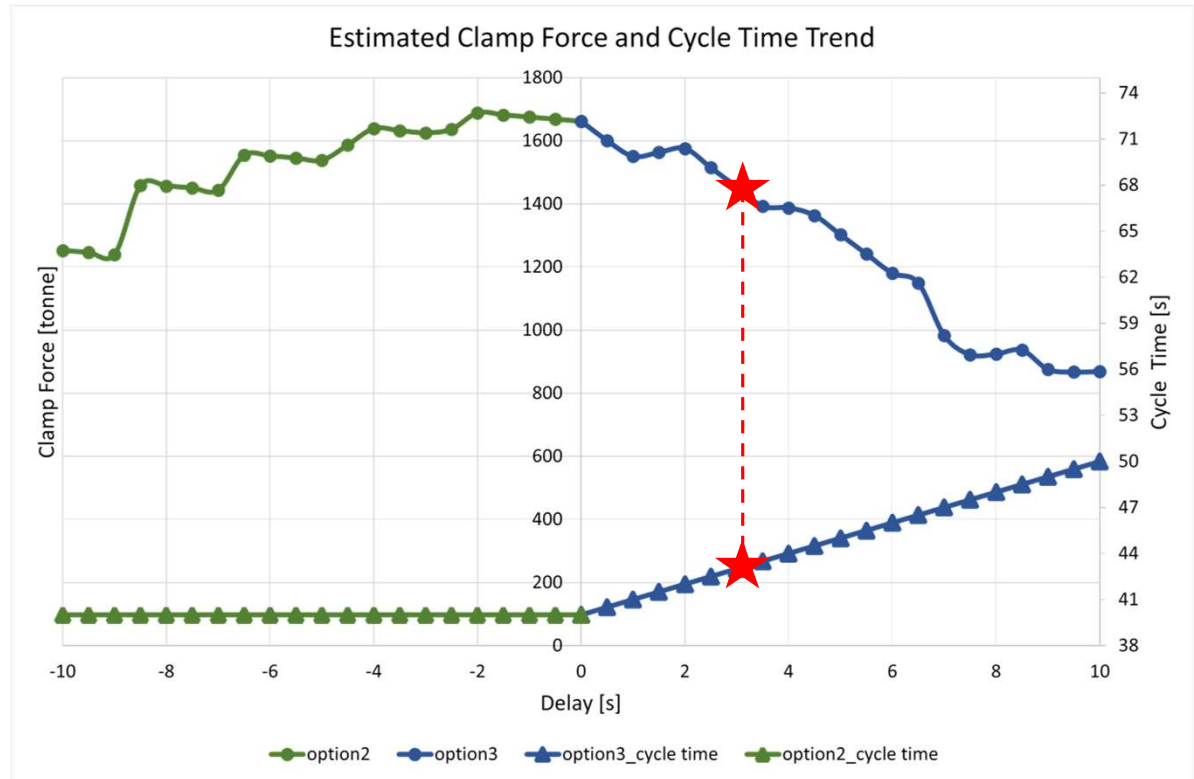
- First cavity open after 3.5s from the beginning of filling.
- Specific FLEXflow settings on each nozzles permit to control holding phase of biggest cavity during the filling of the smallest one.
- Optimisation of cycle time as the thicker cavity is filled first.
- High delay to significantly reduce clamping force



Option 3: Open second cavity with a delay

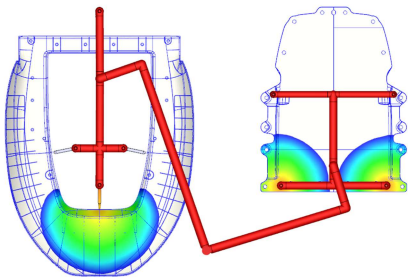
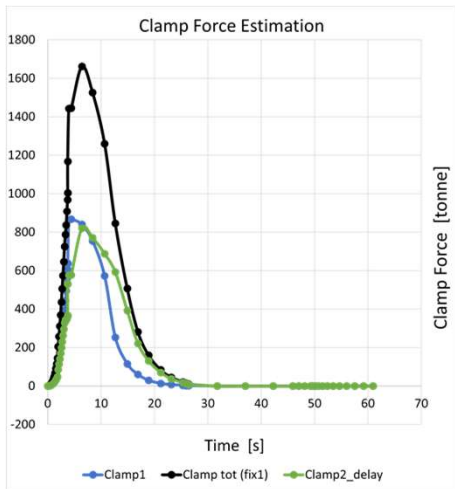


- First cavity open after 3.5s from the beginning of filling.
- Specific FLEXflow settings on each nozzles permit to control holding phase of biggest cavity during the filling of the smallest one.
- Longer cycle time as the thicker cavity is filled with a delay.
- Lower delay than Option 2 to significantly reduce clamping force

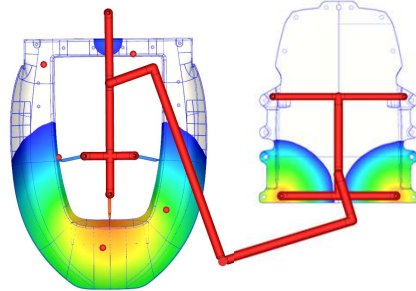
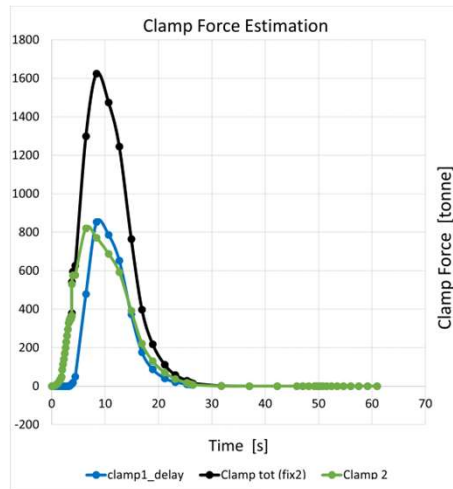


Clamp force estimation

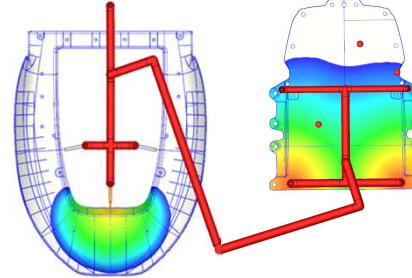
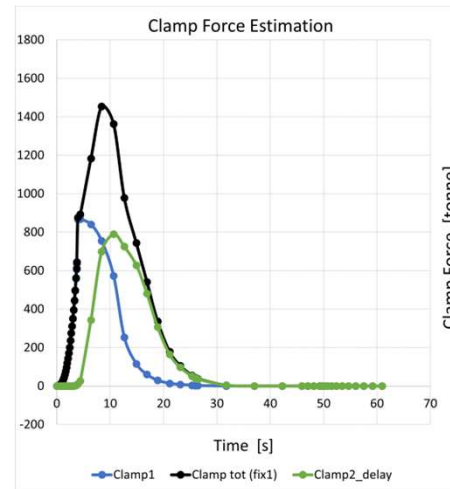
OPTION 1
Balance filing
Opening delay=0



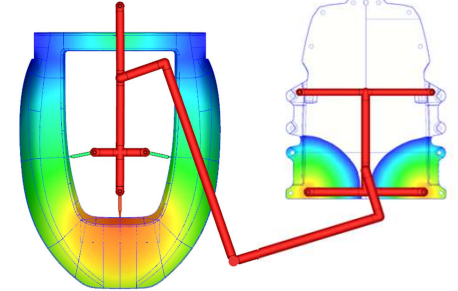
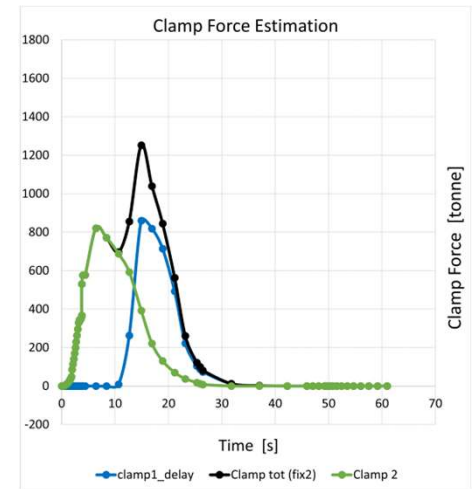
OPTION 2
Open first cavity with a delay
Opening delay=3s



OPTION 3
Open second cavity with a delay
Opening delay=3s

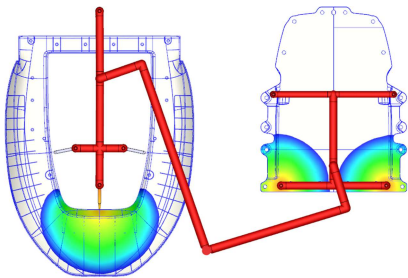
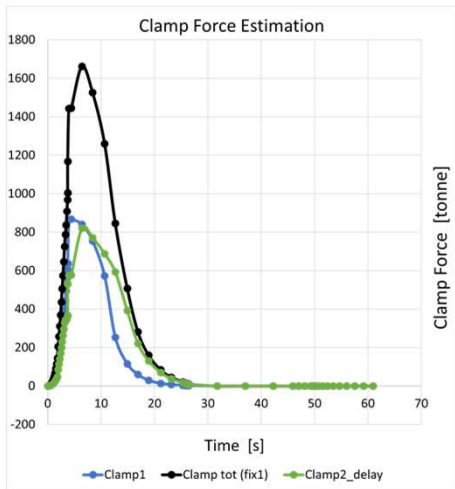


FINAL OPTION
Open first cavity with max delay
Opening delay=10s

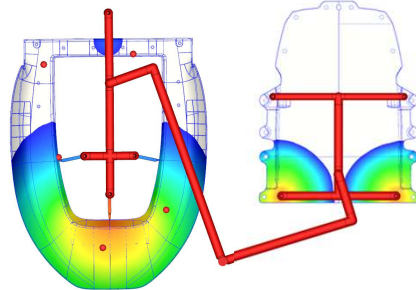
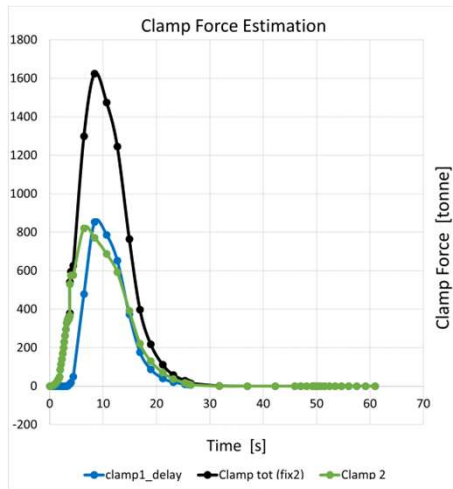


Clamp force estimation

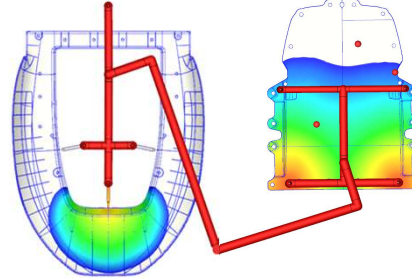
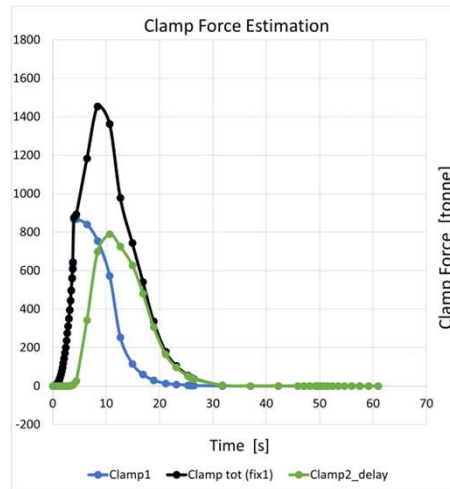
OPTION 1
Balance filing
Opening delay=0



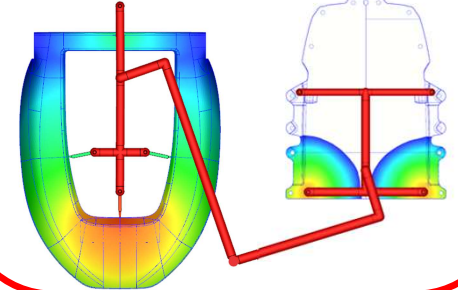
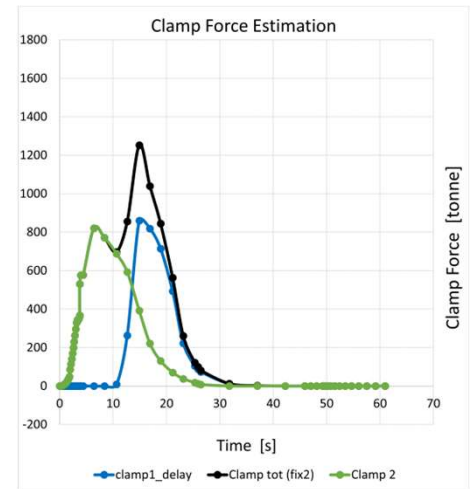
OPTION 2
Open first cavity with a delay
Opening delay=3s



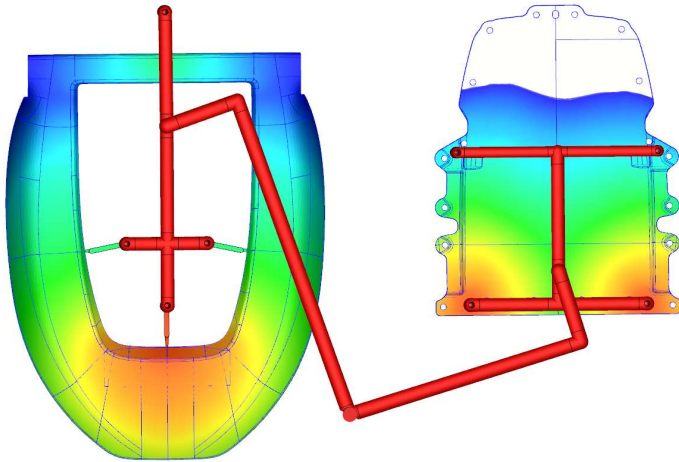
OPTION 3
Open second cavity with a delay
Opening delay=3s



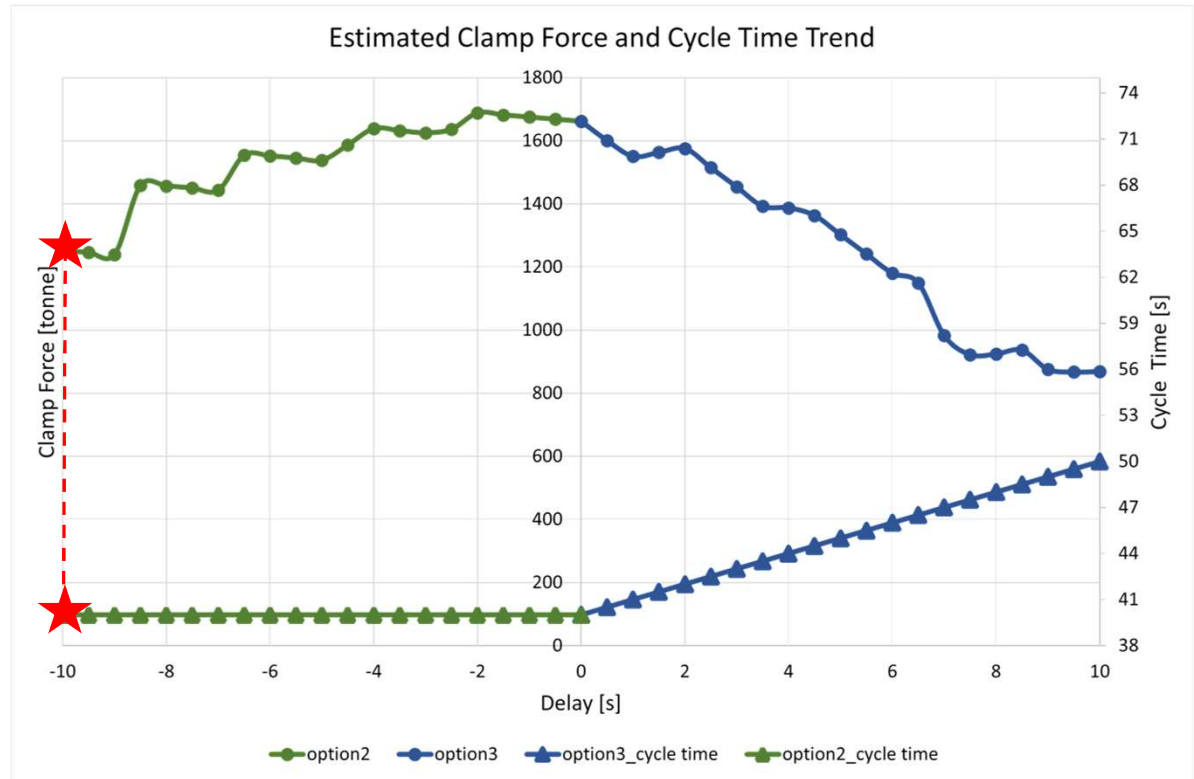
FINAL OPTION
Open first cavity with max delay
Opening delay=10s



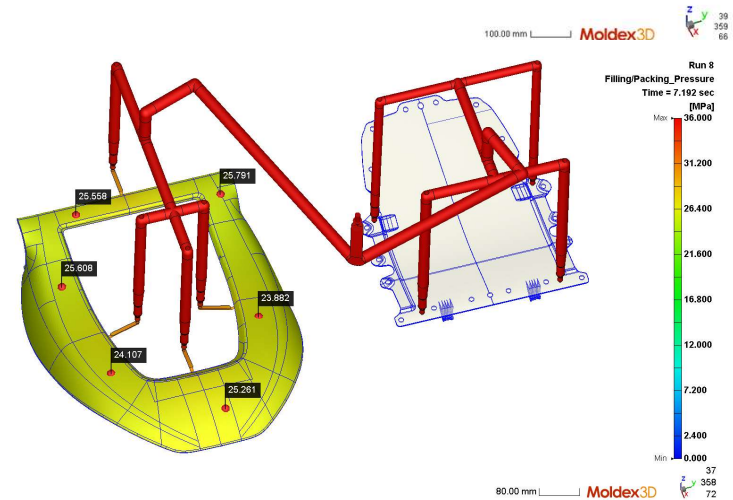
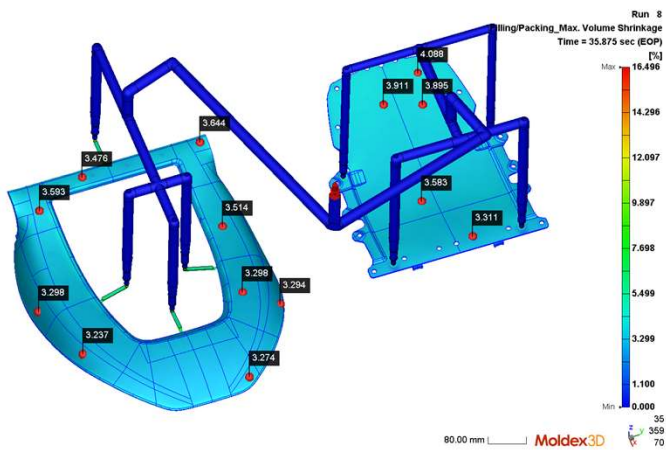
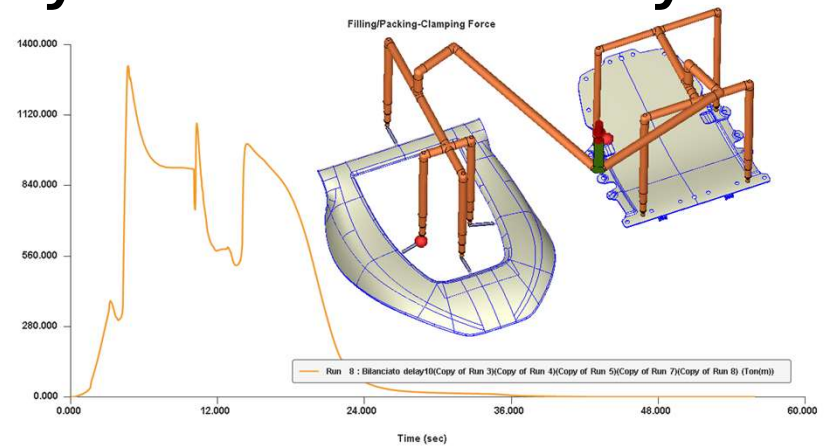
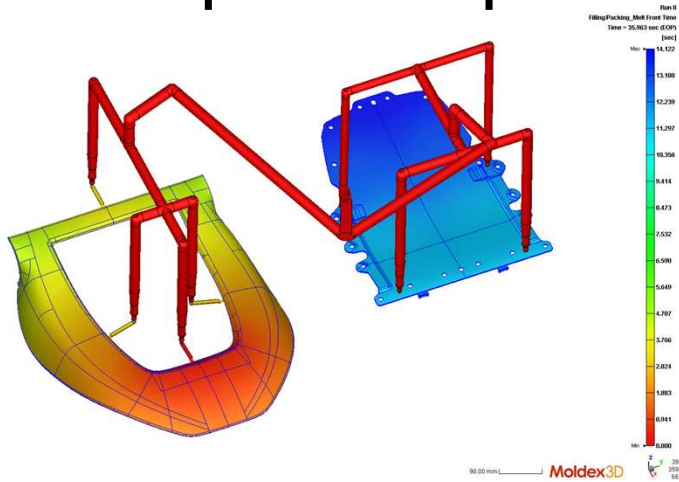
Final option: Open first cavity with a max delay



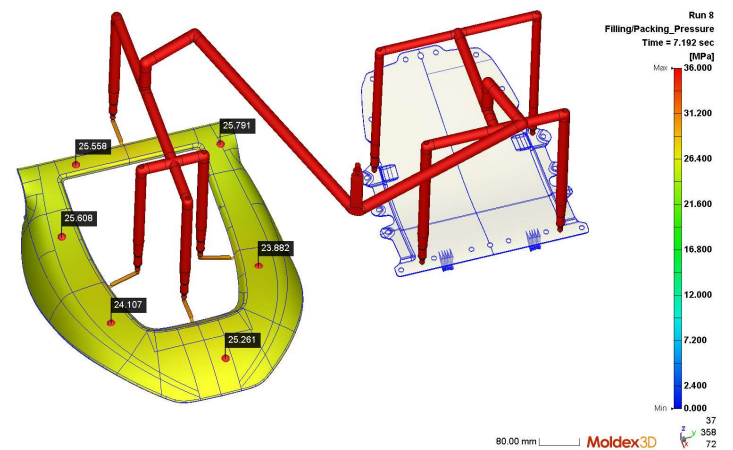
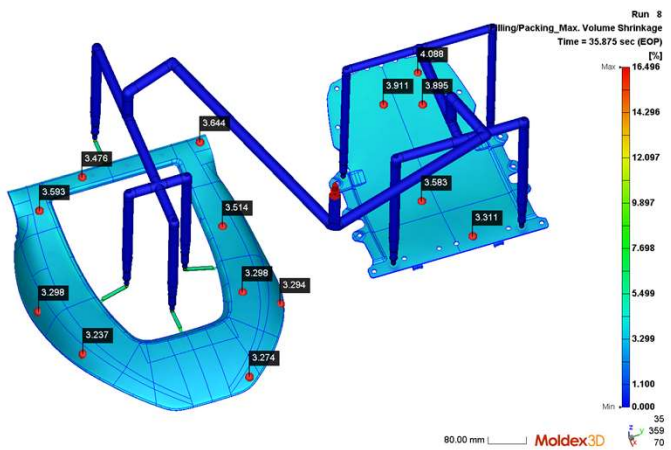
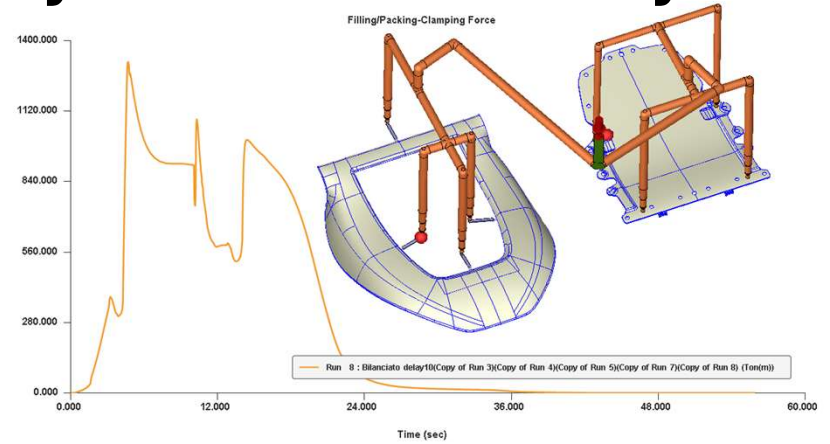
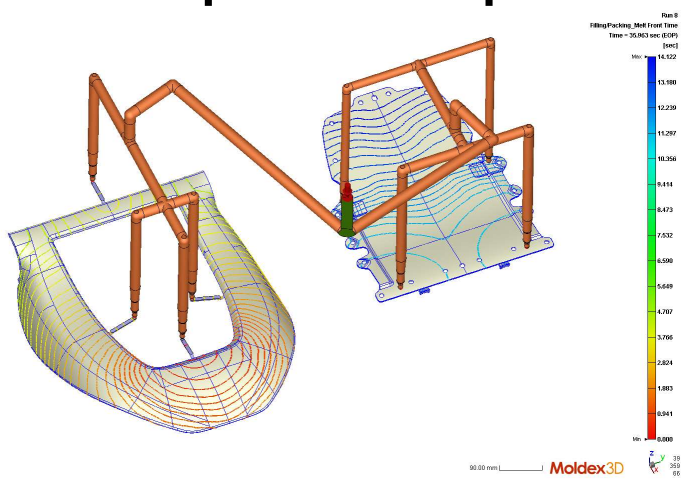
- Find the best situation to reduce clamp force and reduce clamp force as much as possible.
- First cavity open after 10s from the beginning of filling.
- Specific FLEXflow settings on each nozzles permit to control holding phase of biggest cavity during the delay and during the filling of the smallest one.



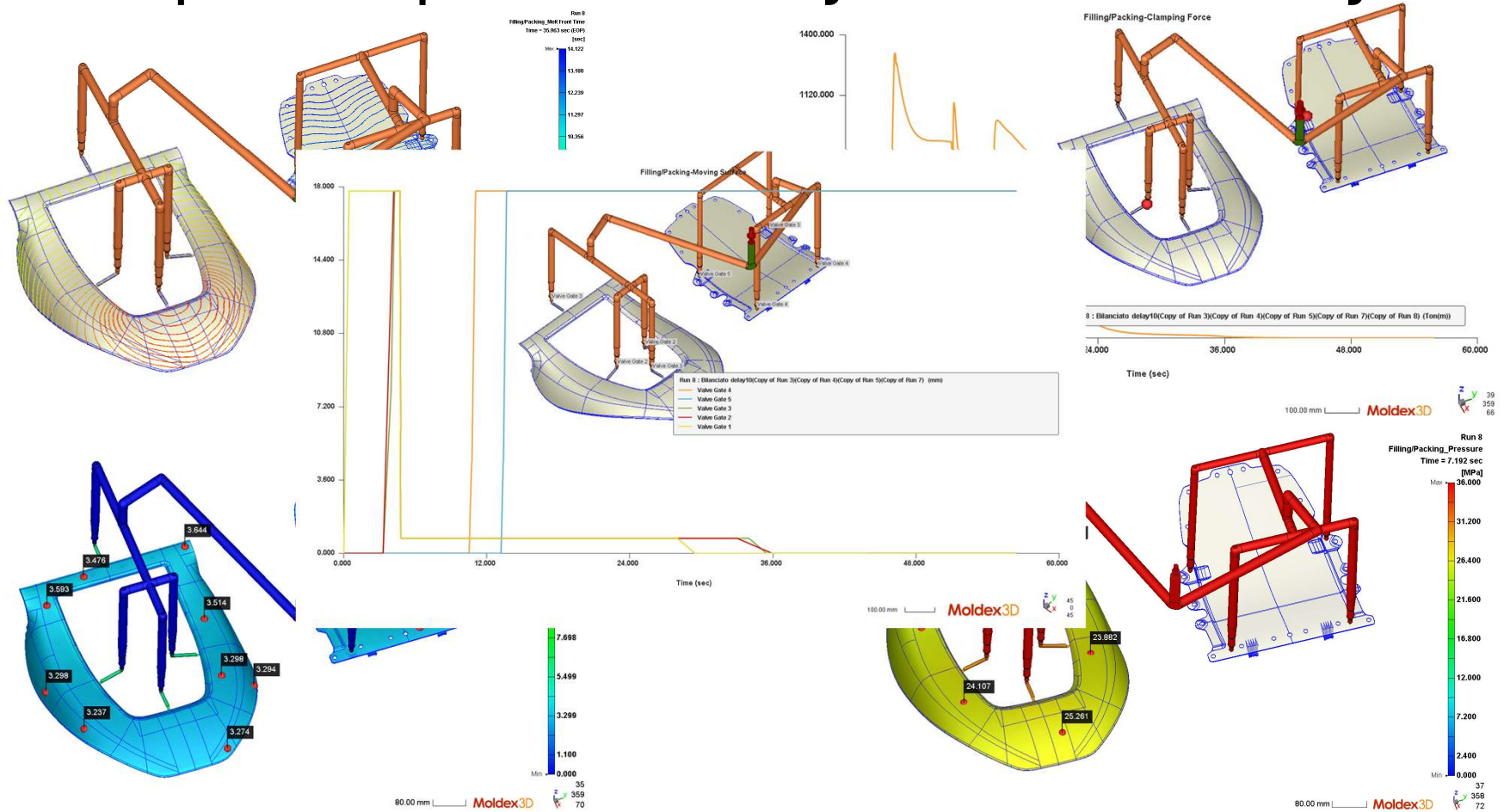
Final option: Open first cavity with a max delay



Final option: Open first cavity with a max delay



Final option: Open first cavity with a max delay



Conclusion

- FLEXflow technology:
 - Permit to control holding phase for each cavity with a tandem injection molding.
 - Permit to control the flow rate of every single nozzle to move the weld lines.
- Tandem injection molding
 - Permit to optimize process setting for each cavity.
 - Permit to reduce total clamp force.

The background features a series of flowing, wavy lines in shades of blue and orange, creating a sense of motion and energy. The lines are layered and have a soft, glowing appearance, set against a dark, almost black background. The overall effect is reminiscent of a digital or light-based wave pattern.

Thank you