Case Study: Click2Cast and NovaFlow&Solid

Altair
Partner Alliance

Altair Offers Flexibility and Enhancement for Casting Process Design and Optimization

Key Highlights

Industry:
Automotive

Challenge:
Design and optimize the entire casting process to avoid typical defects during filling and solidification of casted components using Altair and Altair Partner Alliance casting tools.

Altair Solution:
Improve quality and productivity with simulating the mold filling and solidification of metals using:

- solidThinking Click2Cast for Fast, Easy and, Accurate casting feasibility and process refinement
- NovaFlow&Solid package for re-validating the detailed gating or chiller and avoiding possible casting defects.

solidThinking Click2Cast and NovaFlow&Solid are both able to be deployed via HyperWorks Units.

Benefits:

- Access a variety of tools on demand
- Enhance and optimize manufactured components
- Avoid typical casting defects such as air entrapment, porosity, cold shots, etc
- Validate the filling design using different ingate locations.
- Validate the solidification porosity defects and optimization of the risers.

CLICK2CAST

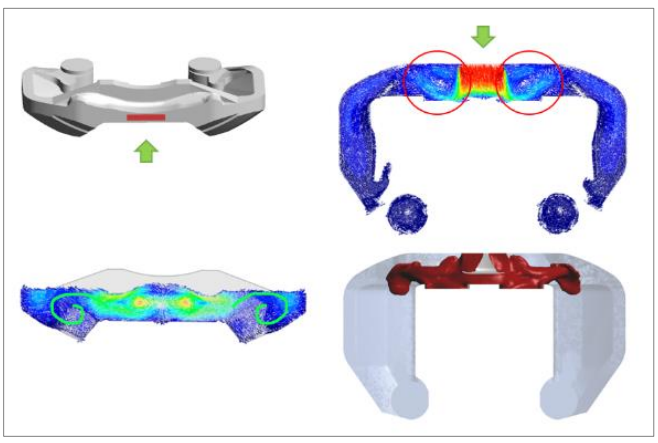
Click2Cast is a casting process simulation software developed under an innovative user experience allowing a complete simulation to be done in five simple steps within a completely new and user-friendly interface. This allows the user to enhance and optimize their manufactured components, avoiding typical casting defects such as air entrapment, porosity, and cold shots, etc. thanks to the simple and quick mold filling and solidification simulation.

Challenge:

The goal of this project is to get the optimal gating system (size and position of ingate) to help avoid porosity and other common defects in the produced parts, achieving the final design to begin casting the component.

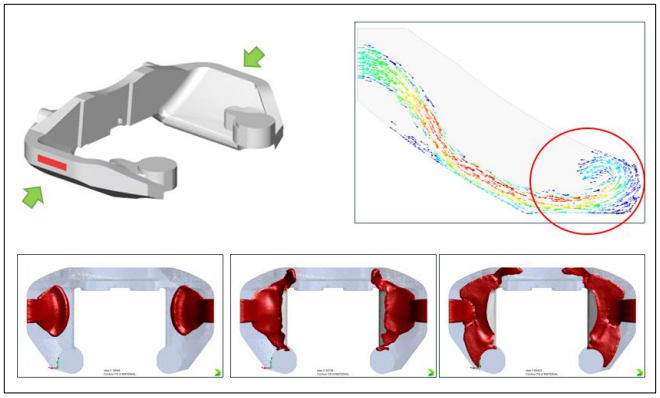
Getting the Right Part:

solidThinking Click2Cast, available through Altair's HyperWorks suite, is used to find the best ingate position for the part. As a first trial, a single ingate has been defined behind the geometry. The size of this ingate is 5x30 mm. Observing the simulation results, we can see how the material is colliding directly with the wall, causing a lot of turbulence. That turbulence can provoke the formation of air bubbles and porosity.



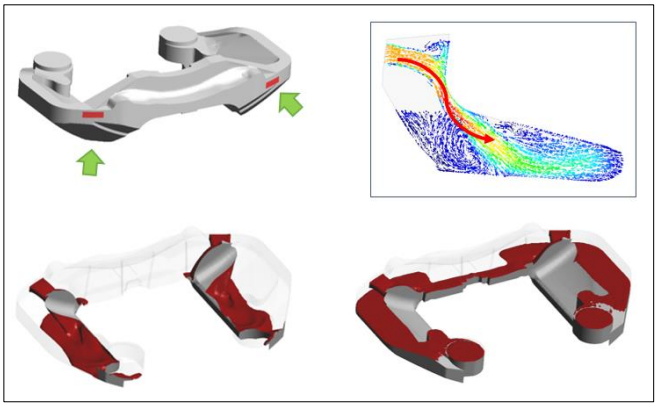
Velocity vectors showing turbulence

It has been proven effective to attack through the laterals of the caliper, but this new position is also forming bubbles when the material collides with the front wall on both sides.



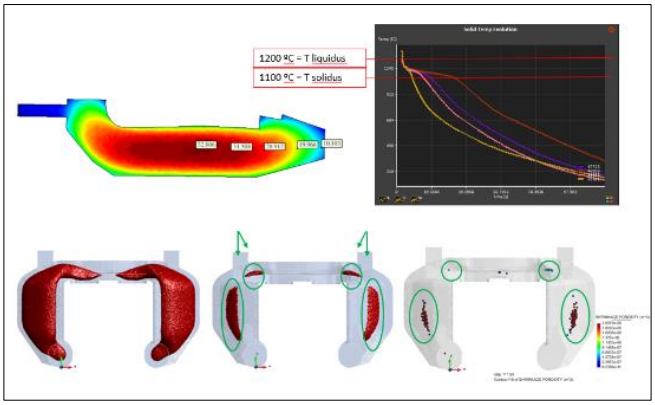
Material colliding against the front wall

Finally, a good position for the ingate has been identified: even though the material is colliding with the front wall, it is clearly filling with more stability than the previous solutions as well as avoiding the turbulence issues.



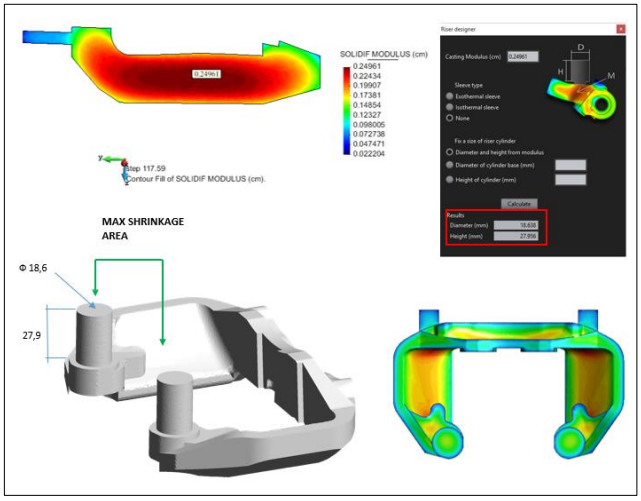
Final ingate position

Using this size and position, a real ingate has been designed using computer-aided design (CAD) software and the solidification of the caliper has been simulated. This ingate position also allows for feeding both isolated liquid material areas during the solidification.



Solidification evolution

The riser designer tool will recommend the optimal size for the riser to avoid the porosity located at critical areas and help reduce the shrinkage porosity.



Final design component, with ingates and risers

After three fast and easy iterations changing the ingate position and size, a good solution for this component was found. The simulation and the filling behavior analysis, as well as the solidification results, confirmed that porosity problems due to contraction of material have been avoided.

Getting the Right Process:

After obtaining the optimal position and size for the ingate and risers thanks to solidThinking Click2Cast, a detailed re-validation of the entire casting system can be done using NovaFlow&Solid.

NovaFlow&Solid is an innovative casting process simulation tool that helps you work faster, easier and achieve accurate casting designs. NovaFlow&Solid simulates mold filling, solidification and stresses and contains multiple features to really give you the possibility to simulate the casting production that you are looking for. Timesaving comes from switching mesh in the simulation (as you would use a bigger mesh resolution for the sections that are thick-walled and for sensitive areas you would use a finer mesh) and from filling over several steps. Shortening simulation time is crucial for all foundries to be able to optimize their casting projects, and NovaFlow&Solid lets you investigate your casting designs and guides you on how to increase your yield and optimize your production process, helping make casting production greener.

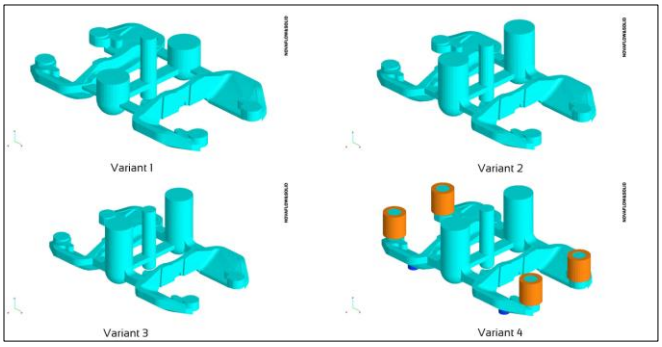
Click2Cast and NovaFlow&Solid

Challenge:

The goal is to refine the optimal gating and feeding system (size and position of the ingate) to further minimize porosity and other common defects in the produced parts. Yield improvement is an important part of the project as is designing the casting and part to achieve limited stresses in order to decrease the risk of cracks.

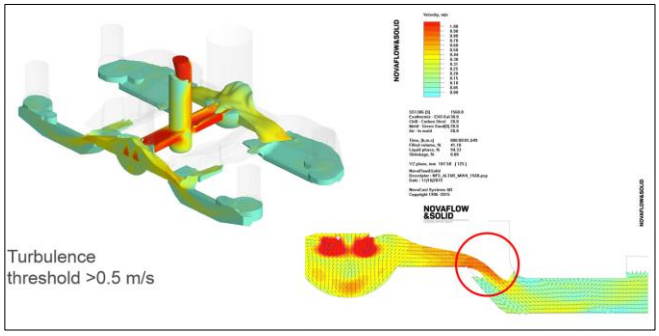
Finding the Best Solution for Production:

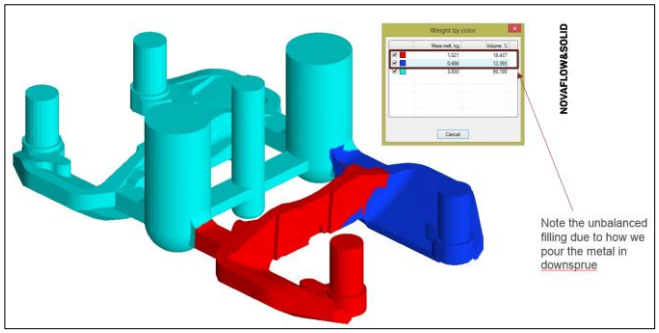
NovaFlow&Solid, available through the Altair Partner Alliance, is used to find the best production process and process parameters as well as to refine the optimal gating and feeding system. In this example we have setup four different variants:



Four different ways to setup the casting layout

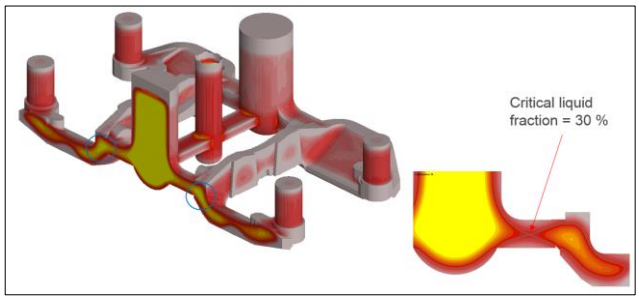
We started by performing a mold filling simulation to refine the gating system design and look for turbulence.

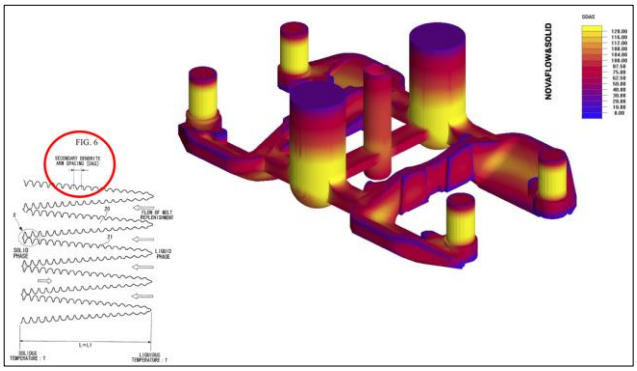




Balancing of the gating system is important. The flow color function can be used here.

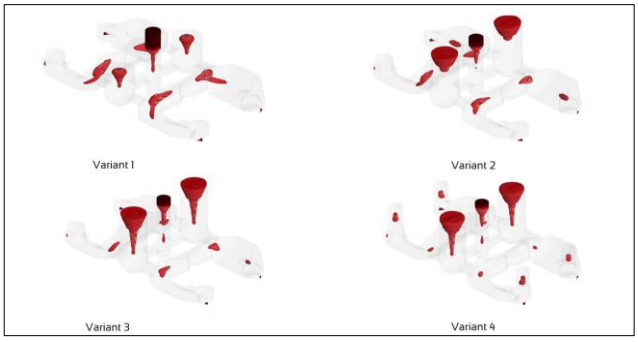
When the gating system is designed and looks correct to avoid the turbulence (under the thresholds of 0.5 m/s) it is time to look at the solidification of the part to evaluate the feeders.

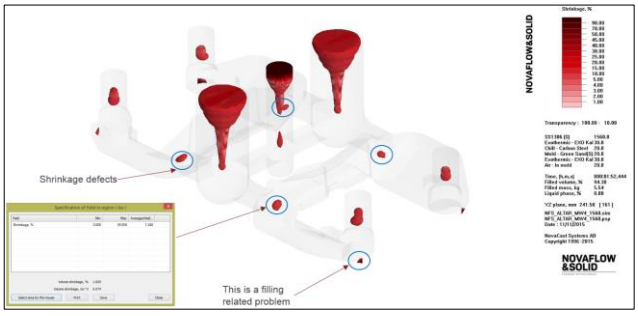




Solidification evaluation including the SDAS prediction = Secondary Dendrite arm spacing

The liquid phase fraction shows the hot spot areas of the casting and the solidification patterns with the casting in combination with the feeders.

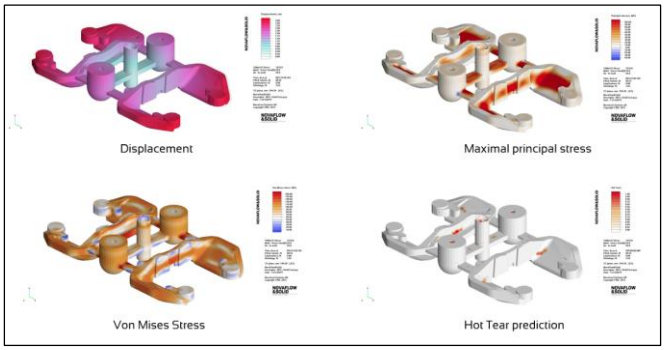


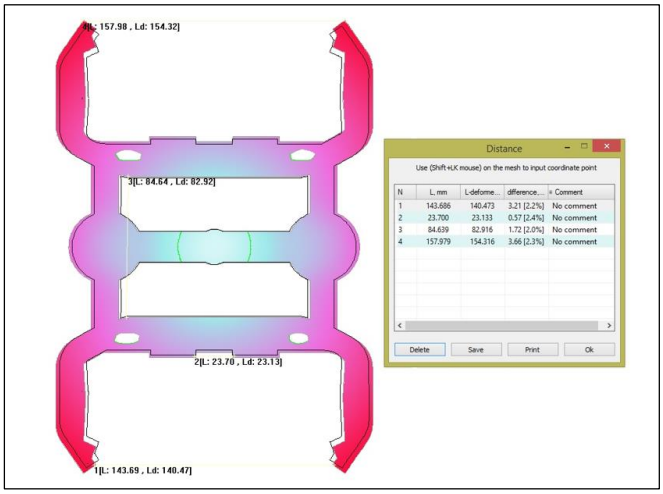


Shrinkage prediction with individual evaluation of each shrinkage. We can see on the picture that variant 4 gives the best result. This can be evaluated visually or numerically, in general or in detail.

Click2Cast and NovaFlow&Solid

NovaFlow&Solid also has a built in feeder size calculation program that can determine the size of feeders and feeder neck design. It uses the built in Thermal Modulus and Geometric Modulus calculation.





Stress calculation results with possibility to measure dimensional changes and distortion

At the final stage, the residual stress calculation is made and from this we can investigate dimensional changes during solidification and cooling, risk for cold and hot cracks and residual stress distribution. It is then possible to export the final stress distribution to most finite element modeling (FEM) based software tools via node based export.