

# FINE TUNING SIMULATION INPUT DATA FOR THE SPECIFIC FOUNDRY



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**ARTICLE TAKEAWAYS:**

- Simulation is an Excellent Predictor of Shop Floor Results
- Fine Tuning is a Normal Practice for each Foundry
- Problem Castings are Useful for the Tuning Process

Simulation has proven to be a very useful tool for predicting what is going to happen on the shop floor, before tooling is made. That being said, every foundry that uses simulation can benefit from fine tuning their input data, based on actual results from their own castings. Normally, this is a simple process, using data from previous casting failures. This article provides a case study of how this process is typically carried out.

Our example is a ductile iron rotor casting made using a vertically parted molding machine. Figure 1 shows the pattern layout.

This was a real problem job for the foundry, as you can see from Figures 2 and 3, which show slices through the left and right castings, respectively.

In each casting you can see massive shrinkage. This was occurring in almost 40% of the current production, so it was imperative to identify which simulation inputs were important and what were the best settings to use for that foundry, in order to accurately predict solidification results, and then using that information to solve the problem.

When we went back into the production records, they showed

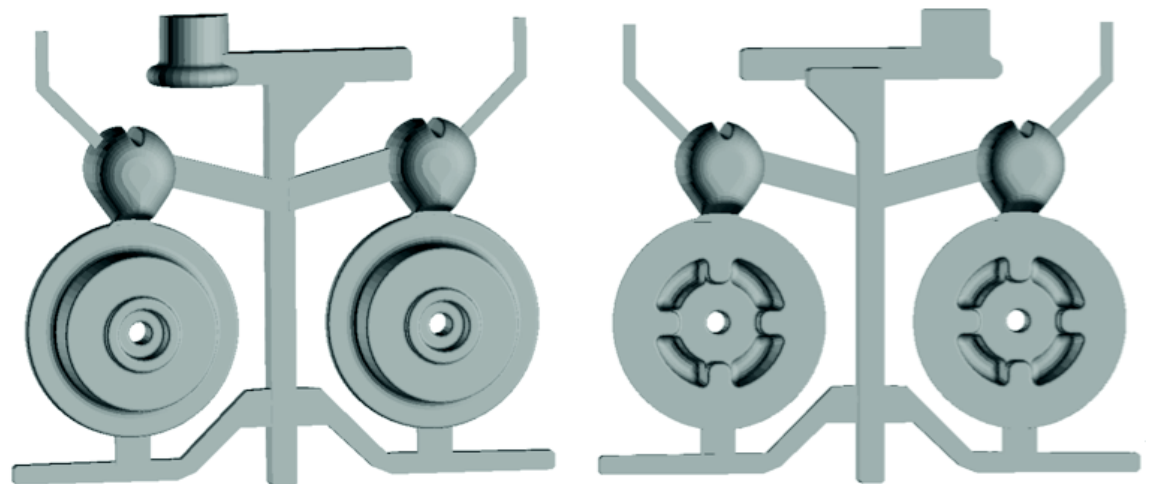


Figure 1. Pattern layout for a ductile iron rotor casting in a vertically parted mold.



Figure 2. Slice through the left casting, showing shrinkage.

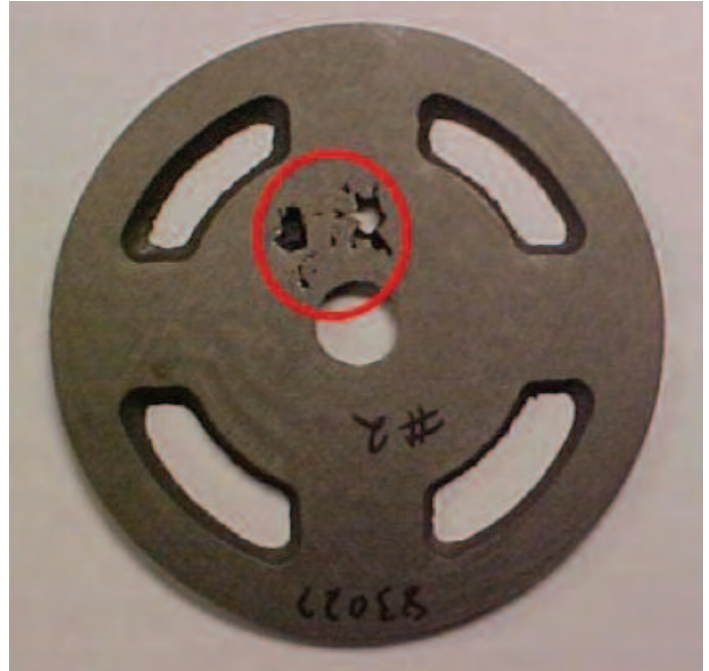


Figure 3. Slice through the right casting, showing shrinkage.

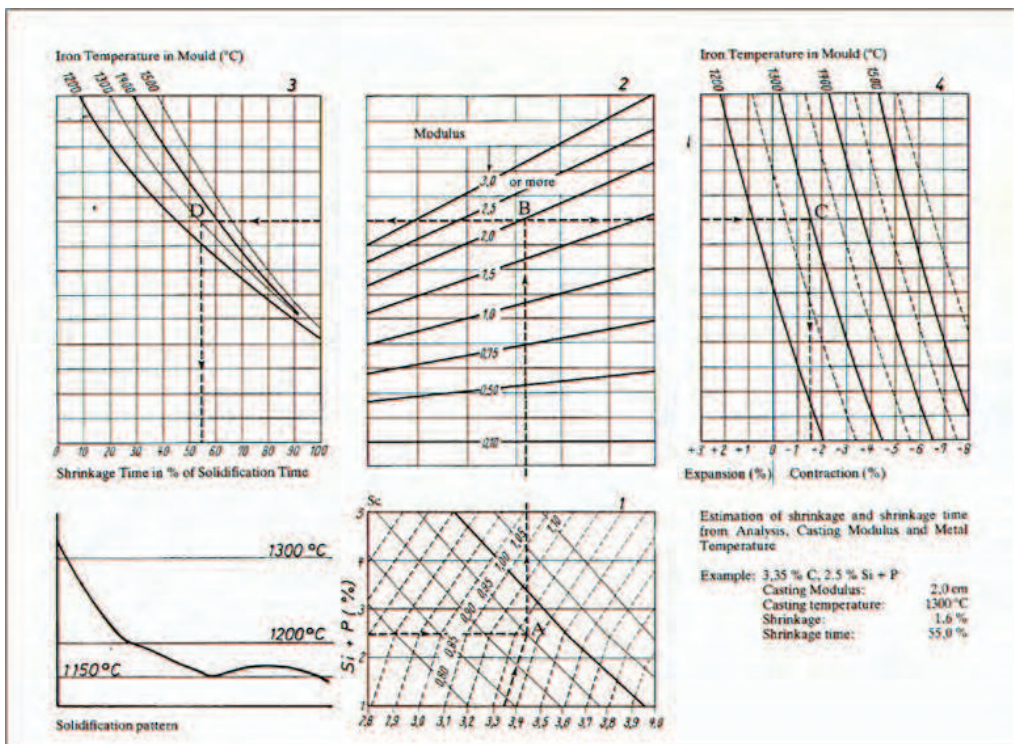


Figure 4. The VDG Nomogram, used to predict solidification behavior in cast irons.

that for chemistry there was a variation of up to 0.3% in the carbon equivalent and the pouring temperature could change by as much as 50°F. So, we have target values, but on the shop floor we have a range of inputs. Which data best predicts the results we are seeing?

For gray and ductile irons, we can predict solidification and shrinkage/expansion behavior using the VDG Nomogram. Figure 4 show what that original nomogram looks like.

Working with the nomogram is a rather tedious way of doing things, but that is the way things were done before computers. We have incorporated the VDG Nomogram electronically into the SOLIDCast software and then added the additional things like mold dilation and metallurgical

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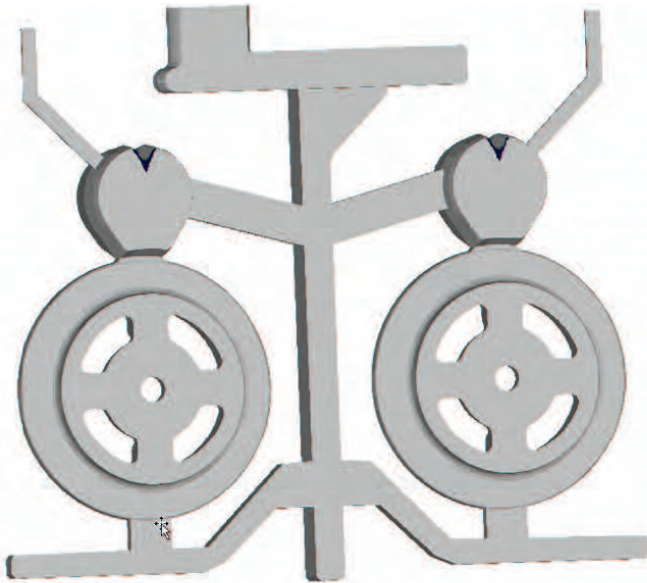


Figure 5. Simulation results of a slice through the castings.

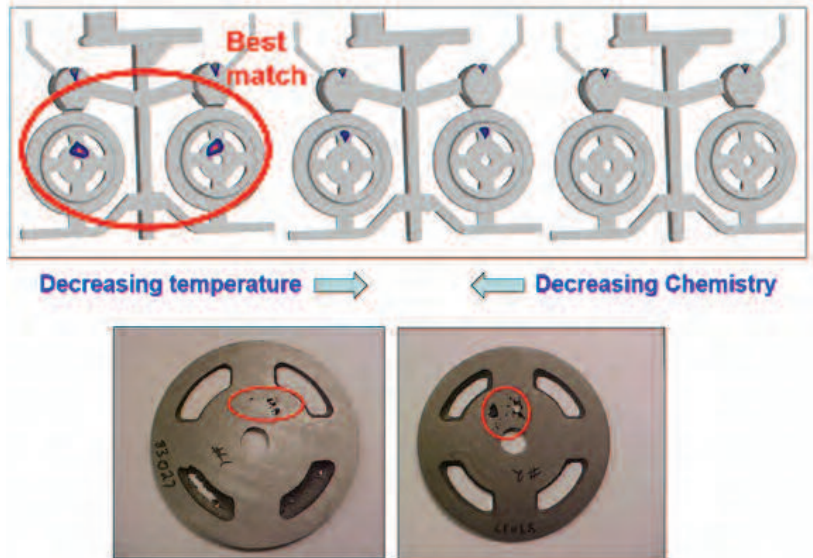


Figure 6. Comparison of simulation results with shop floor results.

quality so that you do not have to go through these sorts of calculations manually. It is taken care of automatically when we do a simulation. Figure 5 shows a look at those results on a slice through the middle of the model.

We can see that there are no predicted problems. This simulation was done using the highest levels of the chemistry and the lowest level of the pouring temperature. That clearly was not matching what was going on in the foundry. If we go to an intermediate chemistry, that is, lowering the carbon and silicon levels to the middle of the range and the middle of the expected range of pouring temperature, we see that defects are starting to occur in the simulation, but they are not really occurring in the area that we saw on the sectioned casting.

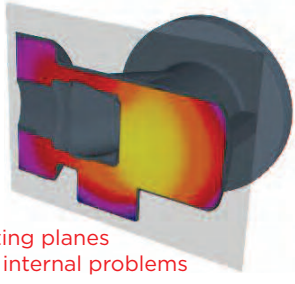
If we go to the lowest level of chemistry and the highest pouring temperature, we see that we are now predicting shrinkage areas right down in the area that the production casting was showing. In fact, simulation now shows a massive loss of density in the middle, which literally would be a hole just like we saw in the castings. A comparison of the results from the 3 sets of simulations is shown in Figure 6.

So, by using the high end of the Pouring Temperature and the low end of the Chemistry Range, we are best able to predict shop floor problems. Knowing that there are going to be variations, we normally want to design the process for the worst of those conditions. So, for future simulations, what the foundry is going to do is use the lower end of the chemistry spectrum

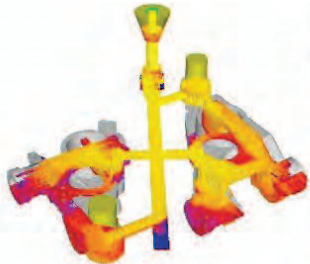
in the higher end of the pouring temperature spectrum, because that produces the worst situation, and then design the gating and risering to attack those worst-case scenarios.



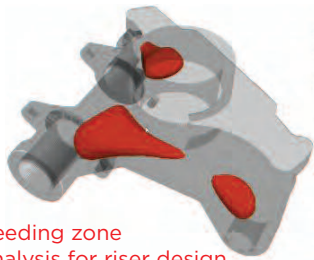
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