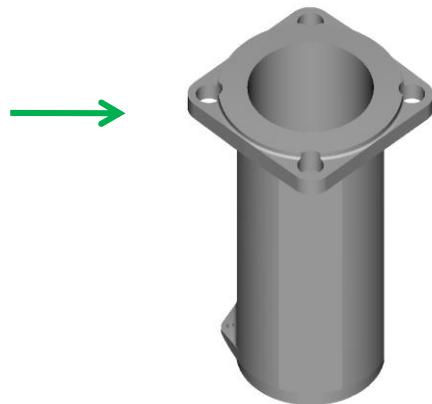
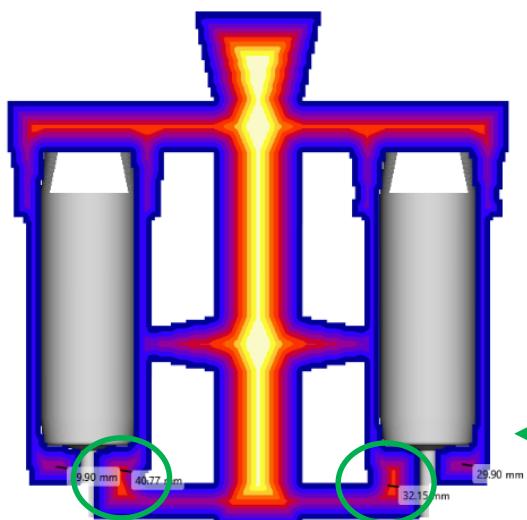
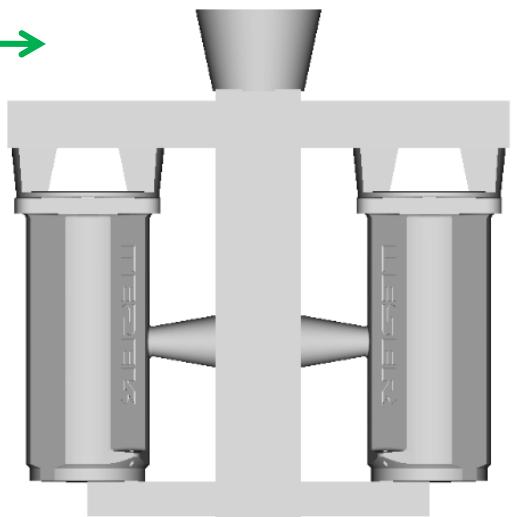


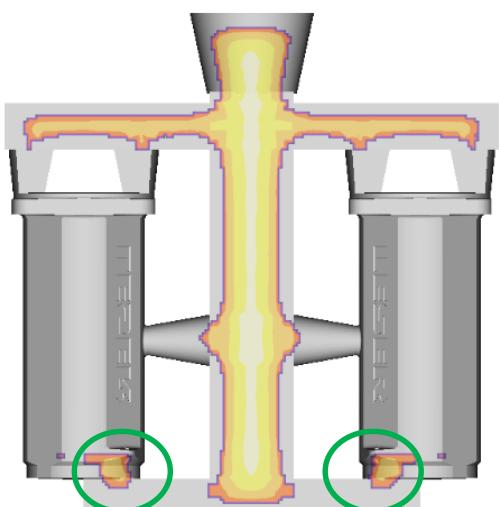
**Case:** This is a gate valve, Investment casting part made of steel. The overall size of the part is 128 X 128 X 256 mm and weight is about 8.3 Kg. The major rejection was faced because of shrinkage defect.



The initial methoding includes double cavity layout. There are four ingates to each cavity. The shell of 10 mm is preheated to 1000 °C.



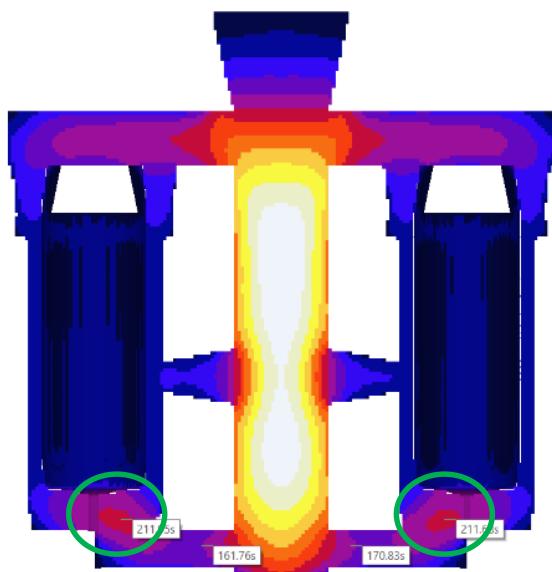
There are couple of thick regions in the casting at bottom section where ingate is connected. Thickness analysis shows mass concentration in the bottom portion.



Simulation of current methoding and analysis of solidification contour clearly indicates an isolated hot spot region at bottom sections of the castings where ingate is connected.

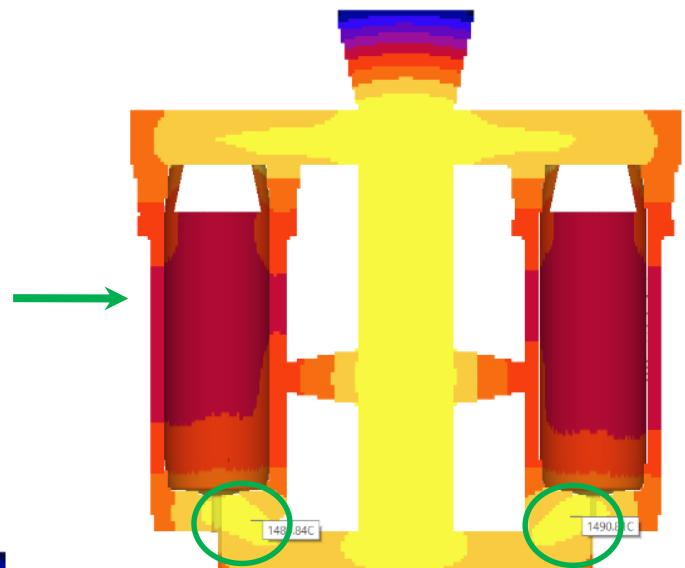


Solidification temperature analysis shows isolated temperature region at bottom side, which leads to shrinkage at the same location of shop floor defect.

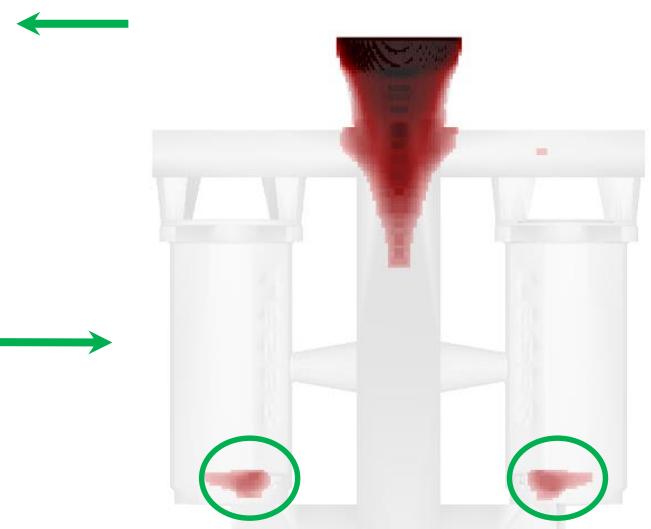


Shrinkage porosity analysis gives the same locations for the shrinkage at bottom side of the casting where defects observed in shop floor.

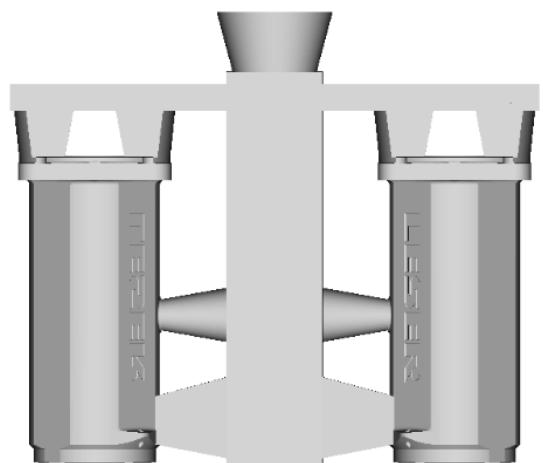
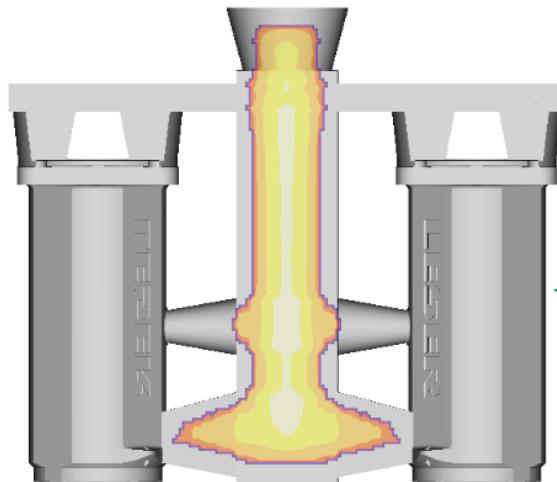
Liquid fraction shows metal solidifying last in the thick bottom section of the casting which leads to porosity . Two isolations are observed at the bottom portion of the castings.



Solidification time analysis shows last solidifying region is at bottom side, which matches with hotspot and solidification temperature analysis along with shop floor defect.

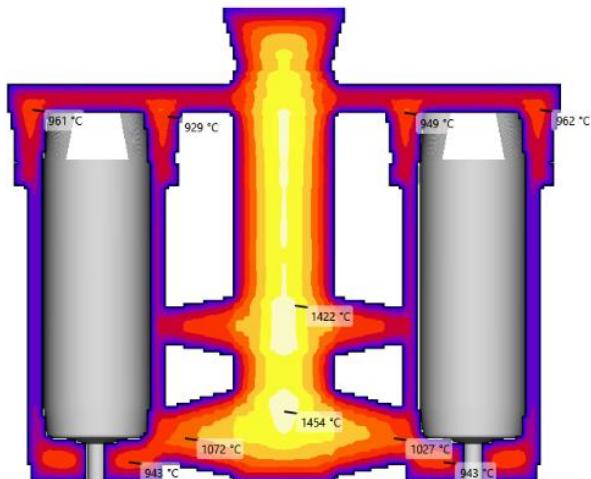


The method of the casting was revised by changing the ingate connections at the bottom side. Also the size of bottom side ingates are increased.

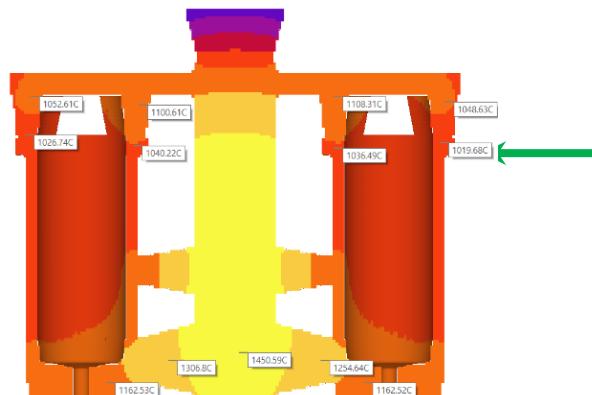


The quick solidification simulation now shows better directional solidification, with hotspot shifting entirely to the sprue and leading to a defect-free casting.

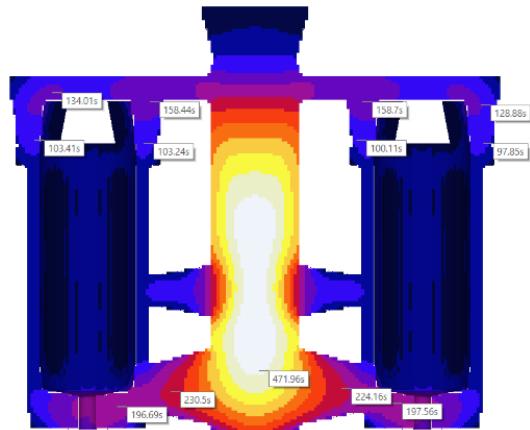
The sectional temperature analysis also shows the high temperature isolations in the center sprue.



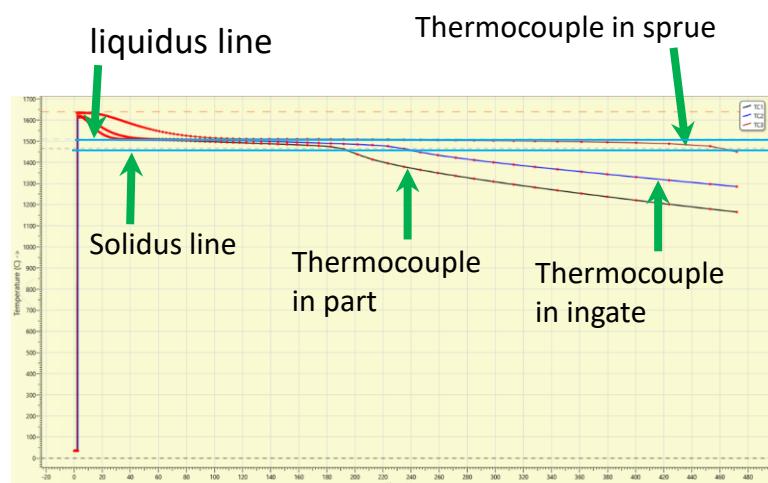
Liquid fraction shows liquid region which solidifies last. Figure shows improved results of Liquid fraction and sprue will be solidify at last.



Solidification time analysis shows better solidification results and the last solidifying region is inside the sprue and casting will solidify before the sprue. So it is resulted in shrinkage free casting.



Thermocouple analysis reveals that thermocouple in part region crosses solidus temperature earlier and thermocouple at sprue crosses solidus afterwards thus sprue solidifies last.



**Summary:** The revised method with changed bottom ingate locations and dimensions resulted in directional solidification and eliminates the shrinkage defect completely and improves casting quality.