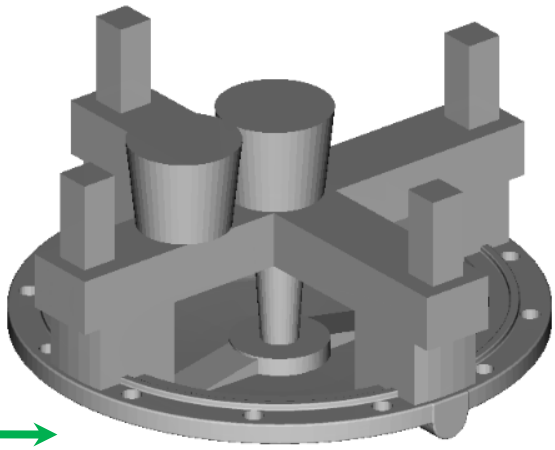
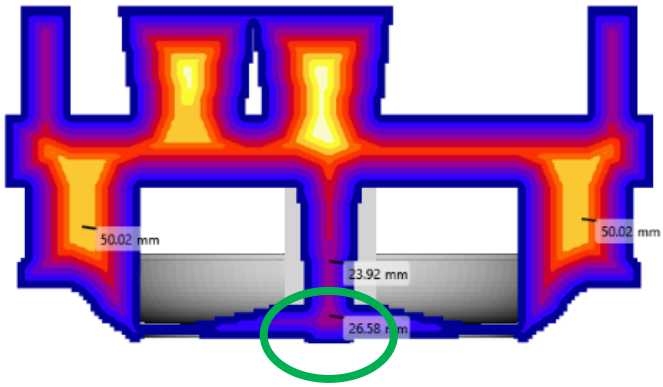
Plate Casting

Cast Steel, Investment Casting

***Case*: The WCB Investment casting part has a bunch weight 29 kg. The main defect observed was the shrinkage defect at the center thick boss like region where one ingate is connected.**

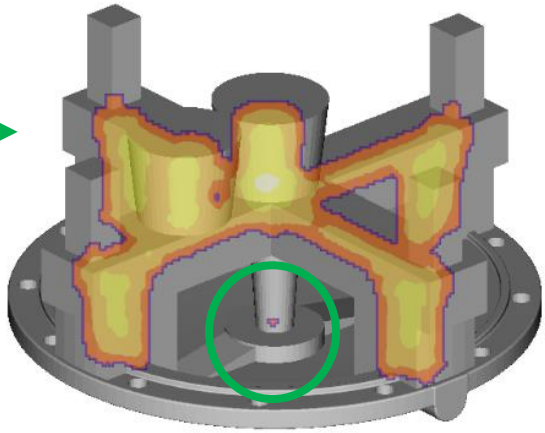


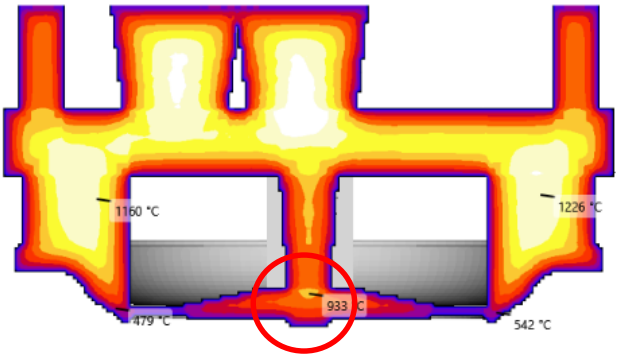
The initial methoding has included five ingates. The four ingates are placed over the periphery of the circular plate and one is connected to center boss region. The ceramic shell of 8 mm thickness is preheated to 980 °C.



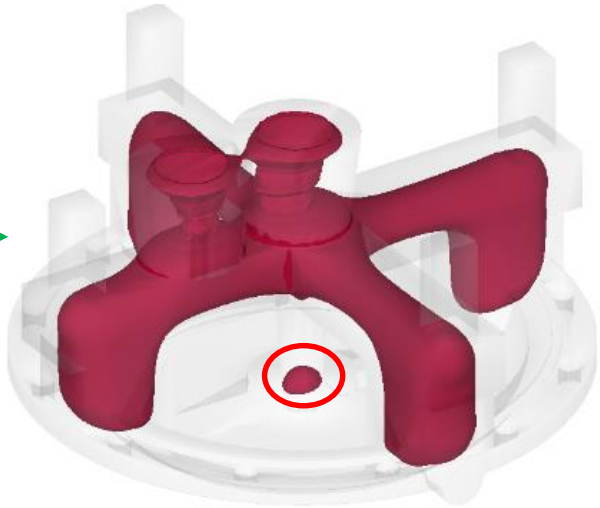
The sectional thickness analysis shows there is more uniform section thickness variation from part to ingates placed at periphery. But there is measurable thickness variation at center boss region and the corresponding ingate. This thick boss region may lead to shrinkage defect.

Preliminary analysis of casting solidification showed hotspot region at the thickest section of part i.e. boss just below the top ingate. The original methoding of the casting had resulted in shrinkage porosity in this locations.



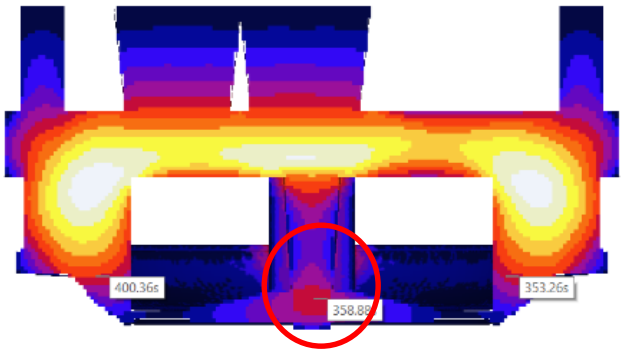


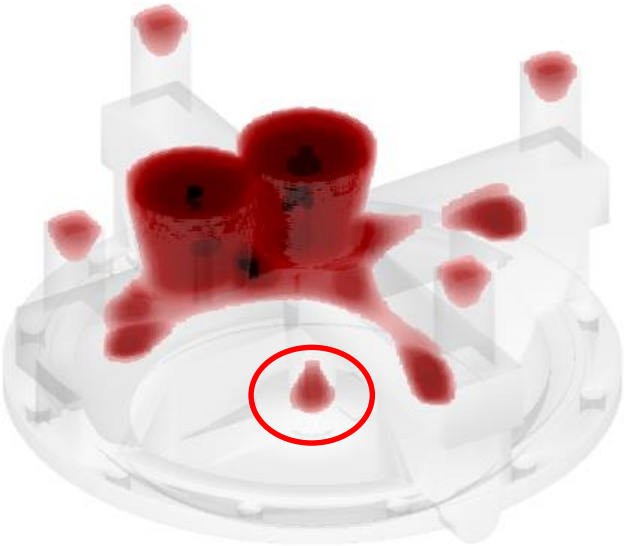
The quick solidification temperature analysis for the current layout indicates temperature isolation at the boss region which is increasing the chances of shrinkage porosity.



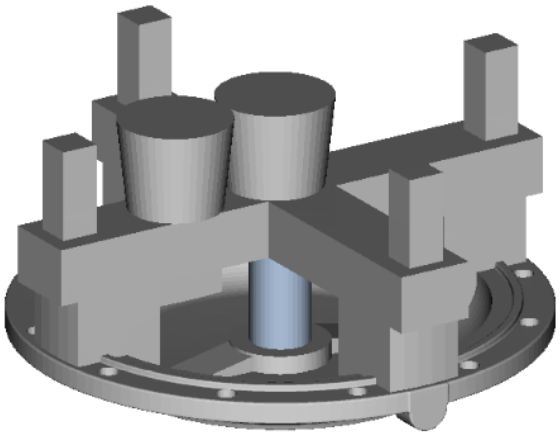
Liquid fraction analysis shows isolation at the center boss portion. At the same location, shrinkage porosity is also seen.

The time taken to solidify the liquid metal at the boss portion is more than the top ingate and other surrounding areas. This shows absence of directional solidification. This increases the chances of shrinkage defect.



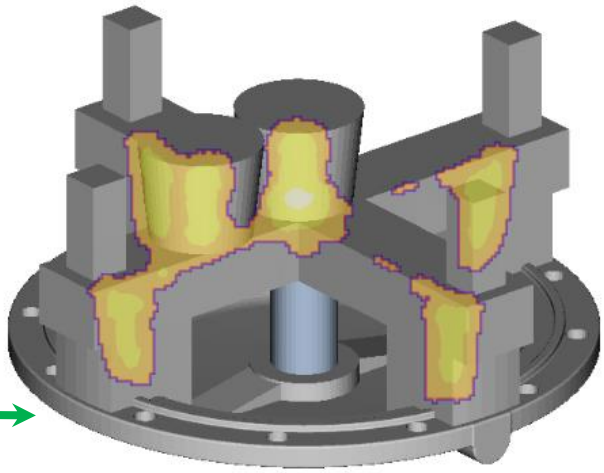


The shrinkage porosity analysis shows presence of shrinkage defect at the bottom boss region.

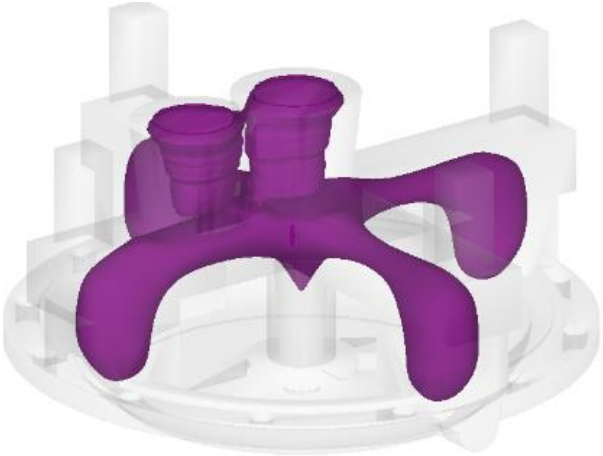


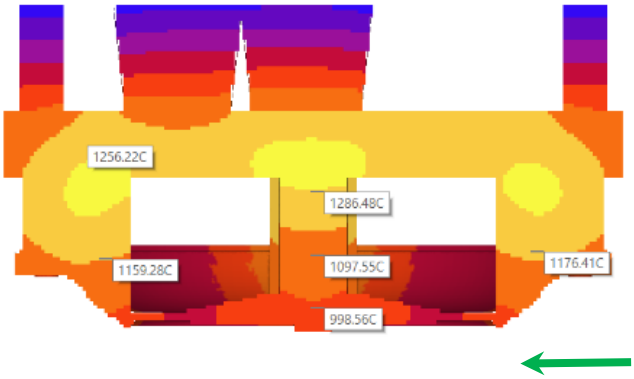
To improve the quality of the casting, methoding was revised by increasing the diameter to central ingate to 40 mm.

Hotspot analysis shows that the hot spot from the center boss region is shifted to top ingate because of improved thermal modulus. This reduces probability for the shrinkage porosity.

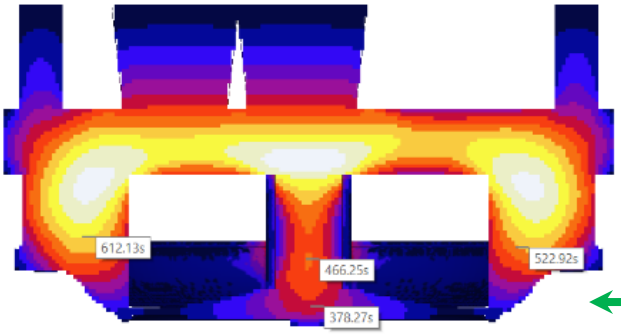


Liquid fraction analysis shows all the liquid metal in the part are solidified and the gating still contains molten metal at the end of the solidification in the part which helps in shifting of the shrinkage porosity from part to the gating and results in the defect free casting.



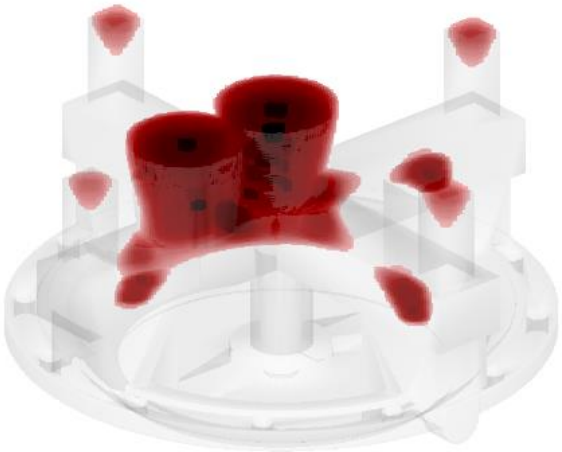


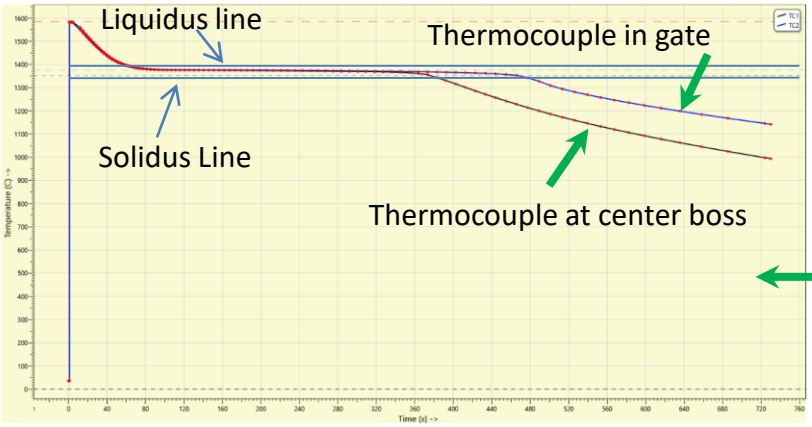
Solidification temperature analysis shows the part has lower temperature which solidify first and higher temperature inside the gating which promotes directional solidification.



Solidification time shows that time taken to solidify the boss region portion is less as compared with the top ingate placed over it suggesting no chances of shrinkage defect in this area.

Shrinkage porosity results shows macro and micro porosities are seen in the gating only and the part is free from defect.





The thermocouple analysis reveals that thermocouple at the center boss region of the part crosses solidus temperature earlier and thermocouple at gate crosses solidus afterwards thus gating solidifies last showing directional solidification.

Summary: **The improved methoding with increased top ingate diameter helps in eliminating the shrinkage defect from the center boss region.**