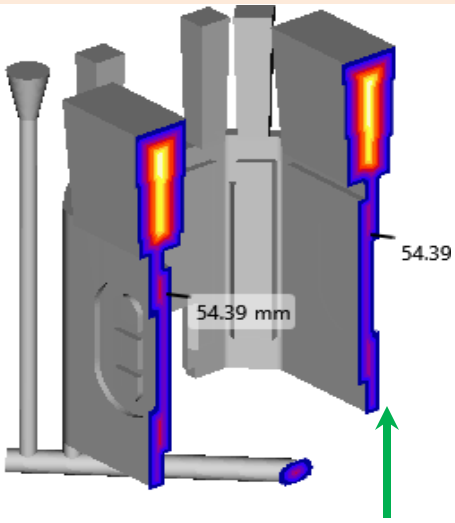
Magnetic Frame Tube

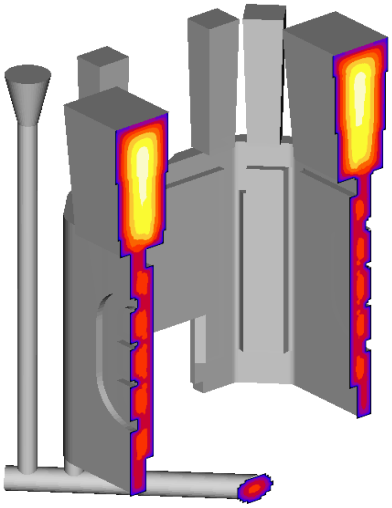
Cast Steel, Green Sand Casting

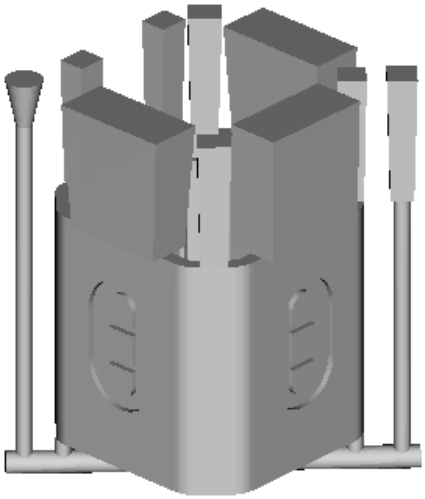
***Insight*: Magnet frame tube is a railways component, used to fabricate the housing for traction motor. It is 915x915x1295 mm, weighing 1.49 ton, and produced with eight top feeders (yield 55%). Persistent shrinkage porosity was observed during machining the inner faces, resulting in high rework and rejections**.



Thickness analysis of the part shows several thick regions and junctions with relatively higher complexity factor.

The current methoding included 8 top feeders with rectangular cross section having varying dimensions.





Simulation of the current methods design showed that the feeder size is adequate, but the feed metal is unable to reach shrinkage-prone area because of a thin neck in-between. Location of the defect matches the simulation.

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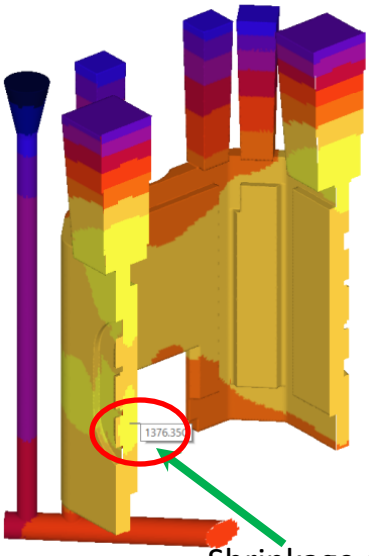
Shrinkage defect

Liquid fraction analysis displays liquid metal remains inside thick sections below the feeders . The neck is getting solidify before these thick regions These locations may lead to shrinkage porosity.

Solidification temperature analysis shows that high temperature isolations inside the casting which leads to the shrinkage porosity . This location clearly matches with shop floor defect locations.

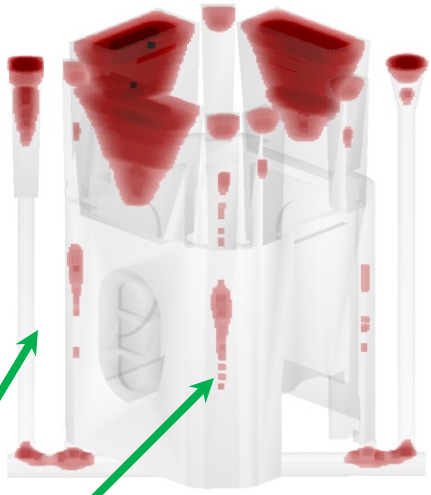


Shrinkage defect

Shrinkage defect

Solidification time analysis also confirms the locations of castings solidifies last. This leads to shrinkage porosity defect exactly observed on the shop floor

Shrinkage porosity analysis shows micro porosity observed in thick regions below the feeders at same locations shown by solidification temperature and time analysis.



Shrinkage defect

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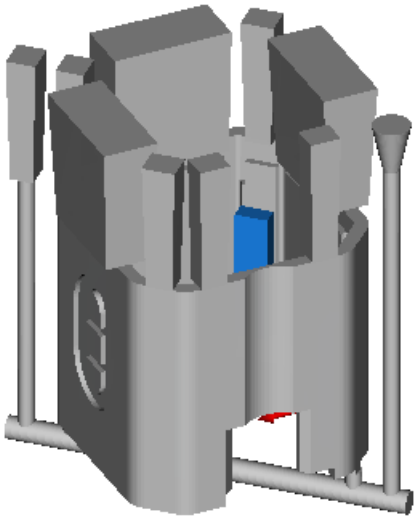
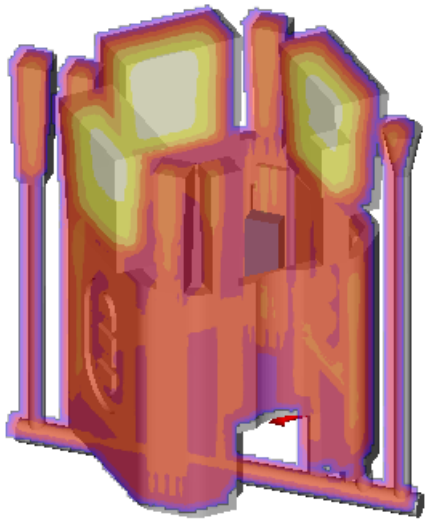


To improve the quality, the methoding was revised by placing chills at defect locations. The feeder size is adequate to compensate shrinkage defect.

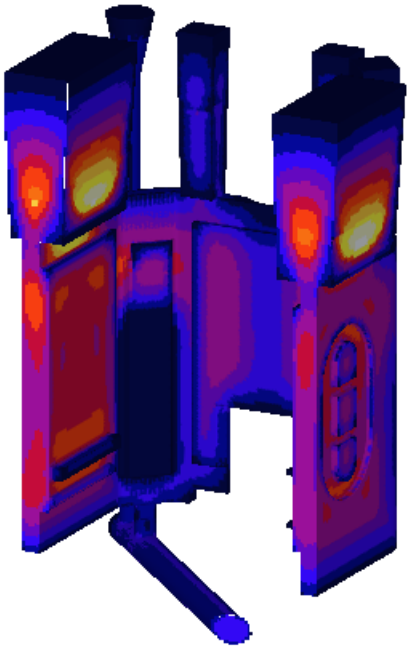


Solidification analysis shows improved solidification behavior. Chills placed at thick sections extracts heat and enhances directional solidification.

Liquid fraction analysis shows last solidifying metal present in feeder, while there is no liquid metal remaining at the end of solidification in part which gives defect free casting.

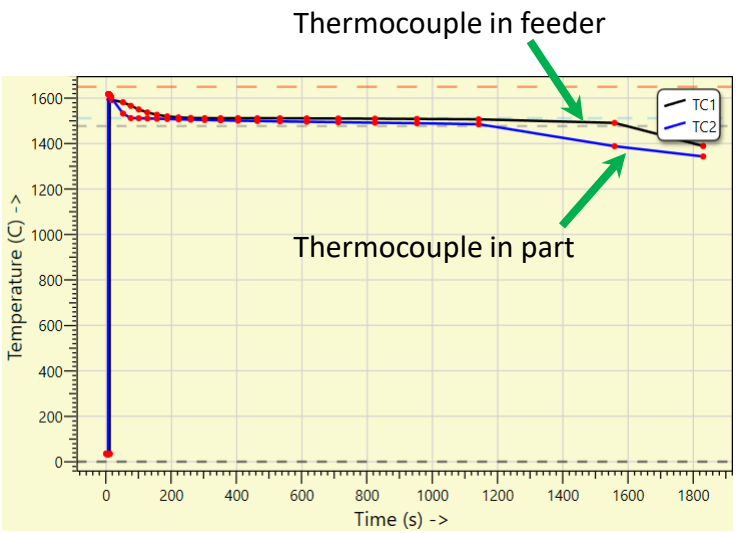
Solidification temperature shows directional solidification with hottest region in feeder and part connected to feeder at relatively lower temperature .

Solidification time analysis also confirms that feeders will solidify at last. This improved directional solidification eliminates shrinkage from the casting.



Shrinkage porosity results shows macro porosity in the feeder and there is almost no shrinkage in casting observed at locations of shop floor .

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



Summary: **Feeders with chills at thick sections will resulted in improved casting quality and defect free casting.**