

Thermal defects:

- Geometric secondary grain prediction – Single Crystal
- Porosity – Single Crystal & Equiaxed
- Freckling – Single Crystal

Problem definition

Thermal undercooling of overhanging features causes geometric secondary grains. This is due to heterogeneous nucleation of secondary grains from the mould wall.

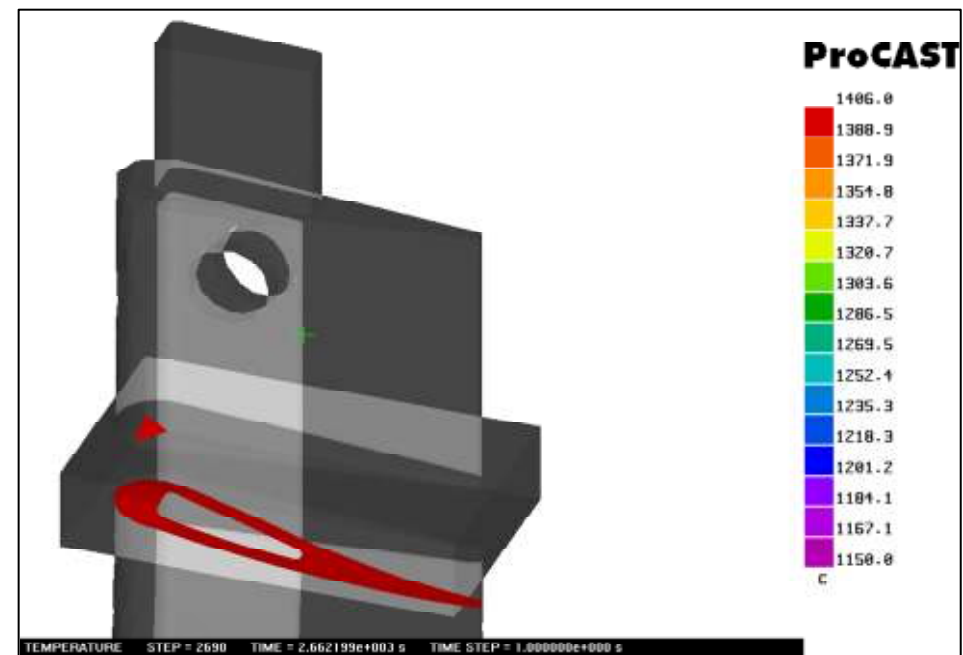
Process modelling

Process modelling predicted significant thermal undercooling, which was sufficient to nucleate a secondary grain and grow into a High Angle grain Boundary (HAB).

Problem solution

There are numerous parameters that can be altered to reduce undercooling to acceptable levels on the model, and hence eliminate or reduce geometric HABs.

Defect prediction



Geometric HAB on shroud platform corner

Problem definition

Shrinkage (or interdendritic) porosity is caused by a shortage of residual eutectic between the dendrite arms during solidification. This leads to depressions, pores, pipes, cavities, etc, in the casting.

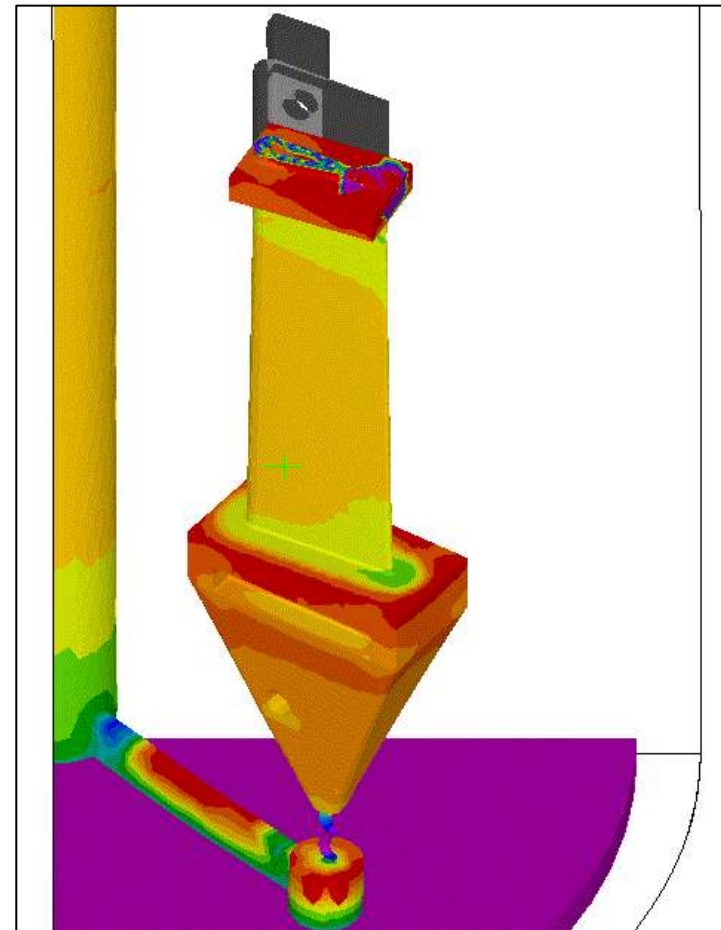
Process modelling

Severe shrinkage porosity was predicted to occur in upward facing areas. These are the last areas to solidify and/or where the feed path is interrupted.

Problem solution

There are numerous parameters that can be altered to reduce shrinkage to acceptable levels on the model, and hence eliminate or reduce macro-porosity.

Defect prediction



Shrinkage porosity on root and shroud platform

Problem definition

Freckling defect caused by thermo-solutal convection within the mushy zone. This is due to density inversions in the liquid phase during solidification.

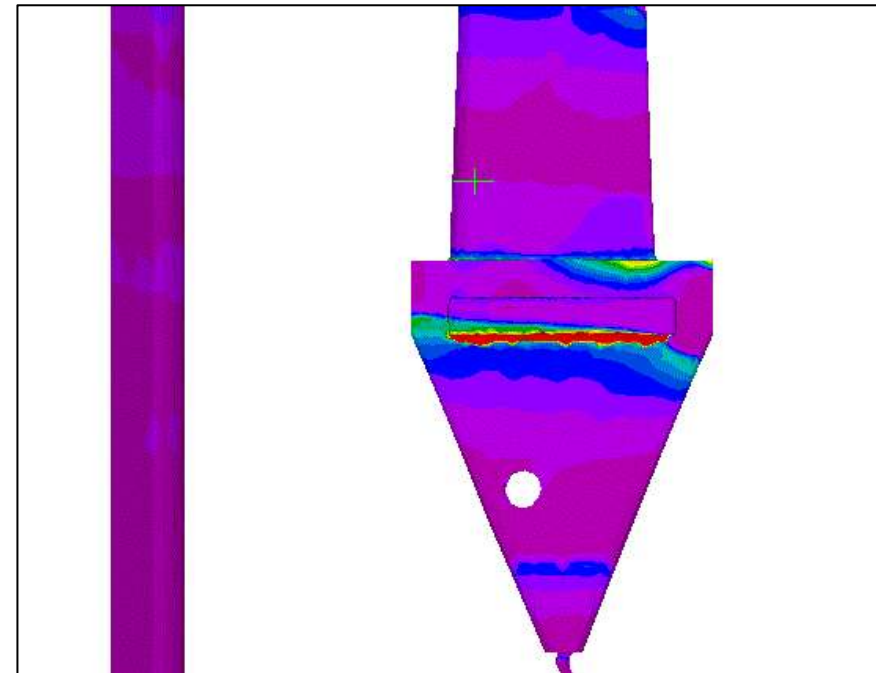
Process modelling

Freckling was predicted to occur in regions of large liquidus front curvature, primary dendrite arm spacing and casting volume, e.g. turbine blade root blocks.

Problem solution

There are numerous parameters that can be altered to reduce the likelihood of freckling occurring, and hence eliminate or reduce freckle grains.

Defect prediction



High freckling propensity in root block

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