

# AMC

AMERICAN METALCASTING CONSORTIUM

## SOLIDIFICATION MODELING PREDICTS SHRINKAGE AREAS



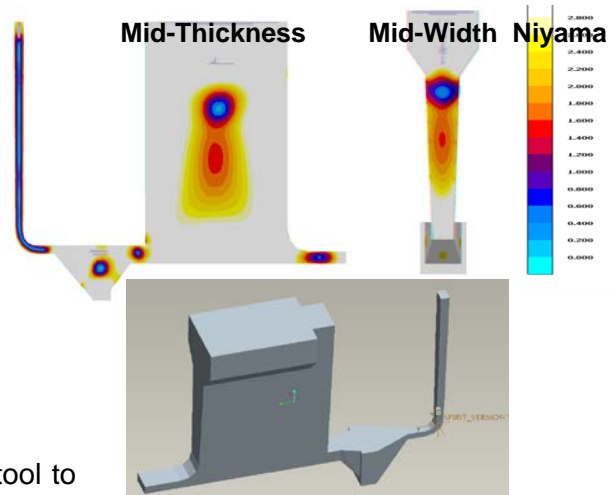
The ability to predict the location and extent of shrinkage areas of a cast part provides a new tool to foundry engineers. As a part of AMC's Castings Solutions for Readiness Program, computer modeling work is being developed at the University of Iowa that address this need. The efforts are being utilized to confidently produce cast parts with improved performance characteristics. The techniques also extend predictability to micro shrinkage porosity which is beyond present Non Destructive Testing (NDT) detection capabilities.

## SUCCESS STORY

**Problem:** The ability to identify potential micro-shrinkage within a component without the time consuming process of producing, evaluating and adjusting manufacturing processes is very important. Although radiographic or ultrasonic inspections are used to identify shrinkage porosity, they are unable to detect porosity less than approximately 2% of the section thickness. The presence of micro shrinkage below this detection limit reduces the ductility. Improved casting performance with better ductility allows the use of superior design features available in castings.

**Solution:** Research work at the University of Iowa developed computer simulation models of the solidification of steel castings to predict micro shrinkage. The modeling simulation software allows the determination of the Niyama value to indicate micro shrinkage. In steels, a Niyama value greater than 1.0 indicates no micro shrinkage. Niyama values less than 1.0 but greater than 0.3 predict micro shrinkage that would not be detected by radiography or ultrasonic methods. Values below 0.3 predict large shrinkage porosity. An example of the modeling of a wedge casting is shown to the right.

**Benefits:** Defense and commercial markets now have a tool to identify micro porosity in advance of producing a cast part. Prior to the application of this technique it was necessary to produce a cast part then destructively test to identify if micro shrinkage presented a potential problem. This technique is applicable across all metal alloy system. Approximately 8 out of 1000 commercial steel castings that are highly machined are found to contain porosity. Computer modeling is capable of reducing this number to zero.



"Sivyer Steel has been a supplier of defense castings for 80 years, and solidification analysis allows us to deliver high quality components to enable the performance of America's weapon systems."

—Hal Davis, VP Technology



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