Spring, 2006

Volume 4, No. 2

DEFORM™ News

Events:

- May 2 & 3, 2006: The Spring DEFORM Users Group Meeting in North America will be held in Columbus, OH. Call for more information.
- May 25, 2006: A machining (cutting) workshop is being planned in conjunction with OSU/ERC at Diamond Innovations in Columbus, OH. For more information contact SFTC or OSU/ERC.
- August 16 & 17, 2006: The 11th Annual Die Stress Analysis Workshop will be held at Marquette University in Milwaukee, WI.

Training:

- April 25 & 26, 2006: DEFORM-2D (includes DEFORM-F2) training will be conducted at SFTC in Columbus, OH.
- April 27 & 28, 2006: 3D training (includes DEFORM-F3) will be conducted at the SFTC office.
- May 4 & 5, 2006: Advanced training will be held at the SFTC office, in conjunction with the Spring DEFORM Users Group Meeting.

DEFORM™

Design Environment for FORMing

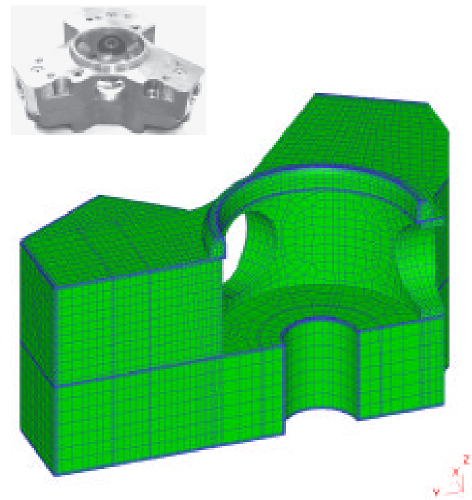
Heat Treatment Modeling:

Predicting and managing heat treatment distortion of complex parts is a huge challenge. DEFORM-HT is a powerful tool for simulating heat treatment processes. The system predicts heat treat distortion, residual stresses and phase volume fraction. Heat treatment modeling helps to achieve hardness and strength requirements while minimizing heat treat distortion and residual stresses.

Kistler-IGeL GmbH, the DEFORM distributor in Germany, worked with Rob. Bosch GmbH, DaimlerChrysler AG, Institute of Material Science and Engineering of Karlsruhe and other partners on a Computer Aided Simulation of Heat Treatment project (CASH), funded by the German Federal Ministry for Education and Research. The objective was to establish a modeling methodology for the heat treatment of complex parts.

Bosch was interested in the heat treatment modeling of a fuel injection pump housing made of AISI 5120 steel alloy. It is a thick-walled part with a piston guide and complex geometric features. To accurately predict the case depth and distortion, a very fine

Fuel injection pump housing (Bosch)



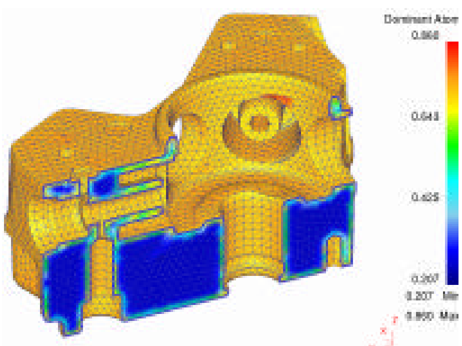
The mesh used to simulate case hardening (green) and actual pump housing (gray) are shown.

mesh, on the order of one million elements would be required. Models of this size are impractical to analyze in the current computing environment.

In order to retain the resolution required for an accurate solution, the geometry was simplified. The use of symmetry, and the elimination of very small features, resulted in a manageable model size. This compromise was the result of multiple simulation trials using different levels of geometric abstraction. Thin layers of highly refined elements were used to model the surface effects during carburization. For modeling distortion, geometric features at noncritical locations were simplified without modifying the mass of the part. In this case, volumetric effects are important to accurately capture thermal changes and phase transformation. Prediction accuracy was compared for various levels of geometric detail.

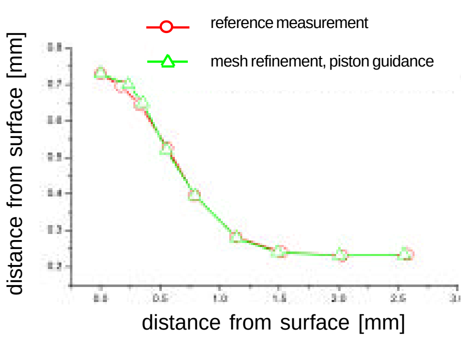
Detailed material data was generated for two different case hardening steels, AISI 5120 and 18CrNiMo7-6. Transformation kinetics, along with thermal and mechanical properties as a function of temperature and c-content, were determined. Local heat transfer coefficients as a function of temperature and location were generated for the quenching process.

Case depth after carburization of the fuel injection pump housing was validated. The model predictions matched the shop floor observation. Temperature profile predictions during the quenching process, at key thermo-coupled locations, matched well with experimental data. The modeled prediction of volume fraction of retained austenite matched the actual part with excellent accuracy.

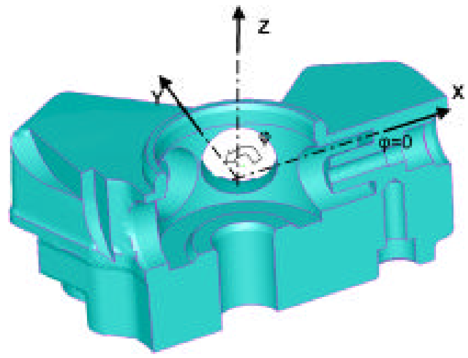


Carbon content after carburization

Heat treat distortion varies with the part's position in the batch during quench. A sensitivity analysis was modeled to study this effect. The distortion at the piston guide hole was measured and the model predictions matched the characteristic change of shape and dimension very well.

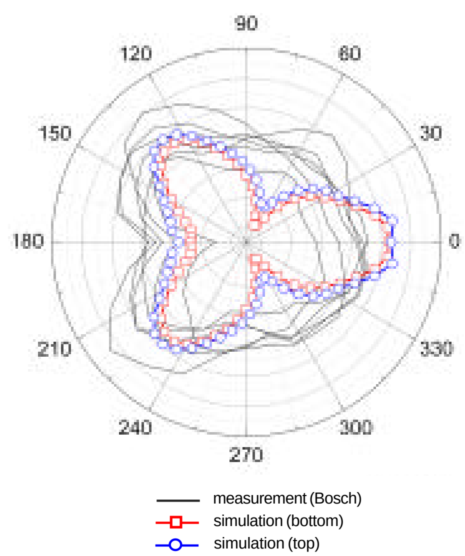


Measured case depth correlated well with simulation results.



The measurement coordinate system for hole roundness is shown in a sectioned solid model.

This project demonstrated the capabilities and accuracy of DEFORM in predicting heat treatment process responses. Heat treat modeling makes it possible to achieve an optimum balance of mechanical properties (for example, hardness vs. ductility). Critical process variables can be identified and their effects on heat treat distortion and residual stresses can be readily analyzed.



Validation of heat treat distortion is shown.

Examples are Welcome

Please forward copies of technical papers, presentations or DEFORM examples to SFTC staff. We are interested in any new applications or production case studies.

Releases:

DEFORM-2D and DEFORM-F2 version 9.0 is scheduled for release on May 1. A beta version is available for download. Highlights of the release include:

- improved movement (press) control, including press stretch (elastic loss);
- tool wear (2D);
- machining distortion module (2D);
- new material models and additions to the material library;
- current flux for resistance heating;
- meshing objects with multiple boundaries;
- strain components due to plastic, thermal, elastic, transformation and creep;
- improvements in the rate dependent elastoplastic material model, and
- GUI refinements (F2) to geometry, BCCs, die stress and operation management.

DEFORM-3D and DEFORM-F3 version 6.0 beta is available on the user area. Enhancements and bug fixes include:

- improved movement control;
- geometry editing/repairing module;
- heat transfer stages and transient analysis options in rolling;
- GUI improvements (F3);
- improved convergence in rate sensitive elasto-plastic materials;
- postprocessing large databases without purging and merging, and
- significant improvement to multiple CPU scalability in both multiple processor and cluster computers.

The DEFORM-3D and DEFORM-F3 V6.0 official release is currently scheduled for July, 2006.

For a complete list of all the improvements, please refer to the release notes on the DEFORM User's area.

With these releases, DEFORM will be supported on the Suse 92 Linux operating system. At the end of 2006, support for Sun and SGI (UNIX) will be phased out for future releases.

Scientific Forming Technologies Corporation

5038 Reed Road
Columbus, Ohio
43220-2514
Tel: (614) 451-8330
Fax: (614) 451-8325

www.deform.com
email: sales@deform.com