Ansys

CASE STUDY /

Ansys + ISGEC Hitachi Zosen Limited

"Ansys' user programmable feature (UPF) was used to create a creep subroutine based on ASME code case 2605, which allowed us to evaluate the creep damage of pressure equipment at elevated temperatures in high strength chrome-moly steels."

Balram Kalra
Assistant Manager-PED Design / ISGEC Hitachi Zosen Limited

CASE STUDY

With the rising demand for cost-effective designs of structural components in the oil and gas sector, manufacturers want to utilize the maximum temperature capability of the materials. The current ASME code (Section VIII, Division 2) limits the generation of fatigue curves up to a maximum of 371 °C. ASME Code Case 2605 is a special rule used in the industry worldwide for fatigue evaluation of 2.25Cr-1Mo-0.25V steels at temperatures greater than 371 °C and less than 454 °C.

Utilizing the Maximum Temperature Capability of Materials for Creep-Based Design of Pressure Equipment

/ Challenges

Code Case 2605 proposes carrying out full inelastic analysis, such as ratcheting elastic shakedown analysis, using the actual time-dependent thermal and mechanical loading histograms. Treating plasticity and creep as two independent phenomena in stress and strain calculations using spreadsheet-like applications are subject to human error and may lead to unrealistic damage parameters. The challenge was to create a creep subroutine capable of analysis at the higher temperatures of Code Case 2605 using Ansys simulation solutions to increase accuracy and accelerate calculations.

/ Technology Used

Ansys MAPDL

/ Engineering Solution

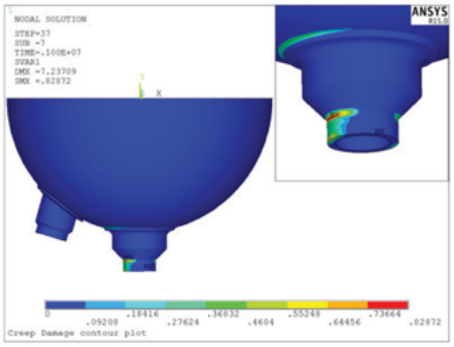
With help of Ansys technical team members, ISGEC Hitachi Zosen engineers used the user programmable feature (UPF) in Ansys MAPDL to implement a Code Case 2605 creep model. By combining user creep with standard plasticity material models already available in Ansys solutions, they succeeded in calculating the overall creep strain and creep damage under cyclic loading conditions at temperatures up to 454 °C.

/ Benefits

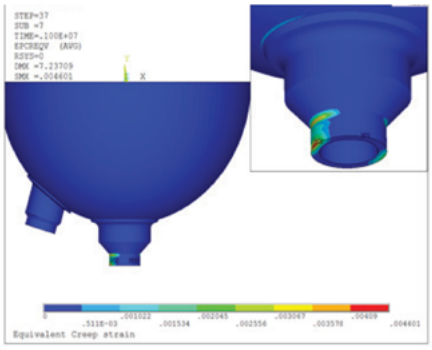
After implementing the creep subroutine for calculation of creep damage and creep strains for chrome-moly steels, ISGEC Hitachi Zosen engineers were able to:

- Optimize the equipment weight by maximizing the material capacity at high temperatures while ensuring that any creep damage was within the acceptable code limit.
- Drastically reduce the time required for calculation and post-processing of creep strain and creep damage results using a seamless finite element analysis process.
- Nullify chances of human error common in manual spreadsheet calculations, which involve many assumptions and often overestimate creep damage.

ISGEC Hitachi Zosen Limited is the market-leading manufacturer of complex pressure vessels and heat exchanger equipment for customers all over the world. We provide solutions for a variety of industry segments in which we are the manufacturing leaders. We also help in reducing the scale-up risks from lab to the plant.



Creep damage contour plot after implementing the Ansys subroutine.



Creep strain contour plot after implementing the Ansys subroutine.

ANSYS, Inc.
Southpointe
2600 Ansys Drive
Canonsburg, PA 15317
U.S.A.
724.746.3304
ansysinfo@ansys.com

If you've ever seen a rocket launch, flown on an airplane, driven a car, used a computer, touched a mobile device, crossed a bridge or put on wearable technology, chances are you've used a product where Ansys software played a critical role in its creation. Ansys is the global leader in engineering simulation. We help the world's most innovative companies deliver radically better products to their customers. By offering the best and broadest portfolio of engineering simulation software, we help them solve the most complex design challenges and engineer products limited only by imagination.

Visit www.ansys.com for more information.