Stress and Fatigue Analysis of ASME Pressure Vessels using Femap and Fatigue Essentials

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ABSTRACT

The application of the ASME Section VIII, Division 2 pressure vessel code is becoming increasingly more popular since it facilitates the optimization of pressure vessels via detailed stress and fatigue analysis. The basis of this analysis is the creation of a high quality plate and/or solid mesh followed by accurate load application and then the extraction and classification of stresses per code. Much of this work is algebraic in nature and is well suited for automation. Through the use of Femap's Application Programing Interface (API) and customized spreadsheets, the analysis of ASME-type pressure vessels can be accelerated from days to minutes. In many cases, once the vessel has passed its baseline load requirements, a fatigue analysis is required to address cyclic mechanical and thermal loads. Although fatigue analysis can be quite basic and almost an accounting exercise, the more stringent ASME requirements of specialized fatigue curves and stress output as stress intensity complicates the procedure. To simplify this calculation, the software program Fatigue Essentials is used and a brief example is presented on how this program automates the fatigue calculation.

AUTHOR BIOGRAPHY

Adrian Jensen
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Adrian Jensen graduated with a Bachelor of Science in Mechanical Engineering from Oregon State University in 2008. Since then, he has been working at Predictive Engineering as an analyst. Although he has worked on a variety of analysis projects (including optical electronics with transient thermal loading, a passive energy building with natural convection, wind turbine tower with vibration concerns, and many others) the bulk of his experience has been with ASME Section VIII pressure vessels. The stress and fatigue analysis of complex vessels has led to extensive algorithm and programming development to automate many of the reporting and analysis requirements by ASME Section VIII, Division 2.

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Brian Reiling graduated from University of Portland in Mechanical Engineering. He has over 20 years of aerospace structural analysis experience working on Airbus, Boeing, Bombardier, and Sikorsky aircraft along with several others. Currently a founding partner at Endeavor Analysis the focus is on landing gear, hydraulic actuation, and test rig design and analysis. Endeavor Analysis is considered one of the premier independent consultants for landing gear structural analysis. For FE analysis Endeavor uses NX Nastran and ADINA pre- and post-processed with FEMAP.