AMC

AMERICAN METALCASTING CONSORTIUM

FINITE ELEMENT ANALYSIS & DESIGN WITH STRAIN-LIFE FATIGUE DATA

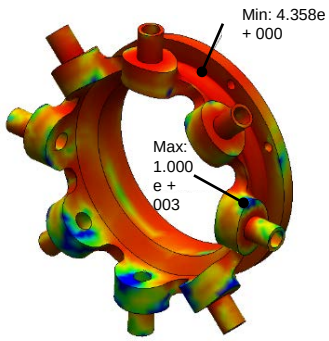
As part of the AMC's Casting Solutions for Readiness (CSR), a strain-life fatigue database for cast metals was developed by the American Foundry Society during research funded by the Defense Logistics Agency (DLA). The database contains monotonic and cyclic property data, as well as the associated chemical analysis, section thickness, molding process and microstructural data for a variety of cast irons, including gray, ductile, compacted graphite, and white cast irons and a few aluminum alloys. The fatigue data in the database were developed in accordance with ASTM standard E606 over a life range of 100 cycles to 5 million cycles and tensile data was developed using ASTM standard E8 test bars. The current project incorporates this verified strain-life fatigue data into solidification and engineering modeling software to assist engineers in designing cast components, using a case study of a cast steel hub for a brake rotor, which bolts onto an axle in a light rail application (picture above).

SUCCESS STORY

Problem: During product development, design engineers need validated data on potential fatigue life for use in designing cast metal components. However, many modern material databases do not contain fatigue limits.

Solution: Strain-life material parameters impact the predicted component fatigue life. An on-line database with validated fatigue properties is beneficial for design engineers. Casting process modeling software in conjunction with finite element modeling programs can use strain-life data to predict lives and locations of fatigue fractures in the vicinity of holes, thickness changes, and other stress concentrators in cast components.

Benefit: Accurate failure criteria enables engineers to make design and material selections, including section size, heat treatment, weldability, corrosion, castability, machinability, and ultimately, determine the life cycle cost. Design engineers can combine the on-line strain-life fatigue data with finite analysis modeling to select optimal materials and design geometries to create lighter products with longer and more predictable product service lives.



FEA of a reverse engineered cast brake disk hub (PDA LLC)

"Using this approach, designers can evaluate various cast alloys at the early design stage to achieve the desired fatigue life for identical service loads. This methodology will yield an optimized geometry through FEA-based validations using the latest strain controlled fatigue material data. — Jiten Shah, Product Development & Analysis LLC, Naperville, IL, USA

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