Redesign of Sucker Rod End Fitting Link

Overview
John Crane is the largest subsidiary of Smiths Group plc., known for its outstanding reputation for designing and engineering high-quality, durable, customized solutions. The objective was to work with John Crane to redesign their current end fitting. The end fitting is used as a connection point for sucker rods in oil and gas artificial lifts. The current end fitting, Series 200, utilizes a four-wedge design that is filled with an epoxy that bonds to the sucker rod.

Objectives
Deliver John Crane a new design for the connection between the sucker rod and end fitting that displays potential to increase tensile loading and decrease or maintain manufacturing costs compared to the Series 200 fitting. The design should also have innovative qualities that may disrupt the market.

Approach
- Brainstorming sessions and external search conducted to create list of design concepts
- Patent search performed to understand current and past end fitting designs
- Conversations with sponsor led to filtering out non-feasible designs
- Analytical calculations performed on concepts to determine feasibility in sustaining tensile loads
- Weekly meetings with sponsor led to concept list narrowed down to 3 concepts
  - Inner Cone Wedge, Thermal Expansion, and Threaded Wedges designs
- 3D CAD models created for final 3 concepts
- Solidworks FEA utilized to filter out Inner Cone Wedge design due to high stresses on end fitting
- FEA run in Abaqus to analyse stresses on final 2 designs
- Abundance of complications led to filtering out Thermal Expansion design
- Final design determined – Threaded Wedge design
- Parameter optimization performed on final design to determine optimum wedge angle
- FEA supports design optimization
- Cost analysis performed on design
- 3D printed model of final design created

Outcomes
Design package consisting of FEA supporting optimized wedge angle - 8°
- Design is able to support 50kips axial force. Additional parameter optimization can be done to increase load capabilities
- Disruptive technology – Design allows opportunity to decrease thickness of end fitting – reduces manufacturing costs, increases oil well efficiency
- Cost analysis
  - Manufacturing costs ~ $20
  - Comparable to Series 200 fitting