Wilde

CIRCOR ENERGY

Structural Analysis of a Pipeline Closure System

Pipeline Engineering required an assessment of the structural performance of a new 72" Class 300 Pipeline Closure design. This closure was larger than those previously designed and manufactured by the company. Wilde used FEA (Finite Element Analysis) to assess the structural response of the closure door and the door hinge.

Company

Pipeline Engineering is a CIRCOR Energy brand, and a world leader in the design, testing and manufacture of pipeline pigging and flow assurance products, engineering, pipeline cleaning services and project management. Based in Richmond, North Yorkshire, it provides precision solutions for clients worldwide in the Oil, Gas, Process and Renewables industries.

Pipeline Engineering supplies a full range of pipeline pigging tools, pig launchers and pig receivers, quick opening closures and pig signallers. Recognised for its expertise in polyurethane technology, the company also designs and produces a range of client-specific polyurethane products.

Fig 1: Pipeline Closure

> “” Using FEA at an **early development stage eliminated the need for expensive** prototyping and testing.

Fig 2: Pipeline Closure

> “” Wilde's FEA work **reduced the risk** of having to implement **expensive modifications** further along the design process. It also provided **valuable insight** into how the system would perform in operation and testing.

Challenge

Pipeline closures are pressure-retaining structures designed to provide access to pipelines and pressure vessels. Pipeline Engineering has developed its closures to provide fast access to pipelines and pressure vessels.

Pipeline Engineering required an assessment of the structural performance of a new 72" Class 300 pipeline closure design. This closure was larger than those previously designed and manufactured by the company.

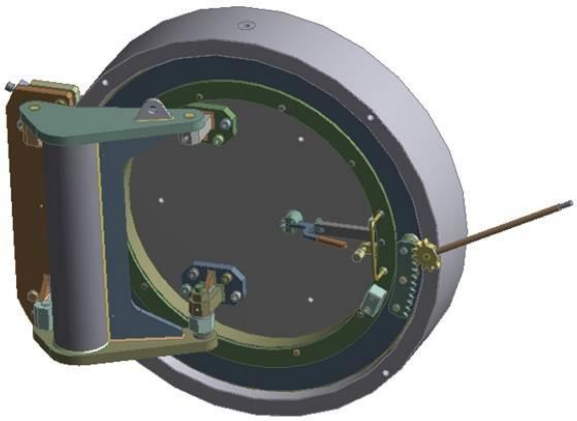

Fig 3: 2D FEA model

Solution

Finite element analysis was used to assess the structural response of the closure door and the door hinge.

Multiple load cases were considered including:

- Internal pressure loading
- Hinge response at varying hinge angles.

The analysis was used to predict deflections of the closure system, the loads and stresses on the locking keys and the deflections of the door hinge when the door was opened. The results indicated the areas where design modifications were necessary.

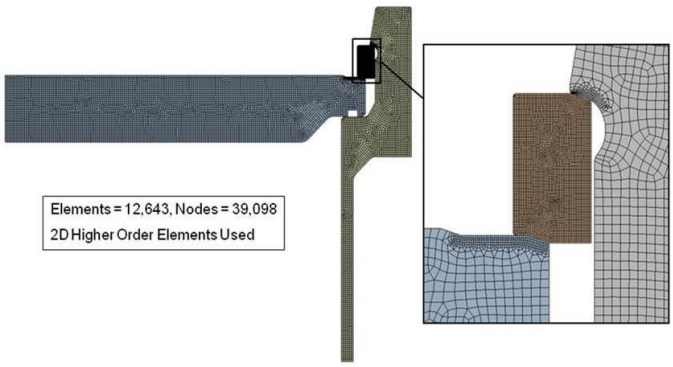

Fig 4: Finite element mesh

Pipeline Engineering supplied Wilde with 3D CAD files that were subsequently defeatured and prepared to make suitable for use with **ANSYS FEA** simulation software. For efficiency and accuracy, a combination of 2D and 3D methods was used.

The door and locking system was simplified into a 2D axis-symmetric problem using **ANSYS DesignModeler**. Contact modelling within **ANSYS** was used to model load transfer between the components of the closure mechanism.

Each load case was analysed to identify areas of the structure most highly affected by that load case. A technical report was prepared summarising the results for all identified operating conditions.

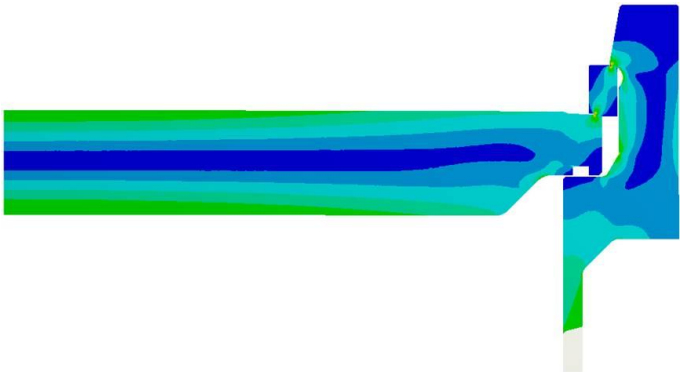

Fig 5: 2D FEA results showing stress intensities

A separate 3D finite element model and mesh was created to predict the response of the door hinge at different angles.

Business Benefits

Finite element analysis allowed the product designers at Pipeline Engineering to gather design feedback of the closure system at an early development stage without having to commit to expensive prototyping and testing. This greatly reduced the risk of having to implement expensive modifications further along the design process and provided valuable insight into how the system would perform in operation.

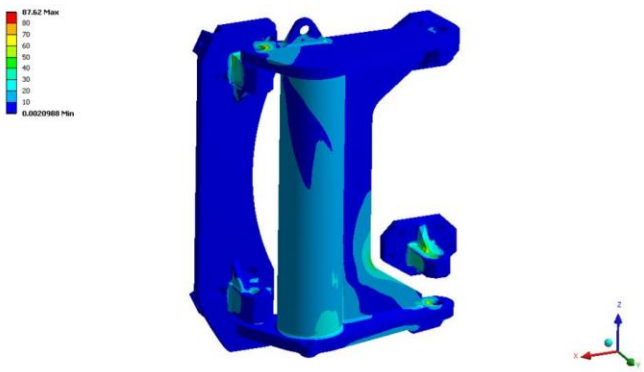

Fig 6: 3D FEA results showing stress intensities with the hinge and bracket