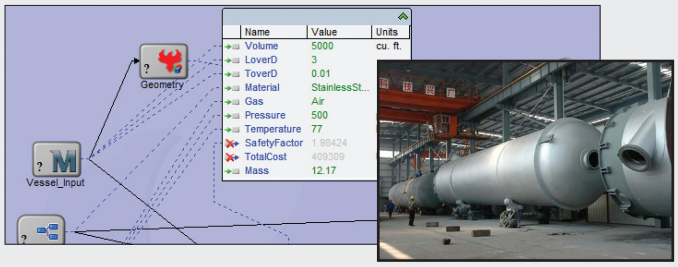
CASE STUDY

Industry: Heavy Industry
Product: PHX ModelCenter®

PHX ModelCenter Speeds Selection of Safe, Cost-Effective Pressure Vessel Design

Challenge: Verify Compliance of Pressure Vessel Design with ASME Guidelines



Pressure vessel design involves finding optimal ratios of length-to-diameter and thickness-to-diameter in order to reduce cost. Additionally, given the potential dangerous nature of pressure vessels—as evidenced by several spectacular accidents through history—the design must also comply with strict legal guidelines and requirements dictated by the American Society of Mechanical Engineers (ASME).

Solution: PHX ModelCenter to Perform Cost as an Independent Variable (CAIV) Analysis

PHX ModelCenter was used to create a process for initial design analysis and selection of a pressure vessel. For this case, a cylindrical vessel with two hemispherical end caps is assumed. It lies horizontally, has some constant wall thickness, and is supported at both ends, creating a bending stress in the middle. The vessel was analyzed using standard thin wall equations for hoop and longitudinal stress. Other components in the model handle input, render the geometry, find gas properties, and compute a preliminary cost of the vessel for sizing purposes. The essential inputs and outputs are shown on the data monitor, from which quick, manual verification studies can be done. The next step is to gather customer requirements and enter them as input parameters in the model. The basic sizing problem reduces to finding the optimal length and thickness (non-dimensionalized by diameter) of the vessel by weighing the total cost and safety factor of each alternative. This analysis was performed using the Design of Experiments (DOE) tool in conjunction with one of the many visualization tools available in PHX ModelCenter. The DOE for this case is set up using a deliberately wide design space. After the run, the Data Visualizer scatter plot is invoked with the Total Cost selected for the x-axis and the Safety Factor for the y-axis. Once set up, further runs can be made to fill in the matrix. Thus, a Cost as an Independent Variable (CAIV) analysis is quickly set up and provides, at a glance, the essential trade-off for this problem. Such a plot can even by shared with the customer in an effort to help him/her make a choice about how much safety factor to buy. In this particular case, the Data Visualizer is set up to weigh the safety factor and total cost to create a Pareto frontier of options. It color codes the best designs in blue and by hovering over each design point in the plot, a pop-up with design information (including rendered geometry) appears, enabling the best design alternatives to be seen and selected easily.

Benefit: Easily Visualize Trade-offs Between Competing Designs to Select Best Design More Quickly

Analysis of Alternatives (AoA) is used frequently by engineers and analysts who are evaluating multiple design concepts. The goal is to identify the best configurations, or alternatives, when many variables can be changed across a very wide design space. PHX ModelCenter® offers unique trade study, visualization, and optimization tools specifically designed for AoA and provides a decision support environment for performance, cost, and operational assessments. Additionally, PHX ModelCenter's design environment assists analysts in performing conceptual design and optimization using distributed network resources. When performing trade studies with parametric models of complex systems, engineers must navigate large design spaces using visualization tools. Searching for the best designs with optimization algorithms and communicating results to management less familiar with design optimization technology can be difficult. PHX ModelCenter® enables engineers to automate and integrate design codes and build complex parametric models of systems. Phoenix Integration's Data Visualizer helps design engineers to easily see trade-offs between competing designs, as well as interactively and intuitively explore design spaces to locate best designs in minimal time.

Toll-free: 800.500.1936 Website: www.phoenix-int.com

PHOENIX® INTEGRATION