FEPipe v10.1

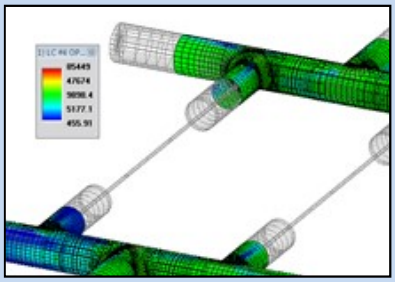
Finite Element Analysis provides the right answer.

FEPipe addresses many needs of PVP engineers working in today's market.

Typical pressure vessel design codes, such as ASME Section VIII, cannot address all design cases. For instance, external loads on nozzles are not addressed within the Code. Engineers often need to go outside of the Code and apply recognized design procedures such as finite element analysis using FEPipe. Simplified calculation methods commonly used in the PVP industry such as WRC 107/297 are based on limited test data and are known to be inaccurate in many cases. FEPipe provides realistic results for all cases.

Finite Element Analysis

Pressure Vessel & Piping Engineers



Supports New ASME Sec. VIII - Div. 2 Rules

Fast, Accurate and Easy to Understand Results

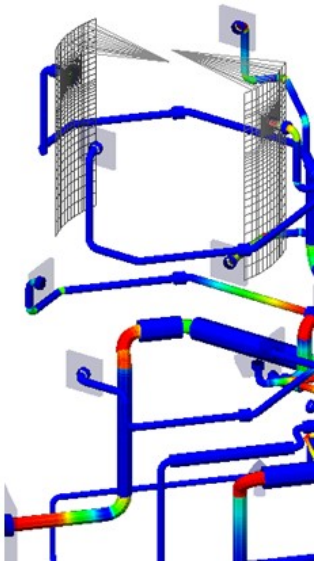
Template-Based Design Tools with Improved Drawing Tools

Code Compliance Reports

FEPipe has been designed to meet the needs of the PVP industry. General FEA tools are not tailored to the PVP engineer.

FEPipe automatically evaluates calculated stresses against Code Limits and produces ASME code output reports, drastically reducing the time needed to document your results and be confident in your design.

FEPipe automatically produces stress intensification factors and flexibilities for typical piping junctions. These are known issues with the current piping codes. This supplements detailed piping analysis.



New Features in Version 10.1

New Modules

BOS B31 analyses the fluid-structure interaction using Frequency Domain Analysis of piping systems to comply with the B31.3 Loading Requirements in Para. 301.5.

Point Cloud Scanning Software allows users to take measurements of FEA models of pipe or vessels, or to compare FEA models to the actual scanned model of images. High and low resolution editing is provided.

Model Generation

New Drawing Tools allow for graphical "CAD-like" modification of shell model details and addition of model components. This significantly speeds up the process of modeling custom designs.

Interactive Output Processing - MimOut

Analysis & the Codes

MultiCore SuperNode Solver (4-to-8 times faster)
Automatic Generation of B31.d SSIs or B31.1 replacement for .75i per B31J
Pressure stiffened SIFs and k-factors for supports on bends
ASME B31J Nozzle Stress Calculations (STP-PT-074) – *PRGiK Calculator*
Guidelines for Multiple Olet Model Types for Pipe Stress
Support for ASME VIII-w Part 5 Nonlinear Analysis
Option to Deactivate Fatigue Analysis when not required
Updated Allowable Load Algorithm for Pipe Shoes & Saddles
Single Bolt Unloading Analysis in AxiPRO
Directives for EN13445 Local Stress Analysis

Plasticity Solution

Reinhart Elastic-Plastic Ratcheting Evaluation
Twice Yield Fatigue Evaluation
Automatic Nonlinear Calculation of ASME VIII-2 Para 5.3.3.1 ep/eL ratio
Automatic Collapse & Twice Elastic Analysis
All shell templates can be analyzed using the VIII-2 Part 5 Nonlinear Solver.

Fitness for Service

Latest Version of API-579 / FFS-1 & Enhanced Local Thickness Modeling
J Integral Calculations
RSF Factor for Elastic FFS

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MODELING - from the complex to the sublime...

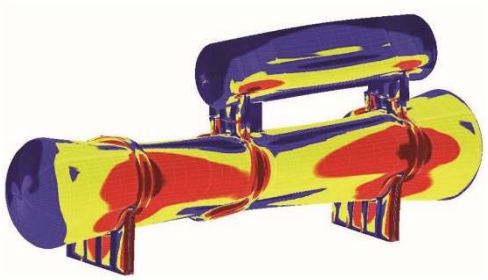
A large number of common PVP geometry can be modeled using FE/Pipe templates. Standard models routinely analyzed by our users include...

- Unreinforced and reinforced tees, lateral, and hillside nozzles or piping intersections
- Saddle supported vessels and heat exchangers
- Large diameter piping and ducting using shell elements
- Piping systems using standard 6 degree of freedom (DOF) beam elements, new 18 DOF beam elements, or shell elements
- Vessels with all geometric features including nozzles, support skirts, heads, structural clips, and stiffening rings.
- Flanges with bolt loads, pressure, external loads, and thermal analysis
- Tangential entry nozzles in cylindrical shells (rectangular, obround, and cylindrical nozzles)

LOAD ANALYSIS

FEPipe includes a load case processor that automatically accounts for load cases that contribute to failure in piping and pressure vessel components.

- Weight, Operating, Occasional, Thermal and Pressure
- Internal or external pressure
- Applied point or surface loadings
- Piping loads applied to nozzles
- Wind
- Acceleration due to ship motion or transportation
- Seismic
- Fluid head



SOLUTION CAPABILITIES

FEPipe offers similar solution capabilities that would be found in any FEA tool.

- Element library (beam, shell, axisymmetric, & brick)
- Linear elastic analysis
- Material non-linear analysis (plasticity)
- Dynamic/modal analysis
- Dynamic harmonic analysis
- Eigenvalue buckling
- Steady state and transient thermal analysis
- Stress stiffening (large displacement)
- Refractory
- 2007 Edition of ASME Section VIII-2

PCL-GOLD PIPE STRESS MODULE

FEPipe clients who maintain active support service agreements receive access to the PCL-Gold.

- Automatic Fatigue Damage Calculations for multiple load cases
- Path dependent, convergent friction algorithm
- Refractory lined pipe
- Glass lined pipe
- Hinged expansion joints with friction
- FEA i-factors and k-factors
- Pressure fatigue
- i-factors and k-factors for flat, conical, elliptical, spherical and dished heads
- Ability to enter 10-SIFs for branch connections
- Structural elements & pipe elements in same interface

RESULTS VERIFICATION

At the most basic level, the element formulations and related output have been compared against classical hand calculations. Additionally, FEPipe has been benchmarked against other general FEA software tools. The benchmark problems have included a range of complexity from single element verification problems to complete PVP analysis cases.

In addition, PAULIN Research Group routinely conducts experimental work in the PRG Laboratory. FEA models are constructed for comparison against strain gauge measurements from experimental cases. This work extends to included burst tests, fatigue tests, cryogenic work, and heat transfer experiments. Further, PRG is active in the PVP research field and continually processes other available test data for validation of the model building and analysis approaches used in FEPipe.

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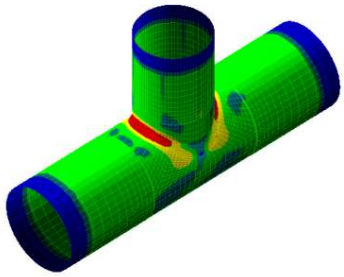
STANDARD TEMPLATES

FEPipe includes a large let of standard templates that allows the user to build complex geometries by entering in basic data such as dimension, thickness, length, direction and angles. FEPipe allows the user to join together different models from different templates to create more complex systems.

SHELL MODELS

- Unreinforced Fabricated Tee
- Pad Reinforced Fabricated Tee
- Hillside Tee
- Welding Tee
- Y-Fitting Tee
- Bend with Staunchion
- Tank Settlement
- Low Tank Nozzle
- Tangential Nozzle



- Shell-To-Head Nozzle
- Pipe Supports
- String Modeler: string together a series of geometries to create mitered bends, annual plates, conical sections, etc.
- Nozzles / Plates / Shells: build complex geometries such as multiple nozzles on heads, stacked vessels, saddles, skirted vessels with lifting lugs and other supports.

BRICK MODELS

- Unreinforced Fabricated Tee
- Pad Reinforced Fabricated Tee
- Olet Intersection
- Axi-symmetric Flange Modeler

ADVANCED MODULES

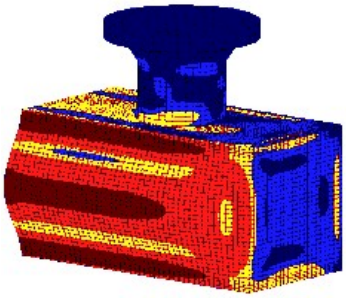
These modules were designed to add increased ease-of-use & design for the most common analysis needs. All of these modules use the FEA engine from FEPipe to perform the high-level calculations and reporting. All of the following modules are included with FEPipe v10.1 as specialized templates.

NOZZLEPRO quickly and easily analyzes individual nozzles, saddles, pipe shoes and clips. A variety of head types are allowed including spherical, elliptical, ASME dished, cylindrical & conical. The engineer can include thermal, weight, operating, occasional, pressure, wind and earthquake loads. ASME Code Compliance reports are automatically generated.

AXIPRO is an axisymmetric and brick finite element modeler, designed to analyze flanged joints. Analyze for flange leakage, fugitive emissions, bolt up loads, gasket properties, as well as stresses and rotations in DIN, API, ASME B16.5, B16.47or user-defined flanges.

MATPRO is PRG's materials database which includes high temperature curves, allowable stress plots, NH reporting, creep-fatigue interaction diagrams, elastic-plastic stress strain curves, and fatigue curves generated as a function of creep temperature.

661PRO analyses header box nozzles for air-cooled heat exchangers. It performs tube load analysis from multiple nozzle loads per ASME Section VIII-1 Appendix A. All nozzle loads are applied to the perforated tubesheet and analyzed per ASME 2004-Div 2 Art 4-9.



SERVICE PLAN MODULES

These modules were also designed to add increased ease-of-use & design for the most common analysis needs. Some of the **STANDARD** templates were converted to more simplified analysis tools. These modules are included with an active FEPipe v10.1 service plan.

FE107
FESIF
FEBEND
FETEE

PCL-GOLD PIPE STRESS MODULE
BOS B31
POINT CLOUD SCANNING