CAEPIPE™

Information Document

1983 25 2008

25 Years of Proven Value!

SST SYSTEMS, INC.

The *FASTEST* Solutions for Piping Design and Analysis

SST Systems, Inc. produced this document for distribution to piping analysis software evaluators.

Information contained herein is subject to change without prior notice.

CAEPIPE Information Document Version 6

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CAEPIPE - Pipe Stress Analysis Software

Rapidly Create & Analyze Piping Systems of Any Complexity with the Least Effort

Why CAEPIPE

• Easy to (re) Learn, Cuts your time in half

• Acclaimed user-interface, Quick to Learn and Use

• Uniquely Quick Iterative Studies

• Most Cost-effective

• Realistic Graphical Visualization using industry-standard OpenGL ®

• Verified results accuracy

• 25+ Years! Mature, Robust and Comprehensive

Easier • Faster
More Productive

• Design Better Piping, Faster ***• Reduce Overall Costs***

• Make Your Job Easier ***• Become Twice as Productive***

Get DONE faster when you use CAEPIPE's carefully designed features for rapid modeling, powerful analyses with quick solution times, and easy results review. You will benefit from being **able to quickly evaluate alternate design solutions** ("what-if" scenarios).

Avoid frustration when you work with the elegantly simple and intuitive user-interface to model or edit simple or complex piping systems.

Save your money because first, CAEPIPE costs less and second, you will see dramatically increased productivity. CAEPIPE pays for itself faster than others do, if at all.

CAEPIPE – the first pipe stress analysis software on the PC back in 1983 – was an immediate success when it entered the energy, process and aerospace markets. Since that time, most of SST Systems' efforts have been directed towards aggressively providing CAEPIPE's large and loyal installed user base with enhancements and improvements that have made CAEPIPE comprehensive and robust.

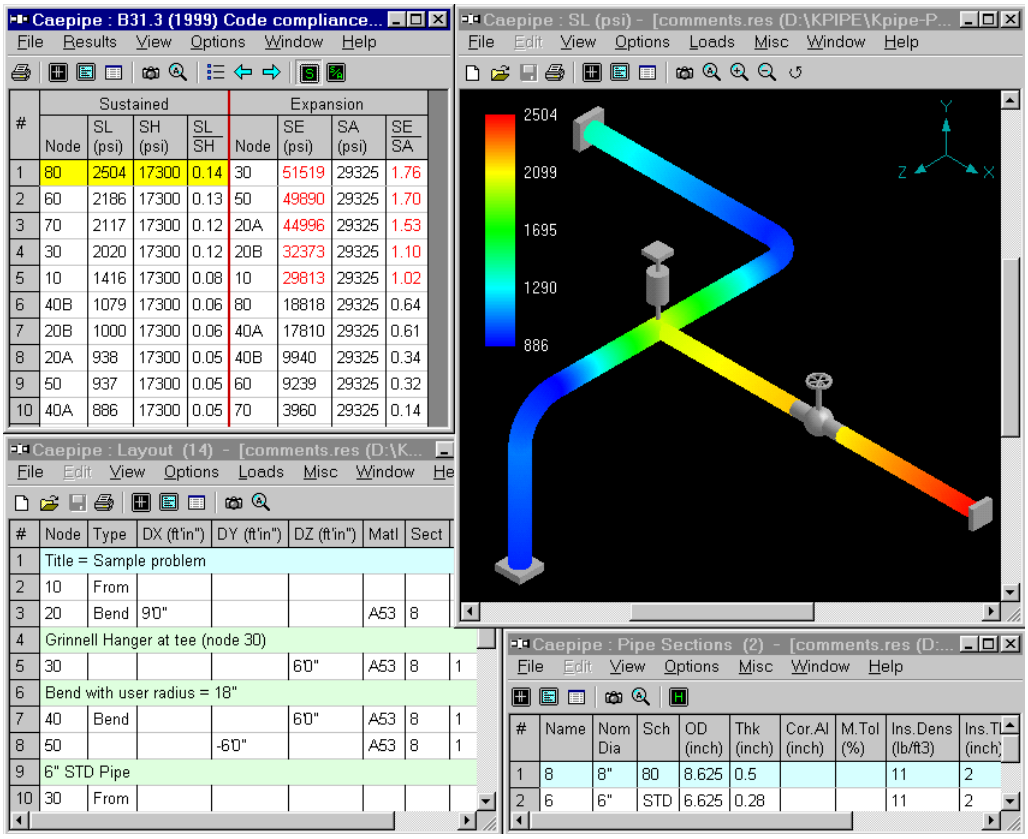
Now, in its latest generation, it allows you to perform complete static and dynamic analyses, check your design for compliance with required piping codes (ASME, B31, Canadian, Swedish and more) and with guidelines (WRC, NEMA, API), among many other things.

Find out why more and more companies stuck with costly competing software (with costly capital costs, needlessly required training costs, that run in the thousands of dollars every year) are switching to CAEPIPE. Download a free uncrippled, fully-featured copy that you can **learn to use in 20 minutes or less**. (go to www.sstusa.com).

This document contains a non-comprehensive list of CAEPIPE's features. We suggest you print this document before reviewing it.

Modeling Capabilities

- Native 32-bit Windows application with an acclaimed user interface
- Multiple, independently resizable windows
  - View Results, Graphics, Input and Details – all at the same time

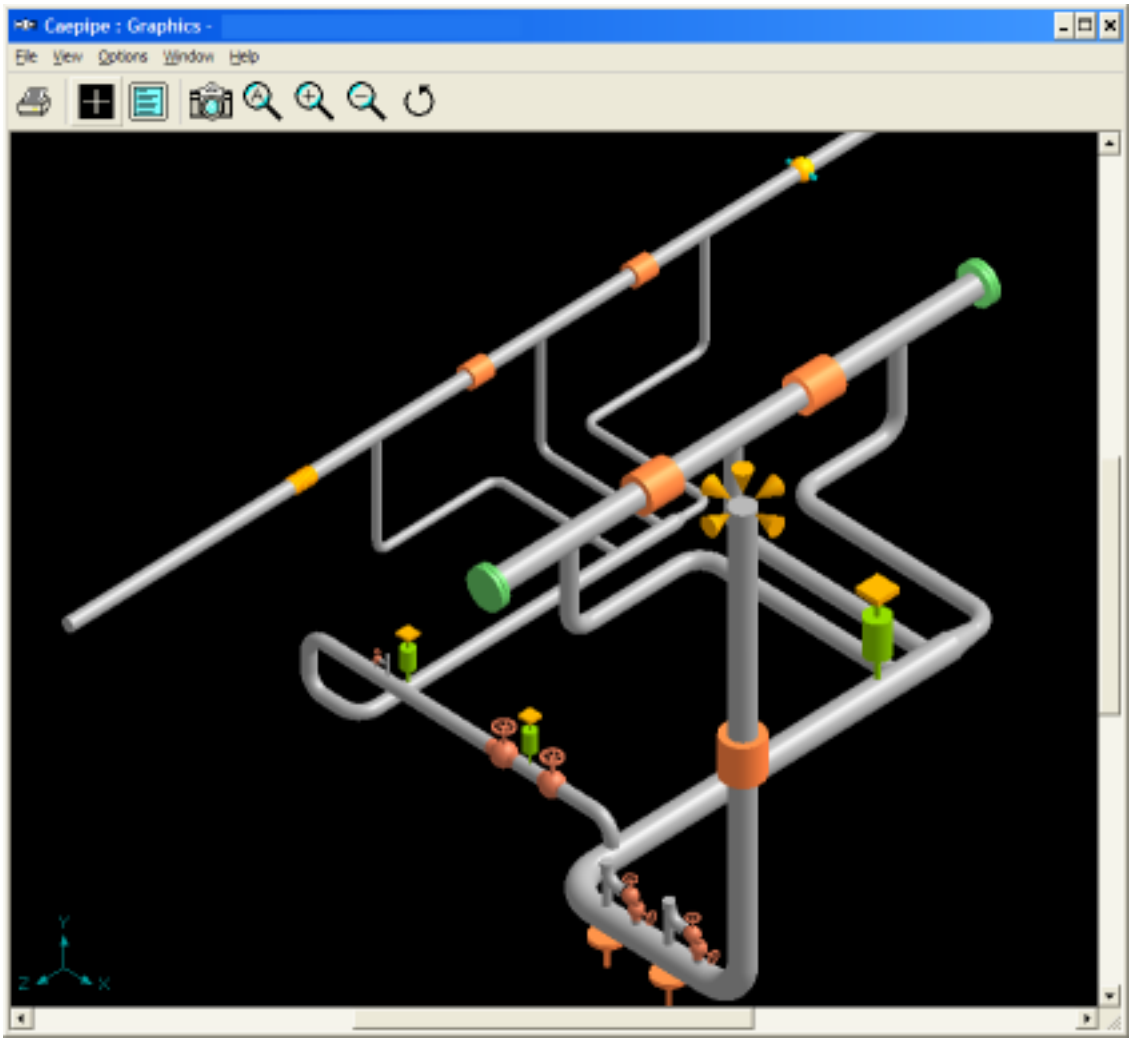


#	Sustained				Expansion			
	Node	SL (psi)	SH (psi)	SL / SH	Node	SE (psi)	SA (psi)	SE / SA
1	80	2504	17300	0.14	30	51519	29325	1.76
2	60	2186	17300	0.13	50	49890	29325	1.70
3	70	2117	17300	0.12	20A	44996	29325	1.53
4	30	2020	17300	0.12	20B	32373	29325	1.10
5	10	1416	17300	0.08	10	29813	29325	1.02
6	40B	1079	17300	0.06	80	18818	29325	0.64
7	20B	1000	17300	0.06	40A	17810	29325	0.61
8	20A	938	17300	0.05	40B	9940	29325	0.34
9	50	937	17300	0.05	60	9239	29325	0.32
10	40A	886	17300	0.05	70	3960	29325	0.14

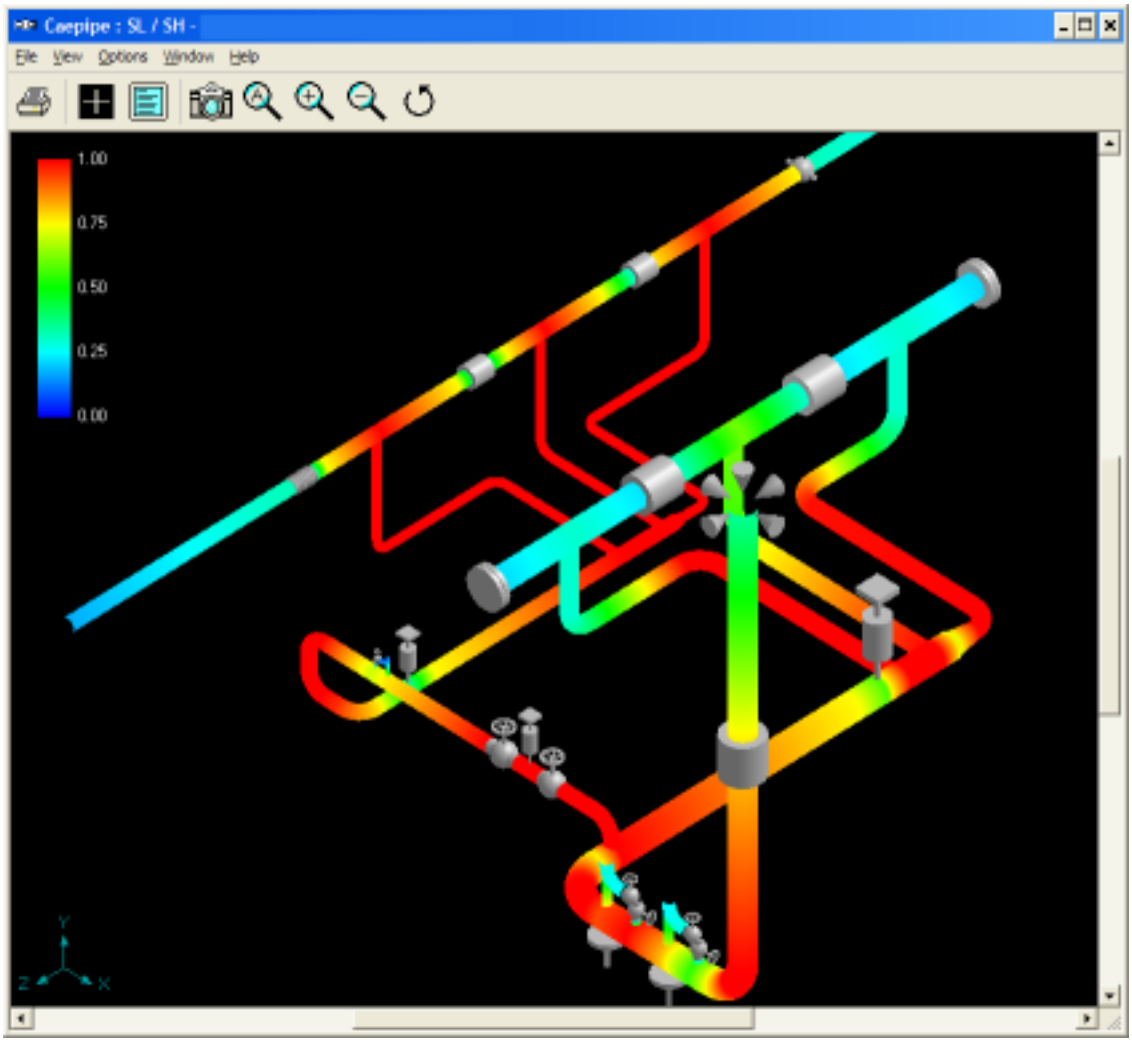
#	Node	Type	DX (ft'in")	DY (ft'in")	DZ (ft'in")	Matl	Sect	
1	Title = Sample problem							
2	10	From						
3	20	Bend	9'0"			A53	8	
4	Grinnell Hanger at tee (node 30)							
5	30				6'0"	A53	8	1
6	Bend with user radius = 18"							
7	40	Bend			6'0"	A53	8	1
8	50			-6'0"		A53	8	1
9	6" STD Pipe							
10	30	From						

#	Name	Nom Dia	Sch	OD (inch)	Thk (inch)	Cor.Al (inch)	M.Tol (%)	Ins.Dens (lb/ft3)	Ins.Th (inch)
1	8	8"	80	8.625	0.5			11	2
2	6	6"	STD	6.625	0.28			11	2

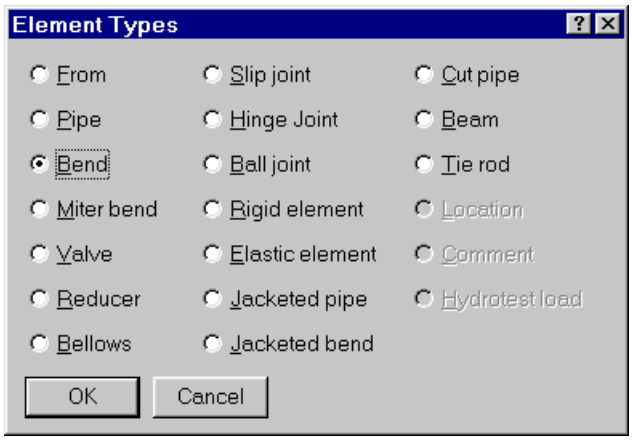
- Industry standard OpenGL® graphics, capabilities include:
  - Zoom, pan and rotate
  - 3D Rendering
  - Selective showing and plotting of various entities
  - View from any direction (automatic iso and plan views)
  - Color coded stress contour mapping
  - Copy image from the graphics window to the clipboard
  - Several graphics output formats – HPGL, DXF, EPS, EMF
  - AutoCAD export of model data
  - Specify title for plot separate from model
  - Print in color (Low/Medium/High Resolution, and Black/White background)
  - No anisotropic graphical distortions upon window resizing



- Easy model generation and powerful editing features
- Instantaneous error checking of input data

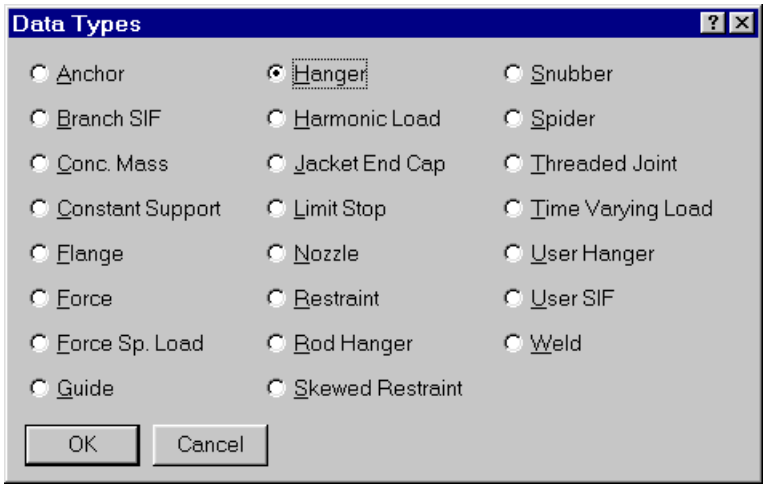


- Various element types
  - Pipe
  - Elbow/Bend (Flexibility factor, User SIF, Different material, Thickness, etc.)
  - Miter bend (Flexibility factor, User SIF, Different material, Thickness, etc.)
  - Jacketed pipe
  - Jacketed bend
  - Reducer
  - Rigid element
  - Valve
  - Bellows
  - Slip joint (with friction)
  - Hinge joint (with friction and rotation limits)
  - Ball joint (with friction and rotation limits)
  - Beam (end releases, beta angle, shear deformation)
  - Elastic element



- Tierod (with different stiffnesses and gaps in tension/compression)
- Cold spring (cut short or long)

- Various support types
  - Rigid and flexible anchor
    - Release anchors during hanger design
  - Two-way rigid restraint
  - Skewed restraint (translational or rotational)
  - Guide (with gap, friction and stiffness)
  - Hangers
    - Variable spring support
    - Constant support
    - User defined
  - Rod hanger
  - Limit stop (with gap, friction and stiffness)
  - Snubber (rigid or flexible)



- Other useful data
  - Flange
  - Force and moment
  - Jacket end cap
  - Spider
  - Nozzle
  - Weld
  - Threaded joint
  - Concentrated mass
  - SIFs (tee, branch, and such)

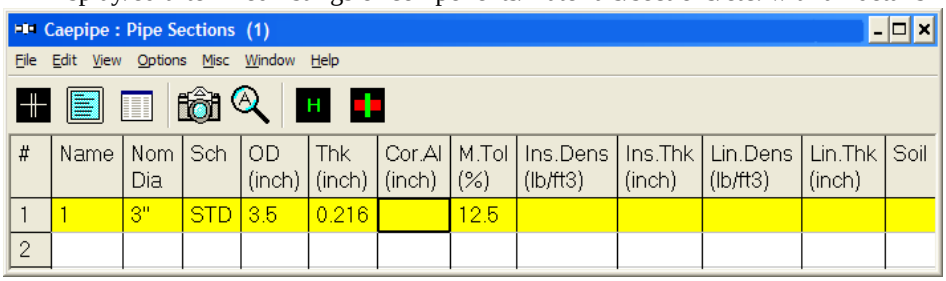
- Built-in databases
  - Pipe sizes (ISO, ANSI, JIS and DIN, including bend radius data)
  - Insulation materials
  - Over 30 spring hanger catalogs
  - Flanges (weights, SIFs)
  - Valves (types, lengths)
  - Material libraries for commonly used materials and codes (user-definable too)
  - Nozzle flexibilities according to WRC 297 and API 650
  - SIF values for different components from each piping code
  - AISC library of beam sections (user-definable too)

- Piping codes
  - B31.1
  - B31.1 (1967)
  - B31.3
  - B31.4
  - B31.5
  - B31.8
  - ASME Section III, Class 2 (1980)
  - ASME Section III, Class 2 (1986)
  - ASME Section III, Class 2 (1992)
  - European EN 13480
  - French RCC-M and CODETI
  - Swedish
  - Dutch Stoomwezen
  - Norwegian
  - British BS 806
  - Canadian Z183
  - Canadian Z184

- Rotating equipment
  - NEMA SM-23 (Turbines)
  - API 610 (Vertical and Horizontal pumps)
  - API 617 (Compressors)

- Supports can be connected to other nodes

- Non-linearities
  - Friction in Ball, Hinge and Slip joints
  - Gaps and friction in Limit stops and Guides
  - Rotation limits in Ball and Hinge joints,
  - Tension/compression stiffnesses and gaps in Tie rods
- Nozzle stiffnesses
  - WRC 297
  - API 650
- Units in any combination
  - SI
  - Metric
  - English
  - Any combination of above
- List window – Fully editable and printable
  - Display/edit itemized listings of components/materials/sections/etc. with all details



#	Name	Nom Dia	Sch	OD (inch)	Thk (inch)	Cor.Al (inch)	M.Tol (%)	Ins.Dens (lb/ft3)	Ins.Thk (inch)	Lin.Dens (lb/ft3)	Lin.Thk (inch)	Soil
1	1	3"	STD	3.5	0.216		12.5					
2												

- Many keyboard shortcuts for quick and efficient operation
- Node search feature
- Comments in the model (make as many comments anywhere)
- Block and Edit operations
  - Generate new piping from existing piping
  - Change material, pipe size, and temperature and pressure in one click
  - Changes immediately updated in all open windows
  - Edit and split elements
  - Merge models interactively
- Automatic backup and periodic saving of model data
- Default settings for ease of use
  - When a bend is input, by default, the radius, radius type, thickness, material and flexibility factor from the previous bend are used.
  - When a hanger is input, the defaults are set from the previous hanger
- Conversion of a time function to a force spectrum
- Local coordinate system shown for most elements including a nozzle

- Automatic node number increment (can be turned off)
- Specify slope for an element
- Very large model sizes (up to 10,000 nodes)

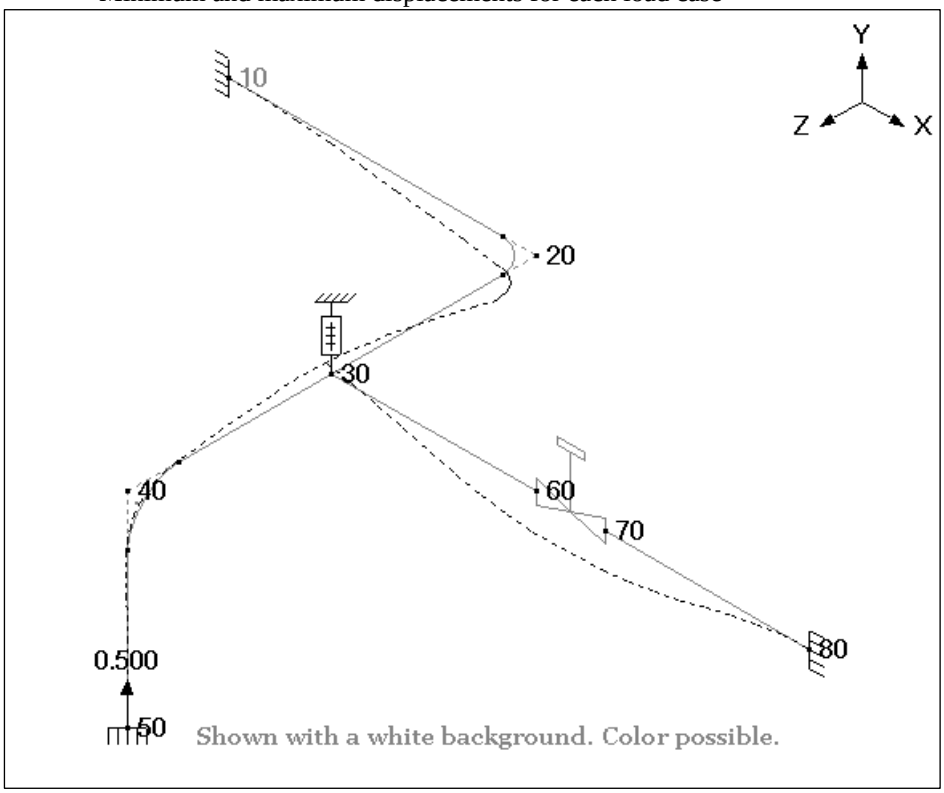
Analysis Features

- Static linear/non-linear analysis
  - Sustained
  - Expansion
  - Operating
  - Occasional
  - Cold Spring
- Automatic spring hanger design
  - Over 30 hanger catalogs (US, European, Japanese and Indian manufacturers)
- Loads
  - Weight and multiple pressures (Sustained)
  - External forces and moments (Sustained)
  - Hydrostatic test load (Sustained)
  - Multiple temperatures with specified displacements and Bourdon effect (Expansion)
  - Thermal anchor/nozzle movements (Expansion)
  - Combinations of weight, pressure and temperature (Operating)
  - Wind load (Occasional)
  - Seismic anchor movements (Occasional)
  - Static seismic acceleration (Occasional)
  - Force Spectrum load (Occasional)
  - Seismic response spectra (Occasional)
  - Harmonic loads, e.g., periodic excitation from equipment such as pumps (Occasional)
  - Time history loads, e.g., a fluid hammer (Occasional)
  - Non-repeated anchor movement: (Settlement)
  - Peak pressure for occasional loads
- Analysis option: Solve Thermal case = Operating – Sustained,
  - Use instead of solving thermal case independently, recommended procedure especially when non-linearities (limit stops, friction etc.) are present.
- Modal analysis: Fast solver – Includes Dynamic Susceptibility analysis
- Seismic response spectrum analysis
  - Combination method: SRSS (square root of sum of squares) or Absolute sum
  - Spectrum Types: Frequency (or period) versus displacement, velocity or acceleration. Linear or logarithmic interpolation, multiple units supported
  - Spectrum entered interactively or through user created text file
- Missing mass correction for response spectrum analysis
- Closely spaced modes use NRC Guide 1.92

- Time history analysis
- Force spectrum analysis
- Harmonic analysis
- FRP piping analysis (user-definable allowables for different directions)
- Buried piping analysis

Results Review

- Output
  - Displacements at
    - All nodes
    - Ball joints (with bending displacements)
    - Flexible joints (Bellows, Slip, Hinge and Ball joints)
    - Guides
    - Hangers
    - Limit stops
    - Minimum and maximum displacements for each load case

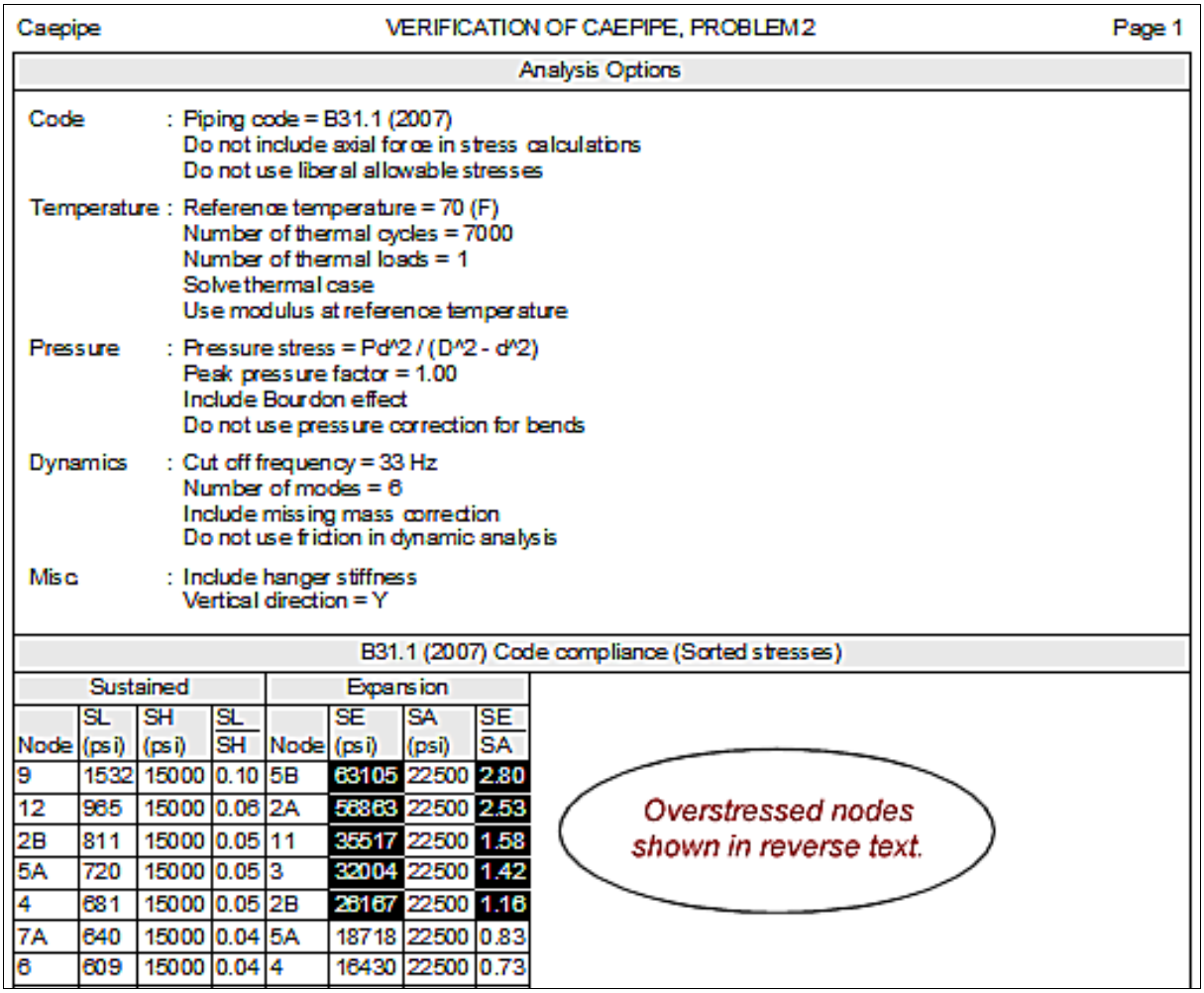


- Deflected shape (animation possible) – shown here with a white background
- Support loads for all load cases
- Support load summary
- Element forces and moments (local and global)
- Stresses

- Code compliance stresses
- Sorted code stresses
- Von Mises, Maximum and Minimum stresses

- Plotted stresses and stress ratios
- Hanger report
- Flange report
- Rotating equipment reports
- Frequencies and mode shapes (animation possible)
- Response spectrum analysis results
- Color coded stresses and stress ratios
- Center of gravity calculation

- Clean, Concise, Clearly Organized, Formatted and Customizable reports



Caepipe VERIFICATION OF CAEPIPE, PROBLEM 2 Page 1

Analysis Options

Code : Piping code = B31.1 (2007)
Do not include axial force in stress calculations
Do not use liberal allowable stresses

Temperature : Reference temperature = 70 (F)
Number of thermal cycles = 7000
Number of thermal loads = 1
Solve thermal case
Use modulus at reference temperature

Pressure : Pressure stress = Pd^2 / (D^2 - d^2)
Peak pressure factor = 1.00
Include Bourdon effect
Do not use pressure correction for bends

Dynamics : Cut off frequency = 33 Hz
Number of modes = 6
Include missing mass correction
Do not use friction in dynamic analysis

Misc : Include hanger stiffness
Vertical direction = Y

B31.1 (2007) Code compliance (Sorted stresses)

Sustained				Expansion			
Node	SL (psi)	SH (psi)	SL / SH	Node	SE (psi)	SA (psi)	SE / SA
9	1532	15000	0.10	5B	63105	22500	2.80
12	965	15000	0.06	2A	56863	22500	2.53
2B	811	15000	0.05	11	35517	22500	1.58
5A	720	15000	0.05	3	32004	22500	1.42
4	681	15000	0.05	2B	26167	22500	1.16
7A	640	15000	0.04	5A	18718	22500	0.83
6	609	15000	0.04	4	16430	22500	0.73

- Print preview for reports and graphics

- Bill of materials and Table of contents for reports

Related Features

- Neutral file input and output
- Compact and fast: Program size still approximately 1.5MB!
- Widest Support For Importing Piping data
  - AVEVA PDMS
  - AutoCAD Plant 3D
  - Intergraph PDS
  - CADWorx
  - Cadmatic
  - Bentley Autoplant
  - Dassault/IBM CATIA
  - DST Pipestress
  - CAEPIPE Neutral file, and others
- Export Data
  - AutoCAD DXF
  - PDMS
  - Pipestress
  - CAESAR-II
  - CAEPIPE Neutral file
  - Microsoft Excel CSV file (All input and results) for further post-processing
- Advanced 32-bit Windows technology
  - Multithreading: Layout, Graphics, Animation and Analysis run in separate threads
  - Robust Exception handling: Better error diagnostics
  - Memory mapped files: Really fast data access
  - Ability to change display and print fonts for text and graphics
  - Long filename support (including spaces)
- Advanced software features
  - Super fast dynamic scrollbar with tracking scroll box in real-time for text and graphics
  - Dynamic updating of data in all open windows – Layout, List and Graphics
  - Synchronization of the highlight/cursor between all open text and graphics windows
  - Simultaneous visual updates of deflected and mode shapes. Simply switch between different load cases (or mode shapes) to show corresponding deflected (or mode shape).
  - Flashing cursor in graphics window synchronized at all times with the input window
  - A pop-up context menu of frequently used commands in Graphics window
  - Graphics scales dynamically in real-time. Simply resize the window for fast and dynamic resizing.

SST continues to constantly enhance and improve CAEPIPE.
Please check with us if you do not see a feature listed in this document.
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