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SST Systems, Inc. 5674 Stoneridge Drive, Suite 107 Pleasanton, CA 94588, USA

Tel: (408) 452 8111 Fax: (408) 452 8388

email: info@sstusa.com

www.sstusa.com

The best way to learn CAEPIPE is to try it yourself. In this tutorial we will create a simple model to help you understand the use of CAEPIPE. The details of the model are shown below:



You will learn how to:

- 1. Enter Title
- 2. Select Analysis options (piping code etc.)
- 3. Define Material, Section and Loads for the model
- 4. Input Model Layout
- 5. Select Load Cases for Analysis
- 6. Analyze
- 7. View Results

Start CAEPIPE. Click on the option "File > New" from the layout window. The "New file" dialog opens.



From the "New file" dialog, select the type of the new file as "Model (.mod)" file. This opens two independent windows: "Layout" and "Graphics".

Layout window

1-0-1	Caepipe	e : Layou	ıt (2) - [Un	titled]					-	_	×
File	Edit	View	Options L	oads Misc	Window	Help					
) 🖻		4	+		ô1 (A,				
#	Node	Туре	DX (ft'in")	DY (ft'in")	DZ (ft'in")	Matl	Sect	Load	Data		
1	Title =										
2	10	From							Anchor		
3											

Graphics window



Adjust the size of the windows to fit your desktop such that you can view both comfortably at the same time.

1. Enter Title

Type "Sample Problem" as the title in the first row that contains "Title =". Press Enter.

2. Select Analysis options (piping code etc.)

Click on the "Options" menu and then select "Analysis" (Options > Analysis) to specify options for analysis.

-0-1	Caepip	e : Layo	ut (2) - [¹	Untitled]									\times
File	Edit	View	Options	Loads	Misc	Window	Help						
	<u>م</u> ۱	• 🗖	Ana	alysis									
		′ 📼	<u>U</u> ni	ts		(Ctrl+U	•					
#	Node	Турє	<u>F</u> on	ıt				ct	Load	Data			
1	Title =	Samp	<u>I</u> nci	rease For	nt	Ct	trl+Up						
2	10	From	<u>D</u> ec	rease Fo	nt	Ctrl+	Down			Ancho	r		
3			No	de increr	nent								

This opens the "Analysis" Options dialog.

Analysis	Options	?	×
Code	Temperature Pressure Dynamics Misc		
Pi	ping code		
B	31.3 (2022) 🚽		
V	Use B31J for SIFs and Flexibility Factors		
	Include axial force in stress calculations		
	Use liberal allowable stresses		
	ОК	Ca	incel

On the Code property page, select "B31.3 (2022)" for Piping code. Then click on "OK" to close "Analysis Options" dialog.

3. Define Material, Sections and Load Material

Click on "Matl" in the header in the Layout window (or press "Ctrl+Shift+M")

1-0-1	Caepipe	e : Layou	ıt (2) - [Un	titled]					-	_	×
File	Edit	View	Options L	oads Misc	Window	Help					
) 🖻		4	+		ô1 (A				
#	Node	Туре	DX (ft'in")	DY (ft'in")	DZ (ft'in")	Matl	Sect	Load	Data		
1	Title =	Sample	e Problem			13					
2	10	From							Anchor		
3											

This opens up the "Materials" list in a separate "List" window. Position and resize the list window as you desire. Click on "Library" button on the "Toolbar" (or choose File > Library).

The "Open Material Library" dialog is shown

💵 Open Material Library		×
Look in: Material_Library	← 🗈 💣 📰 -	
Name	Date modified	
B313-2022.mat	18-12-2023 03:11	
B314-2002 mot Type: MAT File B314-200 B314-200 B314-200 Date modified: 18-12-2023 03:11 B314-2012.mat	23-07-2014 22:50 23-07-2014 22:50 23-07-2014 22:50 13-06-2019 21:50	
File name: B313-2022 Files of type: Material Library files (*.mat)	Open Cancel	

Select "B313-2022.mat" as the library file to open by double clicking on it. The available materials in the library are shown.

Mate	erial Library - [B313-2022.mat (C: 🗙						
Piping code : B31.3							
#	Material Description						
1	A53 GRADE A						
2	A53 GRADE B						
3	A106 GRADE A						
4	A106 GRADE B						
5	A106 GRADE C						
6	A135 GRADE A						
7	A135 GRADE B						
8	API 5L X46						
9	API 5L X42						
10	API 5L-X52						
11	API5L-X56						
12	A381-Y35						
	OK Cancel Library						

Double click on "A53 Grade B" material to select it. The properties for this material are transferred to the material in the List window. Type "A53" for material name and then press "Enter".

-0-1	Caepipe : M	1aterials (0) - [Un	titled]								-	D	×
File	Edit Vie	w Options Mis	c V	/indow H	lelp									
-#		- E	۲	H Q	2		• 🔿	•						
#	Name	Description	Ty pe	Density (lb/in3)	Nu	Joint factor	Yield (psi)	Tensile (psi)	#	Temp (F)	E (psi)	Alpha (in/in/F)	Allowable (psi)	
1	A53	A53 GRADE B	CS	0.283	0.3	1.00	35000	60000	1	-20	29.9E+6	6.25E-6	20000	
									2	18	29.7E+6	6.31E-6	20000	
									3	70	29.4E+6	6.40E-6	20000	
									4	100	29.3E+6	6.47E-6	20000	
									5	200	28.8E+6	6.70E-6	20000	
									6	300	28.3E+6	6.90E-6	20000	
									7	400	27.4E+6	7.10E-6	19900	
									8	500	27.3E+6	7.30E-6	19000	
									9	600	26.5E+6	7.40E-6	17900	
									10	650	26.0E+6	7.50E-6	17300	
									11	700	25.5E+6	7.60E-6	16700	
									12	750	24.9E+6	7.70E-6	13900	
									13	800	24.2E+6	7.80E-6	11400	
									14	850	23.4E+6	7.85E-6	8700	
									15	900	22.5E+6	7.90E-6	5900	
									16	950	21.5E+6	8.00E-6	4000	
									17	1000	20.4E+6	8.10E-6	2500	
									18	1050	19.2E+6	8.15E-6	1600	
									19	1100	18.0E+6	8.20E-6	1000	
									20					

Sections

Select "Sections" from the "Misc" menu of the List window (or press "Ctrl+Shift+S").

1-0-1	Caepipe : I	Materials (0) -	[Unti	itled]								—		\times
<u>F</u> ile	<u>E</u> dit <u>V</u> i	ew <u>O</u> ptions	<u>M</u> isc	<u>W</u> indow	<u>H</u> elp									
				<u>C</u> oordinate	25	Ctrl+S	hift+C							
				<u>M</u> aterials		Ctrl+S	hift+M		1	-	-		AU 11	_
#	Name	Description		<u>S</u> ections		Ctrl+S	Shift+S) ensile Isiì	#	líF)	l⊏ (psi)	Alpha (in/in/F)	Allowable (psi)	
1	A53	A53 GRAD		<u>L</u> oads		Ctrl+S	Shift+L	0000	1	-20	29.9E+6	6.25E-6	20000	
				Beam <u>M</u> ate	erials				2	18	29.7E+6	6.31E-6	20000	1
				Beam <u>S</u> ecti	ions				3	70	29.4E+6	6.40E-6	20000	
				Beam <u>L</u> oad	ls				4	100	29.3E+6	6.47E-6	20000	
				Dumper					5	200	28.8E+6	6.70E-6	20000	
				Compress					6	300	28.3E+6	6.90E-6	20000	
				Turbines	//3				7	400	27.4E+6	7.10E-6	19900	
				1 <u>u</u> rbines					8	500	27.3E+6	7.30E-6	19000	
				Spectrums					9	600	26.5E+6	7.40E-6	17900	
				Force spec	trums				10	650	26.0E+6	7.50E-6	17300	
				Time Funct	tions				11	700	25.5E+6	7.60E-6	16700	
				Soils					12	750	24.9E+6	7.70E-6	13900	
									13	800	24.2E+6	7.80E-6	11400	
									14	850	23.4E+6	7.85E-6	8700	
									15	900	22.5E+6	7.90E-6	5900	
									16	950	21.5E+6	8.00E-6	4000	
									17	1000	20.4E+6	8.10E-6	2500	
									18	1050	19.2E+6	8.15E-6	1600	
									19	1100	18.0E+6	8.20E-6	1000	
	1						I I		00					

The "Sections" list is shown. To enter the first section, Type "8" for section name and press "Enter". The Section Properties dialog is shown with the section name 8.

-0-1	Caepipe	: Pipe S	Sectior	ns (0) -	[Untitle	d]								×
<u>F</u> ile	<u>E</u> dit	<u>V</u> iew	<u>O</u> ptio	ns <u>M</u> is	c <u>W</u> in	dow <u>H</u>	elp							
-#			E) 🖉		1								
#	Name	Nom Dia	Sch	OD (inch)	Thk (inch)	Cor.Al (inch)	M.Tol (%)	Ins.Dens (Ib/ft3)	Ins.Thk (inch)	Lin.Dens (lb/ft3)	Lin.Thk (inch)	Soil		
1	8													

The Section Properties dialog ("Section #1") is shown with the section name 8.

Section # 1		×
Section name 8		O JISI O ISO
Nominal diameter	Schedule	-
Outside diameter 1" 1-1/4"	(inch) Thickness	(inch)
Corrosion allowance	(inch) Mill tolerance	. (%)
Insulation : Density 3.1/2"	(lb/ft3) Thickness	(inch)
Lining : Density	(lb/ft3) Thickness	(inch)
OK Ca 10" 12"	ulation Soi	-

Click on the "down arrow" of the "Drop Down" combo box for "Nominal diameter" and select 8" for "Nominal diameter". The "Outside diameter" (8.625") is automatically entered.

To select the schedule for the 8" pipe, click on the "down arrow" of the "Drop Down" combo box for "Schedule" and select 80 for "Schedule".

Section # 1			×
Section name 8 💿 A	NSI O DIN	O JISI O I	so
Nominal diameter 8''	Schedule	5S 💌	
Outside diameter 8.625 (inch)	Thickness	5S 10S LW	(inch)
Corrosion allowance (inch)	Mill tolerance	20 30 STD	(%)
Insulation : Density (Ib/ft3)	Thickness	40S 40	(inch)
Lining : Density (Ib/ft3)	Thickness	60 XS 80S	(inch)
OK Cancel Insulation	Soil	80 100 120	

The "Thickness" (0.5") is automatically entered.

For "Insulation density", click on the "Insulation" button or Press "Alt+I". A table of "Insulation materials and their densities" is shown.

Insulation Densiti	es X
Insulation Material	Density (Ib/ft3)
Amosite Asbestos	16
Calcium Silicate	15
Careytemp	10
Cellular Glass	9
Fiberglass	7
High Temperature	24
Kaylo 10	12.5
Mineral Wool	8.5
Perlite	13
Poly Urethane	2.2
Styro Foam	1.8
Super-X	25
OK Ca	incel

Double click on "Calcium Silicate". The "Insulation density" (15.0 lb/ft3) is entered on the "Section" dialog. Type 2 (inches) for "Insulation Thickness" then press "Enter" or click "OK" to enter the first section.

-0-	Caepipe	: Pipe S	Sectior	ns (1) -	[Untitle	d]								×
<u>F</u> ile	<u>E</u> dit	<u>V</u> iew	<u>O</u> ptior	ns <u>M</u> is	c <u>W</u> in	dow <u>H</u>	elp							
-#			E) 🖉		1								
#	Name	Nom Dia	Sch	OD (inch)	Thk (inch)	Cor.Al (inch)	M.Tol (%)	Ins.Dens (Ib/ft3)	Ins.Thk (inch)	Lin.Dens (lb/ft3)	Lin.Thk (inch)	Soil		
1	8	8"	80	8.625	0.5			15	2					
2														

Now repeat the process for the second section.

H	Caepipe	: Pipe S	Section	s (2) -	[Untitled	i]								×
File	Edit	View	Option	s Miso	Wind	ow He	lp							
-#			f ô	ð 🔍				➡						
#	Name	Nom Dia	Sch	OD (inch)	Thk (inch)	Cor.Al (inch)	M.Tol (%)	Ins.Dens (Ib/ft3)	Ins.Thk (inch)	Lin.Dens (lb/ft3)	Lin.Thk (inch)	Soil		
1	8	8"	80	8.625	0.5			15	2					
2	6	6"	STD	6.625	0.28			15	2					
3														

In row # 2, type 6 for section "Name" and press Enter. The "Section Properties" dialog is shown with the section name "6". Select 6" for "Nominal diameter", STD for "Schedule" and 2" Calcium Silicate for "Insulation". Press "Enter" or click on "OK" to enter the second section.

Load

Select "Loads" from the "Misc" menu (or press "Ctrl+Shift+L").

H	Caepipe	: Pipe S	Section	s (2) -	[Untitled]							_	D	×
<u>F</u> ile	<u>E</u> dit	<u>V</u> iew	<u>O</u> ption	s <u>M</u> is	c <u>W</u> indow <u>H</u> elp									
-#			fô	d	<u>C</u> oordinates	Ctrl+Shift+C								
					<u>M</u> aterials	Ctrl+Shift+M			Lin David	1 :	0-3			
#	Name	Nom Dia	Sch		Sections	Ctrl+Shift+S	_	nk 1)	(lb/ft3)	(inch)	501			
1	8	8"	80	18	<u>L</u> oads	Ctrl+Shift+L								
2	6	6"	STD	6	Beam <u>M</u> aterials									
3					Beam Sections									
					Beam <u>L</u> oads									
<u> </u>					<u>P</u> umps									
<u> </u>				-	Compressors									
┝				-	T <u>u</u> rbines									
					Spectrums									
					Force spectrums									
					Time Functions									
					Soils									

The "Loads" list is shown. To enter the first load, Type "1" for "Name", Tab to "T1" and type 600, Tab to "P1" and type 200, Tab to "Desg. T" and type 800, Tab to "Desg. Pr." And type 250 and Tab to "Specific gravity" and type 0.8. Then press "Enter". That is it! The load is entered. (Alternately, you could have pressed "Ctrl+E" on the first row and typed in the same information in a dialog box).

H	Caepipe	: Load	s (1) -	[Untitled]	l							_	-	×
File	Edit	View	Option	ns Misc	Window	Help								
-#)] Q	Н		•							
#	Name	T1 (F)	P1 (psi)	Desg.T (F)	Desg.Pr. (psi)	Specific gravity	Add.Wgt. (lb/ft)	Wind Load 1	Wind Load 2	Wind Load 3	Wind Load 4			
1	1	600	200	800	250	0.8								
2														

Note:

Design Temperature and Design Pressure should always be greater than or equal to the Operating Temperature and Operating Pressure (T1 and P1 for this tutorial).

Design Temperature entered will be used to compute the allowable stress for material while computing the Allowable Pressure as per the piping code selected.

The Allowable Pressure computed as per the piping code selected is then compared against the Design Pressure entered above and reported in the Code Compliance results.

In addition to the above, starting "CAEPIPE V.12.10", there is an additional load case for Design Pressure and Design Temperature that computes and show results for "Displacements", "Element Forces" & "Moments", "Support Loads" and "Support Load Summary".

Click in the Layout window or press F3 to move the focus to the Layout window.

4. Input Model Layout

We are going to model the 8" header line first, followed by the 6" branch line.

NOTE

- In the following text, the word "type" should be distinguished from the words "Type column" or simply "Type" (upper case "T"). The former ("type") would mean press the keys for the text you want to type. The latter word "Type" would refer to the Type column in the Layout spreadsheet.
- Also, the instruction "type B for Bend" does not necessarily mean the upper case "B". The lower case "b" could also be typed.
- For items input in the "Data" column (such as "Anchor" or "Hanger"), the cursor needs to be in the "Data" column. This can be quickly done by pressing Ctrl+D from any column or clicking in the "Data" column. Another way is to Tab repeatedly to reach the "Data" column.
- As the graphics window is simultaneously updated, you should position the graphics window in such a way that you can see it along with the input window.

First the 8" header

Following the "Title" at row #1, row #2 is already generated with "Node" 10 of Type "From" with an "Anchor" in the "Data" column.

Press "Enter" to move the highlight to the next row #3. Tab to the "Type" column. The next "Node" 20 is automatically assigned. In the "Type" column, type "b" (for Bend), Tab to "DX", type 9. Tab over to "Material", type A53, Tab to "Section", type 8, Tab to "Load", type 1. Press "Enter" and the cursor moves to the next row (#4).

H	Caepipe	e : Layou	ıt (3) - [Un	titled]					-	_	×
File	Edit	View	Options L	oads Misc	Window	Help					
) 🖻		4			ô1 (<u>a</u>				
#	Node	Туре	DX (ft'in")	DY (ft'in")	DZ (ft'in")	Matl	Sect	Load	Data		
1	Title =	Sample	e Problem								
2	10	From							Anchor		
3	20	Bend	9'0"			A53	8	1			
4											

You will see the model in the graphics window as it is entered. You can press "F2" to switch between text and graphics windows.



In row #4, Tab to the "Type" column. The next "Node" 30, is automatically assigned.

In row #4 with "Node" 30, Tab to "DZ", type 6, Tab to "Data" (or press "Ctrl+Shift+D"), type "h" (for a to be designed Hanger) and press "Enter", the "Hanger" dialog is opened.

Hange	r at node 30	? ×
Tag		
Туре	Grinnell	•
Numb	er of Hangers	1
l 1	.oad Variation	25 (%)
	Hanger below	🗌 Short Range
	Connected to	
	Level Tag	•
OK	Cancel	

Press "Enter" or click on "OK" to input the hanger. The material, section and load are automatically inserted (based on the previous row's material, section and load), and the cursor moves to the next row.

1-0-0	Caepipe	e : Layou	ıt (4) - [Un	titled]					-	-	×
File	Edit	View	Options L	oads Misc	Window	Help					
) 🖻	;	4	+		ê (2				
#	Node	Туре	DX (ft'in")	DY (ft'in")	DZ (ft'in")	Matl	Sect	Load	Data		
1	Title =	Sample	e Problem								
2	10	From							Anchor		
3	20	Bend	9'0"			A53	8	1			
4	30				6'0"	A53	8	1	Hanger		
5											

The Graphics window will look like this.



In row #5, Tab to the "Type" column. The next "Node" 40, is automatically assigned. In the "Type" column, type "b" (for "Bend") and press Tab. This bend has a non-standard (user defined) bend radius. Therefore, the bend radius needs to be modified from the default long radius. Double click on the "Bend" in the "Type" column or press "Ctrl+T" to bring up the "Bend" dialog box. Click on "User" (Bend Radius > User) radio button and enter 18 for "Bend Radius". Press "Enter" or click on "OK" to modify the bend.

Bend at node 40	? ×
Bend Radius C Long C Short 18 (inch) © User	
Bend <u>T</u> hickness (inch)	
Bend <u>M</u> aterial	
Elexibility Factor: In Plane	Out Plane
<u>S</u> IFs: In Plane	Out Plane
Axial	Torsion
Intermediate Nodes	
Node at Angle	(deg)
Node at Angle	(deg)
OK Cancel	

While still in row #5, Tab to "DZ", type 6 then press- "Enter". The material, section and load are automatically inserted like before, and the cursor moves to the next row.

In row #6, Tab to the "DY" column. The next "Node" 50, is automatically assigned. In the "DY" column, type -6, Tab to the "Data" column or press "Ctrl+Shift+D" to move to the data column, then type "a" (for "Anchor"). Anchor, material, section and load fields are automatically inserted, and the cursor moves to the next row.

Let us specify a thermal anchor movement for the "Anchor" we just put in at node 50. Double click on the "Anchor" at node 50 in row #6. The "Anchor" dialog comes up.

Anchor at node 50		? ×
Tag	Level Tag	~
Translational stiffness (lb/inch) KX KY KZ Rigid Rigid	Rotational stiffness (in-lb/de KXX KYY KZ Rigid Rigid Ri	eg) Z gid
Releases for hanger selection $\square imes \square$	i y ⊡ z ⊡ xx ⊡ yy	n 🗆 🗠
OK Cancel Displacement	s 🔽 Rigid 🔲 Ancho	r in Pipe LCS

Note:

Option "Anchor in Pipe LCS" allows the user to input Anchor stiffnesses in the "Local Coordinate System" (LCS) of the adjoining pipe. On the other hand, if "Anchor in Pipe LCS" is not turned ON, then the user has to input Anchor stiffnesses in the "Global Coordinate System" (GCS).

Click on "Displacements" button. The "Specified Displacements" dialog for the anchor comes up. Tab to "Y" displacement field and type 0.5.

Specified	Displacem	ents for A	nchor at n	ode 50		×
Load	X (inch)	Y (inch)	Z (inch)	XX (deg)	YY (deg)	ZZ (deg)
Design						
T1		0.5				
T2						
ТЗ						
Τ4						
T5						
Т6						
T7						
Т8						
Т9						
T10						
Seismic 1						
Seismic 2						
Seismic 3						
Settlement						
Wind 1						
Wind 2						
Wind 3						
Wind 4						
OK	Cancel	🗌 🗖 Disp	placements	in Pipe LCS		

Press "Enter" to exit the "Specified Displacements" dialog. Press "Enter" again to exit the "Anchor" dialog. In the "Layout" window, press "Enter" to move to the next row.

-0-1	Caepipe	e : Layou	ıt (6) - [Un	titled]					_		\times
File	Edit	View	Options L	oads Misc	Window	Help					
) 🖻		4	╈		ô1 (A,				
#	Node	Туре	DX (ft'in")	DY (ft'in")	DZ (ft'in")	Matl	Sect	Load	Data		
1	Title =	Sample	e Problem			_					
2	10	From							Anchor		
3	20	Bend	9'0"			A53	8	1			
4	30				6'0"	A53	8	1	Hanger		
5	40	Bend			6'0"	A53	8	1			
6	50			-6'0"		A53	8	1	Anchor		
7											

Click on the "Zoom All" button (or press "Ctrl+A") to view the 8" header line fully in the graphics window.



Now the 6" branch

Let us input a comment saying that this is a 6" std pipe. On an empty row, if the first character in the Node field is input as "c", that row becomes a comment row. On row #7, type "c" to create the comment and then type: "6" std pipe" and then press "Enter" to go to the next row.

1-0-1	Caepipe	e : Layou	ıt (7) - [Un	titled]					_	-	D	×
File	Edit	View	Options L	oads Misc	Window	Help						
) 🖻		4			â (A,					
#	Node	Туре	DX (ft'in")	DY (ft'in")	DZ (ft'in")	Matl	Sect	Load	Data			
1	Title =	Sample	e Problem	_				_				
2	10	From							Anchor			
3	20	Bend	9'0"			A53	8	1				
4	30				6'0"	A53	8	1	Hanger			
5	40	Bend			6'0"	A53	8	1				
6	50			-6'0"		A53	8	1	Anchor			
7	6" std p	oipe										
8												

On the next row (#8), type 30 for Node, Tab to the "Type" column, type "f" (for "From", since we are beginning a new branch), press "Enter". In the next row (#9), Tab to the "DX" column. The next "Node" 60 is automatically assigned. In the "DX" column, type 6 and press "Enter".

CAEPIPE inserts the previous material, and automatically detects the new branch and asks if you want to change section.



Since we want to change the section to 6, click on "Yes". This opens the "Select Section" dialog.

Select Section X										
Name	Nominal Diameter	Sch	OD (inch)	Thk (inch)						
8	8"	80	8.625	0.5						
6	6''	STD	6.625	0.28						
OK Cancel										

Select the 6" section by double clicking on it. The section (6) is entered in the "Section" column in the "Layout" window. Press "Enter" to go to the next row. The load is again automatically inserted from the previous load.

HH	Caepipe	e : Layou	ıt (9) - [Un	titled]					-	-		×
File	Edit	View	Options L	oads Misc	Window	Help						
#	Node	Туре	DX (ft'in")	DY (ft'in")	DZ (ft'in")	Matl	Sect	Load	Data			
1	Title =	Sample	e Problem									
2	10	From							Anchor			
3	20	Bend	9'0"			A53	8	1				
4	30				6'0"	A53	8	1	Hanger			
5	40	Bend			6'0"	A53	8	1				
6	50			-6'0"		A53	8	1	Anchor			
7	6" std p	oipe										
8	30	From										
9	60		6'0"			A53	6	1				
10												

The graphics window will look like this.



In the next row (#10), Tab to the "Type" column. The next "Node" 70, is automatically assigned. In the "Type" column, type "v" (for "Valve"). This brings up the "Valve" dialog box.

Valve from 60 to 70	?	\times	Valve from 60 to 70 \qquad ? \qquad
Weight 200	(lb)		Weight 200 (lb)
Length	(inch)		Length (inch)
Thickness X			Thickness X 3.00
Insulation weight X			Insulation weight X 1.75
Additional weight 50	(lb)		Additional weight 50 (lb)
Valve Type	•		Valve Type
Offsets of additional weight from	valve cer	nter	Offsets of additional weight from valve center
DX (inch) DY (inch) DZ (inc	ch)		DX (inch) DY (inch) DZ (inch)
OK Cancel Librar	y .		OK Cancel Library

In the "Valve" dialog box, type 200 for "Weight", 50 for "Additional Weight" and 18 for "DY" offset. Then press "Enter" or click on "OK" to input the valve. The "Thickness X" and "Insulation weight X" are automatically added as 3.00 and 1.75 by CAEPIPE as shown.

In the Layout window, type 2 for "DX" offset and press "Enter". The material, section and load are automatically inserted as before, and the cursor moves to the next row.

In the next row (#11), Tab to "DX". The next "Node" 80 is automatically assigned. In the "DX" column, type 6. Tab to "Data" or press "Ctrl+Shift+D" to move to the data column, then type "a" (for "Anchor"). Material, section and load are automatically inserted like before, and the cursor moves to the next row.

101	Caepipe	e : Layou	t (11) - [Ur	ntitled]						.		×
File	Edit	View (Options Lo	oads Misc	Window	Help						
	🗋 🚔 🖶 🐻 🔳 🛅 🛅 🚳 🔍											
#	Node	Туре	DX (ft'in")	DY (ft'in")	DZ (ft'in")	Matl	Sect	Load	Data			
1	Title =	Sample	Problem									
2	10	From							Anchor			
3	20	Bend	9'0"			A53	8	1				
4	30				6'0"	A53	8	1	Hanger			
5	40	Bend			6'0"	A53	8	1				
6	50			-6'0"		A53	8	1	Anchor			
7	6" std j	oipe										
8	30	From										
9	60		6'0"			A53	6	1				
10	70	Valve	2'0"			A53	6	1				
11	80		6'0"			A53	6	1	Anchor			
12												

5. Select Load Cases for Analysis

Select "Loads" cases from the Loads menu.

-0-1	Caepipe	e : Layou	t (11) -	[Untitled	d]					_	- (\times
<u>F</u> ile	<u>E</u> dit	<u>V</u> iew	<u>O</u> ptions	<u>L</u> oads	<u>M</u> isc	<u>W</u> indow	<u>H</u> elp					
) 🖻	;	4		oad cas	es (4)		2				
#	Node	Туре	DX (ft'ir	, s	itatic sei	smic 2		Sect	Load	Data		
1	Title =	Sample	Proble	s	itatic sei	smic 3						
2	10	From		v	Vind 1					Anchor		
3	20	Bend	9'0"	v				3	1			
4	30			v	Vind 3			3	1	Hanger		
5	40	Bend		v	Vind 4			3	1			
6	50			S	pectrun	n		3	1	Anchor		
7	6" std p	oipe		Т	ime hist	torv				•		
8	30	From		- F	larmoni	ic		_				
9	60		6'0"	-			[~~~]	ð	1			
10	70	Valve	2'0"				A53	6	1			
11	80		6'0"				A53	6	1	Anchor		
12												

The "Load cases" dialog is shown.

Load cases (4)	×					
▼ Sustained (W+P)	🔽 Operating (W+P1+T1)					
🔽 Empty Weight (W)	🔲 Design (W+PD+TD)					
🔽 Expansion (T1)	🔲 Modal analysis					
OK Cancel	All None					

By default, "Sustained" (W+P), "Empty Weight" (W), "Expansion" (T1) and "Operating" (W+P1+T1) load cases are already selected. "Design" (W+PD+TD) load case when selected for the "Analysis", CAEPIPE will compute and show results for "Displacements", "Element Forces & Moments", "Support Loads" and "Support Load Summary". A design load case does not include "Stress Calculations", "Rotating Equipment Qualifications" and "Flange Equivalent Pressure Calculations". Press "OK" to return to the "Layout" window. The model input is now complete.

Click on the "Zoom All" button (or press "Ctrl+A") to show the whole model in the graphics window.



To see a 3D rendered view of the model, click on the "Render" button (or press "Ctrl+R") in the graphics window.

Caepipe : Graphics - [Untitled]	-		×
File View Options Window Help			
<i>≞</i> ≡ ™ ≪ < < ∪	<mark>н</mark>		
	Z	Ť	×

To return to the non-rendered view, click on the "Do not render" button (or press "Ctrl+R").

List

One of the useful features of CAEPIPE is the ability to show a list of all like-items such as anchors, bends etc. in a separate "List" window. Click on the "List" button (or press "Ctrl+L") to show the list dialog.

List		×
Anchors	O Loads	
C <u>B</u> ends	Materials	
C Branch points	C Sections	
C <u>C</u> oordinates	Specified displ	
C <u>H</u> angers	⊂ <u>V</u> alves	
OK Car	ncel	

Click on an item of interest to show the list for that item.

A list of all the anchors in the sample model is shown below:

- Caepipe : Anchors (3) - [Untitled]											×						
File	Edit	View	Options	Misc W	indow H	elp											
-#																	
#	Node	Tag	KX/kx	KY/ky	KZ/kz	KXX/kxx	KYY/kyy	KZZ/kzz		F	Rele	ease	∋s			Level	Tag
			(lb/inch)	(lb/inch)	(lb/inch)	(in-lb/deg)	(in-lb/deg)	(in-lb/deg)	Х	Υ	Z	\times	YY	ZZ	Anchor in		
1	10		Rigid	Rigid	Rigid	Rigid	Rigid	Rigid							GCS		
2	50		Rigid	Rigid	Rigid	Rigid	Rigid	Rigid							GCS		
3	80		Rigid	Rigid	Rigid	Rigid	Rigid	Rigid							GCS		

The highlighted item can be edited directly in the "List" window (in most cases) or in a dialog by pressing "Ctrl+E". The items can be deleted by pressing "Ctrl+X". The item is also highlighted in the graphics window by flashing and with a box around the node number.

A list of all the bends in the sample model is shown below:

100	••• Caepipe : Bends (2) - [Untitled]													×	
File	Edit	View O	ptions	Misc	Window	/ Help									
-#															
#	Bend Node	Radius (inch)	Rad. Type	Thk (inch)	Bend Matl	Flex.F In Pln	Flex.F Out Pln	In Pin SIF	Out Pln SIF	Axial SIF	Torsion SIF	lnt. Node	Angle (deg)	lnt. Node	Angle (deg)
1	20	12	Long												
2	40	18	User												

Editing in the Graphics Window

Another useful feature is the ability to edit an item in the graphics window. When an item such as a "Hanger" is clicked in the graphics window, a dialog box for that item is opened, where it can be modified.



Save the model by clicking on the Save button.												
*** Caepipe : Layout (11) - [Untitled] -												×
File	Edit	View (Options Lo	oads Misc	Window	Help						
) 🖻		4			<u>i</u>	2					
#	Node	Typ <mark>Sav</mark>	/e)X (ft'in")	DY (ft'in")	DZ (ft'in")	Matl	Sect	Load	Data			
1	Title =	Sample	Problem									
2	10	From							Anchor			
3	20	Bend	9'0"			A53	8	1				
4	30				6'0"	A53	8	1	Hanger			
5	40	Bend			6'0"	A53	8	1				
6	50			-6'0"		A53	8	1	Anchor			
7	6" std p	oipe										
8	30	From										
9	60		6'0"			A53	6	1				
10	70	Valve	2'0"			A53	6	1				
11	80		6'0"			A53	6	1	Anchor			
12												
<u> </u>												

The "Save Model As" dialog is shown.

⊫⊪ Save Mo	del As			×
Save in: 🚞	CAEPIPE	•	🗢 🗈 💣 🛽	
Name		^	Status	Date mod
	١	No items match your search	n.	
File name:	Sample			Save
Save as type:	Model files ((*.mod)	• (Cancel

Type the File name as "Sample" and press Enter to save the model. We are done with modelling. Let us analyze now.

6. Analyze

Click on "Analyze" under the File menu.

1-0-1 (-II- Caepipe : Layout (11) - [Sample.mod (C:\Users\venum\OneDrive\Desktop\ — 🛛 🗙								
<u>F</u> ile	Edit View Options Loads New Open	<u>Misc</u> <u>Wi</u> Ctrl+N Ctrl+O	ndow] É		2				
	Recent <u>M</u> odels Open <u>R</u> esults	>	(ft'in")	Matl	Sect	Load	Data		
	Merge <u>C</u> lose	Ctrl+M		A53	8	1	Anchor		
	<u>S</u> ave	Ctrl+S		A53 A53	8 8	1 1	Hanger		
	Save <u>A</u> s <u>E</u> xport to MBF			A53	8	1	Anchor		
	Export to 3 <u>D</u> Plant Design Export to PC <u>F</u>			453	6	1			
_	Print Model	Ctrl+P		A53	6	1	á a shi sa		
	QA Block Revision Record			A53	6		Anchor		
	<u>Revision Record</u>	Alt+F4							

Analyze	
Original bandwidth = 30 New bandwidth = 18 Average bandwidth = 12	Number of equations = 60 Stiffness matrix size = 714 = 6 K
Do you want Yes	to see the results ?
Time = 0	

After the analysis, you are asked if you want to see the results. Select "Yes".

7. View Results

After finishing the analysis and choosing to see the results or by opening the results file (.res), the results window is displayed. The "Results" dialog is opened automatically.

Results >							
 Sorted stresses 	C Support loads						
Code compliance	C Element forces						
C Hanger report	C Displacements						
C Support load summary							
OK Cancel]						

	Ŷ	
--	---	--

Select an item of interest by clicking on it. When you are viewing the results, use Tab (or "Next Result" button) to view the next result and "Shift+Tab" (or "Previous Result" button) to view the previous result. The "Results" dialog can be brought up by clicking on the "Results" button (or press "Ctrl+R").

While viewing the results, the model data can also be simultaneously viewed in separate "Layout" and "List" windows. These are now "read only" windows, i.e. the model data cannot be modified while viewing the results. Some of the results from the sample problem are shown below:

Sorted Stresses

The computed stresses ("sustained", "expansion" and "occasional") are sorted in descending order by stress ratios.

101	📲 Caepipe : B31.3 (2022) Code compliance (Sorted stresses) — 🗆 🗙										
File	File Results View Options Window Help										
4	🚑 于 🗐 🗊 🎕 😫 🖨 🔿 🖪 🕺										
	Sustained Expansion										
#	Node	SL (psi)	SH (psi)	SL SH	Node	SE (psi)	SA (psi)	<u>SE</u> SA			
1	80	2390	17900	0.13	30	53621	29475	1.82			
2	60	2057	17900	0.11	50	51187	29475	1.74			
3	70	1985	17900	0.11	20A	48316	29475	1.64			
4	30	1887	17900	0.11	20B	34161	29475	1.16			
5	10	1300	17900	0.07	10	32551	29475	1.10			
6	40B	908	17900	0.05	80	27453	29475	0.93			
7	20B	835	17900	0.05	40A	19081	29475	0.65			
8	20A	795	17900	0.04	60	17711	29475	0.60			
9	50	777	17900	0.04	70	11985	29475	0.41			
10	40A	758	17900	0.04	40B	10378	29475	0.35			

When the stress ratio exceeds 1.00, the stress and the stress ratio are shown in red. In this particular case, the high thermal stresses may be reduced by replacing the anchor at "Node" 80 by a guide. This allows the 6" pipe to expand more freely and reduce the thermal stresses. The maximum thermal stress is reduced to 22784 psi and the stress ratio is reduced to 0.77.

S

Color coded stresses may be rendered in the graphics window by pressing the "Show Stresses" button (or choose "View > Show Stresses"). The stresses in the highlighted columns (the bar highlights three columns simultaneously) are displayed in the graphics window. Use the left and right arrow keys to change the highlighted column or click in a particular column.



The stress ratios may similarly be rendered by using the "Show Stress Ratios" button (or choose "View > Show Stress Ratios").

Instead of rendering color coded stresses/ratios, the values of stresses/stress ratios may be plotted by using the menu: "View > No color coding".



While plotting stresses or stress ratios, thresholds may be specified (choose "View > Thresholds"). Only the stresses or stress ratios exceeding the thresholds are plotted.

Thresholds	×
Stress threshold Ratio threshold	(psi)
OK Cancel	

Code compliance

The element stresses and stress ratios calculated according to the piping code are shown under "Code Compliance". Design pressure and CAEPIPE calculated "Allowable pressures" are shown in 2nd column.

-0-1	📲 Caepipe : B31.3 (2022) Code Compliance - [Sample.res (C:\ — 🗆 🗙									
File	File Results View Options Window Help									
4										
		Press.	S	ustaine	4	Ex	pansior	1		
#	Node	Allow. (psi)	SL (psi)	SH (psi)	SL SH	SE (psi)	SA (psi)	<u>SE</u> SA		
1	10 20A	250 1386	1300 788	17900 17900	0.07 0.04	32551 28464	29475 29475	1.10 0.97		
2	20A 20B	250 1386	795 835	17900 17900	0.04 0.05	48316 34161	29475 29475	1.64 1.16		
3	20B 30	250 1386	822 1622	17900 17900	0.05 0.09	19856 53621	29475 29475	0.67 1.82		
4	30 40A	250 1386	1614 758	17900 17900	0.09 0.04	<mark>48188</mark> 15951	29475 29475	<mark>1.63</mark> 0.54		
5	40A 40B	250 1386	758 908	17900 17900	0.04 0.05	19081 10378	29475 29475	0.65 0.35		
6	40B 50	250 1386	907 777	17900 17900	0.05 0.04	9311 51187	29475 29475	0.32 1.74		
7	30 60	250 997	1887 2057	17900 17900	0.11 0.11	<mark>37900</mark> 17711	29475 29475	<mark>1.29</mark> 0.60		
8	70 80	250 997	1985 2390	17900 17900	0.11 0.13	11985 27453	29475 29475	0.41 0.93		

Hanger report

The hanger report is shown below.

HIH	💵 Caepipe : Hanger Report - [Sample.res (C:\Users\venum\OneDri — 🛛 🛛 🛛											
File	File Results View Options Window Help											
4	<i>⊕</i> ≡ ≡ ™ № ♦ →											
#	Node	No of	Туре	Figure No.	Size	Spring rate (lb/inch)	Vert travel (inch)	Horz tra∨el (inch)	Hot Ioad (Ib)	Cold Ioad (lb)	Var (%)	
1	30	1	Grinnell	B-268	10	260	0.606	0.618	1287	1445	12	

The "No of" field shows the number of hangers required at the indicated location. The "Figure No." and "Size" refer to the manufacturer's catalog. The vertical travel (also referred to as "Hanger travel") is the vertical deflection at the hanger location for the first operating load case. Similarly, the horizontal travel is the resultant horizontal deflection at the hanger location for the first operating load case. The hot load is the hanger load at the operating condition and the cold load is the hanger load at zero deflection.

Variability (%) = (Spring rate \times Hanger travel / Hot load) \times 100

Support load summary

"Support load summary" for each support is created by considering all the load cases and appropriate combinations and then showing the maximum and minimum loads.

•0• Caepipe : Suppor	rt load sumr	nary for and	hor at node	10 - [Samp	ole.res	- 0	×
File Results View	Options	Window	Help				
4 • •		<u>ê</u> (Q		<- →			>
Load combination	FX (lb)	FY (lb)	FZ (lb)	MX (ft-lb)	MY (ft-lb)	MZ (ft-lb)	
Empty Weight	9	-181	58	-331	-374	-43	
Sustained	-14	-397	26	-375	-174	-1157	
Operating1	-29058	1469	-13979	-6927	58803	16363	
Maximum	9	1469	58	-331	58803	16363	
Minimum	-29058	-397	-13979	-6927	-374	-1157	
Allowables	0	0	0	0	0	0	



Use the "Other supports" button (F6), "Next support" button ("Ctrl+Right arrow") or "Previous support" button ("Ctrl+Left arrow") to see loads on other supports (e.g. other

anchors, hangers etc.).

Support load summary $ imes$							
Node	Туре						
10	Anchor						
50	Anchor						
80	Anchor						
30	Hanger						
OK Cancel							

Support loads

Support loads are the loads acting on the supports by the piping system for the selected load case. The loads on anchors for the "Sustained" case are shown below.

-0-1	•I+ Caepipe : Loads on Anchors: Sustained (W+P) - [Sample.res (C:\Users\venum\OneDrive\D — □ ×									
File	File Results View Options Window Help									
4										
#	Node	Tag	FX (lb)	FY (lb)	FZ (lb)	MX (ft-lb)	MY (ft-lb)	MZ (ft-lb)	Next load case	
1	10		-14	-397	26	-375	-174	-1157		
2	50		-42	-201	-27	126	107	-89		
3	80		56	-378	1	-23	17	966		



Use the "Load cases" button, "Next load case" button ("Right arrow") or "Previous load case" button ("Left arrow") to see loads for different load cases (e.g. Sustained,

Expansion etc.).



Use the "Other Supports" button (F6), "Next support" button ("Ctrl+Right arrow") or "Previous support" button ("Ctrl+Left arrow") to see loads on other supports (e.g. other anchors, hangers etc.).

Other Supports $ imes$							
Anchors							
C Hangers							
ОК	Cancel						

For example, the loads on hangers (i.e. the loads acting at the hanger locations imposed by the piping system) for the "Expansion" case are shown below.

-0-1	Caepipe	e : Load	ls on Hang	jers: Sustain	ed (W+I	P) - [Sample	e.res (C:\Users\venum\OneDrive\Desktop — 🛛 🗙	
File	Result	s Vie	w Optio	ns Windo	w Help	0		
Æ	3 -			iði (2 [II (=	$ \Rightarrow \equiv \Leftarrow \Rightarrow \equiv \Leftarrow \Rightarrow $	
#	Node	Tag	Туре	Load (lb)	No.of	Total (lb)	Next suppo	ort
1	30		Grinnell	-1443	1	-1443		

Element Forces

For pipe (also bend and reducer), element forces in local coordinates, "Stress Intensification Factors" (SIF), "Flexibility Factors" (FF) and stresses are shown by default for the selected load case.

H	Caepip	e : Pipe for	ces in local	coordinat	es: Expansio	on (T1) - [S	ample.res (C:\Users\ve	enum\One[)rive\Deskt	op\CA	EPIPE_	Futoria	–)	×
File	Result	ts View	Options	Window	Help												
4	3 -			<u>ê</u> (Q		<	⇒∣≡] (- -	\rightarrow	•	\Rightarrow	1	i →				
#	Node	Axial	y Shear	z Shear	Torsio	n(ft-lb)	Inplan	e(ft-lb)	Outpla	ne(ft-lb)	Fle:	x. Fac	Global	Forces	SA	SE	
		(lb)	(lb)	(lb)	Moment	SIF	Moment	SIF	Moment	SIF	FFi	FFo	FFt	(psi)	(psi)	SA	
1	10 20A	-29044 -29044	1866 1866	-14005 -14005	-6552 -6552		17520 2594		58976 -53065					32551 28464	30000 30000	5.21 4.55	
2	20A 20B	-29044 -14005	-14005 29044	-1866 -1866	-6552 728	1.00 1.00	53065 38026	1.77 1.77	2594 4686	1.47 1.47	4.54 4.54	4.54 4.54		48316 34161	30000 30000	7.73 5.47	
3	20B 30	-1 4005 -1 4005	1866 1866	29044 29044	728 728		4686 -4643		-38026 107193					19856 53621	30000 30000	3.18 8.58	
4	30 40A	-12750 -12750	4100 4100	-18031 -18031	17445 17445		-3066 -21514		94791 13653					48188 15951	30000 30000	7.71 2.55	
5	40A 40B	-12750 -4100	-4100 12750	18031 18031	17445 13394	1.00 1.00	21514 8538	1.35 1.35	-13653 9601	1.12 1.12	3.03 3.03	3.03 3.03		19081 10378	30000 30000	3.05 1.66	
6	40B 50	-4100 -4100	-18031 -18031	12750 12750	13394 13394		9601 90740		-8538 48839					9311 51187	30000 30000	1.49 8.19	
7	30 60	-47075 -47075	-2077 -2077	-1255 -1255	1577 1577		-16717 -4253		12401 4873					37900 17711	30000 30000	6.06 2.83	
8	70 80	-47075 -47075	-2077 -2077	-1255 -1255	1577 1577		-98 12366		2364 -5165					11985 27453	30000 30000	1.92 4.39	

†G Use the "Global Forces" button (F7) to see the element forces in global coordinates.

HIH	Caepipe	e : Pipe fo	rces in glo	bal coord	inates: Exp	pansion (T	1) - [Samj	ple.res (C:\Users\venum\OneDrive\Desktop\CAEPIPE_Tutor — 🛛	×
File	Result	ts View	Options	Windov	v Help				
4	3 🗖			6	2 🗄	=) 🗲			
#	Node	FX	FY	FZ	МΧ	MY	MZ	Local Forces	
		(lb)	(lb)	(lb)	(ft-lb)	(ft-lb)	(ft-lb)		
1	10 20A	29044 -29044	-1866 1866	14005 -14005	6552 -6552	-58976 -53065	-17520 2594		
2	20A 20B	29044 -29044	-1866 1866	14005 -14005	6552 -4686	53065 -38026	-2594 728		
3	20B 30	29044 -29044	-1866 1866	14005 -14005	4686 4643	38026 107193	-728 728		
4	30 40A	-18031 18031	-4100 4100	12750 -12750	-3066 21514	-94791 13653	-17445 17445		
5	40A 40B	-18031 18031	-4100 4100	12750 -12750	-21514 8538	-13653 -13394	-17445 -9601		
6	40B 50	-18031 18031	-4100 4100	12750 -12750	-8538 -48839	13394 -13394	9601 -90740		
7	30 60	47075 -47075	2077 -2077	1255 -1255	-1577 1577	-12401 4873	16717 -4253		
8	70 80	47075 -47075	2077 -2077	1255 -1255	-1577 1577	-2364 -5165	98 12366		



Use the "Local Forces" button (F7) to see the element forces in local coordinates.



Use the "Other Forces" button (F6), "Next Force" button ("Ctrl+Right arrow") or "Previous Force" button ("Ctrl+Left arrow") to see other element forces (e.g. valves,

bellows etc.).



-0-1	Caepipe	e : Other	forces in	global co	ordinates	: Expansi	on (T1) -	[Sample.r	es (C:\Users\venum\OneDrive\Desktop\CAEPIPE_Tut	-	×
File	ile Results View Options Window Help										
4	3 -			tôt	Q		╞╺╡		$\blacksquare \Longleftrightarrow \blacksquare \diamondsuit \diamondsuit \diamondsuit$		
#	Node	Туре	FX (lb)	FY (lb)	FZ (lb)	MX (ft-lb)	MY (ft-lb)	MZ (ft-lb)			
1	60 70	Valve	47075 -47075	2077 -2077	1255 -1255	-1577 1577	-4873 2364	4253 -98			

Displacements

The nodal displacements are shown.

1=0=1	Caepipe	e : Displacen	nents: Expar	sion (T1) -	[Sample.res	(C:\Users\ve	num\OneDr	ive\Desktop	\CAEPIF	PE_Tutorial.		D	\times
File	Result	ts View (Options W	/indow He	lp								
4	3 🕂			ð 🔍	E 🕻	■ 🚽					$\triangleright \mid \blacksquare$	A	
#			٢	Displaceme	ents (globa	I)							
	Node	X (inch)	Y (inch)	Z (inch)	XX (deg)	YY (deg)	ZZ (deg)						
1	10	0.000	0.000	0.000	0.0000	0.0000	0.0000						
2	20A	0.369	0.226	-0.403	-0.1809	0.0628	0.2136						
3	20B	0.290	0.322	-0.291	-0.2555	-0.9104	0.2589						
4	30	-0.615	0.602	-0.058	-0.2558	-0.4514	0.2714						
5	40A	-0.646	0.794	0.152	-0.1090	0.1963	0.5423						
6	40B	-0.372	0.711	0.177	0.2407	0.2080	0.5994						
7	50	0.000	0.500	0.000	0.0000	0.0000	0.0001						
8	60	-0.354	0.466	0.135	-0.1331	0.0654	-0.3559						
9	70	-0.262	0.313	0.103	-0.1227	0.0838	-0.3670						
10	80	0.000	0.000	0.000	0.0000	0.0000	0.0000						



Use the "Load Cases" button, "Next load case" button (Right arrow) or "Previous load case" button (Left arrow) to see displacements for different load cases (e.g. Sustained,

Expansion etc.).



Use the "Deflected shape" button (or "View > Show deflected shape") to plot the deflected shape in the graphics window.



Use the "Animated deflected shape" button (or "View > Show animated deflected shape") to plot the animated deflected shape in the graphics window.



Choose "View > Magnification" to change the magnification of the deflected shape.

Magnification			×
Deflection mag	nification 14		
ОК	Cancel	Apply	Reset

The reset button is used to calculate a default magnification factor which scales the maximum deflection to about 5% of the width of the graphics window.



Use the "Other displacements" button (F6), "Next displacement" button ("Ctrl+Right arrow") or "Previous displacement" button ("Ctrl+Left arrow") to see other displacements (e.g. Min/Max, displacements at hangers, flex joints, limit stops etc.).



The minimum and maximum displacements for each of the directions and the corresponding nodes are shown below.

💷 Caepip	e : Minimum	& Maximum	Displacemen	its: Expansio	n (T1) -	[Sample.	res (C:\Use	:r	-		×
File Resu	lts View (Options Wir	ndow Help								
a) 🔍 🛙	∃ 🔶	\Rightarrow		- -			$\langle \neg$	⇒
Direction	Туре	Value	Node								
×	Minimum	-0.646	40A								
(inch)	Maximum	0.369	20A								
Y	Minimum	0.000	10								
(inch)	Maximum	0.794	40A								
Z	Minimum	-0.403	20A								
(inch)	Maximum	0.177	40B								
\times	Minimum	-0.2558	30								
(deg)	Maximum	0.2407	40B								
YY	Minimum	-0.9104	20B								
(deg)	Maximum	0.2080	40B								
ZZ	Minimum	-0.3670	70								
(deg)	Maximum	0.5994	40B								

The displacements at hanger nodes are shown below.

	Caepipe	: Displacemen	nts at Hangers:	Expansion (T1)) - [Sample.res	; (C:\Users\ven	um\One	- 0	×
File	Results	s View Opt	tions Window	v Help					
	3 +		1 6	\ E				ļ (\Rightarrow
#	Node	X (inch)	Y (inch)	Z (inch)	XX (deg)	YY (deg)	ZZ (deg)		
1	30	-0.615	0.602	-0.058	-0.2558	-0.4514	0.2714		

Print



To print results and model data, click on the Print button (or press Ctrl+P). In the "Print Results" dialog, the items to print can be selected.

Print Results	?	×
Model Load cases Results Misc F	Printer	
 ✓ Q.A.Block ✓ Layout ✓ Rev. Record ✓ Details ✓ Options ✓ Coordinates 	✓ Materials✓ Sections✓ Loads	
Print Cancel Preview To File	All	None

You can also print to a text file by using the "To File" button.

A preview of the printed output can be seen by using the "Preview" button.

The printing options such as choice of printer, margins, portrait or landscape and font can be set on the Printer tab.

Print Results	?	×
Model Load cases Results Misc Printer		
Text Printer		
Printer setup Microsoft Print to PDF		
Page setup Orientation : Landscape		
Font Arial, 10 point		
Print Cancel Preview To File All	N	one

The sample problem report is shown next. Observe that for sorted stresses and code compliance, when the stress ratio exceeds 1.00, the stress and the stress ratio are shown in white letters on black background.

This is the end of the tutorial. If you have questions or comments, please email them to:

support@sstusa.com.

Caepipe		Sample Problem		
	Qu	ality Assurance Block		
		Caenine		
		Version 12 10		
		VEISION 12.10		
Clien				
Proje	ct :			
File N	umber :			
Repo	rt Number :			
Mode	I Name sami	hle		
Title	· Sam	ale Problem		
	. Jam			
Analy	zea : Inu	Jan 11 10:54:26 2024		
Prepa	red by :		_ Date:	
Chec	ked by :		_ Date:	
Version 12.10		sample		Jan 11,2024

	Sample Problem	Pa
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Analysis options		1
Lavout		1
Details		1
Anchors		1
Bends		1
Hangers		1
Specified displacements		
Valves		1
Coordinates		2
Pipe materials		2
Pipe sections		2
Pipe loads		2
Sorted stresses		- 2
Code compliance		2
		3
Hanger report		3
Support load summary		3
Anchor at Node 10		3
Anchor at Node 50		
Hanger at Node 30		4
Load case = Empty Weight (W)		1
Loads on anchors		4
Loads on hangers		4
Pipe forces (local coordinates)		4
Other forces (local coordinates)		4
Pipe forces (global coordinates)		
Other forces (global coordinates)		5
Displacements		
Load case = Sustained (W+P)		5
Loads on anchors		
Loads on hangers		5
Other forces (local coordinates)		5
Pine forces (global coordinates)		6
Other forces (global coordinates)		6
Displacements		6
Load case = Expansion (T1)		6
Loads on anchors		6
Loads on hangers		6
Pipe forces (local coordinates)		
Other forces (local coordinates)		7
Pipe forces (global coordinates)		7
Other forces (global coordinates)		7
Displacements		7
Load case = Operating (W+P1+11)		
Loads on hangers		8
Pine forces (local coordinates)		8
Other forces (local coordinates)		8
Pipe forces (global coordinates)		8
Other forces (global coordinates)		8
Displacements		9
Weight & Center of gravity		9
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Version 12.10

sample

Jan 11,2024

Ca	epip	e										Sa	mp	le Pi	robler	n							Pa	ige 1
												An	aly	sis C	Option	s								
С	ode		:	Piping c Include Do not i Use B3	ode = axial use lit	= B31 force beral a SIFs	3 (20 in str allow and	022) ress calc able stre Flexibility	ulatio sses / Fac	ons ctors														
Т	empe	eratu	ire :	Referer Number Number Therma Use mo	r of th r of th r of th I = Op dulus	mpera iermal iermal peratii s at rel	ature cyclo load ng - S eren	= 70 (F) es = 700 s = 1 Sustained ce tempo	0 d eratu	ire														
P	ressi	ure	:	Pressur Peak pr Do not i Do not i	e stre essur nclud use pr	ess = re fact le Bou ressui	Pd^2 or = irdon e coi	2 / (D^2 - 1.00 effect rrection f	d^2) for be	ends														
D	ynan	nics	:	Cut off I Number Include Do not i	freque r of m missi use fr	ency = iodes ing ma riction	: 33 H = 20 ass ci in dy	Hz orrection mamic ar	halys	sis														
M	isc.		:	Include Vertical	hang direc	er stif	fness Y	3																
													Lay	/out	(11)									
#	Nod	le T	ype	DX (ft'ir	ים ("ו	Y (ft'in	") D	Z (ft'in")	Matl	Sec	t Loa	d Dat	a		. ,									
1	Title	e = S	ampl	e Proble	em																			
2	10	F	rom									Anc	hor											
3	20	B	end	9'0"	_				A53	8	1													
4	30	-			_		6'	0"	A53	8	1	Har	iger	-										
5	40	В	end		6	'O"	61	0"	A53	8	1	400	hor											
7	50 6" s	td ni	ne		-0	0			A33	0	11	And	nor											
8	30	F	rom																					
9	60			6'0"					A53	6	1													
10	70	V	alve	2'0"					A53	6	1													
11	80			6'0"					A53	6	1	Anc	hor	s										
													And	chors	s (3)									
No	de T	ag	KX/k	(KY/	ky	KZ/kz	K	XX/kxx	KY	Y/ky	/ K	ZZ/kzz			Relea	ses	; ; /		Lev	vel Ta	ag			
10		1	(lb/ine	ch) (lb/i	nch)	(lb/ind	:h) (i	n-lb/deg) (in-	-lb/de	eg) (ir	n-lb/de	g))	XY	Z XX	(Y	Y ZZ	Anchor in	n					
10		_	Rigid	Rigi	d	Rigid	R	Rigid	Rig	gid	RI	gid	-	-		-		GCS	-					
80	-		Rigid	Rigi	id id	Rigid	R	Rigid	Rig	yia nid	Ri	igid	-	-				GCS			_			
00			Ngiu	rtig	u	Ttigiu	10	ligiu	1.16	Jiu		igiu	Be	ends	(2)			000	-					1
Be No	nd F de (i	Radiu inch)	us Ra) Ty	ad. Thk pe (inc	: Be h) Ma	end F atl Ir	lex.F 1 Pln	Flex.F Out Plr	In I SIF	Pln -	Out I SIF	PIn Ax SI	ial F	Tors SIF	sion I	nt. Node	An e (de	ngle Int. eg) Node	Angle (deg)	e)		 		
20	1	2	Lc	ng																				
40	1	8	Us	ser																				
No	de T	ag	Туре	No	Load	Shor	t Sp	ring rate	Loa	ad Lo	ad C	Node	Har Le	ngers vel T	s (1) ag									
				of	var%	rang	e (lb	/inch)	(lb)	Ty	/pe													
30			Grinn	ell 1	25						0	pecific	4 0	ienla		nte	(1)							
Nic	do T	-	1.	od V/-	linel	N MA	linet) 7/- /:-	ob)	VVI	5			ispia			(1)	Dian in						
50		ype			(inch	i) 1/y	UNC	1) Z/Z (in	cn)	~~/X	< (ueg	J) T Y/	yy ((ueg)	LLIZ	z (d	eg)	GCS						
0	1		T			0.5			-						-			GCS						
													Va	lves	(1)			<i>.</i>						
Fro	m T	o	Wei	ght Ler	ngth 1	Thick	Insul	Add.V	Vgt		Offse	ets of A	٨dd.	Wgt	1									
			(lb)	(inc	:h))	X	Wgt	X (lb)		DX (i	nch)	DY (in	ch)	DZ	(inch)									
60	7	0	200		3	3.00	1.75	50		0		18		0								 		
Ve	rsion	12.1	10										S	amp	le								 Jan 11,	2024

Caepi	ipe								Samp	e Proble	em		Page 2
									Coord	inates (1	2)		
Node	X (ft'in	n") Y (ft'in")	Z (ft'in")								
10	0	0	(0									
20A	8'0"	0	(0									
20	9'0"	0	(0									
20B	9'0"	0	2	1'0"	1								
30	9'0"	0	(6'0"									
40A	9'0"	0		10'6"	-								
40	9'0"	0		12'0"	-								
40B	9'0"	-1'6	5" ·	12'0"	-								
50	9'0"	-6'()"	12'0"	-								
60	15'0"	0	- (6'0"	-								
70	17'0"	0	(6'0"	-								
80	23'0"	0		6'0"	-								
00	200	U		00				Pine	material	A53: a5	3 ora	ide b	
Densi Yield	ity = 0.2 strenat	283 (lb h = 35)/in3), i000 (p	Nu = 0 si)	.300, J	oint fac	ctor = 1.00), Type =	CS		o gra		
Tensi	le strer	ngth =	60000	(psi)									
Temp	E	A	pha	Allowa	able								
(F)	(psi)	(ir	n/in/F)	(psi)									
-20	29.9E	+6 6.	25E-6	20000									
18	29.7E	+6 6.	31E-6	20000	E.								
70	29.4E	+6 6.	40E-6	20000	K.								
100	29.3E	+6 6.	47E-6	20000	l i								
200	28.8E	+6 6.	70E-6	20000	K.								
300	28.3E	+6 6.	90E-6	20000	K.								
400	27.4E	+6 7.	10E-6	19900) :								
500	27.3E	+6 7.	30E-6	19000	l.								
600	26.5E	+6 7.	40E-6	17900	K.								
650	26.0E	+6 7.	50E-6	17300	E C								
700	25.5E	+6 7.	60E-6	16700	l.								
750	24.9E	+6 7.	70E-6	13900	1								
800	24.2E	+6 7.	80E-6	11400	1								
850	23.4E	+6 7.	85E-6	8700									
900	22.5E	+6 7.	90E-6	5900									
950	21.5E	+6 8.	00E-6	4000									
1000	20.4E	+6 8.	10E-6	2500									
1050	19.2E	+6 8.	15E-6	1600									
1100	18.0E	+6 8.	20E-6	1000									
									Pipe S	ections	(2)		
Name	Nom	Sch	OD	Thk	Cor Al	M Tol	Ins Dens	Ins Thk	L in Dens	l in Th	k Soi	1	
carrie	Dia	2011	(inch)	(inch)	(inch)	(%)	(lb/ft3)	(inch)	(lb/ft3)	(inch)	001		
8	8"	80	8.625	0.5		. ,	15	2					
6	6"	STD	6.625	0.28			15	2				1	
									Pipe	Loads (1	l)		
Name		P1	Desa	Deso	Pr Sn	ecific	Add Wat	Wind	Wind	/ind M	/ind		
Hame	(F)	(psi)	(F)	(psi)	gra	avity	(lb/ft)	Load 1	Load 2 L	oad 3 L	oad 4	1	
1	600	200	800	250	0.8	3							
							B31	3 (2022)	Code co	mpliance	e (Soi	rted stresses)	
	Susta	ained			Expar	nsion							
	SL	SH	SL		SE	SA	SE						
Node	(psi)	(psi)	SH	Node	(psi)	(psi)	SA						
80	2390	17900	0.13	30	53621	29475	1.82						
60	2057	17900	0.11	50	51187	29475	1.74						
70	1985	17900	0.11	20A	48316	29475	1.64						
30	1887	17900	0.11	20B	34161	29475	1.16						
10	1300	17900	0.07	10	32551	29475	1.10						
		0											
versio	on 12.1	U							Si	ample			Jan 11,2024

Caepi	Caepipe Sample Problem Page 3												
								B3	1.3 (2	022) Co	ode	complian	ce (Sorted stresses)
	Sus	staine	b			Expar	nsion						
Mada	SL	SH		SL	Nede	SE	SA	SE					
Node	(psi) (psi) :	5H	Node	(psi)	(psi)	5A 0.02					
40B	900	179		0.05	40.0	10081	29475	0.95					
20D	795	179		0.05	60	17711	29475	0.60					
50	777	179		0.04	70	11985	29475	0.00					
40A	758	179	00 0	0.04	40B	10378	29475	0.35					
										B31.3 (202	22) Code (Compliance
	Pres	ss.	Su	staine	ed	E	pansio	n					
Node	Allo	w. SL	S	SH	SL	SE	SA	SE					
	(psi) (ps	si) (psi)	SH	(psi)	(psi)	SA					
10 20A	250	13 6 78	00 1 8 1	7900	0.07	32551	29475	1.10					
204	250	79	5 1	17900	0.04	48316	29475	1.64					
20B	138	6 83	5 1	7900	0.05	34161	29475	1.16					
20B	250	82	2 1	7900	0.05	19856	29475	0.67					
30	138	6 16	22 1	7900	0.09	53621	29475	1.82					
30	250	16	14 1	7900	0.09	48188	29475	1.63					
40A	138	6 75	8 1	7900	0.04	15951	29475	0.54					
40A 40B	250	6 90	8 1 8 1	17900	0.04	19081	29475	0.65					
40B	250	90	7 1	7900	0.05	9311	29475	0.32					
50	138	6 77	7 1	7900	0.04	51187	29475	1.74					
30	250	18	87 1	7900	0.11	37900	29475	1.29					
60	997	20	57 1	7900	0.11	17711	29475	0.60					
70	250	19	85 1	7900	0.11	11985	29475	0.41					
80	991	23	50 1	17900	0.15	21455	29475	0.95			H	anger Ren	ort
<u></u>			1			Spring	Vert	Horz	Hot	Cold			
Node	No	Туре	F	igure	Size	rate	trave	travel	load	load	Va	r	
	of	_	N	lo.		(lb/inch	n) (inch	(inch)	(lb)	(lb)	(%))	
30	1	Grinn	ell B	8-268	10	260	0.606	6 0.618	1287	1445	12	. <u>.</u>	
			-						Suppo	rt load :	sum	imary for a	anchor at node 10
Load	comł	ninatio		X (lb)	EV	(lb)	E7 (lb)	MX	(ft_lb)	MV (ft_	ы	MZ (ft-lb)	
Empty	/We	iaht	9	7 (ID)	-18	81	58	-331	(11-10)	-374	10)	-43	
Susta	ined	igin	-1	4	-39	97	26	-375	5	-174		-1157	-
Opera	ting	1	-2	9058	14	69	-13979	-692	27	58803		16363	
Maxim	num		9		14	69	58	-331	l.	58803		16363	
Minim	um		-2	9058	-39	97	-13979	-692	27	-374		-1157	
Allowa	ables	5	0		0		0	0		0		0	
								5	Suppo	rt load :	sum	mary for a	anchor at node 50
Load	com	pinatio	n F)	X (lb)	FY	(lb)	FZ (lb)	MX	(ft-lb)	MY (ft-	lb)	MZ (ft-lb)	
Empty	We	ight	-2	23	33	04	-64	242		74	_	-88	-
Susta	inea tina	•	-4	2072	-20	201	-27	120	24	107	_	-89	
Maxin	num		-1	0073	33	301	12723	409	64 64	13501	_	90050	
Minim	um		-2	8073	-4	301	-64	126	04	74		-89	
Allowa	ables	:	0	0070	0	001	0	0		0		0	
7			1.				-	5	oqqu	rt load :	sum	mary for a	anchor at node 80
1													
Load	com	oinatio	n F	X (lb)	FY	′ (lb)	FZ (lb)	MX	(ft-lb)	MY (ft-	lb)	MZ (ft-lb)	
Empty	We	ight	14	4	-28	80	6	12		50		644	
Susta	ined		56	6	-3	78	1	-23		17		966	
Opera	ting	1	47	7130	16	99	1256	-160)1	5182		-11400	-
Maxim	num		47	7130	16	99	1256	12		5182		966	
Versic	on 12	2.10										sample	Jan 11,2024

Caepi	ре									Sa	mple Pro	blem				Pa	ige 4
									Suppo	rt load sur	mmary for	anchor	at nod	e 80			
Lood	oonahi	nation		16.)	EV.	(16)	F7 (AV (61 Ib)	MAX (# 16)	M7 /# 16						
Minim	um	nation	14	(0)	-378	(ID) B	Γ <u></u> (M (dl)	1601	17	-11400	<u>')</u>					
Allowa	ables		0		0	-	0	C)	0	0	-					
									Suppo	rt load sur	nmary for	hanger	at nod	e 30			
Dis	placer	ments (globa	al)													
Load	combi	nation	Load	d (lb)													
Empty	VVeig	ght	-144	1													
Opera	perating1 -1287																
Maxin	num		-128	7													
Minim	um		-144	3													
			-						Loa	ads on And	chors: Err	npty Weig	ght (W)			
Node	Tag	Fag FX (lb) FY (lb) FZ (lb) MX (ft-lb) MY (ft-lb) MZ (ft-lb) 0 181 52 331 374 43															
10		9	-1	181	5	08 64	-	331	-374	-43							
80		-23 14	-2	3 280	-	04 S	1	242 2	50	-00							
00		14	-	-00		,		2	Loa	ads on Har	ngers: Em	npty Wei	aht (W	')			
Node	Tag	Tvpe	Loa	ad (lb) No	o.of To	otal (I	lb)			3	1.3		,			
30	J	Grinne	II -14	41	1	-1	441										
								F	Pipe force	es in local	coordinat	es: Emp	y Wei	ght (V	/)		
Node	Axial	y S	Shear	z Sh	ear	Tor	sion((ft-lb)	Inplar	ne(ft-lb)	Outplar	ne(ft-lb)	Flex	k. Fac	tors		2
	(lb)	(lb))	(lb)		Mome	ent S	SIF	Moment	SIF	Moment	SIF	FFi	FFo	FFt		
10	9	-18	31 1	58	3	-331			-43		-374						
20A	9	58	1	-221		-331	1	00	-206	1 77	94 -206	1 47	4 54	4 54		-	
20B	58	-9		-300		-456	1	.00	-143	1.77	59	1.47	4.54	4.54			
20B	58	300	0	-9	2	-456			59		143						
30	58	552	2	-9		-456			-2072		97					-	
30 40A	64	-60	78	-23		225			126		-39						
40A	64	378	8	23		225	1	.00	-126	1.35	39	1.12	3.03	3.03		-	
40B	259	-64	L	23		74	1	.00	-532	1.35	-191	1.12	3.03	3.03		_	
40B	259	-23	3	-64	8	74 74			-191		532						
30	-14	-28	, 35	-6		-12	-		-681		33				-	-	
60	-14	-13	37	-6		-12			587		-2						
70	-14	13	2	-6		-12			592		-14						
80	-14	280	0	-0		-12		0	-044		-50	tos: Emr	ty Mc	iaht ()	M)		
		fy	fv	f-7		nv	mi			es in local	coordina	ιes. Επιβ	ty vve	igint (1	•)		
Node	Туре	(lb)	(lb)	(lb)) ((ft-lb)	(ft-lb)) (ft-lb)									
60	Valve	ə -14	-112	2 -6	-	·12	-2	612									
70		-14	107	-6	-	-12	-14	617				1 F	4 . 14/-	·	A/\		
Node	EV	EV	57			MAX	N.4-	7 P	ipe torce	s in global	coordina	ies: Emp	ty we	ignt (\	(V)		
node	(lb)	(lb)	(lb)	(f	t-lb)	(ft-lb) (ft-	-lb)									
10	-9	181	-58	3	31	374	43										
20A	9	221	58	-3	331	94	-20	06									
20A	-9	-221	-58	3	31	-94	20	6									
20B	-9	300	58	-5	a a	143	-45	00									
30	9	552	58	21	072	97	-45	56									
30	-23	604	-64	-2	2084	-64	-22	25									
40A	23	-378	64	-1	26	-39	22	:5									
Versio	n 12.	10									sample	1				Jan 11,2	2024

Caepi	ре								Sample P	oblem						Page 5
							Pipe fo	rces in g	lobal coordir	ates: Emp	pty We	ight (W)			
Node	FX	FY	FZ	MX	MY	MZ										
	(lb)	(lb)	(lb)	(ft-lb)) (ft-lb)	(ft-lb)										
40A	-23	378	-64	126	39	-225										
40B	23	-259	64	-532	-74	101										
40B	23	-33	-04 64	-242	-74	88										
30	14	285	6	12	-33	681										
60	-14	-137	-6	-12	-2	587										
70	14	-132	6	12	14	-592										
80	-14	280	-6	-12	-50	-644	Othor f	proos in c	lobal coordi	aataa: Em	nty M/	aight (14/1			
		FX	FY	FZ	MX M	Y MZ		nces in f		iales. Em	pty vvi	signi ((vv)			
Node	Туре	(lb)	(lb)	(lb)	(ft-lb) (ft-	lb) (ft-	b)									
60	Valve	14	112	6	12 2	-61	2									
70		-14	107	-6	-12 -14	4 61	7		11							
				<u>.</u>				Displac	cements: Em	pty Weigh	nt (W)					
Node	X (inc	h) V	(inch)	Jisplace	ements (g	Jobal)	(dea)	77 (doc)	-							
10	e X (inch) Y (inch) Z (inch) XX (deg) YY (deg) ZZ (deg)															
204	0.000 0.000 0.000 0.0000 0.0000 0.000 0.003 0.004 -0.0091 -0.0030 0.0031															
20R	-0.000 0.006 0.004 -0.0101 -0.0005 0.0001 0.000 0.013 0.004 0.0011 0.0072															
30	0.000	0.	013	0.004	0.00	19 0.	0011	-0.0078	-							
40A	0.001	0.	003	0.004	0.012	26 0.	0012	-0.0043	-							
40B	0.001	0.	000	0.002	0.004	46 0.	0011	-0.0017	-							
50	0.000	0.	000	0.000	0.000	0. 00	0000	0.0000	-							
60	0.000	-0	.005	0.002	0.00	10 0.	0020	-0.0062]							
70	0.000	-0	.006	0.001	0.000	0.	0019	-0.0028								
80	0.000	0.	000	0.000	0.000	0.00	0000	0.0000								
								Loads o	n Anchors: S	Sustained	(W+P))				
Node	Tag F	TX (lb)	FY	′ (lb)	FZ (lb)	MX (f	t-lb) MY	(ft-lb) M	Z (ft-lb)							
10	-	14	-39	97	26	-375	-17	4 -1	157							
50	-	42	-20	01	-27	126	107	-8	9							
80	5	56	-31	/8	1	-23	1/	96	56 		(14/- D)					
	-	-				. <i></i> .		Loads o	n Hangers: 3	Sustained	(VV+P)				
Node 30	Tag I	l ype Grinne	Loa	d (Ib) N 13 1	0.of 1 ota	il (Ib) 3										
00		5111110				0	Pipe	forces in	local coordir	ates: Sus	tained	(W+F))			
Node	Axial	v S	hear	z Shear	Torsic	on(ft-lb)	In	plane(ft-ll	a) Outpl	ane(ft-lb)	Fle	x. Fac	tors	SL		
	(lb)	(lb)		(lb)	Moment	SIF	Morr	ent SIF	Momer	t SIF	FFi	FFo	FFt	(psi)		
10	-14	-39	7	26	-375		-115	7	-174					1300		
20A	-14	13	2	26	-375		-100		35					788		
20A	-14	26		-132	-375	1.00	-35	1.77	-100	1.47	4.54	4.54		795		
20B	26	14		-236	-270	1.00	-75	1.77	177	1.47	4.54	4.54		835		
20B	20	230	7	14 14	-270		-183	1	144					822		
30	27	-55	0.	-42	339		-180	7	143				-	1614		
40A	27	-25	2 .	-42	339		-4	20	-44					758		
40A	27	25	2	42	339	1.00	4	1.35	44	1.12	3.03	3.03		758		
40B	96	-27	-	42	107	1.00	-249	1.35	-277	1.12	3.03	3.03		908		
40B	96	-42	·	-27	107		-277		249					907		
30	-201	-42	7	-27	23		-09		120					1887		
60	-56	-52	9	- 1 -1	23		730		-7					2057		
70	-56	170) .	-1	23		679		-10					1985		
80	-56	378	3.	-1	23		-966		-17					2390		
							10									
Versio	on 12.1	0							samn	le					Ja	an 11,2024
	1992 - 1955 - 1993 - 1993 - 1993 - 1993 - 1993 - 1993 - 1993 - 1993 - 1993 - 1993 - 1993 - 1993 - 1993 - 1993 -															

Caepi	pipe Sample Problem Page 6																		
							(Other forc	es in l	ocal coord	nates: S	ustaine	d (W+	P)					
Nada	T	fx	fy (III)	fz	mx	my	mz												
Node 60	Valve	(ID) -56	(ID) -94	(ID) -1	(IT-ID) 23	(III-ID) -7	(ft-lb) 755												
70	varve	-56	145	-1	23	-10	704												
							F	Pipe force	s in gl	obal coord	nates: S	ustaine	d (W+	P)					
Node	FX	FY	FZ	MX	MY	MZ	:												
10	(lb)	(lb)	(lb)	(ft-lb) (ft-lb) (ft-	b)												
20A	-14	132	-26	-375	35	-10	0												
20A	14	-132	-26	375	-35	100)												
20B	-14	236	26	-177	75	-27	0												
20B 30	14	-236 567	-26 26	177	-75	-27	0												
30	-42	550	-27	-180	7 -143	-33	9												
40A	42	-252	27	4	-44	339	9												
40A	-42	252	-27	-4	44	-33	9 7												
40B	-42	96	-27	249	107	-27	7												
50	42	201	27	-126	-107	89													
30	56	327	1	-23	-1	610	2												
70	-56	-119	1	-23	-7	-67	9												
80	-56	378	-1	23	-17	-96	6												
							С	ther force	es in gl	lobal coord	inates: S	Sustaine	ed (W	+P)					
Nada	T	FX	FY	FZ	MX	MY	MZ												
Node	Valve	(ID) 56	(ID) 94	(ID) 1	(π-ID) -23	(ftt-lb) 7	(π-ID)												
70	varve	-56	145	-1	23	-10	704												
								۵	Displac	ements: S	ustained	(W+P)							
]	Displac	ements	s (gloł	oal)												
Node	X (incl	1) Y ((inch)	Z (inc	h) Χλ	(deg) YY (deg) ZZ ((deg)										
20A	0.000	-0	008	0.000	-0	0104	-0.00	00 0.00	059										
20B	-0.000	-0.	007	0.002	-0	.0130	-0.00	004 -0.0	067										
30	0.000	0.0	004	0.002	-0	.0038	0.00	10 -0.0	114										
40A	0.002	0.0	002	0.002	0.0	0057	0.00	16 -0.0	061										
40B	0.001	0.0	000	0.001	0.0	0022	0.00	17 -0.0	022										
60	0.000	-0.	013	0.000	-0	.0020	0.00	0.00	016										
70	0.000	-0.	012	0.001	-0	.0018	0.00	08 0.00	024										
80	0.000	0.0	000	0.000	0.0	0000	0.00	0.00	000									 	
								Lo	oads o	n Anchors	Expansi	on (T1)						
Node	Tag F	X (lb)	FY	(lb)	FZ (lb)) N	IX (ft-lb) MY (ft-l	b) MZ	(ft-lb)									
10		19024	186	00	-14005	b -6	0552	13204	175	20									
80	4	7075	207	77	12750	-1	1577	5165	-12	366									
			20					Lc	ads o	n Hangers	Expansi	ion (T1)						
Node	Tag T	уре	Load	l (lb) N	o.of T	otal (I	b)											 	
30	G	Grinnel	157	1	15	57												 	
								Pipe for	ces in l	ocal coord	inates: E	xpansi	on (T1)					
Node	Axial	y SI	near z	shear	Tor	sion(ft-lb)	Inplan	e(ft-lb)	Outp	ane(ft-lb) Flo	ex. Fa	ctors	SE	SA	SE		
10	(ID)	(lb)	6	14005	Mome	ent S	IF	Moment	SIF	Mome	nt SIF	FFi	FFO	FFt	(psi)	(psi)	SA 1.00		
20A	-29044	+ 186 4 186	6 -	14005	-6552			2594		-53065	8			1	28464	30000	0.95		
20A	-29044	4 -140	005 -	1866	-6552	! 1.	00	53065	1.77	2594	1.47	4.54	4 4.54	•	48316	30000	1.61		
20B	-1400	5 290	44 -	1866	728	1.	00	38026	1.77	4686	1.47	4.54	4 4.54		34161	30000	1.14		
Versio	on 12.1	0								sam	le							Jan	11,2024

Caepi	aepipe Sample Problem Page 7																			
								Pipe f	orces i	n loca	al coordin	ates: Exp	ansio	n (T1))					
Node	Axial	y Shea	ar z Sh	ear	Torsio	n(ft-	lb)	Inpl	ane(ft-	lb)	Outpla	ne(ft-lb)	Flex	x. Fac	tors	SE	SA	SE		
005	(lb)	(lb)	(lb)	N	Moment	SIF		Mome	nt SIF		Moment	SIF	FFi	FFo	FFt	(psi)	(psi)	SA	•	
20B 30	-14005	1866	290	44 / 14 7	728 728			4686			-38026					19856	30000	0.66		
30	-12750	4100	-180	31 1	17445			-3066			94791				-	48188	30000	1.61	*	
40A	-12750	4100	-180	31 1	17445			-21514	4		13653					15951	30000	0.53		
40A	-12750	-4100	180	31 1	17445	1.0	C	21514	1.3	5	-13653	1.12	3.03	3.03		19081	30000	0.64		
40B	-4100	12750	180	31 1	13394	1.00	0	8538	1.3	5	9601	1.12	3.03	3.03		10378	30000	0.35		
40B	-4100	-18031	1 1273	50 1 50 1	13394			9601 90740			-8538					9311 51187	30000	0.31		
30	-47075	-2077	-125	5 1	1577			-1671	7		12401					37900	30000	1.26		
60	-47075	-2077	-125	5 1	1577			-4253			4873					17711	30000	0.59		
70	-47075	-2077	-125	5 1	1577			-98			2364		10			11985	30000	0.40		
80	-47075	-2077	-125	15	1577			12366 Other 1	forcos	in loc	-5165	atos: Ex	nansia	n /T1	\	27453	30000	0.92		
		fv I	fu	fz	my		mu		orces			Iales. EX	parisic	лі (і і)					
TXTYTZMXMYMZNodeType(lb)(lb)(lb)(ft-lb)(ft-lb)																				
60	Valve ·	47075 -	-2077	-125	55 157	7	4873	-42	53											
70	ŀ	47075	-2077	-125	55 157	7	2364	-98												
							1	Pipe fo	rces ir	n glob	bal coordii	nates: Ex	pansic	on (T1)					
Node	FX (lb)	FY (lb)	FZ (lb)	IV (f	/IX I ft-lb)	VIY ′ft₌lh) (f	Z -lb)												
10	29044	-1866	1400	05 6	552 -	-589	76 -1	7520												
20A	29044 -1866 14005 6552 -5897 -29044 1866 -14005 -6552 -5306							594												
20A	29044	29044 1866 -14005 -0552 -550 9044 -1866 14005 6552 5306 29044 1866 -14005 -4686 -3803						594												
208	-29044	90441866-14005-4686-3802044-18661400546863802				26 7	28													
30	-29044	1866	-1400	05 4	643	1071	93 72	28												
30	-18031	14 1866 -14005 4643 107193 31 -4100 12750 -3066 -94791		91 -1	7445															
40A	18031	4100	-127	50 2	1514	1365	3 1	7445												
40A 40B	-18031	-4100 4100	1275	50 -2	21514 -	136	53 -1 94 -0	7445												
40B	-18031	-4100	1275	50 -8	8538	1339	4 90	501												
50	18031	4100	-127	50 -4	48839 -	133	94 -9	0740												
30	47075	2077	1255	5 -1	1577 -	124	01 10	6717												
70	47075	-2077	125	5 1	1577	+073	-4 1 Q1	253												
80	-47075	-2077	-125	5 1	577 -	-516	5 12	2366												
	5.		di.				C	ther fo	orces i	n glol	bal coordi	nates: Ex	pansi	on (T	1)					
		FX I	FY	FZ	MX		MY	MZ												
Node	Type	(lb) ((lb)	(lb)	(ft-lk)	(ft-lb)	(ft-lt))											
60 70	Valve .	47075	-2077	-125	5 -157	7	-4873 2364	-98	3											
	I						- /		Disp	lacer	ments: Ex	pansion ((T1)							
			Disp	lacen	ments (g	loba	I)													
Node	X (inch) Y (inc	ch) Z	(inch)) XX (c	leg)	YY (c	eg) Z	Z (deg)										
10	0.000	0.000) 0.	000	0.000	00	0.000	0 0	.0000	_										
20A	0.369	0.226	o -0	.403	-0.18	09	0.062	8 0	2136	_										
208	0.290	0.322	2 -0	.291	-0.25	55 58	-0.91	14 0.	2714	_										
40A	-0.646	0.794	0 - 0.	152	-0.10	90	0.196	3 0	5423											
40B	-0.372	0.711	0.	177	0.240)7	0.208	0 0	5994											
50	0.000	0.500	0.	000	0.000	00	0.000	0 0	.0001											
60	-0.354	0.466	6 0.	135	-0.13	31	0.065	4 -0	.3559											
70	-0.262	0.313	3 O.	103	-0.12	27	0.083	8 -0	0.3670	_										
80	0.000	0.000	0.	000	0.000	0	0.000	0 0.	0000											
Vereir	n 12 10	1									comple	•							lon	11 2024
veisit	11 12.10										sample	, ,							Jan	11,2024

Caepi	pe								Sa	ample Pro	oblem						Page 8
								Loads	on Anch	nors: Ope	rating (W	'+P1+1	Г1)				
Node	Tag F	X (lb)	FY (lb)	FZ	(lb)	MX	(ft-lb)) MY (ft-lb) MZ (ft	-lb)							
10	-2	29058	1469	-13	3979	-69	27	58803	16363	3							
50	-1	8073	-4301	12	723	489	964 01	13501	90650)							
80	4	/ 130	1099	12:	50	-10	01	Loads	on Hand	u ners: One	rating (M	+P1+	T1)				
Node	Tag T	VNO	Load (lh	Noo	f Tota	al (lb)		LUdus	on nang	gers. Ope	rating (w		• •)				
30	G	rinnell	-1287	1	-128	37											
					-		Pip	e forces i	n local co	oordinate	s: Operat	ing (W	/+P1+	T1)			
Node	Axial	y She	ear z Sh	ear	Torsic	on(ft-	lb)	Inplane	e(ft-lb)	Outpla	ne(ft-lb)	Flex	x. Fac	tors	Sopr		
	(lb)	(lb)	(lb)	M	oment	t SIF	:	Moment	SIF	Moment	SIF	FFi	FFo	FFt	(psi)		
10	-29058	1469	-139	79 -6	927			16363		58803					31622		
20A	2006 -29058 -13979 -1998 -6927 1.00 53030 1.77 2494 1.47 4.54 4.54 27757																
20B	2008 -13979 29058 -2102 458 1.00 37951 1.77 4863 1.47 4.54 4.54 19111																
20B	-13979	2102	2905	58 45	58			4863		-37951					19111		
30	-13978	3550	-180	08 45 73 17	08 7785	-		-6474		94935					47617		
40A	-12723	3848	-180	73 17	7785			-21518		13608					15434		
40A	-12723	-3848	B 1807	73 17	7785	1.0	0	21518	1.35	-13608	1.12	3.03	3.03		15434		
40B	-4003	1272	3 1807	73 13	3501	1.0	0	8290	1.35	9324	1.12	3.03	3.03	2	9276		
40B 50	-4003	-1807	73 1272	23 13	3501			9324 90650		-8290					9276 51241		
30	-47130	-2404	4 -125	6 16	501			-17327		12402					37574		
60 -47130 -2197 -1256 1601 -3523 4866 16054 70 -47130 -1907 -1256 1601 581 2354 11067																	
70 -47130 -1907 -1256 1601 581 2354 80 -47130 -1699 -1256 1601 11400 -5182													11067				
		1000				-	Oth	er forces	in local c	coordinate	s: Opera	ting (V	V+P1+	+T1)	20100		
		fx	fy	fz	mx		my	mz			•						
Node	Туре	(lb)	(lb)	(lb)	(ft-l	b)	(ft-lb)	(ft-lb)									
60	Valve	-47130	-2172	-1256	5 160 5 160	01	4866	-3498									
10		-17100	1002	1200			Pipe	e forces in	alobal o	coordinate	es: Opera	itina (V	V+P1-	+T1)			
Node	FX	FY	FZ	M>	x	MY	M	IZ	5			5.					
	(lb)	(lb)	(lb)	(ft-	-lb)	(ft-lb) (f	t-lb)									
10	29058	-1469	9 1397	9 69	27	-588	03 -1	6363									
20A	-29058	-1998	-139	9 69	927	-530	30 24	494									
20B	-29058	2102	-139	79 -48	863	-379	51 4	58									
20B	29058	-2102	2 1397	9 48	63	3795	51 -4	158									
30	-29058	3 2433	-139	79 64	74	1073	337 4	58									
40A	18073	3848	-1272	23 21	518	1360	35 - 1)8 1	7785									
40A	-18073	-3848	3 1272	3 -21	1518	-136	08 -1	17785									
40B	18073	4003	-127	23 82	90	-135	01 -9	0324									
40B 50	-18073	4301	-1272	3 -82 23 -48	290 8964	-1350	01 -9	324 90650									
30	47130	2404	1256	-16	601	-124	02 1	7327									
60	-47130	-2197	7 -125	6 16	01	4866	3 -3	3523									
70	47130	1907	1256	-16	501 01	-235	4 -5	581 1400									
00	41100	1008	120		51	010	Othe	er forces i	n global	coordinate	es: Opera	ating (\	W+P1	+T1)			
-		FX	FY	FZ	MX		MY	MZ				3 (,			
Node	Туре	(lb)	(lb)	(lb)	(ft-I	b)	(ft-lb)	(ft-lb)									
60 70	Valve	47130	2172	1256	-16	01	-4866	3498 606									
10		-1150	-1352	-1200	100	/1	2004	000									
Versio	on 12.10)								sample	Э						Jan 11,2024
-																	

Displacements: Operating (W+P1+T1)
Displacements (global)
10 0.000 0.000 0.000 0.00000 0.00000 0.00000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.000000
20A 0.369 0.217 -0.402 -0.1912 0.0613 0.2077
20B 0.290 0.315 -0.289 -0.2685 -0.9108 0.2522
30 -0.615 0.606 -0.056 -0.2596 -0.4504 0.2601
40A -0.645 0.796 0.154 -0.1033 0.1979 0.5362
40B -0.371 0.711 0.178 0.2430 0.2097 0.5972
50 0.000 0.500 0.000 0.0000 0.0000 0.0001
$\begin{array}{cccccccccccccccccccccccccccccccccccc$
80 0.000 0.000 0.000 0.0000 0.0000
Weight & Center of gravity
Empty weight = 1551.2 //b)
Empty weight = 1551.2 (ib) Insulation weight = 267.8 (ib)
Content weight = 550.32 (lb)
Lining weight = 0 (lb) Additional weight = 50 (lb)
Total weight = 2419.3 (lb)
Center of Gravity for Total weight
x = 9.9313, $Y = -0.4053$, $z = 5.4705$ (Itim)
Bill of materials: Materials
Name Description
1 A53 a53 grade b
Bill of materials: Pipes
Material OD Thk Total length Total weight
1 A53 6.625 0.28 12'0" 227.45
2 A53 8.625 0.5 22'0" 953.53
Bill of materials: Bends
Material OD Thk Radius Angle Count Total weight
(inch) (inch) (inch) (deg) (lb)
1 A53 8.625 0.5 12 90.00 1 68.082
Z A33 0.025 0.5 16 90.00 1 102.12 Bill of materials: Values
Bill Of Hiddenials. Valves
(inch) (lb) (lb) (lb)
1 6.625 0.28 200 50 1 250
Bill of materials: Itemized Element Weights
From To Type Length OD Thk Mat.Den Fluid.Den Ins.Den Ins.Thk Lin.Den Lin.Thk Empty.Wt Fluid.Wt Ins.Wt Lin.Wt Add.Wt
(inch) (inch) (inch) (lb/in3) (lb/in3) (lb/in3) (lb/in3) (inch) (lb/in3) (inch) (lb/ (lb) (lb) (lb) (lb) (lb)
1 10 20A 96 8.625 0.5 0.283 0.029 0.009 2 346.74 126.57 55.632 0 0
2 20A 20B Bend 18.85 8.625 0.5 0.283 0.029 0.009 2 68.082 24.851 10.923 0 0
3 200 50 60 6.625 0.5 0.029 0.009 2 216.71 79.104 34.77 0 0 4 30 40A 54 8.625 0.5 0.283 0.029 0.009 2 195.04 71.103 31.203 0 0
5 40A 40B Bend 28 274 8 625 0.5 0 283 0 029 0 009 2 102 12 37 277 16 385 0 0
6 40B 50 54 8.625 0.5 0.283 0.029 0.009 2 195.04 71.193 31.293 0 0
7 30 60 72 6.625 0.28 0.029 0.009 2 113.73 60.057 33.87 0 0
8 60 70 Valve 24 6.625 0.84 0.283 0.029 0.009 2 2001 20.019 19.758 0 0
9 70 80 72 6.625 0.28 0.283 0.029 0.009 2 113.73 60.057 33.87 0 0
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