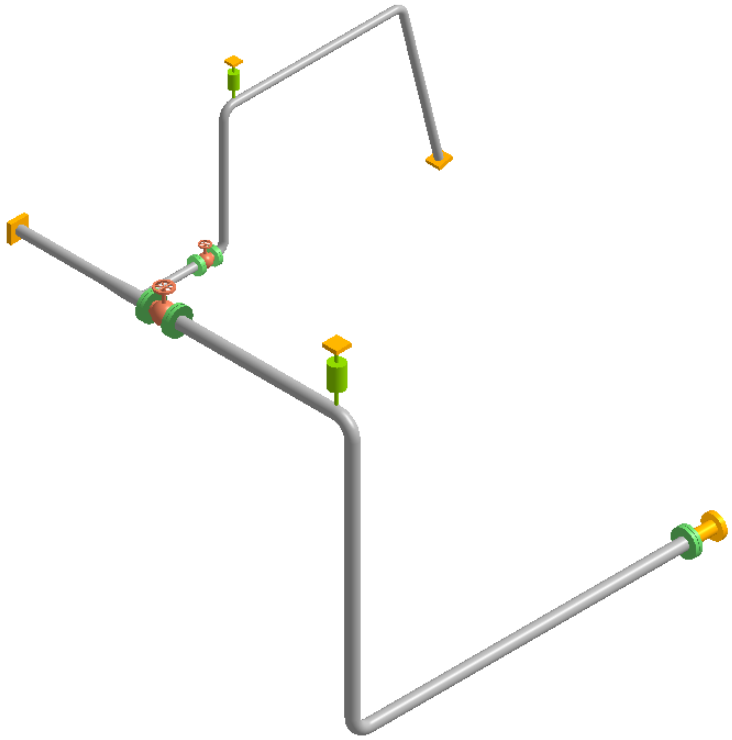
CAEPIPE™

Tutorial for Modeling and Results Review

Problem 2



SST SYSTEMS, INC.

The ***FASTEST*** Solutions for Piping Design and Analysis

Disclaimer

Please read the following carefully:

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

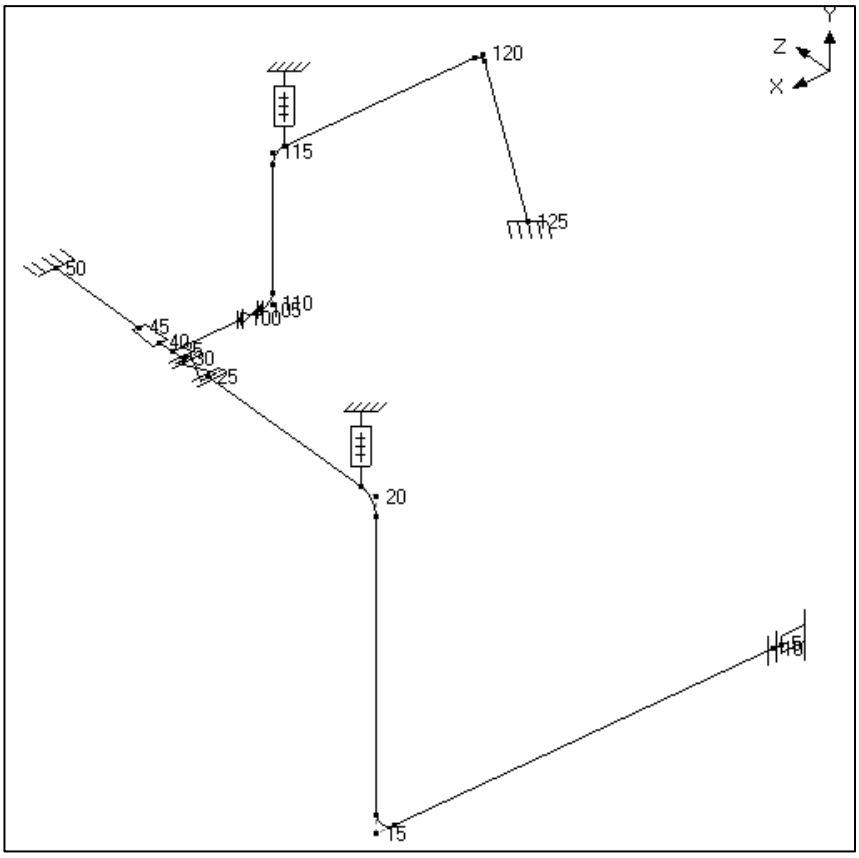
Tel: (408) 452 8111
Fax: (408) 452 8388

email: info@sstusa.com

www.sstusa.com

Modeling and Results Review – Problem 2

Let us model a slightly more advanced piping system now that you have familiarized yourself with the basic use of CAEPIPE via Tutorial 1. The details of the model (in SI units) 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 (different loads for different segments)
5. Select Load Cases for Analysis
6. Analyze
7. View Results

Model Description

Details of the Layout, Material, Sections, Loads and Connection details are summarized for reference:

1. **Axes Chosen:** Global X = East, Global Y = Up and Global Z = South
2. **Piping Code:** ASME B31.1 (2020)
3. **Section Properties:**
    a. Main Line: 10" Schedule STD
    b. Branch Line: 6" Schedule STD

4. **Insulation throughout the Piping system**:
    a. **Density**: 176.2 kg/m3
    b. **Thickness**: 65 mm
5. **Material**: A 312 TP 316
6. **Temperature**:
    a. For Main Line and Branch Line up to Valve End Node 105:

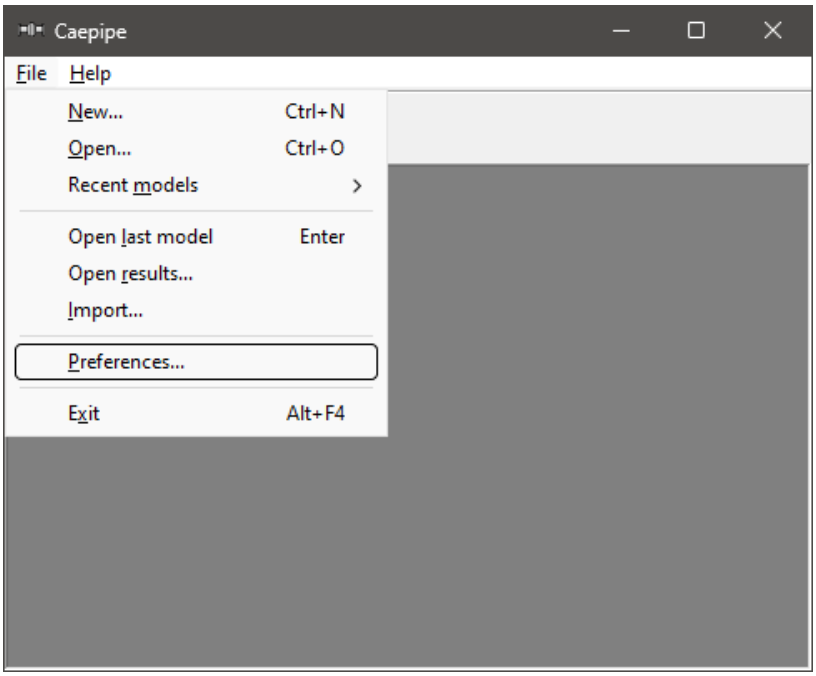
       Operating Temperature = 185 Deg. C and Design Temperature = 230 Deg. C
    b. For Branch Line after Valve Node 105:

       Operating Temperature = 260 Deg. C and Design Temperature = 300 Deg. C
7. **Pressure**:
    a. For Main Line and Branch Line up to Valve End Node 105:

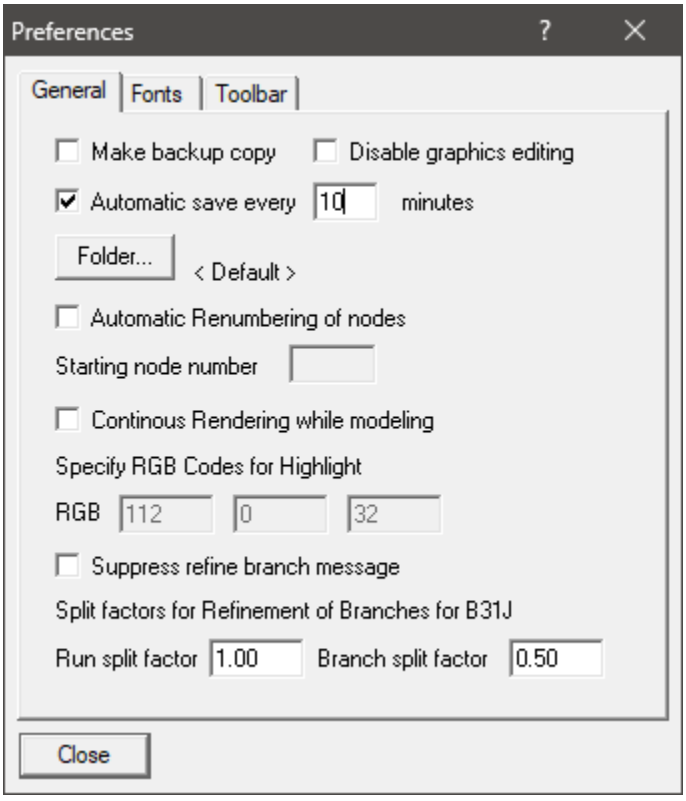
       Operating Pressure = 10 bar and Design Pressure = 15 bar
    b. For Branch Line after Valve Node 105:

       Operating Pressure = 32 bar and Design Pressure = 48 bar
8. **Operating Fluid and Specific Gravity**: Steam, 0.1
9. **Connection Details**:
    a. Node 5 connecting to Nozzle of a Cylindrical Vessel
    b. Node 50 connecting to Nozzle of a API 610 Horizontal Pump
10. **Wind Velocity**: 100 km/hr
11. **Static Seismic g's**: X=0.3, Y=0.2 and Z=0.3

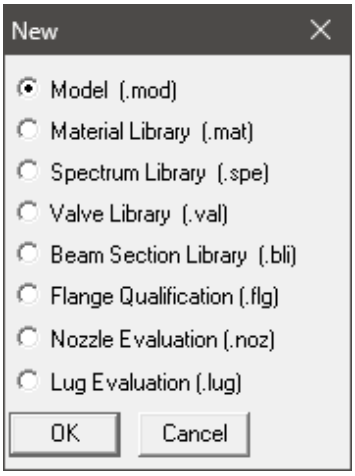
Start CAEPIPE. From the "File" pull down menu select "Preferences".



Make sure that the "Automatic save feature" is enabled and the "Automatic Renumbering of nodes" feature is disabled.

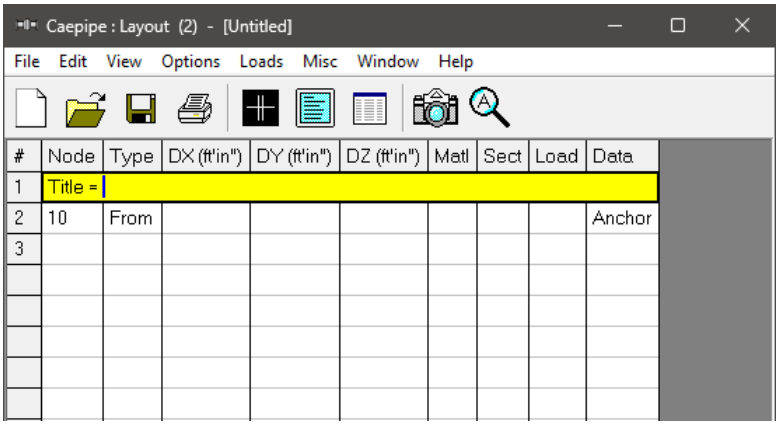


Start CAEPIPE. Then click on the "New" file button.

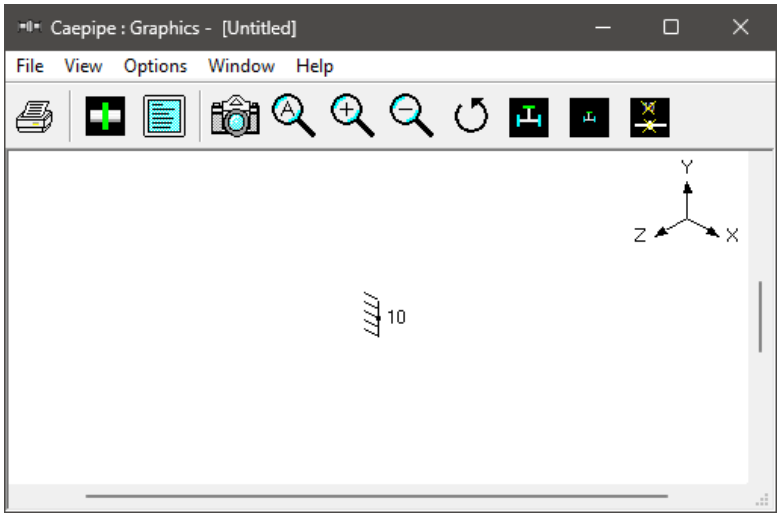


From the "New" file dialog, select the type of the new file as "Model (.mod)" file. This opens two independent windows: Layout and Graphics.

Layout window



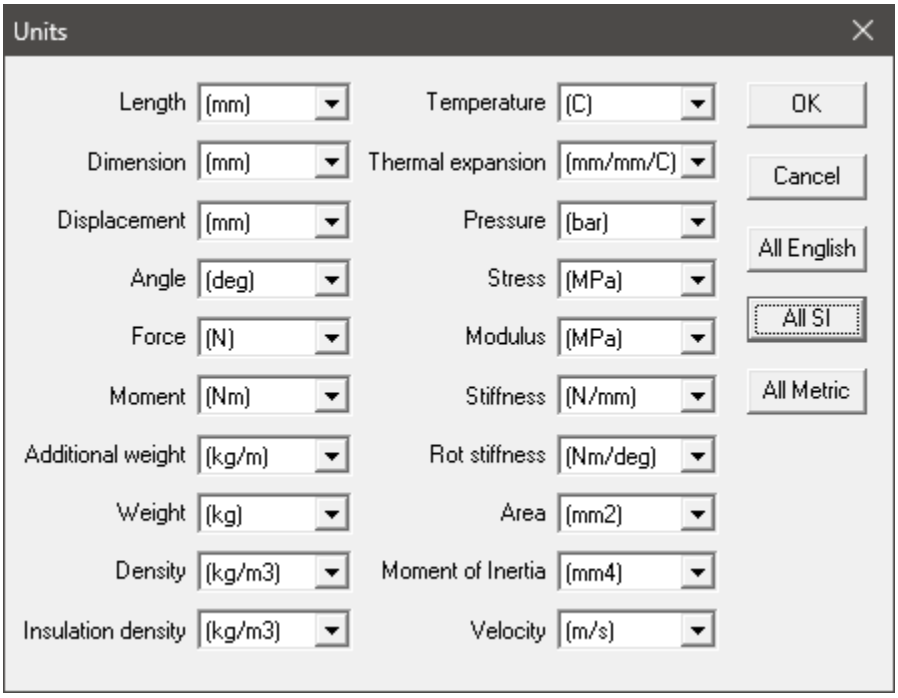
Graphics window



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

Change Units

As this is a SI/Metric model, change the units appropriately. From the layout window, click on "Options menu > Units" (alternately, press the hotkey "Ctrl+U"). Click on "All SI" button followed by "OK". The layout window will show the offsets (DX/DY/DZ) in mm units.

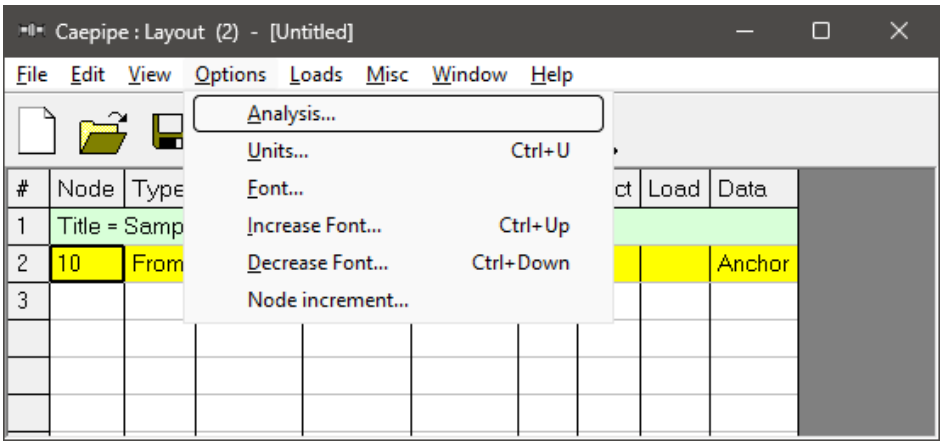


1. Enter Title

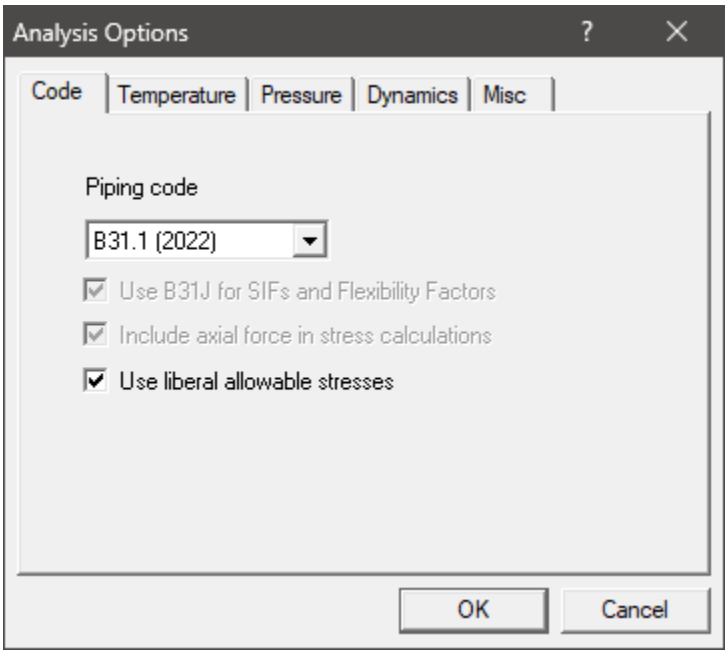
Type "Sample Problem 2" as the title in the first row that contains "Title =". Press Enter.

2. Select Analysis options (piping code etc.)

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



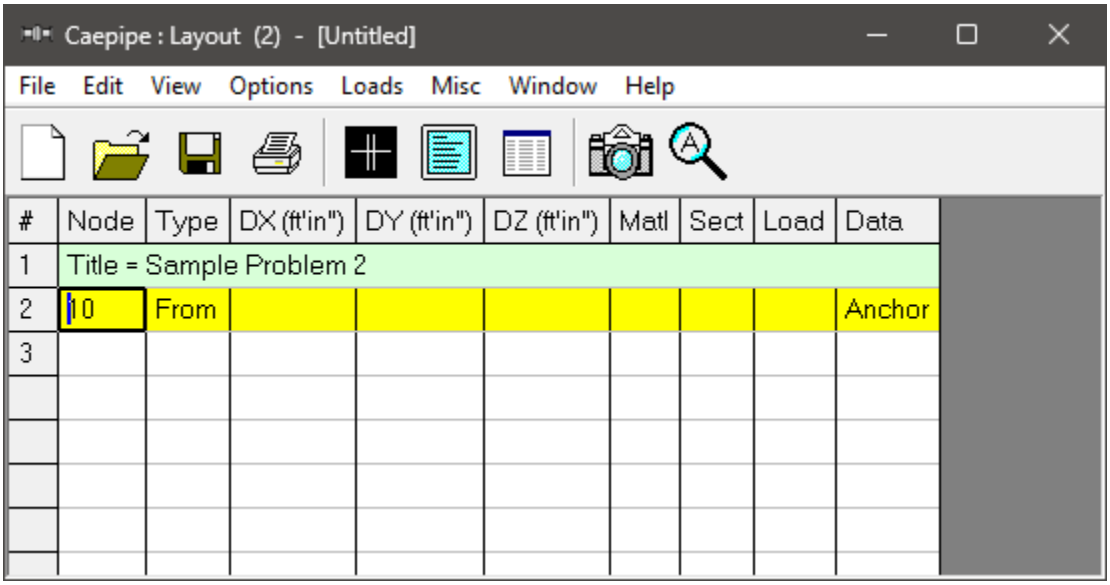
This opens the "Analysis Options" dialog.



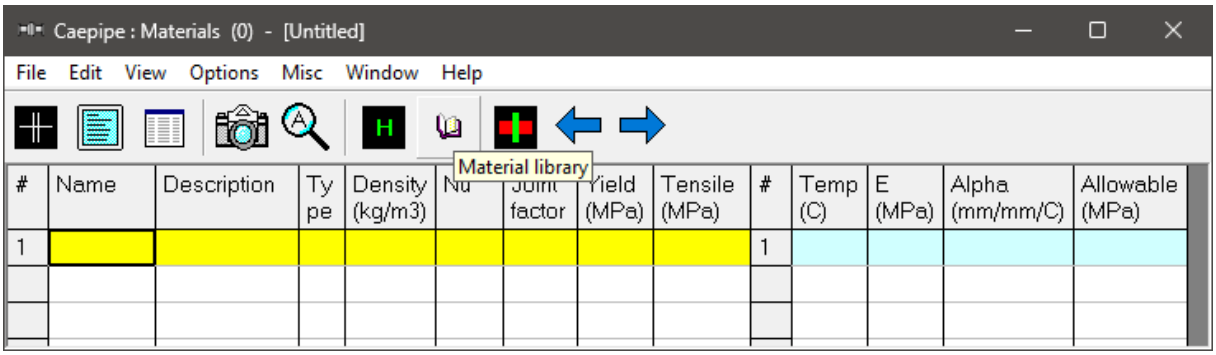
On the Code property page, select "B31.1 (2022)" for "Piping code". Turn ON the option "Use liberal allowable stresses". Then click on OK to close "Analysis Options" dialog.

3. Define Material, Sections and Loads

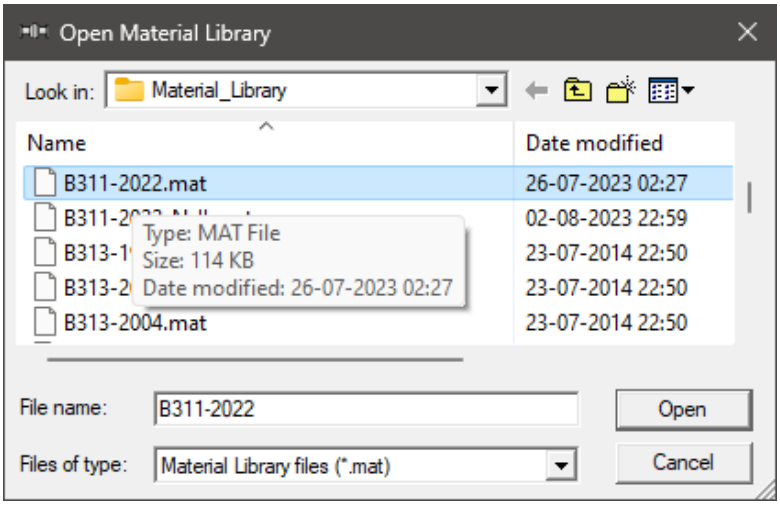
Click on "Matl" in the header in the Layout window (or press "Ctrl+Shift+M")



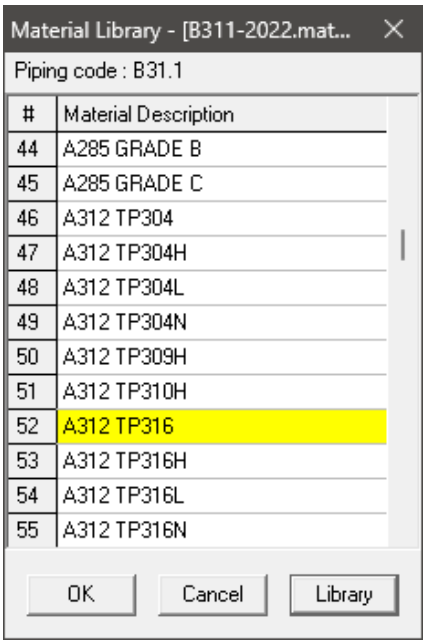
This opens up the "Materials" list in a separate List window. Position and resize the list window as you desire. Click on "Library" button on the Toolbar (or "choose File > Library").



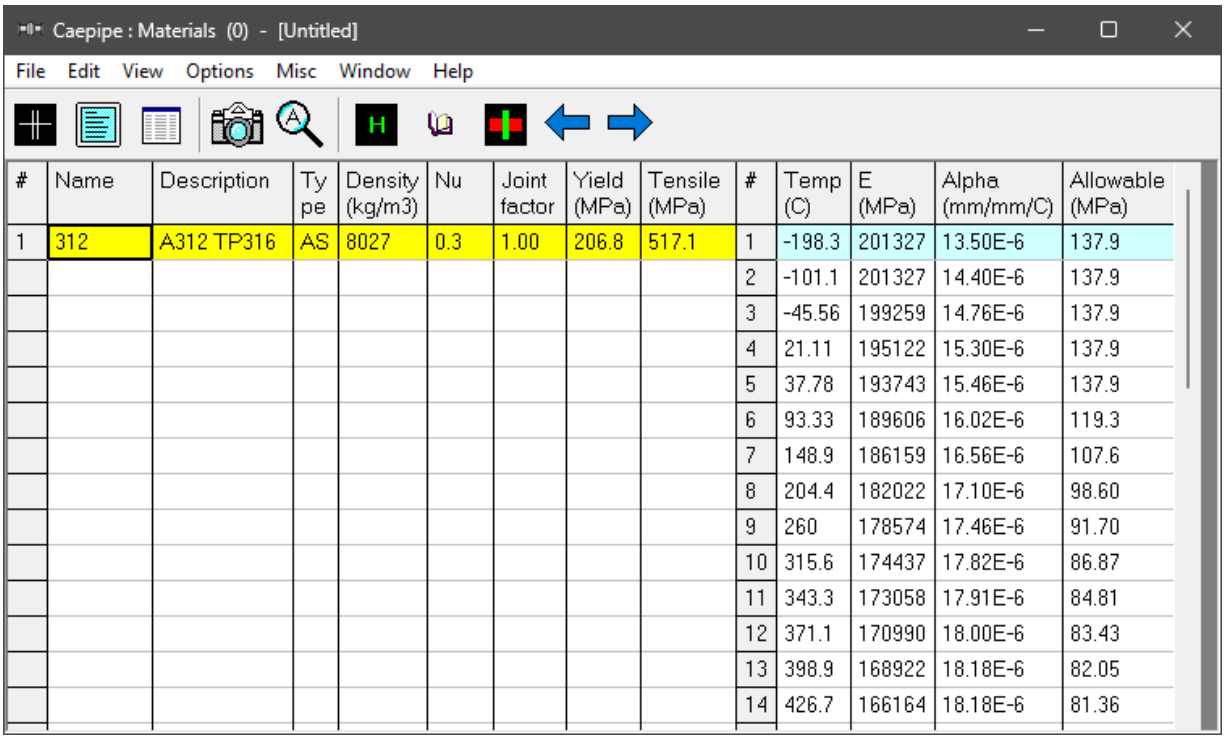
The Open Material Library dialog is shown. *If you don't see the folder shown below, then navigate to the Material Library folder under the CAEPIPE installed folder (usually C:\CAEPIPIE\xxxx, xxxx = version number).*



Select "B311-2022.mat" as the library file by double clicking on it. The available materials in the library are shown. Scroll down to "A312 TP 316". Double click on it or click on "OK" to select it.



The properties for this selected material are transferred to the material in the List window. Type "312" for material name and then **press "Enter"**.

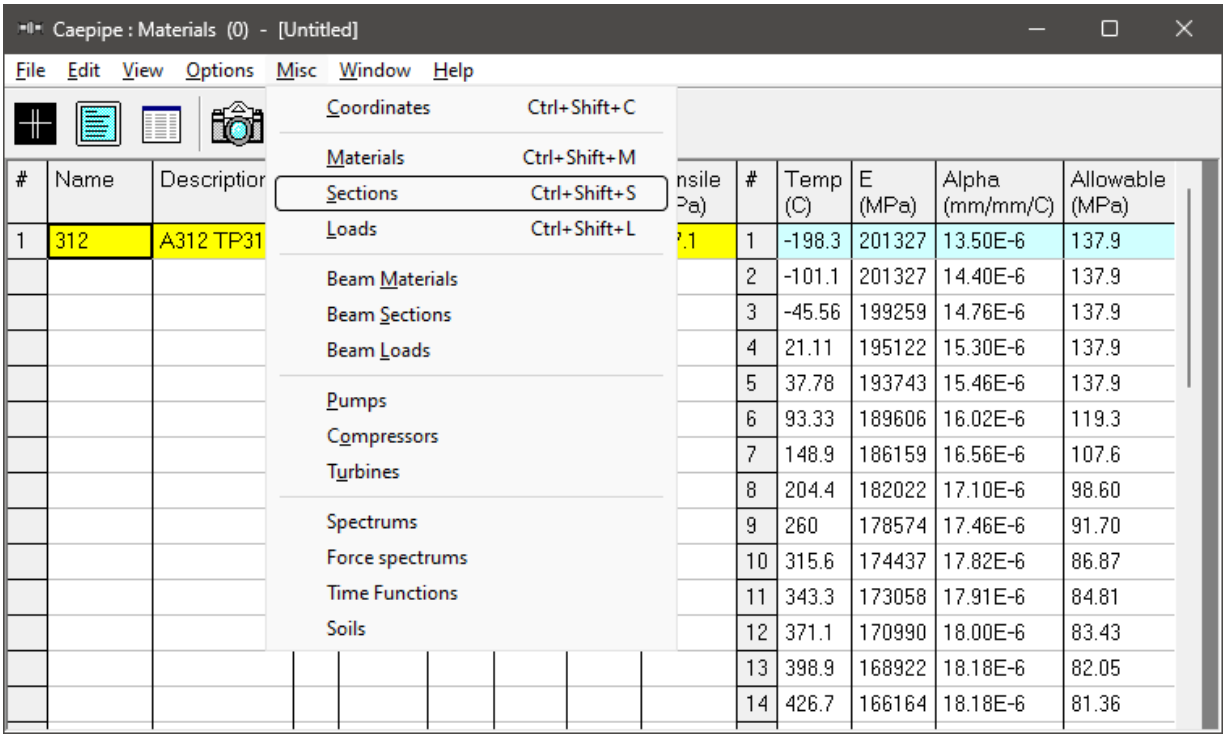


#	Name	Description	Type	Density (kg/m3)	Nu	Joint factor	Yield (MPa)	Tensile (MPa)
1	312	A312 TP316	AS	8027	0.3	1.00	206.8	517.1

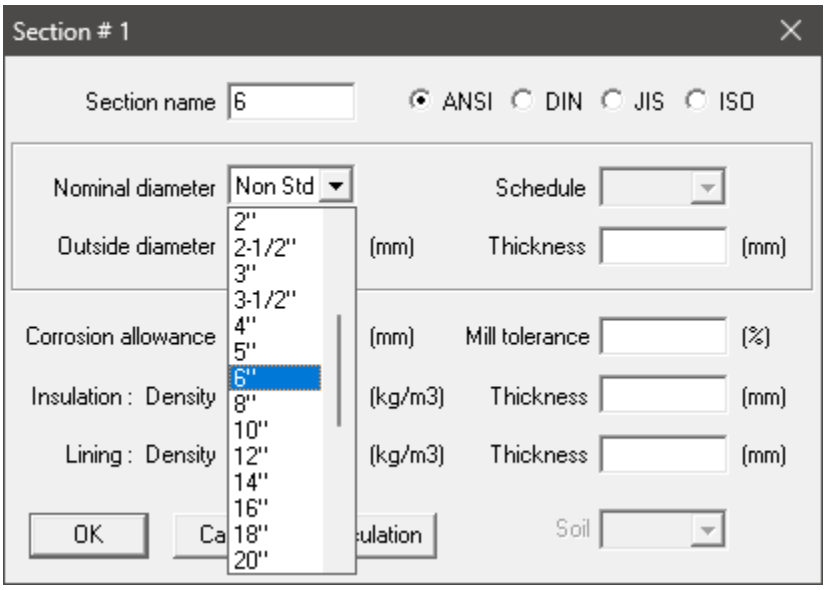
#	Temp (C)	E (MPa)	Alpha (mm/mm/C)	Allowable (MPa)
1	-198.3	201327	13.50E-6	137.9
2	-101.1	201327	14.40E-6	137.9
3	-45.56	199259	14.76E-6	137.9
4	21.11	195122	15.30E-6	137.9
5	37.78	193743	15.46E-6	137.9
6	93.33	189606	16.02E-6	119.3
7	148.9	186159	16.56E-6	107.6
8	204.4	182022	17.10E-6	98.60
9	260	178574	17.46E-6	91.70
10	315.6	174437	17.82E-6	86.87
11	343.3	173058	17.91E-6	84.81
12	371.1	170990	18.00E-6	83.43
13	398.9	168922	18.18E-6	82.05
14	426.7	166164	18.18E-6	81.36

Sections

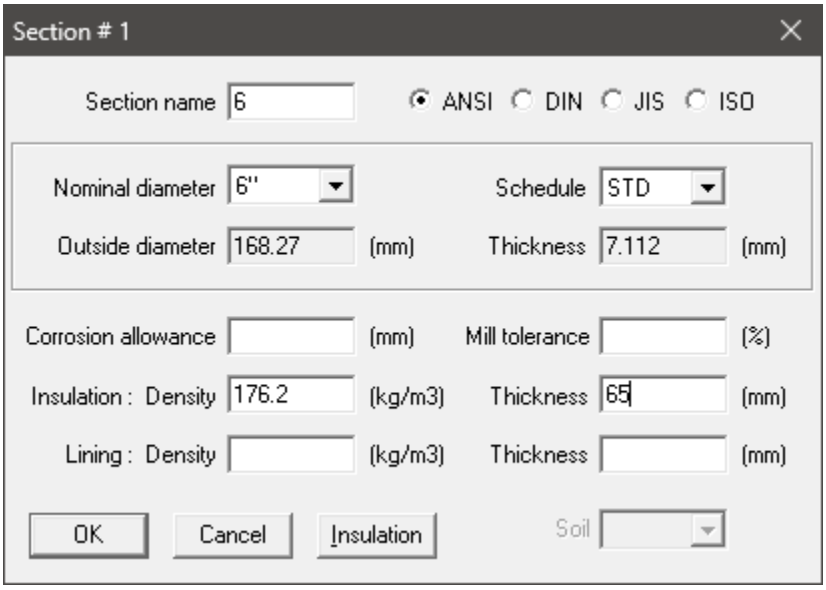
Select "Sections" from the "Misc" menu of the List window (or press "Ctrl+Shift+S").



A list of Sections is shown. This system has three sections: 6", 8" and 10". To enter the first section, type '6' for "Section name" and press "Enter". The "Section #1" properties dialog is shown with the section name 6.



Click on the down arrow of the dropdown combo box for "Nominal diameter" and select 6" for "Nominal diameter". Select/Enter other properties (STD thickness, Insulation density [Alt+I may be used for a list of insulation materials or you may enter your own density, in this case, 176.2 kg/cu.m] and thickness).

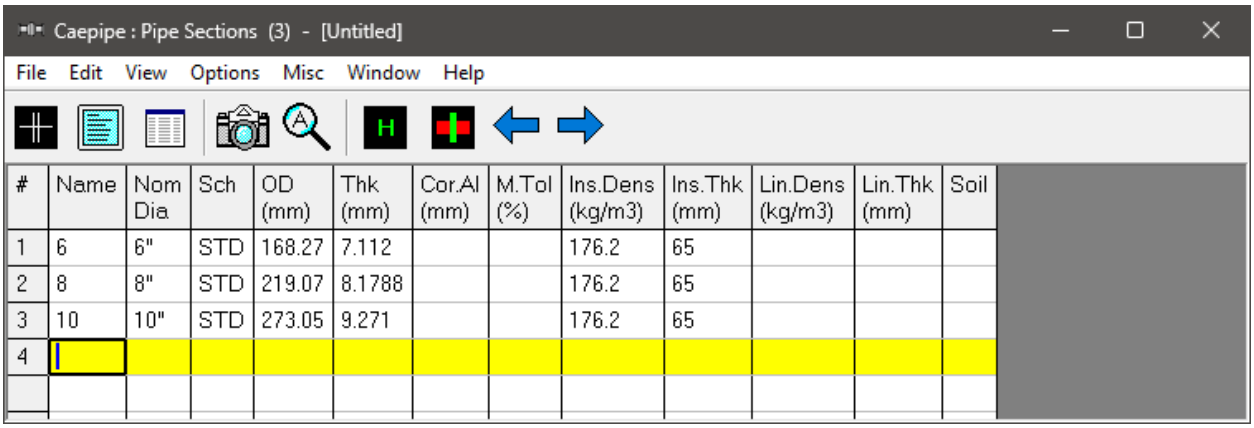


After entering all properties, press "Enter" or click on "OK" to enter the first section.

Now repeat the process for the 8" pipe section.

In row # 2, Type 8 for "Section name" and press "Enter". The "Section Properties" dialog is shown with the section name 8. Select 8" for "Nominal diameter", STD for "Schedule", and same insulation

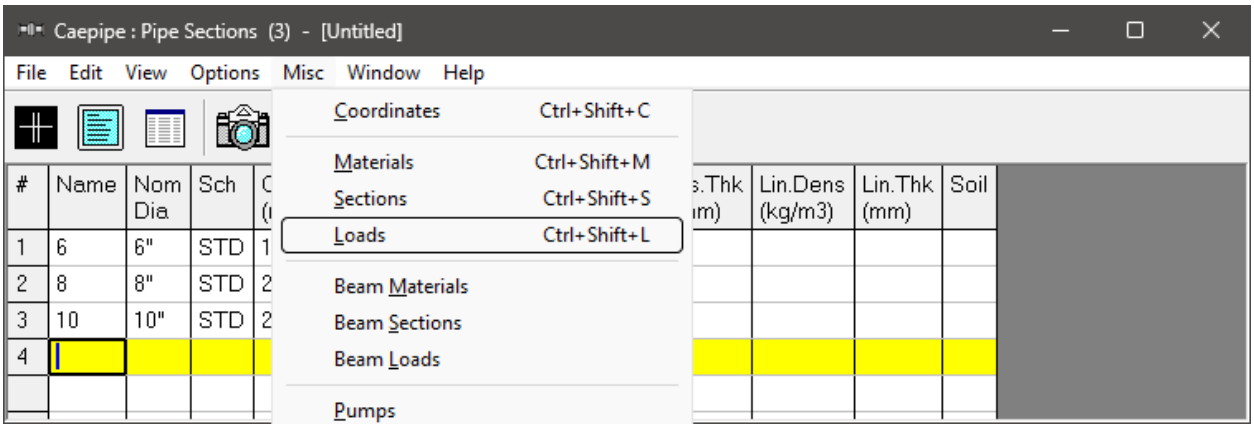
properties as before for "Insulation". Press "Enter" or click on "OK' to enter the second section. Do similarly for the 10" pipe section.



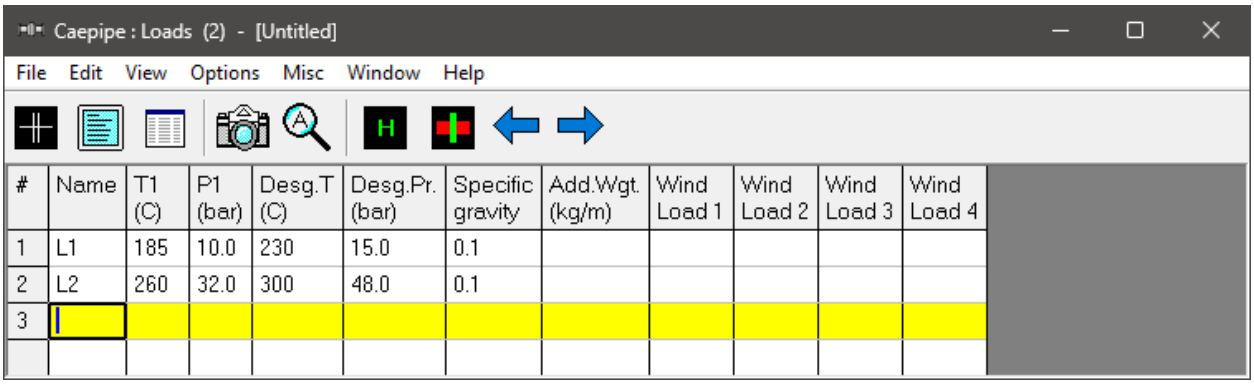
#	Name	Nom Dia	Sch	OD (mm)	Thk (mm)	Cor.Al (mm)	M.Tol (%)	Ins.Dens (kg/m3)	Ins.Thk (mm)	Lin.Dens (kg/m3)	Lin.Thk (mm)	Soil
1	6	6"	STD	168.27	7.112			176.2	65			
2	8	8"	STD	219.07	8.1788			176.2	65			
3	10	10"	STD	273.05	9.271			176.2	65			
4												

Load

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



The Loads list is shown. To enter the first load, Type 'L1' for "Name", Tab to "T1" and type 185, Tab to "P1" and type 10 bar, tab to "Desg.T" and type 230, Tab to "Desg.Pr." and type 15 and Tab to "Specific gravity" and type 0.1. 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). Similarly, enter the second load set "L2" {260°C, 32 bar, 300°C, 48 bar and Sp. Gravity = 0.1}.



#	Name	T1 (C)	P1 (bar)	Desg.T (C)	Desg.Pr. (bar)	Specific gravity	Add.Wgt. (kg/m)	Wind Load 1	Wind Load 2	Wind Load 3	Wind Load 4
1	L1	185	10.0	230	15.0	0.1					
2	L2	260	32.0	300	48.0	0.1					
3											

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

4. Input Model Layout

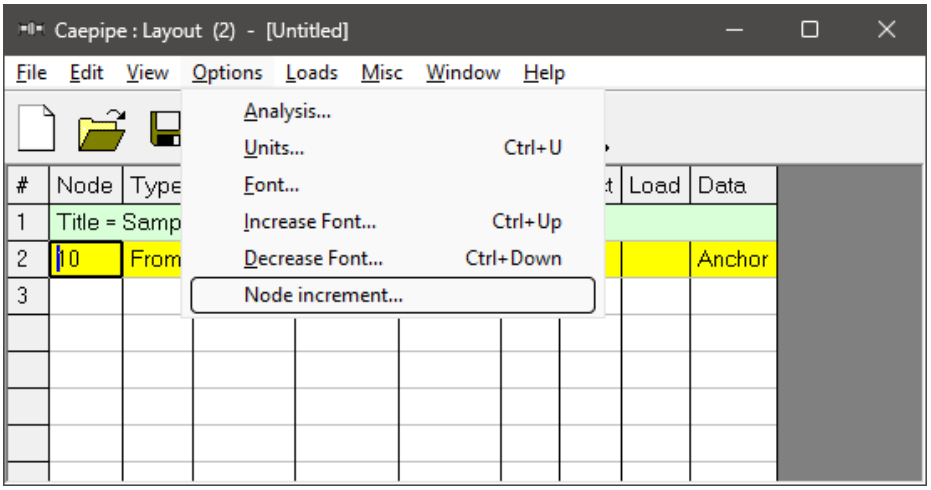
We are going to model the 10" main line first, followed by the 8" segment.

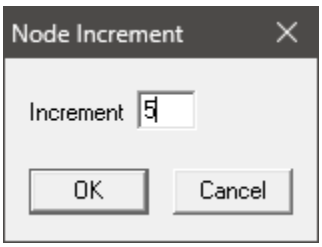
CONVENTIONS

- In the following text, the word 'type' should be distinguished from the words 'Type column' or simply 'Type' (upper case 'T'). The former ('type') will mean press the keys on the keyboard. The latter word 'Type' will refer to the "Type column" in the Layout spreadsheet. Of course, occurrence of Type at the beginning of a sentence will mean type the keys.
- Also, the instruction "type B for Bend" does not necessarily mean the upper case 'B'. The lower case 'b' can also be typed.
- For items in the "Data" column (such as "Anchor" or "Hanger"), the cursor needs to be in the "Data" column. To move the cursor quickly to that column, press "Ctrl+Shift+D" from any column or click in the "Data" column. Or press the Tab key 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. Simultaneous feedback is one of the chief design intents in CAEPIPE.
- For mouse clicks, when you read the word "click on xxx," this means left-click on your mouse. For the context menu, if referred to, right-click.

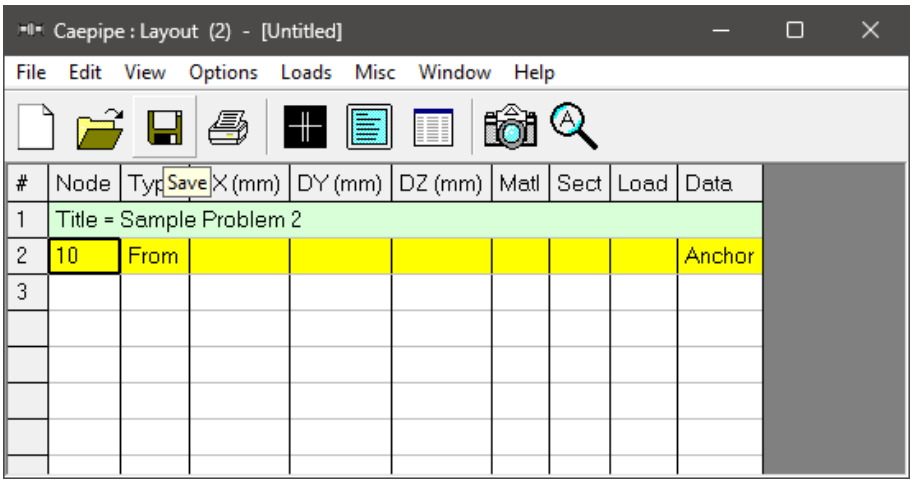
Change Node Increment

You might have noticed in the model drawing that the node numbering scheme has an increment of 5. CAEPIPE has a feature that allows you to specify a node increment. Select "Options menu > Node increment"…type 5 for value. Click on "OK".

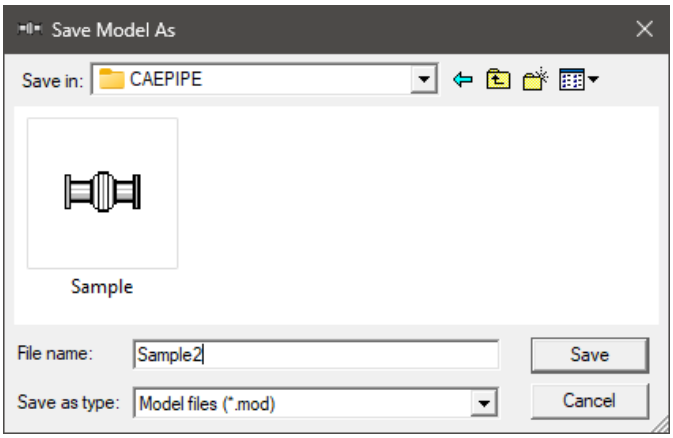




After defining the above parameters,  Save the model by clicking on the Save button.



The "Save Model As" dialog is shown.



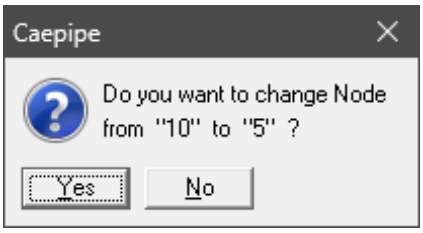
Type the File name as "Sample2" and press "Enter" to save the model.

First model the 10" Main line

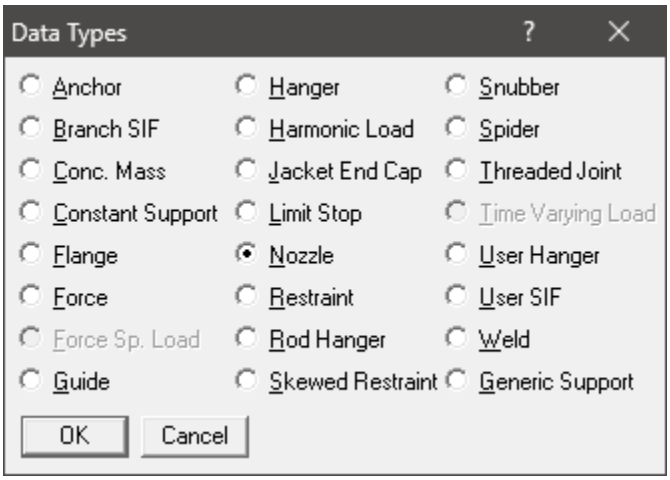
Following the "Title" at row #1, row #2 is already generated with Node 10 of Type "From" with an Anchor in the "Data" column.

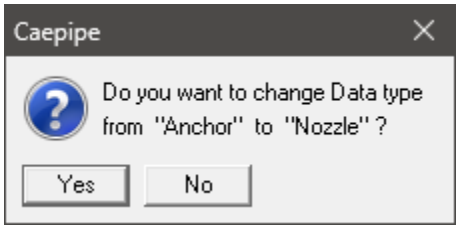
Model information shows that the piping is connecting to a Nozzle of a Cylindrical Vessel with node number as 5. So, to account for the stiffness of the Nozzle protruding out of the Cylindrical Vessel, the nozzle portion is modeled as a pipe in this model. The junction of this Pipe (Nozzle) and the Shell is modeled as "Nozzle".

To change the Node number and to replace "Anchor" with "Nozzle", click on 10, press Backspace to erase 10, type 5. Press Tab to advance. Confirm the node number change when asked (by clicking on Yes, or simply pressing the Spacebar key on the keyboard).



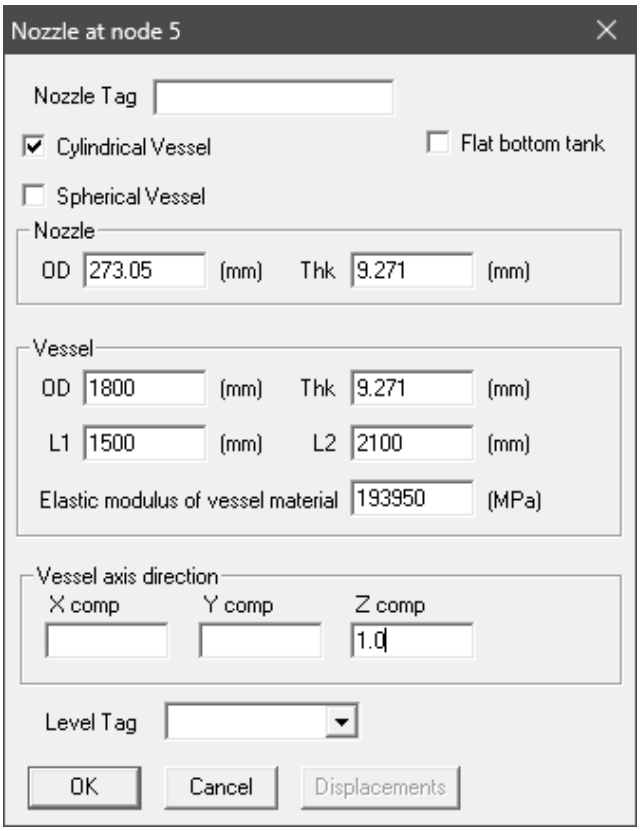
To replace the "Anchor" with "Nozzle", highlight the data type "Anchor" at row #2 using mouse left button and then click on "Data" in the header in the Layout window. From the "Data types" dialog box shown, select the new data type as "Nozzle".

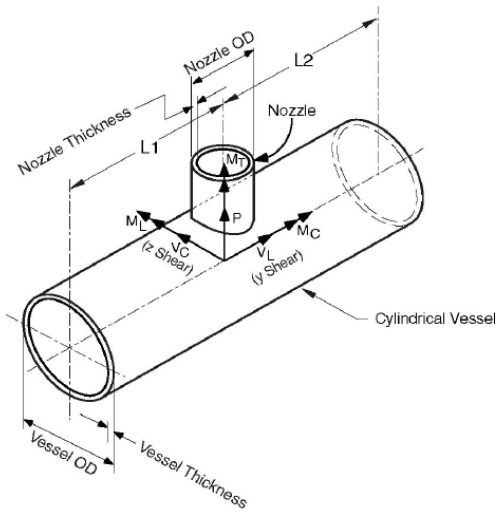




CAEPIPE will prompt as shown below. Press "Yes" to proceed.

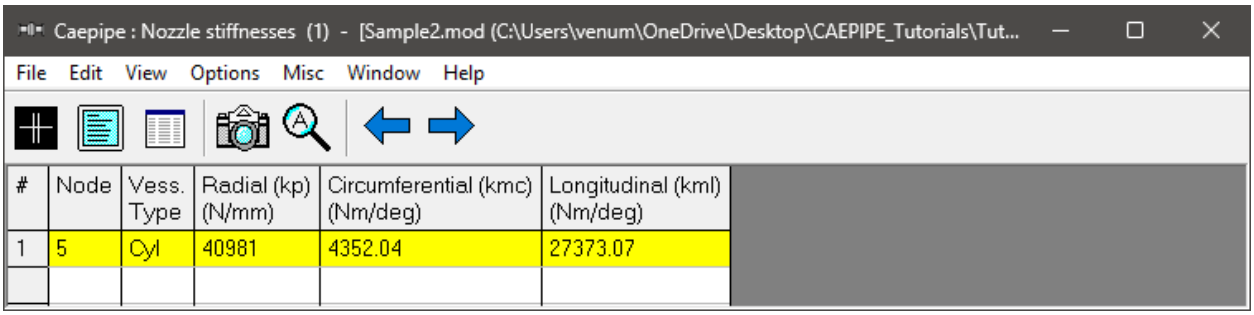
Enter the Nozzle and Vessel parameters as shown below and press "OK".





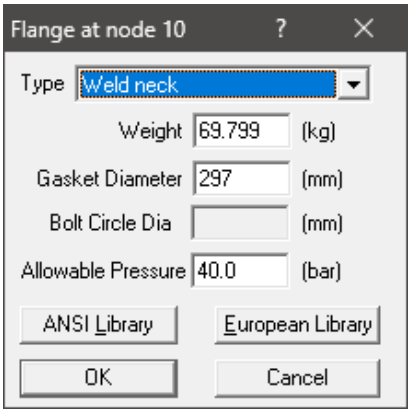
From the snap shots shown above, Lengths L1 and L2 on either side of the nozzle are the distances from the nozzle center line to the nearest location on vessel where the "ovalization deformation" of the vessel is stopped such as at a stiffener on the inner or outer surface of the vessel, or at the center of a

saddle support to the vessel or at the junction to the torispherical enclosure (also called the head) or at a tube sheet inside the vessel etc. Nozzle stiffness computed by CAEPIPE can be seen through Layout window > View > List > Nozzle Stiffnesses.

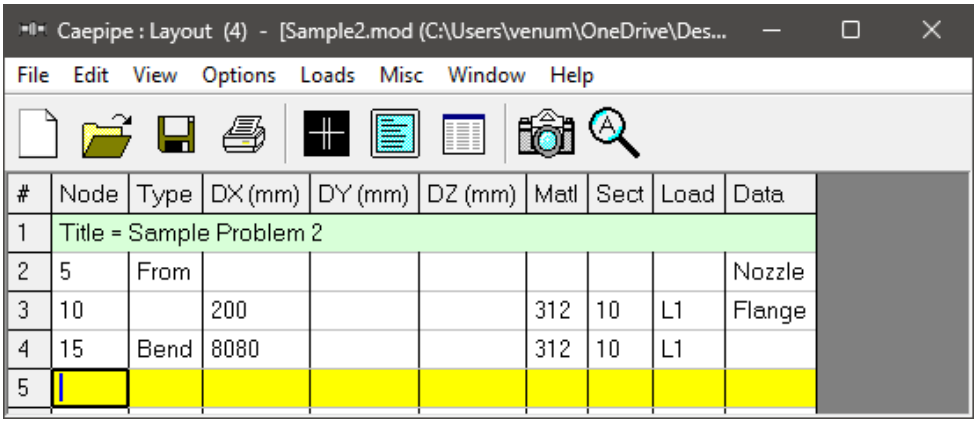


#	Node	Vess. Type	Radial (kp) (N/mm)	Circumferential (kmc) (Nm/deg)	Longitudinal (kml) (Nm/deg)
1	5	Cyl	40981	4352.04	27373.07

Now, press Enter to move the highlight to the next row (#3). Tab to the Type column. The next Node 10 is automatically assigned. Tab over to DX, type 200 (mm), Tab over to Material, press Enter to open the list of materials and select 312. Next Tab over to Section and press Enter. Select section 10 and press OK. Tab over to Load and press Enter, select L1 and click OK. Tab again to Data to input the flanges mating with the pipe and the equipment nozzle. Type "fl" to model flange and enter the data as shown below and press OK. CAEPIPE moves the highlight automatically to the next (new) row (#4).

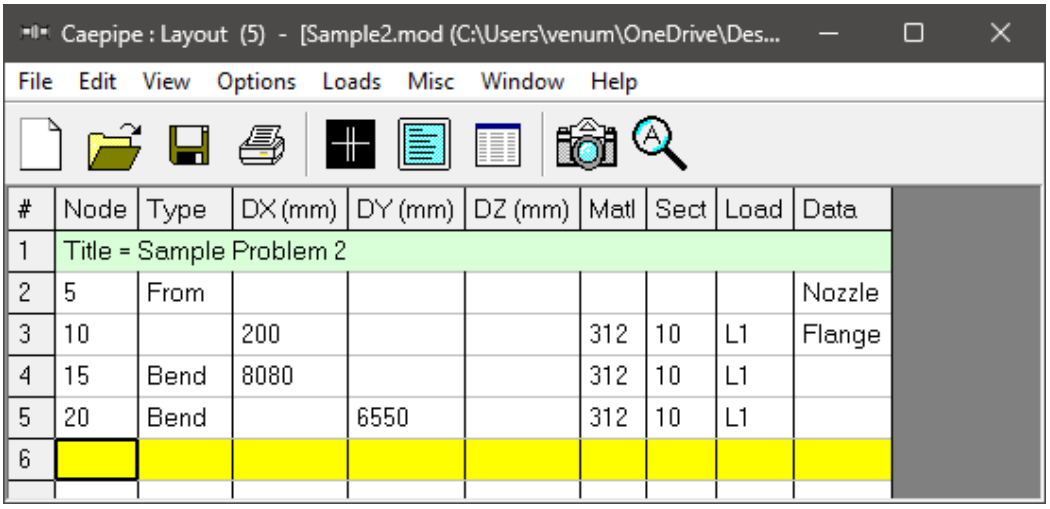


Tab to the type column. The next node 15 is automatically assigned. Node 15 has a LR (long radius) bend (in CAEPIPE, a bend node is defined always at the tangent intersection point, being such, this node does not exist on the physical bend). Tab to the Type column; type "ben" to insert a default LR bend. Tab to DX, type in 8080 (mm), press Enter. CAEPIPE automatically enters the material, section and load from the previous row and moves the highlight to the next new row.



#	Node	Type	DX (mm)	DY (mm)	DZ (mm)	Matl	Sect	Load	Data
1	Title = Sample Problem 2								
2	5	From							Nozzle
3	10		200			312	10	L1	Flange
4	15	Bend	8080			312	10	L1	
5									

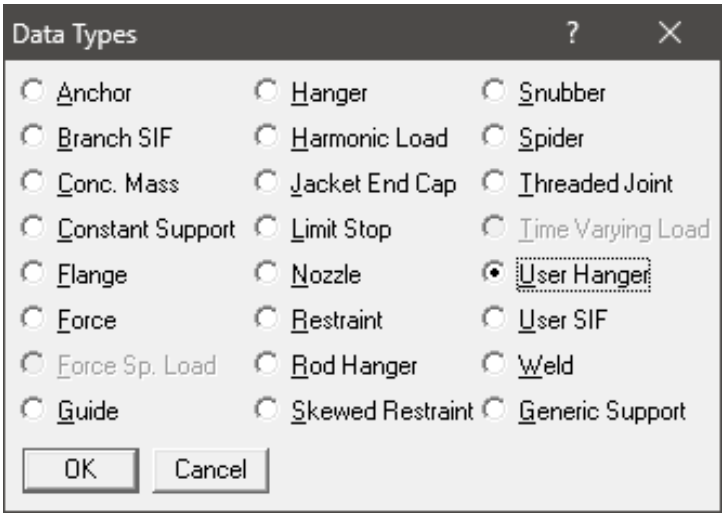
The following vertical bend (at node 20) can be modeled as before. Tab to Type (node 20 is automatically inserted), and type "ben" to insert a default LR bend, Tab again to DY, type 6550 (mm) and press Enter.

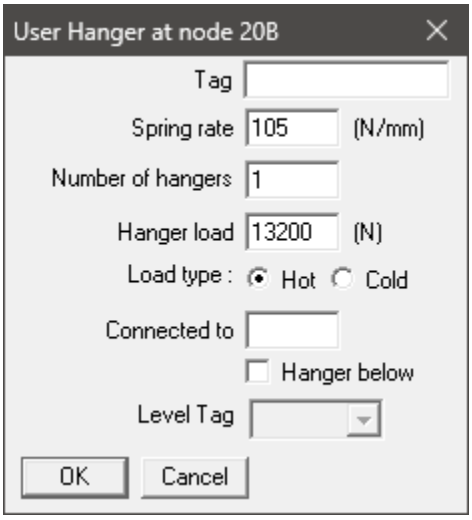


#	Node	Type	DX (mm)	DY (mm)	DZ (mm)	Matl	Sect	Load	Data
1	Title = Sample Problem 2								
2	5	From							Nozzle
3	10		200			312	10	L1	Flange
4	15	Bend	8080			312	10	L1	
5	20	Bend		6550		312	10	L1	
6									

This bend has an already existing hanger (called "User Hanger" in CAEPIPE) at the far end, referred to as node 20B, an internally generated bend node.

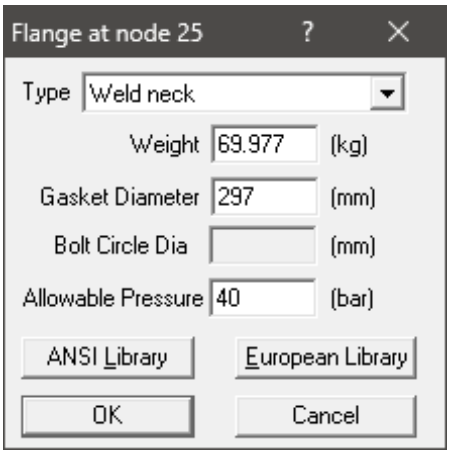
So, on the next row, type 20B for Node, Tab to Type, press "L" for Location, which spawns the available data types you can insert at this node. Pick "User Hanger" from the dialog.



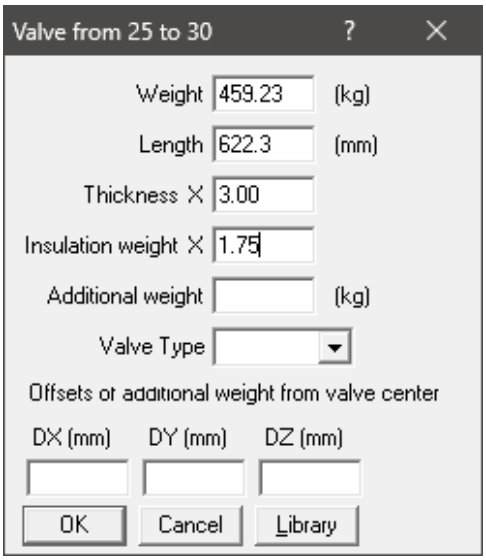


Enter its properties as shown. Click on OK.

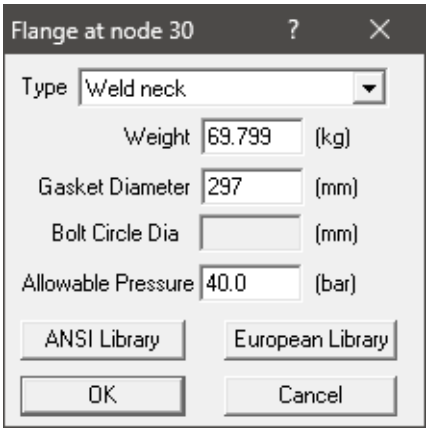
Next, the line moves in the Z direction to the flange node 25. Pressing Tab on the new row generates node 25 for you. Tab to DZ, type 4240, (click in Data column) or press Ctrl+Shift+D to move cursor to Data column. Type "fl" to open the Flange Data type dialog. Enter the details shown below and press OK.

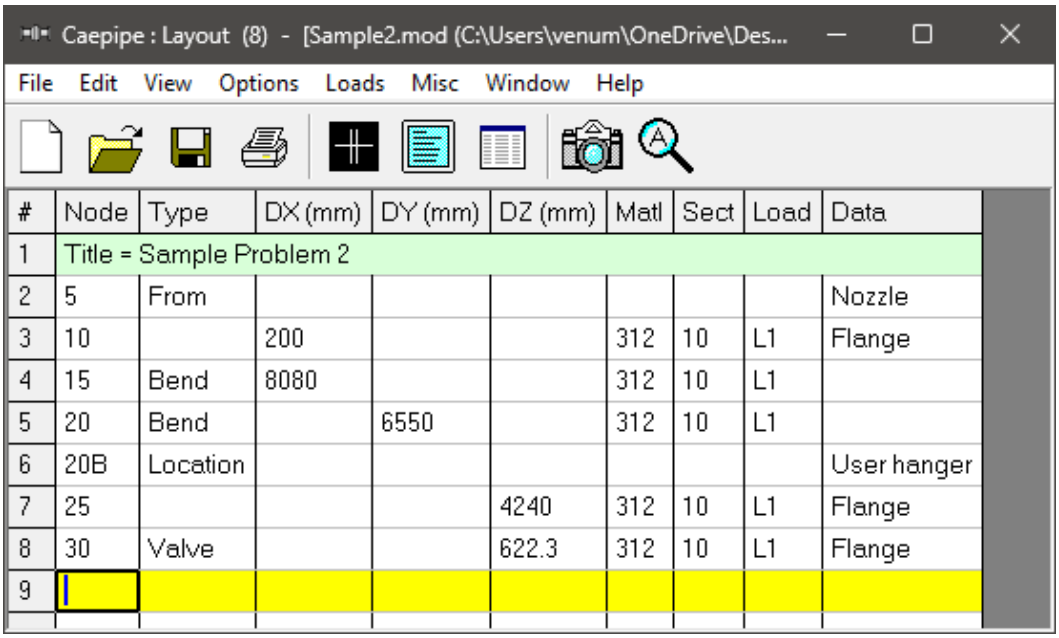


A valve is placed next from Node 25 to Node 30, where another mating flange is located. Pressing Tab on the new row generates node 30. Tab to the Type column; type "v" to insert a "Valve" and enter the data as shown below and press OK.



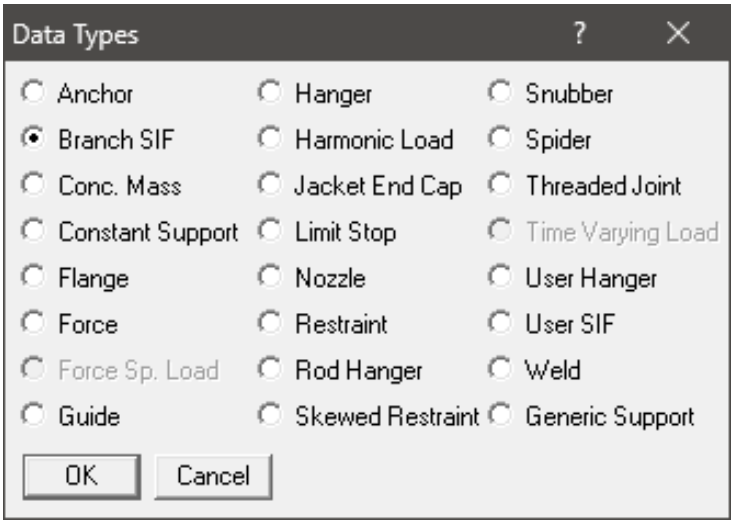
Tab to Data and type "fl" to enter a "flange". Type "fl" to open the Flange Data type dialog. Enter the details shown below and press OK.

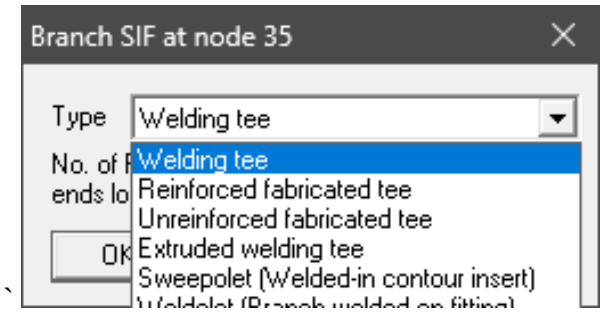


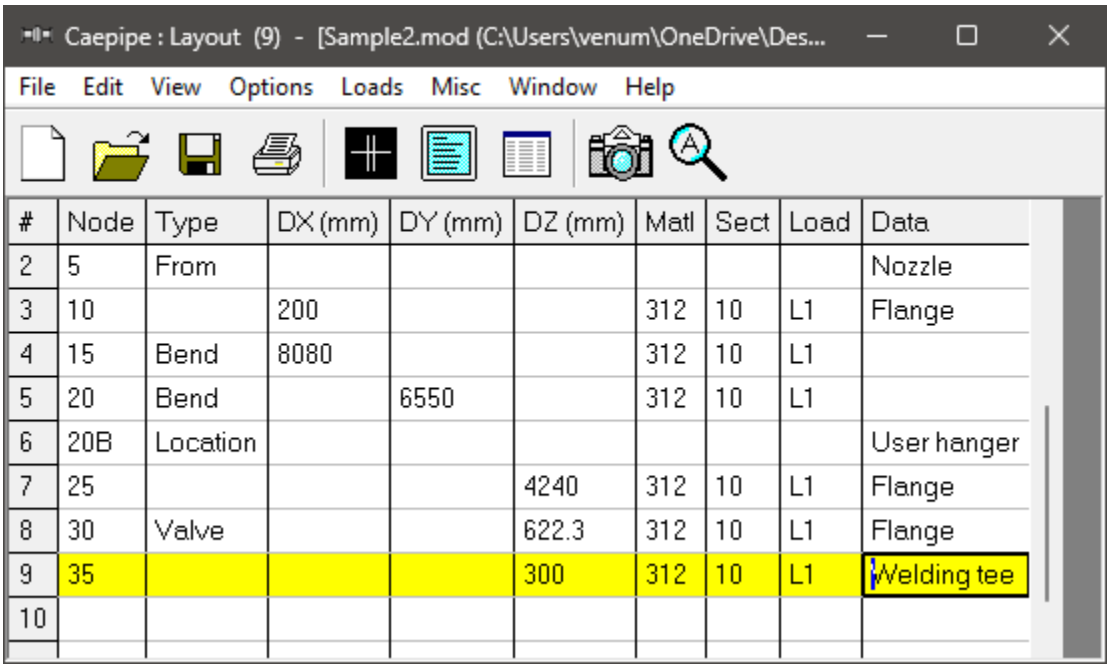


#	Node	Type	DX (mm)	DY (mm)	DZ (mm)	Matl	Sect	Load	Data
1	Title = Sample Problem 2								
2	5	From							Nozzle
3	10		200			312	10	L1	Flange
4	15	Bend	8080			312	10	L1	
5	20	Bend		6550		312	10	L1	
6	20B	Location							User hanger
7	25				4240	312	10	L1	Flange
8	30	Valve			622.3	312	10	L1	Flange
9									

Next model a pipe element till node 35 (welding tee). Press Tab for node 35, Tab to DZ, type 300, (click in Data column) or press Ctrl+Shift+D to move cursor to Data column. Type "br" (or right-click in Data, select Branch SIF) to open the Tee types Data type dialog. Select Welding Tee from the dropdown box. Click on OK (or press Enter).



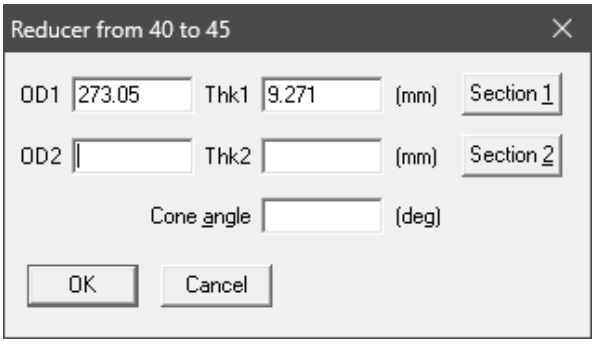




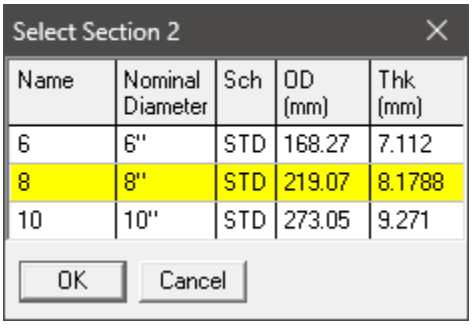
#	Node	Type	DX (mm)	DY (mm)	DZ (mm)	Matl	Sect	Load	Data
2	5	From							Nozzle
3	10		200			312	10	L1	Flange
4	15	Bend	8080			312	10	L1	
5	20	Bend		6550		312	10	L1	
6	20B	Location							User hanger
7	25				4240	312	10	L1	Flange
8	30	Valve			622.3	312	10	L1	Flange
9	35				300	312	10	L1	Welding tee
10									

Next model a pipe element till node 40. Press Tab for node 40, Tab to DZ, type 300 and press Enter.

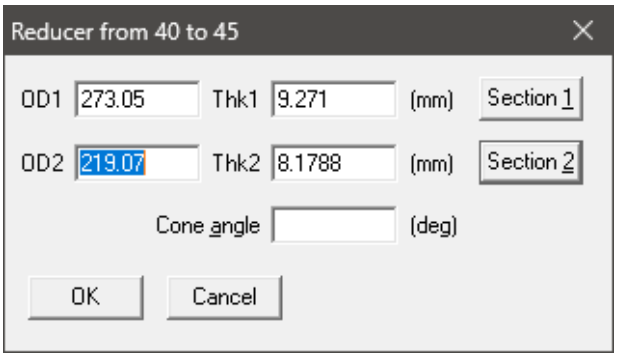
The next element is a 10x8 concentric reducer. Here is how to model it. Tab for the next node # (45), type "red" for Reducer in the Type column. CAEPIPE displays the Reducer dialog with the current section properties.



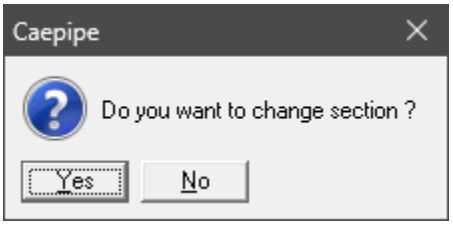
Click on "Section 2" button to select the following section, in this case, the 8" section. After placing the highlight on the 8" section, press Enter (or click on OK).

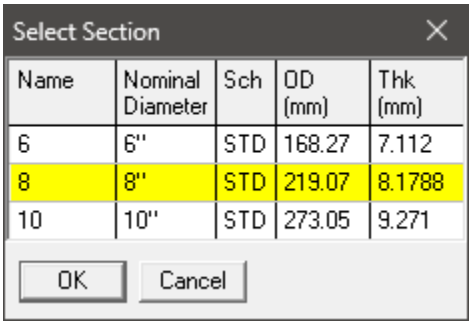


You are back at the Reducer dialog.

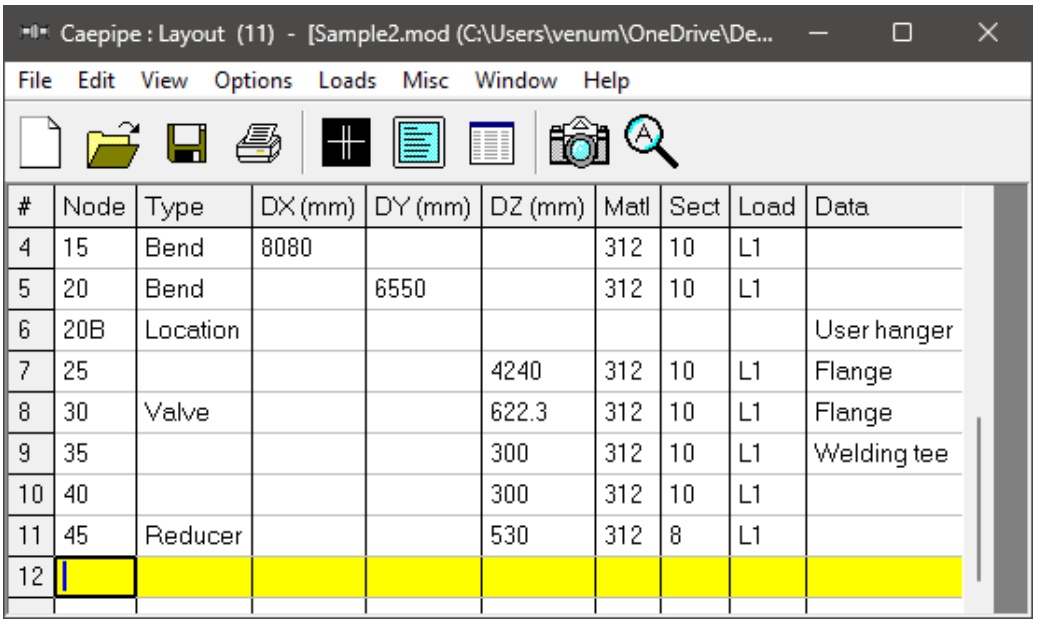


Click on OK to finish inserting the reducer. On the layout screen, type 530 for DZ and press Enter, at which point CAEPIPE wants you to confirm the section change. Click on Yes.



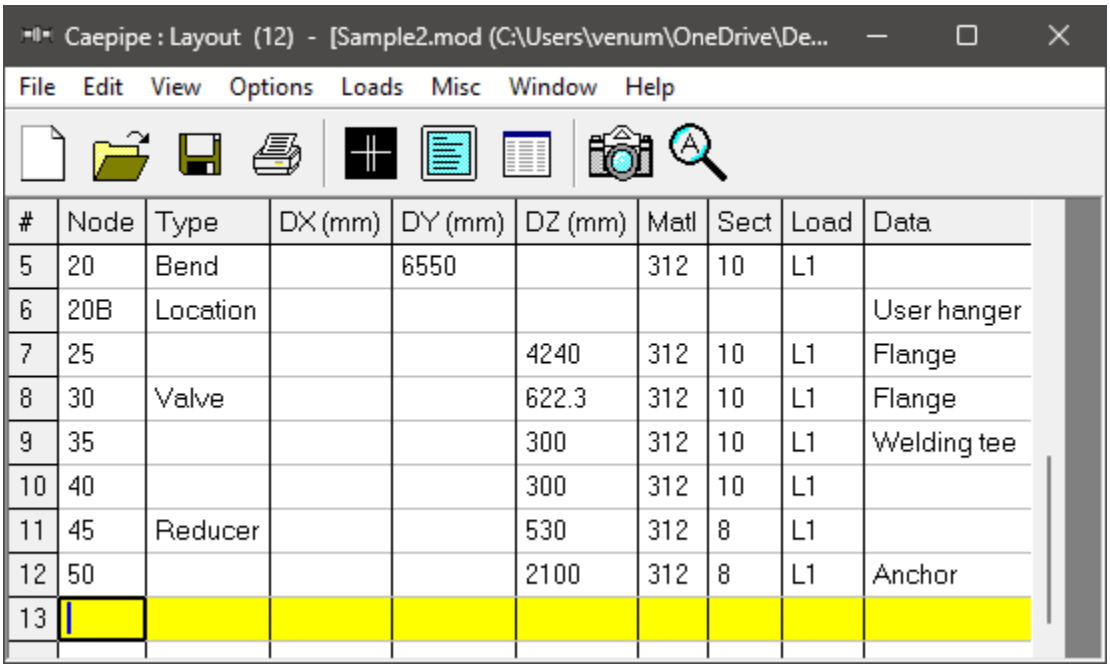


Then select 8 as the new section from here on. Press Enter to move to next row.



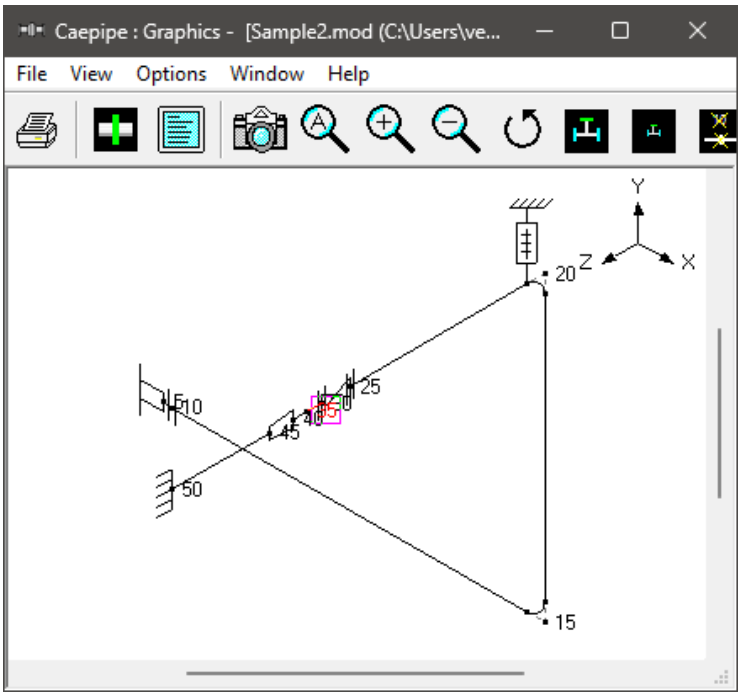
#	Node	Type	DX (mm)	DY (mm)	DZ (mm)	Matl	Sect	Load	Data
4	15	Bend	8080			312	10	L1	
5	20	Bend		6550		312	10	L1	
6	20B	Location							User hanger
7	25				4240	312	10	L1	Flange
8	30	Valve			622.3	312	10	L1	Flange
9	35				300	312	10	L1	Welding tee
10	40				300	312	10	L1	
11	45	Reducer			530	312	8	L1	
12									

The last element here is an 8" pipe that ends at node 50. As before, press Tab for Node 50, type 2100 for length in the same direction. Press Ctrl+Shift+D to go to Data and press A to insert a rigid anchor (note that CAEPIPE inserts the correct old material, new section and old load for this row).



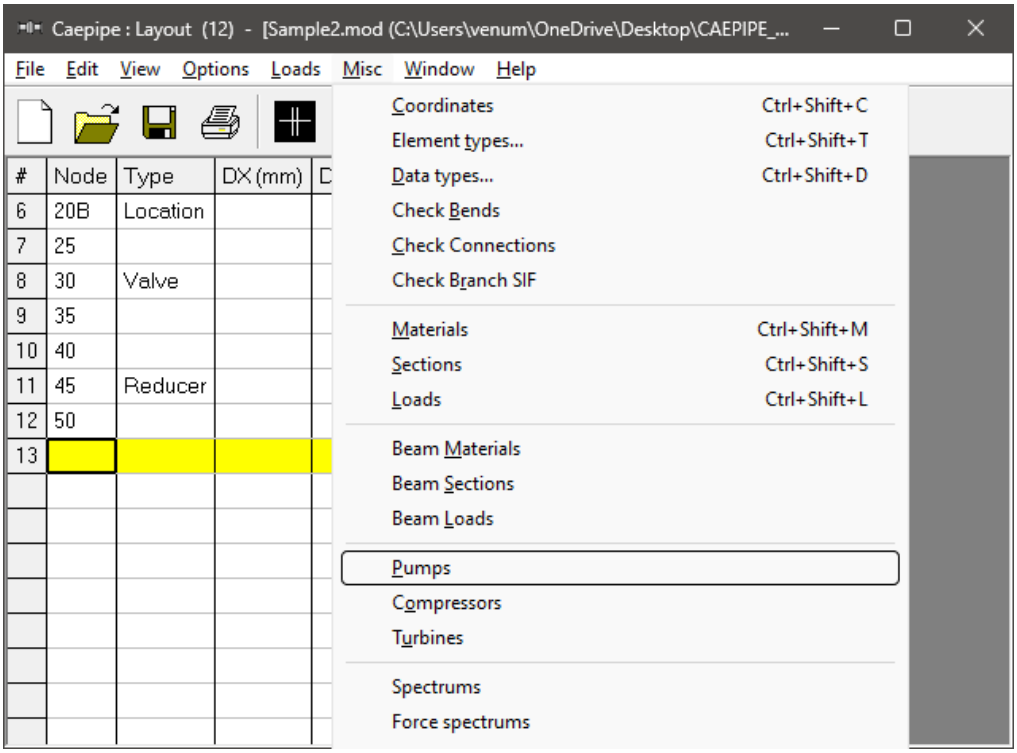
#	Node	Type	DX (mm)	DY (mm)	DZ (mm)	Matl	Sect	Load	Data
5	20	Bend		6550		312	10	L1	
6	20B	Location							User hanger
7	25				4240	312	10	L1	Flange
8	30	Valve			622.3	312	10	L1	Flange
9	35				300	312	10	L1	Welding tee
10	40				300	312	10	L1	
11	45	Reducer			530	312	8	L1	
12	50				2100	312	8	L1	Anchor
13									

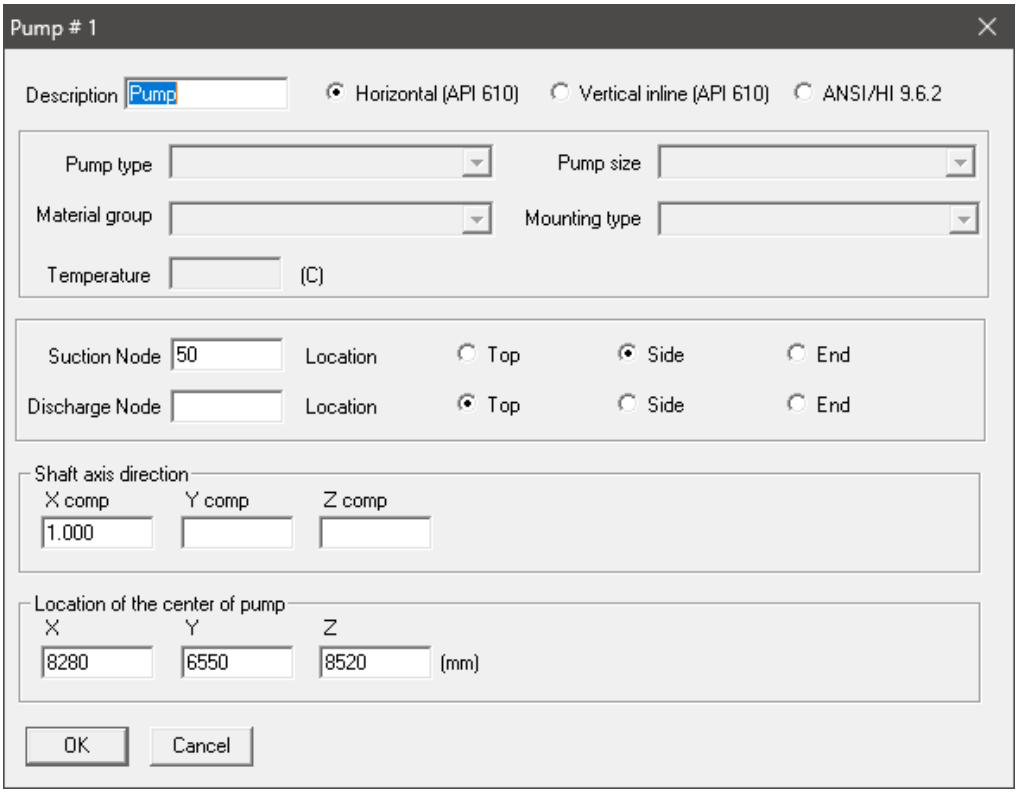
 Click on the Zoom All button (or press Ctrl+A) to view the header line fully in the graphics window.



Node 50 is connecting to a Side Suction Nozzle of an API 610 Horizontal Pump. To model this, select the option "Pumps" through Layout Window > Misc. Double click on an empty row and enter the

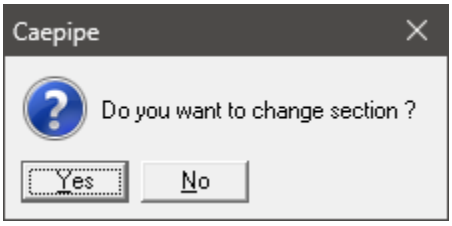
values as shown below. Once modeled, CAEPIPE will automatically perform the Pump Qualification and shows the report in Results.



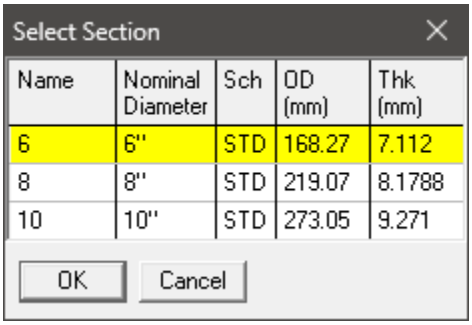


Now the 6" branch

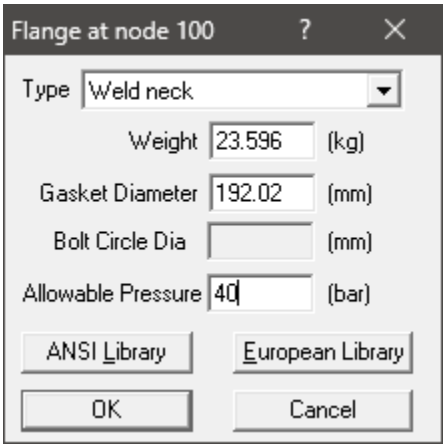
On the next row (#13), type 35 for Node, Tab to the Type column, type 'f' (for "From", since we are beginning a new branch from an existing Node 35), press Enter. In the next row (#14), type "100" in the Node column to clearly identify the new branch. Tab to DX and enter –1400. CAEPIPE inserts the previous 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 Section selection dialog.

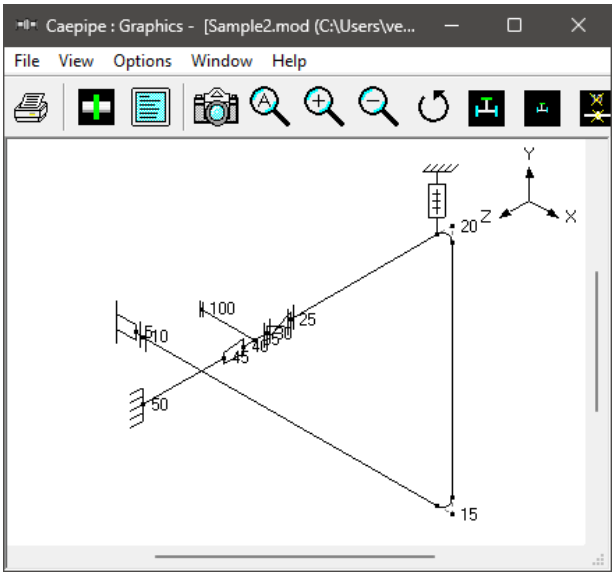


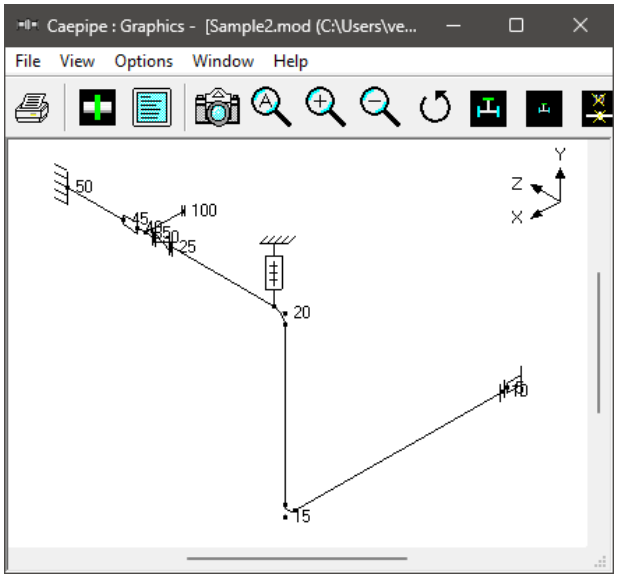
Select the 6" section by double clicking on it. The section (6) is entered in the Section column in the Layout window. The load is again automatically inserted from the previous load. Lastly, type "fl" in the Data column and hit enter to create a mating Flange. This will bring up the Flange type dialog box.

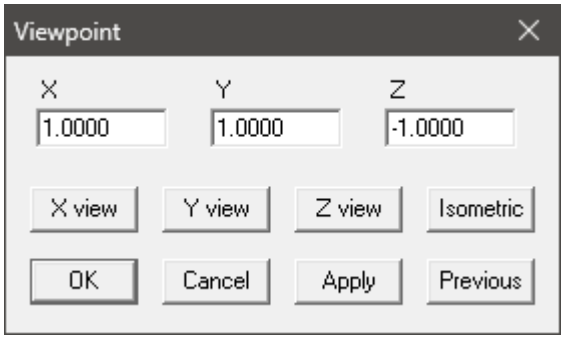


Type in 23.596 for Weight, 192.02 for Gasket Diameter, 40 for Allowable Pressure and click Ok.

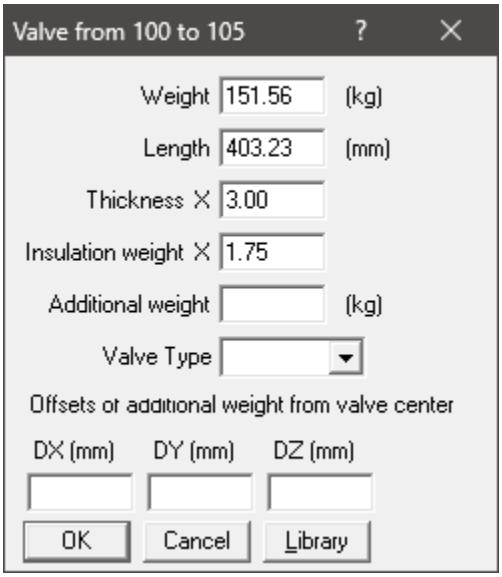
The graphics window will look like this. For better view, rotate the model by clicking the icon  and scrolling the horizontal scroll bar towards left using the mouse left button or through keyboard left arrow key. Alternatively, you can specify the viewpoint as shown below by selecting the icon  from the graphics frame.





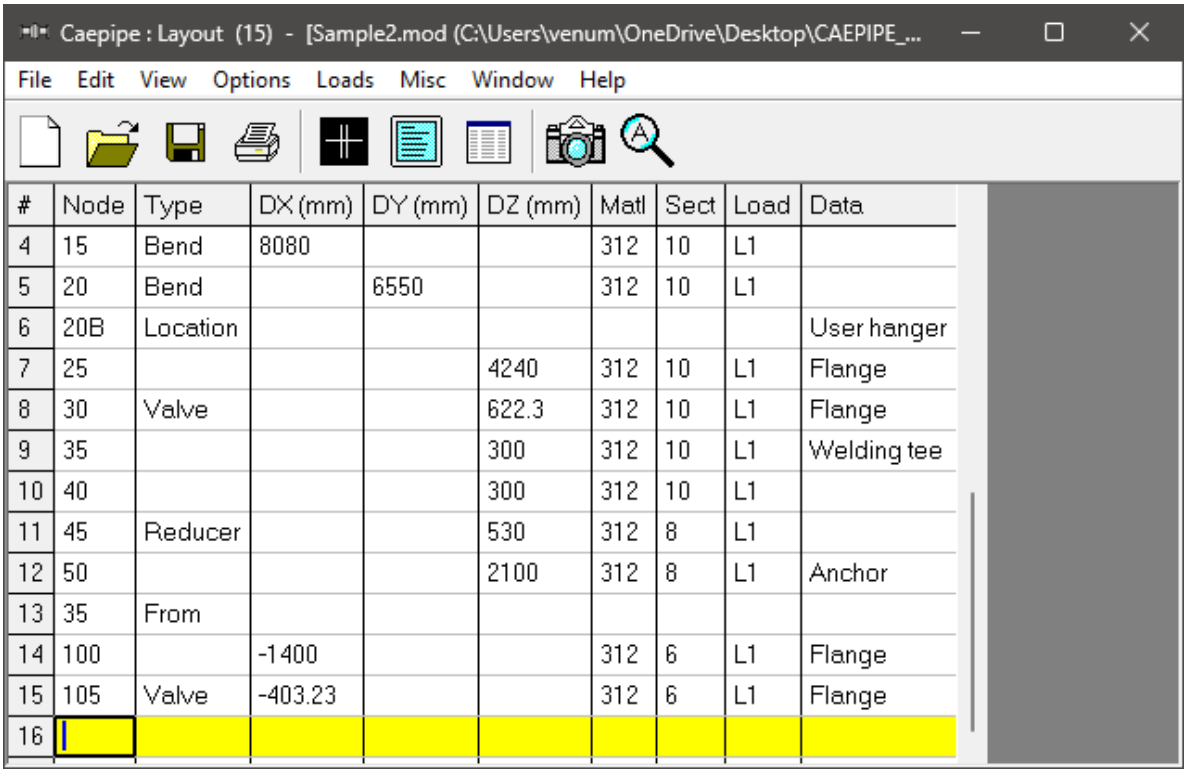


In the next row (#15), Tab to the Type column. The next Node 105 is automatically assigned. In the Type column, type 'v' (for Valve). This brings up the Valve dialog box. In the Valve dialog box, type 151.56 for Weight, 403.23 for Length, 3.00 for Thickness, and 1.75 for Insulation weight. Then press Enter or click on OK to input the valve. Press Enter again.



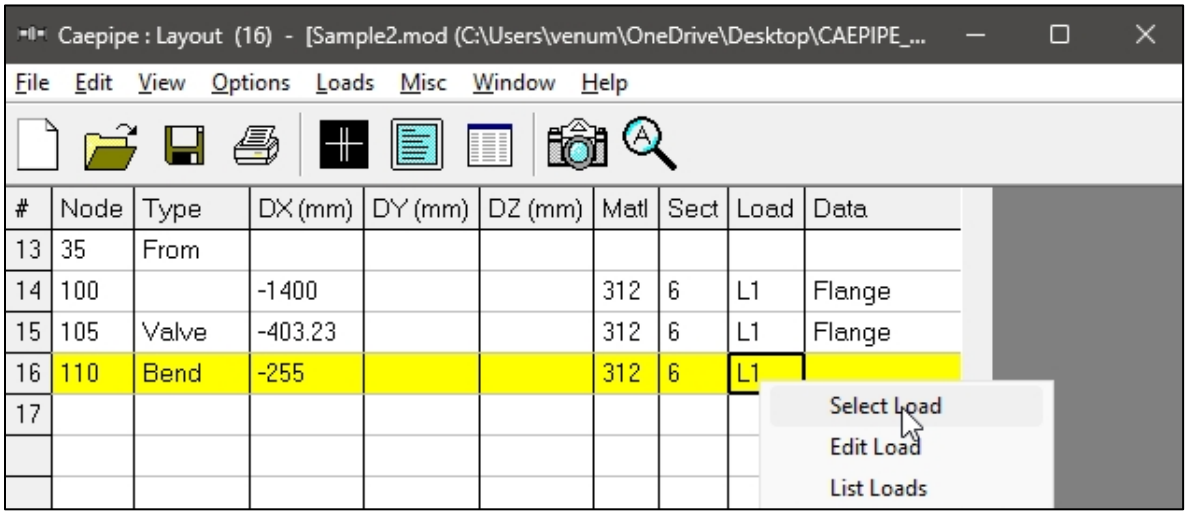
You will see that the DX, Material, Section and Load information is automatically input in the Layout window.

You can now copy the flange along with data from Node 100 and paste it at Node 105. To perform this, highlight row # 14 and press Ctrl+C. Then move the cursor to Data column of row #15 and press Ctrl+V to paste the flange. Press Enter to move to the next row.



#	Node	Type	DX (mm)	DY (mm)	DZ (mm)	Matl	Sect	Load	Data
4	15	Bend	8080			312	10	L1	
5	20	Bend		6550		312	10	L1	
6	20B	Location							User hanger
7	25				4240	312	10	L1	Flange
8	30	Valve			622.3	312	10	L1	Flange
9	35				300	312	10	L1	Welding tee
10	40				300	312	10	L1	
11	45	Reducer			530	312	8	L1	
12	50				2100	312	8	L1	Anchor
13	35	From							
14	100		-1400			312	6	L1	Flange
15	105	Valve	-403.23			312	6	L1	Flange
16									

In the next row (#16), Tab to the Type column, type "ben" to create a Long Radius Bend and then Tab to the DX column. The default LR Bend is automatically input when you Tab over. In the DX column type –255 and hit Enter. The Material, Section and Load information and is automatically input. As the Temperature and Pressure is changing from this element, change the Load from L1 to L2 by right clicking on the "L1" in the Load field.



#	Node	Type	DX (mm)	DY (mm)	DZ (mm)	Matl	Sect	Load	Data
13	35	From							
14	100		-1400			312	6	L1	Flange
15	105	Valve	-403.23			312	6	L1	Flange
16	110	Bend	-255			312	6	L1	
17									

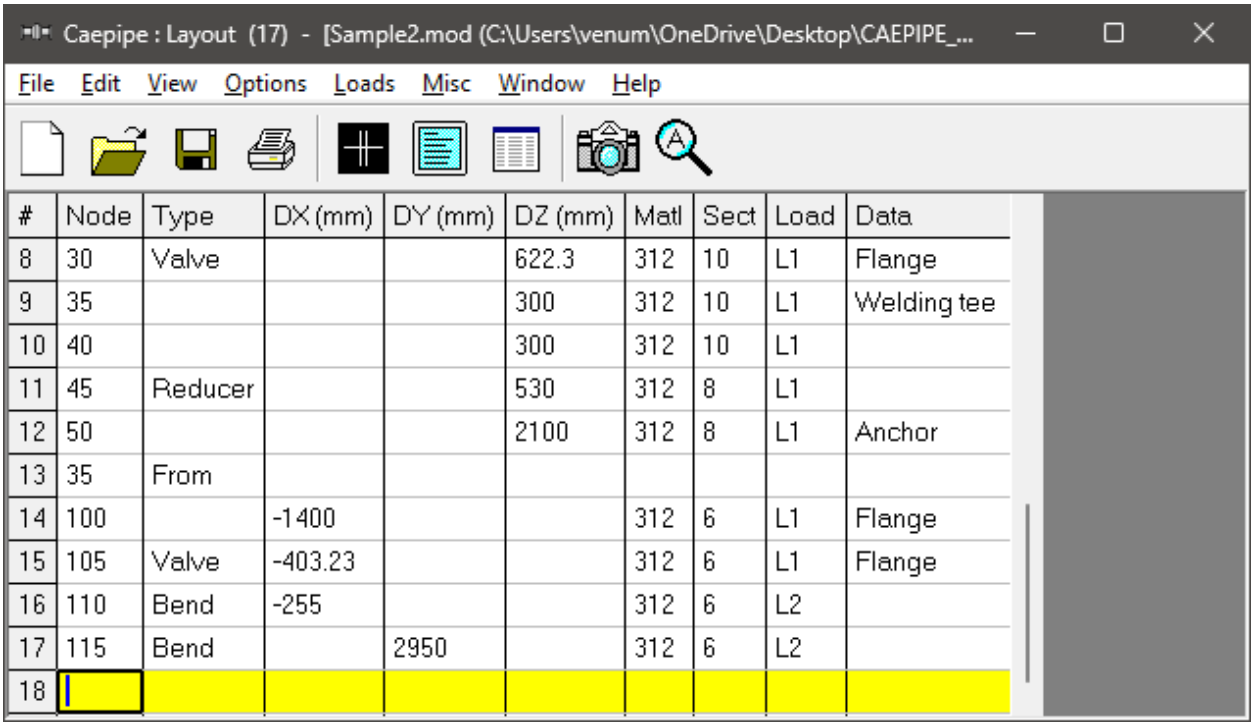
This will bring up a small Context menu from which you will choose Select Load. This will bring up the Select Load window. Highlight L2 and click Ok. Press Enter to complete inputting Node 110 at row (#16).

Select Load

Name	T1 (C)	P1 (bar)	Specific gravity	Addialog.Wgt. (kg/m)	Wind Load
L1	185	10.0	0.1		
L2	260	32.0	0.1		

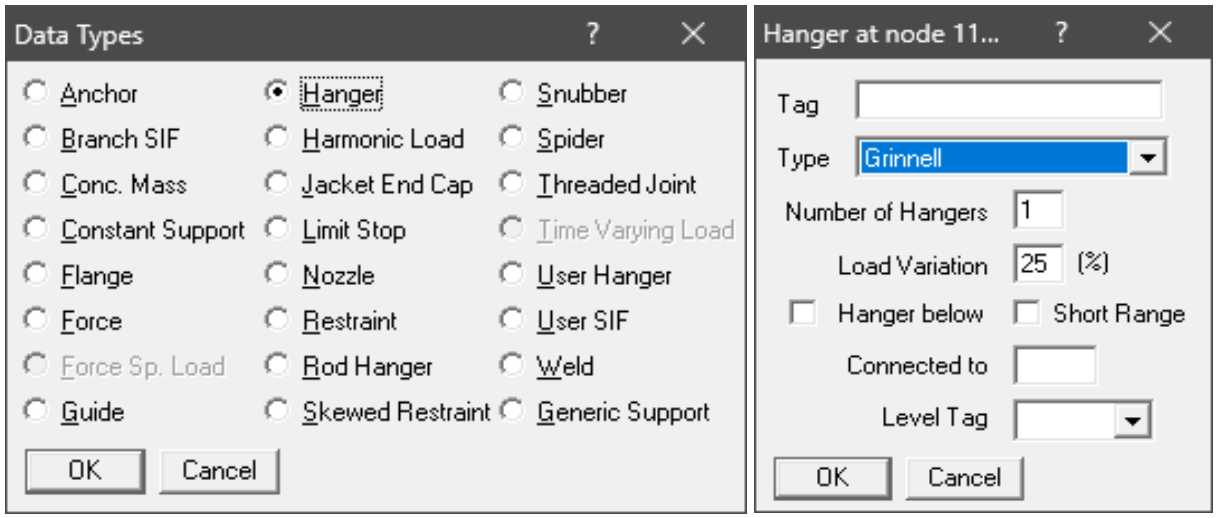
OK Cancel

In the next row (#17), create another Long Radius Bend just like the one in row (#17), except change the DX -255 to DY 2950 and press Enter. Your layout window should look like this.



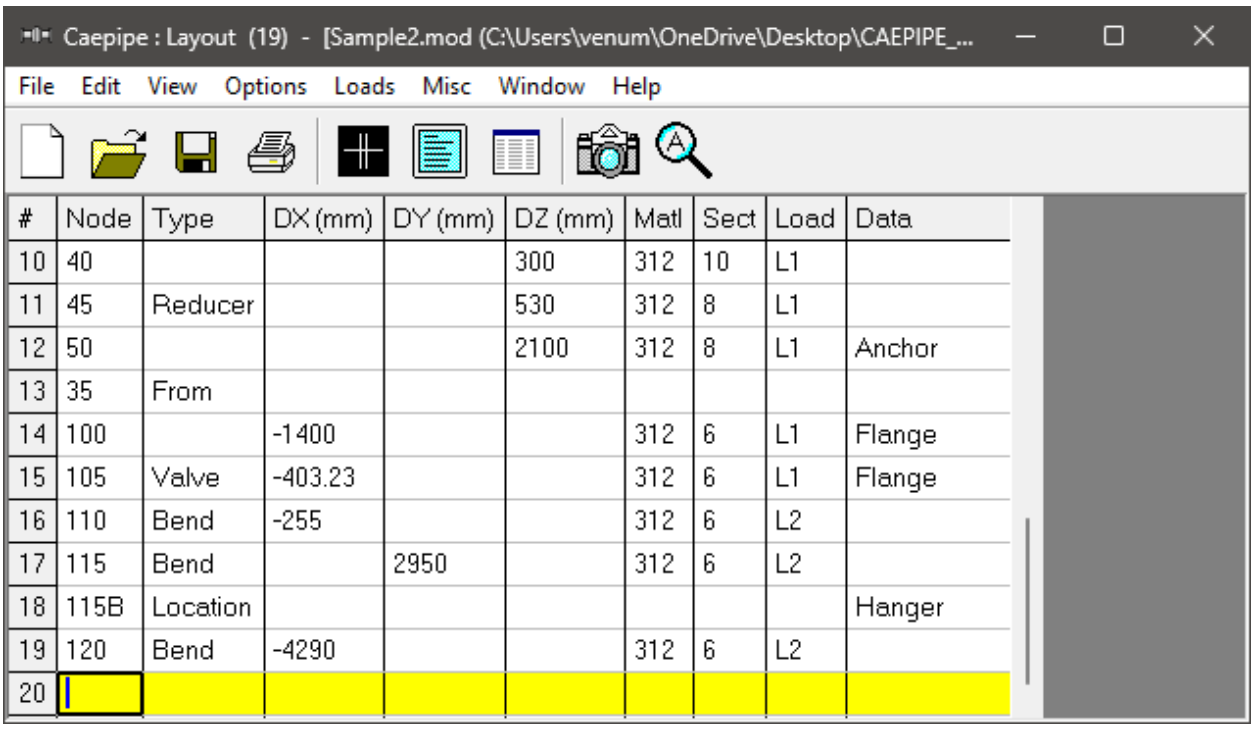
#	Node	Type	DX (mm)	DY (mm)	DZ (mm)	Matl	Sect	Load	Data
8	30	Valve			622.3	312	10	L1	Flange
9	35				300	312	10	L1	Welding tee
10	40				300	312	10	L1	
11	45	Reducer			530	312	8	L1	
12	50				2100	312	8	L1	Anchor
13	35	From							
14	100		-1400			312	6	L1	Flange
15	105	Valve	-403.23			312	6	L1	Flange
16	110	Bend	-255			312	6	L2	
17	115	Bend		2950		312	6	L2	
18									

Start the next row (#18) by typing 115B in the Node column. Tab to the Type column and type "L" to specify a Location type. This will automatically open the Data Types dialog box. Select Hanger.



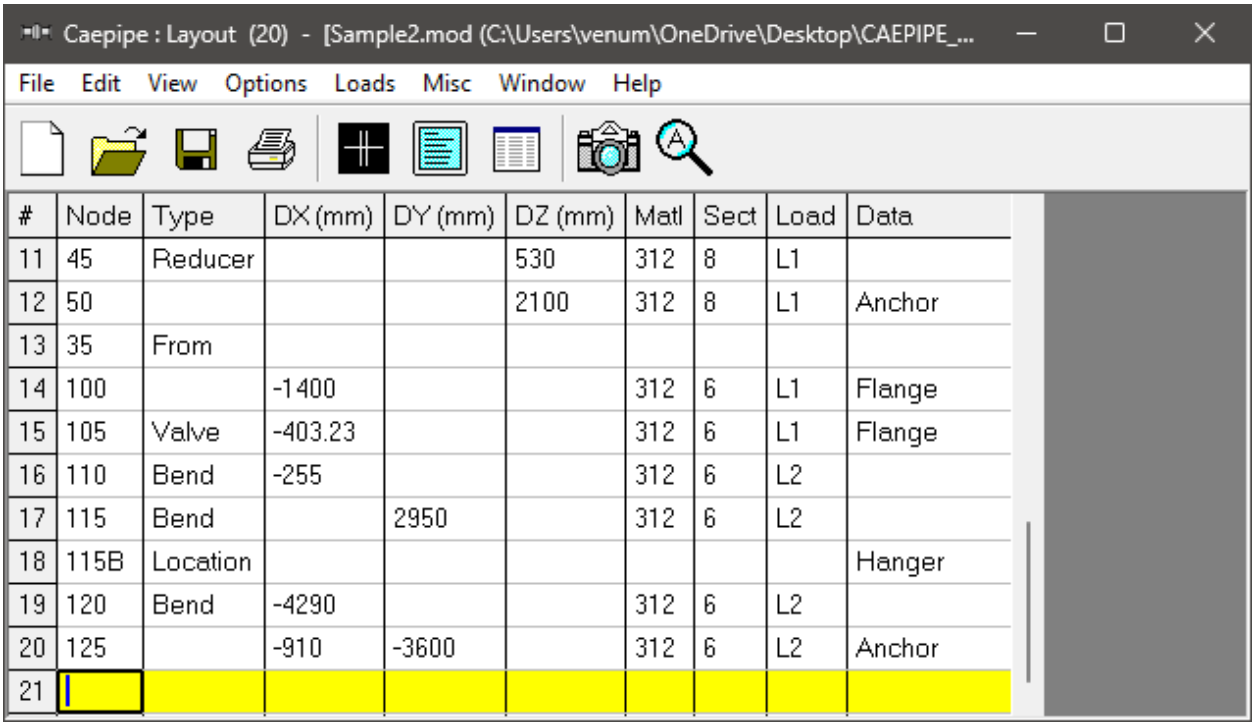
Another dialog box will appear with specific Hanger type input options. Keep the default settings and click OK.

At Node 120 on the next row (#19), Tab to the Type column and input a default LR Bend by typing "ben". Tab to the DX column and input –4290 and press Enter.



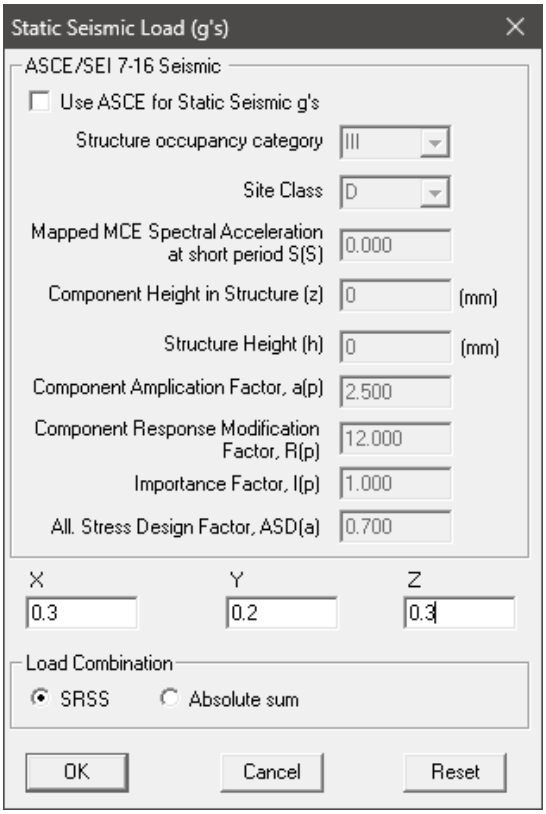
#	Node	Type	DX (mm)	DY (mm)	DZ (mm)	Matl	Sect	Load	Data
10	40				300	312	10	L1	
11	45	Reducer			530	312	8	L1	
12	50				2100	312	8	L1	Anchor
13	35	From							
14	100		-1400			312	6	L1	Flange
15	105	Valve	-403.23			312	6	L1	Flange
16	110	Bend	-255			312	6	L2	
17	115	Bend		2950		312	6	L2	
18	115B	Location							Hanger
19	120	Bend	-4290			312	6	L2	
20									

On the next row (#20), Tab over to the DX column and input -910, then in DY input –3660. Create an Anchor in the Data column by either pressing Ctrl+Shift+D or Tabbing to the Data column and typing "a". Press Enter and you are done with Layout window input.

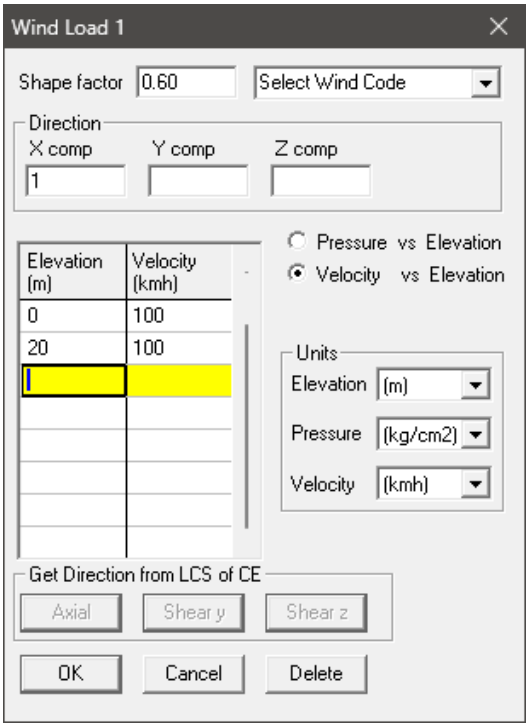


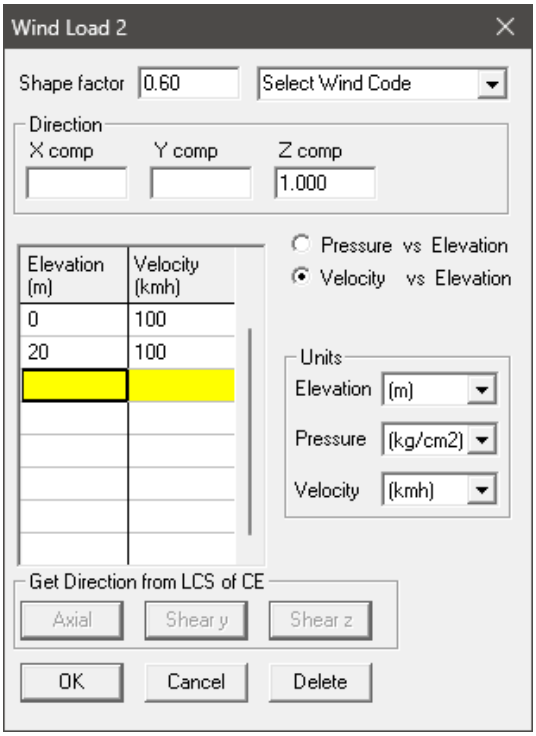
#	Node	Type	DX (mm)	DY (mm)	DZ (mm)	Matl	Sect	Load	Data
11	45	Reducer			530	312	8	L1	
12	50				2100	312	8	L1	Anchor
13	35	From							
14	100		-1400			312	6	L1	Flange
15	105	Valve	-403.23			312	6	L1	Flange
16	110	Bend	-255			312	6	L2	
17	115	Bend		2950		312	6	L2	
18	115B	Location							Hanger
19	120	Bend	-4290			312	6	L2	
20	125		-910	-3600		312	6	L2	Anchor
21									

Define "Static seismic" through Layout Window > Loads > Static Seismic. Enter the value as shown below.



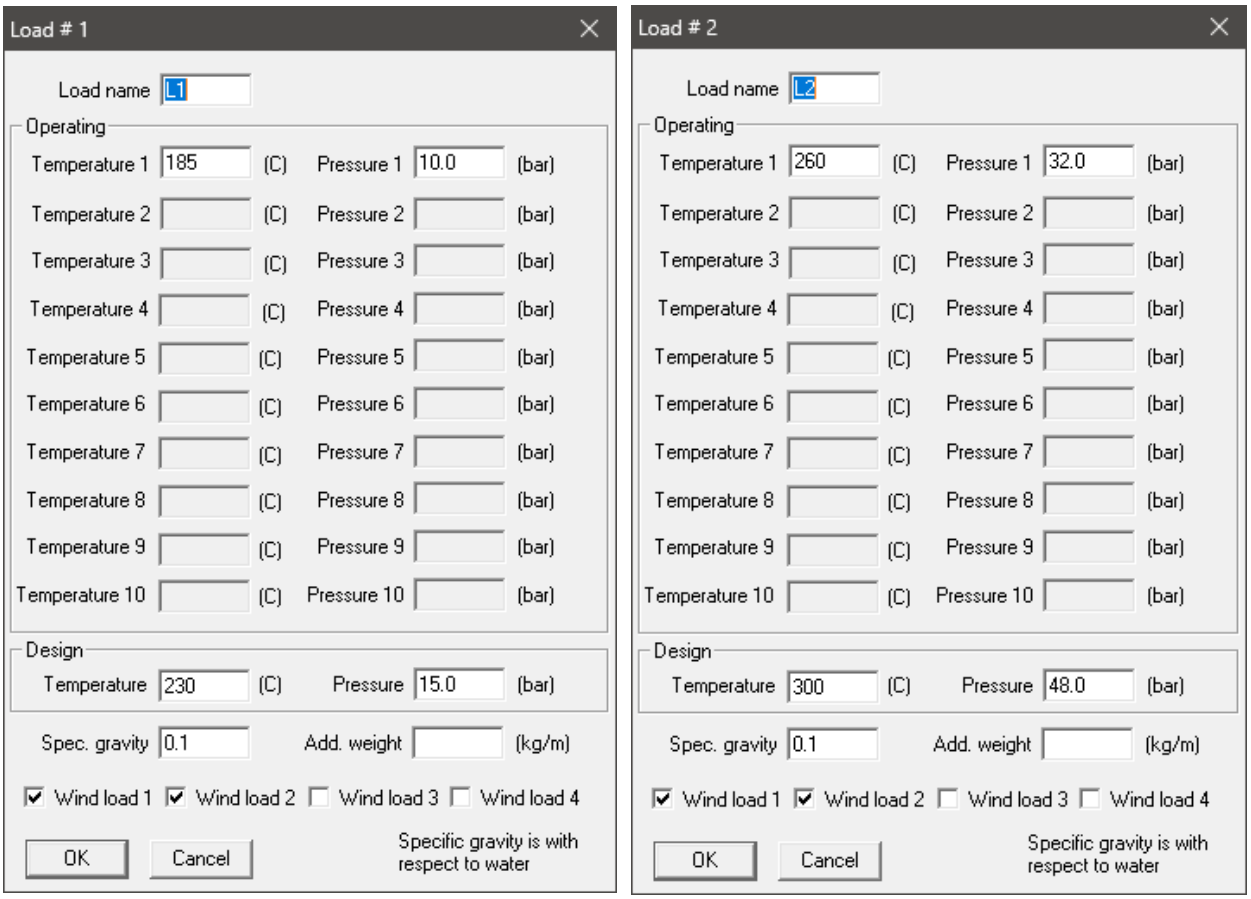
Let us define "Wind Load" profile in +X direction through Layout Window > Loads > Wind 1 and enter the data as shown below and press OK. The maximum elevation of 20m is chosen so that the entire piping system experiences wind load.





Similarly, define "Wind Load" profile in +Z direction through Layout Window > Loads > Wind 2 and enter the data as shown below and press OK.

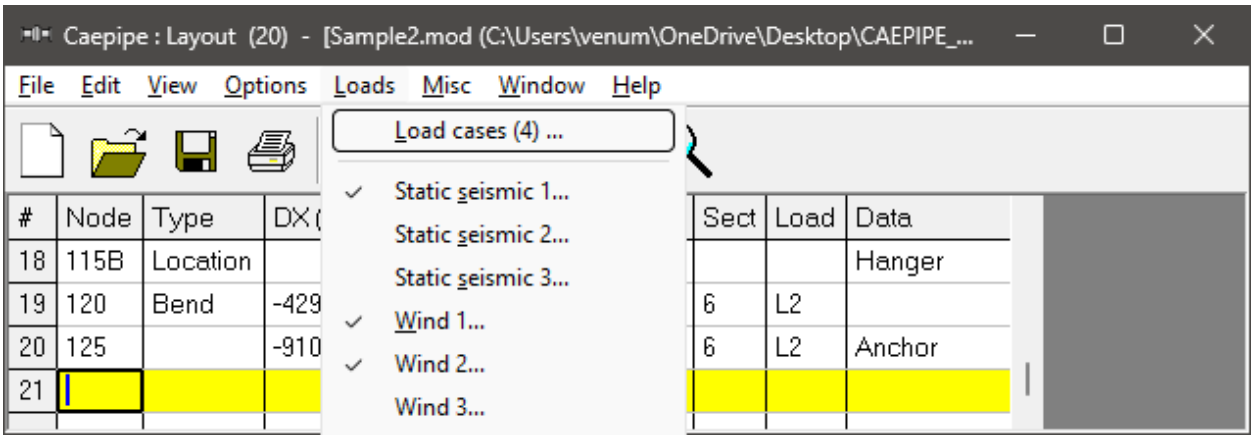
Assign the Wind Load defined above to the stress layout through Layout window > Misc > Loads and then double click on the Loads "L1" and select the check box "Wind load 1" and "Wind load 2" as shown below.



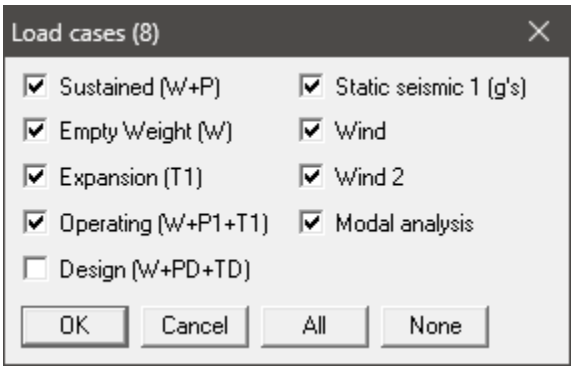
Similarly, select the check boxes "Wind load 1" and "Wind load 2" for "L2".

5. Select Load Cases for Analysis

Select Loads cases from the Loads menu.



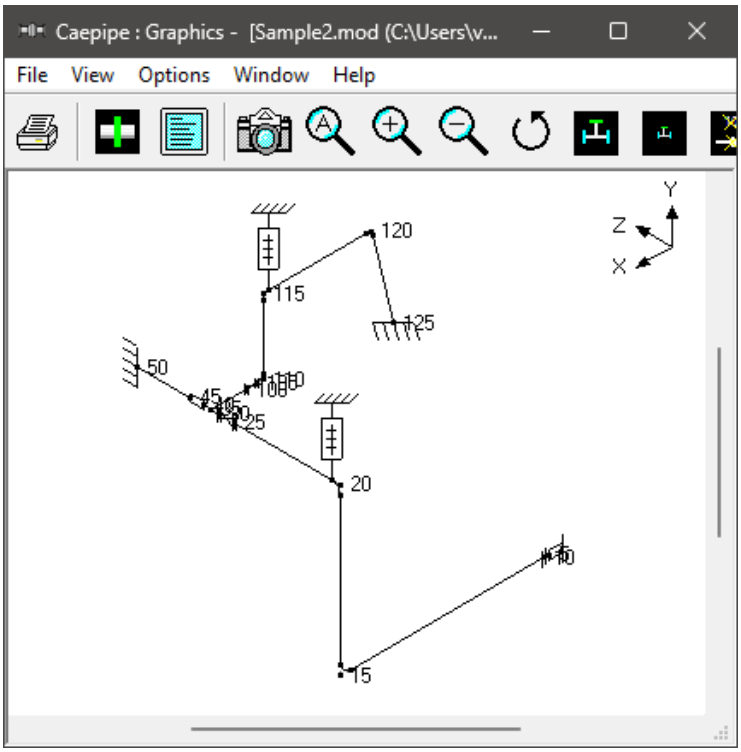
The Load cases dialog is shown.

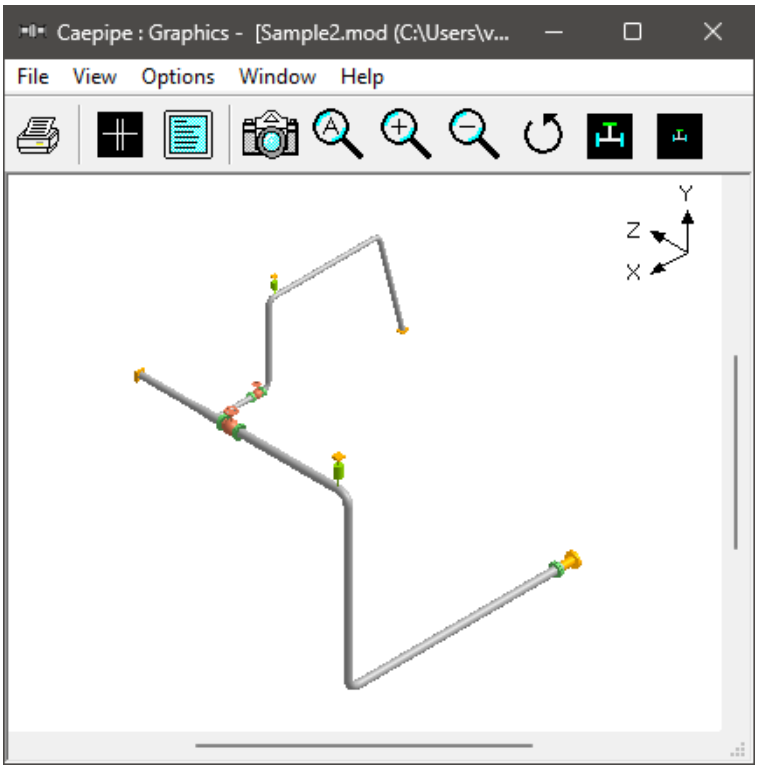


By default, Sustained (W+P), Empty Weight (W), Expansion (T1) and Operating (W+P1+T1) load cases are already selected. Add Static Seismic (g's), Wind, Wind 2, and the Modal analysis Load cases by clicking on the checkbox next to it. Design (W+PD+TD) load cases when selected for the Analysis, CAEPIPE will compute and show results for Displacements, Element Forces & Moments, Support Loads and Support Load Summary. Design load cases 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.

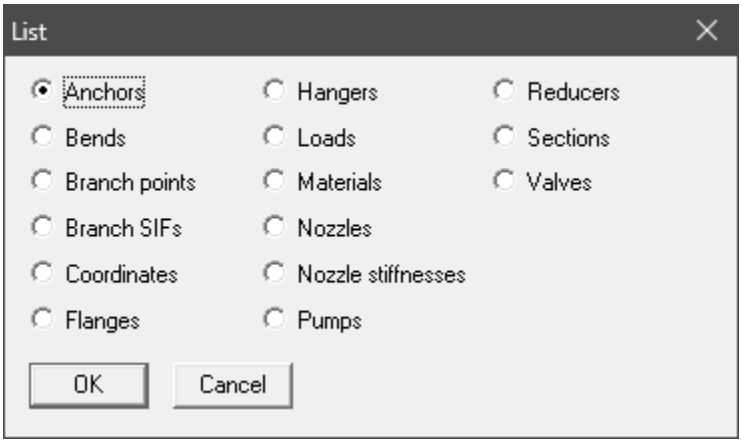




To return to the non-rendered view, click on the Do not render button (or press Ctrl+R).

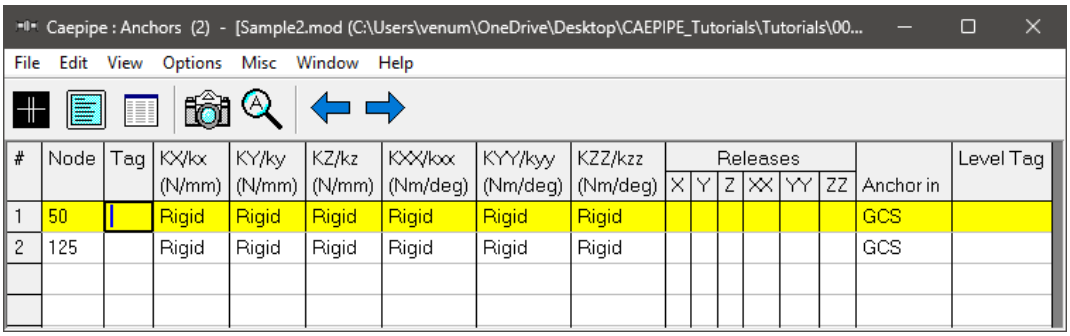
List

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.



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

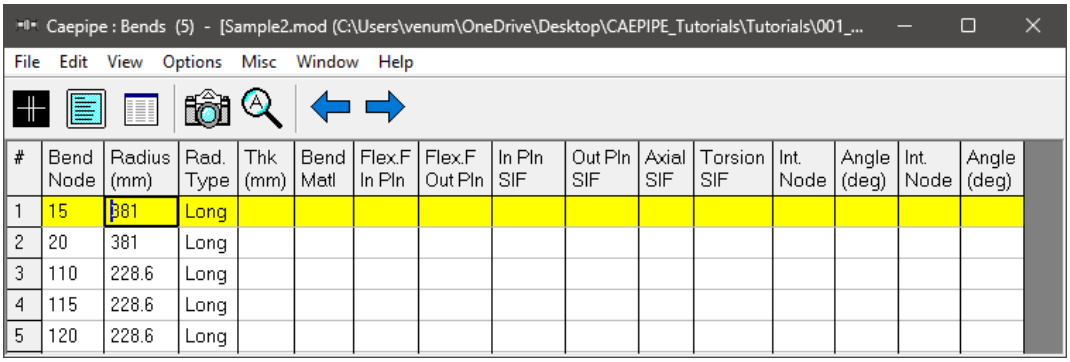
A list of all the anchors present in this sample model is shown below:



#	Node	Tag	KX/kx (N/mm)	KY/ky (N/mm)	KZ/kz (N/mm)	KXX/kxx (Nm/deg)	KYY/kyy (Nm/deg)	KZZ/kzz (Nm/deg)	Releases X	Y	Z	XX	YY	ZZ	Anchor in	Level Tag
1	50		Rigid	Rigid	Rigid	Rigid	Rigid	Rigid							GCS	
2	125		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.

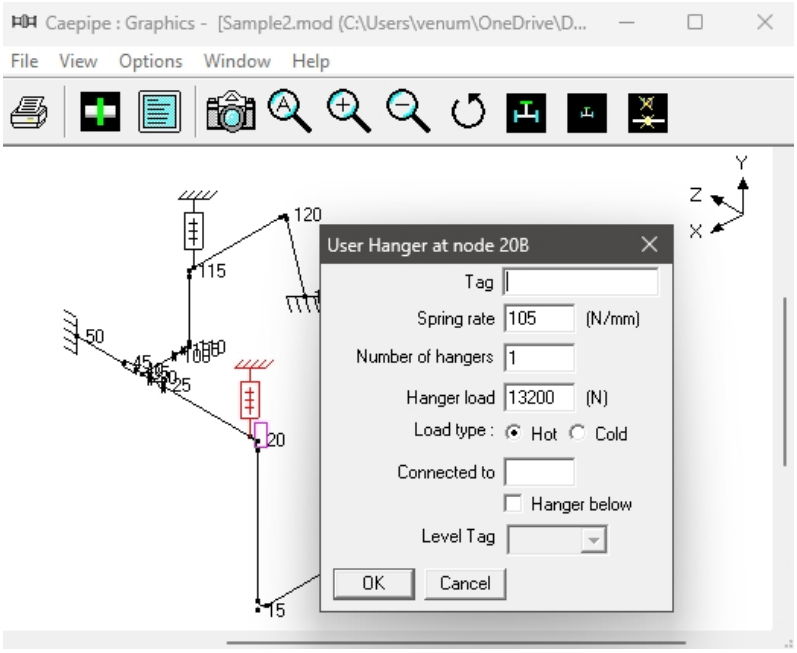
A list of all the bends in the sample model is shown below:



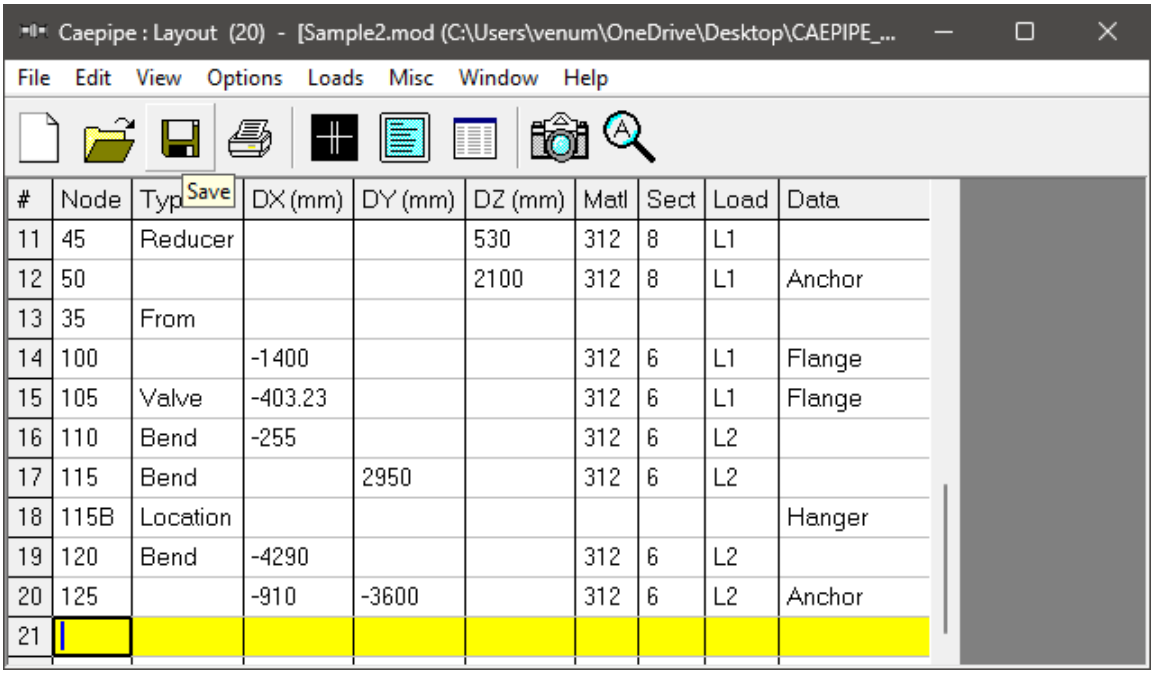
#	Bend Node	Radius (mm)	Rad. Type	Thk (mm)	Bend Matl	Flex.F In Pln	Flex.F Out Pln	In Pln SIF	Out Pln SIF	Axial SIF	Torsion SIF	Int. Node	Angle (deg)	Int. Node	Angle (deg)
1	15	381	Long												
2	20	381	Long												
3	110	228.6	Long												
4	115	228.6	Long												
5	120	228.6	Long												

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.



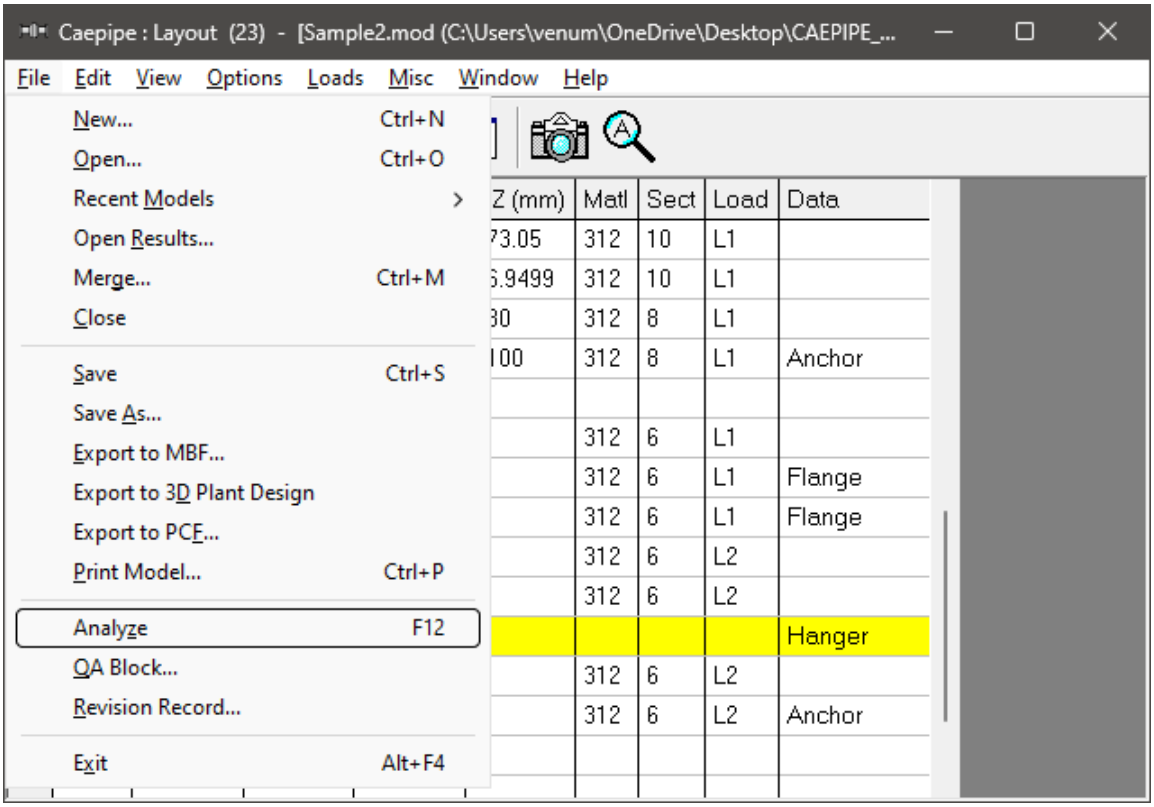

Save the model by clicking on the Save button.



#	Node	Typ	DX (mm)	DY (mm)	DZ (mm)	Matl	Sect	Load	Data
11	45	Reducer			530	312	8	L1	
12	50				2100	312	8	L1	Anchor
13	35	From							
14	100		-1400			312	6	L1	Flange
15	105	Valve	-403.23			312	6	L1	Flange
16	110	Bend	-255			312	6	L2	
17	115	Bend		2950		312	6	L2	
18	115B	Location							Hanger
19	120	Bend	-4290			312	6	L2	
20	125		-910	-3600		312	6	L2	Anchor
21									

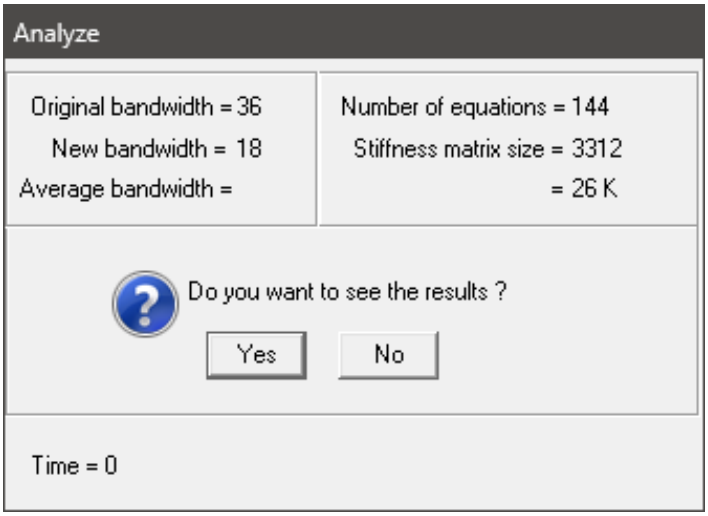
6. Analyze

Click on Analyze under the File menu.



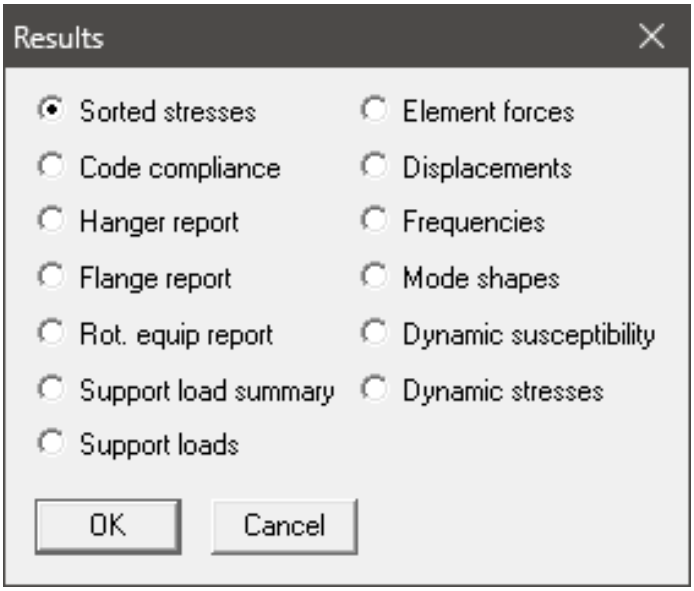
Z (mm)	Matl	Sect	Load	Data
73.05	312	10	L1	
6.9499	312	10	L1	
30	312	8	L1	
100	312	8	L1	Anchor
	312	6	L1	
	312	6	L1	Flange
	312	6	L1	Flange
	312	6	L2	
	312	6	L2	
				Hanger
	312	6	L2	
	312	6	L2	Anchor

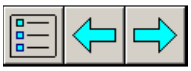
After the analysis, you are asked if you want to see the results. Select Yes.



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.





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 icon (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

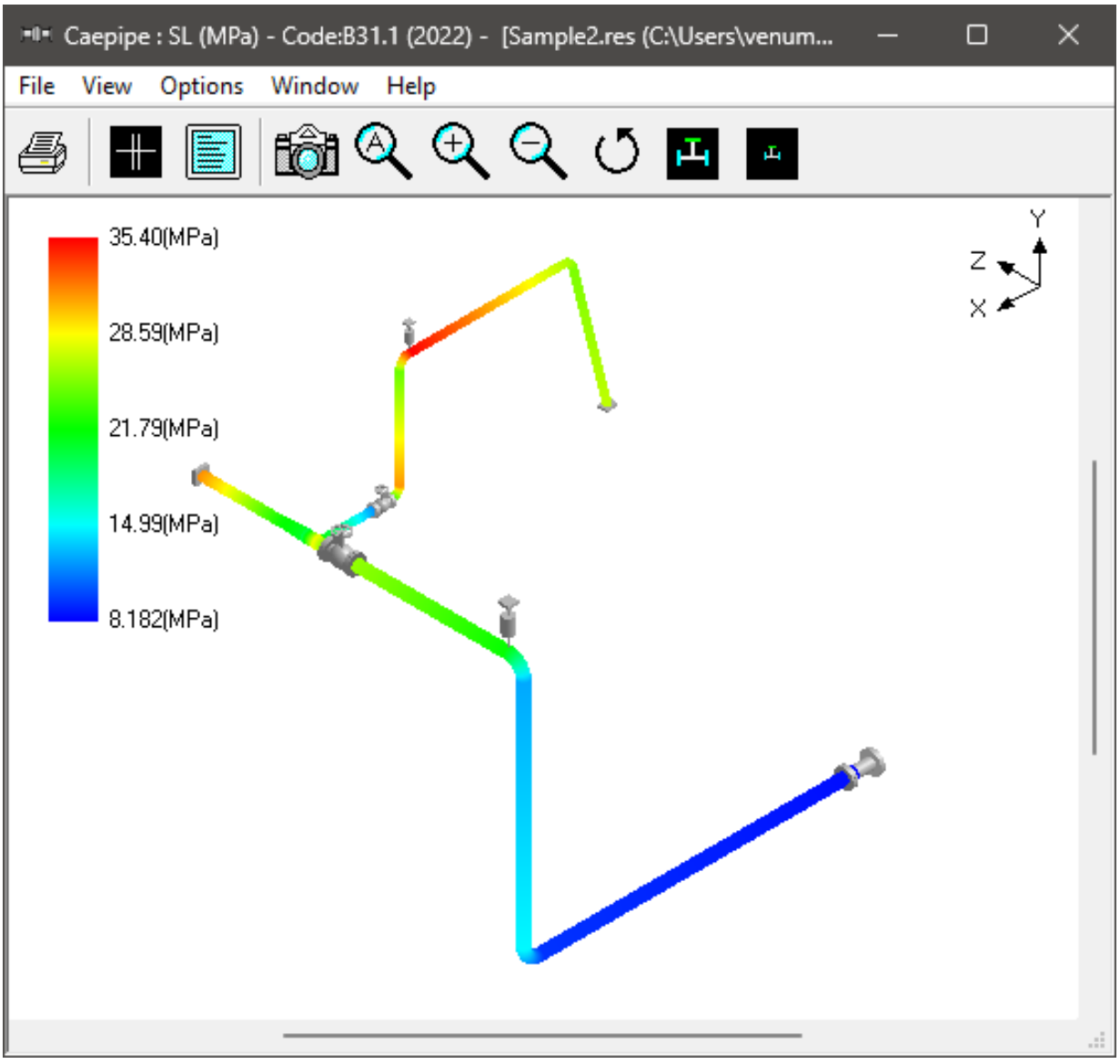
The computed stresses (sustained, expansion and occasional) are sorted in descending order by stress ratios.

Caepipe : B31.1 (2022) Code compliance (Sorted stresses) - [Sample2.res (C:\Us...

File Results View Options Window Help

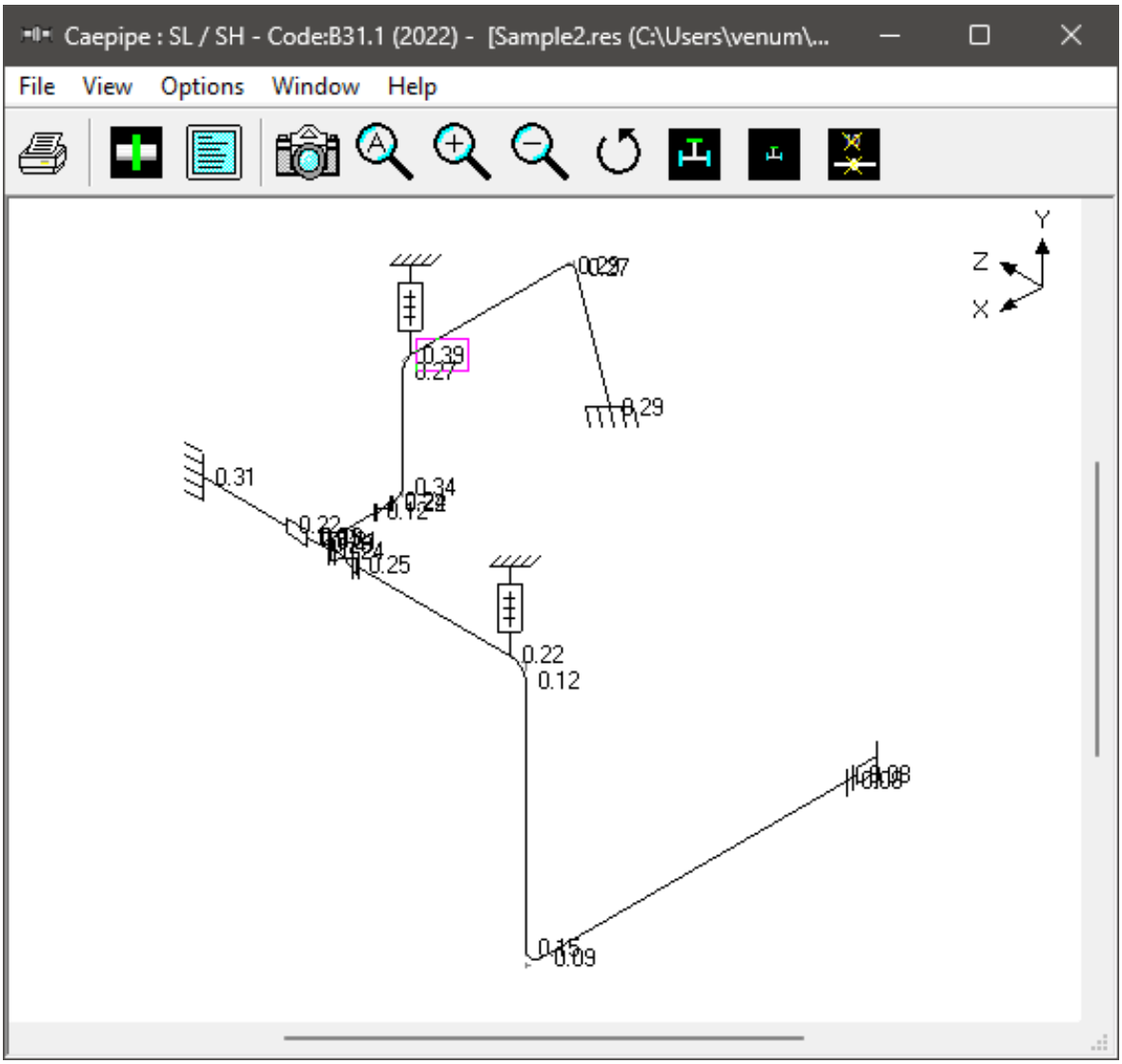
#	Sustained				Expansion				Occasional			
	Node	SL (MPa)	SH (MPa)	SL / SH	Node	SE (MPa)	SA (MPa)	SE / SA	Node	SO (MPa)	1.2SH (MPa)	SO / 1.2SH
1	115B	35.40	91.70	0.39	110A	52.93	270.8	0.20	50	78.98	122.1	0.65
2	110B	31.36	91.70	0.34	110B	46.93	261.1	0.18	125	50.75	110.0	0.46
3	50	31.82	101.7	0.31	115B	41.80	256.9	0.16	110B	41.77	110.0	0.38
4	125	26.94	91.70	0.29	125	38.98	265.6	0.15	115B	41.23	110.0	0.37
5	120A	26.51	91.70	0.29	115A	36.24	267.9	0.14	35	45.45	122.1	0.37
6	35	28.55	101.7	0.28	120A	33.61	266.0	0.13	120A	39.11	110.0	0.36
7	120B	25.12	91.70	0.27	50	34.29	273.4	0.13	20B	41.69	122.1	0.34
8	115A	24.64	91.70	0.27	35	29.54	276.7	0.11	120B	36.83	110.0	0.33
9	25	25.82	101.7	0.25	120B	27.11	267.4	0.10	45	40.32	122.1	0.33
10	110A	21.86	91.70	0.24	15A	29.96	296.2	0.10	110A	34.34	110.0	0.31
11	30	24.25	101.7	0.24	15B	26.86	290.7	0.09	65	35.03	122.1	0.29
12	55	24.02	101.7	0.24	105	24.17	272.5	0.09	115A	29.92	110.0	0.27
13	105	20.19	91.70	0.22	100	22.41	293.9	0.08	25	33.10	122.1	0.27
14	45	21.99	101.7	0.22	20B	20.32	283.5	0.07	105	29.12	110.0	0.26
15	20B	21.97	101.7	0.22	65	18.19	284.1	0.06	15B	32.20	122.1	0.26
16	65	21.37	101.7	0.21	45	16.86	283.4	0.06	30	31.59	122.1	0.26
17	40	20.90	101.7	0.21	20A	17.41	292.9	0.06	55	31.39	122.1	0.26
18	60	19.46	101.7	0.19	5	6.254	297.5	0.02	20A	30.61	122.1	0.25
19	15B	14.86	101.7	0.15	55	5.669	281.4	0.02	15A	28.51	122.1	0.23
20	20A	12.70	101.7	0.12	10	5.974	297.2	0.02	40	27.15	122.1	0.22

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 columns 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).

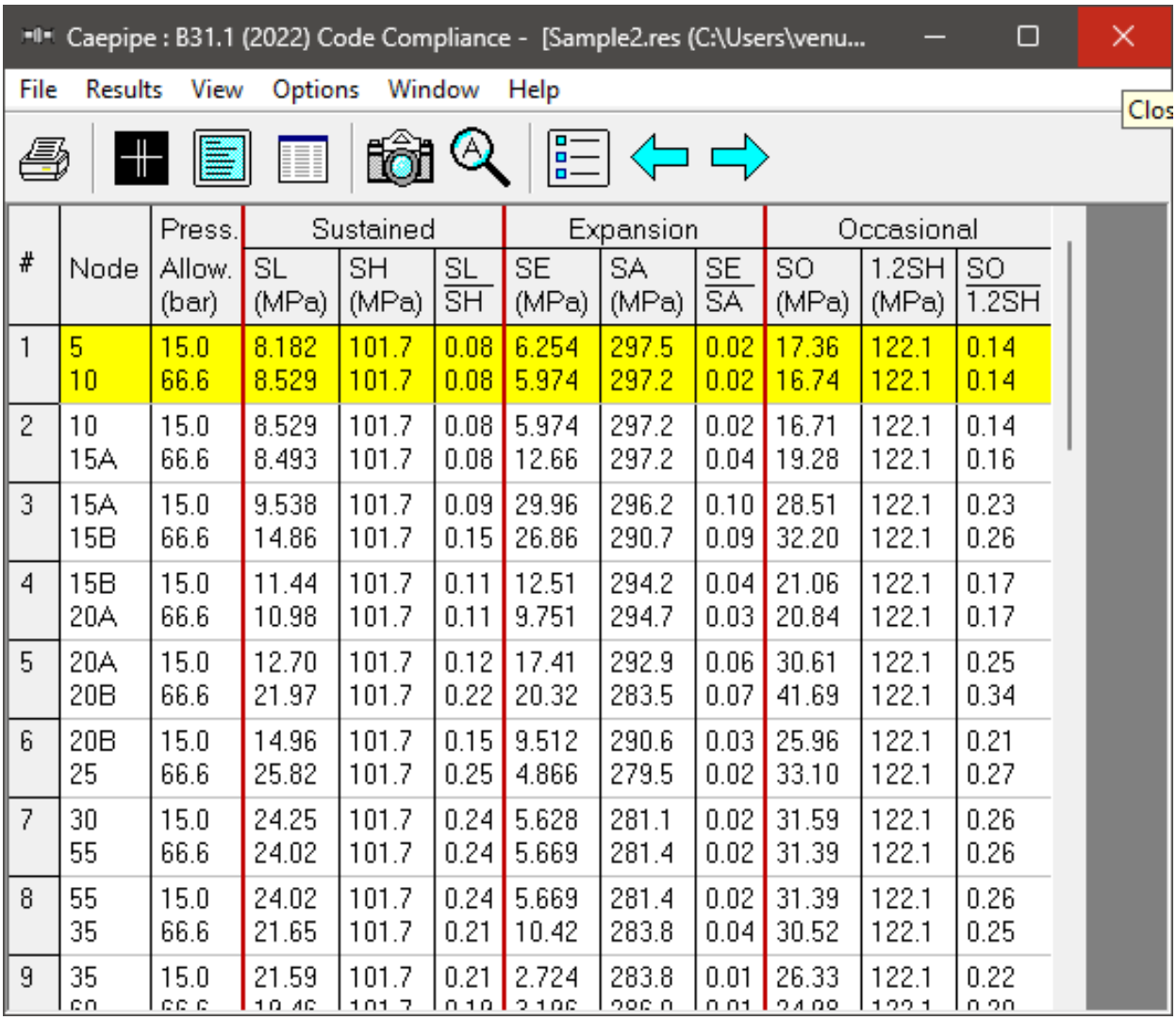
Instead of rendering color coded stresses/stress ratios, the values of stresses/stress ratios may be plotted by using the menu: View > No color coding and pressing the icon S or S/A.



While plotting stresses or stress ratios, thresholds may be specified from the graphics window (choose View > Thresholds). Only those stresses or stress ratios exceeding the threshold are plotted.

Code compliance

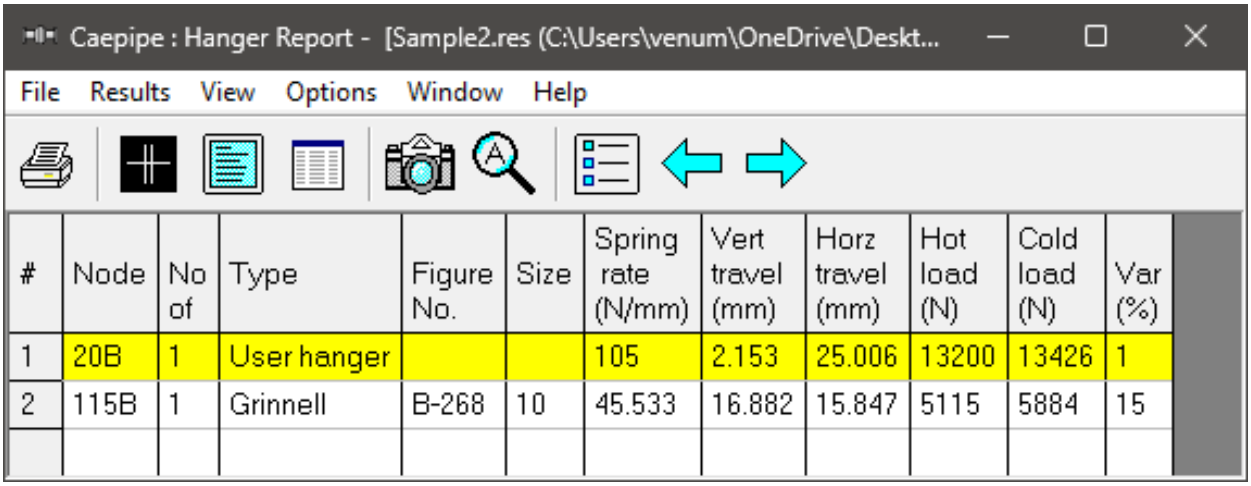
Element stresses and stress ratios calculated according to the selected piping code are shown under Code compliance. Design pressure and CAEPIPE computed Allowable pressure are shown in 2nd column.



#	Node	Press. Allow. (bar)	Sustained SL (MPa)	Sustained SH (MPa)	Sustained SL/SH	Expansion SE (MPa)	Expansion SA (MPa)	Expansion SE/SA	Occasional SO (MPa)	Occasional 1.2SH (MPa)	Occasional SO/1.2SH
1	5	15.0	8.182	101.7	0.08	6.254	297.5	0.02	17.36	122.1	0.14
	10	66.6	8.529	101.7	0.08	5.974	297.2	0.02	16.74	122.1	0.14
2	10	15.0	8.529	101.7	0.08	5.974	297.2	0.02	16.71	122.1	0.14
	15A	66.6	8.493	101.7	0.08	12.66	297.2	0.04	19.28	122.1	0.16
3	15A	15.0	9.538	101.7	0.09	29.96	296.2	0.10	28.51	122.1	0.23
	15B	66.6	14.86	101.7	0.15	26.86	290.7	0.09	32.20	122.1	0.26
4	15B	15.0	11.44	101.7	0.11	12.51	294.2	0.04	21.06	122.1	0.17
	20A	66.6	10.98	101.7	0.11	9.751	294.7	0.03	20.84	122.1	0.17
5	20A	15.0	12.70	101.7	0.12	17.41	292.9	0.06	30.61	122.1	0.25
	20B	66.6	21.97	101.7	0.22	20.32	283.5	0.07	41.69	122.1	0.34
6	20B	15.0	14.96	101.7	0.15	9.512	290.6	0.03	25.96	122.1	0.21
	25	66.6	25.82	101.7	0.25	4.866	279.5	0.02	33.10	122.1	0.27
7	30	15.0	24.25	101.7	0.24	5.628	281.1	0.02	31.59	122.1	0.26
	55	66.6	24.02	101.7	0.24	5.669	281.4	0.02	31.39	122.1	0.26
8	55	15.0	24.02	101.7	0.24	5.669	281.4	0.02	31.39	122.1	0.26
	35	66.6	21.65	101.7	0.21	10.42	283.8	0.04	30.52	122.1	0.25
9	35	15.0	21.59	101.7	0.21	2.724	283.8	0.01	26.33	122.1	0.22
	60	66.6	19.46	101.7	0.19	3.196	286.0	0.01	24.08	122.1	0.20

Hanger report

The hanger report is shown below.



#	Node	No of	Type	Figure No.	Size	Spring rate (N/mm)	Vert travel (mm)	Horz travel (mm)	Hot load (N)	Cold load (N)	Var (%)
1	20B	1	User hanger			105	2.153	25.006	13200	13426	1
2	115B	1	Grinnell	B-268	10	45.533	16.882	15.847	5115	5884	15

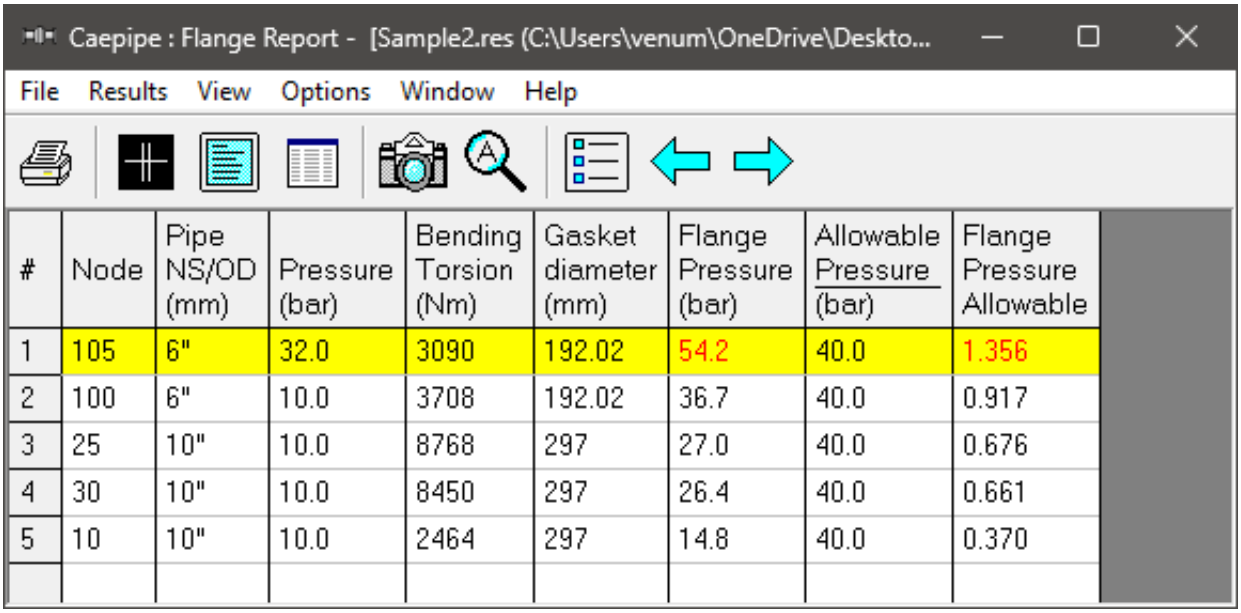
The "No of" field shows the number of hangers required at the indicated location. The Figure No. and Size refer to the manufacturer's catalog. The vertical travel (also referred to as "Hanger travel") is the vertical deflection at the hanger location for the first operating load case. Similarly, the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

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

Flange report

The Flange report in the CAEPIPE results window shows the loads at each flange location for the operating case (W+P1+T1).

The Flange Pressure is an "equivalent pressure" calculated from the actual pressure in the piping element, the bending moment and the axial force on the flange for the first operating case (W+P1+T1).



#	Node	Pipe NS/OD (mm)	Pressure (bar)	Bending Torsion (Nm)	Gasket diameter (mm)	Flange Pressure (bar)	Allowable Pressure (bar)	Flange Pressure Allowable
1	105	6"	32.0	3090	192.02	54.2	40.0	1.356
2	100	6"	10.0	3708	192.02	36.7	40.0	0.917
3	25	10"	10.0	8768	297	27.0	40.0	0.676
4	30	10"	10.0	8450	297	26.4	40.0	0.661
5	10	10"	10.0	2464	297	14.8	40.0	0.370

The last column shows a ratio of this "equivalent" Flange Pressure to a user-input Allowable Pressure. This ratio is flagged in red when it exceeds 1.0.

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.

Note: Allowable loads at an equipment nozzle can be calculated using the module "Nozzle Evaluation" available in CAEPIPE through Main Frame > New > Nozzle Evaluation.

The allowable loads thus calculated can then be entered as "User Allowables" in CAEPIPE Stress Model through Layout window > Misc. See the CAEPIPE tutorial titled "*Tutorial on Qualification of Nozzles to Equipment using CAEPIPE*" for more details.

Caepipe : Support load summary for anchor at node 50 - [Sample2.res (...

File Results View Options Window Help

Load combination	FX (N)	FY (N)	FZ (N)	MX (Nm)	MY (Nm)	MZ (Nm)
Empty Weight	-360	-4992	25	-4871	1556	-1057
Sustained	-330	-5482	7	-6729	1287	-1106
Operating1	2754	-5675	1078	-6457	-8087	-615
Sustained+Wind	878	-5602	151	-7396	-2594	-1786
Operating1+Wind	3962	-5795	1222	-7124	-11969	-1295
Sustained+Wind 2	-314	-5252	1816	-6761	1271	-1222
Operating1+Wind 2	2770	-5445	2887	-6489	-8104	-731
Sustained+Seismic 1	3544	-2665	6506	1726	12102	456
Sustained-Seismic 1	-4203	-8298	-6492	-15184	-9527	-2669
Operating1+Seismic 1	6628	-2858	7577	1998	2727	947
Operating1-Seismic 1	-1119	-8491	-5421	-14912	-18902	-2177
Maximum	6628	-2665	7577	1998	12102	947
Minimum	-4203	-8491	-6492	-15184	-18902	-2669
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.).

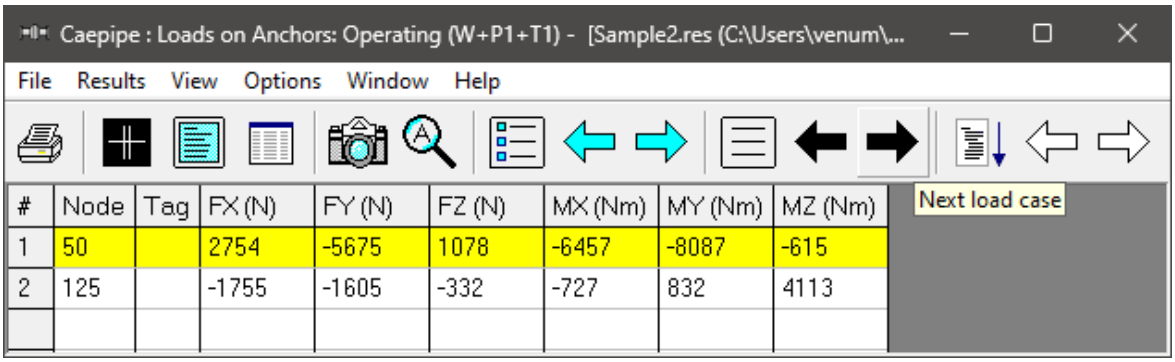
Support load summary

Node	Type
50	Anchor
125	Anchor
20B	User hanger
115B	Hanger
5	Nozzle

OK Cancel

Support loads

Support loads are the loads acting on all the supports of each support type for a specific loading case. The loads on anchors for the Operating load case are shown below.

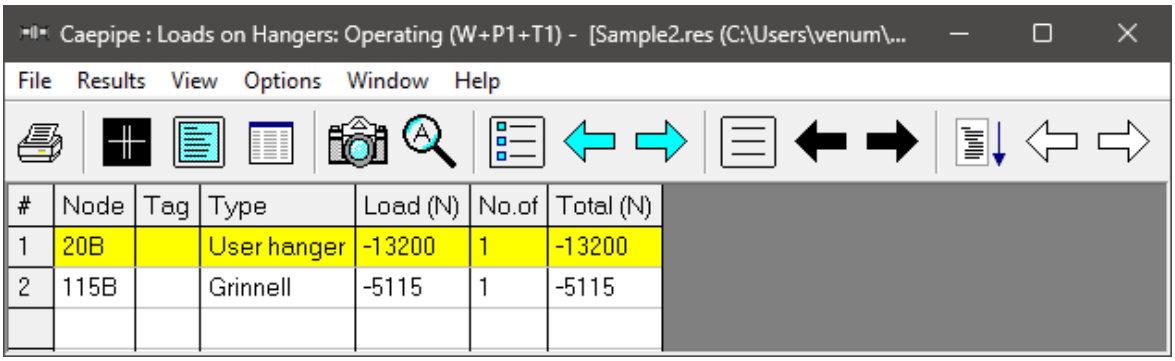


#	Node	Tag	FX (N)	FY (N)	FZ (N)	MX (Nm)	MY (Nm)	MZ (Nm)
1	50		2754	-5675	1078	-6457	-8087	-615
2	125		-1755	-1605	-332	-727	832	4113

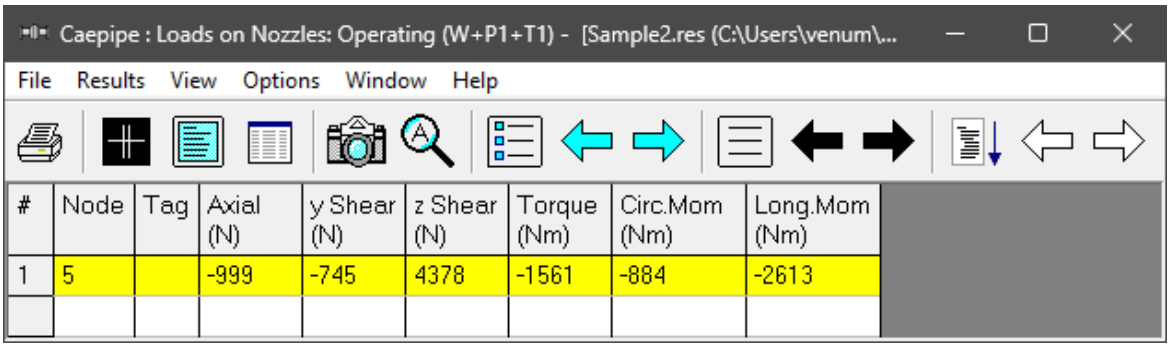
Use the Load cases button, Next load case button (Right arrow) or Previous load case button (Left arrow) to see loads for different load cases (e.g. Sustained, Expansion etc.).

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

The loads on hangers (i.e. the loads acting at the hanger locations imposed by the piping system) and the loads on the nozzle for the Operating case are shown below.



#	Node	Tag	Type	Load (N)	No.of	Total (N)
1	20B		User hanger	-13200	1	-13200
2	115B		Grinnell	-5115	1	-5115

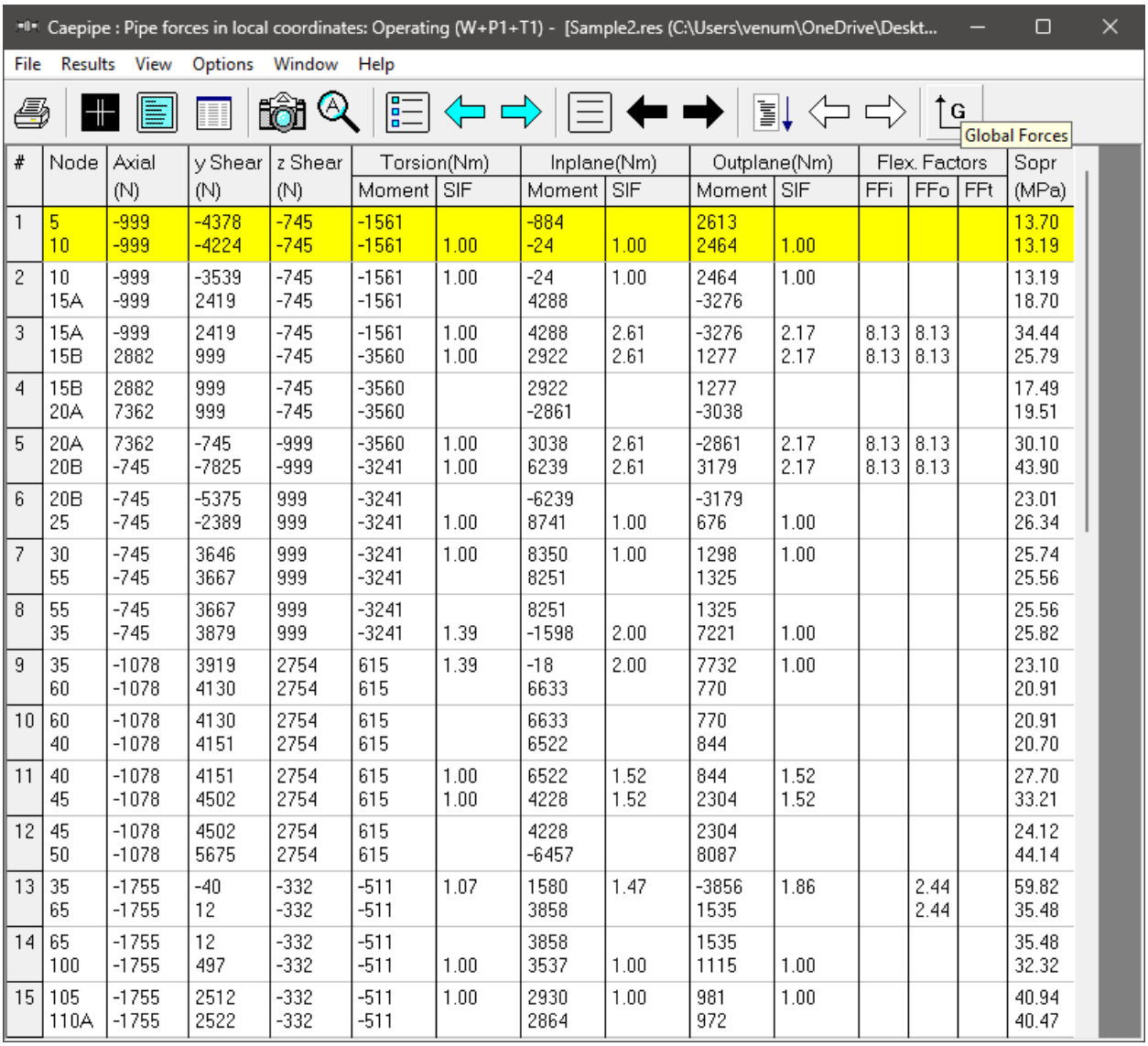


#	Node	Tag	Axial (N)	y Shear (N)	z Shear (N)	Torque (Nm)	Circ.Mom (Nm)	Long.Mom (Nm)
1	5		-999	-745	4378	-1561	-884	-2613

Element forces

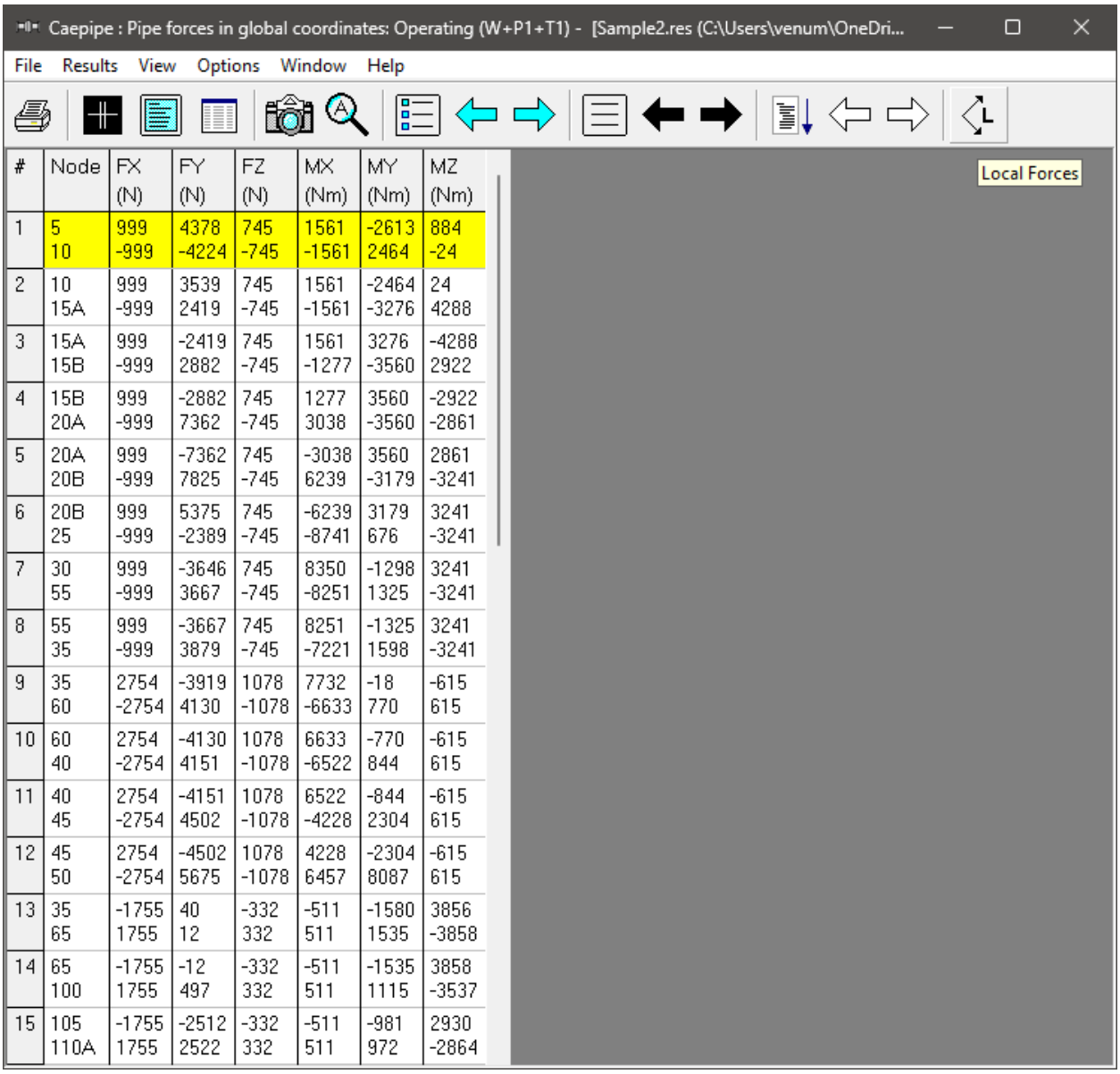
For pipe (also bend and reducer), element forces in local coordinates, Stress Intensification Factors (SIF) and stresses are shown by default for the selected load case.

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



#	Node	Axial (N)	y Shear (N)	z Shear (N)	Torsion(Nm) Moment	Torsion(Nm) SIF	Inplane(Nm) Moment	Inplane(Nm) SIF	Outplane(Nm) Moment	Outplane(Nm) SIF	Flex. Factors FFi	Flex. Factors FFo	Flex. Factors FFt	Sopr (MPa)
1	5 10	-999 -999	-4378 -4224	-745 -745	-1561 -1561	1.00	-884 -24	1.00	2613 2464	1.00				13.70 13.19
2	10 15A	-999 -999	-3539 2419	-745 -745	-1561 -1561	1.00	-24 4288	1.00	2464 -3276	1.00				13.19 18.70
3	15A 15B	-999 2882	2419 999	-745 -745	-1561 -3560	1.00 1.00	4288 2922	2.61 2.61	-3276 1277	2.17 2.17	8.13 8.13	8.13 8.13		34.44 25.79
4	15B 20A	2882 7362	999 999	-745 -745	-3560 -3560		2922 -2861		1277 -3038					17.49 19.51
5	20A 20B	7362 -745	-745 -7825	-999 -999	-3560 -3241	1.00 1.00	3038 6239	2.61 2.61	-2861 3179	2.17 2.17	8.13 8.13	8.13 8.13		30.10 43.90
6	20B 25	-745 -745	-5375 -2389	999 999	-3241 -3241	1.00	-6239 8741	1.00	-3179 676	1.00				23.01 26.34
7	30 55	-745 -745	3646 3667	999 999	-3241 -3241	1.00	8350 8251	1.00	1298 1325	1.00				25.74 25.56
8	55 35	-745 -745	3667 3879	999 999	-3241 -3241	1.39	8251 -1598	2.00	1325 7221	1.00				25.56 25.82
9	35 60	-1078 -1078	3919 4130	2754 2754	615 615	1.39	-18 6633	2.00	7732 770	1.00				23.10 20.91
10	60 40	-1078 -1078	4130 4151	2754 2754	615 615		6633 6522		770 844					20.91 20.70
11	40 45	-1078 -1078	4151 4502	2754 2754	615 615	1.00 1.00	6522 4228	1.52 1.52	844 2304	1.52 1.52				27.70 33.21
12	45 50	-1078 -1078	4502 5675	2754 2754	615 615		4228 -6457		2304 8087					24.12 44.14
13	35 65	-1755 -1755	-40 12	-332 -332	-511 -511	1.07	1580 3858	1.47	-3856 1535	1.86		2.44 2.44		59.82 35.48
14	65 100	-1755 -1755	12 497	-332 -332	-511 -511	1.00	3858 3537	1.00	1535 1115	1.00				35.48 32.32
15	105 110A	-1755 -1755	2512 2522	-332 -332	-511 -511	1.00	2930 2864	1.00	981 972	1.00				40.94 40.47

Use the Global forces button (F7) to see the element forces in global coordinates.

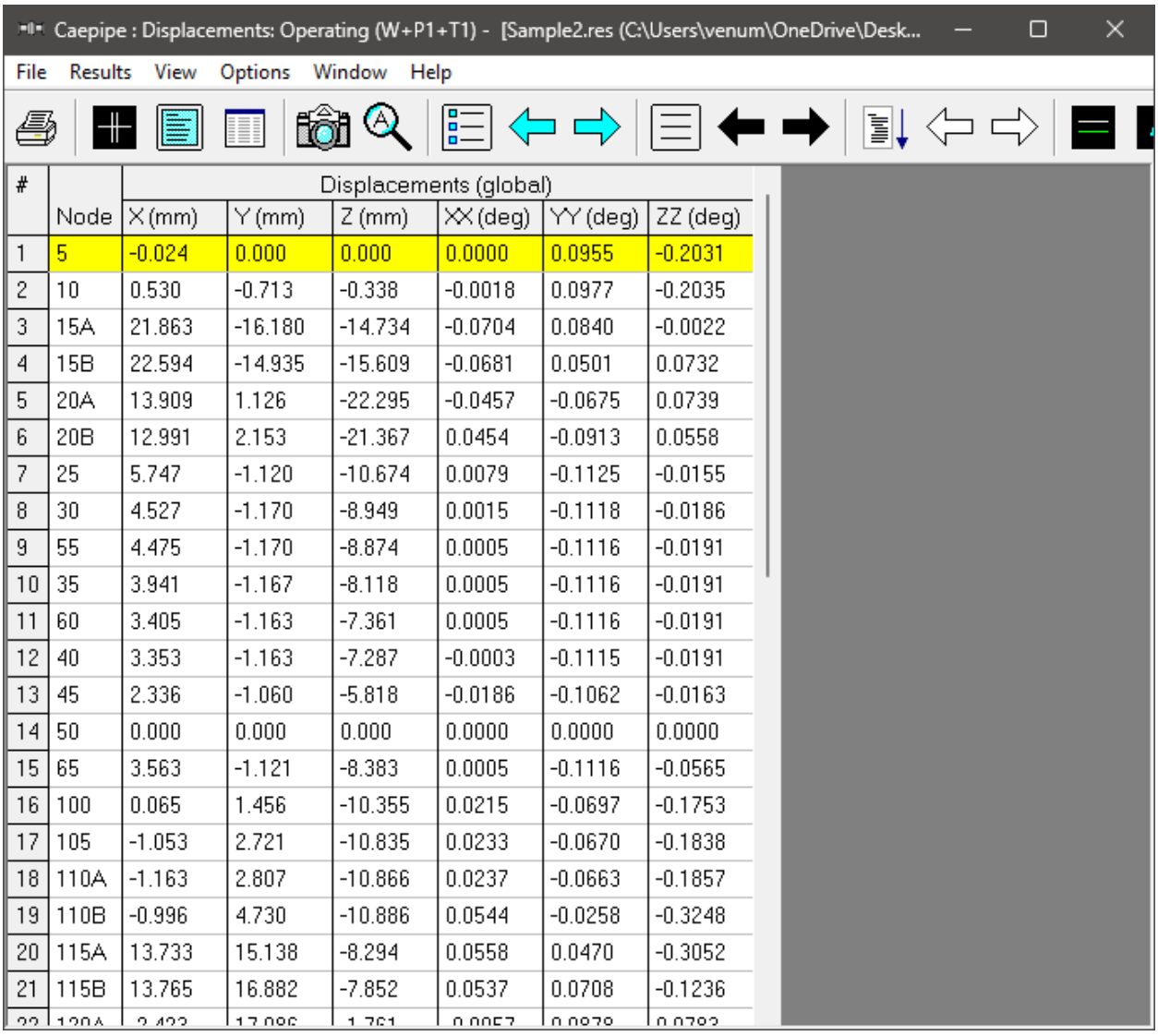


#	Node	FX (N)	FY (N)	FZ (N)	MX (Nm)	MY (Nm)	MZ (Nm)
1	5 10	999 -999	4378 -4224	745 -745	1561 -1561	-2613 2464	884 -24
2	10 15A	999 -999	3539 2419	745 -745	1561 -1561	-2464 -3276	24 4288
3	15A 15B	999 -999	-2419 2882	745 -745	1561 -1277	3276 -3560	-4288 2922
4	15B 20A	999 -999	-2882 7362	745 -745	1277 3038	3560 -3560	-2922 -2861
5	20A 20B	999 -999	-7362 7825	745 -745	-3038 6239	3560 -3179	2861 -3241
6	20B 25	999 -999	5375 -2389	745 -745	-6239 -8741	3179 676	3241 -3241
7	30 55	999 -999	-3646 3667	745 -745	8350 -8251	-1298 1325	3241 -3241
8	55 35	999 -999	-3667 3879	745 -745	8251 -7221	-1325 1598	3241 -3241
9	35 60	2754 -2754	-3919 4130	1078 -1078	7732 -6633	-18 770	-615 615
10	60 40	2754 -2754	-4130 4151	1078 -1078	6633 -6522	-770 844	-615 615
11	40 45	2754 -2754	-4151 4502	1078 -1078	6522 -4228	-844 2304	-615 615
12	45 50	2754 -2754	-4502 5675	1078 -1078	4228 6457	-2304 8087	-615 615
13	35 65	-1755 1755	40 12	-332 332	-511 511	-1580 1535	3856 -3858
14	65 100	-1755 1755	-12 497	-332 332	-511 511	-1535 1115	3858 -3537
15	105 110A	-1755 1755	-2512 2522	-332 332	-511 511	-981 972	2930 -2864

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.).

Displacements

The nodal displacements are shown.

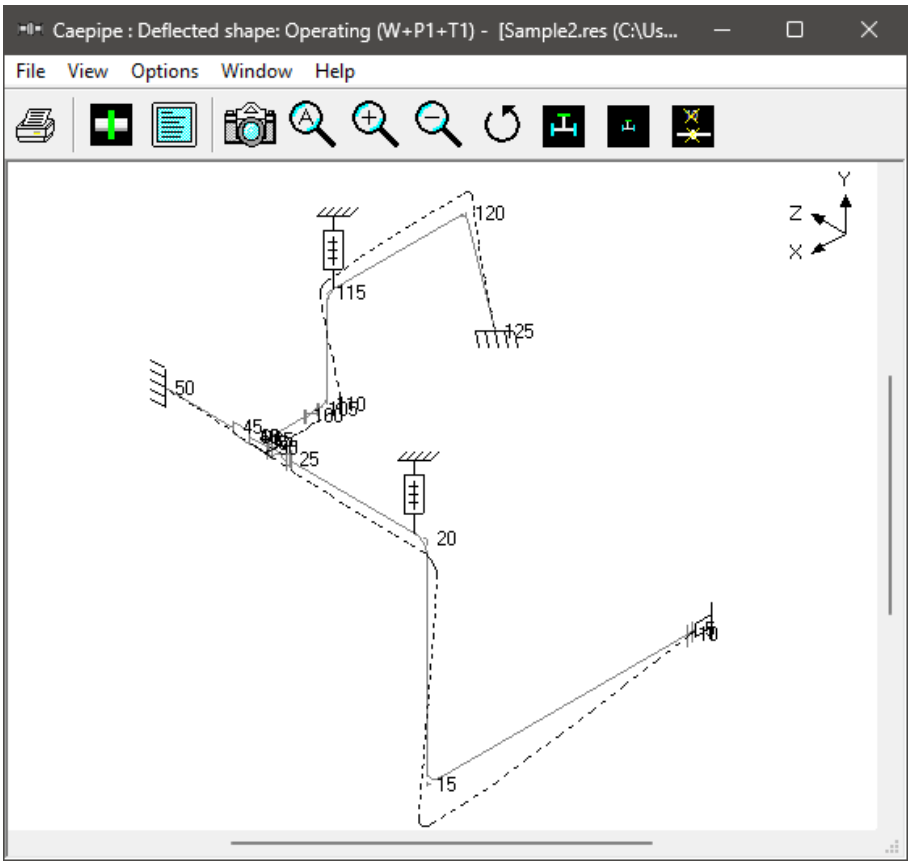


#	Node	Displacements (global) X (mm)	Y (mm)	Z (mm)	XX (deg)	YY (deg)	ZZ (deg)
1	5	-0.024	0.000	0.000	0.0000	0.0955	-0.2031
2	10	0.530	-0.713	-0.338	-0.0018	0.0977	-0.2035
3	15A	21.863	-16.180	-14.734	-0.0704	0.0840	-0.0022
4	15B	22.594	-14.935	-15.609	-0.0681	0.0501	0.0732
5	20A	13.909	1.126	-22.295	-0.0457	-0.0675	0.0739
6	20B	12.991	2.153	-21.367	0.0454	-0.0913	0.0558
7	25	5.747	-1.120	-10.674	0.0079	-0.1125	-0.0155
8	30	4.527	-1.170	-8.949	0.0015	-0.1118	-0.0186
9	55	4.475	-1.170	-8.874	0.0005	-0.1116	-0.0191
10	35	3.941	-1.167	-8.118	0.0005	-0.1116	-0.0191
11	60	3.405	-1.163	-7.361	0.0005	-0.1116	-0.0191
12	40	3.353	-1.163	-7.287	-0.0003	-0.1115	-0.0191
13	45	2.336	-1.060	-5.818	-0.0186	-0.1062	-0.0163
14	50	0.000	0.000	0.000	0.0000	0.0000	0.0000
15	65	3.563	-1.121	-8.383	0.0005	-0.1116	-0.0565
16	100	0.065	1.456	-10.355	0.0215	-0.0697	-0.1753
17	105	-1.053	2.721	-10.835	0.0233	-0.0670	-0.1838
18	110A	-1.163	2.807	-10.866	0.0237	-0.0663	-0.1857
19	110B	-0.996	4.730	-10.886	0.0544	-0.0258	-0.3248
20	115A	13.733	15.138	-8.294	0.0558	0.0470	-0.3052
21	115B	13.765	16.882	-7.852	0.0537	0.0708	-0.1236
22	120A	2.423	17.086	1.761	0.0057	0.0878	0.0783

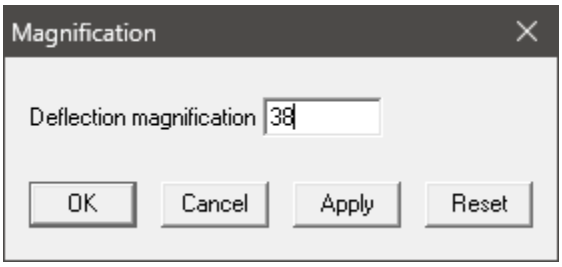
Use the Load cases button, Next load case button (Right arrow) or Previous load case button (Left arrow) to see loads for different load cases(e.g. Sustained, Expansion etc.).

Use the 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.



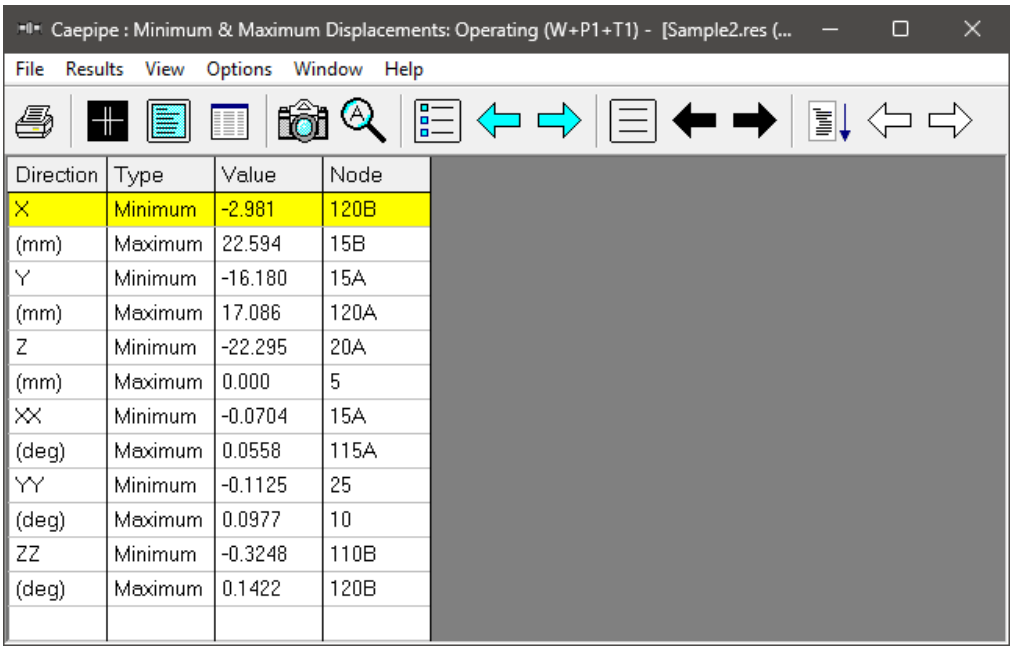
Choose View > Magnification to change the magnification of the deflected shape.



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.

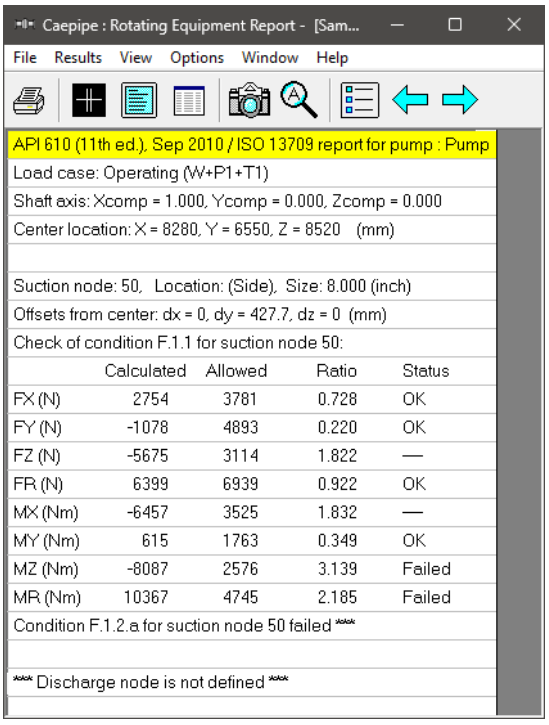
Use the Other displacements button (F6), Next displacement button (Ctrl+Right arrow) or Previous displacement button (Ctrl+Left arrow) to see other displacements (e.g. Min/Max, displacements at hangers, flex joints, limit stops etc.).

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



Direction	Type	Value	Node
X	Minimum	-2.981	120B
(mm)	Maximum	22.594	15B
Y	Minimum	-16.180	15A
(mm)	Maximum	17.086	120A
Z	Minimum	-22.295	20A
(mm)	Maximum	0.000	5
XX	Minimum	-0.0704	15A
(deg)	Maximum	0.0558	115A
YY	Minimum	-0.1125	25
(deg)	Maximum	0.0977	10
ZZ	Minimum	-0.3248	110B
(deg)	Maximum	0.1422	120B

The Pump qualification report (Rotating Equipment report) is shown below.



API 610 (11th ed.), Sep 2010 / ISO 13709 report for pump : Pump
Load case: Operating (W+P1+T1)
Shaft axis: Xcomp = 1.000, Ycomp = 0.000, Zcomp = 0.000
Center location: X = 8280, Y = 6550, Z = 8520 (mm)

Suction node: 50, Location: (Side), Size: 8.000 (inch)
Offsets from center: dx = 0, dy = 427.7, dz = 0 (mm)
Check of condition F.1.1 for suction node 50:

	Calculated	Allowed	Ratio	Status
FX (N)	2754	3781	0.728	OK
FY (N)	-1078	4893	0.220	OK
FZ (N)	-5675	3114	1.822	—
FR (N)	6399	6939	0.922	OK
MX (Nm)	-6457	3525	1.832	—
MY (Nm)	615	1763	0.349	OK
MZ (Nm)	-8087	2576	3.139	Failed
MR (Nm)	10367	4745	2.185	Failed

Condition F.1.2.a for suction node 50 failed ****

**** Discharge node is not defined ****

Frequencies and Mode shapes

A list of natural frequencies, periods, modal participation factors and modal mass fractions is shown next. You can show each frequency's mode shape graphically or animate it by clicking on Show mode shape or Show animated mode shape button in the toolbar.

Caepipe : Frequencies - [Sample2.res (C:\Users\venum\OneDrive\Des...

File Results View Options Window Help

#	Frequency (Hz)	Period (second)	Participation factors			Modal mass / Total mass		
			X	Y	Z	X	Y	Z
1	1.703	0.5872	0.7395	-1.9310	1.2246	0.0314	0.2138	0.0860
2	2.458	0.4069	0.8526	-2.2220	-1.5016	0.0417	0.2831	0.1293
3	2.675	0.3739	-2.4950	-1.3661	0.2625	0.3570	0.1070	0.0040
4	4.158	0.2405	-0.3444	0.3579	-1.2489	0.0068	0.0073	0.0894
5	6.661	0.1501	0.8111	-1.2509	0.1106	0.0377	0.0897	0.0007
6	6.761	0.1479	0.9343	0.6600	-0.0140	0.0501	0.0250	0.0000
7	7.456	0.1341	0.0803	-0.1084	-0.1687	0.0004	0.0007	0.0016
8	9.959	0.1004	1.2280	0.1913	-0.1710	0.0865	0.0021	0.0017
9	11.629	0.0860	0.0727	-0.9579	0.0383	0.0003	0.0526	0.0001
10	13.281	0.0753	-0.6669	-0.0590	-1.1835	0.0255	0.0002	0.0803
11	30.952	0.0323	-2.2993	-0.0525	0.0055	0.3032	0.0002	0.0000
12	53.862	0.0186	-0.1820	0.1712	-0.5697	0.0019	0.0017	0.0186
13					Total	0.9423	0.7834	0.4117

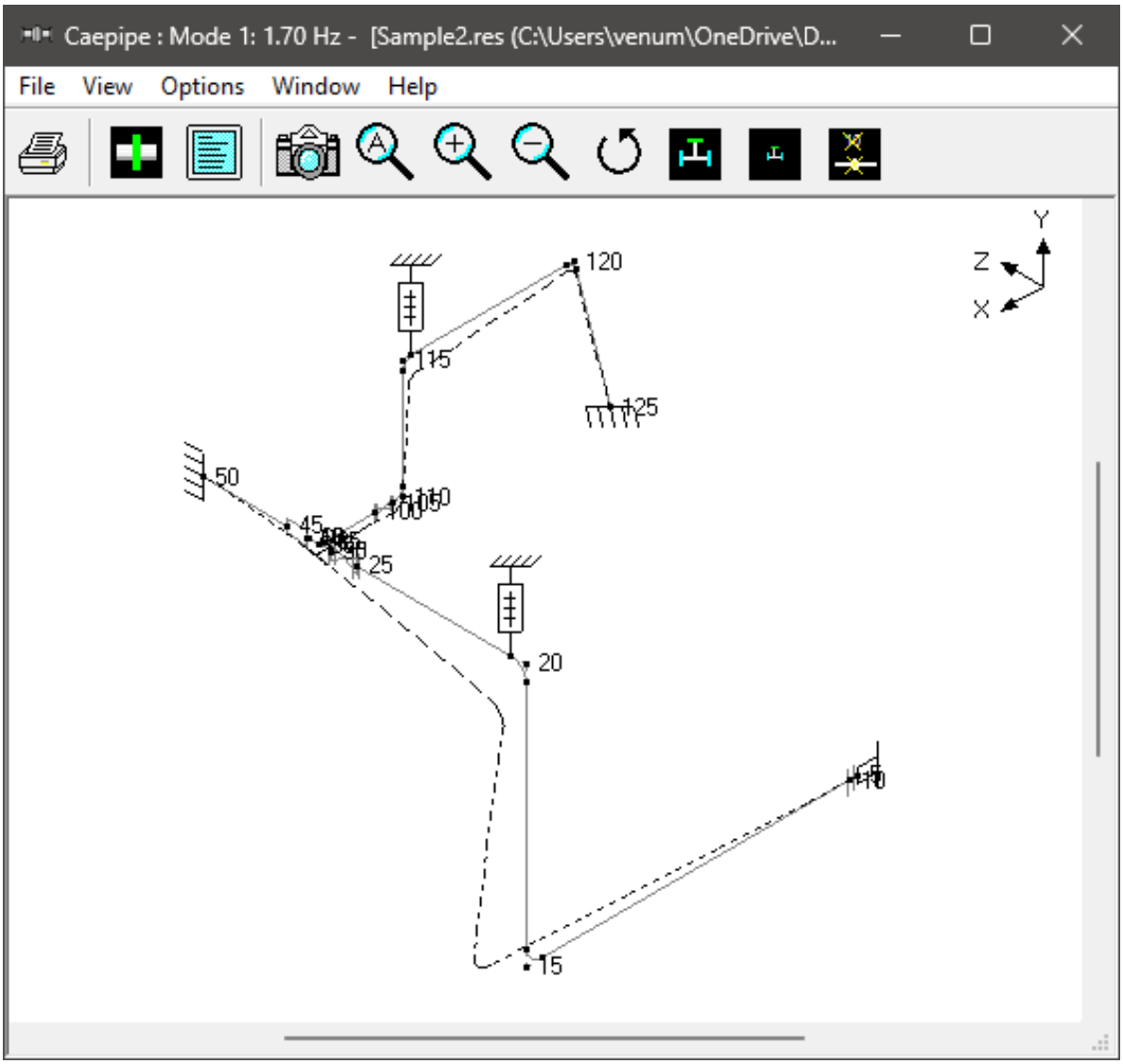
Each frequency's mode shape detail is shown in the next window. As in the earlier window, you can show graphically the mode shape or animate it by clicking on the appropriate button.

Caepipe : Mode 1: 1.70 Hz - [Sample2.res (C:\Users\venum\OneDriv...

File Results View Options Window Help

#	Node	X (mm)	Y (mm)	Z (mm)	XX (deg)	YY (deg)	ZZ (deg)
1	5	0.000	0.000	0.000	0.0000	-0.0583	-0.0444
2	10	0.000	-0.155	0.206	-0.0017	-0.0597	-0.0446
3	15A	0.000	-6.256	10.160	-0.0657	-0.0766	-0.0440
4	15B	0.278	-6.539	10.121	-0.0864	-0.0619	-0.0402
5	20A	3.941	-6.537	0.568	-0.0928	-0.0455	-0.0306
6	20B	3.830	-6.013	0.000	-0.0695	-0.0424	-0.0265
7	25	1.357	-2.102	0.000	-0.0461	-0.0297	-0.0142
8	30	1.039	-1.607	0.000	-0.0450	-0.0289	-0.0137
9	55	1.025	-1.586	0.000	-0.0448	-0.0288	-0.0136
10	35	0.887	-1.372	0.000	-0.0448	-0.0288	-0.0136
11	60	0.750	-1.158	0.000	-0.0448	-0.0288	-0.0136
12	40	0.736	-1.137	0.000	-0.0446	-0.0287	-0.0135

The graphic window will show the mode shape as below.

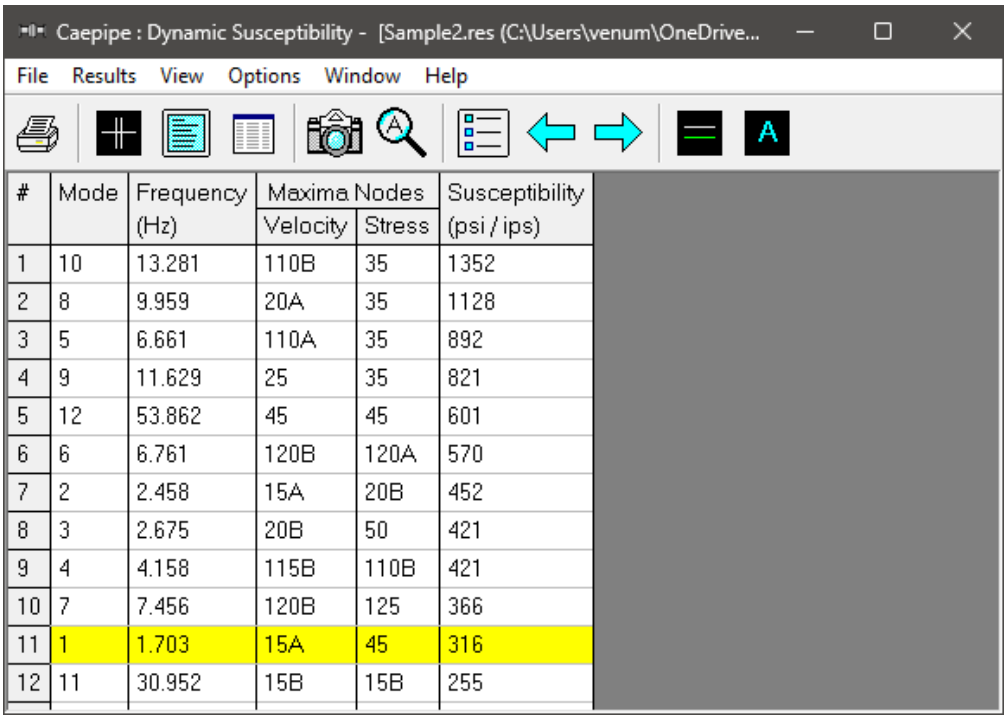


Use the black arrow buttons to cycle through the different Modes.

Dynamic Susceptibility

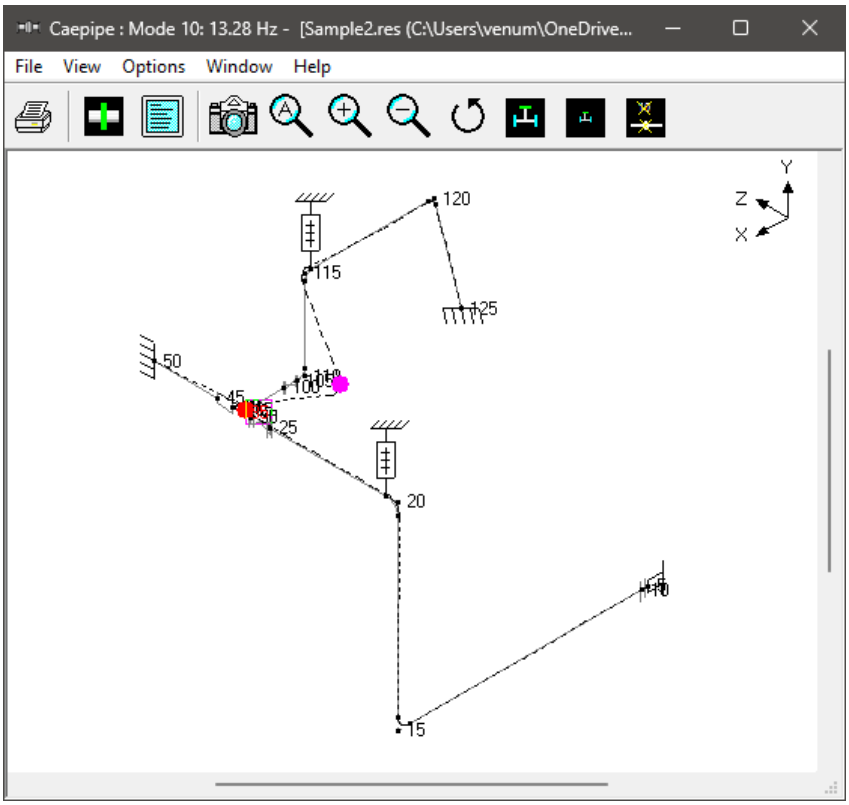
Note: *Dynamic Susceptibility is NOT available for Evaluation Version of CAEPIPE. For Full Version of CAEPIPE, this feature can be turned ON by setting an environment variable "HARTLEN" that needs to be declared under My Computer or This PC Icon > Mouse Right Click > Properties > Advanced System Settings > Environmental Variable with its Value set to (YES). Refer to CAEPIPE User's Manual for more details.*

The stress / velocity method, implemented in CAEPIPE as the "Dynamic Susceptibility" feature, provides quantified insights into the stress versus vibration characteristics of the system layout per se.

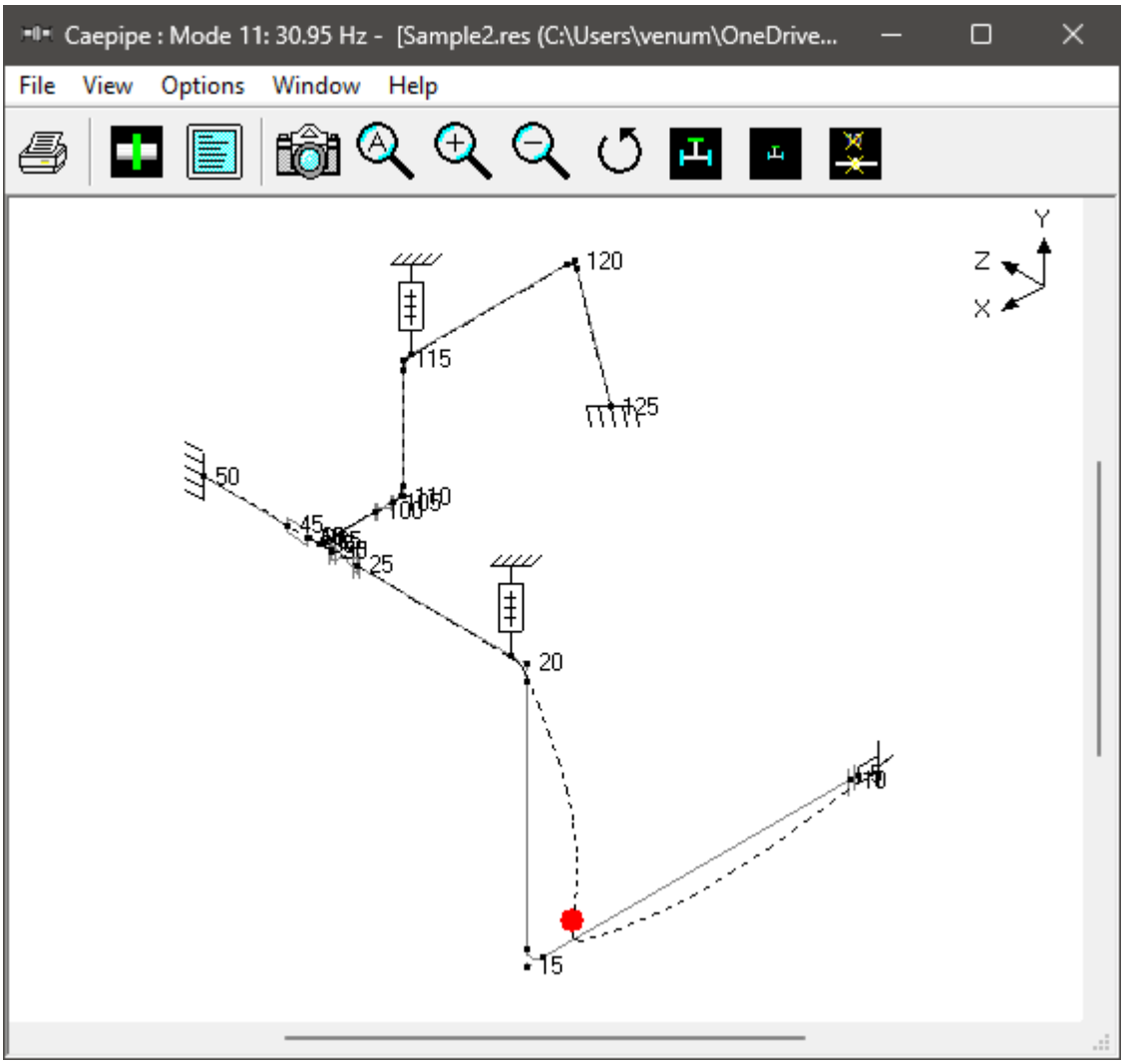


#	Mode	Frequency (Hz)	Maxima Nodes		Susceptibility (psi / ips)
			Velocity	Stress	
1	10	13.281	110B	35	1352
2	8	9.959	20A	35	1128
3	5	6.661	110A	35	892
4	9	11.629	25	35	821
5	12	53.862	45	45	601
6	6	6.761	120B	120A	570
7	2	2.458	15A	20B	452
8	3	2.675	20B	50	421
9	4	4.158	115B	110B	421
10	7	7.456	120B	125	366
11	1	1.703	15A	45	316
12	11	30.952	15B	15B	255

Pressing the Animated mode shape button (or View > Show animated mode shape) for Mode 10, for example, shows the maximum dynamic bending stress at the Bend Node 35 (RED dot) and the maximum velocity at the Bend Node 110B (PINK dot).



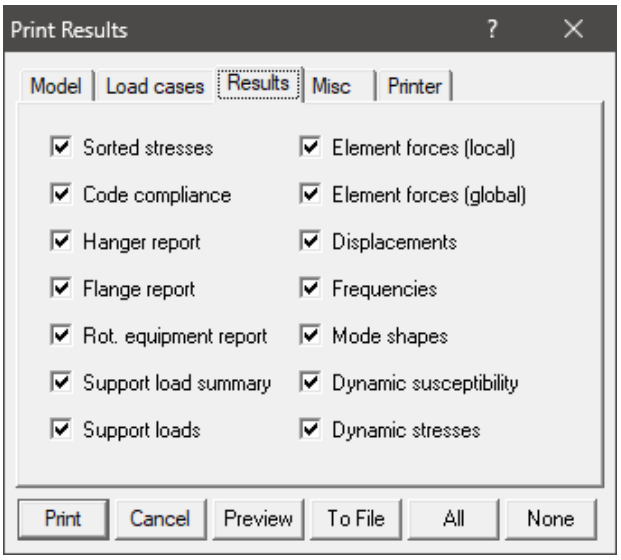
In case the maximum dynamic bending stress and the maximum velocity occur at the same node for a specific mode, then the RED and PINK dots overlap with each other and only the RED dot is seen for that mode. See the Animated mode shape shown below for mode 11 as an example.



The dynamic susceptibility module *does not apply directly to meeting code or other formal stress analysis requirements.* However, it is an incisive analytical tool to help the designer understand the stress / vibration relationship, assess the situation and to decide how to modify the design if necessary to possibly reduce the susceptibility to vibration. It can be used for design, planning acceptance tests, troubleshooting and correction.

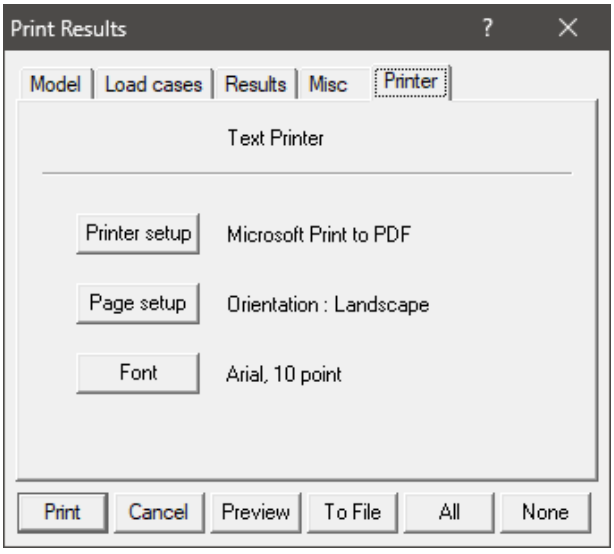
Print

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.



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.



The sample problem report is shown next. Note that for sorted stresses and code compliance, wherever the stress ratio exceeds 1.00, the corresponding stress and stress ratio are shown in white letters on black background. Similarly, wherever the Flange Pressure exceeds the Allowable Pressure, the corresponding Flange Pressure and the 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.co**

Quality Assurance Block

Caepipe

Version 12.10

Client :

Project :

File Number :

Report Number :

Model Name : Sample2

Title : Sample Problem 2

Analyzed : Thu Jan 04 16:34:29 2024

Prepared by : _____ Date:

Checked by : _____ Date:

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Analysis Options

Code : Piping code = B31.1 (2022)
Include axial force in stress calculations
Use liberal allowable stresses
Use B31J for SIFs and Flexibility Factors

Temperature : Reference temperature = 21.11 (C)
Number of thermal cycles = 7000
Number of thermal loads = 1
Thermal = Operating - Sustained
Use modulus at reference temperature

Pressure : Pressure stress = PD / 4t
Peak pressure factor = 1.00
Do not include Bourdon effect
Do not use pressure correction for bends

Dynamics : Cut off frequency = 33 Hz
Number of modes = 20
Include missing mass correction
Do not use friction in dynamic analysis

Misc. : Include hanger stiffness
Vertical direction = Y

Layout (23)

#	Node	Type	DX (mm)	DY (mm)	DZ (mm)	Matl	Sect	Load	Data
1	Title = Sample Problem 2								
2	5	From							Nozzle
3	10		200			312	10	L1	Flange
4	15	Bend	8080			312	10	L1	
5	20	Bend		6550		312	10	L1	
6	20B	Location							User hanger
7	25				4240	312	10	L1	Flange
8	30	Valve			622.3	312	10	L1	Flange
9	55				26.9499	312	10	L1	
10	35				273.05	312	10	L1	Welding tee
11	60				273.05	312	10	L1	
12	40				26.9499	312	10	L1	
13	45	Reducer			530	312	8	L1	
14	50				2100	312	8	L1	Anchor
15	35	From							
16	65		-136.525			312	6	L1	
17	100		-1263.47			312	6	L1	Flange
18	105	Valve	-403.23			312	6	L1	Flange
19	110	Bend	-255			312	6	L2	
20	115	Bend		2950		312	6	L2	
21	115B	Location							Hanger
22	120	Bend	-4290			312	6	L2	
23	125		-910	-3600		312	6	L2	Anchor

Anchors (2)

Node	Tag	KX/kx (N/mm)	KY/ky (N/mm)	KZ/kz (N/mm)	KXX/kxx (Nm/deg)	KYY/kyy (Nm/deg)	KZZ/kzz (Nm/deg)	Releases X	Y	Z	XX	YY	ZZ	Anchor in	Level Tag
50		Rigid	Rigid	Rigid	Rigid	Rigid	Rigid							GCS	
125		Rigid	Rigid	Rigid	Rigid	Rigid	Rigid							GCS	

Bends (5)

Bend Node	Radius (mm)	Rad. Type	Thk (mm)	Bend Matl	Flex.F In Pln	Flex.F Out Pln	In Pln SIF	Out Pln SIF	Axial SIF	Torsion SIF	Int. Node	Angle (deg)	Int. Node	Angle (deg)
15	381	Long												
20	381	Long												
110	228.6	Long												
115	228.6	Long												

Bends (5)

Bend Node	Radius (mm)	Rad. Type	Thk (mm)	Bend Matl	Flex.F In Pln	Flex.F Out Pln	In Pln SIF	Out Pln SIF	Axial SIF	Torsion SIF	Int. Node	Angle (deg)	Int. Node	Angle (deg)
120	228.6	Long												

Branch SIFs (1)

Node	Type
35	Welding tee ,No. of flanges = 0

Flanges (5)

Node	Pipe NS/OD	Type	Weight (kg)	Gasket Dia (mm)	Allow Pres (bar)
10	10"	Weld neck	69.799	297	40.0
25	10"	Weld neck	69.977	297	40.0
30	10"	Weld neck	69.799	297	40.0
100	6"	Weld neck	23.596	192.02	40.0
105	6"	Weld neck	23.596	192.02	40.0

Hangers (2)

Node	Tag	Type	No of	Load var%	Short range	Spring rate (N/mm)	Load (N)	Load Type	CNode	Level Tag
20B		User hanger	1			105	13200	Hot		
115B		Grinnell	1	25						

Nozzles (1)

Node	Tag	Vess. Type	Rnf Pad	Nozzle OD/R	Nozzle Thk	Vessel OD/R	Vessel Thk	L1 (mm)	L2 (mm)	Modulus (MPa)	Vessel axis direction X comp	Vessel axis direction Y comp	Vessel axis direction Z comp	Level Tag
5		Cyl		273.05	9.271	1800	9.271	1500	2100	193950			1.000	

Nozzle stiffnesses (1)

Node	Vess. Type	Radial (kp) (N/mm)	Circumferential (kmc) (Nm/deg)	Longitudinal (kml) (Nm/deg)
5	Cyl	40981	4352.04	27373.07

Pump: Pump

Type = Horizontal Suct. Node: 50 Suct. Loc: Side Shaft axis direction:1.000, 0.000, 0.000,
Location of center: 8280, 6550, 8520 (mm)

Reducers (1)

From	To	OD1 (mm)	Thk1 (mm)	OD2 (mm)	Thk2 (mm)	Cone angle (deg)
40	45	273.05	9.271	219.07	8.1788	

Valves (2)

From	To	Weight (kg)	Length (mm)	Thick X	Insul Wgt X	Add.Wgt (kg)	Offsets of Add.Wgt DX (mm)	Offsets of Add.Wgt DY (mm)	Offsets of Add.Wgt DZ (mm)
25	30	459.23	622.3	3.00	1.75				
100	105	151.56	403.23	3.00	1.75				

Coordinates (29)

Node	X (mm)	Y (mm)	Z (mm)
5	0	0	0
10	200	0	0
15A	7899	0	0
15	8280	0	0
15B	8280	381	0
20A	8280	6169	0
20	8280	6550	0
20B	8280	6550	381
25	8280	6550	4240
30	8280	6550	4862.3
55	8280	6550	4889.25
35	8280	6550	5162.3
60	8280	6550	5435.35

Coordinates (29)

Node	X (mm)	Y (mm)	Z (mm)
40	8280	6550	5462.3
45	8280	6550	5992.3
50	8280	6550	8092.3
65	8143.48	6550	5162.3
100	6880	6550	5162.3
105	6476.77	6550	5162.3
110A	6450.37	6550	5162.3
110	6221.77	6550	5162.3
110B	6221.77	6778.6	5162.3
115A	6221.77	9271.4	5162.3
115	6221.77	9500	5162.3
115B	5993.17	9500	5162.3
120A	2109.78	9500	5162.3
120	1931.77	9500	5162.3
120B	1888.15	9327.42	5162.3
125	1021.77	5900	5162.3

Pipe material 312: a312 tp316

Density = 8027 (kg/m3), Nu = 0.300, Joint factor = 1.00, Type = AS
Yield strength = 206.8 (MPa)
Tensile strength = 517.1 (MPa)

Temp (C)	E (MPa)	Alpha (mm/mm/C)	Allowable (MPa)
-198.3	201327	13.50E-6	137.9
-101.1	201327	14.40E-6	137.9
-45.56	199259	14.76E-6	137.9
21.11	195122	15.30E-6	137.9
37.78	193743	15.46E-6	137.9
93.33	189606	16.02E-6	119.3
148.9	186159	16.56E-6	107.6
204.4	182022	17.10E-6	98.60
260	178574	17.46E-6	91.70
315.6	174437	17.82E-6	86.87
343.3	173058	17.91E-6	84.81
371.1	170990	18.00E-6	83.43
398.9	168922	18.18E-6	82.05
426.7	166164	18.18E-6	81.36
454.4	164095	18.36E-6	79.98
482.2	162027	18.36E-6	79.29
510	159958	18.54E-6	78.60
537.8	157201	18.54E-6	77.91
565.6	154443	18.72E-6	77.22
593.3	151685	18.72E-6	76.53
621.1	148927	18.90E-6	67.57
648.9	146169	19.08E-6	51.02

Pipe Sections (3)

Name	Nom Dia	Sch	OD (mm)	Thk (mm)	Cor.Al (mm)	M.Tol (%)	Ins.Dens (kg/m3)	Ins.Thk (mm)	Lin.Dens (kg/m3)	Lin.Thk (mm)	Soil
6	6"	STD	168.27	7.112			176.2	65			
8	8"	STD	219.07	8.1788			176.2	65			
10	10"	STD	273.05	9.271			176.2	65			

Loads

Static Seismic Load Case 1: (g's)

Static seismic load 1: X = 0.30, Y = 0.20, Z = 0.30 (g's)

Seismic load combination = Square Root of Sum of Squares

Wind load 1

Shape factor = 0.60
Wind direction: X comp = 1.000, Y comp = 0.000, Z comp = 0.000

Elevation (m)	Velocity (kmh)
0	100
20	100

Wind load 2

Shape factor = 0.60
Wind direction: X comp = 0.000, Y comp = 0.000, Z comp = 1.000

Elevation (m)	Velocity (kmh)
0	100
20	100

Pipe Loads (2)

Name	T1 (C)	P1 (bar)	Desg.T (C)	Desg.Pr. (bar)	Specific gravity	Add.Wgt. (kg/m)	Wind Load 1	Wind Load 2	Wind Load 3	Wind Load 4
L1	185	10.0	230	15.0	0.1		Y	Y		
L2	260	32.0	300	48.0	0.1		Y	Y		

B31.1 (2022) Code compliance (Sorted stresses)

Sustained				Expansion				Occasional			
Node	SL (MPa)	SH (MPa)	SL SH	Node	SE (MPa)	SA (MPa)	SE SA	Node	SO (MPa)	1.2SH (MPa)	SO 1.2SH
115B	35.40	91.70	0.39	110A	52.93	270.8	0.20	50	78.98	122.1	0.65
110B	31.36	91.70	0.34	110B	46.93	261.1	0.18	125	50.75	110.0	0.46
50	31.82	101.7	0.31	115B	41.80	256.9	0.16	110B	41.77	110.0	0.38
125	26.94	91.70	0.29	125	38.98	265.6	0.15	115B	41.23	110.0	0.37
120A	26.51	91.70	0.29	115A	36.24	267.9	0.14	35	45.45	122.1	0.37
35	28.55	101.7	0.28	120A	33.61	266.0	0.13	120A	39.11	110.0	0.36
120B	25.12	91.70	0.27	50	34.29	273.4	0.13	20B	41.69	122.1	0.34
115A	24.64	91.70	0.27	35	29.54	276.7	0.11	120B	36.83	110.0	0.33
25	25.82	101.7	0.25	120B	27.11	267.4	0.10	45	40.32	122.1	0.33
110A	21.86	91.70	0.24	15A	29.96	296.2	0.10	110A	34.34	110.0	0.31
30	24.25	101.7	0.24	15B	26.86	290.7	0.09	65	35.03	122.1	0.29
55	24.02	101.7	0.24	105	24.17	272.5	0.09	115A	29.92	110.0	0.27
105	20.19	91.70	0.22	100	22.41	293.9	0.08	25	33.10	122.1	0.27
45	21.99	101.7	0.22	20B	20.32	283.5	0.07	105	29.12	110.0	0.26
20B	21.97	101.7	0.22	65	18.19	284.1	0.06	15B	32.20	122.1	0.26
65	21.37	101.7	0.21	45	16.86	283.4	0.06	30	31.59	122.1	0.26
40	20.90	101.7	0.21	20A	17.41	292.9	0.06	55	31.39	122.1	0.26
60	19.46	101.7	0.19	5	6.254	297.5	0.02	20A	30.61	122.1	0.25
15B	14.86	101.7	0.15	55	5.669	281.4	0.02	15A	28.51	122.1	0.23
20A	12.70	101.7	0.12	10	5.974	297.2	0.02	40	27.15	122.1	0.22
100	11.78	101.7	0.12	30	5.628	281.1	0.02	60	24.98	122.1	0.20
15A	9.538	101.7	0.09	25	4.866	279.5	0.02	100	20.96	122.1	0.17
10	8.529	101.7	0.08	40	4.933	284.6	0.02	5	17.36	122.1	0.14
5	8.182	101.7	0.08	60	3.196	286.0	0.01	10	16.74	122.1	0.14

B31.1 (2022) Code Compliance

Node	Press. Allow. (bar)	Sustained			Expansion			Occasional		
		SL (MPa)	SH (MPa)	SL SH	SE (MPa)	SA (MPa)	SE SA	SO (MPa)	1.2SH (MPa)	SO 1.2SH
5	15.0	8.182	101.7	0.08	6.254	297.5	0.02	17.36	122.1	0.14
10	66.6	8.529	101.7	0.08	5.974	297.2	0.02	16.74	122.1	0.14

B31.1 (2022) Code Compliance

Node	Press. Allow. (bar)	Sustained SL (MPa)	Sustained SH (MPa)	Sustained SL SH	Expansion SE (MPa)	Expansion SA (MPa)	Expansion SE SA	Occasional SO (MPa)	Occasional 1.2SH (MPa)	Occasional SO 1.2SH
10	15.0	8.529	101.7	0.08	5.974	297.2	0.02	16.71	122.1	0.14
15A	66.6	8.493	101.7	0.08	12.66	297.2	0.04	19.28	122.1	0.16
15A	15.0	9.538	101.7	0.09	29.96	296.2	0.10	28.51	122.1	0.23
15B	66.6	14.86	101.7	0.15	26.86	290.7	0.09	32.20	122.1	0.26
15B	15.0	11.44	101.7	0.11	12.51	294.2	0.04	21.06	122.1	0.17
20A	66.6	10.98	101.7	0.11	9.751	294.7	0.03	20.84	122.1	0.17
20A	15.0	12.70	101.7	0.12	17.41	292.9	0.06	30.61	122.1	0.25
20B	66.6	21.97	101.7	0.22	20.32	283.5	0.07	41.69	122.1	0.34
20B	15.0	14.96	101.7	0.15	9.512	290.6	0.03	25.96	122.1	0.21
25	66.6	25.82	101.7	0.25	4.866	279.5	0.02	33.10	122.1	0.27
30	15.0	24.25	101.7	0.24	5.628	281.1	0.02	31.59	122.1	0.26
55	66.6	24.02	101.7	0.24	5.669	281.4	0.02	31.39	122.1	0.26
55	15.0	24.02	101.7	0.24	5.669	281.4	0.02	31.39	122.1	0.26
35	66.6	21.65	101.7	0.21	10.42	283.8	0.04	30.52	122.1	0.25
35	15.0	21.59	101.7	0.21	2.724	283.8	0.01	26.33	122.1	0.22
60	66.6	19.46	101.7	0.19	3.196	286.0	0.01	24.98	122.1	0.20
60	15.0	19.46	101.7	0.19	3.196	286.0	0.01	24.98	122.1	0.20
40	66.6	19.24	101.7	0.19	3.326	286.2	0.01	24.90	122.1	0.20
40	15.0	20.90	101.7	0.21	4.933	284.6	0.02	27.15	122.1	0.22
45		21.99	101.7	0.22	16.86	283.4	0.06	40.32	122.1	0.33
45	15.0	20.17	101.7	0.20	11.15	285.3	0.04	36.54	122.1	0.30
50	73.4	31.82	101.7	0.31	34.29	273.4	0.13	78.98	122.1	0.65
35	15.0	28.55	101.7	0.28	29.54	276.7	0.11	45.45	122.1	0.37
65	83.5	21.37	101.7	0.21	18.19	284.1	0.06	35.03	122.1	0.29
65	15.0	21.37	101.7	0.21	18.19	284.1	0.06	35.03	122.1	0.29
100	83.5	11.78	101.7	0.12	22.41	293.9	0.08	20.96	122.1	0.17
105	48.0	20.19	91.70	0.22	24.17	272.5	0.09	29.12	110.0	0.26
110A	77.2	20.73	91.70	0.23	24.29	271.9	0.09	29.46	110.0	0.27
110A	48.0	21.86	91.70	0.24	52.93	270.8	0.20	34.34	110.0	0.31
110B	77.2	31.36	91.70	0.34	46.93	261.1	0.18	41.77	110.0	0.38
110B	48.0	26.64	91.70	0.29	21.87	265.9	0.08	33.79	110.0	0.31
115A	77.2	22.81	91.70	0.25	17.44	269.8	0.06	26.52	110.0	0.24
115A	48.0	24.64	91.70	0.27	36.24	267.9	0.14	29.92	110.0	0.27
115B	77.2	35.40	91.70	0.39	41.80	256.9	0.16	41.23	110.0	0.37
115B	48.0	28.66	91.70	0.31	19.42	263.8	0.07	32.67	110.0	0.30
120A	77.2	23.42	91.70	0.26	15.64	269.2	0.06	31.03	110.0	0.28
120A	48.0	26.51	91.70	0.29	33.61	266.0	0.13	39.11	110.0	0.36
120B	77.2	25.12	91.70	0.27	27.11	267.4	0.10	36.83	110.0	0.33
120B	48.0	22.55	91.70	0.25	12.80	270.1	0.05	29.63	110.0	0.27
125	77.2	26.94	91.70	0.29	38.98	265.6	0.15	50.75	110.0	0.46

Hanger Report

Node	No of	Type	Figure No.	Size	Spring rate (N/mm)	Vert travel (mm)	Horz travel (mm)	Hot load (N)	Cold load (N)	Var (%)
20B	1	User hanger			105	2.153	25.006	13200	13426	1
115B	1	Grinnell	B-268	10	45.533	16.882	15.847	5115	5884	15

Flange report - NC.3658.1 of ASME Section III Class 2 (2017)

Node	Pipe NS/OD (mm)	Pressure (bar)	Bending Torsion (Nm)	Gasket diameter (mm)	Flange Pressure (bar)	Allowable Pressure (bar)	Flange Pressure Allowable
105	6"	32.0	3090	192.02	54.2	40.0	1.356
100	6"	10.0	3708	192.02	36.7	40.0	0.917
25	10"	10.0	8768	297	27.0	40.0	0.676
30	10"	10.0	8450	297	26.4	40.0	0.661
10	10"	10.0	2464	297	14.8	40.0	0.370

API 610 (11th ed.), Sep 2010 / ISO 13709 report for pump : Pump

Load case: Operating (W+P1+T1)
Shaft axis: Xcomp = 1.000, Ycomp = 0.000, Zcomp = 0.000
Center location: X = 8280, Y = 6550, Z = 8520 (mm)

Suction node: 50, Location: (Side), Size: 8.000 (inch)
Offsets from center: dx = 0, dy = 427.7, dz = 0 (mm)

Check of condition F.1.1 for suction node 50:

	Calculated	Allowed	Ratio	Status
FX (N)	2754	3781	0.728	OK
FY (N)	-1078	4893	0.220	OK
FZ (N)	-5675	3114	1.822	----
FR (N)	6399	6939	0.922	OK
MX (Nm)	-6457	3525	1.832	----
MY (Nm)	615	1763	0.349	OK
MZ (Nm)	-8087	2576	3.139	Failed
MR (Nm)	10367	4745	2.185	Failed

Condition F.1.2.a for suction node 50 failed ***

*** Discharge node is not defined ***

Support load summary for anchor at node 50

Load combination	FX (N)	FY (N)	FZ (N)	MX (Nm)	MY (Nm)	MZ (Nm)
Empty Weight	-360	-4992	25	-4871	1556	-1057
Sustained	-330	-5482	7	-6729	1287	-1106
Operating1	2754	-5675	1078	-6457	-8087	-615
Sustained+Wind	878	-5602	151	-7396	-2594	-1786
Operating1+Wind	3962	-5795	1222	-7124	-11969	-1295
Sustained+Wind 2	-314	-5252	1816	-6761	1271	-1222
Operating1+Wind 2	2770	-5445	2887	-6489	-8104	-731
Sustained+Seismic 1	3544	-2665	6506	1726	12102	456
Sustained-Seismic 1	-4203	-8298	-6492	-15184	-9527	-2669
Operating1+Seismic 1	6628	-2858	7577	1998	2727	947
Operating1-Seismic 1	-1119	-8491	-5421	-14912	-18902	-2177
Maximum	6628	-2665	7577	1998	12102	947
Minimum	-4203	-8491	-6492	-15184	-18902	-2669
Allowables	0	0	0	0	0	0

Support load summary for anchor at node 125

Load combination	FX (N)	FY (N)	FZ (N)	MX (Nm)	MY (Nm)	MZ (Nm)
Empty Weight	220	-1584	50	152	-104	-997
Sustained	231	-1715	24	22	-28	-1177
Operating1	-1755	-1605	-332	-727	832	4113
Sustained+Wind	834	-1741	-71	-211	145	-2289
Operating1+Wind	-1152	-1631	-427	-960	1004	3001
Sustained+Wind 2	239	-1714	690	1750	-496	-1203
Operating1+Wind 2	-1747	-1604	334	1000	364	4087
Sustained+Seismic 1	1502	-1100	811	2083	708	1523
Sustained-Seismic 1	-1041	-2330	-763	-2038	-763	-3877
Operating1+Seismic 1	-484	-990	455	1333	1567	6813
Operating1-Seismic 1	-3027	-2220	-1119	-2787	96	1413
Maximum	1502	-990	811	2083	1567	6813
Minimum	-3027	-2330	-1119	-2787	-763	-3877
Allowables	0	0	0	0	0	0

Support load summary for hanger at node 20B

Displacements (global)	
Load combination	Load (N)
Empty Weight	-12895
Sustained	-13280
Operating1	-13200
Sustained+Wind	-13451
Operating1+Wind	-13371
Sustained+Wind 2	-13501
Operating1+Wind 2	-13421
Sustained+Seismic 1	-11744
Sustained-Seismic 1	-14815
Operating1+Seismic 1	-11664
Operating1-Seismic 1	-14736
Maximum	-11664
Minimum	-14815

Support load summary for hanger at node 115B

Displacements (global)	
Load combination	Load (N)
Empty Weight	-5767
Sustained	-5810

Support load summary for hanger at node 115B

Displacements (global)

Load combination	Load (N)
Operating1	-5115
Sustained+Wind	-5810
Operating1+Wind	-5116
Sustained+Wind 2	-5812
Operating1+Wind 2	-5118
Sustained+Seismic 1	-5613
Sustained-Seismic 1	-6006
Operating1+Seismic 1	-4919
Operating1-Seismic 1	-5311
Maximum	-4919
Minimum	-6006

Support load summary for nozzle at node 5

Load combination	Radial (P) (N)	y Shear (VL) (N)	z Shear (VC) (N)	Torque (MT) (Nm)	Circ.Mom (MC) (Nm)	Long.Mom (ML) (Nm)
Empty Weight	140	-75	3419	462	-106	-581
Sustained	99	-31	3687	252	-247	-298
Operating1	-999	-745	4378	-1561	-884	-2613
Sustained+Wind	972	-80	3476	-58	-251	-105
Operating1+Wind	-126	-795	4167	-1871	-888	-2419
Sustained+Wind 2	75	923	3732	-1413	-328	1849
Operating1+Wind 2	-1023	208	4424	-3226	-965	-466
Sustained+Seismic 1	3952	1734	4817	3142	290	3373
Sustained-Seismic 1	-3755	-1796	2557	-2638	-783	-3969
Operating1+Seismic 1	2854	1019	5509	1329	-347	1058
Operating1-Seismic 1	-4852	-2510	3248	-4451	-1420	-6284
Maximum	3952	1734	5509	3142	290	3373
Minimum	-4852	-2510	2557	-4451	-1420	-6284
Allowables	0	0	0	0	0	0

Loads on Anchors: Empty Weight (W)

Node	Tag	FX (N)	FY (N)	FZ (N)	MX (Nm)	MY (Nm)	MZ (Nm)
50		-360	-4992	25	-4871	1556	-1057
125		220	-1584	50	152	-104	-997

Loads on Hangers: Empty Weight (W)

Node	Tag	Type	Load (N)	No.of	Total (N)
20B		User hanger	-12895	1	-12895
115B		Grinnell	-5767	1	-5767

Loads on Nozzles: Empty Weight (W)

Node	Tag	Axial (N)	y Shear (N)	z Shear (N)	Torque (Nm)	Circ.Mom (Nm)	Long.Mom (Nm)
5		140	-75	3419	462	-106	-581

Pipe forces in local coordinates: Empty Weight (W)

Node	Axial	y Shear	z Shear	Torsion(Nm)		Inplane(Nm)		Outplane(Nm)		Flex. Factors		
	(N)	(N)	(N)	Moment	SIF	Moment	SIF	Moment	SIF	FFi	FFo	FFt
5	140	-3419	-75	462		-106		581				
10	140	-3274	-75	462	1.00	564	1.00	566	1.00			
10	140	-2590	-75	462	1.00	564	1.00	566	1.00			
15A	140	2985	-75	462		-955		-9				
15A	140	2985	-75	462	1.00	-955	2.61	-9	2.17	8.13	8.13	
15B	3418	-140	-75	-38	1.00	-2099	2.61	-490	2.17	8.13	8.13	
15B	3418	-140	-75	-38		-2099		-490				
20A	7609	-140	-75	-38		-1291		-923				
20A	7609	-75	140	-38	1.00	923	2.61	-1291	2.17	8.13	8.13	
20B	-75	-8042	140	-1238	1.00	3955	2.61	91	2.17	8.13	8.13	

Pipe forces in local coordinates: Empty Weight (W)

Node	Axial (N)	y Shear (N)	z Shear (N)	Torsion(Nm) Moment	Torsion(Nm) SIF	Inplane(Nm) Moment	Inplane(Nm) SIF	Outplane(Nm) Moment	Outplane(Nm) SIF	Flex. Factors FFi	Flex. Factors FFo	Flex. Factors FFt
20B	-75	-4853	-140	-1238		-3955		-91				
25	-75	-2059	-140	-1238	1.00	9381	1.00	-630	1.00			
30	-75	3945	-140	-1238	1.00	8794	1.00	-717	1.00			
55	-75	3965	-140	-1238		8687		-721				
55	-75	3965	-140	-1238		8687		-721				
35	-75	4162	-140	-1238	1.39	759	2.00	7578	1.00			
35	-25	3339	-360	1057	1.39	503	2.00	7457	1.00			
60	-25	3537	-360	1057		6519		-601				
60	-25	3537	-360	1057		6519		-601				
40	-25	3556	-360	1057		6423		-610				
40	-25	3556	-360	1057	1.00	6423	1.52	-610	1.52			
45	-25	3886	-360	1057	1.00	4451	1.52	-801	1.52			
45	-25	3886	-360	1057		4451		-801				
50	-25	4992	-360	1057		-4871		-1556				
35	220	823	50	120	1.07	-256	1.47	-2295	1.86		2.44	
65	220	873	50	120		2179		-250			2.44	
65	220	873	50	120		2179		-250				
100	220	1335	50	120	1.00	784	1.00	-187	1.00			
105	220	3343	50	120	1.00	-160	1.00	-167	1.00			
110A	220	3352	50	120		-248		-166				
110A	220	3352	50	120	1.00	-248	2.27	-166	1.89	6.59	6.59	
110B	3484	-220	50	-154	1.00	-975	2.27	-109	1.89	6.59	6.59	
110B	3484	220	-50	-154		975		109				
115A	4395	220	-50	-154		426		-15				
115A	4395	220	-50	-154	1.00	426	2.27	-15	1.89	6.59	6.59	
115B	220	-4527	-50	-26	1.00	1400	2.27	143	1.89	6.59	6.59	
115B	220	-1240	50	-26		-1400		-143				
120A	220	180	50	-26		658		50				
120A	220	-180	-50	-26	1.00	-658	2.27	-50	1.89	6.59	6.59	
120B	-228	-285	-50	-63	1.00	-569	2.27	2	1.89	6.59	6.59	
120B	-228	285	50	-63		569		-2				
125	-1482	601	50	-63		-997		173				

Other forces in local coordinates: Empty Weight (W)

Node	Type	fx (N)	fy (N)	fz (N)	mx (Nm)	my (Nm)	mz (Nm)
25	Valve	-75	-1373	-140	-1238	-630	9381
30		-75	3261	-140	-1238	-717	8794
100	Valve	220	1567	50	120	-187	784
105		220	3111	50	120	-167	-160

Pipe forces in global coordinates: Empty Weight (W)

Node	FX (N)	FY (N)	FZ (N)	MX (Nm)	MY (Nm)	MZ (Nm)
5	-140	3419	75	-462	-581	106
10	140	-3274	-75	462	566	564
10	-140	2590	75	-462	-566	-564
15A	140	2985	-75	462	-9	-955
15A	-140	-2985	75	-462	9	955
15B	140	3418	-75	490	-38	-2099
15B	-140	-3418	75	-490	38	2099
20A	140	7609	-75	923	-38	-1291
20A	-140	-7609	75	-923	38	1291
20B	140	8042	-75	3955	-91	-1238
20B	-140	4853	75	-3955	91	1238
25	140	-2059	-75	-9381	-630	-1238
30	-140	-3945	75	8794	717	1238
55	140	3965	-75	-8687	-721	-1238

Pipe forces in global coordinates: Empty Weight (W)

Node	FX (N)	FY (N)	FZ (N)	MX (Nm)	MY (Nm)	MZ (Nm)
55	-140	-3965	75	8687	721	1238
35	140	4162	-75	-7578	-759	-1238
35	-360	-3339	25	7457	503	-1057
60	360	3537	-25	-6519	-601	1057
60	-360	-3537	25	6519	601	-1057
40	360	3556	-25	-6423	-610	1057
40	-360	-3556	25	6423	610	-1057
45	360	3886	-25	-4451	-801	1057
45	-360	-3886	25	4451	801	-1057
50	360	4992	-25	4871	-1556	1057
35	220	-823	50	120	256	2295
65	-220	873	-50	-120	-250	-2179
65	220	-873	50	120	250	2179
100	-220	1335	-50	-120	-187	-784
105	220	-3343	50	120	167	-160
110A	-220	3352	-50	-120	-166	248
110A	220	-3352	50	120	166	-248
110B	-220	3484	-50	-109	-154	975
110B	220	-3484	50	109	154	-975
115A	-220	4395	-50	15	-154	426
115A	220	-4395	50	-15	154	-426
115B	-220	4527	-50	26	-143	1400
115B	220	1240	50	-26	143	-1400
120A	-220	180	-50	26	50	-658
120A	220	-180	50	-26	-50	658
120B	-220	291	-50	18	61	-569
120B	220	-291	50	-18	-61	569
125	-220	1584	-50	-152	104	997

Other forces in global coordinates: Empty Weight (W)

Node	Type	FX (N)	FY (N)	FZ (N)	MX (Nm)	MY (Nm)	MZ (Nm)
25	Valve	-140	1373	75	9381	630	1238
30		140	3261	-75	-8794	-717	-1238
100	Valve	220	-1567	50	120	187	784
105		-220	3111	-50	-120	-167	160

Displacements: Empty Weight (W)

	Displacements (global)					
Node	X (mm)	Y (mm)	Z (mm)	XX (deg)	YY (deg)	ZZ (deg)
5	0.003	0.000	0.000	0.0000	0.0212	-0.0243
10	0.003	-0.087	-0.075	0.0005	0.0217	-0.0241
15A	0.004	4.933	-3.845	0.0208	0.0311	0.0902
15B	-0.459	5.465	-3.888	0.0269	0.0281	0.0541
20A	-3.575	5.486	-0.361	0.0448	0.0269	0.0111
20B	-3.386	5.056	0.000	0.0880	0.0333	-0.0043
25	-1.299	-0.125	0.000	0.0268	0.0271	-0.0315
30	-1.007	-0.378	0.000	0.0200	0.0266	-0.0327
55	-0.994	-0.387	0.000	0.0189	0.0266	-0.0329
35	-0.867	-0.471	0.000	0.0189	0.0266	-0.0329
60	-0.740	-0.557	0.000	0.0189	0.0266	-0.0329
40	-0.728	-0.565	0.000	0.0182	0.0265	-0.0328
45	-0.492	-0.634	0.000	-0.0003	0.0241	-0.0281
50	0.000	0.000	0.000	0.0000	0.0000	0.0000
65	-0.867	-0.392	0.063	0.0189	0.0266	-0.0540
100	-0.868	1.425	0.569	0.0140	0.0196	-0.1025
105	-0.868	2.154	0.705	0.0136	0.0192	-0.1034
110A	-0.868	2.202	0.714	0.0135	0.0191	-0.1033

Displacements: Empty Weight (W)

	Displacements (global)					
Node	X (mm)	Y (mm)	Z (mm)	XX (deg)	YY (deg)	ZZ (deg)
110B	-0.548	2.573	0.815	0.0070	0.0116	-0.0604
115A	1.000	2.587	1.027	0.0041	-0.0009	-0.0166
115B	1.023	2.567	1.028	0.0025	-0.0059	0.0287
120A	1.022	-0.236	0.369	0.0058	-0.0104	0.0201
120B	1.021	-0.263	0.315	0.0056	-0.0089	-0.0107
125	0.000	0.000	0.000	0.0000	0.0000	0.0000

Loads on Anchors: Sustained (W+P)

Node	Tag	FX (N)	FY (N)	FZ (N)	MX (Nm)	MY (Nm)	MZ (Nm)
50		-330	-5482	7	-6729	1287	-1106
125		231	-1715	24	22	-28	-1177

Loads on Hangers: Sustained (W+P)

Node	Tag	Type	Load (N)	No.of	Total (N)
20B		User hanger	-13280	1	-13280
115B		Grinnell	-5810	1	-5810

Loads on Nozzles: Sustained (W+P)

Node	Tag	Axial (N)	y Shear (N)	z Shear (N)	Torque (Nm)	Circ.Mom (Nm)	Long.Mom (Nm)
5		99	-31	3687	252	-247	-298

Pipe forces in local coordinates: Sustained (W+P)

Node	Axial	y Shear	z Shear	Torsion(Nm)		Inplane(Nm)		Outplane(Nm)		Flex. Factors			SL
	(N)	(N)	(N)	Moment	SIF	Moment	SIF	Moment	SIF	FFi	FFo	FFt	(MPa)
5	99	-3687	-31	252		-247		298					8.182
10	99	-3532	-31	252	1.00	475	1.00	292	1.00				8.529
10	99	-2848	-31	252	1.00	475	1.00	292	1.00				8.529
15A	99	3111	-31	252		-537		55					8.493
15A	99	3111	-31	252	1.00	-537	2.61	55	2.17	8.13	8.13		9.538
15B	3574	-99	-31	44	1.00	-1749	2.61	-264	2.17	8.13	8.13		14.86
15B	3574	-99	-31	44		-1749		-264					11.44
20A	8053	-99	-31	44		-1177		-442					10.98
20A	8053	-31	99	44	1.00	442	2.61	-1177	2.17	8.13	8.13		12.70
20B	-31	-8516	99	-1139	1.00	3634	2.61	-6	2.17	8.13	8.13		21.97
20B	-31	-4763	-99	-1139		-3634		6					14.96
25	-31	-1777	-99	-1139	1.00	8986	1.00	-375	1.00				25.82
30	-31	4258	-99	-1139	1.00	8213	1.00	-437	1.00				24.25
55	-31	4279	-99	-1139		8098		-439					24.02
55	-31	4279	-99	-1139		8098		-439					24.02
35	-31	4490	-99	-1139	1.39	466	2.00	6901	1.00				21.65
35	-7	3726	-330	1106	1.39	322	2.00	6894	1.00				21.59
60	-7	3937	-330	1106		5848		-412					19.46
60	-7	3937	-330	1106		5848		-412					19.46
40	-7	3958	-330	1106		5741		-420					19.24
40	-7	3958	-330	1106	1.00	5741	1.52	-420	1.52				20.90
45	-7	4309	-330	1106	1.00	3551	1.52	-595	1.52				21.99
45	-7	4309	-330	1106		3551		-595					20.17
50	-7	5482	-330	1106		-6729		-1287					31.82
35	231	764	24	7	1.07	-145	1.47	-2246	1.86		2.44		28.55
65	231	817	24	7		2138		-141			2.44		21.37
65	231	817	24	7		2138		-141					21.37
100	231	1302	24	7	1.00	799	1.00	-111	1.00				11.78
105	231	3317	24	7	1.00	-132	1.00	-102	1.00				20.19
110A	231	3327	24	7		-220		-101					20.73
110A	231	3327	24	7	1.00	-220	2.27	-101	1.89	6.59	6.59		21.86
110B	3465	-231	24	-96	1.00	-939	2.27	-2	1.89	6.59	6.59		31.36
110B	3465	231	-24	-96		939		2					26.64
115A	4422	231	-24	-96		364		-58					22.81

Pipe forces in local coordinates: Sustained (W+P)

Node	Axial (N)	y Shear (N)	z Shear (N)	Torsion(Nm) Moment	Torsion(Nm) SIF	Inplane(Nm) Moment	Inplane(Nm) SIF	Outplane(Nm) Moment	Outplane(Nm) SIF	Flex. Factors FFi	Flex. Factors FFo	Flex. Factors FFt	SL (MPa)
115A	4422	231	-24	-96	1.00	364	2.27	-58	1.89	6.59	6.59		24.64
115B	231	-4560	-24	-63	1.00	1342	2.27	90	1.89	6.59	6.59		35.40
115B	231	-1250	24	-63		-1342		-90					28.66
120A	231	241	24	-63		616		2					23.42
120A	231	-241	-24	-63	1.00	-616	2.27	-2	1.89	6.59	6.59		26.51
120B	-290	-311	-24	-21	1.00	-512	2.27	55	1.89	6.59	6.59		25.12
120B	-290	311	24	-21		512		-55					22.55
125	-1606	644	24	-21		-1177		28					26.94

Other forces in local coordinates: Sustained (W+P)

Node	Type	fx (N)	fy (N)	fz (N)	mx (Nm)	my (Nm)	mz (Nm)
25	Valve	-31	-1091	-99	-1139	-375	8986
30		-31	3574	-99	-1139	-437	8213
100	Valve	231	1534	24	7	-111	799
105		231	3085	24	7	-102	-132

Pipe forces in global coordinates: Sustained (W+P)

Node	FX (N)	FY (N)	FZ (N)	MX (Nm)	MY (Nm)	MZ (Nm)
5	-99	3687	31	-252	-298	247
10	99	-3532	-31	252	292	475
10	-99	2848	31	-252	-292	-475
15A	99	3111	-31	252	55	-537
15A	-99	-3111	31	-252	-55	537
15B	99	3574	-31	264	44	-1749
15B	-99	-3574	31	-264	-44	1749
20A	99	8053	-31	442	44	-1177
20A	-99	-8053	31	-442	-44	1177
20B	99	8516	-31	3634	6	-1139
20B	-99	4763	31	-3634	-6	1139
25	99	-1777	-31	-8986	-375	-1139
30	-99	-4258	31	8213	437	1139
55	99	4279	-31	-8098	-439	-1139
55	-99	-4279	31	8098	439	1139
35	99	4490	-31	-6901	-466	-1139
35	-330	-3726	7	6894	322	-1106
60	330	3937	-7	-5848	-412	1106
60	-330	-3937	7	5848	412	-1106
40	330	3958	-7	-5741	-420	1106
40	-330	-3958	7	5741	420	-1106
45	330	4309	-7	-3551	-595	1106
45	-330	-4309	7	3551	595	-1106
50	330	5482	-7	6729	-1287	1106
35	231	-764	24	7	145	2246
65	-231	817	-24	-7	-141	-2138
65	231	-817	24	7	141	2138
100	-231	1302	-24	-7	-111	-799
105	231	-3317	24	7	102	-132
110A	-231	3327	-24	-7	-101	220
110A	231	-3327	24	7	101	-220
110B	-231	3465	-24	-2	-96	939
110B	231	-3465	24	2	96	-939
115A	-231	4422	-24	58	-96	364
115A	231	-4422	24	-58	96	-364
115B	-231	4560	-24	63	-90	1342
115B	231	1250	24	-63	90	-1342
120A	-231	241	-24	63	2	-616

Pipe forces in global coordinates: Sustained (W+P)

Node	FX (N)	FY (N)	FZ (N)	MX (Nm)	MY (Nm)	MZ (Nm)
120A	231	-241	24	-63	-2	616
120B	-231	358	-24	59	7	-512
120B	231	-358	24	-59	-7	512
125	-231	1715	-24	-22	28	1177

Other forces in global coordinates: Sustained (W+P)

Node	Type	FX (N)	FY (N)	FZ (N)	MX (Nm)	MY (Nm)	MZ (Nm)
25	Valve	-99	1091	31	8986	375	1139
30		99	3574	-31	-8213	-437	-1139
100	Valve	231	-1534	24	7	111	799
105		-231	3085	-24	-7	-102	132

Displacements: Sustained (W+P)

	Displacements (global)					
Node	X (mm)	Y (mm)	Z (mm)	XX (deg)	YY (deg)	ZZ (deg)
5	0.000	0.000	0.000	0.0000	0.0109	-0.0567
10	0.000	-0.200	-0.039	0.0003	0.0112	-0.0566
15A	0.003	1.188	-2.022	0.0114	0.0170	0.0715
15B	-0.371	1.617	-2.050	0.0143	0.0162	0.0436
20A	-2.774	1.639	-0.193	0.0232	0.0176	0.0064
20B	-2.619	1.394	0.000	0.0573	0.0245	-0.0081
25	-1.037	-1.634	0.000	-0.0043	0.0214	-0.0332
30	-0.807	-1.550	0.000	-0.0108	0.0211	-0.0343
55	-0.797	-1.545	0.000	-0.0118	0.0210	-0.0344
35	-0.697	-1.482	0.000	-0.0118	0.0210	-0.0344
60	-0.596	-1.420	0.000	-0.0118	0.0210	-0.0344
40	-0.586	-1.414	0.000	-0.0125	0.0210	-0.0343
45	-0.399	-1.211	0.000	-0.0283	0.0192	-0.0294
50	0.000	0.000	0.000	0.0000	0.0000	0.0000
65	-0.697	-1.399	0.050	-0.0118	0.0210	-0.0552
100	-0.697	0.436	0.467	-0.0121	0.0170	-0.1033
105	-0.697	1.170	0.586	-0.0121	0.0167	-0.1043
110A	-0.697	1.219	0.594	-0.0121	0.0167	-0.1042
110B	-0.369	1.597	0.600	-0.0137	0.0131	-0.0632
115A	1.362	1.610	0.027	-0.0120	0.0053	-0.0225
115B	1.414	1.623	0.000	-0.0113	0.0029	0.0192
120A	1.413	-0.372	0.000	-0.0033	-0.0014	0.0075
120B	1.379	-0.353	0.000	-0.0018	-0.0021	-0.0208
125	0.000	0.000	0.000	0.0000	0.0000	0.0000

Loads on Anchors: Expansion (T1)

Node	Tag	FX (N)	FY (N)	FZ (N)	MX (Nm)	MY (Nm)	MZ (Nm)
50		3084	-193	1071	272	-9375	491
125		-1986	110	-356	-750	860	5290

Loads on Hangers: Expansion (T1)

Node	Tag	Type	Load (N)	No.of	Total (N)
20B		User hanger	80	1	80
115B		Grinnell	695	1	695

Loads on Nozzles: Expansion (T1)

Node	Tag	Axial (N)	y Shear (N)	z Shear (N)	Torque (Nm)	Circ.Mom (Nm)	Long.Mom (Nm)
5		-1098	-715	691	-1813	-637	-2315

Pipe forces in local coordinates: Expansion (T1)

Node	Axial (N)	y Shear (N)	z Shear (N)	Torsion(Nm) Moment	Torsion(Nm) SIF	Inplane(Nm) Moment	Inplane(Nm) SIF	Outplane(Nm) Moment	Outplane(Nm) SIF	Flex. Factors FFi	Flex. Factors FFo	Flex. Factors FFt	SE (MPa)	SA (MPa)	SE SA
5	-1098	-691	-715	-1813		-637		2315					6.254	306.8	0.02
10	-1098	-691	-715	-1813	1.00	-499	1.00	2172	1.00				5.974	306.4	0.02
10	-1098	-691	-715	-1813	1.00	-499	1.00	2172	1.00				5.974	306.4	0.02
15A	-1098	-691	-715	-1813		4825		-3331					12.66	306.5	0.04
15A	-1098	-691	-715	-1813	1.00	4825	2.61	-3331	2.17	8.13	8.13		29.96	305.4	0.10
15B	-691	1098	-715	-3603	1.00	4670	2.61	1541	2.17	8.13	8.13		26.86	300.0	0.09
15B	-691	1098	-715	-3603		4670		1541					12.51	303.5	0.04
20A	-691	1098	-715	-3603		-1684		-2596					9.751	303.9	0.03
20A	-691	-715	-1098	-3603	1.00	2596	2.61	-1684	2.17	8.13	8.13		17.41	302.2	0.06
20B	-715	691	-1098	-2102	1.00	2605	2.61	3185	2.17	8.13	8.13		20.32	292.7	0.07
20B	-715	-612	1098	-2102		-2605		-3185					9.512	299.9	0.03
25	-715	-612	1098	-2102	1.00	-244	1.00	1051	1.00				4.866	288.8	0.02
30	-715	-612	1098	-2102	1.00	136	1.00	1735	1.00				5.628	290.4	0.02
55	-715	-612	1098	-2102		153		1764					5.669	290.6	0.02
55	-715	-612	1098	-2102		153		1764					5.669	290.6	0.02
35	-715	-612	1098	-2102	1.39	-2064	2.00	320	1.00				10.42	293.0	0.04
35	-1071	193	3084	-491	1.39	-339	2.00	838	1.00				2.724	293.1	0.01
60	-1071	193	3084	-491		785		1181					3.196	295.3	0.01
60	-1071	193	3084	-491		785		1181					3.196	295.3	0.01
40	-1071	193	3084	-491		780		1264					3.326	295.5	0.01
40	-1071	193	3084	-491	1.00	780	1.52	1264	1.52				4.933	293.8	0.02
45	-1071	193	3084	-491	1.00	678	1.52	2899	1.52				16.86	292.7	0.06
45	-1071	193	3084	-491		678		2899					11.15	294.5	0.04
50	-1071	193	3084	-491		272		9375					34.29	282.6	0.12
35	-1986	-805	-356	-518	1.07	1724	1.47	-1611	1.86		2.44		29.54	286.0	0.10
65	-1986	-805	-356	-518		1721		1676			2.44		18.19	293.3	0.06
65	-1986	-805	-356	-518		1721		1676					18.19	293.3	0.06
100	-1986	-805	-356	-518	1.00	2737	1.00	1226	1.00				22.41	303.1	0.07
105	-1986	-805	-356	-518	1.00	3062	1.00	1082	1.00				24.17	284.3	0.09
110A	-1986	-805	-356	-518		3083		1073					24.29	283.7	0.09
110A	-1986	-805	-356	-518	1.00	3083	2.27	1073	1.89	6.59	6.59		52.93	282.6	0.19
110B	-805	1986	-356	992	1.00	2813	2.27	437	1.89	6.59	6.59		46.93	272.9	0.17
110B	-805	-1986	356	992		-2813		-437					21.87	277.7	0.08
115A	-805	-1986	356	992		2137		451					17.44	281.6	0.06
115A	-805	-1986	356	992	1.00	2137	2.27	451	1.89	6.59	6.59		36.24	279.7	0.13
115B	-1986	805	356	532	1.00	2407	2.27	-910	1.89	6.59	6.59		41.80	268.7	0.16
115B	-1986	-110	-356	532		-2407		910					19.42	275.6	0.07
120A	-1986	-110	-356	532		-1980		-472					15.64	281.0	0.06
120A	-1986	110	356	532	1.00	1980	2.27	472	1.89	6.59	6.59		33.61	277.8	0.12
120B	-380	1952	356	650	1.00	1612	2.27	-321	1.89	6.59	6.59		27.11	279.2	0.10
120B	-380	-1952	-356	650		-1612		321					12.80	281.9	0.05
125	-380	-1952	-356	650		5290		-937					38.98	277.4	0.14

Other forces in local coordinates: Expansion (T1)

Node	Type	fx (N)	fy (N)	fz (N)	mx (Nm)	my (Nm)	mz (Nm)
25	Valve	-715	-612	1098	-2102	1051	-244
30		-715	-612	1098	-2102	1735	136
100	Valve	-1986	-805	-356	-518	1226	2737
105		-1986	-805	-356	-518	1082	3062

Pipe forces in global coordinates: Expansion (T1)

Node	FX (N)	FY (N)	FZ (N)	MX (Nm)	MY (Nm)	MZ (Nm)
5	1098	691	715	1813	-2315	637
10	-1098	-691	-715	-1813	2172	-499
10	1098	691	715	1813	-2172	499
15A	-1098	-691	-715	-1813	-3331	4825

Pipe forces in global coordinates: Expansion (T1)

Node	FX (N)	FY (N)	FZ (N)	MX (Nm)	MY (Nm)	MZ (Nm)
15A	1098	691	715	1813	3331	-4825
15B	-1098	-691	-715	-1541	-3603	4670
15B	1098	691	715	1541	3603	-4670
20A	-1098	-691	-715	2596	-3603	-1684
20A	1098	691	715	-2596	3603	1684
20B	-1098	-691	-715	2605	-3185	-2102
20B	1098	612	715	-2605	3185	2102
25	-1098	-612	-715	244	1051	-2102
30	1098	612	715	136	-1735	2102
55	-1098	-612	-715	-153	1764	-2102
55	1098	612	715	153	-1764	2102
35	-1098	-612	-715	-320	2064	-2102
35	3084	-193	1071	838	-339	491
60	-3084	193	-1071	-785	1181	-491
60	3084	-193	1071	785	-1181	491
40	-3084	193	-1071	-780	1264	-491
40	3084	-193	1071	780	-1264	491
45	-3084	193	-1071	-678	2899	-491
45	3084	-193	1071	678	-2899	491
50	-3084	193	-1071	-272	9375	-491
35	-1986	805	-356	-518	-1724	1611
65	1986	-805	356	518	1676	-1721
65	-1986	805	-356	-518	-1676	1721
100	1986	-805	356	518	1226	-2737
105	-1986	805	-356	-518	-1082	3062
110A	1986	-805	356	518	1073	-3083
110A	-1986	805	-356	-518	-1073	3083
110B	1986	-805	356	437	992	-2813
110B	-1986	805	-356	-437	-992	2813
115A	1986	-805	356	-451	992	2137
115A	-1986	805	-356	451	-992	-2137
115B	1986	-805	356	-532	910	2407
115B	-1986	110	-356	532	-910	-2407
120A	1986	-110	356	-532	-472	1980
120A	-1986	110	-356	532	472	-1980
120B	1986	-110	356	-471	-551	1612
125	1986	-110	356	750	-860	-5290

Other forces in global coordinates: Expansion (T1)

Node	Type	FX (N)	FY (N)	FZ (N)	MX (Nm)	MY (Nm)	MZ (Nm)
25	Valve	1098	612	715	-244	-1051	2102
30		-1098	-612	-715	-136	1735	-2102
100	Valve	-1986	805	-356	-518	-1226	2737
105		1986	-805	356	518	1082	-3062

Displacements: Expansion (T1)

	Displacements (global)					
Node	X (mm)	Y (mm)	Z (mm)	XX (deg)	YY (deg)	ZZ (deg)
5	-0.027	0.000	0.000	0.0000	0.0846	-0.1464
10	0.527	-0.512	-0.299	-0.0021	0.0865	-0.1469
15A	21.860	-17.368	-12.713	-0.0817	0.0670	-0.0738
15B	22.965	-16.552	-13.560	-0.0824	0.0339	0.0296
20A	16.683	-0.513	-22.102	-0.0690	-0.0851	0.0675
20B	15.610	0.759	-21.367	-0.0119	-0.1158	0.0639
25	6.784	0.514	-10.674	0.0123	-0.1339	0.0176
30	5.334	0.380	-8.949	0.0123	-0.1328	0.0156

Displacements: Expansion (T1)

	Displacements (global)					
Node	X (mm)	Y (mm)	Z (mm)	XX (deg)	YY (deg)	ZZ (deg)
55	5.272	0.374	-8.874	0.0123	-0.1326	0.0153
35	4.638	0.315	-8.118	0.0123	-0.1326	0.0153
60	4.001	0.257	-7.361	0.0123	-0.1326	0.0153
40	3.939	0.251	-7.287	0.0122	-0.1325	0.0152
45	2.735	0.151	-5.818	0.0097	-0.1254	0.0131
50	0.000	0.000	0.000	0.0000	0.0000	0.0000
65	4.260	0.278	-8.433	0.0123	-0.1326	-0.0014
100	0.762	1.019	-10.822	0.0336	-0.0867	-0.0720
105	-0.355	1.551	-11.421	0.0354	-0.0837	-0.0795
110A	-0.465	1.588	-11.459	0.0358	-0.0830	-0.0815
110B	-0.627	3.133	-11.486	0.0682	-0.0389	-0.2616
115A	12.371	13.528	-8.321	0.0677	0.0417	-0.2827
115B	12.351	15.259	-7.850	0.0649	0.0678	-0.1427
120A	-3.836	17.457	-1.761	-0.0024	0.0891	0.0708
120B	-4.360	16.309	-1.425	-0.0081	0.0793	0.1630
125	0.000	0.000	0.000	0.0000	0.0000	0.0000

Loads on Anchors: Operating (W+P1+T1)

Node	Tag	FX (N)	FY (N)	FZ (N)	MX (Nm)	MY (Nm)	MZ (Nm)
50		2754	-5675	1078	-6457	-8087	-615
125		-1755	-1605	-332	-727	832	4113

Loads on Hangers: Operating (W+P1+T1)

Node	Tag	Type	Load (N)	No.of	Total (N)
20B		User hanger	-13200	1	-13200
115B		Grinnell	-5115	1	-5115

Loads on Nozzles: Operating (W+P1+T1)

Node	Tag	Axial (N)	y Shear (N)	z Shear (N)	Torque (Nm)	Circ.Mom (Nm)	Long.Mom (Nm)
5		-999	-745	4378	-1561	-884	-2613

Pipe forces in local coordinates: Operating (W+P1+T1)

Node	Axial	y Shear	z Shear	Torsion(Nm)		Inplane(Nm)		Outplane(Nm)		Flex. Factors			Sopr
	(N)	(N)	(N)	Moment	SIF	Moment	SIF	Moment	SIF	FFi	FFo	FFt	(MPa)
5	-999	-4378	-745	-1561		-884		2613					13.70
10	-999	-4224	-745	-1561	1.00	-24	1.00	2464	1.00				13.19
10	-999	-3539	-745	-1561	1.00	-24	1.00	2464	1.00				13.19
15A	-999	2419	-745	-1561		4288		-3276					18.70
15A	-999	2419	-745	-1561	1.00	4288	2.61	-3276	2.17	8.13	8.13		34.44
15B	2882	999	-745	-3560	1.00	2922	2.61	1277	2.17	8.13	8.13		25.79
15B	2882	999	-745	-3560		2922		1277					17.49
20A	7362	999	-745	-3560		-2861		-3038					19.51
20A	7362	-745	-999	-3560	1.00	3038	2.61	-2861	2.17	8.13	8.13		30.10
20B	-745	-7825	-999	-3241	1.00	6239	2.61	3179	2.17	8.13	8.13		43.90
20B	-745	-5375	999	-3241		-6239		-3179					23.01
25	-745	-2389	999	-3241	1.00	8741	1.00	676	1.00				26.34
30	-745	3646	999	-3241	1.00	8350	1.00	1298	1.00				25.74
55	-745	3667	999	-3241		8251		1325					25.56
55	-745	3667	999	-3241		8251		1325					25.56
35	-745	3879	999	-3241	1.39	-1598	2.00	7221	1.00				25.82
35	-1078	3919	2754	615	1.39	-18	2.00	7732	1.00				23.10
60	-1078	4130	2754	615		6633		770					20.91
60	-1078	4130	2754	615		6633		770					20.91
40	-1078	4151	2754	615		6522		844					20.70
40	-1078	4151	2754	615	1.00	6522	1.52	844	1.52				27.70
45	-1078	4502	2754	615	1.00	4228	1.52	2304	1.52				33.21
45	-1078	4502	2754	615		4228		2304					24.12
50	-1078	5675	2754	615		-6457		8087					44.14

Pipe forces in local coordinates: Operating (W+P1+T1)

Node	Axial (N)	y Shear (N)	z Shear (N)	Torsion(Nm) Moment	Torsion(Nm) SIF	Inplane(Nm) Moment	Inplane(Nm) SIF	Outplane(Nm) Moment	Outplane(Nm) SIF	Flex. Factors FFi	Flex. Factors FFo	Flex. Factors FFt	Sopr (MPa)
35	-1755	-40	-332	-511	1.07	1580	1.47	-3856	1.86		2.44		59.82
65	-1755	12	-332	-511		3858		1535			2.44		35.48
65	-1755	12	-332	-511		3858		1535					35.48
100	-1755	497	-332	-511	1.00	3537	1.00	1115	1.00				32.32
105	-1755	2512	-332	-511	1.00	2930	1.00	981	1.00				40.94
110A	-1755	2522	-332	-511		2864		972					40.47
110A	-1755	2522	-332	-511	1.00	2864	2.27	972	1.89	6.59	6.59		67.01
110B	2660	1755	-332	896	1.00	1874	2.27	435	1.89	6.59	6.59		51.39
110B	2660	-1755	332	896		-1874		-435					34.91
115A	3617	-1755	332	896		2501		393					39.22
115A	3617	-1755	332	896	1.00	2501	2.27	393	1.89	6.59	6.59		61.48
115B	-1755	-3755	332	469	1.00	3749	2.27	-820	1.89	6.59	6.59		80.55
115B	-1755	-1360	-332	469		-3749		820					46.21
120A	-1755	131	-332	469		-1364		-470					29.34
120A	-1755	-131	332	469	1.00	1364	2.27	470	1.89	6.59	6.59		41.77
120B	-670	1641	332	628	1.00	1100	2.27	-266	1.89	6.59	6.59		37.56
120B	-670	-1641	-332	628		-1100		266					28.04
125	-1986	-1308	-332	628		4113		-909					48.97

Other forces in local coordinates: Operating (W+P1+T1)

Node	Type	fx (N)	fy (N)	fz (N)	mx (Nm)	my (Nm)	mz (Nm)
25	Valve	-745	-1703	999	-3241	676	8741
30		-745	2962	999	-3241	1298	8350
100	Valve	-1755	729	-332	-511	1115	3537
105		-1755	2280	-332	-511	981	2930

Pipe forces in global coordinates: Operating (W+P1+T1)

Node	FX (N)	FY (N)	FZ (N)	MX (Nm)	MY (Nm)	MZ (Nm)
5	999	4378	745	1561	-2613	884
10	-999	-4224	-745	-1561	2464	-24
10	999	3539	745	1561	-2464	24
15A	-999	2419	-745	-1561	-3276	4288
15A	999	-2419	745	1561	3276	-4288
15B	-999	2882	-745	-1277	-3560	2922
15B	999	-2882	745	1277	3560	-2922
20A	-999	7362	-745	3038	-3560	-2861
20A	999	-7362	745	-3038	3560	2861
20B	-999	7825	-745	6239	-3179	-3241
20B	999	5375	745	-6239	3179	3241
25	-999	-2389	-745	-8741	676	-3241
30	999	-3646	745	8350	-1298	3241
55	-999	3667	-745	-8251	1325	-3241
55	999	-3667	745	8251	-1325	3241
35	-999	3879	-745	-7221	1598	-3241
35	2754	-3919	1078	7732	-18	-615
60	-2754	4130	-1078	-6633	770	615
60	2754	-4130	1078	6633	-770	-615
40	-2754	4151	-1078	-6522	844	615
40	2754	-4151	1078	6522	-844	-615
45	-2754	4502	-1078	-4228	2304	615
45	2754	-4502	1078	4228	-2304	-615
50	-2754	5675	-1078	6457	8087	615
35	-1755	40	-332	-511	-1580	3856
65	1755	12	332	511	1535	-3858
65	-1755	-12	-332	-511	-1535	3858
100	1755	497	332	511	1115	-3537

Pipe forces in global coordinates: Operating (W+P1+T1)

Node	FX (N)	FY (N)	FZ (N)	MX (Nm)	MY (Nm)	MZ (Nm)
105	-1755	-2512	-332	-511	-981	2930
110A	1755	2522	332	511	972	-2864
110A	-1755	-2522	-332	-511	-972	2864
110B	1755	2660	332	435	896	-1874
110B	-1755	-2660	-332	-435	-896	1874
115A	1755	3617	332	-393	896	2501
115A	-1755	-3617	-332	393	-896	-2501
115B	1755	3755	332	-469	820	3749
115B	-1755	1360	-332	469	-820	-3749
120A	1755	131	332	-469	-470	1364
120A	-1755	-131	-332	469	470	-1364
120B	1755	248	332	-412	-544	1100
120B	-1755	-248	-332	412	544	-1100
125	1755	1605	332	727	-832	-4113

Other forces in global coordinates: Operating (W+P1+T1)

Node	Type	FX (N)	FY (N)	FZ (N)	MX (Nm)	MY (Nm)	MZ (Nm)
25	Valve	999	1703	745	8741	-676	3241
30		-999	2962	-745	-8350	1298	-3241
100	Valve	-1755	-729	-332	-511	-1115	3537
105		1755	2280	332	511	981	-2930

Displacements: Operating (W+P1+T1)

Node	Displacements (global)					
	X (mm)	Y (mm)	Z (mm)	XX (deg)	YY (deg)	ZZ (deg)
5	-0.024	0.000	0.000	0.0000	0.0955	-0.2031
10	0.530	-0.713	-0.338	-0.0018	0.0977	-0.2035
15A	21.863	-16.180	-14.734	-0.0704	0.0840	-0.0022
15B	22.594	-14.935	-15.609	-0.0681	0.0501	0.0732
20A	13.909	1.126	-22.295	-0.0457	-0.0675	0.0739
20B	12.991	2.153	-21.367	0.0454	-0.0913	0.0558
25	5.747	-1.120	-10.674	0.0079	-0.1125	-0.0155
30	4.527	-1.170	-8.949	0.0015	-0.1118	-0.0186
55	4.475	-1.170	-8.874	0.0005	-0.1116	-0.0191
35	3.941	-1.167	-8.118	0.0005	-0.1116	-0.0191
60	3.405	-1.163	-7.361	0.0005	-0.1116	-0.0191
40	3.353	-1.163	-7.287	-0.0003	-0.1115	-0.0191
45	2.336	-1.060	-5.818	-0.0186	-0.1062	-0.0163
50	0.000	0.000	0.000	0.0000	0.0000	0.0000
65	3.563	-1.121	-8.383	0.0005	-0.1116	-0.0565
100	0.065	1.456	-10.355	0.0215	-0.0697	-0.1753
105	-1.053	2.721	-10.835	0.0233	-0.0670	-0.1838
110A	-1.163	2.807	-10.866	0.0237	-0.0663	-0.1857
110B	-0.996	4.730	-10.886	0.0544	-0.0258	-0.3248
115A	13.733	15.138	-8.294	0.0558	0.0470	-0.3052
115B	13.765	16.882	-7.852	0.0537	0.0708	-0.1236
120A	-2.423	17.086	-1.761	-0.0057	0.0878	0.0783
120B	-2.981	15.956	-1.423	-0.0099	0.0772	0.1422
125	0.000	0.000	0.000	0.0000	0.0000	0.0000

Loads on Anchors: Seismic 1 (g)

Node	Tag	FX (N)	FY (N)	FZ (N)	MX (Nm)	MY (Nm)	MZ (Nm)
50		3873	2816	6499	8455	10815	1562
125		1272	615	787	2060	736	2700

Loads on Hangers: Seismic 1 (g)

Node	Tag	Type	Load (N)	No.of	Total (N)
20B		User hanger	1536	1	1536
115B		Grinnell	196	1	196

Loads on Nozzles: Seismic 1 (g)

Node	Tag	Axial (N)	y Shear (N)	z Shear (N)	Torque (Nm)	Circ.Mom (Nm)	Long.Mom (Nm)
5		3853	1765	1130	2890	536	3671

Pipe forces in local coordinates: Seismic 1 (g)

Node	Axial	y Shear	z Shear	Torsion(Nm)		Inplane(Nm)		Outplane(Nm)		Flex. Factors			SL+SO	SA	SL+SO
	(N)	(N)	(N)	Moment	SIF	Moment	SIF	Moment	SIF	FFi	FFo	FFt	(MPa)	(MPa)	SA
5	3853	1130	1765	2890		536		3671					17.36	122.1	0.14
10	3807	1102	1719	2890	1.00	354	1.00	3334	1.00				16.74	122.1	0.14
10	3602	982	1515	2890	1.00	354	1.00	3334	1.00				16.71	122.1	0.14
15A	1818	606	338	2890		4231		1973					19.28	122.1	0.16
15A	1818	606	338	2890	1.00	4231	2.61	1973	2.17	8.13	8.13		28.51	122.1	0.23
15B	663	1679	461	1911	1.00	3727	2.61	2763	2.17	8.13	8.13		32.20	122.1	0.26
15B	663	1679	461	1911		3727		2763					21.06	122.1	0.17
20A	1424	364	1776	1911		2451		4100					20.84	122.1	0.17
20A	1424	1776	364	1911	1.00	4100	2.61	2451	2.17	8.13	8.13		30.61	122.1	0.25
20B	1914	1511	246	2540	1.00	4576	2.61	1996	2.17	8.13	8.13		41.69	122.1	0.34
20B	1914	466	246	2540		4576		1996					25.96	122.1	0.21
25	2808	739	724	2540	1.00	2811	1.00	1891	1.00				33.10	122.1	0.27
30	4616	1841	2522	2540	1.00	2646	1.00	2032	1.00				31.59	122.1	0.26
55	4622	1845	2528	2540		2648		2057					31.39	122.1	0.26
55	4622	1845	2528	2540		2648		2057					31.39	122.1	0.26
35	4685	1886	2592	2540	1.39	-2414	2.00	2722	1.00				30.52	122.1	0.25
35	5973	2473	3347	1562	1.39	-649	2.00	1590	1.00				26.33	122.1	0.22
60	6036	2514	3410	1562		1929		1267					24.98	122.1	0.20
60	6036	2514	3410	1562		1929		1267					24.98	122.1	0.20
40	6043	2519	3417	1562		1972		1348					24.90	122.1	0.20
40	6043	2519	3417	1562	1.00	1972	1.52	1348	1.52				27.15	122.1	0.22
45	6148	2587	3522	1562	1.00	3034	1.52	3096	1.52				40.32	122.1	0.33
45	6148	2587	3522	1562		3034		3096					36.54	122.1	0.30
50	6499	2816	3873	1562		8455		10815					78.98	122.1	0.65
35	757	616	1306	1135	1.07	2274	1.47	-1082	1.86		2.44		45.45	122.1	0.37
65	741	606	1290	1135		1019		2114			2.44		35.03	122.1	0.29
65	741	606	1290	1135		1019		2114					35.03	122.1	0.29
100	595	516	1148	1135	1.00	666	1.00	984	1.00				20.96	122.1	0.17
105	12	219	573	1135	1.00	630	1.00	883	1.00				29.12	110.0	0.26
110A	15	219	570	1135		626		879					29.46	110.0	0.27
110A	15	219	570	1135	1.00	626	2.27	879	1.89	6.59	6.59		34.34	110.0	0.31
110B	212	54	533	855	1.00	584	2.27	1013	1.89	6.59	6.59		41.77	110.0	0.38
110B	212	54	533	855		584		1013					33.79	110.0	0.31
115A	257	341	310	855		310		277					26.52	110.0	0.24
115A	257	341	310	855	1.00	310	2.27	277	1.89	6.59	6.59		29.92	110.0	0.27
115B	382	275	287	306	1.00	299	2.27	815	1.89	6.59	6.59		41.23	110.0	0.37
115B	382	216	287	306		299		815					32.67	110.0	0.30
120A	829	354	393	306		993		247					31.03	110.0	0.28
120A	829	354	393	306	1.00	993	2.27	247	1.89	6.59	6.59		39.11	110.0	0.36
120B	514	789	421	313	1.00	916	2.27	280	1.89	6.59	6.59		36.83	110.0	0.33
120B	514	789	421	313		916		280					29.63	110.0	0.27
125	763	1188	787	313		2700		2165					50.75	110.0	0.46

Other forces in local coordinates: Seismic 1 (g)

Node	Type	fx (N)	fy (N)	fz (N)	mx (Nm)	my (Nm)	mz (Nm)
25	Valve	3013	850	926	2540	1891	2811
30		4411	1709	2317	2540	2032	2646
100	Valve	526	474	1080	1135	984	666
105		61	238	636	1135	883	630

Pipe forces in global coordinates: Seismic 1 (g)

Node	FX (N)	FY (N)	FZ (N)	MX (Nm)	MY (Nm)	MZ (Nm)
5	3853	1130	1765	2890	3671	536
10	3807	1102	1719	2890	3334	354
10	3602	982	1515	2890	3334	354
15A	1818	606	338	2890	1973	4231
15A	1818	606	338	2890	1973	4231
15B	1679	663	461	2763	1911	3727
15B	1679	663	461	2763	1911	3727
20A	364	1424	1776	4100	1911	2451
20A	364	1424	1776	4100	1911	2451
20B	246	1511	1914	4576	1996	2540
20B	246	466	1914	4576	1996	2540
25	724	739	2808	2811	1891	2540
30	2522	1841	4616	2646	2032	2540
55	2528	1845	4622	2648	2057	2540
55	2528	1845	4622	2648	2057	2540
35	2592	1886	4685	2722	2414	2540
35	3347	2473	5973	1590	649	1562
60	3410	2514	6036	1929	1267	1562
60	3410	2514	6036	1929	1267	1562
40	3417	2519	6043	1972	1348	1562
40	3417	2519	6043	1972	1348	1562
45	3522	2587	6148	3034	3096	1562
45	3522	2587	6148	3034	3096	1562
50	3873	2816	6499	8455	10815	1562
35	757	616	1306	1135	2274	1082
65	741	606	1290	1135	2114	1019
65	741	606	1290	1135	2114	1019
100	595	516	1148	1135	984	666
105	12	219	573	1135	883	630
110A	15	219	570	1135	879	626
110A	15	219	570	1135	879	626
110B	54	212	533	1013	855	584
110B	54	212	533	1013	855	584
115A	341	257	310	277	855	310
115A	341	257	310	277	855	310
115B	382	275	287	306	815	299
115B	382	216	287	306	815	299
120A	829	354	393	306	247	993
120A	829	354	393	306	247	993
120B	639	692	421	195	372	916
120B	891	305	421	348	235	916
125	1339	449	787	2176	228	2700

Other forces in global coordinates: Seismic 1 (g)

Node	Type	FX (N)	FY (N)	FZ (N)	MX (Nm)	MY (Nm)	MZ (Nm)
25	Valve	926	850	3013	2811	1891	2540
30		2317	1709	4411	2646	2032	2540
100	Valve	526	474	1080	1135	984	666
105		61	238	636	1135	883	630

Displacements: Seismic 1 (g)

	Displacements (global)					
Node	X (mm)	Y (mm)	Z (mm)	XX (deg)	YY (deg)	ZZ (deg)
5	0.094	0.000	0.000	0.0000	0.1341	0.1233
10	0.095	0.432	0.475	0.0033	0.1372	0.1237
15A	0.108	14.916	20.497	0.1303	0.1368	0.1010
15B	0.966	15.466	20.300	0.1720	0.1108	0.1526
20A	17.085	15.462	1.112	0.1850	0.1100	0.1442

Displacements: Seismic 1 (g)

	Displacements (global)					
Node	X (mm)	Y (mm)	Z (mm)	XX (deg)	YY (deg)	ZZ (deg)
20B	17.129	14.624	0.024	0.1351	0.1334	0.1067
25	7.618	6.236	0.018	0.1240	0.1483	0.0514
30	6.006	4.893	0.017	0.1235	0.1482	0.0490
55	5.936	4.834	0.017	0.1234	0.1481	0.0486
35	5.226	4.244	0.016	0.1233	0.1481	0.0486
60	4.516	3.654	0.015	0.1233	0.1481	0.0486
40	4.446	3.596	0.015	0.1232	0.1480	0.0484
45	3.099	2.485	0.013	0.1153	0.1407	0.0415
50	0.000	0.000	0.000	0.0000	0.0000	0.0000
65	5.227	4.227	0.353	0.1233	0.1481	0.0404
100	5.228	4.383	3.250	0.1055	0.1175	0.0188
105	5.228	4.451	4.064	0.1048	0.1152	0.0172
110A	5.228	4.455	4.116	0.1046	0.1147	0.0168
110B	5.202	4.466	4.562	0.1018	0.0846	0.0197
115A	4.131	4.466	6.697	0.1063	0.0310	0.0462
115B	4.048	4.311	6.963	0.0988	0.0359	0.0562
120A	4.045	1.195	4.157	0.0865	0.0575	0.0599
120B	3.848	0.971	3.735	0.0831	0.0502	0.0794
125	0.000	0.000	0.000	0.0000	0.0000	0.0000

Loads on Anchors: Wind

Node	Tag	FX (N)	FY (N)	FZ (N)	MX (Nm)	MY (Nm)	MZ (Nm)
50		1208	-121	144	-666	-3881	-680
125		603	-26	-95	-233	172	-1112

Loads on Hangers: Wind

Node	Tag	Type	Load (N)	No.of	Total (N)
20B		User hanger	-171	1	-171
115B		Grinnell	-1	1	-1

Loads on Nozzles: Wind

Node	Tag	Axial (N)	y Shear (N)	z Shear (N)	Torque (Nm)	Circ.Mom (Nm)	Long.Mom (Nm)
5		873	-50	-211	-310	-4	194

Pipe forces in local coordinates: Wind

Node	Axial	y Shear	z Shear	Torsion(Nm)		Inplane(Nm)		Outplane(Nm)		Flex. Factors			SL+SO	SA	SL+SO
	(N)	(N)	(N)	Moment	SIF	Moment	SIF	Moment	SIF	FFi	FFo	FFt	(MPa)	(MPa)	SA
5	873	211	-50	-310		-4		-194					8.045	122.1	0.07
10	873	211	-50	-310	1.00	-46	1.00	-204	1.00				8.384	122.1	0.07
10	873	211	-50	-310	1.00	-46	1.00	-204	1.00				8.384	122.1	0.07
15A	873	211	-50	-310		-1673		-585					12.13	122.1	0.10
15A	854	230	-50	-310	1.00	-1673	2.61	-585	2.17	8.13	8.13		16.47	122.1	0.13
15B	230	-854	-50	-604	1.00	-1435	2.61	291	2.17	8.13	8.13		20.58	122.1	0.17
15B	250	-421	-50	-604		-1037		291					13.59	122.1	0.11
20A	250	-421	-50	-604		1399		5					9.513	122.1	0.08
20A	250	-50	-32	-604	1.00	-5	2.61	1001	2.17	8.13	8.13		10.35	122.1	0.08
20B	-50	-250	-32	989	1.00	109	2.61	592	2.17	8.13	8.13		22.41	122.1	0.18
20B	-50	78	346	989		-109		-768					15.15	122.1	0.12
25	-50	78	346	989	1.00	-412	1.00	568	1.00				24.85	122.1	0.20
30	-50	78	735	989	1.00	-461	1.00	1166	1.00				23.24	122.1	0.19
55	-50	78	735	989		-463		1186					23.01	122.1	0.19
55	-50	78	756	989		-463		1185					23.01	122.1	0.19
35	-50	78	756	989	1.39	-1391	2.00	-485	1.00				20.75	122.1	0.17
35	-144	121	853	680	1.39	-878	2.00	-313	1.00				21.22	122.1	0.17
60	-144	121	853	680		-346		1111					19.01	122.1	0.16
60	-144	121	875	680		-346		1111					19.01	122.1	0.16
40	-144	121	875	680		-349		1135					18.80	122.1	0.15

Pipe forces in local coordinates: Wind

Node	Axial (N)	y Shear (N)	z Shear (N)	Torsion(Nm) Moment	Torsion(Nm) SIF	Inplane(Nm) Moment	Inplane(Nm) SIF	Outplane(Nm) Moment	Outplane(Nm) SIF	Flex. Factors FFi	Flex. Factors FFo	Flex. Factors FFt	SL+SO (MPa)	SA (MPa)	SL+SO SA
40	-144	121	912	680	1.00	-349	1.52	1132	1.52				20.35	122.1	0.17
45	-144	121	912	680	1.00	-413	1.52	1615	1.52				21.36	122.1	0.17
45	-144	121	1078	680		-413		1573					19.70	122.1	0.16
50	-144	121	1078	680		-666		3836					35.66	122.1	0.29
35	-58	-42	-95	-172	1.07	514	1.47	309	1.86		2.44		25.64	122.1	0.21
65	-58	-42	-95	-172		-304		501			2.44		19.43	122.1	0.16
65	-58	-42	-95	-172		-304		501					19.43	122.1	0.16
100	-58	-42	-95	-172	1.00	-250	1.00	381	1.00				10.42	122.1	0.09
105	-58	-42	-95	-172	1.00	-233	1.00	343	1.00				22.15	110.0	0.20
110A	-58	-42	-95	-172		-232		341					22.68	110.0	0.21
110A	-49	-51	-95	-172	1.00	-232	2.27	341	1.89	6.59	6.59		25.04	110.0	0.23
110B	-51	49	-95	319	1.00	-232	2.27	150	1.89	6.59	6.59		34.28	110.0	0.31
110B	-59	91	95	319		287		-150					28.79	110.0	0.26
115A	-59	91	95	319		60		86					23.24	110.0	0.21
115A	-68	232	95	319	1.00	5	2.27	86	1.89	6.59	6.59		24.70	110.0	0.22
115B	232	68	95	107	1.00	-63	2.27	-298	1.89	6.59	6.59		34.80	110.0	0.32
115B	240	-77	-95	107		63		298					28.36	110.0	0.26
120A	240	-77	-95	107		363		-70					26.11	110.0	0.24
120A	246	70	95	107	1.00	-363	2.27	70	1.89	6.59	6.59		31.03	110.0	0.28
120B	128	-221	95	110	1.00	-336	2.27	-66	1.89	6.59	6.59		29.24	110.0	0.27
120B	122	410	-95	110		443		66					25.75	110.0	0.23
125	122	410	-95	110		-1005		-268					34.29	110.0	0.31

Other forces in local coordinates: Wind

Node	Type	fx (N)	fy (N)	fz (N)	mx (Nm)	my (Nm)	mz (Nm)
25	Valve	-50	78	678	989	738	-412
30		-50	78	678	989	1160	-461
100	Valve	-58	-42	-95	-172	381	-250
105		-58	-42	-95	-172	343	-233

Pipe forces in global coordinates: Wind

Node	FX (N)	FY (N)	FZ (N)	MX (Nm)	MY (Nm)	MZ (Nm)
5	-873	-211	50	310	194	4
10	873	211	-50	-310	-204	-46
10	-873	-211	50	310	204	46
15A	873	211	-50	-310	-585	-1673
15A	-854	-230	50	310	585	1673
15B	854	230	-50	-291	-604	-1435
15B	-421	-250	50	291	604	1037
20A	421	250	-50	-5	-604	1399
20A	32	-250	50	5	604	-1001
20B	-32	250	-50	109	-592	989
20B	346	-78	50	-109	768	-989
25	-346	78	-50	412	568	989
30	735	-78	50	-461	-1166	-989
55	-735	78	-50	463	1186	989
55	756	-78	50	-463	-1185	-989
35	-756	78	-50	485	1391	989
35	853	-121	144	-313	-878	-680
60	-853	121	-144	346	1111	680
60	875	-121	144	-346	-1111	-680
40	-875	121	-144	349	1135	680
40	912	-121	144	-349	-1132	-680
45	-912	121	-144	413	1615	680
45	1078	-121	144	-413	-1573	-680
50	-1078	121	-144	666	3836	680

Pipe forces in global coordinates: Wind

Node	FX (N)	FY (N)	FZ (N)	MX (Nm)	MY (Nm)	MZ (Nm)
35	-58	42	-95	-172	-514	-309
65	58	-42	95	172	501	304
65	-58	42	-95	-172	-501	-304
100	58	-42	95	172	381	250
105	-58	42	-95	-172	-343	-233
110A	58	-42	95	172	341	232
110A	-49	51	-95	-172	-341	-232
110B	49	-51	95	150	319	232
110B	91	59	-95	-150	-319	-287
115A	-91	-59	95	-86	319	60
115A	232	68	-95	86	-319	-5
115B	-232	-68	95	-107	298	-63
115B	240	77	-95	107	-298	63
120A	-240	-77	95	-107	-70	-363
120A	246	70	-95	107	70	363
120B	-246	-70	95	-91	-91	-336
120B	427	18	-95	91	91	443
125	-427	-18	95	233	-172	1005

Other forces in global coordinates: Wind

Node	Type	FX (N)	FY (N)	FZ (N)	MX (Nm)	MY (Nm)	MZ (Nm)
25	Valve	678	-78	50	-412	-738	-989
30		-678	78	-50	461	1160	989
100	Valve	-58	42	-95	-172	-381	-250
105		58	-42	95	172	343	233

Displacements: Wind

	Displacements (global)					
Node	X (mm)	Y (mm)	Z (mm)	XX (deg)	YY (deg)	ZZ (deg)
5	0.021	0.000	0.000	0.0000	-0.0071	-0.0010
10	0.021	-0.003	0.025	-0.0004	-0.0072	-0.0010
15A	0.026	-1.465	1.749	-0.0140	-0.0206	-0.0300
15B	0.375	-1.750	1.817	-0.0143	-0.0262	-0.0644
20A	7.177	-1.749	0.120	-0.0181	-0.0461	-0.0598
20B	7.169	-1.631	0.000	-0.0172	-0.0592	-0.0440
25	2.992	-0.594	0.000	-0.0127	-0.0609	-0.0223
30	2.333	-0.458	0.000	-0.0124	-0.0602	-0.0213
55	2.305	-0.452	0.000	-0.0124	-0.0601	-0.0212
35	2.017	-0.393	0.000	-0.0124	-0.0601	-0.0212
60	1.730	-0.334	0.000	-0.0124	-0.0601	-0.0212
40	1.702	-0.328	0.000	-0.0123	-0.0599	-0.0211
45	1.165	-0.219	0.000	-0.0110	-0.0553	-0.0181
50	0.000	0.000	0.000	0.0000	0.0000	0.0000
65	2.017	-0.342	-0.143	-0.0124	-0.0601	-0.0182
100	2.018	-0.041	-1.305	-0.0053	-0.0461	-0.0095
105	2.018	0.024	-1.627	-0.0047	-0.0452	-0.0088
110A	2.018	0.028	-1.647	-0.0046	-0.0449	-0.0087
110B	2.018	0.042	-1.793	0.0061	-0.0307	0.0049
115A	1.516	0.042	-1.429	0.0081	-0.0048	0.0157
115B	1.454	-0.017	-1.398	0.0094	0.0046	0.0137
120A	1.453	-0.408	-0.504	-0.0042	0.0157	-0.0071
120B	1.396	-0.352	-0.431	-0.0056	0.0145	-0.0249
125	0.000	0.000	0.000	0.0000	0.0000	0.0000

Loads on Anchors: Wind 2

Node	Tag	FX (N)	FY (N)	FZ (N)	MX (Nm)	MY (Nm)	MZ (Nm)
50		16	230	1809	-32	-16	-116

Loads on Anchors: Wind 2

Node	Tag	FX (N)	FY (N)	FZ (N)	MX (Nm)	MY (Nm)	MZ (Nm)
125		9	1	666	1727	-468	-26

Loads on Hangers: Wind 2

Node	Tag	Type	Load (N)	No.of	Total (N)
20B		User hanger	-221	1	-221
115B		Grinnell	-3	1	-3

Loads on Nozzles: Wind 2

Node	Tag	Axial (N)	y Shear (N)	z Shear (N)	Torque (Nm)	Circ.Mom (Nm)	Long.Mom (Nm)
5		-24	954	45	-1665	-81	2147

Pipe forces in local coordinates: Wind 2

Node	Axial	y Shear	z Shear	Torsion(Nm)		Inplane(Nm)		Outplane(Nm)		Flex. Factors			SL+SO	SA	SL+SO
	(N)	(N)	(N)	Moment	SIF	Moment	SIF	Moment	SIF	FFi	FFo	FFt	(MPa)	(MPa)	SA
5	-24	-45	940	-1665		-81		-2147					11.57	122.1	0.09
10	-24	-45	940	-1665	1.00	-72	1.00	-1959	1.00				11.25	122.1	0.09
10	-24	-45	375	-1665	1.00	-72	1.00	-1253	1.00				9.927	122.1	0.08
15A	-24	-45	375	-1665		277		1632					11.23	122.1	0.09
15A	-24	-45	-215	-1665	1.00	277	2.61	925	2.17	8.13	8.13		11.17	122.1	0.09
15B	-45	24	-215	843	1.00	285	2.61	1584	2.17	8.13	8.13		15.23	122.1	0.12
15B	-45	24	-667	843		285		1981					12.56	122.1	0.10
20A	-45	24	-667	843		145		-1880					13.71	122.1	0.11
20A	-26	-1100	-24	843	1.00	2278	2.61	145	2.17	8.13	8.13		19.86	122.1	0.16
20B	-1100	26	-24	136	1.00	2688	2.61	-853	2.17	8.13	8.13		32.65	122.1	0.27
20B	-1120	-228	24	136		-2688		853					20.34	122.1	0.17
25	-1120	-228	24	136	1.00	-1808	1.00	946	1.00				22.00	122.1	0.18
30	-1120	-228	24	136	1.00	-1666	1.00	961	1.00				20.72	122.1	0.17
55	-1120	-228	24	136		-1660		962					20.50	122.1	0.17
55	-1120	-228	24	136		-1660		962					20.50	122.1	0.17
35	-1120	-228	24	136	1.39	-968	2.00	-1597	1.00				18.27	122.1	0.15
35	-1809	-230	16	116	1.39	30	2.00	-705	1.00				19.97	122.1	0.16
60	-1809	-230	16	116		-643		-26					17.96	122.1	0.15
60	-1809	-230	16	116		-643		-26					17.96	122.1	0.15
40	-1809	-230	16	116		-636		-25					17.76	122.1	0.15
40	-1809	-230	16	116	1.00	-636	1.52	-25	1.52				19.23	122.1	0.16
45	-1809	-230	16	116	1.00	-515	1.52	-17	1.52				19.71	122.1	0.16
45	-1809	-230	16	116		-515		-17					18.16	122.1	0.15
50	-1809	-230	16	116		-32		16					31.65	122.1	0.26
35	9	2	-682	-892	1.07	998	1.47	20	1.86		2.44		30.01	122.1	0.25
65	9	2	-682	-892		-20		905			2.44		23.05	122.1	0.19
65	9	2	-608	-892		-20		891					23.01	122.1	0.19
100	9	2	-608	-892	1.00	-23	1.00	123	1.00				13.19	122.1	0.11
105	9	2	-483	-892	1.00	-23	1.00	-70	1.00				21.61	110.0	0.20
110A	9	2	-483	-892		-23		-83					22.12	110.0	0.20
110A	9	2	-464	-892	1.00	-23	2.27	-83	1.89	6.59	6.59		23.38	110.0	0.21
110B	2	-9	-464	-189	1.00	-22	2.27	786	1.89	6.59	6.59		34.14	110.0	0.31
110B	2	9	315	-189		22		-731					28.63	110.0	0.26
115A	2	9	315	-189		1		55					22.87	110.0	0.21
115A	2	9	166	-189	1.00	1	2.27	1	1.89	6.59	6.59		24.73	110.0	0.22
115B	9	-2	166	39	1.00	-1	2.27	227	1.89	6.59	6.59		35.68	110.0	0.32
115B	9	-1	56	39		1		-359					29.15	110.0	0.26
120A	9	-1	56	39		4		-140					23.56	110.0	0.21
120A	9	1	-277	39	1.00	-4	2.27	8	1.89	6.59	6.59		26.56	110.0	0.24
120B	3	-8	-277	-31	1.00	-3	2.27	-97	1.89	6.59	6.59		25.15	110.0	0.23
120B	3	8	479	-31		3		-13					22.58	110.0	0.21
125	3	8	479	-31		-26		1679					33.49	110.0	0.30

Other forces in local coordinates: Wind 2

Node	Type	fx (N)	fy (N)	fz (N)	mx (Nm)	my (Nm)	mz (Nm)
25	Valve	-1120	-228	24	136	946	-1808
30		-1120	-228	24	136	961	-1666
100	Valve	9	2	-513	-892	135	-23
105		9	2	-513	-892	-72	-23

Pipe forces in global coordinates: Wind 2

Node	FX (N)	FY (N)	FZ (N)	MX (Nm)	MY (Nm)	MZ (Nm)
5	24	45	-940	1665	2147	81
10	-24	-45	940	-1665	-1959	-72
10	24	45	-375	1665	1253	72
15A	-24	-45	375	-1665	1632	277
15A	24	45	215	1665	-925	-277
15B	-24	-45	-215	-1584	843	285
15B	24	45	667	1981	-843	-285
20A	-24	-45	-667	1880	843	145
20A	24	26	1100	-2278	-843	-145
20B	-24	-26	-1100	2688	853	136
20B	24	228	1120	-2688	-853	-136
25	-24	-228	-1120	1808	946	136
30	24	228	1120	-1666	-961	-136
55	-24	-228	-1120	1660	962	136
55	24	228	1120	-1660	-962	-136
35	-24	-228	-1120	1597	968	136
35	16	230	1809	-705	30	-116
60	-16	-230	-1809	643	-26	116
60	16	230	1809	-643	26	-116
40	-16	-230	-1809	636	-25	116
40	16	230	1809	-636	25	-116
45	-16	-230	-1809	515	-17	116
45	16	230	1809	-515	17	-116
50	-16	-230	-1809	32	16	116
35	9	-2	-682	-892	-998	-20
65	-9	2	682	892	905	20
65	9	-2	-608	-892	-891	-20
100	-9	2	608	892	123	23
105	9	-2	-483	-892	70	-23
110A	-9	2	483	892	-83	23
110A	9	-2	-464	-892	83	-23
110B	-9	2	464	786	-189	22
110B	9	-2	-315	-731	189	-22
115A	-9	2	315	-55	-189	1
115A	9	-2	-166	1	189	-1
115B	-9	2	166	-39	-227	-1
115B	9	1	56	39	359	1
120A	-9	-1	-56	-39	-140	-4
120A	9	1	277	39	8	4
120B	-9	-1	-277	-86	53	-3
120B	9	1	479	-20	-26	3
125	-9	-1	-479	-1621	441	26

Other forces in global coordinates: Wind 2

Node	Type	FX (N)	FY (N)	FZ (N)	MX (Nm)	MY (Nm)	MZ (Nm)
25	Valve	24	228	1120	-1808	-946	-136
30		-24	-228	-1120	1666	961	136
100	Valve	9	-2	-513	-892	-135	-23
105		-9	2	513	892	-72	23

Displacements: Wind 2

	Displacements (global)					
Node	X (mm)	Y (mm)	Z (mm)	XX (deg)	YY (deg)	ZZ (deg)
5	0.000	0.000	0.000	0.0000	-0.0784	-0.0186
10	0.000	-0.065	0.278	-0.0019	-0.0802	-0.0186
15A	0.000	-2.471	11.731	-0.0751	-0.0738	-0.0152
15B	0.075	-2.557	11.576	-0.1001	-0.0535	-0.0091
20A	0.689	-2.558	0.558	-0.1014	-0.0257	-0.0036
20B	0.577	-2.107	0.008	-0.0472	-0.0160	-0.0067
25	0.005	-0.300	0.005	-0.0091	-0.0007	-0.0038
30	0.000	-0.209	0.005	-0.0078	0.0000	-0.0036
55	0.000	-0.205	0.005	-0.0076	0.0001	-0.0036
35	0.000	-0.169	0.005	-0.0076	0.0001	-0.0036
60	0.000	-0.133	0.004	-0.0076	0.0001	-0.0036
40	0.000	-0.130	0.004	-0.0075	0.0001	-0.0036
45	0.000	-0.070	0.004	-0.0056	0.0000	-0.0031
50	0.000	0.000	0.000	0.0000	0.0000	0.0000
65	0.000	-0.160	0.006	-0.0076	0.0001	-0.0034
100	0.000	-0.093	0.235	0.0291	0.0161	-0.0027
105	0.000	-0.074	0.350	0.0321	0.0162	-0.0027
110A	0.000	-0.072	0.357	0.0329	0.0162	-0.0027
110B	0.008	-0.064	0.618	0.0603	0.0244	-0.0013
115A	0.044	-0.064	3.885	0.0814	0.0090	-0.0006
115B	0.046	-0.061	4.227	0.0777	0.0012	-0.0006
120A	0.046	-0.014	3.366	0.0728	-0.0231	-0.0008
120B	0.043	-0.011	3.061	0.0707	-0.0215	-0.0010
125	0.000	0.000	0.000	0.0000	0.0000	0.0000

Frequencies

#	Frequency	Period	Participation factors			Modal mass / Total mass		
	(Hz)	(second)	X	Y	Z	X	Y	Z
1	1.703	0.5872	0.7395	-1.9310	1.2246	0.0314	0.2138	0.0860
2	2.458	0.4069	0.8526	-2.2220	-1.5016	0.0417	0.2831	0.1293
3	2.675	0.3739	-2.4950	-1.3661	0.2625	0.3570	0.1070	0.0040
4	4.158	0.2405	-0.3444	0.3579	-1.2489	0.0068	0.0073	0.0894
5	6.661	0.1501	0.8111	-1.2509	0.1106	0.0377	0.0897	0.0007
6	6.761	0.1479	0.9343	0.6600	-0.0140	0.0501	0.0250	0.0000
7	7.456	0.1341	0.0803	-0.1084	-0.1687	0.0004	0.0007	0.0016
8	9.959	0.1004	1.2280	0.1913	-0.1710	0.0865	0.0021	0.0017
9	11.629	0.0860	0.0727	-0.9579	0.0383	0.0003	0.0526	0.0001
10	13.281	0.0753	-0.6669	-0.0590	-1.1835	0.0255	0.0002	0.0803
11	30.952	0.0323	-2.2993	-0.0525	0.0055	0.3032	0.0002	0.0000
12	53.862	0.0186	-0.1820	0.1712	-0.5697	0.0019	0.0017	0.0186
13					Total	0.9423	0.7834	0.4117

Mode 1: 1.70 Hz

Node	X (mm)	Y (mm)	Z (mm)	XX (deg)	YY (deg)	ZZ (deg)
5	0.000	0.000	0.000	0.0000	-0.0583	-0.0444
10	0.000	-0.155	0.206	-0.0017	-0.0597	-0.0446
15A	0.000	-6.256	10.160	-0.0657	-0.0766	-0.0440
15B	0.278	-6.539	10.121	-0.0864	-0.0619	-0.0402
20A	3.941	-6.537	0.568	-0.0928	-0.0455	-0.0306
20B	3.830	-6.013	0.000	-0.0695	-0.0424	-0.0265
25	1.357	-2.102	0.000	-0.0461	-0.0297	-0.0142
30	1.039	-1.607	0.000	-0.0450	-0.0289	-0.0137
55	1.025	-1.586	0.000	-0.0448	-0.0288	-0.0136
35	0.887	-1.372	0.000	-0.0448	-0.0288	-0.0136
60	0.750	-1.158	0.000	-0.0448	-0.0288	-0.0136

Mode 1: 1.70 Hz

Node	X (mm)	Y (mm)	Z (mm)	XX (deg)	YY (deg)	ZZ (deg)
40	0.736	-1.137	0.000	-0.0446	-0.0287	-0.0135
45	0.487	-0.749	0.000	-0.0391	-0.0252	-0.0116
50	0.000	0.000	0.000	0.0000	0.0000	0.0000
65	0.887	-1.339	-0.067	-0.0448	-0.0288	-0.0124
100	0.887	-1.109	-0.616	-0.0389	-0.0211	-0.0083
105	0.887	-1.052	-0.763	-0.0384	-0.0205	-0.0080
110A	0.887	-1.048	-0.772	-0.0383	-0.0204	-0.0079
110B	0.896	-1.030	-0.969	-0.0301	-0.0105	0.0009
115A	0.782	-1.029	-2.142	-0.0249	0.0068	0.0015
115B	0.787	-1.016	-2.192	-0.0208	0.0145	-0.0061
120A	0.786	-0.249	-0.870	-0.0183	0.0197	-0.0153
120B	0.735	-0.186	-0.749	-0.0161	0.0159	-0.0176
125	0.000	0.000	0.000	0.0000	0.0000	0.0000

Mode 2: 2.46 Hz

Node	X (mm)	Y (mm)	Z (mm)	XX (deg)	YY (deg)	ZZ (deg)
5	0.000	0.000	0.000	0.0000	0.0593	-0.0435
10	0.000	-0.152	-0.210	0.0018	0.0607	-0.0436
15A	0.000	-6.078	-9.610	0.0695	0.0623	-0.0421
15B	0.264	-6.346	-9.388	0.0954	0.0367	-0.0383
20A	3.806	-6.343	-0.217	0.0631	-0.0064	-0.0304
20B	3.866	-6.397	-0.005	-0.0227	-0.0247	-0.0174
25	1.736	-3.225	-0.003	-0.0628	-0.0349	-0.0082
30	1.357	-2.540	-0.003	-0.0631	-0.0347	-0.0078
55	1.341	-2.511	-0.003	-0.0632	-0.0347	-0.0078
35	1.175	-2.208	-0.003	-0.0632	-0.0347	-0.0078
60	1.009	-1.905	0.000	-0.0632	-0.0347	-0.0078
40	0.992	-1.875	0.000	-0.0631	-0.0346	-0.0077
45	0.681	-1.302	0.000	-0.0597	-0.0322	-0.0066
50	0.000	0.000	0.000	0.0000	0.0000	0.0000
65	1.175	-2.189	-0.085	-0.0632	-0.0347	-0.0063
100	1.175	-2.095	-0.773	-0.0615	-0.0271	-0.0029
105	1.175	-2.075	-0.961	-0.0613	-0.0264	-0.0028
110A	1.175	-2.073	-0.974	-0.0613	-0.0262	-0.0028
110B	1.178	-2.067	-1.284	-0.0550	-0.0145	0.0000
115A	1.227	-2.066	-3.603	-0.0514	0.0109	-0.0048
115B	1.263	-2.017	-3.729	-0.0444	0.0228	-0.0167
120A	1.263	-0.409	-1.659	-0.0368	0.0310	-0.0282
120B	1.175	-0.297	-1.446	-0.0326	0.0250	-0.0293
125	0.000	0.000	0.000	0.0000	0.0000	0.0000

Mode 3: 2.67 Hz

Node	X (mm)	Y (mm)	Z (mm)	XX (deg)	YY (deg)	ZZ (deg)
5	-0.024	0.000	0.000	0.0000	-0.0057	-0.0505
10	-0.025	-0.177	0.020	0.0003	-0.0058	-0.0506
15A	-0.030	-4.171	0.010	0.0099	0.0140	0.0143
15B	-0.478	-3.873	-0.096	0.0045	0.0293	0.0965
20A	-12.517	-3.873	0.086	-0.0056	0.0744	0.1179
20B	-12.602	-3.749	0.000	-0.0256	0.1026	0.0858
25	-5.294	-1.680	0.000	-0.0336	0.1081	0.0424
30	-4.123	-1.315	0.000	-0.0336	0.1073	0.0406
55	-4.072	-1.299	0.000	-0.0335	0.1071	0.0403
35	-3.559	-1.138	0.000	-0.0335	0.1071	0.0403
60	-3.047	-0.977	0.000	-0.0335	0.1071	0.0403
40	-2.996	-0.961	0.000	-0.0335	0.1069	0.0401
45	-2.042	-0.660	0.000	-0.0311	0.0982	0.0344

Mode 3: 2.67 Hz

Node	X (mm)	Y (mm)	Z (mm)	XX (deg)	YY (deg)	ZZ (deg)
50	0.000	0.000	0.000	0.0000	0.0000	0.0000
65	-3.559	-1.234	0.255	-0.0335	0.1071	0.0336
100	-3.559	-1.727	2.460	-0.0339	0.0918	0.0107
105	-3.559	-1.796	3.101	-0.0340	0.0903	0.0088
110A	-3.559	-1.800	3.142	-0.0340	0.0899	0.0083
110B	-3.481	-1.769	3.299	-0.0430	0.0690	-0.0347
115A	-1.396	-1.768	1.541	-0.0352	0.0219	-0.0527
115B	-1.196	-1.580	1.464	-0.0347	0.0058	-0.0431
120A	-1.194	0.307	0.702	0.0000	-0.0183	-0.0073
120B	-1.165	0.294	0.622	0.0057	-0.0195	0.0184
125	0.000	0.000	0.000	0.0000	0.0000	0.0000

Mode 4: 4.16 Hz

Node	X (mm)	Y (mm)	Z (mm)	XX (deg)	YY (deg)	ZZ (deg)
5	-0.003	0.000	0.000	0.0000	-0.0046	0.0072
10	-0.003	0.025	0.016	-0.0001	-0.0048	0.0072
15A	-0.004	1.189	0.568	-0.0051	-0.0008	0.0110
15B	-0.097	1.273	0.511	-0.0082	0.0039	0.0161
20A	-1.793	1.271	-0.052	0.0009	0.0145	0.0150
20B	-1.760	1.194	-0.004	0.0168	0.0196	0.0097
25	-0.604	0.262	-0.005	0.0025	0.0100	0.0040
30	-0.501	0.244	-0.005	0.0007	0.0089	0.0038
55	-0.497	0.243	-0.005	0.0003	0.0087	0.0037
35	-0.454	0.240	-0.005	0.0003	0.0087	0.0037
60	-0.412	0.237	-0.004	0.0003	0.0087	0.0037
40	-0.408	0.237	-0.004	0.0005	0.0088	0.0037
45	-0.315	0.212	-0.004	0.0041	0.0107	0.0032
50	0.000	0.000	0.000	0.0000	0.0000	0.0000
65	-0.454	0.232	0.013	0.0003	0.0087	0.0025
100	-0.454	0.210	-0.478	-0.1911	-0.0384	-0.0001
105	-0.455	0.211	-0.750	-0.2067	-0.0380	-0.0002
110A	-0.455	0.212	-0.767	-0.2107	-0.0376	-0.0002
110B	-0.451	0.214	-2.085	-0.3547	-0.0773	-0.0012
115A	-0.389	0.214	-21.257	-0.4784	0.0057	-0.0013
115B	-0.384	0.217	-23.008	-0.4486	0.0522	-0.0003
120A	-0.384	0.114	-16.693	-0.3870	0.1140	0.0042
120B	-0.364	0.092	-15.123	-0.3690	0.1022	0.0077
125	0.000	0.000	0.000	0.0000	0.0000	0.0000

Mode 5: 6.66 Hz

Node	X (mm)	Y (mm)	Z (mm)	XX (deg)	YY (deg)	ZZ (deg)
5	0.017	0.000	0.000	0.0000	-0.0105	0.0239
10	0.017	0.084	0.037	-0.0004	-0.0108	0.0240
15A	0.020	2.675	0.972	-0.0155	0.0049	0.0087
15B	0.022	2.693	0.743	-0.0251	0.0204	-0.0027
20A	-1.088	2.683	-0.333	0.0212	0.0545	0.0411
20B	-1.207	2.209	0.003	0.0951	0.0422	0.0835
25	0.890	-2.651	0.000	0.0016	0.0030	0.1730
30	0.902	-2.614	0.000	-0.0089	-0.0010	0.1769
55	0.902	-2.609	0.000	-0.0107	-0.0017	0.1775
35	0.894	-2.559	0.000	-0.0107	-0.0017	0.1775
60	0.881	-2.495	0.000	-0.0107	-0.0017	0.1775
40	0.880	-2.489	0.000	-0.0122	-0.0022	0.1766
45	0.786	-2.185	0.000	-0.0464	-0.0154	0.1515
50	0.000	0.000	0.000	-0.0000	0.0000	0.0000
65	0.895	-2.995	-0.003	-0.0107	-0.0017	0.2595

Mode 5: 6.66 Hz

Node	X (mm)	Y (mm)	Z (mm)	XX (deg)	YY (deg)	ZZ (deg)
100	0.901	-10.380	-0.028	-0.0081	-0.0005	0.3398
105	0.902	-12.739	-0.030	-0.0079	-0.0003	0.3274
110A	0.902	-12.890	-0.031	-0.0078	-0.0003	0.3233
110B	0.628	-13.611	-0.051	-0.0047	0.0026	-0.0778
115A	9.561	-13.623	-0.168	-0.0007	0.0069	-0.2478
115B	10.434	-12.845	-0.131	0.0024	0.0097	-0.1650
120A	10.438	-3.203	0.543	0.0101	0.0079	-0.1609
120B	9.836	-2.484	0.532	0.0127	0.0043	-0.2204
125	0.000	0.000	0.000	0.0000	0.0000	0.0000

Mode 6: 6.76 Hz

Node	X (mm)	Y (mm)	Z (mm)	XX (deg)	YY (deg)	ZZ (deg)
5	-0.018	0.000	0.000	0.0000	-0.0002	-0.0135
10	-0.018	-0.047	0.000	0.0002	-0.0002	-0.0135
15A	-0.022	-1.001	-0.197	0.0076	0.0047	0.0062
15B	-0.159	-0.903	-0.191	0.0074	0.0077	0.0271
20A	-2.240	-0.900	0.113	-0.0074	0.0190	-0.0021
20B	-1.881	-0.740	0.000	-0.0319	0.0392	-0.0406
25	0.183	0.888	0.000	-0.0005	0.0112	-0.1044
30	0.291	0.876	0.000	0.0030	0.0085	-0.1072
55	0.295	0.874	0.000	0.0036	0.0080	-0.1077
35	0.334	0.857	0.000	0.0036	0.0080	-0.1077
60	0.369	0.836	0.000	0.0036	0.0080	-0.1077
40	0.372	0.834	0.000	0.0041	0.0076	-0.1071
45	0.387	0.732	0.000	0.0155	-0.0026	-0.0919
50	0.000	0.000	0.000	0.0000	0.0000	0.0000
65	0.335	1.118	0.019	0.0036	0.0080	-0.1651
100	0.340	6.404	0.214	0.0018	0.0087	-0.2910
105	0.340	8.470	0.274	0.0016	0.0085	-0.2954
110A	0.340	8.606	0.278	0.0016	0.0084	-0.2963
110B	1.714	9.902	0.303	-0.0016	0.0044	-0.3646
115A	15.699	9.898	0.175	-0.0042	-0.0035	-0.2083
115B	16.032	9.857	0.133	-0.0067	-0.0073	0.1317
120A	16.025	-4.136	-0.476	-0.0102	-0.0078	0.0835
120B	15.630	-3.934	-0.467	-0.0119	-0.0049	-0.2464
125	0.000	0.000	0.000	0.0000	0.0000	-0.0000

Mode 7: 7.46 Hz

Node	X (mm)	Y (mm)	Z (mm)	XX (deg)	YY (deg)	ZZ (deg)
5	0.003	0.000	0.000	0.0000	0.0014	-0.0013
10	0.003	-0.004	-0.005	0.0000	0.0014	-0.0013
15A	0.004	-0.276	-0.097	0.0014	-0.0013	-0.0034
15B	0.040	-0.305	-0.065	0.0028	-0.0038	-0.0066
20A	0.666	-0.304	0.047	-0.0025	-0.0097	-0.0033
20B	0.590	-0.252	0.009	-0.0102	-0.0132	0.0020
25	0.016	0.122	0.009	0.0061	0.0018	0.0088
30	0.043	0.048	0.009	0.0078	0.0033	0.0091
55	0.045	0.044	0.009	0.0081	0.0035	0.0091
35	0.061	0.006	0.009	0.0081	0.0035	0.0091
60	0.076	-0.031	0.009	0.0081	0.0035	0.0091
40	0.078	-0.034	0.009	0.0079	0.0034	0.0091
45	0.093	-0.081	0.007	0.0030	0.0003	0.0078
50	0.000	0.000	0.000	0.0000	0.0000	0.0000
65	0.061	-0.016	0.023	0.0081	0.0035	0.0143
100	0.061	-0.450	0.696	0.1959	0.0303	0.0214
105	0.061	-0.599	0.895	0.2112	0.0248	0.0210

Mode 7: 7.46 Hz

Node	X (mm)	Y (mm)	Z (mm)	XX (deg)	YY (deg)	ZZ (deg)
110A	0.061	-0.609	0.907	0.2152	0.0230	0.0208
110B	0.017	-0.670	1.898	0.3126	-0.0276	0.0052
115A	0.064	-0.671	17.400	0.3203	-0.3231	-0.0051
115B	0.089	-0.642	16.648	0.1336	-0.5120	-0.0083
120A	0.090	-0.042	-21.395	-0.3442	-0.4708	-0.0074
120B	0.075	-0.019	-21.538	-0.5029	-0.2678	-0.0036
125	0.000	0.000	0.000	-0.0000	0.0000	0.0000

Mode 8: 9.96 Hz

Node	X (mm)	Y (mm)	Z (mm)	XX (deg)	YY (deg)	ZZ (deg)
5	-0.034	0.000	0.000	0.0000	-0.0247	-0.0227
10	-0.034	-0.080	0.088	0.0007	-0.0252	-0.0228
15A	-0.041	-0.999	0.338	0.0296	0.0537	0.0253
15B	-0.443	-0.693	-0.143	0.0070	0.1148	0.0775
20A	-8.739	-0.686	0.171	-0.0119	0.2892	0.0654
20B	-6.887	-0.434	-0.010	-0.0499	0.3414	0.0219
25	8.429	1.831	-0.009	0.0111	-0.0277	0.0217
30	7.945	1.677	-0.009	0.0172	-0.0608	0.0217
55	7.914	1.669	-0.009	0.0181	-0.0661	0.0217
35	7.581	1.578	-0.009	0.0181	-0.0661	0.0217
60	7.235	1.486	-0.009	0.0181	-0.0661	0.0217
40	7.201	1.477	-0.009	0.0187	-0.0696	0.0216
45	6.110	1.225	-0.007	0.0327	-0.1495	0.0186
50	0.000	0.000	0.000	0.0000	-0.0000	0.0000
65	7.582	1.528	-0.171	0.0181	-0.0661	0.0296
100	7.595	0.499	-2.685	0.0497	-0.1375	0.0689
105	7.595	0.000	-3.654	0.0523	-0.1370	0.0734
110A	7.595	-0.036	-3.717	0.0530	-0.1366	0.0747
110B	7.011	-0.496	-3.912	0.0912	-0.1026	0.1881
115A	-1.936	-0.494	0.616	0.1028	-0.0491	0.1784
115B	-2.450	-0.852	0.832	0.0941	-0.0353	0.0382
120A	-2.452	0.602	-0.204	0.0231	-0.0030	-0.0242
120B	-2.414	0.606	-0.246	0.0078	0.0073	0.0337
125	0.000	0.000	0.000	0.0000	0.0000	0.0000

Mode 9: 11.63 Hz

Node	X (mm)	Y (mm)	Z (mm)	XX (deg)	YY (deg)	ZZ (deg)
5	-0.039	0.000	0.000	0.0000	-0.0079	0.0217
10	-0.039	0.076	0.028	-0.0011	-0.0080	0.0217
15A	-0.047	2.806	0.842	-0.0451	0.0010	0.0166
15B	-0.197	2.925	0.454	-0.0564	0.0116	0.0298
20A	-1.544	2.891	-1.040	0.0757	0.0183	-0.0323
20B	-0.813	1.473	0.004	0.2734	0.0506	-0.1030
25	1.314	-10.510	0.000	-0.0744	-0.0063	-0.2239
30	1.220	-9.514	0.000	-0.1066	-0.0107	-0.2292
55	1.215	-9.460	0.000	-0.1113	-0.0114	-0.2300
35	1.155	-8.889	0.000	-0.1113	-0.0114	-0.2300
60	1.097	-8.330	0.000	-0.1113	-0.0114	-0.2300
40	1.091	-8.275	0.000	-0.1145	-0.0119	-0.2289
45	0.918	-6.804	0.000	-0.1873	-0.0232	-0.1963
50	0.000	0.000	0.000	-0.0000	0.0000	0.0000
65	1.155	-8.327	-0.024	-0.1113	-0.0114	-0.3420
100	1.153	1.756	-0.149	-0.0528	-0.0022	-0.4907
105	1.153	5.186	-0.163	-0.0480	-0.0021	-0.4801
110A	1.153	5.408	-0.164	-0.0468	-0.0021	-0.4760
110B	2.015	6.735	-0.247	-0.0007	0.0141	-0.0604

Mode 9: 11.63 Hz

Node	X (mm)	Y (mm)	Z (mm)	XX (deg)	YY (deg)	ZZ (deg)
115A	-1.678	6.752	0.857	0.0361	-0.0014	0.1468
115B	-2.205	6.279	0.960	0.0271	-0.0121	0.1036
120A	-2.214	0.752	-0.278	0.0019	-0.0176	0.0652
120B	-2.040	0.518	-0.327	-0.0054	-0.0098	0.0545
125	0.000	0.000	0.000	0.0000	0.0000	0.0000

Mode 10: 13.28 Hz

Node	X (mm)	Y (mm)	Z (mm)	XX (deg)	YY (deg)	ZZ (deg)
5	-0.006	0.000	0.000	0.0000	-0.0013	-0.0020
10	-0.006	-0.007	0.005	0.0000	-0.0013	-0.0020
15A	-0.007	-0.048	0.026	0.0002	0.0027	0.0031
15B	-0.053	-0.013	-0.008	-0.0012	0.0058	0.0086
20A	-0.857	-0.012	-0.094	-0.0003	0.0143	0.0042
20B	-0.760	-0.014	-0.093	0.0005	0.0151	0.0002
25	-1.557	-0.172	-0.093	0.0056	-0.0648	-0.0000
30	-2.299	-0.235	-0.092	0.0062	-0.0732	-0.0000
55	-2.332	-0.238	-0.092	0.0063	-0.0749	-0.0000
35	-2.671	-0.266	-0.092	0.0063	-0.0749	-0.0000
60	-3.001	-0.294	-0.086	0.0063	-0.0749	-0.0000
40	-3.034	-0.296	-0.085	0.0060	-0.0712	-0.0000
45	-3.220	-0.308	-0.070	-0.0021	0.0165	-0.0000
50	0.000	0.000	0.000	0.0000	0.0000	0.0000
65	-2.672	-0.267	-0.319	0.0063	-0.0749	-0.0007
100	-2.681	-0.174	-14.334	0.1986	-0.9363	-0.0105
105	-2.681	-0.095	-20.965	0.2143	-0.9388	-0.0121
110A	-2.681	-0.089	-21.399	0.2183	-0.9365	-0.0125
110B	-2.529	0.018	-23.356	0.4757	-0.7072	-0.0541
115A	0.241	0.017	1.676	0.5838	-0.3063	-0.0580
115B	0.414	0.144	2.909	0.5554	-0.1868	-0.0163
120A	0.415	-0.092	-0.071	0.1586	0.0307	0.0078
120B	0.416	-0.104	-0.243	0.0786	0.0757	-0.0045
125	0.000	0.000	0.000	0.0000	0.0000	0.0000

Mode 11: 30.95 Hz

Node	X (mm)	Y (mm)	Z (mm)	XX (deg)	YY (deg)	ZZ (deg)
5	-9.395	0.000	0.000	0.0000	-0.0026	-0.1125
10	-9.446	-0.398	0.009	0.0001	-0.0027	-0.1122
15A	-10.710	-1.279	0.023	0.0021	0.0056	0.1880
15B	-12.541	0.532	-0.030	0.0005	0.0111	0.1378
20A	-0.167	0.566	0.017	-0.0013	0.0255	-0.2356
20B	1.318	0.576	0.000	0.0034	-0.0120	-0.1857
25	0.034	0.055	0.000	0.0072	-0.0120	-0.0697
30	-0.086	-0.021	0.000	0.0065	-0.0098	-0.0646
55	-0.091	-0.024	0.000	0.0063	-0.0094	-0.0638
35	-0.137	-0.056	0.000	0.0063	-0.0094	-0.0638
60	-0.180	-0.085	0.000	0.0063	-0.0094	-0.0638
40	-0.184	-0.088	0.000	0.0061	-0.0090	-0.0635
45	-0.229	-0.121	0.000	0.0015	-0.0014	-0.0544
50	0.000	0.000	0.000	0.0000	0.0000	0.0000
65	-0.137	0.094	-0.020	0.0063	-0.0094	-0.0348
100	-0.140	0.059	0.013	0.0035	0.0081	0.0247
105	-0.140	-0.121	0.072	0.0033	0.0084	0.0256
110A	-0.140	-0.133	0.076	0.0032	0.0084	0.0255
110B	-0.199	-0.216	0.113	-0.0005	0.0063	0.0050
115A	0.000	-0.220	-0.004	-0.0036	0.0025	-0.0078
115B	0.024	-0.203	-0.010	-0.0037	0.0013	-0.0033

Mode 11: 30.95 Hz

Node	X (mm)	Y (mm)	Z (mm)	XX (deg)	YY (deg)	ZZ (deg)
120A	0.025	-0.012	0.000	-0.0011	-0.0004	-0.0020
120B	0.022	-0.006	0.000	-0.0006	-0.0007	-0.0009
125	0.000	0.000	0.000	0.0000	0.0000	0.0000

Mode 12: 53.86 Hz

Node	X (mm)	Y (mm)	Z (mm)	XX (deg)	YY (deg)	ZZ (deg)
5	-0.218	0.000	0.000	-0.0000	-0.5900	0.1098
10	-0.219	0.395	2.146	-0.0297	-0.5950	0.1086
15A	-0.215	1.753	7.777	-1.1724	0.9900	-0.1339
15B	0.552	0.701	-9.871	-0.9121	1.3985	-0.0115
20A	-2.625	0.373	-8.608	0.8323	0.8100	-0.1007
20B	3.104	-5.466	-1.895	0.4485	0.4586	-0.0882
25	4.437	-2.218	-1.147	-0.3887	-0.4890	-0.0376
30	-1.109	2.073	-1.102	-0.3755	-0.4869	-0.0354
55	-1.354	2.253	-1.095	-0.3685	-0.4779	-0.0350
35	-3.904	4.089	-1.023	-0.3684	-0.4778	-0.0350
60	-6.212	5.879	-0.953	-0.3684	-0.4778	-0.0350
40	-6.435	6.052	-0.946	-0.3593	-0.4665	-0.0348
45	-9.246	8.165	-0.784	-0.0957	-0.1426	-0.0299
50	0.000	0.000	0.000	0.0000	0.0000	0.0000
65	-3.935	4.199	-2.149	-0.3684	-0.4778	0.0021
100	-4.191	1.944	-1.546	-0.1722	0.4097	0.2497
105	-4.205	0.087	1.486	-0.1562	0.4352	0.2687
110A	-4.206	-0.042	1.691	-0.1521	0.4363	0.2704
110B	-5.087	-1.135	3.138	-0.0882	0.4577	0.0695
115A	-0.298	-1.192	-0.182	-0.0593	0.2074	-0.1702
115B	0.211	-0.828	0.196	-0.0861	0.1024	-0.0539
120A	0.235	-0.036	0.014	-0.0254	-0.0509	0.0090
120B	0.256	-0.068	-0.111	-0.0195	-0.0479	0.0020
125	0.000	0.000	0.000	0.0000	0.0000	0.0000

Dynamic susceptibility

Mode	Frequency (Hz)	Maxima Nodes		Susceptibility (psi / ips)
		Velocity	Stress	
10	13.281	110B	35	1352
8	9.959	20A	35	1128
5	6.661	110A	35	892
9	11.629	25	35	821
12	53.862	45	45	601
6	6.761	120B	120A	570
2	2.458	15A	20B	452
3	2.675	20B	50	421
4	4.158	115B	110B	421
7	7.456	120B	125	366
1	1.703	15A	45	316
11	30.952	15B	15B	255

Dynamic stresses for mode 10: 13.28 Hz, susceptibility = 1352

Node	Displacement	Nominal Stress	SIF	Intensified Stress
5	0.0000E+00	1.0974E+01	1.00	1.0974E+01
10	3.3603E-04	7.7408E+00	1.00	7.7415E+00
15A	2.1654E-03	1.1873E+02	2.61	3.0931E+02
15B	2.1091E-03	5.6996E+01	2.61	1.4848E+02
20A	3.3923E-02	1.5963E+02	2.61	4.1585E+02
20B	2.9936E-02	8.0856E+01	2.61	2.1064E+02
25	6.1668E-02	2.7189E+03	1.00	2.7192E+03
30	9.0975E-02	4.0671E+03	1.00	4.0675E+03

Dynamic stresses for mode 10: 13.28 Hz, susceptibility = 1352

Node	Displacement	Nominal Stress	SIF	Intensified Stress
55	9.2305E-02	4.1650E+03	1.00	4.1650E+03
35	1.0568E-01	5.6011E+04	2.00	1.0435E+05
60	1.1872E-01	9.3189E+03	1.00	9.3189E+03
40	1.2001E-01	9.1709E+03	1.52	1.3966E+04
45	1.2734E-01	1.1023E+04	1.52	1.6788E+04
50	0.0000E+00	1.1880E+04	1.00	1.1880E+04
65	1.6356E-02	5.1086E+04	1.00	5.1086E+04
100	5.6437E-01	5.6100E+03	1.00	5.6105E+03
105	8.2542E-01	3.6630E+03	1.00	3.6634E+03
110A	8.4248E-01	3.8478E+03	2.27	8.7171E+03
110B	9.2489E-01	6.2693E+03	2.27	1.4203E+04
115A	6.6656E-02	2.6975E+03	2.27	6.1110E+03
115B	1.1465E-01	4.5477E+03	2.27	1.0303E+04
120A	4.5947E-03	2.8515E+02	2.27	6.4601E+02
120B	1.9388E-02	2.9647E+03	2.27	6.7165E+03
125	0.0000E+00	1.6407E+03	1.00	1.6407E+03

Dynamic stresses for mode 8: 9.96 Hz, susceptibility = 1128

Node	Displacement	Nominal Stress	SIF	Intensified Stress
5	0.0000E+00	2.0187E+02	1.00	2.0187E+02
10	4.6663E-03	1.4841E+02	1.00	1.4843E+02
15A	4.1541E-02	1.7460E+03	2.61	4.5484E+03
15B	1.8342E-02	6.1493E+02	2.61	1.6020E+03
20A	3.4414E-01	1.0622E+03	2.61	2.7672E+03
20B	2.7169E-01	7.8423E+02	2.61	2.0430E+03
25	3.3958E-01	1.3815E+04	1.00	1.3816E+04
30	3.1970E-01	1.3305E+04	1.00	1.3306E+04
55	3.1843E-01	1.3204E+04	1.00	1.3204E+04
35	3.0486E-01	1.2158E+04	2.00	2.4292E+04
60	2.9079E-01	8.9986E+03	1.00	8.9986E+03
40	2.8941E-01	8.8247E+03	1.52	1.3439E+04
45	2.4533E-01	9.4639E+03	1.52	1.4413E+04
50	0.0000E+00	1.7342E+04	1.00	1.7342E+04
65	6.0516E-02	4.5669E+03	1.00	4.5669E+03
100	1.0752E-01	1.7551E+03	1.00	1.7553E+03
105	1.4385E-01	2.0157E+03	1.00	2.0159E+03
110A	1.4635E-01	2.0308E+03	2.27	4.6006E+03
110B	3.1607E-01	2.1922E+03	2.27	4.9664E+03
115A	8.0003E-02	2.3807E+03	2.27	5.3935E+03
115B	4.6877E-02	2.5413E+03	2.27	5.7572E+03
120A	2.5034E-02	1.1383E+03	2.27	2.5789E+03
120B	9.8468E-02	1.3507E+03	2.27	3.0599E+03
125	0.0000E+00	2.0679E+03	1.00	2.0679E+03

Dynamic stresses for mode 5: 6.66 Hz, susceptibility = 892

Node	Displacement	Nominal Stress	SIF	Intensified Stress
5	0.0000E+00	9.0716E+01	1.00	9.0716E+01
10	3.6076E-03	7.5490E+01	1.00	7.5497E+01
15A	1.1207E-01	4.5087E+02	2.61	1.1746E+03
15B	2.9275E-02	8.0454E+01	2.61	2.0959E+02
20A	4.4775E-02	1.5654E+03	2.61	4.0780E+03
20B	9.9096E-02	7.9618E+02	2.61	2.0741E+03
25	1.1009E-01	4.3271E+03	1.00	4.3275E+03
30	1.0886E-01	4.7377E+03	1.00	4.7381E+03
55	1.0868E-01	4.7435E+03	1.00	4.7435E+03
35	1.0672E-01	1.0171E+04	2.00	1.8948E+04

Dynamic stresses for mode 5: 6.66 Hz, susceptibility = 892

Node	Displacement	Nominal Stress	SIF	Intensified Stress
60	1.0417E-01	4.0401E+03	1.00	4.0401E+03
40	1.0392E-01	3.9628E+03	1.52	6.0350E+03
45	9.1433E-02	4.3221E+03	1.52	6.5822E+03
50	0.0000E+00	6.8378E+03	1.00	6.8378E+03
65	1.1792E-01	8.8168E+03	1.00	8.8168E+03
100	4.0867E-01	3.5292E+03	1.00	3.5295E+03
105	5.0154E-01	6.4964E+03	1.00	6.4970E+03
110A	5.0747E-01	6.6274E+03	2.27	1.5014E+04
110B	2.4808E-02	6.9514E+03	2.27	1.5748E+04
115A	3.7647E-01	1.2840E+03	2.27	2.9089E+03
115B	5.0575E-01	1.3561E+03	2.27	3.0721E+03
120A	1.2791E-01	1.2694E+03	2.27	2.8757E+03
120B	3.9994E-01	1.1720E+03	2.27	2.6551E+03
125	0.0000E+00	6.3614E+03	1.00	6.3614E+03

Dynamic stresses for mode 9: 11.63 Hz, susceptibility = 821

Node	Displacement	Nominal Stress	SIF	Intensified Stress
5	0.0000E+00	6.9629E+01	1.00	6.9629E+01
10	3.1829E-03	5.5744E+01	1.00	5.5749E+01
15A	1.1534E-01	2.3759E+02	2.61	6.1894E+02
15B	1.9477E-02	3.1387E+02	2.61	8.1766E+02
20A	7.3272E-02	3.6543E+03	2.61	9.5197E+03
20B	6.6255E-02	1.8563E+03	2.61	4.8358E+03
25	4.1701E-01	1.4148E+04	1.00	1.4149E+04
30	3.7765E-01	1.1937E+04	1.00	1.1938E+04
55	3.7552E-01	1.1715E+04	1.00	1.1715E+04
35	3.5290E-01	1.3430E+04	2.00	2.5018E+04
60	3.3078E-01	8.2527E+03	1.00	8.2527E+03
40	3.2860E-01	8.0899E+03	1.52	1.2320E+04
45	2.7031E-01	8.4626E+03	1.52	1.2888E+04
50	0.0000E+00	1.8183E+04	1.00	1.8183E+04
65	3.2786E-01	1.2056E+04	1.00	1.2056E+04
100	6.9362E-02	2.2657E+03	1.00	2.2659E+03
105	2.0429E-01	6.3288E+03	1.00	6.3294E+03
110A	2.1301E-01	6.5165E+03	2.27	1.4763E+04
110B	7.9922E-02	7.6134E+03	2.27	1.7248E+04
115A	7.4197E-02	6.0022E+02	2.27	1.3598E+03
115B	2.5008E-01	6.5207E+02	2.27	1.4772E+03
120A	3.1562E-02	2.7920E+02	2.27	6.3253E+02
120B	8.3844E-02	2.8900E+02	2.27	6.5473E+02
125	0.0000E+00	1.1557E+03	1.00	1.1557E+03

Dynamic stresses for mode 12: 53.86 Hz, susceptibility = 601

Node	Displacement	Nominal Stress	SIF	Intensified Stress
5	0.0000E+00	4.7818E+03	1.00	4.7818E+03
10	8.5905E-02	1.6979E+03	1.00	1.6980E+03
15A	3.1388E-01	2.6558E+04	2.61	6.9186E+04
15B	3.8923E-01	2.4440E+04	2.61	6.3668E+04
20A	3.5430E-01	1.8149E+04	2.61	4.7279E+04
20B	2.4747E-01	2.6021E+04	2.61	6.7786E+04
25	1.9529E-01	2.1194E+04	1.00	2.1196E+04
30	9.2561E-02	2.7837E+04	1.00	2.7840E+04
55	1.0349E-01	2.9302E+04	1.00	2.9302E+04
35	2.2258E-01	4.4299E+04	2.00	8.8511E+04
60	3.3673E-01	3.6251E+04	1.00	3.6251E+04
40	3.4778E-01	3.6406E+04	1.52	5.5443E+04

Dynamic stresses for mode 12: 53.86 Hz, susceptibility = 601

Node	Displacement	Nominal Stress	SIF	Intensified Stress
45	4.8563E-01	6.4842E+04	1.52	9.8750E+04
50	0.0000E+00	5.6042E+04	1.00	5.6042E+04
65	1.8571E-01	4.0141E+04	1.00	4.0141E+04
100	9.7797E-02	2.2162E+04	1.00	2.2165E+04
105	5.8607E-02	3.6880E+03	1.00	3.6884E+03
110A	6.6597E-02	2.8344E+03	2.27	6.4213E+03
110B	2.3533E-01	9.7806E+03	2.27	2.2158E+04
115A	1.3746E-02	1.9305E+03	2.27	4.3735E+03
115B	3.3516E-02	3.6982E+03	2.27	8.3781E+03
120A	1.5356E-03	1.6203E+02	2.27	3.6708E+02
120B	1.1313E-02	4.4538E+02	2.27	1.0090E+03
125	0.0000E+00	3.4754E+02	1.00	3.4754E+02

Dynamic stresses for mode 6: 6.76 Hz, susceptibility = 570

Node	Displacement	Nominal Stress	SIF	Intensified Stress
5	0.0000E+00	1.7400E+01	1.00	1.7400E+01
10	1.8595E-03	6.2283E+00	1.00	6.2289E+00
15A	4.0177E-02	3.6060E+02	2.61	9.3939E+02
15B	9.7625E-03	2.2224E+02	2.61	5.7895E+02
20A	8.8306E-02	9.7549E+02	2.61	2.5412E+03
20B	7.9573E-02	2.6455E+02	2.61	6.8917E+02
25	3.5705E-02	1.7054E+03	1.00	1.7056E+03
30	3.6327E-02	1.8951E+03	1.00	1.8952E+03
55	3.6319E-02	1.8995E+03	1.00	1.8995E+03
35	3.6221E-02	6.6249E+03	2.00	1.2342E+04
60	3.5963E-02	1.6688E+03	1.00	1.6688E+03
40	3.5943E-02	1.6383E+03	1.52	2.4950E+03
45	3.2594E-02	1.8428E+03	1.52	2.8065E+03
50	0.0000E+00	2.5600E+03	1.00	2.5600E+03
65	4.4027E-02	6.1773E+03	1.00	6.1773E+03
100	2.5225E-01	2.1099E+03	1.00	2.1101E+03
105	3.3363E-01	1.4323E+03	1.00	1.4324E+03
110A	3.3900E-01	1.4312E+03	2.27	3.2423E+03
110B	6.8544E-02	7.8496E+02	2.27	1.7783E+03
115A	6.1809E-01	5.9943E+03	2.27	1.3580E+04
115B	3.8811E-01	5.7475E+03	2.27	1.3021E+04
120A	1.6390E-01	6.7794E+03	2.27	1.5359E+04
120B	6.3480E-01	6.6803E+03	2.27	1.5134E+04
125	0.0000E+00	1.2477E+04	1.00	1.2477E+04

Dynamic stresses for mode 2: 2.46 Hz, susceptibility = 452

Node	Displacement	Nominal Stress	SIF	Intensified Stress
5	0.0000E+00	4.8339E+02	1.00	4.8339E+02
10	1.0195E-02	4.5899E+02	1.00	4.5903E+02
15A	4.4765E-01	4.3452E+02	2.61	1.1320E+03
15B	3.6977E-01	4.1770E+02	2.61	1.0882E+03
20A	1.5008E-01	1.1786E+03	2.61	3.0703E+03
20B	2.9427E-01	1.2005E+03	2.61	3.1273E+03
25	1.4420E-01	2.5830E+02	1.00	2.5832E+02
30	1.1340E-01	1.1787E+02	1.00	1.1788E+02
55	1.1206E-01	1.1844E+02	1.00	1.1844E+02
35	9.8455E-02	2.5804E+02	2.00	4.8070E+02
60	8.4848E-02	2.3327E+02	1.00	2.3327E+02
40	8.3509E-02	2.4511E+02	1.52	3.7329E+02
45	5.7840E-02	8.6519E+02	1.52	1.3176E+03
50	0.0000E+00	2.6325E+03	1.00	2.6325E+03

Dynamic stresses for mode 2: 2.46 Hz, susceptibility = 452

Node	Displacement	Nominal Stress	SIF	Intensified Stress
65	8.6259E-02	2.5718E+02	1.00	2.5718E+02
100	8.7911E-02	3.0277E+02	1.00	3.0280E+02
105	9.0027E-02	3.2276E+02	1.00	3.2279E+02
110A	9.0183E-02	3.2365E+02	2.27	7.3323E+02
110B	6.8610E-02	6.3716E+01	2.27	1.4435E+02
115A	1.4985E-01	2.1331E+02	2.27	4.8326E+02
115B	1.6691E-01	3.7707E+02	2.27	8.5424E+02
120A	6.7274E-02	1.4621E+02	2.27	3.3124E+02
120B	7.4268E-02	1.2866E+02	2.27	2.9149E+02
125	0.0000E+00	1.0262E+03	1.00	1.0262E+03

Dynamic stresses for mode 3: 2.67 Hz, susceptibility = 421

Node	Displacement	Nominal Stress	SIF	Intensified Stress
5	0.0000E+00	7.9832E+01	1.00	7.9832E+01
10	7.0117E-03	4.8088E+01	1.00	4.8093E+01
15A	1.6422E-01	1.2314E+03	2.61	3.2078E+03
15B	1.9209E-02	1.0749E+03	2.61	2.8001E+03
20A	4.9280E-01	6.3978E+02	2.61	1.6667E+03
20B	5.1763E-01	4.8436E+02	2.61	1.2618E+03
25	2.1867E-01	2.2141E+02	1.00	2.2144E+02
30	1.7037E-01	4.5137E+02	1.00	4.5142E+02
55	1.6828E-01	4.6454E+02	1.00	4.6454E+02
35	1.4713E-01	8.0762E+02	2.00	1.5045E+03
60	1.2597E-01	6.3163E+02	1.00	6.3163E+02
40	1.2388E-01	6.4562E+02	1.52	9.8323E+02
45	8.4488E-02	1.6439E+03	1.52	2.5035E+03
50	0.0000E+00	3.6640E+03	1.00	3.6640E+03
65	4.9614E-02	8.2568E+02	1.00	8.2568E+02
100	1.1834E-01	9.8913E+02	1.00	9.8923E+02
105	1.4108E-01	1.0003E+03	1.00	1.0004E+03
110A	1.4257E-01	9.9833E+02	2.27	2.2617E+03
110B	1.8883E-01	7.0948E+02	2.27	1.6073E+03
115A	8.1844E-02	2.7807E+02	2.27	6.2997E+02
115B	8.4801E-02	6.1447E+02	2.27	1.3921E+03
120A	3.0155E-02	5.5352E+02	2.27	1.2540E+03
120B	5.3266E-02	5.4465E+02	2.27	1.2339E+03
125	0.0000E+00	1.0388E+03	1.00	1.0388E+03

Dynamic stresses for mode 4: 4.16 Hz, susceptibility = 421

Node	Displacement	Nominal Stress	SIF	Intensified Stress
5	0.0000E+00	3.8777E+01	1.00	3.8777E+01
10	1.1845E-03	3.5317E+01	1.00	3.5320E+01
15A	5.1875E-02	1.1648E+02	2.61	3.0343E+02
15B	2.0470E-02	7.8477E+01	2.61	2.0444E+02
20A	7.0632E-02	2.5861E+02	2.61	6.7370E+02
20B	8.3737E-02	1.8810E+02	2.61	4.9003E+02
25	2.5923E-02	7.8486E+02	1.00	7.8494E+02
30	2.1928E-02	9.7258E+02	1.00	9.7268E+02
55	2.1774E-02	9.8151E+02	1.00	9.8151E+02
35	2.0237E-02	3.1306E+03	2.00	5.8321E+03
60	1.8715E-02	4.6540E+02	1.00	4.6540E+02
40	1.8567E-02	4.5553E+02	1.52	6.9374E+02
45	1.4947E-02	4.6759E+02	1.52	7.1210E+02
50	0.0000E+00	9.7831E+02	1.00	9.7831E+02
65	9.1308E-03	2.8495E+03	1.00	2.8495E+03
100	2.0564E-02	2.5062E+02	1.00	2.5064E+02

Dynamic stresses for mode 4: 4.16 Hz, susceptibility = 421

Node	Displacement	Nominal Stress	SIF	Intensified Stress
105	3.0666E-02	5.6585E+02	1.00	5.6591E+02
110A	3.1341E-02	6.1750E+02	2.27	1.3989E+03
110B	8.3967E-02	4.3960E+03	2.27	9.9591E+03
115A	8.3704E-01	2.7204E+02	2.27	6.1631E+02
115B	9.0588E-01	1.2995E+03	2.27	2.9440E+03
120A	6.5720E-01	7.9281E+01	2.27	1.7961E+02
120B	5.9558E-01	7.7686E+02	2.27	1.7600E+03
125	0.0000E+00	8.2297E+03	1.00	8.2297E+03

Dynamic stresses for mode 7: 7.46 Hz, susceptibility = 366

Node	Displacement	Nominal Stress	SIF	Intensified Stress
5	0.0000E+00	1.1389E+01	1.00	1.1389E+01
10	2.6127E-04	9.5623E+00	1.00	9.5633E+00
15A	1.1512E-02	6.7125E+01	2.61	1.7487E+02
15B	2.9890E-03	4.5384E+01	2.61	1.1823E+02
20A	2.6272E-02	1.7531E+02	2.61	4.5670E+02
20B	2.5256E-02	7.3374E+01	2.61	1.9114E+02
25	4.8609E-03	8.3983E+02	1.00	8.3991E+02
30	2.5322E-03	9.7093E+02	1.00	9.7103E+02
55	2.4693E-03	9.7657E+02	1.00	9.7657E+02
35	2.3979E-03	3.8297E+03	2.00	7.1344E+03
60	3.2401E-03	6.0139E+02	1.00	6.0139E+02
40	3.3527E-03	5.9209E+02	1.52	9.0170E+02
45	4.8503E-03	7.2721E+02	1.52	1.1075E+03
50	0.0000E+00	5.9135E+02	1.00	5.9135E+02
65	1.0945E-03	3.3104E+03	1.00	3.3104E+03
100	3.2624E-02	1.5017E+03	1.00	1.5018E+03
105	4.2418E-02	2.9472E+03	1.00	2.9475E+03
110A	4.3011E-02	3.0360E+03	2.27	6.8779E+03
110B	7.4739E-02	3.9993E+03	2.27	9.0603E+03
115A	6.8504E-01	3.7327E+03	2.27	8.4563E+03
115B	6.5591E-01	3.9903E+03	2.27	9.0399E+03
120A	8.4233E-01	4.8723E+03	2.27	1.1038E+04
120B	8.4796E-01	4.6252E+03	2.27	1.0478E+04
125	0.0000E+00	1.4544E+04	1.00	1.4544E+04

Dynamic stresses for mode 1: 1.70 Hz, susceptibility = 316

Node	Displacement	Nominal Stress	SIF	Intensified Stress
5	0.0000E+00	4.7604E+02	1.00	4.7604E+02
10	1.0163E-02	4.5921E+02	1.00	4.5925E+02
15A	4.6974E-01	1.7214E+02	2.61	4.4843E+02
15B	3.9862E-01	4.2194E+02	2.61	1.0992E+03
20A	1.5676E-01	3.1888E+02	2.61	8.3072E+02
20B	2.8069E-01	4.0958E+02	2.61	1.0670E+03
25	9.8487E-02	5.2491E+02	1.00	5.2496E+02
30	7.5318E-02	5.6931E+02	1.00	5.6937E+02
55	7.4329E-02	5.7178E+02	1.00	5.7178E+02
35	6.4319E-02	5.9701E+02	2.00	1.1929E+03
60	5.4313E-02	5.4173E+02	1.00	5.4173E+02
40	5.3328E-02	5.4388E+02	1.52	8.2829E+02
45	3.5156E-02	1.0438E+03	1.52	1.5897E+03
50	0.0000E+00	1.3549E+03	1.00	1.3549E+03
65	5.2792E-02	2.9205E+02	1.00	2.9205E+02
100	4.9950E-02	2.8110E+02	1.00	2.8113E+02
105	5.1143E-02	2.7863E+02	1.00	2.7866E+02
110A	5.1245E-02	2.7848E+02	2.27	6.3090E+02

Dynamic stresses for mode 1: 1.70 Hz, susceptibility = 316

Node	Displacement	Nominal Stress	SIF	Intensified Stress
110B	5.1958E-02	2.0076E+02	2.27	4.5483E+02
115A	8.9787E-02	1.2786E+02	2.27	2.8967E+02
115B	9.5139E-02	2.4922E+02	2.27	5.6460E+02
120A	3.5636E-02	1.1395E+02	2.27	2.5815E+02
120B	4.1969E-02	7.1201E+01	2.27	1.6130E+02
125	0.0000E+00	5.9742E+02	1.00	5.9742E+02

Dynamic stresses for mode 11: 30.95 Hz, susceptibility = 255

Node	Displacement	Nominal Stress	SIF	Intensified Stress
5	0.0000E+00	1.4646E+02	1.00	1.4646E+02
10	1.5675E-02	3.1518E+02	1.00	3.1521E+02
15A	5.0371E-02	4.9476E+03	2.61	1.2889E+04
15B	4.9376E-01	9.4124E+03	2.61	2.4520E+04
20A	6.6195E-03	7.1781E+02	2.61	1.8699E+03
20B	5.6615E-02	7.8056E+02	2.61	2.0334E+03
25	2.5409E-03	7.3779E+02	1.00	7.3787E+02
30	3.5020E-03	1.1400E+03	1.00	1.1401E+03
55	3.7069E-03	1.1496E+03	1.00	1.1496E+03
35	5.8159E-03	3.5062E+03	2.00	6.5318E+03
60	7.8377E-03	8.9247E+02	1.00	8.9247E+02
40	8.0367E-03	8.8308E+02	1.52	1.3449E+03
45	1.0177E-02	1.2017E+03	1.52	1.8301E+03
50	0.0000E+00	1.1001E+03	1.00	1.1001E+03
65	3.7752E-03	3.2570E+03	1.00	3.2570E+03
100	2.3907E-03	8.2121E+02	1.00	8.2129E+02
105	5.5300E-03	6.7829E+01	1.00	6.7835E+01
110A	6.0183E-03	1.1129E+02	2.27	2.5212E+02
110B	9.0113E-03	5.3472E+02	2.27	1.2114E+03
115A	1.5636E-04	9.7670E+01	2.27	2.2127E+02
115B	8.0027E-03	3.8549E+01	2.27	8.7331E+01
120A	4.6548E-04	2.2762E+01	2.27	5.1567E+01
120B	8.7610E-04	2.6008E+01	2.27	5.8921E+01
125	0.0000E+00	1.0013E+01	1.00	1.0013E+01

Weight & Center of gravity

Empty weight = 2536.7 (kg)
Insulation weight = 385.57 (kg)
Content weight = 134.17 (kg)
Lining weight = 0 (kg)
Additional weight = 0 (kg)
Total weight = 3056.4 (kg)
Center of Gravity for Total weight
X = 6460.7, Y = 4740.72, Z = 2735.61 (mm)

Bill of materials: Materials

#	Name	Description
1	312	a312 tp316

Bill of materials: Pipes

#	Material	OD (mm)	Thk (mm)	Total length (mm)	Total weight (kg)
1	312	168.27	7.112	11337.8	327.71
2	312	219.07	8.1788	2100	91.344
3	312	273.05	9.271	18146	1119.1

Bill of materials: Bends

#	Material	OD (mm)	Thk (mm)	Radius (mm)	Angle (deg)	Count	Total weight (kg)
1	312	168.27	7.112	228.6	75.81	1	8.743

Bill of materials: Bends

#	Material	OD (mm)	Thk (mm)	Radius (mm)	Angle (deg)	Count	Total weight (kg)
2	312	168.27	7.112	228.6	90.00	2	20.758
3	312	273.05	9.271	381	90.00	2	73.817

Bill of materials: Reducers

#	Material	OD1 (mm)	Thk1 (mm)	OD2 (mm)	Thk2 (mm)	Length (mm)	Count	Total weight (kg)
1	312	273.05	9.271	219.07	8.1788	530	1	27.676

Bill of materials: Valves

#	OD (mm)	Thk (mm)	Weight (kg)	Add.Weight (kg)	Count	Total weight (kg)
1	168.27	7.112	151.56	0	1	151.56
2	273.05	9.271	459.23	0	1	459.23

Bill of materials: Itemized Element Weights

#	From	To	Type	Length (mm)	OD (mm)	Thk (mm)	Mat.Den (kg/m3)	Fluid.Den (kg/m3)	Ins.Den (kg/m3)	Ins.Thk (mm)	Lin.Den (kg/m3)	Lin.Thk (mm)	Empty.Wt (kg)	Fluid.Wt (kg)	Ins.Wt (kg)	Lin.Wt (kg)	Add.Wt (kg)
1	5	10		200	273.05	9.271	8027	99.9	176.2	65			12.334	1.0164	2.4327	0	0
2	10	15A		7699	273.05	9.271	8027	99.9	176.2	65			474.8	39.127	93.645	0	0
3	15A	15B	Bend	598.47	273.05	9.271	8027	99.9	176.2	65			36.908	3.0415	7.2794	0	0
4	15B	20A		5788	273.05	9.271	8027	99.9	176.2	65			356.95	29.415	70.401	0	0
5	20A	20B	Bend	598.47	273.05	9.271	8027	99.9	176.2	65			36.908	3.0415	7.2794	0	0
6	20B	25		3859	273.05	9.271	8027	99.9	176.2	65			237.99	19.612	46.938	0	0
7	25	30	Valve	622.3	273.05	27.813	8027	99.9	176.2	65			459.23	3.1626	13.246	0	0
8	30	55		26.95	273.05	9.271	8027	99.9	176.2	65			1.662	0.13696	0.3278	0	0
9	55	35		273.05	273.05	9.271	8027	99.9	176.2	65			16.839	1.3877	3.3212	0	0
10	35	60		273.05	273.05	9.271	8027	99.9	176.2	65			16.839	1.3877	3.3212	0	0
11	60	40		26.95	273.05	9.271	8027	99.9	176.2	65			1.662	0.13696	0.3278	0	0
12	40	45	Reducer	530	246.06	8.7249	8027	99.9	176.2	65			27.676	2.1732	5.9318	0	0
13	45	50		2100	219.07	8.1788	8027	99.9	176.2	65			91.344	6.7705	21.464	0	0
14	35	65		136.52	168.27	7.112	8027	99.9	176.2	65			3.9461	0.25419	1.1459	0	0
15	65	100		1263.5	168.27	7.112	8027	99.9	176.2	65			36.519	2.3524	10.605	0	0
16	100	105	Valve	403.23	168.27	21.336	8027	99.9	176.2	65			151.56	0.75075	5.9227	0	0
17	105	110A		26.4	168.27	7.112	8027	99.9	176.2	65			0.76306	0.049152	0.22158	0	0
18	110A	110B	Bend	359.08	168.27	7.112	8027	99.9	176.2	65			10.379	0.66856	3.0139	0	0
19	110B	115A		2492.8	168.27	7.112	8027	99.9	176.2	65			72.052	4.6412	20.923	0	0
20	115A	115B	Bend	359.08	168.27	7.112	8027	99.9	176.2	65			10.379	0.66856	3.0139	0	0
21	115B	120A		3883.4	168.27	7.112	8027	99.9	176.2	65			112.25	7.2303	32.594	0	0
22	120A	120B	Bend	302.48	168.27	7.112	8027	99.9	176.2	65			8.743	0.56318	2.5388	0	0
23	120B	125		3535.2	168.27	7.112	8027	99.9	176.2	65			102.18	6.582	29.672	0	0