Readme Supplement

CAEPIPE

Version 6.5

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Annexure A

Import CESAR II Neutral Files into CAEPIPE

Reference

This section describes in detail, the methodology followed for transferring the CAESAR II Piping Systems to CAEPIPE.

Basic Element Data

Pipe

Transfers PIPE element from CAESAR II as PIPE to CAEPIPE, when the Pointer to Bend Auxiliary, Rigid Element Auxiliary, Expansion Joint Auxiliary and Reducer Auxiliary are set to 0 in IEL array of CAESAR II under Basic Element Data.

Delta X, Delta Y and Delta Z from real basic-element data (REL) of CAESAR II will be transferred to DX, DY and DZ of CAEPIPE element. Section, Load and Material reference will be set in CAEPIPE as explained below.

Section

Defines a new section property in CAEPIPE by reading the following values from REL of CAESAR II.

a. Diameter
b. Wall Thickness
c. Insulation Thickness
d. Insulation Density
e. Corrosion Allowance and
f. Plus Mill Tolerance

The reference index internally generated will be assigned to CAEPIPE element as a Section reference.

When any one of the above mentioned section properties changes in CAESAR II, the Import module in CAEPIPE will add a new Section property automatically and will assign the new reference index internally generated to CAEPIPE element as a Section reference.

Load

Defines a new Load property in CAEPIPE by reading the following values from REL of CAESAR II.

a. Temperature #1
b. Temperature #2
c. Temperature #3
d. Pressure #1
e. Pressure #2
f. Pressure #3 and
g. Fluid Density

The reference index internally generated will be assigned to CAEPIPE element as a Load reference.

When any one of the above mentioned Load properties changes in CAESAR II, the Import module in CAEPIPE will add a new Load property automatically and will assign the new reference index internally generated to CAEPIPE element as a Load reference.

Material

Only Material ID number is available in CAESAR II Neutral file corresponding to each element. Since the mechanical properties are not available in CAESAR II neutral file, CAEPIPE defines Material properties corresponding to each Material ID available in CAESAR II as follows.

Material Properties

a. Material Name = Unique Index corresponding to CAESAR II Material ID
b. Material Description = Material ID from CAESAR II
c. Density = Pipe Density from CAESAR II

d. Poission’s Ratio = Poission’s ratio from CAESAR II
e. Long Joint Factor = 1.0
f. Circular Joint Factor = 1.0
g. Tensile Strength = 0.0

Temperature related properties

a. Temp[1] = 70.0 deg F
b. Young’s Modulus[1] = 30.0E6;
c. Alpha[1] = 6.0E-6
d. Allowable_stress[1] = 20000.0;
e. Yield_stress[1] = 0.0
f. Rupture_stress[1] = 0.0

a. Temp[2] = 1200.0 deg F
b. Young’s Modulus[2] = 20.0E6
c. Alpha[2] = 8.0E-6
d. Allowable_stress[2] = 1000.0;
e. Yield_stress[2] = 0.0
f. Rupture_stress[2] = 0.0

User can later replace the above set material properties with the material properties available in CAEPIPE library by reading the description in CAEPIPE material property (equivalent to CAESAR II Material ID).

Hydrotest Load

If the Hydro pressure is available in element auxiliary of CAESAR II with non-zero values, a Hydrotest Load is created in CAEPIPE as listed below.

Hydro Test Pressure = Hydro Pressure

Specific Gravity of the Test fluid = 1.0

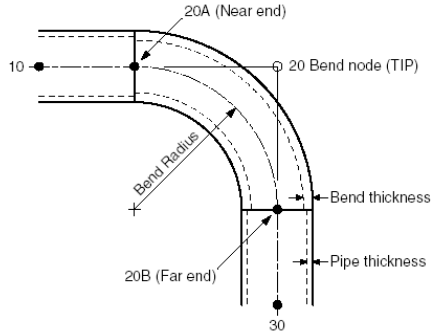
A new Hydrotest Load is automatically created in CAEPIPE, whenever a new Hydro Pressure which is different from the previous Hydro Pressure is encountered in CAESAR II neutral file.

Bend

A Bend in CAESAR II is transferred as Bend to CAEPIPE with the following details.

a. Bend Radius = Bend Radius
b. Node1 = node number at position #1
c. Angle1 = angle to node position #1
d. Node2 = node number at position #2
e. Angle2 = angle to node position #2
f. Bend Thk = fitting thickness of bend

In CAEPIPE, the term Bend refers to all elbows and bends (custom-bent pipes). Some of the items associated with the bend are shown in figure below.



Node 20 is the Bend node, which is at the Tangent Intersection Point (TIP). As you can see from the figure, TIP is not physically located on the bend. Its only purpose is to define the bend. CAEPIPE automatically generates the end nodes of the curved portion of the bend (nodes 20A and 20B, called the near and far ends of the bend). The data items such as flanges, hangers, forces, etc. can be specified at the bend end nodes (20A and 20B in the figure).

In CAESAR II, the actual bend curvature is always referred from the "**To end**" (Far end) of the element. Hence, any restraint located at Bend Node in CAESAR II will be transferred to "Far end" in CAEPIPE.

Valve

Transfers RIGID element from CAESAR II as VALVE in CAEPIPE with the following details, if the length of the RIGID element in CAESAR II is greater than Section OD for that element.

Thickness factor = 10.0

Insulation Thickness factor = 3.0

Empty Weight of VALVE in CAEPIPE = Weight of RIGID element in CAESAR II (empty weight)

Rigid

Transfers RIGID element from CAESAR II as RIGID in CAEPIPE with the following details, if the length of the RIGID element in CAESAR II is less than or equal to Section OD for that element.

Empty Weight of RIGID element in CAEPIPE = Weight of RIGID element in CAESAR II (empty weight)

Content weight is calculated from the Specific Gravity of the fluid, Section OD, Wall thickness and the Length for that element and is added to the RIGID weight in CAEPIPE.

Insulation weight is ignored at this time.

Reducer

Transfers Reducer from CAESAR II as Reducer in CAEPIPE. The Diameter (OD) and Wall Thickness entered in CAESAR II element auxiliary will be transferred as OD1 and Thk1 of the reducer element in CAEPIPE.

The 2nd diameter and 2nd thickness available in the Reducer Auxiliary of CAESAR II will be transferred to OD2 and Thk2 field of CAEPIPE Reducer.

If the 2nd diameter and 2nd thickness is set to 0.0 in the Reducer Auxiliary, then the same will be obtained from the next element in CAEPIPE for which the section properties are defined.

Bellows

Transfers Expansion Joint data from CAESAR II as BELLOWS in CAEPIPE, if the effective inside bellow diameter is > 0.0 with the following details.

Axial Stiffness = Axial Stiffness

Bending Stiffness = Bending Stiffness

Torsional Stiffness = Torsional Stiffness

Lateral Stiffness = Transverse Stiffness

Ball Joint

Transfers Expansion Joint data from CAESAR II as BALL in CAEPIPE, if the length of the element is less than 0.001 (in) with bending and torsional stiffnesses set to 0.0.

Elastic Element

Transfers Expansion Joint data from CAESAR II as Elastic element in CAEPIPE, if the effective inside bellow diameter is set to 0.0. Transfers the stiffnesses available in CAESAR II to CAEPIPE Elastic Element as listed below.

kx = Axial Stiffness

ky = kz = Lateral Stiffness

kxx = Torsional Stiffness

kyy = kzz = Bending Stiffness

Restraints

Transfers the Restraints from CAESAR II to CAEPIPE as explained below. The Restraint properties that can be entered in CAESAR II are

1. Stiffness
2. Gap
3. Friction Coefficient (Mu)
4. X direction cosine (XComp)
5. Y direction cosine (YComp)
6. Z direction cosine (ZComp)
7. Connecting Node (CNode)

CAESAR II Restraint Type	Internal Ref. Number	Transferred to CAEPIPE as	CAESAR II Input Data Values	Corresponding CAEPIPE Data Values	Remarks
ANC	1	Anchor	Stiffness	KX = KY = KZ = Stiffness KXX = KYY = KZZ = Stiffness	
X	2	X Restraint	Stiffness XComp = 1.0 YComp = 0.0 ZComp = 0.0		If Stiffness >= 1E12 lb/in
Y	3	Y Restraint	Stiffness XComp = 0.0 YComp = 1.0 ZComp = 0.0		If Stiffness >= 1E12 lb/in
Z	4	Z Restraint	Stiffness XComp = 0.0 YComp = 0.0 ZComp = 1.0		If Stiffness >= 1E12 lb/in
X(XComp,YComp,ZComp)	2	Translational Skewed restraint	Stiffness XComp YComp ZComp	Stiffness = stiffness xcomp = XComp ycomp = YComp zcomp = ZComp	If Stiffness < 1E12 lb/in
Y(XComp,YComp,ZComp)	3				
X(XComp,YComp,ZComp)	4				
RX(XComp,YComp,ZComp)	5	Rotational Skewed restraint	Stiffness XComp YComp ZComp	Stiffness = stiffness xcomp = XComp ycomp = YComp zcomp = ZComp	If Stiffness < 1E12 in-lbs/deg
RY(XComp,YComp,ZComp)	6	Rotational Skewed restraint	Stiffness XComp YComp ZComp	Stiffness = stiffness xcomp = XComp ycomp = YComp zcomp = ZComp	If Stiffness < 1E12 in-lbs/deg
RZ(XComp,YComp,ZComp)	7	Rotational Skewed restraint	Stiffness XComp YComp ZComp	Stiffness = stiffness xcomp = XComp ycomp = YComp zcomp = ZComp	If Stiffness < 1E12 in-lbs/deg
GUI	8	Guide	Stiffness Gap Mu CNode	Stiffness = stiffness Gap = Gap Connected To = CNode	

CAESAR II Restraint Type	Internal Ref. Number	Transferred to CAEPIPE as	CAESAR II Input Data Values	Corresponding CAEPIPE Data Values	Remarks
LIM	9	Limit Stop	Stiffness Gap Mu XComp YComp ZComp CNode	Stiffness = stiffness xcomp = XComp ycomp = YComp zcomp = ZComp Mu = Mu Upper Limit = +Gap Lower Limit = -Gap Connected To = CNode	
XSNB	10	Snubber	Stiffness XComp YComp ZComp	Stiffness = stiffness xcomp = XComp ycomp = YComp zcomp = ZComp	
YSNB	11				
ZSNB	12				
+X	13	Limit Stop	Stiffness Gap XComp YComp ZComp Mu CNode	Stiffness = stiffness xcomp = XComp ycomp = YComp zcomp = ZComp Mu = Mu Upper Limit = NONE Lower Limit = -Gap Connected Node = CNode	
+Y	14				
+Z	15				
+LIM	25				
-X	16	Limit Stop	Stiffness Gap XComp YComp ZComp Mu CNode	Stiffness = stiffness xcomp = XComp ycomp = YComp zcomp = ZComp Mu = Mu Upper Limit = Gap Lower Limit = NONE Connected Node = CNode	
-Y	17				
-Z	18				
-LIM	26				
+XROD	30	Limit Stop	Stiffness Gap XComp YComp ZComp Mu CNode	Stiffness = stiffness xcomp = XComp ycomp = YComp zcomp = ZComp Mu = Mu Upper Limit = NONE Lower Limit = 0.0 Connected Node = CNode	
+YROD	31				
+ZROD	32				
-XROD	33	Limit Stop	Stiffness Gap XComp YComp ZComp Mu CNode	Stiffness = stiffness xcomp = XComp ycomp = YComp zcomp = ZComp Mu = Mu Upper Limit = 0.0 Lower Limit = None Connected Node = CNode	
-YROD	34				
-ZROD	35				

The restraints other than those explained in the table above will not be transferred and will be skipped during import as the equivalent restraints types are not available in CAEPIPE at this time.

Displacement (Specified displacements at anchor / nozzle)

When the restraint type at the specified node in CAESAR II is Anchor or Nozzle, the displacements specified in CAESAR II at that node are transferred as “Specified Displacements” in CAEPIPE.

Three sets of thermal displacements corresponding to thermal cases T1, T2 and T3 will be transferred from CAESAR II to CAEPIPE at this time.

Force and Moment

Forces and Moments specified for T1 only in CAESAR II will be transferred to CAEPIPE at this time.

Note: These Forces and Moments are included only in Sustained and Operating load cases in CAEPIPE at this time.

Units Conversion for Input Data

Models from CAESAR II are imported into CAEPIPE in English units by default. To some extent, quantity type in CAEPIPE is set automatically depending upon the conversion constants defined in CAESAR II. These are explained in the table below. You can also set any combination of units in CAEPIPE: English, SI or Metric, for any item after the CAESAR II models are imported into CAEPIPE.

UNIT Type in CAESAR II	Conversion constants in CAESAR II	Quantity Type in CAEPIPE	Units in CAEPIPE
CNVLEN – Length	25.4	Length	mm
CNVFOR – Force	0.45359237	Force	kg
CNVMIN – Moment Input	0. 011521246	Moment	Kg-m
CNVSTR – Stress	7.0307E-4	Stress	Kg/mm2
CNVTSC – Temperature	0.556	Temperature	Deg C
CNVPRE – Pressure	0.070307	Pressure	Kg/cm2
CNVYM – Young's Modulus	7.0307E-4	Modulus	Kg/mm2
CNVPDN – Pipe Density	2.76799E4	Density	Kg/m3
CNVIDN – Insulation density	2.76799E4	Insulation Density	Kg/m3
CNVTSF – Translational Stiffness	0.017857967	Stiffness	Kg/mm
CNVRSF – Rotational Stiffness	0.0002001	Rotational Stiffness	Kg-m/deg

SIF and TEES

Transfers SIF & TEES from CAESAR II to CAEPIPE as shown in the table below.

SIF & TEES in CAESAR II	Internal Ref. number in CAESAR II	Branch SIF in CAEPIPE
Welding Tee	3	Welding Tee
Reinforced Fabricated Tee	1	Reinforced Fabricated Tee
Unreinforced Fabricated Tee	2	Unreinforced Fabricated Tee
Weldolet	5	Weldolet
Extruded Welding Tee	6	Extruded Welding Tee
Sweepolet	4	Sweepolet
Full Encirclement	17	Branch Connection

SIF & TEES in CAESAR II	Threaded Joint and Weld in CAEPIPE
Threaded Joint	Threaded Joint
Buttweld	Buttweld
Double weld	Fillet Weld
Tapered	Tapered
Lap Joint	Concave

SIF & TEES other than those specified above will be transferred to CAEPIPE as USER SIF.

Hanger

Transfers Hanger from CAESAR II as Hanger in CAEPIPE with the following details.

Load variation = allowable load variation

No. of hangers = IHGRNUM

Hangers in CAESAR II	Internal Ref. Number	Hangers in CAEPIPE
Basic Engineers	10	Basic Engineers
Bergen Power	2	Bergen-Paterson
BHEL	14	BHEL Hyderabad
Carpenter & Paterson	16	Carpenter & Paterson

Comet	17	Comet
Flexider	15	Flexider
Fronek	6	Fronek
PSS-Grinnell	1	Grinnell
Hydra	18	Hydra
Lisega	5	Lisega
Myricks	20	Myricks
Piping Services	9	Piping Services
Piping Technology	7	Piping Tech & Products
Sarathi	19	Sarathi

Please note if the Hanger catalog for CAEPIPE corresponding to CAESAR II is not available, then it will be replaced with “GRINNELL” at this time.

Nozzle

Transfers Nozzle from CAESAR II as Nozzle in CAEPIPE as follows. Transfers only WRC-297 and API 650 nozzles at this time to CAEPIPE.

Vessel OD = Vessel outside diameter

Vessel Thk = Vessel Wall Thickness

Nozzle OD = Nozzle Outside Diameter

Nozzle Thk = Nozzle Wall Thickness

Vessel axis direction = Vessel centerline direction (X, Y and Z)

Reinforcing Pad = Reinforcing Pad Thickness

L1 = Dist. to stiffeners or head / Height of nozzle centerline

L2 = Dist. to opposite side stiffeners or head.

Execution Options

Execution options from CAESAR II are transferred to CAEPIPE as follows.

a. Bourdon pressure will be turned ON in CAEPIPE, when the execution option Activate Bourdon Pressure in CAESAR II is set to 1 or 2.
b. Liberal Allowable will be turned ON in CAEPIPE, when the execution option Use Liberal Stress Allowable is set to 1.
c. Pressure correction for bends will be turned ON in CAEPIPE, when the execution option Stress Stiffening due to Pressure in CAESAR II is set to 1 or 2.
d. Reference Temperature in CAEPIPE is set to a value equal to Ambient Temperature defined in CAESAR II.

Verification and Validation

General

In order to study and understand the way CAESAR II performs analysis for different types of elements under different loading conditions, 30 problems were modeled, both in CAESAR II and CAEPIPE manually in-house with an increasing complexity (i.e., three Elements with simple load condition at the beginning and with a number of elements with complex loading conditions at the end).

The analyses were performed on both the software and the results thus obtained were compared against each other. Models in CAEPIPE were fine-tuned to minimize any difference in results and re-performed the analyses. The knowledge gathered from the above study was then used to develop the algorithm for the import module.

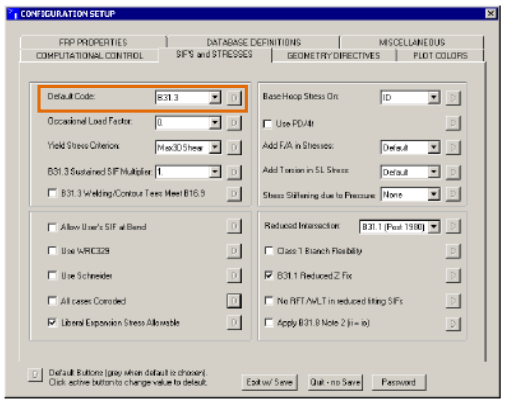
To test the algorithm for the import module built into CAEPIPE, the CAESAR II models were then transferred electronically back to CAEPIPE and the resulting CAEPIPE models were analyzed. The results thus obtained for the converted CAEPIPE models were compared against the manually modeled CAESAR II models. Such comparison confirmed that the results were identical between CAESAR II and CAEPIPE. The results for some of the models are listed below for your reference.

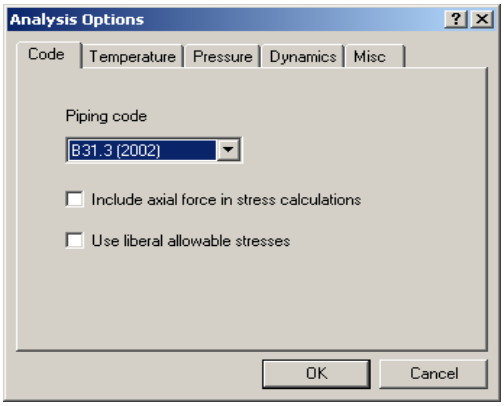
Points to be considered

The most important task to be performed for producing identical results between CAESAR II and CAEPIPE is to configure manually in CAEPIPE the analysis option identical to CAESAR II analysis option. Since CAESAR II batch input does not have the provision to store some of this information, CAEPIPE cannot import these options electronically. This section describes in detail about setting the analysis options in CAEPIPE identical to those options set in CAESAR II.

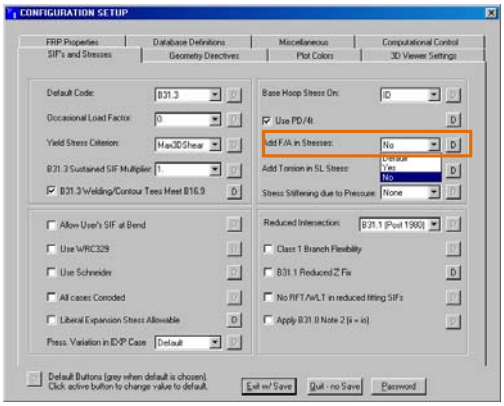
The following are the steps to be followed to set the analysis options in CAEPIPE corresponding to CAESAR II analysis options.

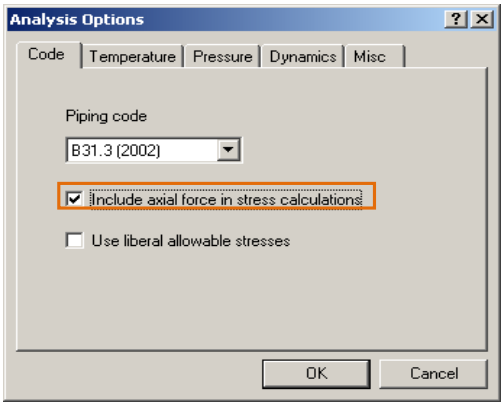
a. The left figure below shows the analyses option related to code in CAESAR II. The piping code to be used for performing analysis can be selected from the "Piping code" drop-down combo box of CAEPIPE.



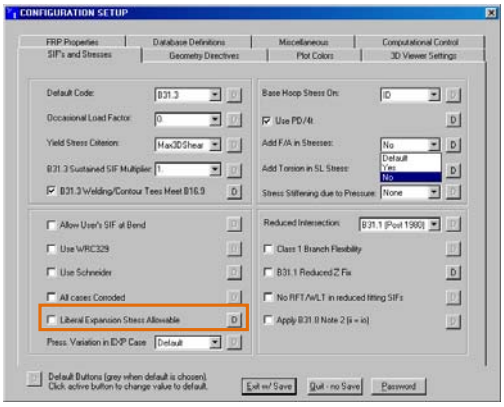


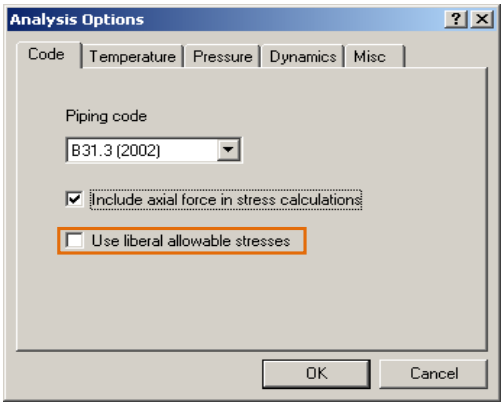
b. The analysis option in CAEPIPE corresponding to CAESAR II “Add F/A in Stresses” is shown in figure right below.



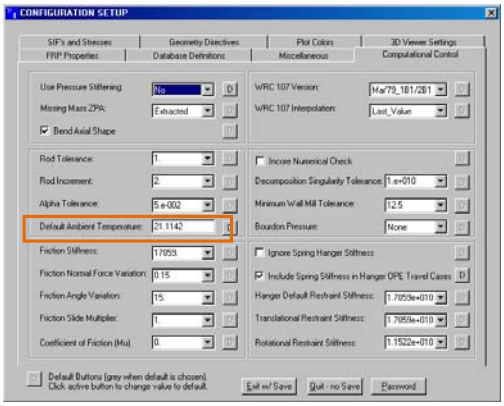


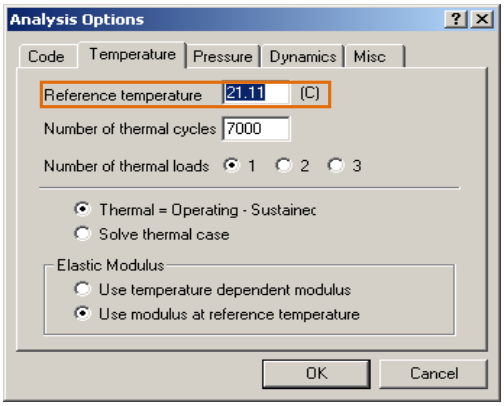
c. The analysis option in CAEPIPE corresponding to CAESAR II “Liberal Expansion Stress Allowable” is shown in figure right below.



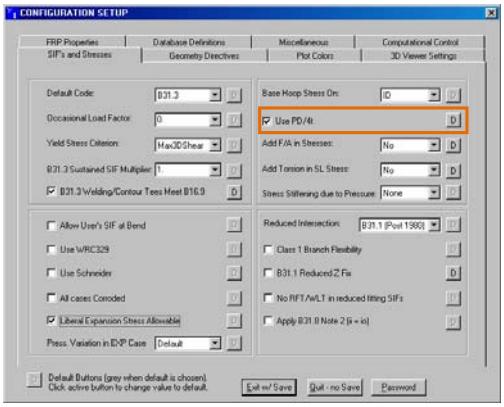


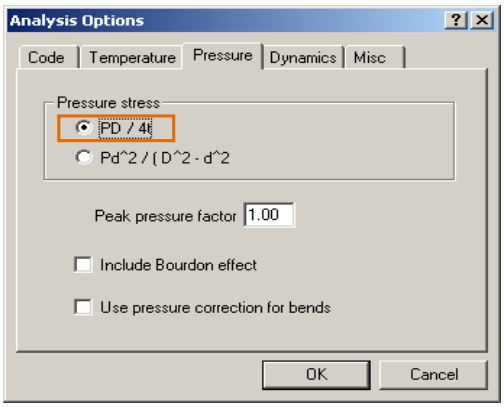
d. The analysis option in CAEPIPE corresponding to CAESAR II “Default Ambient Temperature” is shown in figure right below.



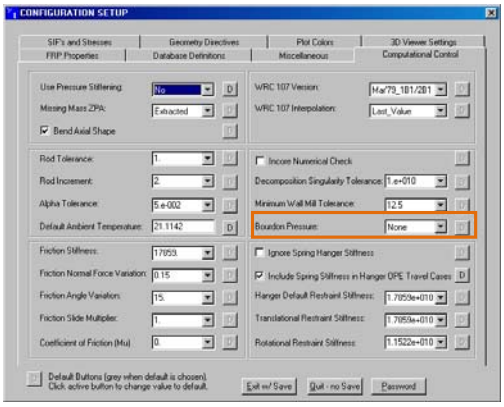


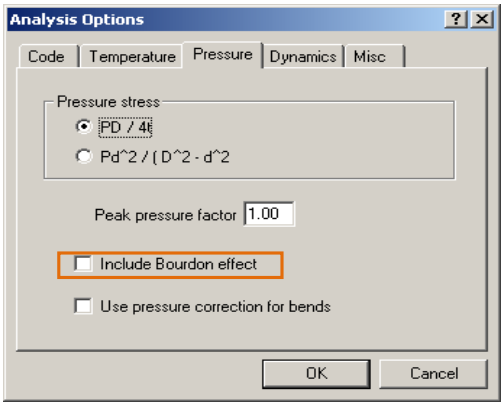
e. The analysis option in CAEPIPE corresponding to CAESAR II “use PD/4T” is shown in figure right below.



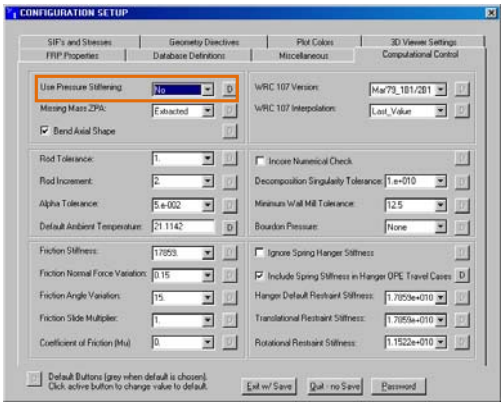


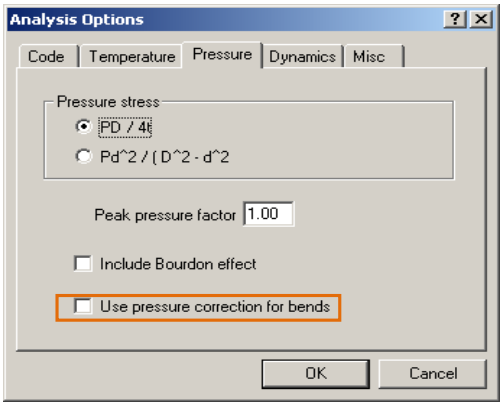
f. The analysis option in CAEPIPE corresponding to CAESAR II “Bourdon Pressure” is shown in figure right below.



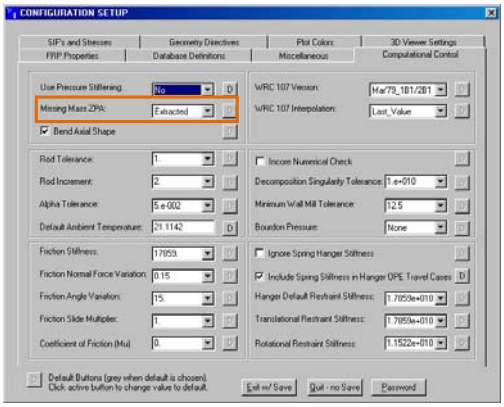


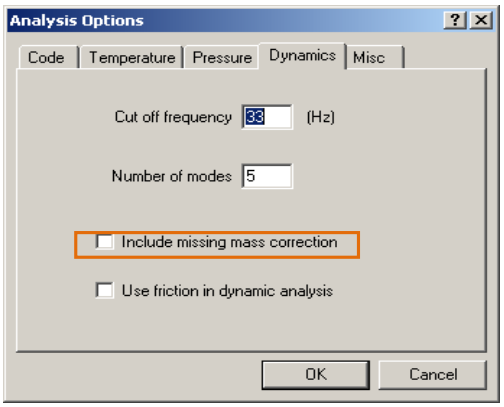
g. The analysis option in CAEPIPE corresponding to CAESAR II “Use pressure Stiffening” is shown in figure right below.



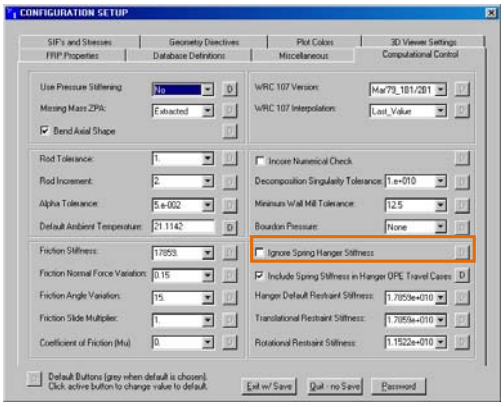


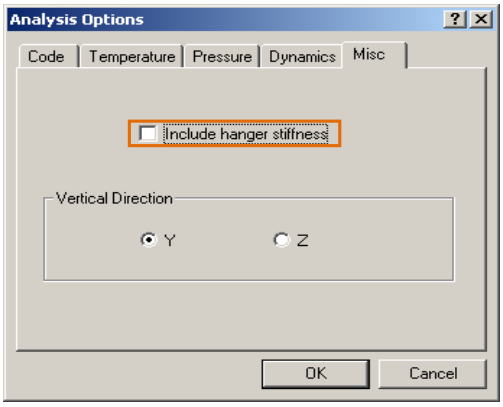
h. The analysis option in CAEPIPE corresponding to CAESAR II “Missing Mass ZPA” is shown in figure right below.



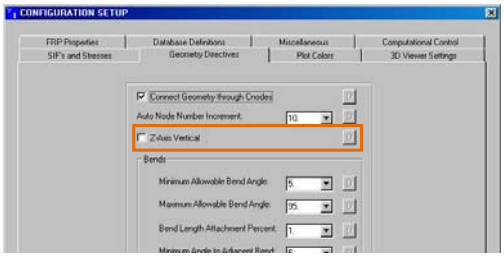


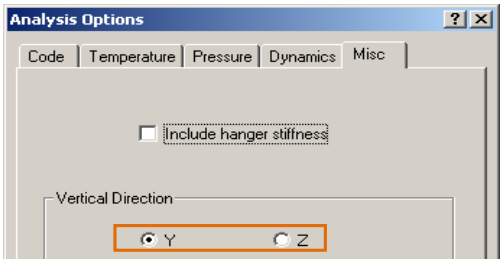
i. The analysis option in CAEPIPE corresponding to CAESAR II “Ignore Spring Hanger Stiffness” is shown in figure right below.





j. The analysis option in CAEPIPE corresponding to CAESAR II “Z-Axis Vertical” is shown in figure right below.



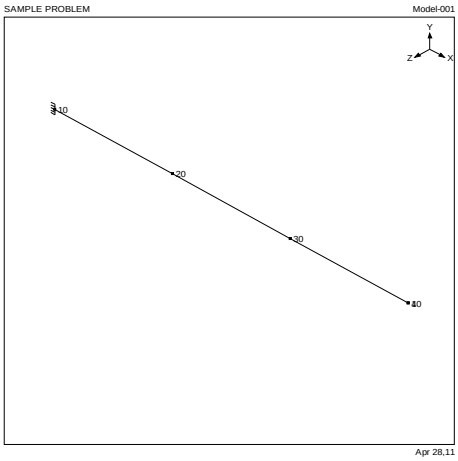


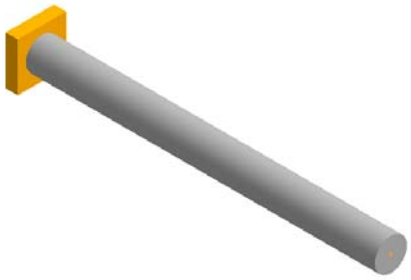
About Model-001

This model has the following

a. Three Pipe elements with 4 node points starting from node 10. The length of each piping element is 1m.
b. Rigid anchor at node 10.
c. Rigid element of 1000 kg at node 40.
d. Design pressure and design temperature are 0 kg/cm2 and 148.9^0 C respectively.
e. A53 Grade B material and 10” Nominal diameter section are used.
f. Insulation, Fluid density and Pipe material density are taken to be zero.

The pictorial representation of the model is shown below.





Name of the Model		**Model – 001**
Analysis Options in CAESAR II		
1	Code – B 31.3	
2	Add F/A in Stresses = NO	
3	Liberal Expansion Stress Allowable = NO	
4	Reference Temperature = 21.11^{0}c	
5	Number of Thermal Cycles = 7000	
6	Use PD/4T = Yes	
7	Bourdon Pressure = None	
8	Use pressure Stiffening = No	
9	Missing Mass ZPA = Enables	
10	Ignore Spring Hanger Stiffness	
11	Y – Vertical	
12	Cut-off frequency = 33 Hz	

Total Weight (Kg)	
CAESAR II	1000
CAEPIPE	1000

Support Load (Sustained)							
	Node	Fx (Kg)	Fy (Kg)	Fz (Kg)	Mx (Kg-m)	My (Kg-m)	Mz (Kg-m)
CAESAR II	10	0	-1000	0	0	0	-2998.8
CAEPIPE	10	0	-1000	0	0	0	-3000
Operating Case							
	Node	Fx (Kg)	Fy (Kg)	Fz (Kg)	Mx (Kg-m)	My (Kg-m)	Mz (Kg-m)
CAESAR II	10	0	-1000	0	0	0	-2998.8
CAEPIPE	10	0	-1000	0	0	0	-3000

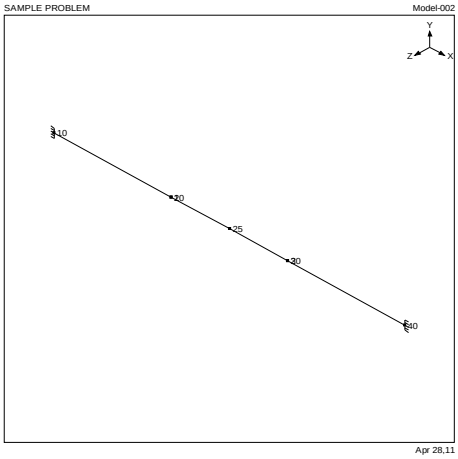
Frequencies (in Hz)		
Mode Number	CAESAR II	CAEPIPE
1	7.584	7.588
2	7.584	7.588

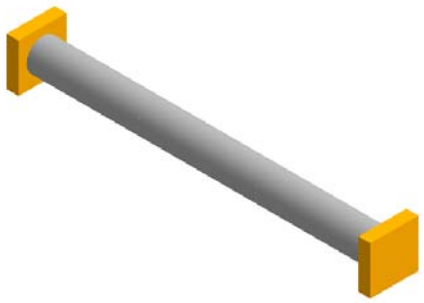
About Model-002

This model shown below is the same as Model-001 above, with the following modifications.

a. Rigid element at node 40 is replaced by Rigid anchor.
b. Two Rigid elements of 500 kg each are added at nodes 20 and 30.
c. An intermediate node is inserted at mid-point between nodes 20 and 30.

The pictorial representation of the model is shown below.





Name of the Model	**Model – 002**
Analysis Options in CAESAR II	
1	Code – B 31.3
2	Add F/A in Stresses = NO
3	Liberal Expansion Stress Allowable = NO
4	Reference Temperature = 21.11^{0}c
5	Number of Thermal Cycles = 7000
6	Use PD/4T = Yes
7	Bourdon Pressure = None
8	Use pressure Stiffening = No
9	Missing Mass ZPA = Enables
10	Ignore Spring Hanger Stiffness
11	Y – Vertical
12	Cut-off frequency = 33 Hz

Total Weight (Kg)	
CAESAR II	1000
CAEPIPE	1000

Support Load (Sustained)							
	Node	Fx (Kg)	Fy (Kg)	Fz (Kg)	Mx (Kg-m)	My (Kg-m)	Mz (Kg-m)
CAESAR II	10	0	-500	0	0	0	-333.3
CAEPIPE	10	0	-500	0	0	0	-333
CAESAR II	40	0	-500	0	0	0	333
CAEPIPE	40	0	-500	0	0	0	333.1
Operating Case							
	Node	Fx (Kg)	Fy (Kg)	Fz (Kg)	Mx (Kg-m)	My (Kg-m)	Mz (Kg-m)
CAESAR II	10	-384619	-500	0	0	0	-333.3
CAEPIPE	10	-384636	-500	0	0	0	-333
CAESAR II	40	384619	-500	0	0	0	333.1
CAEPIPE	40	384636	-500	0	0	0	333

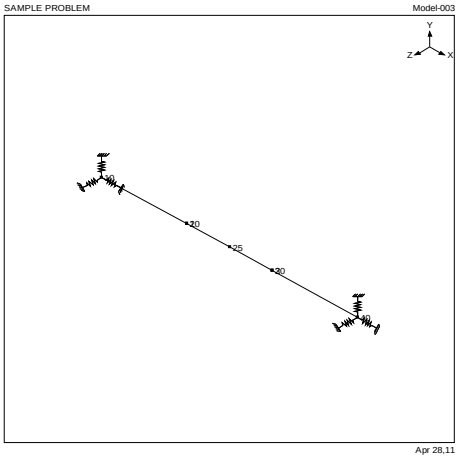
Frequencies (in Hz)		
Mode Number	CAESAR II	CAEPIPE
1	70.78	70.79

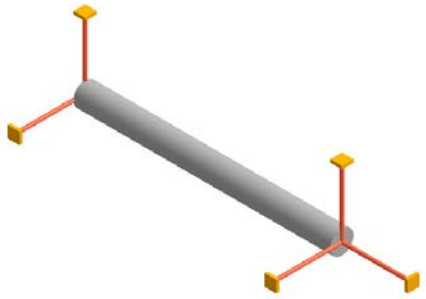
About Model-003

This model shown below is the same as Model-002 above with the following modifications.

a. Rigid anchors at nodes 10 and 40 are replaced by flexible anchor with the following stiffnesses kx=ky=kz=1000kg/mm and kxx=kyy=kzz=1000 kg-m/deg.

The pictorial representation of the model is shown below.





Name of the Model		**Model – 003**
Analysis Options in CAESAR II		
1	Code – B 31.3	
2	Add F/A in Stresses = NO	
3	Liberal Expansion Stress Allowable = NO	
4	Reference Temperature = 21.11^0c	
5	Number of Thermal Cycles = 7000	
6	Use PD/4T = Yes	
7	Bourdon Pressure = None	
8	Use pressure Stiffening = No	
9	Missing Mass ZPA = Enables	
10	Ignore Spring Hanger Stiffness	
11	Y – Vertical	
12	Cut-off frequency = 33 Hz	

Total Weight (Kg)	
CAESAR II	1000
CAEPIPE	1000

Support Load (Sustained)							
	Node	Fx (Kg)	Fy (Kg)	Fz (Kg)	Mx (Kg-m)	My (Kg-m)	Mz (Kg-m)
CAESAR II	10	0	-500	0	0	0	-13.0
CAEPIPE	10	0	-500	0	0	0	-13.0
CAESAR II	40	0	-500	0	0	0	13.0
CAEPIPE	40	0	-500	0	0	0	13.0
Operating Case							
	Node	Fx (Kg)	Fy (Kg)	Fz (Kg)	Mx (Kg-m)	My (Kg-m)	Mz (Kg-m)
CAESAR II	10	-2264	-500	0	0	0	-13.0
CAEPIPE	10	-2264	-500	0	0	0	-13.0
CAESAR II	40	2264	-500	0	0	0	13.0
CAEPIPE	40	2264	-500	0	0	0	13.0

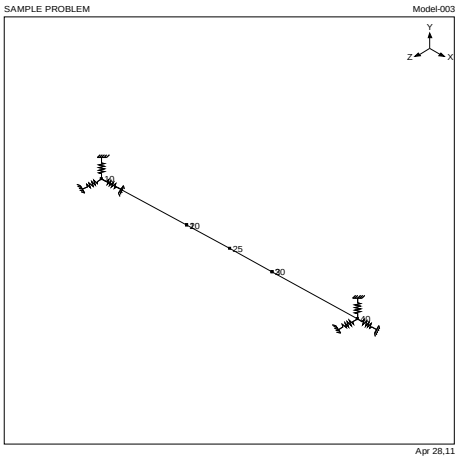
Frequencies (in Hz)		
Mode Number	CAESAR II	CAEPIPE
1	18.825	18.832
2	18.825	18.832
3	22.245	22.254
4	59.037	50.059

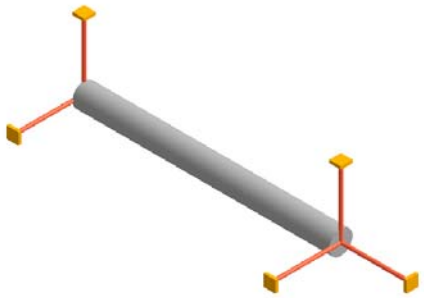
About Model-004

This model shown below is the same as Model-003 above with the following modifications.

a. Insulation density of section as 400 kg/m3 and
b. Insulation thickness of section as 100mm.

The pictorial representation of the model is shown below.





Name of the Model		**Model – 004**
Analysis Options in CAESAR II		
1	Code – B 31.3	
2	Add F/A in Stresses = NO	
3	Liberal Expansion Stress Allowable = NO	
4	Reference Temperature = 21.11^0c	
5	Number of Thermal Cycles = 7000	
6	Use PD/4T = Yes	
7	Bourdon Pressure = None	
8	Use pressure Stiffening = No	
9	Missing Mass ZPA = Enables	
10	Ignore Spring Hanger Stiffness	
11	Y – Vertical	
12	Cut-off frequency = 33 Hz	

Total Weight (Kg)	
CAESAR II	1140.7
CAEPIPE	1140.5

Support Load (Sustained)							
	Node	Fx (Kg)	Fy (Kg)	Fz (Kg)	Mx (Kg-m)	My (Kg-m)	Mz (Kg-m)
CAESAR II	10	0	-571	0	0	0	-14.4
CAEPIPE	10	0	-570	0	0	0	-14.0
CAESAR II	40	0	-570	0	0	0	14.4
CAEPIPE	40	0	-570	0	0	0	14.0
Operating Case							
	Node	Fx (Kg)	Fy (Kg)	Fz (Kg)	Mx (Kg-m)	My (Kg-m)	Mz (Kg-m)
CAESAR II	10	-2264	-571	0	0	0	-14.4
CAEPIPE	10	-2264	-570	0	0	0	-14.0
CAESAR II	40	2264	-570	0	0	0	14.4
CAEPIPE	40	2264	-570	0	0	0	14.0

Frequencies (in Hz)		
Mode Number	CAESAR II	CAEPIPE
1	17.789	17.798
2	17.789	17.798
3	20.831	20.841
4	51.158	51.182

About Model-005

This model shown below is the same as Model-004 above with the following modification.

a. Fluid density as 1000 kg/m3.

Name of the Model		**Model – 005**
Analysis Options in CAESAR II		
1	Code – B 31.3	
2	Add F/A in Stresses = NO	
3	Liberal Expansion Stress Allowable = NO	
4	Reference Temperature = 21.11^0c	
5	Number of Thermal Cycles = 7000	
6	Use PD/4T = Yes	
7	Bourdon Pressure = None	
8	Use pressure Stiffening = No	
9	Missing Mass ZPA = Enables	
10	Ignore Spring Hanger Stiffness	
11	Y – Vertical	
12	Cut-off frequency = 33 Hz	

Total Weight (Kg)	
CAESAR II	1279.8
CAEPIPE	1279.5

Support Load (Sustained)							
	Node	Fx (Kg)	Fy (Kg)	Fz (Kg)	Mx (Kg-m)	My (Kg-m)	Mz (Kg-m)
CAESAR II	10	0	-640	0	0	0	-15.7
CAEPIPE	10	0	-640	0	0	0	-16
CAESAR II	40	0	-640	0	0	0	15.7
CAEPIPE	40	0	-640	0	0	0	16
Operating Case							
	Node	Fx (Kg)	Fy (Kg)	Fz (Kg)	Mx (Kg-m)	My (Kg-m)	Mz (Kg-m)
CAESAR II	10	-2264	-640	0	0	0	-15.7
CAEPIPE	10	-2264	-640	0	0	0	-16
CAESAR II	40	2264	-640	0	0	0	15.7
CAEPIPE	40	2264	-640	0	0	0	16

Frequencies (in Hz)		
Mode Number	CAESAR II	CAEPIPE
1	16.915	16.924
2	16.915	16.924
3	19.670	19.680
4	45.577	45.602

About Model-006

This model shown below is the same as Model-005 above with the following modification.

a. Density of material as 7833 kg/m3.

Name of the Model		**Model – 006**
Analysis Options in CAESAR II		
1	Code – B 31.3	
2	Add F/A in Stresses = NO	
3	Liberal Expansion Stress Allowable = NO	
4	Reference Temperature = 21.11^0c	
5	Number of Thermal Cycles = 7000	
6	Use PD/4T = Yes	
7	Bourdon Pressure = None	
8	Use pressure Stiffening = No	
9	Missing Mass ZPA = Enables	
10	Ignore Spring Hanger Stiffness	
11	Y – Vertical	
12	Cut-off frequency = 33 Hz	

Total Weight (Kg)	
CAESAR II	1566.4
CAEPIPE	1566.1

Support Load (Sustained)							
	Node	Fx (Kg)	Fy (Kg)	Fz (Kg)	Mx (Kg-m)	My (Kg-m)	Mz (Kg-m)
CAESAR II	10	0	-783	0	0	0	-18.5
CAEPIPE	10	0	-783	0	0	0	-19.0
CAESAR II	40	0	-783	0	0	0	18.5
CAEPIPE	40	0	-783	0	0	0	19.0
Operating Case							
	Node	Fx (Kg)	Fy (Kg)	Fz (Kg)	Mx (Kg-m)	My (Kg-m)	Mz (Kg-m)
CAESAR II	10	-2264	-783	0	0	0	-18.5
CAEPIPE	10	-2264	-783	0	0	0	-19.0
CAESAR II	40	2264	-783	0	0	0	18.5
CAEPIPE	40	2264	-783	0	0	0	19.0

Frequencies (in Hz)		
Mode Number	CAESAR II	CAEPIPE
1	15.454	15.461
2	15.454	15.461
3	17.782	17.791
4	37.971	37.990

About Model-007

This model shown below is the same as Model-006 above with the following modification.

a. Internal fluid pressure of 50 kg/cm2.

Name of the Model	**Model – 007**
Analysis Options in CAESAR II	
1	Code – B 31.3
2	Add F/A in Stresses = NO
3	Liberal Expansion Stress Allowable = NO
4	Reference Temperature = 21.11^0c
5	Number of Thermal Cycles = 7000
6	Use PD/4T = Yes
7	Bourdon Pressure = None
8	Use pressure Stiffening = No
9	Missing Mass ZPA = Enables
10	Ignore Spring Hanger Stiffness
11	Y – Vertical
12	Cut-off frequency = 33 Hz

Total Weight (Kg)	
CAESAR II	1566.4
CAEPIPE	1566.1

Support Load (Sustained)							
	Node	Fx (Kg)	Fy (Kg)	Fz (Kg)	Mx (Kg-m)	My (Kg-m)	Mz (Kg-m)
CAESAR II	10	0	-783	0	0	0	-18.5
CAEPIPE	10	0	-783	0	0	0	-19.0
CAESAR II	40	0	-783	0	0	0	18.5
CAEPIPE	40	0	-783	0	0	0	19.0
Operating Case							
	Node	Fx (Kg)	Fy (Kg)	Fz (Kg)	Mx (Kg-m)	My (Kg-m)	Mz (Kg-m)
CAESAR II	10	-2264	-783	0	0	0	-18.5
CAEPIPE	10	-2264	-783	0	0	0	-19.0
CAESAR II	40	2264	-783	0	0	0	18.5
CAEPIPE	40	2264	-783	0	0	0	19.0

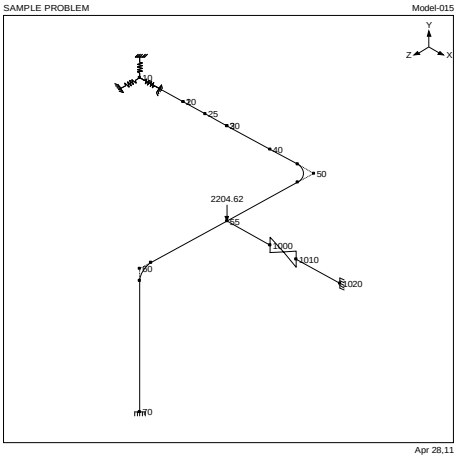
Frequencies (in Hz)		
Mode Number	CAESAR II	CAEPIPE
1	15.454	15.461
2	15.454	15.461
3	17.782	17.791
4	37.971	37.990

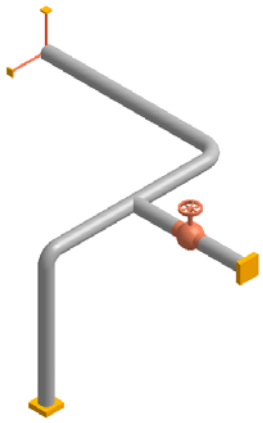
About Model-015

This model shown below is the same as Model-007 above with the following modifications.

a. Long radius bend at node 50.
b. Straight pipe of 2m lengths and
c. Short radius bend at node 60.
d. Vertically downward pipe of length 3m and
e. Rigid anchor at node 70.
f. Welding tee at node 55 and
g. Force of 100kg in vertical direction at node 55.
h. Two horizontal pipes of length 1m and
i. Valve between two pipes with 100 kg weight and 600mm length.

The pictorial representation of the model is shown below.





Name of the Model		**Model – 007**
Analysis Options in CAESAR II		
1	Code – B 31.3	
2	Add F/A in Stresses = NO	
3	Liberal Expansion Stress Allowable = NO	
4	Reference Temperature = 21.11^0c	
5	Number of Thermal Cycles = 7000	
6	Use PD/4T = Yes	
7	Bourdon Pressure = None	
8	Use pressure Stiffening = No	
9	Missing Mass ZPA = Enables	
10	Ignore Spring Hanger Stiffness	
11	Y – Vertical	
12	Cut-off frequency = 33 Hz	

Total Weight (Kg)	
CAESAR II	2979.4
CAEPIPE	2978.7

Support Load (Sustained)							
	Node	Fx (Kg)	Fy (Kg)	Fz (Kg)	Mx (Kg-m)	My (Kg-m)	Mz (Kg-m)
CAESAR II	10	109	-873	-15	-70.2	6.2	-103.2
CAEPIPE	10	109	-873	-15	-70	6	-103
CAESAR II	70	119	-1145	267	108.2	-126.0	38.5
CAEPIPE	70	119	-1145	267	108	-126.0	38.0
CAESAR II	1020	-228	-1962	-252	-1045.8	-493.5	3314.3
CAEPIPE	1020	-228	-1961	-251	-1046.0	-493.0	3313.0

Operating Case							
	Node	Fx (Kg)	Fy (Kg)	Fz (Kg)	Mx (Kg-m)	My (Kg-m)	Mz (Kg-m)
CAESAR II	10	-4043	-883	-794	-137.5	126.6	-123.5
CAEPIPE	10	-4043	-883	-794	-137.0	127.0	-124.0
CAESAR II	70	-1778	-2461	1136	1341.1	73.7	4302.2
CAEPIPE	70	-1777	-2460	1136	1341	74.0	4302.0
CAESAR II	1020	5820	-636	-342	-2214.9	-2443.3	1273.2
CAEPIPE	1020	5820	-636	-342	-2215.0	-2443.0	1273.0

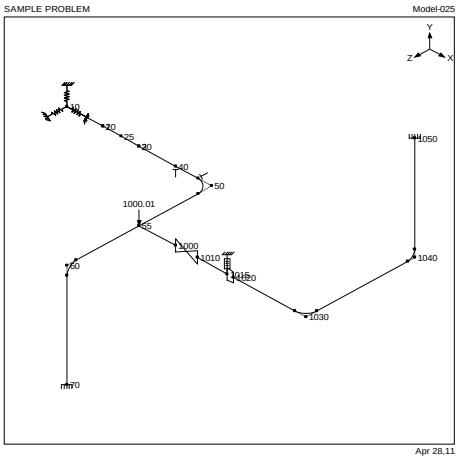
Frequencies (in Hz)		
Mode Number	CAESAR II	CAEPIPE
1	9.086	9.096
2	12.538	12.546
3	18.825	18.841
4	21.545	21.574
5	24.611	24.651
6	26.743	26.834
7	41.099	41.187

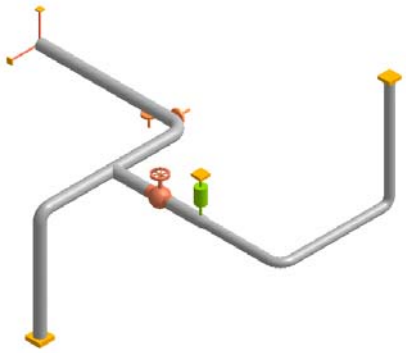
About Model-025

This model shown below is the same as Model-015 above with the following modifications.

a. Long radius bend at node 1030.
b. Reducer of length 128 mm between nodes 1015 and 1020.
c. Horizontal pipe of length 3m in negative z direction and
d. Rigid anchor at node 1040.
e. User hanger at node 1015 with spring rate as 8.0 kg/mm and Cold Load of 1083 Kg.
f. Rigid limit stops without friction coefficient at node 40 and 50.
g. Short radius bend at node 1040 and
h. Vertical pipe of length 3m in Y direction.

The pictorial representation of the model is shown below.





Name of the Model		**Model – 025**
Analysis Options in CAESAR II		
1	Code – B 31.3	
2	Add F/A in Stresses = NO	
3	Liberal Expansion Stress Allowable = NO	
4	Reference Temperature = 21.11^{0}c	
5	Number of Thermal Cycles = 7000	
6	Use PD/4T = Yes	
7	Bourdon Pressure = None	
8	Use pressure Stiffening = No	
9	Missing Mass ZPA = Enables	
10	Ignore Spring Hanger Stiffness	
11	Y – Vertical	
12	Cut-off frequency = 33 Hz	

Total Weight (Kg)	
CAESAR II	4623.7
CAEPIPE	4617.6

Support Load (Sustained)							
	Node	Fx (Kg)	Fy (Kg)	Fz (Kg)	Mx (Kg-m)	My (Kg-m)	Mz (Kg-m)
CAESAR II	10	-36	-561	6	32.1	-0.3	0.2
CAEPIPE	10	-36	-561	8	32.0	0.0	0.0
CAESAR II	70	33	-1455	185	191.9	-23.4	4.0
CAEPIPE	70	34	-1454	184	190.0	-24.0	3.0
CAESAR II	1050	2.0	-612	16	18.4	11.6	-36.3
CAEPIPE	1050	2.0	-612	16	19.0	12.0	-36.0

Operating Case							
	Node	Fx (Kg)	Fy (Kg)	Fz (Kg)	Mx (Kg-m)	My (Kg-m)	Mz (Kg-m)
CAESAR II	10	-719	-590	-48	-61.8	2.0	-0.4
CAEPIPE	10	-724	-590	-30	-62.0	1.0	0.0
CAESAR II	70	290	-2093	2763	5678.9	-457.2	-734.6
CAEPIPE	70	295	-2092	2760	5671.0	-458.0	-746.0
CAESAR II	1050	429	-471	-68	-59.6	525.7	927.5
CAEPIPE	1050	430	-470	-69	-57.0	526.0	930.0

Frequencies (in Hz)		
Mode Number	CAESAR II	CAEPIPE
1	5.918	5.936
2	8.989	9.001
3	9.551	9.574
4	11.448	11.469
5	15.003	15.078
6	17.381	17.466
7	18.416	18.451
8	23.944	24.055
9	30.437	30.555
10	35.764	36.057

About Model-026

This model shown below is the same as Model-025 above with the following modification.

a. Seismic coefficient of 0.3 in x direction.

Name of the Model	**Model – 026**
Analysis Options in CAESAR II	
1	Code – B 31.3
2	Add F/A in Stresses = NO
3	Liberal Expansion Stress Allowable = NO
4	Reference Temperature = 21.11^0c
5	Number of Thermal Cycles = 7000
6	Use PD/4T = Yes
7	Bourdon Pressure = None
8	Use pressure Stiffening = No
9	Missing Mass ZPA = Enables
10	Ignore Spring Hanger Stiffness
11	Y – Vertical
12	Cut-off frequency = 33 Hz

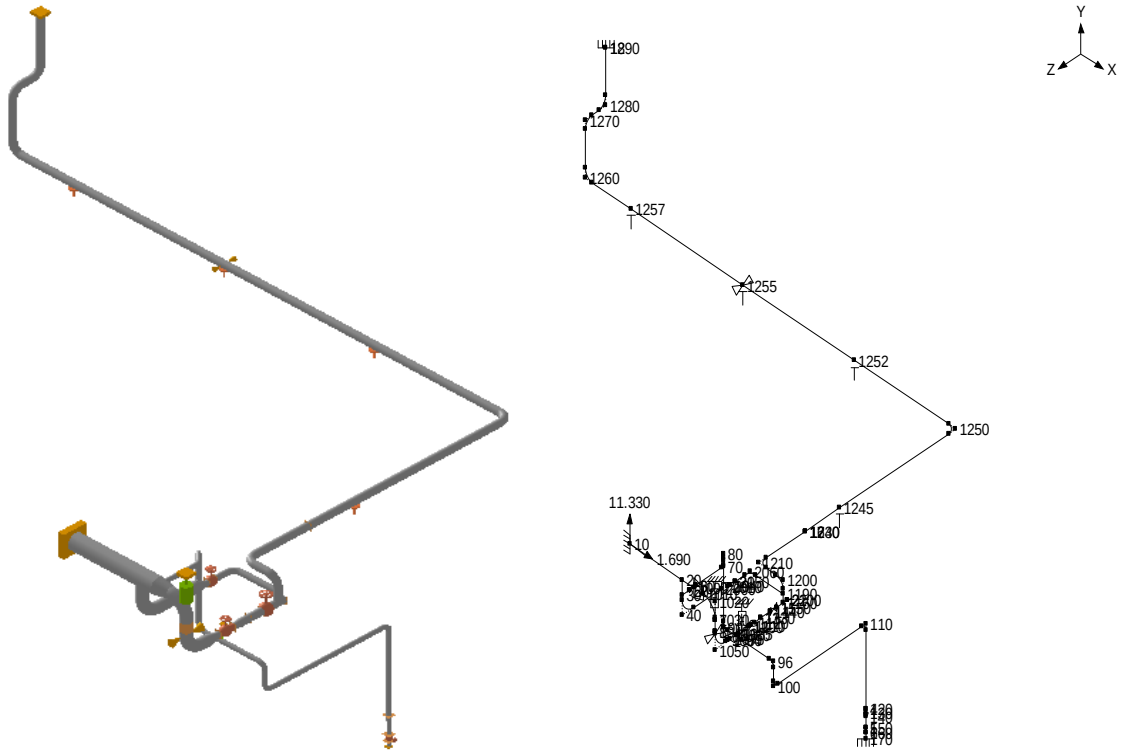
Total Weight (Kg)	
CAESAR II	4623.7
CAEPIPE	4617.6

Support Load (Sustained)							
	Node	Fx (Kg)	Fy (Kg)	Fz (Kg)	Mx (Kg-m)	My (Kg-m)	Mz (Kg-m)
CAESAR II	10	-36	-561	6	32.1	-0.3	0.2
CAEPIPE	10	-36	-561	8	32.0	0.0	0.0
CAESAR II	70	33	-1455	185	191.9	-23.4	4.0
CAEPIPE	70	34	-1454	184	190.0	-24.0	3.0
CAESAR II	1050	2.0	-612	16	18.4	11.6	-36.3
CAEPIPE	1050	2.0	-612	16	19.0	12.0	-36.0
Operating Case							
	Node	Fx (Kg)	Fy (Kg)	Fz (Kg)	Mx (Kg-m)	My (Kg-m)	Mz (Kg-m)
CAESAR II	10	-719	-590	-48	-61.8	2.0	-0.4
CAEPIPE	10	-724	-590	-30	-62.0	1.0	0.0
CAESAR II	70	290	-2093	2763	5678.9	-457.2	-734.6
CAEPIPE	70	295	-2092	2760	5671.0	-458.0	-746.0
CAESAR II	1050	429	-471	-68	-59.6	525.7	927.5
CAEPIPE	1050	430	-470	-69	-57.0	526.0	930.0
Seismic Case							
	Node	Fx (Kg)	Fy (Kg)	Fz (Kg)	Mx (Kg-m)	My (Kg-m)	Mz (Kg-m)
CAESAR II	10	794	17	29	1.7	1.2	0.3
CAEPIPE	10	794	17	29	2.0	1.0	0.0
CAESAR II	70	404	3	13	32.8	68.0	798.4
CAEPIPE	70	404	3	14	35.0	68.0	798.0
CAESAR II	1050	188	9	7	33.4	25.5	329.9
CAEPIPE	1050	188	9	7	34.0	25	330.0

Frequencies (in Hz)		
Mode Number	CAESAR II	CAEPIPE
1	5.918	5.936
2	8.989	9.001
3	9.551	9.574
4	11.448	11.469
5	15.003	15.078
6	17.381	17.466
7	18.416	18.451
8	23.944	24.055
9	30.437	30.555
10	35.764	36.057

About Model-054

This model is a carbon steel (A53 Grade B), 150 lb class insulated piping system connected to a Dryer and operating at 120^0 C in an Oil Refinery Expansion Project. The model has line sizes of nominal diameter 4”, 6”, 8”, 10”, 16” and 24” and comprises of straight pipes, elbows, reducers, tees and welding neck flanges. There are concentrated masses such as valves. The system is of welded construction and has 2 spring hangers, 4 limit stops and 2 lateral restraints. Cases considered for analysis are sustained, operating, seismic and wind. Cut-off frequency is 33Hz. Piping code used is ASME B31.3.



Name of the Model		**Model – 054**
Analysis Options in CAESAR II		
1	Code – B 31.3	
2	Add F/A in Stresses = NO	
3	Liberal Expansion Stress Allowable = NO	
4	Reference Temperature = 21.11^0c	
5	Number of Thermal Cycles = 7000	
6	Use PD/4T = Yes	
7	Bourdon Pressure = Trans + Rot	
8	Use pressure Stiffening = No	
9	Missing Mass ZPA = Enables	
10	Ignore Spring Hanger Stiffness	
11	Y – Vertical	
12	Cut-off frequency = 33 Hz	

Total Weight (Kg)	
CAESAR II	7376.4
CAEPIPE	7330.1

Support Load (Sustained)							
	Node	Fx (Kg)	Fy (Kg)	Fz (Kg)	Mx (Kg-m)	My (Kg-m)	Mz (Kg-m)
CAESAR II	10	2	-854	-65	-2003.5	78.5	-73.0
CAEPIPE	10	-3	-854	-66	-1987	79.0	-86.0
CAESAR II	170	0.0	-432	-10.0	-0.6	-7.1	-10.1
CAEPIPE	170	0.0	-431	-10.0	0.0	-7.0	-10.0
CAESAR II	1290	-11.0	-279	-1	51.1	-2.1	-23
CAEPIPE	1290	-11.0	-279	-1	51.0	-2.0	-23

Operating Case							
	Node	Fx (Kg)	Fy (Kg)	Fz (Kg)	Mx (Kg-m)	My (Kg-m)	Mz (Kg-m)
CAESAR II	10	-26	-900	16.0	-2398.1	87.3	-352.4
CAEPIPE	10	-40	-909	37.0	-2428.0	87.0	-385.0
CAESAR II	170	24	-472	-59	-113.6	29.2	-96.2
CAEPIPE	170	19	-462	-48	-92	23	-81
CAESAR II	1290	-441	642	-249	112.3	-230	-1068
CAEPIPE	1290	-417	593	-270	240	-221	-1006

Frequencies (in Hz)		
Mode Number	CAESAR II	CAEPIPE
1	1.921	1.905
2	2.354	2.315
3	2.449	2.368
4	2.566	2.522
5	3.178	3.134
6	3.410	3.297
7	4.333	4.210
8	4.609	4.530
9	4.667	4.512
10	5.848	5.668

Annexure B

Import PipePak Neutral Files into CAEPIPE

Reference

The PipePak neutral file is a free format, space-delimited ASCII file. The file is composed of numerous lines each consisting of data in the following format:

[KEYWORD] <field1> <field2> <field2> ……

A keyword is a fixed length string assigned by PipePak. Keywords are case insensitive, so it may be available in upper case or lower case. Following the keyword is a series of fields whose definitions depend on the keyword. If a field is blank, then it is entered with (*).

This section describes in detail, the methodology followed for transferring the PipePak Piping Systems to CAEPIPE.

FROM

Transfers keyword “FROM” from PipePak as From in CAEPIPE. X, Y and Z coordinate from PipePak will be transferred to DX, DY and DZ of CAEPIPE.

TO

Transfers keyword “TO” with Bend Radius equal to 0.0 or NULL from PipePak as PIPE in CAEPIPE.

Transfers keyword “TO” with Bend Radius > 0.0 from PipePak as BEND in CAEPIPE. Bend Radius from PipePak will be transferred to Bend Radius in CAEPIPE.

Delta X, Delta Y and Delta Z from PipePak will be transferred as DX, DY and DZ for the CAEPIPE element. Section, Load and Material reference will be set in CAEPIPE as explained below.

PIPE

Defines a new section property in CAEPIPE by reading the following values from keyword PIPE.

- Diameter
- Wall Thickness
- Insulation Thickness
- Insulation Density
- Corrosion Allowance and
- Plus Mill Tolerance

The reference index internally generated will be assigned to CAEPIPE element as a Section reference.

When any one of the above mentioned section properties changes in PipePak neutral file, the Import module in CAEPIPE will add a new Section property automatically and will assign the new reference index internally generated to CAEPIPE element as a Section reference.

LOAD

Defines a new Load property in CAEPIPE by reading the following values from Keyword LOAD.

- Temperature #1
- Temperature #2
- Temperature #3
- Pressure #1
- Pressure #2 and
- Pressure #3

The reference index internally generated will be assigned to CAEPIPE element as a Load reference.

When any one of the above mentioned Load properties changes in PipePak neutral file, the Import module in CAEPIPE will add a new Load property automatically and will assign the new reference index internally generated to CAEPIPE element as a Load reference.

MATERIAL

Only Material density and Poisson ratio are available in PipePak Neutral file corresponding to each material. Since the Temperature related properties of Materials are not available in PipePak neutral file, CAEPIPE defines Temperature related properties corresponding to each Material available in PipePak as follows.

Material Properties

- Material Name = Unique Index generated internally in CAEPIPE corresponding to PipePak reference.
- Material Description = Material Identifier from PipePak
- Density = Pipe Density from PipePak
- Poission's Ratio = Poission's ratio from PipePak
- Long Joint Factor = 1.0
- Circular Joint Factor = 1.0
- Tensile Strength = 0.0

Temperature related properties

- Temp[1] = 70.0 deg F
- Young's Modulus[1] = 30.0E6;
- Alpha[1] = 6.0E-6
- Allowable_stress[1] = 20000.0;
- Yield_stress[1] = 0.0
- Rupture_stress[1] = 0.0

- Temp[2] = 1200.0 deg F
- Young's Modulus[2] = 20.0E6
- Alpha[2] = 8.0E-6
- Allowable_stress[2] = 1000.0;
- Yield_stress[2] = 0.0
- Rupture_stress[2] = 0.0

User can later replace the above set material properties with the material properties available in CAEPIPE library by reading the description from CAEPIPE material property (equivalent to PipePak Material Identifier).

RIGID

Transfers keyword "RIGID" from PipePak as Rigid Element in CAEPIPE.

Initial Displacement #1, #2 and #3 entered in PipePak will be ignored in CAEPIPE at this time.

SPRING

Transfers keyword "SPRING" from PipePak as "User Hanger" in CAEPIPE with the following details.

Spring rate = Spring Constant from PipePak

Cold Load = Installation / Cold Load from PipePak

CONSTANT

Transfers keyword "CONSTANT" from PipePak as "Constant Support Hanger" in CAEPIPE with Number of hanger as 1. Installation Load entered in PipePak will be ignored in CAEPIPE at this time.

HANGER

Transfers keyword “HANGER” from PipePak as “Spring Hanger” in CAEPIPE with the following details.

Type = GRINNELL

Number of hanger = 1

Load Variation = 25%

Short range = FALSE

SNUBBER

Transfers keyword “SNUBBER” from PipePak as “SNUBBER” in CAEPIPE with the following details.

Stiffness = Spring Constant from PipePak

X comp = X component of direction cosine from PipePak

Y comp = Y component of direction cosine from PipePak

Z comp = Z component of direction cosine from PipePak

GUIDE

Transfers keyword “GUIDE” from PipePak as “GUIDE” in CAEPIPE with the following details.

Stiffness = Spring Constant from PipePak

LINESTOP

Transfers keyword “LINESTOP” from PipePak as “Skewed Translational Restraint” in CAEPIPE with the following details.

Stiffness = Spring Constant from PipePak

Xcomp = Ycomp = Zcomp = 0.0

ROTATION

Transfers keyword “ROTATION” from PipePak as “Skewed Rotational Restraint” in CAEPIPE with the following details.

Stiffness = Spring Constant from PipePak

X comp = X component of direction cosine from PipePak

Y comp = Y component of direction cosine from PipePak

Z comp = Z component of direction cosine from PipePak

INCLINED

Transfers keyword “INCLINES” from PipePak as “Skewed Translational Restraint” in CAEPIPE with the following details.

Stiffness = Spring Constant from PipePak

X comp = X component of direction cosine from PipePak

Y comp = Y component of direction cosine from PipePak

Z comp = Z component of direction cosine from PipePak

Cold Load, Initial Displacement #1, #2 and #3 will be ignored in CAEPIPE at this time.

ONEWAY

Transfers keyword “ONEWAY” from PipePak as “Limit Stop” in CAEPIPE with the following details.

Stiffness = Rigid Stiffness

Upper Limit = NONE and LowerLimit = 0.0

Xcomp = 1.0, Ycomp = 0.0 and Zcomp = 0.0 when Direction is +X

Xcomp = -1.0, Ycomp = 0.0 and Zcomp = 0.0 when Direction is -X

Xcomp = 0.0, Ycomp = 1.0 and Zcomp = 0.0 when Direction is +Y

Xcomp = 0.0, Ycomp = -1.0 and Zcomp = 0.0 when Direction is -Y

Xcomp = 0.0, Ycomp = 0.0 and Zcomp = 1.0 when Direction is +Z

Xcomp = 0.0, Ycomp = 0.0 and Zcomp = -1.0 when Direction is –Z

Friction Coefficient = Friction Coefficient from PipePak

LIMITSTOP

Transfers keyword “LIMITSTOP” from PipePak as “Limit Stop” in CAEPIPE with the following details.

Stiffness = Spring Constant from PipePak

Upper Limit = Gap in positive direction

Lower Limit = Gap in negative direction

X comp = X component of direction cosine from PipePak

Y comp = Y component of direction cosine from PipePak

Z comp = Z component of direction cosine from PipePak

Friction Coefficient = Friction Coefficient from PipePak

ANCHOR

Transfers keyword “ANCHOR” from PipePak as “ANCHOR” in CAEPIPE with the following details.

KX = X translational stiffness from PipePak

KY = Y translational stiffness from PipePak

KZ = Z translational stiffness from PipePak

RX = X rotational stiffness from PipePak

RY = Y rotational stiffness from PipePak

RZ = Z rotational stiffness from PipePak

Specified Displacement (T1)

X = X translational displacement case 1 from PipePak

Y = Y translational displacement case 1 from PipePak

Z = Z translational displacement case 1 from PipePak

XX = X rotational displacement case 1 from PipePak

YY = Y rotational displacement case 1 from PipePak

ZZ = Z rotational displacement case 1 from PipePak

Specified Displacement (T2)

X = X translational displacement case 2 from PipePak

Y = Y translational displacement case 2 from PipePak

Z = Z translational displacement case 2 from PipePak

XX = X rotational displacement case 2 from PipePak

YY = Y rotational displacement case 2 from PipePak

ZZ = Z rotational displacement case 2 from PipePak

Specified Displacement (T3)

X = X translational displacement case 3 from PipePak

Y = Y translational displacement case 3 from PipePak

Z = Z translational displacement case 3 from PipePak

XX = X rotational displacement case 3 from PipePak

YY = Y rotational displacement case 3 from PipePak

ZZ = Z rotational displacement case 3 from PipePak

SIF

Transfers keyword “SIF” from PipePak as “USER SIF” in CAEPIPE with the following details.

In Plane = In-plane SIF from PipePak

Out of plane = Out-of plane SIF from PipePak

WEIGHT / MASS

Transfers keyword “WEIGHT / MASS” from PipePak as “CMASS” in CAEPIPE with the following details.

Weight = Concentrated mass from PipePak

CUT

Transfers keyword “CUT” from PipePak as “Cut Pipe” in CAEPIPE with the following details.

Cut Short = Amount of Cut short from PipePak

FORCE

Transfers keyword “FORCE” from PipePak as “Force and Moments” in CAEPIPE with the following details.

FX = X direction force from PipePak

FY = Y direction force from PipePak

FZ = Z direction force from PipePak

MX = X direction moment from PipePak

MY = Y direction moment from PipePak

MZ = Z direction moment from PipePak

VALVE

Transfers keyword “VALVE” from PipePak as “VALVE” in CAEPIPE with the following details.

Thickness factor = 3.0

Insulation Thickness factor = Insulation factor from PipePak

Empty Weight of VALVE in CAEPIPE = Empty Weight of Valve from PipePak

FLANGE

Transfers keyword “FLANGE” from PipePak as “FLANGE” in CAEPIPE with the following details.

Type = Weld / double / socket / lap / screwed from PipePak

Weight = Flange weight from PipePak

Gasket Diameter = Gasket Diameter from PipePak

REDUCER

Transfers keyword “REDUCER” from PipePak as “REDUCER” in CAEPIPE. Reducer weight entered in PipePak is ignored in CAEPIPE at this time.

OD1 = Outside diameter from the current section property of CAEPIPE

Thk1 = Thickness from the current section property of CAEPIPE

OD2 = Outside diameter from the next element section property of CAEPIPE

Thk2 = Thickness from the next element section property of CAEPIPE

BELLOW

Transfers keyword “BELLOW” from PipePak as “BELLOWS” in CAEPIPE with the following details.

Axial Stiffness = Longitudinal Stiffness from PipePak

Bending Stiffness = Bending Stiffness from PipePak

Torsional Stiffness = Torsional Stiffness from PipePak

Lateral Stiffness = Lateral Stiffness from PipePak

Weight = Weight from PipePak

Pressure thrust area = Pressure thrust area from PipePak

TEE

Transfers keyword “TEE” from PipePak as “Branch SIF” in CAEPIPE with the following details.

Type = welding / reinforced / unreinforced / extruded

Pad thickness = reinforcing pad thickness from PipePak

Crotch radius = crotch radius from PipePak

Units Mapping between PipePak and CAEPIPE

The Units of measurements are set in CAEPIPE as mentioned below when a PipePak Neutral file is imported into CAEPIPE.

Sl. No.	Unit of measurement	PipePak	Imported to CAEPIPE as
Keyword UNIT is defined as METRIC in PipePak			
1.	Acceleration	cm/s2	-
2.	Area	cm2	mm2
3.	Coordinates	cm	mm
4.	Density	kg/m3	kg/m3
5.	Force	kg	kg
6.	Frequency	Hz	Hz
7.	Insulation Density	kg/m3	kg/m3
8.	Moment	kg-m	kg-m
9.	Output Moment	kg-m	kg-m
10.	Period	s	-
11.	Pressure	kg/m2	kg/cm2
12.	Radius	cm	mm
13.	Rotational displacement	degree	degree
14.	Rotational Stiffness	kg-m/deg	kg-m/deg
15.	Section Modulus	cm3	mm3
16.	Stress	kg/cm2	kg/cm2
17.	Temperature	deg c	deg c
18.	Thermal strain	cm/cm	mm/mm/c
19.	Translational displacement	cm	mm
20.	Translational stiffness	kg/cm	kg/cm
21.	Unit weight	kg/cm	kg/m
22.	Velocity	cm/s	m/s
23.	Weight	kg	kg
24.	Wind pressure	kg/cm2	kg/cm2
25.	Modulus of elasticity	kg/cm2	kg/cm2
Keyword UNIT is defined as SI in PipePak			
1.	Acceleration	mm/s2	-
2.	Area	mm2	mm2
3.	Coordinates	mm	mm
4.	Density	kg/m3	kg/m3
5.	Force	N	N
6.	Frequency	Hz	Hz
7.	Insulation Density	Kg/m3	Kg/m3
8.	Moment	N-m	N-m
9.	Output Moment	N-m	N-m
10.	Period	S	-
11.	Pressure	bar	bar
12.	Radius	mm	mm
13.	Rotational displacement	degree	degree
14.	Rotational Stiffness	N-m/deg	N-m/deg
15.	Section Modulus	mm3	mm3
16.	Stress	kPa	MPa

17.	Temperature	deg c	deg c
18.	Thermal strain	mm/mm	mm/mm/c
19.	Translational displacement	mm	mm
20.	Translational stiffness	N/mm	N/mm
21.	Unit weight	kg/mm	kg/m
22.	Velocity	mm/s	m/s
23.	Weight	kg	kg
24.	Wind pressure	bar	bar
25.	Modulus of elasticity	MPa	MPa
Keyword UNIT is defined as ENGLISH in PipePak			
1.	Acceleration	in/s2	-
2.	Area	in2	In2
3.	Coordinates	ft	ft
4.	Density	lb/in3	lb/in3
5.	Force	lb	lb
6.	Frequency	Hz	Hz
7.	Insulation Density	lb/ft3	lb/ft3
8.	Moment	in-lb	ft-lb
9.	Output Moment	in-lb	ft-lb
10.	Period	s	-
11.	Pressure	psig	psi
12.	Radius	in	in
13.	Rotational displacement	degree	degree
14.	Rotational Stiffness	lb-in/deg	lb-in/deg
15.	Section Modulus	in3	in3
16.	Stress	psi	psi
17.	Temperature	deg F	deg F
18.	Thermal strain	in/in	-
19.	Translational displacement	in	in
20.	Translational stiffness	lb/in	lb/in
21.	Unit weight	lb/in	lb/ft
22.	Velocity	in/s	mph
23.	Weight	lb	lb
24.	Wind pressure	psf	psi
25.	Modulus of elasticity	psi	psi