Webinar

What's new in PASS/START-PROF 4.85 version.

Dynamic Analysis

Dr. Alex Matveev,

PASS/START-PROF Product Manager

25 February 2021

PASS
PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/START-PROF

PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

Smart Pipe Stress Analysis & Optimal Sizing

Presenter:

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Development, Training, Support of START-PROF Since 2005

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PASS/START-PROF

Smart Pipe Stress Analysis & Optimal Sizing

Comprehensive pipe stress, flexibility, stability, and fatigue strength analysis with related sizing calculations

- Broad Applicability
- Unsurpassed Usability
- Powerful Capabilities
- Extensive Databases
- Flexible Configurations
- Extensive Code Support
- Widely Used

PASS
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PASS/Start-Prof | Broad Applicability

- Developed since 1965
- 3 000+ Active users (companies)
- 10 000+ licenses
- User interface and documentation languages: English, Chinese, Russian
- Piping codes: 32
- Wind, Seismic, Snow, Ice codes: 18

PASS/Start-Prof | Broad Applicability

- Process Industry Piping
- Oil and Gas Pipelines
- Utility Network Pipelines
    - District Heating
    - Natural Gas
    - Water
- Power Generation Piping

PASS/START-PROF | New features of v.4.85

- **Modal analysis**. The automatic mass discretization is implemented
- **Updated code ASME B31.1-2020** Power Piping (USA)
- **Added ASME B31G-2012** Remaining Strength of Corroded Pipeline Analysis Level 1 and level 2 in START-Elements: Original B31G (.67dL), modified B31G (.85dL), Exact Trapezoid, Equivalent Area, Effective Area
- **Added new object: Ball Joint**. Allows rotation of two connected pipes with friction. The friction moment depends on pressure value
- **Added new object: Snubber**
- Added new features into **START-PROF calculator**, built-in into the input fields

The full changelog can be found at [Knowledge Database]

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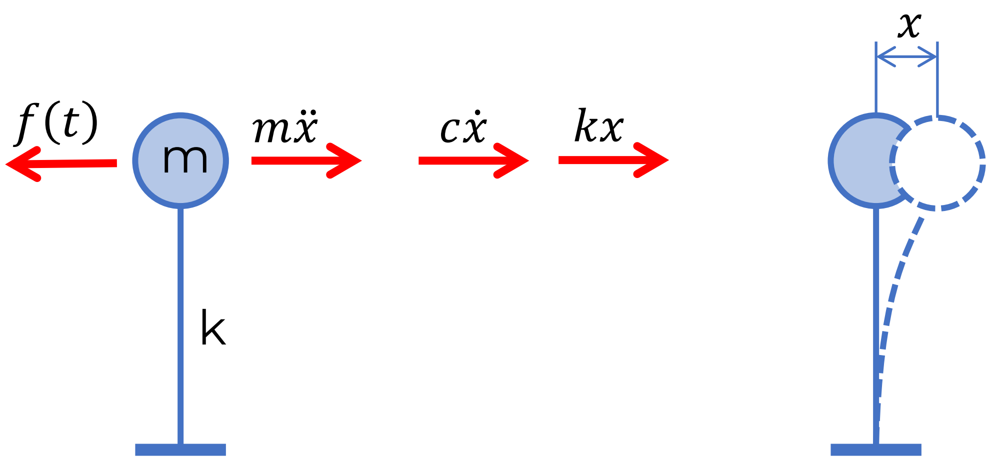
PASS/START-PROF | New features of v.4.85

- Added spring hanger and support selection and database for the following manufacturers:
  - Gradior
  - Pihasa
  - Pipe Support Systems GmbH (PSSI)
  - Piping Technology and Products Inc. (PT&P)
  - Sarathi
- Pipes, Tees, Bends and Reducers Database according to the EN codes: EN 10216, 10217, 10253
- PASS/START-PROF API Interface
- New integration options: import of piping models from Excel and AutoCAD
- Improved START-AVEVA Interface
- Significantly improved the import from CAESAR II. Added support for CAESAR II v.8, v.9, v10, v11, v12. Model converter become smarter

PASS/START-PROF | Dynamic: Modal Analysis

System with one degree of freedom



Sum of the forces acting on the mass

$$m\ddot{x} + c\dot{x} + kx = f(t)$$

m – mass
c – damping
k – stiffness
$f(t)$ – external force as function of time
$x = x(t)$ – displacement as function of time
$\dot{x} = \dot{x}(t)$ – velocity as function of time
$\ddot{x} = \ddot{x}(t)$ – acceleration as function of time

Let’s assume that
$c = 0$ no damping
$f(t) = 0$ no external forces
$x = A \cdot sin(\omega t)$
$\ddot{x} = -\omega^2 \cdot A \cdot sin(\omega t) = -\omega^2 x$

$$-m\omega^2 x + kx = 0$$

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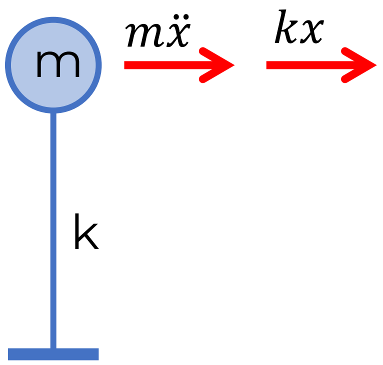
PASS/START-PROF | Dynamic: Modal Analysis

$$-m\omega^2 x + kx = 0$$



$$(k - m\omega^2)x = 0$$

$x = A \cdot sin(\omega t)$

A - amplitude

Solution 1: $x = 0$

Solution 2: $\omega = \sqrt{k/m}$, x = any value

ω – angular frequency, rad/sec
$f = \omega/2\pi$ – technical (ordinary) frequency, 1/sec
$T = 1/f$ – period, sec

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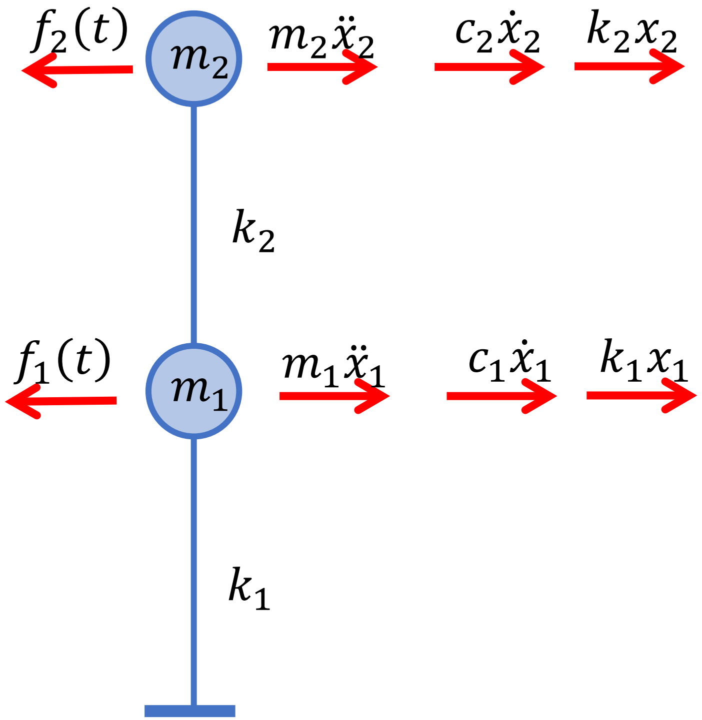
System with 2 and more masses



$$M\ddot{x} + C\dot{x} + Kx = F(t)$$

M – Mass matrix of piping system
C – Damping matrix of piping system
K – Stiffness matrix of piping system
$F(t)$ – External force vector as function of time
$x = x(t)$ – Displacement vector as function of time
$\dot{x} = \dot{x}(t)$ – Velocity vector as function of time
$\ddot{x} = \ddot{x}(t)$ – Acceleration vector as function of time

$$M = \begin{bmatrix} m_1 & 0 \\ 0 & m_2 \end{bmatrix}$$

$$K = \begin{bmatrix} k_1 + k_2 & -k_2 \\ -k_2 & k_2 \end{bmatrix}$$

$$F(t) = \begin{bmatrix} f_1(t) \\ f_2(t) \end{bmatrix}$$

$$\mathrm{x} = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

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PASS/START-PROF | Dynamic: Modal Analysis

$$(K - M\omega^2)x = 0$$

$$M = \begin{bmatrix} m_1 & 0 \\ 0 & m_2 \end{bmatrix} \qquad K = \begin{bmatrix} k_1 + k_2 & -k_2 \\ -k_2 & k_2 \end{bmatrix}$$

Assuming $k_1 = k_2 =$k, $m_1 = m_2 = m$

$$M = \begin{bmatrix} m & 0 \\ 0 & m \end{bmatrix} \qquad K = \begin{bmatrix} 2k & -k \\ -k & k \end{bmatrix}$$

$$det \begin{bmatrix} -m\omega^2 + 2k & -k \\ -k & -m\omega^2 + k \end{bmatrix} = 0$$

Natural frequencies

$$\omega_1 = 0.618\sqrt{k/m}$$

$$\omega_2 = 1.618\sqrt{k/m}$$

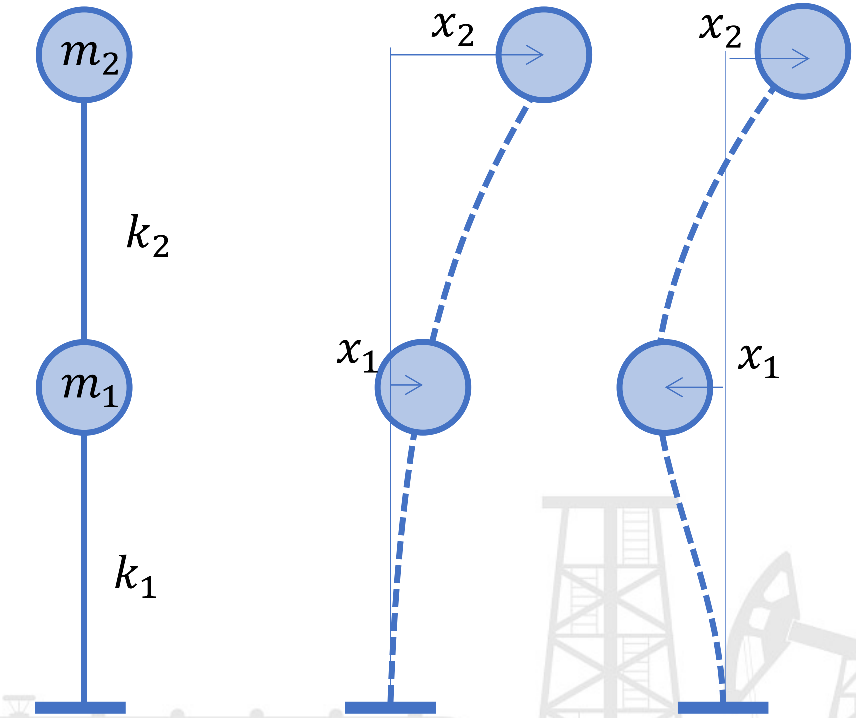
Mode Shape 1

$$\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = A \begin{bmatrix} 0.618 \\ 1 \end{bmatrix}$$

Mode Shape 2

$$\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = A \begin{bmatrix} -1.618 \\ 1 \end{bmatrix}$$

A – amplitude (unknown)



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PASS/START-PROF | Dynamic: Modal Analysis

Modes shapes always orthogonal to each other

$$\begin{bmatrix}0.618\\1\end{bmatrix}\cdot\begin{bmatrix}-1.618\\1\end{bmatrix}=0$$

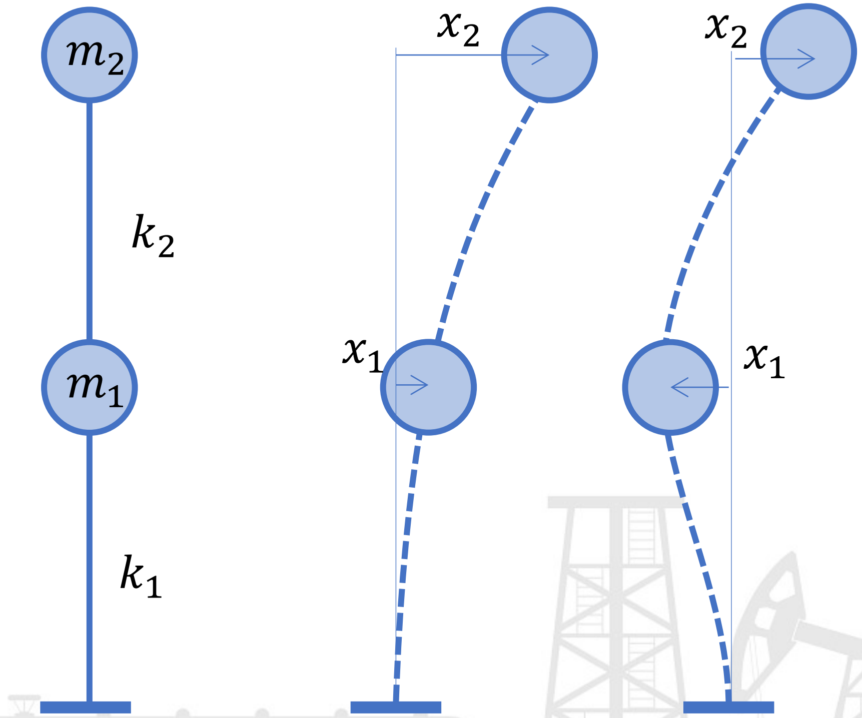
Mode Shape 1

$$\begin{bmatrix}x_1\\x_2\end{bmatrix}=A\begin{bmatrix}0.618\\1\end{bmatrix}$$

Mode Shape 2

$$\begin{bmatrix}x_1\\x_2\end{bmatrix}=A\begin{bmatrix}-1.618\\1\end{bmatrix}$$

A – amplitude (unknown)



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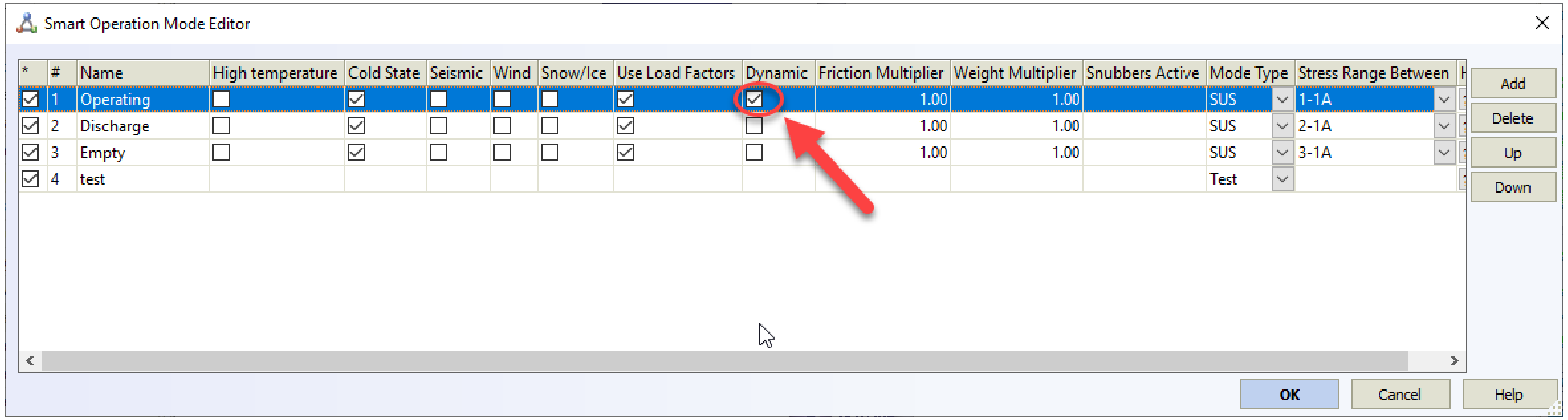
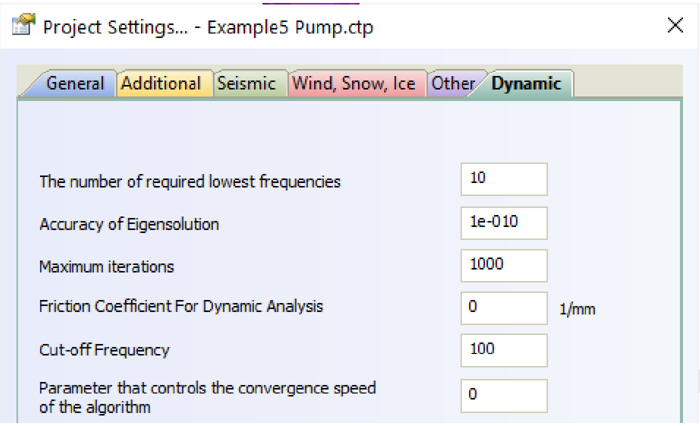
PASS/START-PROF | Dynamic: Modal Analysis

To run the modal analysis, open any piping model and turn on the “Dynamic” checkbox the operation mode editor. Need to choose that operating mode for which you want to run the dynamic analysis. After that run analysis as usually do for static analysis:



*	#	Name	High temperature	Cold State	Seismic	Wind	Snow/Ice	Use Load Factors	Dynamic	Friction Multiplier	Weight Multiplier	Snubbers Active	Mode Type	Stress Range Between
☑	1	Operating	☐	☑	☐	☐	☐	☑	☑	1.00	1.00		SUS	1-1A
☑	2	Discharge	☐	☑	☐	☐	☐	☑	☐	1.00	1.00		SUS	2-1A
☑	3	Empty	☐	☑	☐	☐	☐	☑	☐	1.00	1.00		SUS	3-1A
☑	4	test											Test	

Additionally you may specify the dynamic analysis properties in project settings:



The number of required lowest frequencies	10
Accuracy of Eigensolution	1e-010
Maximum iterations	1000
Friction Coefficient For Dynamic Analysis	0 1/mm
Cut-off Frequency	100
Parameter that controls the convergence speed of the algorithm	0

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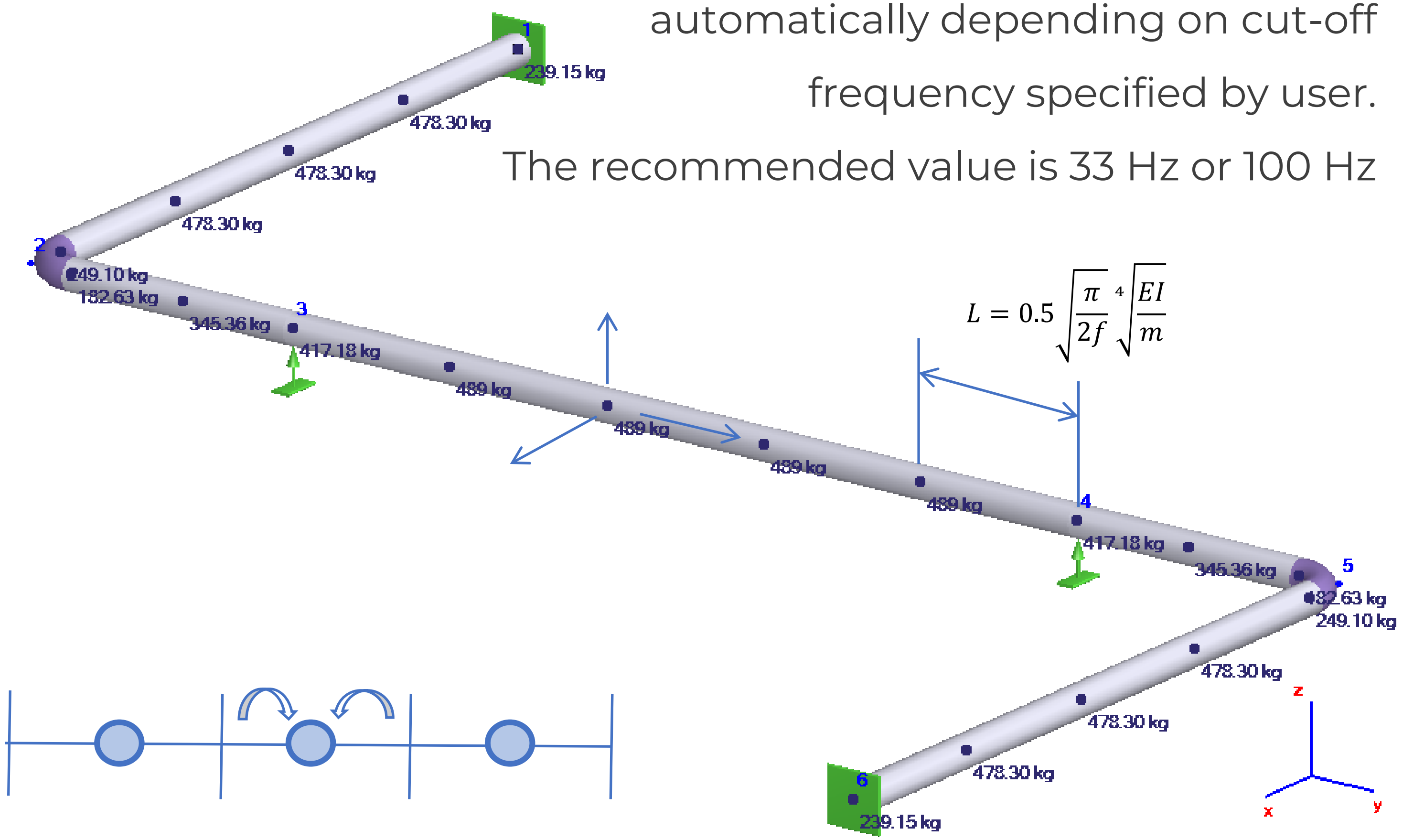
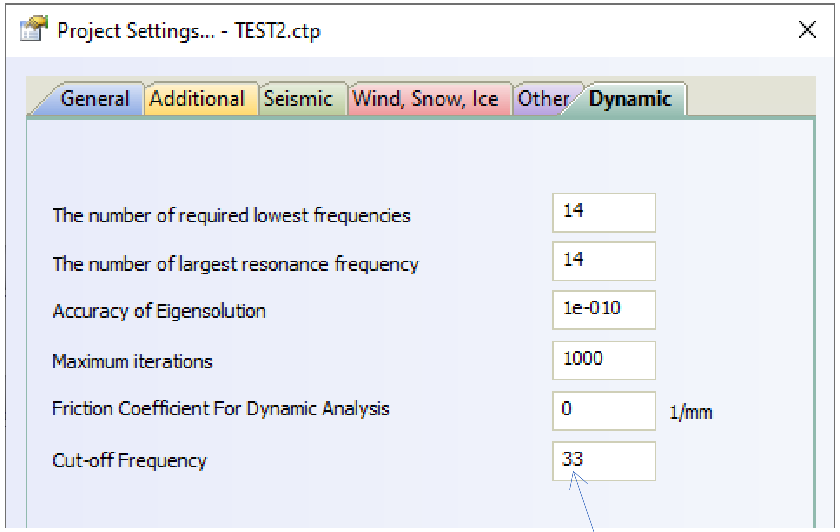
PASS/START-PROF | Dynamic: Modal Analysis

Automatic mass distribution. Additional invisible nodes are added automatically depending on cut-off frequency specified by user.

The recommended value is 33 Hz or 100 Hz





Project Settings... - TEST2.ctp

The number of required lowest frequencies: 14

The number of largest resonance frequency: 14

Accuracy of Eigensolution: 1e-010

Maximum iterations: 1000

Friction Coefficient For Dynamic Analysis: 0 1/mm

Cut-off Frequency: 33

f - is the first natural frequency for a simply supported pipe. The required minimum mass span L value can be determined from this equation (2 masses per length)

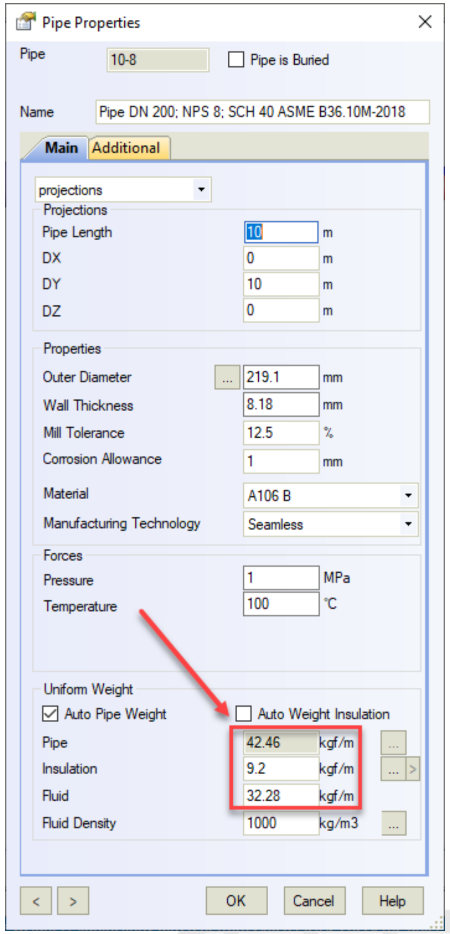
$$f = \frac{\pi}{2L^2}\sqrt{\frac{EI}{m}} \Rightarrow L = 0.5\sqrt{\frac{\pi}{2f}}\sqrt[4]{\frac{EI}{m}}$$

Automatic mass distribution. Additional invisible nodes are added automatically depending on cut-off

PASS/START-PROF | Dynamic: Modal Analysis

Distributed mass on a pipe elements is calculated as sum of pipe, insulation, fluid and additional weights.

Non-weight and additional force-based loads are ignored



Pipe 10-8 ☐ Pipe is Buried

Name Pipe DN 200; NPS 8; SCH 40 ASME B36.10M-2018

projections

Projections

Pipe Length	10	m
DX	0	m
DY	10	m
DZ	0	m

Properties

Outer Diameter	219.1	mm
Wall Thickness	8.18	mm
Mill Tolerance	12.5	%
Corrosion Allowance	1	mm
Material	A106 B	
Manufacturing Technology	Seamless	

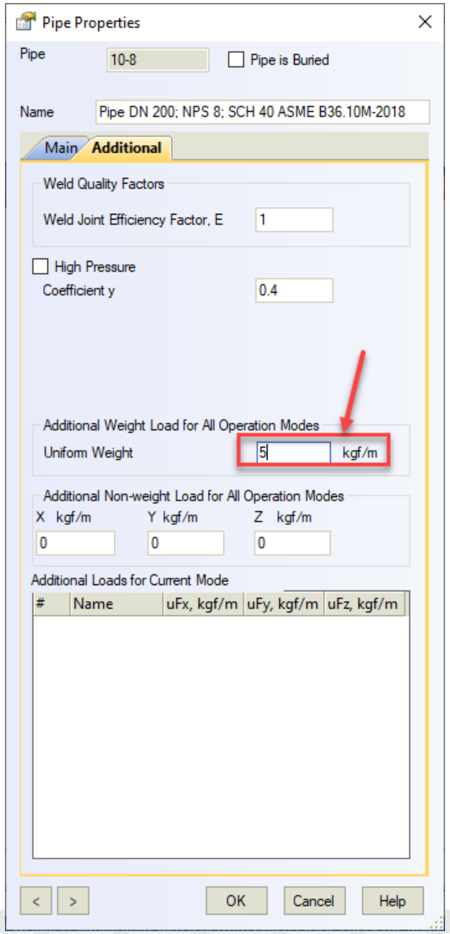
Forces

Pressure	1	MPa
Temperature	100	°C

Uniform Weight

☑ Auto Pipe Weight ☐ Auto Weight Insulation

Pipe	42.46	kgf/m
Insulation	9.2	kgf/m
Fluid	32.28	kgf/m
Fluid Density	1000	kg/m3



Pipe 10-8 ☐ Pipe is Buried

Name Pipe DN 200; NPS 8; SCH 40 ASME B36.10M-2018

Weld Quality Factors

Weld Joint Efficiency Factor, E 1

☐ High Pressure

Coefficient y 0.4

Additional Weight Load for All Operation Modes

Uniform Weight 5 kgf/m

Additional Non-weight Load for All Operation Modes

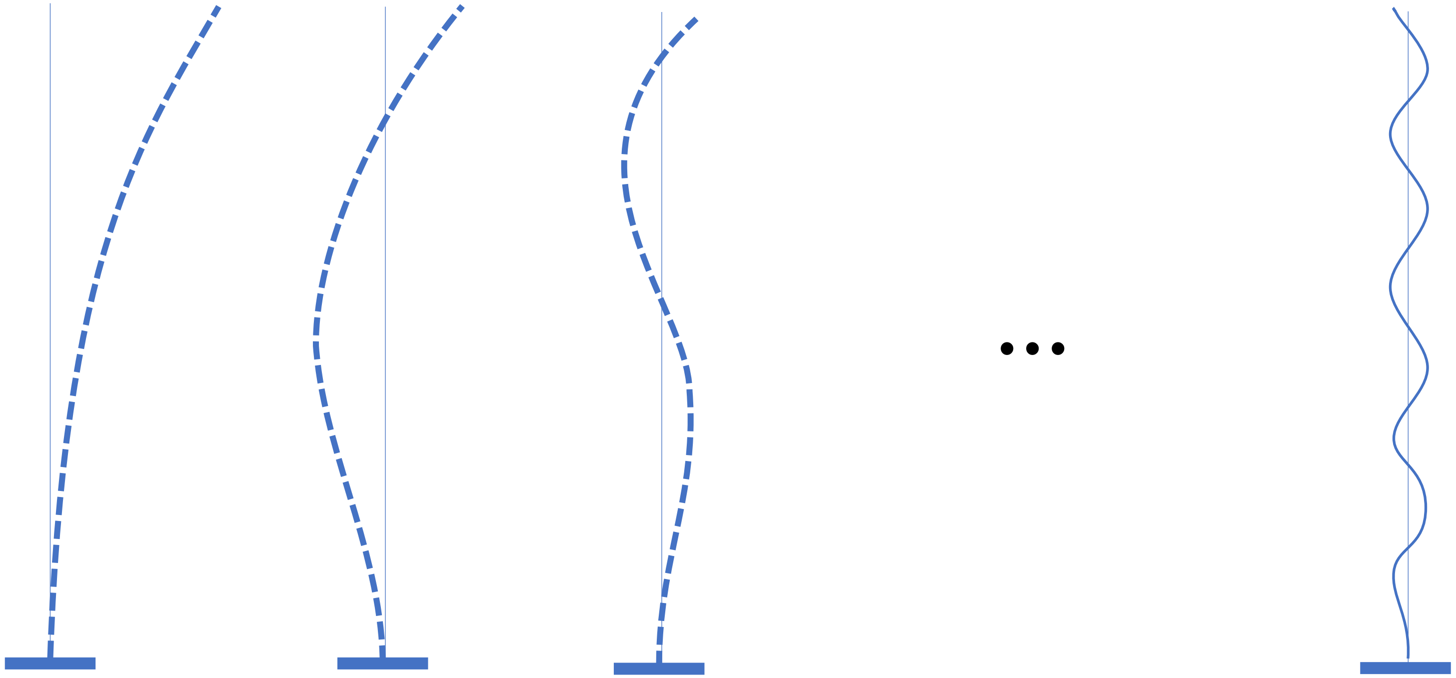
X kgf/m	Y kgf/m	Z kgf/m
0	0	0

Additional Loads for Current Mode

#	Name	uFx, kgf/m	uFy, kgf/m	uFz, kgf/m

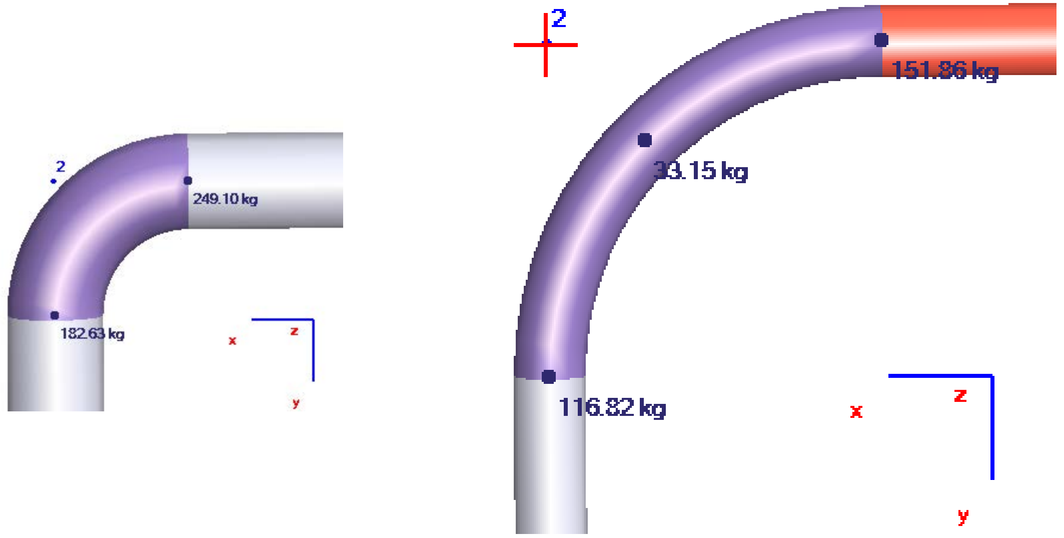
PASS/START-PROF | Dynamic: Modal Analysis

For system with **n** degrees of freedom (DOF), we can find **n** natural frequencies and **n** mode shapes. The real piping system has infinite DOF number, but we model it using the finite number of DOF to simplify the task

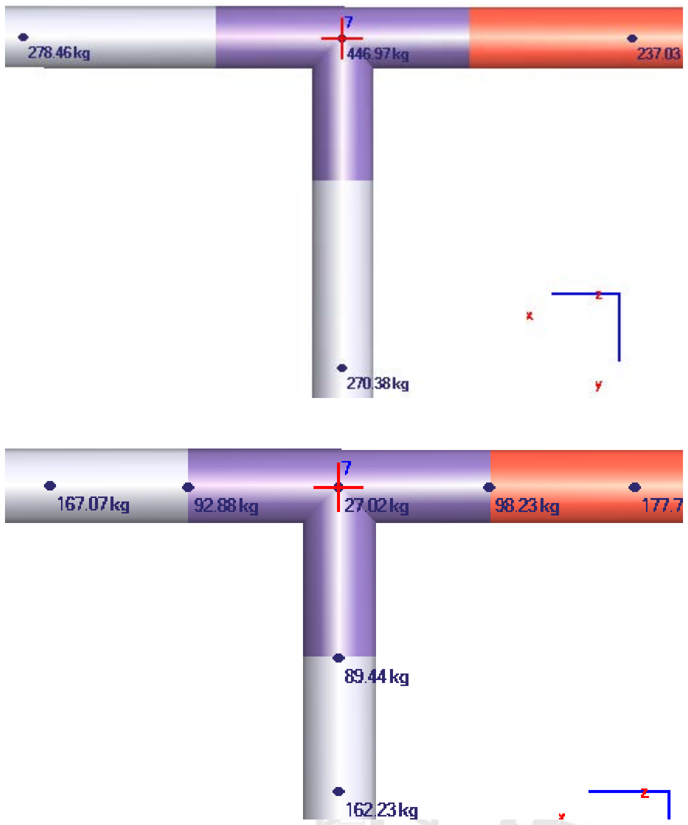


PASS/START-PROF | Dynamic: Modal Analysis

Bend is modeled with 2 or 3 masses depending on bend arc length. Long radius bend can have >3 masses

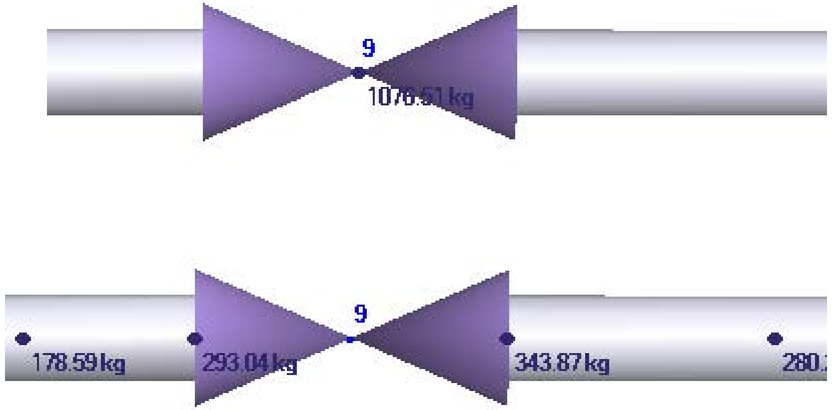


Tee is modeled with 1 or 4 masses depending on the header and branch lengths

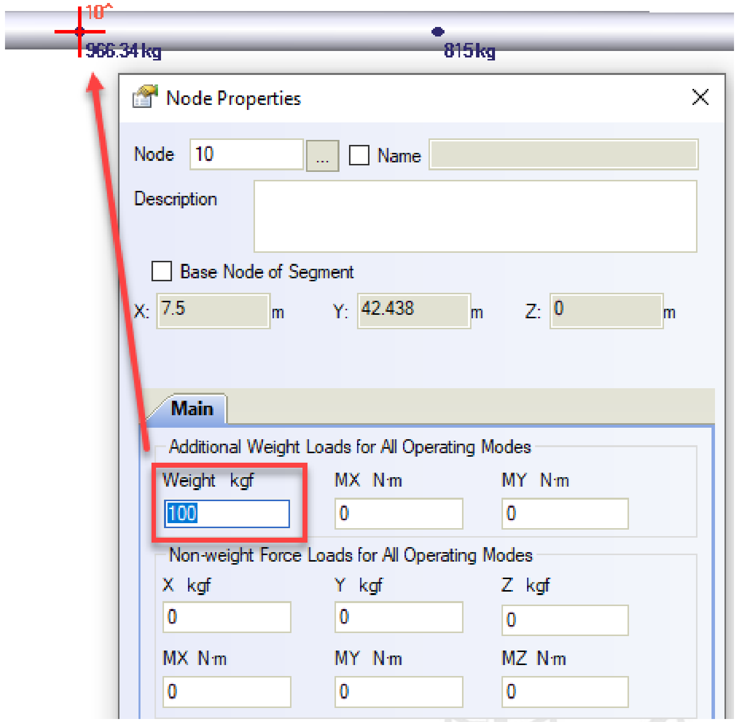


PASS/START-PROF | Dynamic: Modal Analysis

Valve and flange is modeled with 1 or 2 masses depending on the length



Additional concentrated mass can added as weight load in the node



Node Properties

Node: 10 ☐ Name

Description

☐ Base Node of Segment

X: 7.5 m Y: 42.438 m Z: 0 m

Main

Additional Weight Loads for All Operating Modes

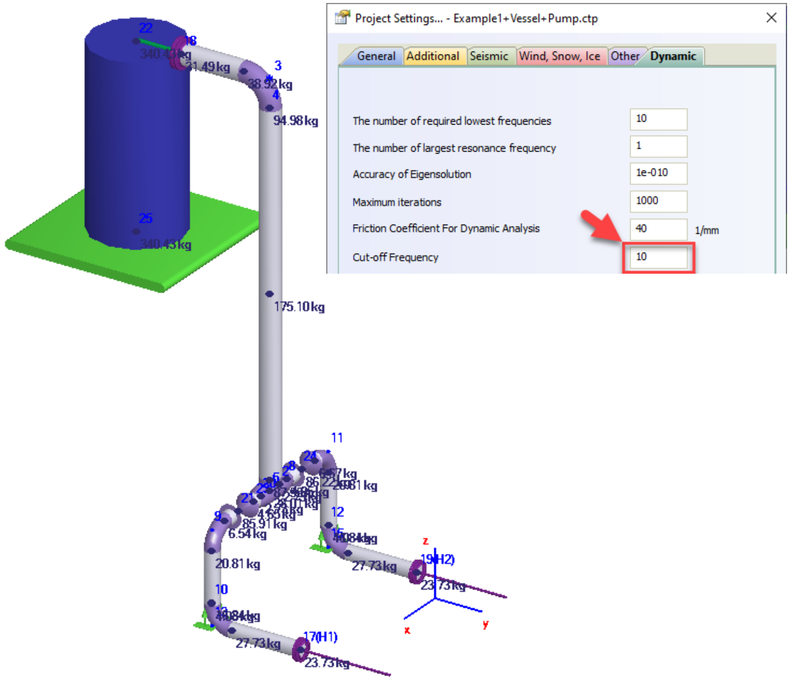
Weight kgf: 100
MX N·m: 0
MY N·m: 0

Non-weight Force Loads for All Operating Modes

X kgf: 0
Y kgf: 0
Z kgf: 0
MX N·m: 0
MY N·m: 0
MZ N·m: 0

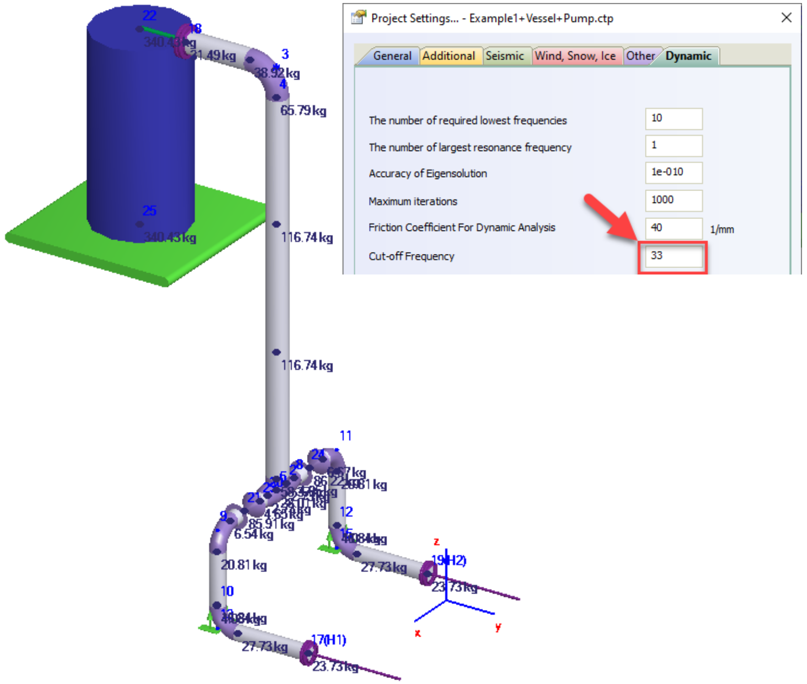
PASS/START-PROF | Dynamic: Modal Analysis

The greater cut-off frequency, the more accurate results you receive, but slower


Project Settings... - Example1+Vessel+Pump.ctp

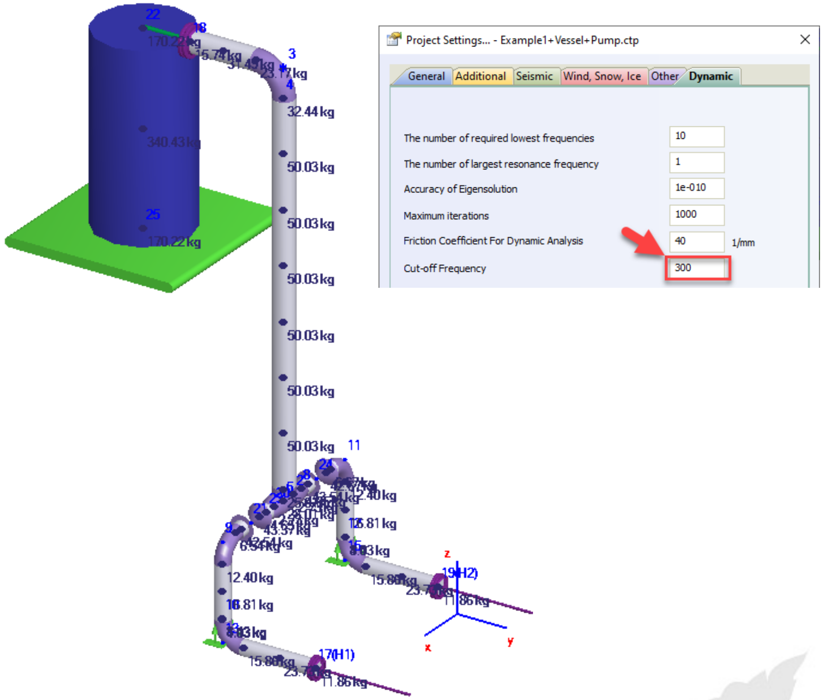
General | Additional | Seismic | Wind, Snow, Ice | Other | **Dynamic**

The number of required lowest frequencies: 10
The number of largest resonance frequency: 1
Accuracy of Eigensolution: 1e-010
Maximum iterations: 1000
Friction Coefficient For Dynamic Analysis: 40 1/mm
Cut-off Frequency: 10


Project Settings... - Example1+Vessel+Pump.ctp

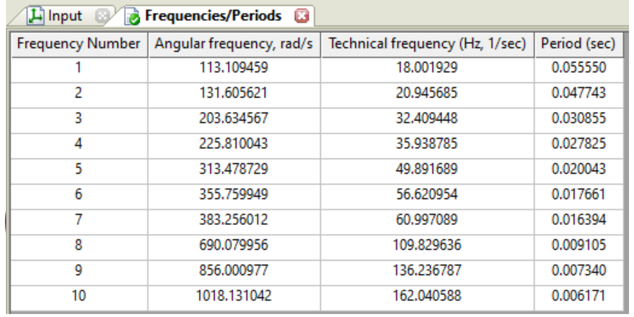
General | Additional | Seismic | Wind, Snow, Ice | Other | **Dynamic**

The number of required lowest frequencies: 10
The number of largest resonance frequency: 1
Accuracy of Eigensolution: 1e-010
Maximum iterations: 1000
Friction Coefficient For Dynamic Analysis: 40 1/mm
Cut-off Frequency: 33

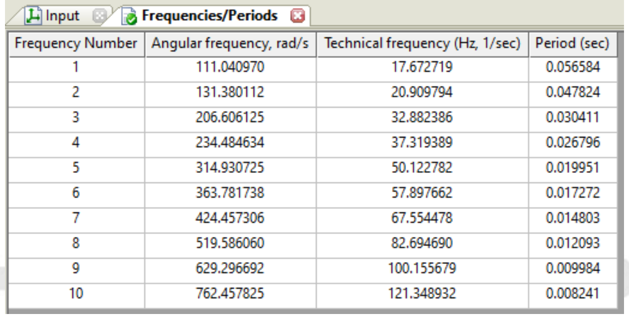

Project Settings... - Example1+Vessel+Pump.ctp

General | Additional | Seismic | Wind, Snow, Ice | Other | **Dynamic**

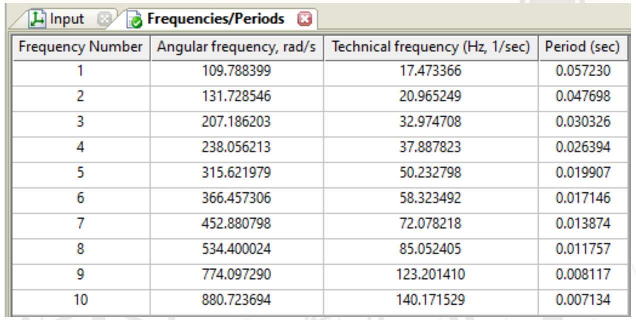
The number of required lowest frequencies: 10
The number of largest resonance frequency: 1
Accuracy of Eigensolution: 1e-010
Maximum iterations: 1000
Friction Coefficient For Dynamic Analysis: 40 1/mm
Cut-off Frequency: 300


Input | **Frequencies/Periods**

Frequency Number	Angular frequency, rad/s	Technical frequency (Hz, 1/sec)	Period (sec)
1	113.109459	18.001929	0.055550
2	131.605621	20.945685	0.047743
3	203.634567	32.409448	0.030855
4	225.810043	35.938785	0.027825
5	313.478729	49.891689	0.020043
6	355.759949	56.620954	0.017661
7	383.256012	60.997089	0.016394
8	690.079956	109.829636	0.009105
9	856.000977	136.236787	0.007340
10	1018.131042	162.040588	0.006171


Input | **Frequencies/Periods**

Frequency Number	Angular frequency, rad/s	Technical frequency (Hz, 1/sec)	Period (sec)
1	111.040970	17.672719	0.056584
2	131.380112	20.909794	0.047824
3	206.606125	32.882386	0.030411
4	234.484634	37.319389	0.026796
5	314.930725	50.122782	0.019951
6	363.781738	57.897662	0.017272
7	424.457306	67.554478	0.014803
8	519.586060	82.694690	0.012093
9	629.296692	100.155679	0.009984
10	762.457825	121.348932	0.008241

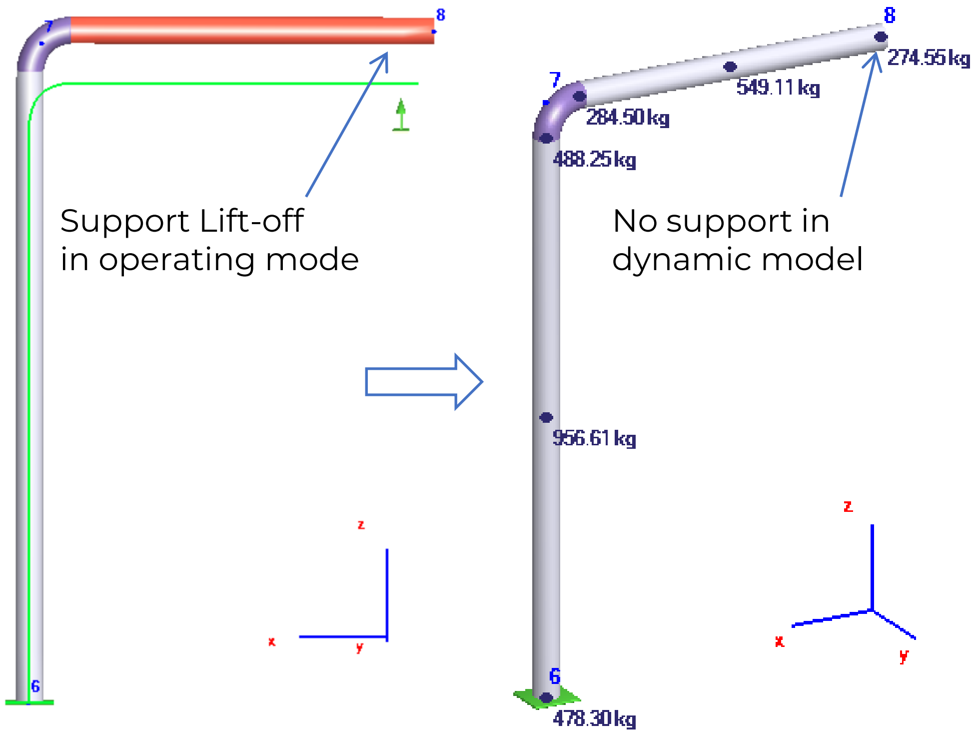

Input | **Frequencies/Periods**

Frequency Number	Angular frequency, rad/s	Technical frequency (Hz, 1/sec)	Period (sec)
1	109.788399	17.473366	0.057230
2	131.728546	20.965249	0.047698
3	207.186203	32.974708	0.030326
4	238.056213	37.887823	0.026394
5	315.621979	50.232798	0.019907
6	366.457306	58.323492	0.017146
7	452.880798	72.078218	0.013874
8	534.400024	85.052405	0.011757
9	774.097290	123.201410	0.008117
10	880.723694	140.171529	0.007134

PASS/START-PROF | Dynamic: Modal Analysis

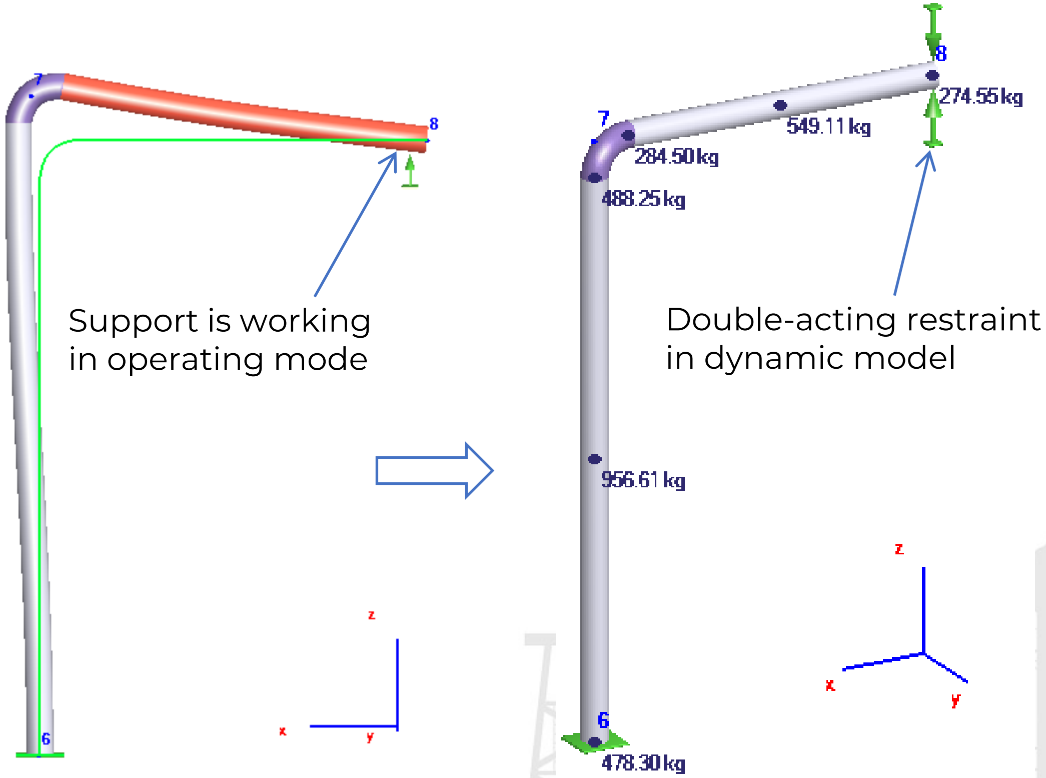
Modal analysis can be applied only for linear systems. START-PROF linearize nonlinear systems.

One-way restraints, gaps condition is taken from operating mode. If single-directional restraints is working, then it is replaced by double-acting restraint. If it’s lift off then it’s removed from dynamic analysis.



Support Lift-off
in operating mode

No support in
dynamic model



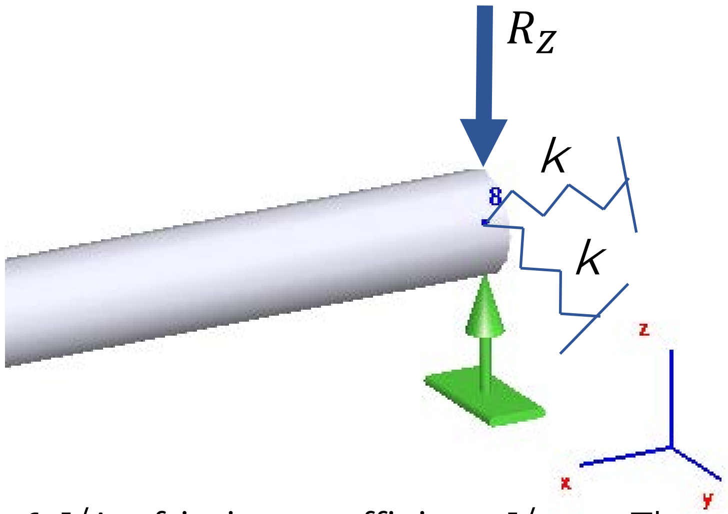
Support is working
in operating mode

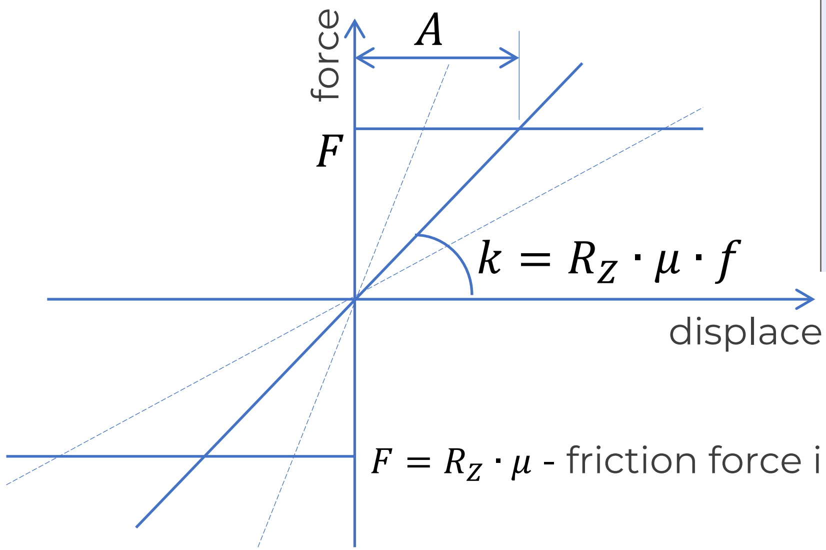
Double-acting restraint
in dynamic model

PASS/START-PROF | Dynamic: Modal Analysis

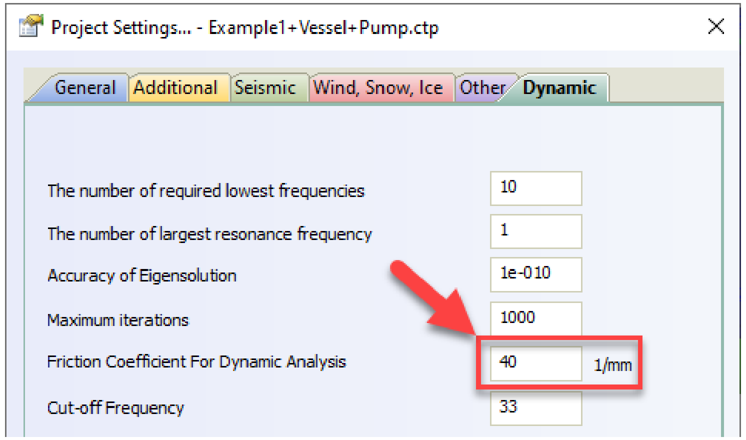
Friction forces are modeled using springs with effective stiffness $k = R_Z \cdot \mu \cdot f$

R_Z - vertical load on support in operation mode, μ – friction factor





$F = R_Z \cdot \mu$ - friction force in operating state



Project Settings... - Example1+Vessel+Pump.ctp

The number of required lowest frequencies	10	
The number of largest resonance frequency	1	
Accuracy of Eigensolution	1e-010	
Maximum iterations	1000	
Friction Coefficient For Dynamic Analysis	40	1/mm
Cut-off Frequency	33	

f=1/A – friction coefficient, 1/mm. The recommended value f=40 1/mm

A – approximate vibration amplitude at the support with friction, mm. If f=40, then A=0.025 mm

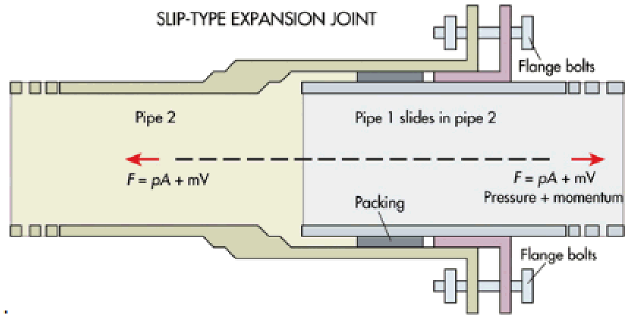
If $f = 0$, then friction is not considered in analysis. If $f = 10000\ 1/mm$, then friction modeled as almost rigid restraints

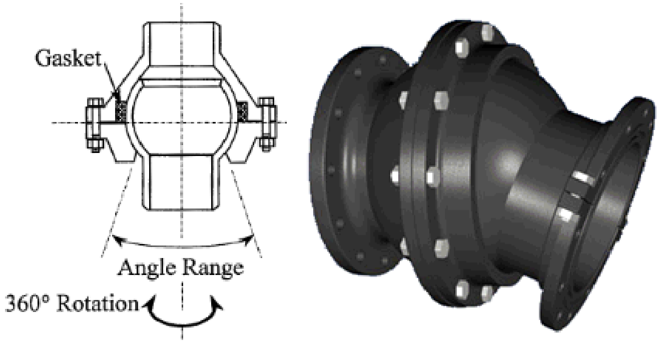
The factor f allows to “tune” the piping computer model to receive a results more corresponding with field measurements

PASS/START-PROF | Dynamic: Modal Analysis

The same coefficient f is applied to linearize the friction effect in the following PASS/START-PROF objects:

- Slip Joint
- Ball Joint
- Torsion Joint

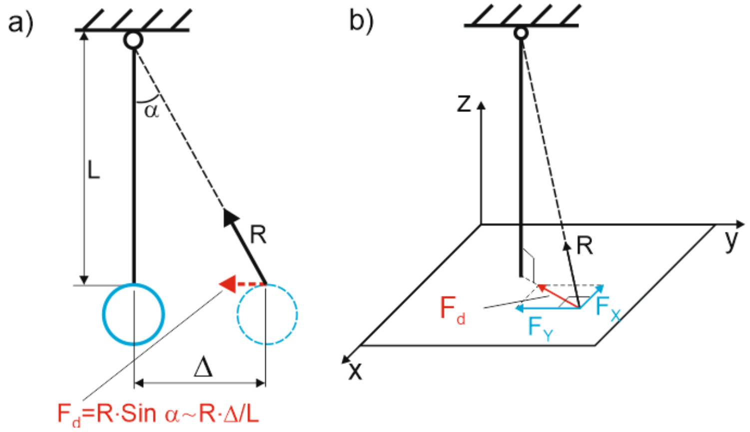


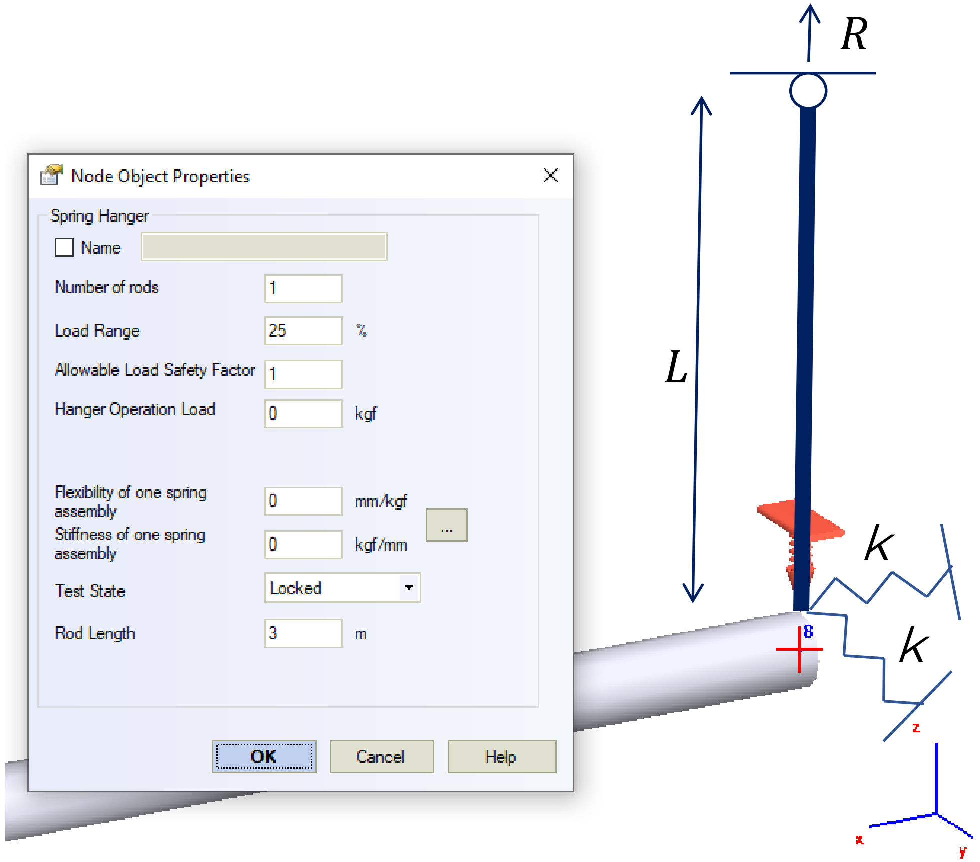


PASS/START-PROF | Dynamic: Modal Analysis

Rotation rod linearization

For spring hangers and rigid hangers with a rotating rod, the additional horizontal springs are added to take into account the pendulum effect





Spring Hanger
☐ Name
Number of rods: 1
Load Range: 25 %
Allowable Load Safety Factor: 1
Hanger Operation Load: 0 kgf
Flexibility of one spring assembly: 0 mm/kgf
Stiffness of one spring assembly: 0 kgf/mm
Test State: Locked
Rod Length: 3 m

$$k = \frac{R_Z}{L}$$

R_Z - vertical load on hanger in operation mode

PASS/START-PROF | Dynamic: Modal Analysis

To avoid the risk of resonance with a rotating equipment and reduce the effects of other dynamic loading, it is recommended that lowest (first) natural frequency be no less than 4-5 Hz. See DNVGL-RP-D101 2.2.7.1

Increasing the natural frequency usually requires more supports, and increases the cost of piping system.

Also the increasing of natural frequency increases the stiffness of piping system that leads to problems with thermal expansions, the expansion stresses and support loads become higher.

PASS/START-PROF | Dynamic: Modal Analysis

The modal analysis is used to calculate the natural frequency of pipe systems connected to compressors and reciprocating pumps. The resonance effect occurs, when natural frequency of the piping system is close to rotating equipment vibration or pulsation frequency. To avoid the resonance effect and reduce the risk of fatigue failure, it is recommended to ensure that following criterion is met:

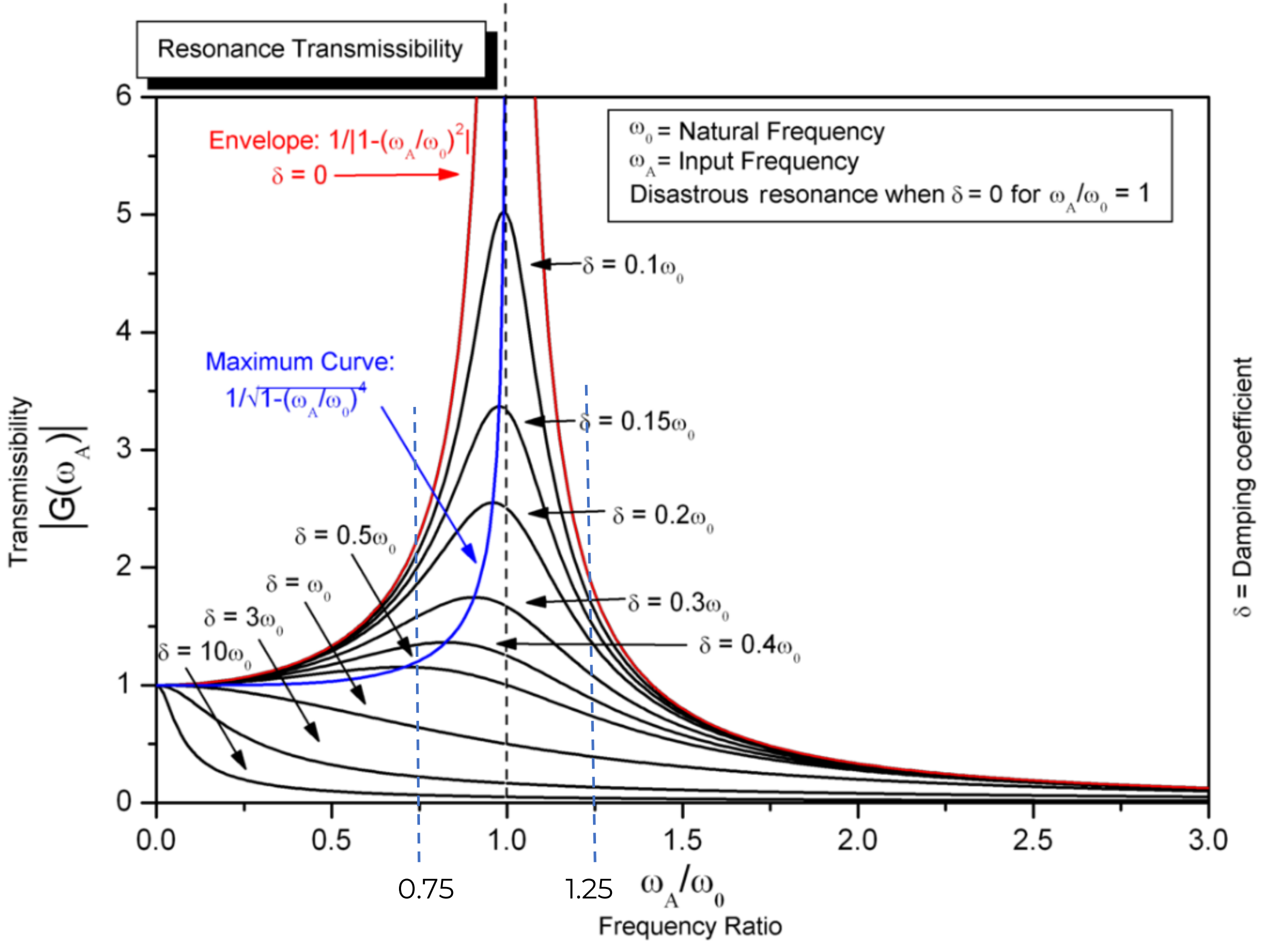
$$0.8 < \frac{f_{ip}}{f_j} < 1.2$$

For higher frequencies in case of high frequency equipment the criteria may be less conservative (GOST 32388 code):

$$0.9 < \frac{f_{ip}}{f_j} < 1.1$$

f_{ip} - equipment vibration or pulsation frequency #i

f_j - piping system natural frequency #j



PASS/START-PROF | Dynamic: Modal Analysis

Energy Institute Guidelines for the Avoidance of Vibration Induced Fatigue Failure in Process Pipework T 10.3.2.1 : "The pipework natural frequencies should be outwith ± 20% of the excitation frequency"

API 618 6th: The predicted mechanical natural frequencies shall be designed to be separated from significant excitation frequencies by at least 20%

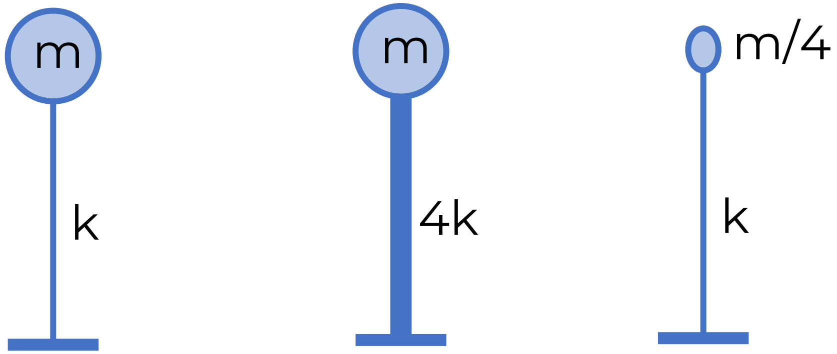
$$0.8 < \frac{f_{ip}}{f_j} < 1.2$$

f_{ip} - equipment vibration or pulsation frequency #i

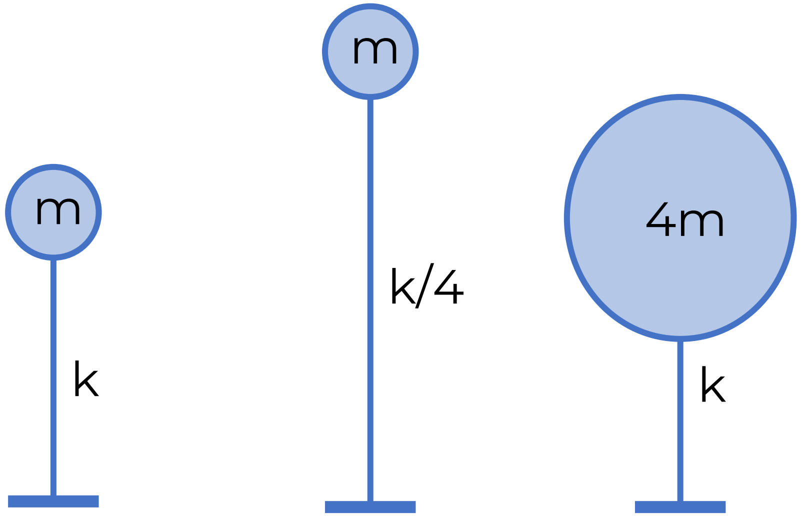
f_j - piping system natural frequency #j

PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/START-PROF | Dynamic: Modal Analysis



$$\omega = \sqrt{k/m} \qquad \omega = 2\sqrt{k/m} \qquad \omega = 2\sqrt{k/m}$$



$$\omega = \sqrt{k/m} \qquad \omega = 0.5\sqrt{k/m} \qquad \omega = 0.5\sqrt{k/m}$$

To increase the natural frequency we need to increase the system stiffness or reduce the mass

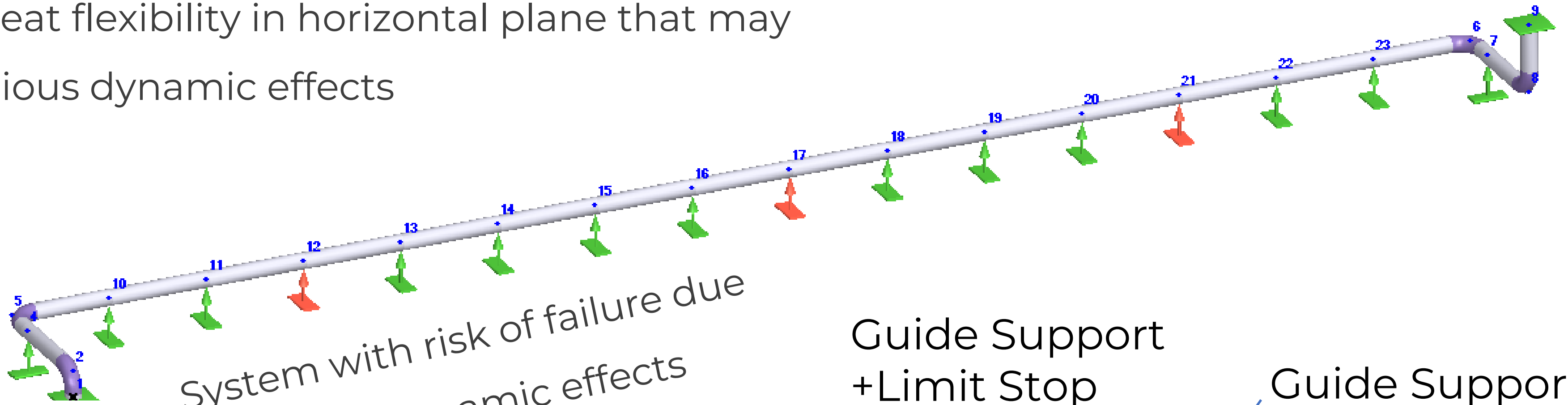
To reduce the natural frequency we need to reduce the stiffness or increase the mass

PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/START-PROF | Dynamic: Modal Analysis

When system is designed to withstand only dead weight and thermal expansion, usually it has a great flexibility in horizontal plane that may lead to high sensitivity to various dynamic effects

$f_1 = 1.2\ Hz$

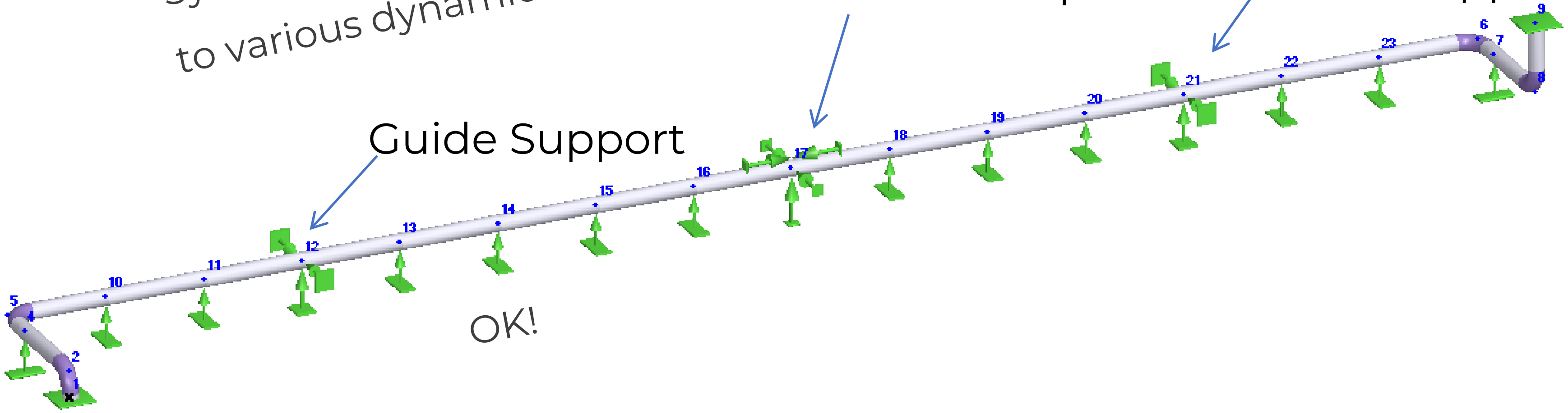


System with risk of failure due to various dynamic effects

Guide Support
+Limit Stop

Guide Support

Guide Support



$f_1 = 9.95\ Hz$

OK!

PASS
PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/START-PROF | Dynamic: Modal Analysis

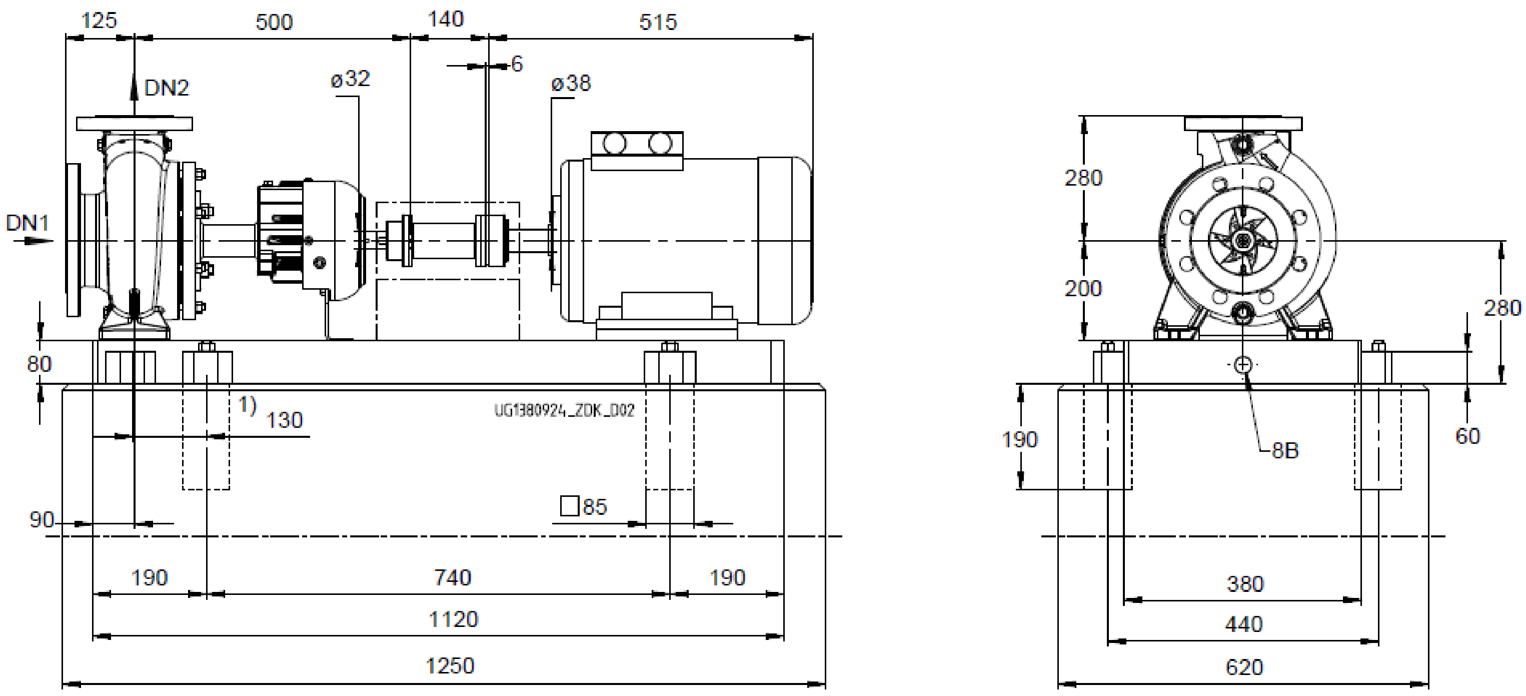
Adding supports at the point with greatest displacements on mode shape increases the natural frequencies

$f_1 = 1.2\ Hz$

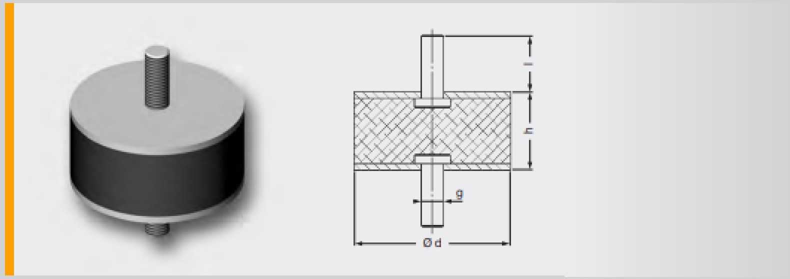
$f_1 = 9.95\ Hz$

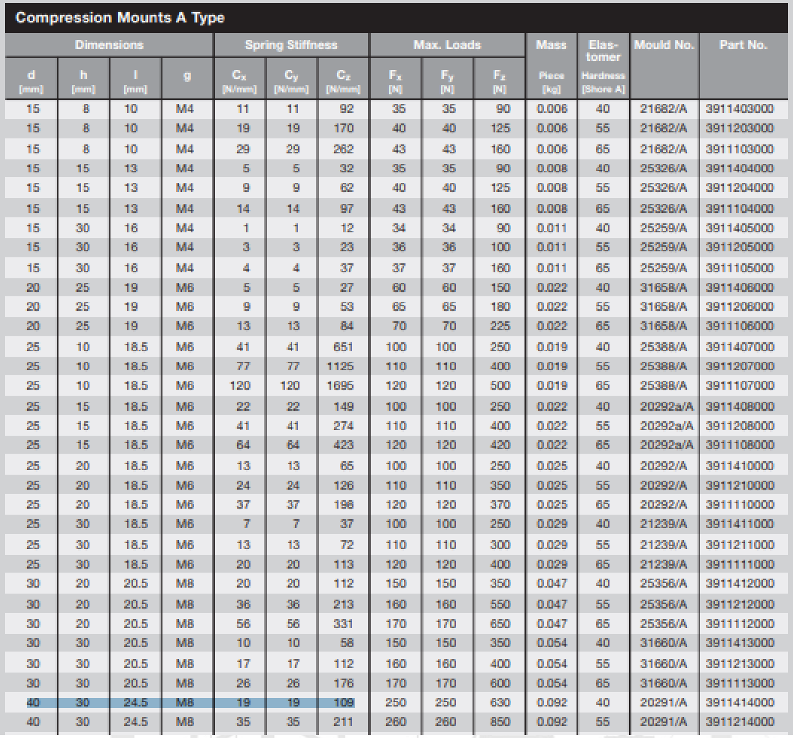
PASS/START-PROF | Dynamic: Modal Analysis

Support and nozzle stiffness strongly affect the natural frequencies



1) Baseplate may also be attached in the region of the casing feet. Refer to KSB if necessary.





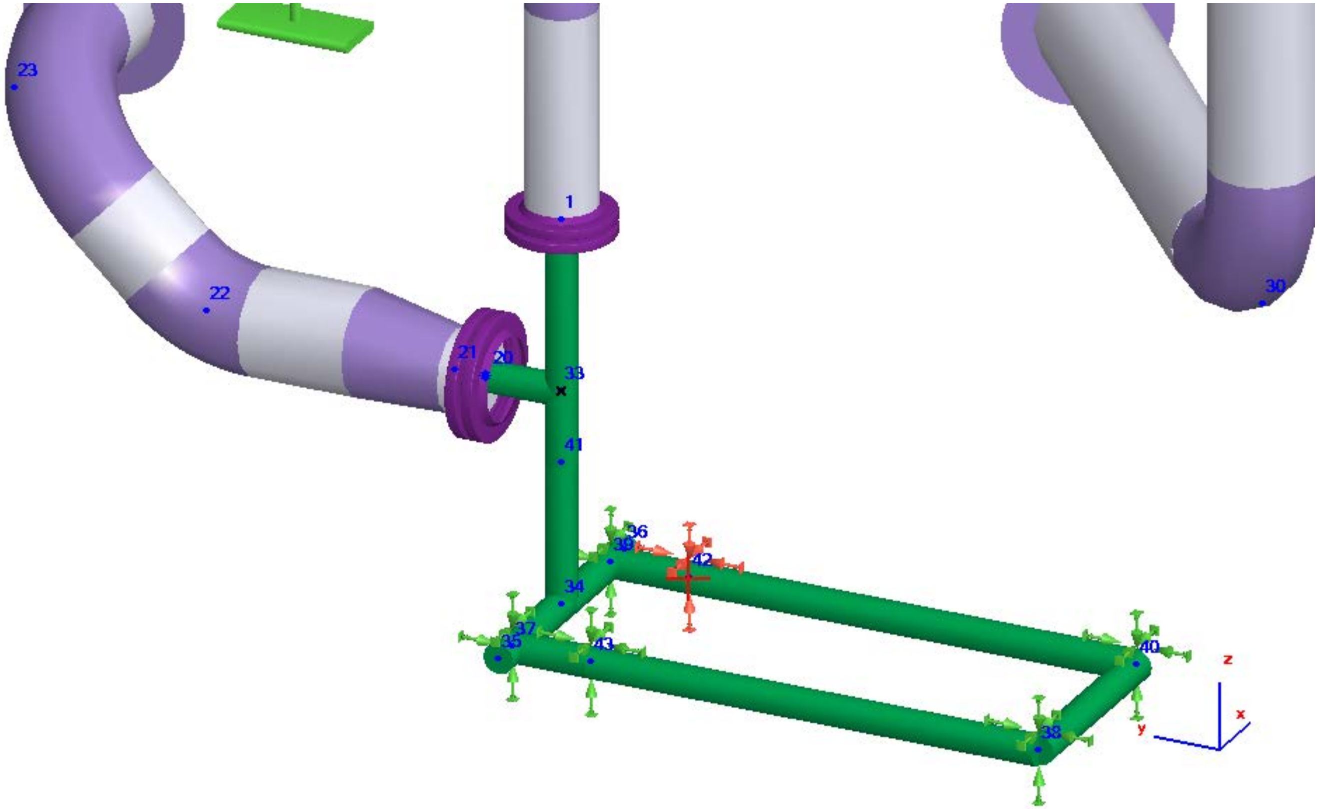
Compression Mounts A Type

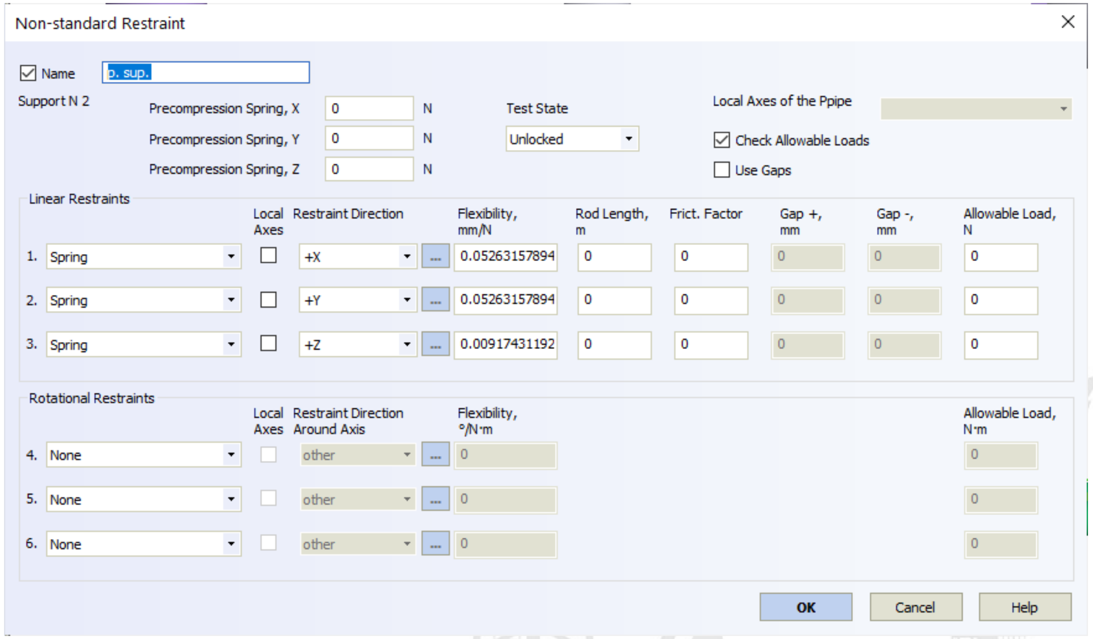
Dimensions				Spring Stiffness			Max. Loads			Mass	Elas-tomer	Mould No.	Part No.
d [mm]	h [mm]	l [mm]	g	C_x [N/mm]	C_y [N/mm]	C_z [N/mm]	F_x [N]	F_y [N]	F_z [N]	Piece [kg]	Hardness [Shore A]		
15	8	10	M4	11	11	92	35	35	90	0.006	40	21682/A	3911403000
15	8	10	M4	19	19	170	40	40	125	0.006	55	21682/A	3911203000
15	8	10	M4	29	29	262	43	43	160	0.006	65	21682/A	3911103000
15	15	13	M4	5	5	32	35	35	90	0.008	40	25326/A	3911404000
15	15	13	M4	9	9	62	40	40	125	0.008	55	25326/A	3911204000
15	15	13	M4	14	14	97	43	43	160	0.008	65	25326/A	3911104000
15	30	16	M4	1	1	12	34	34	90	0.011	40	25259/A	3911405000
15	30	16	M4	3	3	23	36	36	100	0.011	55	25259/A	3911205000
15	30	16	M4	4	4	37	37	37	160	0.011	65	25259/A	3911105000
20	25	19	M6	5	5	27	60	60	150	0.022	40	31658/A	3911406000
20	25	19	M6	9	9	53	65	65	180	0.022	55	31658/A	3911206000
20	25	19	M6	13	13	84	70	70	225	0.022	65	31658/A	3911106000
25	10	18.5	M6	41	41	651	100	100	250	0.019	40	25388/A	3911407000
25	10	18.5	M6	77	77	1125	110	110	400	0.019	55	25388/A	3911207000
25	10	18.5	M6	120	120	1695	120	120	500	0.019	65	25388/A	3911107000
25	15	18.5	M6	22	22	149	100	100	250	0.022	40	20292a/A	3911408000
25	15	18.5	M6	41	41	274	110	110	400	0.022	55	20292a/A	3911208000
25	15	18.5	M6	64	64	423	120	120	420	0.022	65	20292a/A	3911108000
25	20	18.5	M6	13	13	65	100	100	250	0.025	40	20292/A	3911410000
25	20	18.5	M6	24	24	126	110	110	350	0.025	55	20292/A	3911210000
25	20	18.5	M6	37	37	198	120	120	370	0.025	65	20292/A	3911110000
25	30	18.5	M6	7	7	37	100	100	250	0.029	40	21239/A	3911411000
25	30	18.5	M6	13	13	72	110	110	300	0.029	55	21239/A	3911211000
25	30	18.5	M6	20	20	113	120	120	400	0.029	65	21239/A	3911111000
30	20	20.5	M8	20	20	112	150	150	350	0.047	40	25356/A	3911412000
30	20	20.5	M8	36	36	213	160	160	550	0.047	55	25356/A	3911212000
30	20	20.5	M8	56	56	331	170	170	650	0.047	65	25356/A	3911112000
30	30	20.5	M8	10	10	58	150	150	350	0.054	40	31660/A	3911413000
30	30	20.5	M8	17	17	112	160	160	400	0.054	55	31660/A	3911213000
30	30	20.5	M8	26	26	176	170	170	600	0.054	65	31660/A	3911113000
40	30	24.5	M8	19	19	109	250	250	630	0.092	40	20291/A	3911414000
40	30	24.5	M8	35	35	211	260	260	850	0.092	55	20291/A	3911214000

PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/START-PROF | Dynamic: Modal Analysis

Adding supports at the point with greatest displacements on mode shape increases the natural frequencies




Non-standard Restraint

☑ Name: p. sup.

Support N 2

Precompression Spring, X: 0 N
Precompression Spring, Y: 0 N
Precompression Spring, Z: 0 N

Test State: Unlocked

Local Axes of the Ppipe

☑ Check Allowable Loads

☐ Use Gaps

Linear Restraints

		Local Axes	Restraint Direction	Flexibility, mm/N	Rod Length, m	Frict. Factor	Gap +, mm	Gap -, mm	Allowable Load, N
1.	Spring	☐	+X	0.05263157894	0	0	0	0	0
2.	Spring	☐	+Y	0.05263157894	0	0	0	0	0
3.	Spring	☐	+Z	0.00917431192	0	0	0	0	0

Rotational Restraints

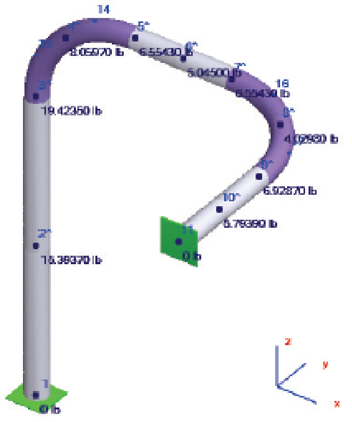
		Local Axes	Restraint Direction Around Axis	Flexibility, °/N·m	Allowable Load, N·m
4.	None	☐	other	0	0
5.	None	☐	other	0	0
6.	None	☐	other	0	0

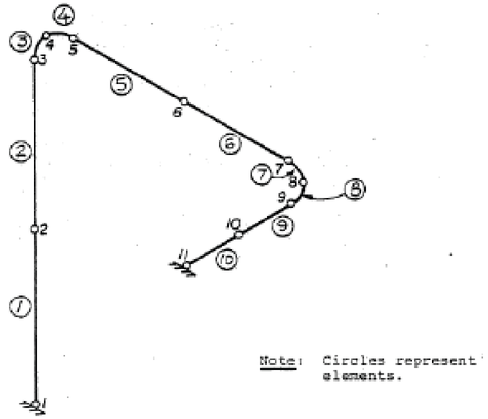
PASS
PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/START-PROF | Dynamic: Modal Analysis

PASS/START-PROF Verification Manual

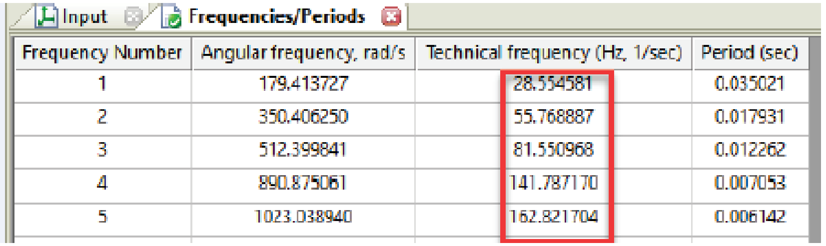
1.2 NRG2 Dynamic response of Hovgaard Bend



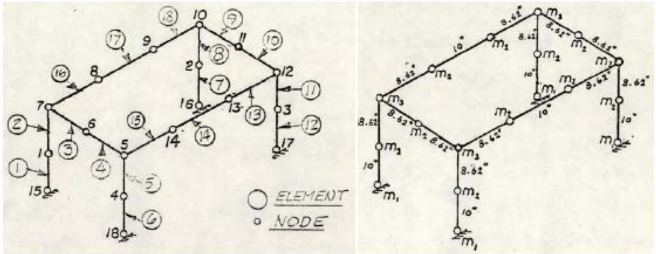


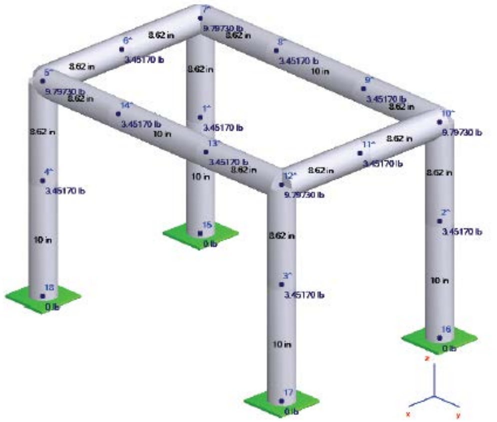
Note: Circles represent elements.

```
PRINT OF FREQUENCIES

MOD       CIRCULAR
NUM       FREQUENCY     FREQUENCY       PERIOD
          (RAD/SEC)   (CYCLES/SEC)      (SEC)

  1       .1793E+03     .2853E+02     .3504E-01

  2       .3504E+03     .5577E+02     .1793E-01

  3       .5121E+03     .8150E+02     .1227E-01

  4       .8906E+03     .1417E+03     .7055E-02

  5       .1023E+04     .1628E+03     .6142E-02
```



Frequency Number	Angular frequency, rad/s	Technical frequency (Hz, 1/sec)	Period (sec)
1	179.413727	28.554581	0.035021
2	350.406250	55.768887	0.017931
3	512.399841	81.550968	0.012262
4	890.875061	141.787170	0.007053
5	1023.038940	162.821704	0.006142

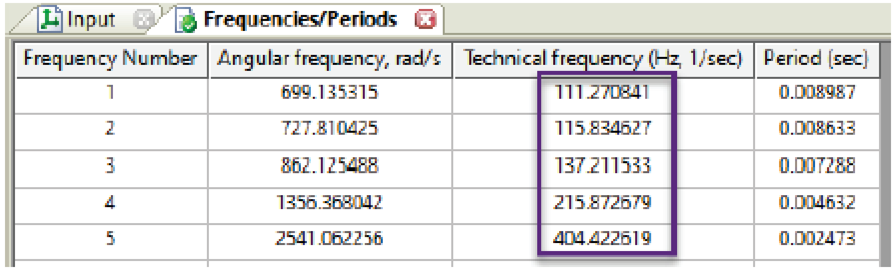




```
                    TABLE 3-3  COFFEE TABLE DYNAMIC CASE A (TIME HISTC
                              N A T U R A L   F R E Q U E N C I E S

 MODE      CIRCULAR
 NUMBER    FREQUENCY     FREQUENCY       PERIOD        TOLERANCE
           (RAD/SEC)   (CYCLES/SEC)      (SEC)

   1      0.6990E 03    0.1112E 03    0.8989E-02    0.2554E-06
   2      0.7278E 03    0.1158E 03    0.8635E-02    0.7043E-06
   3      0.8619E 03    0.1372E 03    0.7290E-02    0.3344E-06
   4      0.1356E 04    0.2158E 03    0.4634E-02    0.0
   5      0.2540E 04    0.4043E 03    0.2474E-02    0.7439E-05
```

Comparison of Natural Frequency Values for Coffee Table Problem

Experimental Values Ref.[15]	Crede Ref.[15]	Tuba and Wright Ref.[17]	ANSYS Ref.[16]	EPIPE Model A
110	109.0	110.5	111.5	111.2
117	115.9	115.0	115.9	115.8
134	135.0	134.7	137.6	137.2
214	212.5	211.7	218.0	215.8
359	350.4	385.5	404.2	404.3

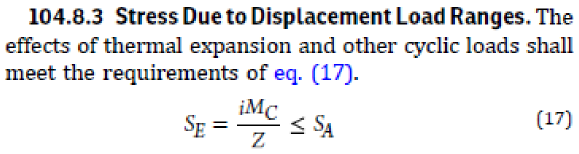


Frequency Number	Angular frequency, rad/s	Technical frequency (Hz, 1/sec)	Period (sec)
1	699.135315	111.270841	0.008987
2	727.810425	115.834627	0.008633
3	862.125488	137.211533	0.007288
4	1356.368042	215.872679	0.004632
5	2541.062256	404.422619	0.002473

PASS/START-PROF | ASME B31.1-2020

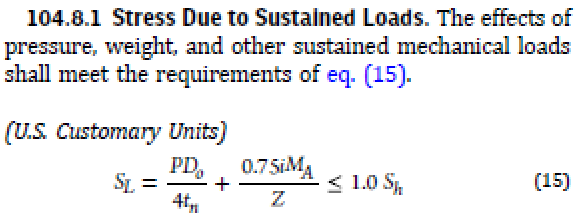
2018 Edition Issues

See the article in the PASS Blog about this issue



104.8.3 Stress Due to Displacement Load Ranges. The effects of thermal expansion and other cyclic loads shall meet the requirements of eq. (17).

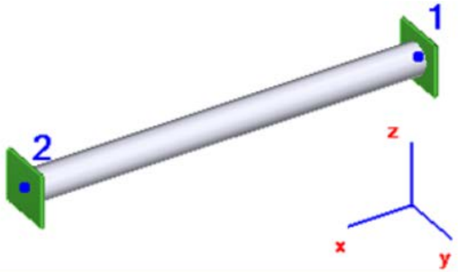
$$S_E = \frac{iM_C}{Z} \le S_A \qquad (17)$$

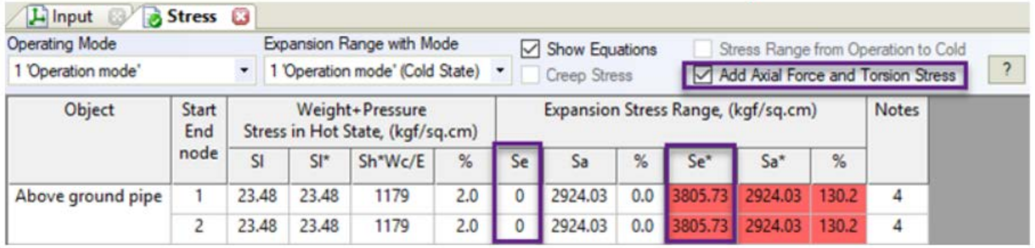


104.8.1 Stress Due to Sustained Loads. The effects of pressure, weight, and other sustained mechanical loads shall meet the requirements of eq. (15).

(U.S. Customary Units)

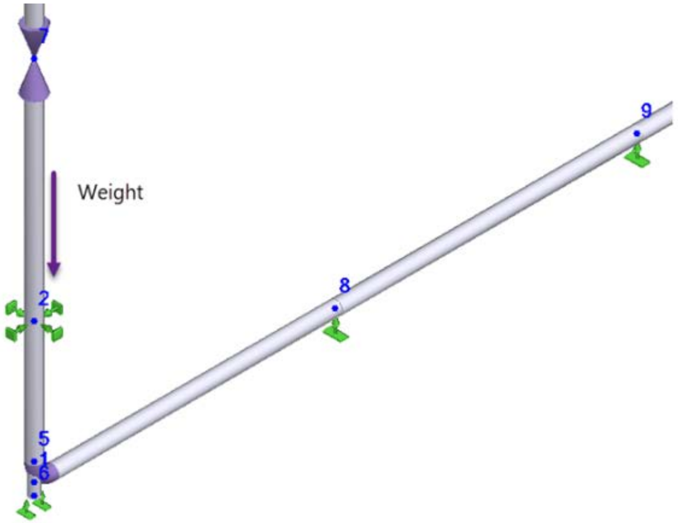
$$S_L = \frac{PD_o}{4t_n} + \frac{0.75iM_A}{Z} \le 1.0\,S_h \qquad (15)$$

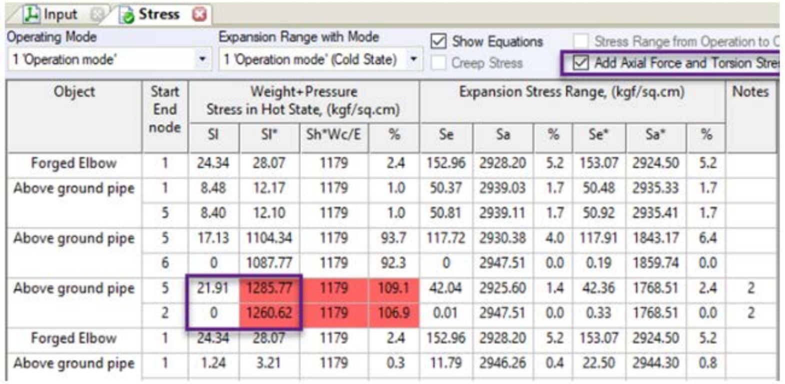




Operating Mode: 1 'Operation mode'
Expansion Range with Mode: 1 'Operation mode' (Cold State)
☑ Show Equations
☐ Creep Stress
☐ Stress Range from Operation to Cold
☑ Add Axial Force and Torsion Stress

Object	Start End node	Weight+Pressure Stress in Hot State, (kgf/sq.cm)				Expansion Stress Range, (kgf/sq.cm)						Notes
		Sl	Sl*	Sh*Wc/E	%	Se	Sa	%	Se*	Sa*	%	
Above ground pipe	1	23.48	23.48	1179	2.0	0	2924.03	0.0	3805.73	2924.03	130.2	4
	2	23.48	23.48	1179	2.0	0	2924.03	0.0	3805.73	2924.03	130.2	4





Operating Mode: 1 'Operation mode'
Expansion Range with Mode: 1 'Operation mode' (Cold State)
☑ Show Equations
☐ Creep Stress
☐ Stress Range from Operation to C
☑ Add Axial Force and Torsion Stre

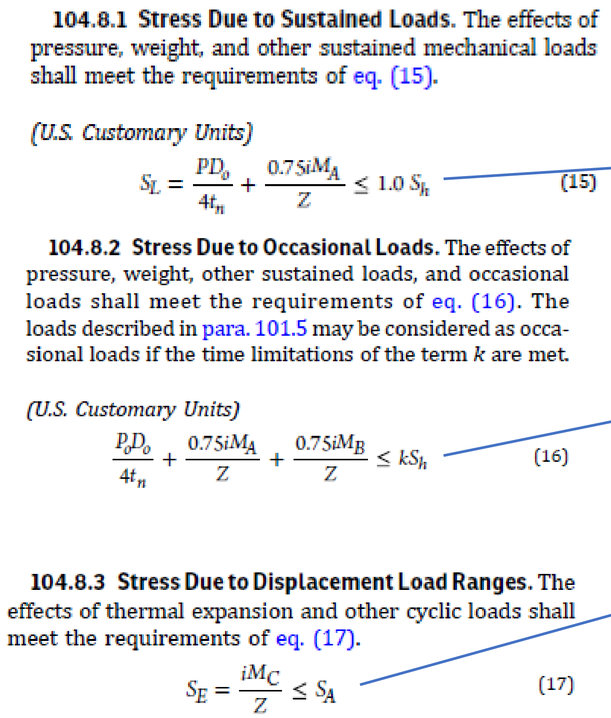
Object	Start End node	Weight+Pressure Stress in Hot State, (kgf/sq.cm)				Expansion Stress Range, (kgf/sq.cm)						Notes
		Sl	Sl*	Sh*Wc/E	%	Se	Sa	%	Se*	Sa*	%	
Forged Elbow	1	24.34	28.07	1179	2.4	152.96	2928.20	5.2	153.07	2924.50	5.2	
Above ground pipe	1	8.48	12.17	1179	1.0	50.37	2939.03	1.7	50.48	2935.33	1.7	
	5	8.40	12.10	1179	1.0	50.81	2939.11	1.7	50.92	2935.41	1.7	
Above ground pipe	5	17.13	1104.34	1179	93.7	117.72	2930.38	4.0	117.91	1843.17	6.4	
	6	0	1087.77	1179	92.3	0	2947.51	0.0	0.19	1859.74	0.0	
Above ground pipe	5	21.91	1285.77	1179	109.1	42.04	2925.60	1.4	42.36	1768.51	2.4	2
	2	0	1260.62	1179	106.9	0.01	2947.51	0.0	0.33	1768.51	0.0	2
Forged Elbow	1	24.34	28.07	1179	2.4	152.96	2928.20	5.2	153.07	2924.50	5.2	
Above ground pipe	1	1.24	3.21	1179	0.3	11.79	2946.26	0.4	22.50	2944.30	0.8	

PASS/START-PROF | ASME B31.1-2020

The ASME B31.1-2020 has two most important changes with respect to 2018 edition:

- **Changed the equations for calculating of sustained, occasional and expansion stresses**
- **All SIF and k-factors should be calculated according to ASME B31J-2017**. PASS/START-PROF do this automatically, without user intervention

2018



104.8.1 Stress Due to Sustained Loads. The effects of pressure, weight, and other sustained mechanical loads shall meet the requirements of eq. (15).

(U.S. Customary Units)

$$S_L = \frac{PD_o}{4t_n} + \frac{0.75iM_A}{Z} \leq 1.0\,S_h \qquad (15)$$

104.8.2 Stress Due to Occasional Loads. The effects of pressure, weight, other sustained loads, and occasional loads shall meet the requirements of eq. (16). The loads described in para. 101.5 may be considered as occasional loads if the time limitations of the term *k* are met.

(U.S. Customary Units)

$$\frac{P_oD_o}{4t_n} + \frac{0.75iM_A}{Z} + \frac{0.75iM_B}{Z} \leq kS_h \qquad (16)$$

104.8.3 Stress Due to Displacement Load Ranges. The effects of thermal expansion and other cyclic loads shall meet the requirements of eq. (17).

$$S_E = \frac{iM_C}{Z} \leq S_A \qquad (17)$$

2020

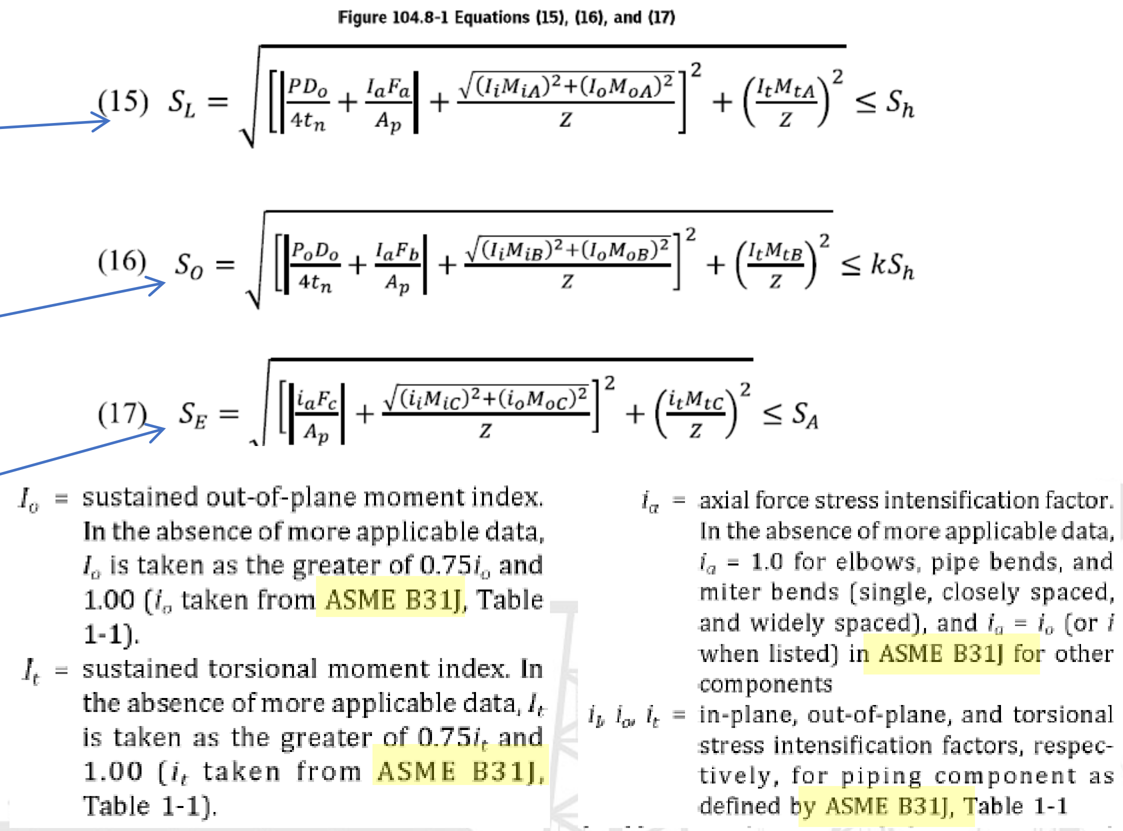


Figure 104.8-1 Equations (15), (16), and (17)

$$(15)\quad S_L = \sqrt{\left[\left|\frac{PD_o}{4t_n} + \frac{I_aF_a}{A_p}\right| + \frac{\sqrt{(I_iM_{iA})^2+(I_oM_{oA})^2}}{Z}\right]^2 + \left(\frac{I_tM_{tA}}{Z}\right)^2} \leq S_h$$

$$(16)\quad S_O = \sqrt{\left[\left|\frac{P_oD_o}{4t_n} + \frac{I_aF_b}{A_p}\right| + \frac{\sqrt{(I_iM_{iB})^2+(I_oM_{oB})^2}}{Z}\right]^2 + \left(\frac{I_tM_{tB}}{Z}\right)^2} \leq kS_h$$

$$(17)\quad S_E = \sqrt{\left[\left|\frac{i_aF_c}{A_p}\right| + \frac{\sqrt{(i_iM_{iC})^2+(i_oM_{oC})^2}}{Z}\right]^2 + \left(\frac{i_tM_{tC}}{Z}\right)^2} \leq S_A$$

I_o = sustained out-of-plane moment index. In the absence of more applicable data, I_o is taken as the greater of $0.75i_o$ and 1.00 (i_o taken from ASME B31J, Table 1-1).

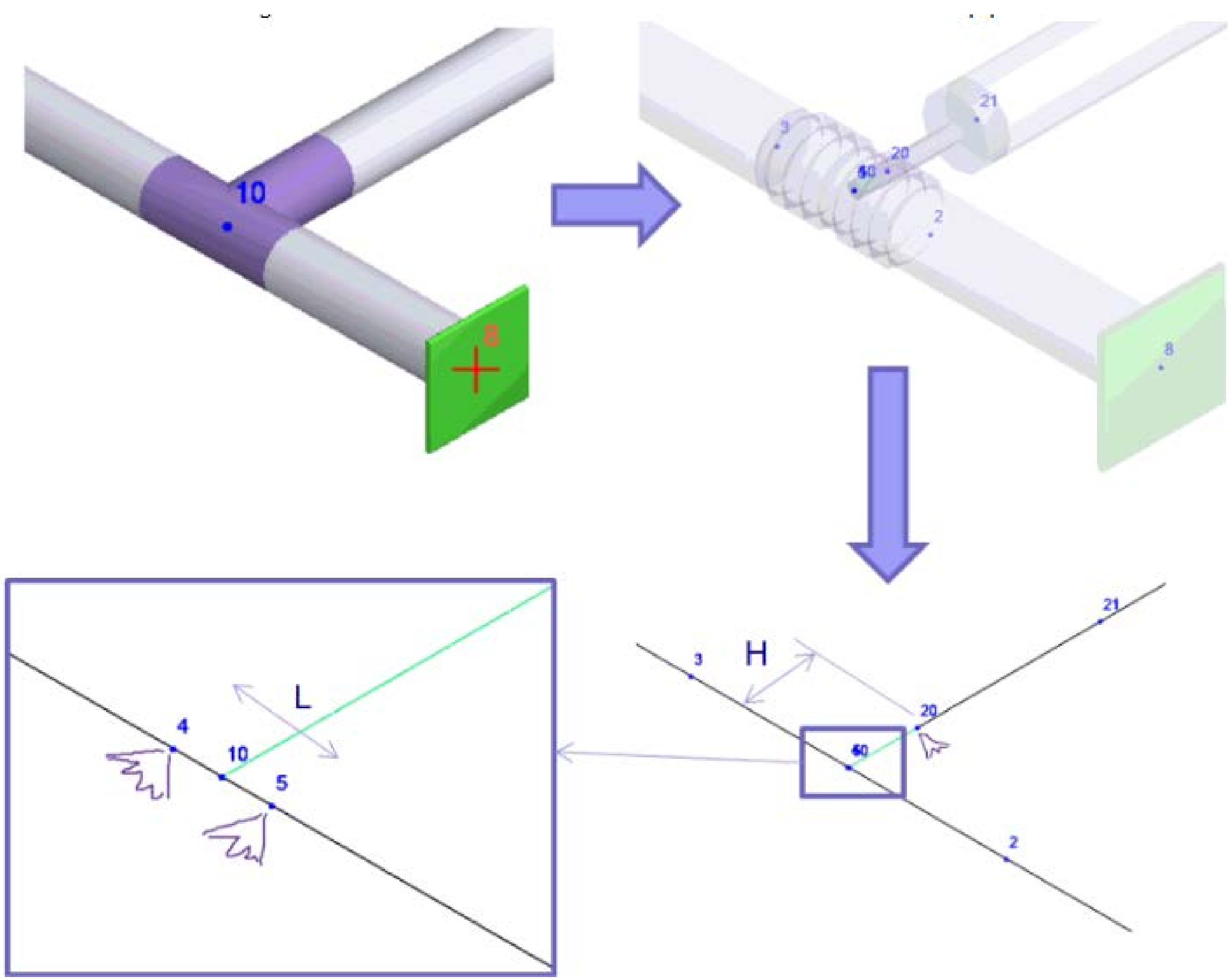
I_t = sustained torsional moment index. In the absence of more applicable data, I_t is taken as the greater of $0.75i_t$ and 1.00 (i_t taken from ASME B31J, Table 1-1).

i_a = axial force stress intensification factor. In the absence of more applicable data, i_a = 1.0 for elbows, pipe bends, and miter bends (single, closely spaced, and widely spaced), and $i_a = i_o$ (or i when listed) in ASME B31J for other components

i_i, i_o, i_t = in-plane, out-of-plane, and torsional stress intensification factors, respectively, for piping component as defined by ASME B31J, Table 1-1

PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/START-PROF | ASME B31.1-2020



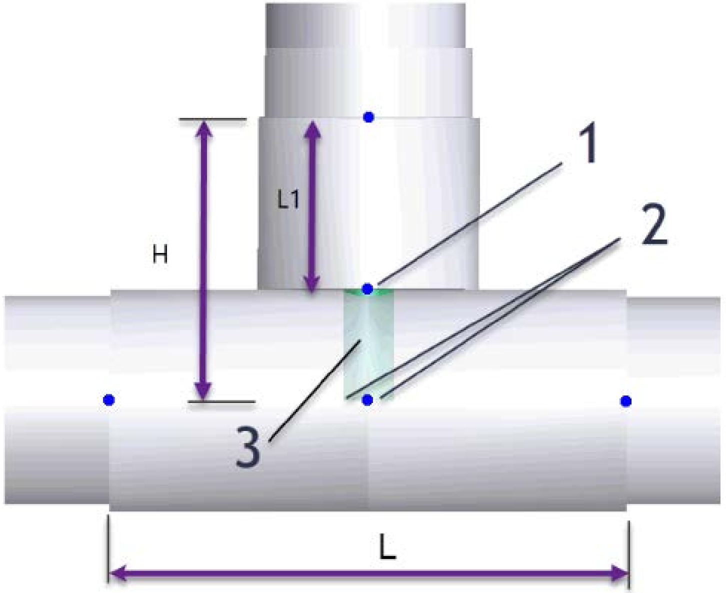
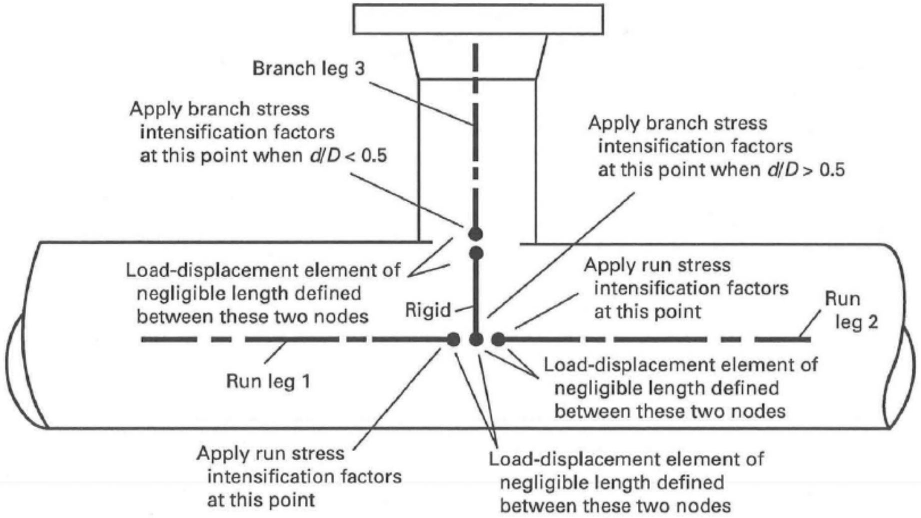


Figure C-2-7 Branch and Run SIF and *k*-Factor Intersection Orientations

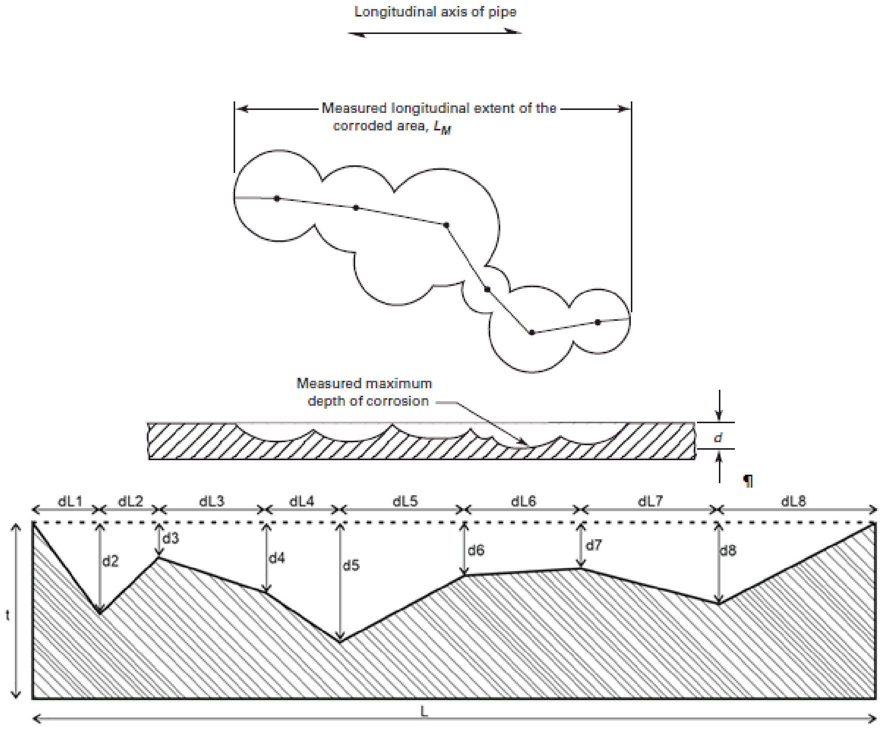


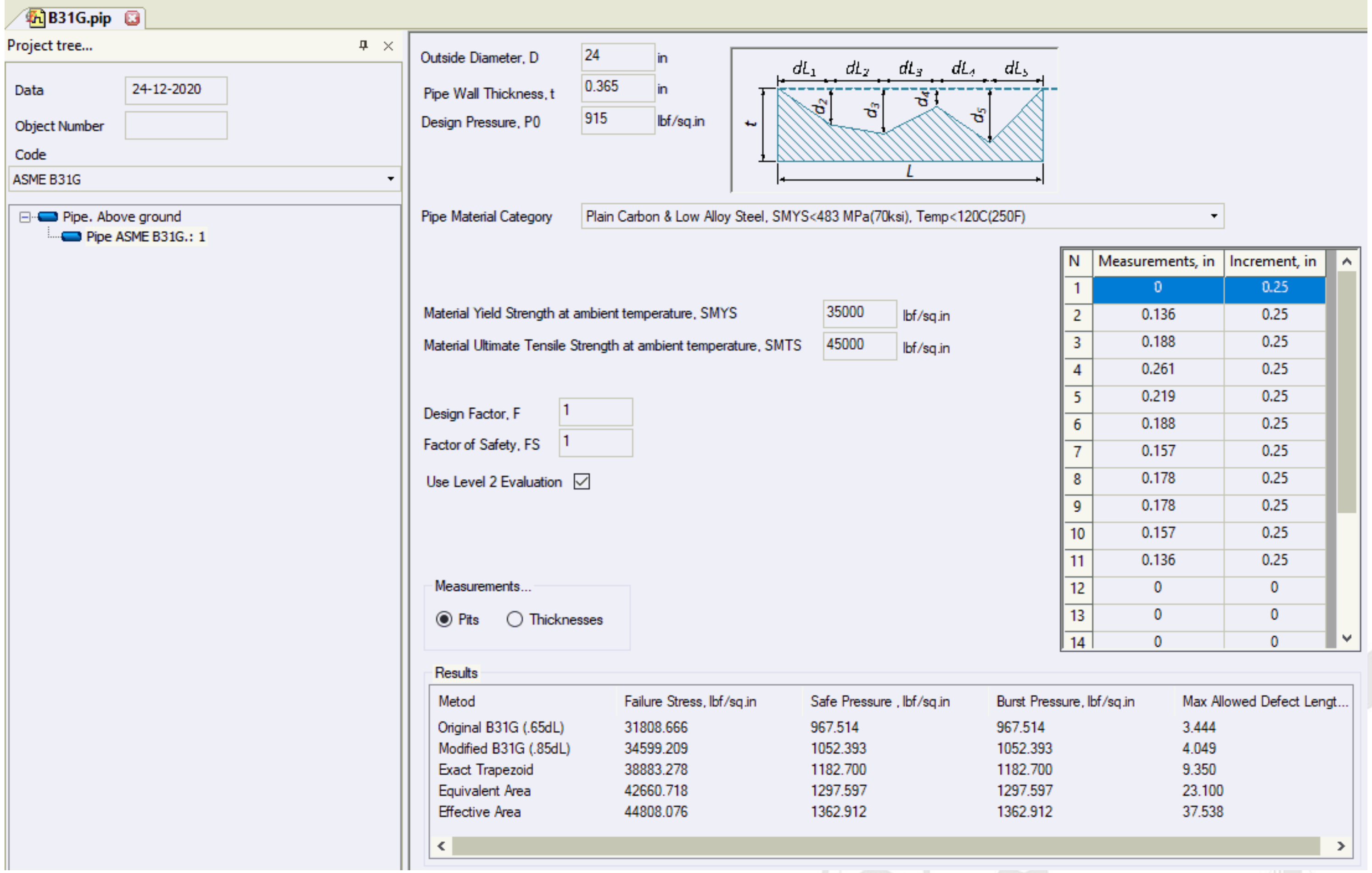
PASS
PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/START-PROF | ASME B31G

ASME B31G Remaining Strength of Corroded Pipeline

Fig. 2.1-1 Corrosion Parameters Used in Analysis





Data	24-12-2020	
Object Number		
Code	ASME B31G	
Outside Diameter, D	24	in
Pipe Wall Thickness, t	0.365	in
Design Pressure, P0	915	lbf/sq.in
Pipe Material Category	Plain Carbon & Low Alloy Steel, SMYS<483 MPa(70ksi), Temp<120C(250F)	
Material Yield Strength at ambient temperature, SMYS	35000	lbf/sq.in
Material Ultimate Tensile Strength at ambient temperature, SMTS	45000	lbf/sq.in
Design Factor, F	1	
Factor of Safety, FS	1	
Use Level 2 Evaluation	☑	

Measurements...

● Pits ○ Thicknesses

N	Measurements, in	Increment, in
1	0	0.25
2	0.136	0.25
3	0.188	0.25
4	0.261	0.25
5	0.219	0.25
6	0.188	0.25
7	0.157	0.25
8	0.178	0.25
9	0.178	0.25
10	0.157	0.25
11	0.136	0.25
12	0	0
13	0	0
14	0	0

Results

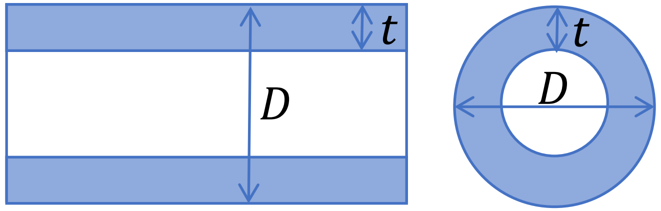
Metod	Failure Stress, lbf/sq.in	Safe Pressure , lbf/sq.in	Burst Pressure, lbf/sq.in	Max Allowed Defect Lengt...
Original B31G (.65dL)	31808.666	967.514	967.514	3.444
Modified B31G (.85dL)	34599.209	1052.393	1052.393	4.049
Exact Trapezoid	38883.278	1182.700	1182.700	9.350
Equivalent Area	42660.718	1297.597	1297.597	23.100
Effective Area	44808.076	1362.912	1362.912	37.538

PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/START-PROF | ASME B31G

Barlow's formula for pipe without flaw

$$P = \frac{\sigma_0 2t}{D}$$



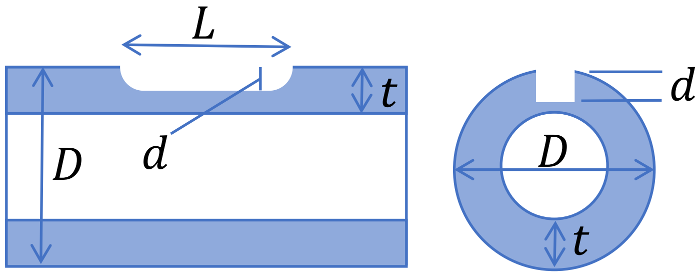
σ_0 - allowable stress
P – burst pressure
t – pipe wall thickness
D – outside diameter

PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/START-PROF | ASME B31G

Original B31G For defect length $L \leq \sqrt{20Dt}$. Parabolic defect

$$P = \frac{\sigma_{flow} 2t}{D} \left(\frac{1 - \frac{A}{A_0}}{1 - \frac{A}{A_0 M}} \right)$$



$$A_0 = \mathrm{Lt} \qquad A = \frac{2}{3}\mathrm{dL}$$

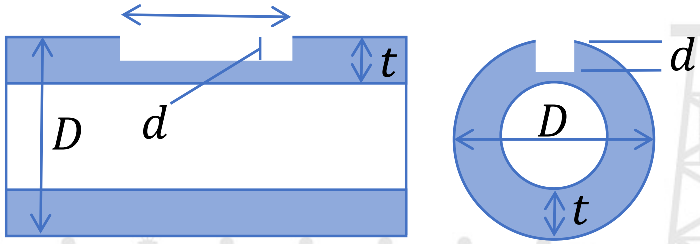
L – defect length
d – max defect depth
$SMYS$ – Specified Minimum Yield Strength

σ_{flow}=1.1SMYS

$$M = \sqrt{1 + \frac{0.8L^2}{Dt}}$$

Original B31G For defect length $L > \sqrt{20Dt}$. Rectangular long defect

$$A = dL$$

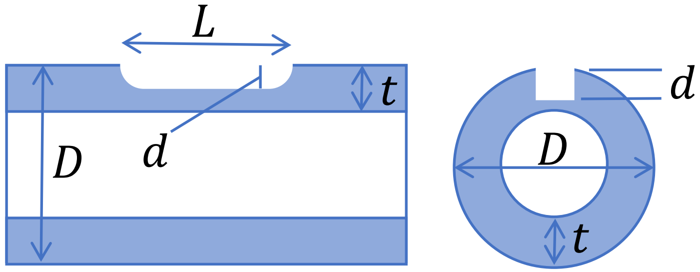


PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/START-PROF | ASME B31G

0.85dL method for defect length $L \leq \sqrt{50Dt}$

$$P = \frac{\sigma_{flow} 2t}{D}\left(\frac{1-\frac{A}{A_0}}{1-\frac{A}{A_0 M}}\right)$$



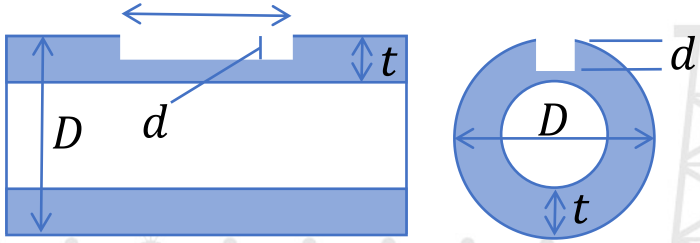
$A_0 = \mathrm{Lt}$ $A = 0.85\mathrm{dL}$ σ_{flow}=SMYS+10,000psi

$$M = \sqrt{1 + 0.6275\frac{L^2}{Dt} - 0.003375\left(\frac{L^2}{Dt}\right)^2}$$

0.85dL method for defect length $L > \sqrt{50Dt}$

$A = 0.85\mathrm{dL}$

$$M = 0.032\frac{L^2}{Dt} + 3.3$$

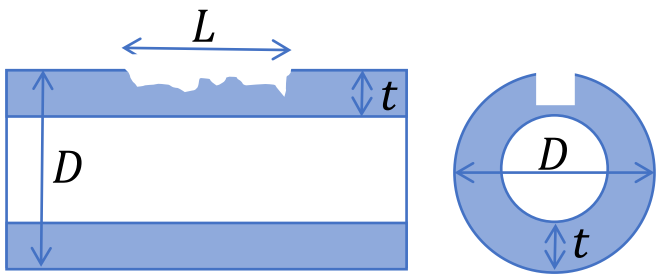


PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

PASS/START-PROF | ASME B31G

Effective area method

$$P = \frac{\sigma_{flow} 2t}{D}\left(\frac{1-\frac{A}{A_0}}{1-\frac{A}{A_0 M}}\right)$$

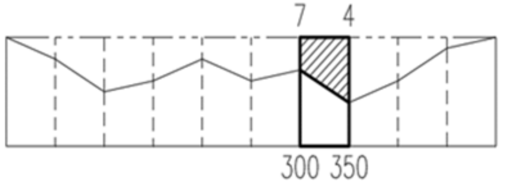


$A_0 = \mathrm{Lt} \quad A = area\ of\ damage$

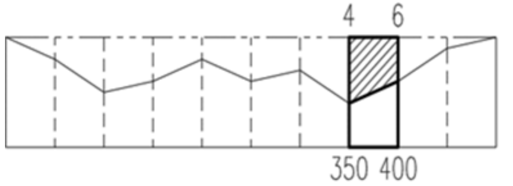
σ_{flow}=SMYS+10,000psi

Method #5 RSTRENG Effective Area, B31G Level 2

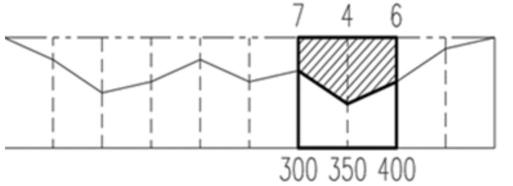
Calculates the corroded area A calculated numerically using the trapezoid method. All possible combinations of local metal loss A are calculated, n!/2(n − 2)! iterations are required to examine all possible combinations of local metal loss with respect to surrounding remaining material. The exact trapezoid method is just a special case of an effective method.



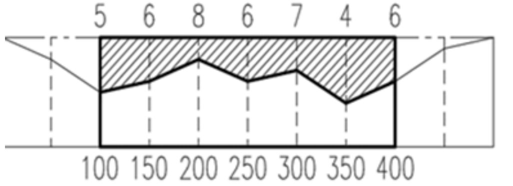
Case 1



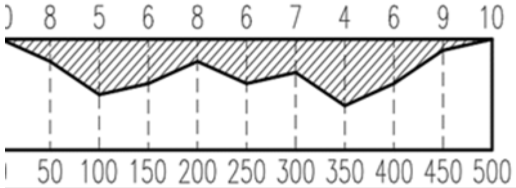
Case 2



Case 3



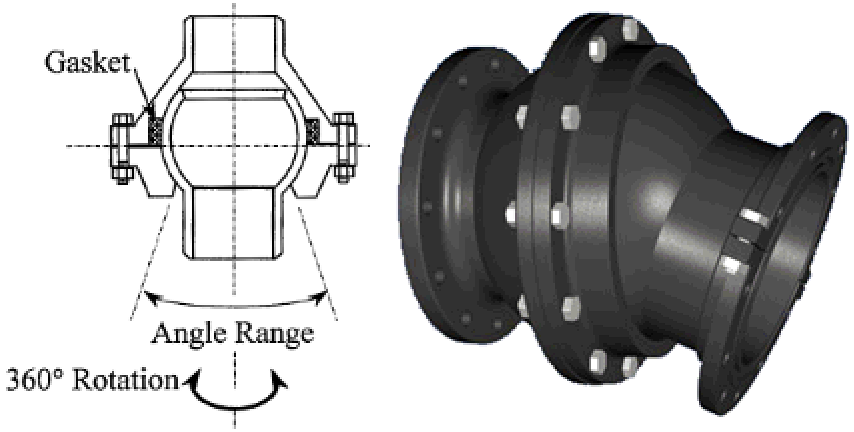
Case 4

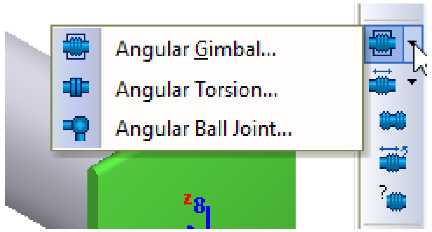


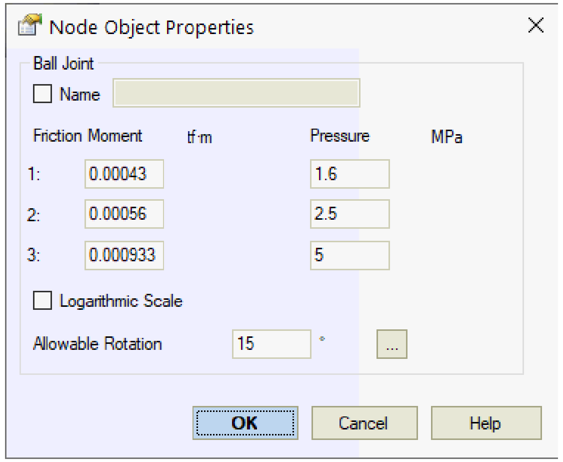
Case 5

PASS/START-PROF | Ball Joint Object

Allows rotation of two connected pipes around 3 axes







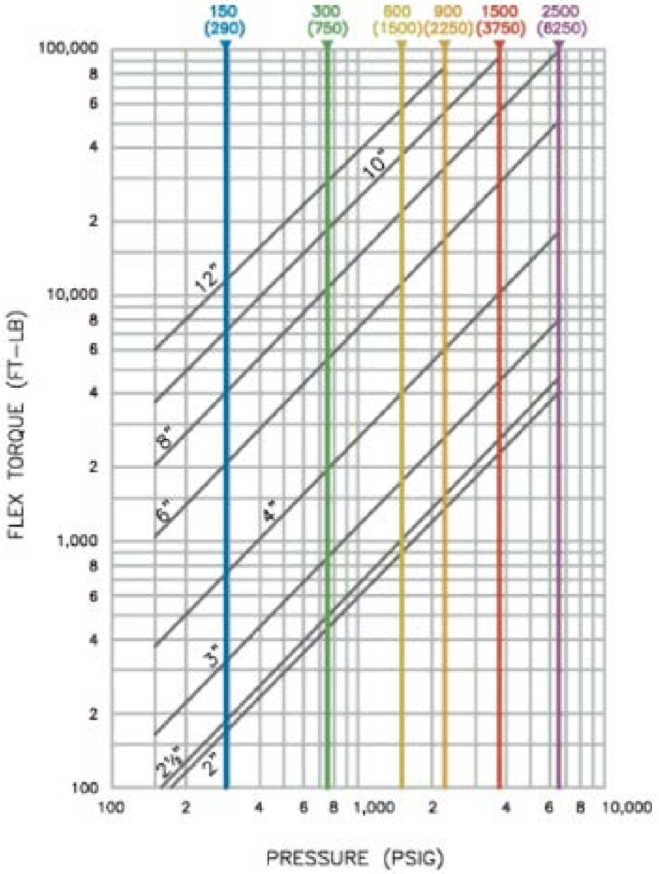
Ball Joint

☐ Name

Friction Moment	tf·m	Pressure	MPa
1:	0.00043	1.6	
2:	0.00056	2.5	
3:	0.000933	5	

☐ Logarithmic Scale

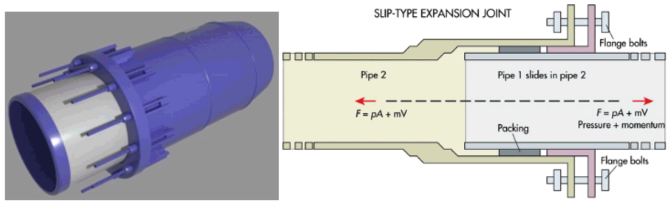
Allowable Rotation 15 °

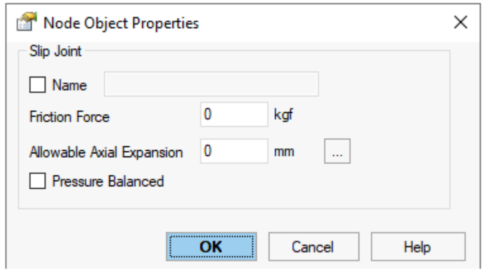


$$M \geq M_f$$

$$M = \sqrt{M_x^2 + M_y^2 + M_z^2}$$

Slip Joint





Slip Joint

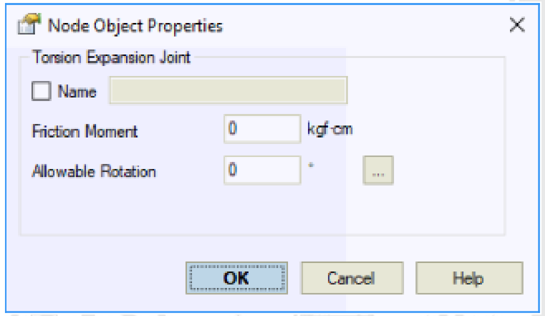
☐ Name

Friction Force 0 kgf

Allowable Axial Expansion 0 mm

☐ Pressure Balanced

Torsion Joint



Torsion Expansion Joint

☐ Name

Friction Moment 0 kgf·cm

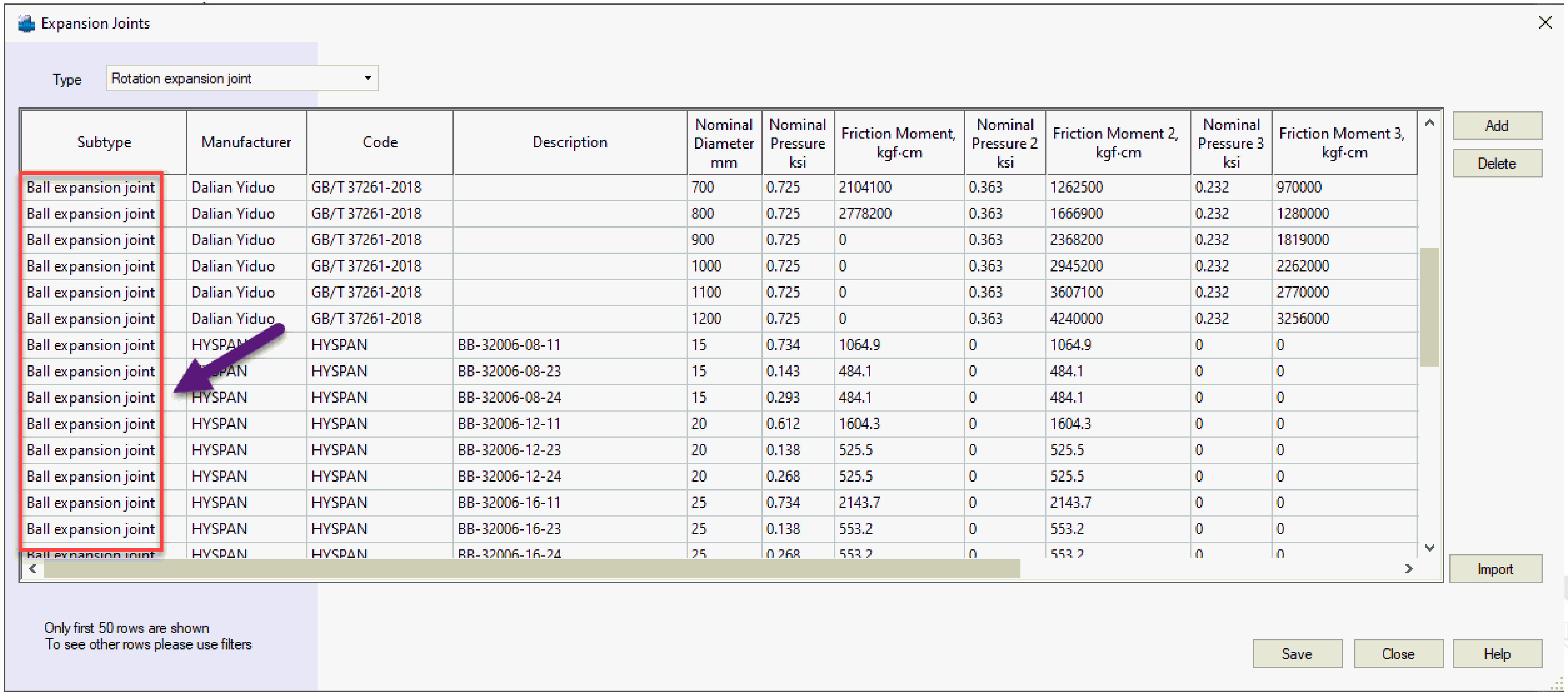
Allowable Rotation 0 °

PASS

PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/START-PROF | Ball Joint Object

Ball Joint Database



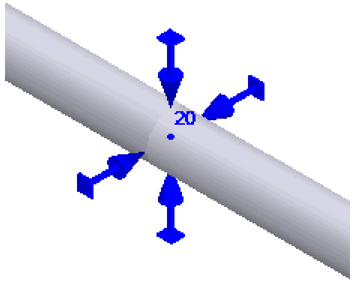
Type: Rotation expansion joint

Subtype	Manufacturer	Code	Description	Nominal Diameter mm	Nominal Pressure ksi	Friction Moment, kgf·cm	Nominal Pressure 2 ksi	Friction Moment 2, kgf·cm	Nominal Pressure 3 ksi	Friction Moment 3, kgf·cm
Ball expansion joint	Dalian Yiduo	GB/T 37261-2018		700	0.725	2104100	0.363	1262500	0.232	970000
Ball expansion joint	Dalian Yiduo	GB/T 37261-2018		800	0.725	2778200	0.363	1666900	0.232	1280000
Ball expansion joint	Dalian Yiduo	GB/T 37261-2018		900	0.725	0	0.363	2368200	0.232	1819000
Ball expansion joint	Dalian Yiduo	GB/T 37261-2018		1000	0.725	0	0.363	2945200	0.232	2262000
Ball expansion joint	Dalian Yiduo	GB/T 37261-2018		1100	0.725	0	0.363	3607100	0.232	2770000
Ball expansion joint	Dalian Yiduo	GB/T 37261-2018		1200	0.725	0	0.363	4240000	0.232	3256000
Ball expansion joint	HYSPAN	HYSPAN	BB-32006-08-11	15	0.734	1064.9	0	1064.9	0	0
Ball expansion joint	HYSPAN	HYSPAN	BB-32006-08-23	15	0.143	484.1	0	484.1	0	0
Ball expansion joint	HYSPAN	HYSPAN	BB-32006-08-24	15	0.293	484.1	0	484.1	0	0
Ball expansion joint	HYSPAN	HYSPAN	BB-32006-12-11	20	0.612	1604.3	0	1604.3	0	0
Ball expansion joint	HYSPAN	HYSPAN	BB-32006-12-23	20	0.138	525.5	0	525.5	0	0
Ball expansion joint	HYSPAN	HYSPAN	BB-32006-12-24	20	0.268	525.5	0	525.5	0	0
Ball expansion joint	HYSPAN	HYSPAN	BB-32006-16-11	25	0.734	2143.7	0	2143.7	0	0
Ball expansion joint	HYSPAN	HYSPAN	BB-32006-16-23	25	0.138	553.2	0	553.2	0	0
Ball expansion joint	HYSPAN	HYSPAN	BB-32006-16-24	25	0.268	553.2	0	553.2	0	0

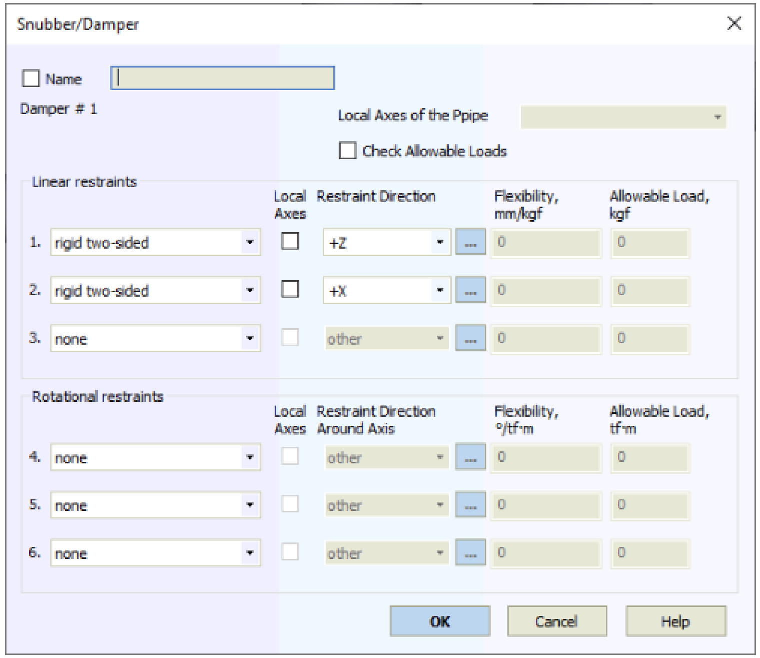
Only first 50 rows are shown
To see other rows please use filters

PASS
PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/START-PROF | Snubber Object



Snubbers are usually used for reducing the displacements, stresses and support loads from Earthquake events. Snubbers doesn't resist to the thermal displacements of piping system and doesn't reduce the piping flexibility. But in case of quickly applied occasional load, snubbers instantaneously form a practically rigid restraint.



☐ Name

Damper # 1

Local Axes of the Ppipe

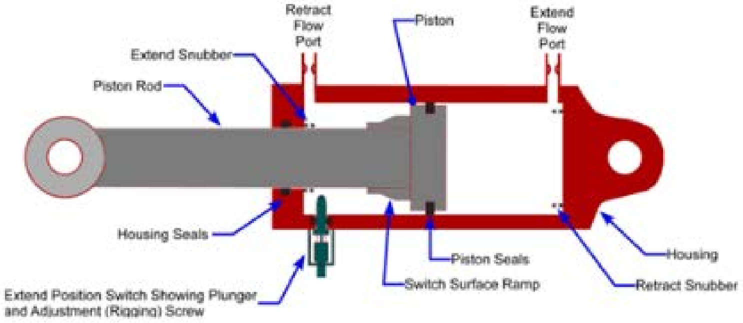
☐ Check Allowable Loads

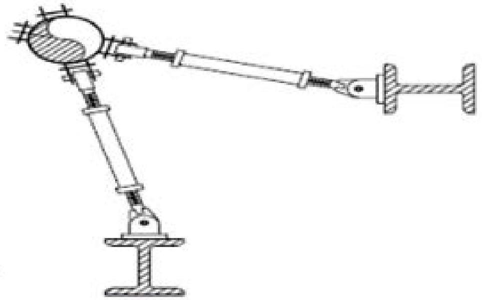
Linear restraints

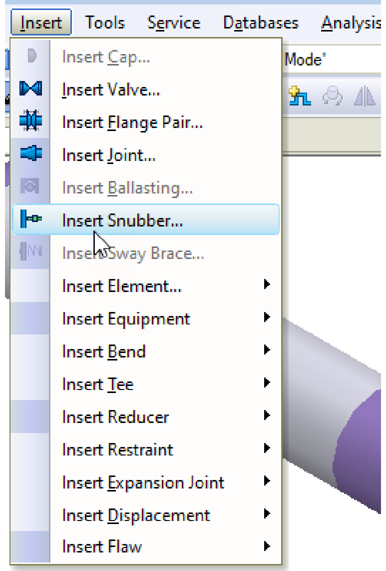
		Local Axes	Restraint Direction		Flexibility, mm/kgf	Allowable Load, kgf
1.	rigid two-sided	☐	+Z	...	0	0
2.	rigid two-sided	☐	+X	...	0	0
3.	none	☐	other	...	0	0

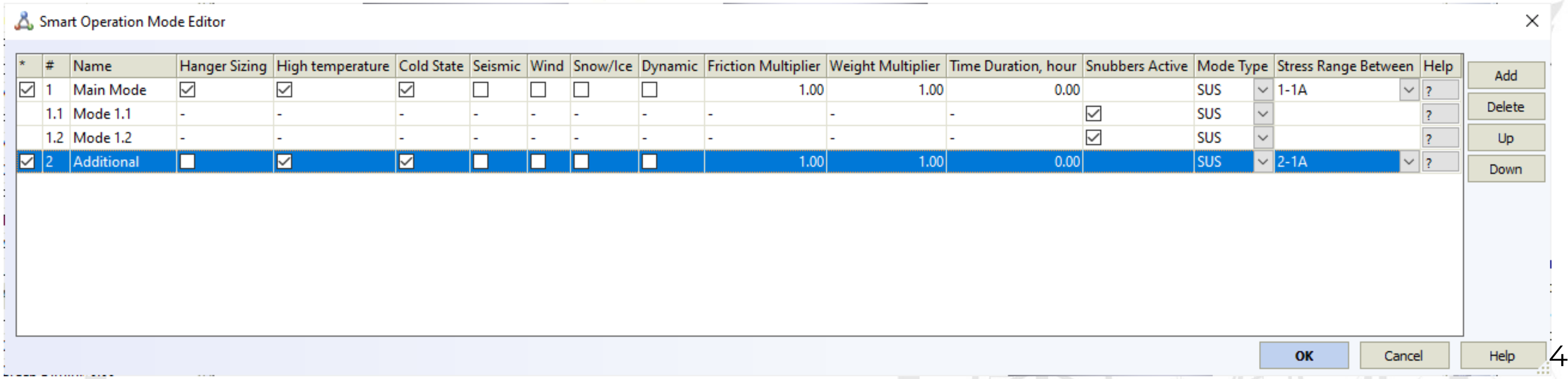
Rotational restraints

		Local Axes	Restraint Direction Around Axis		Flexibility, °/tf·m	Allowable Load, tf·m
4.	none	☐	other	...	0	0
5.	none	☐	other	...	0	0
6.	none	☐	other	...	0	0





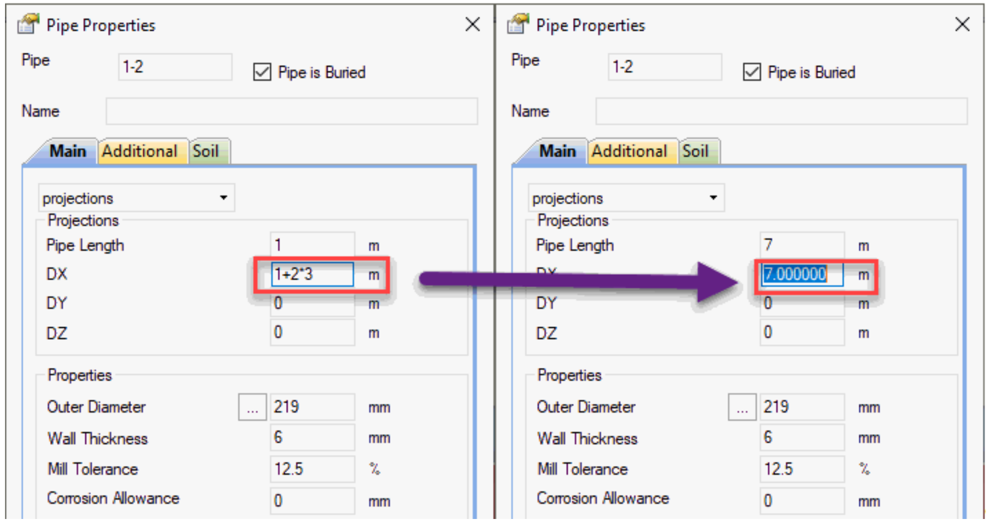




*	#	Name	Hanger Sizing	High temperature	Cold State	Seismic	Wind	Snow/Ice	Dynamic	Friction Multiplier	Weight Multiplier	Time Duration, hour	Snubbers Active	Mode Type	Stress Range Between	Help
☑	1	Main Mode	☑	☑	☑	☐	☐	☐	☐	1.00	1.00	0.00		SUS	1-1A	?
	1.1	Mode 1.1	-	-	-	-	-	-	-	-	-	-	☑	SUS		?
	1.2	Mode 1.2	-	-	-	-	-	-	-	-	-	-	☑	SUS		?
☑	2	Additional	☐	☑	☑	☐	☐	☐	☐	1.00	1.00	0.00		SUS	2-1A	?

PASS/START-PROF | Built-in Calculator Update

Added ability to input data in any units and combine different units. Added feet-inch representation.



Pipe Properties

Pipe: 1-2 ☑ Pipe is Buried

Name:

projections

Projections

Pipe Length: 1 m

DX: 1+2*3 m

DY: 0 m

DZ: 0 m

Properties

Outer Diameter: 219 mm

Wall Thickness: 6 mm

Mill Tolerance: 12.5 %

Corrosion Allowance: 0 mm

Pipe Properties

Pipe: 1-2 ☑ Pipe is Buried

Name:

projections

Projections

Pipe Length: 7 m

DX: 7.000000 m

DY: 0 m

DZ: 0 m

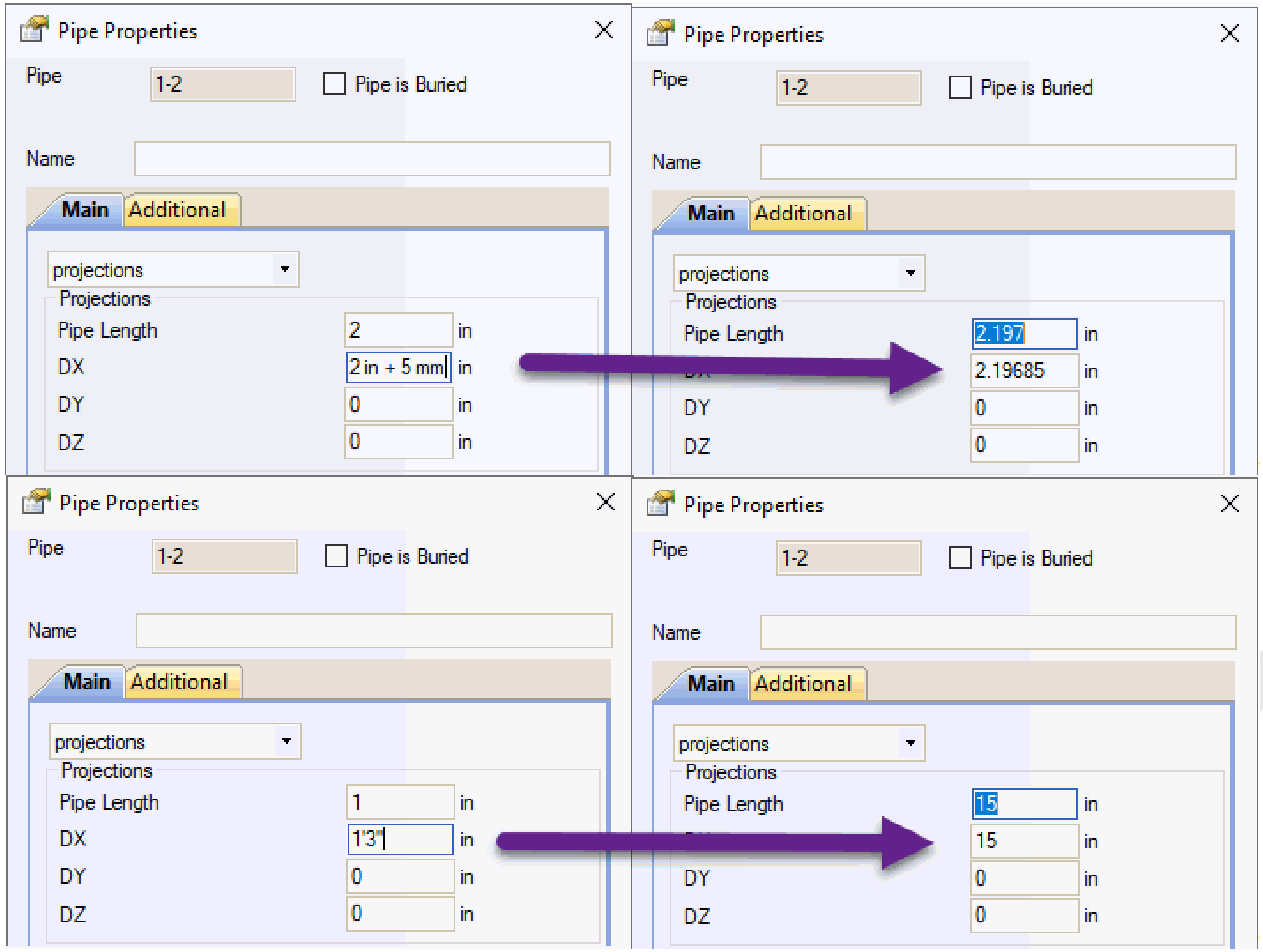
Properties

Outer Diameter: 219 mm

Wall Thickness: 6 mm

Mill Tolerance: 12.5 %

Corrosion Allowance: 0 mm



Pipe Properties

Pipe: 1-2 ☐ Pipe is Buried

Name:

projections

Projections

Pipe Length: 2 in

DX: 2 in + 5 mm in

DY: 0 in

DZ: 0 in

Pipe Properties

Pipe: 1-2 ☐ Pipe is Buried

Name:

projections

Projections

Pipe Length: 2.197 in

DX: 2.19685 in

DY: 0 in

DZ: 0 in

Pipe Properties

Pipe: 1-2 ☐ Pipe is Buried

Name:

projections

Projections

Pipe Length: 1 in

DX: 1'3" in

DY: 0 in

DZ: 0 in

Pipe Properties

Pipe: 1-2 ☐ Pipe is Buried

Name:

projections

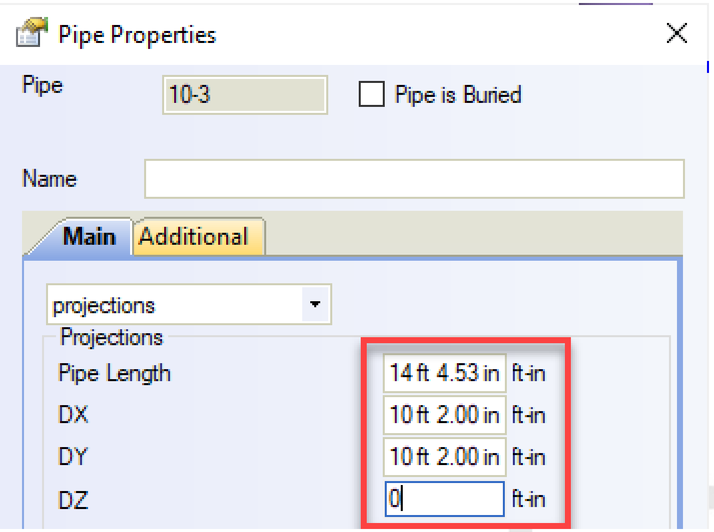
Projections

Pipe Length: 15 in

DX: 15 in

DY: 0 in

DZ: 0 in



Pipe Properties

Pipe: 10-3 ☐ Pipe is Buried

Name:

projections

Projections

Pipe Length: 14 ft 4.53 in ft-in

DX: 10 ft 2.00 in ft-in

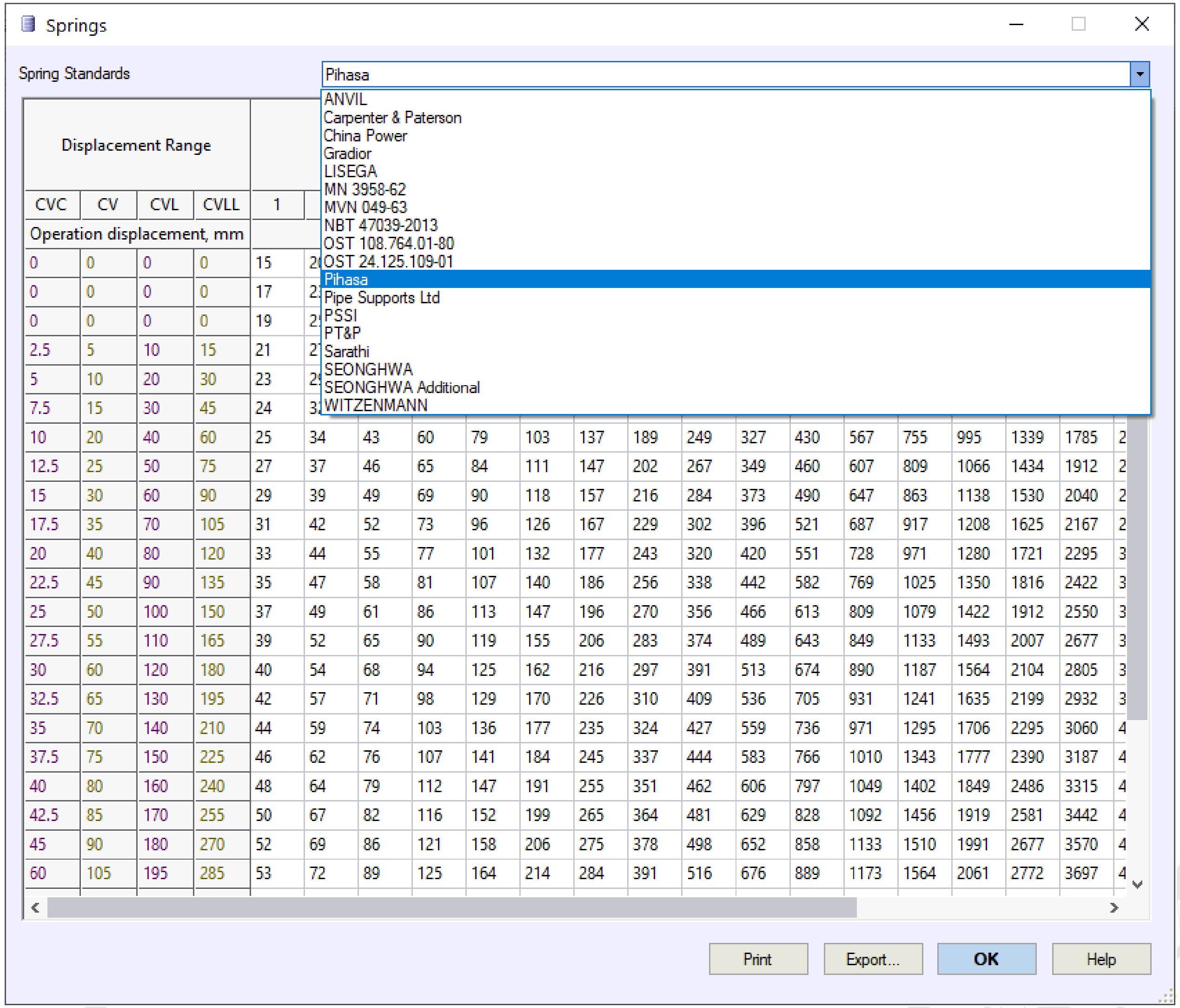
DY: 10 ft 2.00 in ft-in

DZ: 0 ft-in

PASS/START-PROF | New spring hanger tables

Added spring selection: Gradior, Pihasa, Pipe Support Systems GmbH (PSSI), Piping Technology and Products Inc. (PT&P), Sarathi

Please type in Q&A section which spring manufacturers should be added in the next versions of START-PROF?



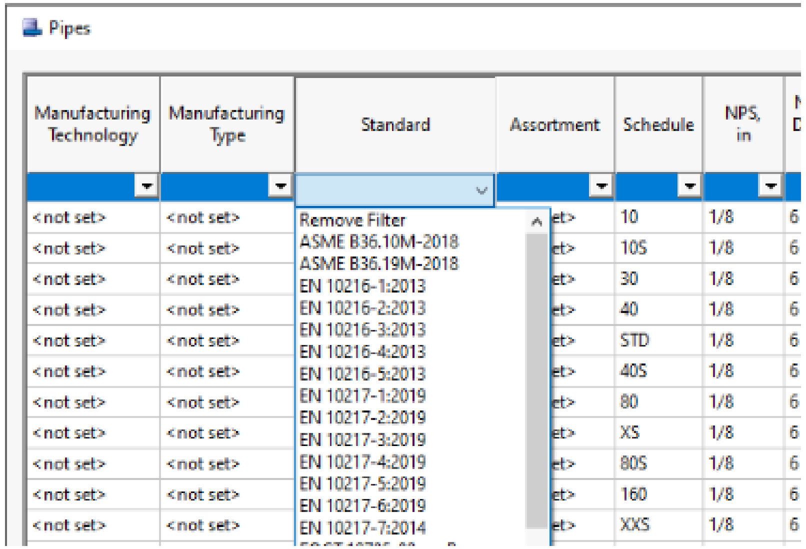
Spring Standards: Pihasa

Displacement Range																			
CVC	CV	CVL	CVLL	1															
Operation displacement, mm																			
0	0	0	0	15															
0	0	0	0	17															
0	0	0	0	19															
2.5	5	10	15	21															
5	10	20	30	23															
7.5	15	30	45	24															
10	20	40	60	25	34	43	60	79	103	137	189	249	327	430	567	755	995	1339	1785
12.5	25	50	75	27	37	46	65	84	111	147	202	267	349	460	607	809	1066	1434	1912
15	30	60	90	29	39	49	69	90	118	157	216	284	373	490	647	863	1138	1530	2040
17.5	35	70	105	31	42	52	73	96	126	167	229	302	396	521	687	917	1208	1625	2167
20	40	80	120	33	44	55	77	101	132	177	243	320	420	551	728	971	1280	1721	2295
22.5	45	90	135	35	47	58	81	107	140	186	256	338	442	582	769	1025	1350	1816	2422
25	50	100	150	37	49	61	86	113	147	196	270	356	466	613	809	1079	1422	1912	2550
27.5	55	110	165	39	52	65	90	119	155	206	283	374	489	643	849	1133	1493	2007	2677
30	60	120	180	40	54	68	94	125	162	216	297	391	513	674	890	1187	1564	2104	2805
32.5	65	130	195	42	57	71	98	129	170	226	310	409	536	705	931	1241	1635	2199	2932
35	70	140	210	44	59	74	103	136	177	235	324	427	559	736	971	1295	1706	2295	3060
37.5	75	150	225	46	62	76	107	141	184	245	337	444	583	766	1010	1343	1777	2390	3187
40	80	160	240	48	64	79	112	147	191	255	351	462	606	797	1049	1402	1849	2486	3315
42.5	85	170	255	50	67	82	116	152	199	265	364	481	629	828	1092	1456	1919	2581	3442
45	90	180	270	52	69	86	121	158	206	275	378	498	652	858	1133	1510	1991	2677	3570
60	105	195	285	53	72	89	125	164	214	284	391	516	676	889	1173	1564	2061	2772	3697

PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

PASS/START-PROF | Pipe & Fitting Database

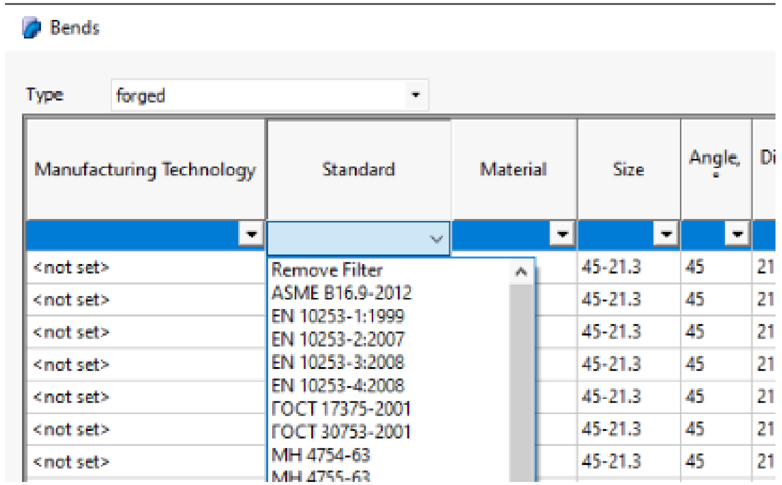
Updated Pipes, Tees, Bends and Reducers Database according to the EN codes: EN 10216, 10217, 10253



Pipes

Manufacturing Technology	Manufacturing Type	Standard	Assortment	Schedule	NPS, in	
<not set>	<not set>		et>	10	1/8	6
<not set>	<not set>		et>	10S	1/8	6
<not set>	<not set>		et>	30	1/8	6
<not set>	<not set>		et>	40	1/8	6
<not set>	<not set>		et>	STD	1/8	6
<not set>	<not set>		et>	40S	1/8	6
<not set>	<not set>		et>	80	1/8	6
<not set>	<not set>		et>	XS	1/8	6
<not set>	<not set>		et>	80S	1/8	6
<not set>	<not set>		et>	160	1/8	6
<not set>	<not set>		et>	XXS	1/8	6

Remove Filter
ASME B36.10M-2018
ASME B36.19M-2018
EN 10216-1:2013
EN 10216-2:2013
EN 10216-3:2013
EN 10216-4:2013
EN 10216-5:2013
EN 10217-1:2019
EN 10217-2:2019
EN 10217-3:2019
EN 10217-4:2019
EN 10217-5:2019
EN 10217-6:2019
EN 10217-7:2014

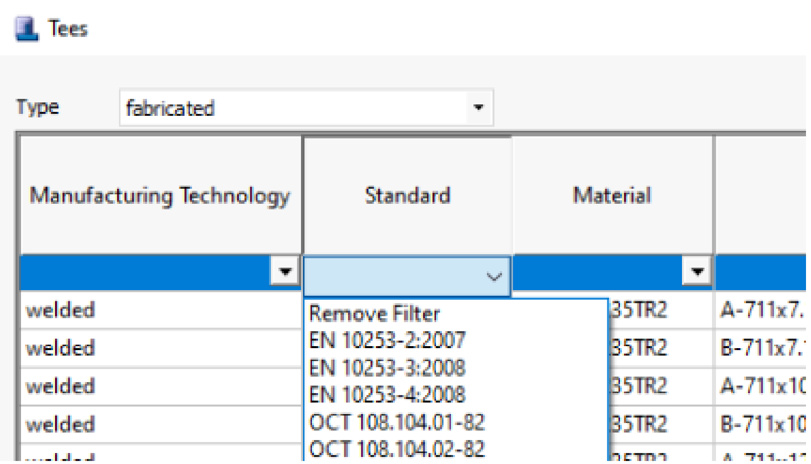


Bends

Type: forged

Manufacturing Technology	Standard	Material	Size	Angle, °	Di
<not set>			45-21.3	45	21
<not set>			45-21.3	45	21
<not set>			45-21.3	45	21
<not set>			45-21.3	45	21
<not set>			45-21.3	45	21
<not set>			45-21.3	45	21
<not set>			45-21.3	45	21

Remove Filter
ASME B16.9-2012
EN 10253-1:1999
EN 10253-2:2007
EN 10253-3:2008
EN 10253-4:2008
ГОСТ 17375-2001
ГОСТ 30753-2001
МН 4754-63
МН 4755-63

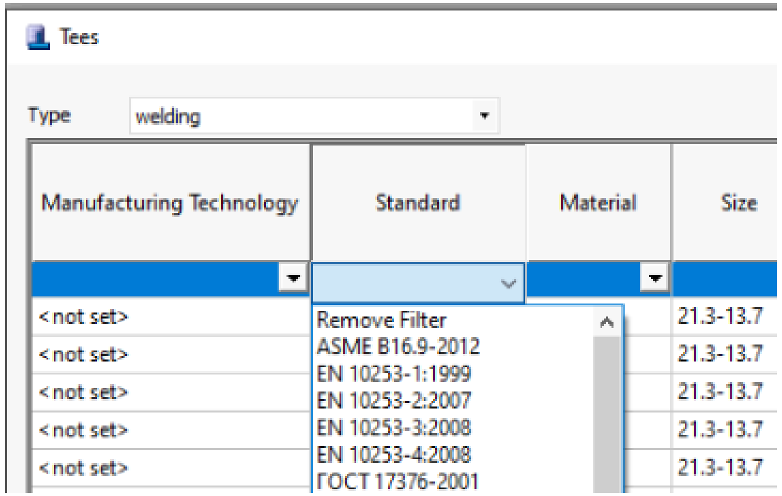


Tees

Type: fabricated

Manufacturing Technology	Standard	Material	
welded		35TR2	A-711x7.
welded		35TR2	B-711x7.
welded		35TR2	A-711x10
welded		35TR2	B-711x10

Remove Filter
EN 10253-2:2007
EN 10253-3:2008
EN 10253-4:2008
ОСТ 108.104.01-82
ОСТ 108.104.02-82

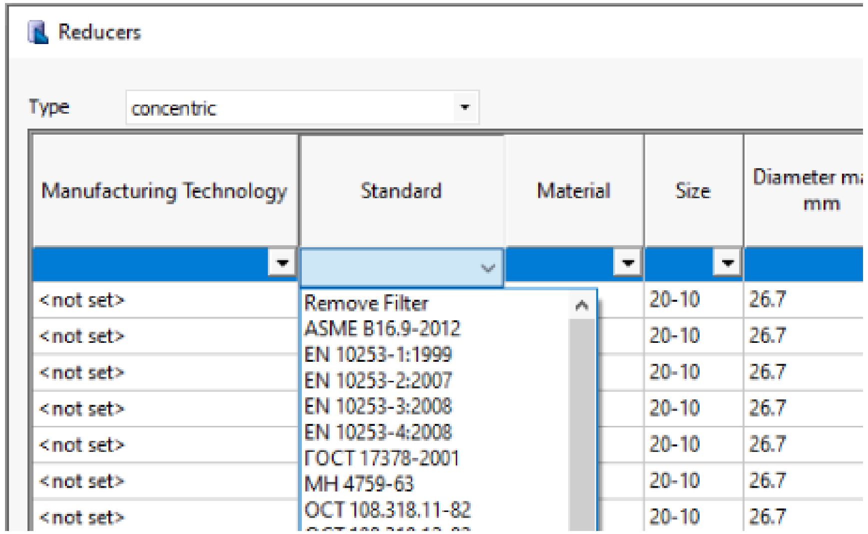


Tees

Type: welding

Manufacturing Technology	Standard	Material	Size
<not set>			21.3-13.7
<not set>			21.3-13.7
<not set>			21.3-13.7
<not set>			21.3-13.7
<not set>			21.3-13.7

Remove Filter
ASME B16.9-2012
EN 10253-1:1999
EN 10253-2:2007
EN 10253-3:2008
EN 10253-4:2008
ГОСТ 17376-2001

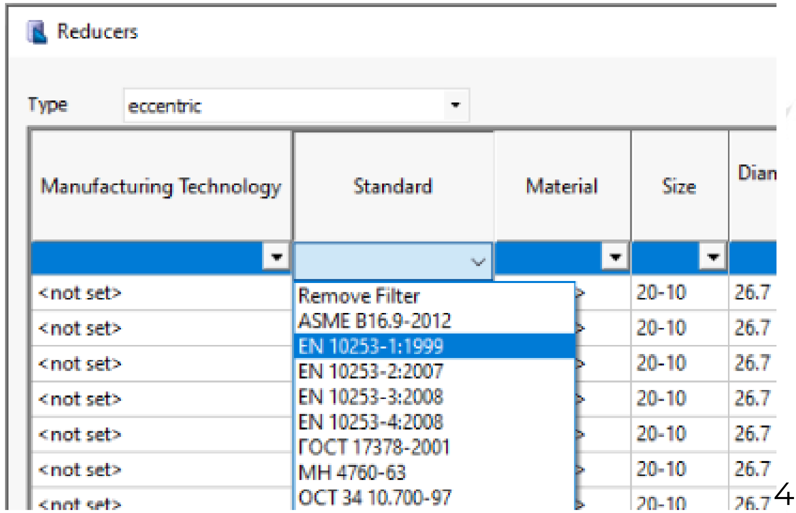


Reducers

Type: concentric

Manufacturing Technology	Standard	Material	Size	Diameter mm
<not set>			20-10	26.7
<not set>			20-10	26.7
<not set>			20-10	26.7
<not set>			20-10	26.7
<not set>			20-10	26.7
<not set>			20-10	26.7
<not set>			20-10	26.7

Remove Filter
ASME B16.9-2012
EN 10253-1:1999
EN 10253-2:2007
EN 10253-3:2008
EN 10253-4:2008
ГОСТ 17378-2001
МН 4759-63
ОСТ 108.318.11-82



Reducers

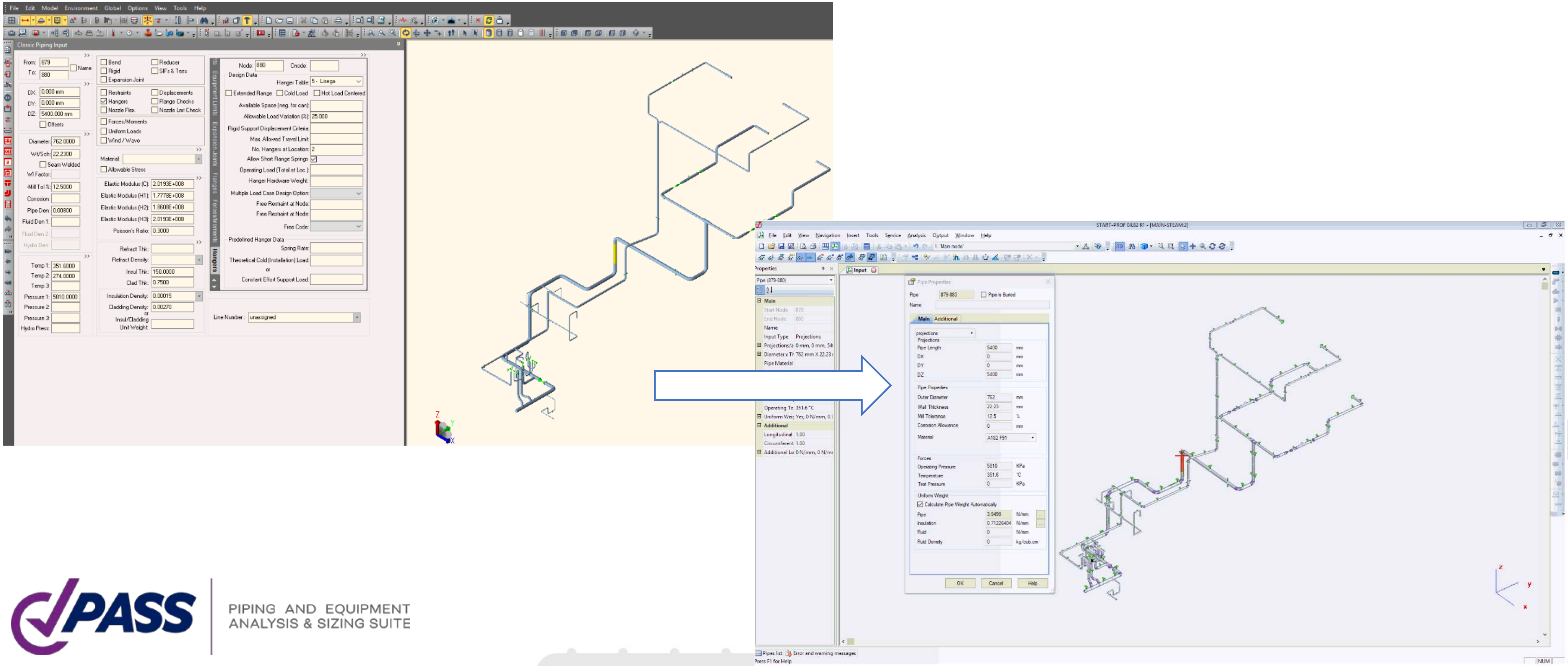
Type: eccentric

Manufacturing Technology	Standard	Material	Size	Dian
<not set>			20-10	26.7
<not set>			20-10	26.7
<not set>			20-10	26.7
<not set>			20-10	26.7
<not set>			20-10	26.7
<not set>			20-10	26.7
<not set>			20-10	26.7

Remove Filter
ASME B16.9-2012
EN 10253-1:1999
EN 10253-2:2007
EN 10253-3:2008
EN 10253-4:2008
ГОСТ 17378-2001
МН 4760-63
ОСТ 34 10.700-97

PASS/START-PROF | Import from CAESAR II

Significantly improved the import from CAESAR II. Added support for CAESAR II v.8, v.9, v10, v11, v12. Model converter became much smarter



From: 879
To: 880
☐ Name
DX: 0.000 mm
DY: 0.000 mm
DZ: 5400.000 mm
☐ Offsets
Diameter: 762.0000
Wt/Sch: 22.2300
☐ Seam Welded
Wl Factor:
-Mill Tol %: 12.5000
Corrosion:
Pipe Den: 0.00800
Fluid Den 1:
Fluid Den 2:
Hydro Den:
Temp 1: 351.6000
Temp 2: 274.0000
Temp 3:
Pressure 1: 5810.0000
Pressure 2:
Pressure 3:
Hydro Press:

☐ Bend
☐ Reducer
☐ Rigid
☐ SIFs & Tees
☐ Expansion Joint
☐ Restraints
☐ Displacements
☑ Hangers
☐ Flange Checks
☐ Nozzle Flex
☐ Nozzle Lmt Check
☐ Forces/Moments
☐ Uniform Loads
☐ Wind / Wave
Material:
☐ Allowable Stress
Elastic Modulus (C): 2.0193E+008
Elastic Modulus (H1): 1.7778E+008
Elastic Modulus (H2): 1.8608E+008
Elastic Modulus (H3): 2.0193E+008
Poisson's Ratio: 0.3000
Refract Thk:
Refract Density:
Insul Thk: 150.0000
Clad Thk: 0.7500
Insulation Density: 0.00015
Cladding Density: 0.00270
or
Insul/Cladding Unit Weight:

Node: 880
Cnode:
Design Data
Hanger Table: 5 - Lisega
☐ Extended Range
☐ Cold Load
☐ Hot Load Centered
Available Space (neg. for can):
Allowable Load Variation (%): 25.000
Rigid Support Displacement Criteria:
Max. Allowed Travel Limit:
No. Hangers at Location: 2
Allow Short Range Springs ☑
Operating Load (Total at Loc.):
Hanger Hardware Weight:
Multiple Load Case Design Option:
Free Restraint at Node:
Free Restraint at Node:
Free Code:
Predefined Hanger Data
Spring Rate:
Theoretical Cold (Installation) Load:
or
Constant Effort Support Load:
Line Number: unassigned

Pipe (879-880)
Main
Start Node 879
End Node 880
Name
Input Type Projections
Projections/a 0 mm, 0 mm, 54
Diameter x Th 762 mm X 22.23
Pipe Material
Operating Te 351.6 °C
Uniform Wei Yes, 0 N/mm, 0.7
Additional
Longitudinal 1.00
Circumferent 1.00
Additional Lo 0 N/mm, 0 N/mi

Pipe 879-880
☐ Pipe is Buried
Name
projections
Projections
Pipe Length 5400 mm
DX 0 mm
DY 0 mm
DZ 5400 mm
Pipe Properties
Outer Diameter 762 mm
Wall Thickness 22.23 mm
Mill Tolerance 12.5 %
Corrosion Allowance 0 mm
Material A182 F91
Forces
Operating Pressure 5810 KPa
Temperature 351.6 ℃
Test Pressure 0 KPa
Uniform Weight
☑ Calculate Pipe Weight Automatically
Pipe 3.9499 N/mm
Insulation 0.71226404 N/mm
Fluid 0 N/mm
Fluid Density 0 kg/cub.cm

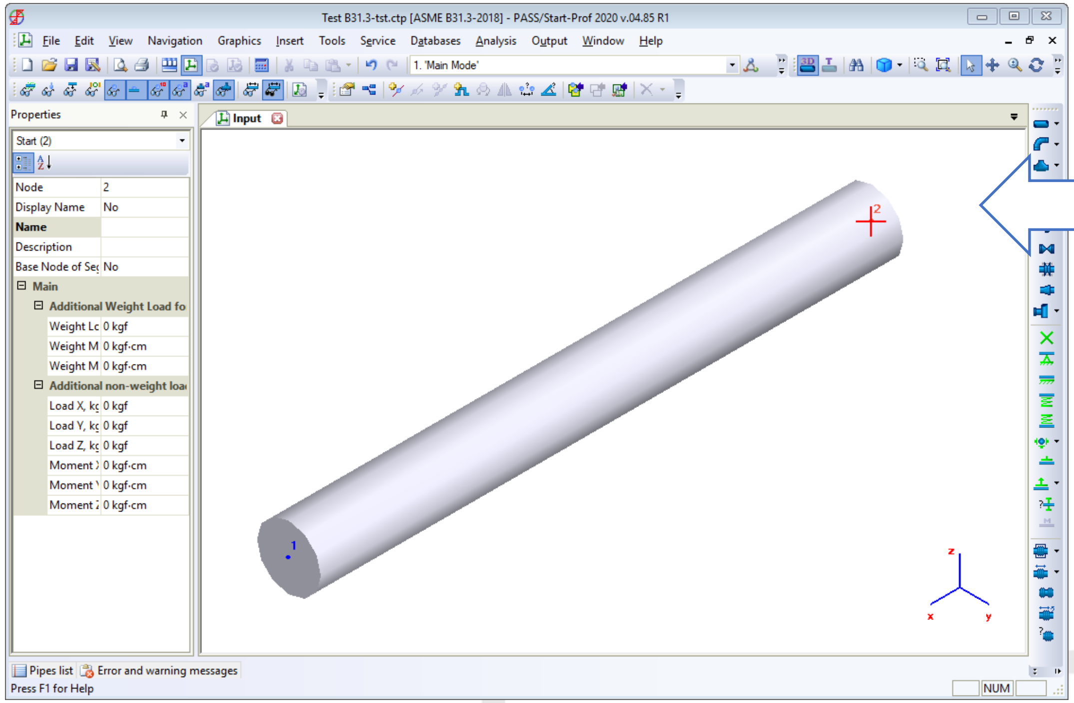
PASS/START-PROF | API Interface

Now we offer the PASS/START-PROF **API (application programming interface)** that allows for side applications on **C#**, **Basic, etc.** to create, modify and analyze models using START-PROF and read the analysis results.

The plugins for **Export to PCF**, **Import from PCF**, **Export to CAESAR II**, **Import from CAESAR II**, **Import from AVEVA**, **Internal quality assurance software** were written with the help of PASS/START-PROF API.

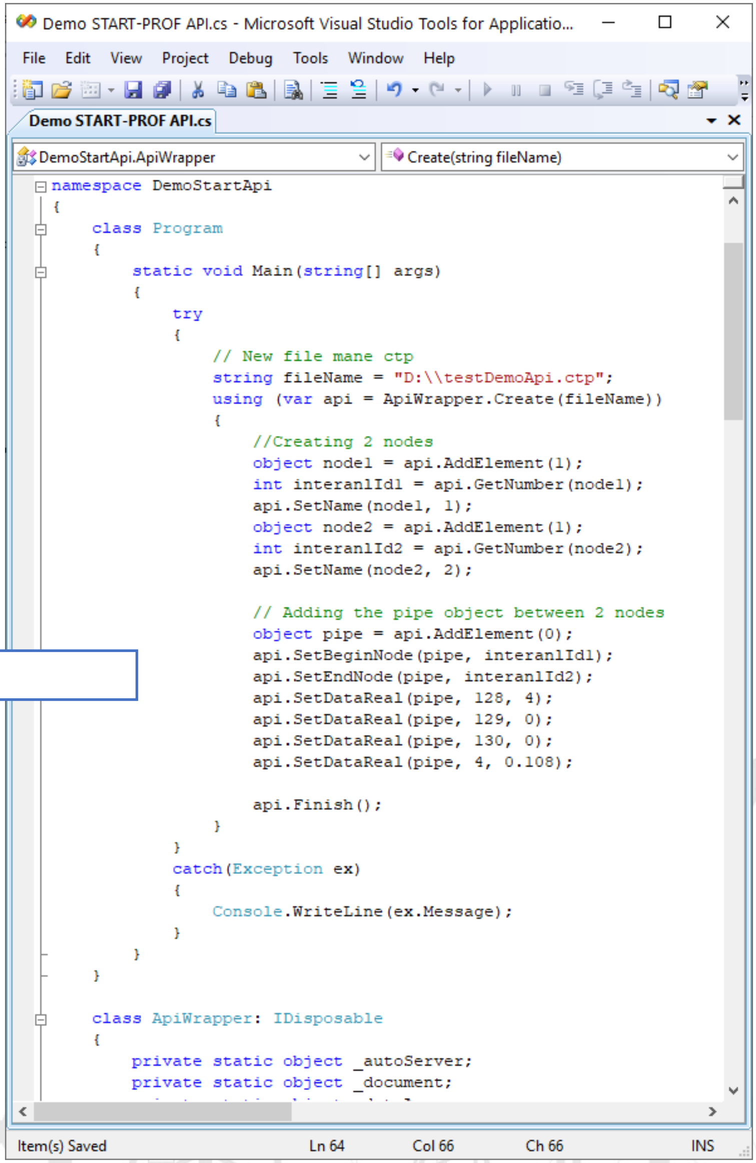
Any company can create its own plugin for seamless integration of PASS/START-PROF software into company's workflow.

- Invoke PASS/START-PROF stress analysis from 3D modeling software in background and transfer the analysis results back or generate the reports following the corporate templates
- Data conversion between PASS/START-PROF and any other corporate software
- Piping model optimization or running complex sequences of parametric model piping stress analysis
- And so on…



Start (2)

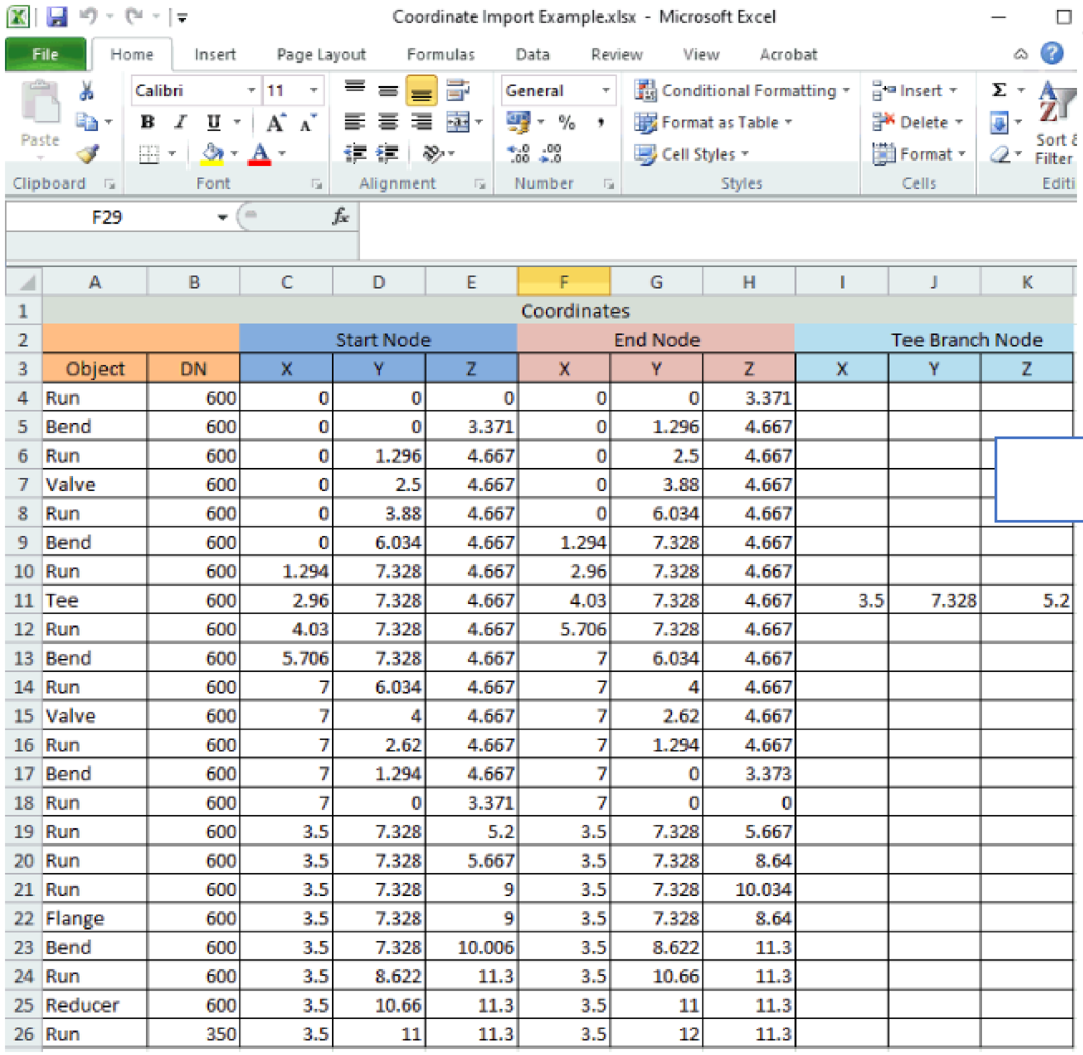
Node	2
Display Name	No
Name	
Description	
Base Node of Se	No
⊟ **Main**	
⊟ **Additional Weight Load fo**	
Weight Lc	0 kgf
Weight M	0 kgf·cm
Weight M	0 kgf·cm
⊟ **Additional non-weight loa**	
Load X, kg	0 kgf
Load Y, kg	0 kgf
Load Z, kg	0 kgf
Moment X	0 kgf·cm
Moment Y	0 kgf·cm
Moment Z	0 kgf·cm



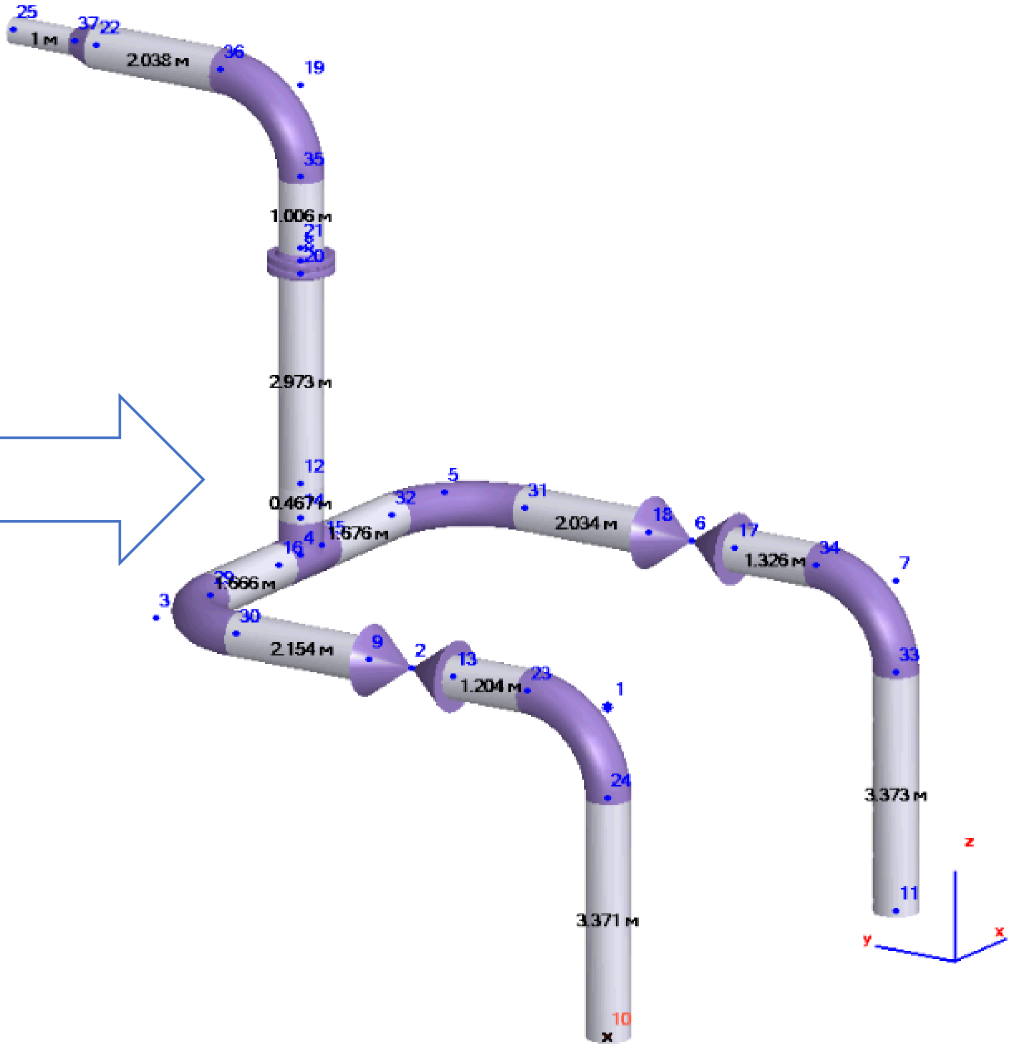
```
namespace DemoStartApi
{
    class Program
    {
        static void Main(string[] args)
        {
            try
            {
                // New file mane ctp
                string fileName = "D:\\testDemoApi.ctp";
                using (var api = ApiWrapper.Create(fileName))
                {
                    //Creating 2 nodes
                    object node1 = api.AddElement(1);
                    int interanlId1 = api.GetNumber(node1);
                    api.SetName(node1, 1);
                    object node2 = api.AddElement(1);
                    int interanlId2 = api.GetNumber(node2);
                    api.SetName(node2, 2);

                    // Adding the pipe object between 2 nodes
                    object pipe = api.AddElement(0);
                    api.SetBeginNode(pipe, interanlId1);
                    api.SetEndNode(pipe, interanlId2);
                    api.SetDataReal(pipe, 128, 4);
                    api.SetDataReal(pipe, 129, 0);
                    api.SetDataReal(pipe, 130, 0);
                    api.SetDataReal(pipe, 4, 0.108);

                    api.Finish();
                }
            }
            catch(Exception ex)
            {
                Console.WriteLine(ex.Message);
            }
        }
    }

    class ApiWrapper: IDisposable
    {
        private static object _autoServer;
        private static object _document;
```

PASS/START-PROF | Import from Excel & AutoCAD

New integration options: import from MS Excel

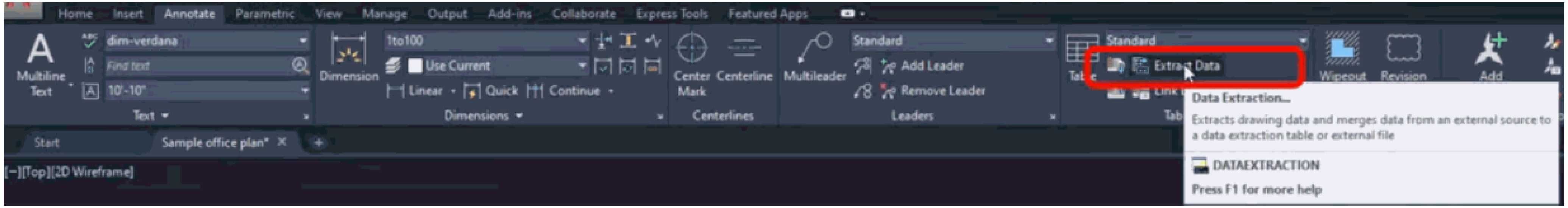


	A	B	C	D	E	F	G	H	I	J	K
1	Coordinates										
2			Start Node			End Node			Tee Branch Node		
3	Object	DN	X	Y	Z	X	Y	Z	X	Y	Z
4	Run	600	0	0	0	0	0	3.371			
5	Bend	600	0	0	3.371	0	1.296	4.667			
6	Run	600	0	1.296	4.667	0	2.5	4.667			
7	Valve	600	0	2.5	4.667	0	3.88	4.667			
8	Run	600	0	3.88	4.667	0	6.034	4.667			
9	Bend	600	0	6.034	4.667	1.294	7.328	4.667			
10	Run	600	1.294	7.328	4.667	2.96	7.328	4.667			
11	Tee	600	2.96	7.328	4.667	4.03	7.328	4.667	3.5	7.328	5.2
12	Run	600	4.03	7.328	4.667	5.706	7.328	4.667			
13	Bend	600	5.706	7.328	4.667	7	6.034	4.667			
14	Run	600	7	6.034	4.667	7	4	4.667			
15	Valve	600	7	4	4.667	7	2.62	4.667			
16	Run	600	7	2.62	4.667	7	1.294	4.667			
17	Bend	600	7	1.294	4.667	7	0	3.373			
18	Run	600	7	0	3.371	7	0	0			
19	Run	600	3.5	7.328	5.2	3.5	7.328	5.667			
20	Run	600	3.5	7.328	5.667	3.5	7.328	8.64			
21	Run	600	3.5	7.328	9	3.5	7.328	10.034			
22	Flange	600	3.5	7.328	9	3.5	7.328	8.64			
23	Bend	600	3.5	7.328	10.006	3.5	8.622	11.3			
24	Run	600	3.5	8.622	11.3	3.5	10.66	11.3			
25	Reducer	600	3.5	10.66	11.3	3.5	11	11.3			
26	Run	350	3.5	11	11.3	3.5	12	11.3			



PASS/START-PROF | Import from Excel & AutoCAD

New integration options: import from AutoCAD

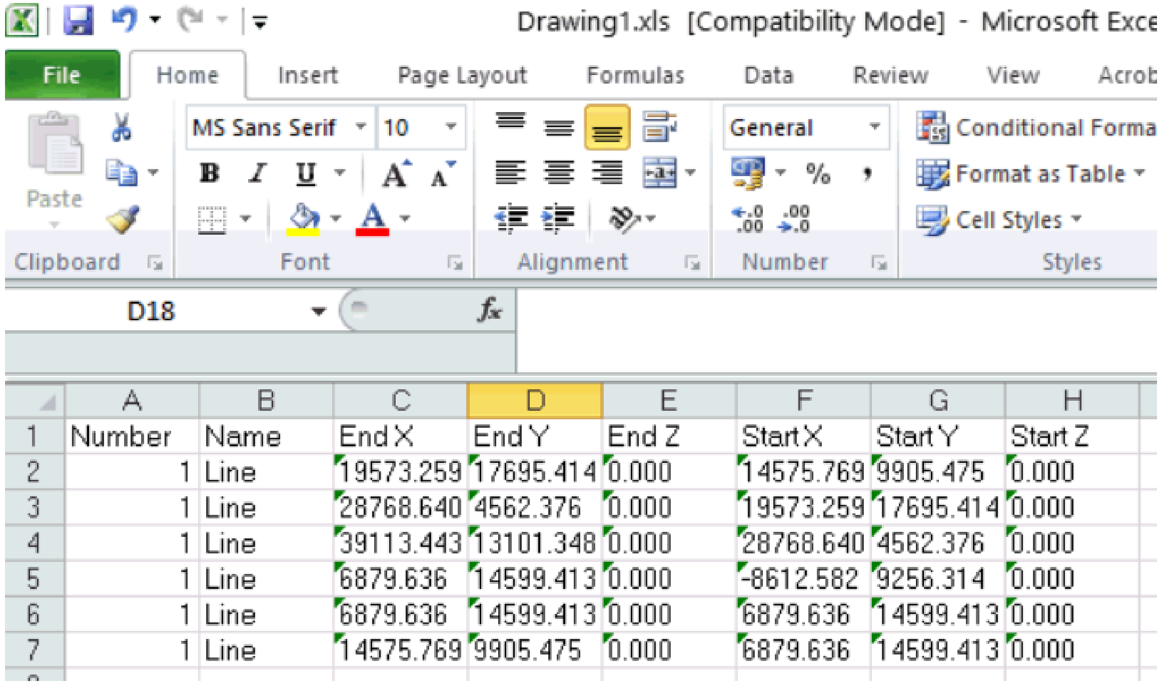


Data Extraction...

Extracts drawing data and merges data from an external source to a data extraction table or external file

DATAEXTRACTION

Press F1 for more help



	A	B	C	D	E	F	G	H
1	Number	Name	End X	End Y	End Z	Start X	Start Y	Start Z
2	1	Line	19573.259	17695.414	0.000	14575.769	9905.475	0.000
3	1	Line	28768.640	4562.376	0.000	19573.259	17695.414	0.000
4	1	Line	39113.443	13101.348	0.000	28768.640	4562.376	0.000
5	1	Line	6879.636	14599.413	0.000	-8612.582	9256.314	0.000
6	1	Line	6879.636	14599.413	0.000	6879.636	14599.413	0.000
7	1	Line	14575.769	9905.475	0.000	6879.636	14599.413	0.000

PASS/START-PROF | Features

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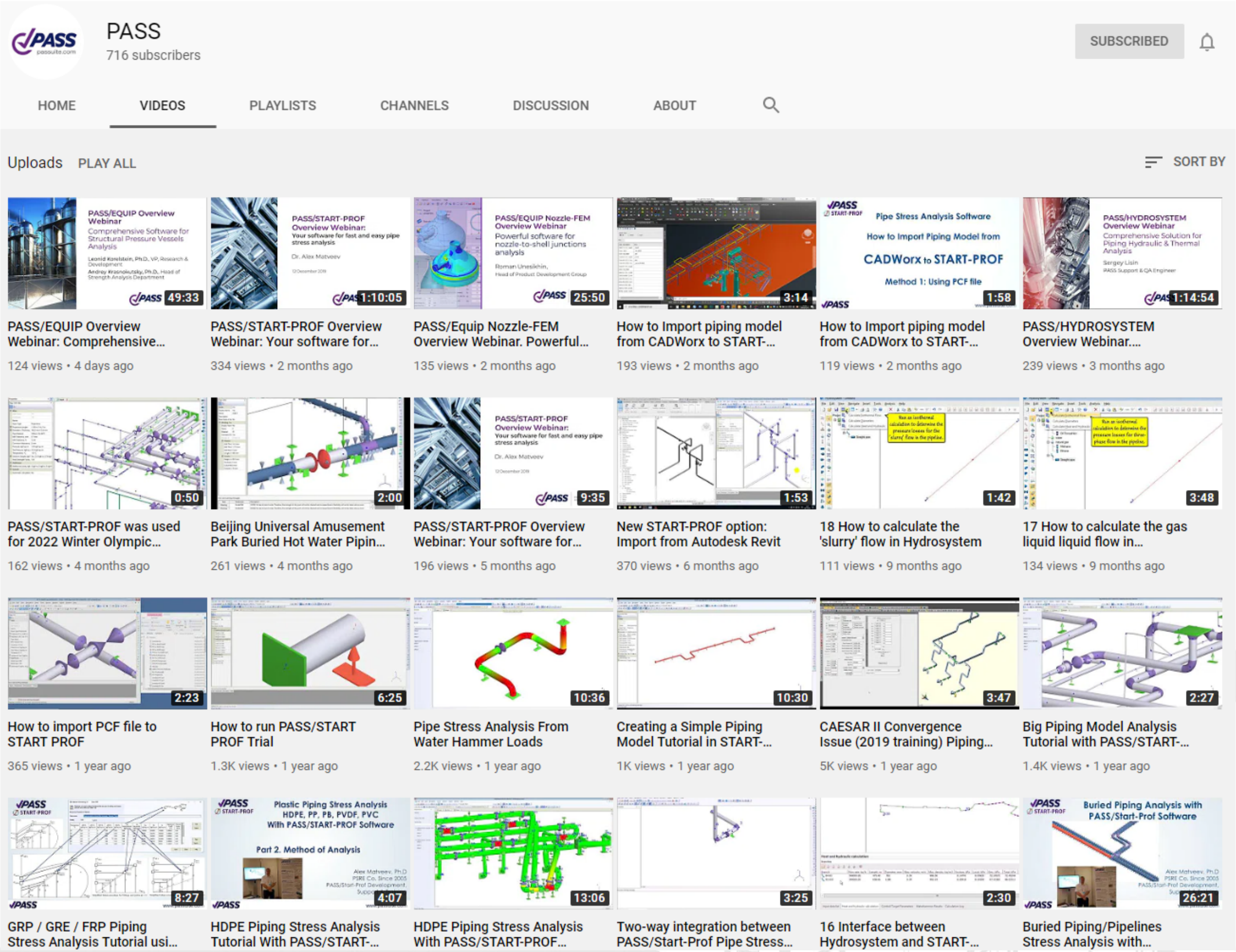

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Buried Piping/Pipelines Stress Analysis with...
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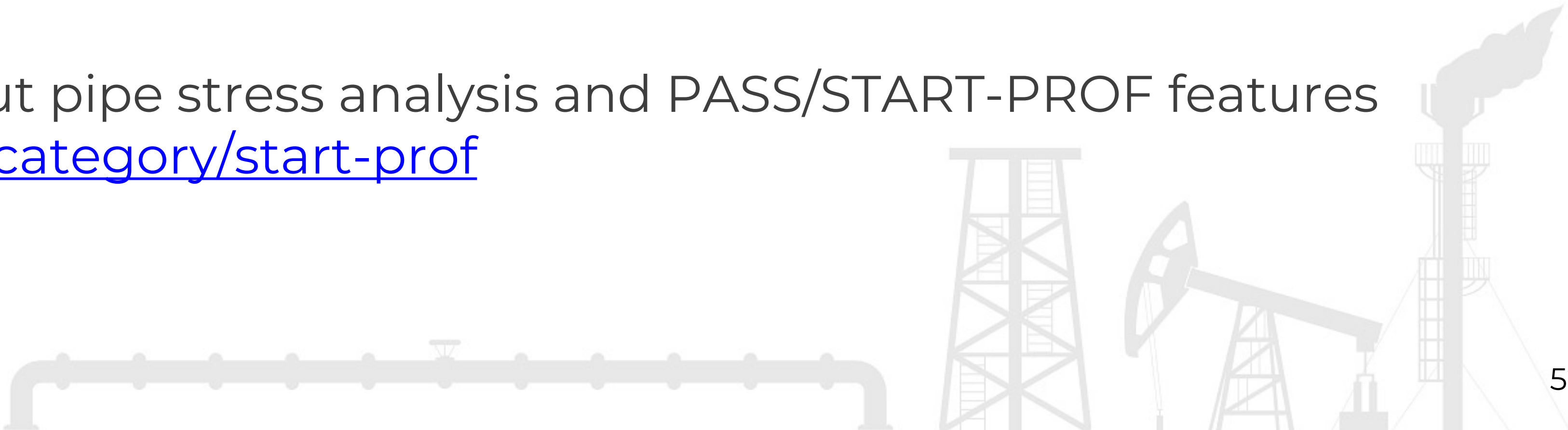
- Twitter: twitter.com/passuitecom
- More than 50 articles about pipe stress analysis and PASS/START-PROF features https://whatispiping.com/category/start-prof



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