Process and Power Piping. Increase Productivity and Save your Time Twice with PASS/START-PROF 4.84

Dr. Alex Matveev,
START-PROF Product Owner

PASS
PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

PASS/START-PROF

Smart Pipe Stress Analysis & Optimal Sizing

Presenter:

Dr. Alex Matveev

START-PROF Product Owner

Development, Training, Support of START-PROF Since 2005

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PASS PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

Webinar Agenda – Part 1

- Quick introduction of PASS/START-PROF
- Supported codes for power and process piping
- Integration capabilities
- Object-oriented piping model creation principle
- Piping object types: pipe, tees, bends, reducers, etc.
- Equipment objects: Nozzle, Tank Nozzle, Pump, In-line Pump, Turbine, Compressor, Air cooler, Fired heater
- Expansion joint objects
- Databases, ASME B31J, Creep self-springing effect, wind, ice, snow, seismic loads

Webinar Agenda – Part 2

- Minimum design metal temperature (MDMT) according to 323.2.2 (a)-(j) ASME B31.3
- Alternative occasional allowable stress 302.3.6 ASME B31.3
- Creep-Rupture usage factor, Appendix V ASME B31.3
- FRP/GRP/GRE piping analysis
- Pipe and fittings wall thickness calculation
- Operation mode editor. Load cases
- Analysis reports: Stress in piping, Stress in insulation, Seismic stress, Flaw stress, Restraint loads, Equipment loads, Displacements, Expansion joints check, variable spring selection, constant spring selection, buckling analysis, flange leakage
- Special features

PASS/Start-Prof

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

PASS
PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

Quick Pipe Stress Analysis & Optimal Sizing

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

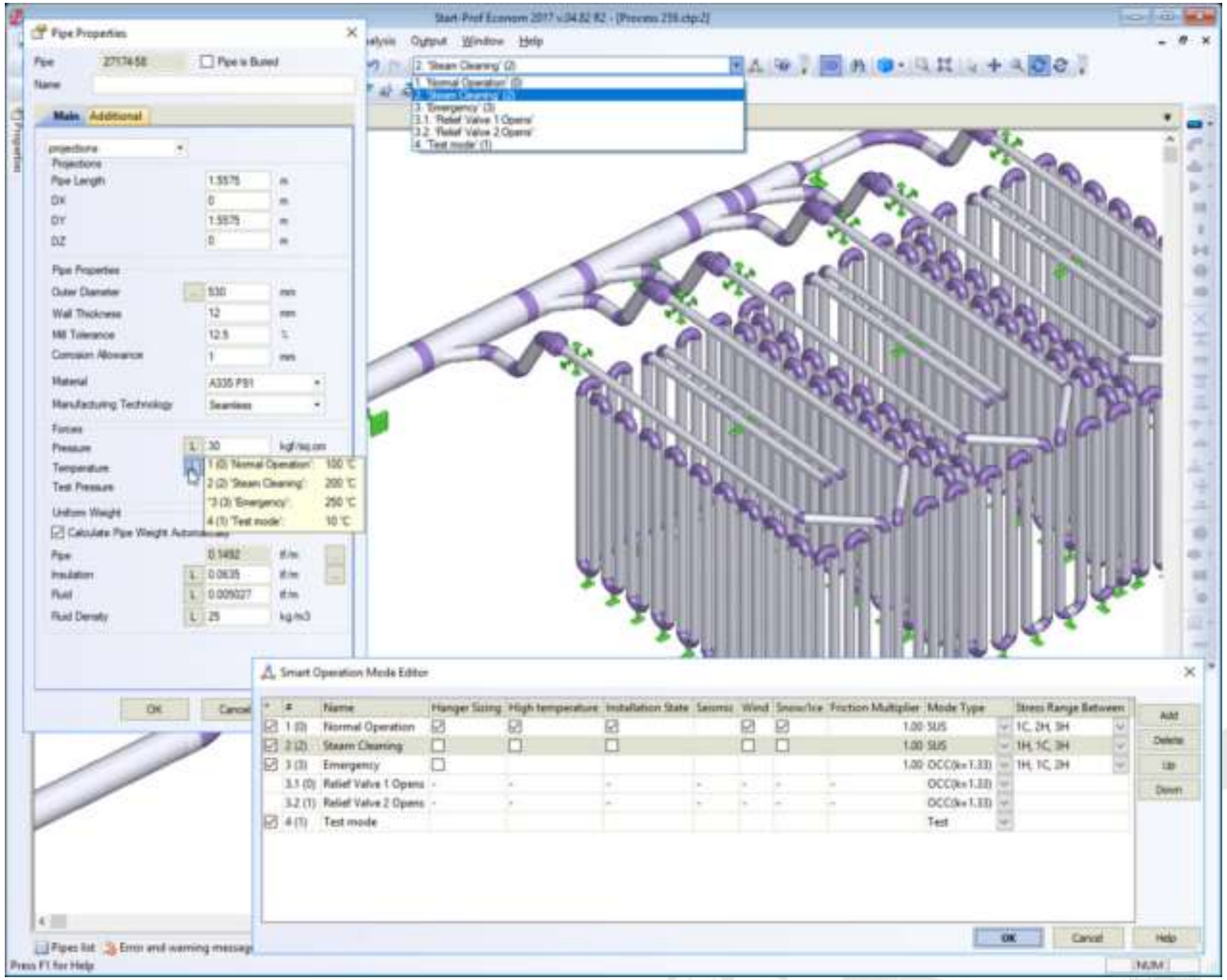
PASS/Start-Prof | Broad Applicability

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




PASS/Start-Prof | Features

- PASS/START-PROF for Process and Power Piping Stress Analysis
- Increase your Productivity and Save your Time
- Save your Money (we have a friendly pricing policy)
- Increase the Accuracy of Pipe Stress Analysis



PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

PASS/Start-Prof | Broad Applicability

- Developed since 1965
- 2000+ Active users (companies). Licenses 8000+
- User interface and documentation languages: English, Chinese, Russian
- Piping codes: 32
- Wind, Seismic, Snow, Ice codes: 18

PASS/Start-Prof | Our Customers

ROSNEFT

TechnipFMC

LUKOIL OIL COMPANY

GAZPROM NEFT

GAZPROM

UNG O'ZLITINEFTGAZ

CEEC CHINA POWER ENGINEERING CONSULTING GROUP NORTHWEST ELECTRIC POWER DESIGN INSTITUTE CO.,LTD.

中国石油天然气股份有限公司 PetroChina Company Limited

SNC·LAVALIN

Northern Reflections DESIGN AND DRAFTING

TRANSNEFT

КазМунайГаз

Severstal

WorleyParsons resources & energy

Caspian Pipeline Consortium

Tecnimont

THE LINDE GROUP

NOVATEK

KEPCO

SIBUR

KazTransOil

SEPA MÜHENDİSLİK & MÜŞAVİRLİK ENGINEERING & CONSULTING

thyssenkrupp

E&R

DAELIM

MITSUBISHI HEAVY INDUSTRIES AMERICA, INC.

PASS PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

PASS/Start-Prof | Features

- First hand quick response from experienced piping engineers in UK, China, Mexico, Brazil, Australia, Egypt, Turkey and others
- Direct support from developers via e-mail is available
- Easy to learn, fast and simple to work with for a new pipe stress analyst
- Due to intuitive modern object-oriented user interface, you can start working immediately. Companies can put PASS/START-PROF into application immediately after purchase, significantly reducing costs and save the time without compromising on the quality of end results

PASS/Start-Prof | Features

PASS/START-PROF is a part of PASS Suite:

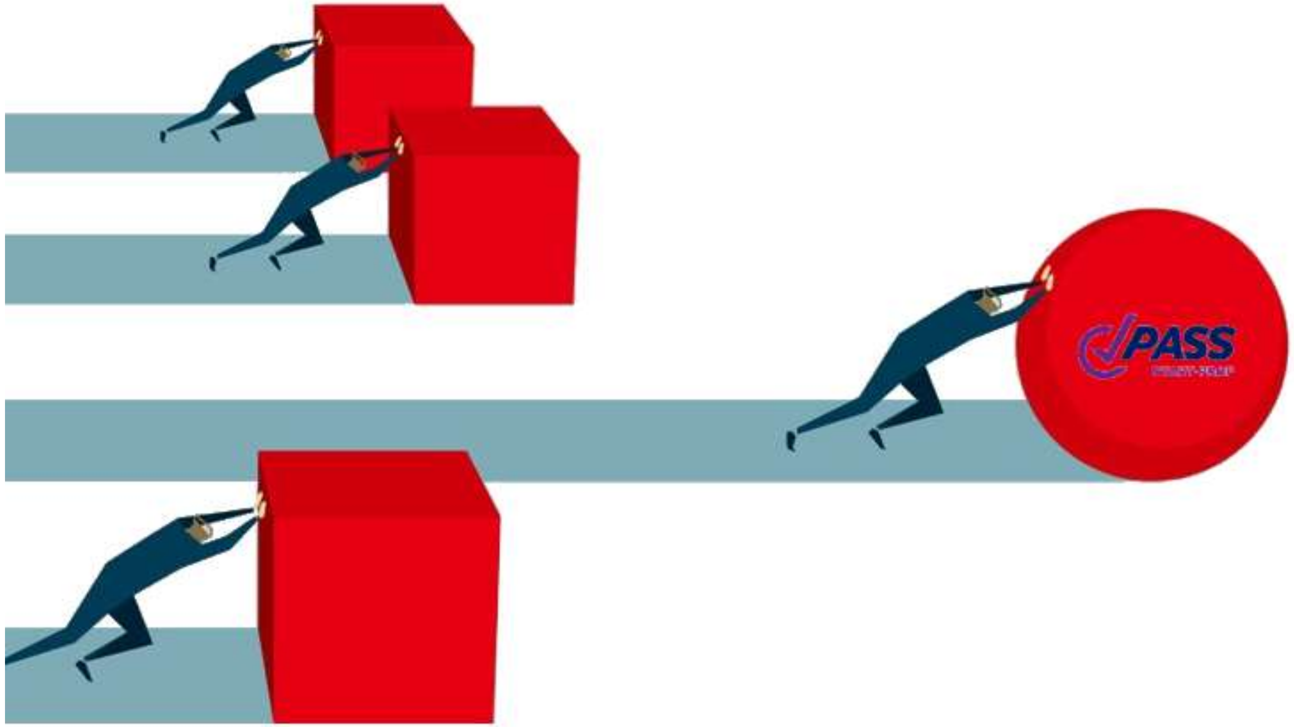
- PASS/START-PROF – Pipe Stress Analysis Software
- PASS/HYDROSYSTEM – Piping hydraulic and Thermal Analysis Software
- PASS/ NOZZLE-FEM – Nozzle to Shell Junction Finite Element Analysis Software. Calculate SIF, k-factors, Nozzle Flexibility and Stress Analysis, etc.
- PASS/EQUIP – Pressure Vessel, Column, Heat Exchanger, Tank Design and Analysis Software

PASS/Start-Prof | Increase Productivity

PASS/START-PROF is a Professional Modern Pipe Stress Analysis Software

PASS/START-PROF Makes Complex Things Simple

You will Get the Same Result, but Faster and Easier



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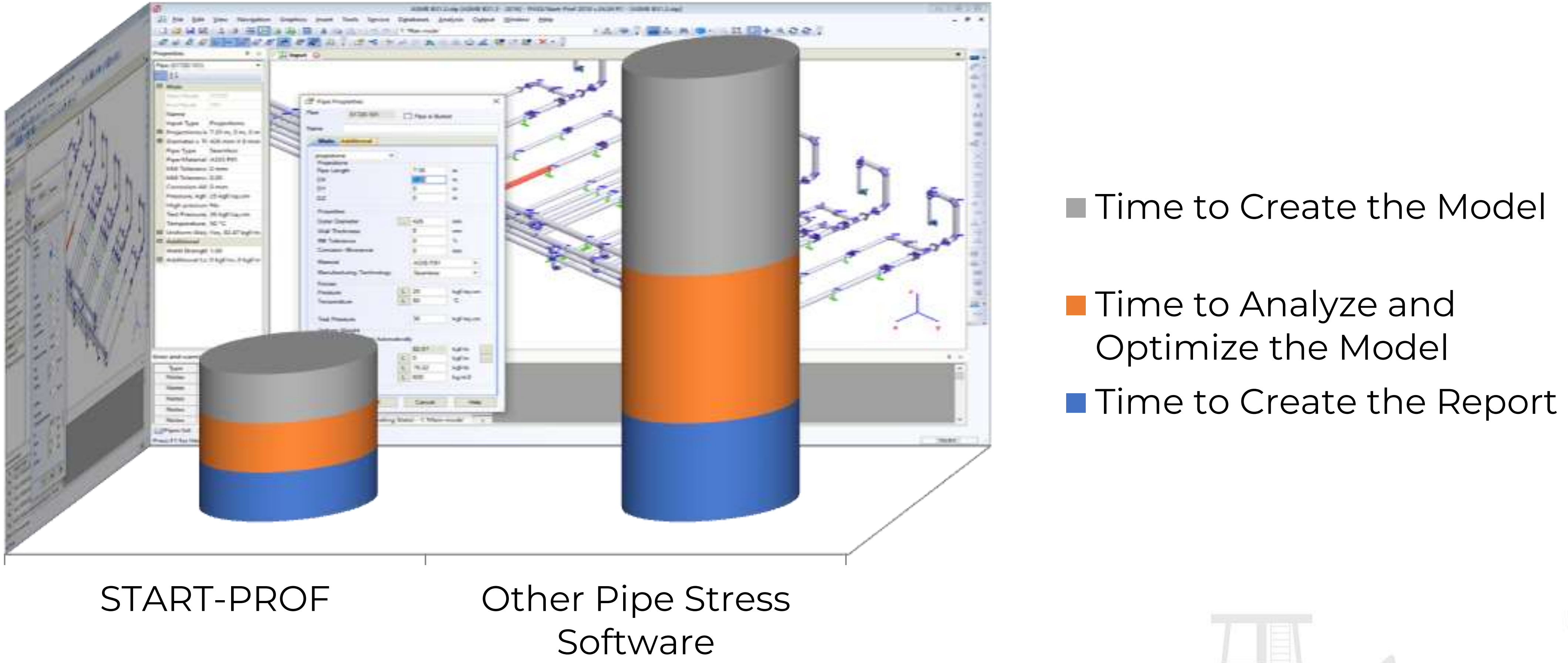
ANALYSIS & SIZING SUITE

PASS/Start-Prof |How START-PROF Saves your Time



PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

PASS/Start-Prof | Interfaces with Other Software

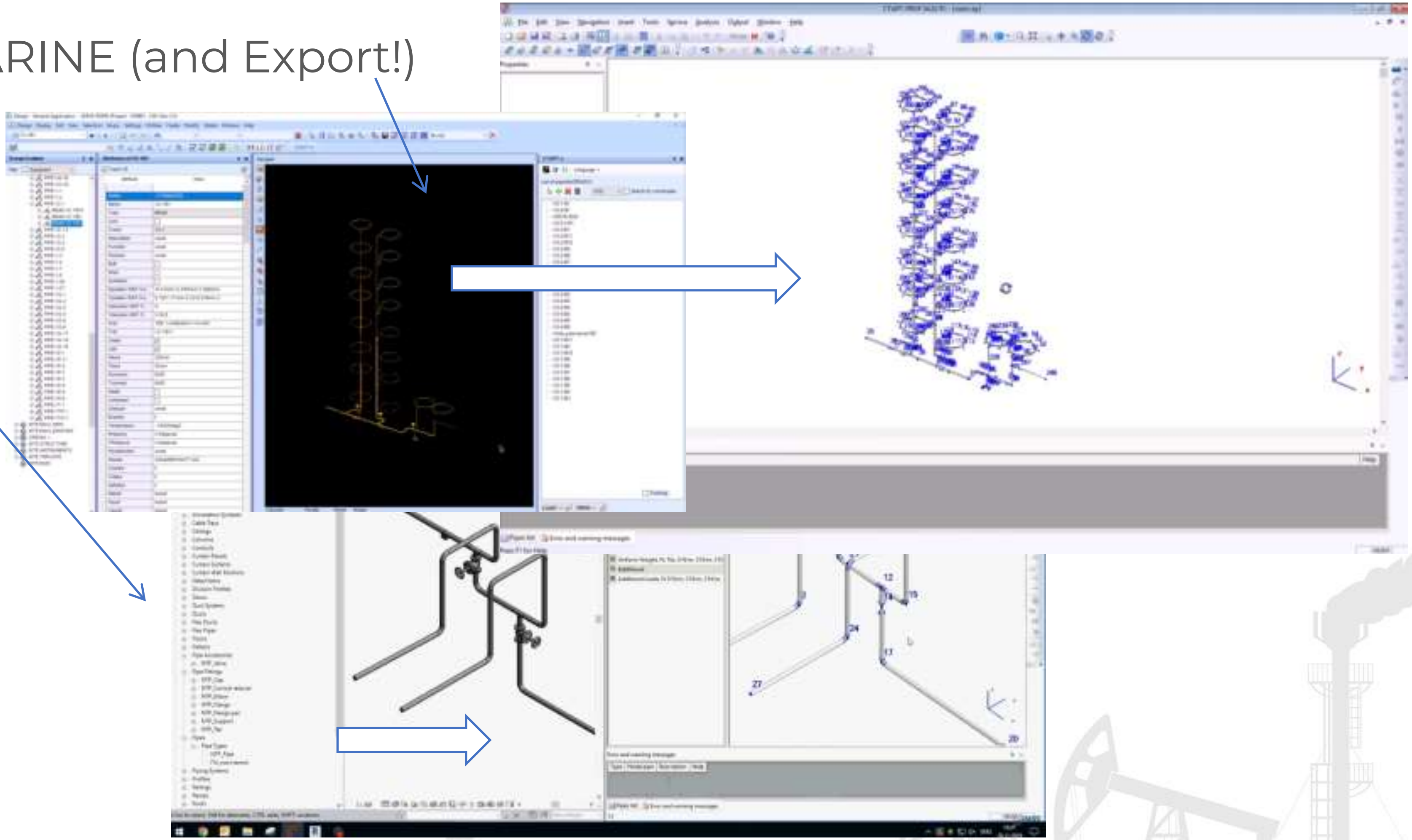
PASS/START-PROF can analyze piping according to 32 piping codes.
The software contains all needed and latest codes for Power and Process Industry:

- ASME B31.1
- ASME B31.3
- ASME B31.12
- EN 13480
- DL/T 5366 (China)
- GB 50316 (China)
- GB 20801 (China)
- RD 10-249-98 (Russia)
- GOST 32388 (Russia)
- ISO 14692 FRP/GRP/GRE
- Thermoplastic Piping (HDPE, PVC, PP, PVDF)

PASS/Start-Prof | Interfaces with Other Software

PASS/START-PROF can Import the Piping Models from

- AVEVA PDMS, E3D, MARINE (and Export!)
- SmartPlant 3D
- Autodesk Revit
- OpenPlant
- AutoPlant
- CADWorx
- Smart 3D
- CAESAR II
- Autopipe
- PASS/HYDROSYSTEM
- PCF



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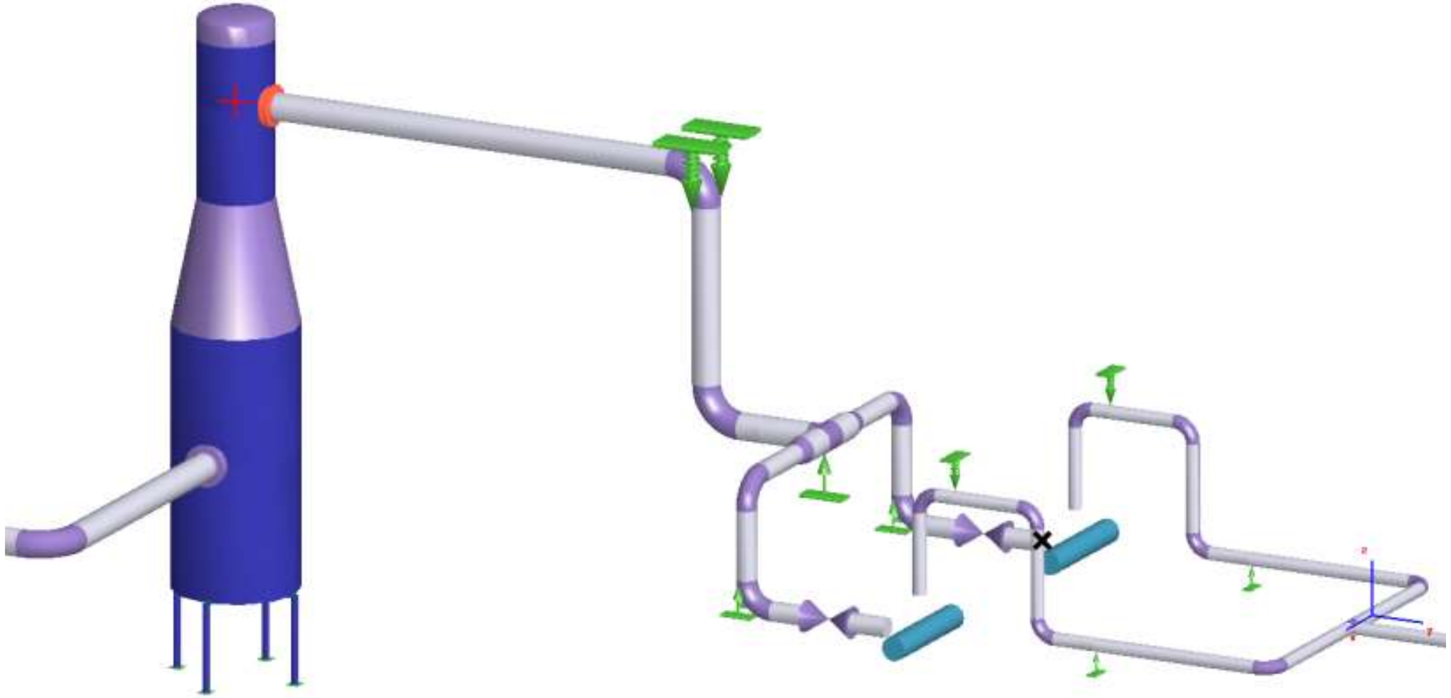
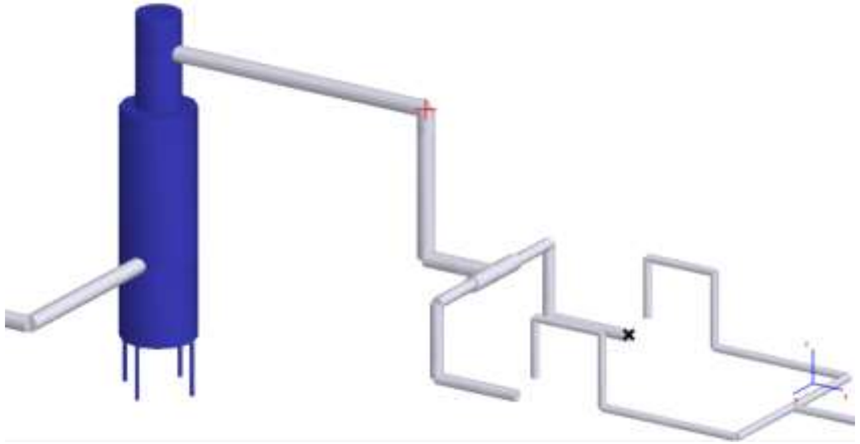
PASS/Start-Prof | Piping Model Creation

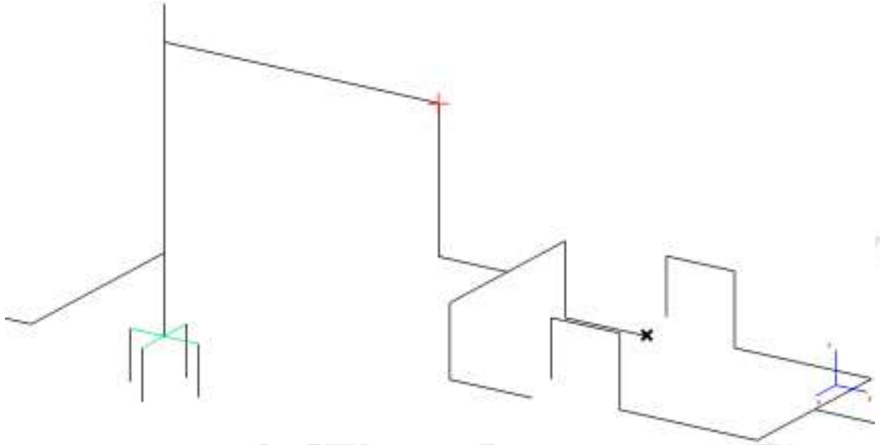
In PASS/START-PROF the piping model creation is simple and straightforward.
Even a beginner will understand what to do.
Create the Piping and Equipment Model by Combining the Objects
Like LEGO

- Fast Model Creation
- Fast and Easy Existing Model Modification
- You can Add, Delete, Modify, Copy, Rotate, Mirror, Split Objects
- Work With Object Groups

PASS/Start-Prof | Piping Model Creation







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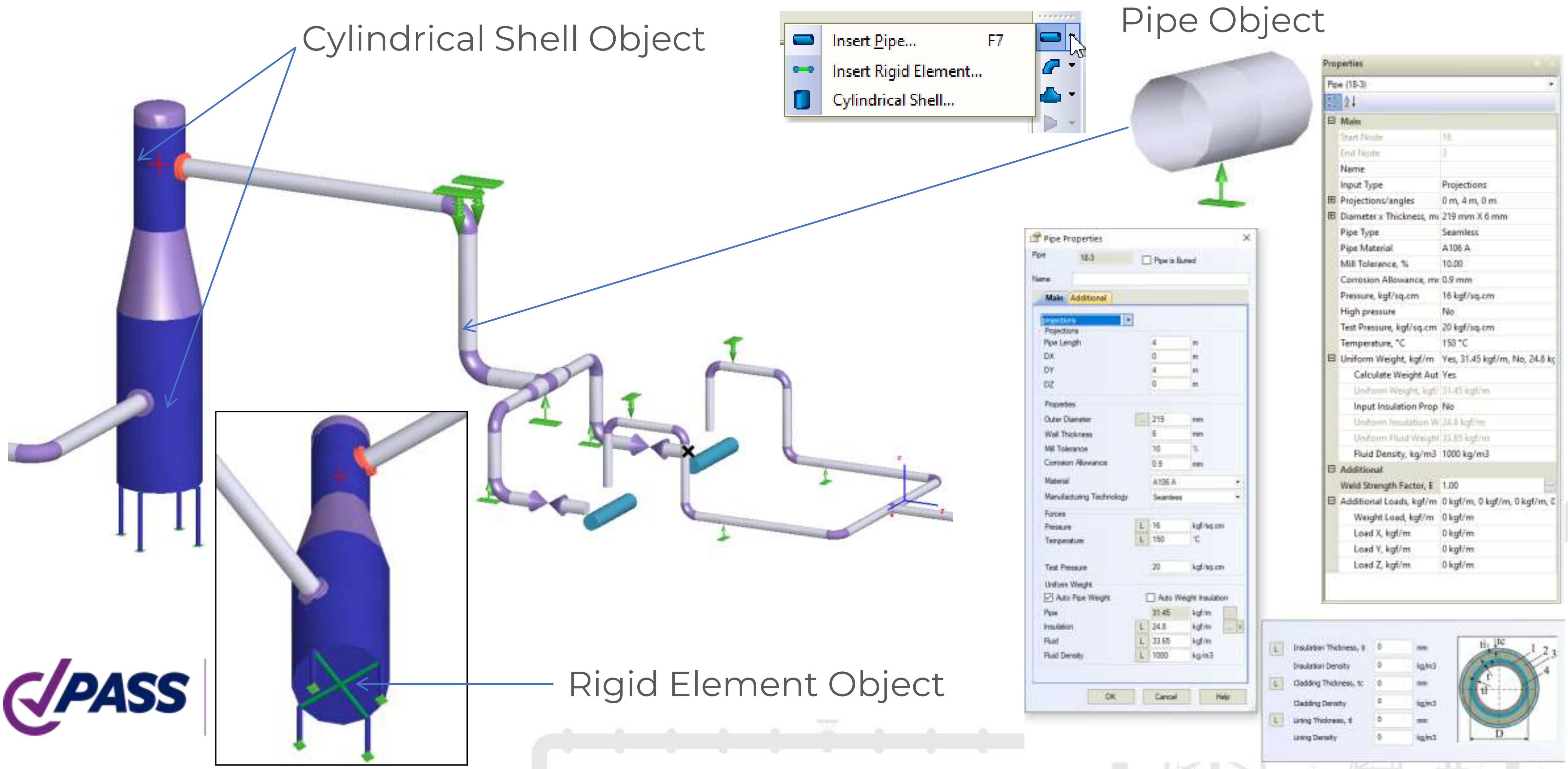
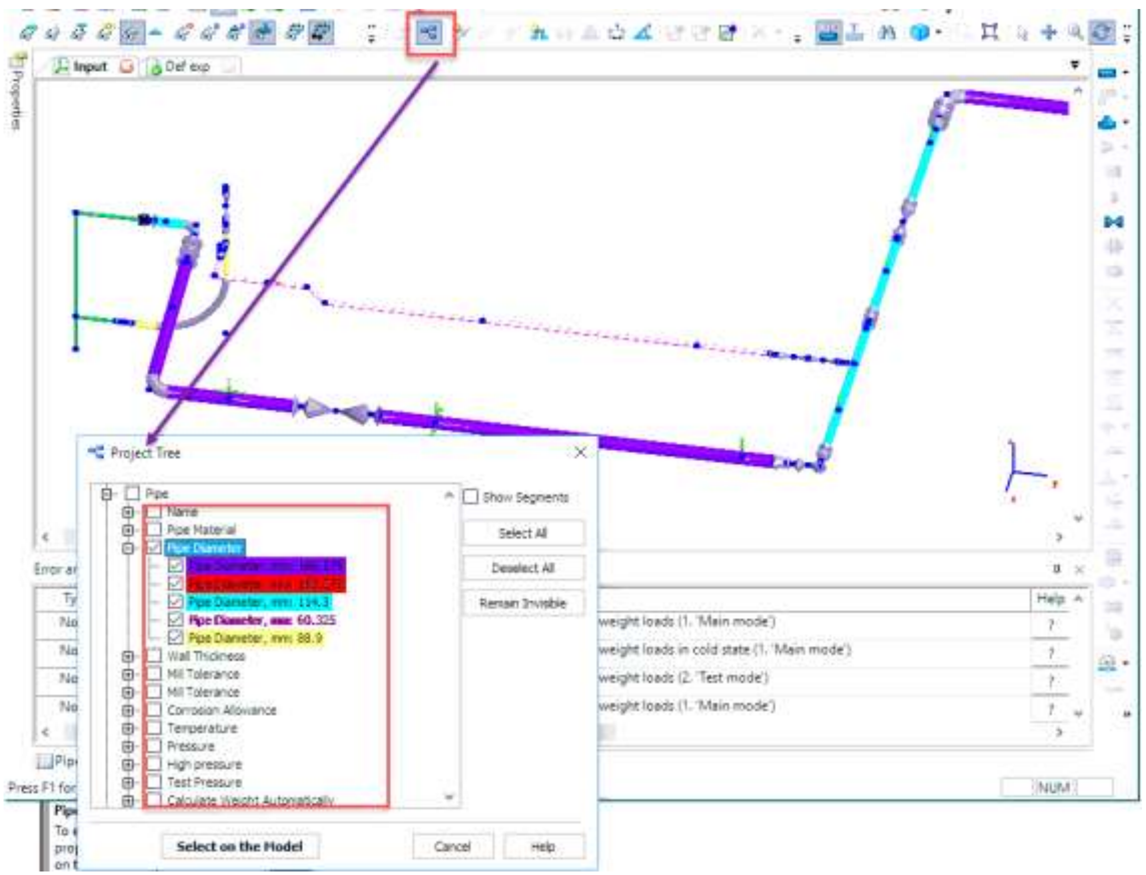
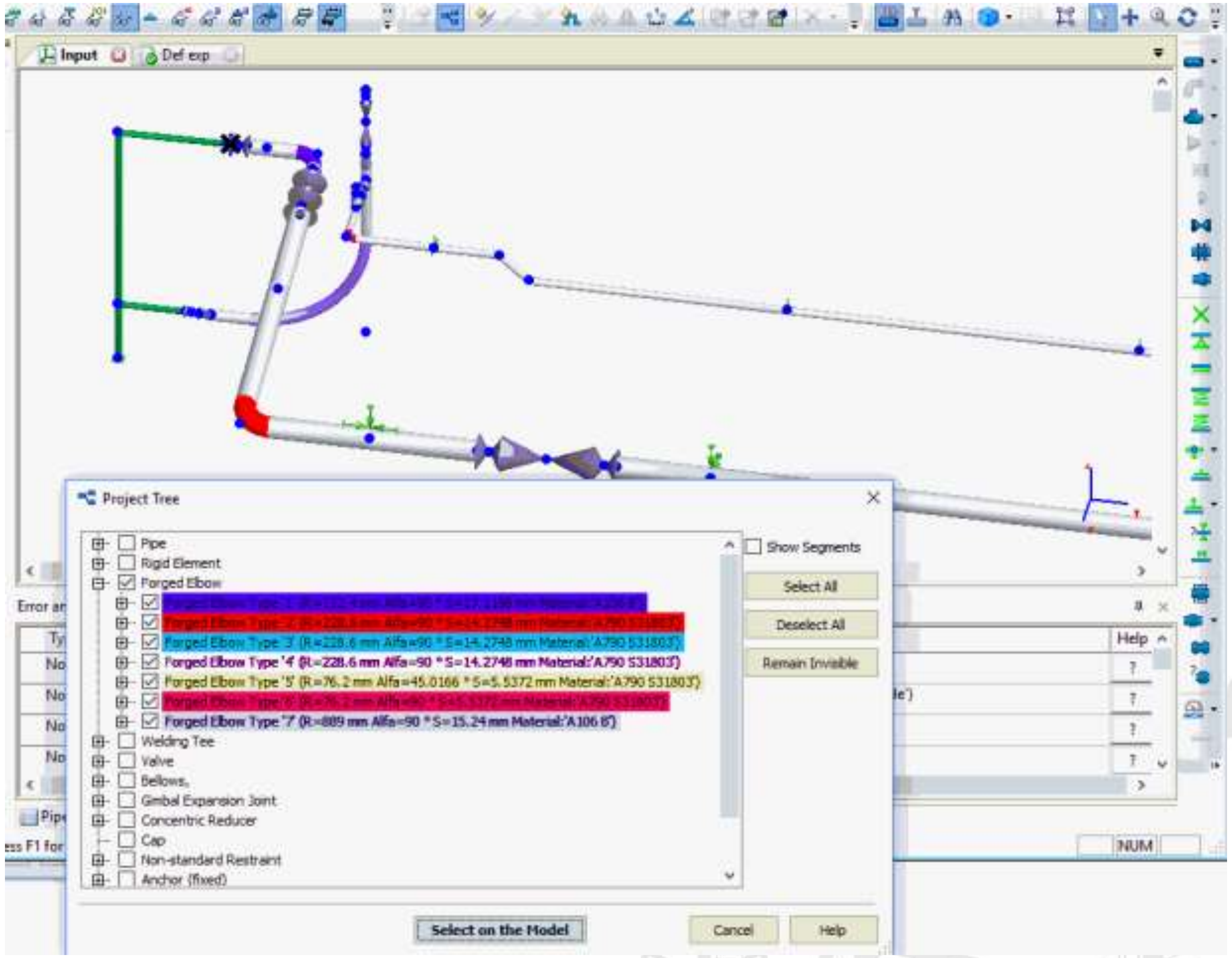
PASS/Start-Prof | Piping Model Creation



PASS/Start-Prof | Piping Model Creation

Color map for any properties of any objects: diameter, temperature, pressure, material…





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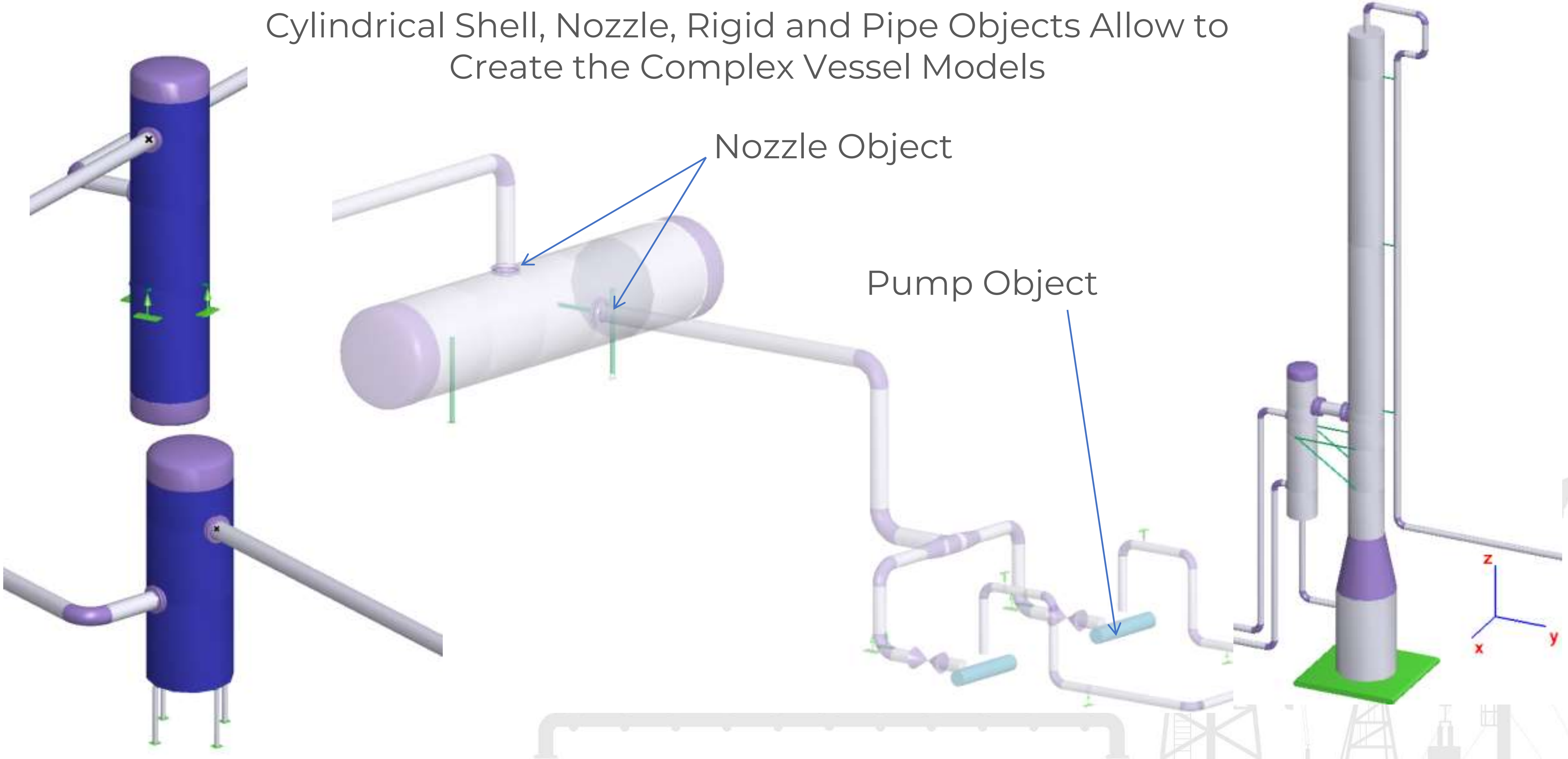
PASS/Start-Prof | Piping Model Creation

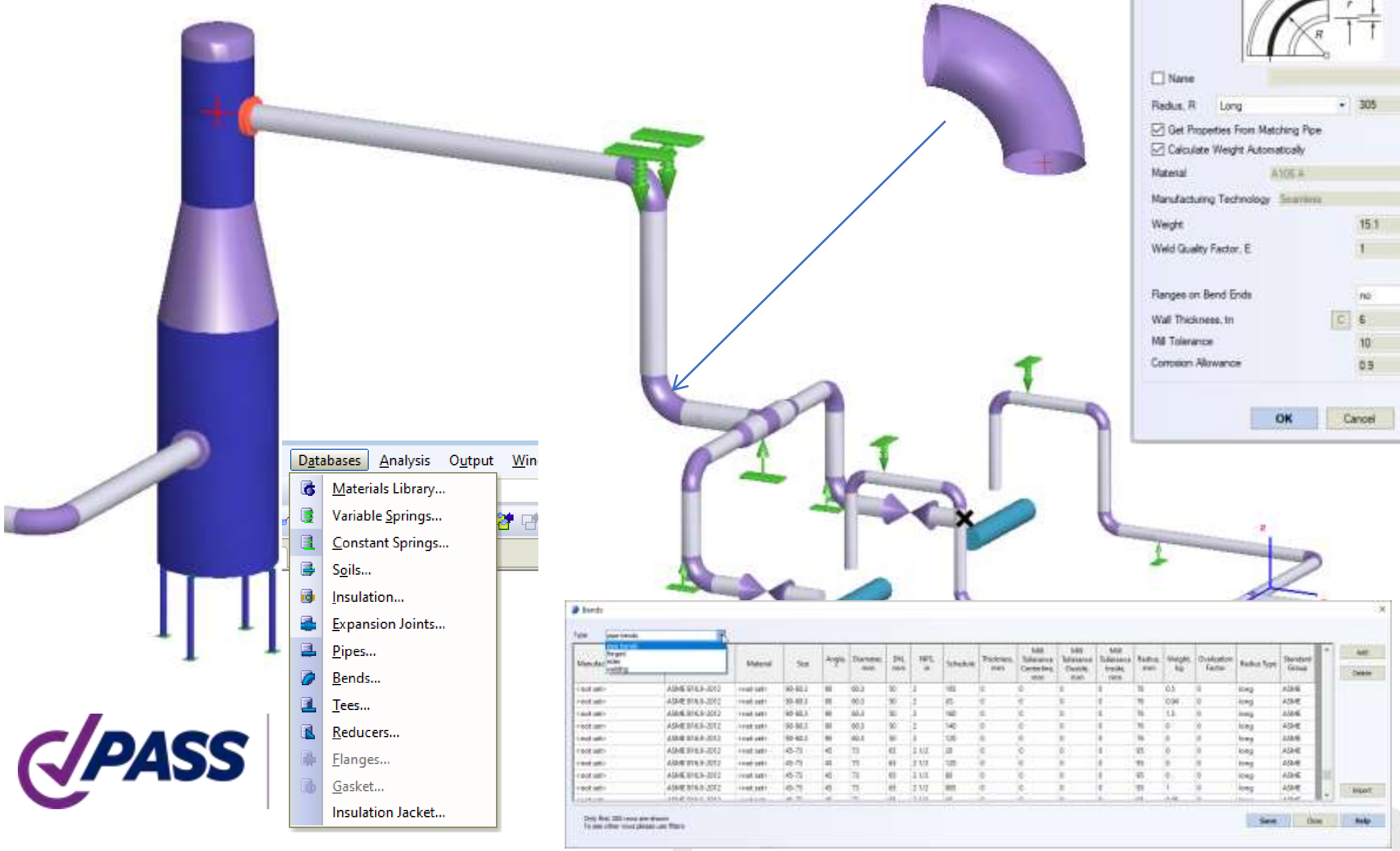
Cylindrical Shell, Nozzle, Rigid and Pipe Objects Allow to Create the Complex Vessel Models

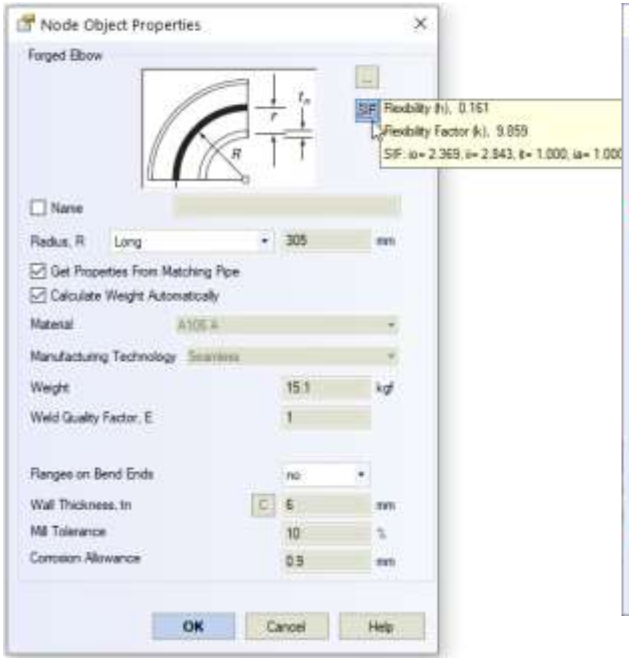


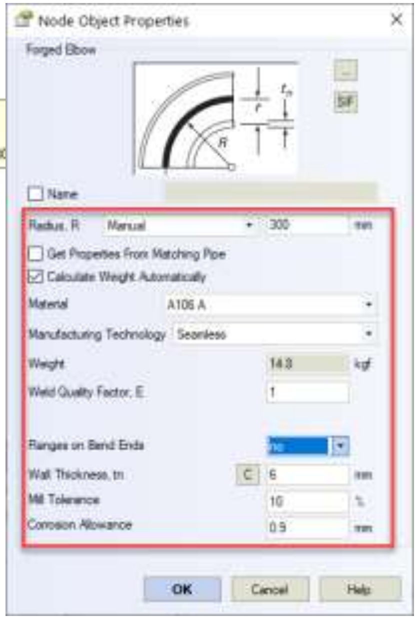
PASS/Start-Prof | Piping Model Creation

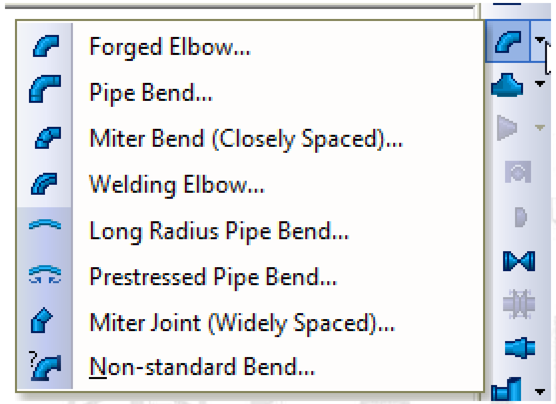
Objects can be copied, deleted, etc.

Bend Object









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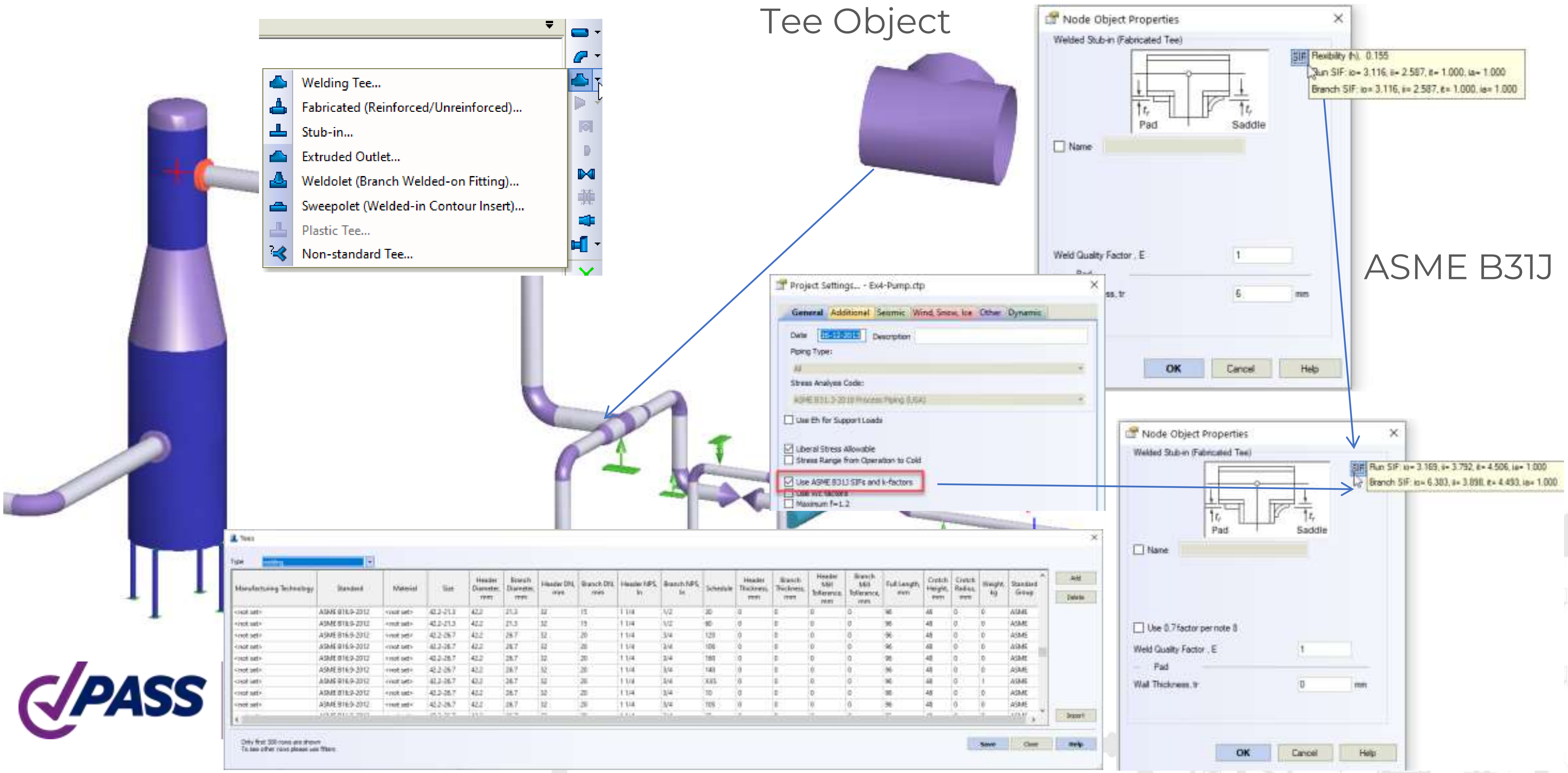


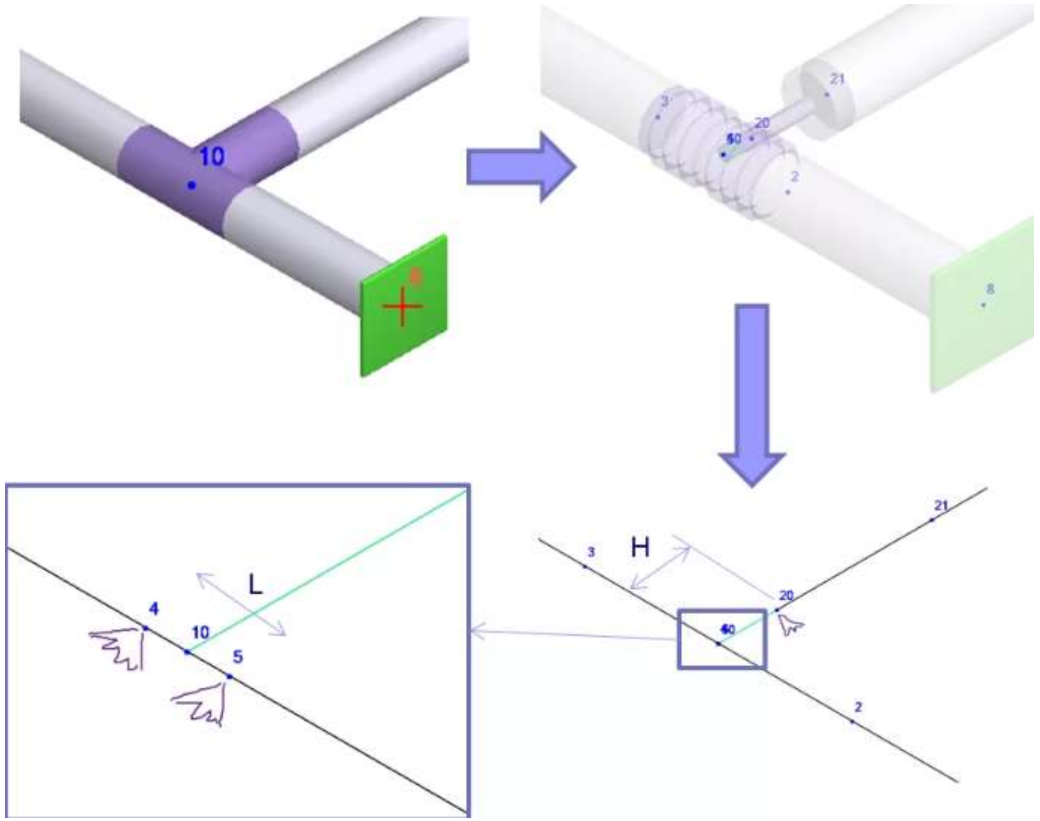
PASS/Start-Prof | Piping Model Creation

Automatic Detailed Tee Model

- Rigid Elements
- Flexibilities of Header and Branch
- Takes into Account the Wall thickness of Header and Branch

Consider SIF for Header and Branch

- According to the Code
- According to ASME B31J
- From FEA (Nozzle-FEM Software)



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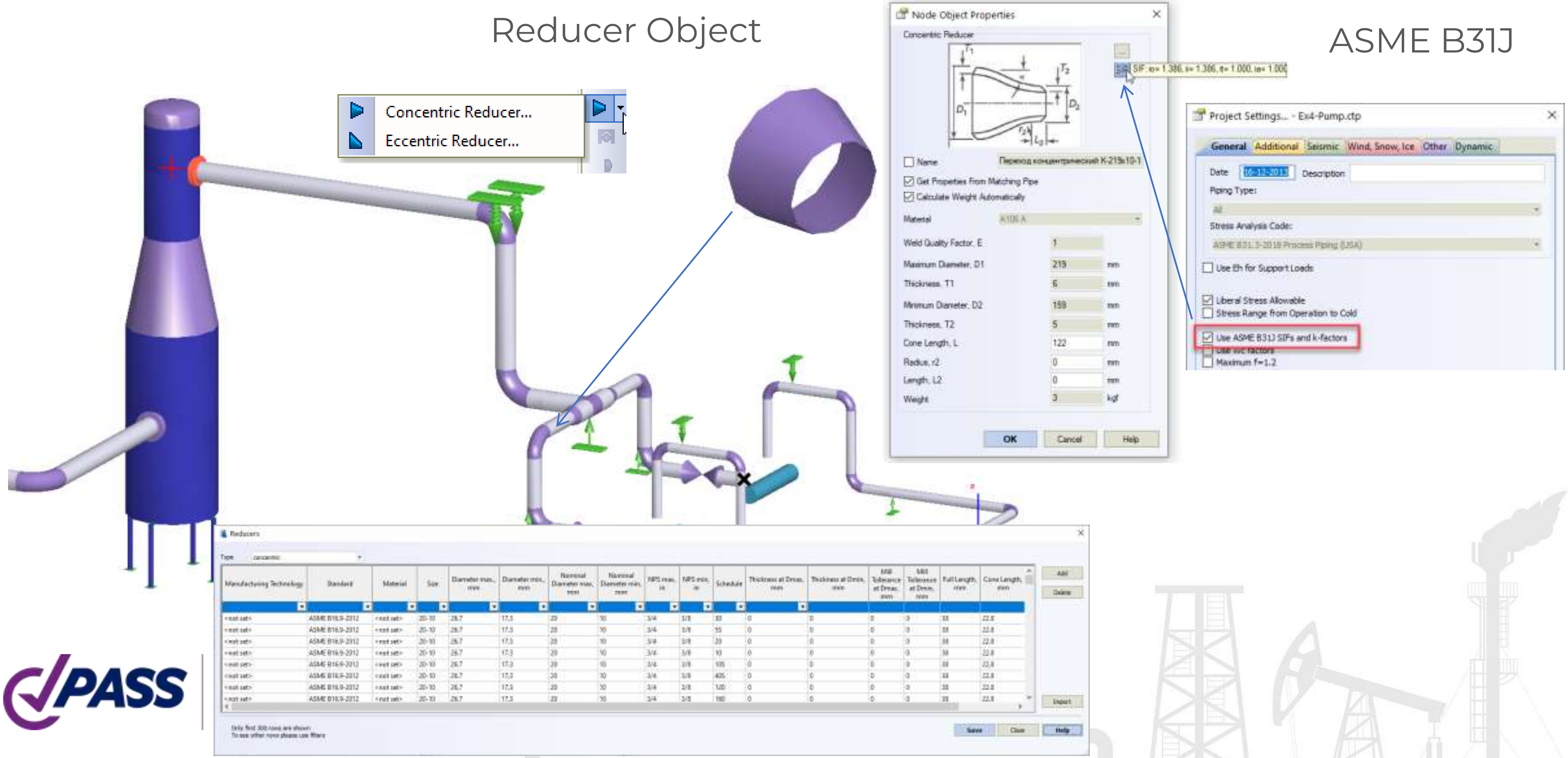
Reducer Object

ASME B31J



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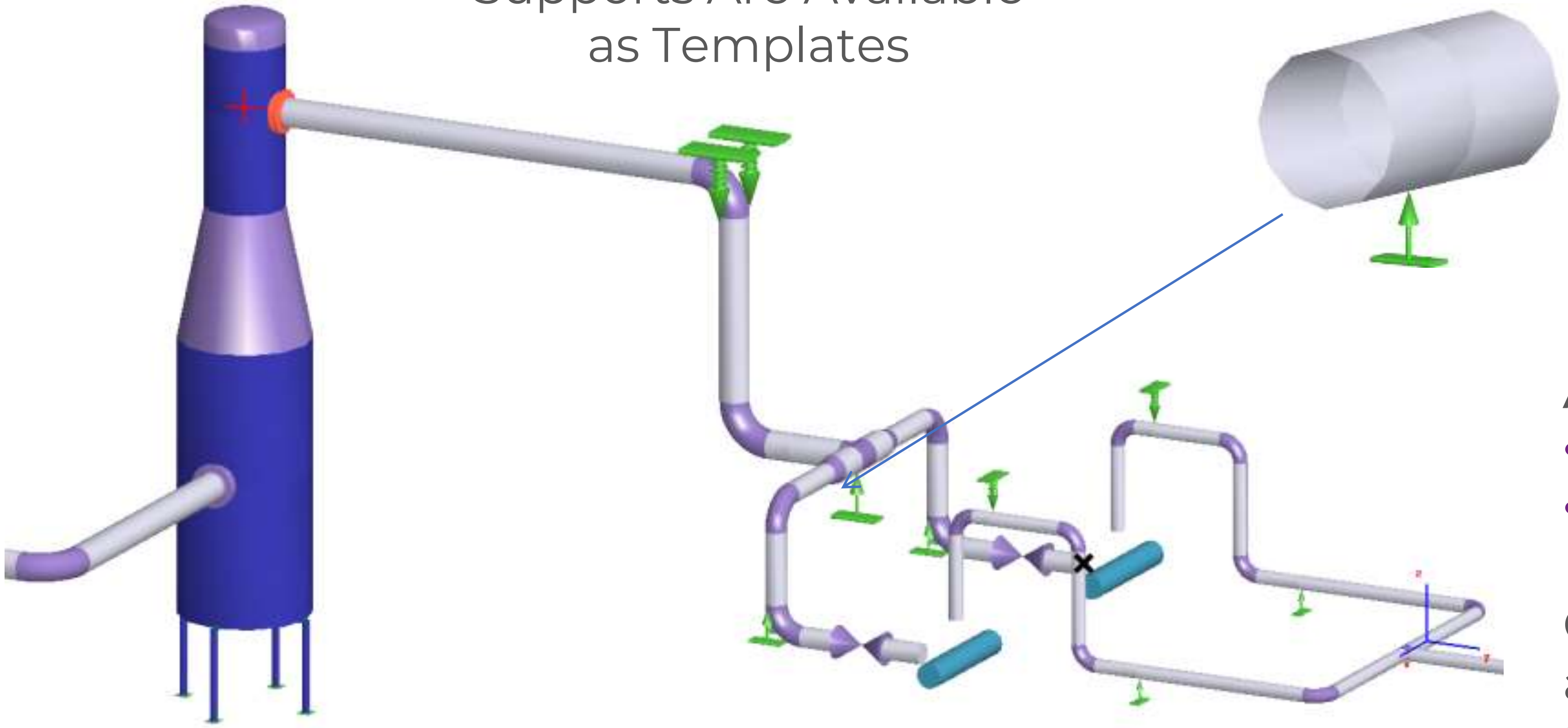
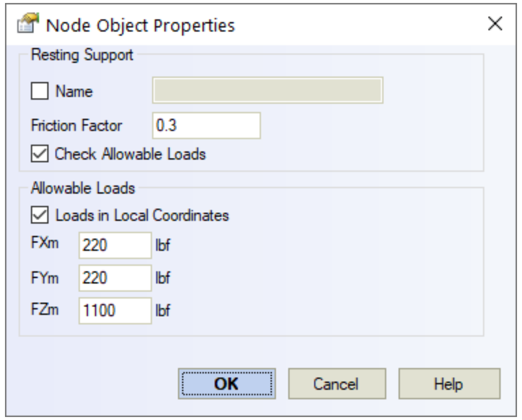
Resting Support Object

Supports Are Available as Templates



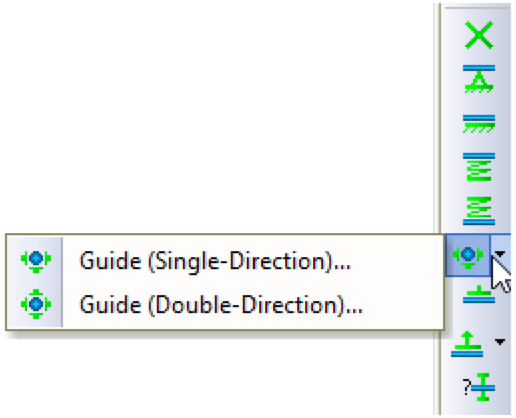


Automatically Checks:

- Allowable Loads
- Lift Off

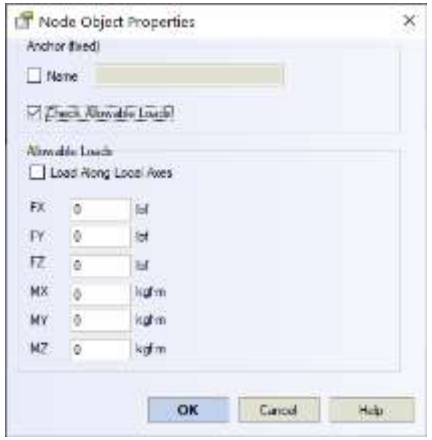
Calculate Loads in Global and Local Coordinate Systems

PASS/Start-Prof | Piping Model Creation

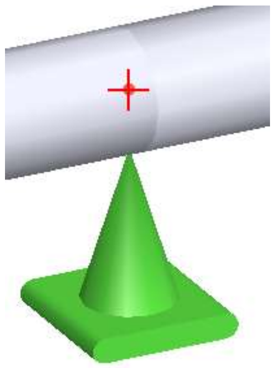


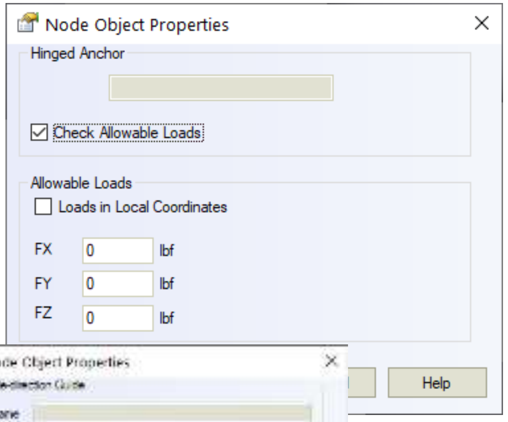
- Automatic Variable Spring Selection
- Automatic Constant Spring Selection

Anchor

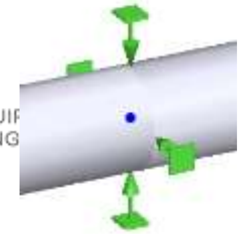


Hinged Anchor

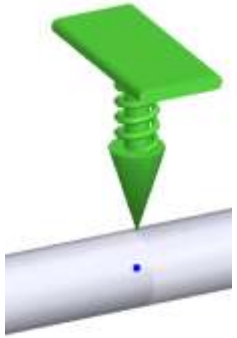


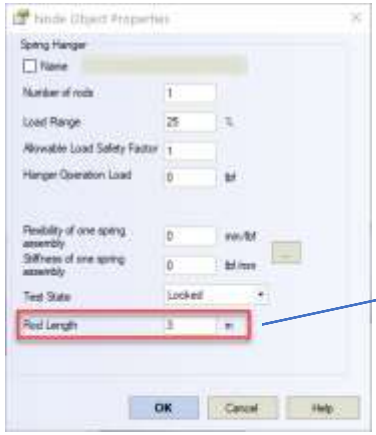


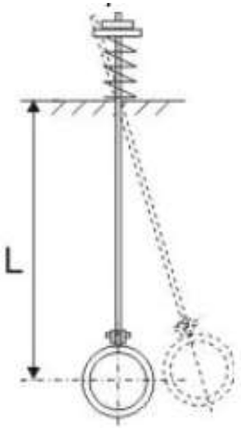
Guide Support



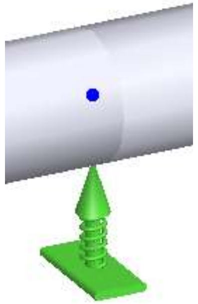
Spring Hanger

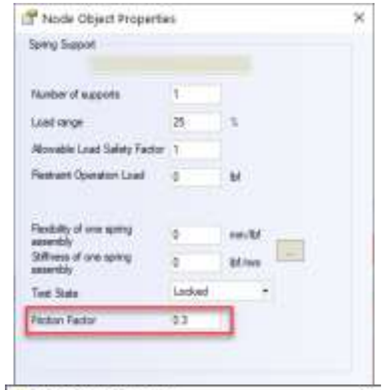




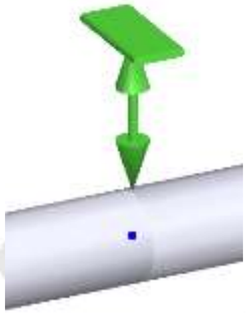


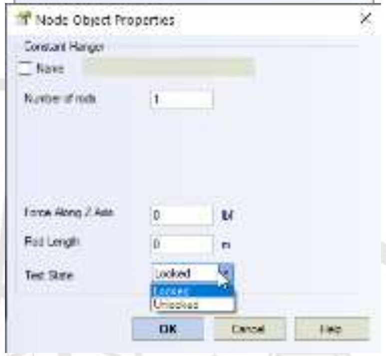
Spring Support





Constant Hanger





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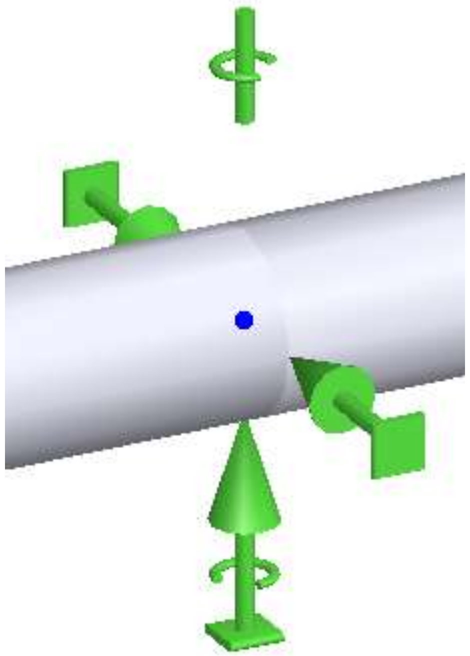
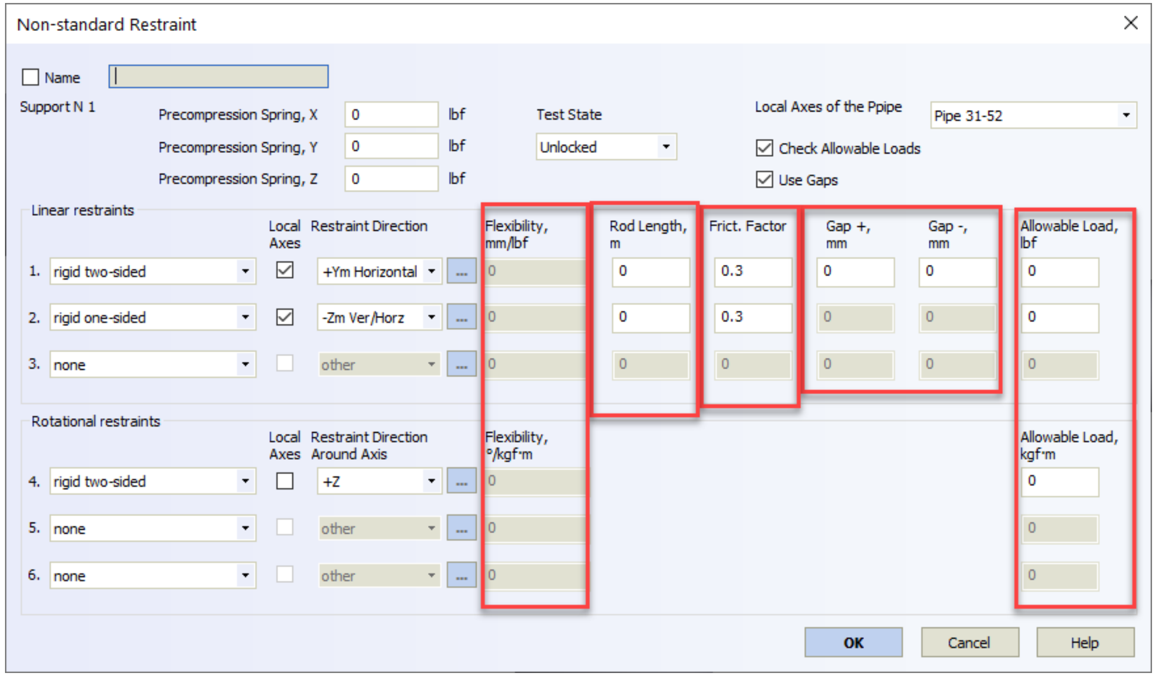
Custom Non-Standard Restraint Object





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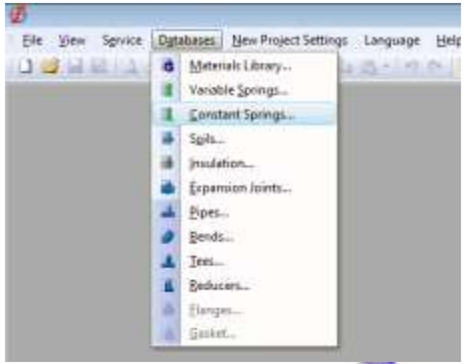
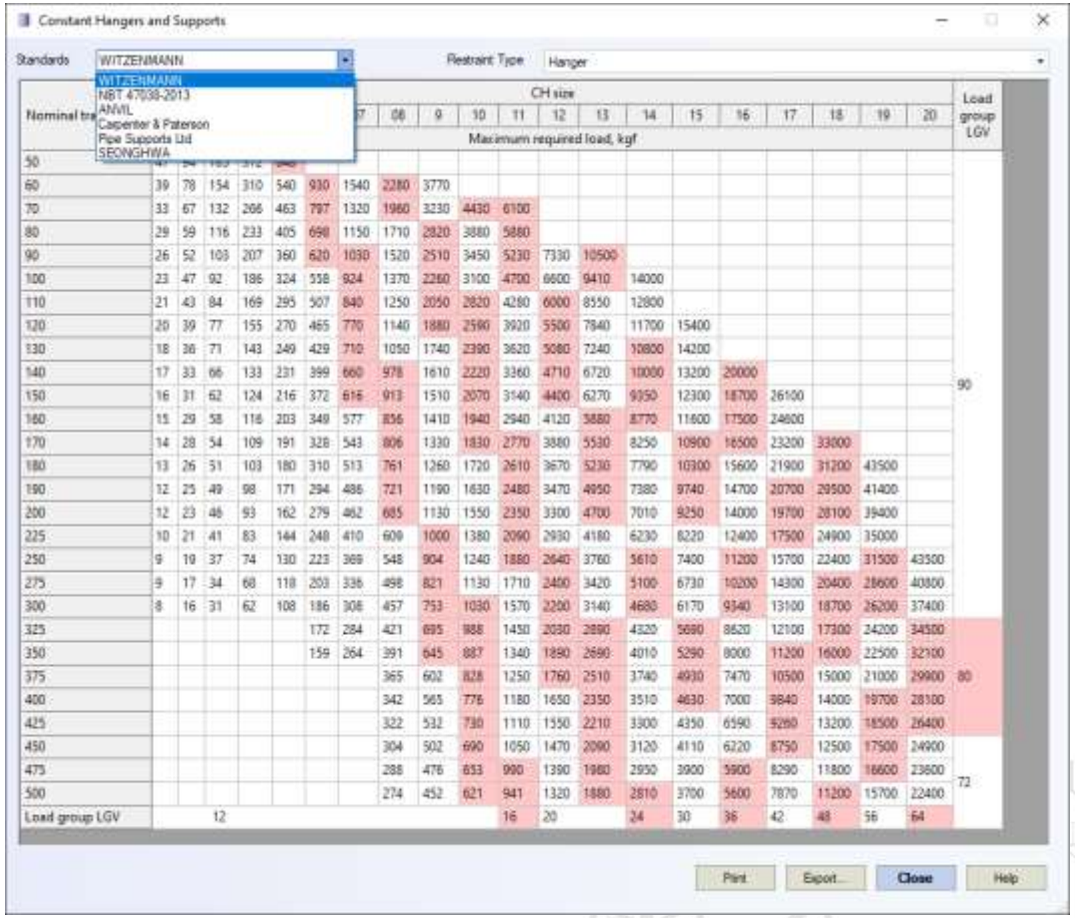
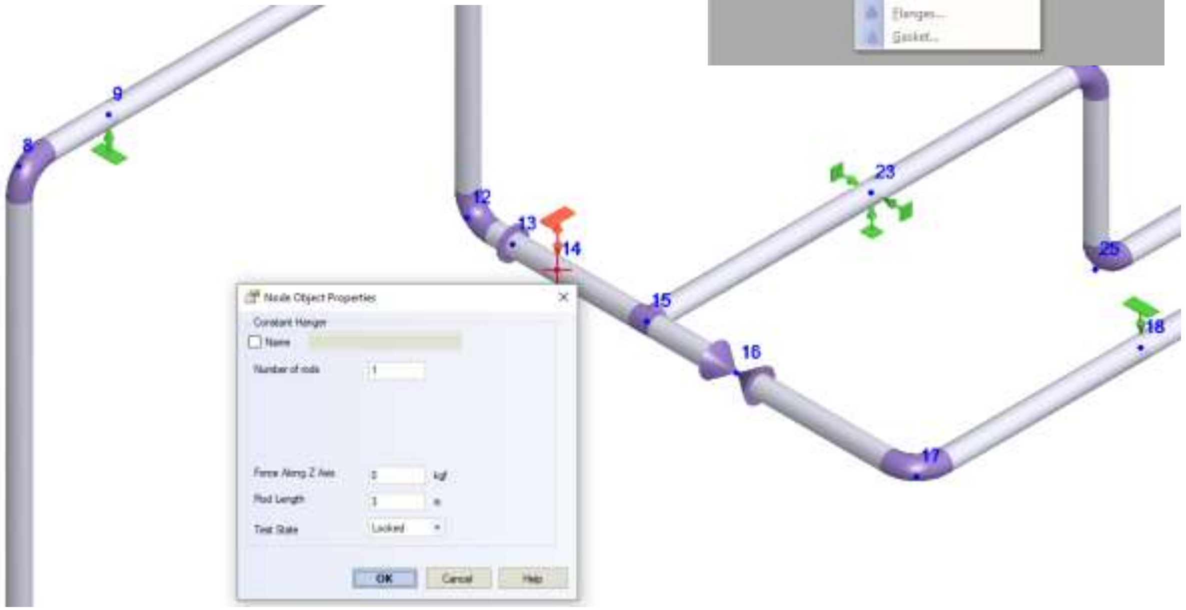
Automatic selection of constant effort hangers and supports







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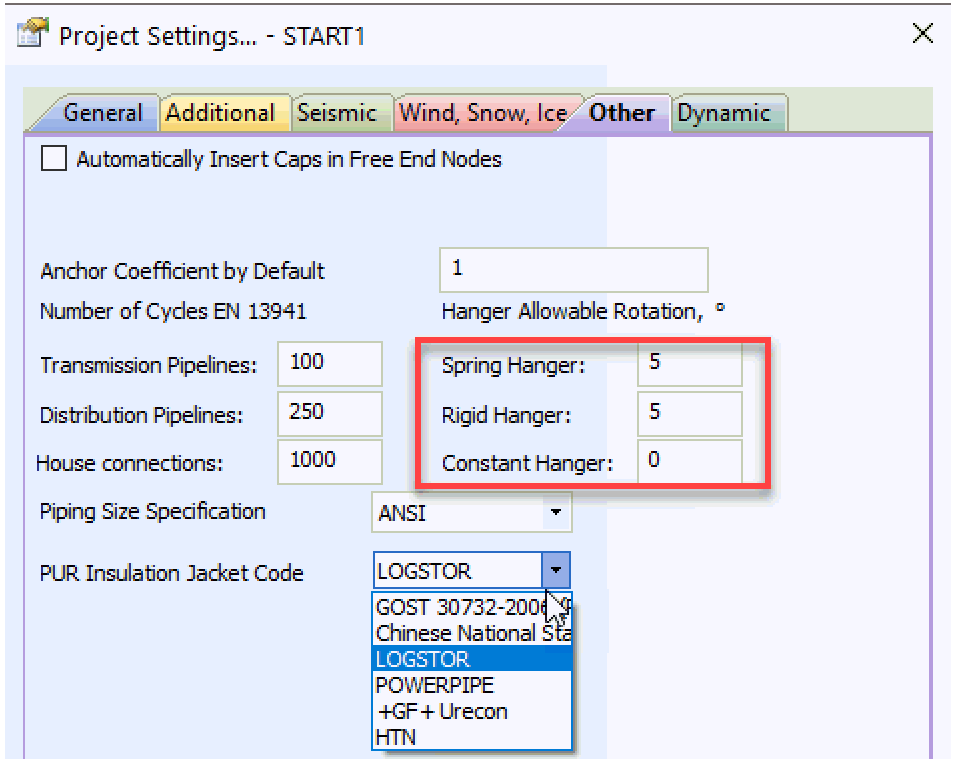
User can enter the custom hanger allowable rotation angle for different types of hangers. START-PROF automatically check the hanger rotation angle and show the note message after analysis if restriction is violated.



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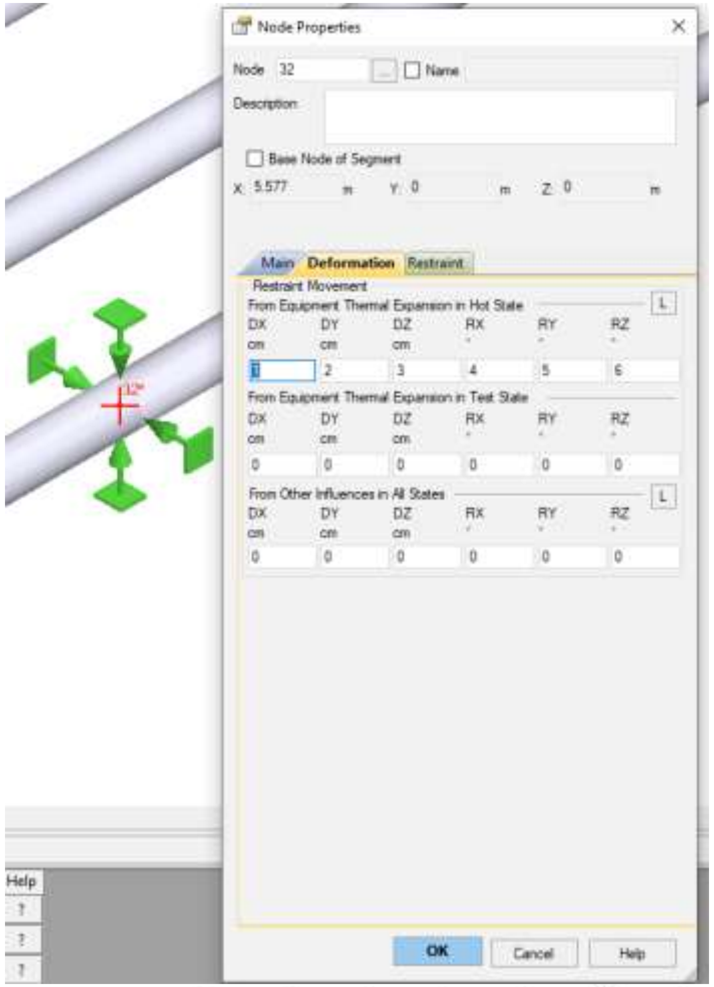
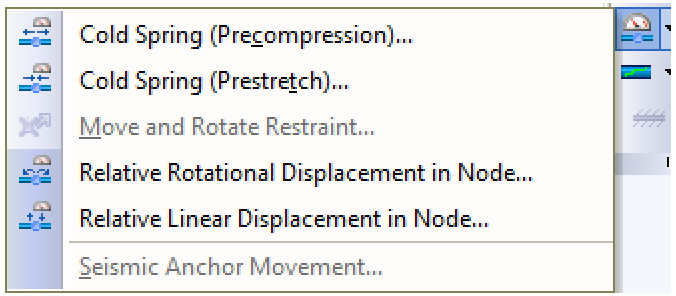
To specify support movement, just add displacement object to the support object





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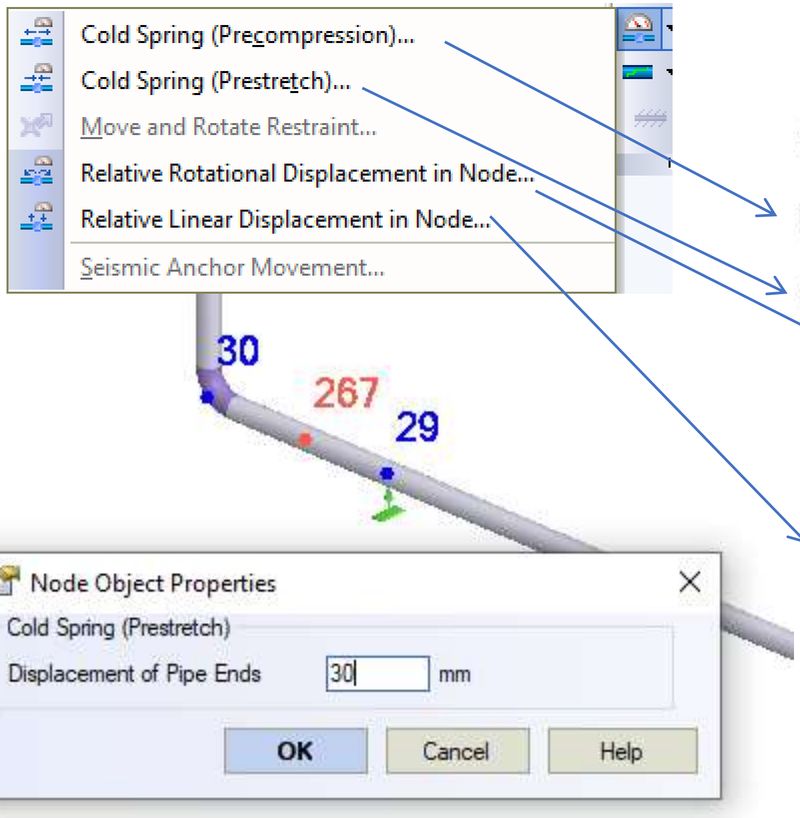
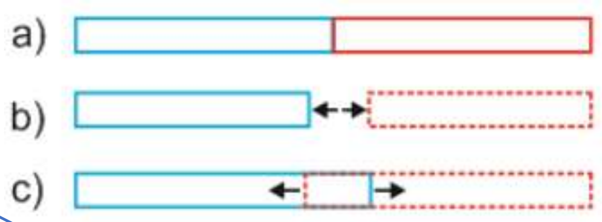
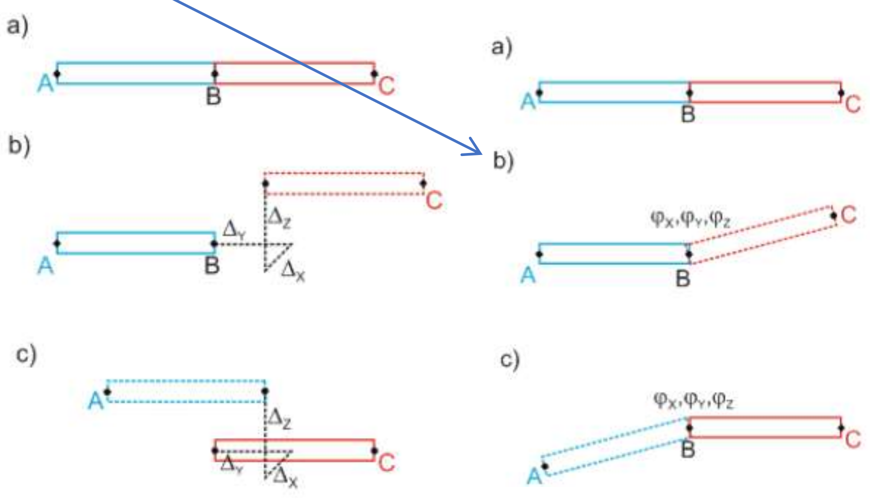
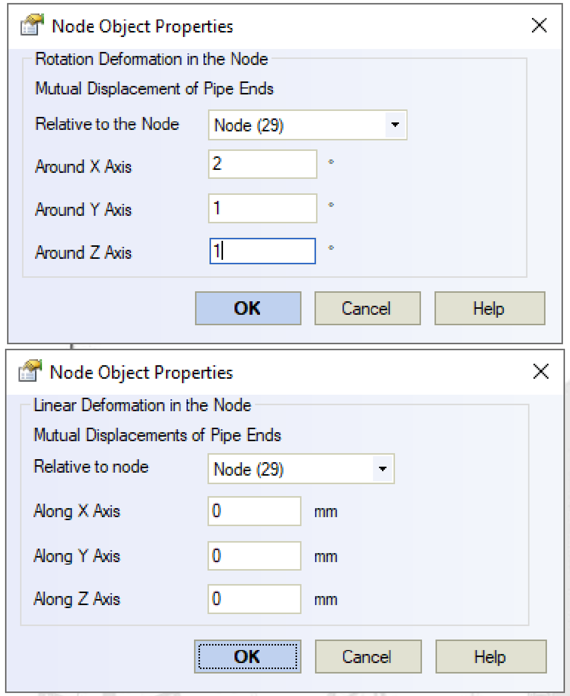
To specify the cold spring (cold pull, pre-stretch), just add the cold spring object in the node





Also pre-compression, and relative rotational or linear displacements of the pipe ends





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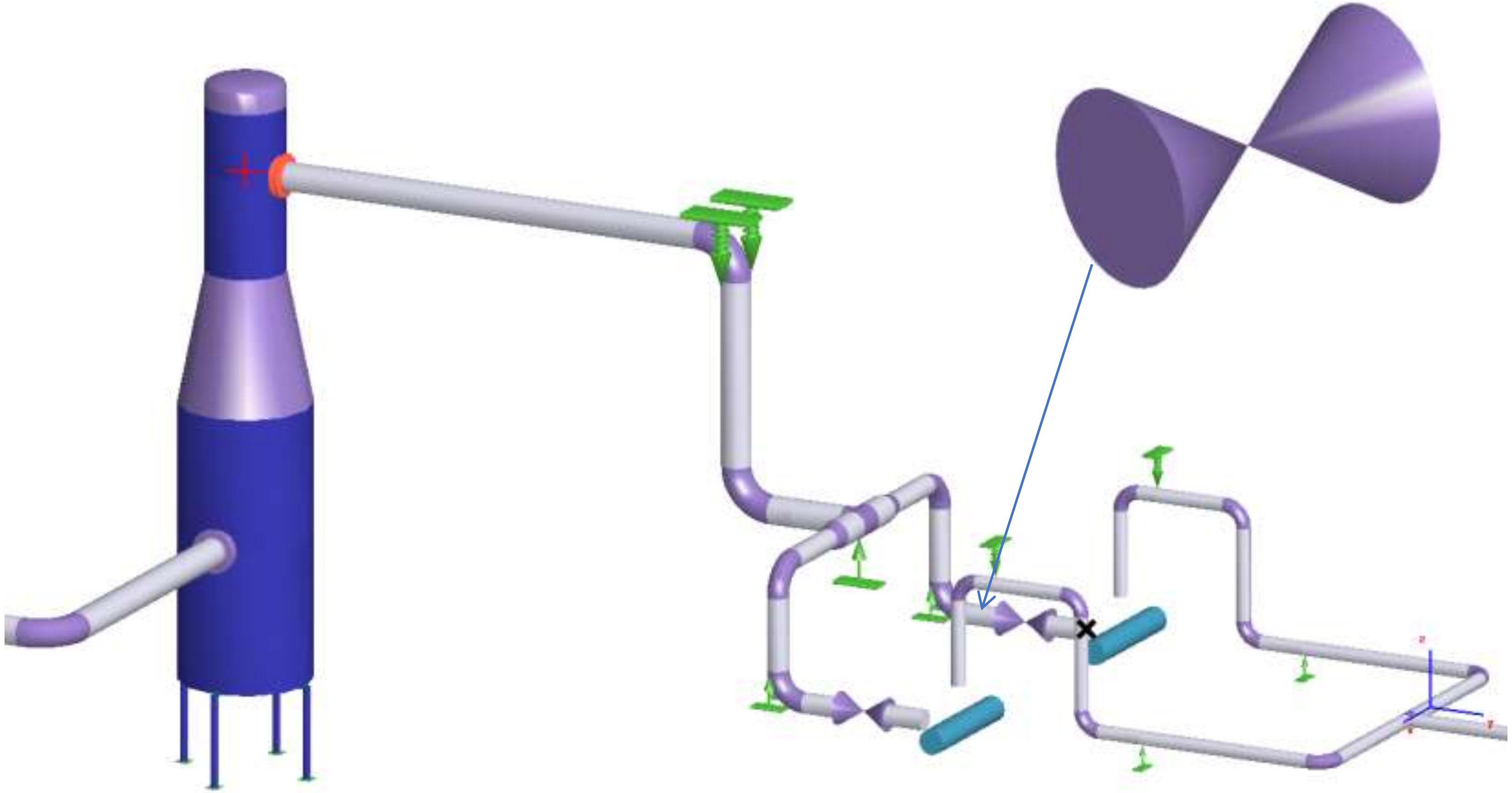
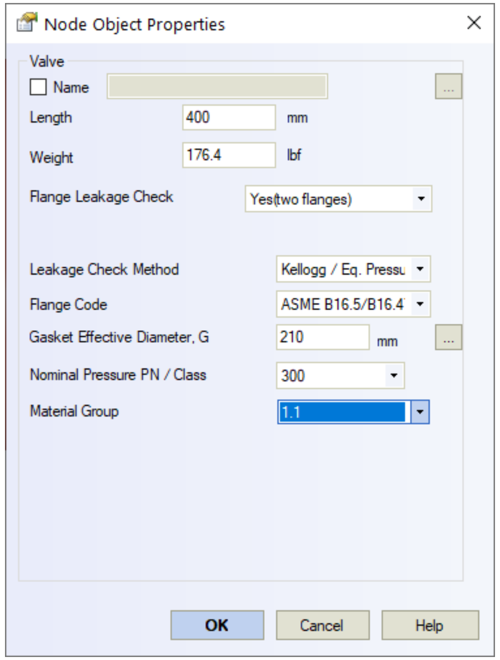
Valve Object





Automatic Flange Leakage Check

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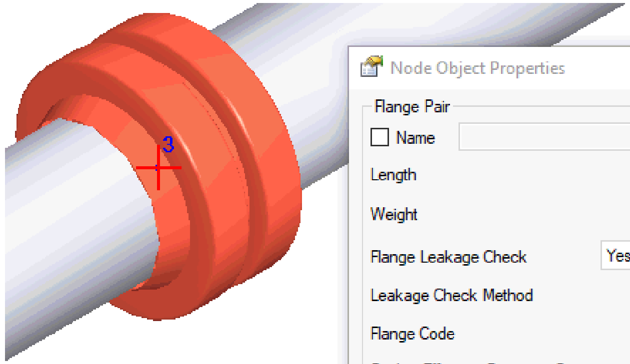
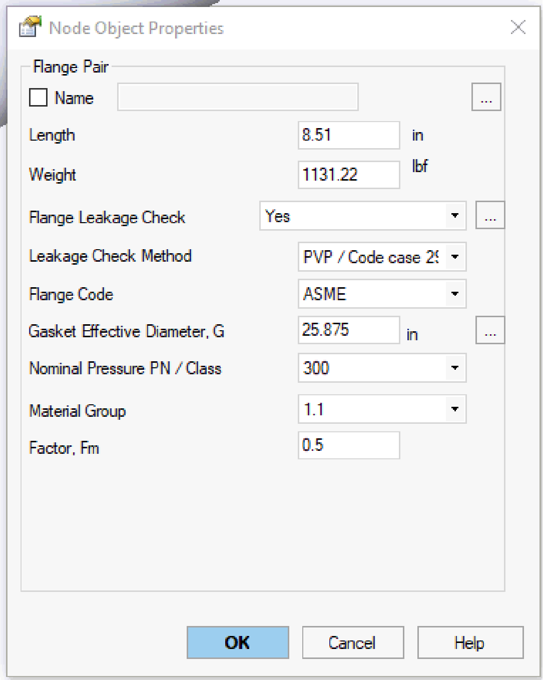
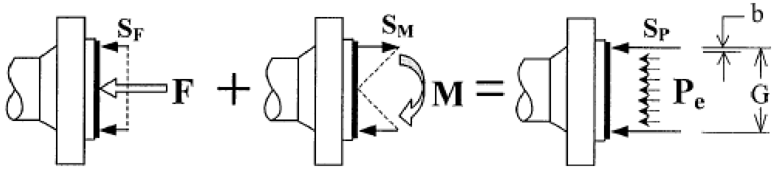
Flange Object





Automatic Flange Leakage Check:

- Equivalent pressure / Kellogg Method
- Code Case 2901 / PVP2013-97814 Method
- DNV Method
- NC 3658.3 Method



Input | Flange leakage

Operating Mode: 1 'Operation mode' (0) — Submode: Operation (all loads)

Node Number	Object	Flange on the side of node	Pipe outside diameter, (mm)	Temperature, (°C)	Axial Force, (kgf)	Bending Moment, (kgf·m)	Parameters	Condition, (MPa)			Notes
								calcu-lated	allow-able	%	
3	Flange Pair	-	219.08	400	-1000	1499.98	1.60 MPa	4.29 MPa	17.36 MPa	24.70	

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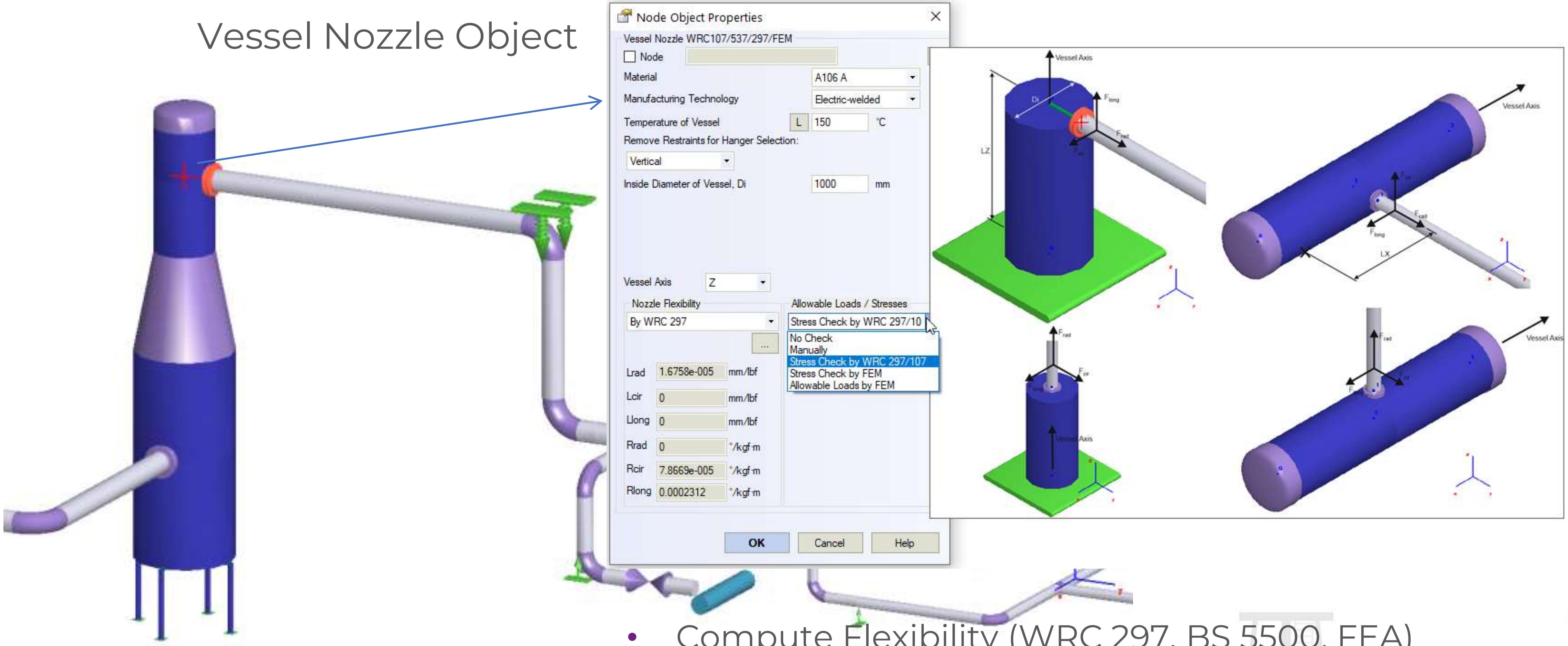
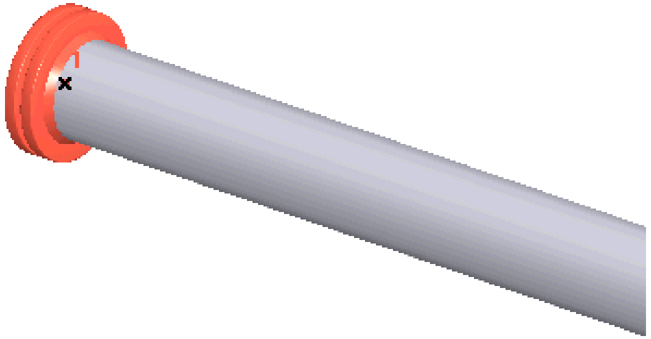
Vessel Nozzle Object

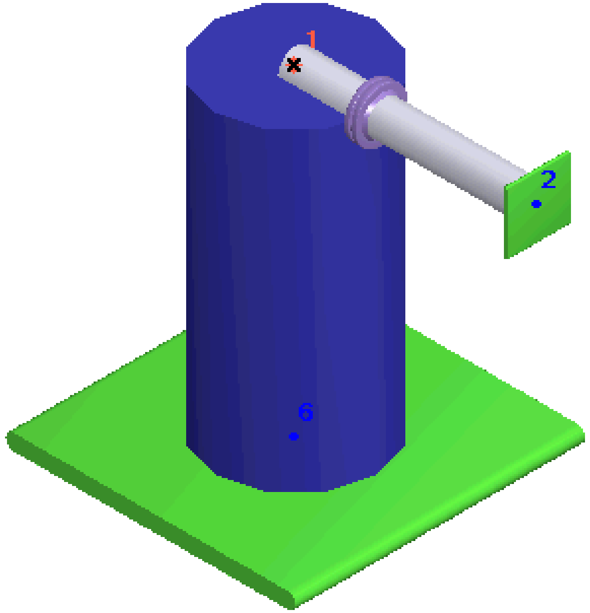


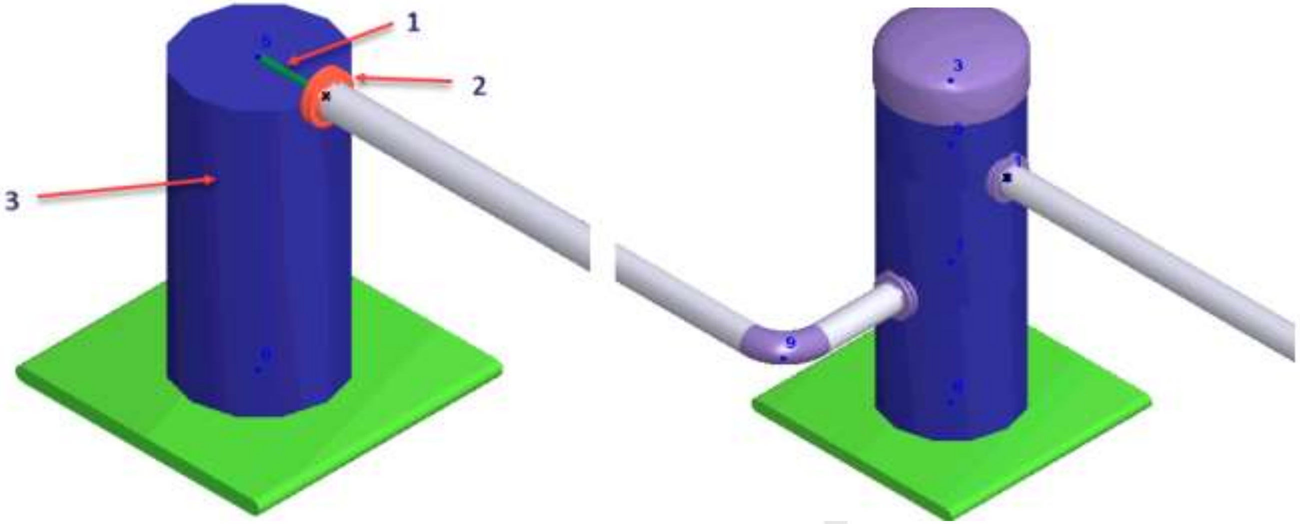
- Compute Flexibility (WRC 297, BS 5500, FEA)
- Check Allowable Loads
- Check Nozzle Stress (WRC 537/297, FEA using NOZZLE-FEM)

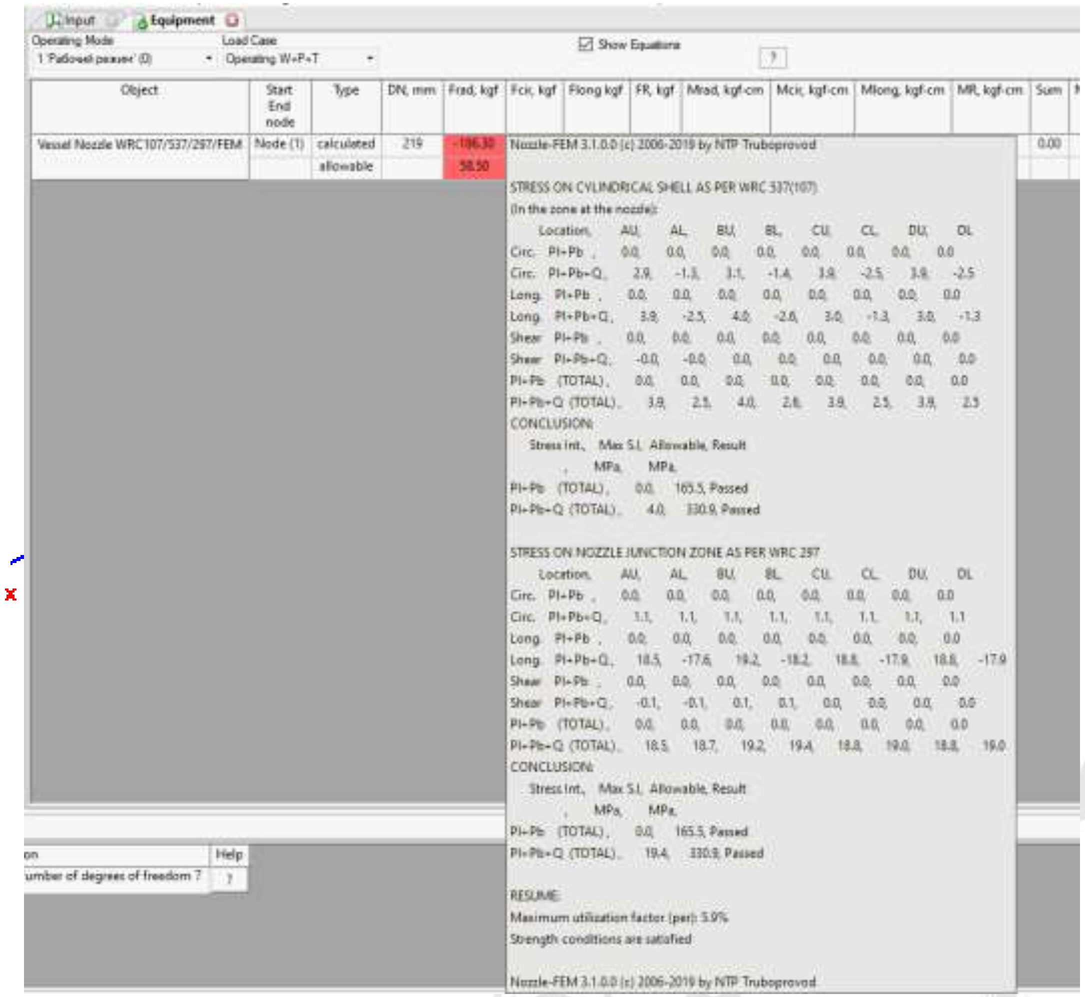
PASS | PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

PASS/Start-Prof | Piping Model Creation









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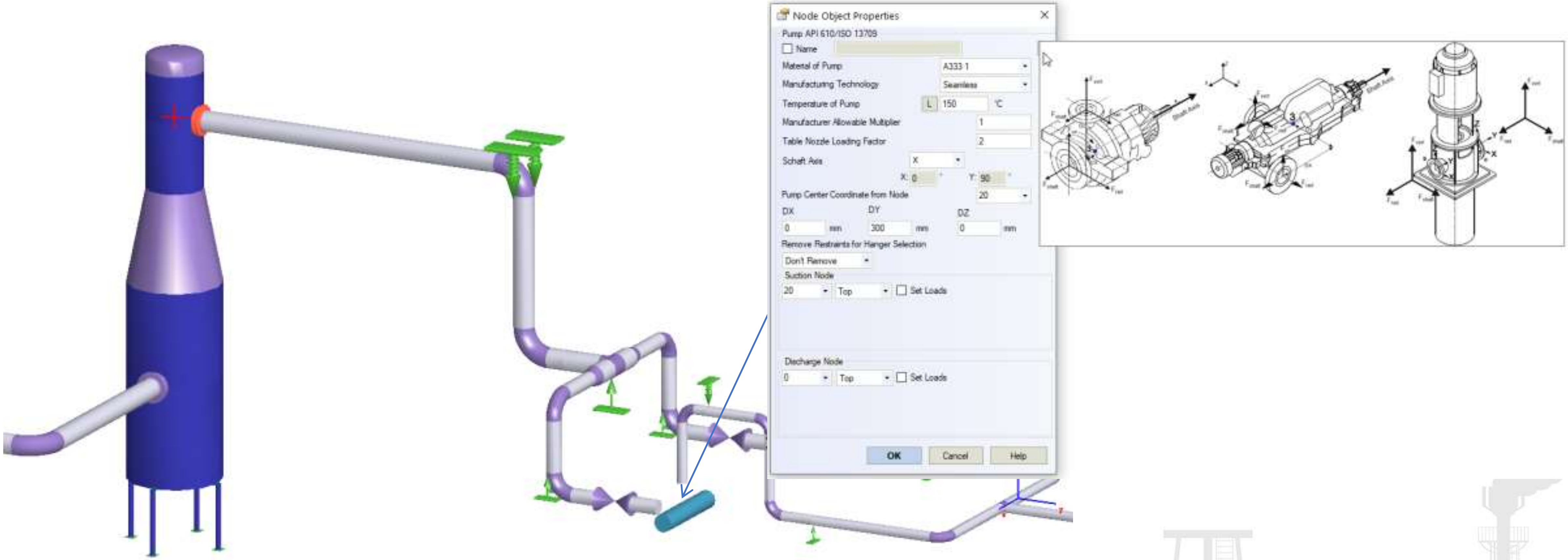
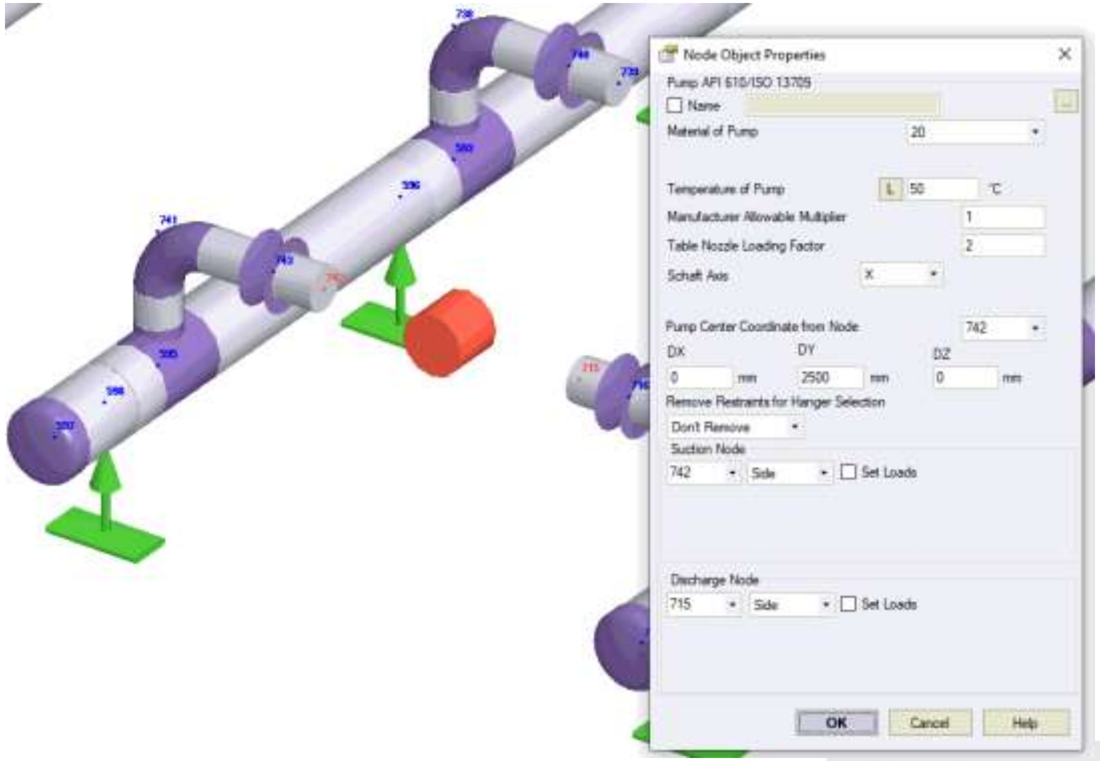
Pump Object



PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/Start-Prof | Piping Model Creation

- Object "Pump API 610/ISO 13709", allows to automatically model the pumps, consider thermal movements of the nozzles, checks allowable loads using API 610 and ISO 13709
- Object "Pump ISO 9905"
- Object "Pump ISO 5199"



a) The individual component forces and moments acting on each pump nozzle flange shall not exceed the range specified in Table 5 (T4) by a factor of more than 2.

b) The resultant applied force (F_{RSA}, F_{RDA}) and the resultant applied moment (M_{RSA}, M_{RDA}) acting on each pump-nozzle flange shall satisfy the appropriate interaction equations as given in Equations (F.1) and (F.2):

$$[F_{RSA}/(1,5 \times F_{RST4})] + [M_{RSA}/(1,5 \times M_{RST4})] < 2 \quad (F.1)$$

$$[F_{RDA}/(1,5 \times F_{RDT4})] + [M_{RDA}/(1,5 \times M_{RDT4})] < 2 \quad (F.2)$$

c) The applied component forces and moments acting on each pump nozzle flange shall be translated to the centre of the pump. The magnitude of the resultant applied force, F_{RCA}, the resultant applied moment, M_{RCA}, and the applied moment shall be limited by Equations (F.3) to (F.5). (The sign convention shown in Figures 21 through 25 and the right-hand rule should be used in evaluating these equations.)

$$F_{RCA} < 1,5(F_{RST4} + F_{RDT4}) \quad (F.3)$$

$$|M_{YCA}| < 2,0(M_{YST4} + M_{YDT4}) \quad (F.4)$$

$$M_{RCA} < 1,5(M_{RST4} + M_{RDT4}) \quad (F.5)$$

where

$$F_{RCA} = [(F_{XCA})^2 + (F_{YCA})^2 + (F_{ZCA})^2]^{0,5}$$

where

$$F_{XCA} = F_{XSA} + F_{XDA}$$

$$F_{YCA} = F_{YSA} + F_{YDA}$$

$$F_{ZCA} = F_{ZSA} + F_{ZDA}$$

$$M_{RCA} = [(M_{XCA})^2 + (M_{YCA})^2 + (M_{ZCA})^2]^{0,5}$$

where

$$M_{XCA} = M_{XSA} + M_{XDA} - [(F_{YSA})(zS) + (F_{YDA})(zD) - (F_{ZSA})(yS) - (F_{ZDA})(yD)]/1\,000$$

$$M_{YCA} = M_{YSA} + M_{YDA} + [(F_{XSA})(zS) + (F_{XDA})(zD) - (F_{ZSA})(xS) - (F_{ZDA})(xD)]/1\,000$$

$$M_{ZCA} = M_{ZSA} + M_{ZDA} - [(F_{XSA})(yS) + (F_{XDA})(yD) - (F_{YSA})(xS) - (F_{YDA})(xD)]/1\,000$$

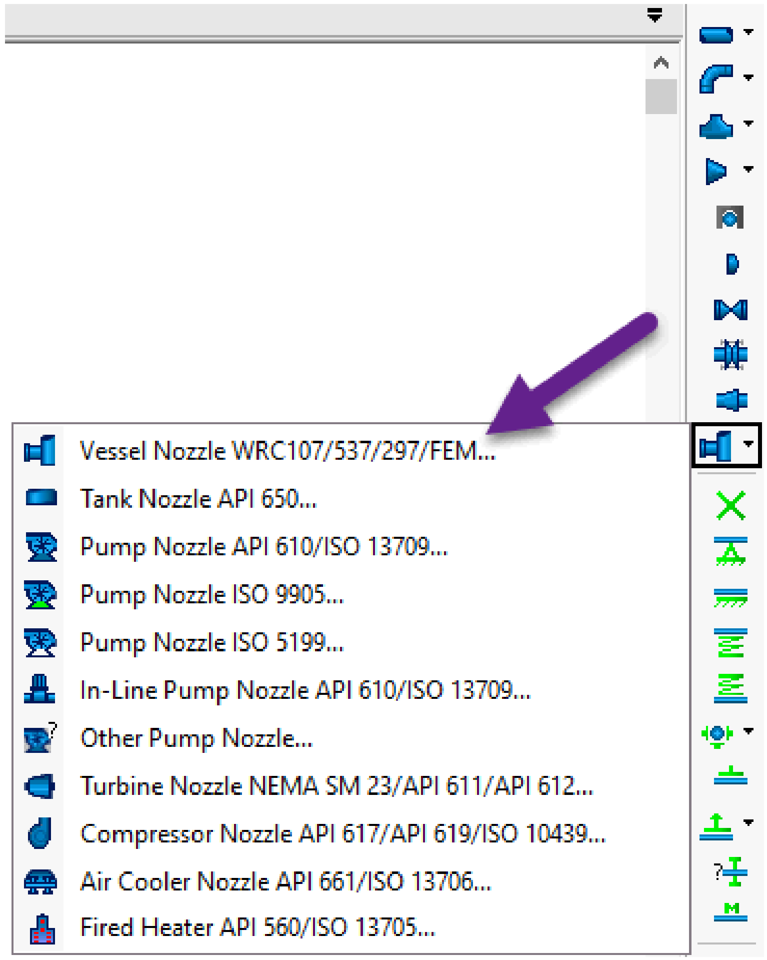
Input | Equipment

Operating Mode: 1 'main mode' (0)
Load Case: Operating W+P+T
☑ Show Equations ?

Object	Start End node	Type	DN, mm	Frad, N	Fcir, N	Flong N	FR, N	Mrad, N·m	Mcir, N·m	Mlong, N·m	MR, N·m	Sum	Notes
Pump API 610/ISO 13709	Node (1)	Suction, Side	200	-7333	5887	-29592	31050	-2626.53	18306.88	4598.20	19057.39	2.84	1
				9780	6220	7560	6920	3520	5160	7060	4710		
	Node (3)	Discharge, Side	200	1440505	-173	0	1440505	0		28.89	28.89	69.39	1
				9780	6220	7560	6920	3520	5160	7060	4710		
		Summary Loads		1433173	5714	-29592	1433490	-2626.53	33102.90	7657.21	34078.35		1
							20760	[My_sum]=2([MradT1] + [MradT2])=2*(1760+1760)=7040 N·m					

PASS/Start-Prof | Piping Model Creation

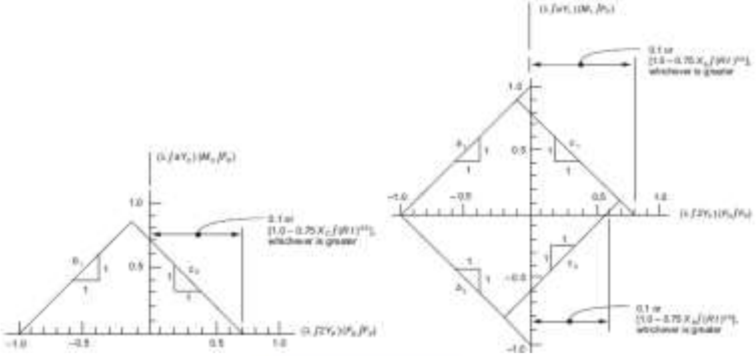
Full Scope of Equipment Objects for Power and Process Piping

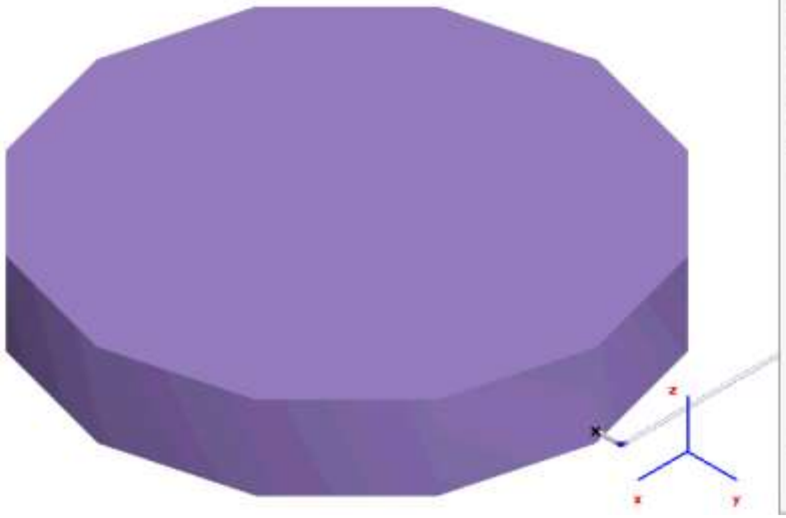


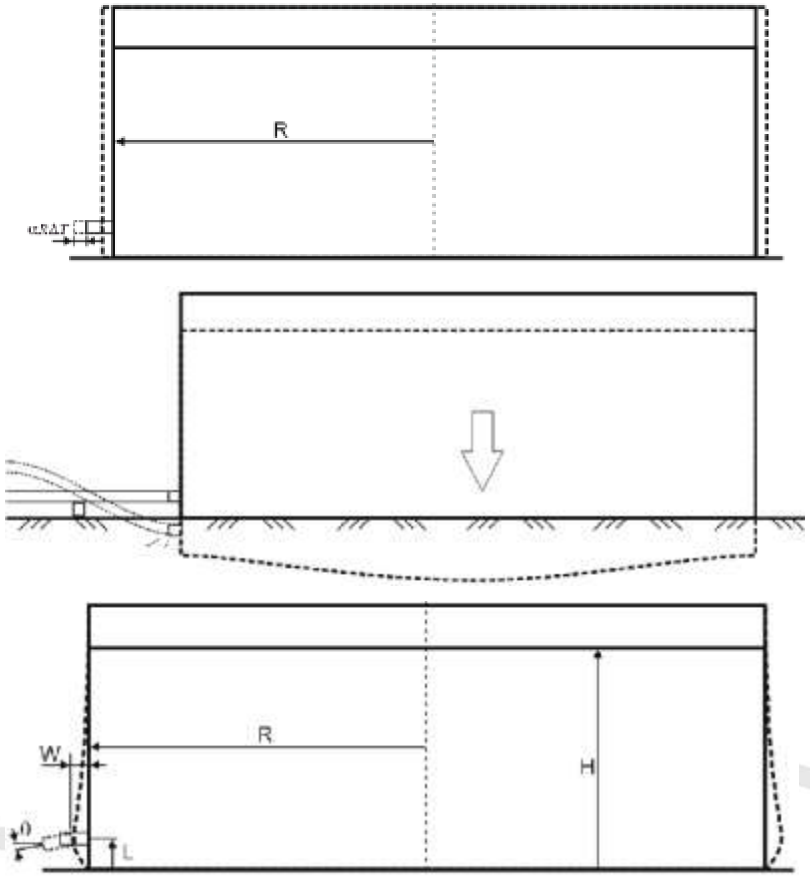
PASS PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

PASS/Start-Prof | Piping Model Creation

Object "Tank Nozzle API 650", allows to automatically model the storage tank nozzles. Automatically model flexibilities using API 650, thermal movements of the nozzle, movements and rotation due to tank bulging effect using API 650, tank settlement, automatically checks allowable loads using API 650 and STO-SA 03-002-2009.

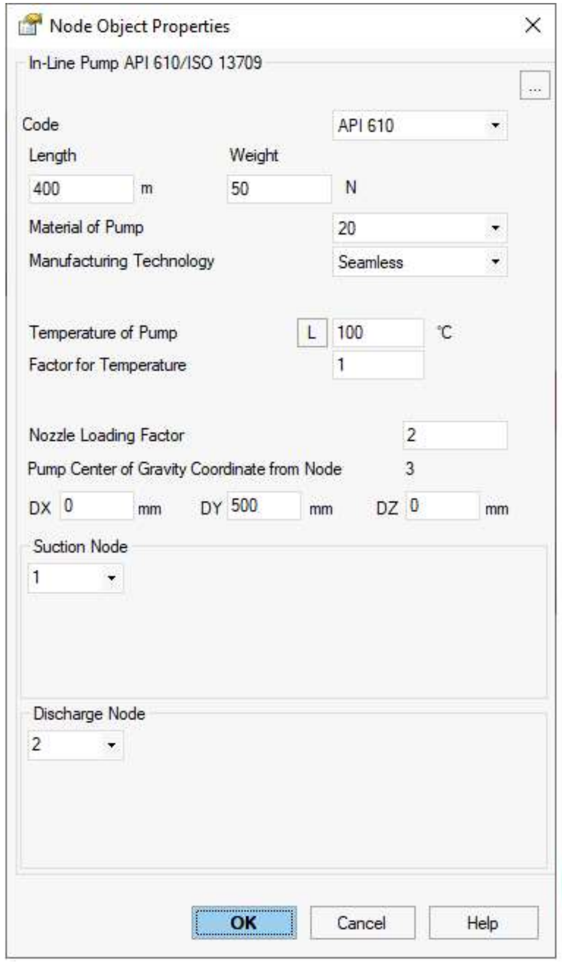






PASS/Start-Prof | Piping Model Creation

Object "In-line Pump", allows to automatically model the vertical in-line pumps, consider thermal movements of the nozzles, checks allowable loads using API 610 and ISO 13709.



For SI units, Equations (F.6) to (F.8) apply:

$$\sigma_p = (\sigma/2) + (\sigma^2/4 + \tau^2)^{0,5} < 41 \qquad \text{(F.6)}$$

$$\sigma_l = [1,27F_Y/(D_o^2 - D_i^2)] + [10\,200D_o(M_X^2 + M_Z^2)^{0,5}]/(D_o^4 - D_i^4) \qquad \text{(F.7)}$$

$$\tau = [1,27(F_X^2 + F_Z^2)^{0,5}]/(D_o^2 - D_i^2) + [5\,100D_o(|M_Y|)]/(D_o^4 - D_i^4) \qquad \text{(F.8)}$$

For USC units, Equations (F.9) to (F.11) apply:

$$\sigma_p = (\sigma/2) + (\sigma^2/4 + \tau^2)^{0,5} < 5\,950 \qquad \text{(F.9)}$$

$$\sigma_l = [1,27F_Y/(D_o^2 - D_i^2)] + [122D_o(M_X^2 + M_Z^2)^{0,5}]/(D_o^4 - D_i^4) \qquad \text{(F.10)}$$

$$\tau = [1,27(F_X^2 + F_Z^2)^{0,5}]/(D_o^2 - D_i^2) + [61D_o(|M_Y|)]/(D_o^4 - D_i^4) \qquad \text{(F.11)}$$

where

- σ_p is the principal stress, expressed in megapascals (pounds-force per square inch);
- σ_l is the longitudinal stress, expressed in megapascals (pounds-force per square inch);
- τ is the shear stress, expressed in megapascals (pounds-force per square inch);
- F_X is the applied force on the X axis;
- F_Y is the applied force on the Y axis;
- F_Z is the applied force on the Z axis;

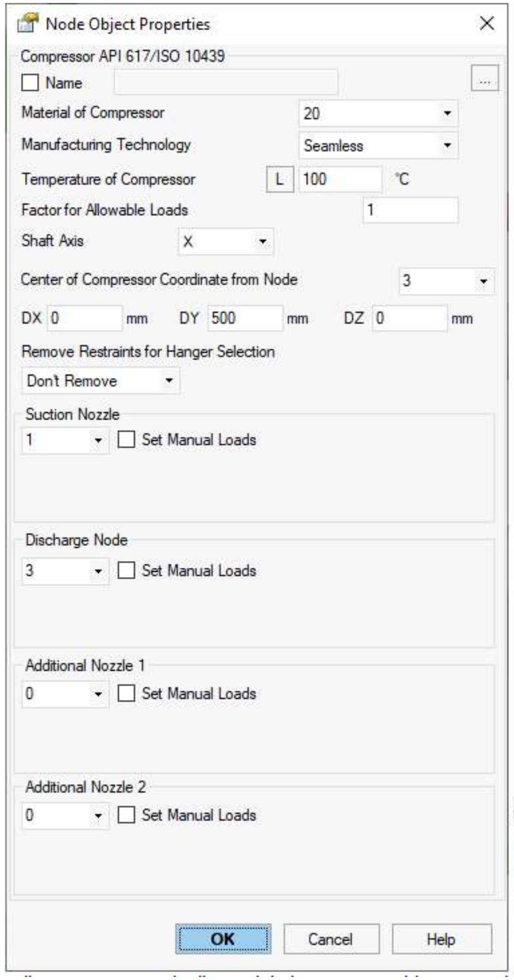
Input | Equipment

Operating Mode: 1 'main mode' (0) | Load Case: Operating W+P+T | Show Equations | ?

Object	Start End node	Type	DN, mm	Frad, N	Fcir, N	Flong N	FR, N	Mrad, N·m	Mcir, N·m	Mlong, N·m	MR, N·m	Sum	Notes
In-Line Pump API 610/ISO 13709	Node (1)	Suction, Side	219	-1200421		-28			47.98			0.00	1
				7560	9780	6220		7060	3520	5160			
	Node (2)	Discharge, Side	219	-1200421		-27			47.98			0.00	1
				7560	9780	6220		7060	3520	5160			

PASS/Start-Prof | Piping Model Creation

Object "Compressor API 617/API 619/ISO 10439", allows to automatically model the compressors, consider thermal movements of the nozzles, checks allowable loads using API 617 and ISO 10439.



In SI units:

$$F_r + 1.09 M_r \le 54.1 D_e \quad \text{(F.1a)}$$

In U.S. customary (USC) units:

$$3 F_r + M_r \le 927 D_e \quad \text{(F.1b)}$$

F_r is the resultant force, Newtons (lb) (see Figure F.1);

$$F_r = \sqrt{F_x^2 + F_y^2 + F_z^2} \quad \text{(F.2)}$$

M_r resultant moment, in Newton-meters (ft-lb) from Figure F.1;

$$M_r = \sqrt{M_x^2 + M_y^2 + M_z^2} \quad \text{(F.3)}$$

For sizes greater than 200 mm (8 in.), use the following values.

In SI units:

$$D_e = \frac{(400 + D_{nom})}{3} \text{ (mm)} \quad \text{(F.4a)}$$

In USC units:

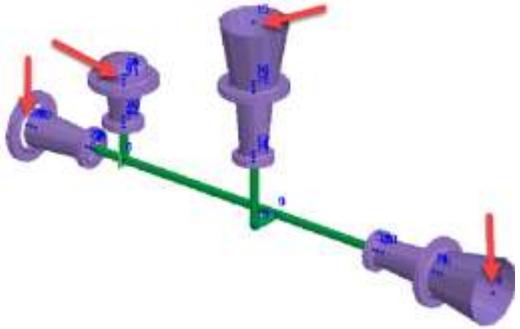
$$D_e = \frac{(16 + D_{nom})}{3} \text{ (in.)} \quad \text{(F.4b)}$$

In SI units:

$$F_c + 1.64 M_c \le 40.4 D_c \quad \text{(F.5a)}$$

In USC units:

$$2F_c + M_c \le 462 D_c$$



In SI units:

$$F_c + 1.64 M_c \le 40.4 D_c \quad \text{(F.5a)}$$

In USC units:

$$2F_c + M_c \le 462 D_c \quad \text{(F.5b)}$$

where

F_c is the combined resultant of inlet, sidestream, and discharge forces, Newtons (lb);

M_c is the combined resultant of inlet, sidestream, and discharge moments, and moments resulting from forces, Newton-meters (ft-lb);

D_c is the diameter [mm (in.)] of one circular opening equal to the total areas of the inlet, sidestream, and discharge openings. If the equivalent nozzle diameter is greater than 230 mm (9 in.), use a value of D_c equal to the following.

In SI units:

$$D_c = \frac{(460 + \text{Equivalent Diameter})}{3} \text{ (mm)} \quad \text{(F.6a)}$$

In USC units:

$$D_c = \frac{(18 + \text{Equivalent Diameter})}{3} \text{ (in.)} \quad \text{(F.6b)}$$

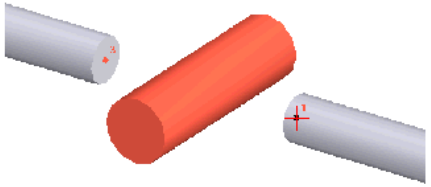
The absolute value of the individual components (Figure F.1) of these resultants should not exceed the following.

In SI units:

$F_x = 16.1 D_c$ $M_x = 24.6 D_c$

$F_y = 40.5 D_c$ $M_y = 12.3 D_c$

$F_z = 32.4 D_c$ $M_z = 12.3 D_c$



Input | Equipment

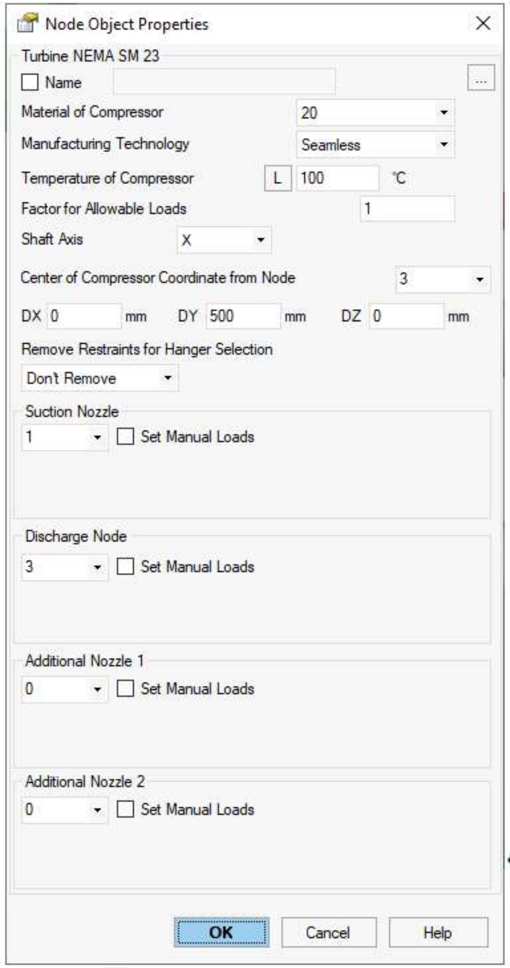
Operating Mode: 1 'Рабочий режим' (0) — Load Case: Operating W+P+T — Show Equations

Object	Start End node	Type	DN, mm	Frad, N	Fcir, N	Flong N	FR, N	Mrad, N-m	Mcir, N-m	Mlong, N-m	MR, N-m	Sum	Notes
Compressor API 617/API 619/ISO 10439	Node (1)	Suction, Top	200	-15918	12907	-23209	30962	-2577.83	11010.28	8677.81	14253.98	4.30	1
	Node (3)	Discharge, Top	200	1440505	-173	0	1440505	0		28.89	28.89	133.14	1
		ext1											
		ext2											
		Summary Loads	250.91	1424587	12734	-23209	1424833	-2577.83	22615.01	15246.83	27396.16	144.99	
				8130					986.24	6172.49			

Dc=250.9141 mm
[Fcir]=k1*40.5Dc=1.00*10162.02=10162.02 N

PASS/Start-Prof | Piping Model Creation

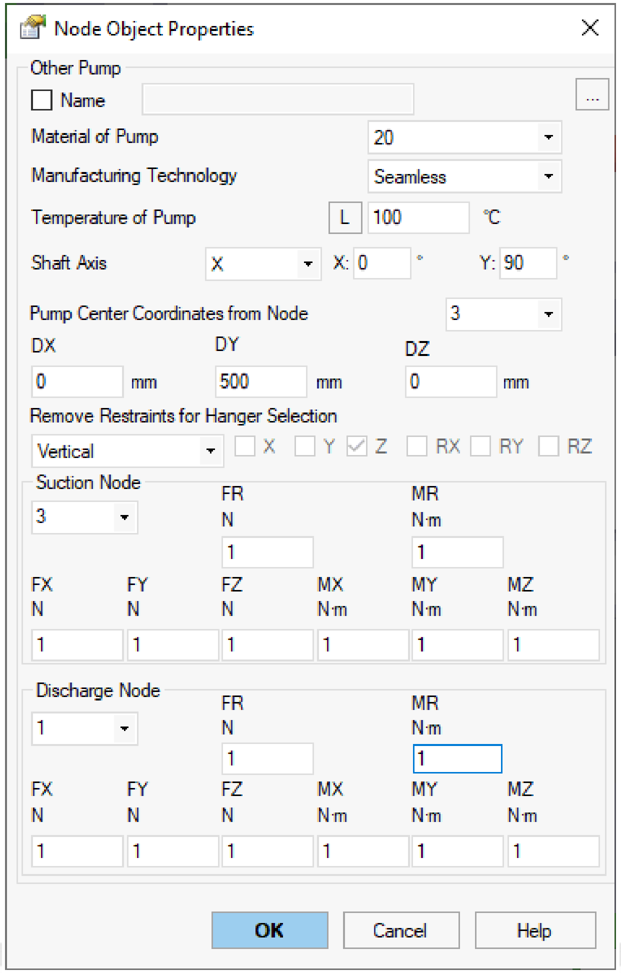
Object "Turbine NEMA SM23/API 611/API 612", allows to automatically model the steam turbines, consider thermal movements of the nozzles, checks allowable loads using NEMA SM23, API 611, API 612, ISO 10437.



PASS
PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

PASS/Start-Prof | Piping Model Creation

Object "Other Pump", allows to automatically model the pumps, consider thermal movements of the nozzles, checks allowable loads.



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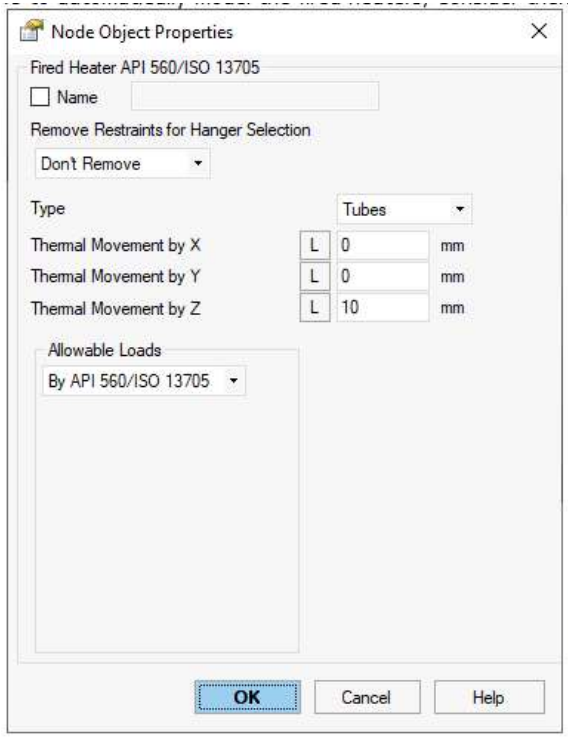
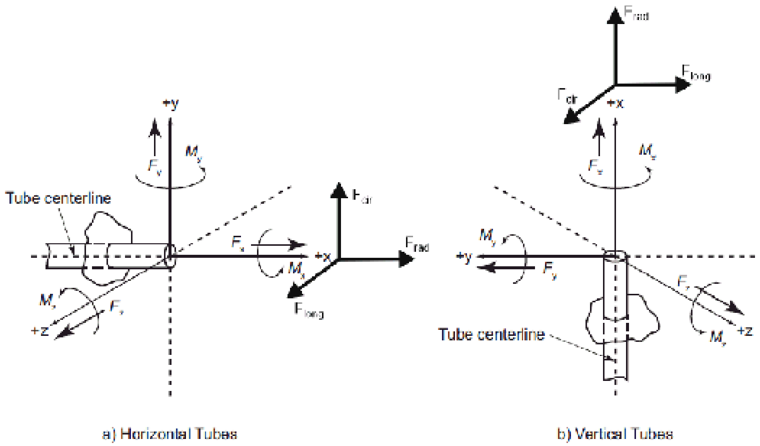
PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/Start-Prof | Piping Model Creation

Object "Fired Heater API 560/ISO 13705", allows to automatically model the fired heaters, consider thermal movements of the nozzles, checks allowable loads using API 560 and ISO 13705.





splayed. In the second row the allowable values are displayed.

Input | Equipment

Operating Mode: 1 'main mode' (0) | Load Case: Operating W+P+T | Show Equations | ?

Object	Start End node	Type	DN, mm	Frad, kgf	Fcir, kgf	Flong kgf	FR, kgf	Mrad, kgf·cm	Mcir, kgf·cm	Mlong, kgf·cm	MR, kgf·cm	Sum	Notes
Fired Heater API 560/ISO 13705	Node (1)	calculated	219	-96033.70		40605.70			-2029708.86				1
		allowable		133.40	266.90	266.90		11660	8810	8810			

PASS
PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

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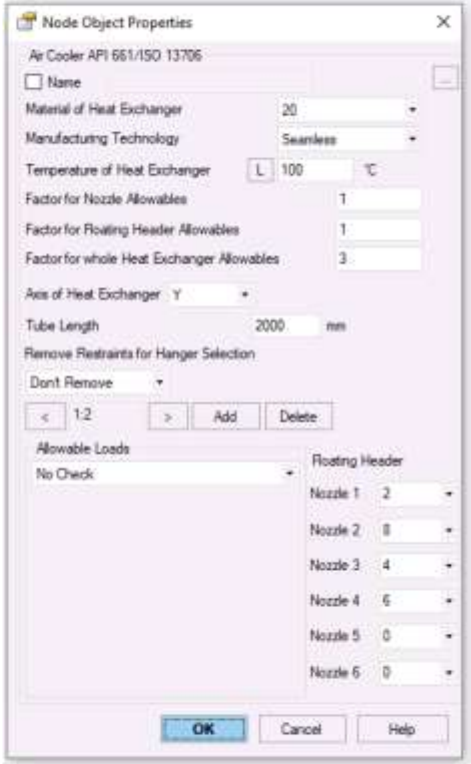
Object "Air cooled Heat Exchanger API 661/ISO 13706", allows to automatically model the air cooled heat exchangers, consider thermal movements of the nozzles, checks allowable loads using API 661 and ISO 13706.



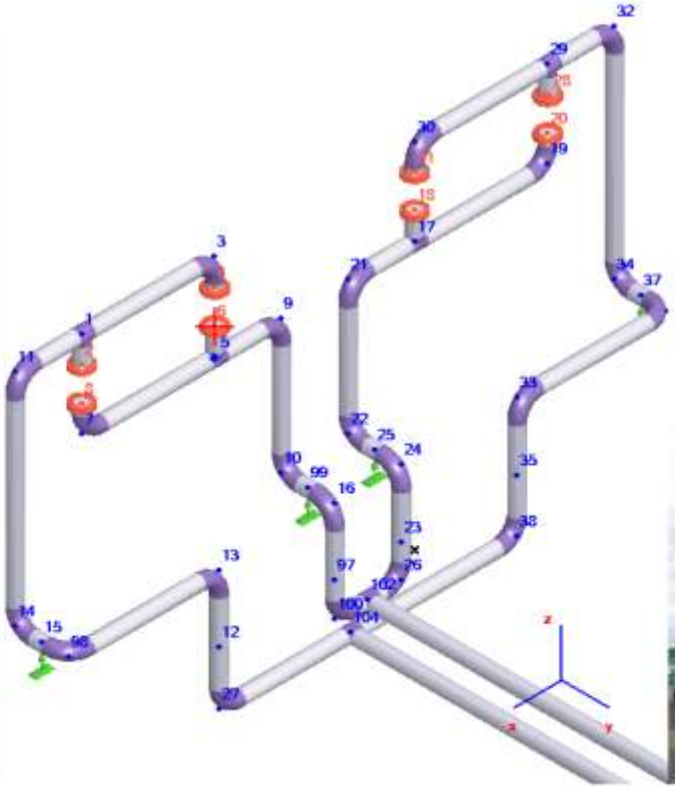


Table 4 — Maximum Allowable Nozzle Loads

Nozzle Size DN (NPS)	Moments N·m (ft·lbf)			Forces N (lbf)		
	M_x	M_y	M_z	F_x	F_y	F_z
40 (1½)	110 (80)	150 (110)	110 (80)	670 (150)	1020 (230)	670 (150)
50 (2)	150 (110)	240 (180)	150 (110)	1020 (230)	1330 (300)	1020 (230)
80 (3)	410 (300)	610 (450)	410 (300)	2000 (450)	1690 (380)	2000 (450)
100 (4)	810 (600)	1220 (900)	810 (600)	3340 (750)	2670 (600)	3340 (750)
150 (6)	2140 (1580)	3050 (2250)	1630 (1200)	4000 (900)	5030 (1130)	5030 (1130)
200 (8)	3050 (2250)	6100 (4500)	2240 (1650)	5690 (1280)	13,340 (3000)	8010 (1800)
250 (10)	4070 (3000)	6100 (4500)	2550 (1880)	6670 (1500)	13,340 (3000)	10,010 (2250)
300 (12)	5080 (3750)	6100 (4500)	3050 (2250)	8360 (1880)	13,340 (3000)	13,340 (3000)
350 (14)	6100 (4500)	7120 (5250)	3570 (2630)	10,010 (2250)	16,680 (3750)	16,680 (3750)

lues from 7.1.10.2

7.1.10.2 The design of each fixed or floating header, the design of the connections of fixed headers to side frames, and the design of other support members shall ensure that the simultaneous application (sum) of all nozzle loadings on a single header does not cause any damage. The components of the nozzle loadings on a single header shall not exceed the following values:

M_x 6100 N·m (4500 ft·lbf)
M_y 8130 N·m (6000 ft·lbf)
M_z 4070 N·m (3000 ft·lbf)
F_x 10,010 N (2250 lbf)
F_y 20,020 (4500 lbf)
F_z 16,680 (3750 lbf)

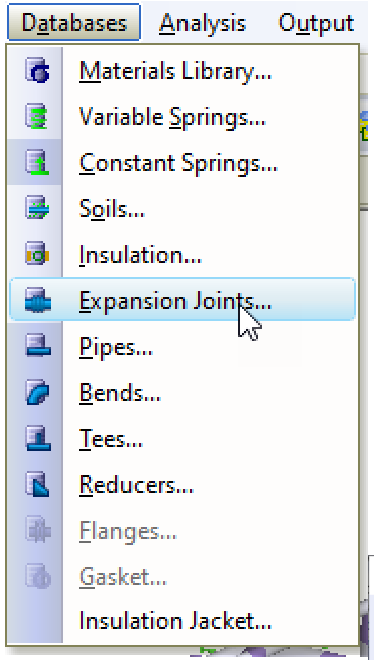
om 7.1.10.2 multiplied by 3

7.1.10.3 The total of all nozzle loads on one multi-bundle bay shall not exceed three times that allowed for a single header.

PASS

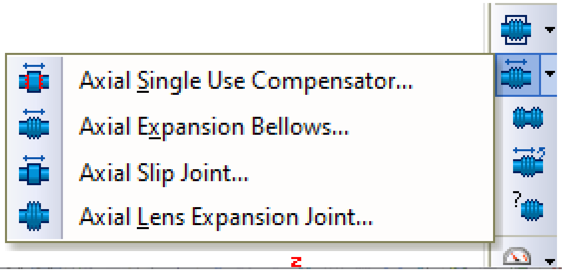
PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

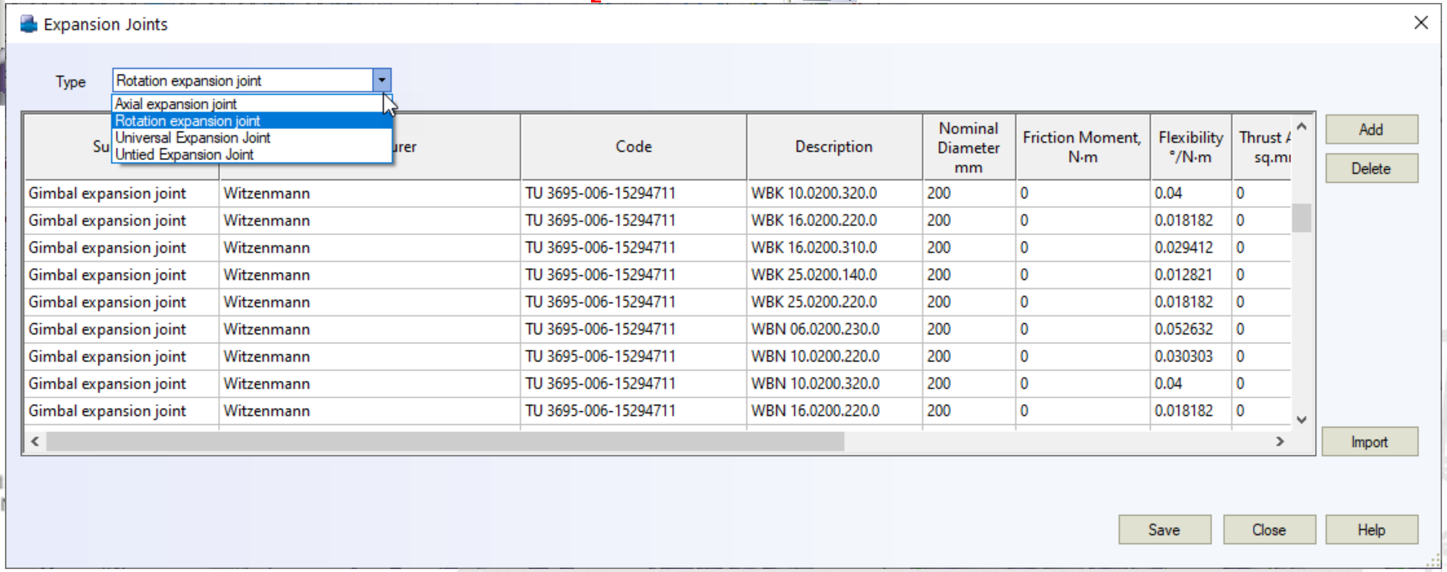
PASS/Start-Prof | Piping Model Creation

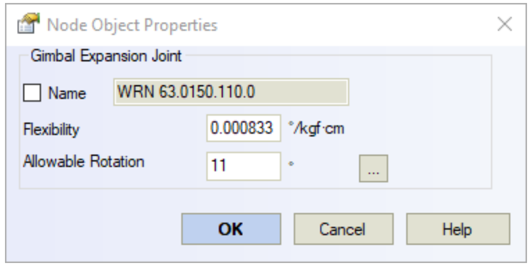


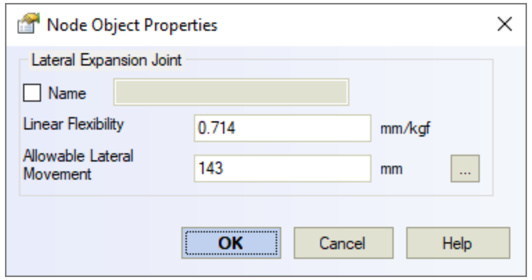
Expansion Joint Objects + Database

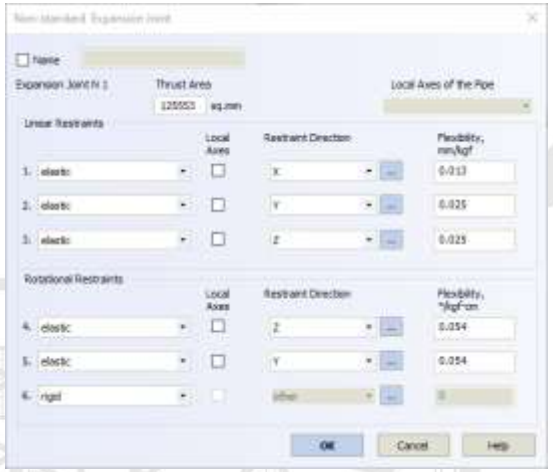
PASS/START-PROF has several expansion joint types and database. Expansion joint deformations are checked automatically.





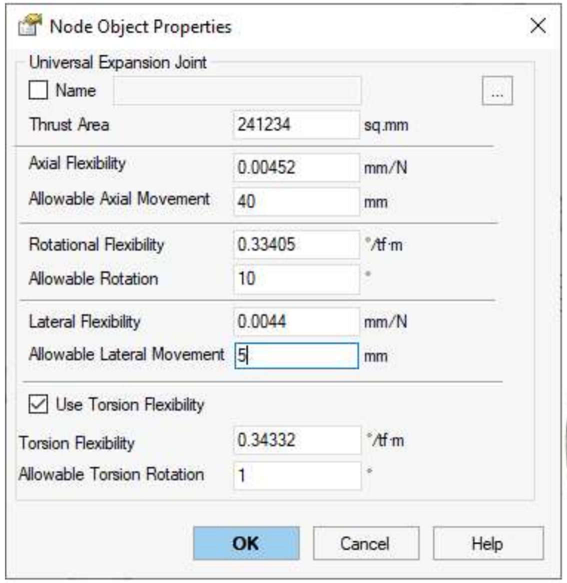


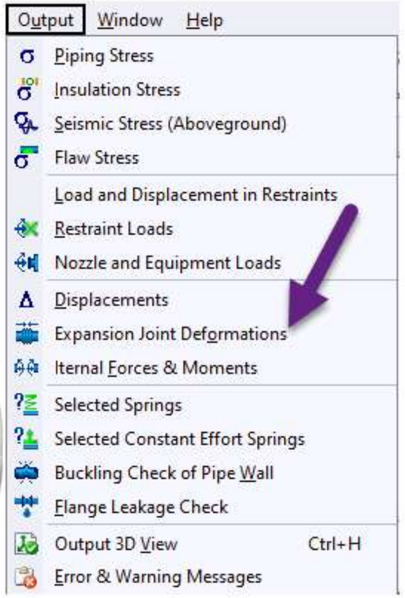




PASS/Start-Prof | Piping Model Creation

Object Untied Expansion Joint and database of Untied Expansion Joints, allows to specify the axial, rotational, shear and torsion flexibility and automatically checks the individual and combined allowable deformations. No need to manually model it using nonstandard expansion joint any more.





$$\frac{|\lambda_p|}{[\lambda_p]} + \frac{|\lambda_\theta|}{[\lambda_\theta]} + \frac{|\lambda_\Delta|}{[\lambda_\Delta]} \le 1.$$

Input | Def exp

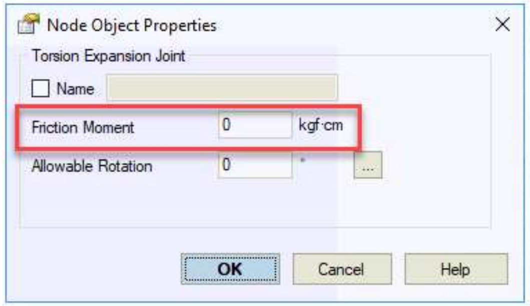
Operating Mode: 1 操作模式 (0) | Load Case: Operating W+P+T | Axis: Local axis (Design/Allowable) | ?

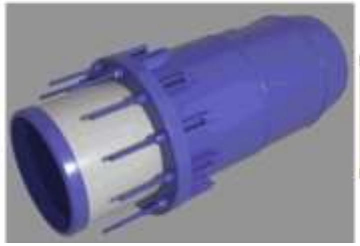
Node Number	Type	Local axis	Axial, (mm)	Allowable, (mm)	Shear, (mm)	Allowable, (mm)	Angular, (°)	Allowable, (°)	Torsion, (°)	Allowable, (°)	Summary	Notes
12	Untied Expansion Joint	Pipe 3 - 12	2.41	50	1.22	15	9.59131	10	-2.05119	No	1.09	1
13	Torsion Expansion Joint	Pipe 5 - 13	0	No	0	No	0	No	13.9229	51.5662	0.27	
15	Torsion Expansion Joint	Pipe 7 - 15	0	No	0	No	0	No	10.1299	51.5662	0.20	
21	Torsion Expansion Joint	Pipe 19 - 21	0	No	0	No	0	No	-4.36021	51.5662	0.08	

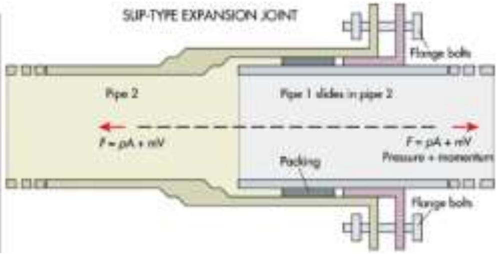
PASS
PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

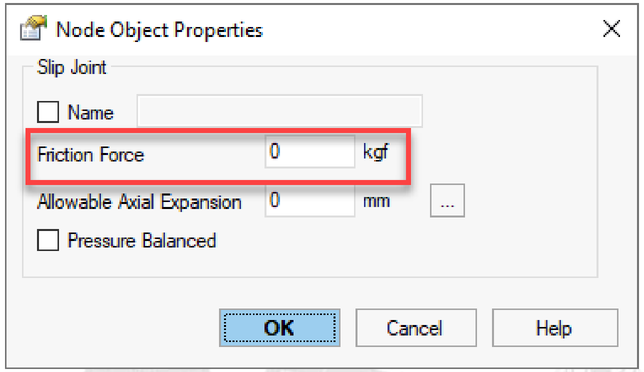
PASS/Start-Prof | Piping Model Creation

- Object Torsion Expansion Joint and database of torsion expansion joints, automatically model torsion friction (friction moment) and checks allowable rotation angle.
- Object Slip Joint and database of slip joints, automatically model axial friction and checks allowable deformation.



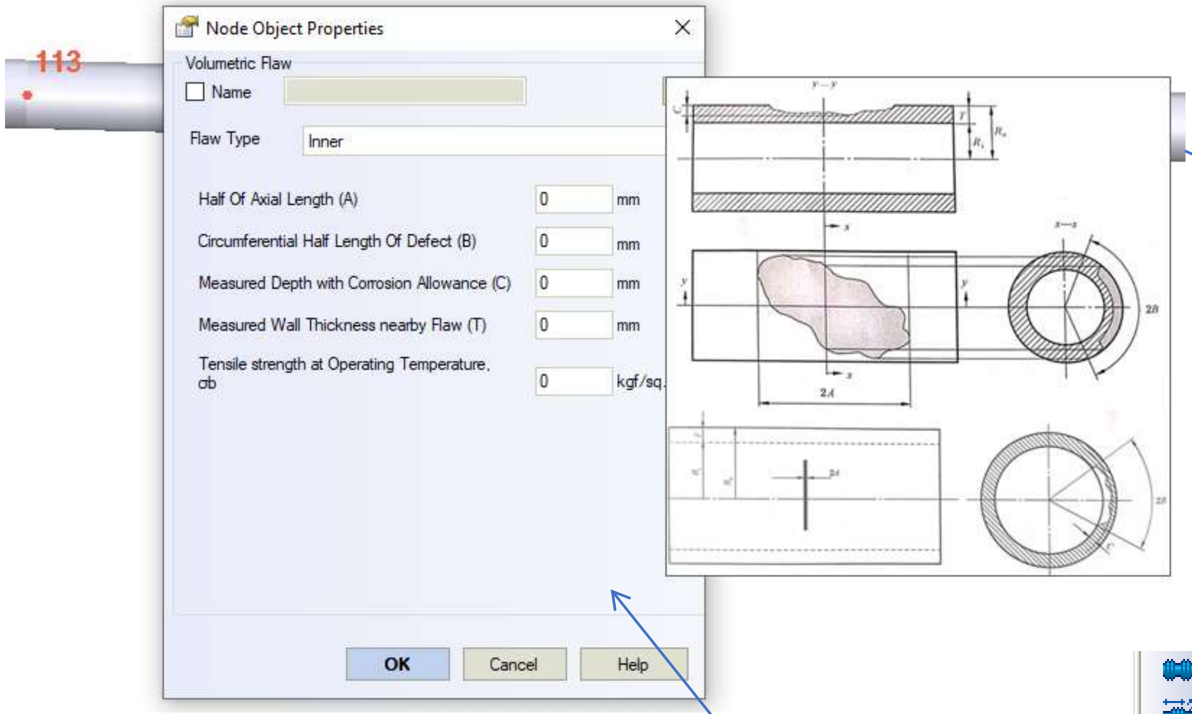


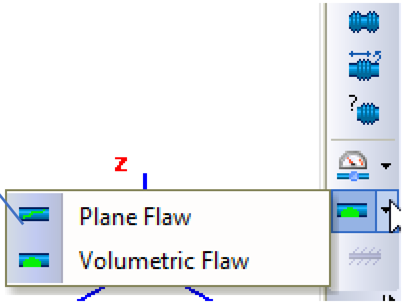


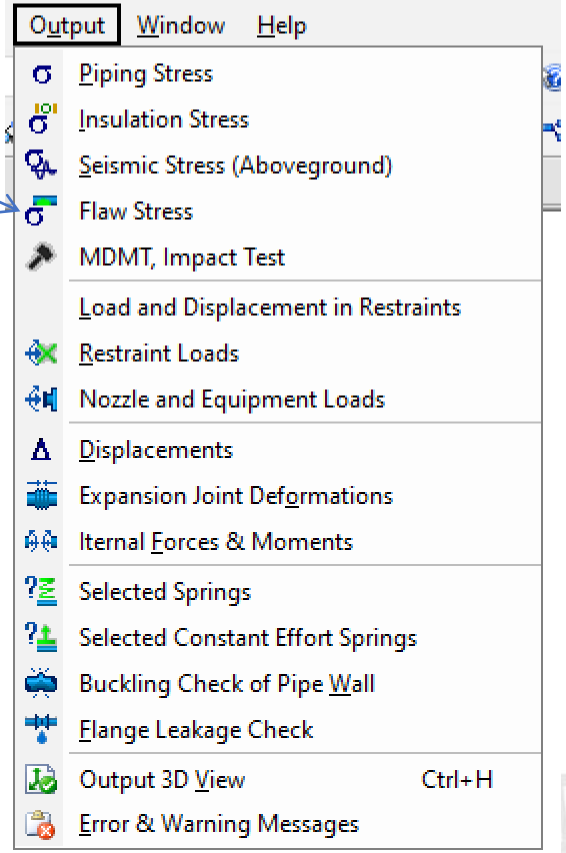


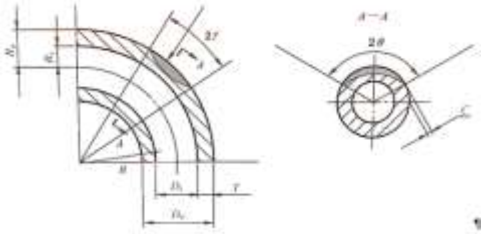
PASS/Start-Prof | Piping Model Creation

Plane flaw and volumetric flaw objects for fitness-for-service calculations









PASS/Start-Prof | Material Database

Individual Material database for each piping code.

ASME B31.3

- Contain data for Creep Rupture Factor calculation, and alternative occasional stress
- Contain data for minimum design temperature calculation
- Contain flag to use f=1.2 or f=1.0

(d) Allowable Displacement Stress Range, S_A. The computed displacement stress range, S_E, in a piping system (see para. 319.4.4) shall not exceed the allowable displacement stress range, S_A (see paras. 319.2.3 and 319.3.4), calculated by eq. (1a)

$$S_A = f(1.25S_c + 0.25S_h) \quad (1a)$$

When S_h is greater than S_L, the difference between them may be added to the term $0.25S_h$ in eq. (1a). In that case, the allowable stress range is calculated by eq. (1b)

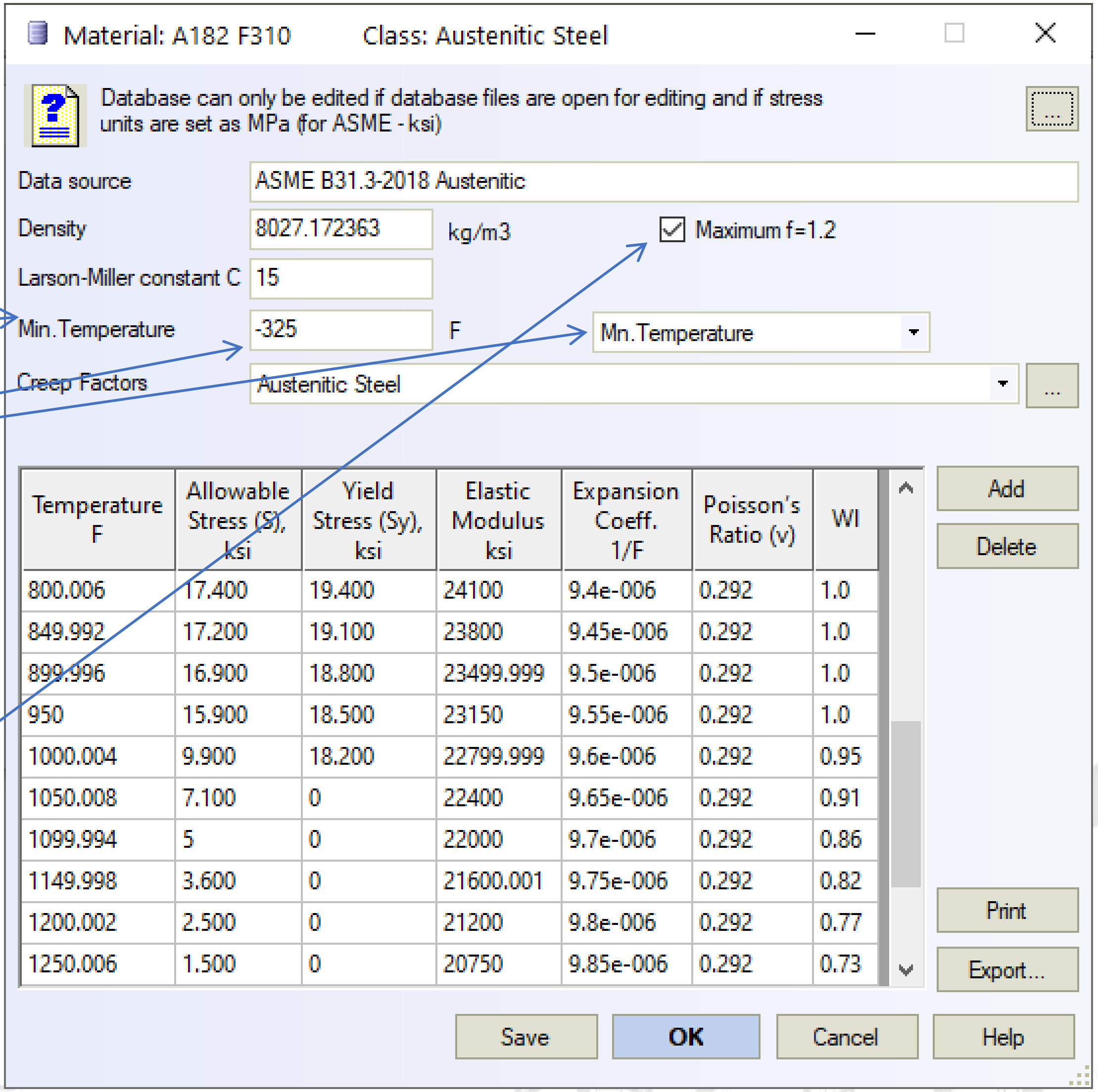
$$S_A = f[1.25(S_c + S_h) - S_L] \quad (1b)$$

For eqs. (1a) and (1b)

f = stress range factor,[3] calculated by eq. (1c)[4]

$$f \text{ (see Fig. 302.3.5)} = 6.0(N)^{-0.2} \leq f_m \quad (1c)$$

f_m = maximum value of stress range factor: 1.2 for ferrous materials with specified minimum tensile strengths ≤517 MPa (75 ksi) and at metal temperatures ≤371°C (700°F); otherwise f_m = 1.0



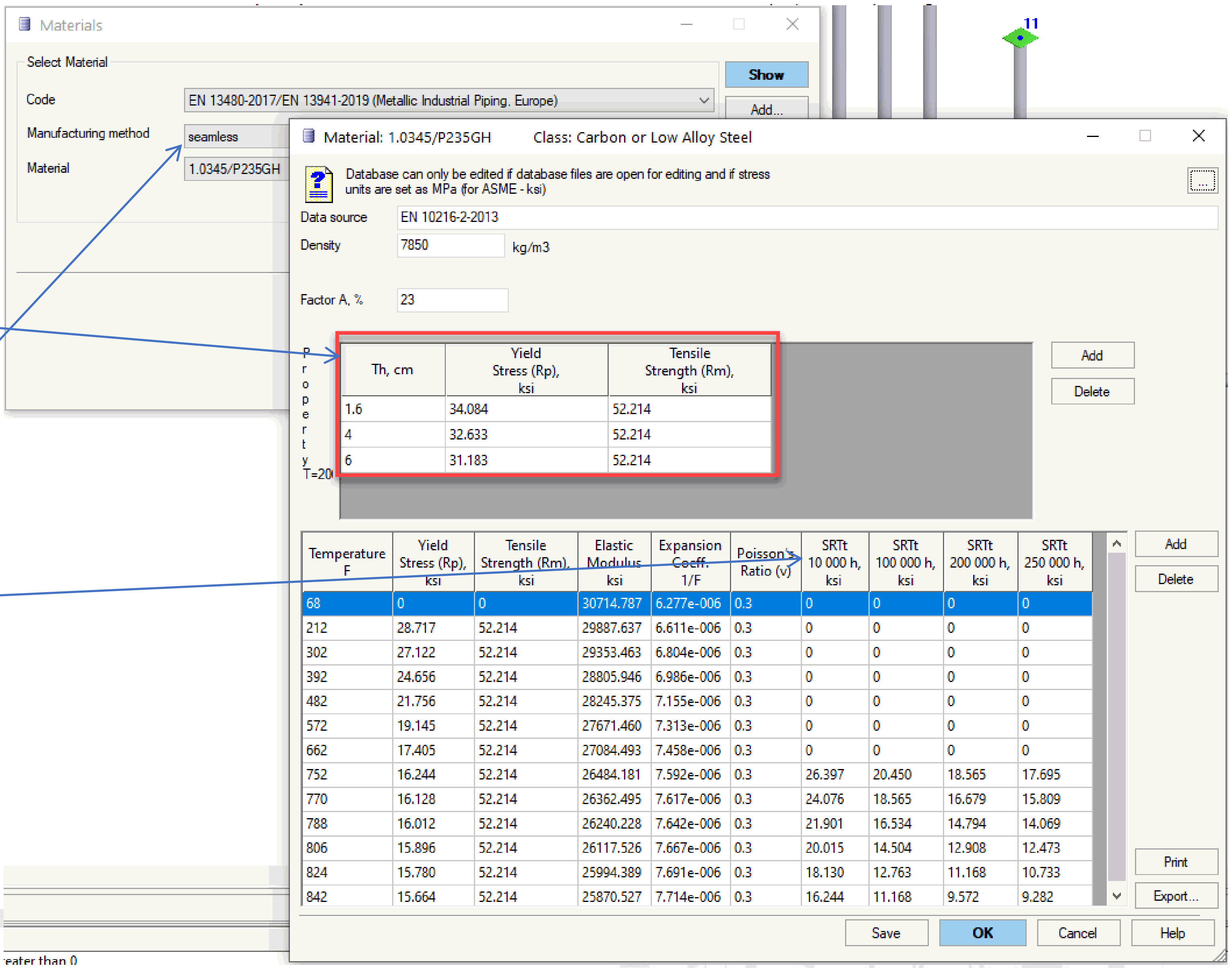
Temperature F	Allowable Stress (S), ksi	Yield Stress (Sy), ksi	Elastic Modulus ksi	Expansion Coeff. 1/F	Poisson's Ratio (v)	WI
800.006	17.400	19.400	24100	9.4e-006	0.292	1.0
849.992	17.200	19.100	23800	9.45e-006	0.292	1.0
899.996	16.900	18.800	23499.999	9.5e-006	0.292	1.0
950	15.900	18.500	23150	9.55e-006	0.292	1.0
1000.004	9.900	18.200	22799.999	9.6e-006	0.292	0.95
1050.008	7.100	0	22400	9.65e-006	0.292	0.91
1099.994	5	0	22000	9.7e-006	0.292	0.86
1149.998	3.600	0	21600.001	9.75e-006	0.292	0.82
1200.002	2.500	0	21200	9.8e-006	0.292	0.77
1250.006	1.500	0	20750	9.85e-006	0.292	0.73

PASS/Start-Prof | Material Database

Individual Material database for each piping code

For example EN 13480/EN 13941 database

- Can automatically select material properties depending on the wall thickness and seamless/welding option
- Contain properties for creep analysis

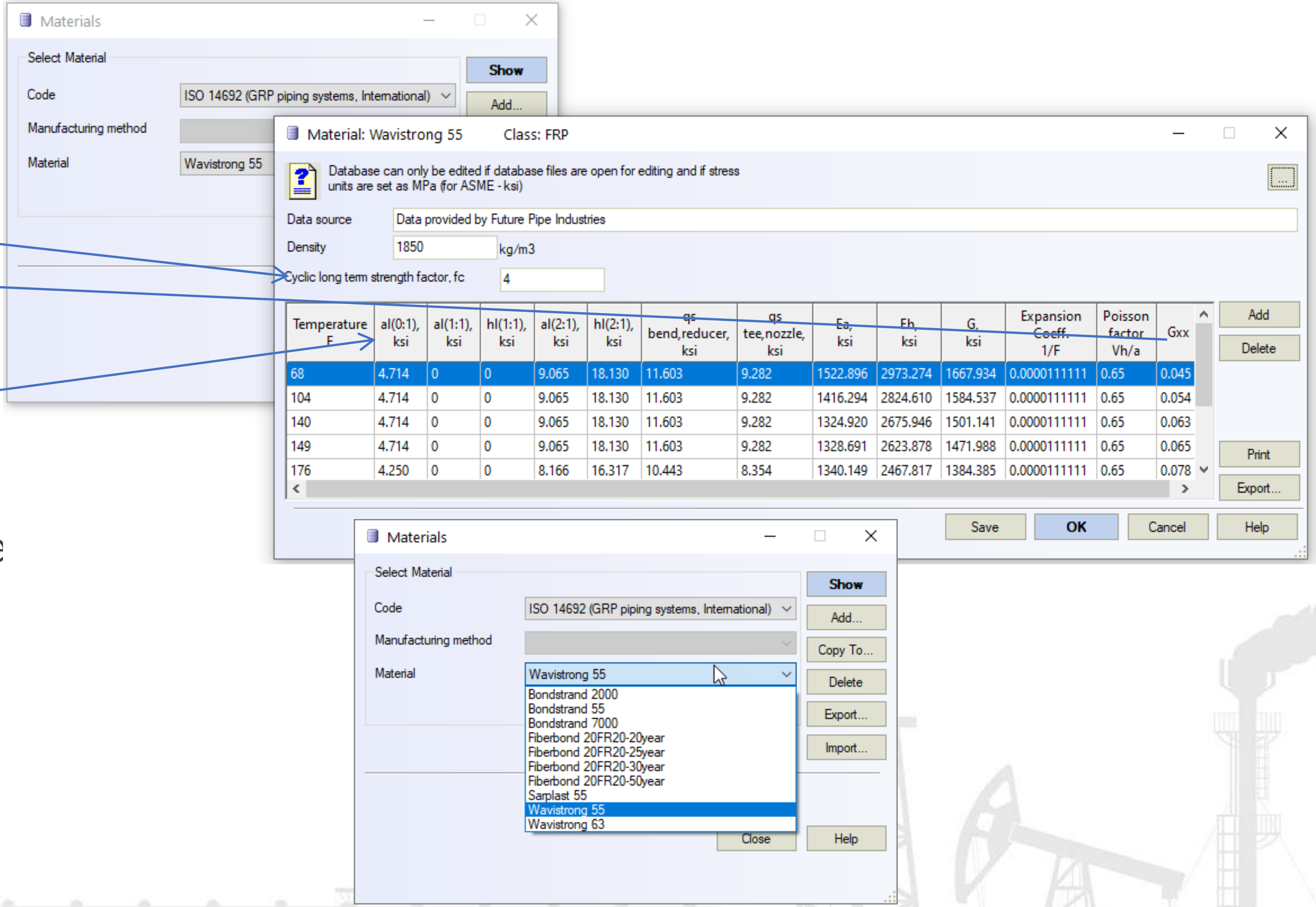


PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

PASS/Start-Prof | Material Database

Individual Material database for each piping code

ISO 14692 database
- Contains fc factor
- Contains Gxx factor
- And everything to perform accurate professional analysis, just need ask the manufacturer to provide the data for this table



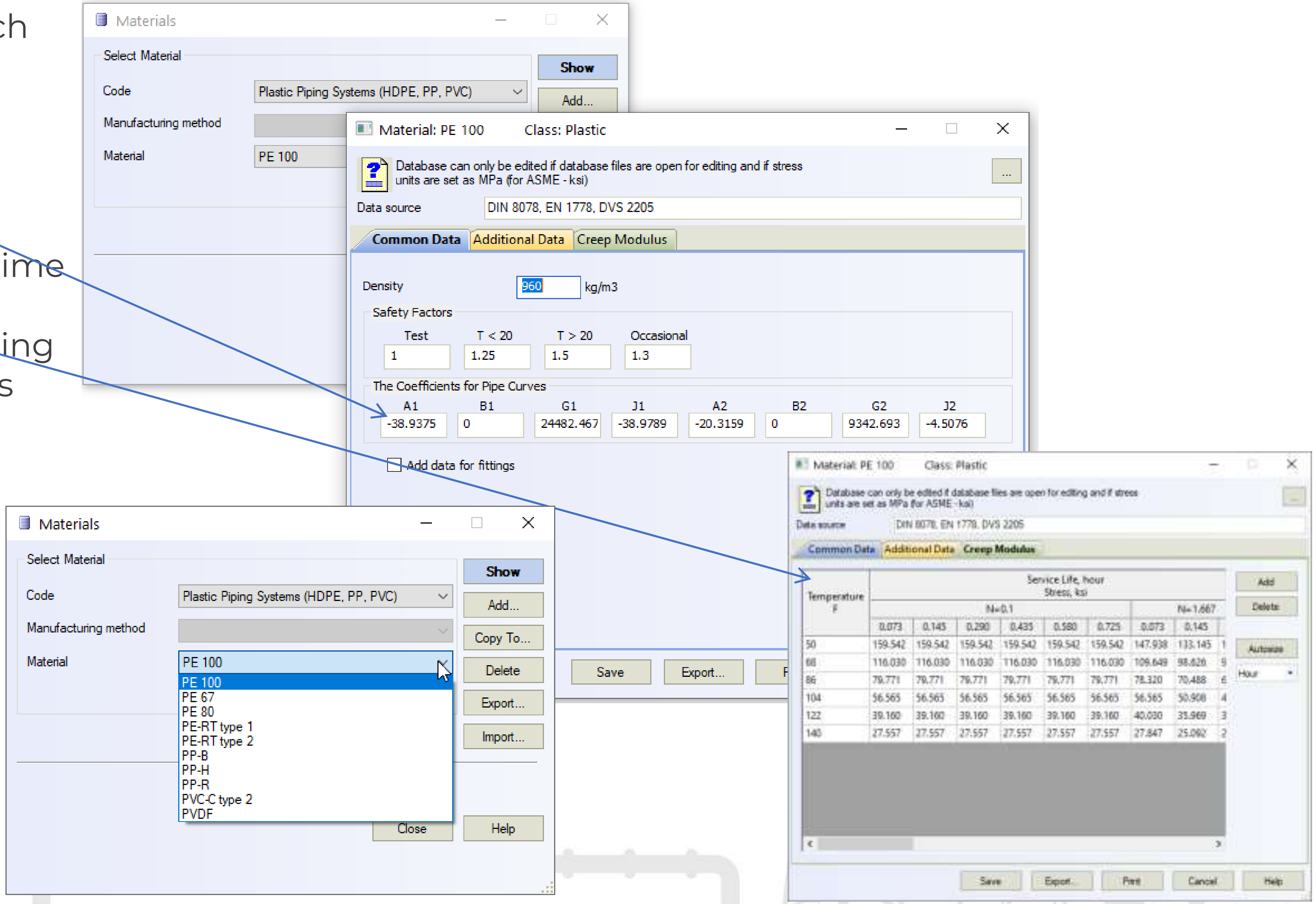
PASS
PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

PASS/Start-Prof | Material Database

Individual Material database for each piping code

Thermoplastic (HDPE) Piping Database

- Contain factors to calculate allowable stress depending on time and temperature
- Contain creep modulus depending on temperature, time, and stress



PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

PASS/Start-Prof | Analysis Capabilities

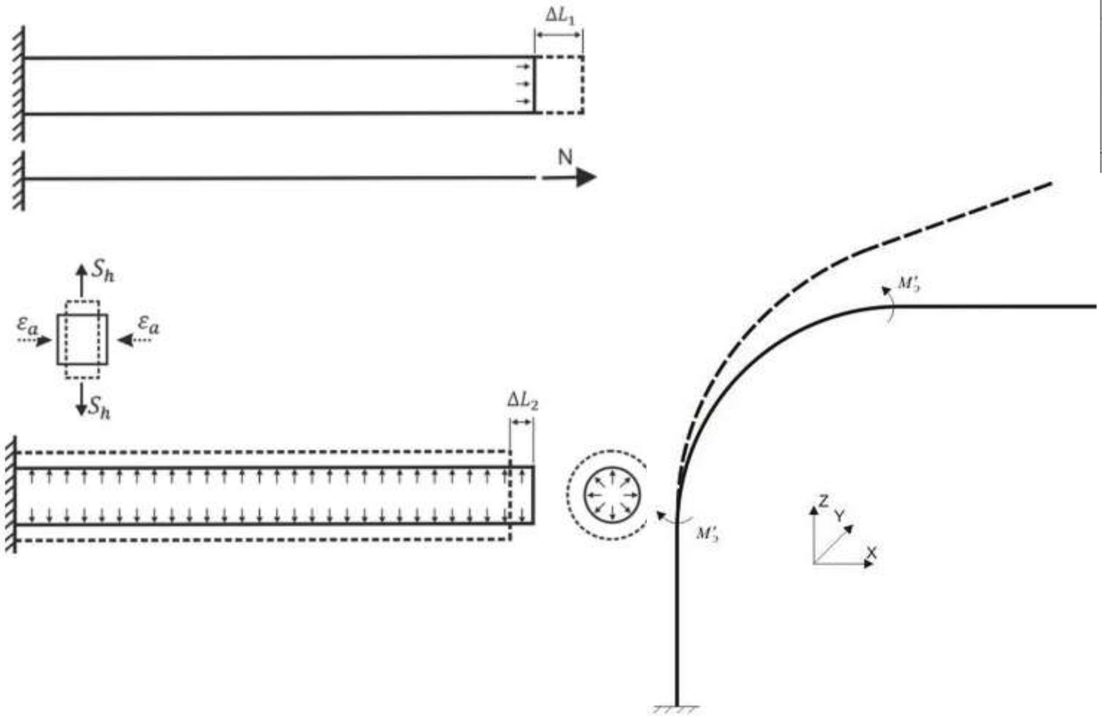
PASS/START-PROF has professional analysis abilities needed for Process and Power Piping Stress Analysis:

- Nonlinear analysis of gaps, friction, one-way restraints, rotating rods, etc.
- Special algorithm that improves the nonlinear model convergence on-the-fly without manual tuning (gaps and one-way restraints cycling, friction force cycling etc.). We receive from users the models that didn’t converge, put it into our collection and continuously improve that algorithm for past 55 years. It allow to achieve convergence in 99.9% models
- Nozzle, tee, bend flexibilities and SIF (Code, ASME B31J, WRC 537/297, PD 5500, FEA)
- Nozzle, pump and other equipment automatic checks (API, ISO, NEMA standards)
- Optimal automatic variable and constant spring selection using manufacturers catalogue

PASS/Start-Prof | Analysis Capabilities

Bourdon Effect (translation & bend rotation)

	Unrestrained pipe $k = 0$	Restrained pipe $k = \infty$	Partially restrained pipe with flexible spring k
Support Load	$R = 0$	$R = \alpha \Delta T E A + (1-2v) A \frac{P(D-2t)^2}{D^2-(D-2t)^2} \approx \alpha \Delta T E A + (0.5-v) S_h \cdot A$	$R = \frac{\alpha \Delta T E A + (1-2v) A \frac{P(D-2t)^2}{D^2-(D-2t)^2}}{\frac{EA}{kL}+1} \approx \frac{\alpha \Delta T E A + (0.5-v) S_h \cdot A}{\frac{EA}{kL}+1}$
Axial Force	$N = P\frac{\pi(D-2t)^2}{4} \approx 0.5 S_h \cdot A$	$N = -\alpha \Delta T E A + 2v \frac{P\pi(D-2t)^2}{4} \approx -\alpha \Delta T E A + v S_h \cdot A$	$N = \frac{-\alpha \Delta T E A - 2v \frac{P\pi(D-2t)^2}{4}}{\frac{EA}{kL}+1} + \frac{P\pi(D-2t)^2}{4} \approx \frac{-\alpha \Delta T E A - (0.5-v) S_h \cdot A}{\frac{EA}{kL}+1} + 0.5 S_h \cdot A$
Axial Stress	$S_a = \frac{P(D-2t)^2}{D^2-(D-2t)^2} \approx 0.5 S_h$	$S_a = -\alpha \Delta T E + 2v \frac{P(D-2t)^2}{D^2-(D-2t)^2} \approx -\alpha \Delta T E + v S_h$	$S_a = \frac{-\alpha \Delta T E - 2v \frac{P(D-2t)^2}{D^2-(D-2t)^2}}{\frac{EA}{kL}+1} + \frac{P(D-2t)^2}{D^2-(D-2t)^2} \approx \frac{-\alpha \Delta T E - (0.5-v) S_h}{\frac{EA}{kL}+1} + 0.5 S_h$
Elongation	$\Delta L = \alpha \Delta T L + (1-2v)\frac{P(D-2t)^2}{D^2-(D-2t)^2}\frac{L}{E} \approx \alpha \Delta T L + (0.5-v) S_h \frac{L}{E}$	$\Delta L = 0$	$\Delta L = \left(\alpha \Delta T L + (1-2v)\frac{P(D-2t)^2}{D^2-(D-2t)^2}\frac{L}{E}\right)\left(\frac{1}{\frac{EA}{kL}+1}\right) \approx \left(\alpha \Delta T L + (0.5-v) S_h \frac{L}{E}\right)\left(\frac{1}{\frac{EA}{kL}+1}\right)$

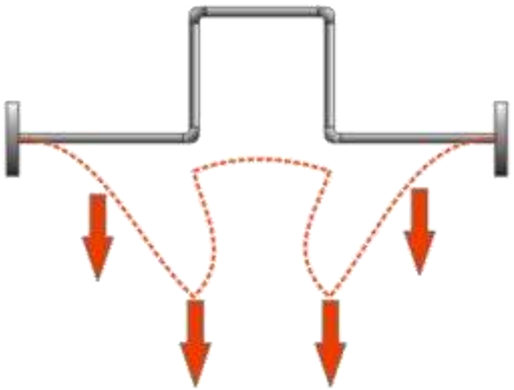


PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

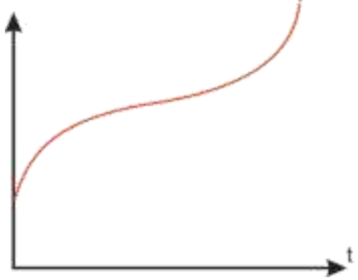
PASS/Start-Prof | Analysis Capabilities

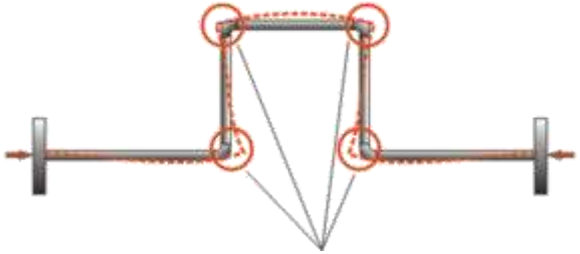
Calculate creep stresses in operating state and after cooling down (relaxation)

Calculate support loads with creep effect after cooling down with creep self-springing effect (ASME B31.3 319.2.3 a)

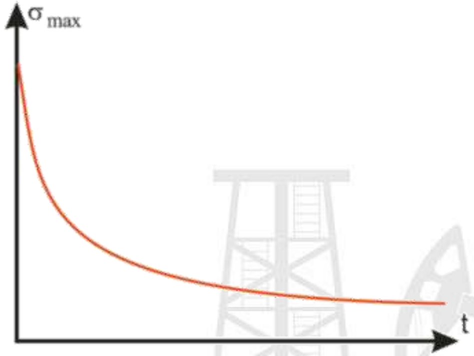


Creep lead to increasing the deformations from the weight loads





Creep lead to expansion stress and support loads relaxation (reduction) with time



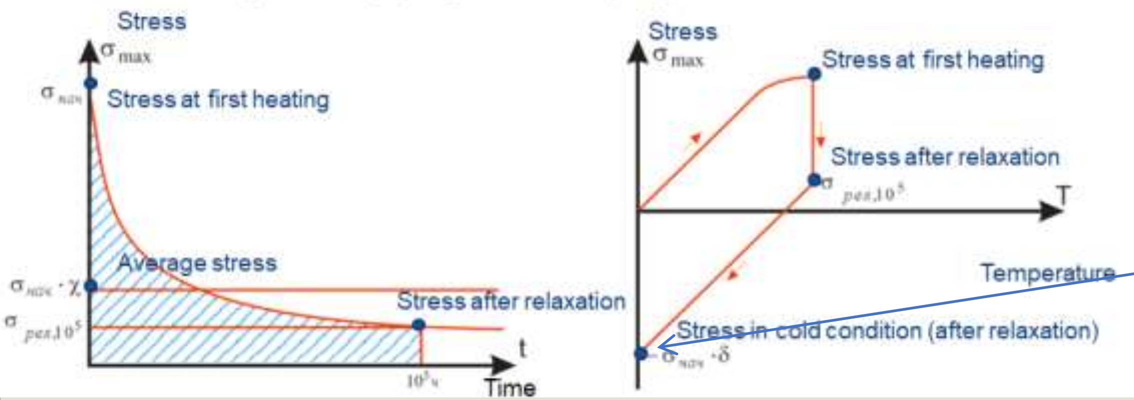
PASS PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

PASS/Start-Prof | Analysis Capabilities

Calculate creep stresses in operating state and after cooling down (relaxation)

Calculate support loads with creep effect after cooling down with creep self-springing effect (ASME B31.3 319.2.3 a)

Creep lead to piping self cold-spring in cold condition



319.2.3 Displacement Stress Range

(a) In contrast with stresses from sustained loads, such as internal pressure or weight, displacement stresses may be permitted to attain sufficient magnitude to cause local yielding in various portions of a piping system. When the system is initially operated at the condition of greatest displacement (highest or lowest temperature, or greatest imposed movement) from its installed condition, any yielding or creep brings about a reduction or relaxation of stress. When the system is later returned to its original condition (or a condition of opposite displacement), a reversal and redistribution of stresses occurs that is referred to as self-springing. It is similar to cold springing in its effects.

Input | Stress

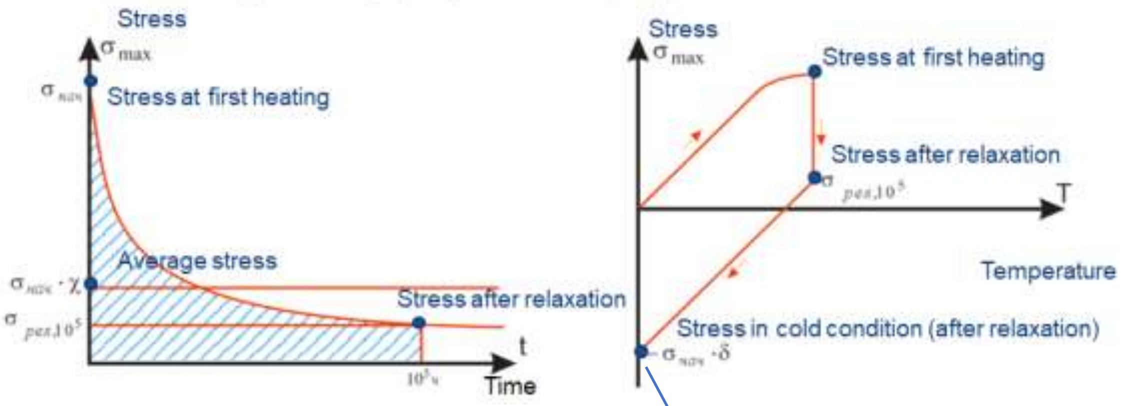
Operating Mode: 1 'CTAPT1' | Expansion Stress Range: 1 'CTAPT1' (1-1A) | ☑ Show Equations | ☑ Creep Stress | ☐ Stress Range from Operation to Cold | ☐ Add Axial Force and Torsion Stress | ?

Object	Start End node	Primary Loads Stress in Hot State, (ksi)			Expansion Stress Range, (ksi)			Creep Stress (Operating State), (ksi)			Creep Stress (Cold State), (ksi)			Notes
		Sl	Sh*Wc/E	%	Se	Sa	%	Slcreep	Sh, creep	%	Slcreep	Sc, creep	%	
Above ground pipe	14	4.733	15.215	31.1	4.795	45.535	10.5	4.762	12.172	39.1	7.364	30	24.5	
	29,2 Flange	6.244	15.215	41.0	4.127	44.025	9.4	6.103	12.172	50.1	8.580	30	28.6	
Forged Elbow	29,2 Flange	7.270	15.215	47.8	7.012	43.060	16.3	7.033	12.172	57.8	10.611	30	35.4	
Above ground pipe	29,2 Flange	6.491	15.215	42.7	4.542	43.778	10.4	6.254	12.172	51.4	9.429	30	31.4	
	15	3.422	15.215	22.5	5.656	46.847	12.1	3.989	12.172	32.8	7.435	30	24.8	
Above ground pipe	14	4.923	15.215	32.4	16.859	45.346	37.2	5.603	12.172	46.0	20.829	30	69.4	
	16	5.016	15.215	33.0	13.674	45.252	30.2	5.687	12.172	46.7	16.348	30	54.5	
Weldolet (branch welded-on fitting)	16	10.051	15.215	66.1	75.640	41.251	183.4	13.462	12.172	110.6	60.670	30	202.2	33,13,14,333
Above ground pipe	16	4.204	15.215	27.6	8.415	46.065	18.3	5.036	12.172	41.4	9.884	30	32.9	
	30,1 flange	5.496	15.215	36.1	3.603	44.773	8.0	5.621	12.172	46.2	6.755	30	22.5	

Often the greatest stresses and support loads are in cold state after creep relaxation due to self-springing!

PASS/Start-Prof | Analysis Capabilities

Creep lead to piping self cold-spring in cold condition



Often the greatest stresses and support loads are in cold state after creep relaxation due to self-springing!

Input | Stress | Loads

Operating Mode: 1 'CTAPT1' | Load Case: Cold Creep (W+P)-T*d | Axis: Global axis | Support Type: Anchor (fixed), Resting...

Node Number	Type	Forces along coordinate axis, (kgf)			Moments around coordinate axis, (kgf·cm)		
		X	Y	Z	X	Y	Z
5,Bend	Anchor (fixed)	-4821.20	-741.20	-516.80	-7516.52	-164260.46	310608.63
7,Bend	Anchor (fixed)	-15296.50	6107.60	-508.40	-134784.76	68006.50	1955982.59
9	Anchor (fixed)	4594.90	-2450.80	-474.70	25199.76	149356.38	-211296.82
11	Anchor (fixed)	738.80	282	-1175.80	98675.08	-172333.62	-52396.02
13	Resting Support	0	0.10	39.20	0	0	0
15	Anchor (fixed)	143.70	-102.60	-850.80	-63010.91	33497.13	-33351.85
17	Anchor (fixed)	25.40	-259.90	-742.60	-125347.83	66853.35	-23842.90
19	Anchor (fixed)	182.20	-481.60	-881	-210262.61	17410.30	-13870.44
21	Anchor (fixed)	14432.80	-2353.50	15.30	-27776.98	425.14	-456489.75

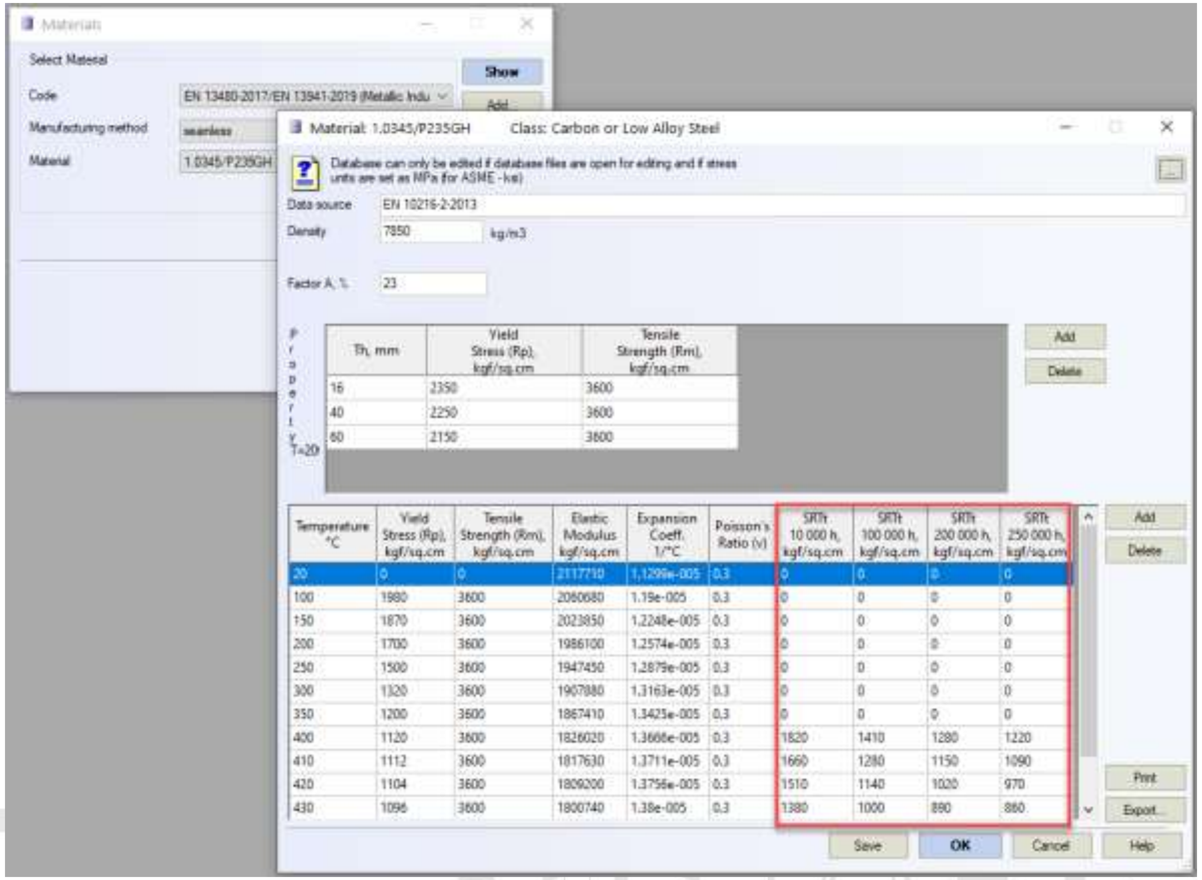
PASS/Start-Prof | Analysis Capabilities

EN 13480 creep stresses are calculated automatically without any user's manual efforts

e) For the combination of sustained loads and restrained thermal expansion loads

$$\sigma_4 = \frac{p_c\ D_o}{4e_n} + 0{,}75i\frac{M_A}{Z} + i\frac{M_C}{Z} + \sigma_{MT} + \frac{\sigma_{PT}}{2} \le f_h + f_a \text{ , and } 0{,}75i \ge 1{,}0 \qquad (11.6\text{-}5)$$

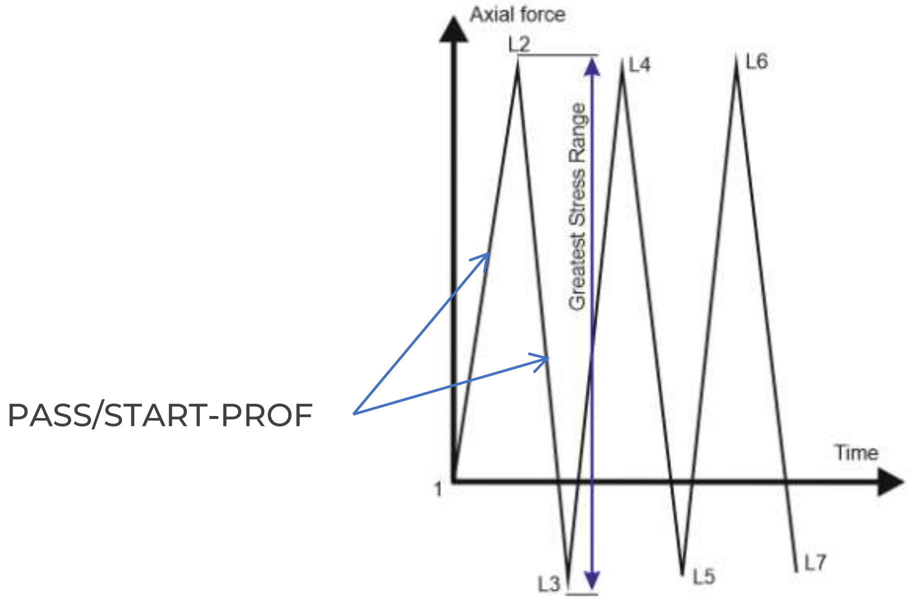
EN 13480 database contains all needed information for creep analysis

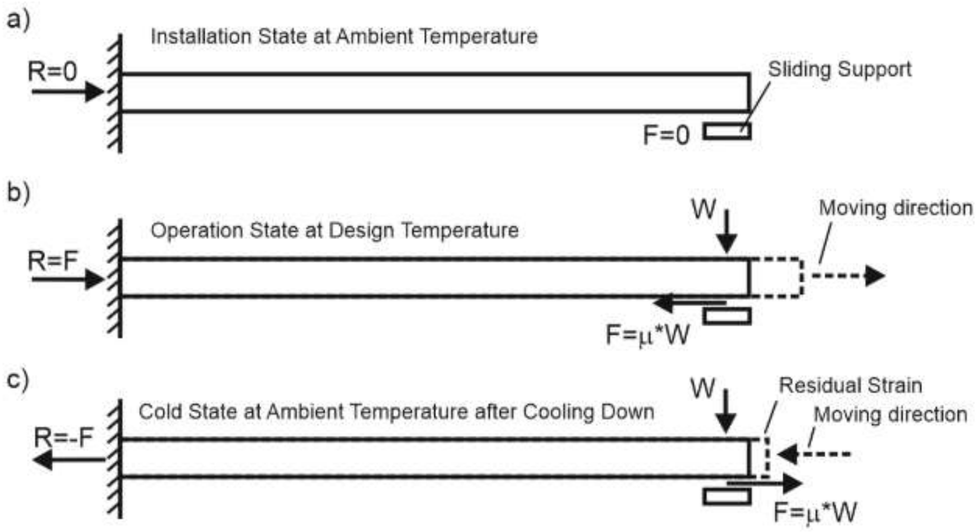


PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

PASS/Start-Prof | Analysis Capabilities

START-PROF calculates the cold state after cooling down from the hot state. It allows to get more realistic expansion stress range



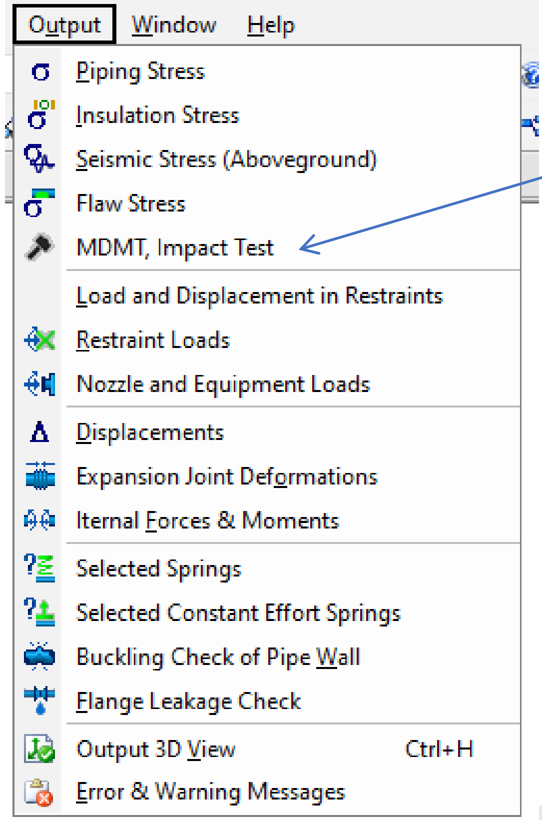


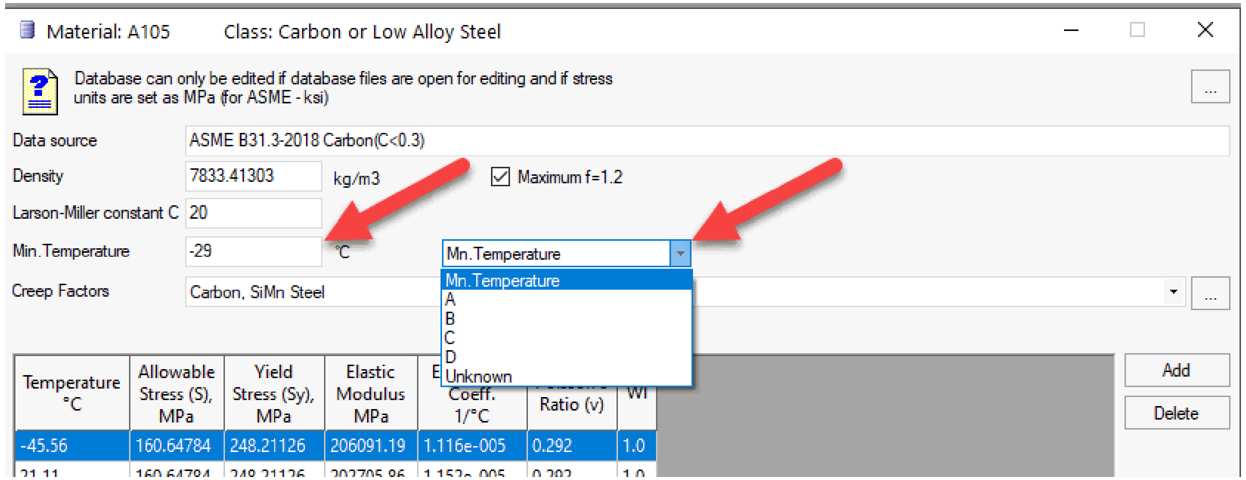
PASS
PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/Start-Prof | Analysis Capabilities

Minimum Design Metal Temperature (MDMT) calculation according to 323.2.2 (a), (b), (d), (e), (f), (g), (h), (i), (j) of ASME B31.3-2018.

Material database contains all needed data.





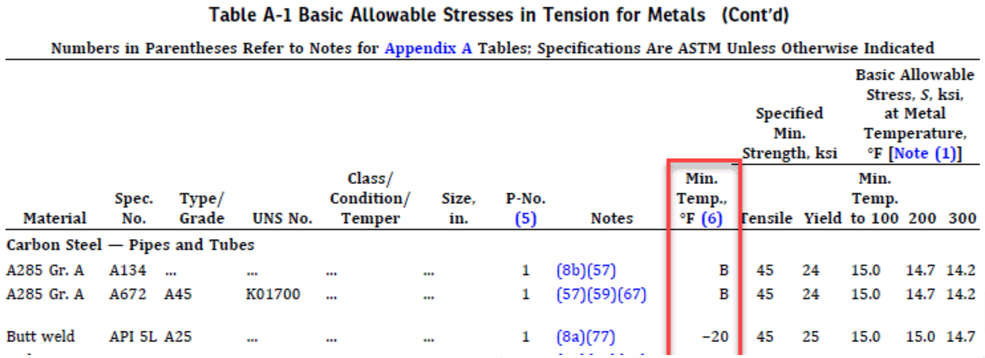


Table A-1 Basic Allowable Stresses in Tension for Metals (Cont'd)

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Material	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi: Tensile	Yield	Basic Allowable Stress, S, ksi, at Metal Temperature, °F [Note (1)]: Min. Temp. to 100	200	300
Carbon Steel — Pipes and Tubes													
A285 Gr. A	A134	...	...	...	...	1	(8b)(57)	B	45	24	15.0	14.7	14.2
A285 Gr. A	A672	A45	K01700	...	...	1	(57)(59)(67)	B	45	24	15.0	14.7	14.2
Butt weld	API 5L	A25	...	...	...	1	(8a)(77)	−20	45	25	15.0	15.0	14.7

PASS/Start-Prof | Analysis Capabilities

PASS/START-PROF calculates the MDMT according to figure 323.2.2A and figure 323.2.2B depending on the calculated stress ratio if user select appropriate option in project settings, taking into account the code requirements 323.2.2 (g), (h), (i).

After analysis the output report table is provided. For each pipe START-PROF show if the impact test is needed or not

Object	Start End node	Thickness, cm	Material	Stress Ratio, r	Tmin, °C	MDMT, °C	Output
Above ground pipe	3,Restrained	0.600	A106 B	0.294	-40	-48	OK
Above ground pipe	23	0.600	A106 B	0.395	-40	-48	OK
	5,Bend	0.600	A106 B	0.840	-40	-37.869	Impact Test
Above ground pipe	6,0 Flange	0.600	A106 B	0.436	-40	-48	OK
	24	0.600	A106 B	0.400	-40	-48	OK
Above ground pipe	6,0 Flange	0.600	A106 B	0.342	-40	-48	OK
	8	0.600	A106 B	0.373	-40	-48	OK
Above ground pipe	8	0.600	A106 B	0.317	-40	-48	OK
	25	0.600	A106 B	0.283	-40	-48	OK
Above ground pipe	27	0.600	A106 B	0.430	-40	-48	OK
	9	0.600	A106 B	0.951	-40	-31.783	Impact Test
Above ground pipe	8	0.600	A106 B	0.330	-40	-48	OK

Figure 323.2.2A Minimum Temperatures Without Impact Testing for Carbon Steel Materials
(See Table A-1 or Table A-1M for Designated Curve for a Listed Material; see Table 323.2.2A for Tabular Values)

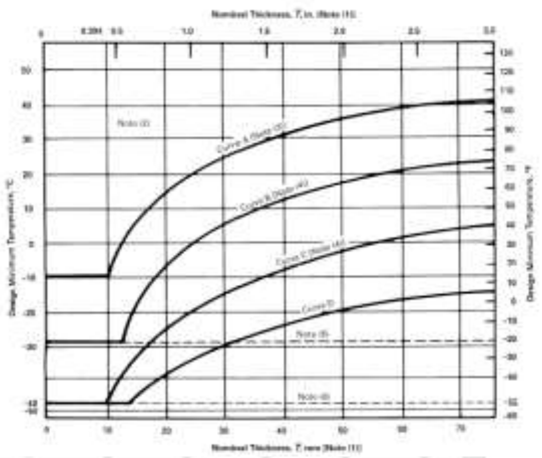
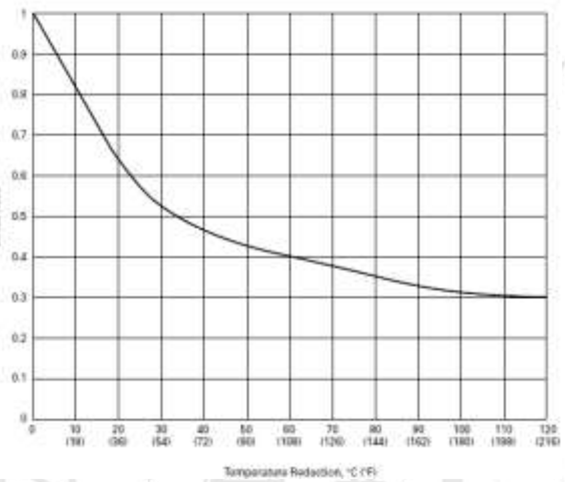


Figure 323.2.2B Reduction in Lowest Exemption Temperature for Steels Without Impact Testing
(See Table 323.2.2B for Tabular Values)

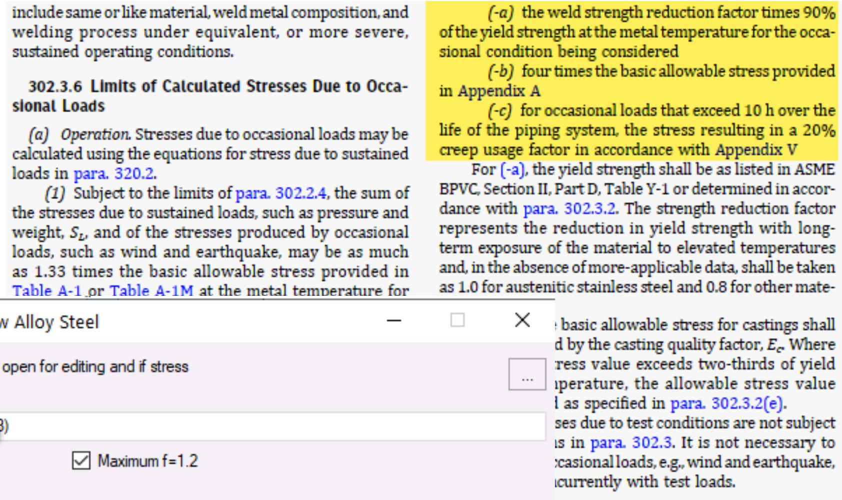


PASS/Start-Prof | Analysis Capabilities

Alternative occasional allowable calculation for elevated temperature fluid service 302.3.6 (2) ASME B31.3-2018, added appendix V.

"Time duration", "Alternative Occasional" options in operating mode editor.

Larson-Miller constant "C" in ASME B31.3 material database.


include same or like material, weld metal composition, and welding process under equivalent, or more severe, sustained operating conditions.

302.3.6 Limits of Calculated Stresses Due to Occasional Loads

(a) *Operation.* Stresses due to occasional loads may be calculated using the equations for stress due to sustained loads in para. 320.2.

(1) Subject to the limits of para. 302.2.4, the sum of the stresses due to sustained loads, such as pressure and weight, S_L, and of the stresses produced by occasional loads, such as wind and earthquake, may be as much as 1.33 times the basic allowable stress provided in Table A-1 or Table A-1M at the metal temperature for

(-a) the weld strength reduction factor times 90% of the yield strength at the metal temperature for the occasional condition being considered

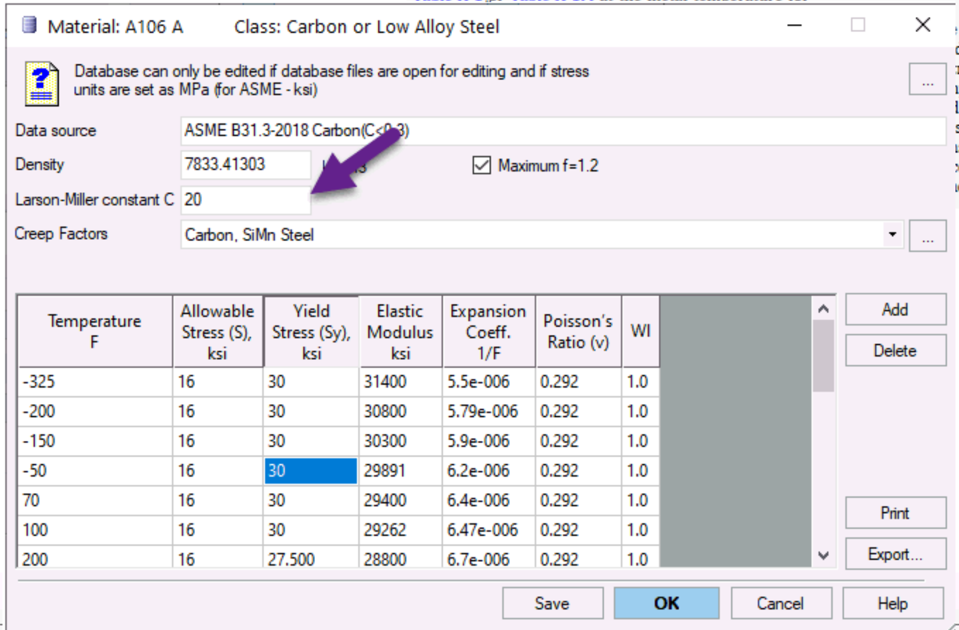
(-b) four times the basic allowable stress provided in Appendix A

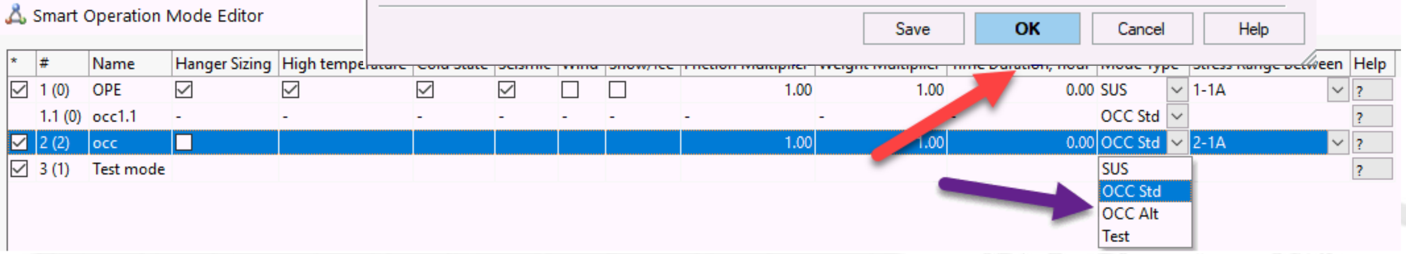
(-c) for occasional loads that exceed 10 h over the life of the piping system, the stress resulting in a 20% creep usage factor in accordance with Appendix V

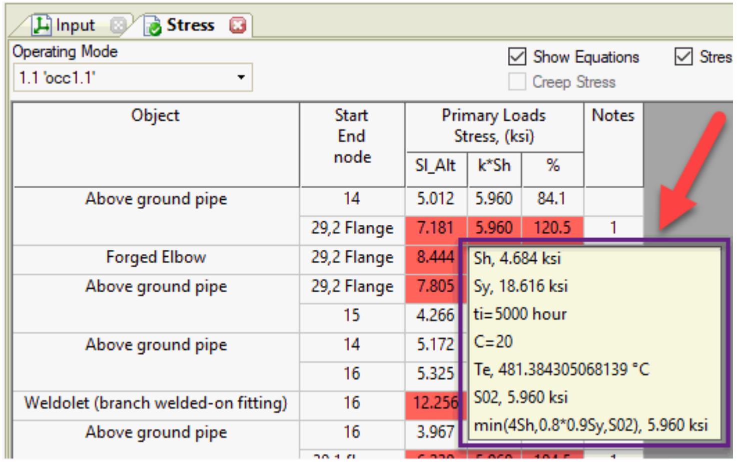
For (-a), the yield strength shall be as listed in ASME BPVC, Section II, Part D, Table Y-1 or determined in accordance with para. 302.3.2. The strength reduction factor represents the reduction in yield strength with long-term exposure of the material to elevated temperatures and, in the absence of more-applicable data, shall be taken as 1.0 for austenitic stainless steel and 0.8 for other mate-

basic allowable stress for castings shall d by the casting quality factor, E_c. Where ress value exceeds two-thirds of yield perature, the allowable stress value l as specified in para. 302.3.2(e).

ses due to test conditions are not subject s in para. 302.3. It is not necessary to casional loads, e.g., wind and earthquake, currently with test loads.

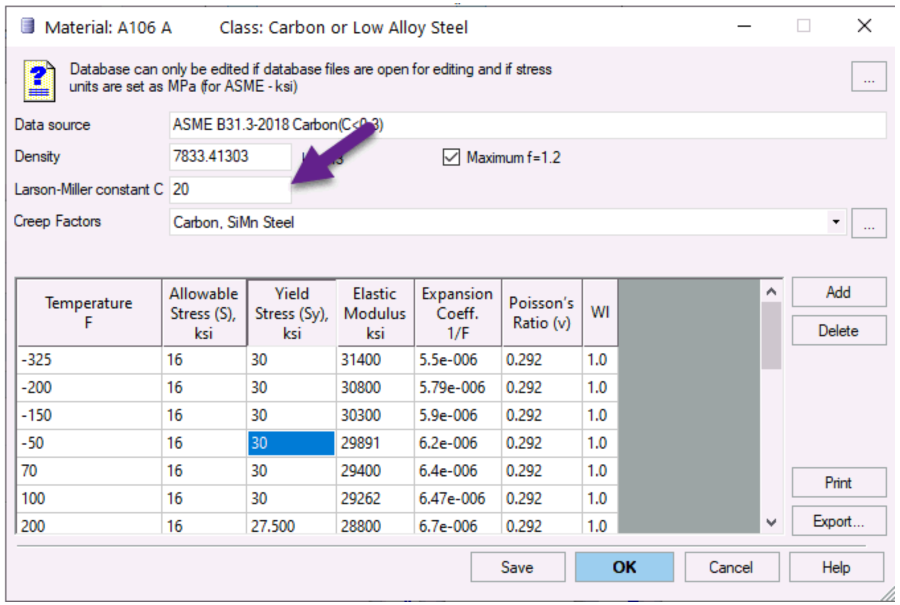






PASS/Start-Prof | Analysis Capabilities

Automatic Creep-Rupture Usage Factor calculation according to ASME B31.3-2018 Appendix V (V303.1-V303.3)



V303.2 Determine Creep-Rupture Usage Factor

The usage factor, u, is the summation of individual usage factors, t_i / t_{ri}, for all service conditions considered in para. V303.1. See eq. (V4).

$$u = \sum (t_i / t_{ri}) \tag{V4}$$

where

i = as a subscript, 1 for the prevalent operating condition; i = 2, 3, etc., for each of the other service conditions considered

t_i = total duration, h, associated with any service condition, i, at pressure, P_i, and temperature, T_i

t_{ri} = as defined in para. V303.1.4

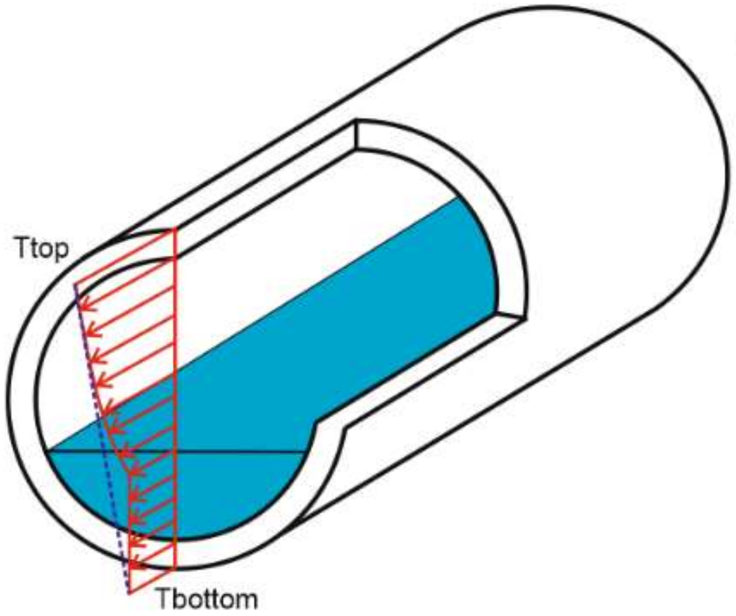
V303.3 Evaluation

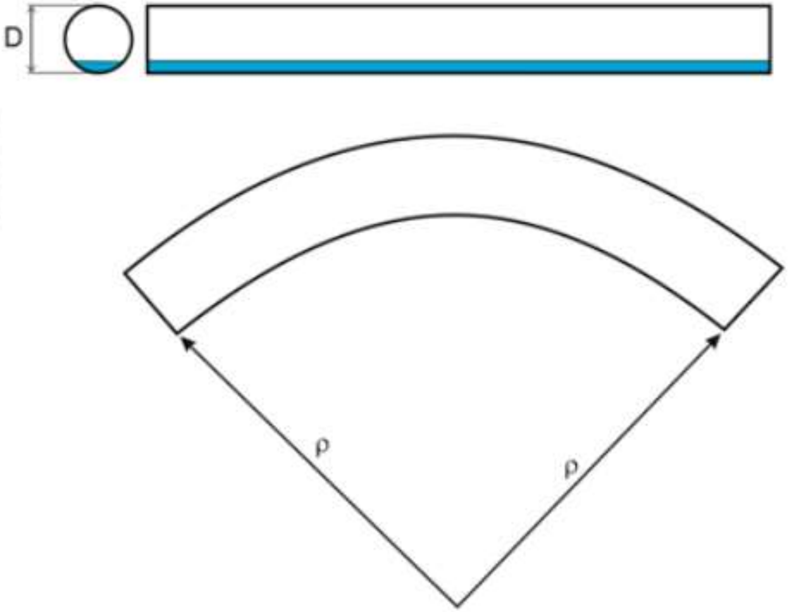
The calculated value of u indicates the nominal amount of creep-rupture life expended during the service life of the piping system. If $u \leq 1.0$, the usage factor is acceptable including excursions. If $u > 1.0$, the designer shall either increase the design conditions (selecting piping system components of a higher allowable working pressure if necessary) or reduce the number and/or severity of excursions until the usage factor is acceptable.

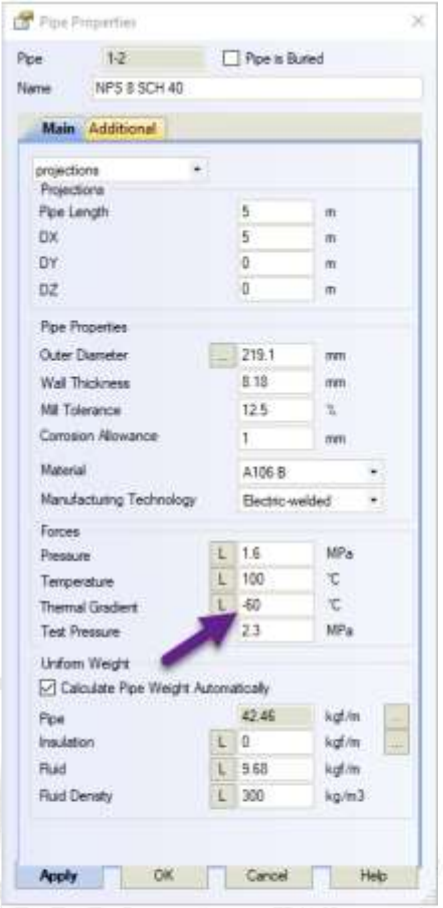
PASS PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

PASS/Start-Prof | Analysis Capabilities

Thermal Bowing Analysis – phenomenon occurs when a horizontal pipe is filled partially by hot or cold fluid (LNG). Many thermal bowing occurrences cause unexpected damage to the piping or supporting structure







$$\frac{1}{\rho} = \frac{\alpha(T_{top} - T_{botton})}{D}$$

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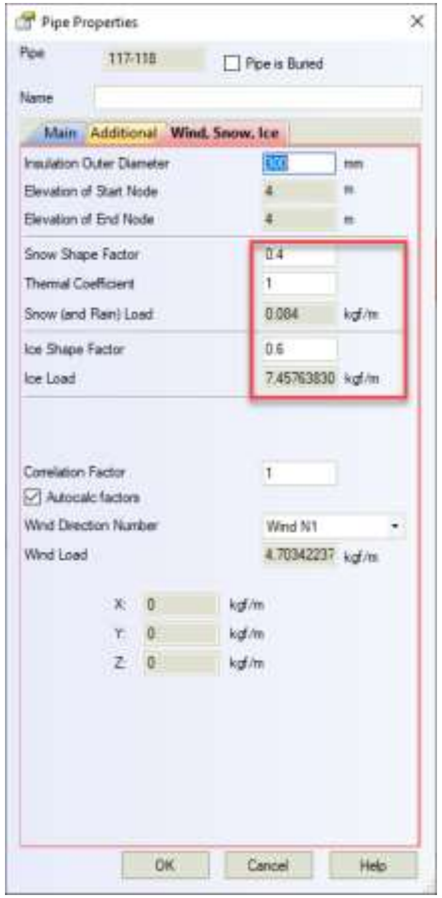
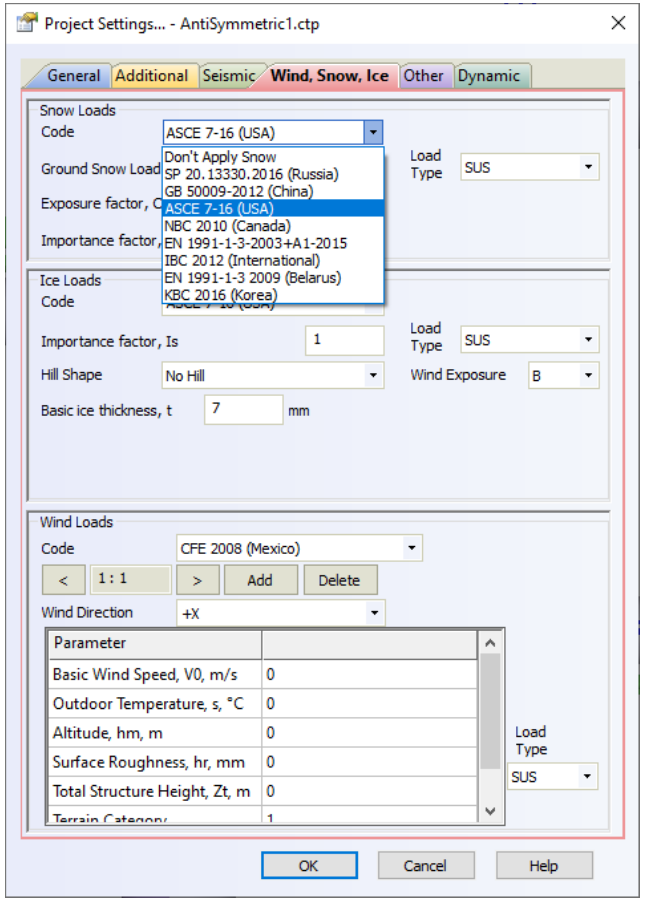
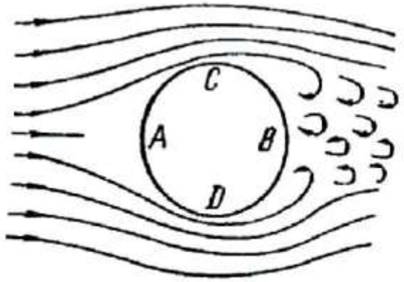
PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

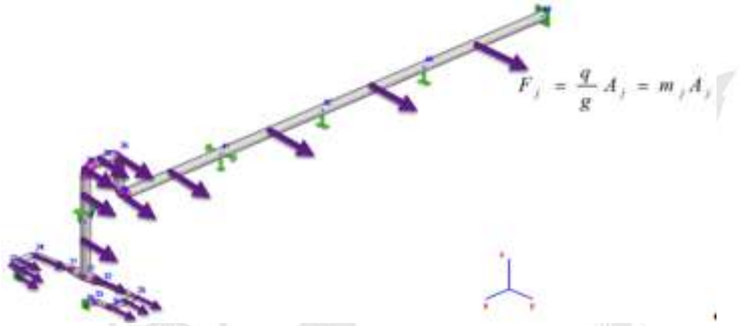
PASS/Start-Prof | Analysis Capabilities

Automatic generation of a wind, snow, ice, seismic loads according to 18 national codes









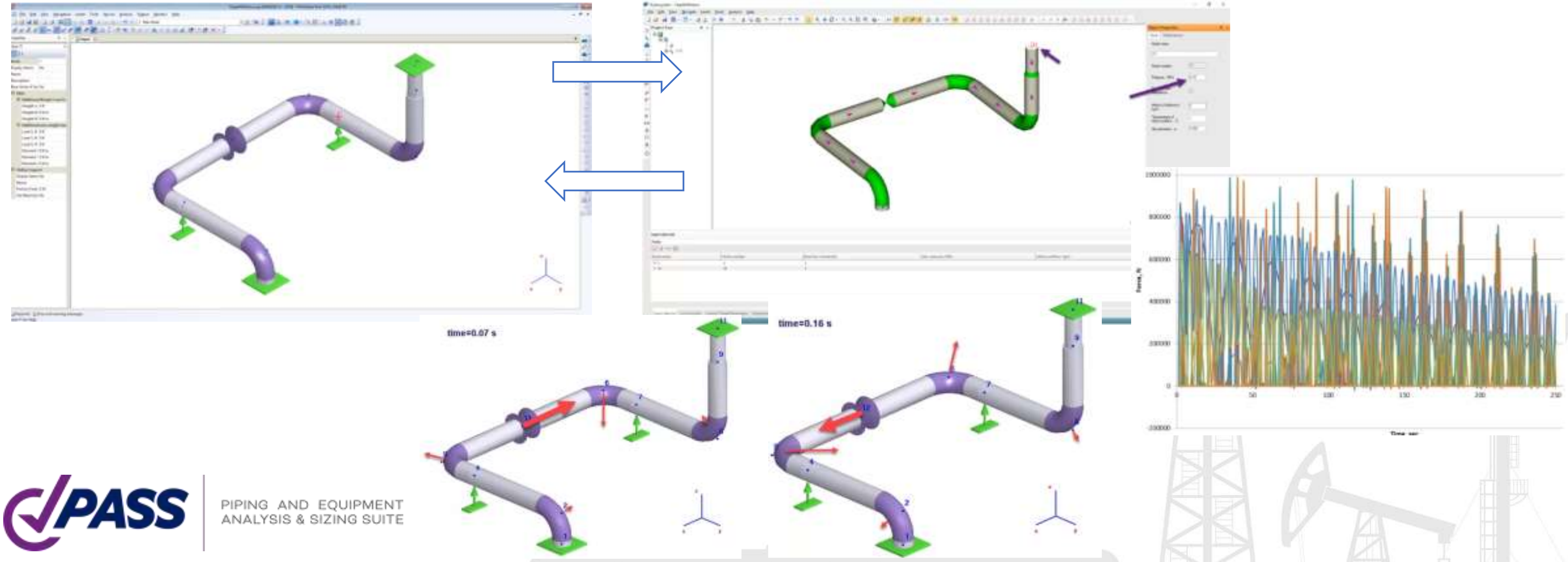
PASS

PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/Start-Prof | Analysis Capabilities

PASS/START-PROF + PASS/HYDROSYSTEM Allows to Water Hammer Surge Analysis

- 3D piping Models converted automatically from START-PROF to HYDROSYSTEM and back
- 3D loading is converted simultaneously for all nodes in the system at the same moment of time

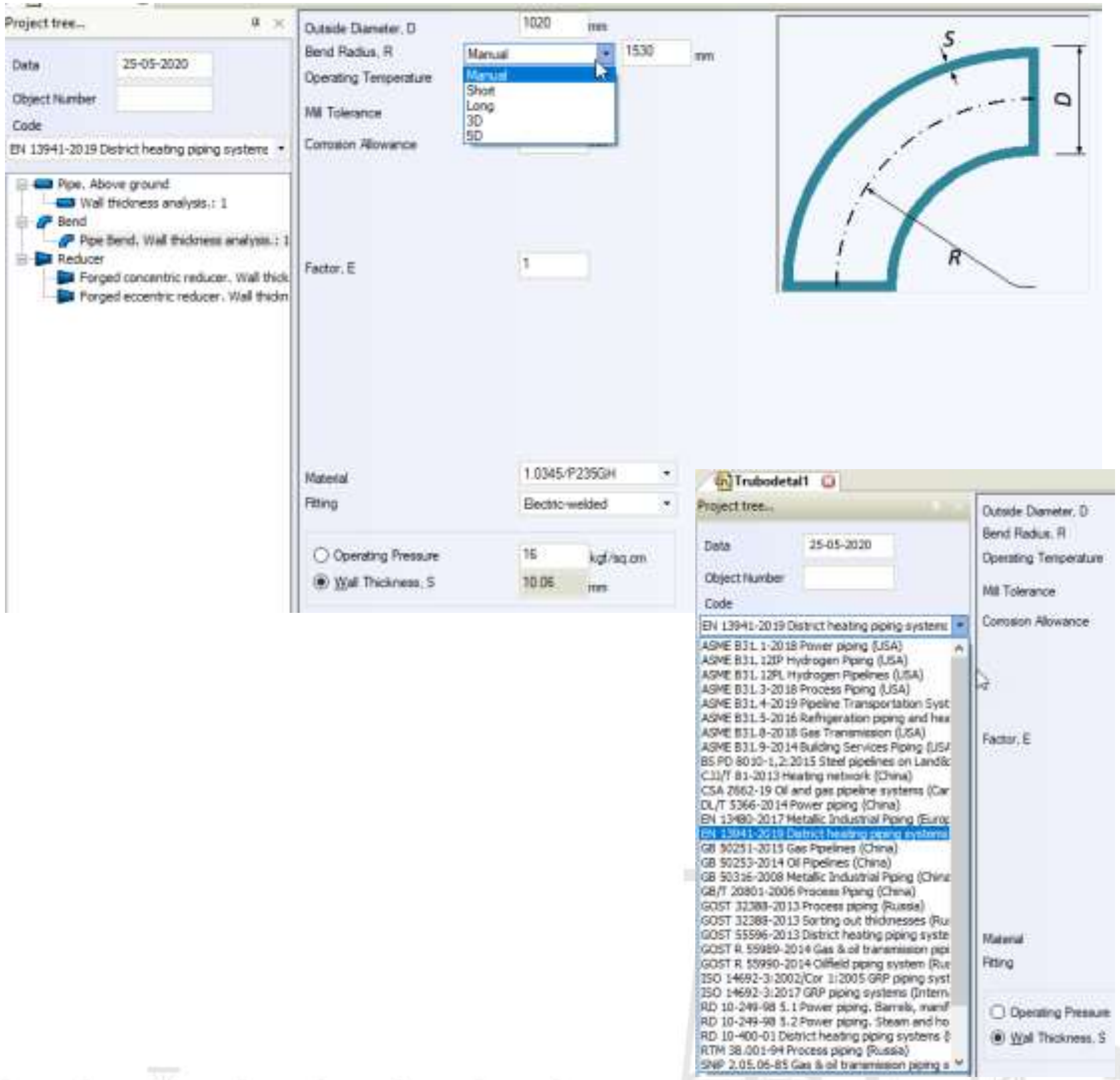


PASS
PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

PASS/Start-Prof | START-Elements

Pipe wall thickness calculator and bend wall thickness calculator for all piping codes.

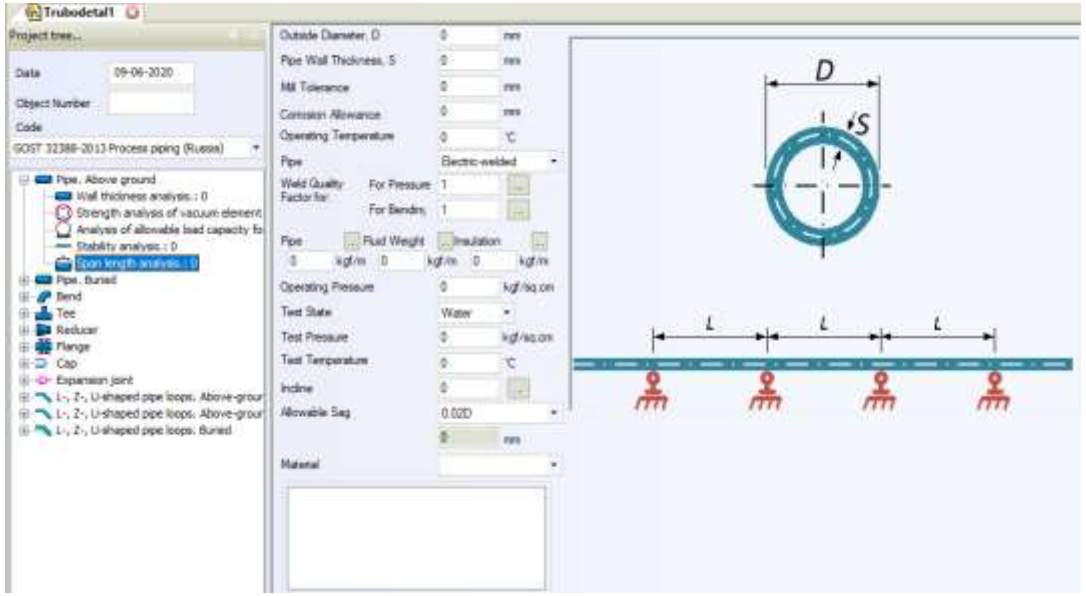
All pipe and fitting wall thicknesses are automatically checked before every run of the pipe stress analysis according to the selected code.

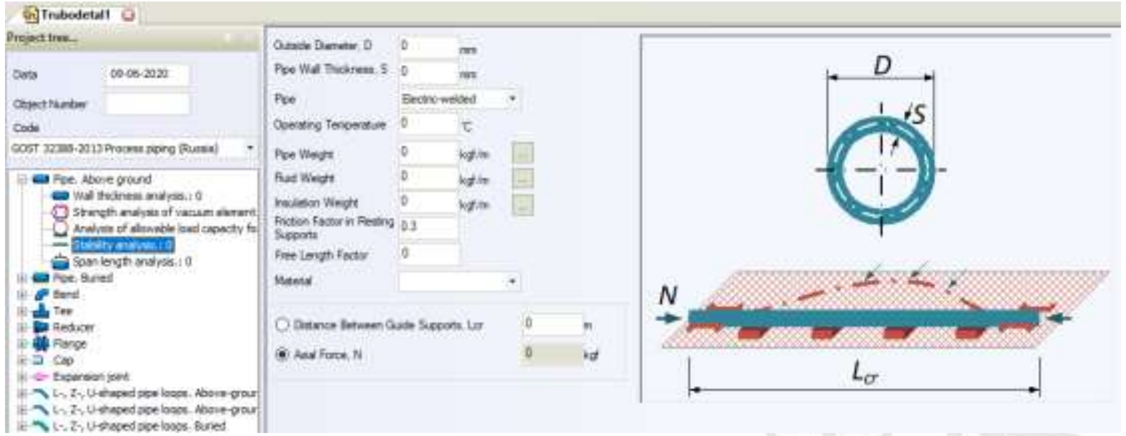


PASS/Start-Prof | START-Elements

Pipe Span Length Analysis

Longitudinal Stability Analysis

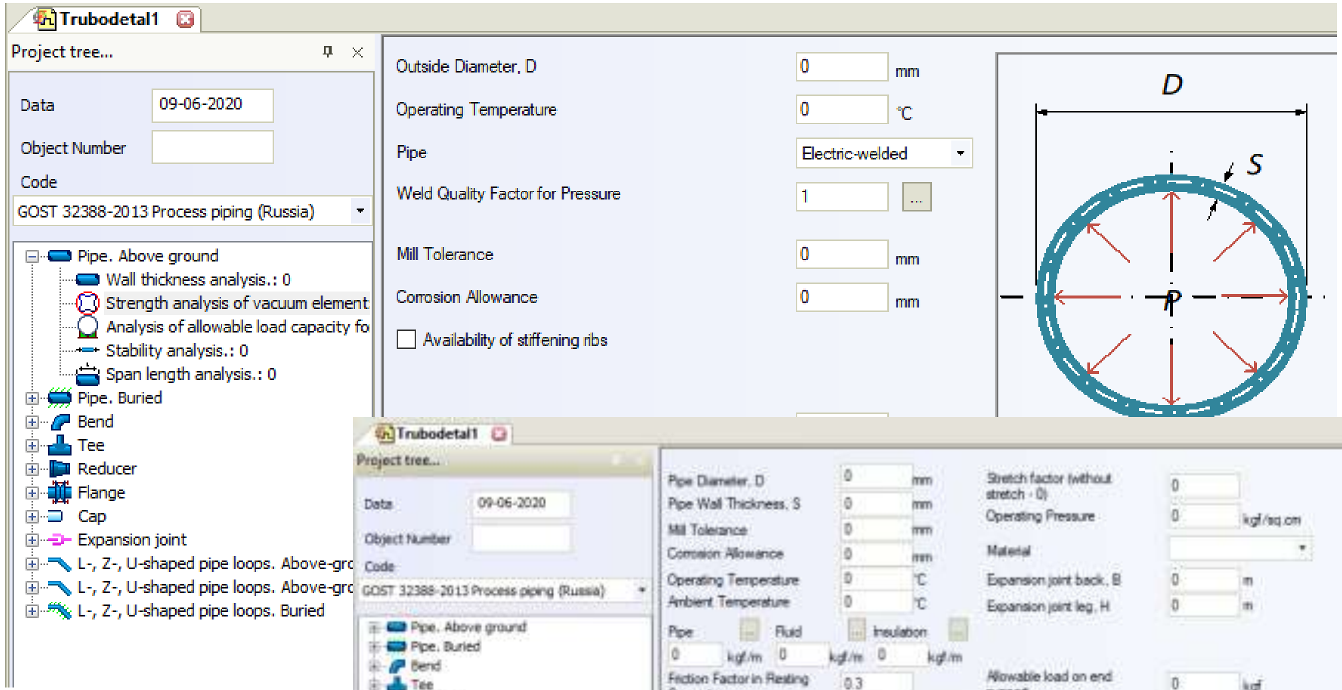


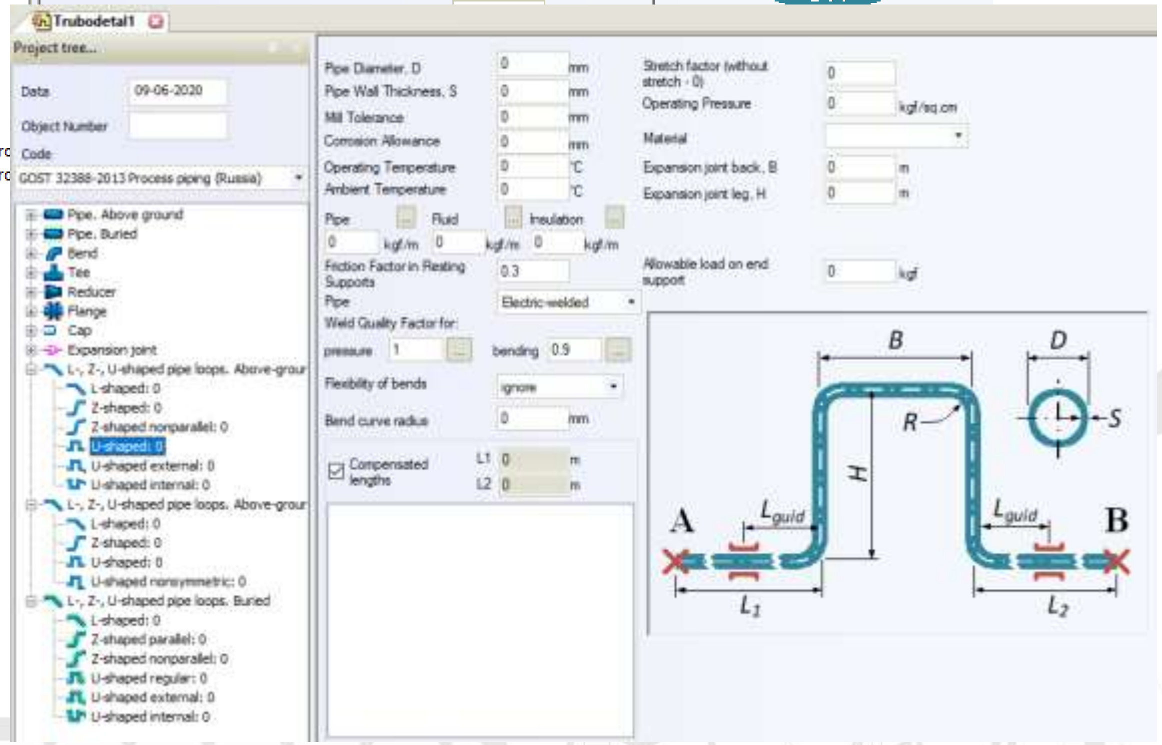


PASS/Start-Prof | START-Elements

Calculate Wall Thickness Under Vacuum and External Loading

Simple Expansion Loop Analysis



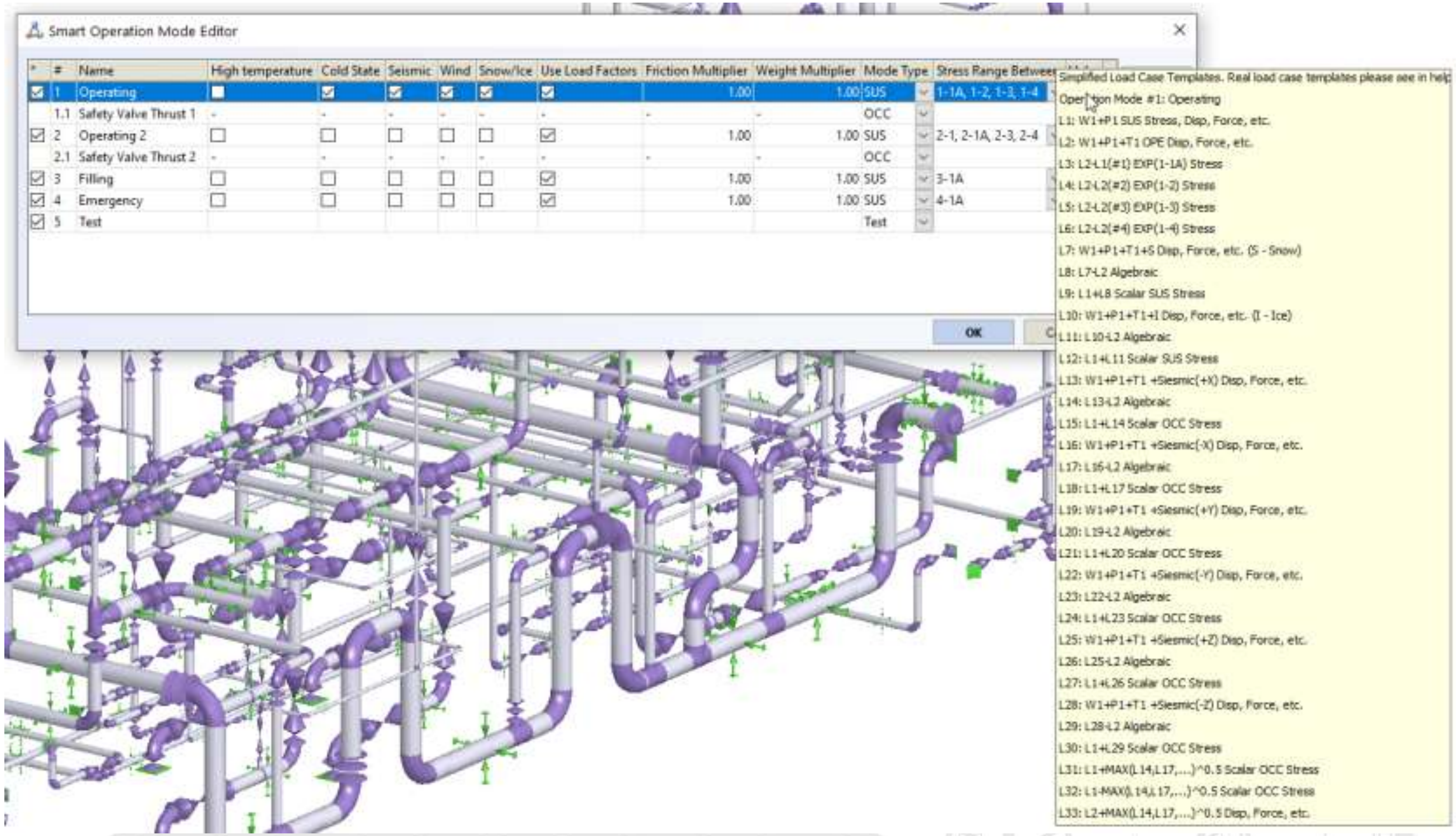


PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/Start-Prof | Piping Model Creation

- No need to create the load cases manually
- Save a lot of time and protect from mistakes
- Operation Mode Editor will do this job for you
- Easy to understand and change
- No limit on pressure, temperature number

67 complex load cases are automatically generated based on simple five START-PROF operating modes

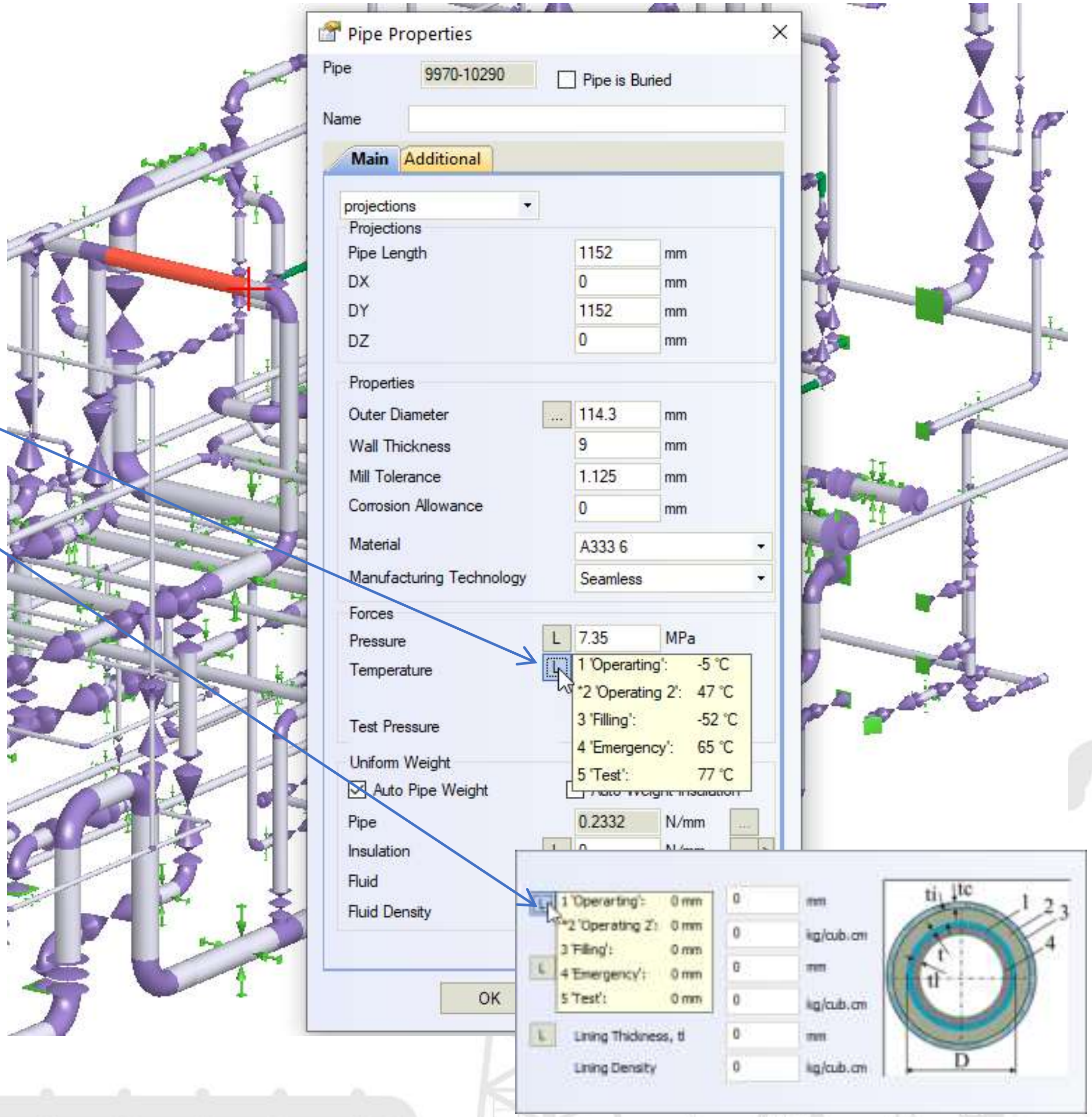


PASS
PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

PASS/Start-Prof | Piping Model Creation

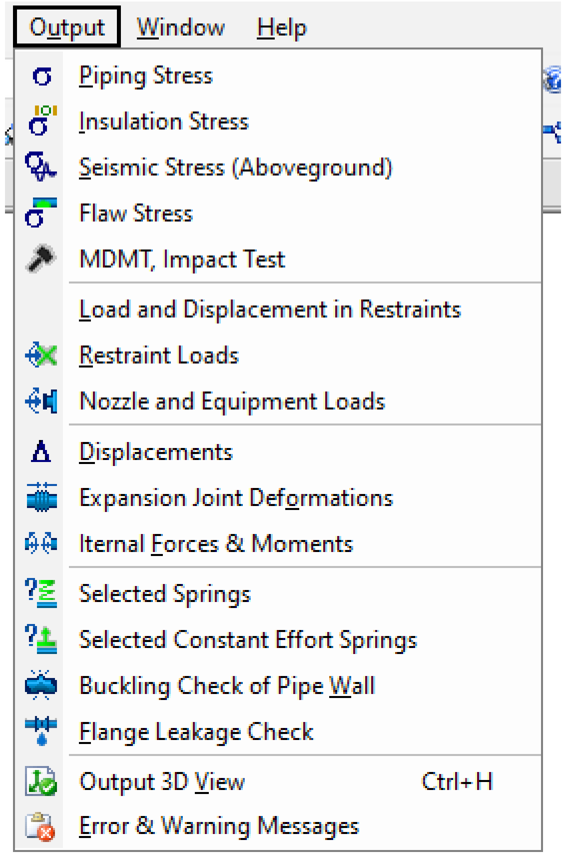
Different operating modes can have different:

- Temperatures 1-∞
- Pressures 1-∞
- Fluid weight 1-∞
- Restraint displacements 1-∞
- Forces and moments, uniform loads 1-∞
- Insulation layers and density, weight 1-∞
- No limit on pressure, temperature, etc. number
- No limit on operation mode number
- Load cases created automatically
- Interactive reports are compiled automatically for all operating modes



PASS/Start-Prof | Reports

Full scope of the needed interactive reports after analysis



- Reports are interactive. For example, you can add or remove stresses from axial force on-the-fly, change global/local coordinates, add or remove creep stress etc.
- Reports can be copied to MS Excel
- Reports can be exported into MS Word
- Free Viewer is Available
  You can send your piping model to customer, who can open it using viewer and review piping model and all analysis results

PASS
PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

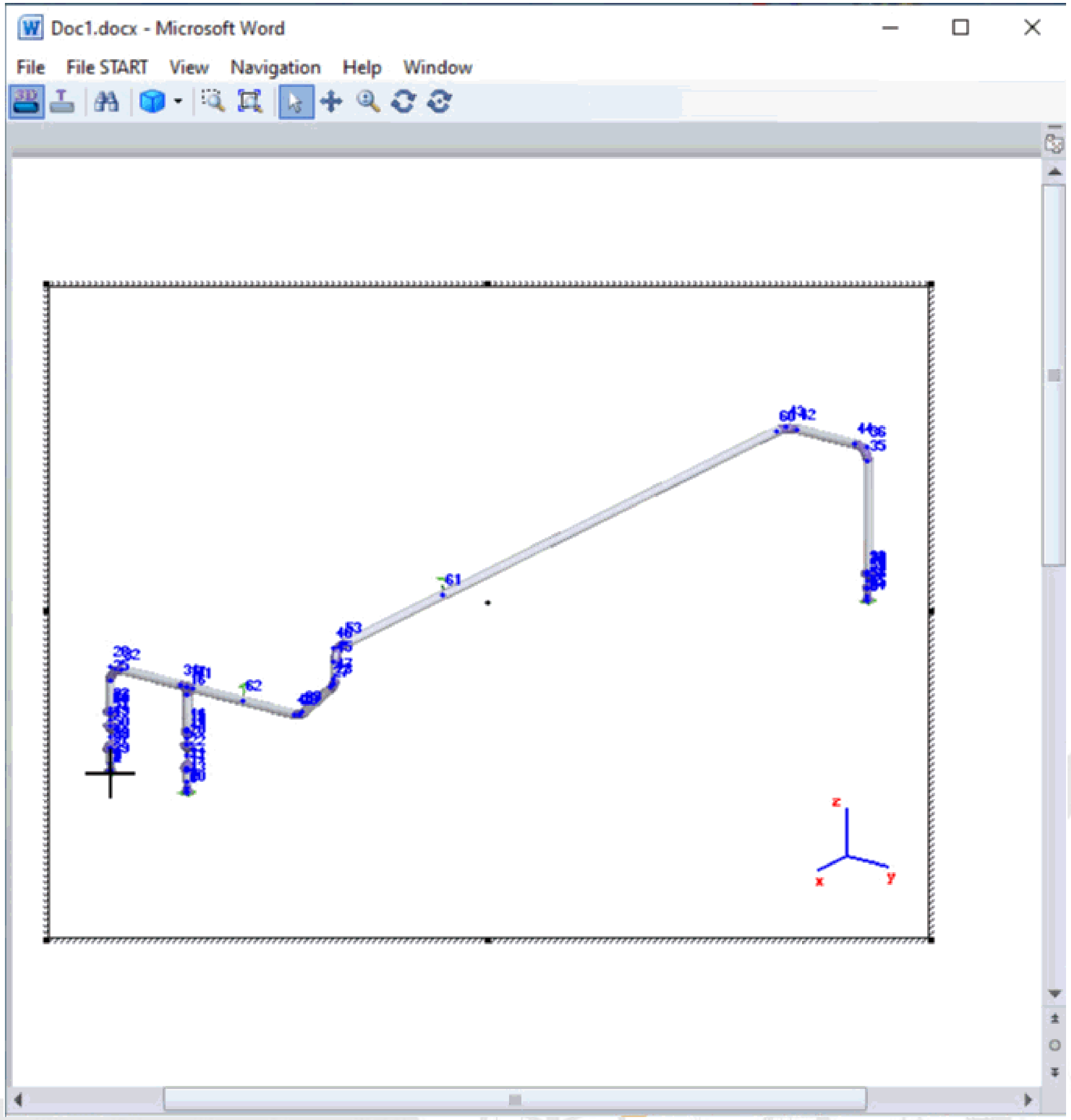
PASS/Start-Prof | Features

Function ‘Copy Whole Model’.

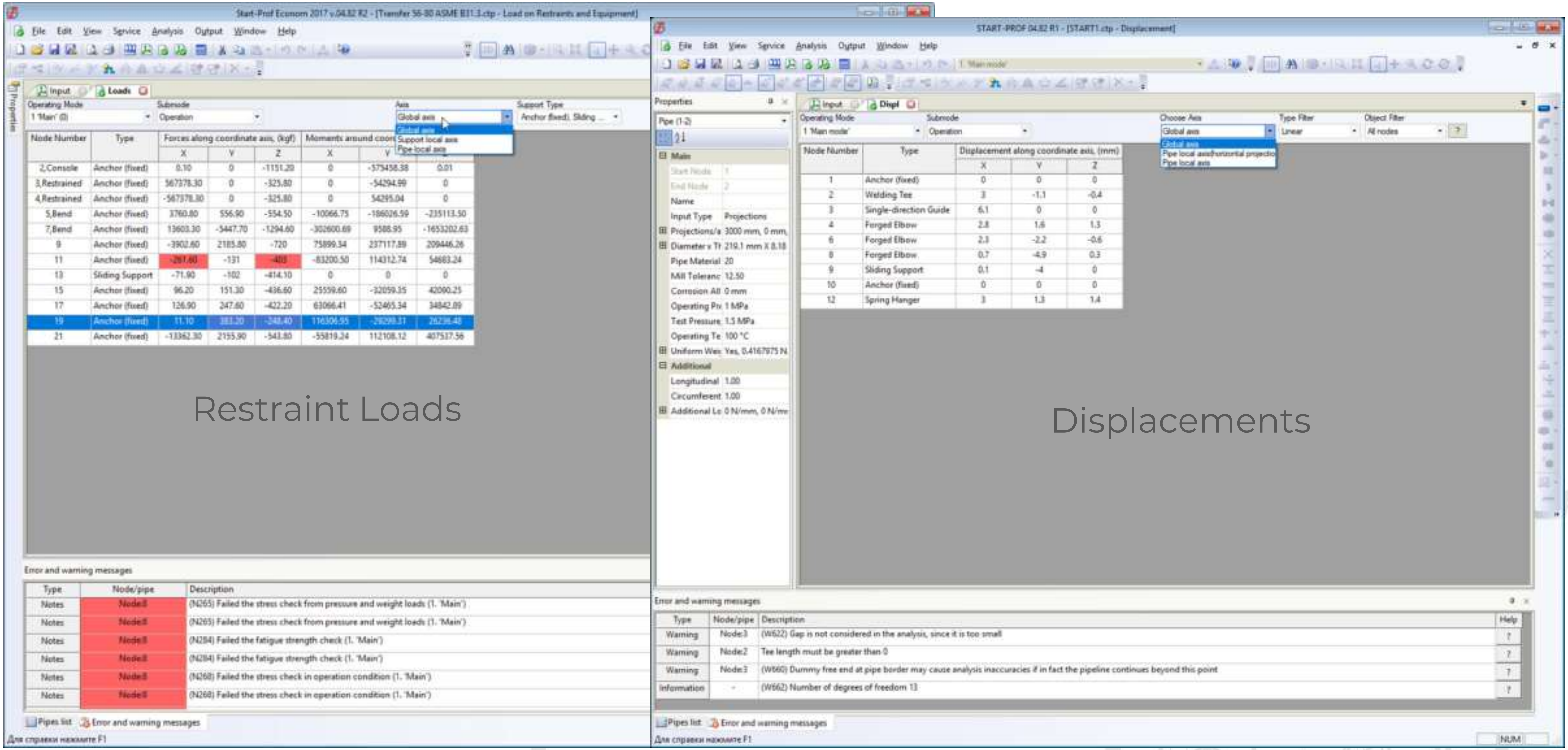
Allows to copy whole piping model as an object into clipboard. After that you can insert this interactive model into any other software like MS WORD, EXCEL etc.

You can rotate, pan zoom the model right inside MS Word

You can add interactive into report in MS Word and send to your customer for review

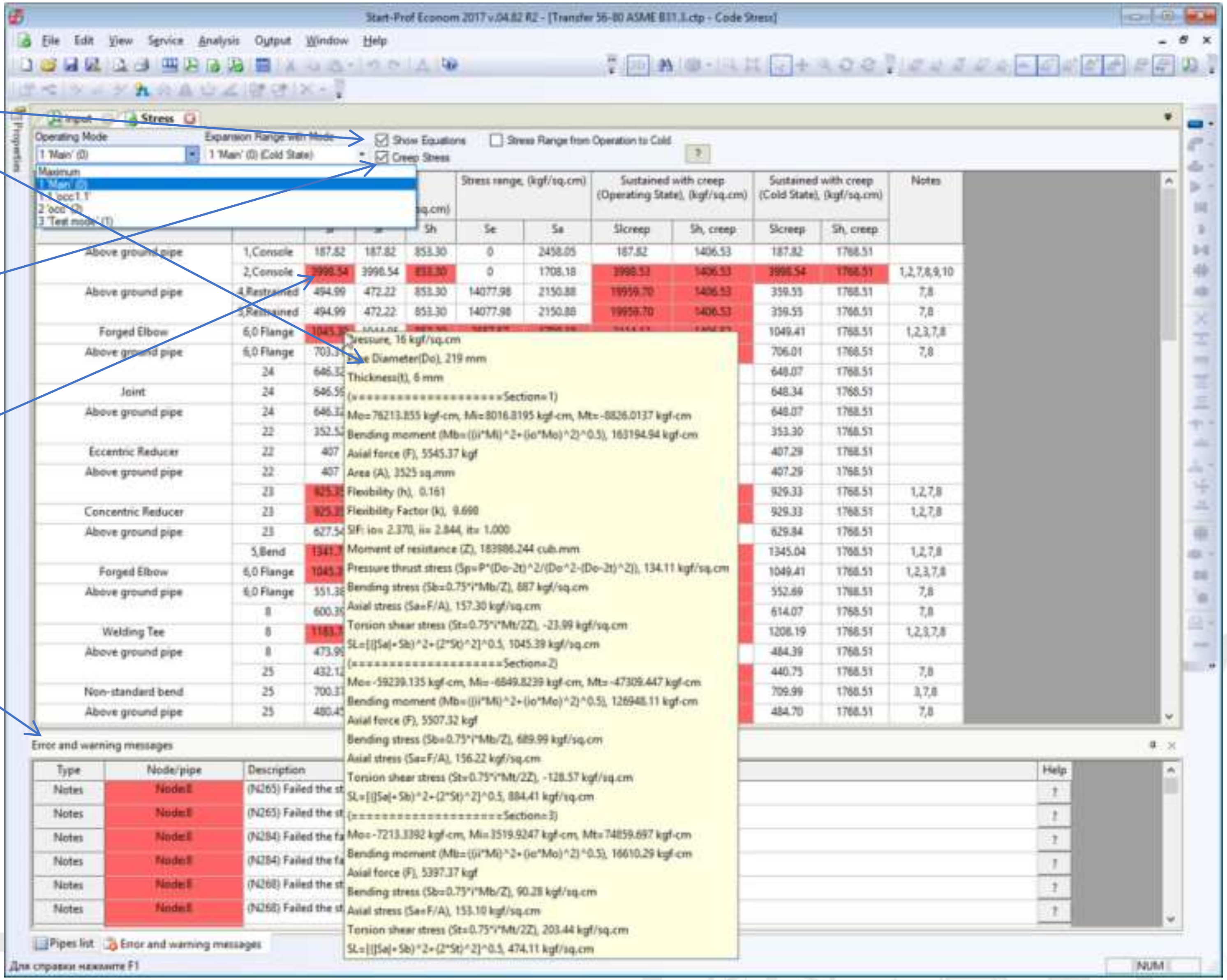


PASS/Start-Prof | Reports



PASS/Start-Prof | Reports

- Stress report show all used equations
- You can add/remove stress from axial force
- Activate individual features for each pipe stress code
- Cells where the check fails has a red color
- Messages about stress check fail duplicated in the errors and warning window

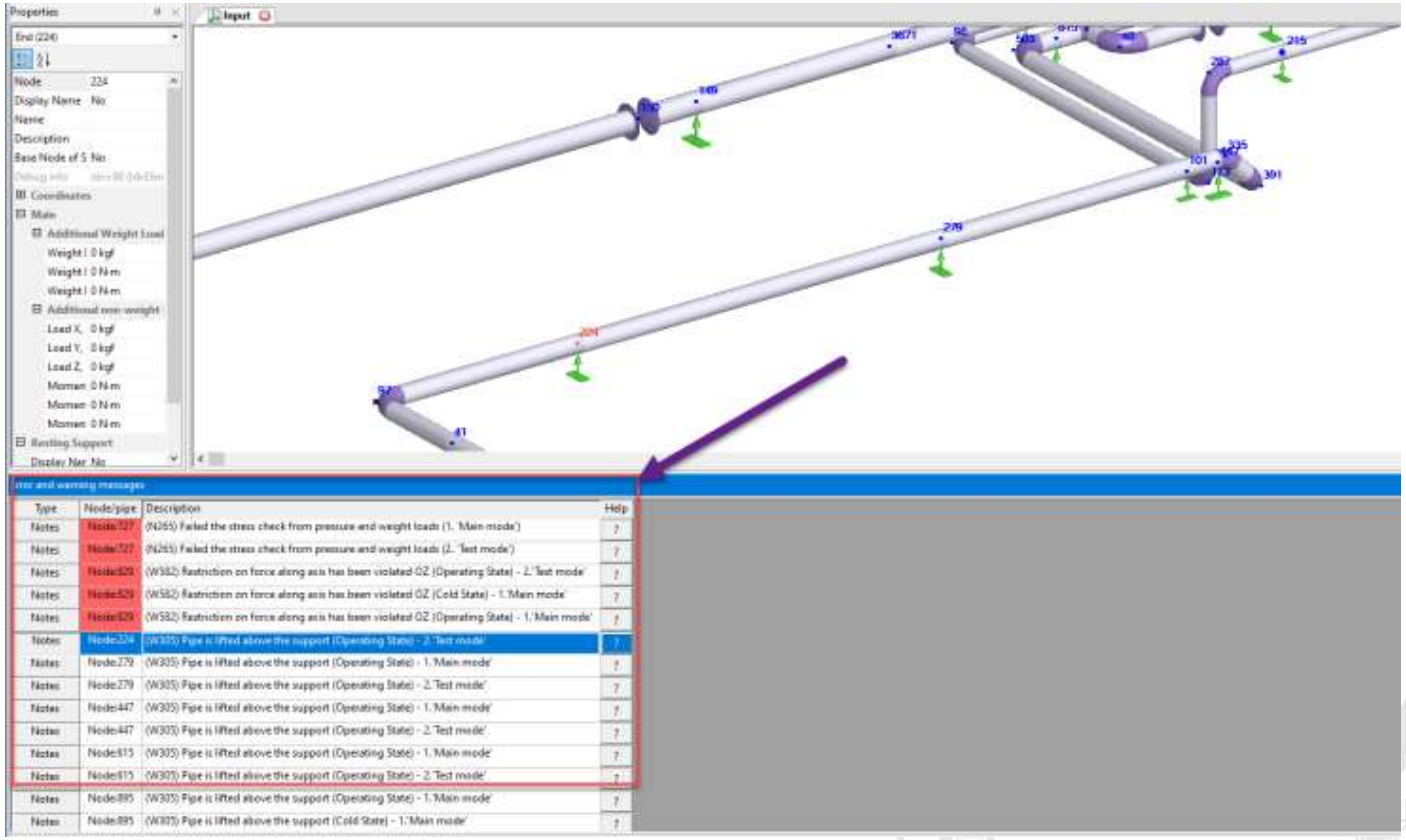


PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/Start-Prof | Reports

PASS/START-PROF has smart warnings in error checker.

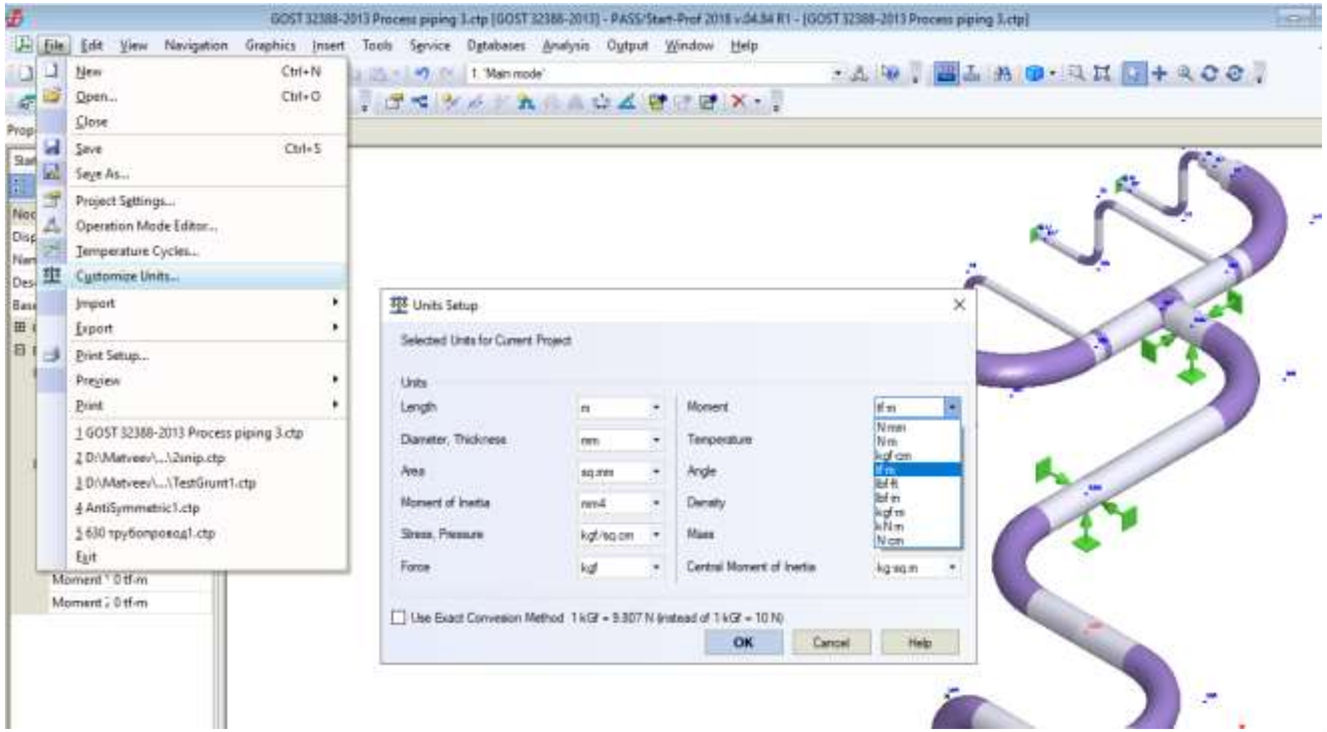
It show all engineering warnings like support is lifting off, support loads are greater than allowable, expansion joint deformation exceed the limits, buckling analysis failed, flange leakage failed, spring hanger variable range greater than 25%, spring load in one of load cases is greater than allowable, rod rotation exceed the limit and many others.

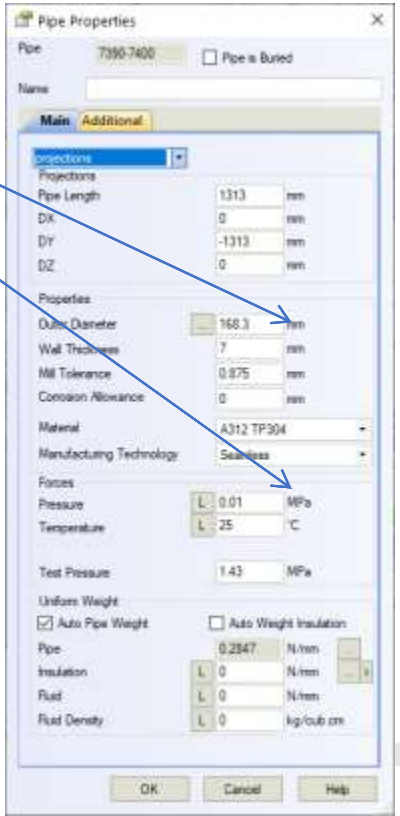


PASS/Start-Prof | Features

Change of the model units available at any moment of time on-the-fly, <u>even after analysis is done</u>.

The units are always displayed for each input field.





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PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

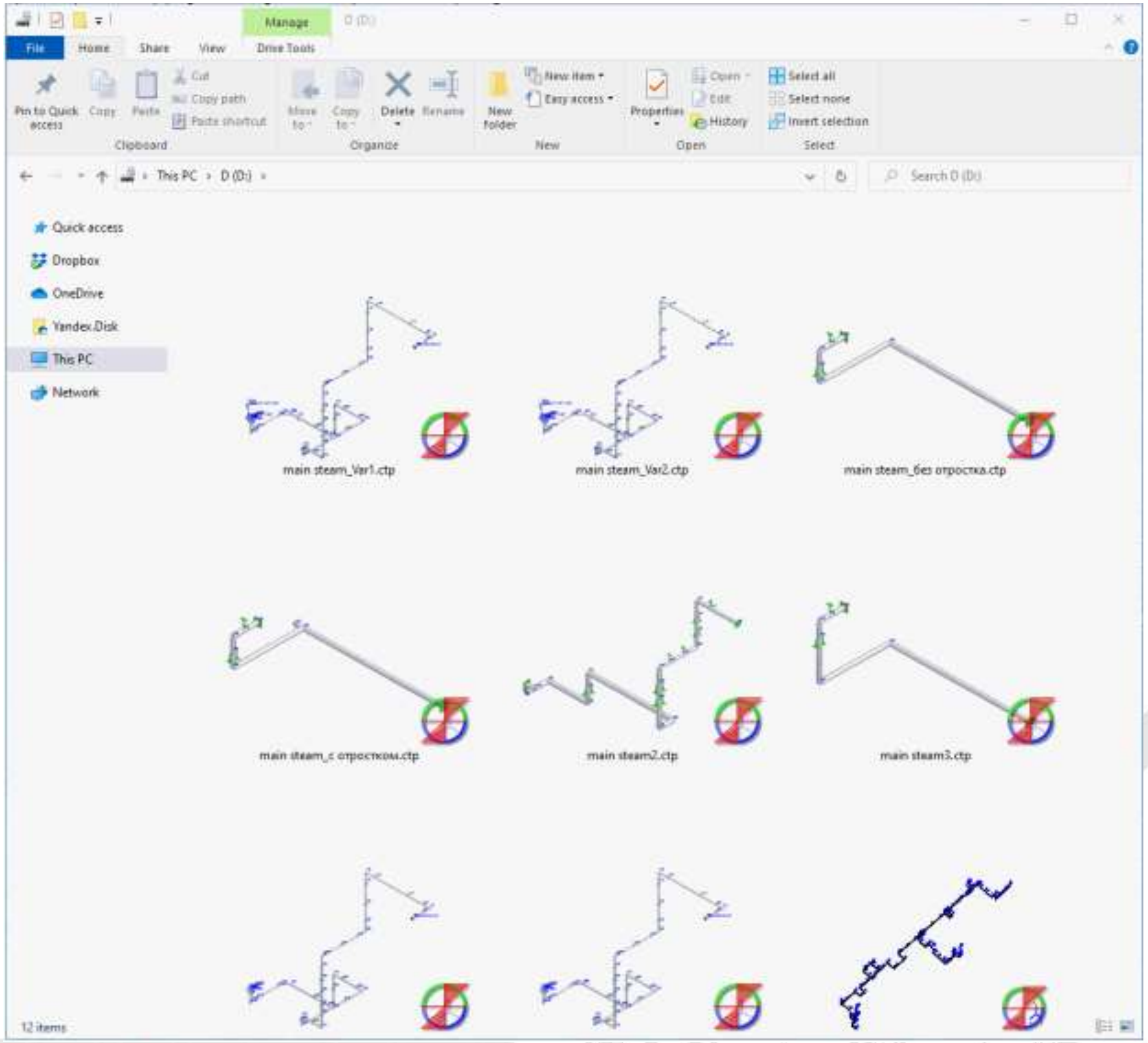
PASS/Start-Prof | Features

- Each piping system project is stored in just one file

- Thumbnails for windows explorer. You can preview all piping models right in the explorer before opening the file

- Fast opening even big models

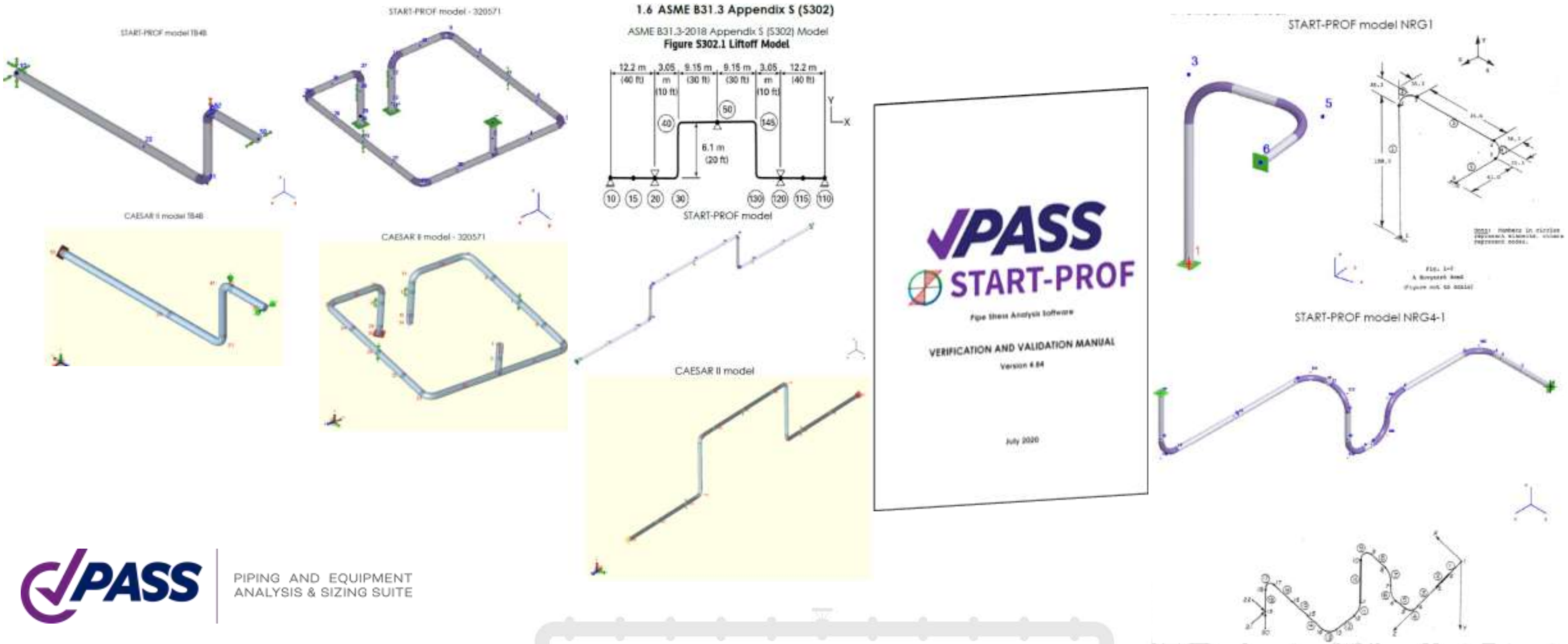
- High speed of stress analysis and working with a really big models



PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/Start-Prof | Reliability

Full Verification and Validation manual. Added a lot of verification examples, compared to manual calculations and other software.



PASS/Start-Prof | Reliability

Each new PASS/START-PROF release is:

- Automatically verified on more than 300 examples with previous versions (quality assurance system).
- Checked manually with group of pipe stress experts (testers).
- Each release pass through 1-3 pipe stress training with 10-20 students before official release.
- After release, all bugs reported by our 2000 companies active users are quickly fixed and new release is provided.

PASS/Start-Prof | Licensing

Configurations/Pricing Options

PASS/Start-Prof Complete Advanced

Simulation and sizing for any piping network considering all applicable national codes.

PASS/Start-Prof Complete Standard

configuration includes only worldwide popular standarts.

PASS/Start-Prof Process Advanced

Simulation and sizing for piping networks based on applicable national codes for process plants as well as for gas and oil transportation systems.

PASS/Start-Prof Process Standard

configuration includes only worldwide popular standarts.

PASS/Start-Prof Power Advanced

Simulation and sizing for any piping networks based on applicable national codes for power generation piping as well as for central heating networks.

PASS/Start-Prof Power Standard

configuration includes only worldwide popular standarts.

PASS/START-PROF HDPE+FRP

Piping stress analysis of high density polyethylene and/or fiberglass reinforced plastic piping systems.

- Permanent License at Affordable Price (+1 year maintenance for free!)
- Maintenance Renew 1 Year: 25%
- Annual License: 40%
- Semi-Annual License: 25%

PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

Configurations Comparison

Code	Complete Advanced	Process Advanced	Power Advanced	Complete Standard (40% discount)	Process Standard (40% discount)	Power Standard (40% discount)	HDPE+FRP (40% discount)
ISO 14692	✓	✓	✓				✓
HDPE Piping	✓	✓	✓				✓
ASME B31.1	✓		✓	✓		✓	
ASME B31.3	✓	✓		✓	✓		
ASME B31.4	✓	✓		✓	✓		
ASME B31.5	✓	✓	✓	✓	✓	✓	
ASME B31.8	✓	✓		✓	✓		
ASME B31.9	✓	✓	✓	✓	✓	✓	
EN 13480	✓	✓	✓	✓	✓	✓	
GB 50316	✓	✓	✓	✓	✓		
GB/T 20801	✓	✓		✓	✓		
GB 50251	✓	✓		✓	✓		
GB 50253	✓	✓		✓	✓		
DL/T 5366	✓		✓	✓		✓	
CJJ/T 81	✓		✓				
RD 10-249-98	✓		✓				
GOST R 55596	✓		✓				
GOST 32388	✓	✓					
SNiP 2.05.06-85	✓	✓					
SP 36.13330	✓	✓					

PASS/Start-Prof | Resources

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- More than 50 articles about pipe stress analysis and PASS/START-PROF features https://whatispiping.com/category/start-prof

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PASS/Start-Prof | Resources

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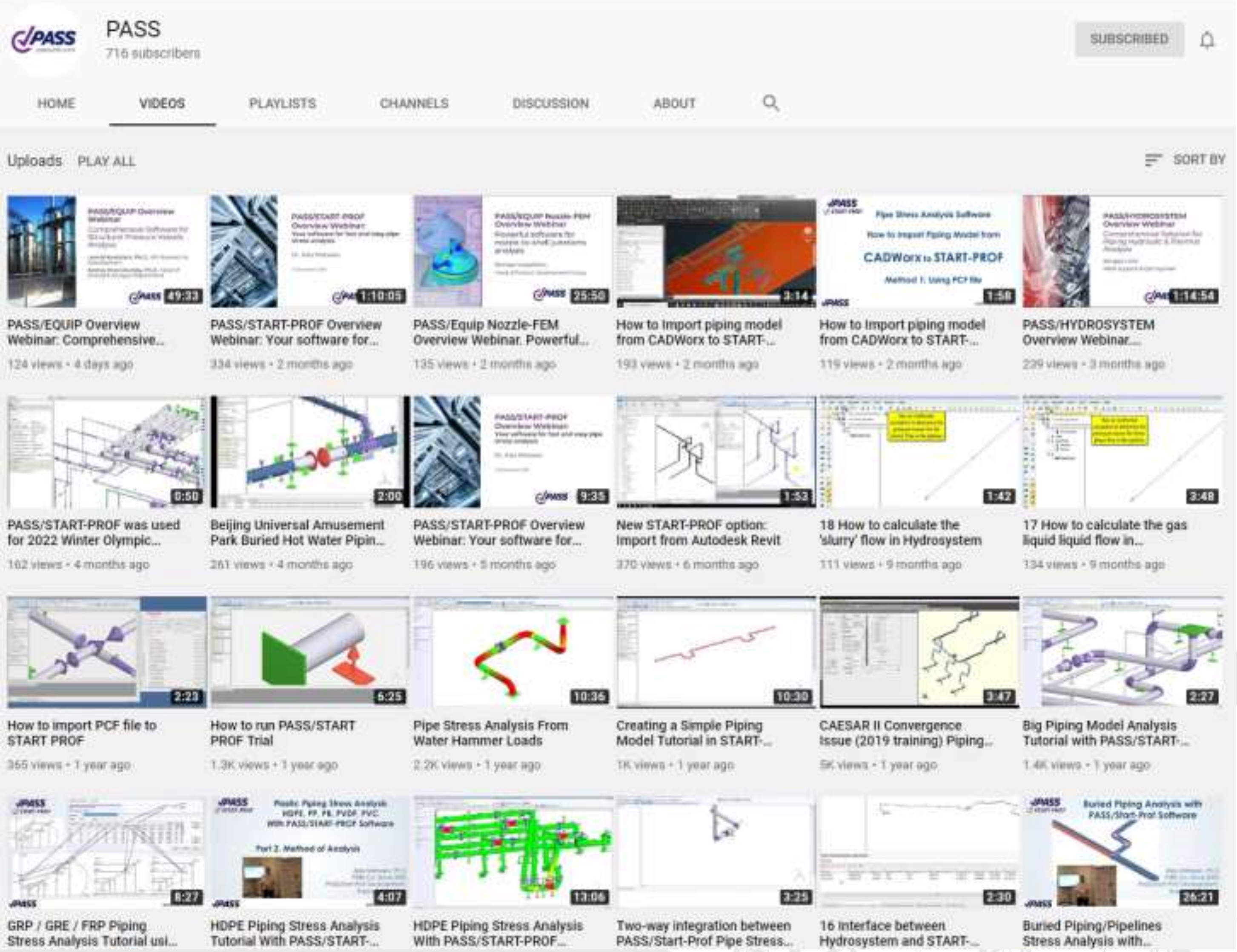
www.youtube.com/passuite



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Q & A

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Thank YOU!