

What's new



Pipe Stress Analysis And Sizing

in 4.84 version



# PASS/START-PROF

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## Quick Pipe Stress Analysis & Optimal Sizing

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Presenter:

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START-PROF Product Owner

Development, Training, Support of  
START-PROF Since 2005

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PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE

# PASS/Start-Prof | Upcoming Version 4.84

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About one year has passed since our last version of PASS/START-PROF Software release.

We worked hard during this time.

Check out that we have prepared for our customers!

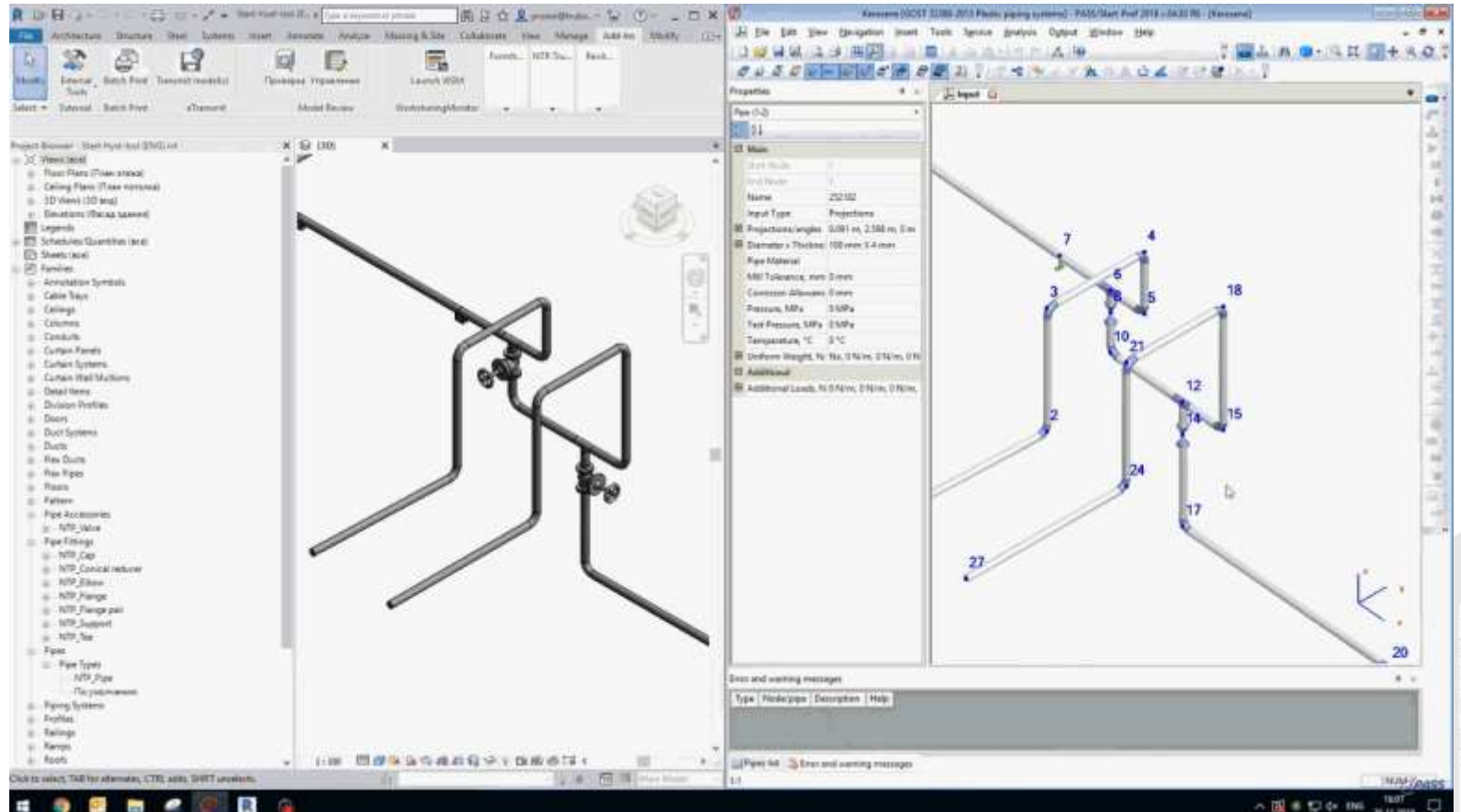


PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE



# PASS/Start-Prof | External Interfaces

- Added export & import from AVEVA E3D version 3.1
- Added export & import from AVEVA MARINE version 12.1SP4 and 12.1SP5
- Added AVEVA MDS Support
- Added import from Autodesk Revit to PASS/START-PROF



PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE

# PASS/Start-Prof | Codes Updates

- Updated code ASME B31.9-2017 Building Services Piping (USA)
- Updated code ASME B31.4-2019 Pipeline Transportation Systems for Liquids and Slurries (USA)
- ISO 14692-2017 Glass-reinforced Plastics Piping (GRP). Updated the database

Material: Wavistrong 55 Class: FRP

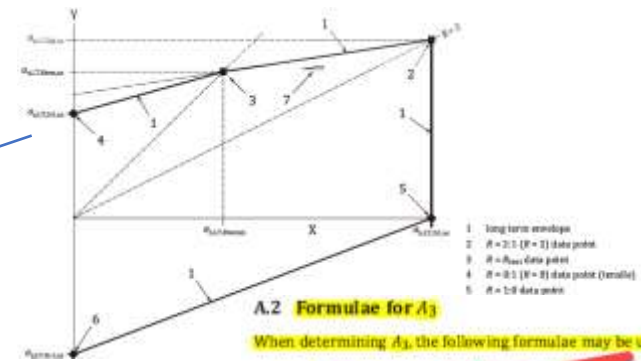
Database can only be edited if database files are open for editing and if stress units are set as MPa (for ASME - ksi)

Data source: Data provided by Future Pipe Industries

Density: 1850 kg/m<sup>3</sup>

Cyclic long term strength factor, fc: 4

Temperature °C	al(0:1), MPa	al(1:1), MPa	hl(1:1), MPa	al(2:1), MPa	hl(2:1), MPa	qs bend, reducer, MPa	qs tee, nozzle, MPa	Ea, MPa	Eh, MPa	G, MPa	Expansion Coeff. 1/°C	Poisson factor Vh/a	Gxx
20	32.5	0	0	62.5	125	80	64	10500	20500	11500	0.00002	0.65	0.045
40	32.5	0	0	62.5	125	80	64	9765	19475	10925	0.00002	0.65	0.054
60	32.5	0	0	62.5	125	80	64	9135	18450	10350	0.00002	0.65	0.063
65	32.5	0	0	62.5	125	80	64	9161	18091	10149	0.00002	0.65	0.065
80	29.3	0	0	56.3	112.5	72	57.6	9240	17015	9545	0.00002	0.65	0.078
95	26	0	0	50	100	64	51.2	7980	15785	8855	0.00002	0.65	0.092
100	25	0	0	48	96	61.6	49.3	7560	15375	8625	0.00002	0.65	0.096
110	22.9	0	0	44.1	88.1	56.4	45.1	7140	14350	8050	0.00002	0.65	0.105



## A.2 Formulae for A3

When determining A3, the following formulae may be used in lieu of the graph.

$$f_c = \frac{\sigma_{\text{Static } 100,000}}{\sigma_{\text{Cyclic } 150,000,000}} \quad (A.1)$$

The cyclic long term strength factor, fc, is defined as the ratio of the projected stress values at 100 000 h (static loading) and 150 000 000 cycles (cyclic loading) respectively. These values shall be determined from regression analysis as defined in the ASTM D2992-96, Procedures A (cyclic) and B (static). In case no test data is available, fc shall be 1.0.

When Rc > 0.4:

$$A_3 = \left( \frac{1-f_c}{0.6 f_c} \right) \left( \frac{1-R_c}{\log(150 \times 10^6) - \log(7,000)} \right) \log(N) + 1 - \text{TAN} \left[ \left( \frac{1-f_c}{0.6 f_c} \right) \left( \frac{1-R_c}{\log(150 \times 10^6) - \log(7,000)} \right) \right] \log(7,000) \quad (A.2)$$

When Rc ≤ 0.4:

$$A_3 = \left( \frac{1-f_c}{f_c} \right) \left( \frac{1}{\log(150 \times 10^6) - \log(7,000)} \right) \log(N) + 1 - \left( \frac{1-f_c}{f_c} \right) \left( \frac{1}{\log(150 \times 10^6) - \log(7,000)} \right) \log(7,000) \quad (A.3)$$

A3 shall be greater than or equal to 1/fc. A3 shall be 1.0 if the calculated value is between 0.9 and 1.0. At 7,000 cycles or less, A3 shall be 1.0. The minimum value for A3 shall be 0.25.

### 6.1.1 Design life

A0 shall be used to scale the long term envelopes to the design envelopes at design lives other than 20 years. A0 shall be defined by Formula (1):

$$A_0 = \frac{1}{10^{(\log(t) - \log(175,200)) \times G_{xx}}} \quad (1)$$

where

- t is the time expressed in h;
- Gxx is the gradient of regression line at xx °C;
- A0 shall not be greater than 1.0.



PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

# PASS/Start-Prof | Codes Updates

Ring bending stress is calculated using finite element method with geometrical nonlinearity and consider stiffening effect of the pressure

## 7.8 Allowable stresses

The sum of the hoop stresses shall be defined by the following formulae:

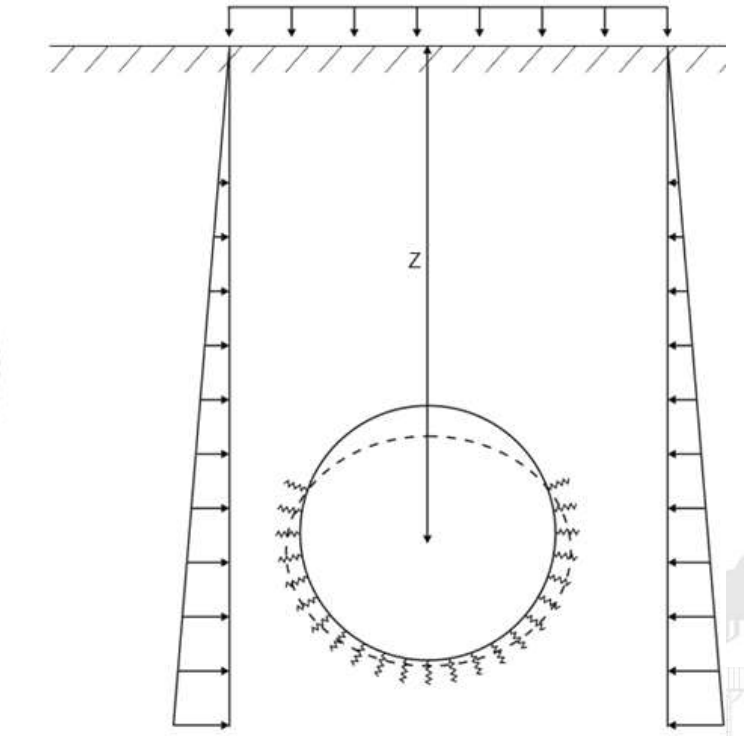
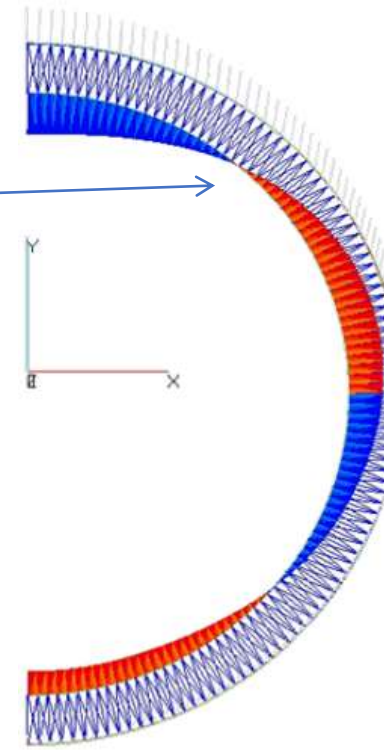
$$\sigma_{h,sum} = \sigma_{hp} + \sigma_{hu} \quad (10)$$

$$\sigma_{hp} = \frac{P \times D_{r,min}}{2 \times t_{r,min}} \quad (11)$$

$$\sigma_{hu} = r_c \times D_f \times E_{hb} \times \frac{\Delta y}{D_{r,min}} \times \frac{t_{r,min}}{D_{r,min}} \quad (12)$$

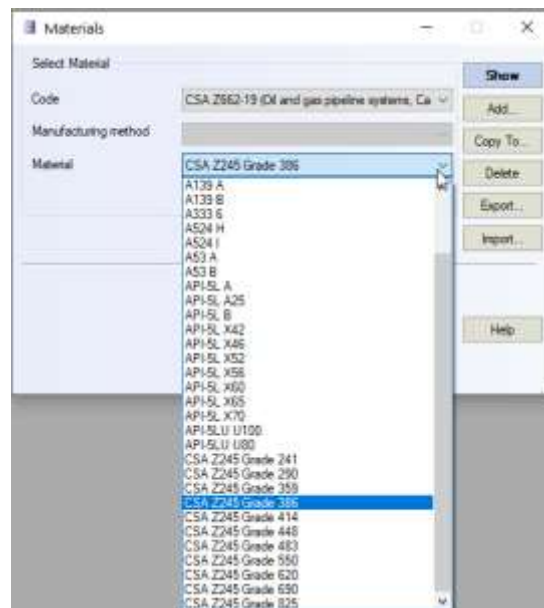
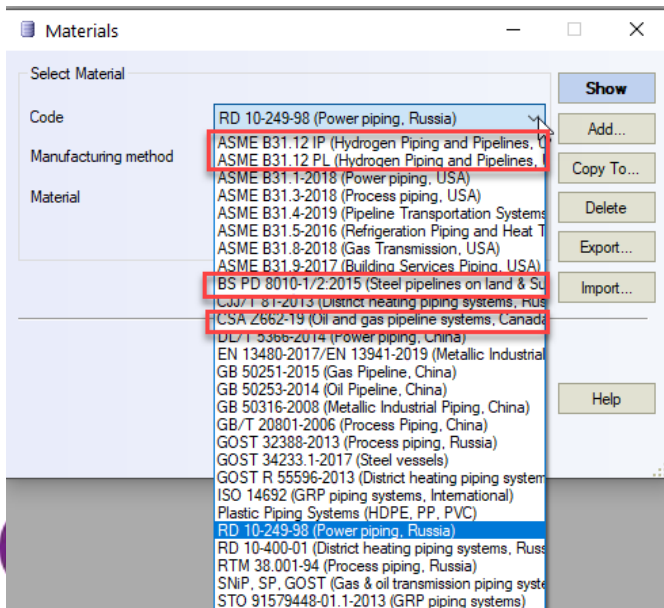
where

- $P$  is the internal pressure, expressed in MPa;
- $t_{r,min}$  is the minimum reinforced pipe wall thickness, expressed in mm;
- $D_{r,min}$  is the mean diameter of the minimum reinforced pipe wall, expressed in mm;
- $t_l$  is the internal liner thickness of the pipe wall, expressed in mm;
- $r_c$  is the rerounding coefficient, for  $P \leq 3$  then  $r_c = 1 - P/3$ , for  $P > 3$  then  $r_c = 0$ ;
- $D_f$  is the shape factor, see AWWA Manual M45 (second edition), [Table 1](#);
- $\Delta y/D_{r,min}$  is the predicted vertical pipe deflection [see [Formula \(9\)](#)];
- $E_{hb}$  is the hoop bending modulus, expressed in MPa.



# PASS/Start-Prof | New Codes

- ASME B31.12-2014 Hydrogen Piping and Pipelines (USA)
- BS PD 8010-1:2015 Pipeline systems – Part 1: Steel pipelines on land (UK)
- BS PD 8010-2:2015 Pipeline systems – Part 2: Subsea pipelines (UK)
- CSA Z662 + Ch.11 Oil and gas pipeline systems (Canada)
- GOST R 55989-2014 Gas and Oil Transmission Pipelines for Pressure Greater 10 MPa
- GOST R 55990-2014 Field pipelines (Russia)
- SP 284.1325800.2016 Field pipelines (Russia)
- SP 33.13330.2012 Steel Pipelines (Russia)
- Individual databases was created and filled with Material properties for all new codes



Material: CSA Z245 Grade 241 Class: Carbon or Low Alloy Steel

Database can only be edited if database files are open for editing and if stress units are set as MPa (for ASME -kg)

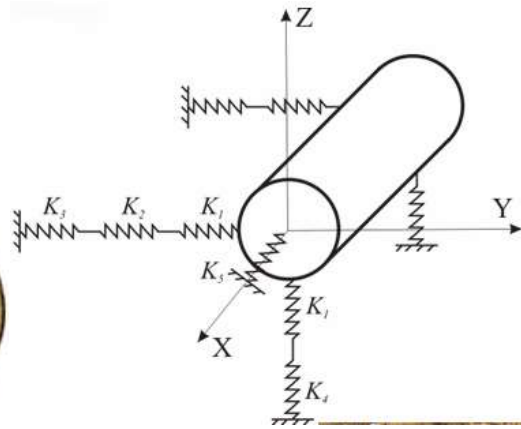
Data source: CSA Z245

Density: 7830 kg/m<sup>3</sup>

Temperature °C	Yield Stress (Sy), kgf/sq.cm	Elastic Modulus kgf/sq.cm	Expansion Coeff, 1/°C	Poisson's Ratio (ν)
-30	2409.9934	2070000	1.12e-005	0.3
30	2409.9934	2070000	1.12e-005	0.3
120	2409.9934	2070000	1.12e-005	0.3
150	2337.6936	2070000	1.12e-005	0.3

# PASS/Start-Prof | New Codes

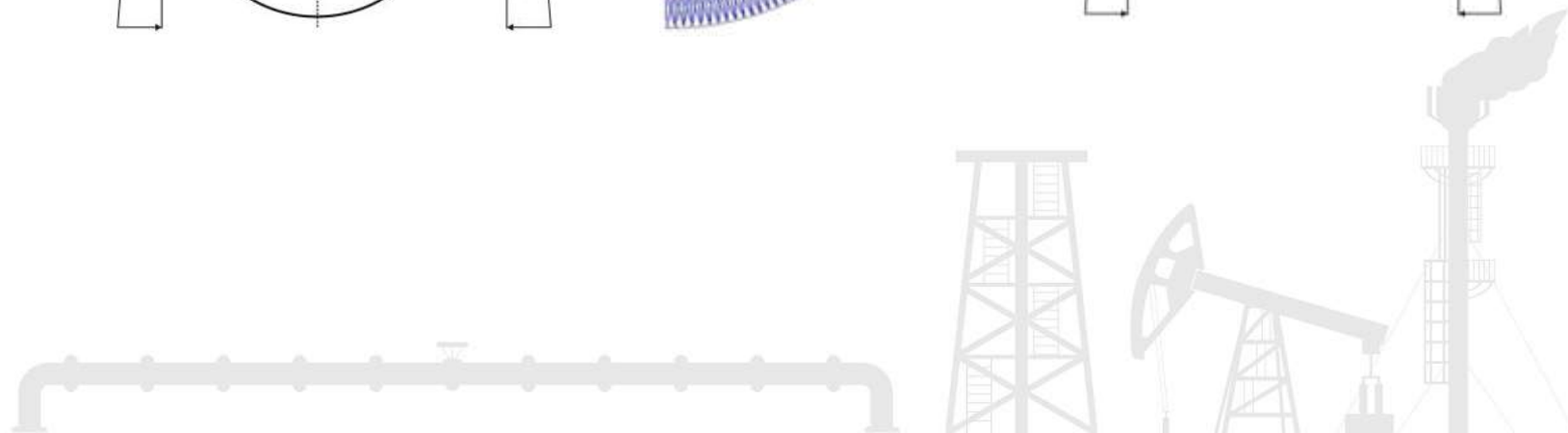
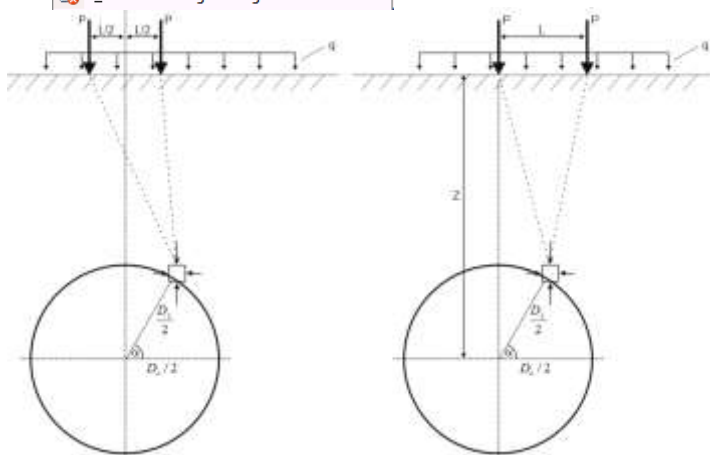
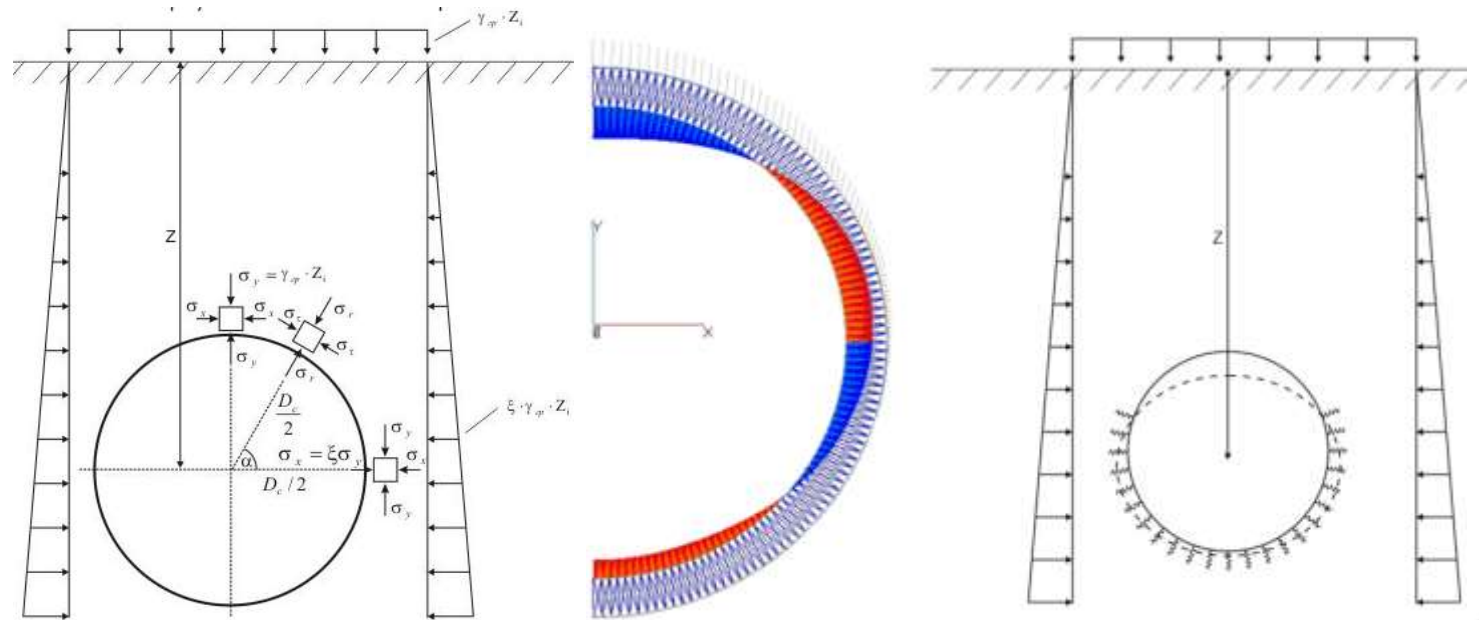
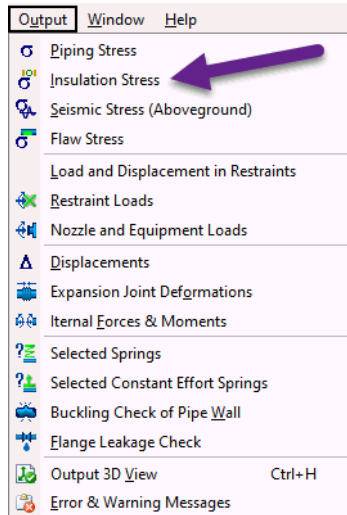
EN 13941-2019 District heating pipes - Design and installation of thermal insulated bonded single and twin pipe systems for directly buried hot water networks





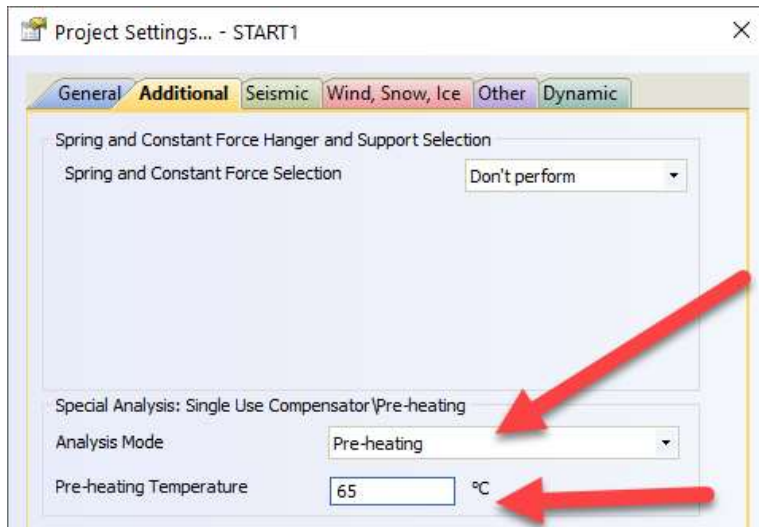
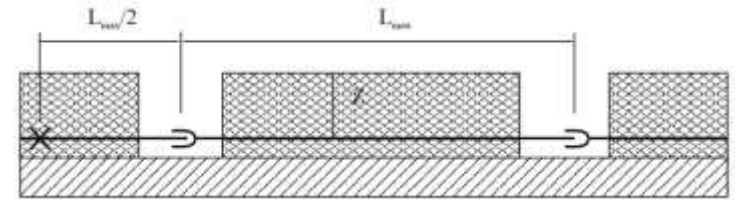
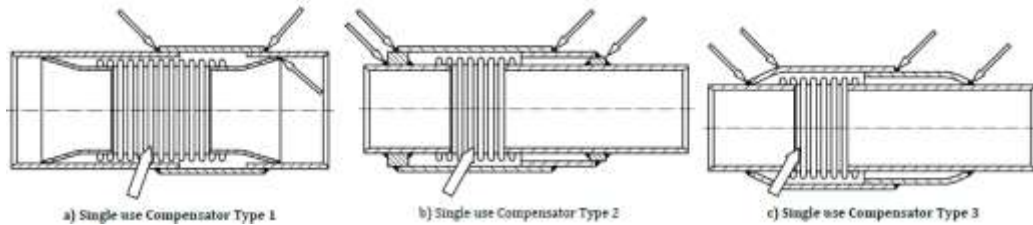
# PASS/Start-Prof | New Codes

Calculate And Check Stresses In Polyurethane Insulation (EN 13941 7.3.1, 7.3.2, EN 253).  
Check Stresses from Surface Vehicle Loads



# PASS/Start-Prof | New Codes

- START-PROF has everything that is needed for district heating networks analysis and widely used for it since 1998.
- Pre-heating analysis
- Single use compensators analysis + Database + Distance Calculation



Trubodetal

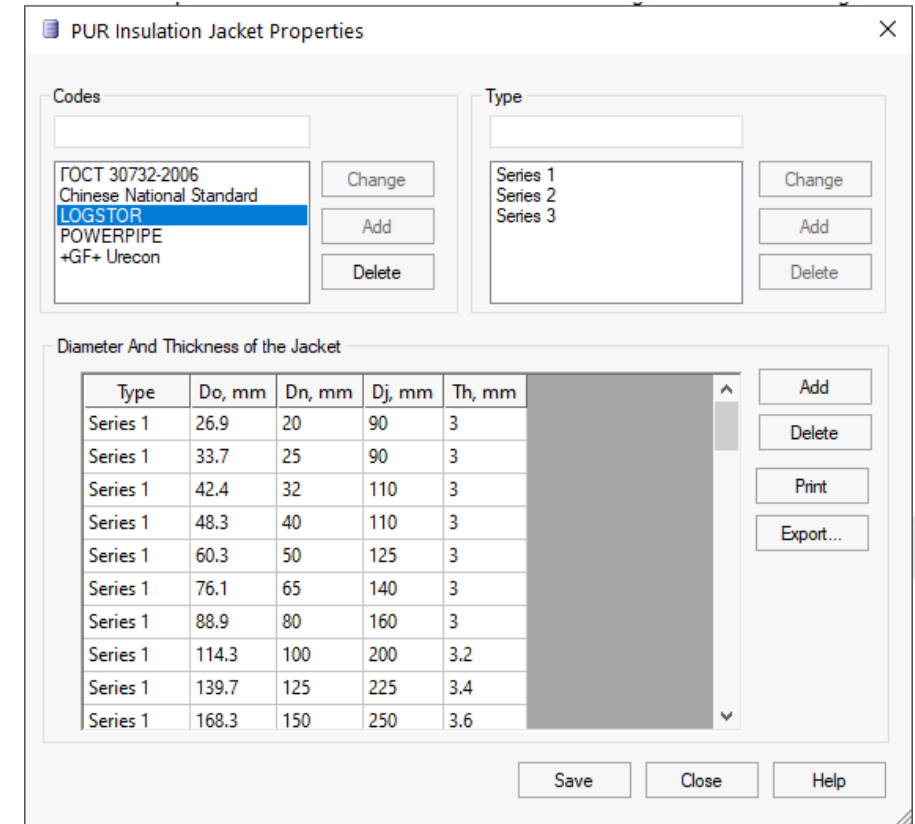
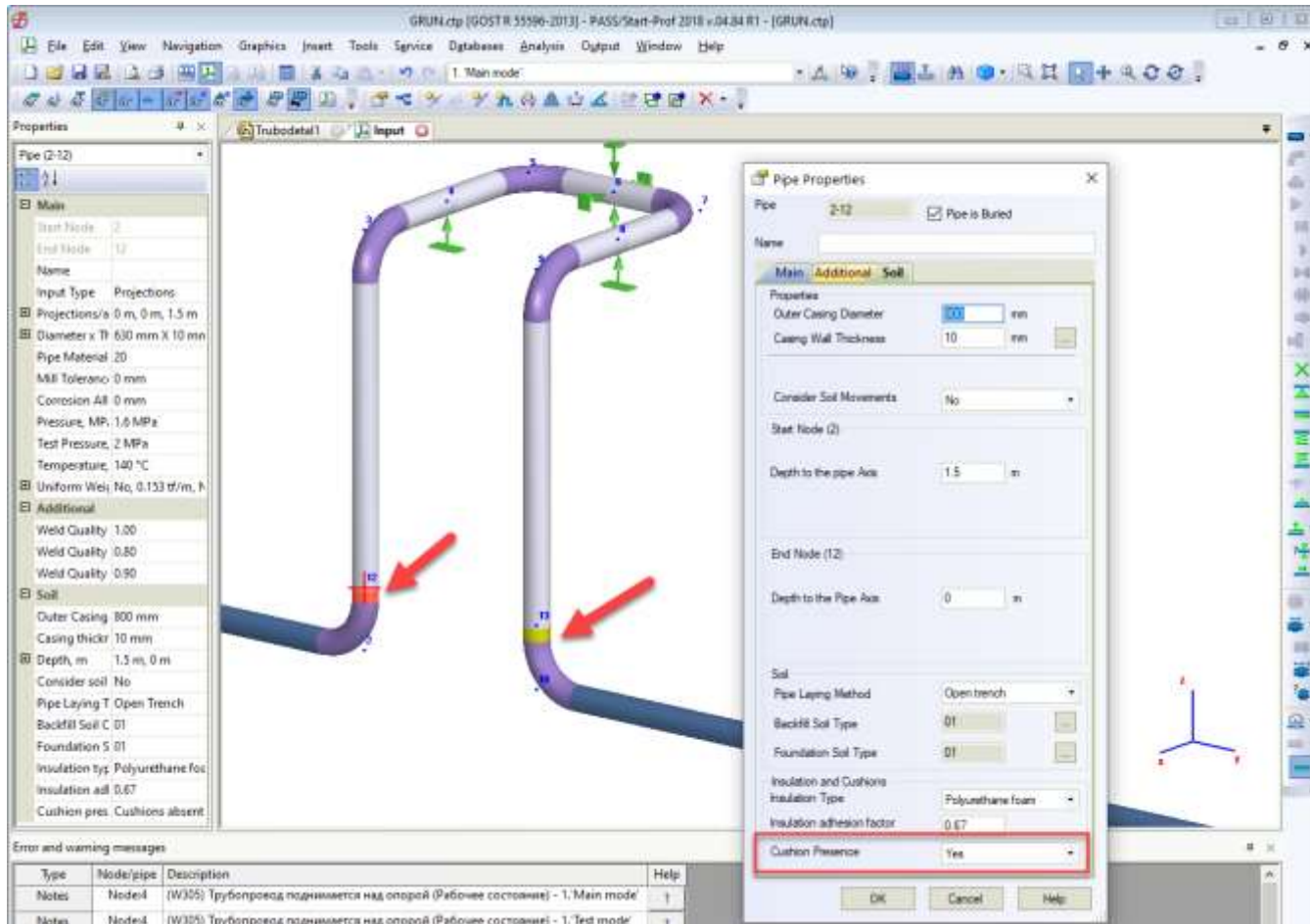
Project tree...  
Data: 25-09-2020  
Object Number:  
Code: GOST 55596-2013 District heating piping systems (Russia)

Outer Diameter, D: 0 mm  
Wall Thickness, S: 0 mm  
External Casing Diameter (if absent), Dc: 0 mm  
Casing wall thickness: 0 mm  
Depth, Z: 0 m  
Operating Temperature: 0 °C  
Cold Temperature: 0 °C  
Pipe: Fluid Weight: 0 kgf/m, Insulation: 0 kgf/m  
Insulation Type: Foamed polystyrene  
Backfill Soil Code: 04  
Foundation Soil Code: 01  
Operating Pressure: 0 kgf/cm²  
Material:  
Friction Factor: 0.67  
Distance between the expansion joints: 0 m

Diagram showing a pipe with an expansion joint. The distance from the joint to the end of the pipe is labeled  $L/2$ . The total length of the pipe section is labeled  $L$ . The diagram also shows the outer diameter  $D$ , wall thickness  $S$ , and external casing diameter  $D_c$ .

# PASS/Start-Prof | New Codes

- Added LOGSTOR, POWERPIPE, +GF+ Urecon Polyurethane Pre-insulated Pipe Jacket Sizes Database for district heating and district cooling networks
- Now it is allowed to add expansion cushions on the vertical pipes



# PASS/Start-Prof | Code Updates

Updated material database  
EN 13480/EN 13941.

Added all piping materials by  
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 10217-1-2019, EN 10217-2-2019,  
EN 10217-3-2019, EN 10217-4-2019,  
EN 10217-5-2019, EN 10217-6-2019,  
EN 10217-7-2014, EN 10220-2002  
(2007), EN 10253-2-2007.

Added automatic material  
properties selection depending  
on wall thickness and  
seamless/welding option



PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE

Materials

Select Material

Code: EN 13480-2017/EN 13941-2019 (Metallic Industrial Piping, Europe)

Manufacturing method: seamless

Material: 1.0345/P235GH

Material: 1.0345/P235GH Class: Carbon or Low Alloy Steel

Database can only be edited if database files are open for editing and if stress units are set as MPa (for ASME - ksi)

Data source: EN 10216-2-2013

Density: 7850 kg/m3

Factor A, %: 23

Th, cm	Yield Stress (Rp), ksi	Tensile Strength (Rm), ksi
1.6	34.084	52.214
4	32.633	52.214
6	31.183	52.214

Temperature F	Yield Stress (Rp), ksi	Tensile Strength (Rm), ksi	Elastic Modulus ksi	Expansion Coeff. 1/F	Poisson's Ratio (ν)	SRTt 10 000 h, ksi	SRTt 100 000 h, ksi	SRTt 200 000 h, ksi	SRTt 250 000 h, ksi
68	0	0	30714.787	6.277e-006	0.3	0	0	0	0
212	28.717	52.214	29887.637	6.611e-006	0.3	0	0	0	0
302	27.122	52.214	29353.463	6.804e-006	0.3	0	0	0	0
392	24.656	52.214	28805.946	6.986e-006	0.3	0	0	0	0
482	21.756	52.214	28245.375	7.155e-006	0.3	0	0	0	0
572	19.145	52.214	27671.460	7.313e-006	0.3	0	0	0	0
662	17.405	52.214	27084.493	7.458e-006	0.3	0	0	0	0
752	16.244	52.214	26484.181	7.592e-006	0.3	26.397	20.450	18.565	17.695
770	16.128	52.214	26362.495	7.617e-006	0.3	24.076	18.565	16.679	15.809
788	16.012	52.214	26240.228	7.642e-006	0.3	21.901	16.534	14.794	14.069
806	15.896	52.214	26117.526	7.667e-006	0.3	20.015	14.504	12.908	12.473
824	15.780	52.214	25994.389	7.691e-006	0.3	18.130	12.763	11.168	10.733
842	15.664	52.214	25870.527	7.714e-006	0.3	16.244	11.168	9.572	9.282

# PASS/Start-Prof | New Features

Added 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. Added into material database. 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).

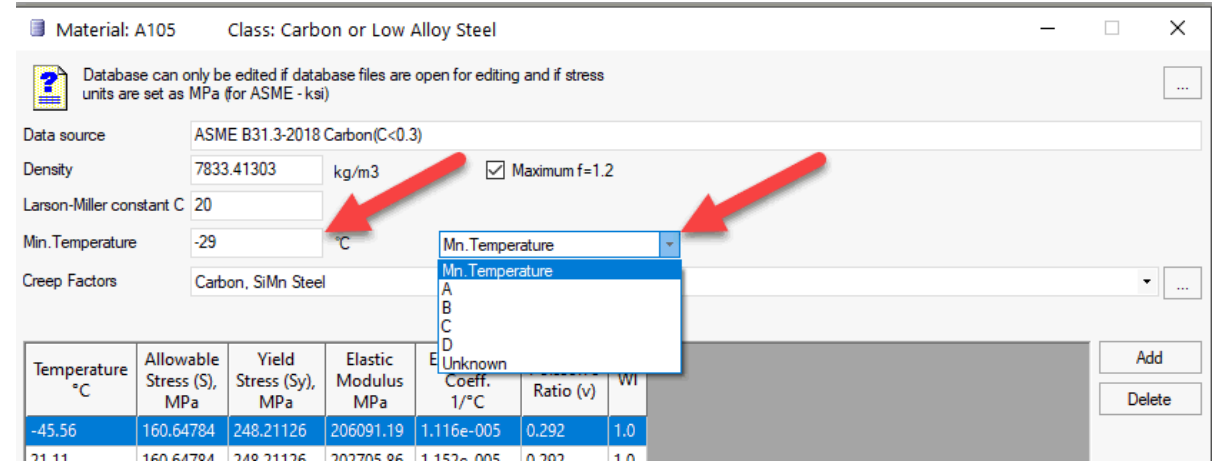


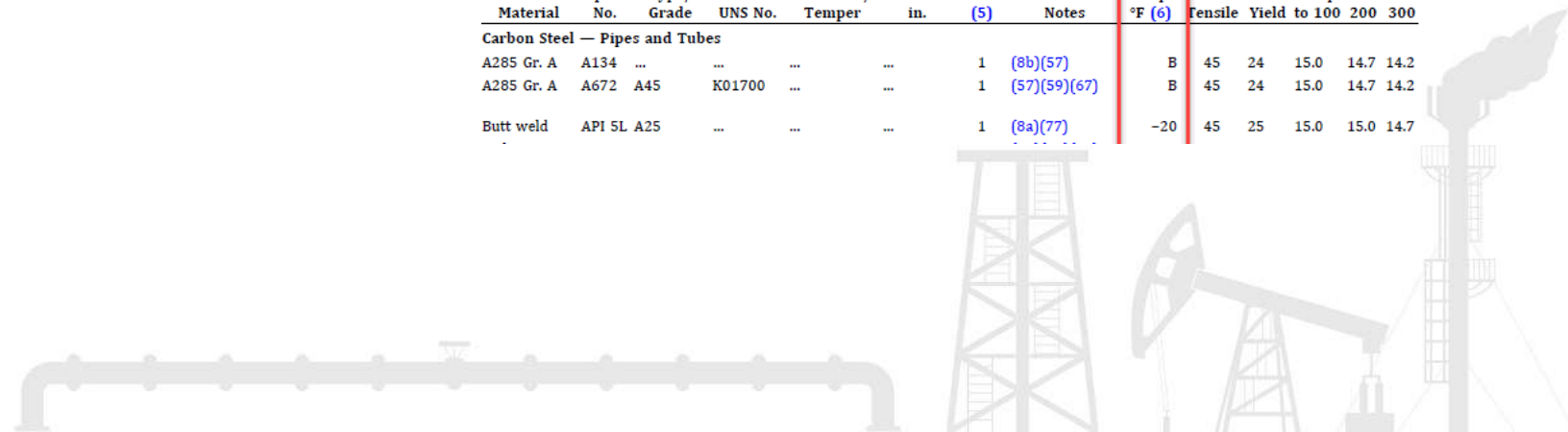
Table A-1 Basic Allowable Stresses in Tension for Metals (Cont'd)

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/Temp	Size, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Strength, ksi		Basic Allowable Stress, S, ksi, at Metal Temperature, °F [Note (1)]		
									Tensile	Yield	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



PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE



# PASS/Start-Prof | New Features

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-3B for Designated Curve for a Listed Material; see Table 323.2.2A for Tabular Values)

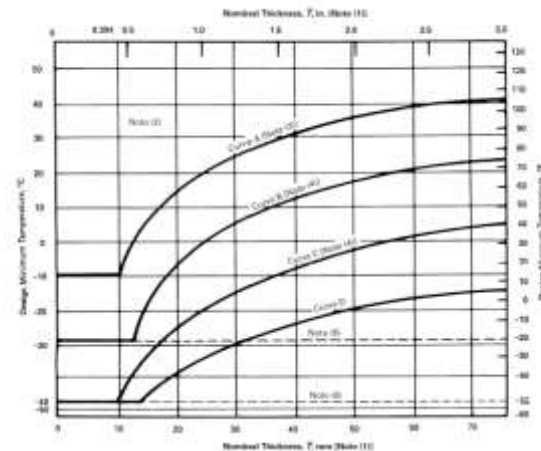
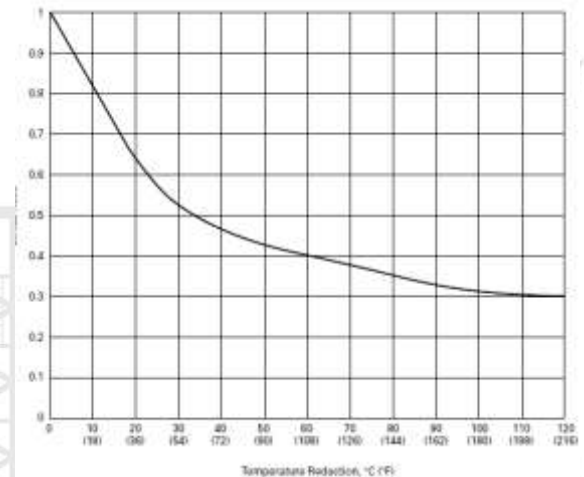


Figure 323.2.2B Reduction in Lowest Exemption Temperature for Steels Without Impact Testing (See Table 323.2.2B for Tabular Values)



PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE

# PASS/Start-Prof | New Features

Updated material library, weld reduction factors for ASME B31.3-2018. Added occasional allowable calculation for elevated temperature fluid service 302.3.6 (2) ASME B31.3-2018, added appendix V. Added "Time duration", "Alternative Occasional" options to operating mode editor. Added Larson-Miller constant "C" into 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. 302.2.

(1) Subject to the limits of para. 302.2.4, the sum of the stresses due to sustained loads, such as pressure and weight,  $S_s$ , and of the stresses produced by occasional

(-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 material to elevated temperatures of more-applicable data, shall be taken as 0.8 for stainless steel and 0.8 for other materials.

basic allowable stress for castings shall be the casting quality factor,  $E_c$ . Where this value exceeds two-thirds of yield strength, the allowable stress value shall be specified in para. 302.3.2(e).

Due to test conditions are not subject to occasional loads, e.g., wind and earthquake, stresses resulting with test loads.

Material: A106 A Class: Carbon or Low Alloy Steel

Database can only be edited if database files are open for editing and if stress units are set as MPa (for ASME - ksi)

Data source: ASME B31.3-2018 Carbon(C<0.3)

Density: 7833.41303  Maximum f=1.2

Larson-Miller constant C: 20

Creep Factors: Carbon, SiMn Steel

Temperature F	Allowable Stress (S), ksi	Yield Stress (Sy), ksi	Elastic Modulus ksi	Expansion Coeff. 1/F	Poisson's Ratio (v)	WI
-325	16	30	31400	5.5e-006	0.292	1.0
-200	16	30	30800	5.79e-006	0.292	1.0
-150	16	30	30300	5.9e-006	0.292	1.0
-50	16	30	29891	6.2e-006	0.292	1.0
70	16	30	29400	6.4e-006	0.292	1.0
100	16	30	29262	6.47e-006	0.292	1.0
200	16	27.500	28800	6.7e-006	0.292	1.0

Buttons: Save, OK, Cancel, Help

Input Stress

Operating Mode: 1.1 'occ1.1'

Show Equations  Stress  Creep Stress

Object	Start End node	Primary Loads Stress, (ksi)			Notes
		SI_Alt	k*Sh	%	
Above ground pipe	14	5.012	5.960	84.1	
	29,2 Flange	7.181	5.960	120.5	1
Forged Elbow	29,2 Flange	8.444			Sh, 4.684 ksi
Above ground pipe	29,2 Flange	7.805			Sy, 18.616 ksi
	15	4.266			ti=5000 hour
Above ground pipe	14	5.172			C=20
	16	5.325			Te, 481.384305068139 °C
Weldolet (branch welded-on fitting)	16	12.256			S02, 5.960 ksi
Above ground pipe	16	3.967			min(4Sh, 0.8*0.9Sy, S02), 5.960 ksi

### Smart Operation Mode Editor

* #	Name	Hanger Sizing	High temperature	Cold State	Seismic	Wind	Snow/Ice	Friction Multiplier	Weight Multiplier	Time Duration, hour	Mode Type	Stress Range Between	Help
<input checked="" type="checkbox"/> 1 (0)	OPE	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1.00	1.00	0.00	SUS	1-1A	?
1.1 (0)	occ1.1	-	-	-	-	-	-	-	-	-	OCC Std		?
<input checked="" type="checkbox"/> 2 (2)	occ	<input type="checkbox"/>						1.00	1.00	0.00	OCC Std	2-1A	?
<input checked="" type="checkbox"/> 3 (1)	Test mode										SUS		?

# PASS/Start-Prof | New Features

Added 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).

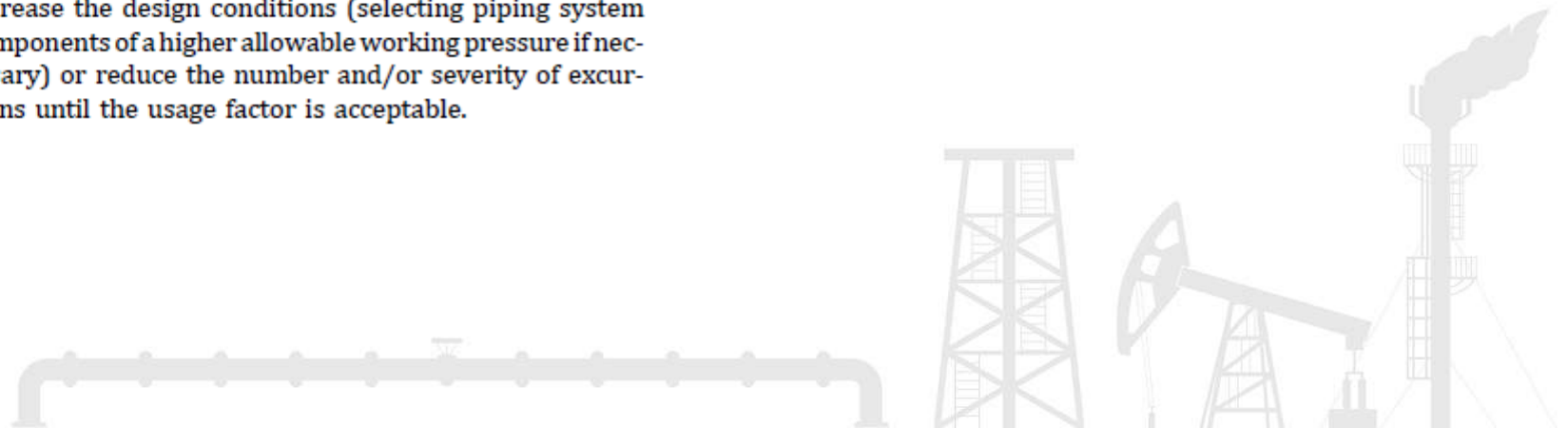
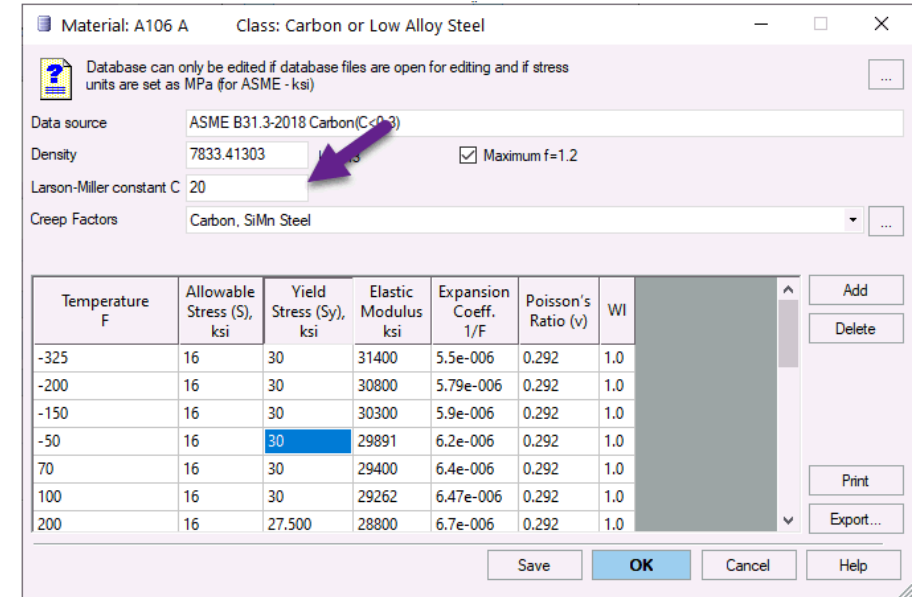
$$u = \sum (t_i / t_{ri}) \quad (V4)$$

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.

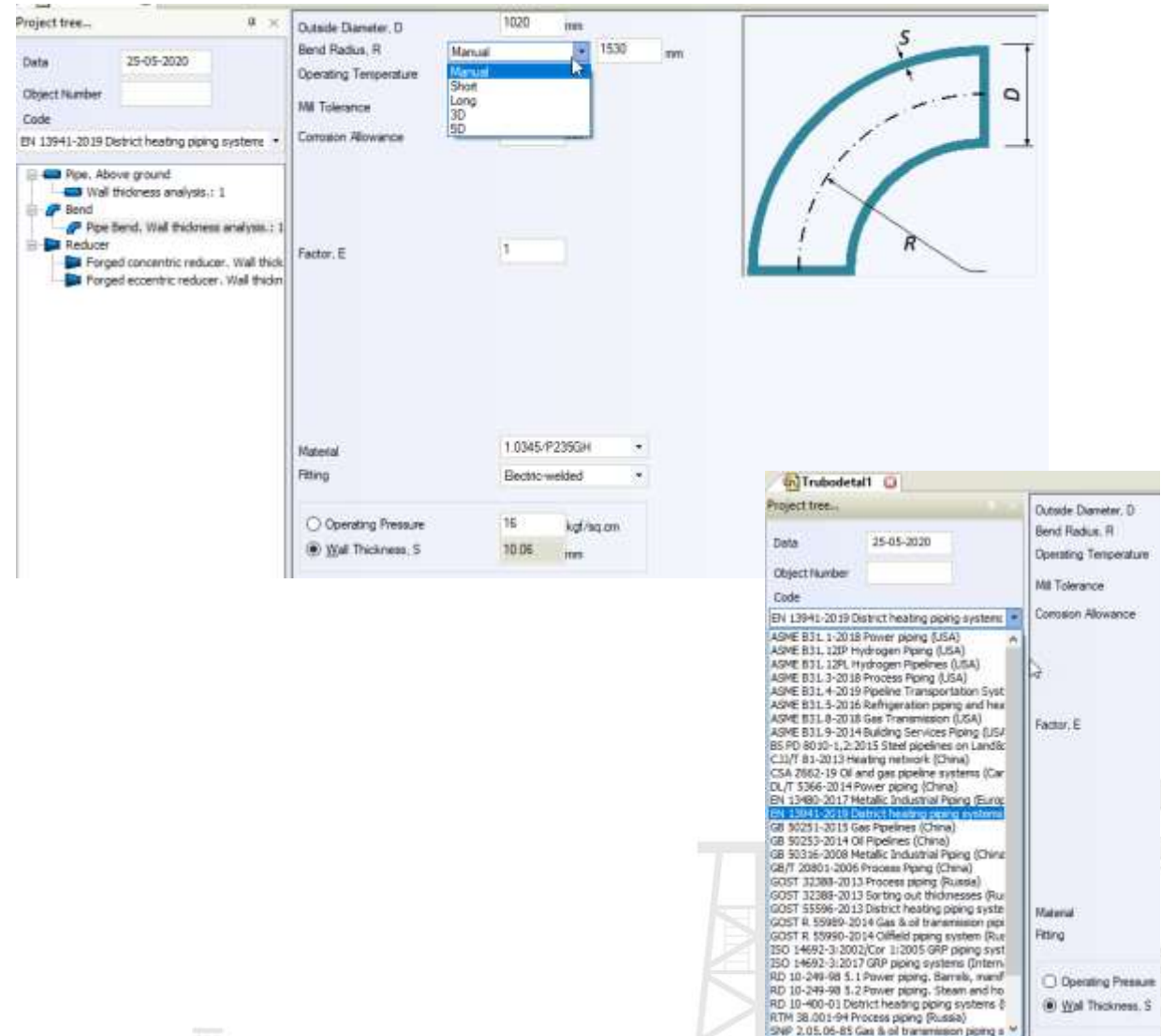




# PASS/Start-Prof | New Features

Added pipe wall thickness calculator and bend wall thickness calculator for all new codes like ISO 14692-2017, EN 13941, ASME B31.12, BS PD 8010, CSA Z662, GOST R 55989, GOST R 55990, SP 284.1325800.2016, SP 33.13330.2012.

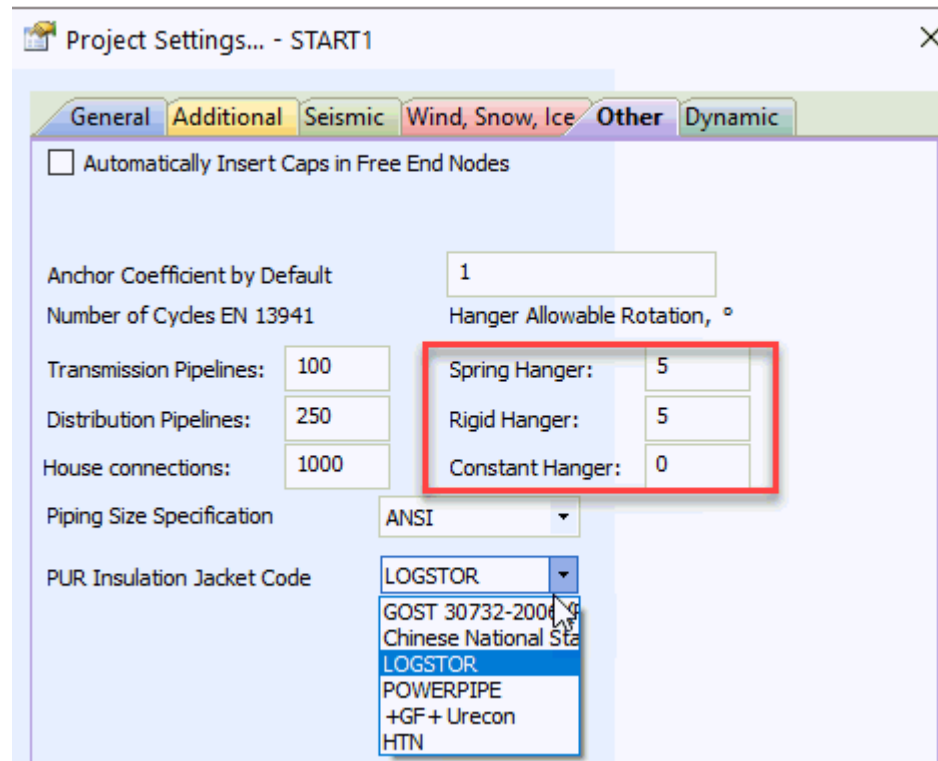
All pipes and fitting wall thicknesses are automatically checked before every run of the pipe stress analysis according to the selected code



PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE

# PASS/Start-Prof | New Features

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

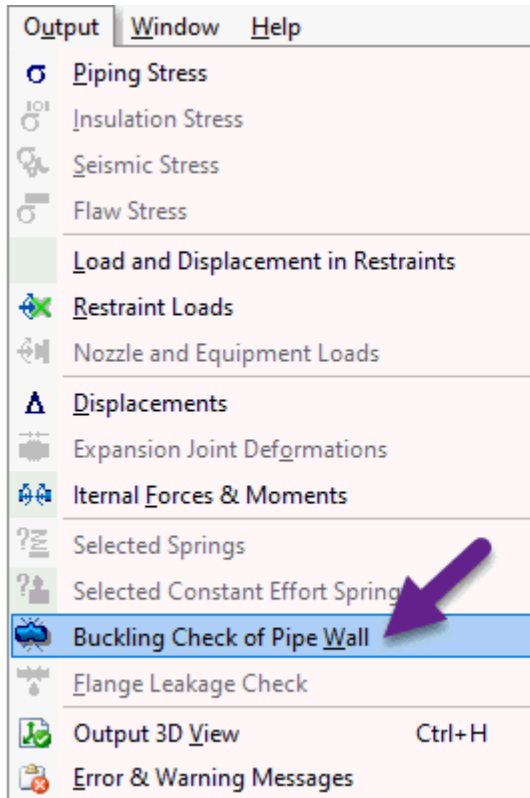


PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE



# PASS/Start-Prof | New Features

- Added automatic local pipe wall buckling check per ASME B31.8-2018
- EN 13941-2019 7.2.4.2

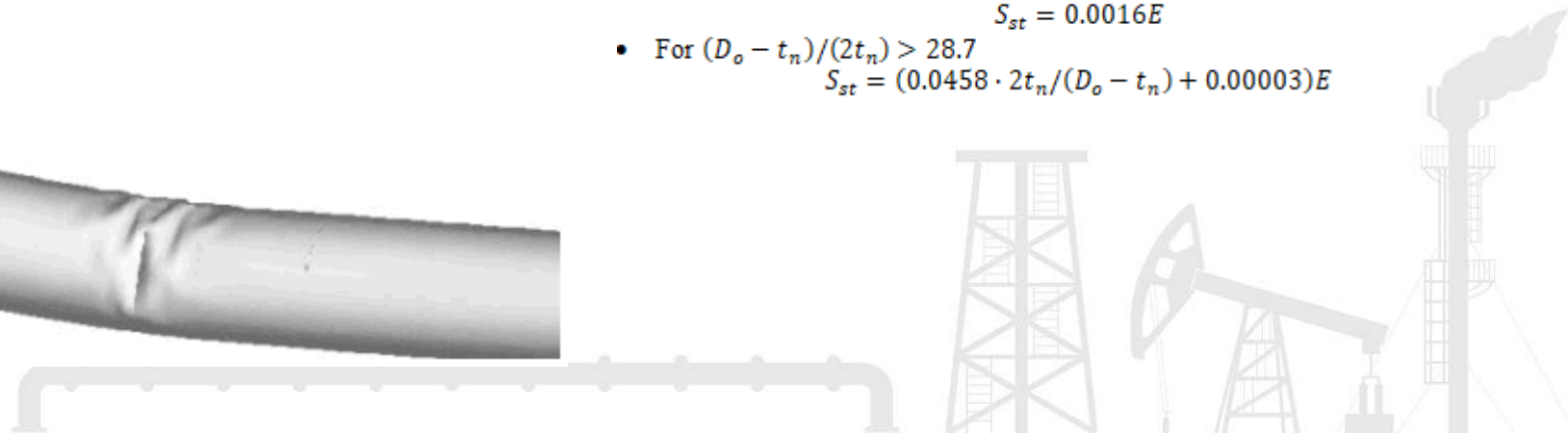
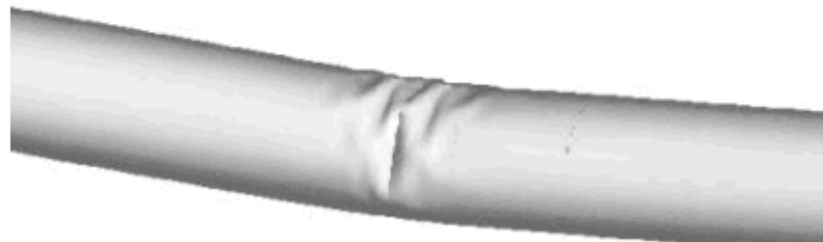


Operating Mode								
1 操作模式 (0) ?								
Object	Start End node	C1 Local Buckling in Hot Condition, (MPa)		C1 Local Buckling in Cold Condition, (MPa)		C1 Local Buckling in Test Condition, (MPa)		Notes
		calculated	allowable	calculated	allowable	calculated	allowable	
Buried pipe	1	36.09	33.88	38.39	33.88	0.01	33.88	1,2
	2	12.95	33.88	34.84	33.88	0	33.88	2
Bend	2							
Buried pipe	2	21.44	33.88	34.63	33.88	0	33.88	2
	3	35.93	33.88	38.89	33.88	0.01	33.88	1,2

- For  $(D_o - t_n)/(2t_n) \leq 28.7$   

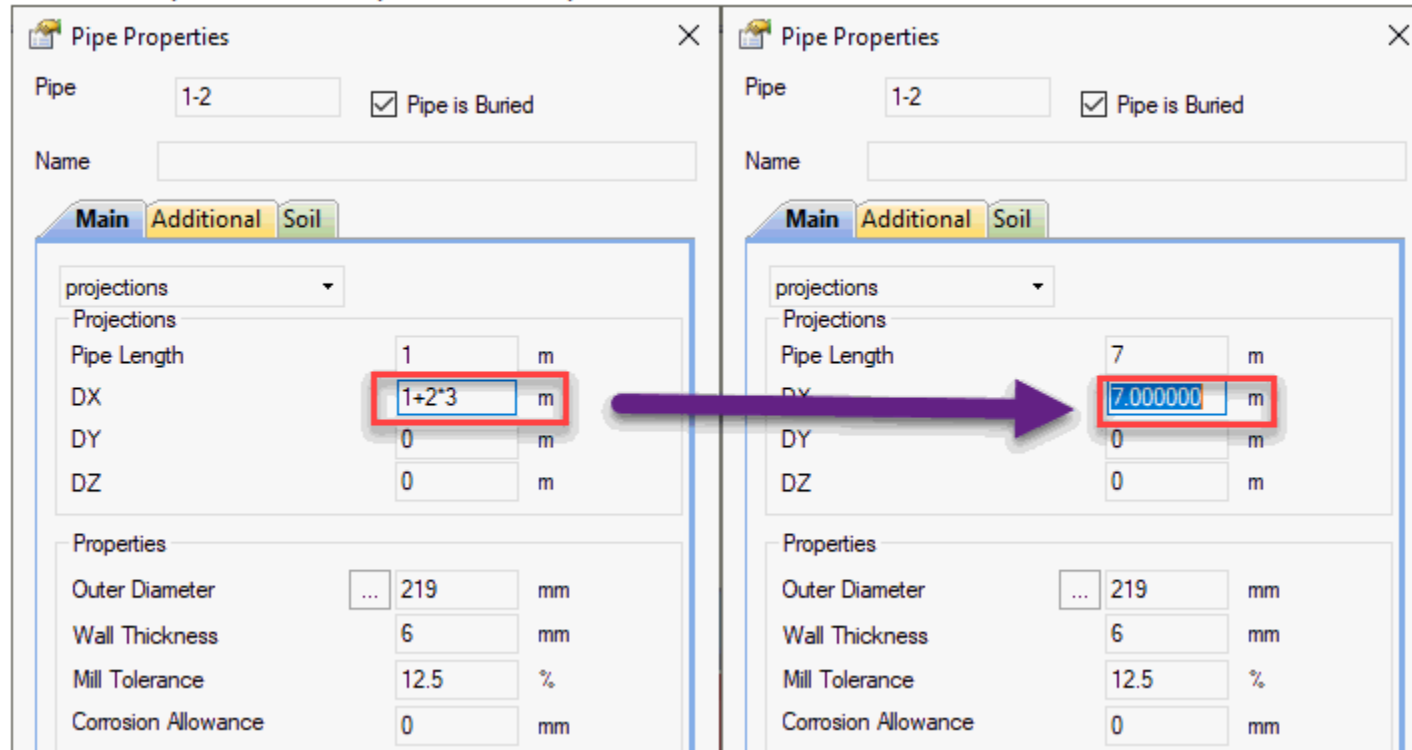
$$S_{st} = 0.0016E$$
- For  $(D_o - t_n)/(2t_n) > 28.7$   

$$S_{st} = (0.0458 \cdot 2t_n/(D_o - t_n) + 0.00003)E$$

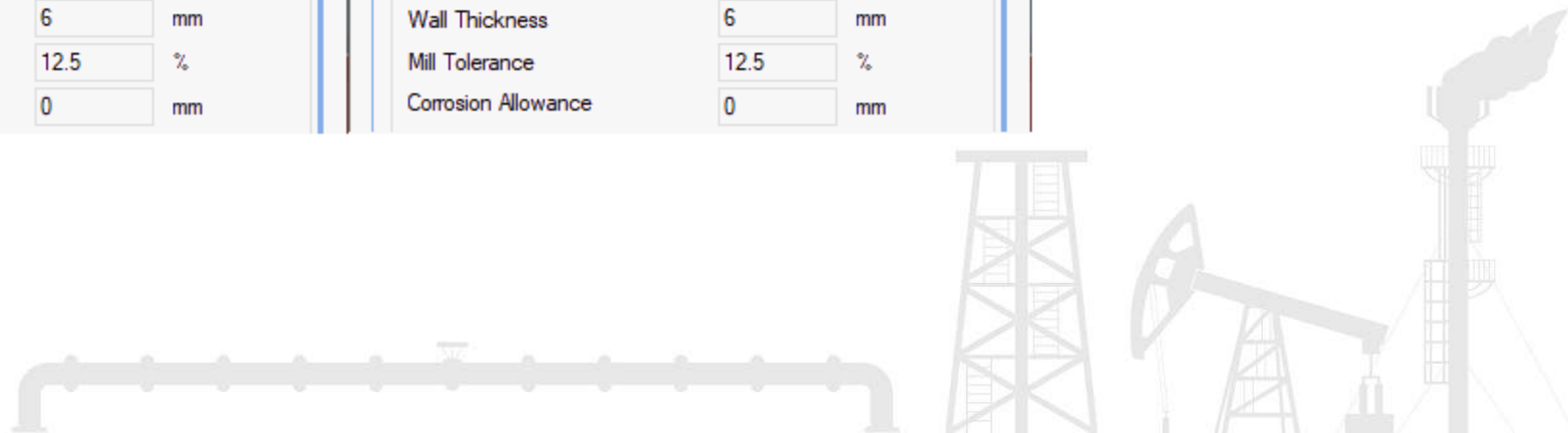


# PASS/Start-Prof | New Features

Added built-in calculator in some input fields



PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE



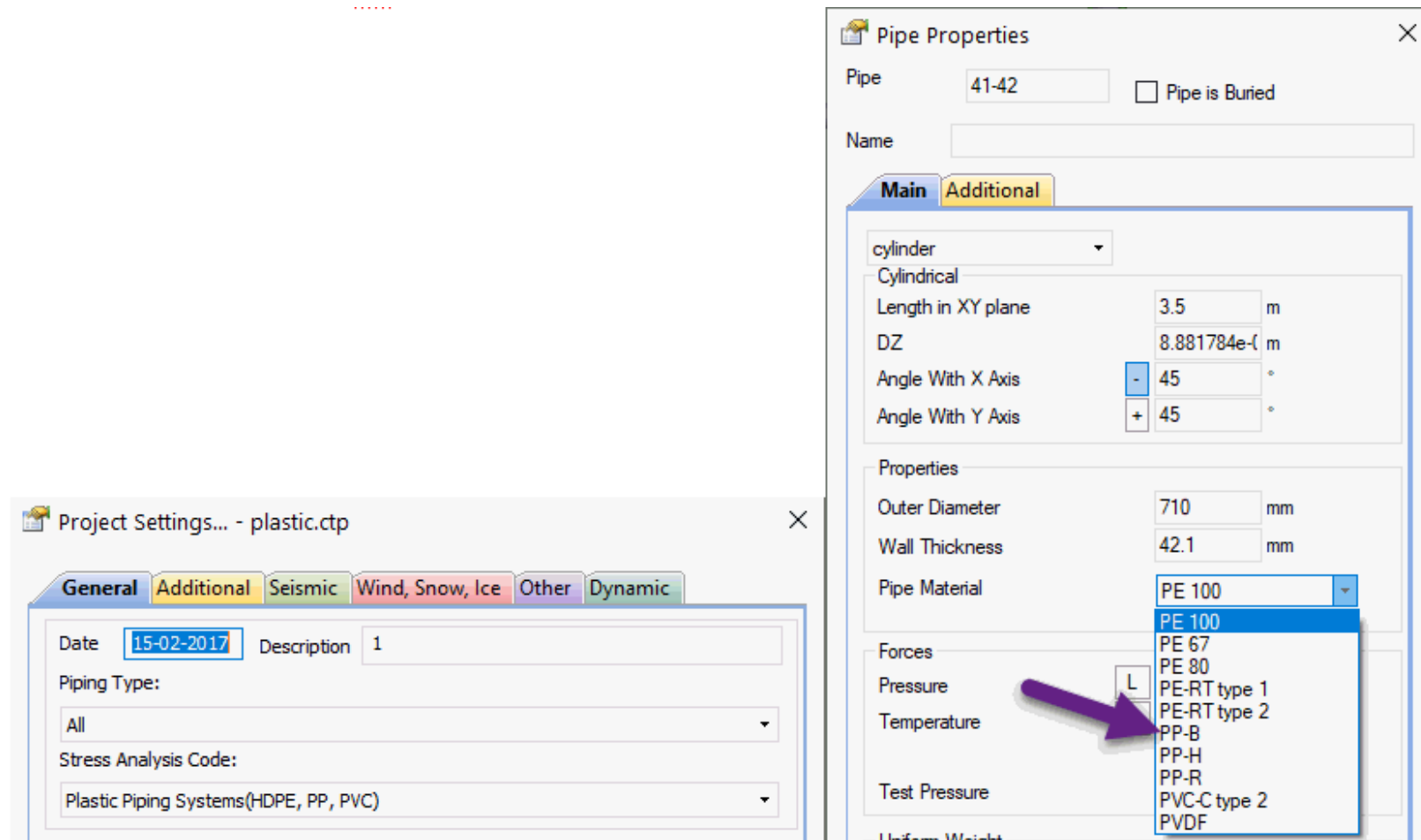
# PASS/Start-Prof | New Features

- Updated database ASME B36.10M-2018
- Added more than 140 new standards into pipes, tees, bends, and reducers database, including ASME B16.9 and lot of Russian GOST, OST, RD, TU codes

The screenshot displays the PASS software interface with two database windows open. On the left, a sidebar lists various components: Materials Library..., Variable Springs..., Constant Springs..., Soils..., Insulation..., Expansion Joints..., Pipes..., Bends..., Tees..., Reducers..., Flanges..., Gasket..., and Insulation Jacket... The 'Pipes...' and 'Tees...' items are highlighted with a red box. The 'Pipes' window shows a table with columns: Manufacturing Technology, Manufacturing Type, Standard, Assortment, Schedule, NPS, in, Nominal Diameter mm, Material, Size, Diameter, cm, Thickness, cm, Mill-Tolerance, cm, Weight, kg, and Standard Group. The 'Tees' window shows a table with columns: Manufacturing Technology, Standard, Material, Size, Header Diameter, cm, Branch Diameter, cm, Header DN, cm, Branch DN, cm, Header NPS, in, Branch NPS, in, Schedule, Header Thickness, cm, and Branch Thickness, cm. Both windows include 'Add' and 'Delete' buttons. The PASS logo is visible in the bottom left corner.

# PASS/Start-Prof | New Features

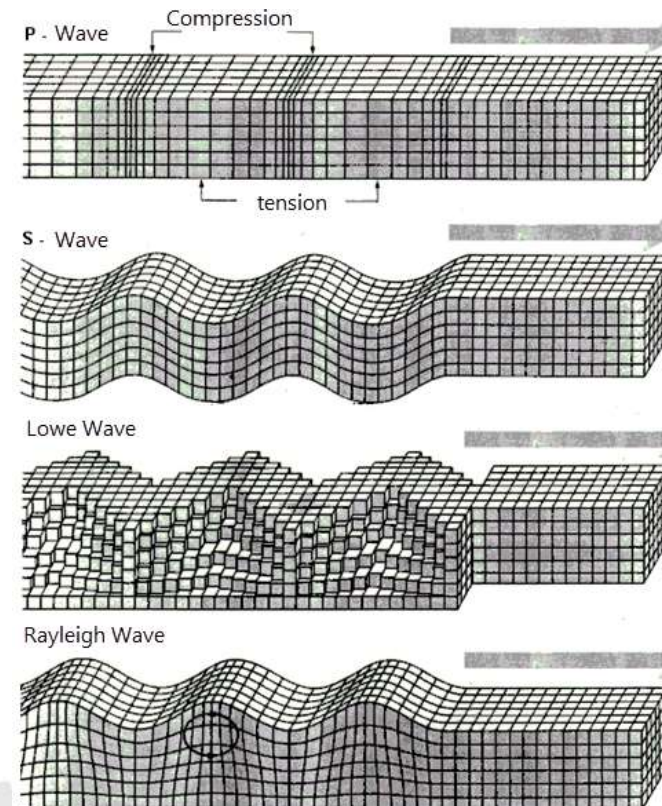
Added polypropylene "PP-B" into material database. Data taken from DVS 2205, EN 1778, and DIN 8078



# PASS/Start-Prof | New Features

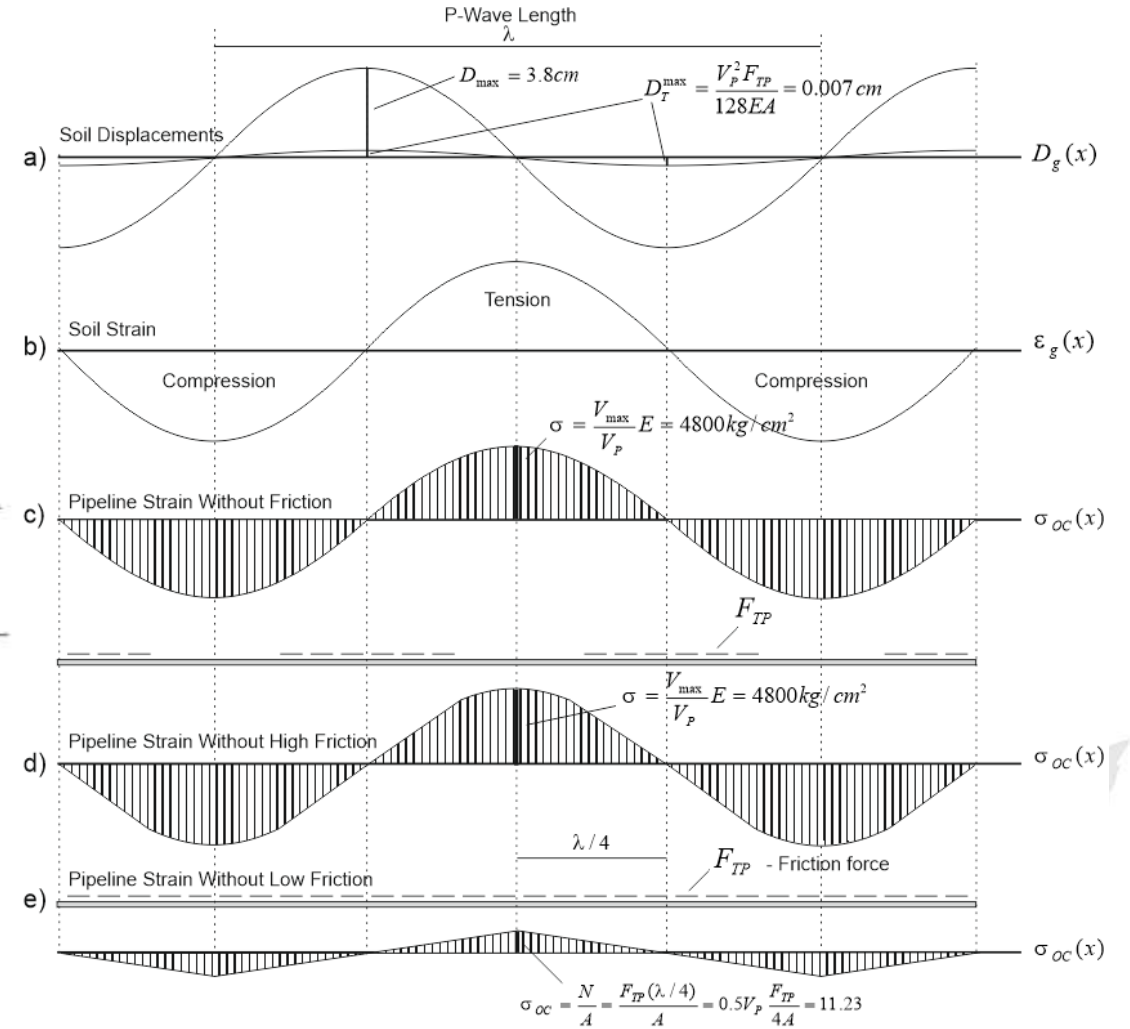
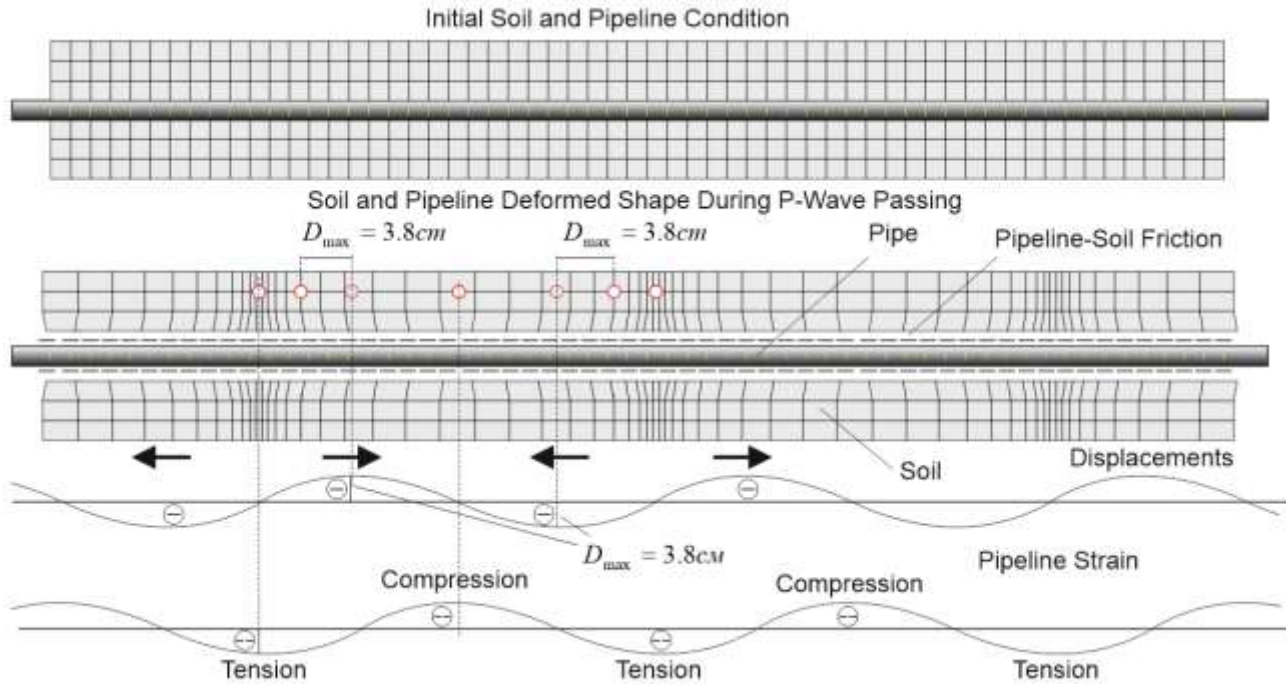
Added seismic wave propagation analysis for underground pipelines. START-PROF calculate stress and strain in buried pipeline caused by seismic wave propagation and check the stress and strain limits according to

- ASCE 2001 Guidelines for the Design of Buried Steel Pipe (American Lifelines Alliance). Improved by START-PROF authors, added shear wave effect
- GB 50032 (China)
- GB 50470 (China)
- SNiP 2.05.06-85 (Russia)
- SP 36.13330.2012 (Russia)
- GOST R 55989-2014 (Russia)
- GOST R 55990-2014 (Russia)
- SP 284.1325800.2016 (Russia)
- SP 33.13330.2012 (Russia)



PIPING AND EQUIPMENT  
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# PASS/Start-Prof | New Features



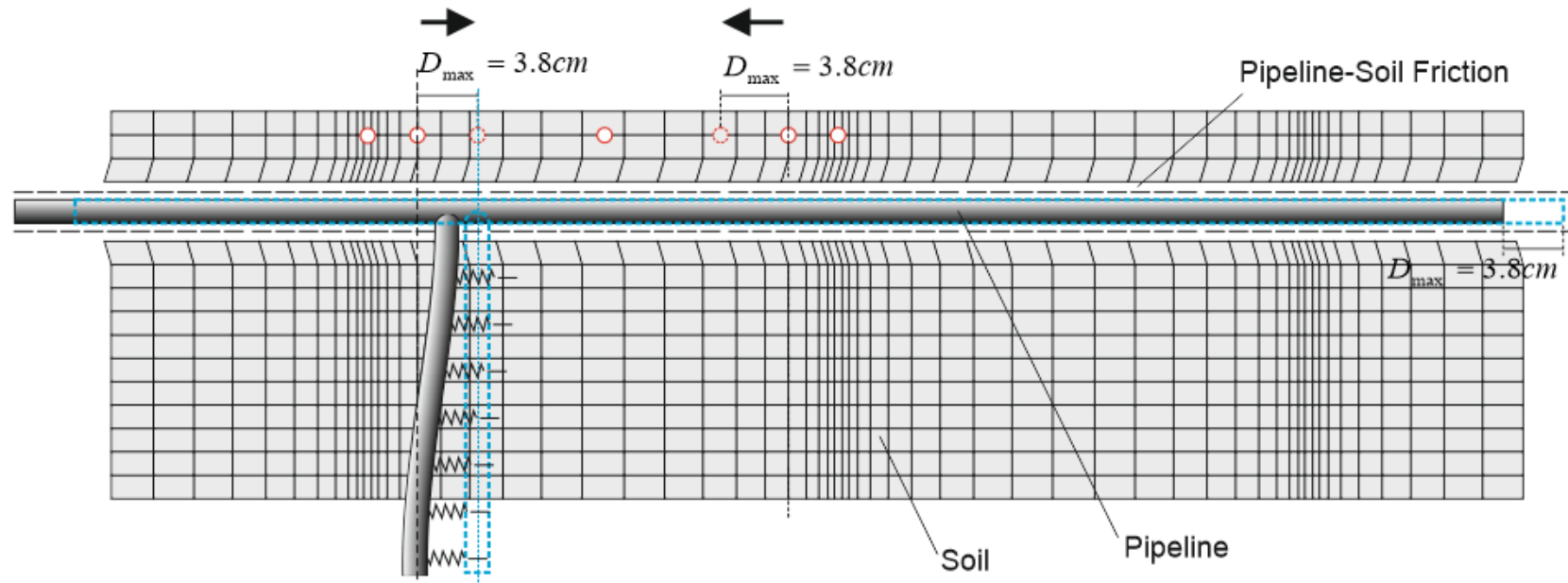
PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE



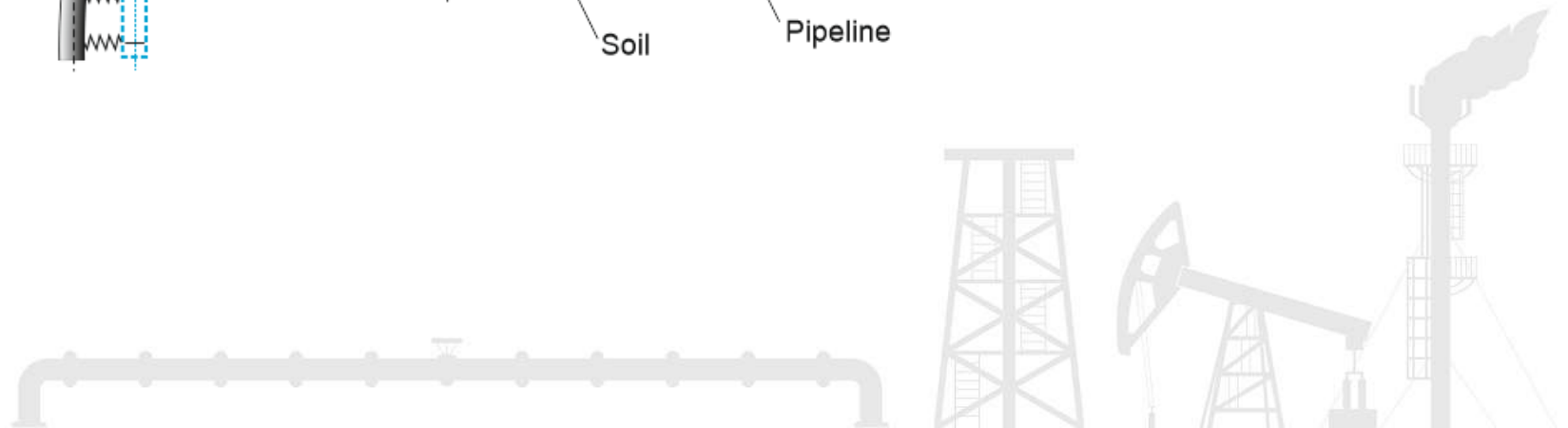


# PASS/Start-Prof | New Features

Every pipe branch, turn or anchor cause great axial and bending stresses



PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE



# PASS/Start-Prof | New Features

Axial seismic strain due to wave propagation is calculated using equation:

$$\varepsilon = \pm \max \left( \min(\varepsilon_a, \varepsilon_{fr}); \frac{D}{2} \rho_{max} \right) \cos \omega$$

Actually, pipe curvature can cause only the bending moments, but we convert it into equivalent axial strain to simplify the stress analysis procedure in START-PROF software.

$\omega$  – Incline angle of the pipe. 0 for horizontal pipe, 90 for vertical pipe

$D$  – Pipe diameter, m

$\varepsilon_a$  – Maximum axial strain from P-, S-, R-waves

$$\varepsilon_a = \max \left( \frac{V_g}{C_p}; \frac{V_g}{2C_s}; \frac{V_g}{C_R} \right)$$

Maximum strain from P-wave friction forces is

$$\frac{T_u \lambda}{4EA}$$

$\lambda$  – Wave length, m

$$\lambda = 0.5C_p$$

So maximum strain caused by friction from P-, S-, R-waves is

$$\varepsilon_{fr} = \max \left( 0.5C_p \frac{T_u}{4EA}; 0.5C_s \frac{T_u}{4EA}; 0.5C_R \frac{T_u}{4EA} \right)$$

$\rho_{max}$  – Maximum curvature from P-, S-, R-waves

$$\rho_{max} = \max \left( \frac{0.385A_g}{(C_p)^2}; \frac{A_g}{(C_s)^2}; \frac{A_g}{(C_R)^2} \right)$$

$V_g$  – Peak ground velocity, m/s. Specified by user in pipe properties

$A_g$  – Peak ground acceleration, m/s<sup>2</sup>. Specified by user in pipe properties

$A$  – Pipe cross-section area, m<sup>2</sup>

$T_u$  – Peak friction force, t/m

$$T_u = \tan(n_m \cdot \varphi) \left[ \gamma_a Z \pi D_c \left( \frac{1 + K_0}{2} \cos^2 \alpha - K_0 \sin^2 \alpha \right) \right] + \pi D_c \omega c$$

$$\omega = 0.608 - 0.123c - \frac{0.274}{c^2 + 1} + \frac{0.695}{c^3 + 1}$$

$c$  – Soil cohesion

$C_p$  – Apparent P-wave propagation velocity, m/s. Specified by user in START-PROF pipe properties. Default value 2

km/s

$C_s$  – Apparent S-wave propagation velocity, m/s. Specified by user in START-PROF pipe properties. Default value 1

km/s

$C_R$  – Apparent R-wave propagation velocity, m/s

Rayleigh wave velocity is equal to  $C_R = kC_s$ , where  $k$  is obtained from the equation

$$\frac{1}{8}k^6 - k^4 + \frac{2-\nu}{1-\nu}k^2 - \frac{1}{1-\nu} = 0.$$

Depending on Poisson's ratio values the  $k$  values are within  $0.92 < k < 0.95$  We approximately assume that  $k = 0.92$

$$C_R \approx 0.92C_s$$

**Pipe Properties**

Pipe: 160-180  Pipe is Buried

Name: \_\_\_\_\_

**Main Additional Soil Seismic**

Piping Location

Aboveground/in Underground Channel/On Low Restraints Installation

Overpass/On the Stand/At the First Floor and Above Installation

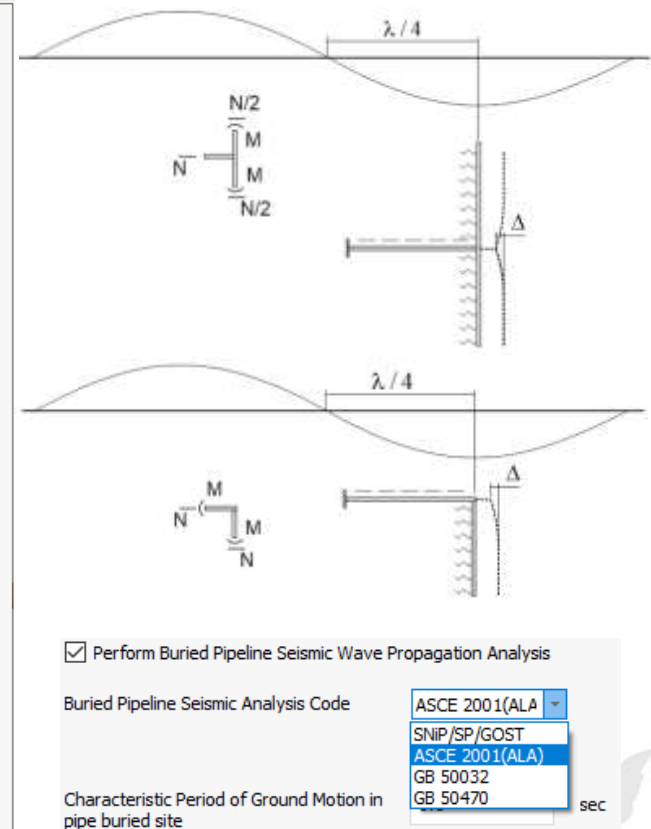
Automatic Calculation of Kpsi

Factor to Account for the Ability to Dissipate Energy, Kpsi: 1.48

Factor Taking Into Account the Appointment of the Piping, K0: 1.5

Peak Ground Velocity, Vg	0.1	m/s
Peak Ground Acceleration, Ag	4	m/s <sup>2</sup>
Apparent Propagation Velocity, Ca	120	m/s
Shear Wave Velocity, Cs	60	m/s

OK Cancel Help



# PASS/Start-Prof | New Features

Added strain check according to ASCE 2001 Guidelines for the Design of Buried Steel Pipe (American Lifelines Alliance), SNIIP, SP, GOST, GB Codes

Input Stress

Operating Mode: 1.1 \*Soil Seismic Wave Propage

Show Equations  Stress Range from Operation to Cold  Add Axial Force and Torsion Stress

Object	Start End node	Buried piping Seismic Check, (MPa)			Buried piping Seismic Check, (%)			Notes
		SI	Allow	%	Σ	Allow	%	
Buried pipe	9	515.60	965.27	53.4	0.2009	0.2939	68.4	
	3	515.58	965.27	53.4	0.2009	0.2939	68.4	
Buried pipe	8	510.81	965.27	52.9	0.1985			E, 201051.12 MPa
	9	515.60	965.27	53.4	0.2009			[εa]=0.75(0.5t/D-0.0025+3000(PD/(2Et))²), 0.002939
Buried pipe	7	490.91	965.27	50.9	0.1884			[εa]%, 0.2939
	8	510.81	965.27	52.9	0.1985	0.2939	67.5	

Compression strain limit

$$0.75 \left[ 0.50 \left( \frac{t}{D'} \right) - 0.0025 + 3000 \left( \frac{pD}{2Et} \right)^2 \right]$$

$$D' = \frac{D}{1 - \frac{3}{D}(D - D_{min})}$$

Input Stress

Operating Mode: Maximum

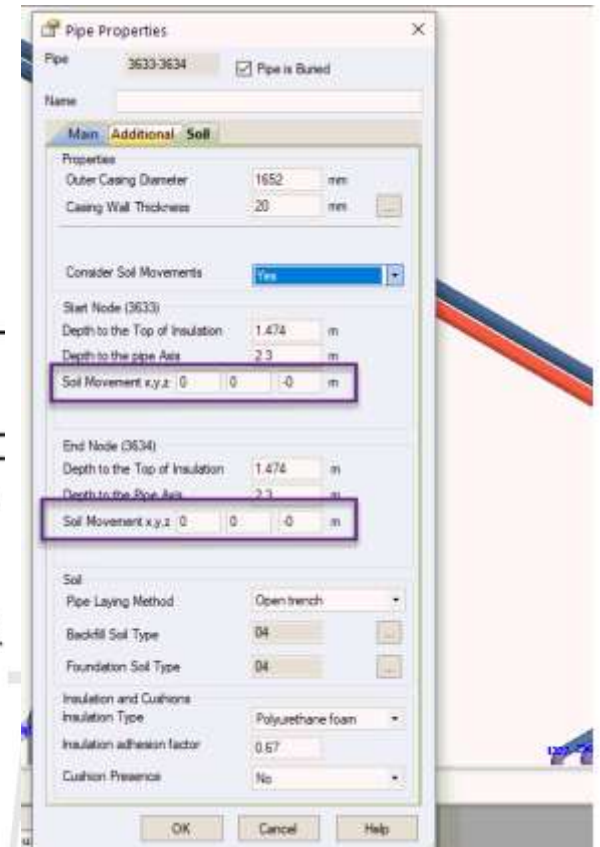
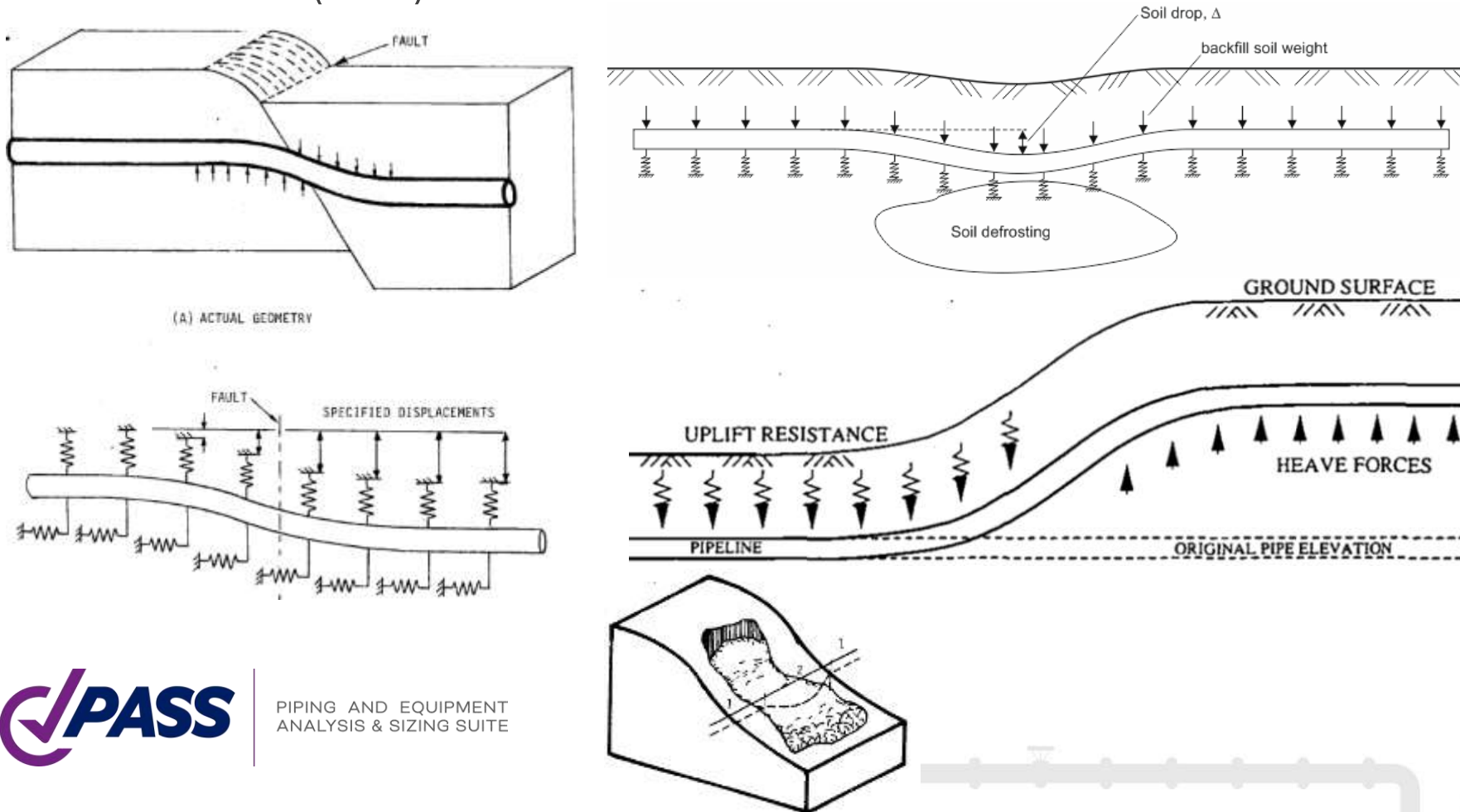
Show Equations  Stress Range from Operation to Cold  Add Axial Force and Torsion Stress

Object	Start End node	Hoop Stress, (MPa)			Primary Loads Stress in Hot State, (MPa)			Primary&Secondary Loads Stress in Hot State, (MPa)						Expansion Stress Range, (MPa)			Buried piping Seismic Check, (MPa)			Buried piping Seismic Check, (%)			Notes			
		Sh	F*Sy	%	Seq	F*Sy	%	Seq	F*Sy	%	Seq	F*Sy	%	Seq	F*Sy	%	Se	Sa	%	SI	Allow	%		Σ	Allow	%
Buried pipe	9	85	173.75	48.9				24.62	180.99	13.6	154	217.18	70.9	69	217.18	31.8	93.61	217.18	43.1	515.60	965.27	53.4	0.2009	0.2939	68.4	
	3	85	173.75	48.9				24.62	180.99	13.6	154	217.18	70.9	69	217.18	31.8	93.61	217.18	43.1	515.58	965.27	53.4	0.2009	0.2939	68.4	
Buried pipe	8	85	173.75	48.9				24.69	180.99	13.6	153.55	217.18	70.7	68.55	217.18	31.6	93.23	217.18	42.9	510.81	965.27	52.9	0.1985	0.2939	67.5	
	9	85	173.75	48.9				24.62	180.99	13.6	154	217.18	70.9	69	217.18	31.8	93.61	217.18	43.1	515.60	965.27	53.4	0.2009	0.2939	68.4	
Buried pipe	7	85	173.75	48.9				24.98	180.99	13.8	151.70	217.18	69.9	66.70	217.18	30.7	91.60	217.18	42.2	490.91	965.27	50.9	0.1884	0.2939	64.1	
	8	85	173.75	48.9				24.69	180.99	13.6	153.55	217.18	70.7	68.55	217.18	31.6	93.23	217.18	42.9	510.81	965.27	52.9	0.1985	0.2939	67.5	
Long Radius Pipe Bend	2	85	173.75	48.9				35.27	180.99	19.5	204.13	217.18	94.0	119.13	217.18	54.9	84.97	217.18	39.1	732.51	965.27	75.9	0.1589	0.2939	54.1	
Buried pipe	2	85	173.75	48.9				30.03	180.99	16.6	169.99	217.18	78.3	84.99	217.18	39.1	84.91	217.18	39.1	568.23	965.27	58.9	0.1588	0.2939	54.0	
	7	85	173.75	48.9				24.98	180.99	13.8	151.70	217.18	69.9	66.70	217.18	30.7	91.60	217.18	42.2	490.91	965.27	50.9	0.1884	0.2939	64.1	



# PASS/Start-Prof | New Features

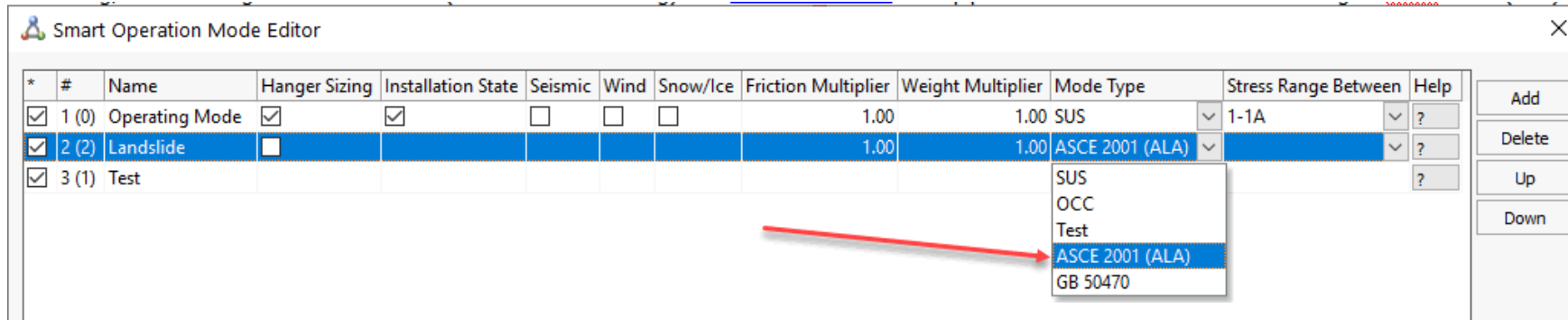
Landslide, Soil subsidence, frost heaving, Permanent ground deformation (seismic fault crossing) can also be modeled. The pipeline strain check is made according to ASCE 2001 (ALA) and GB 50470



PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE

# PASS/Start-Prof | New Features

The pipeline strain check is made according to ASCE 2001 (ALA) and GB 50470



Input Stress

Operating Mode: 2 'Landslide' (2)    Expansion Stress Range: 1 '操作模式' (0) (2-1A)     Show Equations     Stress Range from Operation to Cold     Add Axial Force and Torsion Stress

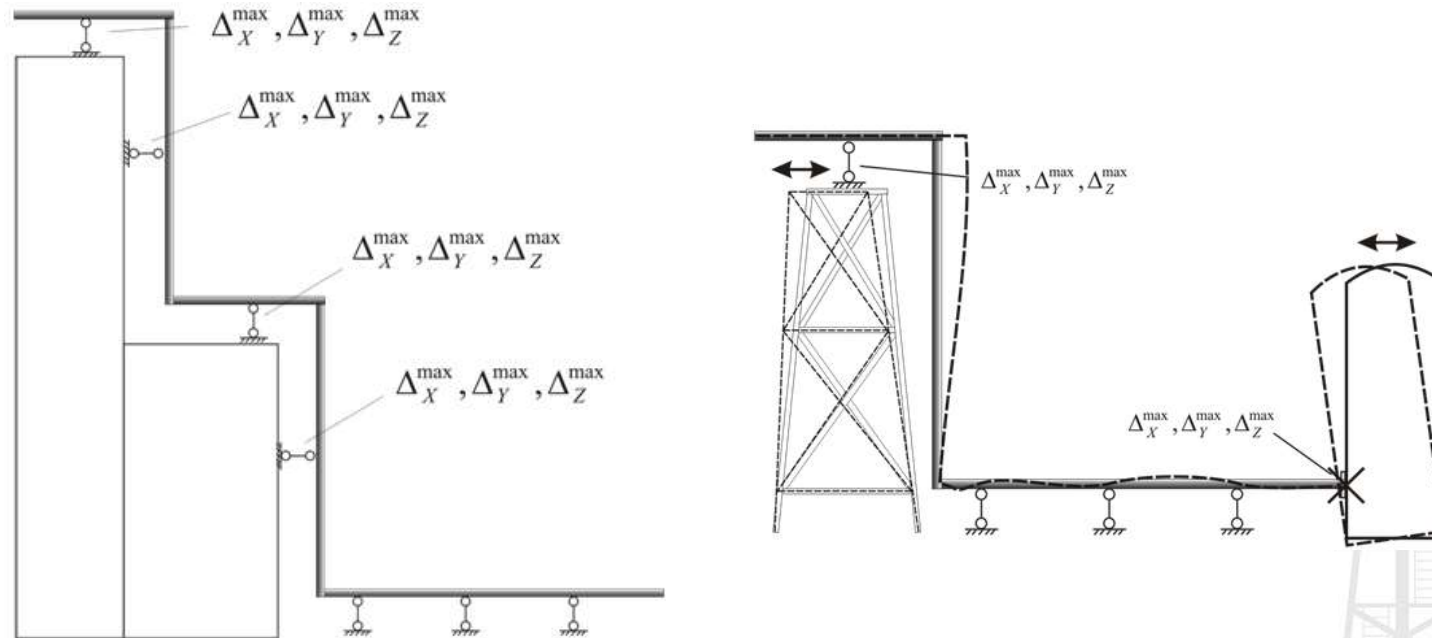
Object	Start End node	Landslide strength, (MPa)			Landslide strength (Tension Area), (%)			Landslide strength (Compression Area), (%)			Notes
		SI	Allow	%	$\epsilon$	Allow	%	$\epsilon$	Allow	%	
Buried pipe	1	48.20	1930.53	2.5	0.02387	2	1.2	-0.02386	2	1.2	
	2	186.69	1930.53	9.7	0.09247	2	4.6	-0.02027	2	1.0	
Buried pipe	2	77.07	1930.53	4.0	0.03817	2	1.9	0.03403	0.7304	4.7	
	3	45.84	1930.53	2.4	0.0227	0.7304	3.1	-0.0227			E, 201906.18 MPa $[\epsilon a] = 0.5t/D - 0.0025 + 3000(PD/(2Et))^2$ , 0.007304 $[\epsilon a]\%$ , 0.7304



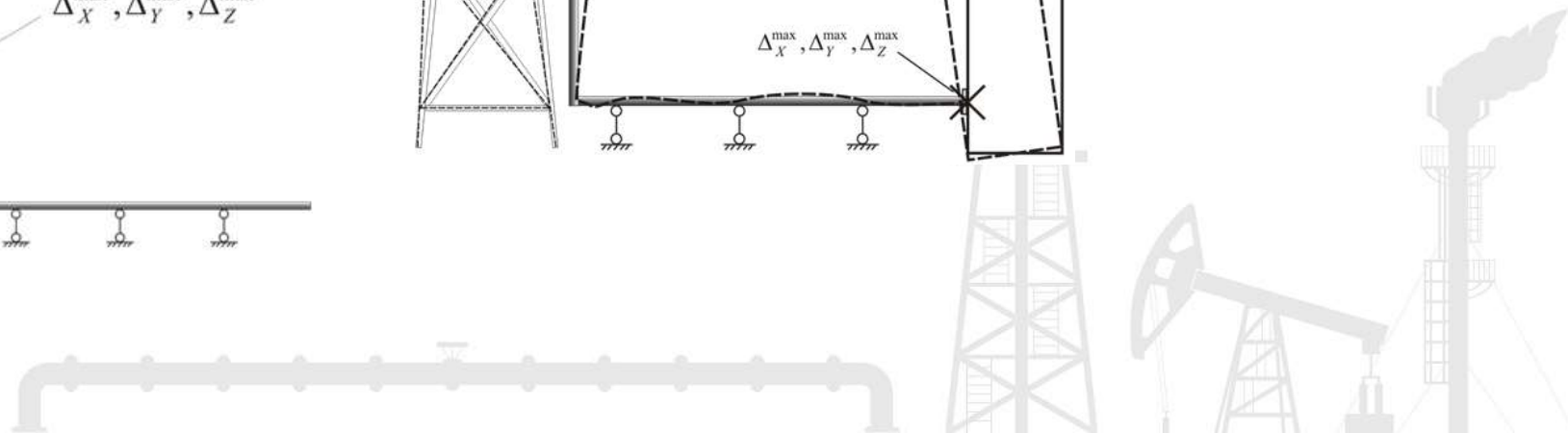
PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

# PASS/Start-Prof | New Features

- Added ability to specify different seismic anchor movement values for the same phase group. It is used to define various restraint movement on several floors of the same building
- Added new functions to Operation Mode Editor: Disable overload factors, add a factor to weight loads

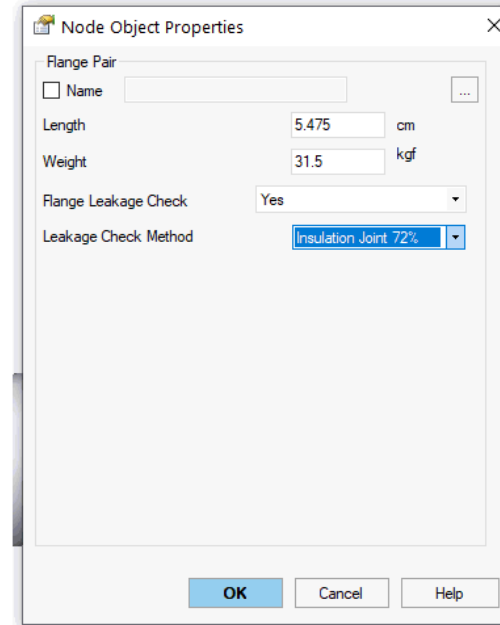
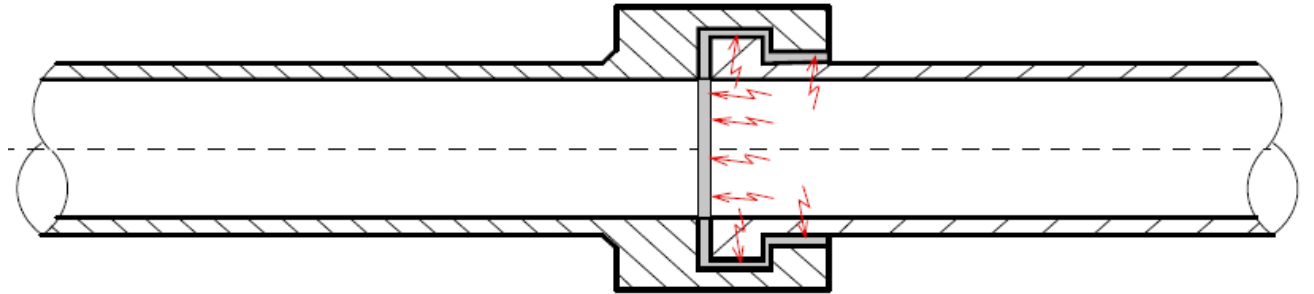


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# PASS/Start-Prof | New Features

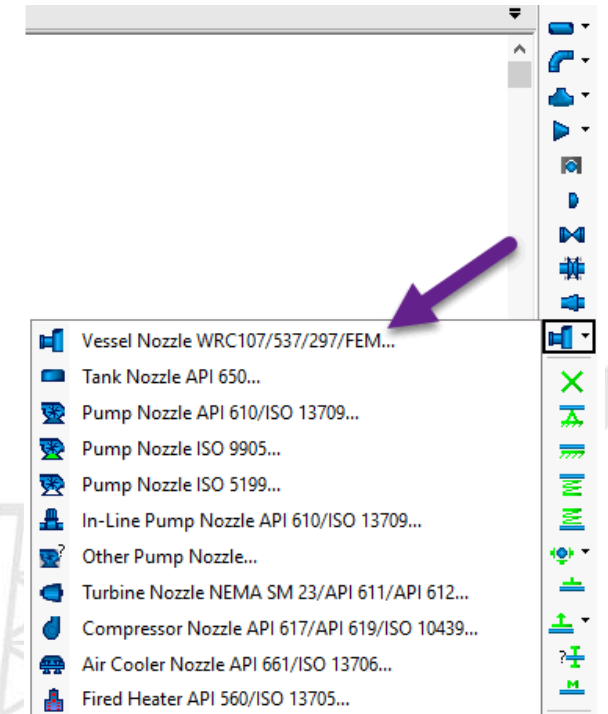
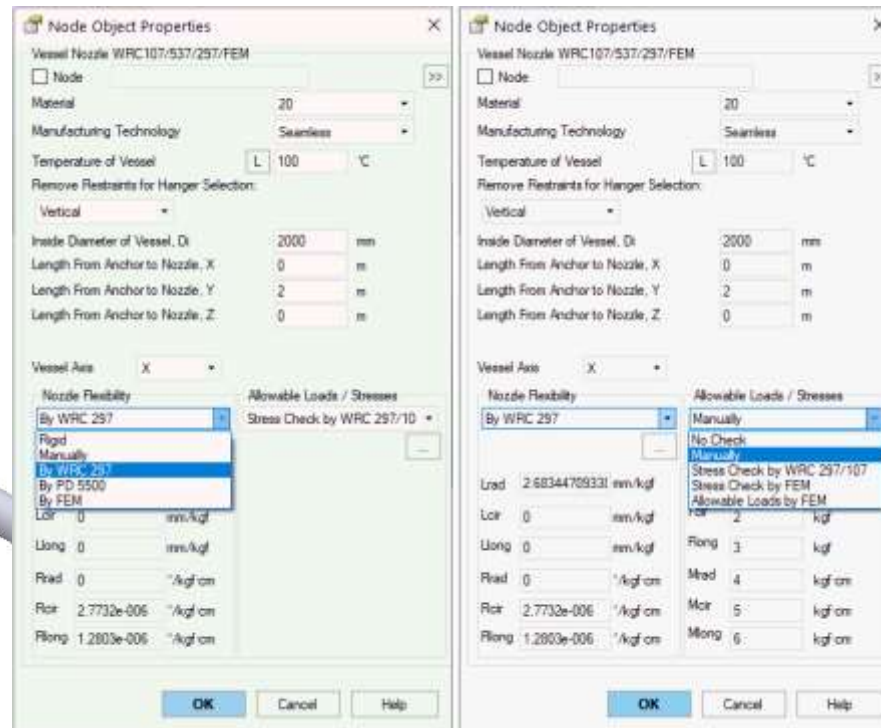
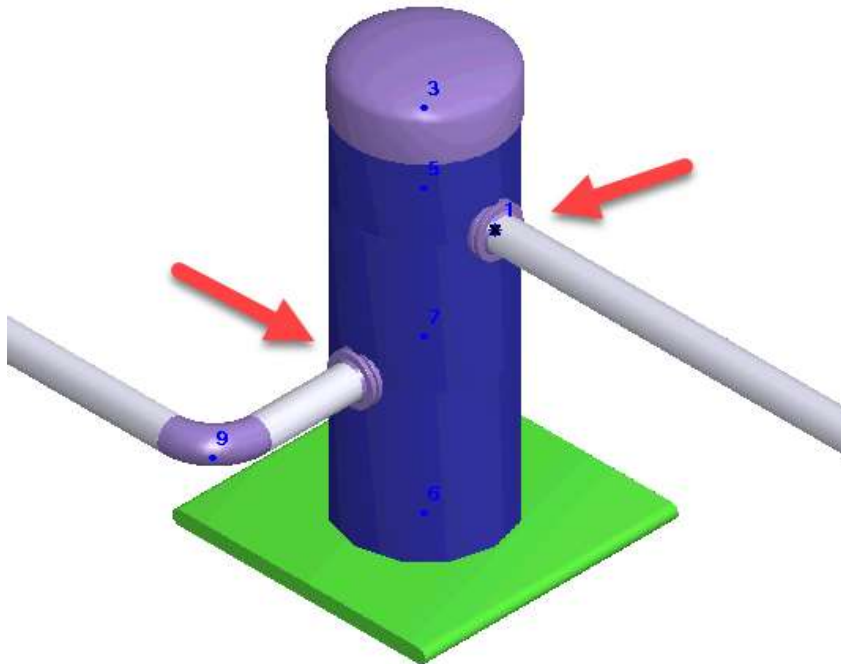
Added Insulation Joint (Insulation Kit) stress analysis. The axial stress and stress from torsion moment is checked automatically



PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE

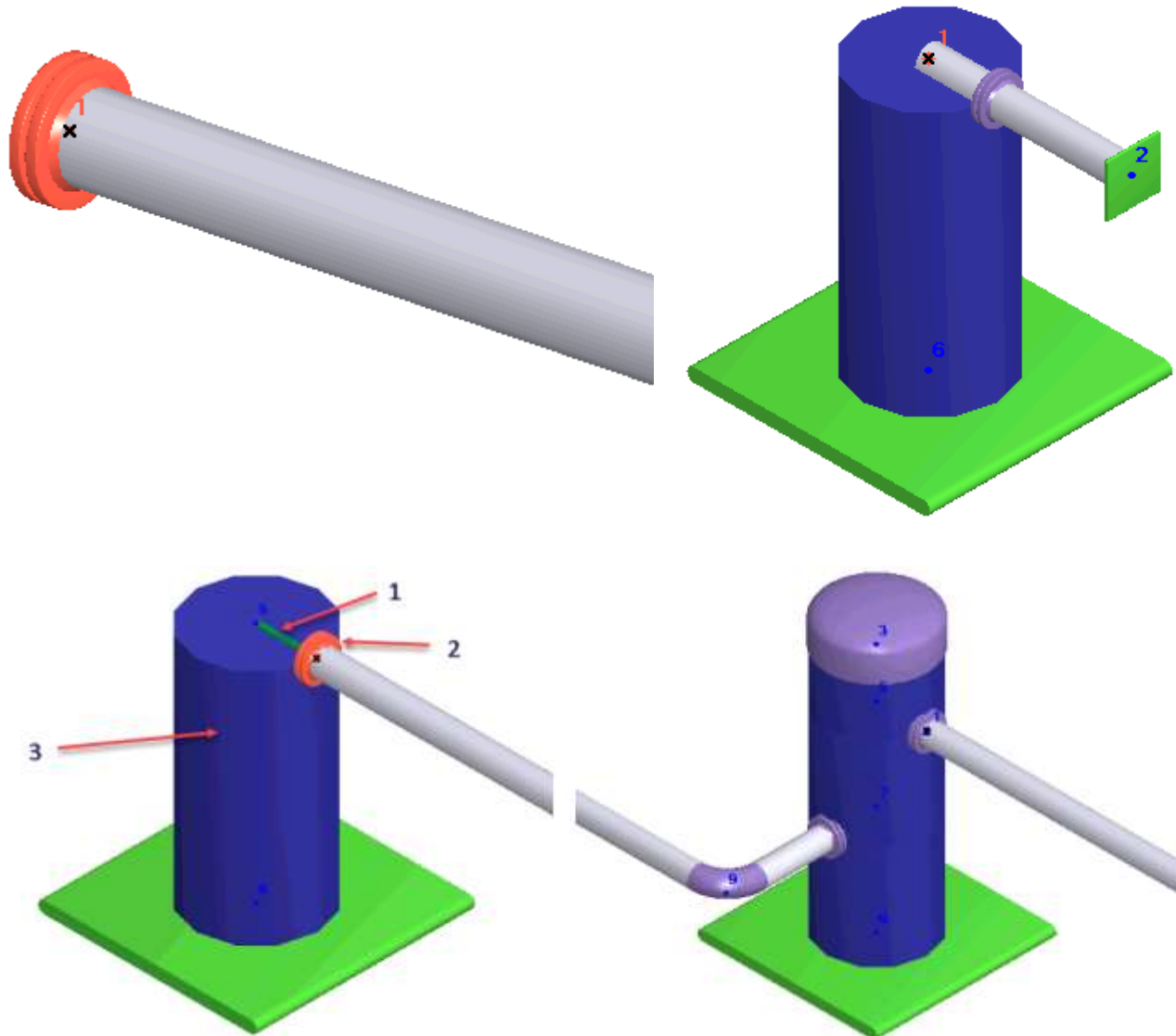
# PASS/Start-Prof | New Features

- Added new object "Cylindrical Shell", that is used for modelling of boilers, pressure vessels, columns, horizontal vessels,
- Added new object "Nozzle", allows to automatically model nozzles of boiler and pressure vessels, and columns. Automatically model shell flexibilities using WRC 297/PD 5500, custom values or FEM method, movements due to thermal expansion of the vessel, checks allowable loads, automatically checks stresses using WRC 107/537/297





# PASS/Start-Prof | New Features



Equipment | Show Equations

Operating Mode: 1 | Load Case: Operating W+P+T

Object	Start-End node	Type	DN, mm	Prod, kgf	Fci, kgf	Flong, kgf	FR, kgf	Mrad, kgf-cm	Mci, kgf-cm	Mlong, kgf-cm	MRL, kgf-cm	Sum
Vessel Nozzle WRC 107/537/297/FEM	Node (1)	calculated	219	-196.33								0.00
		allowable		58.50								

Stress Analysis Results:

STRESS ON CYLINDRICAL SHELL AS PER WRC 337(107)  
(In the zone at the nozzle):

Location	AU	AL	BU	BL	CU	CL	DU	DL
Circ. PI-Pb	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Circ. PI-Pb-Q	2.9	-1.3	3.1	-1.4	3.0	-2.5	3.8	-2.5
Long. PI-Pb	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Long. PI-Pb-Q	3.9	-2.5	4.0	-2.0	3.0	-1.3	3.0	-1.3
Shear PI-Pb	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shear PI-Pb-Q	-0.0	-0.0	0.0	0.0	0.0	0.0	0.0	0.0
PI-Pb (TOTAL)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PI-Pb-Q (TOTAL)	3.9	2.5	4.0	2.8	3.9	2.5	3.8	2.5

CONCLUSION:

Stress Int.	Max S.L.	Allowable	Result
MPa	MPa		
PI-Pb (TOTAL)	0.0	165.5	Passed
PI-Pb-Q (TOTAL)	4.0	330.9	Passed

STRESS ON NOZZLE JUNCTION ZONE AS PER WRC 397

Location	AU	AL	BU	BL	CU	CL	DU	DL
Circ. PI-Pb	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Circ. PI-Pb-Q	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Long. PI-Pb	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Long. PI-Pb-Q	18.5	-17.6	19.2	-18.2	18.8	-17.9	18.8	-17.9
Shear PI-Pb	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shear PI-Pb-Q	-0.1	-0.1	0.1	0.1	0.0	0.0	0.0	0.0
PI-Pb (TOTAL)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PI-Pb-Q (TOTAL)	18.5	18.7	19.2	19.4	18.8	19.0	18.8	19.0

CONCLUSION:

Stress Int.	Max S.L.	Allowable	Result
MPa	MPa		
PI-Pb (TOTAL)	0.0	165.5	Passed
PI-Pb-Q (TOTAL)	19.4	330.9	Passed

RESUME

Maximum utilization factor (per): 5.9%

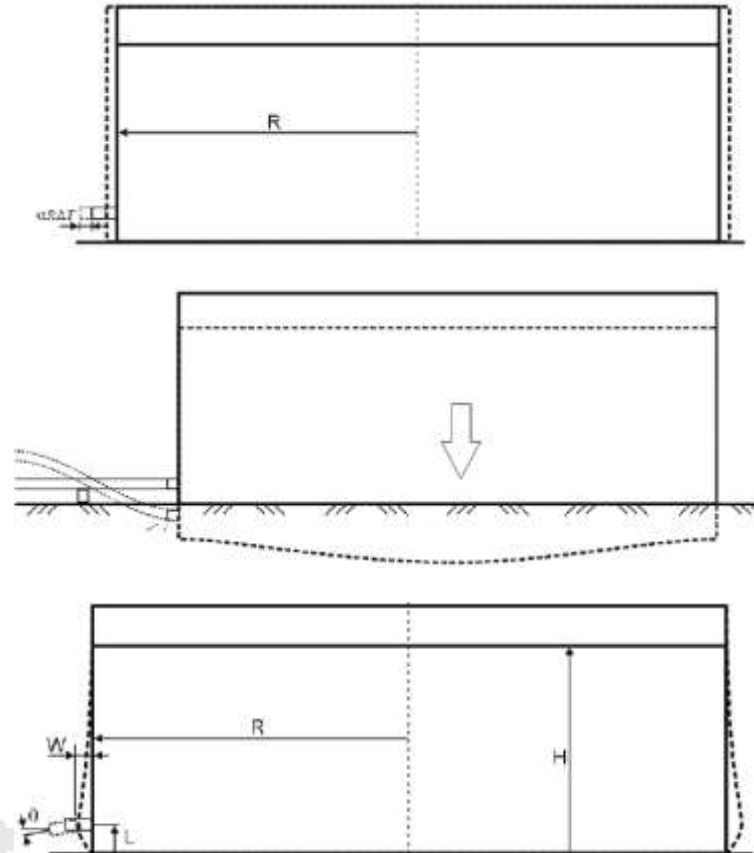
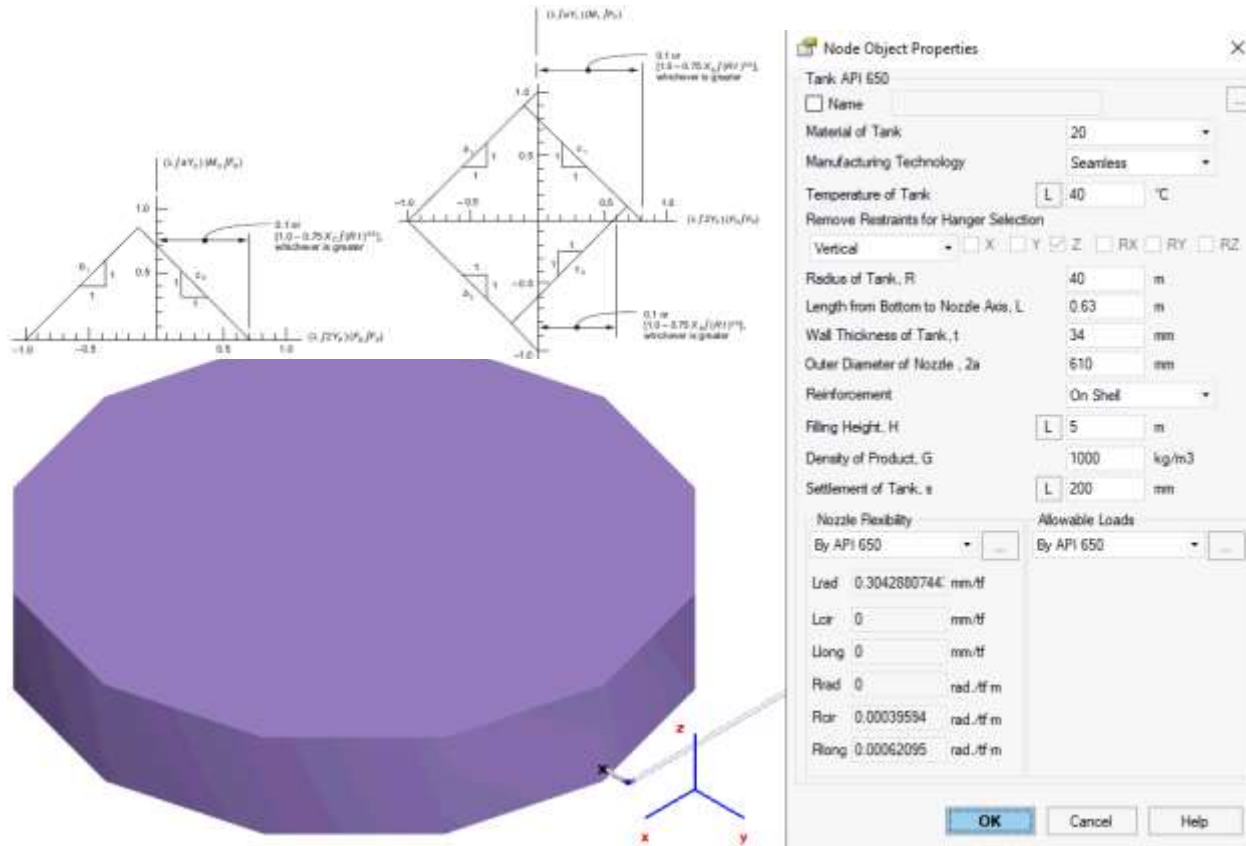
Strength conditions are satisfied

Number of degrees of freedom: 7

Help

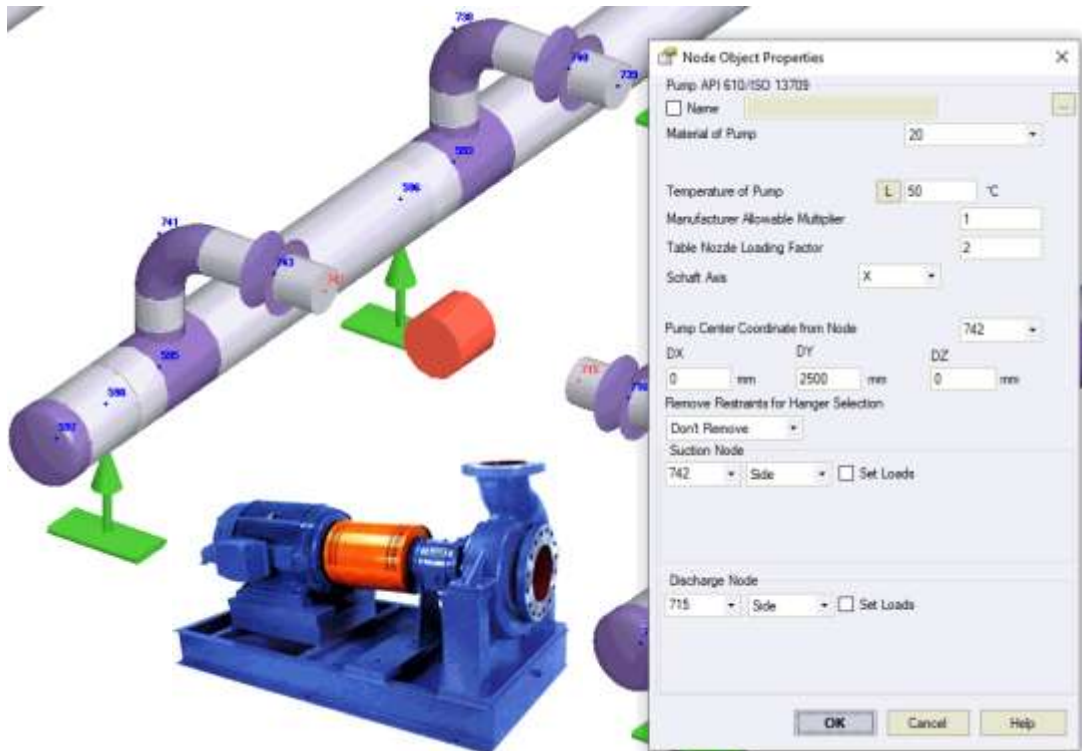
# PASS/Start-Prof | New Features

Added new 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 | New Features

- Added new 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
- Added new object "Pump ISO 9905"
- Added new 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

$$M_{XCA} = M_{XSA} + M_{XDA} - [(F_{YSA} \chi_{zS}) + (F_{YDA} \chi_{zD}) - (F_{ZSA} \psi_S) - (F_{ZDA} \psi_D)] / 1000$$

$$M_{YCA} = M_{YSA} + M_{YDA} + [(F_{XSA} \chi_{zS}) + (F_{XDA} \chi_{zD}) - (F_{ZSA} \chi_{xS}) - (F_{ZDA} \chi_{xD})] / 1000$$

$$M_{ZCA} = M_{ZSA} + M_{ZDA} - [(F_{XSA} \psi_S) + (F_{XDA} \psi_D) - (F_{YSA} \chi_{xS}) - (F_{YDA} \chi_{xD})] / 1000$$

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 | New Features

Added new 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

**Node Object Properties**

In-Line Pump API 610/ISO 13709

Code: API 610

Length: 400 m    Weight: 50 N

Material of Pump: 20

Manufacturing Technology: Seamless

Temperature of Pump: L 100 °C

Factor for Temperature: 1

Nozzle Loading Factor: 2

Pump Center of Gravity Coordinate from Node: 3

DX: 0 mm    DY: 500 mm    DZ: 0 mm

Suction Node: 1

Discharge Node: 2

OK    Cancel    Help



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

$$\sigma_p = (\alpha/2) + (\sigma^2/4 + \tau^2)^{0.5} < 41 \quad (F.6)$$

$$\alpha = [1,27F_y/(D_o^2 - D_i^2)] + [10\ 200D_o(M_x^2 + M_z^2)^{0.5}]/(D_o^4 - D_i^4) \quad (F.7)$$

$$\tau = [1,27(F_x^2 + F_z^2)^{0.5}]/(D_o^2 - D_i^2) + [5\ 100D_o(M_y)]/(D_o^4 - D_i^4) \quad (F.8)$$

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

$$\sigma_p = (\alpha/2) + (\sigma^2/4 + \tau^2)^{0.5} < 5\ 950 \quad (F.9)$$

$$\alpha = [1,27F_y/(D_o^2 - D_i^2)] + [122D_o(M_x^2 + M_z^2)^{0.5}]/(D_o^4 - D_i^4) \quad (F.10)$$

$$\tau = [1,27(F_x^2 + F_z^2)^{0.5}]/(D_o^2 - D_i^2) + [61D_o(M_y)]/(D_o^4 - D_i^4) \quad (F.11)$$

where

- $\sigma_p$  is the principal stress, expressed in megapascals (pounds-force per square inch);
- $\sigma_l$  is the longitudinal stress, expressed in megapascals (pounds-force per square inch);
- $\tau$  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;

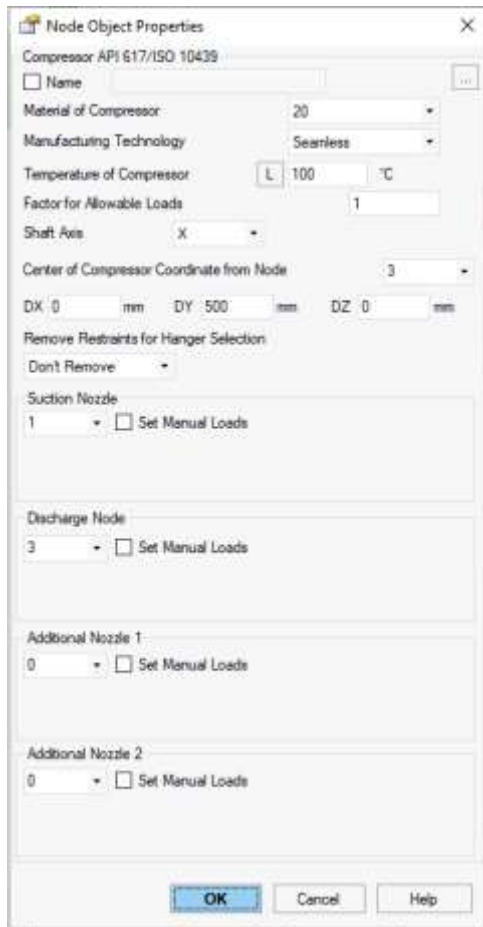
Input    Equipment

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
	Node (2)	Discharge, Side	219	-1200421	9780	6220		7060	3520	5160		0.00	1
				7560	9780	6220		7060	3520	5160			

# PASS/Start-Prof | New Features

Added new 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:  
 $F_r = 1.09 M_c \leq 54.1 D_o$  (F.1a)

In U.S. customary (USC) units:  
 $3 F_r + M_c \leq 927 D_o$  (F.1b)

$F_r$  is the resultant force, Newtons (N) (see Figure F.1);  
 $M_c$  resultant moment, in Newton-meters (N-m) from Figure F.1;

$$F_r = \sqrt{F_{rx}^2 + F_{ry}^2 + F_{rz}^2}$$
 (F.2)
$$M_c = \sqrt{M_{cx}^2 + M_{cy}^2 + M_{cz}^2}$$
 (F.3)

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

In SI units:  
 $D_o = \frac{(400 + D_{nom})}{3}$  (mm) (F.4a)

In USC units:  
 $D_o = \frac{(16 + D_{nom})}{3}$  (in.) (F.4b)

In SI units:  
 $F_r + 1.64 M_c \leq 40.4 D_o$  (F.5a)

In USC units:  
 $2 F_r + M_c \leq 462 D_o$  (F.5b)



In SI units:  
 $F_r + 1.64 M_c \leq 40.4 D_o$  (F.5a)

In USC units:  
 $2 F_r + M_c \leq 462 D_o$  (F.5b)

where

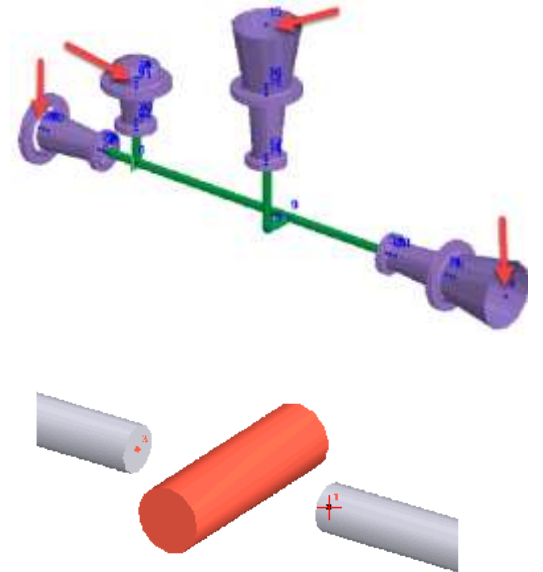
$F_r$  is the combined resultant of inlet, sidestream, and discharge forces, Newtons (N);  
 $M_c$  is the combined resultant of inlet, sidestream, and discharge moments, and moments resulting from forces, Newton-meters (N-m);  
 $D_o$  is the diameter [mm (in.)] of one circular opening equal to the total areas of the inlet, sidestream, and discharge openings. If the equivalent nozzle diameter is greater than 200 mm (8 in.), use a value of  $D_o$  equal to the following:

In SI units:  
 $D_o = \frac{(460 + \text{Equivalent Diameter})}{3}$  (mm) (F.6a)

In USC units:  
 $D_o = \frac{(18 + \text{Equivalent Diameter})}{3}$  (in.) (F.6b)

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

In SI units:  
 $F_{rx} = 16.1 D_o$      $M_{cx} = 34.6 D_o$   
 $F_{ry} = 40.5 D_o$      $M_{cy} = 12.3 D_o$   
 $F_{rz} = 31.4 D_o$      $M_{cz} = 12.3 D_o$



Input Equipment

Operating Mode: 1 'Pafloasi peximi' (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	193.14	1	1
		ext1											
		ext2											
		Summary Loads	250.91	1424587	12734	-23209	1424833	-2577.83	22615.01	15246.81	27396.16	144.99	
				8130					86.24	6172.49			

$D_o = 250.9141$  mm  
 $[F_{cir}] = k1 * 40.5 D_o = 1.00 * 10162.02 = 10162.02$  N

# PASS/Start-Prof | New Features

Added new 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

Node Object Properties

Turbine NEMA SM 23

Name

Material of Compressor: 20

Manufacturing Technology: Seamless

Temperature of Compressor: L 100 °C

Factor for Allowable Loads: 1

Shaft Axis: X

Center of Compressor Coordinate from Node: 3

DX: 0 mm DY: 500 mm DZ: 0 mm

Remove Restraints for Hanger Selection: Don't Remove

Suction Nozzle: 1  Set Manual Loads

Discharge Node: 3  Set Manual Loads

Additional Nozzle 1: 0  Set Manual Loads

Additional Nozzle 2: 0  Set Manual Loads

OK Cancel Help



PIPING AND EQUIPMENT  
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# PASS/Start-Prof | New Features

Added new object "Other Pump", allows to automatically model the pumps, consider thermal movements of the nozzles, checks allowable loads

**Node Object Properties**

Other Pump

Name

Material of Pump: 20

Manufacturing Technology: Seamless

Temperature of Pump: L 100 °C

Shaft Axis: X X: 0 ° Y: 90 °

Pump Center Coordinates from Node: 3

DX: 0 mm DY: 500 mm DZ: 0 mm

Remove Restraints for Hanger Selection: Vertical  X  Y  Z  RX  RY  RZ

Suction Node: 3

FR	MR				
N	N-m				
1	1				
FX	FY	FZ	MX	MY	MZ
N	N	N	N-m	N-m	N-m
1	1	1	1	1	1

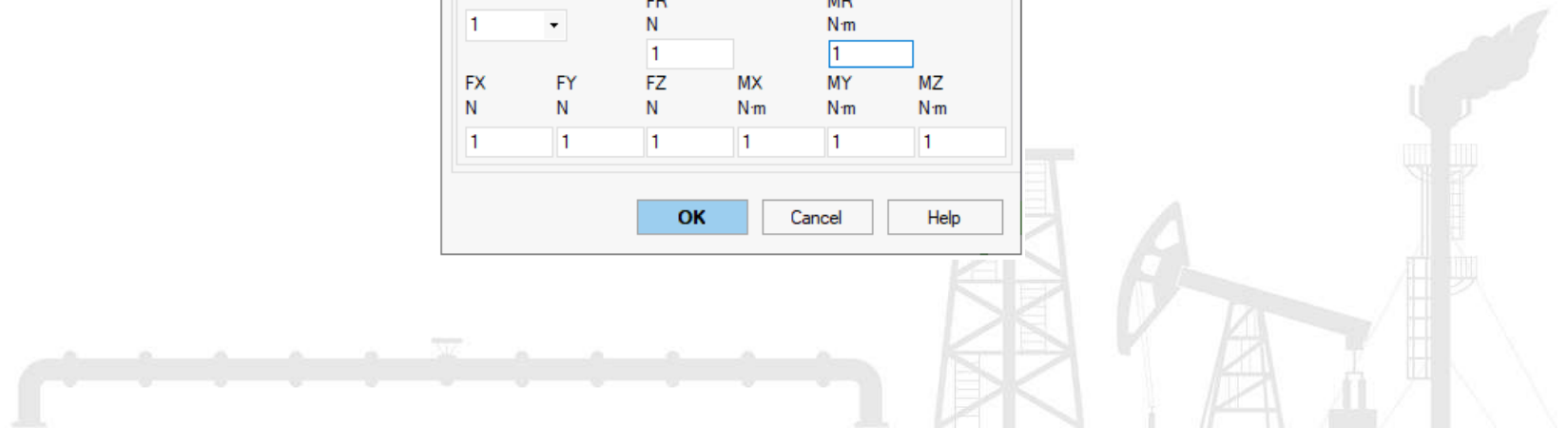
Discharge Node: 1

FR	MR				
N	N-m				
1	1				
FX	FY	FZ	MX	MY	MZ
N	N	N	N-m	N-m	N-m
1	1	1	1	1	1

OK Cancel Help

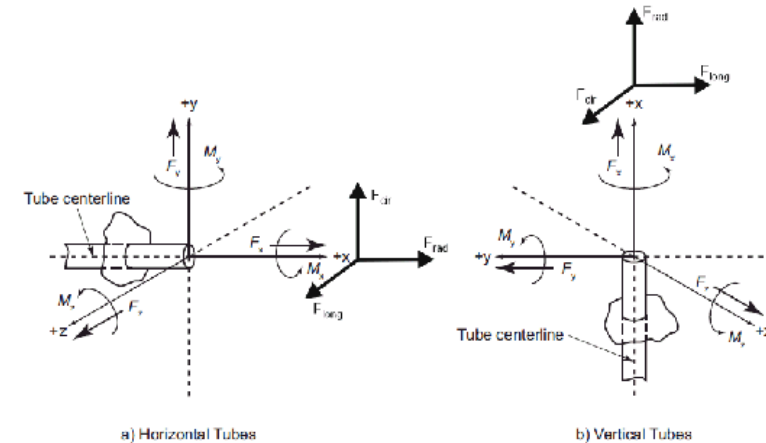
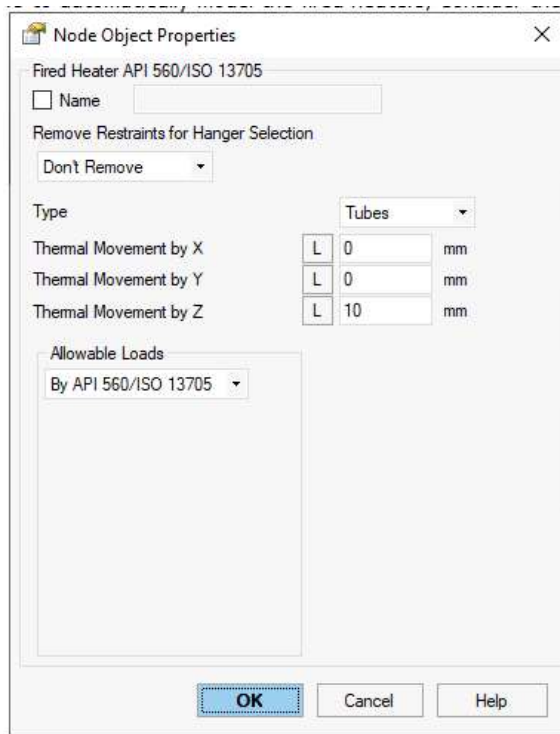


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# PASS/Start-Prof | New Features

Added new 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



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

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			



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# PASS/Start-Prof | New Features

Added new 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

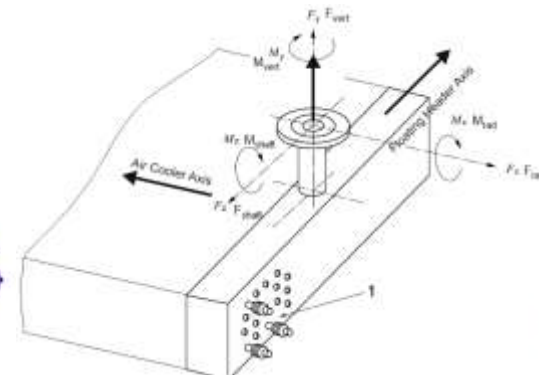
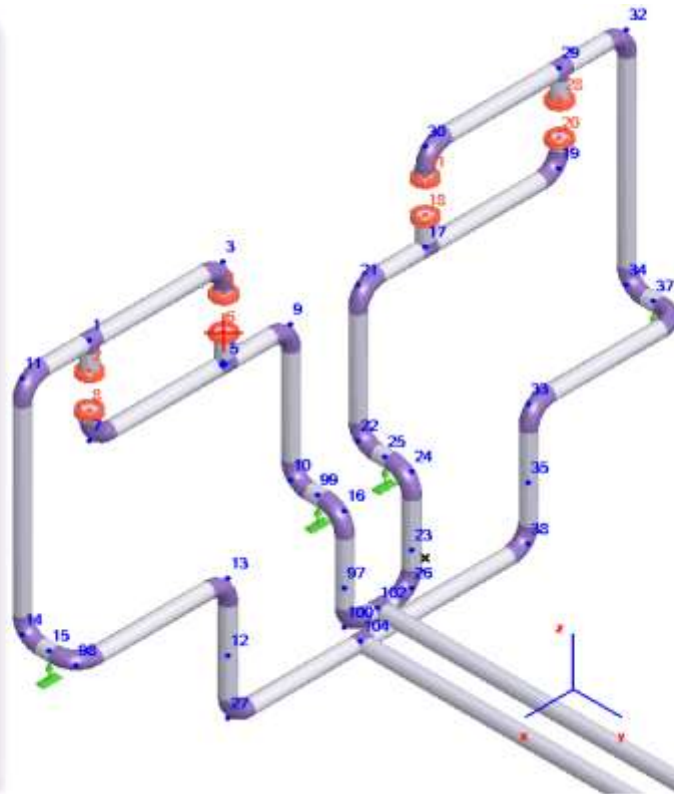
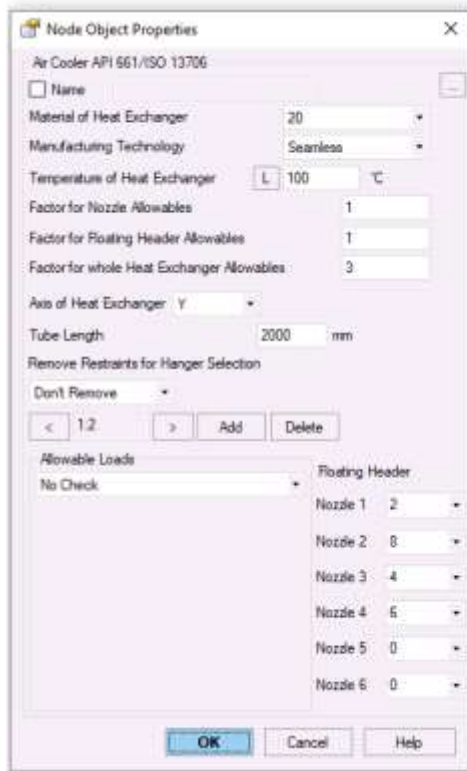


Table 4 — Maximum Allowable Nozzle Loads

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 (1 1/2)	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)
60 (3)	410 (300)	610 (450)	410 (300)	2000 (450)	2680 (600)	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)	5890 (1320)	13,340 (3000)	8010 (1800)
250 (10)	4070 (3000)	6100 (4500)	2550 (1880)	6670 (1500)	13,340 (3000)	10,010 (2250)
300 (12)	5060 (3750)	6100 (4500)	3050 (2250)	6360 (1430)	13,340 (3000)	13,340 (3000)
350 (14)	6100 (4500)	7120 (5250)	3570 (2630)	10,010 (2250)	16,680 (3750)	16,680 (3750)

Notes 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:

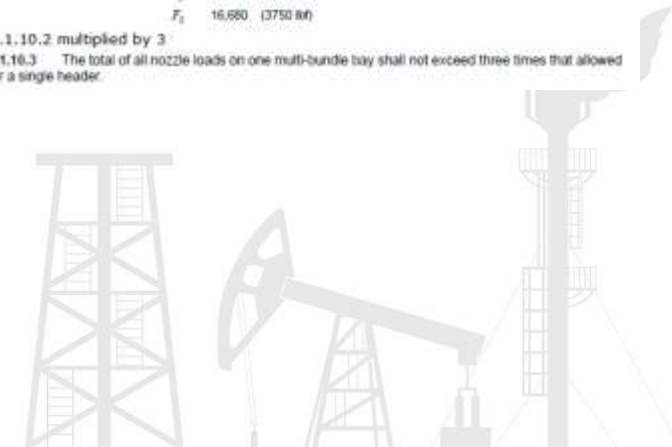
- $M_x$  6100 N m (4500 ft lbf)
- $M_y$  8130 N m (6000 ft lbf)
- $M_z$  4070 N m (3000 ft lbf)
- $F_x$  10,010 N (2250 lbf)
- $F_y$  20,020 (4500 lbf)
- $F_z$  16,680 (3750 lbf)

From 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.



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# PASS/Start-Prof | New Features

Added new 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

no need to manually model it using nonstandard expansion joint any more



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

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	



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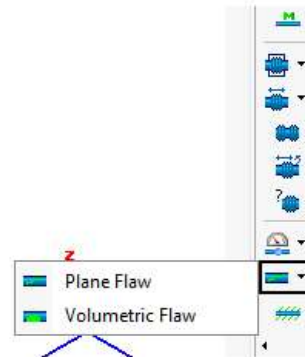
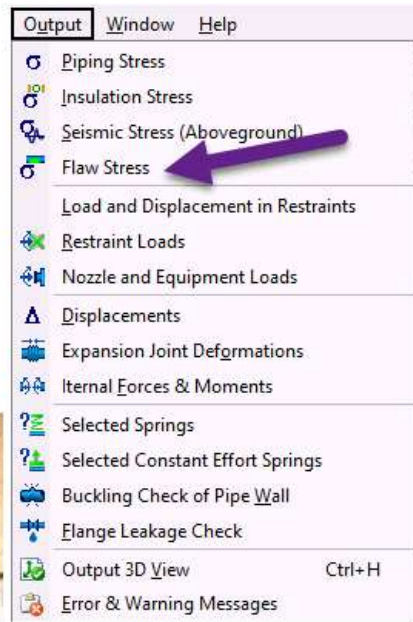
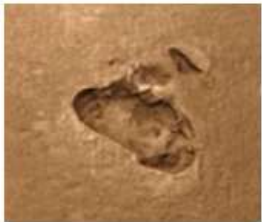
# PASS/Start-Prof | New Features

Added new object Torsion Expansion Joint and database of torsion expansion joints, automatically model torsion friction (friction moment) and checks allowable rotation angle

The image displays a software interface for defining joint properties. On the left, a photograph shows a large, curved pipe with a torsion expansion joint. In the center, a toolbar contains icons for 'Angular Gimbal...' and 'Angular Torsion...', with a purple arrow pointing to the latter. To the right, a 3D model of a blue slip joint is shown next to a cross-sectional diagram of a 'SLIP-TYPE EXPANSION JOINT'. The diagram illustrates 'Pipe 1 slides in pipe 2' and includes labels for 'Flange bolts', 'Packing', and the force equation  $F = \mu A + mV$ . Below the diagram, a 'Node Object Properties' dialog box is open for a 'Slip Joint'. The 'Friction Force' field is highlighted with a red box and set to 0 kgf. Other fields include 'Allowable Axial Expansion' (0 mm) and 'Pressure Balanced' (unchecked). The 'Node Object Properties' dialog for the 'Torsion Expansion Joint' is also visible on the left, with its 'Friction Moment' field highlighted in red and set to 0 kgf cm.

# PASS/Start-Prof | New Features

Added new fitness-for-service abilities: “Plane Flaw” object and “Volumetric Flaw” object, allows to model the plain flaw on the pipe, bend, tee and check the stresses in the flaws



Operating Mode		1 'Main mode' (0)						<input checked="" type="checkbox"/> Show Equations
Node	Object	Flaw Type	Defect Stress, (MPa)		%	Result	Notes	
			calculated	allowable				
3	Above ground pipe	Plane Flaw	32.55	7.19	452.78	FAILED	1	
4	Above ground pipe	Volumetric Flaw	0.030	0.44	6.85	PASS		
5	Forged Elbow	Volumetric Flaw	0.046	0.44	10.40	PASS		
6	Welding Tee	Volumetric Flaw	0.051	0.44	11.51	PASS		
8	Above ground pipe	Volumetric Flaw	pr=2 MPa Ri=103.5 mm Ro=109.5 mm T=6 mm F=6730.7029 kgf M=387.37067 kgf-cm a=1.170411 c=0.333333 b=0.061509 σs=221 MPa σb=200 MPa σ'=(σs+σb)/2=210.5 MPa P10=2/(3)^0.5*σ'*log(Ro/Ri)=1369.739628 M10=4σ'*(Ro^3-Ri^3)/3=5.731620 Ac=c*(min(3,a)*b*c)^1/3=0.096146 pls=0.95-(0.85+0.013a/b)*Ac=0.844493 Pls=pls*P10=1156.734923 mls=cos(π/2 *cb)-c/2*sin(πb)=0.967475 Mls=mls*M10=5.545201 pr^2/pls^2+M^2/Mls^2=0.029895					



PIPING AND EQUIPMENT  
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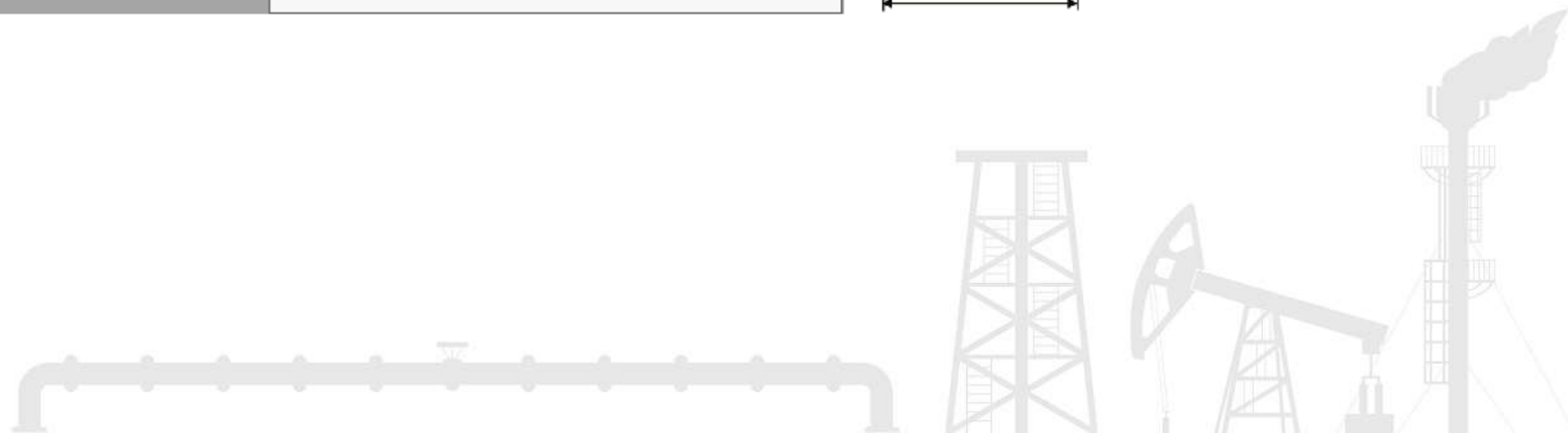
# PASS/Start-Prof | New Features

Added ability to specify insulation, cladding, and liner layers density and thickness in pipe properties. The ability to choose an insulation weight from the database still exist

The screenshot displays the software's pipe properties dialog box. On the left, a 'Uniform Weight' section includes a checked box for 'Calculate Pipe Weight Automatically' and input fields for Pipe (179.98 kgf/m), Insulation (49.31 kgf/m), Fluid (14.74 kgf/m), and Fluid Density (1000 kg/m<sup>3</sup>). On the right, a detailed section allows for specifying layer properties: Insulation Thickness (50 mm), Insulation Density (800 kg/m<sup>3</sup>), Cladding Thickness (10 mm), Cladding Density (1500 kg/m<sup>3</sup>), Lining Thickness (0 mm), and Lining Density (0 kg/m<sup>3</sup>). To the right of these settings is a cross-sectional diagram of a pipe with an outer diameter 'D'. It shows four distinct layers: 1 (insulation), 2 (cladding), 3 (liner), and 4 (pipe wall). Labels indicate thicknesses:  $t_i$  for insulation,  $t_c$  for cladding,  $t$  for the pipe wall, and  $t_l$  for the liner.

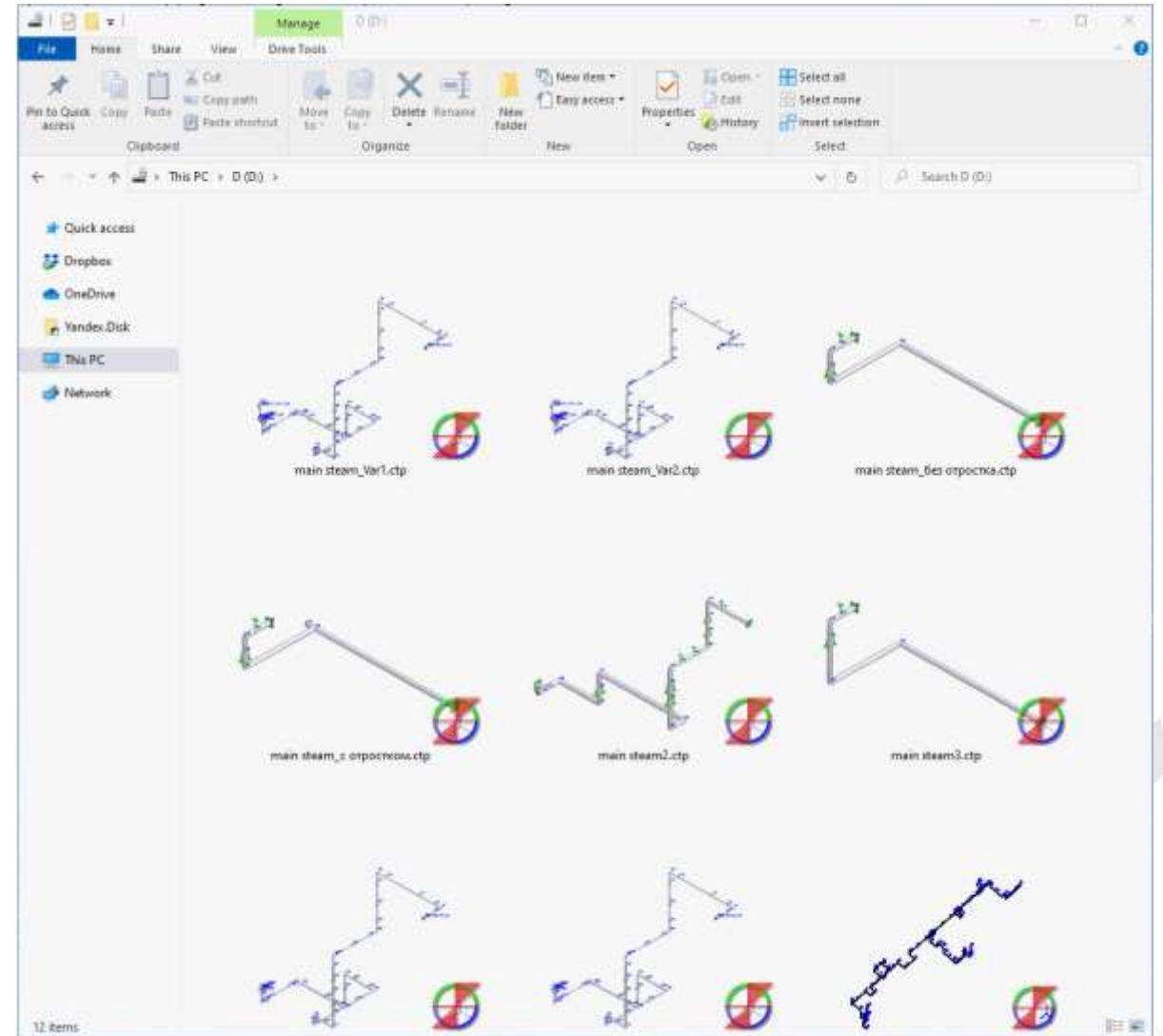


PIPING AND EQUIPMENT  
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# PASS/Start-Prof | New Features

Added thumbnails for windows explorer. Now you can preview all piping models right in the explorer before opening the file

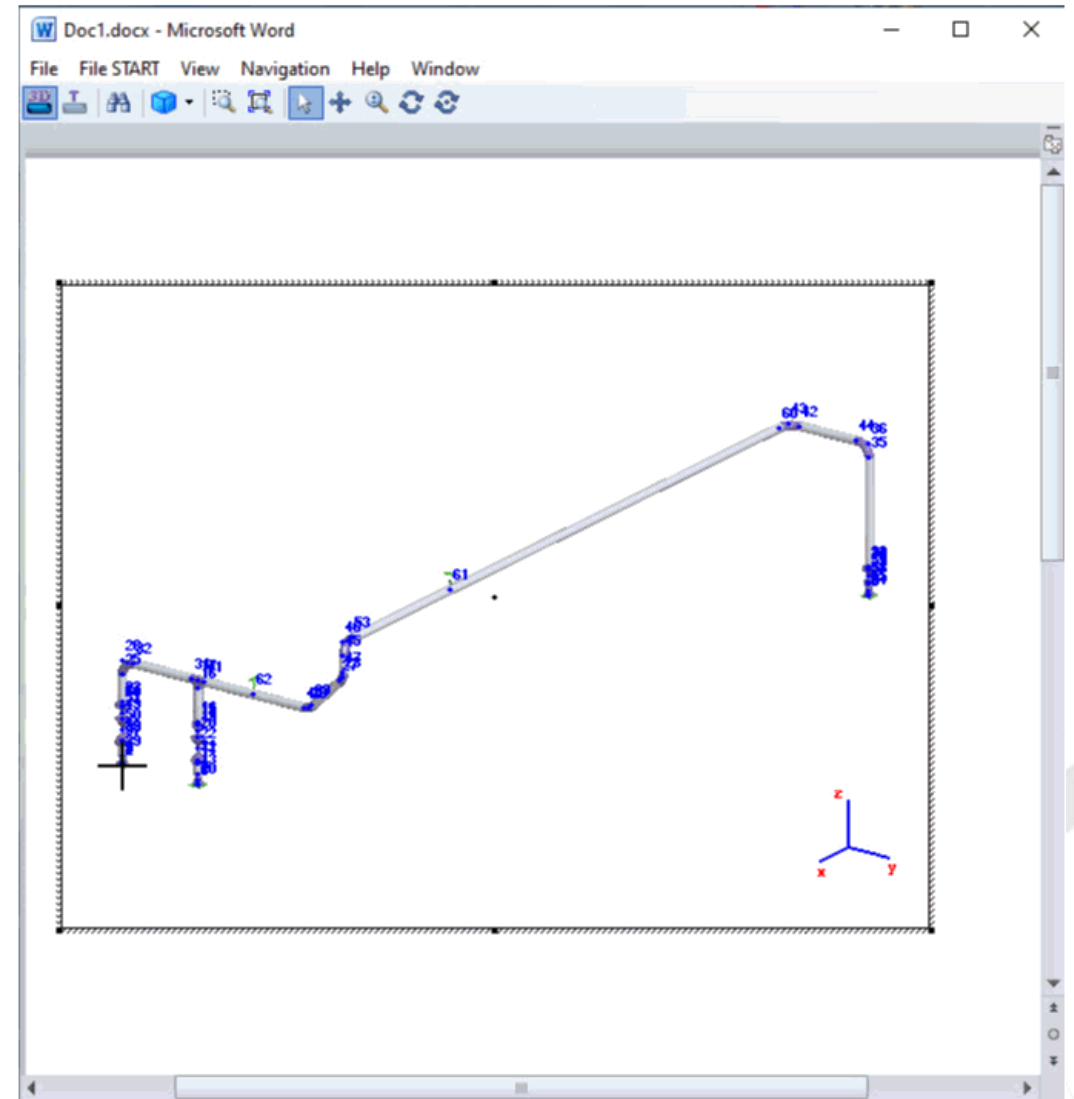


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# PASS/Start-Prof | New Features

Added 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 for your customer for review



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# PASS/Start-Prof | New Features

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- Added export to EHS pipe support sizing software. START-PROF can create cad8.dat file
- Added function that save backup copy of the file before each run with date and time stamp. It is available in general settings
- Added automatic compression of START-PROF piping model files (.ctp). Now files become 10 times smaller
- Significantly increased the speed of opening and saving big piping models into file
- Added new topics into Application Guide



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# PASS/Start-Prof | Reliability

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

The collage features several key elements:

- 3D Pipe Models:** Multiple 3D renderings of pipe systems. On the left, two models are labeled 'START-PROF model TB48' and 'CAESAR II model TB48'. In the center, two models are labeled 'START-PROF model - 320571' and 'CAESAR II model - 320571'. On the right, two models are labeled 'START-PROF model NRG1' and 'START-PROF model NRG4-1'. A 'START-PROF model' is also shown in a 2D perspective view.
- Technical Drawing:** A detailed 2D drawing titled '1.6 ASME B31.3 Appendix S (S302) ASME B31.3-2018 Appendix S [S302] Model Figure S302.1 Liftoff Model'. It shows a pipe with a lift-off section, with dimensions in meters and feet: 12.2 m (40 ft), 3.05 m (10 ft), 9.15 m (30 ft), 9.15 m (30 ft), 3.05 m (10 ft), and 12.2 m (40 ft). A lift-off height of 6.1 m (20 ft) is indicated. Nodes are numbered 10 through 145.
- Book Cover:** The cover of the 'PASS START-PROF Pipe Stress Analysis Software VERIFICATION AND VALIDATION MANUAL Version 4.84 July 2020'. The PASS logo is prominent.
- Support Arm Drawing:** A technical drawing of a support arm, labeled 'FIG. 3-4 A Support Arm (Figure not to scale)'. It shows a curved arm with dimensions and node numbers.



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# PASS/Start-Prof | Reliability

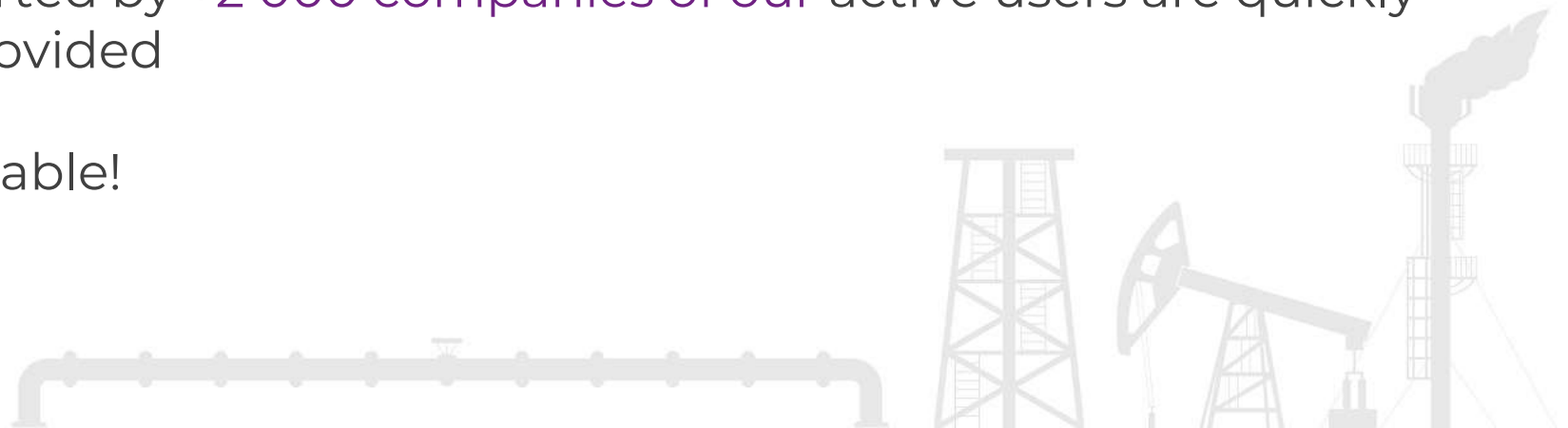
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Each new PASS/START-PROF release is:

- 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 trainings with 10-20 students before official release
- After release, all bugs reported by **+2 000 companies of our** active users are quickly fixed and new release is provided
- Software is trusted and reliable!



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# PASS/Start-Prof | Features

Subscribe our YouTube channel, you will find a lot of PASS/START-PROF training videos

[www.youtube.com/passuite](http://www.youtube.com/passuite)



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A screenshot of the PASS YouTube channel page. The channel name is "PASS" with 716 subscribers. The page shows a grid of 24 video uploads. Each video thumbnail includes a title, a duration, and view/viewer information. The videos cover various topics such as software overviews, import tutorials, stress analysis, and specific case studies like the Beijing Universal Amusement Park. The interface includes navigation tabs for HOME, VIDEOS, PLAYLISTS, CHANNELS, DISCUSSION, and ABOUT, along with a search icon and a "SUBSCRIBED" button.

# PASS/Start-Prof | Licensing

## Configurations/Pricing Options

<p><b>PASS/Start-Prof Complete Advanced</b></p> <p>Simulation and sizing for any piping network considering all applicable national codes.</p> <p><b>PASS/Start-Prof Complete Standard</b></p> <p>configuration includes only worldwide popular standarts.</p>	<p><b>PASS/Start-Prof Process Advanced</b></p> <p>Simulation and sizing for piping networks based on applicable national codes for process plants as well as for gas and oil transportation systems.</p> <p><b>PASS/Start-Prof Process Standard</b></p> <p>configuration includes only worldwide popular standarts.</p>	<p><b>PASS/Start-Prof Power Advanced</b></p> <p>Simulation and sizing for any piping networks based on applicable national codes for power generation piping as well as for central heating networks.</p> <p><b>PASS/Start-Prof Power Standard</b></p> <p>configuration includes only worldwide popular standarts.</p>	<p><b>PASS/START-PROF HDPE+FRP</b></p> <p>Piping stress analysis of high density polyethylene and/or fiberglass reinforced plastic piping systems.</p>
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- Permanent License at Affordable Price (+1 year maintenance for free!)
- Maintenance Renew 1 Year: 25%
- Annual License: 40%
- Semi-Annual License: 25%

## 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	✓	✓					



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# PASS/Start-Prof | Resources

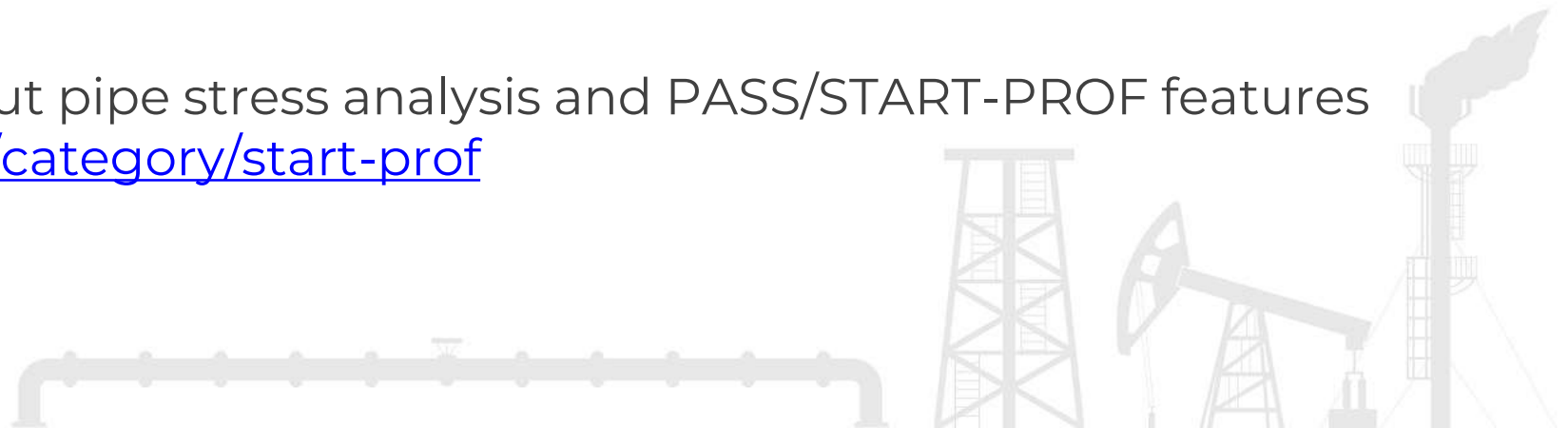
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- LinkedIn: [www.linkedin.com/company/passuite/](http://www.linkedin.com/company/passuite/)
- Facebook: [www.facebook.com/PASSuite](http://www.facebook.com/PASSuite)
- Twitter: [twitter.com/passuitecom](http://twitter.com/passuitecom)
- More than 50 articles about pipe stress analysis and PASS/START-PROF features  
<https://whatispiping.com/category/start-prof>



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Video Title	Views	Upload Date
PASS/EQUIP Overview Webinar: Comprehensive...	124 views	4 days ago
PASS/START-PROF Overview Webinar: Your software for...	334 views	2 months ago
PASS/Equip Nozzle-FEM Overview Webinar: Powerful...	135 views	2 months ago
How to Import piping model from CADWorx to START...	193 views	2 months ago
How to Import piping model from CADWorx to START...	119 views	2 months ago
PASS/HYDROSYSTEM Overview Webinar...	239 views	3 months ago
PASS/START-PROF was used for 2022 Winter Olympic...	162 views	4 months ago
Beijing Universal Amusement Park Buried Hot Water Pipin...	261 views	4 months ago
PASS/START-PROF Overview Webinar: Your software for...	196 views	5 months ago
New START-PROF option: Import from Autodesk Revit	370 views	6 months ago
18 How to calculate the 'slurry' flow in Hydrosystem	111 views	9 months ago
17 How to calculate the gas liquid liquid flow in...	134 views	9 months ago
How to import PCF file to START PROF	365 views	1 year ago
How to run PASS/START PROF Trial	1.3K views	1 year ago
Pipe Stress Analysis From Water Hammer Loads	2.2K views	1 year ago
Creating a Simple Piping Model Tutorial in START...	1K views	1 year ago
CAESAR II Convergence Issue (2019 training) Piping...	5K views	1 year ago
Big Piping Model Analysis Tutorial with PASS/START...	1.4K views	1 year ago
GRP / GRE / FRP Piping Stress Analysis Tutorial usl...		
HDPE Piping Stress Analysis Tutorial With PASS/START...		
HDPE Piping Stress Analysis With PASS/START-PROF...		
Two-way integration between PASS/Start-Prof Pipe Stress...		
16 Interface between Hydrosystem and START...		
Buried Piping/Pipeline Stress Analysis with...		

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# Thank YOU!