What’s new

PASS
START-PROF

Pipe Stress Analysis And Sizing

in 4.84 version

PASS/START-PROF

Quick Pipe Stress Analysis & Optimal Sizing

Presenter:

Dr. Alex Matveev

START-PROF Product Owner

Development, Training, Support of START-PROF Since 2005

matveev@passuite.com

LinkedIn: linkedin.com/in/alex-matveev/

PASS
PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/Start-Prof | Upcoming Version 4.84

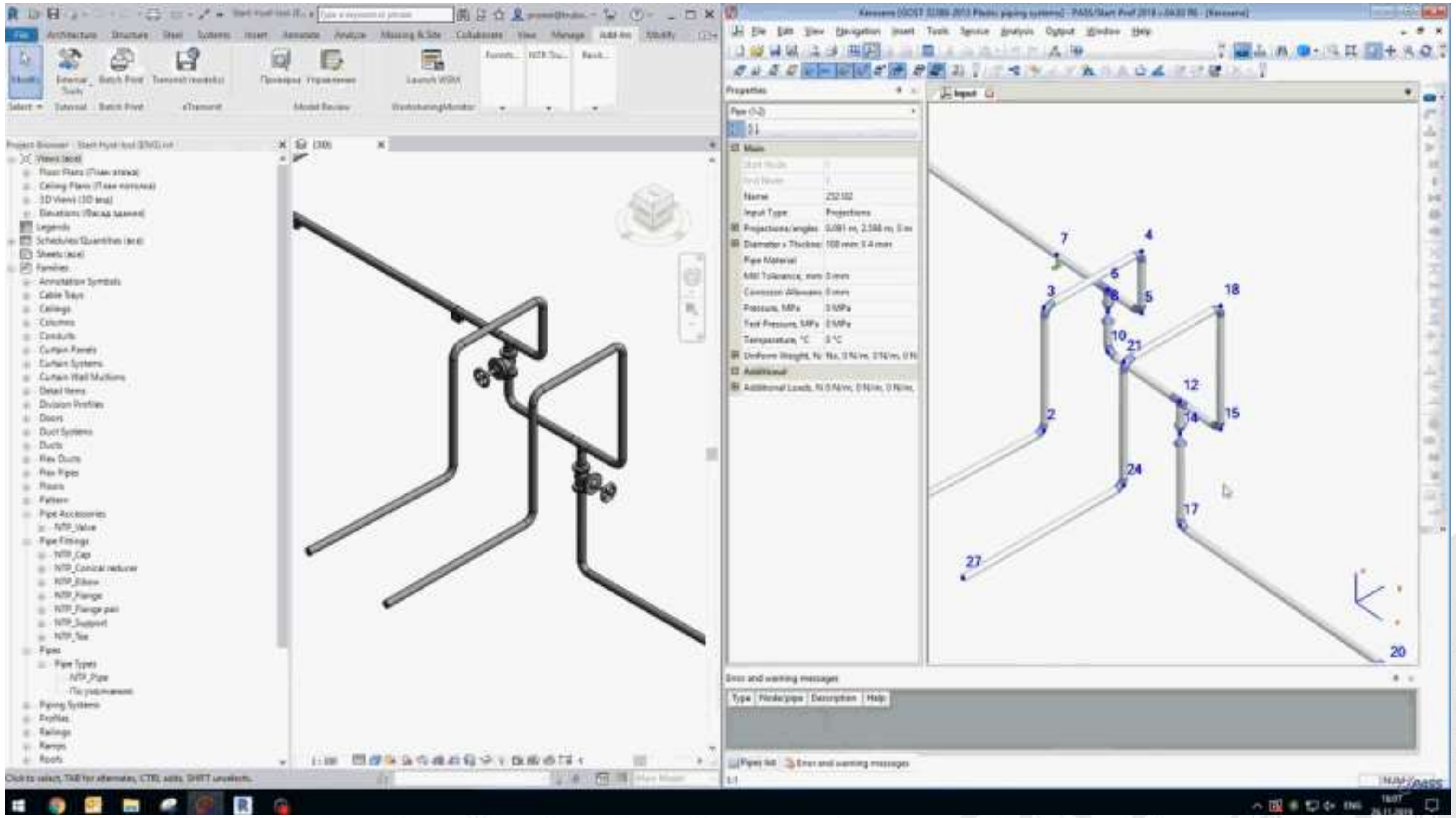
About one year has passed since our last version of PASS/START-PROF Software release.

We worked hard during this time.

Check out that we have prepared for our customers!

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/m3

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

Add | Delete | Print | Export...

6.1.1 Design life

A_0 shall be used to scale the long term envelopes to the design envelopes at design lives other than 20 years. A_0 shall be defined by Formula (1):

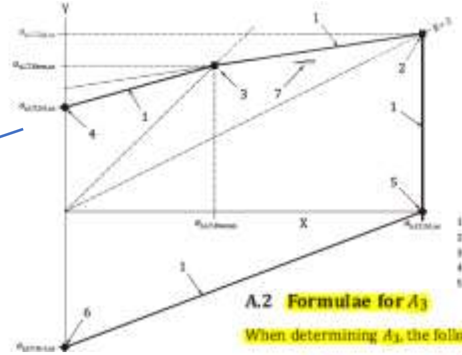
$$A_0 = \frac{1}{10^{(\log(t)-\log(175\,200))\times G_{xx}}} \quad (1)$$

where

t is the time expressed in h;

G_{xx} is the gradient of regression line at xx °C;

A_0 shall not be greater than 1,0.



A.2 Formulae for A_3

When determining A_3, the following formulae may be used in lieu of the graph.

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

The cyclic long term strength factor, f_c, 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, f_c shall be 4,0.

When $R_c > 0{,}4$:

$$A_3 = \left(\frac{1-f_c}{0{,}6f_c}\right)\left(\frac{1-R_c}{\log(150\times10^6)-\log(7\,000)}\right)\log(N) + 1 - TAN\left[\left(\frac{1-f_c}{0{,}6f_c}\right)\left(\frac{1-R_c}{\log(150\times10^6)-\log(7\,000)}\right)\right](\log(7\,000)) \quad (A.2)$$

When $R_c \leq 0{,}4$:

$$A_3 = \left(\frac{1-f_c}{f_c}\right)\left(\frac{1}{\log(150\times10^6)-\log(7\,000)}\right)\log(N) + 1 - \left(\frac{1-f_c}{f_c}\right)\left(\frac{\log(7\,000)}{\log(150\times10^6)-\log(7\,000)}\right) \quad (A.3)$$

A_3 shall be greater than or equal to $1/f_c$. A_3 shall be 1,0 if the calculated value is between 0,9 and 1,0. At 7 000 cycles or less, A_3 shall be 1,0. The minimum value for A_3 shall be 0,25.

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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:

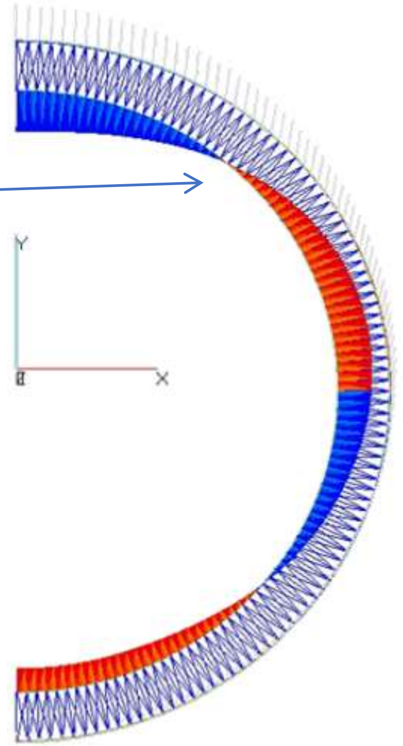
$$\sigma_{h,sum} = \sigma_{hp} + \sigma_{hu} \quad (10)$$

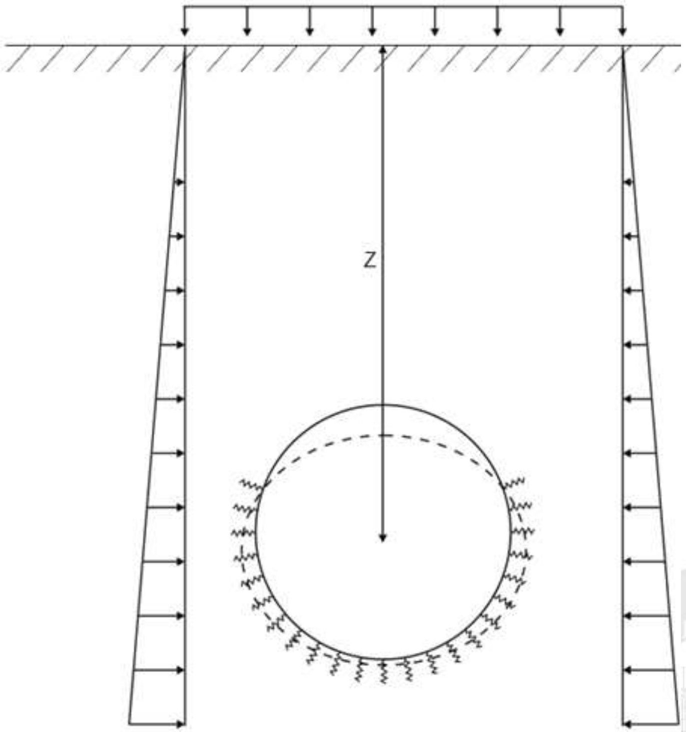
$$\sigma_{hp} = \frac{P \times D_{r,min}}{2 \times t_{r,min}} \quad (11)$$

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

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.





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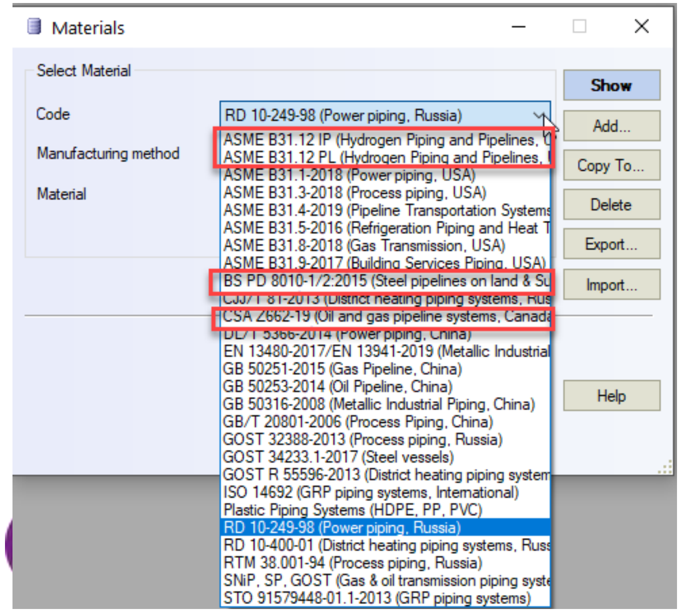
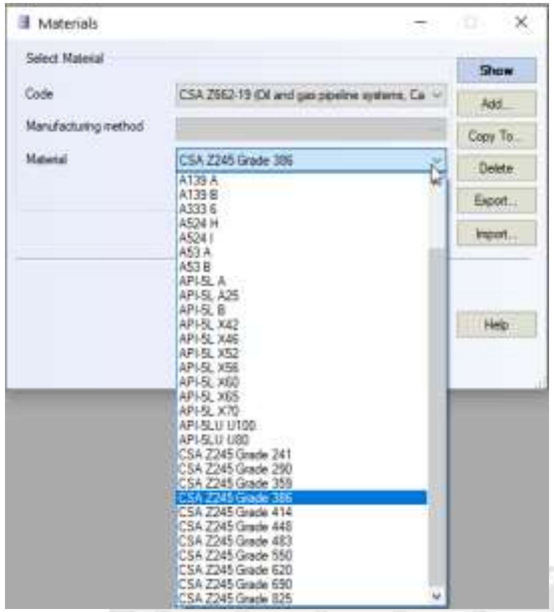
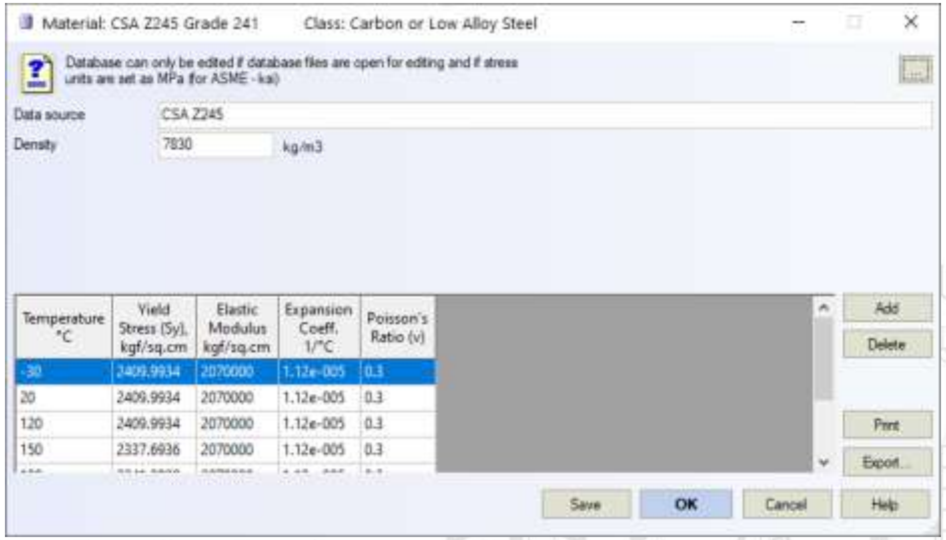
PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

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

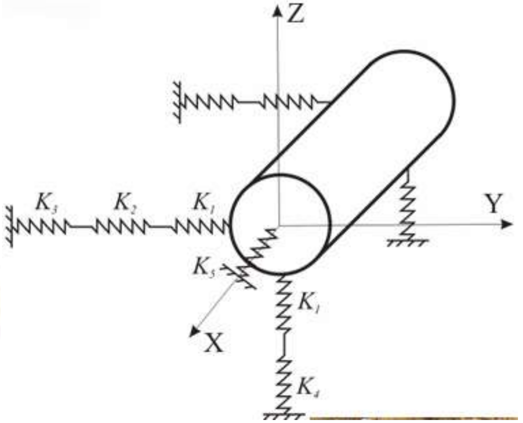






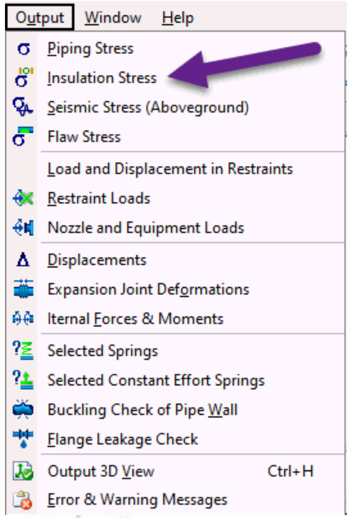
PASS/Start-Prof | New Codes

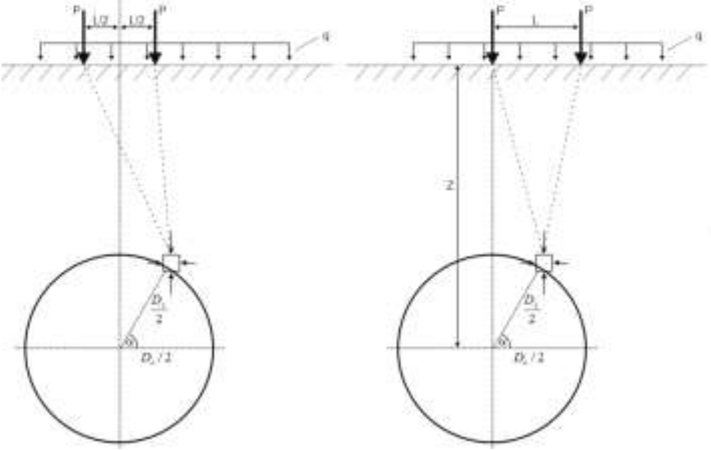
EN 13941-2019 District heating pipes - Design and installation of thermal insulated bonded single and twin pipe systems for directly buried hot water networks

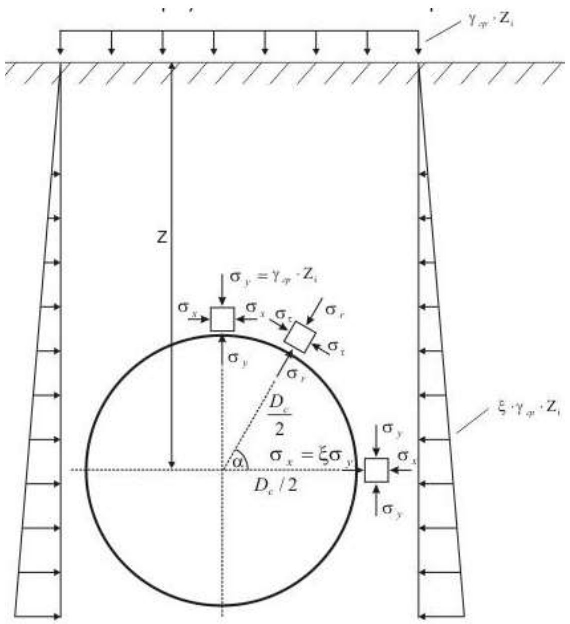


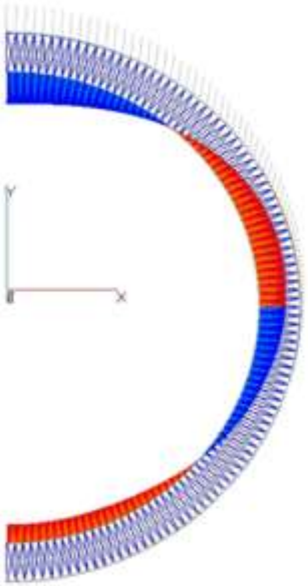
PASS/Start-Prof | New Codes

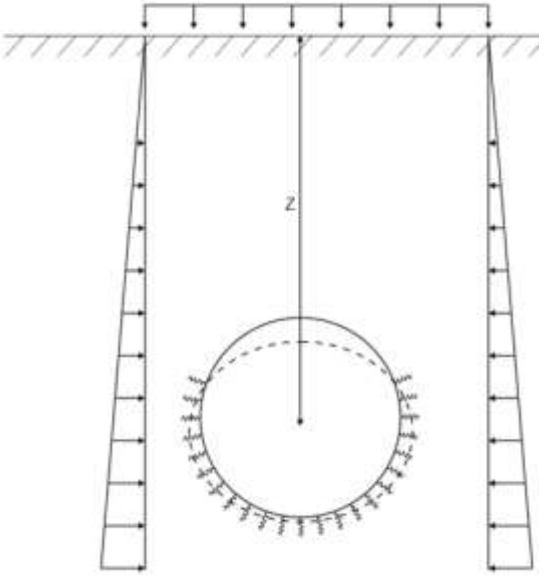
Calculate And Check Stresses In Polyurethane Insulation (EN 13941 7.3.1, 7.3.2, EN 253).
Check Stresses from Surface Vehicle Loads





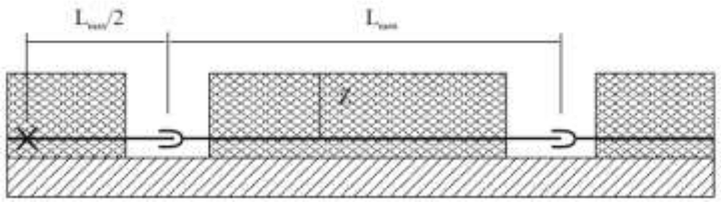


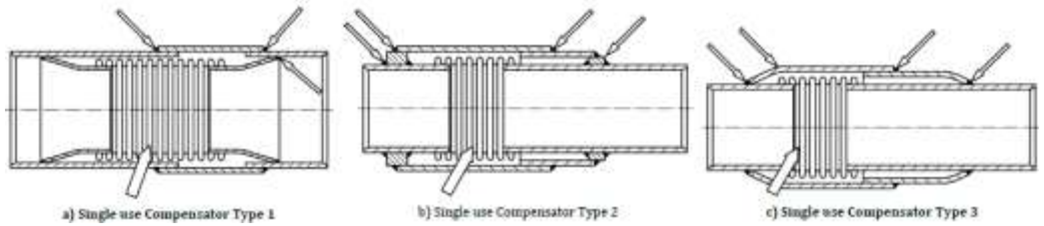


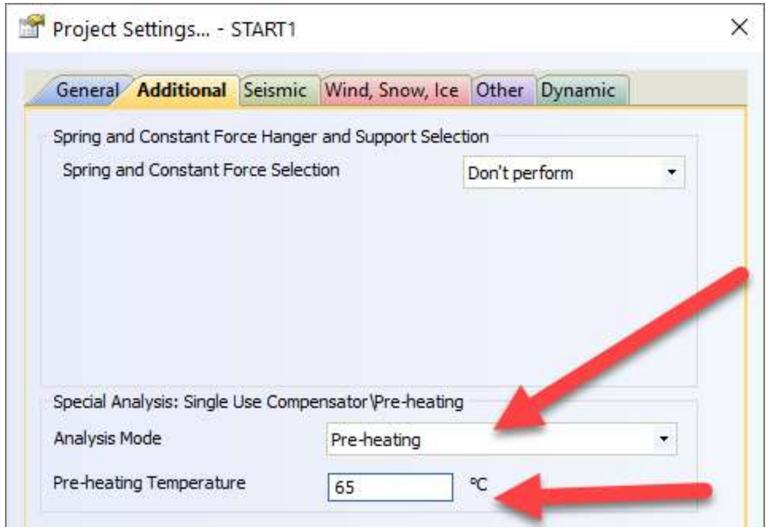


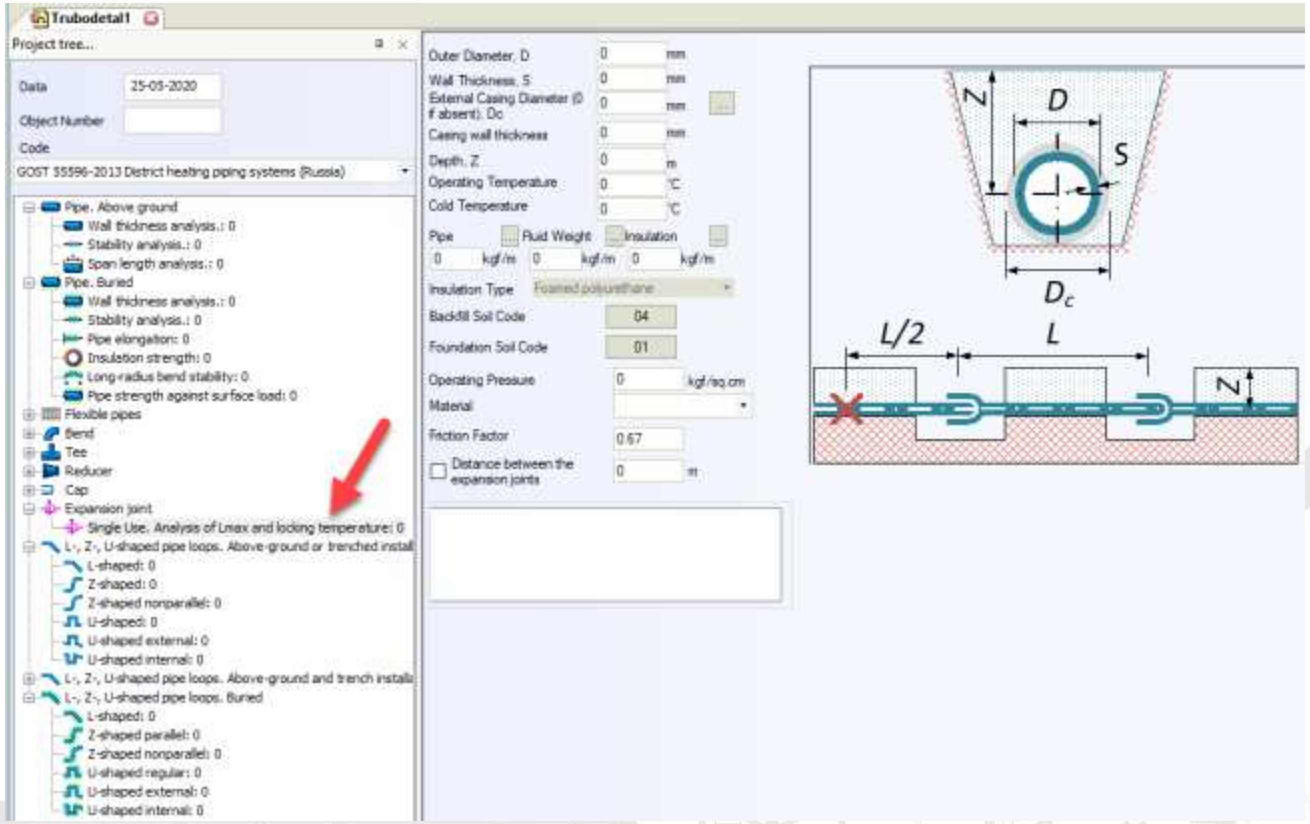
PASS/Start-Prof | New Codes

- 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



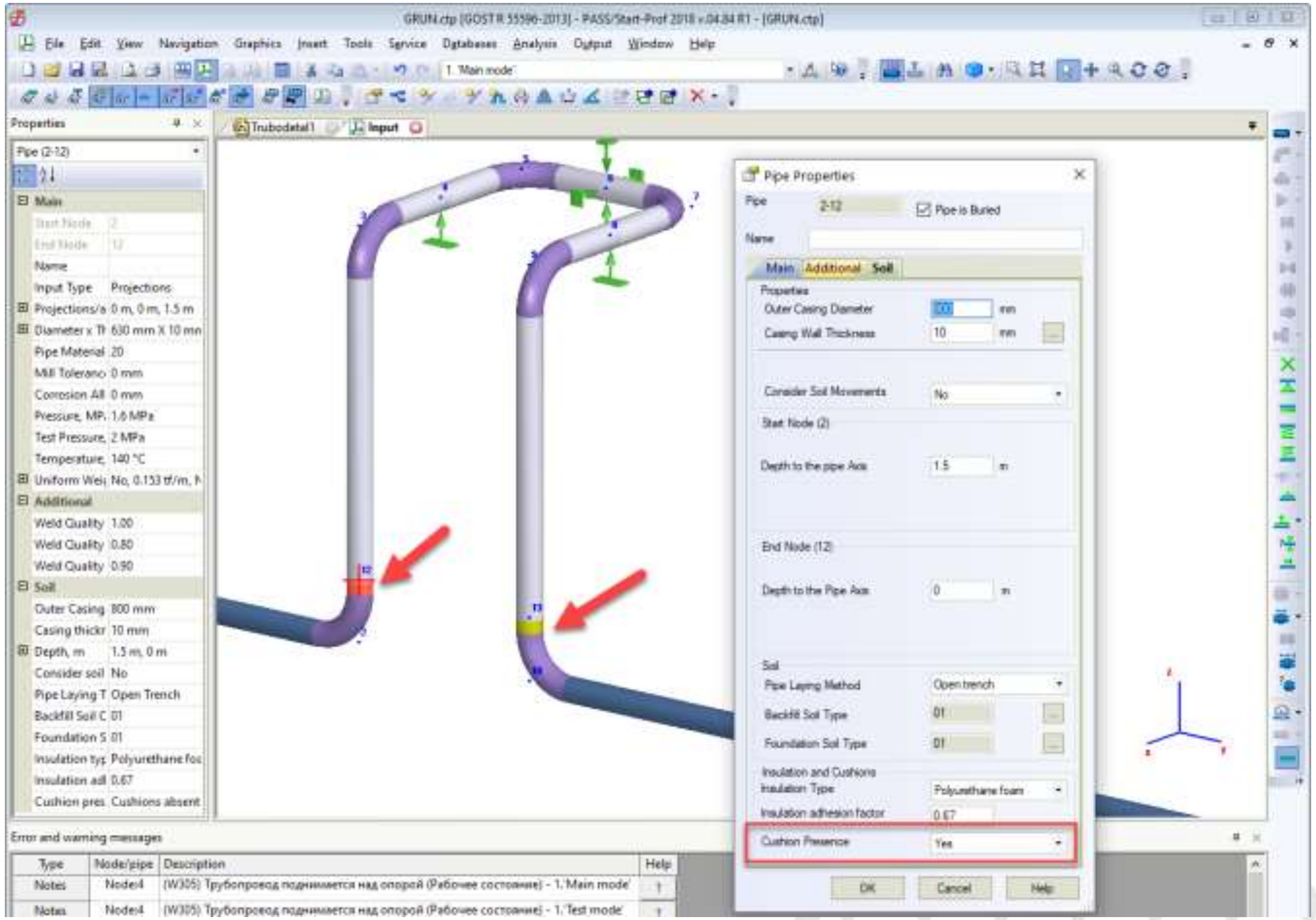


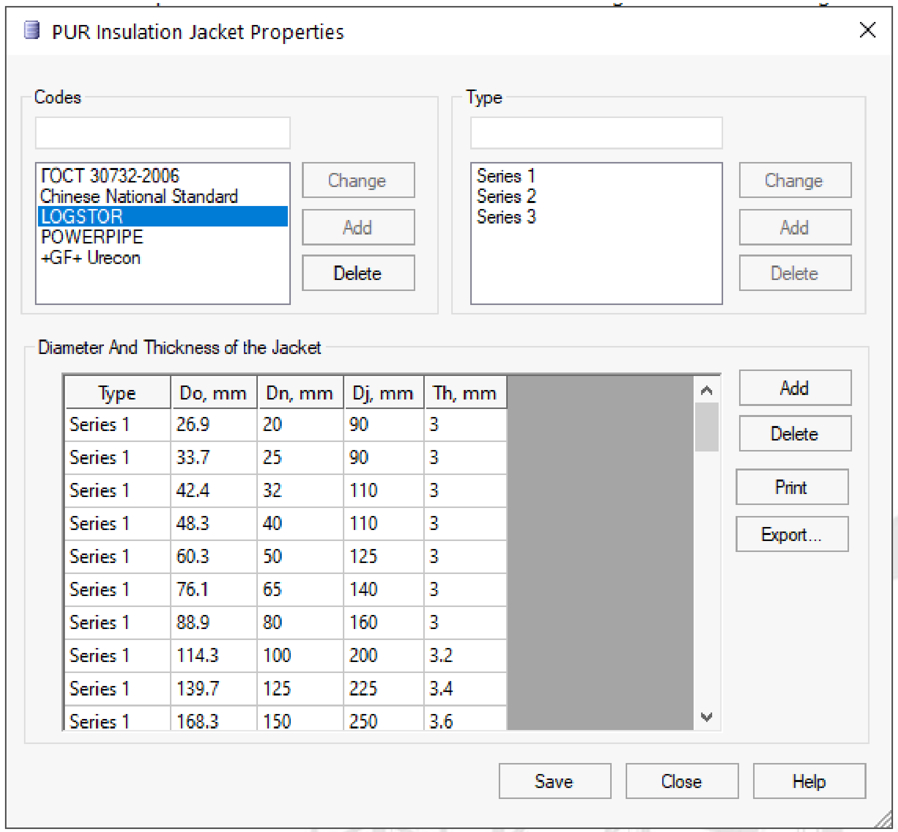




PASS/Start-Prof | New Codes

- 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



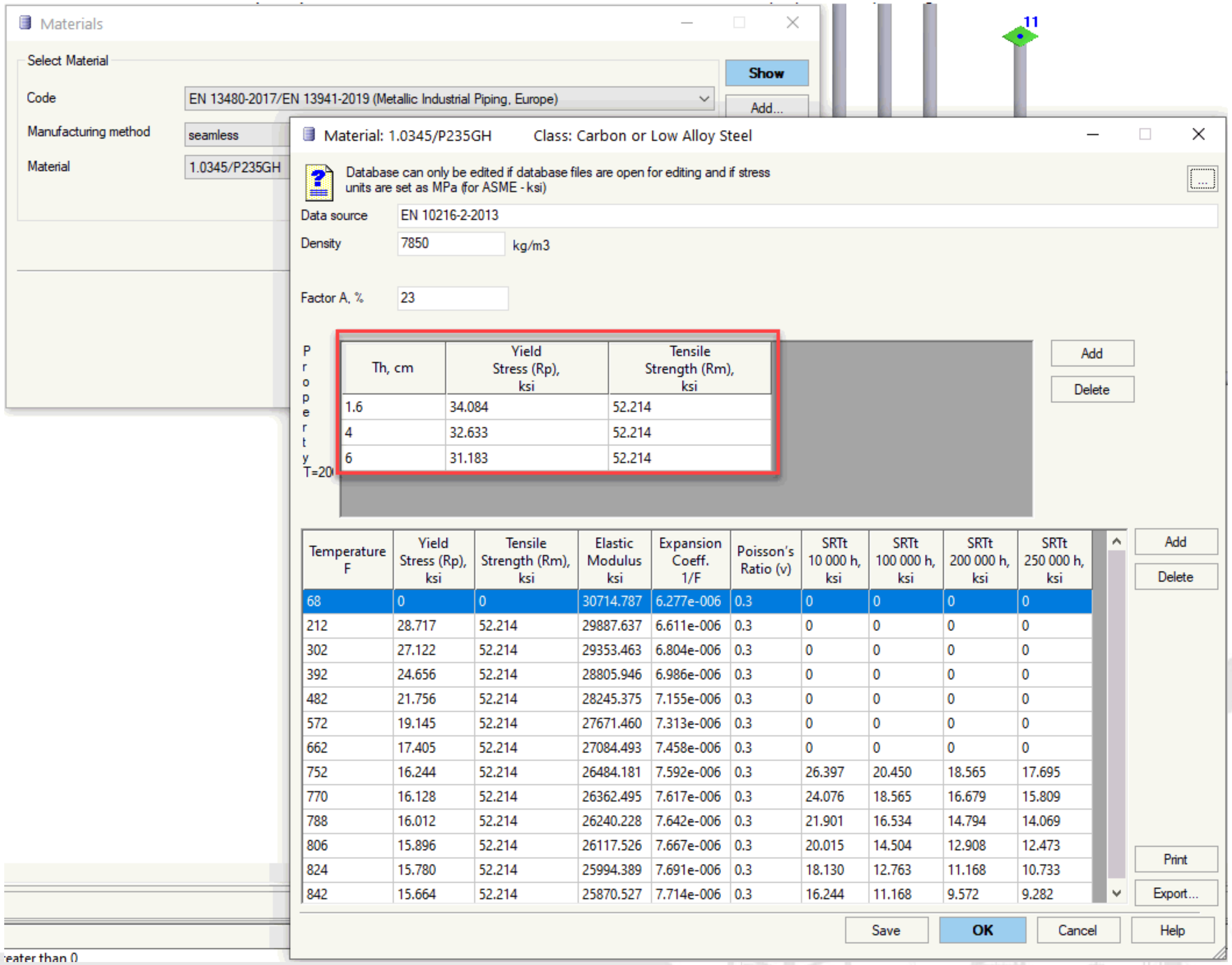


PASS/Start-Prof | Code Updates

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.

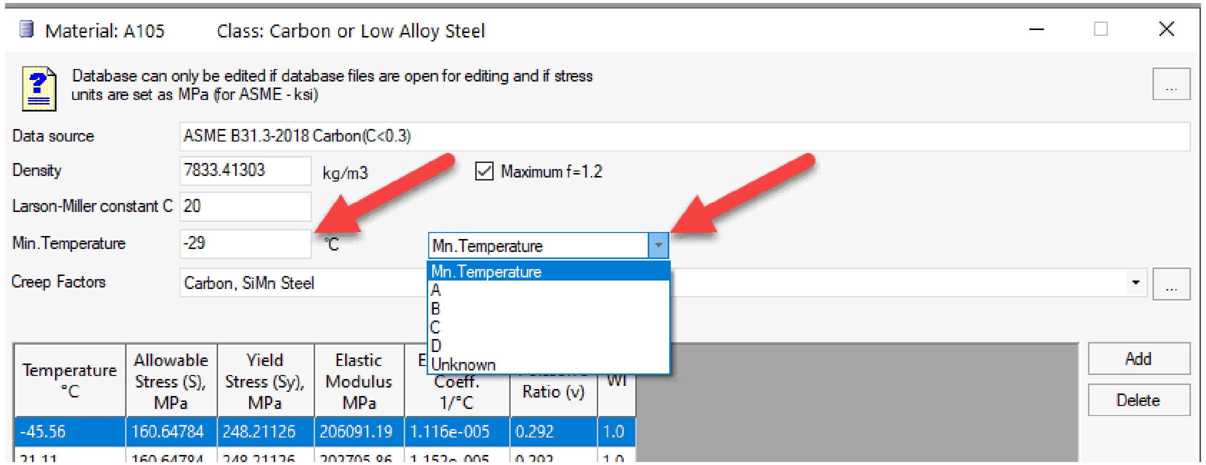
Added automatic material properties selection depending on wall thickness and seamless/welding option



PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

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).



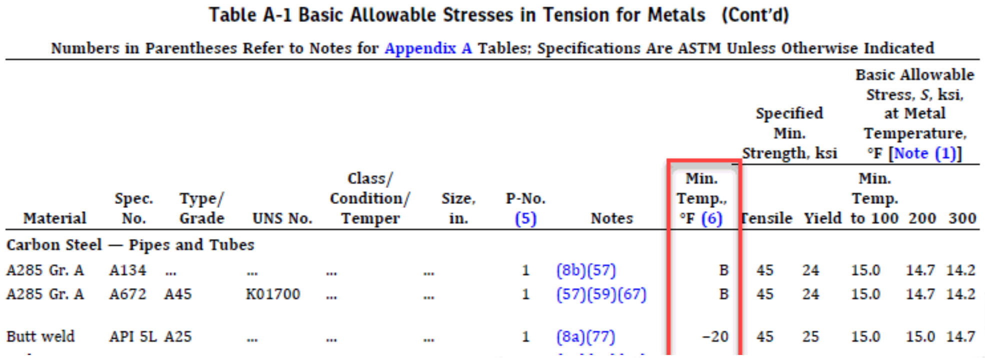


Table A-1 Basic Allowable Stresses in Tension for Metals (Cont'd)

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

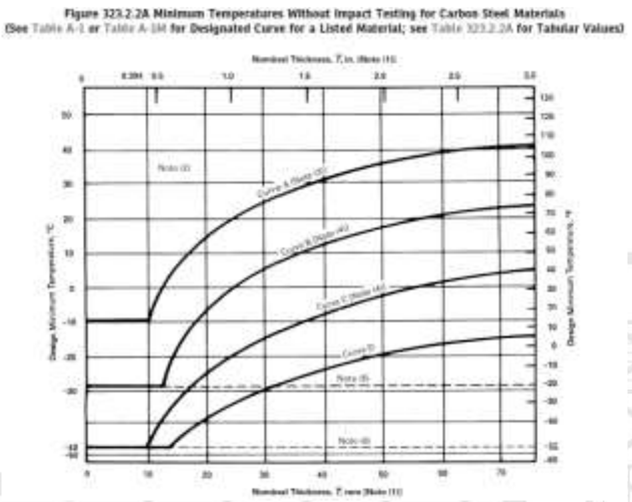
Material	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi: Tensile	Specified Min. Strength, ksi: Yield	Basic Allowable Stress, S, ksi, at Metal Temperature, °F [Note (1)]: Min. Temp. to 100	200	300
Carbon Steel — Pipes and 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

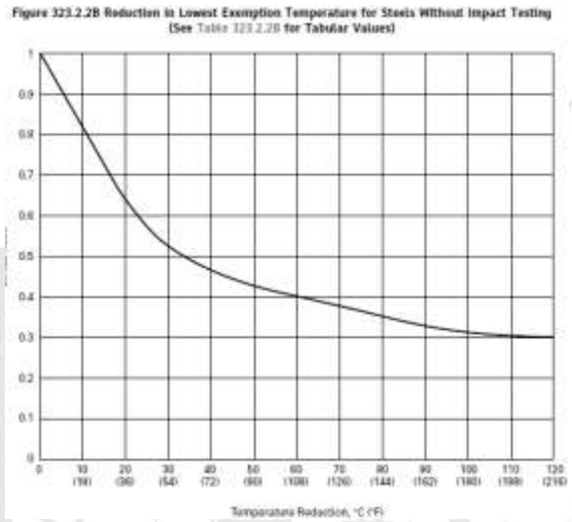
PASS/Start-Prof | New Features

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

Input | **MDMT**

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





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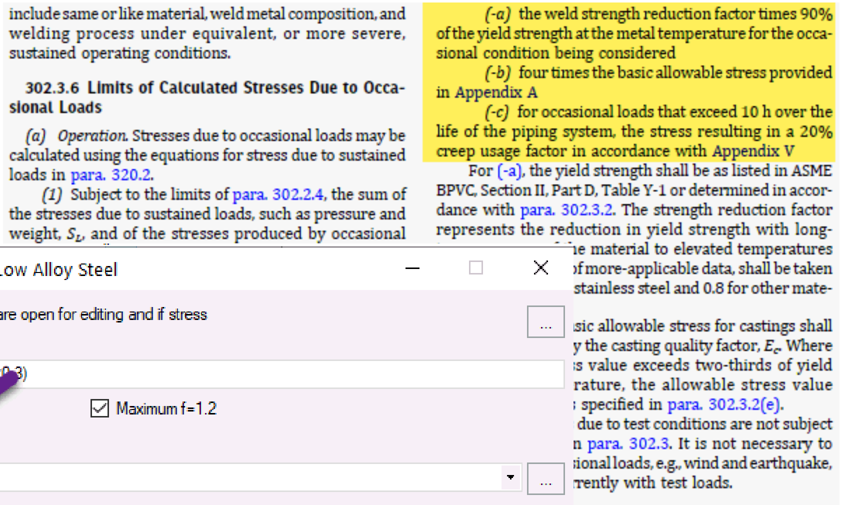
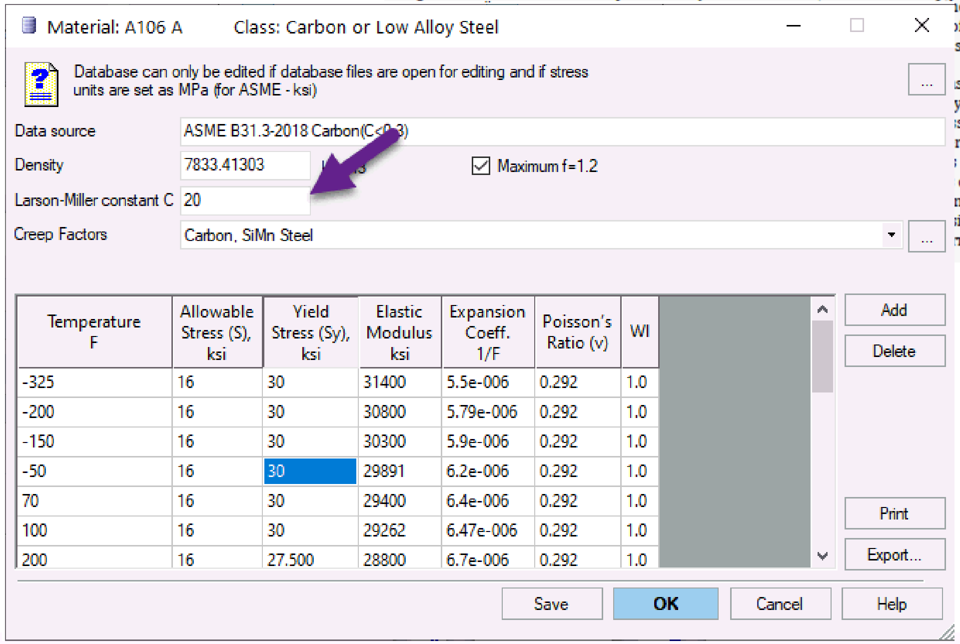
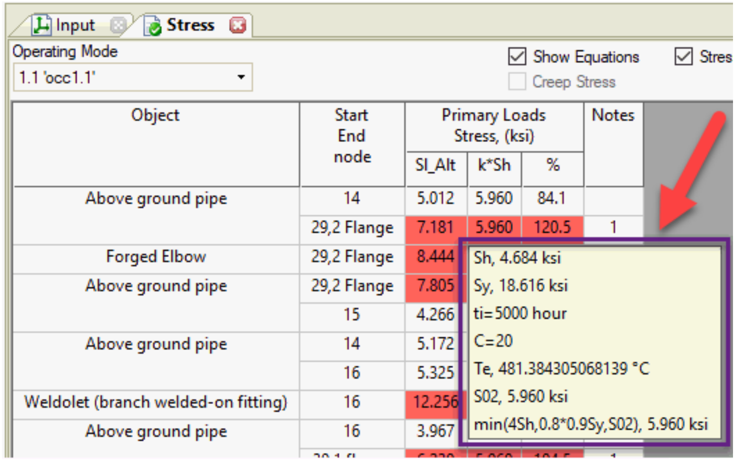
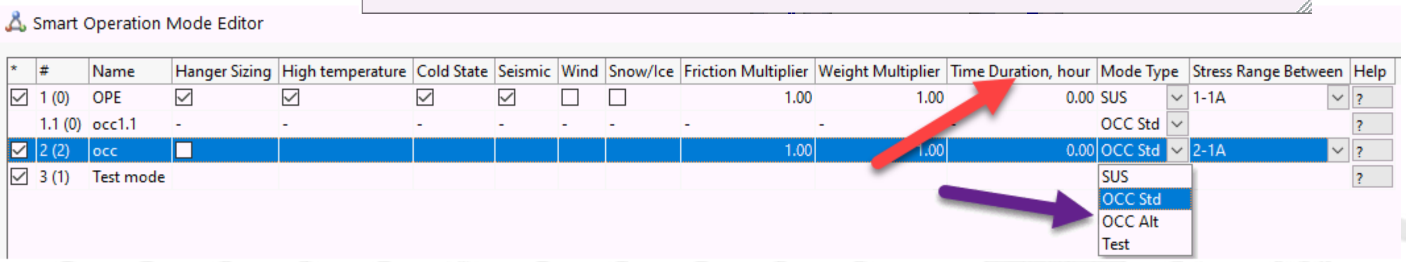
PASS/Start-Prof | New Features

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.



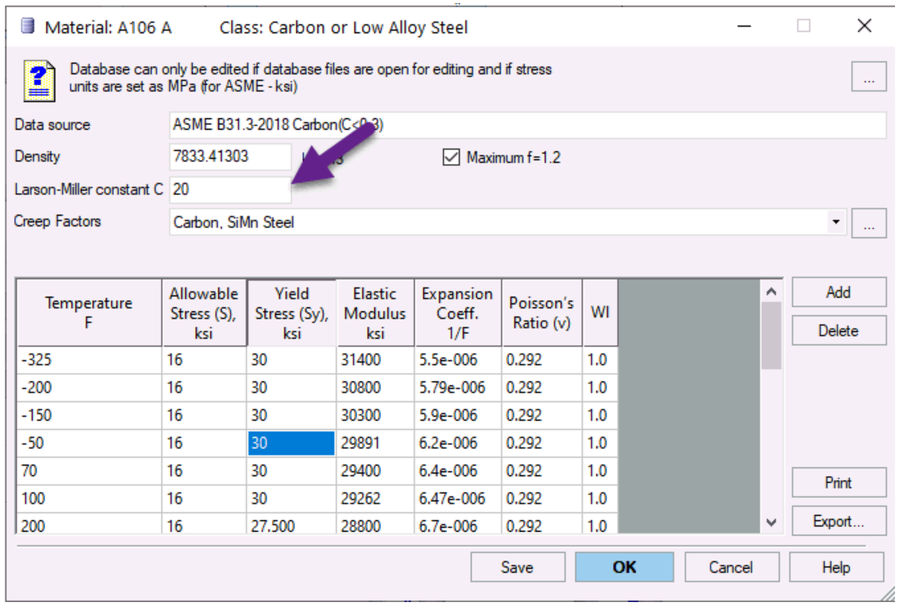






PASS/Start-Prof | New Features

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).

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

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 $u \le 1.0$, 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.

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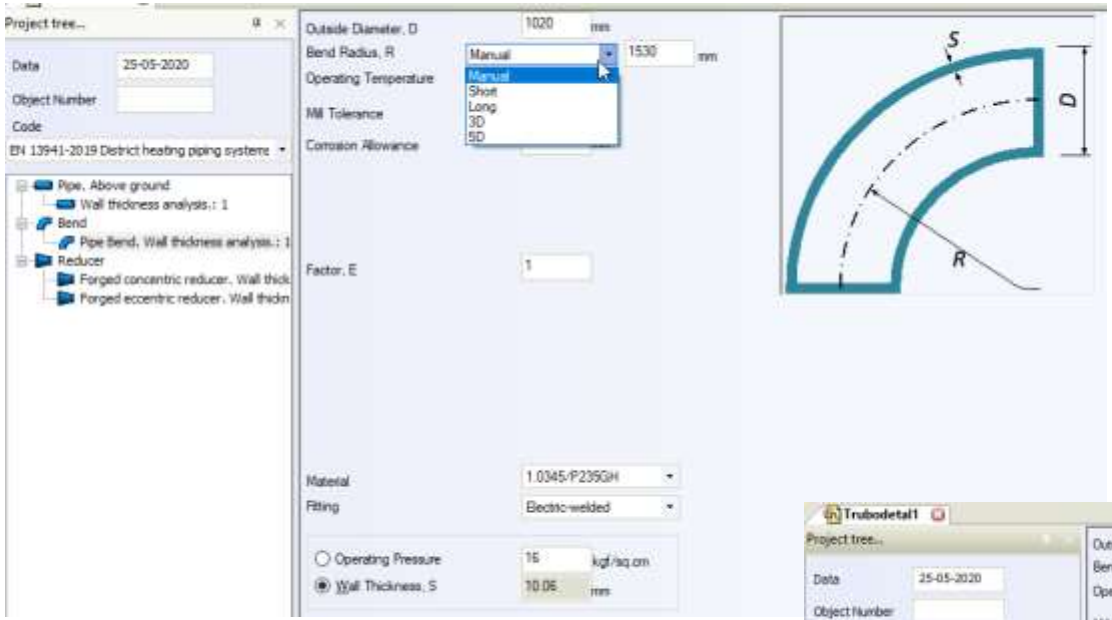
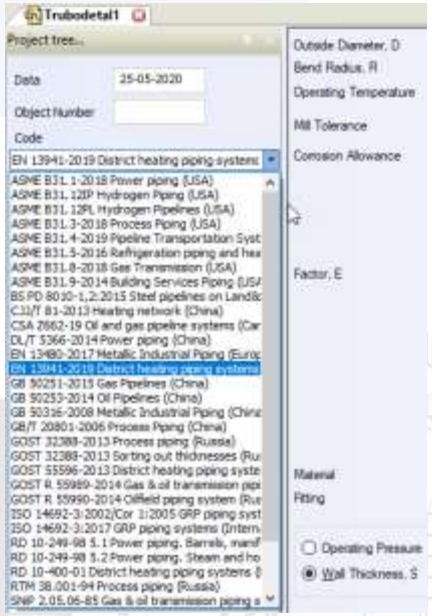
PASS/Start-Prof | New Features

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



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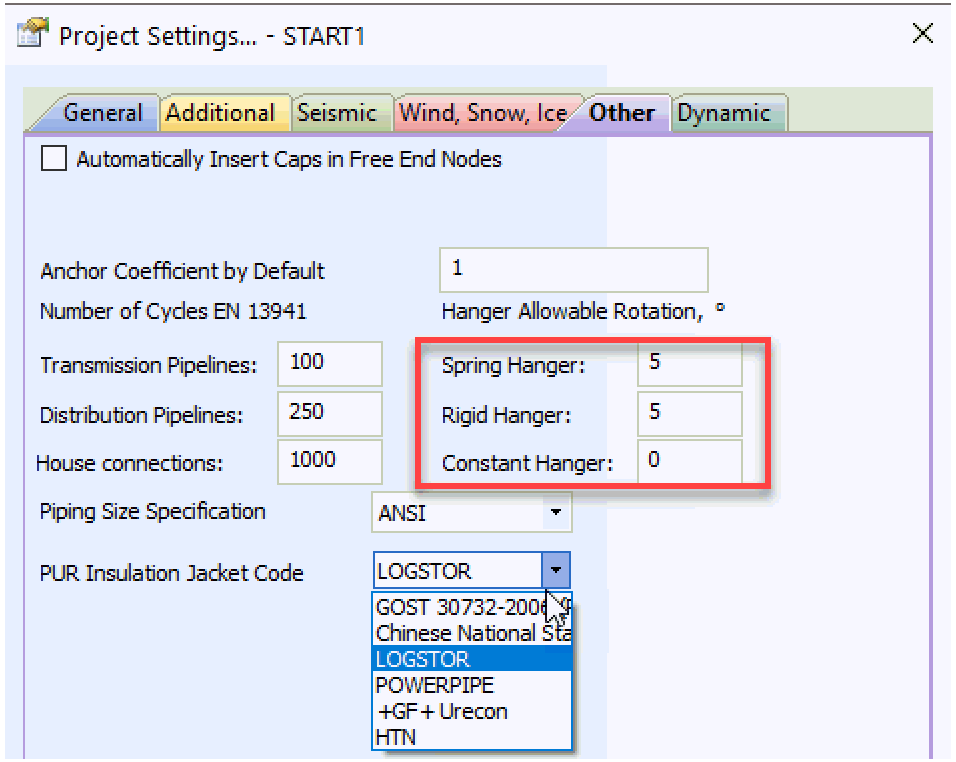
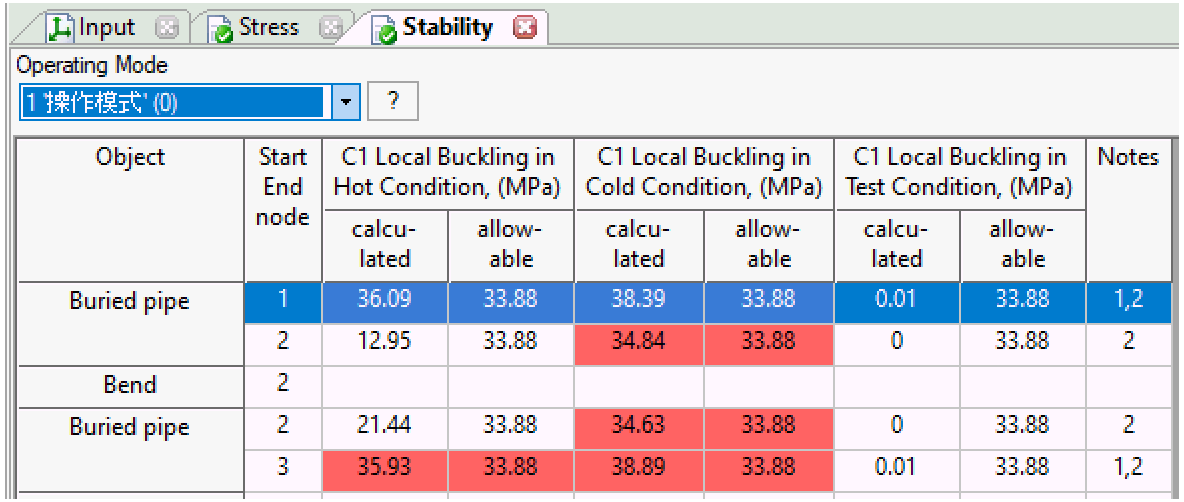
PASS/Start-Prof | New Features

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



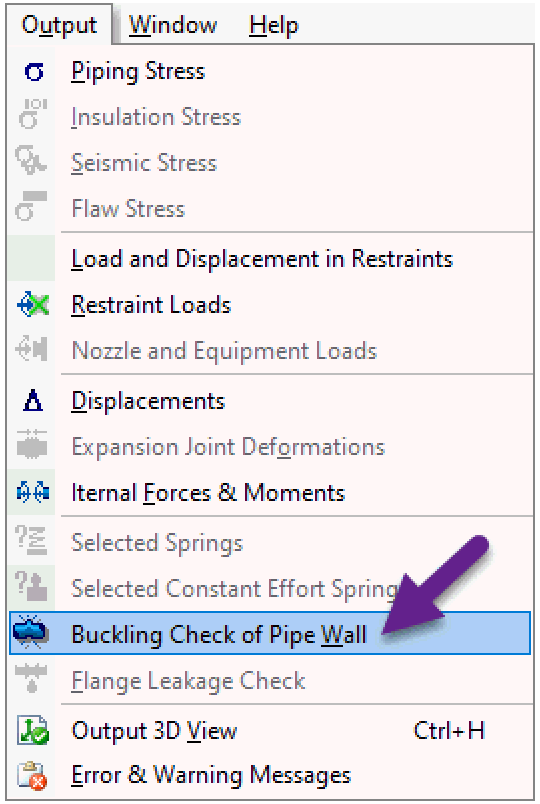
PASS/Start-Prof | New Features

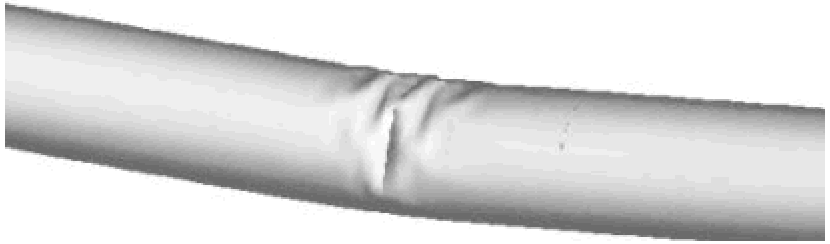
- Added automatic local pipe wall buckling check per ASME B31.8-2018
- EN 13941-2019 7.2.4.2



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
		calcu-lated	allow-able	calcu-lated	allow-able	calcu-lated	allow-able	
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

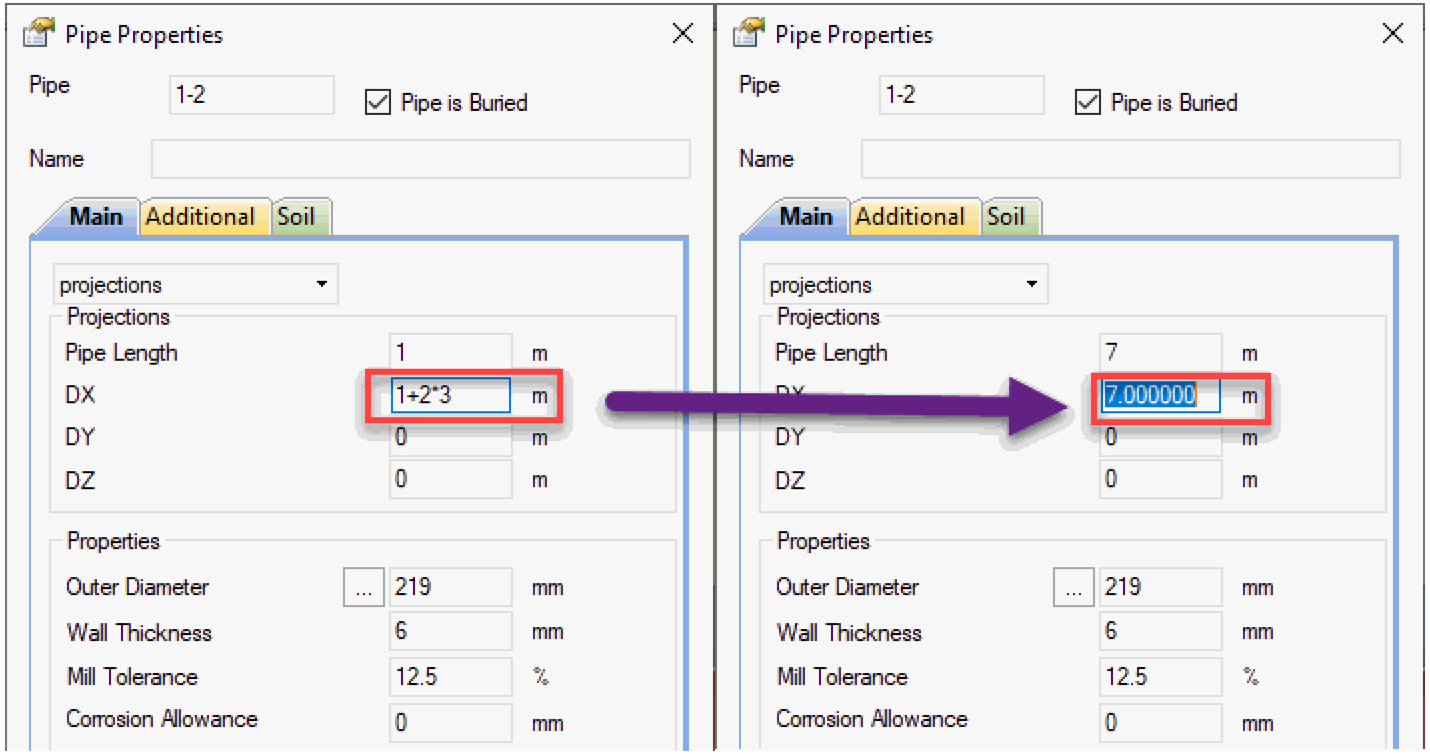
- For $(D_o - t_n)/(2t_n) \leq 28.7$
  $$S_{st} = 0.0016E$$
- For $(D_o - t_n)/(2t_n) > 28.7$
  $$S_{st} = (0.0458 \cdot 2t_n/(D_o - t_n) + 0.00003)E$$





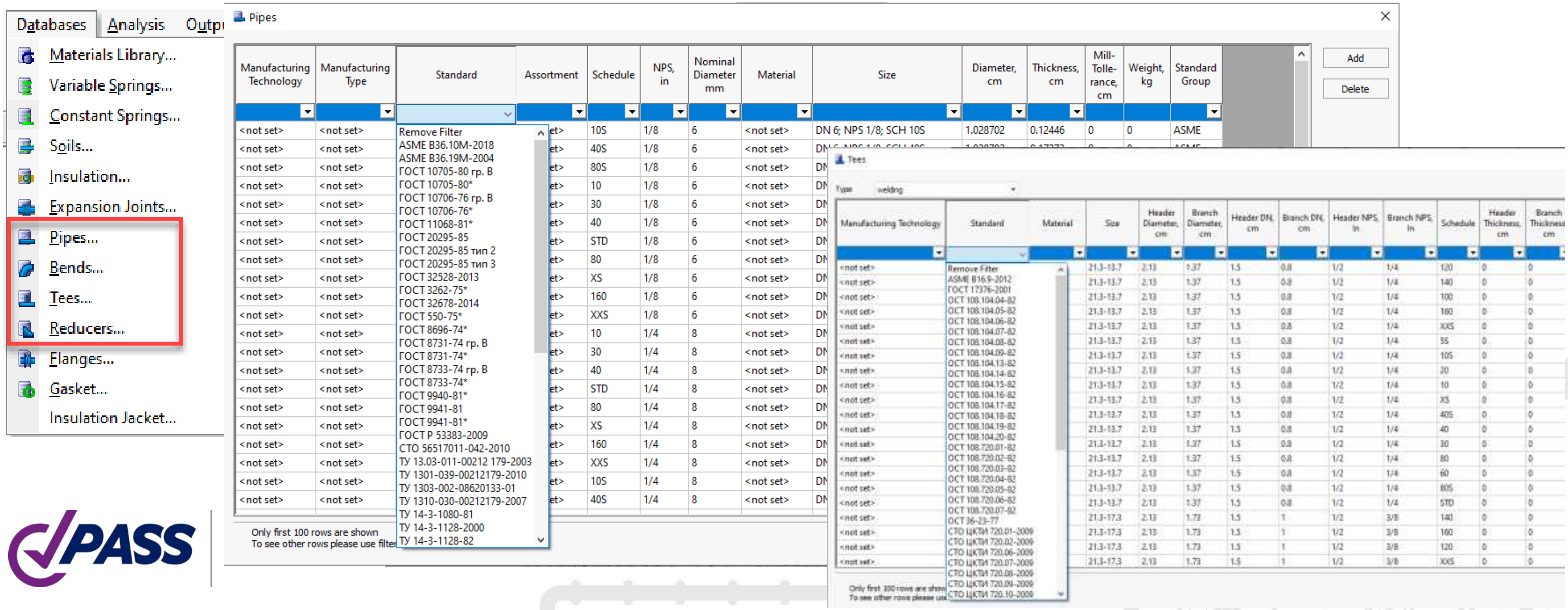
PASS/Start-Prof | New Features

Added built-in calculator in some input fields



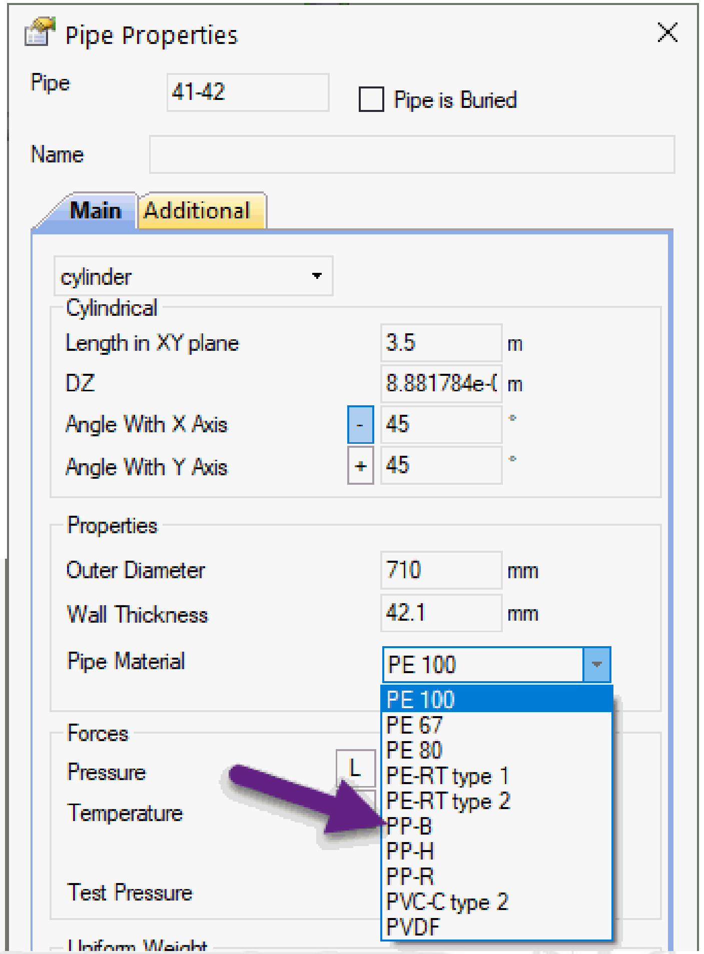
PASS/Start-Prof | New Features

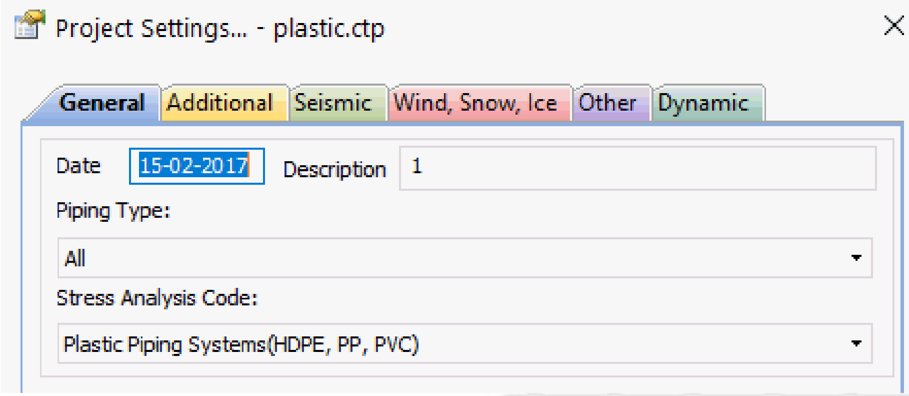
- Updated database ASME B36.10M-2018
- Added more than 140 new standards into pipes, tees, bends, and reducers database, including ASME B16.9 and lot of Russian GOST, OST, RD, TU codes



PASS/Start-Prof | New Features

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

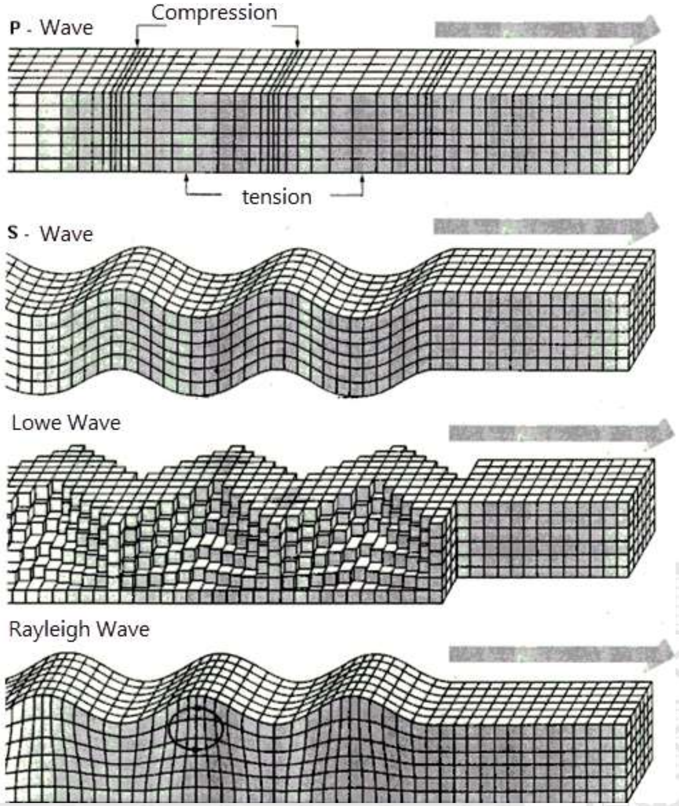




PASS/Start-Prof | New Features

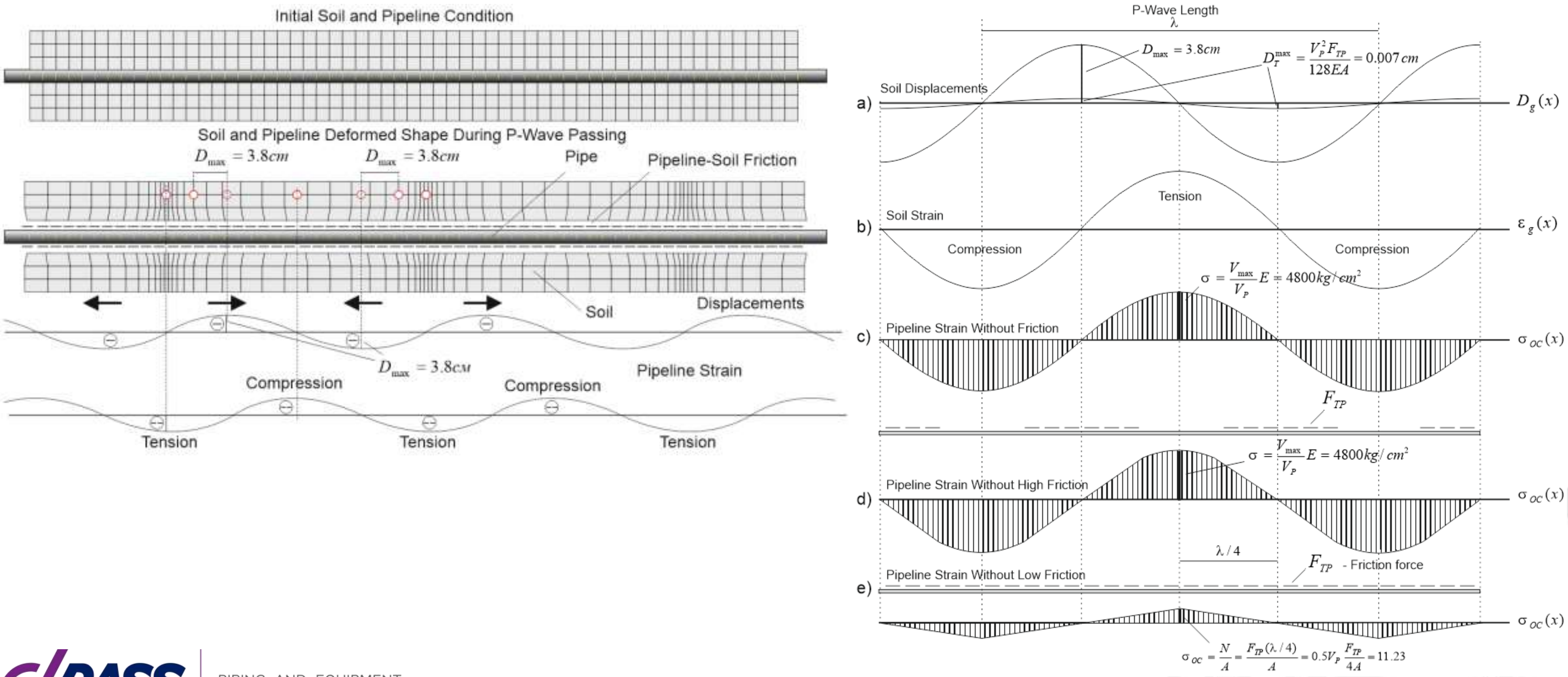
Added seismic wave propagation analysis for underground pipelines. START-PROF calculate stress and strain in buried pipeline caused by seismic wave propagation and check the stress and strain limits according to

- 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)



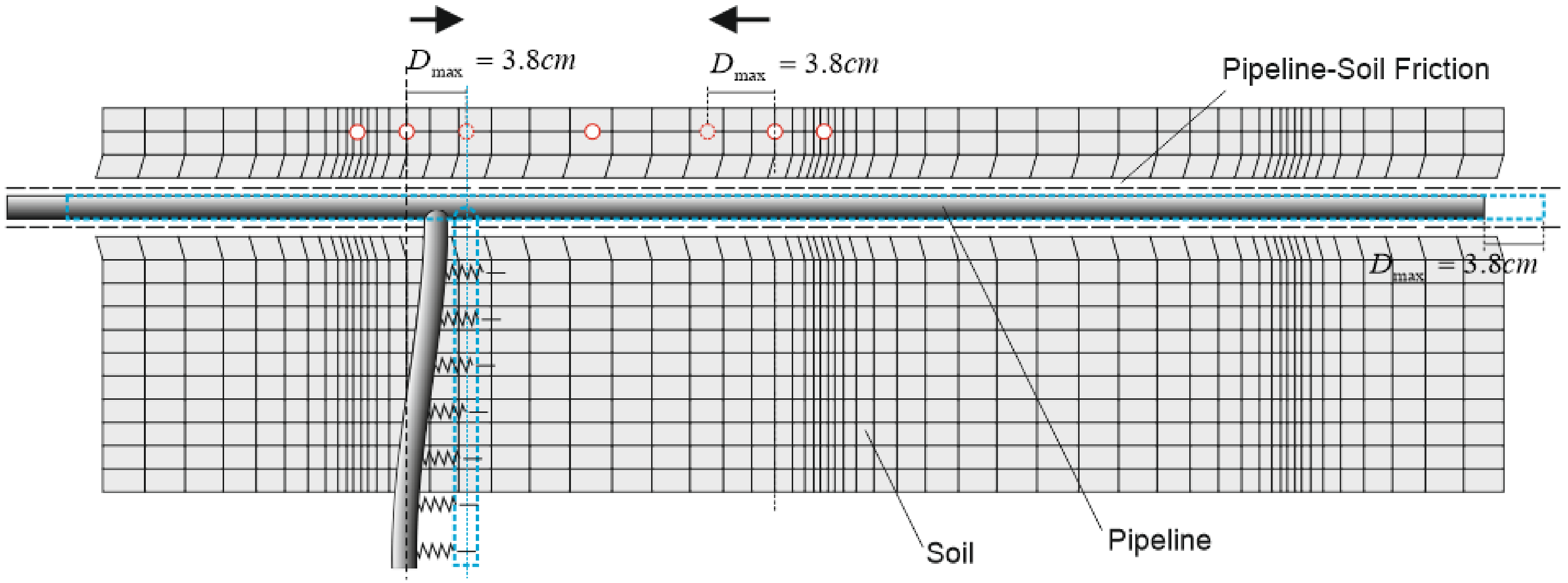
PASS
PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

PASS/Start-Prof | New Features



PASS/Start-Prof | New Features

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



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.

ω – Incline angle of the pipe. 0 for horizontal pipe, 90 for vertical pipe

D – Pipe diameter, m

ε_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

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

λ –Wave length, m

$$\lambda = 0.5C_p$$

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

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

ρ_{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/s2. Specified by user in pipe properties

A – Pipe cross-section area, m2

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

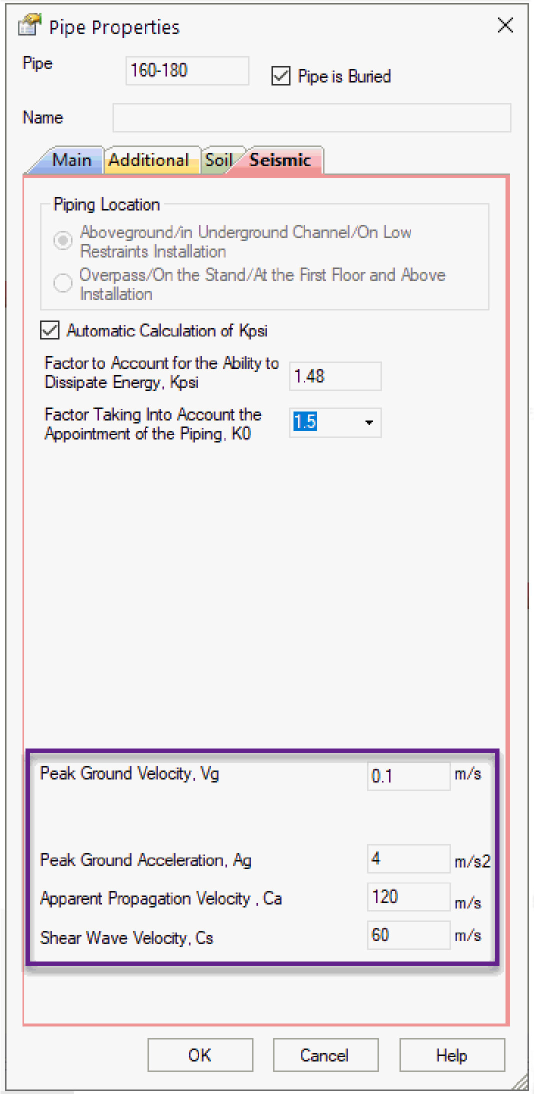
C_R – Apparent R-wave propagation velocity, m/s

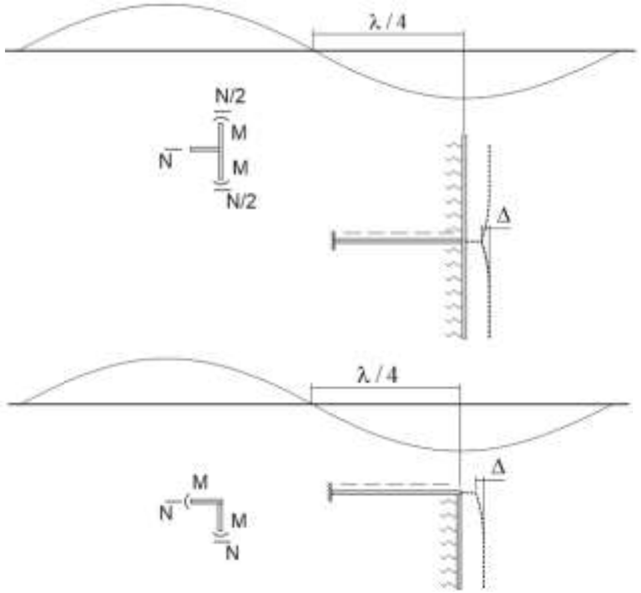
Rayleigh wave velocity is equal to $C_R = kC_S$, where k is obtained from the equation

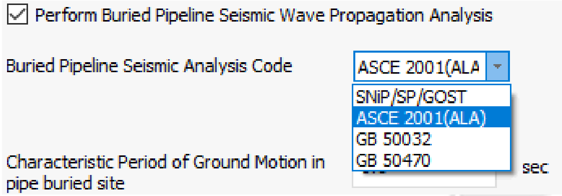
$$\frac{1}{8}k^6 - k^4 + \frac{2-\nu}{1-\nu}k^2 - \frac{1}{1-\nu} = 0.$$

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

$$C_R \approx 0.92C_S$$







PASS/Start-Prof | New Features

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

Input | Stress

Operating Mode: 1.1 'Soil Seismic Wave Propaga

☑ 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			
	9	515.60	965.27	53.4	0.2009			
Buried pipe	7	490.91	965.27	50.9	0.1884			
	8	510.81	965.27	52.9	0.1985	0.2939	67.5	

E, 201051.12 MPa

[εa]=0.75(0.5t/D-0.0025+3000(PD/(2Et))²), 0.002939

[εa]%, 0.2939

Compression strain limit

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

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

Input | Stress

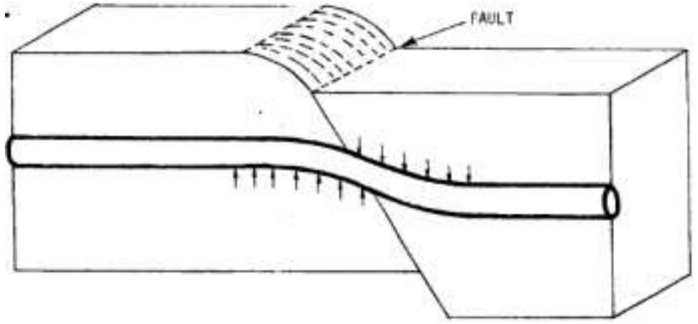
Operating Mode: Maximum

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

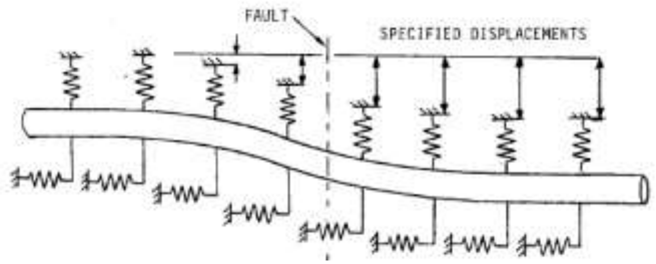
Object	Start End node	Hoop Stress, (MPa)			Primary Loads Stress in Hot State, (MPa)						Primary&Secondary Loads Stress in Hot State, (MPa)						Expansion Stress Range, (MPa)			Buried piping Seismic Check, (MPa)			Buried piping Seismic Check, (%)			Notes
		Sh	F*E*Sy	%	Seq	F*Sy	%	SI	F*Sy	%	Seq	F*Sy	%	SI	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	

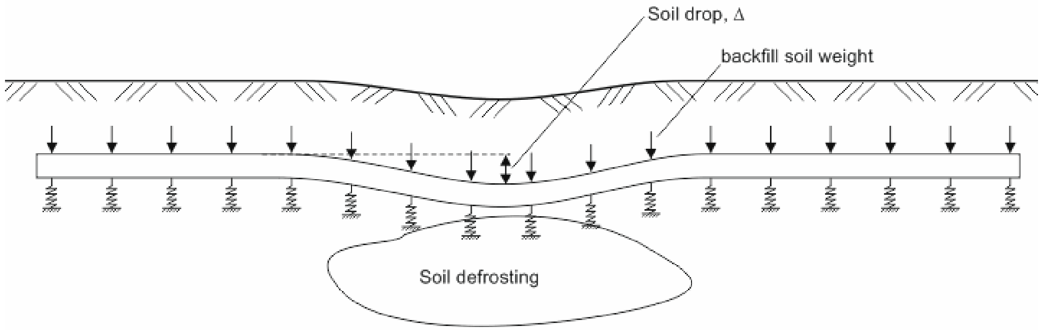
PASS/Start-Prof | New Features

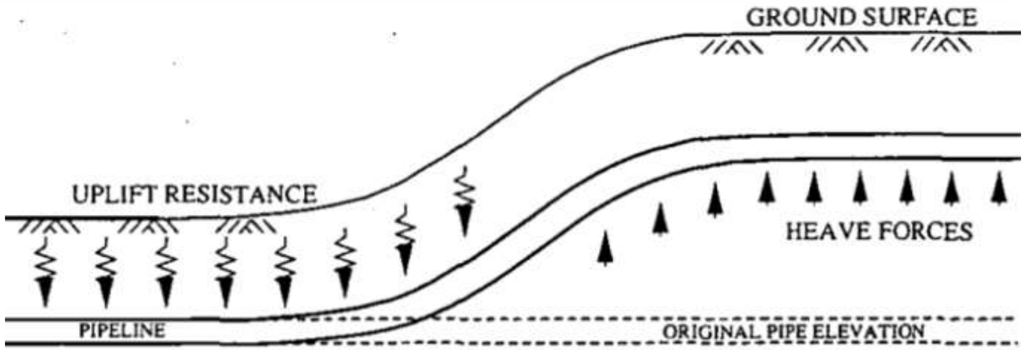
Landslide, Soil subsidence, frost heaving, Permanent ground deformation (seismic fault crossing) can also be modeled. The pipeline strain check is made according to ASCE 2001 (ALA) and GB 50470

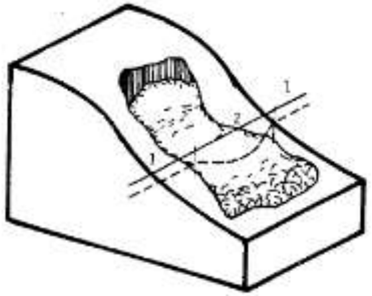


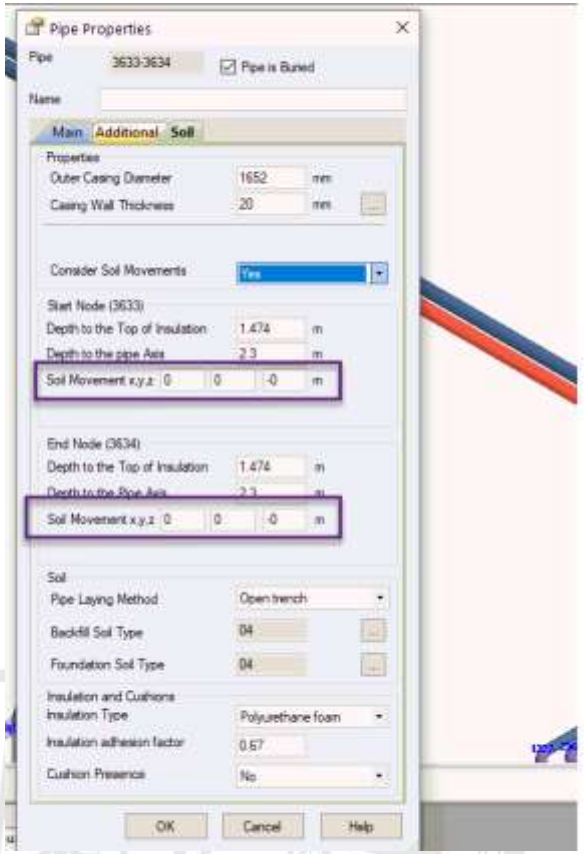
(A) ACTUAL GEOMETRY







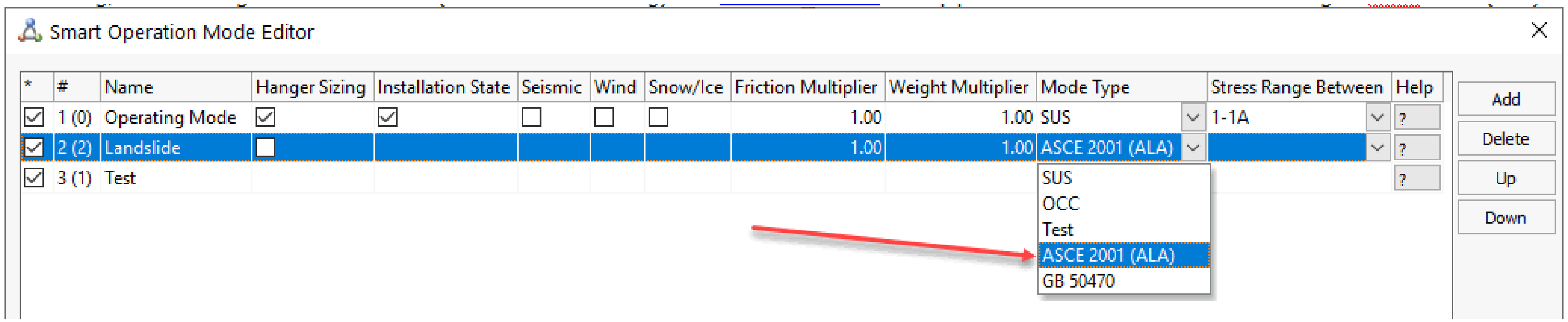


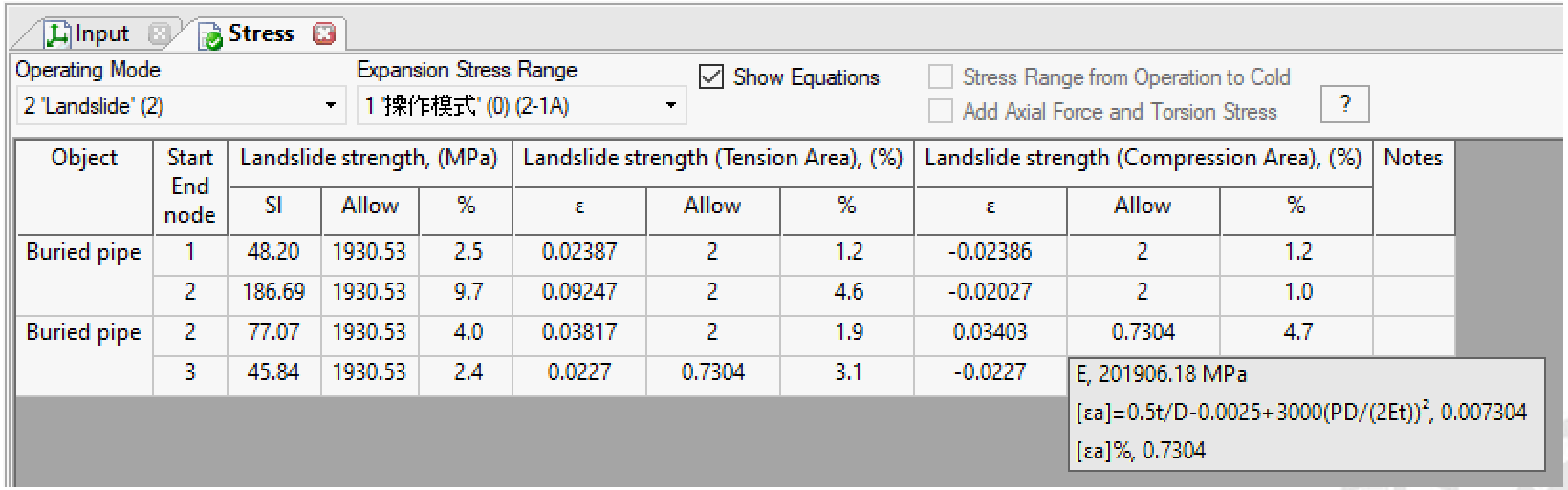


PASS
PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

PASS/Start-Prof | New Features

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

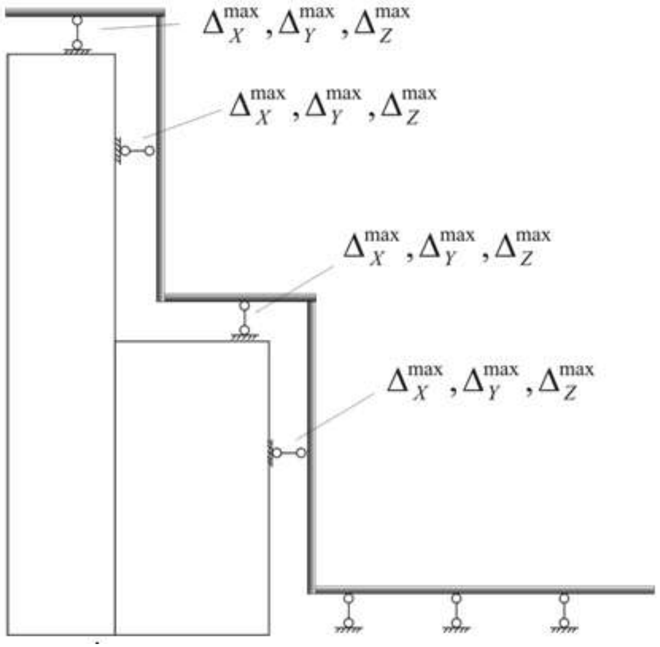


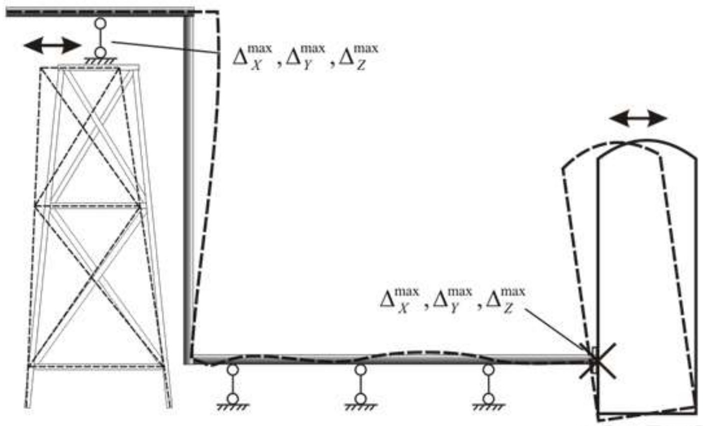


Object	Start End node	Landslide strength, (MPa)			Landslide strength (Tension Area), (%)			Landslide strength (Compression Area), (%)			Notes
		SI	Allow	%	ε	Allow	%	ε	Allow	%	
Buried pipe	1	48.20	1930.53	2.5	0.02387	2	1.2	-0.02386	2	1.2	
	2	186.69	1930.53	9.7	0.09247	2	4.6	-0.02027	2	1.0	
Buried pipe	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			

PASS/Start-Prof | New Features

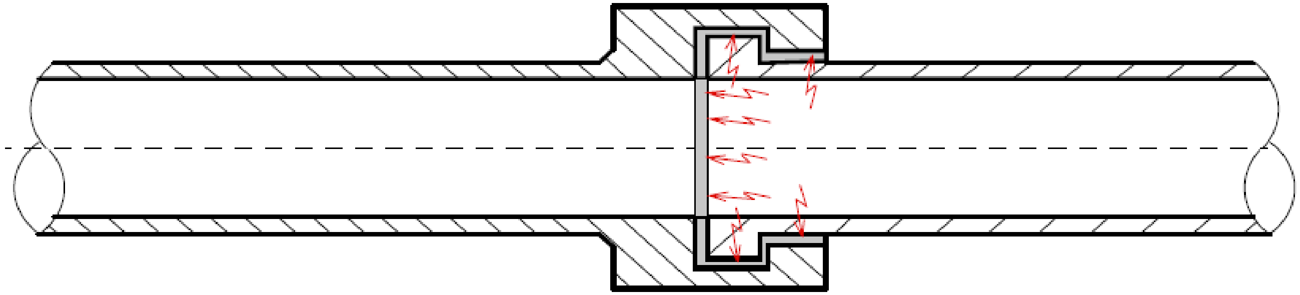
- Added ability to specify different seismic anchor movement values for the same phase group. It is used to define various restraint movement on several floors of the same building
- Added new functions to Operation Mode Editor: Disable overload factors, add a factor to weight loads

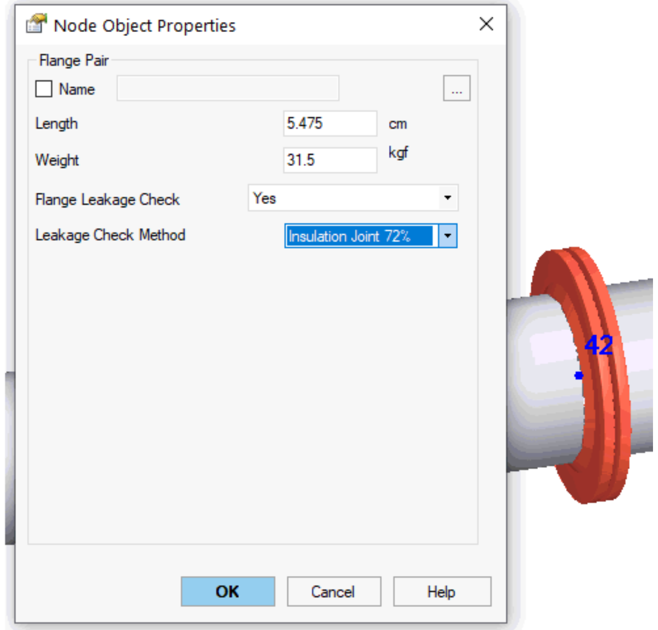




PASS/Start-Prof | New Features

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

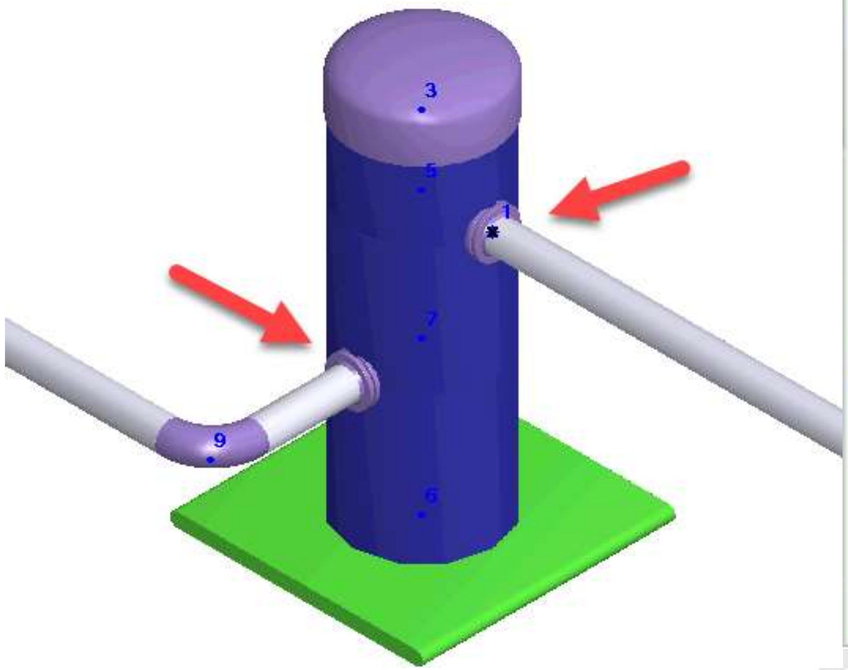


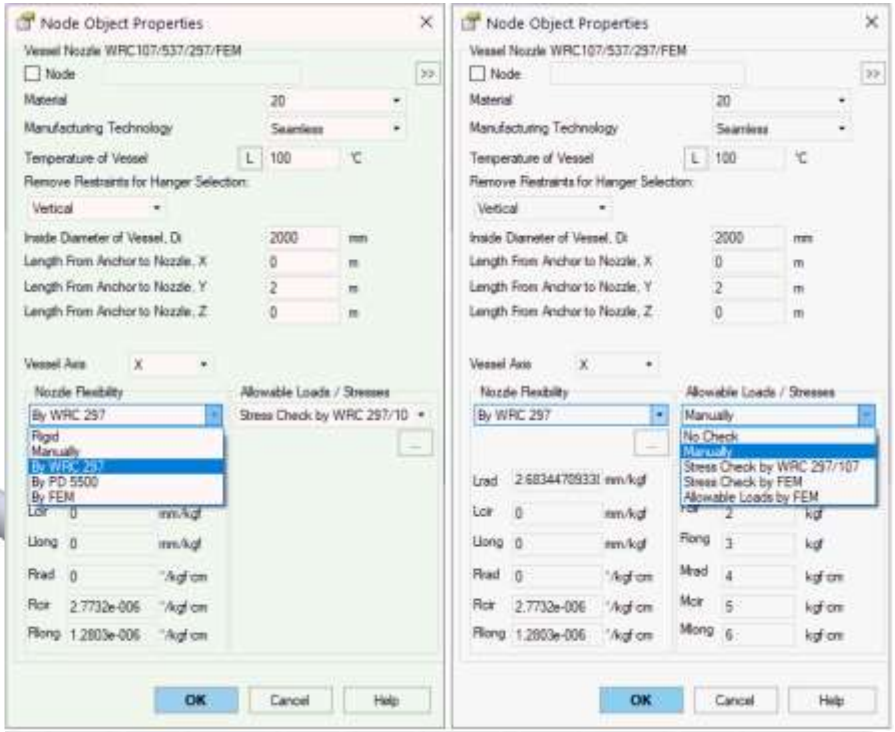


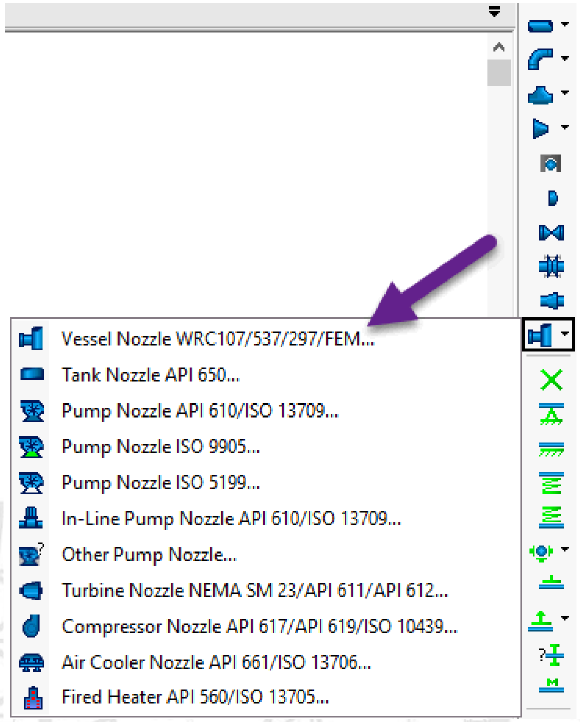
PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/Start-Prof | New Features

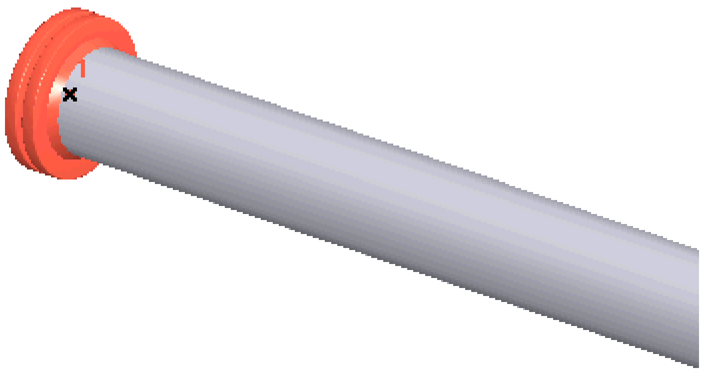
- Added new object "Cylindrical Shell", that is used for modelling of boilers, pressure vessels, columns, horizontal vessels,
- Added new object "Nozzle", allows to automatically model nozzles of boiler and pressure vessels, and columns. Automatically model shell flexibilities using WRC 297/PD 5500,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

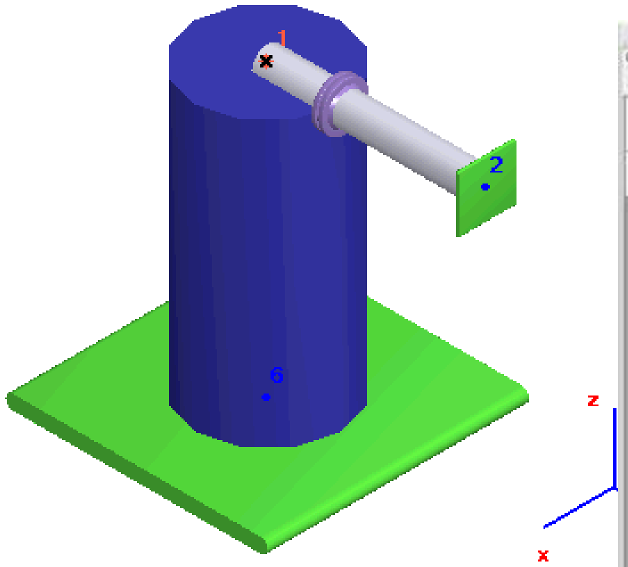


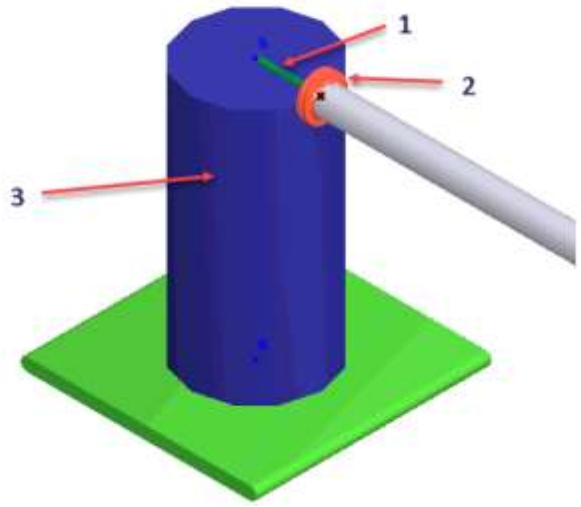


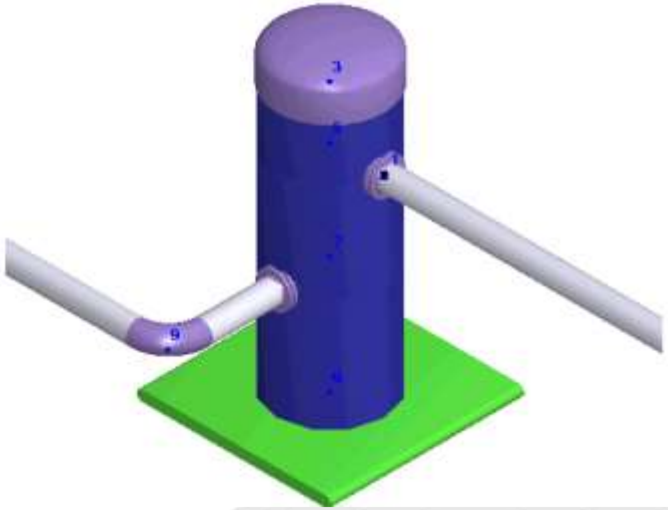


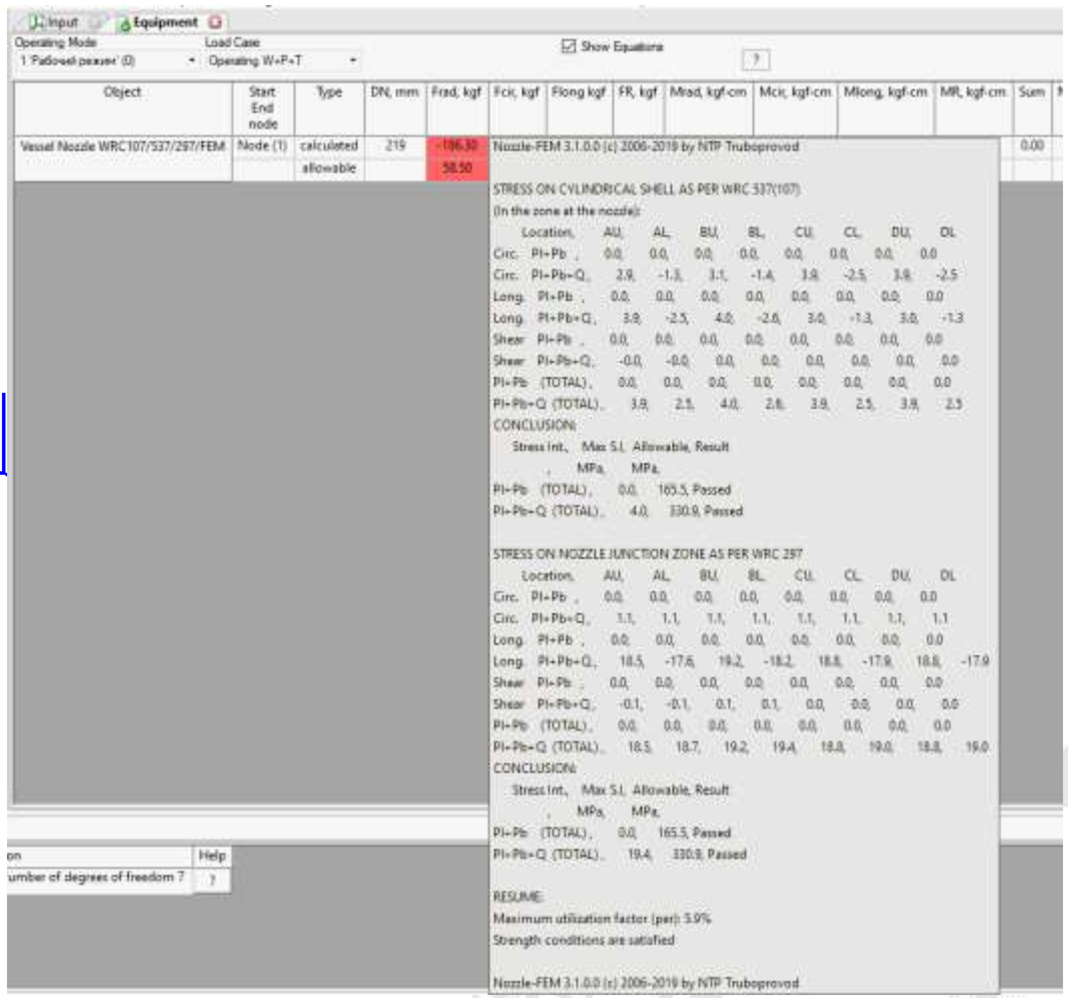
PASS/Start-Prof | New Features





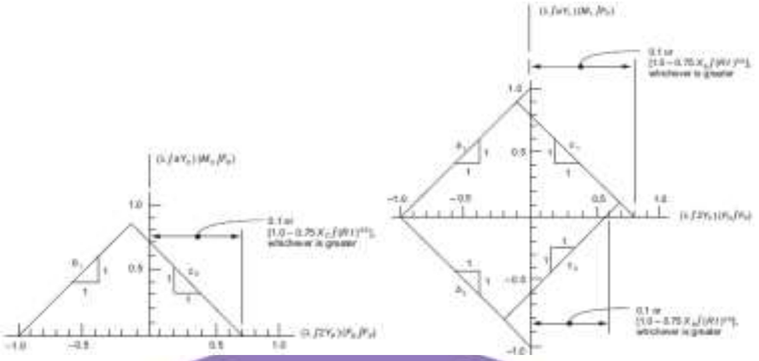


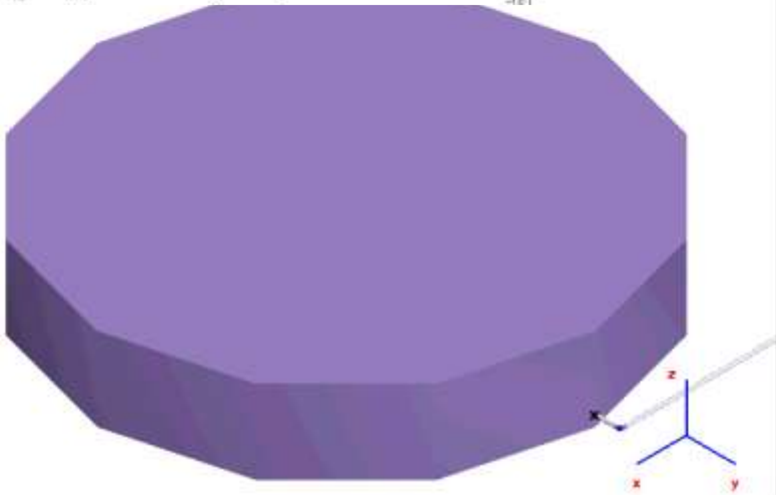


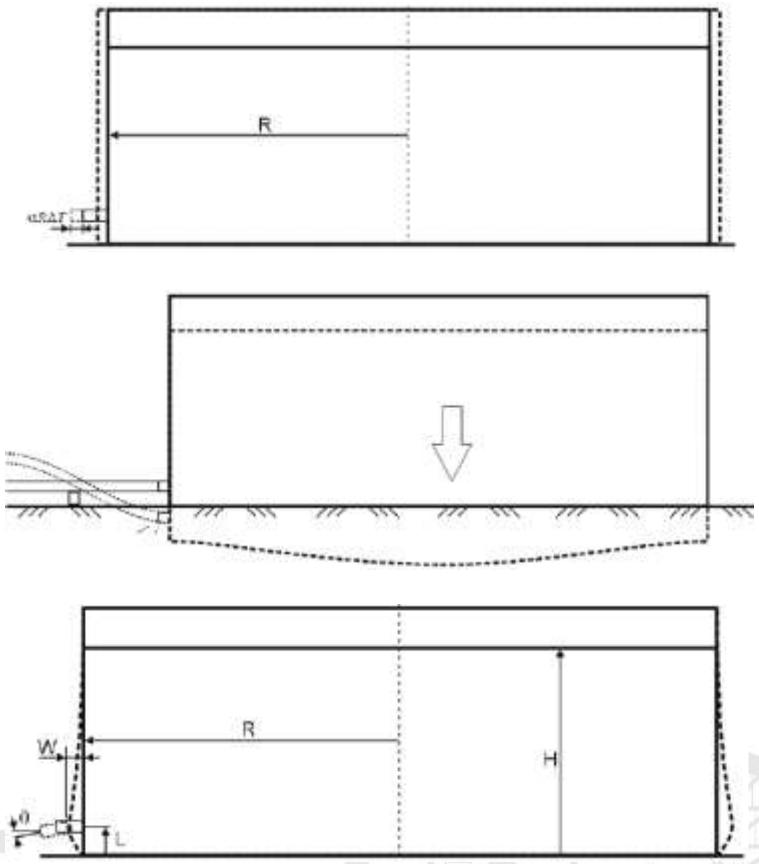


PASS/Start-Prof | New Features

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

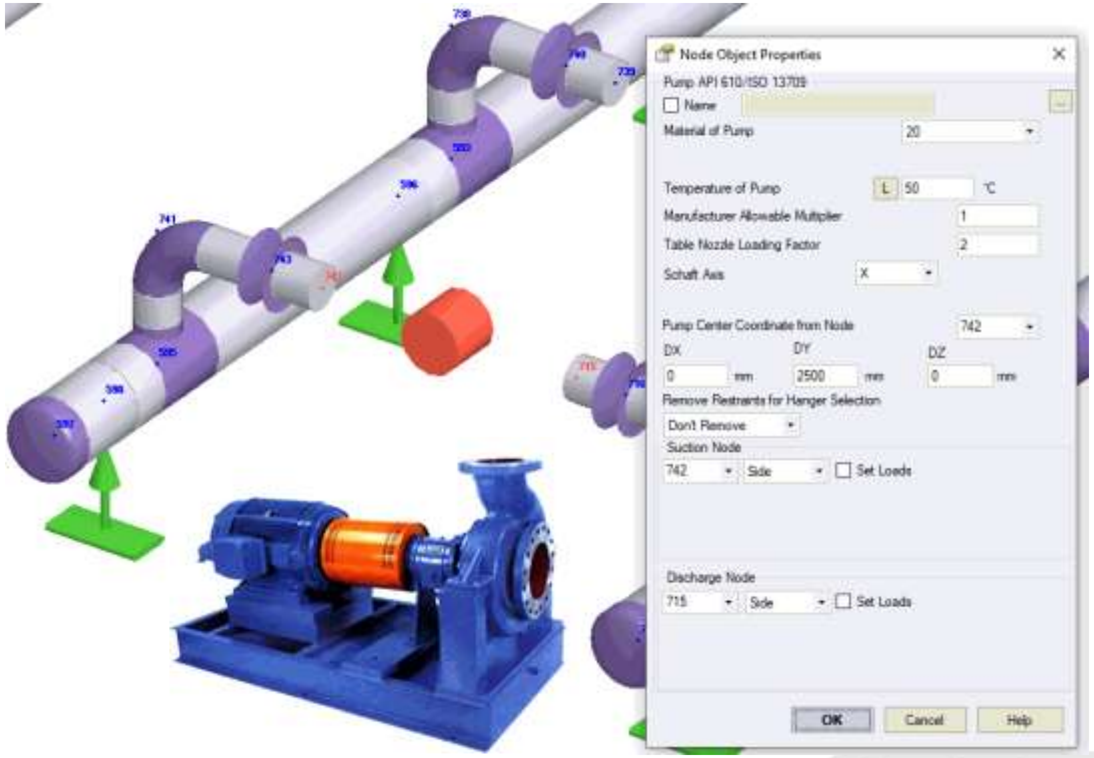






PASS/Start-Prof | New Features

- 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):

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

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

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.)

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

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

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

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

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

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

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

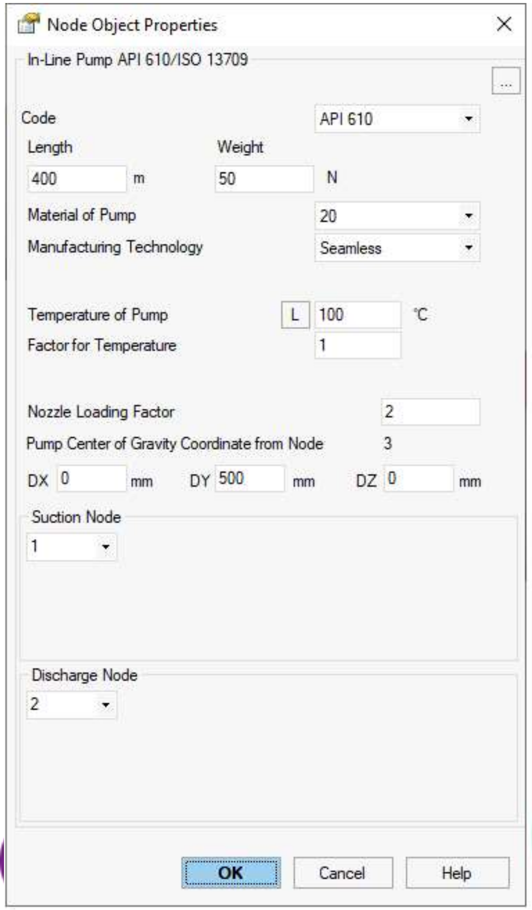
Input | Equipment

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 | 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



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

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

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

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

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

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

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

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

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)

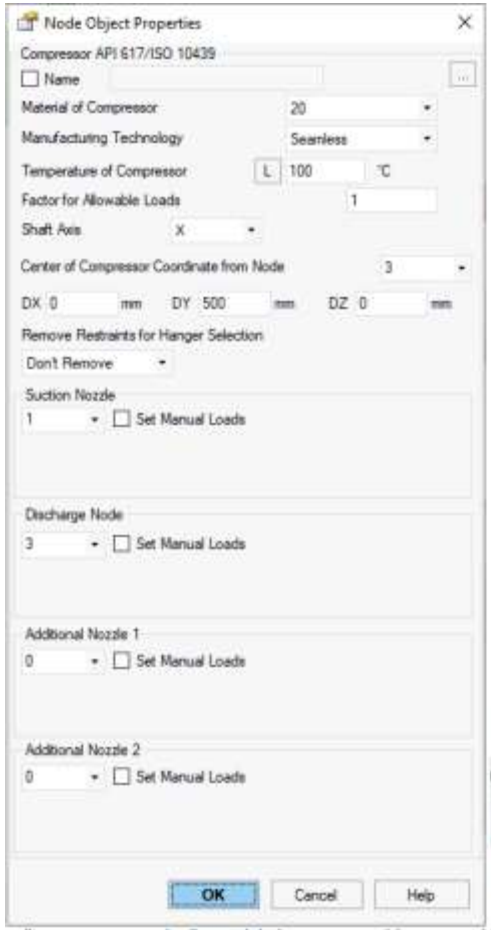
Load Case: Operating W+P+T

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 | 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:

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

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:

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

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:

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

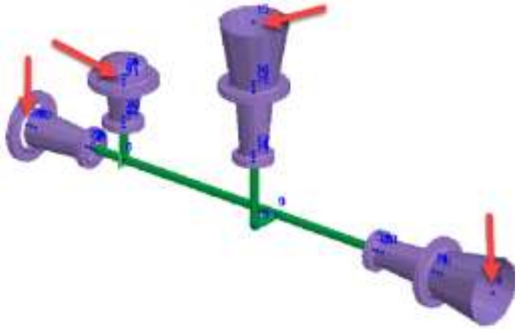
The absolute value of the individual components (Figure F.1) of these resultants should not exceed the following.

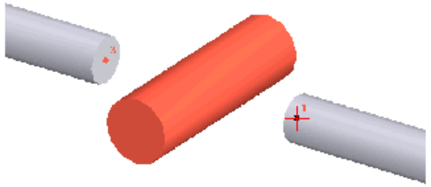
In SI units:

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

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

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





Input | Equipment

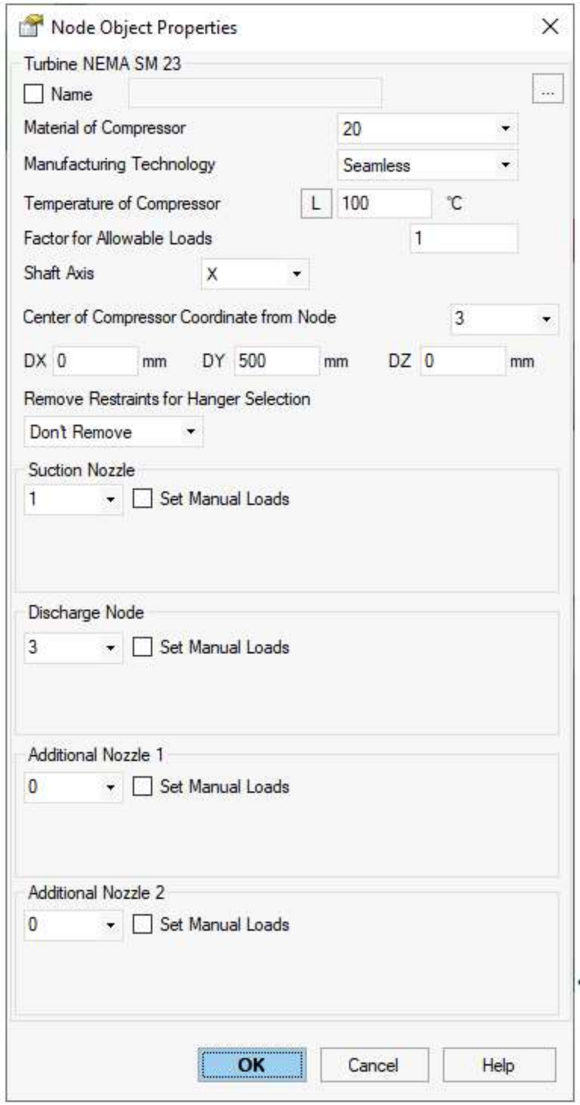
Operating Mode: 1 'Рабочий режим' (0) — Load Case: Operating W+P+T — Show Equations — ?

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	!
	Node (3)	Discharge, Top	200	1440505	-173	0	1440505	0		28.89	28.89	333.14	!
		ext1											
		ext2											
		Summary Loads	250.91	1424587	12734	-23209	1424833	-2577.83	22615.01	15246.83	27396.16	144.99	
				8130					86.24	6172.49			

Dc=250.9141 mm
[Fcir]=k1*40.5Dc=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

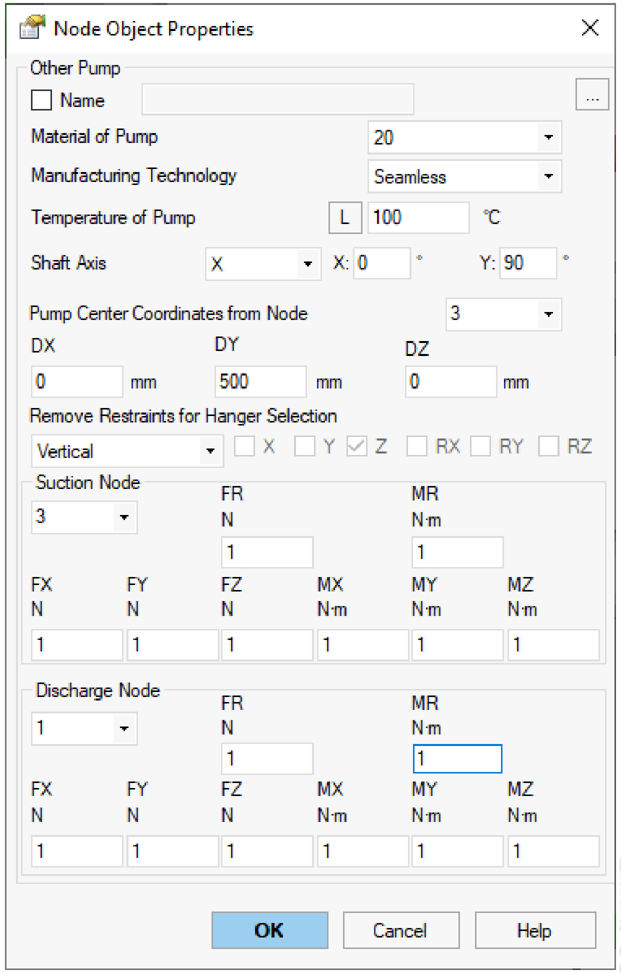


PASS

PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/Start-Prof | New Features

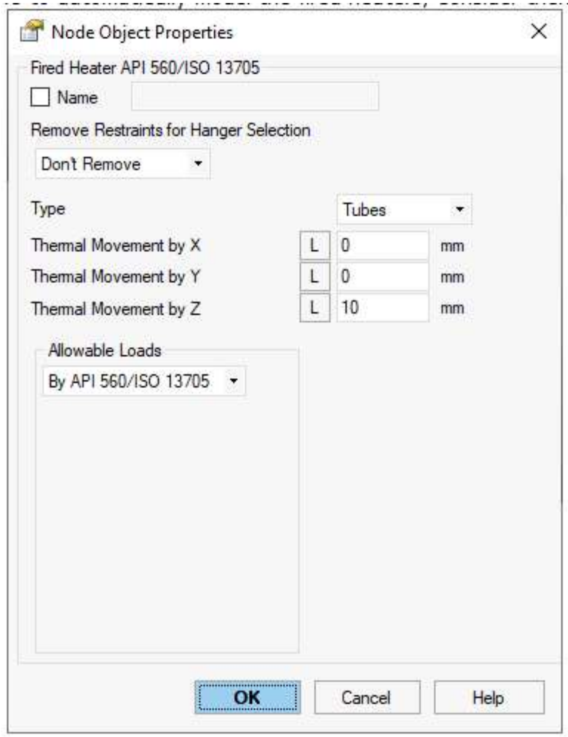
Added new object "Other Pump", allows to automatically model the pumps, consider thermal movements of the nozzles, checks allowable loads

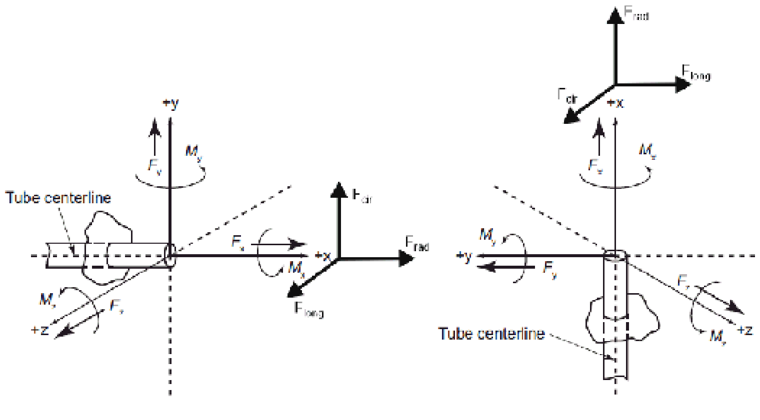


PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

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





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

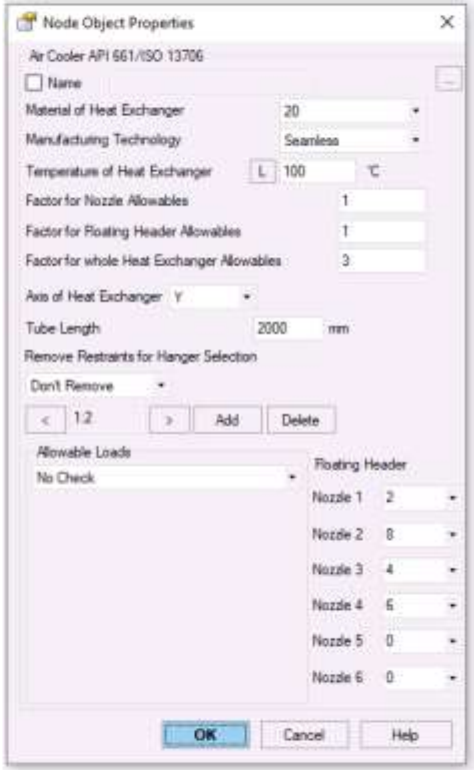
Input | Equipment

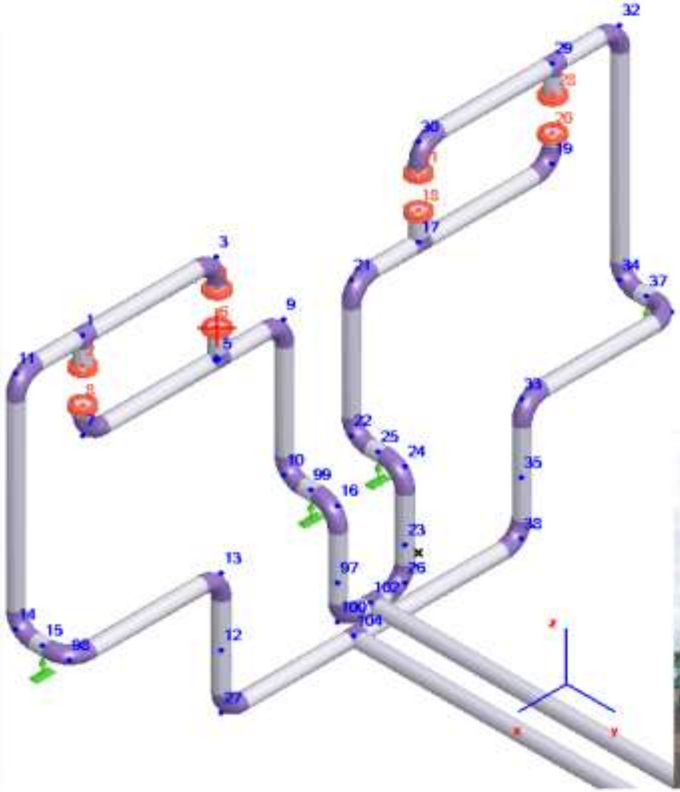
Operating Mode: 1 'main mode' (0) — Load Case: Operating W+P+T — Show Equations — ?

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/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





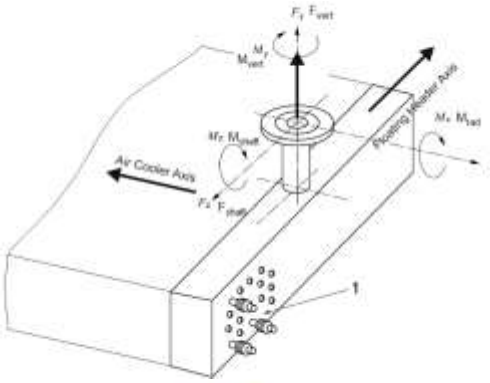


Table 4 — Maximum Allowable Nozzle Loads

Nozzle Size DN (NPS)	Moments N·m (ft·lbf) M_x	M_y	M_z	Forces N (lbf) 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

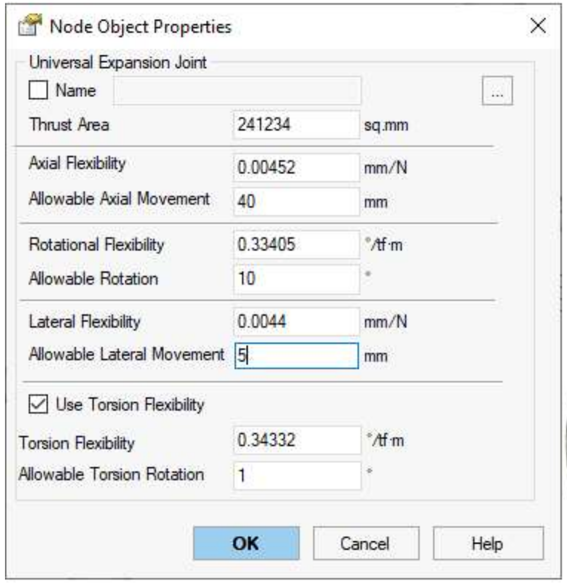
7.1.10.3 The total of all nozzle loads on one multi-bundle bay shall not exceed three times that allowed for a single header.

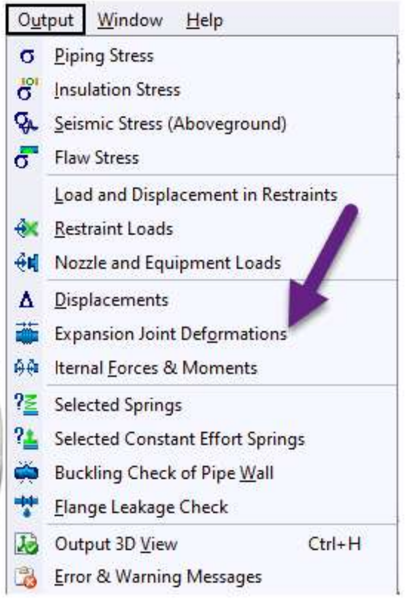
PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

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

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	

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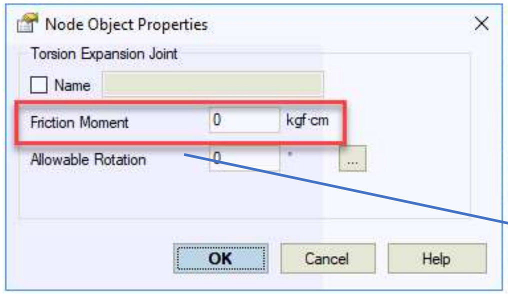
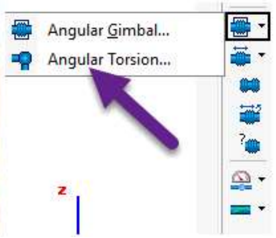
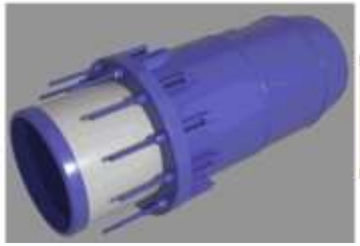
PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

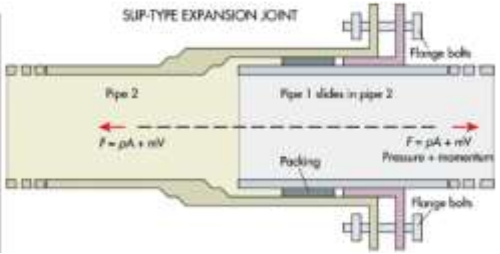
PASS/Start-Prof | New Features

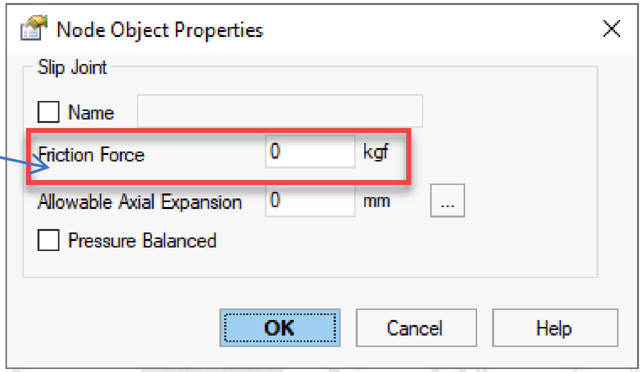
Added new object Torsion Expansion Joint and database of torsion expansion joints, automatically model torsion friction (friction moment) and checks allowable rotation angle





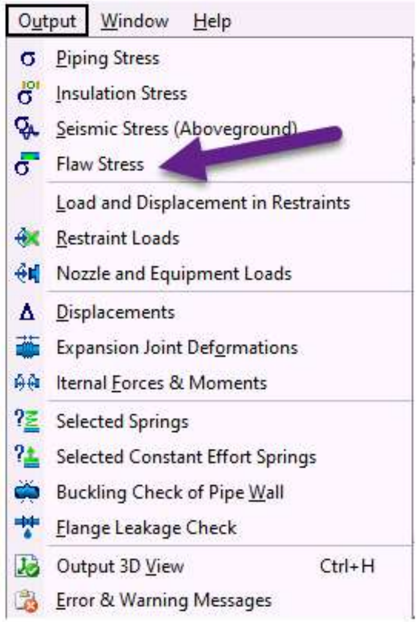


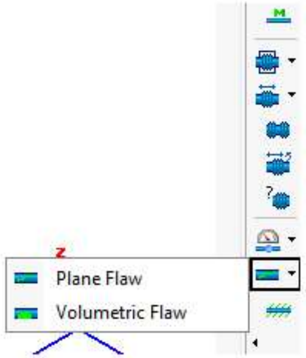


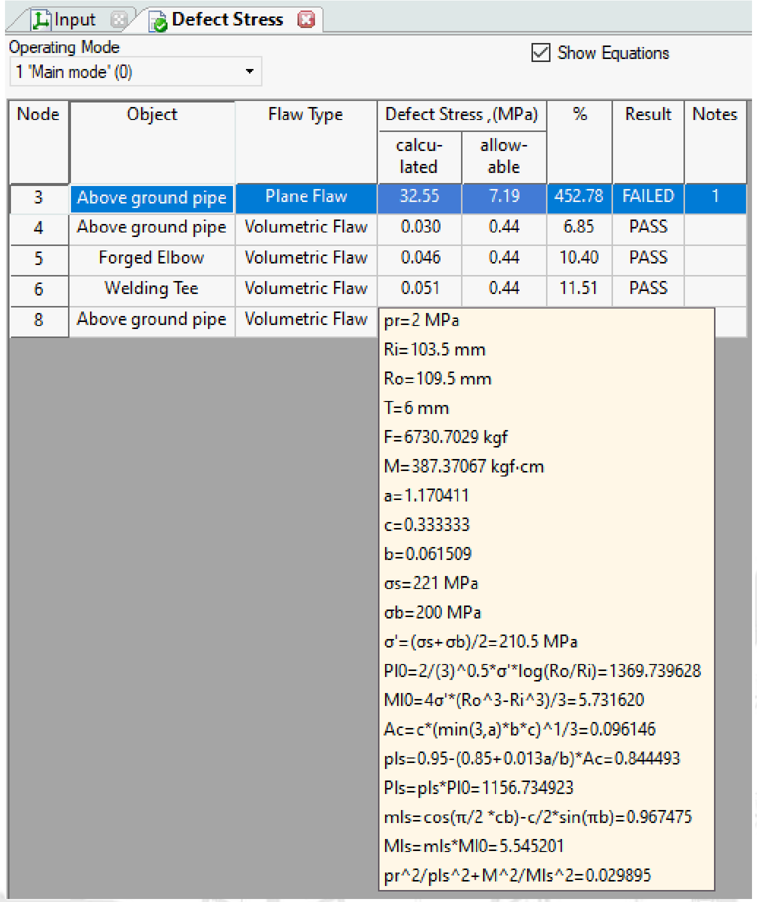


PASS/Start-Prof | New Features

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







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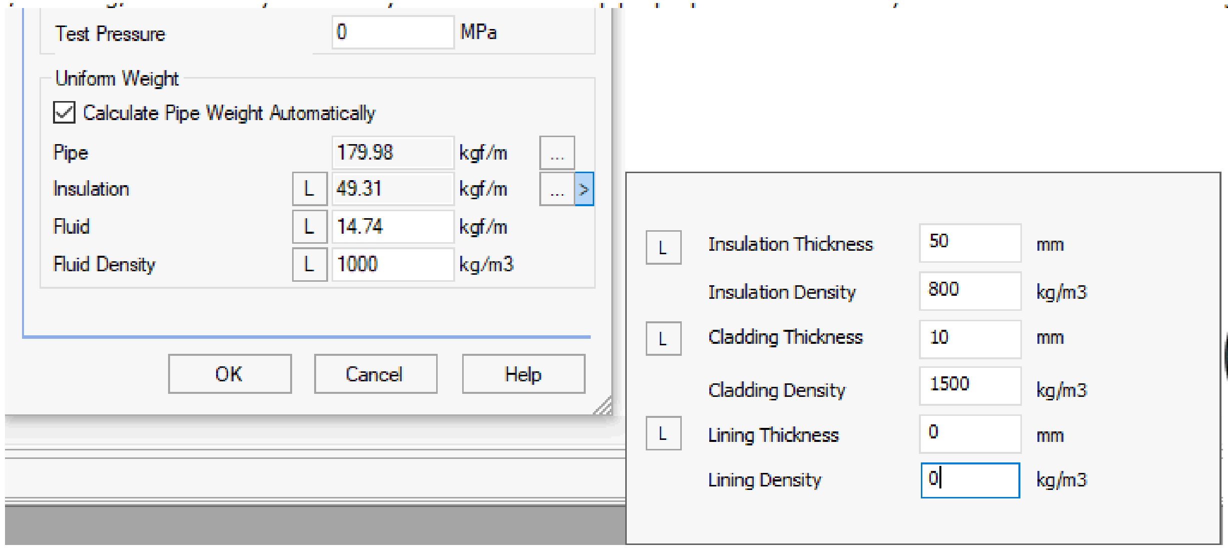
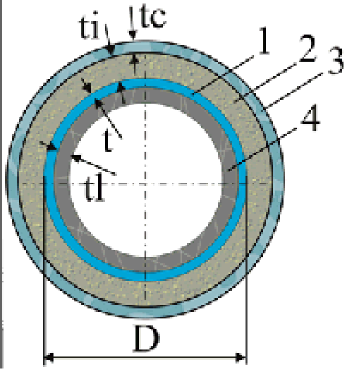
PASS/Start-Prof | New Features

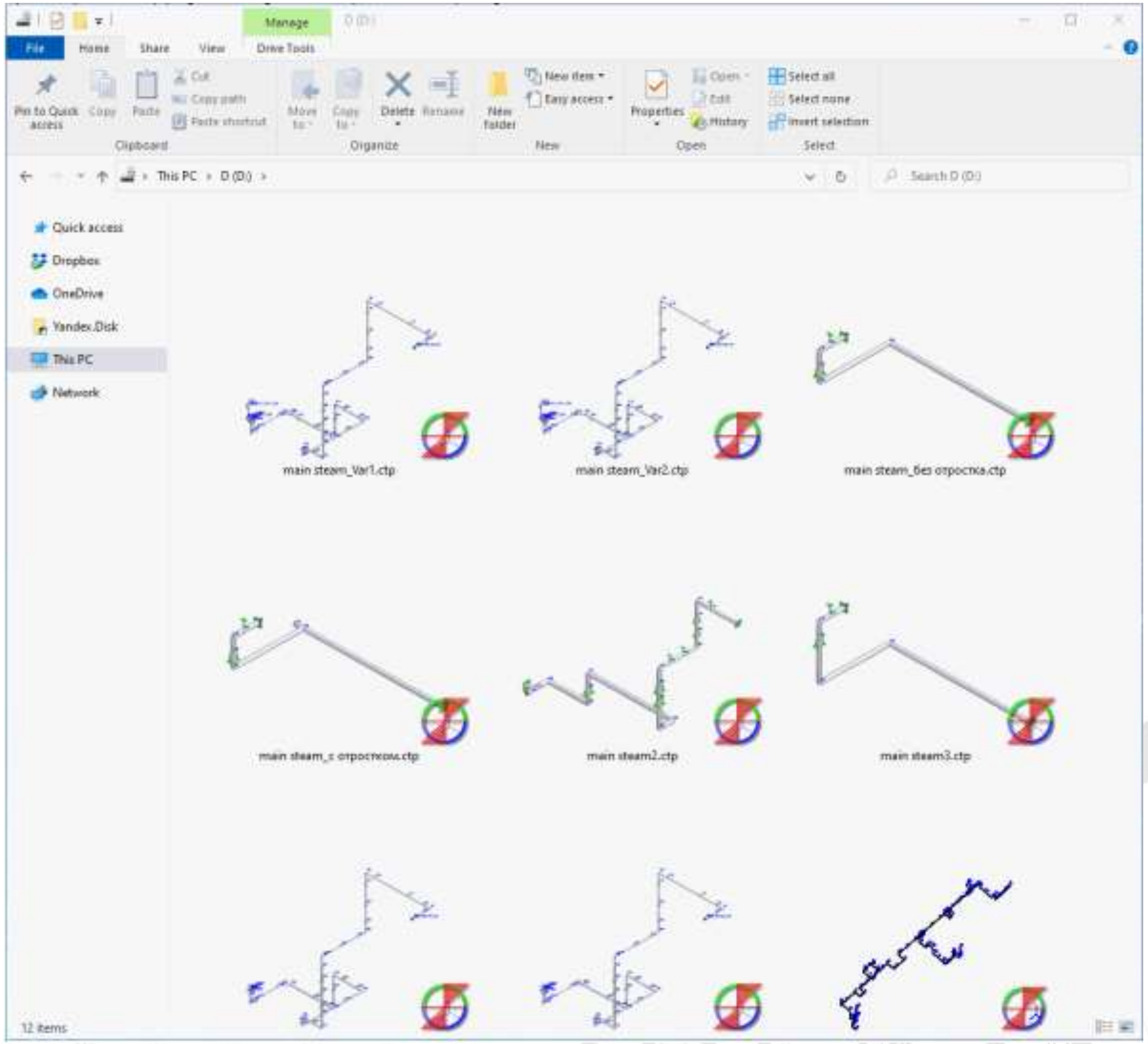
Added ability to specify insulation, cladding, and liner layers density and thickness in pipe properties. The ability to choose an insulation weight from the database still exist





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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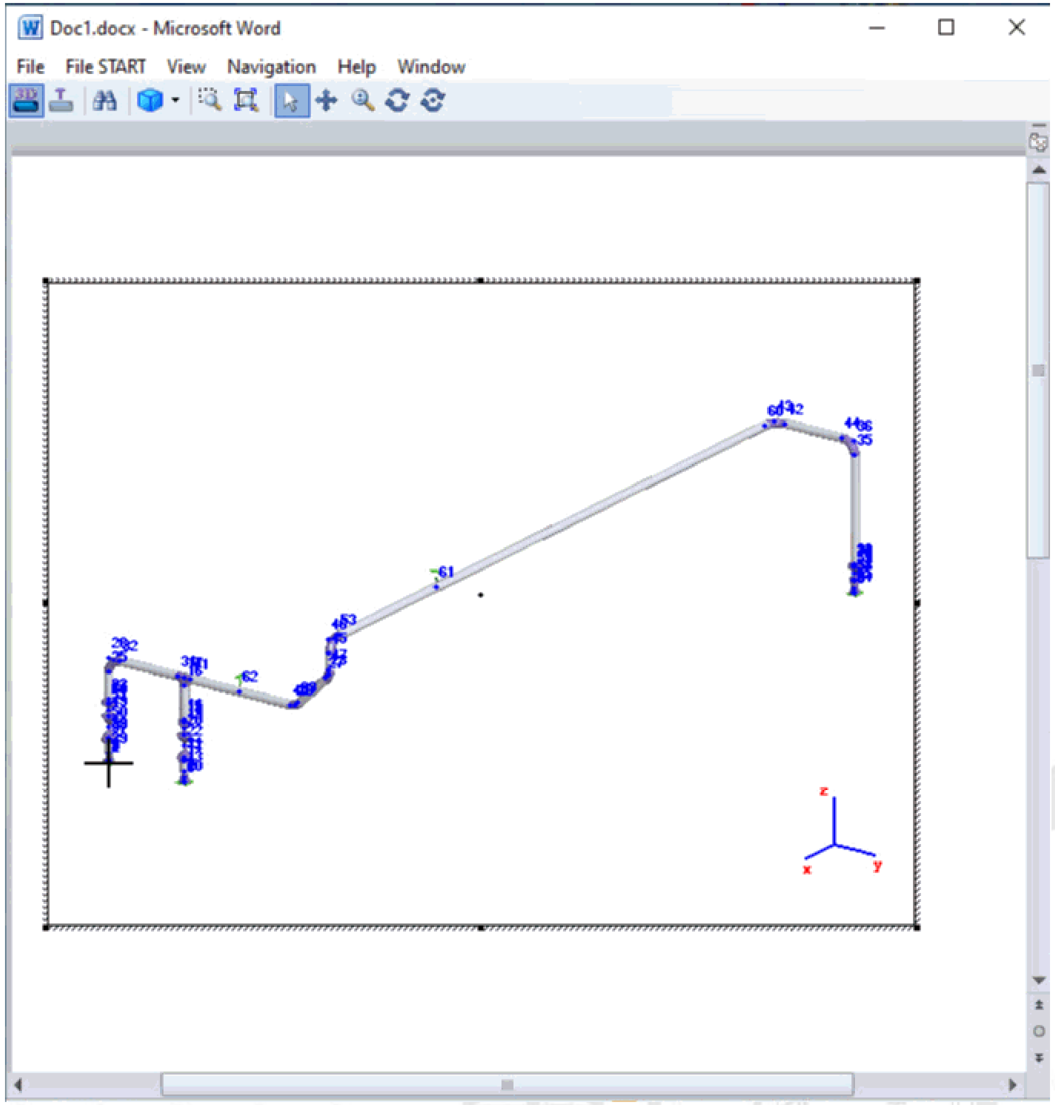
PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

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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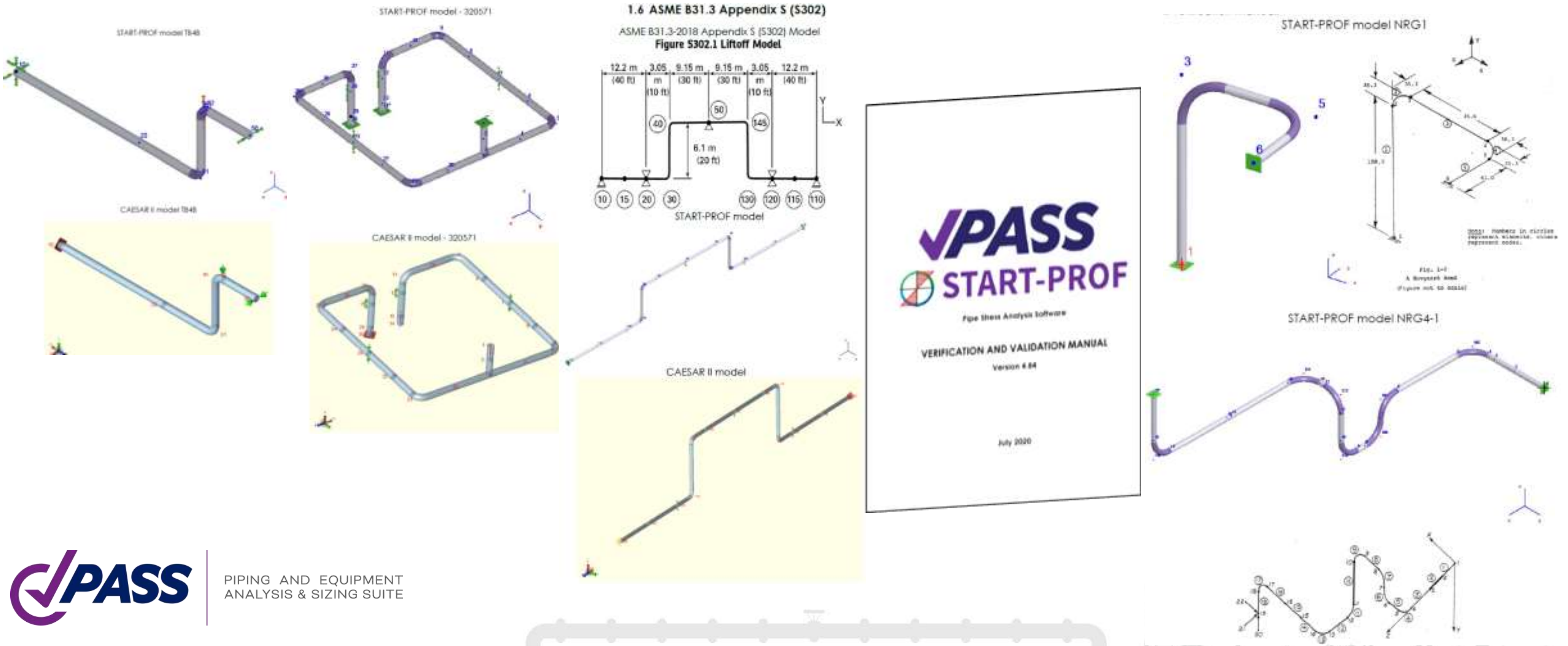
PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

PASS/Start-Prof | New Features

- 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

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 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!

PASS/Start-Prof | Features

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

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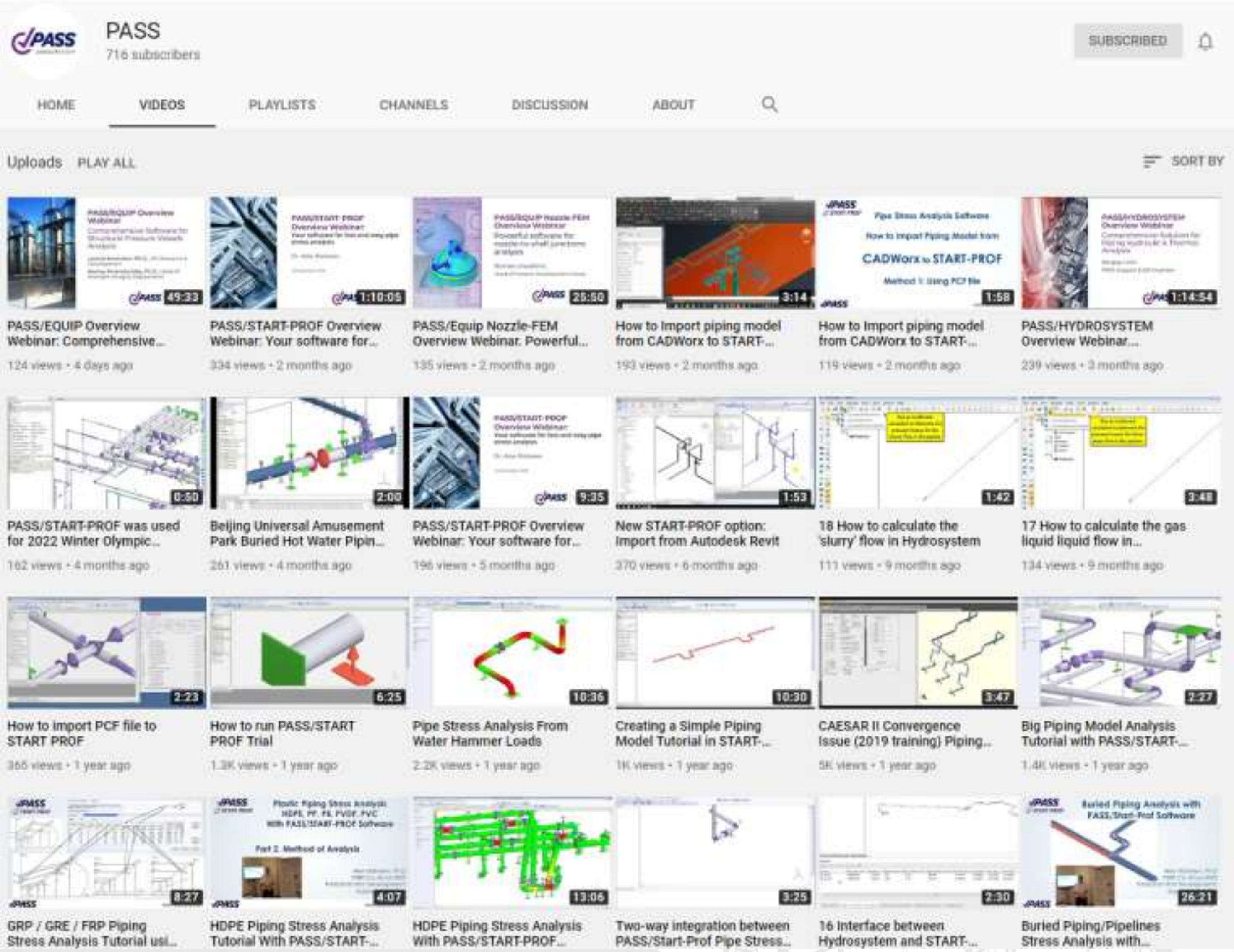

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Simulation and sizing for any piping network considering all applicable national codes.

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configuration includes only worldwide popular standarts.

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

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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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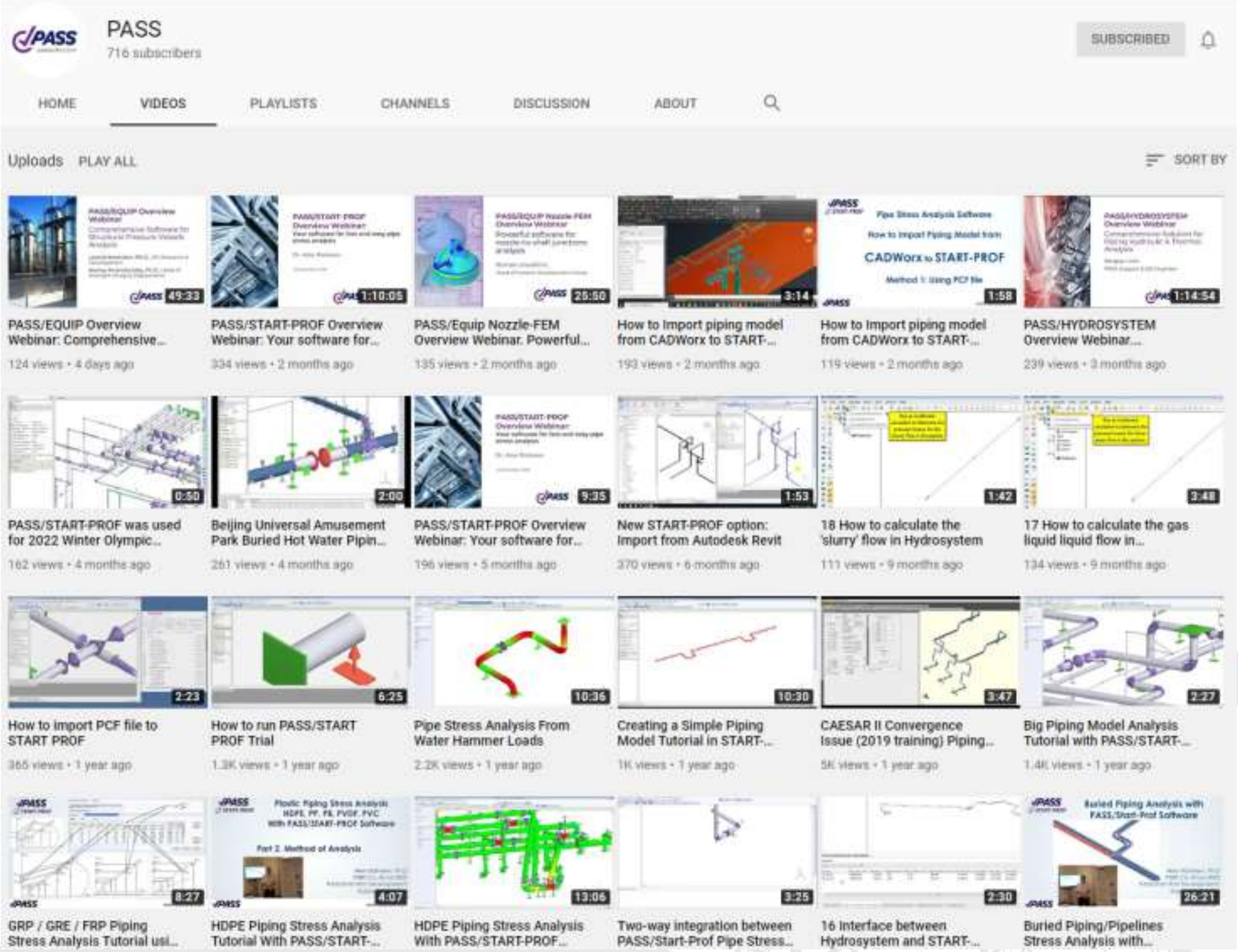

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P: +7 495 225 94 32
F: +7 495 368 50 65
E: sales@passuite.com
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Thank YOU!