

District Heating Networks

Increase Productivity and Save your Time Twice with PASS/START-PROF 4.84

Dr. Alex Matveev, START-PROF Product Owner



PASS/START-PROF





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PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

Smart 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: <u>linkedin.com/in/alex-matveev/</u>

Webinar Agenda – Part 1

Introduction

- Quick introduction of PASS/START-PROF
- Supported codes for district heating networks
- Underground and aboveground pipeline modeling abilities

How to model and analyze district heating pipelines

- Soil model for horizontal, inclined, vertical pipelines
- Polyurethane foam insulation stiffness, expansion cushion stiffness
- Database of polyurethane pre-insulated pipes: LOGSTOR, POWERPIPE, +GF+ Urecon, etc.
- Polyurethane foam insulation stress check
- Check stresses from surface vehicle loads
- Pre-heating analysis
- Single use compensators analysis. Calculate the distance
- Seismic wave propagation analysis



Webinar Agenda – Part 2

PASS/START-PROF features and usability

- Object-oriented piping model creation principle
- Piping object types: pipe, tees, bends, reducers, etc.
- Equipment objects: Pump, Nozzle
- Expansion joint objects
- Material Database for EN 13480 and 13941 codes
- Ring bending calculation using nonlinear FEA
- Databases, wind, ice, snow, seismic loads
- Natural arch of collapse phenomena, horizontal directional drilling
- Pipe and fittings wall thickness calculation
- Analysis reports: Stress in piping, Stress in insulation, Seismic stress, Flaw stress, Restraint loads, Displacements, Expansion joints check, variable spring selection



PASS/Start-Prof

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



PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

Quick Pipe Stress Analysis & Optimal Sizing

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

PASS/Start-Prof | Broad Applicability

PASS/START-PROF is an Industry standard in Russia, Kazakhstan and Belarus for:

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











PASS/Start-Prof | Features

- Increase your Productivity and Save your Time
- Save your Money (we have a friendly pricing policy)
- Increase the Accuracy of Pipe Stress Analysis

PIPING AND EQUIPMENT

ANALYSIS & SIZING SUITE





PASS/Start-Prof | Broad Applicability

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



PASS/Start-Prof | Our Customers



PASS/Start-Prof | Features

- Direct support from developers via e-mail is provided
- Easy to learn, fast and simple to work with for a new pipe stress analyst
- Due to intuitive modern object-oriented user interface, you can start working immediately. Companies can put PASS/START-PROF into application immediately after purchase, significantly reducing costs and save the time without compromising on the quality of end results



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

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



PASS/Start-Prof | Increase Productivity

PASS/START-PROF is a Professional Modern Pipe ASME B31.8 Pig launcher.ctp [ASME B31.8 - 2016] - PASS/Start-Prof 2018 v.04.84 R1 - O 🗙 🗜 File Edit Graphics Insert Tools Service Databases Analysis Output Window Help _ 8 × Stress Analysis Software - 💪 😡 📜 🔚 🗛 🕤 - 🔍 🕱 🕞 🕂 🍳 😋 🧟 📜 67 64 67 | 🔝 📃 🗺 🔫 | 🌮 🖉 🛠 🗞 🙈 🧥 🎂 🔏 | 😚 📑 😅 | 🗙 🗸 🥛 roperties 📜 Input 🛛 PASS/START-PROF Makes Complex Things Pipe (40-80) **1** 2↓ Simple 🗆 Main Start Node You will Get the Same Result, but Faster and Name Input Type Easier Projections/a 0 m, -38.9402 m, Diameter x Tr 1020 mm X 18 m Pipe Material API-5L X80 Mill Tolerance 12.50 Corrosion All 0 mm Pressure, MPi 7.4 MPa Temperature, 40 °C Piping Locati Onshore Pipeline ∃ Uniform Weic No, 443.7 kgf/m, Weld Strengtl 1.00 Safety Factor, 1.00 🗆 Soil Insulation dia 1026 mm Casing thickr 14.9 mm 田 Depth, m 1.51 m, 1.51 m DASS Consider Sub No Consider soil Yes ∃ Soil settlemer 0 m, 0 m, -0 m, 0 Pipe Laying T Open Trench Backfill Soil C 02 Foundation S 02 Insulation typ Other Insulation adl 1.00 PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE 📄 Pipes list 📸 Error and warning messages Press F1 for Help NUM

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



Time to Create the Model

 Time to Analyze and Optimize the Model
 Time to Create the Report

PASS/Start-Prof | Supported Codes

PASS/START-PROF can analyze piping according to 32 piping codes.

The software contains all needed and latest codes for district heating analysis:

- EN 13941-2019
- EN 13480-2017
- GOST R 55596-2013 (Russia)
- CJJ/T 81-2013 (China)
- ASME B31.4-2019 (USA)



Nikolaev's Handbook was a very popular for District Heating Pipeline Thermal Expansion Design 1965-1990x



Since 1998, the Buried Pre-insulated Pipelines with Polyurethane Foam Insulation Began to be Widely Used in Russia.

The Peter Randlov Handbook Become Popular Worldwide since 1997







This piping model can't be properly designed using simple manual methods from handbooks. PASS/START-PROF was already popular for power and process piping design 1970-2000, but the most of district heating design companies was still used the inaccurate manual methods (nomograph) till 2000



Manual analysis methods doesn't allow to properly check the complex design piping systems. It is impossible to check the tee, bend, reducer fitting stresses. Especially for directly buried design



Since 2000 situation start changing. START-PROF became more and more popular for district heating design



Manual analysis methods doesn't allow to properly check the complex design piping systems. It is impossible to check the tee, bend, reducer fitting stresses. Especially for directly buried design



Sometimes the accidents was happened due to the wrong design



In fact PASS/START-PROF Become an Industry Standard for District Heating Network Design. Nowadays the inaccurate manual methods are almost never used



Successfully designed a Lot of district heating systems 219 mm – 1400 mm over Russia since 1998 using PASS/START-PROF



PASS/Start-Prof | Application Examples

Since 2015 START-PROF become popular in China. Already designed a lot of district heating networks in China using PASS/START-PROF, It become an industry standard too





1220 mm X 16 mm, 820 mm X 10 T=150 C, P=1.6 MPa







PASS/Start-Prof | Application Examples

Beijing Universal Amusement Park Buried Hot Water Piping Network Project in PASS/START-PROF







PASS/Start-Prof | Training

PASS/START-PROF Training





PASS/Start-Prof | Training

PASS/START-PROF Training



PASS/Start-Prof | Features

PASS/START-PROF is the Industry Standard for District Heating Network Analysis in China, Russia, Ukraine, Belarus, Kazakhstan. More than 800 District Heating Companies are Active Users



PASS/Start-Prof | Analysis Capabilities

PASS/START-PROF has professional analysis abilities needed for District Heating Stress Analysis:

- Nonlinear analysis of gaps, friction, one-way restraints, rotating rods, etc.
- Special algorithm that improves the nonlinear model convergence on-the-fly without manual tuning (gaps and one-way restraints cycling, friction force cycling etc.). We receive from users the models that didn't converge, put it into our collection and continuously improve that algorithm for past 55 years. It allow to achieve convergence in 99.9% models



PASS/Start-Prof | Analysis Capabilities

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

💣 Pipe Pr	roperties	×	🕈 Project Settings AntiSymmetric1.ctp	×
Pipe	117-118	Pipe is Buried	General Additional Seismic Wind Snow, Ice Other Dynamic	
Name				
Main	Additional Wind,	Snow, Ice	Code ASCE 7-16 (USA)	
Insulation (Outer Diameter	300 mm	Don't Apply Snow Load	
Elevation of	of Start Node	4 m	GB 50009-2012 (China)	
Elevation of	of End Node	4 m	Exposure factor, C ASCE 7-16 (USA) NBC 2010 (Canada)	1 1 margan
Snow Shar	ape Factor	0.4	Importance factor, EN 1991-1-3-2003+A1-2015	
Thermal Co	oefficient	1	Ice Loads EN 1991-1-3 2009 (Belarus)	have been and and and and and and and and and an
Snow (and	d Bain) Load	0.084 kgf/m	Code KBC 2016 (Korea)	
les Chans	Easter	0.0	Importance factor, Is 1 Load Type SUS •	
lce Load	Pactor	7.45763830 kcf/m	Hill Shape No Hill Wind Exposure B	
		7.43703030 Kgi/iii	Basir ice thickness t 7 mm	
Constation	Frates			
	alc factors			
Wind Direc	ction Number	Wind N1 -	- Wind Loads	
Wind Load	d	4.70342237 kgf/m	Code CFE 2008 (Mexico)	
			< 1:1 > Add Delete	
	X: 0	kgf/m	Wind Direction +X •	
	Y: 0	kgf/m	Parameter A	$F_{\perp} = \frac{q}{2}A_{\perp} = m_{\perp}A_{\perp}$
	Z: 0	kgf/m	Basic Wind Speed, V0, m/s 0	
			Outdoor Temperature, s, °C 0	
			Altitude, hm, m 0 Load	
			Surface Roughness, hr, mm 0	
			Total Structure Height, Zt, m 0	
			Terrain Category 1	
	OK	Capacil Help	OK Cancel Help	
	OK	Cancer Thep		
		I		
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PASS/Start-Prof | Analysis Capabilities

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

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



The main goal of dry soil model is to save on the number of supports in whole model to increase analysis speed without loss of result accuracy



Zone #1: Lateral bearing zone (unrestrained) with the length of Lb. Four supports are placed at equal distance

Zone #2: Axial sliding zone (unrestrained) with the length of La. Four supports are placed at a distance increasing exponentially from zone #1 to zone #3

Zone #3: Restrained zone. Supports are placed at 100D spacing, where D - pipe external diameter



Zone #1: Lateral bearing zone (unrestrained) with the length of Lb. Four supports are placed at equal distance



Zone #2: Axial sliding zone (unrestrained) with the length of La. Four supports are placed at a distance increasing exponentially from zone #1 to zone #3



Zone #3: Restrained zone. Supports are placed at 100D spacing, where D - pipe external diameter


Two Long Radius Bend Objects:

- Long radius pipe bend
- Prestressed pipe bend



Prestressed pipe bend – Initial elastic bend curvature in vertical and horizontal plane







Each soil support stiffness consist of vertical, horizontal and longitudinal nonlinear springs

Insulation and Cushions Insulation Type

Cushion Presence

OK

NM

Polyurethane foam

Help

0.67

Yes

Cance

- Horizontal spring consist of 3 springs K1, K2, K3.
- Vertical Spring consist of 2 (or 3) springs K1, K4 (and K2).
- Longitudinal spring K5





PIPING AND EQUIPMEN ANALYSIS & SIZING SUI

Expansion cushion (pad) and polyurethane insulation flexibility PE-Mantel Faktor Ersatzwert PUR-Schaum Β, 1016.2 Stahlrohr B₂ -4.0397В., 83.339 ŏ õ Β, -1.1678 -0.56135 8.8 N/mm² E_{s,Grenz} Key PE-Mantel cushion Dehnpolster 1 PUR-Schaum 2 casing Faktor steif Stahlrohr 3 PUR 4 steel B₁ 1.5026E-06 5 soil B₂ 16.347 D, B₃ 0.1242 Figure 13 - Symbols for bedding constants B, 1.286 $k_1 \quad k_2 \quad k_3$ Key line bedding constant for PUR k_1 line bedding constant for expansion cushion ko k3 line bedding constant for surrounding soil PIPING AND EQUIPMENT Figure 14 - Combined soil spring constant ANALYSIS & SIZING SUITE

👕 Pipe Properties	×					
Pipe 15-16	Pipe is Buried					
Name						
Main Additional Soil						
Properties						
Outer Casing Diameter	1200 mm					
Casing Wall Thickness	14.9 mm					
Consider Soil Movements	No 🔻					
Start Node (15)						
Depth to the Top of Insulation	1.9 m					
Depth to the pipe Axis	2.5 m					
Fed Nede (10)						
End Node (16)	1.0 m					
Depth to the Pipe Avia	2.5 m					
Depurto the tipe Axis	2.3					
Soil						
Pipe Laying Method	Open trench 🔹					
Backfill Soil Type	04					
Foundation Soil Type	01					
Insulation and Cushions						
Insulation Type	Polyurethane foam 🔹					
NM	0.67					
Cushion Presence	No					
	No Vec					
ОК	Cancel Help					

Longitudinal Bi-linear Soil Spring Model



Natural Arch of Collapse Phenomena



Lateral Bi-linear Soil Spring Properties





 R_s – Backfilling Soil maximum lateral force from database



PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

Vertical Tri-linear Soil Spring Properties

Trilinear diagram is used for vertical springs Vertical downward soil stiffness is calculated using the equation $K_{d} = \frac{P_{d}}{\Delta_{d}} = \frac{0.144E_{2}}{(1-v_{2}^{2})\sqrt{D_{c}}}$ $P_{d} = R_{s2}$ Vertical upward soil stiffness is calculated using the equation $K_{u} = \frac{P_{d}}{\Delta_{u}} = \frac{0.072E\eta_{v}}{(1-v^{2})\sqrt{D_{c}}} \left(1-e^{\frac{-2Z}{D_{c}}}\right)$ $\eta_{v} = \begin{cases} 1 \text{ if } Z_{w} \leq Z \\ 0.5(2-Z_{w}/Z) \text{ if } 0 < Z_{w} < Z \\ 0.5 \text{ if } Z_{w} > Z \end{cases}$ $P_{d} = \overline{\gamma}D_{c} \left(Z - \frac{\pi}{8}D_{c}\right) + k \left(\overline{\gamma}Z^{2} \tan 0.7\varphi + \frac{0.7ZC}{\cos 0.7\varphi}\right)$

 $\overline{\gamma}$ – Effective soil unit weight, considering the water liquefaction effect. For horizontal pipes it is calculated using the following method:

• If the pipe is above the water level, then

$$\overline{\gamma} = \gamma$$

• If the pipe is below the water level, then

$$\overline{\gamma} = \gamma \frac{Z - \frac{\pi}{8}D_c - Z_w}{Z - \frac{\pi}{8}D_c} + \frac{\gamma_s - \gamma_w}{1 + e} \frac{Z_w}{Z - \frac{\pi}{8}D_c}$$

• If the water level is within the pipe then

$$\overline{\gamma} = \gamma \frac{Z - Z_w - \frac{\pi}{4}D_c + V_w/D_c}{Z - \frac{\pi}{8}D_c} + \frac{\gamma_s - \gamma_w}{1 + e} \frac{Z_w + \frac{\pi}{8}D_c - V_w/D_c}{Z - \frac{\pi}{8}D_c}$$
$$V_w = \frac{D_c^2}{8} (\alpha - \sin \alpha)$$



PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE



You can define the depth from the surface at any node of the pipeline. Depth, water height and subsidence can change along the pipe length



For inclined and vertical pipes:

- The bilinear properties of each soil spring (stiffness, water buoyancy, spring displacement etc.) are calculated using individual depth of the specific spring
- Stiffness of the springs K3, K4 and K5 are also depend on the pipe angle to the horizontal plane (from 0 to 90 degrees). For vertical pipe elements the vertical stiffness K4 behavior becomes the same as behavior of horizontal spring K3



PASS/START-PROF can automatically calculate the mixed pipeline models with above ground pipes, horizontal pipes, inclined pipes, vertical pipes.

You don't need to do something manually. Just draw the pipeline "as is" and run analysis









PASS/START-PROF can Automatically select the project class or it can be specified manually



To calculate the ring bending stresses the finite element model of pipe cross-section is used. The loads from the soil weight are calculated and applied for each point of pipe cross-section at whole perimeter





PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

Soil is modeled as discrete springs around pipe perimeter. The springs are switched off if tension is detected (usually at the top of the pipe). Flexible insulation also modeled if exist

Internal pressure and product hydrostatic pressure is applied. The analysis consider geometric nonlinearity, the additional internal pressure stiffening effect is taken into account





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



Pipe and Insulation Strength Against the Surface Heavy Truck Loading $\sigma_y = \frac{3P}{2\pi} \frac{h_i^3}{(h_i^2 + x_i^2)^{5/2}}$ Ζ $D_c/2$ $D_c/2$ xi $\sigma_x = \xi \sigma_x$ ៍ 👫 Trubodetal 1 🛛 Project tree. **д** > Outside Diameter, D 1020 mm Pipe Wall Thickness, S 12 mm 08-05-2020 Ambient Temperature °C q₁ Object Numbe Operating Temperature 100 °C Code Pipe Weight 149.08 kgf/m CJJ/T 81-2013 Heating network (China) Fluid Weight 798.01 kgf/m D 67.55 Insulation Weight kgf/m Pipe, Above ground Operating Pressure 16 MPa $D_c/2$ 🗯 Pipe, Buried - Wall thickness analysis.: 0 N Material 20 Him Pipe elongation: 0 -O Insulation strength: 0 Surface load Long-radius bend stability: 0 Type Single force 🗰 Pipe strength against surface load: 1 P Bend Axle load, P 1000 - Tee - Reduce - Cap Distributed load, a 50 kaf/m L-, Z-, U-shaped pipe loops. Above-ground or trench Soil L-, Z-, U-shaped pipe loops. Above-ground and tren Backfill Soil Code 04 D_c L-, Z-, U-shaped pipe loops. Buried Foundation Soil Code 01 Output Depth, Z 0.6 m STRENGTH CONDITIONS NOT MET PIPING AND EQUIPMENT Equivalent stress, MPa operation 437.92 allowable 133 ANALYSIS & SIZING SUITE

- Pre-heating analysis
- Single use compensators analysis + Database + Distance Calculation





 $L_{max}/2$

L

PASS/START-PROF Automatically calculates networks with single use compensators



Automatic Analysis of District Heating Networks Installed with Pre-Heating. Friction factors can be varied for heating and cooling

General Additional Seism	ic Wind, Snow,	Ice Other Dynamic	
Spring and Constant Force Han	iger and Support S	Gelection	
Spring and Constant Force Se	lection	Don't perform	•
Special Analysis: Single Use Cor	mpensator\Pre-he	ating	
Special Analysis: Single Use Cor Analysis Mode	mpensator \Pre-heating	ating	-

Full friction when heating up, full friction when cooling





Full friction when heating up, half friction when cooling



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



Added LOGSTOR, POWERPIPE, +GF+ Urecon Polyurethane Pre-insulated Pipe Jacket Sizes Database for district heating and district cooling networks

Ð	GRUN.ctp [GOST R 55596-2013] - PASS/Start-Prof 2018 v.04.84	4 R1 - [GRUN.ctp]			
Eile Edit View Navigation	Graphics Insert Tools S <u>e</u> rvice D <u>a</u> tabases <u>A</u> nalysis O <u>u</u> tput <u>W</u> indow <u>H</u> elp		_ & ×		
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Properties # ×	🙀 Trubodetal1 🐵 🕒 Input 😮		÷ 🚬		
Pipe (2-12) •	<u>,</u> T		C -		
2 2		Tipe Properties X		, I PUR Insulation Jacket Properties	×
🗆 Main		Pipe 2-12 Pipe is Buried			
Start Node 2			6	Codes	
End Node 12		Name	D		
Name		Main Additional Soil			
Input Type Projections		Properties	美	FOCT 30732-2006 Channel Series 1	
Projections/a 0 m, 0 m, 1.5 m		Outer Casing Diameter 800 mm	=1)=	Chinese National Standard	ange
Diameter x ir 030 mm X 10 mn		Casing Wall Thickness 10 mm	=	LOGSTOR Add Series 3	Add
Mill Toleranci 0 mm			×		uu
Corrosion All 0 mm		Consider Soil Movements No -	<u>—</u>	+GF+ Urecon Delete	elete
Pressure, MPi 1.6 MPa			7777		21000
Test Pressure, 2 MPa		Start Node (2)	2 C		
Temperature, 140 °C		Dopth to the pipe Avia	프	Diameter And Thickness of the Jacket	
🗉 Uniform Weic No, 0.153 tf/m, N			(<u>e</u>) =		
Additional				Type Do mm Do mm Di mm Th mm	Add
Weld Quality 1.00			<u>+</u> -		
Weld Quality 0.80		End Node (12)	5 <u>+</u>	Series 1 20.9 20 90 3 De	elete
Weld Quality 0.90	12		<u>_M</u>	Series 1 33.7 25 90 3	
🗉 Soil		Depth to the Pipe Axis 0 m		Series 1 42.4 32 110 3	rint
Outer Casing 800 mm			🚟 =	Series 1 40.2 40 110 2	
E Denth m 15 m 0 m			88	Series 1 48.3 40 110 3 Exp	ort
Consider soil No	10	Soil	z	Series 1 60.3 50 125 3	
Pipe Laving T Open Trench		Pipe Laying Method Open trench 🔹	?	Series 1 76.1 65 140 3	
Backfill Soil C 01		Backfill Soil Type 01	🕰 •	. Series 1 99.0 90 160 2	
Foundation S 01		Foundation Soil Type 01			
Insulation typ Polyurethane for		Insulation and Cushione	x 7	Series 1 114.3 100 200 3.2	
Insulation adl 0.67		Insulation Type Polyurethane foam	D.	Series 1 139.7 125 225 3.4	
Cushion pres Cushions absent		Insulation adhesion factor 0.67		Series 1 168.3 150 250 3.6	
Error and warning messages		Cushion Presence Yes -	₽ ×		
Type Node/pipe Description	n Help		^	Save	Help
Notes Node:4 (W305) Tp	убопровод поднимается над опорой (Рабочее состояние) - 1.'Main mode' ?	OK Cancel Help		5ave (105e	nop
Notes Node:4 (W305) Tp	убопровод поднимается над опорой (Рабочее состояние) - 1.'Test mode'				

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





Modeling of Soil Subsidence, Frost Heaving, Landslide, Seismic Fault Crossing It is modeled as soil movements at the both ends of the each pipe at X, Y, Z directions



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 ANALYSIS & SIZING SUITE

🚰 Project Settings 1snip.ctp		×
General Additional Seismic W	ind, Snow, Ice Other Dynamic	
Analyze seismic acceleration code	User defined Acceleration	T
Horizontal Acceleration (X)	1 G's	
Horizontal Acceleration (Y)	1 G's	
Vertical Acceleration (Z)	0.7 G's	
Perform Buried Pipeline Seismic Wave	Propagation Analysis	
Buried Pipeline Seismic Analysis Code	ASCE 2001(ALA V SNIP/SP/GOST	
Characteristic Period of Ground Motion in pipe buried site	GB 50470 sec	
	a	
	OK Cancel Help	



PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE



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







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

Linput 🐵 Stress 😰									
Operating Mode Show Equations Stress Range from C						lange from Op	peration to	Cold	
1.1 'Soil Seismic Wave Propaga Add Axial Force and Torsion Stress ?							ress ?		
Object	Start	Buried piping Seismic Check, (MPa) Burie		Buried piping Seismic Check, (%)			Notes		
	node	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	[ɛa]=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			
	0	510.01	065.27	52.0	0 1005	0 2020	67 5		

📕 Input 💿 🔂 Stress 🚺 Operating Mode Show Equations Stress Range from Operation to Cold ? Maximum -Add Axial Force and Torsion Stress Expansion Stress Range, (MPa) Buried piping Seismic Check, (MPa) Buried piping Seismic Check, (%) Object Start Hoop Primary Loads Primary&Secondary Notes End Stress in Hot State, (MPa) Stress, (MPa) Loads Stress node in Hot State. (MPa) Sh F*E*Sy % Seq F*Sy % SI F*Sy % Seq F*Sy % F*Sy % Se Sa % SL Allow % Σ Allow % SI Buried pipe 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 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 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 q 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 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 85 173.75 48.9 217.18 31.6 217.18 42.9 52.9 67.5 8 24.69 180.99 13.6 153.55 217.18 70.7 68.55 93.23 510.81 965.27 0.1985 0.2939 217.18 54.1 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 39.1 732.51 965.27 75.9 0.1589 0.2939 2 85 173.75 48.9 217.18 39.1 568.23 965.27 58.9 0.1588 0.2939 54.0 Buried pipe 30.03 180.99 16.6 169.99 217.18 78.3 84.99 217.18 39.1 84.91 065 27 50.0 0 1004 0 2020 64.1 7 85 173.75 48.9 24.98 180.99 13.8 151.70 217.18 69.9 66.70 217.18 30.7 217.18 42.2 100.01 91.60

Tension strain limit 5%

Compression strain limit

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

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

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

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










Concentric Reducer Eccentric Reducer Name Repexoz KORLeerTrovecoxvil K-219x10-1 Date 16=12-2013 Description		Reducer Object	Node Object Properties \times Concentric Reducer T_1 T_2 T_2 T_2 T_2 T_2	ASME B31J
○ Cate Properties From Machingr Pipe ○ Catoulate Weight Automatically Material Naterial National Weid Quality Factor, E 1 Maximum Dameter, D1 219 mm Trackness, T1 6 Trackness, T2 5 mm Cone Length, L 122 0 weight 3 kgf Note State	Concentric Reducer Eccentric Reducer		Image: Second construction of the second consecond consecond construction of the second constructi	Project Settings Ex4-Pump.ctp General Additional Seismic Wind, Snow, Ice Other Dynamic Date [6=12-2013] Description Piping Type: All Stress Analysis Code: ASME B31.3-2018 Process Piping (USA) Use Eh for Support Loads Use Eh for Support Loads Use ASME B311 SIFs and k-factors Use we ractors Maximum f=1.2

Manufacturing Technology	Standard	Material	Size	Diameter max., mm	Diameter min., mm	Nominal Diameter max, mm	Nominal Diameter min, mm	NPS max, in	NPS min, in	Schedule	Thickness at Dmax, mm	Thickness at Dmin, mm	Mill Tollerance at Dmax, mm	Mill Tollerance at Dmin, mm	Full Length, mm	Cone Length mm	Î	
-	-	-	-	-	-	•	-	-	-	-	-							
not set>	ASME B16.9-2012	<not set=""></not>	20-10	26.7	17.3	20	10	3/4	3/8	30	0	0	0	0	38	22.8		
not set>	ASME B16.9-2012	<not set=""></not>	20-10	26.7	17.3	20	10	3/4	3/8	5S	0	0	0	0	38	22.8		
not set>	ASME B16.9-2012	<not set=""></not>	20-10	26.7	17.3	20	10	3/4	3/8	20	0	0	0	0	38	22.8		
not set>	ASME B16.9-2012	<not set=""></not>	20-10	26.7	17.3	20	10	3/4	3/8	10	0	0	0	0	38	22.8		
not set>	ASME B16.9-2012	<not set=""></not>	20-10	26.7	17.3	20	10	3/4	3/8	10S	0	0	0	0	38	22.8	-	
not set>	ASME B16.9-2012	<not set=""></not>	20-10	26.7	17.3	20	10	3/4	3/8	40S	0	0	0	0	38	22.8		
(not set>	ASME B16.9-2012	<not set=""></not>	20-10	26.7	17.3	20	10	3/4	3/8	120	0	0	0	0	38	22.8		
not set>	ASME B16.9-2012	<not set=""></not>	20-10	26.7	17.3	20	10	3/4	3/8	160	0	0	0	0	38	22.8	~	





Name			
Length	400	mm	
Weight	176.4	lbf	
Flange Leakage Ch	neck	Yes(two flanges)	•
Leakage Check Me	ethod	Kellogg / Eq. Pres	ssu 🔻
Flange Code		ASME B16.5/B16	5.4 -
Gasket Effective D	iameter, G	210 m	m
Nominal Pressure F	N / Class	300	•
Material Group		1.1	•

Automatic Flange Leakage Check



 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

where

- Object "Pump ISO 9905", "Pump ISO 5199"
- etc.

78	Mode Object Properties X
	Pump API 610/ISO 13709
	Name
533	Material of Pump 20 -
.396	Temperature of Pump L 50 °C
741	Manufacturer Allowable Multiplier 1
	Table Nozzle Loading Factor 2
	Schaft Axis X •
	Pump Center Coordinate from Node 742 -
555	DX DY DZ
715	0 mm 2500 mm 0 mm
.538	Remove Restraints for Hanger Selection
597	Don't Remove
	Suction Node
	742 • Side • Set Loads
	Discharge Node
	715 • Side • Set Loads
	OK Cancel Help

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):

$[F_{\rm RSA}/(1,5\times F_{\rm RST4})] + [M_{\rm RSA}/(1,5\times M_{\rm RST4})] < 2$	(F.1)
$[F_{RDA}/(1,5 \times F_{RDT4})] + [M_{RDA}/(1,5 \times M_{RDT4})] < 2$	(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.)

$F_{\text{RCA}} < 1,5(F_{\text{RST4}} + F_{\text{RDT4}})$	(F.3)
$M_{\rm YCA} \mid < 2.0(M_{\rm YST4} + M_{\rm YDT4})$	(F.4)
$M_{\rm RCA} < 1.5(M_{\rm RST4} + M_{\rm RDT4})$	(F.5)

 $F_{\text{RCA}} = [(F_{\text{XCA}})^2 + (F_{\text{YCA}})^2 + (F_{\text{ZCA}})^2]^{0.5}$

where	
$F_{XCA} = F_{XSA} + F_{XDA}$	where
$F_{YCA} = F_{YSA} + F_{YDA}$	$M_{\rm XCA} = M_{\rm XSA} + M_{\rm XDA} - [(F_{\rm YSA})(zS) + (F_{\rm YDA})(zD) - (F_{\rm ZSA})(yS) - (F_{\rm ZDA})(yD)]/1\ 000$
$F_{\text{ZCA}} = F_{\text{ZSA}} + F_{\text{ZDA}}$	$M_{\rm YCA} = M_{\rm YSA} + M_{\rm YDA} + [(F_{\rm XSA})(zS) + (F_{\rm XDA})(zD) - (F_{\rm ZSA})(xS) - (F_{\rm ZDA})(xD)]/1\ 000$
$M_{\rm RCA} = [(M_{\rm XCA})^2 + (M_{\rm YCA})^2 + (M_{\rm ZCA})^2]^{0.5}$	$M_{ZCA} = M_{ZSA} + M_{ZDA} - [(F_{XSA})(yS) + (F_{XDA})(yD) - (F_{YSA})(xS) - (F_{YDA})(xD)]/1 \ 000$

🖉 🖓 Input 🐵 🔂 Equip	ment 😡												
Operating Mode	Load	l Case					Show E	Equations		_			
1 'main mode' (0)	 Ope 	erating W+P+T	•	?									
Object	Start End node	Туре	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	2([MradT1] +	[MradT2])=2*	(1760+1760)=7040	N·m

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.

Ctrl+H



- 2													
	Operating Mode	Load Case	e			Axis							
	1 '操作模式' (0)	 Operating 	yW+P+T →			Local axis (D	esign/Allowable) 🔻	?					
	Node Number	Тире	Local avis	Avial (mm)	Allowable (mm)	Shear (mm)	Allowable (mm)	Angular (°)	Allowable (°)	Torsion (°)	Allowable (*)	Summany	Notes
	Node Number	iype	Local axis		Anowabie, (mm)	Sincar, (min)	Anowabie, (mm)	Angular, ()	Anowabic, ()		Anowabic, (C		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	
		- · - · · ·		-		-				10.00			

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



Mode Object Properties		>
Flange Pair	8.51 in	
Flange Leakage Check Yes Leakage Check Method Flange Code Gasket Effective Diameter, G Nominal Pressure PN / Class	PVP / Code case 2: ASME 25.875 in 300	
Material Group Factor, Fm	1.1	•

Flange Object

Automatic Flange Leakage Check:

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



🖟 Input 📴	📜 Input 🕜 🍃 Flange leakage 🔞											
Operating Mode		Submode										
1 'Operation mode	e' (0)	 Operation (all loads) 	• ?									
Node Number	Object	Flange on the side of node	Pipe outside diameter, (mm)	Temperature, (°C)	Axial Force, (kgf)	Bending Moment, (kgf·m)	Parameters	Condition, (MPa)		Notes		
								calcu- lated	allow- able	%	1	
3	Flange Pair	-	219.08	400	-1000	1499.98	1.60 MPa	4.29 MPa	17.36 MPa	24.70		



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

Test Pressure	0	MPa						5
Uniform Weight								
Calculate Pipe Weigh	nt Automatically							
Pipe	179.98	kgf/m						
Insulation	L 49.31	kgf/m	>					ti, ltc
Fluid	L 14.74	kgf/m			Insulation Thickness	50	mm	1 2
Fluid Density	L 1000	kg/m3						
					Insulation Density	800	kg/m3	4
				L	Cladding Thickness	10	mm	
OK	Cancel	He	lp		Cladding Density	1500	kg/m3	u
			116	L	Lining Thickness	0	mm	
					Lining Density	이	kg/m3	



Guide (Single-Direction) Guide (Double-Direction)	Image: Second state of the second	Spring Hanger	Spring Hanger Name Number of rds Load Range 25 Alowable Load Safety Factor Hanger Operation Load 0 bf Flexibility of one spring 0 bf Stiffness of one spring 0 0 bf/mm Test State Locked Rod Length 3 0 K CK Help
 Automatic Variable Spring Selection Automatic Constant Spring Selection 	Node Object Properties Hinged Anchor Image: Check Allowable Loads Allowable Loads Allowable Loads Image: Loads in Local Coordinates FX Image: Def for the former term of te	Spring Support	Node Object Properties × Spring Support I Number of supports 1 Load range 25 Alowable Load Safety Factor 1 Restraint Operation Load 0 bf Imm/bf assembly 0 Stiffness of one spring assembly 0 Test State Locked Friction Factor 0.3
Guide Su	Double direction Guide Name Friction Factor 0.3 Use Gaps Lateral Gaps 10 mm Gap Upwards 10 mm Check Allowable Loads Allowable Loads Loads in Local Coordinates FX 0 bf FY 0 bf FZ 0 bf FZ 0 bf FZ 0 bf	Constant Hanger	Node Object Properties Constant Hanger Name Number of rods 1 Force Along Z Axis 0 m Test State Locked Unbocked Help

Custom Non-Standard Restraint Object



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

		Tode Properties X	1		
		Node 32 Name			
		Description			
		Base Node of Segment x· 5.577 m Y· 0 m 7· 0 m		Cold Spring (Pre <u>c</u> ompression)	
				Cold Spring (Prestre <u>t</u> ch)	
		Main Deformation Restraint	X	Move and Rotate Restraint	
	•	Restraint Movement From Equipment Thermal Expansion in Hot State	<u>.</u>	Relative Rotational Displacement in Node	
		DX DY DZ RX RY RZ cm cm cm ° ° °	<u>_</u>	Relative Linear Displacement in Node	
	32*	2 3 4 5 6 From Equipment Thermal Expansion in Test State	=:=	Sciencia Az ale a Mauserent	
		DX DY DZ RX RY RZ cm cm cm ° ° °		Seismic Anchor Movement	
		0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0			
		DX DY DZ RX RY RZ cm cm cm ° °			
		0 0 0 0 0 0			
		-			
	Help				
PIPING AND EQUIPMENT	?				
ANALYSIS & SIZING SUITE	?	OK Cancel Help			

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



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

Mutual Displacemen	t of Pipe Ends	
Relative to the Node	e Node (29) 🔹	
Around X Axis	2 *	
Around Y Axis	1 *	
Around Z Axis	1	
	OK Canad	Liele
	OK Cancel	Help
Node Object Pro	OK Cancel	Help
Node Object Pro	OK Cancel	Help
Node Object Pro Linear Deformation i Mutual Displacemen	OK Cancel	Help
Node Object Pro Linear Deformation i Mutual Displacemen Relative to node	OK Cancel	Help
Node Object Pro Linear Deformation i Mutual Displacemen Relative to node Along X Axis	OK Cancel	Help
Node Object Pro Linear Deformation i Mutual Displacemen Relative to node Along X Axis	OK Cancel	Help
Node Object Pro Linear Deformation in Mutual Displacemen Relative to node Along X Axis Along Y Axis	OK Cancel	Help



PASS/Start-Prof | START-Elements

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

🕂 Trubodetal3 🖸			
Project tree 🔍 🗶 🗶	Outer Diameter, D	0 mm	
Data 15-06-2020	Operating Temperature	0°C	
Object Number	Mill Tolerance	0 %	
Code	Corrosion Allowance	0 mm	
EN 13941-2019 District heating piping systems			
Wall thickness analysis.: 0	Factor 'E'	1	— i i i i i i i i i i i i i i i i i i i
Pipe Bend. Wall thickness analysis.: 0			
Forged concentric reducer. Wall thick Forged eccentric reducer. Wall thickn			
	Material	•	
	Pipe	Electric-welded 🔹	
		0 kef (an am	
	Wall Thickness S	0 mm	



PASS/Start-Prof | START-Elements

Pipe Span Length Analysis

Longitudinal Stability Analysis





PASS/Start-Prof | START-Elements

Calculate Wall Thickness Under Vacuum and External Loading

> PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

Simple Expansion Loop Analysis

Project tree 4	Outside Diameter, D	0 mm
Data 09-06-2020	Operating Temperature	
Object Number	Pipe	Flectric-welded
Code		
GOST 32388-2013 Process piping (Russia)	Weld Quality Factor for Pressure	
Pipe. Above ground	Mill Tolerance	0 mm
Wall thickness analysis.: 0		
Analysis of allowable load capacity	fo	
Stability analysis.: 0	Availability of stiffening ribs	
Span length analysis.: 0		
🖶 🗯 Pipe. Buried		
Bend	Trubodetal1 🔯	
Hardwer	Project tree + ×	
		Pipe Diameter, D 0 mm Stretch factor (without 0
	Data 09-06-2020	Pipe Wall Thickness, S 0 mm Operating Pressure 0 kgf/sg.cm
	Object Number	Mill Tolerance 0 mm
🗄 🔨 L-, Z-, U-shaped pipe loops. Above-gr	Code	Constina Tomostium 0 °C Evansion isist back P 0 m
L-, Z-, U-shaped pipe loops. Above-gr	GOST 32388-2013 Process piping (Russia)	Ambient Temperature 0 °C Expansion joint back, B 0 m
. L-, Z-, U-shaped pipe loops. Buried		Pipe Fluid Insulation
	🕀 🗰 Pipe. Buried	0 kof/m 0 kof/m
	er end	Friction Factor in Resting 0.3 Allowable load on end 0 koff
	Reducer	Supports support
	i⊞∰ Flange	Weld Quality Factor for:
		pressure 1 bending 0.9 B D
	L-, Z-, U-shaped pipe loops. Above-grour	Revibility of hende
	L-shaped: 0	
	Z-shaped nonparallel: 0	Bend curve radius 0 mm R
	U-shaped: 0	Compensated L1 0 m
	U-shaped external: 0	
	L-, Z-, U-shaped pipe loops. Above-grour	Lauid E
	U-shaped: 0	
	U-shaped nonsymmetric: 0	
	L-shaped: 0	
	Z-shaped parallel: 0	
	2-snaped nonparallel: 0	
	Just u-shaped external: 0	
	II : WE II share a lister all 0	

C/PASS

Full scope of the needed interactive reports after analysis





• Reports can be copied to MS Excel

- Reports can be exported into MS Word
 - Free Viewer is Available You can send your piping model to customer, who can open it using viewer and review piping model and all analysis results



#		Star	rt-Prof Econom 2017 v	04.82 R2 - [Transfer	56-80 ASME B31.3	.ctp - Load on Restraints and Equipment]												
😼 Eile Edit	View Service	analysis Output Win	dow <u>H</u> elp				Ð				START	-PROF 04.82 R1	- [START1.ctp - Di	splacement]				
	I A M A		B- NOCIA	60	2	30 A 10 - 12 I 1 + 2	🖉 🛃 <u>F</u> ile Edi	it <u>V</u> iew S <u>e</u> rvice	<u>Analysis</u> O <u>u</u> tp	ut <u>W</u> indow <u>H</u> elp								_ @ ×
1-9 -2 19/ -	YA AA	A LIDE DELX -					i 🗅 💕 🖬 🛛	🕺 🗳 🖨 🛄 🗜	🗟 🐱 🔳	800.00	1. 'Main mod	e'		- 2 4	🖉 📮 🕄 🖪 🗛 🕥 •	Q II 2 + Q	C C 📱	
	Caloads (C)	the same and that the pro-	•				67 63 63 6	10° Gr = G [*] G [*] (8 d 4 4	1 🛛 🗍 🗗 🔫 🗠	9 16 91 N	A 12 -	소 영명 명 X	- -				
Operating Mo	le	Submode		Axis		Support Type	Properties	ф ×	📕 Input 🛽	👌 Displ 🛛								Ŧ
9. 1 'Main' (0)	•	Operation	-	Glo	bal axis	Anchor (fixed), Sliding	Pipe (1-2)	•	Operating Mode	Subm	ode			Choose Axis	Type Filter	Object Filter		c.
Node Num	er Type	Forces along coordina	te axis, (kgf) Mome	ts around coord Sup	port local axis		<u>:</u> ::: 2↓		1 'Main mode'	• Ope	ration	•		Global axis	Linear	 All nodes 	• ?	& -
		X Y	Z X	Y Pipe	e local axis		🖯 Main		Node Number	Туре	Displaceme	ent along coord	inate axis, (mm)	Pipe local axis(horizor	tal projectio			
2,Console	Anchor (fixed)	0.10 0	-1151.20 0	-575458.38	0.01		Start Node	1	1	Anchor (fixed)	X 0	¥	0	T perioda data				101
3,Restraine	d Anchor (fixed)	567378.30 0	-325.80 0	-54294.99	0		End Node	2	2	Welding Tee	3	-1.1	-0.4					P
5 Bend	Anchor (fixed)	3760.80 556.90	-554.50 -1006	5.75 -186026.59	-235113.50		Name Input Turne	Projections	3	Single-direction Guid	le 6.1	0	0					
7,Bend	Anchor (fixed)	13603.30 -5447.70	-1294.60 -3026	0.69 9588.95	-1653202.63		Projections	/a 3000 mm. 0 mm.	4	Forged Elbow	2.8	1.6	1.3					
9	Anchor (fixed)	-3902.60 2185.80	-720 7589	.34 237117.89	209446.26		E Diameter x	TF 219.1 mm X 8.18	6	Forged Elbow	2.3	-2.2	-0.6					
11	Anchor (fixed)	-261.60 -131	-403 -8320	0.50 114312.74	54683.24		Pipe Materi	al 20	8	Forged Elbow	0.7	-4.9	0.3					× ÷
13	Sliding Support	-71.90 -102	-414.10 0	0	0		Mill Tolerar	no 12.50	10	Anchor (fixed)	0.1	-4	0					<u>~</u>
15	Anchor (fixed)	96.20 151.30	-436.60 2555	.60 -32059.35	42090.25		Corrosion A	All 0 mm	12	Spring Hanger	3	1.3	1.4					
17	Anchor (fixed)	126.90 247.60	-422.20 6306	.41 -52465.34	34842.89		Operating F	re 15 MPa										
21	Anchor (fixed)	-13362.30 2155.90	-543.80 -5581	112108.12	407537.56		Operating	re 100 °C										(<u>0</u>) -
	, and the second second	10002100	7,5100		101221120		E Uniform We	eic Yes, 0.4167975 N.										÷.
							Additional											그 *
							Longitudina	al 1.00										モ
		Doc	train	+ 1 -	ndc		Circumfere	nt 1.00										
		Res	stialli	LUC	105		E Additional	Lo 0 N/mm, 0 N/mr					Disn	lacem	ents			-
														laccili	CIICS			
																		200
Error and war	ning messages																	
Туре	Node/pipe	Description					Error and warning		(*									
Notes	Nodes	(N205) Failed th	e stress check from pr	essure and weight in	ads (1. Main)		Time	Node/nine Descripti	0.0									Help
Notes	Node:8	(N265) Failed th	e stress check from pr	essure and weight lo	ads (1. 'Main')		Warning	Node:3 (W622) G	ap is not conside	ered in the analysis, sinc	e it is too small							2
Notes	Node:8	(N284) Failed th	e fatigue strength che	:k (1. 'Main')			Warning	Node:2 Tee lengt	h must be greate	er than 0								2
Notes	Node:8	(N284) Failed th	e fatigue strength che	:k (1. 'Main')			Warning	Node:3 (W660) D	ummy free end	at pipe border may caus	e analysis inacc	uracies if in fac	t the pipeline cont	inues beyond this point				
Notes	Node:8	(N268) Failed th	e stress check in oper	tion condition (1. 'N	/lain')		Information	(W662) N	umber of deares	s of freedom 13	ic unarysis indee	corocies in infilia	a the pipeline cont	indes seyond this politi				
Notes	Node:8	(N268) Failed th	e stress check in oper	tion condition (1. 'N	/lain')		mormation	(11002) 1	allocation degree	a or metaorin 13								
Pines list	Error and warnin	a messages					Pines list	Error and wareing n	arrager									
Лая справки нач	Lag chor and warnin	y messages						WMMTE F1	lessages									NUM
ну и справки наж							для справки на	and the first state								11 112 13		

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

(PASS

5	Ð					Start-Pro	of Econor	n 2017 v.04.82	R2 - [Transfe	r 56-80 ASME B3	1.3.ctp - Code S	tress]				- 0	×
		<u>File</u> Edit	View Service Ana	lysis O <u>u</u> tput	Window	Help										-	8 ;
					Ch 191.	10 01	12.14			3D 44	10-141		0.001	000	2 4 = 6 6 to to	88	D
	8.49	- 10/ /	9/ 4 .0. /	A I DE DE I S			1.000.1.100			•		S Lot I					14.565
	: ca)	(a) 2 K	A TE AN UN CO														
	Pr	14 input	Stress 😡													Ŧ	
	oper	Operating Mode	e Exp	Dansion Range with	Mode	> 🛛 Sh	ow Equation	ns 🗌 Stre	ess Range from	Operation to Cold	2						C
\triangleleft	ties	Maximum		main (0) (Cold State	e)	- M Cre	ep Stress				5.					_	. 44
		1 'Main' (0)						Stress range	, (kgf/sq.cm)	Sustained (Operating Stat	with creep (kaf/sa.cm)	Sustained (Cold State)	(kaf/sa.cm)	Notes		^	₽
		2 'occ' (2)					sq.cm)										10
		3 Test mode			ы	э	Sh	Se	Sa	Slcreep	Sh, creep	Slcreep	Sh, creep				9
		Abo	ove ground pipe	1,Console	187.82	187.82	853.30	0	2458.05	187.82	1406.53	187.82	1768.51				Pr
\rightarrow	\neg			2,Console	3998.54	3998.54	853.30	0	1708.18	3998.53	1406.53	3998.54	1768.51	1,2,7,8,9,10			괰
		Abo	ove ground pipe	4,Restrained	494.99	472.22	853.30	14077.98	2150.88	19959,70	1406.53	359.55	1768.51	7,8			1
				3,Restrained	494.99	472.22	853.30	14077.98	2150.88	19959.70	1406.53	359.55	1768.51	7,8			×
		F	orged Elbow	6,0 Flange	1045.30	Sressure, 16	kgf/sq.cr	n 7257 57	1700.10	3114.13	1406 63	1049.41	1768.51	1,2,3,7,8			3
		Abo	ove ground pipe	6,0 Flange	703.3	ine Diamet	er(Do), 21	9 mm				706.01	1768.51	7,8			
				24	646.32	Thickness(t)	, 6 mm					648.07	1768.51				3
			Joint	24	646.59	(=======		=====Sect	tion=1)			648.34	1768.51				1
\rightarrow		Abo	ove ground pipe	24	646.32	Mo=76213.8	55 kgf-cn	n, Mi=8016.81	95 kgf-cm, M	t=-8826.0137 kgf	-cm	648.07	1768.51				101
				22	352.52	Bending mo	ment (M	b=((ii*Mi)^2+	(io*Mo)^2)^(0.5), 163194.94 kg	gf-cm	353.30	1768.51				1
		Eco	entric Reducer	22	407	Axial force (F), 5545.3	7 kgf				407.29	1768.51				
		Abo	ove ground pipe	22	407	Area (A), 35	25 sq.mm					407.29	1768.51				1
				23	925.35	Flexibility (h), 0.161					929.33	1768.51	1,2,7,8			7
		Con	icentric Reducer	23	925.35	Flexibility Fa	ctor (k),	9.098				929.33	1768.51	1,2,7,8			-
		Abo	ove ground pipe	23	627.54	Moment of	0, II= 2.04	4, It= 1.000	M cub mm			629.84	1/68.51	1070			1
			1.50	5,Bend	1341.7	Pressure thr	ist stress	(Sn=P*(Dn-2t	h^2/(Do^2-(E	0-211/2)) 134 1	1 kaf/sa.cm	1345.04	1/08.51	1,2,7,8			-
		P	orged Elbow	6,0 Flange	1045.3	Bending str	ess (Sb=0.	75*i*Mb/Z). 8	87 kaf/sa.cm	, c _ c) _ c)), (34.1	rigi) sqielli	1049.41	1760.51	1,2,3,7,8			84
		Abo	ove ground pipe	0,0 Flange	500.30	Axial stress	Sa=F/A),	157.30 kgf/sg	.cm			514.07	1760.51	7,0			18
			Nelding Tee	0	1102 7	Torsion she	ar stress (st=0.75*i*Mt/	2Z), -23.99 kg	f/sq.cm		1202 10	1760.51	1,0			9
		Abo	we around nine	8	473.00	SL=[(Sa +Sl	b)^2+(2*S	t)^2]^0.5, 10-	45.39 kgf/sq.c	m		484 30	1768.51	1,2,3,7,0			+++
			ve ground pipe	25	432.12	=======		=====Sect	tion=2)			440.75	1768.51	7.8			
		Nor	-standard bend	25	700.37	Mo=-59239	135 kgf-c	m, Mi=-6849.	8239 kgf-cm, l	Mt=-47309.447 k	gf-cm	709.99	1768.51	378			
\checkmark		Abo	ve ground pipe	25	480.45	Bending mo	ment (M	b=((ii*Mi)^2+	(io*Mo)^2)^(0.5), 126948.11 kg	gf•cm	484,70	1768.51	7.8			
	7					Axial force (F), 5507.3	2 kgf						.,-		v	
	E	Error and warn	ing messages		8	Bending str	ess (Sb=0.	75"1"Mb/Z), 6	689.99 kgf/sq.0	cm						å ×	
	1	Туре	Node/pipe	Description		Axial stress	Sd=F/A),	150.22 kgt/sq	27) -128 57 k	af/sa cm					Help	^	1
	1	Notes	Node:8	(N265) Faile	d the st	SL=[(ISal+SI	a)^2+(2*9	1/21/0.5 88	4.41 kaf/sa.cn	n.					?		4
		Notes	Node:8	(N265) Faile	d the st	=======================================		=====Sect	tion=3)						?		
		Notes	Node:8	(N284) Faile	d the fa	Mo=-7213.3	392 kgf-c	m, Mi=3519.9	247 kgf-cm, N	At=74859.697 kgf	-cm				2		
		Noter	Nodes	(N284) Eaile	d the fa	Bending mo	ment (M	b=((ii*Mi)^2+	(io*Mo)^2)^(0.5), 16610.29 kgt	f-cm				-		
		NUCES	Neder	(11260) 5-11	dahara	Axial force (F), 5397.3	7 kgf							1		
		Notes	Nodes	(IN208) Faile	u the st	Bending str	ess (Sb=0.	75*i*Mb/Z), 9	0.28 kgf/sq.cr	m					?		
		Notes	Node:8	(N268) Faile	d the st	Axial stress	(Sa=F/A),	153.10 kgf/sq	.cm						?	~	
		Pipes list	BError and warning p	nessages		Torsion she	ar stress (st=0.75*i*Mt/	2Z), 203.44 kg	f/sq.cm							
	0.00	conserve user	ura El	lessages	1	SL=[(Sa +S	o)^2+(2*9	t)^2]^0.5, 474	4.11 kgf/sq.cn	n						NUM	

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

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





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- Each piping system project is stored in just one file
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- High speed of stress analysis and working with a really big models





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ASME B31.3	~	×		×	~		
ASME B31.4	~	~		×	~		
ASME B31.5	~	×	~	×	~	~	
ASME B31.8	~	~		×	~		
ASME B31.9	~	~	~	×	~	~	
EN 13480	~	~	~	×	~	~	
GB 50316	×	~	~	×	~		
GB/T 20801	~	~		×	~		
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