



Analisi termo-strutturali di condotte

Webinar 28-07-2020

- Panoramica del software Start-Prof;
- Funzionalità di Start-Prof;
- Creazione di un modello e interfaccia software;
- Elementi per la creazione di reti di condotte;
- Modifica, gestione e importazione di modelli;
- Codici e normative;
- Condotta interrata;
- Azioni di carico e gestione delle combinazioni di carico;



*ANALISI E DIMENSIONAMENTO
DI CONDOTTE E SERBATOI*

Più di 50 anni di esperienza

Più di 3000 utilizzatori

Utilizzo semplice combinato a calcoli avanzati

Ampia applicabilità

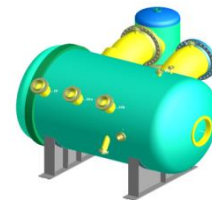
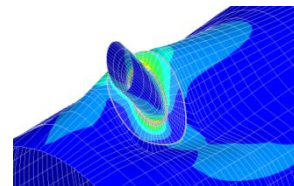
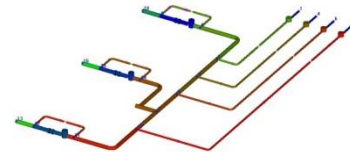
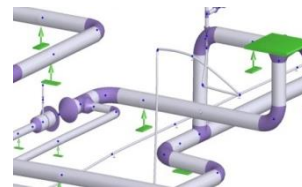
PASS/START-PROF fa parte dei software PASS Suite:

PASS/START-PROF – Analisi termiche e strutturali di condotte

PASS/HYDROSYSTEM – Analisi fluidodinamiche

PASS/ NOZZLE-FEM – Analisi FEM bocchelli-serbatoio. Calcolo SIF, k-factors, Nozzle Flexibility and Stress Analysis, etc.

PASS/EQUIP – Calcolo e analisi di serbatoi, cisterne e apparecchiature in pressione



Analisi termo-strutturali di condotte



Calcolo stress, flessibilità, stabilità, fatica



Analisi strutturale dettagliata



Librerie e database integrati



Visualizzazione risultati interattiva



Vasta integrazione normativa

Campi applicativi

- Reti di condotte industriali
- Reti per impianti Oil&Gas
- Reti di sottoservizi
 - Riscaldamento
 - Gas naturale
 - Acqua
- Reti per generazione energia





SNC · LAVALIN



thyssenkrupp



DAELIM

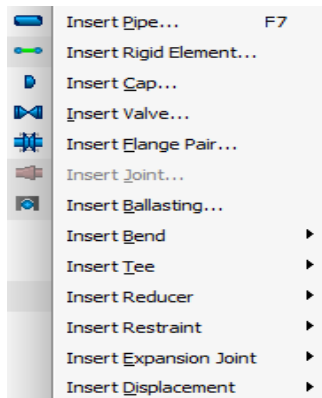
SIBUR



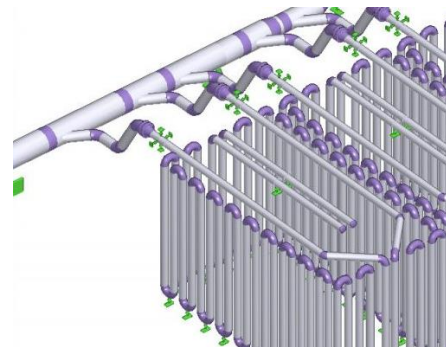
Definizione del modello

- Importazione del modello
- Creazione per elementi in Start-Prof

Importazione in Start-Prof	SmartPlant Isometrics
PASS/Hydrosystem	CADWorx
CAESAR II	Smart 3D
AutoPIPE	SmartPlant 3D
AVEVA PDMS and E3D	PCF format
OpenPlant	Neutral Format
AutoPLANT	PLANT 4D

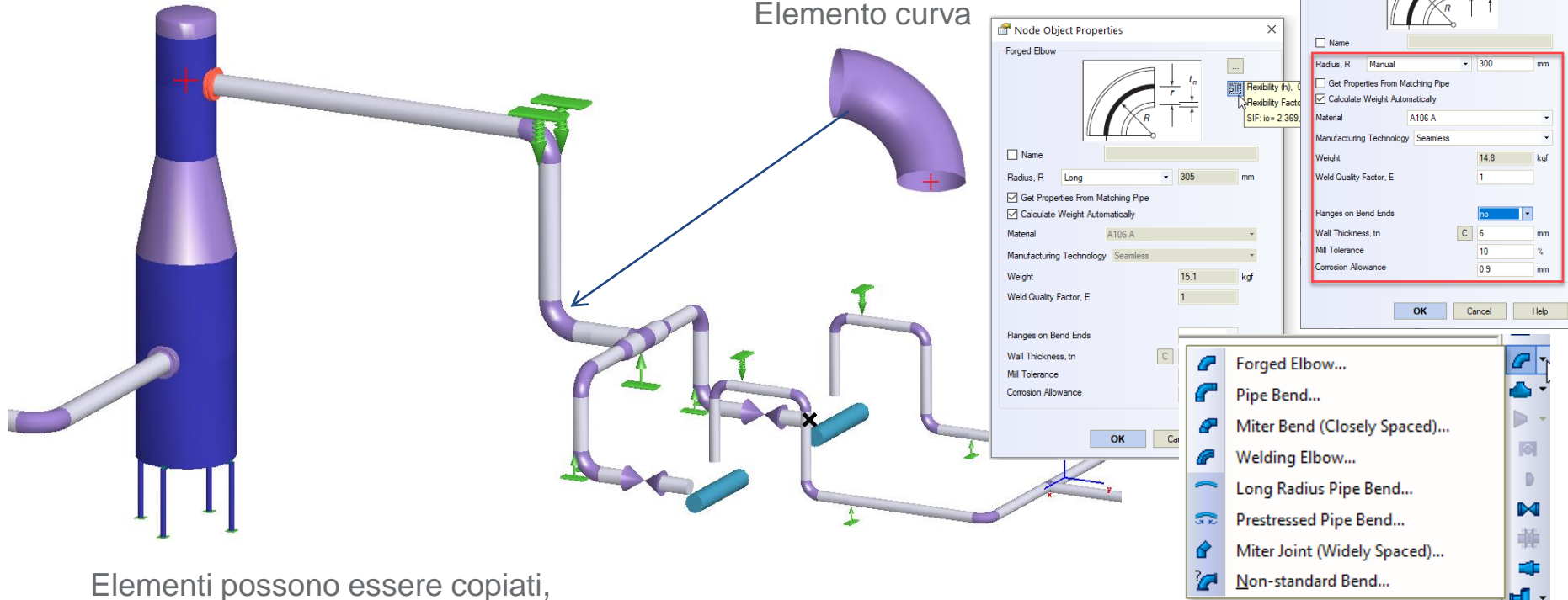


Projections Pipe Length: 20 m DX: 20 m DY: 0 m DZ: 0 m		Forces Pressure: 1000 kgf/sq.cm Temperature: 50 °C Test Pressure: 1500 kgf/sq.cm	
Pipe Properties Outer Diameter: 0 mm Wall Thickness: 5 mm Mill Tolerance: 0 mm Corrosion Allowance: 1 mm Material: P91 (ASME SA335)		Uniform Weight <input checked="" type="checkbox"/> Calculate Pipe Weight Automatically Pipe: 0 kgf/m Insulation: 0 kgf/m Fluid: 35 kgf/m Fluid Density: 445633.84 kg/m3	



Definizione del modello

Elemento curva



Node Object Properties

Forged Elbow

Radius, R: 305 mm

Material: A106 A

Weight: 15.1 kgf

Weld Quality Factor, E: 1

Node Object Properties

Forged Elbow

Radius, R: 300 mm

Material: A106 A

Weight: 14.8 kgf

Weld Quality Factor, E: 1

Context Menu:

- Forged Elbow...
- Pipe Bend...
- Miter Bend (Closely Spaced)...
- Welding Elbow...
- Long Radius Pipe Bend...
- Prestressed Pipe Bend...
- Miter Joint (Widely Spaced)...
- Non-standard Bend...

Elementi possono essere copiati,
incollati ecc...

Normative integrate

- **Power Piping**

- ASME B31.1-2018 Power piping (USA)
- DLT 5366-2014 Steam/Water Piping in Power Plant (China)
- RD 10-249-98 Steam and hot water piping (Russia)

- **Central Heating**

- CJJ/T 81-2013 Buried hot-water heating pipelines (China)
- GOST R 55596-2013 District Heating Networks (Russia)
- RD 10-400-01 District Heating Networks (Russia)

- **Process Piping**

- ASME B31.3-2018 + Ch. IX Process Piping (USA)
- EN 13480-2017 Metallic Industrial Piping (European Union)
- GB/T 20801-2006 Process Piping (China)
- GB 50316-2008 Metallic Industrial Piping (China)
- GOST 32388-2013 Process Piping (Russia)
- RTM 38.001-94 Process Piping (Russia)

- **Oil & Gas**

- ASME B31.4-2016 + Ch. IX & XI Liquid Transportation (USA)
- ASME B31.8-2018 + Ch. VIII Gas Transmission (USA)
- GB 50251-2015 Gas Pipelines (China)
- GB 50253-2014 Oil Pipelines (China)
- SNiP 2.05.06-85 Gas and Oil Pipelines (Russia)
- SP 36.13330.2012 Gas and Oil Pipelines (Russia)

- **Fiberglass Piping**

- ISO 14692-3:2002/Cor 1:2005 (International)
- Plastic Piping (PE, PE-RT, PP, PB, PVC, PVDF etc.)
- GOST 32388-2013 (Russia)

- **Other Piping**

- **SIF and flexibility factors**

- **Equipment Loads Check**

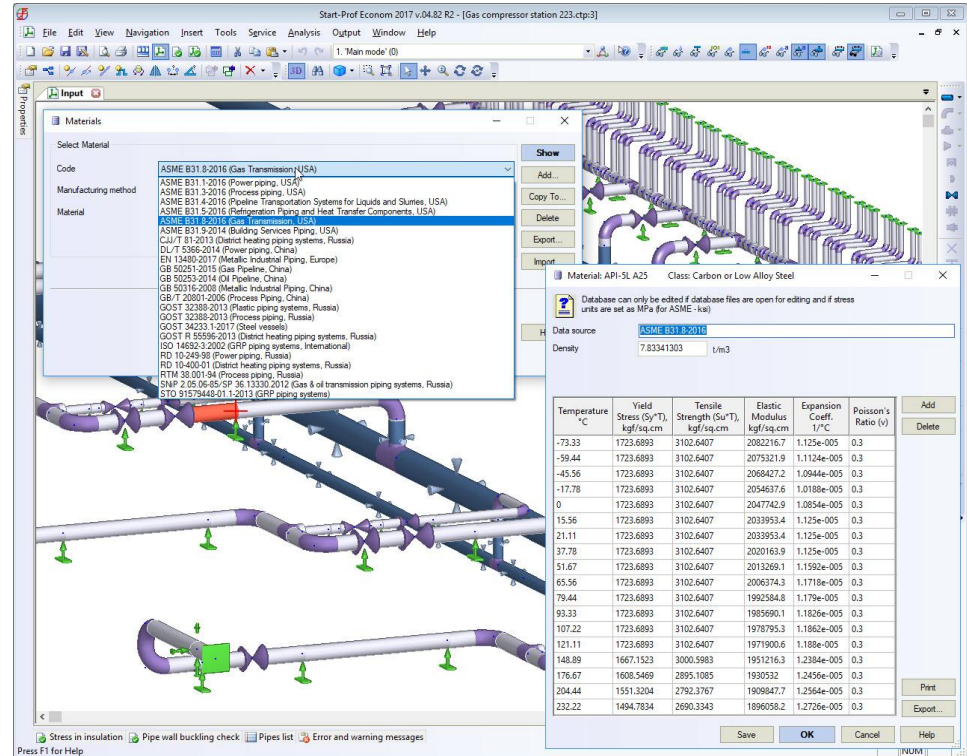
- **Nozzle Flexibility**

- **Seismic Loads, Wind Loads**

- **Snow Loads, Ice Loads**

Database estesi

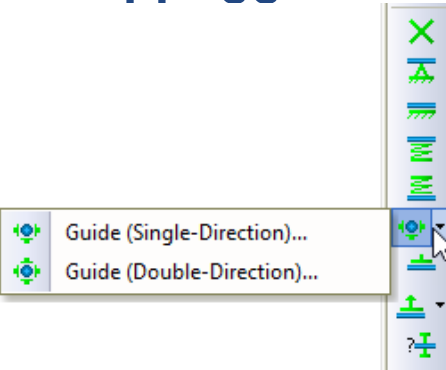
- Materiali
- Suoli (per condotte interrate)
- Giunti di dilatazione
- Isolamenti
- Raccordi a T
- Curve
- Riduttori
- Condotte
- Molle variabili
- Molle a carico costante



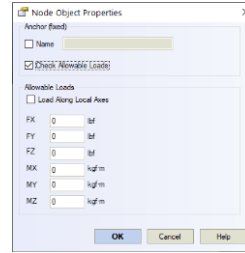
The screenshot displays the Start-Prof Econom 2017 v.04.82 R2 software interface. The main window shows a 3D model of a piping system with various components like pipes, elbows, and supports. A 'Materials' dialog box is open, listing various material codes and standards. The 'Data source' is set to 'ASME B31.3-2016'. A table of material properties is visible, showing temperature, yield strength, tensile strength, elastic modulus, expansion coefficient, and Poisson's ratio.

Temperature °C	Yield Strength (Sy) T, kgf/sq.cm	Tensile Strength (Su) T, kgf/sq.cm	Elastic Modulus, kgf/sq.cm	Expansion Coeff. 1/°C	Poisson's Ratio (v)
-73.33	1723.6893	3102.6407	2082216.7	1.125e-005	0.3
-59.44	1723.6893	3102.6407	2075321.9	1.1124e-005	0.3
-45.56	1723.6893	3102.6407	2068427.2	1.0944e-005	0.3
-17.78	1723.6893	3102.6407	2054637.6	1.0188e-005	0.3
0	1723.6893	3102.6407	2047742.9	1.0854e-005	0.3
15.56	1723.6893	3102.6407	2033953.4	1.125e-005	0.3
21.11	1723.6893	3102.6407	2033953.4	1.125e-005	0.3
37.78	1723.6893	3102.6407	2020163.9	1.125e-005	0.3
51.67	1723.6893	3102.6407	2013269.1	1.1592e-005	0.3
65.56	1723.6893	3102.6407	2006374.3	1.1718e-005	0.3
79.44	1723.6893	3102.6407	1992584.8	1.179e-005	0.3
93.33	1723.6893	3102.6407	1985690.1	1.1826e-005	0.3
107.22	1723.6893	3102.6407	1978795.3	1.1862e-005	0.3
121.11	1723.6893	3102.6407	1971900.6	1.188e-005	0.3
148.89	1667.1523	3000.5983	1951216.3	1.2384e-005	0.3
176.67	1608.5469	2895.1085	1930532	1.2456e-005	0.3
204.44	1551.3204	2792.3767	1909847.7	1.2564e-005	0.3
232.22	1494.7834	2690.3343	1896058.2	1.2726e-005	0.3

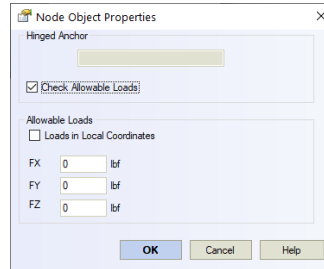
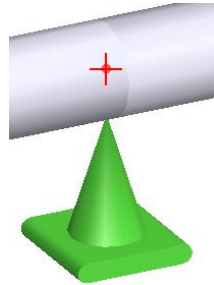
Appoggi



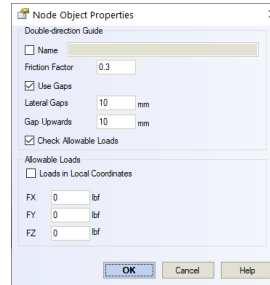
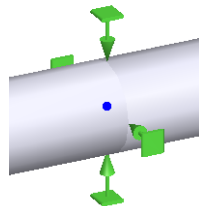
Anchor



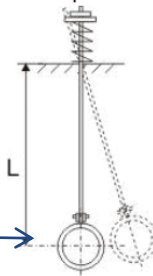
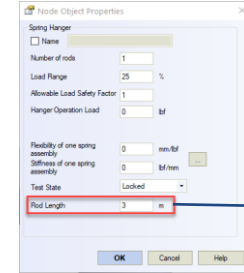
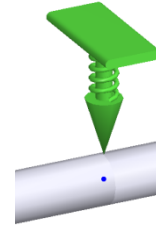
Hinged Anchor



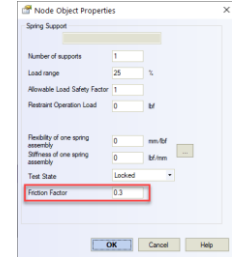
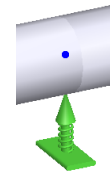
Guide Support



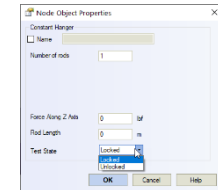
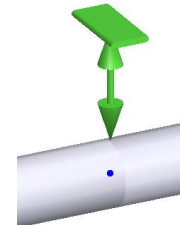
Spring Hanger



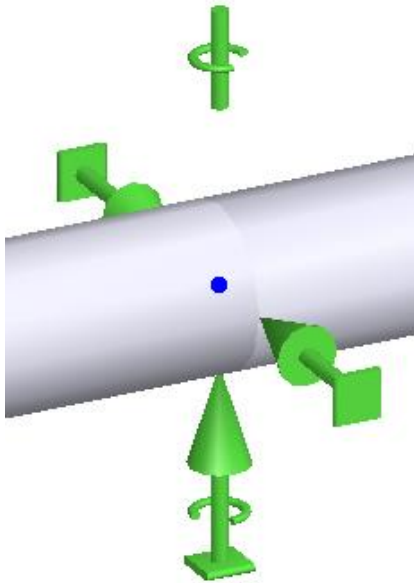
Spring Support



Constant Hanger



Appoggi, non standard



Non-standard Restraint

☐ Name:

Support N 1

Precompression Spring, X: lbf

Precompression Spring, Y: lbf

Precompression Spring, Z: lbf

Test State:

Local Axes of the Pipe:

☒ Check Allowable Loads

☒ Use Gaps

Linear restraints

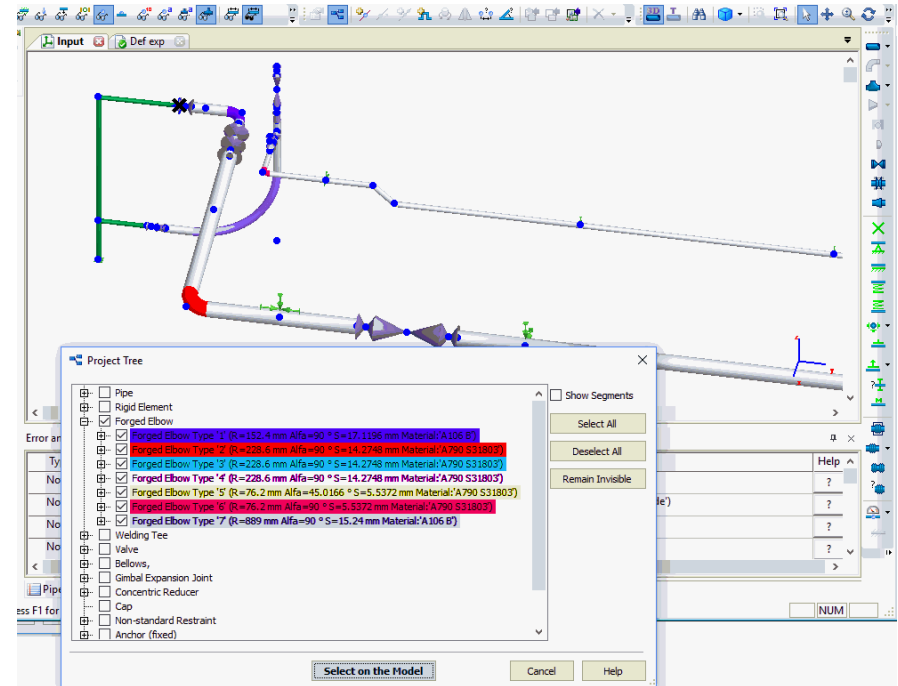
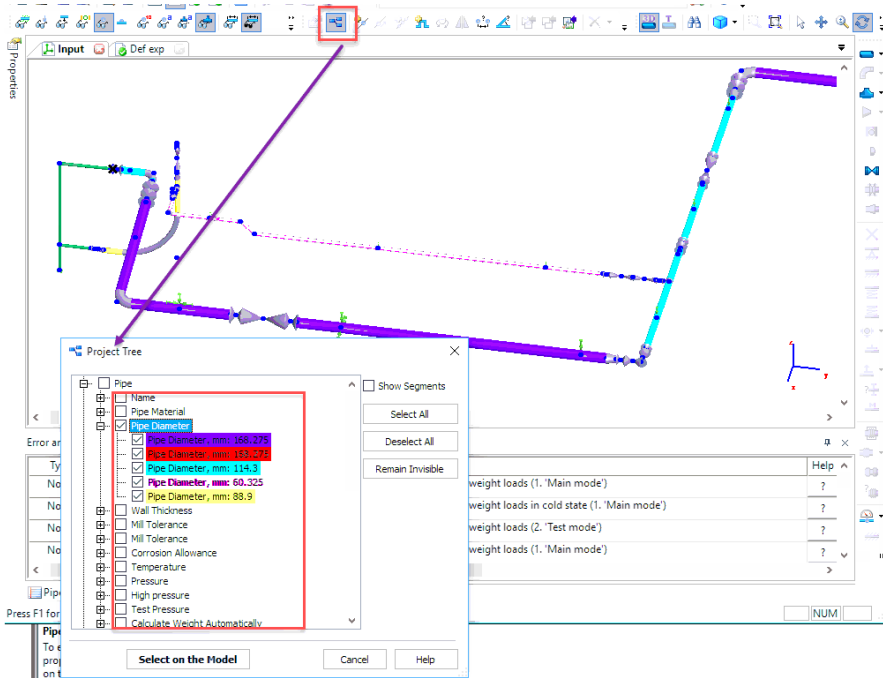
	Local Axes	Restraint Direction	Flexibility, mm/lbf	Rod Length, m	Frict. Factor	Gap +, mm	Gap -, mm	Allowable Load, lbf
1. rigid two-sided	<input checked="" type="checkbox"/>	+Ym Horizontal	<input type="text" value="0"/>	<input type="text" value="0"/>	0.3	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
2. rigid one-sided	<input checked="" type="checkbox"/>	-Zm Ver/Horz	<input type="text" value="0"/>	<input type="text" value="0"/>	0.3	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
3. none	<input type="checkbox"/>	other	<input type="text" value="0"/>	<input type="text" value="0"/>	0	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>

Rotational restraints

	Local Axes	Restraint Direction Around Axis	Flexibility, %/kgf·m	Allowable Load, kgf·m
4. rigid two-sided	<input type="checkbox"/>	+Z	<input type="text" value="0"/>	<input type="text" value="0"/>
5. none	<input type="checkbox"/>	other	<input type="text" value="0"/>	<input type="text" value="0"/>
6. none	<input type="checkbox"/>	other	<input type="text" value="0"/>	<input type="text" value="0"/>

OK Cancel Help

Classificazione degli elementi



Combinazioni di carico

- Generazione automatica combinazioni
- Creazioni di combinazioni di carico manuali aggiuntive

Smart Operation Mode Editor

* #	Name	Hanger Sizing	High temperature	Installation State	Seismic	Wind	Snow/Ice	Friction Multiplier	Mode Type	Stress Range Between
<input checked="" type="checkbox"/>	1 Operation mode	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1.00	SUS	1-1A
<input checked="" type="checkbox"/>	2 Emergency	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1.00	SUS	2-1A
<input checked="" type="checkbox"/>	3 Test mode								Test	

Simplified Load Case Templates. Real load case templates please see in help

Operation Mode #1: Operation mode

L1: W1 Hanger Selection

L2: T1 Hanger Selection

L3: W1+P1+H SUS Stress Check

L4: W1+P1+H Alternative SUS (Using the L3 operating support configuration) Stress Check

L5: W1+P1+T1+H OPE Support Loads, Displacements etc.

L6: L5-L3(#1) EXP(1-1A) expansion Stress Check

Smart Operation Mode Editor

* #	Name	Hanger Sizing	High temperature	Installation State	Seismic	Wind	Snow/Ice	Friction Multiplier	Mode Type	Stress Range Between	Help
<input checked="" type="checkbox"/>	1 Operation mode	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	1.00	SUS	1-1A	?
<input checked="" type="checkbox"/>	2 Emergency	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	1.00	SUS	2-1A	?
	2.1 Relief Valve 1	-	-	-	-	-	-	-	SUS		?
<input checked="" type="checkbox"/>	3 Test mode								Test		?

Add

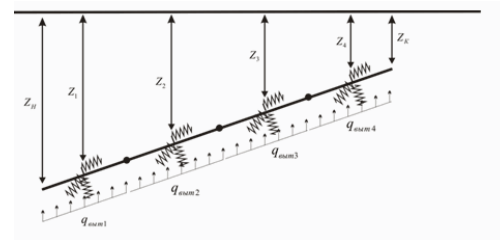
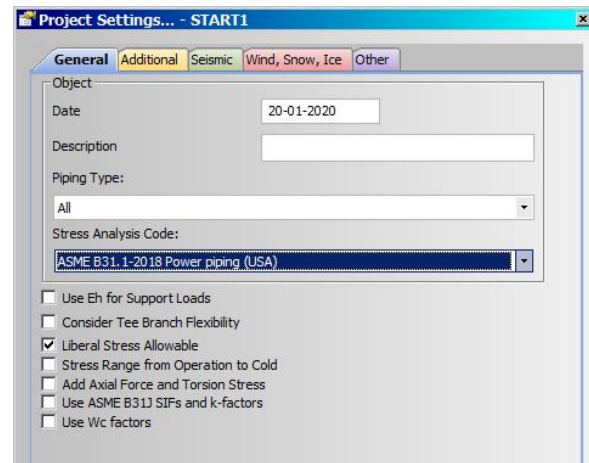
Delete

Up

Down

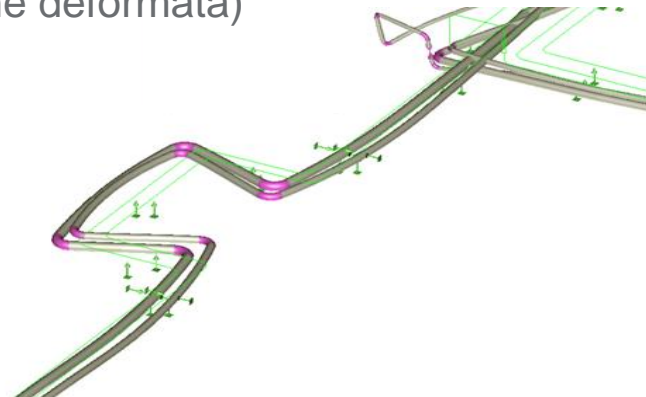
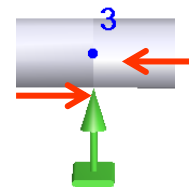
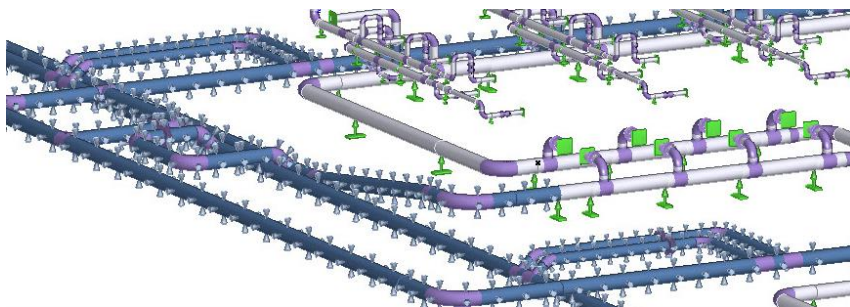
Carichi ed azioni simulati

- Gravità
- Sisma
- Condotta interrata
- Vento
- Pressione
- Sottovuoto
- Reazioni dei vincoli
- Neve e ghiaccio
- Azioni non lineari
- Temperatura ambiente
- Carichi esterni aggiuntivi
- Alte temperature
- Colpo d'ariete
- Condotte criogeniche
- Condotta sommersa
- Spostamenti indotti
- Usure localizzate

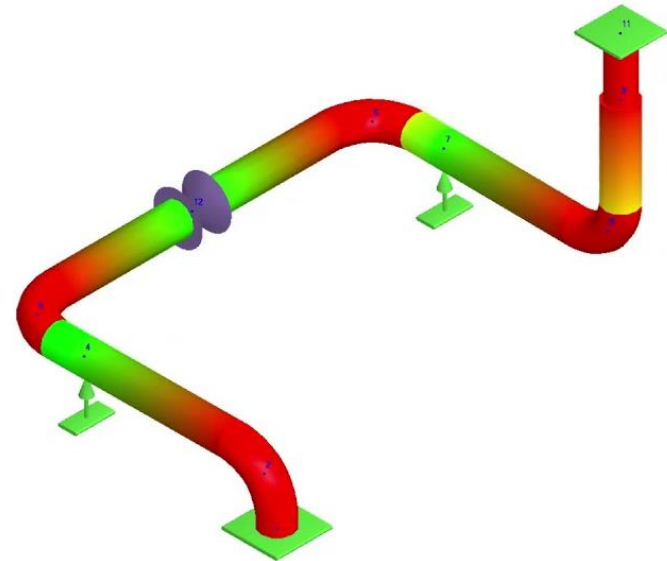
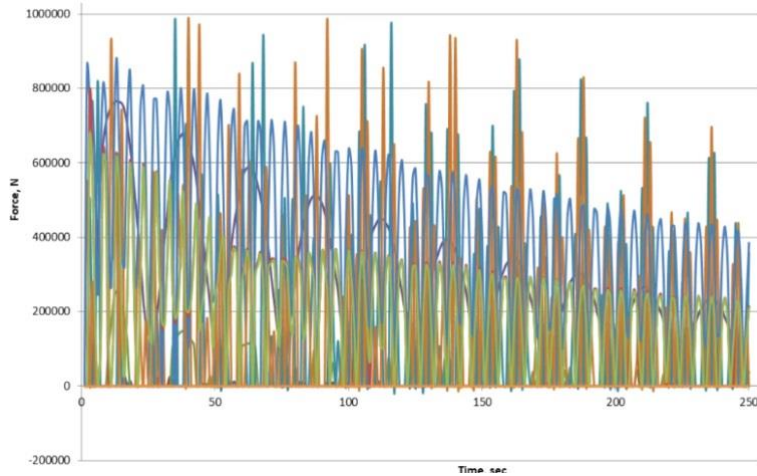


Calcolo sistemi non lineari

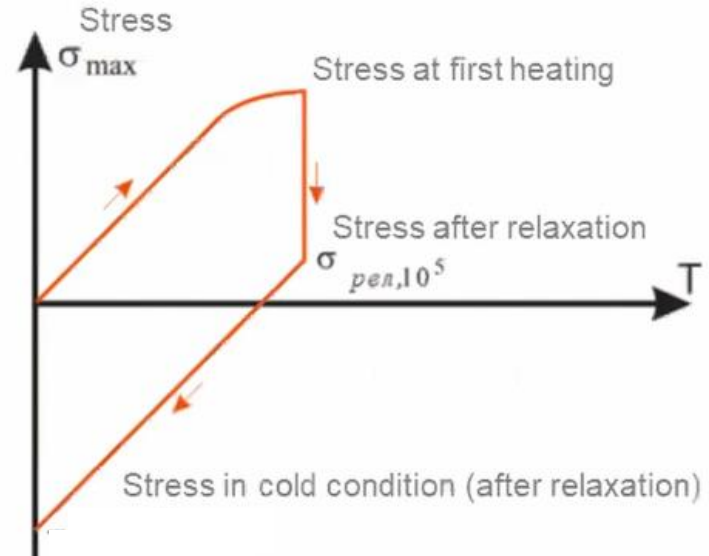
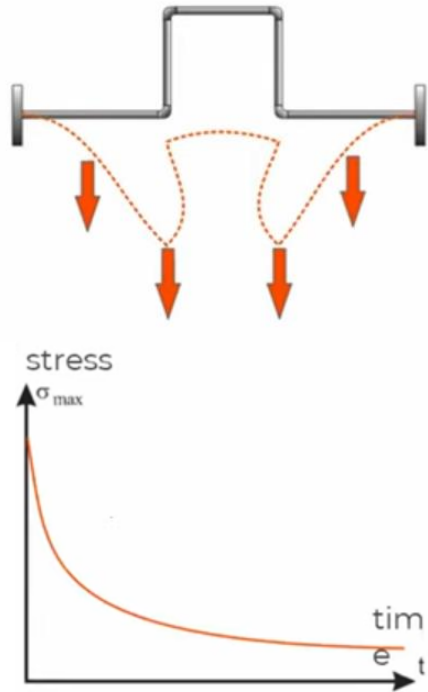
- Attrito nei supporti
- Gaps
- Vincoli monodirezionali
- Selezione automatica degli appoggi con molla
- Effetti del secondo ordine (calcolo nella configurazione deformata)



Colpo d'ariete

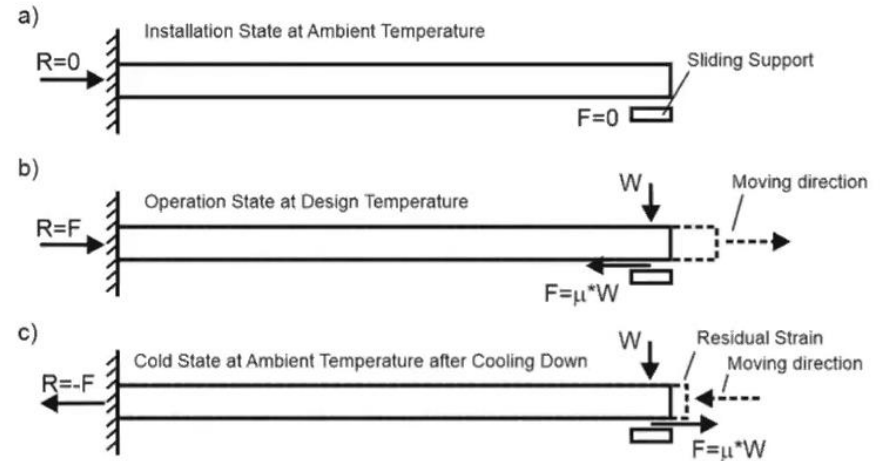
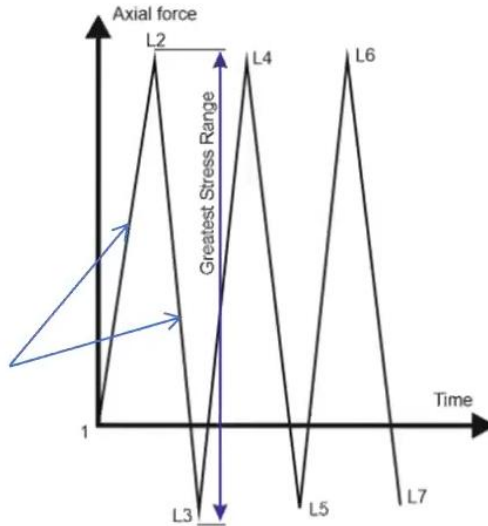


Creep in condotte ad alta temperatura



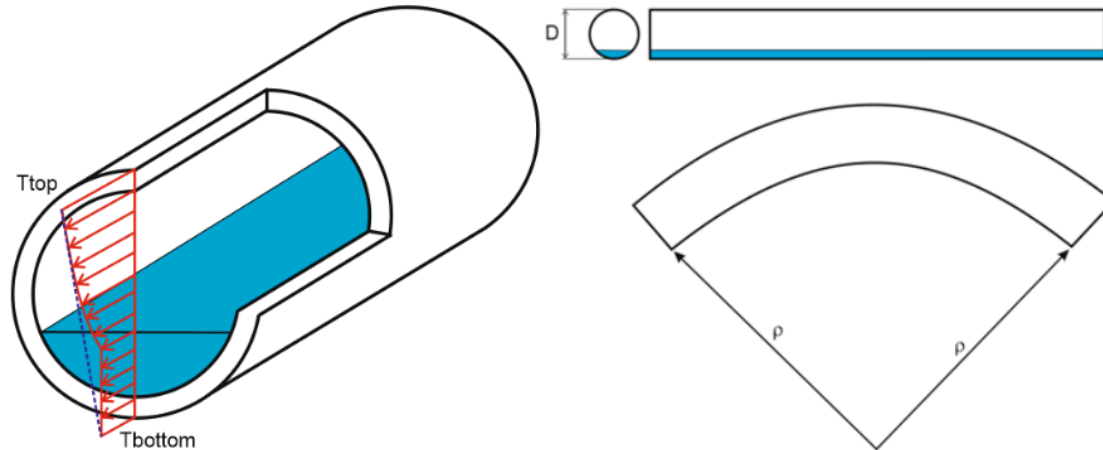
Cicli termici ai vincoli

PASS/START-PROF

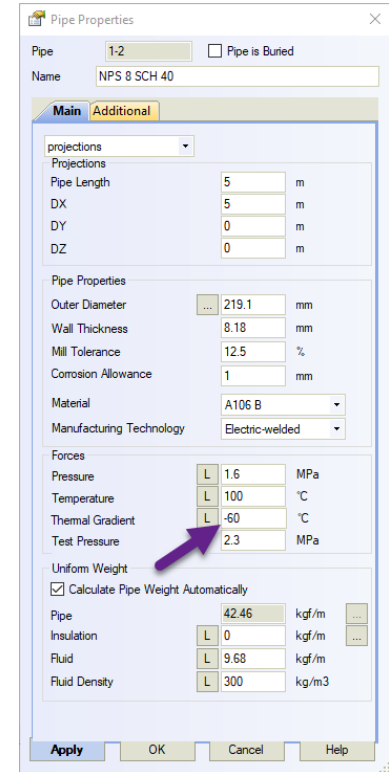


Arco termico

Condotte soggette a elevato gradiente termico sulla sezione



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



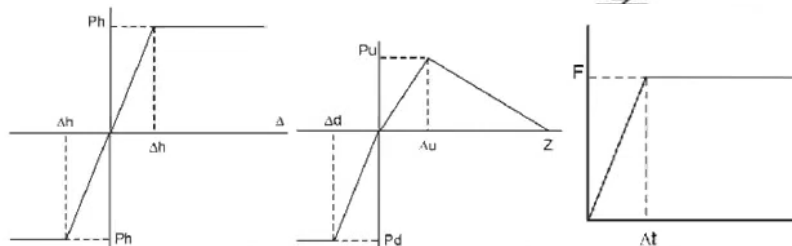
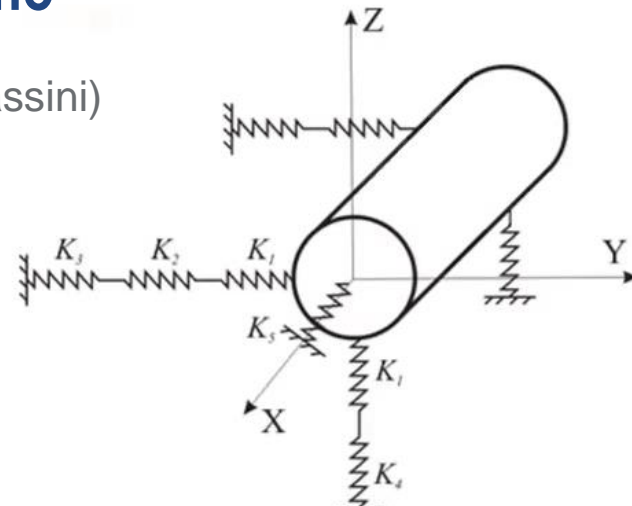
Pipe Properties			
Pipe	1-2	<input type="checkbox"/> Pipe is Buried	
Name	NPS 8 SCH 40		
Main Additional			
projections	Projections		
Pipe Length	5	m	
DX	5	m	
DY	0	m	
DZ	0	m	
Pipe Properties			
Outer Diameter	219.1	mm	
Wall Thickness	8.18	mm	
Mill Tolerance	12.5	%	
Corrosion Allowance	1	mm	
Material	A106 B		
Manufacturing Technology	Electric-welded		
Forces			
Pressure	L 1.6	MPa	
Temperature	L 100	°C	
Thermal Gradient	L -60	°C	
Test Pressure	L 2.3	MPa	
Uniform Weight			
<input checked="" type="checkbox"/> Calculate Pipe Weight Automatically			
Pipe	42.46	kgf/m	
Insulation	L 0	kgf/m	
Fluid	L 9.68	kgf/m	
Fluid Density	L 300	kg/m3	
<input type="button" value="Apply"/> <input type="button" value="OK"/> <input type="button" value="Cancel"/> <input type="button" value="Help"/>			

Condotta interrata, modellazione del terreno

Molle orizzontali K_1 (terreno), K_2 (isolamento), K_3 (materassini)

Molle verticali K_1 (terreno), K_4 (isolamento)

Molle longitudinali K_5 (terreno)

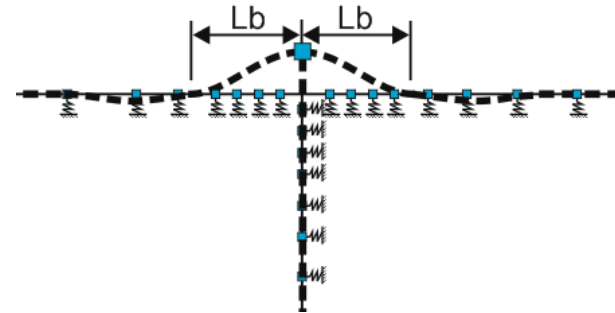
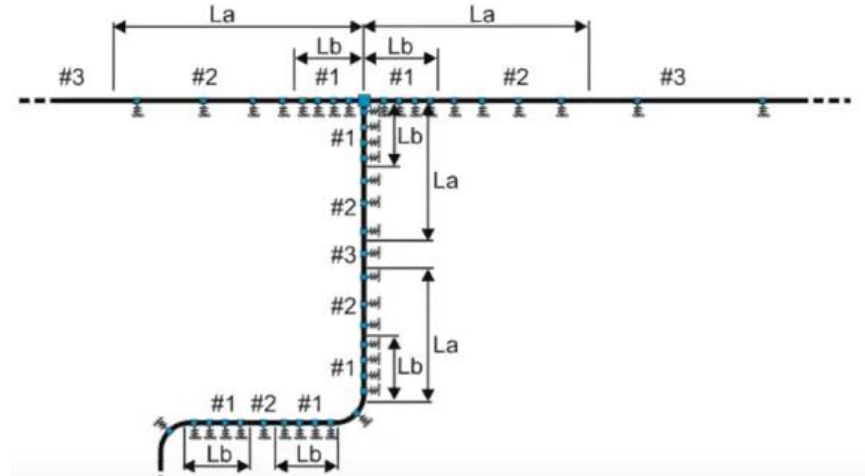


Condotta interrata

Zona #1: flessione laterale della condotta

Zona #2: scorrimento assiale

Zona #3: condizioni di vincoli al contorno

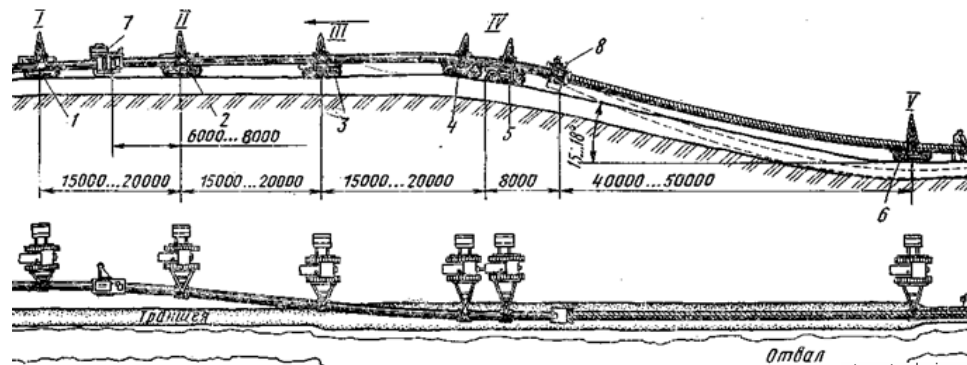
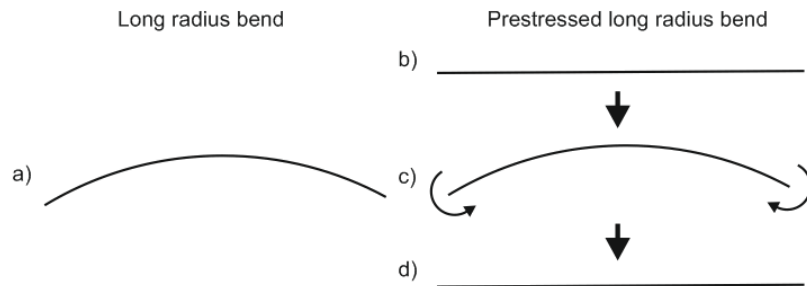


$$L_b = \frac{3\pi}{4} \sqrt[4]{\frac{4EI}{k}}$$

$$L_a = \frac{\alpha \Delta T E A + (0.5 - \nu) S_h A}{q} + 3 \sqrt{\frac{EA}{\pi D C_{x0}}}$$

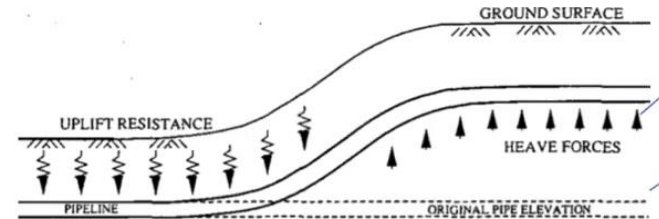
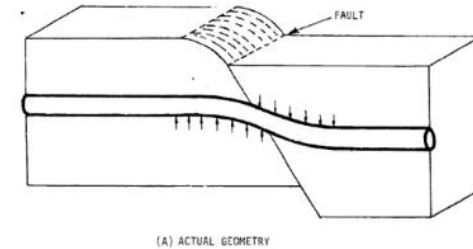
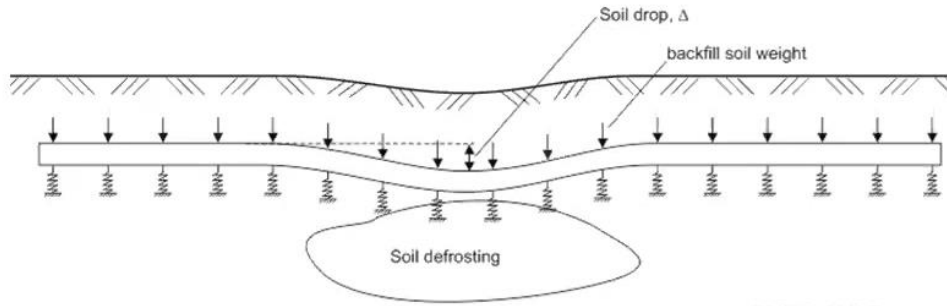
Condotta interrata

- Curve a lungo raggio
- Curve a raggio elevato con deformazione imposta



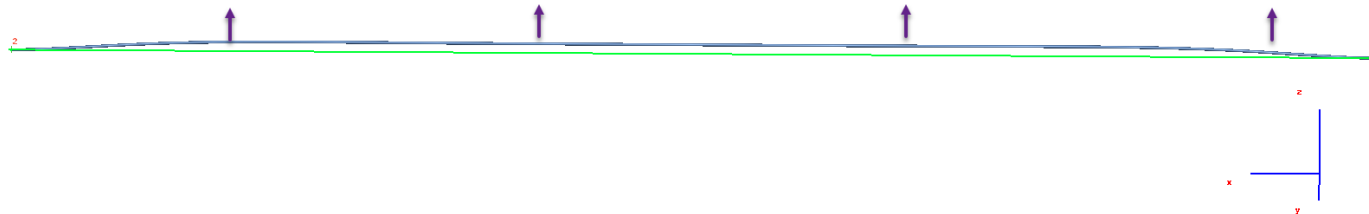
Condotta interrata, modellazione del terreno

Spostamenti imposti: Fenomeni di subsidenza, faglie sismiche, scavi, formazione e scioglimento di ghiaccio ecc..



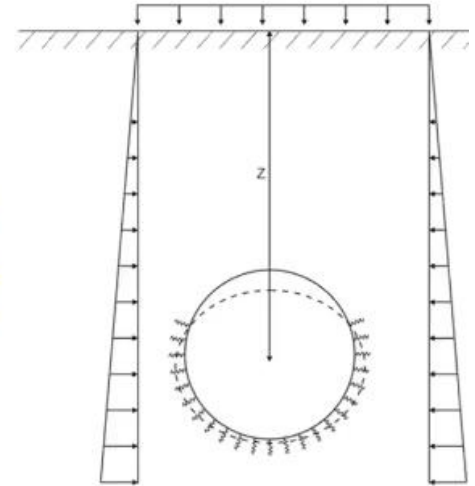
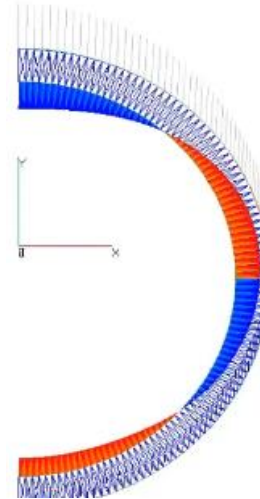
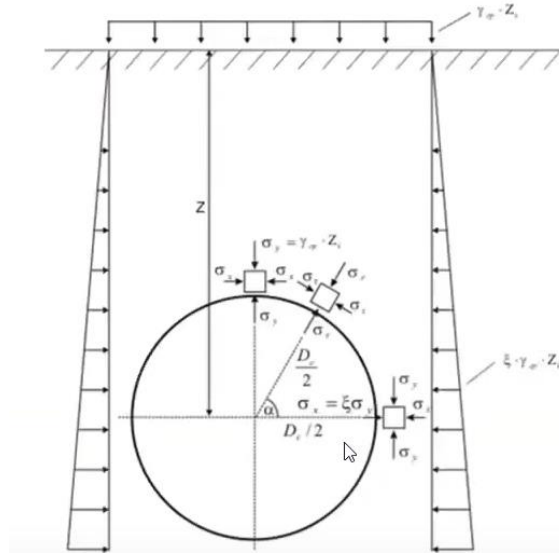
Condotta interrata, suolo bagnato

- Molle terreno ogni 5D;
- Peso della condotta, isolamento e apparecchiature non trascurati;
- Pesi di zavorra;
- Galleggiamento;
- Liquefazione del terreno



Condotta interrata, interazione piana

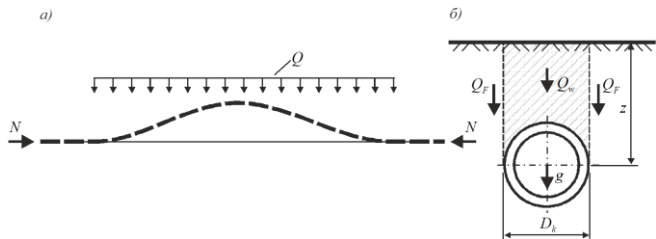
Lo stato di stress piano sulla sezione della condotta è calcolato con metodo FEM



Buckling

Buckling in accordo a ASME B31.8-2018, EN 13941-2019 7.2.4.2 e GOST 32388

Upheaval buckling, instabilità laterale, instabilità locale, ecc...



Imperfezioni locali

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Node Object Properties

Volumetric Flaw

☐ Name

Flaw Type: **Inner**

Half Of Axial Length (A): mm

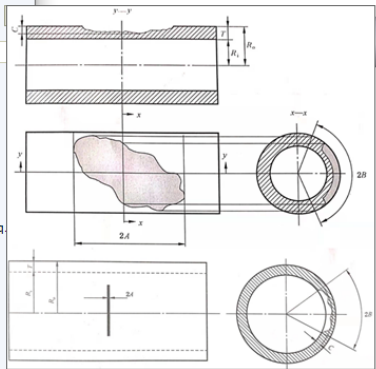
Circumferential Half Length Of Defect (B): mm

Measured Depth with Corrosion Allowance (C): mm

Measured Wall Thickness nearby Flaw (T): mm

Tensile strength at Operating Temperature, σ_b : kgf/sq

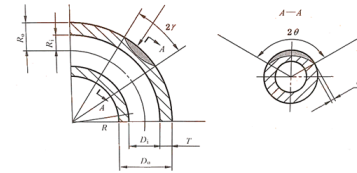
OK **Cancel** **Help**



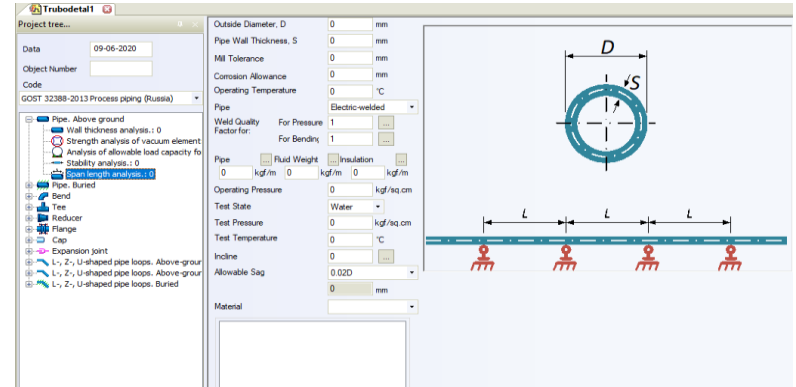
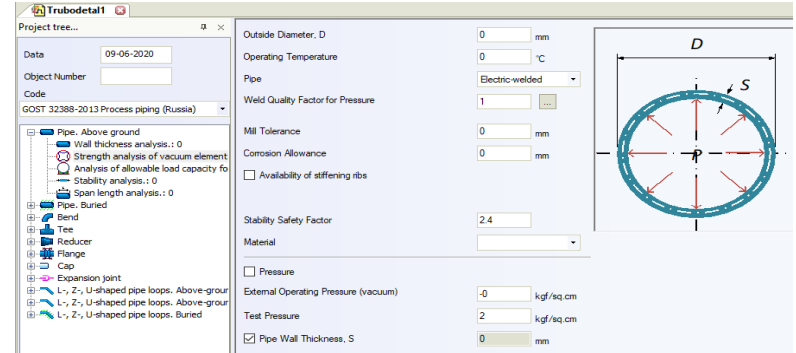
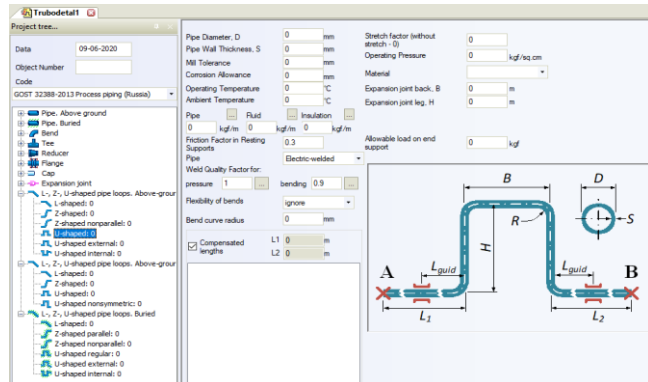
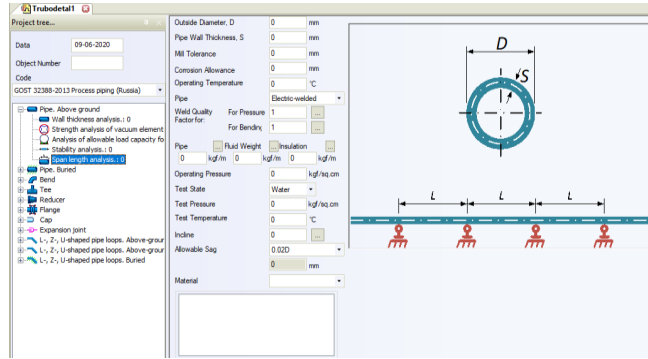
- Plane Flaw
- Volumetric Flaw

Output **Window** **Help**

- Piping Stress
- Insulation Stress
- Seismic Stress (Aboveground)
- Flaw Stress
- MDMT, Impact Test
- Load and Displacement in Restraints
- Restraint Loads
- Nozzle and Equipment Loads
- Displacements
- Expansion Joint Deformations
- Internal Forces & Moments
- Selected Springs
- Selected Constant Effort Springs
- Buckling Check of Pipe Wall
- Flange Leakage Check
- Output 3D View Ctrl+H
- Error & Warning Messages



Strumenti calcolo automatico



Analisi dei risultati

- Messaggi di warning
- Visualizzazione interattiva dei risultati

Output

Window

Help

Piping Stress

Insulation Stress

Seismic Stress (Aboveground)

Flaw Stress

MDMT, Impact Test

Load and Displacement in Restraints

Restraint Loads

Nozzle and Equipment Loads

Displacements

Expansion Joint Deformations

Internal Forces & Moments

Selected Springs

Selected Constant Effort Springs

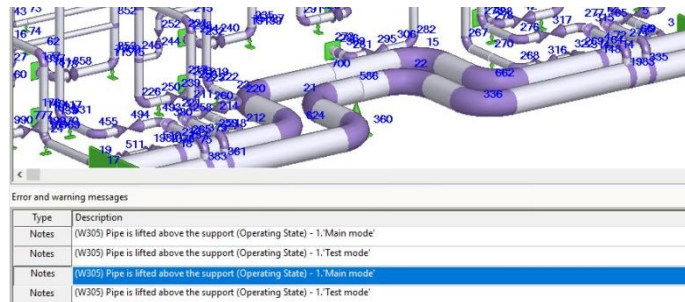
Buckling Check of Pipe Wall

Flange Leakage Check

Output 3D View

Error & Warning Messages

Ctrl+H

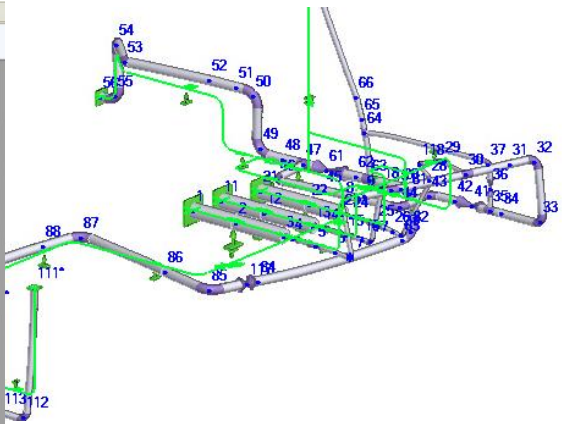


Error and warning messages

Type	Description
Notes	(W305) Pipe is lifted above the support (Operating State) - 1: Main mode
Notes	(W305) Pipe is lifted above the support (Operating State) - 1: Test mode
Notes	(W305) Pipe is lifted above the support (Operating State) - 1: Main mode
Notes	(W305) Pipe is lifted above the support (Operating State) - 1: Test mode

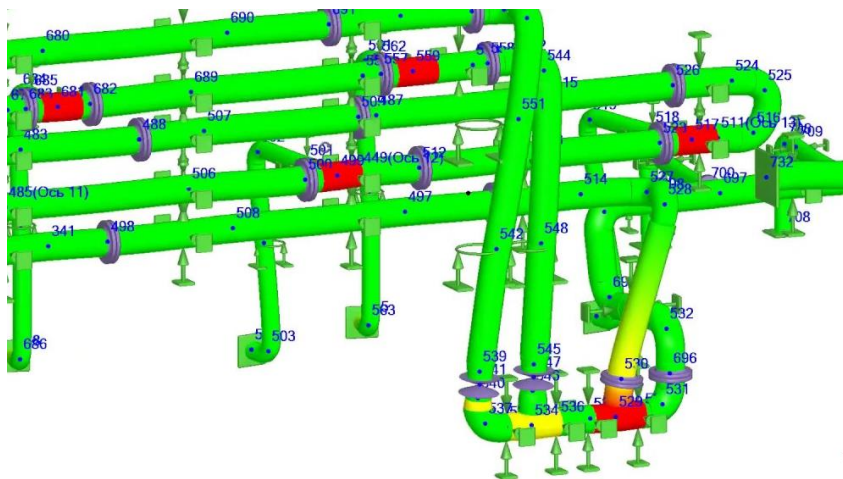


Input		Stress		Expansion Range with Mode		Show Equations		Stress Range from Operation to Cold							
Operating Mode		1 Main' (0)		1 Main' (0) Cold State		<input checked="" type="checkbox"/>		<input type="checkbox"/>							
Maximum		1.1' loc' (1)		2' loc' (2)		3' Test mode' (1)									
		Stress range, (kgf/sq.cm)		Sustained with creep (Operating State), (kgf/sq.cm)		Sustained with creep (Cold State), (kgf/sq.cm)									
		Slcreep	Sh, creep	Slcreep	Sh, creep	Slcreep	Sh, creep								
Above ground pipe		1, Console	187.82	187.82	853.30	0	2458.05	187.82	1406.53	187.82	1768.51				
2, Console		3998.54	3998.54	853.30	0	1708.18	3998.53	3998.54	1406.53	3998.54	1768.51	1,2,7,8,9,10			
Above ground pipe		4, Restrained	494.99	472.22	853.30	140777.98	2150.88	19959.70	1406.53	359.55	1768.51	7,8			
3, Restrained		494.99	472.22	853.30	140777.98	2150.88	19959.70	1406.53	359.55	359.55	1768.51	7,8			
Forged Elbow		6,0 Flange	1045.3	1045.3	1045.3	1045.3	1045.3	1045.3	1045.3	1045.3	1045.3	1,2,3,7,8			
Above ground pipe		6,0 Flange	703.3	703.3	703.3	703.3	703.3	703.3	703.3	703.3	703.3	7,8			
Joint		24	646.32	646.32	646.32	646.32	646.32	646.32	646.32	646.32	646.32				
Above ground pipe		24	646.32	646.32	646.32	646.32	646.32	646.32	646.32	646.32	646.32				
Eccentric Reducer		22	352.52	352.52	352.52	352.52	352.52	352.52	352.52	352.52	352.52				
Above ground pipe		22	407	407	407	407	407	407	407	407	407				
Concentric Reducer		23	825.35	825.35	825.35	825.35	825.35	825.35	825.35	825.35	825.35	1,2,7,8			
Above ground pipe		23	825.35	825.35	825.35	825.35	825.35	825.35	825.35	825.35	825.35	1,2,7,8			
Forged Elbow		5, Bend	1341.7	1341.7	1341.7	1341.7	1341.7	1341.7	1341.7	1341.7	1341.7	1,2,7,8			
Above ground pipe		6,0 Flange	1045.3	1045.3	1045.3	1045.3	1045.3	1045.3	1045.3	1045.3	1045.3	1,2,3,7,8			
Welding Tee		8	600.39	600.39	600.39	600.39	600.39	600.39	600.39	600.39	600.39	7,8			
Above ground pipe		8	473.99	473.99	473.99	473.99	473.99	473.99	473.99	473.99	473.99	7,8			
		25	432.12	432.12	432.12	432.12	432.12	432.12	432.12	432.12	432.12	7,8			

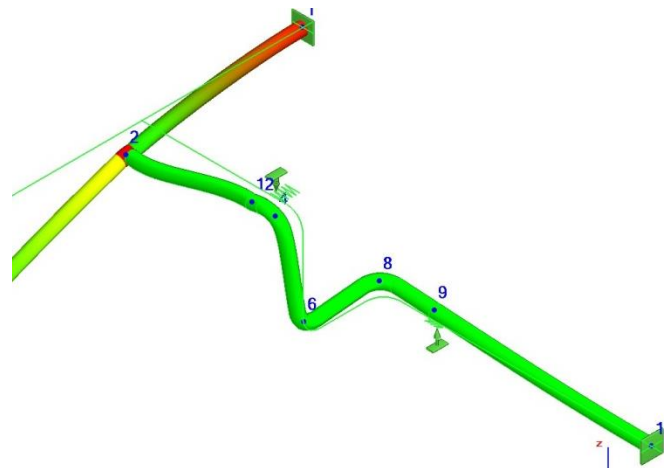


Analisi dei risultati ed esportazione

- Risultati visualizzabili sul modello
- Esportazione del modello



Esportazione con Start-Prof	
PASS/Hydrosystem	AVEVA PDMS and E3D
AutoCAD	Neutral Format



Vantaggi di Start-Prof

FACILE E
VELOCE

PREZZO
CONVENIENTE

VERSATILITÀ



LICENZA
FLESSIBILE

NORME RUSSE
E CINESI

Informazioni utili

- Versione di prova scaricabile dal sito: www.passuite.com



- Videolezioni dei software al link: www.youtube.com/passuite
- ANDREA SILVESTRI e-mail: a.silvestri@enginsoft.com



Thank you!

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www.enginsoft.com