



# Redes urbanas de calefacción

Incremento Productividad y ahorre hasta un 50% de su tiempo usando PASS/START-PROF 4.84

Dr. Alex Matveev,  
Líder de producto START-PROF



PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE

# PASS/START-PROF

Análisis inteligente de esfuerzos en tuberías  
así como un dimensionamiento óptimo

Presentador:

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Desarrollo, Entrenamiento y Soporte  
desde 2005

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# Agenda del webminar – Parte 1

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## Introducción

- Rápida introducción a PASS/START-PROF
- Códigos Incluidos para redes urbanas de calefacción
- Facilidad para realizar análisis de tuberías enterradas y sobre el terreno

## Cómo modelar y analizar redes urbanas de calefacción

- Modelos de suelo para líneas horizontales, inclinadas, y verticales
- Rigidez del aislamiento de espuma de poliuretano, rigidez del cojín de expansión
- Base de datos de tubería pre-aislada de poliuretano: LOGSTOR, POWERPIPE, +GF+ Urecon, etc.
- Verificación de esfuerzos del aislamiento de espuma de poliuretano
- Verifique las esfuerzos por las cargas de vehículos en la superficie
- Análisis de precalentamiento
- Análisis de compensadores de un solo sentido. Calculo de la distancia
- Análisis de propagación de ondas sísmicas.



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# Agenda del webminar – Parte 2

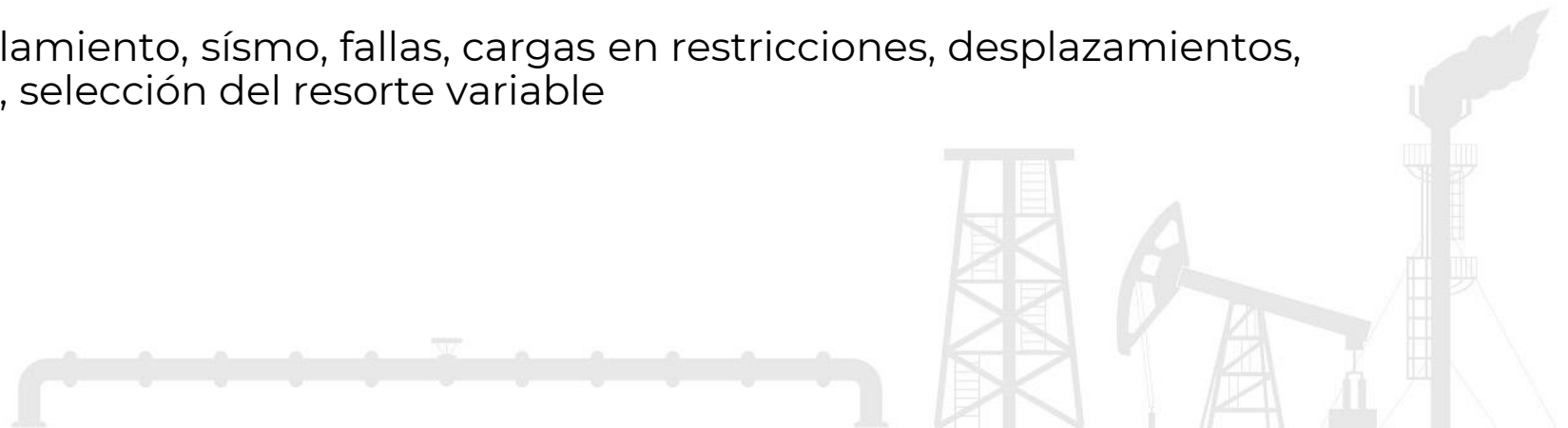
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## Características y aplicación de PASS/START-PROF

- Principio del creación del modelo orientado a objetos
- Tipos de objetos: tubo, tees, codos, reducciones, etc.
- Objetos para equipos: Bomba, Boquilla
- Objetos de junta de expansión
- Bases de datos de acuerdo con códigos EN 13480 y 13941
- Cálculo de doblez de anillo empleando FEA no lineal
- Bases de datos para, viento, hielo, nieve, cargas sísmicas
- Arco natural para fenómenos de colapso, en perforación horizontal direccionada
- Cálculo de espesor de pared para los accesorios y la tubería/cañería
- Reportes: Esfuerzos en tubería, aislamiento, sismo, fallas, cargas en restricciones, desplazamientos, verificación de junta de expansión, selección del resorte variable



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# PASS/Start-Prof

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Análisis completo de esfuerzos en tuberías, flexibilidad, estabilidad y análisis por fatiga con cálculos de dimensionamiento

## Análisis inteligente de esfuerzos en tuberías así como un dimensionamiento óptimo

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- Amplia aplicación
- Aplicación insuperable
- Capacidades poderosas
- Base de datos extensa
- Configuraciones flexibles
- Amplio Soporte a códigos
- Utilizado ampliamente



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# PASS/Start-Prof | Amplia Aplicación

- Tubería para la industria de proceso
- Oleoductos y gasoductos
- Tuberías para redes de servicios públicos
  - Redes de calefacción
  - Gas Natural
  - Agua
- Líneas en plantas de Fuerza

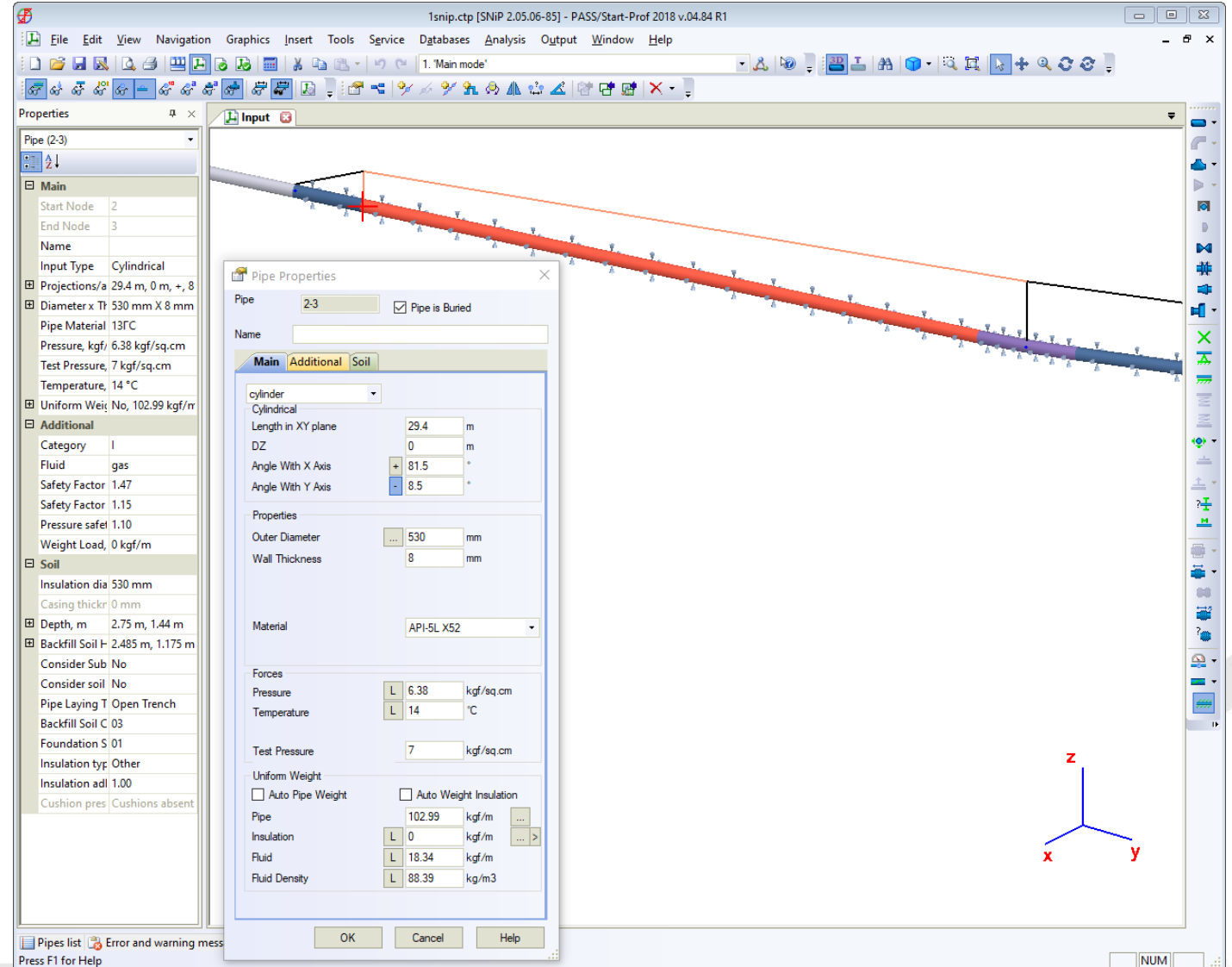


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# PASS/Start-Prof | Características

- Incremento de productividad y ahorro de tiempo
- Ahorre dinero (tenemos políticas amistosas de precios)
- Incremento la exactitud en los análisis



# PASS/Start-Prof | Aplicación amplia

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- Desarrollado desde 1965
- 2000+ usuarios activos (compañías). 8000+ Licencias
- Interfaz del Usuario y documentación en idiomas: Inglés, Chino, Ruso
- Códigos de tuberías: 32
- Códigos de Viento, Sismo, Nieve, Hielo: 18



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# PASS/Start-Prof | Nuestros clientes



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# PASS/Start-Prof | Características

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- Disponible soporte por los desarrolladores vía e-mail
- Fácil de aprender, rápido y sencillo de trabajar para los nuevos analistas de esfuerzos en la tubería.
- Puede trabajar de inmediato gracias a la intuitiva interfaz con el usuario orientada a objetos. Las compañías pueden aplicarla a su trabajos rápidamente, reduciendo significativamente costos y ahorrando tiempo de capacitación sin afectar la calidad de los resultados.



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# PASS/Start-Prof | Características

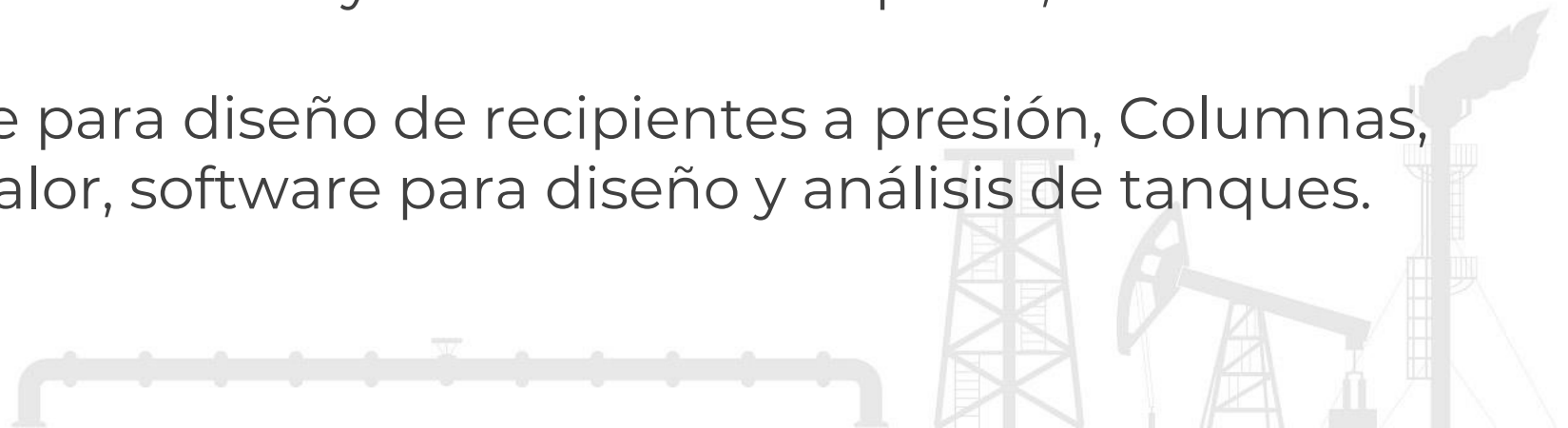
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PASS/START-PROF es una parte de la suite PASS:

- **PASS/START-PROF** – Software para análisis de esfuerzos en tuberías
- **PASS/HYDROSYSTEM** – Software para análisis hidráulico y térmico en la tubería
- **PASS/ NOZZLE-FEM** – Software para análisis por método de elemento finito para uniones de Boquillas al cuerpo principal. Calcula SIF, factores de flexibilidad, Analiza Flexibilidad y esfuerzos en Boquillas, etc.
- **PASS/EQUIP** – Software para diseño de recipientes a presión, Columnas, Intercambiadores de calor, software para diseño y análisis de tanques.



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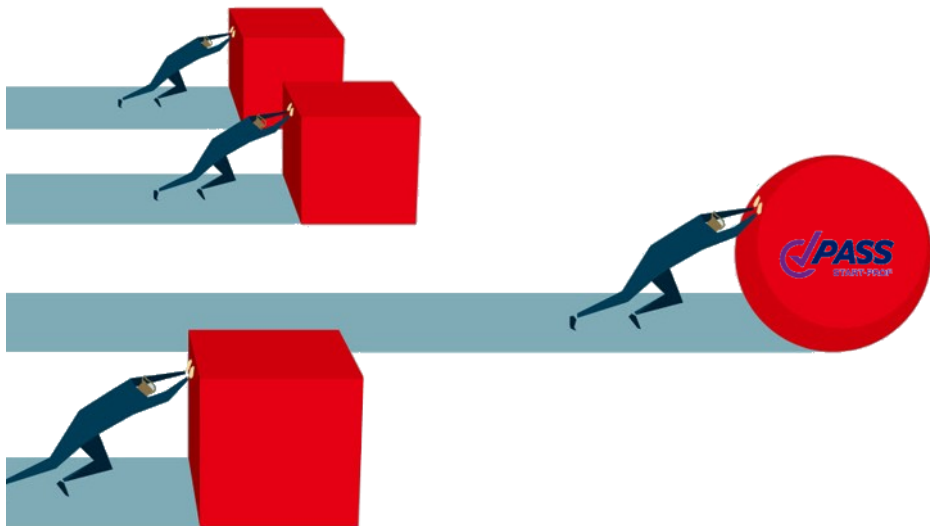


# PASS/Start-Prof | Incremento de productividad

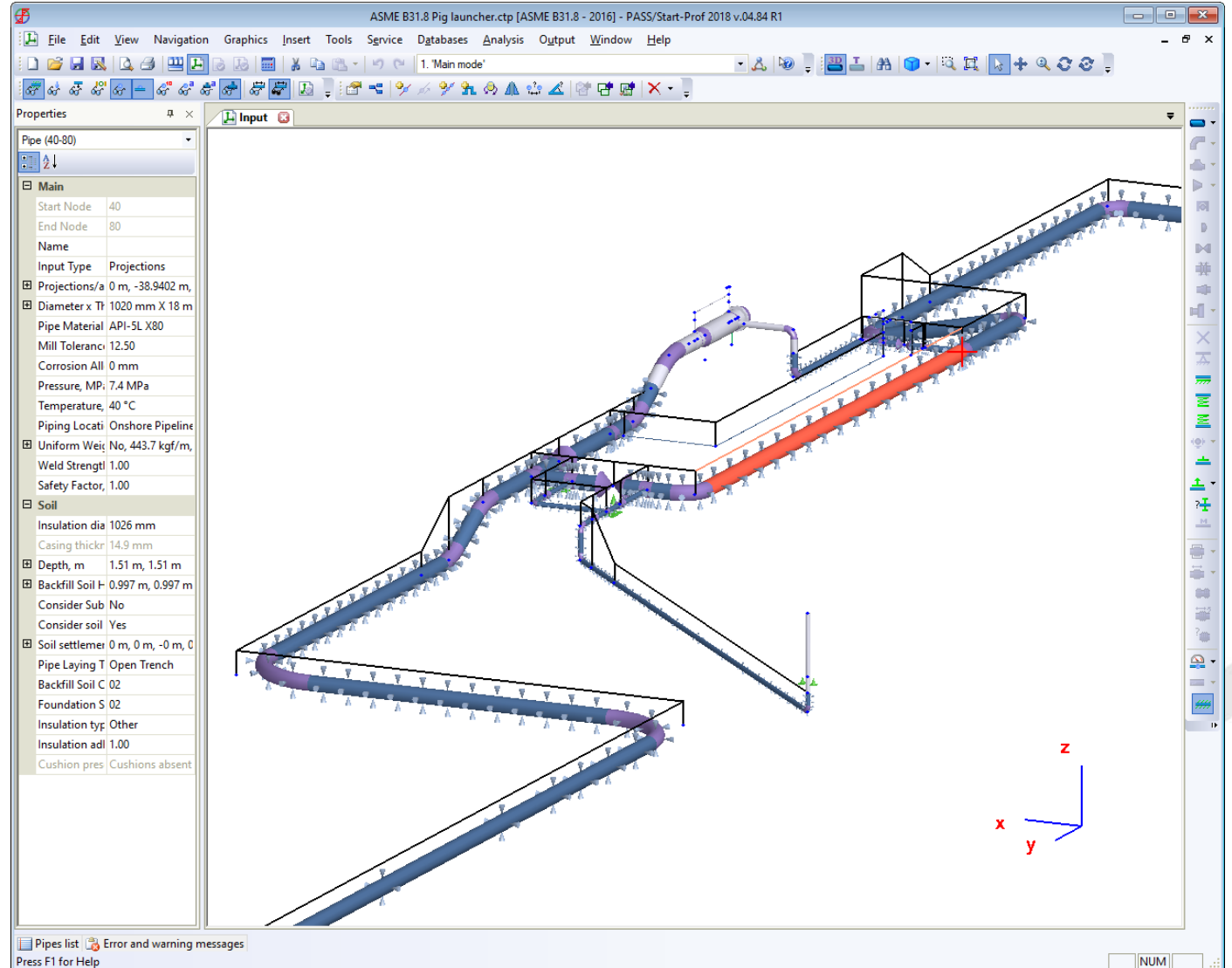
PASS/START-PROF es un software moderno para el análisis de esfuerzos en las tuberías

PASS/START-PROF Hace simple lo complejo

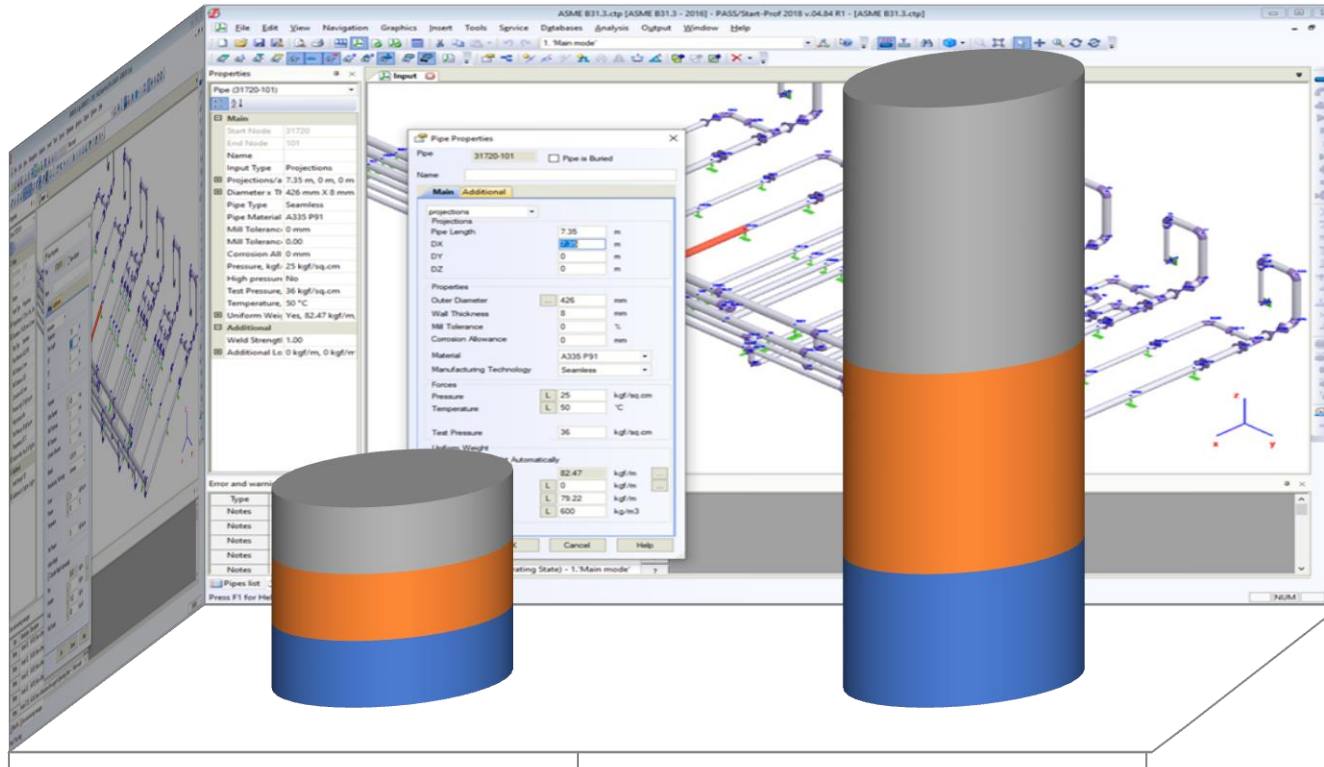
Obtendrá los mismos resultados pero más fácil y más rápidamente



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# PASS/Start-Prof | Cómo START-PROF le ahorra tiempo



START-PROF

Other Pipe Stress  
Software

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



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# PASS/Start-Prof | Supported Codes

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PASS/START-PROF Puede analizar de acuerdo con 32 códigos de tuberías.

Incluye todo lo requerido para el análisis conforme con las últimas ediciones de los códigos para redes de calefacción:

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

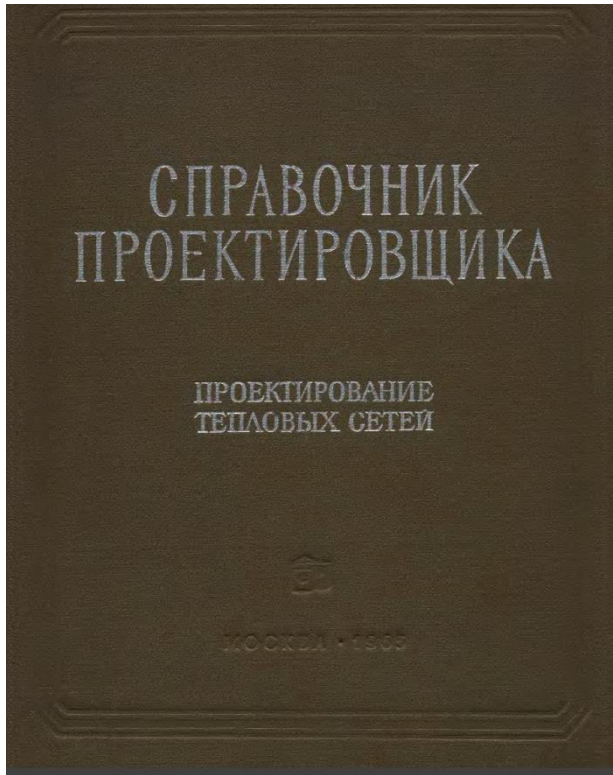


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# PASS/Start-Prof | Historia

El Manual de Nikolaev fue muy Popular para el Diseño de Expansión Térmica de Tuberías de Calefacción Urbana 1965- 1990x



ВСЕСОЮЗНЫЙ ГОСУДАРСТВЕННЫЙ ОРДЕНА ЛЕНИНА  
ПРОЕКТНЫЙ ИНСТИТУТ ТЕПЛОЭЛЕКТРОПРОЕКТ

СПРАВОЧНИК  
ПРОЕКТИРОВЩИКА  
ПРОЕКТИРОВАНИЕ ТЕПЛОВЫХ СЕТЕЙ

Под ред. инж. А. А. НИКОЛАЕВА

ИЗДАТЕЛЬСТВО ЛИТЕРАТУРЫ ПО СТРОИТЕЛЬСТВУ  
Москва—1965

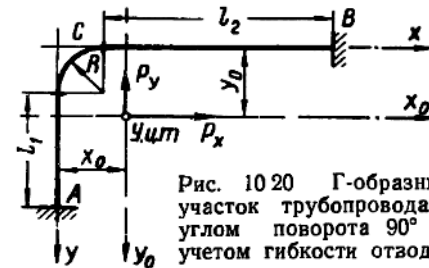


Рис. 10.20 Г-образный участок трубопровода с углом поворота 90° (с учетом гибкости отвода)

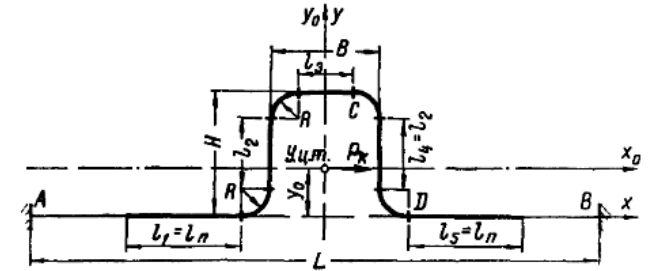


Рис. 10.43. Участок трубопровода с симметричным П-образным компенсатором с гнутыми гладкими отводами при  $l_1=l_5=l_n$

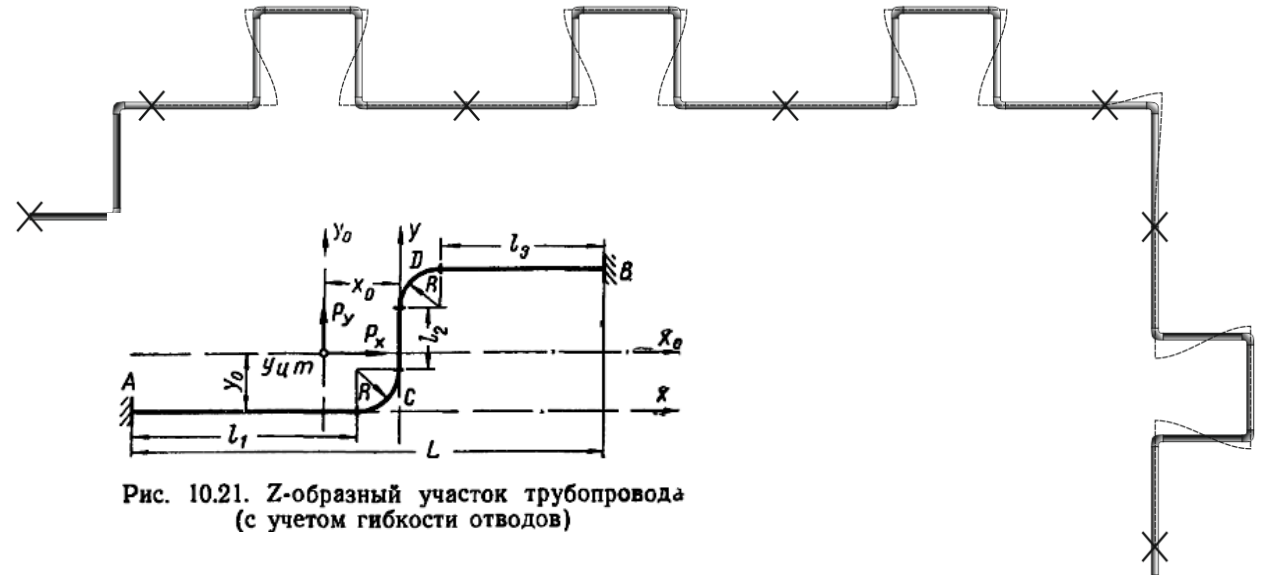


Рис. 10.21. Z-образный участок трубопровода (с учетом гибкости отводов)



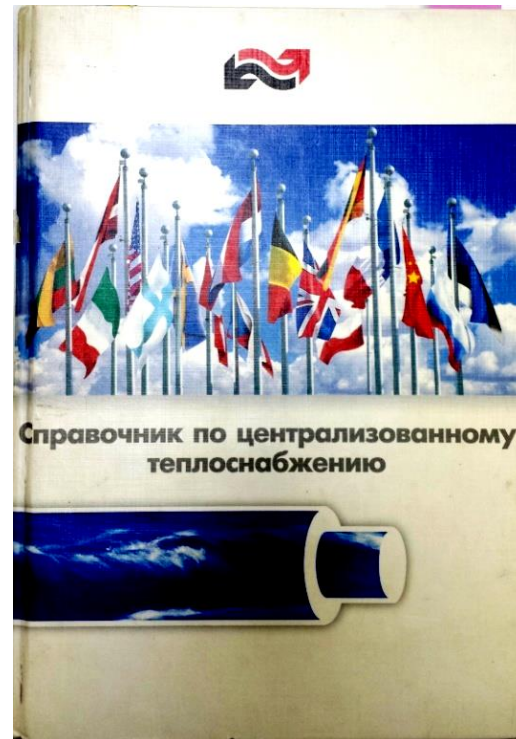
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# PASS/Start-Prof | Historia

Desde 1998, las Tuberías Pre-aisladas Enterradas con Aislamiento de Espuma de Poliuretano Comenzaron a Utilizarse Ampliamente en Rusia.

El Manual de Peter Randlov se Hizo Popular en Todo el Mundo Desde 1997



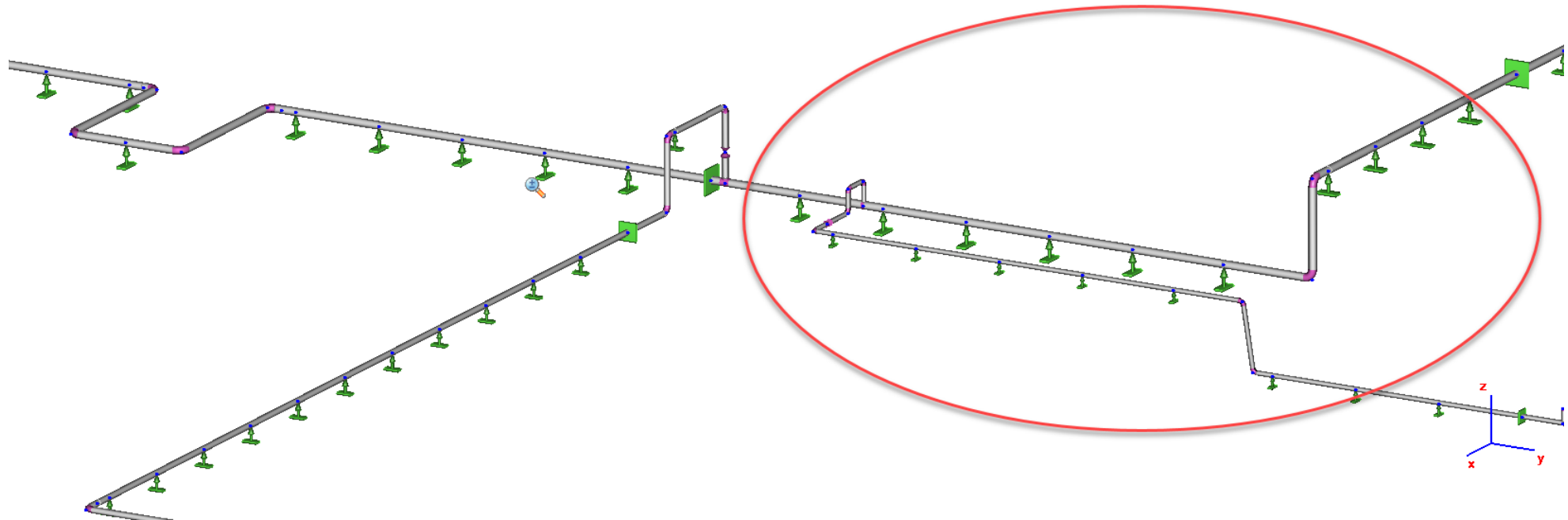
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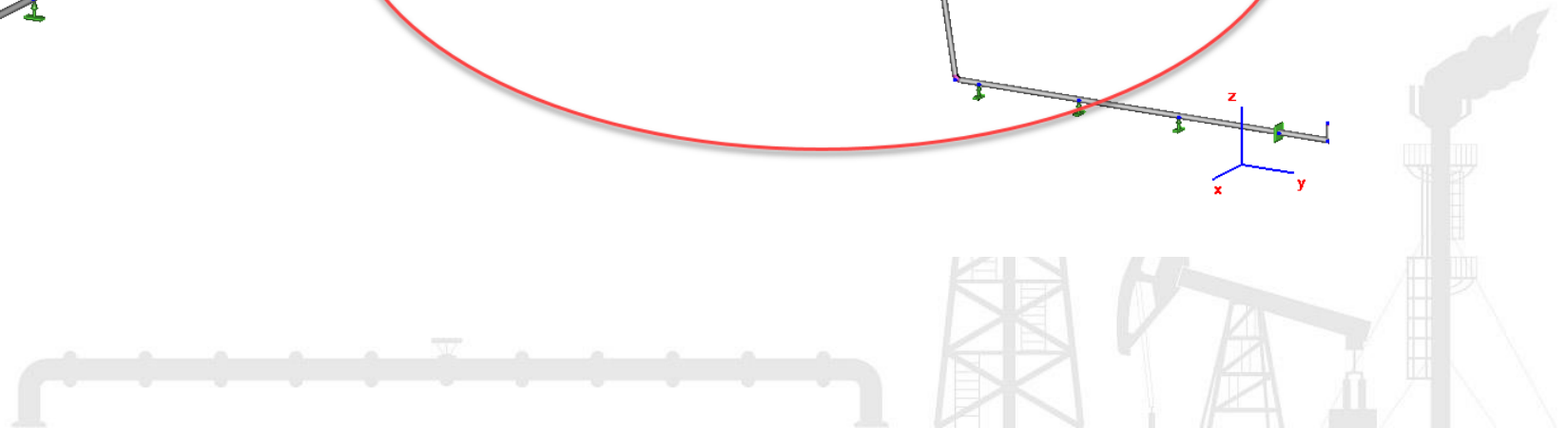


# PASS/Start-Prof | Historia

Este modelo de tubería no se puede diseñar correctamente utilizando métodos manuales simples de manuales. PASS / START-PROF ya era popular para el diseño de tuberías de potencia y proceso en el periodo 1970-2000, pero la mayoría de las empresas de diseño de calefacción urbana todavía usaban métodos manuales inexactos (nomografía) hasta 2000

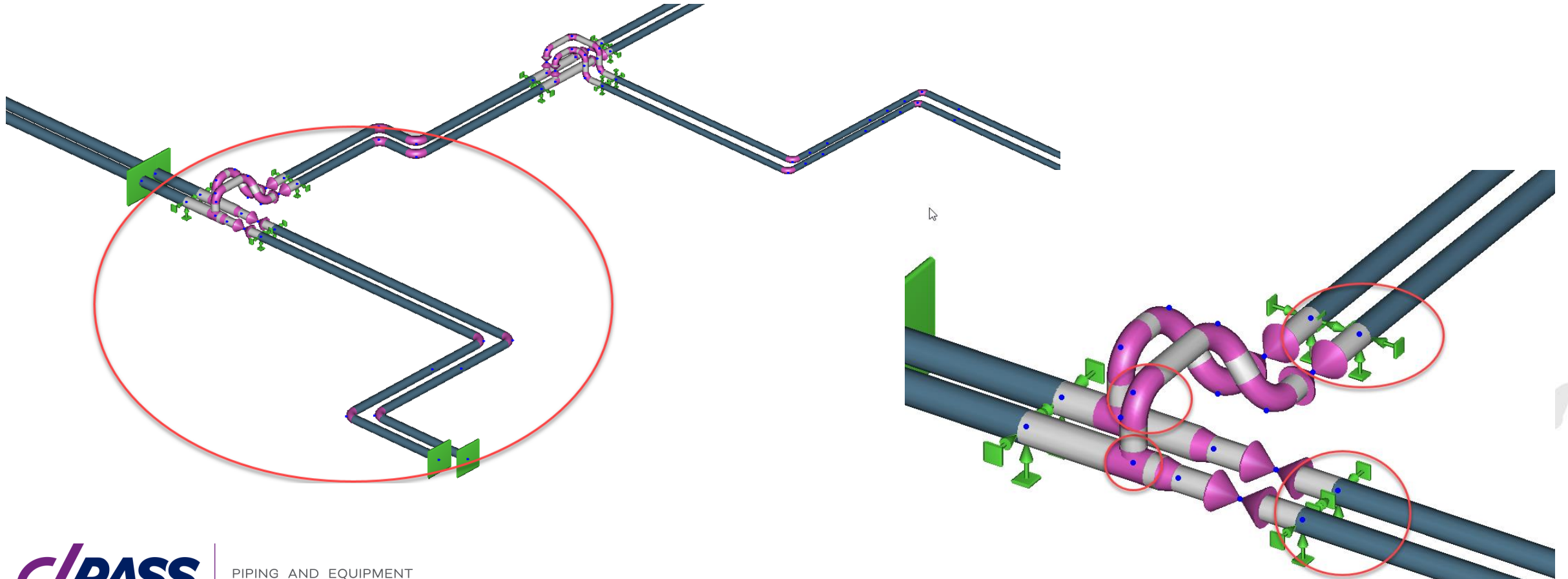


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# PASS/Start-Prof | Historia

Los métodos de análisis manual no permiten verificar adecuadamente los complejos sistemas de tuberías de diseño. Es imposible verificar los esfuerzos en las conexiones, como tees, dobles, reducciones. Especialmente para diseño enterrado directamente

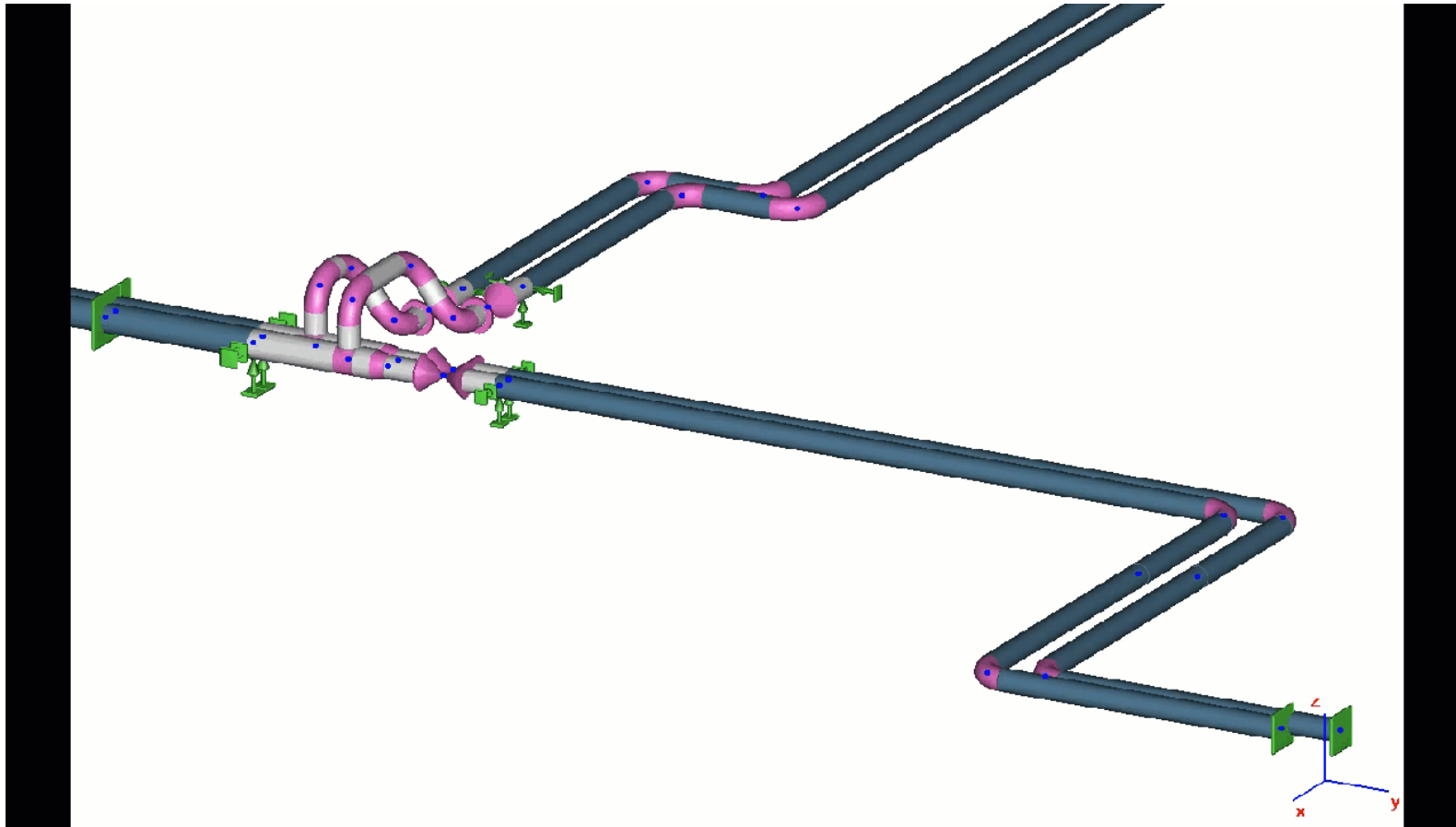


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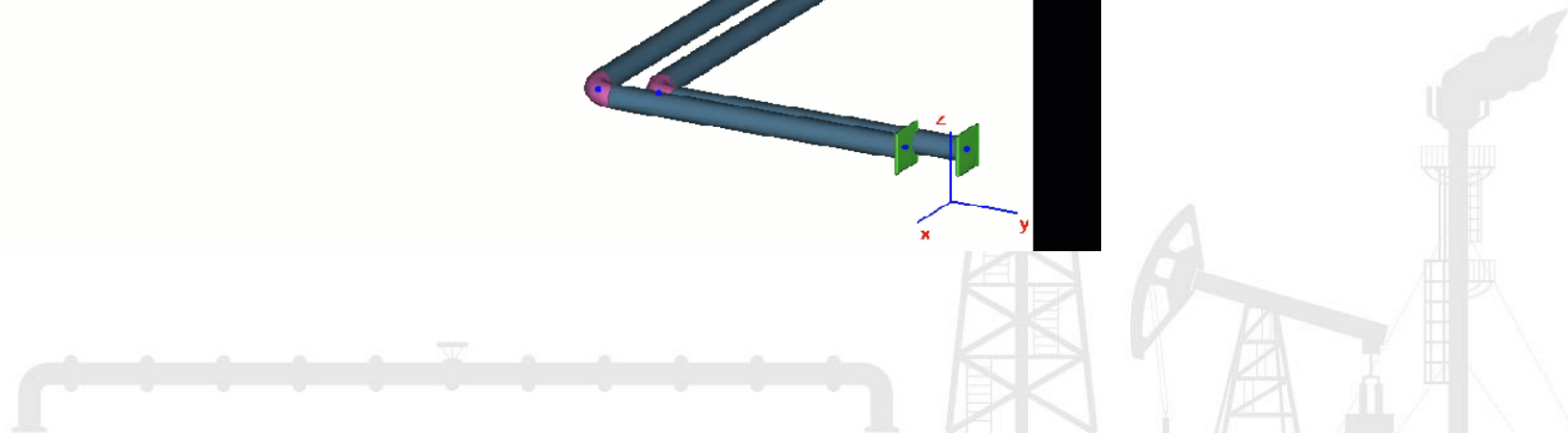


# PASS/Start-Prof | Historia

Desde 2000 la situación comienza a cambiar. START-PROF se hizo cada vez más popular para el diseño de calefacción urbana

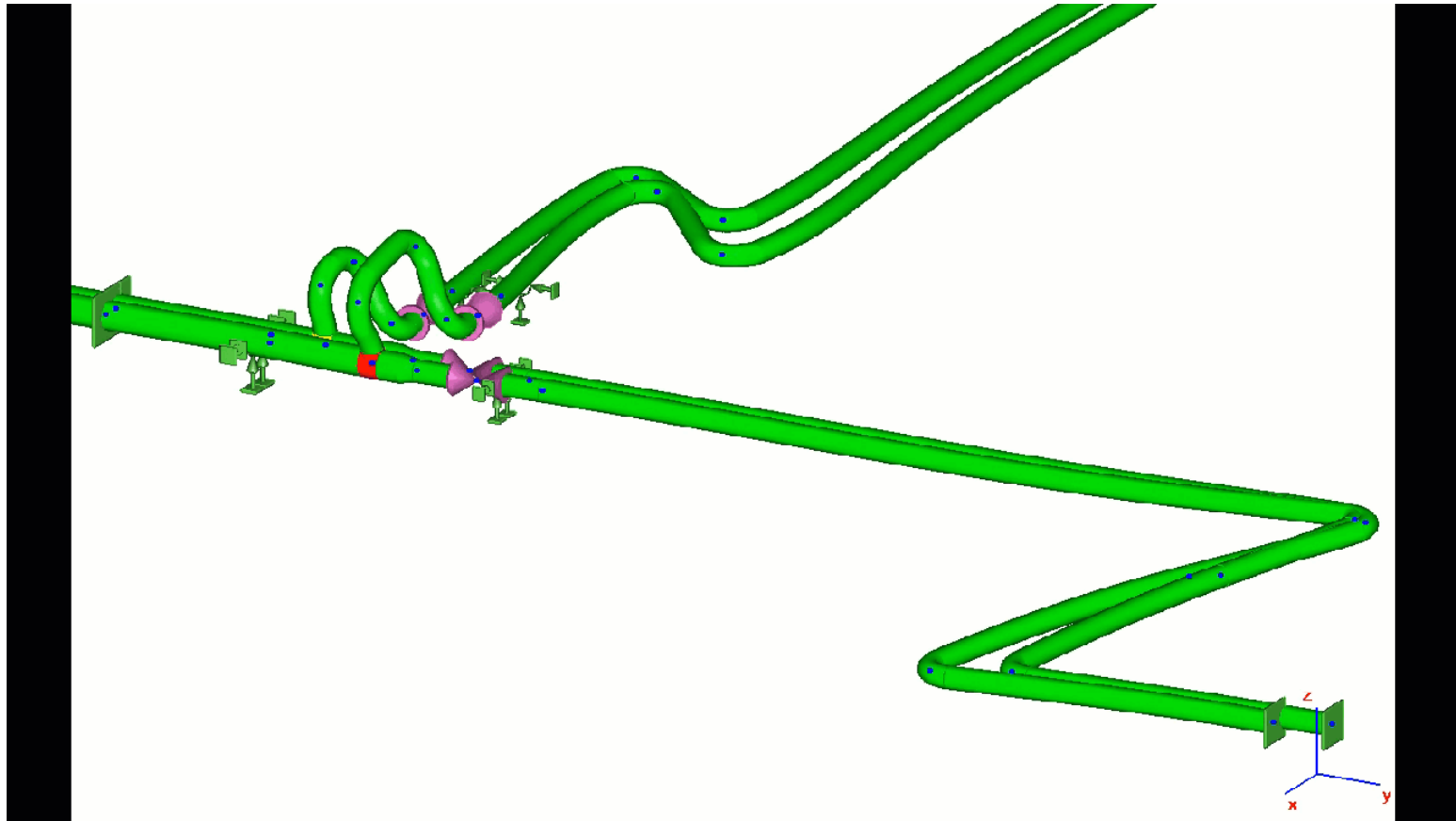


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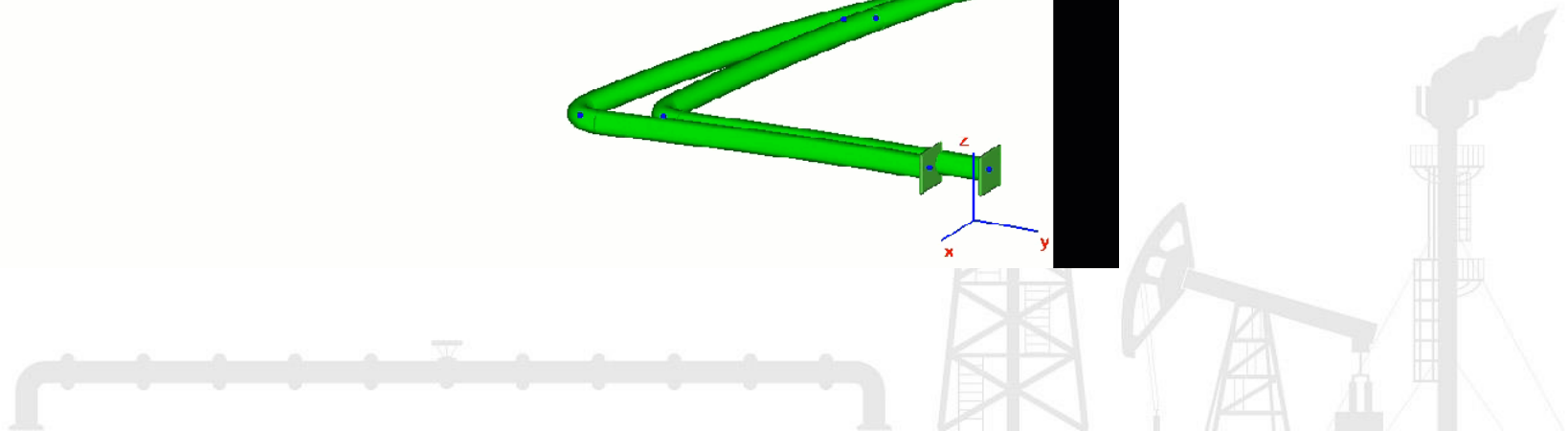


# PASS/Start-Prof | Historia

Los métodos de análisis manual no permiten verificar adecuadamente los complejos sistemas de tuberías de diseño. Es imposible verificar los esfuerzos en las conexiones como tees, codos, reducciones. Especialmente para diseño de sistemas enterrados.



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# PASS/Start-Prof | Historia

A veces los accidentes ocurrieron debido a un incorrecto diseño

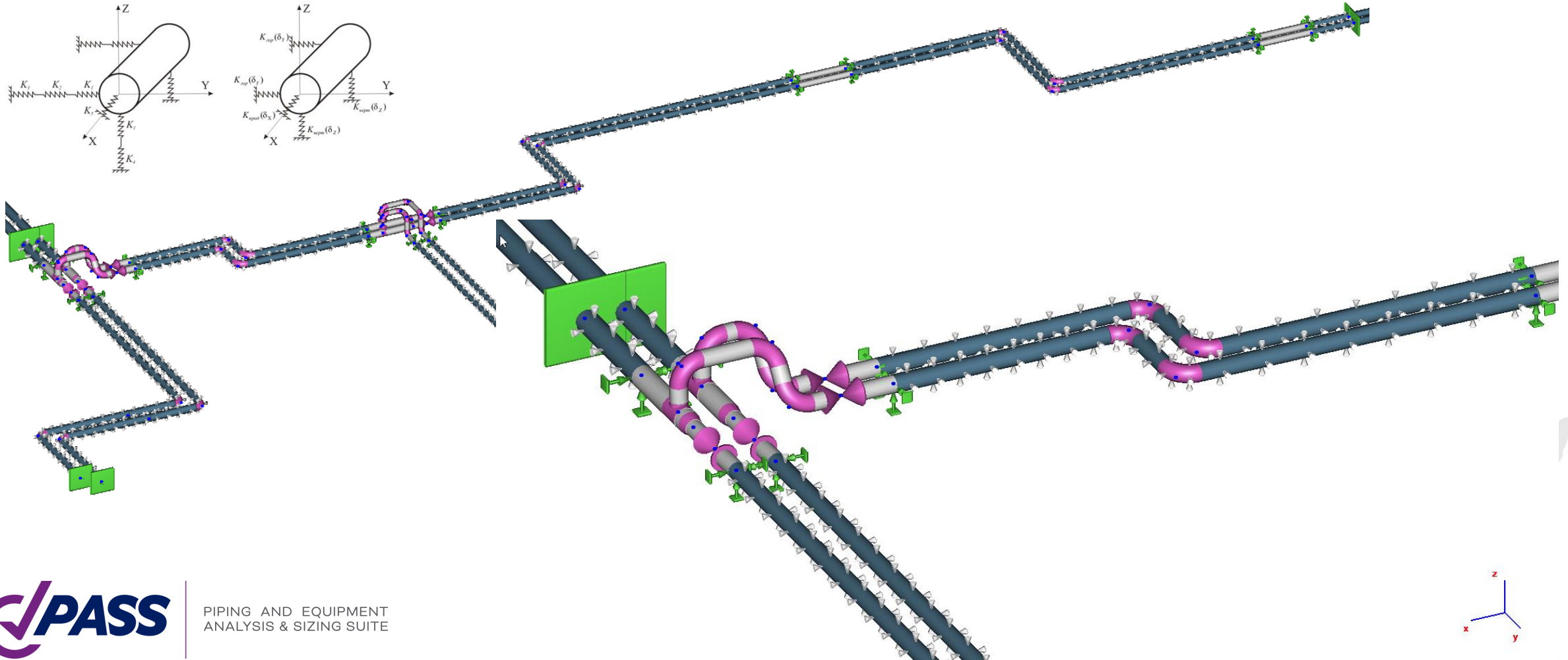


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# PASS/Start-Prof | Historia

De hecho, PASS / START-PROF se convierte en un estándar de la industria para el diseño de redes de calefacción urbana. Hoy en día, los métodos manuales casi nunca se usan



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# PASS/Start-Prof | Historia

Se diseñó con éxito un lote de sistemas de calefacción urbana de 219 mm a 1400 mm sobre Rusia desde 1998 utilizando el software PASS/START-PROF

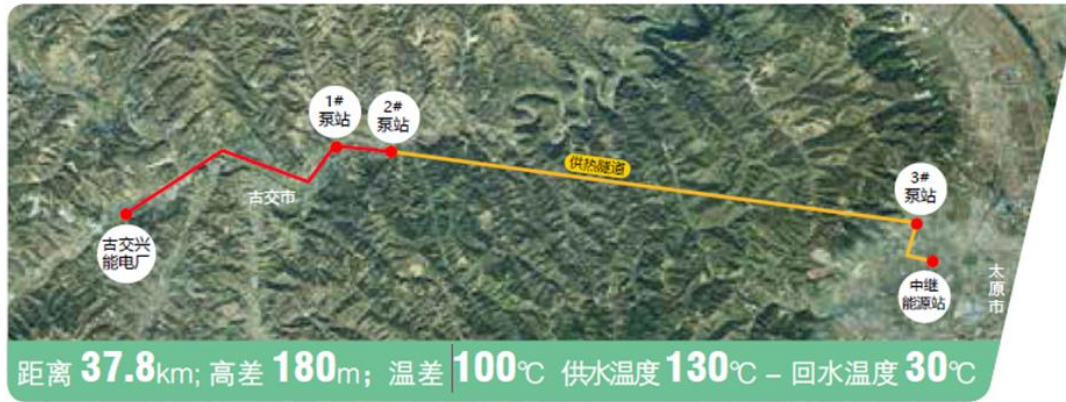


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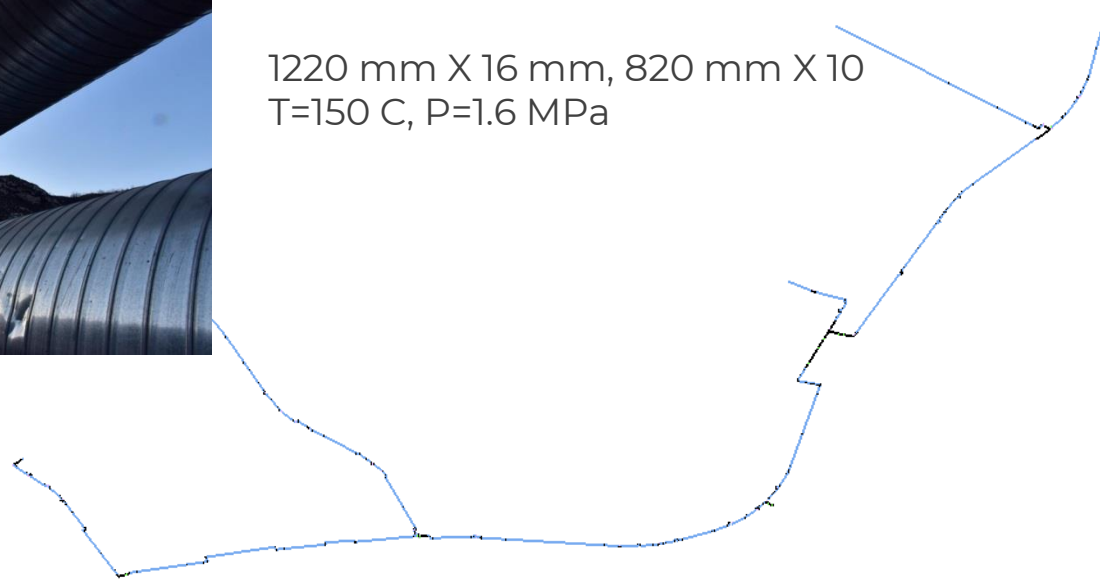


# PASS/Start-Prof | Ejemplos de Aplicación

Desde 2015, START-PROF se hizo popular en China. Ya han diseñado muchas redes de calefacción urbana en China usando PASS / START-PROF, por lo que se convirtió en un estándar de la industria también



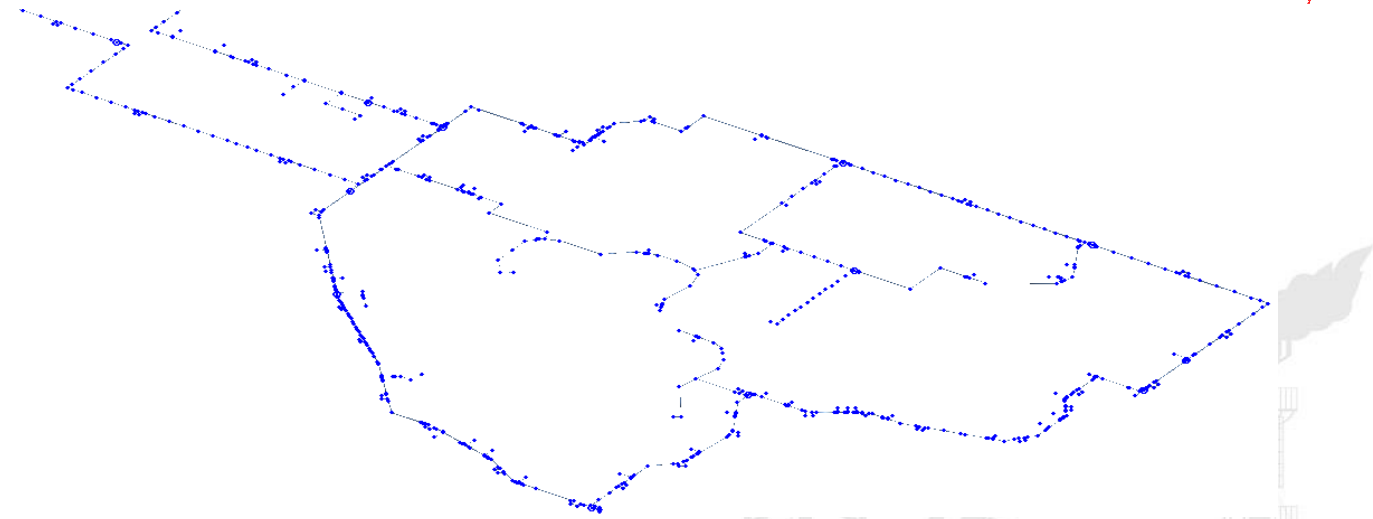
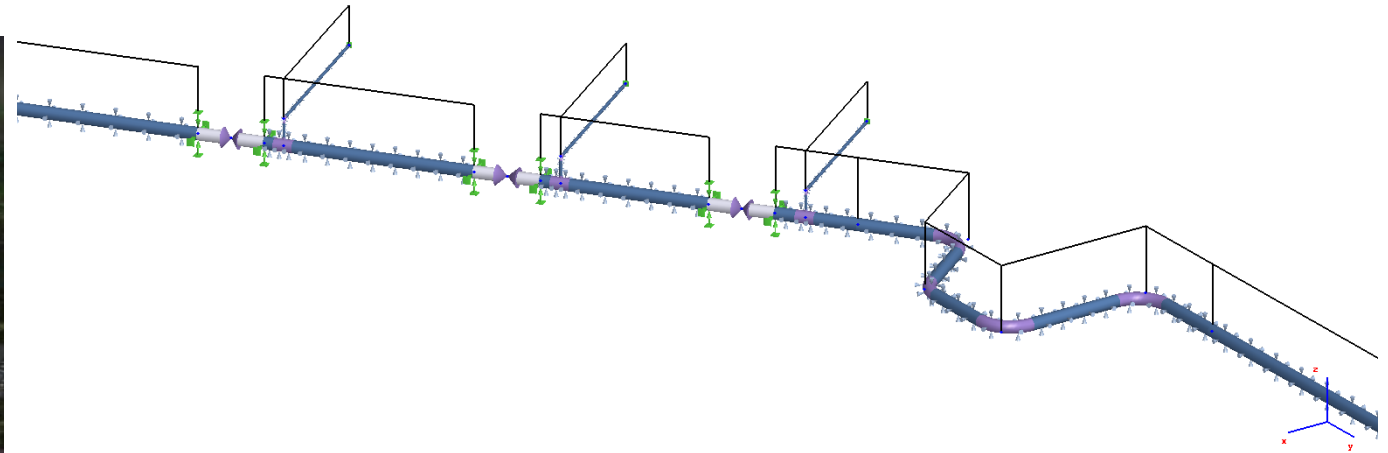
1220 mm X 16 mm, 820 mm X 10  
T=150 C, P=1.6 MPa



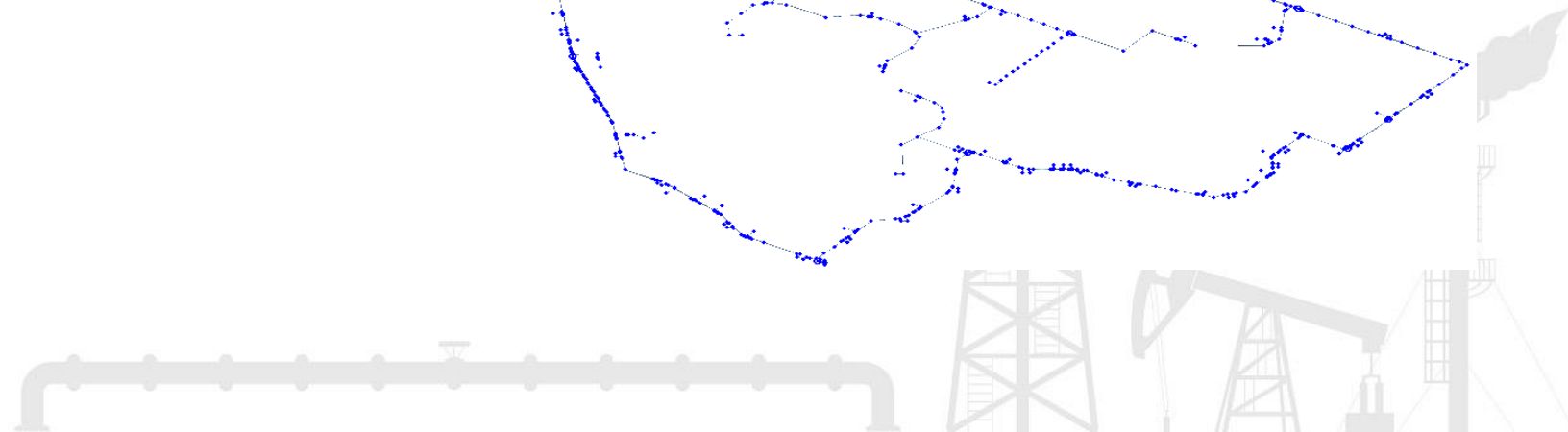


# PASS/Start-Prof | Ejemplos de Aplicación

Parque de Atracciones Universal de Beijing Realizo un proyecto de red de tuberías enterradas de agua caliente con PASS / START-PROF



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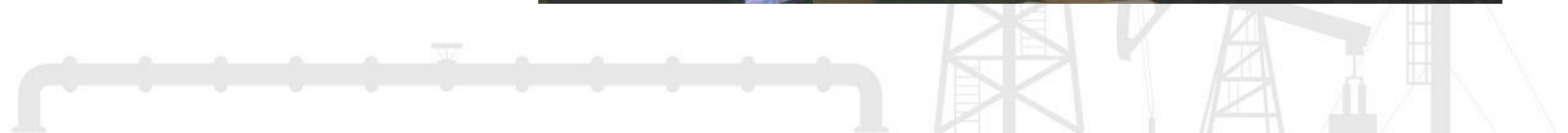


# PASS/Start-Prof | Entrenamiento

Entrenamiento en PASS/START-PROF



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# PASS/Start-Prof | Entrenamiento

Entrenamiento PASS/START-PROF

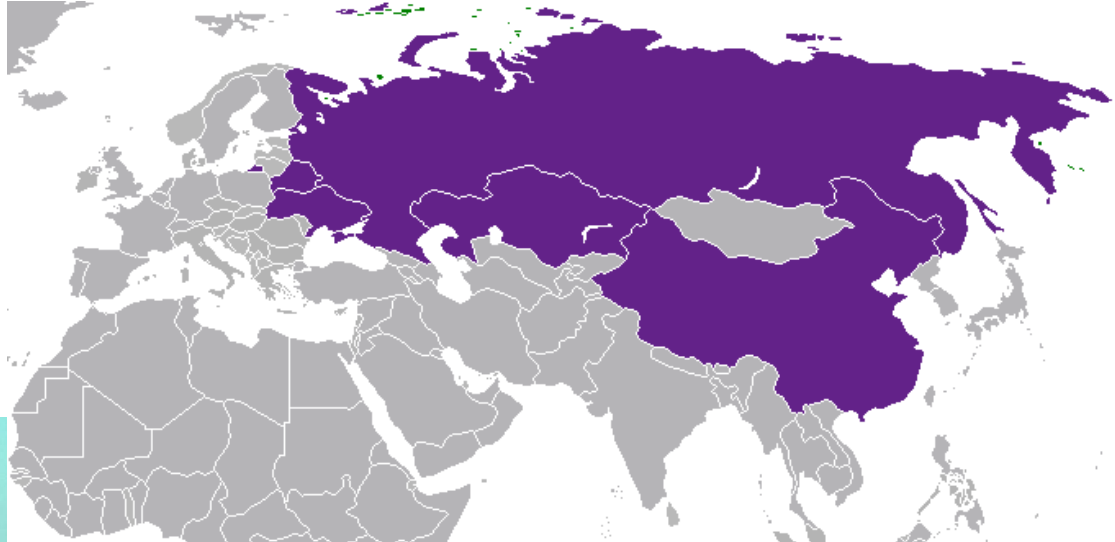
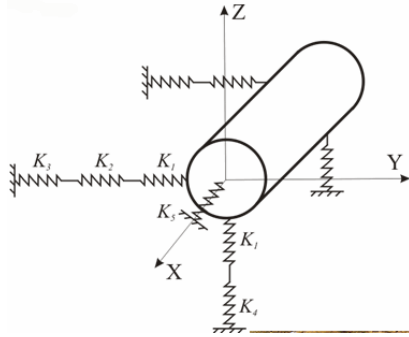


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# PASS/Start-Prof | Características

PASS / START-PROF es el estándar de la industria para el análisis de redes de calefacción urbana en China, Rusia, Ucrania, Bielorrusia, Kazajistán. Más de 800 empresas de calefacción urbana son usuarios activos



# PASS/Start-Prof | Capacidad para análisis

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PASS/START-PROF Incluye las habilidades para el análisis profesional de esfuerzos para redes urbanas de calefacción:

- Análisis no lineal de tolerancias, fricción, restricciones en un sentido, varillas giratorias, etc.
- Algoritmo especial que mejora la convergencia del modelo no lineal durante el análisis sin requerir ajuste manual (por tolerancias, restricciones en un sentido, o por fuerzas por fricción, etc.). Recibimos de los usuarios modelos que no convergen, los agregamos a nuestra colección de casos y continuamente mejoramos el algoritmo desde hace 55 años. Lo que permite la convergencia en el 99.9% de los modelos analizados.



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# PASS/Start-Prof | Capacidad para análisis

Generación automática de cargas por sismo, viento, nieve, hielo de acuerdo con 18 códigos

Pipe Properties

Pipe: 117-118  Pipe is Buried

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

Main Additional **Wind, Snow, Ice**

Insulation Outer Diameter: 300 mm

Elevation of Start Node: 4 m

Elevation of End Node: 4 m

Snow Shape Factor: 0.4

Thermal Coefficient: 1

Snow (and Rain) Load: 0.084 kgf/m

Ice Shape Factor: 0.6

Ice Load: 7.45763830 kgf/m

Correlation Factor: 1

Autocalc factors

Wind Direction Number: Wind N1

Wind Load: 4.70342237 kgf/m

X: 0 kgf/m  
Y: 0 kgf/m  
Z: 0 kgf/m

OK Cancel Help

Project Settings... - AntiSymmetric1.ctp

General Additional Seismic **Wind, Snow, Ice** Other Dynamic

Snow Loads

Code: ASCE 7-16 (USA)

Ground Snow Load: Don't Apply Snow  
SP 20.13330.2016 (Russia)  
GB 50009-2012 (China)

Exposure factor: ASCE 7-16 (USA)

Importance factor: NBC 2010 (Canada)  
EN 1991-1-3-2003+A1-2015  
IBC 2012 (International)  
EN 1991-1-3 2009 (Belarus)  
KBC 2016 (Korea)

Ice Loads

Code: \_\_\_\_\_

Importance factor, Is: 1

Hill Shape: No Hill

Basic ice thickness, t: 7 mm

Wind Loads

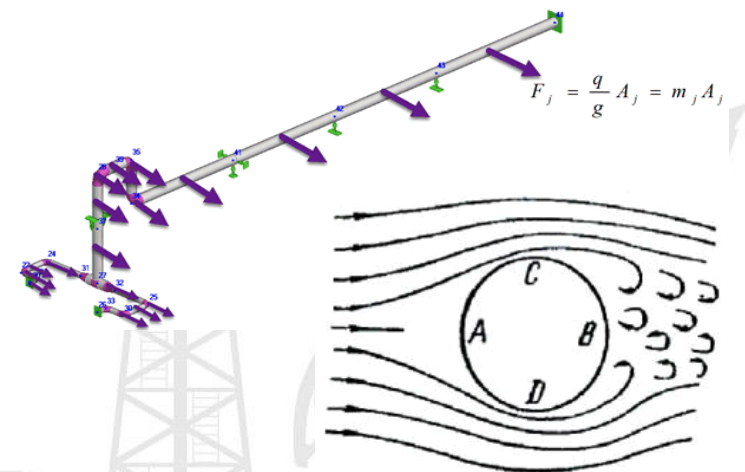
Code: CFE 2008 (Mexico)

Wind Direction: +X

Parameter		
Basic Wind Speed, V0, m/s	0	
Outdoor Temperature, s, °C	0	
Altitude, hm, m	0	
Surface Roughness, hr, mm	0	
Total Structure Height, Zt, m	0	
Terrain Category	1	

Load Type: SUS

OK Cancel Help

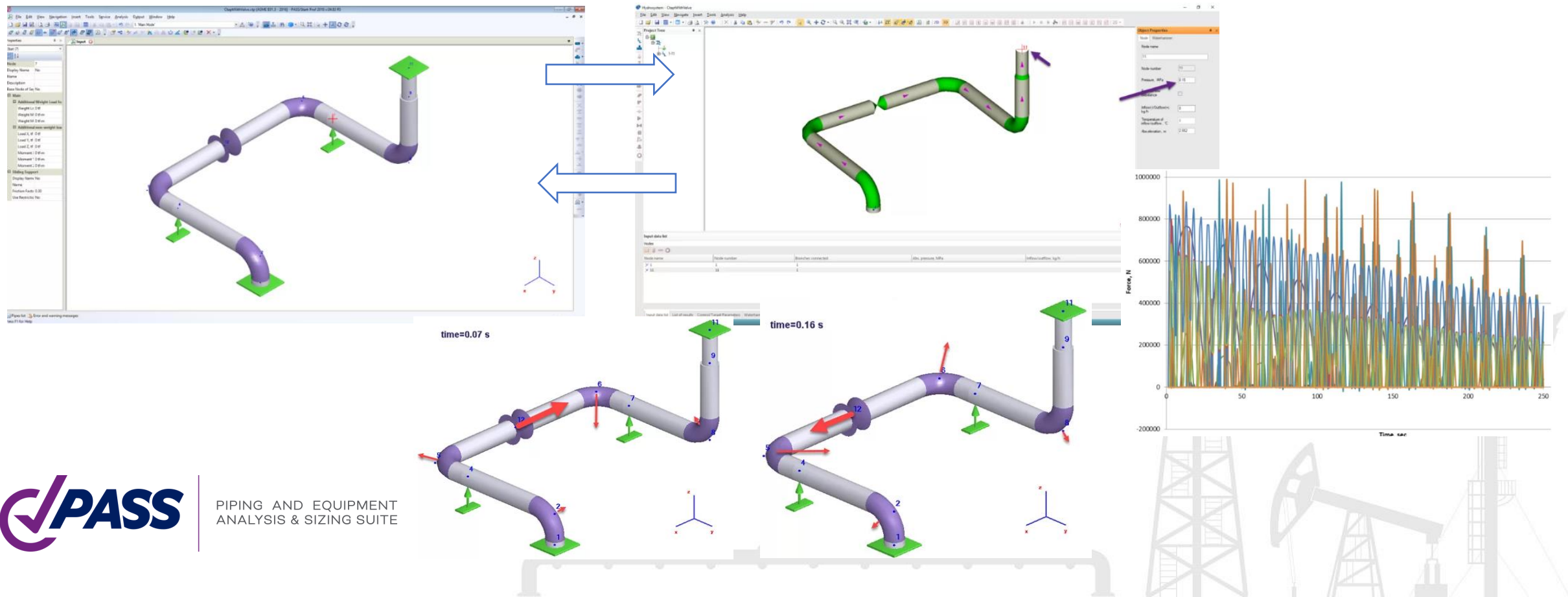


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# PASS/Start-Prof | Capacidad para análisis

PASS/START-PROF + PASS/HYDROSYSTEM le permiten el análisis por sobrepresión y golpe de ariete

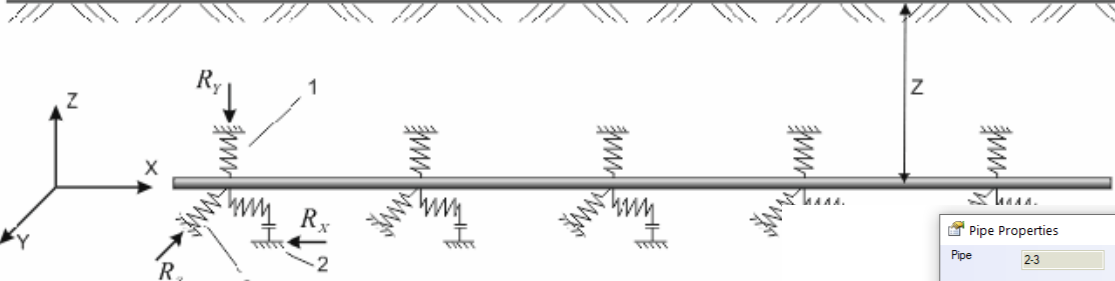
- Los modelos 3D de tubería se transfieren automáticamente de START-PROF a HYDROSYSTEM y viceversa
- Las cargas 3D se convierten simultáneamente para todos los nodos en el sistema en el mismo instante de tiempo



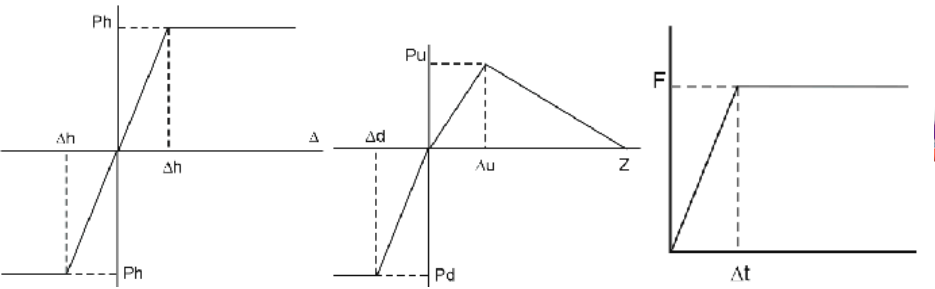
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# PASS/Start-Prof | Modelo de suelo seco

La finalidad principal de modelado de suelo seco es ahorrar en cantidad de soportes en el modelo entero para acelerar el análisis sin sacrificar exactitud en el resultado

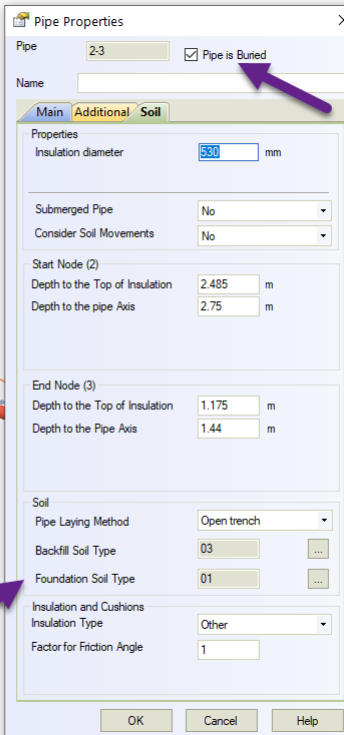


The diagram shows a horizontal pipe with a coordinate system (X, Y, Z). Reaction forces are labeled:  $R_y$  (vertical),  $R_x$  (horizontal), and  $R_z$  (out-of-plane). Springs represent soil support along the pipe length.



Three graphs illustrate soil pressure distributions:

- Graph 1: Pressure  $P_h$  vs. distance  $\Delta$ . Shows a linear increase from 0 to  $P_h$  over distance  $\Delta h$ , then constant at  $P_h$ .
- Graph 2: Pressure  $P_u$  vs. distance  $Z$ . Shows a linear increase from 0 to  $P_u$  over distance  $\Delta u$ , then constant at  $P_u$ .
- Graph 3: Pressure  $F$  vs. distance  $\Delta t$ . Shows a linear increase from 0 to  $F$  over distance  $\Delta t$ , then constant at  $F$ .



**Pipe Properties** dialog box configuration:

- Pipe: 2-3
- Pipe is Buried
- Name: [Empty]
- Properties:
  - Insulation diameter: 500 mm
  - Submerged Pipe: No
  - Consider Soil Movements: No
- Start Node (2):
  - Depth to the Top of Insulation: 2.485 m
  - Depth to the pipe Axis: 2.75 m
- End Node (3):
  - Depth to the Top of Insulation: 1.175 m
  - Depth to the Pipe Axis: 1.44 m
- Soil:
  - Pipe Laying Method: Open trench
  - Backfill Soil Type: 03
  - Foundation Soil Type: 01
- Insulation and Cushions:
  - Insulation Type: Other
  - Factor for Friction Angle: 1



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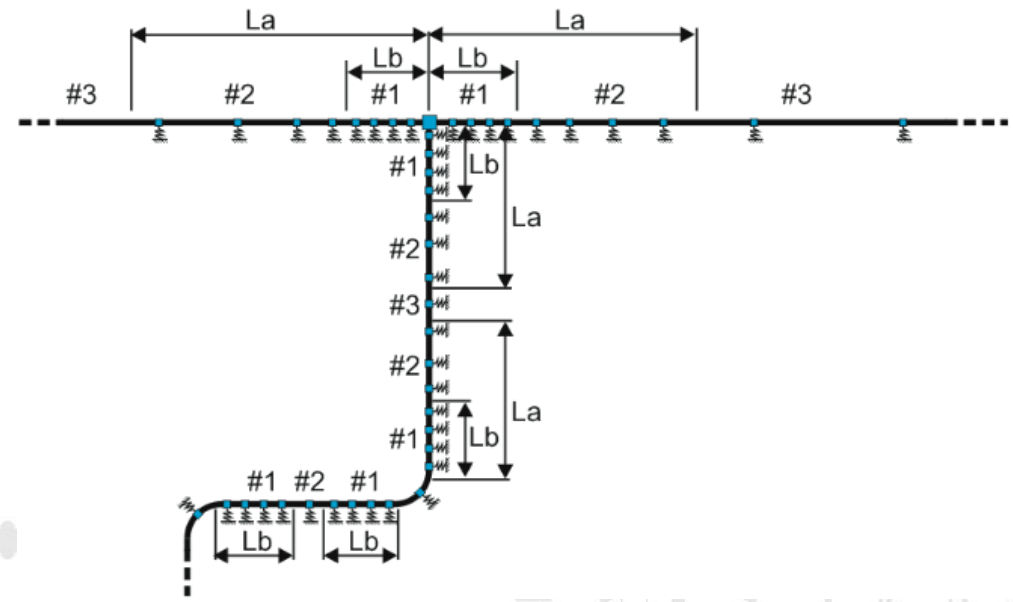


# PASS/Start-Prof | Modelo de suelo seco

**Zona #1:** zona de soportes laterales (no restringida) para una distancia  $L_b$ . Cuatro soportes se colocan en cada espacio y serán separados en la longitud en forma equidistante.

**Zona #2:** zona de deslizamiento axial (no restringida) con distancia  $L_a$ . Cuatro soportes son localizados a distancias que son incrementadas exponencialmente desde la zona #1 hasta la zona #3

**Zona #3:** zona restringida. Los soportes se colocan a espacios de  $100D$ , donde  $D$  es el diámetro externo del tubo

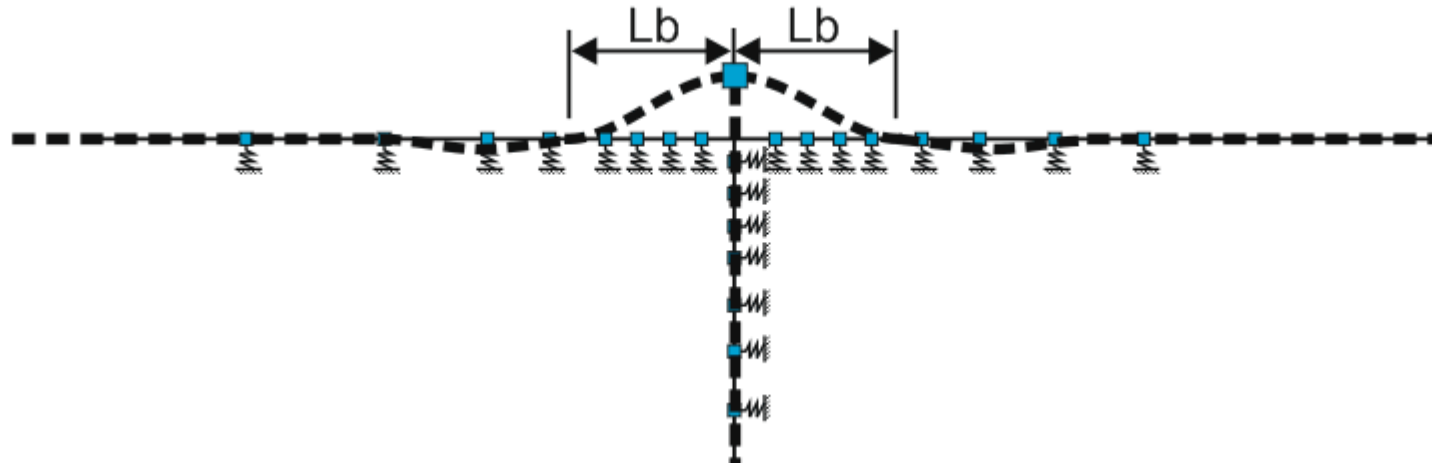


PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE

# PASS/Start-Prof | Modelo de suelo seco

Zona #1: zona de soportes laterales (no restringida) para una distancia  $L_b$ . Cuatro soportes se colocan en cada espacio y serán separados en la longitud en forma equidistante.

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

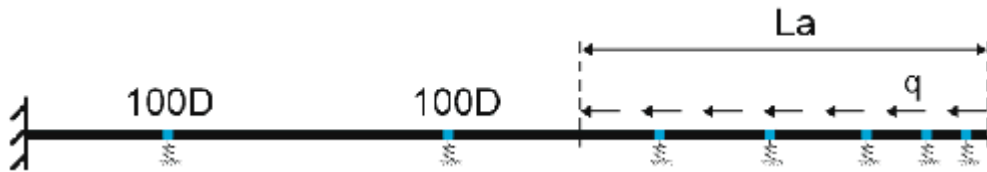


PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE

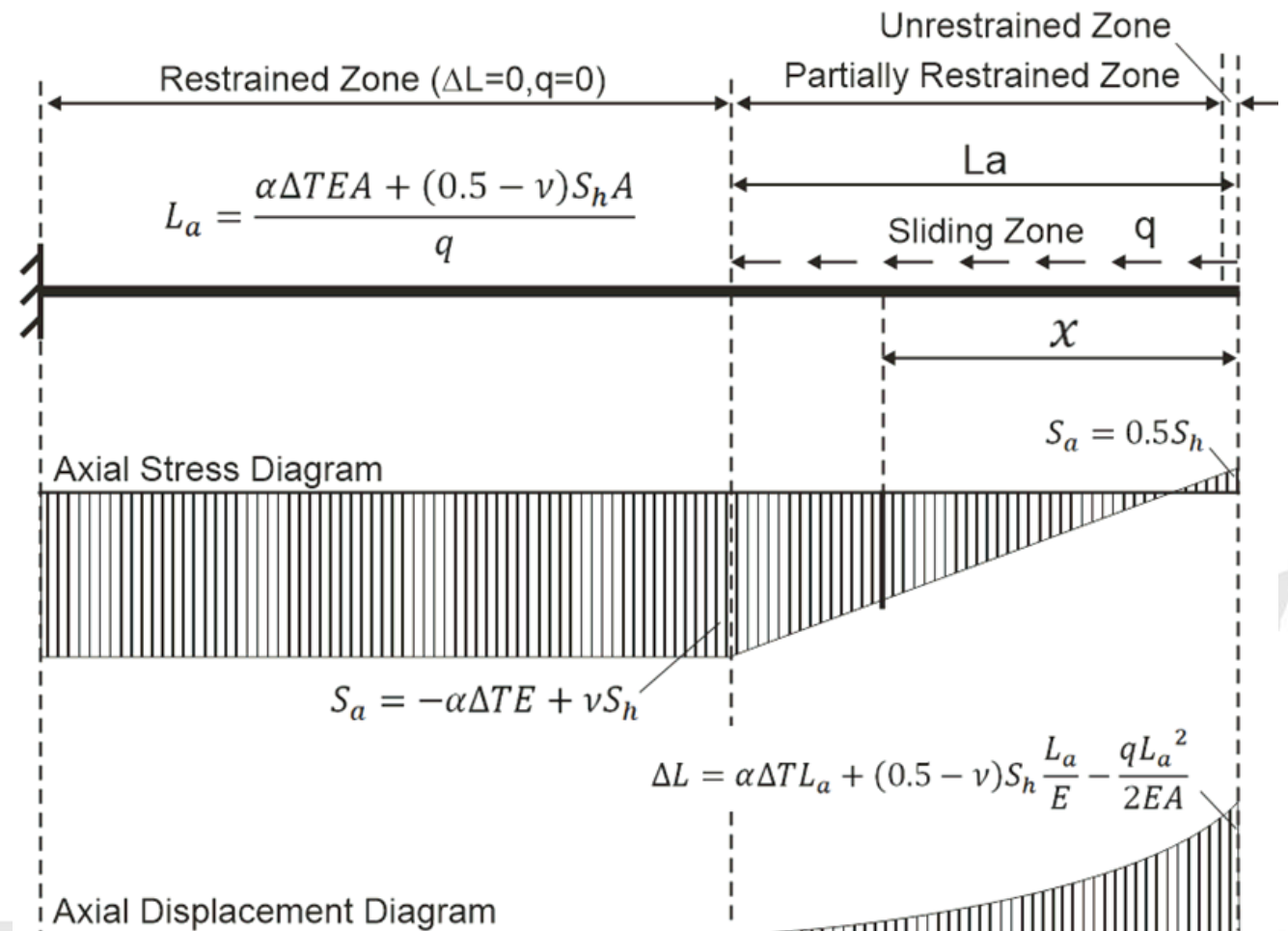


# PASS/Start-Prof | Modelo de suelo seco

Zona #2: zona de deslizamiento axial (no restringida) con distancia  $L_a$ . Cuatro soportes son localizados a distancias que son incrementadas exponencialmente desde la zona #1 hasta la zona #3

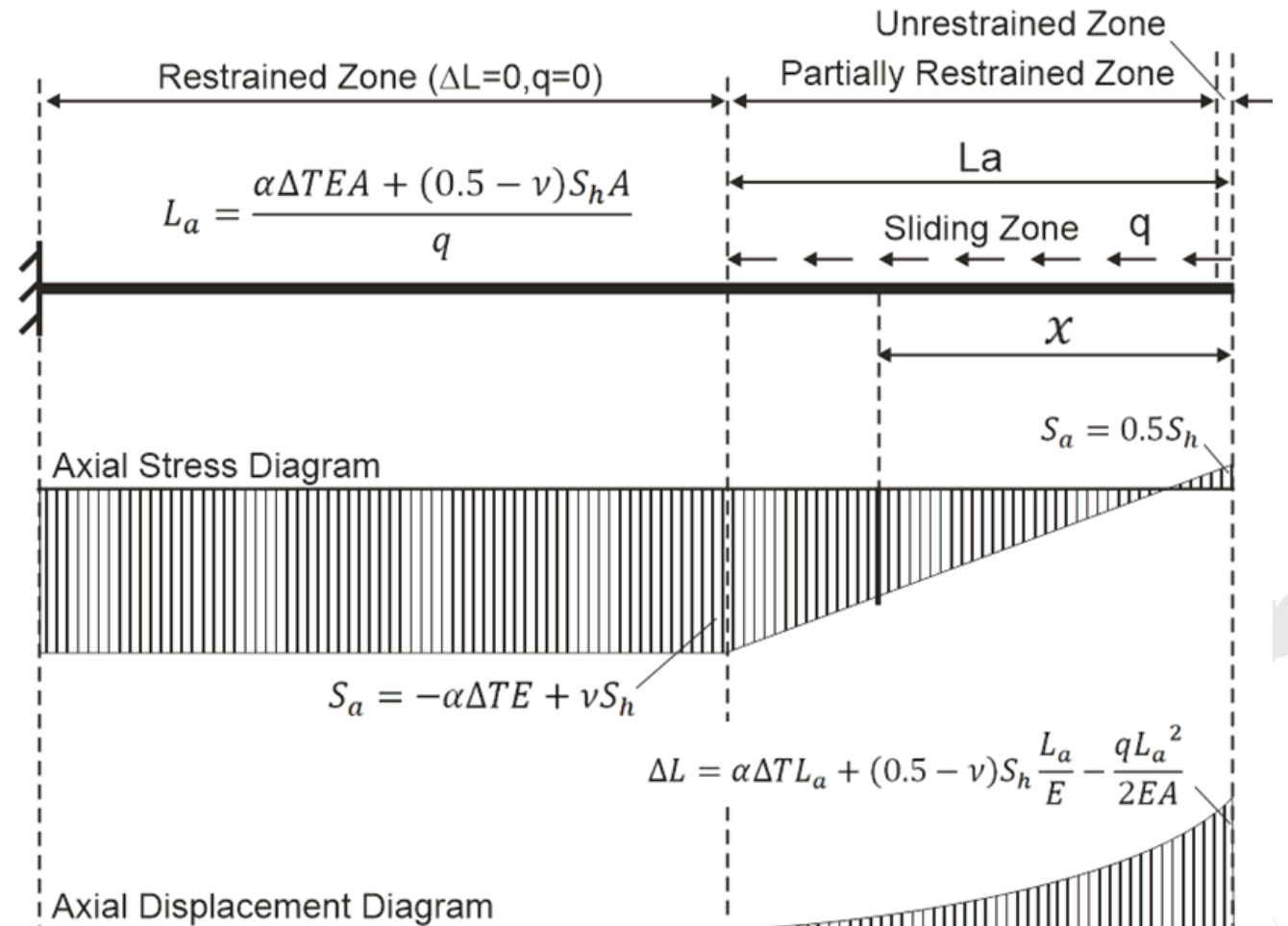
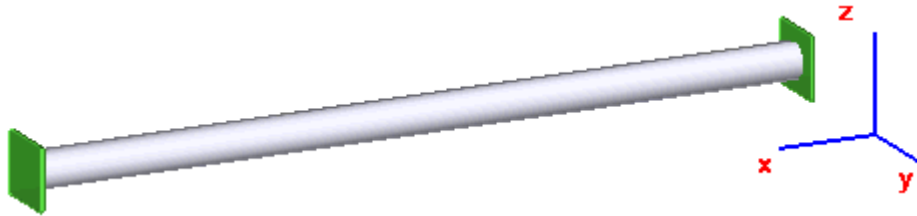


$$L_a = \frac{\alpha \Delta T E A + (0.5 - \nu) S_h A}{q} + 3 \sqrt{\frac{EA}{\pi D C_{x0}}}$$



# PASS/Start-Prof | Modelo de suelo seco

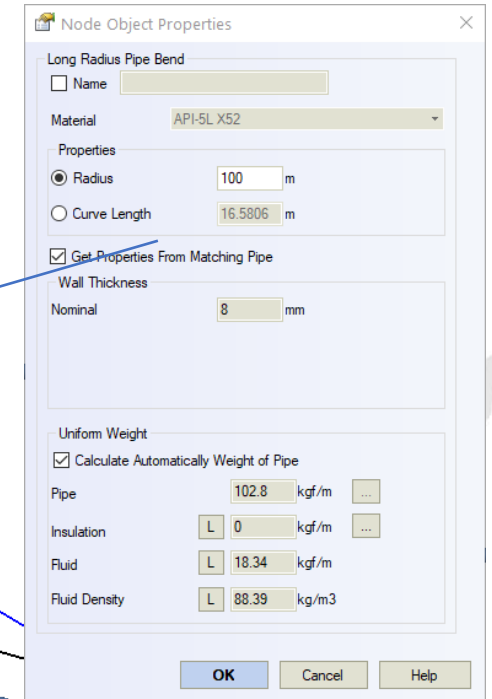
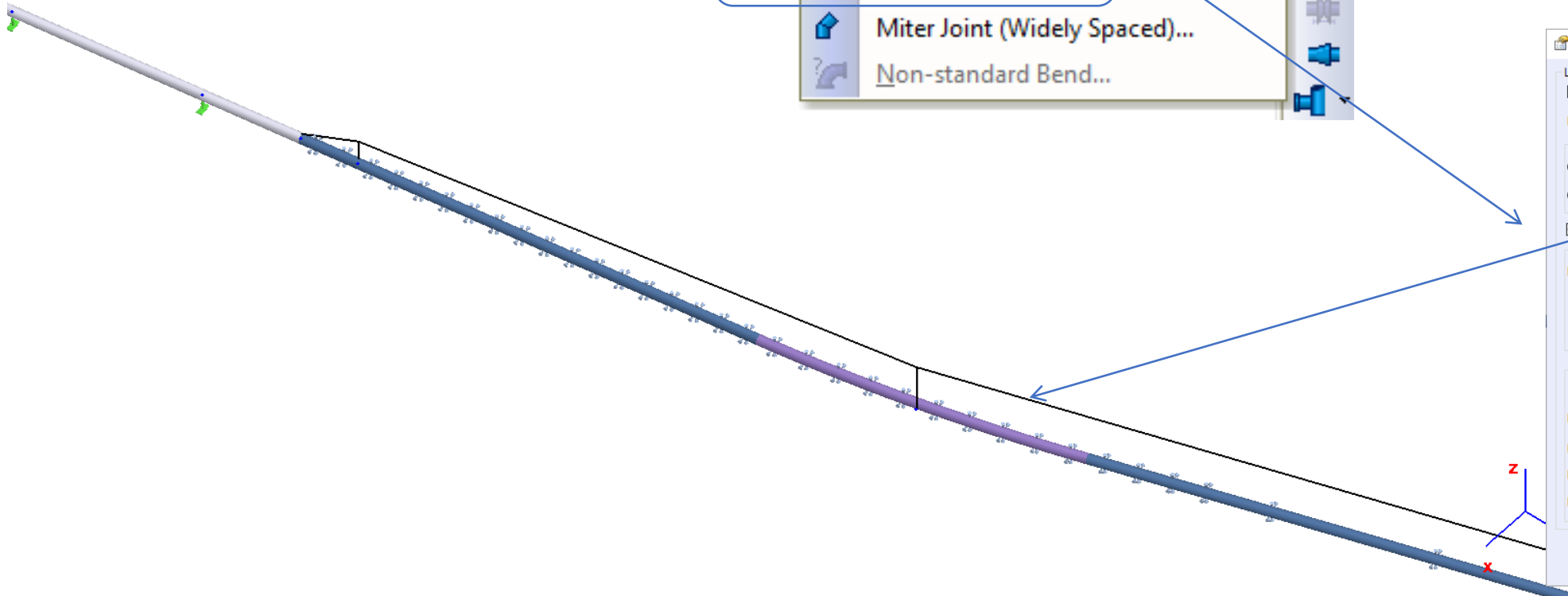
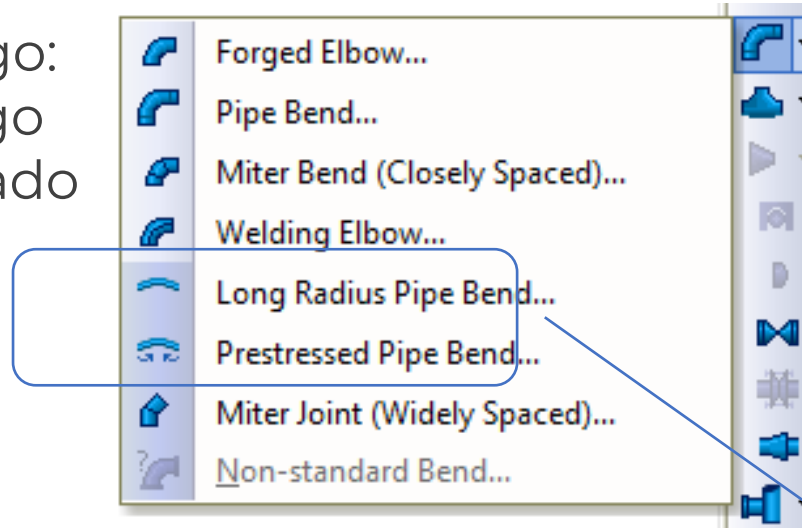
Zona #3: zona restringida. Los soportes se colocan a espacios de  $100D$ , donde  $D$  es el diámetro externo del tubo



# PASS/Start-Prof | Modelo de suelo seco

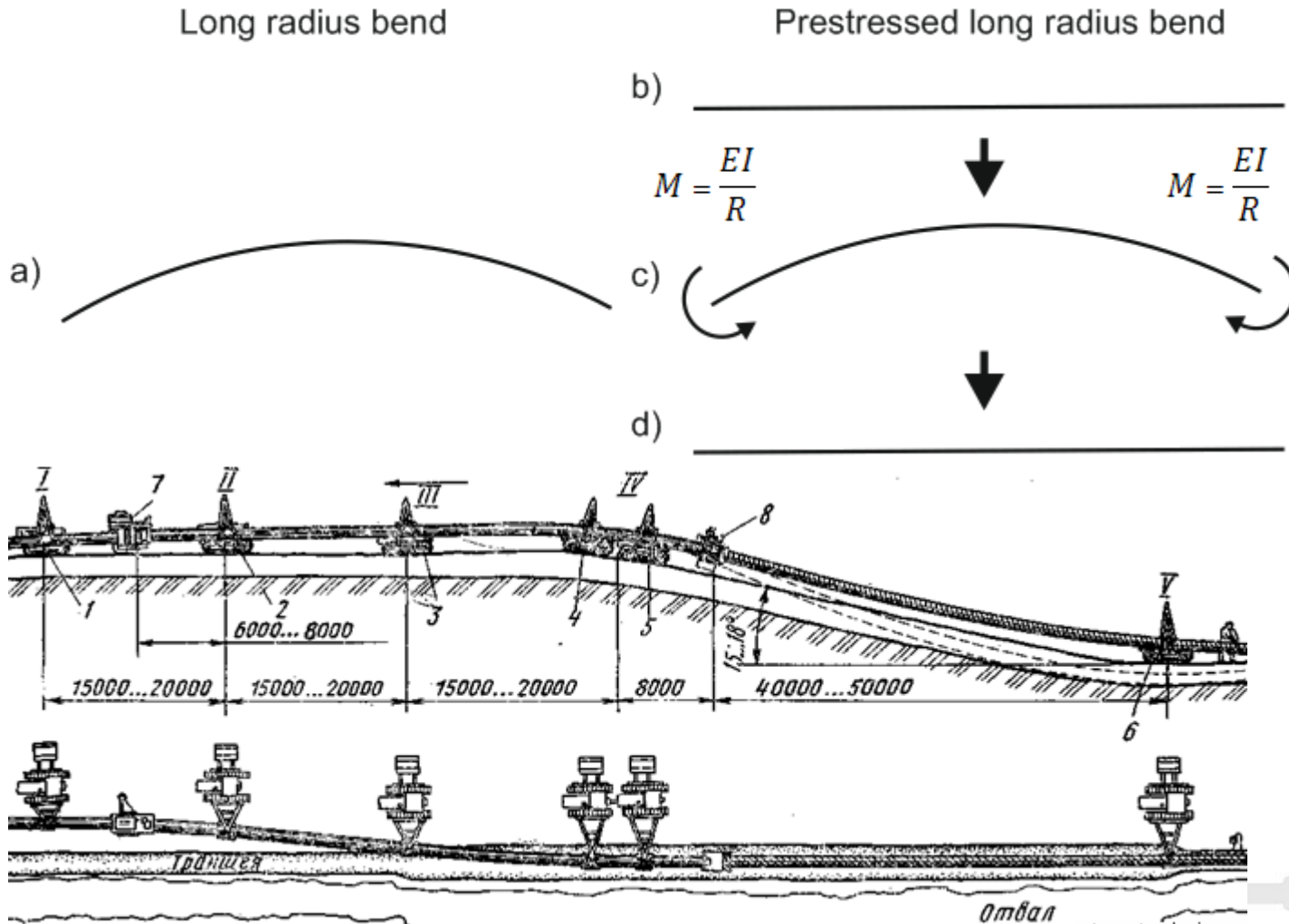
Dos objetos Curva de Radio Largo:

- Curva de tubería de radio largo
- Curva de tubería pre tensionado



# PASS/Start-Prof | Modelo de suelo seco

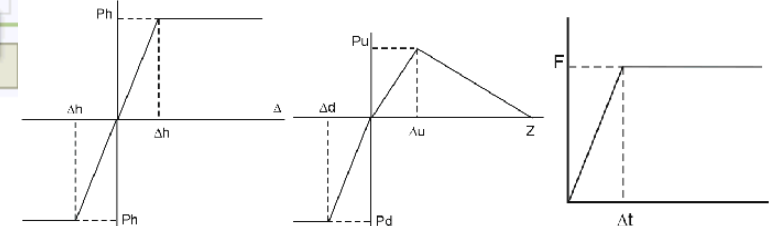
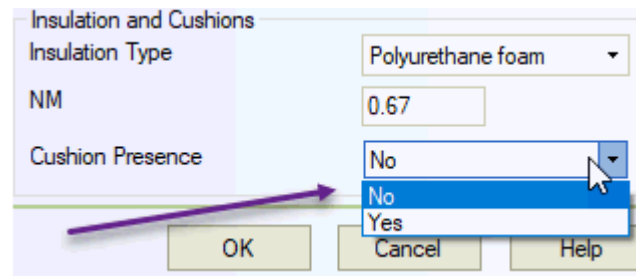
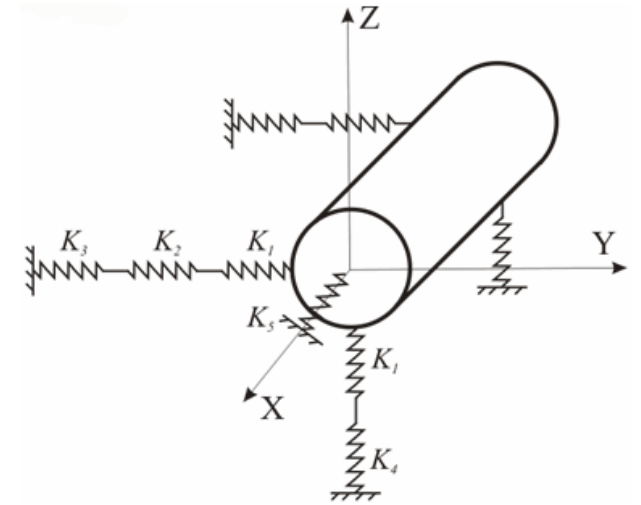
Curva de tubería pre tensionada - curvatura elástica de doblez inicial en plano vertical y horizontal



# PASS/Start-Prof | Modelo de suelo seco

Cada rigidez de soporte del suelo consiste en resortes no lineales verticales, horizontales y longitudinales.

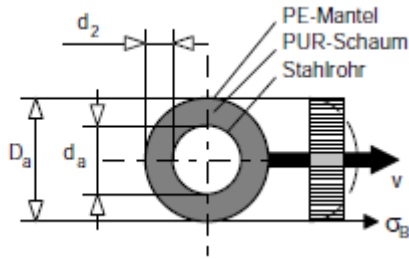
- El resorte horizontal se compone de 3 resortes  $K_1$ ,  $K_2$ ,  $K_3$ .
- El resorte vertical consiste de 2 (o 3) resortes  $K_1$ ,  $K_4$  (y  $K_2$ ).
- El resorte longitudinal es  $K_5$



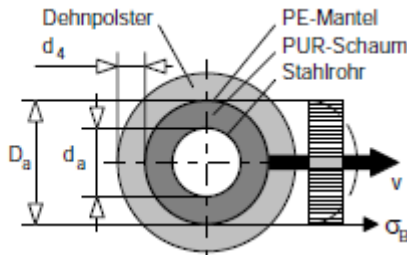
# PASS/Start-Prof | Modelo de suelo seco

Flexibilidad de cojin de expansión y aislamiento de poliuretano

Faktor	Ersatzwert
B <sub>1</sub>	1016.2
B <sub>2</sub>	-4.0397
B <sub>3</sub>	83.339
B <sub>4</sub>	-1.1678
B <sub>5</sub>	-0.56135
E <sub>s,Grenz</sub>	8.8 N/mm <sup>2</sup>



Faktor	steif
B <sub>1</sub>	1.5026E-06
B <sub>2</sub>	16.347
B <sub>3</sub>	0.1242
B <sub>4</sub>	1.286



Key

- 1 cushion
- 2 casing
- 3 PUR
- 4 steel
- 5 soil

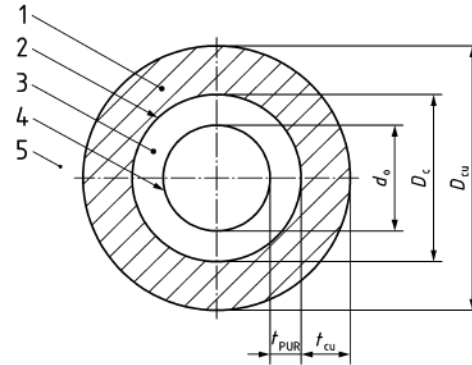
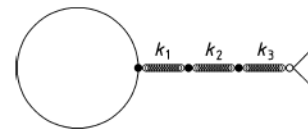


Figure 13 — Symbols for bedding constants



Key

- k<sub>1</sub> line bedding constant for PUR
- k<sub>2</sub> line bedding constant for expansion cushion
- k<sub>3</sub> line bedding constant for surrounding soil

Figure 14 — Combined soil spring constant

**Pipe Properties** [X]

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

End Node (16)

Depth to the Top of Insulation: 1.9 m

Depth to the Pipe Axis: 2.5 m

Soil

Pipe Laying Method: Open trench

Backfill Soil Type: 04

Foundation Soil Type: 01

**Insulation and Cushions**

Insulation Type: Polyurethane foam

NM: 0.67

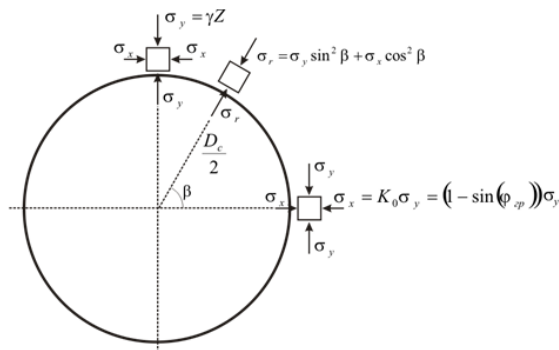
Cushion Presence: **No**

OK Cancel Help



# PASS/Start-Prof | Soil Model

## Modelo de resorte de suelo Bi-lineal Longitudinal



$$q = \mu \frac{D_c}{2} \gamma Z \left( \int_0^{2\pi} \sin^2 \beta d\beta + (1 - \sin(\varphi_{sp})) \int_0^{2\pi} \cos^2 \beta d\beta \right)$$

The  $\int_0^{2\pi} \sin^2 \beta d\beta = \pi$  and  $\int_0^{2\pi} \cos^2 \beta d\beta = \pi$  so

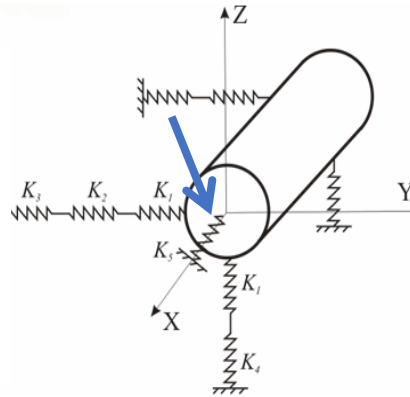
$$q = \mu D_c \gamma Z \pi \frac{(1 + 1 - \sin(\varphi_{sp}))}{2} \text{ or } q = \mu \frac{(1 + K_0)}{2} \gamma_s Z \pi D_c$$

After that we must add here the weight G of the pipe and we got the formula

$$F = \mu \left( \frac{1 + K_0}{2} \cdot \gamma_s \cdot Z \cdot \pi \cdot D_c + G \right)$$

$$\mu = \text{tg}(\varphi \cdot n_m)$$

$$K_0 = 1 - \sin \varphi$$



$D_c$  – Insulation casing outer diameter

Vertical soil stress  $\sigma_y = \gamma Z$

Horizontal soil stress  $\sigma_x = K_0 \sigma_y = (1 - \sin(\varphi_{sp})) \sigma_y$

The soil stress at any point of the pipe (normal to pipe surface)  $\sigma_r = \sigma_y \sin^2 \beta + \sigma_x \cos^2 \beta$

The unit friction at any point of the pipe is  $\mu \sigma_r$

So the result friction force is  $F = \int_S \mu \sigma_r ds$

Let's convert to polar coordinates

$$ds = R d\beta = \frac{D_c}{2} d\beta$$

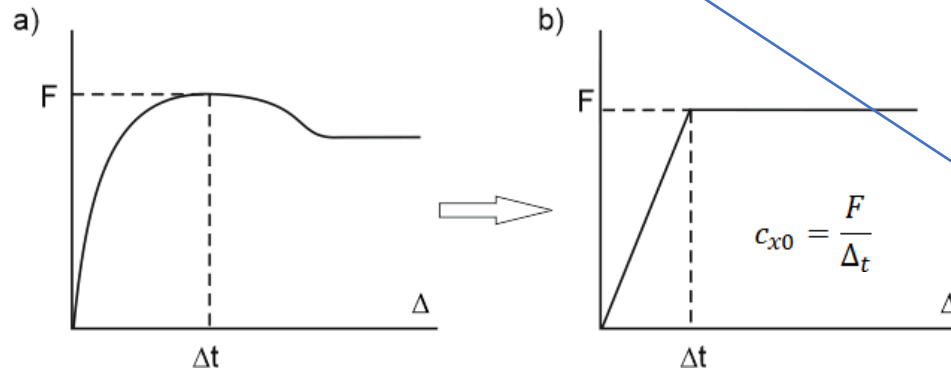
So

$$q = \int_0^{2\pi} \mu \sigma_r \frac{D_c}{2} d\beta$$

And

$$q = \mu \frac{D_c}{2} \int_0^{2\pi} \sigma_r d\beta$$

Let's substitute  $\sigma_r = \sigma_y \sin^2 \beta + \sigma_x \cos^2 \beta$ ,  $\sigma_y = \gamma Z$  and  $\sigma_x = K_0 \sigma_y = (1 - \sin(\varphi_{sp})) \sigma_y$ , here and we got



**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

End Node (16)

Depth to the Top of Insulation: 1.9 m

Depth to the Pipe Axis: 2.5 m

Soil

Pipe Laying Method: Open trench

Back-fill Soil Type: 04

Foundation Soil Type: 01

Insulation and Cushions

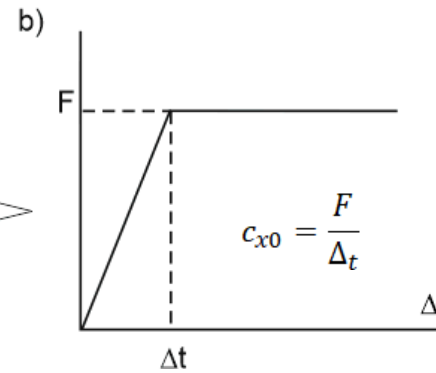
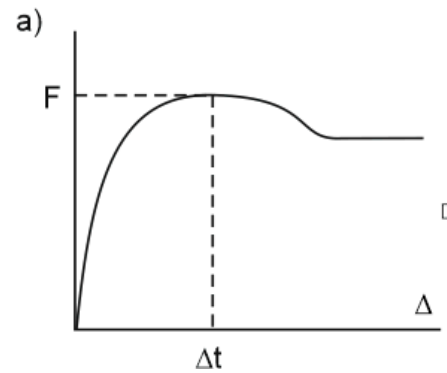
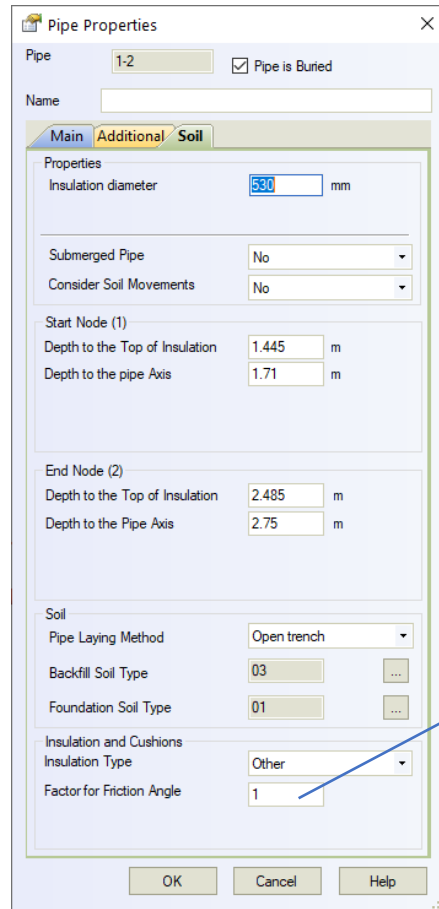
Insulation Type: Polyurethane foam

NM: 0.67

Cushion Presence:

# PASS/Start-Prof | Modelo de suelo seco

## Modelo de resorte de suelo Bi-lineal Longitudinal



$$F = \mu(2\pi D_c^2 C_h \bar{\gamma} + G) + 0.6\pi D_c C$$

$\mu$  – Friction factor

$$\mu = tg(\varphi \cdot n_m)$$

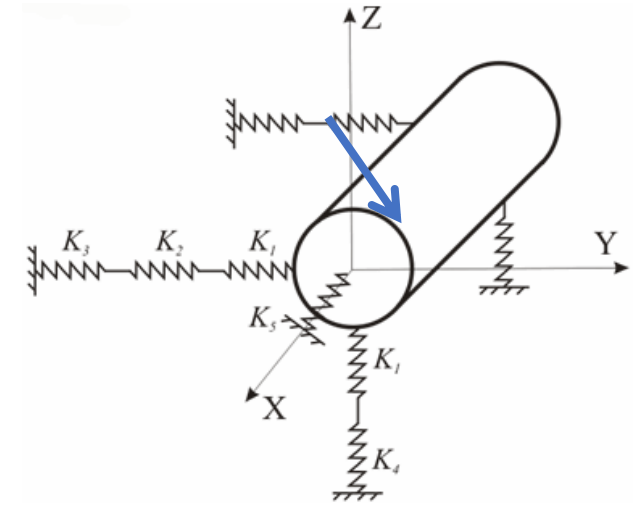
$D_c$  – Insulation casing outer diameter

$C$  – Soil Cohesion from database

$\varphi$  – Soil internal friction angle from database

$G$  – Pipe, Insulation, Product weight, minus Buoyancy

$n_m$  – Insulation adhesion factor. For steel pipes without insulation  $n_m = 0.67$



$$C_s = -0.056\beta^2 + 0.416\beta + 0.095 \text{ - For sand and sandy loam}$$

$$C_s = -0.046\beta^2 + 0.367\beta + 0.06 \text{ - For clay and loam}$$

$$\beta = \begin{cases} \frac{Z}{D_c}, & \frac{Z}{D_c} < 4 \\ 4, & \frac{Z}{D_c} \geq 4 \end{cases}$$

$\bar{\gamma}$  – 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  $\bar{\gamma} = \gamma$
- If the pipe is below the water level, then  $\bar{\gamma} = \frac{\gamma_s - \gamma_w}{1 + e}$

For vertical and horizontal pipes the more complex equations are used, we will skip it to simplify the understanding.

$\gamma$  – Dry soil unit weight from soil database  
 $\gamma_s$  – Soil particle unit weight from soil database  
 $\gamma_w$  – Water unit weight  
 $e$  – Void Ratio

$$e = \frac{V_v}{V_s} = \frac{\gamma_s}{\gamma} \cdot \gamma = \frac{n}{1-n}$$

$V_v$  – Volume of the void space

$V_s$  – Volume of the solids

$n$  – Porosity

All needed soil data is stored in the START-PROF soil database



PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE

# PASS/Start-Prof | Modelo de suelo seco

## Fenómeno del arco natural por colapso

Pipe Properties

Pipe: 285-286  Pipe is Buried

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

Main Additional Soil

Properties

Insulation diameter: 530 mm

Submerged Pipe: No

Consider Soil Movements: No

Start Node (285)

Depth to the Top of Insulation: 29.735 m

Depth to the pipe Axis: 30 m

End Node (286)

Depth to the Top of Insulation: 29.735 m

Depth to the pipe Axis: 30 m

Soil

Pipe Laying Method: Trenchless

Backfill Soil Type: Open trench

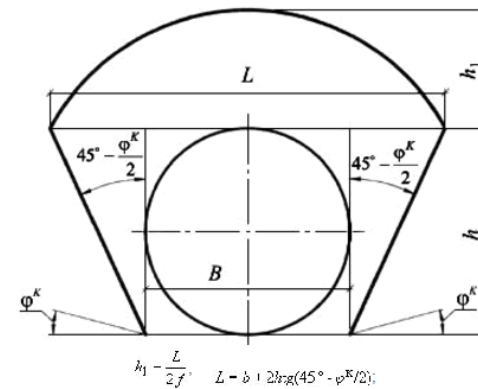
Foundation Soil Type: 03

Insulation and Cushions

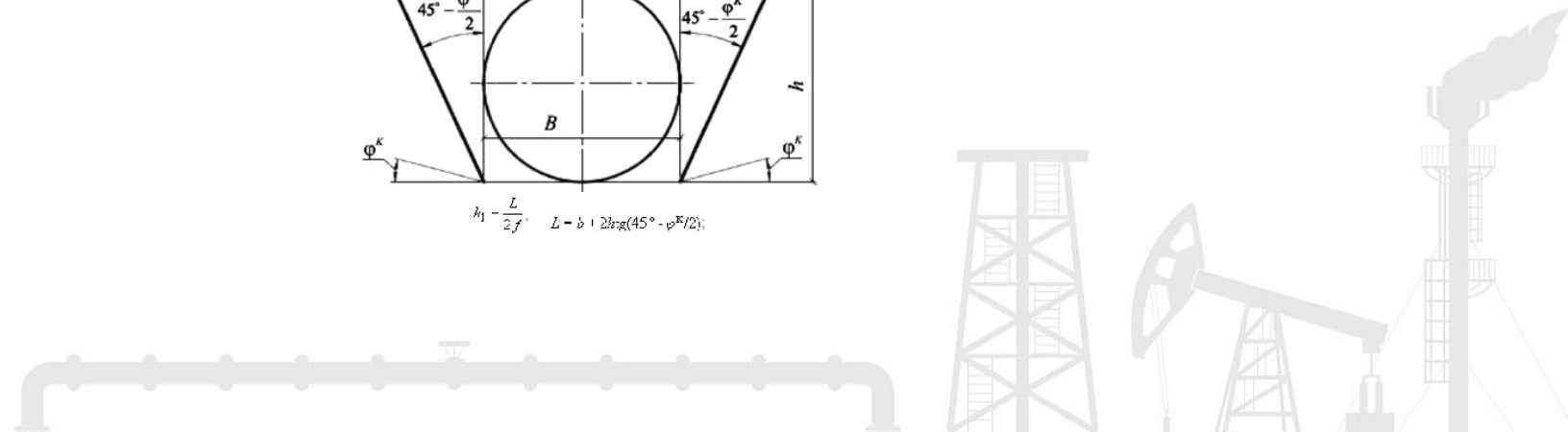
Insulation Type: Other

NM: 1

OK Cancel Help

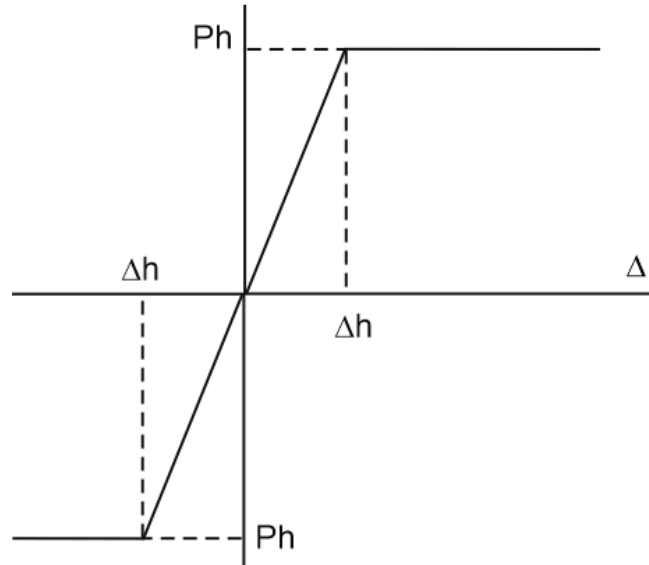


PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE



# PASS/Start-Prof | Modelo de suelo seco

## Propiedades del resorte de suelo Lateral Bi-lineal



Lateral soil stiffness is calculated using the equation

$$K_L = \frac{P_h}{\Delta_h} = \frac{0.12E\eta}{(1-\nu^2)\sqrt{D_c}} \left( 1 + \frac{P_h}{R_s} \right)$$

$Z$  – Soil spring depth from the surface to the pipe axis

$$\eta = 0.547\beta^2 - \beta + 0.854$$

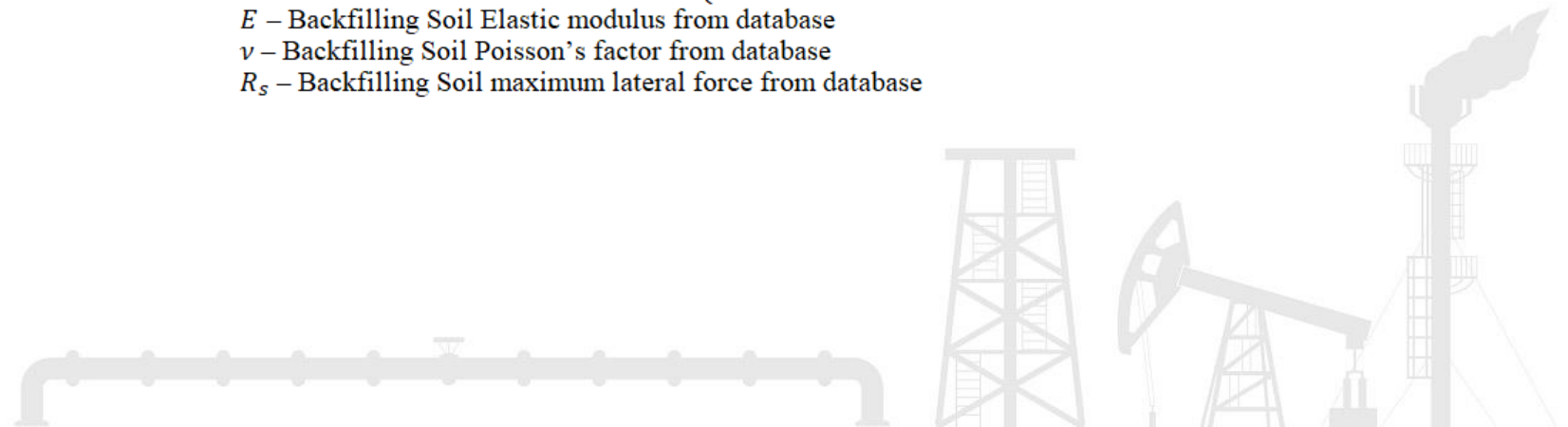
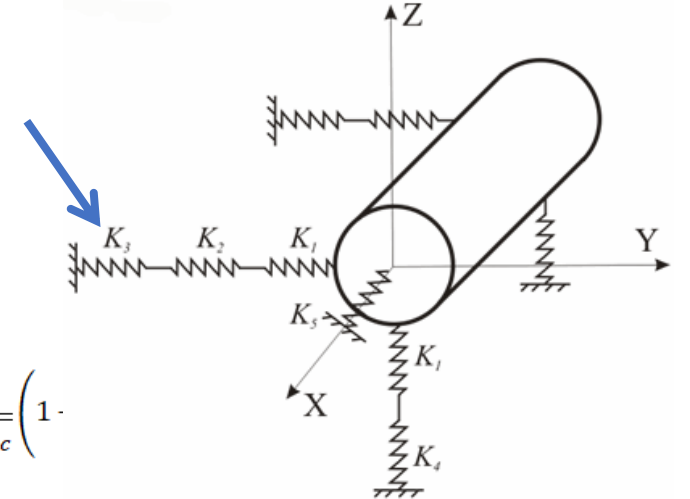
$$\beta = \begin{cases} \frac{a}{Z} & \text{if } a/Z < 1 \\ 1 & \text{if } a/Z \geq 1 \end{cases}$$

$$a = \begin{cases} 150 & \text{if } D_c < 700\text{mm} \\ 0.25D_c & \text{if } D_c \geq 700\text{mm} \end{cases}$$

$E$  – Backfilling Soil Elastic modulus from database

$\nu$  – Backfilling Soil Poisson's factor from database

$R_s$  – Backfilling Soil maximum lateral force from database



# PASS/Start-Prof | Modelo de suelo seco

## Propiedades del resorte de suelo Vertical Tri-lineal

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

$$K_u = \frac{P_u}{\Delta u} = \frac{0.072E\eta_v}{(1 - v^2)\sqrt{D_c}} \left(1 - e^{-\frac{2Z}{D_c}}\right)$$

$$\eta_v = \begin{cases} 1 & \text{if } Z_w \leq Z \\ 0.5(2 - Z_w/Z) & \text{if } 0 < Z_w < Z \\ 0.5 & \text{if } Z_w > Z \end{cases}$$

$$P_d = \bar{\gamma}D_c \left(Z - \frac{\pi}{8}D_c\right) + k \left(\bar{\gamma}Z^2 \tan 0.7\phi + \frac{0.7ZC}{\cos 0.7\phi}\right)$$

$\bar{\gamma}$  – 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

$$\bar{\gamma} = \gamma$$

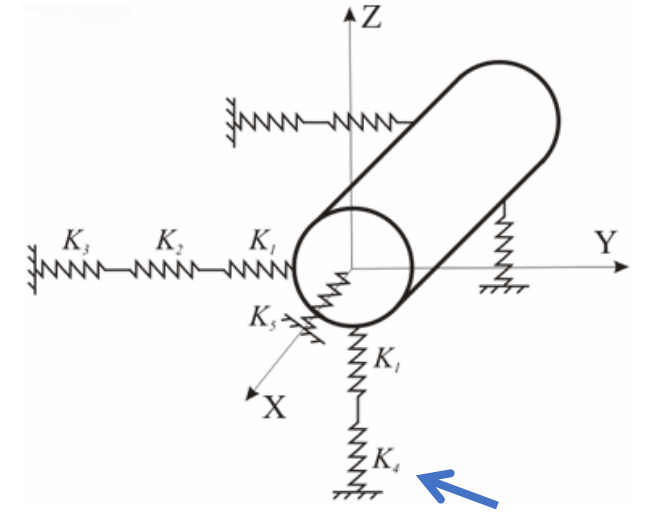
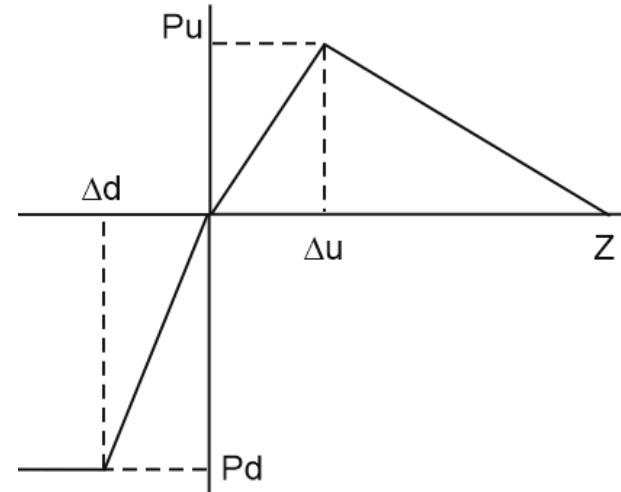
- If the pipe is below the water level, then

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

- If the water level is within the pipe then

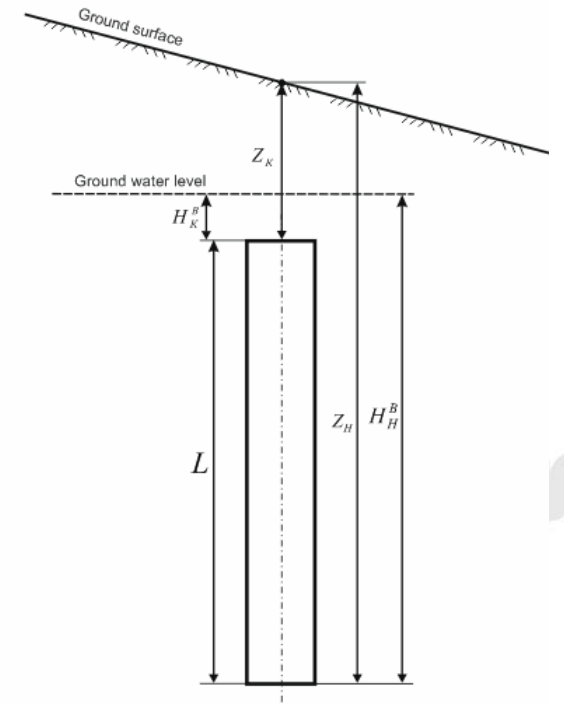
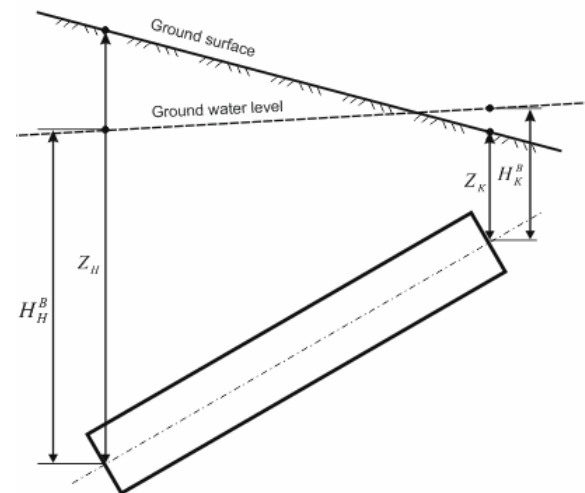
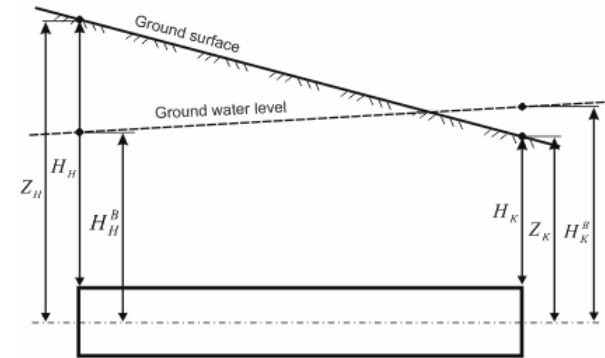
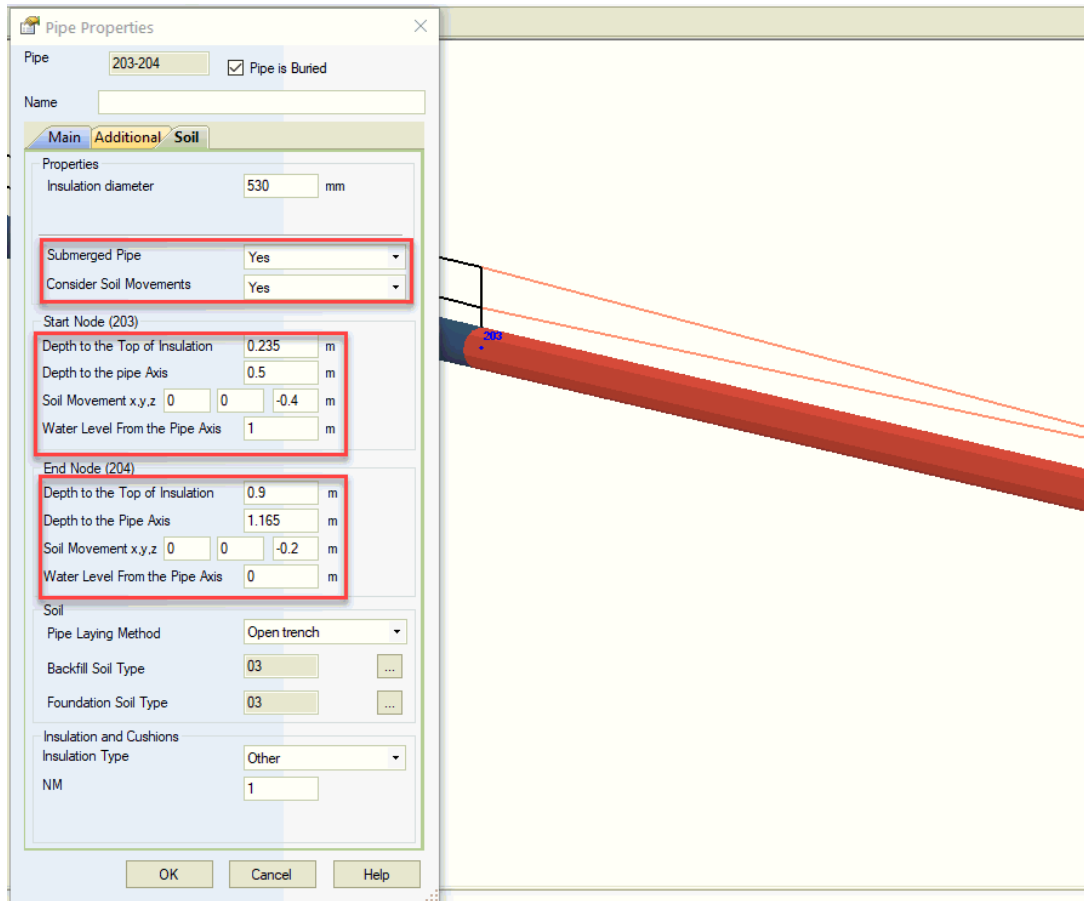
$$\bar{\gamma} = \gamma \frac{Z - Z_w - \frac{\pi}{4}D_c + V_w/D_c}{Z - \frac{\pi}{8}D_c} + \frac{\gamma_s - \gamma_w}{1 + e} \frac{Z_w + \frac{\pi}{8}D_c - V_w/D_c}{Z - \frac{\pi}{8}D_c}$$

$$V_w = \frac{D_c^2}{8} (\alpha - \sin \alpha)$$



# PASS/Start-Prof | Modelo del suelo

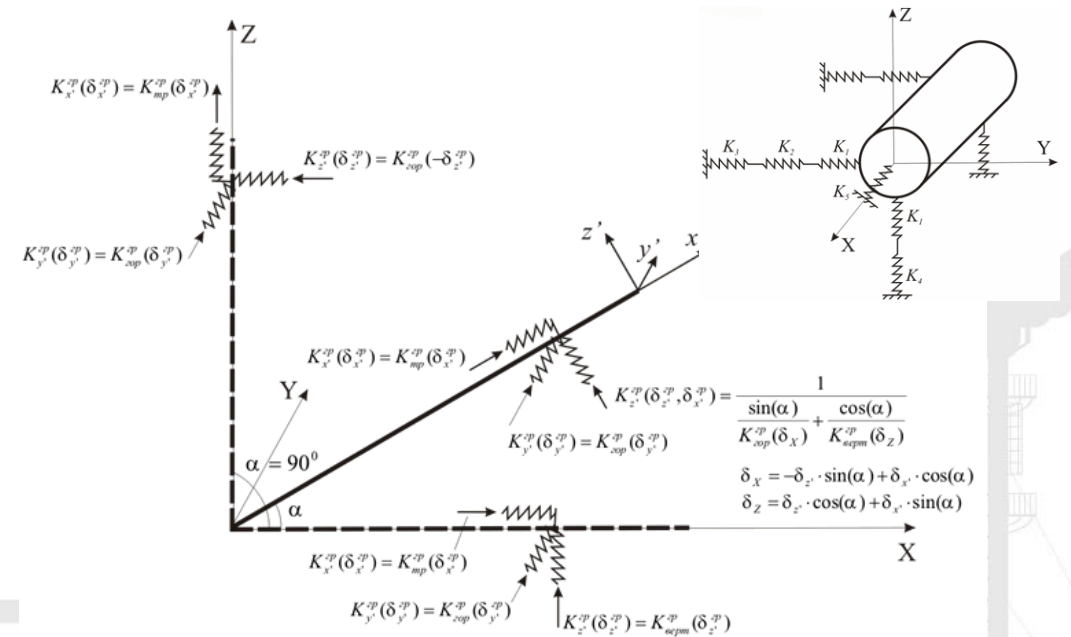
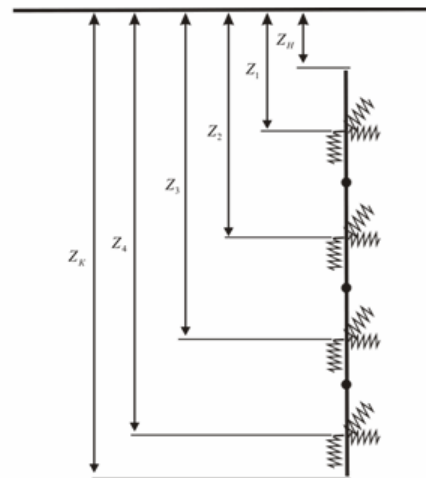
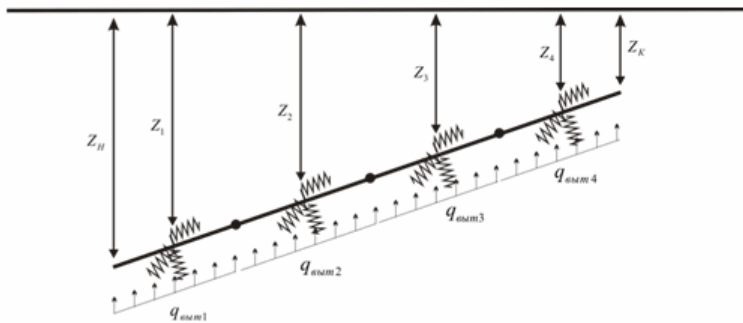
Puede definir lo profundo desde la superficie en cualquier nodo de la línea. La profundidad, altura del agua y hundimiento pueden variar a lo largo de la longitud del tubo



# PASS/Start-Prof | Modelo del suelo

Para tubos inclinados y verticales:

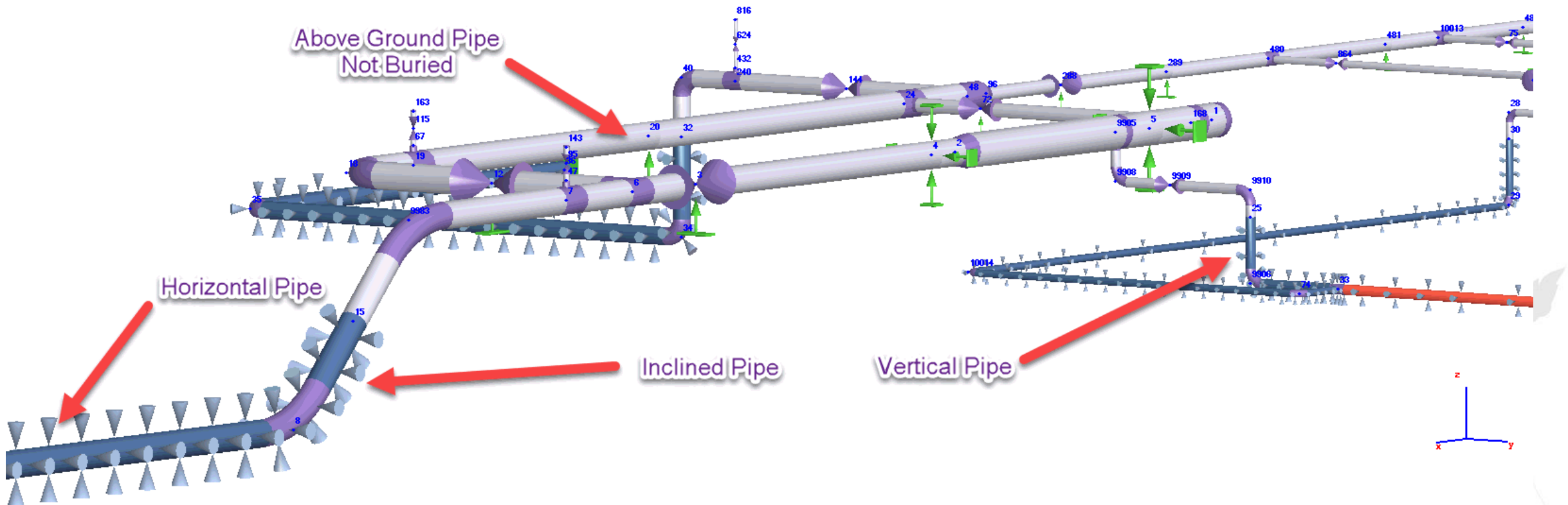
- Las propiedades bilineales de cada resorte del suelo (rigidez, flotación, desplazamiento, etc.) se calculan empleando la profundidad del resorte específico
- La rigidez de los resortes  $K_3$ ,  $K_4$  y  $K_5$  dependen del ángulo del tubo respecto al plano horizontal (de 0 a 90 grados). Para elementos verticales el comportamiento de la rigidez vertical  $K_4$  llega a tener el mismo comportamiento del resorte horizontal  $K_3$



# PASS/Start-Prof | Modelo del suelo

PASS/START-PROF calcula automáticamente modelos combinados con tubería sobre el terreno, horizontal, inclinado o vertical

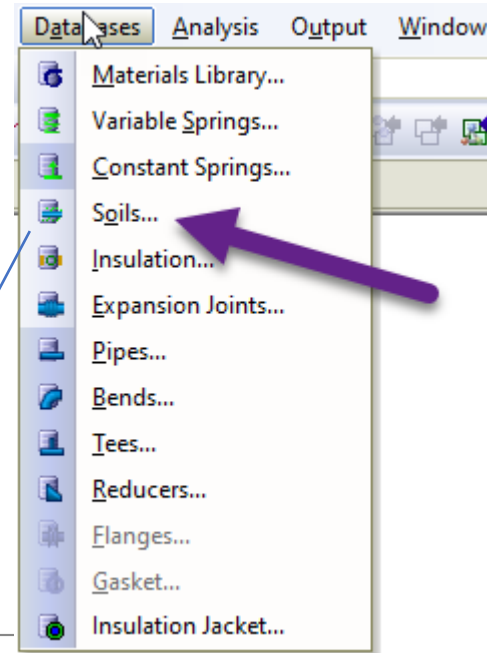
No requiere hacer algo manualmente. Tan solo modele “como está” y ejecute su análisis





# PASS/Start-Prof | Modelo del suelo

Base de datos de tipo de suelo



Soils

Code	Type	Description	E Elastic Modulus kgf/sq.cm	$\nu$ Poisson's Ratio	e Void ratio(e)	$\phi$ Internal friction angle	$\gamma$ Unit weight kgf/cub.m	$\gamma_s$ Unit weight of solid kgf/cub.m	C Cohesion kgf/sq.cm	$R_s$ Carrying capacity kgf/sq.cm	$C_{x0}$ Longitudinal displacement resistance factor kgf/cub.m	Add	Delete
01	sand	large sand	300	0.3	0.65	30	1520	2660	0.01	1.5	270000		
02	sand	fine sand	300	0.38	0.65	30	1550	2660	0.02	1.6	210000		
03	loam	loam with a texture ranging from 0.3 to 0.75	400	0.33	0.42	19	2100	2710	0.1	2	350000		
04	sand	heavy fine sand	300	0.38	0.65	30	1700	2660	0.01	1.6	210000		
05	peat	wet peat	2.7	0.45	15.5	10	500	1600	0.02	0.14	100000		
06	peat	peat drv	2.7	0.45	15.5	10	500	1600	0.02	0.14	50000		

Print  
Export...  
Save Close Help

Pipe Properties

Pipe: 1-2  Pipe is Buried

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

Main Additional Soil

Properties

Insulation diameter: 530 mm

Submerged Pipe: No

Consider Soil Movements: No

Start Node (1)

Depth to the Top of Insulation: 1.445 m

Depth to the pipe Axis: 1.71 m

End Node (2)

Depth to the Top of Insulation: 2.485 m

Depth to the Pipe Axis: 2.75 m

Soil

Pipe Laying Method: Open trench

Backfill Soil Type: 03

Foundation Soil Type: 01

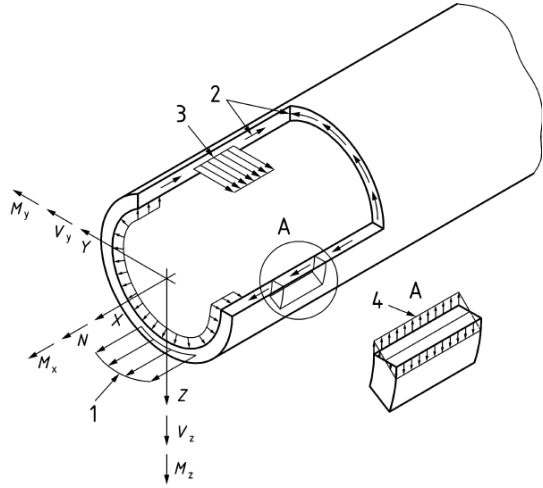
Insulation and Cushions

Insulation Type: Other

Factor for Friction Angle: 1

OK Cancel Help

# PASS/Start-Prof | Análisis de esfuerzos



- 1 Maximum axial stress:  $\Delta \sigma_a = i_{a1} \frac{\Delta N_x}{A} \pm i_{a2} \frac{\sqrt{\Delta M_y^2 + \Delta M_z^2}}{W}$
- 2 Maximum shear stress:  $\Delta \tau = i_{a3} \frac{\Delta M_x}{2W} \pm i_{a4} \frac{2 \cdot \sqrt{\Delta V_y^2 + \Delta V_z^2}}{A}$
- 3 Maximum membrane tangential stress:  $\Delta \sigma_t = i_{a5} \frac{p \cdot d_i}{2t_{min}}$
- 4 Maximum bending tangential stress:  $\Delta \sigma_t = i_{a5} \frac{\sqrt{\Delta M_y^2 + \Delta M_z^2}}{W} + \sigma$

Object	Start End node	A1 Force Controlled Membrane, (MPa)			A1 Force Controlled Membrane+Bending, (MPa)			A2 Force+Deformation, (MPa)			Expansion Stress Range, (MPa)			Notes
		calculated	allowable	%	calculated	allowable	%	calculated	allowable	%	calculated	allowable	%	
Buried pipe	33	79.84	191.40	41.7	149.41	287.10	52.0	39.92	293.10	13.6	160.63	500	32.1	
	34	71.34	191.40	37.3	139.50	287.10	48.6	138.88	293.10	47.4	496.82	500	99.4	
Buried pipe	34	71.34	191.40	37.3	139.50	287.10	48.6	138.88	293.10	47.4	496.82	500	99.4	
	35	70.40	191.40	36.8	137.89	287.10	48.0	242.23	293.10	82.6	696.86	500	139.4	333
Buried pipe	35	70.40	191.40	36.8	137.89	287.10	48.0	242.23	293.10	82.6	696.86	500	139.4	333
	36	70.24	191.40	36.7	137.58	287.10	47.9	311.08	293.10	106.1	720.78	500	144.2	16,333
Buried pipe	36	70.24	191.40	36.7	137.58	287.10	47.9	311.08	293.10	106.1	720.78	500	144.2	16,333
	37	70.24	191.40	36.7	137.58	287.10	47.9	311.08	293.10	106.1	720.78	500	144.2	16,333
Buried pipe	37	70.24	191.40	36.7	137.58	287.10	47.9	311.08	293.10	106.1	720.78	500	144.2	16,333
	38	70.22	191.40	36.7	137.53	287.10	47.9	310.78	293.10	106.0	722.78	500	144.6	16,333
Buried pipe	38	70.22	191.40	36.7	137.53	287.10	47.9	310.78	293.10	106.0	722.78	500	144.6	16,333
	39	70.22	191.40	36.7	137.53	287.10	47.9	310.78	293.10	106.0	723.12	500	144.6	16,333
Buried pipe	39	70.22	191.40	36.7	137.53	287.10	47.9	310.78	293.10	106.0	723.12	500	144.6	16,333
	40	70.13	191.40	36.6	137.35	287.10	47.8	238.61	293.10	81.4	714.57	500	142.9	333
Buried pipe	40	70.13	191.40	36.6	137.35	287.10	47.8	238.61	293.10	81.4	714.57	500	142.9	333

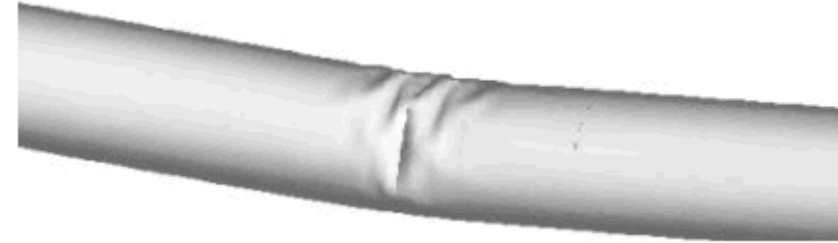
(Ultimate) Limit state (reference clause)	Limit state	Load combinations	Components to investigate	Load factors ( $\gamma_{gi}$ )	Material factor ( $\gamma_{mi}$ )	Limit value	Reference and Remarks
Force controlled action (membrane stress)	A1	1,2		Table 2	1,1	$\sigma_v \leq Re(T) / \gamma_m \quad \left. \begin{matrix} \sigma_m \\ \sigma_{t,m} \end{matrix} \right\} \leq \sigma_d = \frac{R_s(T)}{\gamma_m}$	7.2.2.2
Force controlled action (D.3.1.1) (membrane + bending stresses)	A1	2,3,4		Table 2	1,1	$\sigma_{t,at} \leq \begin{cases} 1,5 \cdot \frac{R_s(T)}{\gamma_m} & \text{for } \sigma_m \leq 0,67 \cdot \frac{R_s(T)}{\gamma_m} \\ 2,5 \cdot \frac{R_s(T)}{\gamma_m} - 1,5 \cdot \sigma_m & \text{for } \sigma_m > 0,67 \cdot \frac{R_s(T)}{\gamma_m} \end{cases}$ $\sigma_{t,ms} \leq \begin{cases} 1,5 \cdot \frac{R_s(T)}{\gamma_m} & \text{for } \sigma_{j,m} \leq 0,67 \cdot \frac{R_s(T)}{\gamma_m} \\ 2,5 \cdot \frac{R_s(T)}{\gamma_m} - 1,5 \cdot \sigma_{j,m} & \text{for } \sigma_{j,m} > 0,67 \cdot \frac{R_s(T)}{\gamma_m} \end{cases}$	7.2.2.2 Including forced displacements
Stepwise deformation plastic Force + deformation controlled	A2	2,3,4		Table 2	1,1	$\epsilon_{max} = \alpha \cdot \Delta T \leq \left[ \frac{R_s(\theta)}{E} \sqrt{1 - \frac{3}{4} \left( \frac{\sigma_p}{R_s(\theta)} \right)^2} + \sqrt{0,9 - \frac{3}{4} \left( \frac{\sigma_p}{R_s} \right)^2} \right]$	7.2.2.3
Low cycle fatigue Force + deformation controlled	B1			Table 2		$\sum \frac{n_i}{N_i} \leq \frac{1}{\gamma_{fat}}$ and $S = k \cdot N^{-1/m}$	6.7 and 7.2.3



# PASS/Start-Prof | Análisis de esfuerzos

Verificación automática de deformación de pared en el tubo conforme a

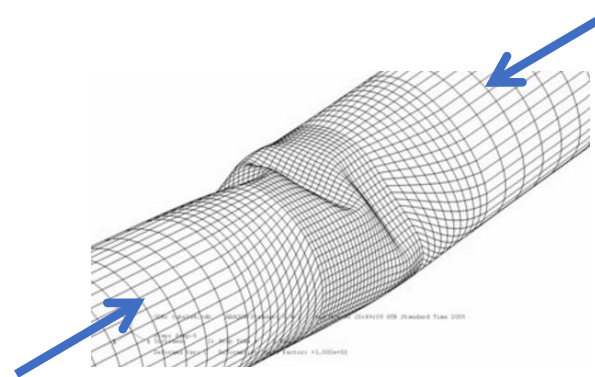
- EN 13941-2019 7.2.4.2



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

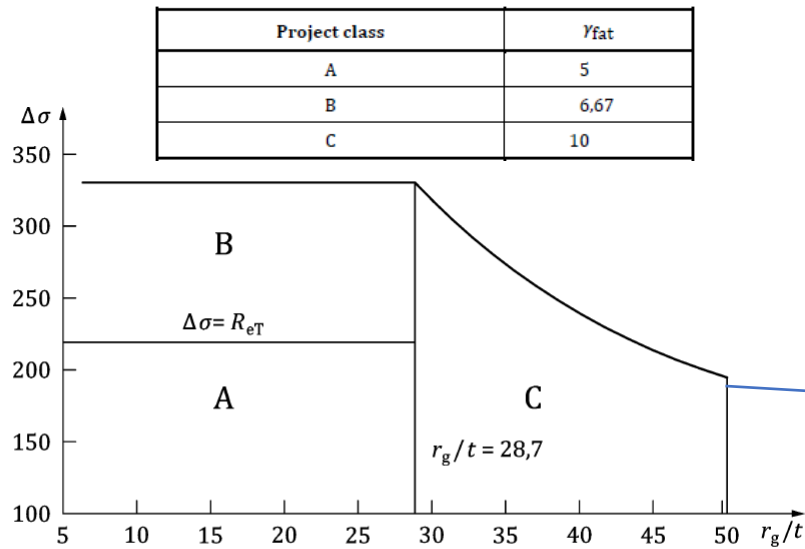
Local buckling	C1	1,3,4	Table 2	1,1	$\varepsilon \leq \frac{1}{2} \left( 0,25 \frac{t}{r_m} - 0,0025 \right)$ (for uniform $\varepsilon$ ) for $\frac{r_m}{t} \leq 28,7$ : $\Delta \varepsilon \leq 0,16 \%$ for $\frac{r_m}{t} > 28,7$ : $\left( 4,58 \frac{t}{r_m} + 0,003 \right) \%$
----------------	----	-------	---------	-----	--

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	8	317.54	198.41	7.92	198.41	16.62	198.41	1
Buried pipe	8	317.54	198.41	7.92	198.41	16.62	198.41	1
	9	318.59	198.41	10.40	198.41	16.63	198.41	1
Buried pipe	9	318.59	198.41	10.40	198.41	16.63	198.41	1
	10	318.77	198.41	10.95	198.41	16.63	198.41	1
Buried pipe	10	318.77	198.41	10.95	198.41	16.63	198.41	1
	11	318.80	198.41	11.06	198.41	16.63	198.41	1
Buried pipe	11	318.80	198.41	11.06	198.41	16.63	198.41	1
	12	318.81	198.41	11.08	198.41	16.63	198.41	1



# PASS/Start-Prof | Análisis de esfuerzos

PASS/START-PROF selecciona automáticamente la clase de Proyecto o puede ser especificado



Key

- A project class A (low)
- B project class B (medium)
- C project class C (high)

$\Delta\sigma$  axial stress range from the temperature difference

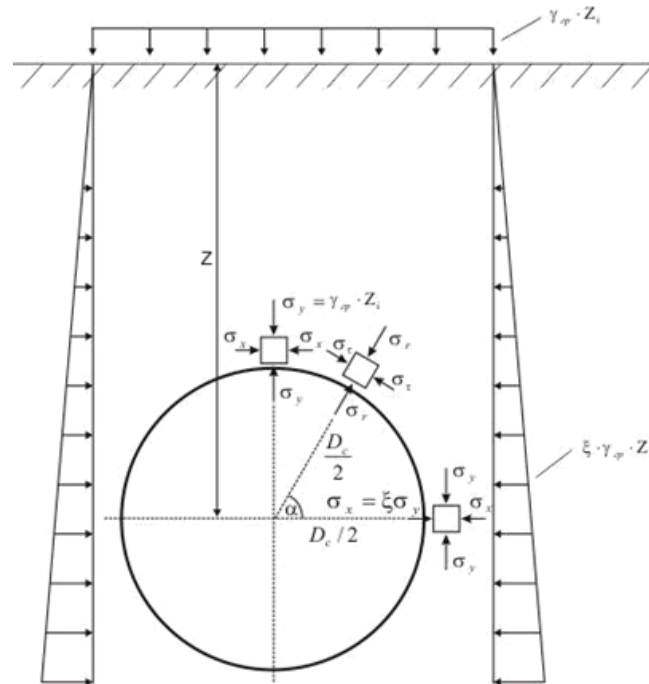
Table 14 — Equivalent full action cycles for  $m = 4$  and  $\Delta T_{ref} = 110 \text{ }^\circ\text{C}$

Character of pipeline	Number of full action cycles	
	30 years operation	50 years operation
Transmission pipelines	100 to 250	170 to 420
Distribution pipelines	250 to 500	420 to 840
House connections	1000 to 2500	1700 to 4200

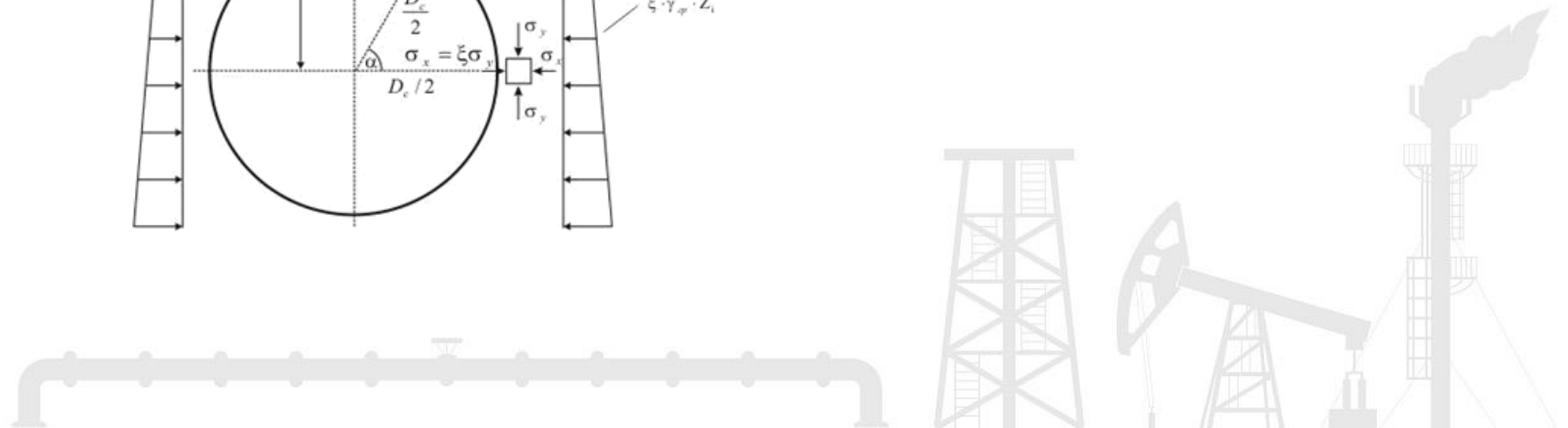


# PASS/Start-Prof | Análisis de esfuerzos

Para calcular los esfuerzos de flexión del anillo se utiliza un modelo por elemento finito de la sección de cruce. Las cargas del peso del suelo se calculan y aplican para cada punto de la sección transversal de la tubería en todo el perímetro.



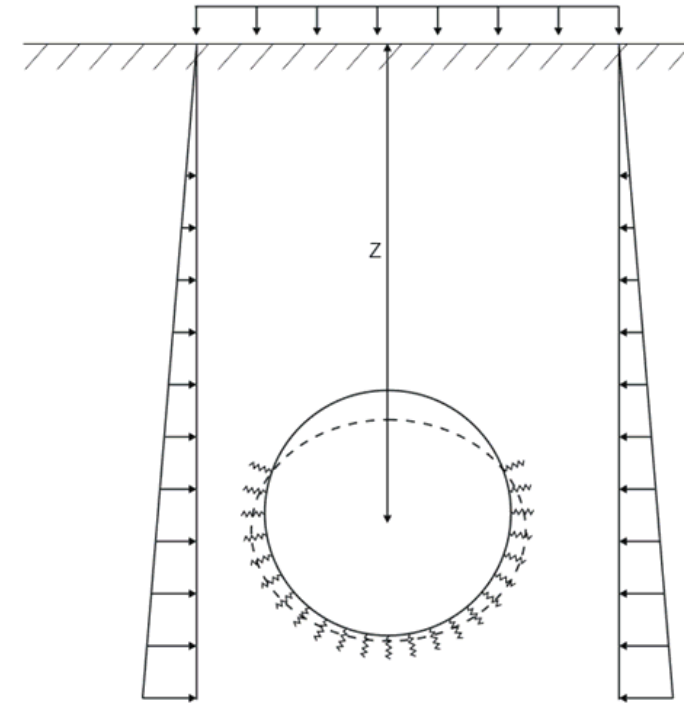
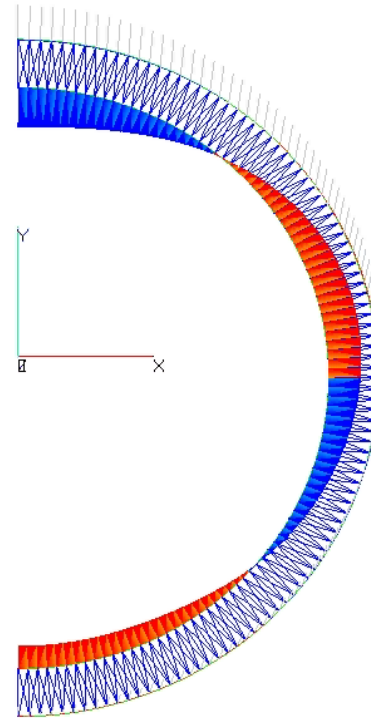
PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE



# PASS/Start-Prof | Análisis de esfuerzos

El suelo es modelado como resortes discretos alrededor del perímetro del tubo. Los resortes se desactivan si la tensión es detectada (usualmente en la parte superior del tubo). Se modela el aislamiento flexible si se requiere.

Se aplican presión interna y presión hidrostática por el producto. El análisis considera no linealidad geométrica, se considera el efecto de rigidez por presión interna

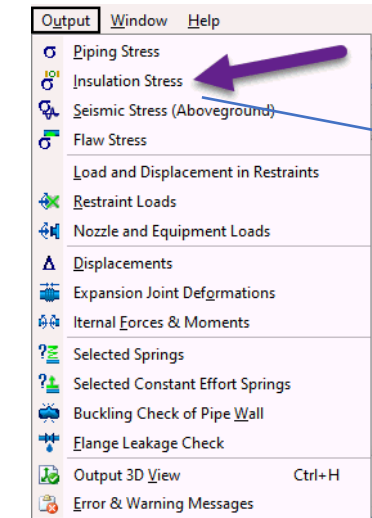


PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE



# PASS/Start-Prof | Análisis de esfuerzos

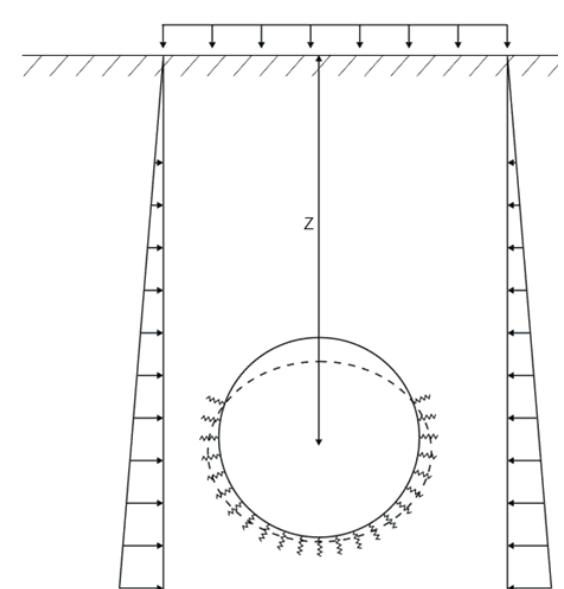
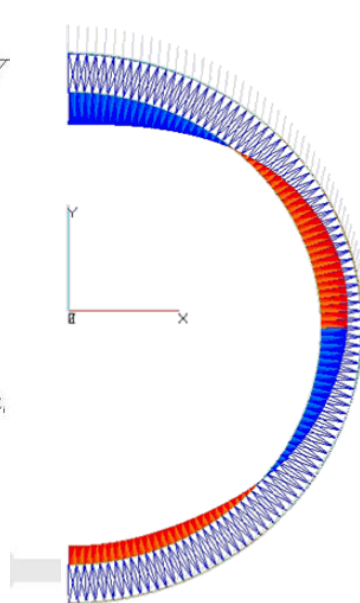
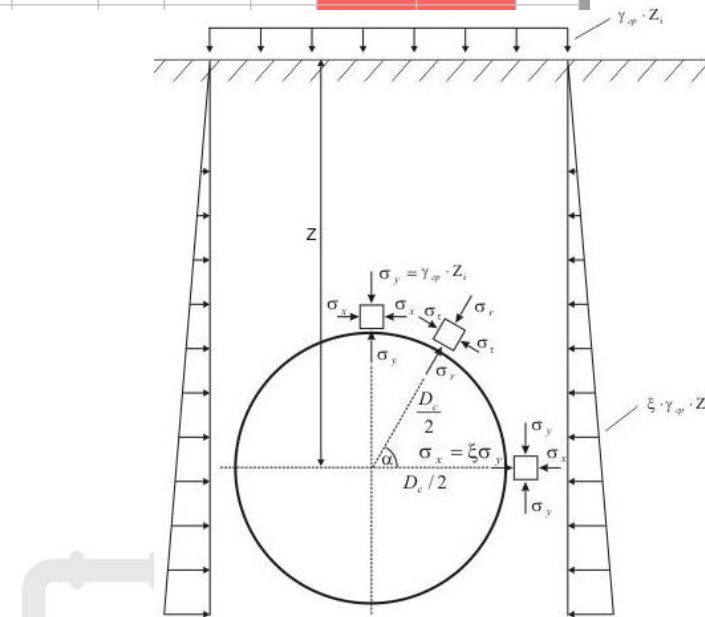
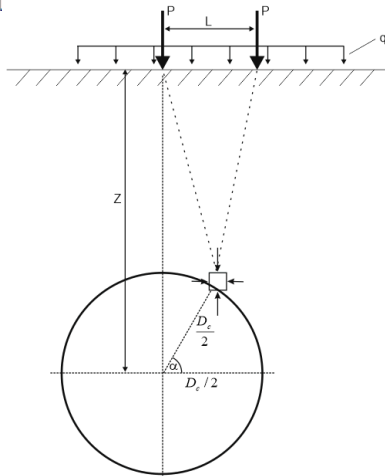
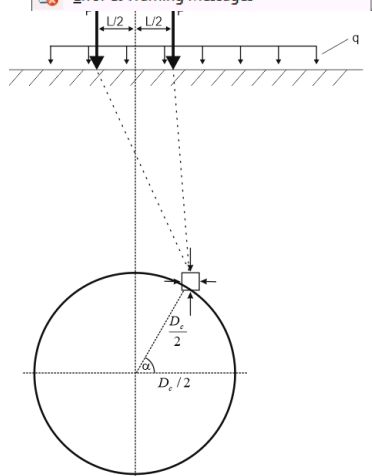
Calcula y verifica esfuerzos en aislamiento de poliuretano (EN 13941 7.3.1, 7.3.2, EN 253).  
Verifica cargas por vehículos en la superficie



Input Stress insul

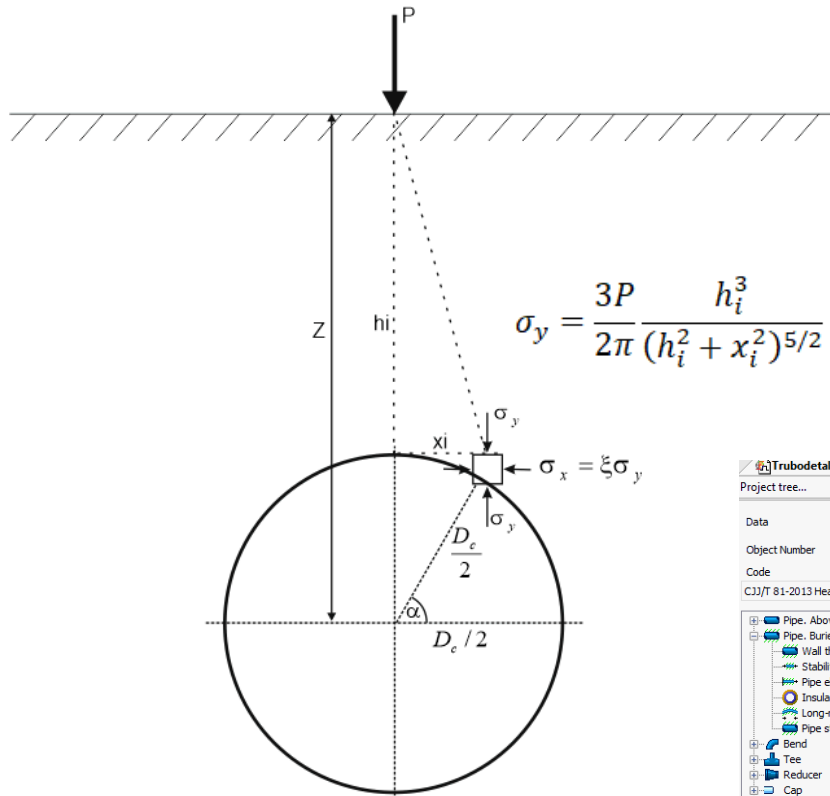
Operating Mode: 1 'Main mode'

Object	Start End node	Tangent stress, (MPa)				Equivalent stress, (MPa)		Notes
		hoop direction	allowable	axial direction	allowable	calculated	allowable	
Buried pipe	1	0.04	0.07	0.02	0.04	0.16	0.15	2
	2,分支1	0.04	0.07	0.02	0.04	0.16	0.15	2
Welding Tee	2,分支1	0.04	0.07	0.02	0.04	0.16	0.15	2
	325	0.04	0.07	0.02	0.04	0.16	0.15	2
Buried pipe	325	0.04	0.07	0.02	0.04	0.16	0.15	2



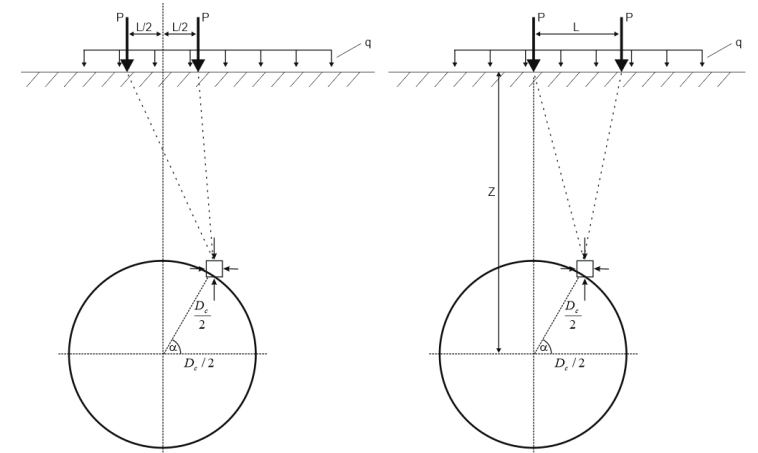
# PASS/Start-Prof | Análisis de esfuerzos

Esfuerzo en la tubería y el aislamiento contra carga en la superficie por vehículos pesados



$$\sigma_y = \frac{3P}{2\pi} \frac{h_i^3}{(h_i^2 + x_i^2)^{5/2}}$$

$$\sigma_x = \xi \sigma_y$$



Parameter	Value	Unit
Outside Diameter, D	1020	mm
Pipe Wall Thickness, S	12	mm
Ambient Temperature	0	°C
Operating Temperature	100	°C
Pipe Weight	149.08	kgf/m
Fluid Weight	798.01	kgf/m
Insulation Weight	67.55	kgf/m
Operating Pressure	1.6	MPa
Material	20	
Surface load Type	Single force	
Axle load, P	1000	kgf
Distributed load, q	50	kgf/m
Soil Backfill Soil Code	04	
Foundation Soil Code	01	
Output Depth, Z	0.6	m

**STRENGTH CONDITIONS NOT MET**  
 Equivalent stress, MPa  
 operation 437.92  
 allowable 133

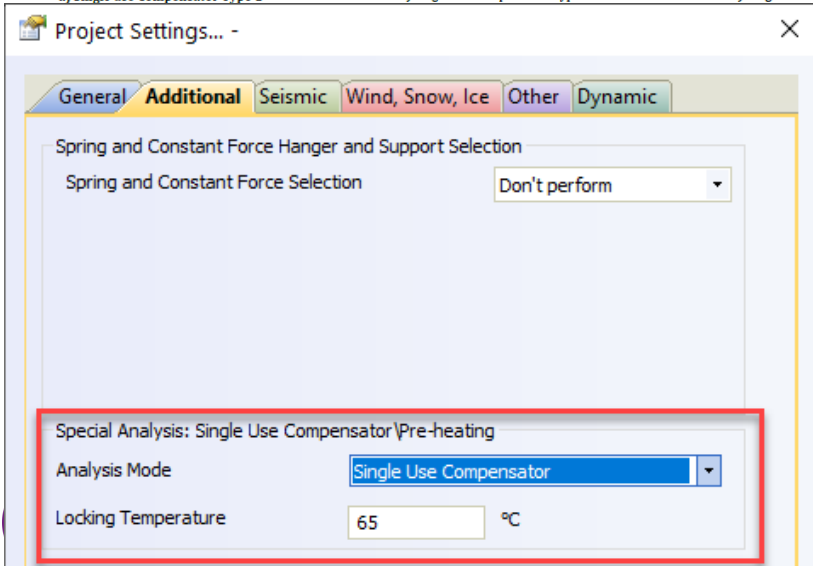
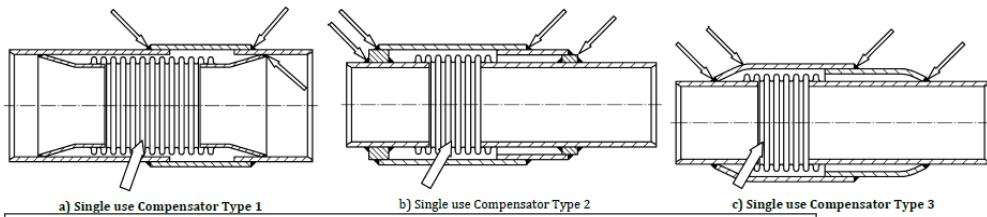


PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

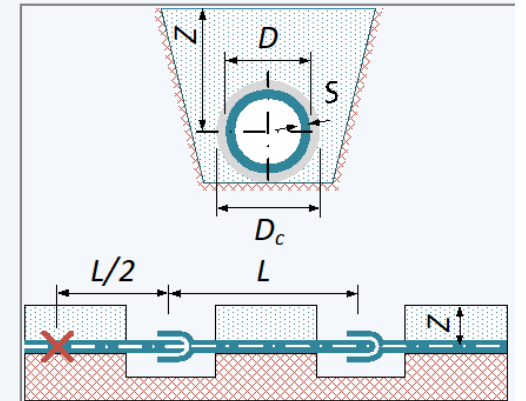
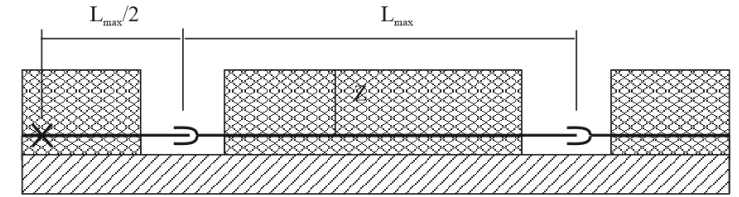


# PASS/Start-Prof | Análisis de esfuerzos

- Análisis de Pre-Calentamiento
- Análisis de Compensadores de uso simple + base de datos + cálculo de distancia

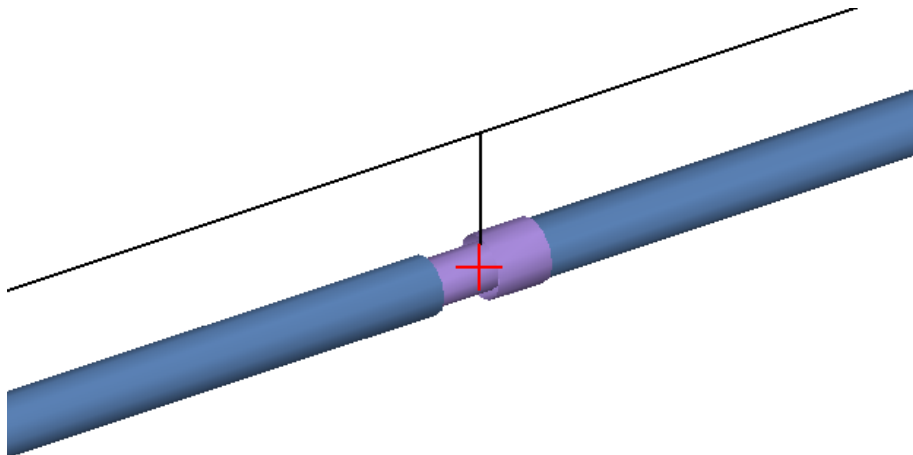
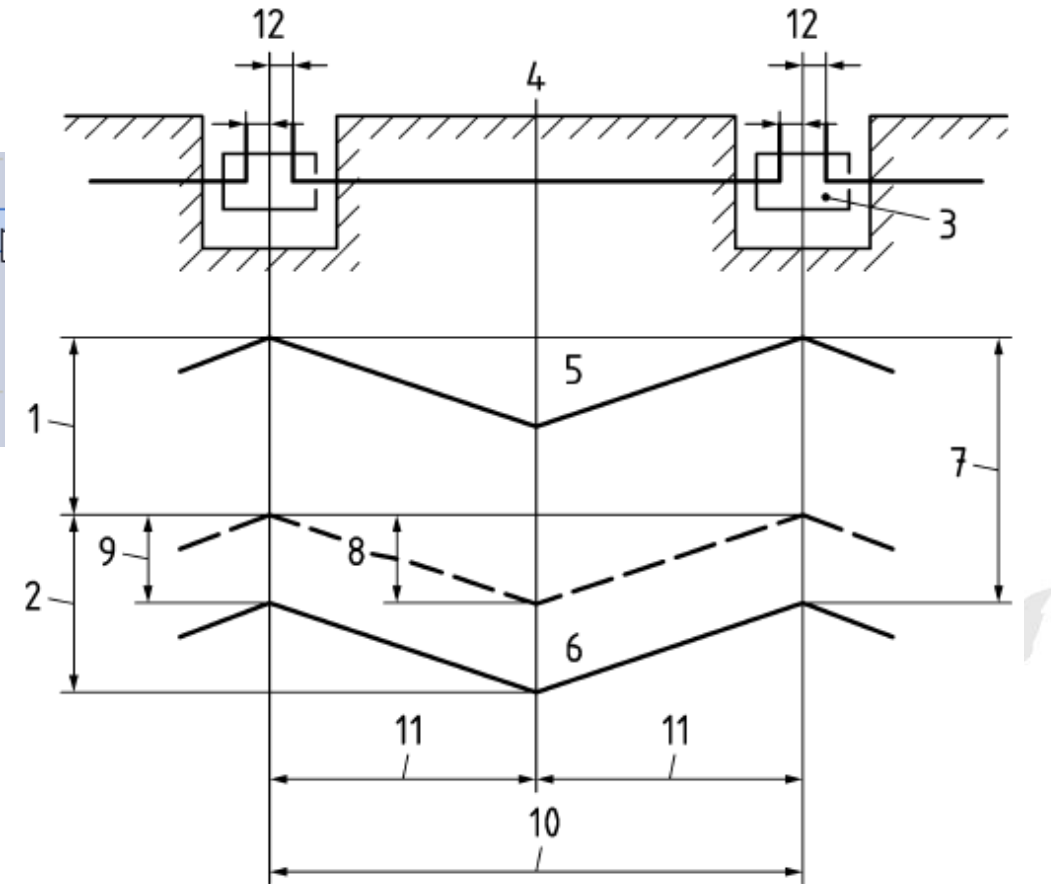
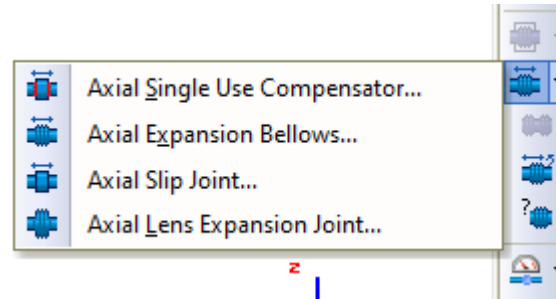
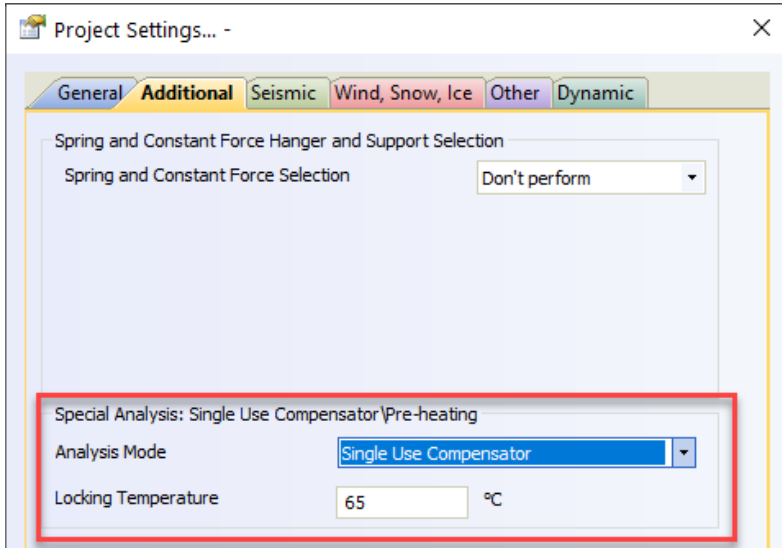


Outer Diameter, D: 0 mm  
Wall Thickness, S: 0 mm  
External Casing Diameter (D if absent), Dc: 0 mm  
Casing wall thickness: 0 mm  
Depth, Z: 0 m  
Operating Temperature: 0 °C  
Cold Temperature: 0 °C  
Pipe: Fluid Weight: 0 kgf/m, Insulation: 0 kgf/m  
Insulation Type: Foamed polyurethane  
Backfill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



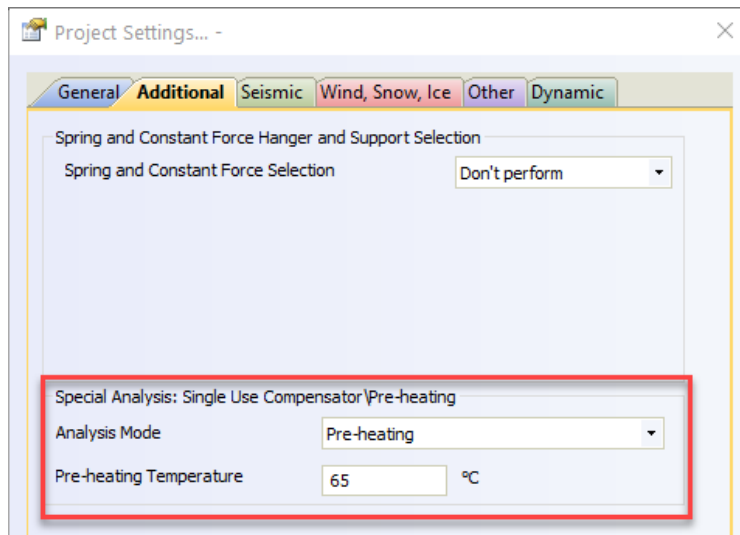
# PASS/Start-Prof | Análisis de esfuerzos

PASS/START-PROF Calcula automáticamente redes con compensadores simples

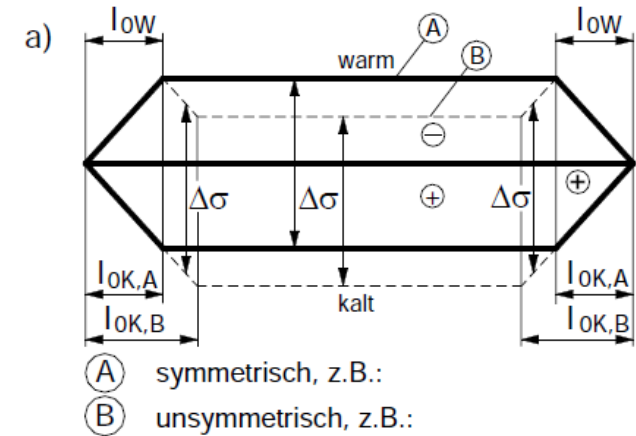


# PASS/Start-Prof | Análisis de esfuerzos

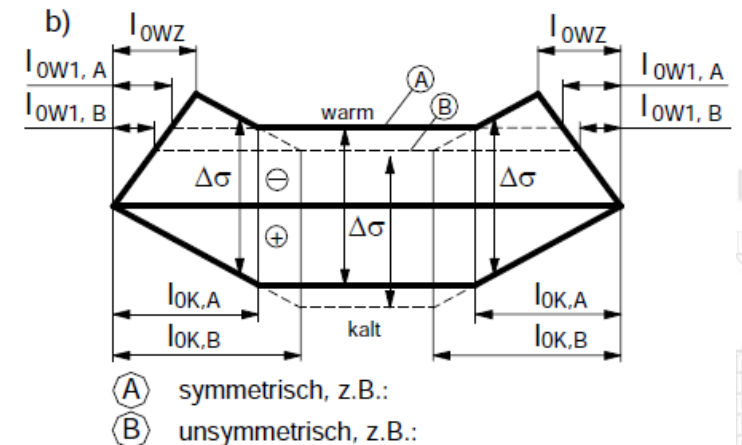
Análisis automático de redes de calefacción urbana instaladas con precalentamiento. Los factores de fricción pueden variar para la condición caliente o de enfriamiento



Fricción total al calentar,  
fricción total al enfriar

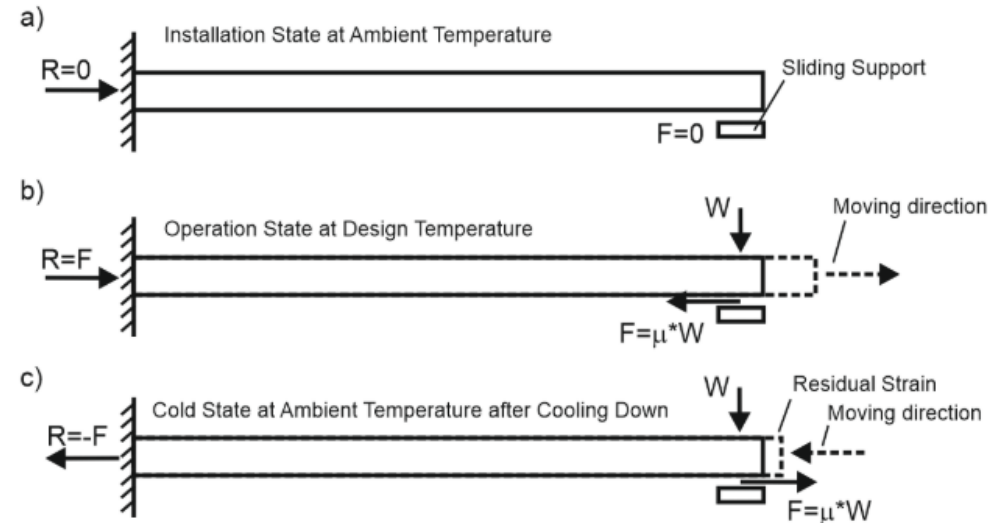
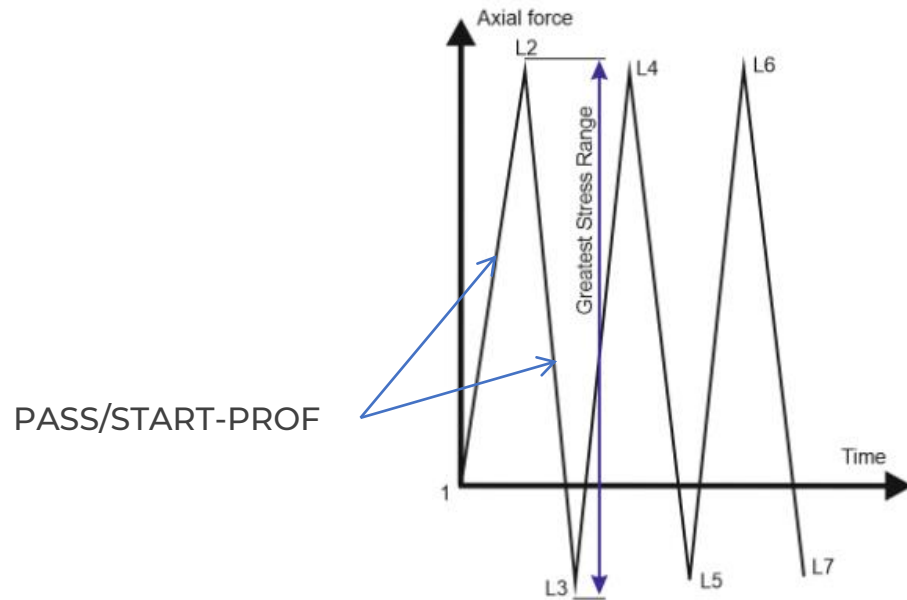


Fricción total al calentar,  
media fricción al enfriar



# PASS/Start-Prof | Análisis de esfuerzos

PASS / START-PROF calcula el estado frío después de enfriarse del estado caliente. Permite obtener un rango de tensión de expansión más realista



PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE



# PASS/Start-Prof | Características

Agregada base de datos de tamaños y espesor de camisa de tubería pre-aislada de poliuretano LOGSTOR, POWERPIPE, +GF+ URECON, para redes urbanas de refrigeración y calefacción

The screenshot shows the PASS/Start-Prof software interface. The main window displays a 3D model of a pipe system with nodes numbered 1 through 12. The 'Pipe Properties' dialog box is open, showing the following settings:

- Pipe: 2-12, Pipe is Buried (checked)
- Name: (empty)
- Main tab: Outer Casing Diameter: 800 mm, Casing Wall Thickness: 10 mm
- Soil tab: Consider Soil Movements: No, Start Node (2): Depth to the pipe Axis: 1.5 m, End Node (12): Depth to the Pipe Axis: 0 m
- Soil: Pipe Laying Method: Open trench, Backfill Soil Type: D1, Foundation Soil Type: D1
- Insulation and Cushions: Insulation Type: Polyurethane foam, Insulation adhesion factor: 0.67
- Cushion Presence: Yes (highlighted with a red box)

The 'Properties' panel on the left shows the following details for the selected pipe:

- Start Node: 2, End Node: 12
- Name: (empty)
- Input Type: Projections
- Projections/a: 0 m, 0 m, 1.5 m
- Diameter x Th: 630 mm X 10 mm
- Pipe Material: 20
- Mill Tolerance: 0 mm
- Corrosion All: 0 mm
- Pressure, MPa: 1.6 MPa
- Test Pressure, 2 MPa
- Temperature, 140 °C
- Uniform Weig: No, 0.153 tf/m, N
- Additional: Weld Quality: 1.00, 0.80, 0.90
- Soil: Outer Casing: 800 mm, Casing thickr: 10 mm, Depth, m: 1.5 m, 0 m, Consider soil: No, Pipe Laying: T Open Trench, Backfill Soil C: 01, Foundation S: 01, Insulation typ: Polyurethane foa, Insulation adl: 0.67, Cushion pres: Cushions absent

The 'Error and warning messages' panel at the bottom shows two messages:

Type	Node/pipe	Description	Help
Notes	Node:4	(W305) Трубопровод поднимается над опорой (Рабочее состояние) - 1. 'Main mode'	?
Notes	Node:4	(W305) Трубопровод поднимается над опорой (Рабочее состояние) - 1. 'Test mode'	?

The 'PUR Insulation Jacket Properties' dialog box is shown, featuring the following sections:

- Codes:** A list of codes including 'ГОСТ 30732-2006 Chinese National Standard LOGSTOR POWERPIPE +GF+ Urecon'. Buttons: Change, Add, Delete.
- Type:** A list of types including 'Series 1', 'Series 2', and 'Series 3'. Buttons: Change, Add, Delete.
- Diameter And Thickness of the Jacket:** A table with columns: Type, Do, mm, Dn, mm, Dj, mm, Th, mm. Buttons: Add, Delete, Print, Export...

Type	Do, mm	Dn, mm	Dj, mm	Th, mm
Series 1	26.9	20	90	3
Series 1	33.7	25	90	3
Series 1	42.4	32	110	3
Series 1	48.3	40	110	3
Series 1	60.3	50	125	3
Series 1	76.1	65	140	3
Series 1	88.9	80	160	3
Series 1	114.3	100	200	3.2
Series 1	139.7	125	225	3.4
Series 1	168.3	150	250	3.6

Buttons at the bottom: Save, Close, Help.

# PASS/Start-Prof | Actualización de códigos

Se actualizaron las bases de datos de Material EN 13480/EN 13941. Se adicionan todos los materiales de tubería para 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. Se adicionan la selección automática de propiedades de materiales dependiendo del espesor de pared y la opción soldable o sin costura



PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE

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

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

Data source: EN 10216-2-2013

Density: 7850 kg/m<sup>3</sup>

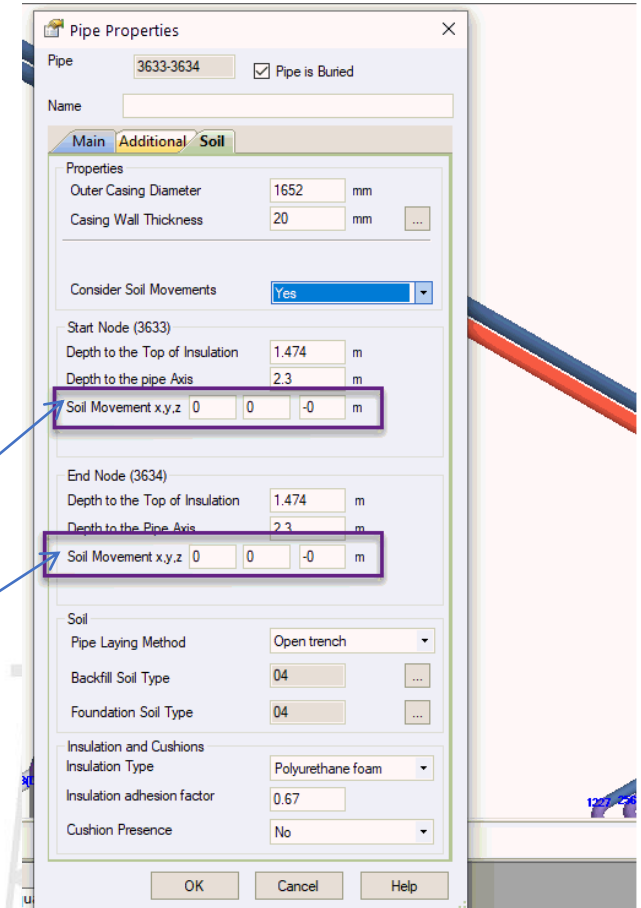
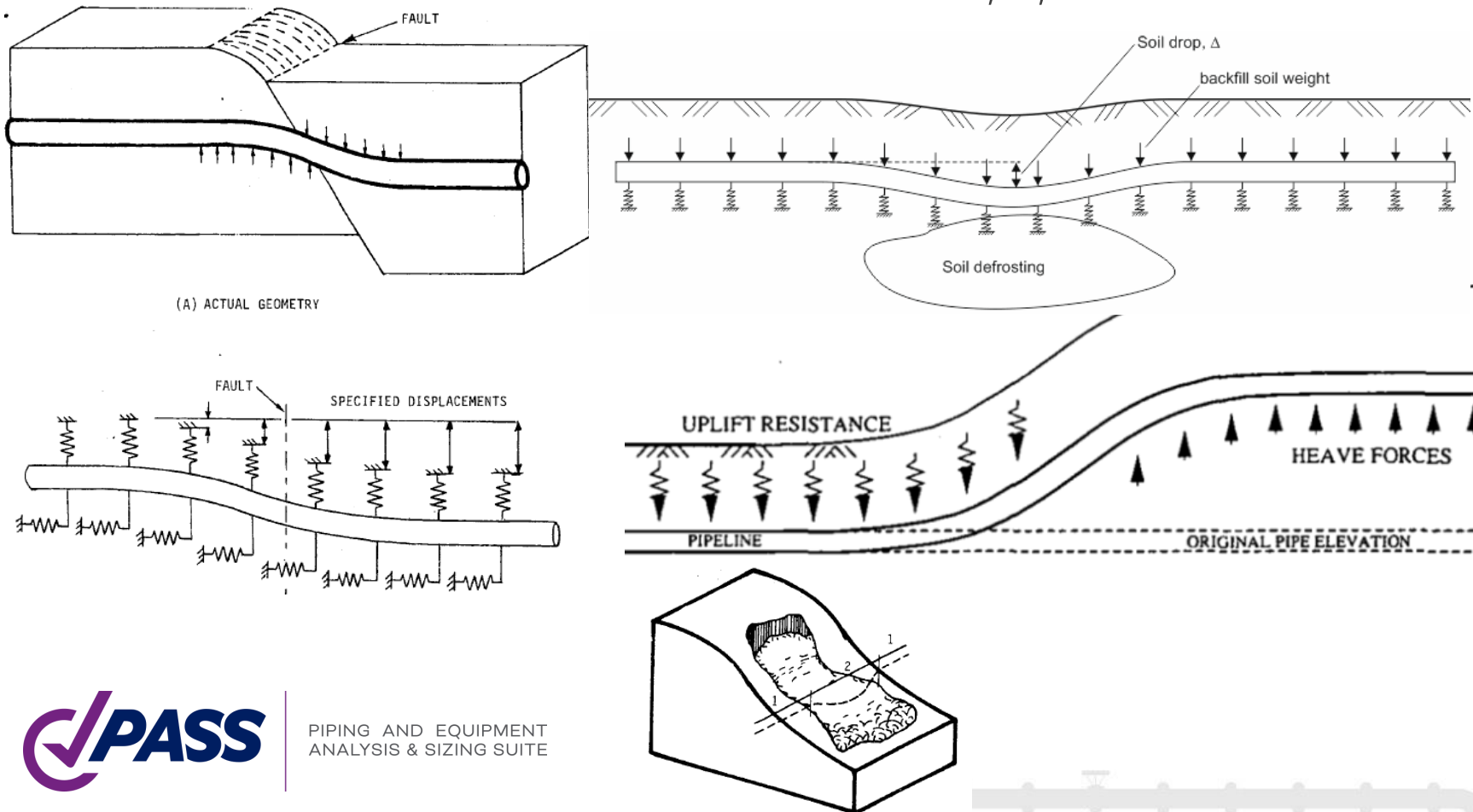
Factor A, %: 23

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

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

# PASS/Start-Prof | Características

Deslizamiento de tierra, hundimiento de suelo, peso por congelamiento, deformación permanente del terreno (falla sísmica en el terreno) así como movimientos de suelo en ambos extremos del tubo en direcciones X, Y, Z

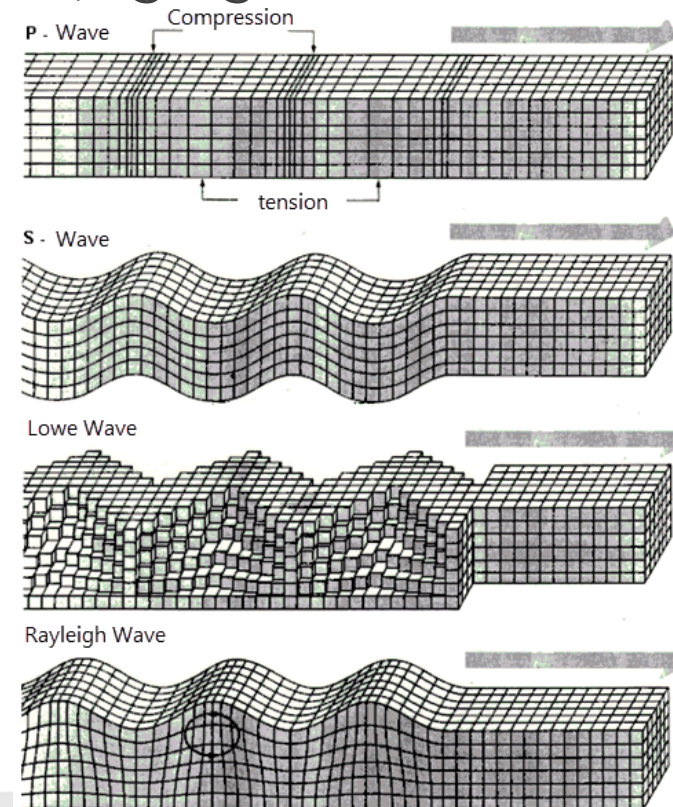


PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE

# PASS/Start-Prof | Características

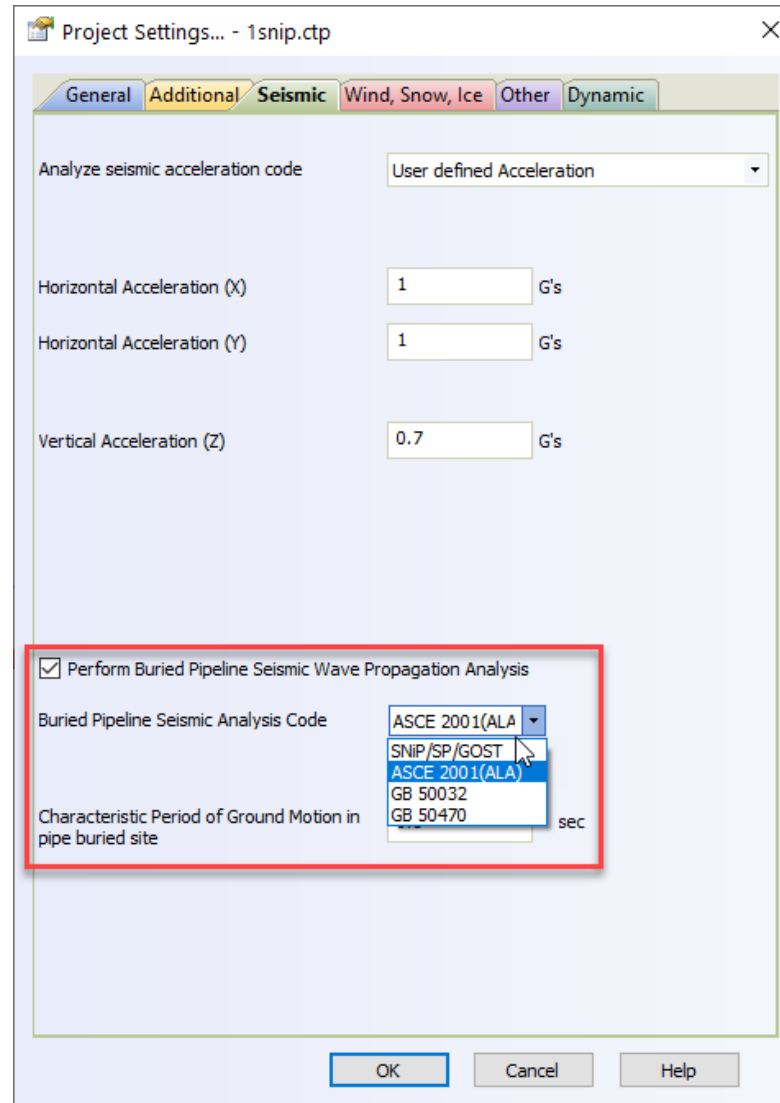
Análisis de propagación de la onda sísmica para tuberías enterradas. START-PROF calcula el esfuerzo y tensión en líneas enterradas causadas por propagación de onda sísmica y verifica que esfuerzos y tensiones estén de acuerdo con

- ASCE 2001 Guidelines for the Design of Buried Steel Pipe (American Lifelines Alliance). Mejorado por los autores de START-PROF, agregando el efecto cortante de onda
- GB 50032 (China)
- GB 50470 (China)
- SNiP 2.05.06-85 (Rusia)
- SP 36.13330.2012 (Rusia)
- GOST R 55989-2014 (Rusia)
- GOST R 55990-2014 (Rusia)
- SP 284.1325800.2016 (Rusia)
- SP 33.13330.2012 (Rusia)





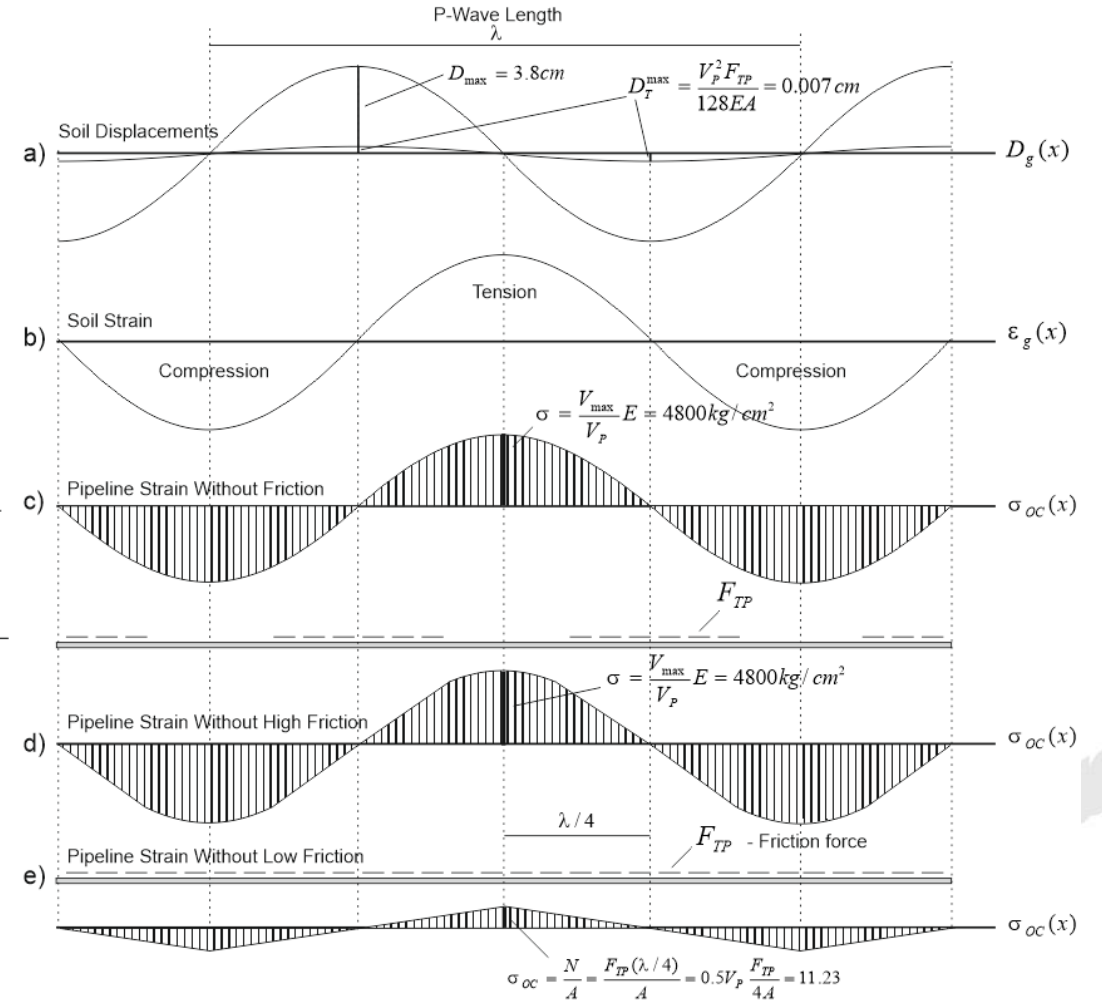
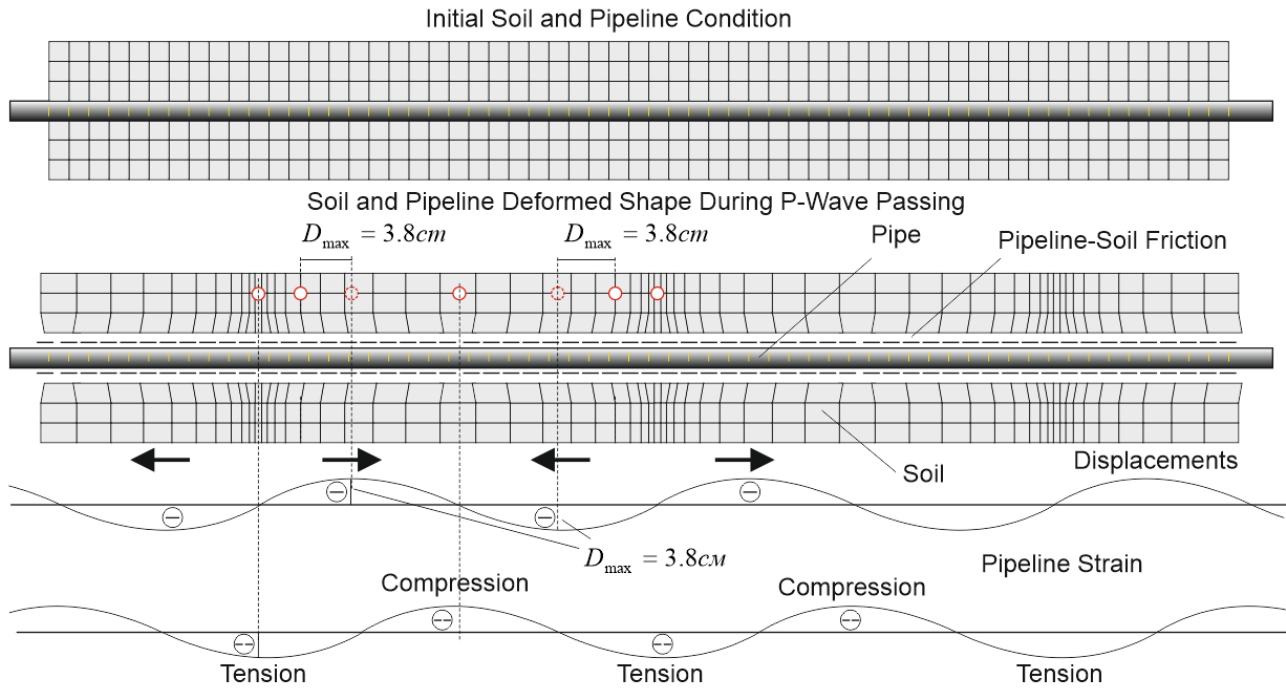
# PASS/Start-Prof | Características



PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE

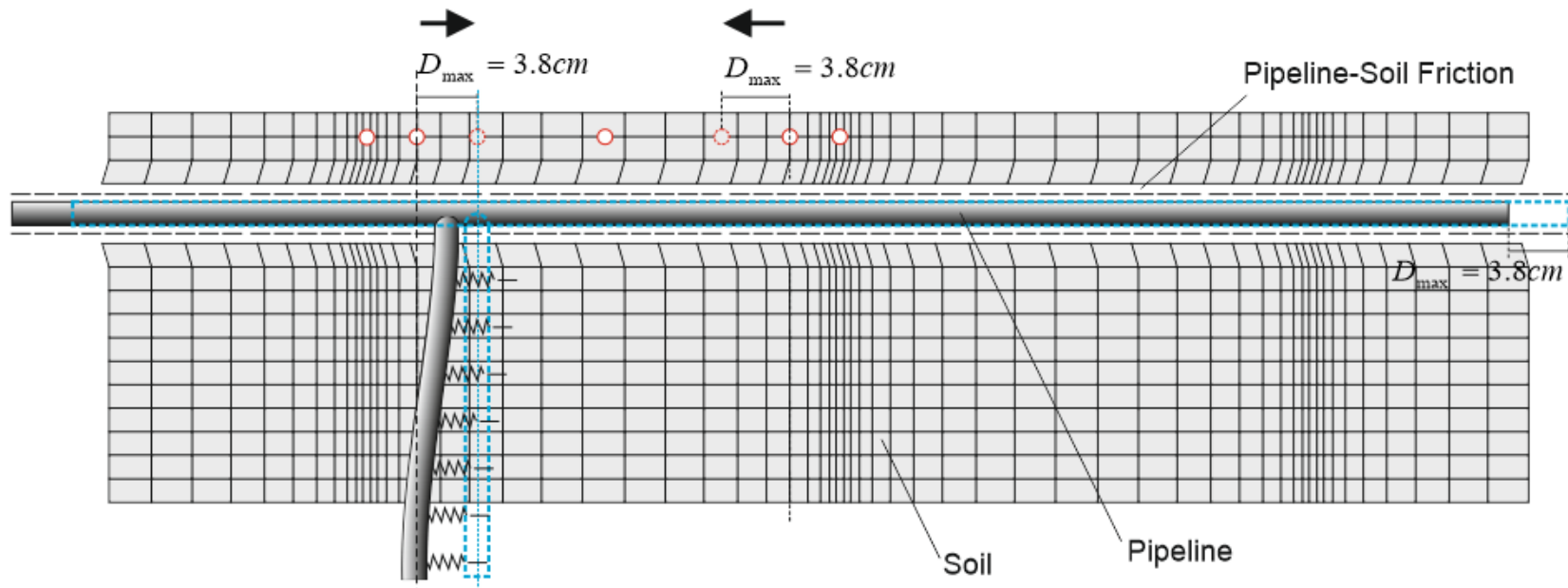


# PASS/Start-Prof | Características

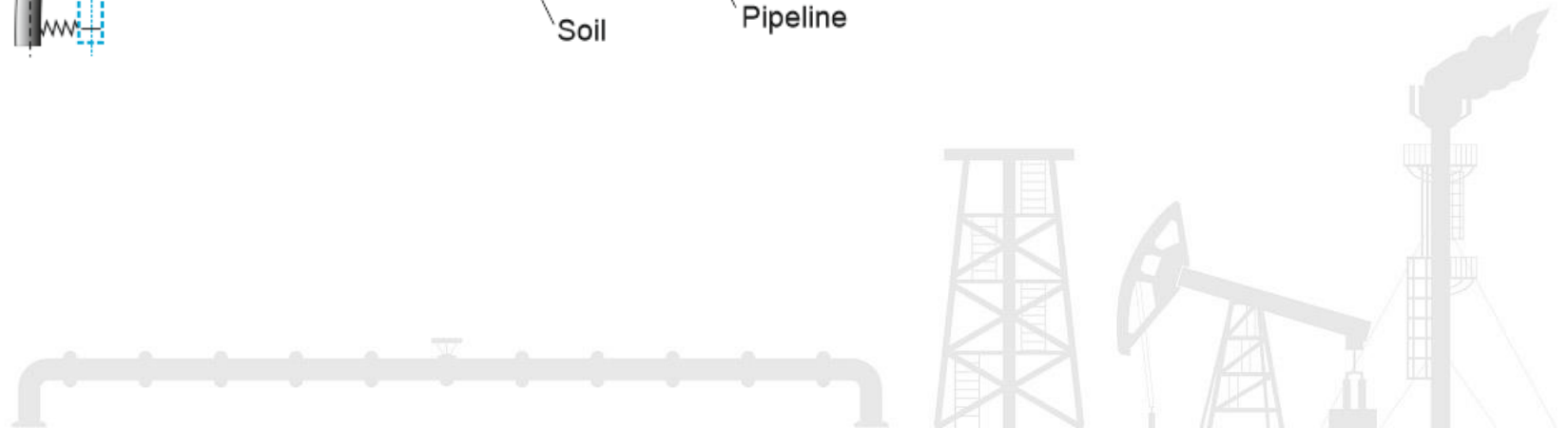


# PASS/Start-Prof | Características

Cada ramal, giro o ancla de la tubería causa grandes esfuerzos axiales y de flexión



PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE



# PASS/Start-Prof | Características

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

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

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

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

$D$  – Pipe diameter, m

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

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

Maximum strain from P-wave friction forces is

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

$\lambda$  – Wave length, m

$$\lambda = 0.5C_p$$

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

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

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

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

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

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

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

$T_u$  – Peak friction force, t/m

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

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

$c$  – Soil cohesion

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

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

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

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

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

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

$$C_R \approx 0.92C_s$$

**Pipe Properties**

Pipe: 160-180  Pipe is Buried

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

**Main Additional Soil Seismic**

**Piping Location**

Aboveground/in Underground Channel/On Low Restraints Installation

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

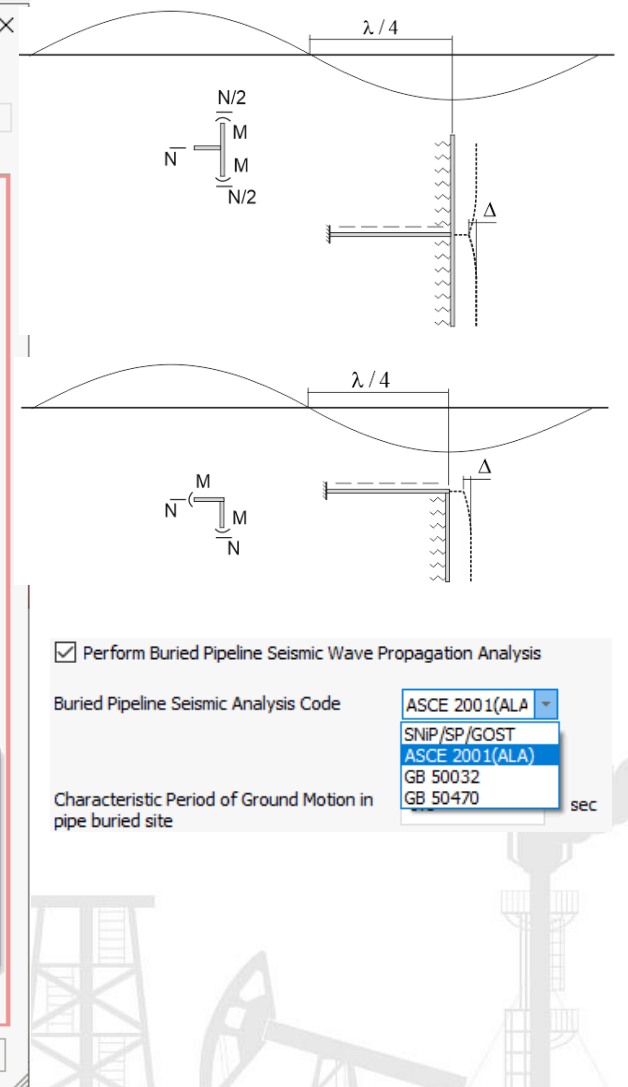
Automatic Calculation of Kpsi

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

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

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

OK Cancel Help



# PASS/Start-Prof | Características

Se adicionó verificación de deformación de acuerdo con códigos ASCE 2001 Guidelines for the Design of Buried Steel Pipe (American Lifelines Alliance), SNIIP, SP, GOST, GB

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			E, 201051.12 MPa
	9	515.60	965.27	53.4	0.2009			[εa]=0.75(0.5t/D-0.0025+3000(PD/(2Et)) <sup>2</sup> ), 0.002939
Buried pipe	7	490.91	965.27	50.9	0.1884			[εa]%, 0.2939
	8	510.81	965.27	52.9	0.1985			

Tension strain limit 5%

Compression strain limit

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

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

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 | Creación del modelo

En START-PROF la creación del modelo es simple, clara y directa.  
Un principiante sabrá qué hacer.

Crear el modelo de la tubería y el equipo es como combinar objetos como en un LEGO

- Rápida creación del modelo
- Fácil y rápida modificación del modelo
- Puede agregar, eliminar, modificar, copiar, rotar, duplicar, dividir objetos
- Trabajar con grupos de objetos

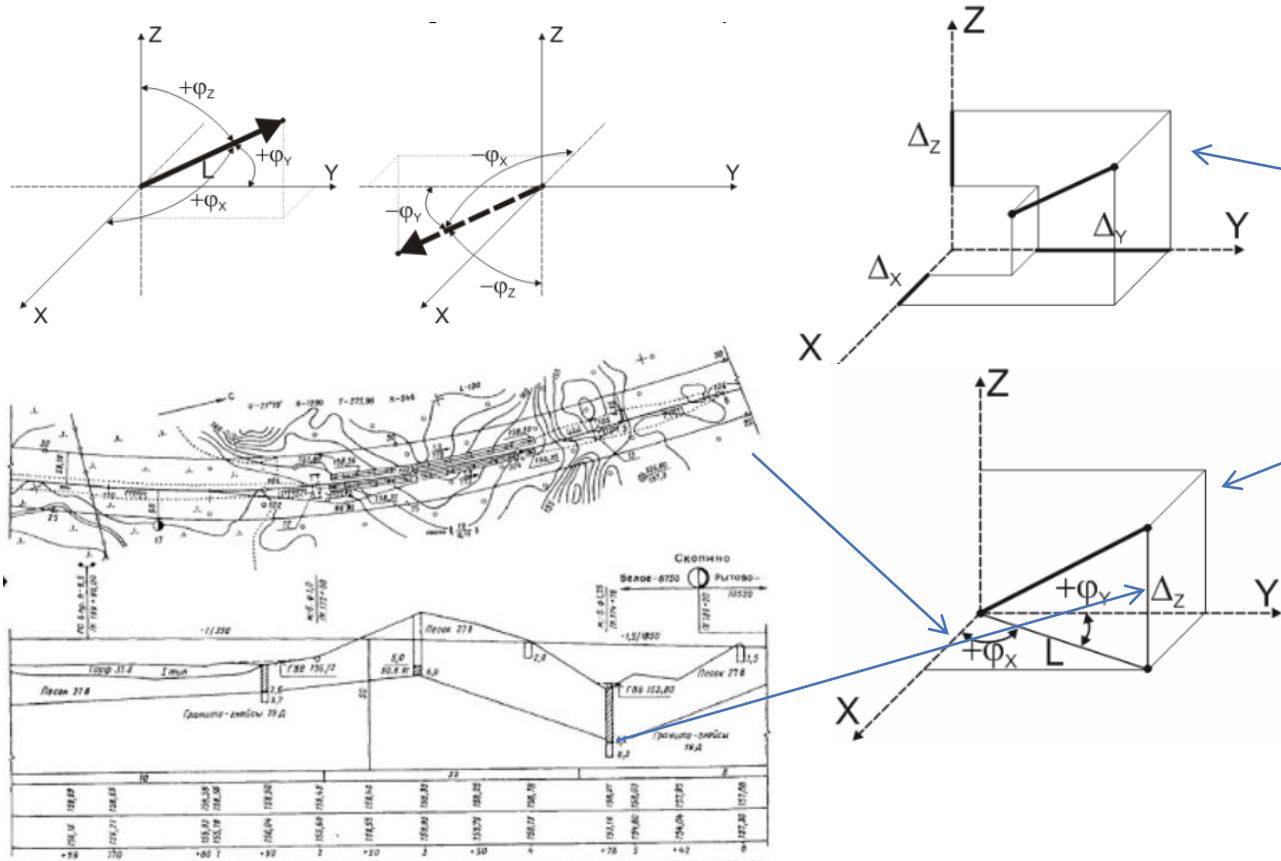


PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE



# PASS/Start-Prof | Creación del modelo

## Objeto Tubo con varios Sistemas de Coordenadas



**Pipe Properties**  
Pipe: 2-3  Pipe is Buried  
Name:   
Main Additional Soil  
projections  
Cylindrical  
Pipe Length: 29.4 m  
DX: 4.345597 m  
DY: -29.07707 m  
DZ: 0 m  
Properties  
Outer Diameter: 530 mm  
Wall Thickness: 8 mm  
Material: API-5L X52  
Forces  
Pressure: L 6.38 kgf/sq.cm  
Temperature: L 14 °C  
Test Pressure: 7 kgf/sq.cm  
Uniform Weight  
 Auto Pipe Weight  Auto Weight Insulation  
Pipe: 102.99 kgf/m  
Insulation: L 0 kgf/m  
Fluid: L 18.34 kgf/m  
Fluid Density: L 88.39 kg/m<sup>3</sup>  
OK Cancel Help

**Pipe Properties**  
Pipe: 2-3  Pipe is Buried  
Name:   
Main Additional Soil  
cylinder  
Cylindrical  
Length in XY plane: 29.4 m  
DZ: 0 m  
Angle With X Axis: + 81.5 °  
Angle With Y Axis: - 8.5 °  
Properties  
Outer Diameter: 530 mm  
Wall Thickness: 8 mm  
Material: API-5L X52  
Forces  
Pressure: L 6.38 kgf/sq.cm  
Temperature: L 14 °C  
Test Pressure: 7 kgf/sq.cm  
Uniform Weight  
 Auto Pipe Weight  Auto Weight Insulation  
Pipe: 102.99 kgf/m  
Insulation: L 0 kgf/m  
Fluid: L 18.34 kgf/m  
Fluid Density: L 88.39 kg/m<sup>3</sup>  
OK Cancel Help



PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE

# PASS/Start-Prof | Creación del modelo

Objeto Doblez



**Node Object Properties**

Forged Elbow

Flexibility (h), 0.161  
Flexibility Factor (k), 9.859  
SIF: i<sub>o</sub>= 2.369, i<sub>i</sub>= 2.843, i<sub>t</sub>= 1.000, i<sub>a</sub>= 1.000

Name

Radius, R Long 305 mm

Get Properties From Matching Pipe

Calculate Weight Automatically

Material A106 A

Manufacturing Technology Seamless

Weight 15.1 kgf

Weld Quality Factor, E 1

Flanges on Bend Ends no

Wall Thickness, t<sub>n</sub> C 6 mm

Mill Tolerance 10 %

Corrosion Allowance 0.9 mm

OK Cancel Help

**Node Object Properties**

Forged Elbow

Radius, R Manual 300 mm

Get Properties From Matching Pipe

Calculate Weight Automatically

Material A106 A

Manufacturing Technology Seamless

Weight 14.8 kgf

Weld Quality Factor, E 1

Flanges on Bend Ends no

Wall Thickness, t<sub>n</sub> C 6 mm

Mill Tolerance 10 %

Corrosion Allowance 0.9 mm

OK Cancel Help

Databases Analysis Output Win

- Materials Library...
- Variable Springs...
- Constant Springs...
- Soils...
- Insulation...
- Expansion Joints...
- Pipes...
- Bends...
- Tees...
- Reducers...
- Flanges...
- Gasket...
- Insulation Jacket...

Bends

Type	Material	Size	Angle, °	Diameter, mm	DN, mm	NPS, in	Schedule	Thickness, mm	Mill Tolerance Centreline, mm	Mill Tolerance Outside, mm	Mill Tolerance Inside, mm	Radius, mm	Weight, kg	Ovalisation Factor	Radius Type	Standard Group
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<not set>	ASME B16.9-2012	<not set>	90-60.3	90	60.3	50	2	160	0	0	0	76	1.5	0	long	ASME
<not set>	ASME B16.9-2012	<not set>	90-60.3	90	60.3	50	2	140	0	0	0	76	0	0	long	ASME
<not set>	ASME B16.9-2012	<not set>	90-60.3	90	60.3	50	2	120	0	0	0	76	0	0	long	ASME
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<not set>	ASME B16.9-2012	<not set>	45-73	45	73	65	2 1/2	120	0	0	0	95	0	0	long	ASME
<not set>	ASME B16.9-2012	<not set>	45-73	45	73	65	2 1/2	60	0	0	0	95	0	0	long	ASME
<not set>	ASME B16.9-2012	<not set>	45-73	45	73	65	2 1/2	805	0	0	0	95	1	0	long	ASME

Only first 300 rows are shown  
To see other rows please use filters

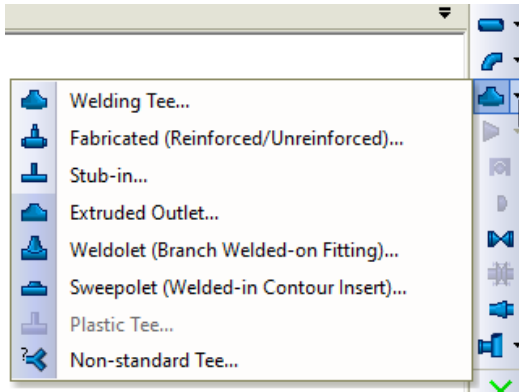
Save Close Help

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

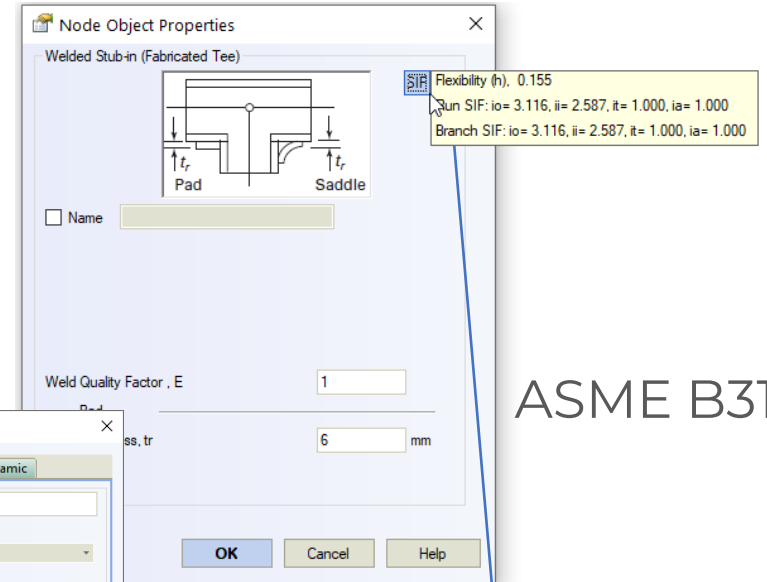
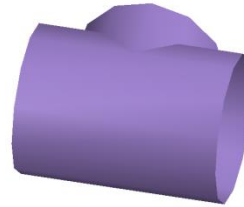




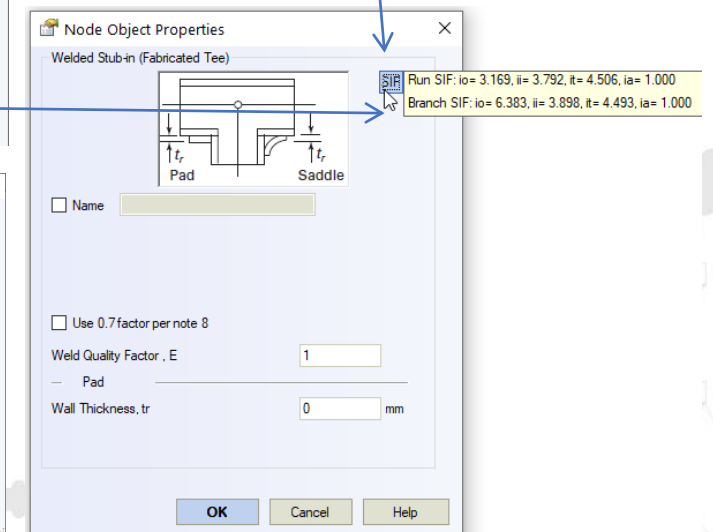
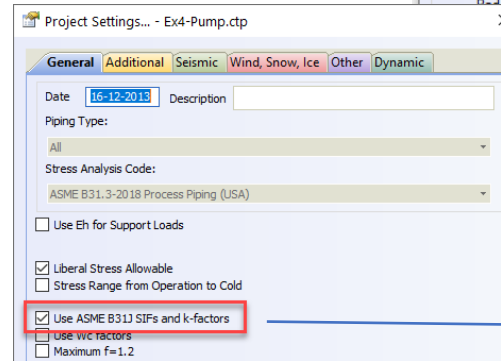
# PASS/Start-Prof | Creación del modelo



Objeto Tee



ASME B31J



Tees

Type: welding

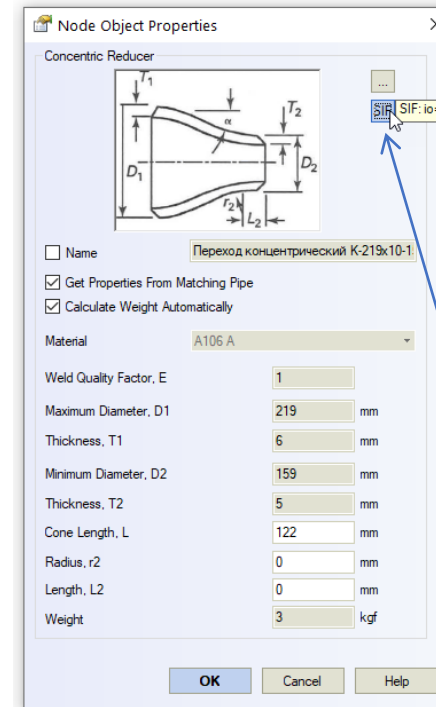
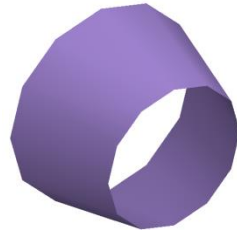
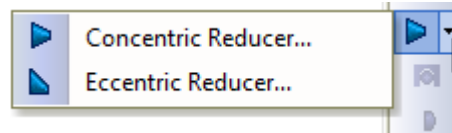
Manufacturing Technology	Standard	Material	Size	Header Diameter, mm	Branch Diameter, mm	Header DN, mm	Branch DN, mm	Header NPS, in	Branch NPS, in	Schedule	Header Thickness, mm	Branch Thickness, mm	Header Mill Tolerance, mm	Branch Mill Tolerance, mm	Full Length, mm	Crotch Height, mm	Crotch Radius, mm	Weight, kg	Standard Group
<not set>	ASME B16.9-2012	<not set>	42.2-21.3	42.2	21.3	32	15	1 1/4	1/2	30	0	0	0	0	96	48	0	0	ASME
<not set>	ASME B16.9-2012	<not set>	42.2-21.3	42.2	21.3	32	15	1 1/4	1/2	60	0	0	0	0	96	48	0	0	ASME
<not set>	ASME B16.9-2012	<not set>	42.2-26.7	42.2	26.7	32	20	1 1/4	3/4	120	0	0	0	0	96	48	0	0	ASME
<not set>	ASME B16.9-2012	<not set>	42.2-26.7	42.2	26.7	32	20	1 1/4	3/4	100	0	0	0	0	96	48	0	0	ASME
<not set>	ASME B16.9-2012	<not set>	42.2-26.7	42.2	26.7	32	20	1 1/4	3/4	160	0	0	0	0	96	48	0	0	ASME
<not set>	ASME B16.9-2012	<not set>	42.2-26.7	42.2	26.7	32	20	1 1/4	3/4	140	0	0	0	0	96	48	0	0	ASME
<not set>	ASME B16.9-2012	<not set>	42.2-26.7	42.2	26.7	32	20	1 1/4	3/4	XXS	0	0	0	0	96	48	0	1	ASME
<not set>	ASME B16.9-2012	<not set>	42.2-26.7	42.2	26.7	32	20	1 1/4	3/4	10	0	0	0	0	96	48	0	0	ASME
<not set>	ASME B16.9-2012	<not set>	42.2-26.7	42.2	26.7	32	20	1 1/4	3/4	105	0	0	0	0	96	48	0	0	ASME

Only first 300 rows are shown  
To see other rows please use filters

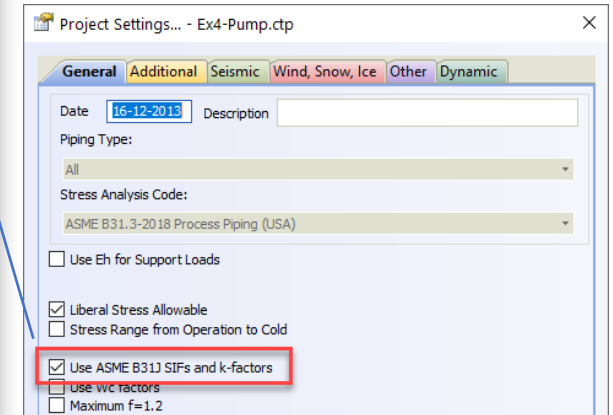


# PASS/Start-Prof | Creación del modelo

## Objeto Reducción



## ASME B31J



Reducers

Type: concentric

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 Tolerance at Dmax, mm	Mill Tolerance at Dmin, mm	Full Length, mm	Cone Length, mm
<not set>	ASME B16.9-2012	<not set>	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>	20-10	26.7	17.3	20	10	3/4	3/8	55	0	0	0	0	38	22.8
<not set>	ASME B16.9-2012	<not set>	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>	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>	20-10	26.7	17.3	20	10	3/4	3/8	105	0	0	0	0	38	22.8
<not set>	ASME B16.9-2012	<not set>	20-10	26.7	17.3	20	10	3/4	3/8	405	0	0	0	0	38	22.8
<not set>	ASME B16.9-2012	<not set>	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>	20-10	26.7	17.3	20	10	3/4	3/8	160	0	0	0	0	38	22.8

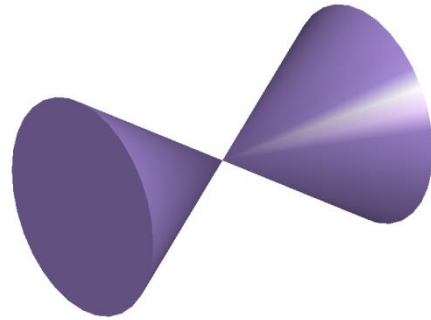
Only first 300 rows are shown  
To see other rows please use filters

Save Close Help



# PASS/Start-Prof | Creación del modelo

## Objeto Válvula



Node Object Properties

Valve

Name

Length  mm

Weight  lbf

Flange Leakage Check

Leakage Check Method

Flange Code

Gasket Effective Diameter, G  mm

Nominal Pressure PN / Class

Material Group

OK Cancel Help

## Automatic Flange Leakage Check



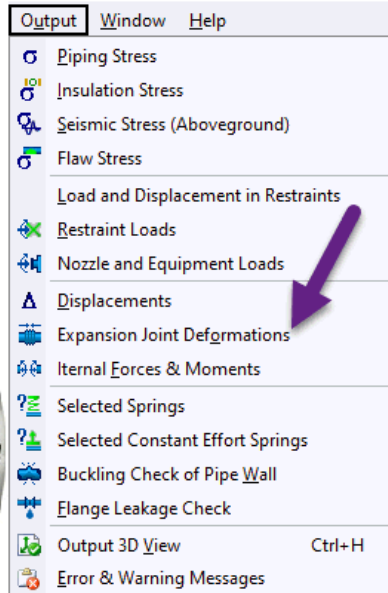
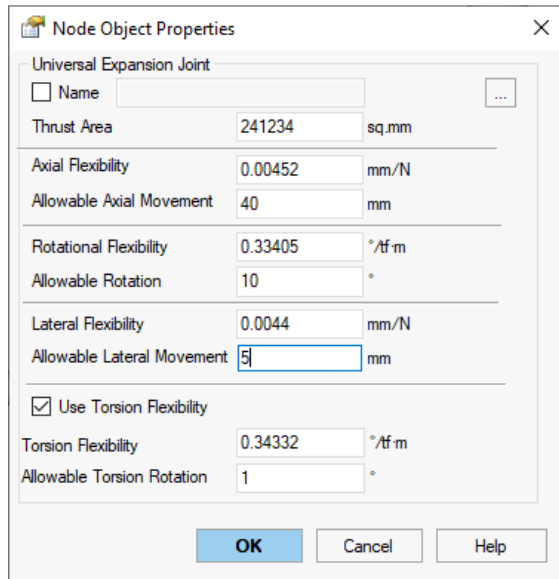
PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE





# PASS/Start-Prof | Creación del modelo

Objeto "Untied Expansion Joint" y base de datos de Juntas de Expansión sin tirantes, lo que permite especificar flexibilidad axial, rotacional, cortante y torsión también verifica automáticamente las deformaciones tanto individuales como combinadas. No necesita más modelar manualmente empleando junta de expansión no-estándar.



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

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



PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE

# PASS/Start-Prof | Creación del modelo

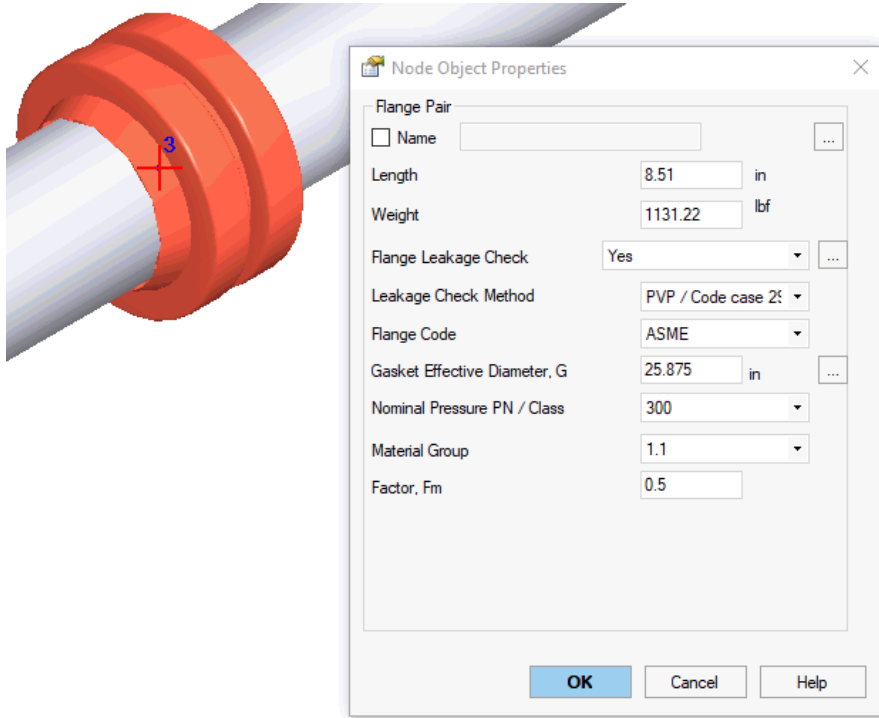
Se agregó el nuevo objeto "Torsion Expansion Joint" y base de datos de juntas de expansión y torsión, modela automáticamente fricción por torsión (momento de torsión) y verifica el ángulo permisible de rotación.

The image illustrates the software interface for creating a Torsion Expansion Joint model. It features a photograph of a large pipe joint, a 3D CAD model of the joint, and a 2D cross-section diagram labeled "SLIP-TYPE EXPANSION JOINT" showing "Pipe 1 slides in pipe 2" with "Packing" and "Flange bolts". The diagram also indicates forces:  $F = pA + mV$  for "Pressure + momentum" and  $F = pA + mV$  for "Pressure + momentum".

Two "Node Object Properties" dialog boxes are shown. The first dialog, titled "Torsion Expansion Joint", has a "Friction Moment" field set to 0 kgf-cm. The second dialog, titled "Slip Joint", has a "Friction Force" field set to 0 kgf. A purple arrow points to the "Angular Torsion..." option in the software toolbar.

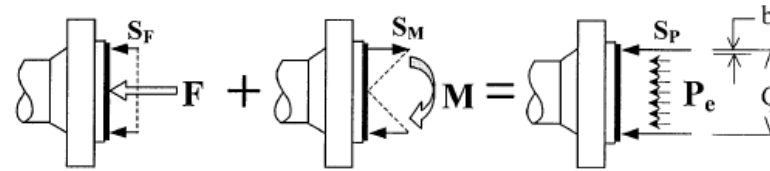
# PASS/Start-Prof | Creación del modelo

## Objeto Brida



### Automatic Flange Leakage Check:

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



Input Flange leakage

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

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



PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE



# PASS/Start-Prof | Creación del modelo

Se agrego la habilidad de especificar aislamiento, recubrimiento, y densidad lineal de las capas y espesor en las propiedades del tubo. La habilidad de escoger el peso del aislamiento desde la base de datos continúa existiendo.

The screenshot displays the software interface for defining pipe properties. On the left, a dialog box shows the following settings:

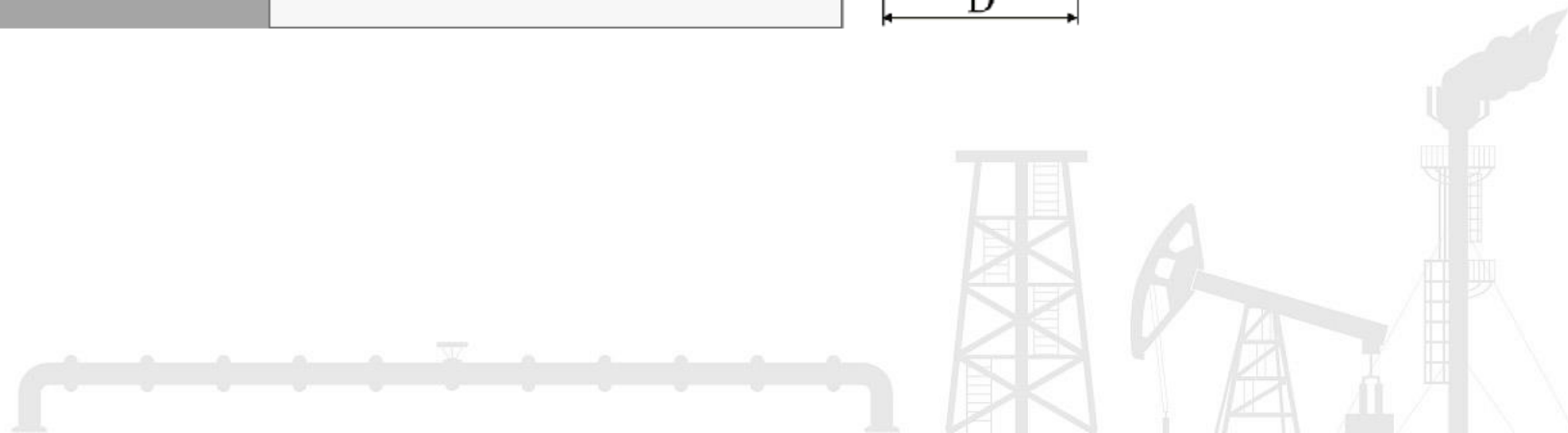
Test Pressure	0	MPa
Uniform Weight		
<input checked="" type="checkbox"/> Calculate Pipe Weight Automatically		
Pipe	179.98	kgf/m
Insulation	L 49.31	kgf/m
Fluid	L 14.74	kgf/m
Fluid Density	L 1000	kg/m3

At the bottom of this dialog are buttons for OK, Cancel, and Help.

To the right, a separate panel lists additional properties:

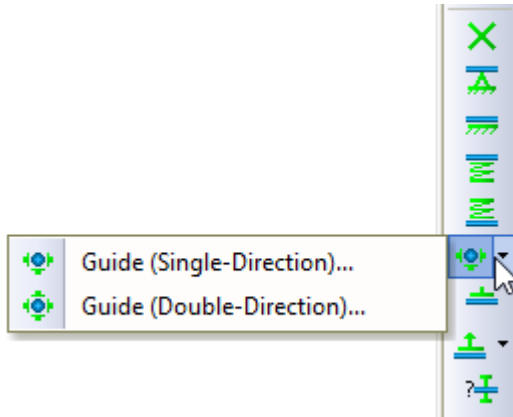
<input type="checkbox"/> Insulation Thickness	50	mm
Insulation Density	800	kg/m3
<input type="checkbox"/> Cladding Thickness	10	mm
Cladding Density	1500	kg/m3
<input type="checkbox"/> Lining Thickness	0	mm
Lining Density	0	kg/m3

On the far right, a cross-sectional diagram of a pipe is shown. It features a central bore, an inner cladding layer (labeled 't'), an insulation layer (labeled 'ti'), and an outer cladding layer (labeled 'tc'). The total outer diameter is labeled 'D'. The diagram is divided into four numbered regions: 1 (insulation), 2 (cladding), 3 (pipe wall), and 4 (inner cladding).

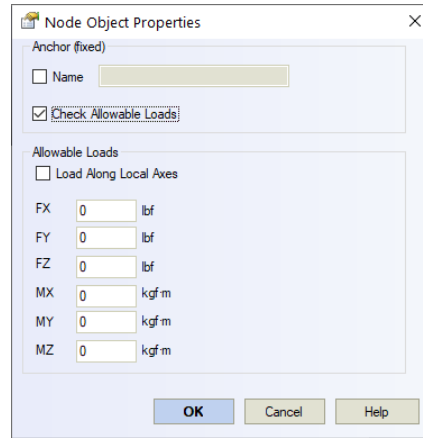




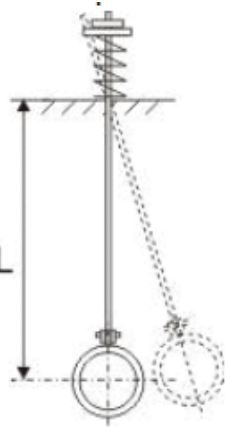
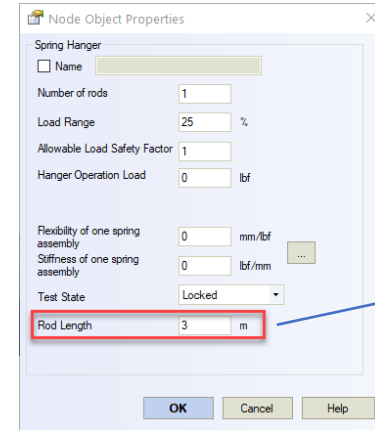
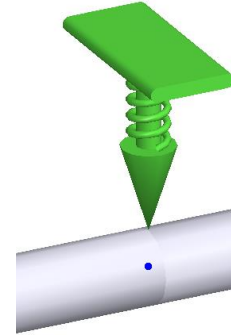
# PASS/Start-Prof | Creación del modelo



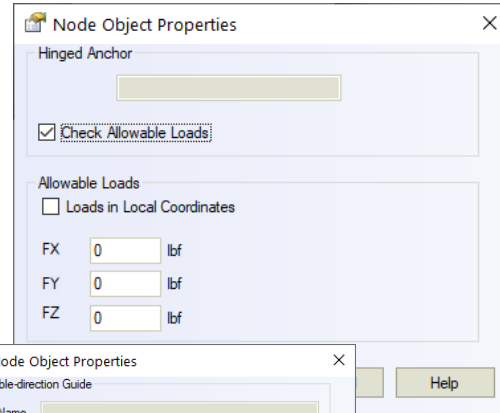
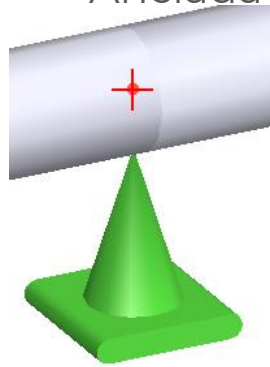
Ancla



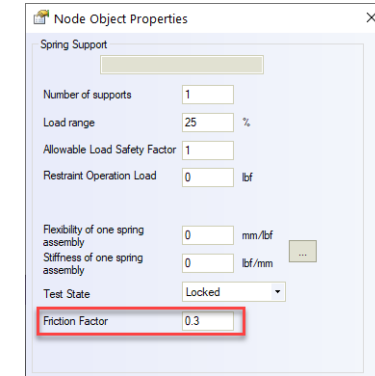
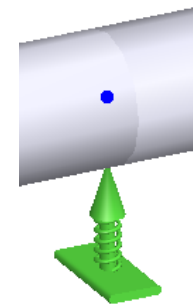
Resorte Colgante



Bisagra Anclada

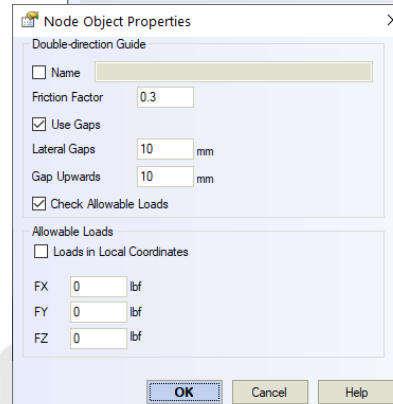
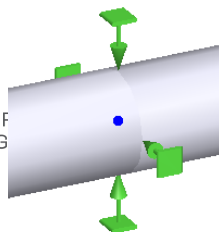


Resorte

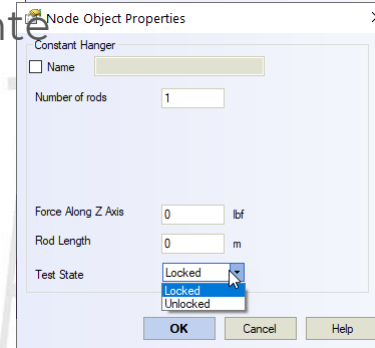
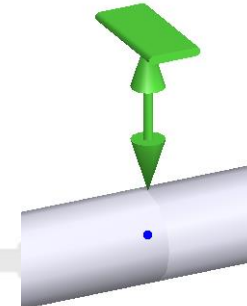


Selección automática de resortes Variable y Constante

Guía



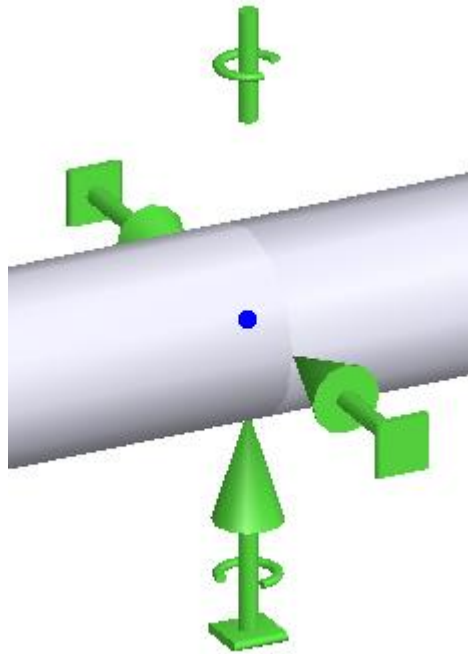
Colgante constante



PIPING AND EQUIP  
ANALYSIS & SIZING

# PASS/Start-Prof | Creación del modelo

## Objeto Restricción Personalizada



Non-standard Restraint

Name:

Support N 1: Precompression Spring, X: 0 lbf; Precompression Spring, Y: 0 lbf; Precompression Spring, Z: 0 lbf

Test State: Unlocked

Local Axes of the Pipe: Pipe 31-52

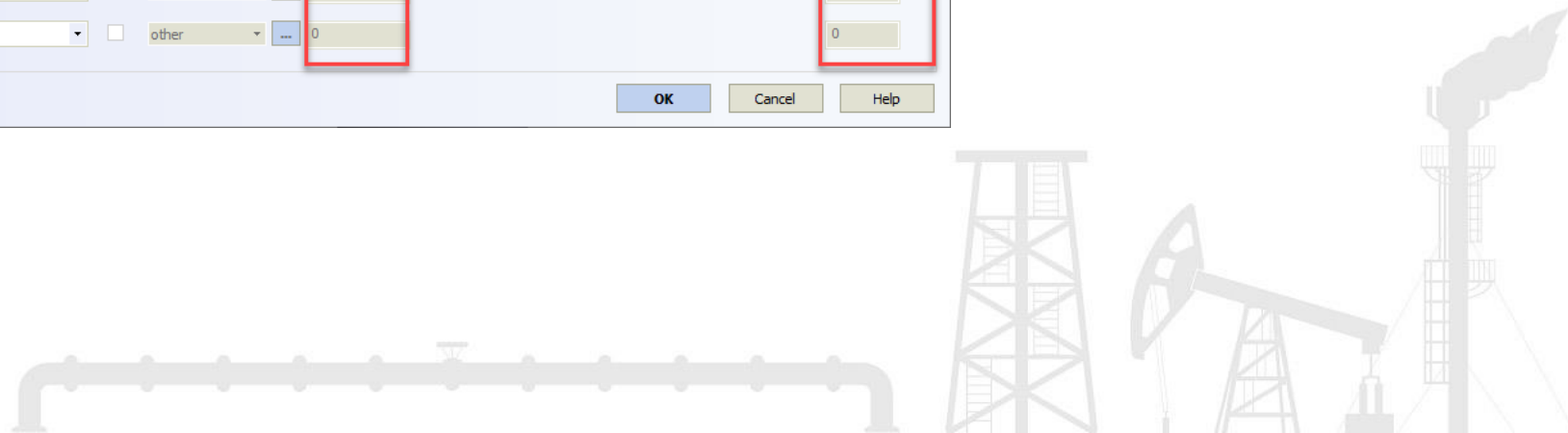
Check Allowable Loads

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	0	0	0.3	0	0	0
2.	rigid one-sided	<input checked="" type="checkbox"/> -Zm Ver/Horz	0	0	0.3	0	0	0
3.	none	<input type="checkbox"/> other	0	0	0	0	0	0

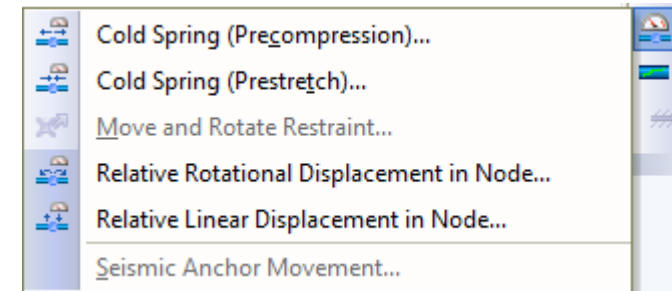
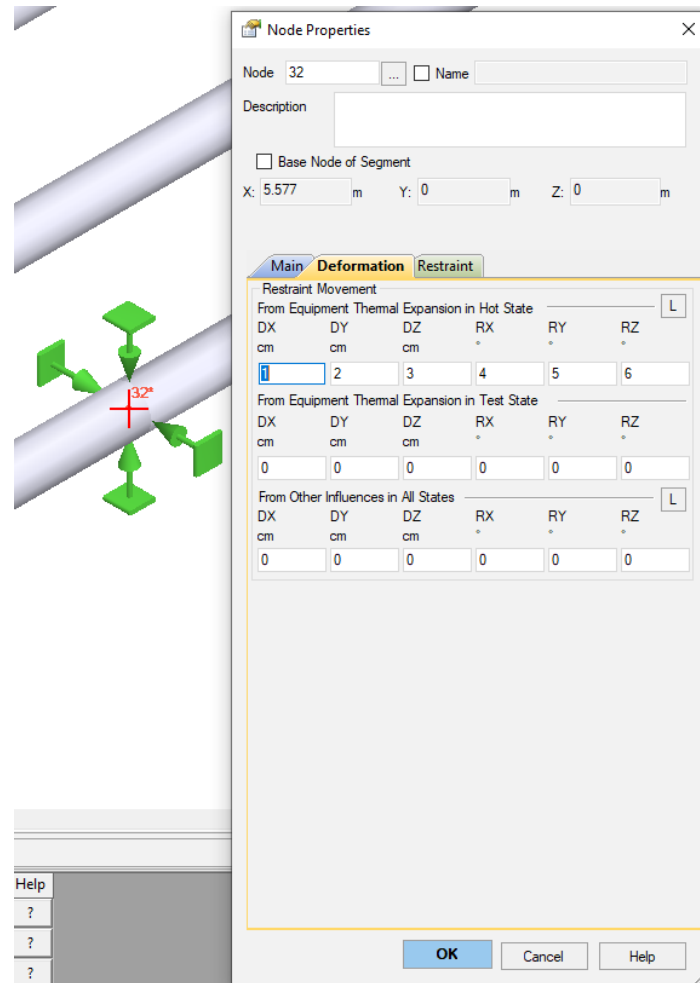
Rotational restraints				
	Local Axes	Restraint Direction Around Axis	Flexibility, °/kgf·m	Allowable Load, kgf·m
4.	rigid two-sided	<input type="checkbox"/> +Z	0	0
5.	none	<input type="checkbox"/> other	0	0
6.	none	<input type="checkbox"/> other	0	0

OK Cancel Help



# PASS/Start-Prof | Creación del modelo

Para especificar el movimiento del soporte, tan solo agregue el objeto desplazamiento al objeto soporte

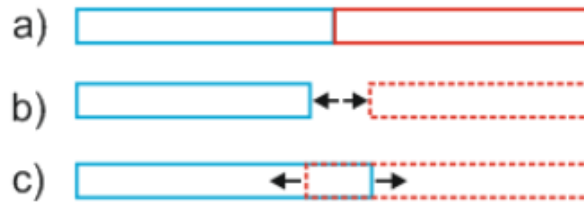
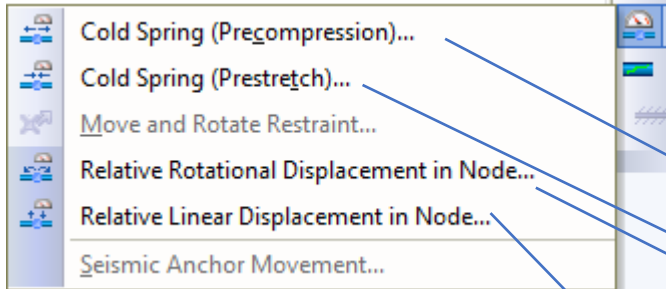


PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE

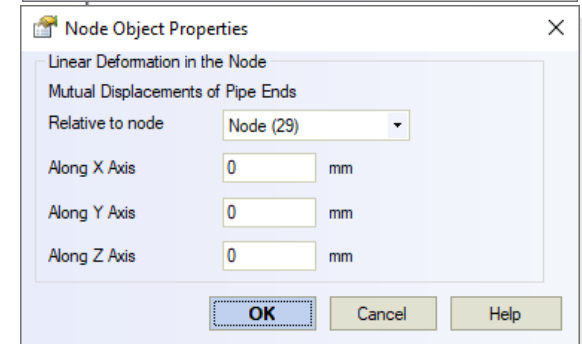
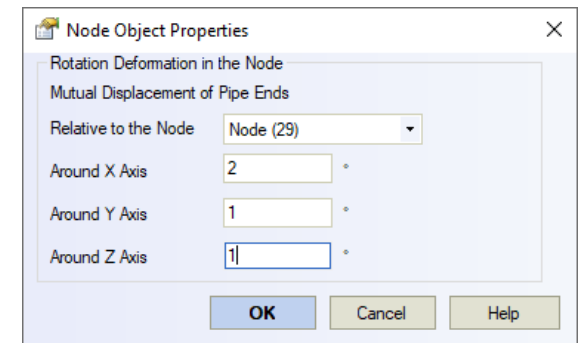
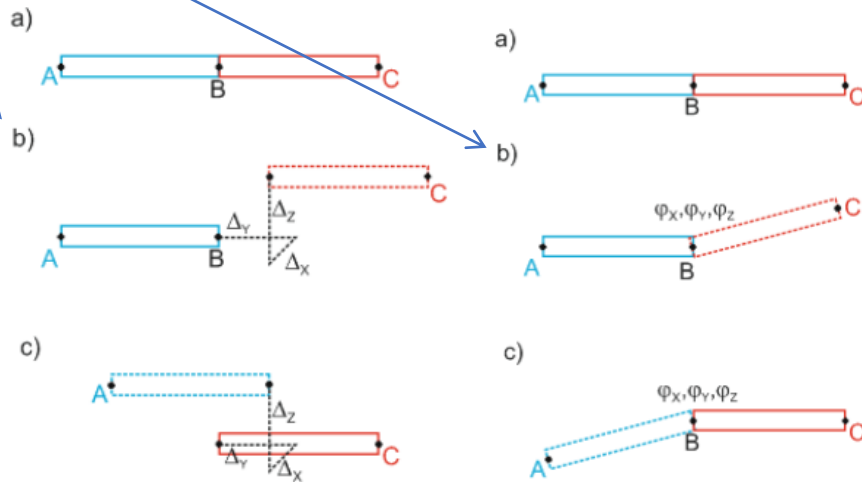
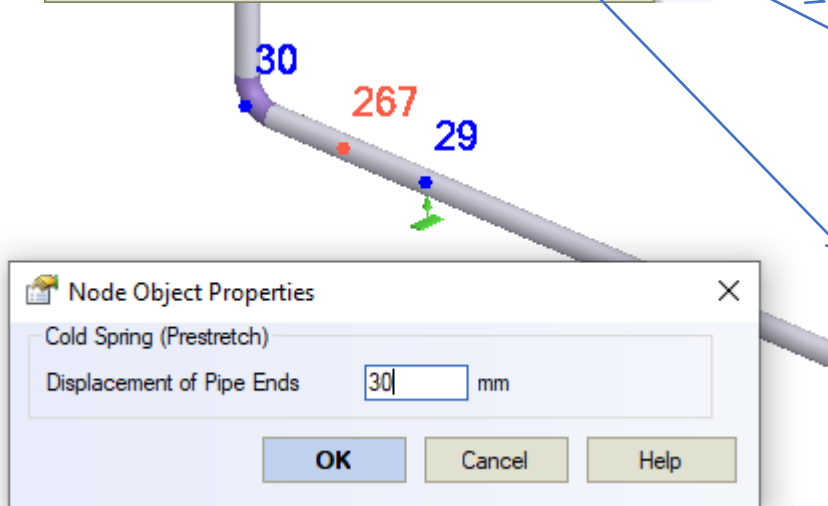


# PASS/Start-Prof | Creación del modelo

Para especificar el resorte en frío (alargamiento de la tubería mediante calentamiento), simplemente agregue el objeto “Cold Spring” al nodo

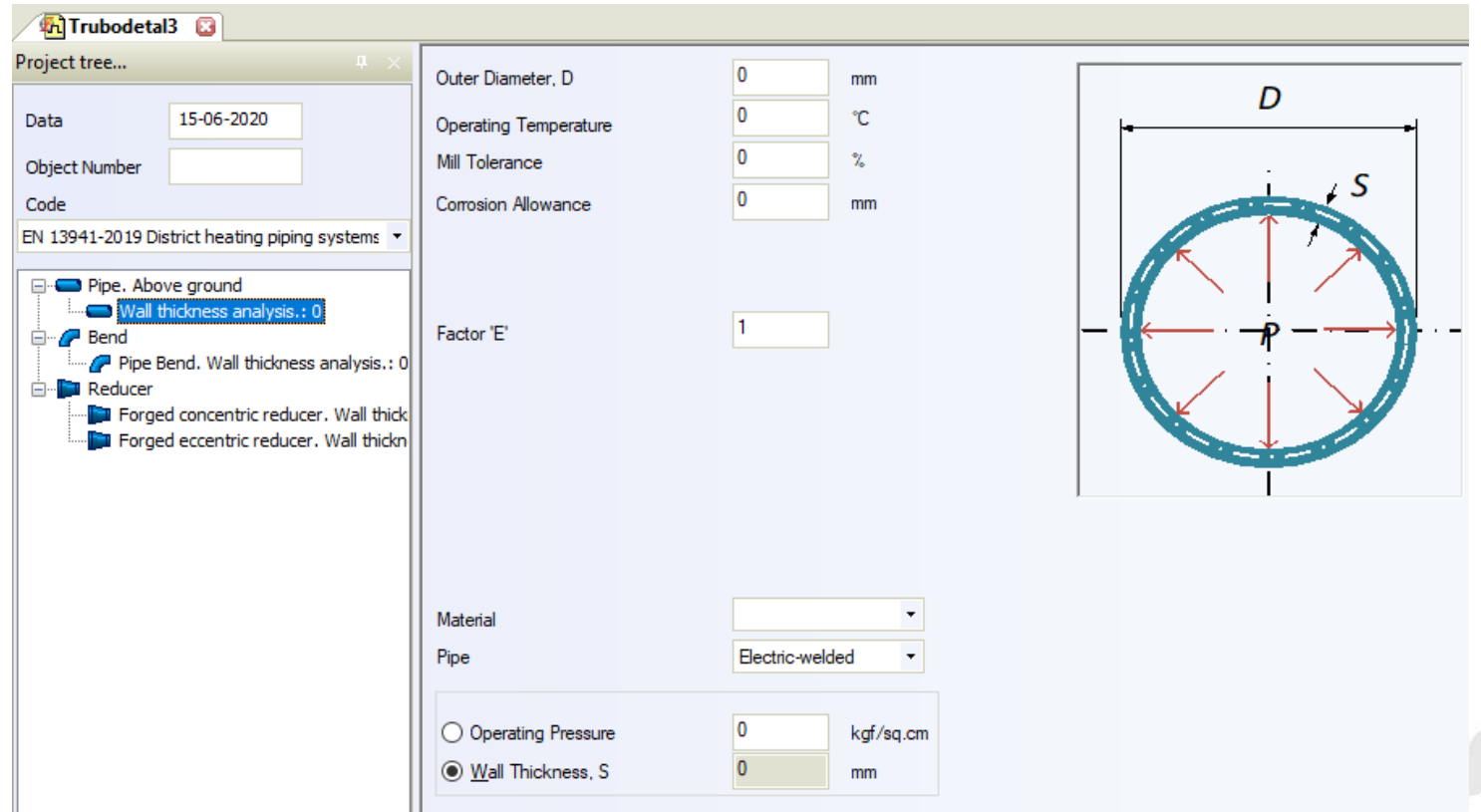


También pre-compresión y desplazamientos rotacionales o lineales relativos de los extremos de la tubería.



# PASS/Start-Prof | Elementos START

Cálculo de espesor de pared en tubería y codos para todos los códigos



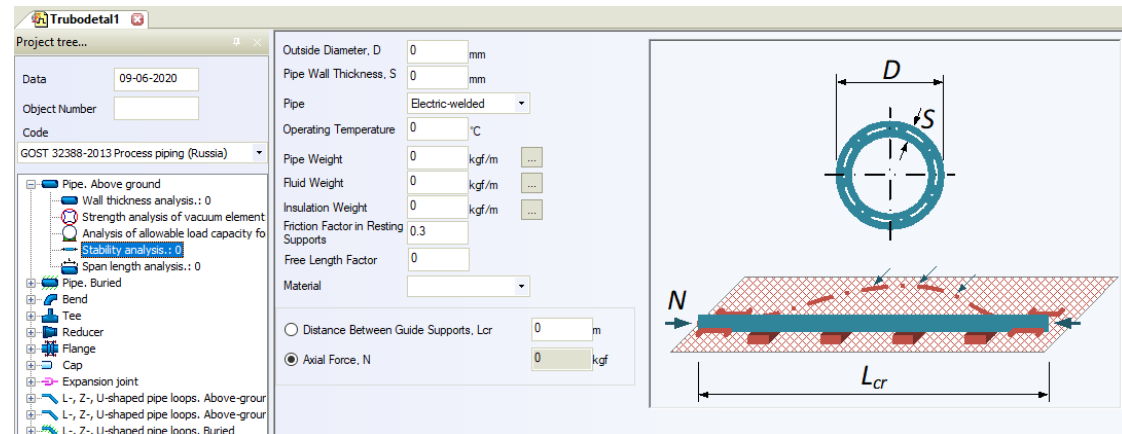
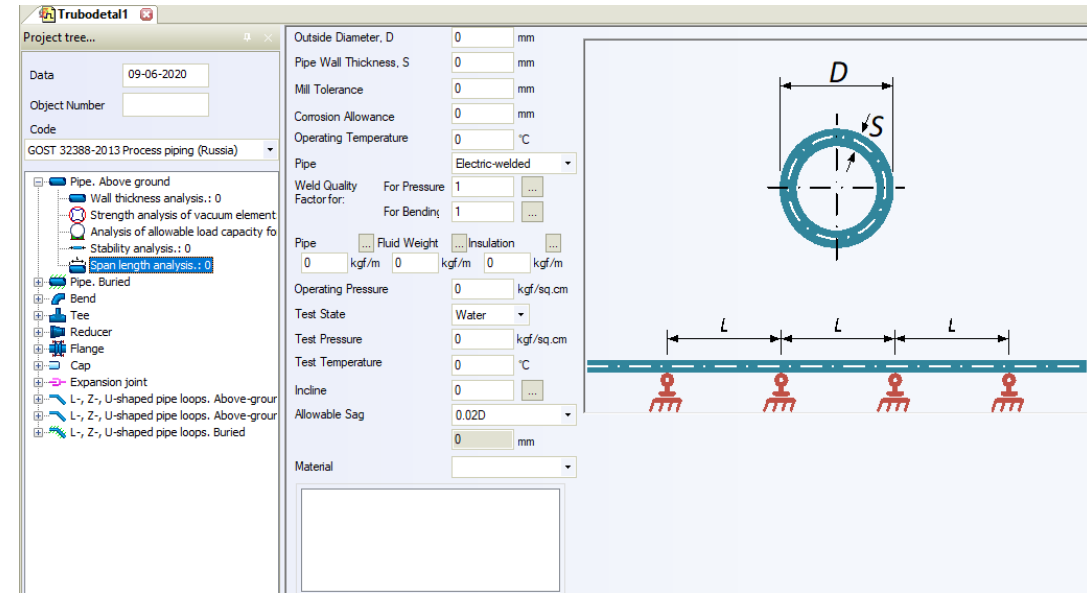
PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE



# PASS/Start-Prof | Elementos START

Análisis del espaciamiento entre soportes

Análisis de estabilidad longitudinal



PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE

# PASS/Start-Prof | Elementos START

Calcule el espesor de la pared en vacío y por carga externa

Análisis de curva de expansión simple

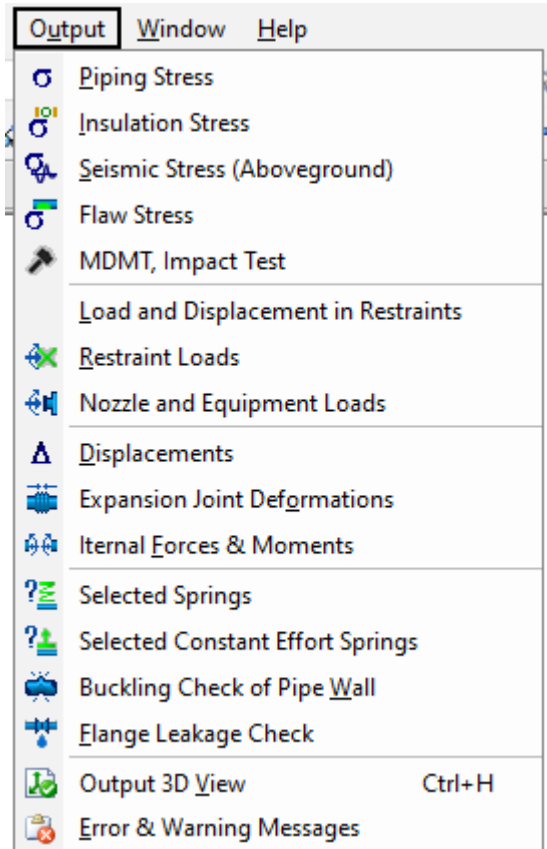
The image displays two overlapping screenshots of the Trubodetail1 software interface. The top screenshot shows the 'Pipe' configuration panel with the following settings: Outside Diameter, D: 0 mm; Operating Temperature: 0 °C; Pipe: Electric-welded; Weld Quality Factor for Pressure: 1; Mill Tolerance: 0 mm; Corrosion Allowance: 0 mm; Availability of stiffening ribs: unchecked. A circular diagram to the right illustrates a pipe cross-section with diameter D and wall thickness S. The bottom screenshot shows the 'Expansion joint' configuration panel with settings: Pipe Diameter, D: 0 mm; Pipe Wall Thickness, S: 0 mm; Stretch factor (without stretch - 0): 0; Operating Pressure: 0 kgf/sq.cm; Material: (empty); Expansion joint back, B: 0 m; Expansion joint leg, H: 0 m; Friction Factor in Resting Supports: 0.3; Allowable load on end support: 0 kgf; Pipe: Electric-welded; Weld Quality Factor for pressure: 1 (pressure), 0.9 (bending); Flexibility of bends: ignore; Bend curve radius: 0 mm; Compensated lengths: checked, L1: 0 m, L2: 0 m. A diagram to the right shows a U-shaped expansion joint with dimensions B, D, S, R, H, L<sub>guid</sub>, L<sub>1</sub>, and L<sub>2</sub>. The project tree on the left of both screenshots lists various pipe components and analysis types, such as 'Pipe. Above ground', 'Bend', 'Tee', 'Reducer', 'Flange', 'Cap', 'Expansion joint', and 'L-, Z-, U-shaped pipe loops'.



PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE

# PASS/Start-Prof | Reportes

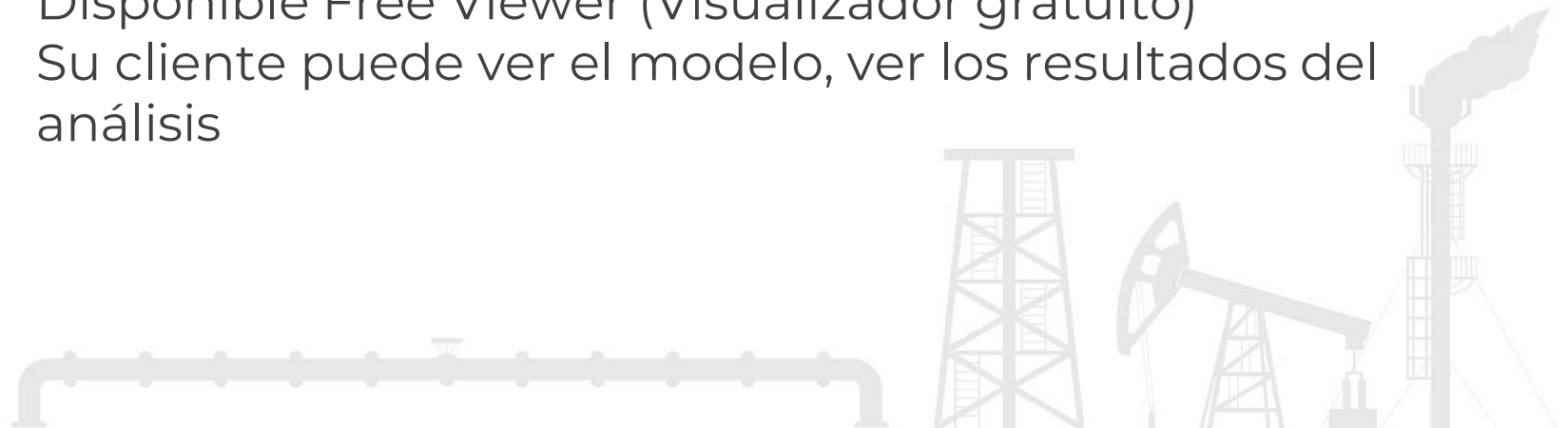
Todos los reportes que necesite después del análisis



- Los reportes son interactivos. Por ejemplo, puede agregar o quitar esfuerzos desde fuerza axial en el momento, cambiar coordenadas global/local, agregar esfuerzos por arrastre, y demás.
- Los reportes se pueden copiar MS Excel
- Los reportes se pueden incluir en MS Word
- Disponible Free Viewer (Visualizador gratuito)  
Su cliente puede ver el modelo, ver los resultados del análisis



PIPING AND EQUIPMENT  
ANALYSIS & SIZING SUITE





# PASS/Start-Prof | Reportes

Start-Prof Econom 2017 v.04.82 R2 - [Transfer 56-80 ASME B31.3.ctp - Load on Restraints and Equipment]

File Edit View Service Analysis Output Window Help

Input Loads

Operating Mode: 1 'Main' (0) Submode: Operation Axis: Global axis Support Type: Anchor (fixed), Sliding ...

Node Number	Type	Forces along coordinate axis, (kgf)			Moments around coord		
		X	Y	Z	X	Y	Z
2, Console	Anchor (fixed)	0.10	0	-1151.20	0	-575458.38	0.01
3, Restrained	Anchor (fixed)	567378.30	0	-325.80	0	-54294.99	0
4, Restrained	Anchor (fixed)	-567378.30	0	-325.80	0	54295.04	0
5, Bend	Anchor (fixed)	3760.80	556.90	-554.50	-10066.75	-186026.59	-235113.50
7, Bend	Anchor (fixed)	13603.30	-5447.70	-1294.60	-302600.69	9588.95	-1653202.63
9	Anchor (fixed)	-3902.60	2185.80	-720	75899.34	237117.89	209446.26
11	Anchor (fixed)	-261.60	-131	-403	-83200.50	114312.74	54683.24
13	Sliding Support	-71.90	-102	-414.10	0	0	0
15	Anchor (fixed)	96.20	151.30	-436.60	25559.60	-32059.35	42090.25
17	Anchor (fixed)	126.90	247.60	-422.20	63066.41	-52465.34	34842.89
19	Anchor (fixed)	11.10	-383.20	-248.40	116306.95	-29299.31	26236.48
21	Anchor (fixed)	-13362.30	2155.90	-543.80	-55819.24	112108.12	407537.56

Cargas en restricciones

Error and warning messages

Type	Node/pipe	Description
Notes	Node:8	(N265) Failed the stress check from pressure and weight loads (1. 'Main')
Notes	Node:8	(N265) Failed the stress check from pressure and weight loads (1. 'Main')
Notes	Node:8	(N284) Failed the fatigue strength check (1. 'Main')
Notes	Node:8	(N284) Failed the fatigue strength check (1. 'Main')
Notes	Node:8	(N268) Failed the stress check in operation condition (1. 'Main')
Notes	Node:8	(N268) Failed the stress check in operation condition (1. 'Main')

Pipes list Error and warning messages

Для справки нажмите F1

START-PROF 04.82 R1 - [START1.ctp - Displacement]

File Edit View Service Analysis Output Window Help

1 'Main mode'

Input Displ

Operating Mode: 1 'Main mode' Submode: Operation Choose Axis: Global axis Type Filter: Linear Object Filter: All nodes

Node Number	Type	Displacement along coordinate axis, (mm)		
		X	Y	Z
1	Anchor (fixed)	0	0	0
2	Welding Tee	3	-1.1	-0.4
3	Single-direction Guide	6.1	0	0
4	Forged Elbow	2.8	1.6	1.3
6	Forged Elbow	2.3	-2.2	-0.6
8	Forged Elbow	0.7	-4.9	0.3
9	Sliding Support	0.1	-4	0
10	Anchor (fixed)	0	0	0
12	Spring Hanger	3	1.3	1.4

Desplazamientos

Error and warning messages

Type	Node/pipe	Description	Help
Warning	Node:3	(W622) Gap is not considered in the analysis, since it is too small	?
Warning	Node:2	Tee length must be greater than 0	?
Warning	Node:3	(W660) Dummy free end at pipe border may cause analysis inaccuracies if in fact the pipeline continues beyond this point	?
Information	-	(W662) Number of degrees of freedom 13	?

Pipes list Error and warning messages

Для справки нажмите F1

# PASS/Start-Prof | Reportes

- Los reportes muestran las ecuaciones empleadas
- Puede añadir/quitar tensiones desde la fuerza axial
- Activar funciones individuales para cada Código de esfuerzos en la tubería
- Se indica en rojo donde la verificación falla
- También en rojo la verificación de falla de esfuerzos junto con mensajes de advertencia



PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE

Start-Prof Econom 2017 v.04.82 R2 - [Transfer 56-80 ASME B31.3.ctp - Code Stress]

Operating Mode: 1 'Main' (0) | Expansion Range with Mode: 1 'Main' (0) (Cold State) | Show Equations:  | Stress Range from Operation to Cold:  | Creep Stress:

		Stress range, (kgf/sq.cm)		Sustained with creep (Operating State), (kgf/sq.cm)		Sustained with creep (Cold State), (kgf/sq.cm)		Notes			
		Se	Sa	Slcreep	Sh, creep	Slcreep	Sh, creep				
Above ground pipe	1, Console	187.82	187.82	853.30	0	2458.05	187.82	1406.53	1768.51		
	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
Above ground pipe	4, Restrained	494.99	472.22	853.30	14077.98	2150.88	19959.70	1406.53	359.55	1768.51	7,8
	3, Restrained	494.99	472.22	853.30	14077.98	2150.88	19959.70	1406.53	359.55	1768.51	7,8
Forged Elbow	6,0 Flange	1045.3	703.3	853.30	1700.18	1700.18	1045.3	1406.53	1049.41	1768.51	1,2,3,7,8
Above ground pipe	6,0 Flange	703.3	646.32	853.30	1700.18	1700.18	703.3	1406.53	706.01	1768.51	7,8
	24	646.32	646.32	853.30	1700.18	1700.18	646.32	1406.53	648.07	1768.51	
	24	646.32	646.32	853.30	1700.18	1700.18	646.32	1406.53	648.34	1768.51	
Above ground pipe	22	352.52	407	853.30	1700.18	1700.18	352.52	1406.53	648.07	1768.51	
	22	407	407	853.30	1700.18	1700.18	407	1406.53	407.29	1768.51	
	22	407	407	853.30	1700.18	1700.18	407	1406.53	407.29	1768.51	
Concentric Reducer	23	925.35	925.35	853.30	1700.18	1700.18	925.35	1406.53	929.33	1768.51	1,2,7,8
Above ground pipe	23	627.54	627.54	853.30	1700.18	1700.18	627.54	1406.53	929.33	1768.51	1,2,7,8
	5, Bend	1341.7	1341.7	853.30	1700.18	1700.18	1341.7	1406.53	629.84	1768.51	
Forged Elbow	6,0 Flange	1045.3	703.3	853.30	1700.18	1700.18	1045.3	1406.53	1345.04	1768.51	1,2,7,8
Above ground pipe	6,0 Flange	551.38	600.39	853.30	1700.18	1700.18	551.38	1406.53	1049.41	1768.51	1,2,3,7,8
	8	600.39	600.39	853.30	1700.18	1700.18	600.39	1406.53	552.69	1768.51	7,8
	8	1183.7	1183.7	853.30	1700.18	1700.18	1183.7	1406.53	614.07	1768.51	7,8
Above ground pipe	8	473.99	473.99	853.30	1700.18	1700.18	473.99	1406.53	1208.19	1768.51	1,2,3,7,8
	25	432.12	432.12	853.30	1700.18	1700.18	432.12	1406.53	484.39	1768.51	
	25	700.37	700.37	853.30	1700.18	1700.18	700.37	1406.53	440.75	1768.51	7,8
Non-standard bend	25	700.37	700.37	853.30	1700.18	1700.18	700.37	1406.53	709.99	1768.51	3,7,8
Above ground pipe	25	480.45	480.45	853.30	1700.18	1700.18	480.45	1406.53	484.70	1768.51	7,8

**Equations (from tooltip):**  
 Pressure, 16 kgf/sq.cm  
 Pipe Diameter(Do), 219 mm  
 Thickness(t), 6 mm  
 (=Section=1)  
 Mo=76213.855 kgf-cm, Mi=8016.8195 kgf-cm, Mt=-8826.0137 kgf-cm  
 Bending moment (Mb=((ii\*Mi)^2+(io\*Mo)^2)^0.5), 163194.94 kgf-cm  
 Axial force (F), 5545.37 kgf  
 Area (A), 3525 sq.mm  
 Flexibility (h), 0.161  
 Flexibility Factor (k), 9.698  
 SIF: io= 2.370, ii= 2.844, it= 1.000  
 Moment of resistance (Z), 183986.244 cub.mm  
 Pressure thrust stress (Sp=P\*(Do-2t)^2/(Do^2-(Do-2t)^2)), 134.11 kgf/sq.cm  
 Bending stress (Sb=0.75\*i\*Mb/Z), 887 kgf/sq.cm  
 Axial stress (Sa=F/A), 157.30 kgf/sq.cm  
 Torsion shear stress (St=0.75\*i\*Mt/2Z), -23.99 kgf/sq.cm  
 SL=((|Sa|+Sb)^2+(2\*St)^2)^0.5, 1045.39 kgf/sq.cm  
 (=Section=2)  
 Mo=-59239.135 kgf-cm, Mi=-6849.8239 kgf-cm, Mt=-47309.447 kgf-cm  
 Bending moment (Mb=((ii\*Mi)^2+(io\*Mo)^2)^0.5), 126948.11 kgf-cm  
 Axial force (F), 5507.32 kgf  
 Bending stress (Sb=0.75\*i\*Mb/Z), 689.99 kgf/sq.cm  
 Axial stress (Sa=F/A), 156.22 kgf/sq.cm  
 Torsion shear stress (St=0.75\*i\*Mt/2Z), -128.57 kgf/sq.cm  
 SL=((|Sa|+Sb)^2+(2\*St)^2)^0.5, 884.41 kgf/sq.cm  
 (=Section=3)  
 Mo=-7213.3392 kgf-cm, Mi=3519.9247 kgf-cm, Mt=74859.697 kgf-cm  
 Bending moment (Mb=((ii\*Mi)^2+(io\*Mo)^2)^0.5), 16610.29 kgf-cm  
 Axial force (F), 5397.37 kgf  
 Bending stress (Sb=0.75\*i\*Mb/Z), 90.28 kgf/sq.cm  
 Axial stress (Sa=F/A), 153.10 kgf/sq.cm  
 Torsion shear stress (St=0.75\*i\*Mt/2Z), 203.44 kgf/sq.cm  
 SL=((|Sa|+Sb)^2+(2\*St)^2)^0.5, 474.11 kgf/sq.cm

**Error and warning messages:**

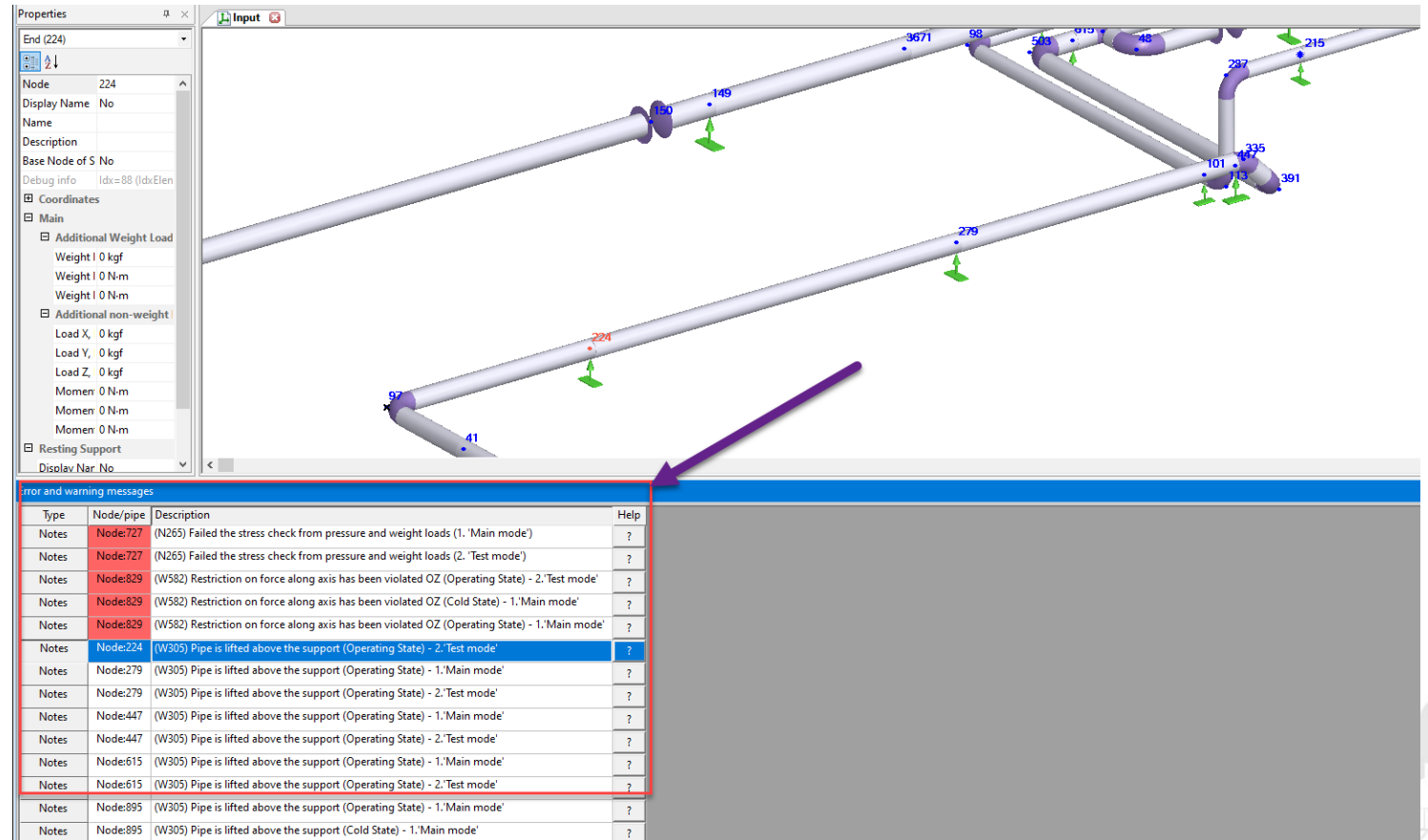
Type	Node/pipe	Description
Notes	Node:8	(N265) Failed the st
Notes	Node:8	(N265) Failed the st
Notes	Node:8	(N284) Failed the fa
Notes	Node:8	(N284) Failed the fa
Notes	Node:8	(N268) Failed the st
Notes	Node:8	(N268) Failed the st

Для справки нажмите F1

# PASS/Start-Prof | Reportes

PASS/START-PROF tiene un inteligente verificador de fallas.

Se muestran advertencias tal como levantamiento del soporte, cargas del soporte mayores que el permisible, deformación mayor que el límite de la junta de expansión, falla del análisis por deformación, falla en la fuga de bridas, el rango mayor al 25% del resorte colgante variable, carga del resorte en un caso de carga mayor al permisible, límite excedido por giro de varilla y muchos otros.



The screenshot displays the PASS/Start-Prof software interface. On the left, a 'Properties' window shows details for 'End (224)', including 'Node 224', 'Display Name No', 'Name', 'Description', 'Base Node of S No', 'Debug info Idx=88 (IdxElen)', 'Coordinates', 'Main' (Additional Weight Load, Additional non-weight), and 'Resting Support'. The main window shows a 3D model of a piping system with various nodes and supports. A purple arrow points from the 'Error and warning messages' table to the 'Node:224' entry in the table.

Type	Node/pipe	Description	Help
Notes	Node:727	(N265) Failed the stress check from pressure and weight loads (1. 'Main mode')	?
Notes	Node:727	(N265) Failed the stress check from pressure and weight loads (2. 'Test mode')	?
Notes	Node:829	(W582) Restriction on force along axis has been violated OZ (Operating State) - 2. 'Test mode'	?
Notes	Node:829	(W582) Restriction on force along axis has been violated OZ (Cold State) - 1. 'Main mode'	?
Notes	Node:829	(W582) Restriction on force along axis has been violated OZ (Operating State) - 1. 'Main mode'	?
Notes	Node:224	(W305) Pipe is lifted above the support (Operating State) - 2. 'Test mode'	?
Notes	Node:279	(W305) Pipe is lifted above the support (Operating State) - 1. 'Main mode'	?
Notes	Node:279	(W305) Pipe is lifted above the support (Operating State) - 2. 'Test mode'	?
Notes	Node:447	(W305) Pipe is lifted above the support (Operating State) - 1. 'Main mode'	?
Notes	Node:447	(W305) Pipe is lifted above the support (Operating State) - 2. 'Test mode'	?
Notes	Node:615	(W305) Pipe is lifted above the support (Operating State) - 1. 'Main mode'	?
Notes	Node:615	(W305) Pipe is lifted above the support (Operating State) - 2. 'Test mode'	?
Notes	Node:895	(W305) Pipe is lifted above the support (Operating State) - 1. 'Main mode'	?
Notes	Node:895	(W305) Pipe is lifted above the support (Cold State) - 1. 'Main mode'	?



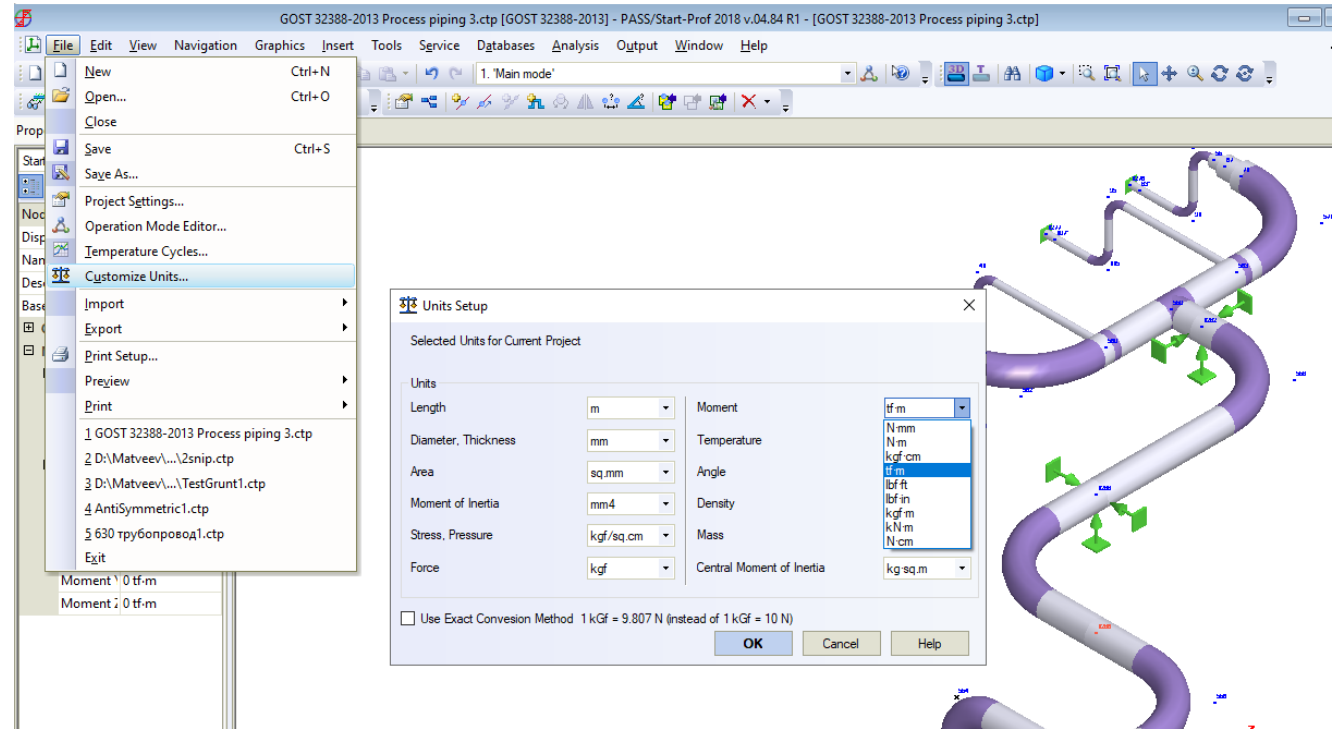
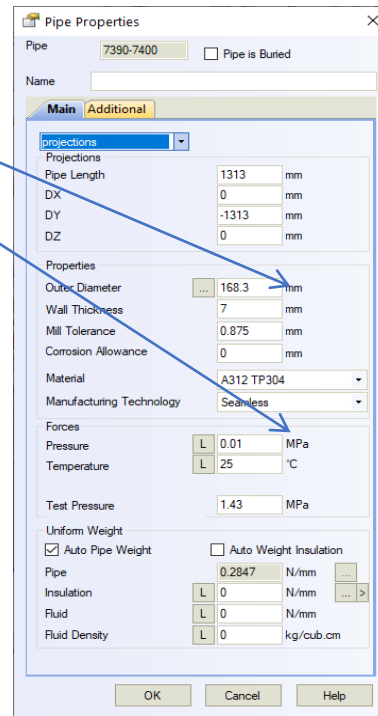
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# PASS/Start-Prof | Características

Puede cambiar las unidades en cualquier momento, incluso si ya corrió el análisis.

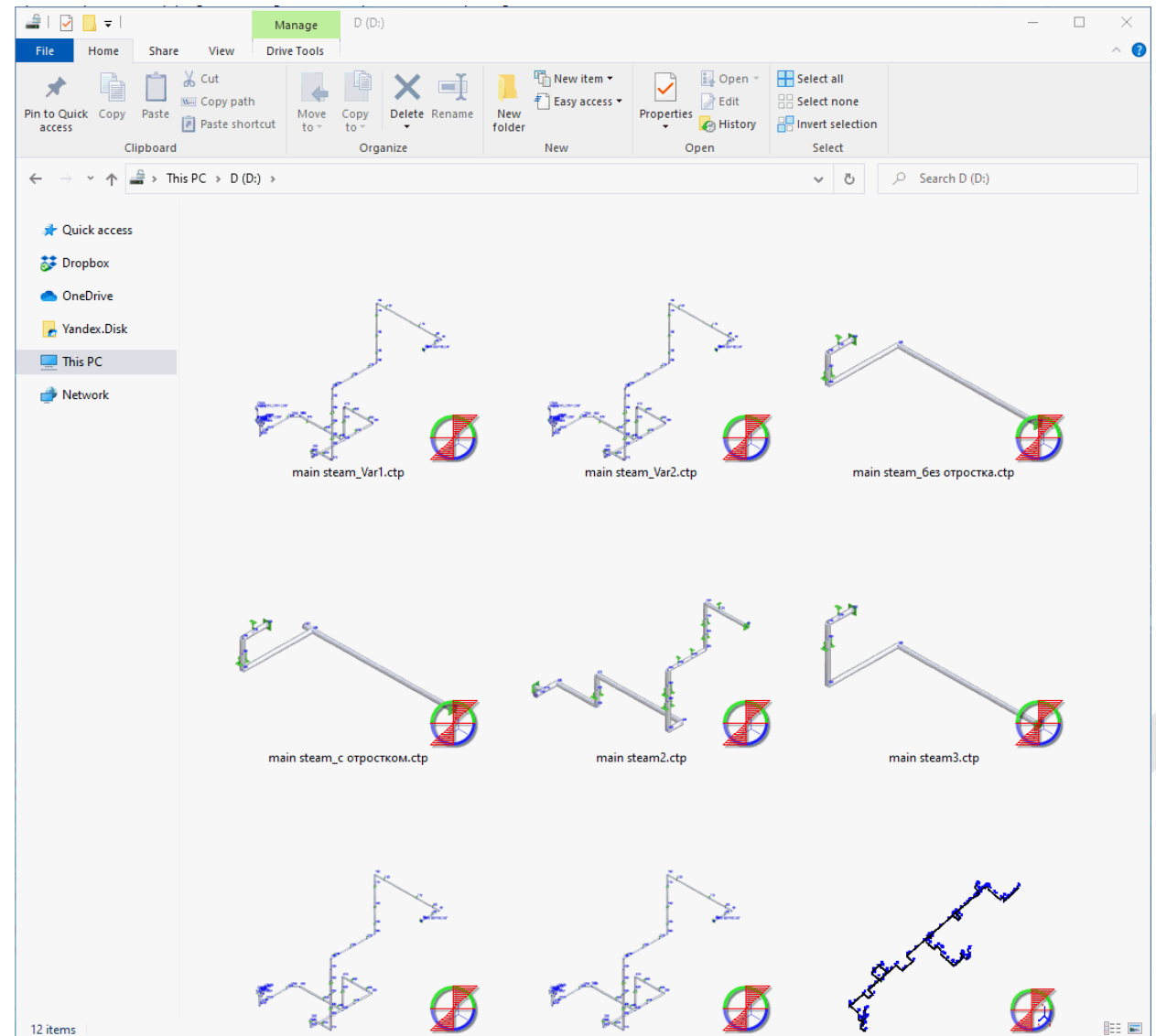
Se muestran siempre las unidades para cada valor.



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# PASS/Start-Prof | Características

- Cada Proyecto se guarda en un solo archivo
- Capacidad de ver en miniaturas el modelo dentro del Explorador de Windows. Ahora se pueden ver todos los modelos antes de abrir el archivo.
- Abre rápidamente archivos grandes
- Alta velocidad para el análisis de esfuerzos en modelos realmente grandes



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# PASS/Start-Prof | Confiabilidad

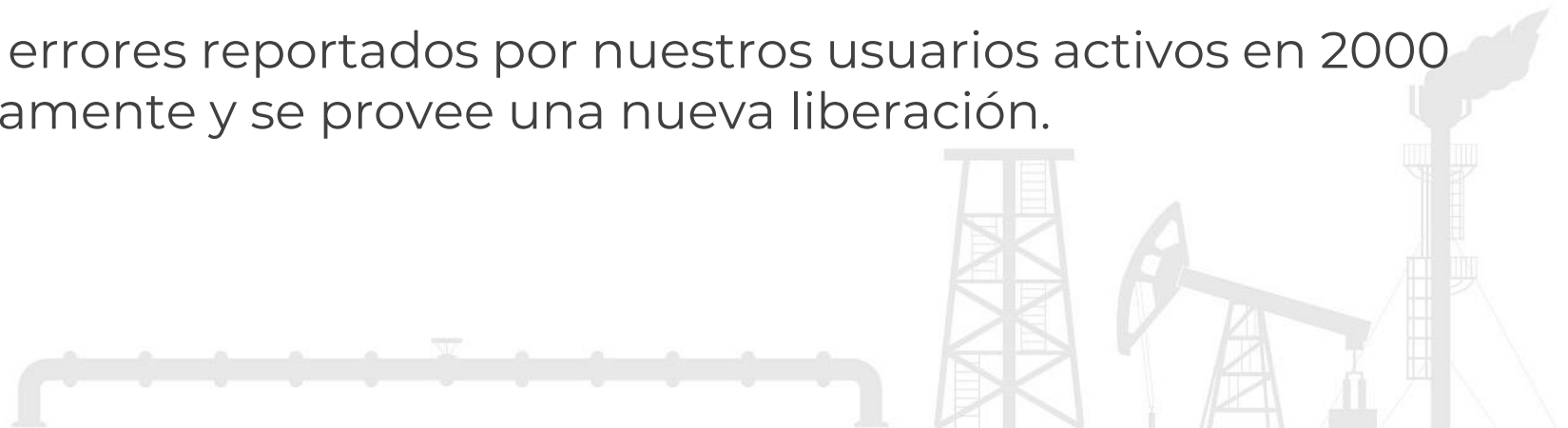
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Cada nueva versión de PASS/START-PROF es:

- Verificada automáticamente en más de 300 ejemplos con versiones previas (Sistema de aseguramiento de Calidad)
- Verificada manualmente por un grupo de expertos en análisis de esfuerzos en la tubería (testers)
- Cada versión pasa por 1 a 3 entrenamientos de análisis de esfuerzos en la tubería con 10 a 20 estudiantes antes de su liberación oficial.
- Tras la liberación, todos los errores reportados por nuestros usuarios activos en 2000 empresas se reparan rápidamente y se provee una nueva liberación.



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# PASS/Start-Prof | Licenciamiento

## Configuraciones / Opciones de Precios

<p><b>PASS/Start-Prof Complete Advanced</b></p> <p>Simulation and sizing for any piping network considering all applicable national codes.</p> <p><b>PASS/Start-Prof Complete Standard</b></p> <p>configuration includes only worldwide popular standarts.</p>	<p><b>PASS/Start-Prof Process Advanced</b></p> <p>Simulation and sizing for piping networks based on applicable national codes for process plants as well as for gas and oil transportation systems.</p> <p><b>PASS/Start-Prof Process Standard</b></p> <p>configuration includes only worldwide popular standarts.</p>	<p><b>PASS/Start-Prof Power Advanced</b></p> <p>Simulation and sizing for any piping networks based on applicable national codes for power generation piping as well as for central heating networks.</p> <p><b>PASS/Start-Prof Power Standard</b></p> <p>configuration includes only worldwide popular standarts.</p>	<p><b>PASS/START-PROF HDPE+FRP</b></p> <p>Piping stress analysis of high density polyethylene and/or fiberglass reinforced plastic piping systems.</p>
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- Licencia perpetua(¡Un año de mantenimiento incluido gratis!)
- Renuevo de mantenimiento. 1 año 25%
- Renta anual 40%
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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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# PASS/Start-Prof | Recursos

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- Twitter [twitter.com/passuitecom](http://twitter.com/passuitecom)
- Más de 50 artículos acerca de análisis de esfuerzos en la tubería y funciones en PASS/START-PROF <https://whatispiping.com/category/start-prof>



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# PASS/Start-Prof | Recursos

Suscríbese al canal de YouTube, encontrará muchos vídeos de entrenamiento en PASS/START-PROF

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



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The screenshot displays the YouTube channel page for PASS, which has 716 subscribers. The page is organized into a grid of video uploads. The top navigation bar includes links for HOME, VIDEOS, PLAYLISTS, CHANNELS, DISCUSSION, and ABOUT. Below the navigation, there are tabs for 'Uploads' and 'PLAY ALL', along with a 'SORT BY' dropdown menu. The video grid contains 24 thumbnails, each with a title, a duration, and view/viewer information. The videos cover a wide range of topics, including software overviews, tutorials for importing models from other software like CADWorx and Revit, and specific case studies such as the analysis of piping for the 2022 Winter Olympics and the Beijing Universal Amusement Park. The thumbnails show various 3D piping models, stress analysis plots, and software interface screenshots.

Video Title	Duration	Views	Time Ago
PASS/EQUIP Overview Webinar: Comprehensive...	49:33	124	4 days ago
PASS/START-PROF Overview Webinar: Your software for...	1:10:05	334	2 months ago
PASS/EQUIP Nozzle-FEM Overview Webinar. Powerful...	25:50	135	2 months ago
How to Import piping model from CADWorx to START-...	3:14	193	2 months ago
Pipe Stress Analysis Software How to Import Piping Model from CADWorx to START-PROF Method 1: Using PCF file	1:58	119	2 months ago
PASS/HYDROSYSTEM Overview Webinar: Comprehensive Solution for Piping Hydraulic & Thermal Analysis	1:14:54	239	3 months ago
PASS/START-PROF was used for 2022 Winter Olympic...	0:50	162	4 months ago
Beijing Universal Amusement Park Buried Hot Water Pipin...	2:00	261	4 months ago
PASS/START-PROF Overview Webinar: Your software for...	9:35	196	5 months ago
New START-PROF option: Import from Autodesk Revit	1:53	370	6 months ago
18 How to calculate the 'slurry' flow in Hydrosystem	1:42	111	9 months ago
17 How to calculate the gas liquid flow in...	3:48	134	9 months ago
How to import PCF file to START PROF	2:23	365	1 year ago
How to run PASS/START PROF Trial	6:25	1.3K	1 year ago
Pipe Stress Analysis From Water Hammer Loads	10:36	2.2K	1 year ago
Creating a Simple Piping Model Tutorial in START-...	10:30	1K	1 year ago
CAESAR II Convergence Issue (2019 training) Piping...	3:47	5K	1 year ago
Big Piping Model Analysis Tutorial with PASS/START-...	2:27	1.4K	1 year ago
GRP / GRE / FRP Piping Stress Analysis Tutorial usi...	8:27		
Plastic Piping Stress Analysis HDPE, PP, PB, PVDF, PVC With PASS/START-PROF Software Part 2. Method of Analysis	4:07		
HDPE Piping Stress Analysis Tutorial With PASS/START-...	13:06		
HDPE Piping Stress Analysis With PASS/START-PROF...	3:25		
Two-way integration between PASS/Start-Prof Pipe Stress...	2:30		
16 Interface between Hydrosystem and START-...	26:21		
Buried Piping/Pipelines Stress Analysis with...			

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Thank YOU!