Stress Analysis of GRP / GRE / FRP Piping using START-PROF

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Table of Contents

GRP / GRE / FRP / HDPE piping modeling in START-PROF is as easy as for steel piping. Your job is only to select the appropriate code and choose the material. That's all!

Difference between GRE/GRP/FRP and Steel

The main differences of GRP / GRE / FRP piping to steel piping is:

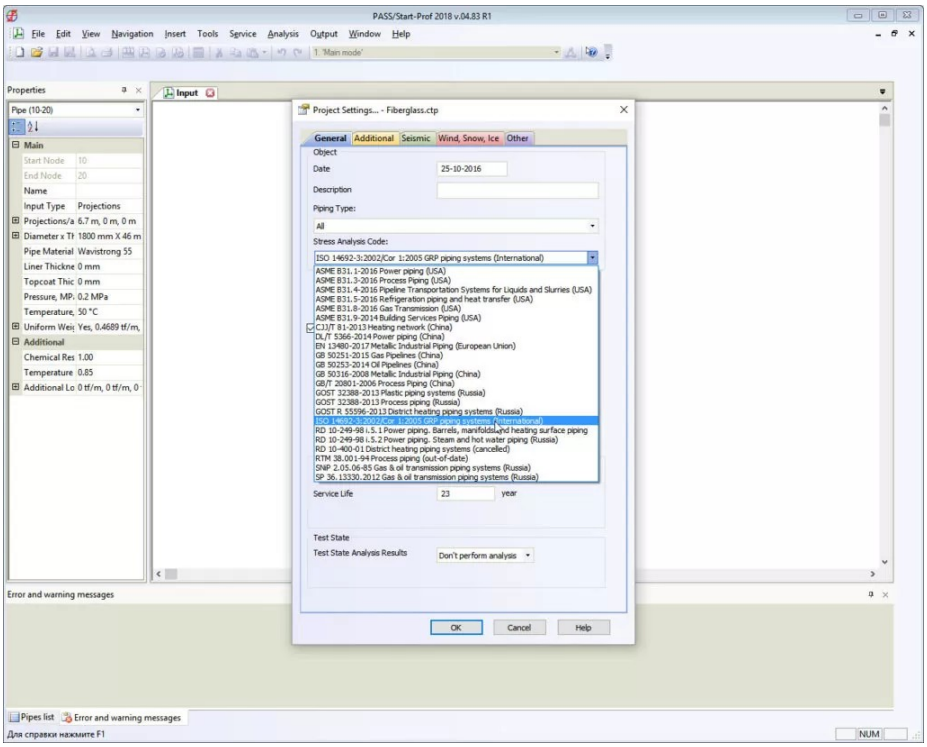
The material is orthotropic. The stress values in axial as well as hoop direction need to be considered during analysis. Mechanical properties needed for analysis differ from steel piping: Ea – Elasticity modulus in the axial direction, Eh – Elasticity modulus in hoop direction, G – Shear modulus, vh/a – Poisson ratio hoop/axial, va/h – Poisson ratio axial/hoop. Material properties are different for each vendor, so please ask manufacturer for values needed for stress analysis in the database.

Linear expansion for GRP / GRE / FRP piping is much greater than for steel piping. Pressure elongation is significant (Bourdon effect), and thermal expansion is also great. Due to uneven heating of pipe wall thickness, the real thermal expansion is lower than thermal expansion for the full temperature range. To consider this piping behavior thermal expansion is multiplied by temperature range factor that is usually considered as 0.85.

Long-term failure envelope is used instead of single allowable stress. See the material database for more details. Allowable stresses depend on load type factor f2, temperature factor A1, chemical resistance factor A2, fatigue factor A3. A different envelope is used for pipes and fittings.

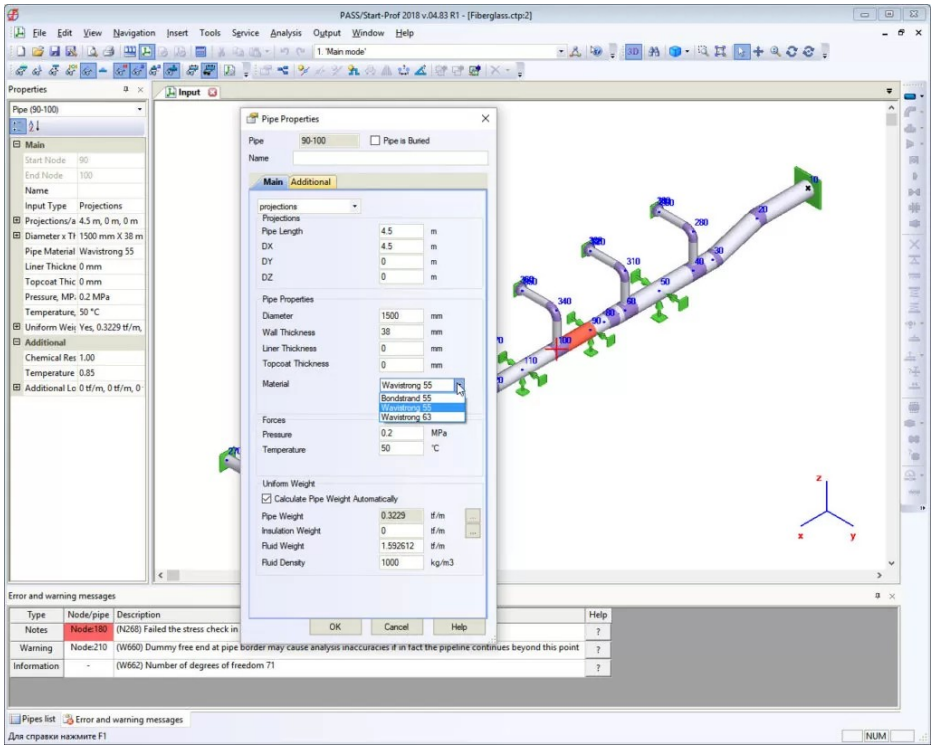
Modeling of GRP / GRE / FRP / Reinforced HDPE Piping using PASS/Start-Prof

To model GRP / GRE / FRP piping choose **ISO 14692 code**. This code is also suitable for modeling of reinforced HDPE or other plastic piping:



Selecting the piping code for Analysis

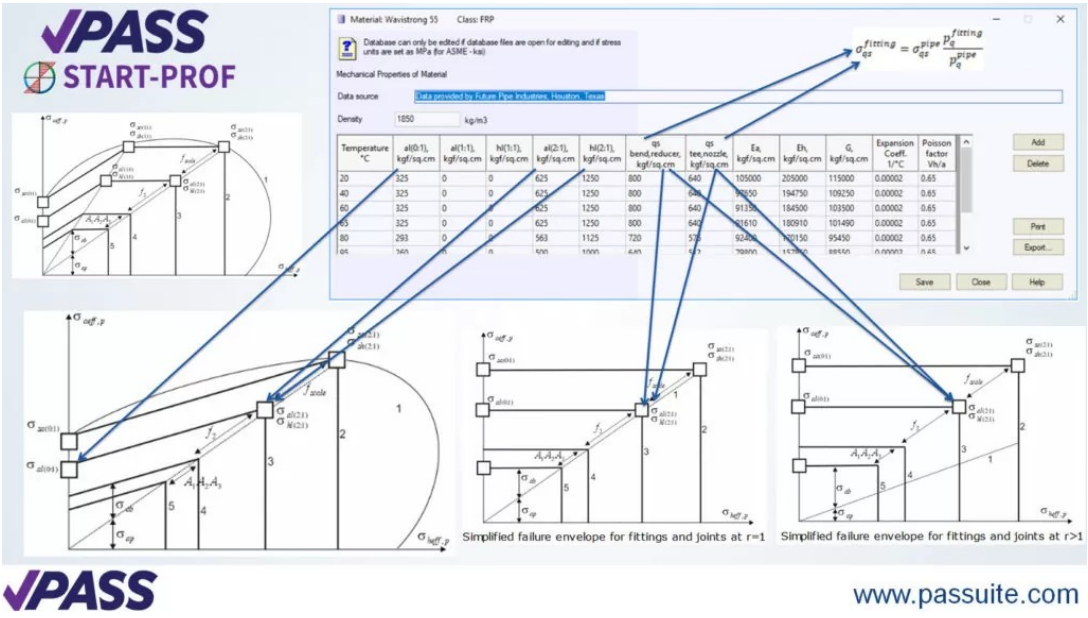
Then select material from the database:



Selecting the Material Database

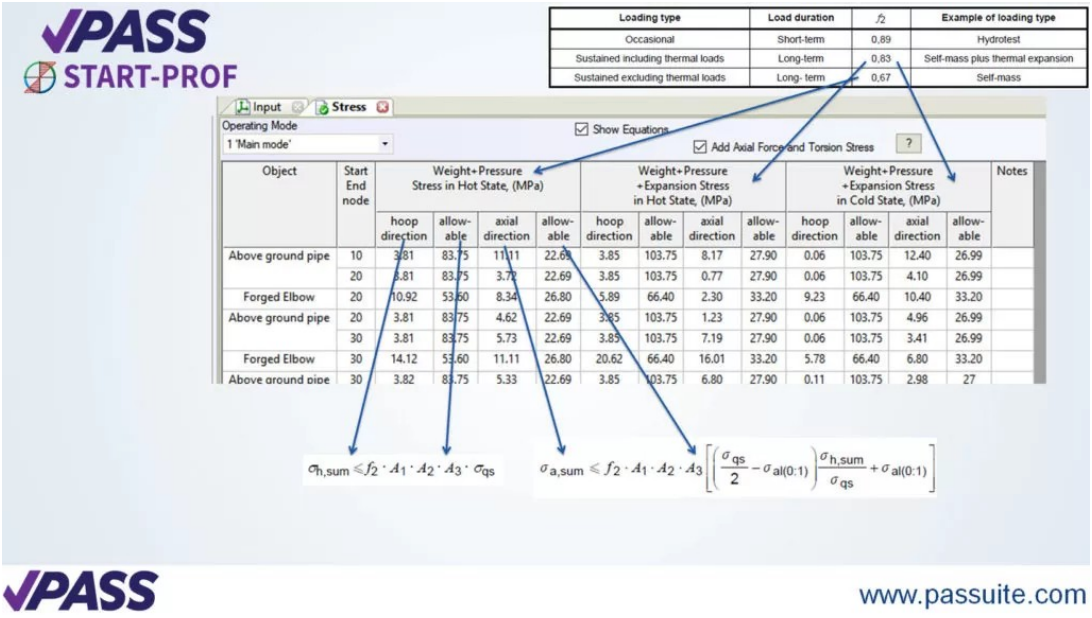
That’s all. All other job is the same as for steel piping.

The material Database contains all material properties. If there’s no material you need in the database, please ask your vendor to fill the table and add it to the database manually. Future pipe industries and NOV already provided needed data and it is included in the START-PROF database.



Sample Failure Envelope for GRE/GRP/FRP

All load cases for the ISO 14692 code will be created automatically. Just draw piping. After analysis, you get results according to ISO 14692 code.



Output Results after Analysis

Also, we did a job for the vendor of MRPP pipes to add material properties into the START-PROF database for 50-year service life and now START-PROF used for stress analysis of MRPP piping.

MRPP – a HDPE pipe, reinforced by a rigid steel carcass made of a welded wire.

MRPP Pipes

Stress Analysis Methodology

The complete video explaining the stress analysis methodology using Start/Prof is given below for your quick reference.

https://youtu.be/KftZl5rmcHc

Download the FRP piping example file. See how to open the piping model file.

Alex Matveev

Alex Matveev is one of the authors of pipe stress analysis codes GOST 32388-2013 Process Piping, and GOST 55596-2013 District Heating Networks. He is also one of the developers of PASS/Start-Prof software, which is developed since 1965 and used in 95% of process, power, district heating, gas and oil transportation design companies in Russia and CIS countries; it is a standard de facto in that region