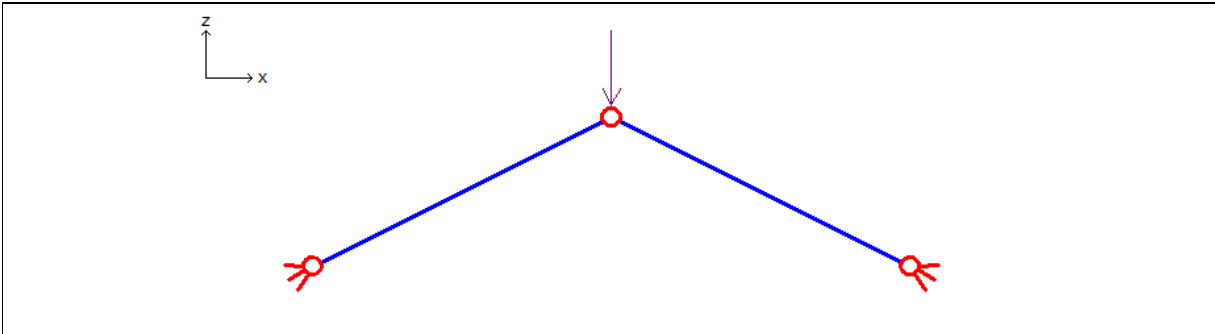


Validation of Sargon Nonlinear solver (CURAN, version 9.60)

TEST TR025

VALIDATION, RELIABILITY, BENCHMARK

Marco Croci Rev.2-06/12/2010

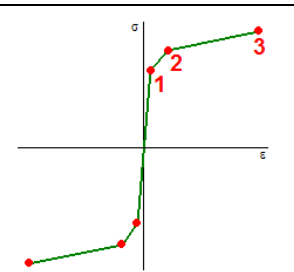


Test description

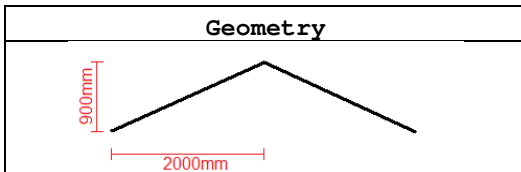
Constitutive law of trusses material: trilinear elastic-plastic law. This case is similar to test 012, but here the third branch is reached (σ_2 is exceeded).

Test model: **curanTR_025.WSR**

Material properties

Name	S235TR	
ν	0,3	
ϵ_1	0,001119	
σ_1	235N/mm ²	
ϵ_2	0,004	
σ_2	300N/mm ²	
ϵ_3	0,02	
σ_3	360N/mm ²	

Cross-section: circular section, diameter=40mm (area=1256,64mm²)



Force (z direction)	
Load case 1	F = -360000N

CHECK

In linear elastic case (target model) displacement and normal stress in trusses are the following: $d_L = -8,883\text{mm}$ and $N/A = -349,05\text{N/mm}^2$. In nonlinear model with trilinear constitutive law, normal stress should be the same and displacement should be $d_T = d_L * [\sigma_1/E + (\sigma_2 - \sigma_1)/E_{T,1} + (\sigma_{max} - \sigma_2)/E_{T,2}] / (\sigma_{max}/E) = -91,29\text{mm}$, where σ_{max} is equal to $|-349,1\text{N/mm}^2|$, $E_{T,1}$ is second branch slope and $E_{T,2}$ is third branch slope.

Load case	Value	Unit	CURAN	THEORETICAL	% diff.
1	Truss #1 normal stress	N/mm ²	-3,491E+02	-3,491E+02	0,00
1	Node #8 displacement (z)	mm	-9,129E+01	-9,129E+01	0,00

% difference = (CURAN - THEORETICAL) / THEORETICAL * 100
 Precision of limit multiplier for the analysis: 0.005