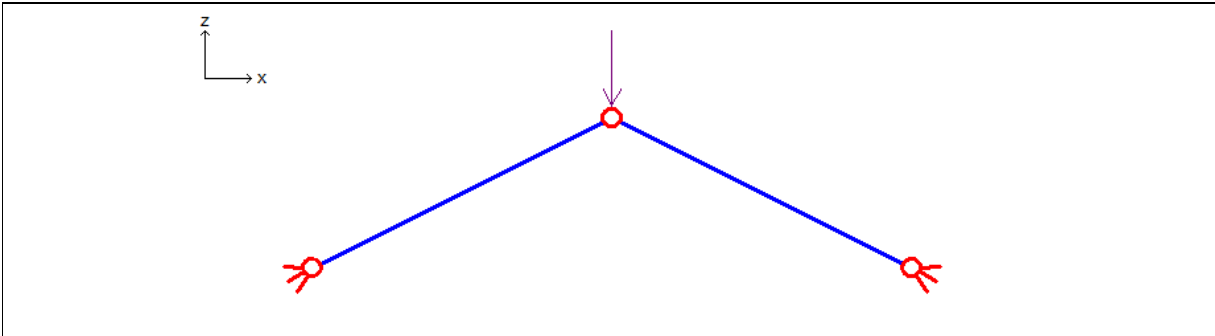


Validation of Sargon Nonlinear solver (CURAN, version 9.60)

TEST TR012

VALIDATION, RELIABILITY, BENCHMARK

Marco Croci Rev.2-03/12/2010

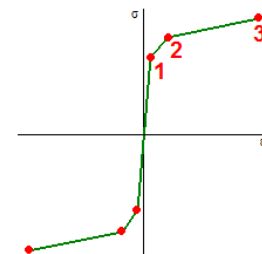


Test description

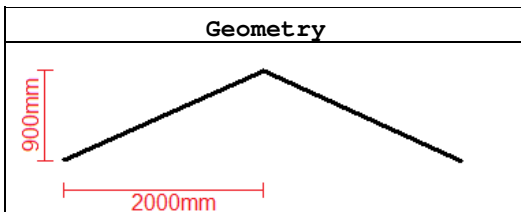
Constitutive law of trusses material: trilinear; the second branch is reached

Test model: **curanTR_012.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 = -300000N
Load case 2	F = +300000N
Load path: not active	

CROSS CHECK

f_y should be equal to 290,9Nmm² (see test 001, linear elastic case, with a displacement equal to 0,7403mm), so we reach the second branch. Here, displacement reached at the end of the first branch is $d_1=0,740\text{mm}/290,9\text{mm}^2*235\text{mm}^2=0,598\text{mm}$
 For the second branch we have the following partial displacement:
 $d_2=0,7403*(290,9/\sigma_1-1)/(290,9/\sigma_1)*(\sigma_1/\epsilon_1)/[(\sigma_2-\sigma_1)/(\epsilon_2-\epsilon_1)]=13,24\text{mm}$
 Total displacement is equal to $d_1+d_2=19,22\text{mm}$

Load case	Value	Unit	CURAN	THEORETICAL	% diff.
1	Truss #1 normal stress	N/mm ²	-2,909E+02	-2,909E+02	0,00
1	Node #8 displacement (z)	mm	-1,922E+01	-1,922E+01	0,00
2	Truss #1 normal stress	N/mm ²	2,909E+02	2,909E+02	0,00
2	Node #8 displacement (z)	mm	1,922E+01	1,922E+01	0,00

% difference = (CURAN - THEORETICAL) / THEORETICAL * 100

Precision of limit multiplier for the analysis: 0.005