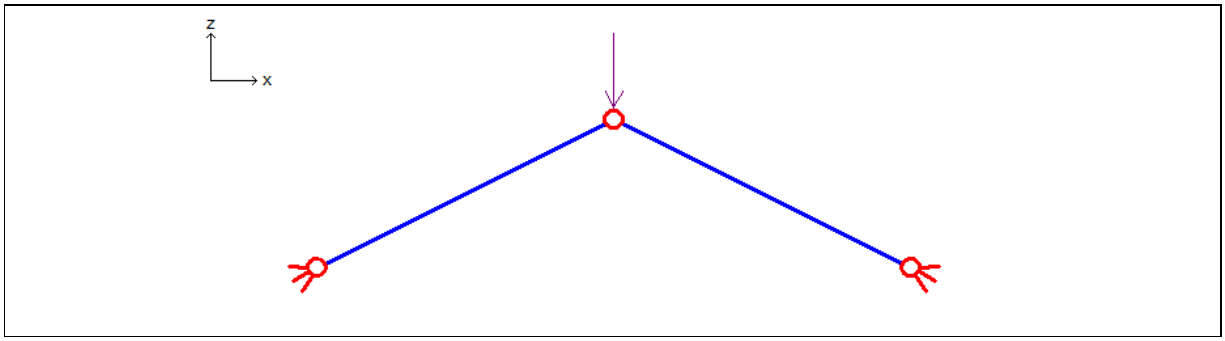
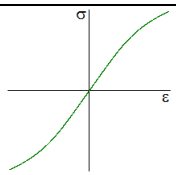
Validation of Sargon Nonlinear solver (CURAN, version 9.60)			
TEST TR009	**VALIDATION, RELIABILITY, BENCHMARK**	**Marco Croci**	**Rev.2-03/12/2010**

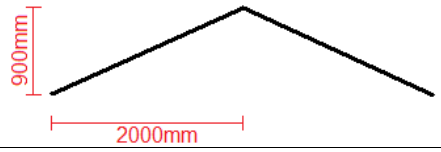


Test description
Constitutive law of trusses material: elastic defined by Ramberg-Osgood equation
In comparison to a linear elastic analysis, internal axial forces in trusses should be the same, and the displacements ratio should be equal to the ratio between ε_L and $\varepsilon_{R.O.}$ (linear deformation and Ramberg-Osgood deformation)
Test model: **curanTR_009.WSR**

Material properties		
Name	S235RO	 $\varepsilon_{R.O.} = \frac{\sigma}{E} + \left(\frac{\sigma}{K}\right)^{1/n}$
E	210000N/mm^2	
ν	0,3	
K	2000N/mm^2	
n	0,2	

Cross-section: circular section, diameter=40mm (area=1256,64mm^2)

Geometry



Force (z direction)	
Load case 1	F = -240000N
Load case 2	F = +240000N
Load path: not active	

CHECK

In a linear elastic analysis, axial force is equal to 2,924e5N and the vertical displacement s_L of central node is equal to 5,922mm (see tests from 004 to 006). Axial force with Ramberg-Osgood equation should be the same, and vertical displacement is given by: $s_{R.O.}=s_L*\varepsilon_{R.O.}/\varepsilon_L=s_L*\{1+[(\sigma/K)^{(1/n)}]/(\sigma/E)\}=6,036$mm.

Load case	Value	Unit	CURAN	THEORETICAL	% diff.
1	Truss #1 axial force	N	-2,924E+05	-2,924E+05	0,00
1	Node #8 displacement (z)	mm	-6,036E+00	-6,036E+00	0,00
2	Truss #1 axial force	N	2,924E+05	2,924E+05	0,00
2	Node #8 displacement (z)	mm	6,036E+00	6,036E+00	0,00

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

Precision of limit multiplier for the analysis: 0.005