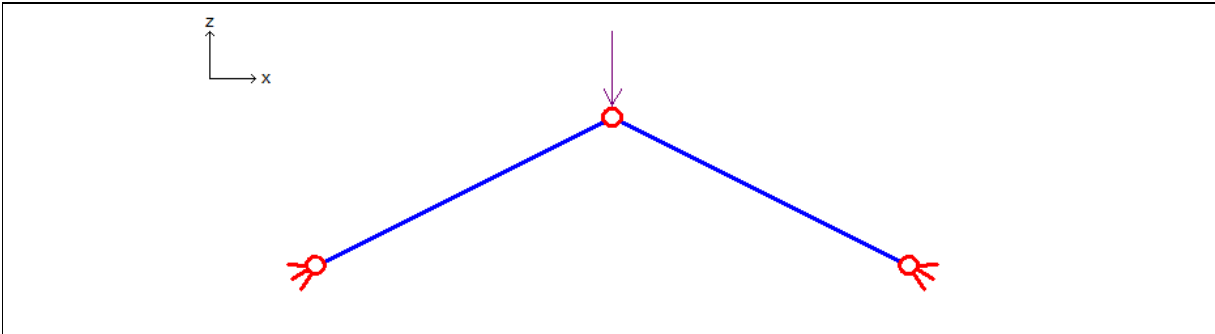


**Validation of Sargon Nonlinear solver (CURAN, version 9.60)**

**TEST TR007**

VALIDATION, RELIABILITY, BENCHMARK

Marco Croci Rev.2-03/12/2010



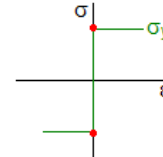
**Test description**

Constitutive law of trusses material: rigid-perfectly plastic  
if  $\sigma_y$  is reached, structure collapses.

Test model: **curanTR\_007.WSR**

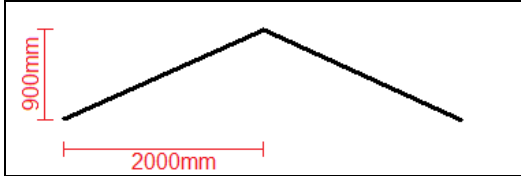
**Material properties**

Name	S235RP
$\sigma_y$	235N/mm <sup>2</sup>



**Cross-section:** circular section, diameter=40mm (area: A=1256,64mm<sup>2</sup>)

**Geometry**



**Force (z direction)**

Load case 1	$F_1 = -240000N$
Load case 2	$F_2 = -300000N$
Load path: not active	

**CHECK**

In load case 1, axial force should be 2,924e5N, as in a linear elastic case (see tests 004-006) and displacements should be null.

In load case 2,  $\sigma_y$  is exceeded: normal stress should be equal to  $\sigma_y$  and solution should stop at a load level causing  $\sigma_y$ . This load level is equal to the ratio between the force causing exactly  $\sigma_y$  ( $F_{\sigma_y}$ ) and currently applied force ( $F_2$ ).

Normal stress in load case 1 is  $\sigma_1 = 2,924e5N/A = 2,924e5N/1256,64mm^2 = 232,7N/mm^2$   
 $F_{\sigma_y} = F_1 * \sigma_y / \sigma_1 = -240000N * 235N/mm^2 / 232,7N/mm^2 = 242372,15N$ . Load level =  $|F_{\sigma_y} / F_2| = 0,8079$

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	-1,244E-06	0,000E+00	~0,00
2	Failure load level	/	8,067E-01	8,079E-01	-0,15
2	Truss #1 normal stress	N	-2,347E+02	-2,350E+02	-0,13

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

Precision of limit multiplier for the analysis: 0.001