

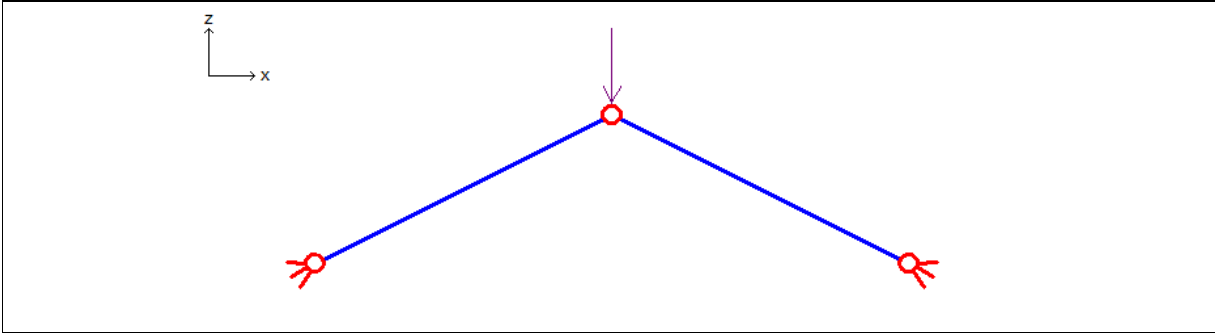
**Validation of Sargon Nonlinear solver (CURAN, version 9.60)**

**TEST TR024**

**VALIDATION, RELIABILITY, BENCHMARK**

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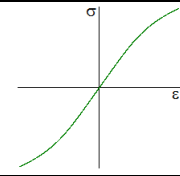


**Test description**

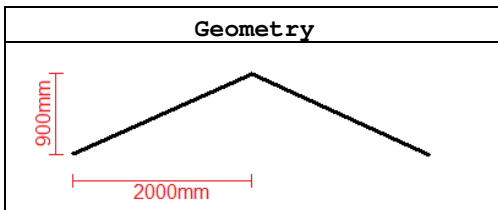
Constitutive law of trusses material: elastic defined by Ramberg-Osgood equation  
 This case is similar to test 013, but here load path includes 4 load cases.  
 Sum of  $F_1$ ,  $F_2$ ,  $F_3$  and  $F_4$  is equal to 0 and constitutive law is elastic and symmetrical: final condition after load case 4 should be with null deformations/displacements and null internal forces.

Test model: **curanTR\_024.WSR**

**Material properties**

Name	S235RO	 $\epsilon_{R.O.} = \frac{\sigma}{E} + \left(\frac{\sigma}{K}\right)^{1/n}$
E	210000N/mm <sup>2</sup>	
v	0,3	
K	2000N/mm <sup>2</sup>	
n	0,2	

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



**Force (z direction)**

Load case 1	$F_1 = -200000N$
Load case 2	$F_2 = +1000000N$
Load case 3	$F_3 = -300000N$
Load case 4	$F_4 = -500000N$
Load path: active ( $F_1+F_2+F_3+F_4=0$ )	

**CHECK**

Load case	Value	Unit	CURAN	THEORETICAL	% diff.
4	Truss #1 axial force	N	-2,003E-10	0,000E+00	~0,00
4	Node #8 displacement (z)	mm	-1,243E-14	0,000E+00	~0,00

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

Precision of limit multiplier for the analysis: 0.005