SSNP122 - Tension. Model of Rousselier in versions local and nonlocal

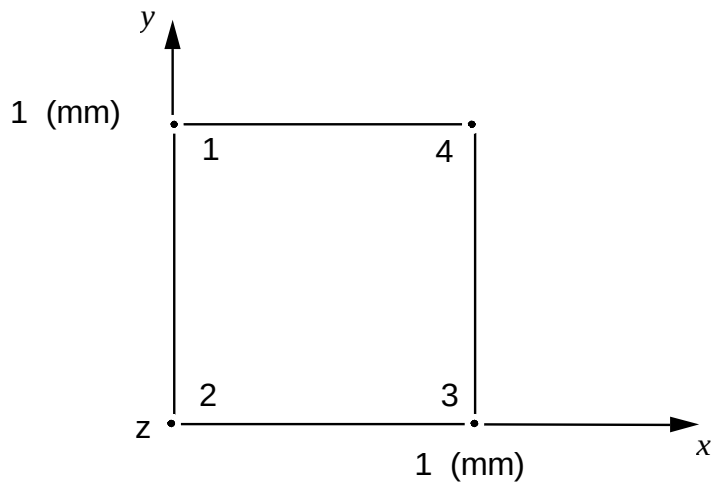
Abstract:

This quasi-static test consists in applying to a bar a loading of tension. One uses two versions of the model of Rousselier with the kinematics of the large deformations of Simo and Miehe: the local version and the nonlocal version (models with gradient of local variables). For a traction test, the terms in gradient are not activated: one thus finds the results of the local version, at least as long as the solution of the local version remains homogeneous (not localization).
The bar is modelled by a quadrangular element (QUAD8) in plane strain.

The got results are results of non regression. The two models give identical results as long as the solution of the local version does not locate. The solution of the model with gradient remains homogeneous throughout the way of loading.

1 Problem of reference

1.1 Geometry

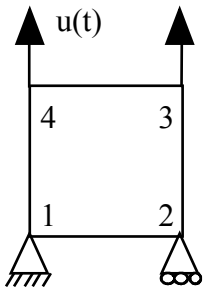


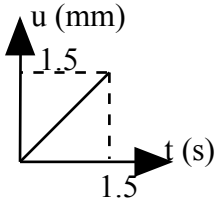
1.2 Properties of the isotropic

material Elasticity	Young Modulus: $E=200000\,MPa$	
	Poisson's ratio: $\nu=0.3$	
Coefficients of the model of Rousselier	initial Porosity: $f_0=0.01$	
	$D=2$	
	$\sigma_1=500\,MPa$	
Rational curve of tension	Logarithmic strain	rational Stress (MPa)
	0.0	0.0
	0.002	400.0
	1.002	2400.0
Models not characteristic	room Length: $0.1\,mm$	

1.3 Boundary conditions and loadings

the bar, blocked in the direction Oy on the face $[1,2]$, is subjected to a displacement $u(t)$ on the face $[3,4]$.





1.4 Forced

initial conditions and null strains with $t=0$.

2 Results of reference

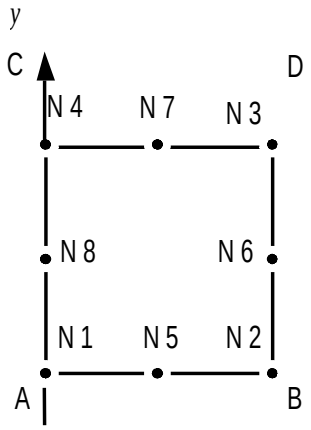
We do not have reference solution.

- As long as the solution of the local model remains homogeneous Gauss points for the different ones, i.e. for $t=0.93\text{s}$, one will take as reference solution the results got with *Code_Aster* for this model. For the results of the model with gradient, one must find exactly the results got with the local version. A this time, one will thus test, for the two models, the stress of Cauchy σ_{yy} in the direction y, the stress of Cauchy σ_{zz} in the direction z, the cumulated plastic strain p and porosity f, calculated at the Gauss point n°1 of the mesh [1,2,3,4].
- For the model with gradient, the response must remain homogeneous in Gauss points throughout the way of loading. To test this result, one will adopt like reference solution, the stress of Cauchy σ_{yy} in the direction there with Gauss points the n°1, 2,3 and 4 of the mesh [1,2,3,4] and with final moment.

3 Modelization A

3.1 Characteristic of the modelization

Modelization $2D$ **:** 1 quadrangle QUAD8



the imposed loading is the following:

- the nodes $N1$, $N5$ and $N2$ are blocked according to the direction y ,
- the node $N1$ is blocked according to the direction x ,
- the nodes $N4$, $N7$ and $N3$ undergo a displacement of 1.5mm in 1.5s distributed according to 50 increments.

3.2 Quantities tested and results

the values are calculated at the Gauss point.

At the time of computation $t=0.93\,s$, one finds for the two models:
For the model of Rousselier in local version:

Identification	Reference	*Aster*	% difference
To the Gauss point n° 1			
σ_{yy}	1056.20	1056.27	0.007
σ_{zz}	179.51	179.42	-0.048
p	0.6536	0.6538	0.04
f	0.2108	0.2110	0.097

For the model of Rousselier in nonlocal version:

Identification	Reference	*Aster*	% difference
To the Gauss point n° 1			
σ_{yy}	1056.20	1056.20	-1.37 10-04
σ_{zz}	179.51	179.51	-5.17 10-05
p	0.6536	0.6536	6.93 10-04
f	0.2108	0.2107	-0.009

To final moment $t=1.5\,s$, one finds for the model with gradient:

Identification	Reference	*Aster*	% difference

To the Gauss point n° 1: σ_{yy}	799.19100	799.19116	1.98 10-05
At the Gauss point n° 2: σ_{yy}	799.19100	799.19116	1.98 10-05
At the Gauss point n° 3: σ_{yy}	799.19100	799.19116	1.98 10-05
At the Gauss point n° 4: σ_{yy}	799.19100	799.19116	1.98 10-05

4 Summary of the results

As long as the solution of the local model remains homogeneous, the values obtained with the two versions of the model of Rousselier are identical.

For the model with gradient, the solution remains homogeneous throughout the loading.