SSNA113 – Notched sample in viscoplasticity

Summary:

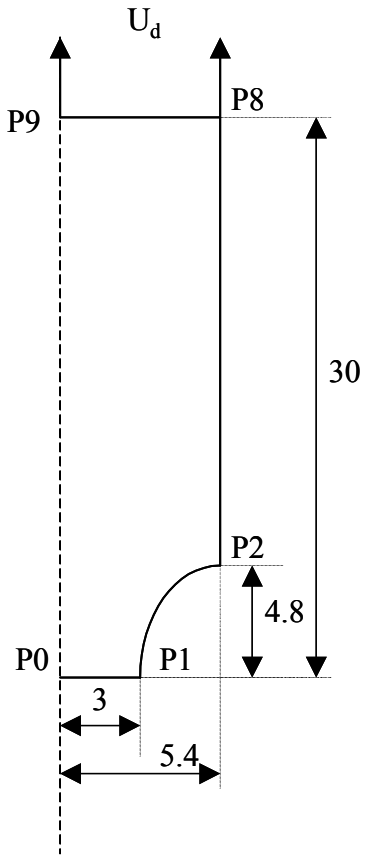
This test models a notched sample into axisymmetric. The law of behavior used is the law VISC_ISOT_TRAC. Two loading rates are simulated:

- slow: $T=1000\text{s}$ That is to say $\dot{\varepsilon}=10^{-3}s^{-1}$
- rapid: $T=0.001\text{s}$ That is to say $\dot{\varepsilon}=10^{-3}s^{-1}$

The results (effort resulting and contraction from the ligament) are compared with the calculations carried out with the model of viscous Rousselier (ROUSS_VISC) degenerated so that the evolution of porosity is negligible.

1 Problem of reference

1.1 Geometry



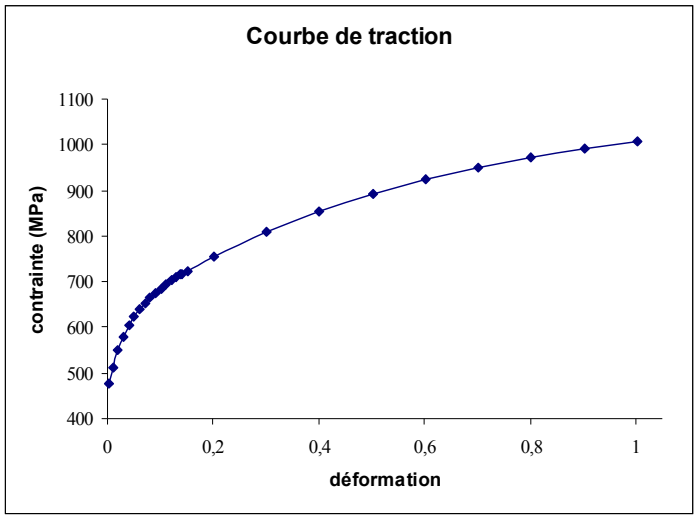
The test-tube is axisymmetric, and only half of the test-tube is represented. Dimensions are given in millimetres.

1.2 Properties of material

Isotropic elasticity

Young modulus: $E=215000\,MPa$
Poisson's ratio: $\nu=0.3$

Traction diagram



Coefficient for viscous law VISC_SINH

$\sigma_0=6176\,MPa$
$\varepsilon_0=3.31131121483\,10^{13}$
$m=6.76$

Coefficients of the model of Rousselier used to obtain the reference solution

$f_0=5.10^{-9}$
$D=0.0001$
$\sigma_1=1575\,MPa$

1.3 Boundary conditions and loadings

Because of symmetry, vertical displacements are blocked for the side $P0P1$ that is to say $DY=0$.
The side $P8P9$ is subjected to an imposed displacement $U_d=1\,mm$.
The loading is imposed using 500 pas de time in $T=1000\mathrm{s}$ for the slow case and $T=0.001\mathrm{s}$ for the fast case.

2 Reference solution

2.1 Results of reference

The reference solution is obtained by carrying out same calculation with the model of Rousselier in viscous version (BEHAVIOR = 'ROUSS_VISC', DEFORMATION = 'PETIT_REAC') whose parameters were selected in order to return the effect of negligible porosity.
One compares the contraction of the ligament, i.e. following displacement x node $P1$ as well as the resulting effort (REAC_NODA) on the face $P8P9$. One is interested in 3 values of displacement U_d : $0.05\mathrm{mm}$, $0.5\mathrm{mm}$ and $1\mathrm{mm}$.

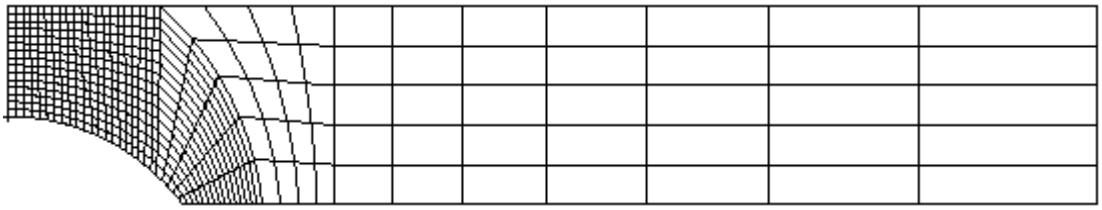
3 Modeling A

3.1 Characteristics of modeling

- Modeling AXIS_SI

3.2 Characteristics of the grid

The grid is obtained by **GIBI**.



Many nodes: 1440
Many meshs: 445 QUAD8

3.3 Sizes tested and results

Fast speed

Displacement	Identification	Reference	% tolerance
$U=0.05\,mm$	REAC_NODA on $P8P9$	3.43132 10^3	-0.12
	U_y in $P1$	-8.0411 10^{-3}	0.67
$U=0.5\,mm$	REAC_NODA on $P8P9$	3.93495 10^3	-0.22
	U_y in $P1$	-4.06758 10^{-1}	-0.03
$U=1\,mm$	REAC_NODA on $P8P9$	3.17328 10^3	-0.28
	U_y in $P1$	-8.89457 10^{-1}	-0.03

Slow speed

Displacement	Identification	Reference	% tolerance
$U=0.05\,mm$	REAC_NODA on $P8P9$	2.86423 10^3	-0.12
	U_y in $P1$	-1.52635 10^{-2}	0.24
$U=0.5\,mm$	REAC_NODA on $P8P9$	3.36223 10^3	-0.19
	U_y in $P1$	-4.19637 10^{-1}	-0.03
$U=1\,mm$	REAC_NODA on P8P9	2.73903 10^3	-0.26
	U_y in $P1$	-9.14404 10^{-1}	-0.04

4 Summary of the results

One obtains a good agreement of the results between the 2 models with lower deviations than 1% .

At the total level, one notes that to the maximum 4 iterations are necessary to obtain convergence. On the level of the integration of the law of behavior, less than 10 iterations are necessary to obtain an accuracy of 10^{-9}.