SSNA303: Elastoplastic notched sample in large deformations

Summarized:

This test models a notched sample in axi-symmetry. The behavior is elastoplastic with linear isotropic hardening of type von Mises (VMIS_ISOT_LINE).

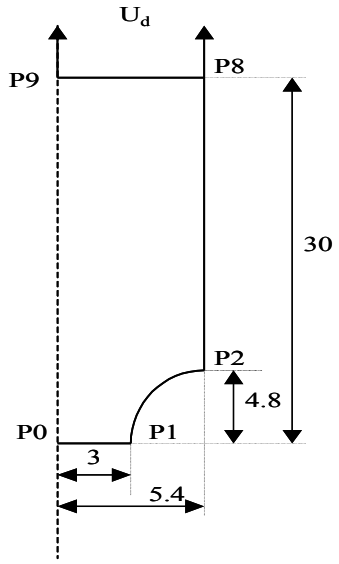
In the modelization A, two modelizations of the large deformations are compared:
- SIMO-MIEHE, very-elastic and catch here like reference
- GDEF-HYPO-ELAS, hypo-elastic and tested here.

In the modelization B two modelizations of the large deformations are compared:
- SIMO-MIEHE, very-elastic and catch here like reference
- GDEF-LOG, hypo-elastic and tested here.

The compared data are the force resulting and the contraction from the ligament.

1 Problem of reference

1.1 Figure1



Geometry: Problem of reference

the test-tube is axisymmetric, and only half of the test-tube is modelled by elements. Dimensions are given here in millimetres.

1.2 Given material

the material considered is elastoplastic with linear isotropic hardening of type von Mises (VMIS_ISOT_LINE).
The material characteristics used are the following ones:

Young modulus:	$200\,000\ MPa$
Poisson's ratio	$0{,}3$
linear	$200\ MPa$
Elastic limit Hardening modulus	$20\,000\ MPa$

1.3 Boundary conditions and loadings

Because of symmetry, vertical displacements are blocked on line $P0-P1$ and the horizontal displacements are blocked on the axis $P0-P9$; the loading consists of a vertical displacement imposed on the side $P8-P9$:

center $P0-P9$	$DX=0$
axis $P0-P1$	$DY=0$
centers $P8-P9$	$DY=6\,mm$

the loading is imposed in 50 increments of $0.12\,mm$.

2 Results of reference

the results of reference are got by carrying out same computation with the model of large deformations of Simo-Miehe (DEFORMATION = "SIMO-MIEHE"). One compares the contraction of the ligament, i.e. the displacement following x of the node $P1$, as well as the resulting force (REAC_NODA) on the face $P8-P9$.

The values of imposed displacement $Ud=0,6\,mm$, $Ud=3\,mm$ and $Ud=6\mathrm{mm}$ are considered.

The final strains obtained are to the maximum of 70%.

3 Modelization A

3.1 Characteristic of the modelization

The modelization tests GDEF_HYPO_ELAS in AXIS

3.2 Characteristics of the mesh

The mesh is carried out under GIBI. It is represented on Figure 2. It contains 1440 nodes for 445 quadratic quadrangular elements (QUAD8).

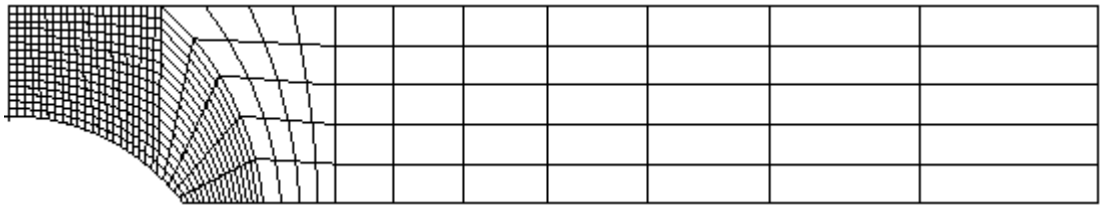


Figure 2: Mesh GIBI used

3.3 Quantities tested and Displacement

results imposed	Quantities tested	Reference	Tolerance (%)
$U=0,6\,mm$	REAC_NODA on $P8P9$	$6616,59\,N$	1
	Ux in $P1$	$-0,0845\,mm$	1
$U=3\,mm$	REAC_NODA out of $P8P9$	$21541\,N$	1
	Ux in $P1$	$-0,3766\,mm$	1
$U=6\,mm$	REAC_NODA out of $P8P9$	$33821\,N$	1
	Ux in $P1$	$-0,826\,mm$	1

4 Modelization B

4.1 Characteristic of the modelization

The modelization tests GDEF_LOG, in AXIS.

4.2 Characteristics of the mesh

The mesh is identical to that of modelization A.

4.3 Grandeurs tested and Displacement

results imposed	Quantities tested	Reference	Tolerance (%)
$U=0,6\,mm$	REAC_NODA on $P8P9$	$6616,59\,N$	1
	Ux in $P1$	$-0,0845\,mm$	1
$U=3\,mm$	REAC_NODA out of $P8P9$	$21541\,N$	1
	Ux in $P1$	$-0,3766\,mm$	2
$U=6\,mm$	REAC_NODA out of $P8P9$	$33821\,N$	3
	Ux in $P1$	$-0,826\,mm$	1

5 Summary of the results

the results got with the hypoelastic large deformations formulation agree with those obtained with SIMO_MIEHE with a maximum change of $0,36\%$ for displacement of $P1$ and $0,81\%$ for the forces on the face $P8P9$.

Formulation GDEF_LOG leads to a maximum difference of 4%, which is explained by the difference in strain measurement.

Convergence is obtained in 108 iterations with the total with SIMO_MIEHE, in 165 iterations with GDEF_LOG, and 500 iterations with GDEF_HYPO_ELAS.