HSNV127 – Plate in traction-shearing: viscoplasticity with isotropic work hardening

Summary:

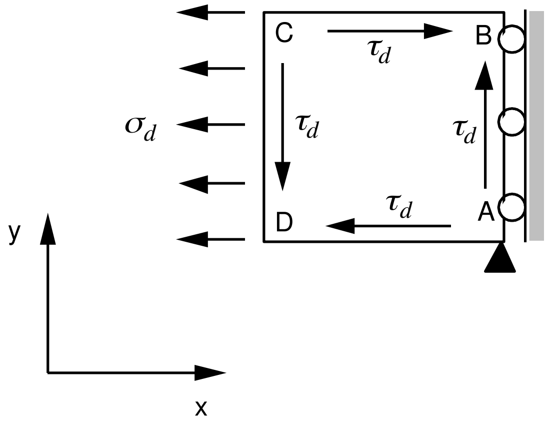
This test of nonlinear quasi-static mechanics consists in charging in traction-shearing a square plate. One thus validates the relation of behavior of viscoplasticity with isotropic work hardening (in $3D$) for a radial loading.

The plate is represented by a voluminal element (HEXA8). It is modelled in two different but equivalent ways: maybe with the model META_V_INL (modeling A), is with the model VISC_CIN1_CHAB (modeling B).

One must then obtain the same answer for two modelings A and B.

1 Problem of reference

1.1 Geometry



1.2 Properties of materials

$E=195\,000\,MPa$

$\nu=0.3$

Viscoplastic relation of behavior of Chaboche (VISC_CIN1_CHAB):

$N=3.5$

$K=600.$

UN_SUR_M$=0.$

R_0$=30.$

R_I$=300.$

$B=100.$

1.3 Boundary conditions and loadings

On A : $u_x=u_y=0$
On the side AB : $u_x=0$

Loading:

1. Way of 0 up to the point ($\tau_d=146\,MPa$, $\sigma_d=242\,MPa$) from duration 10 seconds,
2. Time of maintenance in this 50 seconds point.

2 Reference solution

2.1 Method of calculating used for the reference solution

Validation of the law VISC_CIN1_CHAB is done by the comparison of two modelings A and B. Each of two modelings thus constitutes a reference solution for the other.

2.2 Results of reference

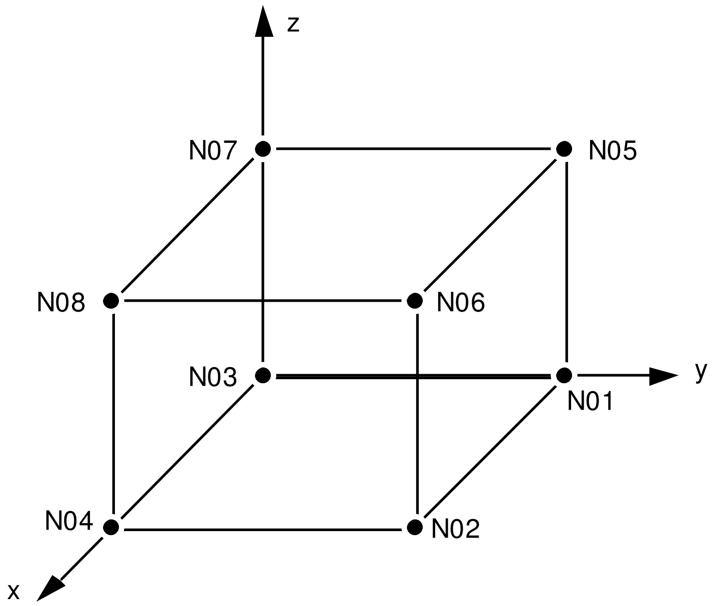
Deformations at the point B , at the moments $t=10.0\text{s}$ and $t=60.0$.

2.3 Uncertainty on the solution

Without object (intercomparison of two modelings).

3 Modeling A

3.1 Characteristics of modeling



The law of behavior used is `META_V_INL` (cf [U4.51.11] and [R4.04.02]).
One uniformly imposes on the structure a temperature $T=700°C$ and the TRC is such as the metallurgical state corresponding to this temperature is 100% ferritic.

3.2 Characteristics of the grid

Many nodes: 8
Many meshs and types: 1 HEXA8

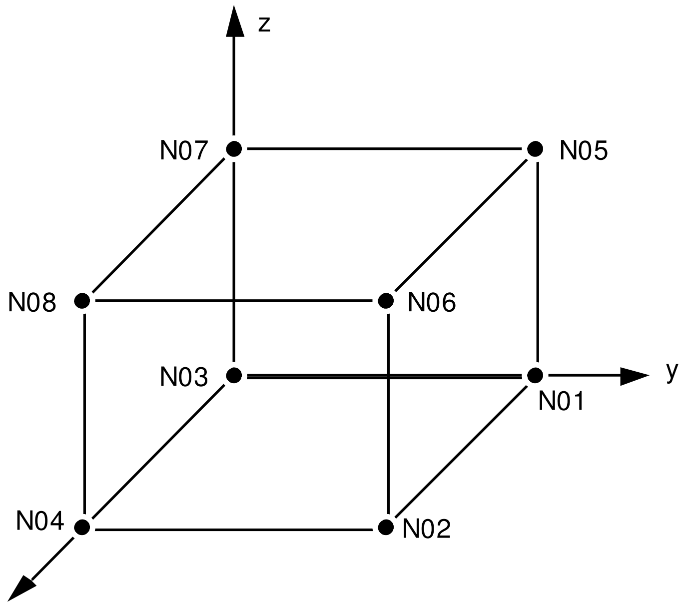
3.3 Sizes tested and results

Identification	Reference	Type of reference	Tolerance (%)
Deformation $EPXX$ with the node $NO2$ with $t=10.0s$	0.0106503	'AUTRE_ASTER'	0.5
Thermal deformation $EPXX$ with the node $NO2$ with $t=10.0s$	0	'AUTRE_ASTER'	0.1
Mechanical deformation $EPXX$ with the node $NO2$ with $t=10.0s$	0.0106503	'AUTRE_ASTER'	0.5
Plastic deformation $EPXX$ with the node $NO2$ with $t=10.0s$	0.009409	'AUTRE_ASTER'	0.5
Deformation $EPXY$ with the node $NO2$ with $t=10.0s$	0.0094884	'AUTRE_ASTER'	0.5

Mechanical deformation $EPXY$ with the node $NO2$ with $t=10.0\,s$	0.0094884	'AUTRE_ASTER'	0.5
Plastic deformation $EPXY$ with the node $NO2$ with $t=10.0\,s$	0.0085151	'AUTRE_ASTER'	0.5
Deformation $EPXX$ with the node $NO2$ with $t=60.0\,s$	0.027626	'AUTRE_ASTER'	0.5
Mechanical deformation $EPXX$ with the node $NO2$ with $t=60.0\,s$	0.027626	'AUTRE_ASTER'	0.5
Plastic deformation $EPXX$ with the node $NO2$ with $t=60.0\,s$	0.026385	'AUTRE_ASTER'	0.5
Deformation $EPXY$ with the node $NO2$ with $t=60.0\,s$	0.024851	'AUTRE_ASTER'	0.5
Mechanical deformation $EPXY$ with the node $NO2$ with $t=60.0\,s$	0.024851	'AUTRE_ASTER'	0.5
Plastic deformation $EPXY$ with the node $NO2$ with $t=60.0\,s$	0.023877	'AUTRE_ASTER'	0.5

4 Modeling B

4.1 Characteristics of modeling



One uses the viscoplastic law of Chaboche (`VISC_CIN1_CHAB`).

4.2 Characteristics of the grid

Many nodes:	8
Many meshs and types:	1 `HEXA8`

4.3 Sizes tested and results

Identification	Reference	Type of reference	Tolerance (%)
Deformation $EPXX$ with the node $NO2$ with $t=10.0\,s$	0.010684	'AUTRE_ASTER'	0.5
Thermal deformation $EPXX$ with the node $NO2$ with $t=10.0\,s$	0	'AUTRE_ASTER'	0.1
Mechanical deformation $EPXX$ with the node $NO2$ with $t=10.0\,s$	0.010684	'AUTRE_ASTER'	0.5
Plastic deformation $EPXX$ with the node $NO2$ with $t=10.0\,s$	0.0094428	'AUTRE_ASTER'	0.5
Deformation $EPXY$ with the node $NO2$ with $t=10.0\,s$	0.00951868	'AUTRE_ASTER'	0.5
Mechanical deformation $EPXY$ with the node $NO2$ with	0.00951868	'AUTRE_ASTER'	0.5

$t=10.0\,s$			
Plastic deformation $EPXY$ with the node $NO2$ with $t=10.0\,s$	0.00854534	'AUTRE_ASTER'	0.5
Deformation $EPXX$ with the node $NO2$ with $t=60.0\,s$	0.0276785	'AUTRE_ASTER'	0.5
Mechanical deformation $EPXX$ with the node $NO2$ with $t=60.0\,s$	0.0276785	'AUTRE_ASTER'	0.5
Plastic deformation $EPXX$ with the node $NO2$ with $t=60.0\,s$	0.0264375	'AUTRE_ASTER'	0.5
Deformation $EPXY$ with the node $NO2$ with $t=60.0\,s$	0.0248982	'AUTRE_ASTER'	0.5
Mechanical deformation $EPXY$ with the node $NO2$ with $t=60.0\,s$	0.0248982	'AUTRE_ASTER'	0.5
Plastic deformation $EPXY$ with the node $NO2$ with $t=60.0\,s$	0.0239248	'AUTRE_ASTER'	0.5

5 Summary of the results

The precision necessary for this test was fixed at 0.5% instead of 0.1% not to lengthen the computing time too much. The results found with these two modelings are concordant.