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

Summary:

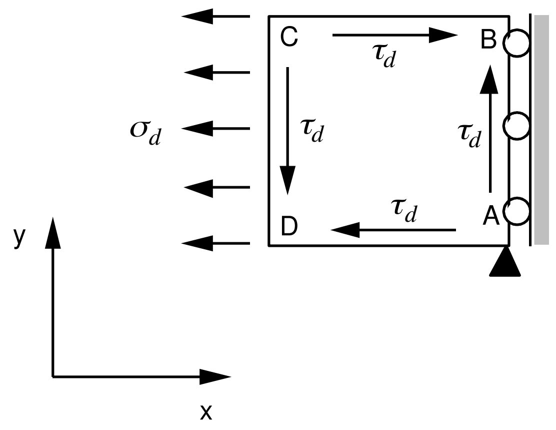
This test of nonlinear quasi-static mechanics consists in charging in traction-shearing a square plate. One thus validates the relation of behavior of viscoplasticity with isotropic work hardening (in $3D$) for a radial loading.

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

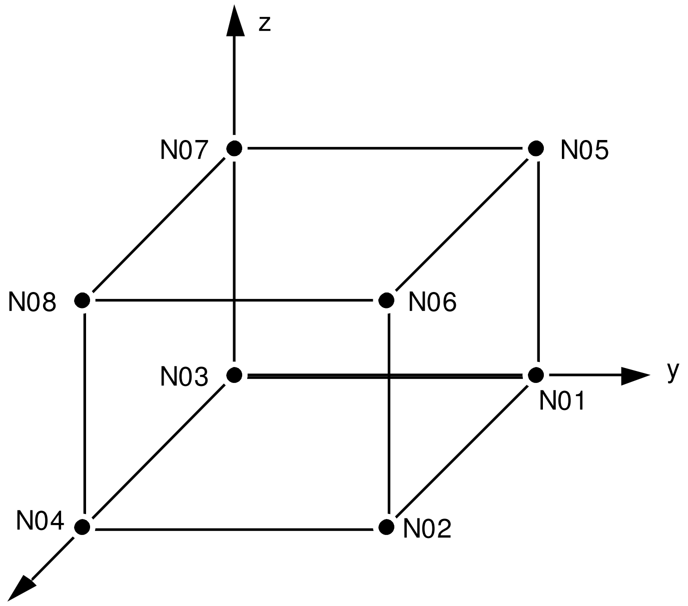
Deformations at the point B , at the moments $t=10.0\mathrm{s}$ and $t=60.0$.

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

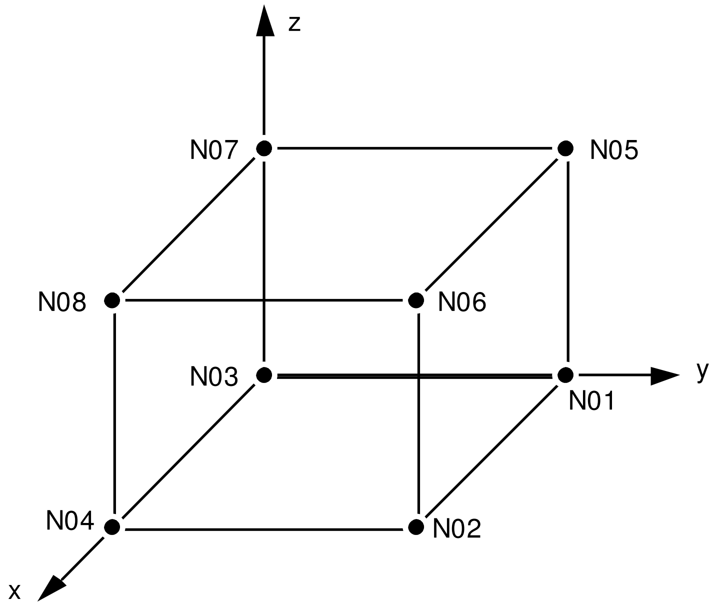
Many nodes: 8
Many meshs and types: 1 `HEXA8`

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
Deformation $EPXY$ with the node $NO2$ with $t=10.0s$	0.0094884	'AUTRE_ASTER'	0.5
Deformation $EPXX$ with the node $NO2$ with $t=60.0s$	0.027626	'AUTRE_ASTER'	0.5
Deformation $EPXY$ with the node $NO2$ with $t=60.0s$	0.024851	'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
Deformation $EPXY$ with the node $NO2$ with $t=10.0\,s$	0.00951868	'AUTRE_ASTER'	0.5
Deformation $EPXX$ with the node $NO2$ with $t=60.0\,s$	0.0276785	'AUTRE_ASTER'	0.5
Deformation $EPXY$ with the node $NO2$ with $t=60.0\,s$	0.0248982	'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.