HSNV128 – Plate in traction-shearing: viscoplasticity with kinematic work hardening

Summary:

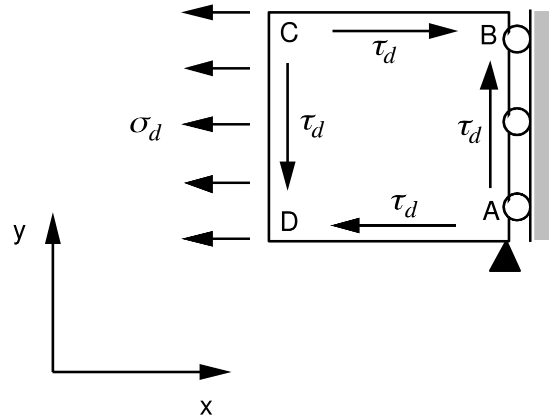
This test of nonlinear quasi-static mechanics consists in charging in traction-shearing a square plate. One thus validates the relation of behavior of viscoplasticity with kinematic work hardening (in $3D$) for a radial loading.

The plate is represented by a voluminal element (`HEXA8`). It is modelled in two different but equivalent ways: maybe with the model `META_V_CL` (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 Material properties

$E=195\,000\,MPa$

$\nu=0.3$

Viscoplastic relation of behavior of Chaboche (`VISC_CIN1_CHAB`)

$N=3.5$

UN_SUR_K = 0.001666667
UN_SUR_M = 0.
R_0 = 30.

C_I = 2000.

$K=1.$

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

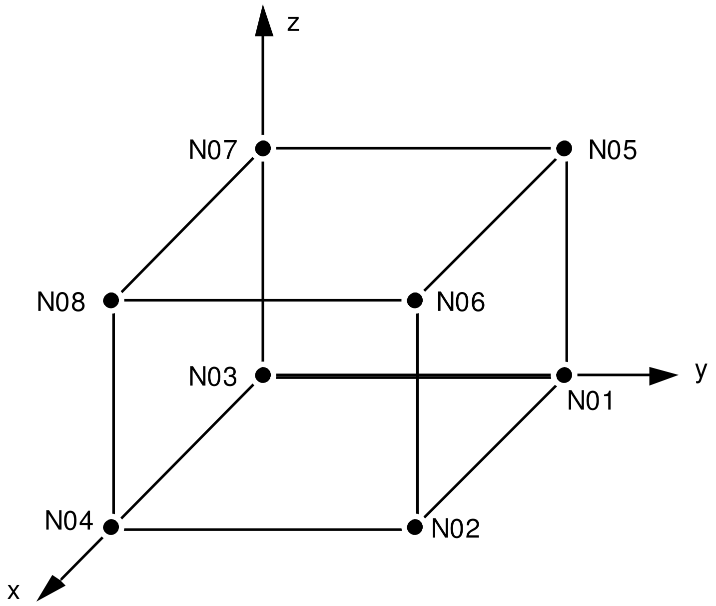
Deformations at the point B , at the moments $t=10.0\mathrm{s}$ and $t=60.0$.

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_CL (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

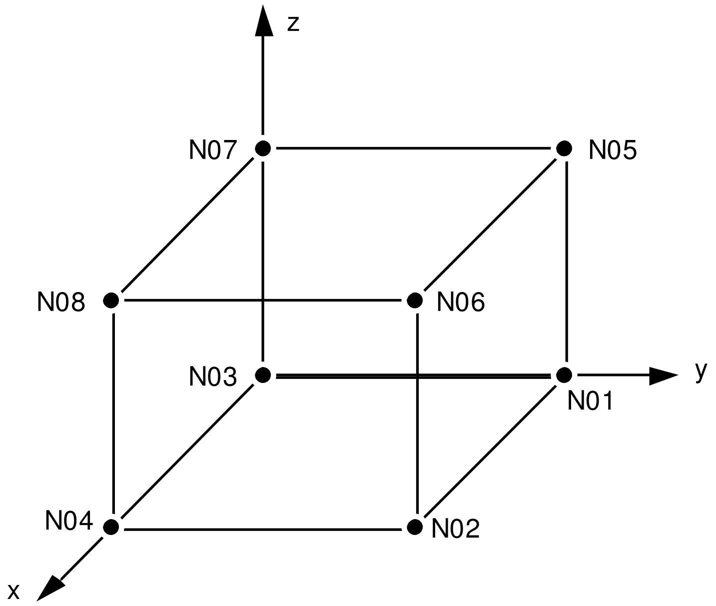
3.3 Sizes tested and results

Identification	Reference	Type of reference	Tolerance (%)
Deformation $EPXX$ with the node $NO2$ with $t=10.0\,s$	0.0481775	'AUTRE_ASTER'	0.1
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 $t=10.0\,s$	0.0481775	'AUTRE_ASTER'	0.1
Plastic deformation $EPXX$ with the node $NO2$ with $t=10.0\,s$	0.0469364	'AUTRE_ASTER'	0.1
Deformation $EPXY$ with the node $NO2$ with $t=10.0\,s$	0.0434489	'AUTRE_ASTER'	0.1
Mechanical deformation $EPXY$	0.0434489	'AUTRE_ASTER'	0.1

with the node $NO2$ with $t=10.0\,s$			
Plastic deformation $EPXY$ with the node $NO2$ with $t=10.0\,s$	0.0424755	'AUTRE_ASTER'	0.1
Deformation $EPXX$ with the node $NO2$ with $t=60.0\,s$	0.0930464	'AUTRE_ASTER'	0.1
Mechanical deformation $EPXX$ with the node $NO2$ with $t=60.0\,s$	0.0930464	'AUTRE_ASTER'	0.1
Plastic deformation $EPXX$ with the node $NO2$ with $t=60.0\,s$	0.0918054	'AUTRE_ASTER'	0.1
Deformation $EPXY$ with the node $NO2$ with $t=60.0\,s$	0.0840534	'AUTRE_ASTER'	0.1
Mechanical deformation $EPXY$ with the node $NO2$ with $t=60.0\,s$	0.0840534	'AUTRE_ASTER'	0.1
Plastic deformation $EPXY$ with the node $NO2$ with $t=60.0\,s$	0.0830801	'AUTRE_ASTER'	0.1

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 $t=10.0\,s$	0.0481774	'AUTRE_ASTER'	0.1
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 $t=10.0\,s$	0.0481774	'AUTRE_ASTER'	0.1
Plastic deformation $EPXX$ with the node $NO2$ with $t=10.0\,s$	0.0469364	'AUTRE_ASTER'	0.1
Deformation $EPXY$ with the node $NO2$ with $t=10.0\,s$	0.0434488	'AUTRE_ASTER'	0.1
Mechanical deformation $EPXY$ with the node $NO2$ with $t=10.0\,s$	0.0434488	'AUTRE_ASTER'	0.1

Plastic deformation $EPXY$ with the node $NO2$ with $t=10.0\,s$	0.0424755	'AUTRE_ASTER'	0.1
Deformation $EPXX$ with the node $NO2$ with $t=60.0\,s$	0.0930464	'AUTRE_ASTER'	0.1
Mechanical deformation $EPXX$ with the node $NO2$ with $t=60.0\,s$	0.0930464	'AUTRE_ASTER'	0.1
Plastic deformation $EPXX$ with the node $NO2$ with $t=60.0\,s$	0.0918054	'AUTRE_ASTER'	0.1
Deformation $EPXY$ with the node $NO2$ with $t=60.0\,s$	0.0840534	'AUTRE_ASTER'	0.1
Mechanical deformation $EPXY$ with the node $NO2$ with $t=60.0\,s$	0.0840534	'AUTRE_ASTER'	0.1
Plastic deformation $EPXY$ with the node $NO2$ with $t=60.0\,s$	0.0830801	'AUTRE_ASTER'	0.1

5 Summary of the results

The results found with these two modelings are concordant (lower deviation than 0.1 %).