

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

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### Summary:

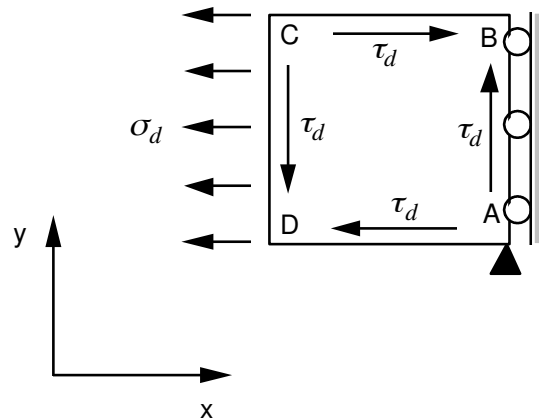
This test of nonlinear quasi-static mechanics consists in charging in traction-shearing a square plate. One thus validates the relation of behavior of viscoplasticity with kinematic work hardening (in 3D ) for a radial loading.

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

$$E = 195\,000 \text{ MPa}$$

$$\nu = 0.3$$

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

$$\text{On } A : u_x = u_y = 0$$

$$\text{On the side } AB : u_x = 0$$

Loading:

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

## 2 Reference solution

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### 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

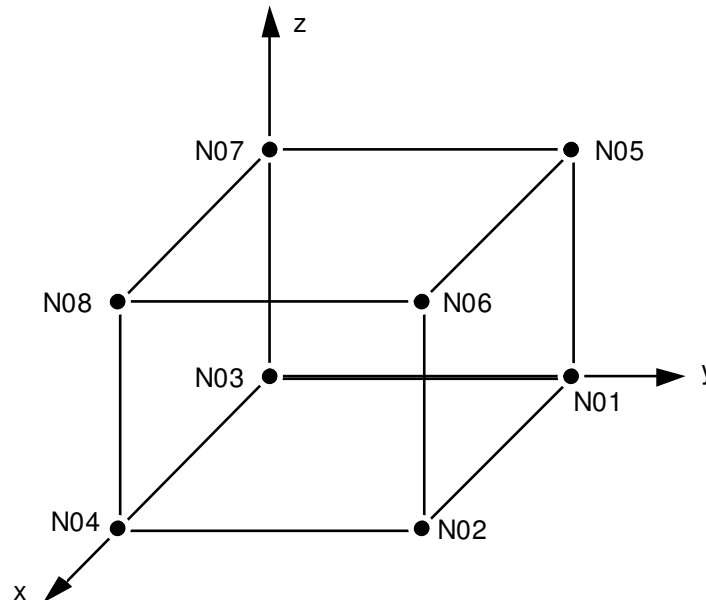
Deformations at the point  $B$ , at the moments  $t=10.0s$  and  $t=60.0$ .

### 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  $T=700^{\circ}C$  and the TRC is such as the metallurgical state corresponding to this temperature is 100% ferritic.

### 3.2 Characteristics of the grid

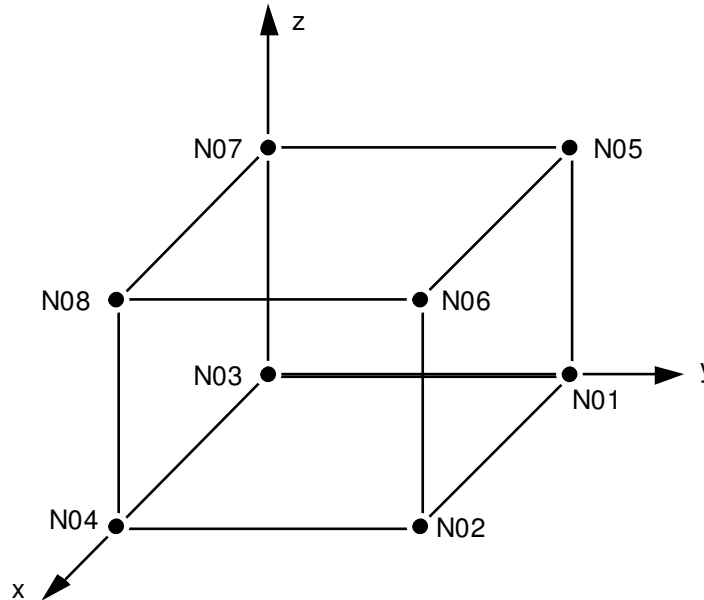
Many nodes: 8  
Many meshes and types: 1 HEXA8

### 3.3 Sizes tested and results

| Identification  | Reference | Type of reference | Tolerance (%) |
|---|-----------|-------------------|---------------|
| Deformation <i>EPXX</i> with the node <i>NO2</i> with $t=10.0s$ | 0.0481775 | 'AUTRE_ASTER'     | 0.1           |
| Deformation <i>EPXY</i> with the node <i>NO2</i> with $t=10.0s$ | 0.0434489 | 'AUTRE_ASTER'     | 0.1           |
| Deformation <i>EPXX</i> with the node <i>NO2</i> with $t=60.0s$ | 0.0930464 | 'AUTRE_ASTER'     | 0.1           |
| Deformation <i>EPXY</i> with the node <i>NO2</i> with $t=60.0s$ | 0.0840534 | '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 meshes and types: 1 HEXA8

### 4.3 Sizes tested and results

| Identification   | Reference | Type of reference | Tolerance (%) |
|--|-----------|-------------------|---------------|
| Deformation <i>EPXX</i> with the node <i>NO2</i> with $t=10.0 s$ | 0.0481774 | 'AUTRE_ASTER'     | 0.1           |
| Deformation <i>EPXY</i> with the node <i>NO2</i> with $t=10.0 s$ | 0.0434488 | 'AUTRE_ASTER'     | 0.1           |
| Deformation <i>EPXX</i> with the node <i>NO2</i> with $t=60.0 s$ | 0.0930464 | 'AUTRE_ASTER'     | 0.1           |
| Deformation <i>EPXY</i> with the node <i>NO2</i> with $t=60.0 s$ | 0.0840534 | 'AUTRE_ASTER'     | 0.1           |

## 5 Summary of the results

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