SSNP05 - Plate in tension-shears: viscoelasticity of Summarized

Lemaître:

This test of nonlinear quasi-static mechanics consists in charging in tension-shears a square plate. One thus validates the nonlinear behavior model of viscoelasticity of Lemaître (in $3D$) for a nonradial loading. This test is drawn from guide VPCS of the French company of Mechanics.

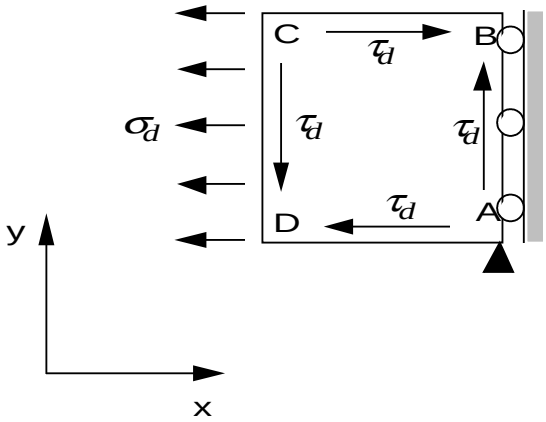
The plate is modelled by a voluminal element (HEXA8).

The results got by *Code_Aster* are very close to the reference solution.

1 Problem of reference

1.1 Geometry

Plates square



1.2 Material properties

$E = 178\,600\,MPa$

$\nu = 0.3$

viscoelastic Behavior model of Lemaître

$n = 11 \qquad \frac{1}{K} = 3.284\,10^{-4} \quad (K = 3045) \qquad \frac{1}{m} = 0.17857 \, (m = 5.6)$

1.3 Boundary conditions and loadings

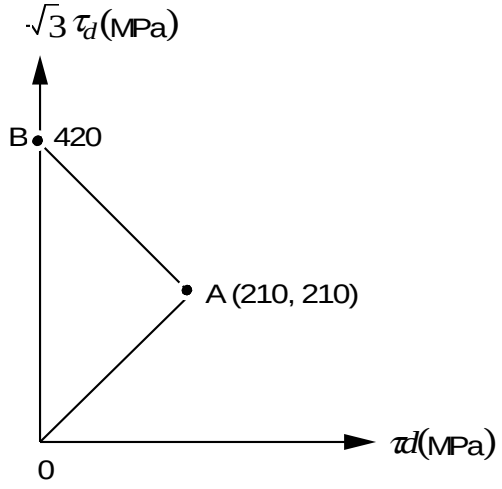
On A : $u_x = u_y = 0$

On the side AB : $u_x = 0$

Loading below:

Ways OA and AB , of period 30 seconds,

Time of maintenance in A and B of 3600 second



2 Reference solution

2.1 Method of calculating used for the reference solution

Computation carried out with various codes of finite elements using various explicit algorithms, semi - implicit or implicit.

2.2 Results of reference

$\varepsilon_{v_{xx}}$ and $\varepsilon_{v_{xy}}$ with times $t=30\,s$ $t=3630\,s$, $t=3660\,s$ and $t=3720\,s$

2.3 Uncertainty on the solution

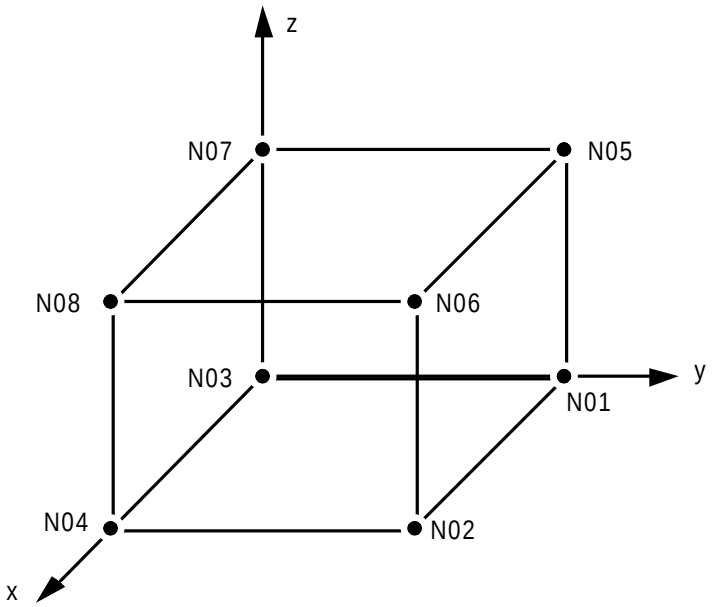
Uncertainty lower than 0.01%.

2.4 Bibliographical references

- Card-indexes SSNP05/89 of Commission VPCS

3 Modelization A

3.1 Characteristic of the modelization



the loading and the boundary conditions are modelled by:

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DDL_IMPO: (THE NODE IS OUTSIDE THE FIELD OF DEFINITION WITH A RIGHT
PROFILE OF THE EXCLU TYPE NODE: N04, DX: 0. , DY: 0.)
DDL_IMPO: (THE NODE IS OUTSIDE THE FIELD OF DEFINITION WITH A RIGHT
PROFILE OF THE EXCLU TYPE NODE: N08, DX: 0. , DY: 0. , DZ: 0.)
DDL_IMPO: (THE NODE IS OUTSIDE THE FIELD OF DEFINITION WITH A RIGHT
PROFILE OF THE EXCLU TYPE NODE: N02, DX: 0.)
DDL_IMPO: (THE NODE IS OUTSIDE THE FIELD OF DEFINITION WITH A RIGHT
PROFILE OF THE EXCLU TYPE NODE: N06, DX: 0.)
FORCE_NODALE: (THE NODE IS OUTSIDE THE FIELD OF DEFINITION WITH A RIGHT
PROFILE OF THE EXCLU TYPE NODE: (N01 N03 N05 N07), FX: -1/4*sigma_d(t) , FY:
-1/4*tau_d(t) )
FORCE_NODALE: (THE NODE IS OUTSIDE THE FIELD OF DEFINITION WITH A RIGHT
PROFILE OF THE EXCLU TYPE NODE: (N03 N04 N07 N08), FX: -1/4*tau_d(t)
)
FORCE_NODALE: (THE NODE IS OUTSIDE THE FIELD OF DEFINITION WITH A RIGHT
PROFILE OF THE EXCLU TYPE NODE: (N02 N04 N06 N08),                FY:
1/4*tau_d(t) )
FORCE_NODALE: (THE NODE IS OUTSIDE THE FIELD OF DEFINITION WITH A RIGHT
PROFILE OF THE EXCLU TYPE NODE: (N01 N02 N05 N06), FX: 1/4*tau_d(t)
)
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3.2 Characteristic of the mesh

Many nodes: 8
Number of meshes and types: 1 Urgent

3.3 HEXA8 Quantities tested and

Variable	results (s)	Reference	*Aster*	% difference
$\varepsilon_{v_{xx}}$	30	2.465 10-4	2.457 10-4	0.333%
$\varepsilon_{v_{xy}}$	30	2.135 10-4	2.128 10-4	0.333%
$\varepsilon_{v_{xx}}$	3630	2.867 10-3	2.876 10-3	0.316%
$\varepsilon_{v_{xy}}$	3630	2.483 10-3	2.491 10-3	0.326%
$\varepsilon_{v_{xx}}$	3660	2.879 10-3	2.889 10-3	0.337%
$\varepsilon_{v_{xy}}$	3660	2.565 10-3	2.562 10-3	– 0.101%
$\varepsilon_{v_{xx}}$	3720	2.879 10-3	2.889 10-3	0.337%
$\varepsilon_{v_{xy}}$	3720	3.272 10-3	3.271 10-3	– 0.037%

4 Summary of the results

the accuracy necessary for this test was fixed at 0.5% instead of 0.1% not lengthening the computing time too much. However, it is checked that by refining the discretization in time, the mistake made compared to the reference solution tends towards zero.