

SSNA01 - Infinite cylinder under pressure: viscoelasticity of Lemaître

Summary:

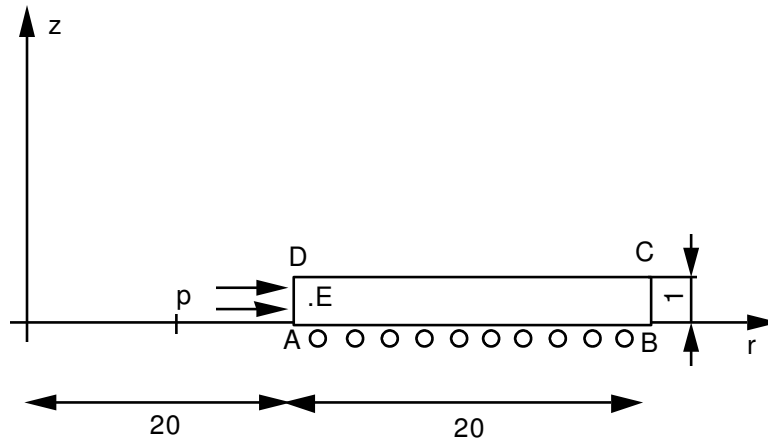
This test of nonlinear quasi-static mechanics consists in modelling an infinite cylinder subjected to an internal pressure depending on time. One thus validates the relation of nonlinear behavior of viscoelasticity of Lemaître into axisymmetric, and on a complete grid. This test is drawn from guide VPCS of the SFM.

The cylinder is modelled by elements 2D axisymmetric (QUAD8).

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

1 Problem of reference

1.1 Geometry



1.2 Material properties

$$E = 210\,000 \text{ MPa}$$

$$\nu = 0.3$$

Viscoelastic relation of behavior of Lemaitre

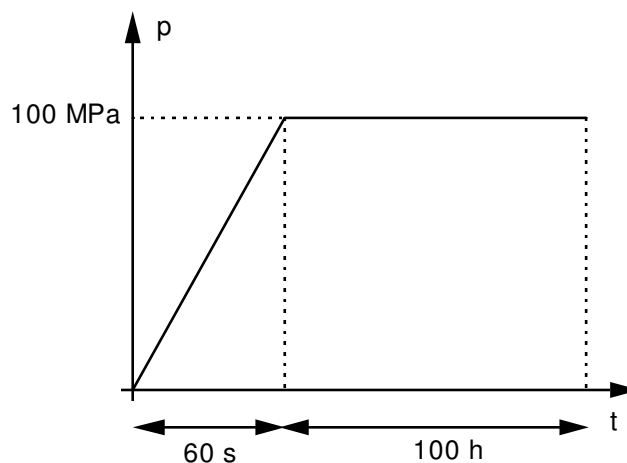
$$N = 11 \quad \frac{1}{K} = 3.284 \cdot 10^{-4} \quad (K = 3045) \quad \frac{1}{m} = 0.17857 \quad (m = 5.6)$$

1.3 Boundary conditions and loadings

On AB : $u_z = 0$

On CD : u_z uniform

Loading below: uniform pressure p according to along AD .



2 Reference solution

2.1 Method of calculating used for the reference solution

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

2.2 Results of reference

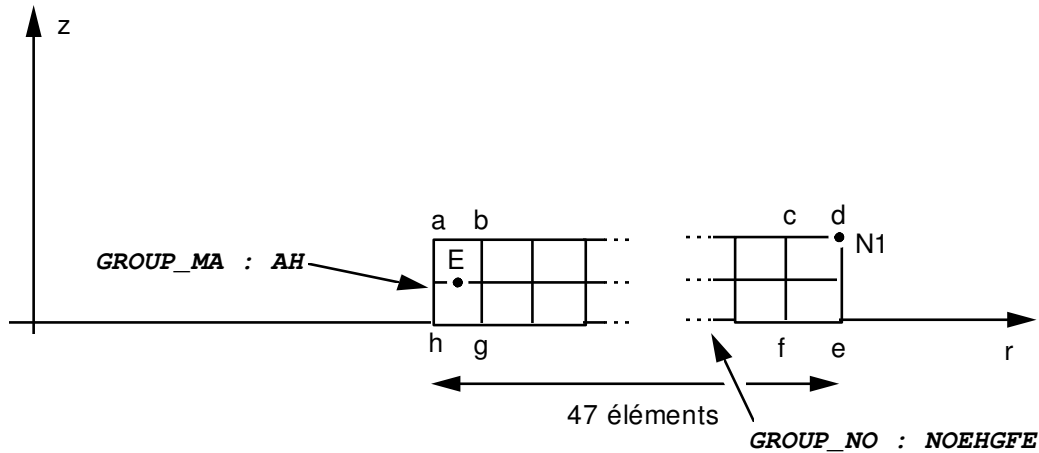
$\varepsilon_{v_{rr}}$ and $\varepsilon_{v_{zz}}$ at the moment $60 s$ at the point E located at a distance $d = \frac{3 - \sqrt{3}}{6}$ interior surface of the cylinder.

2.3 Bibliographical references

Card SSNA01/89 of Commission VPCS.

3 Modeling A

3.1 Characteristics of modeling



The loading and the boundary conditions are modelled by:

```
DDL_IMPO: (GROUP_NO: NOEHGFE, DY: 0.)
LIAISON_DDL: (NODE: (N1 NXXX), DDL: ('DY', 'DY'), COEF_MULT: (1, -1),
COEF_IMPO: 0.)
```

for all the nodes belonging to the edge AD (u_z uniform on ad)

```
PRES_REP: (GROUP_MA: AH, NEAR: p (T))
```

where $p(t)$ is the higher definite positive function [§1.3].

3.2 Characteristics of the grid

Many nodes: 381
Many meshes and types: 94 elements QUAD8

3.3 Sizes tested and results

One tests the structural parameters of data results:

Identification	Reference	Test	Tolerance
INST for NUME ORDRE= 7	60 , 0	ANALYTICAL	0,10 %
ITER_GLOB for NUME_ORDRE=7	3	NON_REGRESSION	0,00%

Identification	Reference	Test	Tolerance
ε_{v_r} at the point E with $t=60 s$	0,0000E+000	NON_DEFINI	0.5%
ε_{v_z} at the point E with $t=60 s$	0,0000E+000	NON_DEFINI	0.5%

3.4 Remarks

One stopped with $t=60 s$ not to have time too long calculation.

4 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. However, it is checked that by refining the discretization in time, the mistake made compared to the reference solution tends towards zero.