ZZZZ367 - Validation of keyword POST_INCR of BEHAVIOR

Summary:

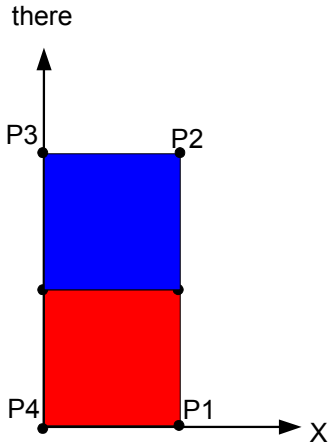
This test validates the operation of order POST_INCR with option REST_ECRO (restoration of work hardening) in the case of a bi--material.

The objective is to check the possibility of activating the restoration of work hardening only on part of the grid.

1 Problem of reference

1.1 Geometry

Axisymmetric cylinder



1.2 Material properties

The properties materials of the two pennies fields (blue and red) are those of steel 316L, described below. Parameters of restoration of work hardening are also defined but only on the red under-field.

Thermal parameters:

Voluminal heat-storage capacity $\rho C_p = 3.9 \times 10^6 \left(J.m^{-3.} \circ C^{-1} \right)$

Conductivity $\lambda \left(W.m^{-1} \circ C^{-1} \right)$:

T (°C)	λ
20.	14.
100.	15.2
200.	16.6
300.	17.9
400.	19.0
500.	20.6
600.	21.8
700.	23.1
800.	24.3
900.	26.
1000.	27.3
1200.	29.9
1450.	35.
1500.	70.

Thermomechanical parameters:

- Thermoelastic parameters:

  Young modulus $E(Pa)$
  Poisson's ratio: $\nu = 0.3$
  Thermal dilation coefficient α
  Temperature of definition of the dilation coefficient: $T_{ref} = 20\,°C$
  Elastic limit $\sigma_y(Pa)$

T (°C)	$E(\times 10^6)$
20.	195600.
100.	191200.
200.	185700.
300.	179600.
400.	172600.
500.	164500.
600.	155000.
700.	144100.
800.	131400.
900.	116800.
1000.	100000.
1100.	80000.
1200.	57000.
1300.	30000.
1400.	2000.
1500.	1000.

T (°C)	$\alpha(\times 10^{-6})$
20.	14.56
100.	15.39
200.	16.21
300.	16.86
400.	17.37
500.	17.78
600.	18.12
700.	18.43
800.	18.72
900.	18.99
1000.	19.27
1100.	19.53
1200.	19.79
1300.	20.02
1600.	20.02

T (°C)	$\sigma_y(\times 10^6)$
20.	286.
200.	212.
400.	180.
600.	137.
800.	139.
1000.	70.
1100.	35.
1200.	16.
1300.	10.
1500.	10.

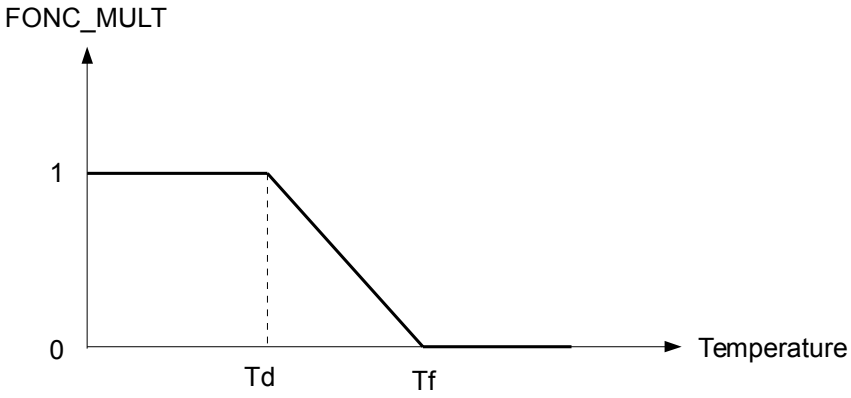
- Thermoplastic parameters (law with linear work hardening)

  Tangent module $E_T(Pa)$

T (°C)	$E_T(\times 10^6)$
20.	2400.
700.	2400.
800.	2350.
900.	1500.
1000.	800.
1100.	725.
1200.	150.
1300.	10.

- Parameter of restoration of work hardening: multiplicative function FONC_MULT

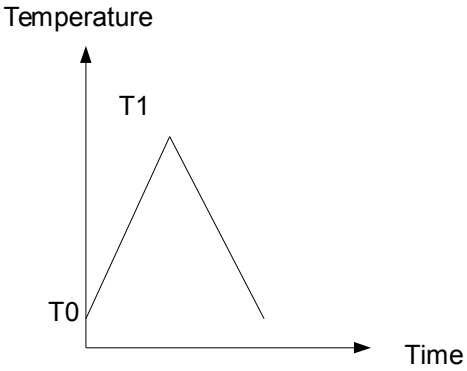
Initial temperature of restoration: Td = 600°C
Temperature of end of restoration: Tf = 1000°C



1.3 Boundary conditions and loadings

- Blockings:
  uy = 0 in P1, P2, P3 and P4

- Loading:
  The following thermal loading is applied to all the grid:



with T0 = 20°C and T1 = 1125°C

2 Reference solution

2.1 Method of calculating

A test of nonregression is considered.

2.2 Results of reference

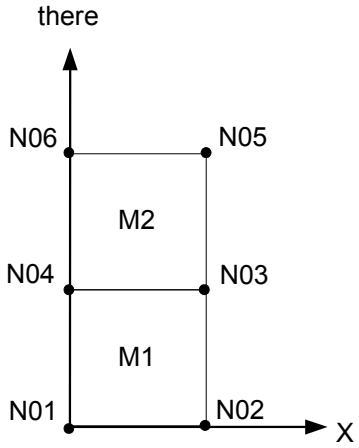
One will be interested in the values of the constraint σ_{yy} at the end of the loading and with the value of the cumulated plastic deformation p at the end of the restoration of work hardening.

The objective is to check that the option of calculation of restoration of work hardening is applied only in the desired zone. 100%

3 Modeling A

3.1 Characteristics of modeling

Axisymmetric modeling 2D



The boundary conditions are modelled by:

On the nodes (N01, N02, N05, N06), DY=0.

Mechanical calculation is carried out with the elastoplastic law of behavior of Von Mises with linear isotropic work hardening (keyword 'RELATION = VMIS_ISOT_LINE'). The restoration of work hardening is activated only on the mesh M1 (keyword POST_INCR = 'REST_ECRO').

3.2 Characteristics of the grid

Many nodes:	6
Number of meshs and type:	2 QUAD4

3.3 Sizes tested and results

One tests to it not regression of the values of p and σ_{yy} with the nodes N01 and N06 for moments 89 S and 200 S.

4 Summary of the results

This case test makes it possible to check the taking into account of the option of calculation POST_INCR = 'REST_ECRO' only on part of a grid.