

SSNV218 – Calculation of the energy parameter G_p in 3D

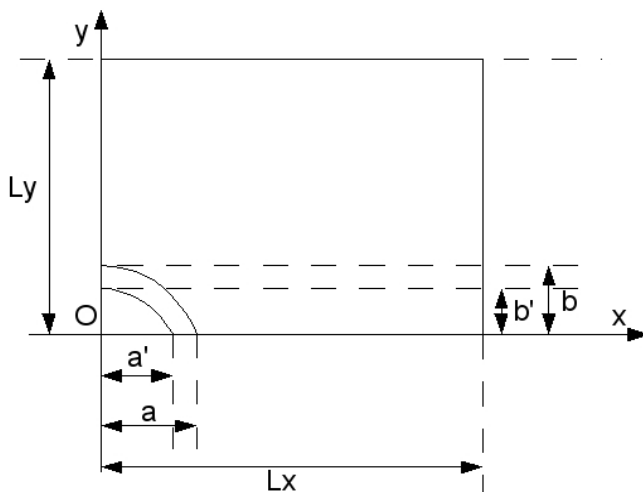
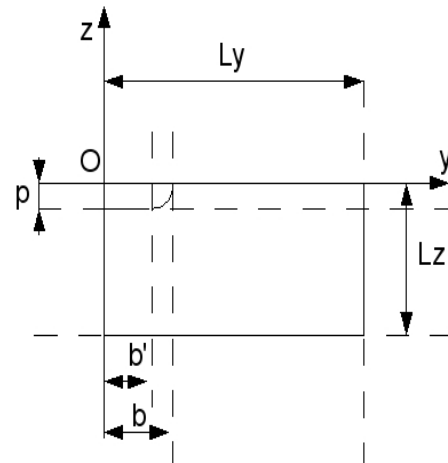
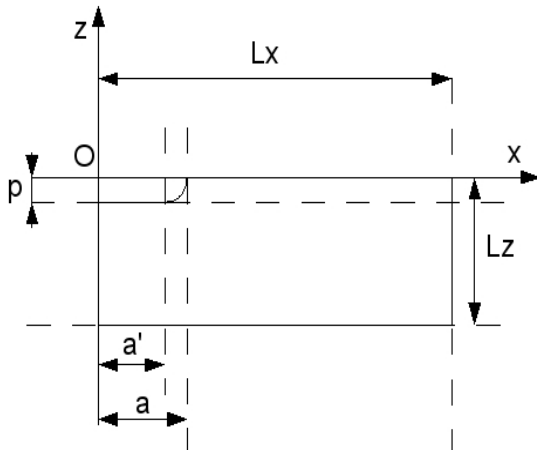
Summary

This test of nonlinear static mechanics presents the calculation of the parameter G_p in 3D for a structure of the shape quarter of block ellipse using the macro one of postprocessing `CALC_GP`. The structure is subjected to a traction in mode I at constant temperature.

Calculation carried out upstream is a non-linear calculation with écrouissage isotropic (`VMIS_ISOT_TRAC`) in great deformations.

1 Problem of reference

1.1 Geometry



Measurements	Values (mm)
Lx	22.2
Ly	15
Lz	4
a	9
a'	8.94
b	6
b'	5.94
p	0.1

The structure considered is a block with an elliptic notch of form. Within the framework of this modeling and for reasons of symmetry, only a quarter of the block is taken into account.

1.2 Properties of material

Young modulus: 223 194 MPa .

Poisson's ratio: $\nu = 0.3$.

Traction diagram (isotropic plasticity of Von Misès):

Deformation applied	Threshold of constraint raised [MPa]
0.00379042	846
0.00579042	849.2
0.01179042	840.9
0.01479042	842.4
0.01879042	849.7
0.02179042	855.9
0.02979042	894.2
0.04679042	951.2
0.07179042	1012.9
0.10379042	1067.1
0.13479042	1106.6
0.20379042	1165.7
0.30379042	1228.4
0.40379042	1275.3
0.50379042	1313
0.60379042	1344.8
0.70379042	1372.4
0.80379042	1396.8
0.90379042	1418.7
1.0037904	1438.7

Table 1.1

1.3 Boundary conditions and loadings

The face located in $x=0$ a displacement imposed along the axis has of x no one.

The face located in $y=L_y$ a displacement imposed along the axis has of y no one.

The face located in $z=0$ a displacement imposed along the axis has of z no one.

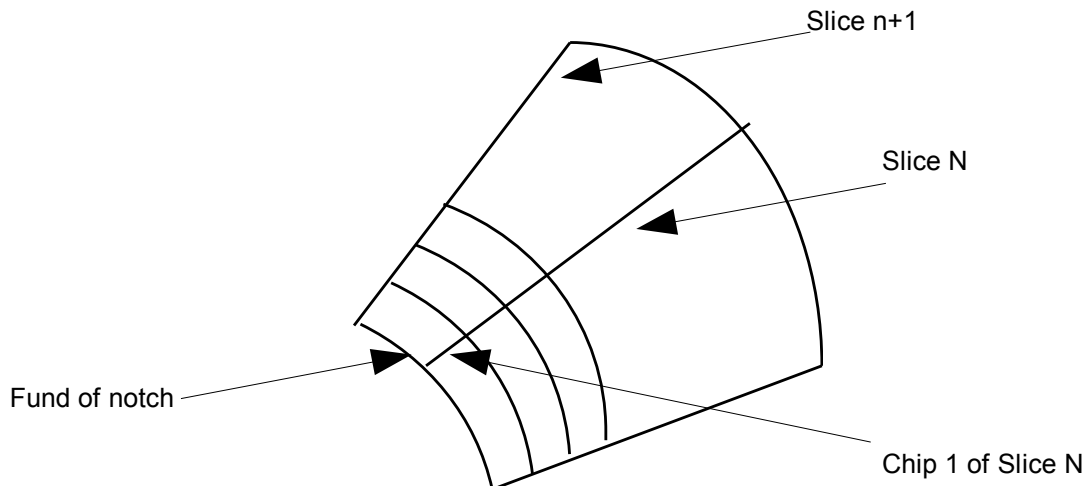
A force with linear growth in time is applied to the face located at an altitude of L_z .

This force is worth 2000N at the moment $INST = 20s$.

2 Reference solution

This case test is a case of nonregression. The solution with which one compares oneself here is obtained by using a version of development python of the order, which made it possible to develop the approach G_p .

The bottom of notch is of form elliptic. This one is described by slices. Each slice consists of chips. This total zone of chips corresponds to the virtual propagation of the notch.



One determines in each chip and at every moment the evolution of the quantity $G_p(\Delta S)$ defined by:

$$G_p(\Delta S) = 2[W_{elas}(\Delta S)] / \Delta S$$

where $W_{elas}(\Delta S)$ is the elastic energy calculated on the zone cumulated of chip according to a slice.

3 Modeling A

3.1 Characteristics of modeling

The crack is modelled by a notch of ray 100 microns. The zone Ze of 2 mm of length is divided into 20 microns thickness zones (also called "chips"). Selected modeling is 3D.

3.2 Characteristics of the grid

Many nodes: 7598

Many meshes and types: 2 POI1, 231 SEG3, 185 TRIA6, 532 QUAD8, 1368 PENTA15, 704 HEXA20

3.3 Sizes tested and results

One tests the values of G_p determined by the macro one CALC_GP.

3.3.1 Values tested of G_p

Moment	Slice	Chip	G_p	Tolerance (%)
1.0	1	1	0.438815	2.0E-03
1.0	1	2	0.780974	2.0E-03
1.0	4	1	0.445910	2.0E-03
1.0	4	2	0.495423	2.0E-03
3.0	1	1	0.678008	2.0E-03
3.0	1	2	0.732731	2.0E-03
3.0	4	1	0.729344	2.0E-03
3.0	4	2	0.816681	2.0E-03

Table 3.1

In all the cases, the variation enters the computed values by the two versions of CALC_GP is minimal, which validates them mutually.

4 Summary of the results

For the whole of the data tested, the variation is lower than 2E-04% .