SSNP158 – Adaptation of grid into non-linear

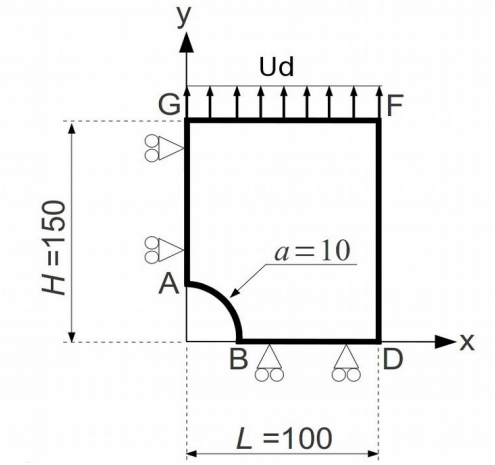
Summary:

This test 2D in plane constraints quasi-static allows to illustrate on a simple case the problems of the adaptation of grid into non-linear.
It implements the elements presented in documentation [U2.08.09] “Adaptation of grid into non-linear”, i.e. the various phases of resolution, adaptation, projection and balancing.

1 Problem of reference

1.1 Geometry

It is about a rectangular plate, comprising a hole, modelled in $2D$ plane constraints. One models only one quarter of the plate thanks to symmetries. Dimensions are given in millimetres.



1.2 Boundary conditions and loadings

Conditions of symmetry
The plate is blocked according to Ox along the side AG and following Oy along the side BD.

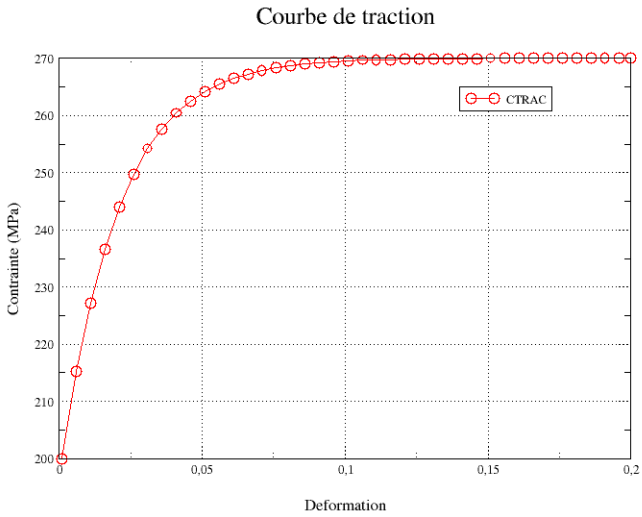
Loading in imposed displacement
It is subjected to an imposed displacement $U^d=0.2\,mm$ according to Oy distributed on the side FG.

1.3 Properties of materials

The behavior is elastoplastic of Von Mises, with isotropic work hardening.

Characteristics rubber bands itsT:
- Young modulus $E=200\,000\,MPa$;
- Poisson's ratio $\nu=0.3$;
- Elastic limit: $200\,MPa$;

Work hardening is deduced from the traction diagram defined by the following data (prolongation constant right `PROL_DROITE=' CONSTANT'`):



Epsilon	Sigma (Mpa)		Epsilon	Sigma (Mpa)
1.00000E-03	2.00000E+02		1.06000E-01	2.69626E+02
6.00000E-03	2.15275E+02		1.11000E-01	2.69709E+02
1.10000E-02	2.27253E+02		1.16000E-01	2.69773E+02
1.60000E-02	2.36630E+02		1.21000E-01	2.69823E+02
2.10000E-02	2.43964E+02		1.26000E-01	2.69862E+02
2.60000E-02	2.49694E+02		1.31000E-01	2.69893E+02
3.10000E-02	2.54168E+02		1.36000E-01	2.69917E+02
3.60000E-02	2.57659E+02		1.41000E-01	2.69935E+02
4.10000E-02	2.60382E+02		1.46000E-01	2.69949E+02
4.60000E-02	2.62506E+02		1.51000E-01	2.69961E+02
5.10000E-02	2.64161E+02		1.56000E-01	2.69969E+02
5.60000E-02	2.65451E+02		1.61000E-01	2.69976E+02
6.10000E-02	2.66457E+02		1.66000E-01	2.69981E+02
6.60000E-02	2.67240E+02		1.71000E-01	2.69986E+02
7.10000E-02	2.67850E+02		1.76000E-01	2.69989E+02
7.60000E-02	2.68325E+02		1.81000E-01	2.69991E+02
8.10000E-02	2.68696E+02		1.86000E-01	2.69993E+02
8.60000E-02	2.68984E+02		1.91000E-01	2.69994E+02
9.10000E-02	2.69209E+02		1.96000E-01	2.69996E+02
9.60000E-02	2.69384E+02		2.00000E-01	2.69996E+02
1.01000E-01	2.69520E+02			

2 Reference solution

The reference solution is obtained by calculation on a very fine grid which constitutes modeling B of this test.

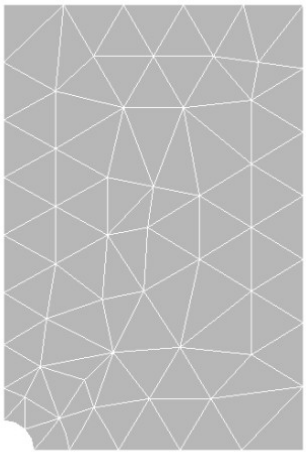
3 Modeling A

3.1 Characteristics of modeling

Elastoplastic calculation on a model in plane constraints (C_PLAN). One carries out an adaptation of grid to each step of time, followed by a phase of projection and balancing. For the adaptation, one provides to the software LOBSTER a very fine description of the geometry of the hole so as to follow its contour well. In the contrary case, stress concentrations not-physics appear.

3.2 Characteristics of the grid

One uses an initial grid which comprises 91 TRIA6 and 210 nodes.



3.3 Sizes tested and results

One tests the value of the components of constraints at the end of the loading:

Component	Type of reference	Value	Tolerance
SIGM_NOEU – $SIYY$ in B	AUTRE_ASTER	250.17 MPa	0,40%
SIGM_NOEU – $SIXX$ in A	AUTRE_ASTER	-218.93 MPa	6,00%

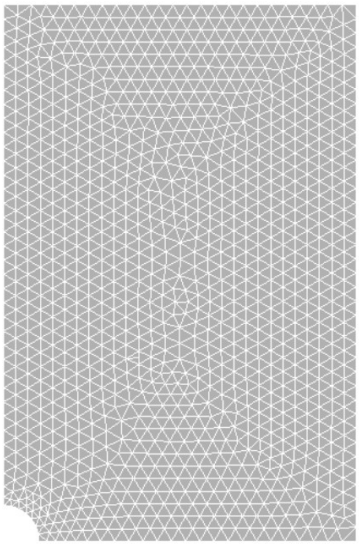
4 Modeling B

4.1 Characteristics of modeling

Elastoplastic calculation on a model in plane constraints (C_PLAN) by using a fine grid which is used as reference solution to modeling A.

4.2 Characteristics of the grid

One uses an initial grid which comprises 2168 TRIA6 and 4467 nodes.



4.3 Sizes tested and results

On this modeling, one carries out only tests of not-regression which are irrelevant here.

5 Summary of the results

This test implements a non-linear calculation with adaptation of grid during the transient. The comparison with a calculation of reference on a fine grid confirms the relevance of the approach.