SSNP158 – Mesh adaptation in nonlinear

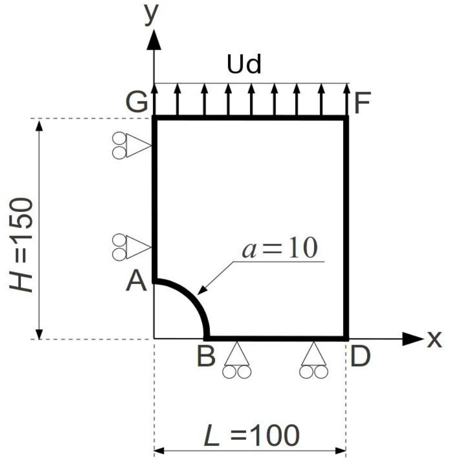
Abstract:

This quasi-static $2D$ test in plane stresses makes it possible to illustrate on a simple case the problems of the mesh adaptation into nonlinear.
It implements the elements presented in documentation [U2.08.09] “Mesh adaptation into nonlinear”, i.e. the various phases of resolution, adaptation, projection and balancing.

1 Problem of reference

1.1 Geometry

It acts D `a rectangular plate, comprising a hole, modelled in $2D$ plane stresses. 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.

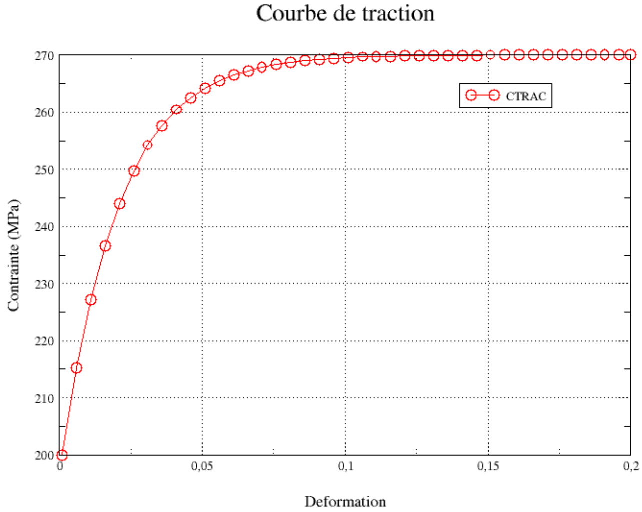
Loading in imposed displacement
It is subjected to a following imposed $U^d=0.2\,mm$ displacement Oy distributed on the side FG.

1.3 Properties of the materials

the behavior is elastoplastic of Von Mises, with isotropic hardening.

The elastic characteristics are:
- Young modulus $E=200\,000\,MPa$;
- Poisson's ratio $\nu=0.3$;
- Elastic limit: $200\,MPa$;

Hardening is deduced from the curve of tension defined by the following data (prolongation right constant `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 computation on a very fine mesh which constitutes the modelization B this test.

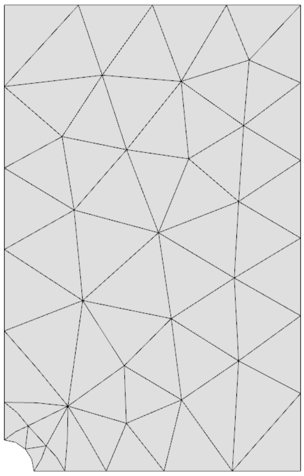
3 Modelization A

3.1 Characteristic of the elastoplastic

modelization Computation on a model in plane stresses (C_PLAN). One carries out a mesh adaptation with each time step, followed by a phase of projection and balancing. For the adaptation, one provides to the software HOMARD a very fine description of the geometry of hole so as to follow his contour well. In the contrary case, stress concentrations NON-physics appear.

3.2 Characteristics of the mesh

One uses an initial mesh which comprise 61 TRIA6 and 146 nodes.



3.3 Quantities tested and results

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

Standard	component of reference	Value	Tolerance
SIGM_NOEU – $SIYY$ in B	AUTRE_ASTER	250.41 MPa	0.40%
SIGM_NOEU – $SIXX$ in A	AUTRE_ASTER	-214.58 MPa	6.00%

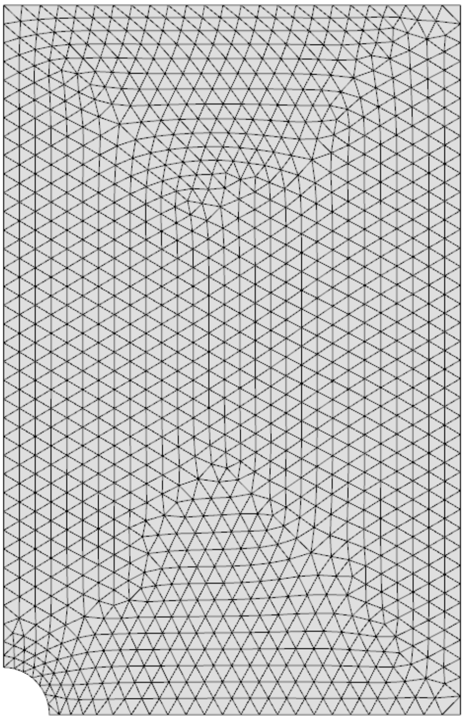
4 Modelization B

4.1 Characteristic of the elastoplastic

modelization Computation on a model in plane stresses (C_PLAN) by means of a fine mesh which are used as reference solution to modelization A.

4.2 Caractéristiques of the mesh

One uses an initial mesh who comprises 2258 TRIA6 and 4647 nodes.



4.3 Quantities tested and results

On this modelization, one carries out only tests of NON-regression which are irrelevant here.

5 Summary of the results

This test implements a nonlinear computation with mesh adaptation during the transient. The comparison with a computation of reference on a fine mesh confirms the relevance of the approach.