SSLS130 - Structural zoom: perforated plate subjected to a normal effort on an edge

Summary:

This test represents the static calculation of an embedded perforated plate free setting in inflection by a normal effort applied to its free edge.

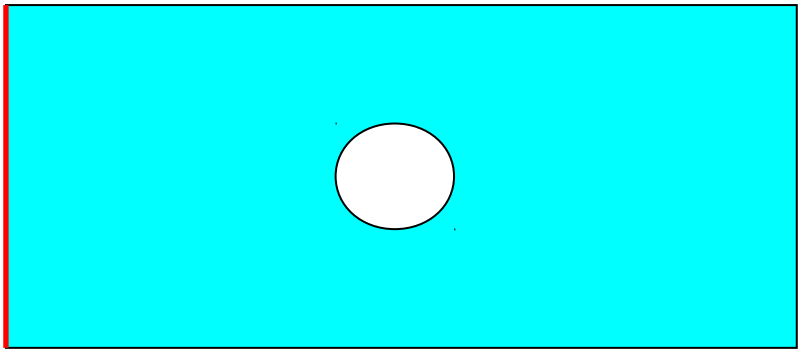
It is about an application of the method known as of “structural zoom” which makes it possible to improve quality of a result got on a too coarse or insufficiently detailed grid. The characteristic of the method lies in the fact that one calculates the solution on a network located around the zone of interest (patch), by applying like loading to the contour of the patch displacements (or efforts) resulting from the initial model.

In this test, the solutions obtained on a fine network and a coarse grid after use of the structural zoom are compared.

1 Problem of reference

1.1 Geometry

It is about a rectangular plate, perforated are center:



Thickness: $0.001\mathrm{m}$

1.2 Properties of material

Homogeneous classical material on all the structure: $E=7.1\ 10^{10}$, $\nu=0.3$.

1.3 Boundary conditions and loadings

Embedding on the 6 degrees of freedom on the left side of the plate.

Nodal force on the right side of the plate of amplitude $100\mathrm{N}$ in the direction X and $1\mathrm{N}$ in Z .

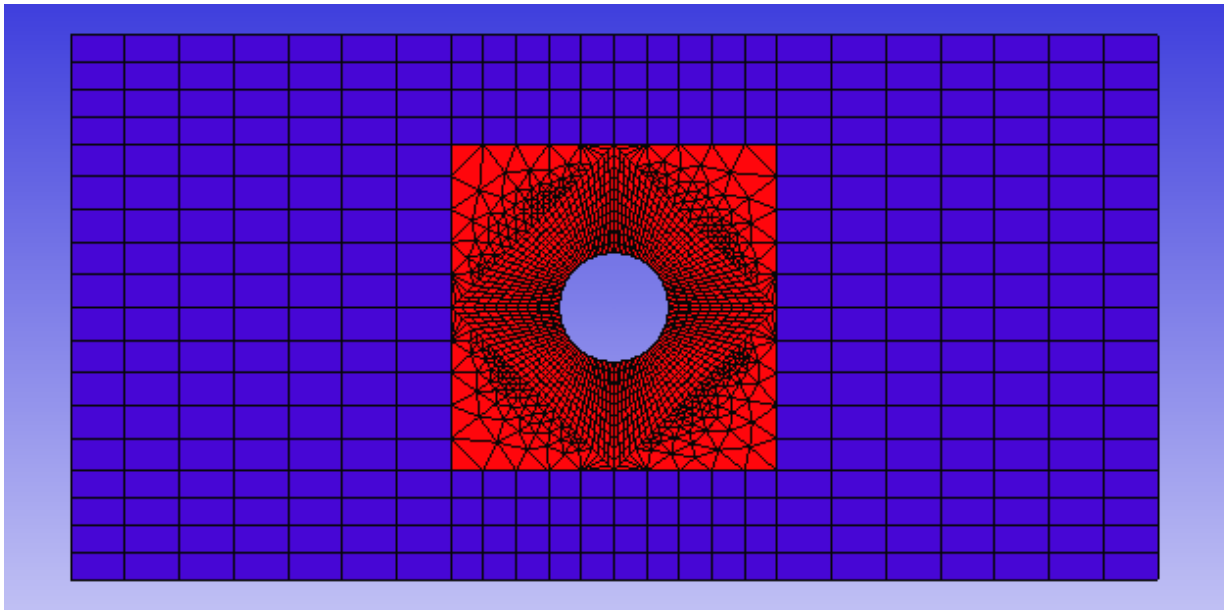
2 Reference solution

2.1 Method of calculating used for the reference solution

The reference solution is obtained by modeling A. It acts of the same calculation obtained on a grid of which the degree of refinement is similar to that of modeling B after use of the method of structural modification.

3 Modeling A

3.1 Characteristics of modeling



3.2 Characteristics of the grid

Many nodes: 1944
Number of meshs and type: 620 TRIA3 and 1532 QUAD4

3.3 Sizes tested and results

– One tests to it not regression of the component maximum values SIXX, SIYY on the M1533 mesh.
– Shear stresses of the DKT are also tested.

Identification	Type of reference	Value of reference	Precision
SIXZ *M1533, P1, SP1*	'AUTRE_ASTER'	7.9745E+04	1%
SIYZ *M1533, P1, SP1*	'AUTRE_ASTER'	14377.0954	1 %
EPXZ *M1533, P1, SP1*	'AUTRE_ASTER'	1.1681E-06	1 %
EPXZ *M1533, P1, SP1*	'AUTRE_ASTER'	2.1060E-07	

One visualizes the constraint of Von Mises around the hole:

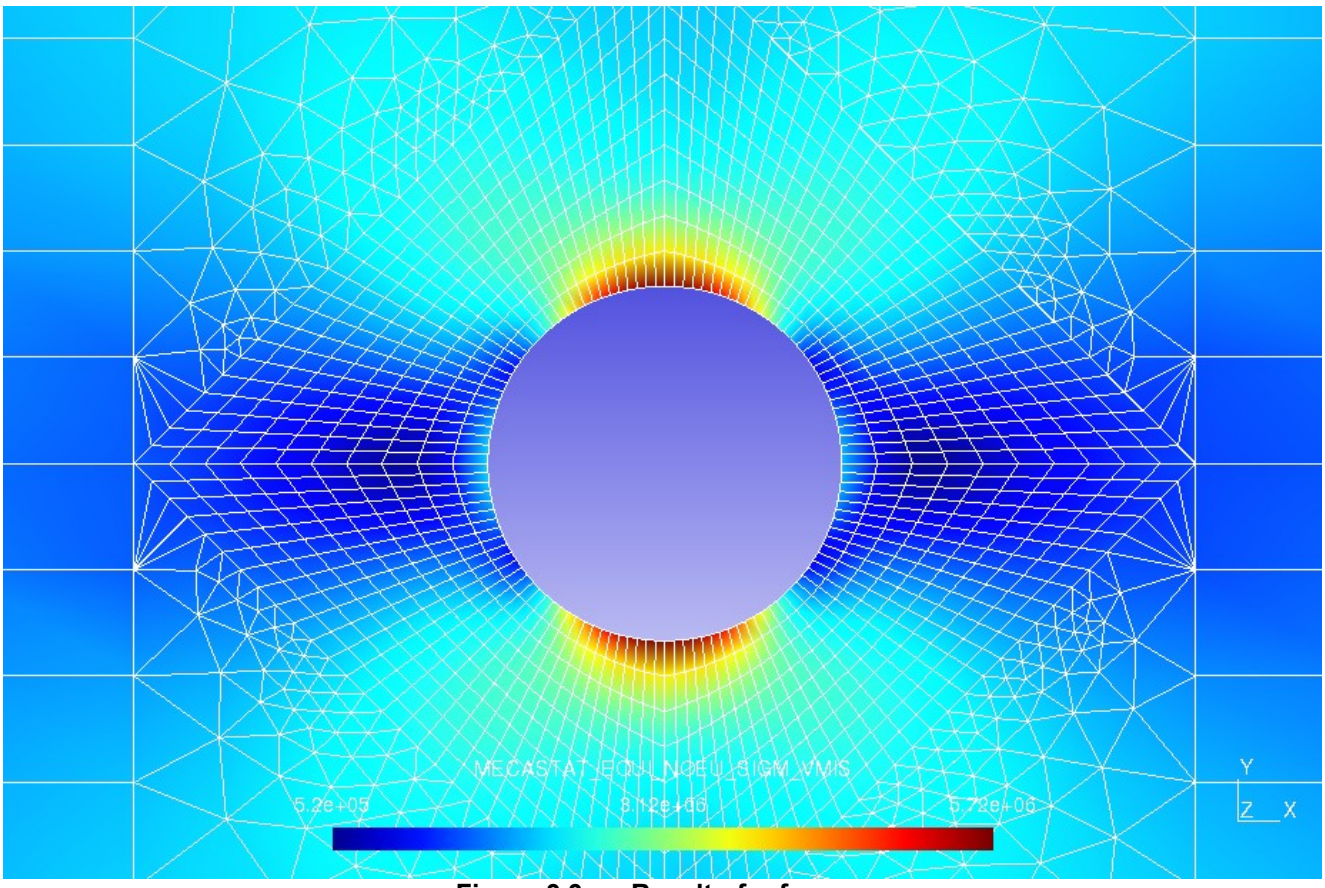
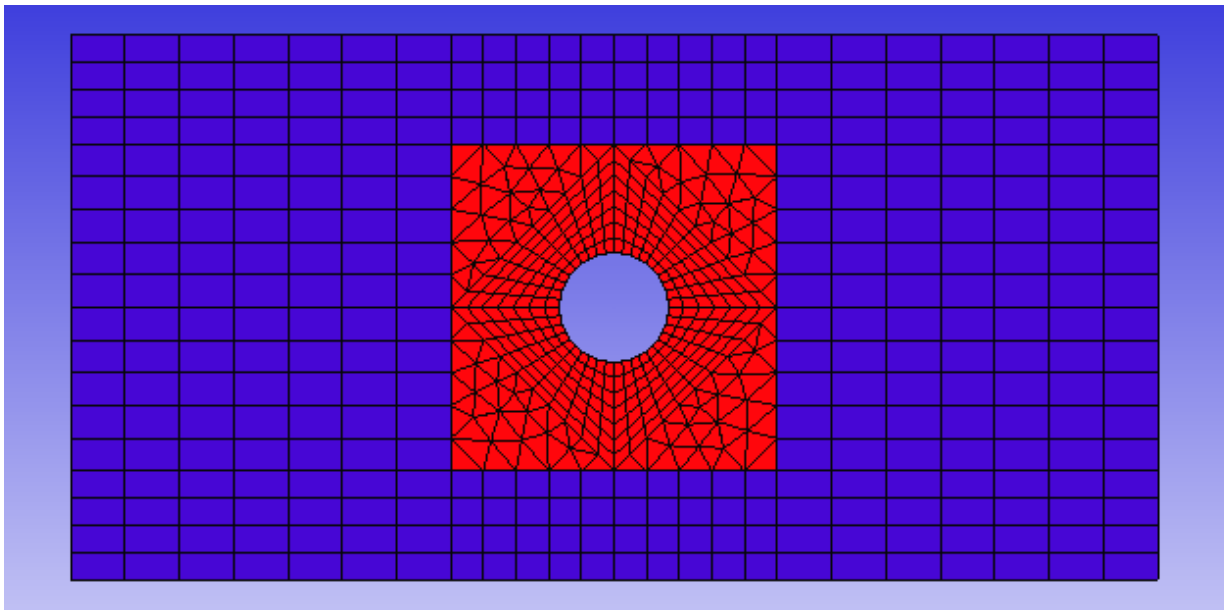


Figure 3.3-a : Result of reference

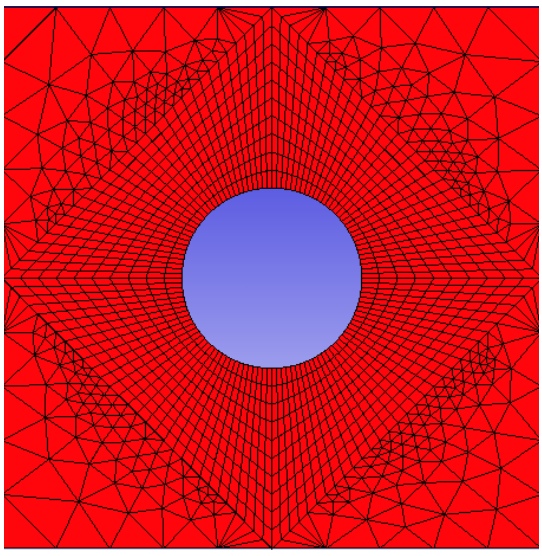
4 Modeling B

4.1 Characteristics of modeling

Below initial coarse grid:



Below fine grid said patch:



4.2 Characteristics of the grid

The characteristics of the coarse grid are the following ones:

Many nodes: 754

Number of meshs and type: 160 TRIA3
612 QUAD4

The characteristics of the fine grid are the following ones:

Number of meshs and type: 620 TRIA3
580 QUAD4

4.3 Sizes tested and results

It is about a test with respect to the values obtained on modeling A

Identification	Reference	Tolerance (%)
SIXX max	6.019E+06	2.0
SIXX min	-2.486E+05	2.0
SIYY max	9.782E+05	2.0
SIYY min	-2.092E+06	2.0

One visualizes the constraint of Von Mises around the hole:

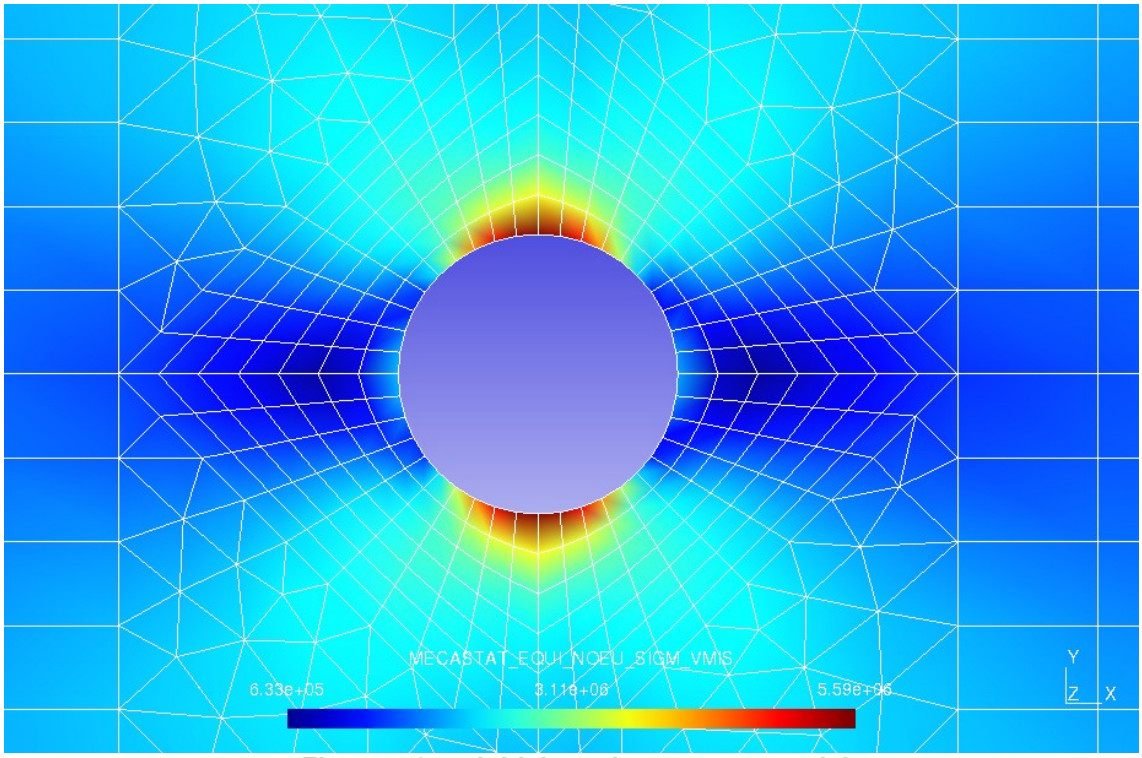


Figure 4.3-a : Initial result on coarse model

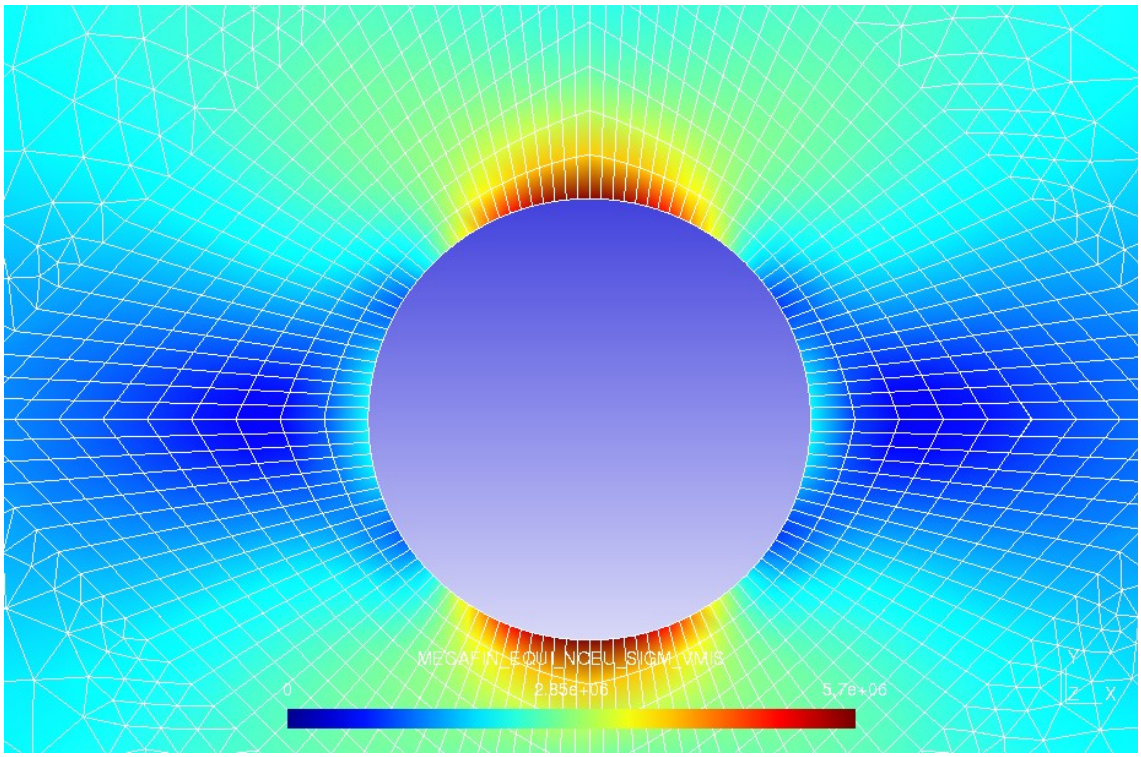


Figure 4.3-b : Result got after structural zoom

5 Summary of the results

The very good agreement of the results between two modelings validates the method structural zoom.