CAELinux and finite element analysis. Tutorial 3, 2D perforated face

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May 28, 2006

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Abstract

The goal of this third tutorial is to confirm the results we got in the previous tutorial, but this time using a 2D model. So, we will apply a pressure load on the edge of a perforated square.

1 Start

The tutorials shipped with CAELinux are 3D studies. And we also started this serie of tutorials by working on a 3D example, the perforated cube. The second tutorial demonstrated that the 3D analysis could have its own limitations. Misunderstanding the results on a face could lead to wrong conclusions. Moreover, when one studies a "long" part and axial loads, a 3D mesh could be too large whereas a 2D mesh would be good enough.

2 2D Mesh

Create a 2*2 square face, with a 0.5 perforation in its center. Explode the figure and name the edge Y=0 "base", the edge Y=2 "pression" and the circle "cercle". You should get something similar to 1. As we are in 2D and not 3D anymore, we will produce a finer mesh. The numbers of elements will be smaller for an equivalent mesh. In 2, i used 0.1 as the Average length for the mesh. As a reminder, we will use the hypotheses and algorithms that have already been described in the first tutorials. Constructing the groups is straightforward. Export in MED 2.2 and launch ASTK+EFICAS before analyzing the results.

3 Tweak EFICAS for the 2D case

The available templates (Template files in New FE Analysis - Create new ASTER job) are only 3D cases. That's too bad! So, open the first one and just tweak it:

- In AFFE_MODELE change MODELISATION=3D for MODELISATION=D_PLAN.

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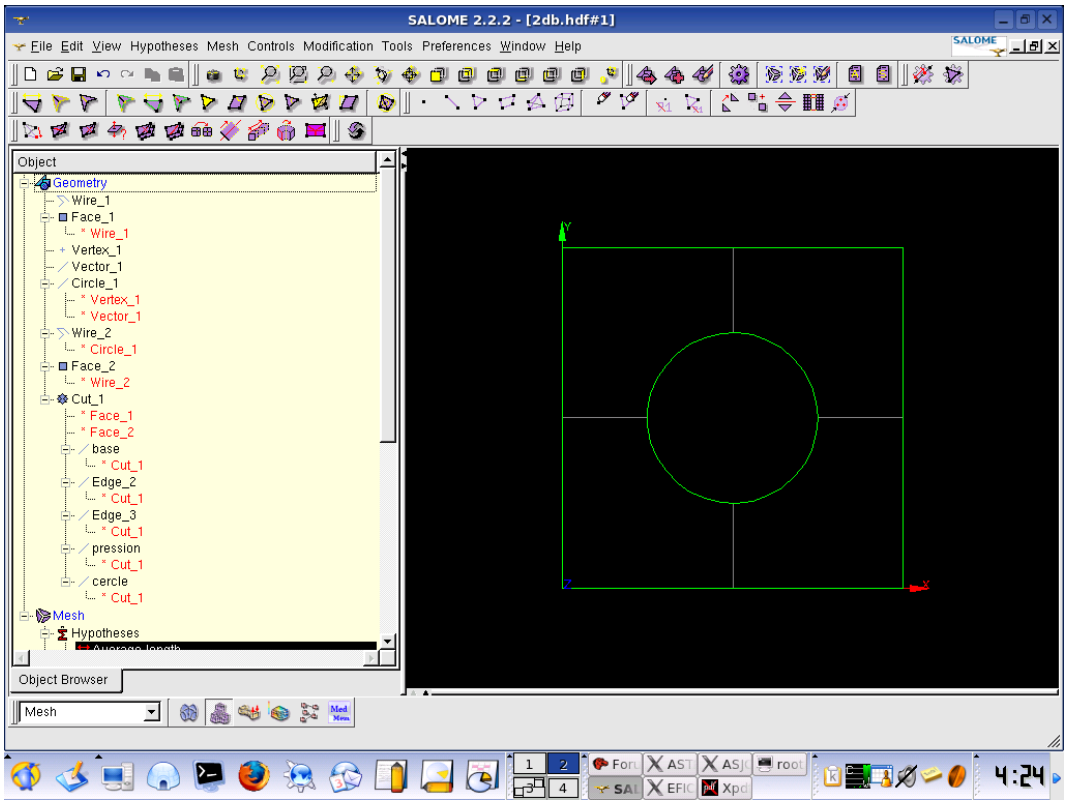

Figure 1: Perforated square

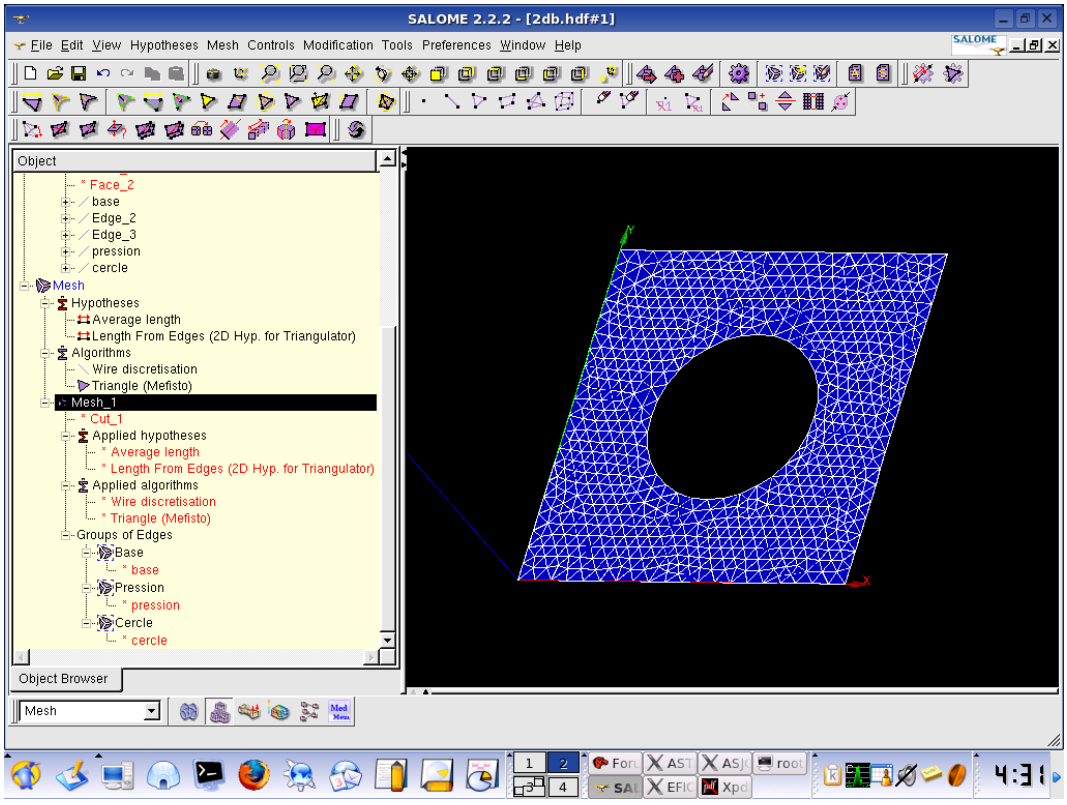

Figure 2: 0.1 for Average length

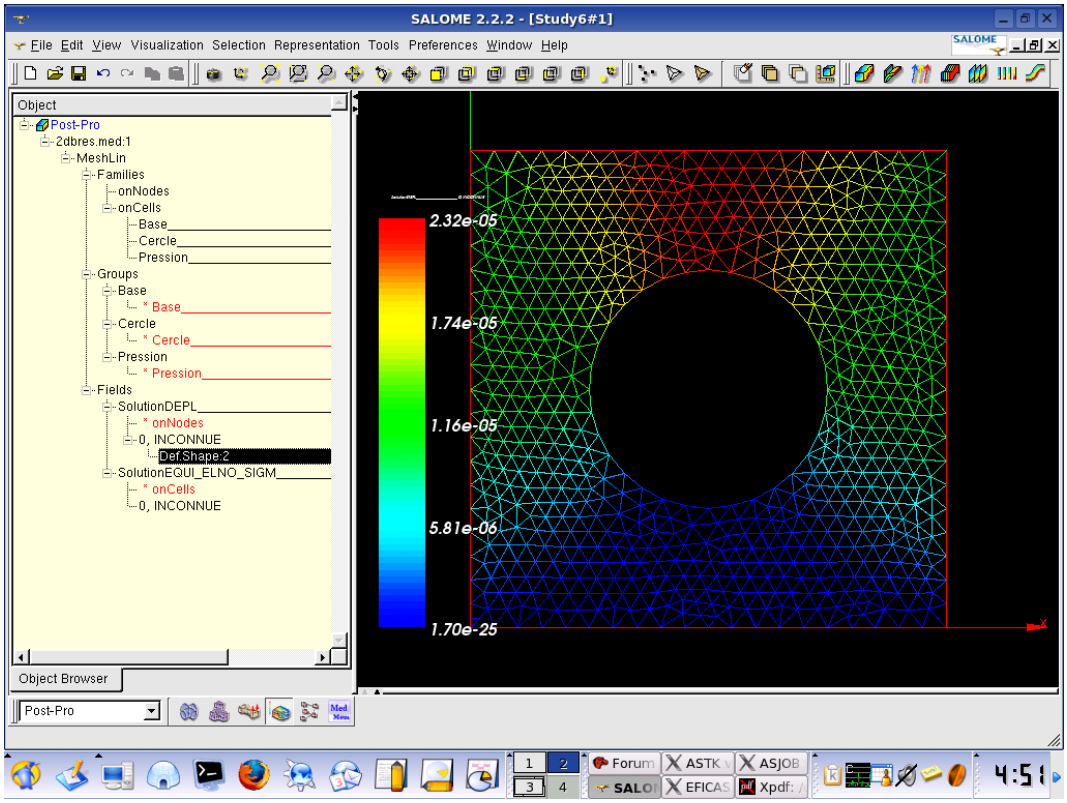

Figure 3: Perforated square

- In IMPR_RESU / RESU change NOM_CMP=('DX','DY','DZ') for NOM_CMP=('DX','DY') or TOUT_CMP='OUI'. Since we are in 2D, DZ is meaningless and would generate an error.

Setting-up AFFE_CHAR_MECA is similar to the Tutorials 1 & 2, the edge Base is fixed, DX=0, DY=0, delete DZ or you will get an error during the Code-Aster run. The pressure on the face is defined for a 3D case but we will come back on that matter soon.

4 Results analysis in SALOME

Once the calculations have been carried out, the results are loaded in the SALOME post-pro module and you should get something similar to 3. It is now time to check that the 2D and 3D results are similar. If they are, then our method would be validated. My machine's configuration (256Mo) doesn't allow to mesh and to calculate in a reasonnable amount of time the displacements of a 2*2*2 cube with a mesh average length of 0.1. So, i ran it quickly with average length = 0.2 so i could compare the displacement for the square and for the cube. I opened two times Import MED in the post-pro module to have my two results to get the results diplayed in figure 4 (x10000 scale).
The cube was imported with no color so it could be distinguished. If we magnify the top of the circle, we notice a slight difference between the two shapes, the square looks more deformed than the cube. If we have a close look (see Tutorial 2), it is confirmed: the square has a maximum displacement of 1.02336e-5 whereas the cube has a maximum displacement of 1.92248 e-5 and 1.88 e-5 in the middle section. So there is a small difference between the section of the cube and the 2D face. So, i would say that the 2 methods, 3D analysis and 2D D_PLAN analysis, are rather similar. Changing D_PLAN for C_PLAN leads to larger differences, typically 7 to 10%. One could surely find the accurate explanation in the CODE-ASTER manual. D_PLAN is dedicated to planar deformation and C_PLAN for planar stress. I have to admit i have to study this topic on my own...

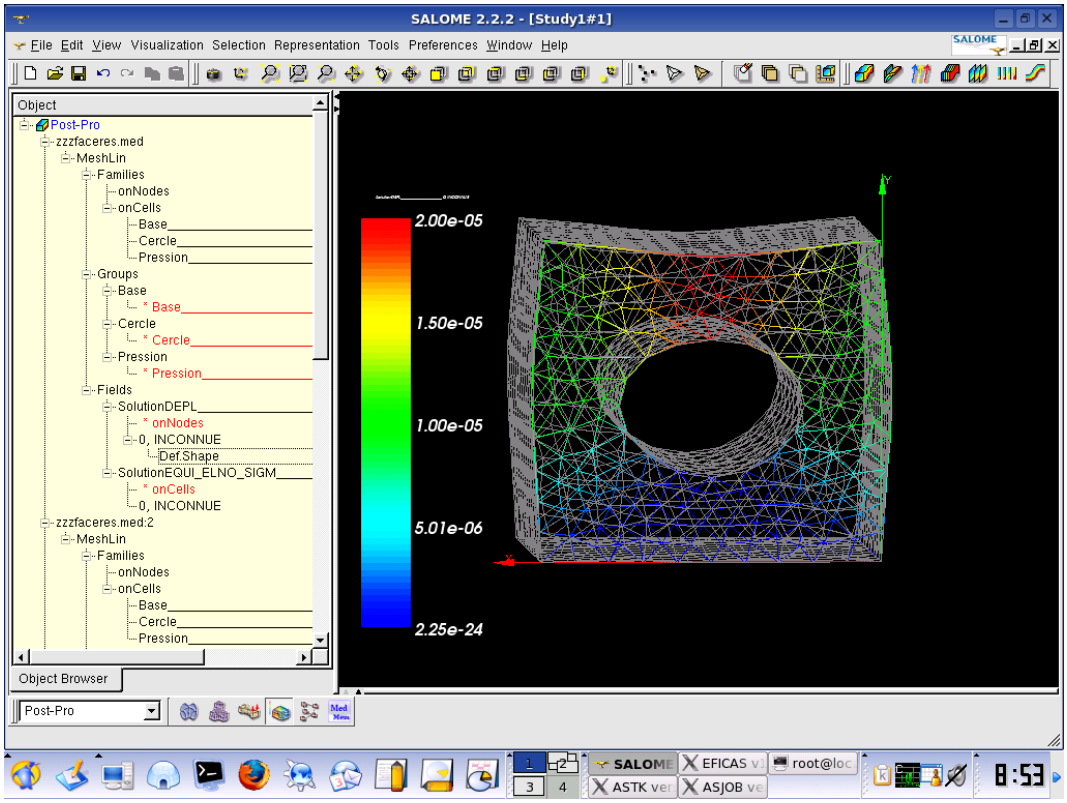

Figure 4: Perforated square in foreground, perforated cube in background

5 Conclusion, author, translation

This tutorial is the third one of a serie of others in which i write down my various experiences with CAELinux.
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