Universitat Politècnica de Catalunya

Master of Science in Computational Mechanics

Computational Structural Mechanics and Dynamics

Assignment 8
Shells

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1 Hyperbolic Shell

A concrete shell of thickness $t = 0,1$ m is clamped around all of it's edges and subject to self-weight. A scheme representing the geometry (with vertices coordinates) and boundary conditions is presented on Figure 1.1.

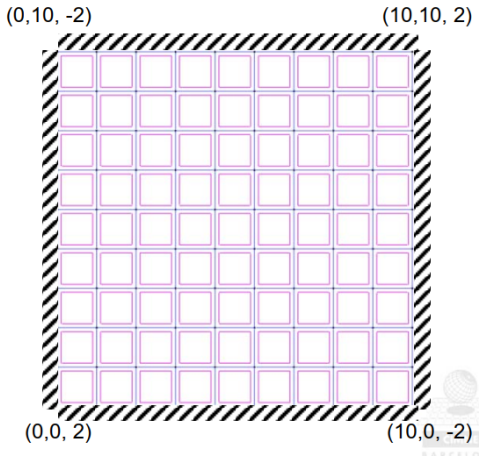
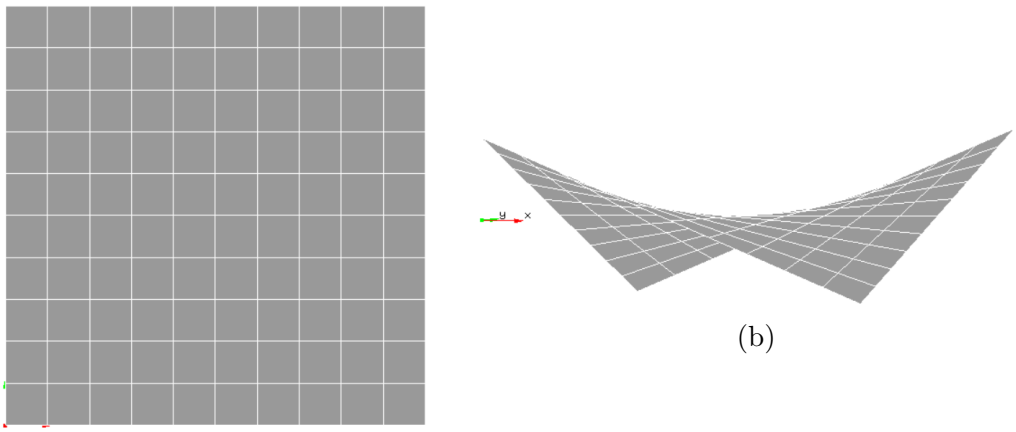


Figure 1.1: Domain and boundary conditions of the shell

To analyse the stress response of the hyperbolic shell, the domain was discretized in a 10x10 mesh as shown on Figure 1.2.

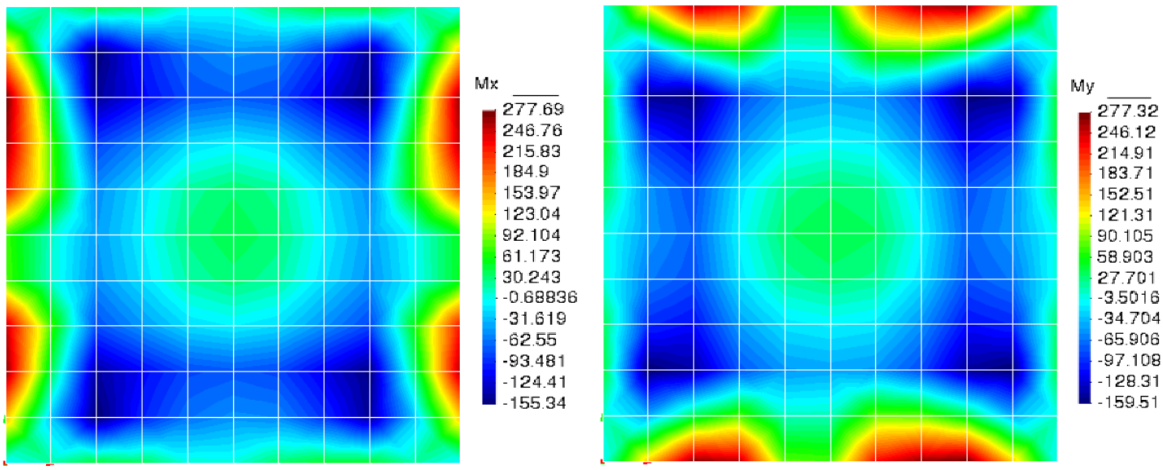


(a) (b)

Figure 1.2: Discretization of the shell viewed from above (a) and from the side (b)

Once the domain, mesh and boundary conditions were defined (using the pre-processing tool of MATFEM-GiD), the Finite Element computation was processed via a MATLAB and the results analysed on MATFEM-GiD.

The results for the moment the shell is subject to are presented on Figure 1.3. As expected, the higher values are found close the boundaries, due to the type of joint. It's also worth noticing that, given that shells tend to distribute the forces with the whole structure, it also generates the perceivable moment around the center.



(a) (b)

Figure 1.3: Contour of local moment values around x (a) and around y (b)

This can be further investigated through the membrane forces, shown on Figure 1.4. It's evident that the in-plane are most relevant on the mid-plane of the shell, explaining the contour found for the moment.

The results regarding the deformation are presented on Figure 1.5 and follow the previous analysis on membrane forces, yielding a higher deformation on the region around the center. Furthermore, the shear forces are depicted on Figure 1.6, showing the effect of the clamped edges on the shell under self-weight.

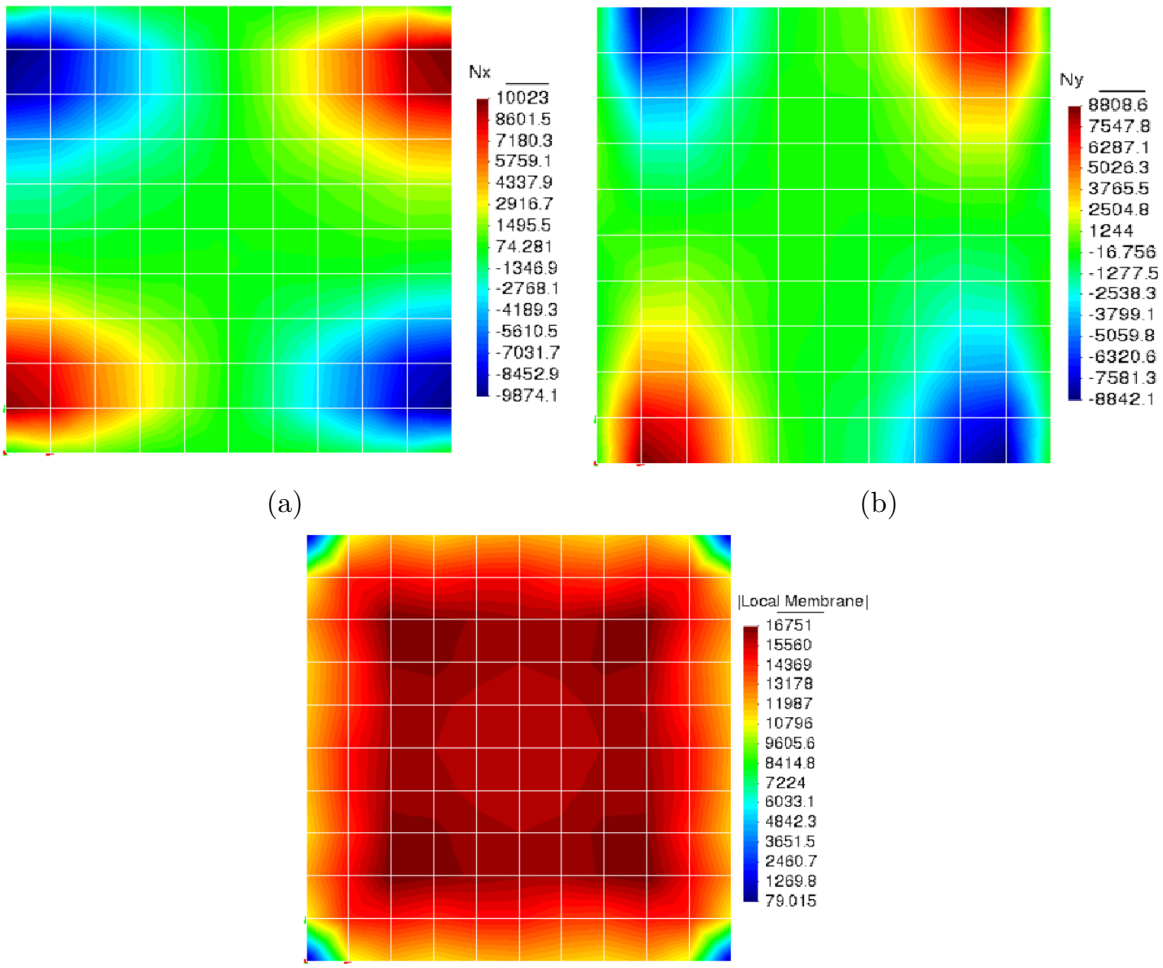


Figure 1.4: Contour of membrane forces in x (a), y (b) and xy (c)

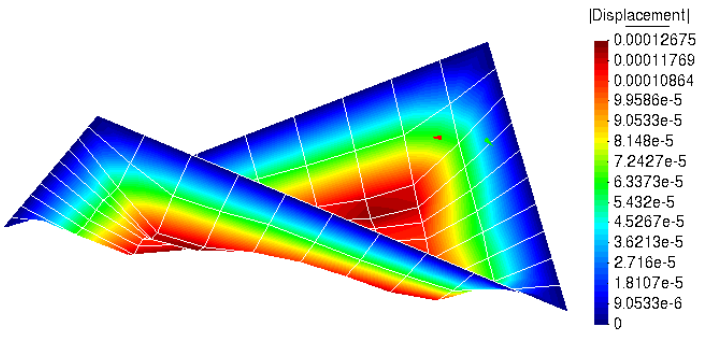
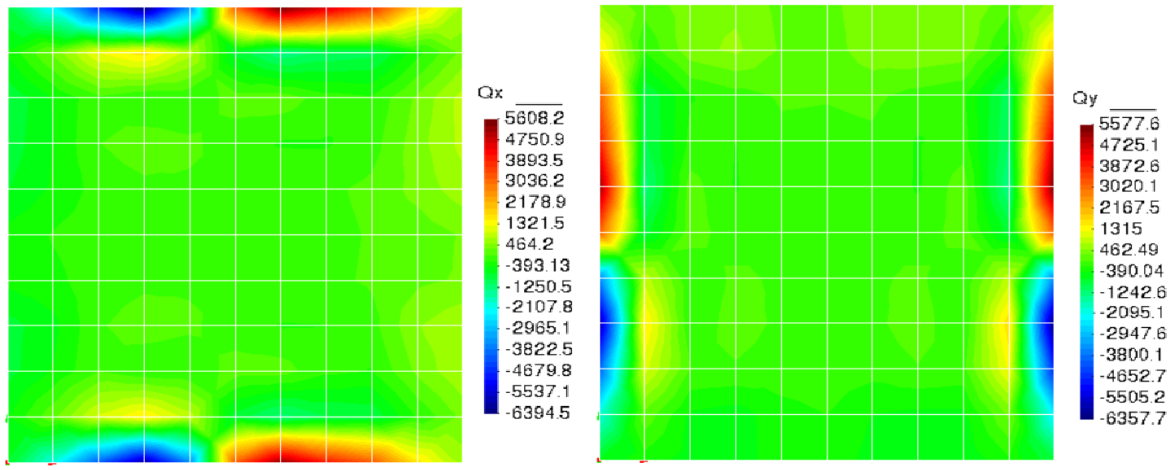


Figure 1.5: Displacements and deformation (x1000 factor) of the shell due to self-weight



(a) (b)

Figure 1.6: Contour of shear stresses in x (a) and y (b)