UNIVERSITAT POLITÈCNICA
DE CATALUNYA
BARCELONATECH

Assignment 8

Computational Structural Mechanics and Dynamics

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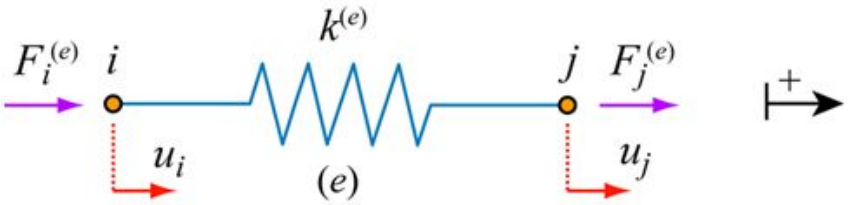
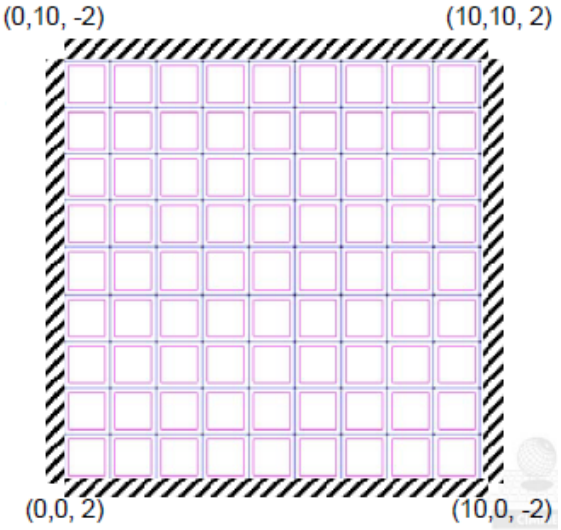


Contents

1 Assignment 8.1

Analyze the following concrete hyperbolic Shell under self weight.

Explain the behavior of all the Stresses presented.
t = 0.1



1.1 Deformed shape

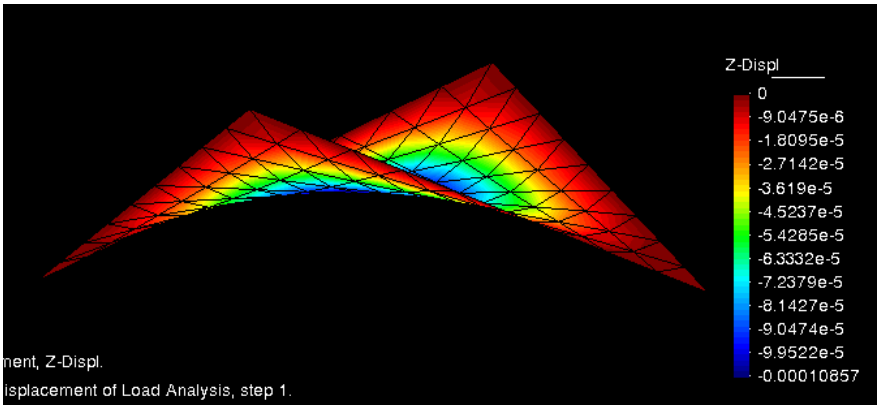
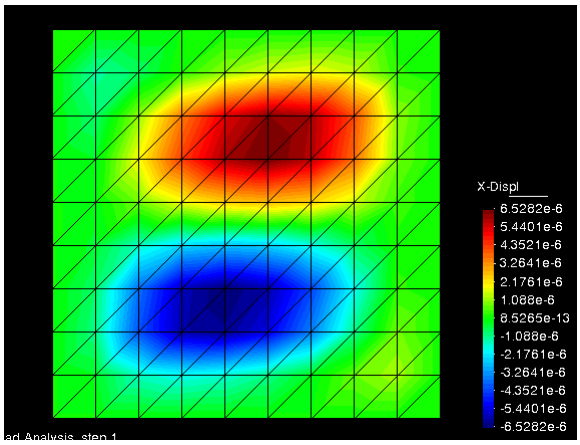


Figure 1: Deformed shape. Displacements z diagram

1.2 Displacements



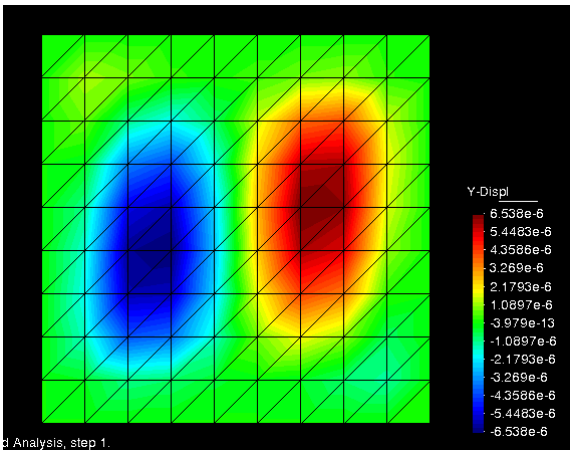


Table 1: Displacements x and y

Discussion: In the case of displacements in "x" and "y" it can be seen that these are very small and parallel to its axis, which is an expected behavior. While in the case of the z axis, the displacements grow as they get closer to the center of the shell. In neither case are displacements at the edges due to boundary conditions.

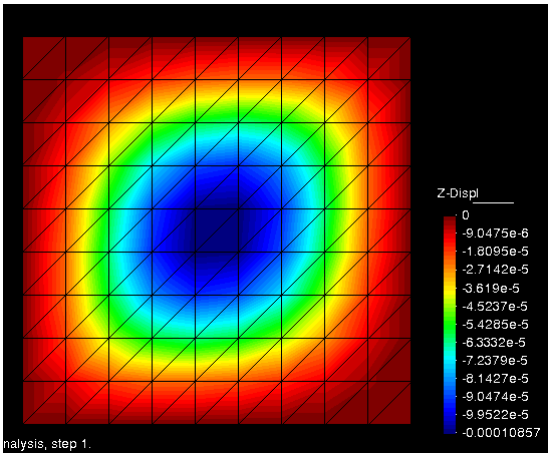
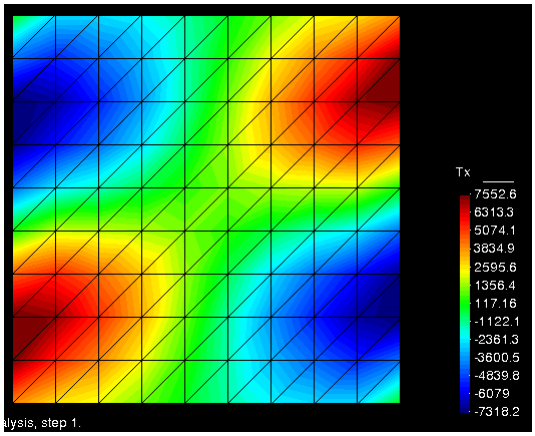


Table 2: Discussion and Displacements z

1.3 Membrane Stresses



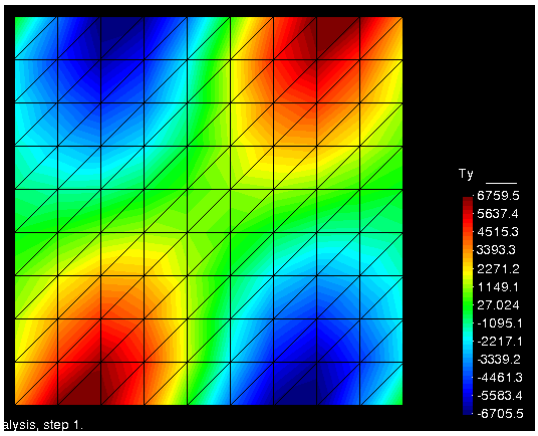


Table 3: Membrane Stresses Tx and Ty

Discussion: The membrane stresses for the case "x" and "y" appear naturally at the corners and perpendicular to their plane due to the hyperbolic geometry of the shell, whereas for the case of "T_{xy}" clearly these increase as they get closer to the center.

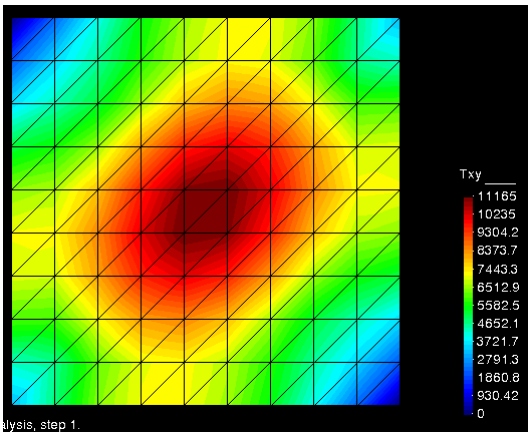
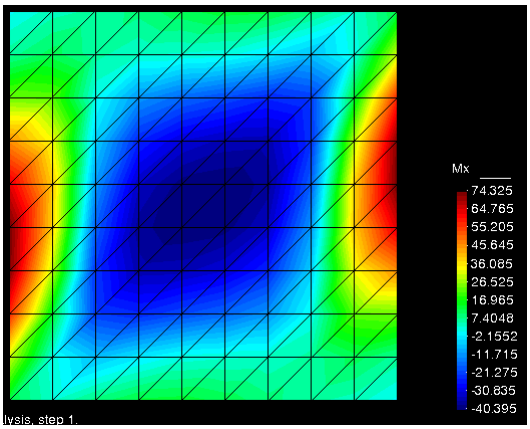


Table 4: Discussion and Membrane Stresses Txy

1.4 Moments



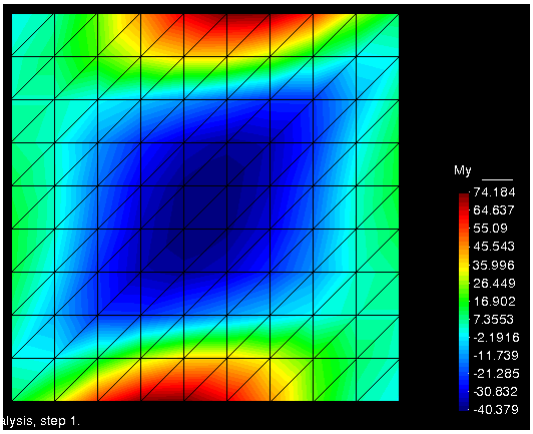


Table 5: Moments x and y

Discussion: The moment diagrams "M_x" and "M_y" reflect an expected behavior, since they present the highest concentrations at the edges, since the shell's own weight generates a torque perpendicular to the boundary conditions. It is also to be expected that as it approaches the center it will change its sign. In the case of the moments "M_{xy}" they will naturally be concentrated in the corners symmetrically, although the hyperbolic geometry slightly distorts this appreciation.

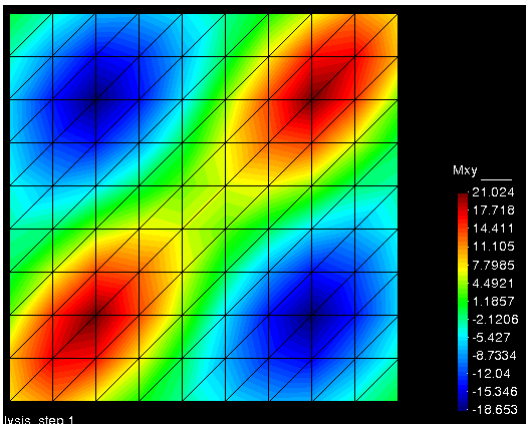
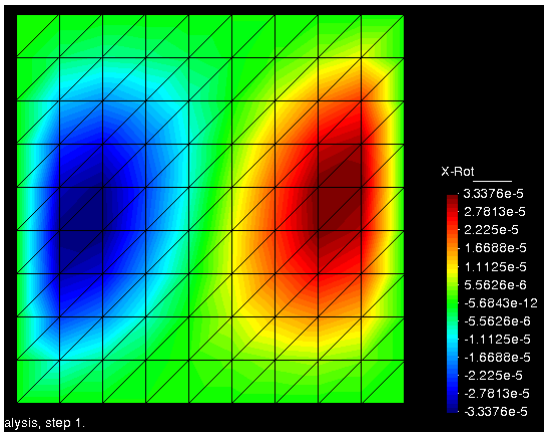


Table 6: Discussion and Moments Mxy

1.5 Rotations



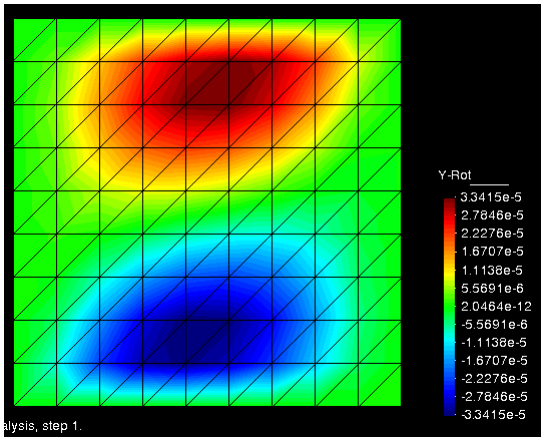
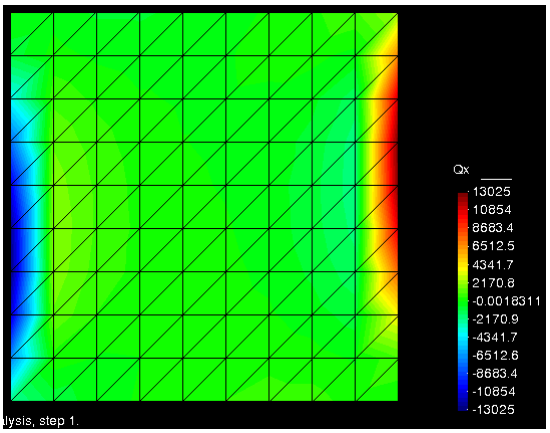


Table 7: Rotations x and y

Discussion: Rotations do not occur in the central and side stripes, concentrating between these two areas and being perpendicular to their axis. This phenomenon is due to the geometry of the shell.

1.6 Shear Stresses



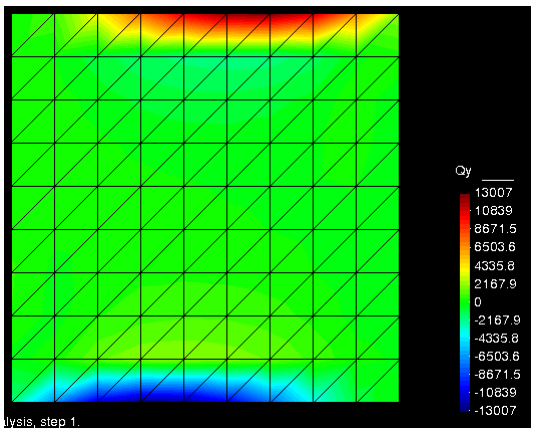


Table 8: Shear Stresses Qx and Qy

Discussion: Due to the boundary conditions and the geometry of the shell, the shear stresses accumulate at the edges perpendicular to their planes, in the case of a purely flat geometry, these would be completely symmetrical.