Computational Structural Mechanics and Dynamics

Assignment 8: Shell elements
by
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Exercise 1: Hyperbolic clamped shell under self weight

1. Explain the behavior of all the Stresses presented
   Material properties

$$E_s = 3.0 10^{10} \frac{N}{m^2} \tag{1}$$

$$\nu_s = 0.2 \tag{2}$$

$$\gamma = 2.5 10^4 \frac{N}{m^3} \tag{3}$$

$$t = 0.1m \tag{4}$$

   Loads

$$Self weight \tag{5}$$

2. It was used quadrilateral linear shell elements. Boundaries of the geometry was clamped. The figure below shows the mesh and boundary constrains.
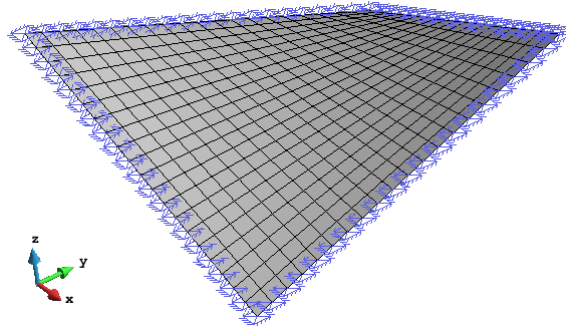

Figure 1: Mesh and bondary conditions.

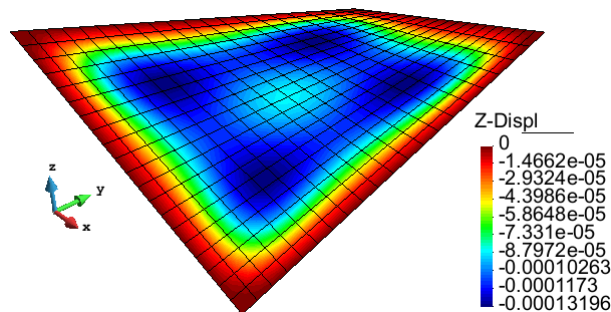3. The z-displacement obtained is shown in figure below.

Figure 2: Z-displacement [m].

It can be observed that the direction of the displacements are in accordance with the applied load.

4. Figure 3. shows the membran forces (Nx and Ny) and in-plane shear force (Nxy). Figure 4. shows the bending moment (Mx and My), and torsion moment (Mxy) and Figure 5 presents two shear forces Qx and Qy.
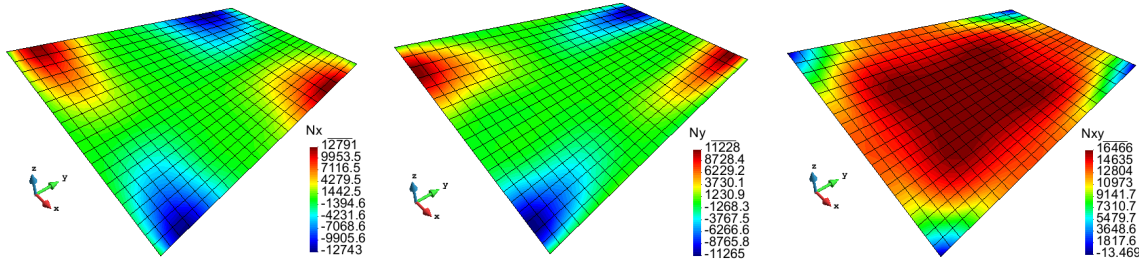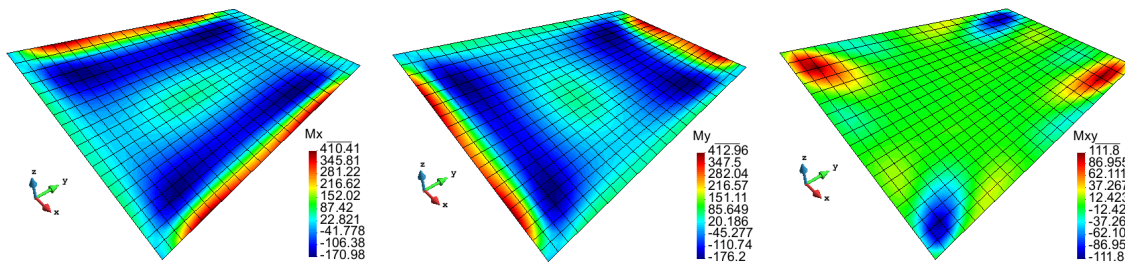

Figure 3: Membran forces.

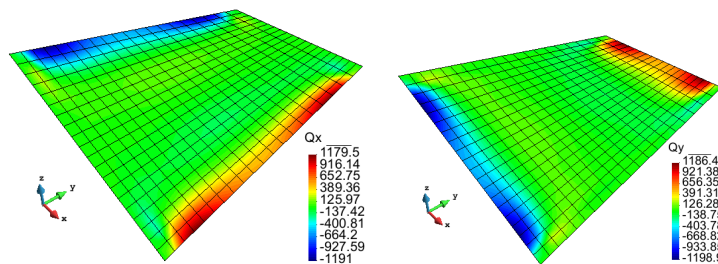Figure 4: Left: Bending Moment Mx, center: Bending Moment My and right: Torsion Moment.

Figure 5: Left: Shear force Qx, and right: Shear force Qy.

Several remarks can be said. First of all, the different plots can be shown that computed forces were symmetrically distributed in concordance to the symmetry of the problem, (material, load, constraint and geometry). Second, bending and torsion moment con be considered negligible, and out-of-plane shear forces can be considered negligible as well. It means that stress state of the structure is in accordance with a membranal stress state. Only membrane forces (Nx and Ny) and in-plane shear force (Nxy) are importants.