Computational Structural Mechanics and Dynamics - Assignment 8 Shells

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13. April 2018

1 Exercise

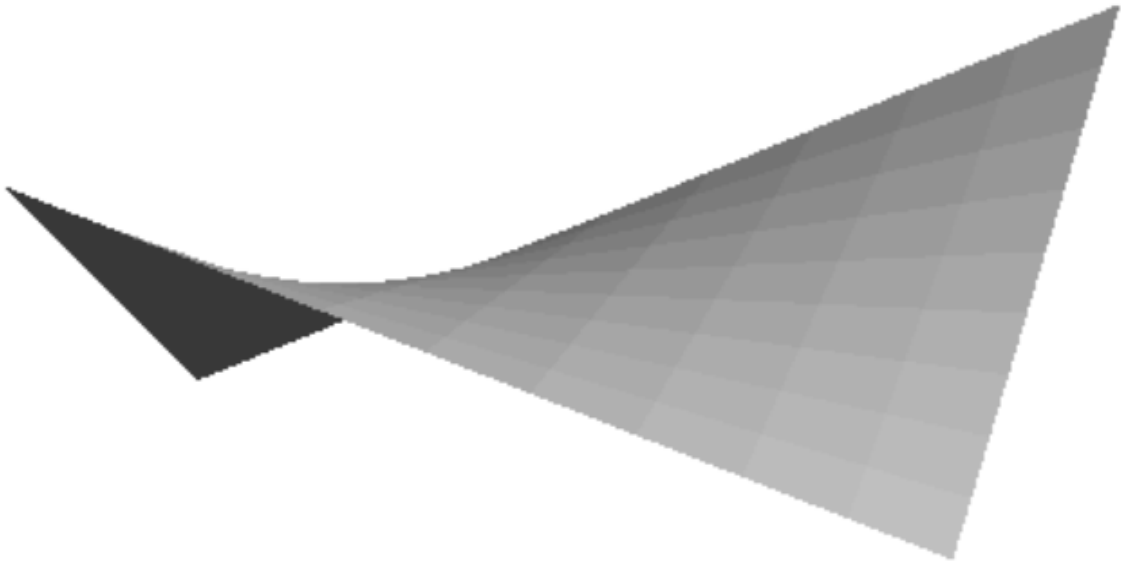

Figure 1: The shell given in the assignment shown in 3D

Using the shell interface obtained from the website of CIMNE, the input file to the Matlab code was created. The geometry was drawn according to the assignment and the shell was clamped on all sides. As asked in the assignment the material was chosen to be concrete and considered under self weight. Since the solution of the shell using the Reissner-Mindlin theory is based on using triangle elements, the mesh was created using triangle elements assigning the same amount for each partial surface. Below is the figures showing the drawn geometry together with the generated mesh.

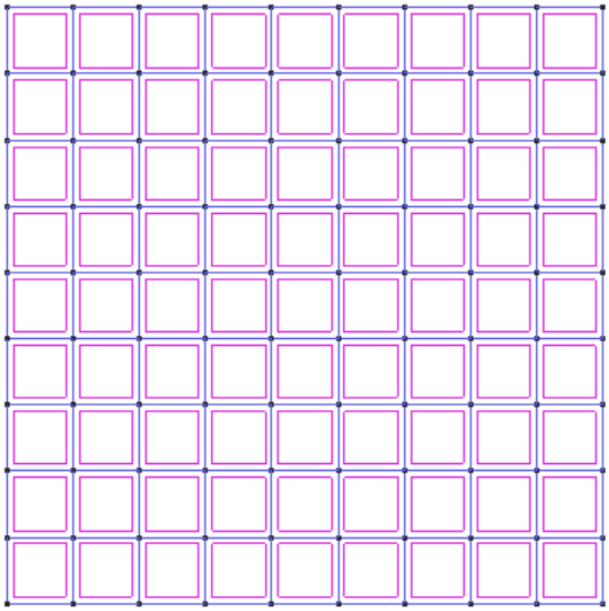

Figure 2: Geometry drawn in GID

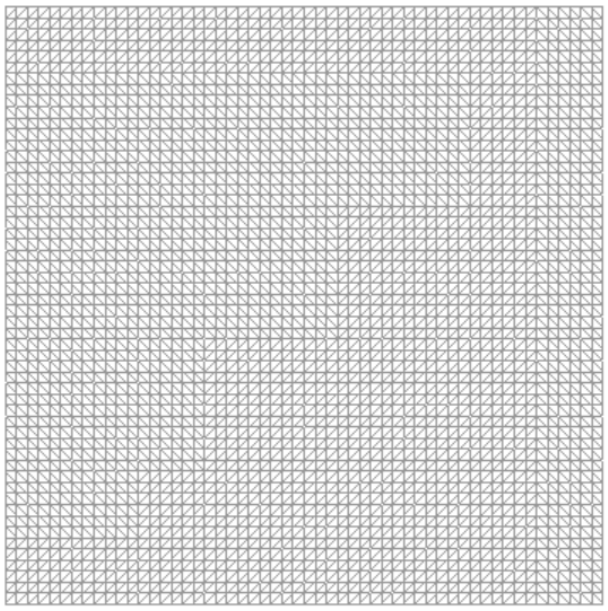

Figure 3: Structured mesh with triangle elements.

After the generated input file was run using the Matlab-code, the result file was opened in post process in GID. All results shown below is obtained from post processing the results for the input file for the clamped shell under self weight.

First, we look at the displacement in the different directions.

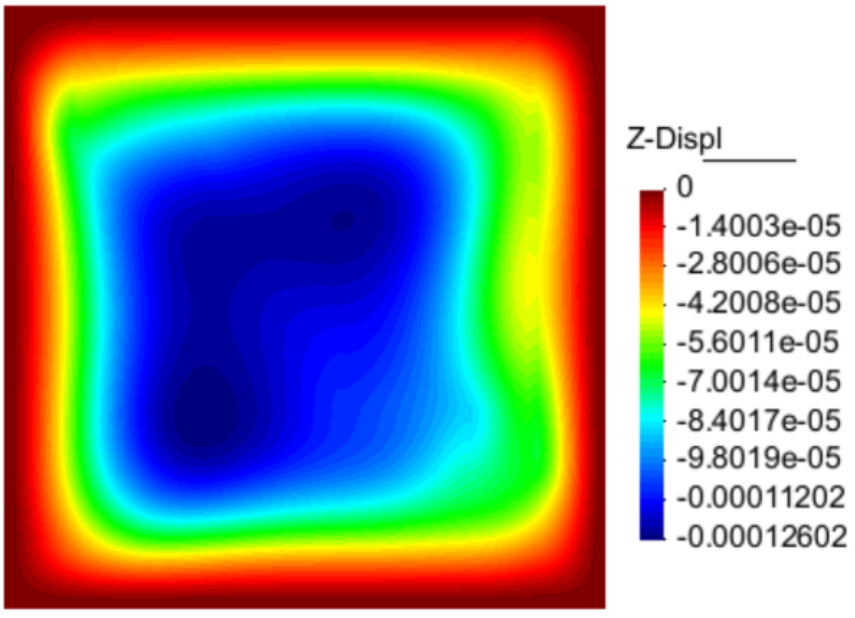

Figure 4: Displacement in z-direction.

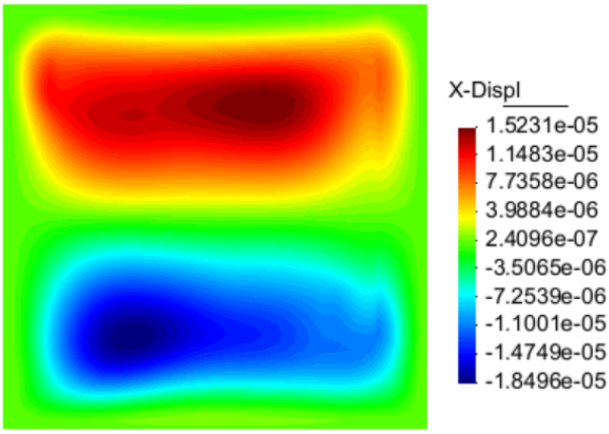

Figure 5: Displacement in x-direction.

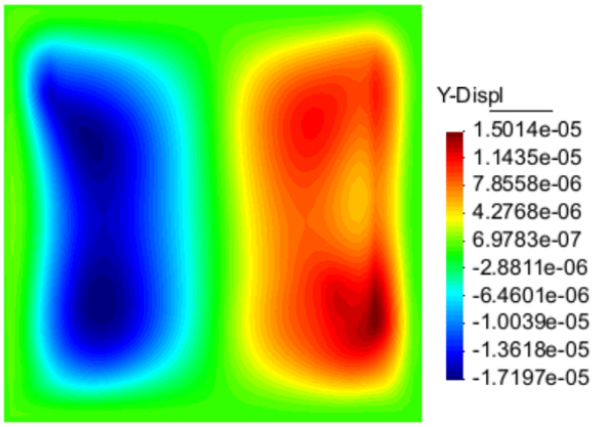

Figure 6: Displacement in y-direction.

As we can observe from the figures above, the displacement is not perfectly symmetric for a plane going across from corner to corner, but considering the differences of displacements in z-direction the displacement may be considered symmetric for planes going from corner to corner. We also observe that the displacement are 0 in the boundaries as expected since the shell is clamped at all outer boundaries.

Below is the figures showing the membrane and moment in x- and y-direction.

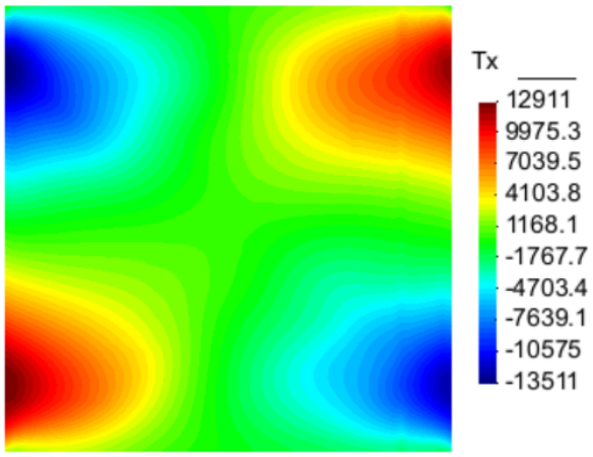

Figure 7: Membrane stress in x-direction.

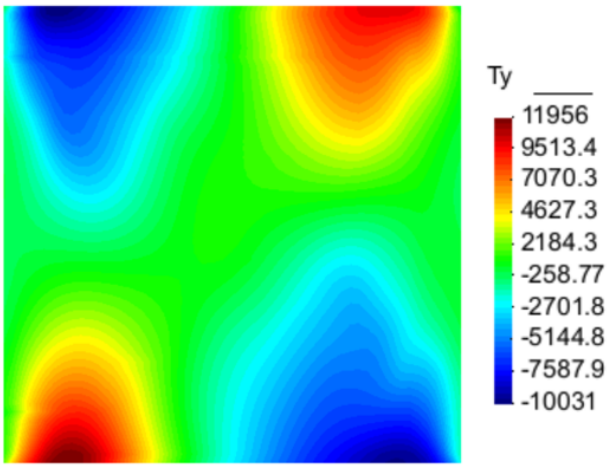

Figure 8: Membrane stress in y-direction.

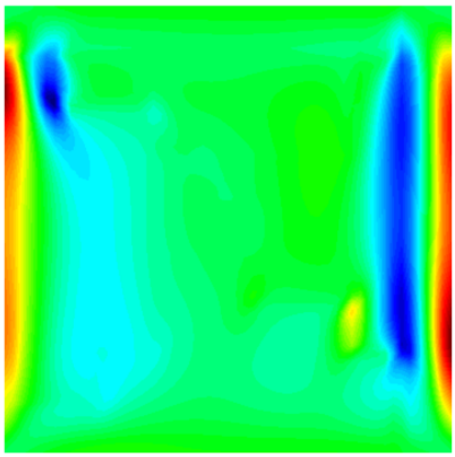

Figure 9: Moment in x-direction.

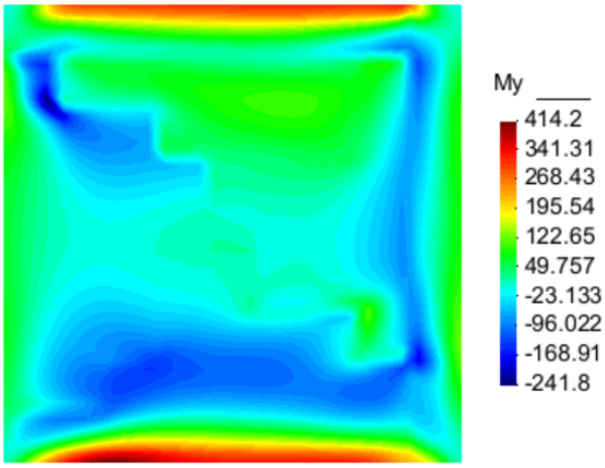

Figure 10: Moment in y-direction.

Similar to the displacement, both the membrane and the moment acts symmetric for the plane going through two opposite corners. Since the shell only consist of concrete, the structure could be considered homogeneous. Therefore, the membrane and moment are independent of each other and not coupled.

Since the shell is clamped at all outer edges, both membrane and moment acts in the outer boundaries. Worth noticing is that the membrane acting in both x- and y-direction is negative in the areas where the shell has negative z-coordinates, while it is positive in the areas where the shell has positive z-coordinates.

Below is the figures showing the shear distribution in the shell.

Figure 11: Shear stress in x-direction.

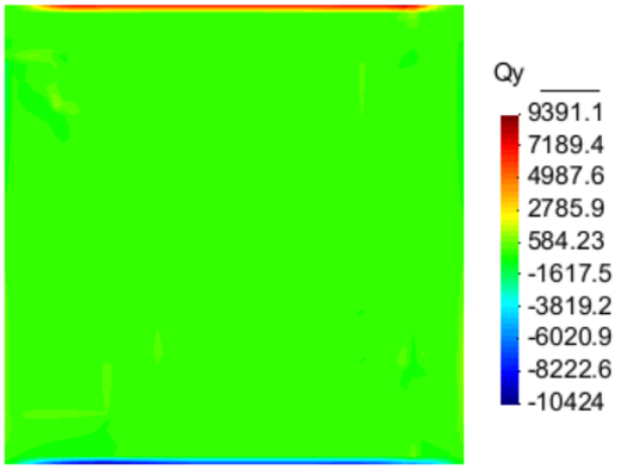

Figure 12: Shear stress in y-direction.

As mentioned before, the shell is clamped at the outer edges, and therefore the highest shear stresses acts in the outer edges. Also considering that the only load acting on the shell is the self weight working as an uniform load, the rest of the shell has a constant shear distribution.