Assignment 8 - Shells

Computational Structural Mechanics and Dynamics

Universitat Politecnica de Catalunya

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Problem: analyse the following concrete hyperbolic shell under its self-weight, and explain the behaviour of all the stresses presented. t=0.1m

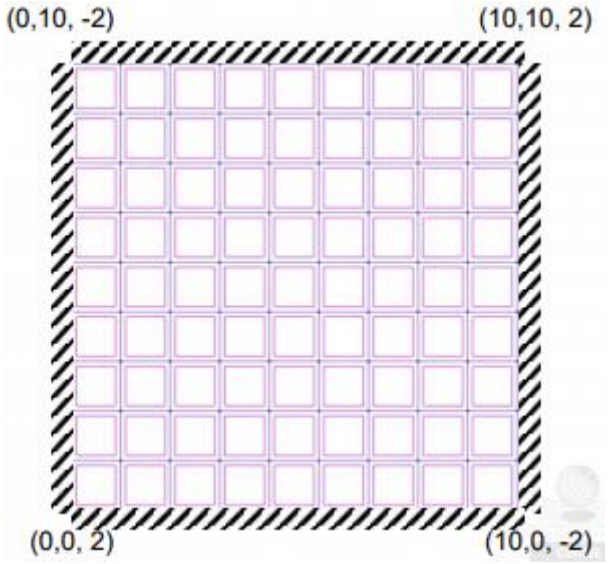

Figure 1 - Geometry of the shell structure

The problem is solved by modelling the geometry with boundary conditions, material properties and mesh in GID, with the use of the problem type Mat-FEM_shells. This is so used to a generate a file with all the necessary data of the shell structure, which is so analysed by the Matlab script "Lamina_T_RM". From Matlab I get a res-file, where the structure has gone through a FE-analysis, that is opened in GID to visualize the results. On the next page are the most interesting results shown and commented.

Results

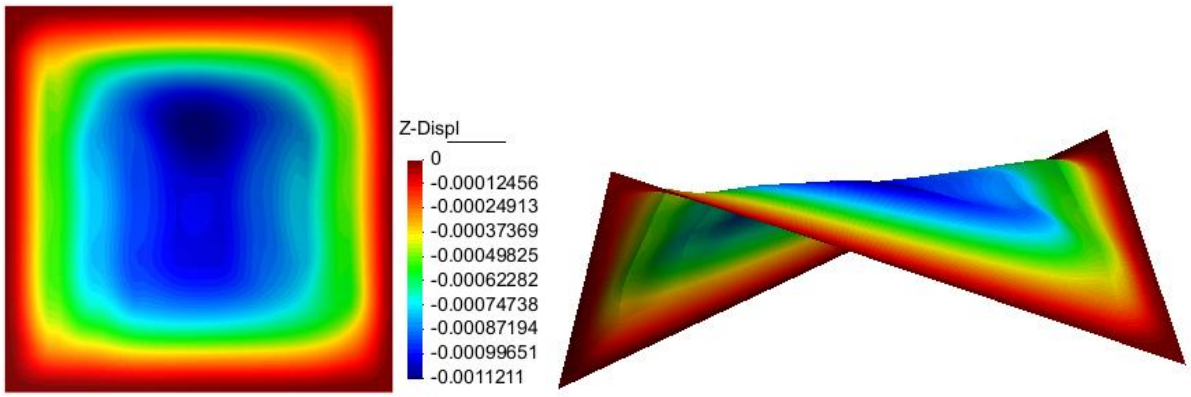

Figure 2 - Displacement of the shell structure

Figure 2 show the displacement with values for the shell structure. As this is a sort of plate with more complex geometry, do we see many of the same characteristics as it where a plate. I. e. we have maximum displacement towards the centre of the structure, with “symmetric” distribution. As we will see in the following figures, will the distribution of forces also have certain similarities.

As the figure show, does the maximum displacement not occur in the exact centre of the plate. With the geometry and the gravity force working symmetric on the structure, you would think that the maximum displacement occurs in the centre. There was used a structured mesh, but the program chose to not compute it 100% symmetric, which might be a reason for why the displacement distribution is not symmetric. However, the mesh was refined to very small elements, but the same distribution still occurred.

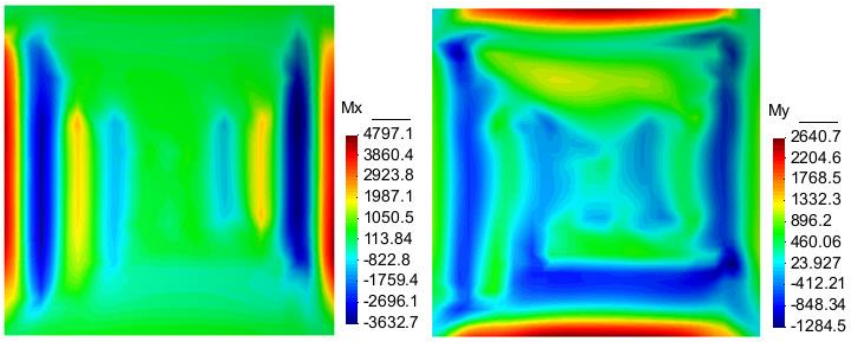

Figure 3

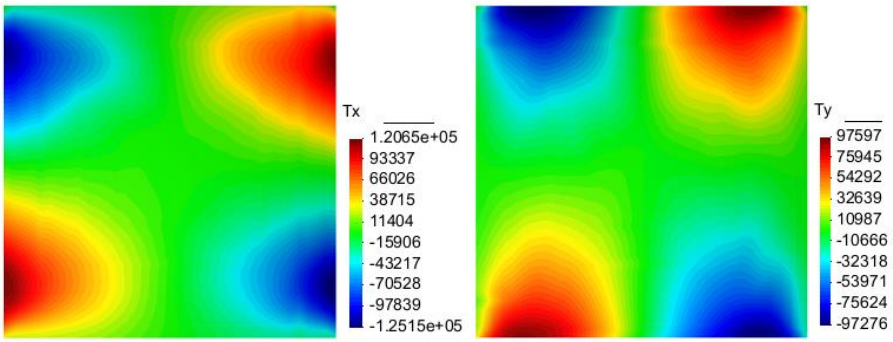

Figure 4

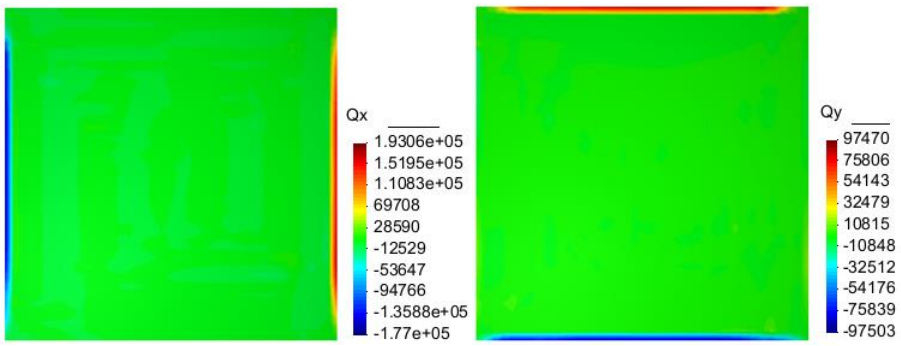

Figure 3

Figure 4 to Figure 5 shows the distribution of forces in the plate, and what it shows us is that the distribution is approximately symmetric, with the maximal values in the border of the shell structure. With a “plate similar” geometry are the maximum moments in the border. One interesting thing to notice is that the negative moments in the centre of the plate, are of much smaller size than in the borders. From plate theory is the centre moment about one half of the moment in the border, but in this case is the shape of the shell preventing large moments in the centre.

What is worth mentioning is how the sizes vary in the two directions. As mentioned in the previous section is the structure with the gravity force symmetric. Therefore one should expect the distributions of forces to also be symmetric, as far as the mesh allows it. The values in the figures show that this is not achieved in this case. Since the Matlab script produces the result on its own, will the “human error” most likely occur when modelling the geometry and generating the mesh. However, it was tried running the analysis with several different mesh and different ways of defining the geometry, but the same the same appeared, so it is difficult to say where the error happens.