Computational Structural Mechanics and Dynamics

Analysis of shells with plate elements

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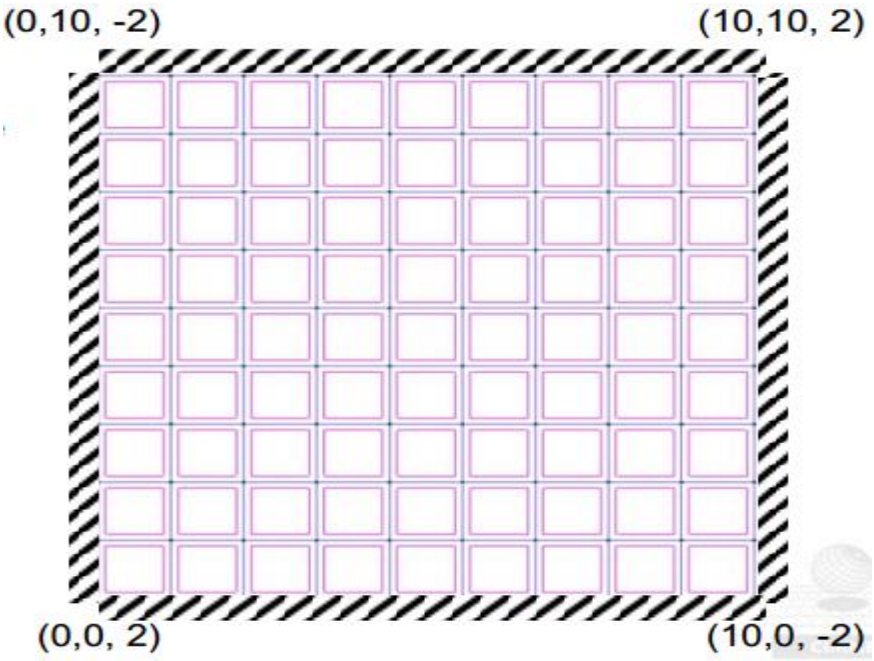
Analyze the following concrete hyperbolic Shell under self weight. Explain the behavior of all the Stresses presented. t = 0.1



ANS.

Initially using given data in the question, hyperbolic shell was created in 'GID 13.0.4' software and assigned following material properties for concrete E=3.0e10N/m2, v = 0.2, t=0.1 m . In matlab,input _les are created aditya.m etc., which includes inputs which has to be run in 'Shell_QLLL_r3D_v1_2 ' (main _le for shells was downloaded from Mat-Fem page), in which 4 Nodes CLLL Quadri-lateral elements is implemented and when after executing result _le in 'GID 13.0.4' post-process section, we obtain the results which are shown here.

Displacement;

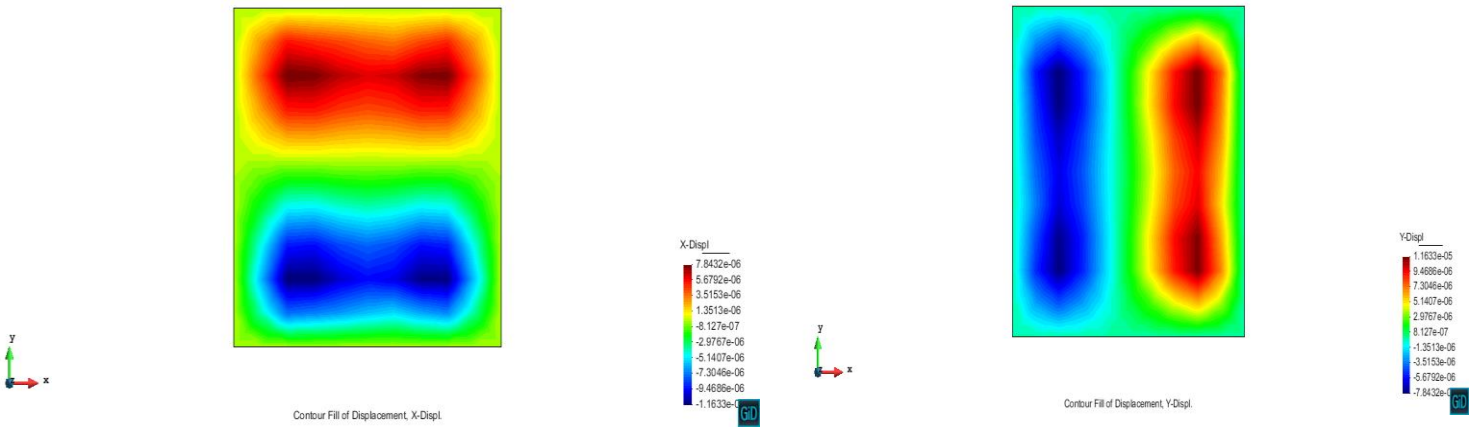


Figure 1 X and Y Displacement

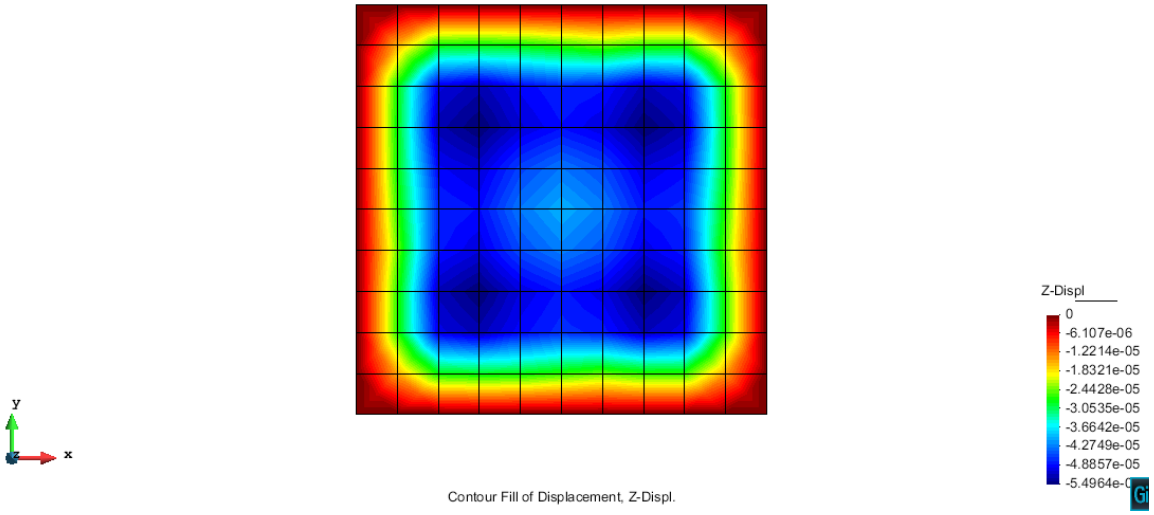


Figure 2 Z Displacement

To explain analysis or the behavior of different parameters like displacement and different types of stress distribution on concrete hyperbolic shell under self-weight,'aditya.m' input in which 10* 10 mesh is created.

After analysis, the maximum displacement along 'Z' of concrete Shell under self-weight considering 10*10 mesh for the above-mentioned properties is obtained as 'Z = 0.0000549m' which is as shown in Figure 3 below. We can observe that displacement is maximum at the mid-section of the Shell, since all the edges are constrained and self-weight acting upon it is concentrated more only at the centre which leads for the maximum displacement at centre.

Moment

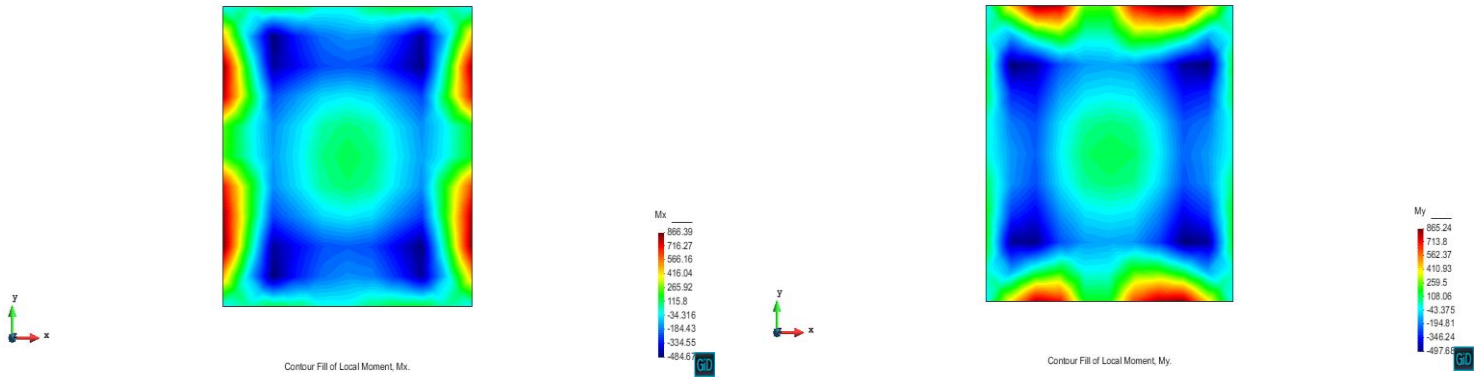


Figure 31 X and Y moment

Moment is found maximum in x and y direction as compared to XY Moment which is clearly visible from the results.

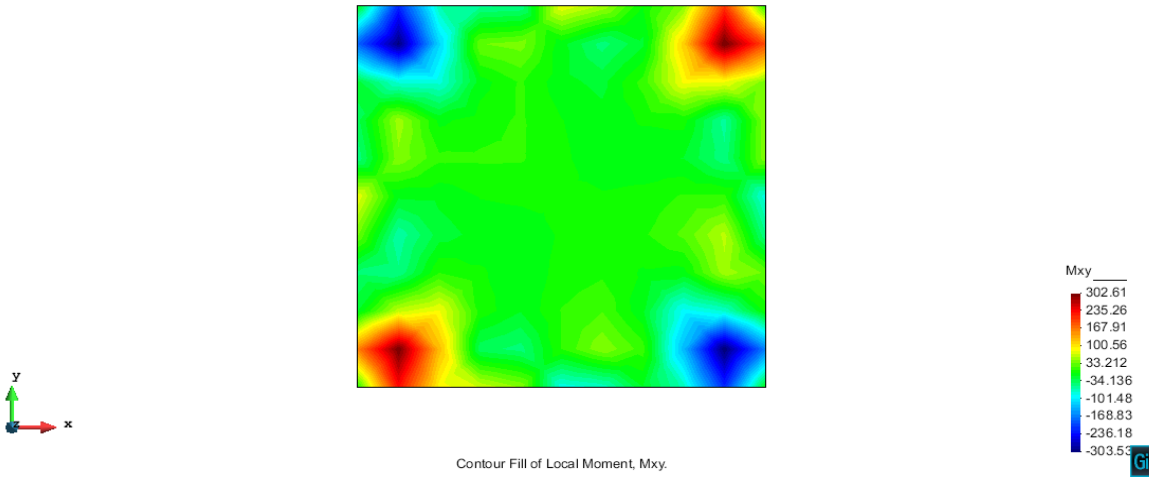


Figure 4 XY Moment

Membrane

The following membrane stresses patterns were found in the analysis.

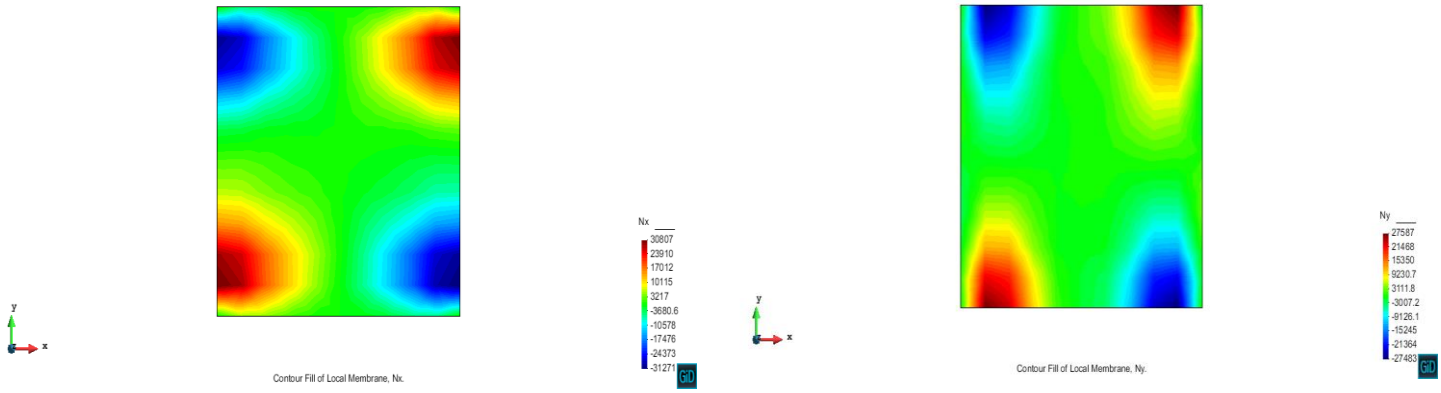


Figure 5 X and Y Membrane

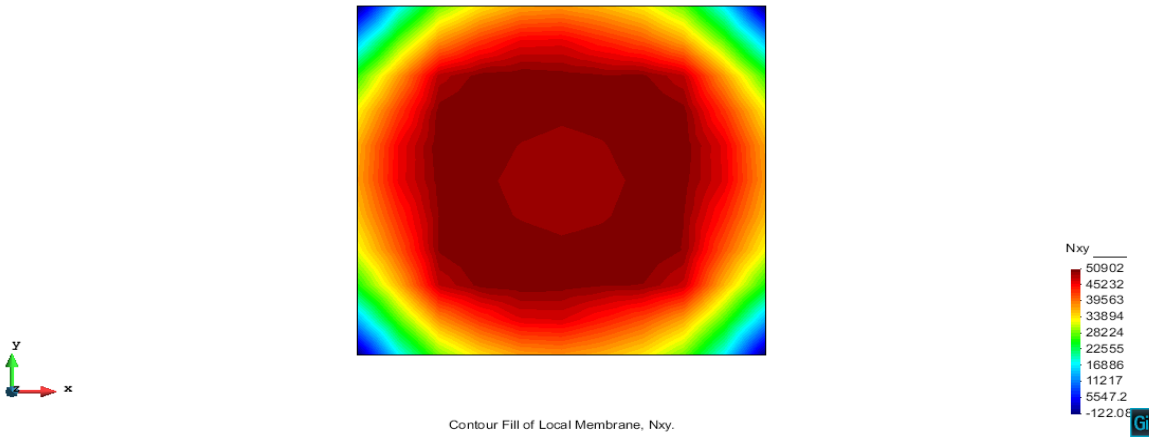


Figure 6 XY Membrane

Shear

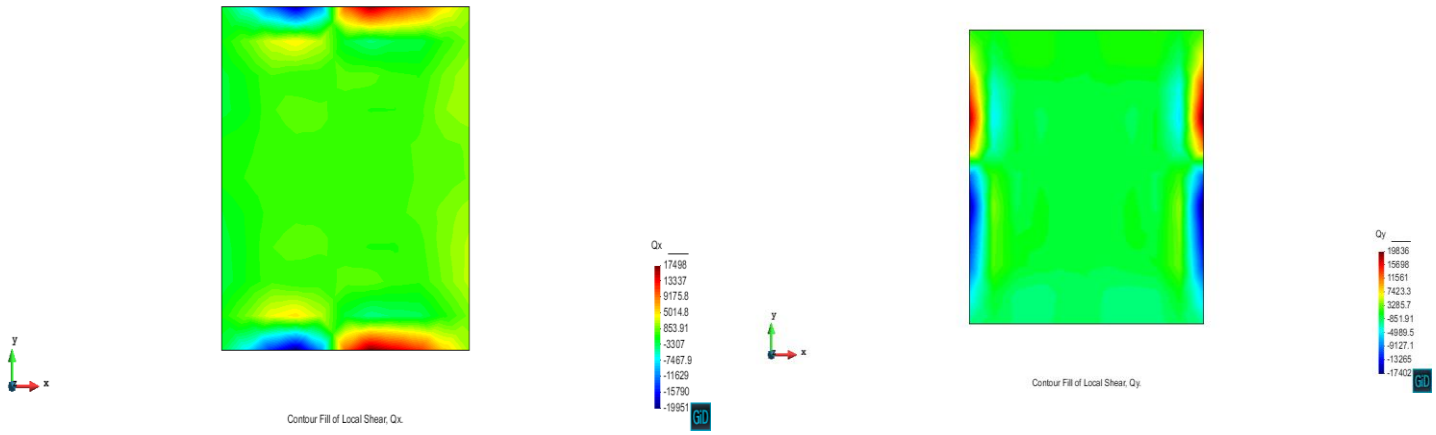


Figure 7 X and Y Shear

Comments on Stresses:

The existence of axial forces (membrane forces) which, together with the bending effects in shells, contributes to provide the foil bearing capacity higher than plates. We know that in shells, 3 types of stresses will occur, membrane stress (Plane stress) , stress due to bending moments and shear stress.

We can see that bending moments along X and Y is maximum around the edges of concrete hyperbolic shell because of maximum rotations around edges along X and Y, which clearly gives information that Bending stresses are maximum around the edges of shell.

Axial forces acting along X and Y is maximum around the corner edges of the shell, which leads to maximum Membrane stresses around the corner edges of the shell.

Shear is maximum around the edges since edges are constrained, due to which maximum shear stress occurs around edges. To conclude we can say that, from our analysis, it is concerned that the overall stresses due to Membrane, Moments and Shear is maximum around the edges of the concrete hyperbolic Shell which is acted upon self-weight, which means that failure chances are more around the edges of shell.