



UNIVERSITAT POLITECNICA DE CATALUNYA

MASTERS IN COMPUTATIONAL MECHANICS

COMPUTATIONAL STRUCTURAL MECHANICS AND
DYNAMICS

ASSIGNMENT-8
SHELLS

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1 Introduction

We have to analyse a concrete hyperbolic shell of thickness 0.1 m under self weight. Material Properties are: $E = 2.1e11N/m^2$, $\nu = 0.2$, $\rho = 78000N/m^3$. Using GiD-MatFEM, the geometry will be constructed and constrained (sides of shell are fixed). After meshing, the no. of elements = 162, no. of nodes = 100.

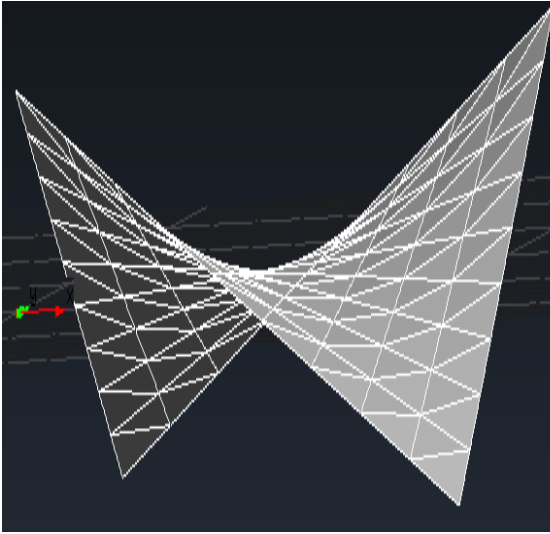


Figure 1: Shell Meshed (3D view)

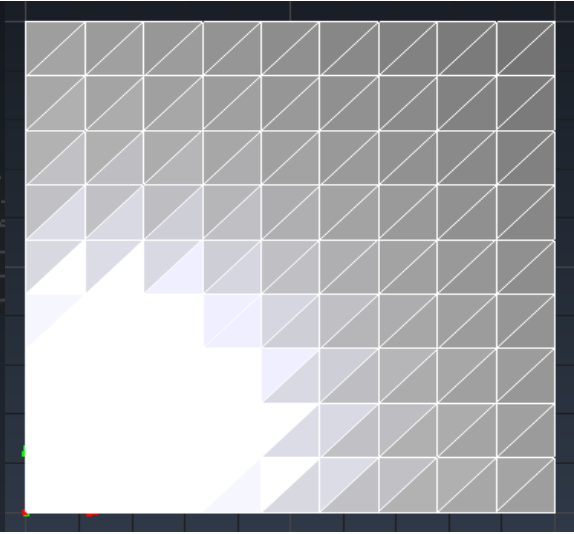


Figure 2: Shell Meshed (XY view)

2 Displacement

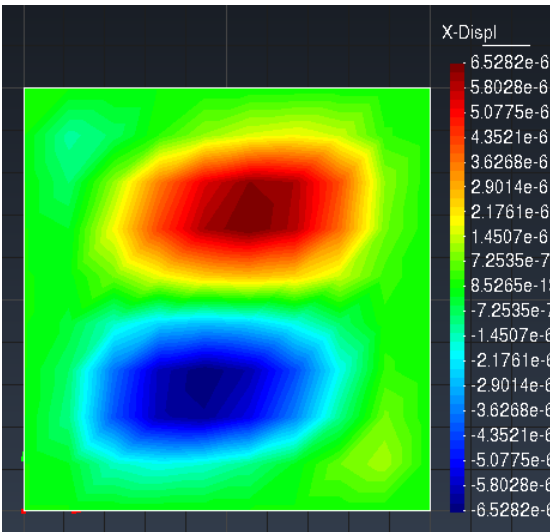


Figure 3: displacement(x-axis)

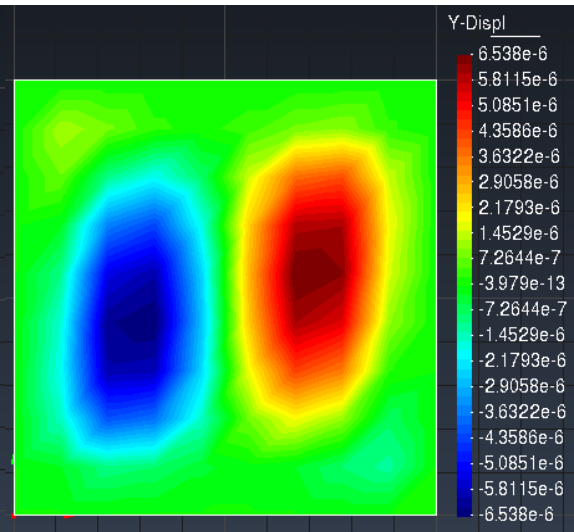


Figure 4: displacement(y-axis)

It is observed that the displacement at the sides is zero due the fact that sides are fixed. Displacement is only due to gravity, i.e., self-weight. Taking in account the displacement along z-axis, the max. value is attained near the center of the shell

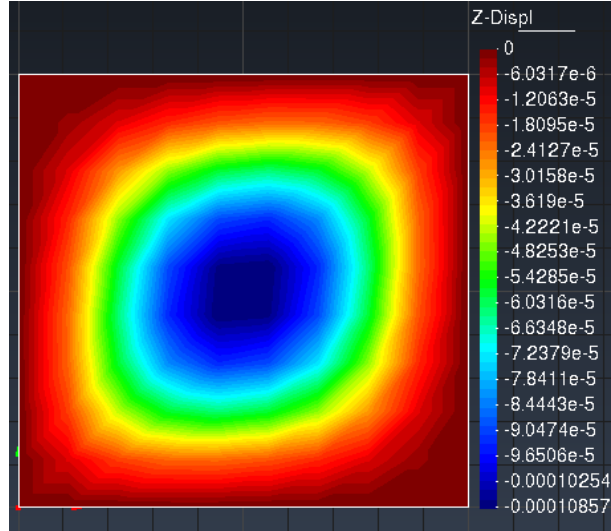


Figure 5: displacement(z-axis)

though in negative z-direction. Further, z-displacement plot show symmetry along diagonals. The x and y displacement have almost same value due to symmetry of the geometry.

3 Rotations

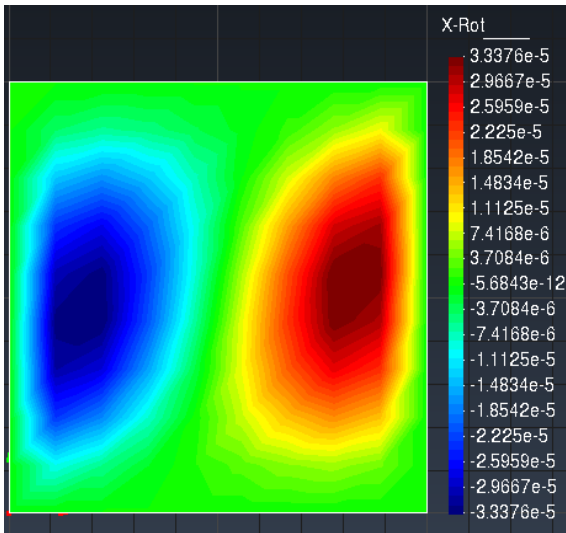


Figure 6: rotation(x-axis)

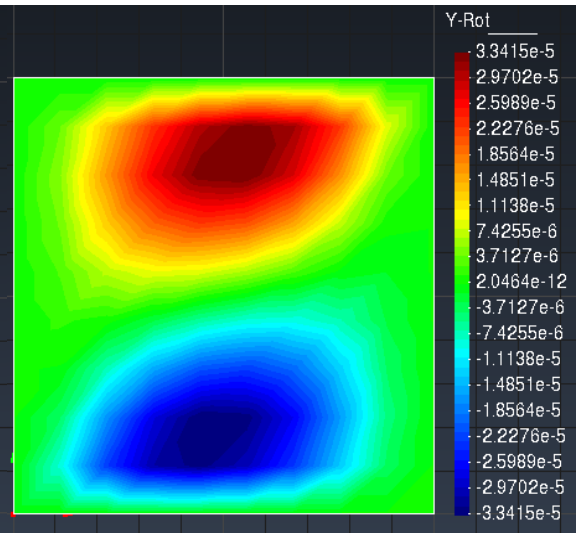


Figure 7: rotation(y-axis)

The rotation along x and y axes have same value due to presence of symmetry of the geometry. As the edges are fixed constraints, therefore, rotation values at the edges are zero.

4 Membrane Stress

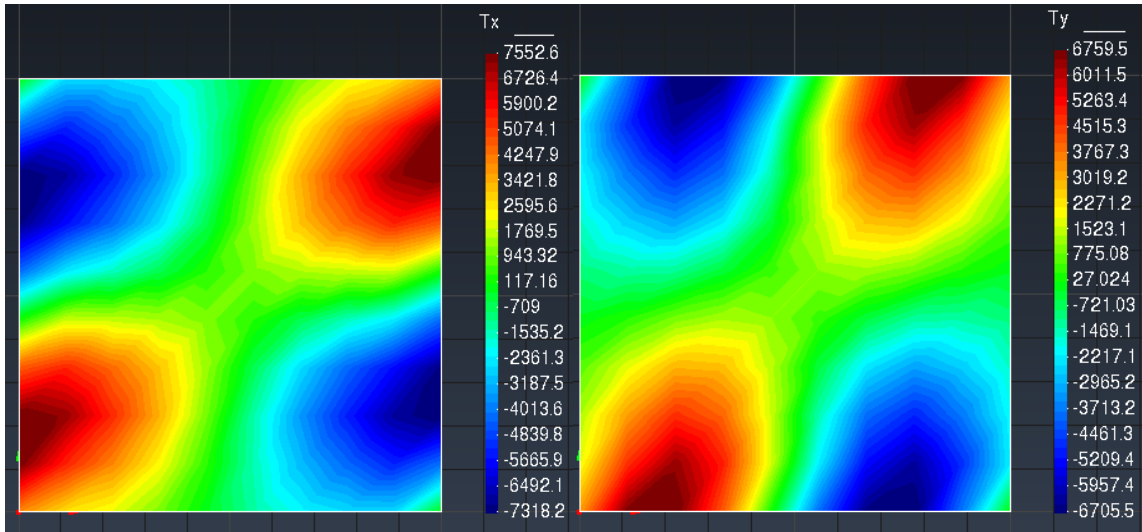


Figure 8: Membrane Stress(x-direction) Figure 9: Membrane Stress(y-direction)

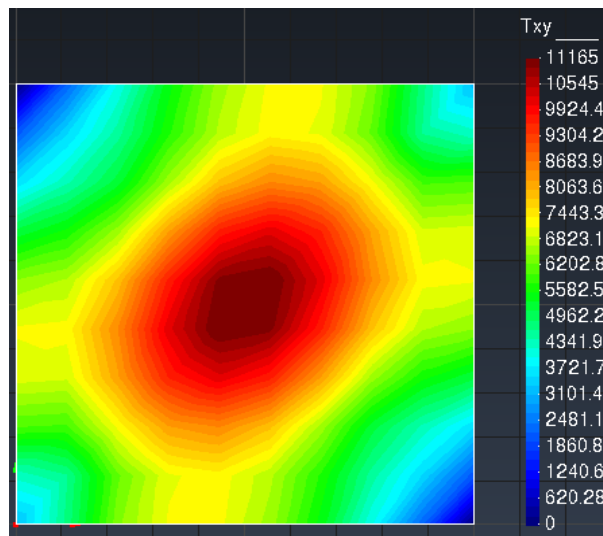


Figure 10: Membrane Stress(x-y plane)

The corners of the shell near the blue region in figure 8 and 9 are the topmost corners, while near the red region are the lowermost corners. Therefore, the positive stress (T_x and T_y) are concentrated near top corners, whereas the negative stress are concentrated near top corners. However, it can be deduced from the Fig. 10 that the max. value concentration region of T_{xy} is near the centre, but the corners have negligible values of T_{xy} .

5 Moments

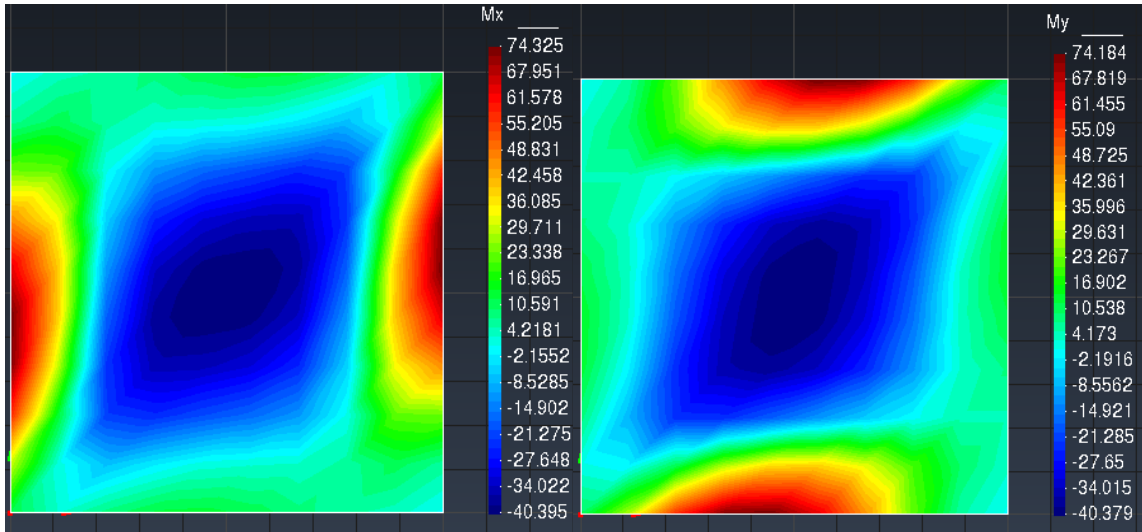


Figure 11: Moment(x-direction)

Figure 12: Moment(y-direction)

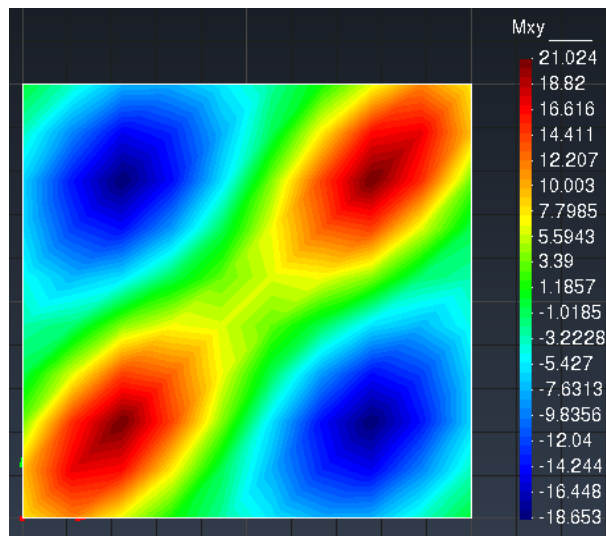


Figure 13: Moment(x-y plane)

As observed from the figures 11 and 12, the maximum value of stress for M_x and M_y are along the sides in y - and x - direction respectively. Further, the M_x and M_y have almost similar values for maximum negative and positive values. The positive M_{xy} region is near low corners while the negative M_{xy} region is near top corners. But, the M_{xy} is zero near top corners.

6 Shear Stress

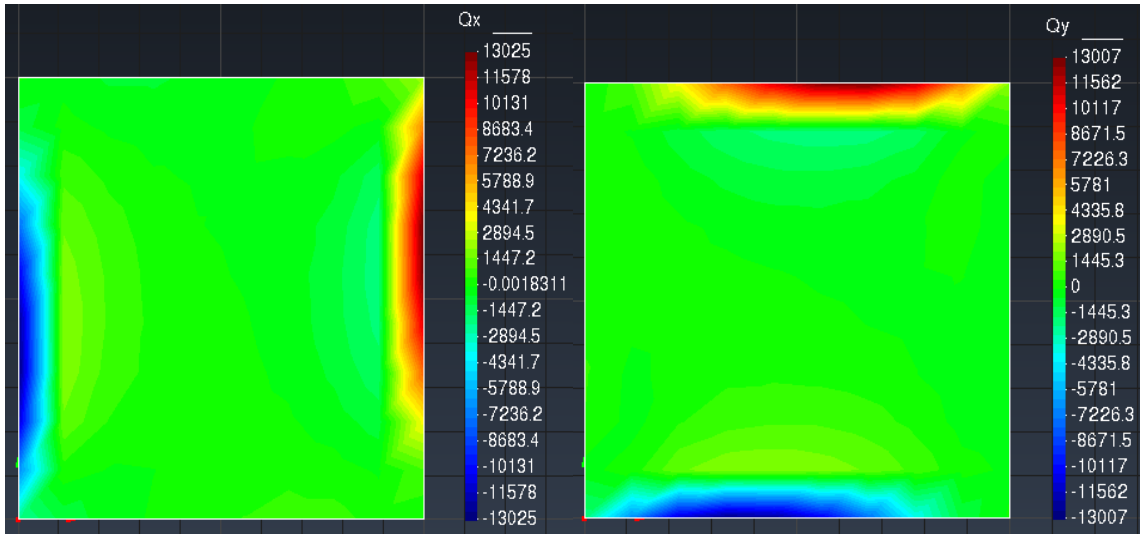


Figure 14: Shear Stress(x-direction)

Figure 15: Shear Stress(y-direction)

Q_x and Q_y have the maximum values near the sides along y and x direction respectively. Therefore, it can be deduced that the force remain constant over the shell, but at the edges there is a variation in the force due to which shear stress arises.