Universitat Politecnica De Catalunya, BarcelonaTech
Masters in Computational Mechanics

Course
Computational Structural Mechanics and Dynamics

Assignment 8

by

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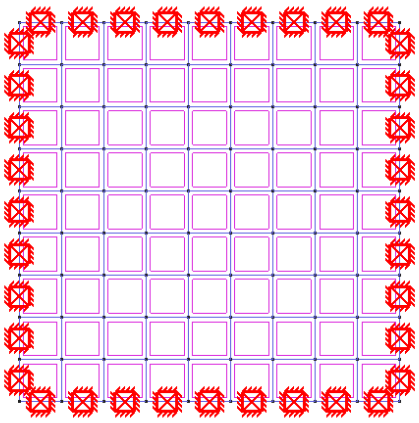
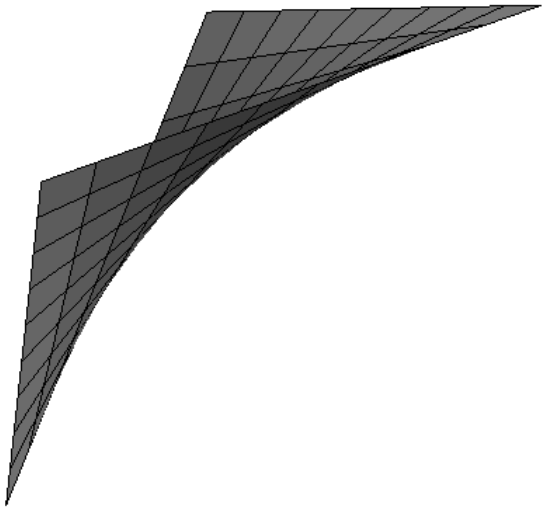
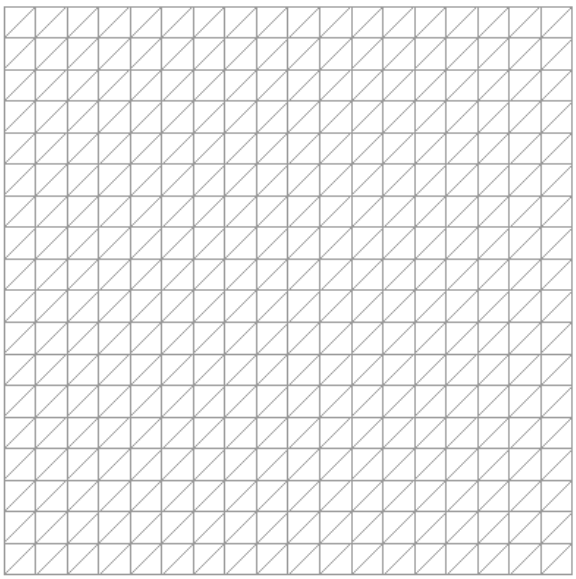
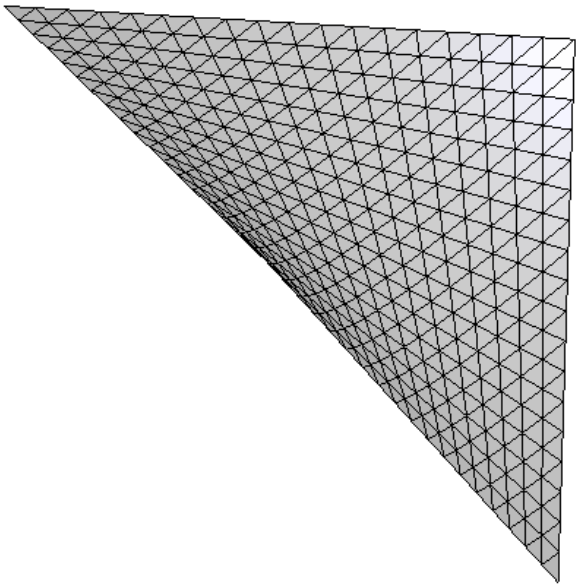
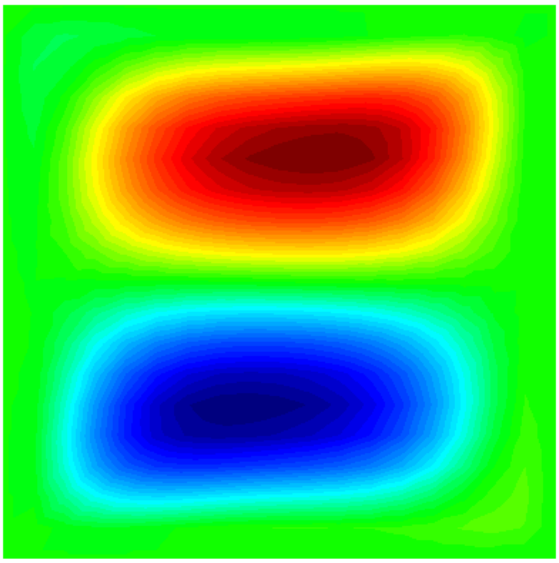
Assignment

Analyse the following concrete hyperbolic Shell under self weight. Explaining the behaviour of all the Stresses presented. T = 0.1

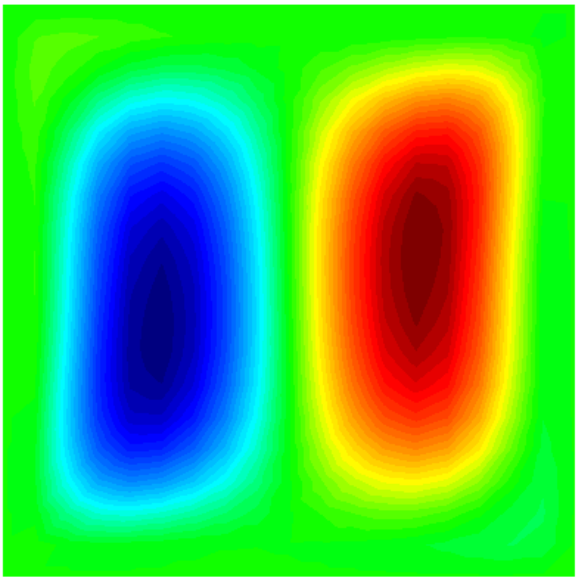
Analysis:

	
Top View With Constraints	View to show the Hyperbolic Nature of Geometry
	
Top View of Mesh Number of Triangle Elements 648. Number of Nodes 361	View to show the Hyperbolic Nature of Meshed Geometry



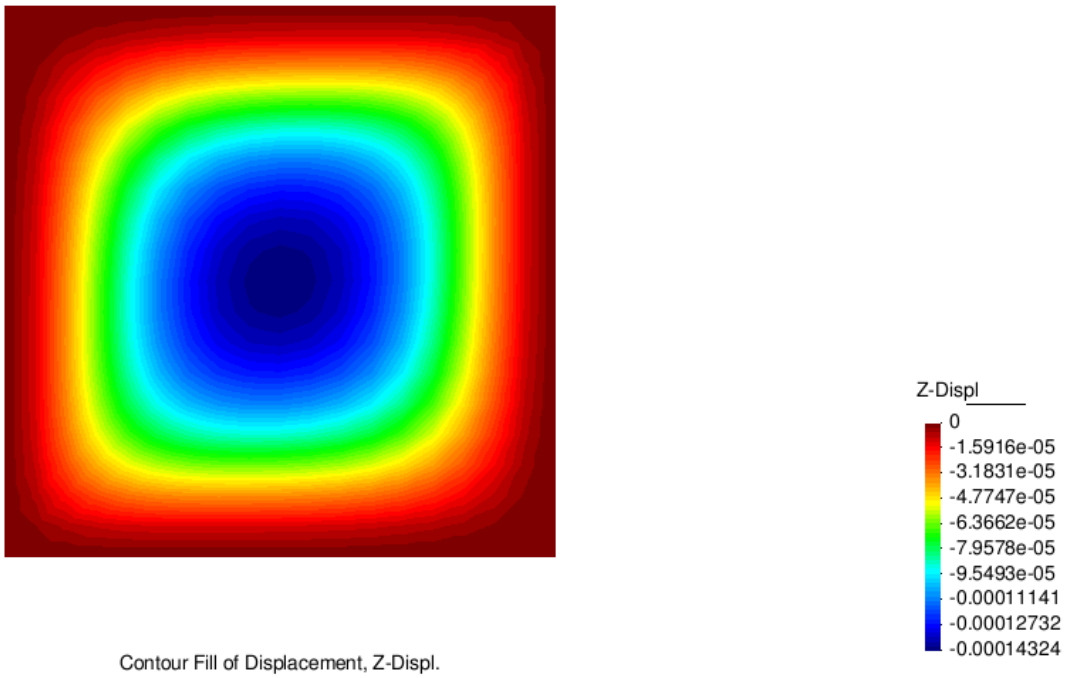
Contour Fill of Displacement, X-Displ.

Displacement in X-Direction

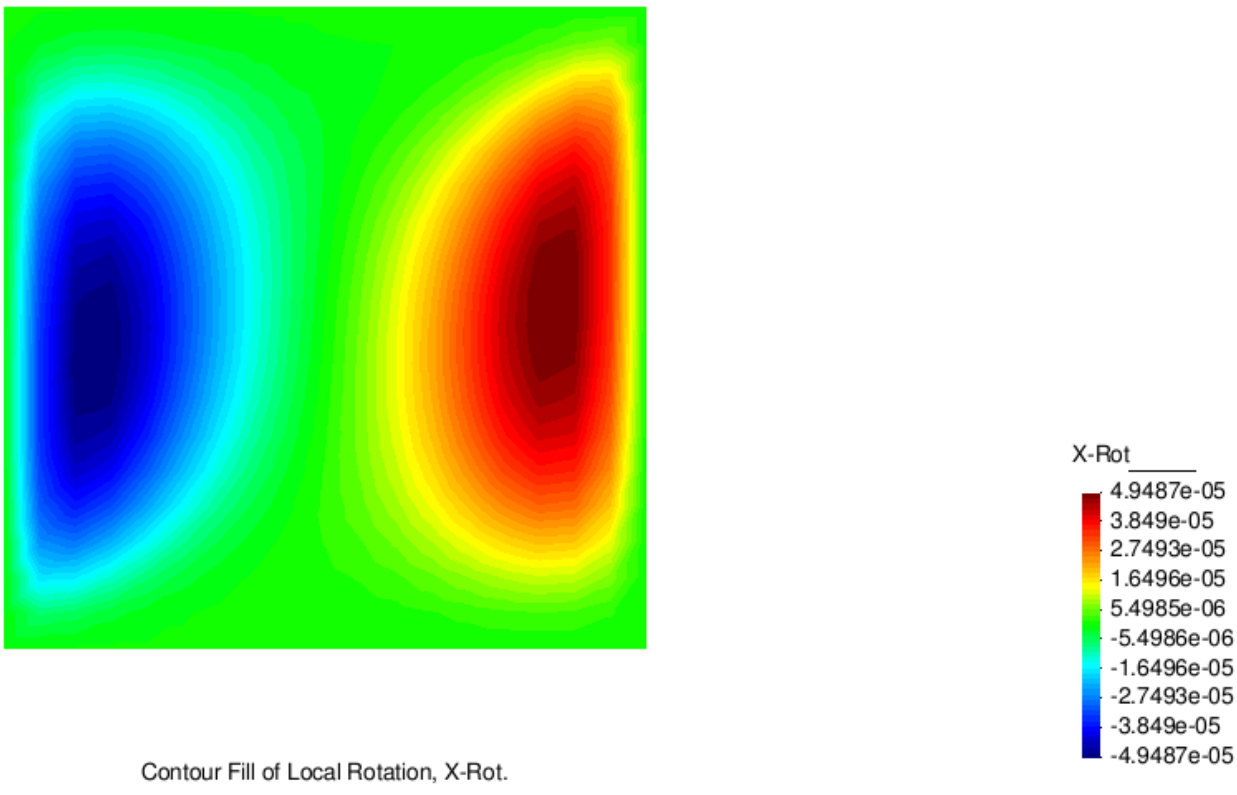


Contour Fill of Displacement, Y-Displ.

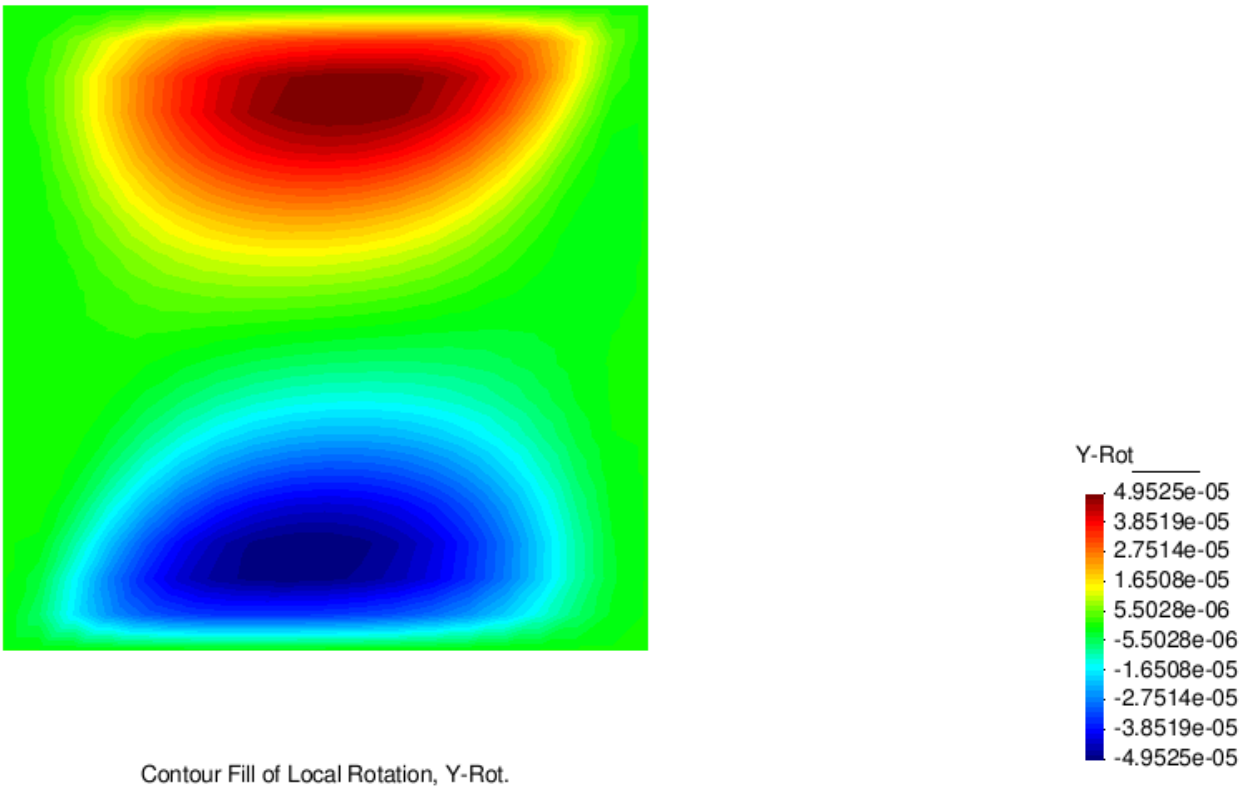
Displacement in Y-Direction



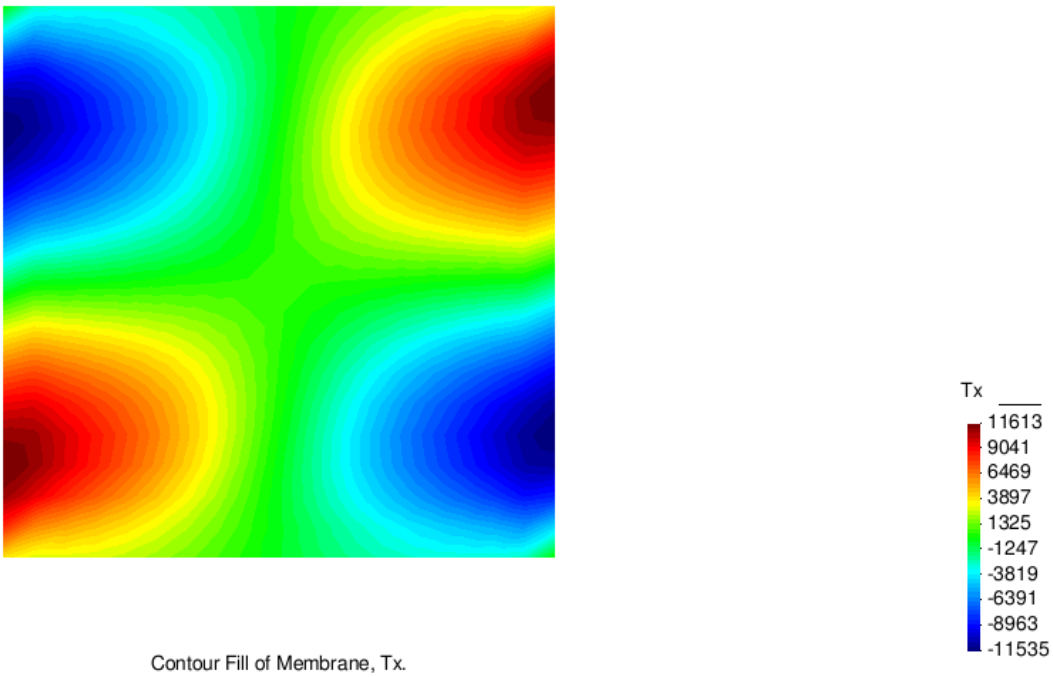
Displacement in Z-Direction



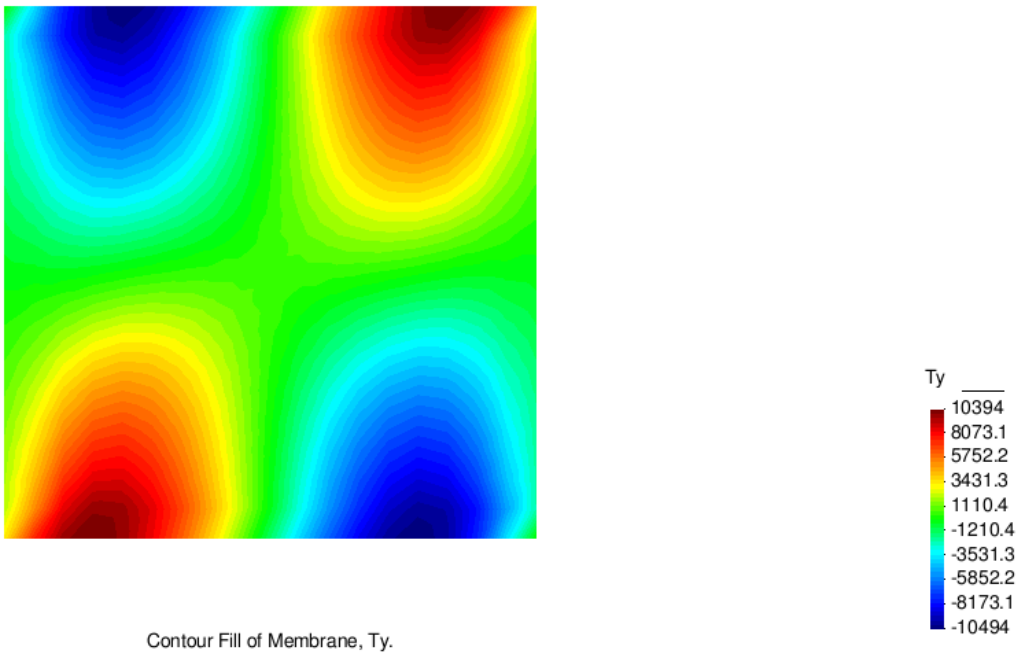
Rotation in X-Direction



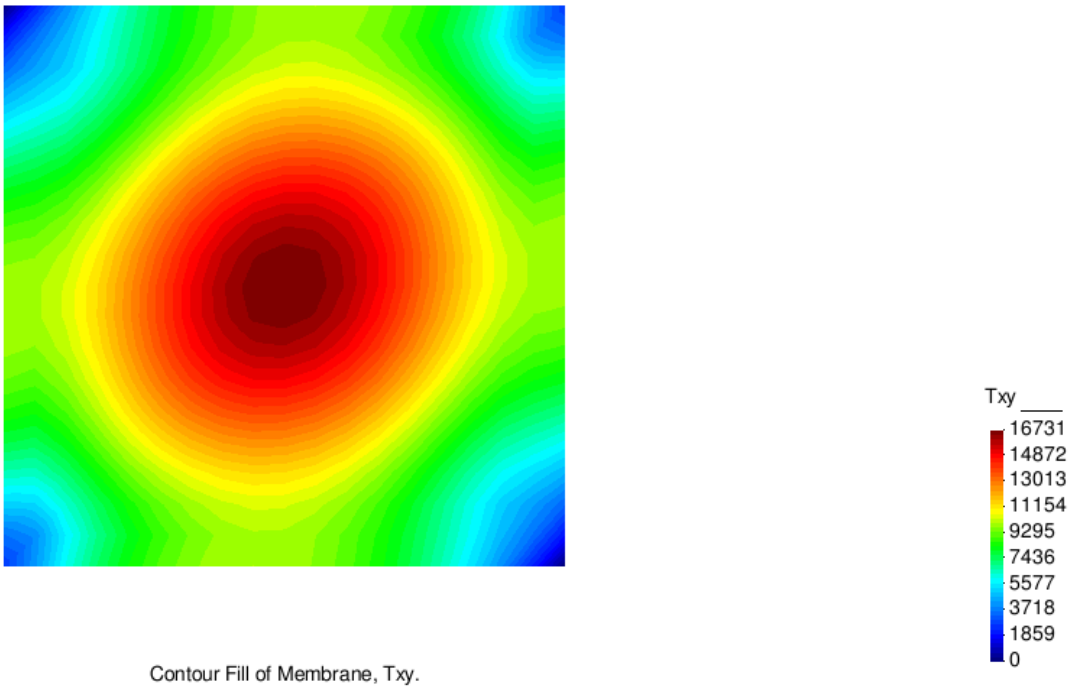
Rotation in Y-Direction



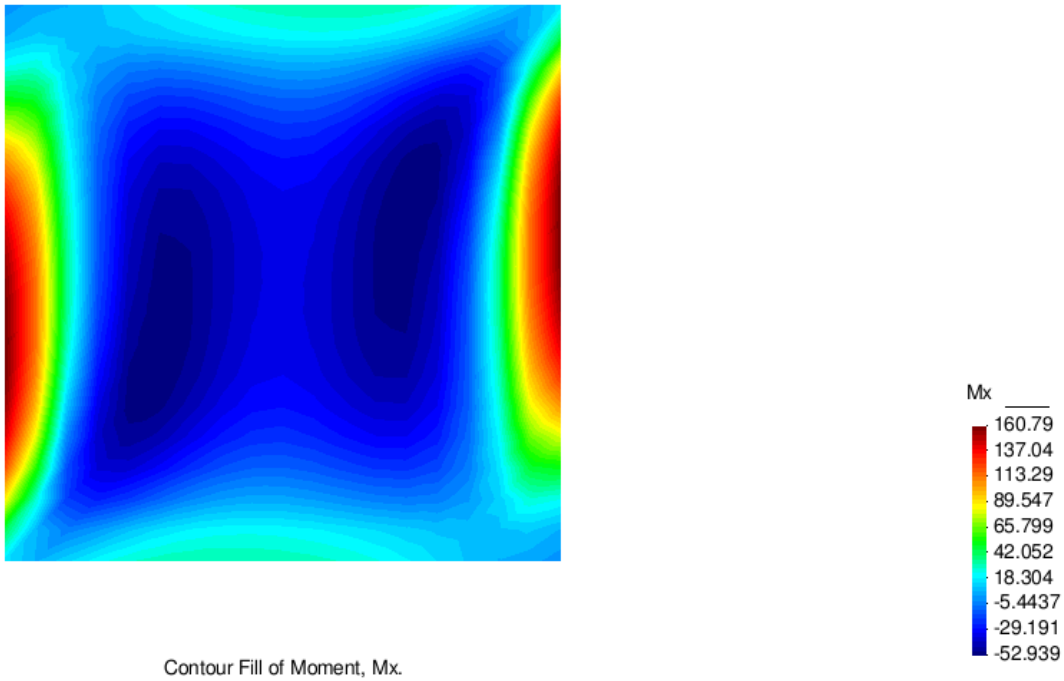
Membrane T_x



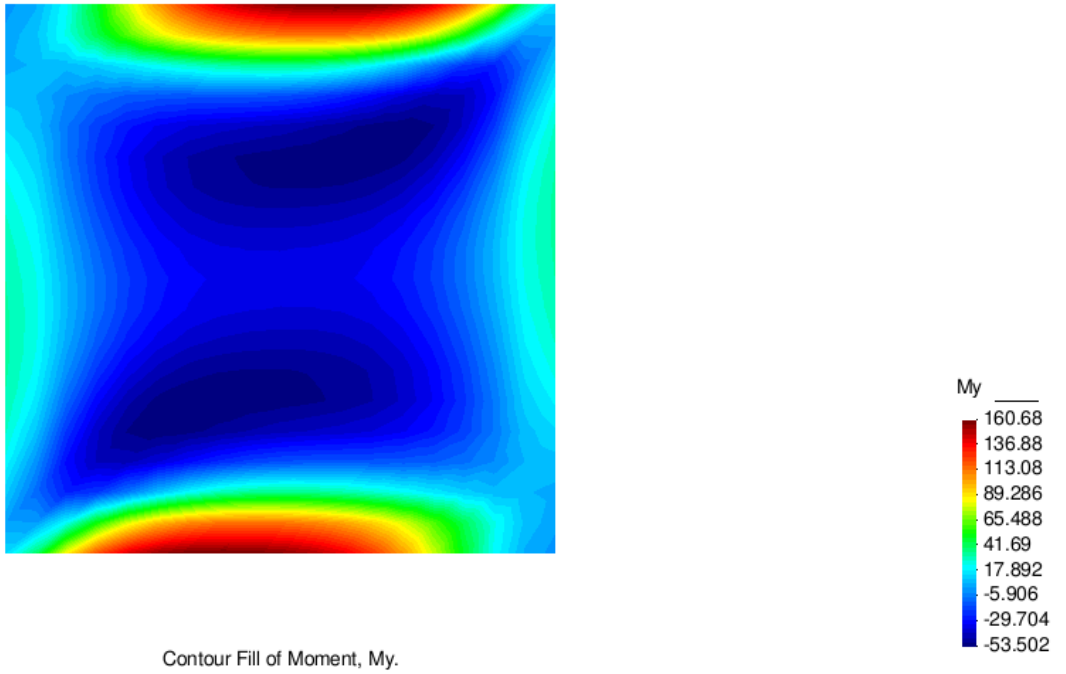
Membrane T_y



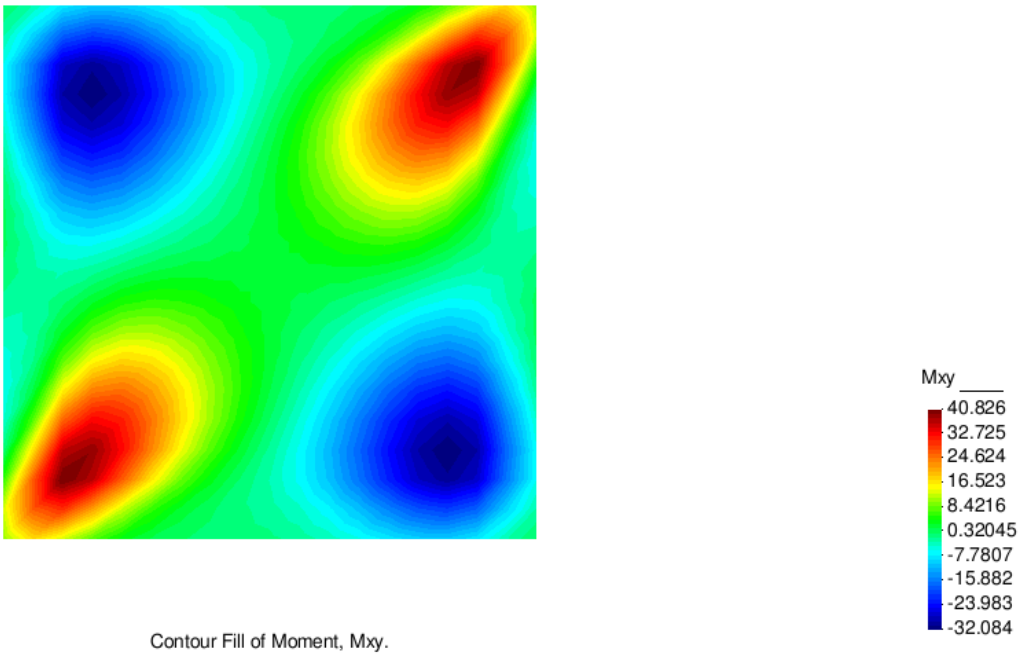
Membrane T_{xy}



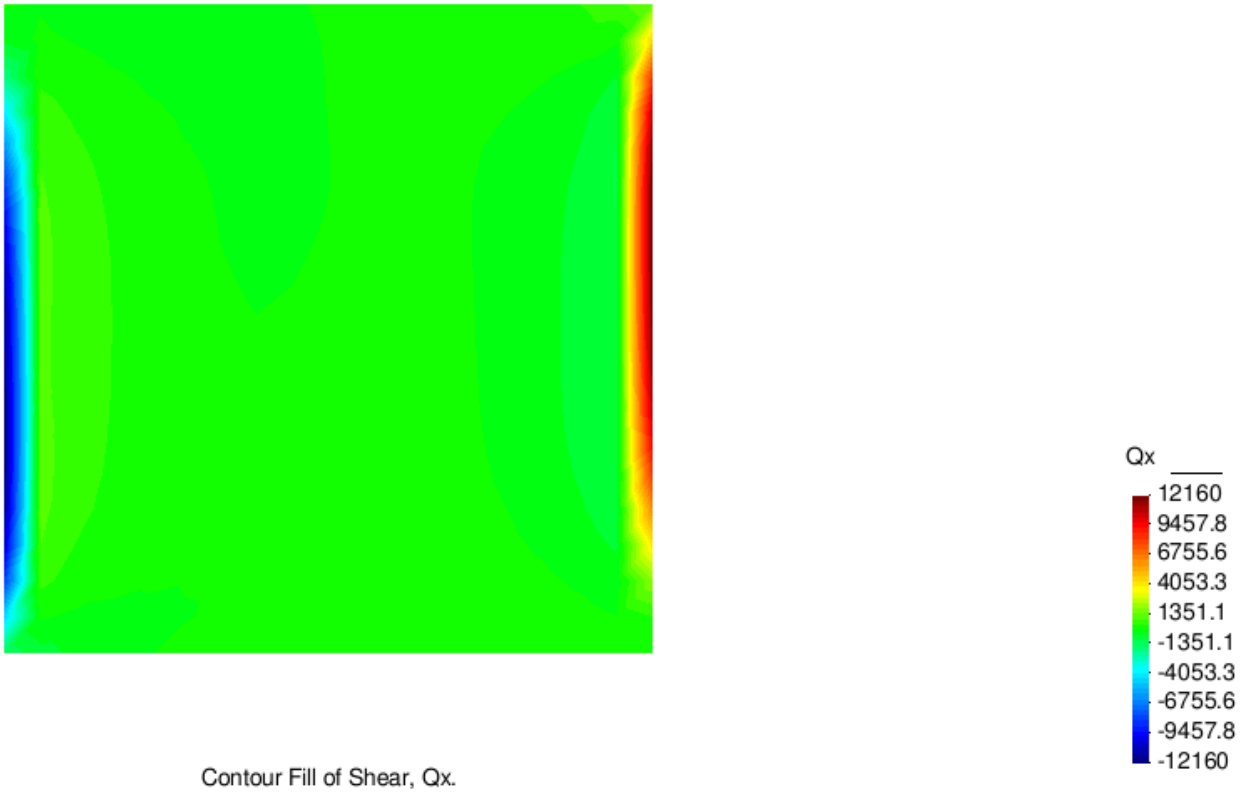
Moment in Direction M_x



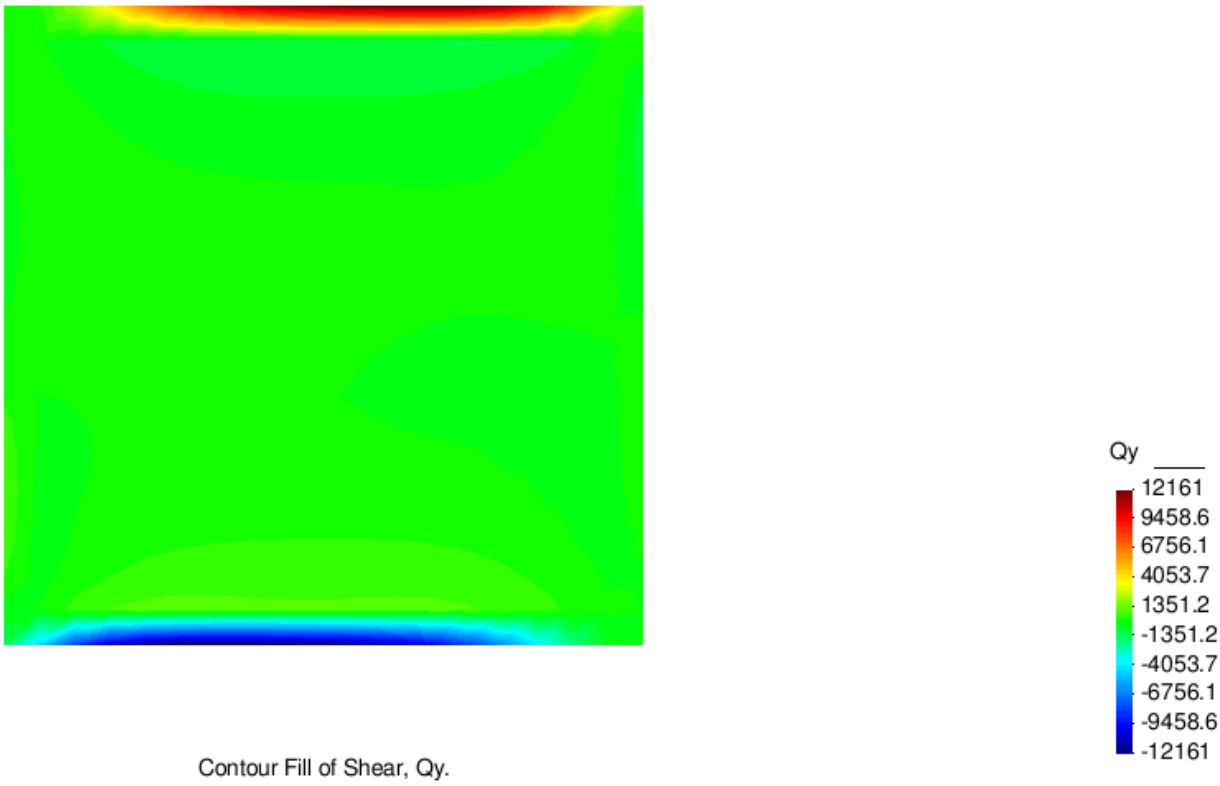
Moment in Direction M_y



Moment in Direction M_{xy}



Transverse Shear Stress Q_x



Transverse Shear Stress Q_y

Explanation (Observations)

Hyperbolic Structure are inherently stiff due to their shape. Hyperbolic structures are doubly curved. The deflections are less than when compared to flat plates. Same observations are also made in case of stresses which are generally low. They can also withstand in-plane shear stresses much better.

It is observed from the results that for Hyperbolic Structures clamped on all the edges, the structure tends to bend in opposite directions in terms of displacement. Similar observations are also made in terms of Bending Stresses.

Due to the Curved Shape of Shells they can carry transverse loads only by Tension forces. Since the shape of the structure is hyperbolic the tension forces T_x and T_y act in opposite directions in the opposite edges of the Structure.

It follows from the above observation that bending Stresses are also acting in opposite directions.

As expected from Hyperbolic Structures, the transverse shear stress are not observed in the centre of the structure but only limited to only the edges.