Assignment: Shell

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Introduction

Shells are a really important elements since they can be used to model many structures in engineering. From building structures, silos, sheet metal components from a car. In this work, shells will be studied by solving a problem under self-weight of an hyperbolic plate by using plate elements.

Results

The geometry of our problem is an square hyperbolic shell represented by plate elements with its boundaries clamped. The only forces acting on our geometry are gravity, so this structure is under self-weight. *Figure 1.* shows the geometry of our problem.
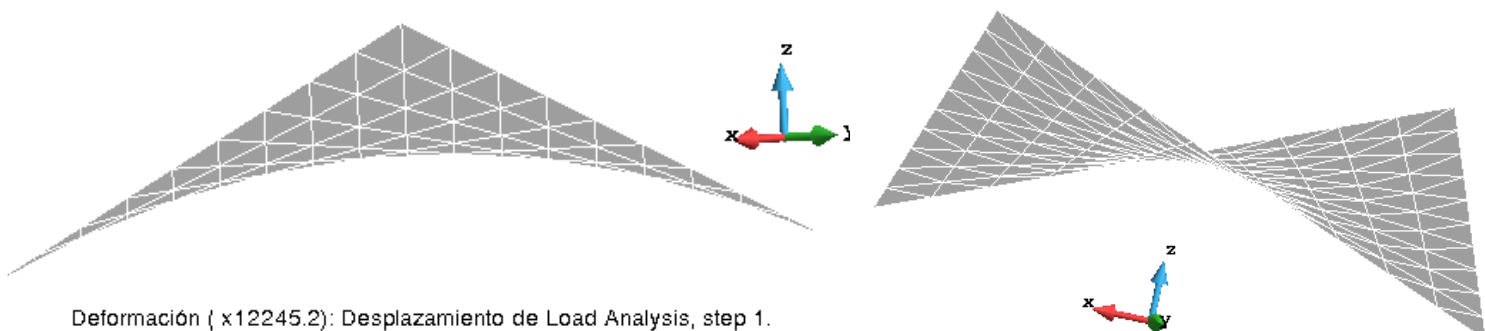

Deformación (x12245.2): Desplazamiento de Load Analysis, step 1.

Figure 1. Geometry of our problem from two different points of view.

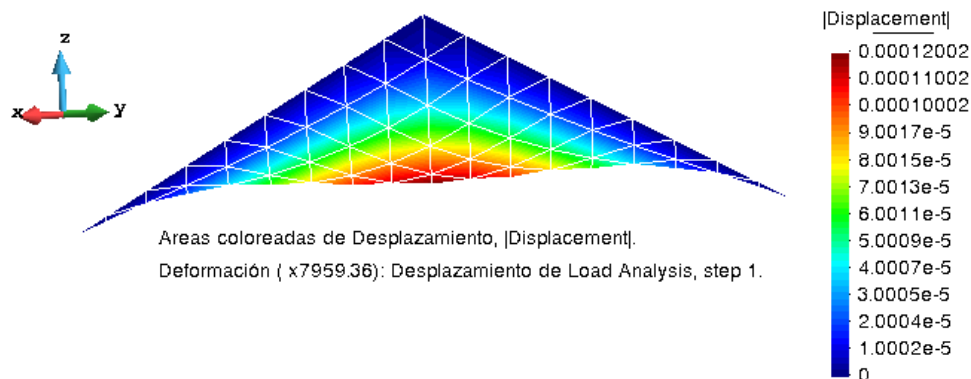When gravity forces act in our body, displacements deform the geometry as seen in *Figure 2.*

Areas coloreadas de Desplazamiento, |Displacement|.
Deformación (x7959.36): Desplazamiento de Load Analysis, step 1.

|Displacement|
- 0.00012002
- 0.00011002
- 0.00010002
- 9.0017e-5
- 8.0015e-5
- 7.0013e-5
- 6.0011e-5
- 5.0009e-5
- 4.0007e-5
- 3.0005e-5
- 2.0004e-5
- 1.0002e-5
- 0

Figure 2. Exaggerated deformed shape and colour representation of the displacements.
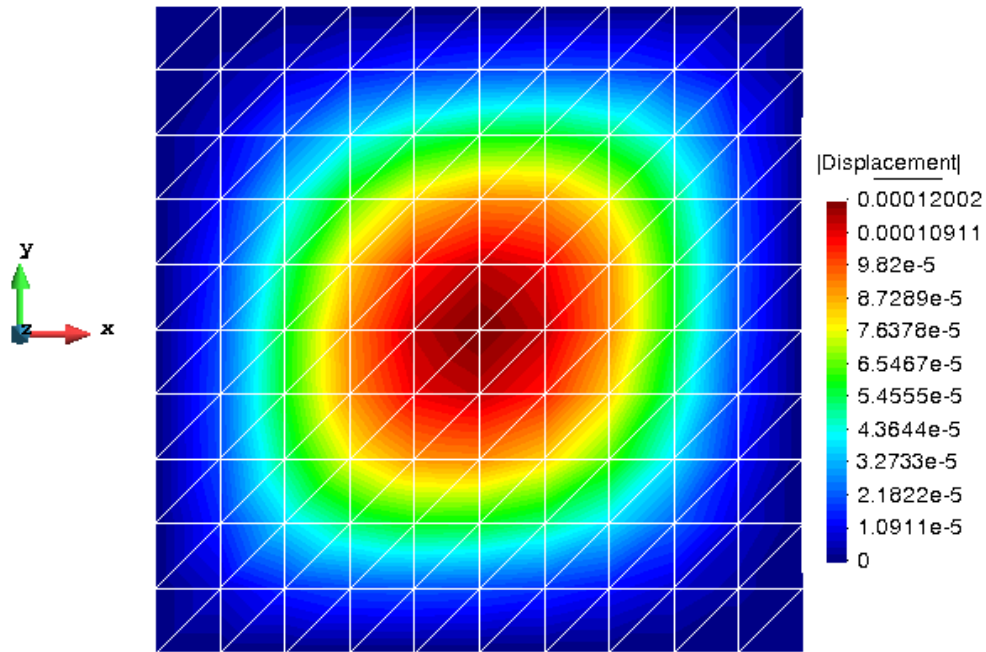
Figure 3. Representation of the displacement modulus of our body.

Given that there are only self-weight forces and our body is in equilibrium, internal forces must sustain the structure. In the following figures stresses and moments are presented.

Regarding forces produced due to elongation of the material. Membrane forces are represented in the following figure.
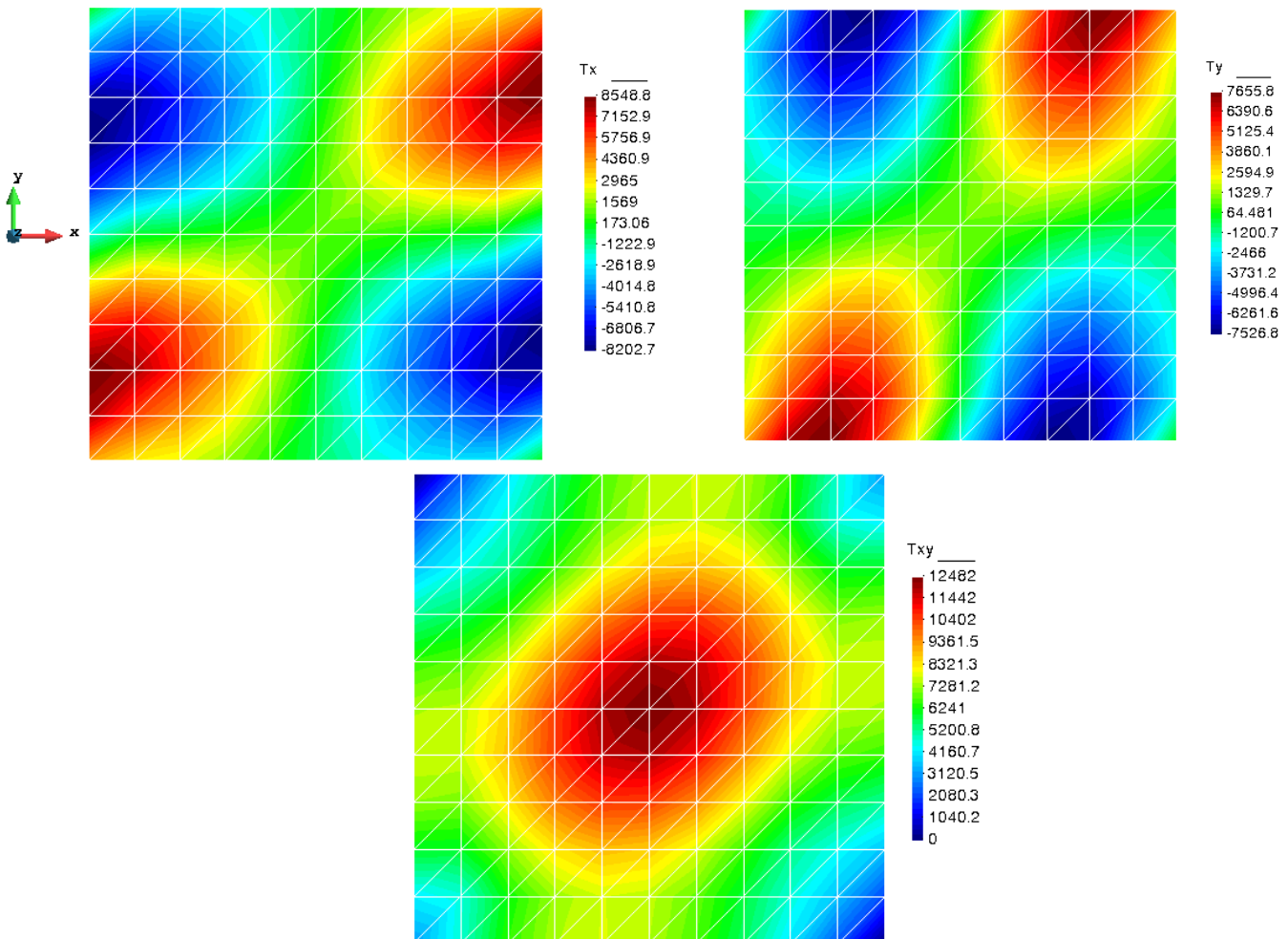

Figure 4. Representation of membrane stresses (Tx (left), Ty (right) and Txy (bottom)).
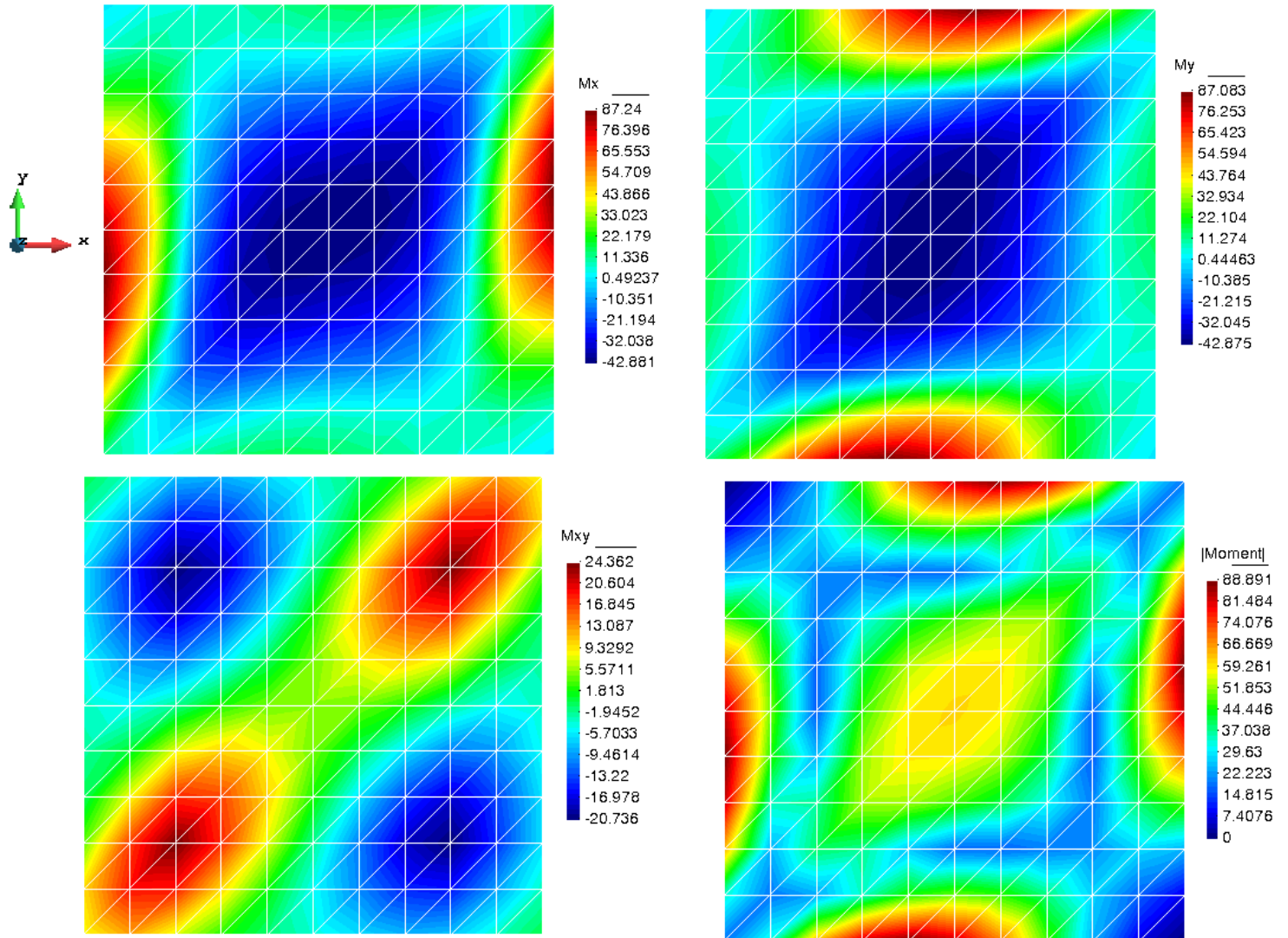
If we consider moments:

Figure 5. Representation of moments in x direction (top left), in y direction (top right), xy moments (bottom left) and moment modulus (bottom right).

From the previous figure it must be remarked it is clearly seen that X and Y moments are concentrated in the edges where our geometry is clamped.

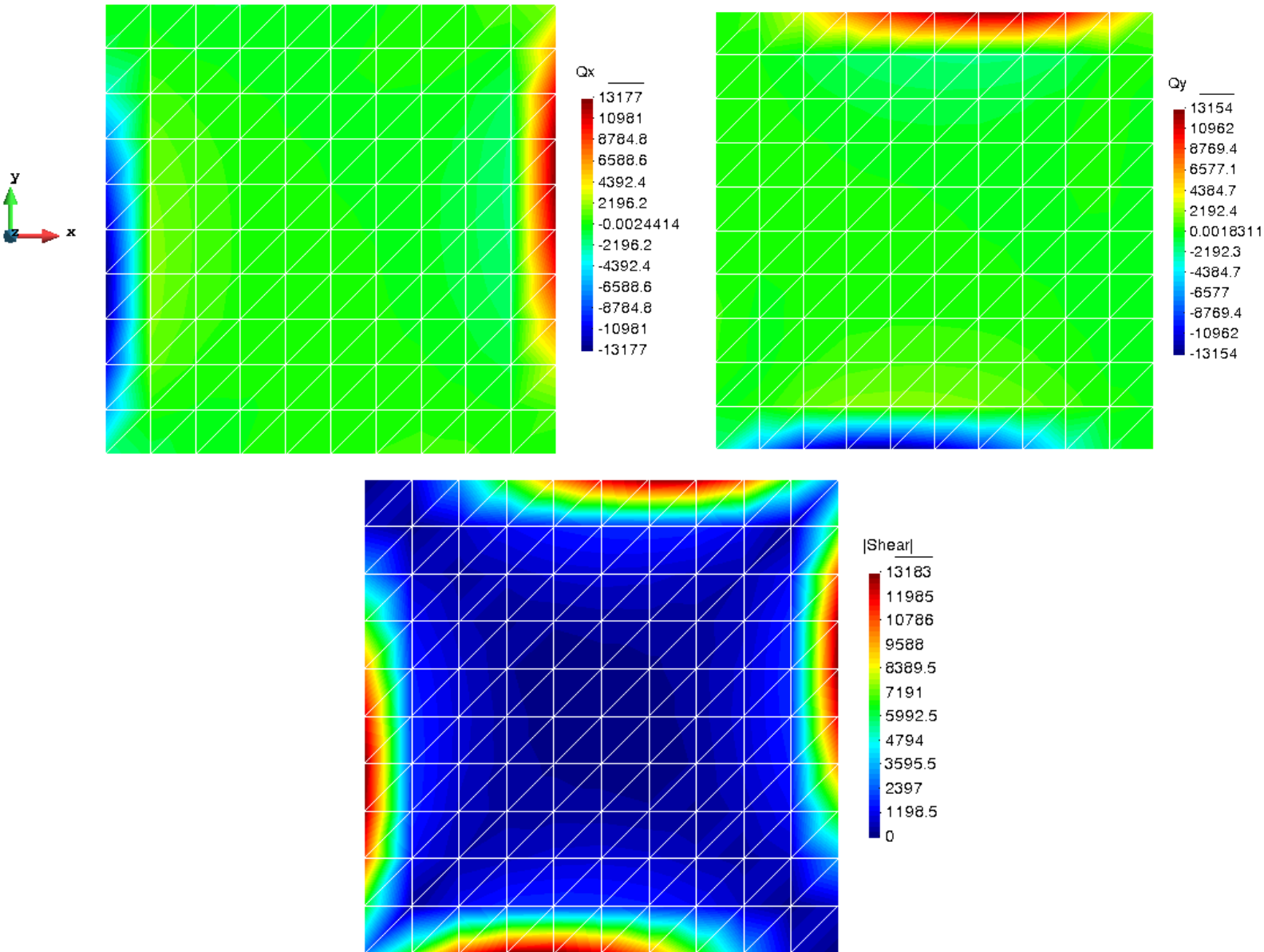To end with the stresses, shear forces are plotted in *Figure 6*.

Figure 6. Shear stresses representation in the x direction (left), y direction (right) and modulus (bottom)

Shear stresses concentrate in the edges since our structure is clamped. At those points, since prescribed displacements are set to 0 and they must support all structure's weight, huge shear stresses appear.