



UNIVERSITAT POLITÈCNICA  
DE CATALUNYA  
BARCELONATECH



Universitat Politècnica de Catalunya

Escola Tècnica Superior d'Enginyers de Camins, Canals i Ports

MASTER EN INGENIERÍA ESTRUCTURAL Y DE LA CONSTRUCCIÓN

Course:

# **COMPUTATIONAL STRUCTURAL MECHANICS AND DYNAMICS**

**Assignment 8**

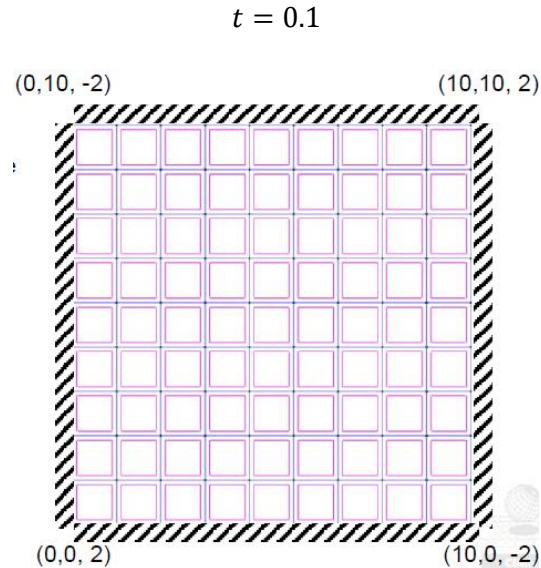
**On “Shell”**

**By**

**Sierra, Pablo Leonel**

## Assignment 8:

Analyse the following concrete hyperbolic Shell under self-weight. Explain the behaviour of all the Stresses presented.



The material used in the model is concrete with the next properties

$$E = 3 \cdot 10^{10} \frac{N}{m^2}$$

$$\nu = 0.2$$

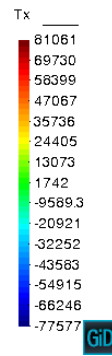
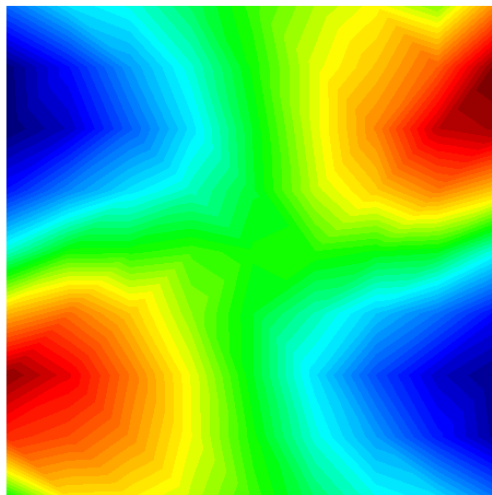
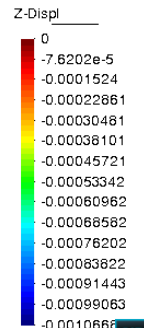
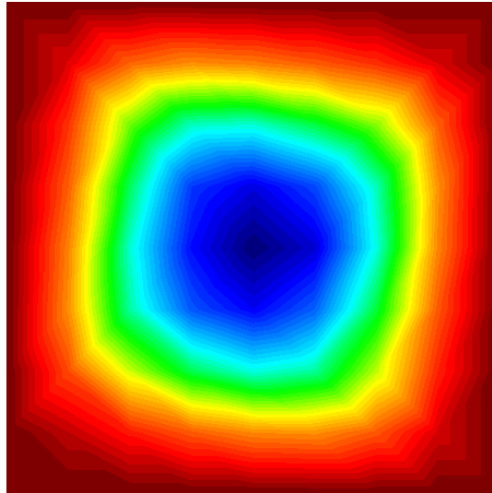
$$\rho = 25000 \frac{N}{m^3}$$

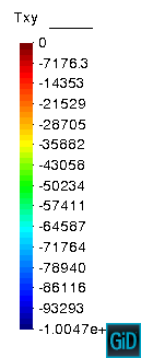
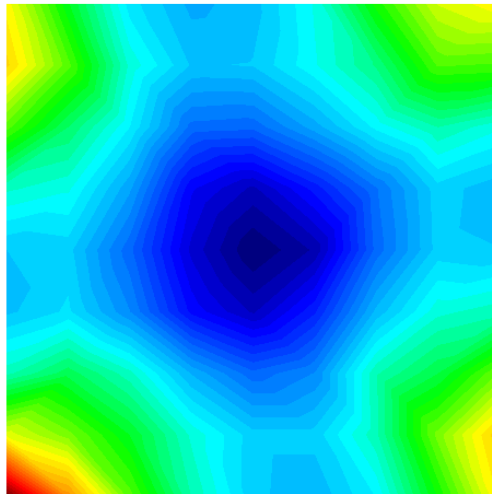
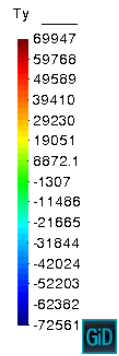
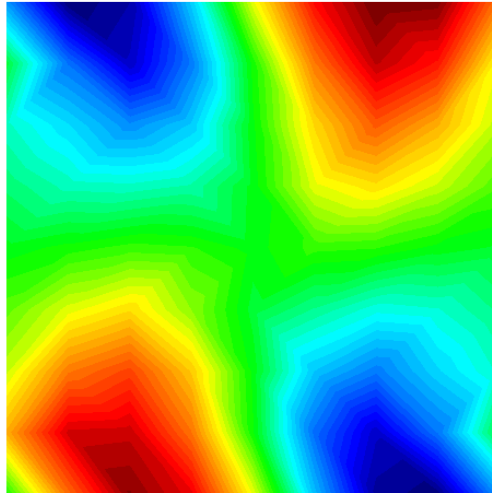
$$t = 0.1 \text{ m}$$

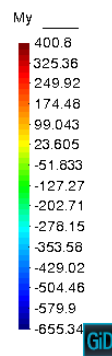
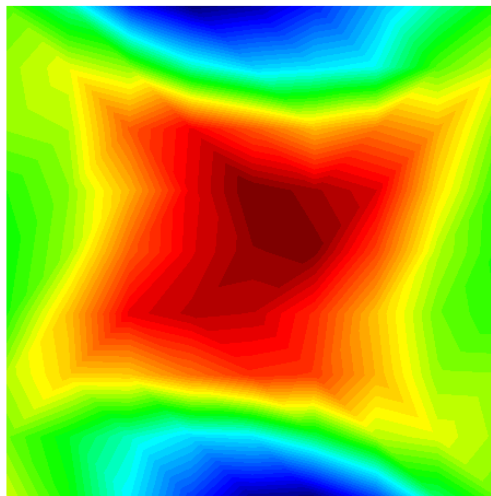
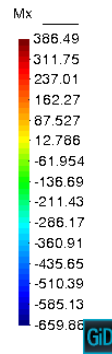
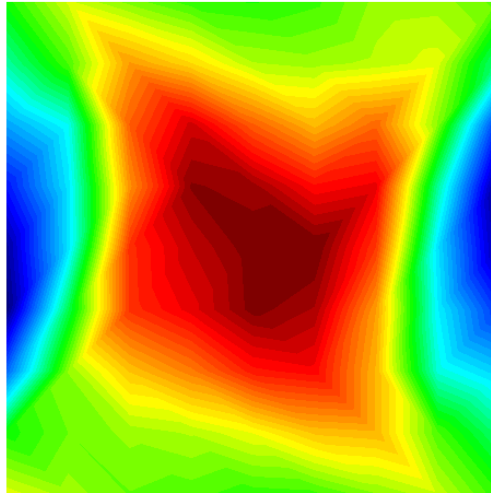
There aren't loads applied, is only the self-weight acting over the structure.

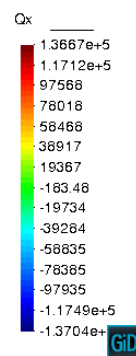
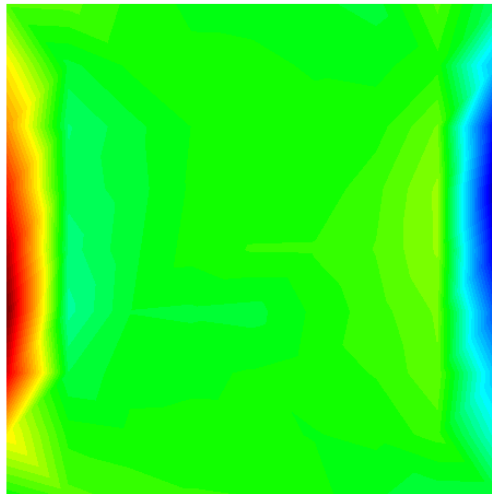
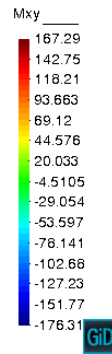
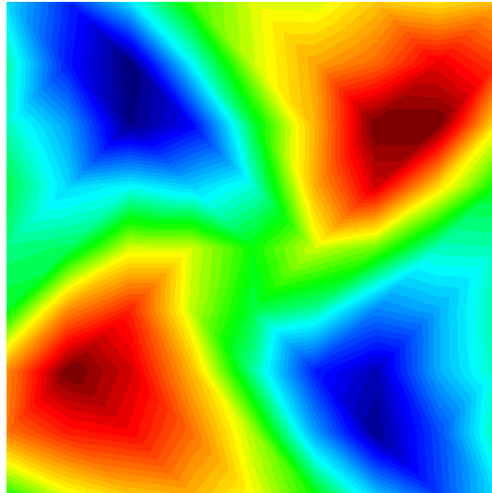
The four sides of the hyperbolic shell are clamped.

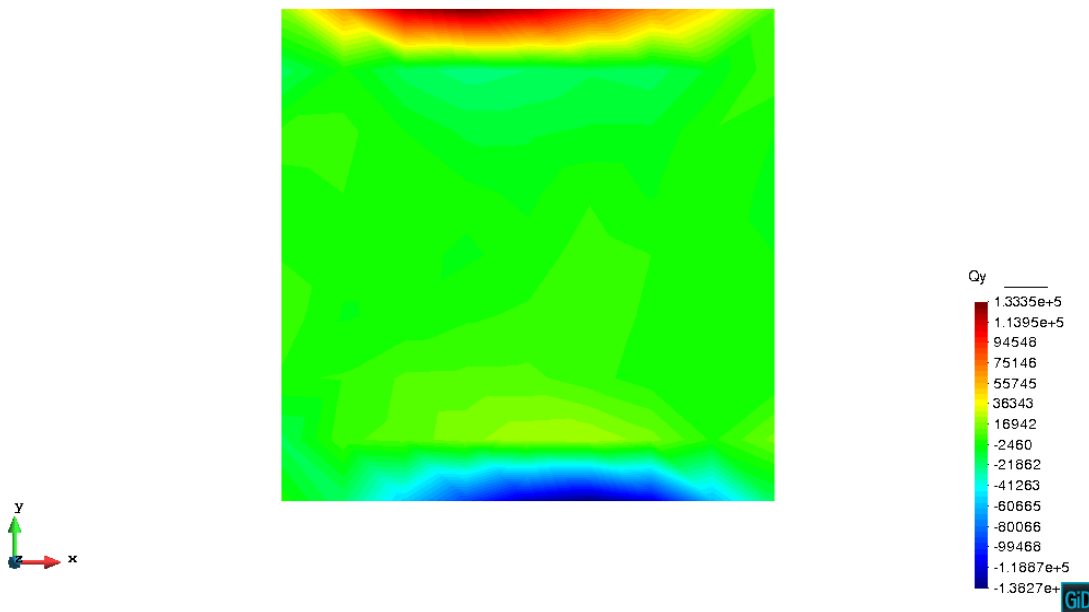
The model is made with GiD. The exported data file is processed by Mat – Fem. The obtained results are shown in the next figures. The results units are  $m$  for displacements,  $\frac{N}{m^2}$  for tension and  $\frac{Nm}{m}$  for moments.











Observing the results obtained, it concludes the hyperbolic shell behaviour is governed by the membrane stresses. The tensions, traction and compression, are an order higher than the tensions results of moments. Also it is observed that all the results present a strong symmetry, either in horizontal and vertical axes or in axes in the diagonals of the square that represents in plant the hyperbolic paraboloid.

This kind of structures using reinforced concrete are appropriate to cover big surfaces with thin elements. The membrane behaviour minimizes the material avoiding the shear and bending stresses.