# Computational Structural Mechanics and Dynamics

Practice 4

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Exercise 1: Cylindrical tank

Analyze the state of stress of the tank shown in the figure, which is submitted to an internal pressure.
Suppose a continuous variation of the thickness of the spherical cupola. Use revolutions shell
elements with two nodes and 3D shells elements with three nodes.
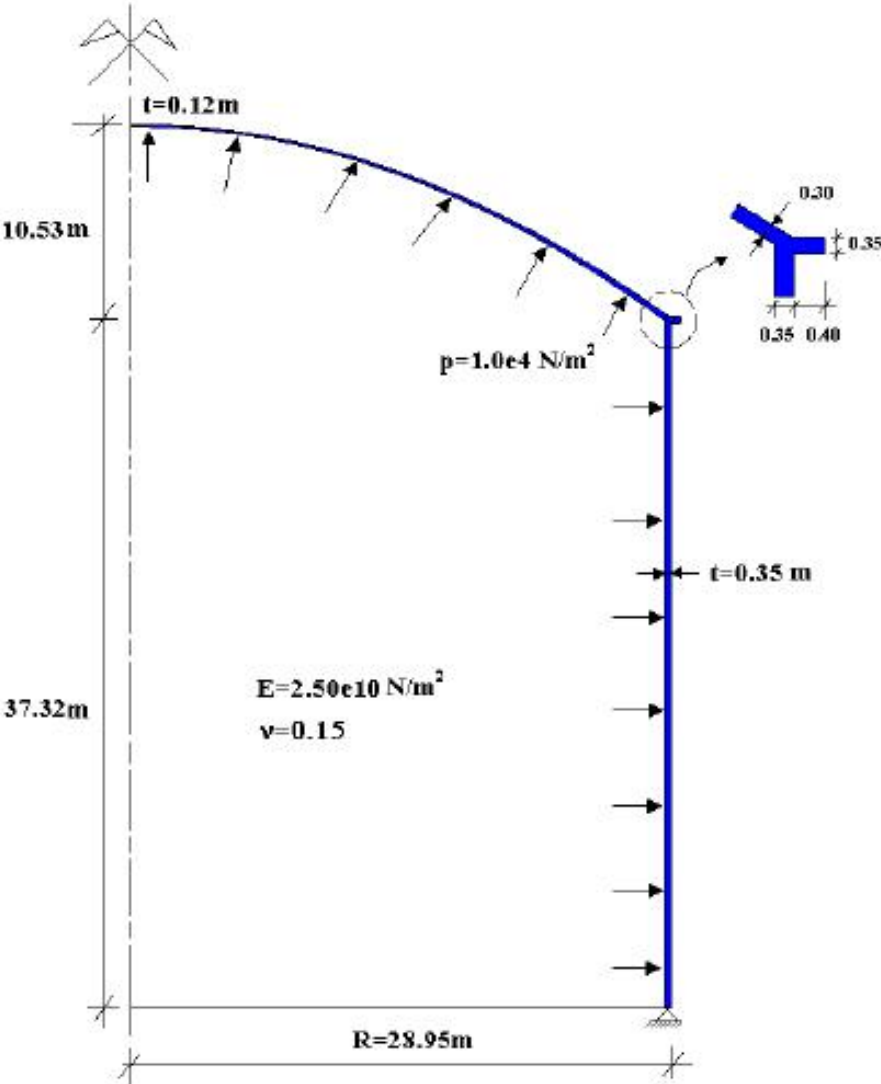
First, we draw the lines and then we analyze in the post-process, using Ramseries. Then we get the following results.
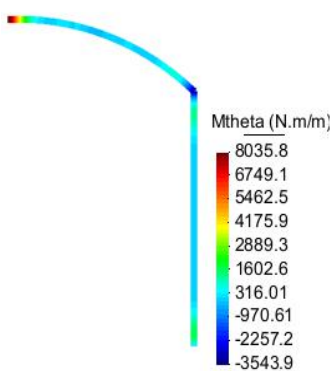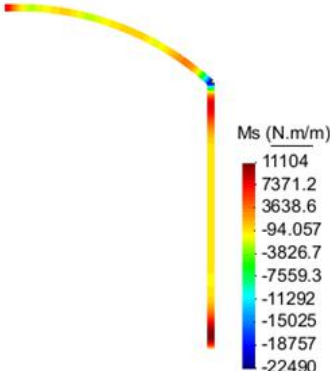

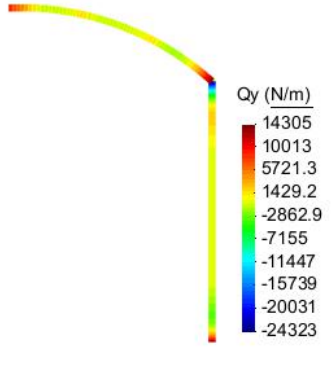**Figure 1-Mtheta values**

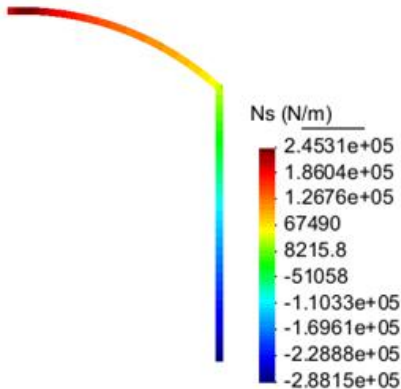**Figure 2-Moment Ms values**

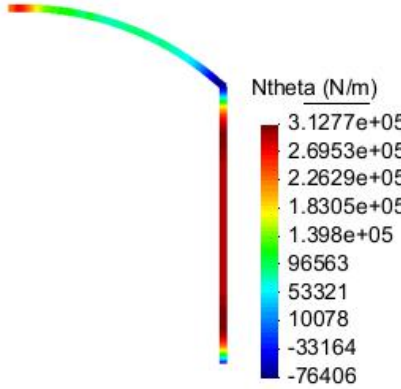**Figure 3-Qy values**

Figure 4-Ns values

Figure 5-Ntheta values

The connection point between the straight section and the curved section is a point of interest. We see a high concentration of stresses and moment in it. Moreover, the highest axial stresses are concentrated in the member extremities along with moment and stresses. The reason of this the restriction in movement at these points.

The results that we get are shown in Table 1.

Moment,Stress	Mtheta (Nm/m)	Ms (Nm/m)	Qy (Nm)	Ns (N/m)	Ntheta (N/m)
Max(+)	8036	11104	14305	2.45E+05	3.13E+05
Max(-)	-3543	-22490	-24323	-2.88E+05	-76406

Table 1

- **3D Shell Element with Three Nodes**

The tanks is exposed to internal pressure. Frst,we divide the tank into 3 part, changing the thickness of each one, varying from 0,12,0,21 to 0,30 m one after the other. Then we analyze %25 of the structure. This helps us to compute faster since we know it is symmetrical. The results are shown in following figures.
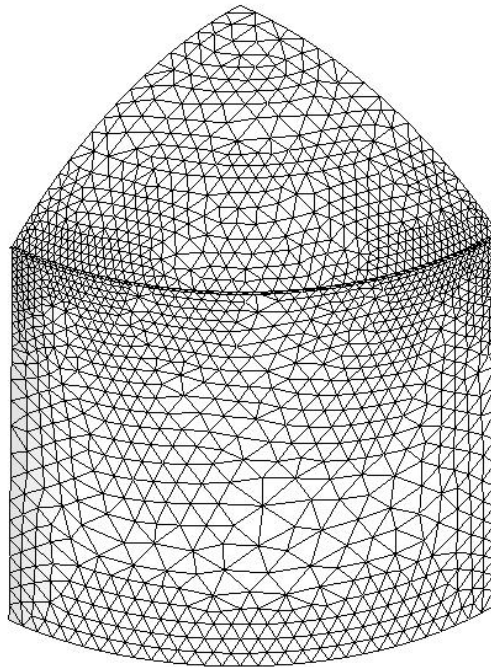

Figure 6-Triangular Mesh of Tank

- **Analysis**

Moment distribution in the X-direction is shown in Figure 7.
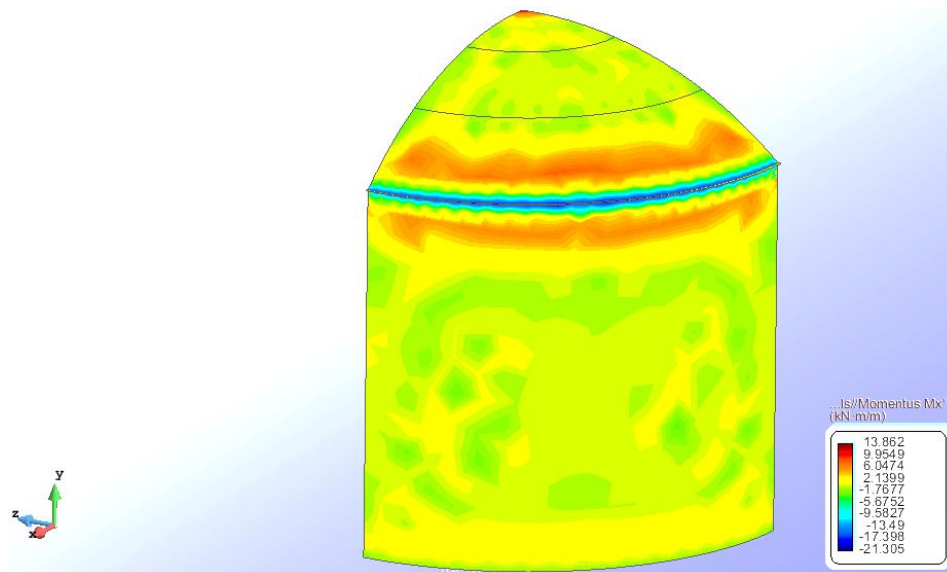

Figure 7-Moment distribution in the X-direction

The maximum positive moment occurs at the top of the tank while the maximum negative moment occurs in the connection strip. The reason of this is the rapid change in the section geometry.

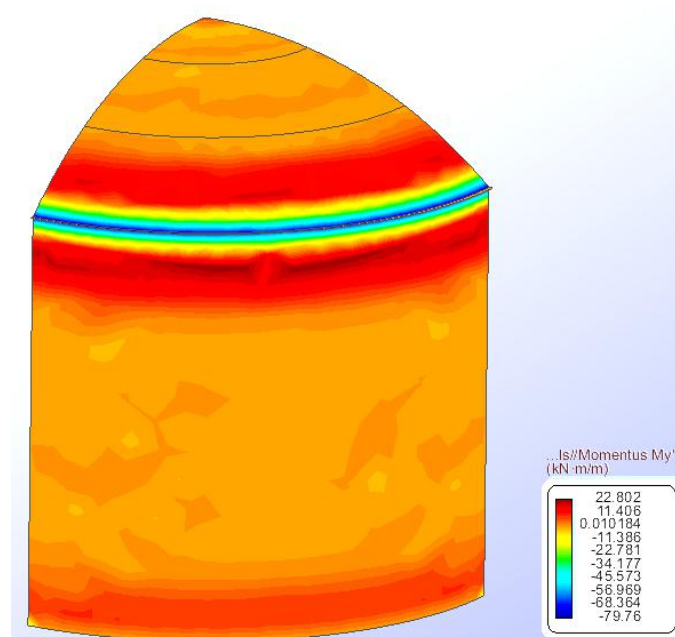Moment distribution in the Y-direction is given in Figure 8.

Figure 8-Moment distribution in the Y-direction

In the Y direction the maximum positive moment occurs with the value of 22.8 kNm/m whereas the negative moment occurs with the value of -79.76 kNm/m.

- **Results- Shear Stresses**

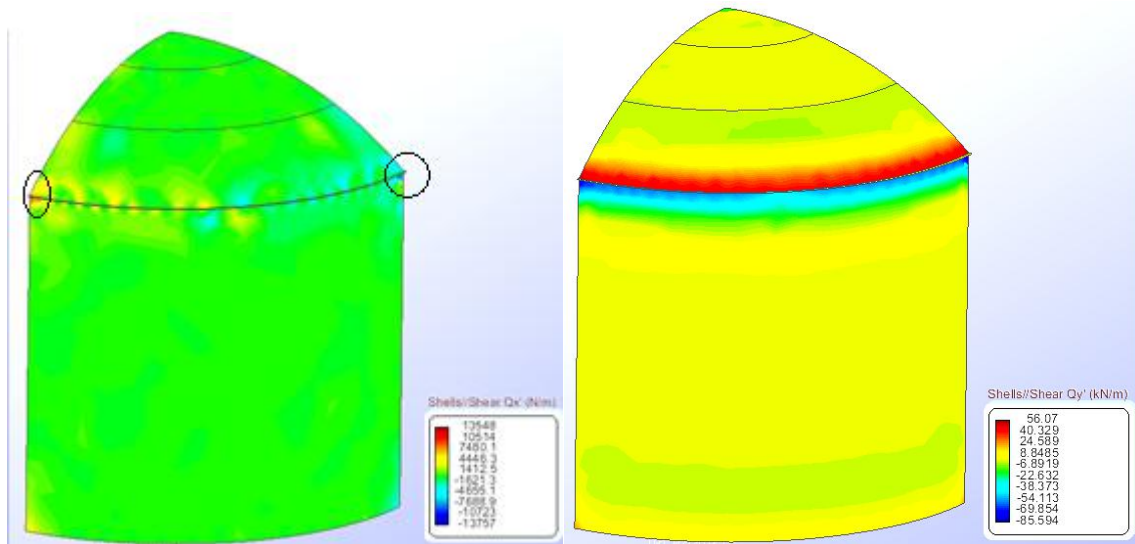Shear stress distributions Qx,Qy are shown in Figure 9 and Figure 10.

Figure 9-Shear Stress Distribution Qx   **Figure 10-Shear Stress Distribution Qy**

In the Figure 9, we see that the maximum amount of shear is found on the marked edges of the tank.

In the Figure 10, we see that the maximum shear stresses occur where the change in geometry occurs at the connection strip.

- **Results - Uniaxial Normal Stresses**

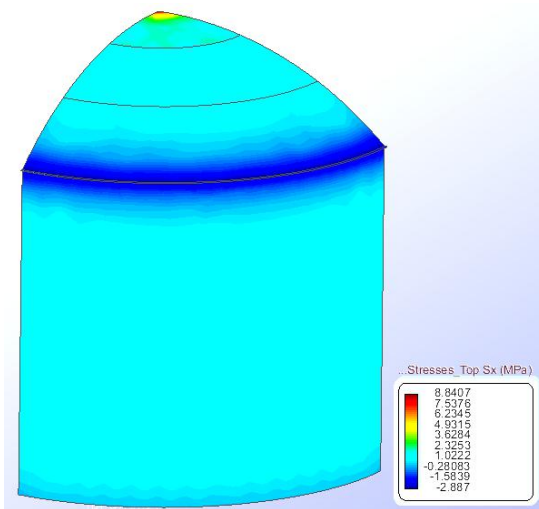Tensile stresses Sx, Sy are shown in Figure 11 and Figure 12.
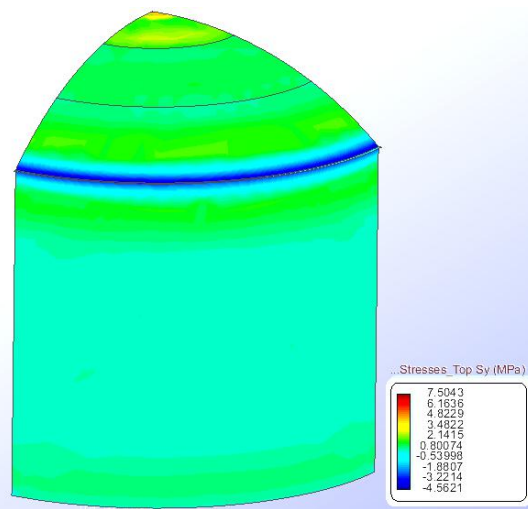
Figure 11- Tensile Stresses Sx   **Figure 12-Tensile stresses Sy**

In the Figure 11, we see that the maximum amount of tensile stress occurs with the value of 8.8407 mPa at the top of the tank. The maximum compressive stress occurs at the connection strip with value of -2.887 mPa.

In the Figure 12, we see that the maximum amount for Sy occurs with the value of 7.5043 mPa whereas the maximum compressive stress occurs with value of -4.5621 mPa.

All results are presented in the Table 2.

Moment-Stress	Max(+)	Max(-)
Mx (kNm/m)	13.862	21.305
My (kNm/m)	22.802	79.76
Qx (kN/m)	13.548	13.757
Qy (kN/m)	56.07	85.594
Sx (MPa)	8.84	2.887
Sy (MPa)	7.5043	-4.5621

Table 2