CSMD HW 4

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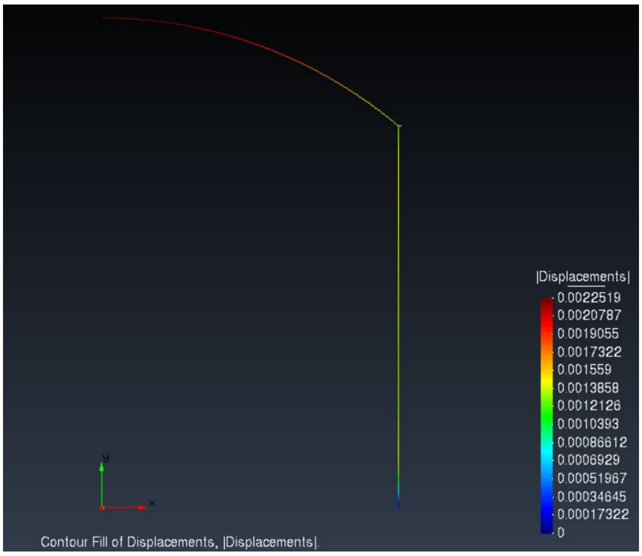
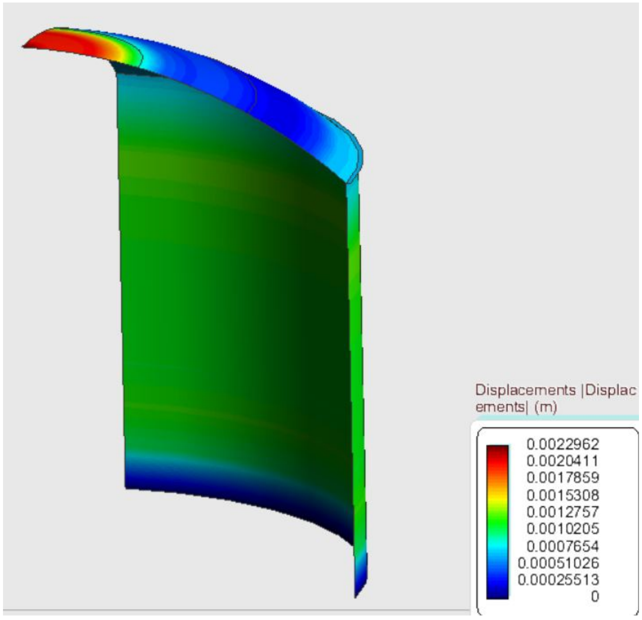
A cylindrical tank, subjected to a uniform internal pressure, is being studied. The thickness of the spherical cupola continuously vary. The material of the tank is assumed to be linear elastic. The problem is analyzed using revolutions shell 2-node shell elements and using 3d shell elements with 3 nodes. The state of stress is studied and compared for the two cases.



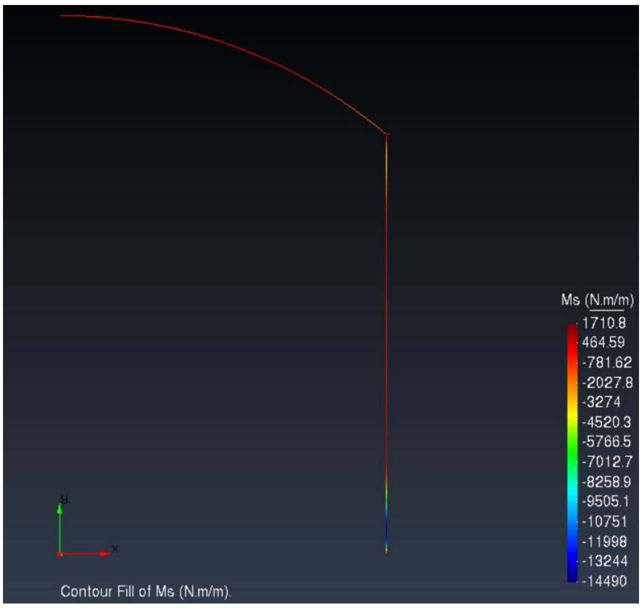
1d displacements



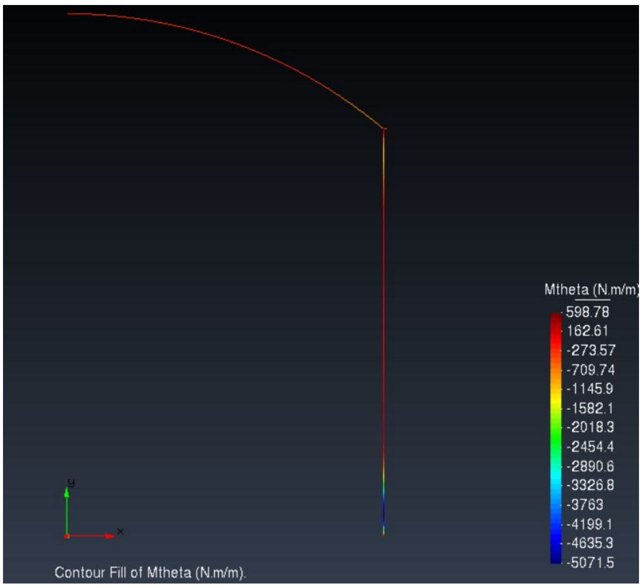
3d displacements

Using both 1d and 3d analysis produced the similar behaviour for the total displacement. As shown in the above figures, the displacement is zero at the bottom fixed point. The displacement is lower in the reinforced part as expected. The displacement increases as we go to the upper end.

The main difference between the results is that the distribution of displacement along the top of the tank is different. Probably the change in the thickness can have an effect in the obtained results. Moreover, the discretization is different as different types of elements are used, thus having unlike mesh sizes.

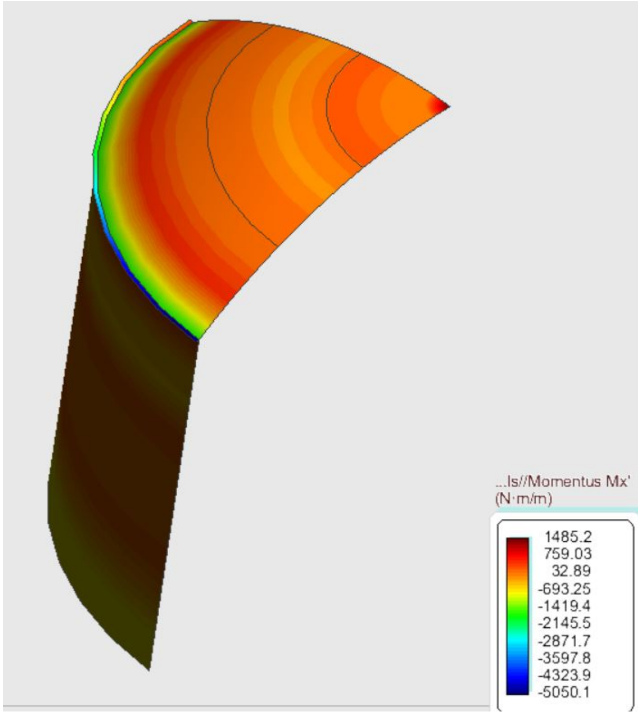


M_s for the 1d

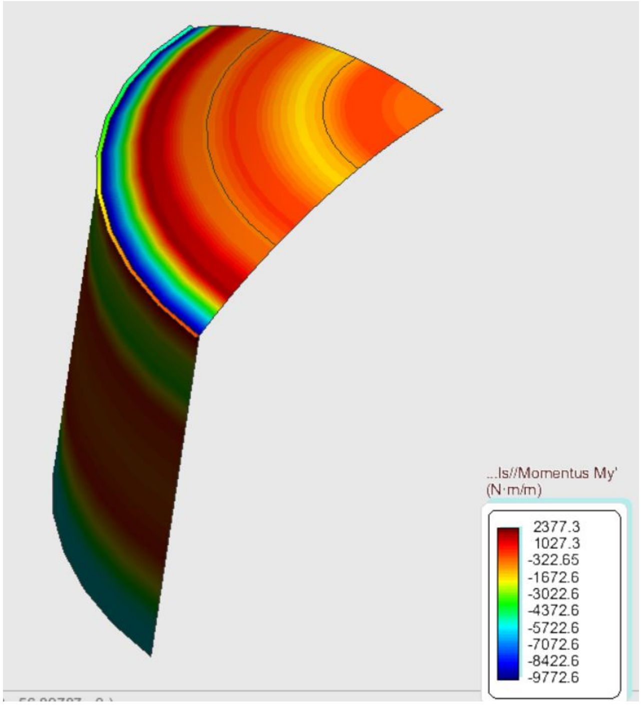


M_θ for the 1d

For the 1d case, M_s and M_θ are obtained since we are working with a revolving framework. The behaviour of both of them is the same, however, it should be noted that their magnitudes are different being higher for the M_s.



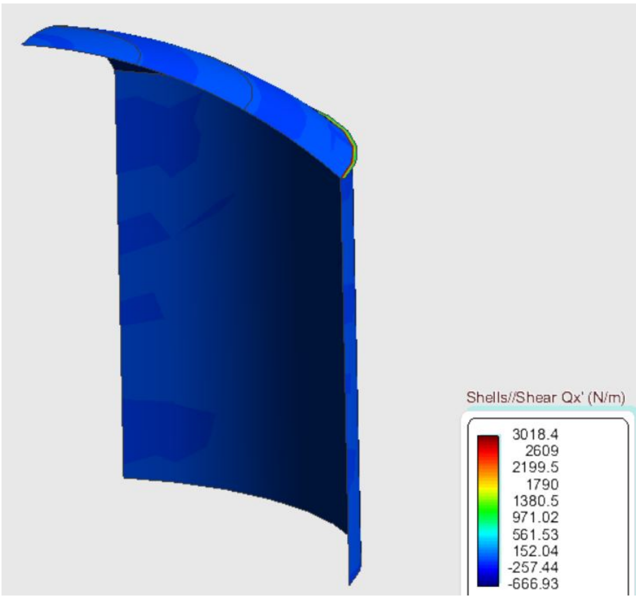
M_x for the 3d



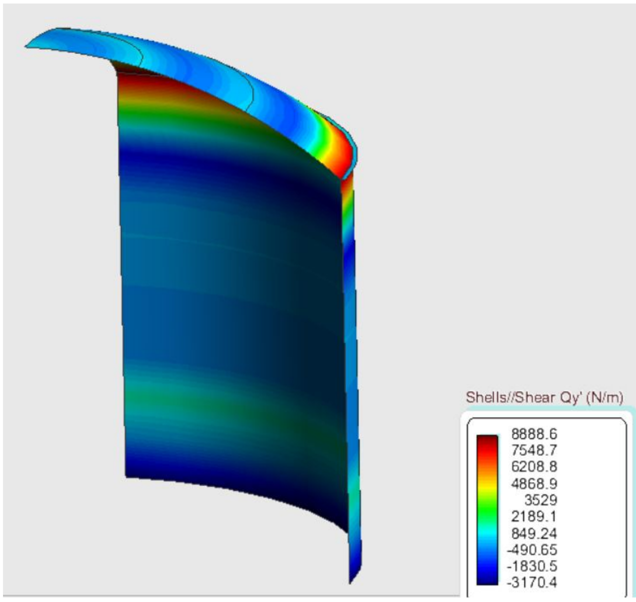
M_y for the 3d

For the 3d case, looking to M_x has highest values along the lip which is not symmetrically distributed because of the boundary conditions applied. Another positive maximum is obtained on the top point.

Analyzing M_y, in which the magnitudes are higher than M_x, the maximums are obtained in the parts of the tank in touch with the lip, which is expected.



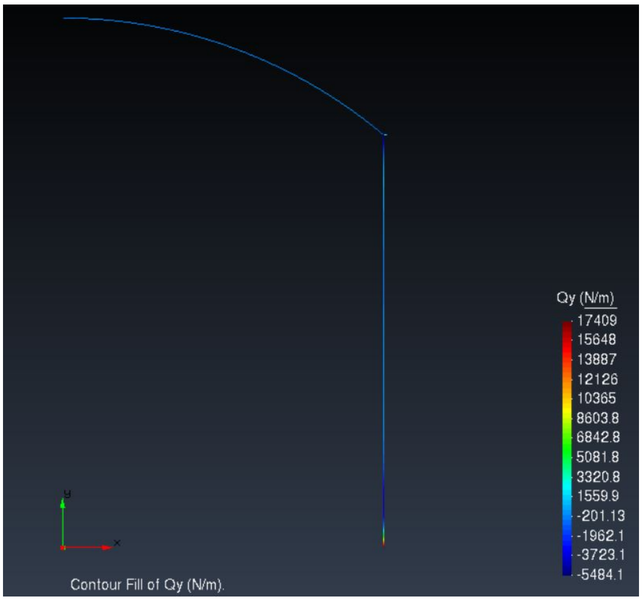
Q_x for the 3d



Q_y for the 3d

For the Q_x, the maximum values appear on the lip. The lip is used as a reinforcement of the tank, in that way it limit the tank expansion.

For the Q_y, the maximum values appear in those zones in touch with the lip. This could be explained due to the fact that the lip is used to limit the expansion of the tank. This acts as some form of fixture. Thus the angle near the lip is kept nearly constant while it increases further from the lip. This explains the increase in the shearing stress as the material is subjected to higher shearing distortion near the lip.



Q for the 1d

A similar behavior is is observed in the in the 1D case. Drawing near the location of the lip, the magnitude of the shear increases till it reaches a maximum at the location of the lip. Another, location of maximum shear is at the fixture point at the bottom of the tank. Shear is induced due large shearing distortion and this occurs near the lip and the fixture point at the bottom.