Computational Structural Mechanics and Dynamics **March 29, 2019**
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Assignment 7

7.1 Analyze the shear blocking effect on the Reissner Mindlin element and compare with the MZC element. For the Simple Support Uniform Load square plate.

Practically, the only drawback of Reissner-Mindlin plate elements is the appearance of shear locking for thin plate situations.
In this case we are going to analize a plate of 10mx10m with the followings values:

- t=0,001
- t=0,010
- t=0,020
- t=0,100
- t=0,400

To compare both elements, the displacement obtained with each one is analyzed.

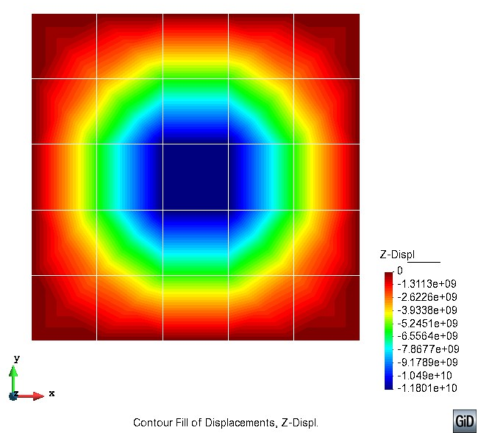

Figure 7.1.1: MZC

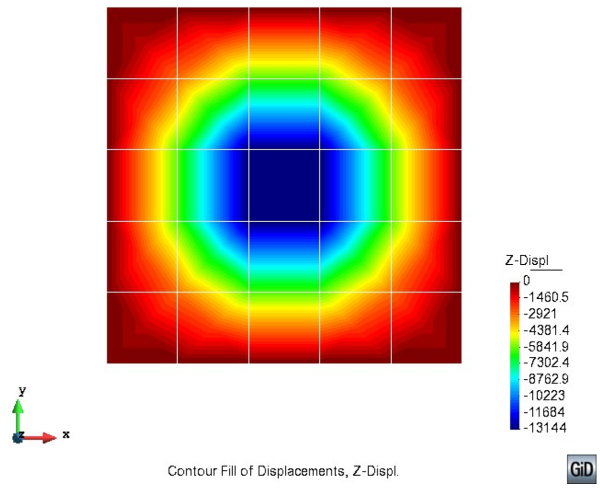

Figure 7.1.2: Quadratic

In the center of the plate, the maximum displacement value is reached. The graph shows the discretization used, for both theories the same thickness of 0.001m was used. The MZC plate shows a larger displacement magnitude. This can be explained since the RM formulation has an additional stiffness that tends to values larger than the exact one.

Now we can consider the following graph showing the maximum displacement:

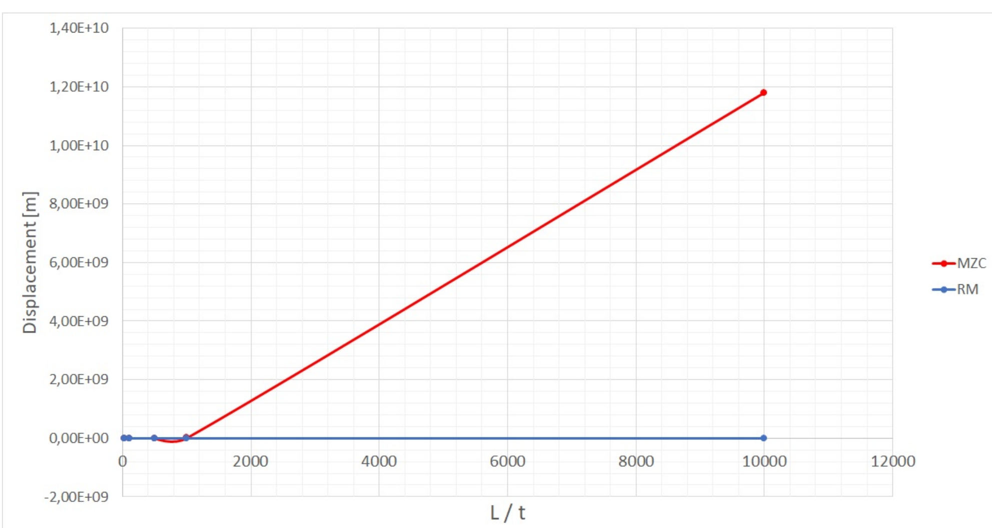

Figure 7.1.3: Maximum displacement

We can clearly see how the tendency is for the displacement to be equal when the plates are thicker.

Now we can compare the maximum moment:

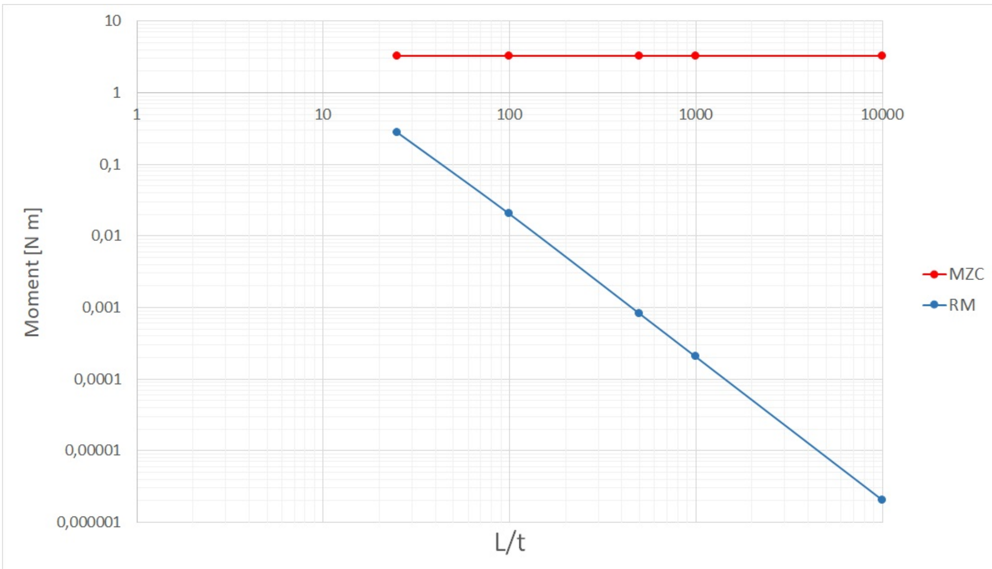

Figure 7.1.4: Maximum moment

We can see that when the thickness tends to zero, the bending part of the system of equations is negligible and the shear part determines the magnitude of the solution.

7.2 Define and verify a patch test mesh for the MCZ element.

A simple patch test of type B can be applied in thin plate elements in order to verify the good representation of rigid body displacements and the absence of spurious modes. The following displacement field is imposed at the boundary nodes:

$$w = c - ax - by$$

where a, b and c are arbitrary numbers.
After solving the system of equations the internal DOFs must comply with the previous equation and the curvatures must be zero at each point in the patch.

A similar type B patch test can be devised for verifying the capability of the element for reproducing a constant curvature field. The test is based on imposing to the patch boundary nodes the quadratic displacement field:

$$w = \frac{1}{2}\left(ax^2 + by^2 + cxy\right)$$

where again a, b and c are arbitrary numbers. The numerical solution for the deflection at internal nodes must be in accordance with the previous equation.
First then we are going to choose the parameters: a=0.01m; b=0.015m and c=0.012m.

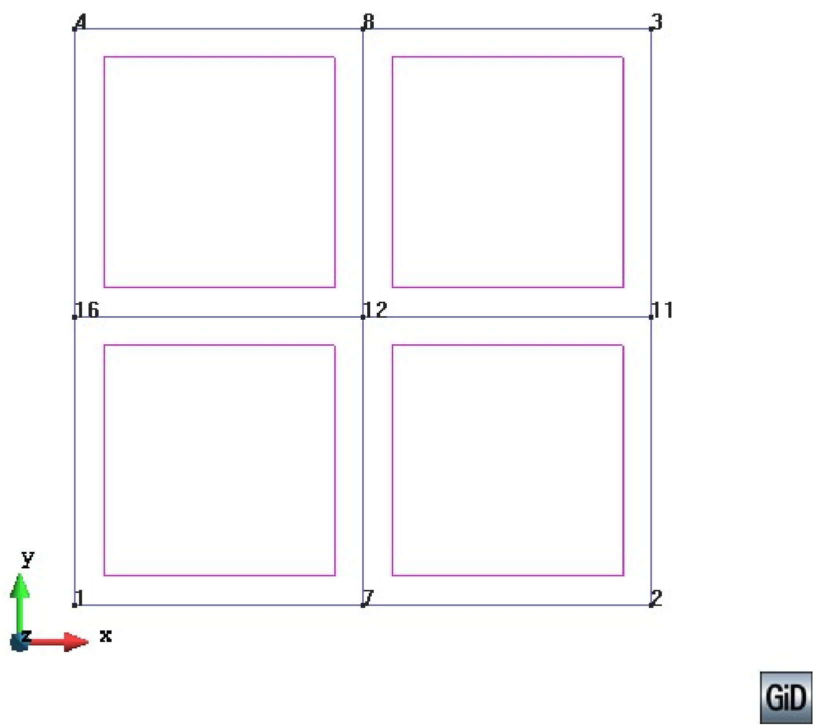

Figure 7.2.1: Maximum moment

Node	X	Y	W
1	0	0	0,012
2	10	0	-0,088
3	10	10	-0,238
4	0	10	-0,138
7	5	0	-0,038
8	5	10	-0,188
11	10	5	-0,163
12	5	5	-0,113
16	0	5	-0,063

Table 1: LINEAR.

Node	X	Y	W
1	0	0	0,012
2	10	0	-0,988
3	10	10	-2,488
4	0	10	-1,488
7	5	0	-0,238
8	5	10	-1,738
11	10	5	-1,363
12	5	5	-0,613
16	0	5	-0,363

Table 2: QUADRATIC.

And taking into account the lineal and the quadratic forms for the patch test we have the next results:

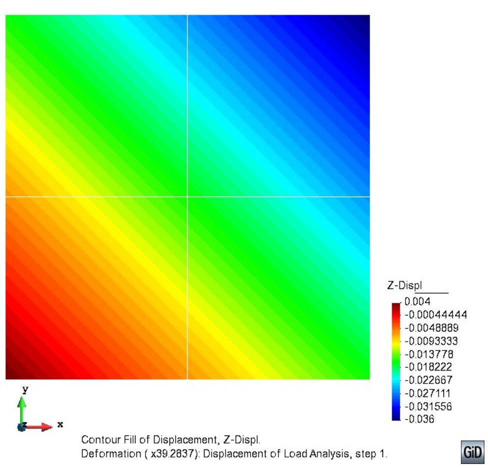

Figure 7.2.2: LINEAR

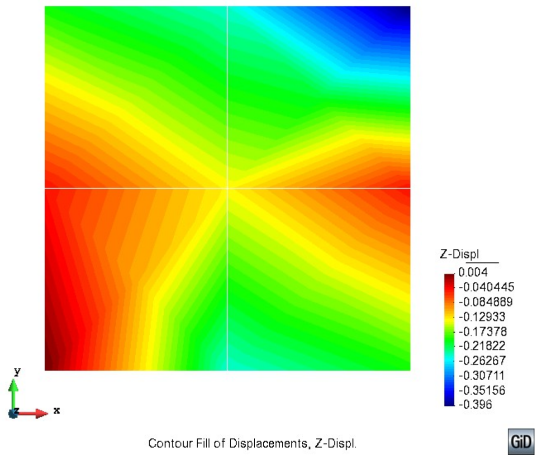

Figure 7.2.3: QUADRATIC