Assignment 7 – Nicolas Andre Caronte Grønland

a)

Analyze the shear locking effect of the Reissner Mindlin element and compare with the MZC element. For the simple support uniform load square plate. Use the 5x5 mesh:

t=0.001 t=0.010 t=0.020 t=0.100 t=0.400

E=10.92 v=0.3 Q=1.0

To achieve this the MatLAB programs available on CIMNE were used. To study the shear blocking effect we can analylze the maximum displacement in the middle of the plate for both elements.

Running the MatLAB programs I got the following:

Maximum displacements:

Thickness	**Reissner Mindlin**	**MZC**
0.001	1.290*10^10	1.290*10^10
0.010	4.767*10^4	5.826 *10^5
0.020	1.540*10^3	5.294* 10^3
0.100	1.016*10^3	1.877* 10^3
0.400	2.857*10^2	4.304*10^2

The maximum displacements were found in the middle of the plate and are dimensionless because of how it is stated in the MatLAB program. Nevertheless, this is only for comparison, so the dimensions don't really matter.

As we can see from the table above in general the Reissner Mindlin plate give smaller maximum displacements for reasonable thicknesses. For very low thicknesses they both give large displacements, but as the thickness becomes larger the results start to give more sense. Because of the shear locking effect of the Reissner Mindlin plate, some energy will be absorbed and thus the result will be stiffer.

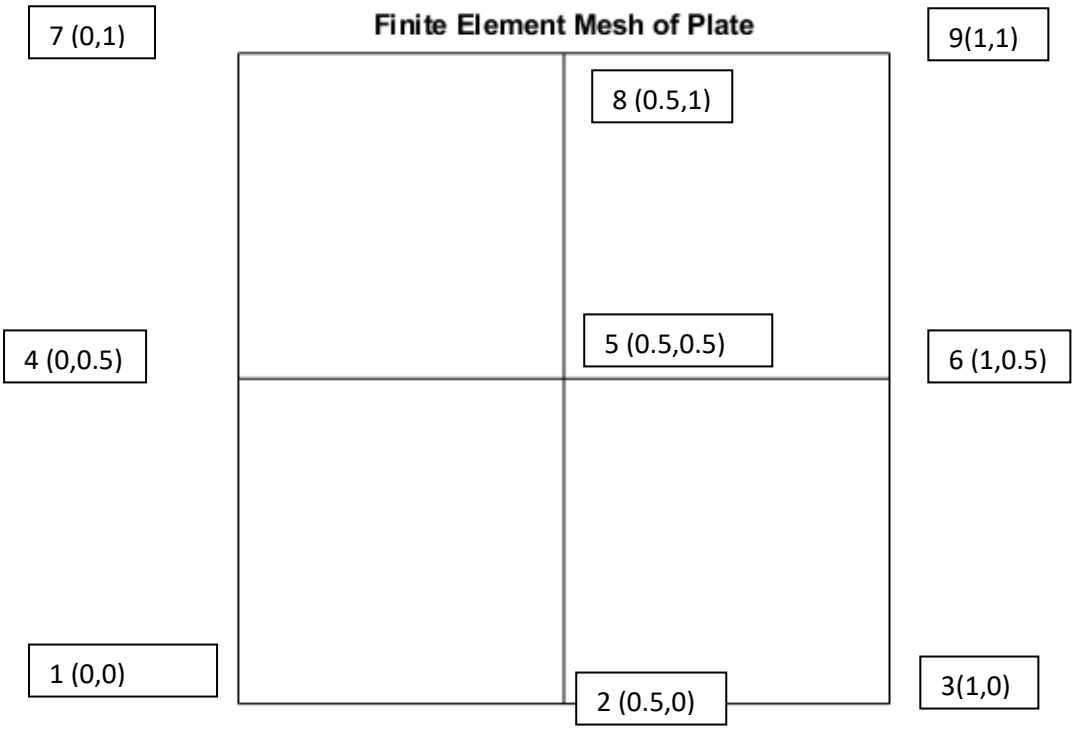
b)

Define and verify a patch test mesh for the MZC element.

To preform a patch test for the MZC element one can discretize it into 4 elements with a total of 9 nodes. This way, the central node is the free node while the remaining nodes on the boundary are set to zero. Then the patch trial function will only propagate over the chosen patch and will be zero beyond it. Now, since the MZC elements are linearly interpolated one should expect the displacement variation between the boundary and the free middle node to also be linear. Because of this an arbitrary displacement can be described as follows: w=c+a*x+b*y.

Now if we consider the 4 elements as follows (from left to right, bottom to top):
Thickness of 0.1

Node	X-coordinate	Y-coordinate
1	0	0
2	0.5	0
3	1	0
4	0	0.5
5	0.5	0.5
6	1	0.5
7	0	1
8	0.5	1
9	1	1



The free node is node number 5(0.5,0.5). For w=-0.01x-0.01y we get:

If we calculate the displacement of node 5: w=-0.01.

Now if we run the same MatLab-program used in exercise a) we get a result of w=-0.010005 which is very close to the one calculated with our linear displacement model, this means that MZC element with linear shape functions will pass the patch test.