Assignment 7 – Plates

Computational Structural Mechanics and Dynamics

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1. What kind of strategy will you use to solve the following problems

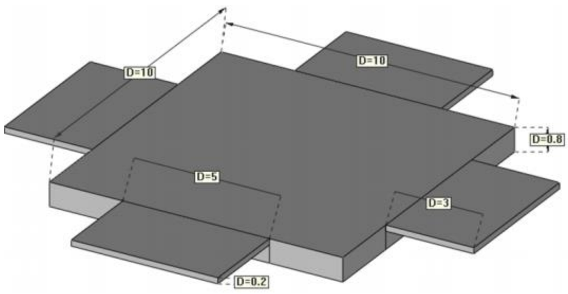

Figure 1

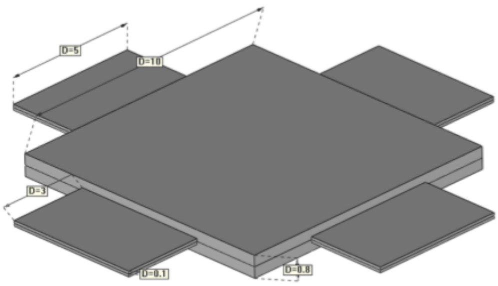

Figure 2

For the plate shown in Figure 1 we have the problem that the midplanes of the two plates do not coincide. This will give a problem for the plate theories we so far have learned, because all the deformations is related to the displacement and rotation of the midplane. However, the Kirchoff theory and Reissner-Mindlin theory can be used, with the condition that the relation between the two midplanes is taken into consideration.

In Figure 2 do however the two midplanes coincide. The plate consists of plates considered as thin plates, hence I would use the Kirchoff theory for thin plates. This theory can only use rectangular elements, as arbitrary quadrilateral elements do not fulfil the patch test.

2. Patch test of the MCZ- and RM-element

For patch test I have chosen to look at the displacement values obtained from the Matlab script when imposing an displacement at the boundary of the patch element. If the displacements and strains within the patch coincide with the prescribed displacement field, the patch test is satisfied, if else not.

When imposing a displacement at the boundary of the element, it will in the first case with 9 nodes mean that the imposed displacements are in the boundary of the plate. In case 2 the imposed displacements are given in the boundary of the patch element. The idea is shown in Figure 3. Withouth external forces the displacement in the interior node of the patch element, should be equal to the imposed displacement at the boundary of the patch, and with strain equal zero.

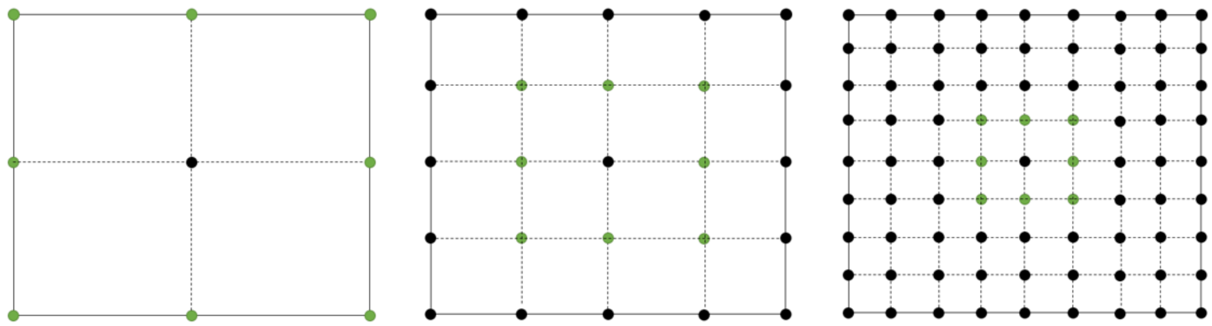

Figure 3 - Patch test

MZC-element:

The thickness of the plate consisting of MZC elements is only 0.01, hence the deformations are very large. For every mesh I therefore impose a displacement 1*10^7 at the boundary of the patch. The results are shown in Table 1.

Table 1

Elements	Displacement obtained	Correct displacement
4	1,0E+07	1,0E+07
16	1,0E+07	1,0E+07
36	1,0E+07	1,0E+07
64	1,0E+07	1,0E+07

RM-element:

The thickness of the plate consisting of RM elements is 1, which gives much smaller deformations in the case with MZC-elements. For every mesh I impose a displacement 1 at the boundary of the patch. The results are shown in Table 2.

Table 2

Elements	Displacement obtained	Correct displacement
4	1,0	1,0
16	1,0	1,0
36	1,0	1,0
64	1,0	1,0

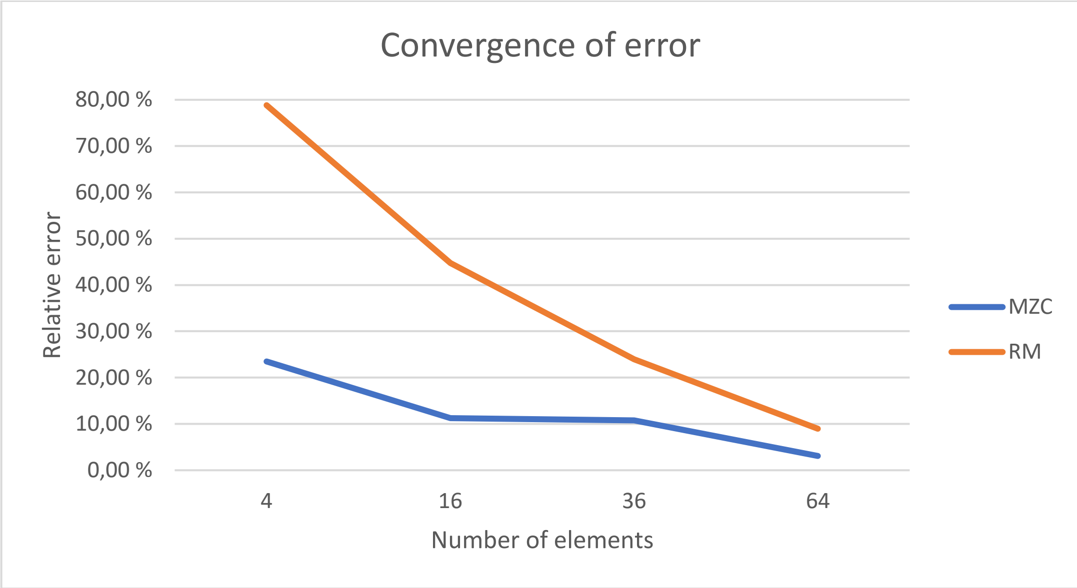

Figure 4

The values in Figure 4 is obtained from using the scripts for finding displacement for plates by using MZC- and RM-elements. The correct value is given by $w = \propto \frac{qL^4}{D}$ (given in lecture material) and this value is compared by the displacements given by the different meshes. As we see do the error converge against zero, and together with the fact that the patch test is satisfied, we do have elements that can converge to the correct solution.