COMPUTATIONAL SUCTURAL MECHANICS AND DYNAMICS

Master of Science in Computational Mechanics/Numerical Methods

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Assignment 7: Plate elements

1. **Analyse the shear blocking effect on the Reissner Mindlin element and compare with the MZC element. For the Simple Support Uniform Load square plate. Use the 5x5 mesh.**

Simulations have been performed with the two elements using a mesh with 5 nodes per side. The results for the RM element with a thickness of 0.001 are plotted in the figure:

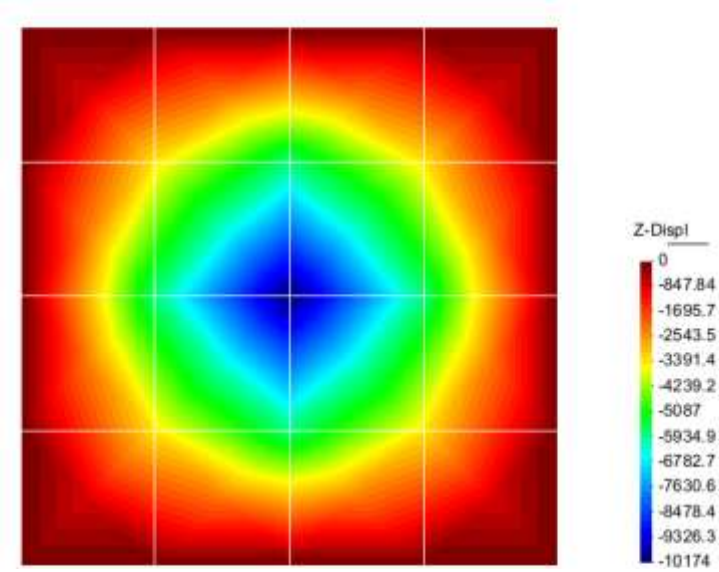

Figure 1: Displacement for RM element

To compare both elements, the maximum displacement has been computed with different thickness. The results are presented in the table:

Table 1: Deflection

Thickness	Deflection for RM	Deflection for MZC
0.001	$1.017 \cdot 10^{4}$	$1.408 \cdot 10^{10}$
0.01	$1.017 \cdot 10^{3}$	$1.408 \cdot 10^{7}$
0.02	508.6	$1.760 \cdot 10^{6}$
0.1	101.7	$1.408 \cdot 10^{4}$
0.4	23.51	219.95

It is realised that the displacement for the RM element is orders of magnitude lower than the computed for the MZC. But as the thickness increases, the difference is reduced. This is explained due to the fact that the RM element present shear locking and for thicker plates, the shear becomes more relevant so the results more accurated.

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

The patch test will only be verified for transverse displacements, as the thickness is irrelevant, it has been set to 0.01. About the mesh, a 3x3 mesh has been used, first it has been checked with a regular mesh and then with a distorted one. In this case, there is only one interior node as can be seen in the plot of the mesh:

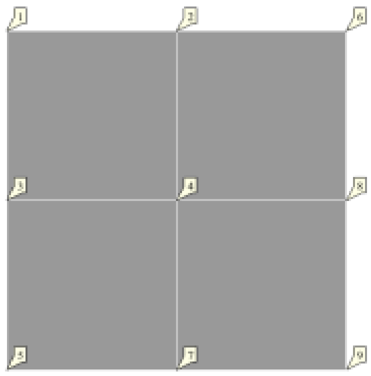

Figure 2: Regular mesh for the patch test

The first test is to impose a constant solution on the boundary nodes and check that in the inner node the solution is fulfilled. The result is satisfactory:

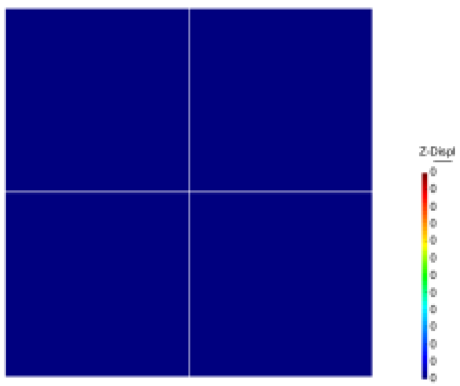

Figure 3: Constant solution for regular mesh

Then, a linear solution of the form $u^z = k \cdot x \cdot y$ is imposed and again, the solution is satisfactory as the element preserve the linear solution.

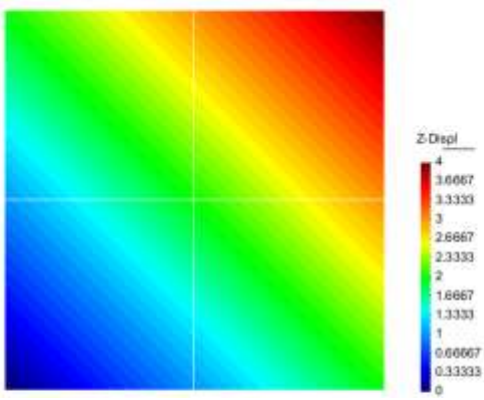

Figure 4: Linear solution for regular mesh

After that, the same tests have been performed on a distorted mesh. The result is satisfactory on the constant solution but not on the linear solution.

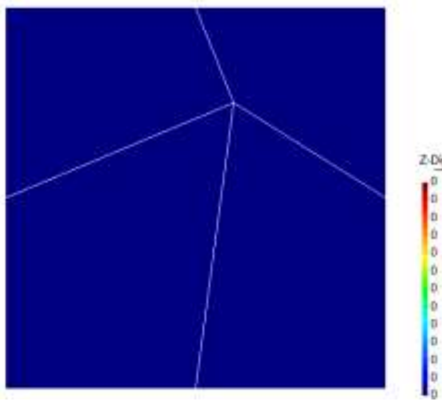

Figure 5: Constant solution for distorted mesh

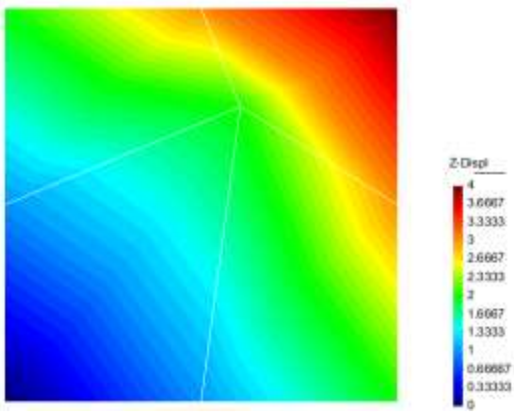

Figure 6: Linear solution for distorted mesh

This behaviour is what it was expected for these elements: they are only convergent for regular meshes.