Universitat Politecnica De Catalunya

Computational Solid Mechanics

Computational Structural Mechanics and Dynamics

Assignment-7 (PLATES)

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a) In the first part of the assignment, we need to analyze the shear blocking effect on the Reissner Mindlin element and compare with the MZC element. The 5*5 mesh is used for the simply supported square plate of dimensions 1m*1m. The material properties are as follows: E = 10.92 Pa, $\nu = 0.3$. The effect of Q = 1N is observed on the sq. plates of thickness: (a) 0.001 (b) 0.01 (c) 0.02 (d) 0.1 (e) 0.4

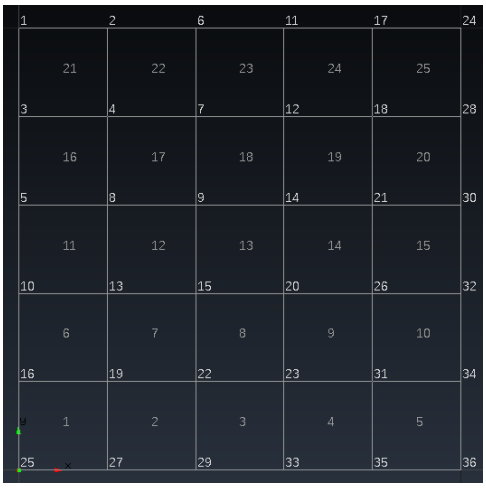

Figure 1: 5x5 Mesh sq. plate

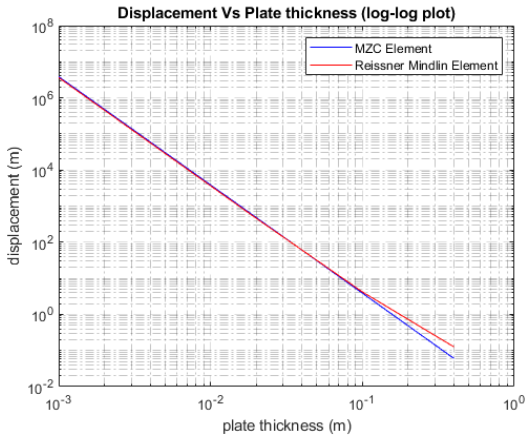

Figure 2: Disp.-plate thickness

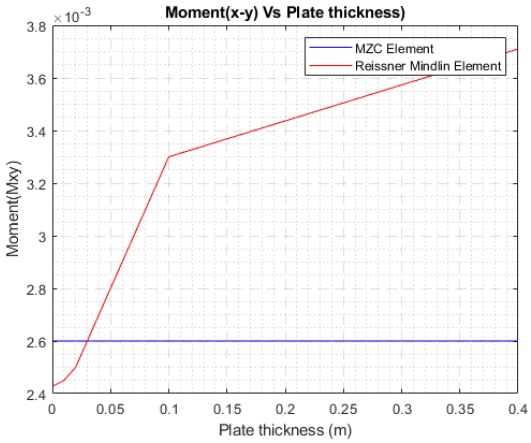

Figure 3: M_{xy} Vs plate thickness

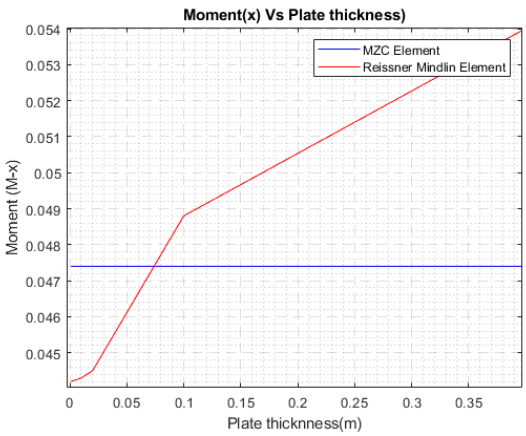

Figure 4: M_x Vs plate thickness

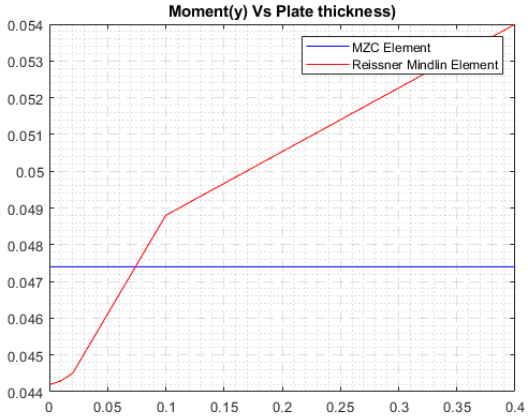

Figure 5: M_y Vs plate thickness

		Displacement (z)		Moment (Mxy)		Moment (Mx)		Moment (My)	
	Plate Thickness	MZC Element	Reissner Mindlin	MZC Element	Reissner Mindlin	MZC Element	Reissner Mindlin	MZC Element	Reissner Mindlin
1	0.001	3.86E+06	3.64E+06	2.60E-03	2.43E-03	4.74E-02	4.42E-02	4.74E-02	4.42E-02
2	0.01	3.86E+03	3.65E+03	2.60E-03	2.45E-03	4.74E-02	4.43E-02	4.74E-02	4.43E-02
3	0.02	4.83E+02	4.59E+02	2.60E-03	2.50E-03	4.74E-02	4.45E-02	4.74E-02	4.45E-02
4	0.1	3.86E+00	4.18E+00	2.60E-03	3.30E-03	4.74E-02	4.88E-02	4.74E-02	4.88E-02
5	0.4	6.03E-02	1.26E-01	2.60E-03	2.71E-03	4.74E-02	5.40E-02	4.74E-02	5.40E-02

Figure 6: Table for MZC and Reissner Mindlin Element

It is evident from the Fig. 2 that the vertical displacement decreases for both element as the plate thickness increases. Moreover, the displacement value for MZC element reamins greater than that of Reissner Mindlin till plate thickness of 0.02. However, when the plate thickness value is further increased to 0.1 and 0.4, this trend is reversed,i.e, the displacement value for Reissner Mindlin Element exceeds the MZC Element's. displacement value, which can be attributed to decreasing influence of shear block effect due to increment in thickness.

Further, the M_x,M_y and M_{xy} values remains constant for MZC Element, while moment values (M_x, M_y, M_{xy})increases with increment in thickness for Reissner Mindlin Element.

b) In the second part, we are performing the patch test. Convergence of the non-conforming element to the correct solution can be proved by passing the patch test. If the displacement at interior points of the patch is equal to the prescribed displacement at the boundary, then the patch test is satisfied. In our case, a square plate with 4x4 mesh is considered and vertical displacement at the boundary is taken as zero, i.e., nodes 1,3,6,10,16,2,18,5,21,11,23,17,19,22, 24,25 have zero vertical displacement. Now, we consider a patch from this plate whose boundary value of rotations (θ_x ans θ_y) are fixed to zero and the prescribed displacement at these patch boundary's nodes,i.e., nodes 4,8, 12 ,14,20,15,13,7 is 2. It has been calculated using GiD-RamSeries that prescribed displacement values at patch boundaries is equal to interior node (Node 9) displacement. Therefore, the patch test is satisfied.

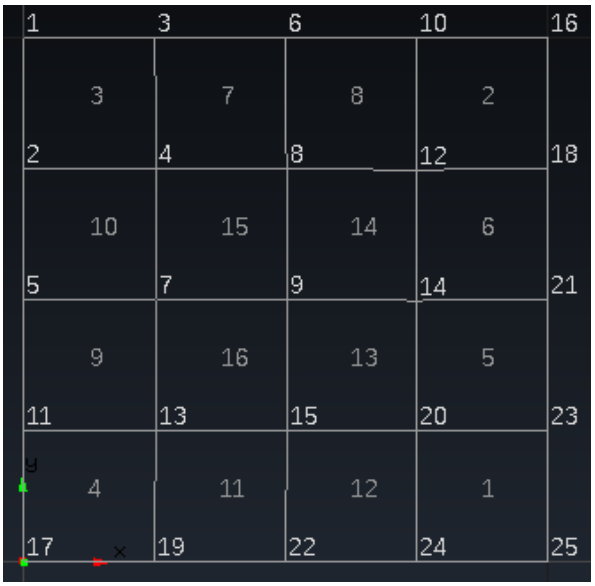

Figure 7: 4x4 Mesh sq. plate

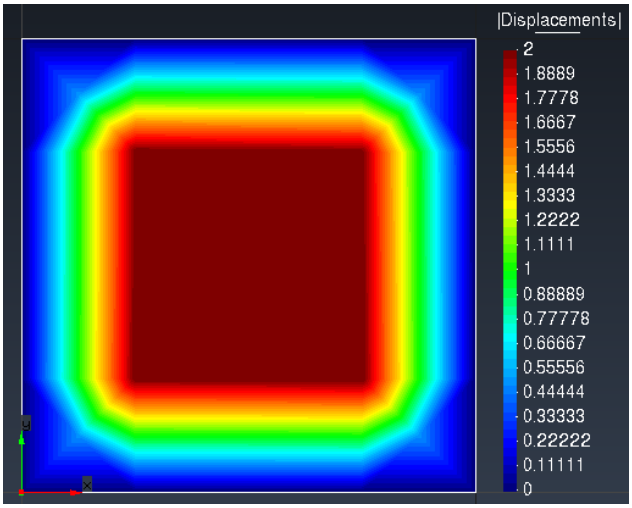

Figure 8: Patch Test