PLATES ASSIGNMENT.
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We modify Matlab code given in order to analyze the shear blocking effect on the Reissner Midlin element and we will compare them with the MZC element.

We will analyze a square plate and we will use a 5x5 mesh.

The plate is submitted to a uniform pressure of 1 Pa.

I enclose 3 folders:

- Placa_MZC folder
- Placa_RM Full folder
- Placa_RM Reduced folder

In all of them there are these files:

- A **main script (Plate_xx.m)**. It calls **B_mat_Plate_xxx.m and ToGiD_VigaD.m** scripts, which generates Clamp_UL_5.flavia.res and Clamp_UL_5.flavia.msh in which we can find the results. These results can be viewed with GID program. At the end of the script we add some code to plot results
- **timing.m** is just to time each of the parts of the program execution.
- **Clamp_UL_5.m** define the mesh. We define material properties such as thickness.
- **figures** folder with all the figures for each different thickness value:
  1. t = 0,001 m
  2. t = 0,010 m
  3. t = 0,020 m
  4. t = 0,100 m
  5. t = 0,400 m

  with displacement in z direction plot, X-der and Y-der plots and GID snapshots (displacements in z direction, Mx, My, Mxy, X-der, Y-der, Shear, Qx, Qy…)

Placa_RM Reduced is obtained from Placa_RM Full folder just neglecting Kb (imposing Kb=0)

We obtain higher maximum and minimum values in Reduced version than in Full ones for Qx, Qy, X-der and Y-der.

Z-displacements from 0 in the borders to maximum values in the middle. In Reduced version we obtain maximum value 5/3 higher than in Full version.

The blocking effect makes that we do not have Mx, My, Mxy, such we have in Full or in MZC.

If we compare all the pictures from Full, Reduced and MZC we can see similar shapes, but different values.

	Mx	My	Mxy	Qx	Qy	Shear	X-der	Y-der	Z-disp
MZC	=	=	=				-	-	-
FULL	+	+	+	+	+	+	-	-	-
REDUCED				=	=		-	-	-

*Table. **Behavior with thickness increases**. + means increases, - decreases and = remains equal*

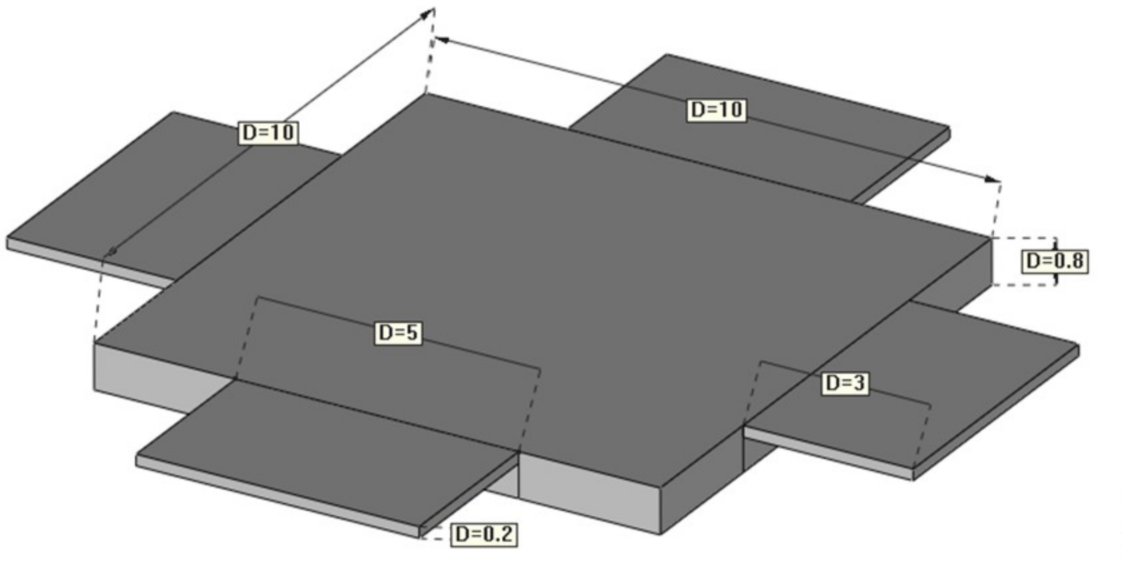
In this table we can see the behavior of each element when thickness is higher.

In FULL Mx, My and Mz increases as thickness is bigger.

In MZC Mx, My and Mxy remains equal (and Mx=My) because of the orthogonality condition (the points along normal to the middle plane before deformation remain on straight lines also orthogonal to the middle plane after deformation). FULL model is more realistic and it does not take this orthogonality condition into account. We have no results for Mx, My and Mxy in the reduced version, because of the transverse share locking effect of this approximation.

As we expected in the three models minimum values are in the borders (they are clamped) and maximum in its center. This maximum values decreases when thickness is bigger.

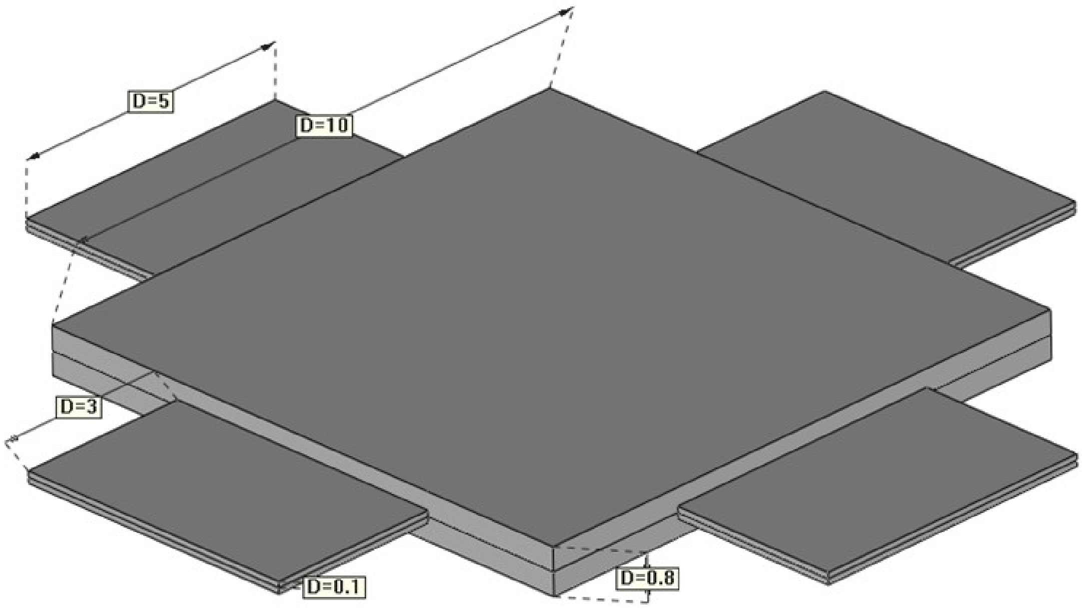
STRATEGY FOR SOLVING THE FOLLOWING PROBLEMS



In this problem, we can not use classical Kirchhoff plate theory because thickness is bigger than 0.1 m. So we must use Reissner-Midlin plate theory.

We can see this problem as a square with its boundary conditions (if it is clamped on its borders we will impose 0 displacement in x, y and z direction) and 4 small rectangles with restriction in x, y and displacements just in the side clamped to the big square.

We will mesh with square elements because of its geometry and Full integration will be used because middle plane of square and rectangle do not coincide and the transverse share locking effect is not valid here. Rectangle thicknesses are not negligible.



In this problem, we can not use classical Kirchhoff plate theory because thickness is bigger than 0.1 m in the square. So we must use Reissner-Midlin plate theory.

We also can see this problem as a square with its boundary conditions (if it is clamped on its borders we will impose 0 displacement in x, y and z direction) and 4 small rectangles with restriction in x, y and displacements just in the side clamped to the big square.

We will mesh with square elements because of its geometry and Full integration is not necessary now. While Full integration is more exact we can use in this case the reduced integration because middle plane of square and rectangle coincide. Also rectangle thickness would be acceptable in Kirchhoff plate theory. Transverse share locking effect can be used here.

PATCH TEST

A non-conforming plate element can still converge to the correct solution if it satisfies the patch test.

The patch test is based in **in imposing at the boundary of a patch of element a displacement field** which can be exactly reproduced by the shape functions.

The patch test is satisfied if the displacements and strains within the patch coincide with the exact values deduced from the prescribed displacement field.

The MZC element satisfies the patch test for rectangular shapes.

The patch test is not fulfilled for arbitrary quadrilateral shapes and the MZC is not reliable in these cases.

So we have written Clamp_UL_5_PatchTest. M script in which fixed nodes has not all its values equal to 0.

We impose a Z displacement in all its nodes:

```
fixdesp  = [
    1, 1,  0.0;
    1, 2,  0.0;
    1, 3,  disp;
    2, 1,  0.0;
    2, 2,  0.0;
    2, 3,  disp;

    (…)

]
```

We have tested MZC element with a fixed thickness=0.4 m and 3 tests with disp=-0.1, -0.5 and +2.5.

In Placa_MZC\Placa_MZC\figures\PatchTest you can see the 3 patch test results.

Patch1 folder, disp=-0.1
Patch2 folder, disp =-0.5
Patch3 folder, disp =+2.5

The patch test is satisfied. We obtain the same results in the three test and in the original, (when disp=0) as you can see in Placa_MZC\Placa_MZC\figures\5 folder.