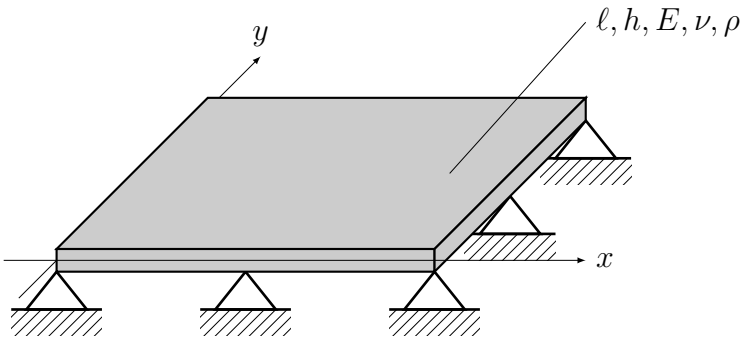
Mini-project 3
Natural frequencies and mode shapes of a square plate

Project organization:

- Groups: 3 to 5 students
- 20% of final grade
- Pdf report: maximum 10 pages
- Programming language: Matlab
- Submission: 1 June, 2025
- Total workload: 40h (approx. 10h per student)



a) Model, using the finite element method, a square, isotropic, thin plate that is simply supported along all four edges using two $n \times n$ meshes, one using AMC plate bending elements and the second using CR plate bending elements. The geometrical and material properties of the plate are given as:

- length of the edge $\ell = 0.5$ m,
- thickness $h = 0.005$ m,
- elasticity modulus $E = 210$ GPa,
- Poisson's ratio $\nu = 0.3$,
- density $\rho = 7850$ kg/m^3.

b) Compute the approximate first natural frequencies and corresponding mode shapes of the plate for discretizations with 2×2, 4×4, 8×8, and 16×16 elements. Discuss the results, compare them against exact analytical frequencies, and evaluate the convergence behavior of the numerical predictions.

c) Investigate the effect of changing the span/thickness ratio from $\ell/h = 100$ to $\ell/h = 10$ on the accuracy of the lowest frequency of a simply supported square plate computed using AMC or CR elements. Compare the results obtained using a thin plate formulation with the exact one and with the one obtained from a thick plate model.