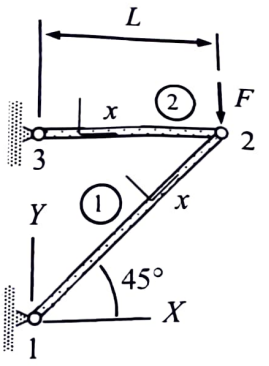
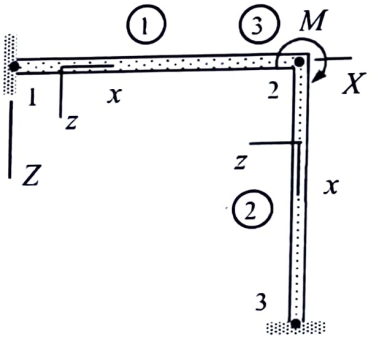
MEC-E1050 Finite Element Method in Solids, onsite exam 04.12.2023

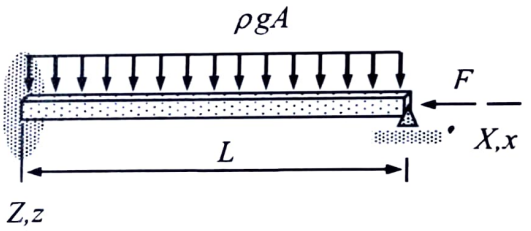
1. Determine the horizontal and vertical displacements of node 2. Cross-sectional area of bar 1 is $\sqrt{2}A$ and that of bar 2 is A. Young's modulus of the material is E.



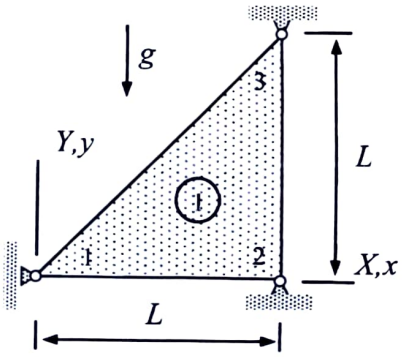
2. Determine the rotation θ_{Y2} at node 2 of the structure loaded by a point moment (magnitude M) acting on node 2. Use beam elements (1) and (2) of length L and a point moment element (3). Assume that the beams are inextensible in the axial directions. Young's modulus E and the second moment of area I are constants. Use the principle of virtual work.



3. The beam of the figure is loaded by its own weight and a point force acting on the right end. Determine the displacement and rotation of the right end starting with the virtual density of the Bernoulli beam model. The x-axis of the material coordinate system is placed at the geometric centroid of the rectangle cross-section. Beam properties A, I_{yy}, I_{zz} and E of the planar problem are constants.



4. A thin triangular slab (assume plane stress conditions) loaded by its own weight is allowed to move vertically at node 1 and nodes 2 and 3 are fixed. Find the displacement u_{Y1}. Material parameters E, ν, ρ and thickness t of the slab are constants.



5. A plate, loaded by point force F acting at the free corner, is simply supported on two edges and free on the other two edges as shown in the figure. Determine the parameter a_0 of approximation $w(x,y) = a_0(x/L)(y/L)$ and displacement at the center point. Use the virtual work density of the plate bending mode with constant E, ν, ρ and t.