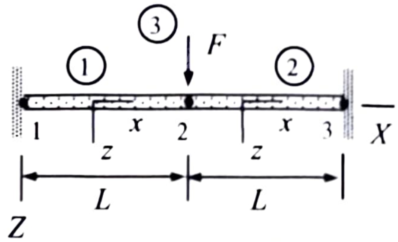
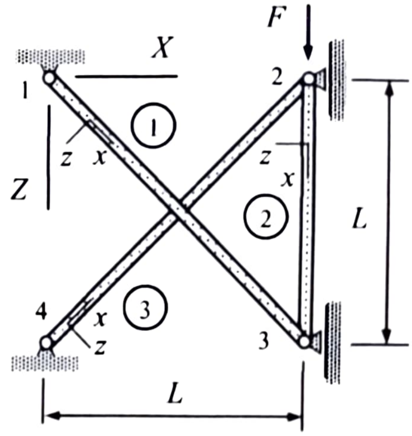
MEC-E1050 Finite Element Method in Solids, exam 13.12.2021

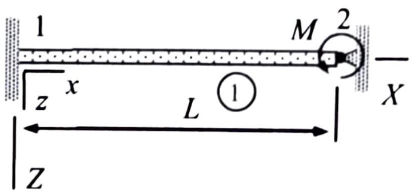
1. Determine displacement u_{Z2} at node 2 of the beam structure shown. Use two beam elements of equal length. Assume that rotation $\theta_{Y2} = 0$. Point force of magnitude F is acting on node 2. Young's modulus of the material E and the second moment of area I are constants.



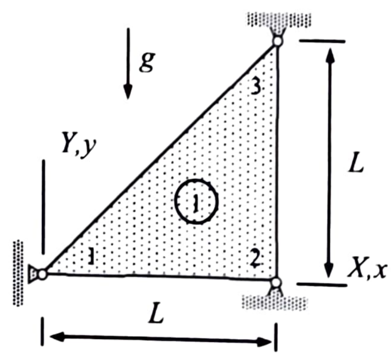
2. The bar truss shown in loaded by vertical force F at node 2. Assuming that bar 2 is inextensible, determine the non-zero displacements of the nodes. The cross-sectional area of bar 1 and 3 is A and that of bar 2 is $\sqrt{2}A$. Young's modulus E of the material is constant. Use the principle of virtual work.



3. Determine the rotation θ_{Y2} of the beam shown at the support of the right end which allows rotation but not transverse displacement. Young's modulus E of the material and second moment of cross-section $I_{yy} = I$ are constants. Use the virtual work density of beam bending mode $\delta w_{\Omega} = -(d^2\delta w / dx^2)EI_{yy}(d^2 w / dx^2) + \delta w f_z$ and cubic approximation to the transverse displacement.



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.