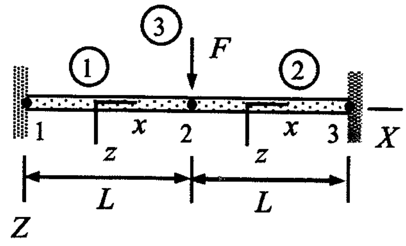
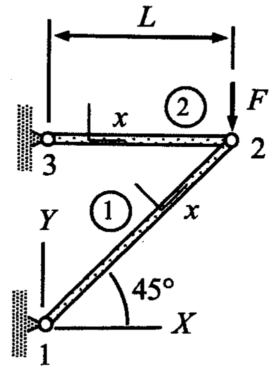
MEC-E1050 Finite Element Method in Solids, exam 21.02.2019

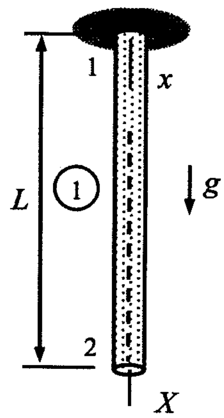
1. Determine displacement u_{Z2} at node 2 of the beam structure shown. Use two beam elements of equal length. Assume that rotation $\theta_{Y2} = 0$. Point force of magnitude F is acting on node 2. Young's modulus of the material E and the second moment of area I are constants.



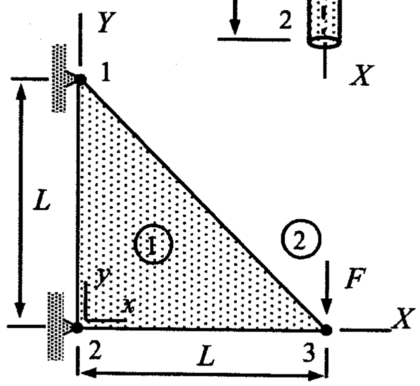
2. Determine the horizontal and vertical displacements of node 2. Cross-sectional area of bar 1 is $\sqrt{2}A$ and that of bar 2 is A. Young's modulus of the material is E.



3. Consider a bar of length L loaded by its own weight (figure). Determine the displacement u_{X2} at the free end. Start with the virtual work density expression $\delta w_{\Omega} = -\delta(du/dx)EA(du/dx) + \delta u f_x$ and approximation $u = (1 - x/L)u_{x1} + (x/L)u_{x2}$. Cross-sectional area A, acceleration by gravity g, and material properties E and ρ are constants.



4. A thin triangular slab of thickness t is loaded by a point force at node 3. Nodes 1 and 2 are fixed. Derive the virtual work expression δW of the structure in terms of u_{X3} and u_{Y3}, and solve for the nodal displacements. Approximation is linear and material parameters E and ν are constants. Assume plane-stress conditions.



5. Consider the plate strip shown loaded by its own weight. Thickness, length and width of the plate are t, L, and H, respectively. Density ρ, Young's modulus E, and Poisson's ratio ν are constants. Find an approximation to the transverse displacement w of the plate using series $w = a_0(1 - x/L)(x/L)$ (just one term of a series) in which a_0 is an unknown parameter.