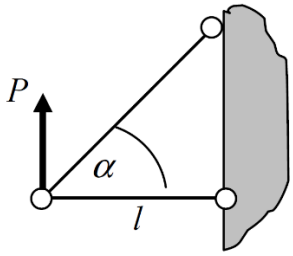
Finite Element Method 1- Homework training / part 2

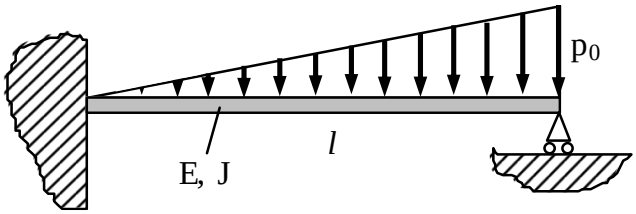
Problems

1. Build a finite element (FE) model and find elongation of a bar rotating about one of the ends with the circular frequency ω. Use 1 and 2 finite elements.
   l - length, E - Young modulus, A- cross-sectional area, ρ – density. Compare the results with the exact analytical solution.

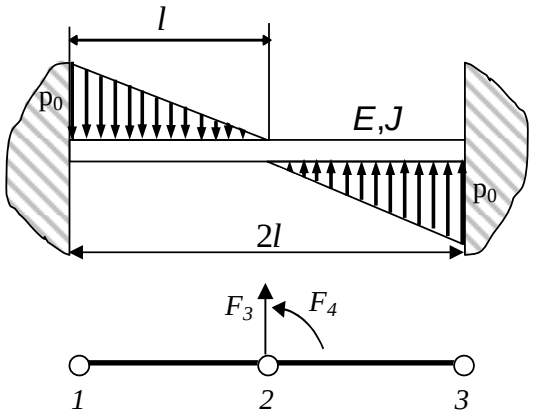
2. Write the system of FEM equations for a 2-D truss (after including the displacement boundary conditions) and find the displacement vector of the joint loaded be force P.
   E - Young modulus, A- cross-sectional area. α = 45°.



3. Find the beam deflection and the bending moment and shear force distributions. Compare results obtained for the Ritz method (with approximate functions of 1 and 2 parameters) and for FEM (1 and 2 finite beam elements)

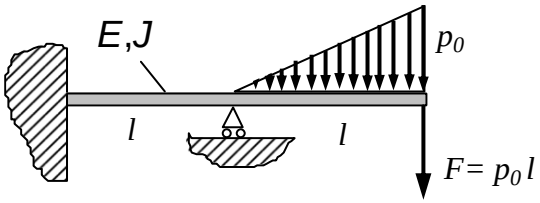


3. Find equivalent nodal forces F_3, F_4. Write a final system of two linear FEM equations. Find nodal displacements the beam deflection and the bending moment and shear force distributions.



4. Find systems of FEM linear equations before and after considering the constraints.

a)



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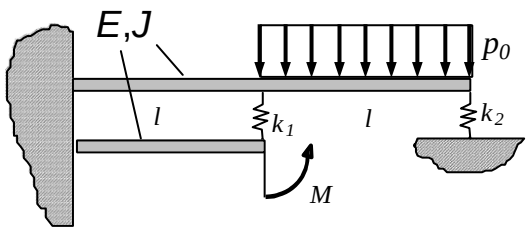

Theory

1. Compare the finite element method and the Ritz method for beam structures.
2. Describe the requirements for the shape functions that are needed to decrease discrepancy between the approximate and the exact solution with increasing discretization density.
3. Write the total potential energy V for a single finite element representing the bar supported at one end and loaded by the axial force F at the second end. Plot the graph of V as a function of the axial displacement at the point where the force is applied. Mark the two points on the graph where $V = 0$ and the point represening FE solution: l - length, E - Young modulus, A- cross-sectional area