INTRODUCTION TO THE FINITE ELEMENT METHOD

Department of Mechanical Engineering

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Fall 2019

HOMEWORK #2

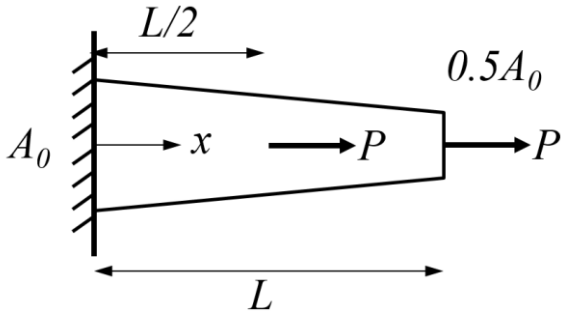
Due October 3, 2019

1. A tapered elastic bar, with a square cross section varied from A_0 to $0.5A_0$, is subjected to a concentrated load P at $x = L$ and another concentrated load P at $x = L/2$. Use "direct stiffness method" to calculate the displacement at the free end. L = 10 m, A_0 = 4 m^2, P = 1000 N. The elastic modulus and Poisson's ratio of the bar are 210 GPa and 0.3, respectively.

   (1) Derive the interpolation functions for the 2-node bar element; express the approximation solution using these functions: $u_N^e(\bar{x}) = u_1^e \phi_1(\bar{x}) + u_2^e \phi_2(\bar{x})$; determine the element equation.

   (2) Use two 2-node elements to solve $u(L)$.

   (3) Use three 2-node elements to solve $u(L)$.



2. (**Software application**) Solve Problem 1 using a commercial package, such as ANSYS, ABAQUS, or COMSOL.

   (1) Use 1-D beam element (e.g. BEAM188).

   (2) Use 2-D structural solid (e.g. PLANE182).

   (3) Use 3-D structural solid (e.g. SOLID185).

   (4) Compare and discussion the results obtained in Problem 1 and Problem 2 (1) and (2).