

2.092/2.093

FINITE ELEMENT ANALYSIS OF SOLIDS AND FLUIDS I

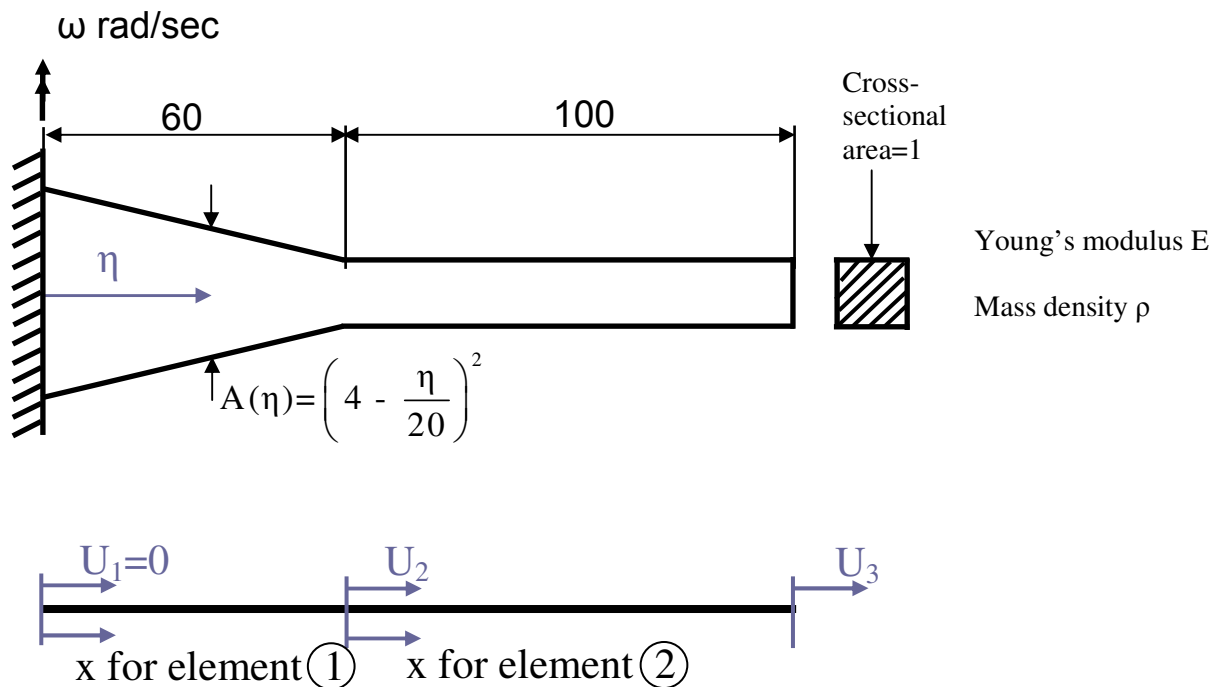
FALL 2009

Quiz #1

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Problem 1 (10 points):

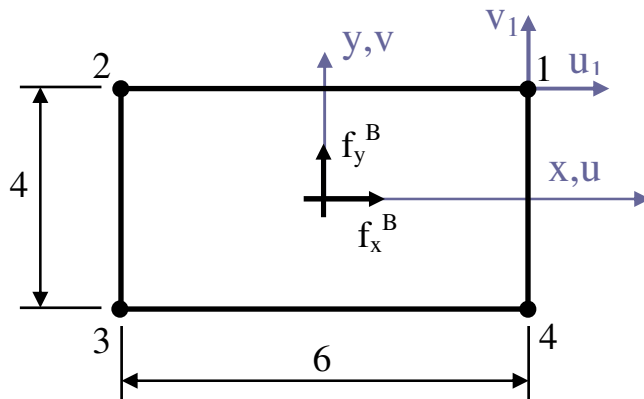
Consider the solution of the problem shown below. A rod is spinning in steady-state at ω rad/sec. The rod is idealized as two one-dimensional elements. Assume linear analysis.



- Establish the finite element displacement interpolation functions, for each element.
- Give the element stiffness matrices and load vectors, but do not perform any integration.

Problem 2 (10 points):

Consider the two-dimensional plane stress element shown below.



4 node element

Thickness t

Young's modulus E

Poisson's ratio ν

$$f_x^B = (4+x)$$

$$f_y^B = 0$$

$$\begin{bmatrix} \tau_{xx} \\ \tau_{yy} \\ \tau_{xy} \end{bmatrix} = \frac{E}{1-\nu^2} \begin{bmatrix} 1 & \nu & 0 \\ \nu & 1 & 0 \\ 0 & 0 & \frac{1-\nu}{2} \end{bmatrix} \begin{bmatrix} \epsilon_{xx} \\ \epsilon_{yy} \\ \gamma_{xy} \end{bmatrix}; \quad \epsilon_{xx} = \frac{\partial u}{\partial x}; \quad \epsilon_{yy} = \frac{\partial v}{\partial y}; \quad \gamma_{xy} = \left(\frac{\partial u}{\partial y} + \frac{\partial v}{\partial x} \right)$$

- Establish all displacement interpolation functions.
- Give the \mathbf{K} matrix and the load vector \mathbf{R}_B of the element. Give all required expressions but do not perform any integration.

Give all answers but write as little as possible !

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