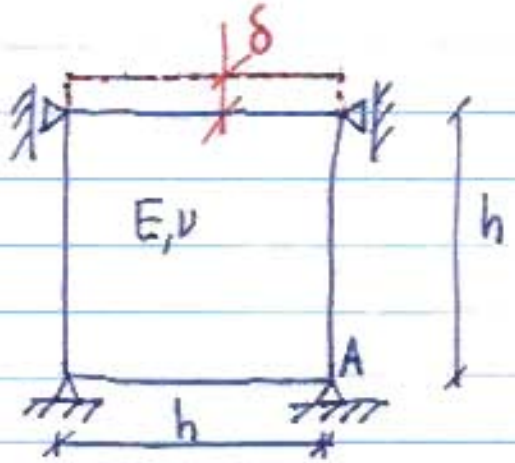
16.21
Practice problems

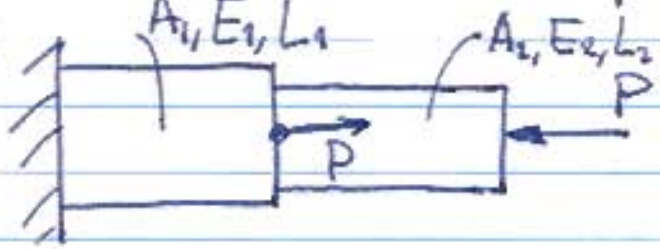
(1) Model the following (plane strain) structure with one 4-node quadrilatered element. Find the horizontal reaction at A when the displacement δ is imposed.
Compare with exact solution.
(In the final the stiffness matrix for the element would be given. In this case obtain it or get it from the notes).



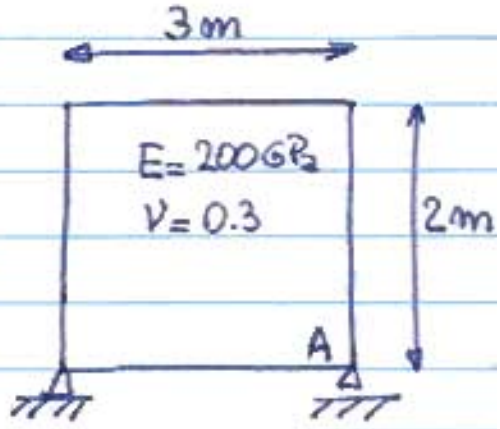
(2) Derive the PVD for the following differential equation associated with the buckling of beams

$$\frac{d^2}{dx^2}\left(EI\frac{d^2w_0}{dx^2}\right)+N\frac{d^2w_0}{dx^2}=0 \qquad 0<x<L$$

(3) Find stresses in each member of the following rod-like structure. Use finite elements. Compare with exact solution.



(4) The 4-node plane strain element is subjected to the constant stresses:



$\sigma_{11} = 200\ MPa$
$\sigma_{22} = 100\ MPa$ (loads not shown)
$\sigma_{12} = 100\ MPa$

Compute the horizontal displacement at A

(5) Consider the structure in the figure

- Write down the PVD for this problem by specializing the general expression.
- Use the PVD to check whether:

$$\sigma(x) = \left(\frac{72}{73} + \frac{24x}{73L}\right)\frac{F}{A_0}$$

is the exact solution. Use the virtual displacement fields

① $\delta u = a\frac{x}{L}$ ② $\delta u = ax^3$