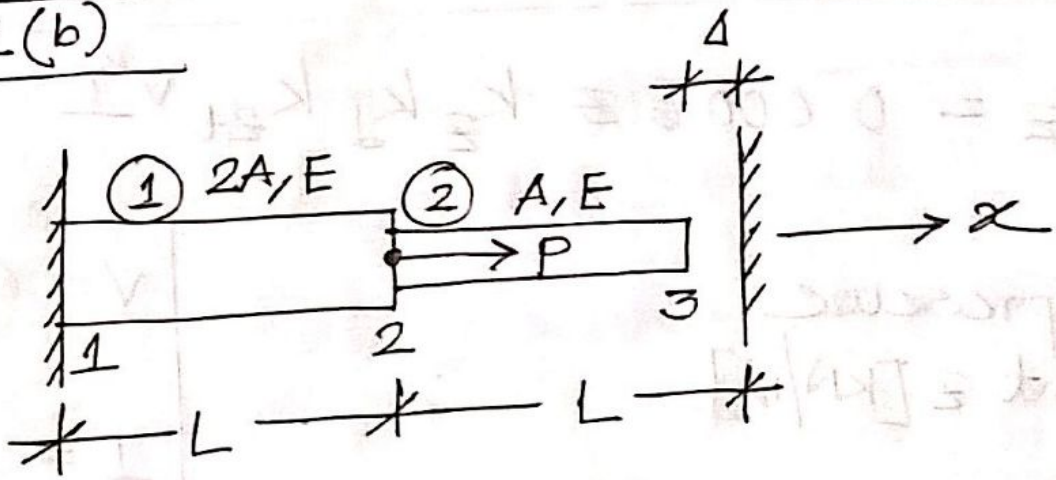
2013-2014

2(b)



$$\Delta_0 = \sum \frac{PL}{AE} = \frac{6\times10^4\times150}{2\times250\times2\times10^4} + \frac{0\times150}{250\times2\times10^4}$$

$$= 0.9\ \text{mm} < \Delta$$

So, contact doesn't occur and there's no reaction at node 3.

Stiffness Matrix for the elements,

$$K_1 = \frac{AE}{L}\begin{bmatrix} 2 & -2 \\ -2 & 2 \end{bmatrix}$$

$$K_2 = \frac{AE}{L}\begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$$

The global stiffness matrix,

$$k = \frac{AE}{L}\begin{bmatrix} 2 & -2 & 0 \\ -2 & 3 & -1 \\ 0 & -1 & 1 \end{bmatrix}$$

The FE equation

$$\frac{AE}{L}\begin{bmatrix} 2 & -2 & 0 \\ -2 & 3 & -1 \\ 0 & -1 & 1 \end{bmatrix}\begin{Bmatrix} 0 \\ u_2 \\ 40 \end{Bmatrix} = \begin{Bmatrix} F_1 \\ P \\ 0 \end{Bmatrix}$$

Here, the first equation gives

$$\frac{AE}{L}\left[2\times 0 - 2\times u_2 + 0\times 0.9\right] = F_1 \quad \text{—①}$$

The second equation gives

$$\frac{AE}{L}\left[-2\times 0 + 3\times u_2 - 1\times 0.9\right] = 6\times 10^4$$

$$\Rightarrow \frac{250\times 2\times 10^4}{150}\left[3u_2 - 0.9\right] = 6\times 10^4$$

$$u_2 = 0.9\ \text{mm}$$

From ①, $F_1 = -6\times 10^4\ \text{N}$