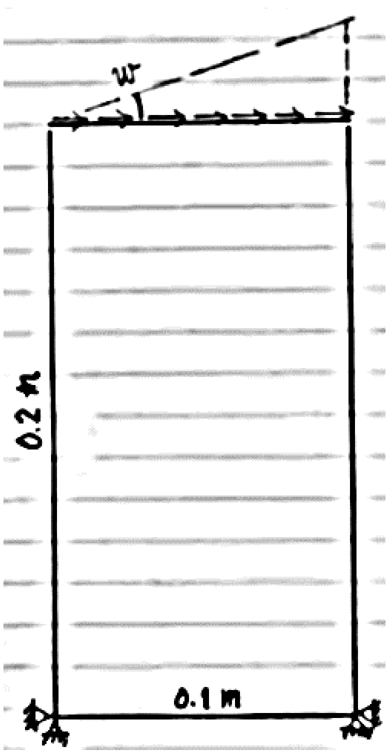
$[k]$: singular, symmetric

$$[K] = \sum_{i=1}^{NE} [k] : \text{symmetric}$$

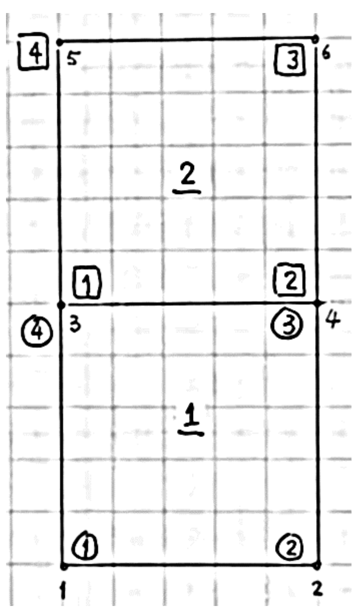
singular before applying B.C.'s

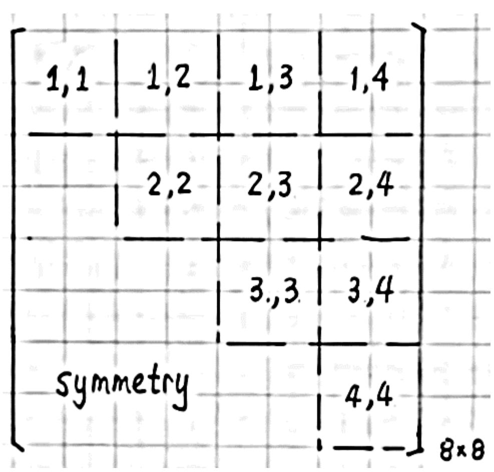


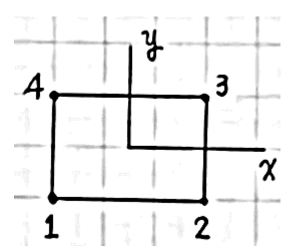
thickness $= 5\ mm$

$E = 200\ GPa$

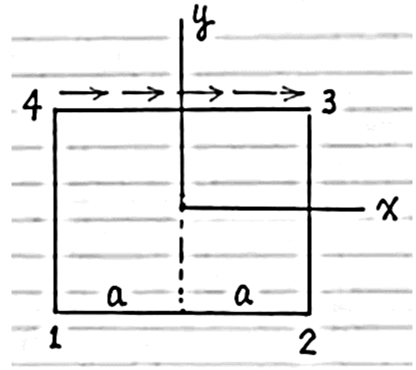
$\nu = 0.3$







$$[k] = 10^8 \times \begin{bmatrix} 494.51 & 178.57 & -302.20 & -13.736 & & & & \\ 178.57 & 494.51 & 13.736 & 54.945 & & & & \\ & & 494.51 & -178.57 & & & & \\ & & -178.57 & 494.51 & & & & \\ & \text{sym.} & & & & & & \end{bmatrix}$$



Surface load on edge "4 − 3":

$$\Phi = \begin{Bmatrix} \Phi_x \\ \Phi_y \end{Bmatrix} = \begin{Bmatrix} \Phi_x \\ 0 \end{Bmatrix}$$

$$\Phi_x = w(x + a)$$
$$w: force/length^3$$

On the other hand, shape functions are, when evaluated at the edge where $y = b$,

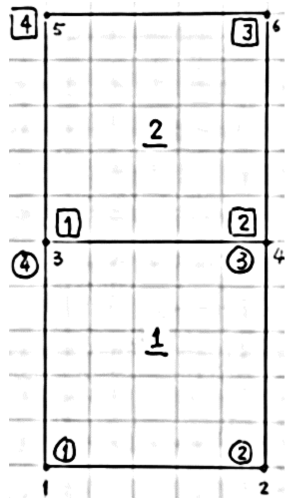
$$\bar{N}_1 = \bar{N}_2 = 0$$
$$\bar{N}_3 = (a + x)/(2a)$$
$$\bar{N}_4 = (a - x)/(2a)$$

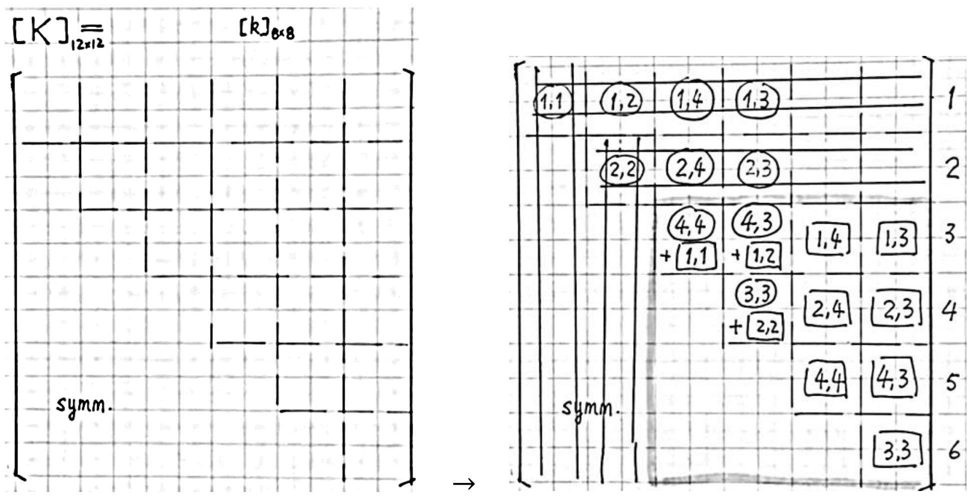
$$\therefore \{f_{eq}\} = \int_{-a}^{a} [\bar{N}]^T \{\Phi\}\, t\, dx$$

$$[\bar{N}] = \begin{bmatrix} \bar{N}_1 & & \bar{N}_2 & & \dots & \bar{N}_4 & \\ & \bar{N}_1 & & \bar{N}_2 & \dots & & \bar{N}_4 \end{bmatrix}_{2x8}$$

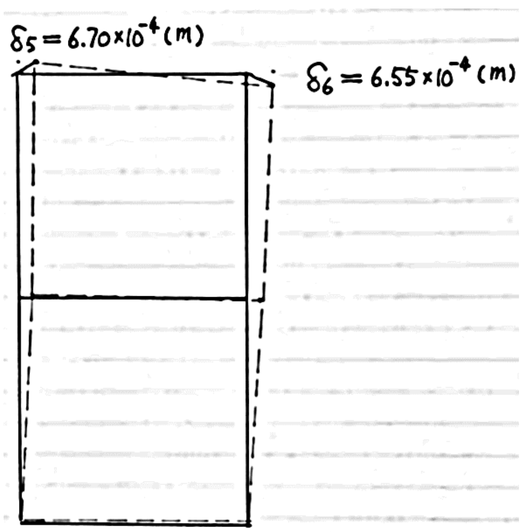
$$\therefore \{f_{eq}\} = \left[0,\ 0,\ 0,\ 0,\ \frac{4}{3} w t a^2,\ 0,\ \frac{2}{3} w t a^2,\ 0\right]^T$$

for element <u>2</u>





Results:



Stresses at Node 3 & 4 (in MPa):