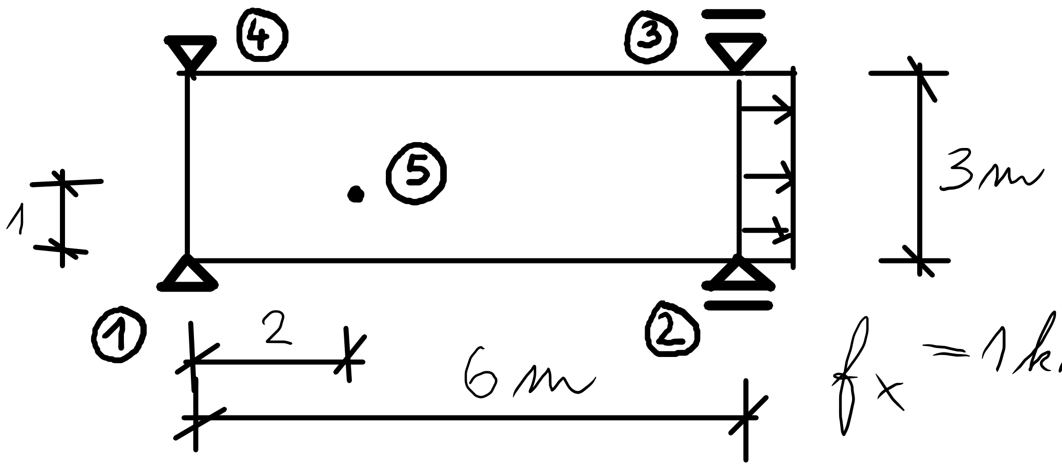


$E = 10\, kPa$

$\nu = 0.1$

$t = 1\, m$

$f_x = 1\, kN/m^2$

CONSTITUTIVE EQ. - PLANE STRESS:

$$\begin{Bmatrix} \sigma_x \\ \sigma_y \\ \tau_{xy} \end{Bmatrix} = \frac{E}{1-\nu^2} \begin{bmatrix} 1 & \nu & 0 \\ \nu & 1 & 0 \\ 0 & 0 & \frac{1-\nu}{2} \end{bmatrix} \begin{Bmatrix} \varepsilon_x \\ \varepsilon_y \\ \gamma_{xy} \end{Bmatrix}$$

DEF. SHAPE:

$u = a \cdot x$

$v = 0$

$$\sigma_x = 1\, kPa = \frac{10}{1-(0.1)^2} 1 \cdot a$$

$$\Rightarrow a = \frac{1-(0.1)^2}{10} = 0.099 = \varepsilon_x$$

$$\sigma_y = \frac{10}{1-(0.1)^2} 0.1 \cdot 0.099 = 0.1\, kPa$$

KINEMATIC EQUATIONS:

$$\varepsilon_x = \frac{\partial u}{\partial x} = a$$

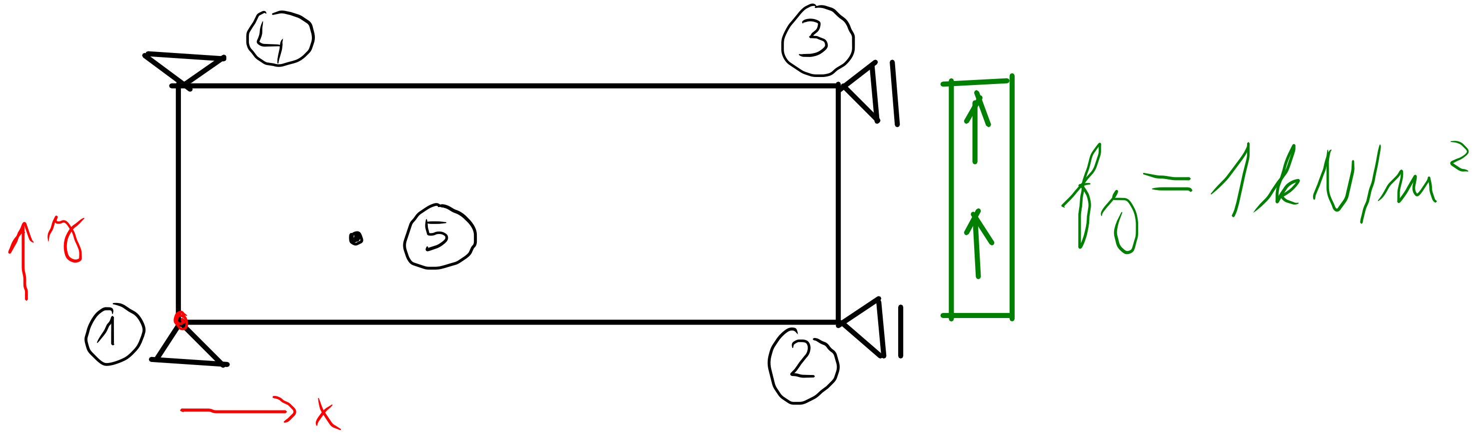
$$\varepsilon_y = \frac{\partial v}{\partial y} = 0$$

$$\gamma_{xy} = \frac{\partial u}{\partial y} + \frac{\partial v}{\partial x} = 0$$

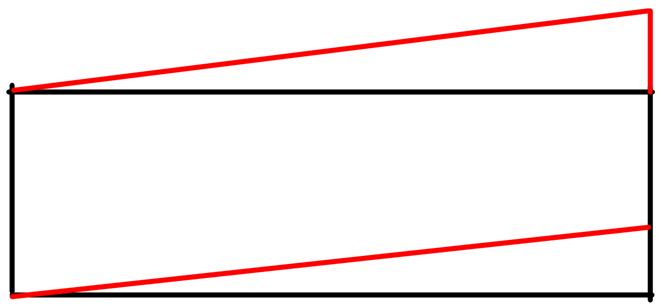
DISPLACEMENTS:

$$u_2 = \varepsilon_x \cdot x_2 = 0.099 \cdot 6 = \underline{0.594\, m}$$

$$u_5 = \varepsilon_x \cdot x_5 = 0.099 \cdot 2 = \underline{0.198\, m}$$



DEF. SHAPE :



$$u = 0$$

$$v = a \cdot x$$

$$\varepsilon_x = \frac{\partial u}{\partial x} = 0$$

$$\varepsilon_y = \frac{\partial v}{\partial y} = 0$$

$$\gamma_{xy} = \frac{\partial u}{\partial y} + \frac{\partial v}{\partial x} = a$$

$$\tau_{xy} = \frac{E}{1-\nu^2} \cdot \frac{(1-\nu)}{2} \cdot a = 1 kPa$$

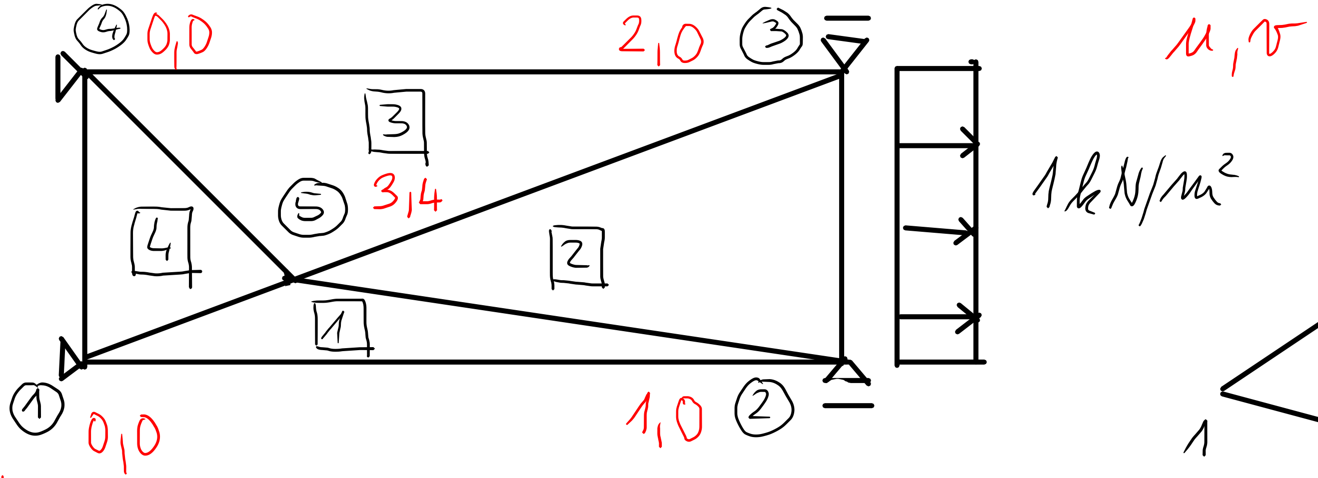
$$\Rightarrow a = \frac{(1-(0.1)^2)}{10} \cdot \frac{2}{(1-0.1)} = 0.22 = \gamma_{xy}$$

$$\tau_{xy} = \ldots\ldots 1 kPa$$

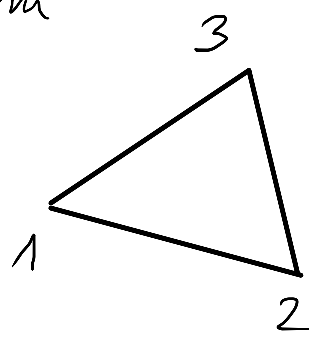
DISPLACEMENTS :

$$v_2 = \gamma_{xy} \cdot x_2 = 0.22 \cdot 6 = 1.32 m$$

$$v_5 = \gamma_{xy} \cdot x_5 = 0.22 \cdot 2 = 0.44 m$$



kč.:



$$\underline{K}\,\underline{r} = \underline{f}$$

$$\underline{u}^e = \underline{N}^{eT} \underline{r}_u^e \qquad \underline{N}^e = \{N_1, N_2, N_3\}$$

$$\underline{v}^e = \underline{N}^{eT} \underline{r}_v^e \qquad \underline{r}^e = \{u_1, v_1, u_2, v_2, u_3, v_3\}$$

$$\underline{\varepsilon}^e = \underline{B}^{eT} \underline{r}^e$$

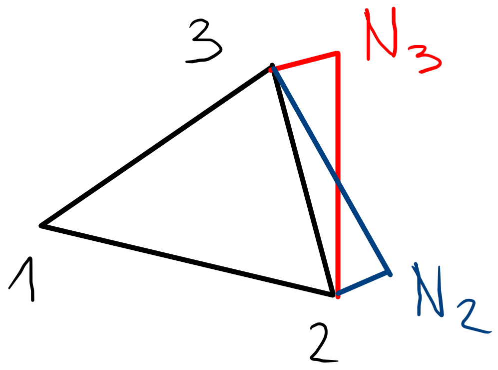
$$\underline{\sigma}^e = \underline{D}^e \underline{B}^{eT} \underline{r}^e$$

FROM KINEMATIC EQS.:

$$\underline{B}^e = \begin{bmatrix} \frac{\partial N_1}{\partial x} & 0 & \frac{\partial N_2}{\partial x} & 0 & \frac{\partial N_3}{\partial x} & 0 \\ 0 & \frac{\partial N_1}{\partial y} & 0 & \frac{\partial N_2}{\partial y} & 0 & \frac{\partial N_3}{\partial y} \\ \frac{\partial N_1}{\partial y} & \frac{\partial N_1}{\partial x} & \frac{\partial N_2}{\partial y} & \frac{\partial N_2}{\partial x} & \frac{\partial N_3}{\partial y} & \frac{\partial N_3}{\partial x} \end{bmatrix} = \begin{bmatrix} y_{23} & 0 & y_{31} & 0 & y_{12} & 0 \\ 0 & x_{32} & 0 & x_{13} & 0 & x_{21} \\ x_{32} & y_{23} & x_{13} & y_{31} & x_{21} & y_{12} \end{bmatrix}$$

$$\underline{K}^e = \int_{\Omega^e} \underline{B}^{eT} \underline{D}^e \underline{B}^e \, d\Omega = \underline{B}^{eT} \underline{D}^e \underline{B}^e \int_{\Omega^e} d\Omega = A \cdot d \cdot \underline{B}^{eT} \underline{D}^e \underline{B}^e \implies \text{IN MATLAB}$$

RIGHT-HAND SIDE VECTOR:



$$\underline{f}_x^e = \int_{x_2}^{x_3} \begin{Bmatrix} 0 \\ N_2 \\ N_3 \end{Bmatrix} \bar{p}_x \, ds = \frac{1}{2} \ell \begin{Bmatrix} 0 \\ \bar{p}_x \\ \bar{p}_x \end{Bmatrix} = \begin{array}{c} \begin{Bmatrix} 0 \\ 1.5 \\ 1.5 \end{Bmatrix} \end{array} \begin{array}{c} 0 \\ 1 \\ 2 \end{array}$$

(CODE NUMBERS)

$$\underline{f}_y^e = \int_{x_2}^{x_2} \begin{Bmatrix} 0 \\ N_2 \\ N_3 \end{Bmatrix} \bar{p}_y \, ds = \ldots$$

$$f^e = \begin{Bmatrix} 0 \\ 0 \\ 1.5 \\ 0 \\ 1.5 \\ 0 \end{Bmatrix} \begin{array}{c} 3 \\ 4 \\ 1 \\ 0 \\ 2 \\ 0 \end{array}$$