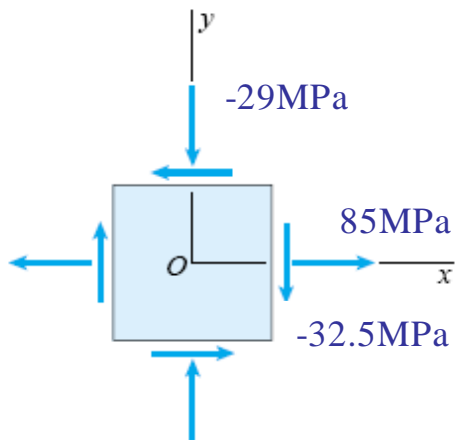


### Primjer 3.1

Element je izložen naponima kao na slici:  $\sigma_x=85\text{MPa}$ ,  $\sigma_y=-29\text{MPa}$ ,  
 $\tau_{xy}=-32.5\text{MPa}$ .

- Odrediti glavne napone i prikaži na skici elementa napona
- Odrediti maksimalni tangencijalni napon i pokaži na elementu napona



\*\*\*\*\*

$$\sigma_x := 85\text{MPa}$$

$$\sigma_y := -29\text{MPa}$$

$$\tau_{xy} := -32.5\text{MPa}$$

\*\*\*\*\*

a)

$$\text{tg}(2\theta_p) = \frac{2 \cdot \tau_{xy}}{\sigma_x - \sigma_y}$$

$$\theta_p := \begin{cases} \text{if } \tau_{xy} \cdot (\sigma_x - \sigma_y) > 0 & = \begin{pmatrix} 75.155 \\ 165.155 \end{pmatrix} \cdot ^\circ \\ \left| \begin{array}{l} \alpha_0 \leftarrow \operatorname{atan}\left(\frac{2 \cdot \tau_{xy}}{\sigma_x - \sigma_y}\right) \\ \alpha_1 \leftarrow \operatorname{atan}\left(\frac{2 \cdot \tau_{xy}}{\sigma_x - \sigma_y}\right) + \pi \end{array} \right. \\ \text{otherwise} \\ \left| \begin{array}{l} \alpha_0 \leftarrow \operatorname{atan}\left(\frac{2 \cdot \tau_{xy}}{\sigma_x - \sigma_y}\right) + \pi \\ \alpha_1 \leftarrow \operatorname{atan}\left(\frac{2 \cdot \tau_{xy}}{\sigma_x - \sigma_y}\right) + 2\pi \end{array} \right. \\ 0.5\alpha \end{cases}$$

$$\sigma := \frac{\sigma_x + \sigma_y}{2} + \frac{\sigma_x - \sigma_y}{2} \cos(2\theta_p) + \tau_{xy} \cdot \sin(2\theta_p) = \begin{pmatrix} -37.614 \\ 93.614 \end{pmatrix} \cdot \text{MPa}$$

$$\sigma_1 := \max(\sigma) = 93.614 \cdot \text{MPa}$$

$$\theta_{p1} := \begin{cases} \theta_{p0} & \text{if } \sigma_0 = \max(\sigma) = 165.155 \cdot ^\circ \\ \theta_{p1} & \text{otherwise} \end{cases}$$

$$\sigma_2 := \min(\sigma) = -37.614 \cdot \text{MPa}$$

$$\theta_{p2} := \begin{cases} \theta_{p0} & \text{if } \sigma_0 = \min(\sigma) = 75.155 \cdot ^\circ \\ \theta_{p1} & \text{otherwise} \end{cases}$$

iii

$$\underline{\sigma} := \begin{matrix} s_0 \leftarrow \frac{\sigma_x + \sigma_y}{2} + \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2} = \begin{pmatrix} 93.614 \\ -37.614 \end{pmatrix} \cdot \text{MPa} \\ s_1 \leftarrow \frac{\sigma_x + \sigma_y}{2} - \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2} \\ s \end{matrix}$$

b)

$$\tau_{\max} := \frac{\sigma_1 - \sigma_0}{2} = -65.614 \cdot \text{MPa}$$

iii

$$\tau_{\max} := \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2} = 65.614 \cdot \text{MPa}$$

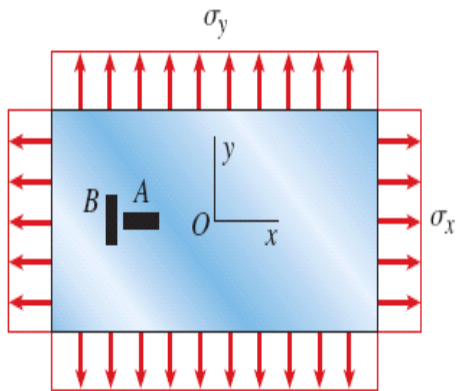
$$\sigma_{\tau_{\max}} := \frac{\sigma_x + \sigma_y}{2} = 28 \cdot \text{MPa}$$

$$\theta_{s1} := \theta_{p1} - \frac{\pi}{4} = 120.155^\circ$$

$$\theta_{s2} := \theta_{p2} - \frac{\pi}{4} = 30.155^\circ$$

### Primjer 3.2

Pravougaona čelična ploča debljine  $t=6$  mm napregnuta je na ravnomjerne napone  $\sigma_x$  i  $\sigma_y$ , kao na slici. Mjerne trake A i B, koje su postavljene u pravcima  $x$  i  $y$  su postavljene na ploču. Ako su čitanja mjernih traka  $\varepsilon_x=0.001$  (izduženje) i  $\varepsilon_y=0.0007$  (skraćenje) izračunati napone  $\sigma_x$  i  $\sigma_y$ , te promjenu debljine ploče. Podaci:  $E=200$  GPa.



\*\*\*\*\*

$$t := 6\text{mm} \qquad E := 200\text{GPa} \qquad \nu := 0.3$$

$$\varepsilon_x := 0.001$$

$$\varepsilon_y := -0.0007$$

\*\*\*\*\*

$$\sigma_x := \frac{E}{1 - \nu^2} \cdot (\varepsilon_x + \nu \cdot \varepsilon_y) = 173.626 \text{ MPa}$$

$$\sigma_y := \frac{E}{1 - \nu^2} \cdot (\varepsilon_y + \nu \cdot \varepsilon_x) = -87.912 \text{ MPa}$$

$$\Delta t = \varepsilon_z \cdot t$$

$$\Delta t := \frac{-\nu}{E} \cdot (\sigma_x + \sigma_y) \cdot t = -0.771 \text{ } \mu\text{m}$$