RESCAN

PROBLEM NO. 3-26	MECHANICAL ENGINEERING DEPARTMENT	NAME KOUL
DATE		SECTION

Given: Fig P3-24

$\varepsilon_x = 1500\ \mu m/m$

$\varepsilon_y = -1250\ \mu m/m$

$\gamma_{xy} = 1000\ \mu rad$

Find:

ε_{nBD}

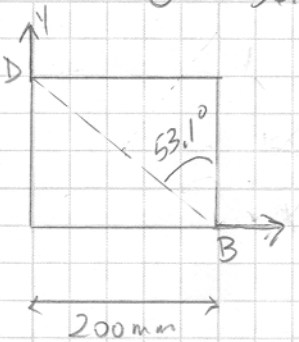
Relationships:

Eq 3-7(a)

$\theta = 53.1 + 90 = 143.1°$

or

$\theta = -36.9°$



System Sketch or FBD

Solution:

$$\varepsilon_n = \varepsilon_x \cos^2\theta + \varepsilon_y \sin^2\theta + \gamma_{xy} \sin\theta \cos\theta$$

$$\theta = -36.9°$$

$$\varepsilon_{n_{BD}} = 1500 \cos^2(-37°) - 1250 \sin^2(-37°) + 1000 \sin(-37) \cos(-37)$$

$$\varepsilon_{nBD} = 28.5\ \mu m/m$$

PROBLEM NO. 3-33	MECHANICAL ENGINEERING DEPARTMENT	NAME Koul
DATE		SECTION

Given: Fig P3-29,

$\varepsilon_x = 750\mu$

$\varepsilon_y = 360\mu$

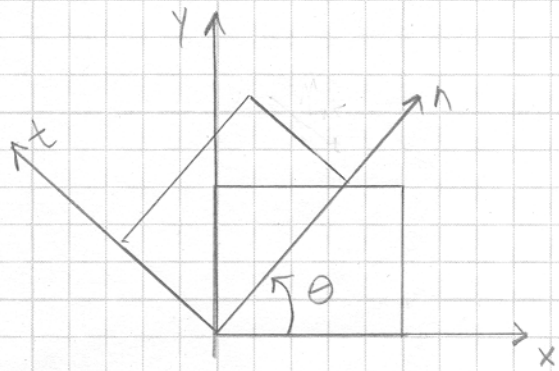
$\gamma_{xy} = -300\mu$

$\theta = 52°$ (positive)

Find: $\varepsilon_n, \varepsilon_t, \gamma_{nt}$

Relationships:

Eq. 3-7, 3-8.



System Sketch or FBD

Solution:

$$\varepsilon_n = \varepsilon_x \cos^2\theta + \varepsilon_y \sin^2\theta + \gamma_{xy} \sin\theta\cos\theta$$

$$\varepsilon_n = 750\cos^2(52) + 360\sin^2(52) - 300\sin(52)\cos(52)$$

$$\boxed{\varepsilon_n = 362.4\mu}$$

$$\gamma_{nt} = -2(\varepsilon_x - \varepsilon_y)\sin\theta\cos\theta + \gamma_{xy}(\cos^2\theta - \sin^2\theta)$$

$$= -2(750 - 360)\sin(52)\cos(52) - 300(\cos^2(52) - \sin^2(52))$$

$$\boxed{\gamma_{nt} = -306\mu}$$

For the transverse ε, $\theta = 52° + 90° = 142°$

$$\varepsilon_t = \varepsilon_x \cos^2\theta + \varepsilon_y \sin^2\theta + \gamma_{xy} \sin\theta\cos\theta$$

$$= 750\cos^2(142) + 360\sin^2(142) - 300\sin(142)\cos(142)$$

$$\boxed{\varepsilon_t = 748\mu}$$

PROBLEM NO. 3-51	MECHANICAL ENGINEERING DEPARTMENT	NAME Kovl
DATE		SECTION

Given: $\varepsilon_x = -325\mu$ $\quad \varepsilon_{p3} = 0$

$\varepsilon_y = -625\mu$

$\gamma_{xy} = 380\mu$

Find: $\varepsilon_{p1}, \varepsilon_{p2}, \gamma_{max}$ Sketch

Relationships: Eq. 3-9

System Sketch or FBD

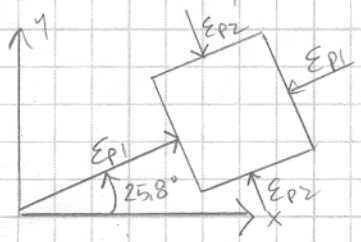
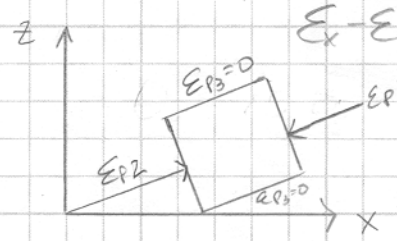
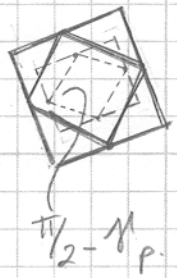
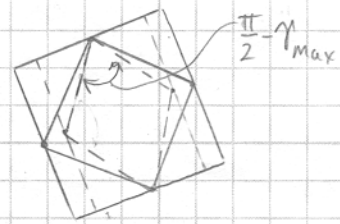
Solution:

$$\varepsilon_{p1}, \varepsilon_{p2} = \frac{\varepsilon_x + \varepsilon_y}{2} \pm \sqrt{\left(\frac{\varepsilon_x - \varepsilon_y}{2}\right)^2 + \left(\frac{\gamma_{xy}}{2}\right)^2}$$

$$\varepsilon_{p1}, \varepsilon_{p2} = \frac{-325 - 625}{2} \pm \sqrt{\left(\frac{-325+625}{2}\right)^2 + \left(\frac{380}{2}\right)^2}$$

$$\boxed{\varepsilon_{p1} = -233\mu \qquad \varepsilon_{p2} = -717\mu \qquad \varepsilon_{p3} = 0}$$

$$\gamma_{max} = \varepsilon_{max} - \varepsilon_{min} = 0 + 717\mu \neq \gamma_p$$

$$\boxed{\gamma_{max} = 717\mu} \qquad \boxed{\gamma_p = \frac{-233 + 717}{2} = 484\mu}$$

Determine θ_p for sketch $\rightarrow \tan 2\theta_p = \dfrac{\gamma_{xy}}{\varepsilon_x - \varepsilon_y} \rightarrow \theta_p = 25.8°$