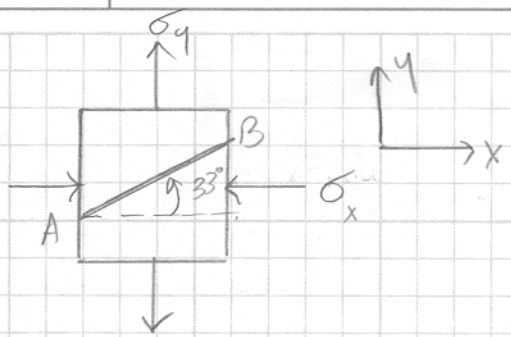
PROBLEM NO. 2-126	MECHANICAL ENGINEERING DEPARTMENT	NAME KOUL
DATE		SECTION

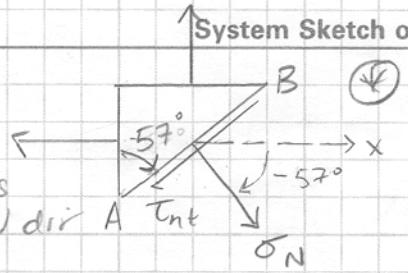
Given: Fig P2-126
$\sigma_x = -27$ MPa
$\sigma_y = 45$ MPa
$\tau_{xy} = 0$



Find: σ_n
τ_{nt}

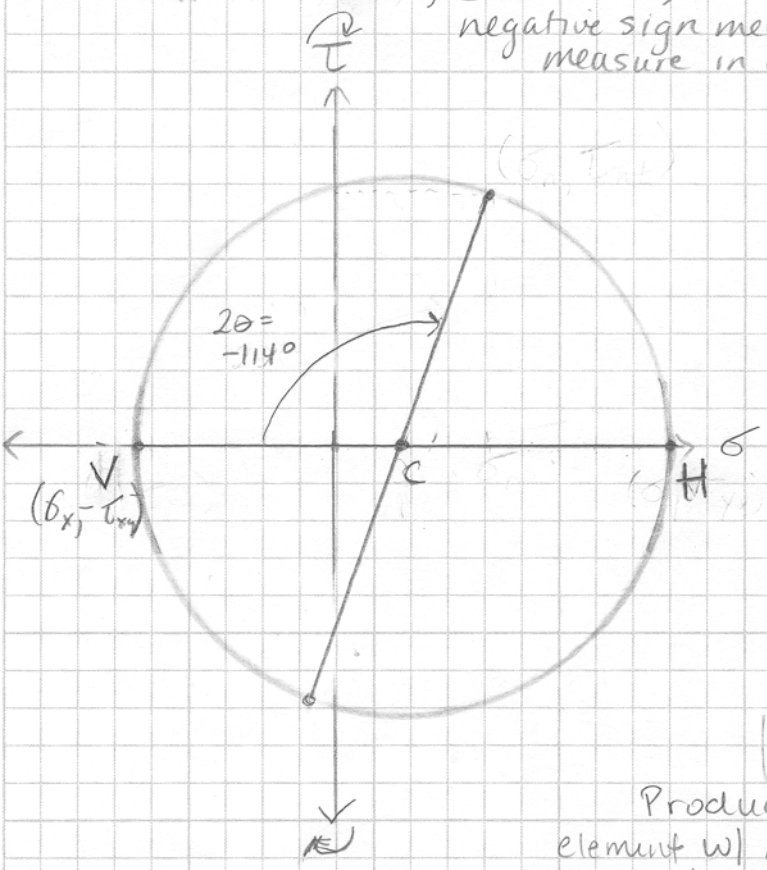
Relationships:
Mohr's Circle
Eq 2-12, 2-13.

System Sketch or FBD



Solution:

$\theta = -57°$ For eqs 2-12, 2-13
Reference line is HCV, $2\theta = -114°$,
negative sign means
measure in CW dir



$a = \frac{\sigma_x + \sigma_y}{2} = 9$ MPa

$R = \frac{\sigma_y - \sigma_x}{2} = 36$ MPa

$\sigma_n = a + 36\cos 66°$

$\boxed{\sigma_n = 23.6 \text{ MPa}}$

$\tau_{nt} = (R^2 - (\sigma_n - a)^2)^{1/2}$
$(1296 - 213.2)^{1/2}$

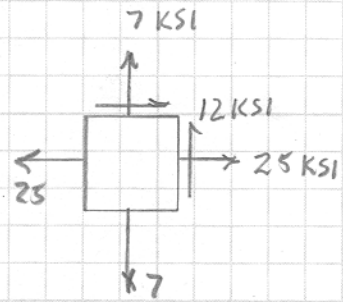
$\tau_{nt} = 32.9$ MPa ↻

Produces a CW couple on an element w/ AB as one of its faces. (see *)
this is a negative shear stress in (*) so

$\boxed{\tau_{nt} = -32.9 \text{ MPa}}$

PROBLEM NO. 2-129	MECHANICAL ENGINEERING DEPARTMENT	NAME CDR DREON
DATE		SECTION

Given: THE 2D STRESS ELEMENT



Find: $\sigma_{P_1}, \sigma_{P_2}, \sigma_{P_3}, \tau_{max}$

Relationships:

$$\sigma_{P_1}, \sigma_{P_2} = \frac{\sigma_x + \sigma_y}{2} \pm \left\{ \left(\frac{\sigma_x - \sigma_y}{2} \right)^2 + \tau_{xy}^2 \right\}^{1/2}$$

$$\tau_p = \left\{ \left(\frac{\sigma_x - \sigma_y}{2} \right)^2 + \tau_{xy}^2 \right\}^{1/2} \qquad \tan 2\theta_p = \frac{\tau_{xy}}{(\sigma_x - \sigma_y)/2}$$

$$\tau_{max} = (\sigma_{max} - \sigma_{min})/2$$

System Sketch or FBD

Solution:

$$\sigma_{P_1}, \sigma_{P_2} = \frac{25+7}{2} \pm \left\{ \left(\frac{25-7}{2} \right)^2 + 12^2 \right\}^{1/2}$$

$$= 16 \pm \left\{ (9)^2 + 144 \right\}^{1/2}$$

$$= 16 \pm 15$$

$$\tau_p = \left\{ \left(\frac{\sigma_x - \sigma_y}{2} \right)^2 + \tau_{xy}^2 \right\}^{1/2}$$

$$= \left\{ \left(\frac{25-7}{2} \right)^2 + 12^2 \right\}^{1/2}$$

$$= \left\{ 9^2 + 12^2 \right\}^{1/2}$$

$$\tau_p = \pm 15$$

IN-PLANE SHEAR STRESS

$\sigma_{P_1} = 31$ KSI MAX

$\sigma_{P_2} = 1$ KSI

BOTH HAVE SAME SIGN and $|\sigma_{P_1}| > |\sigma_{P_2}|$

$\therefore \tau_p \neq \tau_{max}$

$\sigma_{P_3} = 0$ KSI MIN

$$\tau_{max} = \frac{31 - 0}{2}$$

$$\boxed{\tau_{max} = 15.5 \text{ KSI}}$$

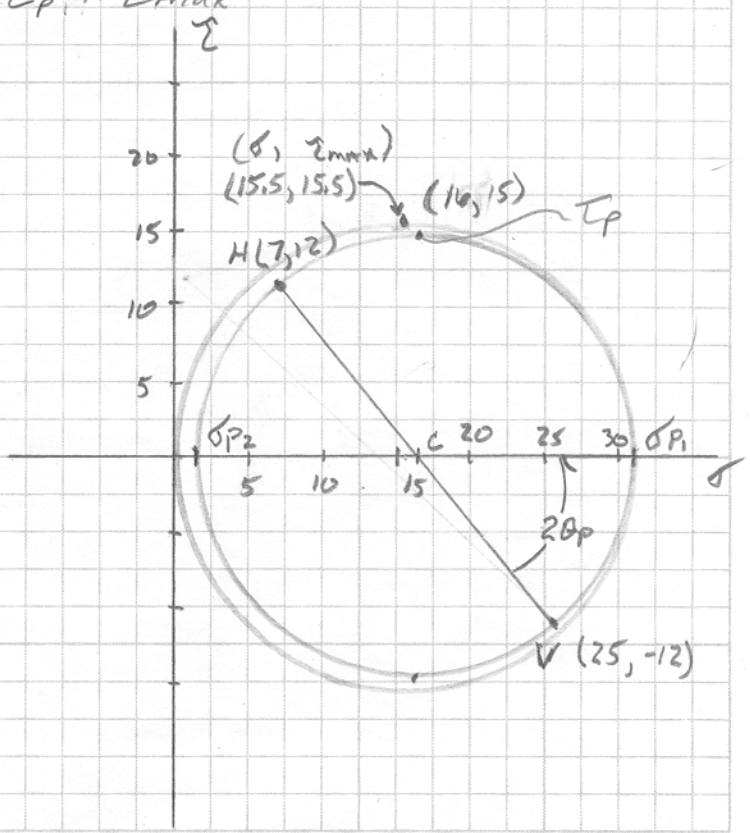
$$\tan 2\theta_p = \frac{\tau_{xy}}{(\sigma_x - \sigma_y)/2} = \frac{12}{(25-7)/2}$$

$$= 1.33$$

$$2\theta_p = \tan^{-1} 1.33$$

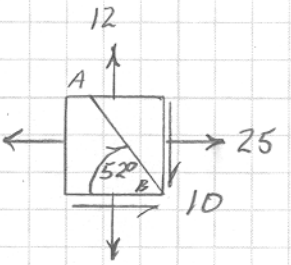
$$= 53.1$$

$$\boxed{\theta_p = 26.6^\circ}$$



PROBLEM NO. 2-135	MECHANICAL ENGINEERING DEPARTMENT	NAME CDR DREON
DATE 26 JAN 00		SECTION 4322, 6521

Given: STRESS ELEMENT SHOWN



Find: a. PRINCIPLE STRESSES & τ_{max}
b. STRESS AND SHEAR STRESS AT AB

Relationships:

$$\sigma_{P_{1,2}} = \frac{\sigma_x+\sigma_y}{2} \pm \left\{\left(\frac{\sigma_x-\sigma_y}{2}\right)^2 + \tau_{xy}^2\right\}^{1/2}$$

$$\tan 2\theta_p = \frac{\tau_{xy}}{(\sigma_x-\sigma_y)/2}$$

$$\sigma_n = \frac{\sigma_x+\sigma_y}{2} + \frac{\sigma_x-\sigma_y}{2}\cos 2\theta + \tau_{xy}\sin 2\theta \qquad \tau_{nt} = -\frac{\sigma_x-\sigma_y}{2}\sin 2\theta + \tau_{xy}\cos 2\theta$$

System Sketch or FBD

Solution:

$\sigma_x = 25 \quad \sigma_y = 12 \quad \tau_{xy} = -10$ KSI

$$\sigma_{P_{1,2}} = \frac{25+12}{2} \pm \left\{\left(\frac{25-12}{2}\right)^2 + (-10)^2\right\}^{1/2}$$

$$= 18.5 \pm \{6.5^2 + 10^2\}^{1/2}$$

$$= 18.5 \pm 11.92$$

$$\tau_p = \left\{\left(\frac{25-12}{2}\right)^2 + (-10)^2\right\}^{1/2}$$

$$\boxed{\tau_p = 11.92}$$

$\boxed{\sigma_{P_1} = 30.42 \text{ KSI}}$

$\boxed{\sigma_{P_2} = 6.58 \text{ KSI}}$

SAME SIGN, $|\sigma_{P_1}| > |\sigma_{P_2}|$ SO $\tau_p \neq \tau_{max}$

$\boxed{\sigma_{P_3} = 0}$

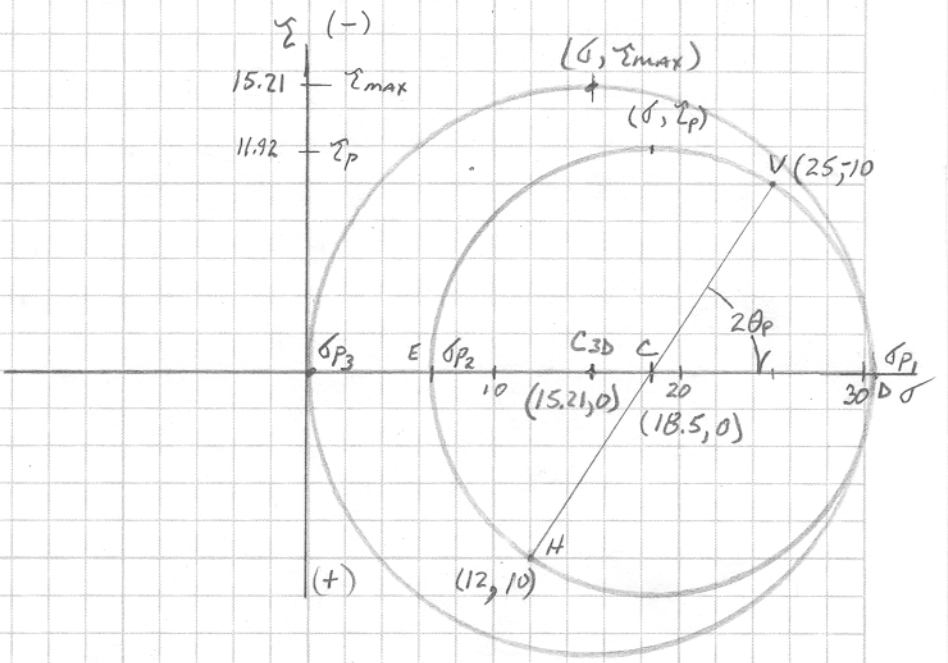
$$\tau_{max} = \frac{\overset{\sigma_{P_1}}{\sigma_{max}} - \overset{\sigma_{P_3}}{\sigma_{min}}}{2} = \frac{30.42-0}{2}$$

$$\boxed{\tau_{max} = 15.21} \text{ KSI}$$

$$\tan 2\theta_p = \frac{-10}{(25-12)/2} = -1.538$$

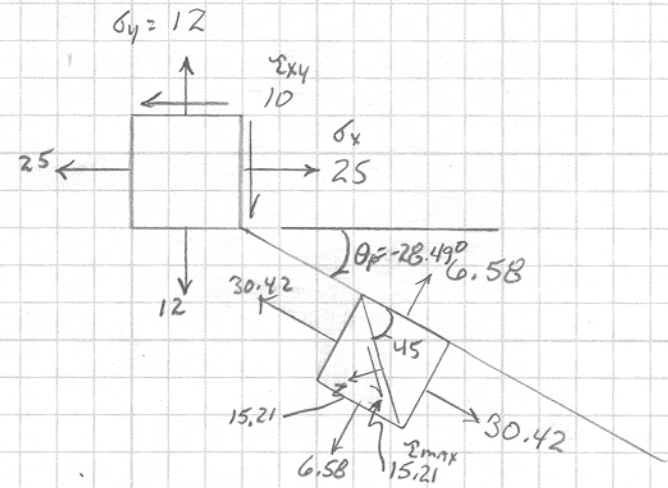
$$2\theta_p = -56.98°$$

$$\theta_p = -28.49$$

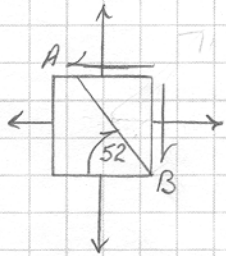


Solution: 2-135(2)

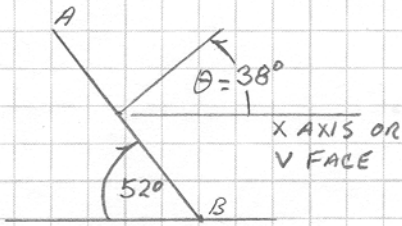
TO DRAW OUT τ_{max}
TAKE 45° FROM PRINCIPLE STRESS
DIAGRAM



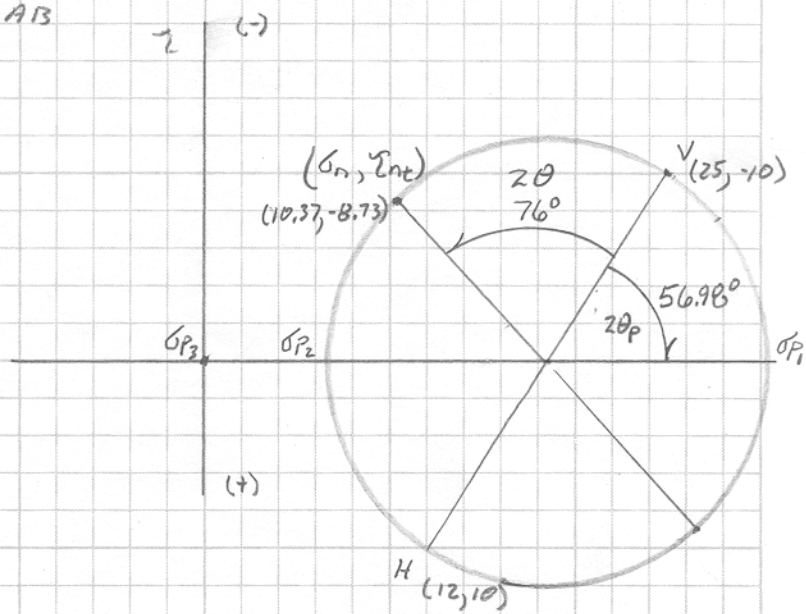
B.



FIND NORMAL AND SHEAR STRESS FOR PLANE AB



$2\theta = 2 * 38$
$= 76°$



Solution: 2-135(3)

$$\sigma_n = \frac{\sigma_x + \sigma_y}{2} + \frac{\sigma_x - \sigma_y}{2}\cos 2\theta + \tau_{xy}\sin 2\theta$$

$$= \frac{25+12}{2} + \frac{25-12}{2}\cos(2*38^\circ) + (-10)\sin(2*38^\circ)$$

$$= 18.5 + 1.572 - 9.70$$

$$\sigma_n = 10.37 \text{ KSI}$$

$$\tau_{nt} = -\frac{\sigma_x - \sigma_y}{2}\sin 2\theta + \tau_{xy}\cos 2\theta$$

$$= -\frac{25-12}{2}\sin(2\times 38^\circ) + (-10)\cos(2\times 38^\circ)$$

$$= -6.31 - 2.42$$

$$= -8.73 \text{ Ksi}$$ PLOT IN TOP HALF