

ME 556 Homework #3

Solution

Suitable plots are shown on the following pages. Answers at three points are summarized below:

• At $r = a = 1.0$ inches (i.e., at the inner radius):

$$\sigma_r = \tau_{r\theta} = 0$$

$$\sigma_\theta = + 38079 \text{ psi.}$$

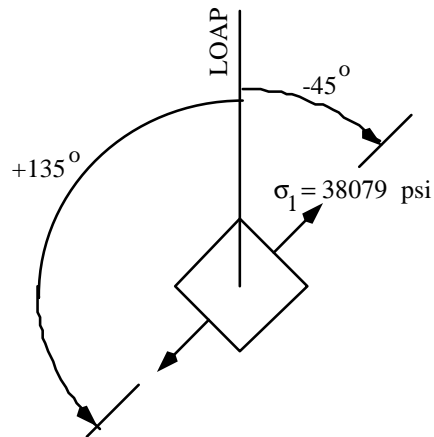
Therefore:

(a) $\sigma_1 = \sigma_\theta = + 38079 \text{ psi}$

(b) $\sigma_2 = \sigma_r = 0 \text{ psi}$

(c) the angle between the radial direction and the +1 axis is *EITHER* -90° *OR* $+90^\circ$

(d) the angle between the line of action of force P (“LOAP”) and the +1-axis is *EITHER*: -45° *OR* $+135^\circ$



• At $r = 2.0$ inches (midway between the inner and outer radius):

$$\sigma_r = 5746 \text{ psi}$$

$$\sigma_\theta = -3045 \text{ psi}$$

$$\tau_{r\theta} = -852 \text{ psi}$$

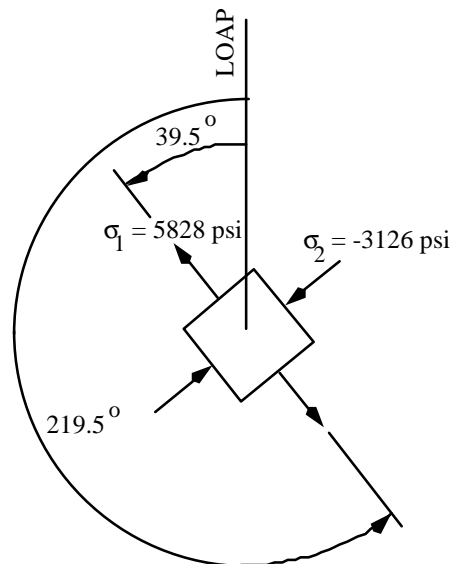
Therefore:

(a) $\sigma_1 = 5828 \text{ psi}$

(b) $\sigma_2 = -3126 \text{ psi}$

(c) the angle between the radial direction and the +1 axis is *EITHER* -5.5° *OR* $+174.5^\circ$

(d) the angle between the line of action of force P (“LOAP”) and the +1-axis is *EITHER*: $+39.5^\circ$ *OR* $+219.5^\circ$ (the angle reported at $r = 2.0$ must be consistent with the convention adopted at $r = a$)



• At $r = b = 3.0$ inches (i.e., at the outer radius):

$$\sigma_r = \tau_{r\theta} = 0$$

$$\sigma_\theta = -17605 \text{ psi.}$$

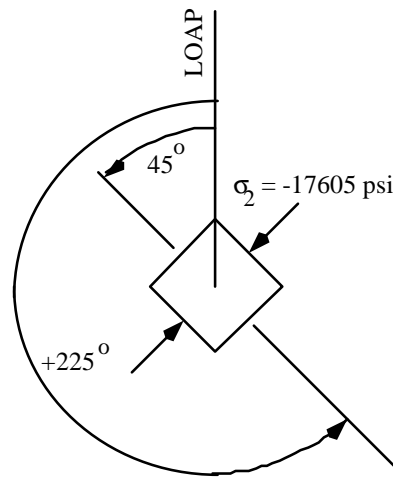
Therefore:

(a) $\sigma_1 = \sigma_r = 0$ psi

(b) $\sigma_2 = \sigma_\theta = -17605$ psi,

(c) the angle between the radial direction and the +1 axis is *EITHER* 0° *OR* $+180^\circ$

(d) the angle between the line of action of force P (“LOAP”) and the +1-axis is *EITHER*: $+45^\circ$ *OR* $+225^\circ$ (the angle reported at $r = b$ must be consistent with the convention adopted at $r = a$)



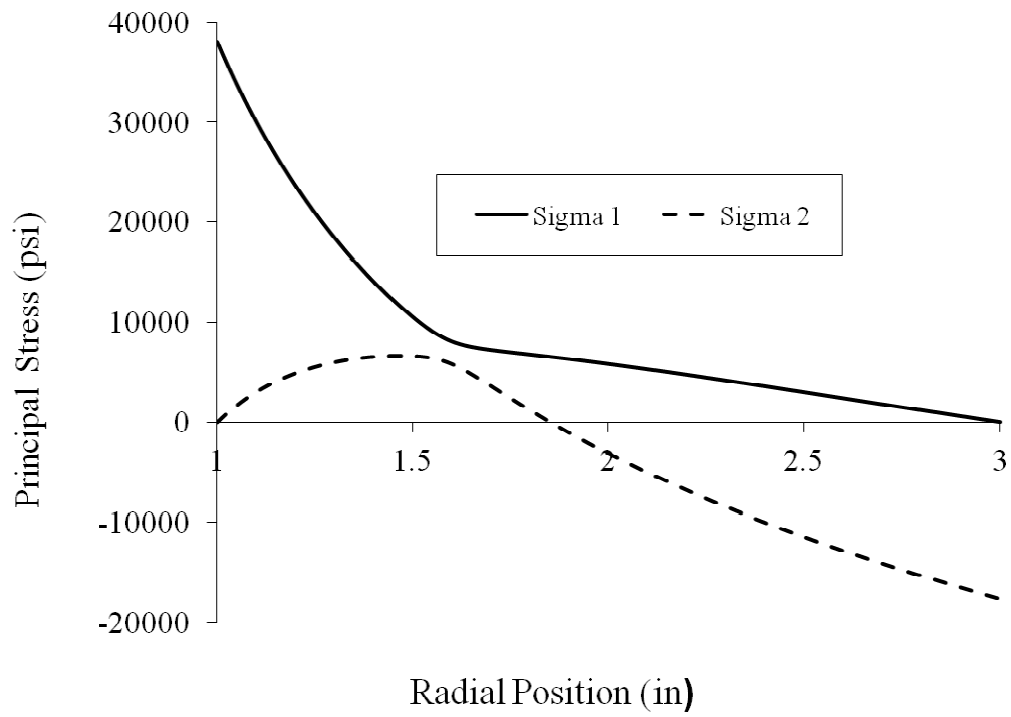


Figure 1: Summary of principal stresses as a function of radial position

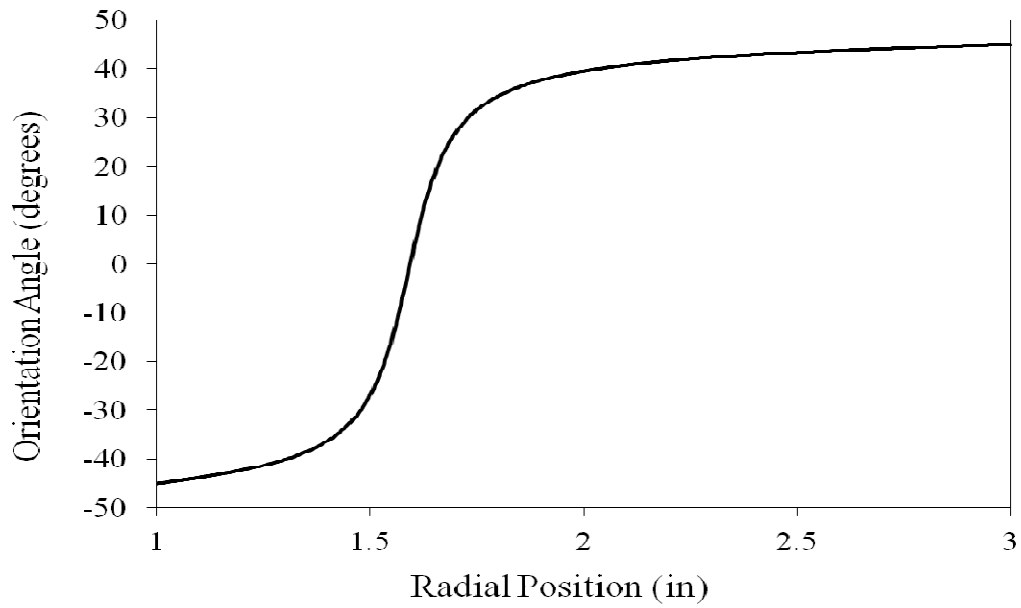


Figure 2: Summary of the angle between σ_1 and the line-of-action of force P, if angle defined such that: $-45^\circ < \theta < 45^\circ$

OR, ALTERNATIVELY

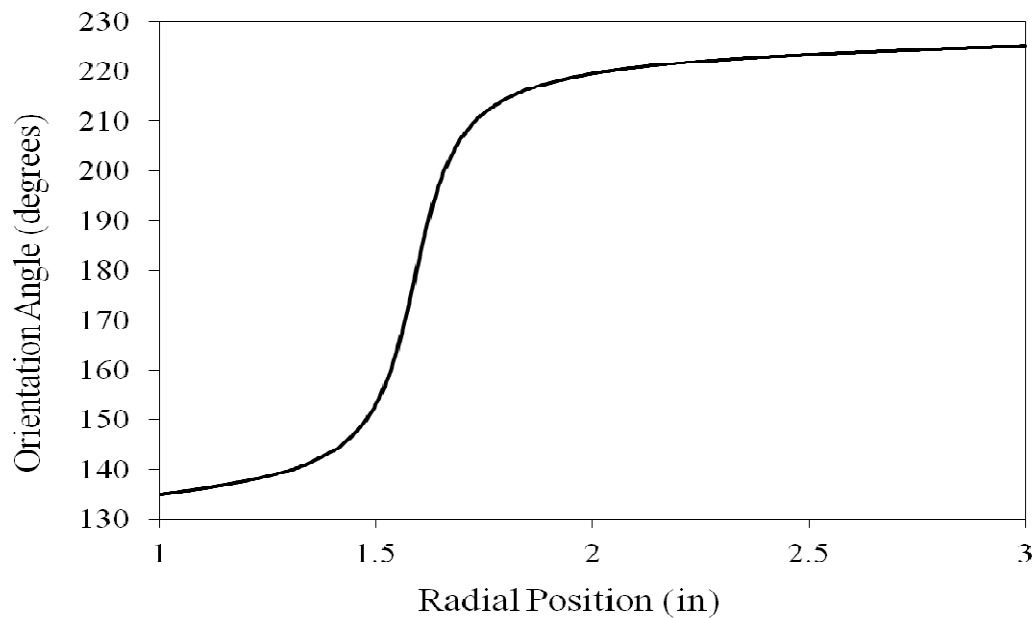


Figure 3: Summary of the angle between σ_1 and the line-of-action of force P, if angle defined such that: $135^\circ < \theta < 225^\circ$