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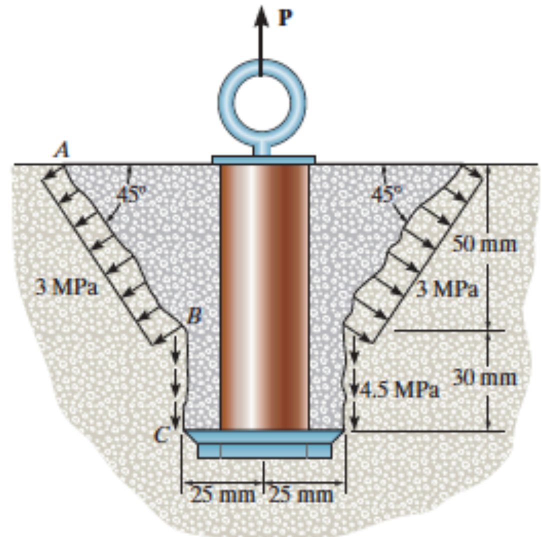
1–58. The anchor bolt was pulled out of the concrete wall and the failure surface formed part of a frustum and cylinder. This indicates a shear failure occurred along the cylinder BC and tension failure along the frustum AB. If the shear and normal stresses along these surfaces have the magnitudes shown, determine the force $\mathbf{P}$ that must have been applied to the bolt.



Average Normal Stress:

For the frustum, $A = 2\pi\bar{x}L = 2\pi(0.025 + 0.025)\left(2\sqrt{0.05^2 + 0.05^2}\right)$

$$= 0.02221 \text{ m}^2$$

$$\sigma = \frac{P}{A}; \qquad 3\left(10^6\right) = \frac{F_1}{0.02221}$$

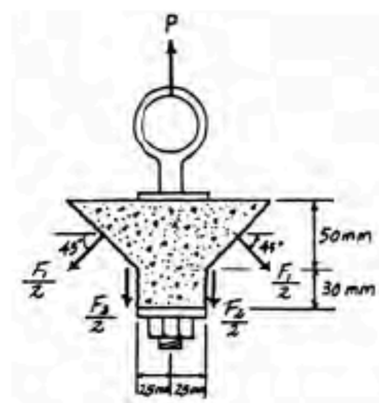
$$F_1 = 66.64 \text{ kN}$$

Average Shear Stress:

For the cylinder, $A = \pi(0.05)(0.03) = 0.004712 \text{ m}^2$

$$\tau_{\text{avg}} = \frac{V}{A}; \qquad 4.5\left(10^6\right) = \frac{F_2}{0.004712}$$

$$F_2 = 21.21 \text{ kN}$$

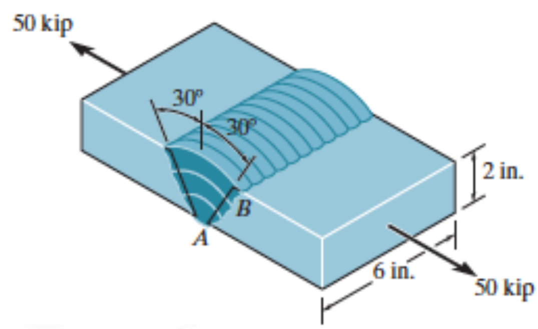


Equation of Equilibrium:

$+\uparrow \Sigma F_y = 0; \qquad P - 21.21 - 66.64 \sin 45° = 0$

$$P = 68.3 \text{ kN}$$ **Ans.**

1–59. The open square butt joint is used to transmit a force of 50 kip from one plate to the other. Determine the average normal and average shear stress components that this loading creates on the face of the weld, section AB.

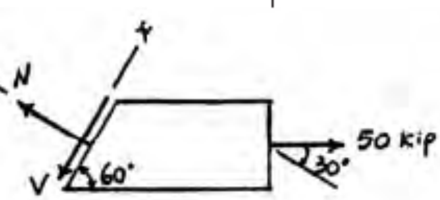


Equations of Equilibrium:

$\nwarrow^{+} \Sigma F_y = 0; \qquad N - 50 \cos 30° = 0 \qquad N = 43.30 \text{ kip}$

$^{+}\nearrow \Sigma F_x = 0; \qquad -V + 50 \sin 30° = 0 \qquad V = 25.0 \text{ kip}$

Average Normal and Shear Stress:



$$A' = \left(\frac{2}{\sin 60°}\right)(6) = 13.86 \text{ in}^2$$

$$\sigma = \frac{N}{A'} = \frac{43.30}{13.86} = 3.125 \text{ ksi}$$ **Ans.**

$$\tau_{\text{avg}} = \frac{V}{A'} = \frac{25.0}{13.86} = 1.80 \text{ ksi}$$ **Ans.**

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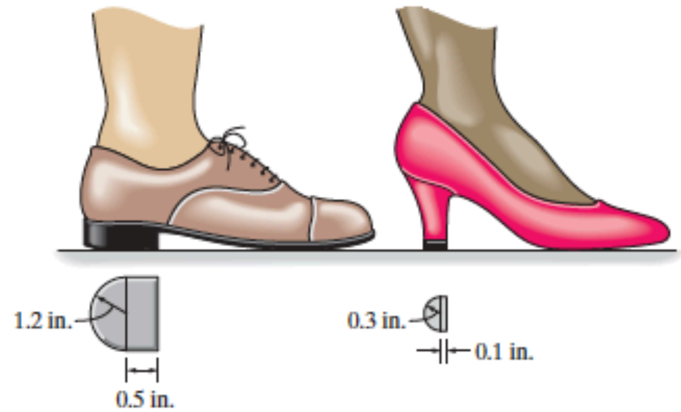
***1–44.** A 175-lb woman stands on a vinyl floor wearing stiletto high-heel shoes. If the heel has the dimensions shown, determine the average normal stress she exerts on the floor and compare it with the average normal stress developed when a man having the same weight is wearing flat-heeled shoes. Assume the load is applied slowly, so that dynamic effects can be ignored. Also, assume the entire weight is supported only by the heel of one shoe.



Stiletto shoes:

$$A = \frac{1}{2}(\pi)(0.3)^2 + (0.6)(0.1) = 0.2014 \text{ in}^2$$

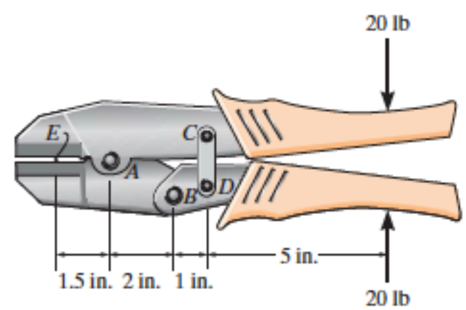
$$\sigma = \frac{P}{A} = \frac{175 \text{ lb}}{0.2014 \text{ in}^2} = 869 \text{ psi} \qquad \textbf{Ans.}$$

Flat-heeled shoes:

$$A = \frac{1}{2}(\pi)(1.2)^2 + 2.4(0.5) = 3.462 \text{ in}^2$$

$$\sigma = \frac{P}{A} = \frac{175 \text{ lb}}{3.462 \text{ in}^2} = 50.5 \text{ psi} \qquad \textbf{Ans.}$$

1–62. The crimping tool is used to crimp the end of the wire E. If a force of 20 lb is applied to the handles, determine the average shear stress in the pin at A. The pin is subjected to double shear and has a diameter of 0.2 in. Only a vertical force is exerted on the wire.

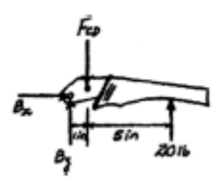


Support Reactions:

From FBD(a)

$$\circlearrowleft +\Sigma M_D = 0; \qquad 20(5) - B_y(1) = 0 \qquad B_y = 100 \text{ lb}$$

$$\overset{+}{\rightarrow} \Sigma F_x = 0; \qquad B_x = 0$$



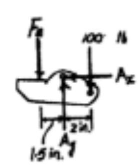
(a)

From FBD(b)

$$\overset{+}{\rightarrow} \Sigma F_x = 0; \qquad A_x = 0$$

$$\circlearrowleft +\Sigma M_E = 0; \qquad A_y(1.5) - 100(3.5) = 0$$

$$A_y = 233.33 \text{ lb}$$



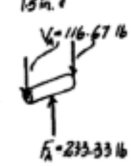
(b)

Average Shear Stress: Pin A is subjected to double shear. Hence,

$$V_A = \frac{F_A}{2} = \frac{A_y}{2} = 116.67 \text{ lb}$$

$$(\tau_A)_{\text{avg}} = \frac{V_A}{A_A} = \frac{116.67}{\frac{\pi}{4}(0.2^2)}$$

$$= 3714 \text{ psi} = 3.71 \text{ ksi} \qquad \textbf{Ans.}$$



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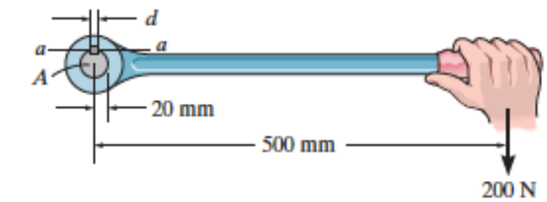
1–74. The lever is attached to the shaft A using a key that has a width d and length of 25 mm. If the shaft is fixed and a vertical force of 200 N is applied perpendicular to the handle, determine the dimension d if the allowable shear stress for the key is $\tau_{allow} = 35$ MPa.

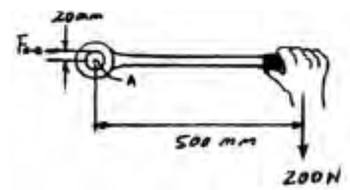


$$\circlearrowleft + \Sigma M_A = 0; \qquad F_{a-a}(20) - 200(500) = 0$$

$$F_{a-a} = 5000 \text{ N}$$

$$\tau_{allow} = \frac{F_{a-a}}{A_{a-a}}; \qquad 35(10^6) = \frac{5000}{d(0.025)}$$

$$d = 0.00571 \text{ m} = 5.71 \text{ mm}$$ **Ans.**



(For fundamental problem solutions please see the back of your course textbook)