

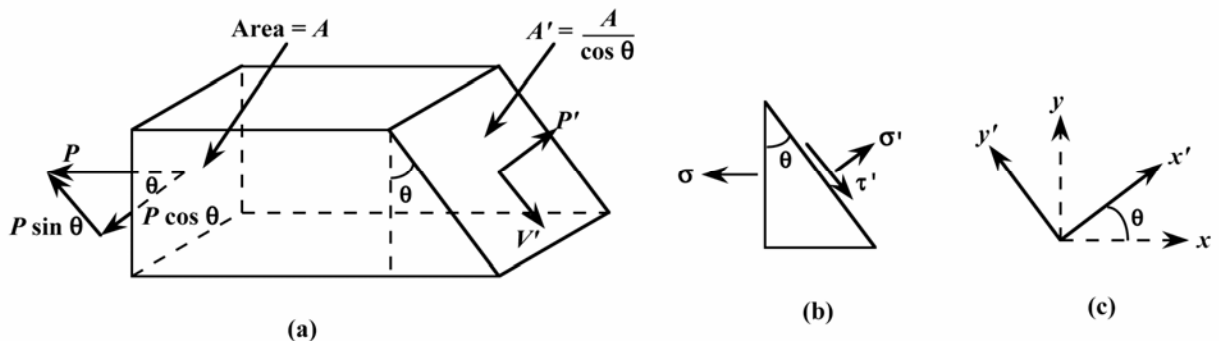
CHAPTER 6

MECHANICAL PROPERTIES OF METALS

PROBLEM SOLUTIONS

Concepts of Stress and Strain

6.1 This problem asks that we derive Equations 6.4a and 6.4b, using mechanics of materials principles. In Figure (a) below is shown a block element of material of cross-sectional area A that is subjected to a tensile force P . Also represented is a plane that is oriented at an angle θ referenced to the plane perpendicular to the tensile axis; the area of this plane is $A' = A/\cos \theta$. In addition, the forces normal and parallel to this plane are labeled as P' and V' , respectively. Furthermore, on the left-hand side of this block element are shown force components that are tangential and perpendicular to the inclined plane. In Figure (b) are shown the orientations of the applied stress σ , the normal stress to this plane σ' , as well as the shear stress τ' taken parallel to this inclined plane. In addition, two coordinate axis systems are represented in Figure (c): the primed x and y axes are referenced to the inclined plane, whereas the unprimed x axis is taken parallel to the applied stress.



Normal and shear stresses are defined by Equations 6.1 and 6.3, respectively. However, we now chose to express these stresses in terms (i.e., general terms) of normal and shear forces (P and V) as

$$\sigma = \frac{P}{A}$$

$$\tau = \frac{V}{A}$$

For static equilibrium in the x' direction the following condition must be met:

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