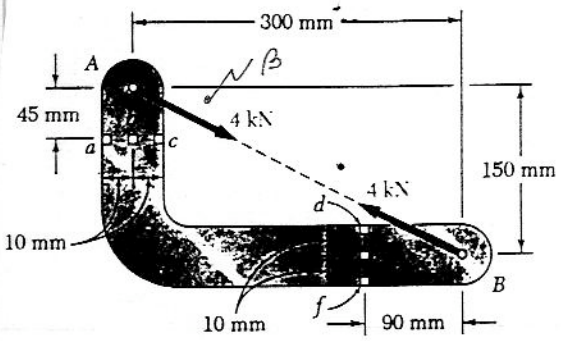
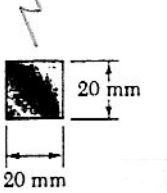
## Problem 8.32

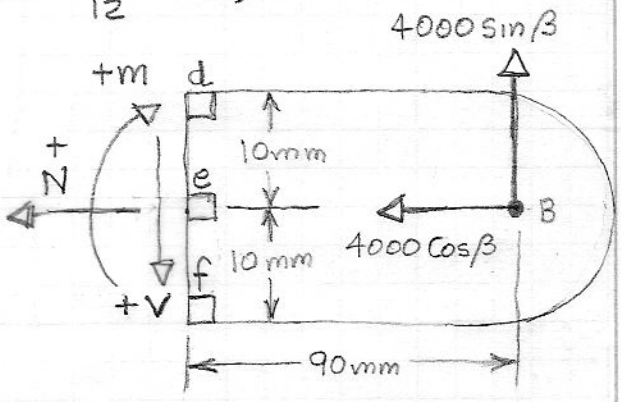
**8.32** Two 4-kN forces are applied to an L-shaped machine element $AB$ as shown. Determine the normal and shearing stresses at (*a*) point *d*, (*b*) point e, (*c*) point *f*.




$\tan\beta = \frac{150}{300}$ , $\beta = 26.57°$

$I = \frac{bh^3}{12} = \frac{20(20)^3}{12} = 13{,}333\ mm^4 = 13.33 \times 10^{-9}\ m^4$




$N = -4000\cos\beta = -3577.7\ N = N$

$V = +4000\sin\beta = +1788.9\ N = V$

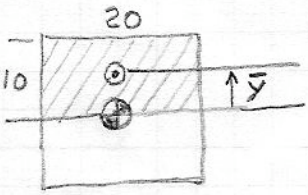
$M = 0.09(4000\sin\beta) = 161\ N\cdot m = M$

Area, $A = 20(20) = 400\ mm^2 = 400 \times 10^{-6}\ m^2 = A$

a) Point d: $\sigma = \frac{P}{A} - \frac{My}{I} = \frac{-3577.7}{400\times10^{-6}} - \frac{161(0.01)}{13.33\times10^{-9}}$ $\boxed{\sigma = -129.7\ MPa}$

$\boxed{\tau = 0}$

b) Point e: $\sigma = \frac{P}{A} = \frac{-3577.7}{400\times10^{-6}}$ $\boxed{\sigma = -8.94\ MPa}$




$Q = \bar{y}A = 5[10(20)]$

$Q = 1000\ mm^3 = 10^{-6}\ m^3$

$\tau = \frac{VQ}{It} = \frac{1788.9(10^{-6})}{13.33\times10^{-9}(0.02)}$

$\boxed{\tau = 6.71\ MPa}$

c) Point f: $\sigma = \frac{P}{A} - \frac{My}{I} = \frac{-3577.7}{400\times10^{-6}} - \frac{161(-0.01)}{13.33\times10^{-9}}$ $\boxed{\sigma = 111.8\ MPa}$

$\boxed{\tau = 0}$