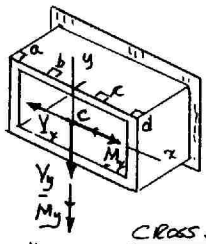
5.88



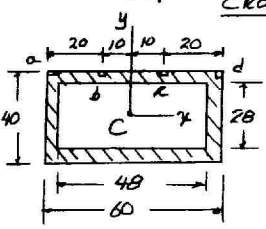
FORCES AND COUPLES AT C

$V_x = 8\ kN$

$V_y = 6\ kN$

$M_x = (6\ kN)(120\ mm) = 720\ N \cdot m$

$M_y = (8\ kN)(145\ mm) = 1160\ N \cdot m$



CROSS SECTION DIMENSIONS IN mm

$A = (40)(60) - (28)(48) = 1056\ mm^2$

$A = 1.056 \times 10^{-3}\ m^2$

$I_x = \frac{1}{12}\left[(60)(40)^3 - (48)(28)^3\right]$

$= 232.2 \times 10^3\ mm^4$

$I_x = 232.2 \times 10^{-9}\ m^4$

$I_y = \frac{1}{12}\left[(40)(60)^3 - (28)(48)^3\right]$

$= 461.15 \times 10^3\ mm^4$

$I_y = 461.95 \times 10^{-9}\ m^4$

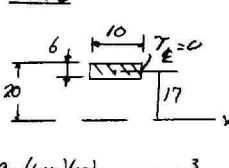
(a) POINT a: $\sigma_A = + \frac{M_x y_a}{I_x} - \frac{M_y x_a}{I_y}$

$= + \frac{(720\ N \cdot m)(0.020\ m)}{232.2 \times 10^{-9}\ m^4} - \frac{(1160\ N \cdot m)(0.030\ m)}{461.95 \times 10^{-9}\ m^4}$

$= 62.015\ MPa - 75.333\ MPa$

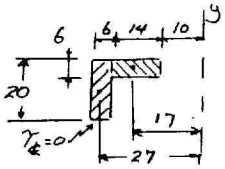
$\sigma_a = -13.32\ MPa$ ◀

(b) POINT b:



$Q_x = (6 \times 10)(17) = 1020\ mm^3$

$= 1.020 \times 10^{-6}\ m^3$



$Q_y = (6 \times 20)(27) + (14 \times 6)(17) = 4668\ mm^3$

$= 4.668 \times 10^{-6}\ m^3$

$\pm \tau_b = \frac{V_x Q_y}{I_y t} + \frac{V_y Q_x}{I_x t}$

$= \frac{(8\ kN)(4.668 \times 10^{-6}\ m^3)}{(461.95 \times 10^{-9}\ m^4)(0.006\ m)} + \frac{(6\ kN)(1.02 \times 10^{-6}\ m^3)}{(232.2 \times 10^{-9}\ m^4)(0.006\ m)}$

$= 13.473\ MPa + 4.393\ MPa = 17.866\ MPa$

$\tau_b = 17.87\ MPa$ ◀

5.89

SAME LOADING AND CROSS SECTION AS PROB 5.88

(a) POINT c VALUES OF Q_x AND Q_y ARE THE SAME AS THOSE FOR POINT b OF PROB 5.88.

$Q_x = 1.020 \times 10^{-6}\ m^3$

$Q_y = 4.668 \times 10^{-6}\ m^3$

$\pm \tau_c = \frac{V_x Q_y}{I_y t} - \frac{V_y Q_x}{I_x t}$

$= \frac{(8\ kN)(4.668 \times 10^{-6}\ m^3)}{(461.95 \times 10^{-9}\ m^4)(0.006\ m)} - \frac{(6\ kN)(1.02 \times 10^{-6}\ m^3)}{(232.2 \times 10^{-9}\ m^4)(0.006\ m)}$

$= 13.473\ MPa - 4.393\ MPa$

$= 9.08\ MPa$

$\tau_c = 9.08\ MPa$ ◀

(b) POINT d: $\sigma_d = \frac{M_x y_a}{I_x} + \frac{M_y x_a}{I_y}$

$= \frac{(720\ N \cdot m)(0.020\ m)}{232.2 \times 10^{-9}\ m^4} + \frac{(1160\ N \cdot m)(0.030\ m)}{461.5 \times 10^{-9}}$

$= 62.015\ MPa + 75.233\ MPa$

$\sigma_d = 137.3\ MPa$ ◀