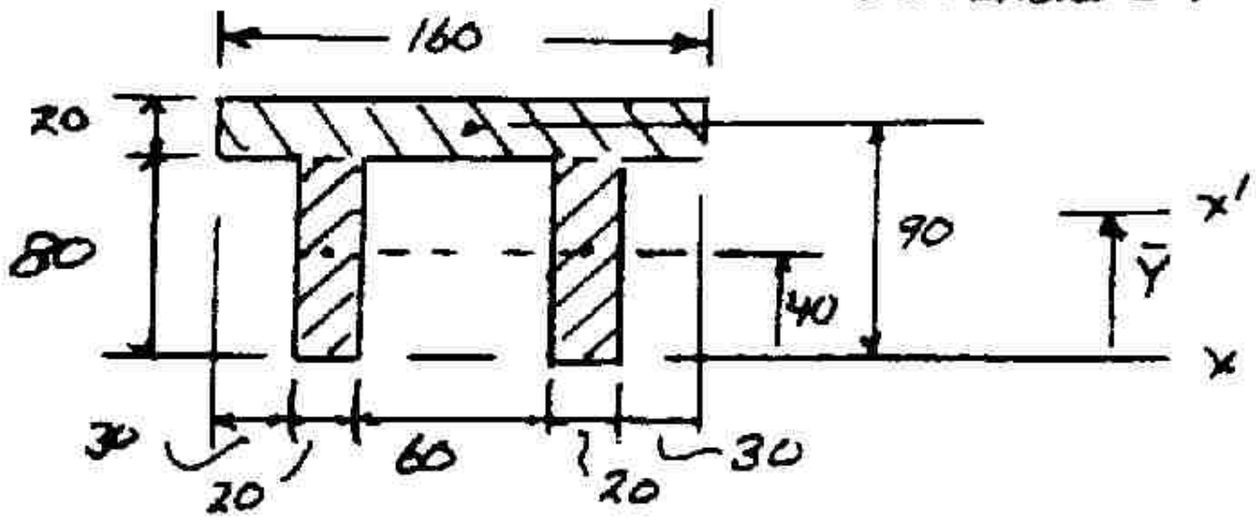
5.23

AT SECTION n-n: $V = 90\ kN$

DIMENSIONS IN mm



$$\bar{Y} = \frac{(20\times160)(90)+2(80\times20)(40)}{(20\times160)+2(80\times20)} = \frac{416\times10^3\ mm^3}{6400\ mm^2}$$

$$\bar{Y} = 65\ mm$$

$$A = 6400\ mm^2$$

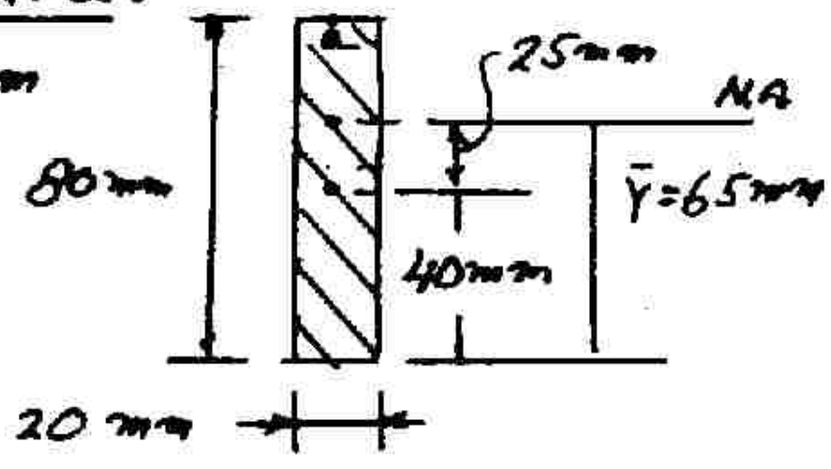
$$I_x = \frac{1}{3}(160)(100)^3 - \frac{1}{3}(30+60+30)(80)^3 = 32.853\times10^6\ mm^4$$

$$I_x = \bar{I}_{x'} + A\bar{Y}^2: \quad 32.853\times10^6\ mm^4 = \bar{I}_{x'} + (6400\ mm^2)(65\ mm)^2$$

$$\bar{I}_{x'} = 5.8133\times10^6\ mm^4 = 5.8133\times10^{-6}\ m^4$$

(a) POINT a:

$t = 20\ mm$



$$Q_a = (20\times80)(25) = 40\times10^3\ mm^3$$

$$Q_a = 40\times10^{-6}\ m^3$$

$$\tau_a = \frac{VQ_a}{It} = \frac{(90\ kN)(40\times10^{-6}\ m^3)}{(5.8133\times10^{-6}\ m^4)(0.020\ m)}$$

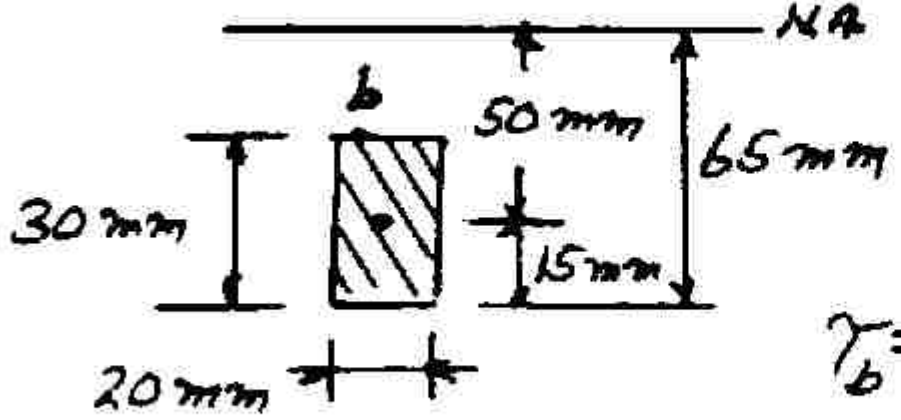
$$\tau_a = 31.0\ MPa$$

CONTINUED

(4)[3]

5.23 CONTINUED

(b) Point b:



$$Q_b = (20\times30)(50) = 30\times10^3\ mm^3$$

$$= 30\times10^{-6}\ m^3$$

$$t = 20\ mm$$

$$\tau_b = \frac{VQ_b}{It} = \frac{(90\ kN)(30\times10^{-6}\ m^3)}{(5.8133\times10^{-6}\ m^4)(0.020\ m)}$$

$$\tau_b = 23.2\ MPa$$