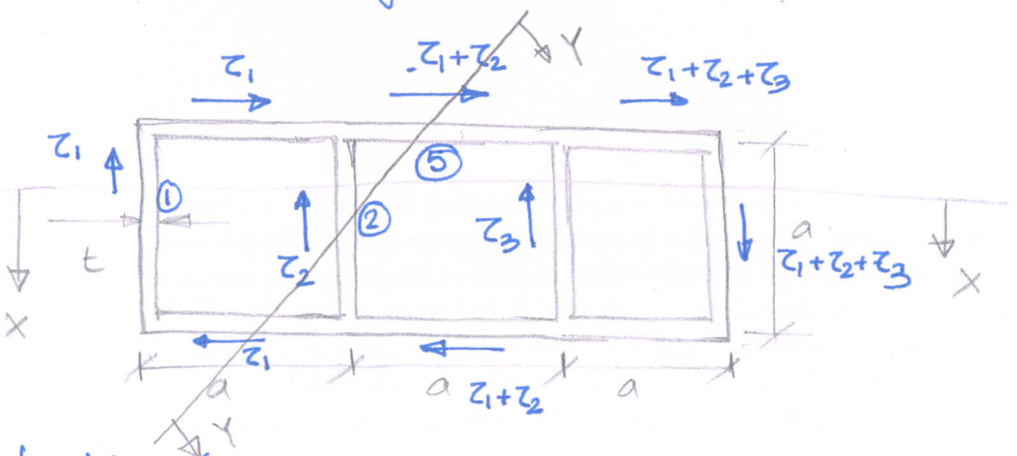
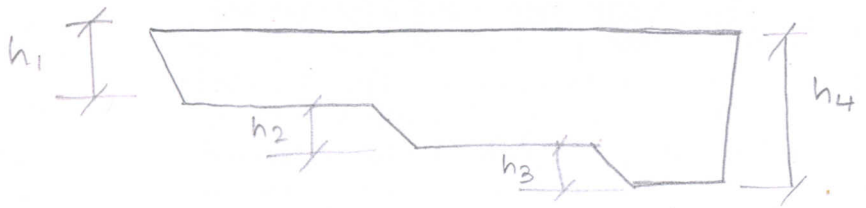
Solution: Class Assignment 3



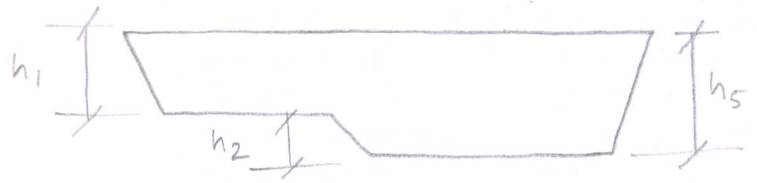
Uniform thickness t.

Section XX (without considering symmetry)



$h_4 = h_1 + h_2 + h_3 \Rightarrow \tau_4 = \tau_1 + \tau_2 + \tau_3$ ——— (1)

Section Y Y



$h_5 = h_1 + h_2$

$\Rightarrow \tau_5 = \tau_1 + \tau_2$. ——— (2)

Torque $T = 2h_1 \times 3A + 2h_2 \times 2A + 2h_3 A$.

$= 2(3h_1 + 2h_2 + h_3)A = 2(3\tau_1 + 2\tau_2 + 3\tau_3)At$. ——— (3)

$3a\tau_1 - a\tau_2 = 2G\theta a^2 \Rightarrow 3\tau_1 - \tau_2 = 2G\theta a$ ——— (4)

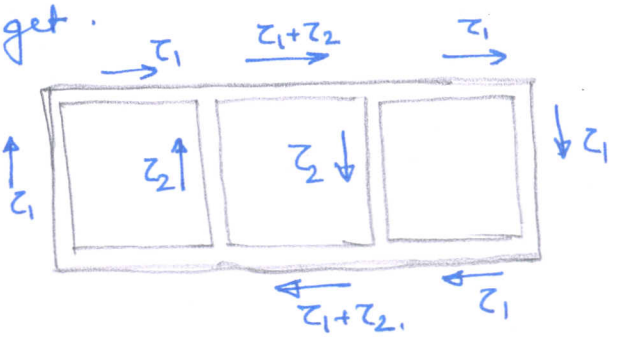
$\tau_2 a + 2(\tau_1+\tau_2)a - \tau_3 a = 2G\theta a^2 \Rightarrow 2\tau_1 + 3\tau_2 - \tau_3 = 2G\theta a$ ——— (5)

$\tau_3 a + 3(\tau_1+\tau_2+\tau_3)a = 2G\theta a^2 \Rightarrow 3\tau_1 + 3\tau_2 + 4\tau_3 = 2G\theta a$ ——— (6)

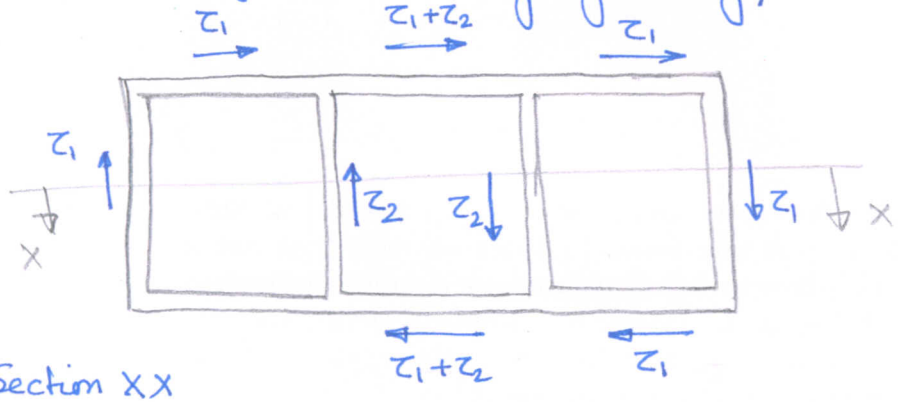
Solving Eqns. (4), (5) & (6) we get.

$\tau_1 = \frac{5G\theta a}{7}$ $\quad \tau_3 = -\frac{G\theta a}{7}$

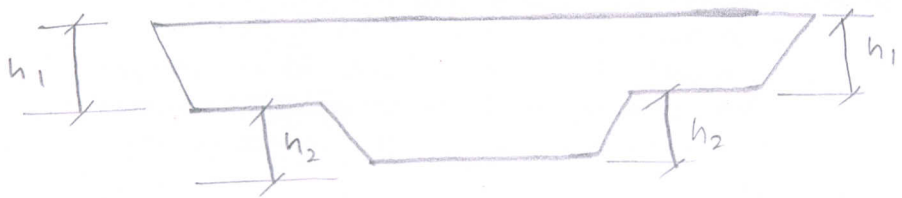
$\tau_2 = \frac{6G\theta a}{7}$



Alternatively (considering symmetry)



Section XX



$T = 2(3Ah_1 + Ah_2) = 2(3h_1 + h_2)A = 2(3\tau_1 + \tau_2)At$ ——— (i)

$3\tau_1 a - \tau_2 a = 2G\theta a^2 \Rightarrow 3\tau_1 - \tau_2 = 2G\theta a$ ——— (2)

$2\tau_2 a + 2(\tau_1 + \tau_2)a = 2G\theta a^2 = 2\tau_1 + 4\tau_2 = 2G\theta a$ ——— (3)

Solving Eqns. (2) & (3), we get,

$\tau_1 = \frac{5}{7} G\theta a$ and $\tau_2 = \frac{G\theta a}{7}$.

Substituting the values of τ_1 & τ_2 in Eqn. (i), T can be obtained as.

$T = 2At\left(\frac{15}{7} + \frac{1}{7}\right)G\theta a = \frac{2G\theta a^2 t.16}{7} = \frac{32G\theta a^2 t}{7}$.