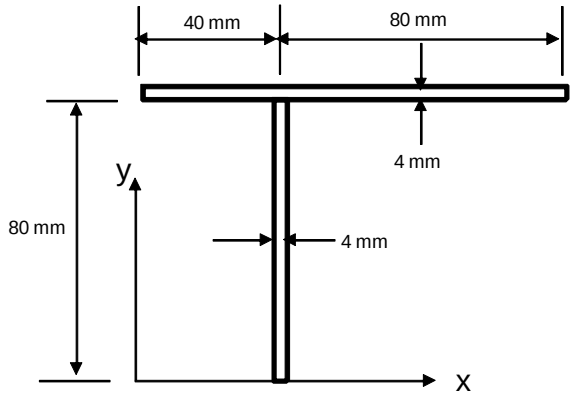
Megson Example 15.4 Modified, as worked in class



Define Geometry:

$t := 4 \cdot mm$

$L_w := 80 \cdot mm$ $\quad L_f := 120 \cdot mm$

$A_w := L_w \cdot t$ $\quad A_f := L_f \cdot t$

$xbar_w := 40 \cdot mm$ $\quad xbar_f := 60 \cdot mm$

$ybar_w := 40 \cdot mm$ $\quad ybar_f := 82 \cdot mm$

Calculate x and y coordinates of centroid: xbar, ybar

$$xbar := \frac{\left(A_w \cdot xbar_w + A_f \cdot xbar_f\right)}{\left(A_w + A_f\right)} \qquad xbar = 52 \cdot mm$$

$$ybar := \frac{\left(A_w \cdot ybar_w + A_f \cdot ybar_f\right)}{\left(A_w + A_f\right)} \qquad ybar = 65.2 \cdot mm$$

Distance from centroid of section to centroid of individual elements:

$d_{xw} := xbar_w - xbar$ $\quad d_{xf} := xbar_f - xbar$

$d_{xw} = -12 \cdot mm$ $\quad d_{xf} = 8 \cdot mm$

$d_{yw} := ybar_w - ybar$ $\quad d_{yf} := ybar_f - ybar$

$d_{yw} = -25.2 \cdot mm$ $\quad d_{yf} = 16.8 \cdot mm$

Moments and product of inertia:

$$I_x := \frac{1}{12} \cdot t \cdot L_w^{\,3} + A_w \cdot d_{yw}^{\,2} + \frac{1}{12} L_f \cdot t^3 + A_f \cdot d_{yf}^{\,2} \qquad I_x = 5.1 \times 10^5 \cdot mm^4$$

$$I_y := \frac{1}{12} L_w \cdot t^3 + A_w \cdot d_{xw}^{\,2} + \frac{1}{12} \cdot t \cdot L_f^{\,3} + A_f \cdot d_{xf}^{\,2} \qquad I_y = 6.532 \times 10^5 \cdot mm^4$$

$$I_{xy} := A_w \cdot d_{xw} \cdot d_{yw} + A_f \cdot d_{xf} \cdot d_{yf} \qquad I_{xy} = 1.613 \times 10^5 \cdot mm^4$$

Applied bending moments:

$M_x := 1500 \cdot N \cdot m$ $\quad M_y := 0$

Inclination of neutral axis:

$$\alpha := \operatorname{atan}\left[\frac{\left(M_y \cdot I_x - M_x \cdot I_{xy}\right)}{\left(M_x \cdot I_y - M_y \cdot I_{xy}\right)}\right] \qquad \alpha = -13.869 \cdot deg$$

Bending stress

$$\sigma_z(x,y) := \frac{M_y \cdot I_x - M_x \cdot I_{xy}}{I_x \cdot I_y - I_{xy}^2} \cdot x + \frac{\left(M_x \cdot I_y - M_y \cdot I_{xy}\right)}{I_x \cdot I_y - I_{xy}^2} \cdot y$$

At far left end of flange:

$x := 0 \cdot mm - xbar$ $\quad x = -52 \cdot mm$

$y := L_w + t - ybar$ $\quad y = 18.8 \cdot mm$

$$\sigma_z(x,y) = 100.937 \cdot \frac{N}{mm^2}$$

At bottom of web:

$x := 40 \cdot mm + \frac{t}{2} - xbar$ $\quad x = -10 \cdot mm$

$y := 0 \cdot mm - ybar$ $\quad v = -65.2 \cdot mm$

$$\sigma_z(x,y) = -200.131 \cdot \frac{N}{mm^2}$$