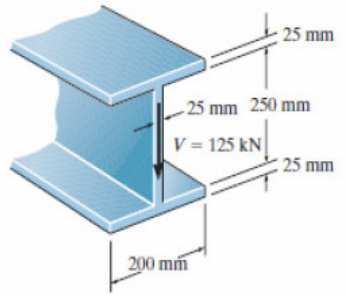
Problem 7-5

If the wide-flange beam is subjected to a shear of $V = 125$ kN, determine the shear force resisted by the web of the beam.



Given: $b_f := 200\text{mm}$ $\quad d_w := 250\text{mm}$

$t_f := 25\text{mm}$ $\quad t_w := 25\text{mm}$

$V := 125\text{kN}$

Solution:

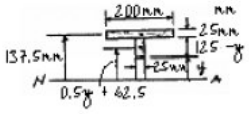
Section Property : $D := d_w + 2t_f$

$$I := \frac{1}{12}\cdot\left[b_f D^3 - \left(b_f - t_w\right)\cdot d_w^{\,3}\right]$$

$A_1 = b_f t_f$ $\quad y_{1c} = 0.5\left(D - t_f\right)$

$A_2 = \left(0.5d_w - y\right)\cdot t_w$ $\quad y_{2c} = 0.5\left(0.5d_w - y\right) + y$

$y_{2c} = 0.5\left(0.5d_w + y\right)$



$$Q_w = A_1\cdot\left(y_{1c}\right) + A_2\cdot\left(y_{2c}\right)$$

$$Q_w = 0.5b_f t_f\left(D - t_f\right) + 0.5\left(0.5d_w - y\right)\cdot t_w\cdot\left(0.5d_w + y\right)$$

$$Q_w = 0.5b_f t_f\left(D - t_f\right) + 0.5t_w\left(0.25d_w^{\,2} - y^2\right)$$

Shear Stress: $\tau = \dfrac{V\cdot Q}{I\cdot t}$

$$\tau_w = \left(\frac{V}{I\cdot t_w}\right)\cdot Q_w$$

$$\tau_w = \left(\frac{V}{I\cdot t_w}\right)\cdot\left[0.5\cdot b_f t_f\left(D - t_f\right) + 0.5\cdot t_w\cdot\left(0.25\cdot d_w^{\,2} - y^2\right)\right]$$

Resultant Shear Force: For the web. $V = \int_A \tau\, dA = 0$

$$V_w := \int_{-0.5d_w}^{0.5d_w}\left(\frac{V}{I\cdot t_w}\right)\cdot\left[0.5\cdot b_f t_f\left(D - t_f\right) + 0.5\cdot t_w\cdot\left(0.25\cdot d_w^{\,2} - y^2\right)\right]\cdot t_w\, dy$$

$V_w = 115.04\,\text{kN}$ **Ans**