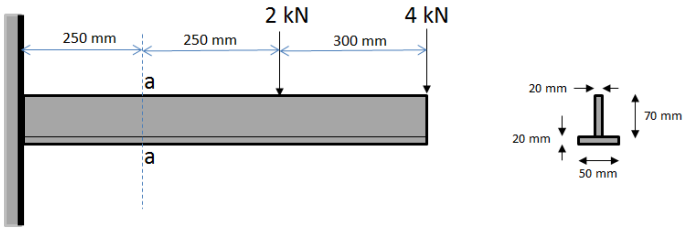
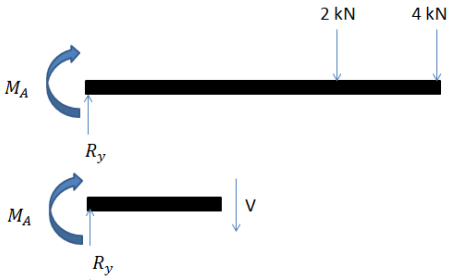
Example 10.14

Determine the maximum shear stress acting on the section a-a of the cantilevered beam below.



Solution:

FBD with equilibrium eqns:



$R_y = 6kN$

$V = 6\ kN\ at\ a-a$

$\eta_1 = 10\ mm, \eta_2 = 20 + 35 = 55mm$

$A_1 = 50x20 = 1000mm^2; A_2 = 20x70 = 1400mm^2$

Neutral Axis:

$\bar{\eta} = \frac{10x1000+55x1400}{2400} = 36.25\ mm$

Second area moment:

$$I = \frac{(50)(20)^3}{12} + 1000(36.25-10)^2 + \frac{(20)(70)^3}{12} + 1400(36.25-55)^2$$
$$= 1.786\ x\ 10^6 mm^4$$

Maximum shear stress acts along the Neutral axis

For the shaded region:

$Q = y'A = 26.875\ x\ 20x\ 53.75 = 28890.625\ mm^3$

(The same Q will be obtained if calculated over the non shaded region)

$\tau_{max} = \frac{VQ}{It} = \frac{6*10^3*28890.625}{1.786*10^6*20} = 4.853\ MPa$