

EGR180

6/24/10

Note Title

6/24/2010

# Equilibrium

$$\sum \vec{F} = 0 \quad \sum \vec{M} = 0$$

In 2D

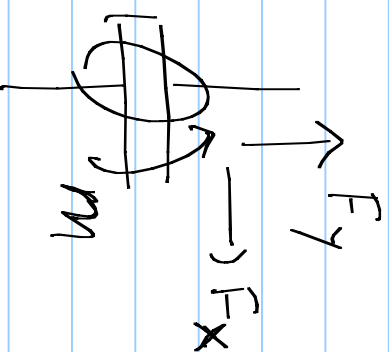
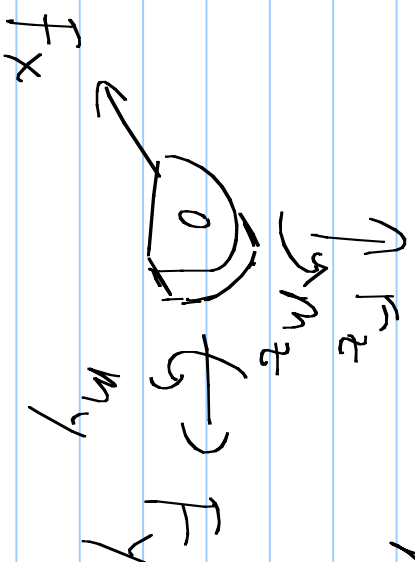
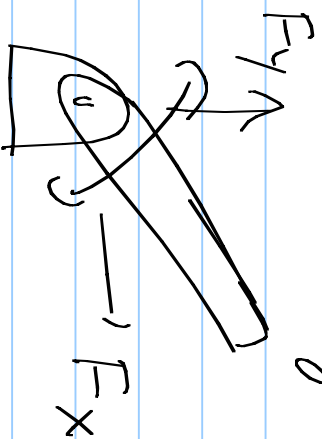
$$\sum F_x = 0 \quad \sum F_y = 0 \quad \sum M_z = 0$$

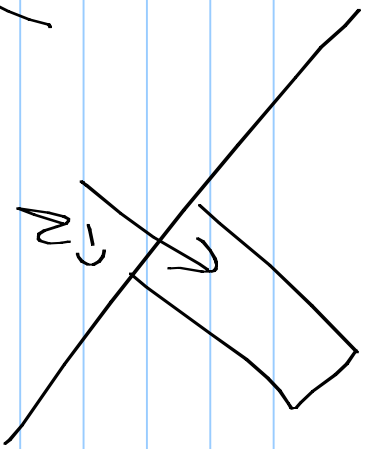
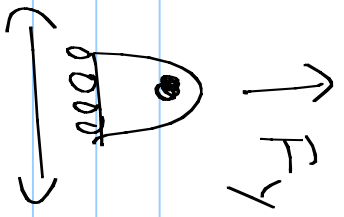
At most 3 unknowns

In 3D at 6 unknowns

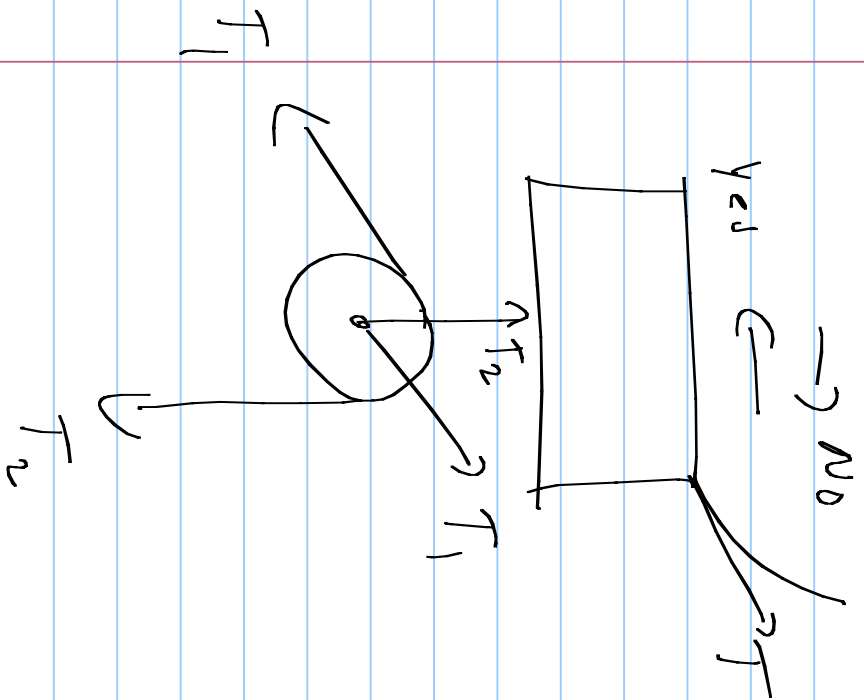
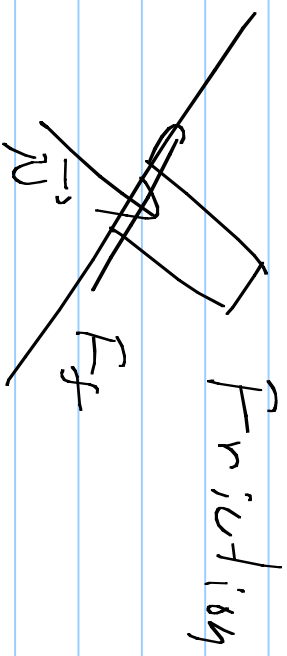
# Free Body Diagrams

Removing a body  $\rightarrow$  the force and/or moment it induces

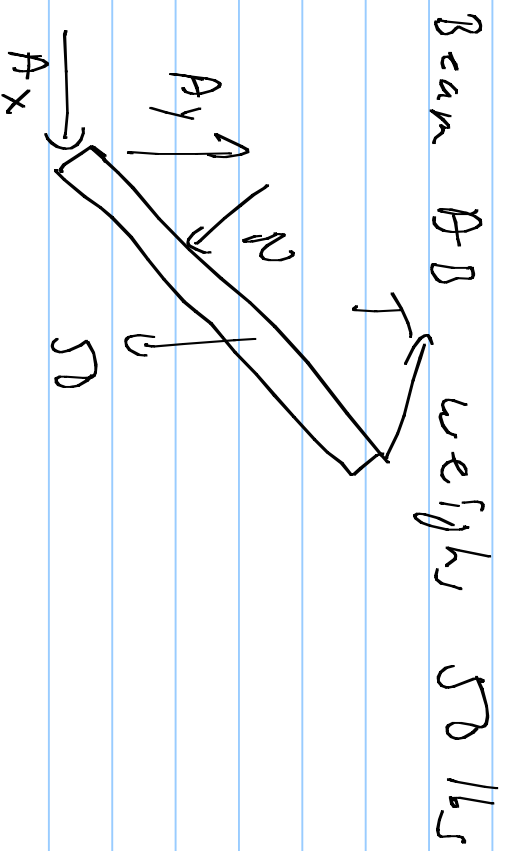
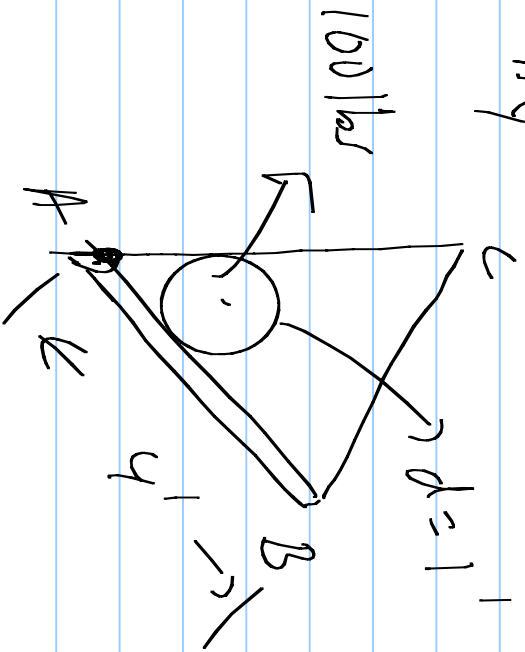
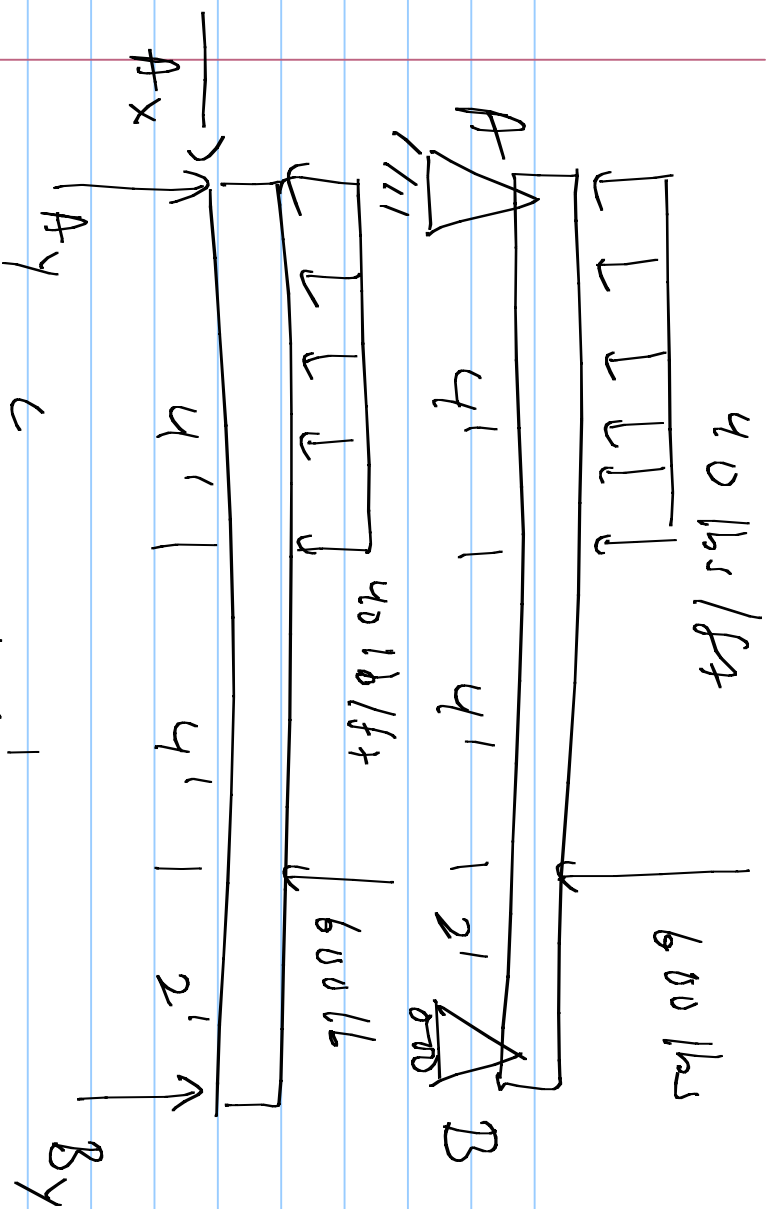




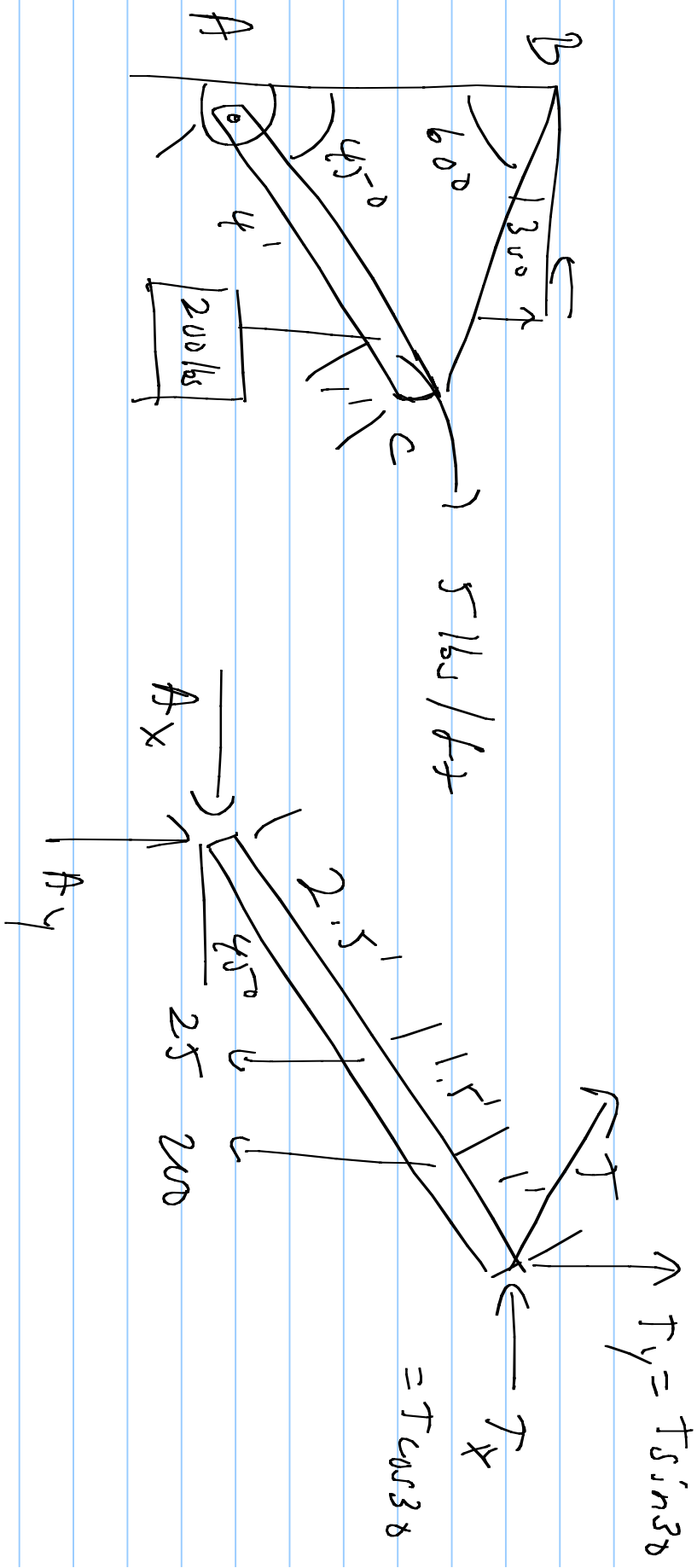
No Friction











$$\sum M_A = - (2.5 \cos 45) (200) - 4 \cos 45 (200)$$

$$+ 5 \sin 45 (T \cos 38) + 5 \cos 45 (T \sin 38) = 0$$

$$862.5 = T [2.5\sqrt{3} + 2.5]$$

$$T = \frac{862.5}{2.5(\sqrt{3} + 1)} = 126.3 \text{ lbs}$$

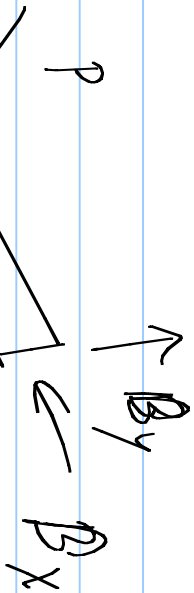
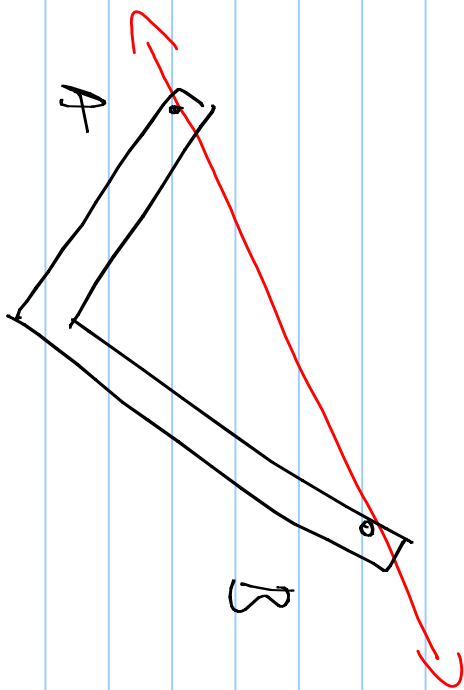
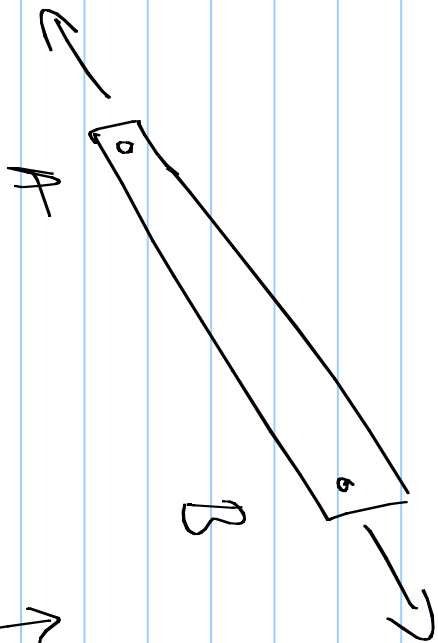
$$\sum F_y = A_y - 25 - 200 + T \sin 30 = 0$$

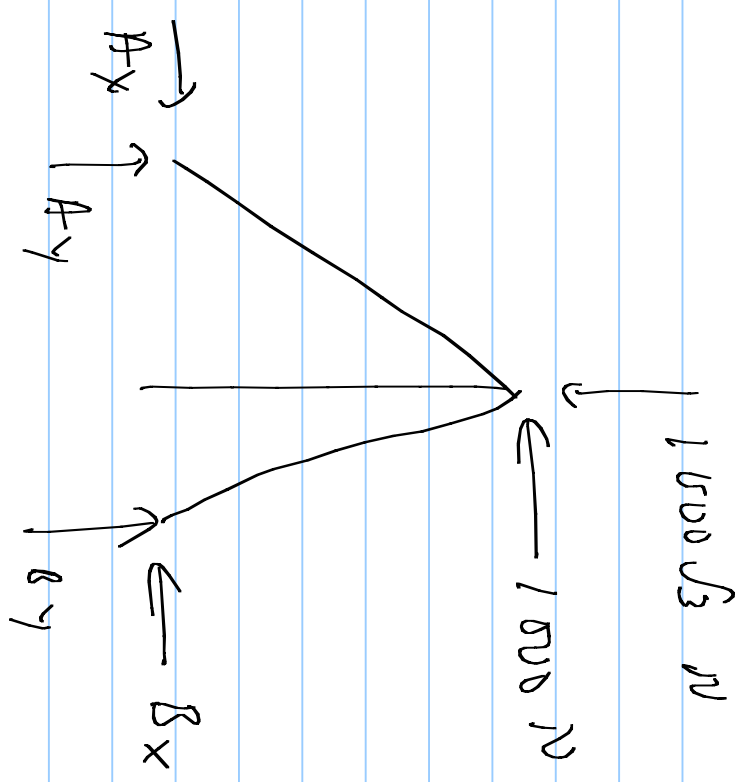
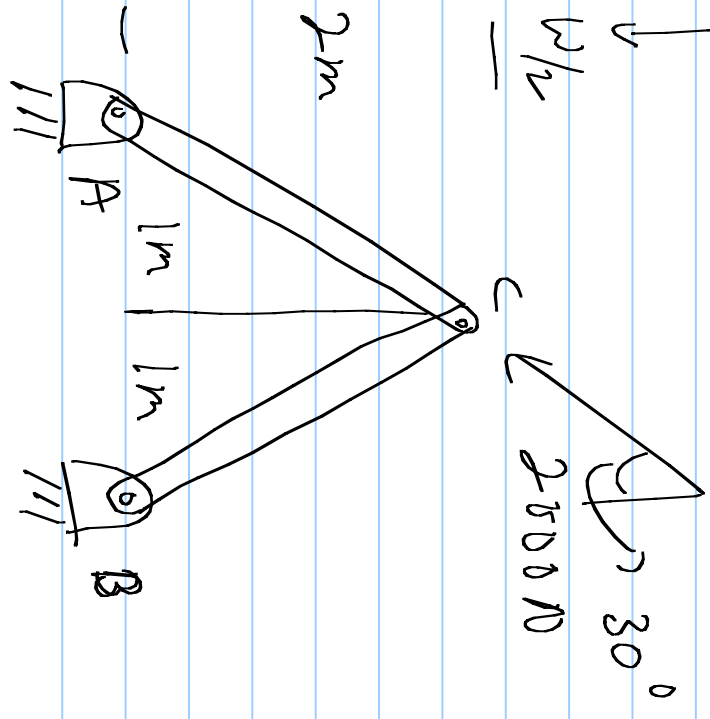
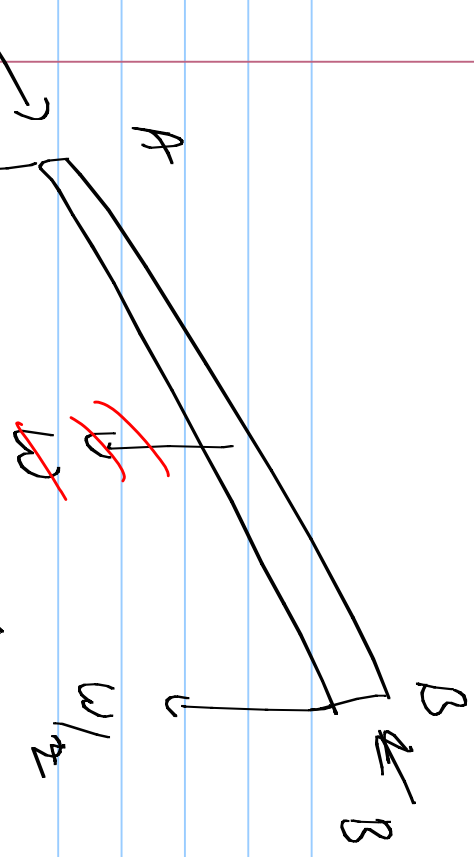
$$A_y = 225 - T \sin 30 = 161.9 \text{ lbs}$$

$$\sum F_x = A_x - T \cos 30 = 0$$

$$A_x = T \cos 30 = 109.4 \text{ lbs}$$

# Two Force Body





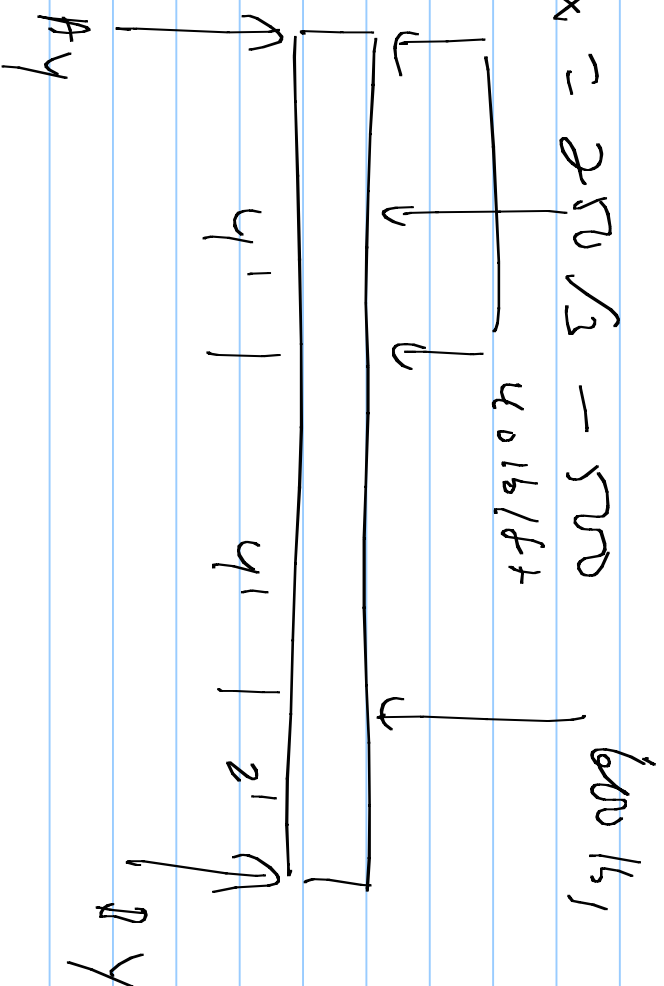
$$\sum M_A = 2B_y - 1000 \sqrt{3} + 2000 = 0 \quad B_y = 500 \sqrt{3} - 1000$$

$$A_y = 500 \sqrt{3} + 1000$$

$$A_x = B_x + 1000$$

$$A_x = 250 \sqrt{3} + 500$$

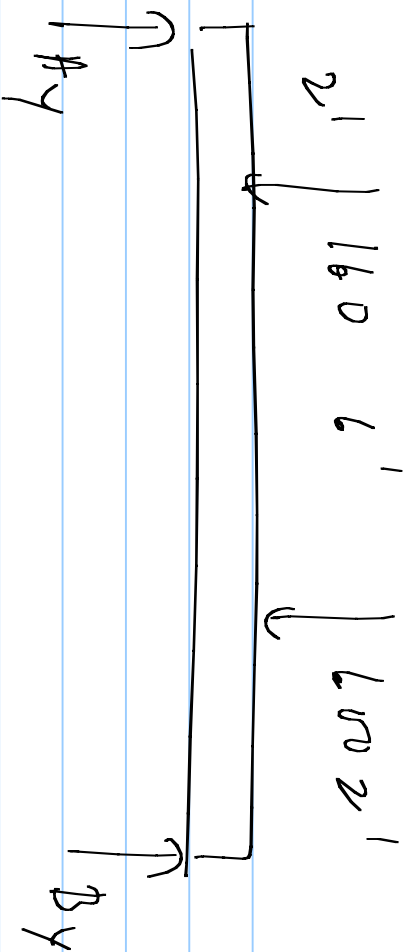
$$B_x = 250 \sqrt{3} - 500$$



$$R = A = 1600$$

$$M = \int_0^y 40x dx = 20x^2 \Big|_0^y = 3200 \text{ ft}$$

$$x = \frac{3200}{220} = 14.5$$



$$\sum M_A = -2 \cdot 160 - 8 \cdot 600 + 10B_y = 0$$

$$10B_y = 5120 \Rightarrow B_y = 512 \text{ lbs}$$

$$\sum F_y = A_y - 160 - 600 + 512 = 0$$

$$A_y = 248 \text{ lbs}$$