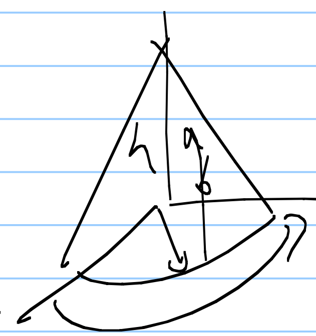
EGR 180 7/27

Note Title 7/27/2009

10-95) $I_y = \iiint_V (x^2+z^2)\,dV$

$= \int_0^{\pi/2}\int_0^b\int_0^{h(1-r/b)} (r^2\cos^2\theta + z^2)\,dz\,r\,dr\,d\theta$

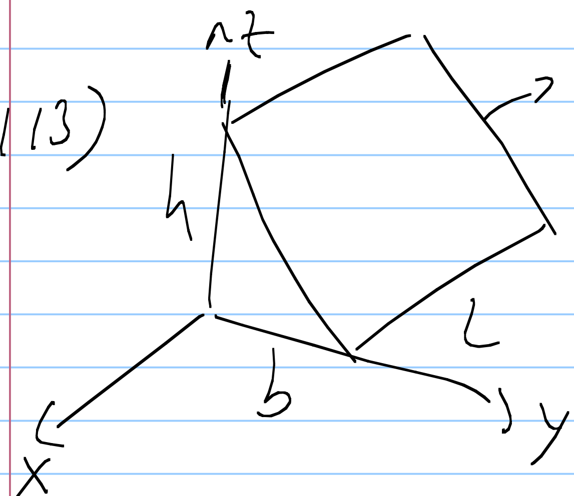


$\theta \in [0, \pi/2]$

$r \in [0, b]$

$z \in (0, h(1-\frac{r}{b}))$

10-113)

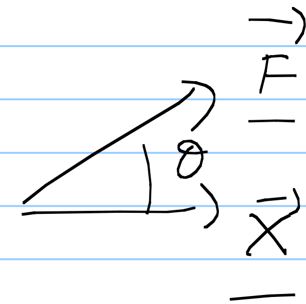


$\frac{z}{h} + \frac{y}{b} = 1 \Rightarrow z = h(1 - \frac{y}{b})$

$I_{xy} = \int_{-l}^{0}\int_0^b\int_0^{h(1-y/b)} xy\,dz\,dy\,dx$

I_{zx} xz

Virtual Work



$$W = \vec{F} \cdot \vec{x} = F x \cos\theta$$

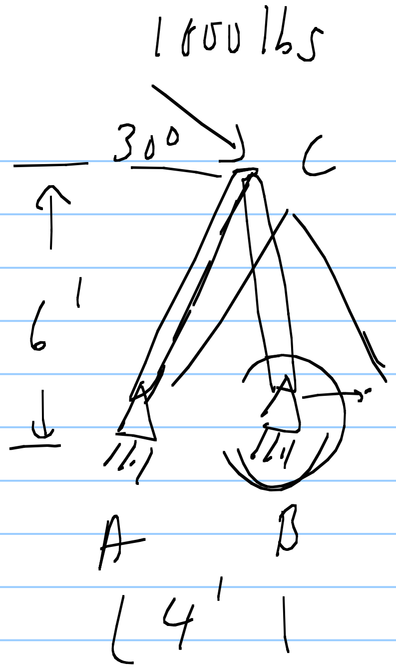
$$dW = \vec{F}(\vec{x}) \cdot d\vec{x}$$

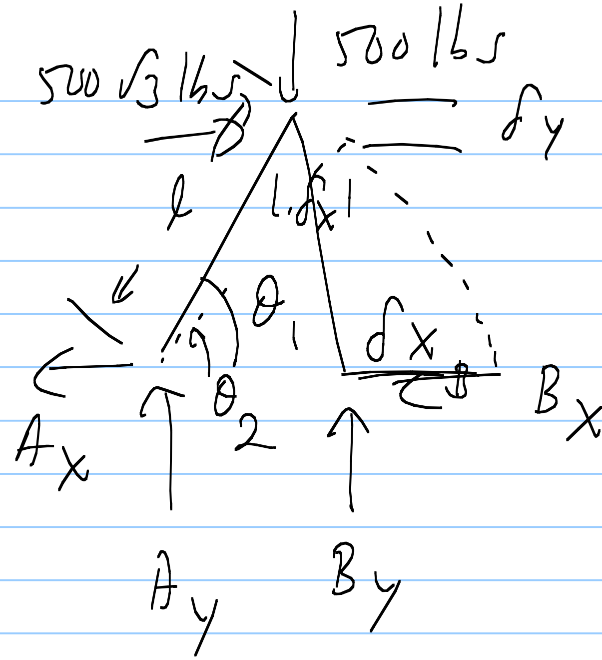
$$W = \int_C \vec{F}(\vec{x}) \cdot d\vec{x}$$

Statics object doesn't move

Technically no work can be performed.

Virtual work – work that would be performed if we freed one of the contraints.

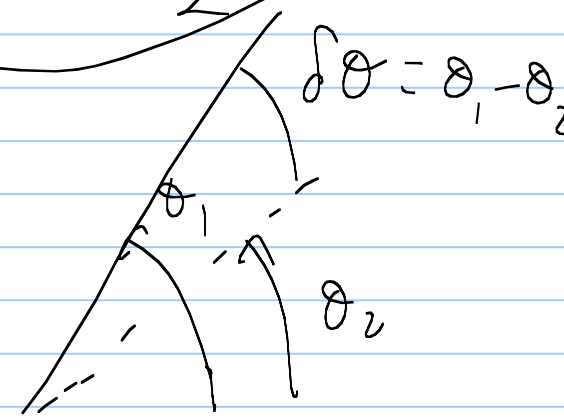




$\delta W_B = -B_x \delta x_B$

$\delta W_C = 500\sqrt{3}\,\delta x + 500\,\delta y$

$\delta x = \frac{\delta x_B}{2}$



$\delta y = l \sin(\theta_1) - l \sin \theta_2$

$\delta x_B = 2l \cos \theta_2 - 2l \cos \theta_1$

$$\theta_2 = \theta_1 - \delta\theta$$

$$\delta y = l\sin\theta_1 - l\sin(\theta_1 - \delta\theta)$$

$$= l\sin\theta_1 - l\sin\theta_1\cos\delta\theta + l\sin\delta\theta\cos\theta_1$$

$$\delta x_B = 2l\cos(\theta_1 - \delta\theta) - 2l\cos\theta_1$$

$$= 2l\cos\theta_1\cos\delta\theta + 2l\sin\theta_1\sin(\delta\theta) - 2l\cos\theta_1$$

$$\delta y = l\cos\theta_1\delta\theta$$

$$dx_B = 2l\sin\theta_1\delta\theta$$

$$\delta W = 500\sqrt{3}\, l \sin\theta_1 \,\delta\theta + 500\, l \cos\theta_1 \,\delta\theta$$

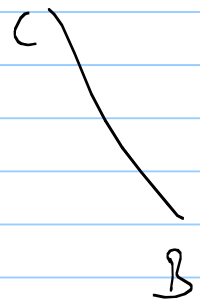
$$- B_x \, 2l \sin\theta_1 \,\delta\theta = 0$$

$$B_x = 250\sqrt{3} + 250 \cot(\theta_1)$$

$$= 250\sqrt{3} + 250/3 \quad \text{lbs}$$

$$\sum M_A = -2 \cdot 500 - 6 \cdot 500\sqrt{3} + 4 B_y = 0$$

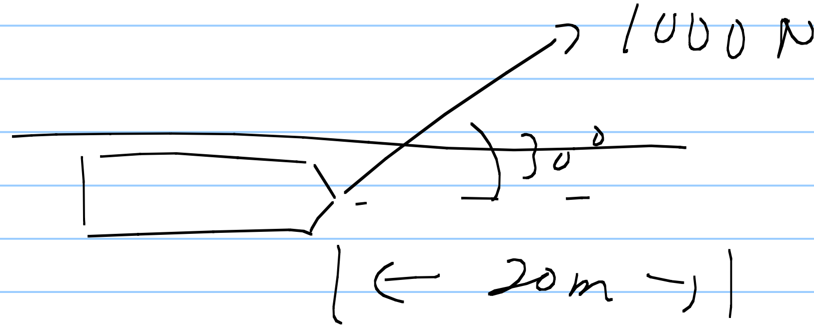
$$B_y = 250 + 750\sqrt{3} \quad \text{lbs}$$



Two force member

$$\frac{B_x}{B_y} = \frac{2}{6} = \frac{1}{3} \Rightarrow B_x = \frac{1}{3} B_y$$

$$= \frac{250}{3} + 250\sqrt{3}$$

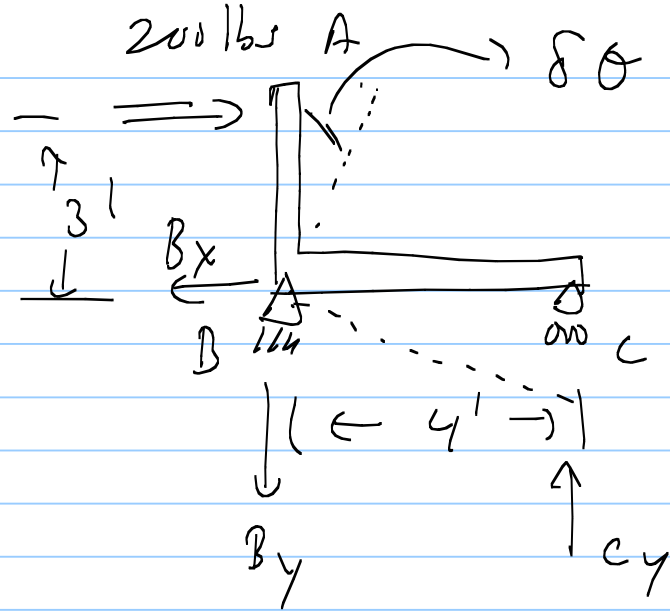


$$W = F \cdot x \cdot \cos\theta$$

$$= 1000 \cdot 20 \cdot \cos(30)$$

$$= 10{,}000\sqrt{3} \text{ N}\cdot\text{m}$$

$$= 17.3 \text{ kN}\cdot\text{m}$$



$$3\sin(\delta\theta)\cdot 200 = \delta W_A$$

$$-4\sin(\delta\theta)\cdot C_y = \delta W_C$$

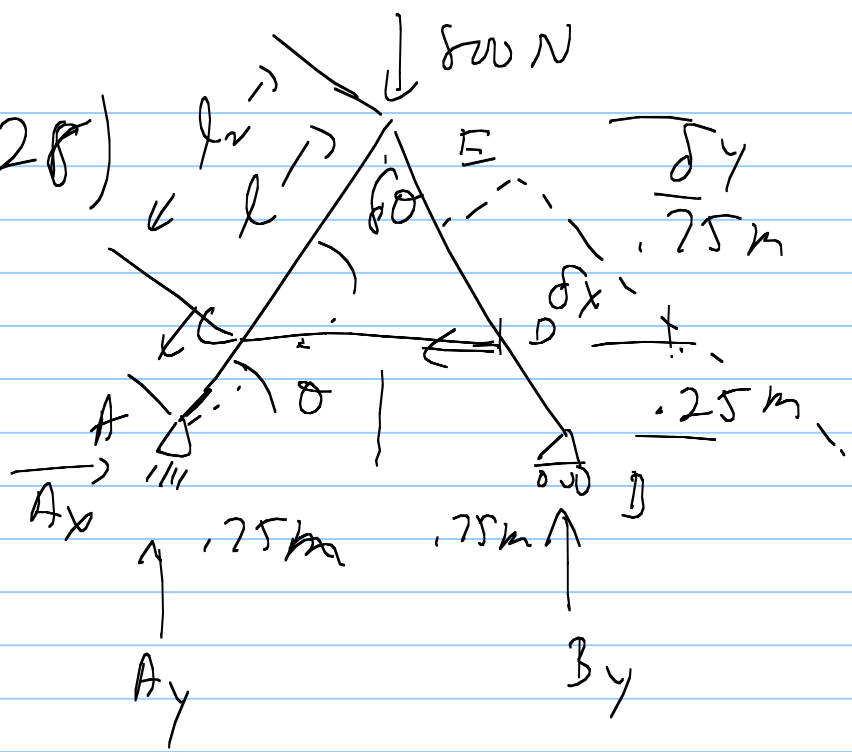
$$\delta W = 600\sin(\delta\theta) - 4C_y\sin(\delta\theta) = 0$$

$C_y = 150$ lbs

$B_y = 150$ lbs

$B_x = 200$ lbs

11-28)



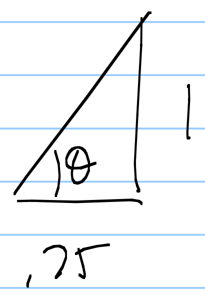
$$800\,\delta y - T_{CD}\,\delta x = 0$$

$$\delta y = l\sin\theta - l\sin(\theta-\delta\theta)$$
$$= l\cos\theta\,\delta\theta$$

$$\delta x = 2l_2\cos(\theta-\delta\theta) - 2l_2\cos\theta$$
$$= 2l_2\sin\theta\,\delta\theta$$

$$800\,l\cos\theta\,\delta\theta - T_{CD}\,2l_2\sin\theta\,\delta\theta = 0$$

$$T_{CD} = 400\,\frac{l}{l_2}\cot(\theta) = 400\cdot\frac{16}{15} = \frac{6400}{15}\text{ N}$$

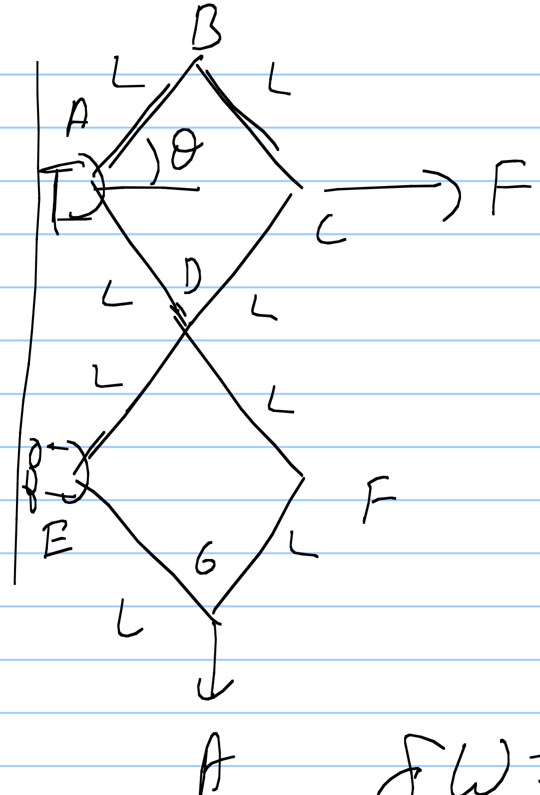


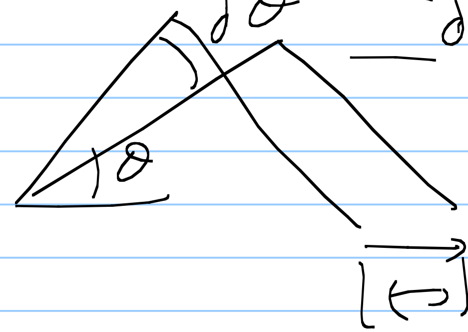
$$\cot(\theta) = \frac{1}{.75} = \frac{4}{3}$$

$$l = \sqrt{(.75)^2 + 1^2} = 5/4$$

$$\frac{l}{l_2} = \frac{4}{3}$$

$$l_2 = .75\, l = \frac{15}{16}$$





$$\delta y = l\sin\theta - l\sin(\theta - \delta\theta)$$
$$= l\cos(\theta)\,\delta\theta$$

$$\delta x = 2l\cos(\theta - \delta\theta) - 2l\cos\theta$$
$$= 2l\sin(\theta)\,\delta\theta$$

$$\delta W = F\delta x - A\delta y$$
$$= 2Fl\sin\theta\,\delta\theta - 500\,l\cos\theta\,\delta\theta = 0$$

$F = 250 \cot(\theta) = 250 \text{ lbs}$