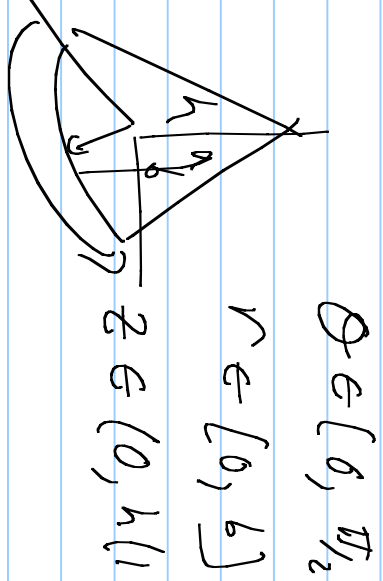


# EGR 180 2/27

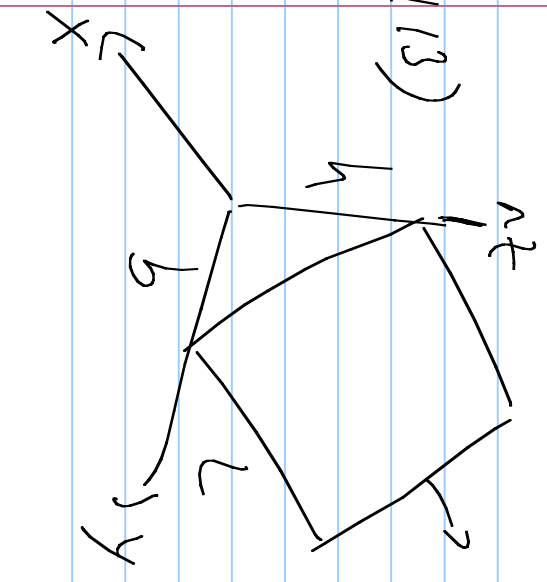
10-95)  $I_y = \iiint_V (x^2 + z^2) dV$

$$= \int_0^{\pi/2} \int_b^5 \int_0^{h(1-r/b)} (r^2 \cos^2 \theta + z^2) dz r dr d\theta$$



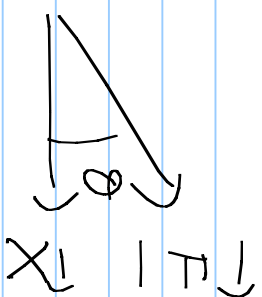
16-113)  $\frac{z}{h} + \frac{y}{b} = 1 \Rightarrow z = h(1 - \frac{y}{b})$

$$I_{xy} = \int_{-L}^0 \int_b^5 \int_0^{h(1-y/b)} xy dz dy dx$$



$I_{zx}$   $xz$

# Virtual Work



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

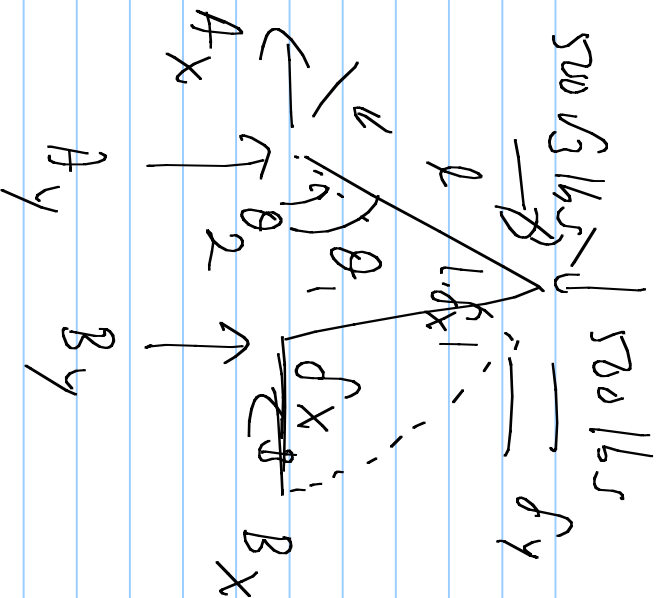
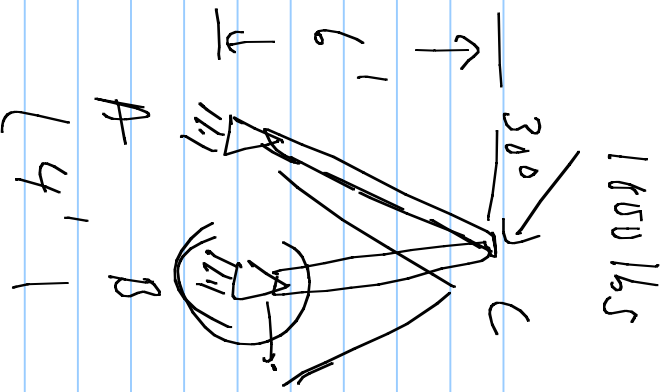
$$dW = \vec{F}(\vec{x}) \cdot d\vec{x}$$

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

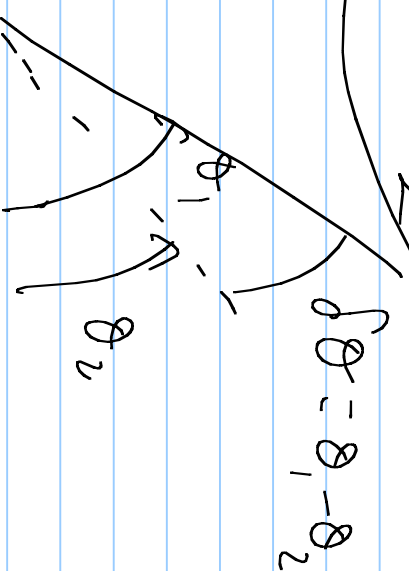
Statistics object doesn't move

Technically no work can be performed.

Virtual work - work that would be performed if we freed one of the constraints.



$$\begin{aligned}
 \delta U &= -B_x \delta x \\
 &+ 500 \delta y \\
 \delta x &= \frac{\delta x_2}{2}
 \end{aligned}$$



$$\delta y = 2 \sin(\theta_1) - 2 \sin \theta_2$$

$$\delta U_B = 2L \cos \theta_2 - 2L \cos \theta_1$$

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

$$\begin{aligned} \delta y &= l \sin \theta_1 - l \sin(\theta_1 - \delta\theta) \\ &= \underline{l \sin \theta_1} - \underline{l \sin \theta_1 \cos \delta\theta + l \sin \delta\theta \cos \theta_1} \end{aligned}$$

$$\begin{aligned} \delta x_B &= 2l \cos(\theta_1 - \delta\theta) - 2l \cos \theta_1 \\ &= \underline{2l \cos \theta_1 \cos \delta\theta} + \underline{2l \sin \theta_1 \sin \delta\theta} - \underline{2l \cos \theta_1} \end{aligned}$$

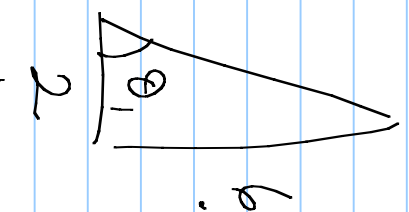
$$\delta y = l \cos \theta_1 \delta\theta$$

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

$$\delta W = 500 \delta x \cos \theta + 500 \delta x \sin \theta - B_x 2 \delta \sin \theta, \delta \theta = 0$$

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

$$= 250 \sqrt{3} + 250 / 3 \quad 165$$



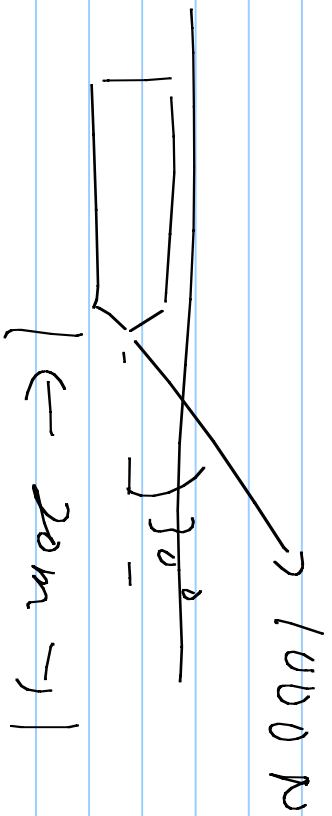
$$\sum M_A = -2 \cdot 500 - 6 \cdot 500 \sqrt{3} + 4 B_y = 0$$

$$B_y = 250 + 750 \sqrt{3} \quad 165$$

c) Two force member

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

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

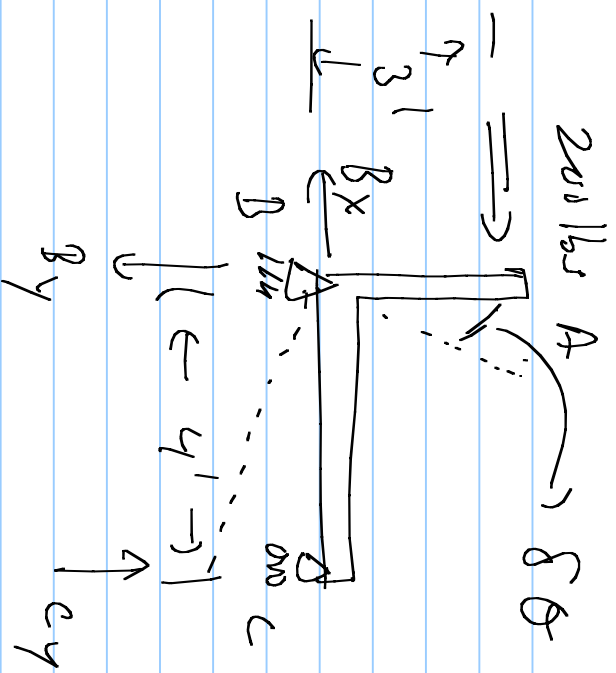


$$W = F \cdot X \cdot \cos \theta$$

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

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

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



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

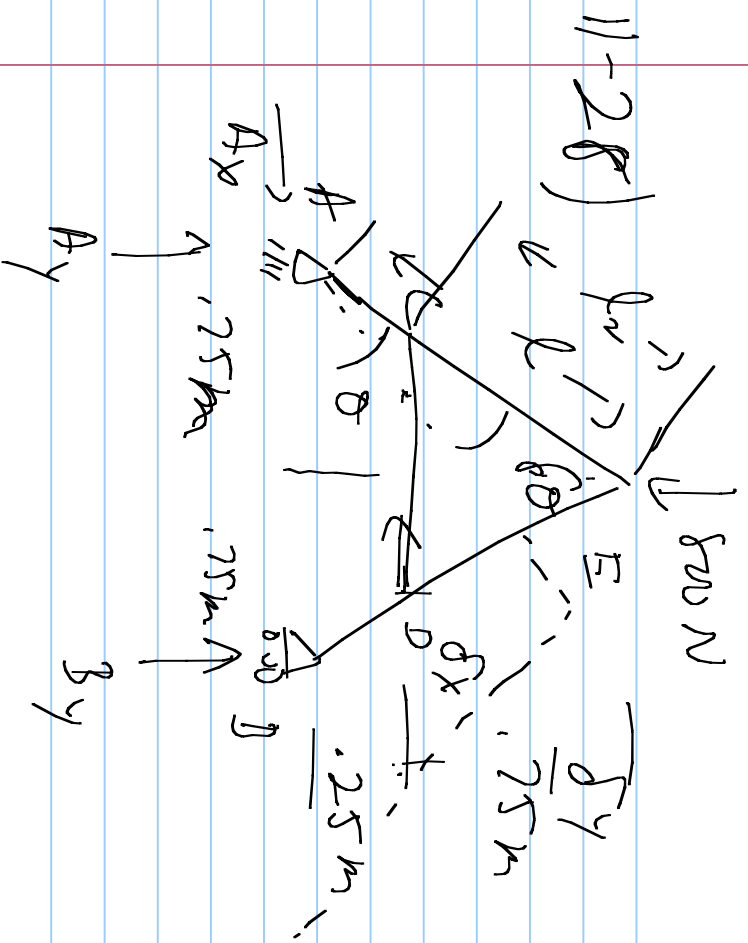
$$-4 \sin(\delta\theta) \cdot c_y = \delta W_C$$

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

$$c_y = 150 \text{ lbs}$$

$$B_y = 150 \text{ lbs}$$

$$B_x = 200 \text{ lbs}$$



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

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

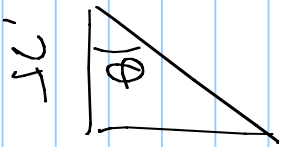
$$= l \cos \theta \delta \theta$$

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

$$= 2l_2 \sin \theta \delta \theta$$

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

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

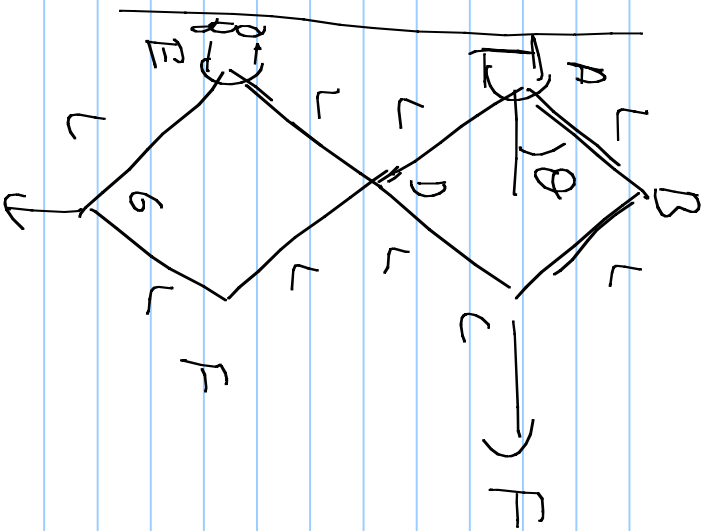


$$\cos(\theta) = \frac{1}{r} = \frac{4}{5}$$

$$r = \sqrt{(0.75)^2 + 1^2} = \frac{5}{4}$$

$$\frac{1}{r} = \frac{4}{5}$$

$$r_2 = 0.75 \cdot r = \frac{15}{16}$$



A geometric diagram showing a right-angled triangle with a hypotenuse of length  $2L$ . The vertical side is  $\delta y$  and the horizontal side is  $\delta x$ . The angle between the hypotenuse and the vertical side is  $\theta$ . The diagram shows that  $\delta y = L \sin \theta - L \sin(\theta - \delta \theta)$  and  $\delta x = 2L \cos(\theta - \delta \theta) - 2L \cos \theta$ .

$$\delta W = F \delta x - A \delta y$$

$$= 2L \cos \theta - 2L \cos(\theta - \delta \theta)$$

$$\delta W = F \delta x - A \delta y = 2FL \sin \theta \delta \theta - 570 L \cos \theta \delta \theta = 0$$

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$$F = 250 \cos(0) = 250 \text{ lbs}$$