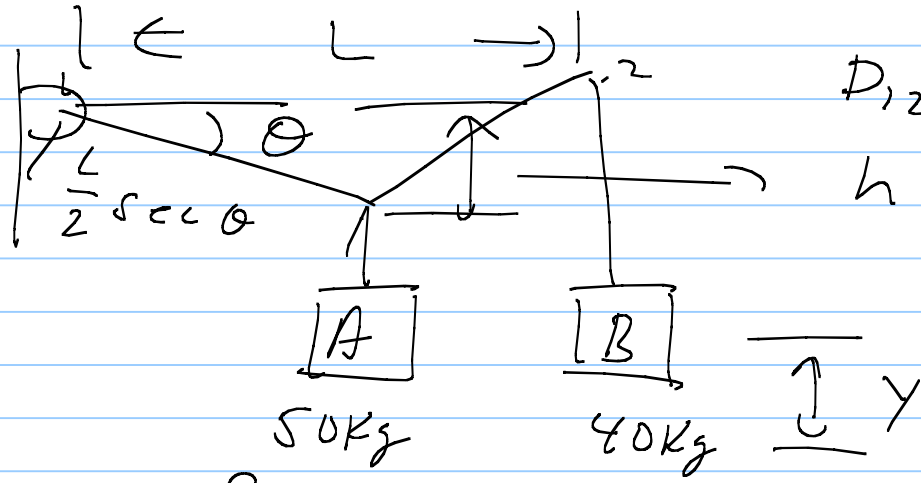
EGR 180 8/3

Note Title 8/3/2009

11-30



$D_{12} = L\sec(\theta) = y$

$h = \frac{L}{2}\tan\theta$

P_A P_B

$P_A = m_A g \frac{L}{2}\tan\theta$

$P_B = -m_B g L\sec\theta$

$P = m_A g \frac{L}{2}\tan\theta - m_B g L\sec(\theta)$

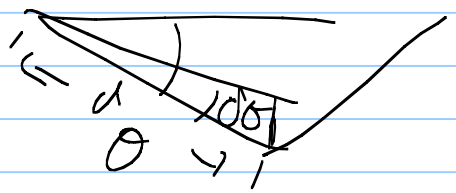
$$\frac{dP}{d\theta} = 0 = \frac{L}{2} m_A g \sec^2\theta - m_B g L \sec\theta \tan\theta$$

$$= \frac{L}{2} g \sec(\theta) \left[m_A \sec\theta - 2 m_B \tan\theta \right]$$

$$m_A \sec\theta = 2 m_B \tan\theta$$

$$\frac{m_A}{2 m_B} = \sin\theta = \frac{50}{88} = \frac{5}{8} \Rightarrow \theta = \sin^{-1}\left(\frac{5}{8}\right)$$

$$= 38.7^\circ$$



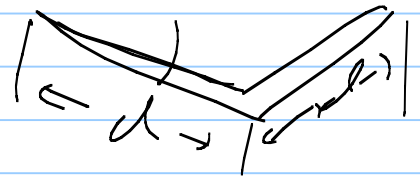
$$d = \frac{L}{2} \sec\theta$$

$$\delta h = d_1 \sin\theta - d_2 \sin(\theta - \delta\theta)$$

$$= \frac{L}{2} \tan\theta - \frac{L}{2} \tan(\theta - \delta\theta)$$

$$= \frac{L}{2} \sec^2\theta \, \delta\theta$$

δL

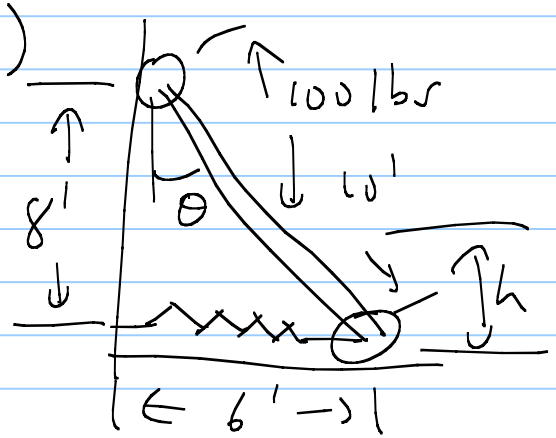


$$\delta L = L\sec(\theta) - L\sec(\theta - \delta\theta)$$
$$= L\sec\theta\tan\theta\,\delta\theta$$

$$\delta W_A = -m_A g \frac{L}{2}\delta\theta \cdot \sec^2\theta$$

$$\delta W_B = m_B g L \sec\theta\tan\theta\,\delta\theta$$

11-45)



$$P_s = \frac{1}{2}Kx^2 = \frac{1}{2}K[10\sin\theta - 5]^2$$

$$P_g = mgh = 100 \cdot 5\cos\theta = 500\cos\theta$$

$$P = \frac{1}{2}K[10\sin\theta - 5]^2 + 500\cos\theta$$

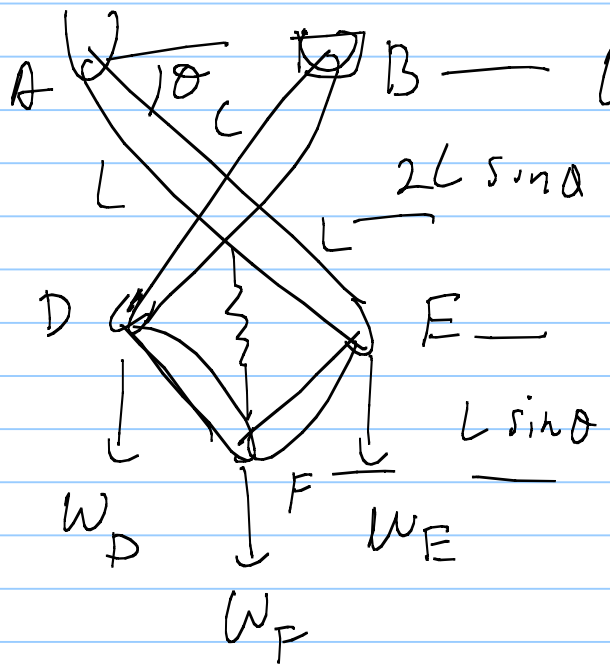
$$\frac{dP}{d\theta} = 0 = K\left[10\sin\theta - 5\right]\left[10\cos\theta\right) - 500\sin\theta = 0$$

$$K = \frac{500\sin\theta}{\cancel{5}\cos\theta\,(10\sin\theta - 5)} = \frac{10\sin\theta}{\cos\theta\,(2\sin\theta - 1)}$$

$\sin\theta = .6, \quad \cos\theta = .8$

$$K = \frac{(10)(.6)}{(.8)(1.2-1)} = \frac{6}{.16} = 37.5 \text{ lbs/ft}$$

11-49)



$W_D = W_E = W_F = 80\ lb$

$L = 2'$ $\quad K = 350\ lb/ft$

@ $2'$

$h_F = 3L - 3L\sin\theta$

$h_D = L - L\sin\theta$

$D_{CF} = 2L\sin\theta$

$X = D_{CF} - 2$

$$W_D h_D + W_E h_D + W_F h_F + \frac{1}{2} K X^2 = P$$

$$2L \quad -2L\sin\theta]$$

$$80\left[2L - 2L\sin\theta + 2L - 2L\sin\theta + 3L - 3L\sin\theta\right)$$
$$+ \tfrac{1}{2}K\left[2L\sin\theta - 2\right)^2 = P$$

$$\frac{dP}{d\theta} = -560L\cos\theta + K\left[2L\sin\theta - 2\right](2L\cos\theta) = 0$$

$$= 2\cos\theta\left[2K\left[2L\sin\theta - 2\right] - 560\right] = 0$$

$$2L\sin\theta - 2 = \frac{560}{2K} = \frac{280}{350} = = \frac{4}{5}$$

$$2L\sin\theta = 2.8$$
$$\sin\theta = .7 \Rightarrow \theta = \sin^{-1}(.7) = 44.4^\circ$$

$$\frac{d^2P}{d\theta^2} = 56L\sin\theta - 2kL\sin\theta(2L\sin\theta - 2) + 4kL^2\cos^2\theta \qquad \theta = 90^\circ$$

$$= 56L - 2kL(2L - 2)$$

$$= L[56 - 700(2)] < 0 \quad \text{unstable}$$

$$> 0 \quad \text{stable}$$

Virtual Work	— 12pts	Easy
Potential Energy	— 12pts	Difficult
Stability	— 12pts	Impossible