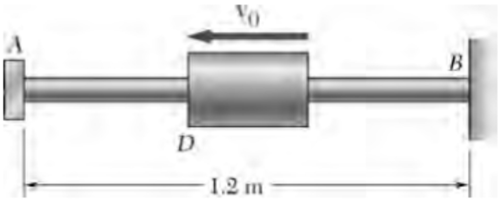
26 September 2020 00:47



$$\frac{1}{2} m v_0^2 = \int_0^L \frac{P^2}{2EA}\,dx = \frac{P^2 L}{2EA}$$

$$P^2 = \frac{m v_0^2 EA}{L} \Rightarrow P = \sqrt{\frac{m v_0^2 EA}{L}}$$

$$\sigma = \frac{P}{A}\ , \quad \Delta = \sqrt{\frac{m v_0^2 EA}{L}} \times \frac{L}{EA}$$

$$= \frac{1}{A}\sqrt{\frac{m v_0^2 EA}{L}}$$

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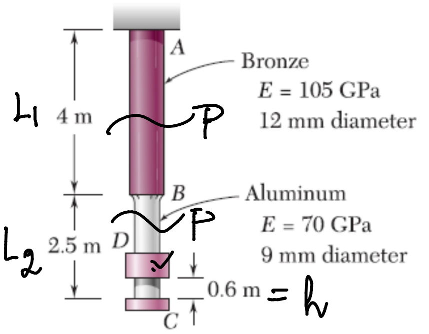

$$mg(h+\delta_m) = \int_0^L \frac{P_m^2}{2EA}\,dx = \frac{P_m^2}{2}\int_0^{L_1}\frac{dx}{E_1A_1} + \frac{P_m^2}{2}\int_{L_1}^{L_1+L_2}\frac{dx}{E_2A_2}$$

$$= \frac{P_m^2}{2}\left(\frac{L_1}{E_1A_1}+\frac{L_2}{E_2A_2}\right)$$

Energy balance at max deflection at C

$$\delta = P\left(\frac{L_1}{E_1A_1}+\frac{L_2}{E_2A_2}\right) \longrightarrow$$ force vs displacement at C

$$mg\left[h + P_m\left(\frac{L_1}{E_1A_1}+\frac{L_2}{E_2A_2}\right)\right] = \frac{P_m^2}{2}\left(\frac{L_1}{E_1A_1}+\frac{L_2}{E_2A_2}\right)$$

Solve for P_m (+ve root)

$$\sigma_{m1} = \frac{P_m}{A_1}, \quad \sigma_{m2} = \frac{P_m}{A_2}$$

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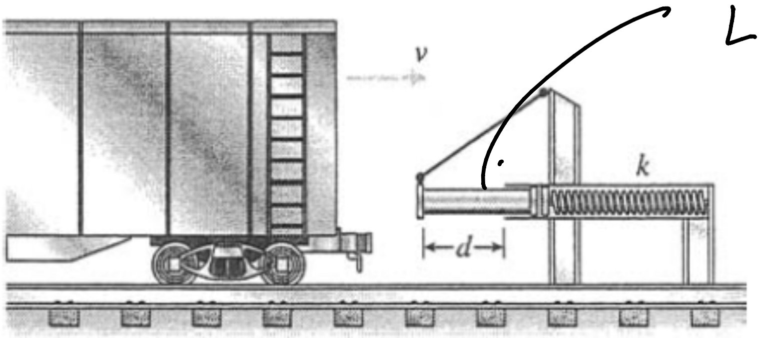

$\frac{EA}{L}$

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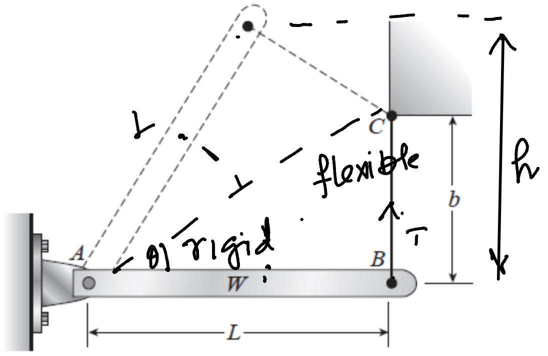
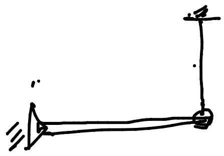


$\tan\theta = \frac{b}{L}$, $2\theta = ?$ use $\sin 2\theta$ formula

$h = L\sin 2\theta = L \times \frac{2b/L}{1+(b/L)^2}$

c.m. loses $\frac{h}{2}$ height

$mg\left(\frac{h}{2} + \delta_m\right) = \frac{T_m^2 b}{2EA}$



$\delta_m = \frac{Tb}{EA} \Rightarrow T_m = \frac{EA}{b}$

$mg\left(\frac{h}{2} + \frac{T_m b}{EA}\right) = \frac{T_m^2 b}{2EA}$

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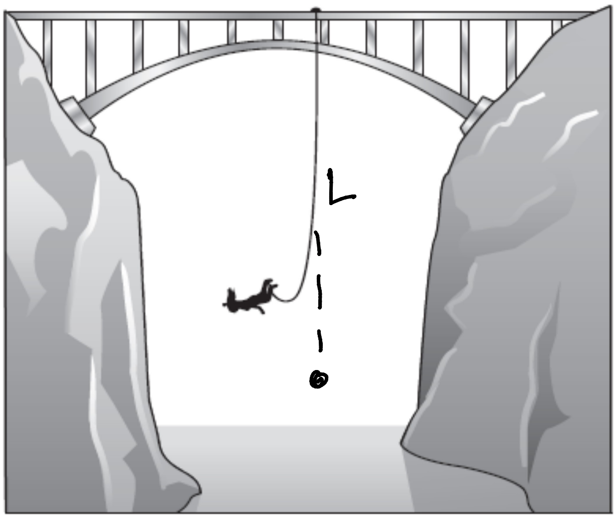

$$mg(L+\delta_m) = \frac{T^2 L}{2EA}$$

$$\delta = \frac{TL}{EA}$$

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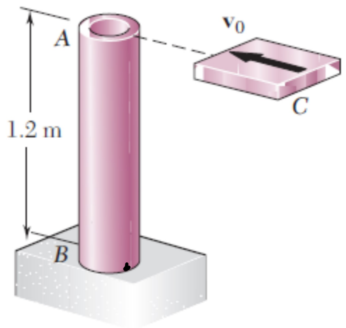

$$\frac{1}{2} m v_0^2 = \int_0^L \frac{M^2}{2EI}\,dx = \int_0^L \frac{P_m^2 (L-x)^2}{2EI}\,dx$$

$$\frac{PL^3}{3EI} = \delta \quad , \quad \sigma_B = \frac{M_B y}{I} = \frac{P_m L y}{EI}$$

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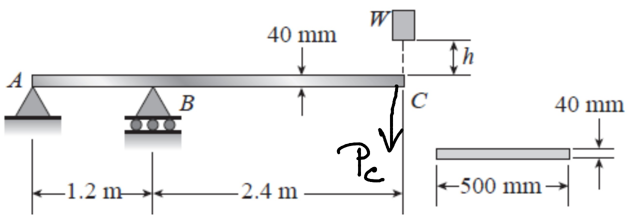

$$mg(h+\delta_{c,max}) = \int_0^L \frac{M^2}{2EI}\,dx.$$

$$\delta_c \rightarrow P_c.$$

1. Find $M(x)$ in terms of P_c $\longrightarrow$ Energy balance eqn
2. Find δ_c in terms of P_c $\rightarrow$ Substitute for δ_c in above eqn

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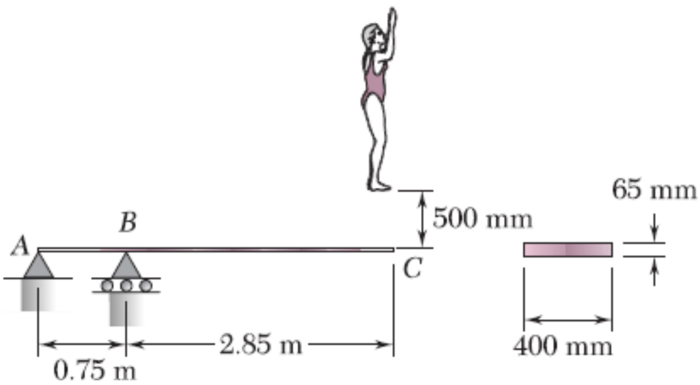

Real life version

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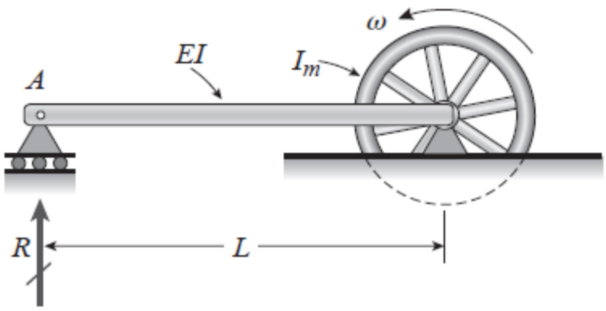

$$\frac{1}{2} I_m \omega^2 = \int_0^L \frac{M^2}{2EI}\,dx.$$

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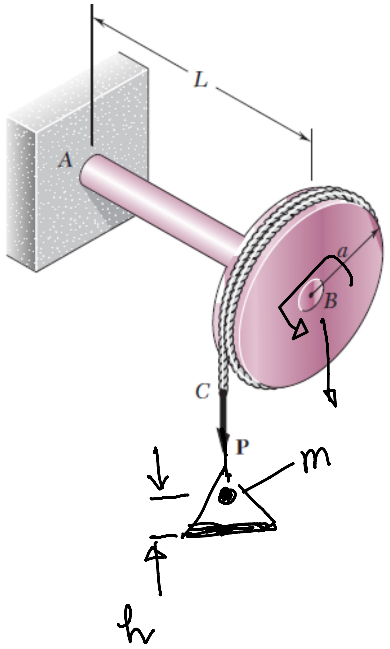

$$T = Pa$$

$$\frac{1}{2}P\delta = \frac{T^2 L}{2GJ} + \int_0^L \frac{\{P(L-x)\}^2}{2EI}\,dx = U_{total}$$

$$mg(h+\delta_m) = U_{total}$$

$$\frac{1}{2}\cancel{P}\delta = \frac{P^{\cancel{2}}a^2L}{2GJ} + \frac{P^{\cancel{2}}L^3}{6EI} \Rightarrow \delta = P\left(\frac{a^2L}{2GJ} + \frac{L^3}{3EI}\right)$$

$$mg(h+\delta_m) = \frac{P_m^2 a^2 L}{2GJ} + \frac{P_m^2 L^3}{6EI}$$