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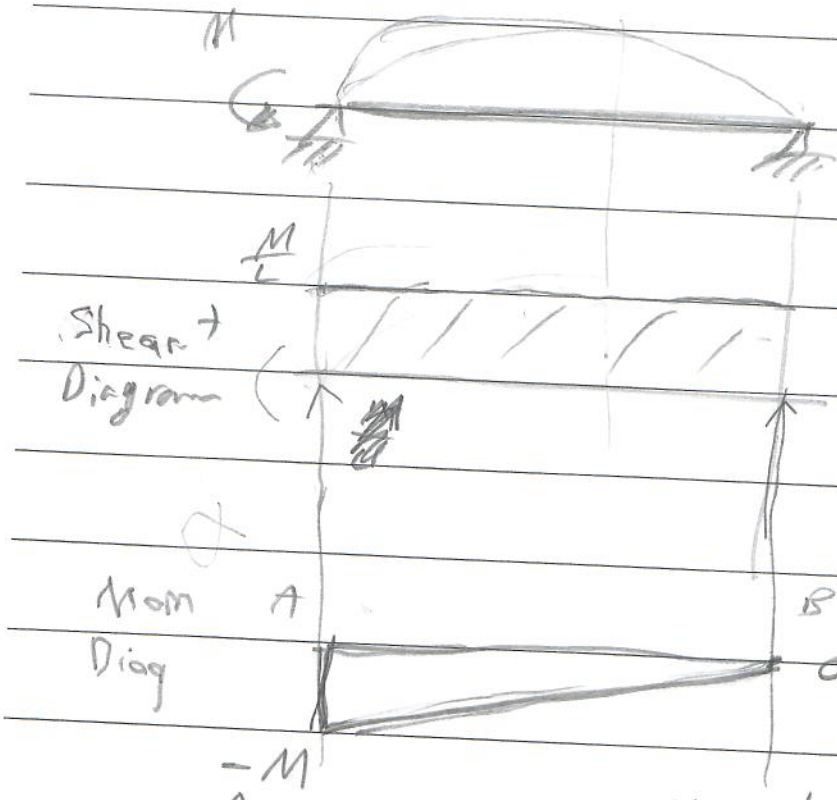
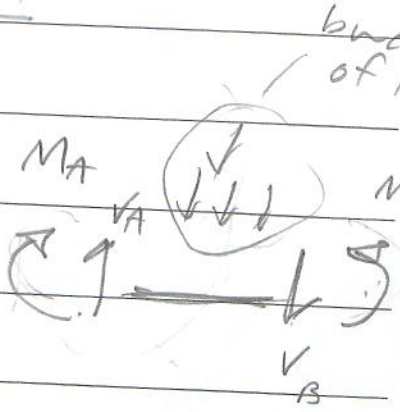
CIE 418: Lecture 1, Oct 27



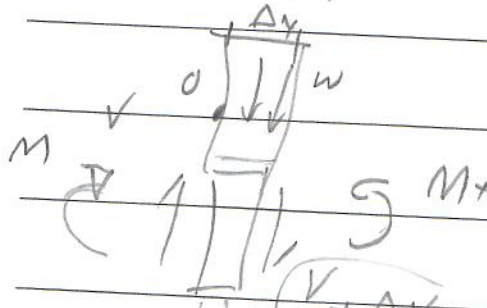


V_A - bunch of load $= V_B$

M_B = Area under shear diagram + M_A

Moment diag { cc: moment → jump down

Shear diag { force up → jump up



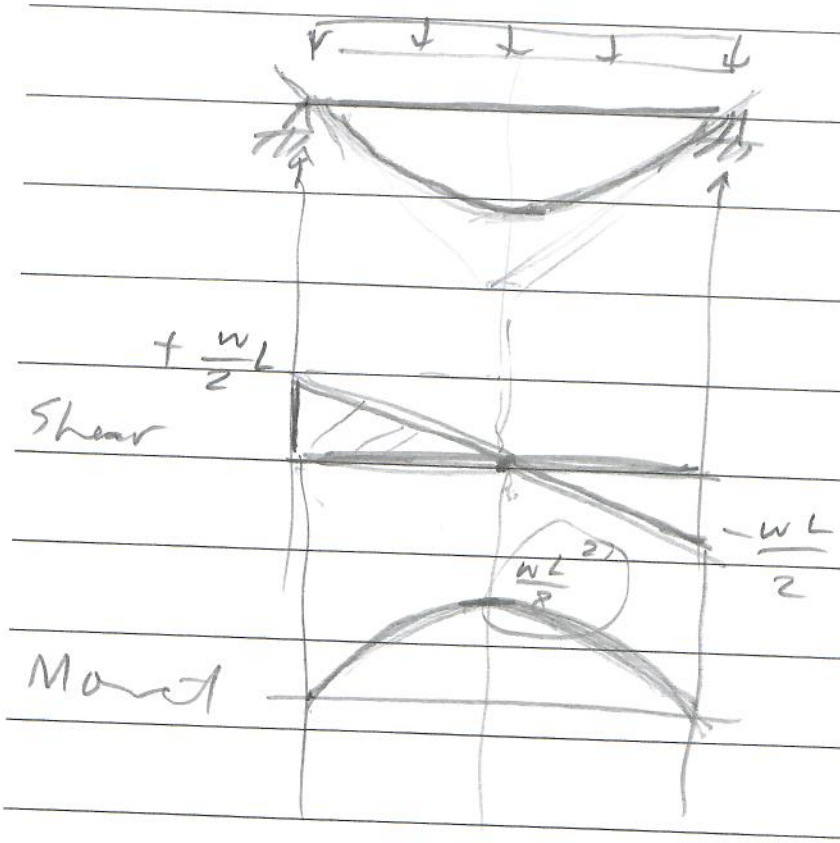
$$-(V+\Delta V)\Delta x + V - w\Delta x = 0$$

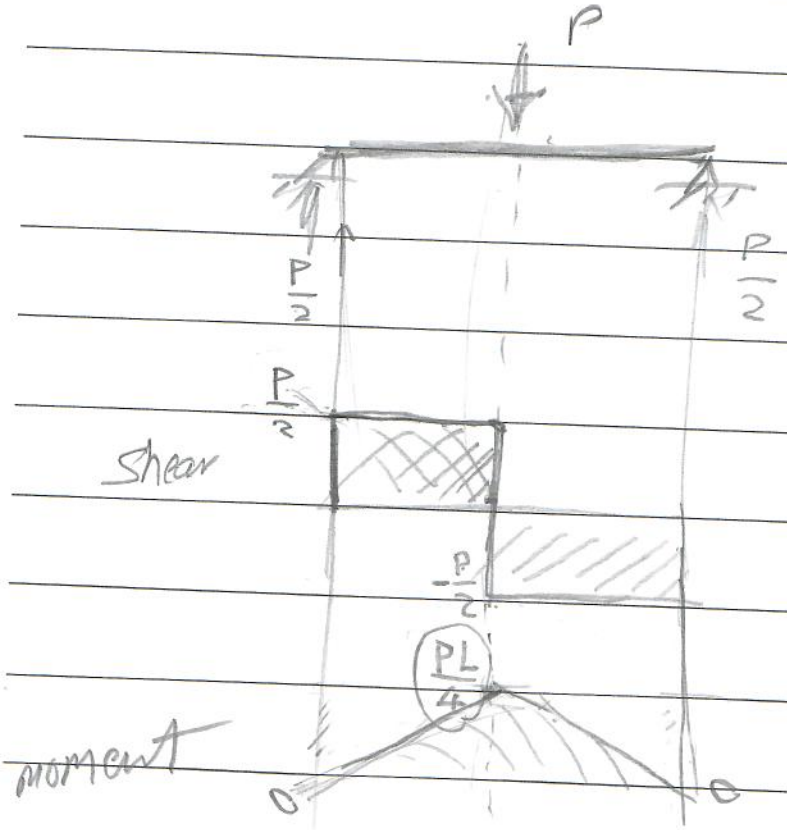
$$\Delta V = -w\Delta x \Rightarrow \frac{\Delta V}{\Delta x} \sim \frac{dV}{dx} = -w$$

$$+\circlearrowleft \Sigma M_O = 0: \quad M+\Delta M - M - w\Delta x \times \frac{\Delta x}{2} - (V+\Delta V)\Delta x = 0$$

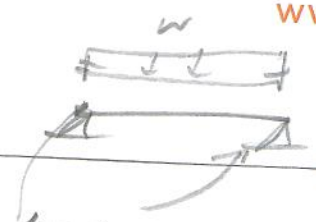
$$\Delta M = V\Delta x$$

$$\Rightarrow \frac{dM}{dx} = V \iff M_B - M_A = \int_{x_A}^{x_B} V\,dx$$





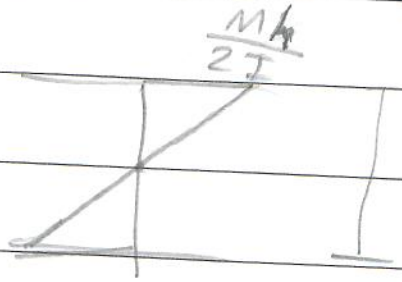
Bending formulas



$$\sigma = \frac{My}{I} \quad ; \quad \boxed{M = EI\kappa}$$

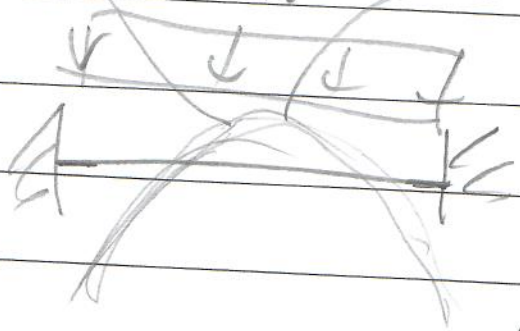
u''
y''

I — moment of inertia for x-section



$$\frac{wL^2}{24} = \frac{1}{3}\left(\frac{wL^2}{8w}\right)$$

$$\boxed{M = V' \qquad V' = -w}$$

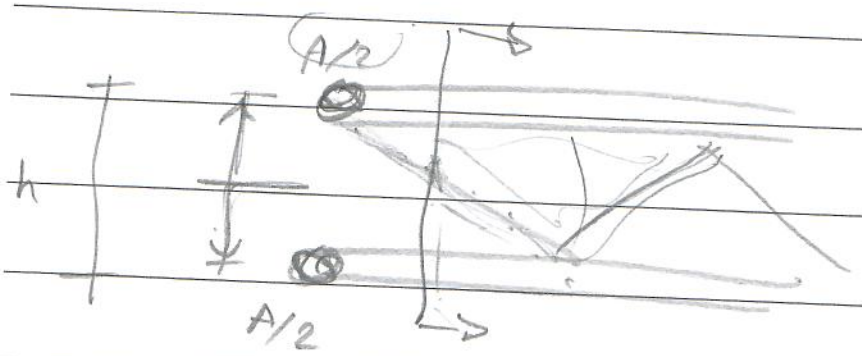


$$\frac{wL^2}{8} \cdot \frac{2}{3} = \frac{1}{12} wL^2$$

Initial yield when $M_{max} \rightarrow \sigma = \sigma_y$

Symmetric: $\boxed{\sigma_y = \frac{M_{max}\, h}{2I}}$

$\frac{W}{\rho}$ as function of specified in assignment.



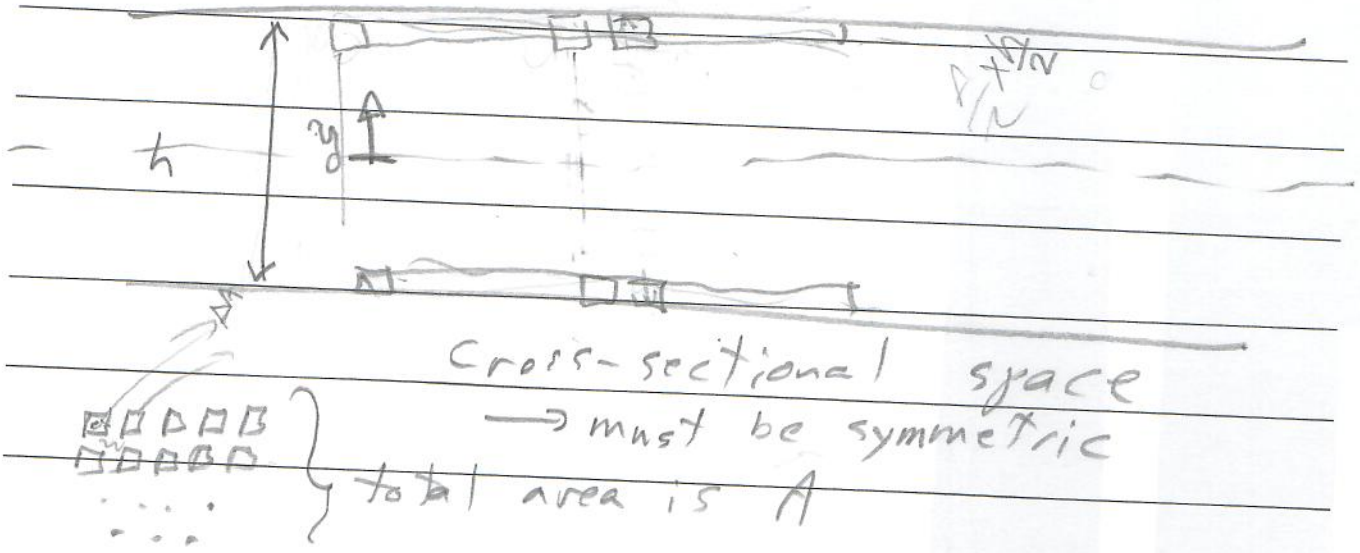
$M = EI\,u''$

$\tau = \frac{Mh}{2I}$; budget $A \times L \times \rho = \text{Mass}$

architect $h \leq h_{max}$

For fixed A and h what is the maximum I that we can get?

$I = \int y^2 dA = \sum y_i^2 \Delta A$ ← maximized



$$I_{max} = \frac{A}{2} \times \left(\frac{h}{2}\right)^2 + \frac{A}{2} \times \left(\frac{h}{2}\right)^2$$

$$\frac{Ah^2}{8} + \frac{Ah^2}{8} = \frac{2Ah^2}{8}$$

$$I_{max} = \frac{Ah^2}{4}$$

$$\frac{bh^3}{12} - \frac{bh \times h^2}{12}$$

$$I_{rect} = \frac{Ah^2}{12}$$

$$\frac{I_{rect}}{I_{max}} = \frac{12}{4} = 3$$