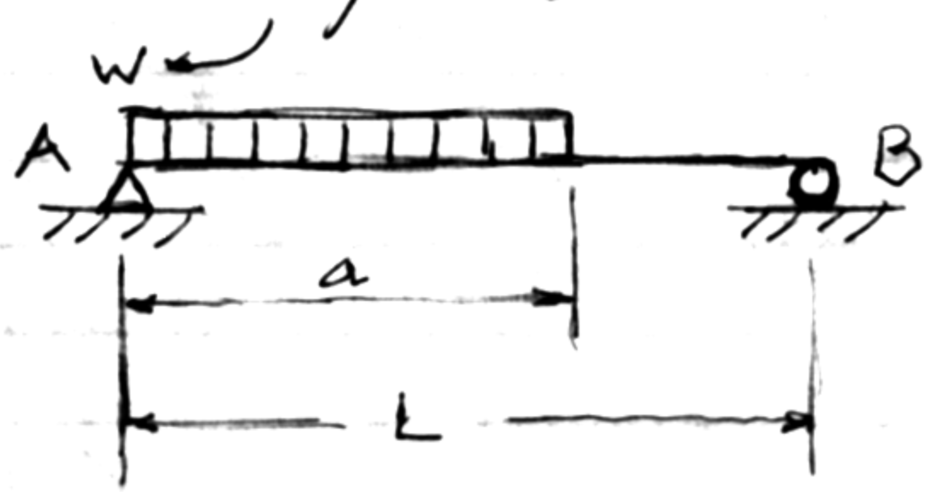
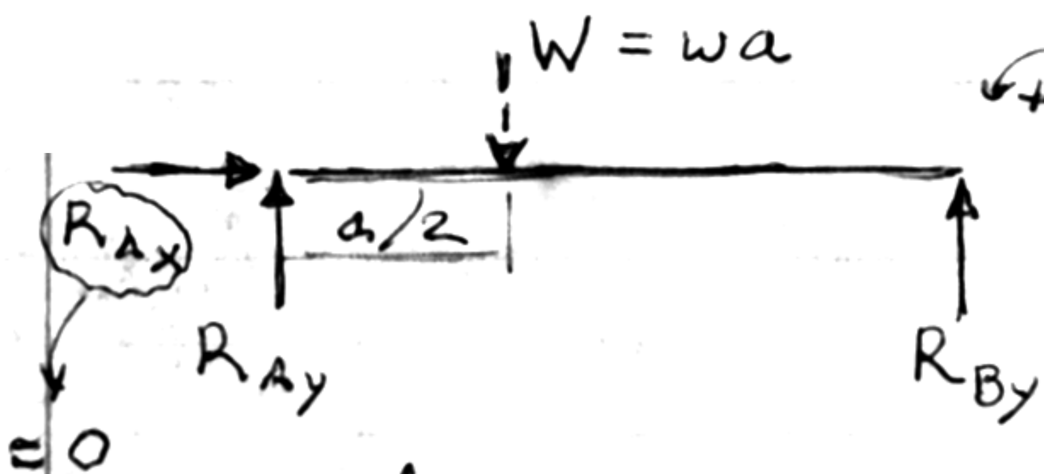
Lecture Notes 4

Load Patterns

DISTRIBUTED LOADS

Uniformly Distributed Load over part of span





$\circlearrowleft + \; \Sigma M_A = 0$

$$-W \cdot \frac{a}{2} + R_{By} L = 0$$

$$R_{By} = + \frac{wa^2}{2L}$$

$+\uparrow \; \Sigma F_y = 0$

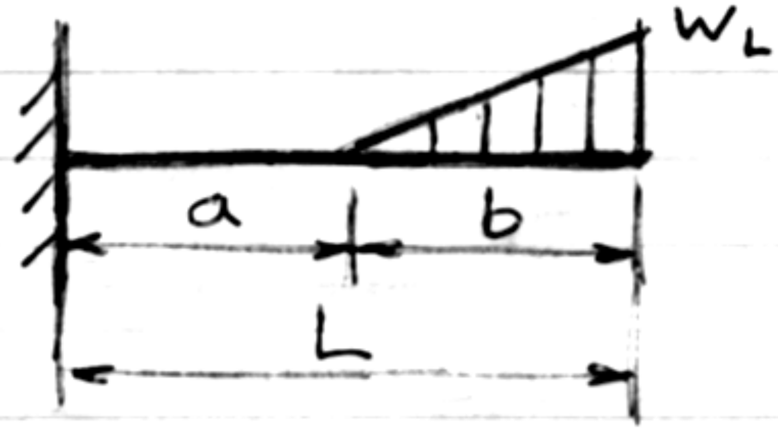
$$-W + R_{Ay} + R_{By} = 0$$

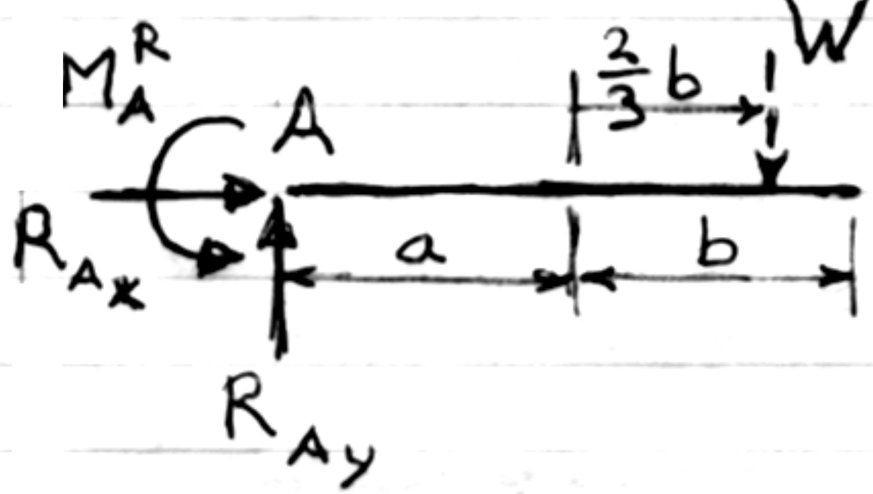
$$R_{Ay} = wa - wa^2/2L$$

$$= wa(1 - a/2L)$$

Varying Loads

Uniformly Varying Load





$$W = \frac{1}{2} w_L b$$

$$\circlearrowleft + \Sigma M_A = 0$$

$$+M_A^R - \left(a + \frac{2}{3}b\right)W = 0$$

$$M_A^R = \frac{1}{2} b \left(a + \frac{2}{3}b\right) w_L$$

$$+\uparrow \Sigma F_y = 0$$

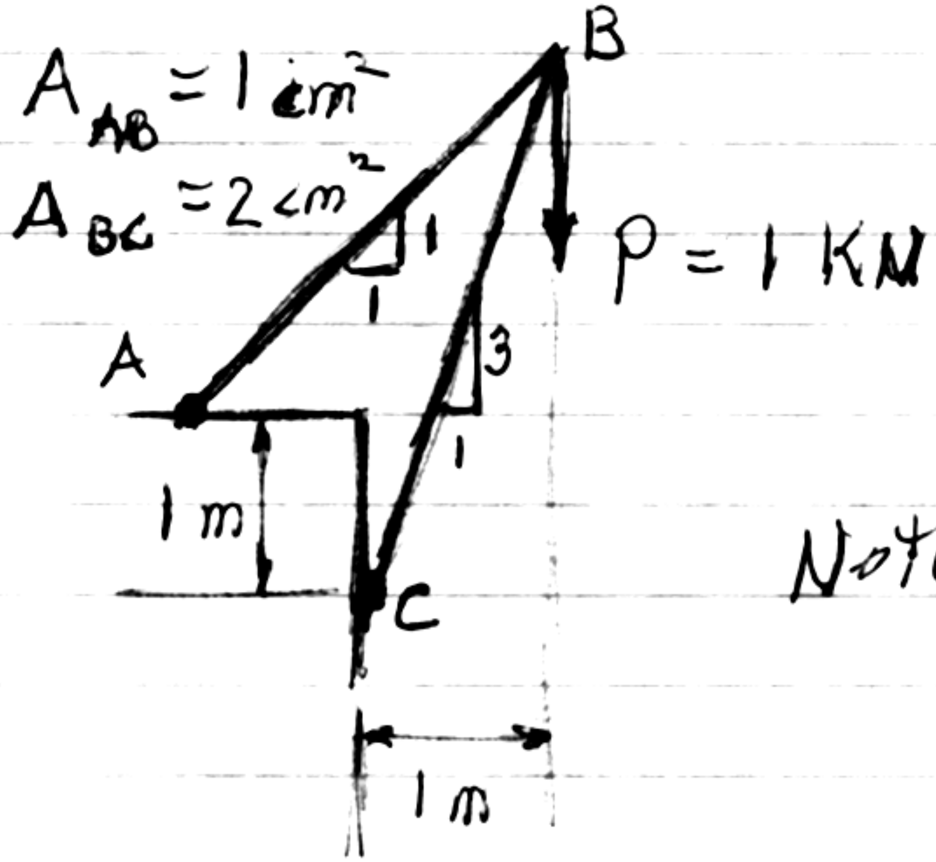
$$R_{Ay} - W = 0$$

$$R_{Ay} = \frac{1}{2} w_L b$$

$$\Sigma F_x = 0 \quad R_{Ax} = 0$$

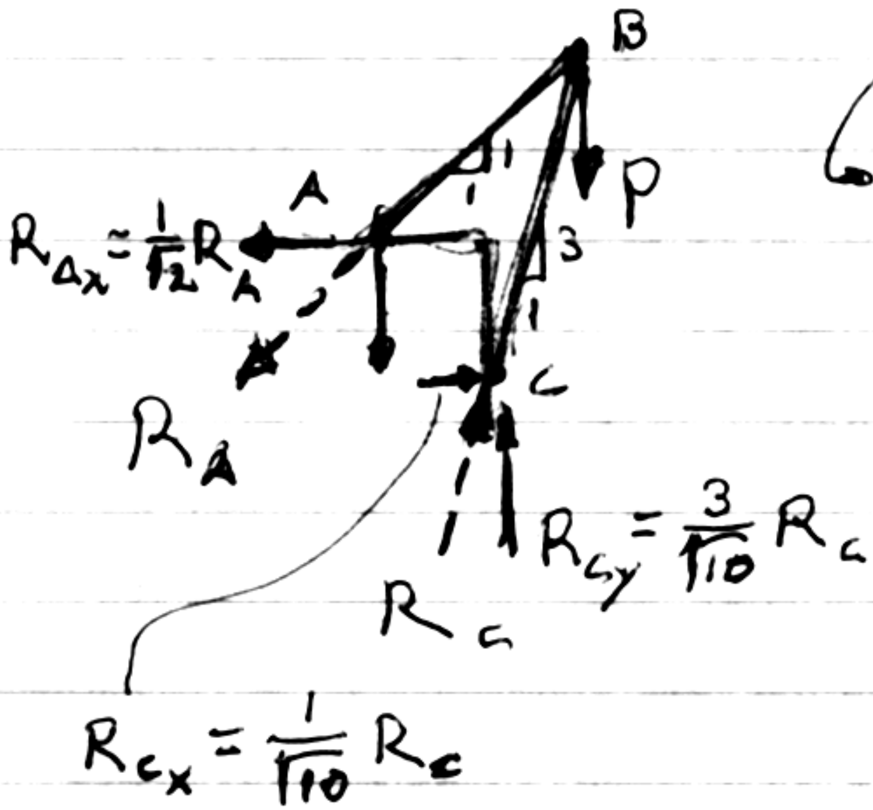
Axial Force and Stress

Force and Stress



Determine the reactions and the stresses

Note: Members AB and BC are 'two force' members



$$\circlearrowleft + \Sigma M_A = 0$$

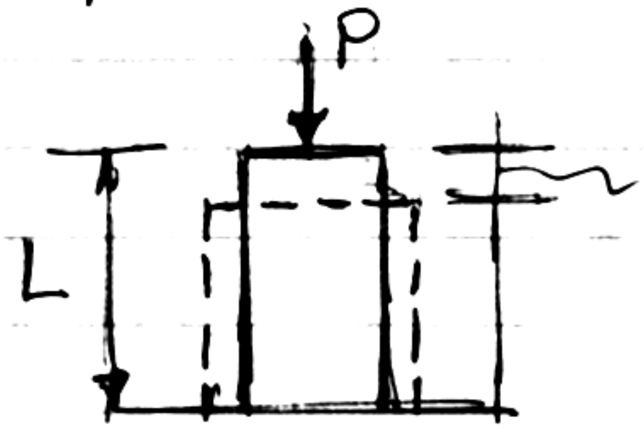
$$+ R_{cy} \cdot 1\,m + R_{cx} \cdot 1\,m - 1\,KN \cdot 2\,m = 0$$

$$= \frac{3}{\sqrt{10}} R_c \cdot 1 + \frac{1}{\sqrt{10}} R_c \cdot 1 - 1\,KN \cdot 2\,m = 0$$

then $\sigma_{BC} = R_c / A_{BC}$

Normal Strain

Displacement and Strain



$\delta \equiv$ Axial Displacement

Axial Strain

Normal strain or Axial Strain

Longitudinal

$\epsilon = \delta / L$

unitless (Displacement per Unit Length)

m/m or in/in

Poisson's Ratio

Poisson's Ratio

$$\mu \text{ or } \nu = \left| \frac{\epsilon_{lateral}}{\epsilon_{axial}} \right|$$

Ratio of lateral to longitudinal strain

$+\epsilon$ elongates the part

$-\epsilon$ contracts the part

μ is always positive after taking the absolute value. Note: $0 \leq \mu \leq .5$

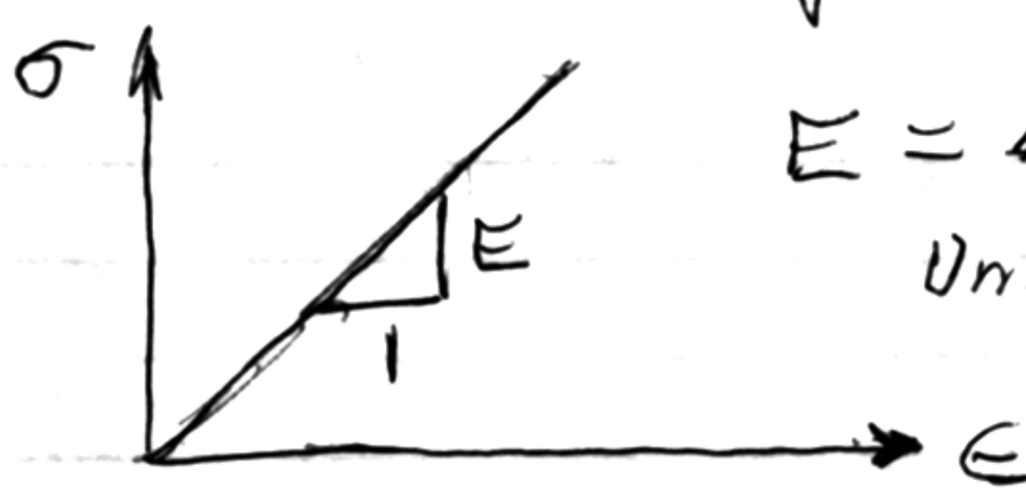
Deformable Mechanics

Elasticity

Property that stores and returns energy in a solid.

Measured by the ratio of the stress to the strain.

Young's Modulus or the Modulus of Elasticity assumes a linear relationship between the change of stress and the change of strain.



$E = \Delta\sigma / \Delta\epsilon$

Units: $\frac{\text{force}}{\text{area}}$