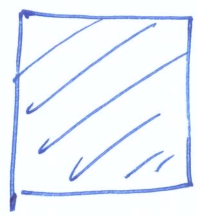
UNIVERSITY OF NEW BRUNSWICK	FACULTY OF ENGINEERING	
Course No.	Assignment No. Date	Page
Problem No.	By Alan Lloyd	of

Elastic and Plastic section Properties of a

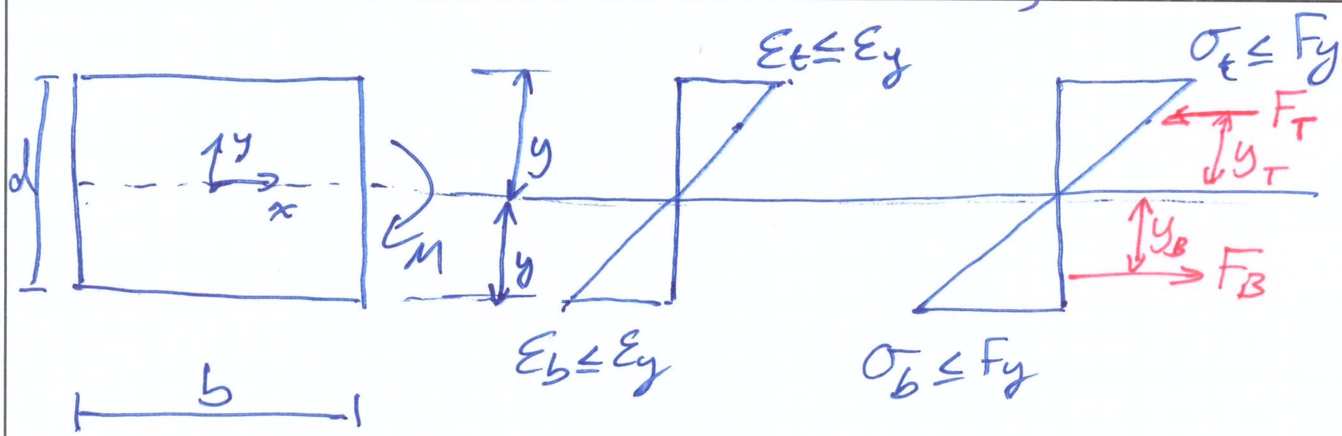


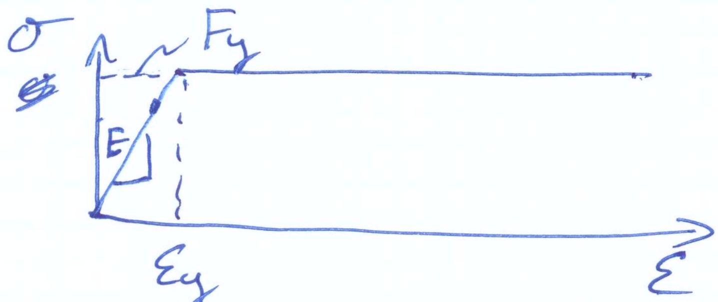
Rectangular shape

S_x, M_y

Z_x, M_p

k





$y = d/2$ (N.A. Location)

$\Sigma F = 0 \rightarrow F_T = F_B$

$F_T = \frac{\sigma_T y b}{2} = F_B$

y_T: $\frac{2}{3}y = y_T = y_B$

$\Sigma M = 0$

$M = F_T y_T + F_B y_B = 2F_T y_T$

$M = 2\left(\frac{\sigma_T y b}{2}\right)\left(\frac{2}{3}y\right)$ since $y = d/2$

$M = \frac{2}{3}\sigma\left(\frac{d}{2}\right)^2 b = M = \frac{1}{6}\sigma b d^2$

$M = \frac{\sigma I}{y}$ $\left(\sigma = \frac{My}{I}\right)$

$I = \frac{1}{2} b d^3 \rightarrow M = \frac{\sigma}{d/2}\left(\frac{1}{12} b d^3\right) = \frac{1}{6}\sigma b d^2$

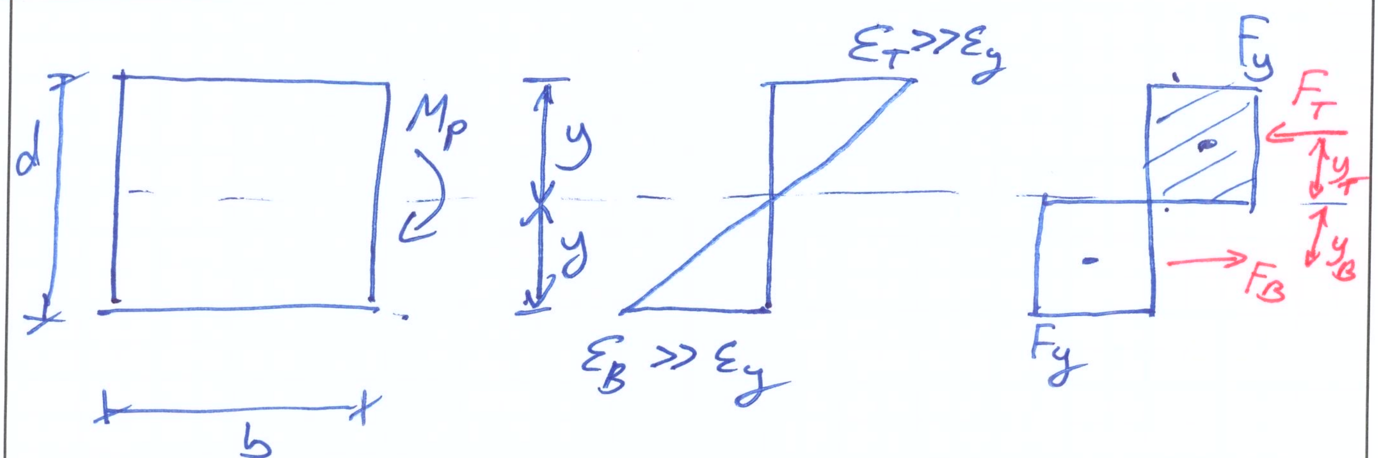
Let's define: Elastic Section Modulus

$$S = I/y$$

For this section $S_x = \frac{I_x}{y} = \boxed{\frac{1}{6} b d^2 = S_x}$

$$\boxed{M_y = F_y S_x} \qquad \boxed{M = S\sigma}$$

Plastic Section Properties.



$\Sigma F = 0 \qquad \underline{F_T = F_B}$

$$F_T = (F_y)(y)(b) = F_B$$

$$y_T = y_B = \frac{y}{2} = \frac{d}{4}$$

$\Sigma M_{NA} = 0$

$$M_p = F_T(y_T) + F_B(y_B) = 2 F_T y_T$$

$$M_p = 2\left[(F_y)(y)(b)\right]\left(\frac{y}{2}\right) = F_y y^2 b$$

$$M_p = F_y \left(\frac{d}{2}\right)^2 b = \boxed{\frac{1}{4} F_y b d^2} \quad \underline{M_p}$$

Let's define: Plastic Section Modulus

$$Z = M_p / F_y$$

$$Z_x = M_{p_x} / F_y$$

$$M_p = Z_x F_y$$

For our shape: $Z = \frac{1/4 F_y bd^2}{F_y}$

$$Z = \frac{1}{4} bd^2$$ ← for our shape.

$$S = \frac{1}{6} bd^2$$

Let's define: Shape factor.

$$K = Z/S$$

In our case: $K = \frac{\frac{1}{4} bd^2}{\frac{1}{6} bd^2}$

$$K = 1.5$$