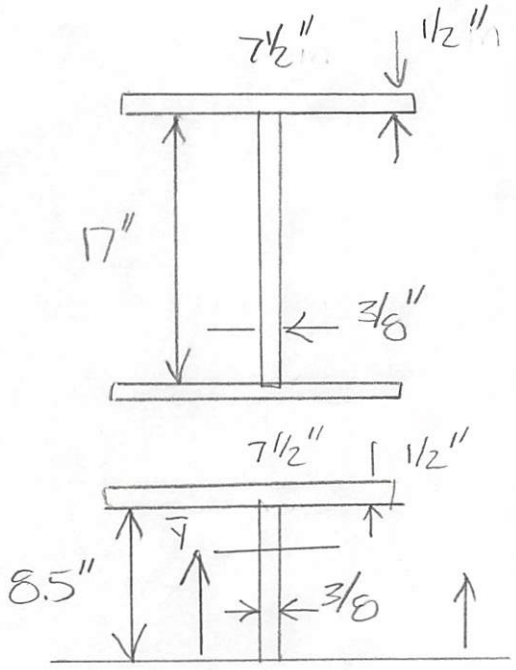
1/2

5.2-1 A flexural member is fabricated from two flange plates $^1/_2 \times 7^1/_2$ **(12.7 × 200 mm)** and a web plate $^3/_8 \times 17$ **(9.5 × 430 mm)** . The yield stress of the steel is 50 ksi **(345 MPa)** .

a. Compute the plastic section modulus Z and the plastic moment M_p with respect to the major principal axis.

b. Compute the elastic section modulus S and the yield moment M_y with respect to the major principal axis.



$Z = a(A/2)$

$A_{FLANGE} = 7.5\text{in}(1/2\text{in}) = 3.75\ \text{in}^2$

$A_{WEB} = 17\text{in}(3/8\text{in}) = 6.375\ \text{in}^2$

HALF AREA $A_{WEB/2} = 8.5\text{in}(3/8\text{in}) = 3.1875\ \text{in}^2$

* FIND $\bar{y}$

	$A(\text{in}^2)$	y (in)	$Ay\ (\text{in}^3)$
FLANGE	3.75	$8.5" + \frac{1}{2}(1/2\text{in})$ $= 8.75\text{ in}$	32.8125
WEB	3.1875	$8.5"/2$ $= 4.25$	13.5469
	Σ 6.9375		46.3594

$$\bar{y} = \frac{\Sigma yA}{\Sigma A} = \frac{46.3594\ \text{in}^3}{6.9375\ \text{in}^2} = \underline{6.6824\ \text{in}}$$

5.2-1

$$Z = a\left(\frac{A}{2}\right) = \overbrace{2(6.6824\,in)}^{a}\left(6.9375\,in^2\right)$$

$$= \underline{92.7183\,in^3}$$

$$M_p = F_y Z = 50ksi\left(92.7183\,in^3\right) = 4{,}635.92\,in$$

$$= \underline{386.33\,kft}$$

b) COMPUTE I $\Rightarrow I_x = \frac{bh^3}{12}$

COMPONENT	$A(in^2)$	$d(in)$	I_x	$I_x + Ad^2$
FLANGE TOP	3.75	8.75	$\frac{7.5in(1/2in)^3}{12} = 0.0781$	287.1875
FLANGE BOTTOM	3.75	8.75	0.0781	287.1875
WEB	6.375	0	$\frac{3/8in(17in)^3}{12} = 153.5313$	153.5313
	13.875			727.9063

$$S = \frac{I}{c} = \frac{727.9063\,in^4}{8.5'' + 1/2''} = \underline{80.8785\,in^3}$$

$$M_y = F_y S = 50ksi\left(80.8785\,in^3\right) = 4{,}043.92\,kin$$

$$= \underline{336.99\,kft}$$