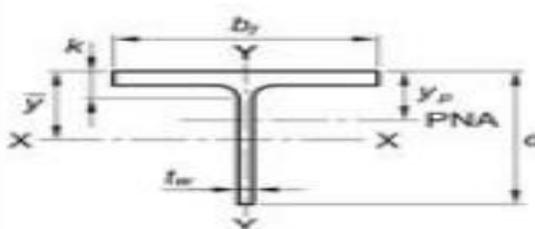


11. Determine the elastic neutral axis, elastic section modulus, plastic neutral axis, and plastic section modulus for a WT5×22.5 modeled as two rectangles forming the flange and the stem. Compare the calculated values to those given in the *Manual*.

WT 5 X 22-S



**Table 1-8 (continued)
WT-Shapes
Dimensions**

Shape	Area, A in. ²	Depth, d in.	Stem			Flange			Distance		Work- able Gage in.			
			Thickness, t _w in.	t _w / 2 in.	Area in. ²	Width, b _f in.	Thickness, t _f in.	k						
								k _{des} in.	k _{det} in.					
→ WT5×22.5	6.63	5.05	5	0.350	3/8	3/16	1.77	8.02	8	0.620	5/8	1.12	15/16	
x19.5	5.73	4.96	5	0.315	5/16	3/16	1.56	7.99	8	0.530	1/2	1.03	13/16	
x16.5	4.85	4.87	4 7/8	0.290	5/16	3/16	1.41	7.96	8	0.435	7/16	0.935	1 1/8	

$b_f = 8.02$
 $t_f = 0.62$
 $d = 5.05$
 $t_w = 0.35$

$A = 6.63 \text{ inch}^2$

Prepared by Eng. Maged Kamel.

WT 5x22.5

Table 1-8 (continued)
WT-Shapes
Properties



Nom- inal Wt. lb/ft	Compact Section Criteria		Axis X-X						Axis Y-Y				Q_s	Torsional Properties	
	$\frac{b_f}{2t_f}$	$\frac{d}{t_w}$	I in. ⁴	S in. ³	r in.	\bar{y} in.	Z in. ³	y_p in.	I in. ⁴	S in. ³	r in.	Z in. ³	$F_y = 50$ ksi	J in. ⁴	C_w in. ⁶
22.5	6.47	14.4	10.2	2.47	1.24	0.907	4.65	0.413	26.7	6.65	2.01	10.1	1.00	0.753	0.981
19.5	7.53	15.7	8.84	2.16	1.24	0.876	3.99	0.359	22.5	5.64	1.98	8.57	1.00	0.487	0.616
16.5	9.15	16.8	7.71	1.93	1.26	0.869	3.48	0.305	18.3	4.60	1.94	7.00	1.00	0.291	0.356

$S_x = 2.47 \text{ inch}^3$
 $Z_x = 4.65 \text{ inch}^3$

11. Determine the elastic neutral axis, elastic section modulus, plastic neutral axis, and plastic section modulus for a WT5×22.5 modeled as two rectangles forming the flange and the stem. Compare the calculated values to those given in the *Manual*.

Solution

WT 5×22.5

Find y_1

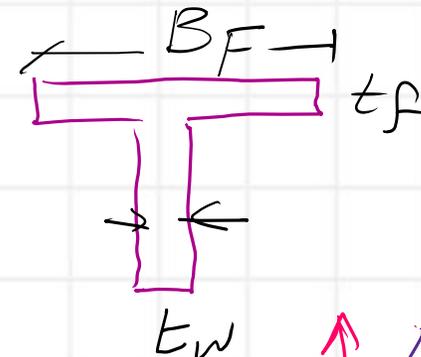


Table 1-8
Pg 1-64

$$B_F = 8.02''$$

$$d = 5.05''$$

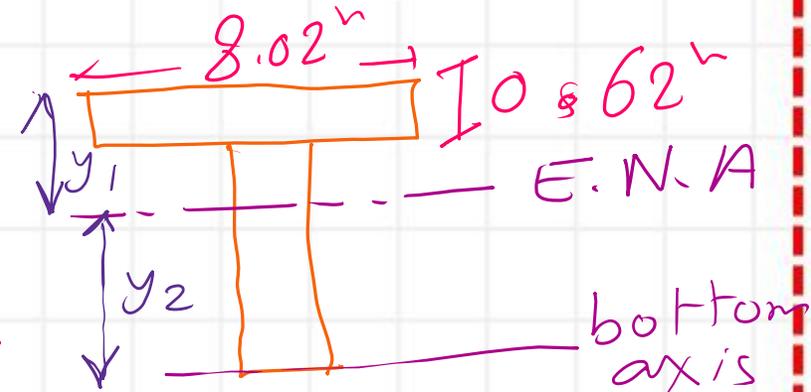
$$A = 6.63 \text{ inch}^2$$

$$t_F = 0.62''$$

$$t_w = 0.35''$$

$$\Sigma A = 8.02(0.62) + (5.05 - 0.62)0.35$$

$$\text{Area} = 6.522 \text{ inch}^2$$



$$\Sigma Ay \Rightarrow 4.972(0.62) + 1.55 \left(\frac{1}{2} (5.05 - 0.62) + 0.62 \right)$$

$$\Sigma Ay = 1.541 + 4.394 = 5.935 \text{ inch}^3$$

$$y_1 = 5.935 / 6.522 = 0.91'' \Rightarrow y_2 = 4.14''$$

Prepared by Eng. Maged Kamel.

11. Determine the elastic neutral axis, elastic section modulus, plastic neutral axis, and plastic section modulus for a WT5×22.5 modeled as two rectangles forming the flange and the stem. Compare the calculated values to those given in the Manual.

WT 5X22.5

$$S_x = \frac{I_x}{\max(y_1, y_2)} \Rightarrow I_x = 8.02 \frac{(0.91)^3}{12} + 4.972(0.6)^2$$

$$I_{x1} = 1.949 \text{ in}^4$$

$$I_{x2} = 0.35 \frac{(4.14)^3}{12} + 1.55 (1.925)^2$$

$$I_{x2} = 8.279 \text{ in}^4$$

$$\Sigma I_x = I_{x1} + I_{x2} = 10.228 \text{ inch}^4$$

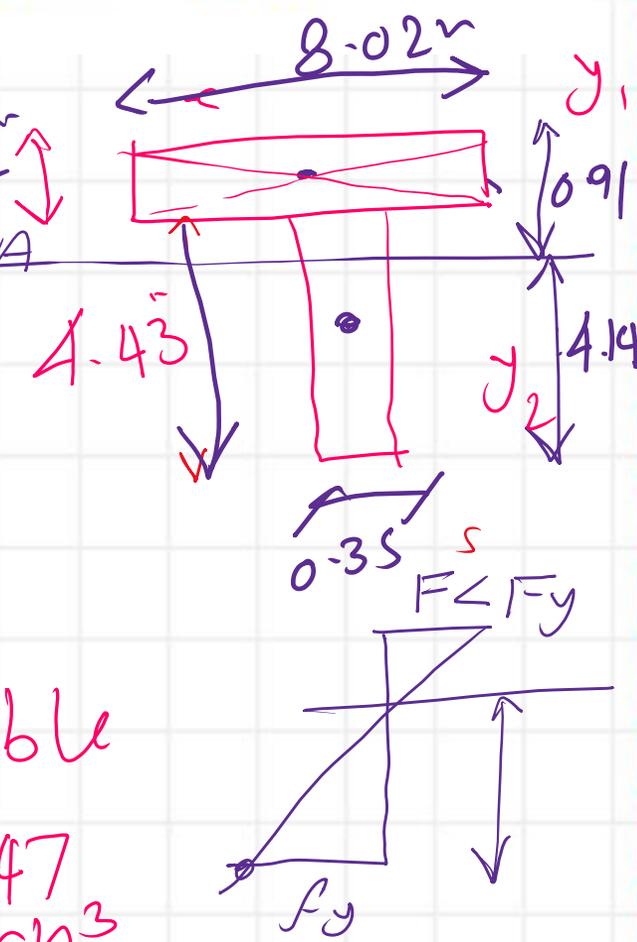
$$S_x = \frac{10.228}{4.14} = 2.47 \text{ inch}^3$$

Larger value

To avoid having $F > F_y$

From Table

$$S_x = 2.47 \text{ inch}^3$$



11. Determine the elastic neutral axis, elastic section modulus, plastic neutral axis, and plastic section modulus for a WT5×22.5 modeled as two rectangles forming the flange and the stem. Compare the calculated values to those given in the *Manual*.

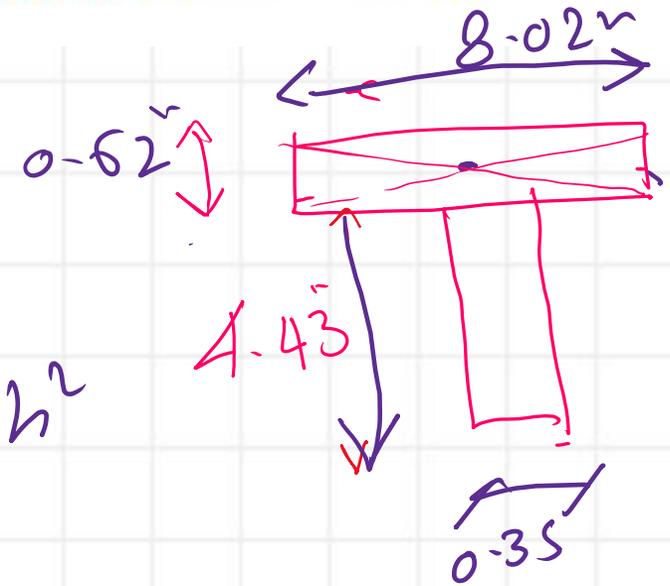
WT 5X22.5

(b) P.N.A divides area into
Two equal parts

$$A = 6.522 \text{ inch}^2 \rightarrow A/2 = 3.261 \text{ inch}^2$$

Check P.N.A Location

$$A_f = 4.972 \text{ inch}^2 > 3.251 \text{ inch}^2 \Rightarrow \text{P.N.A Cuts Flange}^e$$



11. Determine the elastic neutral axis, elastic section modulus, plastic neutral axis, and plastic section modulus for a WT5×22.5 modeled as two rectangles forming the flange and the stem. Compare the calculated values to those given in the *Manual*.

$$A/2 = 3.261 \text{ inch}^2$$

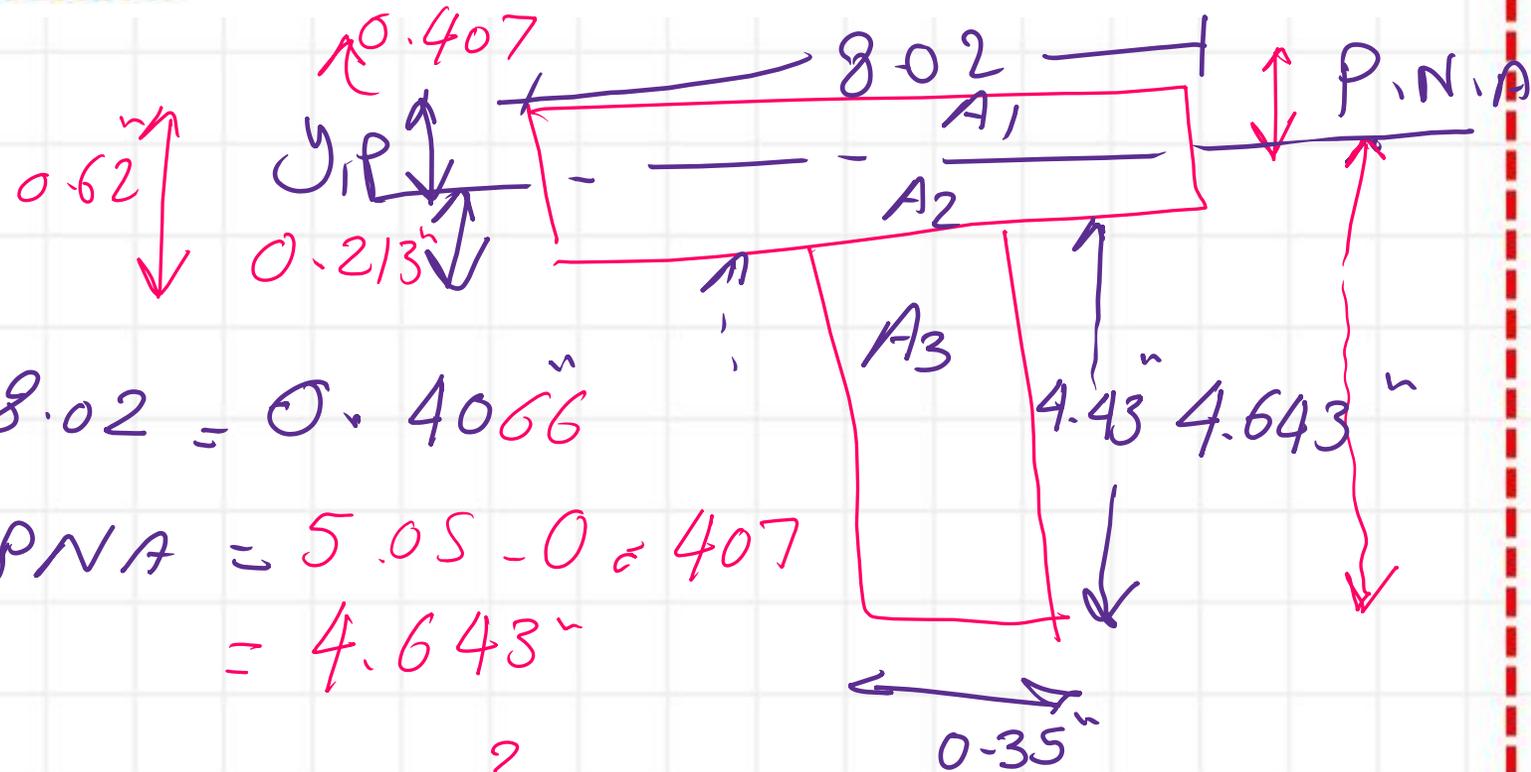
$$y_{1,PNA} = 3.261 / 8.02 = 0.4066$$

$$y_{2,PNA} = d - y_{1,PNA} = 5.05 - 0.407 = 4.643$$

$$Z_x = \sum A y$$

$$= 8.02 \left(\frac{0.407}{2} \right)^2 + 8.02 \left(0.213 \right)^2 \left(\frac{1}{2} \right) +$$

$$+ \underbrace{0.35}_{\text{stem width}} (4.43) (4.643 - 2.215) = 4.615 \text{ inch}^3$$



Prepared by Eng. Maged Kamel.

11. Determine the elastic neutral axis, elastic section modulus, plastic neutral axis, and plastic section modulus for a WT5×22.5 modeled as two rectangles forming the flange and the stem. Compare the calculated values to those given in the *Manual*.

$$Z_x \text{ from Table} = 4.65 \text{ inch}^3$$

$$Z_x \text{ from Calculations} = 4.615 \text{ inch}^3$$

Prepared by Eng.Maged Kamel.