

ENCE 355 – Introduction to Structural Design
SOLUTIONS to Homework Set No. 13
Fall 2002

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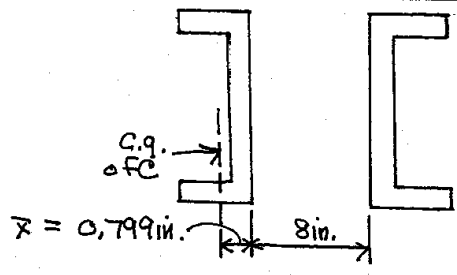
PROB # 6-22 (1)

Assume $\frac{KL}{r} = 50$

$$\phi_c F_{cr} = 35.40 \text{ ksi}$$

$$A_{\text{Reqd}} = \frac{925}{35.40} = 26.13 \text{ in}^2 \text{ or } 13.065 \text{ in}^2 \text{ per C}$$

Try 2 Cs 15 X 50 [For each channel $A = 14.7 \text{ in}^2$,
 $\bar{x} = 0.799 \text{ in.}$, $I_x = 404 \text{ in}^4$, $I_y = 11.0 \text{ in}^4$, $r_y = 0.865 \text{ in.}$]



$$I_x = (2)(404) = 808 \text{ in}^4$$

$$I_y = (2)(11) + (2)(14.7)(4.799)^2 = 699.1 \text{ in}^4$$

$$r_y = \sqrt{\frac{699.1}{(2)(14.7)}} = 4.88 \text{ in.}$$

$$\left(\frac{KL}{r}\right)_y = \frac{(1)(12 \times 24)}{4.88} = 59.02$$

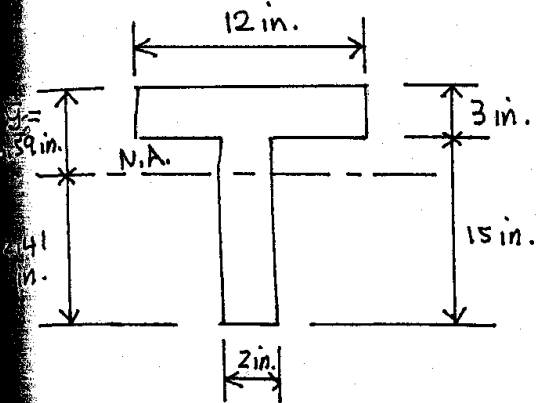
$$\phi_c F_{cr} = 32.95 \text{ ksi}$$

$$\phi_c P_n = (32.95)(2)(14.7) = 968.7 \text{ k} > 925 \text{ k} \quad \underline{\text{OK}}$$

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PROB #8-2

Elastic calculations



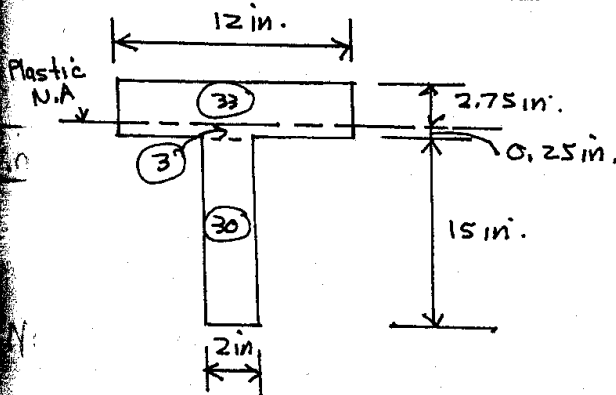
$$A = (12)(3) + (15)(2) = 66 \text{ in.}^2$$

$$\bar{y} = \frac{(36)(1.5) + (30)(10.5)}{66} = 5.59 \text{ in.}$$

$$I_x = \left(\frac{1}{3}\right)(12)(5.59)^3 - \left(\frac{1}{3}\right)(10)(2.59)^3 + \left(\frac{1}{3}\right)(2)(12.41)^3 = 1914.96 \text{ in.}^4$$

$$S_x = \frac{1914.96}{12.41} = \boxed{154.31 \text{ in.}^3}$$

Plastic calculations



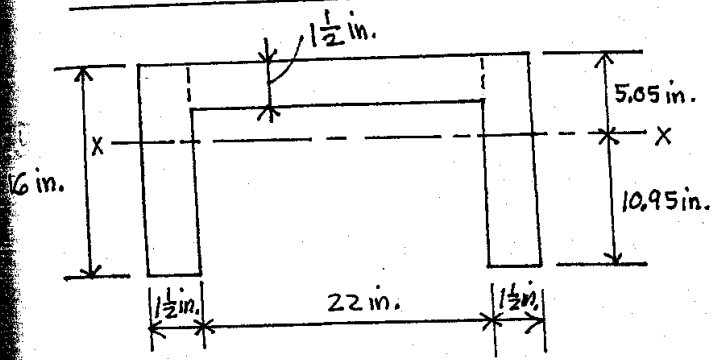
$$Z_x = (33)\left(\frac{2.75}{2}\right) + (3)\left(\frac{0.25}{2}\right) + (30)\left(0.25 + \frac{15}{2}\right) = \boxed{278.2 \text{ in.}^3}$$

$$\text{Shape factor} = \frac{278.2}{154.31} = \boxed{1.80}$$

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PROB # 8-4

Elastic calculations



$$A = (2)(16)(1.5) + (22)(1.5)$$

$$= 81 \text{ in.}^2$$

$$\bar{y} = \frac{(2)(16)(1.5)(8) + (22)(1.5)(9.75)}{81}$$

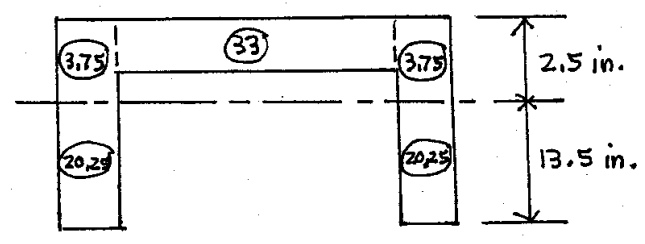
$$= 5.05 \text{ in.}$$

$$I_x = (2)\left(\frac{1}{3}\right)(1.5)(5.05^3 + 10.95^3) + \left(\frac{1}{3}\right)(22)(5.05^3 - 3.55^3)$$

$$= 2058 \text{ in.}^4$$

$$S_x = \frac{2058}{10.95} = \boxed{187.95 \text{ in.}^3}$$

Plastic analysis



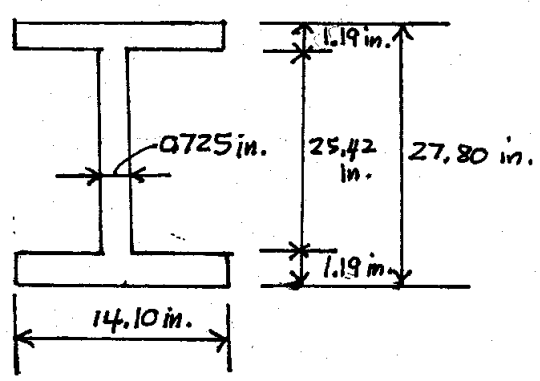
$$Z_x = (2)(20.25)\left(\frac{13.5}{2}\right) + (2)(3.75)\left(\frac{2.5}{2}\right) + (33)(1.75) = \boxed{340.5 \text{ in.}^3}$$

$$\text{Shape Factor} = \frac{340.5}{187.95} = \boxed{1.81}$$

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PROB # 8-11

Using a W27X178



Elastic calculations

$$I_x = \left(\frac{1}{12}\right)(14.10)(27.80)^3 - \left(\frac{1}{12}\right)(14.10 - 0.725)(25.42)^3 = 6937 \text{ in.}^4$$

(Manual $I_x = 7020 \text{ in.}^4$)

$$S_x = \frac{6937}{13.90} = \boxed{499 \text{ in.}^3} \quad (\text{Manual gives } 505 \text{ in.}^3)$$

Plastic calculations

$$Z_x = (2)(14.10)(13.90)\left(\frac{13.90}{2}\right) - (2)(14.10 - 0.725)(12.71)\left(\frac{12.71}{2}\right)$$

$$= \boxed{563.6 \text{ in.}^3} \quad (\text{Manual gives } 570 \text{ in.}^3)$$

$$\text{Shape factor} = \frac{563.6}{499} = \boxed{1.13}$$

(Using Manual values = $\frac{570}{505} = 1.13$)

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