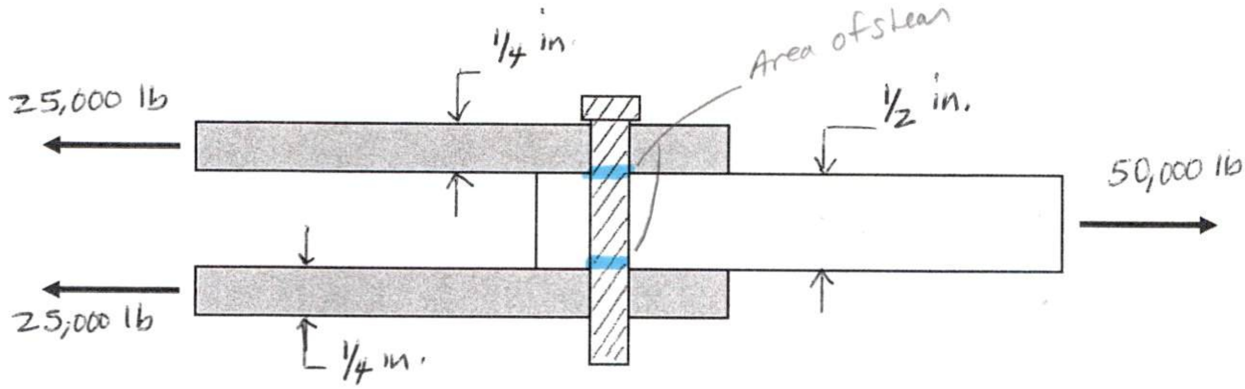
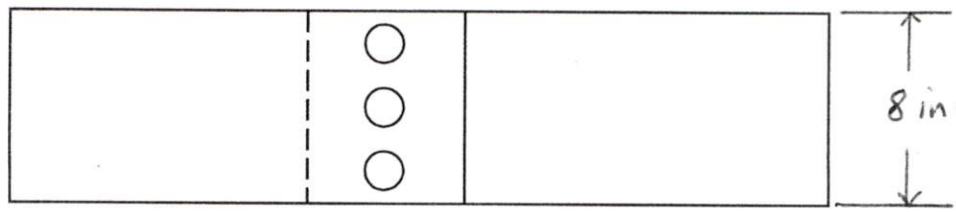
CMGT350	Exam #2	Fall 2021

One page of notes, front and back handwritten by you. Handout of Tables. Algebra and Trig Cheat Sheets
SHOW ALL WORK FOR FULL CREDIT

Name Solution

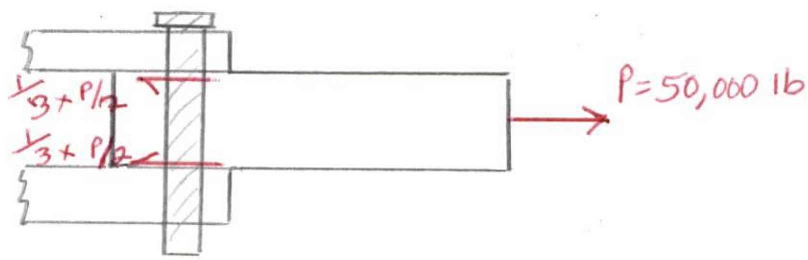
1. The lap joint shown below is subjected to a tension force of 50,000 lb. The bolts are ¾ in diameter. Calculate the shear stress developed by the bolts and the tension stress developed by the inside and outside plates.





Solution.

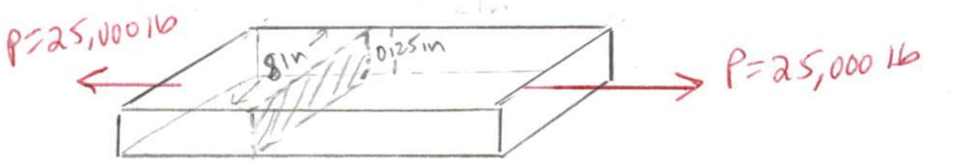
Bolts are in Double-Shear
∴ Two Areas of shear for each bolt.
There are 3 bolts



$$\tau = \frac{P}{A} = \frac{\frac{P}{6}}{\frac{\pi \cdot d^2}{4}} = \frac{\frac{50{,}000\ \text{lb}}{6}}{\frac{\pi (0.75\text{in})^2}{4}} = 18{,}863\ \text{psi}$$

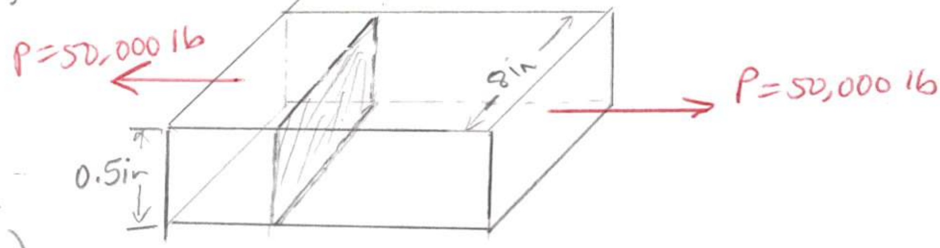
Normal Stress

Outside Plate



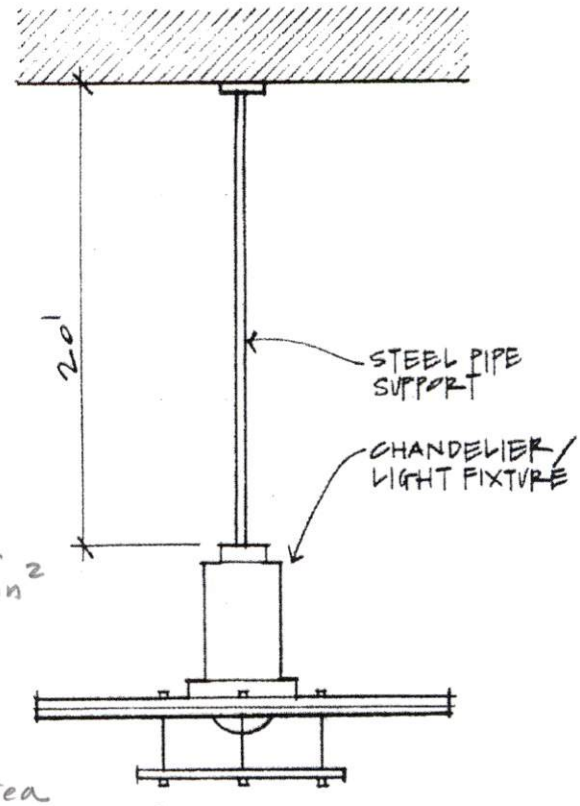
$$\sigma = \frac{P}{A} = \frac{25{,}000\ \text{lb}}{8\text{in}\,(0.125\text{in})} = 12{,}500\ \text{psi}$$

INSIDE Plate



$$\sigma = \frac{P}{A} = \frac{50{,}000\ \text{lb}}{8\text{in}\,(0.5\text{in})} = 12{,}500\ \text{psi}$$

2. A Heavy Chandelier weighing 4500 lb is suspended from the ceiling of a theater lobby. The steel pipe from which it hangs is 20 feet long.
   (a) Determine the nominal diameter of the pipe necessary to carry the chandelier safely. Use A-36 steel and a Factor of Safety = 2.5. Select pipe from Table A-5(a).
   (b) Determine the resulting elongation of the pipe.



Solution.

(a) Table A-7(a)

A-36 Steel

$\sigma_y = 36$ ksi

$$\sigma_{allow} = \frac{\sigma_y}{F.S.} = \frac{36 \text{ ksi}}{2.5} = 14.4 \text{ ksi}$$

$$\sigma = \frac{P}{A} \Rightarrow A = \frac{P}{\sigma} = \frac{4500 \text{ lb}}{14{,}400 \text{ lb/in}^2} = 0.3125 \text{ in}^2$$

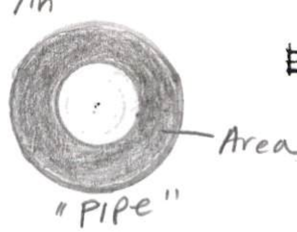


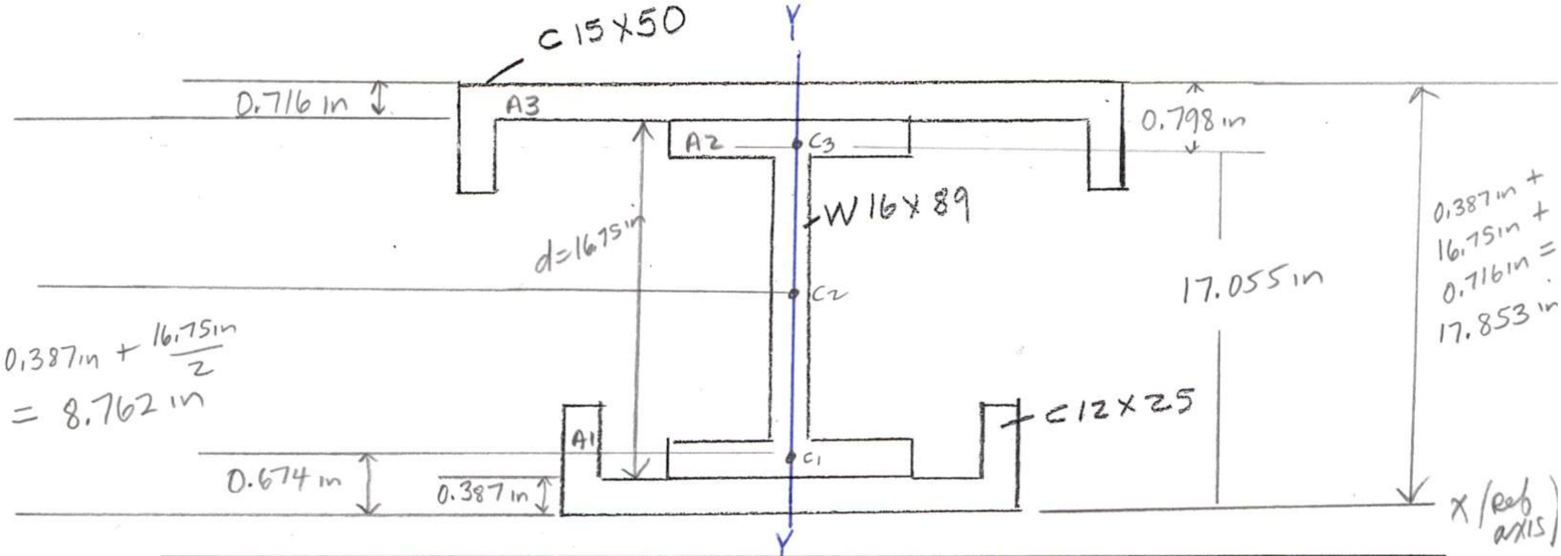
Table A-5(a)

3/4" $\quad A = 0.333 \text{ in}^2$

$0.3125 \text{ in}^2 < 0.333 \text{ in}^2 \Rightarrow$ Use, 3/4 in. Steel pipe

(b) $$\delta = \frac{PL}{AE} = \frac{4500 \text{ lb}\,(20 \text{ ft})(12 \text{ in/ft})}{(0.333 \text{ in}^2)\; 30{,}000{,}000 \text{ lb/in}^2} = 0.108 \text{ in.}$$

3. Determine the moment of inertia about the centroidal x- and the centroidal y-axes for the shape shown.



Shape	A (in²)	y (in)	Ay (in³)	($\bar{y}$-y) (in)	A ($\bar{y}$-y)² (in⁴)	I (in⁴)
C12X25	7.35	0.674	4.9539	9.426	653.044	4.47
W16X89	26.2	8.762	229.5644	1.338	46.904	1300
C15X50	14.7	17.055	250.7085	-6.955	711.069	11.0
	48.25		485.2268		1411	1315.5

$$\bar{y} = \frac{\Sigma Ay}{\Sigma A} = \frac{485.2268 \text{ in}^3}{48.25 \text{ in}^2} = 10.1 \text{ in.}$$

$$\bar{I}_x = \Sigma\left[I + A(\bar{y}-y)^2\right] = 1316 \text{ in}^4 + 1411 \text{ in}^4 = \underline{\underline{2727 \text{ in}^4}}$$

$$\bar{I}_y = 144 \text{ in.}^4 + 163 \text{ in.}^4 + 404 \text{ in}^4 = \underline{\underline{711 \text{ in}^4}}$$

4. A circular steel bar carries a tension load of 35,000 lb. If the allowable stress level is set to 60% of the yield stress, determine the diameter of the bar necessary to carry the load to the nearest ¼ inch. The yield stress of the steel is 50 ksi.

$\sigma_y = 50 \text{ ksi}$

$\sigma_{allow} = 0.6 \times 50 \text{ ksi} = 30 \text{ ksi}$

$$\sigma = \frac{P}{A} \Rightarrow A = \frac{P}{\sigma} = \frac{35{,}000 \text{ lb}}{30{,}000 \text{ lb/in}^2} = 1.167 \text{ in}^2$$

$$A = \frac{\pi d^2}{4} \quad \text{(circular bar)}$$

$$\frac{\pi d^2}{4} = 1.167 \text{ in}^2$$

$$d = \sqrt{\frac{4(1.167 \text{ in}^2)}{\pi}} = 1.219 \text{ in.}$$

$0.219 \times 4 = 0.875$

use, $\underline{d = 1\tfrac{1}{4} \text{ in.}}$