CMGT 350	Exam #2	Fall 2020

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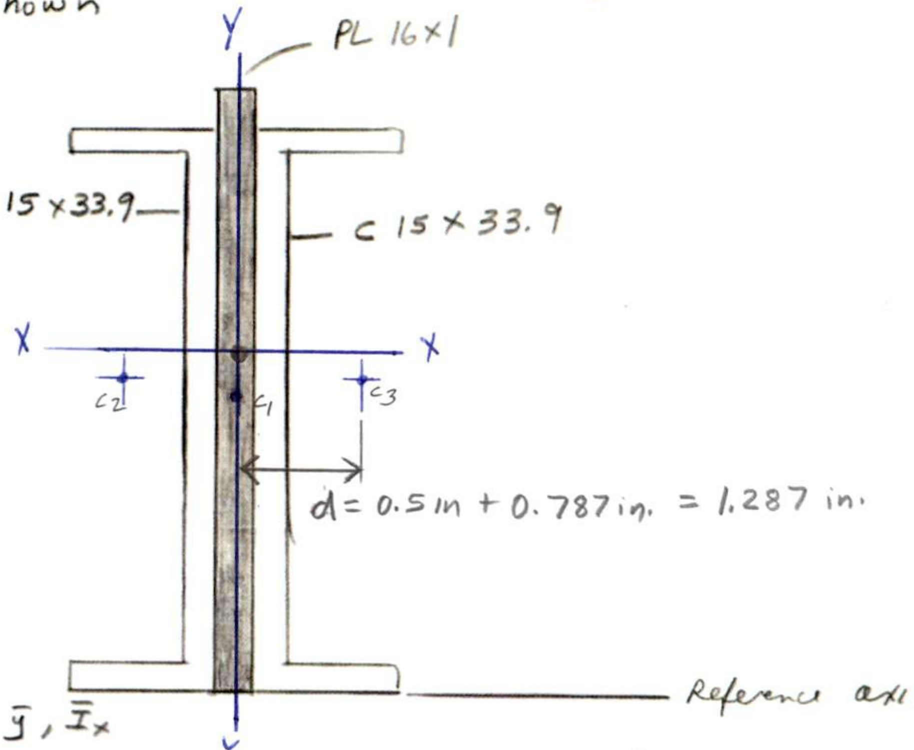
Practice Exam

Solutions

calculate the moment of Inertia about the centroidal x- and the centroidal y-axes for the shape shown



solution. Find $\bar{y}$, $\bar{I}_x$

Part	Area (in.^{2})	y (in.)	Ay (in.^{3})	$\bar{y}$-y (in.)	A$(\bar{y}-y)^2$ in.^{4}	I_x total
PL 16×1	16	8	128	−0.28	1.25	341.33
C15×33.9	9.96	7.5	74.7	0.22	0.48	315
C15×33.9	9.96	7.5	74.7	0.22	0.48	315
Σ	35.92		277.4		2.22	971.33

$$\bar{y} = \frac{\Sigma Ay}{\Sigma A} = \frac{277.4 \text{ in.}^3}{35.92 \text{ in.}^2} = 7.72 \text{ in.}$$

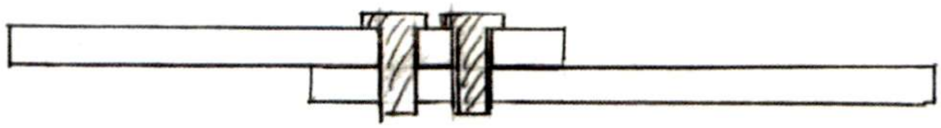
$$\bar{I}_x = \Sigma\left[I + A(\bar{y}-y)^2\right] = 971.33 \text{ in.}^4 + 2.22 \text{ in.}^4 = 973.55 \text{ in.}^4$$

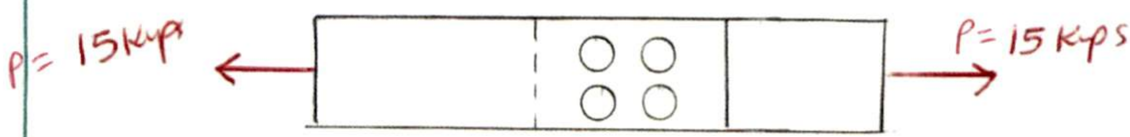
Find $\bar{I}_y$ (Parallel-axis Theorem)

Part	Area (in.^{2})	d (in.)	Ad^2	I_y total
PL 16×1	16	0	0	1.33
C 15×33.9	9.96	1.287	16.5	8.13
C15×33.9	9.96	1.287	16.5	8.13
		Total	33	17.59

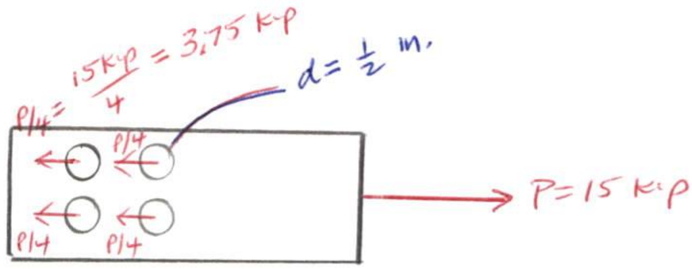
$$\bar{I}_y = \Sigma\left[Ad^2 + I_y\right]$$
$$= 33 \text{ in.}^4 + 17.59 \text{ in.}^4$$
$$= 50.59 \text{ in.}^4$$

The plates shown are subjected to an applied load of 15 kips. The connection is made using four $\frac{1}{2}$ in. diameter bolts. Calculate the shear stress that must be developed in the bolts to keep the connection intact.





Solution.

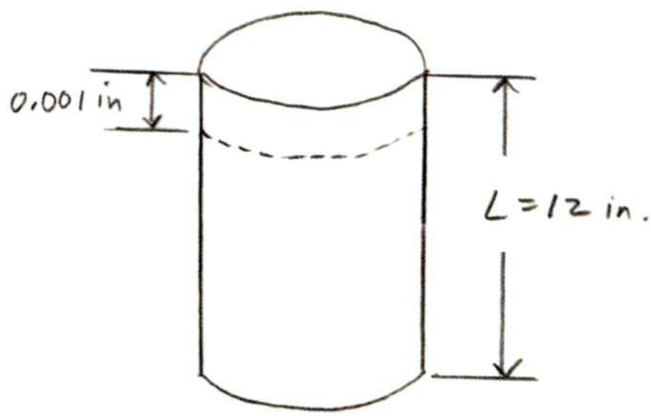


FBD

$$\tau = \frac{P}{A} = \frac{3.75\text{ kip}}{\frac{\pi (0.5\text{in})^2}{4}}$$

$$= \underline{\underline{19.1 \text{ ksi}}}$$

Determine the axial compressive load that would cause a 6in. x 12 in. (6 in. diameter and 12 in. length) medium strength concrete cylinder to deform 0.001 in.



Solution.

$$A = \frac{\pi (6\text{in.})^2}{4} = 28.27 \text{ in.}^2$$

$L = 12$ in.

$\delta = 0.001$ in.

$E = 3.6 \times 10^3$ ksi (Table A-7(a))

$$\epsilon = \frac{\delta}{L} = \frac{0.001 \text{ in.}}{12 \text{ in.}} = 0.00008333$$

$$E = \frac{\sigma}{\epsilon}$$

$$\sigma = \epsilon E = 0.00008333 (3.6 \times 10^3 \text{ ksi})$$

$$= 0.29998 \text{ ksi} \times \frac{1000 \text{ psi}}{\text{ksi}}$$

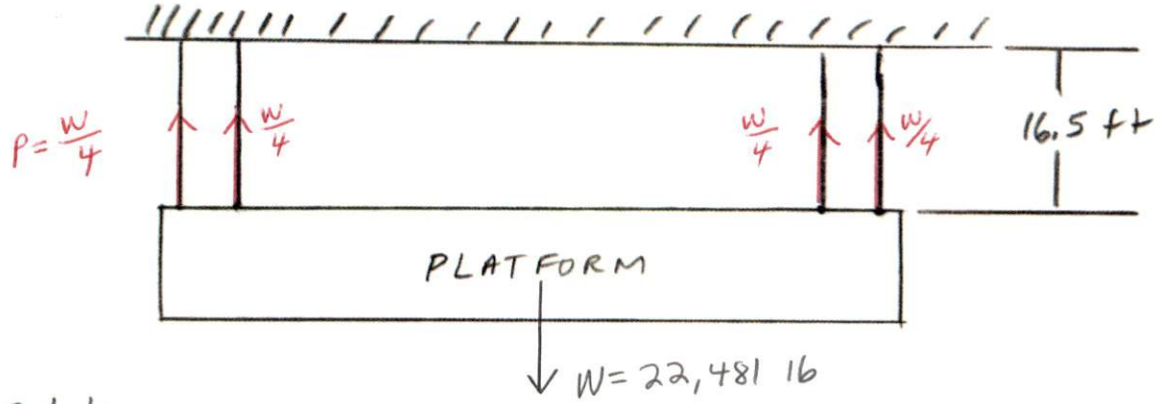
$$= 300 \text{ psi}$$

$$\sigma = \frac{P}{A} \Rightarrow P = \sigma A$$

$$= 300 \text{psi} (28.27 \text{ in.}^2)$$

$$= \underline{\underline{8481}} \text{ lb}$$

A platform weighs 22,481 lb and is supported by four circular steel cables with an equal amount of load being carried by each. Determine the minimum diameter of the cables, such that the deformation does not exceed 0.3937 in. The cables are 16.5 ft long. $E_{steel} = 30 \times 10^3$ ksi
(Find d to the nearest sixteenth of an inch)



Solution.

$L = 16.5$ ft

$\delta = 0.3937$ in.

$P = \frac{22,481 \text{ lb}}{4} = 5620.25$ lb (per cable)

$E = 30 \times 10^3$ ksi

$$\delta = \frac{PL}{AE}$$

$$A = \frac{PL}{\delta E} = \frac{5620.25 \text{ lb}\,(16.5 \text{ ft})}{\left(0.3937 \text{ in.} \times \frac{1 \text{ ft}}{12 \text{ in}}\right)\left(30\,000 \text{ ksi} \times \frac{1000 \text{ psi}}{\text{ksi}}\right)}$$

$$= 0.0942 \text{ in.}^2$$

$$\frac{\pi d^2}{4} = 0.0942 \text{ in.}^2$$

$$d = \sqrt{\frac{4(0.0942 \text{ in.}^2)}{\pi}} = 0.3464 \text{ in}$$

use $\underline{d = 6/16 \text{ in.}} = 0.375$ in