

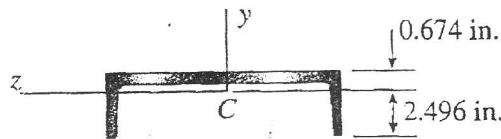
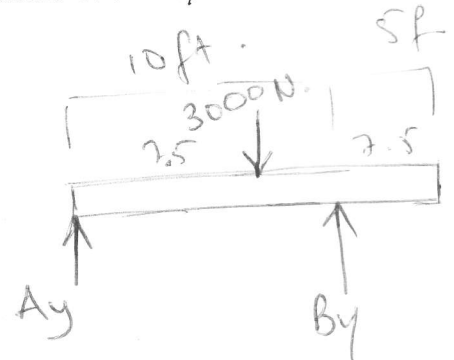
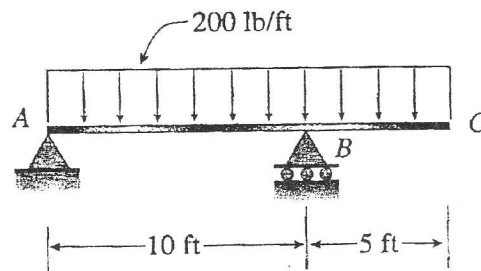
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Name: ~~XXXXXXXXXX~~

MEN 102
Exam 2
Spring 2007

1) (20 pts) A beam ABC with an overhang from B to C , supports a uniform load of 200 lb/ft throughout its length. The beam has a channel cross section whose centroid is located at C as shown in the figure. The moment of inertia about the neutral axis (the z -axis) is equal to 5.14 in^4 . Calculate the maximum tensile stress σ_t and maximum compressive stress σ_c due to the uniform load.



$\oplus \sum M_A = 0$

$B_y(10) - 3000(7.5) = 0$

$B_y = 2250 \text{ lb}$

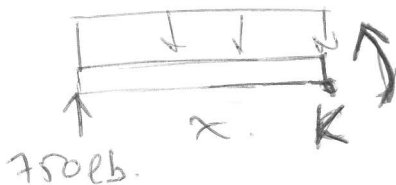
$\sum F_y = 0$

$A_y - 3000 + 2250 = 0$

$A_y = 750 \text{ lb}$

$0 \leq x < 10$

①

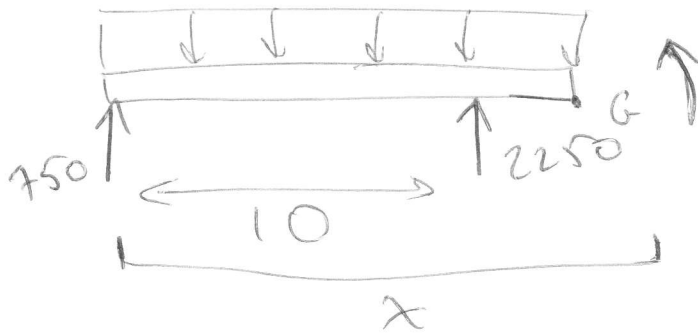


$\sum M_K = 0 \Rightarrow M_1 + (200)(x)\left(\frac{x}{2}\right) - 750\left(\frac{x}{2}\right) = 0$

$M_1 = -100x^2 + 375x$

② $10 \leq x < 15$

②



$$\sum MG = 0.$$

$$M_2 - 2250(x-10) - 750(x) + 200(x)\left(\frac{x}{2}\right)$$

$$M_2 = -100x^2 + 3000x - 22500$$

$$\frac{dM_1}{dx} = 0.$$

$$-200x + 375 = 0$$

$$x = 1.875 \text{ ft.}$$

$$M_1 = 351.56 \text{ lb.ft.} \left(\left(\frac{29.29 \text{ lb}}{\text{ft}} \right) \right)$$

$$\frac{dM_2}{dx} = 0.$$

$$= 4218.72 \text{ lb/in}$$

$$-200x + 3000 = 0$$

$$x = 15. \quad M_2 = 0.$$

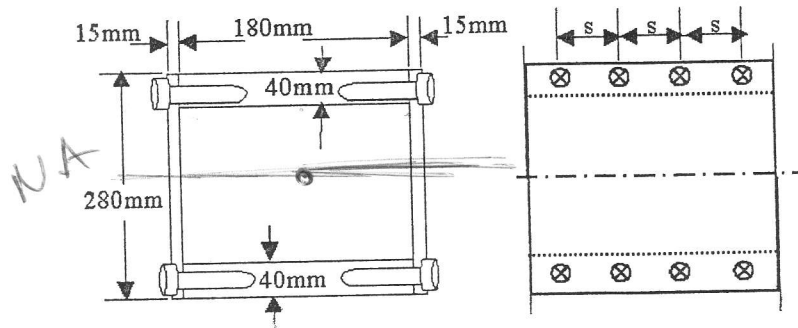
$$\sigma_{c \text{ max}} = \frac{M c}{I} = \frac{351.56}{5.4}$$

$$= \frac{(4218.72)(0.674)}{5.4}$$

$$5.4$$

$$= 553.2 \text{ lb/in}^2. \quad X$$

- 2) (20 pts) A wood box beam is constructed of two boards (each $40\text{ mm} \times 180\text{ mm}$ in cross section) that serve as flanges and two webs of plywood, each 15 mm thick. The total height of the beam is 280 mm . The plywood is fastened to the flanges by screws having an allowable load in shear of $F = 1100\text{ N}$ per screw. If the shear force V acting on the cross section is 10.5 kN , find the maximum permissible longitudinal spacing s of the screws.



$$q = \frac{QV}{I}$$

$$I = I_{\text{out}} - I_{\text{in}}$$

$$= \frac{1}{12} (b)(h)^3 - \frac{1}{12} (b)(h)^2$$

$$= \frac{1}{12} (210 \times 10^{-3})(280 \times 10^{-3})^3 - \frac{1}{12} (180 \times 10^{-3})(200 \times 10^{-3})^2$$

$$= 3.8416 \times 10^{-4} - 1.2 \times 10^{-4}$$

$$= 2.6416 \times 10^{-4} \text{ m}^4$$

$$Q = \bar{y}' A'$$

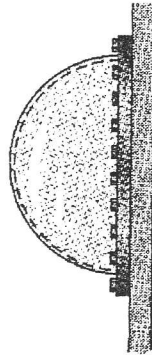
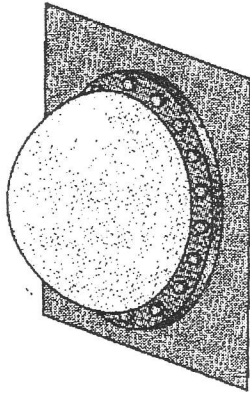
$$= (160 \times 10^{-3})(40 \times 10^{-3} \times 180 \times 10^{-3})$$

$$= 1.152 \times 10^{-3} \text{ m} \cdot \text{m}^2$$

$$q = \frac{2F}{s} = \frac{QV}{I} = ?$$

$$s = \frac{1100}{44,482.1} = 0.02473 \text{ m}$$

- 3) (10 pts) A hemispherical window (or viewport) in a decompression chamber is subjected to an internal air pressure of 90 psi. The port is attached to the wall of the chamber by 18 bolts. Find the tensile force F in each bolt and the tensile stress σ in the viewport if the radius of the hemisphere is 15 in and its thickness is 1.0 in.



$$P_{air} = 90 \text{ psi}$$

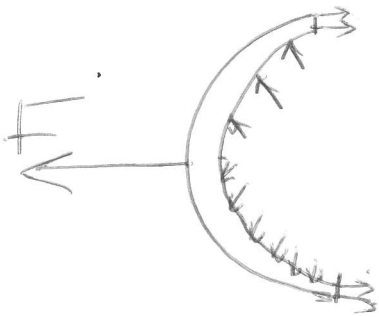
$$r = 15 \text{ in.}$$

$$t = 1.0 \text{ in.}$$

$$P_{air} = \frac{F}{A}$$

$$\sigma_{long} = \frac{Pr}{2t} \leftarrow \text{show values.}$$

$$= 675 \text{ lb/ft}^2 \text{ OK}$$



$$F = P \cdot A \checkmark$$

$$= (\pi r^2)(90) \checkmark$$

$$= 63585 \text{ lb.} \leftarrow \text{show values}$$

$$\text{Force/bolt} = \frac{F}{18} = 3532.5 \frac{\text{lb.}}{\text{bolt}}$$