Problem 522

A box beam is composed of four planks, each 2 inches by 8 inches, securely spiked together to form the section shown in Fig. P-522. Show that I_{NA} = 981.3 in^4. If w_o = 300 lb/ft, find P to cause a maximum flexural stress of 1400 psi.

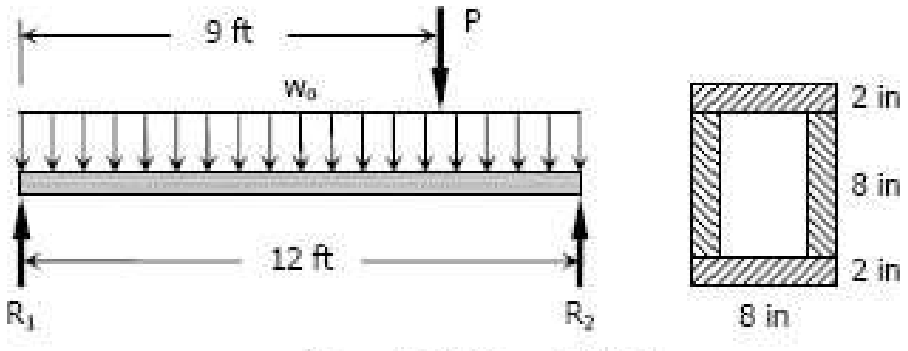
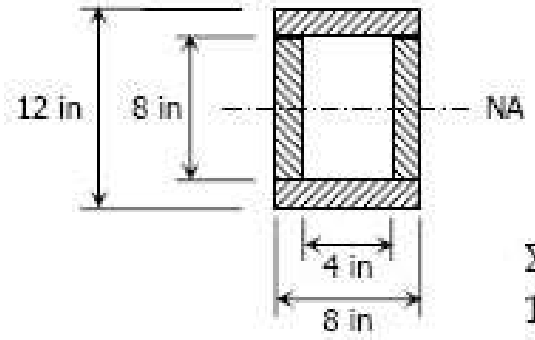


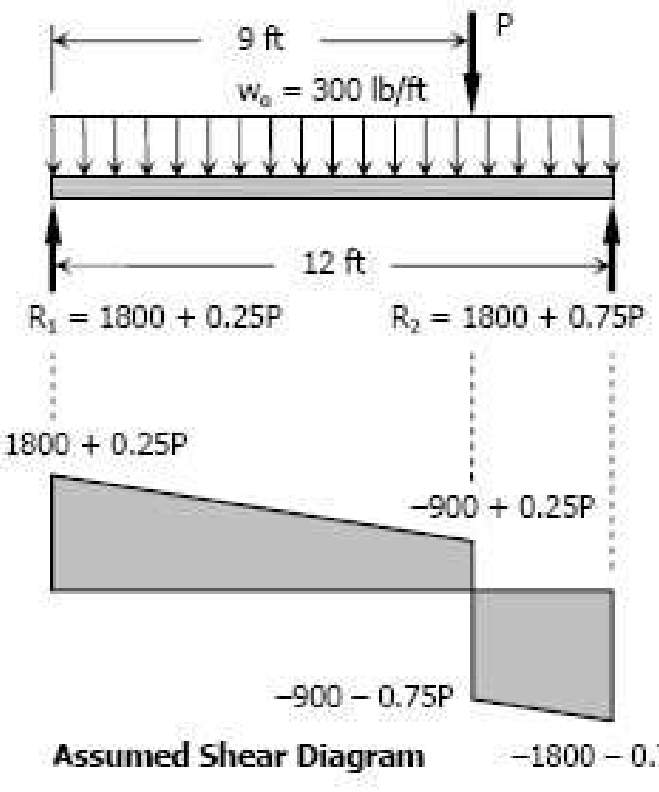
Figure P-522 and P-523

Solution 522



$$I_{NA} = \frac{8(12^3)}{12} - \frac{4(8^3)}{12}$$

$$I_{NA} = 981.33 \text{ in}^4$$



Assumed Shear Diagram

$$\Sigma M_{R2} = 0$$
$$12R_1 = 300(12)(6) + 3P$$
$$R_1 = 1800 + 0.25P$$

$$\Sigma M_{R1} = 0$$
$$12R_2 = 300(12)(6) + 9P$$
$$R_2 = 1800 + 0.75P$$

$$M = \tfrac{1}{2}[(1800 + 0.25P) + (-900 + 0.25P)](9)$$
$$M = 4050 + 2.25P \text{ lb-ft}$$

$$(f_b)_{max} = \frac{Mc}{I}$$

$$1400 = \frac{(4050 + 2.25P)(6)(12)}{981.33}$$

$$P = 6680.63 \text{ lb}$$

Check if the shear at P is positive as assumed

$$-900 + 0.25P = -900 + 0.25(6680.63)$$
$$= 770.16 \text{ lb} \quad (ok!)$$

Thus, P = 6680.63 lb

Problem 523

Solve Prob. 522 if w_o = 600 lb/ft.