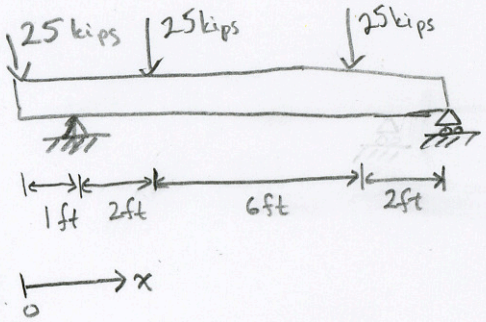
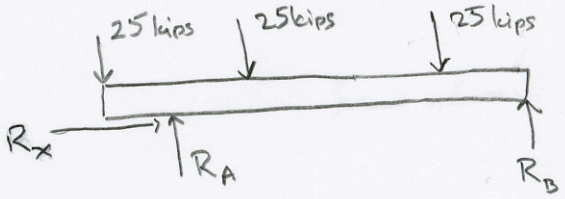
12.19 |

(i) Draw shear and bending-moment diagrams for the beam below.



FBD



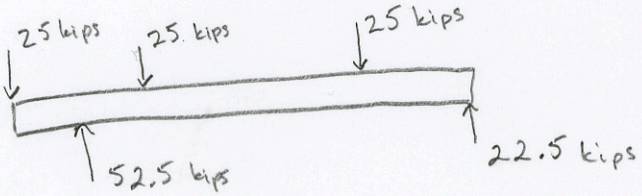
$\Sigma F_x = 0 \Rightarrow R_x = 0$

$\Sigma M_{/B} = 0 \Rightarrow R_A = \frac{1}{10\,ft}\left[25\,kips(2\,ft) + 25\,kips(8\,ft) + 25\,kips(11\,ft)\right]$

$R_A = 52.5$ kips

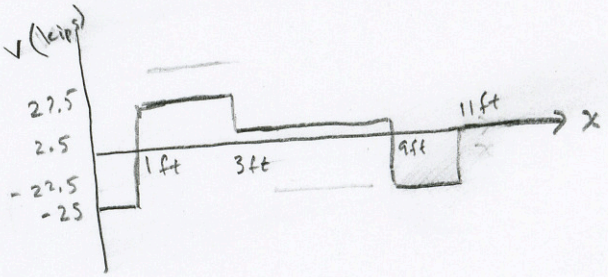
$\Sigma F_y = 0 \Rightarrow R_A + R_B = 75$ kips

$R_B = 22.5$ kips



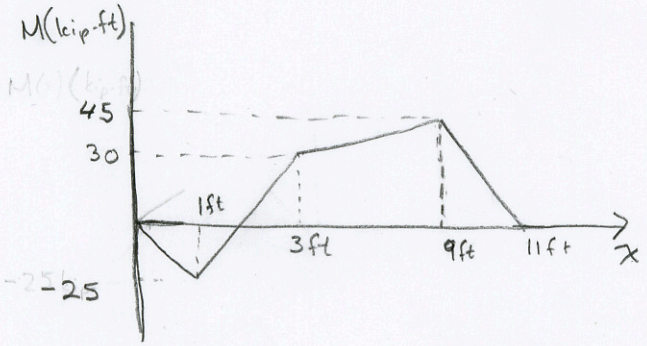
$w(x) = 25\,kips\langle x\rangle^{-1} - 52.5\,kips\langle x-1\,ft\rangle^{-1} + 25\,kips\langle x-3\,ft\rangle^{-1} + 25\,kips\langle x-9\,ft\rangle^{-1} - 22.5\,kips\langle x-11\,ft\rangle^{-1}$

$v(x) = -\int w(x)\,dx = -25\,kips\langle x\rangle^{0} + 52.5\,kips\langle x-1\,ft\rangle^{0} - 25\,kips\langle x-3\,ft\rangle^{0} - 25\,kips\langle x-9\,ft\rangle^{0} + 22.5\,kips\langle x-11\,ft\rangle^{0}$



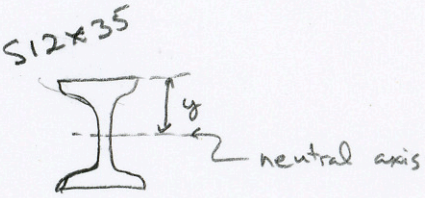
12.19 cont'd

$$M(x) = \int V(x)\,dx = -25\ \text{kips}\langle x\rangle^1 + 52.5\ \text{kips}\langle x-1\text{ft}\rangle^1 - 25\ \text{kips}\langle x-3\text{ft}\rangle^1 - 25\ \text{kips}\langle x-9\text{ft}\rangle^1 + 22.5\ \text{kips}\langle x-11\text{ft}\rangle^1$$



(ii) What is the maximum normal stress

$$|M|_{max} = 45\ \text{kip}\cdot\text{ft}$$



$$\sigma_{max} = \frac{|M|_{max}\, y}{I}$$

$$y = \frac{12\ \text{in}}{2}$$

$$I = 228\ \text{in}^4$$

} → From Appendix B

$$\sigma_{max} = \frac{45\ \text{kip}\cdot\text{ft}\cdot\left(\frac{\text{ft}}{12\ \text{in}}\right)\cdot 6\ \text{in}}{228\ \text{in}^4}$$

$$\boxed{\sigma_{max} = 14.2\ \text{ksi}}$$