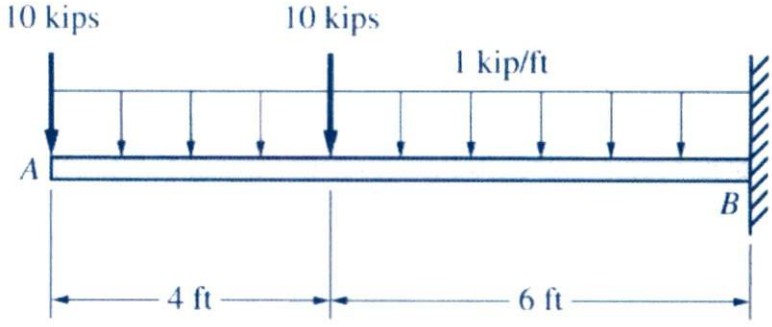
15-6

For each of the beams subjected to the loadings shown, the weight of the beam is already included in the uniform load. Select the lightest wide-flange steel shape using A36 steel. Assume that the beam is supported laterally for its entire length.

Solution.



Step 1.

$w = 1\ \text{kip/ft}$

$P = 10\ \text{kips}$

$L = 10\ \text{ft}$

$a = 6\ \text{ft}$

A36 steel

$\sigma_{allow} = 24\ \text{ksi}$

$\tau_{allow} = 14.5\ \text{ksi}$

Step 2. Table 13-1, case 5 and case 6

$$V_{MAX} = P + P + wa = 10\ \text{kips} + 10\ \text{kips} + 1.0\ \text{kip/ft}\,(10\ \text{ft}) = 30\ \text{kips}$$

$$M_{MAX} = PL + Pa + \frac{wa^2}{2} = 10(10) + 10(6) + \frac{1(10)^2}{2} = 210\ \text{kip.ft} = 2520\ \text{kip.in}$$

Step 3.

$$S_{req} = \frac{M_{MAX}}{\sigma_{allow}} = \frac{2520\ \text{kip.in}}{24\ \text{ksi}} = 105\ \text{in}^3$$

Step 4. Table A-1(a)

W 21 x 62	$S = 127\ \text{in}^3$
W 18 x 60	$S = 108\ \text{in}^3$ (Lightest)
W 16 x 89	$S = 155\ \text{in}^3$
W 14 x 74	$S = 112\ \text{in}^3$

Select W 18 x 60

$d = 18.24\ \text{in}$

$t_w = 0.415\ \text{in}$

Step 5.

$$\tau_{avg} = \frac{V_{MAX}}{d\,t_w} = \frac{30\ \text{kips}}{18.24\ \text{in}\,(0.415\ \text{in})} = 3.96\ \text{ksi} < \tau_{allow} = 14.5\ \text{ksi}$$ ✓

Use, W 18 x 60