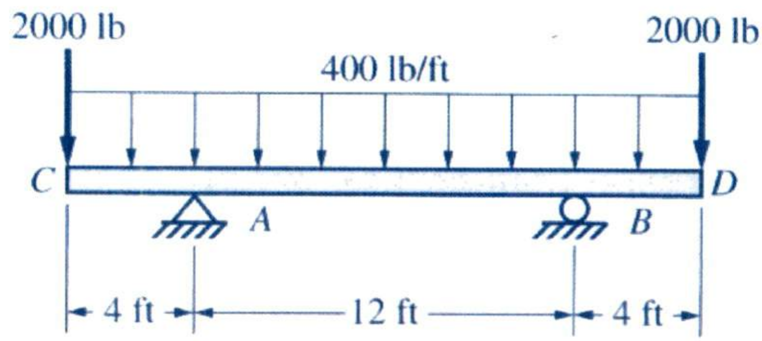
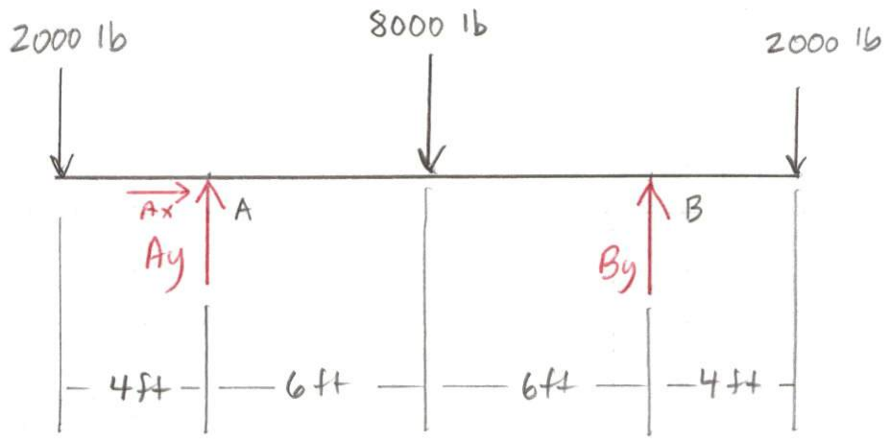
15-18

Select the lightest, rectangular Southern pine section for the overhanging beam subjected to the loading shown in Fig. P15-18. The weight of the beam is already included in the uniform load.

Solution.



Solve for the reactions at the supports A and B. Draw the V & M diagrams



FBD - Entire Beam

Equilibrium Equations

$[\Sigma F_x = 0]$ $A_x = 0$

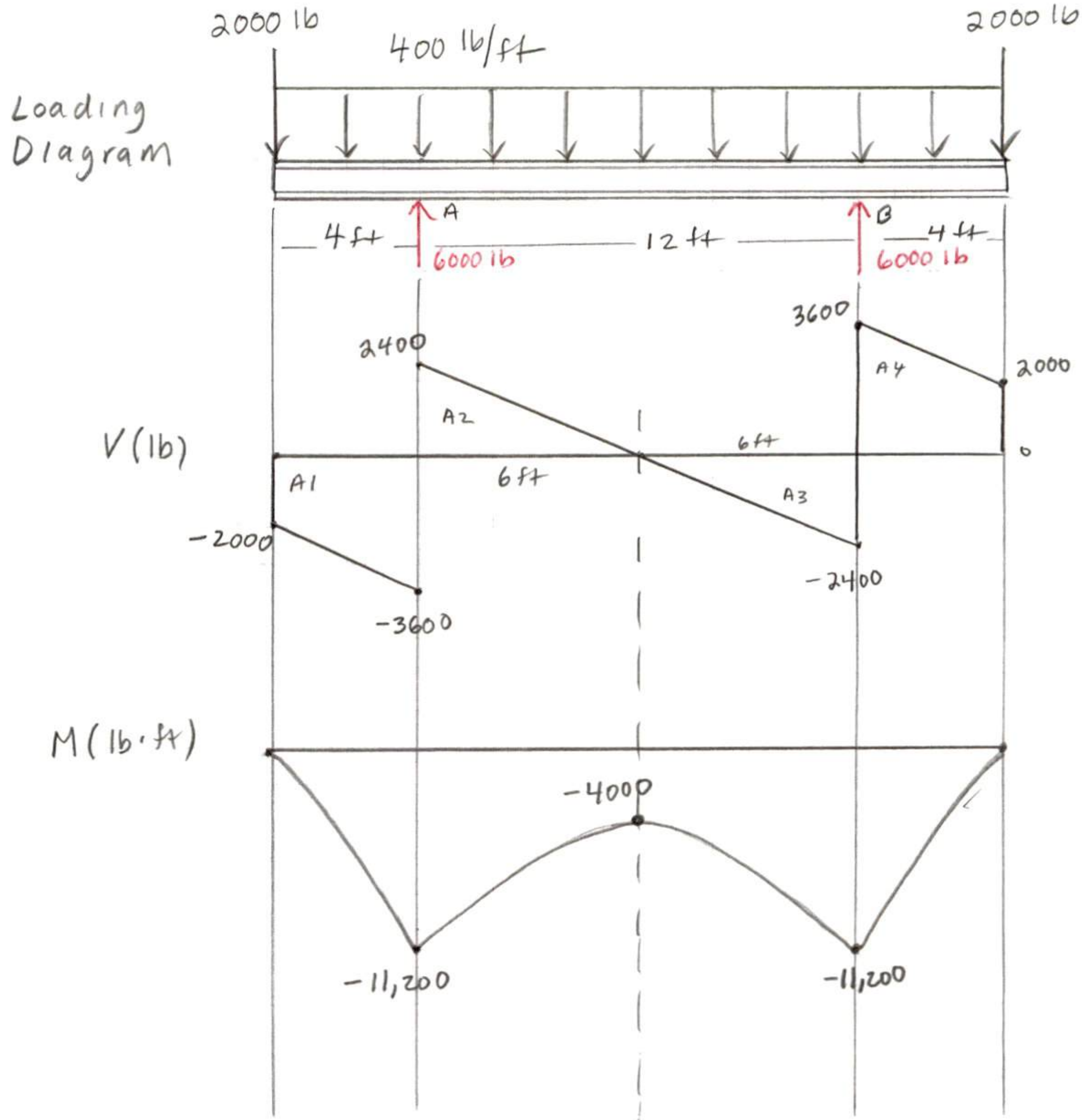
$+\circlearrowleft [\Sigma M_A = 0]$ $2000\text{ lb}(4\text{ ft}) - 8000\text{ lb}(6\text{ ft}) + B_y(12\text{ ft}) - 2000\text{ lb}(16\text{ ft}) = 0$

$$B_y = \frac{72{,}000\text{ lb}\cdot\text{ft}}{12\text{ ft}} = 6000\text{ lb} \uparrow$$

$[\Sigma F_y = 0]$ $-2000\text{ lb} + A_y - 8000\text{ lb} + B_y - 2000\text{ lb} = 0$

$$A_y = 12000\text{ lb} - 6000\text{ lb} = 6000\text{ lb} \uparrow$$

V & M Diagrams



$A1 = 4(-2000) + \frac{1}{2}(4)(-1600) = -11,200$

$A2 = \frac{1}{2}(6)(2400) = 7200$

$A3 = 7200$

$A4 = +11,200$

$V_{MAX} = 3600$ lb

$M_{MAX} = 11,200$ lb·ft

Step 1.

Southern Pine

$\sigma_{allow} = 1600$ psi

$\tau_{allow} = 90$ psi

Step 2.

$V_{MAX} = 3600$ lb

$M_{MAX} = 11,200 \text{ lb}\cdot\text{ft} \left(\frac{12 \text{ in}}{\text{ft}}\right) = 134,400 \text{ lb}\cdot\text{in}$

Step 3.

$$S_{req} = \frac{M_{MAX}}{\sigma_{allow}} = \frac{134,400 \text{ lb}\cdot\text{in}}{1600 \text{ psi}} = 84 \text{ in.}^3$$

Step 4.

$$A_{req} = \frac{1.5\, V_{MAX}}{\tau_{allow}} = \frac{1.5\,(3600 \text{ lb})}{90 \text{ psi}} = 60 \text{ in.}^2$$

Step 5. Table A-6(a)

6 × 12	$A = 63.3$ in.^{2}	$S = 121$ in.^{3}	wt = 17.6 lb/ft
8 × 10	$A = 71.3$ in.^{2}	$S = 113$ in.^{3}	wt = 19.8 lb/ft
10 × 10	$A = 90.3$ in.^{2}	$S = 143$ in.^{3}	wt = 25.1 lb/ft

Since the weight of the beam is already included in the uniform all of these sections would satisfy the requirements for strength.

Choose the lightest $\Rightarrow$ 6×12

$\boxed{\text{Use, } 6\times 12 \text{ Rectangular Section}}$