

Select a solid, rectangular, Eastern hemlock beam section for a 16-ft simple span carrying a superimposed uniform load of 800 lb/ft.

Solution.

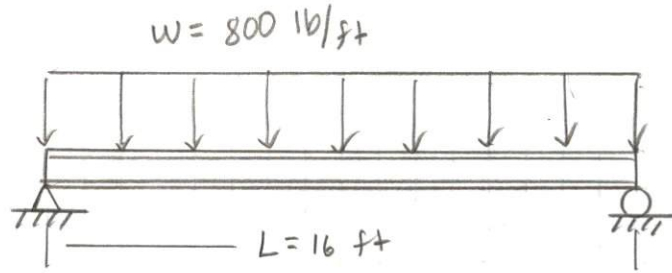
Step 1.

$$w = 800 \text{ lb/ft}$$

$$L = 16 \text{ ft}$$

Eastern Hemlock - Table 15-2

$$\sigma_{\text{allow}} = 1350 \text{ psi} \quad \tau_{\text{allow}} = 80 \text{ psi}$$



Step 2. Table 13-1, case 4

$$V_{\text{max}} = \frac{wL}{2} = \frac{800 \text{ lb/ft} (16 \text{ ft})}{2} = 6400 \text{ lb}$$

$$M_{\text{max}} = \frac{wL^2}{8} = \frac{800 \text{ lb/ft} (16 \text{ ft})^2}{8} = 25,600 \text{ lb}\cdot\text{ft} \left(\frac{12 \text{ in}}{\text{ft}} \right) = 307,200 \text{ lb}\cdot\text{in}$$

Step 3.
$$S_{\text{req}} = \frac{M_{\text{max}}}{\sigma_{\text{allow}}} = \frac{307,200 \text{ lb}\cdot\text{in}}{1350 \text{ psi}} = 228 \text{ in}^3$$

Step 4.
$$A_{\text{req}} = \frac{1.5 V_{\text{max}}}{\tau_{\text{allow}}} = \frac{1.5 (6400 \text{ lb})}{80 \text{ psi}} = 120 \text{ in}^2$$

Step 5. Table A-6(a)

| | | | |
|--------|------------------------|------------------------|----------------------------|
| 8 x 18 | $A = 131 \text{ in}^2$ | $S = 383 \text{ in}^3$ | $w_t = 36.5 \text{ lb/ft}$ |
|--------|------------------------|------------------------|----------------------------|

| | | | |
|---------|------------------------|------------------------|----------------------------|
| 10 x 14 | $A = 128 \text{ in}^2$ | $S = 289 \text{ in}^3$ | $w_t = 35.6 \text{ lb/ft}$ |
|---------|------------------------|------------------------|----------------------------|

Select the lightest, 10 x 14

$$\frac{\text{wt of Beam}}{\text{Load}} = \frac{35.6 \text{ lb/ft}}{800 \text{ lb/ft}} = 0.045 = 4.5\%$$

$$\frac{\text{Extra } S}{S_{\text{req}}} = \frac{289 \text{ in}^3 - 228 \text{ in}^3}{228 \text{ in}^3} = 0.268 = 26.8\% > 4.5\% \checkmark$$

(bending)

$$\frac{\text{Extra } A}{A_{\text{req}}} = \frac{128 \text{ in}^2 - 120 \text{ in}^2}{120 \text{ in}^2} = 0.063 = 6.3\% > 4.5\% \checkmark$$

(shear)

Use, 10 x 14 Rectangular Section