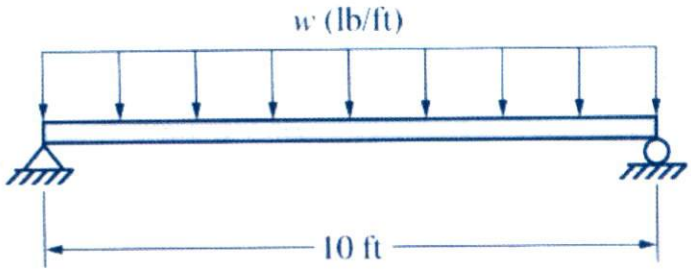
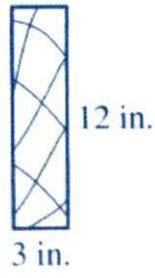
14-25

A simple beam having the full-size rectangular section shown in Fig. P14-25 carries a uniform load. The beam is made of oak with an allowable flexural stress of 1900 psi and an allowable longitudinal shear stress (parallel to the grain) of 145 psi. Determine the maximum superimposed uniform load w in lb/ft that can be applied to the beam.

Solution.





Section

$\tau_{allow} = 145$ psi

$\sigma_{allow} = 1900$ psi

Section Modulus for Rectangular Shape

$$S = \frac{bh^2}{6} = \frac{(3\text{in})(12\text{in})^2}{6} = 72\ \text{in.}^3$$

Table 13-1, Case 4

$$V_{MAX} = \frac{WL}{2}$$

$$\tau_{allow} = \tau_{MAX} = 1.5\frac{V}{A} = 1.5\frac{WL}{2A}$$

$$W = \frac{2A\tau_{allow}}{1.5L} = \frac{2(3\text{in})(12\text{in})(145\ \text{lb/in}^2)}{1.5(10\text{ft})(12\frac{\text{in}}{\text{ft}})}$$

$$= 58\frac{\text{lb}}{\text{in}}$$

$$W = 696\ \text{lb/ft}$$

$$M_{MAX} = \frac{WL^2}{8}$$

$$\sigma_{allow} = \sigma_{MAX} = \frac{M_{MAX}}{S} = \frac{WL^2}{8S}$$

$$W = \frac{8S\sigma_{allow}}{L^2} = \frac{8(72\text{in}^3)(1900\ \text{lb/in}^2)}{(120\ \text{in})^2} = 76\ \text{lb/in}$$

$$W = 919\ \text{lb/ft}$$

$$\boxed{W_{allow} = 696\ \text{lb/ft}}$$