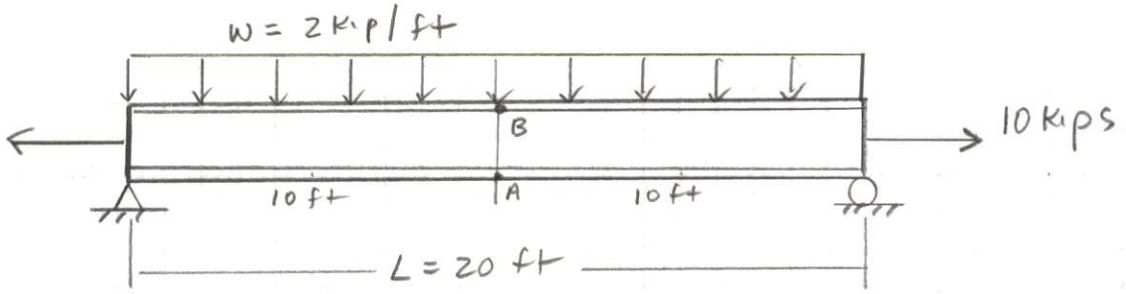
18-1

A beam of W16 x 50 section has a simple span of 20 ft. The beam is subjected to a uniform load of 2 kips/ft and an axial tensile force of 10 kips. Determine the maximum tensile and compressive stresses in the beam.

Solution.



W16 x 50 Table A-1(a)

$A = 14.7\ in^2$

$S = 81.0\ in^3$

Axial Load

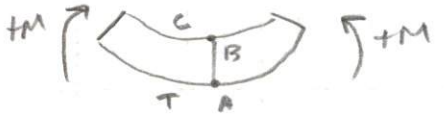
$$\sigma_A = \sigma_B = \frac{P}{A} = \frac{10\ kips}{14.7\ in^2} = 0.68\ ksi$$

Beam Bending Load

maximum occurs at Midspan

$$M_{MAX} = \frac{wL^2}{8} = \frac{2\ kip/ft\ (20\ ft)^2}{8} = 100\ kip\cdot ft\left(\frac{12\ in}{ft}\right) = 1200\ kip\cdot in$$

$$\sigma_{MAX} = \frac{M}{S} = \frac{1200\ kip\cdot in}{81.0\ in^3} = 14.8\ ksi$$



Combined Stresses

$$\sigma_A^{(T)} = \frac{P}{A} + \frac{M}{S} = 0.68\ ksi + 14.8\ ksi = 15.5\ ksi\ (T)$$

$$\sigma_B^{(C)} = \frac{P}{A} - \frac{M}{S} = 0.68\ ksi - 14.8\ ksi = -14.1\ ksi\ (C)$$