10-1

A 10-ft steel bar is subjected to a tensile stress of 20 ksi. Determine (a) the linear strain and (b) the total deformation of the bar. The modulus of elasticity of steel is 30×10^3 ksi.

(a) $\epsilon = \frac{\sigma}{E} = \frac{+20 \text{ ksi}}{30 \times 10^3 \text{ ksi}} = 6.67 \times 10^{-4}$

(b) $\delta = \epsilon L = (6.67 \times 10^{-4})(10 \text{ ft}) = 0.00667 \text{ ft}$

$\delta = 0.00667 \text{ ft} \times 12 \frac{\text{in.}}{\text{ft}} = 0.08 \text{ in. (elongation)}$

10-3

A 20-ft wrought-iron bar ½ in. in diameter is subjected to a tensile force of 3 kips. Determine the stress, strain, and elongated length of the bar. The modulus of elasticity of wrought iron is $E = 29 \times 10^3$ ksi.

$\sigma = \frac{P}{A} = \frac{3 \text{ kips}}{\frac{\pi (\frac{1}{2} \text{ in.})^2}{4}} = 15.3 \text{ ksi (T)}$

$\epsilon = \frac{\sigma}{E} = \frac{+15.3 \text{ ksi}}{29\,000 \text{ ksi}} = +0.000527$

$\delta = \epsilon L = (0.000527)(20 \text{ ft}) = 0.011 \text{ ft}$

Elongated Length = 20 ft + 0.011 ft

= 20.011 ft