A tie bar of length 2.5m and a diameter 10mm carries an axial load of 12KN. the modulus of elasticity of the material is 180 GPA. Determine the induced tensile stress, the tensile strain and the change in length that occurs

Solution

E is the modulus of elasticity of the material.

A is cross sectional area of tie bar.

$$A = \frac{\pi d^2}{4} = \frac{\pi(10 * 10^{-3}m)^2}{4} = 5.35 * 10^{-5}m^2.$$

σ is the induced tensile stress.

$$\sigma = \frac{F}{A} = \frac{12 * 10^3\text{N}}{5.35 * 10^{-5}m^2} = 2.243 * 10^9 Pa.$$

ε is the tensile strain.

$$\varepsilon = \frac{\sigma}{E} = \frac{2.243 * 10^9 Pa}{180 * 10^9 Pa} = 0.01246.$$

The change in length that occurs

$$x = \varepsilon L = 0.01246 * 2.5\text{m} = 0.0312\text{m} = 31.2\text{ mm}.$$

Answer: $2.243\ GPa$; 0.01246; 31.2 mm.