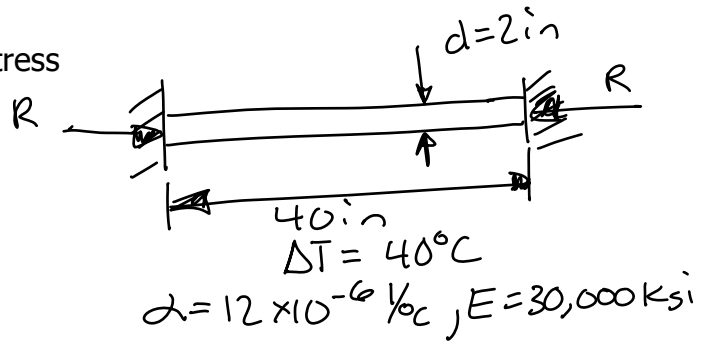


Thermal Stresses

Problem Statement: Determine the axial stress due to the temperature change.



1.) Determine the thermal strain and thermal elongation/contraction if the object was free to expand or contract.

$$\epsilon_T = \alpha \Delta T = (12 \times 10^{-6} / ^\circ\text{C})(40^\circ\text{C}) = 4.8 \times 10^{-4}$$

$$\delta_T = \epsilon_T L = (4.8 \times 10^{-4})(40 \text{ in}) = 0.0192 \text{ in}$$

2.) Determine the mechanical elongation required to resist the thermal expansion.

$$\text{No gap} \Rightarrow \delta_R = \delta_T = 0.0192 \text{ in}$$

3.) Determine the force and thermal stress.

$$\delta_R = \frac{RL}{EA} \quad R = \frac{EA\delta_R}{L}$$

$$R = \frac{(30,000 \text{ ksi}) \left(\frac{\pi}{4} (2 \text{ in})^2 \right) (0.0192 \text{ in})}{40 \text{ in}}$$

$$R = 45.2 \text{ k}$$

$$\sigma_T = \frac{R}{A} = \frac{45.2 \text{ k}}{\frac{\pi}{4} (2 \text{ in})^2}$$

$$\boxed{\sigma_T = 14.4 \text{ ksi}}$$