PM-8 Soln)

We have two competing effects: thermal expansion and the elastic compression of the bar.

$$\Delta L = \alpha\, L_o \Delta T \qquad \frac{F}{A} = -Y\,\frac{\Delta L}{L_o} \quad .$$

If you like, think of it as the bar expanding, then being pushed back to its initial size.

$$\alpha\,\Delta T = \frac{F}{AY} \quad \rightarrow \quad F = \alpha\,\Delta T\,A\,Y \quad .$$

Let's look up some stuff:

Coefficient of linear thermal expansion at 20^{o}C for aluminum: 23.1×10^{-6} K^{-1}

Young's modulus at 20^{o}C for aluminum: 68×10^{9} N/m^{2}.

$$F = \alpha\,\Delta T\,A\,Y = 23.1\times10^{-6}(40)(10^{-4})68\times10^{9} = 6283\ \mathrm{N} = 0.641\ \mathrm{tonne} \quad .$$