

Physics I

Elasticity

$$\Delta L = \frac{FL}{EA} \quad (\text{the "flea" equation})$$

Problem 1.- A steel cable 12 m long and has a diameter of 8mm. Calculate how much it will stretch under a tension of 4500 N.

[Young's modulus of steel = $200 \times 10^9 \text{ N/m}^2$]

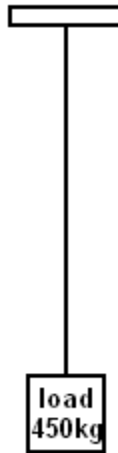
Solution: The area of the cross section is: $A = \pi R^2 = \pi(0.004\text{m})^2$

The other values of the "flea" equation are given in the problem so:

$$\Delta L = \frac{FL}{EA} = \frac{(4500\text{N})(12\text{m})}{(200 \times 10^9 \text{ N/m}^2) [\pi \times (0.004\text{m})^2]} = \mathbf{5.4 \text{ mm}}$$

Problem 1a.- Calculate the elongation of a steel cable 12m long with a diameter of 16mm under a 450kg load. [Young's modulus of steel $E = 200 \times 10^9 \text{ N/m}^2$]

Note: The area of a circle is $A = \frac{\pi D^2}{4}$, where D is the diameter.



Solution: This problem shows the use of the "Flea equation", all you need to do is substitute the correct numbers in the equation:

$$\Delta L = \frac{FL}{EA} = \frac{mgL}{E \left(\frac{\pi D^2}{4} \right)} = \frac{450 \times 9.8 \times 12}{200 \times 10^9 \left(\frac{\pi (0.016)^2}{4} \right)} = \mathbf{0.0013 \text{ m}}$$