Stress, Strain, Young Modulus – Tutorial

1. A steel wire of cross-sectional area 0.50mm^2 and length 4.0m stretches 3.0mm when the tension in it is increased by 75N. When the extra tension is removed the wire returns to its original length.

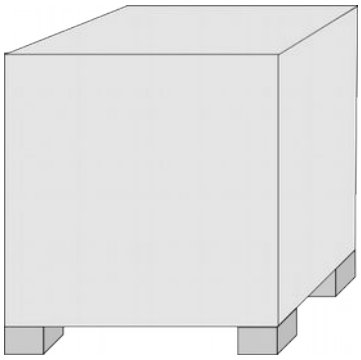
   (a) Calculate:
   (i) the stress applied to the wire. *(150N/mm^2)*
   (ii) the strain produced. (7.5x10^{-4})
   (iii) the Young modulus for this steel. *(2.0x10^{11}Pa)*

   (b) The lift cable in a sky-scraper consists of 100 strands of this wire. Calculate the extra extension of a 90m length of this cable when an 80kg passenger steps into the lift. The tension is the same in each strand. *(7mm)*

2. A machine, mass 500kg, is to be mounted on four rubber blocks, each 10cm x 10cm x 10cm. The load is spread evenly.

   Calculate how much is each block compressed vertically. E_{rubber} = 20MPa.

   (0.61mm)



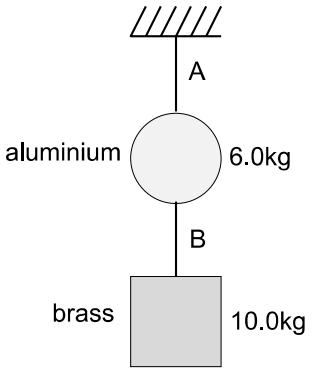
3. A load-bearing, tubular steel column is 3.0m tall, external diameter 300mm, internal diameter 280mm. It carries a load of 0.50MN.
   Young modulus of steel = 2.0x10^{11}Pa.

   Calculate:

   (a) the compressive stress, *(5.49x10^{7}N/m^2)*

   (b) the amount by which the column is compressed by this load. *(0.82mm)*

4. In constructing a large mobile, an artist hangs an aluminium sphere of mass 6.0kg from a vertical steel wire A, 0.50m long and 2.5mm^2 in cross-sectional area.
   On the bottom of the sphere is attached a similar steel wire, B, from which hangs a brass cube of mass 10.0kg.
   Young modulus of steel = 2.0×10^{11}Pa.



   Calculate:

   (a) the tensile stress in wire A and in wire B, *(62.7N/mm^2, 39.2N/mm^2)*

   (b) the extension of wire A and of wire B. *(0.157mm, 0.098mm)*