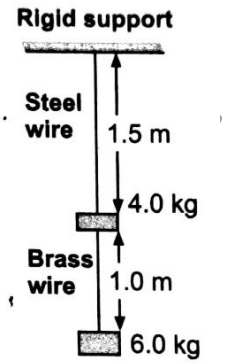
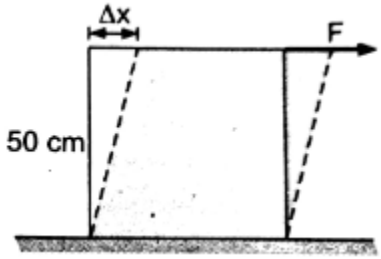
Assignment – Mechanical Properties of SOLID

1. Two long metallic strips arc joined together by two rivets, each of radius 2.0 mm. Each rivet can stand a maximum shearing Stress of 1 .5 x 10^9 Pa. What is the maximum tensile force that the strip can exert assuming that each rivet shares the stretching load equally?
2. A wire increases by 10^{-3} of its length when a stress of $10^8 \frac{N}{m^2}$ is apphed to it. What is the Young's modulus of the material of the wire?
3. Four identical hollow cylindrical columns of steel support a big structure of mass 50,000 kg. The inner and outer radii of each column are 30 cm and 40 cm respectively. Assuming the load distribution to be uniform, calculate the compression strain of each column. The Young's modulus of steel is $2.0 \times 10^{11}\ Pa$.
4. A steel wire of length 4.7 m and cross-section $3.0 \times 10^{-5}\ m^2$ stretches by same amount as a copper wire of length 3.5 m and cross-section $4.0 \times 10^{-5}\ m^2$ under a given load. What is the ratio of the Young's modulus of steel to that of copper?
5. Calculate the percentage increase in length of a wire of diameter 2.5 mm stretched by a force of 100 kg wt. Young's modulus of elasticity of the wire is $12.5 \times 10^{10} \frac{N}{m^2}$.
6. Compute the elongations of the steel and brass wires in the Fig. The unloaded length of steel wire = 1.5 m and that of brass wire = 1 .0 m. The diameter of each wire 0.25 cm. Young's modulus of steel is 2.0 x 10^{11} Pa and that of brass is O.91x 10^{11} Pa.



7. A cable is replaced by another one of the same length and material but twice the diameter. (a) How will this affect the elongation under a given load? (b) How does this affect the maximum load it can support without exceeding the elastic limit ?
8. A spherical ball contracts in volume by 0.0 1% when subjected to a normal uniform pressure of 100 atmospheres. Calculate the bulk modulus of the material.
9. The volume of a solid is 5000 cm^3 under one atmosphere pressure. Find the change in its volume when subjected to a pressure of 101 atmospheres. Given bulk modulus of solid = $1O^{11}$ N/m^2.
10. Compute the bulk modulus of water from the following data. Initial volume = 100.0 litre, pressure increase = 100.0 atm. Final volume = 100.5 litre. Compare the bulk modulus of water with that of air (at constant temperature). Explain in simple terms why the ratio is so large.
11. What is the density of water at a depth where the pressure is 80.0 atm, given its density at the surface is $1.03 \times 10^3 \frac{kg}{m^3}$? Compressibility of water = 45.8 x $1O^{11}$ Pa^{-1}.
12. A square lead slab of side 50 cm and thickness 10 cm is subject to a shearing force (on its narrow face) of magnitude 9.0 x 10^4 N. The lower edge is riveted to the floor, [Fig.]. How much is the upper edge displaced if the shear modulus of lead is $5.6 \times 10^9\ Pa$?



13. A metallic wire is suspended by attaching a weight to it. If $\propto$ is the longitudinal strain and Y is the Young's modulus of elasticity, show that the clastic potential energy per unit volume is given by (1/ 2) Y $\propto^2$.
14. When the load on a wire is increased slowly from 3 kg wt to 5 kg wt, the elongation increases from 0.61 mm to 1.02 mm. How much work is done during the extension of the wire?
15. What type of elasticity is involved in the following cases? (a) A gas (b) A liquid (e) A wire pulled at its ends (d) A hook with a tangential force applied uniformly to its upper face and the lower face remaining stationary on the table.
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21. Two wires of different materials are suspended from a rigid support. They have the same length and diameter and carry the same load at their free ends. (a) Will the stress and strain in each wire be the same? (b) Will the extension in both wires be the same?
22. Two different types of rubbers are found to have the stress-strain curves as shown in Fig. (a) In which significant ways do these curves differ from the stress-strain curve of a metal?
(b) A heavy machine ism he installed in a factory. To absorb vibrations of the machine, a block of rubber is placed between the machinery and the floor. Which of the two rubbers, A and B would you prefer to use for this purpose? Why?