Chapter 6 Properties of materials

Short investigation 6.2: Load, stress and strain

Name: .....

Aim

To explore the relationship between stress, strain and load

Materials

Retort stand, boss head and clamp, 1 m length of thick string, set of brass weights (50 g increments) and hanger, metre ruler, masking tape, sewing pin

Method

1. Set up the retort stand and clamp.
2. Tie one end of the string with a firm, non-slip knot (or a few of them!) to the clamp. Make sure that the clamp is tightly attached to the retort stand and does not slide down when tugged.
3. Tape the pin to the bottom of the weight hanger so that it sticks out at right angles to the hanger rod. This will act as a position pointer.
4. Tie the hanger hook to the free end of the string.
5. Hold a metre ruler vertically in place next to the string and hanger. Measure the distance between the top and bottom knots in the string. This will give you the length L_1 of the string. Enter this value in table 6.2A.
6. On the ruler, mark the position of the pin pointer.
7. Using a micrometer or vernier calliper, measure the diameter of the string and note its value in the results section.
8. Add a 50 g weight to the hanger, and note the distance ΔL moved by the pointer pin. Enter this value in table 6.2A.
9. Repeat step 8 until a load of 500 g has been reached.

Results

Diameter of string = cm

L_1 = cm

Table 6.2A

Load (kg)	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50

Δ*L* (cm)	0									

Analysing the results

1. Calculate the cross-sectional area A of the string in m^2.

2. Use your results from table 6.2A to complete the values of stress, σ, and strain, ε, under the increasing load in table 6.2B. You will need the following equations:
   F (N) = Load (kg) $\times$ 9.8 (m s^{-2})
   σ (N m^{-2}) = $\dfrac{F\,(\mathrm{N})}{A\,(\mathrm{m}^2)}$
   $\varepsilon = \dfrac{\Delta L\,(\mathrm{N})}{L\,(\mathrm{m}^2)}$

Table 6.2B

Load (kg)	***F* (N)**	**σ (N m^{-2})**	**ε**
0.05			
0.10			
0.15			
0.20			
0.25			
0.30			
0.35			
0.40			
0.45			
0.50			

3. On the grid below, plot a stress–strain graph of your values from table 6.2B with strain on the horizontal axis and stress on the vertical axis.

4. Does the string demonstrate elastic behaviour over the load range used? Explain.

5. Use your graph to determine an approximate value of Young's modulus for the string.

6. What difficulties did you encounter during this investigation that may have contributed errors to your measurements?

Conclusion

State the general relationship between the stress and strain values of string for the load range of 50–500 g.

Notes:

