SOLUTIONS TO TUTORIAL EXAMPLES

CHAPTER 18

Question 1

Axial force P = 3000 kN

Cross-sectional area A = (400 mm × 350 mm)

Direct stress σ = P/A = (3000 × 10^3 N) / (400 mm × 350 mm) = 21.4 N/mm^2.

Question 2

Cross sectional area A = P/σ = (750 ×10^3 N) / 460 N/mm^2 = 1630 mm^2.

Area of a circle A = π r^2, so r = √(A/π) = √(1630/π) =22.8 mm

Diameter of a circle is twice the radius.

So minimum diameter = (2 × 22.8) = 45.6 mm.

If the rod had been in compression, the possibility of *buckling* would need to be considered. A slender section such as a rod is likely to buckle or bend before its full potential compressive strength is realised.

Question 3

Cross sectional area A = P/σ = (60 × 10^3 N) / 6 N/mm^2 = 10 000 mm^2.

A suitable size of timber section is one that has at least the above value of cross sectional area.

Examples are:

100 mm × 100 mm section (A = 10 000 mm^2)
75 mm × 150 mm section (A = 11 250 mm^2)

Question 4

Strain $\varepsilon = \delta L / L$ = 1.5 mm / 3000 mm = 0.0005 (or 0.5%)

Question 5

$$\delta L = \frac{PL}{AE} = \frac{150 \text{ x } 10^3 \text{ N x } 3500 \text{ mm}}{\pi \text{ x } 10^2 \text{ mm}^2 \text{ x } 200 \text{ x } 10^3 \text{ N/mm}^2}$$

δL = 8.35 mm.

Question 6

Stress $\sigma = P/A = (50 \times 10^3 \text{ N}) / 220 \text{ mm}^2 = 227.27 \text{ N/mm}^2$.

Strain $\varepsilon = \sigma / E = 227.27 \text{ N/mm}^2 / (70 \text{ x } 10^3 \text{ N/mm}^2) = 3.25 \times 10^{-3} = 0.00325$.

Change in length $\delta L = \varepsilon \times L = 3.25 \times 10^{-3} \times 1500 \text{ mm} = 4.87 \text{ mm}$.

Question 7

Force P = 13 000 tonnes = 130 000 kN = 130×10^6 N (since 10 kN = 1 tonne)

Area $A = \pi \text{ x } r^2 = \pi \times 500^2 = 785{,}398 \text{ mm}^2 = 0.785 \times 10^6 \text{ mm}^2$.

Stress $\sigma = P/A = (130 \times 10^6 \text{ N}) / (0.785 \times 10^6 \text{ mm}^2) = 166 \text{ N/mm}^2$.