

Slope and deflection – supplementary questions

1. A beam 7 m long is simply supported at its ends and loaded as follows: 120 kN at 1 m from one end, A, 20 kN at 4 m from A and 60 kN at 5 m from A. Calculate the position and magnitude of the maximum deflection. The second moment of area of the beam section is $400 \times 10^{-6} \text{ m}^4$ and E for the beam material is 210 GPa.

Ans: 9.8 mm at 3.474

2. A 500 mm x 175 mm steel beam of length 8 m is supported at the left-hand end and at a point 1.6 m from the right-hand end. The beam carries a uniformly distributed load (UDL) of 12 kN/m over its whole length, an additional UDL of 18 kN/m on the length between the supports and a point load of 30 kN at the right hand end. Determine the slope and deflection of the beam at the section midway between the supports and also at the right-hand end. EI for the beam is $1.5 \times 10^8 \text{ Nm}^2$.

Ans: 1.13×10^{-4} , 3.29 mm, 9.7×10^{-4} , 1.71 mm

3. A flat spring is made of steel and has a rectangular cross-section 40 mm by 3 mm. It is clamped rigidly at one end so that its span is 350 mm. What is the maximum elastic load, P, that can be applied at a point 25 mm from the free end, if $E = 210 \text{ GPa}$ and the yield stress is 280 MPa? Find the maximum deflection of the free end when P is a maximum.

Ans: 103.38 N, 69.8 mm

4. Find the reactions at A and at D for the beam and loading shown in Figure Q4.

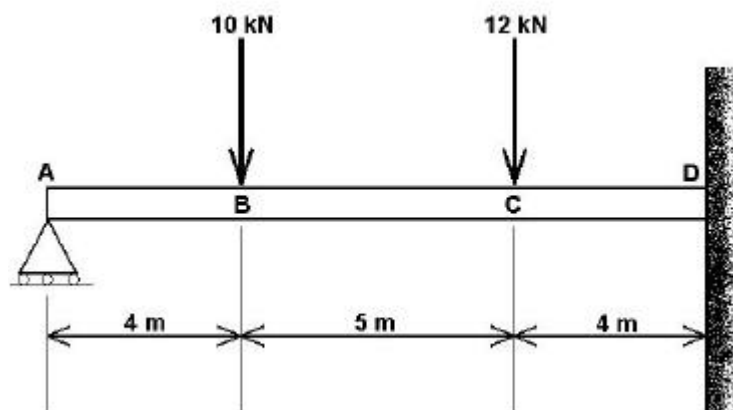


Figure Q4.

Ans: 7.06 kN, 14.94 kN & -46.22 kNm