EQSD2
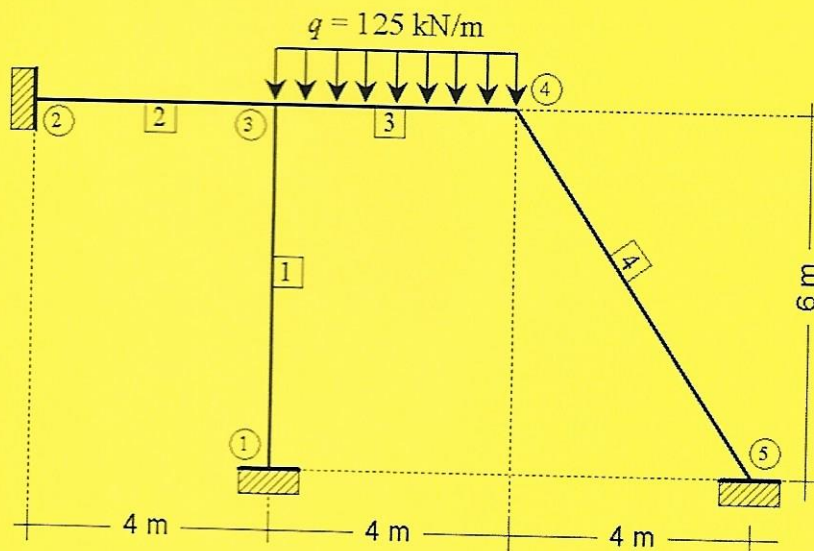
Figure 1 shows a plane frame under vertical loading. The stiffness coefficient $4EI/L$ of member ① is equal to 0.8 x 10^6 kNm/rad. The stiffness coefficient $4EI/L$ of both members ② and ③ is equal to 1.3 x 10^6 kNm/rad. Member ④ has modulus of elasticity $E = 2$ x 10^8 kN/m² and its cross section has a moment of inertia about the axis of bending equal to $I = 0.006$ m⁴.

(a)   At what joints do you expect rotations to be different from zero?

(b)   Find the fixed-end moments of member ③.

(c)   Using a stiffness method approach (**slope deflection equations**) find the rotations of the free joints.

(d)   Find the end moments of member ② **only**.

(e)   What is the bending moment at the centre of the span of member ③?

Figure 1. Plane frame under vertical loading

Answers:
   (a)   Joints 3 & 4 will experience rotation (*i.e.* they are the free joints)
   (b)   FEM$_3$ = -FEM$_4$ = 166.67 kNm
   (c) $\theta_3 = -6.96$x10^{-5} rad, $\theta_4 = 1.08$x10^{-4} rad
   (d) $M_2^2 = -45.24$ kNm, $M_3^2 = -90.48$ kNm
   (e)   141.05 kNm