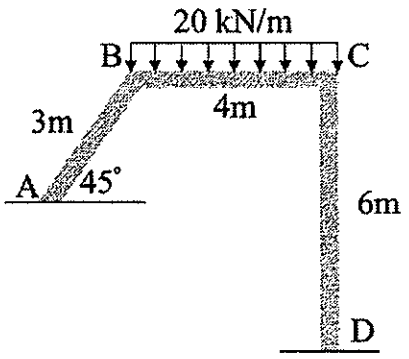
1. (20 points) Please use the **slope deflection method** (傾角變位法) to determine the moments at each joint, i.e., M_{AB}, M_{BA}, M_{BC}, M_{CB}, M_{CD}, M_{DC}, of the frame shown in Figure 1. EI is constant for each member. Note that the sloping member AB will cause the frame to move sideways to the right. Failure to use the specified method to answer will result in 0 points.



Hint:

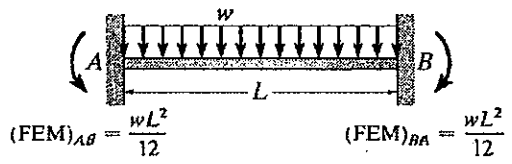


Figure 1

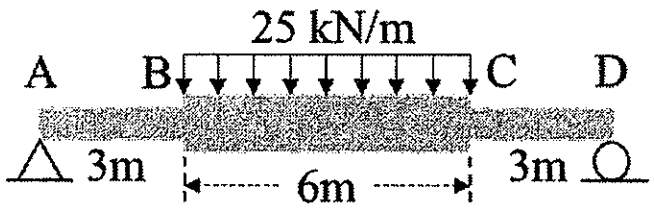


Figure 2

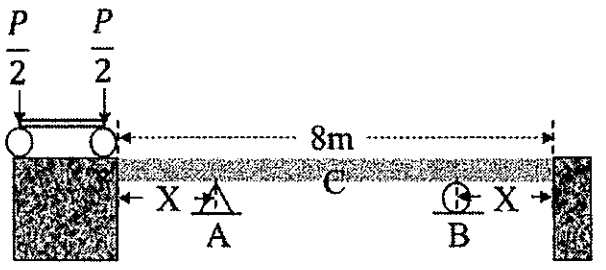


Figure 3

2. (20 points) Please use the **virtual work method** (虛功法) to determine the displacement at point C, shown in Figure 2. The moment of inertia of the segment $BC = 2I = 600\ (10^6)\ mm^4$, whereas segments AB and CD have a moment of inertia $I = 300\ (10^6)\ mm^4$. The modulus of elasticity of the material is $E = 200$ GPa. Failure to use the specified method to answer will result in 0 points.
3. (20 points) Please determine the distance X in Figure 3 of a bridge that the moving loads produce the same maximum moment at the supports, M_A, as in the center C, M_{center}.
4. (20 points) Please determine the vertical reaction B_y at the support B and the vertical force F_{sp} from the spring in Figure 4. Then, draw the moment diagram. Each spring is originally unstretched and has a stiffness $k = 12EI/L^3$. EI is constant.

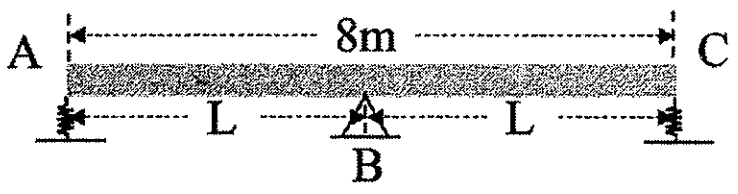


Figure 4

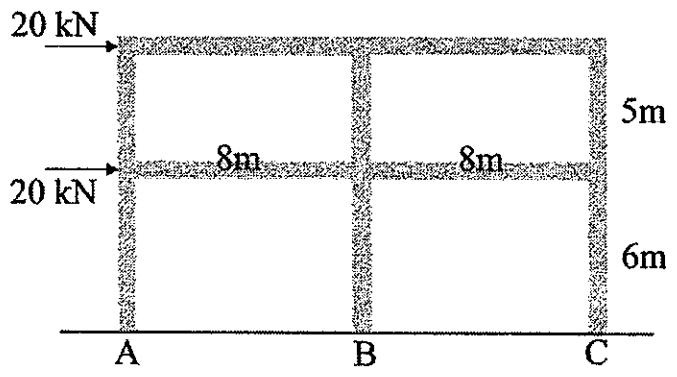


Figure 5

5. (20 points) For the portal frame, a frame is fixed supported at its base, inflection points (hinges) occur at approximately the center of each girder and column, and the columns carry equal shear loads. For a building bent deflects in the same way as a portal frame, we can consider each bent to be composed of a series of portals. Then, as a further assumption, the interior columns will represent the effect of two portal columns and will therefore carry twice the shear V as the two exterior columns (***Portal methods***). Please use this assumption to determine the approximate reactions at the base of columns, i.e., A_x, A_y, M_A, B_x, B_y, M_B, of the frame shown in Figure 5.

試題隨卷繳回