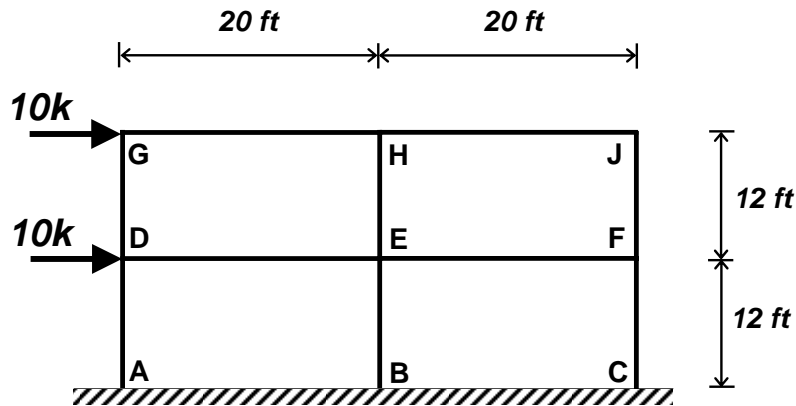


- 1) A two-story, two-bay planar steel frame is loaded with two 10 kip lateral loads as shown below. All members have identical moment of inertia, I .
- Using portal method of analysis, analyze the structure approximately to find the distribution of bending moment throughout the structure and draw the bending moment diagram.
 - Considering displacements due to bending only, i.e. consider flexure only, and using virtual work approach
 - estimate the lateral displacement of node D,
 - estimate the rotation of node D.

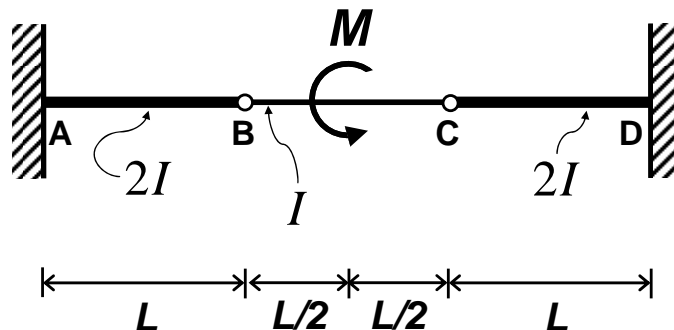


- 2) Three aluminum beams of identical length are put together to span length $3L$ as shown below. The interior is attached to the exterior beams with frictionless pin connections (joints B and C). The exterior beams are fixed at their other ends (joints A and D). The interior beam has half the moment of inertia of the exterior beams (I vs $2I$, as shown on the figure).

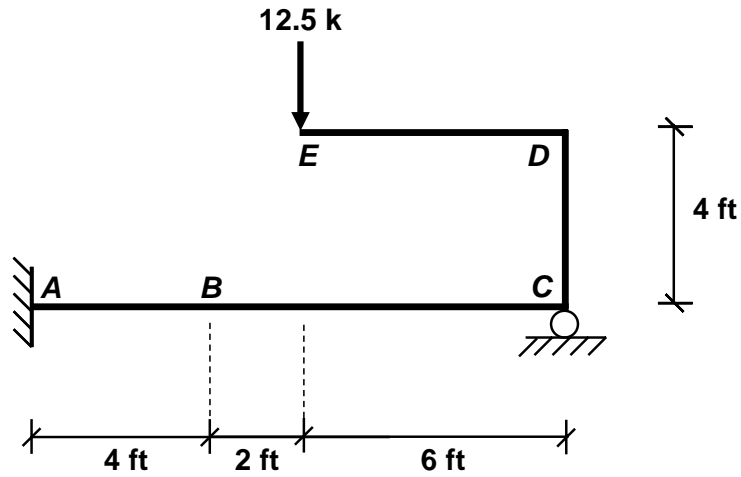
The built-up structure is loaded at the mid-span of the interior beam with a couple (moment) of amplitude M .

Calculate the vertical displacements of point B , mid-span point (loading point) of the interior beam, and point C .

Calculate the rotation angle of...



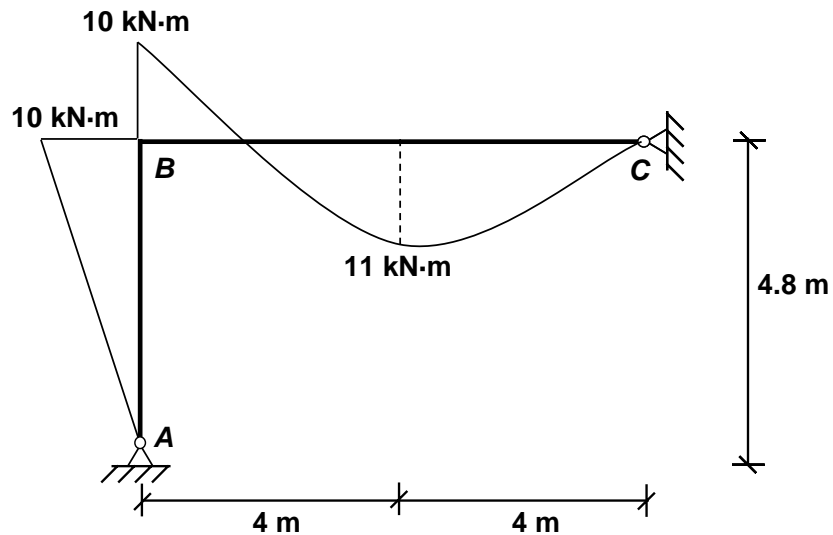
- 3) A continuous frame is loaded at its free end E with a downward 12.5-kip point load. The inflection point is at point B . Find the vertical deflection of the frame at point B . Consider flexural response only and ignore self-weight. Assume that $E = 30,000 \text{ ksi}$ and $I = 576 \text{ in}^4$ throughout the structure.



- 4) A uniformly distributed load (not shown) on span BC of the continuous frame ABC causes the given bending moment distribution. Note that supports A and C are pinned.

If $EI = 10^3 \text{ kN} \cdot \text{m}^2$ throughout the structure, find the rotation of rigid-joint B .

Consider flexural response only. Ignore self-weight.



[Bending moment diagram; drawn on the tension side of the members.]

5) The frame structure shown below is loaded with a lateral load at point D . Support A is pinned and support E is fixed. Joints B and C are rigid. All elements of the structure have the same plastic moment capacity M_p .

- Find the ultimate load, P_{ult} , the structure can sustain without collapsing.
- Draw the bending moment diagram to show the moments throughout the structure when the structure is at its ultimate state.

Hint: Use of principle of virtual displacements is highly recommended. There are three mechanisms (two independent plus one combined) to check.

